EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16564

November 2020

ICS 25.080.20; 25.080.60; 73.120

Supersedes EN 16564:2014

English Version

Machines and plants for mining and tooling of natural stone - Safety - Requirements for bridge type sawing/milling machines, included numerical control (NC/CNC) versions

Machines et équipements pour l'exploitation et l'usinage de pierres naturelles - Sécurité - Prescriptions relatives aux machines à scier/fraiseuses de type pont, y compris les versions à commande numérique (NC/CNC)

Maschinen und Anlagen zur Gewinnung und Bearbeitung von Naturstein - Sicherheit - Anforderungen an Brücken-Säge-/Fräsmaschinen einschließlich numerischer Steuerungsversionen (NC/CNC)

This European Standard was approved by CEN on 28 September 2020.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN 16564:2020 E

Contents

European foreword

This document (EN 16564:2020) has been prepared by Technical Committee CEN/TC 151 “Construction equipment and building material machines - Safety”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2021, and conflicting national standards shall be withdrawn at the latest by month year of May 2021.

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

This document supersedes EN 16564:2014.

The following major changes were introduced:

— list of the significant hazards has been moved from Clause 4 to Annex A, according to 6.10.3.1 of CEN Guide 414;

— normative references have been modified and updated to Clause 2;

— terms and definitions have been introduced to Clause 3 (e.g. control power on, telecontrol, teleservice);

— requirements related to hand-held control sets have been added or modified to 4.2.2.2;

— requirements related to starting have been added or modified to 4.2.3;

— requirements related to teleservice have been added to 4.2.10;

— requirements related to transport and installation of machine have been added to 4.3.1;

— requirements related to stability have been added to 4.3.2;

— requirements related to prevention of access to moving parts and safeguards to minimize the effect of ejection have been added or modified to 4.3.5;

— requirements related to noise have been added or modified to 4.4.2 and Annex D;

— requirements related to electrical hazards have been added or modified to 4.4.3;

— requirements related to unintended movements have been added to 4.4.8;

— requirements related to information for use have been added or modified to Clause 5;

— Annex ZA has been modified according to the last edition of CEN Guide 414.

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

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

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

Introduction

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

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

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises);

— consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

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.

1 Scope

This document deals with all significant hazards, hazardous situations and events which are relevant to:

— bridge sawing machines;

— bridge sawing and milling machines;

— numerical control bridge sawing/milling machines.

These machines are designed to saw and mill natural stone and engineered/agglomerated stone as defined by EN 14618:2009, when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Clause 4).

This document specifies the appropriate technical measures to eliminate or reduce risks arising from the significant hazards.

This document deals with the foreseeable lifetime of the machinery including the phases of transport, assembly, dismantling, disabling and scrapping.

This document also applies to machines fitted with the following facilities/devices:

— mechanical, pneumatic, hydraulic or vacuum workpiece clamping;

— automatic tool change;

— loading and unloading conveyor system;

— tilting and/or rotating head axis;

— rotating workpiece support(s);

— tilting workpiece support(s) when loading;

— lathe unit;

— undercut grooving unit;

— axes operating in accordance with an NC work programme.

This document does not apply to:

— machines intended for operation in a potentially explosive atmosphere;

— machines operating in severe environmental conditions (e.g. extreme temperatures, corrosive environment);

— machines intended for outdoor operation;

— machines which are manufactured before the date of their publication as EN.

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.

EN 166:2001, *Personal eye-protection — Specifications*

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

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

EN 14618:2009, *Agglomerated stone — Terminology and classification*

EN 50370-1:2005, *Electromagnetic compatibility (EMC) — Product family standard for machine tools — Part 1: Emission*

EN 50370-2:2003, *Electromagnetic compatibility (EMC) — Product family standard for machine tools — Part 2: Immunity*

EN 60204-1:2018, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2016, mod.)*

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

EN 60529:1991/A1:2000, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989/A1:1999)*

EN 60529:1991/A2:2013, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989/A2:2013)*

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

EN 61439-1:2011, *Low-voltage switchgear and controlgear assemblies — Part 1: General rules*

EN 61496-1:2013, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests (IEC 61496-1:2012)*

EN 61800-5-2:2017, *Adjustable speed electrical power drive systems — Part 5-2: Safety requirements — Functional (IEC 61800-5-2:2016)*

EN 82079-1:2012, *Preparation of instructions for use — Structuring, content and presentation — Part 1: General principles and detailed requirements (IEC 82079-1:2012)*

EN ISO 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane (ISO 3744:2010)*

EN ISO 3746:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:2010)*

EN ISO 3747:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering/survey methods for use in situ in a reverberant environment (ISO 3747:2010)*

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

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

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

EN ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201:2010)*

EN ISO 11202:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections (ISO 11202:2010)*

EN ISO 11204:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections (ISO 11204:2010)*

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

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

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

EN ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design (ISO 13850:2015)*

EN ISO 13854:2019, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body (ISO 13854:2017)*

EN 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 13856-3:2013)*

EN ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2019)*

EN ISO 14118:2018, *Safety of machinery — Prevention of unexpected start-up (ISO 14118:2017)*

EN ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection (ISO 14119:2013)*

EN ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards (ISO 14120:2015)*

3 Terms and definitions

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

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

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

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

3.1
bridge sawing machine
integrated fed machine designed for sawing and/or shaping workpieces (see Figure 1) by the use of a diamond disk water-cooled during the working process having at least two squared axes which the working head moves over

Note 1 to entry: This machine can be equipped with the following facilities:

a) loading and unloading conveyor system;

b) tilting (A/B) and/or rotating (C) head axis;

c) rotating workpiece support(s);

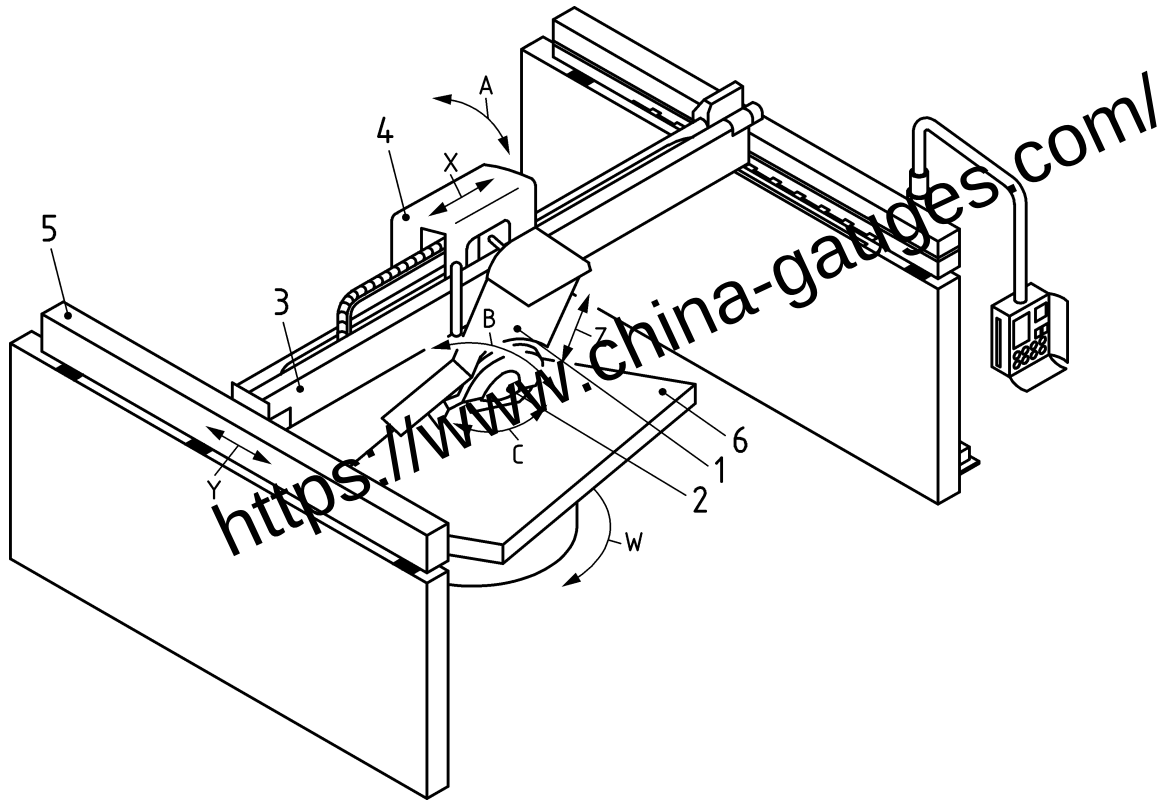
d) tilting workpiece support(s) when loading;

e) lathe unit (see Figure 2);

f) workpiece vacuum moving system;

g) undercut grooving unit;

h) axes operating in accordance with an NC work programme.

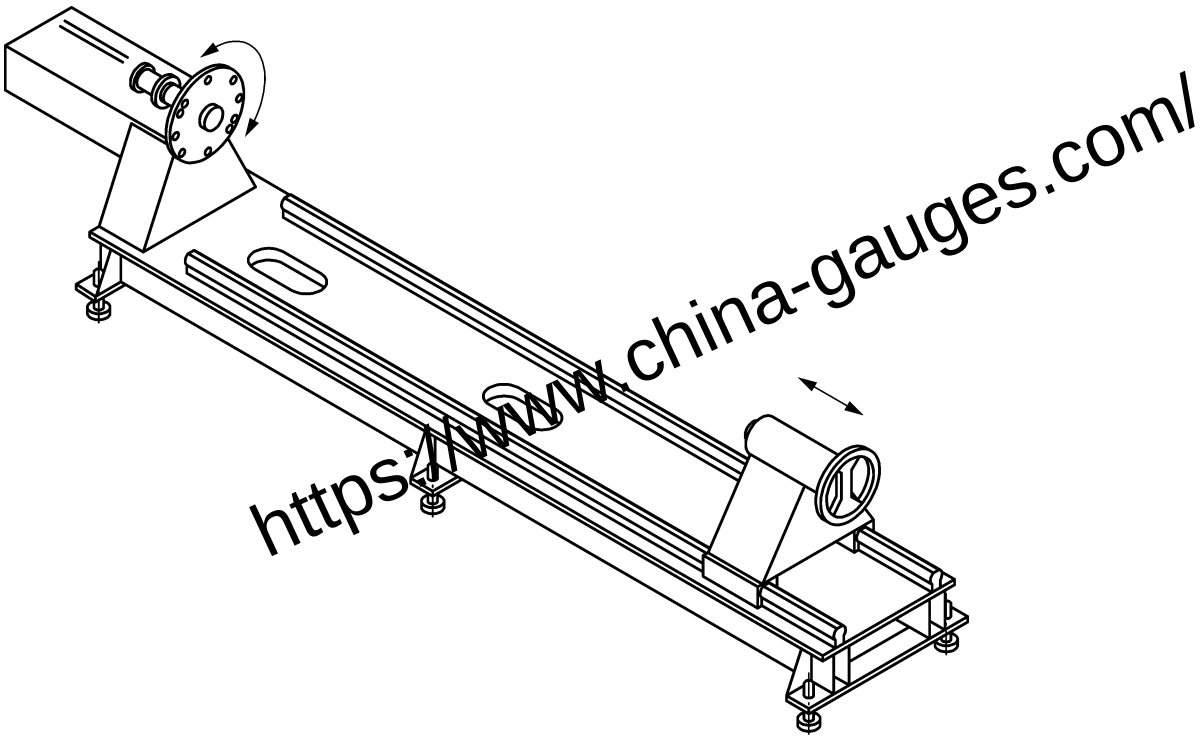


Safeguarding devices are not illustrated

Key

1	tool holder head (tilting version)	A	direction of the tilting movement of the head
2	diamond disk	B	direction of the tilting movement of the head
3	bridge	C	direction of the rotating movement of the head
4	carriage	W	direction of the rotating movement of the workpiece support(s)
5	slide rail	X	longitudinal movement of the head along the carriage
6	tilting and rotating workpiece support(s)	Y	transverse movement of the bridge along the slide rail
		Z	vertical movement of the head

