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# Woodworking machines — Safety —

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

ICS: 13.110; 79.120.10





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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 19085-1:2020, 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.

This second edition cancels and replaces the first edition (ISO 19085-3:2017), which has been technically revised.

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

— In Scope, machines are “intended for continuous production use”, in line with part-1, ed.2;

— the list of significant hazards is moved to an Annex, according to ISO-CEN rules. Following Clauses and Annexes are renumbered accordingly;

— the structure was simplified, thanks to simplifications in part-1, ed.2; in particular, 6.6;

— the machines designs covered were clarified, and the relevant requirements were made more explicit (and stricter in some cases) for each design in new 6.6.2, with examples figures in new Annex;

— the example solutions in 6.6.3 were improved and simplified;

— 7.2 is new, and a new updated full Noise Test Code is in Annex F, with reference to part-1, ed.2.

# 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 to 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.

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

Thus, Clauses 4, 5, 6, and 7 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.

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

— “ISO 19085-1:2020, [subclause/Annex], applies”;

— “ISO 19085-1:2020, [subclause/Annex], applies with the following additions.” or “ISO 19085-1:2020, [subclause/Annex], applies with the following additions, subdivided into further specific subclauses.”;

— “ISO 19085-1:2020, [subclause/Annex], does not apply.”;

— “ISO 19085-1:2020, [subclause/Annex], is replaced by the following text.” or “ISO 19085-1:2020, [subclause/Annex], is replaced by the following text, subdivided into further specific subclauses.”.

Specific subclauses and annexes in this document without correspondent in ISO 19085-1:2020 are indicated by the introductory sentence: “Subclause/Annex specific to this document.”.

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

# Woodworking machines — Safety —

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

## 1 Scope

This document gives the safety requirements and measures for numerically controlled (NC/CNC) boring machines, NC/CNC routing machines and NC/CNC combined boring/routing machines (as defined in 3.2 and 3.3), designed for continuous production use, hereinafter referred to as "machines".

This document deals with all significant hazards, hazardous situations and events, listed in Annex A, 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.

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 working units for sawing, sanding, edge banding, assembling or dowel inserting;

— fixed or movable workpiece support;



— mechanical, pneumatic, hydraulic or vacuum workpiece clamping;

— automatic tool change devices.

Machines covered in this document are designed for workpieces consisting of

— solid wood,

— material with similar physical characteristics to wood (see ISO/DIS 19085-1:2020, 3.2),

— gypsum boards, gypsum bounded fibreboards, cardboard,

— matrix engineered mineral boards, silicate boards,

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

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

— aluminium light alloy profiles,

— aluminium light alloy plates with a maximum thickness of 10 mm,

— 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 through openings guarded by curtains on machines where the height of the opening in the enclosure above the workpiece support 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 847-1:2017 and EN 847-2:2017,

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

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

This document is not applicable to:

— single spindle hand fed or integrated fed routing machines,

— machines designed to process aluminium light alloy only,

— machines intended for use in potentially explosive atmosphere,

— 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/DIS 19085-1:2020, *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 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

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

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

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

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

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

ISO 13854:2017, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010, ISO 13849-1:2015, ISO/DIS 19085-1:2020 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**
**Numerical Control**
**NC**
**CNC**
automatic control of a process by a device that makes use of numerical data

Note 1 to entry: in the CNC ("Computerized Numerical Control"), the numerical data can be changed with a computer

**3.2**
**numerically controlled boring and routing machine**
**NC/CNC boring and routing machine**
integrated fed machine designed for the machining of workpieces by the use of milling tools and 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 an NC/CNC work programme



Note 1 to entry: Examples of different machine designs covered by this document are illustrated, without safeguarding devices, in Figures 1 to 6.

