



BSI Standards Publication

Machine tools safety — Machining centres, Milling machines, Transfer machines

Part 1: Safety requirements

This is a preview of BS EN ISO 16090-1:2022. [Click here to purchase the full version from the ANSI store.](#)

National foreword

This British Standard is the UK implementation of EN ISO 16090-1:2022. It is identical to ISO 16090-1:2022. It supersedes BS EN ISO 16090-1:2018 which is withdrawn.

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

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

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 29391 3

ICS 13.110; 25.080.01

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 December 2022.

Amendments/corrigenda issued since publication

Date	Text affected
30 November 2023	Implementation of ISO corrected text 30 October 2023

This is a preview of BS EN ISO 16090-1:2022. [Click here to purchase the full version from the ANSI store.](#)

EUROPÄISCHE NORM

December 2022

ICS 25.080.01; 13.110

Supersedes EN ISO 16090-1:2018

English Version

Machine tools safety - Machining centres, milling machines, transfer machines - Part 1: Safety requirements (ISO 16090-1:2022, Corrected version 2023-10)

Sécurité des machines-outils - Centres d'usinage, fraiseuses, machines transfert - Partie 1: Exigences de sécurité (ISO 16090-1:2022, Version corrigée 2023-10)

Werkzeugmaschinen-Sicherheit - Bearbeitungszentren, Fräsmaschinen, Transfermaschinen - Teil 1: Sicherheitsanforderungen (ISO 16090-1:2022, korrigierte Fassung 2023-10)

This European Standard was approved by CEN on 17 October 2022.

This European Standard was corrected and reissued by the CEN-CENELEC Management Centre on 01 November 2023.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.



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

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

European foreword

This document (EN ISO 16090-1:2022) has been prepared by Technical Committee ISO/TC 39 "Machine tools" in collaboration with 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 June 2023, and conflicting national standards shall be withdrawn at the latest by June 2023.

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

This document supersedes EN ISO 16090-1:2018.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

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, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Endorsement notice

The text of ISO 16090-1:2022, Corrected version 2023-10 has been approved by CEN as EN ISO 16090-1:2022 without any modification.

This is a preview of BS EN ISO 16090-1:2022. [Click here to purchase the full version from the ANSI store.](#)

Contents

	Page
Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	2
3 Terms and definitions	4
3.1 General terms.....	4
3.2 Groups of machines.....	7
3.3 Parts of machines.....	8
3.4 Mode of operations.....	9
3.5 Maximum permissible spindle speed and feed rate.....	11
4 List of significant hazards	11
4.1 General.....	11
4.2 Main hazard zones.....	11
4.3 Significant hazards and hazardous situations covered by this document.....	12
5 Safety requirements and/or protective/risk reduction measures	16
5.1 General requirements.....	16
5.1.1 General.....	16
5.1.2 Guards requirements.....	16
5.1.3 Requirement for gravity loaded axes.....	19
5.2 Specific requirements resulting from mechanical hazards.....	19
5.2.1 Protective measures for Group 1 machines.....	19
5.2.2 Protective measures for Group 2 machines.....	19
5.2.3 Protective measures for Group 3 and Group 4 machines.....	20
5.2.4 Mode of operation (MO).....	21
5.2.5 Optional or additional equipment for machines.....	28
5.3 Specific requirements resulting from electrical hazards.....	36
5.4 Specific requirements resulting from noise hazards.....	37
5.5 Specific requirements resulting from radiation hazards.....	37
5.6 Specific requirements resulting from material or substance hazards.....	37
5.6.1 Combustible coolants.....	37
5.6.2 Minimum quantity lubrication (MQL).....	39
5.6.3 Dry processing and combustible dust.....	39
5.6.4 Requirements for biological or microbiological hazards.....	39
5.7 Specific requirements resulting from neglect of ergonomic principles hazards.....	40
5.8 Specific requirements resulting from failure or disorder of the control system.....	41
5.8.1 General.....	41
5.8.2 Starting.....	41
5.8.3 Normal stop.....	42
5.8.4 Emergency stop.....	42
5.8.5 Manual reset function.....	42
5.8.6 Safety related parts of control system (SRP/CS).....	43
5.8.7 Monitoring rotational speed limits and limits of linear and rotary movements.....	44
5.8.8 Requirements for electromagnetic compatibility of electrical equipment.....	44
5.9 Specific requirements resulting from failure of any power supply.....	45
5.10 Specific requirements resulting from errors of fitting hazards.....	45
5.11 Specific requirements resulting from ejected fluids or parts.....	45
5.11.1 General requirements.....	45
5.11.2 Ejection of parts — Guard strength.....	46
5.11.3 Power-operated workpiece and tool clamping.....	46
5.11.4 Additional requirements for Group 3 and Group 4 machines.....	47
5.12 Specific requirements resulting from loss of stability hazards.....	47

This is a preview of BS EN ISO 16090-1:2022. [Click here](#) to purchase the full version from the ANSI store.

