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# Safety of machinery — Prevention of unexpected start-up

*Sécurité des machines — Prévention de la mise en marche intempestive*

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# Foreword

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

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

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

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

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

This document was prepared by Technical Committee ISO/TC 199, *Safety of machinery*.

This second edition cancels and replaces the first edition (ISO 14118:2000), which has been technically revised and contains the following changes:

— the text has been edited to facilitate implementation of this document;

— the Scope has been redefined to exclude the specification of performance levels or safety integrity levels for safety-related parts of control systems;

— Figure 1 has been updated.


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# Introduction

The structure of safety standards in the field of machinery is as follows:

a) type-A standards (basic safety standards) giving basic concepts, principles for design, and general aspects that can be applied to all machinery;

b) type-B standards (generic safety standards) dealing with one safety aspect or one or more type(s) 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);

c) type-C standards (machine safety standards) dealing with detailed safety requirements for a particular machine or group of machines.

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

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

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance, etc.)

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

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises);

— consumers (in case of machinery intended for use by consumers).

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

In addition, this document is intended for standardization bodies elaborating type-C standards.

The requirements of this document can be supplemented or modified by a type-C standard.

For machines which are covered by the scope of a type-C standard and which have been designed and built according to the requirements of that standard, the requirements of that type-C standard take precedence.

Keeping a machine in a stopped condition while persons are present in danger zones is one of the most important conditions of the safe use of machinery and hence, one of the major aims of the machine designer and machine user.

In the past, the concepts of “operating machine” and “stopped machine” were generally unambiguous; a machine was

— operating when its movable elements or some of them were moving;

— stopped when its movable elements were at rest.

Machine automation has made the relationship between “operating” and “moving” on one hand and “stopped” and “at rest” on the other hand, more difficult to define. Automation has also increased the

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potential for unexpected start-up and a significant number of hazardous events have occurred where machines, stopped for diagnostic work or corrective actions, started up unexpectedly.

Hazards other than mechanical hazards generated by movable elements (e.g. from a laser beam) also need to be taken into account.

The risk assessment relating to the presence of persons in a danger zone of a stopped machine needs to take into account the probability of an unexpected start-up of the hazard-generating elements.

This document provides machine designers and machinery safety standard technical committees with samples of built-in measures which can be used to prevent unexpected start-up.


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# Safety of machinery — Prevention of unexpected start-up

## 1 Scope

This document specifies requirements for designed-in means aimed at preventing unexpected machine start-up (see 3.2) to allow safe human interventions in danger zones (see Annex A).

This document applies to unexpected start-up from all types of energy source, i.e.:

— power supply, e.g. electrical, hydraulic, pneumatic;

— stored energy due to, e.g. gravity, compressed springs;

— external influences, e.g. from wind.

This document does not specify performance levels or safety integrity levels for safety-related parts of control systems. While available means to prevent unexpected start-up are identified, this document does not specify the means for the prevention of unexpected machine start-up for specific machines.

NOTE A type-C standard can define the required means for the prevention of harm arising from unexpected start-up. Otherwise, the requirements for a specific machine need to be determined by risk assessment outside the scope of this document.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

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

IEC 62061, *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

**3.1**
**start-up**
**machine start-up**
change from rest to motion or switch-on of a machine or of one of its parts

Note 1 to entry: An example of function other than motion is switch-on of a laser.

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**3.2**
**unexpected start-up**
**unintended start-up**
*start-up* (3.1) which, because of its unexpected nature, generates a risk to persons

Note 1 to entry: This can be caused by, for example:

— 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 such as a sensor or a power control element;

— restoration of the power supply after an interruption;

— external/internal influences (gravity, wind, self-ignition in internal combustion engines, etc.) on parts of the machine.

Note 2 to entry: Machine start-up during the normal sequence of an automatic cycle is not unintended, but can be considered as being unexpected from the point of view of the operator. Prevention of hazardous events in this case involves the use of safeguarding measures (see 6.3).

**3.3**
**isolation and energy dissipation**
procedure which consists of all of the four following actions:

a) isolating (disconnecting, separating) the machine (or defined parts of the machine) from all power supplies;

b) locking (or otherwise securing), if necessary (for instance, when the operator is not able, from every location he may be at, to check that the power supply remains interrupted), all the isolating units in the "isolated" position;

c) dissipating or restraining (containing) any stored energy which may give rise to a hazard.

Note 1 to entry Energy considered in c) may be stored in e.g. mechanical parts continuing to move through inertia, e.g. backdriving of a ventilation fan, mechanical parts liable to move by gravity, capacitors and accumulators, pressurized fluids and springs.

d) verifying by using a safe working procedure (e.g. by measuring) that the actions taken according to a), b) and c) have produced the desired effect.

# 4 General measures to prevent unexpected start-up

## 4.1 General

A risk assessment in accordance with ISO 12100 shall be performed to identify the required measures to prevent unexpected start-up.

NOTE Measures to prevent unexpected start-up of specific machinery can be specified in a type-C standard. The machine manufacturer is responsible for the suitability of measures identified by risk assessment.

The necessary procedures to prevent unexpected start-up including energy dissipation or restraint (containment) and verification method if necessary, shall be described in the instruction handbook of the machine and/or in warnings on the machine itself. The instructions should be provided with respect to each;

— source of energy;

— means;

— task (see Annex A);


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