**3.3**
**numerically controlled boring machine**
**NC/CNC boring machine**



integrated fed machine designed for the machining of workpieces by the use of 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 an NC/CNC work programme

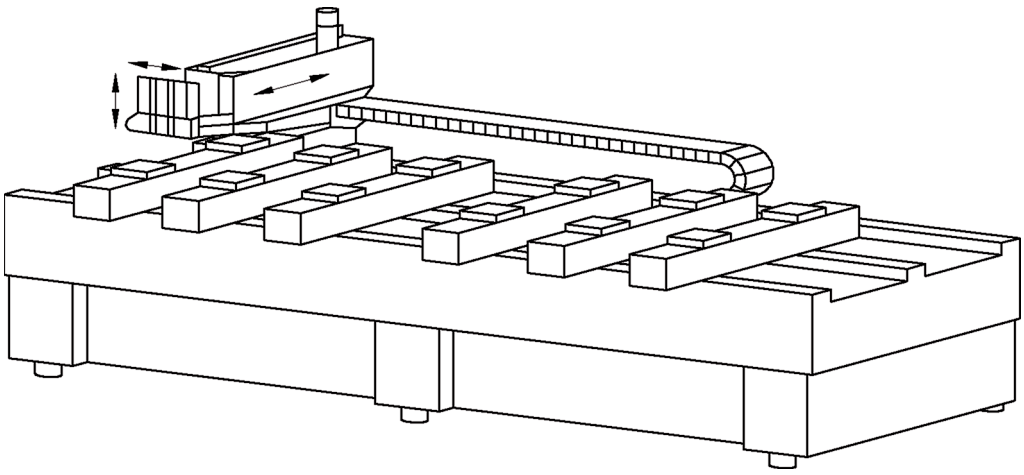

**Figure 1 — Example of a C frame machine with fixed table and moving machining head**

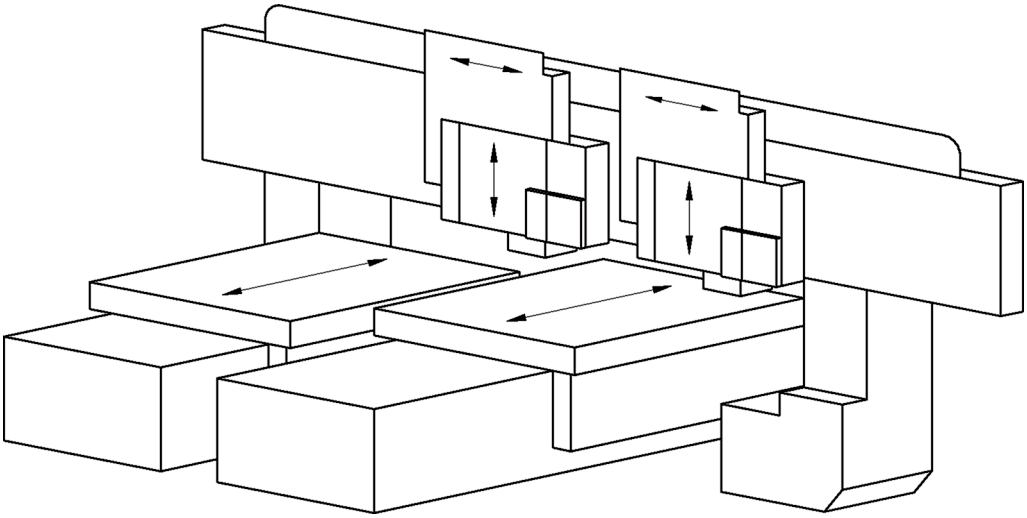

**Figure 2 — Example of portal frame machine with moving tables, fixed portal, moving machining heads**

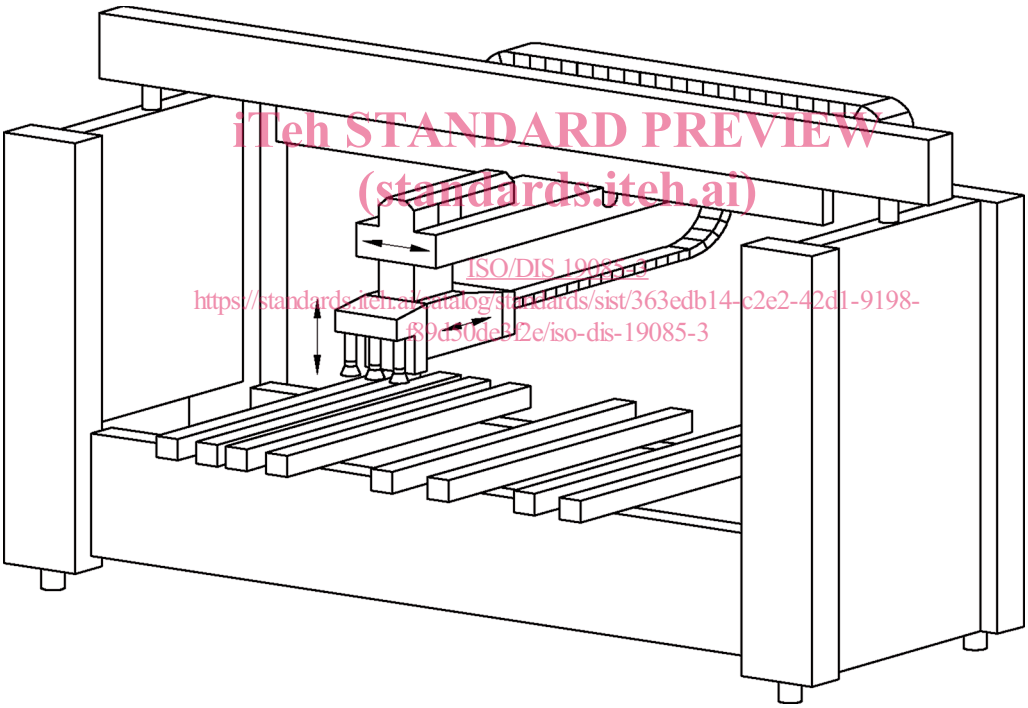



**Figure 3 — Example of portal frame machine with fixed portal, feeding belts, moving machining head**

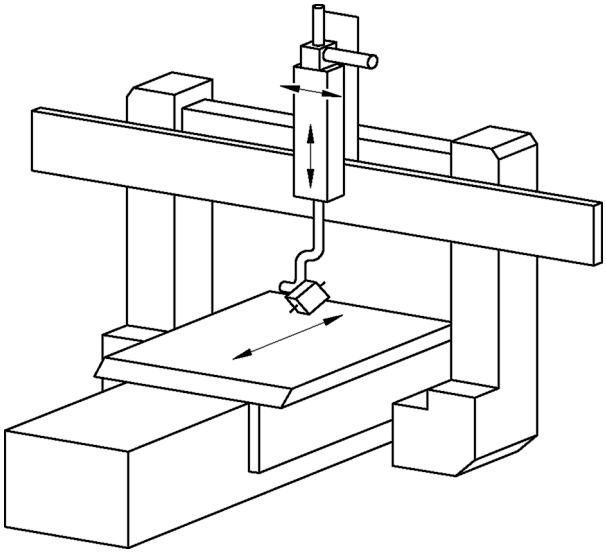

**Figure 4 — Example of a machining centre with moving table, fixed portal, moving machining head**

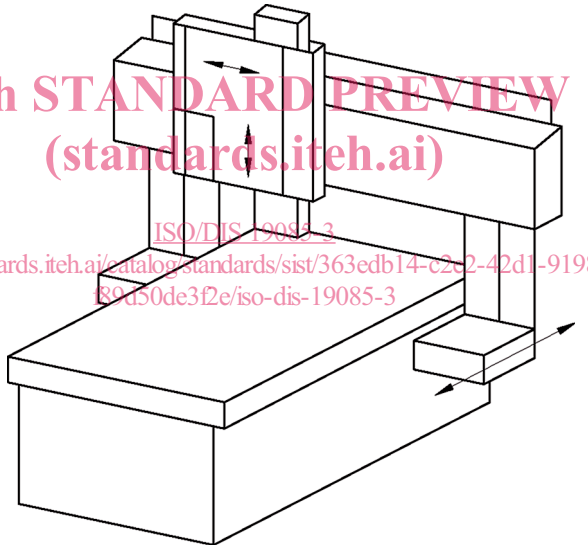



**Figure 5 — Example of portal frame machine with fixed table, moving portal, moving machining head**

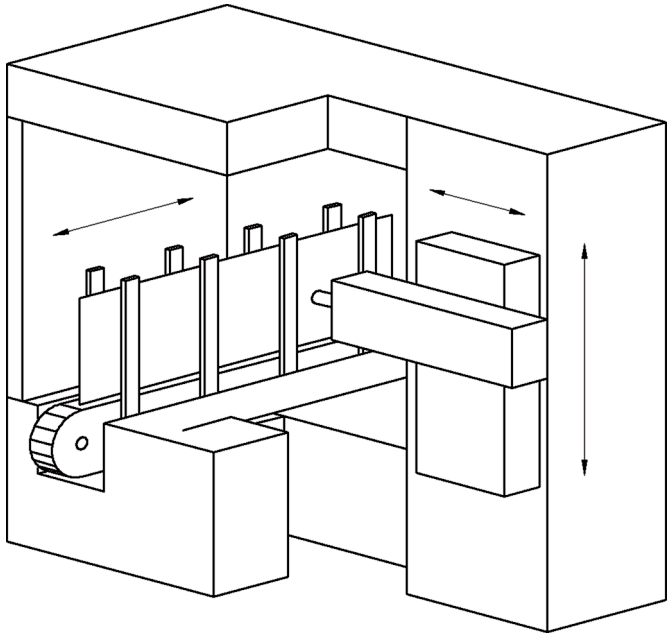

