BS EN 848-3:2012

BSI Standards Publication

Safety of woodworking machines — One side moulding machines with rotating tool

Part 3: Numerically controlled (NC) boring and routing machines

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National foreword

This British Standard is the UK implementation of EN 848-3:2012. It supersedes BS EN 848-3:2007+A2:2009 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MTE/23, Woodworking machines.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Safety of woodworking machines - One side moulding machines with rotating tool - Part 3: Numerically controlled (NC) boring and routing machines

Sécurité des machines pour le travail du bois - Machines à fraiser sur une face à outils rotatifs - Partie 3: Perceuses et défonceuses à commande numérique

Sicherheit von Holzbearbeitungsmaschinen - Fräsmaschinen für einseitige Bearbeitung mit drehendem Werkzeug - Teil 3: NC-Bohr- und Fräsmaschinen

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 848-3:2012) has been prepared by Technical Committee CEN/TC 142 “Woodworking machines - Safety”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2013, and conflicting national standards shall be withdrawn at the latest by April 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 848-3:2007+A2:2009.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of the Machinery Directive.

For relationship with EU Directive, see informative Annex ZA, which is an integral part of this document.

The main modification to the 2009 edition relates to the introduction of performance levels (PL) and curtains wear test.

Organisations contributing to the preparation of this document include the European Committee of Woodworking Machinery Manufacturers Association "EUMABOIS".

EN 848 consists of the following parts:

— EN 848-1, *Safety of woodworking machines — One side moulding machines with rotating tool — Part 1: Single spindle vertical moulding machines*;

— EN 848-2, *Safety of woodworking machines — One side moulding machines with rotating tool — Part 2: Single spindle hand fed/integrated fed routing machines*;

— EN 848-3, *Safety of woodworking machines — One side moulding machines with rotating tools — Part 3: Numerically controlled (NC) boring and routing machines* (the present document).

The European Standards produced by CEN/TC 142 are particular to woodworking machines and compliment the relevant A and B standards on the subject of general safety (see Introduction of EN ISO 12100:2010 for a description of A, B and C standards).

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document has been prepared to be a harmonised standard to provide one means of conforming to the essential health and safety requirements of the Machinery Directive and associated EFTA Regulations.

This document is a type C standard as defined in EN ISO 12100:2010.

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

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

The requirements of this document are directed to manufacturers and their authorised representatives of numerically controlled (NC) boring machines and routing machines. It is also useful for designers.

This also includes examples of information to be provided by the manufacturer to the user.

Common requirements for tooling are given in EN 847-1:2005+A1:2007 and EN 847-2:2001.

1 Scope

This European Standard specifies all significant hazards, hazardous situations and events as listed in Clause 4, which are relevant to NC boring machines, NC routing machines and NC combined boring/routing machines (as defined in 3.1) herein after referred to as "machines" designed to cut solid wood, chip board, fibreboard, plywood and also these materials where these are covered with plastic/light alloy laminate or edgings when they are used as intended and under the conditions foreseen by the manufacturer including reasonably foreseeable misuse.

Machines which are designed to work wood based materials may also be used for working hardened plastic materials with similar physical characteristics as wood.

This document also applies to machines fitted with:

— additional equipment for sawing, sanding, edge banding or assembly units and dowel devices;

— fixed or movable workpiece support;

— mechanical, pneumatic, hydraulic or vacuum workpiece clamping;

— automatic tool change facilities.

This document does not deal with the specific hazards of edge banding equipment fitted to NC boring machines, NC routing machines and NC combined boring/routing machines.

This document is only applicable to NC boring machines, NC routing machines and NC combined boring/routing machines which are designed to use milling tools with a cutting circle diameter below 16 mm or milling tools or saw-blades conforming to EN 847-1:2005+A1:2007 and EN 847-2:2001 and boring tools or sanding wheels.

This document is not applicable to NC boring machines, NC routing machines and NC combined boring/routing machines which are designed to use grinding wheels.

This document is not applicable to single spindle hand fed/integrated fed routing machines.

NOTE Single spindle hand fed/integrated fed routing machines are dealt with in EN 848-2:2007+A1:2009.

This document does not deal with the specific hazards of ejection through openings on machines where the distance between the work-piece support and the lower edge of the partial enclosure exceeds 400 mm.

This document is not applicable to NC boring machines, NC routing machines and NC combined boring/routing machines which are manufactured before the date of its publication as EN.

2 Normative references

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

EN 847-1:2005+A1:2007, *Tools for woodworking — Safety requirements — Part 1: Milling tools, circular saw blades*

EN 847-2:2001, *Tools for woodworking — Safety requirements — Part 2: Requirements for the shank of shank mounted milling tools*

EN 894-1:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 1: General principles for human interactions with displays and control actuators*

EN 894-2:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays*

EN 894-3:2000+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators*

EN 1005-1:2001+A1:2008, *Safety of machinery — Human physical performance — Part 1: Terms and definitions*

EN 1005-2:2003+A1:2008, *Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery*

EN 1005-3:2002+A1:2008, *Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation*

EN 1005-4:2005+A1:2008, *Safety of machinery — Human physical performance — Part 4: Evaluation of working postures and movements in relation to machinery*

EN 1037:1995+A1:2008, *Safety of machinery — Prevention of unexpected start-up*

EN 1088:1995+A2:2008, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

EN 1760-1:1997+A1:2009, *Safety of machinery — Pressure sensitive protective devices — Part 1: General principles for the design and testing of pressure sensitive mats and pressure sensitive floors*

EN 1760-3:2004+A1:2009, *Safety of machinery — Pressure sensitive protective devices — Part 3: General principles for the design and testing of pressure sensitive bumpers, plates, wires and similar devices*

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

EN 12779:2004+A1:2009, *Safety of woodworking machines — Chip and dust extraction systems with fixed installation — Safety related performances and safety requirements*

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 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)*

EN 60439-1:1999[1)], *Low-voltage switchgear and controlgear assemblies — Part 1: Type-tested and partially type-tested assemblies (IEC 60439-1:1999)*

EN 60529:1991[2)], *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 60825-1:2007, *Safety of laser products — Part 1: Equipment classification and requirements (IEC 60825-1:2007)*

1) EN 60439-1:1999 is impacted by EN 60439-1:1999/A1:2004.

2) EN 60529:1991 is impacted by EN 60529:1991/A1:2000.

EN 61496-1:2004, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests (IEC 61496-1:2004, modified)*

CLC/TS 61496-2:2006, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs) (IEC 61496-2:2006)*

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

EN ISO 3743-1:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for small movable sources in reverberant fields — Part 1: Comparison method for a hard-walled test room (ISO 3743-1:2010)*

EN ISO 3743-2:2009, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering methods for small, moveable sources in reverberant fields — Part 2: Methods for special reverberation test rooms (ISO 3743-2:1994)*

EN 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 3744:2010)*

EN ISO 3745:2009[3)], *Acoustics — Determination of sound power levels of noise sources using sound pressure — Precision methods for anechoic and semi-anechoic rooms (ISO 3745:2003)*

EN 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 3746:2010)*

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

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

EN ISO 4871:2009, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 9614-1:2009, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 1: Measurement at discrete points (ISO 9614-1:1993)*

EN 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 11202:2010)*

EN 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 11204:2010)*

EN ISO 11688-1:2009, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

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

EN ISO 13849-1:2008, *Safety of machinery — Safety-related parts of controls systems — Part 1: General principles for design (ISO 13849-1:2006)*

3) EN ISO 3745:2009 is superseded by EN ISO 3745:2012.

EN ISO 13850:2008, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)*

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and the following apply.

3.1
Numerically Controlled (NC) boring and routing machines
integrated fed machines designed for the machining of workpieces by the use of milling and/or boring tools having at least two orthogonal axes programmable by the user (e.g. X, Y) for positioning and/or machining, where the axes operate in accordance with a NC work programme

Note 1 to entry The machine can have:

a) additional equipment for sawing or sanding or assembly units and dowel devices;

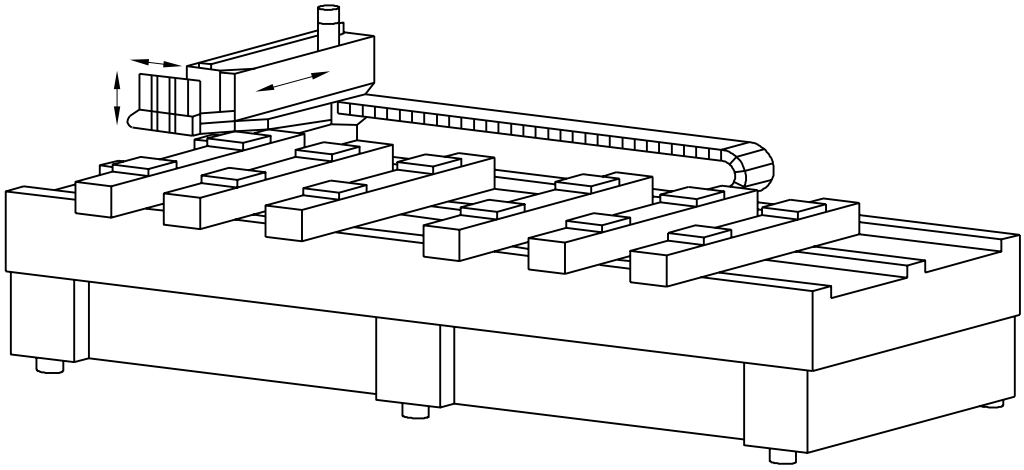
b) additional equipment for edge banding;

c) fixed or movable workpiece support;

d) mechanical, pneumatic, hydraulic or vacuum workpiece clamping;

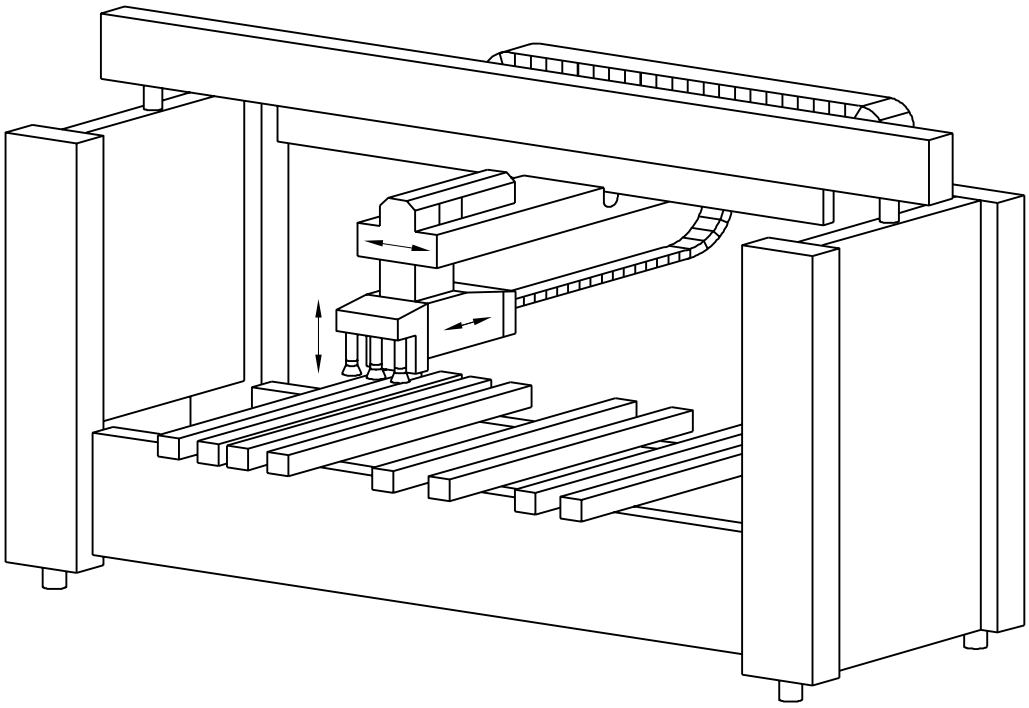
e) automatic tool change facilities.

Examples of different machine design are illustrated in Figures 1 to 9.



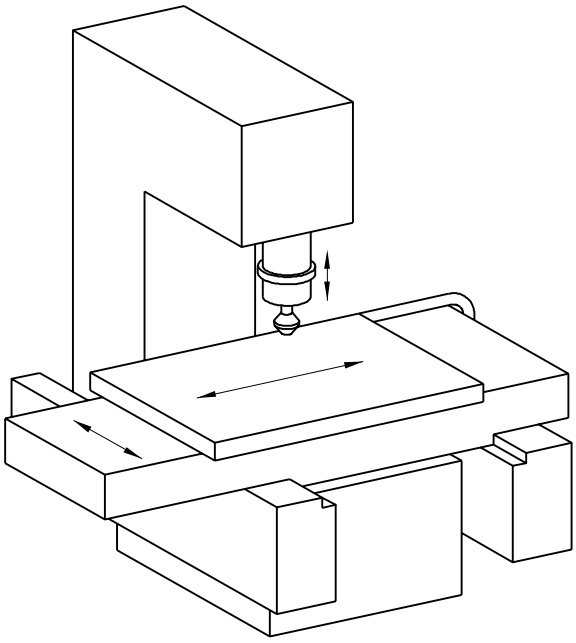
Safeguarding devices are not illustrated.

Figure 1 — Example 1 of a C frame machine (fixed table, moveable head)



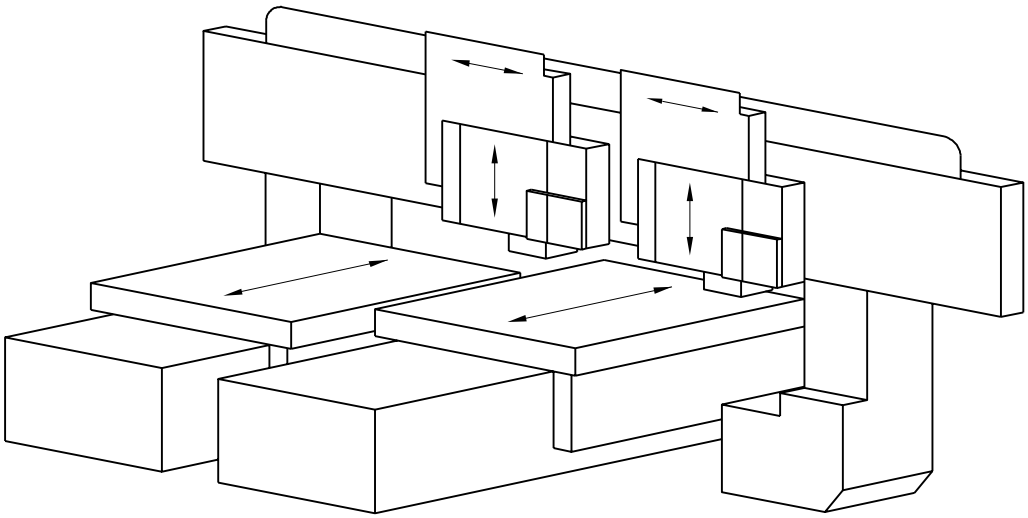
Safeguarding devices are not illustrated.

Figure 2 — Example 2 of a portal frame machine (fixed portal, fixed table moving head)



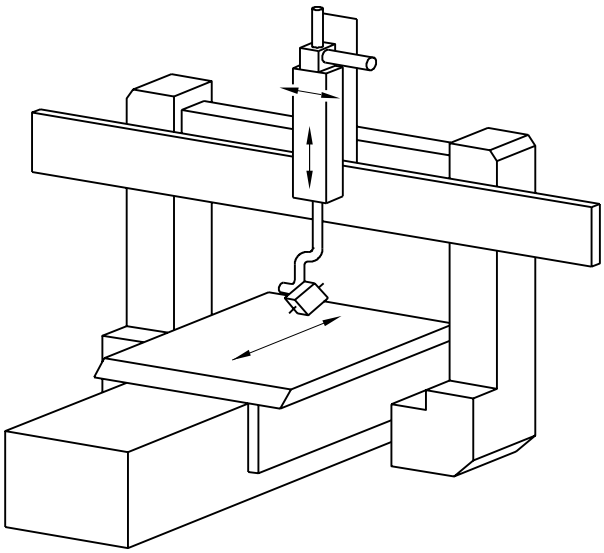
Safeguarding devices are not illustrated.

Figure 3 — Example 3 of an overhead router (moving table)



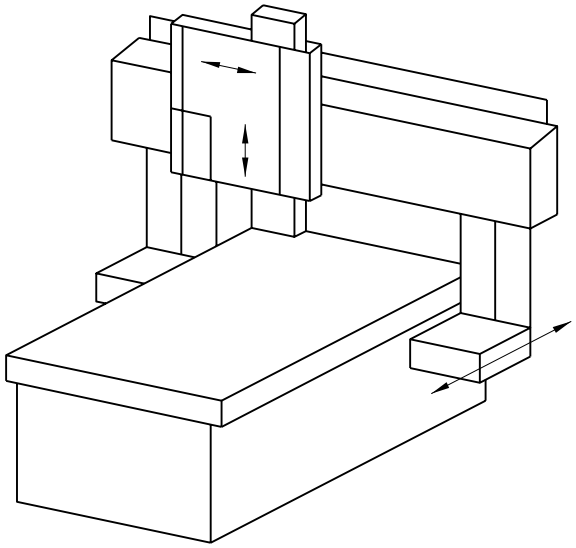
Safeguarding devices are not illustrated.

Figure 4 — Example 4 of an overhead router (moving tables, fixed portal, and moving heads)



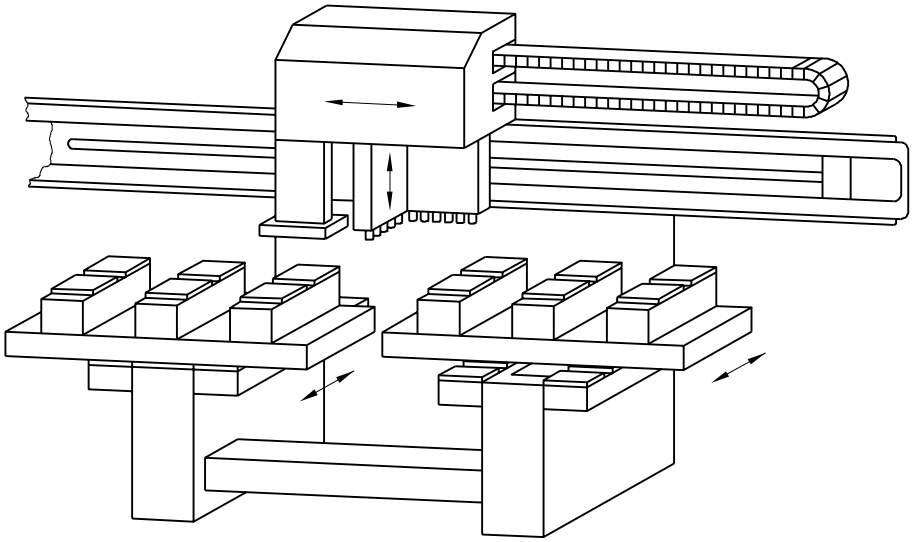
Safeguarding devices are not illustrated.

