

Machine tools — Safety — Stationary grinding machines

ICS 25.080.50

National foreword

This British Standard is the UK implementation of EN 13218:2002+A1:2008, incorporating corrigendum October 2008. It supersedes BS EN 13218:2002 which is withdrawn.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by CEN corrigendum October 2008 is indicated in the text by AC1 AC1.

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The UK participation in its preparation was entrusted to Technical Committee MTE/1, Machine tools.

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

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

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English Version

Machine tools - Safety - Stationary grinding machines

Machines-outils - Sécurité - Machines à meuler fixes

Werkzeugmaschinen - Sicherheit - Ortsfeste
Schleifmaschinen

This European Standard was approved by CEN on 26 August 2001 and includes Amendment 1 approved by CEN on 29 June 2008.

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Foreword

This document (EN 13218:2002+A1:2008) has been prepared by Technical Committee CEN/TC 143 "Machine tools - Safety", the secretariat of which is held by SNV.

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of an identical text or by endorsement, at the latest by January 2009, and conflicting national standards shall be withdrawn at the latest by December 2009.

This document includes Amendment 1, approved by CEN on 2008-06-29.

This document supersedes EN 13218:2002.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1**.

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

A1 For relationship with EC Directive(s), see informative Annexes ZA and ZB, which are integral parts of this document. **A1**

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

Introduction

This European standard has been prepared to be a harmonised standard to provide one means of conforming with the essential safety requirements of the Machinery Directive and associated EFTA regulations. This standard is a type C standard as stated in  EN ISO 12100-1:2003 .

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

1 Scope

This standard specifies the technical safety requirements and/or protective measures to be adopted by persons undertaking the design, construction and supply (including installation and dismantling, arrangements for transport and maintenance) of stationary grinding machines as defined in 3.1 and 3.2 and intended to be used for the grinding of workpieces of cold metal.

This standard deals with the significant hazards as listed in 4.

This standard does not apply to honing, polishing and belt grinding machines.

This standard applies to machines which are manufactured after the date of issue of this standard.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

CR 1030-1, *Hand arm vibration – Guidelines for vibration hazards reduction – Part 1: Engineering methods by design of machinery*

EN 287-1, *Approval testing of welders – Fusion welding – Part 1: Steels*

EN 287-2, *Approval testing of welders – Fusion welding – Part 2: Aluminium and aluminium alloys*

EN 288-1, *Specification and qualification of welding procedures for metallic materials – Part 1: General rules for fusion welding*

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EN 294, *Safety of machinery – Safety distances to prevent danger zones being reached by the upper limbs*

EN 349, *Safety of machinery – Minimum gaps to avoid crushing of parts of the human body*

EN 418, *Safety of machinery – Emergency stop equipment, functional aspects – Principles for design*

EN 547-1, *Safety of machinery - Human body measurements – Part 1: Principles for determining the dimensions required for openings for whole body access into machinery*

EN 547-2, *Safety of machinery - Human body measurements – Part 2: Principles for determining the dimensions required for access openings*

EN 614-1, *Safety of machinery - Ergonomic design principles – Part 1: Terminology and general principles*

EN 626-1, *Safety of machinery - Reduction of risks to health from hazardous substances emitted by machinery – Part 1: Principles and specifications for machinery manufacturers*

EN 729-1, *Quality requirements for welding – Fusion welding of metallic materials – Part 1: Guidelines for selection and use*

EN 953, *Safety of machinery – Guards – General requirements for the design and construction of fixed and movable guards*

EN 954-1, *Safety of machinery – Safety related parts of control systems – Part 1: General principles for design*

EN 982, *Safety of machinery – Safety requirements for fluid power systems and their components – Hydraulics*

EN 983, *Safety of machinery – Safety requirements for fluid power systems and their components – Pneumatics*

EN 1033, *Hand arm vibration – Laboratory measurement of vibration at the grip surface of hand guided machinery – General*

EN 1037, *Safety of machinery – Prevention of unexpected start-up*

EN 1050:1996, *Safety of machinery – Principles for risk assessment*

EN 1070, *Safety of machinery – Terminology*

EN 1088:1995, *Safety of machinery – Interlocking devices associated with guards – Principles for design and selection*

EN 1127-1:1997, *Explosive atmospheres – Explosion prevention and protection – Part 1: Basic concepts and methodology*

EN 1837, *Safety of machinery - Integral lighting of machines*

EN 10025, *Hot rolled products of non-alloy structured steels - Technical delivery conditions*

EN 10130:1991+A1, *Cold-rolled low carbon steel flat products for cold forming – Technical delivery conditions*

EN 12096, *Mechanical vibration – Declaration and verification of vibration emission values*

EN 12413, *Safety requirements for bonded abrasive products*

EN 13236, *Safety requirements for superabrasives*

EN 13478, *Safety of machinery – Fire prevention and protection*

EN 22553, *Welded, brazed and soldered joints – Symbolic representation on drawings (ISO 2553:1992)*

EN 25817:1992, *Arc welded joints in steel – Guidance on quality levels for imperfections (ISO 5817:1992)*

