



SLOVENSKI STANDARD
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Safety of machine tools - Milling machines (including boring machines)

Safety of machine tools - Milling machines (including boring machines)

Sicherheit von Werkzeugmaschinen - Fräs- und Bohr-Fräsmaschinen

Sécurité des machines-outils - Fraiseuses (comprenant les aléseuses)

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Boring and milling machines

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English version

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Sicherheit von Werkzeugmaschinen - Fräs- und Bohr-Fräsmaschinen

This European Standard was approved by CEN on 7 March 2001.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This European Standard 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of an identical text or by endorsement, at the latest by October 2001, and conflicting national standards shall be withdrawn at the latest by October 2001.

This European Standard 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).

This standard has been prepared to provide one means of conforming with the essential requirements of the Machinery Directive and associated EFTA regulations.

Annexe A is normative. Annexes B, C, D and ZA are informative. This Standard also contains a Bibliography.

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

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

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0 Introduction

This European standard is a type C standard as stated in EN 292–1.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence.

Milling machines present a wide range of hazards, not least from their wide application as rotating tool, 'stationary' workpiece machine tools, for general purpose cutting of cold metal work material.

Protection of operators and other persons from contact with moving cutting tools, especially when being rapidly rotated in the spindle or from contact with fast–moving workpieces, is of great importance.

When power–operated mechanisms are provided for workpiece transfer, they can also create hazardous situations during loading/unloading and workpiece alignment or clamping.

On automatic milling machines, total enclosure of the work zone using guards during cutting is the preferred method of safeguarding. Where this is not practicable (e.g. due to size of the workpiece, its geometry, or its special characteristics), operators may be safeguarded by other means (e.g. perimeter fencing, protective devices at the operating position). Operators may also benefit from pendant controls which enable them to move about the machine.

The significant hazards covered by this standard are those listed in table 1. The safety requirements and/or protective measures to prevent or minimize those hazards identified in table 1 and procedures for verification of these requirements or measures are found in clause 5 (tables 2, 3, 4 and 5).

The figures in annex C are examples only and are not intended to illustrate the only interpretation of the text.

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1 Scope

1.1 This standard specifies the technical safety requirements and measures to be adopted by persons undertaking the design, construction and supply (including installation and dismantling, with arrangements for transport and maintenance) of milling machines (see 3.1) including machines capable of performing boring operations (see 3.5).

Machines covered by this standard include but are not limited to:

- knee and column type milling machines (see figures C.1, C.2);
- bed-type milling machines (see figure C.3);
- multi-spindle milling machines (see figures C.4 and C.5);
- plano-milling machines (see figures C.4 and C.5);
- profile and contouring milling machines (see figure C.6),
- milling and boring machines (see figure C.7).

1.2 This standard takes account of intended use including reasonably foreseeable misuse, maintenance, cleaning, and setting operations. It presumes access to the machine from all directions. It describes means to reduce risks to operators and other exposed persons.

1.3 This standard also applies to workpiece transfer devices when they form an integral part of the machine.

1.4 This standard deals with significant hazards relevant to milling machines when they are used as intended and under the conditions foreseen by the manufacturer (see clause 4).

1.5 Hazards arising from other metal working processes (e.g. grinding, turning, forming, EDM, laser processing) are covered by other standards (see Bibliography).

1.6 Milling machines with automatic tool changing capabilities are not covered by this standard (see prEN 12417:1996).

1.7 This standard is not applicable to milling machines which were manufactured before the date of publication by CEN of this standard.

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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).

- | | |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EN 292-1: 1991 | <i>Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology</i> |
| EN 292-2: 1991 and EN 292-2/A1:1995 | <i>Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles and specifications</i> |
| EN 294: 1992 | <i>Safety of machinery – Safety distances to prevent danger zones being reached by the upper limbs</i> |
| EN 349 | <i>Safety of machinery – Minimum gaps to avoid crushing of parts of the human body</i> |
| EN 457 | <i>Safety of machinery - Auditory danger signals - General requirements, design and testing (ISO 7731:1986 modified)</i> |
| EN 574 | <i>Safety of machinery - Two hand control devices – Functional aspects – Principles for design</i> |
| EN 614 | <i>Safety of machinery - Ergonomic design principles –</i>
Part 1 <i>Terminology and general principles</i>
Part 2 <i>Interaction between machinery design and work tasks</i> |
| EN 626 | <i>Safety of machinery – Reduction of risks to health from hazardous substances emitted by machinery</i> |
| EN 811 | <i>Safety of machinery – Safety distances to prevent danger zones being reached by the lower limbs</i> |