Figure 1 — Example of a bridge sawing machine upper tilting head, rotating workpiece support



Safeguarding devices are not illustrated

Figure 2 — Example of a lathe unit

3.2
bridge sawing and milling machine
integrated fed machine designed for sawing, milling and boring workpieces (see Figure 3) by the use of a diamond disk and by a milling tool water-cooled installed in the same head unit equipped with a single or double spindle having at least three squared axes (XYZ)

Note 1 to entry: This machine can be equipped with the following facilities:

a) loading and unloading conveyor system;

b) tilting (A/B) and/or rotating (C) head axis;

c) rotating workpiece support(s);

d) tilting workpiece support(s) when loading;

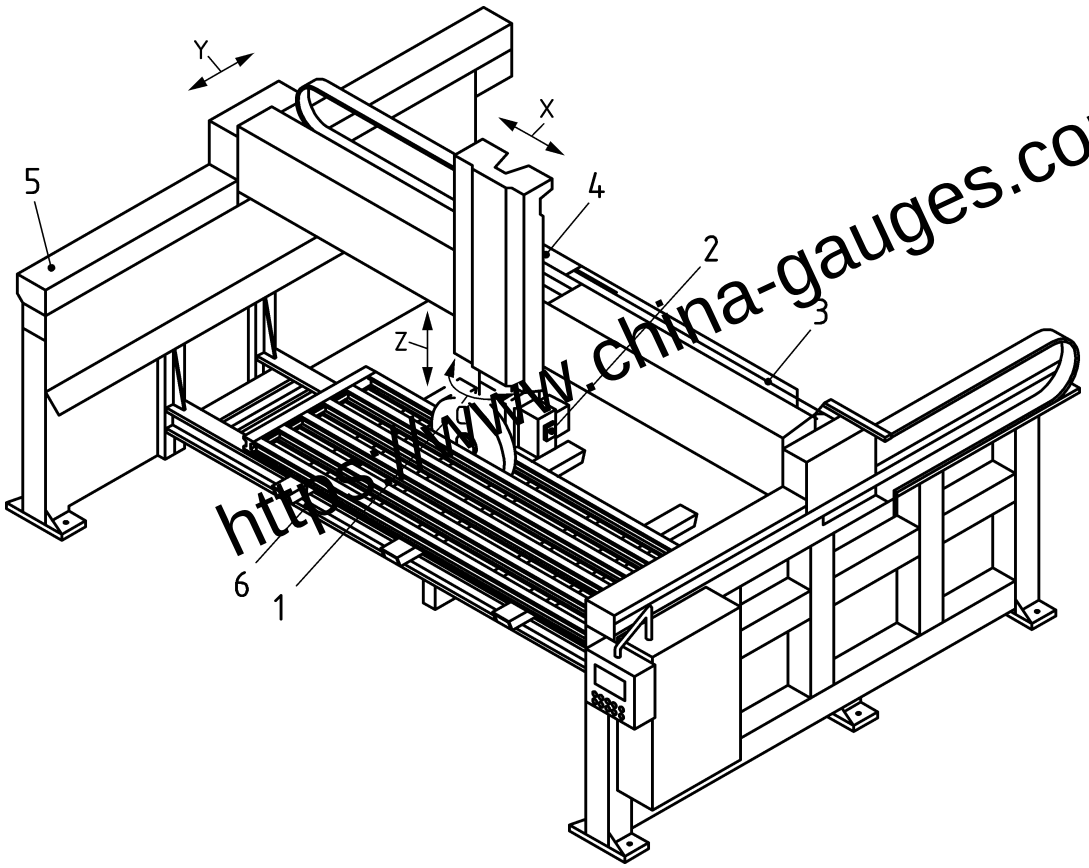
e) lathe unit (see Figure 2);

f) workpiece vacuum moving system;

g) undercut grooving unit;

h) mechanical, pneumatic, hydraulic, or vacuum workpieces clamping;

i) axes operating in accordance with an NC work programme.



Safeguarding devices are not illustrated

Key

1	main drive - diamond disk	C	direction of the rotating movement of the head
2	milling unit	X	longitudinal movement of the head along the carriage
3	bridge	Y	transverse movement of the bridge along the slide rail
4	carriage	Z	vertical movement of the head
5	slide rail		
6	tilting and rotating workpiece support(s)		

Figure 3 — Example of a bridge sawing and milling machine with double spindle

3.3
numerical control bridge sawing/milling machine
integrated fed machines provided with automatic tool change designed for machining of workpieces (see Figure 4) by the use of milling/boring/sanding/grinding tools and/or diamond disks water-cooled with at least three square axes programmable by the user (X, Y, Z) for positioning and/or machining and axes operated in accordance with an NC work programme

Note 1 to entry: This machine can be equipped with the following facilities:

a) loading and unloading conveyor system;

b) tilting (A/B) and/or rotating (C) head axis;

c) rotating workpiece support(s);

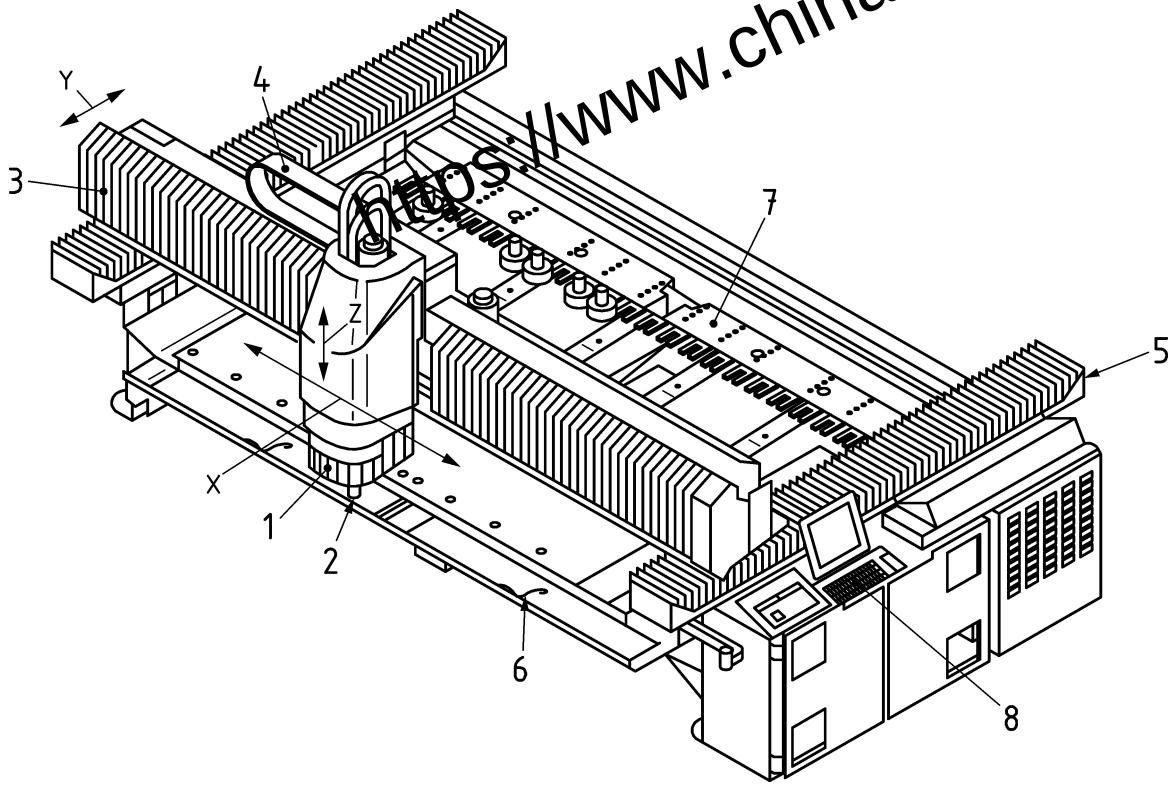
d) tilting workpiece support(s) when loading;

e) lathe unit (see Figure 2);

f) workpiece vacuum moving system;

g) undercut grooving unit;

h) mechanical, pneumatic, hydraulic, or vacuum workpieces clamping.



Safeguarding devices are not illustrated

Key

1	tool holder head	7	tool magazine
2	tool	8	PC for numerical control
3	bridge	X	longitudinal movement of the head along the carriage
4	carriage	Y	transverse movement of the bridge along the slide rail
5	slide rail	Z	vertical movement of the head
6	tilting and rotating workpiece support(s)		

Figure 4 — Example of a numerical control bridge sawing and milling machine

3.4
bumper
pressure-sensitive protective device comprising:

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

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

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

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

Note 1 to entry: See 4.3.5.4.

[SOURCE: EN ISO 13856-3:2013]

3.5
boring tool
tool intended/designed for feed only along/parallel its axis of rotation

3.6
sanding tool
tool where the active part is made of coated abrasive

3.7
grinding tool
tool where the active part is made of bounded abrasive

3.8
machine actuator
power mechanism used to affect motion of the machine

3.9
machining mode of operation
automatic, programmed, sequential mode of operation of the machine with the facility for manual or automatic loading/unloading of the workpiece

3.10
machine-setting mode of operation
setting, programming, fault finding, program verification, testing mode of operation of the machine

3.11
monitoring
safety function which ensures that a safety measure is initiated if the ability of a component or an element to perform its function is diminished, or if the process conditions are changed in such a way that hazards are generated

3.12
unbraked run-down time
time elapsed from the actuation of the stop control, but not the braking device (if fitted) up to spindle standstill

3.13
braked run-down time
time elapsed from the actuation of the stop control and the brake device up to spindle standstill

3.14
peripheral enclosure
combination of fixed and movable guards which enclose the machine danger zone preventing access to it and also form a means of safeguarding against ejected parts which may or may not have a ceiling

3.15
safety function
function of the machine whose failure can result in an immediate increase of the risk(s)

[SOURCE: EN ISO 12100:2010, 3.30]

3.16
safety-related part of a control system
SRP/CS
part of a control system that responds to safety-related input signals and generates safety-related output signals

[SOURCE: EN ISO 13849-1:2015, 3.1.1]

Note 1 to entry: The combined safety-related parts of a control system start at the point where the safety-related input signals are initiated (including for example the actuating cam and the roller of the position switch) and end at the output of the power-control elements (including for example the main contacts of the contactor).

Note 2 to entry: If monitoring systems are used for diagnostics, they are also considered as SRP/CS.

3.17
performance level
PL
discrete level used to specify the ability of safety-related parts of control systems to perform a safety function under foreseeable conditions

[SOURCE: EN ISO 13849-1:2015, 3.1.23, 4.5.1]

3.18
control power-on
control that after activation enables providing power to machines actuators, also on a lower control level, e.g. by the PLC (Programmed Logic Control)

3.19
telecontrol
control of the machine movements from a remote service site

3.20
teleservice
machine diagnosis (including trouble-shooting), software update and telecontrol from a remote service site

3.21
non-positive clamping
fixing without any element passing through the guard

4 Safety requirements and/or protective measures

4.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause. In addition, the machine shall be designed according to the principles of EN ISO 12100:2010 for relevant but not significant hazards (e.g. sharp edges of the machine frame), which are not dealt with by this document.

