

Safety of machinery — Basic concepts, general principles for design —

Part 1: Basic terminology, methodology

ICS 01.040.13; 13.110

National foreword

This British Standard is the UK implementation of EN ISO 12100-1:2003+A1:2009. It is identical to ISO 12100-1:2003, incorporating amendment 1:2009. It supersedes BS EN ISO 12100-1:2003 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to ISO text carry the number of the ISO amendment. For example, text altered by ISO amendment 1 is indicated by **A1** **A1**.

The UK participation in its preparation was entrusted to Technical Committee MCE/3, Safeguarding of machinery.

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

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Amendments/corrigenda issued since publication

Amd. No.	Date	Comments
14974 Corrigendum No. 1	19 January 2004	Incorporating corrected EN foreword and Annex ZA pages and adding Annex ZB page
	31 July 2009	Implementation of ISO amendment 1:2009 with CEN endorsement A1:2009
	31 October 2009	Incorporating CEN correction notice 15 July 2009

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 7 November 2003

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ISBN 978 0 580 68672 6

English version

Safety of machinery - Basic concepts, general principles for
design - Part 1: Basic terminology, methodology (ISO 12100-
1:2003)

Sécurité des machines - Notions fondamentales, principes
généraux de conception - Partie 1: Terminologie de base,
méthodologie (ISO 12100-1:2003)

Sicherheit von Maschinen - Grundbegriffe, allgemeine
Gestaltungsleitsätze - Teil 1: Grundsätzliche Terminologie,
Methodologie (ISO 12100-1:2003)

This European Standard was approved by CEN on 9 June 2003.

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CORRECTED 2003-12-17

Foreword

This document (EN ISO 12100-1:2003) has been prepared by Technical Committee ISO/TC 199 "Safety of machinery" in collaboration with Technical Committee CEN/TC 114 "Safety of machinery", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by May 2004, and conflicting national standards shall be withdrawn at the latest by May 2004.

This document supersedes EN 292-1:1991.

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 EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZB, which is an integral part of this document.

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Endorsement notice

The text of ISO 12100-1:2003 has been approved by CEN as EN ISO 12100-1:2003 without any modifications.

The CEN correction notice 15 July 2009 provided a revised English language text incorporating the following editorial correction.

CEN/TC 114 request that the **Annex ZA** relating to **ISO and EN standards** is maintained.

Foreword to amendment A1

This document (EN ISO 12100-1:2003/A1:2009) has been prepared by Technical Committee ISO/TC 199 "Safety of machinery" in collaboration with Technical Committee CEN/TC 114 "Safety of machinery" the secretariat of which is held by DIN.

This Amendment to the European Standard EN ISO 12100:2003 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2009, and conflicting national standards shall be withdrawn at the latest by December 2009.

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Endorsement notice

The text of ISO 12100-1:2003/Amd 1:2009 has been approved by CEN as a EN ISO 12100-1:2003/A1:2009 without any modification.

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Introduction

The primary purpose of ISO 12100 is to provide designers with an overall framework and guidance to enable them to produce machines that are safe for their intended use. It also provides a strategy for standard makers.

The concept of safety of machinery considers the ability of a machine to perform its intended function(s) during its lifecycle where risk has been adequately reduced.

This standard is the basis for a set of standards which has the following structure:

- **type-A standards** (basic safety standards) giving basic concepts, principles for design, and general aspects that can be applied to all machinery;
- **type-B standards** (generic safety standards) dealing with one safety aspect or one type of safeguard that can be used across a wide range of machinery:
 - type-B1 standards on particular safety aspects (e.g. safety distances, surface temperature, noise);
 - type-B2 standards on safeguards (e.g. two-hand controls, interlocking devices, pressure sensitive devices, guards);
- **type-C standards** (machine safety standards) dealing with detailed safety requirements for a particular machine or group of machines.

This standard is a type-A standard.

When a type-C standard deviates from one or more provisions dealt with by Part 2 of this standard or by a type-B standard, the type-C standard takes precedence.

It is recommended that this standard be incorporated in training courses and manuals to convey basic terminology and general design methods to designers.

ISO/IEC Guide 51 has been taken into account as far as practicable at the time of drafting of this standard.

Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology

1 Scope

This standard defines basic terminology and methodology used in achieving safety of machinery.

The provisions stated in this standard are intended for the designer.

This standard does not deal with damage to domestic animals, property or the environment.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 12100-2:2003, *Safety of machinery – Basic concepts, general principles for design – Part 2 : Technical principles*.

3 Terms and definitions

For the purposes of ISO 12100-1 and -2, the following terms and definitions apply.

3.1

machinery machine

assembly of linked parts or components, at least one of which moves, with the appropriate machine actuators, control and power circuits, joined together for a specific application, in particular for the processing, treatment, moving or packaging of a material.