- EN 894: *Safety of machinery –Ergonomics requirements and data for the design of displays and control actuators-*
Part 1:1997 *Human interactions*
Part 2:1997 *Displays*
Part 3:2000 *Control actuators*
- EN 953:1997 *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 I: General principles for design*
- EN 982:1996 *Safety of machinery - Safety requirements for fluid power systems and their components - Hydraulics*
- EN 983:1996 *Safety of machinery - Safety requirements for fluid power systems and their components - Pneumatics*
- EN 999 *Safety of machinery – The positioning of protective equipment in respect of approach speeds of parts of the human body*
- prEN 1005:1998 *Safety of machinery – Human physical performance –*
Part 1: *Terms and definitions*
Part 2: *Manual handling of heavy weights associated with machinery*
Part 3: *Recommended force limits for machinery operation*
- EN 1037:1995 *Safety of machinery – Prevention of unexpected start-up*
- EN 1050:1996 *Safety of machinery - Principles for risk assessment*
- 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 a methodology*
- EN 1760–1:1997 *Safety of machinery - Pressure sensitive protective devices – Part 1: General principles for the design and testing of pressure sensitive mats and pressure sensitive floors*
- EN 1837 *Safety of machinery – Integral lighting of machines*
- EN 60825-1:1994 + A11:1996 *Safety of laser products – Equipment classification, requirements and user's guide*
- EN ISO 3744:1995 *Acoustics – Determination of sound power level of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane*
- EN ISO 3746:1995 *Acoustics – Determination of sound power level of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane*
- EN ISO 4871 *Acoustics – Declaration and verification of noise emission values of machinery and equipment*
- EN ISO 9614-1:1995 *Acoustics – Determination of sound power level of noise sources using sound intensity – Part 1: Measurement at discrete points*
- EN ISO 11202:1995 *Acoustics – Noise emitted by machinery and equipment – Measurement method of emission sound power levels at the work station and at other specified positions – Survey method in situ*
- EN ISO 11204:1995 *Acoustics - Noise emitted by machinery and equipment – Method requiring environmental corrections*
- EN ISO 11688-1 *Acoustics – Recommended practice for the design of low–noise machinery and equipment - Part 1: Planning*
- ISO/TR 11688-2:1998 *Acoustics – Recommended practice for the design of low–noise machinery and equipment - Part 2: Introduction to the physics of low-noise design*
- EN 14122: 2001 *Permanent means of access to machines and industrial plants*
Part 2: *Working platforms and gangways*
Part 3: *Stairways, stepladders and guard-rails*
- prEN 13478:1999 *Safety of machinery - Fire prevention and protection*
- EN 60204-1:1997 *Safety of machinery - Electrical equipment of machines - Part 1: General requirements*
- EN 60529:1991 *Degrees of protection provided by enclosures (IP Code)*
- EN 61496-1:1997 *Safety of machinery - Electrosensitive protective equipment - Part 1 - General requirements and tests*

- prEN 61496-2:1997 *Safety of machinery – Electro-sensitive protective equipment – Part 2: Particular requirements for equipment using active opto-electronic protective devices*
- EN 50081-2 *Electromagnetic compatibility - Generic emission standard – Part 2: Industrial environment*
- EN 61000-6-2 *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards - Immunity for industrial environments (IEC 61000-6-2:1999)*

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply. For other terms and definitions, see EN 292–1, EN 292–2/A1.

3.1

milling machine

a machine designed to shape cold metal by the use of a rotating cutting tool.

3.1.1

manual milling machine

a machine where axis motion is controlled through the actuation of a handwheel or where powered single-axis motion is controlled by mechanical, electrical, or other means but without the capability for programmed multiple axis movements.

