

Safety of machinery — Application of protective equipment to detect the presence of persons

ICS 13.110

National foreword

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English version

**Safety of machinery –
Application of protective equipment
to detect the presence of persons
(IEC 62046:2004)**

Sicherheit von Maschinen –
Anwendung von Schutzausrüstungen zur
Anwesenheitserkennung von Personen
(IEC 62046:2004)

This Technical Specification was approved by CENELEC on 2004-08-28.

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CENELEC

European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of the Technical Specification IEC/TS 62046:2004, prepared by IEC TC 44, Safety of machinery, was submitted to the formal vote and was approved by CENELEC as CLC/TS 62046 on 2004-08-28.

The following date was fixed:

- latest date by which the existence of the CLC/TS
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Annex ZA has been added by CENELEC.

Endorsement notice

The text of the Technical Specification IEC/TS 62046:2004 was approved by CENELEC as a Technical Specification without any modification.

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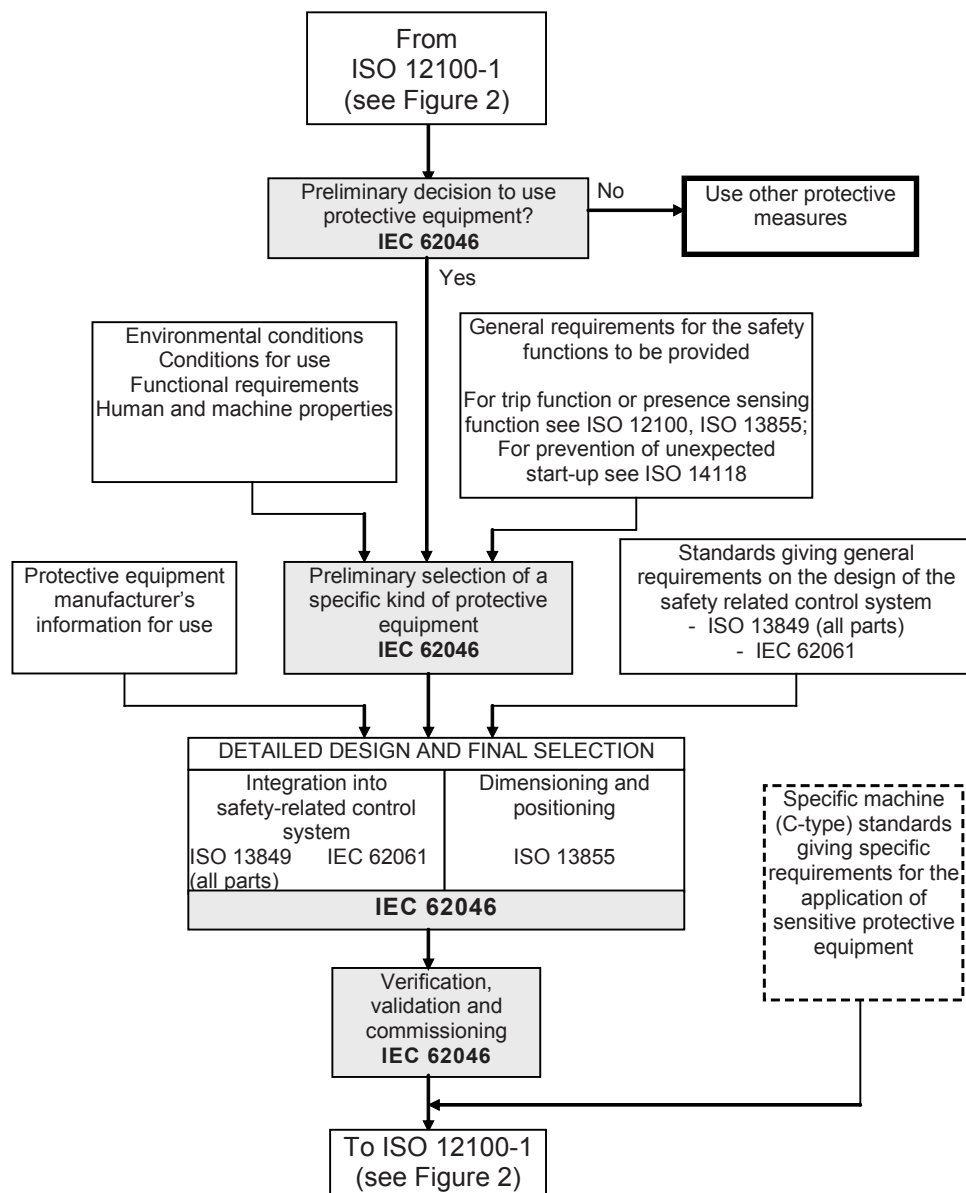
INTRODUCTION

