

Safety of machinery — Guidelines for the understanding and use of safety of machinery standards

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National foreword

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Summary of pages

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TECHNICAL REPORT

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Safety of machinery — Guidelines for the understanding and use of safety of machinery standards

*Sécurité des machines — Lignes directrices pour la compréhension et
l'utilisation des normes sur la sécurité des machines*



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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ISO/TR 18569 was prepared by Technical Committee ISO/TC 199, *Safety of machinery*.

Safety of machinery — Guidelines for the understanding and use of safety of machinery standards

1 Scope

This Technical Report provides assistance to the designer or manufacturer of machinery and related equipment on the contents and how to apply the relevant Type A and Type B safety of machinery standards.

ISO/TR 18569 provides an overview which gives a general outline of the basic steps which can assist the manufacturer to declare conformity with the EU Machinery Directive and related standards or apply supporting standards in the case when specific Type C standards do not exist. It provides an outline of the various standards associated with machinery safety.

NOTE This Technical Report does not address Type C standards.

2 Classification of machinery safety standards

2.1 Type A standards (basic safety standards) giving basic concepts, principles for design, and general aspects that can be applied to machinery.

Table 1 — Type A standards

ISO/IEC	CEN/CENELEC	Title
ISO 12100-1	EN ISO 12100-1	<i>Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology</i>
ISO 12100-2	EN ISO 12100-2	<i>Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles</i>
ISO 14121	EN 1050	<i>Safety of machinery — Principles of risk assessment</i>
—	EN 1070	<i>Safety of machinery — Terminology</i> (This document is an anthology of terms and their definitions taken from other documents.)

2.2 Type B standards (generic safety standards) dealing with one safety aspect or one type of safety-related device 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 safety-related devices (e.g. two-hand controls, interlocking devices, pressure-sensitive devices, guards).

Table 2 — Type B standards

ISO/IEC	CEN/CENELEC	Title
<i>General</i>		
ISO 13849-1	EN 954-1	<i>Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design</i>
ISO 13849-2	EN ISO 13849-2	<i>Safety of machinery — Safety-related parts of control systems — Part 2: Validation</i>
ISO 13850	EN 418	<i>Safety of machinery — Emergency stop — Principles for design</i>
ISO 13851	EN 574	<i>Safety of machinery — Two-hand control devices — Functional aspects and design principles</i>
ISO 13852	EN 294	<i>Safety of machinery — Safety distances to prevent danger zones being reached by the upper limbs</i>
ISO 13853	EN 811	<i>Safety of machinery — Safety distances to prevent danger zones being reached by the lower limbs</i>
ISO 13854	EN 349	<i>Safety of machinery — Minimum gaps to avoid crushing of parts of the human body</i>
ISO 13855	EN 999	<i>Safety of machinery — Positioning of protective equipment with respect to the approach speeds of parts of the human body</i>
ISO 13856-1	EN 1760-1	<i>Safety of machinery — Pressure-sensitive protective devices — Part 1: General principles for design and testing of pressure-sensitive mats and pressure-sensitive floors</i>
ISO 13856-2	EN 1760-2	<i>Safety of machinery — Pressure-sensitive protective devices — Part 2: General principles for the design and testing of pressure-sensitive edges and pressure-sensitive bars</i>
ISO 14118	EN 1037	<i>Safety of machinery — Prevention of unexpected start-up</i>
ISO 14119	EN 1088	<i>Safety of machinery — Interlocking devices associated with guards — Principles for design and selection</i>
ISO 14120	EN 953	<i>Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards</i>
ISO 14122-1	EN ISO 14122-1	<i>Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means of access between two levels</i>
ISO 14122-2	EN ISO 14122-2	<i>Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways</i>
ISO 14122-3	EN ISO 14122-3	<i>Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails</i>
ISO 14122-4	EN ISO 14122-4	<i>Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders</i>
ISO 14123-1	EN 626-1	<i>Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers</i>
ISO 14123-2	EN 626-2	<i>Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 2: Methodology leading to the verification procedure</i>
ISO 14159	—	<i>Safety of machinery — Hygiene requirements for the design of machinery</i>
—	EN 1093-1	<i>Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 1: Selection of test methods</i>

Table 2 (continued)

ISO/IEC	CEN/CENELEC	Title
—	EN 1093-3	<i>Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 3: Emission rate of a specified pollutant — Bench test method using the real pollutant</i>
—	EN 1093-4	<i>Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 4: Capture efficiency of an exhaust system — Tracer method</i>
—	EN 1093-6	<i>Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 6: Separation efficiency by mass, unducted outlet</i>
—	EN 1093-7	<i>Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 7: Separation efficiency by mass, ducted outlet</i>
—	EN 1093-8	<i>Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 8: Pollutant concentration parameter, test bench method</i>
—	EN 1093-9	<i>Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 9: Pollutant concentration parameter, room method</i>
—	EN 1093-11	<i>Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 11: Decontamination index</i>
—	EN 1127-1	<i>Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology</i>
—	EN 12198-1	<i>Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 1: General principles</i>
—	EN 12198-2	<i>Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 2: Radiation emission measurement procedure</i>
—	EN 12198-3	<i>Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 3: Reduction of radiation by attenuation or screening</i>
<i>Electrical</i>		
IEC 60204-1	EN 60204-1	<i>Safety of machinery — Electrical equipment of machines — Part 1: General requirements</i>
IEC 61131-1	EN 61131-1	<i>Programmable controllers — Part 1: General information</i>
IEC 61131-2	EN 61131-2	<i>Programmable controllers — Part 2: Equipment requirements and tests</i>
IEC 61131-3	EN 61131-3	<i>Programmable controllers — Part 3: Programming languages</i>
IEC 61131-7	EN 61131-7	<i>Programmable controllers — Part 7: Fuzzy control programming</i>
IEC/TR 61131-8	—	<i>Programmable controllers — Part 8: Guidelines for the application and implementation of programming languages</i>
IEC 61310-1	EN 61310-1	<i>Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, auditory and tactile signals</i>
IEC 61310-2	EN 61310-2	<i>Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking</i>
IEC 61310-3	EN 61310-3	<i>Safety of machinery — Indication, marking and actuation — Part 3: Requirements for the location and operation of actuators</i>
IEC 61496-1	EN 61496-1	<i>Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests</i>
IEC 61496-2	—	<i>Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)</i>

