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ISO 19085-3

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Woodworking machines — Safety requirements —

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

Machines à bois — Sécurité —

Partie 3: Perceuses et défonceuses à commande numérique (CN)

Reference number
ISO 19085-3:2017(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

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

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

This document is intended to be used in conjunction with ISO 19085-1:2017, which gives requirements common to different machine types.

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

Introduction

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

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

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

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

The full set of requirements for a particular type of woodworking machine are those given in the part of ISO 19085 applicable to that type, together with the relevant requirements from ISO 19085-1:2017, to the extent specified in the Scope of the applicable part of ISO 19085.

As far as possible, in parts of ISO 19085 other than ISO 19085-1:2017, safety requirements are referenced to the relevant sections of ISO 19085-1:2017 to avoid repetition and reduce their length. The other parts contain replacements and additions to the common requirements given in ISO 19085-1:2017.

This document is intended to be used in conjunction with ISO 19085-1:2017, which gives requirements common to the different machine types.

Thus, Clauses 5, 6, 7 and 8, with their subclauses and the annexes of this document can either

— confirm as a whole,

— confirm with additions,

— exclude in total, or

— replace with specific text,

the corresponding subclauses or annexes of ISO 19085-1:2017.

This interrelation is indicated in the first paragraph of each clause, subclause or annex, right after the title, by one of the following statements:

— “This subclause of ISO 19085-1:2017 applies”;

— “This subclause of ISO 19085-1:2017 applies with the following additions”, or “This subclause of ISO 19085-1:2017 applies with the following additions, subdivided into further specific subclauses.”;

— “This subclause of ISO 19085-1:2017 does not apply.”;

— “This subclause of ISO 19085-1:2017 is replaced by the following text.”, or “This subclause of ISO 19085-1:2017 is replaced by the following text, subdivided into further specific subclauses.”.

Specific subclauses and annexes in this document without correspondent in ISO 19085-1:2017 are indicated by the introductory sentence: "This subclause (or annex) is specific to this document."

Clauses 1, 2 and 4 replace the correspondent clauses of ISO 19085-1:2017, with no need for indication since they are specific to each part of the series.

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

Woodworking machines — Safety requirements —

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

1 Scope

This document gives the safety requirements and measures for numerically controlled (NC) boring machines, NC routing machines and NC combined boring/routing machines (as defined in 3.1), hereinafter referred to as "machines".

This document deals with all significant hazards, hazardous situations and events, listed in Clause 4, relevant to the machines when they are operated, adjusted and maintained as intended and under the conditions foreseen by the manufacturer including reasonably foreseeable misuse. Also, transport, assembly, dismantling, disabling and scrapping phases have been taken into account.

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

This document is also applicable to machines fitted with one or more of the following devices/ additional working units, whose hazards have been dealt 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.

Machines covered in this document are designed for workpieces consisting of

— solid wood,

— material with similar physical characteristics to wood (see ISO 19085-1:2017, 3.2),

— gypsum boards, gypsum bounded fibreboards,

— composite materials with core consisting of polyurethane or mineral material laminated with light alloy,

— polymer-matrix composite materials and reinforced thermoplastic/thermoset/elastomeric materials, and

— composite boards made from the materials listed above.

This document does not deal with specific hazards related to

— edge-banding equipment fitted to the machines,

— use of grinding wheels,

— ejection from milling and/or sawing tools through openings guarded by curtains on machines where the distance between the workpiece support surface and the lower edge of the partial enclosure exceeds 600 mm,

— ejection due to failure of milling tools with a cutting circle diameter equal to or greater than 16 mm and sawing tools not conforming to EN 847-1:2013 and EN 847-2:2013,

— the combination of a single machine being used with other machines (as a part of a line),

— the necessity to step onto or into the machine body due to its large size, e.g. to adjust clamping elements on machines for wooden walls, and

— integrated workpiece loading/unloading systems (e.g. robots).

This document is not applicable to single spindle hand fed or integrated fed routing machines, machines intended for use in potentially explosive atmosphere, or to machines manufactured prior to its publication.

2 Normative references

The following documents are referred to in text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*

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

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

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

ISO 19085-1:2017, *Woodworking machines — Safety — Part 1: Common requirements*

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

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

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010, ISO 13849-1:2015, ISO 19085-1:2017 and the following apply.

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

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

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

3.1
numerically controlled boring and routing machine
NC boring and routing machine
integrated fed machine 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 may also be fitted with one or more of the following devices/facilities:

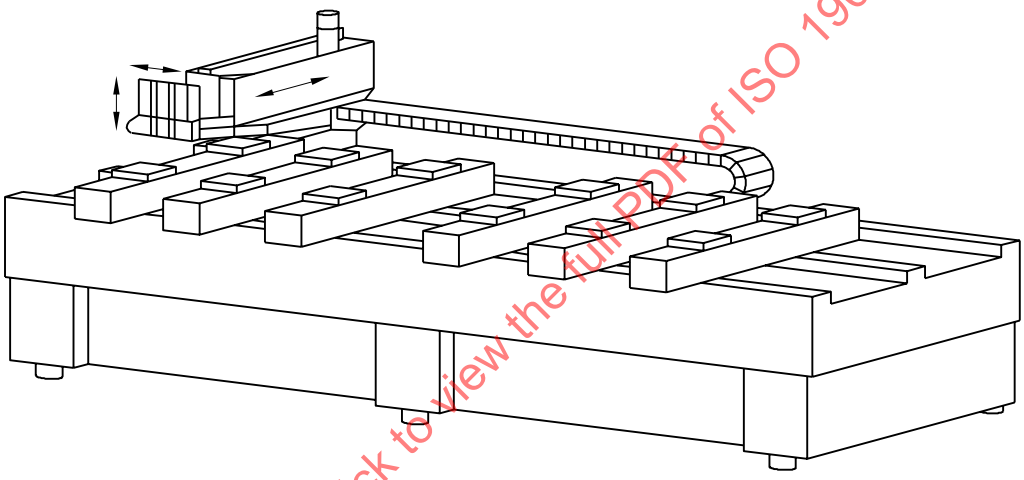
a) additional equipment for sawing, sanding, edge banding or assembly units and dowel devices;

b) fixed or movable workpiece support;

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

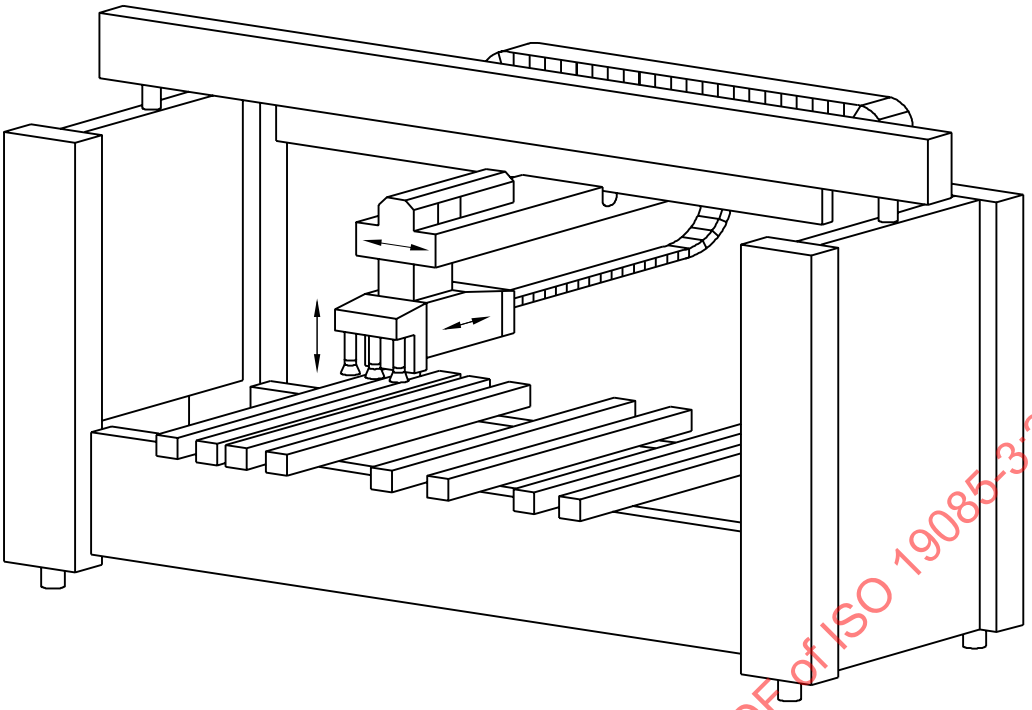
d) automatic tool change facilities.

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



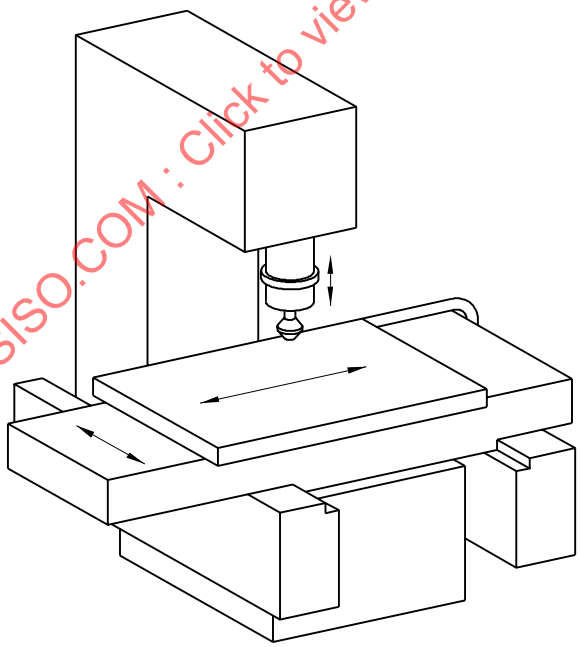
NOTE Safeguarding devices are not illustrated.

