INTERNATIONAL STANDARD

ISO 14118

First edition
2000-09-15

Safety of machinery — Prevention of unexpected start-up

Sécurité des machines — Prévention de la mise en marche intempestive

Reference number
ISO 14118:2000(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14118 was prepared by Technical Committee ISO/TC 199, *Safety of machinery*.

ISO 14118 has been prepared to be a harmonized standard in the sense of the Machinery Directive of the European Union and associated regulations of the European Free Trade Association (EFTA). It is in relationship with, in particular, the essential safety requirements expressed in subclauses 1.2.3, 1.2.6, 1.2.7, 1.6.3 and 1.6.4 of annex A of ISO/TR 12100-2:1992.

Introduction

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 the one hand and "stopped" and "at rest" on the other hand, more difficult to define. Automation has also increased the potential for unexpected start-up, and a significant number of accidents 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 International Standard provides machine designers and machinery safety standard technical committees with a survey of built-in measures which can be used to prevent unexpected start-up.

Safety of machinery — Prevention of unexpected start-up

1 Scope

This International Standard specifies 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 International Standard 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.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/TR 12100-1:1992, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology.*

ISO/TR 12100-2:1992, *Safety of machinery — Basic concepts — General principles for design — Part 2: Technical principles and specifications.*

ISO 14121, *Safety of machinery — Principles for risk assessment.*

IEC 60204-1:1997, *Electrical equipment of industrial machines — Part 1: General requirements.*

EN 1070, *Safety of machinery — Terminology.*

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in EN 1070 and the following apply.

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

NOTE The definition includes functions other than motion, e.g. switch-on of a laser beam.

3.2
unexpected [unintended] start-up
any start-up caused by:

— a start command which is the result of a failure in, or an external influence on, the control system;

— a start command generated by inappropriate 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 (gravity, wind, self-ignition in internal combustion engines, etc.) on parts of the machine.

NOTE Start-up by the normal operation of automatic machinery is not to be considered as unintended start-up, 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/TR 12100-2:1992, clause 4).

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 in large machines or in installations), all the isolating units in the "isolated" position;

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

NOTE Energy considered in c) above may be stored in e.g.:

— mechanical parts continuing to move through inertia;

— mechanical parts liable to move by gravity;

— capacitors, accumulators;

— pressurized fluids;

— springs.

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

4 General requirements

4.1 Isolation and energy dissipation

Machines shall be provided with means intended for isolation and energy dissipation (see clause 5), especially with a view to major maintenance, work on power circuits and decommissioning in accordance with the essential safety requirement expressed in ISO/TR 12100-2:1992, annex A, 1.6.3.

4.2 Other means to prevent unexpected [unintended] start-up

If the use of isolation and energy dissipation is not appropriate (e.g. for frequent short interventions), the designer shall provide, according to the risk assessment in accordance with ISO 14121, other measures (see clause 6) to prevent unexpected start-up. Additional means such as signalling and/or warning may be appropriate (see annex B).

NOTE 1 Examples of tasks which can require the presence of persons in danger zones are given in annex A.

NOTE 2 According to ISO/TR 12100-1:1992, 5.7.1, the designer should determine as completely as possible the different machine operating modes and the need for the presence of persons in danger zones. Appropriate safety measures can then be provided. These measures should prevent operators from being induced to use hazardous operating modes and hazardous intervention techniques caused by technical difficulties in the use of the machine (see ISO/TR 12100-1:1992, 3.12).

5 Means for isolation and energy dissipation

5.1 Devices for isolation from power supplies

5.1.1 Isolation devices shall:

— ensure a reliable isolation (disconnection, separation);

— have a reliable mechanical link between the manual control and the isolating element(s);

— be equipped with clear and unambiguous identification of the state of the isolation device which corresponds to each position of its manual control (actuator).

NOTE 1 For electrical equipment, a supply disconnecting device complying with IEC 60204-1:1997, 5.3 "Supply disconnecting (isolating) device" meets this requirement.

NOTE 2 Plug and socket systems (for electrical supplies), or their pneumatic, hydraulic or mechanical equivalents, are examples of isolating devices with which it is possible to achieve a visible and reliable discontinuity in the power supply circuits. For electrical plug/socket combinations, see IEC 60204-1:1997, 5.3.2 d).

NOTE 3 For hydraulic and pneumatic equipment, see also EN 982:1996, 5.1.6 and EN 983:1996, 5.1.6.

5.1.2 The location and number of isolation devices will be determined by the configuration of the machine, the need for the presence of persons in danger zones and the risk assessment. Each isolation device shall be readily identifiable as to which machine, or part of it, it isolates (e.g. by durable marking where necessary).

NOTE For electrical equipment of machinery, see also IEC 60204-1:1997, 5.4.