Table 2 (continued)

ISO/IEC	CEN/CENELEC	Title
IEC 61496-3	EN 61496-3	<i>Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for active opto-electronic protective devices responsive to diffuse reflection (AOPDDR)</i>
<i>Fluid power</i>		
ISO 4413	EN 982	<i>Hydraulic fluid power — General rules relating to systems (EN title: Safety of machinery — Safety requirements for fluid power systems and their components — Hydraulics)</i>
ISO 4414	EN 983	<i>Pneumatic fluid power — General rules relating to systems (EN title: Safety of machinery — Safety requirements for fluid power systems and their components — Pneumatics)</i>
<i>Vibration</i>		
—	EN 1032	<i>Mechanical vibration — Testing of mobile machinery in order to determine the whole-body vibration emission value — General</i>
—	EN 1033	<i>Hand-arm vibration — Laboratory measurement of vibration at the grip surface of hand-guided machinery — General</i>
<i>Electromagnetic compatibility (EMC)</i>		
—	EN 50081-1	<i>Electromagnetic compatibility — Generic emission standard — Part 1: Residential, commercial and light industry</i>
—	EN 50081-2	<i>Electromagnetic compatibility — Generic emission standard — Part 2: Industrial environment</i>
—	EN 50082-1	<i>Electromagnetic compatibility — Generic immunity standard — Part 1: Residential, commercial and light industry</i>
IEC 61000-4-2	EN 61000-4-2	<i>Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 2: Electrostatic discharge immunity test — Basic EMC Publication</i>
IEC 61000-4-3	EN 61000-4-3	<i>Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 3: Radiated, radio-frequency, electromagnetic field immunity test</i>
IEC 61000-4-4	EN 61000-4-4	<i>Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 4: Electrical fast transient/burst immunity test — Basic EMC Publication</i>
IEC 61000-4-5	EN 61000-4-5	<i>Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 5: Surge immunity test</i>
IEC 61000-4-8	EN 61000-4-8	<i>Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 8: Power frequency magnetic field immunity test — Basic EMC Publication</i>
IEC 61000-4-11	EN 61000-4-11	<i>Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 11: Voltage dips, short interruptions and voltage variations immunity tests</i>
IEC 61000-6-2	EN 61000-6-2	<i>Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments</i>
<i>Acoustics</i>		
ISO 3740	EN ISO 3740	<i>Acoustics — Determination of sound power levels of noise sources — Guidelines for the use of basic standards</i>

Table 2 (continued)

ISO/IEC	CEN/CENELEC	Title
ISO 3741	EN ISO 3741	<i>Acoustics — Determination of sound power levels of noise sources using sound pressure — Precision methods for reverberation rooms</i>
ISO 3743-1	EN ISO 3743-1	<i>Acoustics — Determination of sound power levels of noise sources — Engineering methods for small, movable sources in reverberant fields — Part 1: Comparison method for hard-walled test rooms</i>
ISO 3743-2	EN ISO 3743-2	<i>Acoustics — Determination of sound power levels of noise sources — Engineering methods for small, movable sources in reverberant fields — Part 2: Methods for special reverberation test rooms</i>
ISO 3744	EN ISO 3744	<i>Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane</i>
ISO 3745	EN ISO 3745	<i>Acoustics — Determination of sound power levels of noise sources using sound pressure — Precision methods for anechoic and hemi-anechoic rooms</i>
ISO 3746	EN ISO 3746	<i>Acoustics — Determination of sound power levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane</i>
ISO 3747	EN ISO 3747	<i>Acoustics — Determination of sound power levels of noise sources using sound pressure — Comparison method in situ</i>
ISO 4871	EN ISO 4871	<i>Acoustics — Declaration and verification of noise emission values of machinery and equipment</i>
ISO 9614-1	EN ISO 9614-1	<i>Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 1: Measurement at discrete points</i>
ISO 9614-2	EN ISO 9614-2	<i>Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 2: Measurement by scanning</i>
ISO 9614-3	EN ISO 9614-3	<i>Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 3: Precision method for measurement by scanning</i>
ISO 11200	EN ISO 11200	<i>Acoustics — Noise emitted by machinery and equipment — Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and at other specified positions</i>
ISO 11201	EN ISO 11201	<i>Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Engineering method in an essentially free field over a reflecting plane</i>
ISO 11202	EN ISO 11202	<i>Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Survey method in situ</i>
ISO 11203	EN ISO 11203	<i>Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level</i>
ISO 11204	EN ISO 11204	<i>Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Method requiring environmental corrections</i>
ISO 11205	EN ISO 11205	<i>Acoustics — Noise emitted by machinery and equipment — Engineering method for the determination of emission sound pressure levels in situ at the work station and at other specified positions using sound intensity</i>
ISO/TR 11688-1	EN ISO 11688-1	<i>Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning</i>
ISO 11690-1	EN ISO 11690-1	<i>Acoustics — Recommended practice for the design of low-noise workplaces containing machinery — Part 1: Noise control strategies</i>

Table 2 (continued)

