

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

Part 1: Basic terminology, methodology

The European Standard EN ISO 12100-1:2003 has the status of a
British Standard

ICS 01.040.13; 13.110

National foreword

This British Standard is the official English language version of EN ISO 12100-1:2003. It is identical with ISO 12100-1:2003. It supersedes BS EN 292-1:1991 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/3, Safeguarding of machinery, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN ISO title page, the EN ISO foreword page, the ISO title page, pages ii to v, a blank page, pages 1 to 33, the Annex ZA page, the Annex ZB page and a back cover.

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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)

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of an identical text or by endorsement, at the latest by May 2004, and conflicting national standards shall be withdrawn at the latest by May 2004.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

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

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

NOTE Normative references to International Standards are listed in Annex ZA (normative).

INTERNATIONAL STANDARD

ISO 12100-1

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

Part 1: Basic terminology, methodology

*Sécurité des machines — Notions fondamentales, principes généraux
de conception —*

Partie 1: Terminologie de base, méthodologie



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 12100-1 was prepared by Technical Committee ISO/TC 199, *Safety of machinery*.

This edition cancels and replaces ISO/TR 12100-1:1992, which has been technically revised.

This standard results from the revision of EN 292:1991 / ISO/TR 12100:1992, carried out by a Special Working Group composed of experts from ISO, CEN, IEC and CENELEC.

ISO 12100 consists of the following parts, under the general title *Safety of machinery — Basic concepts, general principles for design*:

- *Part 1: Basic terminology, methodology*, expressing the basic overall methodology to be followed when designing machinery and when producing safety standards for machinery, together with the basic terminology related to the philosophy underlying this work;
- *Part 2: Technical principles*, giving advice on how this philosophy can be applied using available techniques.

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). The adjustment remains fixed during a particular operation

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.

[IEV 191-05-01]

NOTE 2 In the field of machinery, the English term 'fault' is commonly used in accordance with the definition in IEV 191-05-01, whereas the French term "défaut" and the German term "Fehler" are used rather than the terms "panne" and "Fehlzustand" that appear in the IEV with this definition.

NOTE 3 In practice, the terms "fault" and "failure" are often used synonymously.

3.32

failure

the termination of the ability of an item to perform a required function

NOTE 1 After failure, the item has a fault.

NOTE 2 "Failure" is an event, as distinguished from "fault", which is a state.

NOTE 3 The concept as defined does not apply to items consisting of software only.

[IEV 191-04-01]

3.33

common cause failures

failures of different items, resulting from a single event, where these failures are not consequences of each other

NOTE Common cause failures should not be confused with common mode failures.

[IEV 191-04-23]

3.34

common mode failures

failures of items characterized by the same fault mode

NOTE Common mode failures should not be confused with common cause failures, as the common mode failures may result from different causes.

[IEV 191-04-24]

3.35

emergency situation

hazardous situation needing to be urgently ended or averted

NOTE An emergency situation may arise :

- during normal operation of the machine (e.g. due to human interaction, or as a result from external influences);
- as a consequence of a malfunction or a failure of any part of the machine.

3.36

emergency operation

all actions and functions intended to end or avert an emergency situation

3.37

emergency stop

function which is intended:

- to avert arising or to reduce existing hazards to persons, damage to machinery or to work in progress;
- to be initiated by a single human action

NOTE ISO 13850 gives detailed provisions.

3.38

emission value

numerical value quantifying an emission generated by a machine (e.g. noise, vibration, hazardous substances, radiation)

NOTE 1 Emission values are part of the information on the properties of a machine and are used as a basis for risk assessment.

NOTE 2 The term “emission value” should not be confused with “exposure value” which quantifies the exposure of persons to emissions when the machine is in use. Exposure values can be estimated using the emission values.

NOTE 3 Emission values are preferably measured and their associated uncertainties determined by means of standardized methods, e.g. to allow comparison between similar machines.

3.39

comparative emission data

set of emission values of similar machines collected for the purpose of comparison

NOTE For noise comparison, see ISO 11689.

4 Hazards to be taken into account when designing machinery

4.1 General

The purpose of this clause is to provide a description of basic hazards with a view to assisting the designer in identifying the relevant and significant hazards which the machine under consideration can generate and the hazards associated with the environment in which the machine is intended to be used (see also 5.3).

NOTE See ISO 14121:1999, annex A for a more detailed list of possible hazards and hazardous situations related to machinery.

4.2 Mechanical hazard

4.2.1 Mechanical hazards associated with a machine, machine parts or surfaces, tools, workpieces, loads, or projected solid or fluid materials can result in:

- crushing;
- shearing;
- cutting or severing;
- entanglement;
- drawing-in or trapping;
- impact;
- stabbing or puncture;
- friction or abrasion;
- high pressure fluid injection (ejection hazard).

4.2.2 The mechanical hazards which can be generated by a machine, machine parts (including work material holding mechanisms), workpieces or loads are conditioned, among other factors, by:

- shape (cutting elements, sharp edges, angular parts, even if they are motionless);
- relative location, which can create crushing, shearing, entanglement zones when elements are moving;
- stability against overturning (considering kinetic energy);
- mass and stability (potential energy of elements which can move under the effect of gravity);
- mass and velocity (kinetic energy of elements in controlled or uncontrolled motion);
- acceleration/deceleration;
- inadequate mechanical strength, which can generate hazardous breakages or bursts;
- potential energy of elastic elements (springs), or of liquids or gases under pressure or vacuum;
- working environment.

4.3 Electrical hazard

This hazard can cause injury or death from electric shock, or burn; these can be caused by:

- contact of persons with:
 - live parts, i.e. conductors or conductive parts intended to be energized in normal operation (direct contact);
 - parts which have become live under fault conditions, especially as a result of an insulation failure (indirect contact);
- approach of persons to live parts, especially in the range of high voltage;
- insulation not suitable for reasonably foreseeable conditions of use;
- electrostatic phenomena such as contact of persons with charged parts;
- thermal radiation;
- phenomena such as projection of molten particles or chemical effects from short-circuits or overloads.

It can also cause falls of persons (or of objects dropped by persons) as a result of the surprise caused by electric shock.

4.4 Thermal hazard

Thermal hazard can result in:

- burns and scalds from contact with objects or materials with an extreme temperature, flames or explosions and radiation from heat sources;
- health-damaging effects generated by hot or cold work environment.

4.5 Hazard generated by noise

Noise can result in:

- permanent hearing loss;
- tinnitus;
- tiredness, stress;
- other effects such as loss of balance, loss of awareness;
- impairment of speech communication or of the perception of acoustic signals.

4.6 Hazards generated by vibration

Vibration can be transmitted to the whole body (use of mobile equipment) and particularly to hands and arms (use of hand-held and hand-guided machines).

The most severe vibration (or less severe vibration over a long time) may generate serious disorders (low-back morbidity and trauma of the spine), severe discomfort resulting from whole-body vibration and vascular disorders, e.g. white-finger disease, neurological, osteo-articular disorders, resulting from hand-arm vibration.

4.7 Hazards generated by radiation

These hazards, which can have immediate effects (e.g. burns) or long-term effects (e.g. genetic mutations), are produced by a variety of sources and can be generated by non-ionizing or ionizing radiation:

- electromagnetic fields (e.g. in the low frequency, radio frequency, micro-wave ranges);
- infra-red light, visible light and ultra-violet light;
- laser radiation;
- X and γ rays;
- α , β rays, electron or ion beams, neutrons.

4.8 Hazards generated by materials and substances

Materials and substances processed, used, produced or exhausted by machinery, and materials used to construct machinery can generate several different hazards:

- hazards resulting from ingestion, contact with the skin, eyes and mucous membranes or inhalation of fluids, gases, mists, fumes, fibres, dusts or aerosols, having, e.g. a harmful, toxic, corrosive, teratogenic, carcinogenic, mutagenic, irritant or sensitizing effect;
- fire and explosion hazards;
- biological (e.g. mould) and micro-biological (viral or bacterial) hazards.

4.9 Hazards generated by neglecting ergonomic principles in machine design

Mismatch of machinery with human characteristics and abilities can show itself by:

- physiological effects (e.g. musculo-skeletal disorders) resulting, e.g. from unhealthy postures, excessive or repetitive efforts;

- psycho-physiological effects generated by, e.g. mental overload or underload, or stress, arising from the operation, supervision or maintenance of a machine within the limits of its intended use;
- human errors.

4.10 Slipping, tripping and falling hazards

Neglecting the surface of the floorings and access means may result in injuries from slips, trips or falls.

4.11 Hazard combinations

Some individual hazards which seem to be minor can, when combined with each other, be equivalent to a significant hazard.

4.12 Hazards associated with the environment in which the machine is used

Where a machine is designed to operate under environmental conditions which can result in hazards (e.g. temperature, wind, snow, lightning) these hazards shall be taken into account.

5 Strategy for risk reduction

5.1 General provisions

5.1.1 It is assumed that, when present on machinery, a hazard will sooner or later lead to harm if no protective measure(s) is (are) taken.