3.1.2

automatic milling machine

a machine capable of performing programmed multiple axis movements.

3.2

boring machine

a machine designed to perform boring operations (see 3.5). Such machines are normally capable of milling operations.

3.3

numerical control (computer numerical control) (NC, CNC)

automatic control of a process performed by a device that makes use of numeric data introduced while the operation is in progress. (ISO 2806:1994, 2.1.1)

3.4

workpiece transfer device

a mechanism integrated with the machine (e.g. pallet changing device) as a means of supplying a previously loaded workpiece to a machine in exchange for a finished workpiece.

3.5

boring operation

the process of finishing to size previously formed holes in cold metal normally by the use of a rotating single-point tool using powered axial feed.

3.6

work zone

the space where the metal cutting process can take place.

3.7

electronic handwheel

a manually operated control device which initiates and maintains an axis movement by pulse generation input to the numerical control during its rotation.

4 List of significant hazards

4.1 The list of hazards contained in table 1 is the result of a hazard identification and risk assessment carried out as described by EN 1050, for the wide range of milling machines covered by the scope of this standard. The safety requirements and/or 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 (i.e. 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.

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Table 1 – List of significant hazards and major sources of these hazards associated with milling machines

*	Description	Example(s) of related hazardous situation(s)	Associated activity	Related danger zone	Clause 5 Reference
1.	Mechanical hazards:				
1.1	Crushing	moving axes, workpiece and tool clamping	setting, loading/unloading, maintenance	between fixed and moving elements of the machine	Tables 2, 3; or Table 4 and Table 5 – 1.1 – 1.5
		moving axes	maintenance	within pits	
		movement of operating platforms	normal operation, maintenance	at or near machine	
1.2	Shearing	moving axes	machine operation	between tool/ spindle and table/ workpiece	
1.3	Cutting or severing	spindle or tool running or cutting	spindle running	at spindle or tool	
1.4	Entanglement	rotating spindle or tool removal of swarf/chips	workpiece load/unload, positional adjustment, manual swarf/chip removal, cutting fluid application	at spindle or tool	
		other rotating parts (e.g. conveyors, transmission elements)	setting, cleaning, maintenance	swarf/chip collection and discharge zones, transmission elements	
1.5	Drawing-in or trapping	rapid travel of table or spindle head	power-operated motion of workpiece on table or tool in spindle	envelope of movement of workpiece on table axes; envelope of movement of tool in spindle head	
		rotating power transmission mechanisms	maintenance	in or around machine	
1.6	Impact	moving/rotating tool	spindle running	at spindle or tool	
		automatic workpiece transfer (e.g. pallet loading system)	power-operated workpiece transfer	envelope of motion of workpiece and workpiece transfer mechanisms	
1.7	Stabbing or puncture	moving/rotating tool (especially eccentric tools)	process control	at tool in spindle	

•	Description	Example(s) of related hazardous situation(s)	Associated activity	Related danger zone	Clause 5 Reference
1.7	Stabbing or puncture	handling tools	during manual tool change	at sharp cutter faces	(see 7.2 of clause 7)
		handling swarf/chips	during loading/unloading and cleaning	at workpiece, table, and swarf /chip collecting and discharge zones	(see 7.2 of clause 7)
2	Electrical hazards:				
2.1	Contact of persons with live parts (direct contact)	contact with live parts or connections	during commissioning, maintenance, trouble shooting	electrical cabinet, terminal boxes, control panels at machine	Table 5: 2.1
2.2	Contact of persons with parts which have become live under faulty conditions (indirect contact)	contact with live parts or connections	during operation, inspection and maintenance of machine	at machine or faulty part	Table 5: 2.2
4	Hazards generated by noise:				
4.1	Hearing loss (deafness), other physiological disorders (e.g. loss of balance, loss of awareness)	motion of power transmission elements, cutting processes and fluid power systems	during operating cycle of machine	near machine	Table 5: 4
4.2	Interference with speech communication, acoustical signals	air blast used for cleaning of tool, pallet or workpiece locations	during operating cycle of machine	near machine	Table 5: 4
6	Hazards generated by radiation				
6.5	Lasers	direct or reflected visual exposure to laser radiation	maintenance of laser positional feedback system	within machine	Table 5: 6.5
7	Hazards generated by materials and substances				
7.1	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes, and dusts	conditions near machine caused by ejection of particles of work material, fluid droplets or mist from metal working fluids	during operating cycle of the machine	at or near machine	Table 5: 7.1
7.2	Fire or explosion	flammable work material, flammable (low flash point) metal working fluids	during operating cycle of the machine	at or near machine	Table 5: 7.2
7.3	Biological or micro-biological (viral or bacterial) hazards	contact with hydraulic or metal working fluid as liquid or mist containing detritus and bacteria	during operation, process control, and maintenance	at or near machine	Table 5: 7.3
8	Hazards generated by neglecting ergonomic principles in the design process				
8.1	Unhealthy postures or excessive effort (repetitive strain)	lifting and reaching while handling workpiece, tools, and machine parts	during loading/unloading, process control, and maintenance	at load/unload and tool mounting positions, maintenance action points	Table 5: 8.1
8.2	Inadequate consideration of hand-arm or foot-leg anatomy	inappropriate location of controls	during loading/unloading, process control, and maintenance	at load/unload and tool mounting positions, maintenance action points	Table 5: 8.2