**Figure 6 — Example of a through-feed vertical machine with moving workpiece, fixed frame, moving machining head**



**3.4**
**loading/unloading zone**
area close to the machine accessible to the operator for workpiece loading and/or unloading



**3.5**
**machine setting mode**
**MODE 2**
condition with safeguards disabled for setting, programming, fault finding, program verification, testing and manually controlled non-sequential operation of the machine

**3.6**
**clamping device manual positioning mode**
**MODE 3**
condition with safeguards disabled for manual positioning of clamping devices with laser indication

**3.7**
**boring units positioning mode**
**MODE 4**
condition with safeguards disabled for manual change of boring bits on boring machines only

## 4 Safety requirements and measures for controls

### 4.1 Safety and reliability of control systems

ISO/DIS 19085-1:2020, 4.1, applies with the following additions.

Table B.1 of this document replaces ISO/DIS 19085-1:2020, Table B.1.

### 4.2 Control devices

ISO/DIS 19085-1:2020, 4.2, applies with the following additions, subdivided into further specific subclauses.

#### 4.2.1 General

The control devices for control power-on, operational and normal stop 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;

An emergency stop control 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 to 5.6.1, 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.



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



#### 4.2.2 Hand-held control sets

Additional control devices for cycle starting (not including reset function), operational/normal stop (if provided) may be duplicated/provided on hand-held control sets with or without cable connection taking account of the requirements of 4.4.4 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. The SRP/CS for the emergency stop activation in case of wireless control disconnection shall achieve $PL_r$ = c.

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

### 4.3 Start

#### 4.3.1 Direct start

ISO/DIS 19085-1:2020, 4.3.1, does not apply.

#### 4.3.2 Start via control power-on

ISO/DIS 19085-1:2020, 4.3.2, applies.