Figure 1 — Example of a C frame machine with fixed table and moveable machining head



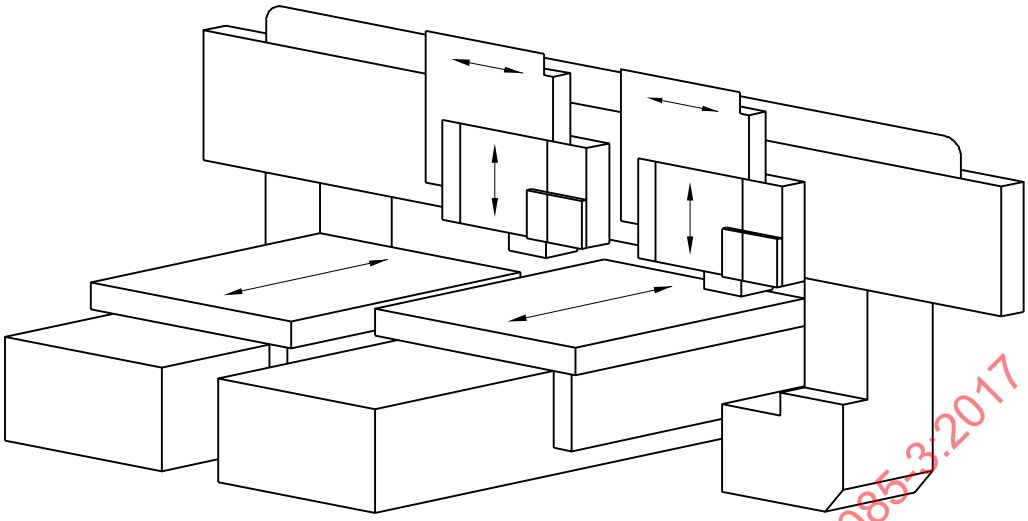
NOTE Safeguarding devices are not illustrated.

Figure 2 — Example of a portal frame machine with fixed portal, fixed table, moving machining head



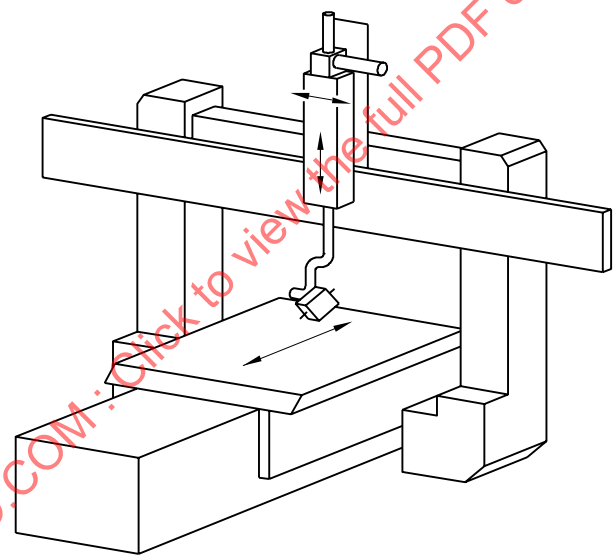
NOTE Safeguarding devices are not illustrated.

Figure 3 — Example of an overhead router with moving table



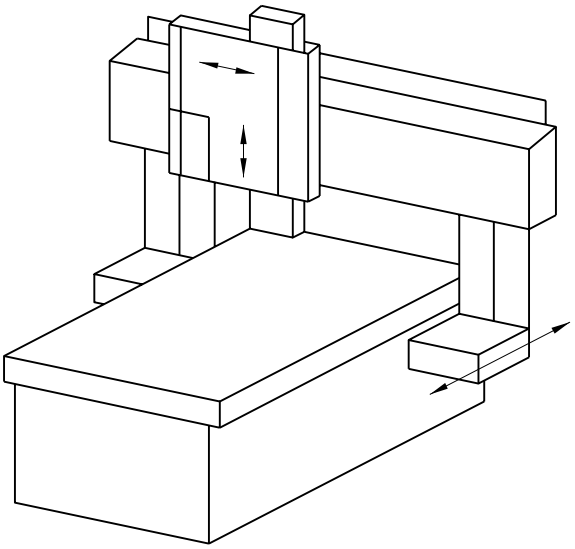
NOTE Safeguarding devices are not illustrated.

Figure 4 — Example of overhead router with moving tables, fixed portal, moving machining heads



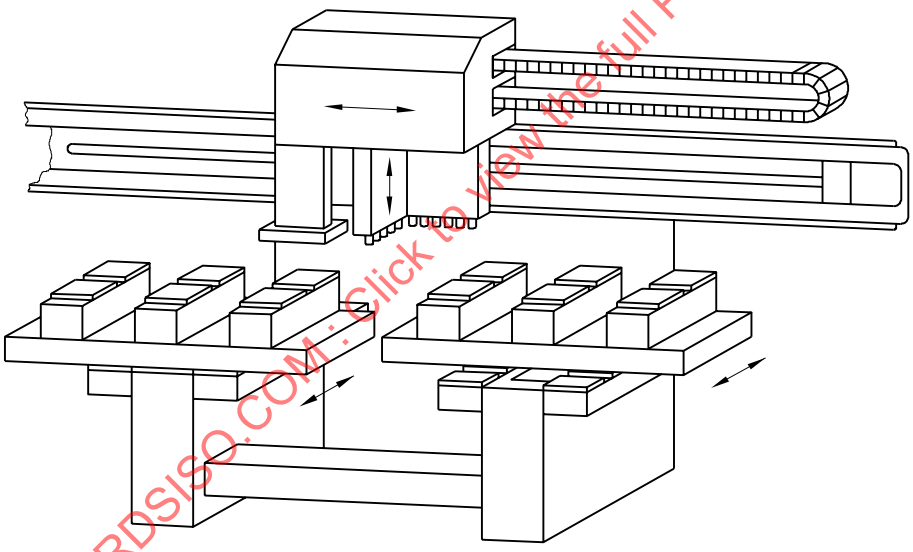
NOTE Safeguarding devices are not illustrated.

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



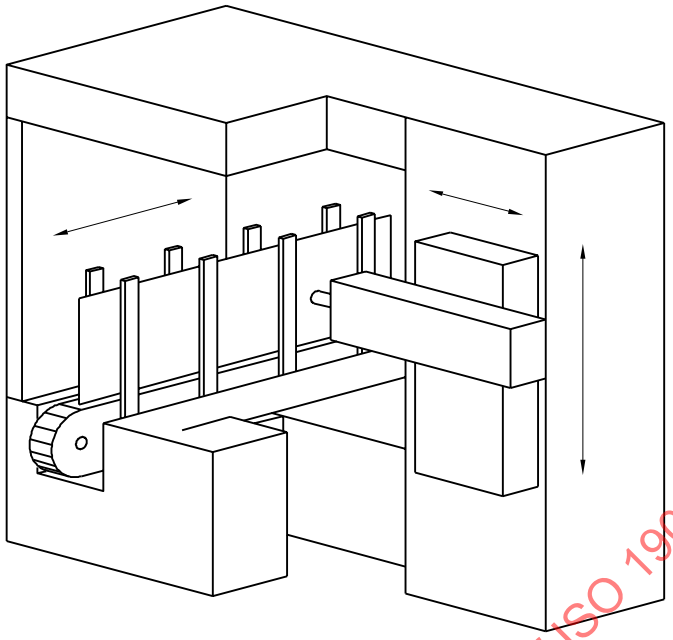
NOTE Safeguarding devices are not illustrated.

Figure 6 — Example of an overhead router with fixed table, moving portal, moving machining head



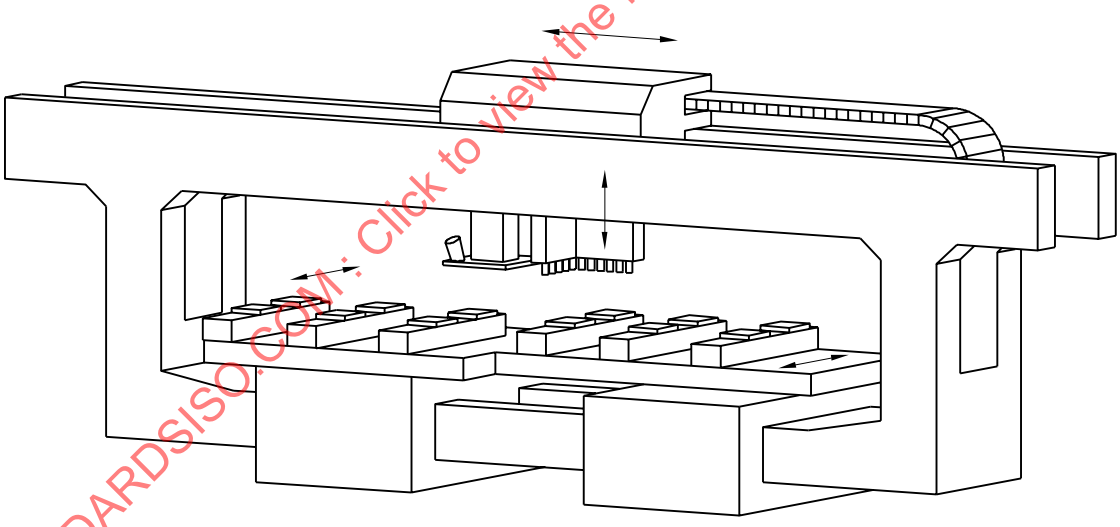
NOTE Safeguarding devices are not illustrated.

Figure 7 — Example of a C frame boring machine with moving tables, fixed portal, moving machining head



NOTE Safeguarding devices are not illustrated.

Figure 8 — Example of a vertical machine with moving support, fixed frame, moving machining head



NOTE Safeguarding devices are not illustrated.

Figure 9 — Example of a portal frame boring machine with moving tables, fixed portal, moving machining head

3.2
control power-on
control that after activation enables providing power to machines actuators, also on a lower control level, e.g. by the PLC (Programmed Logic Control)

3.3
machining mode
MODE 1
automatic, programmed, sequential operation of the machine

3.4
machine setting mode
MODE 2
setting, programming, fault finding, program verification, testing and manually controlled (under power) non-sequential operation of the machine

3.5
clamping device manual positioning mode
MODE 3
manual positioning of clamping devices with laser indication

3.6
Numerical Control
NC
Computerized Numerical Control
CNC
automatic control of a process by a device that makes use of numerical data

3.7
partial enclosure
combination of fixed and moveable guards, protective devices and curtains which encloses the defined machine danger zone and which may or may not have apertures or a ceiling

3.8
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

3.9
stopping distance
distance between positions at initiation of the stop signal and standstill of the movement

Note 1 to entry: See also IEC 61800-5-2:2007.

3.10
remaining safety distance
closest horizontal distance between the outer edge/surface of a PSPE and any hazard point of the machine (i.e. crushing, shearing, drawing-in and entanglement points) measured after the machine has come to a stop from the maximum feeding speed

3.11
loading/unloading zone
area close to the machine accessible to the operator for workpiece loading and/or unloading

Note 1 to entry: See Figure 10, key *E* as an example.