5.1.2 Protective measures are a combination of the measures taken by the designer and the user (see figure 1). Measures which can be incorporated at the design stage are preferable to and generally more effective than those which are implemented by the user.

5.1.3 Taking into account the experience of users of similar machines and whenever practicable, an exchange of information with the potential users, the designer shall take the following actions, in the order indicated below (see figure 2):

- specify the limits and the intended use of the machine (see 5.2);
- identify the hazards and associated hazardous situations (see clause 4 and 5.3);
- estimate the risk, for each identified hazard and hazardous situation (see 5.3);
- evaluate the risk and take decisions about the need for risk reduction (see 5.3);
- eliminate the hazard or reduce the risk associated with the hazard by protective measures (see 5.4 and 5.5);

The first four above indents are related to risk assessment, on which detailed information can be found in ISO 14121.

5.1.4 The objective to be met is the greatest risk reduction taking into account the four factors below. The strategy defined above is represented by the flowchart in figure 2. The process is iterative and several successive applications may be necessary to reduce the risk, making the best use of available technology.

In carrying out this process, it is necessary to take into account in the following order of preference:

- the safety of the machine during all the phases of its lifecycle;

- the ability of the machine to perform its function;
- the usability of the machine;
- the manufacturing, operational and dismantling costs of the machine.

NOTE 1 The ideal application of these principles requires knowledge of the use of the machine, the accident history and health records, available risk reduction techniques, the legal framework in which the machine is to be used.

NOTE 2 A machine design which is acceptable at a particular time may no longer be justifiable when technological development allows the design of an equivalent machine with lower risk.

5.1.5 For the continued safe operation of a machine, it is important that the protective measures allow its easy use and do not hinder its intended use. Not doing this could lead to protective measures being bypassed in order to achieve maximum utility of the machine.

5.1.6 If standardized (or other suitable) measurement methods exist for an emission, they should be used, in conjunction with existing machinery or prototypes, to determine emission values and comparative emission data. This makes it possible for the designer:

- to estimate the risk associated with the emissions;
- to evaluate the effectiveness of the protective measures implemented at the design stage;
- to provide potential buyers with quantitative information on emissions in the technical documentation;
- to provide users with quantitative information on emissions in the information for use.

Hazards other than emissions that are described by measurable parameters can be dealt with in a similar manner.

5.2 Specification of the limits of the machine

The design of the machine begins with the specification of its limits (see also ISO 14121:1999, clause 5):

- use limits:
 - the intended use of the machine, including the different machine operating modes, phases of use and the different intervention procedures for the operators and
 - the reasonably foreseeable misuse of the machine;
- space limits (e.g. range of movement, space requirements for installation and maintenance of the machine, "operator-machine" interface, "machine-power supply" interface);
- time limits: the foreseeable "life limit" of the machine and / or of some of its components (e.g. tools, wear parts, electrical components), taking into account its intended use.

5.3 Hazard identification, risk estimation and risk evaluation

Having identified the various hazards that can be generated by the machine (permanent hazards and those which can appear unexpectedly: see 3.6 and clause 4), the designer shall estimate the risk for each hazard, as far as possible on the basis of quantifiable factors, and finally decide if risk reduction (see 5.4) is required as a result of the risk evaluation. For this purpose, the designer shall take into account the different operating modes and intervention procedures, in particular:

- a) human interaction during the whole lifecycle of the machine, as described below:

- 1) construction;
 - 2) transport, assembly and installation;
 - 3) commissioning;
 - 4) use:
 - setting, teaching/programming or process changeover;
 - operation;
 - cleaning;
 - fault finding;
 - maintenance;
 - 5) de-commissioning, dismantling and, as far as safety is concerned, disposal;
- b) possible states of the machine:
- 1) the machine performs the intended function (the machine operates normally);
 - 2) the machine does not perform the intended function (i.e. it malfunctions) due to a variety of reasons, including:
 - variation of a property or of a dimension of the processed material or of the workpiece;
 - failure of one (or more) of its component parts or services;
 - external disturbances (e.g. shocks, vibration, electromagnetic interference);
 - design error or deficiency (e.g. software errors);
 - disturbance of its power supply;
 - surrounding conditions (e.g. damaged floor surfaces);
- c) unintended behaviour of the operator or reasonably foreseeable misuse of the machine , e.g.:
- loss of control of the machine by the operator (especially for hand-held or mobile machines);
 - reflex behaviour of a person in case of malfunction, incident or failure during the use of the machine;
 - behaviour resulting from lack of concentration or carelessness;
 - behaviour resulting from taking the "line of least resistance" in carrying out a task;
 - behaviour resulting from pressures to keep the machine running in all circumstances;
 - behaviour of certain persons (e.g. children, disabled persons).

Risk estimation and evaluation have to be applied after each of the three steps of risk reduction defined in 5.4 and illustrated in figure 2.

When carrying out a risk assessment, the risk from the most likely severity of the harm that is likely to occur from each identified hazard shall be considered, but the highest foreseeable severity shall also be taken into account, even if the probability of such an occurrence is not high.

5.4 Elimination of hazards or reduction of risk by protective measures

This objective may be met by removing the hazards or by reducing, separately or simultaneously, each of the two elements which determine the risk:

- d) severity of harm from the hazard under consideration;
- e) probability of occurrence of that harm.

All protective measures intended to reach this objective shall be applied according to the following sequence, referred to as the "3-step method" (see also figures 1 and 2):

- inherently safe design measures (see ISO 12100-2: 2003, clause 4);
NOTE This stage is the only one at which hazards can be eliminated, thus avoiding the need for additional protective measures such as safeguarding or complementary protective measures.
- safeguarding and possibly complementary protective measures (see ISO 12100-2: 2003, clause 5);
- information for use about the residual risk (see ISO 12100-2: 2003, clause 6).

Information for use shall not be a substitute for the correct application of inherently safe design measures or safeguarding or complementary protective measures.

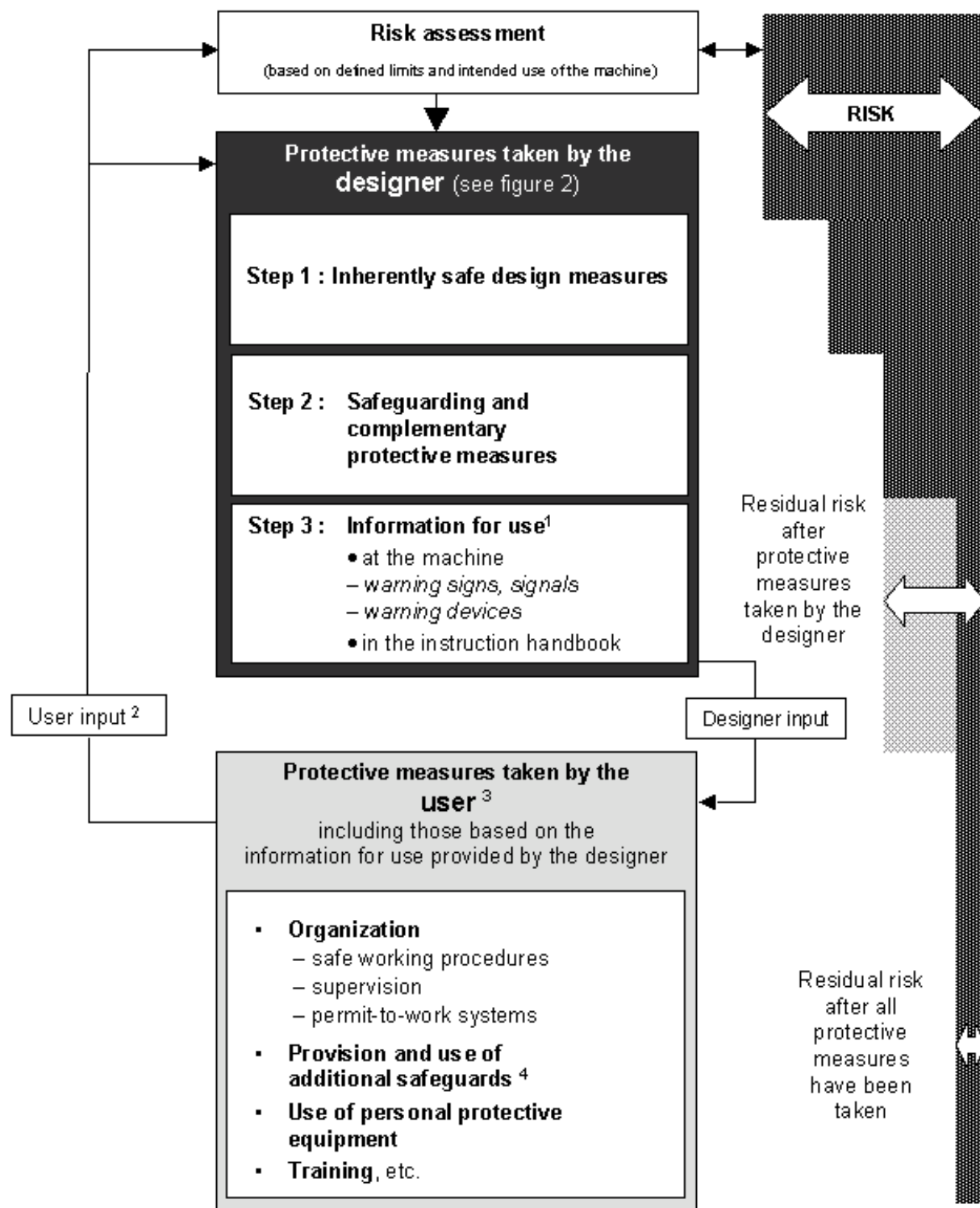
Adequate protective measures associated with each of the operating modes and intervention procedures (see 5.3) prevent operators from being induced to use hazardous intervention techniques in case of technical difficulties.