5.13	Requirements resulting from slips, trips, and fall of persons hazards.....	47
5.14	Requirements resulting from accessibility for maintenance or troubleshooting on high parts of the machine.....	47
5.15	Requirements for machinery with operator cabins and perimeter fencing.....	47
5.15.1	General.....	47
5.15.2	Overall concept for entering/leaving machinery.....	48
5.15.3	Requirements for moveable/adjustable operator cabins and operation platforms.....	48
5.15.4	Requirements for perimeter fencing.....	51
5.16	Requirements for teleservice.....	51
5.17	Verification of the safety requirements and/or protective measures.....	51
6	Information for use.....	56
6.1	General.....	56
6.2	Marking.....	56
6.2.1	General markings.....	56
6.2.2	Symbols of operating modes (MO) on machines.....	57
6.3	Instruction for use.....	58
6.3.1	General.....	58
6.3.2	Tooling.....	60
6.3.3	Workpiece clamping.....	61
6.3.4	Machine functions accessible from the NC panel.....	61
6.3.5	Restart.....	61
6.3.6	Noise.....	61
6.3.7	Residual risks to be addressed to the machinery user.....	62
6.3.8	Installations instructions of machinery.....	63
6.3.9	Cleaning instructions of machinery.....	63
6.3.10	Machinery with operator cabins and/or perimeter fencing.....	63
6.3.11	Machinery equipped with gravity loaded axes or slant axes.....	63
6.3.12	Machinery equipped with MO 3.....	63
6.3.13	Machinery that is telecontrol-ready.....	64
Annex A	(normative) Impact test method for guards on machines.....	65
Annex B	(informative) Equipment for impact test and examples of tested materials.....	68
Annex C	(informative) Illustrative figures as examples of machines.....	70
Annex D	(informative) Illustrative figures as examples of guards.....	79
Annex E	(informative) Examples of the integration of exhaust and extinguishing systems when using combustible coolants or combustible dust.....	86
Annex F	(informative) Provisions when using combustible coolants and combustible dust.....	88
Annex G	(normative) Gravity-loaded axes.....	91
Annex H	(informative) Examples: Concept for leaving/returning to a cabin (control station) at Group 3 and Group 4 machines.....	98
Annex I	(informative) Typical demand rates of safety functions for calculations according to Table 3 and Annex J.....	100
Annex J	(normative) Safety functions.....	105
Annex K	(normative) Noise emission measurement.....	152
Bibliography	154

This is a preview of BS EN ISO 16090-1:2022. [Click here to purchase the full version from the ANSI store.](#)

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 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 39, *Machine tools*, Subcommittee SC 10, *Safety*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 143, *Machine tools — Safety*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 16090-1:2017), which has been technically revised.

The main changes are as follows:

- update and addition of safety functions in [Annex J](#),
- revision of operating modes and change of designation from MSO (mode of safe operation) to MO (mode of operation),
- former MSO 3 (optional special mode for manual intervention under restricted operating conditions), in the current addition referred to as MO 3 (manual intervention under restricted operating conditions), has been revised in a way, that the usage of an enabling device is necessary in any case, i.e. dispensing of the enabling device is no longer possible.

A list of all parts in the ISO 16090 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This corrected version of ISO 16090-1:2022 incorporates the following corrections:

- [Figure 2](#) has been modified so that the measurement *Y* is taken from the lower part of the moving band and not from the centre of the axis of the roller.

Introduction

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

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

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organisations, market surveillance, etc.).

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

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e.g. for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers).

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

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

When requirements of this type-C standard are different from those stated in type-A or type-B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

Machining centres, milling machines and transfer machines present a wide range of hazards. Protection of operators and other persons from contact with moving cutting tools, especially when being rapidly rotated in the spindle or being swung from a tool magazine to the spindle during power-operated tool changing, 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, clamping or releasing of the workpiece.

The significant hazards covered by this document are those listed in [Clause 4](#). 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 [5.17](#).

[Figures D.1](#) to [D.8](#) are examples only and are not intended to illustrate the only interpretation of the text.

This is a preview of BS EN ISO 16090-1:2022. Click here to purchase the full version from the ANSI store.

Machine tools safety — Machining centres, milling machines, transfer machines —

Part 1: Safety requirements

1 Scope

This document specifies the technical safety requirements and protective measures for the design, construction and supply (including installation and dismantling, with arrangements for transport and maintenance) of:

- milling machines (see [3.1.1](#)), including machines capable of performing boring operations (see [3.1.2](#));
- machining centres; and
- transfer machines (see [3.1.3](#))

designed for continuous production use, which are intended to cut cold metal and other non-combustible cold materials, except wood or materials with physical characteristics similar to those of wood as defined in ISO 19085-1 and glass, stone and engineered/agglomerated materials as defined in EN 14618.

This document covers the following machines (referred to as "machines" in this document):

- a) manually, without numerical control, operated boring and milling machines (see [3.2.1](#), Group 1), e.g. knee and column type milling machines (see [Figures C.1](#) and [C.2](#));
- b) manually, with limited numerical control, operated boring and milling machines (see [3.2.2](#), Group 2), e.g. profile and contouring milling machines (see [Figures C.3](#) and [C.4](#));
- c) numerically controlled milling machines and machining centres (see [3.2.3](#), Group 3), e.g. automatic milling machines and milling centres, e.g. multi-spindle milling machines, gear-milling machines (see [Figures C.5](#) to [C.7](#));
- d) transfer and special-purpose machines (see [3.2.4](#), Group 4), which are designed to process only pre-specified workpieces or limited range of similar workpieces by means of a predetermined sequence of machining operations and process parameters (see [Figures C.8](#) to [C.13](#)).
- e) machines fitted with the following devices/facilities, whose hazards have been dealt with:
 - tool magazine(s);
 - tool changer(s);
 - workpiece handling mechanism(s);
 - powered workpiece clamping mechanism(s);
 - swarf/chip conveyor(s);
 - power-operated door(s);
 - moveable operator cabin(s);