TECHNICAL REPORT

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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

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— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

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Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

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In its resolution 6 (November 1991), Technical Committee ISO/TC 199, *Safety of machinery*, endorsed the contents of European Standard EN 292-1 : 1991 prepared by Technical Committee CEN/TC 114, *Safety of machinery*. It recommended further that this European Standard be published as an ISO Technical Report of type 2 and be implemented with the highest priority throughout ISO/IEC and publicized as widely as possible.

This document is being issued in the type 2 Technical Report series of publications (according to part 1 of the ISO/IEC Directives) as a "prospective standard for provisional application" in the field of safety of machinery because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the ISO Central Secretariat.

A review of this type 2 Technical Report will be carried out not later than three years after its publication with the options of: extension for another three years; conversion into an International Standard; or withdrawal.

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

— *Part 1: Basic terminology, methodology*

— *Part 2: Technical principles and specifications*

Annexes A and B of this part of ISO/TR 12100 are for information only.

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Descriptors: Safety of machines, design, definitions, hazards, safety measures, categories

English version

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

Sicherheit von Maschinen - Grundbegriffe, allgemeine Gestaltungsleitsätze - Teil 1: Grundsätzliche Terminologie, Methodologie

This European Standard was approved by CEN on 1991-09-20
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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

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Foreword

This standard has been prepared by CEN/TC 114/WG 1 "Basic concepts".

Part 2 of EN 292 deals with "Technical principles and specifications" (see clause 0 "Introduction" for more detailed explanations).

0 Introduction

This standard has been produced to assist designers, manufacturers and other interested bodies to interpret the essential safety requirements in order to achieve conformity with European Legislation on machinery safety.

It is the first in a programme of standards produced by CEN/CENELEC under mandates from CEC and EFTA. This programme has been divided into several categories to avoid duplication and to develop a logic which will enable rapid production of standards and easy cross-reference between standards.

The hierarchy of standards is as follows :

a) **Type A standards** (fundamental safety standards) giving basic concepts, principles for design, and general aspects that can be applied to all machinery.

b) **Type B standards** (group safety standards) dealing with one safety aspect or one type of safety related device 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 safety related devices (e.g. two-hand controls, interlocking devices, pressure sensitive devices, guards).

c) **Type C standards** (machine safety standards) giving detailed safety requirements for a particular machine or group of machines.

The primary purpose of EN 292 is to provide designers, manufacturers, etc. 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 producing type C standards, in conjunction with ENV .. ... "Terminology" and EN 414 "Rules for the drafting and presentation of safety standards". In addition, this strategy is also a useful guide for designers and manufacturers of machines when no C standard exists ; it can also assist designers to use the type B standards to best advantage and to prepare the construction file.

The programme of standards is continuously evolving and some clauses of EN 292 are now the subject of type A or B standards being prepared. Where such a type A or B standard exists, a reference to this standard will be added to the relevant clause heading of EN 292. **It is intended that, where another type A or a type B standard covering a specific clause of EN 292 exists, it takes precedence over EN 292.**

NOTE : In particular, any definition of term(s) given in other type A or in type B1 and B2 standards has precedence over the corresponding definition given in EN 292.

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EN 292 consists of two parts :

- **Part 1** "Safety of machinery - Basic concepts, general principles for design - **Basic terminology, methodology**" expressing the basic overall methodology to be followed when producing safety standards for machinery, together with the basic terminology related to the philosophy underlying this work,

- **Part 2** "Safety of machinery - Basic concepts, general principles for design - **Technical principles and specifications**" giving advice on how this philosophy can be applied using available techniques.

The overall purpose of EN 292 is to provide manufacturers, designers, etc. with the strategy or framework necessary to achieve conformity with the European Legislation in the most pragmatic way. An essential element in this process is an understanding of the underlying legal framework, which is expressed in the essential safety requirements of the Machinery Directive and the equivalent EFTA agreements. Therefore, it has been decided to reprint annex I of the Directive 89/392/EEC as an annex to EN 292-2.

It is intended to revise EN 292 at an early date to take account of subsequent standards and legislation.

1 Scope

This European standard defines basic terminology and specifies general design methods, to help designers and manufacturers in achieving safety in the design of machinery (see 3.1) for professional and non-professional purposes. It may also be used for other technical products having similar hazards.

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

2 Normative references

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.

EN 292-2	Safety of machinery - Basic concepts, general principles for design - Part 2 : Technical principles and specifications.
ENV .. ...[1]	Safety of machinery - Terminology
EN 414	Safety of machinery - Rules for the drafting and presentation of safety standards

1) Predraft standard under study by CEN/TC 114/WG 3.

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EN.. ... [2] Safety of machinery - Risk assessment

EN 60 204-1:1985[3] Electrical equipment of industrial machines - Part 1 : General requirements

3 Basic concepts (see also ENV .. ...[1] "Terminology")

For the purposes of this standard, the following definitions apply :

3.1 Machinery (machine)

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

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

Annex A provides the general schematic representation of a machine.

3.2 Reliability

The ability of a machine or 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

The ability of a machine to be maintained in a state which enables it to fulfil its function under conditions of intended use (see 3.12), or restored into such a state, the necessary actions (maintenance) being carried out according to specified practices and using specified means.

3.4 Safety of a machine

The ability of a machine to perform its function, to be transported, installed, adjusted, maintained, dismantled and disposed of under conditions of intended use (see 3.12) specified in the instruction handbook (and, in some cases, within a given period of time indicated in the instruction handbook) without causing injury or damage to health.

3.5 Hazard

A source of possible injury or damage to health.

> NOTE : The word "hazard" is generally used in conjunction with other words defining its origin or the nature of the expected injury or damage to health : electrical shock hazard, crushing hazard, shearing hazard, toxic hazard, etc. Hazards generated by machinery are described in clause 4.