3.12
teleservice
machine diagnosis (including trouble-shooting), software update and telecontrol from a remote service site

3.13
telecontrol
control of the machine movements from a remote service site

4 List of significant hazards

This Clause contains all significant hazards, hazardous situations and events (see 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	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	6.5, 6.6, 6.8, 7.5
	b) relative location		6.5, 6.6
	c) mass and stability (potential energy of elements which may move under the effect of gravity)		6.1, 6.3 7.5, 7.14
	d) mass and velocity (kinetic energy of elements in controlled or uncontrolled motion)		5.7, 6.5 6.6, 6.8
	e) mechanical strength		6.9, Annexes B, D, F, G, H
	— accumulation of energy inside the machinery:		
	f) liquids or gases under pressure, or	6.2.10 6.3.5.4	7.7, 7.8
	g) vacuum		6.8
1.1	Crushing hazard	—	6.6, 8.3
1.2	Shearing hazard		6.6, 8.3
1.3	Cutting or severing hazard		6.6, 8.3
1.4	Entanglement hazard		6.6
1.5	Drawing in or trapping hazard		6.6
1.6	Impact hazard		6.7
1.7	Stabbing or puncture hazard		6.6
1.8	Friction or abrasion hazard		6.6
1.9	High pressure fluid injection or ejection hazard	6.2.10	7.8
2	**Electrical hazards**		
2.1	Contact of persons with live parts (direct contact)	6.2.9, 6.3.5.4	7.4
2.2	Contact of persons with parts which have become live under faulty conditions (indirect contact)	6.2.9	7.4
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	7.2
4.2	Interference with speech communication, acoustic signals		7.2
6	**Hazards generated by radiation**		
6.1	Low frequency, radio frequency radiation, microwaves	—	7.9
6.5	Lasers	6.3.4.5	7.10
7	**Hazards generated by materials and substances (and their constituent elements) processed, or used by the machinery:**		
7.1	Hazards from contact with or inhalation of harmful fluids and dusts	6.2.3, 6.2.4	7.3
7.2	Fire hazard	6.2.4	7.1, 7.11
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, 7.5
8.2	Hand-arm or foot-leg anatomy	6.2.8	7.5
8.4	Local lighting	6.2.8.6	7.6, 8.3

Table 1 *(continued)*

No	Hazards, hazardous situations and hazardous events	ISO 12100:2010	Relevant Clauses of this document
8.5	Mental overload and underload, stress	6.2.8.5	7.5
8.6	Human error	6.2.8.1, 6.2.11.8, 6.2.11.10, 6.3.5.2, 6.4	7.12, 8.3
8.7	Design, location or identification of manual controls	6.2.8.7, 6.2.11.8	5.2, 8.3
8.8	Design or location of visual display units	6.2.8, 6.4.2	5.2
9	**Hazard combination**	6.3.2.1	5.2
10	**Unexpected start-up, unexpected overrun/overspeed (or any similar malfunction) from**		
10.1	Failure/disorder of the control system	6.2.11, 6.3.5.4	5.1, 5.8
10.2	Uncontrolled restoration of energy supply after an interruption	6.2.11.4	5.8
10.3	External influences on electrical equipment	6.2.11.11	5.1, 7.9
10.5	Errors in the software	6.2.11.7	5.1
11	**Impossibility of stopping the machine in the best possible conditions**	6.2.11.1, 6.2.11.3, 6.3.5.2	5.1
12	**Variations in the rotational speed of tools**	6.2.2.2, 6.2.3	5.7
13	**Failure of the power supply**	6.2.11.1, 6.2.11.4	5.8
14	**Failure of the control circuit**	6.2.11, 6.3.5.4	5.1
15	**Errors of fitting**	6.2.7, 6.4.5	7.12
16	**Break-up during operation**	6.2.3	6.2
17	**Falling or ejected objects or fluids**	6.2.3, 6.2.10	6.2, 6.3, 6.9.2, 6.5, 6.6
18	**Loss of stability/overturning of machinery**	6.3.2.6	6.1, 6.2
19	**Slip, trip and fall of persons (related to machinery)**	6.3.5.6	6.9.2

5 Safety requirements and measures for controls

5.1 Safety and reliability of control systems

This subclause of ISO 19085-1:2017 applies.

5.2 Control devices

This subclause of ISO 19085-1:2017 applies with the following additions, subdivided into further specific subclauses.

5.2.1 General

The control devices for control power-on, operational/normal stop, emergency stop, mode selection shall be located at the operator's position adjacent to the control display (at the main control panel).

Hold-to-run control devices and/or enabling control devices for tool or axes movements shall be located on the main control panel and/or on a hand-held set of controls connected to the machine by cable or wireless;

As an exception to the requirement in ISO 19085-1:2017 at machines with more than one loading/unloading zone, the reset of the safeguarding system at the loading/unloading zone may be achieved by the manual control device for cycle start. In this case reset and cycle start may occur at the same time.

The emergency stop device shall be provided at each working station and in particular,

a) at the main control panel,

b) at the hand-held control set,

c) adjacent to all hold-to-run control devices,

d) at the workpiece loading and unloading station,

e) close to or inside the tool magazine, where this is separated from the machining area and the magazine is under power during loading and unloading of the tools,

f) inside any enclosure fitted with access door when required according 6.6.2.2, and

g) adjacent to all cycle start control devices.

If, in fulfilment of the above requirements, the distance between two separate emergency-stop devices results to be less than 1 m, one device is sufficient and its position can be chosen.

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

5.2.2 Hand-held control sets

Additional control devices for cycle starting (not including reset function), operational/normal stopping (if provided) may be duplicated/provided on hand-held control sets with or without cable connection taking account of the requirements of 5.4.4 for emergency stop. Reset function control devices, control power-on control devices and mode selector shall not be fitted on hand-held control sets.

When a wireless control set loses its connection to the machine, an emergency stop shall be automatically activated.

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

5.3 Start

This subclause of ISO 19085-1:2017 is replaced by the following specific text.

Control power-on activation shall only be possible if all relevant safeguards are in place and operational. This is achieved by the interlocking arrangement, including PL required, described in 5.6, 6.5, 6.6 and 6.8. The control power-on device shall be protected against unintended actuation, e.g. by shroud.

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

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

NOTE 1 No PL is required for cycle start and restart functions.

Closure of interlocking movable guards or moving away from a triggered ESPE or PSPE shall not lead to an automatic restart of dangerous movements. For each restart, a deliberate action of the operator is required, i.e. safeguard reset. If only one safeguard is triggered, safeguard local reset and cycle start may occur at the same time.

NOTE 2 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.

5.4 Safe stops

5.4.1 General

This subclause of ISO 19085-1:2017 applies with the following additions.

At the end of stopping sequence, powered workpiece clamping devices may be de-energized if no additional hazard will occur.

Stop initiated by opening of moveable guards or activation/triggering of the safety related control system of a protective device shall be either a normal stop or an operational stop or an emergency stop.

If the machine is divided into physically separated danger zones, actuators to be stopped may be only those of the relevant danger zone. In this case, a local manual reset control device is required.

5.4.2 Normal stop

This subclause of ISO 19085-1:2017 applies.

5.4.3 Operational stop

This subclause of ISO 19085-1:2017 applies.

5.4.4 Emergency stop

This subclause of ISO 19085-1:2017 applies.

5.5 Braking function of tool spindles

This subclause of ISO 19085-1:2017 applies with the following addition.

Only electric braking systems are allowed, except for a mechanical device for positioning and locking.

5.6 Mode selection

This subclause of ISO 19085-1:2017 applies with the following addition, subdivided into further specific subclauses.

5.6.1 General

In addition to the requirements in ISO 19085-1:2017, 5.6 a) to d), the following requirements also apply:

a) the mode selection switch shall be located outside the hazards zone, e.g. on the main control panel and not reachable from inside the hazards zone;

b) the safeguarding requirements given in 5.6.2, 5.6.3 and 5.6.4 shall be effective in their respective mode of operation.

NOTE In ISO 19085-1:2017, 5.6 d), “mode with lower safety measure” refers to MODE 2 or MODE 3, “mode with higher safety measure” refers to MODE 1.

5.6.2 Machining mode [MODE 1]

In machining mode, movement shall only be possible when the interlocking moveable guards and protective devices are in place and functional.

The safety related maximum speed of axes movement and spindle rotation shall fulfil the requirements of 5.11 and 5.7.3 respectively.

5.6.3 Machine setting mode [MODE 2]

In machine setting mode of operation, when moveable guards are opened and protective devices disabled, any dangerous movement shall only be possible when all following requirements are met:

a) spindle rotation, if provided, shall be controlled by a jog control together with an enabling control; the jog control need not achieve any PL_r;

b) only one powered (physical or virtual) axis movement shall be possible at a time; The SRP/CS for the selection of the axis shall achieve PL_r = b;

c) any physical or virtual axis movement shall be controlled by a jog control together with an enabling control; the jog control need not achieve any PL_r. The movement speed of each physical axis shall be limited to 2 $m \cdot min^{-1}$ according to 5.11. In addition, the movement speed of linear virtual axis (i.e. axis, vector or tangential speed) shall be limited to 2 $m \cdot min^{-1}$ without PL_r, e.g. by PLC;

d) if tool rotation is provided, it shall be limited to a maximum of 300 $m \cdot min^{-1}$;

e) tool rotation shall stop in less than 2 revolutions after release of the enabling control device; the SRP/CS for monitoring the tool stopping in maximum of 2 revolutions shall achieve PL_r = c;

f) speed monitoring in accordance with 5.7.3 shall be provided for spindle rotation;

g) unexpected movement of the automatic tool change mechanism shall be prevented by SRP/CS achieving PL_r = c. When crushing and shearing hazards exist, two-hand control device shall be provided;

h) initiation of any other dangerous movement shall be prevented. The SRP/CS for prevention of unexpected start up shall achieve PL_r = c.

5.6.4 Clamping device manual positioning mode [MODE 3]

For machines without bumpers or sensitive edges, trip bars or trip plates, in clamping device manual positioning mode with laser indication fitted to the moving machining head, if front side safeguards are disabled, any hazardous movement shall only be possible when all following requirements are met:

a) spindle rotation shall not be allowed;

b) machining head movement in direction where crushing and shearing hazards may occur shall be controlled by a jog control together with an enabling control. This axis movement speed shall be limited to 10 $m \cdot min^{-1}$ according to 5.11. The jog control does not need to achieve any PL_r.

5.7 Spindle speed changing

5.7.1 Spindle speed changing by changing belts on the pulleys

This subclause of ISO 19085-1:2017 applies to milling aggregates with fixed spindle speed not controlled by inverter and for boring tools.

5.7.2 Spindle speed changing by incremental speed change motor

This subclause of ISO 19085-1:2017 does not apply.

5.7.3 Infinitely variable speed by frequency inverter

This subclause of ISO 19085-1:2017 applies with the following additions.

As an exception to speed monitoring with the selected speed as limit value, the monitoring may use the maximum rotational speed of the tool.

