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Machine tools — Safety — Turning machines

Machines-outils — Sécurité — Machines de tournage

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 39, *machine tools*, Subcommittee SC 10, *Safety*.

This second edition cancels and replaces the first edition (ISO 23125:2010), of which it constitutes a minor revision. It also incorporates the Amendment ISO 23125:2010/Amd1:2012.

The International Standards produced by ISO/TC 39/SC 10 in collaboration with CEN/TC 143 are particular to machine tools and complement the relevant A and B standards on the subject of general safety (see Introduction to ISO 12100 for a description of type-A, -B and -C standards).

This International 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 EU Directive(s).

Introduction

This International Standard has been prepared to be a Harmonized Standard to provide one means of conforming to the Essential Safety Requirements of the Machinery Directive of the European Union and associated EFTA regulations.

This International Standard is a type-C standard as defined in ISO 12100:2010.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered is indicated in the Scope of this International Standard. In addition, turning machines shall comply as appropriate with ISO 12100:2010 for hazards which are not covered by this International Standard.

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 over the provisions of the other International Standards for machines that have been designed and built in accordance with the provisions of this type-C standard.

This International Standard makes reference to the "safety categories" in EN 954-1:1996 as resistance to faults and their subsequent behaviour in the fault condition together with the "performance level" defined in ISO 13849-1:2006 in terms of probability of dangerous failure per hour. It is the decision of the user of this International Standard to apply "safety categories" or "performance levels".

The requirements of this International Standard concern designers, manufacturers, suppliers and importers of machines described in the Scope.

This International Standard also includes a list of informative items to be provided by the manufacturer to the user.

The requirements for a new mode of operation, Mode 3 "manual intervention machining mode" will be discussed in the future.

Machine tools — Safety — Turning machines

1 Scope

This International Standard specifies the requirements and/or measures to eliminate the hazards or reduce the risks in the following groups of turning machines and turning centres, which are designed primarily to shape metal by cutting.

— **Group 1**: Manually controlled turning machines without numerical control.

— **Group 2**: Manually controlled turning machines with limited numerically controlled capability.

— **Group 3**: Numerically controlled turning machines and turning centres.

— **Group 4**: Single- or multi-spindle automatic turning machines.

NOTE 1 For detailed information on the machine groups, see the definitions in 3.4 and mandatory and optional modes of operation in 3.3.

NOTE 2 Requirements in this International Standard are, in general, applicable to all groups of turning machines. If requirements are applicable to some special group(s) of turning machines only, then the special group(s) of turning machine(s) is/are specified.

NOTE 3 Hazards arising from other metalworking processes (e.g. grinding and laser processing) are covered by other International Standards (see Bibliography).

This International Standard covers the significant hazards listed in Clause 4 and applies to ancillary devices (e.g. for workpieces, tools and work clamping devices, handling devices and chip handling equipment), which are integral to the machine.

This International Standard also applies to machines which are integrated into an automatic production line or turning cell inasmuch as the hazards and risks arising are comparable to those of machines working separately.

This International Standard also includes a minimum list of safety-relevant information which the manufacturer has to provide to the user. See also ISO 12100:2010, Figure 2, which illustrates the interaction of manufacturer's and user's responsibility for the operational safety.

The user's responsibility to identify specific hazards (e.g. fire and explosion) and reduce the associated risks can be critical (e.g. whether the central extraction system is working correctly).

Where additional processes (milling, grinding, etc.) are involved, this International Standard can be taken as a basis for safety requirements; for specific information see the Bibliography.

