INTERNATIONAL STANDARD

ISO 19085-6

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2017-11

Woodworking machines — Safety —

Part 6: Single spindle vertical moulding machines ("toupies")

Machines à bois — Sécurité —

Partie 6: Toupies monobroches à arbre vertical

Reference number
ISO 19085-6:2017(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 voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee 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 that the manufacturer will need to give to the user.

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

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

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

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

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 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 part of ISO 19085 without correspondent in ISO 19085-1:2017 are indicated by the introductory sentence: “Subclause (or annex) specific to this part of ISO 19085.”

Clauses 1, 2, 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 —

Part 6:
Single spindle vertical moulding machines ("toupies")

1 Scope

This document gives the safety requirements and measures for stationary and displaceable hand-fed single spindle vertical moulding machines, hereinafter referred to as “machines”, designed to cut wood and materials with similar physical characteristics to wood.

NOTE 1 For the definitions of stationary and displaceable machines, see ISO 19085-1:2017, 3.4 and 3.5.

It deals with all significant hazards, hazardous situations and events as 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 are taken into account.

NOTE 2 For relevant but not significant hazards, e.g. sharp edges of the machine frame, see ISO 12100:2010.

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

a) device for the arbor to be vertically adjustable relative to the table;

b) device to tilt the arbor;

c) device to fit a manually operated tenoning sliding table;

d) glass bead saw unit;

e) adjustable table insert;

f) device for changing the direction of rotation of the spindle;

g) device for fixing shank mounted tools on the arbor;

h) interchangeable arbor;

i) quick tool/arbor change system;

j) demountable power feed unit;

k) support for the demountable power feed unit with power driven adjustments.

This document does not apply to

1) machines equipped with outboard bearings,

2) machines equipped with powered movements of a front extension table and/or a tenoning sliding table, and

3) machines with an intended maximum tool diameter of less than or equal to 180 mm.

NOTE 3 Hand-held motor-operated electric tools are dealt with in IEC 60745-1 together with IEC 60745-2-17.

NOTE 4 Transportable motor-operated electric tools are dealt with in IEC 61029-1:1990, IEC 61029-2-8:1995/AMD1:1999 and IEC 61029-2-8:1995/AMD2:2001

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

2 Normative references

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

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

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

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

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

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 shanks of shank mounted milling tools*

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

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

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

3 Terms and definitions

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

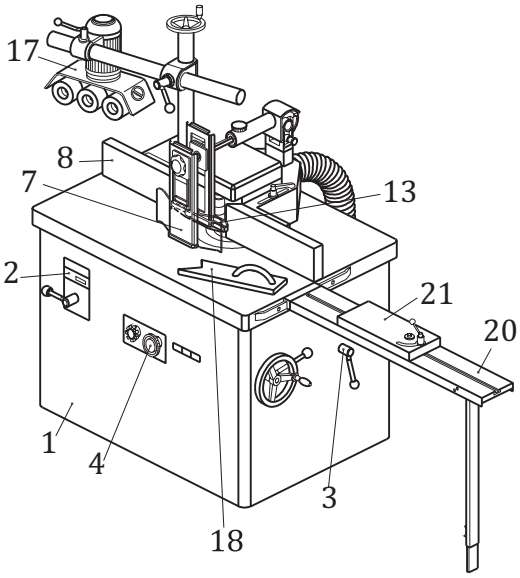
— IEC Electropedia: available at http://www.electropedia.org/

3.1
single spindle vertical moulding machine
hand-fed machine fitted with a single vertical arbor (interchangeable or not interchangeable), which is fixed in position during the cutting operation and a horizontal table, which is fixed in total or in part during the cutting operation

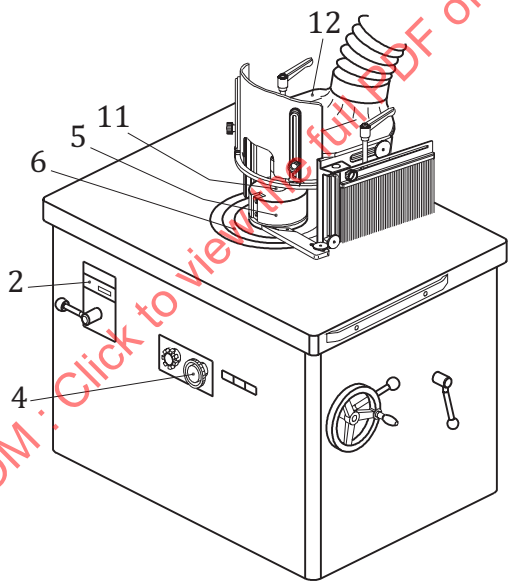
Note 1 to entry: The arbor passes through the table and its drive is situated beneath the table.

Note 2 to entry: The main parts of the machine and their terminology are shown in Figure 1.

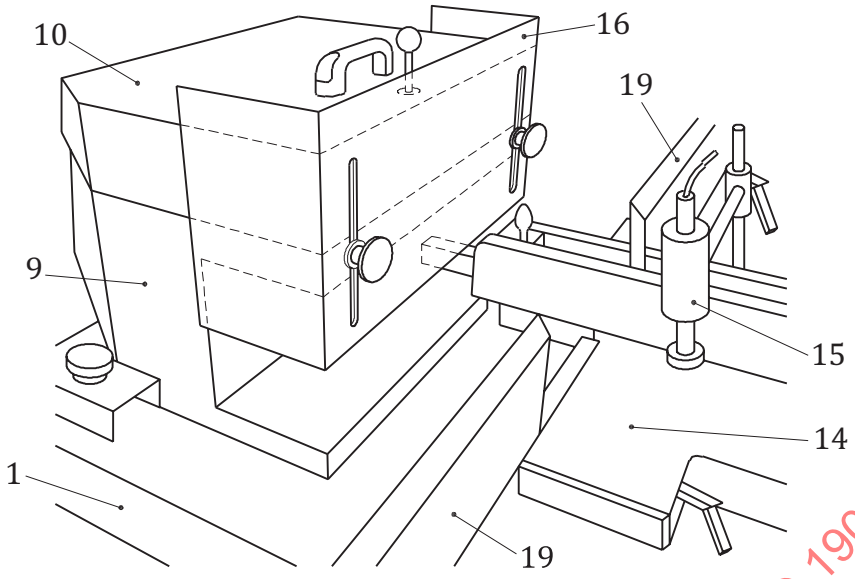
Note 3 to entry: These machines are also known as shapers in the USA and toupie in Europe.



a) Example of a single spindle vertical moulding machine equipped for straight work



b) Example of a single spindle vertical moulding machine equipped for curved work



c) Example of a tool safeguard for tenoning with fixed and adjustable guards mounted on the machine and on the sliding table

Key

1	main frame	12	bonnet guard
2	speed indicator	13	table pressure pad
3	spindle lock	14	sliding table
4	start and stop controls	15	work-piece clamping device
5	tool	16	adjustable guard
6	table rings	17	de-mountable power feed unit
7	fence pressure pad	18	push stick
8	fence plates connected to straight work guard	19	guards fixed to the sliding table
9	enclosure	20	extension table
10	hinged cover	21	adjustable end stop
11	curved work guard		

Figure 1 — Single spindle vertical moulding machine terminology

3.2
straight work
profiling or grooving of a work-piece with one face in contact with the table and a second with the fence, and where the work starts at one end of the work-piece and continues through to the other end

Note 1 to entry: See Figures 1 a) and 2.

3.3
stopped straight work
machining of only a part of the work-piece length

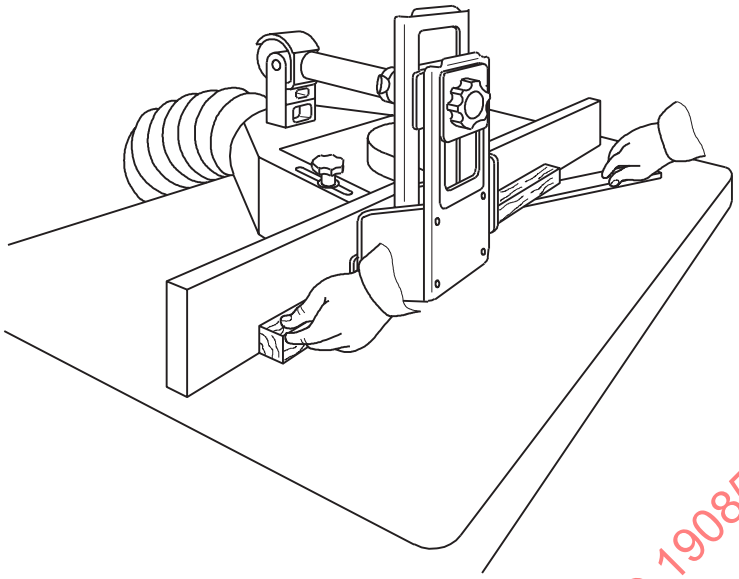


Figure 2 — Example of straight work

3.4
curved work
profiling or grooving of a curve on a work-piece by having one side in contact with the table (or if held in a jig with the jig in contact with the table) and the other in contact with the vertical reference of a steady or ball ring guide when using a jig

Note 1 to entry: See Figures 1 b) and 3.