Figure 5 — Example 5 of a machining centre (moving table, fixed portal, moving head)



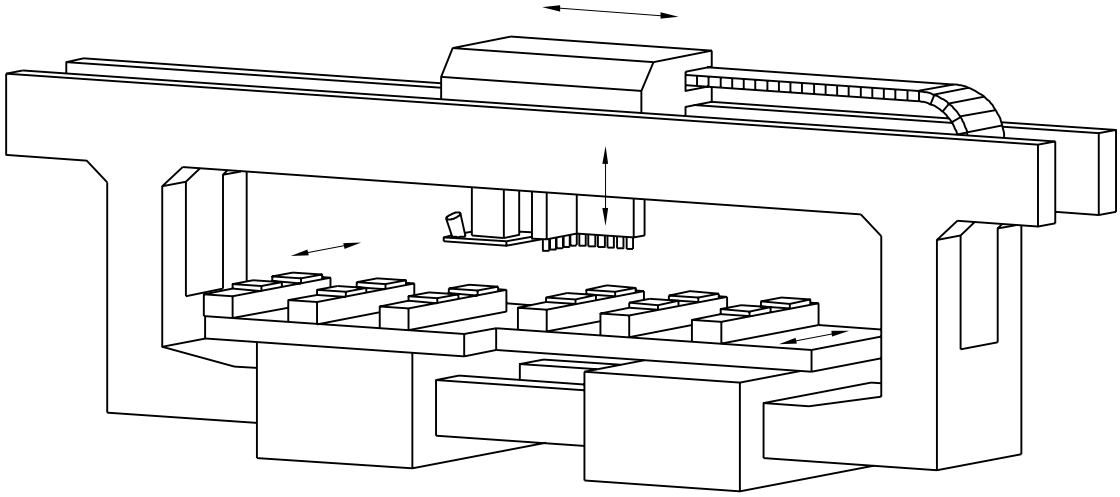
Safeguarding devices are not illustrated.

Figure 6 — Example 6 of an overhead router (fixed table, moving portal, moving head)



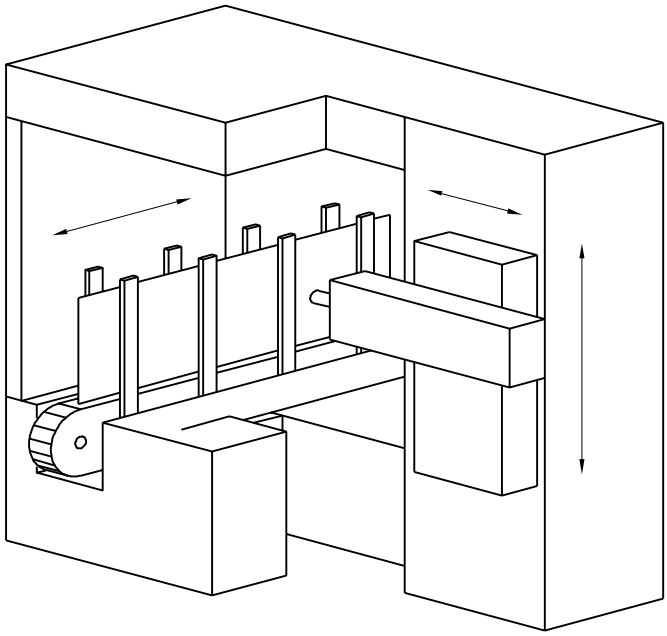
Safeguarding devices are not illustrated.

Figure 7 — Example 7 of a C frame boring machine (moving tables, fixed portal, moving heads)



Safeguarding devices are not illustrated.

Figure 8 — Example 8 of a portal frame boring machine (moving tables, fixed portal, moving heads)



Safeguarding devices are not illustrated.

Figure 9 — Example 9 of a vertical machine (moving support, fixed frame, moving heads)

3.2
boring tools
tools whose feed movement during machining is only in direction of their axis of rotation

3.3
sanding wheel
tool where the active part is made of coated abrasive

3.4
grinding wheel
tool where the active part is made of bounded abrasive

3.5
speed range
range between the lowest and the highest rotational speed for which the tool spindle or tool is designed to operate

3.6
ejection
uncontrolled movement of the workpiece or parts of it or part of the tool from the machine during processing

3.7
machine actuator
power mechanism used to effect motion of the machine

3.8
machining mode of operation
automatic, programmed, sequential operation of the machine with the facility for manual or automatic loading/unloading of workpieces

3.9
machine setting mode of operation
setting, programming, fault finding, program verification, testing and manually controlled (under power) non-sequential operation of the machine

3.10
information of the supplier
statements, sales literature, leaflets or other documents where a manufacturer (supplier) declares either the compliance of the characteristics of e.g. a material or product or the conformity of a material or a product to a relevant standard

3.11
Numerical Control (NC) Computerised Numerical Control (CNC)
automatic control of a process by a device that makes use of numerical data introduced while the process is in progress

3.12
partial enclosure
combination of fixed and moveable guards, safety devices and curtains which encloses the defined machine danger zone which may or may not have apertures or a ceiling

3.13
peripheral enclosure
combination of fixed and moveable guards which encloses the machine danger zone preventing access to it and also forms a means of safeguarding against ejected parts (e.g. wood dust and chips) which may or may not have a ceiling

3.14
integrated feed on NC boring and routing machines
power operated feed mechanism for the work piece, the work piece support and/or the machine element with incorporated tool which is integrated with the machine

3.15
operational stop
control through which the machine can be brought to a monitored and maintained safe stop but where the energy supply to the machine actuators need not be cut off when the machine or the dangerous parts of it are stopped

3.16
bumper
pressure sensitive protective device

Note 1 to entry See EN 1760-3:2004+A1:2009 and 3.26.

Note 2 to entry Pressure sensitive protective device comprise:

a) sensor(s) which generate(s) a signal when pressure is applied to part of its outer surface, where:

   1) the cross section throughout the pressure sensitive area may be regular or irregular;

   2) the sensor is intended to detect a person or a part of his body (head, arm leg, etc.) when entering the protected zone;

b) where necessary a control unit, which responds to the signal from the sensor and generates output signal(s) to the control system of the machine.

Note 3 to entry For some bumpers the sensors generate directly the output signal(s).

3.17
safety related part of a control system
SRP/CS
part or subpart(s) of a control system that responds to input signals and generates safety-related output signals

Note 1 to entry The combined safety-related parts of a control system start at the point where the safety-related signals are initiated (including e.g. the actuating cam and the roller of the position switch) and end at the output of the power control elements (including e.g. the main contacts of the contactor). This also includes monitoring systems (EN ISO 13849-1:2008, 3.1).

3.18
embedded software
SRESW
software that is part of the system supplied by the control manufacturer and which is not accessible for modification by the user of the machinery

Note 1 to entry Firmware or system software are examples of embedded software (EN ISO 13849-1:2008, 3.1.37).

Note 2 to entry Manufacturer means manufacturer of the system.

Note 3 to entry For example the operating system of a speed monitoring device.

3.19
application software
SRASW
software specific to the application, implemented by the machine manufacturer, and generally containing logic sequences, limits and expressions that control the appropriate inputs, outputs, calculations and decisions necessary to meet the SRP/CS requirements

[SOURCE: EN ISO 13849-1:2008, definition 3.1.36]

3.20
redundancy
application of more than one device or system, or part of a device or a system, with the objective of ensuring that, in the event of one failing to perform its function, another is available to perform that function

Note 1 to entry: See EN 60204-1:2006, 3.44, and EN ISO 12100:2010, 6.2.12.4.

3.21
monitoring
safety function which ensures that a safety measure is initiated if the ability of a component or an element to perform its function is diminished, or if the process conditions are changed in such a way that hazards are generated

3.22
un-braked run-down time
time elapsed from the actuation of the stop control device for stopping until spindle standstill when the brake is not effective

3.23
braked run-down time
time elapsed from the actuation of the stop control device for stopping until spindle standstill when the brake is effective

3.24
electro-sensitive protective equipment
ESPE
non-mechanically actuated assembly of devices and/or components working together for protective tripping or presence-sensing purposes

Note 1 to entry: ESPE comprise as a minimum:

- a sensing function;
- a control / monitoring function;
- one or more output signal switching device(s).

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

Note 2 to entry: Examples are light beam, capacitive, active infra-red, ultra-sonic and image monitoring equipment.

3.25
pressure sensitive protective equipment
PSPE
mechanically actuated assembly of devices and/or components working together for protective tripping or presence-sensing purposes

Note 1 to entry: PSPE comprise as a minimum:

- one or more sensing elements;
- a control unit where necessary;
- one or more output signal switching device(s).

Safety related control system associated with the PSPE or the PSPE itself can further include a secondary switching device, start interlock, re-start interlock, etc.

Note 2 to entry Examples are pressure sensitive edges, pressure sensitive floors, pressure sensitive mats and pressure sensitive bars.

3.26
performance level
PL
discrete level used to specify the ability of safety-related parts of control systems to perform a safety function under foreseeable conditions

[SOURCE: EN ISO 13849-1:2008, definition 3.1.23]

4 List of significant hazards

This clause contains all significant hazards, hazardous situations and events (see EN ISO 12100:2010), identified by risk assessment as significant for the machines as defined in the scope and which require action to eliminate or reduce the risk. This document deals with these significant hazards by defining safety requirements and/or measures or by reference to relevant standards:

These hazards are listed in Table 1.

Table 1 — List of significant hazards

No	Hazards, hazardous situations and hazardous events	EN ISO 12100:2010	Relevant clauses of this document
1	Mechanical hazards related to machine parts or workpiece due to:		
	a) shape	6.2.2.1, 6.2.2.2, 6.3	5.3.7, 5.3.8, 5.4.5
	b) relative location		5.2.2, 5.2.3, 5.2.5, 5.3.7
	c) mass and stability (potential energy of elements which may move under the effect of gravity)		5.2.10, 5.3.3, 5.4.5, 5.4.12
	d) mass and velocity (kinetic energy of elements in controlled or uncontrolled motion)		5.2.7, 5.3.7, 5.3.8
	e) mechanical strength		5.3.7.5, Annex B
	- accumulation of energy inside the machinery:		
	f) liquids or gases under pressure, or	6.2.10, 6.3.5.4	5.2.10, 5.4.7, 5.4.8, 5.4.13
	g) vacuum		5.3.8
1.1	Crushing hazard		5.3.4, 5.3.7.2, 6.3
1.2	Shearing hazard		5.3.7.2
1.3	Cutting or severing hazard		5.3.7.1.1, 5.3.7.1.2, 5.3.7.2
1.4	Entanglement hazard		5.3.3, 5.3.7
1.5	Drawing in or trapping hazard		5.3.7
1.6	Impact hazard		5.3.5
1.7	Stabbing or puncture hazard		5.3.7.2
1.8	Friction or abrasion hazard		5.3.7

No	Hazards, hazardous situations and hazardous events	EN ISO 12100:2010	Relevant clauses of this document
1.9	High pressure fluid injection or ejection hazard	6.2.10	5.3.8
2	Electrical hazards		
2.1	Contact of persons with live parts (direct contact)	6.2.9, 6.3.5.4	5.4.4
2.2	Contact of persons with parts which have become live under faulty conditions (indirect contact)	6.2.9	5.4.4
4 Hazards generated by noise, resulting in:			
4.1	Hearing loss (deafness), other physiological disorders (loss of balance, loss or awareness)	6.2.2.2, 6.3	5.4.2
4.2	Interference with speech communication, acoustic signals		5.4.2
6 Hazards generated by radiation			
6.1	Low frequency, radio frequency radiation, micro waves		5.4.10
6.5	Lasers	6.3.4.5	5.4.11
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, 6.2.4	5.4.3
7.2	Fire hazard	6.2.4	5.4.1, 5.4.9
8 Hazards generated by neglecting ergonomic principles in machine design:			
8.1	Unhealthy postures or excessive efforts	6.2.7, 6.2.8, 6.2.11.12, 6.3.5.5, 6.3.5.6	5.2.2
8.2	Hand-arm or foot-leg anatomy	6.2.8	5.4.5
8.4	Local lighting	6.2.8.6	5.4.6, 6.3
8.5	Mental overload and underload, stress	6.2.8.5	5.4.5
8.6	Human error	6.2.8.1, 6.2.11.8, 6.2.11.10, 6.3.5.2, 6.4	5.2.7, 6.3
8.7	Design, location or identification of manual controls	6.2.8.7, 6.2.11.8	5.2.2
8.8	Design or location of visual display units	6.2.8, 6.4.2	5.2.2
9	Hazard combination	6.3.2.1	5.2.7
10 Unexpected start-up, unexpected overrun/overspeed (or any similar malfunction) from			

No	Hazards, hazardous situations and hazardous events	EN ISO 12100:2010	Relevant clauses of this document
10.1	Failure/ disorder of the control system	6.2.11, 6.3.5.4	5.2.8, 5.2.11
10.2	Uncontrolled restoration of energy supply after an interruption	6.2.11.4	5.2.10
10.3	External influences on electrical equipment	6.2.11.11	5.2.1, 5.4.4
10.5	Errors in the software	6.2.11.7	5.2.1
11	Impossibility of stopping the machine in the best possible conditions	6.2.11.1, 6.2.11.3, 6.3.5.2	5.2.4, 5.2.5, 5.4.13
12	Variations in the rotational speed of tools	6.2.2.2, 6.2.3	5.2.8
13	Failure of the power supply	6.2.11.1, 6.2.11.4	5.2.10
14	Failure of the control circuit	6.2.11, 6.3.5.4	5.2.1, 5.2.11
15	Errors of fitting	6.2.7, 6.4.5	6.3
16	Break-up during operation	6.2.3	5.3.2
17	Falling or ejected objects or fluids	6.2.3, 6.2.10	5.3.2, 5.3.3, 5.3.5, 5.3.7
18	Loss of stability/overturning of machinery	6.3.2.6	5.3.1, 5.3.2
19	Slip, trip and fall of persons (related to machinery)	6.3.5.6	5.3.5

5 Safety requirements and/or measures

5.1 General

The machine shall comply with the safety requirements and/or protective measures of Clause 5.

In addition, the machine should be designed according to the principles of EN ISO 12100:2010 for hazards relevant but not significant, which are not dealt with by this document (e.g. sharp edges of the machine frame).

NOTE For guidance in connection with risk reduction by design, see EN ISO 12100:2010, 6.2, and for safeguarding measures see EN ISO 12100:2010, 6.3.

5.2 Controls

5.2.1 Safety and reliability of control systems

5.2.1.1 General

For the purpose of this document, safety related part of a control system means the system which implements safety functions from the initial device, e.g. actuator, position detector or sensor up to and including the power control element of the final machine actuator, e.g. motor or brake. The safety functions are detailed below. The control system for these functions shall be designed so as to fulfil at least the stated PL in accordance with the requirements of EN ISO 13849-1:2008:

— for initiation of any movement: PL=c (see 5.2.3);

— for normal stopping: PL=c (see 5.2.4);

— for emergency stopping: PL=c (see 5.2.5);

— for standstill monitoring: PL=c (see 5.2.6, 5.2.8);

— for axes/spindle speed monitoring: PL=c (see 5.2.8);

— for tool release: PL=c or two independent systems in PL=b (see 5.3.3);

— for interlocking: PL=c (see 5.2.7, 5.2.9);

— for interlocking with guard locking: PL=c (see 5.3.7.4 and 5.3.7.1.2);

— for hold to run control or limited movement control: PL=c or PL=b if combined with an enabling device in PL=c (see 5.2.7.3);

— for workpiece powered clamping: PL=b (see 5.3.8);

— for mode selection: PL=c (see 5.2.7);

— for trip device: PL=c (see 5.3.7.1.2, 5.3.7.2 and 5.3.7.3);

— for braking function: PL=b with additional requirements (see 5.3.4);

— for axis position control: PL=c (see 5.3.7.2);

— for interlocking between the position of the curtains and the movements of any spindle: PL=c (see 5.3.7.1.2.4).

Verification: By checking the relevant drawings and/or circuit diagrams and inspection of the machine, evaluation of the achieved performance level according to EN ISO 13849-1:2008, 4.5.

5.2.1.2 Use protective devices

Protective devices shall be in accordance with the specific standards. For the devices listed below the following requirements apply:

a) pressure sensitive mats shall be designed to detect persons weighing more than 35 kg, be fitted with a reset device and shall conform to the requirements of EN 1760-1:1997+A1:2009: The system as a whole (including sensor(s), control system and outlet interface, interlocking control system) shall conform at least to PL=c in accordance with the requirements of EN ISO 13849-1:2008;

b) active opto-electronic protective devices (light barrier) shall as minimum be in accordance with type 2 as defined in CLC/TS 61496-2:2006 and the associated control system shall conform at least to PL=c in accordance with the requirements of EN ISO 13849-1:2008;

c) proximity switches shall be in accordance with the requirements of EN 1088:1995+A2:2008, 6.2, and the related control system shall conform at least to PL=c in accordance with the requirements of EN ISO 13849-1:2008.

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

5.2.2 Position of controls

5.2.2.1 General

The main electrical control devices for the initiation of any movement, operational/normal stopping (if provided, see 5.2.6), emergency stop, mode selection shall be located at the operator's position adjacent to the control display (at the main control panel) at a height between 600 mm and 1 800 mm above the floor level.

Hold-to-run control devices and enabling devices for tool or axes movements shall be located on the main control panel and/or on a mobile set of controls connected to the machine by a fixed cable or wireless (if provided).

Any safeguarding equipment reset control device shall be located outside the protected zone. It shall either not be reachable from within the protected zone or not be effective if actuated from inside the protected zone (see 5.3.7.1.2.3, 5.3.7.2).

The emergency stop device shall be provided at each working station (see 6.3 g)) and in particular:

a) at the main control panel;

b) at the mobile control set (if provided);

c) adjacent to all hold-to-run control;

d) adjacent to all limited movement control;

e) at the workpiece loading and unloading station;

f) close to or inside the tool magazine, where this is separated from the machining area;

g) inside any peripheral enclosure fitted with access door (see 5.3.7.1.2).

Cycle restart of the machine shall be interlocked with workpiece powered clamping.

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

5.2.2.2 Mobile control sets

Additional control devices for starting, operational/ normal stopping (if provided) may be duplicated/provided on mobile control sets with or without fixed cable connection taking account of the requirements of 5.2.5 for emergency stop.

No reset function control devices, no control devices for initiation of dangerous movements shall be permitted on wireless mobile control sets or mobile control sets with fixed cable connection.

When on a wireless control set the connection between the set and the machine is lost an emergency stop according to 5.2.5 shall be automatically activated.

NOTE 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.

5.2.3 Starting

Start or restart (including after operational stop) of machines shall be possible only when all safeguards described in 5.3.7 are in place and functional. Cycle start or restart when using powered workpiece clamping shall be possible only when all safeguards are in place and functional and when the powered workpiece clamping force has been activated.

This is achieved by the interlocking arrangement, including PL required, described in 5.2.7, 5.3.7 and 5.3.8. Cycle start or restart shall only be possible after actuation of a control device for the initiation of any movement provided for that purpose and protected against unintended actuation e.g. by shrouded control devices.

Mobile control sets with or without fixed cable connection may be equipped with cycle start control device(s) (see also 5.2.2.2).

The safety related part of the control system for initiation of any movement shall conform to at least PL =c in accordance with the requirements of EN ISO 13849-1:2008 and the requirements of EN 60204-1:2006, 9.2.5.2 apply.

NOTE No PL is required for starting and/or restarting functions.

The same control device e.g. push button can be used as initiation of any movement control device and safeguard(s) reset control devices if the danger zone is visible from the control position (see relevant clause(s)).

Closure of movable interlocked guards shall not lead to an automatic restart of hazardous movements. For each restart a deliberate action of the operator is required.

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

5.2.4 Normal stopping

A normal stop control system shall be provided for the machining and setting modes of operation, which when actuated shall fulfil the stopping sequences and shall disconnect power from all machine actuators except workpiece clamping unless STO in accordance with EN 61800-5-2:2007 is used.

When STO is provided in accordance with EN 61800-5-2:2007 no disconnection by contactor is required.

For normal stopping of PDS(SR) (power drive system, safety related) see EN 61800-5-2:2007, 4.2.2.2 "safe torque off (STO)" and 4.2.2.3 "safe stop 1 (SS1)".