4.2 Controls

4.2.1 Safety and reliability of control system

For the purpose of this document, safety-related part of a control system means the system which implements safety functions from the initial device (e.g. actuator, position detector or sensor) up to include the power-control element of the final machine actuator (e.g. motor). Safety related parts of the control system of this machine comprise parts concerning the following functions and they shall fulfil the requirements of the PL given below, in accordance with the requirements of EN ISO 13849-1:2015:

a) for control power on: PL = c (see 4.2.3);

b) for normal stop (braking function excluded): PL = c (see 4.2.4);

c) for emergency stop (braking function excluded): PL = c (see 4.2.5);

d) for standstill monitoring: PL = c (see 4.2.6);

e) for prevention of automatic restart: PL = c (see 4.2.8);

f) for tool release: PL = c or two independent systems PL = b (see 4.3.3);

g) for interlocking with guard locking: PL = c (see 4.2.6, 4.2.7, 4.3.3, 4.3.5.2 and 4.3.5.6);

h) for hold-to-run control or limited speed/increment monitoring: PL = c or in conjunction with an enabling device in accordance with EN 60204-1:2018, 9.2.3.2, conforming to PL = c (see 4.2.7.3);

i) for mode selection: PL = c (see 4.2.7);

j) for trip device: PL = c (see 4.3.5.2, 4.3.5.3 and 4.3.5.4);

k) for braking function: PL = b with additional requirements (see 4.3.4);

l) for limited speed control: PL = c (see 4.3.5.3);

m) for electronic light barrier: PL = c (see 4.3.5.1);

n) for unexpected automatic tool change movements: PL = c (see 4.2.7.3).

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

4.2.2 Position of controls

4.2.2.1 General

The main electrical control devices that are, enabling controls, reset control, control power on, operational/normal stop, emergency stop, mode selection shall be located at the operator's position adjacent to the control display (at the main control panel) at a distance of at least 600 mm and not exceeding 1 800 mm from the floor level.

Any safeguarding equipment reset control device shall be located outside the protected zone and shall not be effective if actuated from inside the protected zone (see 4.3.5). The operator shall have a good view on the protected zone from the reset position.

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

a) at the main control panel;

b) at the mobile control panel connected by cable or wireless system;

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

d) adjacent to all limited movement controls;

e) at the workpiece loading and unloading area;

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

g) inside any enclosure fitted with access door if the operator does not have a clear view of the complete machining area from the control position;

h) adjacent to all cycle start control devices.

If, in compliance with the above requirements, the distance between two emergency stop devices results less than 1 m, one of the two devices can be removed. This technical solution can be applied only if the two emergency devices are fixed on board of machine and are not separated by any obstacle.

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

4.2.2.2 Hand-held control sets

Additional control devices for cycle setting (see 4.2.7. c), starting, operational/normal stopping may be duplicated/provided on hand-held control sets.

For wireless hand-held control sets, EN 60204-1:2018, 9.2.4, applies.

No reset function control device, no control power on device, no mode-selection switch shall be permitted on wireless control sets or control sets with cable connection.

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

4.2.3 Starting

Control power on activation shall only be possible when all safeguards described in 4.2.7 and 4.3.5 are in place and functional.

This is achieved by the interlocking arrangement, including PL required, described in 4.2.7 and 4.3.5.

Cycle start or restart shall only be possible after actuation of a control power on device provided for that purpose and protected against unintended actuation e.g. by shrouded control device.

The safety-related part of the control system for the control power on shall achieve at least PL = c and the requirements of EN 60204-1:2018, 9.2.3.2, apply.

NOTE No minimum PL is required for cycle-starting and restarting functions.

Manual reset may be achieved by control power-on circuit, where control-power on device fulfils position requirements stated in 5.2 for manual reset devices.

If only one safeguard is triggered, safeguard local reset and process start may occur at the same time.

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

4.2.4 Normal stop

A normal stop control system shall be provided which, when actuated, shall fulfil the stopping sequences and shall disconnect power from all machine actuators except workpiece clamping.

The stop shall be of a category 1 in accordance with the requirements of EN 60204-1:2018, 9.2.2, to allow the actuation of the electrical brake (if fitted) and maintain clamping until the braking sequence is complete (see also 4.3.4).

The stopping sequence for normal stop shall be:

a) stop axes movements;

b) stop spindle rotation;

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

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

The control circuit for normal stop (braking function excluded) shall be at least PL = c in accordance with the requirements of EN ISO 13849-1:2015.

For normal stop of PDS(SR) (power drive system, safety-related), EN 61800-5-2:2017, 4.2.3.2 (safe torque off (STO)), and EN 61800-5-2:2017, 4.2.3.3 (safe stop 1 (SS1)), apply.

The design of the control circuits shall be such as to satisfy the requirements for the normal-stop sequence. If a time-delay device is used, the time delay shall be at least equal to the run-down time. Either the time delay shall be fixed or the time-delay adjustment device shall be sealed.

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

4.2.5 Emergency stop

Machines shall be fitted with an emergency stop control device which complies with the requirements of EN ISO 13850:2015 and additionally with the requirements of EN 60204-1:2018, 10.7. The emergency stop control device shall be at any time of self-latching type.

The emergency-stop function shall comply with the requirements of EN 60204-1:2018, 9.2.3.4.2 and the emergency stop shall be of a stop category 1 in accordance with the requirements of EN 60204-1:2018, 9.2.2, to allow the actuation of the electrical brake (if fitted) and maintain clamping until the braking sequence is complete (see also 4.3.4).

When initiated, the emergency-stop sequence shall:

a) stop axes movements;

b) stop spindle rotation;

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

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

The control circuit for emergency stop (braking function excluded) shall be at least PL = c in accordance with the requirements of EN ISO 13849-1:2015.

For emergency stop of PDS(SR) (power drive system, safety-related), EN 61800-5-2:2017, 4.2.3.2 (safe torque off (STO)), and EN 61800-5-2:2017, 4.2.3.3 (safe stop 1 (SS1)), apply.

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

4.2.6 Operational stop

If an operational stop function is needed for intervention in the machine while drive systems remain under control, the stop function provided (e.g. cycle stop) shall be of stop category 2 in accordance with the requirements of EN 60204-1:2018, 9.2.2, actuated in conjunction with standstill monitoring, and the control system for standstill monitoring shall be at least PL = c in accordance with the requirements of EN ISO 13849-1:2015.

For operational stop of PDS(SR) (power drive system, safety-related), EN 61800-5-2:2017, 4.2.4.2 (safe operating stop" (SOS)), and EN 61800-5-2:2017, 4.2.3.4 (Safe stop 2 (SS2)), apply.

Any activation/triggering of a protective device located in a zone where machining is under progress (see 4.3.5.1, 4.3.5.2, 4.3.5.3) shall initiate the stopping sequence in accordance with 4.2.4 or 4.2.5. The relevant PL stated in 4.2.4 or 4.2.5 shall be fulfilled.

When the operational stop sequence is initiated, it shall:

a) stop axes movements;

b) stop spindle rotation;

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

If the intervention in the machine is allowed only with a change of mode of operation, the features of the control circuit shall be as described in 4.2.7.

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

4.2.7 Mode selection

4.2.7.1 General

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

a) the mode-selection switch shall be lockable in each position (e.g. by key or password) and shall be located outside the hazard zone, e.g. on the main control panel (see 4.2.2 for location of control devices);

b) the control system for mode selection shall be at least PL = c in accordance with the requirements of EN ISO 13849-1:2015;

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

d) the safeguarding requirements given in 4.2.7.2 and 4.2.7.3 shall be effective in their respective mode of operation;

e) selecting any of the modes shall not initiate any movement of the machine;

f) when changing from machining mode of operation (see 4.2.7.2) to setting mode of operation (see 4.2.7.3), the machine shall be brought to a complete stop in accordance with 4.2.4 or 4.2.5 or 4.2.6.

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

4.2.7.2 Machining mode of operation

In the machining mode, movement shall only be possible when the interlocking guards (for definition see EN ISO 14119:2013, 3.2 and 3.5) and/or protective devices are in place and functional.

The safety-related maximum speed of axes movement shall fulfil the requirements of 4.3.5.3 for speed monitoring and control.

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

4.2.7.3 Machine-setting mode of operation

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

a) tool rotation shall not be possible;

b) any single axis (physical or virtual) movement shall be controlled by a hold-to-run control. The movement shall be limited to 5 m/min or 5 rpm speed, or 10 mm increment. Both the hold-to-run control and the limited speed/increment monitoring shall be PL = c in accordance with the requirements of EN ISO 13849-1:2015. If this is technically not possible, alternatively hold-to-run control and the limited speed/increment monitoring shall be provided in conjunction with enabling device PL = c in accordance with the requirements of EN ISO 13849-1:2015, and no PL requirements for the hold-to-run control device and axes limited speed/increment monitoring shall be met;

c) hold-to-run control devices and enabling devices for axes movements shall be located on the main control panel and/or, if provided, on a mobile set of controls connected to the machine by a cable or wireless system (if provided);

d) automatic tool change mechanism shall be protected against unexpected movements at least PL = c in accordance with the requirements of EN ISO 13849-1:2015.

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

4.2.8 Failure of any power supply

In case of any supply interruption, the automatic restart of the machine after the restoration of the supply shall be prevented and the clamping of the workpiece if fitted shall be maintained.

Where valves are used (e.g. non-return valve) to maintain workpiece clamping, they shall be fitted directly at the actuating cylinders.

For electric supply, see EN 60204-1:2018, 7.5, paragraphs 1 and 3.

The requirements of EN ISO 14118:2018, Clause 6, apply.

The safety-related part of the control system to prevent automatic restart shall achieve at least PL = c.

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

4.2.9 Failure of the control circuits

See 4.2.1.

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

4.2.10 Teleservice

For machines with tele-service capability, the following requirements apply.

A secure connection line, e.g. VPN, shall be in place between the provider of the tele-service and customer.

During tele-control, the connection line shall periodically be supervised to ensure it does not hang.

Hanging communication lines shall be terminated on both ends, e.g. after a timeout of more than 1 min. (no PL required).

The tele-service functions provided for diagnosis, software update and/or tele-control shall be enabled from the machine side.

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

Any single machine shall be readily and clearly identifiable by the tele-service remote operator.

The emergency stop control function and all safety functions at the machine shall take precedence over any command issued by the remote tele-service operator.

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

Before software update, the service technician at the remote site shall ask the operator at the machine to check that the machine is on, in normal stop condition and empty from workpieces.

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

After the tele-service operations are accomplished, a message shall appear on the control panel stating that teleservice is finished.

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

4.3 Protection against mechanical hazards

4.3.1 Transport and installation of machine

For transport of the machine, appropriate provisions for the easy and safe handling shall be made in accordance with EN ISO 12100:2010, 6.3.5.5 (see 5.4.2 dd)).

For the installation of the machine, appropriate provisions for the installation of the machine shall be made in accordance with EN ISO 12100:2010, 6.3.2.6 (see 5.4.2 ee)).

If lifting accessories (e.g. eyelets inside the structure/frame of machinery) are provided, strength calculations shall take account the value of a safety factor chosen to guarantee an adequate level of safety. This safety factor shall be at least equal to 1,5.

Verification: By calculation, checking of relevant drawings of machine's parts and relative provisions, checking of instruction handbook and inspection of the machine.

4.3.2 Stability

It shall be possible to fix the machines and auxiliary equipment to a suitable stable structure, e.g. floor. Facilities for fixing are e.g. fixing holes in the machine frame and auxiliary equipment frame.

As regards the fixing to the floor/foundation structure, strength calculation of the support structure and relative provisions shall take into account the value of a safety factor chosen to guarantee an adequate level of safety in the worst operating conditions. This safety factor shall be at least equal to 1,5.

Verification: By calculation, checking of relevant drawings of machine's parts and relative provisions, checking of instruction handbook and inspection of the machine.

4.3.3 Tool changing

4.3.3.1 Automatic tool changing

The tool fixing device shall be such that the tools do not become loose during start up, working, rundown (e.g. fixing with central and self-locking screws with flanges having screw threads or self-locking worm-lock devices).

The milling tool spindle run-out shall not exceed 0,03 mm.

Tool release and dismounting shall only be possible if the spindle is stopped.

The control system for interlocking between tool release and spindle rotation shall be at least PL = c in accordance with the requirements of EN ISO 13849-1:2015 or consist of two independent systems of at least PL = b in accordance with the requirements of EN ISO 13849-1:2015.

As an exception, the tool-release function can be of PL = b in accordance with the requirements of EN ISO 13849-1:2015 if there is an additional mechanical system which prevents releasing the tool during rotation (e.g. by centrifugal force).

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

4.3.3.2 Manual tool changing

The tool-fixing device shall be such that the tools do not become loose during start up, working, run-down.