- ENV 26385, *Ergonomic principles for the design of work systems (ISO 6385:1981)*
- EN 50081-2, *Electromagnetic compatibility – Generic emission standard – Part 2: Industrial environment*
- EN 50082-2, *Electromagnetic compatibility – Generic immunity standard – Part 2: Industrial environment*
- EN 60204-1:1997, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements (IEC 60204 1:1997)*
- EN 61310-2, *Safety of machinery – Indication, marking and actuation – Part 2: Requirements for marking (IEC 61310 2:1995)*
- EN ISO 3744, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane (ISO 3744:1994)*
- EN ISO 3746, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:1995)*
- EN ISO 4871, *Acoustics – Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*
- EN ISO 11201, *Acoustics – Noise emitted by machinery and equipment – Measurements of emission sound pressure levels at a work station and at other specified positions – Engineering method in an essentially free field over a reflecting plane (ISO 11201:1995)*
- EN ISO 11202, *Acoustics – Noise emitted by machinery and equipment – Measurements of emission sound pressure levels at a work station and at other specified positions – Survey method in situ (ISO 11202:1995)*
- EN ISO 11204, *Acoustics – Noise emitted by machinery and equipment – Measurements of emission sound pressure levels at a work station and at other specified positions – Method requiring environmental corrections (ISO 11204:1995)*
- EN ISO 11688-1, *Acoustics – Recommended practice for the design of low noise machinery and equipment – Part 1: Planning (ISO/TR 11688 1:1995)*
- [A1]** EN ISO 12100-1:2003, *Safety of machinery – Basic concepts, general principles for design – Part 1: Basic terminology, methodology (ISO 12100-1:2003)* **[A1]**
- [A1]** EN ISO 12100-2:2003, *Safety of machinery – Basic concepts, general principles for design – Part 2: Technical principles (ISO 12100-2:2003)* **[A1]**
- ISO 230-5, *Test code for machine tools – Part 5: Determination of the noise emission*
- ISO 666, *Machine tools – Mounting of plain grinding wheels by means of hub flanges*
- ISO 1052, *Steels for general engineering purposes*
- ISO 1083, *Spheroidal graphite cast iron – Classification*
- ISO 3522, *Cast aluminium alloys – Chemical composition and mechanical properties*
- ISO 3574, *Cold reduced carbon steel sheet of commercial and drawing qualities*
- ISO 4997, *Cold reduced steel sheet of structural quality*
- ISO 6316, *Hot rolled steel strip of structural quality*
- ISO 6361-2, *Wrought aluminium and aluminium alloy sheets, strips and plates – Part 2: Mechanical properties*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 1070 and the following terms and definitions apply.

Additional terms and definitions specifically needed for this standard are added below.

3.1

grinding machine

machine tool intended to machine workpieces by means of abrasive products

3.2

stationary grinding machine

grinding machine fixed in position during operation and capable of a combination of one or more types of operations, examples see Table 1

Table 1 — Stationary grinding machines

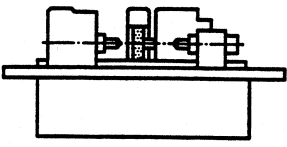
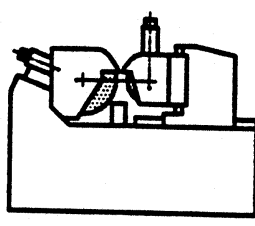
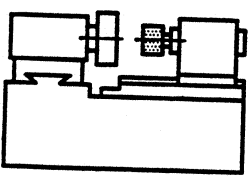
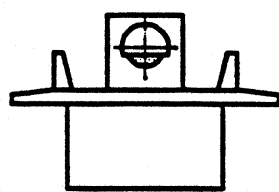
No.	Machine	Designation	Grinding method
1.1		de: Außenrundscheif- maschine en: External cylindrical grinding machine fr: Rectifieuse cylindrique extérieure	External cylindrical grind- ing The grinding of the external surface of a rotating workpiece. The workpiece and the grinding wheel are mechanically guided.
1.2		de: Spitzenlose Außen rundscheifmaschine en: Centreless external cylindrical grinding machine fr: Rectifieuse cylindrique sans centre	Centreless grinding The grinding of the external surface of a rotating workpiece. The workpiece is rotated mechanically guided with reference to the grinding wheel by means of a control-wheel and rests on a straight-edge placed between the two wheels.
1.3		de: Innenrundscheif maschine en: Internal cylindrical grinding machine fr: Rectifieuse cylindrique intérieure	Internal grinding The grinding of the internal surface of a rotating work- piece. The workpiece and the grinding wheel are mechanically guided.
1.4		de: Planscheifmaschine, Rechtecktisch, waage rechte Spindel en: Surface grinding machine, reciprocating table, horizontal spindle fr: Rectifieuse plane à table à déplacement rectiligne – broche horizontale (continued)	Surface grinding- peripheral grinding The grinding of plane surfaces of a workpiece. The workpiece is secured to a reciprocating table. The workpiece and the grinding wheel are mechanically guided.

Table 1 (continued)