The stop control circuit shall be of a category 1 in accordance with the requirements of EN 60204-1:2006, 9.2.2 to allow the actuation of the electrical brake (if fitted) and maintain clamping.

The stopping sequence for normal stopping shall be:

a) stop axes movements;

b) stop spindle rotation;

c) for machines equipped with powered workpiece clamping: maintain workpiece clamping until the machine has come to a complete and safe stop;

d) disconnect the machine actuators (except workpiece clamping) from all energy sources.

Powered workpiece clamping devices may be de-energised if no additional hazard will occur.

The safety related part of control system for normal stopping shall be at least PL=c in accordance with the requirements of EN ISO 13849-1:2008.

If a time delay device is used the time delay shall be at least in PL=c in accordance with the requirements of EN ISO 13849-1:2008 and at least equal to the run-down time. Either the time delay shall be fixed or the time delay adjustment device shall be sealed.

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

5.2.5 Emergency stop

Machines shall be fitted with an emergency stop control device which complies with the requirements of EN ISO 13850:2008 and additionally with the requirements of EN 60204-1:2006, 10.7. The emergency stop control device shall be at any time of self latching type.

When STO is provided in accordance with EN 61800-5-2:2007 no disconnection by contactor is required.

For emergency stop of PDS(SR) see EN 61800-5-2:2007, 4.2.2.2 "safe torque off (STO)" and 4.2.2.3 “safe stop 1 (SS1)”.

Mobile control sets with or without fixed cable connection shall be equipped with an emergency stop control device. (See also 5.2.2.2.)

The emergency stop function shall comply with the requirements of EN 60204-1:2006, 9.2.5.4.2 and the emergency stop control circuit shall be of a category 1 in accordance with the requirements of EN 60204-1:2006, 9.2.2 to allow the actuation of the electrical brake and maintain clamping until the braking sequence is complete (see also 5.3.4).

When initiated the emergency stop sequence shall:

a) stop the axes movements;

b) stop spindle rotation;

c) for machines equipped with powered workpiece clamping: maintain workpiece clamping until the machine has come to a complete and safe stop;

d) disconnect the machine actuators (except workpiece clamping) from all energy sources.

Powered workpiece clamping devices may be de-energised if no additional hazard will occur.

The safety related part of control system for emergency stop shall be at least PL=c in accordance with the requirements of EN ISO 13849-1:2008.

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

5.2.6 Operational stop

If an operational stop function is provided for intervention in the machine while drive systems remain under control the following requirements shall apply:

The stop function provided (e.g. cycle stop) shall be of category 2 in accordance with the requirements of EN 60204-1:2006, 9.2.2, actuated in conjunction with standstill monitoring and the control system for standstill monitoring shall be at least PL=c in accordance with the requirements of EN ISO 13849-1:2008.

For operational stop of PDS(SR) see EN 61800-5-2:2007, 4.2.3.1 "safe operating stop (SOS)" and 4.2.2.4 "safe stop 2 (SS2)".

Any opening of a moveable guard or activation/triggering of the safety related control system of a protective device located in a zone where machining is under progress (see 5.3.7.1.1, 5.3.7.1.2 and 5.3.7.2) shall initiate either a normal stop (see 5.2.5) or an operational stop.

When the operational stopping sequence is initiated it shall:

a) stop the axes movements;

b) stop spindle rotation;

c) for machines equipped with powered work piece clamping: maintain work piece clamping until the machine has come to a complete and safe stop.

Powered work piece clamping devices may be de-energised if no additional hazard will occur.

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

5.2.7 Mode selection switch

5.2.7.1 General

Where machines are designed to be operated during setting with the moveable interlocked guards and/or protective devices disabled, a mode selection switch shall be provided to select between the machining and setting modes of operation and the following conditions shall be met:

a) the mode selection switch shall be lockable in each position and be located outside the hazards zone e.g. on the main control panel (see 5.2.2.1 for location of control devices);

b) the control system for mode selection shall conform at least to PL=c in accordance with the requirements of EN ISO 13849-1:2008;

c) the mode selection switch shall not allow more than one mode to be active at any one time;

d) the safeguarding requirements given in 5.2.7.2 and 5.2.7.3 shall be effective in their respective mode of operation (see Figure 10);

e) selecting any of the modes shall not initiate a starting command;

f) when changing from machining mode to setting mode the machine shall be brought to a complete and safe stop.

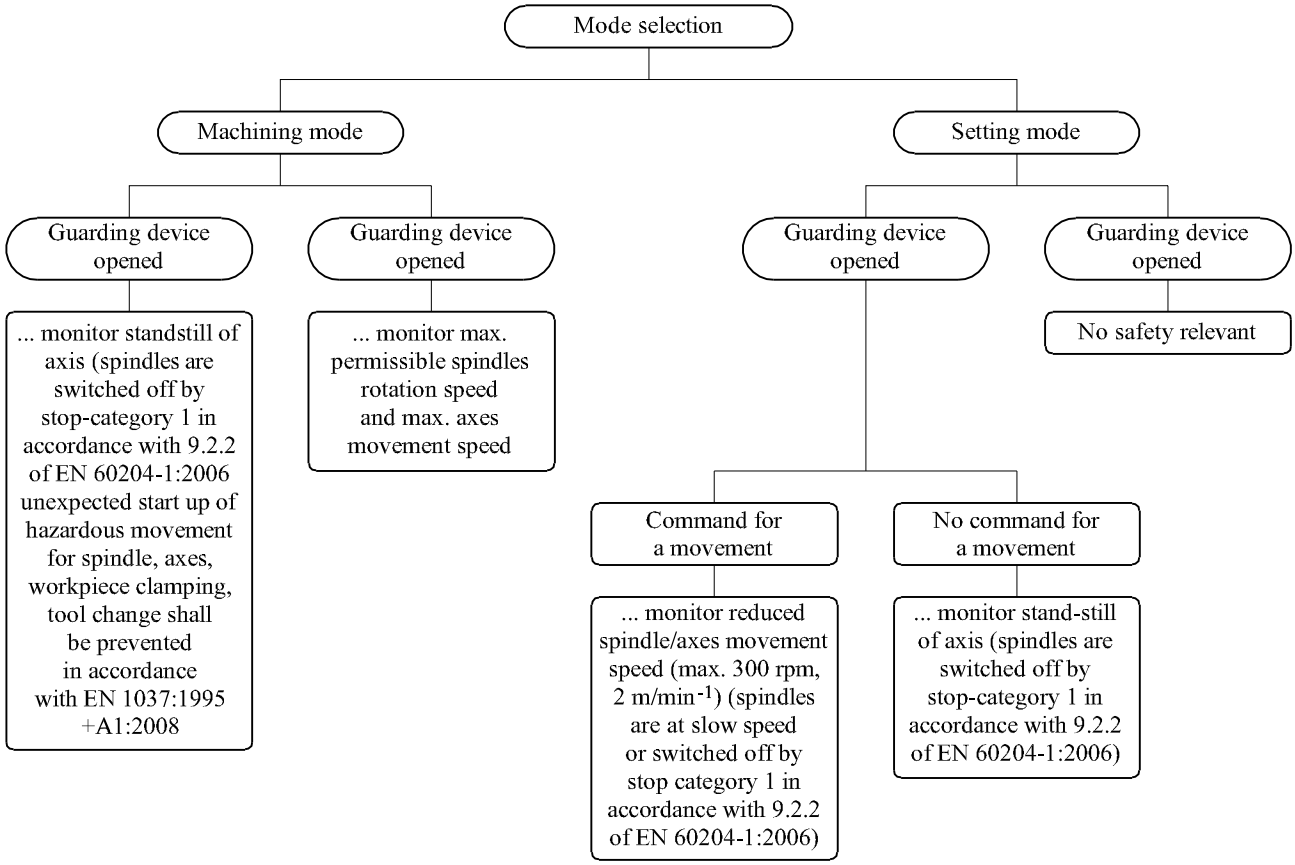


Figure 10 — Mode selection coherence synopsis

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

5.2.7.2 Machining mode of operation

In machining mode, movement shall only be possible when the interlocked moveable guards (for definition, see EN 1088:1995+A2:2008, 3.2 and 3.3) and/or protective devices are in place and functional.

The safety related maximum speed of axes movement or spindle rotation shall fulfil the requirements of 5.2.8 for speed monitoring and control.

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

5.2.7.3 Machine setting mode of operation

In machine setting mode of operation if the moveable guards are open and/or protective devices disabled, any hazardous movement shall only be possible when all the following requirements are met:

a) spindle rotation, if provided, shall be controlled by a hold-to-run control/enabling device;

b) any single axis movement shall be controlled by a hold to run control. The movement shall be limited to 2 m min^{-1} speed or 10 mm increment. Both the hold to run control and speed limited movement control system shall be at least PL=c in accordance with the requirements of EN ISO 13849-1:2008. If the hold to run control device is combined with an enabling device in PL = c in accordance with the requirements of EN ISO 13849-1:2008 no additional requirements for the hold to run control device shall be met; and

c) if tool rotation is provided it shall be limited to a maximum of 300 min^{-1} and

d) tool rotation shall stop in less than 2 rotations after release of the hold-to-run control;

e) maximum speed monitoring in accordance with 5.2.8 shall be provided for spindle rotation (if provided) and axes movements and

f) detection of a fault in maximum speed monitoring shall stop all movements of the machine in accordance with the requirements of EN 60204-1:2006, 9.2.2, category 0 or 1, and

g) automatic tool change mechanism shall be protected against unexpected movements at least in PL=c in accordance with the requirements of EN ISO 13849-1:2008.

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

5.2.8 Speed control system

Unless the tool characteristics are automatically read from the tool, at least the maximum rotational speed and the diameter of the tool need to be set by the operator after loading of the tool changing system or after manual insertion of the tool. These stored data shall be monitored and confirmed by the operator. The selected speed shall never exceed the maximum tool rotational speed.

For milling aggregates with fixed spindle speed not controlled by inverter and for boring tools no monitoring is required.

On machines fitted with an automatic electric control device for spindle rotational speed changing (e.g. a frequency inverter), the spindle speed shall be controlled such that the actual rotational speed can not exceed the maximum tool rotational speed by more than 10 % (e.g. by means of an auxiliary electrical circuit). The actual speed of the spindle shall be automatically compared with the tool maximum rotation speed continuously. The processor used for this purpose shall have an external watch dog function.

If the actual spindle rotational speed exceeds the maximum tool rotational speed by more than 10 %, the drive motor shall be stopped automatically. This stop shall be of category 1 in accordance with the requirements of EN 60204-1:2006, 9.2.2. If stopping of the spindle drive result in two or more simultaneous failures, the stop shall be of category 0 in accordance with the requirements of EN 60204-1:2006, 9.2.2 (see also 5.3.4). In addition the following measures shall be taken against loss or falsification of data:

a) the following measures against loss of the data for tools and maximum speed stored in the machine control:

   1) the safety related data for the machine tools (e.g. maximum rotational speed) shall be stored either in 2 independent memory chips or stored twice in one single chip (one time inverse);

   2) after input of the safety related data for the tools the data shall be confirmed by the operator;

   3) the two data shall be compared at each switching on of the isolator, at each fetch of the data, at least once per shift. If the two data are not identical spindle motor start shall not be possible or if running the spindle motor shall be stopped and a warning signal given;

b) appropriate measures against falsification in safety relevant data transfer between those components involved in rotation control.

In machining and in setting mode with axes moving and/or tool rotating at reduced speeds as well as for over speed (speed exceeding more than 10% of tool maximum rotational speed) the speed monitoring system shall conform at least to PL=c in accordance with the requirements of EN ISO 13849-1:2008.

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

5.2.9 Interlocking of guards, protective devices, movements and functions

If not otherwise specified in this standard the interlocking system of guards, protective devices, movements and functions shall be at least PL=c in accordance with the related requirements of EN ISO 13849-1:2008.

NOTE For exception see 5.3.7.1.2.4.

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

5.2.10 Failure of the power supply

In the case of supply interruption for electrically driven machines, automatic restart after the restoration of the supply voltage shall be prevented in accordance with the requirements of EN 60204-1:2006, paragraphs 1 and 3 of 7.5).

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

5.2.11 Failure of the control circuits

The requirements of EN 1037:1995+A1:2008, Clause 6 apply and in addition:

The control circuits shall be designed so that a line rupture in any circuit (e.g. broken wire, pipe or hose) will not result in the loss of a safety function e.g. unexpected start and shall conform to EN 60204-1:2006, EN ISO 4413:2010 and EN ISO 4414:2010.

See also 5.2.1.

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

5.3 Protection against mechanical hazards

5.3.1 Stability

It shall be possible to fix the machines and auxiliary equipment to a suitable stable horizontal structure e.g. floor. Facilities for fixing are e.g. fixing holes in the machine frame and auxiliary equipment frame (see also 6.3).

Dangerous movements of the machine or part of it caused by gravity, pressure etc. shall be avoided, e.g. by mechanical blocking devices capable of withstanding the maximum load for which the machine is designed.

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

5.3.2 Risk of break-up during operation

Risk of break-up during operation shall be prevented for fall arrester in accordance with 5.4.12, for enclosures in accordance with 5.3.7.1.2 and for guards in accordance with 5.3.7.5. (See also 6.3.)

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

5.3.3 Tool holder

The tool fixing device shall be such, that the tools do not become loose during start up, operation, rundown and braking.

Hydrostatic tool fixing devices which are an integral part of the spindle or which are permanently connected with it shall have an additional mechanical device to prevent loosening of the tool in case of leakage in the hydrostatic system (see also 6.3).

Milling tool spindle run-out shall not exceed 0,02 mm.

Tool release shall only be possible if the spindle is stopped and restart is prevented (this second requirement applies only when operator changes the tool manually).

The safety related part of control system for interlocking between tool release and spindle rotation shall be at least PL=c in accordance with the requirements of EN ISO 13849-1:2008 or consist of 2 independent systems of PL=b in accordance with the requirements of EN ISO 13849-1:2008.

As an exception tool release function can be PL=b in accordance with the requirements of EN ISO 13849-1:2008 if there is an additional mechanical system which prevents releasing the tool during rotation.

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

5.3.4 Braking tool spindle(s)

An automatic electrical brake shall be provided for the tool spindle(s) with an unbraked run-down time exceeding 10 s.

The braking system shall be designed to ensure that the braked run-down time does not exceed 10 s, e.g. braking on the current limit of inverter (quick stop).

In the case of a failure of the power supply the braking function shall be ensured but the run-down time may exceed 10 s (see 6.3).

Electrical brakes and their function shall be performed either by direct current injection or by frequency inverter braking.

A PL of al least b for the breaking function shall be achieved and be designed in category 2 in accordance with the requirements of EN ISO 13849-1:2008 with the exception that the test rate requirement in EN ISO 13849-1:2008, 4.5.4 is not applicable. The safety related part of the control system for braking shall be tested periodically, e.g. by monitoring braked run down time. The feed back 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 function shall be provided in the control system for braking;

b) be independent from the intention of the operator;

c) be performed at each spindle stop.

Where the test result is negative it shall be impossible to operate the machine. A negative test shall be indicated.

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

See EN ISO 13849-1:2008, Annex E for DC estimation.

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 D apply.

5.3.5 Devices to minimise the risk of ejection

The risk of ejection of work-pieces or parts of them shall be minimised e.g. by means of either clamping devices or machining of off-cuts (see 6.3).

NOTE The requirements to minimise the risk of ejection of tool parts are given in 5.3.2, 5.3.3 and 5.3.7.

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

5.3.6 Workpiece supports and guides

NOTE The requirements for workpiece clamping are given in 5.3.8.

See also 6.3.

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

5.3.7 Prevention of access to moving parts and devices to minimise the effect of ejection

5.3.7.1 Guarding of tools

5.3.7.1.1 NC boring machines

Boring machines designed to use only boring tools shall be guarded by:

a) fixed guards and/or fixed distance guards or moveable interlocked guards conforming to EN 1088:1995+A2:2008, 5.2; or

b) protective devices e.g. light barrier; or

c) any combination of a) and b).

If the fixed guards are to be demounted by the user e.g. for maintenance, cleaning purposes, their fixing systems shall remain attached to the guard or to the machine when the guard is removed, e.g. fitted with un-losable screws (see 6.3 w)).

Safety distances from tools shall be at least:

1) 550 mm when openings height for workpiece loading/unloading is up to 200 mm;

2) 850 mm when openings height for workpiece loading/unloading is between 200 and 400 mm

3) according to EN ISO 13857:2008 except Table 1 and Table 5 when openings height for workpiece loading/unloading exceed 400 mm.

When additional equipment for sawing is provided, the above safety distances apply, but measures to minimise the effect of ejection of tools parts or workpieces parts shall be adopted e.g. saw blade enclosing guard (see 5.3.7.5).

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

5.3.7.1.2 NC routing machines and NC combined boring/routing machines

5.3.7.1.2.1 General

On NC routing machines and NC combined boring/routing machines access to hazard zones from above the workpiece support shall be prevented either by a peripheral enclosure or by a partial enclosure in accordance with the requirements of 5.3.7.1.2.2 or 5.3.7.1.2.3 including where appropriate other safeguarding devices, like safety mats and light barriers or pressure sensitive bumpers in accordance with 5.3.7.2, 5.3.7.3 and 5.3.7.4.

If the fixed guards are to be demounted by the user e.g. for maintenance, cleaning purposes their fixing systems shall remain attached to the guard or to the machine when the guard is removed e.g. fitted with un-losable screws (see 6.3 w)).

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

5.3.7.1.2.2 Peripheral enclosure

If fitted with a peripheral enclosure the following requirements in addition of 5.3.7.1.2.1 shall be met:

The enclosure shall prevent access to the danger zone, ejection of part of the tool and any crushing or trapping hazard between fixed and moving machine parts up to at least 1 800 mm from the floor level.

Where it is necessary to enter the enclosure for setting, tool changing, cleaning or loading/unloading a door shall be provided and be interlocked with guard locking to the drives. Guard locking shall be achieved, by at least, an interlocking device with manually operated time delay device in accordance with EN 1088:1995+A2:2008, Annex N. The following additional requirements apply:

a) audible or visual warning (e.g. a yellow light) of impending start up shall be given if from the control position the operator doesn't have a complete view of the machining area (see 6.1) and

b) emergency stop device according to 5.2.5 shall be placed inside the enclosure to stop start up if needed and

c) control device to reset the interlocking of the door conforming to EN ISO 13849-1:2008, 5.2.2 shall be provided outside the enclosure, not reachable from inside the enclosure (with a clear view of the inside of it).

The characteristics of the guards shall conform to 5.3.7.5.

The control system for interlocking with guard locking shall conform to the requirements of 5.2.9.

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

5.3.7.1.2.3 Partial enclosure

5.3.7.1.2.3.1 General

If fitted with a partial enclosure the following requirements in addition to 5.3.7.1.2.1 shall be met:

Direct ejection through the space between the clamping bars shall be prevented at the front and at the rear up to the lowest surface on which the workpiece can be clamped unless other fixed guards are provided to protect against effect of ejection e.g. for the front side by an extension of the partial enclosure downwards

With the exception for the loading and/or unloading zone the requirements of 5.3.7.1.2.2 apply.