This Technical Specification addresses the application of protective equipment, which employs a sensing device(s) to detect person(s) in or approaching an area, in order to reduce or minimize a risk from hazardous parts of machinery, without providing a physical barrier. This specification provides information on the manner in which the protective equipment should be applied to the machine to achieve the targeted level of risk reduction.

The objective of this specification is to assist: standards writing committees responsible for developing machine standards ("C" Standards), machine designers, manufacturers and refurbishers, machine safety certification organizations, workplace authorities and others on the proper application of protective equipment to machinery.

Figures 1 and 2 show the general context and the intended use of this specification.

Clauses 1 to 5, 7 and 8 of this specification apply to all protective equipment included in the scope, Clause 6 contains guidance for the application of specific kinds of protective equipment.



IEC 404/04

Figure 1 – Relationship of this Technical Specification to other standards

(see also Figure 2)

SAFETY OF MACHINERY – APPLICATION OF PROTECTIVE EQUIPMENT TO DETECT THE PRESENCE OF PERSONS

1 Scope

This Technical Specification specifies requirements for the selection, positioning, configuration and commissioning, of protective equipment to detect the presence of persons in order to protect those persons from dangerous part(s) of machinery in industrial applications. This specification covers the application of electro-sensitive protective equipment (ESPE) specified in IEC 61496 (all parts) and pressure sensitive mats and floors specified in ISO 13856-1.

It takes into account the characteristics of the machinery, the protective equipment, the environment and human interaction by persons of 14 years and older.

NOTE This Technical Specification may also be used for guidance in the application of other protective devices.

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.

IEC 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 61496-1:2004, *Safety of Machinery – Electro-sensitive protective equipment – General requirements and tests*

IEC 61496-2:1997, *Safety of machinery – Electro-sensitive protective equipment – Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)*

IEC 61496-3:2001, *Safety of machinery – Electro-sensitive protective equipment – Particular requirements for equipment for Active Opto-Electronic Protective Devices responsive to Diffuse Reflection (AOPDDR)*

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

ISO 12100-1: 2003, *Safety of machinery – Basic concepts, general principles for design – Part 1: Basic terminology, methodology*

ISO 12100-2: 2003, *Safety of machinery – Basic concepts, general principles for design – Part 2: Technical principles*

ISO 13849-1:1999, *Safety of Machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 13855:2002, *Safety of machinery – Positioning of protective equipment with respect to the approach speeds of parts of the human body*

ISO 13856-1:2001, *Safety of machinery – Pressure-sensitive protective devices – Part 1: General principles for design and testing of pressure-sensitive mats and pressure-sensitive floors*

ISO 14118:2000, *Safety of machinery – Prevention of unexpected start-up*

ISO 14121:1999, *Safety of machinery – Principles of risk assessment*

CLC/TS 50418: 2004, *Safety of Machinery - Electro-sensitive protective equipment - Passive infra-red protective devices (PIPDs)*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this technical specification, the following terms and definitions apply.

3.1.1

blanking

optional function that permits an object of a size greater than the detection capability of the ESPE to be located within the detection zone without causing an OFF state of the OSSD(s)

3.1.2

detection capability

sensing function parameter limit specified by the supplier that will cause actuation of the protective equipment

NOTE Adapted from IEC 61496-1.