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

The manufacturer shall indicate the procedures to ensure the correct mounting and fixing (see 5.3).

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

4.3.4 Braking tool spindle

For machines with peripheral enclosure according to 4.3.5.1, no tool-spindle braking is required.

As an exception, only for bridge sawing machines equipped with light beams according to 4.3.5.1, an automatic electrical brake shall be provided for the tool spindle(s) where the unbraked run-down time exceeds 10 s. The braked run-down time shall be less than 10 s.

Only electrical brakes are allowed. They shall perform their function either by direct current injection or by static frequency inverter braking.

Electrical braking systems shall not perform their function by reverse current braking.

The control system for braking shall achieve at least PL = b and be designed in category 2 of EN ISO 13849-1:2015 with the exception that the test-rate requirement in EN ISO 13849-1:2015, 4.5.4, is not applicable. The safety-related part of the control system for braking shall be tested periodically, e.g. by monitoring braked run-down time. The feedback shall come from either the encoder fitted to the spindle motor or from the measurement of the residual current in the wires powering the motor. The test shall be:

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

b) independent from the intention of the operator;

c) performed at each spindle stop.

Where the test result is negative more than three times in succession, it shall not be possible to operate the machine. A negative test result shall be indicated at the main control panel.

NOTE For this safety function, usually category 2 of EN ISO 13849-1:2015 is applied.

The diagnostic coverage (DCavg) shall be at least 60 % (see EN ISO 13849-1:2015, Annex E, for DC estimation).

Verification: For the determination of unbraked run-down time and braked run-down time, if relevant, see the appropriate test given in Annex B.

4.3.5 Prevention of access to moving parts and safeguards to minimize the effect of ejection

4.3.5.1 Guarding of tools

Access to the tools and hazards due to ejection shall be prevented by peripheral enclosure consisting of fixed guards and interlocking movable guards with guard locking.

Guards shall be according to EN ISO 14120:2015, and interlocking movable guards shall be according to EN ISO 14119:2013.

The peripheral enclosure shall extend up to at least 1 800 mm from the floor level and the distance between the top of the guard and the tools shall be not less than 200 mm. To enter the enclosure for setting, tool changing, cleaning or loading/unloading, a door shall be provided and be interlocked with guard locking to the drives. A reset control device according to 4.2.2.1 shall be provided for each door.

As an exception, for bridge sawing machines when the diamond disk is protected with a fixed guard so to cover the disk up to the height of maximum 40 mm (see Figure 5) from the fastening flange, the peripheral enclosure height shall be at least 1 500 mm from the floor level, and the distance from the top of the guard and the tool shall be not less than 850 mm. In this case, the following requirements shall be fulfilled:

a) disk guards shall be resistant to corrosion and wear and to be able to retain the possible ejection of materials or fragments (see 4.3.5.5);

b) the protection cover shall allow the mounting and removal of the diamond disk without dismantling the cover itself.

Dimensions in millimetres

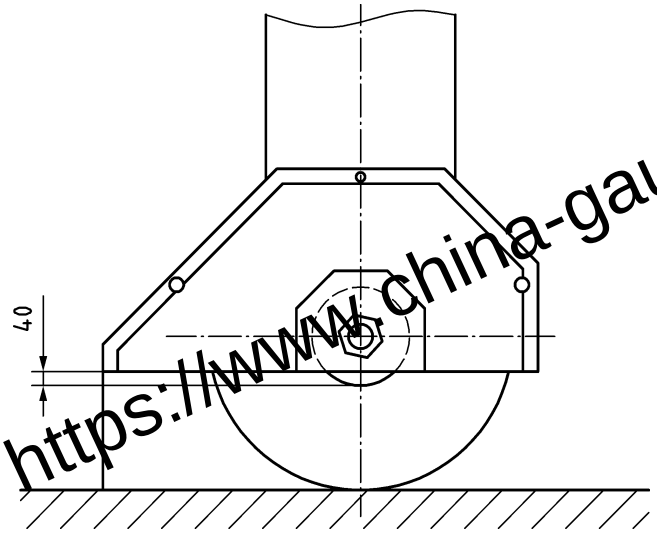


Figure 5 — Example of a diamond disk guard

Guard locking shall be spring-applied/power-released in accordance with EN ISO 14119:2013, Annex F. As an exception, when the tool-stopping time is less than 10 s, guard locking may be by a manually operated delay device in accordance with EN ISO 14119:2013, Annex F.

The control circuit for interlocking with guard locking shall be at least PL = c in accordance with the requirements of EN ISO 13849-1:2015.

As an exception, the bridge sawing machine at the side(s) where direct ejection towards the operator can be excluded (i.e. bridge sawing machine with fixed cutting plane) may be provided with light beams fulfilling the following requirements:

a) any electronic light barrier shall be of at least Type 2 in accordance with EN 61496-1:2013, and its associated safety-related control systems shall be at least PL = c in accordance with EN ISO 13849-1:2015;

b) light barriers shall consist of at least three opto-electronic elements situated at a height of 300 mm, 700 mm, 1 100 mm above the floor level;

c) the light barriers shall be positioned at a minimum distance of 850 mm from any rotating tool;

d) a reset control device according to 4.2.2.1 shall be provided;

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

The materials characteristics of the guards shall conform to 4.3.5.5.

Fixed guards that are to be demounted by the user, e.g. for maintenance and cleaning purposes, shall be fitted with fixing elements remaining attached to the machine or to the guard when the guard is removed, e.g. unlosable screws (see also 5.4.3 l)).

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

4.3.5.2 Guarding of drives

Access to drive mechanisms (which include tool spindles, feed, etc.) shall be prevented either by fixed enclosing guards or interlocking movable guards with guard locking with the corresponding motor drives. If guards with openings are provided, the requirements of EN ISO 13857:2019, Table 4, shall be fulfilled.

Guards shall be according to EN ISO 14120:2015, and interlocking guards shall be according to EN ISO 14119:2013.

Fixed guards that are to be demounted by the user, e.g. for maintenance and cleaning purposes, shall be fitted with fixing elements remaining attached to the machine or to the guard when the guard is removed, e.g. unlosable screws (see also 5.4.3 l)).

When hazardous machinery functions have ceased in less than 10 s after initiation of the stop command, the guard locking may be by a manually operated delay device in accordance with EN ISO 14119:2013, Annex F.

The control circuit for interlocking with guard locking shall be at least PL = c in accordance with the requirements of EN ISO 13849-1:2015.

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

4.3.5.3 Access to moving parts (except tools and drives)

Access to moving parts that present hazards of impact, crushing, shearing, drawing-in and entanglement shall be prevented by:

a) fixed guards or interlocking movable guards with guard locking, extending up to at least 2 000 mm from the floor level (without a minimum distance inwards from the top of the guard and the points that present hazards of impact, crushing, shearing, drawing-in and entanglement to be fulfilled) or up to at least 1 800 mm from the floor level if the distance from the top of the guard and the points that present hazards of impact, crushing, shearing, drawing-in and entanglement is not less than 200 mm;

b) pressure-sensitive bumper according to 4.3.5.4 up to 1 800 mm from the floor level.

Guards shall be according to EN ISO 14120:2015, and interlocking movable guards shall be according to EN ISO 14119:2013. The distance among the openings in the guards shall conform to the requirements of EN ISO 13857:2019, Table 3 or Table 4.

Fixed guards that are to be demounted by the user, e.g. for maintenance and cleaning purposes, shall be fitted with fixing elements remaining attached to the machine or to the guard when the guard is removed, e.g. unlosable screws (see also 5.4.3 l)).

When hazardous machinery functions have ceased in less than 10 s after initiation of the stop command, guard locking may be by a manually operated delay device in accordance with EN ISO 14119:2013, Annex F.

The control circuit for interlocking with guard locking shall be at least PL = c in accordance with the requirements of EN ISO 13849-1:2015.

Where only an impact hazard is foreseeable and the maximum axis speed is below 25 m/min, no protective device is required where no hazards exist from projecting parts, e.g. screws.

The safety-related part of the control system for limited speed control of machine-moving parts (tools excepted) shall be at least PL = c in accordance with the requirements of EN ISO 13849-1:2015.

For safely-limited speed (SLS) of PDS(SR) (power drive system, safety-related), EN 61800-5-2:2017, 4.2.4.5, applies.

When the limited speed of moving machine parts is exceeded, the related drive motor shall be stopped automatically. This stop shall be of stop category 0 in accordance with EN 60204-1:2018, 9.3.2.

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

4.3.5.4 Pressure-sensitive bumper

Pressure-sensitive bumpers shall be such that the movement is stopped before impact/crushing force exceeds maximum:

a) 400 N if impact/crushing risk for the whole body is present; or

b) 250 N if only crushing risk for arm is present; or

c) 150 N if only crushing risk for head/hand/finger is present.

The force shall be measured at a maximum speed of the machining head using a fixed probe as defined in EN ISO 13856-3:2013, positioned perpendicular to the direction of motion.

Pressure-sensitive bumpers shall extend to the whole height of the machine-moving component up to a height of 1 800 mm and from the edge inward up to at least 700 mm from the machine side accessible by the operator when machining.

The control circuit for pressure-sensitive bumpers shall be at least PL = c in accordance with the requirements of EN ISO 13849-1:2015.

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

4.3.5.5 Requirements for guard materials

Where guards are used as capturing devices to minimize the effect of ejection of machine parts or workpiece parts, they shall be:

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

b) light alloy with characteristics in accordance with the requirements of Table 1;

Table 1 — Light alloy guard thickness and tensile strength

Minimum ultimate tensile strength N/mm^2	Minimum wall thickness mm
180	5
240	4
300	3

c) polycarbonate of at least 5 mm thickness;

d) concrete wall minimum thickness 200 mm or 100 mm with RCK not less than 30 MPa;

e) any material passing the impact test in Annex C.

Verification: By checking the relevant drawings, tensile strength, measurement, inspection of the machine and performing the impact test given in Annex C only for materials other than those mentioned above.

4.3.5.6 Clamping devices

Where powered clamping is provided, crushing hazards shall be prevented by any of the means described in 4.3.5.

When the machine is provided with hydraulic or pneumatic clamping device, the requirements of EN ISO 4413:2010 or EN ISO 4414:2010 shall be met.

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

4.4 Protection against no mechanical hazards

4.4.1 Fire

To minimize the risk from fire, the requirements of 4.4.3 shall be fulfilled.

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

4.4.2 Noise

4.4.2.1 Noise reduction at the design stage

Machinery shall be designed and constructed in such a way that risks resulting from the emission of airborne noise are reduced to the lowest level taking account of technical progress and the availability of means of reducing noise, in particular at the source.

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

The main noise sources are:

a) tools;

b) tool spindles drives;

c) axes drives;

d) pneumatic system (if provided);

e) hydraulic system (if provided).

Examples of technical measures for noise reduction are:

a) use of low noise machine components;

b) choice and design of low noise transmission components, e.g. gears, pulleys, belts, bearings clutch;

c) isolation of noise sources by installing enclosures or guards.

Alternative measures with identical or higher effectiveness may be used.

NOTE EN ISO 11688-2:2000 provides useful information on noise generation mechanisms in machinery.

Verification: Noise emission values determined according to the noise test code given in Annex D allow, in particular, to verify the effectiveness of the implemented design measures.

4.4.2.2 Noise emission measurement

The noise emission measurement shall be carried out according to Annex D.

Verification: By checking that the noise emission values determined according to Annex D are given in the instruction handbook.

4.4.3 Electrical hazards

With the exception of 6.3, the requirements of EN 60204-1:2018 apply unless stated otherwise in this document.

See EN 60204-1:2018, 6.2 for the requirements regarding prevention of electric shock due to direct contact and EN 60204-1:2018, Clause 7, for the requirements regarding protection against short circuits (feeder circuit excluded) and overloading.

The machine manufacturer shall provide the protective bonding system of the machine up to the PE terminal and shall provide the user with information on how to complete protection against electric shock due to indirect contact [see 5.4.2 t)].