5.5 Achievement of risk reduction objectives

The iterative risk reduction process according to 5.4 and figure 2 can be concluded after achievement of adequate risk reduction and, if applicable, a favourable outcome of risk comparison (see ISO 14121, 8.3).

Adequate risk reduction can be considered achieved when one is able to give a positive answer to each of the following questions:

- have all operating conditions and all intervention procedures been taken into account?
- has the method stated in 5.4 been applied?
- have hazards been eliminated or risks from hazards been reduced to the lowest practicable level?
- is it certain that the measures taken do not generate new hazards?
- are the users sufficiently informed and warned about the residual risks?
- is it certain that the operator's working conditions are not jeopardized by the protective measures taken?
- are the protective measures taken compatible with each other?
- has sufficient consideration been given to the consequences that can arise from the use of a machine designed for professional / industrial use when it is used in a non-professional / non-industrial context?
- is it certain that the measures taken do not excessively reduce the ability of the machine to perform its function?



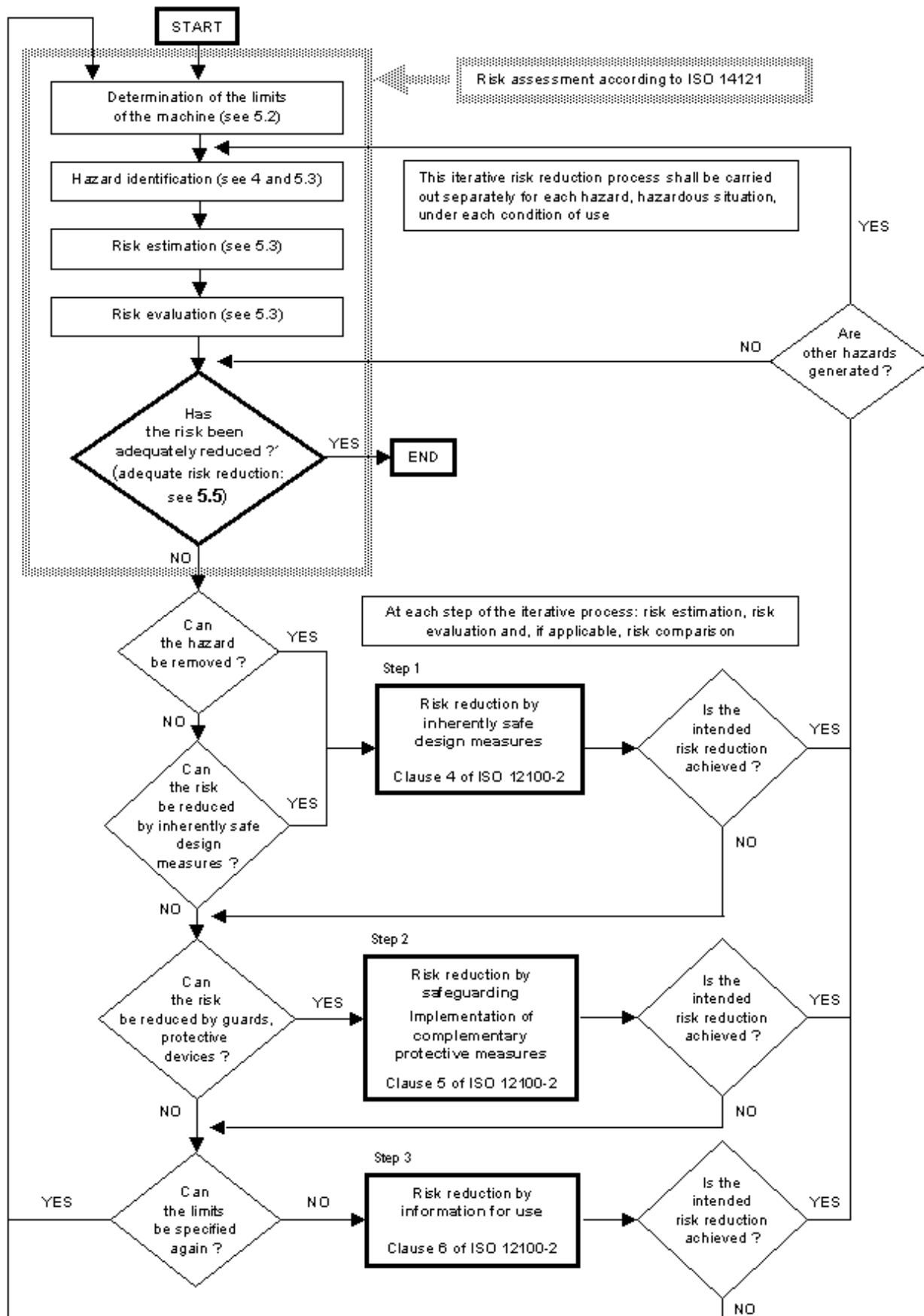
¹ Providing proper information for use is part of the designer's contribution to risk reduction, but the protective measures concerned are only effective when implemented by the user.

² The user input is that information received by the designer from either the user community regarding the intended use of the machine in general or that which is received from a specific user.

³ There is no hierarchy between the various protective measures taken by the user. These protective measures are outside the scope of this standard.

⁴ Those protective measures required due to specific process(es) not envisaged in the intended use of the machine or to specific conditions for installation that cannot be controlled by the designer.

Figure 1 — Risk reduction process from the point of view of the designer



¹ The first time the question is asked, it is answered by the result of the initial risk assessment.

Figure 2 — Schematic representation of the iterative 3-step method for the risk reduction process

Annex A (informative)