For the loading and/or unloading zone when the operator enters in the protected zone the machine shall activate an operational or an emergency stop of the dangerous movements in that zone (for exception see c) below) (see also 5.3.7.1.2.3.2):

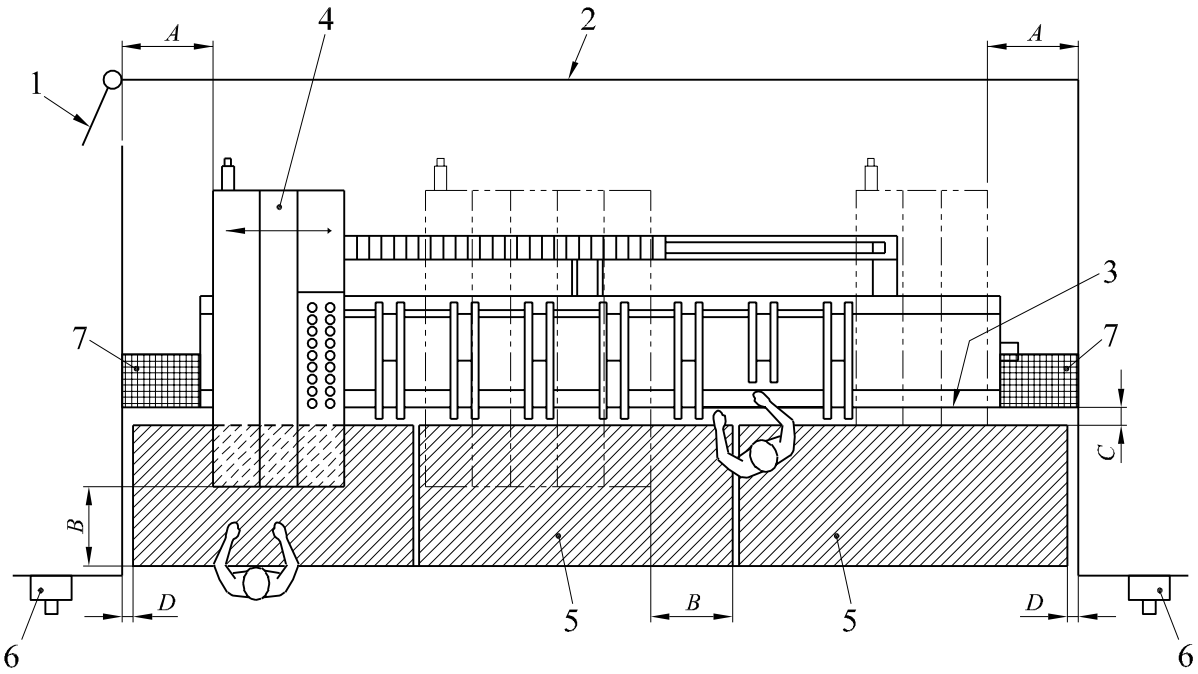
a) Access to the sides and rear zone of the machine from the loading/unloading zone protected by safety devices (e.g. pressure sensitive mats or light barrier according to 5.3.7.1.2.3.2) shall be prevented by either (see Figure 11 key 7):

   1) fixed guard fitted with fixing system attached to the guard or to the machine e.g. un-losable screws if they are demountable by the user e.g. for maintenance, cleaning purposes see 6.3 w), or

   2) deterring/ impeding devices mounted at a height exceeding 700 mm and extending horizontally over a distance of at least 400 mm; or

   3) light barrier, the activation of which shall also activate the functions required in 5.3.7.2; see also 5.3.7.1.2.3.2.2.

b) Crushing hazard between moving parts (table or machining head) and fixed guards shall be avoided by dimensioning the machine such that a minimum distance of 500 mm between the extreme position of the moving part (table or machining head) and the fixed guards is ensured (see dimension A in Figure 11). This requirement does not apply in the rear side of the machine where access is prevented by a rear fence with access door interlocked with machine table or machining head movements (see Figure 11) or when setting mode is activated (see 5.2.7.3).



Key

1 interlocked door with guard locking
2 fixed guard
3 front edge of the table
4 machining head limit position
5 active part of the pressure sensitive mat(s)
6 reset device
7 fixed guard, deterring/impeding device/ light barrier
A distance between machine and fixed guards
B minimum extension of safety devices
C maximum gap between machine and pressure sensitive mat
D maximum gap between machine and fixed guards

Figure 11 — Position of guarding on machines with partial enclosure

c) When access to the danger zone on the front side of the machine (loading/unloading zone) is prevented by safety devices as light barriers or pressure sensitive mats, the detection zone (light barrier) or effective sensing surface (pressure sensitive mats) shall extend at least 850 mm from any running tool being in the closest possible position to the operator, measured in horizontal direction (distance B of Figures 11) (see also 5.3.7.2).

When a person is detected the machining head shall stop within a maximum distance of 700 mm. As an alternative the machining head shall reduce its speed within the same distance of 700 mm to a value compatible with the requirements in h), if pressure sensitive bumpers are provided. See also 5.3.7.2 for exceptions when only impact hazard is foreseeable at an axes speed below 25 m/min. Reduced speed shall be monitored according to 5.2.8.

When the safety device is divided to allow the machine working in one area whilst the other area is accessible for loading/unloading and the light barrier or safety mat is triggered, the horizontal distance between the loading/unloading zone and any crushing, shearing or cutting area (protected zone) shall be at least 850 mm. The control system for ensuring the safety distance shall conform at least to PL=c in accordance with the requirements in EN ISO 13849-1:2008. If this safety distance falls below 850 mm, e.g. though an error in the drive control system or the operator stepping onto a safety mat, an emergency stop control shall be initiated. The control system shall achieve at least PL=c in accordance with the requirements in EN ISO 13849-1:2008.

d) Where the operator's position is not restricted by light barrier(s) or pressure sensitive mat(s) the guarding shall fulfil the requirements of 5.3.7.1.2.4 c) 1) (for crushing, shearing and impact hazards, see also 5.3.7.2 d)).

e) The ejection of parts of the tool shall be minimised in at least in the direction of two horizontal axes by:

1) fixed guard fitted with fixing system attached to the guard or to the machine e.g. un-losable screws if they are demountable by the user e.g. for maintenance, cleaning purposes see 6.3 w). Fixed guards shall fulfil the requirements of 5.3.7.5 and

2) curtains the extension of which covers only the loading/unloading opening (see 5.3.7.1.2.4).

f) All guards where applicable shall fulfil the requirements of 5.3.7.5.

g) An extension table is not required, where no tool can run while it protrudes over the table limits and a safety distance y of at least 850 mm is provided between the operator's position and the extreme position of the moving head (see 5.3.7.1.2.4).

h) When using pressure sensitive bumpers (5.3.7.3) as single safety device (without safety devices as light barriers or pressure sensitive mats), the sensing surface of the bumpers shall extend at least 850 mm measured in horizontal direction (distance y of Figure 12), from any rotating tool being in the closest possible position to the operator.

As an exception the safety distance can be reduced up to 550 mm (distance y in Figure 12), if the height of the opening for the workpieces measured from the workpiece support to the lower edge of the partial enclosure (distance x in Figure 12) is less than 200 mm.

Pressure sensitive bumpers shall conform to the requirements of EN 1760-3:2004+A1:2009.

The safety distance shall be measured at the maximum speed of the machining head using a fixed test probe in accordance with the requirements of EN 1760-3:2004+A1:2009, which is positioned perpendicular to the moving direction and in the compressed condition.

When a person is detected by the bumper the movement shall be stopped before a force is reached of maximum:

1) 400 N if only crushing risk for the whole body is present;

2) 250 N if also crushing risk for arm is present; or

3) 150 N if also crushing risk for hand/ finger is present.

The force shall be measured at maximum speed of the machining head using a fixed probe as defined in EN 1760-3:2004+A1:2009 positioned perpendicular to the direction of motion.

The control systems for interlocking of machining head movement shall conform to the requirements of 5.2.9.

NOTE During the next revision of the standard it is intended to deal with requirements on tool identification.

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

5.3.7.1.2.3.2 Pressure sensitive mats and light barriers

5.3.7.1.2.3.2.1 Pressure sensitive mats

If pressure sensitive mats are used the following requirements apply:

a) any pressure sensitive mats shall be in accordance with the requirements of EN 1760-1:1997+A1:2009, be designed to detect persons weighing more than 35 kg; the system as a whole (including sensor(s), control systems) shall conform at least to PL=c in accordance with the requirements of EN ISO 13849-1:2008;

b) if pressure sensitive mats are used, the distance C in Figure 11 between the active part of the mat and the machine at the mat level shall not exceed 100 mm and the distance D in Figure 11 between the active part of the mat and fixed guards at the mat level shall not exceed 80 mm;

c) the reset control device shall be located outside the protected zone in a way that the reset function cannot be initiated when operated from inside this protected zone; the operator shall have a good view on the protected zone.

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

5.3.7.1.2.3.2.2 Light barriers

If light barriers are used the following requirements apply:

a) any electronic light barrier shall be of at least Type 2 in accordance with EN 61496-1:2004 and its associated safety related control systems shall be at least PL=c in accordance with the requirements of EN ISO 13849-1:2008;

b) light barriers shall consist of at least two opto-electronic elements;

c) pitch between two elements shall be equal or less than 180 mm when mounted horizontally or inclined;

d) if mounted horizontally, the elements shall be situated at a height between 800 mm and 100 mm above the floor level;

e) if mounted inclined, the elements shall be mounted at a height between 400 mm above the floor level and 800 mm above the floor level, the distance of 180 mm being measured on the horizontal projection;

f) if mounted horizontally the distance C in Figure 11 between the active part of the light barriers and the machine at the light barrier levels shall not exceed 100 mm and the distance D in Figure 11 between the active part of the light barriers and fixed guards at the light barrier levels shall not exceed 80 mm;

g) if mounted vertically, the elements shall be situated:

   1) for two beams at a height of 400 mm above the floor level for the lower element and for the upper elements at a height of 900mm above the floor level;

   2) for three beams at a height of 300 mm above the floor level for the lower element and for the upper elements at a height of 1100mm above the floor level with an intermediate beam at 700 mm above the floor level;

h) the reset control device shall be located outside the protected zone in a way that:

   1) it is not reachable from the inside of the protected zone; or

   2) the reset function cannot be initiated from the inside of a protected zone e.g. a continuous detection area protected by horizontal light barrier;

   the operator shall have a good view on the protected zone;

i) accessible supporting parts shall be designed and situated in a way that they do not cause injury or create a tripping hazard.

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

5.3.7.1.2.4 Openings and curtains

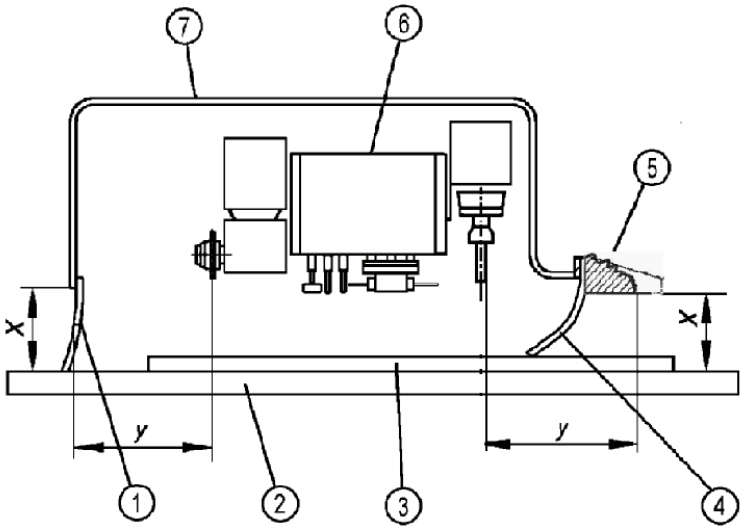
For openings and curtains the following requirements apply:

a) curtains shall protect against ejection of parts of tools or parts of the workpiece from the opening strictly necessary for the machining in accordance with b);

b) the height (distance x in Figure 12) of the opening measured from the work piece clamping surface to the lower edge of the partial enclosure shall not exceed 400 mm;

c) where it is possible to pass a hand through the curtains it shall not be possible to reach a dangerous moving part such as the running shaft/tool and crushing and/or trapping between moving parts inside the partial enclosure e.g. moving spindle or tool change device and fixed components. This is achieved if:

   1) the distance y in Figure 12 between the plane of the opening guarded by the curtain and the moving part (tool periphery or moving parts inside the partial enclosure e.g. moving spindle or tool change device) in its position closest to the plane of the opening guarded by the curtain shall be at least 550 mm for opening heights x in Figure 12 up to 200 mm and at least 850 mm for opening heights x in Figure 13 between 200 mm and 400 mm, or



Key

1 curtain
2 workpiece support
3 workpiece
4 curtain
5 trip device (pressure sensitive bumper)
6 head assembly
7 partial enclosure

$x \leq 200$ mm $\rightarrow y \geq 550$ mm

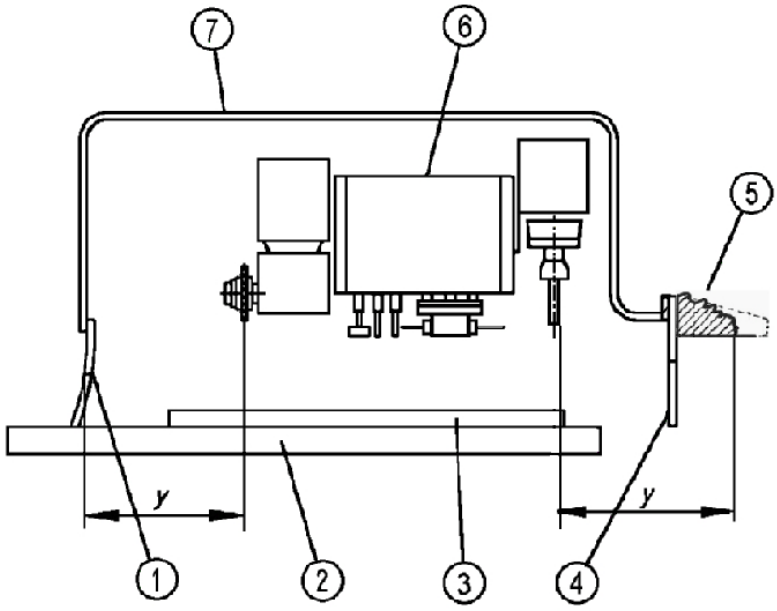
200 mm < $x \leq 400$ mm $\rightarrow y \geq 850$ mm

NOTE y is measured in compressed condition if bumpers are used.

Figure 12 — Safety distances "y" for partial enclosure around the head assembly

2) the position of the operator is limited by light barriers or pressure sensitive mats in accordance with the requirements of 5.3.7.1.2.3.1;

d) the curtain free end on its whole length shall always lie in contact with the workpiece support or extension of it, unless access or ejection is prevented by other means (e.g. by a fixed and additional movable interlocked guards in accordance with 5.3.7.1.2.3.1 e) 1)) and shall extend to the lowest surface on which the workpiece can be clamped (for exception see 5.3.7.1.2.3.1 h) and Figure 13);



Key

1 curtain
2 workpiece support
3 workpiece
4 curtain
5 trip device (pressure sensitive bumper)
6 head assembly
7 partial enclosure
y safety distance

$y \geq 850$ mm

NOTE *y* is measured in compressed condition if bumpers are used.

Figure 13 — Safety distances "*y*" for partial enclosure protruding over a table

e) the curtain shall be located so that it cannot come in contact with the tool;

f) the curtain shall be subject of an impact test and hold a 100 g projectile when hit at a speed of 70 m s^{-1} at the target point (key 2) as shown in Figure B.5 (see also Annex C);

g) the curtain shall be made of a minimum of 6 layers of stripes overlapping on one half with a maximum width of 80 mm;

h) the curtain shall be wear resistant.

As an exception when the combine boring and routing machine during a work uses only boring tools, edge banding aggregate or assembly units and dowel devices, the curtains may be raised, if there is an interlocking between the curtains when they start moving from their guarding position and the rotations of any other spindle.

The control systems for this interlocking shall conform to the requirements of 5.2.9.

Verification: By checking the relevant drawings, inspection of the machine, measurement, relevant tests described in Annex B and Annex E and relevant functional testing of the machine.

5.3.7.2 Access to moving parts (except tools and drives)

Access to impact, crushing, shearing, drawing in and entanglement points (except tools and drives) shall be prevented by fixed guards the safety distance of which shall conform to the requirements of EN ISO 13857:2008, Table 3 or Table 4, and/or by protective devices e.g. light barrier, pressure sensitive mats or bumpers.

If the fixed guards are to be demounted by the user e.g. for maintenance, cleaning purposes, their fixing systems shall remain attached to the guard or to the machine when the guard is removed e.g. fitted with unlosable screws (see 6.3 w)).

The distance between the floor and the fixed guard shall not exceed 300 mm.

At the loading/unloading zone of the machine crushing hazard between moving parts (e.g. table or machining head) and fixed guards shall be avoided by dimensioning the machine such that a minimum distance of 500 mm (see dimension A in Figure 11) between the extreme position of the moving part (table or machining head) and the fixed guards is ensured.

a) When using safety devices as light barriers or pressure sensitive mats the detection zone (light barrier) or effective sensing surface (pressure sensitive mats) shall extend at least 850 mm from any crushing, shearing, drawing in and entanglement point being in the closest possible position to the operator, measured in horizontal direction (distance B of Figure 11). Where only impact hazards from machining head or table exist the minimum extension of safety device can be reduced to at least 700 mm.

b) When a person is detected the machinee shall activate an operational or an emergency stop of the dangerous movements and the machining head shall stop within a maximum distance of 700 mm. As an alternative the machining head shall reduce its speed within the same distance of 700 mm to a value compatible with the requirement in d) if pressure sensitive bumpers are provided. See also below for exceptions when only impact hazard is foreseeable at an axis speed below 25 m/min. Reduced speed shall be monitored according to 5.2.8.

c) When the safety device is divided to allow the machine working in one area whilst the other area is accessible for loading/unloading, interlocking of the machine head movement with the detection of a person in the loading/unloading zone shall be provided.

d) When using pressure sensitive bumpers as single safety device (see 5.3.7.3) (without safety devices as light barriers or pressure sensitive mats), the sensing surface of the bumpers shall extend at least 850 mm from any crushing, shearing, drawing in and entanglement point inside the partial enclosure being in the closest possible position to the operator, measured in horizontal direction (distance y of Figure 12). As an exception the safety distance can be reduced up to 550 mm, if the opening for the workpieces measured from the workpiece support and the lower edge of the opening of the partial enclosure (distance x of Figure 12), is less than 200 mm.

   Pressure sensitive bumpers shall conform to the requirements of EN 1760-3:2004+A1:2009. When a person is detected by the bumper the movement shall be stopped before a force is reached of maximum

   1) 400 N if only crushing risk for the whole body is present;

   2) 250 N if also crushing risk for arm is present; or

   3) 150 N if also crushing risk for head/hand/ finger is present.

The force shall be measured at maximum speed of the machining head using a fixed probe as defined in EN 1760-3:2004+A1:2009 positioned perpendicular to the direction of motion.

When movable guards are in open position, unexpected start up of hazardous movement of spindle, axes, workpiece clamping and tool change mechanism shall be prevented in accordance with EN 1037:1995+A1:2008, Clause 6.

Unexpected restart by the closure of a movable guard or the moving from a zone safeguarded by safety mats or light barriers shall be prevented.

The safety related part of control system for prevention of restart shall at least be PL=c in accordance with the requirements of EN ISO 13849-1:2008.

A reset function control device shall be provided to re-initiate the safeguarding preventing the operator from gaining access to a zone where the risks of crushing, shearing, cutting and/or impact are present e.g. climbing or leaning on the table of the machine when safeguarding other than pressure sensitive bumpers conforming 5.3.7.3 are provided. The reset control device shall be located outside the safeguarded zone (see Figure 11). The reset function shall conform to the requirements of EN ISO 13849-1:2008, 5.2.2, and only be effective if actuated from outside the safeguarded zone. As an exception the functioning of the relevant safeguarding for a safeguarded zone and the initiation of the cycle start enabling the machining head to move to a workpiece loading/unloading section of the machine for machining in that safeguarded zone may be achieved by the same manual control device (at the same time). The machining head shall not be capable of moving from a machining section of the machine to a workpiece loading/unloading section of the machine without resetting safeguarding in this area and enabling the machining head to traverse.

