TECHNICAL REPORT

ISO/TR 22100-2

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Safety of machinery — Relationship with ISO 12100 —

Part 2: How ISO 12100 relates to ISO 13849-1

Sécurité des machines — Relation avec l'ISO 12100 —

Partie 2: Relation entre l'ISO 12100 et l'ISO 13849-1

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 199, *Safety of machinery*.

ISO/TR 22100 consists of the following parts, under the general title *Safety of machinery — Relationship with ISO 12100*:

— *Part 2: How ISO 12100 relates to ISO 13849-1*

How ISO 12100 relates to type-B and type-C standards and the implementation of ergonomics in safety standards are to form the subjects of future parts 1 and 3.

Introduction

The use of ISO 12100 and ISO 13849-1 has shown that readers have experienced difficulty in understanding how these two documents work together. This document has been prepared to guide readers in how the standards are to be used to achieve tolerable risk for a machine in general and for the safety-related parts of the control system, in particular.

Safety of machinery — Relationship with ISO 12100 —

Part 2: How ISO 12100 relates to ISO 13849-1

1 Scope

This part of ISO/TR 22100 describes the general relationship between ISO 12100 and ISO 13849-1 used to reduce the risk of harm. It focuses on the use of safety-related parts of control systems in relation to risk assessment and the risk reduction process.

NOTE The explanations about the relationship to ISO 12100 given in this document are relevant for ISO 13849-1 but could be applied in a similar manner to IEC 62061.

2 Normative reference

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

3 General structure of the system of machinery safety standards

Standards on safety of machinery have the following structure:

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

— **type-B standards** (generic safety standards) dealing with one safety aspect or one type of safeguard that can be used across a wide range of machinery;

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

As shown in Figure 1, ISO 12100 is the type-A standard specifying the general principles for safety of machinery and applies to all machinery. ISO 13849-1 is a typical type-B standard addressing a particular aspect and can be used across a wide range of machinery.