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2) Draft standard(s) under study by CEN/TC 114/WG 14
3) A revised version of EN 60 204-1:1985 should be submitted, in 1991, to the Unique Acceptance Procedure (UAP).

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3.6 Hazardous situation

Any situation in which a person is exposed to a hazard or to hazards.

3.7 Risk

A combination of the probability and the degree of the possible injury or damage to health in a hazardous situation.

3.8 Risk assessment

A comprehensive estimation of the probability and the degree of the possible injury or damage to health in a hazardous situation in order to select appropriate safety measures.

NOTE : Clause 6 deals with risk assessment.

3.9 Hazardous machine function

Any function of a machine which generates a hazard when operating.

3.10 Danger zone

Any zone within and/or around machinery in which a person is exposed to risk of injury or damage to health.

NOTE : The hazard generating the risk envisaged in this definition :

- either is permanently present during the intended use of the machine (motion of hazardous moving elements, electric arc during a welding phase, etc.),
- or may appear unexpectedly (unintended/unexpected start-up, etc.).

3.11 Design of a machine

A series of actions including :

a) The study of the machine itself, taking into account all phases of its "life" :

1) Construction

2) Transport and commissioning
- assembly, installation,
- adjustment,

3) Use
- setting, teaching/programming or process changeover,
- operation,
- cleaning,
- fault finding,
- maintenance.

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4) De-commissioning, dismantling and, as far as safety is concerned, disposal.

b) The drafting of the instructions relating to all above-mentioned phases of the "life" of the machine (except construction), dealt with in 5.5 of EN 292-2.

3.12 Intended use of a machine

The use for which the machine is suited according to the information provided by the manufacturer or which is deemed usual according to its design, construction and function.

Intended use also involves the compliance with the technical instructions laid down notably in the instruction handbook (see 5.5 in EN 292-2), taking into account reasonably foreseeable misuse.

NOTE : With regard to foreseeable misuse, the following behaviour should be particularly taken into account in the risk assessment :

- the foreseeable incorrect behaviours resulting from normal carelessness, but not resulting from deliberate misuse of the machine,
- the reflex behaviour of a person in case of malfunction, incident, failure, etc. , during use of the machine,
- the behaviour resulting from taking the "line of least resistance" in carrying out a task,
- for some machines (especially machines for non-professional use), the foreseeable behaviour of certain persons, such as children or disabled.

See also 5.7.1.

3.13 Safety functions

3.13.1 Safety critical functions

Those functions of a machine, the malfunction of which would immediately increase the risk of injury or damage to health.

There are two categories of safety critical functions :

a) **Safety-specific functions**, which are safety critical functions specifically intended to achieve safety.

EXAMPLES
- function preventing unintended/unexpected start-up (interlocking device associated with a guard ...),
- single-cycle function,
- two-hand control function,
- etc.

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b) **Safety-related functions**, which are safety critical functions other than safety-specific functions.

EXAMPLES
- manual control of a hazardous mechanism during setting phases, with by-passed (muted) safety devices (see 3.7.9 and 4.1.4 in EN 292-2),

- speed or temperature control keeping the machine within safe operating limits.

3.13.2 Back-up safety functions

Those functions whose failure does not immediately generate a hazard, however it reduces the level of safety. This covers notably automatic monitoring (see 3.7.6 in EN 292-2) of any safety critical function (e.g. monitoring of the correct operation of a position switch belonging to an interlocking device).

3.14 Automatic monitoring

A back-up safety function which ensures that a safety measure is initiated if the ability of a component or an element to perform its function is diminished, or if the process conditions are changed in such a way that hazards are generated.

There are two categories of automatic monitoring :

- "continuous" automatic monitoring, whereby a safety measure is immediately initiated when a failure occurs,

- "discontinuous" automatic monitoring, whereby a safety measure is initiated during a following machine cycle, if a failure has occurred.

3.15 Unexpected (or unintended) start-up

Any start-up which, because of its unexpected nature, generates a risk to persons.

3.16 Failure to danger

Any failure in the machinery, or in its power supply, that generates a hazardous situation.

3.17 Fail-safe condition (minimized failure to danger)

A theoretical condition which would be reached if a safety function remained unchanged in the case of a failure of the power supply or of any component contributing to the achievement of this condition.

In practice, achievement of this condition gets closer as the effect of failures on the considered safety function is reduced.

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3.18 Risk reduction by design

Safety measures consisting of :

- avoiding or reducing as many of the hazards as possible by suitable choice of design features, and

- limiting exposure to hazards which are unavoidable or cannot be reduced sufficiently ; this is achieved by reducing the need for operator intervention in danger zones.

NOTE : Clause 3 of EN 292-2 deals with risk reduction by design.

3.19 Safeguarding

Safety measures consisting of the use of specific technical means called safeguards (guards, safety devices), to protect persons from the hazards which cannot reasonably be removed or sufficiently limited by design.

NOTE : Clause 4 of EN 292-2 deals with safeguarding.

3.20 Information for use

Safety measures consisting of communication links, such as texts, words, signs, signals, symbols or diagrams, used separately or in combination, to convey information to the user. It is directed to professional and/or non-professional users.

NOTE : Clause 5 of EN 292-2 deals with information for use.

3.21 Operator

The person or persons given the task of installing, operating, adjusting, maintaining, cleaning, repairing, or transporting machinery.

3.22 Guard

Part of a machine specifically used to provide protection by means of a physical barrier. Depending on its construction, a guard may be called casing, cover, screen, door, enclosing guard, etc.

NOTE 1 : A guard may act :

- alone ; it is then only effective when it is closed,

- 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 : "Closed" means "kept in place" for a fixed guard.

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