The safety related part of control system for reset shall be at least PL=c in accordance with the requirements of EN ISO 13849-1:2008.

Any electronic light barrier shall be of at least Type 2 in accordance with EN 61496-1:2004 and its associated safety related control systems shall be at least PL=c in accordance with EN ISO 13849-1:2008.

Any pressure sensitive mats shall be in accordance with the requirements of EN 1760-1:1997+A1:2009 and be designed to detect persons weighing more than 35 kg. The system as a whole shall at least conform to PL=c in accordance with the requirements of EN ISO 13849-1:2008.

Where only an impact hazard is foreseeable and the maximum axis speed is below 25 m min^{-1} no additional protective device is required where partial movable enclosure corners are rounded to at least 20 mm radius and no hazards exist from projecting parts e.g. screws.

Where the maximum axis speed exceeds 25 m min^{-1} and where an impact hazard exist (e.g. no light barrier or safety mat in accordance with 5.3.7.1.2.3.1 is provided) a trip device e.g. pressure sensitive bumpers according to 5.3.7.3 shall be provided.

NOTE During next revision of this document the application of the 25 m/min limit for axes speed to body, arm, head, hand or fingers impact will be considered.

Crushing hazards may be reduced by restricting the machine heads travel e.g. by mechanical stops. The rear of the machine shall be protected by a distance perimeter fence where no protective devices are provided. Where pressure sensitive bumpers (see 5.3.7.3) are provided no additional protective device e.g. pressure sensitive mat(s), perimeter fence or light barrier(s) is required.

The control systems for interlocking shall conform to the requirements of 5.2.9.

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

5.3.7.3 Pressure sensitive bumper

Pressure sensitive bumpers shall conform to the requirements of EN 1760-3:2004+A1:2009 and shall be such that the movement is stopped before impact force of maximum:

— 400 N if only crushing risk for the whole body is present;

— 250 N if also crushing risk for arm is present; or

— 150 N if also crushing risk for head/hand/ finger is present.

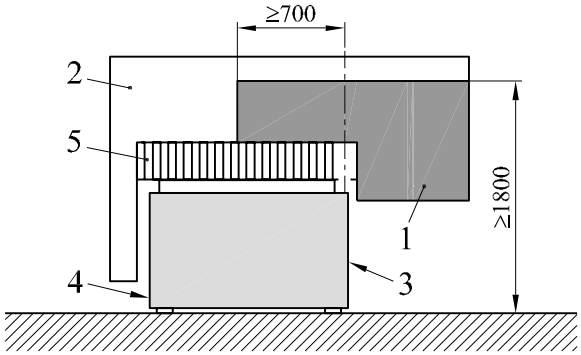
The force shall be measured at maximum speed of the machining head using a fixed probe as defined in EN 1760-3:2004+A1:2009 positioned perpendicular to the direction of motion.

The active part of the pressure sensitive bumper shall be of flexible material e.g. rubber and its width greater than 80 mm.

For pressure sensitive bumpers (whether the signal is or is not provided directly), the associated safety-related control systems shall be at least PL=c in accordance with the requirements of EN ISO 13849-1:2008.

Pressure sensitive bumpers shall extend to the whole height of the machine-moving component up to a minimum height of 1 800 mm and from the edge inward up to 700 mm from the machine side accessible by the operator when machining. (see Figure 14).

Dimensions in millimetres



Key

1 bumper surface

2 peripheral enclosure

3 front machine side

4 rear machine side(not accessible during machining)

5 curtain

Figure 14 — Bumper arrangement

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

5.3.7.4 Guarding of drives

Access to drive mechanisms (which include tool spindles, feed, etc.) shall be prevented either by fixed guards or movable guards interlocked with the corresponding motor drives in accordance with the requirements of EN 1088:1995+A2:2008.

If the fixed guards are to be demounted by the user e.g. for maintenance, cleaning purposes their fixing systems shall remain attached to the guard or to the machine when the guard is removed e.g. fitted with un-losable screws (see 6.3 w)).

Where frequent access to the drives is provided for maintenance or adjustment purposes i.e. more than once per month, access shall be via an interlocked movable guard with guard locking. The guard locking shall be at least a manually operated delay device in accordance with EN 1088:1995+A2:2008, Annex N.

The control systems for interlocking with guard locking shall conform to the requirements of 5.2.9.

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

5.3.7.5 Required characteristics of guards

If the machine is designed to work with milling tools or saw blades guards shall be manufactured from one or a combination of the following materials having at least the properties shown:

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

b) light alloy with characteristics in accordance with the requirements of Table 2;

Table 2 — Light alloy guard thickness and tensile strength

Minimum ultimate tensile strength N mm^{-2}	**Minimum wall thickness** mm
180	5
240	4
300	3

c) polycarbonate of at least 5 mm thickness;

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

e) any material passing the test in Annex F.

See also 5.3.7.1.2 and 6.3.

Verification: By checking the relevant drawings, tensile strength, measurement, performing for material not indicated in a) to d) over the impact test given in Annex F and inspection of the machine.

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

5.3.8 Clamping device

There shall be provision made for fixing a clamping device or devices to the machine (see also 6.3 f)). Where powered clamping is provided and where crushing hazards from workpiece clamping are not prevented by any of the means described in 5.3.7 above they shall be prevented by:

a) two stage clamping with a maximum clamping force at the clamping device of 150 N for the first stage, followed by full clamping force actuated by a manual control, or

b) reduction of the clamp/workpiece gap to 6 mm or less by a manually adjustable device and cylinder stroke limitation to a maximum of 10 mm, or

c) limitation of the clamp closing speed to 10 mm s^{-1} or less, or

d) guarding of the clamp by an adjustable guard attached to the clamping device to reduce the gap between the workpiece and the guard to 6 mm or less; the maximum extension of the clamp outside the guard shall not exceed 6 mm;

e) any other method resulting in the same level of safeguarding.

The safety related parts of the control systems for the monitoring of the first stage clamping force (see 5.3.8 a)) and the limitation of the clamp closing speed (see 5.3.8 c)) shall be at least PL= b in accordance with the requirements of EN ISO 13849-1:2008 (see also 5.2.1).

Where pneumatic or hydraulic clamping is provided additionally the requirements of EN ISO 4413:2010 or EN ISO 4414:2010 shall be met.

In the case of machines incorporating pneumatic/hydraulic clamping of the workpiece, provision shall be made to maintain the pneumatic/hydraulic pressure in the event of a failure in the pneumatic/hydraulic power supply e.g. by the use of a non-return valve.

Where powered (vacuum, pneumatic or hydraulic) clamping is provided the following requirements apply:

1) feed and spindle rotation and clamping of the workpiece being processed shall be interlocked so that axes and/or spindle movements cannot start and run until clamping pressure/vacuum is applied and release of clamping pressure/vacuum during rotation of the spindle is only possible if the machining head is in the rest position and the integrated feed has stopped (no PL value is required for interlocking);

2) where twin table or separate loading/unloading sections are provided, the requirements for release of clamping pressure/vacuum only applies for the part of the machine where machining is under progress; release of clamping pressure/vacuum on the table where no machining is in progress shall only be possible when the corresponding table has come to rest;

3) in the area where the workpiece is processed the release of clamping pressure/vacuum during rotation of the spindle shall only be possible if the machining head is in the rest position and the integrated feed has stopped;

4) for vacuum clamping:

   i) the vacuum sensor shall conform at least to PL=b in accordance with the requirements of EN ISO 13849-1:2008;

   ii) the vacuum sensor shall be adjustable and the lower limit shall be 25 % of the rated under pressure and shall be located as close as possible to the table;

   iii) the loss of pressure shall initiate the machine operational stop or emergency stop (see 5.2.5 or 5.2.6).

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

5.4 Protection against non-mechanical hazards

5.4.1 Fire

To minimise the risk from fire the requirements of 5.4.3, 5.4.4 and 5.4.9 shall be fulfilled.

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

5.4.2 Noise

5.4.2.1 Noise reduction at the design stage

When designing machinery the information and technical measures to control noise at source given in EN ISO 11688-1:2009 shall be taken into account. Also the information given in EN ISO 11688-2:2000 may be taken into account.

The main noise sources are:

a) tool spindles drives;

b) axes drives;

c) clamping, i.e.:

   1) vacuum system including vacuum pump (if provided);

   2) pneumatic system (if provided);

   3) hydraulic system (if provided).

5.4.2.2 Noise emission measurement

Operating conditions for noise measurement shall comply with the requirements of Annex A.

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 in accordance with the enveloping surface measuring method given in EN ISO 3746:2010 with the following modifications:

a) environmental factor K_{2A} shall be equal to or less than 4 dB;

b) 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 EN ISO 3746:2010, 8.3.3, Formula (12);

c) only the parallelepiped measurement surface shall be used 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) accuracy of the test method shall be better than 3 dB;

f) number of microphone positions shall be 9 in accordance with Annex A.

Alternatively, where the facilities exist and the measurement method applies to the machine type, emission sound power levels may also be measured in accordance with a method with higher precision, i.e. EN ISO 3743-1:2010, EN ISO 3743-2:2009, EN ISO 3744:2010 and EN ISO 3745:2009 without the preceding modifications.

For determination of emission sound power level by the sound intensity method, use EN ISO 9614-1:2009, (subject to agreement between the supplier and the purchaser).

Emission sound pressure level at the workstation shall be measured in accordance with EN ISO 11202:2010 with the following modifications:

1) environmental factor K_{2A} and the local environmental factor K_{3A} shall be equal to or less than 4 dB;

2) difference between the background emission sound pressure level and the workstation sound pressure level shall be equal to or greater than 6 dB in accordance with EN ISO 11202:2010, 6.4.1, accuracy grade 2 (Engineering);

3) correction of the local environmental factor K_{3A} shall be calculated in accordance with the requirements of EN ISO 11204:2010, A.2, with the reference restricted to EN ISO 3746:2010 instead of the method given in EN ISO 11202:2010, Annex A, or in accordance with EN ISO 3743-1:2010, EN ISO 3743-2:2009, EN ISO 3744:2010 or EN ISO 3745:2009 where one of these standards has been used as the measuring method.

For noise declaration 6.3 l) shall be met.

5.4.3 Emission of chips and dust

Provision shall be made for the extraction of dust and chips from the machine by providing outlets, so as to enable the machine to be connected to the user's dust extraction system.

Access to the rotating tools through the chip and dust extraction outlet shall be prevented in accordance with the safety distances of EN ISO 13857:2008, Table 4 (see also 6.3 o)).

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 minimise 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 chip and dust.

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

To ensure that the chip and dust extracted during machining are conveyed to the collection system, the design of hoods, ducts and baffles etc. shall 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 be maximum 1 500 Pa (at 20 m s^{-1} air flow rate).

Verification: By checking of drawings, visual inspection and the following procedure:

- Measure the pressure drop at the chosen air flow rate by measurement under the condition given for noise measurement in the relevant C-standard or ISO 7960:1995.
- Run the machine (without processing a work piece) under the conditions for noise measurement in the relevant C-standard or ISO 7960:1995. The CADES shall be disconnected. Check if the machine creates an air flow from the inlet(s) of the capture device(s) to the connection outlet(s) to the CADES by use of smoke at the connection outlet(s).

NOTE 2 For measurement of chip and dust extraction system performance two standardised methods are useful: concentration method (EN 1093-9:1998+A1:2008) and index method (EN 1093-11:2001+A1:2008).

5.4.4 Electricity

With the exception of 6.3, the requirements of EN 60204-1:2006 apply unless otherwise stated in this document.

See EN 60204-1:2006, 6.2, for the prevention of electric shock due to direct contact and EN 60204-1:2006, Clause 7, for protection against short circuiting and for protection against overloading.

The protection of people against electrical shock due to indirect contacts should be normally ensured by automatic isolation of the electrical power supply of the machine by the operation of a protective device installed by the user in the line powering the machine (see the information provided by the manufacturer in the instruction handbook (see 6.3 v)).

The degree of protection of all electric components out of the enclosure(s) and the enclosure(s) for electrical components itself/themselves shall be at least IP 54 accordance with the requirements of EN 60529:1991.

Electrical enclosures shall not be exposed to risk from ejection of tools and workpieces. Live parts shall not be accessible in accordance with EN 60204-1:2006, 6.2.2. Fire risk is not present where power circuits are protected against over current in accordance with EN 60204-1:2006, 7.2.2.

In accordance with EN 60204-1:2006, 18.2 (test 1) and 18.6, the test 1 for the continuity of the protective bonding circuit and functional tests apply.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection and relevant tests (EN 60204-1:2006, test 1 of 18.2 and functional test according to 18.6).

NOTE For the components characteristics confirmation from the components' manufacturers can be useful.

5.4.5 Ergonomics and handling

The machine and its controls shall be designed according to ergonomic principles of EN 1005-4:2005+A1:2008 to enable work postures that are not fatiguing.

The height of the workpiece support should normally be between 750 mm and 900 mm above the floor level.

The positioning and labelling of control devices shall be in accordance with the ergonomic principles of EN 894-1:1997+A1:2008, EN 894-2:1997+A1:2008, EN 894-3:2000+A1:2008, EN 1005-1:2001+A1:2008, EN 1005-2:2003+A1:2008 and EN 1005-3:2002+A1:2008.

Parts of the machine weighing more than 25 kg and that need to be replaced/removed shall be equipped with means for safe handling or enable safe lifting, such as attachments to accommodate the fitting of a lifting device in accordance with EN 1005-2:2003+A1:2008. These attachments shall be positioned such as to avoid machine or components overturn or fall or move in an uncontrolled way during transport, assembly, dismantling, disabling 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.

Useful information on ergonomics can also be found in EN 60204-1:2006, EN 614-1:2006+A1:2009, EN 614-2:2000+A1:2008 and EN 1005-3:2002+A1:2008.

See also 5.2.2 and 6.3 g).

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

5.4.6 Lighting

Where necessary on the machine, work stations and the zones in which control devices, guards and protective devices are located shall be lit sufficiently to ensure that all work equipment and materials can be properly seen, and that eye strain is also avoided in accordance with EN 1837:1999+A1:2009.

Where lighting is required as determined by reference to EN 1837:1999+A1:2009 it shall be provided in accordance with EN 60204-1:2006, 16.2.

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

5.4.7 Pneumatics

Pneumatic power systems and their components shall comply with EN ISO 4414:2010.

See also 5.2.1 and 5.3.8.

5.4.8 Hydraulics

Hydraulic power systems and their components shall comply with EN ISO 4413:2010.

See also 5.2.1 and 5.3.8.

5.4.9 Static electricity

If the machine is fitted with flexible hoses for chip and dust extraction, the hoses shall be able to lead charge to earth potential.

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

5.4.10 Electromagnetic compatibility

The machine shall have sufficient immunity to electromagnetic disturbances to enable it to operate correctly in accordance with EN 60439-1:1999, 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 interference.

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

5.4.11 Lasers

If the machine is fitted with a laser, the laser shall be of category 2, category 2 M or a lower risk category in accordance with the requirements of EN 60825-1:2007 (see also 6.3 k)).

All the provision of the laser manufacturer associated to the installing and the use of this laser shall be fulfilled and the instruction shall be repeated in the machine instruction manual. Warning label and advice on the use of eye protector if any shall be provided on the machine near operator position.

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

5.4.12 Unintended movements

Any hazardous movement by gravity shall be prevented e.g. by means of fall arresters capable to withstand the stresses to which they are subject.

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

5.4.13 Supply disconnecting devices

The principles of EN ISO 12100:2010, 6.2.10 and 6.3.5.4, shall be observed and in addition:

Electrical isolators shall be in accordance with EN 60204-1:2006, 5.3, except that the isolator shall not be type d) in EN 60204-1:2006, 5.3.2.

On machines where pneumatic power is only used for workpiece clamping, isolation shall be possible at least through a quick action coupling according to EN ISO 4414:2010, 5.4.5.8 which does not require a means of locking.

If pneumatic energy is also used for other purposes, it shall be possible to isolate the pneumatic supply by a manually operated lockable mechanical valve. 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.

The machine shall have means to isolate hydraulic power (if provided) according to EN 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.

The electric isolator shall have its function, location and operational position clearly identified, e.g. by a label or a pictogram. The label or pictogram shall be fitted in a position clearly visible in close proximity to the isolator on the machine (see also 6.2 e)).

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

5.4.14 Maintenance

The principles of EN ISO 12100:2010, 6.2.15, shall be observed and in addition:

The information for maintenance listed in EN ISO 12100:2010, 6.4.5.1 under e), shall be provided.

See also 6.3 m), p).

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

6 Information for use

6.1 Warning devices

The principles of EN ISO 12100:2010, 6.4, shall be observed, the requirements of EN 847-1:2005+A1:2007, EN 847-2:2001 shall apply and in addition:

Information on negative test result of braking system and protective devices shall be displayed.

An audible or visual warning (e.g. a yellow light) of impending start up of machines fitted with access door to peripheral enclosure shall be provided if from the control position the operator doesn't have a complete view of the machining area (see 5.3.7.1.2.2 a)).

If the machine is equipped with a pneumatic supply and isolation of the pneumatic energy is not achieved by the electrical isolation 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.

The warnings shall either be in the language of the country in which the machine is to be used or wherever possible by using pictograms.

See also 5.3.7.1.2.

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

6.2 Marking

The principles of EN ISO 12100:2010, 6.4.4, shall be observed and in addition, the machine shall be permanently marked with:

a) business name and address of the machine manufacturer and, where applicable, of his authorised representative;

b) year of construction, which is the year in which the manufacturing process is completed;

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

d) where fitted with a hydraulic and/or pneumatic system with nominal pressure for the hydraulic and/or pneumatic circuits;

e) rating information (mandatory for electro-technical products: voltage, frequency, nominal current, in accordance with EN 60204-1:2006, 16.4);

f) where fitted with hydraulic and/or pneumatic isolators they shall have their function, location and operational position(s) clearly identified e.g. by a label or a pictogram.

Machines fitted with a peripheral enclosure which is fitted with an access door and on machines fitted with a partial enclosure shall be marked with a permanent warning label placed at the machining head warning that only milling tools with a cutting circle diameter below 16 mm or milling tools or saw-blades conforming to EN 847-1:2005+A1:2007 and EN 847-2:2001 and boring tools or sanding wheels shall be used.

The labels or pictograms for marking the nominal pressure and the isolators shall be fitted in a position in close proximity to the installed location of the relevant isolator on the machine.

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

Wherever possible it is recommended to use pictograms.

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

6.3 Instruction handbook

The safety instructions and information shall be in the language of the country where the machine is to be used.