3.1.3

detection zone

zone within which a specified test piece will be detected by the electro-sensitive protective equipment

NOTE 1 ISO 13856 uses the term “effective sensing area” when describing pressure-sensitive mats and floors. In this document the terms “detection zone” and “effective sensing area” are used synonymously.

NOTE 2 Adapted from IEC 61496-1.

3.1.4

effective sensing area

part of the top surface area of the sensor or a combination of the pressure-sensitive mat or pressure-sensitive floor within which a response to an actuating force will take place

NOTE IEC 61496-1 uses the term “detection zone” when describing electro-sensitive protective equipment. In this document the terms “detection zone” and “effective sensing area” are used synonymously.

NOTE Adapted from ISO 13856-1.

3.1.5

failure (of equipment)

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 This concept as defined does not apply to items consisting of software only.

[IEV-191-04-01]

3.1.6

failure to danger

failure which prevents or delays all output signal switching devices going to, and/or remaining in the OFF-state in response to a condition which, in normal operation, would result in their so doing

[IEC 61496-1, 3.8]

3.1.7

fault

state of an item characterized by its inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources

[IEV 191-05-01]

NOTE 1 A fault is often the result of a failure of the item itself, but may exist without prior failure.

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 item "défaut" and the German term "fehler" are used rather than the term "panne" and "fehlzustand" that appear with this definition.

NOTE 3 In practice, the terms "fault" and "failure" (see 3.1.5) are often used synonymously.

3.1.8

hazard

potential source of harm

[ISO 12100-1, 3.6]

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.

3.1.9

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

[ISO 12100-1, 3.9]

3.1.10

hazard zone (danger zone)

any space within and/or around machinery in which a person can be exposed to a hazard

[ISO 12100-1, 3.10]

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);
- or can appear unexpectedly (unintended/unexpected start-up).

3.1.11

integrator

individual or group of individuals responsible for selecting, configuring, installing and/or interfacing the protective equipment to achieve the safeguarding identified by the risk assessment

3.1.12

lock-out condition

condition, initiated by a fault, preventing normal operation of the protective equipment which is automatically attained when all output signal switching devices (OSSDs) and, where applicable, all final switching devices (FSDs) and secondary switching devices (SSD) are signalled to go to the OFF-state

[IEC 61496-1, 3.13 modified]

3.1.13**muting**

temporary automatic suspension of a safety function(s) by safety-related parts of the control system

[IEC 61496-1, 3.16]

NOTE When muting is provided as part of the protective equipment and the protective equipment is muted, the OSSD(s) remain in the 'ON' state upon activation of the protective equipment sensing function and safety is maintained by other means.

3.1.14**overall system stopping performance**

time interval resulting from the sum of the protective equipment response time and the time to the cessation of hazardous machine operation

[IEC 61496-1, 3.20]

3.1.15**Passive Infrared Protective Device****PIPD**

device whose sensing function is performed by a receiving element(s) detecting thermal radiation emitted by an object placed in, or moving within, the specified detection zone

3.1.16**periodic test**

technique which stimulates or simulates the input of the protective equipment sensing device(s) to determine if the protective equipment OSSD(s) go to the off state when required to do so

NOTE The test input signal is usually produced by an external machine test input and is performed at intervals, determined by the risk assessment, which provide a reasonable degree of confidence that the intended risk reduction will be achieved.

3.1.17**protective equipment**

assembly of devices using non-contact (electro-sensitive) or contact (pressure sensitive) sensing means for detection of the presence of person(s) or parts of person(s) for the purpose of controlling hazards associated with machinery and comprising as a minimum:

- a sensing device;
- control and monitoring devices;
- output signal switching devices

NOTE The safety related control system associated with the protective equipment, or the protective equipment itself, can include additional safety features such as secondary switching devices, muting function, stopping performance monitoring, etc.