Schematic representation of a machine

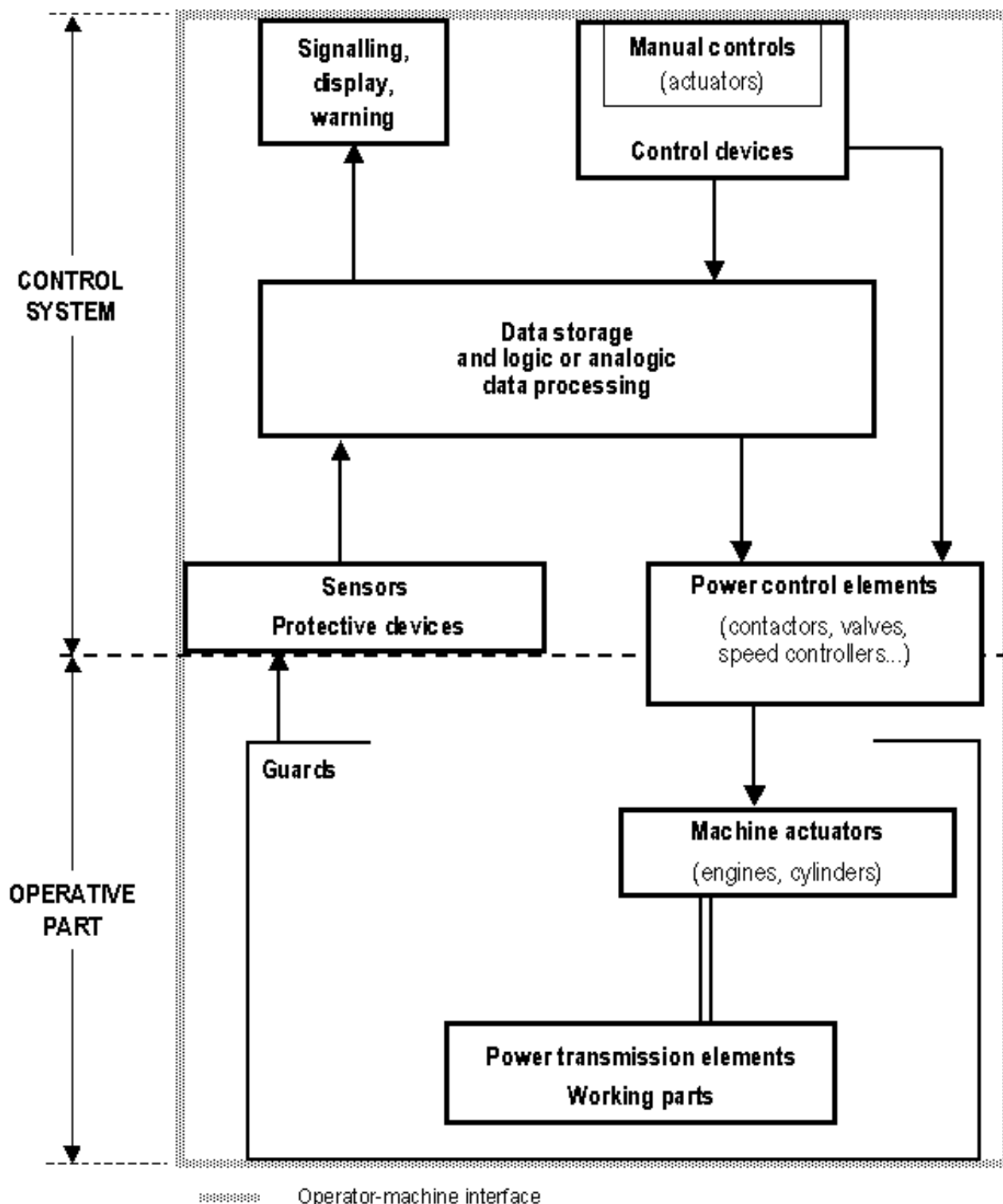


Figure A.1 — Schematic representation of a machine

Trilingual index of specific terms and expressions used in ISO 12100

English	German	French	Subclause	Part
			<u>underlined</u> : ref. to definitions bold : prominent provisions	
A				
Access code	Zugangscode	Code d'accès	4.11.10	2
Access means	Zugänge	Moyens d'accès	4.10	1
Access means	Zugänge	Moyens d'accès	5.5.6	2
Access to a hazard zone (to a danger zone)	Zugang zu einem Gefährdungsbereich	Accès à une zone dangereuse	3.27	1
Access to a hazard zone (to a danger zone)	Zugang zu einem Gefährdungsbereich	Accès à une zone dangereuse	4.11.9; 4.15; 5.1; 5.2 ; 5.5.6	2
Accessibility	Zugänglichkeit	Accessibilité	4.2.1; 4.7	2
Active opto-electronic protective device	Aktive optoelektronische Schutzvorrichtung	Dispositif de protection opto-électronique actif	<u>3.26.6</u>	1
Active opto-electronic protective device	Aktive optoelektronische Schutzvorrichtung	Dispositif de protection opto-électronique actif	5.2.5.3; 5.3.3	2
Actuator (Machine -)	Antriebsselement	Actionneur	3.1; Annex A	1
Actuator (Machine -)	Antriebsselement	Actionneur	4.4	2
Actuator / manual control	Stellteil	Organe de service	3.26.3; Annex A	1
Actuator / manual control	Stellteil	Organe de service	4.2.1; 4.8.7 ; 4.11.7.2; 4.11.8; 5.5.2; 6.5.1.d; 6.5.2.c	2
Adequate risk reduction	Entsprechende Risikominderung	Réduction adéquate du risque	<u>3.17</u> ; clause 5; fig. 2	1
Adjustable guard	Einstellbare trennende Schutzvorrichtung	Protecteur réglable	<u>3.25.3</u>	1
Adjustable guard	Einstellbare trennende Schutzvorrichtung	Protecteur réglable	5.2.3.c; 5.3.2.4; fig 1	2
Angular part	Spitzes Teil	Pièce de forme aiguë	4.2.2	1
Application point	Anschlagpunkt	Point de préhension	6.5.1.a	2
Assembly of machines	Maschinenanlage	Ensemble de machines	3.1	1
Assembly of machines	Maschinenanlage	Ensemble de machines	4.11.1	2
Automatic monitoring	Selbstüberwachung / automatische Überwachung	Auto-surveillance	4.11.6 ; 4.12.3; 5.3.2.3/5	2
B				
Barrier	Sperre	Barrière	3.25; 3.27	1
Burn	Verbrennung	Brûlure	4.3; 4.4; 4.7	1

C					
Centre of gravity	Masseschwerpunkt		Centre de gravité	4.6	2
Chip	Span		Copeau	5.3.2.1	2
Cleaning	Reinigung		Nettoyage	5.3.a	1
Cleaning	Reinigung		Nettoyage	4.11.9; 5.2.4; 6.1.2	2
Colour	Farbe		Couleur	6.4.c; 6.5.2.a/e	2
Commissioning	Inbetriebnahme		Mise en service	5.3.a	1
Commissioning	Inbetriebnahme		Mise en service	6.1.2; 6.5.1.b	2
Common cause failures	Ausfälle aufgrund gemeinsamer Ursache		Défaillances de cause commune	3.33	1
Common cause failures	Ausfälle aufgrund gemeinsamer Ursache		Défaillances de cause commune	4.12.3	2
Common mode failures	Gleichartige Ausfälle		Défaillances de mode commun	3.34	1
Common mode failures	Gleichartige Ausfälle		Défaillances de mode commun	4.12.3	2
Comparative emission data	Vergleichende Emissionsdaten		Données comparatives d'émission	3.39; 5.1.6	1
Complementary protective measures	Ergänzende Schutzmaßnahmen		Mesures de prévention complémentaires	3.18; 5.4; fig. 1; fig. 2	1
Complementary protective measures	Ergänzende Schutzmaßnahmen		Mesures de prévention complémentaires	5.1; 5.5	2
Construction	Herstellung		Construction	5.3.a	1
Construction	Herstellung		Construction	4.3.a	2
Containment (of materials, etc.)	Kapselung / Fernhaltung (von Stoffen, usw.)		Rétention (de matériaux, etc.)	5.3.2.1	2
Containment (of stored energy)	Rückhaltung (von gespeicherter Energie)		Rétention (de l'énergie accumulée)	5.5.4.c	2
Control	Steuerung		Commande	3.1	1
Control device	Steuereinrichtung, Steuerungseinrichtung		Appareil de commande	Annex A	1
Control device	Steuereinrichtung, Steuerungseinrichtung		Appareil de commande	4.1.1.1; 4.11.8; 5.2; 5.5.6	2
Control mode	Steuerungsart		Commande (Mode de -)	4.11.9	2
Control system	Steuersystem / Steuerung		Commande (Système de -)	Annex A	1
Control system	Steuersystem / Steuerung		Commande (Système de -)	4.11 ; 4.13	2
Critical component	Kritisches Bauteil		Composant critique	4.13	2
Crushing hazard	Gefährdung durch Quetschen		Risque d'écrasement	4.2.1	1
Cutting / severing hazard	Gefährdung durch Schneiden		Risque de coupure	4.2.1	1
Cutting element	Schneidelement		Élément coupant	4.2.2	1
D					
Damage to health	Gesundheitsschädigung		Atteinte à la santé	3.5	1
Danger	Gefahr		Danger	6.4.c	2
Danger zone (see also: hazard zone)	Gefährdungsbereich (Gefahrbereich)		Zone dangereuse	3.10; 3.26.5; 3.27	1
Danger zone (see also: hazard zone)	Gefährdungsbereich (Gefahrbereich)		Zone dangereuse	4.2.1; 4.11.8.d; 5.2 ; 5.3.2.4/5	2

De-commissioning	Außerbetriebnahme	Mise hors service	5.3.a	1
De-commissioning	Außerbetriebnahme	Mise hors service	4.6; 6.1.2; 6.5.1.f	2
Defeating (of a protective device)	Umgehen (einer Schutzeinrichtung)	Neutralisation (d'un dispositif de protection)	4.11.1; 4.13; 5.3.1; 5.3.3	2
Defeating (of a warning device)	Umgehen (einer Warneinrichtung)	Neutralisation (d'un dispositif d'avertissement)	6.3	2
Depressurizing	Druckentlastung	Mise à la pression atmosphérique	4.10	2
Design (of a machine)	Konstruktion (einer Maschine)	Conception (d'une machine)	5.1 à 5.4	1
Design error	Konstruktionsfehler	Erreur de conception	5.3.b	1
Designer	Konstrukteur / Entwickler	Concepteur	Introduction; clause 1; 3.8/12/18/23; 4.1; 5.1.2/3/6; 5.3; fig 1	1
Designer	Konstrukteur / Entwickler	Concepteur	Introduction; clause 1; 5.2.5.1; 6.3; 6.5.1.d	2
Diagnostic system	Diagnosesystem	Diagnostic (Système de -)	4.11.12	2
Direct contact	Direktes Berühren	Contact direct	4.3	1
Dismantling (of a machine)	Demontage / Abbau (einer Maschine)	Démontage (d'une machine)	5.1.4; 5.3	1
Dismantling (of a machine)	Demontage / Abbau (einer Maschine)	Démontage (d'une machine)	4.6; 6.1.2; 6.5.1.f	2
Display	Anzeige	Affichage	Annex A	1
Display	Anzeige	Affichage	4.8.1; 4.8.8; 4.11.1	2
Disposal (of a machine)	Entsorgung (einer Maschine)	Mise au rebut (d'une machine)	5.3.a	1
Disposal (of a machine)	Entsorgung (einer Maschine)	Mise au rebut (d'une machine)	6.1.2; 6.5.1.b/f	2
Disturbance(s)	Störung(en)	Perturbation(s)	5.3.b	1
Disturbance(s)	Störung(en)	Perturbation(s)	4.12.1/3	2
Door	Tür	Porte	3.25	1
Drawing-in / trapping hazard	Gefährdung durch Einziehen / Fangen	Risque d'entraînement / d'emprisonnement	4.2.1	1
Drawing-in / trapping hazard	Gefährdung durch Einziehen / Fangen	Risque d'entraînement / d'emprisonnement	5.2.1	2
Dust	Staub	Poussière	4.8	1
Dust	Staub	Poussière	4.2.2; 4.12.1; 5.2.5.1; 5.3.2.1; 6.5.1.c	2
E				
Edge (sharp -)	Scharfe Kante	Arête vive	4.2.2	1
Edge (sharp -)	Scharfe Kante	Arête vive	4.2.1; 5.3.2.6	2
Electric shock	Elektrischer Schlag	Choc électrique	3.6; 4.3	1
Electric shock	Elektrischer Schlag	Choc électrique	4.9	2
Electrical equipment	Elektrische Ausrüstung	Équipement électrique	4.4; 4.9; 6.4; 6.5.1.c	2
Electrical hazard	Elektrische Gefährdung	Risque électrique	3.6; 4.3	1
Electrical hazard (Preventing -)	Verhütung elektrischer Gefährdung	Risque électrique (Prévention du -)	4.9	2