The machine manufacturer shall provide the user with information on how to provide the protection against short circuiting of the feeder circuit [see 5.4.2 u)].

NOTE The protection against short circuiting of the feeder is not up to the machine manufacturer.

The degree of protection of all electric components outside of enclosure(s) and the enclosure(s) for electrical components itself/themselves shall be at least IP 54 in accordance with the requirements of EN 60529:1991, EN 60529:1991/A1:2000, EN 60529:1991/A2:2013.

Electrical enclosures shall not be exposed to risk from the ejection of tools or workpieces. Live parts shall not be accessible in accordance with EN 60204-1:2018, 6.2.2. Fire risk is not present where power circuits are protected against overcurrent in accordance with EN 60204-1:2018, 7.2.3.

In accordance with EN 60204-1:2018, 18.2.2, the test 1 for the continuity of the protective bonding circuit and with EN 60204-1:2018, 18.6, the functional test apply.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant tests (EN 60204-1:2018, 18.2.2, test 1, and functional test according to EN 60204-1:2018, 18.6).

4.4.4 Ergonomics and handling

The machine and its controls shall be designed according to ergonomic principles in accordance with EN 1005-4:2005+A1:2008.

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

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

4.4.5 Hydraulic and pneumatic components

The hydraulic and pneumatic systems shall comply with the requirements of EN ISO 4413:2010 and EN ISO 4414:2010.

When compressed air comes from a compressor outside the machine, the input point shall be fitted with a gate valve, which makes it possible to close the air supply.

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

4.4.6 Electromagnetic compatibility

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

Machines which incorporate CE-marked electrical components and where such components and cabling are installed in accordance with their respective manufacturer's instructions are generally considered to be protected against external electromagnetic interference. If only one of the above-mentioned requirements is not fulfilled, additional testing in accordance with EN 50370-2:2003 is required.

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

4.4.7 Laser radiation

If the machine is fitted with a laser, the laser shall be of category 2, category 2 M or a lower risk category in accordance with the requirements of EN 60825-1:2014 (also see 5.4.2 cc)).

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

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

4.4.8 Unintended movements

Machines shall be designed and constructed in order to minimized any hazard resulting from raised elements falling due to gravity, e.g. in the event of failure of any energy supply (see 4.2.8) or fault.

Devices used to prevent gravity fall, for example:

— check valve piloted valve or a shut-off valve, which are fixed directly to the drive element, e.g. cylinder;

— friction-locked clamping device;

and their associated components/actuators shall be capable of holding a load of at least 1,5 × the static holding load.

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

4.4.9 Isolation

The principles of EN ISO 12100:2010, 6.2.10 and 6.3.5.4, shall be observed and in addition, electrical isolators shall be in accordance with EN 60204-1:2018, 5.3, except that the isolator shall not be type d) in EN 60204-1:2018, 5.3.2.

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

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

be locked in the off position (e.g. by a padlock). Dumping pneumatic pressure shall not be by disconnection of a pipe.

The machine shall have means to isolate hydraulic power (if provided) according to EN ISO 4413:2010.

Where the machine has a hydraulic system that is powered by an integral electrically operated hydraulic pump, isolation of the hydraulic power is allowed by disconnecting the electrical supply. Where hydraulic energy is stored, e.g. in a reservoir or pipe, safe means for dumping of residual pressure shall be provided. Safe means can include a valve, but does not include disconnection of any pipe.

The electric isolator shall have its function, location and operational position clearly identified, e.g. by a label or a pictogram. The label or pictogram shall be fitted in a position clearly visible in close proximity to the isolator on the machine (also see 5.2).

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

4.4.10 Maintenance

The principles of EN ISO 12100:2010, 6.2.15, shall be observed.

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

5 Information for use

5.1 General

Information for use shall be provided in accordance with EN ISO 12100:2010, 6.4.

5.2 Signals and warning devices

Information on negative test result of the braking system shall be displayed at the main control panel.

If the machine is equipped with a pneumatic supply, a permanent warning label shall be placed in proximity to the electrical supply disconnection device, warning that the pneumatic supply is not isolated by isolation of the electrical supply.

The warnings shall either be in the language of the country in which the machine is placed on the market and/or put into service or, wherever possible, by using pictograms.

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

5.3 Marking, signs and written warnings

The following minimum marking shall be permanently marked on the machine:

a) the business name and full address of the manufacturer and, where applicable, his authorized representative;

b) designation of the machinery;

c) mandatory required marking [1];

d) year of manufacturing, that is the year in which the manufacturing process is completed;

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1 For machines and their related products intended to be put on the market in the EEA, CE marking as defined in the applicable European directive(s), e.g. Machinery, Lifts, Explosive Atmospheres ATEX, Pressure Equipment.

e) declaration of the series or type;

f) machine serial number if existing;

g) power designation (compulsory for electrical products: voltage, frequency, nominal current, etc.);

h) the marking of their mass on machine parts that shall be handled with mechanical means;

i) the nominal (maximum) speed of tool spindles (see 5.4.2);

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

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

5.4 Instruction handbook

5.4.1 General

An instruction handbook shall be drawn up in accordance with EN ISO 12100:2010, 6.4.5.

5.4.2 Operator's manual

At least the following user information shall be included:

a) the business name and full address of the manufacturer and of his authorized representative;

b) repetition of the marking, signs and written warnings and any other instructions on the machine as described in 5.3;

c) intended use of the machine;

d) foreseeable misuse (e.g. machining of materials other than those mentioned in the scope of this standard);

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

f) information on the existing residual risks; a warning regarding residual risk:

   1) to wear ear protection to prevent hearing loss;

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

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

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

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

i) the correct procedures for manual mounting and fixing of tools;

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

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

l) the safe clamping of the workpiece when machining;

m) instruction on those devices which shall be verified, how frequently the verifications shall be carried out and by what method. This shall include at least the following:

   1) emergency stop(s) - by functional testing;

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

   3) vacuum clamping - by functional testing;

   4) bumpers - by functional testing;

   5) light-beams - by functional testing;

n) indication that the given rotating direction shall be checked;

o) indication that every contact with the rotating tool shall be avoided;

p) information on the operator's controls, especially on the on/off and on the emergency-stop installation;

q) information on the choice of the appropriate tools and their application regarding the task to be performed;

r) indication that no tools shall be used whose maximum rotational speed is lower than the selected speed of the machine;

s) information about the safety measures for interventions including disconnection of the energy supply or supplies, measures against reconnection, neutralization of residual energies, testing of safe state; if for frequent interventions, such complete disconnection is not possible, the manufacturer shall provide appropriate procedures for safely carrying out the intervention;

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

u) information on how to provide protection against short circuits of the feeder circuit;

v) instructions on the detection of defects, the troubleshooting and the reoperation after intervention;

w) indication on suitable clothing and personal protection equipment (e.g. eye and hearing protection);

x) indication that the correct mounting of guards shall be checked;

y) indication for avoiding the risk of stumbling in the working area of the machine, e.g. prevention of risk of slipping due to moisture and mud, covering open parts of guide rails at the floor;

z) indication that, for safety reasons, every damaged (broken) tool shall be replaced;

aa) advice that apart from the operator, nobody shall be within the working area;

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

cc) that where a laser is fitted to the machine, the laser manufacturer's instructions required by EN 60825-1:2014 shall be provided with a recommendation that no exchange with a different type of laser shall be done, that no additional optical equipment shall be used and that repair shall only be carried out by the laser manufacturer or other authorized persons;

dd) information about transport and lifting of the machine;

ee) information on installation, the manufacturer shall always indicate:

1) machine overall dimensions and weight;

2) workspace;

3) the mounting unit on the ground and the vertical force at supporting foot or machine anchoring points;

4) inlet and outlet water points;

5) inlet and outlet electrical main power supply;

6) the positioning of the machine for ensuring minimum distances between moving parts of the machine (e.g. bridge) and fixed or moving parts in the proximity of the machine in accordance with EN ISO 13854:2019;

7) the fixing of the machine and/or the rails;

8) indications on the connection on the power supply and water supply;

9) specify the proper use of cooling lubricant supply process, usually water, while on line or recovery system;

ff) the instruction for setting the machine. This includes the precautions during setting as:

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

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

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

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

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

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

gg) the instructions to minimize noise levels including:

1) the condition of the tools;

2) the guards positioning so as to reduce noise levels;

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

hh) declaration regarding airborne noise emissions from the machinery in accordance with D.6;

ii) the operating method to be followed in the event of accident or breakdown; if a blockage is likely to occur, the operating method to be followed so as to enable the equipment to be safely unblocked;

jj) where tele-control is provided, information that it shall only be activated with the machine operator present at the machine.

Verification: By checking the instruction handbook.

5.4.3 Maintenance manual

The use and maintenance manuals shall be in accordance with EN 82079-1:2012.

At least the following user information shall be included:

a) information on the existing residual risks; a warning regarding residual risk:

1) to wear eye protection;

2) to wear gloves against the hazard of cutting when handling tools or doing maintenance;

b) indication that every contact with the rotating tool shall be avoided;

c) information about the safety measures for interventions including disconnection of the energy supply or supplies, measures against reconnection, neutralization of residual energies, testing of safe state; if for frequent interventions, such complete disconnection is not possible, the manufacturer shall provide appropriate procedures for safely carrying out the intervention;

d) list of tasks (e.g. adjustment, maintenance, lubrication, cleaning and service activities) that shall be carried out only when the machine is down and the main drive is off;

e) details and frequency of inspections;

f) instruction of maintenance activities which can be carried out by the operator (including indications on safe appliances and facilities to be used);

g) list of maintenance activities which shall only be carried out by qualified maintenance personnel - as they require special technical knowledge - including indications on safe appliances and facilities to be used;

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

i) information about safe cleaning;

j) if fitted with a pneumatic and/or hydraulic system, the method for the safe dissipation of residual energy (see 4.4.9);

k) the identification data of the spare parts to be changed by the user, when these affect the health and safety of operators (parts to be changed only by the manufacturer or personnel hired by the manufacturer are excluded);

l) description of fixed guards which shall be removed by the user for maintenance and cleaning purposes (guards to be dismounted only by the manufacturer or personnel hired by the manufacturer are excluded);

m) information that process water shall be filtered and checked regularly to avoid the presence of pollutants that can be dangerous to the operator;

n) information that when the guard is open, if there are moving parts or pipes under pressure, air or water, the use of safety glasses is required according to EN 166:2001.

Verification: By checking the maintenance manual.