The terms "machinery" and "machine" also cover an assembly of machines which, in order to achieve the same end, are arranged and controlled so that they function as an integral whole.

NOTE Annex A provides a general schematic representation of a machine.

3.2

reliability (of a machine)

ability of a machine or its components or equipment, to perform a required function under specified conditions and for a given period of time without failing

3.3

maintainability (of a machine)

ability of a machine to be maintained in a state which enables it to fulfil its function under conditions of intended use, or restored into such a state, the necessary actions (maintenance) being carried out according to specified practices and using specified means

3.4
usability (of a machine)

ability of a machine to be easily used thanks to, among others, properties or characteristics that enable its function(s) to be easily understood.

3.5
harm

physical injury or damage to health

3.6
hazard

potential source of harm

NOTE 1 The term "hazard" can be qualified in order to define its origin (e.g. mechanical hazard, electrical hazard) or the nature of the potential harm (e.g. electric shock hazard, cutting hazard, toxic hazard, fire hazard).

NOTE 2 The hazard envisaged in this definition:

- either is permanently present during the intended use of the machine (e.g. motion of hazardous moving elements, electric arc during a welding phase, unhealthy posture, noise emission, high temperature);
- or may appear unexpectedly (e.g. explosion, crushing hazard as a consequence of an unintended / unexpected start-up, ejection as a consequence of a breakage, fall as a consequence of acceleration / deceleration).

3.7
relevant hazard

hazard which is identified as being present at or associated with the machine

NOTE A relevant hazard is identified as the result of one step of the process described in ISO 14121.

3.8
significant hazard

hazard which has been identified as relevant and which requires specific action by the designer to eliminate or to reduce the risk according to the risk assessment

3.9
hazardous situation

circumstance in which a person is exposed to at least one hazard. The exposure can immediately or over a period of time result in harm

3.10
hazard zone
danger zone

any space within and/or around machinery in which a person can be exposed to a hazard

3.11
risk

combination of the probability of occurrence of harm and the severity of that harm

3.12
residual risk

risk remaining after protective measures have been taken (see also figure 1)

NOTE This standard distinguishes:

- the residual risk after protective measures have been taken by the designer;
- the residual risk after all protective measures have been implemented.

3.13

risk assessment

overall process comprising a risk analysis and a risk evaluation

3.14

risk analysis

combination of the specification of the limits of the machine, hazard identification and risk estimation

3.15

risk estimation

defining likely severity of harm and probability of its occurrence

3.16

risk evaluation

judgement, on the basis of risk analysis, of whether the risk reduction objectives have been achieved

3.17

adequate risk reduction

risk reduction at least in accordance with the legal requirements under consideration of the current state of the art

NOTE Criteria for determining when adequate risk reduction is achieved are given in 5.5.

3.18

protective measure

measure intended to achieve risk reduction, implemented:

- by the designer (inherently safe design, safeguarding and complementary protective measures, information for use) and
- by the user (organization: safe working procedures, supervision, permit-to-work systems; provision and use of additional safeguards; use of personal protective equipment; training).

See figure 1.

3.19

inherently safe design measure

protective measure which either eliminates hazards or reduces the risks associated with hazards by changing the design or operating characteristics of the machine without the use of guards or protective devices

NOTE ISO 12100-2:2003, clause 4, deals with risk reduction by inherently safe design measures.

3.20

safeguarding

protective measure using safeguards to protect persons from the hazards which cannot reasonably be eliminated or from the risks which cannot be sufficiently reduced by inherently safe design measures

NOTE ISO 12100-2:2003, clause 5, deals with safeguarding.

3.21

information for use

protective measure consisting of communication links (e.g. texts, words, signs, signals, symbols, diagrams) used separately or in combination, to convey information to the user

NOTE ISO 12100-2:2003, clause 6, deals with information for use.

3.22

intended use of a machine

use of a machine in accordance with the information provided in the instructions for use

3.23

reasonably foreseeable misuse

use of a machine in a way not intended by the designer, but which may result from readily predictable human behaviour

3.24

safeguard

guard or protective device

3.25

guard

physical barrier, designed as part of the machine, to provide protection

NOTE 1 A guard may act:

- alone; it is then only effective when it is "closed" for a movable guard or "securely held in place" for a fixed guard;
- in conjunction with an interlocking device with or without guard locking; in this case, protection is ensured whatever the position of the guard.

NOTE 2 Depending on its design, a guard may be called e.g. casing, shield, cover, screen, door, enclosing guard.

NOTE 3 See ISO 12100-2:2003, 5.3.2, and ISO 14120 for types of guards and their requirements.