Unless the tool characteristics are automatically read from the tool, at least the maximum rotational speed of the tool needs 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 displayed, and confirmed by the operator. Alternatively, tool ID can be confirmed if already associated with tool maximum rotational speed. When tool ID is edited, tool maximum rotational speed shall be confirmed.

It shall not be possible to select a speed value higher than the maximum rotational speed of the tool stored in the memory of the control system (no PL_r).

NOTE During the next revision of this document, it is intended that it deals with requirements on tool identification.

For spindles with speed pre-set at a fixed value and for spindles which are only capable of being used with boring tools, no speed monitoring is required.

5.8 Failure of any power supply

This subclause of ISO 19085-1:2017 applies with the following addition.

In the case of machines incorporating pneumatic/hydraulic clamping of the workpiece, in the event of a failure in the pneumatic or hydraulic power supply a normal or emergency stop shall be activated.

5.9 Manual reset control

This subclause of ISO 19085-1:2017 applies.

5.10 Enabling control

This subclause of ISO 19085-1:2017 applies.

5.11 Machine moving parts speed monitoring

This subclause of ISO 19085-1:2017 applies.

5.12 Time delay

This subclause of ISO 19085-1:2017 applies.

5.13 Teleservice

This subclause is specific to this document.

For machines equipped with teleservice facility, the following requirements apply.

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

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

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

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

The emergency stop control function at the machine shall take precedence over any command issued by the remote teleservice operator.

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

Before software update, the machine shall be on, in normal stop condition and empty from workpieces.

The telecontrol shall be activated with the machine operator present at the machine. A warning shall appear on the control panel stating that the operator shall check that all safeguards are in place and operational, the machine is in automatic mode (MODE 1), and that the operator shall stay at the machine during all telecontrol operation checking that nobody else is around the machine. A confirmation of the above from the operator shall be required before starting the telecontrol function. (no PL required).

After the teleservice operations are accomplished, a message shall appear on the control panel stating that the machine is ready to work.

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

6 Safety requirements and measures for protection against mechanical hazards

6.1 Stability

6.1.1 Stationary machines

This subclause of ISO 19085-1:2017 applies with the following additions.

The same requirement apply to any auxiliary equipment, e.g. vacuum pump.

Unintended 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.

6.1.2 Displaceable machines

This subclause of ISO 19085-1:2017 does not apply.

6.2 Risk of break-up during operation

This subclause of ISO 19085-1:2017 is replaced by the following specific text.

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

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

6.3 Tool holder and tool design

6.3.1 General

This subclause of ISO 19085-1:2017 applies with the following additions.

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 8.3).

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 SRP/CS for interlocking between tool release and spindle rotation shall achieve PL_r = c or consist of two independent systems both achieving PL_r = b.

As an exception, tool release function may achieve PL_r = b if there is an additional mechanical system which prevents tool release during rotation.

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

6.3.2 Spindle locking

This subclause of ISO 19085-1:2017 applies.

6.3.3 Circular saw blade fixing device

This subclause of ISO 19085-1:2017 applies.

6.3.4 Flange dimension for circular saw blades

This subclause of ISO 19085-1:2017 applies.

6.4 Braking

6.4.1 Braking of tool spindle

This subclause of ISO 19085-1:2017 applies

6.4.2 Maximum run-down time

This subclause of ISO 19085-1:2017 applies

6.4.3 Brake release

This subclause of ISO 19085-1:2017 applies

6.5 Safeguards

6.5.1 Fixed guards

This subclause of ISO 19085-1:2017 applies.

6.5.2 Interlocking moveable guards

6.5.2.1 General

This subclause of ISO 19085-1:2017 applies.

6.5.2.2 Movable guards with interlocking without guard locking

This subclause of ISO 19085-1:2017 applies.

6.5.2.3 Movable guards with interlocking and guard locking

This subclause of ISO 19085-1:2017 applies.

6.5.3 Hold-to-run control

This subclause of ISO 19085-1:2017 applies.

6.5.4 Two-hand control

This subclause of ISO 19085-1:2017 applies.

6.5.5 Electro-sensitive protective equipment (ESPE)

This subclause of ISO 19085-1:2017 applies with the following additions.

If light barriers (AOPD) are used, the following requirements apply:

a) If mounted horizontally:

   1) the elements shall be situated at a height between 100 mm and 400 mm above the floor level;

   2) the pitch between two elements shall be equal to or less than 180 mm;

   3) the distance *C* in Figure 10 between the active part of the light barriers and the machine at the light barrier level shall not exceed 100 mm and the distance *D* in Figure 10 between the active part of the light barriers and fixed guards at the light barrier levels shall not exceed 80 mm.

b) If mounted inclined:

   1) the pitch between two elements shall be equal to or less than 180 mm, measured on the horizontal projection;

   2) the elements shall be mounted at a height between 400 mm and 800 mm above the floor level;

   3) the horizontal distance between top and bottom ray shall be equal to or greater than 400 mm.

c) If mounted vertically, the elements shall be situated:

   1) at a height of 400 mm and 900 mm above the floor level, for two beams;

   2) at a height of 300 mm, 700 mm and 1 100 mm above the floor level, for three beams.

d) A manual reset control device shall be provided.

If stationary laser scanners are used, the protected area of the scanner shall be situated at a height between 100 mm and 400 mm above the floor level.

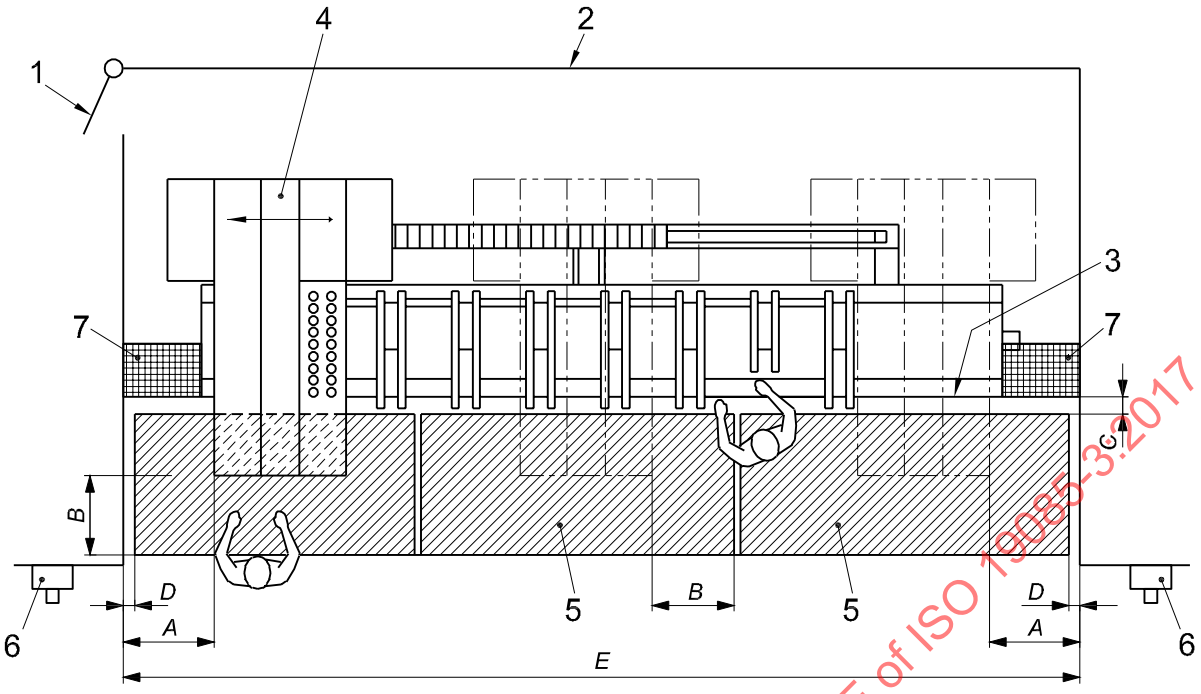
6.5.6 Pressure-sensitive protective equipment (PSPE)

This subclause of ISO 19085-1:2017 applies with the following addition, subdivided into further specific subclauses.

6.5.6.1 Pressure-sensitive mats

If pressure-sensitive mats are used, the distance *C* in Figure 10 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 10 between the active part of the mat and fixed guards at the mat level shall not exceed 80 mm.

A manual reset control device shall be provided.



Key

1 door with interlocking and guard locking
2 fixed guard
3 front edge of the table
4 machining head enclosure limit position
5 active part of the pressure-sensitive mats
6 reset device
7 deterring/impeding device (i.e. fixed guard or movable guard with interlocking)
A minimum distance between machine and side fixed guards on front side when no bumpers are provided
B minimum extension of protective devices
C maximum gap between machine and pressure-sensitive mat/light barrier
D maximum gap between pressure-sensitive mat/light barrier and fixed guards
E loading/unloading zone

Figure 10 — Position of guarding on machines with partial enclosure

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

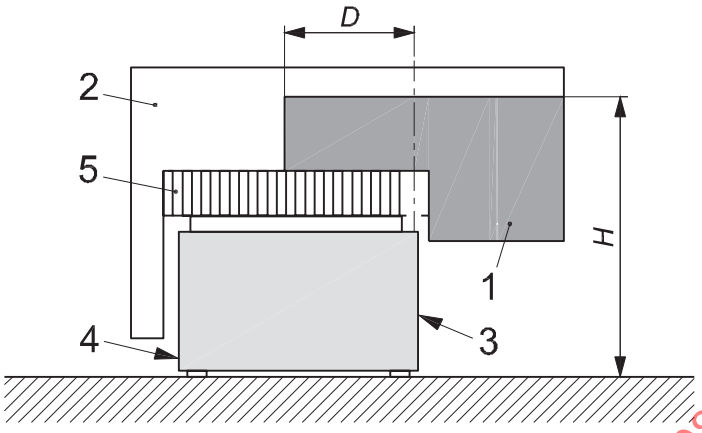
6.5.6.2 Pressure-sensitive bumpers

If pressure-sensitive bumpers are used to protect shearing, crushing and impact hazards caused by the movement of machine part, the movement shall stop when pressure-sensitive bumpers are triggered.

The machines with pressure-sensitive bumpers shall pass the dynamic test according to Annex H.

Pressure-sensitive bumpers shall extend to the whole height of the machine's moving component that can cause impact/crushing/shearing hazard up to a height (*H*) of 1 800 mm and from the edge inward (distance *D*) up to at least 700 mm from the machine side accessible by the operator when machining (see Figure 11). If it is necessary to position the clamping system in a distance more than 700 mm, the bumper shall extended to this value or up to 850 mm, whichever is less.