3.1.18**presence sensing function**

detection of the presence of a person, or a part of a person, while in a hazardous zone to enable prevention of hazardous situations such as unexpected/unintended start-up of the machine

3.1.19

protective measure safety measure

measure intended to achieve risk reduction, implemented:

- by the designer (inherent design, safeguarding and complementary protective measures, information for use) and
- by the user (organization: safe working procedures, supervision, permit-to-work systems, additional safeguards; personal protective equipment; training)

[ISO 12100-1, 3.18]

3.1.20

reasonably foreseeable misuse

use of a machine in a way not intended by the manufacturer, but which can result from readily predictable human behaviour

[ISO/IEC Guide 51, 3.14 modified]

3.1.21

(protective equipment) response time

maximum time between the occurrence of the event leading to the actuation of the sensing device and the output signal switching device (OSSD) achieving the OFF-state

NOTE For pressure-sensitive protective devices, the event leading to the actuation of the sensing device is the application of a force within the effective sensing area

[IEC 61496-1, 3.21 modified]

3.1.22

restart interlock

means of preventing automatic restarting of a machine after actuation of the sensing device during a hazardous part of the machine operating cycle, after a change in mode of operation of the machine, and/or after a change in the means of start control of the machine

[IEC 61496-1, 3.22]

NOTE Modes of operation include inch, single stroke, automatic. Means of start control include foot switch, two-hand control, and single or double actuation of an electro-sensitive protective equipment (ESPE) sensing device.

3.1.23

risk

combination of the probability of occurrence of harm and the severity of that harm

[ISO 12100-1, 3.11]

3.1.24

risk assessment

overall process comprising a risk analysis and a risk evaluation

[ISO 12100-1, 3.13]

3.1.24.1

risk analysis

combination of the specification of the limits of the machine, hazard identification and risk estimation

[ISO 12100-1, 3.14]

**3.1.24.2
risk evaluation**

judgement, on the basis of risk analysis, of whether the risk reduction objectives have been achieved

[ISO 12100-1, 3.16]

**3.1.24.3
risk estimation**

defining likely severity of harm and probability of its occurrence

[ISO 12100-1, 3.15]

**3.1.25
Safety-Related part of a Control System
SRCS**

part or subpart(s) of a control system which responds to input signals and generate(s) safety-related output signals

NOTE 1 This also includes monitoring systems.

NOTE 2 The combined safety-related parts of a control system start at the points where the safety-related signals are initiated and end at the output of the power control elements (see also Annex A of ISO 12100-1).

[IEC 61496-1, 3.23 modified]

**3.1.26
start interlock**

means which prevents an automatic machine start when the electrical supply to the protection equipment(s) is switched on, or is interrupted and restored

[IEC 61496-1, 3.26 modified]

**3.1.27
start test**

manual or automatic test which is performed after the protective equipment has been switched on in order to test its complete safety-related control system before normal machine operation is initiated

[IEC 61946-1, 3.26 modified]

**3.1.28
stopping performance monitor
SPM**

monitoring means to determine whether or not the overall system stopping performance is within the preset limit(s)

[IEC 61496-1, 3.28]

**3.1.29
trip function**

detection of a person or a part of a person entering into a hazardous zone, to initiate a stop function (or otherwise ensure a safe condition)

**3.1.30
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 inopportune action on a start control or other parts of the machine as, for example, 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) on parts of the machine

NOTE Automatic machine start-up during normal operation 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.