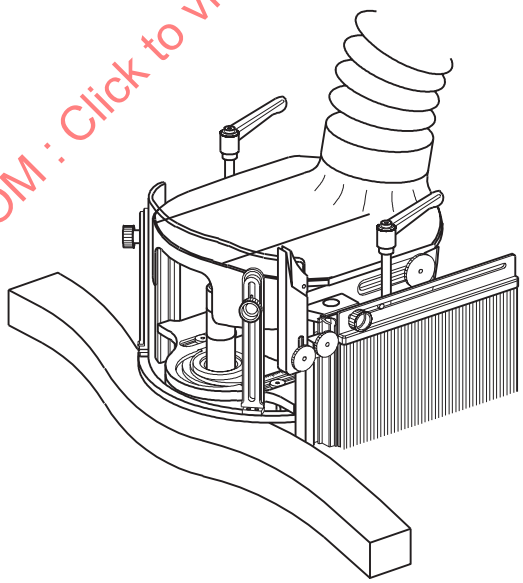
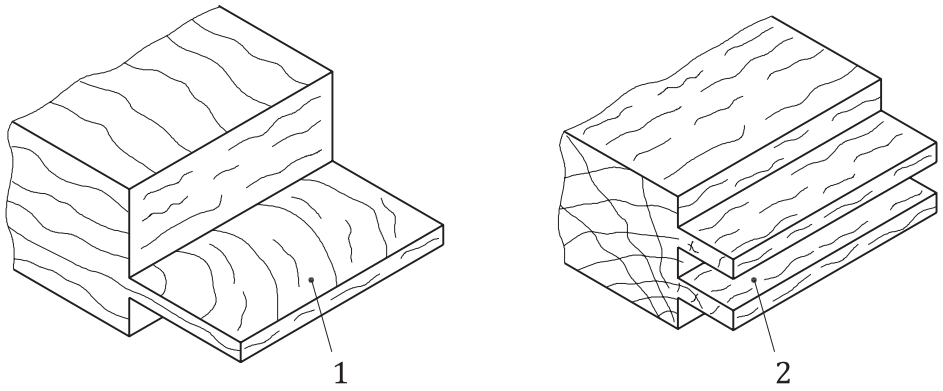


Figure 3 — Example of curved work

3.5
tenoning
machining of tenons and slots at the end of a work-piece to facilitate the joining of work-pieces

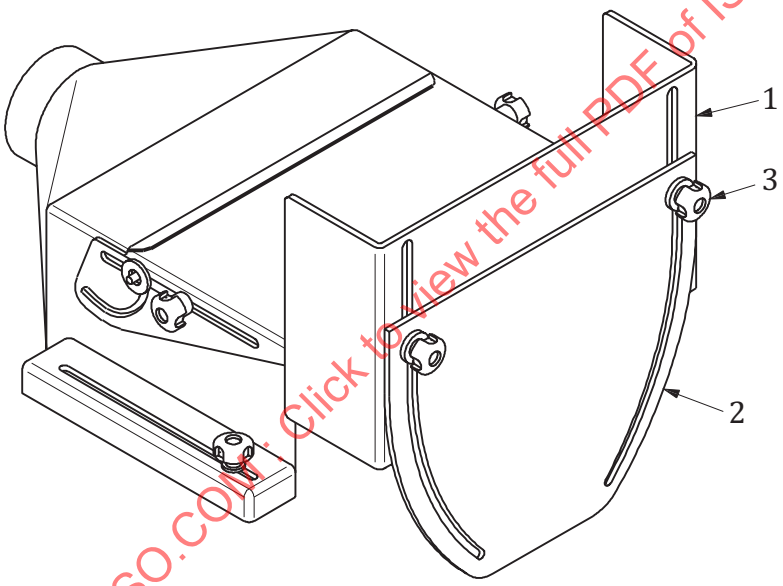
Note 1 to entry: See Figures 1 c), 4 and 5.



Key

1 tenon
2 slot

Figure 4 — Example of work-piece with tenon/slot



Key

1 manually adjustable guard
2 self-adjusting guard
3 device with double function: to adjust part no. 1 and to guide part no. 2

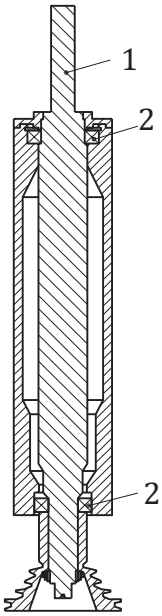
Figure 5 — Example of a tool safeguard for tenoning with manually and automatically adjustable guards

3.6
glass bead saw unit
work unit fitted with a saw blade to cut out a glass bead from the machined profile of the work-piece

Note 1 to entry: Example is given in Figure 13.

3.7
single piece arbor
system where the arbor cannot be changed without dismounting the bearings

Note 1 to entry: See Figure 6.



Key

1 arbor

2 bearings

Figure 6 — Examples of a single piece arbor

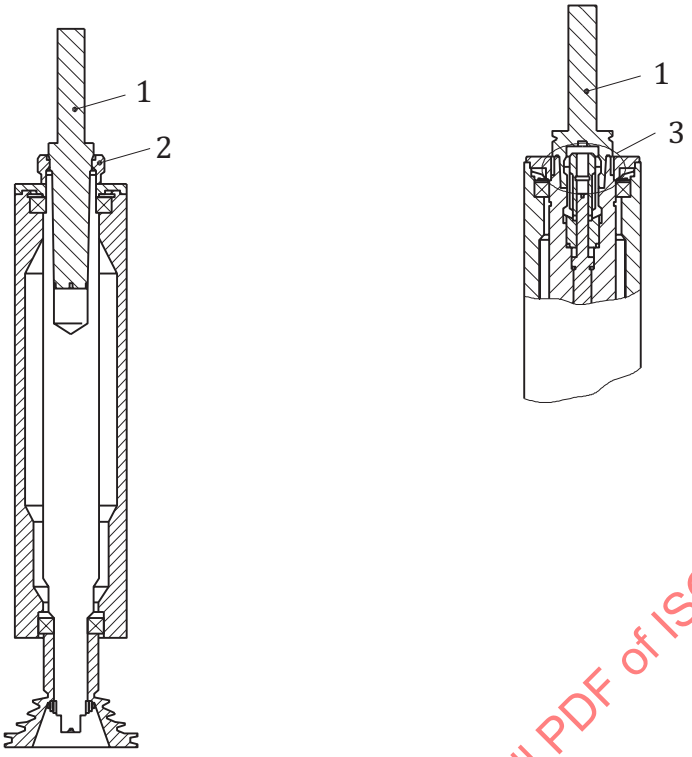
3.8
interchangeable arbor
arbor, connected to the drive spindle, which can be changed either with (removable arbor) or without (quick change arbor) the aid of a tool

Note 1 to entry: See Figures 7 a) and b).

3.9
quick tool/arbor change system
system for quick change of the arbor or of shank mounted tools without the aid of a tool

Note 1 to entry: See key 3 in Figure 7 b).

Note 2 to entry: A pre-mounted combination of tool and arbor is called shank mounted tool (see EN 847-3:2013, Clause 1).



a) Removable arbor **b) Quick change arbor**

Key

1 arbor
2 connecting device
3 quick tool/arbor change system

Figure 7 — Examples of interchangeable arbors

3.10
initiation control
control which, after actuation, enables providing power to specific machine actuators, e.g. by a programmable logic control

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 Clause 1, and which require actions to eliminate or reduce the risk. This document deals with these significant hazards by defining safety requirements and 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 section of ISO 19085-6:2017
1	**Mechanical hazards** related to — Machine parts or work-pieces due to		
	a) shape		6.3, 6.6, 6.9.2, 6.10, 6.11
	b) relative location	6.2.2.1, 6.2.2.2, 6.3	5.2, 6.6, 7.5
	c) mass and stability (potential energy of elements which may move under effect of gravity)		6.1, 6.6, 6.10
	d) mass and velocity (kinetic energy of elements in controlled or uncontrolled motion)		5.13, 6.4, 6.6
	e) mechanical strength		6.2, 6.3, 6.4, 6.6, 6.9, 6.10, Annex D, Annex F, Annex G
	— Accumulation of energy inside the machinery due to		
	f) elastic elements (springs)	6.2.10, 6.3.5.4	6.6, 6.10, 7.5
	g) liquids and gases under pressure		7.7, 7.8
1.1	Crushing hazard		6.6.4, 6.10.1.2
1.2	Shearing hazard		6.6.4, 6.10.1.2
1.3	Cutting or severing hazard		6.3, 6.6, 8.3.2
1.4	Entanglement hazard		6.6, 8.3.2
1.5	Drawing-in or trapping hazard		6.6, 8.3.2
1.6	Impact hazard		6.10, 8.3.2
1.9	High pressure fluid injection or ejection hazard		7.8
2	**Electrical hazards** due to		
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 of awareness)	6.2.2.2, 6.3	7.2
4.2	Interference with speech communication, acoustic signals		7.2, 8.3
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, 8.3
7.2	Fire hazard	6.2.4	7.1
8	**Hazards generated by neglecting ergonomic principles** in machinery design		
8.1	Unhealthy postures or excessive effort	6.2.7, 6.2.8, 6.2.11.12, 6.3.5.5, 6.3.5.6	5.2, 7.5, 8.3
8.2	Hand-arm or foot-leg anatomy	6.2.8.3	5.2, 6.6, 7.5
8.4	Local lighting	6.2.8.6	8.3
8.5	Mental overload and underload, stress	6.2.8.5	8.3
8.6	Human error, human behaviour	6.2.8, 6.2.11.8, 6.2.11.10, 6.3.5.2, 6.4	8.3
8.7	Design, location or identification of manual controls	6.2.8 f), 6.2.11.8	5.2, 7.5
8.8	Design or location of visual display units	6.2.8, 6.4.2	5.2, 7.5
9	**Combination of hazards**	6.3.2.1	5.1, 6.6, 7.13, 7.14
10	**Unexpected start-up**, unexpected overrun/overspeed (or any similar malfunction) from		