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



Key

1 bumper surface
2 peripheral enclosure
3 front machine side
4 rear machine side (not accessible during machining)
5 curtain

Figure 11 — Example of bumper arrangement

6.5.6.3 Pressure-sensitive edges/trip bars/trip plates

Pressure-sensitive edges/trip bars/trip plates are permissible only when the maximum axes speed does not exceed 25 m min^{-1}.

If pressure-sensitive edges/trip bars/trip plates are used to protect shearing and crushing hazards caused by the movement of machine parts, the movement shall stop when they are triggered.

Machines with pressure-sensitive edges/trip bars/trip plates shall pass the dynamic test according to Annex H.

Pressure-sensitive edges, trip bars and trip plates shall extend around all shearing/crushing edges, both vertically and horizontally inward up to at least 700 mm from the machine side accessible by the operator when machining. If it is necessary to position the clamping system in a distance more than 700 mm, the pressure-sensitive edge/trip bar/trip plate shall extend to this value or up to 850 mm whichever is less.

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

6.6 Prevention of access to moving parts

6.6.1 General

This subclause of ISO 19085-1:2017 applies with the following additions.

Access to moving parts shall be prevented as far as possible by fixed or interlocking moveable guards extending from 180 mm up to at least 1 800 mm above the floor level, building together a partial or peripheral enclosure.

Access to moving parts through the area of the machine that needs to be accessible for loading and unloading the workpieces shall be prevented by one or more safeguards, described in 6.5, as follows.

a) Where using stationary protective devices as light barriers (including those with at least either the receiver or the emitter being stationary), or stationary laser scanners or pressure-sensitive mats to prevent access to the crushing, shearing or cutting area (protected zone):

   1) the detection zone (light barrier, stationary laser scanners) 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;

   2) where the protective device is divided into an active and an inactive part to allow the machine to work in one area while the other area is accessible for loading/unloading:

      — the horizontal distance between the area accessible for loading/unloading and the protected zone where the machine is working shall be at least 850 mm; if this safety distance falls below 850 mm, a normal stop shall be initiated;

      — the inactive part of such safeguarding shall be manually reset by the operator before the machining head is allowed to traverse into this area; automatic reset shall not be possible;

   NOTE The prevention of automatic reset is required since the operator can involuntarily release the protective safety device, e.g. by stepping or leaning onto the workpiece support.

   3) when a person is detected, a normal stop shall be initiated and the machining head shall stop within 700 mm. Alternatively, where only the speed of the machining head is reduced by triggering the stationary protective device, the machine shall be equipped with additional bumpers or edges or trip bars or trip plates fulfilling, after speed reduction, the requirements for the systems with only bumpers/edges/trip bars/trip plates given in b). Speed shall be reduced within 500 mm. After activation of the limited speed, a manual reset control device shall be activated to restore the full speed.

b) Where using only moving protective devices mounted to the moving part of the machine as pressure-sensitive bumpers, edges, trip bars, trip plates or laser scanner, to prevent access to the crushing, shearing or cutting area (protected zone):

   1) for laser scanner, the safety distance from the machining head enclosure, when it has come to a stop from the maximum machine feeding speed, shall be at least 850 mm;

   2) for pressure-sensitive bumpers, edges, trip bars, trip plates, the remaining safety distance between the test probe and any crushing, shearing, drawing in and entanglement point inside the machining head enclosure shall be at least y (see Figure 12):

      y = 550 mm, where openings height x for workpiece loading/unloading is up to 200 mm;

      $y = 550 + ¾ (x - 200)$ mm, where openings height x is between 200 mm and 600 mm;

   3) moving protective devices shall also detect an operator if he has no contact to the floor, e.g. by stepping or leaning onto the workpiece support;

   4) when moving protective device is triggered, a normal stop shall be initiated.

c) Where using moving protective devices mounted to the moving part of the machines, as laser scanner, only for machining head speed reduction, together with pressure-sensitive bumpers or edges or trip bars or trip plates for machining head stopping and preventing access to the crushing, shearing or cutting area (protected zone):

   1) machining head speed reduction shall be activated by triggering laser scanner, and the limited speed value shall be monitored and allow the bumpers/edges/trip bars/trip plates to fulfil the requirements defined in 2);

2) the remaining safety distance referred to bumpers/edges/trip bars/trip plates between the test probe and any crushing, shearing, drawing in and entanglement point inside the machining head enclosure shall be at least y (see Figure 12):

   y = 550 mm, where openings height x for workpiece loading/unloading is up to 200 mm;

   y = 550 + ¾ (x – 200) mm, where openings height x is between 200 mm and 600 mm;

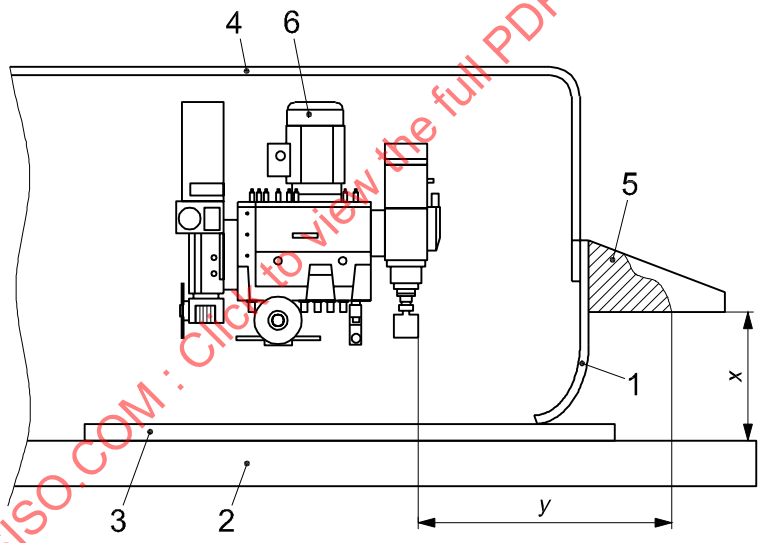
3) laser scanner, pressure-sensitive bumpers, edges, trip bars and trip plates shall detect an operator also if he has no contact to the floor, e.g. by stepping or leaning onto the workpiece support;

4) no laser scanner manual reset is required when moving away from the area safeguarded by laser scanner to restore the full machining head speed if bumpers/edges/trip bars/trip plates have not been triggered;

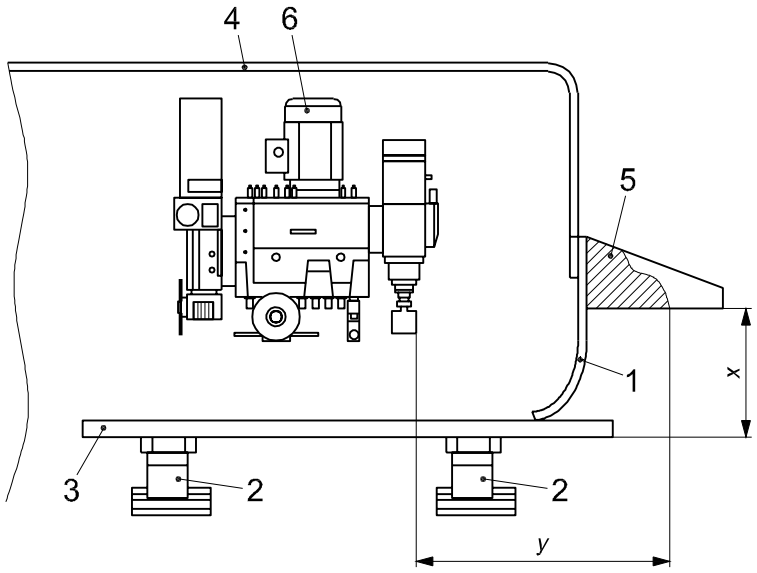
5) when bumpers/edges/trip bars/trip plates are triggered, a normal stop shall be initiated.

The SRP/CS for ensuring the safety distance in a) 1), a) 2) and b) 1) and the remaining safety distance in b) 2) and c) 2) shall achieve PL_r = c.

Unexpected restart by the closure of a movable guard shall be prevented. The SRP/CS for prevention of restart shall achieve PL_r = c.



a) Machining head enclosure above a solid table



b) Machining head enclosure above supporting bars

Key

x	height of opening for workpiece feeding	*y*	remaining safety distance
1	curtain	4	machining head enclosure
2	workpiece support	5	pressure-sensitive bumper/edge or trip bar
3	workpiece	6	machining head

Figure 12 — Safety distance "*y*" for machining head enclosure above different types of workpiece support

6.6.2 Guarding of tools

This subclause of ISO 19085-1:2017 is replaced by the following text, subdivided into further specific subclauses.

6.6.2.1 NC boring machines

Boring machines designed to use only boring tools shall be guarded by one or any combination of

a) fixed guards and/or moveable guards with interlocking without guard locking, or

b) protective devices, e.g. light barrier (see 6.5.5 and 6.5.6).

Safety distances from tools shall be at least (see Figure 12):

a) y = 550 mm, where openings height x for workpiece loading/unloading is up to 200 mm;

b) $y = 550 + ¾ (x - 200)$ mm, where openings height x is between 200 mm and 600 mm;

c) according to ISO 13857:2008, except Tables 1 and 5, where height of the opening, x, exceeds 600 mm.

When additional equipment for sawing is provided with saw blade diameter higher than 125 mm, measures to minimize the effect of ejection of tool parts or workpiece parts shall be adopted, e.g. saw blade enclosing guard (see 6.9).

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

6.6.2.2 NC routing machines and NC boring/routing machines

6.6.2.2.1 General

On NC routing machines and NC combined boring/routing machines, access to hazard zones shall be prevented either by a peripheral enclosure or by a partial enclosure in accordance with the requirements of 6.6.2.2.2 or 6.6.2.2.3, including, where appropriate, other safeguarding devices such as safety mats, light barriers and/or pressure-sensitive bumpers.

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

6.6.2.2.2 Peripheral enclosure

Where entering the enclosure is necessary for setting, tool changing, cleaning or loading/unloading, at least one door shall be provided and interlocked with guard locking to the drives. The following additional requirements apply:

a) audible or visual warning (e.g. a yellow light) of impending start up shall be given if the operator doesn't have a complete view of the machining area from the control position (see 8.1);

b) emergency stop device shall be placed inside the enclosure if the operator does not have a complete view of the machining area from the control position;

c) each door shall be provided with its own manual reset control device to reset its interlocking;

d) it shall be possible to open each door from inside.

The characteristics of the guards shall conform to 6.9 if they also have to prevent ejection of machine parts or workpiece parts.