Annex A
(informative)

List of significant hazards

This clause contains in Table A.1 all the significant hazards, hazardous situations and events, as indicated in EN ISO 12100:2010, Annex B, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

Table A.1 — List of significant hazards

Type or group	Origin	Potential consequences	Subclause of this document
Mechanical hazards	Approach of a moving element to a fixed part	Crushing Impact	4.3.5
	Cutting parts	Cutting and shearing	4.3.3, 4.3.4, 4.3.5
	Gravity Falling objects	Impact	4.3.1, 4.3.2, 4.4.8
	Instability	Crushing Impact Being run over	4.3.1, 4.3.2, 5.4.2
	Kinetic energy, ejection	Impact Being thrown Stabbing	4.3.3, 4.3.4, 4.3.5
	High pressure	Crushing Impact Being thrown	4.4.5, 4.4.9
	Moving elements	Drawing-in Entanglement Being thrown	4.3.5
	Rotating elements	Cutting Abrasion Entanglement Being thrown	4.3.3, 4.3.4, 4.3.5
Electrical hazards	Live parts	Electrical contact with live parts Shock Fire	4.4.1, 4.4.3
	Not enough distance to live parts under high voltage		
	Parts which have become live under fault conditions		

Type or group	Origin	Potential consequences	Subclause of this document
	Short circuit		
Noise hazards	Manufacturing process	Hearing loss Accidents due to interference with speech communication and alert acoustic signals Physiological effects such as loss of awareness, stress and tinnitus	4.4.2
Radiation hazards	Optical radiation (infrared, visible, ultraviolet, including laser	Damage to eyes and skin	4.4.7
Ergonomic hazards	Access (worktable height)	Discomfort Fatigue Stress Impact Human error	4.4.4
	Location of indicators and control devices		
Hazards associated with the environment in which the machine is used	Electromagnetic disturbance	Unexpected start/stop Break Command failure Any other as a consequence of the effect caused by the sources of the hazards on the machine or parts of the machine	4.2, 4.4.3, 4.4.6
	Moisture		
	Temperature		
Hazards associated with unexpected start-up, unexpected overrun/overspeed (or any similar malfunction)	Failure/disorder of the control system	Unexpected start/stop Break Command failure Crushing Impact Cutting and shearing Being run over Being thrown Drawing-in Entanglement Abrasion Any other as a consequence of the effect caused by the sources of the hazards on the	4.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.5, 4.4.6, 4.4.10
	Uncontrolled restoration of energy supply after an interruption		
	Errors in the software		
	Impossibility of stopping the machine in the best possible conditions		
	Variations in the rotational speed of tools		
	Errors of fitting		
	Break-up during operation		

Type or group	Origin	Potential consequences	Subclause of this document
	Loss of stability/ overturning of machinery	machine or parts of the machine	
	Slip, trip and fall of persons (related to machinery)		

Annex B
(normative)

Test for braking function

B.1 Conditions for all tests

a) The spindle unit shall be set in accordance with the intended use of the machine (as stated in the instruction handbook (see 5.4));

b) when selecting the speed and the tool(s) for the tests, conditions shall be chosen which create the greatest kinetic energy for which the machine is designed;

c) before beginning the test, the spindle unit shall be run for at least 15 min at idle speed;

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

B.2 Unbraked run-down time

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

a) start the spindle-drive motor and run at the intended speed (no load) for 1 min;

b) cut power to the spindle-drive motor and measure the unbraked run-down time;

c) repeat steps a) and b) twice.

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

B.3 Braked run-down time

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

a) start the tool spindle drive motor and run at the intended speed (no load) for 1 min;

b) initiate the stopping sequence and measure the braked run-down time;

c) allow the spindle to rest for not more than $(P/c)^2$ min (where P is the motor power (rated input) in kW and factor c = 7,5 kW). The restart interval shall not be less than 1 min;

d) restart the spindle-drive motor and run at no load for not more than $(P/c)^2$ min (where P is the motor power (rated input) in kW and factor c = 7,5 kW). The idle running time shall not be less than 1 min.

The test is repeated 9 times.

The braked run-down time is the average of the 10 measurements taken. The standard deviation of the 10 measurements shall not exceed 10 % of this average.

Annex C
(normative)

Rigid guards on machines - Impact test method

C.1 General

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

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

C.2 Test method

C.2.1 Preliminary remarks

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

C.2.2 Testing equipment

C.2.2.1 General

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

C.2.2.2 Projectiles

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

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

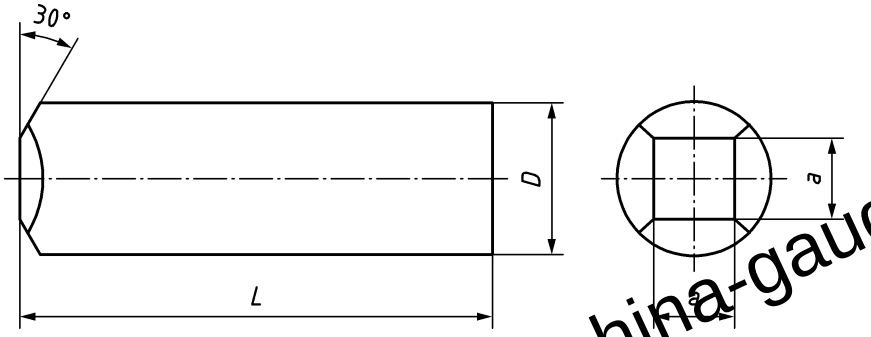
a) tensile strength: Rm = 560 N/mm² to 690 N/mm²;

b) yield strength: $R_{0,2} \geq 330$ N/mm²;

c) elongation at rupture: A ≥ 20 %;

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

e) mass = 100 g.



Key

D	20 mm
A	10 mm
L	length of the projectile

Figure C.1 — Projectile for rigid guard test

C.2.2.3 Sampling and supporting the guard under test

The test is carried out with the guard and/or a sample of the guard material. The guard support shall be equivalent to the guard mounting on the machine. For testing, guard materials samples may be used, fixed on a frame with an inner opening of 450 mm × 450 mm. The frame shall be in accordance with EN ISO 14120:2015. The mounting of the sample shall be by non-positive clamping.

C.2.3 Test procedure

For machines equipped with milling cutters, the impact test shall be executed with projectile indicated in C.2.2.2 and an impact speed of (70 ± 3,5) m/s.

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

Alternatively, a drop test can be performed with the same impact energy. The same impact energy can be obtained, e.g. by adding a mass to the rear of the projectile in Figure C.1 and reducing the impact speed, taking into account the height of drop.

C.3 Results

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

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

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

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

d) penetration (projectile penetrated the test object);

e) guard window loosened from its fixing;

f) guard loosened from guard support.

C.4 Assessment

The test is passed if there is no through crack or penetrations of the test object and if there are no damages as shown in C.3 c), d), e) and f).

C.5 Test report

The test report shall give the following minimum information:

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

b) projectile mass, dimensions, speed;

c) applicant identification;

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

e) clamping or fixing of the test object;

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

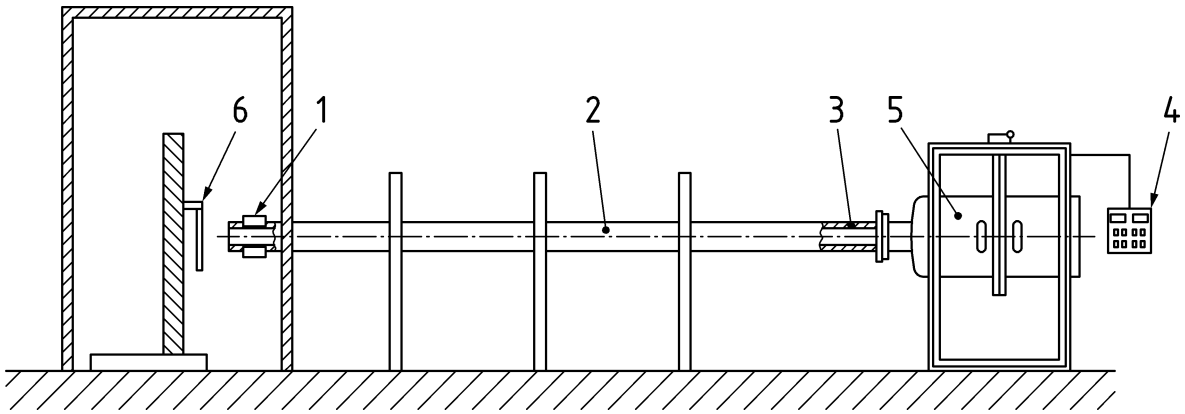
g) test result.

C.6 Example of propulsion device for impact test

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

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

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



Key

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

Figure C.2 — Example of equipment for impact test

Annex D
(normative)

Noise test code

D.1 Introduction

This noise test code specifies all the information necessary to carry out efficiently and under standardized conditions the determination, declaration and verification of the airborne noise emission values of bridge type sawing/milling machines including numerical control (NC/CNC) versions.

The determination of these quantities is necessary for:

a) manufacturers to declare the noise emitted;

b) comparing the noise emitted by machines in the family concerned;

c) purposes of noise control at the source at the design stage.

This noise test code specifies the noise measurement methods and operating and mounting conditions for the test.

The use of this noise test code ensures the reproducibility of the measurements and the comparability of the airborne noise emission values within specified limits determined by the grade of accuracy of the basic measurement method used.

D.2 Measurement of the A-weighted emission sound pressure level at the operator's positions or other specified positions

D.2.1 Basic standards

The determination of the A-weighted emission sound pressure level shall be carried out using a method with an accuracy grade of 2 (engineering) or 3 (survey). One of the following standards shall be applied: EN ISO 11201:2010 (grade 2) or EN ISO 11202:2010 (grade 2 or grade 3) or EN ISO 11204:2010 (grade 2 or grade 3).

For noise measurement, grade 2 (engineering grade) is preferred with the benefit of having a lower uncertainty, but grade 3 (survey grade) is allowed.

NOTE 1 EN ISO 11200:2014 provides explanations about the various methods for determining the emission sound pressure level at workstations.

NOTE 2 Grade 2 of accuracy can be reached only with class 1 measuring instruments. Class 2 instruments are allowed when using EN ISO 11202:2010, but grade 3 of accuracy results are obtained with, consequently, a higher uncertainty.

D.2.2 Measurement procedure and positions

Measurements shall be carried out at each microphone position during at least one test cycle of the machine as defined in D.4.

The microphone shall be located at all operator's positions designated by the manufacturer in the instruction handbook. The A-weighted emission sound pressure level at each of these operator's

positions shall be recorded, reported and declared together with the associated measurement uncertainty.

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

a) 1,60 m above floor level or platform and 0,5 m from the main control panel;

b) 1,60 m above floor level or platform and 0,5 m from any other work station (e.g. loading and unloading) specified by the manufacturer in the instruction handbook.

D.2.3 Measurement uncertainty

If a grade 2 (engineering) method is used, the standard deviation of reproducibility for A-weighted emission sound pressure levels at work stations is:

σ_{RA} = 1,5 dB, resulting in a measurement uncertainty of 3 dB if operating conditions of the machine are stable, which is normally the case for the machines covered by this document.

The measurement uncertainty may be much higher if a grade 3 (survey) method is used and/or operating conditions of the machine are not stable.

NOTE Detailed information about uncertainty is given in EN ISO 11201:2010, Clause 11, EN ISO 11202:2010, Clause 12, and EN ISO 11204:2010, Clause 11. See also EN ISO 4871:2009.

D.3 Determination of sound power level

D.3.1 Measurement procedure and positions

If the A-weighted emission sound pressure level at any of the measurement positions considered in D.2 exceeds 80 dB, the A-weighted sound power level should normally be determined.

However, machines covered by the present document that have at least a largest dimension that exceeds 6 m, are considered as very large machines. Therefore, instead of the A-weighted sound power level, the A-weighted emission sound pressure levels shall be measured on a path at 1 m from the enveloping surface of the machine and at a height of 1,60 m from the floor. Microphone positions on the path shall be separated by not more than 2 m, and measurements shall be carried out as specified in D.2. Values shall be recorded, reported and declared together with the associated measurement uncertainty.

If the A-weighted emission sound pressure level at any of the measurement positions considered in D.2 exceeds 80 dB and no dimension exceeds 6 m, the A-weighted sound power level shall be determined.

The sound power level determination shall be carried out using a method with an accuracy grade of 2 (engineering) or 3 (survey). One of the following standards shall be applied: EN ISO 3744:2010 (grade 2), EN ISO 3746:2010 (grade 3), EN ISO 3747:2010 (grade 2 or grade 3).

For the measurement of the sound power level, a method with the same grade of accuracy as the one used for the emission sound pressure level measurement shall be used.

When using EN ISO 3744 or EN ISO 3746, the measurement surface shall be a parallelepiped and the measurement distance shall be 1 m.

NOTE EN ISO 3740:2019 provides explanations about the various methods for determining sound power levels.

D.3.2 Measurement uncertainty

If a grade 2 (engineering) method is used, the standard-deviation of reproducibility for A-weighted sound power levels is:

σ_{RA} = 1,5 dB, resulting in a measurement uncertainty of 3 dB if operating conditions of the machine are stable, which is normally the case for the machines covered by this document.

The measurement uncertainty may be much higher if a grade 3 (survey) method is used and/or operating conditions of the machine are not stable.

NOTE Detailed information about uncertainty is given in EN ISO 3744:2010, Clause 9, EN ISO 3746:2010, Clause 9. See also EN ISO 4871:2009.