ISO/IEC	CEN/CENELEC	Title
ISO 11690-2	EN ISO 11690-2	<i>Acoustics — Recommended practice for the design of low-noise workplaces containing machinery — Part 2: Noise control measures</i>
ISO 12001	EN ISO 12001	<i>Acoustics — Noise emitted by machinery and equipment — Rules for the drafting and presentation of a noise test code</i>
<i>Ergonomics</i>		
ISO 6385	ENV 26385	<i>Ergonomic principles in the design of work systems</i>
ISO 7243	EN 27243	<i>Hot environments — Estimation of heat stress on working man, based on the WBGT index (wet bulb globe temperature)</i>
ISO 7250	EN ISO 7250	<i>Basic human body measurements for technological design</i>
ISO 7726	EN 27726	<i>Ergonomics of the thermal environment — Instruments for measuring physical quantities</i>
ISO 7730	EN ISO 7730	<i>Moderate thermal environments — Determination of the PMV and the PPD indices and specification of the conditions for thermal comfort</i>
ISO 7933	EN 12515	<i>Ergonomics of the thermal environment — Analytical determination and interpretation of heat stress using calculation of the predicted heat strain</i>
ISO 8996	EN 28996	<i>Ergonomics of the thermal environment — Determination of metabolic rate</i>
ISO 9241-1	EN ISO 9241-1	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 1: General introduction</i>
ISO 9241-2	EN 29241-2	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 2: Guidance on task requirements</i>
ISO 9241-3	EN 29241-3	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 3: Visual display requirements</i>
ISO 9241-4	EN ISO 9241-4	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 4: Keyboard requirements</i>
ISO 9241-5	EN ISO 9241-5	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 5: Workstation layout and postural requirements</i>
ISO 9241-6	EN ISO 9241-6	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 6: Guidance on the work environment</i>
ISO 9241-7	EN ISO 9241-7	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 7: Requirements for display with reflections</i>
ISO 9241-8	EN ISO 9241-8	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 8: Requirements for displayed colours</i>
ISO 9241-9	EN ISO 9241-9	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 9: Requirements for non-keyboard input devices</i>
ISO 9241-10	EN ISO 9241-10	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 10: Dialogue principles</i>
ISO 9241-11	EN ISO 9241-11	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 11: Guidance on usability</i>
ISO 9241-12	EN ISO 9241-12	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 12: Presentation of information</i>
ISO 9241-13	EN ISO 9241-13	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 13: User guidance</i>
ISO 9241-14	EN ISO 9241-14	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 14: Menu dialogues</i>

Table 2 (continued)

ISO/IEC	CEN/CENELEC	Title
ISO 9241-15	EN ISO 9241-15	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 15: Command dialogues</i>
ISO 9241-16	EN ISO 9241-16	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 16: Direct manipulation dialogues</i>
ISO 9241-17	EN ISO 9241-17	<i>Ergonomic requirements for office work with visual display terminals (VDTs) — Part 17: Form filling dialogues</i>
ISO 9355-1	EN 894-1	<i>Ergonomic requirements for the design of displays and control actuators — Part 1: Human interactions with displays and control actuators</i>
ISO 9355-2	EN 894-2	<i>Ergonomic requirements for the design of displays and control actuators — Part 2: Displays</i>
—	EN 894-3	<i>Safety of machinery — Ergonomic requirements for the design of displays and control actuators — Part 3: Control actuators</i>
ISO 9886	EN ISO 9886	<i>Ergonomics — Evaluation of thermal strain by physiological measurements</i>
ISO 9920	EN ISO 9920	<i>Ergonomics of the thermal environment — Estimation of the thermal insulation and evaporative resistance of a clothing ensemble</i>
ISO 9921	EN ISO 9921	<i>Ergonomics — Assessment of speech communication</i>
ISO 10075	EN ISO 10075-1	<i>Ergonomic principles related to mental work-load — General terms and definitions</i>
ISO 10075-2	EN ISO 10075-2	<i>Ergonomic principles related to mental workload — Part 2: Design principles</i>
ISO 10075-3	EN ISO 10075-3	<i>Ergonomic principles related to mental workload — Part 3: Principles and requirements concerning methods for measuring and assessing mental workload</i>
ISO 10551	EN ISO 10551	<i>Ergonomics of the thermal environment — Assessment of the influence of the thermal environment using subjective judgement scales</i>
ISO 11064-1	EN ISO 11064-1	<i>Ergonomic design of control centres — Part 1: Principles for the design of control centres</i>
ISO 11064-2	EN ISO 11064-2	<i>Ergonomic design of control centres — Part 2: Principles for the arrangement of control suites</i>
ISO 11064-3	EN ISO 11064-3	<i>Ergonomic design of control centres — Part 3: Control room layout</i>
ISO/TR 11079	ENV ISO 11079	<i>Evaluation of cold environments — Determination of required clothing insulation (IREQ)</i>
ISO 11226	EN 1005-4	<i>Ergonomics — Evaluation of static working postures (EN title: Safety of machinery — Human physical performance — Part 4: Evaluation of working postures and movements in relation to machinery)</i>
—	EN 1005-3	<i>Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation</i>
ISO 11228-1	EN 1005-2	<i>Ergonomics — Manual handling — Part 1: Lifting and carrying (EN title: Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery)</i>
—	EN 1005-1	<i>Safety of machinery — Human physical performance — Part 1: Terms and definitions</i>
ISO 11399	EN ISO 11399	<i>Ergonomics of the thermal environment — Principles and application of relevant International Standards</i>
ISO 11428	EN 842	<i>Ergonomics — Visual danger signals — General requirements, design and testing (EN title: Safety of machinery — Visual danger signals — General requirements, design and testing)</i>

Table 2 (continued)

ISO/IEC	CEN/CENELEC	Title
ISO 11429	EN 981	<i>Ergonomics — System of auditory and visual danger and information signals (EN title: Safety of machinery — System of auditory and visual danger and information signals)</i>
ISO 12894	EN ISO 12894	<i>Ergonomics of the thermal environment — Medical supervision of individuals exposed to extreme hot or cold environments</i>
ISO 13406-1	EN ISO 13406-1	<i>Ergonomic requirements for work with visual displays based on flat panels — Part 1: Introduction</i>
ISO 13406-2	EN ISO 13406-2	<i>Ergonomic requirements for work with visual displays based on flat panels — Part 2: Ergonomic requirements for flat panel displays</i>
ISO 13407	EN ISO 13407	<i>Human-centred design processes for interactive systems</i>
ISO 13731	EN ISO 13731	<i>Ergonomics of the thermal environment — Vocabulary and symbols</i>
—	EN 563	<i>Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces</i>
ISO 14738	EN ISO 14738	<i>Safety of machinery — Anthropometric requirements for the design of workstations at machinery</i>
ISO 14915-1	EN ISO 14915-1	<i>Software ergonomics for multimedia user interfaces — Part 1: Design principles and framework</i>
ISO 14915-3	EN ISO 14915-3	<i>Software ergonomics for multimedia user interfaces — Part 3: Media selection and combination</i>
ISO 15534-1	EN 547-1	<i>Ergonomic design for the safety of machinery — Part 1: Principles for determining the dimensions required for openings for whole-body access into machinery (EN title: Safety of machinery — Human body measurements — Part 1: Principles for determining the dimensions required for openings for whole body access into machinery)</i>
ISO 15534-2	EN 547-2	<i>Ergonomic design for the safety of machinery — Part 2: Principles for determining the dimensions required for access openings (EN title: Safety of machinery — Human body measurements — Part 2: Principles for determining the dimensions required for access openings)</i>
ISO 15534-3	EN 547-3	<i>Ergonomic design for the safety of machinery — Part 3: Anthropometric data (EN title: Safety of machinery — Human body measurements — Part 3: Anthropometric data)</i>
ISO 15535	EN ISO 15535	<i>General requirements for establishing anthropometric databases</i>
ISO 15536-1	EN ISO 15536-1	<i>Ergonomics — Computer manikins and body templates — Part 1: General requirements</i>
ISO 15537	EN ISO 15537	<i>Principles for selecting and using test persons for testing anthropometric aspects of industrial products and designs</i>

2.3 Type C standards (machine safety standards) dealing with detailed safety requirements for a particular machine or group of machines.