Table 1 *(continued)*

No.	Hazards, hazardous situations and hazardous events	ISO 12100:2010	Relevant section of ISO 19085-6:2017
10.1	Failure/disorder of the control system	6.2.11, 6.3.5.4	5.1, 7.13
10.2	Restoration of energy supply after an interruption	6.2.11.4	5.8, 7.7
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
10.6	Errors made by the operator (due to a mismatch of machinery with human characteristics and abilities; see 8.6)	6.2.8, 6.2.11.8, 6.2.11.10, 6.3.5.2, 6.4	7.5, 8.3
11	**Impossibility of stopping the machine in the best possible conditions**	6.2.11.1, 6.2.11.3, 6.3.5.2	5.4, 7.12
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, 8.2
16	**Break-up during operation**	6.2.3	6.2, 6.9, Annex G
17	**Falling or ejected objects or fluids**	6.2.3, 6.2.10	6.9
18	**Loss of stability/overturning of machinery**	6.3.2.6	6.1, 8.3, Annex C

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.

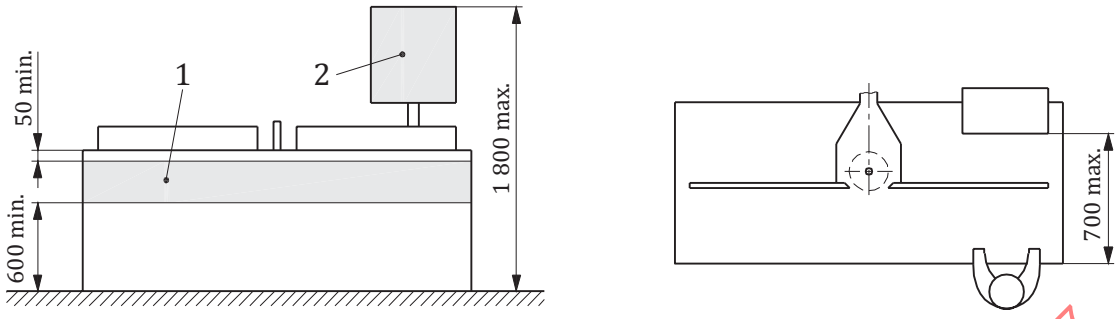
The main electrical control devices for start, normal stop, emergency stop (if required, see 5.4.4), arbor adjustment (see 5.13), spindle speed changing (see 5.7) and direction of rotation (see 5.7.5) shall be located as follows:

a) on the front side of the machine in the shaded area as shown in Figure 8 a) and at least 50 mm below the table top; or

b) on the front side of a fixed or movable control panel at a maximum distance of 700 mm from the front edge of the table [see Figure 8 b)].

Machines fitted with a side tenoning sliding table or a front extension table shall be provided with an additional emergency stop control device, which shall be located on the sliding table or its support.

Dimensions in millimetres



a) Front view **b) Top view**

Key

1 location area for controls

2 fixed or movable control panel

Figure 8 — Position of controls

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

5.3 Start

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

Starting of a demountable power feed unit shall only be possible when the arbor and saw blade of the glass bead saw unit are running or when the arbor is running and the glass bead saw unit is retracted or dismounted.

The SRP/CS for interlocking between the starting of the demountable power feed unit and spindle drive and/or glass bead saw drive shall achieve PL_r = c.

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

5.4 Safe stops

5.4.1 General

This subclause of ISO 19085-1:2017 applies.

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 does not apply.

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.

5.6 Mode selection

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

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.

5.7.2 Spindle speed changing by incremental speed change motor

This subclause of ISO 19085-1:2017 applies.

5.7.3 Infinitely variable speed by frequency inverter

This subclause of ISO 19085-1:2017 applies.

5.7.4 Spindle speed limiting device for tenoning

Subclause specific to this part of ISO 19085.

Machines designed to be fitted with a sliding table for tenoning, which are capable of spindle speeds in excess of 4 800 min^{-1}, shall have a speed limiting device which will prevent the spindle rotating faster than 4 800 min^{-1} while tenoning with tooling of a diameter greater than 275 mm. This shall be achieved by interlocking the guarding system described in 6.6.2.4.2 with the speed monitoring system described in 5.7.3.

The SRP/CS for the interlocking of the guarding system with the speed monitoring system shall achieve PL_r = c.

See also IEC 61800-5-2:2007, 4.2.3.4 [safely-limited speed (SLS)].

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

5.7.5 Changing of the direction of spindle rotation

Subclause specific to this part of ISO 19085.

When the machine is equipped with a spindle which is capable of rotating in only one direction, the spindle shall always rotate in an anticlockwise direction when viewed from the top.

Where spindles are designed to run in two directions of rotation, the following requirements shall be met:

a) a selector of direction of rotation shall be fitted. See 5.2 for the position of this device;

b) a visible warning device shall inform the machine operator when the clockwise direction of rotation is selected;

c) the colour of the warning device shall be yellow. The visible warning device may be supplemented by an audible one;

d) start-up of the spindle rotation shall not be possible with the selector of the direction of rotation;

e) the selector of the direction of rotation shall be either

1) a two position selector fitted with a blocking device such that

i) the “normal” position, without blocking, corresponds to the anticlockwise direction of rotation;

ii) the “non-normal” position, with blocking, corresponds to the clockwise direction of rotation;

iii) selection of the clockwise direction of rotation shall only be possible after manual override of the blocking device;

iv) the selector of direction of rotation shall indicate the selected direction of rotation and be consistent with it;

2) a three position selector, with one neutral position and without blocking device. When the spindle has been started in the clockwise direction of rotation, the selector shall automatically return to its neutral position; or

3) a combination of manually operated push buttons such that

i) the anticlockwise direction of rotation is started by the start button of the spindle drive; or

ii) the clockwise direction of rotation is started by the start button of the spindle drive together with an initiation control device (e.g. push button), which is positioned so that both hands are necessary for starting the spindle drive.

The SRP/CS for selection of the direction of rotation and for initiation control shall achieve PL_r = b.

See also 8.3.2 f) 4) i).

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

5.8 Failure of any power supply

This subclause of ISO 19085-1:2017 applies.

5.9 Manual reset control

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

5.10 Enabling control

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

5.11 Machine moving parts speed monitoring

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

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

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

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

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

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

5.12 Time delay

This subclause of ISO 19085-1:2017 applies.

5.13 Power driven adjustment of arbor, demountable power feed unit, fences and table insert

Subclause specific to this part of ISO 19085.

Power driven movements for adjusting the arbor in height and inclination, the demountable power feed unit in height and horizontally, and the fences and the table insert, shall only be possible after actuation of either an initiation control device or a hold-to-run control device.

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

Any part of the machine that can touch the tool in any position (i.e. adjustable table insert, fence plates and table rings) shall be made of easily machinable material. Alternatively, damage through collision shall be prevented either by

1) limiting the speed to 10 mm/s for linear and 5°/s for rotational movements under hold-to-run control according 5.11 [see also 8.3.2 f) 2) vi)]; or

2) maintaining a minimum distance of 5 mm between edges of the tool and any part of the machine during adjustment and after stopping adjustment. Further movements shall be possible only under hold-to-run control, and their maximum speed shall be limited to 10 mm/s for linear and 5°/s for rotational movements (see also 5.11). The SRP/CS for detection of the position of the tool in relation with any part of the machine that can touch the tool shall achieve PL_r = b.

Where power driven movements are controlled by hold-to-run control, not more than one power driven movement at a time shall be possible. The SRP/CS for the movement limitation shall achieve PL_r = b.

Arbor inclination shall only be possible with the spindle drive being stopped. The SRP/CS for interlocking arbor inclination with spindle drive stop condition shall achieve PL_r = c.

NOTE Spindle rotation is allowed during power driven arbor height adjustments.

Unexpected start of power driven movements under pre-set electronic control shall be prevented, e.g. by using a time delay device cutting power to the actuators with a time delay set to the maximum adjustment time. The SRP/CS for prevention of unexpected start shall achieve PL_r = c.

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

6 Safety requirements and measures for protection against mechanical hazards

6.1 Stability

6.1.1 Stationary machines

This subclause of ISO 19085-1:2017 applies.

6.1.2 Displaceable machines

This subclause of ISO 19085-1:2017 applies.

