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Robotics — Safety requirements for service robots

Robotique — Exigences de sécurité pour les robots de service

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This standard was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the standard will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 299.

This second edition cancels and replaces the first edition (ISO 13482:2014), which has been technically revised.

The main changes compared to the previous edition are as follows:

- The document has been re-structured from safety requirements to specific robot types
- The clauses on personal carrier robots have been removed.
- New clauses on cyber-security and data protection, and robots inter-working with lifts (elevators), with associated informative [annex H](#), are included in the document.
- Detailed coverage of wearable robots, previously referred to as personal assistant robots, is provided in [clause 5](#) with an informative [Annex G](#).

This document has been prepared under a standardisation request addressed to [the relevant ESO] by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For the relationship with EU Legislation, see informative Annex Z, which is an integral part of this document.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document has been developed in recognition of the particular hazards presented by robots and robotic devices for applications in non-industrial environments for providing services rather than manufacturing applications in industrial applications. This document focuses on the safety requirements for service robots in non-medical applications.

This document includes information in line with ISO 12100:2010 and adopts the functional safety approach proposed in ISO 13849 and IEC 62061:2024. This safety document considers the conditions for physical human-robot contact to formulate a safety standard for service robots.

This document is a type-C standard, as stated in ISO 12100:2010.

When a type-C standard deviates from one or more technical provisions dealt with by type-A or by type-B standards, the type-C standard takes precedence.

It is recognized that robots and robotic devices in service applications require close human-robot interaction and collaborations, as well as physical human-robot contact.

The service robots concerned, and the extent to which hazards, hazardous situations or hazardous events are covered, are indicated in the scope of this document.

Hazards are well recognized, and the sources of the hazards are frequently unique to particular robot systems. The number and types of hazards are directly related to the nature of the robot application, the complexity of the installation, and the level of human-robot interaction incorporated.

The risks associated with these hazards vary with the type of robot used and its purpose, and the way in which it is installed, programmed, operated, and maintained.

Not all of the hazards identified by this document apply to every service robot, nor will the level of risk associated with a given hazardous situation be the same from robot to robot. Consequently, the safety requirements, and/or protective measures can vary from what is specified in this document. A risk assessment is conducted to determine the protective measures needed when they do not meet safety requirements and/or protective measures specified in this document, and for the particular application being considered.

In this document, the following verbal forms are used:

- “shall” indicates a requirement;
- “should” indicates a recommendation;
- “may” indicates a permission;
- “can” indicates a possibility or a capability.

In recognition of the variable nature of hazards with service robot applications, this document provides guidance for the assurance of safety in the design and construction of the non-medical service robot, as well as the integration, installation, and use of the robots during their full life cycle. Since safety in the use of service robots is influenced by the design of the particular robot system, a supplementary, though equally important, purpose is to provide guidelines for the information for use of service robots and robotic devices.

The safety requirements of this document have to be met by the manufacturer and the supplier of the service robot.

ISO/TR 23482-2 provides guidance on robot applications covered by this document and gaps and overlaps with standards of similar products.

Robotics — Safety requirements for service robots

1 Scope

This document specifies safety requirements for service robots in *personal service* (3.22) and *professional service* (3.24) applications.

This document provides safety requirements for stationary, mobile, and wearable service robots.

This document describes significant hazards associated with the use of these robots, and provides requirements to eliminate, or reduce, the risks associated with these hazards to an acceptable level.

This document does not apply to:

- robots travelling faster than 20 km/h;
- robot toys;
- water-borne robots and flying robots;
- industrial robots and industrial robot applications covered in ISO 10218-1 and ISO 10218-2;
- cleaning robots and lawn mowers covered in IEC 63327, IEC 60335-2-2 or IEC 60335-2-107;
- robots as medical devices;
- military or public force application robots;
- driverless industrial trucks (AGVs) covered by ISO 3691-4:2023;
- autonomous driving Cargo e-Transporters (ACeTs) covered by IEC 63281-2-2. This document is applicable to robots with multiple intended uses where one of the intended uses falls within the scope of this document.

The scope of this document is limited primarily to human safety.

This document is not applicable to robots manufactured prior to its publication date.

This document deals with all significant hazards, hazardous situations or hazardous events as described in [Annex A](#).

This document does not provide any requirements for participation of service robots in road traffic environments.

This document does not provide any requirements for transportation of persons with service robots.