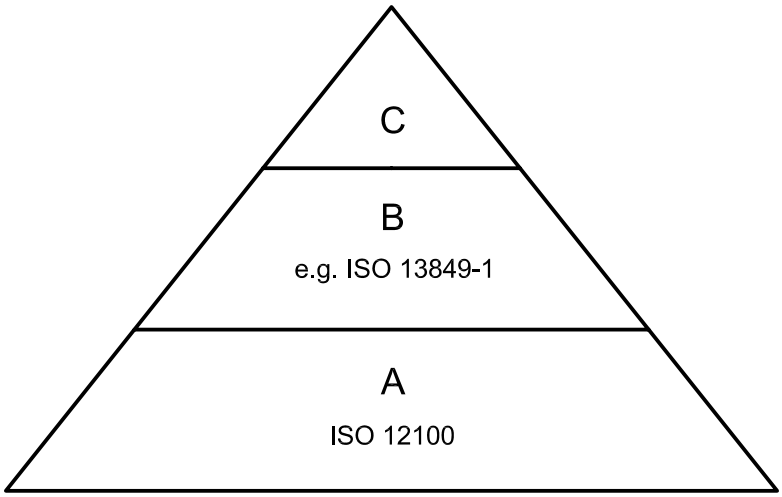


Figure 1 — General structure of the system of machinery safety standards

4 The risk assessment and risk reduction process

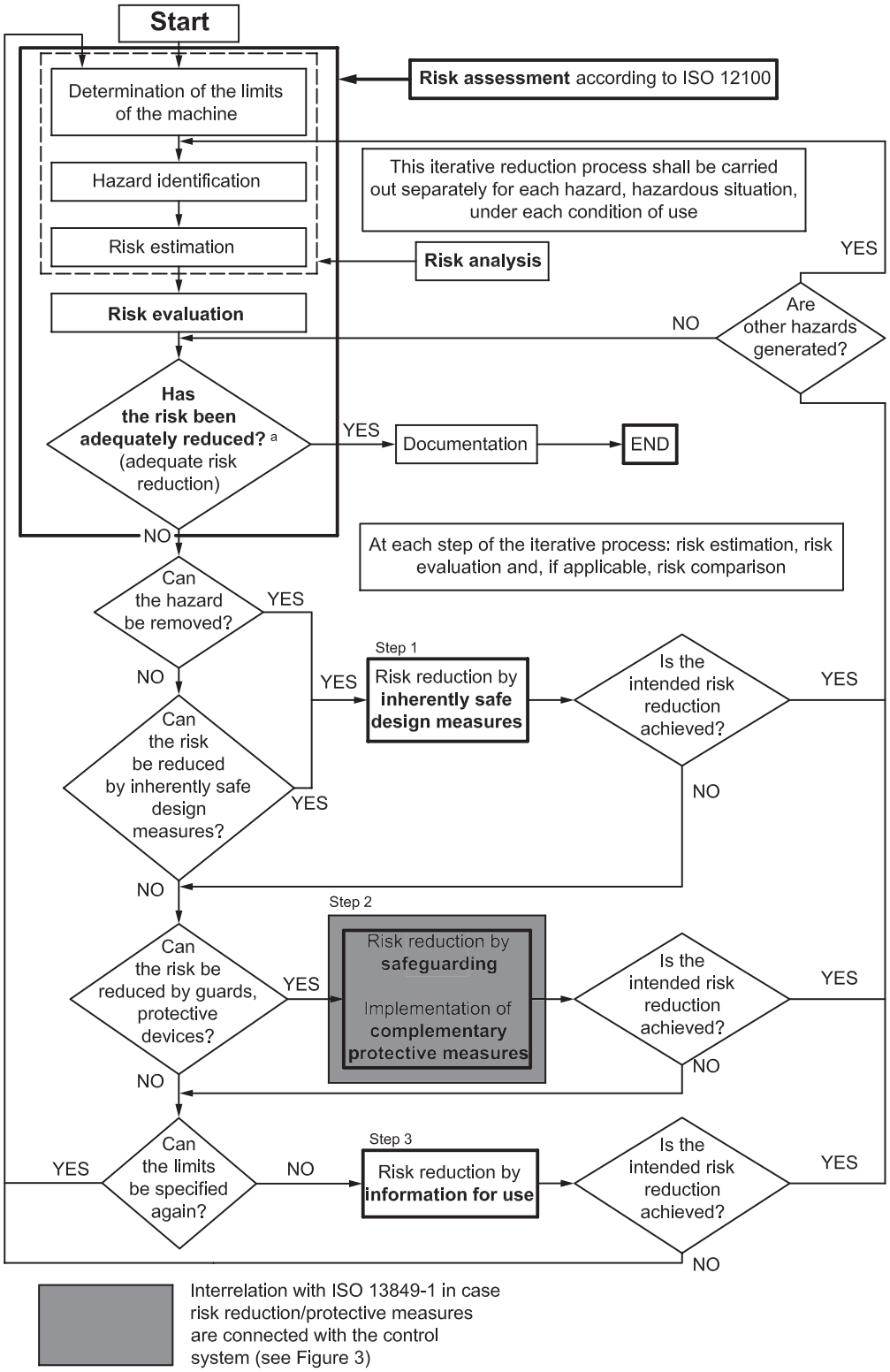
The fundamental International Standard for safety of machinery is ISO 12100. Machinery manufacturers should work through the risk assessment and risk reduction process described in ISO 12100 to identify hazards, estimate risks, and reduce risks adequately (tolerable risk).

Figure 2 shows the risk assessment and risk reduction process according to ISO 12100 and contains additional information regarding its interrelation with ISO 13849-1.

As shown in Figure 2, ISO 13849-1 is relevant for cases where a risk assessment according to ISO 12100 has initiated a risk reduction measure (e. g. interlocking guard) that relies on a safety-related control system. In those cases, the safety-related control system has to perform a safety function. The application of ISO 13849-1 is restricted to those cases only.