6.2 Risk of break-up during operation

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

As an exception to paragraph 2, second sentence, of ISO 19085-1:2017, 6.2, table rings and the part of the machine housing, which can come in contact with the tool during adjustments, may be also made of cast-iron if these adjustments are manual or power driven under hold-to-run control (see 5.13).

6.3 Tool holder and tool design

6.3.1 General

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

The tool arbor shall not allow direct mounting of cutting knives.

The tool arbor shall be manufactured from steel with an ultimate tensile strength of at least 580 N mm^{-2}.

For each arbor provided, the maximum spindle speed shall be calculated (see Annex F for a calculation example).

NOTE The maximum spindle speed of interchangeable arbors and arbors with quick tool/arbor change system is also influenced by their fixing/clamping system.

Maximum usable lengths for arbors and maximum tool diameters are given in Table 2.

Table 2 — Maximum usable dimensions (in millimetres)

Arbor diameter d_1 (see Figure F.1)	**Maximum useable length of arbor from the shoulder** l_1 (see Figure F.1)	**Maximum tool diameter**[a] d_2 (see Figure F.1)	
		Shaping	**Tenoning**
20 ≤ d < 30	125	210	240
30 ≤ d < 40	140	250	300
40 ≤ d < 50	180	250	350
50	220	275	400

[a] Maximum tool diameters that can be mounted without removal of the straight work guard

The arbor for bore mounted tools shall be fitted with a tool fixing device which shall prevent relative movements between the ring and the arbor (see Figure 9), e.g.

a) a lock-nut with an integral arbor ring [see Figure 9 a)],

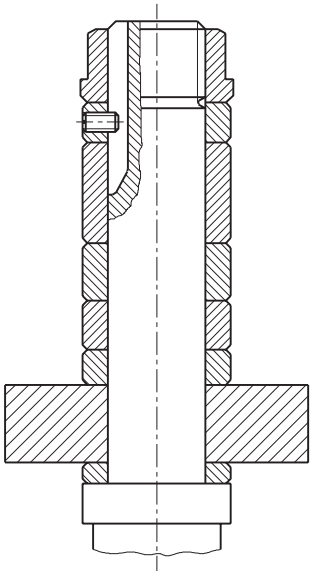
b) an arbor screw with an integral arbor ring, and

c) an arbor screw with a separate arbor ring designed so that clamping is not possible without this ring [see Figure 9 b)].

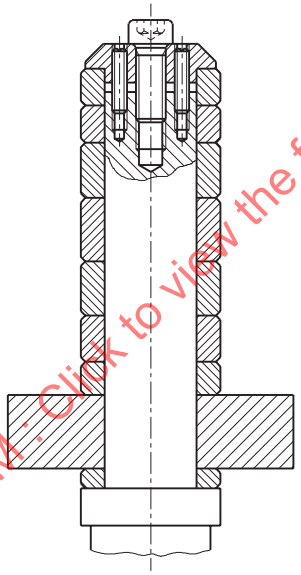
For machines designed to use shank mounted tools, the clamping unit shall provide a minimum clamping length in accordance with EN 847-2:2013, Table 3.

The system for shank clamping shall be capable of clamping shanks with different diameters, e.g. by changing the clamping inserts [see Figure 9 c) and d)].

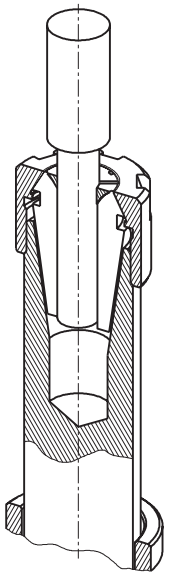
Verification: By checking the relevant drawings, inspection of the machine and measurement.



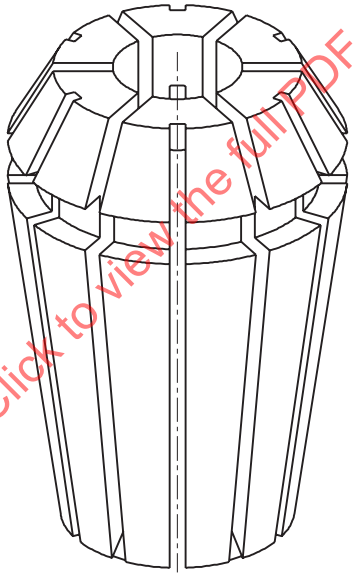
a) Example of an arbor nut



b) Example of an arbor screw



c) Example of an arbor for shank mounted tool



d) Clamping insert (collet) for shank mounted tool

Figure 9 — Examples of tool fixing devices

6.3.2 Spindle locking

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

If it is necessary to hold the spindle stationary (e.g. for tool changing) a spindle locking device (e.g. blocking bar or fork) shall be provided as follows:

a) machines with a table bore diameter ≤ 190 mm shall have an integral or non-integral locking device;

b) machines with a table bore diameter > 190 mm shall have an integral locking device.

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

6.3.3 Circular saw blade fixing device

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

For fixing a glass bead saw blade, a two-parted flange (or in the case of flush mounted saw blade, a single flange) shall be provided.

6.3.4 Flange dimension for circular saw blades

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

The outer clamping diameter of the flanges for the glass bead saw blade shall be at least $D/6$, where D is the diameter of the largest circular saw blade for which the machine is designed.

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

6.3.5 Arbor rings

Subclause specific to this part of ISO 19085.

The machine shall be equipped with a set of arbor rings having a minimum wall thickness of 9,75 mm and a tolerance of H7 on their internal diameter. The arbor rings shall be capable of covering the whole useable length of the arbor. Arbors designed for use with shank mounted tools only need not to be equipped with a set of arbor rings.

Arbor rings shall be manufactured from steel having an ultimate tensile strength of at least 580 N mm^{-2}.

The arbor ring set shall be subjected to an axial run-out test. The axial run-out shall not exceed 0,1 mm, when measured on the test disc at a diameter of 100 mm with the arbor ring set assembled using the same torque for tool mounting (see Figure 10).

The permissible deviation of the run-out of the test disc shall not exceed 0,01 mm.

Verification: By checking the relevant drawings, measurements (see Figure 10) and inspection of the machine.

6.3.6 Quick tool/arbor change system

Subclause specific to this part of ISO 19085.

Tool/arbor release shall only be possible if the spindle is stopped and restart is prevented.

The SRP/CS for interlocking between tool/arbor release and spindle rotation shall achieve $PL_r = c$.

Hydrostatic tool/arbor fixing devices shall have an additional mechanical device to prevent loosening of the tool/arbor in case of leakage in the hydrostatic system.

See also 8.3.2 k).

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

6.3.7 Manual adjustment of arbor height

Subclause specific to this part of ISO 19085.

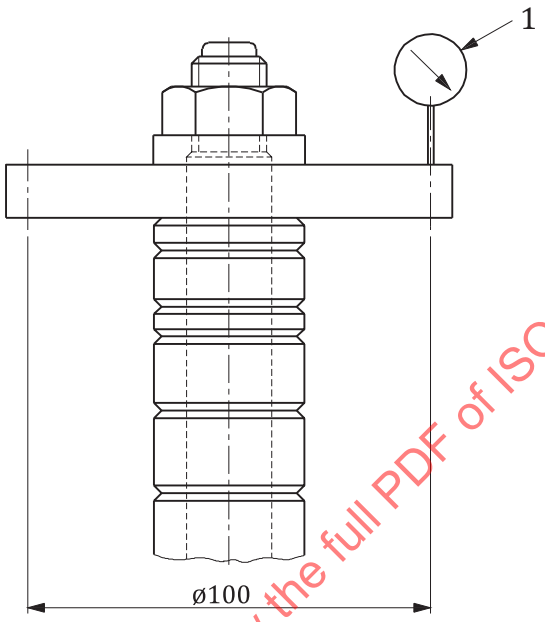
For machines where the arbor is manually adjustable in height, the adjustment device shall be a self-locking system. The machine shall be equipped with an indicator to show incremental vertical movement of the arbor.

With the arbor set in a vertical position and a force of 300 N applied vertically downwards on its exposed end, the change in arbor height shall be less than 0,5 mm.

See also 8.3.2 h).

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

Dimensions in millimetres



Key

1 dial gauge

Figure 10 — Arbor ring set, axial run-out test configuration

6.3.8 Manual adjustment of arbor inclination

This is subclause is specific to this part of ISO 19085.

Where the arbor is capable of being manually inclined, the machine shall be equipped with an indicator to show the degree of inclination. The adjustment device shall be self-locking.

With the arbor set in a vertical position and a force of 300 N applied at its exposed end, in horizontal direction and in the plane perpendicular to the axis of the inclination movement, the inclination of the arbor shall not exceed 1°.

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

6.4 Braking

6.4.1 Braking of tool spindles

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 movable 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 does not apply.

6.5.3 Hold-to-run control

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

As an exception, the SRP/CS for hold-to-run control shall achieve at least PL_r = b. In this case, an emergency stop control device shall be positioned in the vicinity of the hold-to-run control device.

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 does not apply.

6.5.6 Pressure-sensitive protective equipment (PSPE)

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

6.6 Prevention of access to moving parts

6.6.1 General

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

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 Access to the tool from below the table

Access to the tool from below the table shall be prevented by fixed guards and/or by movable guards with interlocking to the spindle drive.