Electrical overloading	Überlastung (Elektrische)	Surcharge (électrique)	6.5.1.b	2
Electromagnetic compatibility	Elektromagnetische Verträglichkeit	Compatibilité électromagnétique	4.11.11	2
Emergency operation	Handlung im Notfall	Opération d'urgence	3.36	1
Emergency situation	Notfall	Situation d'urgence	3.35; 3.36	1
Emergency situation	Notfall	Situation d'urgence	5.5.2; 6.5.1.g	2
Emergency stop (function)	Stillsetzen im Notfall (Funktion zum)	Arrêt d'urgence (fonction)	3.37	1
Emergency stop (function)	Stillsetzen im Notfall (Funktion zum)	Arrêt d'urgence (fonction)	4.11.1; 4.11.8; 5.1; 5.5.2; 5.5.3; 6.5.1.d	2
Emergency stop control	Stellteil zum Stillsetzen im Notfall	Commande d'arrêt d'urgence	4.11.8.c; 4.11.9; 5.5.2	2
Emergency stop device	Einrichtung zum Stillsetzen im Notfall	Arrêt d'urgence (Dispositif d' -)	4.11.1; 4.11.8.c; 5.5.2	2
Emission value	Emissionswert	Valeur d'émission	3.38; 3.39; 5.1.6	1
Emission value	Emissionswert	Valeur d'émission	4.3.c	2
Emissions	Emissions	Émissions	3.6; 3.38; 3.39; 5.1.6	1
Emissions	Emissions	Émissions	4.2.2; 5.1; 5.2.1; 5.2.5.1; 5.2.7; 5.3.2.1; 5.4; 6.5.1.g	2
Enabling device	Zustimmungseinrichtung	Validation (Dispositif de -)	3.26.2	1
Enabling device	Zustimmungseinrichtung	Validation (Dispositif de -)	4.11.9	2
Entanglement hazard	Gefährdung durch Erfassen	Risque de happement	4.2.1; 4.2.2	1
Environment	Umwelt / Umgebung	Environnement	clause 1; 4.1; 4.2.2; 4.4; 4.12	1
Environment	Umwelt / Umgebung	Environnement	clause 1; 4.7; 4.12.1; 5.2.1; 5.2.5.2; 5.3.1; 6.5.1.b	2
Environmental conditions	Umgebungseinflüsse	Conditions liées à l'environnement	4.12.1; 5.2.5.2.a; 6.5.1.b	2
Ergonomic principle	Ergonomischer Grundsatz	Ergonomique (Principe -)	4.9	1
Ergonomic principle	Ergonomischer Grundsatz	Ergonomique (Principe -)	4.8; 4.11.8; 5.2.1	2
Error (Human)	Fehlverhalten (menschliches)	Erreur (humaine)	4.9	1
Escape and rescue (of a person)	Befreiung und Rettung (einer Person)	Dégagement et sauvetage (d'une personne)	5.5.3	2
Explosive atmosphere	Explosionsgefährdete Atmosphäre	Atmosphère explosible	4.4; 6.4.b	2
Exposure to hazard	Gefährdungsexposition / Aussetzung einer Gefährdung	Exposition à un phénomène dangereux	3.9	1
Exposure to hazard	Gefährdungsexposition / Aussetzung einer Gefährdung	Exposition à un phénomène dangereux	4.11.12; 5.1	2
Exposure to hazards (Limiting -)	Gefährdungsexposition (Begrenzen der -)	Exposition à un phénomène dangereux (Limitation de l'exposition à un -)	4.13; 4.14; 4.15	2
Exposure value	Immissionswert	Valeur d'exposition	3.38	1

F					
Failure	Ausfall	Défaillance	3.28 à 3.32; 3.33; 3.34; 3.35; 4.3; 5.3.b/c	1	
Failure	Ausfall	Défaillance	4.11.1; 4.11.6; 4.11.7.1/2; 4.12; 5.3.2.3.b; 5.3.2.5	2	
Failure to danger	Gefährbringender Ausfall	Défaillance dangereuse	3.30	1	
Falling hazard	Sturzgefährdung	Risque de chute (de personne)	3.11	1	
Fault	Fehler	Défaut	3.31; 3.32; 3.34; 4.3	1	
Fault	Fehler	Défaut	4.11.1; 4.11.6; 4.11.7.1/2; 4.11.9; 4.11.12; 4.12; 5.2.4; 5.2.5.2; 6.5.1.d/e	2	
Fault finding	Fehlersuche	Défauts (Recherche de -)	5.3.a	1	
Fault finding	Fehlersuche	Défauts (Recherche de -)	4.11.12; 5.2.4; 6.1.2	2	
Fixed guard	Feststehende trennende Schutzeinrichtung	Protecteur fixe	3.25.1	1	
Fixed guard	Feststehende trennende Schutzeinrichtung	Protecteur fixe	5.1; 5.2.1; 5.2.2.a; 5.2.5.2.b; 5.3.2.2	2	
Foundation	Fundament	Massif	4.6	2	
Friction / abrasion hazard	Gefährdung durch Reibung / Abrieb	Risque de frottement / d'abrasion	4.2.1	1	
G					
Guard	Trennende Schutzeinrichtung	Protecteur	3.19; 3.24; 3.25; 3.26.1; Annex A	1	
Guard	Trennende Schutzeinrichtung	Protecteur	4.8.6; 4.11.9; 4.13; 5.1/2/3; 5.5.6; 6.1.1; 6.4.c; 6.5.1.c	2	
Guard locking device	Zuhalteeinrichtung	Dispositif de blocage du protecteur	3.25.5	1	
H					
Handling	Handhabung	Manutention	4.6; 4.7; 4.14; 5.5.5; 6.5.1; 6.5.3	2	
Harm	Schaden	Dommage	3.5; 3.6; 3.11; 3.15; 5.1.1; 5.3; 5.4	1	
Hazard	Gefährdung	Phénomène dangereux	3.6; 3.11; 3.14; 3.15...	1	
Hazard	Gefährdung	Phénomène dangereux	numerous occurrences	2	
Hazard combination	Gefährdungskombination	Risques (Combinaison de -)	4.11	1	
Hazard identification	Identifizierung der Gefährdungen	Identification des phénomènes dangereux	3.14; 5.3	1	