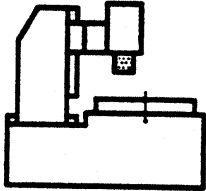
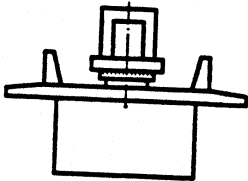
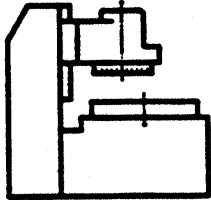
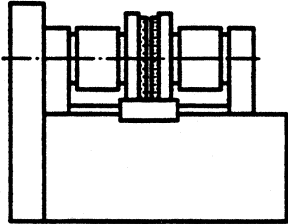
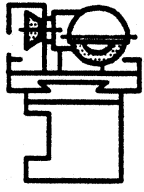
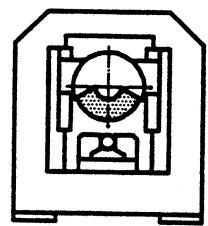
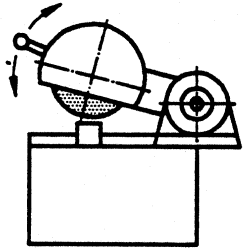
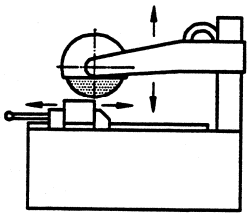
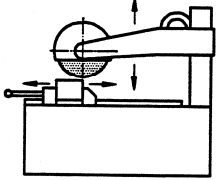
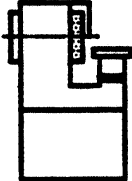
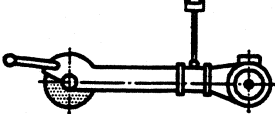
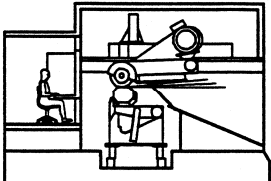
No.	Machine	Designation	Grinding method
1.5		de: Planschleifmaschine, Rundtisch, waagerechte Spindel en: Surface grinding machine, rotary table horizontal spindle fr: Rectifieuse plane à table rotative – broche hori- zontale	Surface grinding – peripheral grinding The grinding of plane surfaces of a workpiece. The workpiece is secured to a rotary table. The workpiece and the grinding wheel are mechanically guided.
1.6		de: Planschleifmaschine, Rechtecktisch, senk- rechte Spindel en: Surface grinding machine, reciprocating table, vertical spindle fr: Rectifieuse plane à table à déplacement rectiligne – broche verticale	Surface grinding – face grinding The grinding of plane surfaces of a workpiece. The workpiece is secured to a reciprocating table. The workpiece and the grinding wheel are mechanically guided.
1.7		de: Planschleifmaschine, Rundtisch, senkrechte Spindel en: Surface grinding machine, rotary table vertical spindle fr: Rectifieuse plane à table à déplacement rota- tive – broche verticale	Surface grinding – face grinding The grinding of plane surfaces of a workpiece. The workpiece is secured to a rotary table. The workpiece and the grinding wheel are mechanically guided.
1.8		de: Doppelspindel-Plan- schleifmaschine, waage- rechte oder senkrechte Spindeln en: Surface grinding machine, double spindle horizontal or vertical fr: Rectifieuse plane à deux (continued)	Surface grinding – face grinding The grinding of a workpiece by passing it between two disc or cylinder wheels or segments. The workpiece and the grinding wheels are mechanically guided.

Table 1 (continued)

No.	Machine	Designation	Grinding method
1.9		de: Werkzeugschleifmaschine en: Tool grinding machine fr: Affûteuse	Peripheral and face grinding The grinding or regrinding of cutting faces and edges of tools (workpiece). The workpieces and the grinding wheels are mechanically guided.
1.10		de: Trennschleifmaschine en: Cutting-off machine fr: Tronçonneuse	Cutting-off The grinding of workpieces for slotting or cutting-off. The workpiece is firmly fixed and the cutting-off wheel is mechanically guided.
1.11		de: Trennschleifmaschine en: Cutting-off machine fr: Tronçonneuse	Cutting-off The grinding of workpieces for cutting-off. The workpiece is firmly clamped, the cutting-off wheel is guided by hand.
1.12		de: Trennschleifmaschine en: Cutting-off machine fr: Tronçonneuse	Cutting-off The grinding of workpieces for slotting or cutting-off. The workpiece is guided by hand. The cutting-off wheel is mechanically guided.

(continued)

Table 1 (concluded)

No.	Machine	Designation	Grinding method
1.13		de: Tisch- oder Ständer schleifmaschine en: Bench or pedestal grinding machine fr: Touret pour établi ou sur	Peripheral grinding The grinding of a surface of a workpiece using the wheel periphery.
1.14		de: Ständerschleifmaschine en: Pedestal grinding machine fr: Lapidaire	Face grinding The grinding of a surface of a workpiece using the wheel face. The workpiece is guided by hand.
1.15		de: Pendelschleifmaschine en: Swing frame grinding machine fr: Meulage et tronçonnage avec machine suspendue	Peripheral grinding/cutting-off The grinding or cutting of a workpiece using the wheel periphery. The workpiece is firmly clamped or stabilized by its own weight. The grinding machine is suspended and guided by hand.
1.16		de: Hochdruckschleif- maschine en: High pressure grinding machine fr: Machine pour meulage à	Surface grinding High pressure grinding where the workpiece is secured to a table. The workpiece and the grinding wheel are mechanically guided.

3.3 abrasive product

cutting tools of varied shapes with geometrically unspecified cutting edges. They are made from abrasive grains and bond. There is a distinction between bonded abrasive products and superabrasives, see EN 12413 and EN 13236

3.4 dressing tool

fixed or rotary tool for the generation or reproduction of the grinding capacity (sharpening) and/or the geometry (truing) of abrasive products

3.5

rotational and peripheral speed

peripheral speed of a grinding wheel is calculated by the formula:

$$v = \frac{D \times \pi \times n}{60 \times 1000}$$

The speed of rotation of a grinding wheel is calculated by the formula:

$$n = \frac{v \times 1000 \times 60}{D \times \pi}$$

where

n is the speed of rotation in rotations per minute ;

v is the peripheral speed in metres per second;

D is the outside diameter of the abrasive product in millimetres.

3.6

maximum operating speed

maximum permissible peripheral speed of a rotating abrasive product

3.7

maximum rotational speed

maximum rotational speed of a grinding wheel spindle under all operating conditions. Rotational speed of a new abrasive product at maximum operating speed

3.8

type of application

see Table 2

Table 2 — Type of application

Grinding method	Type of application	Abrasive product	Workpiece
Grinding	Mechanically guided grinding	Fixed	Guided mechanically
		Guided mechanically	Fixed
		Guided mechanically	Guided mechanically
	Manually guided grinding	Guided by hand	Fixed
		Fixed	Guided by hand
Cutting-off	Mechanically guided cutting-off	Fixed	Guided mechanically
		Guided mechanically	Fixed
		Guided mechanically	Guided mechanically
	Manually guided cutting-off	Guided by hand	Fixed
		Fixed	Guided by hand

The type of feed describes the way in which workpiece and abrasive product are moved to each other. There is a distinction between

a) mechanical feed, see Table 1, e.g. No. 1.1

and

b) manual feed, see Table 1, e.g. No. 1.13.