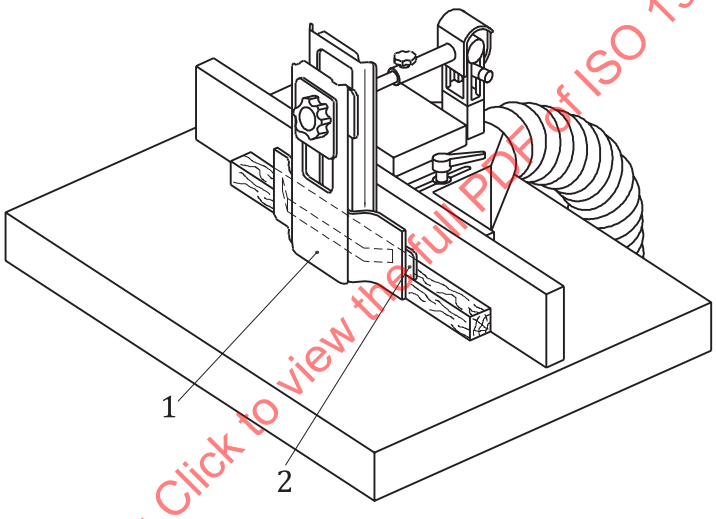
Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

6.6.2.2 Safeguarding for straight work

6.6.2.2.1 Safeguarding the cutting area

The requirements of 6.10.2.2 shall be taken into account and with the following addition.

Fence and table pressure pads shall be provided to keep the work-piece in contact with the table and the fence plates (see Figure 11) and to prevent unintended access to the tool (including shank mounted tool, if fitted).



Key

1 fence pressure pad
2 table pressure pad

Figure 11 — Example of a pressure devices

The pressure pads and their support shall fulfil the following requirements:

a) the pressure pads shall be adjustable in height relative to the table and horizontally towards and away from the fence. All adjustments shall be capable of being carried out without the aid of a tool;

b) the pressure pads shall be symmetrically arranged with respect to the arbor and over their whole adjustment range. The fence pressure pad shall be parallel towards the fence plates and the table pressure pad shall be parallel towards the table;

c) the table pressure pad support shall be provided with a device which prevents the pressure pad and/or its support falling by gravity onto the tool during adjustment;

d) the pressure pads shall be spring loaded to allow for limited variation in work-piece thickness;

e) the length of the pressure pads shall be greater than the maximum possible tool diameter and shall allow the work-piece to contact the pressure pad before it contacts the tool;

f) the height of the fence pressure pad shall at least be equal to the minimum height required for the fence plates in accordance with 6.10.2.1;

g) the support of the pressure pads shall allow to move the pressure pads from their working position to a non-working position, where it is still connected to the machine but does not interfere with tool changing or the use of a de-mountable power feed unit. The support with the pressure pads shall be mechanically locked in the non-working position;

h) the pressure pads shall pass the rigidity test (see G.2);

i) the support of the pressure pads shall not be fixed to the table between the fence plate and the front edge of the table;

j) the pressure pads shall be able to press a work-piece with a minimum section of 8 mm by 8 mm in the vertical and horizontal directions over the whole length given in e);

k) the pressure pads shall be made from wood, wood based material, light alloy or plastic. The fixing components (e.g. screws) for the pressure pads shall be made from a material which is easily machineable (e.g. brass) if they can come into contact with the tool;

l) the vertical adjustment range of the fence pressure pad shall be such that

   1) when adjusted to its lowest position the underside of the pressure pad shall be on the table surface, and

   2) when adjusted to its highest position the top surface of the pressure pad shall be at least at the same height as the top of the useable length of the arbor when the arbor is adjusted to its highest position;

m) the horizontal adjustment range of the fence pressure pad shall cover a distance of at least 160 mm from the arbor axis;

n) the work-piece shall not initially engage the pressure pads at same time during in-feeding: The horizontal distance between the first and second contact point of the pressure pad with the work-piece shall be greater than 10 mm;

o) where the fence pressure pad can be set at an angle to the fence plate in order to allow for work-piece feed during stopped work, this angle shall not be greater than 30°. Means shall be provided to reset and fix the fence pressure pad in a position parallel to the fence plate;

p) the vertical adjustment of the table pressure pad shall be such that it is possible to machine work-pieces of a height of at least

   1) 160 mm on machines with a table bore diameter ≤ 190 mm; and

   2) 250 mm on machines with a table bore diameter > 190 mm.

For machines fitted with a glass bead saw unit, see 6.6.2.5.

Verification: By checking the relevant drawings, measurement, inspection of the machine, performing the rigidity test of Annex G and relevant functional testing of the machine.

6.6.2.2.2 Safeguarding the non-cutting area

Access to the tool at the rear of the fence plates shall be prevented by means of a fixed guard in combination with a movable guard, which does not require interlocking, e.g. a hinged cover, and which shall be positively locked in the closed position during normal operation and can be opened without aid of a tool for tool changing.

NOTE Prevention of an unexpected start during tool change by interlocking of the hinged cover is not required since the operator has the start device under his full control.

The requirements of 7.12 apply to the guard.

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

6.6.2.3 Safeguarding for curved work

Access to the non-cutting part of the tool during operation shall be prevented by an adjustable guard [see Figure 1 b), key 11] which can be fixed in a position relative to the table and fulfils the following requirements:

a) it shall be possible of adjustment without the aid of a tool;

b) it shall encompass the largest tool for which the steady or ball ring guide is designed;

c) the adjustment range shall include all possible tool positions with respect to the table;

d) it shall be fitted with the supporting system for the work-piece guiding device required in 6.10.3;

e) it shall be fitted with an adjustable hand protector to prevent access to the non-cutting part of the tool from the front;

f) it shall support the chip exhaust outlet (also see 7.3).

The hand protector shall be in accordance with the following requirements:

a) it shall be adjustable in height from the table surface up to the maximum height of the work-piece for which the machine is designed (see 8.3.1);

b) after adjustment it shall remain parallel to the table within 0,5 mm over a length of 100 mm;

c) the adjustment shall be possible without the aid of a tool; and

d) the hand protector shall pass the rigidity test specified in G.2.

The hand protector may also allow for pressure on the work-piece during machining.

Verification: By checking the relevant drawings, measurements, inspection of the machine, performing the rigidity test in Annex G and relevant functional testing of the machine.

6.6.2.4 Safeguarding for tenoning

6.6.2.4.1 General

If the machine is fitted with a tenoning or a front sliding table, it shall be equipped with a device that allows locking of the sliding table in any position, e.g. a device with a non-positive connection.

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

6.6.2.4.2 Safeguarding the cutting area

Access to the tool from the front side shall be impeded either

a) by adjustable guards (i.e. two guards linked together or independently adjustable) mounted on the sliding table which impedes access to the tool from the side of the work-piece [see Figure 1 c), key 19] and by an adjustable guard mounted on the fixed guard described in 6.6.2.4.3 [see Figure 1 c), key 16]; or

b) an adjustable guard [see Figure 5, key 1] and by a self-adjusting guard [see Figure 5, key 2], both mounted on the fixed guard described in 6.6.2.4.3.

These guards shall fulfil the requirements of 6.9.2.

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

6.6.2.4.3 Safeguarding the non-cutting area

Access to the tool shall be impeded by means of a fixed guard in combination with a movable guard, which does not require interlocking, e.g. a hinged cover, and which shall be positively locked in a closed position during normal operation and can be opened without aid of a tool for tool changing. [see Figure 1 c)]. These guards shall be in accordance with the following requirements:

a) they shall be horizontally adjustable at right angles to the direction of the feed;

b) they shall encompass the largest tool, according to Table 2, for which the machine is designed at all possible arbor heights;

c) they shall be fitted with an adjustable guard which impedes the access to the tool from above and the sides [see Figure 1 c) key 16];

d) all adjustments shall be possible without the aid of a tool;

e) the requirements of 7.12 apply.

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

6.6.2.5 Safeguarding the glass bead saw blade

On machines fitted with a glass bead saw unit, access to the non-cutting area of the saw blade shall be prevented by a fixed guard.

In addition, a guard self-adjusting to the lowest position shall impede the direct horizontal access to the saw blade in a direction perpendicular to the saw blade plane.

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

6.6.3 Guarding of drives

This subclause of ISO 19085-1:2017 applies.

6.6.4 Guarding of shearing and/or crushing zones

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

For crushing and shearing hazards caused by the work-piece during feeding, see 6.10.2.1.

6.7 Impact hazard

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

6.8 Clamping devices

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

The sliding table for tenoning shall be fitted with a work-piece clamping device [e.g. Figure 1 c), key 15].

The full clamping force of each clamping unit shall be at least 700 N over the whole range of adjustment of the clamping device.

6.9 Measures against ejection

6.9.1 General

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

Anti-splinter devices are not relevant.

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.

Guards used to prevent ejection shall be of class B.

6.9.2.2 Guards of class A

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

6.9.2.3 Guards of class B

This subclause of ISO 19085-1:2017 applies.

