
**Safety of machinery — Interlocking
devices associated with guards —
Principles for design and selection**

**AMENDMENT 1: Design to minimize defeat
possibilities**

*Sécurité des machines — Dispositifs de verrouillage associés à des
protecteurs — Principes de conception et de choix*

*AMENDEMENT 1: Conception réduisant les possibilités de
neutralisation*



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Foreword

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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.

Amendment 1 to ISO 14119:1998 was prepared by Technical Committee ISO/TC 199, *Safety of machinery*.

International Standard ISO 14119 is currently under revision. In addition to incorporating this Amendment and any other technical changes that are necessary, the revised edition will update the normative references made to other documents — including ISO 14121, which is to be cancelled and replaced by ISO 14121-1.

Introduction

This Amendment has the aim of specifying more precise requirements in order to improve the provisions for minimizing the possibilities for defeat by machine operators. Research in some fields has shown that operators often try to defeat a guard-interlocking safety function by attempting to defeat the interlocking device, the possibility of defeat being primarily attributable to shortcomings in the design of the machine.

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Safety of machinery — Interlocking devices associated with guards — Principles for design and selection

AMENDMENT 1: Design to minimize defeat possibilities

Page 12, subclause 5.7

Replace 5.7 entirely, including Figures 5 and 6, with the following revised text and figures.

5.7 Design to minimize defeat possibilities

5.7.1 General

The following requirements for minimizing the possibilities for defeat of an interlocking device need not apply if the safety interlocking function has other measures for minimizing the possibility of its defeat. These other measures include the following.

- The specification of the safety interlocking function such that measures for minimizing the possibilities for defeat are implemented at the system level and therefore do not rely on the interlocking device itself (e.g. cyclical testing, status indication, time limitation). See Note 1.
- The specification of the safety interlocking function such that minimizing the possibilities for defeat is achieved by removing the foreseeable reason for attempting to defeat the switch. This can include the provision of specific operating modes to facilitate the safe and efficient accomplishment of all foreseeable tasks during the full life cycle of the machine. See Notes 1 and 2.

NOTE 1 The specification of safety functions and the design of safety-related control systems that implement them are outside the scope of this International Standard. For information on this subject, refer to ISO 12100, IEC 62061 and ISO 13849.

NOTE 2 This approach can be effective at preventing any defeat of the safety function.

If the specification of the safety interlocking function is such that it is possible to defeat the safety function solely by a reasonably foreseeable action at the interlocking device itself, and if the device itself is to be relied on to prevent defeat, measures should be provided to minimize the possibility of defeat. The extent to which these measures are applied should depend on the likelihood of occurrence of an attempt to defeat the device as well as on the risk exposed by the defeat of the safety function. This information shall be produced by risk assessment (see ISO 14121).

Such measures include, but are not limited to, the provisions given below.

Interlocking devices shall be designed, or instructions for their installation and maintenance shall be given, so that they cannot be defeated in a reasonably foreseeable manner.

NOTE 3 The implementation of alternative modes of operation can avoid the temptation and/or motivation of defeat.

NOTE 4 "Defeat in a reasonably foreseeable manner" needs to take into account the characteristics of a specific application and therefore be based on risk assessment. Typically, it can mean "intended operation achieved manually or with a readily available object". Readily available objects can be

- screws, needles, sheet-metal pieces,
- objects in daily use such as keys and coins,
- spare actuators or spare keys for the trapped-key interlocking devices, or
- tools required by the intended use of the machine or readily available tools (e.g. screwdrivers, wrenches, hexagonal keys and pliers).

"Defeat in a reasonably foreseeable manner" includes the removal of switches or actuators using the above-mentioned tools with the intention to disable an interlocking device.

Provisions by which defeat may be made more difficult shall include, in addition to a correct arrangement and fastening of detectors as given in 5.2, one or more of the following measures, taking into account the characteristics of the device(s):

- a) the use of interlocking devices or systems which are coded or individually coded, e.g. mechanically, electrically, magnetically, optically, used singly or in combination;
- b) physical obstruction or shielding preventing access to the interlocking device while the guard is open (e.g. hidden position) [see examples in Figures 5 and 6, and in Annex F, variant b)];
- c) technical control measures carried out by the functional control system (e.g. cyclical testing);

NOTE 5 When interlocking circuits are defeated, the signals become static. Therefore, monitoring of signal change by control means can be an effective measure.

- d) provision of additional position detectors in accordance with Figure 4 (see 5.4.1);
- e) other equivalent measures.

Where interlocking systems rely on special actuators or keys (coded or not), advice shall be given in the instruction handbook concerning risks associated with the availability of spare actuators or keys and master keys.

5.7.2 Additional requirements for the design of mechanically actuated position detectors

5.7.2.1 Position detectors operated by separate cams

When a single detector is used, it shall be actuated in the positive mode (see 5.1) since, among other characteristics, this mode of actuation prevents the detector from being defeated in a reasonably foreseeable manner (see Annex A).

Furthermore, simple release and turning away of the detector shall be made more difficult by means of fixings which cannot easily be released.