There is also the possibility of mechanical and manual feed combinations on a single grinding machine, see Table 1, e.g. No. 1.12.

3.9

manual mode

operation mode for the machining under manual control. All process steps for the machining are controlled or started by an operator without support by an NC-machining program

3.10

setting mode

operation mode at which the operator executes the setting for the subsequent machining process

NOTE The setting mode includes e.g. alignment of the tool and determination of the workpiece position by touching with the rotating abrasive product.

3.11

special mode

operation mode at which the possibility for manual intervention into the machining process as well as for a limited automatic mode (fixed sequence of separate consecutive steps) started by the operator, is given

3.12

automatic mode

operation mode where only the start-up of a machining process is initiated by the operator, all subsequent process steps being automatically carried out

3.13

operational stop

stop of the machine movements in the production process. Control functions between control system and machine drives are maintained (torque, speed of rotation, position)

3.14

safe operational stop

operation stop with additional control system measures preventing dangerous machine movements due to control system faults

3.15

safe stop

removal of the energy supply to the machine actuator, preventing dangerous machine movements due to control system faults

3.16

grinding face

that part of an abrasive product which is used to grind the workpiece (examples, see Figures 1 to 3)

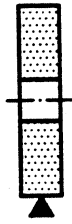


Figure 1
Peripheral grinding

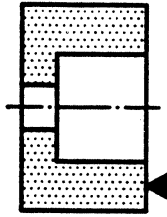


Figure 2
Face grinding

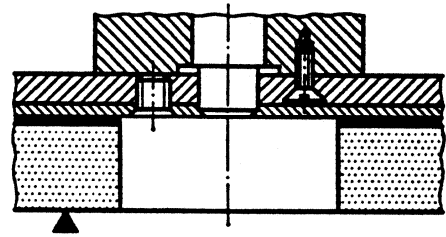


Figure 3
Side grinding

3.17

abrasive product guard

guard which encloses the abrasive product exposing only the part necessary for grinding and which is designed and constructed in such a way that it retains fragments in the guarded area in the event of breakage of the abrasive product

3.18

work zone enclosure

guard enclosing the working area and retaining any parts which may be ejected during processing

3.19

tool holding device

device intended to secure the abrasive product to the grinding wheel spindle

3.20

extraction system

system for removal of the dusts, fumes and mists released during the grinding process

4 List of significant hazards

Significant hazards associated with the machine have been identified in accordance with the procedures described in [A1](#) EN ISO 12100-1:2003 [A1](#), clause 5 and in EN 1050 (see Table 3).

4.1 The list of hazards contained in Table 3 is the result of a hazard identification and risk assessment carried out as described in EN 1050, for the wide range of stationary grinding machines covered by the scope of this standard. The safety requirements and/or protective measures and information for use contained in clauses 5 and 7 are based on the risk assessment and deal with the identified hazards by either eliminating them or reducing the effects of the risks they generate.

4.2 The risk assessment assumes foreseeable access from all directions, as well as unexpected start-up. Risks to both the operators and other persons who can have access to the hazard zones are identified, taking into account hazards which can occur under various conditions (e.g. commissioning, set-up, production, maintenance, repair, decommissioning) during the life of the machine. The assessment includes an analysis of the effect of failure in the control system.

4.3 In addition, the user of this standard (e.g. the designer, manufacturer, supplier) shall validate that the risk assessment is complete for the machine under consideration with particular attention to:

- the intended use of the machine including maintenance, setting and cleaning and its reasonably foreseeable misuse;

– the identification of the significant hazards associated with the machine.

Table 3 — List of significant hazards

Hazards in Annex A of EN 1050		Exposed persons	Hazardous situations (Examples)	Danger zone	Relevant clauses in A1 EN ISO 12100 A1		Relevant Type B standard	Relevant clauses in this standard
No	Designation				Part 1	Part 2		
1	Mechanical hazards due to:				4.2			
1.1 1.2	Crushing/ Shearing	Operator	Manual or automatic workpiece clamping, manual or automatic toolchanging	Work zone	4.2.1 4.2.2	A1 4.2 5.2.1 A1	EN 294 EN 349 EN 953 EN 1088	5.2.4 5.2.7 5.2.10
1.4	Entanglement	Operator	Manual operations close to the grinding wheel or the spindle of the machine	Work zone	4.2.1 4.2.2		EN 953 EN 1088	5.2.4 5.2.5
1.5	Drawing-in or trapping	Operator	Manual operations between the grinding wheel and parts of the machine, particularly the work rest, or between the grinding wheel and the workpiece	Work zone	4.2.1	A1 4.14 5.2.1 5.5.3 A1	EN 953 EN 1088	5.2.4 5.2.5 5.2.7
1.6	Impact	Operator	Operation in the area of travelling axes and in the area of automatic loading devices	Work zone	4.2.1		EN 294 EN 953 EN 1088	5.2.4 5.2.10
1.8	Friction or abrasion	Operator	Unintentional contact with the rotating abrasive product during loading, unloading and/or measuring	Work zone	4.2.1	A1 4.3b 4.14 A1	EN 953 EN 1088	5.2.1 5.2.5 Annex A

(continued)

Table 3 (continued)