5.1.3 When, during isolation of the machine, certain circuits have to remain connected to their power supply in order, e.g., to hold parts, protect information or provide local lighting, special means shall be provided to ensure operator safety.

NOTE Such means include enclosures which can be opened only with a key or a special tool, warning labels and/or warning lights.

5.2 Locking [securing] devices

The isolation devices shall be capable of being locked or otherwise secured in the "isolated" position.

NOTE Locking devices may not be necessary when a plug/socket combination is used and the plug can be kept under immediate supervision of the person present in the danger zone.

Locking devices include:

— facilities to apply one or more padlocks;

— trapped-key interlocking devices (see ISO 14119:1998, annex E), one of the locks of which is associated with the manual control [actuator] of the isolating device;

— lockable housings or enclosures.

Locking devices are not required when reconnection cannot endanger persons.

5.3 Devices for stored-energy dissipation or restraint [containment]

5.3.1 General

5.3.1.1 Devices for stored-energy dissipation or restraint [containment] shall be incorporated into the machine where stored energy can give rise to a hazard.

NOTE Such devices include brakes intended to absorb kinetic energy of moving parts, resistors and relevant circuitry to discharge electrical capacitors, valves or similar devices to depressurize fluidic accumulators (see EN 982:1996, 5.1.6 and EN 983:1996, 5.1.6).

5.3.1.2 When dissipation of stored energy would excessively reduce the ability of the machine to be used, additional means shall be incorporated to reliably restrain or contain the remaining stored energy.

5.3.1.3 The devices for energy dissipation or restraint [containment] should be selected and arranged so that:

— dissipation or restraint [containment] results from the isolation of the machine (or part of it);

— the energy dissipation process does not give rise to hazardous situations.

5.3.1.4 The necessary procedures for energy dissipation or restraint [containment] shall be described in the instruction handbook of the machine or in warnings on the machine itself.

5.3.2 Mechanical elements

When mechanical elements can give rise to a hazardous situation

— by virtue of their mass and position (e.g. unbalanced, or raised, or in any situation where they could move under the effect of gravity),

— or as a result of the action upon them of spring load (whatever this "spring" is made of),

means shall be provided to bring them to the lowest energy state (e.g. lowest position or spring-relaxed) either by the usual machine manual controls or by devices specifically designed and identified (marked) for that function.

When the mechanical elements cannot be brought into an intrinsically safe state, they shall be mechanically secured by brakes or mechanical restraint devices in accordance with ISO/TR 12100-1:1992, 3.23.6.

5.3.3 Locking or securing facilities for the restraint [containment] devices

The devices for energy restraint [containment] shall whenever necessary be capable of being locked or otherwise secured.

5.4 Verification

5.4.1 General

The machine and the isolation and energy dissipation or restraint [containment] devices shall be designed, selected and arranged so that reliable verification of the effectiveness of the isolation and energy dissipation or restraint [containment] can be carried out.

Provisions to verify the effectiveness of the isolation, energy dissipation and restraint [containment] measures shall not impair their effectiveness.

5.4.2 Provisions for verifying isolation

Isolation from any power supply shall either be visible (visible break in the power supply circuits) or indicated by an unambiguous position of the manual control (actuator) of the isolating device.

NOTE See also 5.1.1 relating to the mechanical link between the isolating element(s) and the manual control.

5.4.3 Provisions for verifying energy dissipation or restraint [containment]

5.4.3.1 Built-in devices (such as pressure gauges) or test points shall be provided for verifying the absence of energy in parts of a machine in/on which interventions are intended.

5.4.3.2 The instruction handbook (see ISO/TR 12100-2:1992, 5.5) shall provide precise guidance on safe verification procedures.

5.4.3.3 Permanent labels shall be fixed to assemblies warning against hazards due to stored energy (e.g. compressed springs) where assemblies can be removed or dismantled.

6 Measures, other than isolation and energy dissipation, to prevent unexpected start-up

6.1 Design strategy

For every application where isolation and energy dissipation are not appropriate for all interventions, the designer shall decide, in accordance with the risk assessment, the measures (among those listed below) considered necessary to prevent unexpected start-up. These are given as follows:

— measures (component design, selection and location) to prevent accidental generation of start commands from external or internal influences in any part of the machine (see 6.2);

— measures, dependent on the system architecture/structure, provided to prevent accidental start commands resulting in an unexpected start-up (see 6.3);

— means automatically stopping the hazard-generating part of the machine before a hazardous situation can arise from an unexpected/unintended start-up of this part (see 6.4).

The selected measures shall not be considered to be a substitute for the measures for isolation and energy dissipation set out in clause 5.

NOTE The selected measures will in most cases be a combination of the different measures described in this clause.