*	Description	Example(s) of related hazardous situation(s)	Associated activity	Related danger zone	Clause 5 Reference
8.4	Inadequate local lighting	judgement and accuracy of manual actions impaired during handling/ positioning of work materials and cutters	during loading /unloading, process control, tool handling	at load/unload, tool mounting positions	Table 5: 8.4
8.6	Human errors, human behaviour	reasonably foreseeable misuse, inadvertent operation of controls, incorrect work material and cutter handling and setting	during loading/ unloading, process control, tool handling	at load/unload, tool mounting positions	Table 5: 8.6
8.7	Inadequate design, location or identification of manual controls	inadvertent operation of controls	during setting, operating cycle	at or near machine	Table 5: 8.7
8.8	Inadequate design or location of visual display units	misinterpretation of displayed information	during setting, operating cycle	at or near machine	Table 5: 8.8
10	Unexpected start-up, unexpected overrun/ overspeed:				
10.1	Failure/disorder of the control system	mechanical hazards associated with selected machine movement	during setting, cleaning	at machine	Table 5: 10.1
10.2	Restoration of energy supply after an interruption	unexpected movements of machine	during setting, cleaning or maintenance	at or near machine	Table 5: 10.2
10.3	External influences on the electrical equipment	unpredictable behaviour of electronic controls due to electromagnetic interference	during setting or operating cycle of the machine	at or near machine	Table 5: 10.3
13	Failure of the power supply	malfunctions of the control with consequent misapplication of stored energy or power. Power workholding fails, motor overspeed. Part break-age causes machine elements to move under residual forces (inertia, gravity, spring/ energy storage means) causing external elements to move unexpectedly	during operation, process control, maintenance	at machine where machine elements retained in a safe condition by the application of power or fluid pressure.	Table 5: 13
14	Failure of the control circuit	Unexpected movements of machine	during setting, cleaning or maintenance	at or near machine	Table 5: 14
15	Errors of fitting	machine elements fail or swing unexpectedly	during process control, tool mounting, maintenance	at machine	Table 5: 15
17	Falling or ejected objects or fluids	ejection of machine parts, workpiece or tools caused by clamping device, control system failures or collision due to data errors	during the operating cycle of the machine	at or near machine	Table 5: 17
18	Loss of stability, overturning of machinery	unrestrained machine or machine part (maintained in position by gravity), falls or overturns	during loading/ unloading and process control, at heavy /unwieldy workpieces during maintenance (disassembly/ relocation)	at machine	Table 5: 18
19	Slip , trip, and fall of persons	ejection or spillage of metal working fluids and lubricants (also hydraulic fluid if used); work at heights	during workpiece load/unload, setting, process control and maintenance; work at heights; work to replenish fluids (e.g. lubricants)	machine table, floor area around machine and workpiece; permanent means of access to the machine	Table 5: 19
*	This list is derived from annex A of EN 1050: 1996.				