## 4.4 Safe stops

### 4.4.1 General

ISO/DIS 19085-1:2020, 4.4.1, 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.

### 4.4.2 Normal stop

ISO/DIS 19085-1:2020, 4.4.2, applies.

### 4.4.3 Operational stop

ISO/DIS 19085-1:2020, 4.4.3, applies.

### 4.4.4 Emergency stop

ISO/DIS 19085-1:2020, 4.4.4, applies.



## 4.5 Braking function of tools

ISO/DIS 19085-1:2020, 4.5, applies with the following additions.



Only electric braking systems are allowed.

## 4.6 Mode selection

ISO/DIS 19085-1:2020, 4.6, applies with the following additions, subdivided into further specific subclauses.

### 4.6.1 General

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

### 4.6.2 Machine setting mode [MODE 2]

In machine setting mode of operation, when moveable guards are opened or protective devices disabled, the following requirements apply:

a) spindle rotation, if needed, shall be controlled by a jog control in combination with an enabling control; the SRP/CS for jog control may not achieve any $PL_r$;

b) only one powered (physical or virtual) linear or circular movement shall be possible at a time, no PL is required; any physical or virtual movement shall be controlled by a jog control in combination with an enabling control; the SRP/CS for jog control may not achieve any $PL_r$. The movement speed of each physical axis shall be limited to 2 $m \cdot min^{-1}$ according to 4.11. In addition, the speed of virtual movements (i.e. vector or tangential speed) shall be limited to 2 $m \cdot min^{-1}$ without $PL_r$, e.g. by numerical control;

c) if spindle rotation is provided, it shall be limited to a maximum of 300 $min^{-1}$;

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

e) speed monitoring in accordance with 4.7.3 shall be provided for spindle rotation;

f) movement of the automatic tool change mechanism shall be controlled by a jog control in combination with an enabling control; the jog control need not achieve any $PL_r$. When crushing or shearing hazards exist, two-hand control device shall be provided;

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

### 4.6.3 Clamping device manual positioning mode [MODE 3]

For machines without bumpers or sensitive edges, trip bars or trip plates, and with laser indication fitted to the moving machining head, when front side safeguards are disabled, any hazardous movement including spindle rotations shall not be possible except machine head enclosure movement. This movement shall be controlled by a jog control in combination with an enabling control. The movement speed shall be limited to 10 $m \cdot min^{-1}$ according to 4.11. The SRP/CS for jog control may not achieve any $PL_r$.

### 4.6.4 Boring units positioning mode [MODE 4]

For boring machines, when safeguards are disabled, any hazardous movement including spindle rotation shall not be possible except boring units' movement. Only the movement of one axis of one boring unit at a time shall be possible. This movement shall be controlled by a jog control in combination with an enabling control. The movement speed shall be limited to 10 $m \cdot min^{-1}$ according to 4.11. The SRP/CS for jog control may not achieve any $PL_r$.



## 4.7 Tool speed changing



### 4.7.1 Speed changing by shifting the belts on the pulleys

ISO/DIS 19085-1:2020, 4.7.1, applies to milling aggregates with fixed spindle speed not controlled by inverter and for boring tools.

### 4.7.2 Speed changing by incremental speed change motor

ISO/DIS 19085-1:2020, 4.7.2, does not apply.

### 4.7.3 Infinitely variable speed by frequency inverter

ISO/DIS 19085-1:2020, 4.7.3, is replaced by the following text.

Machines equipped with an infinitely variable speed control (i.e. frequency inverter) for the tool drive shall have speed monitoring.

The control for speed monitoring shall ensure that, as soon as the real speed exceeds the selected speed or the programmed maximum tool speed by more than 10 %, the drive shall be stopped automatically in stop category 0 according to IEC 60204-1:2016, 9.2.2. The SRP/CS for speed monitoring may not achieve any $PL_r$.

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 $PL_r$ required).

For boring tools no speed monitoring is required.

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