The principles of EN ISO 12100:2010, 6.4.5, shall be observed and in addition the instruction handbook shall at least include:

a) repetition of the markings, pictograms and other instructions on the machine as described in 6.1 and 6.2 and, if necessary, information about their meaning;

b) intended use of the machine including reasonably foreseeable misuse;

c) maximum and minimum length, width and thickness of the workpiece;

d) warning regarding residual risk. In particular the risk of off-cut ejection. It shall be recommended that the off-cut is clamped e.g. by mechanical clamp or the risk is completely avoided by machining. Such measures include:

   1) to take precautions to reduce the hazard of inhalation of harmful dusts (e.g. wearing a dust mask);

   2) to wear eye protection;

   3) to wear ear protection to prevent hearing loss and

   4) to wear gloves against the hazard of being cut when handling tools, loading/unloading workpieces into the machine or doing maintenance;

   5) not to try removing chips whilst the tool is running and the machining head is not in the rest position;

   6) not to try using the machine unless all of the guards and other safety devices necessary for machining are in good working order;

   7) to indicate that in case of power supply failure the tool may run for more than 10 s.

e) instruction for installation to ensure that the machine is stable and securely fixed to the floor or a stable structure and how this is to be done;

f) instruction for setting the machine; this includes the precautions during setting as:

   1) a warning that before setting the machine it is necessary, to ensure that the tools used are sharpened, selected, maintained and adjusted in accordance with the tool manufacturer's instructions, to use special equipment for setting (e.g. gauges) where practicable and to take care when handling tools;

   2) that during setting it shall be verified that no contact exists between non rotating tools and any workpiece clamping device or machine element;

   3) instructions for clamping device mounting, setting and use;

   4) information regarding the required clamping pressure (e.g. vacuum and minimum clamping surfaces of the workpiece if the machine is fitted with vacuum clamping);

   5) adjustment method for the pressure devices and the method for fixing auxiliaries;

   6) method for choosing the spindle speed taking into account the work to be done and the tool used; the relationship between the tool diameter the cutting length and the maximum rotational speed of the spindle is important. Examples may be given for the most common cutting lengths;

   7) instruction for the use special equipment e.g. gauges for setting the tool when machine is at a stand still;

   8) instruction for adjustment and use of the safeguarding prescribed in 5.3.7.1;

g) instruction for safe use in accordance with EN ISO 12100:2010, 6.4.5.1 d), including indication of work station(s), necessary information for operators to be adequately trained in the adjustment and operation of the machine including the correct use; this includes taking precautions during machining such as:

   1) the hazards associated with the operation of the machine;

   2) the principles of machine operation, correct use and adjustment of the jigs and guards;

   3) the correct selection of milling tools for each operation. This includes the precautions during machining as:

      i) the range of milling tool diameters and thicknesses which are suitable for the machine;

      ii) that only milling tools with a cutting diameter below 16 mm or milling tools and/or saw blades manufactured in accordance with EN 847-1:2005+A1:2007 and EN 847-2:2001 shall be used;

   4) information regarding the requirements for other tools e.g. boring tools, sanding wheels etc. that can be used on the machine;

   5) the instruction for the selection of spindle speed taking into account the tool being used in order that the maximum permissible speed of the tool is not exceeded;

   6) information that the pull-in force of spindles of HSK clamping systems shall be periodically checked by personal authorised by the manufacturer including the intervals;

   7) the instructions to minimise noise levels including:

      i) condition of the tools;

      ii) guards positioning so as to reduce noise levels;

      iii) choice of the tooling speed to reduce the noise levels;

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

   9) the safe clamping of the workpiece when cutting;

   10) instruction on those devices which shall be verified, how frequently the verification shall be carried out and by what method; this shall include at least the following:

      i) emergency stop(s) – by functional test;

      ii) interlocked guards with guard locking – by proving an inability to open the guard as long the tool is rotating;

      iii) curtains maintenance – by check of absence of damage (at least each month);

      iv) vacuum clamping – by functional test;

      v) pressure sensitive bumpers, light barriers and pressure sensitive mats – by functional test;

   11) use of personal protective equipment e.g. for noise, inhalation of harmful dust and eye protection;

   12) instructions that the dust extraction equipment is to be switched on before commencing machining;

h) a warning that the selection of spindle speed shall be carefully considered by the user by taking into account the tool being used in order that the maximum permissible speed of the tool is not exceeded;

i) for machines equipped with hydrostatic tool fixing facilities, only tool fixing devices with additional mechanical device to protect against loosening of the tool in case of leakage in the hydrostatic system shall be used;

j) guidance for use including the type of workpiece and recommendations regarding the minimum workpiece clamping area;

k) where a laser is fitted to the machine the laser manufacturer's instructions required by EN 60825-1:2007 shall be provided with a recommendation that no exchange with a different type of laser shall be done, that no additional optical equipment shall be used and that repair shall only be carried out by the laser manufacturer or other authorised persons;

l) information concerning airborne noise emissions by the machinery, either the actual value or a value established on the basis of measurements made on identical machinery, measured in accordance with the methods given in 5.4.2.2:

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

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

In the case of very large machinery (i.e. machines with at least one dimension exceeding 7 m), instead of the sound power level, the emission sound pressure levels at specified positions around the machinery may be indicated.

The declaration shall be accompanied by a statement of the measuring method used and the operating conditions applied during the test, and associated uncertainty K using the dual-number form of declaration in accordance with EN ISO 4871:2009 as follows:

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

2 dB when using EN ISO 3743-1:2010, EN ISO 3743-2:2009 or EN ISO 3744:2010;

1 dB when using EN ISO 3745:2009.

For example, for a sound power level L_{WA} = xx dB (measured value)

Associated uncertainty K = 4 dB

Measured in accordance with EN ISO 3746:2010

If a verification of the declared noise emission values is required, it shall be conducted by using the same mounting, installation and operating conditions as those used for the initial determination of noise emission values. The noise declaration in the instruction handbook 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 work-force include the characteristics of the work room, 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 when performance data are provided.

m) installation and maintenance requirements for the machine and its safety equipment, e.g. curtains pressure sensitive bumpers and pressure sensitive mats ;

n) information regarding the dust extraction equipment fitted to the machine as follows:

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

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

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

   4) cross section dimensions and details of each connection;

o) information that during use the machine shall be connected to an external chip and dust extraction system;

   External chip and dust extraction equipment with fixed installations are dealt with in EN 12779:2004+A1:2009.

p) information on how to perform maintenance and that whenever possible maintenance shall be only done if the machine is isolated from all energy sources and involuntary restart is prevented;

q) information about safe cleaning;

r) if fitted with a pneumatic and/or hydraulic system the method for the safe dissipation of residual energy (see 5.4.13);

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 dismounted only by the manufacturer or authorised personal designated by the manufacturer are excluded);

v) information on how to provide protection of people against electrical shock due to indirect contact in the machine by a device for automatic disconnection of the power supply to be installed by the user in the line powering the machine;

w) 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 authorised personal designated by the manufacturer are excluded).

Verification: By checking the instruction handbook and the relevant drawings.

Annex A
(normative)

Operating conditions for noise measurement

A.1 General

For NC routing machines the operating conditions for noise measurements shall comply with the requirements of A.2.

For NC boring machines the operating conditions for noise measurements shall comply with the requirements of A.3.

For NC combined routing and boring machines two different measurements in accordance with 5.4.2.2 shall be performed and they shall comply with the requirements of A.2 and A.3 respectively.

For machines where the requirements of A.2, and A.3 are not applicable e.g. for spindle speed, or tool diameter, the detailed operating conditions used shall be given in the test report.

The mounting and operating conditions of the machine shall be identical for the determination of emission sound pressure levels at the operator's position and sound power levels.

A.2 Operating conditions for routing units of NC routing machines and NC combined boring/routing machines

A.2.1 General

This subclause contains a series of standard operating conditions to be applied in connection with measurement of noise from NC routing machines and NC combined boring/routing machines. Microphone positions are specified in order to allow the measurement of sound pressure level at the operator's position and for determining the sound power level of a machine of this type.

These standard conditions shall be complied with as closely as possible. If, in a specific situation, it is necessary to deviate from them, the actual conditions applied for the test shall be recorded where a blank space in the column "Condition chosen within permitted range or conditions deviating from standard" allows for such a situation.

All mandatory and standard safety attachments shall be mounted and in use during the tests.

The data sheet included in this annex may also be used to record operating condition information.

This subclause shall be used for the measurement of noise from machines as shown in Table A.1.

Table A.1 — Machine classification

Machine type	**Machine classification number** (as shown in ISO 7984:1988)
NC routing machines and NC combined boring/routing machines	12.315.19

This subclause may also be applied to the measurement of noise from machines having a similar construction and function.

A.2.2 Noise measurements

A.2.2.1 Test conditions

The machine shall be tested under the following conditions:

a) no load in accordance with specifications in this clause;

b) loaded as specified in this annex. The measurement result is the average of a series of at least three operations, in accordance with 5.4.2. During the first and last part of the work cycle, when the tool enters or leaves the work piece, a higher level of noise may be emitted. These parts of the operating cycle shall not be included in the measurement;

c) integrating sound level meters shall be used.

A.2.2.2 Microphone positions

A.2.2.2.1 Operator position

The microphone used to measure the emitted noise at the position of the operator shall be situated as follows:

a) 1,5 m above floor level and

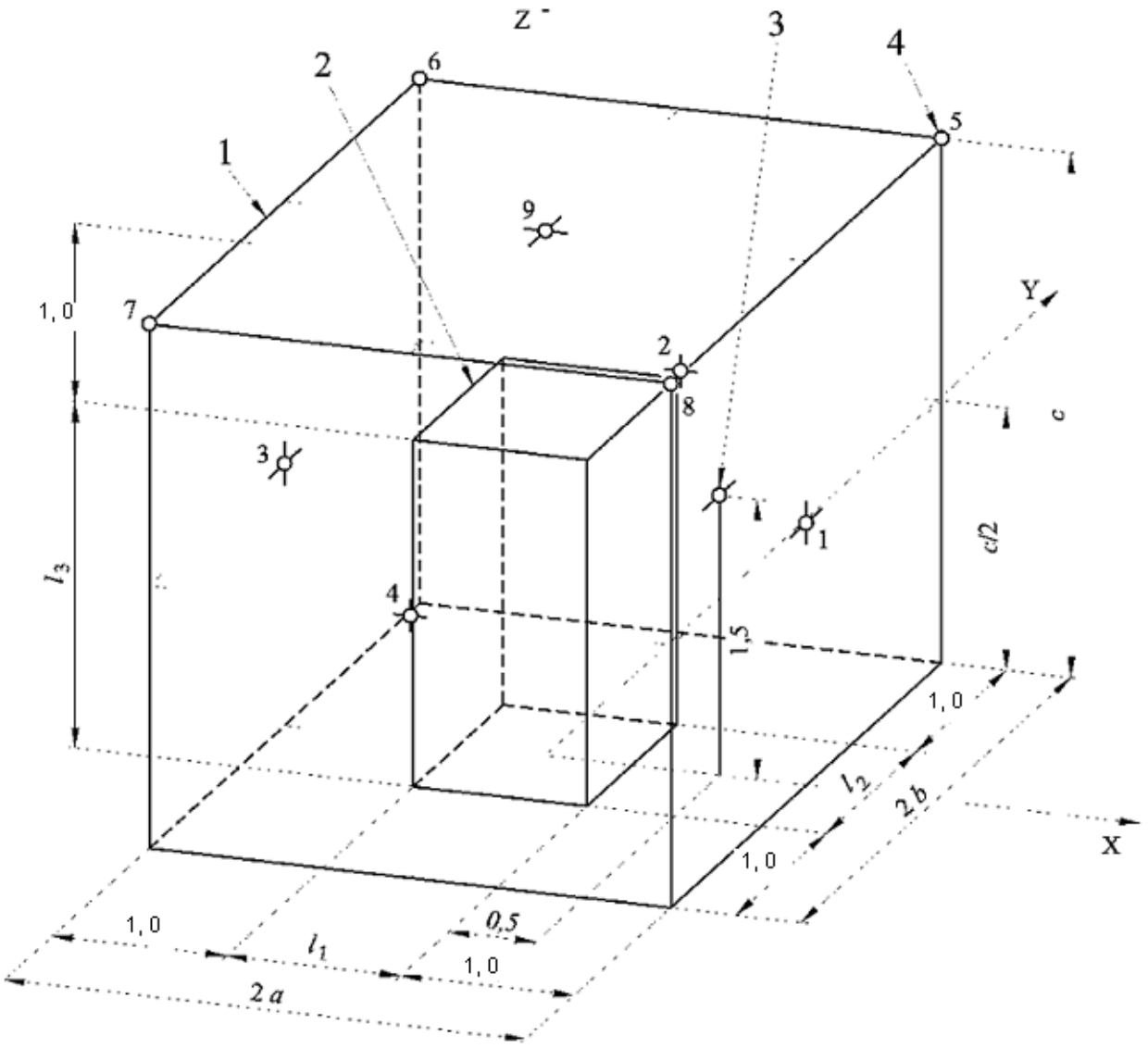
b) for machines with change loading in front of the middle of the machining station, 0,5 m along the x-axis in front of the middle of the reference box (machine or enclosure surface), or

c) 0,5 m in front of the front line of pressure sensitive mat or light barrier in front of the machining station.

A.2.2.2.2 Other microphone positions

The microphones used for the measurement of the sound power level emitted by the machine shall be situated as shown in Figure A.1.

Dimensions in meters



Key

1 measurement surface
2 reference box
3 operator position microphone location
4 measuring microphone positions
l_1 length of the reference box
l_2 width of the reference box
l_3 height of the reference box

Figure A.1 — Microphone positions for noise measurement of routing units of NC routing machines and NC combined boring/routing machines

A.2.3 General data sheet

Machine data

Make: .....

Model: .....

Year of manufacture: ..... Serial n°: .....

Overall dimensions of machine [a]

Length l_1: ..... mm Width l_2: ..... mm Height l_3: ..... mm

Nominal spindle speed min^{-1}	Spindle speed min^{-1}	Head assembly

☐ Attached frequency converter ☐ Separate frequency converter

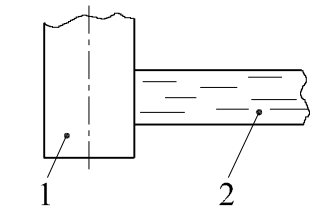
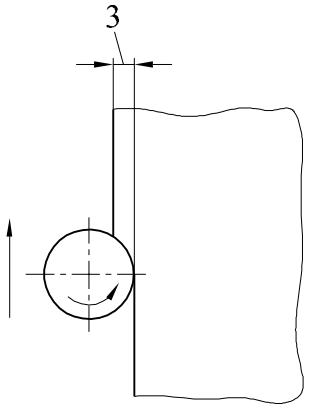
☐ Attached static converter ☐ Change loading

Machine installation

			Remarks/description
Machine installed according to manufacturer's recommendations	yes	☐	.....
	no	☐	.....
Machine installed with dust extraction according to manufacturer's specifications	yes	☐	.....
	no	☐	.....
Machine mounted on vibration damping/isolation material	yes	☐	.....
	no	☐	.....
Machine fitted in separate noise enclosure	yes	☐	.....
	no	☐	.....
Machine equipped with integral noise enclosure	yes	☐	.....
	no	☐	.....
Machine equipped with noise reducing hood	yes	☐	.....
	no	☐	.....
Other noise control measures	yes	☐	.....
	no	☐	.....

[a] Those elements which protrude from the machine and which are not likely to contribute to the noise emission (e.g. hand-wheels, levers) may be disregarded.

(*continued*)

Testing operation Operating arrangement	Routing particle board edges   **Key** 1 router bit 2 particle board 3 cutting depth Direction of work: x-axis: i.e. on the front edge on the side facing the loading position. Position of the workpiece: in the middle of the table for machines with one table or two synchronised tables or against the right side of the left table for machines with two independent tables.	Standard condition(s)	Condition chosen within permitted range or conditions deviating from standard
Tool and cutting data	Type of tool: Router bit with shaft, carbide-tipped, straight not interrupted knife-edges. Spindle speed [b] min^{-1} — 18 000 Cutting circle diameter mm — 25 Cutting speed $m\ s^{-1}$ Number of knives — 2 Cutting knife length mm — 40 to 50 Cutting depth mm — 5 Feed rate $m\ min^{-1}$ — 6 Cutting principle: cutter rotation against the feed		

[b] The spindle speed should be chosen as near as possible to 18 000 min^{-1}.

(*continued*)

Testing material	Material	:	Particle board, three-layer construction
	Moisture content	:	6 % to 10 %
	Board thickness	:	16 mm
	Board length	:	800 mm
	Board width	:	800 mm to 600 mm, processed down to a final width of approximately 300 mm
	Previous processing	:	none

Photo or detailed illustration of the machine tested	

Testing laboratory	Firm/Institution: ..... Address: ..... Telephone: ..... Date: ..... Signature: ..... Test carried out: Place: ..... Date: .....

A.3 Operating conditions for boring units of NC boring machines and NC combined boring/routing machines

A.3.1 General

This subclause contains a series of standard operating conditions to be applied in connection with measurement of noise from NC boring machines and NC combined boring/routing machines. Microphone positions are specified to allow measurement of sound pressure level at operator's position and for determining the sound power level of a machine of this type.

These standard conditions shall be complied with as closely as possible. If, in a specific situation, it is necessary to deviate from standard conditions, the actual condition applied for the test shall be recorded where a blank space in the column "Condition chosen within permitted range or conditions deviating from standard" allows for such a situation.

All mandatory and standard safety attachments shall be mounted and in use during the tests.

This clause may also serve as a data sheet on which information on operating conditions is recorded.

The present subclause shall be used in connection with measurement of noise from machines as shown in Table A.2.

Table A.2 — Machine classification

Machine type	**Machine classification number** (as shown in ISO 7984:1988)
NC boring machines and NC combined boring/routing machines	12.49

This subclause may also be applied for measurement of noise from special kinds of machines having a similar construction and function.

A.3.2 Noise measurements

A.3.2.1 Test conditions

The machine shall be tested under the following conditions:

a) testing under no load in accordance with specifications in this subclause;

b) testing under load as specified in this annex. The measurement result is the average of a series of at least three operations, in accordance with 5.4.2. During the first and last part of the work cycle, when the tool enters or leaves the work piece, a higher level of noise may be emitted. These parts of the operating cycle shall not be included in the measurement;

c) integrating sound level meters shall be used.

A.3.2.2 Microphone positions

A.3.2.2.1 Operator position

The microphone used to measure the emitted noise at the position of the operator shall be situated as follows:

a) 1,5 m above floor level and

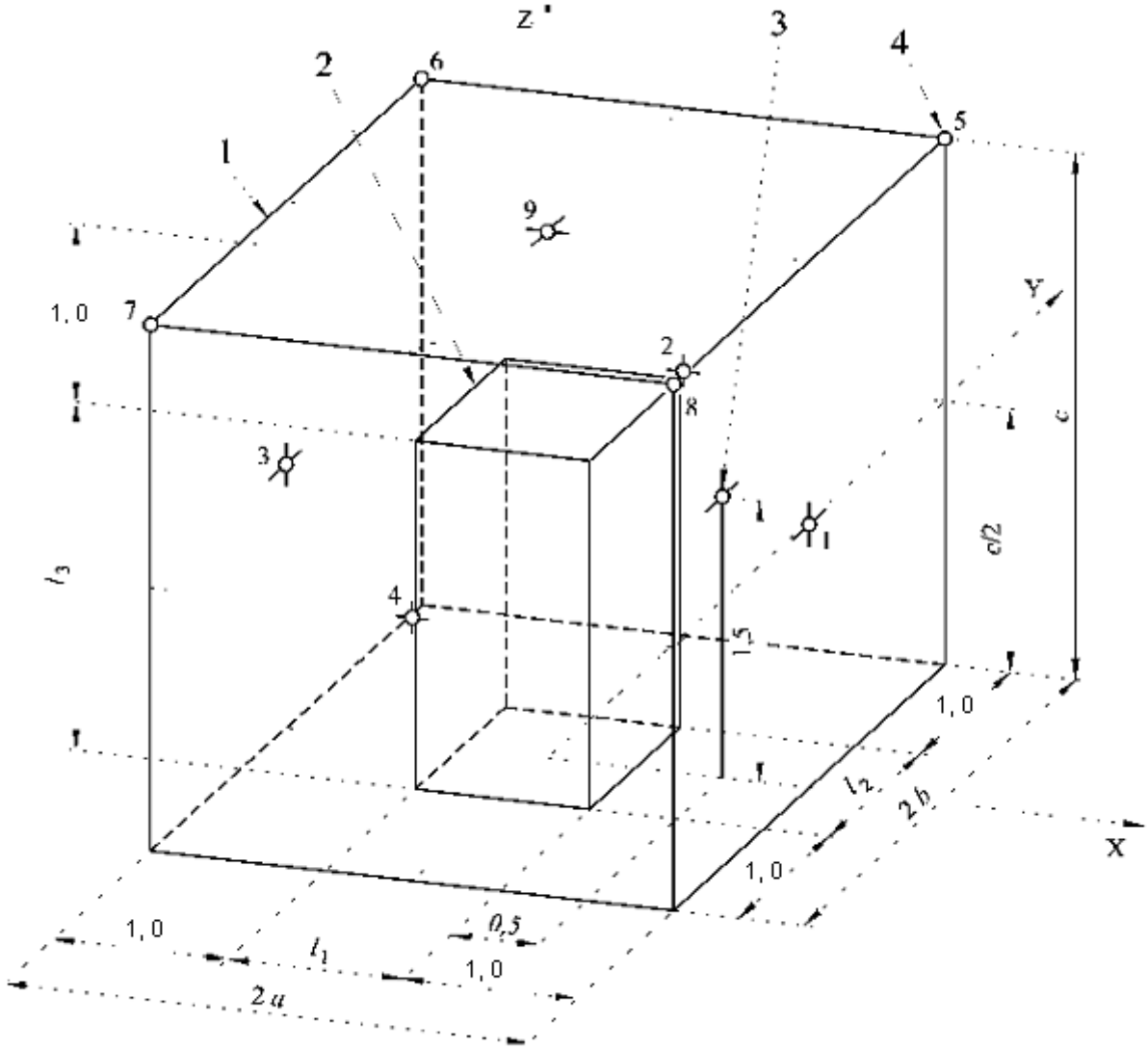
b) 0,5 m in front of the middle of the reference box (machine or enclosure surface) for machines with change loading in front of the middle of the machining station, or

c) 0,5 m in front of the front line of pressure sensitive mat or light barrier in front of the machining station.

