

Australian Standard[®]

Safety of machinery

Part 3101: Materials cutting—Milling machines (including boring machines)—Safety requirements



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- Australian Electrical and Electronic Manufacturers Association
- Department for Administration and Information Services, SA
- Department of Consumer and Employment Protection, WorkSafe Division, WA
- Department of Primary Industries, Mine Safety, NSW
- Engineers Australia
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- National Electrical and Communications Association
- National Safety Council of Australia
- Office of the Australian Safety and Compensation Council
- Safety Institute of Australia
- The University of Melbourne
- Tractor and Machinery Association of Australia
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Part 3101: Materials cutting—Milling machines (including boring machines)—Safety requirements

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PREFACE

This Standard was prepared by the Standards Australia Committee SF-041, General Principles for the Safety of Machinery as a revision of AS CZ14—1971, *Guarding and safe use of milling machines* which was withdrawn in 1997.

During its work, the Committee considered work emanating from the European Community, and agreed to use EN 13128:2001, *Machine tools—Safety—Milling machines (including boring machines)* as the basis for this Australian Standard.

This action will ensure the continuing consistency of machinery safety standards with each other, as well as ensuring that a consistent approach to machinery safety standards is maintained in Australia.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard
Safety of machinery**Part 3101: Materials cutting—Milling machines (including boring machines)—Safety requirements**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

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 including machines capable of performing boring operations.

Machines covered by this Standard include but are not limited to—

- (a) knee and column type milling machines (see Figures D1 and D2);
- (b) bed-type milling machines (see Figure D3);
- (c) multi-spindle milling machines (see Figures D4 and D5);
- (d) plano-milling machines (see Figures D4 and D5);
- (e) profile and contouring milling machines (see Figure D6); and
- (f) milling and boring machines (see Figure D7).

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

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 both operators and other exposed persons.

This Standard deals with significant hazards relevant to milling machines when they are used as intended and under the conditions foreseen by the manufacturer.

Milling machines with automatic tool changing capabilities are not covered by this Standard.

1.2 OBJECTIVE

The objective of this Standard is to provide designers, manufacturers, suppliers, employers and users of milling machines, including boring machines, with means of minimizing risks to the health and safety of employees and others working with or otherwise near milling machines.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- 1657 Fixed platforms, walkways, stairways and ladders—Design, construction and installation
- 1892 Portable ladders
- 1892.2 Part 2: Timber
- 4024 Safeguarding of machinery
- 4024.3 Part 3: Manufacturing and testing requirements for electro-sensitive systems—
Optoelectronic devices
- 4024.5 Part 5: Manufacturing and testing requirements for electro-sensitive systems—
Pressure-sensitive devices
- 4024 Safety of machinery
- 4024.1202 Part 1201: General principles—Technical principles
- 4024.1301 Part 1301: Risk assessment—Principles for risk assessment
- 4024.1501 Part 1501: Design of safety related parts of control systems—General principles
for design
- 4024.1601 Part 1601: Design of controls, interlocks and guarding—Guards—General
requirements for the design and construction of fixed and movable
guards
- 4024.1602 Part 1602: Design of controls, interlocks and guarding—Interlocking devices
associated with guards—Principles for design and selection
- 4024.1801 Part 1801: Safety distances and safety gaps—Safety distances to prevent danger
zones being reached by the upper limbs
- 4024.1802 Part 1802: Safety distances and safety gaps—Safety distances to prevent danger
zones being reached by the lower limbs
- 4024.1803 Part 1803: Safety distances and safety gaps—Minimum gaps to prevent
crushing of parts of the human body
- 4024.2601 Part 2601: Design of controls, interlocks and guarding—Two-hand control
devices—Functional aspects and design principles
- 60204 Safety of machinery—Electrical equipment of machines
- 60204.1 Part 1: General requirements (IEC 60204-1, Ed.5 (FDIS) MOD)

AS/NZS

- 1680 Interior lighting
- 1680.2.4 Part 2.4: Industrial tasks and processes
- 1891 Industrial fall-arrest systems and devices (series)
- 1892 Portable ladders
- 1892.1 Part 1: Metal
- 1892.3 Part 3: Reinforced plastic
- 4251 Electromagnetic compatibility (EMC)—Generic emission standards
- 4251.2 Part 2: Industrial environments
- 61000 Electromagnetic compatibility (EMC)
- 61000.6.2 Part 6.2: General standards—Immunity for industrial environments

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
- 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

9614 Acoustics—Determination of sound power levels of noise sources using sound intensity

9614-1 Part 1: Measurement at discrete points

11202 Acoustics—Noise emitted by machinery and equipment—Measurement of emission sound pressure levels at a work station and at other specified positions—Survey method in situ

11204 Acoustics—Noise emitted by machinery and equipment—Measurement of emission sound pressure levels at a work station and at other specified positions—Method requiring environmental corrections

IEC

60439 Low-voltage switchgear and controlgear assemblies

60439-1 Part 1: Type-tested and partially type-tested assemblies

1.4 DEFINITIONS

For the purpose of this Standard the definitions below apply.