2 Normative references

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 2631-1:1997, *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 1: General requirements*

ISO 3746:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*

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ISO 3864-1:2011, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 3864-2:2016, *Graphical symbols — Safety colours and safety signs — Part 2: Design principles for product safety labels*

ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

ISO 4871:1996, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 7000:2019, *Graphical symbols for use on equipment — Registered symbols*

ISO 7010:2019, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ISO 8373:2021, *Robotics — Vocabulary*

ISO 9227:2022, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 11202:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13732-1:2006, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 13732-3:2005, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 3: Cold surfaces*

ISO 13849-1:2023, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*

ISO 13854:2017, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

ISO 13855:2010¹⁾, *Safety of machinery — Positioning of safeguards with respect to the approach speeds of parts of the human body*

ISO 13856:2013, *(all parts), Safety of machinery — Pressure-sensitive protective devices*

ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14118:2017, *Safety of machinery — Prevention of unexpected start-up*

ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

ISO 15534:2000, *(all parts), Ergonomic design for the safety of machinery*¹

ISO 21227-3:2007, *Paints and varnishes — Evaluation of defects on coated surfaces using optical imaging — Part 3: Evaluation of delamination and corrosion around a scribe*

ISO/TS 8100-21:2018, *Lifts for the transport of persons and goods — Part 21: Global safety parameters (GSPs) meeting the global essential safety requirements (GESRs)*

IEC 60204-1:2021, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

1) If used, consideration shall be given as to the relevance and applicability of the quantitative data to the intended users of the robot, especially for elderly people and children.

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IEC 60335-1:2020, *Household and similar electrical appliances — Safety — Part 1: General requirements*

IEC 60335-2-29:2019, *Household and similar electrical appliances — Safety — Part 2-29: Particular requirements for battery chargers*

IEC 60417:2024, *Graphical symbols for use on equipment*

IEC 60529:2019, *Degrees of protection provided by enclosures (IP Code)*

IEC 60825-1:2014, *Safety of laser products — Part 1: Equipment classification and requirements*

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use — Part 1: General requirements*

IEC 61140:2016, *Protection against electric shock — Common aspects for installation and equipment*

IEC 61326-3-1:2017, *Electrical equipment for measurement, control and laboratory use — EMC requirements — Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) — General industrial applications*

IEC 61496 (all parts), *Safety of machinery — Electro-sensitive protective equipment*

IEC 61508-1, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 1: General requirements*

IEC 62061:2024, *Safety of machinery — Functional safety of safety-related control systems*

IEC 62133-2:2017, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications — Part 2: Lithium systems*

IEC 62368-1:2023, *Audio/video, information and communication technology equipment — Part 1: Safety requirements*

IEC 62471:2006, *Photobiological safety of lamps and lamp systems*

IEC 62619:2022, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

IEC/TS 62998-1:2019, *Safety of machinery — Safety-related sensors used for the protection of persons*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010, ISO 8373:2021 and the following apply.

3.1 allowed contact

any *contact* (3.4) with the *service robot* (3.36) that is permitted by the manufacturer

3.2 autonomous mode

operational mode in which the robot function accomplishes its assigned mission without direct human intervention

EXAMPLE A *service robot* (3.36) waiting for an interaction (a command).

[SOURCE: ISO 8373:2021, 6.13.4]

3.3 command device

device that enables the *operator* (3.21) or a *user* (3.43) to control the robot

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3.4

contact

zero distance between robot and an object (including human) in its external environment

3.5

contact sensing

detection or measurement capability that requires *contact* (3.4) with objects (including humans) in the environment

3.6

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 and/or a safety-related data interface

Note 1 to entry: The safety-related control system associated with the ESPE, or the ESPE itself, can further include a secondary switching device, muting functions, stopping performance monitor, etc.

Note 2 to entry: A safety-related communication interface can be integrated in the same enclosure as the ESPE.

[SOURCE: IEC 61496-1:2020, 3.5, modified: ..., or the ESPE itself, can further include ...]

3.7

hazard

potential source of harm

[SOURCE: ISO 12100:2010, 3.6, modified, notes 1, 2 and 3 to entry removed]

3.8

hazardous force

force of a point of a *service robot* (3.36) that creates an unacceptable *risk* (3.28)

3.9

hazardous obstacle

object, obstruction which can cause harm if it comes into contact or collision with the robot

3.10

hazardous speed

speed of a point (body location) of a *service robot* (3.36) that creates an unacceptable *risk* (3.28)

Note 1 to entry: In the definition, speed can be absolute or relative to the point of interest.

3.11

hazardous surface condition

adverse conditions of travel surface for a *mobile service robot* (3.17) that create an unacceptable *risk* (3.28)

EXAMPLE Surface conditions by which a *mobile service robot* (3.17) can roll over or slip causing injury or damage.

3.12

Low-power wearable robot

wearable robot (3.46) that a *user* (3.43) can overpower

3.13

manual control device

human operated device connected into the control circuit used for controlling the *service robot* (3.36)

Note 1 to entry: One or more manual control devices attached to a panel or housing form a *command device* (3.3).