A.3.2.2.2 Other microphone positions

The microphones used for the measurement of the sound power level emitted by the machine shall be situated as shown in Figure A.2.

Dimensions in meters



Key

1 measurement surface
2 reference box
3 operator position microphone location
4 measuring microphone positions
l_1 length of the reference box
l_2 width of the reference box
l_3 height of the reference box

Figure A.2 — Microphone positions for noise measurement of boring units of NC-Boring machines and NC combined boring/routing machines

A.3.3 General data sheet

Machine data

Make: .....

Model: .....

Year of manufacture: ..... Serial n^{o}: .....

Overall dimensions of machine [a]

Length l_1: ..... mm Width l_2: ..... mm Height l_3: .....mm

Nominal spindle speed min^{-1}	Spindle speed min^{-1}	Head assembly

☐ Attached frequency converter ☐ Separate frequency converter

☐ Attached static converter ☐ Change loading

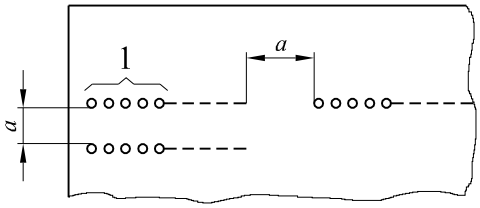
Machine installation

			Remarks/description
Machine installed according to manufacturer's recommendations	yes	☐	.....
	no	☐	.....
Machine installed with dust extraction according to manufacturer's specifications	yes	☐	.....
	no	☐	.....
Machine mounted on vibration damping/isolation material	yes	☐	.....
	no	☐	.....
Machine fitted in separate noise enclosure	yes	☐	.....
	no	☐	.....
Machine equipped with integral noise enclosure	yes	☐	.....
	no	☐	.....
Machine equipped with noise reducing hood	yes	☐	.....
	no	☐	.....
Other noise control measures	yes	☐	.....
	no	☐	.....

[a] Those elements which protrude from the machine and which are not likely to contribute to the noise emission (e.g. hand-wheels, levers) may be disregarded.

(*continued*)

<table>
<tr><td>Testing operation

Operating arrangement</td><td>Reeving particle board bores
 

Key
1 10 bores
a distance between series of bores

Position of the work piece:
In the middle of the table (one table or two synchronised tables) or against the right side of the left table (two independent tables).</td><td>Standard condition(s)</td><td>Condition chosen within permitted range or conditions deviating from standard</td></tr>
<tr><td>Tool and cutting data</td><td>Type of tool:
Multiboring unit with bits, two flutes and centre point, left or right hand
Spindle speed [b] min^{-1} — 18 000
Number of bits n — 10 or max. permissible
Bit diameter mm — 8
Bit working length mm — 2
Pitch mm — 32 or producers specification
Minimum distance a between a series of 10 bores mm — 70
Feed rate for boring m min^{-1} — 1</td><td></td><td></td></tr>
<tr><td>Testing material</td><td colspan="3">Material : Particle board, three-layer construction
Moisture content : 6 % to 10 %
Board thickness : 16 mm
Board length : 800 mm
Board width : 800 mm to 600 mm
Previous processing : none</td></tr>
<tr><td colspan="4">[b] The spindle speed should be chosen as near as possible to 18 000 min^{-1}.</td></tr>
</table>

(*continued*)

Photo or detailed illustration of the machine tested	

Testing laboratory	Firm/Institution: ..... Address: ..... Telephone: ..... Date: ..... Signature: ..... Test carried out: Place: ..... Date: .....

Annex B
(normative)

Curtains on NC routing and NC combined boring and routing machines – Impact test method

B.1 General

This annex defines tests for curtains used on NC routing machines and combined boring and routing machines in order to minimise risks of ejection of parts of tools and/or workpieces out of the working zone.

This annex applies to curtains as well as to samples of curtains.

B.2 Test method

B.2.1 Preliminary remarks

This test method reproduces the hazard of the ejection of tools and/or workpiece parts. The test allows estimating the retention capacity of curtains against penetration and dislodgement from the machine by ejected parts from machine.

B.2.2 Testing equipment

B.2.2.1 General

The testing equipment comprises a propulsion device, a projectile, a support for the test object and a system that allows measuring or recording the impact speed with an accuracy of ± 5 %.

B.2.2.2 Projectiles

The shape, mass and dimensions of projectiles shall be as follows:

a) shape: with geometrical specification indicated in Figure B.1;

b) mass: 100 g;

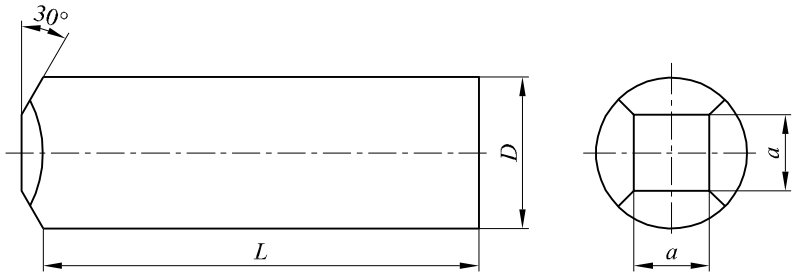
c) material: steel;

d) tensile strength: R_m = 560 N mm^{-2} to 690 N mm^{-2};

e) yield strength: $R_{0,2} \geq$ 330 N mm^{-2};

f) elongation at rupture: $A \geq$ 20 %;

g) hardened to $56\,^{+4}_{0}$ HRC over depth of at least 0,5 mm.



Key

D 20 mm

L length of the projectile

a 10 mm
Mass 100 g

Figure B.1 — Projectile for curtain test

B.2.2.3 Sampling and supporting the curtain under test

The curtain support shall be able to maintain the fixed part of the curtain in position during the test.

The curtain's stripes fixing shall be identical to that used on the machine for which the curtain is designed.

The test sample shall have dimensions not wider than the minimum width of the curtain system mounted on the machine.

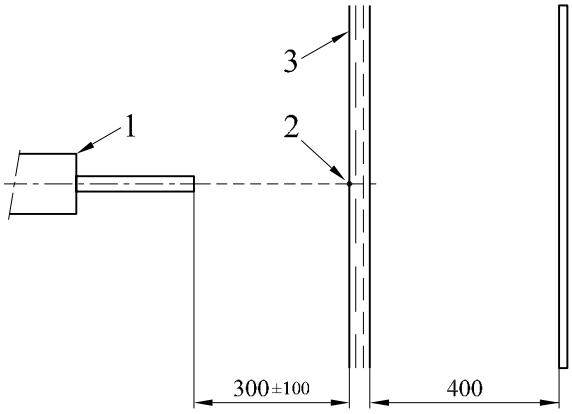
B.2.3 Test procedure

The impact test shall be performed with the projectile indicated in B.2.2.2 and with an impact speed of 70 m s^{-1} ± 5 %. Impact shall be as square as possible to the curtain surface.

The target point is indicated in Figure B.5.

The straight curtain system shall be subject of an impact test (see Figure B.2) with the projectile indicated in B.2.2.2 at a speed of 70 m s^{-1} ± 5 % at the target point (key 2) as shown in Figure B.5 (see also Annex C).

Dimensions in millimetres



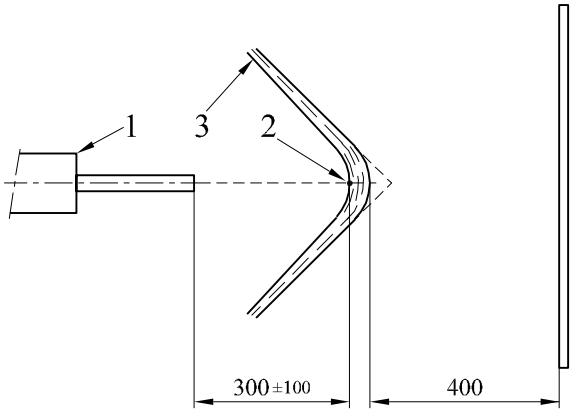
Key

1 propulsion device
2 target point
3 curtain

Figure B.2 — Top view of the test arrangement for straight curtains

The curtain system angle, if existing, shall be subject of an impact test in the bisecting direction (see Figure B.3) with the projectile indicated in B.2.2.2 at a speed of 70 m s^{-1} ± 5 % at the target point (key 2) as shown in Figure B.5 (see also Annex C).

Dimensions in millimetres



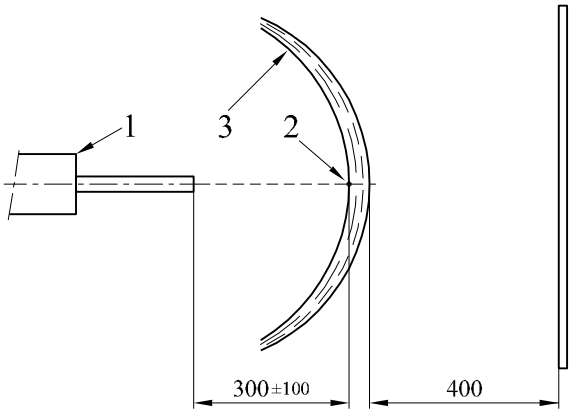
Key

1 propulsion device
2 target point
3 curtain

Figure B.3 — Top view of the test arrangement for angled curtains

If the curtain system is arranged in a curved way the curtain system shall be subject of an impact test in the direction square to the tangent of the curve at the point of minimum curvature radius (see Figure B.4) with the projectile indicated in B.2.2.2 at a speed of 70 m s^{-1} ± 5 % at the target point (key 2) as shown in Figure B.5 (see also Annex C).

Dimensions in millimetres



Key

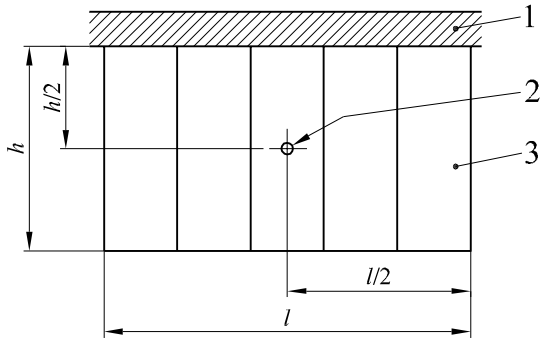
1 propulsion device
2 target point
3 curtain

Figure B.4 — Top view of the test arrangement for curved curtains

The projectile shall hit the stripes at the target point.

The distance between the target and the exit of the projectile from the propulsion device shall be in a range between 200 mm and 400 mm (see Figures B.2, B.3 and B.4).

Five tests shall be carried out and the projectile tip shall hit a different stripe set at each test.



Key

1 support
2 target point
3 curtain stripes
h height of the stripe set
l length of the stripe set

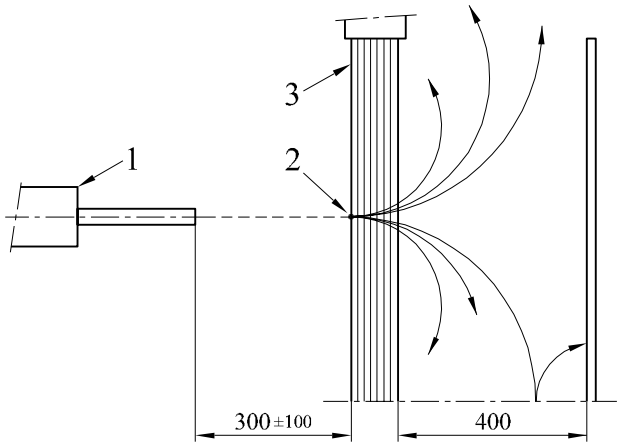
Figure B.5 — Target point for curtains

B.3 Results

The projectile shall fall within the vertical plane square to the barrel axis located at a distance of 400 mm from the rear limit of the curtain over the horizontal plane passing through the bottom edge of the test sample (see Figures B.2, B.3, B.4, B.6 and B.7).

B.4 Assessment

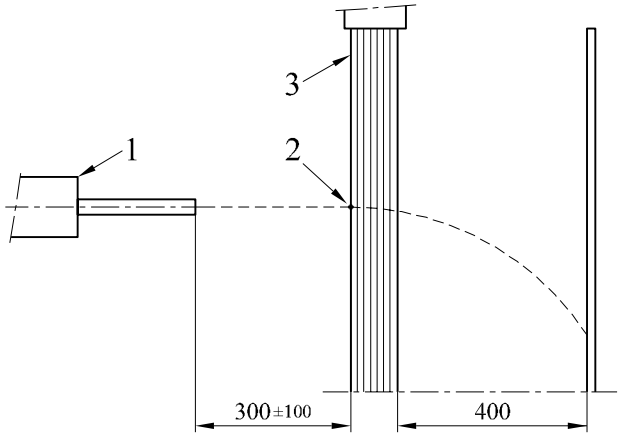
Dimensions in millimetres



key
1 propulsion device
2 target point
3 stripe set

Figure B.6 — Tests positive

Dimensions in millimetres



key
1 propulsion device
2 target point
3 stripe set

Figure B.7 — Test negative

The test is passed if all five tests out of the five tests are positive.

B.5 Test report

The test report shall give the following minimum information:

a) date, place of the test and name of the testing institute;

b) projectile mass, dimensions, speed;

c) applicant identification;

d) design, material and dimensions of the test object;

e) clamping or fixing of the test object;

f) direction of shock, point of impact of the projectile;

g) test result.

Annex C
(informative)

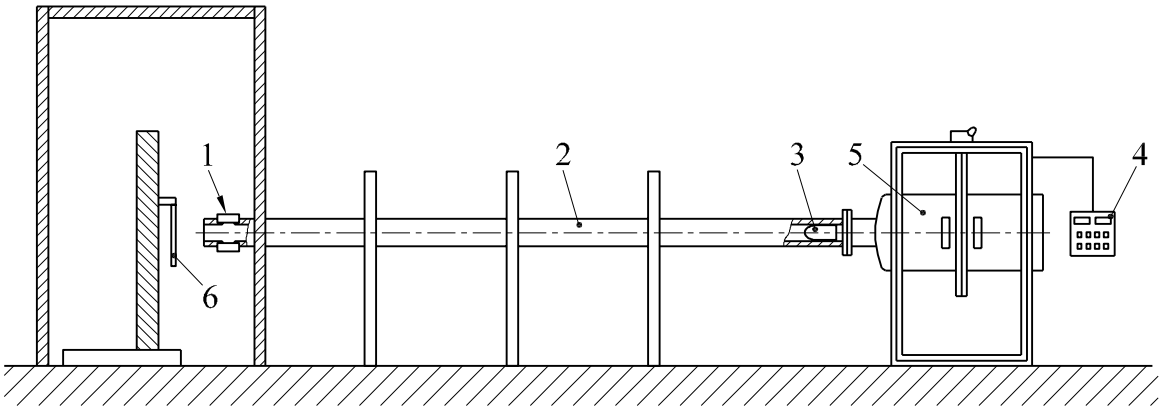
Example of a test equipment for impact test

The propulsion device consists of a compressed air vessel with flanged gun barrel (see Figure C.1). The compressed air may be released by a valve to accelerate the projectile toward the test object.

The air gun is fed by an air compressor. The speed of the projectile may be controlled by the pressure of the air.

The projectile speed is measured near the nozzle of the gun barrel by a suitable speedometer e.g. by proximity sensor or photocell.

The effect of air flow for the propulsion of the projectile on the curtain shall be avoided e.g. by a plate with a hole for the projectile passage.



Key

1 speedometer
2 gun barrel
3 projectile
4 control panel
5 compressed-air vessel
6 test object

Figure C.1 — Example of equipment for impact test

Annex D
(normative)

Braking tests

D.1 Conditions for brake tests

a) The spindle unit shall be set in accordance with the intended use of the machine (e.g. for belt tension) (see 6.3 b));

b) when selecting the speed and the tools, conditions shall be chosen which create the greatest kinetic energy for which the machine is designed (the selection to take into account tool sizes, types, spindle speed, etc.);

c) before beginning the test the spindle unit shall be running for at least 15 min at no load (idle speed);

d) verify that the actual spindle speed is within 10 % of the intended speed;

e) the speed measuring equipment shall have an accuracy ≤ 1 % of full scale;

f) the time measuring equipment shall have an accuracy ≤ 0,1 s.

D.2 Tests

D.2.1 Un-braked run-down time

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

a) initiate spindle stop and measure the un-braked run-down time;

b) restart the spindle drive motor and allow it to reach the intended speed;

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

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

D.2.2 Braked run-down time

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

a) initiate braking and measure the braked run-down time;

b) allow the spindle to remain stationary for $\left(\frac{P}{7,5}\right)^2$ min where P is the motor power in kW;

c) restart the spindle drive motor and run at no load for $\left(\frac{P}{7,5}\right)^2$ min;

d) repeat steps a) to c) nine times.

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

Annex E
(normative)

Curtains on NC routing and NC boring and routing machines – Wear test method

E.1 General

This Annex defines the wear tests for curtains used on NC routing and NC boring and routing machines.

E.2 Test method

E.2.1 Preliminary remarks

This test method reproduces the curtains wear on NC routing and NC boring and routing machines by friction on the workpieces during longitudinal and lateral movement of the machining head. If only one translation movement exists on the machine it has to be tested.