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

6.6.2.2.3 Partial enclosure

6.6.2.2.3.1 General

With the exception of the loading and/or unloading zone, the requirements of 6.6.2.2.2 apply.

In addition, the following requirements apply.

a) Access to the rear zone of the machine through the area between the machine frame and the lateral machine fences shall be prevented by a combination of protective devices and fixed or interlocked moveable guards, e.g. a combination of a deterring/impeding device consisting of guards extending from a height of maximum 180 mm above floor level up to at least 700 mm above floor level and at such height extending inward over a distance of at least 400 mm (see Figure 10, key 7) and a PSPE (see 6.5.6); such PSPE may be a pressure safety mat laid on the top surface of the impeding device or a trip plate replacing such top surface, both 400 mm wide.

   As an exception, a PSPE according to the previous paragraph is not required for machines without option for alternating loading, protected with stationary protective devices as light barriers or stationary laser-scanner or pressure safety mats extending up to the lateral machine fences.

b) Tool crushing/shearing points to be taken into account refer to the tool periphery of any rotating tool being in the closest possible position to the operator; see Figures 12 a) and b) when using pressure-sensitive bumpers or trip bars or pressure-sensitive edges and 6.6.1.

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

6.6.2.2.3.2 Openings guarded by curtains

Openings in the partial enclosure necessary for machining shall be kept as small as possible. 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 600 mm.

Curtains shall cover all these openings to protect against ejection of parts of milling tools and/or of saw blades and/or parts of the workpiece.

For the curtains, the following requirements apply:

a) the curtain's free end on its whole length shall extend to the lowest surface on which the workpiece can be clamped;

b) the curtain shall be located so that it cannot come in contact with any tool that can be mounted into the machine when it is used as intended;

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

d) the curtain shall pass the impact test specified in Annex F;

e) the curtain shall pass the wear test specified in Annex G.

As an exception, curtains are not required on NC routing and/or boring machines where all of the following conditions are met:

— complex milling tools according to EN 847-1:2013 are not allowed (see 8.3.2);

— the milling tool's maximum diameter allowed does not exceed 60 mm;

— the width of the openings for workpiece loading/unloading at any point does not exceed 100 mm;

— the saw blade's maximum diameter allowed does not exceed 125 mm.

The curtains may be raised during operation if:

1) only boring units, edge-banding aggregates, assembly unit or dowel devices are used; and

2) the rotation of any other spindle or unit is prevented once the curtains have left the guarding position.

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

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

6.6.3 Guarding of drives

This subclause of ISO 19085-1:2017 applies with the following additions.

Interlocking moveable guards shall be provided in any case with guard locking according 6.5.3.

6.6.4 Guarding of shearing and/or crushing zones

This subclause of ISO 19085-1:2017 is replaced by the following specific text.

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 positions of the moving part (table or machining head) and the side fixed guards is ensured at front side (see dimension A in Figure 10). This requirement does not apply on the rear side where access is prevented by a fence.

As an exception, minimum distance A can be reduced to 300 mm where sensitive bumpers or edges are provided to prevent crushing hazard to the whole body.

The minimum distance defined above shall be ensured by mechanical end-stops.

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

6.7 Impact hazard

This subclause of ISO 19085-1:2017 applies with the following additions.

The detection zone when using light barriers or laser scanners or the effective sensing surface when using pressure-sensitive mats shall extend at least 700 mm from any impact point being in the closest possible position to the operator, measured in horizontal direction (distance B of Figure 10), where only impact hazards from machining head or table exist.

The limited speed shall be monitored according to 5.11.

6.8 Clamping device

This subclause of ISO 19085-1:2017 is replaced by the following text.

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

a) a two-hand control to control the clamping stroke;

b) 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;

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

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

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

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

The SRP/CS for the limitation of the clamp closing speed in e) shall achieve PL_r = b.

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

When powered clamping is selected (vacuum, pneumatic or hydraulic), the following requirements apply:

1) feed and spindle rotation shall be interlocked so that axes and/or spindle movements cannot start and run until clamping pressure/vacuum supply for clamping is available (no PL is required for interlocking);

2) 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. (no PL is required for interlocking);

3) where twin table or separate loading/unloading sections are provided, the requirements for release of clamping pressure/vacuum stated in 2) only apply 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. (no PL is required for interlocking);

4) for vacuum clamping:

   i) the vacuum sensor shall achieve at least PL = b;

   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 vacuum shall initiate the machine operational stop or emergency stop.

6.9 Measures against ejection

6.9.1 General

This subclause of ISO 19085-1:2017 applies with the following addition.

Anti-splinter and anti-kickback devices are not relevant/applicable.

Direct ejection of parts of the tool or parts of the workpiece in any direction shall be prevented by fixed guards from 180 mm up to at least 1 800 mm above the floor level. Where those fixed guards need to have openings for workpiece loading/unloading, processing and/or feeding, curtains shall be provided, except for the case given in 6.6.2.2.3.2. Fixed guards and curtains may be mounted to the machine body or the machining head.

As exceptions:

— direct ejection through the space between the clamping bars shall be prevented up to the lowest level on which the workpiece can be clamped only at the front and at the rear by fixed guards;

— ejection to the side through the space between the clamping bars is considered to be an acceptable residual risk.

6.9.2 Guards materials and characteristics

6.9.2.1 Choice of guards' class

This subclause of ISO 19085-1:2017 applies with the following additions.

For machines designed to use milling tools or saw blades, guards shall be of class A. As an exception, only for preventing ejection from saw blades guards shall be of class B.

NOTE No requirement for guards' materials and characteristics need to be defined to prevent ejection from boring tools, edge-banding aggregates, assembly units, dowel devices.

6.9.2.2 Guards of class A

This subclause of ISO 19085-1:2017 applies.

6.9.2.3 Guards of class B

This subclause of ISO 19085-1:2017 applies.

6.10 Workpiece support and guides

This subclause of ISO 19085-1:2017 applies with the following addition.

Examples of workpiece supports are solid table and supporting bars (see Figure 12, key 2).

7 Safety requirements and measures for protection against other hazards

7.1 Fire

This subclause of ISO 19085-1:2017 applies.

7.2 Noise

7.2.1 Noise reduction at the design stage

This subclause of ISO 19085-1:2017 applies with the following additions.

Other major noise sources are

a) axle drives, and

b) clamping, i.e. any of the following clamping system:

   1) vacuum system including vacuum pump;

   2) pneumatic system;

   3) hydraulic system.

7.2.2 Noise emission measurement

This subclause of ISO 19085-1:2017 applies with the following addition.

The operating conditions for noise measurement shall comply with Annex E.

7.3 Emission of chips and dust

This subclause of ISO 19085-1:2017 applies with the following additions.

Unintended access to the rotating tool through any dust extraction outlet with disconnected exhaust system shall be impeded. The requirements of ISO 13857:2008 shall not be applied here due to the negative impact on the extraction of chips and dust.

A means shall be provided to improve the efficiency of guiding the chips and dust to the opening of the capture device, e.g. a deflector mounted to the tool or brushes mounted around the machining head.

7.4 Electricity

7.4.1 General

This subclause of ISO 19085-1:2017 applies.

7.4.2 Displaceable machines

This subclause of ISO 19085-1:2017 does not apply.

7.5 Ergonomics and handling

This subclause of ISO 19085-1:2017 applies with the following addition.

The height of the workpiece support surface should be between 750 mm and 900 mm above the floor level. Deviation to such dimensions may apply due to the size of the workpieces.

7.6 Lighting

This subclause of ISO 19085-1:2017 applies.

7.7 Pneumatics

This subclause of ISO 19085-1:2017 applies.

7.8 Hydraulics

This subclause of ISO 19085-1:2017 applies.

7.9 Electromagnetic compatibility

This subclause of ISO 19085-1:2017 applies.

7.10 Laser

This subclause of ISO 19085-1:2017 applies.

7.11 Static electricity

This subclause of ISO 19085-1:2017 applies.

7.12 Errors of fitting

This subclause of ISO 19085-1:2017 applies.

7.13 Isolation

This subclause of ISO 19085-1:2017 applies.

7.14 Maintenance

This subclause of ISO 19085-1:2017 applies.

8 Information for use

8.1 Warning devices

This subclause of ISO 19085-1:2017 applies with the following additions.

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 does not have a complete view of the machining area; see 6.6.2.2.2 a).

8.2 Marking

8.2.1 General

This subclause of ISO 19085-1:2017 applies.

8.2.2 Additional markings

This subclause of ISO 19085-1:2017 does not apply.

8.3 Instruction handbook

8.3.1 General

This subclause of ISO 19085-1:2017 applies.

8.3.2 Additional information

This subclause of ISO 19085-1:2017 is replaced by the following specific text.

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

a) instructions for safe use shall also include:

   1) the correct selection of milling tools for each operation, which includes precautions during machining as

      i) the range of milling tool diameters and lengths which are suitable for the machine, and

      ii) that only milling tools with a cutting diameter below 16 mm shall be used or milling tools with a cutting diameter above 16 mm and/or saw blades both manufactured in accordance with EN 847-1:2013 and EN 847-2:2013 shall be used;

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

   3) information that the pull-in force of spindles of HSK clamping systems shall be periodically checked by personnel authorized by the manufacturer, including the intervals;

   4) where applicable (see 6.6.2.2.3.2), information not to use complex milling tools according to EN 847-1:2013;

b) warnings regarding residual risks shall also include:

   1) recommendation that the off-cut is either clamped, e.g. by mechanical clamp, or completely machined prior to its detachment to avoid the risk of off-cut ejection;

   2) reminder not to remove chips while the tool is running and the machining head is not in the rest position;

   3) reminder to take precautions to reduce the risk of production of ignition sources;

   4) where applicable, reminder to be aware about the residual risk of parts being ejected to the sides through the space between the clamping bars;

c) instructions about protective device tests, method and frequency shall also include:

   1) curtain maintenance by checking the of absence of damage (at least each month);

   2) vacuum clamping by functional test;

d) instructions for setting the machine and precautions during setting:

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

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

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

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

5) 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;

6) instructions for the use of special equipment, e.g. gauges for setting the tool when machine is at a standstill;

7) instruction for adjustment and use of the safeguarding prescribed in 6.6.2;

e) 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.

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

Annex A
(informative)

Performance levels required

This annex replaces ISO 19085-1:2017, Annex A and gives a quick-view summary of the performance level required (PL_r) for each safety function (see Table A.1). However, for full requirements and detailed explanations, refer to Clauses 5 and 6.