NOTE Type C standards are not covered by this Technical Report.

2.4 Overview — Basic flow diagram and grouping by activities

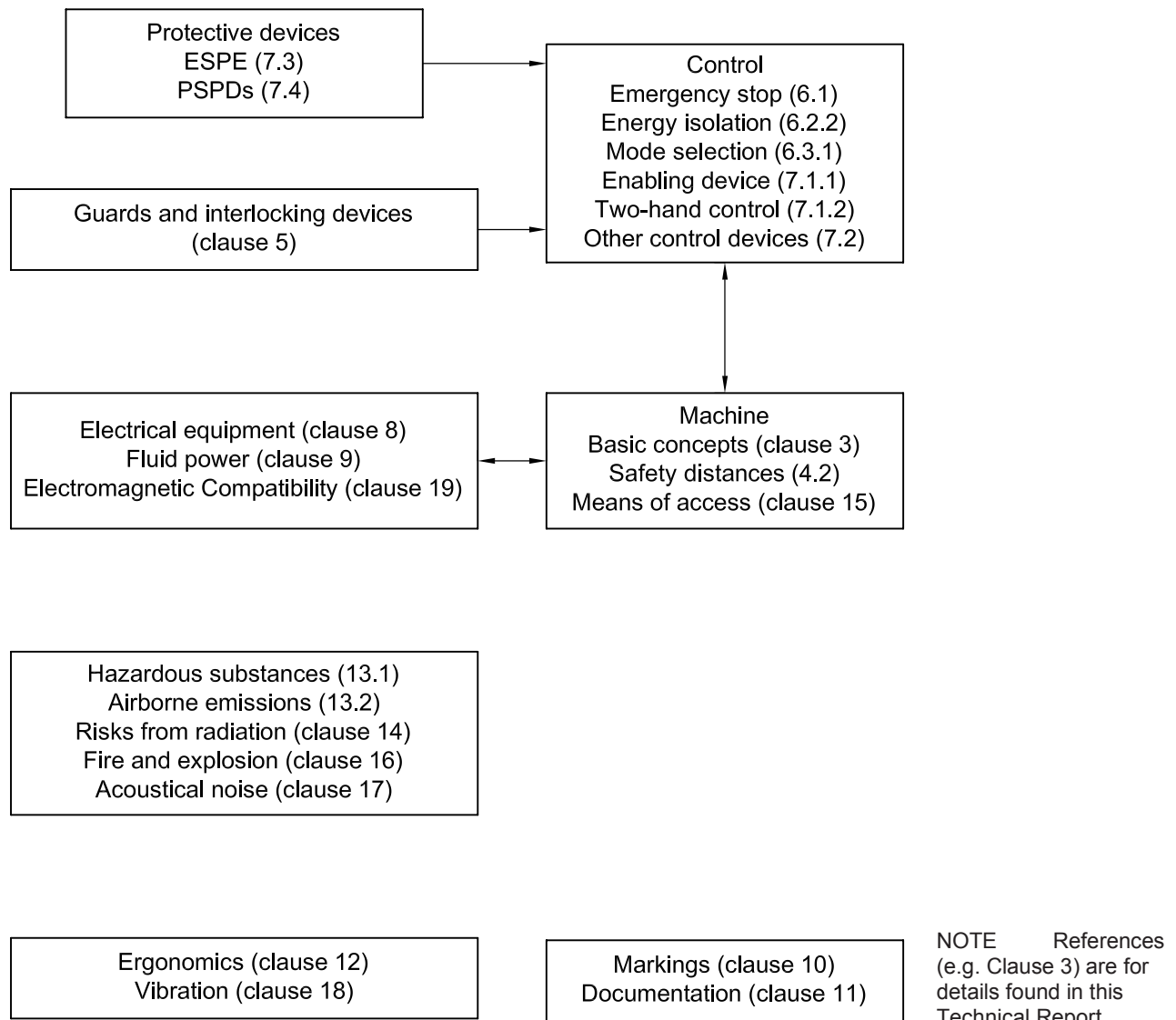


Figure 1 — Overview of the safety of machinery standards

3 Basic concepts, principles and requirements

The basic approach for machinery safety is shown in Figures 2a, 2b, 2c and 2d, which means the concept of risk reduction by using protective measures including safety functions, the iterative method for risk assessment/risk reduction and the selection and validation of safety functions (safety-related parts of control systems). The block in the upper left-hand corner of Figures 2a and 2c portrays the basic steps in the risk assessment procedure as detailed in ISO 14121, *Safety of machinery — Principles of risk assessment*. Figure 2b illustrates the concept of risk reduction using protective measures including safety functions (safety-related parts of control systems). Figure 2c illustrates the basic procedures for risk reduction which is further detailed in ISO 12100-1:2003, Figure 2. Figure 2d illustrates the determination of the protective measure when it has been determined to be a safety-related part of the control system.

The remainder of the document portrays the hierarchical risk reduction procedure undertaken by the supplier:

- 1) intrinsic design measures,
- 2) safeguarding and complementary protective measures and
- 3) information for use.

For further details on information for use, see ISO 12100-1:2003, Clause 5, ISO 12100-2:2003, Clause 6, and Clause 11 of this Technical Report.