This International Standard applies to machines that are manufactured after the date of issue of this International Standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable to its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 230-5:2000, *Test code for machine tools — Part 5: Determination of the noise emission*

ISO 447:1984, *Machine tools — Direction of operation of controls*

ISO 702 (all parts), *Machine tools — Connecting dimensions of spindle noses and work holding chucks*

ISO 841:2001, *Industrial automation systems and integration — Numerical control of machines — Coordinate system and motion nomenclature*

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

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

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

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

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

ISO 6385:2004, *Ergonomic principles in the design of work systems*

ISO 8525:2008, *Airborne noise emitted by machine tools — Operating conditions for metal-cutting machines*

ISO 9241 (all parts), *Ergonomics of human-system interaction*

ISO 9355-1, *Ergonomic requirements for the design of displays and control actuators — Part 1: Human interactions with displays and control actuators*

ISO 9355-2, *Ergonomic requirements for the design of displays and control actuators — Part 2: Displays*

ISO 9355-3, *Ergonomic requirements for the design of displays and control actuators — Part 3: Control actuators*

ISO 10218-2:2011, *Robots and robotic devices — Safety requirements for industrial robots — Part 2: Robot systems and integration*

ISO 11161:2007+Amd.1:2010, *Safety of machinery — Integrated manufacturing systems — Basic requirements*

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

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

ISO 11228 (all parts), *Ergonomics — Manual handling*

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

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

ISO 13849-1:2006, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13849-2:2003, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation*

ISO 13850:2006, *Safety of machinery — Emergency stop — Principles for design*

ISO 13851:2002, *Safety of machinery — Two-hand control devices — Functional aspects and design principles*

ISO 13854:1996, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

ISO 13855:2010, *Safety of machinery — Positioning of safeguards with respect to the approach speeds of parts of the human body*

ISO 13856-2:2005, *Safety of machinery — Pressure-sensitive protective devices — Part 2: General principles for the design and testing of pressure-sensitive edges and pressure-sensitive bars*

ISO 13856-3:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 3: General principles for design and testing of pressure-sensitive bumpers, plates, wires and similar devices*

ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14118:2000, *Safety of machinery — Prevention of unexpected start-up*

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

ISO 14120:2002, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 14122-1:2001, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means of access between two levels*

ISO 14122-2:2001, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways*

ISO 14122-3:2001, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*

ISO 14122-4:2004, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders*

ISO 14159:2002, *Safety of machinery — Hygiene requirements for the design of machinery*

ISO 15534-1:2000, *Ergonomic design for the safety of machinery — Part 1: Principles for determining the dimensions required for openings for whole-body access into machinery*

ISO 15534-2:2000, *Ergonomic design for the safety of machinery — Part 2: Principles for determining the dimensions required for access openings*

ISO 16156:2004, *Machine-tools safety — Safety requirements for the design and construction of work holding chucks*

IEC 60204-1:2009, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

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

IEC 61000-6-2:2005, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments*

IEC 61000-6-4:2011, *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments*

IEC 61800-5-2:2007, *Adjustable speed electrical power drive systems — Part 5-2: Safety requirements — Functional*

EN 954-1:1996, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

EN 1837:1999+A1:2009, *Safety of machinery — Integral lighting of machines*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010, ISO 13849-1:2006 and EN 954-1:1996 and the following apply.

3.1 General terms

3.1.1
turning machine
machine tool in which the principal movement is the rotation of the workpiece against the stationary cutting tool(s)

3.1.2
manual control
mode of operation where each movement of the machine is individually initiated and controlled by the operator

3.1.3
manually controlled turning machine
turning machine (3.1.1) for which process steps for the machining are controlled or started by an operator without support by an NC-machining program

3.1.4
numerical control
NC
computerized numerical control
CNC
automatic control of a process performed by a device that makes use of numerical data introduced while the operation is in progress

[SOURCE: ISO 2806:1994, 2.1.1]

3.1.5
numerically controlled turning machine
NC turning machine
turning machine that operates under *numerical control* (3.1.4) or computerized numerical control (CNC)

3.1.6
turning centre
numerically controlled turning machine (3.1.5) equipped with power-driven tools and the capability to orientate the work holding spindle around its axis

Note 1 to entry: A turning centre can also include, but is not limited to, functions such as gauging, burnishing, threading, boring, milling, grinding and drilling.

Note 2 to entry: If grinding processes are involved, see EN 13218 for additional safety measures.