6.9.3 Anti-kickback devices

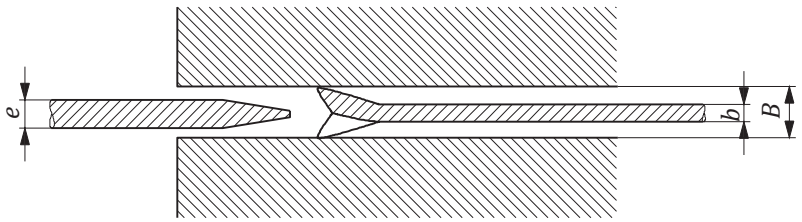
Subclause specific to this part of ISO 19085.

Provision shall be made for the fixing (e.g. fixing holes or "T" slots) of anti-kickback devices (e.g. adjustable end stops) to the fence plates or to the extension table. "T" slots shall be parallel to the direction of feed and fixing holes shall not exceed 12 mm in diameter.

The anti-kickback device shall not deflect more than 2 mm under a static force of 300 N applied in the direction of kickback. The position of the anti-kickback device shall be continuously adjustable on both sides of the arbor up to a distance equal to twice the fence plate length.

When fitted with a glass bead saw unit (see Figure 5), the machine shall be equipped with

a) a bead ledge separator. It shall be manufactured from steel with an ultimate tensile strength of 580 N mm^{-2} or of a comparable material, have flat sides (within 0,1 mm per 100 mm) and shall have a thickness less than the width of cut (kerf) and at least 0,2 mm greater than the thickness of the saw blade plate (see Figure 12);



Key

e bead ledge separator thickness

B width of the cut

b thickness of the saw blade plate

Figure 12 — Bead ledge separator thickness in relation to saw blade dimensions

b) a device to guide the bead ledge, for example a guiding channel (see Figure 13);

c) a pressure device located between the saw blade and the anti-kickback finger (see Figure 13);

d) a device to avoid or minimize the risk of kickback of the bead ledge, for example, an anti-kickback finger (see Figure 13). If an anti-kickback finger is fitted, it shall be designed in accordance with the following requirements:

   1) it shall be located after the glass bead saw blade in the direction of the feed;

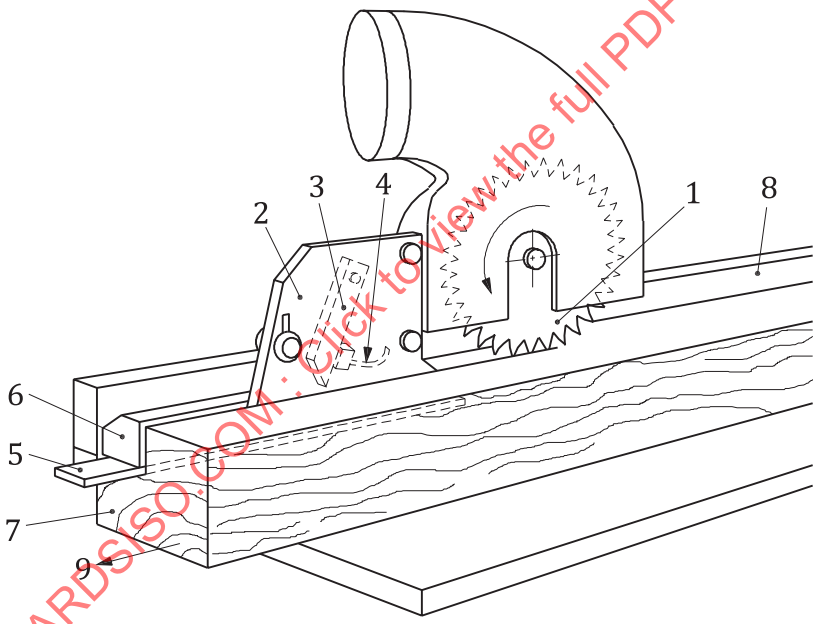
   2) it shall be made from steel with an ultimate tensile strength of 350 N mm^{-2} or of a comparable material;

   3) it shall have a lower tip with a maximum radius of 0,5 mm;

   4) the angle of the tip shall be between 30° and 60° (see Figure 14);

   5) it shall be effective over the full cutting height capacity of the glass bed saw unit. Effective operation shall be between 85° and 55°, this angle being measured between a line from the tip to the axis of pivot of the fingers and the horizontal (see Figure 14); and

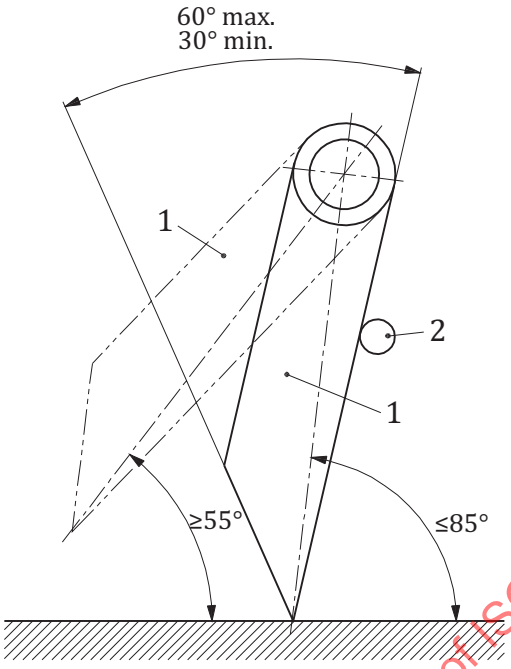
   6) a mechanical stop shall be provided to prevent the anti-kickback finger moving beyond the 85° point (see Figure 14).



Key

1 glass bead saw blade
2 bead ledge separator
3 anti-kickback finger
4 pressure device
5 guiding channel for glass bead ledge
6 glass bead ledge
7 work-piece
8 fence
9 feed direction

Figure 13 — Example of glass bead saw unit



Key

1 anti-kickback finger

2 mechanical end stop

Figure 14 — Example of anti-kickback finger

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

6.10 Work-piece supports and guides

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

6.10.1 Table

6.10.1.1 General

Table dimensions shall vary with the table bore diameter in accordance with Table 3 (see Figures 15 and 16).

Dimensions in millimetres

Table 3 — Size of table and table rings

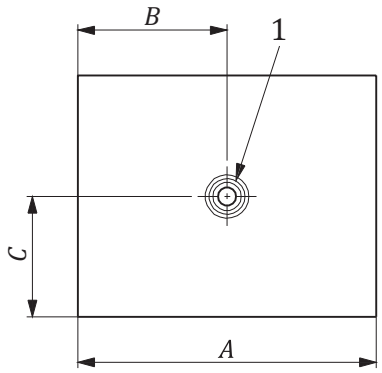
	Table bore diameter			
	≤190		>190	
A	≥600		≥1 000	
B	$250 < B \leq A/2$		$450 < B \leq A/2$	
C[a]	250 – 450 (150 – 550)[b]			
Ranges of internal diameter.	65 to 75		65 to 75	105 to 115
for table rings	105 to 115	145 to 160	145 to 160	200 to 225

a Dimension C extends from the arbor axis to the front edge of the fixed table, or, if provided, to the front edge of an integral sliding table at the same level of the fixed table.

b Figures in brackets for machines with front sliding table.

The table shall not be tiltable.

Fixing holes shall be provided on both sides of the table for fixing the extension table [see Figure 1 a), key 20] to the machine table.



Key

1 table bore

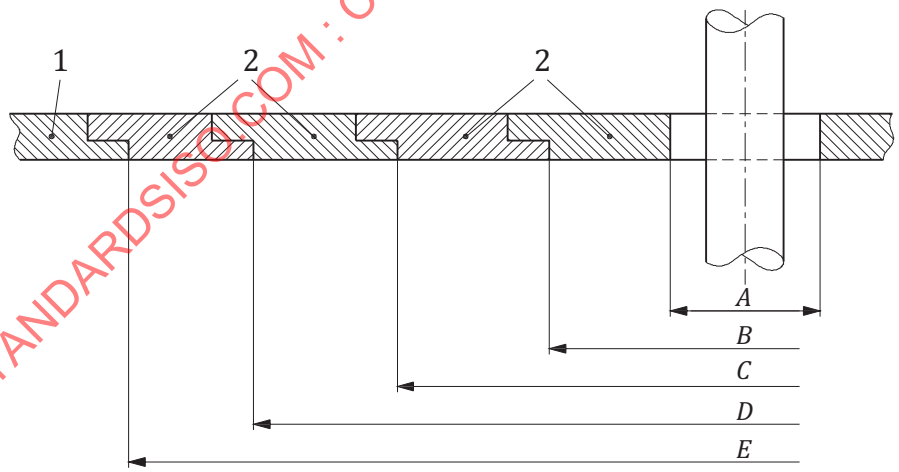
Figure 15 — Definition of table dimensions

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

6.10.1.2 Safeguarding the space between the table and arbor

Space between the table and arbor shall be safeguarded either with table rings or adjustable table insert.

Where the table is equipped with a set of table rings for bore diameter ≤300 mm, their internal diameters shall be as shown in Table 3 (see Figure 16).



Key

1 table

2 table rings

A–D table ring internal diameters

E table bore diameter

Figure 16 — Table rings

For table bore diameters greater than 300 mm, a fifth table ring shall be provided.