Table A.1 — Performance Level (PL) required for machine safety functions

Area	No	Safety functions/devices	PL_r	Clause in ISO 19085-1:2017	Clause in this document
Start	1	Control power-on	c		5.3
	2	Interlocking of control power-on with safeguards	c		5.3
Stop	3	Normal stop (braking function excluded)	c	5.4.2	
	4	Monitoring of the stand-still condition during operational stop	c	5.4.3	
	5	Emergency stop (braking function excluded)	c	5.4.4	
Braking	6	Braking function	b/c	5.5	
	7	Interlocking of brake release	c	6.4.3	
	8	Interlock between brake release and spindle drive motor	c	6.4.3	
Mode selection	9	Mode selection	c	5.6	
	10	Selection of the axis (physical or virtual)	b		5.6.3
	11	Axis movement speed limitation	c		5.6.3
	12	Monitoring of the tool stopping in maximum of 2 revolutions after hold-to-run release	c		5.6.3
	13	Prevention of unexpected start of tool change mechanism	c		5.6.3
	14	Prevention of start-up of any other dangerous movement	c		5.6.3
Spindle speed	15	Speed indication	b	5.7.1	
	16	Infinitely variable speed monitoring	c	5.7.3	
Controls	17	Manual reset	c	5.9	
	18	Enabling	c	5.10	
	19	Axes limited speed monitoring	c	5.11	
	20	Time delay	c	5.12	

Table A.1 *(continued)*

Area	No	Safety functions/devices	PL_r	Clause in ISO 19085-1:2017	Clause in this document
Safeguards	21	Hold-to-run	c	6.5.3	
	22	Two-hand control	c	6.5.4	
	23	Interlocking with ESPE	c	6.5.5	
	24	Interlocking with PSPE	c	6.5.6	
	25	Interlocking of moveable guards	c	6.5.2.2	
	26	Interlocking with guard locking of moveable guards	c	6.5.2.3	
	27	Observance of safety distance in the loading/unloading area	c		6.6.1
	28	Observance of remaining safety distance in the loading/unloading area	c		6.6.1
	29	Prevention of unexpected restart by closure of moveable guards	c		6.6.1
	30	Interlocking of curtain raised position with any other spindle rotation	c		6.6.2.2.3.2
Tool holder	31	Interlocking function of tool release with spindle standstill detection	c		6.3.1
Powered clamping	32	Limitation of clamping closing speed to 10 mm/s	b		6.8
	33	Prevention of unexpected activation of second clamping force stage	b		6.8
	34	Detection of vacuum loss in vacuum clamping systems	b		6.8

Annex B
(normative)

Test for braking function

This annex of ISO 19085-1:2017 applies.

Annex C
(normative)

Stability test for displaceable machines

This annex of ISO 19085-1:2017 does not apply.

Annex D
(normative)

Impact test for guards

This annex of ISO 19085-1:2017 applies.

Annex E
(normative)

Noise emission measurement for machines not in ISO 7960

E.1 General

This subclause of ISO 19085-1:2017 applies.

E.2 Machine operating conditions for testing

This subclause of ISO 19085-1:2017 applies with the following additions.

The machine shall be tested under the following conditions:

a) under no load in accordance with specifications in ISO 19085-1:2017, 5.4.2.2;

b) loaded as specified in Tables E.1 and E.2. The measurement result is the average of a series of at least three operations, in accordance with ISO 19085-1:2017, 5.4.2.2. During the first and last part of the work cycle, when the tool enters or leaves the workpiece, 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.

E.3 Microphone positions

E.3.1 Operator position microphone location

This subclause of ISO 19085-1:2017 is replaced by the following specific text.

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.

For “large” machinery, where one or more dimensions of the machine exceed 7,0 m, instead of the sound power level, the equivalent continuous sound pressure level at specified positions around the machine shall be declared, at a distance of 1,0 m from the surface of the machine, and at a height of 1,6 m from the floor or access platform.

E.3.2 Other measure microphone positions

This subclause of ISO 19085-1:2017 applies.

E.4 Test report

This subclause of ISO 19085-1:2017 is replaced by the following specific text.

The test results and the operating conditions shall be recorded and reported as follows:

— For NC routing machines, classified as ISO 7984:1988, 12.315.19, according to Table E.1.

— For NC boring machines, classified as ISO 7984:1988, 12.49, according to Table E.2.

— For NC combined routing and boring machines, two different measurements in accordance with ISO 19085-1:2017, 5.4.2.2 shall be performed, one on routing unit to be reported in compliance with Table E.1 and one on boring unit to be reported in compliance with Table E.2.

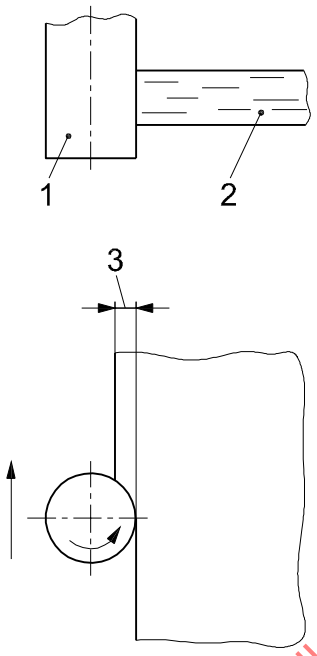
For machines where the data required in the following data sheet sections are not applicable, e.g. regarding spindle speed or tool diameter, the detailed operating conditions used shall be given in the test report.

The forms in Tables E.1 and E.2 may be copied, modified and distributed free of charge.

Table E.1 — Data sheet for NC routing machines and routing units of NC combined routing and boring machines.

<table>
<tr><td>Machine data</td><td>
Make:
Model:
Year of manufacture: Serial no.:
Overall dimension of machine[a]
Length l_1: mm Width l_2: mm Height l_3: mm
<table>
<tr><th>Nominal spindle speed min^{-1}</th><th>Spindle speed min^{-1}</th><th>Machining head assembly</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
☐ Attached frequency converter ☐ Separate frequency converter
☐ Attached static converter ☐ Change loading
</td></tr>
<tr><td colspan="2">[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.</td></tr>
</table>

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

<table>
<tr><td rowspan="2">Testing operating arrangement</td><td colspan="3">Routing particle board edges
 

Key
1 router bit
2 particle board
3 cutting depth</td><td>Standard condition(s)</td><td>Conditions chosen within permitted range or conditions deviating from standard</td></tr>
<tr><td colspan="4">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 synchronized tables or against the right side of the left table for machines with two independent tables.</td></tr>
<tr><td>Tool and cutting data</td><td colspan="3">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</td><td></td><td></td></tr>
<tr><td colspan="5">[b] The spindle speed should be chosen as near as possible to 18 000 min^{-1}.</td></tr>
</table>

Photo or detailed illustration of the machine tested	
Testing laboratory	Firm/Institution: _____ Address: _____ Telephone: _____ Date: _____ Signature _____ Test carried out: Place: _____ Date: _____

Table E.2 — Data sheet for NC boring machines and boring units of NC combined routing and boring machines

<table>
<tr><td>Machine data</td><td>
Make: _____
Model: _____
Year of manufacture: _____ Serial no.: _____
Overall dimension of machine[a]
Length l_1: mm Width l_2: mm Height l_3: mm
<table>
<tr><th>Nominal spindle speed min^{-1}</th><th>Spindle speed min^{-1}</th><th>Machining head assembly</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
☐ Attached frequency converter ☐ Separate frequency converter
☐ Attached static converter ☐ Change loading
</td></tr>
<tr><td colspan="2">[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.</td></tr>
</table>

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	☐	
Testing material	Material	:	Particle board, three-layer construction	
	Moisture content	:	6 % to 10 %	
	Board thickness	:	16 mm	
	Board length	:	800 mm	
	Board width	:	600 mm to 800 mm	
	Previous processing	:	none	

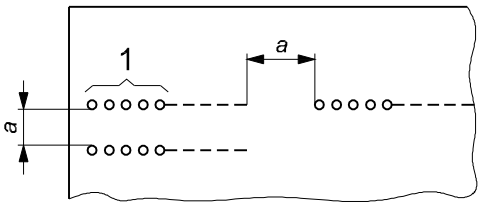
Testing operating arrangement	**Reeving particle board bores**  **Key** 1 10 bores *a* distance between series of bores Position of the work piece: In the middle of the table (one table or two synchronized tables) or against the right side of the left table (two independent tables).		Standard condition(s)	Condition chosen within permitted range or conditions deviating from standard
Tool and cutting data	Type of tool: Multi-boring unit with bits, two flutes and centre point, left or right hand			
	Spindle speed[b]	min^{-1}	6 000	
	Number of bits	n	10 or max. permissible	
	Bit diameter	mm	8	
	Bit working length	mm	50	
	Pitch	mm	32 or manufacturer's specification	
	Minimum distance *a* between a series of 10 bores	mm	70	
	Feed rate for boring	$m\ min^{-1}$	1	
b The spindle speed should be chosen as near as possible to 6 000 min^{-1}.				

Photo or detailed illustration of the machine tested	
Testing laboratory	Firm/Institution: _____ Address: _____ Telephone: _____ Date: _____ Signature _____ Test carried out: Place: _____ Date: _____

Annex F
(normative)

Impact test for curtains

This annex is specific to this document.

F.1 General

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

This Annex applies to curtains, as well as to samples of curtains.

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

F.2 Testing equipment

The test equipment shall be in accordance with ISO 19085-1:2017, D.2.

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

F.3 Projectile

The shape, mass and dimensions of projectiles shall be according to ISO 19085-1:2017, D.3.1 and D.3.2.

F.4 Sampling and supporting of 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.

F.5 Test procedure

The impact test shall be performed with the projectile indicated in F.3 and with an impact speed of 70 $m \cdot s^{-1}$ ± 3,5 $m \cdot s^{-1}$. Impact shall be as square as possible to the curtain surface.

The projectile shall hit the stripes at the target point at a height equal to half of curtain height (see Figure F.4) and located as shown

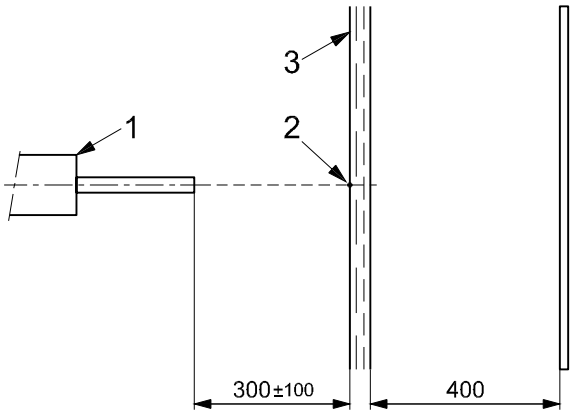
a) in Figure F.1 for straight curtain system,

b) in Figure F.2 for curtain system arranged at an angle, direction of angle bisecting, and

c) in Figure F.3 for curtain system arranged in a curved way, direction square to the curve tangent.