3.1.7
work zone
space where metal cutting is to take place

3.1.8
performance level
PL
discrete level used to specify the ability of safety-related parts of control systems to perform a safety function under foreseeable conditions

[SOURCE: ISO 13849-1:2006, 3.1.23]

3.1.9
mean time to dangerous failure
$MTTF_d$
expectation of the mean time to dangerous failure

[SOURCE: ISO 13849-1:2006, 3.1.25]

3.1.10
category
classification of safety-related parts of a control system in respect of its resistance to fault and its subsequent behaviour in the fault condition, and which is achieved by the structural arrangement of the parts and/or their reliability

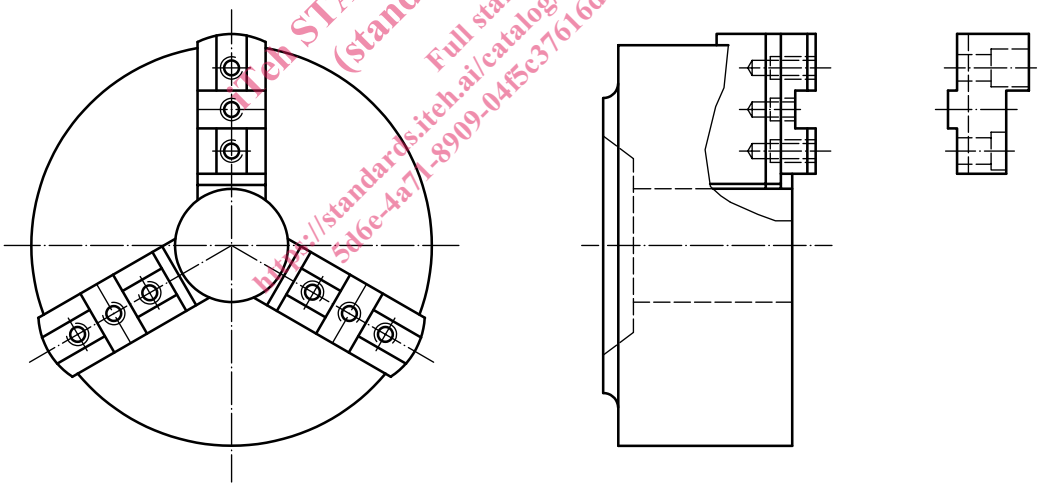
[SOURCE: EN 954-1:1996, 3.2.]

3.2 Terms related to parts of turning machines

3.2.1
vision panel
window provided in a guard through which the operator can view the *work zone* (3.1.7) or other areas of the machine

3.2.2
chuck
clamping device in which workpieces are clamped with the aid of either manual energy or pneumatic, hydraulic or electric energy

Note 1 to entry: See Figure 1.



NOTE The chuck with 3 jaws is an example only, a chuck can have 2, 3, 4 or 6 jaws.

Figure 1 — Chuck

3.2.3
collet
device designed to hold the bar into the turning spindle, e.g. by pressure bar or draw bar

Note 1 to entry: See Figure 2.