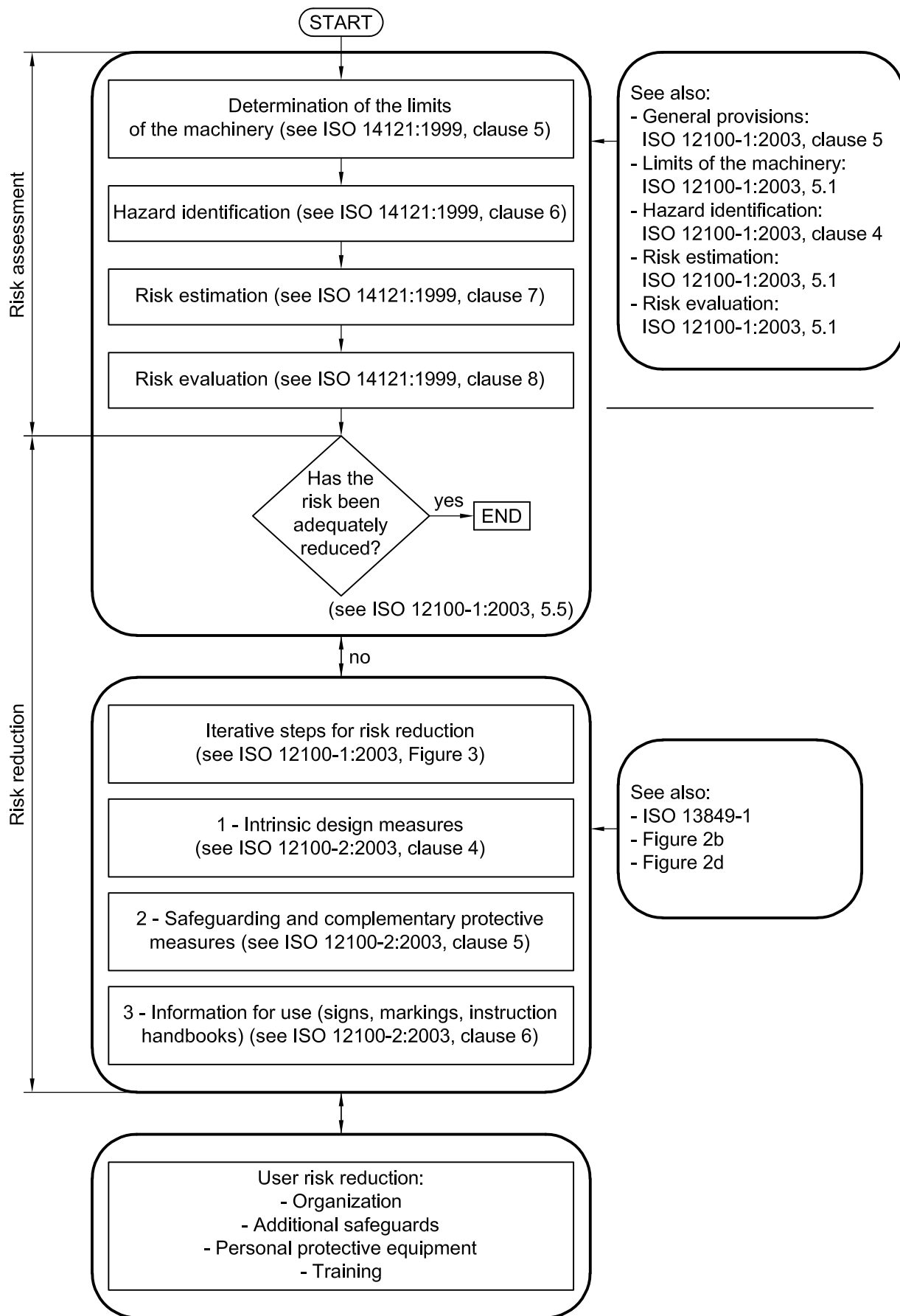
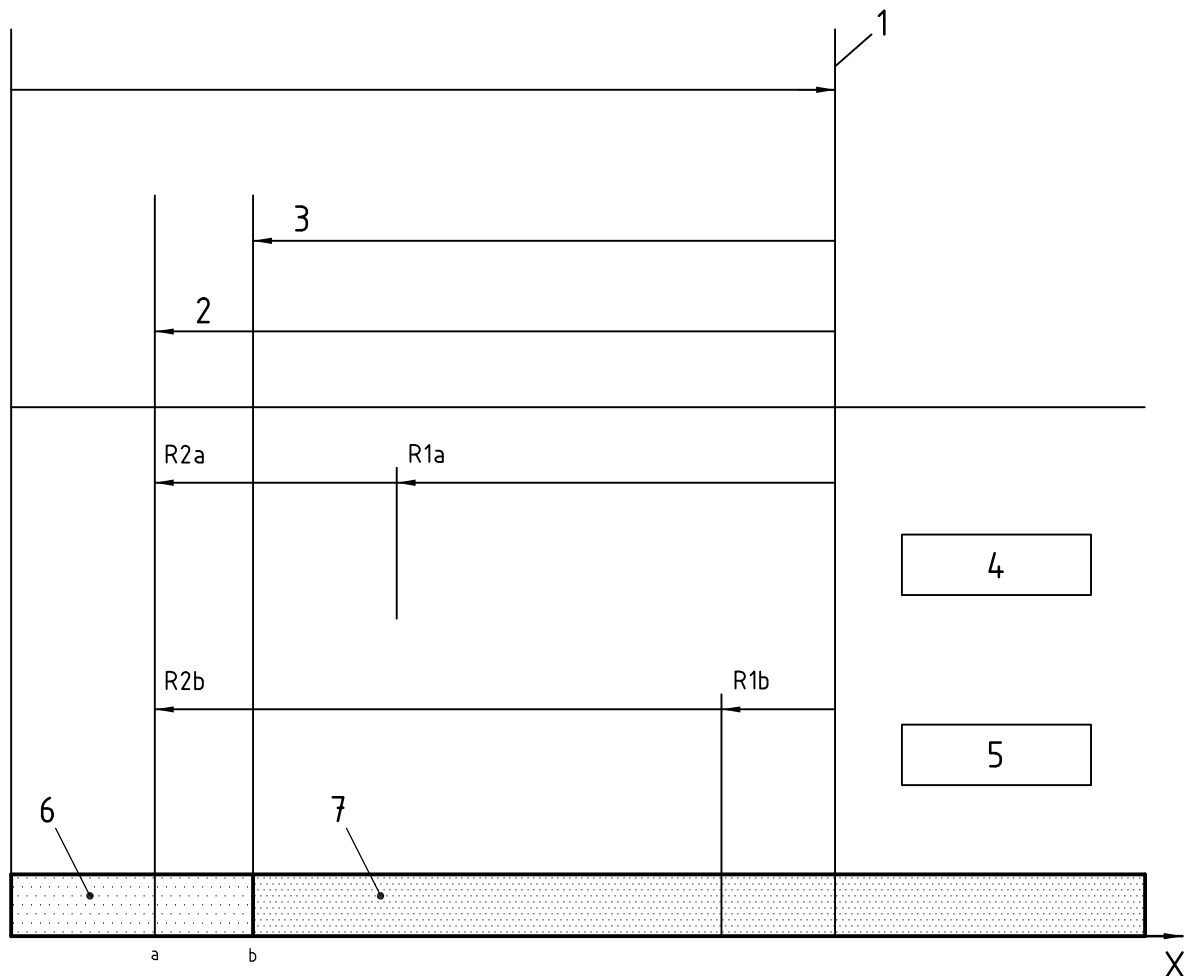