[ISO 12100-1, 3.29 modified]

3.1.31

Active Opto-electronic Protective Device

AOPD

device whose sensing function is performed by opto-electronic emitting and receiving elements detecting the interruption of optical radiations generated, within the device, by an opaque object present in the specified detection zone (or for a light beam device, on the axis of the light beam)

[IEC 61496-2, 3.201 modified]

3.1.32

Active Opto-electronic Protective Device responsive to Diffuse Reflection

AOPDDR

device, whose sensing function is performed by opto-electronic emitting and receiving elements, that detects the diffuse reflection of optical radiations generated within the device by an object present in a detection zone specified in two dimensions

[IEC 61496-3, 3.301]

3.1.33

Electro-Sensitive Protective Equipment

ESPE

assembly of devices and/or components working together for protective tripping or presence-sensing purposes and comprising as a minimum

- a sensing device;
- controlling/monitoring devices;
- output signal switching devices

[IEC 61496-1, 3.5]

3.1.34

pressure-sensitive mat (floor)

safety device that detects a person standing on it or who steps onto it comprising a sensor(s) that responds to the application of pressure, a control unit and one or more output signal switching device(s)

NOTE In a pressure-sensitive mat the effective sensing area is deformed locally when the sensor(s) is actuated. In a pressure-sensitive floor, the effective sensing area is moved as a whole when the sensor(s) is actuated.

[ISO 13856-1, 3.1 and 3.2]

3.1.35

External Device Monitoring

EDM

means by which the electro-sensitive protective equipment monitors the state of control devices which are external to the ESPE

[IEC 61496-1, 3.6]

3.1.36**Final Switching Device****FSD**

component of the machine's safety-related control system that interrupts the circuit to the machine primary control element when the output signal switching device (OSSD) goes to the OFF-state

[IEC 61496-1, 3.10]

3.1.37**Machine Primary Control Element****MPCE**

electrically powered element that directly controls the normal operation of a machine in such a way that it is the last element (in time) to function when machine operation is to be initiated or arrested

[IEC 61496-1, 3.14]

3.1.38**Machine Secondary Control Element****MSCE**

machine control element, independent of the machine primary control element(s), that is capable of removing the source of power from the prime mover of the relevant hazardous parts

[IEC 61496-1, 3.15]

3.1.39**Output Signal Switching Device****OSSD**

component of electro-sensitive protective equipment (ESPE) connected to the machine control system which, when the sensing device is actuated during normal operation, responds by going to the OFF-state

[IEC 61496-1, 3.19 modified]

that part of the pressure-sensitive-mat or pressure-sensitive floor that, when the sensor or monitoring function means is actuated, responds by producing an OFF state

[ISO 13856-1, 3.6]

3.1.40**Secondary Switching Device****SSD**

device which, in a lock-out condition goes to the OFF-state. It may be used to initiate an appropriate machine control action, for example de-energizing the machine secondary control element (MSCE)

3.2 Abbreviations

Abbreviation	Description
AGV	Automated Guided Vehicle
AOPD	Active Optoelectronic Protective Device
AOPDDR	Active Optoelectronic Protective Device responsive to Diffuse Reflection
ESPE	Electro-Sensitive Protective Equipment
EDM	External Device Monitoring
FSD	Final Switching Device
MPCE	Machine Primary Control Element

MSCE	Machine Secondary Control Element
OSSD	Output Signal Switching Device
PIPD	Passive Infrared Protective Device
PSPD	Pressure Sensitive Protective Device
SSD	Secondary Switching Device
SPM	Stopping Performance Monitor

4 Selection

4.1 Procedure (relationship with ISO 12100 (all parts))

This specification is an expansion of Step 2 “risk reduction by safeguarding” of the iterative 3-step method of risk reduction for the design of safe machinery, contained in Clause 5 of ISO 12100-1 (see Figure 2).

NOTE 1 This procedure presumes that a risk assessment has been carried out in accordance with ISO 14121, that measures have been taken to remove or reduce risks by inherently safe design and safeguarding by means of protective equipment is being considered.

The following characteristics shall be considered in the selection process when protective equipment and other protective measures as necessary are being evaluated as a risk reduction means:

- machine characteristics;
- environmental characteristics;
- human characteristics;
- protective equipment characteristics.

NOTE 2 These characteristics should be considered for both normal use and reasonably foreseeable misuse.