Hazard zone (see also: danger zone)	Gefährdungsbereich (Gefahrbereich)	Zone dangereuse	3.10; 3.26.5; 3.27	1
Hazard zone (see also: danger zone)	Gefährdungsbereich (Gefahrbereich)	Zone dangereuse	4.2.1; 4.11.8.d; 5.2 ; 5.3.2.4/5	2
Hazardous malfunctioning	Gefährdung durch Fehlfunktion(en)	Dysfonctionnement dangereux	4.14.1	2
Hazardous situation	Gefährdungssituation / gefährdende Situation	Situation dangereuse	3.9; 3.35; 4.1; 5.1.3	1
Hazardous situation	Gefährdungssituation / gefährdende Situation	Situation dangereuse	4.11.5; 5.2.7	2
Hazardous substances	Gefahrstoffe / Gefährliche Stoffe	Substances dangereuses	3.38	1
Hazardous substances	Gefahrstoffe / Gefährliche Stoffe	Substances dangereuses	4.2.2; 4.3.c; 5.3.2.1; 5.4.4	2
Hazards generated by materials and substances	Gefährdung durch Materialien und Substanzen	Phénomènes dangereux engendrés par des matériaux et des substances	4.8	1
Hazards generated by neglecting ergonomic principles	Gefährdung durch Vernachlässigung ergonomischer Grundsätze	Phénomènes dangereux engendrés par le non-respect des principes ergonomiques	4.9	1
Hazards generated by noise	Gefährdung durch Lärm	Phénomènes dangereux engendrés par le bruit	4.5	1
Hazards generated by radiation	Gefährdung durch Strahlung	Phénomènes dangereux engendrés par les rayonnements	4.7	1
Hazards generated by vibration	Gefährdung durch Vibration	Phénomènes dangereux engendrés par les vibrations	4.6	1
Heat	Hitze	Chaleur	4.4	1
Heat	Hitze	Chaleur	4.12.1; 5.2.1	2
Heat source	Wärmequelle	Chaleur (Source de -)	4.4	1
High pressure fluid ejection hazard	Gefährdung durch Herausspritzen von Flüssigkeiten unter hohem Druck	Risque d'éjection de fluide sous haute pression	4.2.1	1
Hold-to-run control device	Steuereinrichtung mit selbsttätiger Rückstellung (Tippschalter)	Commande nécessitant une action maintenue	3.26.3	1
Hold-to-run control device	Steuereinrichtung mit selbsttätiger Rückstellung (Tippschalter)	Commande nécessitant une action maintenue	4.11.8.b; 4.11.9	2
Human behaviour	Menschliches Verhalten	Comportement humain	3.23; 5.3.c	1
Hydraulic equipment	Hydraulische Ausrüstung	Équipement hydraulique	4.4; 4.10	2
I				
Impact	Stoß	Choc	4.12.1	2
Impact hazard	Gefährdung durch Stoß	Risque de choc	4.2.1	1
Impeding device	Abweisende Schutzeinrichtung (Barriere)	Dispositif dissuasif / déflecteur	3.27	1
Index (of the instruction handbook)	Stichwortverzeichnis (in der Betriebsanleitung)	Index (de la notice d'instructions)	6.5.2.f	2
Indirect contact	Indirekte Berührung	Contact indirect	4.3	1

Information for use	Benutzerinformation	Informations pour l'utilisation	3.18; 3.21; 5.1.6; 5.4	1
Information for use	Benutzerinformation	Informations pour l'utilisation	4.1; 5.5.1; clause 6;	2
Inherently safe design measure	Inhärent sichere Konstruktion	Mesure de prévention intrinsèque	3.18; 3.19; 5.4	1
	Inhärent sichere Konstruktion	Mesure de prévention intrinsèque	clause 4; 5.5.1	2
Inspection	Inspektion	Inspection	4.11.10; 4.12.3; 6.5.1.e	2
Inspection (Frequency of -)	Inspektion (Häufigkeit der -)	Inspections (Périodicité des -)	6.4.c	2
Installation (of the machine)	Aufbau / Einbau (der Maschine)	Installation (de la machine)	5.2; 5.3	1
Installation (of the machine)	Aufbau / Einbau (der Maschine)	Installation (de la machine)	4.6; 6.1.2; 6.5.1.b	2
Instruction handbook	Betriebsanleitung	Notice d'instructions	Fig. 1	1
Instruction handbook	Betriebsanleitung	Notice d'instructions	6.2; 6.5	2
Instructions	Anweisungen	Instructions	6.5.1/2./3	2
Insulation failure	Versagen der Isolierung	Isolement (Défaut d' -)	4.3	1
Insulation failure	Versagen der Isolierung	Isolement (Défaut d' -)	4.12.1	2
Intended use of a machine	Bestimmungsgemäße Verwendung einer Maschine	Utilisation normale d'une machine	Introduction; 3.3; 3.6; 3.22; 4.9; 5.1.3; 5.1.5; 5.2	1
Intended use of a machine	Bestimmungsgemäße Verwendung einer Maschine	Utilisation normale d'une machine	Introduction; 4.8.8; 4.12.1; 5.3.1; 5.5.1; 6.1.1; 6.5.1.d	2
Interlocking device (interlock)	Verriegelungseinrichtung (Verriegelung)	Verrouillage (Dispositif de -)	Introduction; 3.25; 3.25.4/5; 3.26.1	1
Interlocking device (interlock)	Verriegelungseinrichtung (Verriegelung)	Verrouillage (Dispositif de -)	Introduction; 5.3.2.5	2
Interlocking guard	Verriegelte trennende Schutzeinrichtung	Protecteur avec dispositif de verrouillage	3.25.4	1
Interlocking guard	Verriegelte trennende Schutzeinrichtung	Protecteur avec dispositif de verrouillage	5.2.1/2/3; 5.2.5.3; 5.3.2.3; 5.5.6	2
Interlocking guard with a start function (control guard)	Trennende Schutzeinrichtung mit Startfunktion	Protecteur commandant la mise en marche	3.25.6	1
Interlocking guard with a start function (control guard)	Trennende Schutzeinrichtung mit Startfunktion	Protecteur commandant la mise en marche	5.2.3.f; 5.3.2.5	2
Interlocking guard with guard locking	Verriegelte trennende Schutzeinrichtung mit Zuhaltung	Protecteur avec dispositif d'interverrouillage	3.25.5;	1
Interlocking guard with guard locking	Verriegelte trennende Schutzeinrichtung mit Zuhaltung	Protecteur avec dispositif d'interverrouillage	5.2.2; 5.2.3	2
Isolation and energy dissipation	Energietrennung und -ableitung	Consignation	4.11.1; 4.10; 5.2.4; 5.5.4	2
J				
K				

L				
Language	Sprache	Langue	6.4	2
Language (of the instruction handbook)	Sprache (der Betriebsanleitung)	Langue (de la notice d'instructions)	6.5.2.b	2
Life limit of a machine	Lebensdauer einer Maschine	Durée de vie d'une machine	5.2	1
Lifting equipment	Hebevorrichtung	Levage (Équipement de -)	6.5.1.a	2
Lifting gear	Hebezeug	Levage (Appareil de -)	5.5.5	2
Lighting	Beleuchtung	Éclairage	4.8.6; 5.2.1	2
Limit	Grenze	Limite	3.14; 4.9; 5.1.3; 5.2	1
Limited movement control device	Schrittschaltung	Commande de marche par à-coups (Dispositif de -)	<u>3.26.9</u>	1
Limited movement control device	Schrittschaltung	Commande de marche par à-coups (Dispositif de -)	4.11.9	2
Limiting device	Begrenzungseinrichtung	Limiteur (Dispositif -)	<u>3.26.8</u>	1
Limiting device	Begrenzungseinrichtung	Limiteur (Dispositif -)	4.3.a; 4.10; 5.2.6; 5.2.7	2
Live part (of electrical equipment)	Spannungsführendes Teil (der elektrischen Ausrüstung)	Partie active (de l'équipement électrique)	4.3	1
Load	Last	Charge	3.26.8; 4.2.1/2	1
Load	Last	Charge	4.2.1; 4.3; 4.11.1/5; 5.2.6/7	2
Loading (feeding) / unloading (removal) operations	Be-/Entladearbeit (Beschickungs- und Entnahmemarbeiten)	Opérations de chargement (alimentation) / déchargement (évacuation)	4.14	2
Lubrication	Schmierung	Graissage	4.15	2
M				
Machine / machinery	Maschine	Machine	3.1	1
Machine-power supply interface	Schnittstelle "Maschine-Energieversorgung"	Interface "machine-sources d'énergie"	5.2	1
Maintainability (of a machine)	Instandhaltbarkeit (einer Maschine)	Maintenabilité (d'une machine)	3.3	1
Maintainability (of a machine)	Instandhaltbarkeit (einer Maschine)	Maintenabilité (d'une machine)	4.7 ; 4.11.12;	2
Maintenance	Instandhaltung	Maintenance	3.3; 3.31; 4.9; 5.2; 5.3.a	1
Maintenance	Instandhaltung	Maintenance	4.8.6; 4.11.9/10; 5.2.4; 5.3.1; 5.5.4; 5.5.6; 6.1.2; 6.5.1.b/e/h	2
Maintenance point	Wartungsstelle	Maintenance (Point de -)	4.15	2
Maintenance staff	Instandhaltungspersonal	Maintenance (Personnel de -)	4.11.12; 6.5.1.e	2
Malfunction (malfunctioning)	Fehlfunktion	Dysfonctionnement	3.30; 3.35; 5.3.b/c	1
Malfunction (malfunctioning)	Fehlfunktion	Dysfonctionnement	4.12.1; 5.2.1	2