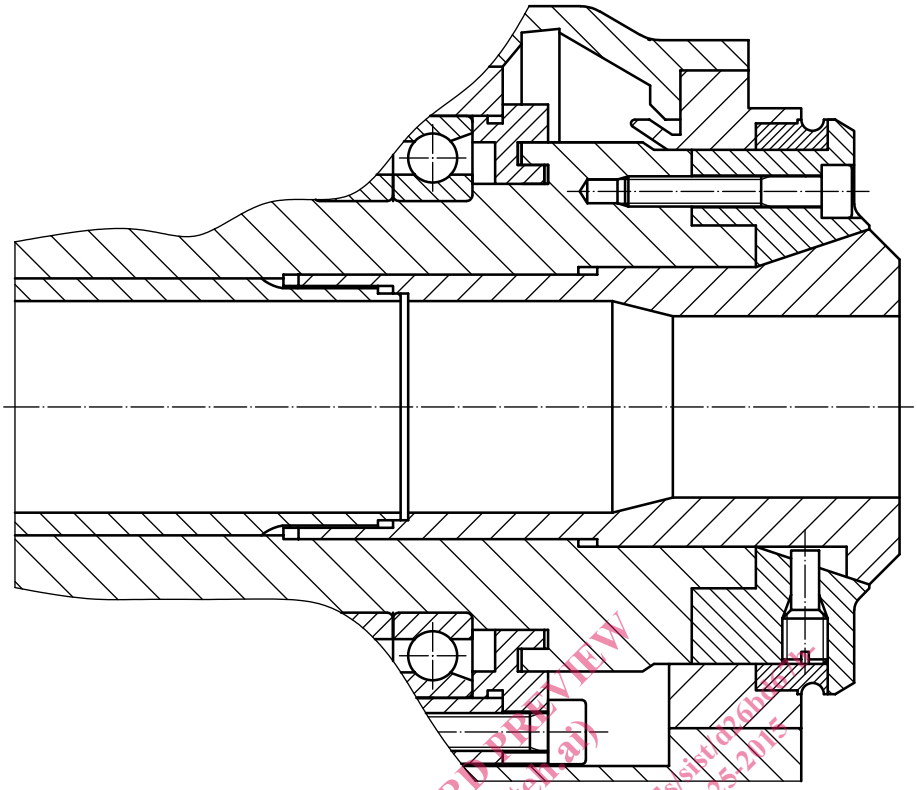


Figure 2 — Collet

3.2.4
electronic handwheel
manually operated control device which initiates and maintains an axis movement by pulse generation input to the *numerical control* (3.1.4) during its rotation

3.3 Terms related to modes of operation — Mandatory and optional modes of operation for turning machines

NOTE Table 1 gives an overview of the mandatory, optional or not allowed modes of operations for turning machines. Table 1 is mandatory.

Table 1 — Overview of turning machine groups and modes of operation

Mode of operation	Turning machines			
	Group 1 Manually controlled turning machines without numerical control	**Group 2** Manually controlled turning machines with limited capability of numerical control	**Group 3** Numerically controlled turning machines and turning centres	**Group 4** Single- or multi-spindle automatic turning machines
Mode 0 manual mode	Mandatory	Mandatory	Optional	Not allowed
Mode 1 automatic mode	Not allowed	Mandatory limited Mode 1	Mandatory	Mandatory
Mode 2[a] setting mode	Not allowed	Optional	Mandatory	Mandatory
Service mode[a]	Not allowed	Optional	Optional	Optional

[a] These modes are key protected and only available for well-trained and qualified staff (see 6.2.1). In order to allocate the access, it may be necessary to provide different key switches (or other appropriate access means) for a turning machine.

For example:

— Key 1: Access to setting mode (and automatic mode) for setting staff;

— Key 2: Access to CNC program code and CNC parameter modifications to adequately trained staff [see 5.8 b) 2)];

— Key 3: Access to service mode for service staff.

NOTE In most applications, key switch 1 (setting mode) and key switch 2 (CNC program code access) can be identical.

3.3.1
Mode 0: manual mode
operation of the machine by the operator without NC functions or non-automatic mode of the machine axes, where the operator has control over the machining process without the use of pre-programmed operations

3.3.2
Mode 1: automatic mode
automatic, programmed, sequential operation of the machine with the facility for manual or automatic loading/unloading of workpiece and tools, until stopped by program or operator

3.3.3
Mode 2: setting mode
mode of operation in which adjustments for the subsequent machining process are performed by the operator

Note 1 to entry: Checking of tool or workpiece position (e.g. by touching the workpiece with a probe or tool) are procedures of the setting mode (see 5.2.4.4).

3.3.4
service mode
mode for service and maintenance tasks, such as axis calibration by laser, ballbar testing and spindle error analysis

Note 1 to entry: In service mode, the machining of a workpiece is not allowed (see 5.2.4.5).