D.4 Installation, mounting and operating conditions for noise emission measurement

During the noise test, the machine shall be installed, mounted and operated as specified/recommended by the manufacturer in the instruction handbook.

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

For the noise tests, the following requirements shall be fulfilled:

a) all integrated auxiliary units, relevant noise sources in the normal cycle and for the measurement, e.g. power feed, pneumatic clamping, shall be in function during testing;

b) all relevant guards, safety protective devices, integral sound enclosures, etc. shall be in position during testing;

c) in accordance with the dimensional requirements of the machine manufacturer, conventional tools normally available on the market shall be used;

d) tools shall be properly installed according to the instructions of their manufacturer. The test measurement shall not comprise the beginning and the end of cutting;

e) the processed material shall be one of the following types of granite: Porrino pink, Sardinian pink, Sardinian white;

f) testing operating arrangement, i.e. slab dimensions, tools characteristics, cutting data and testing operation shall be in accordance with Tables D.1 to D.4. For each machine, only the relevant tests among those defined in Tables D.1 to D.4 shall be performed.

D.5 Information to be recorded and reported

The information to be recorded and reported shall include all the data required by the basic measurement standard(s) used, i.e. precise identification of the machine under test, acoustic environment, instrumentation, presence and position(s) of the operator(s), if any.

The operating conditions of the machine during measurement and the method that has been used for the measurement shall be indicated by reference to this noise test code with indication of possible deviations with justification of them.

At least the data specified in Tables D.1 to D.4 shall be recorded and reported. If in a specific situation, it is necessary to deviate from them, the actual condition applied for the test shall be recorded and reported in the column “Conditions chosen within permitted range or conditions deviating from standard” of Tables D.1 to D.4.

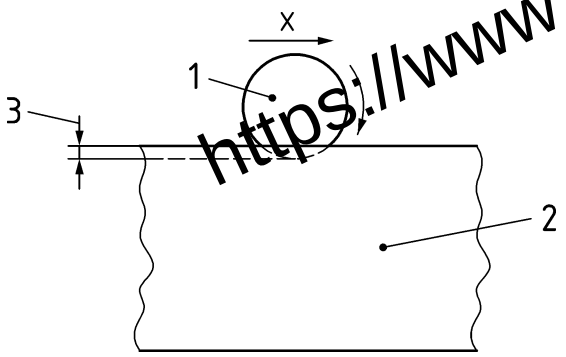
The form in Tables D.1 to D.4 may be copied, modified and distributed free of charge.

Table D.1 — Noise test code - General Data Sheet

Machine data	Manufacturer: …… Model: …… Year of manufacture: …….. Serial no: …… Overall dimensions of machine[a]: Length l_1: …….. mm Width l_2: …….. mm Height l_3: …….. mm
[a] Those elements which protrude from the machine and which are not likely to contribute to the noise emission (e.g. hand-wheels, levers) may be disregarded.	
Report all the data required by the basic measurement standard(s) used, i.e. precise identification of the machine under test, acoustic environment, instrumentation, presence and position(s) of the operator(s) if any.	
Photo or detailed illustration of the machine tested	

<table>
<tr><td>Testing results</td><td colspan="2"></td></tr>
<tr><td rowspan="6">Testing laboratory</td><td colspan="2">Firm/institution:
……</td></tr>
<tr><td colspan="2">Address:
……</td></tr>
<tr><td>Telephone:
……</td><td>Date:
……</td></tr>
<tr><td colspan="2">Signature:
……</td></tr>
<tr><td colspan="2">Test carried out:
……</td></tr>
<tr><td colspan="2">Place:
……</td></tr>
<tr><td colspan="2">Date:
……</td></tr>
</table>

Table D.2 — Noise test code – Testing operating arrangements

Testing operating arrangement	Standard conditions	Conditions chosen within permitted range or conditions deviating from standard
Test 1 - Straight not passing through cut with a diamond disk  **Key** 1 diamond disk 2 granite slab 3 cutting depth *Direction of work:* x-axis, i.e. on the front long edge on the side facing the loading position. *Position of the workpiece:* in the middle of the machine table.		

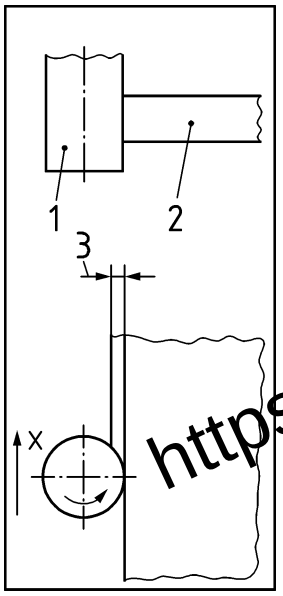
Test 2 – Straight cut with a finger bit milling tool  **Key** 1 finger bit 2 granite slab 3 cutting depth *Direction of work:* x-axis, i.e. on the front long edge on the side facing the loading position. *Position of the workpiece:* in the middle of the table.		
Test 3 – Bore with a core bit tool *Bore position:* in the middle of the slab. *Position of the workpiece:* in the middle of the machine table.		

Table D.3 — Noise test code – Tool and cutting data

Tool and cutting data	Standard conditions	Conditions chosen within permitted range or conditions deviating from standard
Tool 1 - diamond disk Spindle speed: 1 300 r/min [*] Cutting circle diameter: 500 mm [*] Cutting depth: 5 mm Feed rate: 5 m/min [*] As an exception, for bridge sawing machines (as defined in 3.1) designed for mounting cutting disc with a cutting circle diameter greater than 625 mm: — cutting circle diameter shall be at least 80 % of the maximum diameter usable; — spindle speed shall be such as to obtain the same peripheral speed of the test performed with a cutting circle diameter of 500 mm and spindle speed of 1 300 r/min.		
Tool 2 - finger bit milling tool Spindle speed: 5 000 r/min Cutting circle diameter: 22 mm Cutting depth: 5 mm Feed rate: 300 mm/min		
Tool 3 – core bit milling tool Spindle speed: 3 500 r/min Cutting circle diameter: 35 mm Feed rate: 60 mm/min		

Table D.4 — Noise test code – Testing material

Testing material	Standard conditions	Conditions chosen within permitted range or conditions deviating from standard
slab length: 1 200 mm slab width: 600 mm slab height: 30 mm		

D.6 Declaration and verification of noise emission values

D.6.1 General

The noise declaration shall be a dual-number declaration as defined in EN ISO 4871:2009, i.e. the measured values and the measurement uncertainty associated to each value shall be indicated separately. Noise emission data to be declared shall be as follows:

a) for machines with no dimension exceeding 6 m, declare the values of the A-weighted emission sound pressure level measured at work stations or operator's positions (see D.2.2) for the operating conditions in Tables D.1 to D.4 that are relevant for the machine considered as follows:

   1) where a value is less than 70 dB, instead of declaring the measured value, insert the statement "L_{pA} less than 70 dB";

   2) where the value is more than 70 dB, declare the measured value.

      If at least a value of the A-weighted emission sound pressure level measured at these work stations or operator's positions (see D.2.2) is more than 80 dB, declare the A-weighted sound power level measured value as indicated in D.3.1.

      The A-weighted sound power level measured value for the operating arrangement(s) for which the A-weighted emission sound pressure level at workstations or operator's positions is higher than 80 dB(A) shall be declared together with the operating arrangement(s).

b) for machines with at least one dimension exceeding 6 m, declare the values of the A-weighted emission sound pressure level measured at work stations or operator's positions (see D.2.2) for the operating conditions in Tables D.1 to D.4 that are relevant for the machine considered as follows:

   1) where a value is less than 70 dB, instead of declaring the measured value, insert the statement "L_{pA} less than 70 dB";

   2) where the value is more than 70 dB, declare the measured value.

      Where at least a value of the A-weighted emission sound pressure level measured at work stations or operator's positions (see D.2.2) is more than 80 dB, no value of sound power level shall be declared. Instead, declare the values of the A-weighted emission sound pressure level measured at positions on a path around the machine as indicated in D.3.1. Values measured and positions on the measurement path around the machine shall be indicated on a drawing. The A-weighted emission sound pressure level measured at the positions on a path around the

machine shall be measured in testing operating arrangement (described in Tables D.1 to D.4), where the A-weighted emission sound pressure level measured value is higher than 80 dB(A).

The A-weighted emission sound pressure levels measured at the positions on a path around the machine for the operating arrangement(s) for which the A-weighted emission sound pressure level at workstations or operator's positions is higher than 80 dB(A) shall be declared together with the operating arrangement(s).

The noise declaration shall explicitly mention that noise emission values have been obtained according to this noise test code. It shall indicate which basic measurement standard has been used and refer to this noise test code for operating conditions including details of the mounting and operating conditions of the machine during the determination of its noise emission. The noise declaration shall clearly indicate deviation(s) from this noise test code and/or from the basic standard(s) used if any.

If a declared value is to be checked, measurements shall be made using the same method and the same operating conditions as those declared.

The noise declaration shall be accompanied by the following WARNINGS statement:

"WARNING 1 — Noise emission values obtained using the noise test code given in Annex D of EN 16564:2020 may underestimate the noise emission values obtained in real use conditions of the machine."

"WARNING 2 — The noise emission values given are only valid if the same operating and mounting conditions are applied. Other operating and mounting conditions, e.g. a different work process, might lead to higher noise emission values with the risk of underestimation."

"WARNING 3 — The noise emission values given are not exposure levels. Whilst there is a correlation between the emission and exposure levels, emission levels cannot be used to reliably determine whether or not further precautions are required. Factors that influence the actual level of exposure include the characteristics of the work room and the other sources of noise, etc., i.e. the number of machines and other adjacent processes."

Information on noise emission, including noise declaration, shall also be given in the technical sales literature providing performance data of the machine.

D.6.2 Examples of a declaration of noise emission values in the instruction handbook for a machine where the largest dimension does not exceed 6 m

The values shown below are only for illustration.

The airborne noise emissions values have been measured in accordance with the requirements of EN 16564:2020.

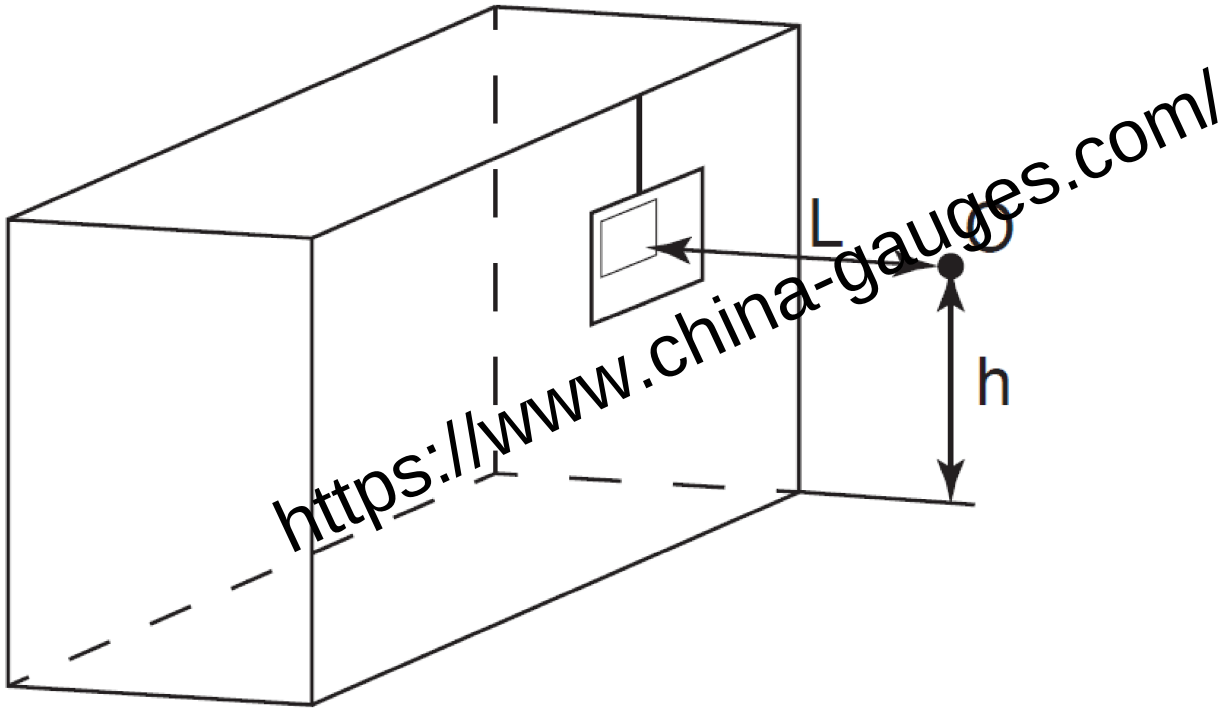
The noise test measurement has been performed using Sardinian Pink granite as workpiece.