Manual control (function)	Handsteuerung	Commande manuelle (fonction)	4.11.8	2
Marking	Zeichen	Marquage	6.4	2
Markings	Kennzeichnungen	Inscriptions	6.4	2
Material	Werkstoff / Material	Matériau	3.1; 4.2.1/2; 4.4; 4.8 ; 5.3.b	1
Material	Werkstoff	Matériau	4.2.1; 4.3.b4.14; 5.2.5.1, 5.3.2.1/6; 5.5.6	2
Maximum speed of rotating parts	Maximale Drehzahl rotierender Teile	Fréquence maximale de rotation des parties tournantes	6.4.c	2
Measurement methods	Messmethoden	Méthodes de mesurage	5.1.6	1
Mechanical hazard	Mechanische Gefährdung	Risque mécanique	4.2	1
Mechanical hazard	Mechanische Gefährdung	Risque mécanique	4.2.2; 5.1	2
Mechanical restraint device	Durch Formschluß wirkende Schutzvorrichtung	Dispositif de retenue mécanique	<u>3.26.7</u>	1
Mode selector	Betriebsartenschalter	Sélecteur de mode	4.11.10	2
Moisture	Feuchte	Humidité	4.12.1; 6.5.1.b	2
Movable elements / parts	Bewegliche Elemente / Teile	Éléments mobiles	4.2.2	2
Movable guard	Bewegliche trennende Schutzvorrichtung	Protecteur mobile	3.25; <u>3.25.2</u> ; 3.25.3	1
Movable guard	Bewegliche trennende Schutzvorrichtung	Protecteur mobile	5.3.2.3; Fig. 1	2
Muting phase	Sperrphase	Inhibition (Phase d')	5.2.5.2	2
Muting phase	Sperrphase	Phase d'inhibition	5.2.5.2	2
N				
Noise	Lärm / Geräusch	Bruit	3.6; 3.38; 3.39; 4.5	1
Noise	Lärm / Geräusch	Bruit	4.2.2; 4.3.c; 4.4.c); 4.8.4; 5.1; 5.2.1; 5.2.5.1, 5.3.2.1; 5.4.2 ; 6.5.1.c	2
Noise	Geräusch (siehe Lärm)	Bruit		
Normal operation	Normaler Betrieb	Fonctionnement normal	3.35; 4.3	1
Normal operation	Normaler Betrieb	Fonctionnement normal	5.2.1/2/3	2
O				
Operating modes	Betriebsarten	Modes de fonctionnement	5.2; 5.3.c	1
Operating modes	Betriebsarten	Modes de fonctionnement	4.11.1; 4.11.10; 4.14; 6.1.1; 6.5.1.c)	2
Operation	Betrieb	Fonctionnement	5.3	1
Operative part	Betriebsteil	Partie opérative	Annex A	1
Operative part	Betriebsteil	Partie opérative	5.2.5.2.b	2

Operator	Bediener (Bedienperson)	Opérateur	3.29; 5.2; 5.3.c; 5.4; 5.5	1
Operator	Bedienperson (Bediener)	Opérateur	numerous occurrences	2
Operator-machine interface	Schnittstelle "Bedienperson-Maschine" oder "Mensch-Maschine"	Interface "opérateur-machine"	5.2; Annex A	1
Oriented failure mode component	Bauteil mit spezifiziertem Ausfallverhalten	Composant à défaillance orientée	4.12.2	2
Overloading (Electrical -)	Überlast (Elektrische -)	Surcharge (électrique)	6.5.1.b	2
Overloading (Mechanical -)	Überlastung (Mechanische -)	Surcharge mécanique	5.2.7	2
Overspeed	Überdrehzahl	Survitesse	6.3	2
P				
Packaging	Verpackung	Emballage	6.2; 6.5.1; 6.5.3.d	2
Pictogram	Piktogramm	Pictogramme	6.4	2
Platform	Bühne / Arbeitsbühne	Plate-forme	5.5.6	2
Pneumatic equipment	Pneumatische Ausrüstung	Équipement pneumatique	4.4; 4.10	2
Portable control unit (teach pendant)	Tragbare Steuereinheit/Tragbares Steuergerät (Schwenkarmschalttafel)	Dispositif de commande portatif (pendant d'apprentissage)	4.11.8.c; 4.11.9	2
Positive mechanical action	Mechanisch zwangsläufige Wirkung	Action mécanique positive	4.5	2
Positive mode (Connected in the -)	Zwangsläufig (verbunden)	Mode positif (Liés suivant le -)	4.5	2
Power control element	Leistungssteuerelement	Préactionneur	3.29; Annex A	1
Power supply	Energieversorgung/Energiequelle	Alimentation en énergie (Source d'-)	3.29; 3.30; 5.2; 5.3.b	1
Power supply	Energieversorgung/Energiequelle	Alimentation en énergie (Source d'-)	4.10; 4.11.1/2/5; 5.2.4; 5.5.4; 6.5.1.b	2
Power transmission element	Energieübertragungselement	Élément de transmission	Annex A	1
Presence-sensing	Anwesenheitsmeldung	Détection de présence	3.26.5	1
Presence-sensing	Anwesenheitsmeldung	Détection de présence	5.2.5.1/3	2
Pressure sensitive mat	Schaltmatte	Tapis sensible	5.2.2; 5.2.5.1	2
Prevention of access	Verhindern des Zugangs	Accès (Prévention de l' -)	5.3.2.1	2
Process changeover	Umrüsten	Processus de fabrication (Changement de -)	5.3.a	1
Process changeover	Umrüsten	Processus de fabrication (Changement de -)	4.11.9; 5.2.4; 6.1.2	2
Programmable electronic control system	Programmierbares elektronisches Steuersystem	Système de commande électronique programmable	4.11.7	2
Prohibited usage	Verbotene Anwendung	Utilisation proscrite	6.5.1.c/d	2
Protective device	Nicht trennende Schutzeinrichtung	Dispositif de protection	3.19; 3.24; 3.26; Annex A	1
Protective device	Nicht trennende Schutzeinrichtung	Dispositif de protection	4.11.1/9; 4.13; 5.1; 5.2 ; 5.3.1/3 ; 5.5.1; 6.1.1; 6.5.1.c	2

Protective measure	Schutzmaßnahme	Mesure de prévention	3.12; 3.18; 3.19; 29/31; 5.1; 5.3; 5.4; 5.5	1
Protective measure	Schutzmaßnahme	Mesure de prévention	numerous occurrences	2
Protruding part	Vorstehendes Teil	Pièce saillante	4.2.1	2
Q				
R				
Radiation	Strahlung	Rayonnement(s)	3.38; 4.3/4; 4.7	1
Radiation	Strahlung	Rayonnement(s)	4.2.2; 4.3. c; 5.2.1; 5.2.5.1; 5.3.2.1; 5.4.5; 6.5.1.b/.c	2
Range of applications	Anwendungsbereich	Utilisations prévues	6.5.1.c	2
Reasonably foreseeable misuse	Vernünftigerweise vorhersehbare Fehlanwendung	Mauvais usage raisonnablement prévisible	3.23; 5.2; 5.3.c	1
Reasonably foreseeable misuse	Vernünftigerweise vorhersehbare Fehlanwendung	Mauvais usage raisonnablement prévisible	5.5.1; 6.1.1; 6.5.1.d	2
Rectification (Fault -)	Fehlerbehebung	Dépannage	4.13	2
Reduced speed	Verminderte Geschwindigkeit	Vitesse (réduite)	4.11.9	2
Redundancy	Redundanz	Redondance	4.12.2; 4.12.3	2
Relevant hazard	Relevante Gefährdung	Phénomène dangereux pertinent	3.7	1
Reliability	Zuverlässigkeit	Fiabilité	4.3.c; 4.8; 4.12; 4.13; 5.2.5.3.a	2
Reliability (of a machine)	Zuverlässigkeit (einer Maschine)	Fiabilité (d'une machine)	3.2	1
Rescue and escape (of a person)	Rettung und Befreiung (einer Person)	Sauvetage et dégagement (d'une personne)	5.5.3	2
Residual risk	Restrisiko	Risque résiduel	3.12; 5.4; 5.5; fig. 1	1
Residual risk	Restrisiko	Risque résiduel	6.1.1	2
Restart / restarting	Wiederaufstart	Remise en marche	4.11.1; 4.11.4; 4.11.65.5.2	2
Restriction of access	Zugangsbeschränkung	Accès (Restriction de l' -)	4.11.9	2
Risk	Risiko	Risque	3.11; numerous occurrences	1
Risk	Risiko	Risque	numerous occurrences	2
Risk analysis	Risikoanalyse	Analyse du risque	3.13; 3.14	1
Risk assessment	Risikobeurteilung	Appréciation du risque	3.8; 3.13; 3.38; 5.1.3	1
Risk assessment	Risikobeurteilung	Appréciation du risque	5.2.1; 5.2.4; 5.5.2	2
Risk comparison	Risikovergleich	Comparaison des risques	5.3.c; 5.5	1