Hazards in Annex A of EN 1050		Exposed persons	Hazardous situations (Examples)	Danger zone	Relevant clauses in A1 EN ISO 12100 A1		Relevant Type B standard	Relevant clauses in this standard
No	Designation				Part 1	Part 2		
2	Electrical hazards due to:							
2.1	Contact of persons with live parts (direct contact)	Operator, maintenance personnel	Work on electrical equipment, contact with live parts, connections during commissioning, maintenance, trouble-shooting	Electrical cabinet, terminal boxes, control panel	4.3	A1 4.9 5.5.4 A1	EN 60204-1	5.3.1
2.2	Contact of persons with parts which have become live under faulty conditions (indirect contact)	Operator, maintenance personnel	Work on electrical equipment, contact with live parts, connections during commissioning, maintenance, trouble-shooting	Whole machine or faulty parts	4.3	A1 4.9 A1 7	EN 60204-1:199 7	5.3.2
4	Hazards generated by noise resulting in							
4.1	Hearing loss (deafness); other physiological disorders (e.g. loss of balance, loss of awareness)	Operator and other persons having access to the area around the machine	Power generation and transmission elements, grinding processes, audible resonance of workpieces	Area around the machine	4.5	A1 text deleted A1	EN ISO 11688-1 EN ISO 4871 EN ISO 3744 EN ISO 3746 EN ISO 11201 EN ISO 11202 EN ISO 11204 ISO 230-5	5.4 5.3 clause 7 Annex D Annex E

(continued)

Table 3 (continued)

Hazards in Annex A of EN 1050		Exposed persons	Hazardous situations (Examples)	Danger zone	Relevant clauses in A1 EN ISO 12100 A1		Relevant Type B standard	Relevant clauses in this standard
No	Designation				Part 1	Part 2		
5	Hazards generated by vibrations							
5.1	Use of manually guided tools resulting in nervous and vascular disorders	Operator	Transmission of vibrations from the grinding process to the operator in the case of machines for manually guided grinding	Handles for the guiding of tools	4.6	A1 4.2 A1	CR 1030-1 EN 1033 EN 12096	5.5 clause 7
7	Hazards generated by materials and substances (and their constituent elements) processed or used by the machinery							
7.1	Contact with or inhalation of harmful fluids, mists, fumes and dusts	Operator and persons having access to the area around the machine	Inhalation of or contact with dust or vapour released by the grinding wheel, particles of workpieces or by coolants applied	Work zone, area around the machine	4.8	A1 4.3b 4.4 A1	EN 626-1	5.7.2
7.2	Fire or explosion	Persons having access to the area around the machine	Fire or explosion from dusts or chips generated during grinding of e.g. aluminium, magnesium or by the use of flammable fluids	Area around the machine	4.8	A1 4.4 A1	EN 1127-1 prEN 13478:1999	5.8 clause 7 Annex F

(continued)

Table 3 (continued)

Hazards in Annex A of EN 1050		Exposed persons	Hazardous situations (Examples)	Danger zone	Relevant clauses in A1 EN ISO 12100 A1		Relevant Type B standard	Relevant clauses in this standard
No	Designation				Part 1	Part 2		
7.3	Biological and microbiological (viral or bacterial) hazards	Operator, maintenance personnel	Contact with hydraulic or cutting fluid as liquid or mist containing detritus and bacteria during loading/ unloading, process control, and maintenance	Work zone, coolant supply system	4.8			5.7.3 clause 7
8	Hazards generated by neglecting ergonomic principles in machinery design, as e.g. hazards from:							
8.1	Unhealthy postures or excessive efforts	Operator	Handling of workpieces, abrasive products and machine parts	Work zone, area around the machine	4.9	A1 4.7 4.8.2 4.11.12 5.5.5 5.5.6 A1	ENV 26385 EN 547-1 EN 547-2 EN 614-1	5.2.9 clause 7
8.4	Inadequate local lighting	Operator	Judgement and accuracy of manual actions impaired during setting, handling and positioning of workpieces (continued)	Work zone		A1 4.8.6 A1	EN 1837	5.9

Table 3 (continued)

Hazards in Annex A of EN 1050		Exposed persons	Hazardous situations (Examples)	Danger zone	Relevant clauses in A1 EN ISO 12100 A1		Relevant Type B standard	Relevant clauses in this standard
No	Designation				Part 1	Part 2		
10	Hazards caused by unexpected start-up, unexpected overrun/ overspeed (or any similar malfunction) from:							
10.1	Failure/disorder of the control system	Operator, maintenance personnel	Undetected failures in the control system leading to malfunctions, unexpected movements, overrun	Work zone		AC1 4.11 5.5.4 AC1	EN 60204-1 EN 954-1 EN 982 EN 983	5.3 5.10
10.2	Restoration of energy supply after an interruption	Operator, maintenance personnel	Unexpected movements of the machine	Work zone		AC1 4.11.4 AC1	EN 60204-1:199 7 EN 1037	5.10.2
10.3	External influences on the electrical equipment	Operator, maintenance personnel	Unpredictable behaviour of electronic controls due to electromagnetic interference	Work zone		AC1 text deleted AC1	EN 50082-2 EN 50081-2	5.11
13	Hazards due to failure of power supply:	Operator	Malfunctions of the control with consequent misapplication of stored energy or power, e.g. power workholding fails, motor overspeed	Work zone		AC1 4.11 4.11.4 AC1	EN 60204-1:199 7	5.2.8 5.3 5.10

(continued)

Table 3 (concluded)

Hazards in Annex A of EN 1050		Exposed persons	Hazardous situations (Examples)	Danger zone	Relevant clauses in A1 EN ISO 12100 A1		Relevant Type B standard	Relevant clauses in this standard
No	Designation				Part 1	Part 2		
14	Hazards due to failure of the control circuit:	Operator	Unexpected movements and speed variations, loss of clamping energy	Work zone		A1 4.11 5.5.4 A1	EN 954-1	5.10
17	Hazards due to falling or ejected objects or fluids:	Operator and other persons having access to the area around the machine	Ejections of – parts of the abrasive product – workpieces or other machine parts – dust or coolant	Work zone, area around the machine	4.2.2	A1 4.3 4.10 A1	EN 953 EN 1088	5.2.1 5.2.2 5.2.3 5.2.8 5.2.9 Annex A Annex B Annex C
18	Loss of stability	Operator and other persons having access to the area around the machine	Unrestrained machine or machine parts, falls or overturns	Work zone, area around the machine	4.2.2	A1 4.6 A1		5.2.9 clause 7

5 Safety requirements and/or protective measures

5.1 General

Grinding machines shall comply with the safety requirements and/or protective measures of this clause. Annex G gives an overview of the relevant and special clauses for different types of stationary grinding machines. In addition, grinding machines shall be designed according to the principles of  EN ISO 12100  for hazards relevant but not significant which are not dealt with by this standard.