1.4.1 Automatic milling machine

A machine with the capability to perform programmed multiple axis movements.

1.4.2 Boring machine

A machine designed to perform boring operations. Such machines are normally capable of milling operations.

1.4.3 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.

1.4.4 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.

1.4.5 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.

1.4.6 Milling machine

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

1.4.7 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.

1.4.8 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.

1.4.9 Work zone

The space where the metal cutting process can take place.

SECTION 2 RISK MANAGEMENT

2.1 RISK ASSESSMENT

A risk assessment in accordance with AS 4024.1301 shall be carried out for milling machines and boring machines. The risk assessment shall take into account hazards which can occur during any phase in the life of the machine to both the machine operator and other persons having access to the hazard zones. The risk assessment shall assume foreseeable access from all directions, as well as unexpected start up.

Such access may be under conditions arising during intended use, including reasonably foreseeable misuse of the machine for both normal machining operations; or operations requiring intervention by the operator or personnel such as setting, cleaning, maintenance or repair.

2.2 HAZARD IDENTIFICATION

The significant hazards associated with the machine shall be identified. Each hazard shall be eliminated or the associated risk reduced as far as is technically possible.

2.3 VALIDATION

The risk assessment shall be validated to ensure it is complete for the machine under consideration. Particular attention shall be paid to—

- (a) the intended use of the machine including maintenance, setting and cleaning;
- (b) reasonably foreseeable misuse of the machine; and
- (c) the identification of significant hazards associated with the machine.

SECTION 3 SAFETY REQUIREMENTS WHICH MAY BE RELEVANT TO ALL MILLING MACHINES

3.1 SCOPE

This Section sets out the safety requirements and measures necessary to minimize the risks to health and safety of operators and others having access to the danger zones of milling machines of all types.

Not all the hazards will be applicable to every machine.

3.2 MECHANICAL HAZARDS

3.2.1 Workpiece transfer devices

3.2.1.1 *Safeguarding*

Workpiece transfer devices include pallet changing devices, and automatic workpiece changing devices.

Access to hazardous movements at the workpiece transfer device shall be prevented by fixed or interlocked movable guards, workpiece transfer devices or hazardous movements shall be either stopped or inhibited by the actuation of protective devices. The operator's position shall be located outside the danger zones of the workpiece transfer device and of the machine.

3.2.1.2 *Access for adjustment or maintenance*

Where access is required to the workpiece transfer device with the guard open or safety devices suspended, powered motion shall be initiated under the control of an appropriately monitored enabling device together with a hold to run control to permit step-by-step movement. Where continuous movement is required, a two hand control device in accordance with AS 4024.2601 shall be provided.

No other hazardous machine movement shall arise from the actuation of any sensor or feedback device.

3.2.2 Swarf collection and removal

Access to hazardous moving parts of swarf collection and removal systems shall be prevented by means of fixed guards. Interlocked movable guards shall be provided where operators have a need to access more frequently than once per shift. Guards shall be in accordance with AS 4024.1601.

Opening an interlocked movable guard, which provides access to the hazardous moving parts of a swarf system, shall cause the movement to cease and remain inhibited. Interlocking provisions shall conform with the categories of control of AS 4024.1501 and as a minimum, to Category 1 of AS 4024.1501.

If movement of a swarf system with an interlocked guard open is essential (e.g. for cleaning purposes) the movement shall only be permitted under the control of a hold-to-run device with an adjacent emergency stop device. A warning sign shall indicate the hazardous area of the swarf system discharge.

3.2.3 Power transmission

Power transmission machinery includes drive shafts, belts, pulleys and gears.

Access to hazardous power transmission parts shall be prevented by means of fixed guards. Interlocked movable guards shall be provided where operators have a need to access more frequently than one per shift. Guard shall be in accordance with AS 4024.1601.