As an exception, for curtains with a height greater than 400 mm, the target point shall be positioned vertically at 200 mm from the bottom edge of the curtains.

Dimensions in millimetres

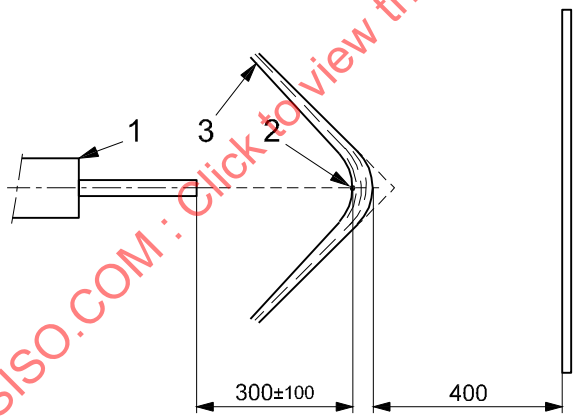


Key

1 propulsion device
2 target point
3 curtain

Figure F.1 — Top view of the test arrangement for straight curtains

Dimensions in millimetres

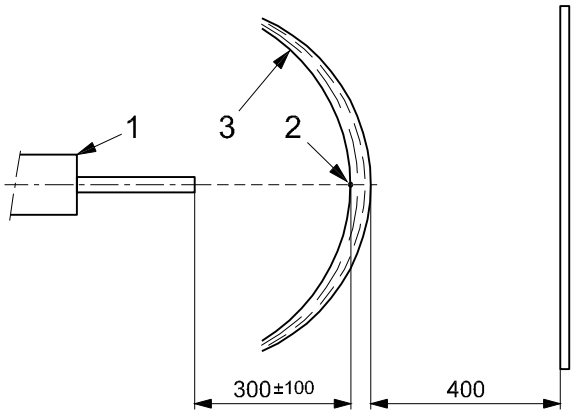


Key

1 propulsion device
2 target point
3 curtain

Figure F.2 — Top view of the test arrangement for angled curtains

Dimensions in millimetres



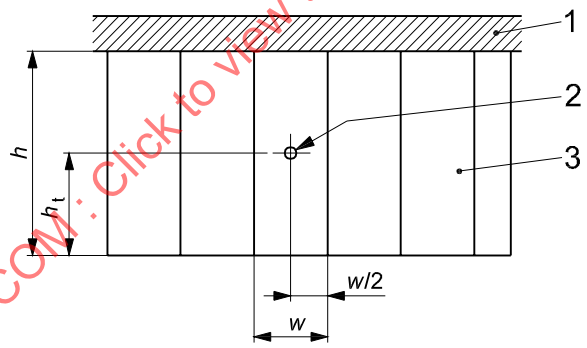
Key

1 propulsion device
2 target point
3 curtain

Figure F.3 — Top view of the test arrangement for curved curtains

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 F.1, F.2 and F.3).

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



Key

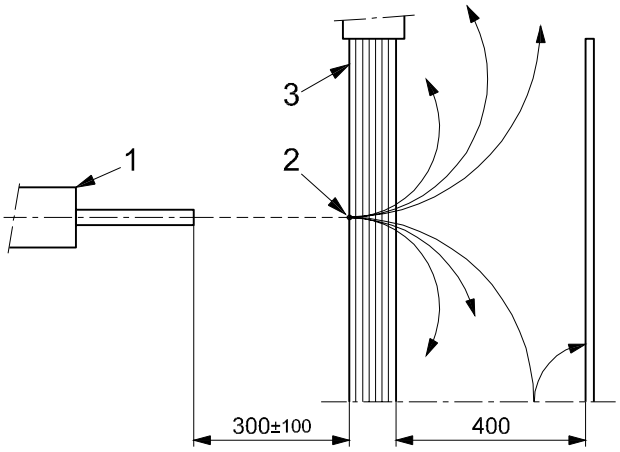
1 support
2 target point
3 curtain stripes
h height of the stripe set
h_t height of the target point
w width of the stripes

Figure F.4 — Target point for curtains

F.6 Results

The projectile shall fall within the virtual 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 F.1, F.2, F.3, F.5 and F.6).

Dimensions in millimetres

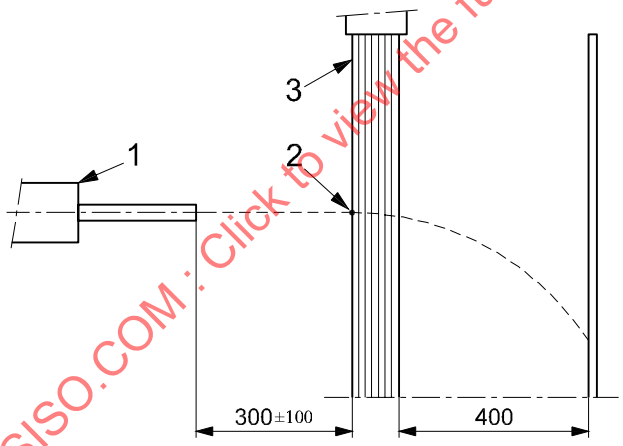


Key

1 propulsion device
2 target point
3 curtain

Figure F.5 — Examples of trajectories giving positive test result

Dimensions in millimetres



Key

1 propulsion device
2 target point
3 curtain

Figure F.6 — Example of trajectories giving negative test result

F.7 Assessment

The test is passed if all of the five tests show positive results as per F.6 and Figure F.5.

F.8 Test report

The test report shall contain, at the minimum, the following 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 G
(normative)

Wear test for curtains

This annex is specific to this document.

G.1 General

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

This test method reproduces the curtains wear on NC routing and NC boring and routing machines by friction on the workpieces during longitudinal and/or lateral movement of the machining head.

G.2 Samplings dimensions, characteristics and arrangement

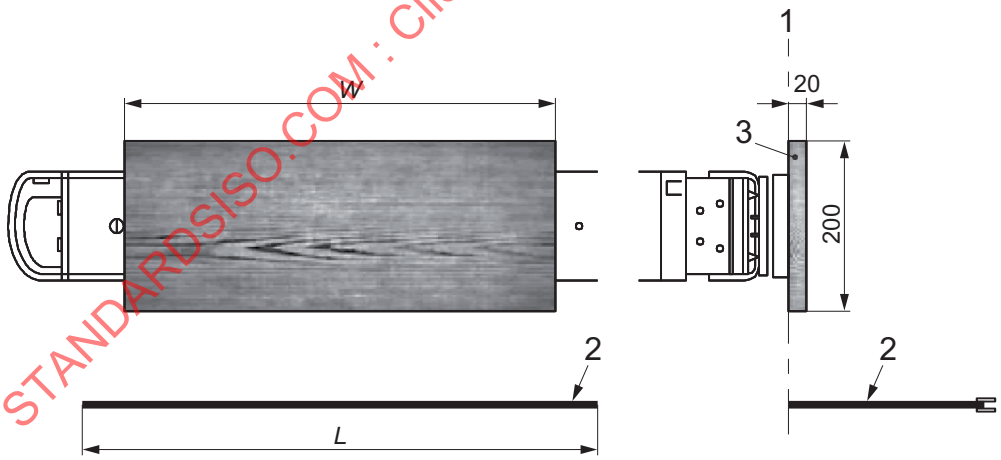
The full curtain set of the machine shall be tested against two workpiece samples mounted on the table or workpiece support made of the following materials:

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

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

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

Dimensions in millimetres

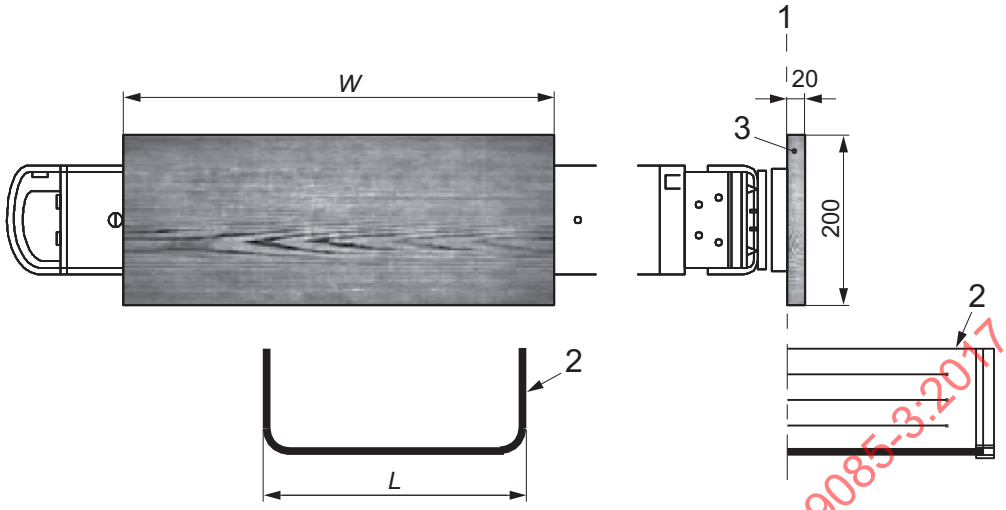


Key

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

Dimensions in millimetres

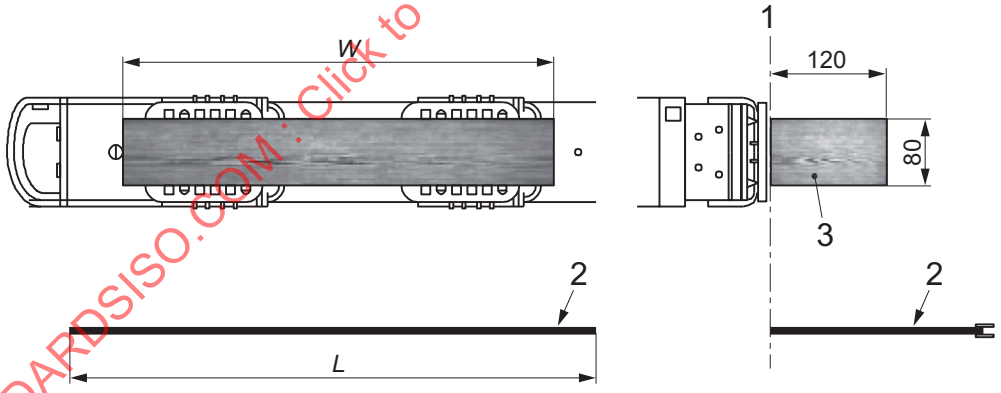


Key

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

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

Dimensions in millimetres



Key

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