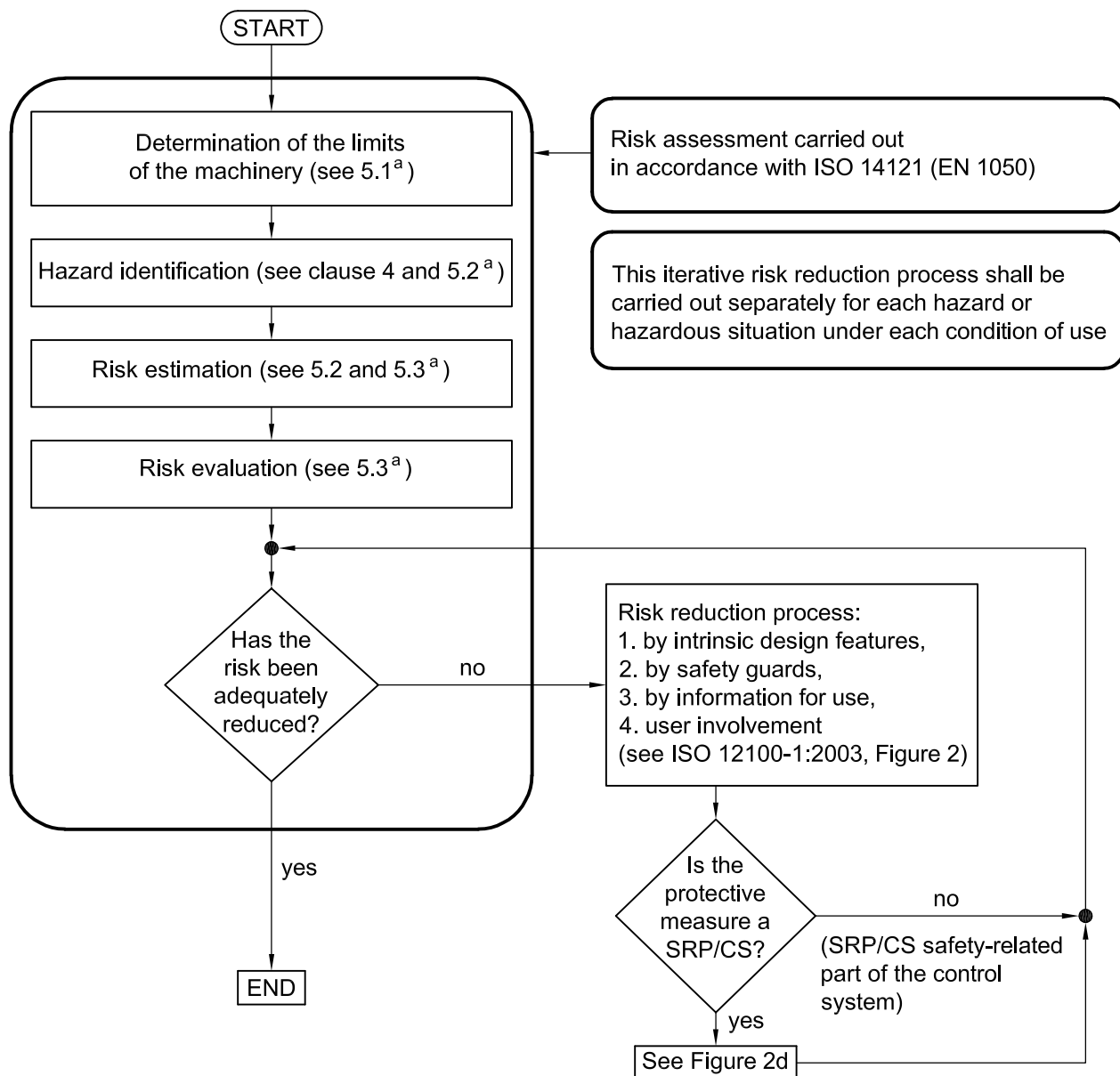
Figure 2a — Basic diagram illustrating risk assessment and risk reduction



- 1 For a given hazardous situation, the risk before protective measures are applied
- 2 Actual risk reduction
- 3 Risk reduction required from protective measures
- 4 Solution "a": Important part of the risk reduction due to mechanical measures (e.g. closed tool), small part of the risk reduction due to SRP/CS
- 5 Solution "b": Important part of the risk reduction due to SRP/CS (e.g. light curtain), small part of the risk reduction due to mechanical measures
- 6 Acceptable
- 7 Unacceptable
- X Risk
- ^a Residual risk
- ^b Acceptable risk achieved
- R1 Risk reduction from protective measures other than SRP/CS
- R2 Risk reduction from the safety function carried out by the SRP/CS (scope of ISO 13849-1)
- SRP/CS Safety-related part of the control system

See ISO 12100 for further information on risk reduction.