Opening an interlocked movable guard, which exposes moving power transmission parts, shall cause their movement to cease and remain inhibited. Interlocking provisions shall conform with the requirements of AS 4024.1602 and as a minimum, to Category 1 of AS 4024.1501.

Where the hazardous moving parts can be reached before they come to rest, guard locking shall be applied to prevent opening of the guard until the hazardous movement has ceased. Delayed unlocking shall be achieved by means of a motion detector or timer control in accordance with AS 4024.1602.

3.2.4 Pits

Pits in or around a machine shall be covered e.g. by floor grids, or protected against persons falling into them by railings in accordance with AS 1657.

Where access to pits is necessary for observation, maintenance, or adjustment purposes, entry into the pit shall be via interlocked access gates which prevent machine movement in Mode 1 (see Clause 5.4.2). Where powered machine movements are necessary, machine elements may be moved under the conditions set out in Clause 5.4.3 and Clauses 3.2.1 and 3.2.2.

Safety distances between moving machine elements and pit walls or other fixed parts shall be in accordance with AS 4024.1803. Where these safety distances cannot be achieved, additional proximity sensing devices shall be provided to minimize the risk of crushing or trapping.

3.2.5 Operating platforms

Operating platforms shall comply with AS 1657.

In addition they shall—

- (a) have lighting and ventilation for the operating position(s);
- (b) provide safe means of access and egress for the operator, independent of power, to and from the platform in any position;
- (c) be designed such that the danger zone cannot be reached, e.g. by safe distances or by virtue of fixed or interlocked movable guards with guard locking; and
- (d) give protection against swarf and metal working fluid.

When an operating platform guard is opened, powered machine movements shall only be possible if the requirements of Mode 2 or Mode 3 are met. (See Clauses 5.4.3 and 5.4.4.)

It shall be possible to control the flow of metal working fluid from the operating position on the operating platform.

For telescoping (horizontally or vertically) operating platforms linked to a machine moving element, safety measures to prevent crushing and collision shall be provided (e.g. expansion bellows, metal roller shutters, pressure sensitive devices).

Powered movements of platforms shall only be permitted, e.g. for observation, by the use of hold-to-run control in Mode 2 or Mode 3, and an emergency stop shall be provided.

3.2.6 Access to elevated areas of the machine

Where frequent access to elevated areas of the machine is required a means of access shall be provided. Such access shall comply with AS 1657, and may include—

- (a) fixed ladders and stairways;
- (b) fixed platforms or walkways; and
- (c) guard rails, hand rails or toeboards.

Where infrequent access to the elevated areas of the machine is required, it is permitted that one or both of the following be provided as an alternative to the means of access given above:

- (i) Means to attach fall arrest devices in accordance with AS/NZS 1891.
- (ii) means to attach portable ladders in accordance with AS 1892.2, AS/NZS 1892.1 or AS/NZS 1892.3.

NOTE: For the purpose of this Standard, frequent access is considered to be once or more per shift.

3.2.7 Ejection of parts

3.2.7.1 Machine parts or components

Guards shall be provided to contain the energies of, or protect persons from the machine parts or components which can be ejected.

When designed and tested in accordance with Appendix A, the guard shall exhibit no cracking which is visible from one surface to the other or penetration of the material.

For guard doors, there shall be no additional damage (see Paragraph A6).

Thickness of guard materials calculated from Appendix A may be reduced where maximum ejection energies are limited by incorporation of systems that identify the tool to the numerical control system, enabling limitation of spindle speed applied.

Where guards are fitted with viewing panels which are also intended to contain ejected parts, special consideration shall be given to the selection of materials and methods of fixing. Materials such as polycarbonate which are liable to a reduction in impact strength over time, due to contamination, e.g. by lubricants, metal working fluids, cleaning agents or solvents or to abrasion, shall be provided with additional protection, e.g. sealed multiplayer or laminated constructions, or additional thickness to counter this harmful effect during the anticipated service life of the machine.

NOTE: One form of equipment for impact testing the guard is given in Appendix B.

3.2.7.2 Swarf or metal working fluid

Ejection of swarf or metal working fluid shall be prevented. Suitable means include a deflecting adjustable guard fixed to the spindle head to direct swarf or metal working fluid towards their collection area, or by a fixed guard covering the whole area of ejection.