Where the table is equipped with an adjustable table insert (see Figure 17), the following requirements shall be met:

a) The side of the adjustable table insert closer to the tool shall be made of easily machinable material e.g. light alloy;

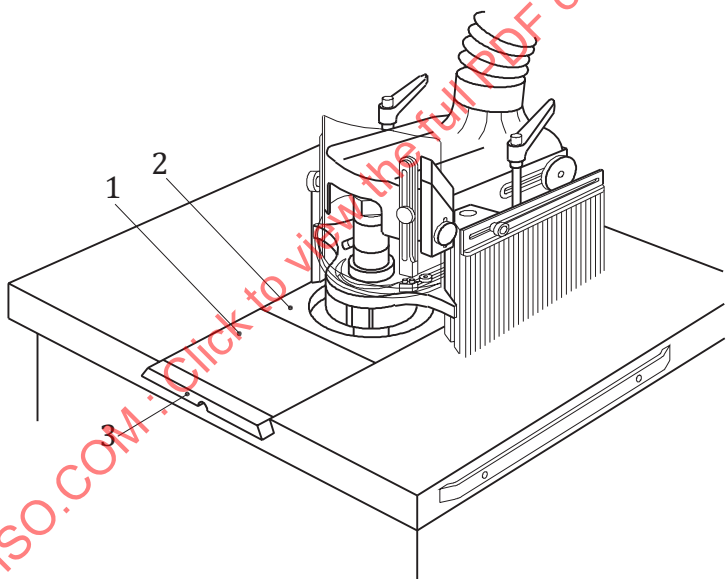
b) The side of the adjustable table insert closer to the tool shall be profiled to allow, when completely retracted, the use of the profiling tool with the greatest diameter, +5 mm, for which the machine is designed. In the advance position, the distance between the adjustable table insert and the axis of the arbor shall be ≤50 mm;

c) Power driven adjustment of the table insert towards the tool under pre-set electronic control shall only be possible with the fence plates in their widest opening positions.

   The SRP/CS for the interlocking of the power driven adjustment under pre-set electronic control and the fence plate widest open positions shall achieve PL_r = b;

d) The section of the adjustable table insert which protrudes over the front table edge when the insert is in its widest open position shall be made of soft material like rubber with hardness between 60 and 70 Shore-A (see Figure 17, key 3).

For power driven adjustment of the adjustable table insert, see 5.13.



Key

1 adjustable table insert
2 easily machinable part of the table insert
3 soft material part of the table insert

Figure 17 — Example of adjustable table insert

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

6.10.2 Work-piece guiding for straight work

6.10.2.1 General

In order to facilitate vertical stability of the work-piece, the machine shall be equipped with two fence plates, which

a) have a minimum height of

   1) 120 mm for table bore diameters ≤ 190 mm, and

   2) 150 mm for table bore diameters > 190 mm, and

b) have a minimum length for each plate of

   1) 300 mm for table bore diameters ≤ 190 mm, and

   2) 450 mm for table bore diameters > 190 mm.

Further devices for guiding the work-piece are described in 6.6.2.2.1.

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

6.10.2.2 Fence adjustment

The fence assembly shall be capable of being fixed to the table and shall be adjustable in order to take account of the tool diameter and the position of the arbor.

When transverse adjustments to the feed direction are provided, the fence plates shall remain integral with their supports.

The transverse adjustment of the fence plates shall allow any opening for the tool to be reduced to a minimum. The fence plates shall either be fitted with a device to ensure continuity between them, or shall be equipped with fixing arrangements which permit such a device (e.g. a false fence) to be fitted.

A fine adjustment control for transverse movement of one of the fences, with respect to the other, shall be provided.

When moved using this control, the movable fence plate shall remain parallel to the fixed fence plate and the method for its re-alignment shall be described (see 8.3).

The part of the fence plate which can come in contact with the tool shall be made of light alloy, plastic, wood or wood based material.

All adjustments, except those to fix and adjust the device for ensuring continuity between the fence plates, shall be capable of being made without the aid of a tool.

Where power driven adjustment of the fence is provided, the requirements of 5.13 shall be met.

The devices for fine adjustment of transverse movement and for all power driven adjustments shall be self-locking.

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

6.10.3 Work-piece guiding for curved work

A work-piece guiding device suitable for curved work shall be provided (see Figure 18). This shall be either a guiding steady (ring guide) or a lead-in device which allows the use of a ball ring guide.

The guiding steady shall meet the following requirements:

a) its shape or adjustment shall allow for progressive penetration of the tool into the work-piece;

b) it shall support and guide the work-piece during machining;

c) it shall have the tangential point where the depth of cut is measured clearly marked;

d) it shall pass the rigidity test (see G.2.2);

e) its adjustment range shall take account of all possible positions of the tool with respect to the table;

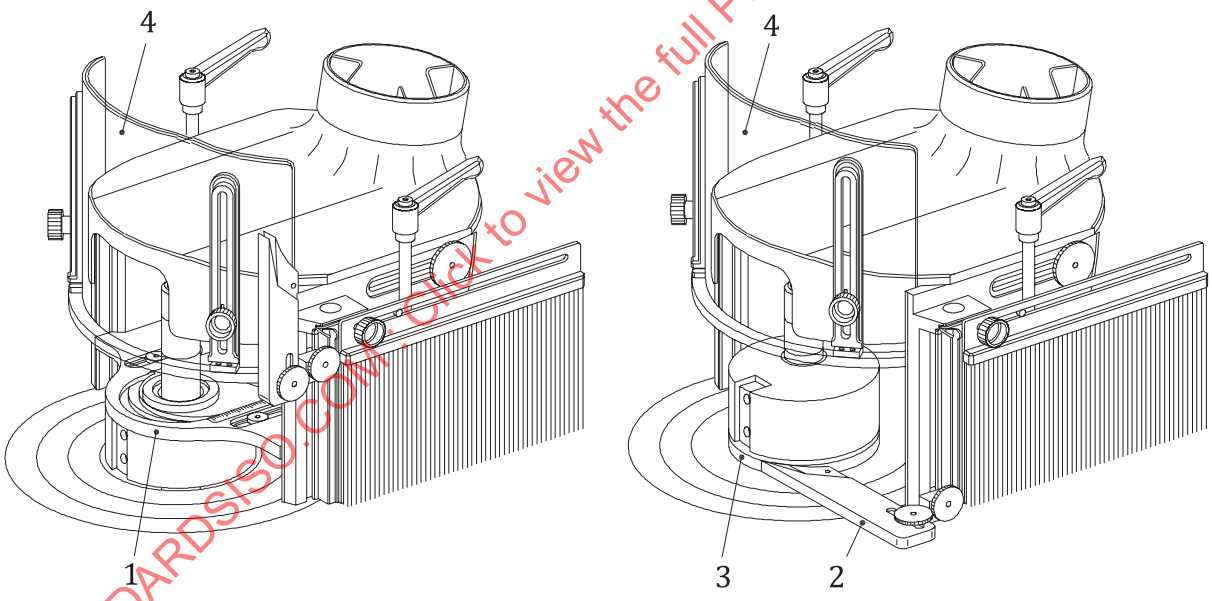
f) it shall remain parallel to the table within 0,5 mm over a length of 100 mm after adjustment.

The lead-in device shall meet the following requirements:

a) it shall allow progressive feed of the work-piece to the tool;

b) where the machine has two directions of spindle rotation, it shall be designed to allow for its use whichever direction of rotation is selected; and

3) where the guard supporting device is designed to allow for the fixing of a guiding steady, and the lead-in device is also capable of being fixed to the supporting device, it shall be capable of being moved out of position while remaining integral with the work-piece guiding device to allow for the use of the guiding steady.



Key

1 guiding steady (ring guide)
2 lead-in device
3 ball ring guide
4 hand protector

Figure 18 — Examples of curved work guiding devices

Verification: By checking the relevant drawings, measurements, inspection of the machine, performing the test in Annex G and relevant functional testing of the machine.

6.11 Safety appliances

Subclause specific to this part of ISO 19085.

A push stick and a push block handle shall be provided.

An adjustable end stop [see Figure 1 a), key 21], an extension table, a work-piece holding device for stopped work (see Figure 19) on small work-piece and a false fence shall be made available as options on all machines.

A socket shall be provided for the connection of a demountable power feed unit on machines with a table bore diameter greater than 190 mm. The electrical connection of this socket shall be such that actuation of the control device for normal stop and/or emergency stop will also cut power to the socket [see 8.3.2 f)].

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

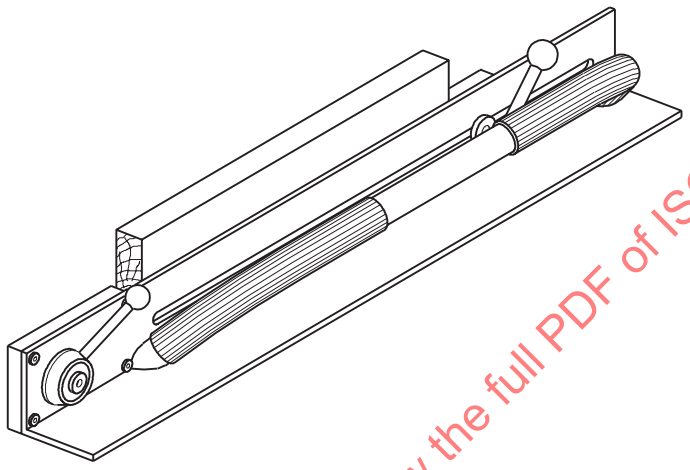


Figure 19 — Example of work-piece holding device for stopped work

7 Safety requirements and measures for protection against other hazards

7.1 Fire

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

For avoiding sparks as a result of contact between the tools and table insert, see 6.10.2.2, fence plates see 6.10.2.2 and pressure pad see 6.6.2.2.1.