5.2 Mechanical hazards

5.2.1 Guards to prevent ejection in the event of abrasive product breakage

5.2.1.1 Abrasive product guards

Grinding machines shall be equipped with abrasive product guards able to contain the fragments effectively in the event of an abrasive product breakage. The wall thicknesses of these guards shall be specified in relation to the type of material used and the maximum operating speed and the mass of the abrasive products.

The guard shall enclose the abrasive product to the greatest extent practicable, see A.3.1 to A.3.3.

Where parts of the abrasive product guard are connected to each other by welding or other means, the connection shall be strong enough to ensure that parts will not separate when subjected to the impact of fragments.

Requirements for abrasive product guards, see A.3.1 to A.3.3.

The abrasive product guards shall be attached to the grinding machines so that they will not loosen or move in an uncontrolled way in the case of an abrasive product breakage.

For requirements for the attachment of the abrasive product guards, see A.4.

An abrasive product guard is not required.

- for internal grinding machines (No 1.3, Table 1), where abrasive products are used with $D \leq 80$ mm and a peripheral speed up to 50 m/s.
- on grinding machines where abrasive products are used with $D \leq 1\,000$ mm and a maximum operating speed of $v_s \leq 16$ m/s.

In circumstances/situations where an abrasive product guard cannot be provided, a guard enclosing the workzone or other measures leading to the required protection shall be provided. The guard enclosing the workzone shall comply with the requirements of A.3.4.2.2 in relation to the wall thickness and material.

Where rotating dressing tools generate the same hazards as rotating abrasive products, relevant protective measures for these tools shall also be provided.

5.2.1.2 Additional guards

Grinding machines on which abrasive products with maximum operating speeds $v_s > 50$ m/s are operated shall be equipped with an additional guard, retaining the fragments ejected from the aperture of the abrasive product guard in the machining area (totally enclosed working area).

The additional guarding provision may include:

- a guard in accordance with A.3.4

- an abrasive product guard, additionally equipped with an internal guard which closes the aperture of the abrasive product guard in the event of an abrasive product breakage (see A.3.1.4)

Additional guarding is not required:

- for manually guided swing frame grinding machines and swing frame cutting-off machines with a maximum operating speed $v_s \leq 80$ m/s, see Table 1, No 1.15
- for manually and mechanically guided cutting-off machines with a maximum operating speed $v_s < 100$ m/s and a diameter of the cutting-off wheel $D \leq 406$ mm, see Table 1 No 1.11 and 1.12.

Abrasive product guards and additional guards shall be rated for the abrasive product with the largest dimensions applicable on the machine at intended use and the maximum rotational speed of the wheel spindle, unless means are provided to detect the diameter and prevent the selection of inappropriate wheel spindle speeds.

5.2.2 Guards to prevent ejection of parts

Grinding machines where besides hazards caused by abrasive product fragments hazards caused by the ejection of workpieces, parts of the workpieces, machine parts, dust or cooling lubricants are likely shall be provided with fixed and/or movable guards retaining these parts and substances in the work zone. The guards shall be designed, constructed and located taking into consideration the expected stress. They shall comply with the general requirements of EN 953.

The guards to prevent ejection of parts can also serve to contain abrasive product fragments in accordance with 5.2.1 and/or to prevent access to the work zone in accordance with 5.2.4 when they are suitably designed, constructed and located.

5.2.3 Protective screens for bench and pedestal grinding machines

Bench and pedestal grinding machines shall be provided with a transparent screen for the protection of the face and especially the eyes of the operator against small grinding particles and grinding sparks.

The screens shall have sufficient resistance to impact and abrasion so that they do not break or crack in the case of impact load during handling of workpieces and that the surface abrasion caused by ejected abrasive grit and grinding sparks is minimised. Polycarbonate is an example for a suitable screen material.

The screen shall be adjustable and of sufficient size so that the operator in normal working positions can only view the grinding operation through the screen. The screen shall not impede guiding and holding of the workpieces.

The minimum dimensions of screens are given in A.3.7.

5.2.4 Guards to prevent access to the work zone

For grinding machines where risks caused by the access to the work zone are likely, e.g. by crushing, shearing, entanglement of impact, fixed and/or movable guards preventing such access shall be provided. The guards shall comply with the general requirements for design and construction in accordance with EN 953 and EN 294. For interlocks see 5.10.6.

The guards to prevent access to the work zone can also serve to contain abrasive product fragments in accordance with 5.2.1 and/or to prevent the ejection of parts in accordance with 5.2.2 when they are suitably designed, constructed and located.

Guards to prevent access to the work zone are not required for grinding machines with the following types of application:

- manually guided grinding

- manually guided cutting-off
- mechanically guided grinding with manual feed.

5.2.5 Means of preventing unintended contact with the abrasive product

Grinding machines shall be provided with means of preventing unintended contact with the abrasive product. The complete abrasive product should be guarded except that part necessarily exposed for the work.

This requirement is met by the abrasive product guard in accordance with 5.2.1.1.

During manual interventions such as loading, unloading or measuring, additional precautions shall be provided. These may include:

- stopping the rotation of the abrasive product,
- or
- providing an automatic safeguard
- or
- positioning the abrasive product so that it cannot be reached by the operator (respect of safety distances).