3.2.7.3 Power operated spindle drawbars

Drawbars shall be designed to avoid risks from tool ejection in the event of power supply failure. The drawbar mechanism shall be monitored so that a failure to achieve correct registration or clamping of the retention knob on the tool shall inhibit the spindle start control in all operating modes. Unclamping of the tool by releasing the drawbar shall be inhibited during spindle rotation.

3.2.8 Loss of stability

Machines shall be designed and constructed so that they are stable under foreseeable operating conditions, and without risks of overturning, falling or unexpected movement.

When the use of foundation bolting is one of the measures used to help prevent overturning, manufacturers shall specify the bolts and foundation requirements necessary (see also Section 6).

3.2.9 Slips, trips and falls

3.2.9.1 *Containment of fluids*

Where a fluid application system is provided. It shall be designed to minimize splash, spray, and mist. Where significant hazards remain, guards to minimize the splashing or mist dispersal during operation shall be provided. Information for use shall draw attention to the importance of preventing fluid spillage onto the surrounding area and thus creating a slipping hazard.

3.2.9.2 *Places of work and means of access on machines*

Places of work and means of access on machines (such as integral ladders, platforms and walkway) shall be designed to minimize the likelihood of slips, trips, and falls by the provision of adequate hand holds, foot holds, and where necessary slip resistant surfaces. Warnings about hazards and precautions shall be given in the instruction handbook, see Clause 6.1.

3.3 ELECTRICAL HAZARDS

3.3.1 Design

To minimize the risk of malfunction, burns or shock, all electrical equipment shall be designed and applied in accordance with AS 60204.1. Means shall be provided to isolate the machine from sources of electrical energy. Such isolation shall be located at the main electrical enclosure.

3.3.2 Electro-magnetic compatibility

3.3.2.1 *Emission*

Electrical/electronic design shall apply technical information and physical measures to limit electromagnetic emissions in accordance with AS/NZS 4251.2 and IEC 60439-1.

3.3.2.2 *Immunity*

Electronic control systems shall be designed and installed so as to be protected from electromagnetic interference and stable when exposed to electrical system operation or failure in accordance with AS/NZS 61000.6.2 and IEC 60439-1.

3.4 NOISE

Risk from noise shall be reduced by the following means in the order given:

- (a) Reduction of the noise at the source
- (b) Control of the noise transmission paths
- (c) Information for use including personal protective equipment

The design shall take into account noise from each source. Major sound sources for milling machines, together with technical means for reducing noise are as follows:

- (i) Transmission noise gearbox damping.
- (ii) Pneumatic exhaust silencers.
- (iii) Power generation source damping or absorber.
- (iv) Noise under cutting process damping or absorber (see Note 2).
- (v) Changing workpiece damping or absorber (see Note 2).

Additional or alternative measures providing an identical or higher noise reduction efficiency may be used.

NOTES:

- 1 The damper or absorber is often located inside the work zone enclosing guard.
- 2 A noise test and report layout is provided at Appendix C.

3.5 HAZARDS GENERATED BY MATERIALS OR SUBSTANCES PROCESSED

3.5.1 Fluids, mists, fumes and dust

3.5.1.1 Design

The system design shall prevent splash, leakage and overflow of the metalworking fluid.

3.5.1.2 Construction materials

Fluid reservoirs and other system components shall be made of materials which will ensure the continued integrity of the system and information on metalworking fluids to be used shall be given.

3.5.1.3 Fluid distribution system

The metalworking fluid distribution system and delivery nozzles shall be designed to minimize spray.

3.5.1.4 Containment of harmful emissions

Where the generation of harmful fine mists and vapour or smoke is foreseen in the work zone, means for containment shall be provided to prevent their escape and for the addition of integral or external extraction equipment.

3.5.1.5 System capacity

The metalworking fluid capacity shall match the correct function of the machine and either be of sufficient volume to avoid excessive heating and subsequent evaporation of the fluid or fluid coolers shall be provided.

The metalworking fluid system shall be capable of delivering sufficient quantity of fluids to minimize the possibility of generating hazardous vapours at the cutting site.

3.5.1.6 Suspension of fluid delivery

Where it is foreseen that it will be necessary for operators to place their hands into the work zone (e.g. during load/unload operations, during setting), metalworking fluid shall be automatically stopped or diverted.

NOTE: Means may be provided to manually turn on the metal-working fluid for adjustment purposes with the guard open.

3.5.1.7 Level indicators

Tanks should be fitted with visual fluid level indication, and coolant filling point which shall be easily legible during machine operation.