For the following testing operating arrangement, the measured values, according to EN ISO 11202:2010, of the A-weighted emission sound pressure level L_{pA} at the main control panel (see figure/picture below) are:

— *L_{pA} = 84 dB(A), Test 1 - Straight not passing through cut with a diamond disk;*

— *L_{pA} = 74 dB(A), Test 2 - Straight cut with a finger bit milling tool;*

— *L_{pA} = 71 dB(A), Test 3 - Straight cut with a core bit milling tool.*



Key

O microphone positions at the main control panel
L = 0,5 m from the main control panel
H = 1,60 m above floor level

For each tests, the declared measurement uncertainty K_{pA} is equal to 4 dB(A).

The measured value of the A-weighted sound power level measured according to EN ISO 3746:2010 is

L_{WA} = 97 dB(A), Test 1 - Straight not passing through cut with a diamond disk,

the declared measurement uncertainty K_{WA} is equal to 5 dB(A).

D.6.3 Example of a declaration of noise emission values in the instruction handbook for a machine where at least one dimension exceeds 6 m

The values shown below are only for illustration.

The airborne noise emission values have been measured in accordance with the requirements of EN 16564:2020.

The noise test measurement has been performed using Sardinian Pink granite as workpiece.

For the following testing operating arrangement, the measured values, according to EN ISO 11202:2010, of the A-weighted emission sound pressure level L_{pA} at the work stations (see figure/picture below) are:

Test 1 - Straight not passing through cut with a diamond disk:

— *at the main control panel: L_{pA} = 81 dB(A);*

— *at the work station 1: L_{pA} = 80 dB(A);*

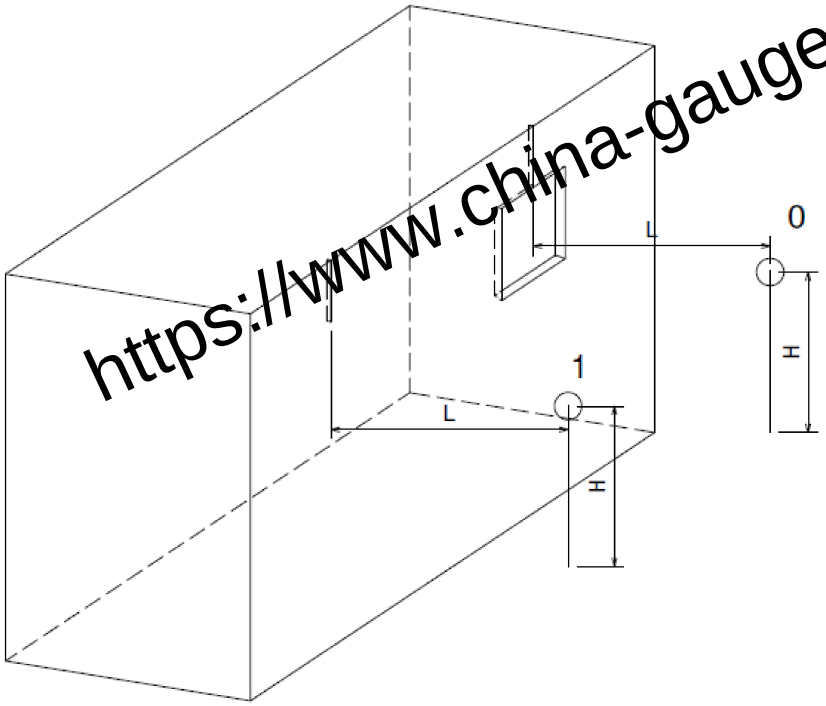
Test 2 - Straight cut with a finger bit milling tool:

— *at the main control panel: L_{pA} = 74 dB(A);*

— *at the work station 1: L_{pA} = 72 dB(A);*

Test 3 - Straight cut with a core bit milling tool:

The measured values of the A-weighted emission sound pressure level LpA at the main control panel and work station 1, LpA are less than 70 dB(A).



Key

0 microphone positions at the main control panel

1 microphone positions at the work station 1

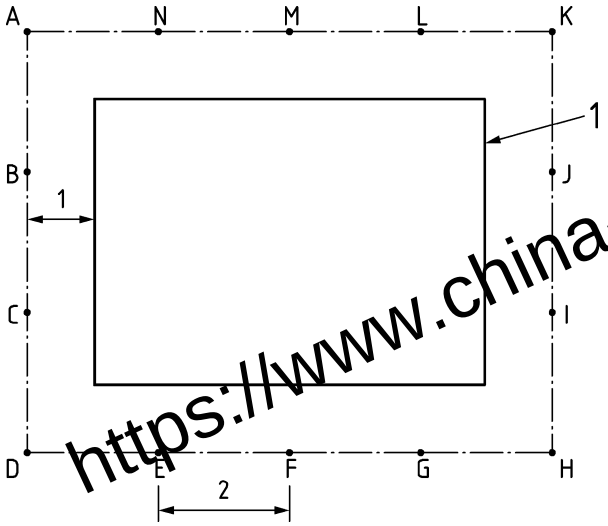
L = 0,5 m from the main control panel

H = 1,60 m above floor level

For each tests, the declared measurement uncertainty K_{pA} is equal to 4 dB(A).

The measured values of the A-weighted emission sound pressure level measured at the positions on a path around the machine for ***Test 1 - Straight not passing through cut with a diamond disk*** *are listed in the table below.*

Dimensions in metres



Key

1 enveloping surface of the machinery
height of microphone from the ground = 1,60 m

Microphone positions on the path around the machine

Test 1 - Straight not passing through cut with a diamond disk:

Microphone positions	L_{pA} *[dB(A)]*
A	*91*
B	*89*
C	*88*
D	*88*
E	*87*
F	*85*
G	*87*
H	*88*
I	*89*
J	*93*
K	*93*
L	*95*
M	*97*
N	*94*

Annex ZA
(informative)

Relationship between this European Standard and the essential requirements of Directive 2006/42/EC aimed to be covered

This European Standard has been prepared under a Commission's standardization request "M/396 Mandate to CEN and CENELEC for Standardisation in the field of machinery" to provide one voluntary means of conforming to essential requirements of Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast).

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

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

Relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.1 General principles		
1.1.2 Principles of safety integration		
a) Principles of safety integration	4.1, 4.2, 4.3, 4.4,	
b) The 3-step method	Clauses 4 and 5	
c) Preventing abnormal use	Clauses 4 and 5	
d) Constraints due to the use of PPE	5.2, 5.3, 5.4	
1.1.3 Materials and products	4.3, 4.4.5, 4.4.9	
1.1.5 Design of machinery to facilitate its handling	4.3.1, 4.4.4, 5.3, 5.4	
1.1.6 Ergonomics	4.4.4, 5.3, 5.4	
1.2 Control systems		
1.2.1 Safety and reliability of control systems	4.2.1, 4.2.9	
1.2.2 Control devices	4.2.2	

Relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.2.3 Starting	4.2.3	
1.2.4.1 Normal stop	4.2.4	
1.2.4.2 Operational stop	4.2.6	
1.2.4.3 Emergency stop	4.2.5	
1.2.5 Selection of control or operating modes	4.2.7	
1.2.6 Failure of the power supply	4.2.8	
1.3 Protection against mechanical hazards		
1.3.1 Risk of loss of stability	4.3.1, 4.3.2, 5.4	
1.3.2 Risk of break-up during operation	4.3.1, 4.3.2, 4.3.5, 4.4.8, 5.4	
1.3.3 Risks due to falling or ejected objects	4.3.5, 5.4	
1.3.6 Risks related to variations in operating conditions	4.2.7, 4.3.3, 4.3.4, 4.3.5	
1.3.7 Risks related to moving parts	4.2.7, 4.3.5	
1.3.8 Choice of protection against risks arising from moving parts 1.3.8.1 Moving transmission parts 1.3.8.2 Moving parts involved in the process	4.3.5	
1.3.8.1 Moving transmission parts	4.3.5	
1.3.8.2 Moving parts involved in the process	4.3.5	
1.3.9 Risks of uncontrolled movements	4.2.3, 4.2.8, 4.2.9, 4.3.3,4.3.4	
1.4 Required characteristics of guard and protective		

Relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.4.1 General requirements	4.3.5	
1.4.2 Special requirements for guards	4.3.5	
1.4.2.1 Fixed guards	4.3.5	
1.4.2.2 Interlocking movable guards	4.2.1, 4.3.5	
1.4.3 Special requirements for protective devices	4.3.5	
1.5 Risks due to other hazards		
1.5.1 Electricity supply	4.4.3, 4.4.9	
1.5.3 Energy supply other than electricity	4.4.5, 4.4.9	
1.5.6 Fire	4.4.1	
1.5.8 Noise	4.4.2	
1.5.11 External radiation	4.4.6	
1.5.12 Laser radiation	4.4.7	
1.6 Maintenance		
1.6.1 Machinery maintenance	4.2.10, 4.4.10, 5.4	
1.6.2 Access to operating positions and servicing points	4.2.2, 4.3.5, 5.4	
1.6.3 Isolation of energy sources	4.4.9, 5.4	
1.6.4 Operator intervention	4.2, 4.4.10, 5.2, 5.3, 5.4	
1.6.5 Cleaning of internal parts	4.2.7, 4.3.5, 5.4	
1.7 Information		
1.7.1 Information and warnings on the machinery	Clause 5	
1.7.1.1 Information and information devices	Clause 5	

Relevant Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.7.1.2 Warning devices	5.2	
1.7.2 Warning of residual risks	5.3, 5.4	
1.7.3 Marking of machinery	5.3	
1.7.4 Instructions	5.4, Annex D	
1.7.4.1 General principles for the drafting of instructions	5.4, Annex D	
1.7.4.2 Contents of the instructions	5.4, Annex D	
1.7.4.3 Sales literature	D.6.1	

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN 388:2016+A1:2018, *Protective gloves against mechanical risks*

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

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

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

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

[6] EN 894-4:2010, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 4: Location and arrangement of displays and control actuators*

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

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

[9] EN 50525-2-21:2011, *Electric cables — Low voltage energy cables of rated voltages up to and including 450/750 V (Uo/U) — Part 2-21: Cables for general applications — Flexible cables with crosslinked elastomeric insulation*

[10] EN 60073:2002, *Basic and safety principles for man-machine interface, marking and identification — Coding principles for indicators and actuators (IEC 60073:2002)*

[11] EN 61310-1:2008, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)*

[12] EN 61496-2:2013, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs) (IEC 61496-2:2006)*

[13] EN ISO 7010:2012, *Graphical symbols — Safety colours and safety signs — Registered safety signs (ISO 7010:2011)*

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

[15] EN ISO 11200:2014, *Acoustics — Noise emitted by machinery and equipment — Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and at other specified positions (ISO 11200:2014)*

[16] EN ISO 3740:2019, *Acoustics — Determination of sound power levels of noise sources — Guidelines for the use of basic standards (ISO 3740:2019)*

[17] EN ISO 13855:2010, *Safety of machinery — Positioning of safeguards with respect to the approach speeds of parts of the human body (ISO 13855:2010)*

[18] EN ISO 13856-2:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 2: General principles for design and testing of pressure-sensitive edges and pressure-sensitive bars (ISO 13856-2:2013)*