7.2 Noise

7.2.1 Noise reduction at the design stage

This subclause of ISO 19085-1:2017 applies.

7.2.2 Noise emission measurement

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

The operating conditions for noise measurement shall comply with ISO 7960:1995, Annex D.

7.3 Emission of chips and dust

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

The guarding systems for straight work, for tenoning, for curved work and for the glass bead saw unit shall incorporate a dust extraction outlet.

A dust extraction outlet shall be provided below the table for machines with a table bore greater than 190 mm.

If the machine has two directions of spindle rotation, the chip and dust extraction shall be so designed that it has the same efficiency irrespective of the direction of rotation.

Unintended access to the tool through any dust extraction outlet with disconnected exhaust system shall be impeded.

NOTE 1 The requirements of ISO 13857 cannot be applied on the access through the dust extraction outlet due to the negative impact on the extraction of chips and dust.

NOTE 2 A proper chips and dust extraction can be obtained with the following recommended air flow rates:

	Recommended air flow rate m^3h^{-1}
Straight work	≥1 100
Curved work	≥2 000
Tenoning	≥1 400

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 applies.

7.5 Ergonomics and handling

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

The height of the work-piece support shall be between 850 mm and 950 mm above the floor level.

Handles, levers and latches or mechanical units shall be reachable from the operator's position and not be located at the rear side of the machine.

7.6 Lighting

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

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.

A visible warning device shall inform the machine operator when the clockwise direction of rotation is selected.

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 applies with the following additions.

The maximum saw blade diameter and the direction of rotation shall be marked in the same way as described in ISO 19085-1:2017, if the machine is fitted with a glass bead saw unit.

A warning to close the hinged cover (see 6.6.2.2.2) shall be issued before starting the spindle.

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 applies with the following additions.

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

a) reasonably foreseeable misuse includes, e.g. feeding small work-pieces without safety appliance, mounting of a saw blade on the arbor instead of milling tools and feeding work-pieces in the same direction as of the running tool (climb cutting);

b) only tools suitable for hand feed machines, conforming to EN 847-1 and EN 847-2:2013 and marked MAN shall be used in order to reduce severity of injuries and kickback speed. Shank mounted milling tools with cutting circle diameter lower than 16 mm can be used without restriction;

c) instruction on how to use all the additional safety appliances and optional equipment that can be fitted;

d) information about the relationship between the tool, work-piece and machine characteristics and appropriate rotational speeds of the spindle;

e) on displaceable machines information, how transportation shall be handled and how to maintain stability of the machine before and during machining;

f) information that operators are adequately trained in the use, adjustment and operation of the machine including the correct use, connection instruction for a demountable power feed unit and positions to be taken by the operator. This includes in particular

   1) for training

      i) the principles of machine setting and operation including the correct use and adjustment of work-piece holding and guiding devices, guards and tool selection,

      ii) the safe handling of the work-piece when cutting,

      iii) the correct use and adjustment of safety appliances such as jigs, templates, extension tables and end stops, and

      iv) the use of personal protective equipment for ear and eye protection;

   2) before machine setting to

      i) ensure that the tools used are sharp, selected, maintained and adjusted in accordance with the tool manufacturer's instructions,

      ii) use table rings or table insert to close the gap between the table and the arbor to a minimum,

      iii) use special equipment for setting, e.g., gauges where practicable,

      iv) take care when handling tools,

      v) ensure that, when using a demountable power feed unit, it is plugged into the socket provided for that purpose on the machine, and

      vi) take care of possible collision of the tool with other parts of the machine before starting any adjustment movement;

   3) for work-piece guiding the use of

      i) a fence,

      ii) a false fence wherever possible to minimize the gap between the cutter(s) and the fence plates,

      iii) a push block or push stick to aid hand feeding or, wherever possible, a de-mountable power feed unit, and

iv) roller or extension tables to support long work-pieces;

4) before machining to

i) fit the tooling to the machine to operate in the correct direction of rotation and to feed the work-piece to the tools against the direction of spindle rotation,

ii) ensure that the selected rotational speed is appropriate for the tooling being used,

iii) select and adjust the guards, especially to close the hinged cover (see 6.6.2.2.2) and to adjust the pressure pads, and

iv) because of the wide variety of work which can be undertaken on vertical spindle moulding machines, not one type of safeguard can be considered effective for all conditions. Each operation should be considered separately and the best practicable safeguard selected. The type of tool, cutting edge projection and the height at which the tool is set, will determine the minimum size of the hole in the table.

I) for straight work: In order to prevent access to the tool during straight work, it is necessary to use, in conjunction with the fence, either a de-mountable power feed unit or fence and table pressure pads equipped with special shoes depending upon the work-piece dimensions;

II) stopped work: In order to prevent access to the tool during stopped work, it is necessary to use, in conjunction with the fence, table and fence pressure pads equipped with special shoes depending upon the work-piece dimensions;

III) in order to prevent kickback, it is necessary to use back and/or front end stops fixed to the fence, table or fixed to an extension table;

IV) unless the work-piece is large enough to provide a safe and adequate hand hold, the use of a jig is recommended;

V) for curved work: In addition to the use of a guiding steady (lead in device) and in conjunction with the adjustable guard (hand protector), a template is useful to prevent access to the tool;

VI) for bevel cutting: In addition to the use of the fence and de-mountable power feed unit or pressure pads, it is important to ensure the firm support of the work-piece by using a special jig or adjustable canting fence in order to prevent access to the tool; and

VII) for tenoning: In order to feed the work-piece safely along the tool during tenoning, it is necessary to use the sliding table and enclosure provided by the manufacturer;

g) information that the cutting speed should be selected between 40 m s^{-1} in order to reduce the risk of kickback and 70 m s^{-1};

h) precaution to be taken when lowering the tool under the table to avoid contact between the tool and any fixed part of the machine;

i) information that for machines equipped with adjustable table insert, the operator shall take care of possible crushing/shearing hazards between the work-piece and the protruding part of the table insert when the work-piece is fed with a demountable power feed unit;

j) information that for machines equipped with quick tool/arbor change system, the pull-in force of their clamping system shall be periodically checked by the personnel authorized by the manufacturer, including the intervals;

k) information that for machines equipped with hydrostatic tool/arbor fixing devices, only fixing devices with additional mechanical device to protect against the loosening of the tool/arbor, in case of leakage in the hydrostatic system shall be used; and

l) information that only tool holders conforming to EN 847-3:2013 shall be used when a quick tool change system is provided.

Annex A
(informative)

Performance level 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 — Safety functions and their PL_r

Area	No.	Safety function/devices	PL_r	Subclause of ISO 19085-1:2017	Subclause of ISO 19085-6:2017
Start	1	Interlocking of demountable power feed with spindle drive and glass bead saw blade	c	5.3	5.3
	2	Interlocking of start with all safeguards	c	5.3	
	3	Prevention of unexpected start/restart	c	5.3	
	4	Initiation control for start clockwise direction of rotation	b		5.7.5
Stop	5	Normal stop (braking function excluded)	c	5.4.2	
	6	Emergency stop (braking function excluded)	c	5.4.4	
Braking	7	Braking function	b/c	5.5	
	8	Interlocking of brake release	c	6.4.3	
Spindle speed	9	Speed indication (belt position)	b	5.7.1	
	10	Incremental speed change	c	5.7.2	
	11	Infinitely variable speed monitoring	c	5.7.3	
	12	Interlocking of the guarding system for tenoning with speed monitoring system	c		5.7.4
	13	Control system for selection of direction of rotation	b		5.7.5
Controls	14	Time delay	c	5.12	
Axes movement	15	Monitoring system for limited speed of axes	b		5.11
	16	Initiation control for powered axes and adjustments	c		5.13
	17	Detection of tool position	b		5.13
	18	Limitation of concurrent movements under hold-to-run control	b		5.13
	19	Interlocking of inclination adjustment with spindle drive stop condition	c		5.13
	20	Prevention of unexpected start at pre-set electronic control	c		5.13
	21	Interlocking between table insert movement with the position of the fence plates	b		6.10.1.2
Quick tool/ arbor change system	22	Interlocking between tool/arbor release and spindle rotation	c		6.3.6

Table A.1 *(continued)*

Area	No.	Safety function/devices	PL_r	Subclause of ISO 19085-1:2017	Subclause of ISO 19085-6:2017
Safeguards	23	Interlocking of movable guards	c	6.5.2.2	
	24	Hold-to-run control	c	6.5.3	
	25	Two-hand control	c	6.5.4	
Clamping	26	Prevention of unexpected activation of second stage clamping force	c	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 applies.