3.25.1

fixed guard

guard affixed in such a manner (e.g. by screws, nuts, welding) that it can only be opened or removed by the use of tools or destruction of the affixing means

3.25.2

movable guard

guard which can be opened without the use of tools

3.25.3

adjustable guard

fixed or movable guard which is adjustable as a whole or which incorporates adjustable part(s). A1 *Text deleted* A1

3.25.4

interlocking guard

guard associated with an interlocking device so that, together with the control system of the machine, the following functions are performed:

- the hazardous machine functions "covered" by the guard cannot operate until the guard is closed;
- if the guard is opened while hazardous machine functions are operating, a stop command is given;
- when the guard is closed, the hazardous machine functions "covered" by the guard can operate. The closure of the guard does not by itself start the hazardous machine functions

NOTE ISO 14119 gives detailed provisions.

3.25.5

interlocking guard with guard locking

guard associated with an interlocking device and a guard locking device so that, together with the control system of the machine, the following functions are performed:

- the hazardous machine functions "covered" by the guard cannot operate until the guard is closed and locked;

- the guard remains closed and locked until the risk due to the hazardous machine functions "covered" by the guard has disappeared;
- when the guard is closed and locked, the hazardous machine functions "covered" by the guard can operate. The closure and locking of the guard do not by themselves start the hazardous machine functions

NOTE ISO 14119 gives detailed provisions.

3.25.6

interlocking guard with a start function control guard

special form of an interlocking guard which, once it has reached its closed position, gives a command to initiate the hazardous machine function(s) without the use of a separate start control

NOTE ISO 12100-2:2003, 5.3.2.5, gives detailed provisions regarding the conditions of use.

3.26

protective device

safeguard other than a guard

NOTE Examples of protective devices are given in 3.26.1 to 3.26.9.

3.26.1

interlocking device interlock

mechanical, electrical or other type of device, the purpose of which is to prevent the operation of hazardous machine functions under specified conditions (generally as long as a guard is not closed)

3.26.2

enabling device

additional manually operated device used in conjunction with a start control and which, when continuously actuated, allows a machine to function

NOTE IEC 60204-1:1997, 9.2.5.8 gives provisions on enabling devices.

3.26.3

hold-to-run control device

control device which initiates and maintains hazardous machine functions only as long as the manual control (actuator) is actuated

3.26.4

two-hand control device

control device which requires at least simultaneous actuation by both hands in order to initiate and to maintain hazardous machine functions, thus providing a protective measure only for the person who actuates it

NOTE ISO 13851 gives detailed provisions.

3.26.5

sensitive protective equipment (SPE)

equipment for detecting persons or parts of persons which generates an appropriate signal to the control system to reduce risk to the persons detected. The signal may be generated when a person or part of a person goes beyond a predetermined limit – e.g. enters a hazard zone – (tripping) or while a person is detected in a predetermined zone (presence sensing), or in both cases

3.26.6

active opto-electronic protective device (AOPD)

device whose sensing function is performed by opto-electronic emitting and receiving elements detecting the interruption of optical radiation, generated within the device, by an opaque object present in the specified detection zone

NOTE IEC 61496-2 gives detailed provisions.

3.26.7

mechanical restraint device

device which introduces into a mechanism a mechanical obstacle (e.g. wedge, spindle, strut, scotch) which, by virtue of its own strength, can prevent any hazardous movement

3.26.8

limiting device

device which prevents a machine or hazardous machine condition(s) from exceeding a designed limit (e.g. space limit, pressure limit, load moment limit)

3.26.9

limited movement control device

control device, a single actuation of which, together with the control system of the machine, permits only a limited amount of travel of a machine element

3.27

impeding device

any physical obstacle – e. g. low barrier, rail – which, without totally preventing access to a hazard zone, reduces the probability of access to this zone by offering an obstruction to free access

3.28

safety function

function of a machine whose failure can result in an immediate increase of the risk(s)

3.29

unexpected start-up

unintended start-up

any start-up which, because of its unexpected nature, generates a hazard. This can be caused by, e. g.:

- a start command which is the result of a failure in, or an external influence on, the control system;
- a start command generated by inopportune action on a start control or other parts of the machine as, e. g., a sensor or a power control element;
- restoration of the power supply after an interruption;
- external / internal influences (e.g. gravity, wind, self-ignition in internal combustion engines) on parts of the machine

NOTE Machine start-up during normal sequence of an automatic cycle is not unintended, but can be considered to be unexpected from the point of view of the operator. Prevention of accidents in this case involves the use of safeguarding measures (see ISO 12100-2:2003, clause 5).

[from ISO 14118:2000, 3.2]

3.30

failure to danger

any malfunction in the machinery, or in its power supply, that increases the risk

3.31

fault

the state of an item characterized by inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources

NOTE 1 A fault is often the result of a failure of the item itself, but may exist without prior failure.