Cutting-off machines for mechanically guided cutting-off shall be provided with measures to ensure that the cutting-off wheel moves automatically back to its initial position after use. It shall remain in that position and be automatically guarded against contact until the cutting-off wheel has stopped.

5.2.6 Tool holding devices

Tool holding devices shall be designed so that the abrasive product cannot become loose during operation including acceleration and braking.

Clamping methods for abrasive products and safety requirements for tool holding devices, see annexes B and C.

5.2.7 Workpiece rests, workpiece guides and clamping devices

Grinding machines shall be provided with clamping devices, holding or guiding the workpieces to prevent them from inadvertent movement.

Grinding machines in accordance with Table 1 No 1.13 and 1.14 shall be provided with workpiece rests capable of accommodating safely the forces generated. The workpiece rest shall be adjustable with respect to the wear of the wheel so that the distance between the abrasive product and the workpiece rest will not exceed 2 mm. It shall be of at least the same width as the abrasive product for which the grinding machine was designed, shall be of substantial construction and securely attached to the grinding machine.

Grinding machines with power operated clamping devices shall be provided so that in the case of clamping energy losses the starting of feed and advance drives is impossible. The operation of the clamping device shall be signalled to the operator by a light or other suitable device.

In the event of a failure or interruption of the clamping energy, the design of the grinding machine shall ensure that no parts can be ejected.

5.2.8 Devices for speed variation of the grinding wheel spindle

On grinding machines with devices for speed variation of the grinding wheel spindle, the following measures/devices for minimizing the risk of exceeding the maximum operating speed of the clamped abrasive product shall be provided alternatively depending on the driving mode of the grinding spindle:

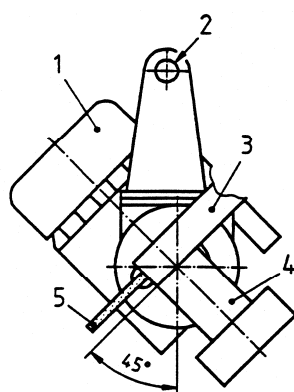
- a) devices which enable the starting of the grinding wheel spindle with the lowest adjustable speed only.
- b) for pole-changing drives, a switch interlock is required, preventing the direct starting of the higher speed step.
- c) on grinding machines where the rotational speed is calculated from the programmed cutting speed and the actual wheel diameter, either the control shall recognize a wheel change or there shall be a clearly visible warning of the necessary data input in case of a wheel change. The data input shall have to be confirmed by the operator.
- d) on grinding machines where abrasive products with different outside diameters can be operated, there shall be a clearly visible warning of the maximum rotational speed for the different diameters. The selected speed shall be clearly visible (e.g. control knob with speed scale).
- e) indication of the selected rotational speed or peripheral speed; the indicated values shall be identical to the selected values.

5.2.9 Swivelling range

Swing frame grinding – and swing frame cutting-off machines in accordance with Table 1, No 1.15 shall be equipped with an adjustable counterbalance weight so that the grinding head moves away from the workpiece after release of the handles.

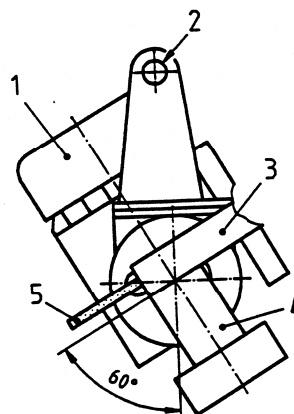
Swing frame grinding machines for manually guided grinding shall be equipped so that they can only be swivelled by up to 45° from the vertical axis on either side, see Figure 4.

Swing frame cutting-off grinding machines for manually guided cutting-off shall be equipped so that they can only be swivelled by up to 60° from the vertical axis on either side, see Figure 5.



- 1 Motor
- 2 Suspension
- 3 Wheel guard
- 4 Swivelling axis
- 5 Wheel

Figure 4



- 1 Motor
- 2 Suspension
- 3 Wheel guard
- 4 Swivelling axis
- 5 Cutting-off wheel

Figure 5

5.2.10 Automatic loading devices

The following requirements shall apply to grinding machines with automatic loading devices for

workpieces

and/or

abrasive products

and their holding devices:

- a) In order to prevent falling or ejection of tools or workpieces the holding device shall be designed so that the heaviest tool/workpiece is held in the holding device at the maximum possible acceleration of the loading device.
- b) design data for loading devices shall include limits for maximum mass and spatial envelopes and shall be made available to users in the instruction handbook,
- c) integral automatic loading devices shall be safeguarded by fixed and/or interlocking guards to prevent access to hazardous movements.

5.3 Electrical hazards

5.3.1 Protection against direct contact

To minimize the hazards of shock or burn, all electrical equipment shall be designed in accordance with EN 60204-1:1997. Means shall be provided to isolate the machine from sources of electrical energy (see EN 60204-1:1997, 6.2).

5.3.2 Protection against indirect contact

The requirements of EN 60204-1:1997, 6.3 shall be followed.

5.4 Noise

When designing grinding machines the information on the design of low-noise machinery given in EN ISO 11688-1 shall be followed, especially concerning measures for noise reduction at source.

The design shall take into account noise from each source.

The main noise sources at grinding machines depend on the grinding method and the components and equipment used on the grinding machine. Sources of airborne noise include:

- Abrasive products and workpieces,
- Grinding wheel spindles,
- Workpiece spindles,
- Axis drives,
- Ball screws,
- Dressing and truing devices,
- Load, unload, ejection and transfer operations,

- Hydraulic systems,
- Extraction systems,
- Pneumatic systems,
- Coolant systems.

If means for the noise reduction at source are insufficient, secondary noise reduction measures shall be taken wherever possible. Measures for noise reduction, see annex D.

Noise emission determination, declaration and verification, see annex E.