Risk estimation	Risikoinschätzung	Estimation du risque	3.15; 5.3	1
Risk evaluation	Risikobewertung	Évaluation du risque	3.13; 3.16; 5.3	1
Risk reduction	Risikominderung	Réduction du risque	3.7; 3.15; 3.17; 3.18; clause 5	1
Risk reduction	Risikominderung	Réduction du risque	4.1; 4.11.1	2
S				
Safeguard	Schutzeinrichtung	Moyen de protection	Introduction; 3.18; 3.20; 3.24; 5.4	1
Safeguard	Schutzeinrichtung	Moyen de protection	Introduction; 4.14.; 5.1; 5.2 ; 5.3; 6.5.1.b/d	2
Safeguarding	Technische Schutzmaßnahmen	Protection	3.18; 3.20; 3.24	1
Safeguarding	Technische Schutzmaßnahmen	Protection	4.1; clause 5	2
Safety function	Sicherheitsfunktion	Fonction de sécurité	3.28	1
Safety function	Sicherheitsfunktion	Fonction de sécurité	4.1.1/6/7; 4.12/14; 5.2.5.2; 5.3.3; 6.5.1.e	2
Scald	Verbrühung	Brûlure (par un liquide chaud)	4.4	1
Sensitive protective equipment	Sensitive Schutzeinrichtung	Équipement de protection sensible	3.26.5	1
Sensitive protective equipment	Sensitive Schutzeinrichtung	Équipement de protection sensible	5.2.1; 5.2.2.d; 5.2.3.b; 5.2.5	2
Sensor	Sensor / Meßfühler	Capteur	3.29; Annex A	1
Sensor	Sensor / Meßfühler	Capteur	4.11.7.2; 4.13	2
Setting	Einrichten / Einstellen	Réglage	5.3.a	1
Setting	Einrichten / Einstellen	Réglage	4.8.6; 4.10; 4.11.9; 4.11.10; 4.15; 5.2.4; 5.3.2.5; 5.5.6; 6.1.2; 6.5.1.d	2
Setting (Control mode for -)	Steuerungsart zum Einstellen	Réglage (Mode de commande pour le -)	4.11.9	2
Setting point	Einricht- / Einstellungspunkt	Réglage (Point de -)	4.15	2
Severing hazard	Gefährdung durch Abschneiden	Risque de sectionnement	4.2.1	1
Shearing hazard	Gefährdung durch Scheren	Risque de cisaillement	4.2.1; 4.2.2	1
Shearing hazard	Gefährdung durch Scheren	Risque de cisaillement	4.2.1; 5.2.1; 5.3.2.6	2
Signal	Signal	Signal	3.21; 4.5	1
Signal	Signal	Signal	4.8.1; 5.2.7; 6.1/2/3; 6.5.1.b	2
Significant hazard	Signifikante Gefährdung	Phénomène dangereux significatif	3.7; 3.8; 4.1; 4.11	1
Siren	Sirene	Sirène	6.3	2

Slipping hazard	Gefährdung durch Ausrutschen	Risque de glissade	4.10	1
Slipping hazard	Gefährdung durch Ausrutschen	Risque de glissade	5.5.6	2
Software	Software	Logiciel	3.32; 5.3	1
Software	Software	Logiciel	4.11.7.3/4	2
Software (Access to the -)	Software (Zugriff auf die -)	Logiciel (Accès au -)	4.11.7.4	2
Space limit	Räumliche Grenze	Limite dans l'espace	3.26.8; 5.2	1
Speed	Geschwindigkeit	Vitesse	4.11.1; 4.11.9; 5.2.7; 6.4.c	2
Stabbing / puncture hazard	Gefährdung durch Durchstich / Einstich	Risque de perforation / piqure	4.2.1	1
Stability	Standfestigkeit / Standsicherheit	Stabilité	4.2.2	1
Stability	Standfestigkeit / Standsicherheit	Stabilité	4.6; 5.2.6	2
Stairs	Treppen	Escaliers	5.5.6	2
Static electricity	Statische Elektrizität	Électricité statique	4.12.1	2
Stopping	Stillsetzen	Mise à l'arrêt	4.11.1/3/6; 5.2.5.1; 6.5.1.d	2
Storage (of a machine)	Lagerung (einer Maschine)	Stockage (d'une machine)	6.5.1.a	2
Stress (Environmental -)	Umweltbeanspruchung	Contrainte d'environnement	4.12.1	2
Stress (human -)	Stress	Stress	4.5; 4.9	1
Stress (human -)	Stress	Stress	4.8.1	2
Stress (Mechanical -)	Mechanische Beanspruchung	Contrainte mécanique	4.3.a; 5.2.7	2
Symbol	Symbol	Symbole	3.21; 5.1; 5.4	1
Symbol (in the instruction handbook)	Symbol (in der Betriebsanleitung)	Symbole (dans la notice d'instructions)	6.5.2.a	2
T				
Teach pendant (portable control unit)	Schwenkamschalttafel (Tragbare Steuereinheit / Tragbares Steuergerät)	Pendant d'apprentissage (dispositif de commande portatif)	4.11.8.c/e	2
Teaching (programming)	Teachen / Programmieren	Apprentissage (programmation)	5.3.a	1
Teaching (programming)	Teachen / Programmieren	Apprentissage (programmation)	4.11.9; 5.2.4; 6.1.2	2
Thermal hazard	Thermische Gefährdung	Risque thermique	4.4	1
Training	Ausbildung	Formation	Introduction; 3.18; fig 1	1
Training	Ausbildung	Formation	Introduction; 6.1.1; 6.5.1.d	2
Transport	Transport	Transport	5.3	1
Transport	Transport	Transport	5.5.5; 6.1.2; 6.5.1.a	2
Trip / tripping device	Schutzeinrichtung mit Annäherungsreaktion	Dispositif sensible	5.2.1	2
Trip / tripping hazard	Gefährdung durch Stolpern	Risque de perte d'équilibre / de trébuchement	4.10	1
Tripping (function)	Annäherungsreaktion	Détection de franchissement d'une limite	3.26.5	1
Tripping (function)	Annäherungsreaktion	Détection de franchissement d'une limite	5.2.5.1/3	2
Two-hand control device	Zweihandschaltung	Commande bimanuelle (Dispositif de -)	3.26.4	1
Two-hand control device	Zweihandschaltung	Commande bimanuelle (Dispositif de -)	4.11.9; 5.2.3.e	2

U					
Unexpected / unintended start-up	Unwarteter / unbeabsichtigter Anlauf	Mise en marche inattendue / intempestive	3.6; 3.29	1	
Unexpected / unintended start-up	Unwarteter / unbeabsichtigter Anlauf	Mise en marche inattendue / intempestive	4.11.1; 5.3.2.5	2	
Unloading (removal) / loading (feeding) operations	Ent-/Beladearbeit (Entnahme- und Beschickungsarbeiten)	Opérations de déchargement (évacuation) / chargement (alimentation)	4.14	2	
Usability (of a machine)	Benutzerfreundlichkeit (einer Maschine)	Commodité d'emploi (d'une machine)	3.4; 5.1.4; 5.5	1	
Usability (of a machine)	Benutzerfreundlichkeit (einer Maschine)	Commodité d'emploi (d'une machine)	5.3.2.1	2	
Use (of a machine)	Verwendung (einer Maschine)	Utilisation (d'une machine)	5.1.5; 5.2; 5.3 (+ numerous occurrences)	1	
User	Benutzer	Utilisateur	3.18/31; 5.1.2/3/6; 5.5; fig. 1	1	
User	Benutzer	Utilisateur	4.8.1; 4.11.7.4; 6.1/2/3	2	
V					
Valve	Ventil	Distributeur	4.3.a; 4.11.4	2	
Vapour, gas	Dampf, Gas	Vapeur, gaz	4.8	1	
Vapour, gas	Dampf, Gas	Vapeur, gaz	5.3.2.1; 6.5.1.c	2	
Vibration	Vibration(en) / Schwingungen	Vibrations	3.38; 4.6; 5.3.b	1	
Vibration	Vibrationen / Schwingungen	Vibrations	4.2.2; 4.3.c; 4.6; 4.8.4; 4.12.1; 5.2.1; 5.3.2.1; 5.4.3 ; 6.5.1/b/c	2	
Vibration	Schwingungen (siehe Vibration)	Vibrations			
W					
Walking area	Gangbereich	Surface de circulation	5.5.6	2	
Walkways	Fußgängerwege / Laufstege	Voie de circulation	5.5.6	2	
Warning	Warnhinweis	Avertissement	Annex A		
Warning device	Warneinrichtung	Avertissement (Dispositif d' -)	6.3	1	
Warning	Warnhinweis	Avertissement	4.10; 5.2.6/7; 6.2; 6.3; 6.4 ; 6.5.1.g; 6.5.2	2	
Work environment	Arbeitsumgebung	Environnement de travail	4.4	1	
Working part	Arbeitsteil	Élément de travail	Annex A	1	
Working part	Arbeitsteil	Élément de travail	4.11.2; 5.2.1 (Fig. 1)	2	
Written warning	Schriftlicher Warnhinweis	Avertissement écrit	6.4	2	

x						
y						
z						

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Annex ZA
(normative)

**Normative references to international publications
with their relevant European publications**

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).

NOTE Where an International Publication has been modified by common modifications, indicated by (mod.), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN</u>	<u>Year</u>
ISO 12100-2	2003	Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles	EN ISO 12100-2	2003

Annex ZB
(informative)

Relationship of this document with EC Directives

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 EC Directive(s) :

Machinery Directive 98/37/EC, amended by Directive 98/79/EC.

Compliance with this document provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

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