In the risk assessment and risk reduction process of ISO 12100 (iterative three-step method), the hazards related to a machine shall be identified and the risk estimated. As shown in Figure 2, risk estimation initially occurs prior to risk reduction. The initial risk is estimated using one of various risk scoring systems or methods (see ISO/TR 14121-2). It should be noted that the method given in ISO 13849-1 is primarily intended to be used for safety functions carried out by safety-related control systems. For example, a resulting category or performance level makes no sense for a slipping hazard or falling hazard.

When a control system with safety functions is selected as a protective/risk reduction measure (such as a guard door interlock) in accordance with ISO 12100, then ISO 13849-1 should be used to design and evaluate the safety-related parts of the control system. Only the part of the control system that is safety-related falls under the scope of ISO 13849-1. Not all aspects of the control system perform safety functions such as some proximity sensors, parts counters, or monitoring devices. There is no need to apply ISO 13849-1 to non-safety-related parts of the control system.



Key

a The first time the question is asked, it is answered by the result of the initial risk assessment.

Figure 2 — Schematic representation of risk assessment and risk reduction process according to ISO 12100:2010, Figure 1

5 Interrelation between ISO 12100 and ISO 13849-1

5.1 General

For the correct application of ISO 13849-1, basic input information resulting from the application of the overall risk assessment and risk reduction process for the particular machine design is necessary. Based on this input information, the safety-related parts of the control system can be appropriately designed according to ISO 13849-1. Information resulting from a detailed design of safety-related parts of the control system relevant for its integration into the machine design has then to be considered in the overall risk assessment and risk reduction process according to ISO 12100. Figure 3 illustrates this interrelation.

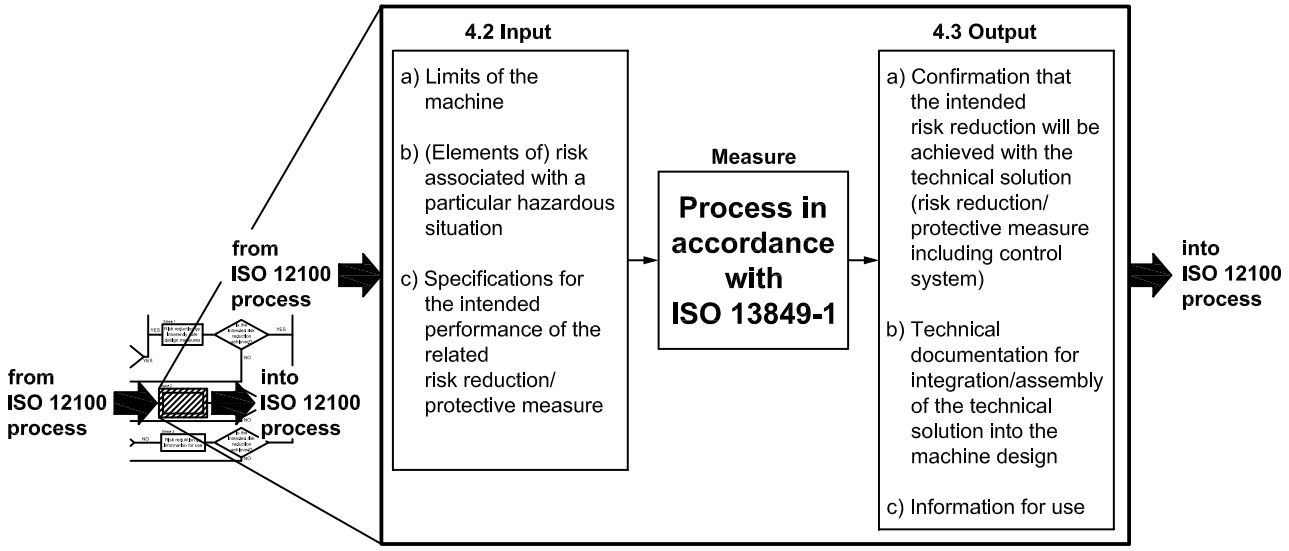


Figure 3 — Interrelation between ISO 12100 and ISO 13849-1

5.2 Input information to ISO 13849-1

The following input information to ISO 13849-1 from the application of the overall risk assessment and risk reduction process according to ISO 12100 for the particular machine is necessary for the correct application of ISO 13849-1.