Figure 2b — Concept of risk reduction using protective measures including safety functions



^a Subclause references to ISO 12100-1:2003

Figure 2c — Iterative process for the selection of protective measures

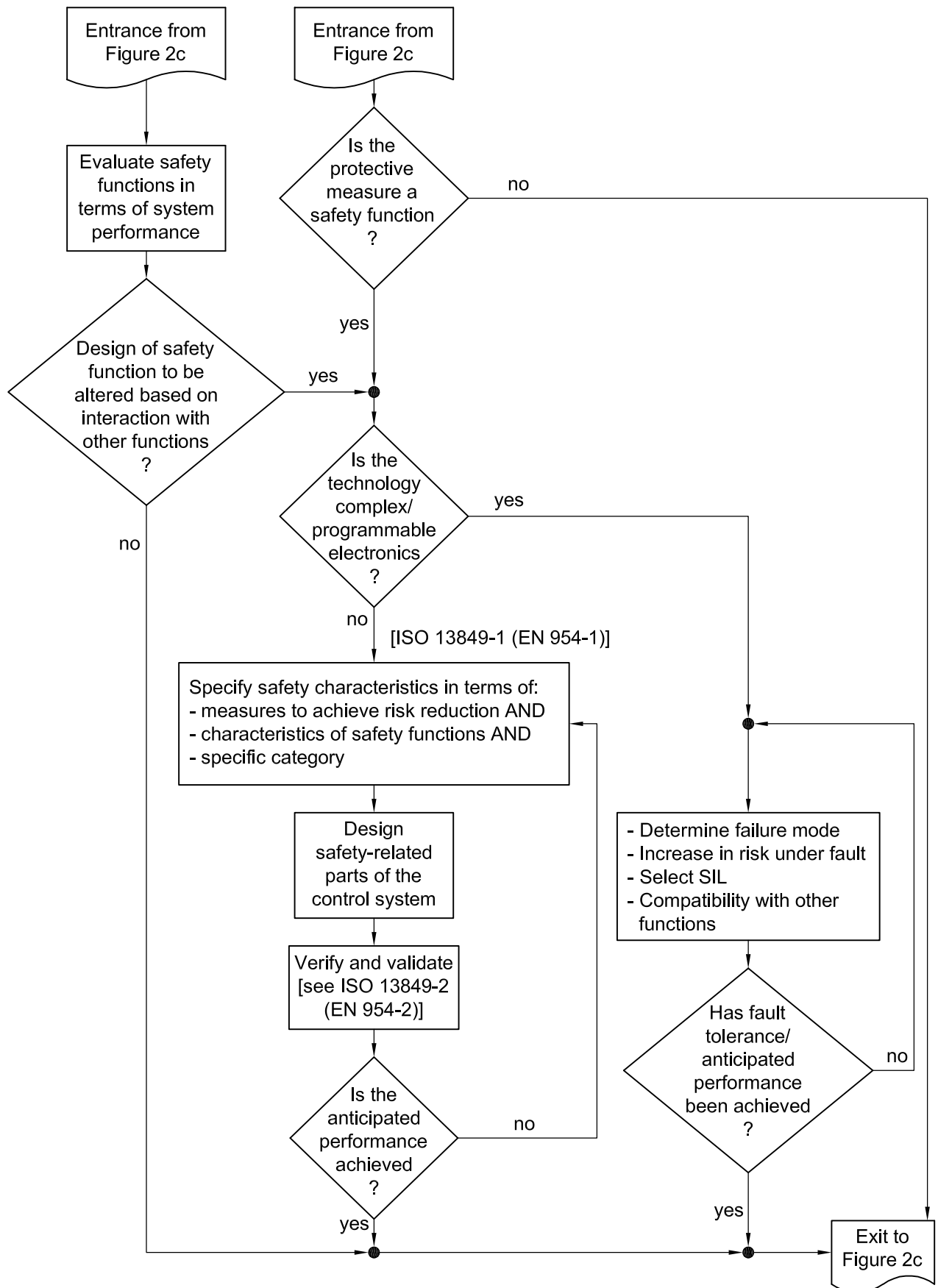


Figure 2d — Overview of the determination and validation of safety functions

4 Safety distances and hand/arm speed

4.1 General

When positioning guards and other safeguarding devices, it may be necessary to determine the distance from the hazard zone to ensure proper effectiveness of the safeguard. This distance is based on approach speed and in general is calculated using the formula given in 4.4.

4.2 Safety distances

a) ISO 13852: Upper limbs (standard to be used in determining reaching values):

1) Reaching values:

- i) upwards;
- ii) around;
- iii) through openings.

2) Effects of additional protective structures.

b) ISO 13854: Minimum gaps to prevent crushing of body parts (standard to be used to determine minimum gaps to avoid crushing of body parts):

Minimum gaps for various parts of the body are given in Table 1 of the standard.

c) ISO 13853: Lower limbs (standard to be used in determining reaching values):

1) Reaching values:

- i) regular openings;
- ii) irregular openings.

4.3 Hand/arm speed

ISO 13855: Approach speed to determine positioning of protective devices:

a) Methodology [see ISO 13855:2002, Figure 2];

b) Method for calculating minimum distances;

c) Methods for calculating minimum distances for:

- 1) electro-sensitive protective systems;
- 2) ground-level trip devices (e.g. PSPDs);
- 3) hold-to-run controls (e.g. single-hand and two-hand control);
- 4) combination of devices.

4.4 Basic formula

The minimum distance from the danger zone is calculated by using the general formula

$$S = (K \times T) + C \quad (1)$$

where

- S* is the minimum distance, in millimetres, from the danger zone to the detection point, line or plane or zone;
- K* is a parameter, in millimetres per second, derived from data on approach speeds of the body or parts of the body;
- T* is the overall system stopping performance [see ISO 13855:2002, 3.2];
- C* is an additional distance, in millimetres, based on intrusion towards the danger zone prior to actuation of the protective equipment.

5 Guards and interlocking devices

5.1 General

Probably the most common safeguard is a guard. Where it is necessary to be able to “open” a guard during operation or maintenance, the guard is normally interlocked so that the hazardous situation covered by the guard is “stopped” or prevented from “starting”. Where additional protection is required due to either stopping time of the hazardous motion or insufficient distance between the guard and the hazard zone, the use of guard locking may be needed.