E.2.2 Test method

E.2.2.1 Workpieces dimensions, characteristics and arrangement

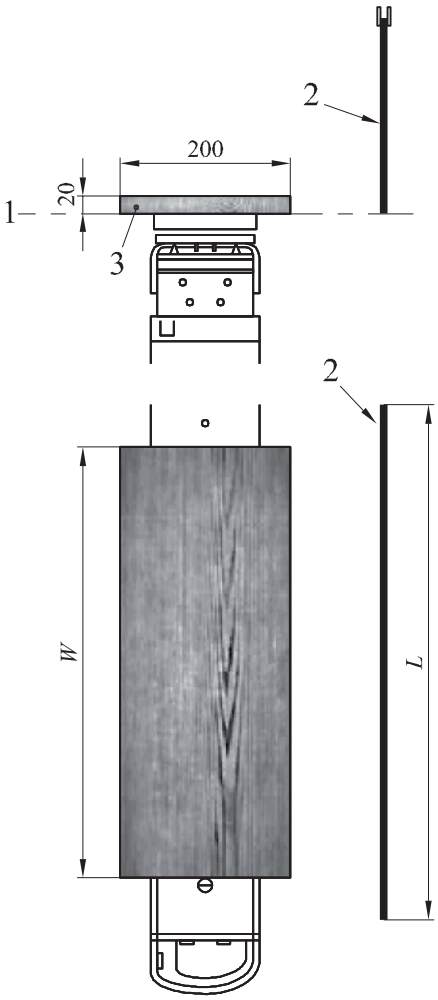
The full curtains set of the machine shall be tested against two workpiece samples mounted on the table or workpiece support, made of different materials:

a) melamine laminated panel 20 mm thick, 200 mm wide (see Figures E.1 and E.2);

b) solid wood bars of oak 120mm high (or the maximum capacity of the machine, the lowest), 80 mm wide (see Figures E.3 and E.4).

Both workpiece samples shall be as long as the maximum workpiece length that can be machined in the direction perpendicular to curtain movement and placed along this direction.

Dimensions in millimetres

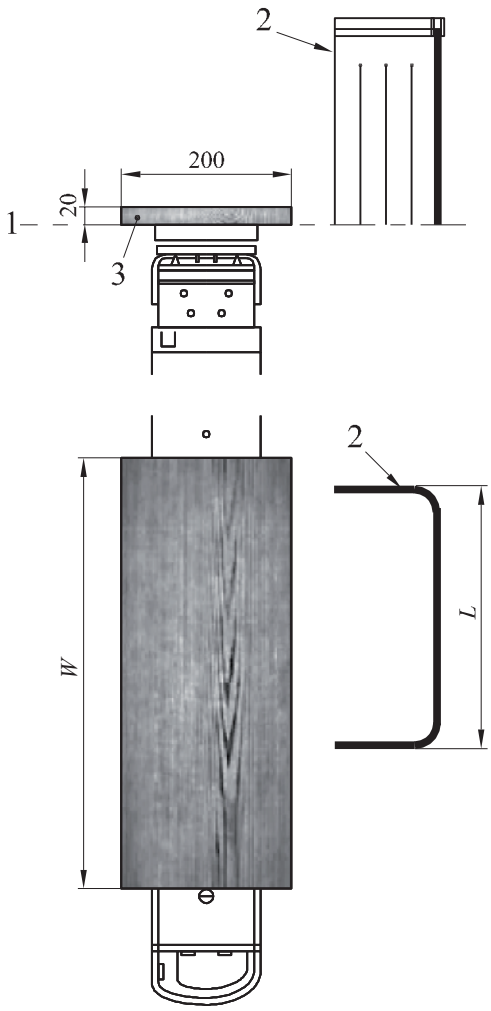


Keys

1 clamping surface
2 curtain arranged in one direction
3 melamine laminated test panel
W maximum workpiece length in the direction perpendicular to curtain movement
L length of the curtain

Figure E.1 — Melamine laminated test panels and curtain arranged in one direction

Dimensions in millimetres

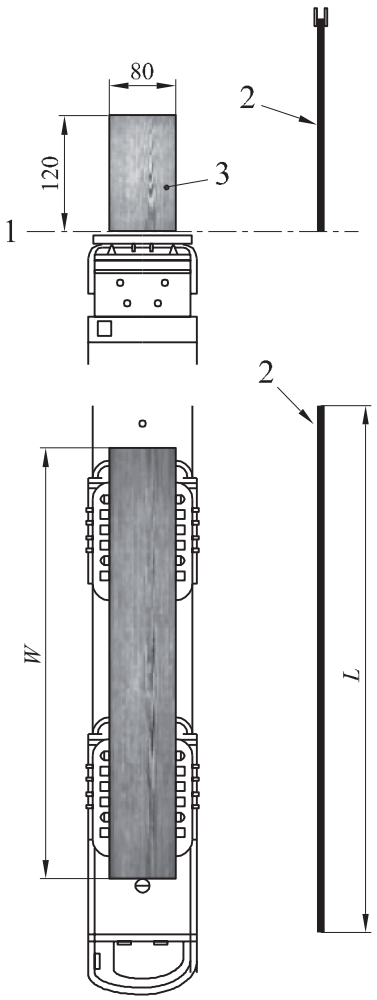


Keys

1 clamping surface
2 curtain arranged in two directions
3 melamine laminated test panel
W maximum workpiece length in the direction perpendicular to curtain movement
L length of the curtain

Figure E.2 — Melamine laminated test panels and curtain arranged in two directions

Dimensions in millimetres

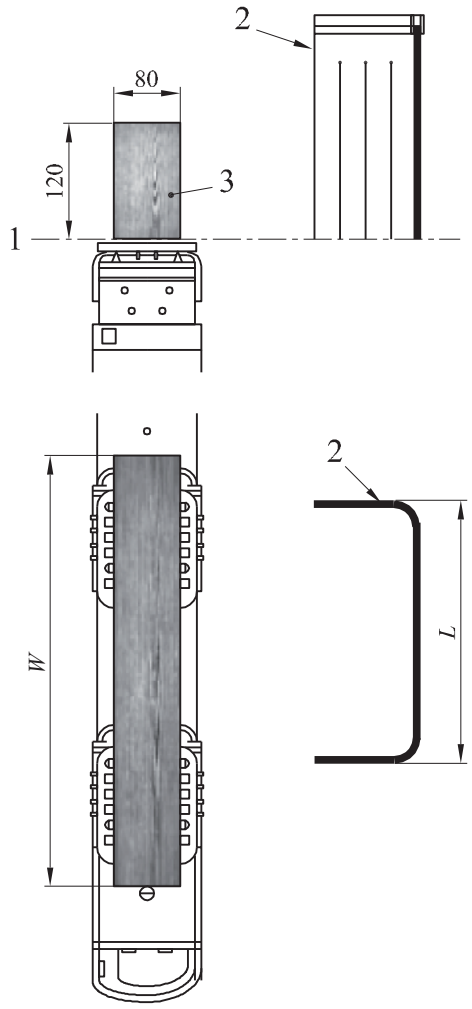


Keys

1 clamping surface
2 curtain arranged in one direction
3 solid wood test bar
W maximum workpiece length in the direction perpendicular to curtain movement
L length of the curtain

Figure E.3 — Solid wood test bars and curtain arranged in one direction

Dimensions in millimetres



Keys

1 clamping surface
2 curtain arranged in two directions
3 solid wood test bar
W maximum workpiece length in the direction perpendicular to curtain movement
L length of the curtain

Figure E.4 — Solid wood test bars and curtain arranged in two directions

E.2.2.2 Test procedure, machine movement and speed

A reciprocating relative movement in one direction shall be performed between the workpiece samples and the curtains set, in such a way that the curtains hit all pieces edges at each passage.

Where the curtains set have perpendicular sides, both sides shall hit the pieces, i.e. at least one curtain side parallel to the workpiece sample and one perpendicular.

The test shall comprise:

a) if the curtain can be raised 40 000 contacts of each side of the curtain with the corresponding edge of the work-piece at the maximum machining speed. When using more than one work-piece placed parallel to each other, their distance shall be at least two times the curtain's height; or

b) if the curtain cannot be raised 40.000 contacts of each side of the curtain with the corresponding edge of the work-piece at the highest machining speed plus 1000 contacts of each side of the curtain with the corresponding edge of the work-piece at maximum transfer speed. When using more than one work-piece placed parallel to each other, their distance shall be at least two times the curtain's height.

The curtains arrangement during the test shall be:

1) according to Figures E.2 and E.4 if the curtain is arranged in two directions;

2) according to Figures E.1 and E.3 if the curtain is arranged in only one direction.

E.3 Results

The curtains shall not present more than 10% of lost or damaged stripes. Damaged stripe means a stripe having lost 15 % of its length and/or thickness during the test e.g. broken stripe.

E.4 Assessment

The test is passed if the conditions in E.3 are fulfilled.

E.5 Test report

The test report shall give the following minimum information:

a) date, place of the test and name of the tester;

b) design, material and dimensions of the test object;

c) applicant identification (if any);

d) clamping or fixing of the test object;

e) test result.

Annex F
(normative)

Rigid guards on NC routing machines – Impact test method

F.1 General

This annex defines tests for rigid guards used on NC routing machines in order to minimise risks of ejection of parts of tools or of workpieces out of the working zone.

This annex applies to guards as well as on samples of guard materials.

F.2 Test method

F.2.1 Preliminary remarks

This test method reproduces the hazard of the ejection of tools parts or of workpieces. The test allows to estimate the resistance/strength of guards and/or samples of guard materials against penetration and dislodgement from the machine by ejected parts from machine or workpiece.

F.2.2 Testing equipment

F.2.2.1 General

The testing equipment comprises a propulsion device, a projectile, a support for the test object and a system that allows to measure or record the impact speed with an accuracy of ± 5 %.

F.2.2.2 Projectiles

The shape, mass and dimensions of projectiles are given in Figure F.1.

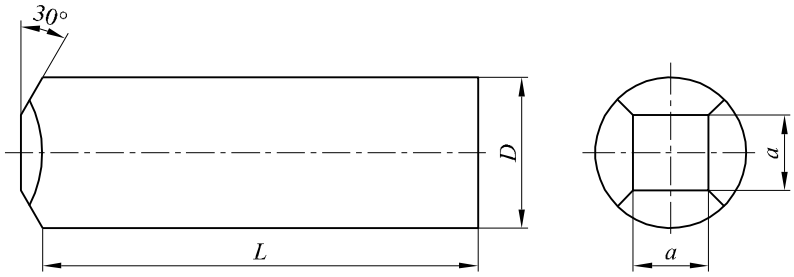
The projectile shall be made from steel with the following properties:

a) tensile strength: R_m = 560 N mm^{-2} to 690 N mm^{-2};

b) yield strength: $R_{0,2} \geq$ 330 N mm^{-2};

c) elongation at rupture: $A \geq$ 20 %;

d) hardened to 56 $^{+4}_{0}$ HRC over depth of at least 0,5 mm.



Key

D	20 mm
a	10 mm
Mass	100 g
L	length of the projectile

Figure F.1 — Projectile for rigid guard test

F.2.2.3 Sampling and supporting the guard under test

The test is carried out with the guard and/or a sample of the guard material. The guard support shall be equivalent to the guard mounting on the machine. For testing guard materials samples may be used, fixed on a frame with an inner opening of 450 mm × 450 mm. The frame shall be sufficiently rigid. The mounting of the sample shall be by non positive clamping.

F.2.3 Test procedure

For machines equipped with milling cutters the impact test shall be executed with projectile indicated in F.2.2.2 and an impact speed of 70 m s^{-1} ± 5 %.

Impact shall be as square to the material sample surface or the guard surface as possible. The targets for the projectiles shall be the weakest and most unfavourable spot on the guard or centre of the material sample.

F.3Results

After the impact damages found on the guard or material shall be assessed as follows:

a) buckling/bulging (permanent deformation without crack);

b) incipient crack (visible only on one surface);

c) through crack (crack visible from one surface to the other);

d) penetration (projectile penetrating the test object);

e) guard window loosened from its fixing;

f) guard loosened from guard support.

F.4Assessment

The test is passed if there is no through crack or penetrations of the test object and if there are no damage as shown in F.3 e) and f).

F.5Test report

The test report shall give the following minimum information:

a) date, place of the test and name of the testing institute;

b) projectile mass, dimensions, speed;

c) applicant identification;

d) design, material and dimensions of the test object;

e) clamping or fixing of the test object;

f) direction of shock, point of impact of the projectile;

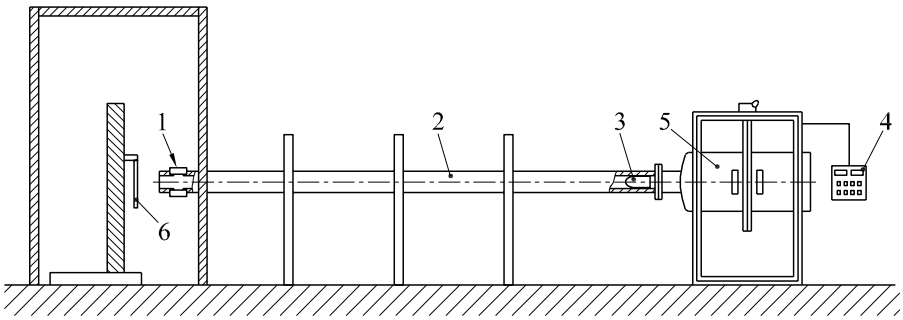
g) test result.

F.6Example of test equipment for impact test

The propulsion device consists of a compressed air vessel with flanged gun barrel (see Figure F.2). The compressed air may be released by a valve to accelerate the projectile toward the test object.

The air gun is fed by an air compressor. The speed of the projectile may be controlled by the pressure of the air.

The projectile speed is measured near the nozzle of the gun barrel by a suitable speedometer, e.g. by proximity sensor or photocell.



Key

1 speedometer
2 gun barrel
3 projectile
4 control panel
5 compressed-air vessel
6 test object

Figure F.2 — Example of equipment for impact test

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Machinery Directive 2006/42/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 2006/42/EC

Clause(s)/sub-clause(s) of this EN	**Essential Requirements (ERs) of Directive 2006/42/EC**
	1.1.2 Principles of safety integration
5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.2.5, 5.2.6, 5.2.7, 5.2.8, 5.3.6, 5.3.8, 5.4.14, 6.3	a) fitted for its function
Clauses 5 and 6	b) eliminate or reduce the risks, give measures, inform
Clauses 5 and 6	c) intended use and reasonably foreseeable misuse
5.4.5, 6.3	d) constraints in use
5.3.1, 5.4.9, 6.3	e) equipment
5.3.2, 5.3.5, 5.3.6, 5.3.7, 5.4.3	1.1.3 Materials and products
5.4.6, 6.3	1.1.4 Lighting
5.2.2, 5.3.7, 5.4.5	1.1.5 Design of machinery to facilitate its handling
5.4.5	1.1.6 Ergonomics
6.3	1.1.7 Operating position
5.2.1, 5.2.7, 5.2.8, 5.2.11, 5.4.13, 5.4.14	1.2.1 Safety and reliability of control systems
5.2.2, 5.2.3, 5.2.4, 5.2.5, 5.2.7, 6.3	1.2.2 Control devices
5.2.2, 5.2.3, 5.2.7	1.2.3 Starting

5.2.4, 5.2.5, 5.2.6	1.2.4 Stopping
5.2.4	1.2.4.1 Normal stop
5.2.6	1.2.4.2 Operational stop
5.2.5	1.2.4.3 Emergency stop
5.2.7, 5.2.8, 6.3	1.2.5 Selection of control or operating mode
5.2.10, 5.4.7, 5.4.13, 5.4.14	1.2.6 Failure of the power supply
5.3.1, 6.3	1.3.1 Risk of loss of stability
5.3.2, 6.3	1.3.2 Risk of break-up during operation
5.3.2, 5.3.3, 5.3.5, 5.3.7	1.3.3 Risks due to falling or ejected objects
5.1	1.3.4 Risk due to surfaces, edges or angles
5.2.8, 5.3.7	1.3.6 Risks relating to variations in the operating conditions
5.3.2, 5.3.3, 5.3.5, 5.3.7	1.3.7 Risks related to moving parts
5.3.7	1.3.8 Choice of protection against risks related to moving parts
5.3.7.2	1.3.8.1 Moving transmission parts
5.3.7	1.3.8.2 Moving parts involved in the process
5.3.5, 5.3.6	1.3.9 Risk of uncontrolled movements
5.2.1.2, 5.3.7	1.4.1 Required characteristics of guards and protective devices - General requirements
5.3.2, 5.3.7	1.4.2.1 Fixed guards
5.3.7.1.2.4, 5.3.7.2, 5.3.7.4	1.4.2.2 Interlocking movable guards
5.3.8	1.4.2.3 Adjustable guards restricting access
5.2.1.2, 5.3.7	1.4.3 Special requirements for protective devices
5.2.10, 5.4.4, 5.4.13	1.5.1 Electricity supply
5.4.9	1.5.2 Static electricity

5.2.10, 5.4.6, 5.4.7	1.5.3 Energy supply other than electricity
5.3.7.1.2.3.1, 5.3.7.1.2.2, 6.2, 6.3	1.5.4 Errors of fitting
5.4.1	1.5.6 Fire
5.4.2	1.5.8 Noise
5.4.10	1.5.11 External radiation
5.4.11	1.5.12 Laser equipment
5.4.3	1.5.13 Emission of hazardous materials and substances
5.3.7	1.5.14 Risk of being trapped in a machine
5.4.14	1.6.1 Machinery maintenance
5.2.2, 5.3.7, 5.4.14	1.6.2 Access to operating position and servicing points
5.4.13	1.6.3 Isolation of energy sources
5.2.2, 5.2.6, 5.2.7, 5.2.8, 5.2.10, 5.3.7, 5.4.5, 5.4.14, 6.3	1.6.4 Operator intervention
5.4.3, 6.3	1.6.5 Cleaning of internal parts
5.2.1, 5.3.3, 5.4.5, 6.3	1.7.1 Information and warnings on the machinery
6.1	1.7.2 Warning devices
6.2	1.7.3 Marking of machinery
6.3	1.7.4 Instructions
	2.3 Machinery for working wood and analogous materials
5.3.6, 5.3.7	a) guiding
5.3.5	b) ejection
5.3.4	c) brake
5.3.7, 5.3.8	d) accidental tool contact

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN 349:1993+A1:2008, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

[2] EN 614-1:2006+A1:2009, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

[3] EN 614-2:2000+A1:2008, *Safety of machinery — Ergonomic design principles — Part 2: Interactions between the design of machinery and work tasks*

[4] EN 848-2:2007+A1:2009, *Safety of woodworking machines — One side moulding machines with rotating tool — Part 2: Single spindle hand fed/integrated fed routing machines*

[5] EN 1093-9:1998+A1:2008, *Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 9: Pollutant concentration parameter, room method*

[6] EN 1093-11:2001+A1:2008, *Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 11: Decontamination index*

[7] EN 60947-4-1:2010, *Low-voltage switchgear and controlgear — Part 4-1: Contactors and motor-starters — Electromechanical contactors and motor-starters (IEC 60947-4-1:2009)*

[8] EN 60947-5-1:2004, *Low-voltage switchgear and controlgear — Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices (IEC 60947-5-1:2003)*

[9] EN 61508-1:2010, *Functional safety of electrical/ electronic/programmable electronic safety-related systems — Part 1: General requirements (IEC 61508-1:2010)*

[10] EN 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems (IEC 61508-2:2010)*

[11] EN 61508-4:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 4: Definitions and abbreviations (IEC 61508-4:2010)*

[12] EN 62061:2005, *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems (IEC 62061:2005)*

[13] EN ISO 11688-2:2000, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design (ISO/TR 11688-2:1998)*

[14] HD 21.1 S4:2002[4)], *Cables of rated voltages up to and including 450/750 V and having thermoplastic insulation — Part 1: General requirements*

[15] HD 22.1 S4:2002[5)], *Cables of rated voltages up to and including 450/750 V and having cross-linked insulation — Part 1: General requirements*

[16] ISO 7984:1988, *Woodworking machines — Technical classification of woodworking machines and auxiliary machines for woodworking*

4) HD 21.1 S4:2002 is superseded with EN 50525-1:2011.

5) HD 22.1 S4:2002 is superseded with EN 50525-1:2011.

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