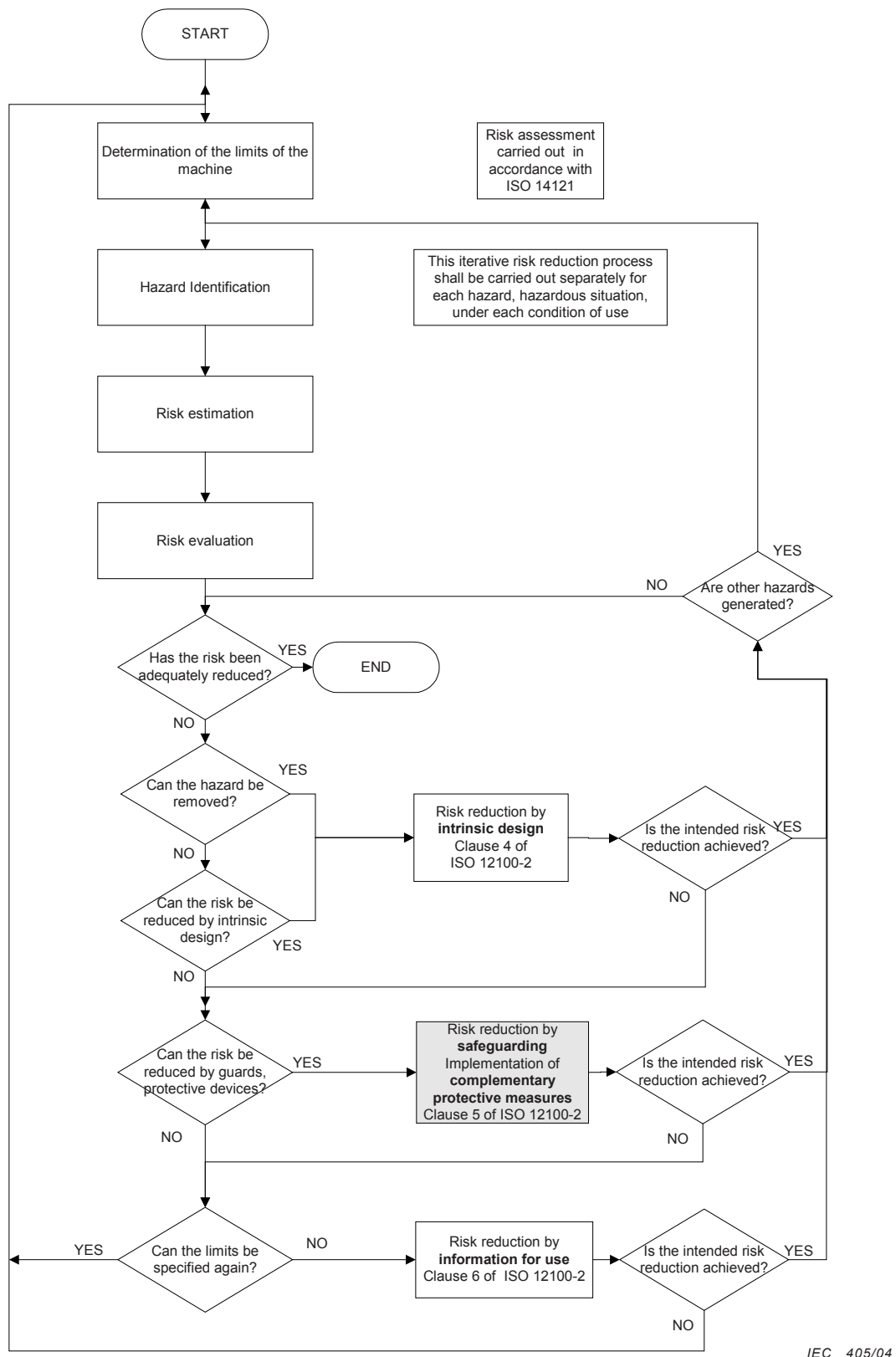


Figure 2 – Risk reduction process (Figure 2 of ISO 12100-1)