5.5 Vibration

On grinding machines with manually guided tool feed using a handle, examples see Table 1, No 1.11 and 1.15, where operators can be subject to vibrations of more than $2,5 \text{ m/s}^2$, measures for preventing vibrations shall be taken. Measures for the reduction of vibrations can be achieved by construction and design, damping, and/or insulation, see CR 1030-1. Measuring of vibrations see EN 1033.

5.6 Hazards resulting from dusts, fumes and mists

Materials or substances used for the construction and operation of grinding machines shall be chosen in such a way that no health hazardous effects occur over the life of the grinding machines, e.g. asbestos shall not be used for brake and clutch lining.

Where material hazardous to health is machined or used or where dusts, fumes and mists are likely to be generated the safeguards shall be designed to minimize operator exposure. An integral extraction system and/or means of fitting and extraction system shall be provided.

Grinding machines with an integral extraction system shall be designed so that the extraction is activated as soon as functions are switched on, which can cause dusts, fumes and mists. After switching off these functions, the extraction system shall continue to run until hazards caused by dusts, fumes and mists do no longer exist, but at least 15 s.

Measures shall be provided to prevent the escape of harmful mist, e.g. resulting from the use of compressed air.

Because the actual requirements for the extraction system will depend on a variety of different parameters e.g. the nature of the materials being used it is not possible to give more detailed technical requirements in this standard.

5.7 Devices for the use of coolants

5.7.1 General

Where lubricants and coolants are used during grinding which can cause hazards to health, the grinding machine shall be provided with devices for the prevention or minimization of these hazards.

5.7.2 Measures for the protection against contact or inhalation

- a) The system shall be designed to prevent splash, overflow and leakage of the coolant.
- b) Fluid reservoirs and other system components shall be made of materials to ensure the continued integrity of the system.
- c) The delivery nozzles shall be designed so that unwanted spray is minimized.

- d) Where the generation of mists and vapours in the workzone is foreseen guards and an extraction system shall be provided or means for attachment of such a system.

NOTE Because the actual requirements for the extraction system will depend on a variety of different parameters e.g. the nature of the coolants being used it is not possible to give detailed technical requirements in this standard.

- e) The coolant shall have a capacity for the correct function of the grinding machine to avoid excessive heating and subsequent evaporation of the fluid. Alternatively cooling systems shall be provided.
- f) Where it is foreseen to be necessary for operators to place their hands into the work zone (e.g. during load/unload operations, setting, etc.), the coolant flow shall be automatically stopped or diverted in the case of grinding machines with interlocked guards. All other machines shall be provided with devices for manual control or diversion of the coolant supply.
- g) Fluid reservoirs shall be fitted with clearly readable fluid level indicators marked with minimum/maximum coolant filling levels.
- h) The coolant system shall be capable of delivering coolant to prevent the generation of hazardous vapours or aerosols during all foreseeable operating/grinding conditions.
- i) The coolant system shall be designed for maintenance and to reduce as far as possible the exposure of personnel to the coolant during maintenance.
- j) The grinding machine shall be designed so that grinding residues can be removed without requiring drainage of the coolant system.

5.7.3 Measures for the protection of biological and microbiological hazards

- a) The coolant system shall be designed so that in normal use the total fluid content is circulated to avoid stagnant areas, except where settlement is required by design.
- b) It shall be possible to empty all parts of the coolant system.
- c) Complete gravity drainage to the reservoir shall prevent coolant accumulating in any part of the machine.
- d) Pipework shall be sized and arranged so that the required coolant flow is achieved and contamination settlement is minimized.
- e) The coolant system shall be provided with means to separate the grinding residues from coolant (e.g. filtration devices) to avoid settlement and contamination of pumps, valves etc.
- f) Coolant reservoirs shall have covers designed to minimize the ingress of foreign matter.
- g) Contamination of the coolant by oils or greases (e.g. from machine lubricant) shall be avoided or devices shall be provided for their systematic removal.
- h) Measures shall be taken to minimize the exposure of the operator to hazards from coolant sampling, cleaning of reservoirs and pipework and filter changing.

5.8 Measures against fire and explosion hazards

5.8.1 Flammable coolants

Grinding machines designed for the use of flammable coolants shall be provided with devices minimizing the risk of generation of flammable mixtures and minimizing the risk of fire and explosion, e.g.

— extraction systems,

- devices for monitoring the coolant supply.

Where an extraction system is used it shall automatically be switched off in case of fire or explosion.

If fire and explosion hazards cannot be prevented by these means, additional measures to limit their effects shall be taken (see EN 1127-1 and prEN 13478:1999).

Such measures may include:

- Fire extinguishing devices,
- Pressure relief devices.

5.8.2 Flammable and explosive dusts

Where grinding machines are designed for the machining of materials which may generate flammable and explosive dusts (e.g. aluminium and magnesium and their alloys) devices for the safe removal of these dusts and any flammable gas (e.g. hydrogen) shall be provided in order to prevent hazards caused by fire or explosion. Explosion protection measures from EN 1127-1 shall be taken where applicable.

To prevent dust explosions the grinding machines shall be provided for example with systems for:

- wet grinding,
 - dry grinding with wet precipitation by means of instantaneous moistening,
- or
- dry grinding with wet precipitation by means of a wet-type cyclone.

Requirements, see annex F.

5.9 Lighting

When designing machinery, lighting intensity, direction, glare, etc. shall be taken into account. When necessary, integral lighting shall be provided. Especially the following items shall be taken into account:

- the required lighting intensity depends on the grinding operation to be performed. It shall be at least 300 lx in the area to be observed;
- glare, reflections and shadows, e.g. from workpiece or machine parts, shall be avoided as far as possible;
- lighting source shall be positioned to minimize its contamination during grinding.

5.10 Control systems and control devices

5.10.1 General

The requirements for components and principles of control systems with safety related functions are specified in this clause.

Safety related control functions include:

- start and restart of dangerous movements,
- normal stop,