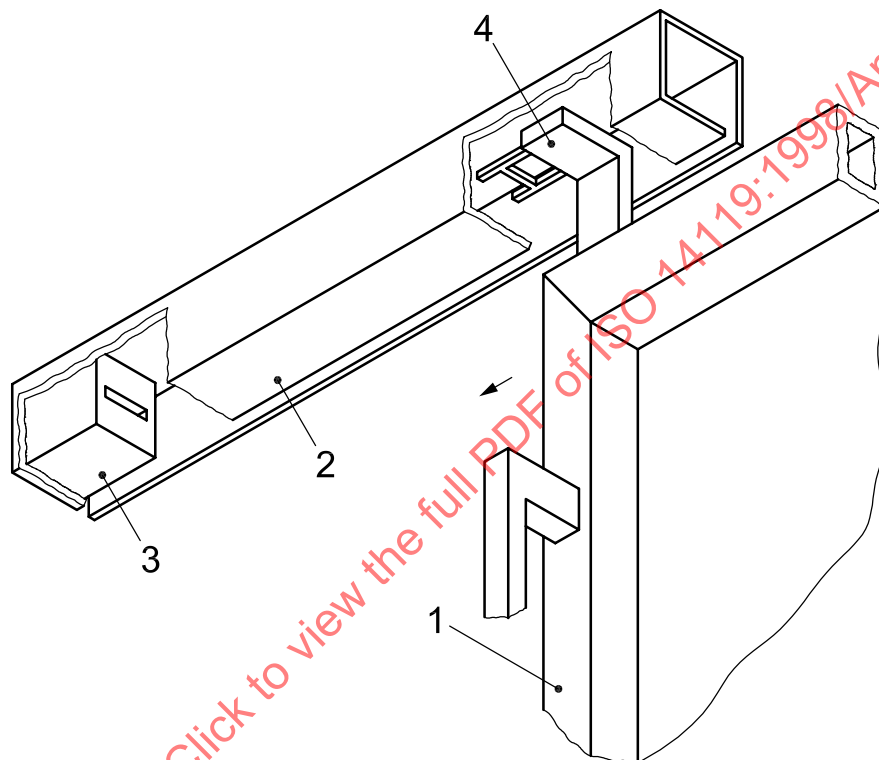
NOTE A higher level of protection against defeat when a single detector is used can be achieved, e.g. by enclosing the cam and detector in the same housing.

5.7.2.2 Tongue-operated switches

The design of the switch and, in particular, of the combination tongue/switching mechanism shall prevent “defeat in a reasonably foreseeable manner” by minimizing the possibility of actuation by tools and objects other than the tongue.

NOTE For “defeat in a reasonably foreseeable manner”, see 5.7.1.

In addition to the requirements of 5.7.1, defeat with the help of a separate or dismantled actuator shall be made more difficult by an assembly that is not easily separable, e.g. joined by welding, riveting, “one-way” screws, glue, or drilled screwhead.



Key

- 1 sliding guard (open)
- 2 cover (fixed part)
- 3 switch
- 4 tongue

Figure 5 — Example of protection against defeating a tongue-operated switch

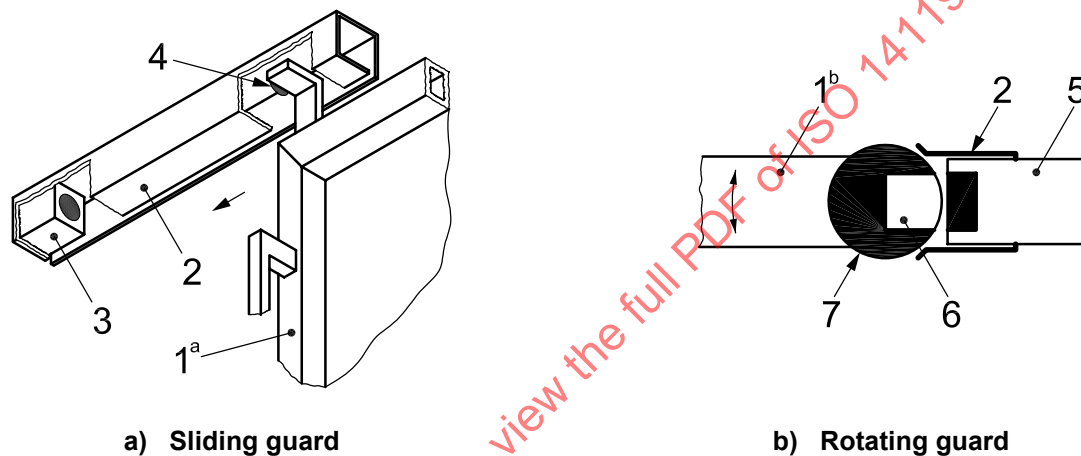
5.7.3 Additional requirements for design to minimize defeat of proximity switches and magnetic switches

Proximity switches and magnetic switches shall be selected, installed and/or shielded such that they cannot be defeated, e.g. by using a magnet or a piece of metal, in a reasonably foreseeable manner (see Figure 6).

NOTE See IEC 60947-5-3 for guidance on the selection of a suitable switch. The standard defines four different types of proximity devices, depending on the resistance to faults and on the behaviour in case of a fault.

In addition to the requirements of 5.7.1, defeat with the help of a separate or dismantled actuator shall be made more difficult by an assembly that is not easily separable, e.g. joined by welding, riveting, "one-way" screws, glue, or drilled screwhead.

Where there is a risk of a substitute actuator being used to defeat the system, an obstruction shall be incorporated into the mechanical arrangement to prevent the substitute actuator from being used to actuate the switch (see Figure 6).



Key

- 1 guard
- 2 cover (fixed part)
- 3 proximity switch
- 4 actuator
- 5 magnetic switch (contact open when guard detected)
- 6 non-detectable part
- 7 detectable part

NOTE Defeating the detector is made difficult by the cover [a) and b)], or by the presence of the guard in front of it [b) only].

- a Open.
- b Closed.

Figure 6 — Examples of protection against defeat of proximity switch or magnetic switch