5.2 Guards

a) Basic definitions – ISO 12100-1:2003:

- 1) guard (3.25);
- 2) fixed (3.25.1);
- 3) movable (3.25.2);
- 4) adjustable (3.25.3);
- 5) interlocking (3.25.4);
- 6) interlocking with guard locking (3.25.5);
- 7) control (3.25.6).

b) Selection – ISO 12100-2:2003, Figure 1.

c) Requirements – ISO 12100-2:2003, 4.2.2.

d) Detailed requirements – ISO 14120:2002:

- 1) definitions (Clause 3);
- 2) requirements for design and construction (Clauses 5 and 7);

- 3) selection of types (Clause 6);
- 4) verification of the safety requirements (Clause 8);
- 5) instructions for use (Clause 9).

5.3 Interlocking devices

- a) Definition – see ISO 12100-1:2003, 3.26.1.
- b) Requirements – see ISO 12100-2:2003, 5.2.2, 5.2.3, 5.3.2.3, 5.3.2.5.
- c) Detailed requirements – ISO 14119:
 - 1) definitions;
 - 2) operating principles;
 - 3) requirements for design;
 - 4) additional requirements for electrical interlocks;
 - 5) selection.
- d) References to interlocking in IEC 60204-1:2000:
 - 1) definition: see 3.29;
 - 2) other references in the text: see 5.3.1, 6.2.2b, 9.2.5.1, 9.2.5.2, 9.3.1, 9.3.3, 9.3.4, 9.4.1, 9.4.2.3.

6 Safety functions

6.1 Emergency stop

There are two standards which deal with the requirements for emergency stop: ISO 13850 and IEC 60204-1. Other requirements are found in ISO 12100-2 and ISO 13849-1.

- a) Basic requirements – see ISO 13850:
 - 1) Category 0;
 - 2) Category 1.
- b) Emergency stop device:
 - 1) General:
 - i) ISO 12100-2:2003, 6.1.1;
 - ii) IEC 60204-1:2000, 10.7;
 - iii) ISO 13850:1996, 4.3 to 4.5;
 - iv) IEC 60947-5-5.

2) Control medium “Mechanical”:

ISO 13850.

3) Control medium “Electrical” (IEC 60204-1:2000):

- i) 5.3.3: Supply disconnecting (isolating) device;
- ii) 9.2.2: Stop functions;
- iii) 9.2.4: Suspension of safeguarding;
- iv) 9.2.5.4: Emergency operations;
- v) 10.2.1: Colours;
- vi) Table 2: Colours for push-button actuators and their meanings;
- vii) Table 3: Colours for indicator lights and their meanings with respect to the condition of the machine;
- viii) 10.4: Illuminated push-buttons;
- ix) 10.7: Devices for emergency stop;
- x) Table F.1: Application options.

4) Control medium “Fluid” (ISO 4413 – Hydraulic; ISO 4414 – Pneumatic):

Only a reference to ISO 13850.

6.2 Energy isolation and prevention of unexpected start-up

6.2.1 General

Means of reducing the risks from energy sources and unintended or unexpected initiation of hazardous situations.

6.2.2 Energy isolation

a) ISO 14118:2000:

- Definition: see 3.3;
- Means for isolation and energy dissipation.

b) IEC 60204-1:2000:

- References: see 5.3.2.

6.2.3 Prevention of unexpected start-up

a) ISO 14118:2000:

- Definition: see 3.2;
- Other means for preventing unexpected start-up: monitoring, 6.4.

- b) IEC 60204-1:2000:

— References: see 5.4, 9.4.3.1.

6.3 Mode selection, reduced speed and monitoring

6.3.1 Mode selection

References – see:

— ISO 12100-2:2003, 3.7.9, 3.7.10;

— IEC 60204-1:2000, 9.2.3, 9.2.4.

6.3.2 Reduced speed

Reference – see ISO 12100-2:2003, 4.11.10.

6.3.3 Monitoring

References – see:

— ISO 12100-2:2003, 4.12.1, 4.12.2, 5.3.2.3;

— IEC 60204-1:2000, 7.5 to 7.9, 9.2.5.5, 9.4.3.1.

7 Protective devices

7.1 Enabling and two-hand control devices

7.1.1 Enabling device

- a) Definition – see ISO 12100-1:2003, 3.26.2.

- b) Requirements – see IEC 60204-1:2000, 9.2.5.8.

Where an enabling device is provided as part of the system, it is designed to allow motion or another hazardous situation when actuated in one position only. In any other position, hazardous situations are stopped safely. Operation of the device by itself does not initiate hazardous situations. When an enabling device is required, it is connected to a category 0 or a category 1 stop (see IEC 60204-1:2000, 9.2.2). Enabling devices are designed in compliance with ergonomic principles. A simple defeat is prevented.

- c) Types of enabling device:

- 1) two-position:

- i) position 1: off-function of the switch (actuator is not pushed);
- ii) position 2: enabling function (actuator is pushed).

- 2) three-position:

- i) position 1: off-function (actuator is not pushed);
- ii) position 2: enabling function (actuator is pushed to its mid position);

- iii) position 3: off-function (actuator is pushed past its mid position).

When returning from position 3 to position 2, the enabling function should not become active.

7.1.2 Two-hand control device

- a) Definition – see:

- ISO 12100-1:2003, 3.26.4;
- ISO 13851:2001, 3.1.

- b) Requirements: Three types of two-hand control device are available, the selection of which is determined by the risk assessment. These should have the following features:

- 1) Type I – This type requires:
 - i) the provision of two control devices requiring concurrent actuation by both hands;
 - ii) continuous actuation during the hazardous condition; and
 - iii) machine operation to cease on release of either control device when hazardous conditions are still present.
- 2) Type II – A type I control requiring the release of both control devices before machine operation may be reinitiated.
- 3) Type III – A type II control requiring concurrent actuation of the control devices as follows:
 - i) it should be necessary to actuate the control devices within a certain time limit of each other (see ISO 13851:2002, Annex B);
 - ii) where the time limit is exceeded, both control devices should be released before operation may be initiated.

Type III is further classified as IIIA, IIIB, IIIC (see ISO 13851:2002, Table 1 – see also IEC 60204-1:2000, 9.2.5.7).

- c) ISO 13851 describes:

- 1) types of two-hand control device and their selection;
- 2) characteristics of safety functions;
- 3) requirements related to categories of control;
- 4) use of programmable electronic systems;
- 5) prevention of accidental actuation and of defeat;
- 6) general requirements;
- 7) test procedures;
- 8) information for use;
- 9) marking.