a) The limits of the machine according to ISO 12100:2010, 5.3, including

   1) use limits,

   2) space limits,

   3) time limits, and

   4) other limits (for example, environmental conditions).

b) The risk associated with a particular hazardous situation according to ISO 12100:2010, 5.5.2 which depends on the following elements

   1) severity of harm, and

   2) probability of occurrence of that harm, which is a function of

      i) exposure of person(s) to the hazard,

      ii) occurrence of a hazardous event, and

      iii) technical and human possibilities to avoid or limit the harm.

These elements of risk should consider all risk reduction measures (inherently safe design, safeguarding/protective measures) already taken in the iterative process according to ISO 12100. In cases where no risk reduction measures (inherently safe design, safeguarding/protective measures) were taken so far, the elements of risk are identical with those obtained in the first step of the iterative process according to ISO 12100.

NOTE 1 The occurrence of a hazardous event can be of technical or human origin. For further explanation see ISO 13849-1:2006, A.2.3, as amended by ISO 13849-1:2006/Amd 1.

NOTE 2 The occurrence of a hazardous event and the technical and human possibilities to avoid or limit the harm are included the same parameter, P, of ISO 13849-1:2006, Annex A.

In cases where for the overall risk assessment and risk reduction process according to ISO 12100 a scale for the elements of risk is used, the output from the risk assessment tool used should be mapped appropriately to the Performance Level scale given in ISO 13849-1. All necessary input information for the selection of the required Performance Level, $PL_{r,}$ (elements of risk values for the considered hazardous situation) are available from the overall risk assessment and risk reduction process according to ISO 12100. Therefore a separate risk assessment for the application of ISO 13849-1 is not necessary.

The graph given in ISO 13849-1:2006, Figure A.1 is used only to select the PL_r for safety functions and is not intended to be used as a risk estimation method for the overall machine according to ISO 12100.

NOTE 3 Some type-C standards already determine values for PL_r for particular safety functions.

c) Specifications for the intended performance of the related risk reduction/protective measure, such as

   1) general prescription of the intended function of the risk reduction/protective measure (relevant functional requirements),

   2) specific safety-related characteristics for the risk reduction/ protective measure (for example, reaction time, operating modes),

   3) prescription of the environmental conditions relevant for the risk reduction/ protective measure (for example, space limitation, temperature, humidity, vibration), and

   4) prescription of other machine and/or process specific conditions (for example, designated safety-related components [sensor, control actuator]).

5.3 Output information resulting from ISO 13849-1

The following output information from ISO 13849-1 resulting from the detailed design of safety-related control system is necessary as an input to ISO 12100 to finalize the overall risk assessment and risk reduction process.

a) The result of the verification and validation according to ISO 13849-1 and ISO 13849-2 used to demonstrate that the intended risk reduction is achieved by the risk reduction measures chosen.

b) Technical documentation for integration/assembly of the technical solution into the machine design according to ISO 13849-1:2006, Clause 10.

c) Information for use (relevant information to be given from the machine designer to the machine user to ensure the correct use of the safety-related part of the control system and interrelated risk reduction/protective measures) according to ISO 13849-1:2006, Clause 11.

Bibliography

[1] ISO 13849-1:2006,*Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design,* amended by ISO 13849-1:2006/Amd 1 (to be published)

[2] ISO 13849-2, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation*

[3] ISO/TR 14121-2, *Safety of machinery — Risk assessment — Part 2: Practical guidance and examples of methods*

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

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