american national standard

# *Robots for Industrial Environment — Safety Requirements Part 1 – Robot*

ANSI/RIA/ISO 10218-1-2007



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**ANSI/RIA/ISO 10218-1-2007**
National Adoption of
ISO 10218-1:2006

# Robots for Industrial Environment – Safety requirements Part 1 – Robot

Secretariat
**Robotic Industries Association**

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# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The American National Standards Institute (ANSI) is the ISO member body representing the United States of America. 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. The USA was represented on the technical committee. The Robotic Industries Association is the secretariat for the US TAG to the 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.

This Nationally Adopted International Standard is considered an identical standard as defined in ISO/IEC Guide 21. Changes have been made in page size and spelling to be consistent with American style. References have been changed or included for significant American National Standards that are equivalent to the ISO or IEC reference. All corrigenda were included as of the date of publication.

ISO 10218-1 was adopted and published by the ISO in June, 2006 following established ISO procedures.

Attention is drawn to the possibility that some of the elements of this part of ISO 10218 may be the subject of patent rights. ISO, ANSI and the RIA shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10218-1 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 2, *Robots for industrial environment*.

This Nationally Adopted International Standard provides information consistent with, but different than clause 4 of ANSI/RIA R15.06-1999. It may be used in lieu of clause 4 and in conjunction with all clauses of ANSI/RIA R15.06-1999.

This standard, as well as the original International Standard is part of a series of standards dealing with industrial robots and robot systems. Other standards cover such topics as integrated robotic systems, coordinate systems and axis motions, general characteristics, performance criteria and related testing methods, terminology, and mechanical interfaces. It is noted that these standards are interrelated and also related to other National and International Standards. Generally other technical solutions are possible, which ensure the same level of safety.

This American National Standard includes five annexes: Annexes A and B are normative, and Annexes C, D, and E are informative.

This new American National Standard is consistent with ANSI/ISO 12100 and its requirements to identify and address in a type C standard the unique hazards associated with industrial robots. New technical requirements include but are not limited to safety-related control system performance, robot stopping function, enabling device, program mode description, axis limiting functionality, wireless pendant criteria, collaborating robot criteria, and safety requirements for synchronous motion.

# Introduction

This American National Standard has been created in recognition of the particular hazards that are presented by industrial robots and industrial robot systems.

This document is a type C standard as stated in ANSI/ISO 12100-1.

The machinery and the hazards, hazardous situations and events that are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards for machines that have been designed and built according to the provisions of this type C standard.

Hazards associated with robots are well recognized but the sources of the hazards are frequently unique to a particular robot system. The number and types of hazards are directly related to the nature of the automation process and the complexity of the installation. 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.

NOTE Not all of the hazards identified by this standard apply to every robot and 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 may vary from what is specified in the standard. A risk assessment/risk reduction may be conducted to determine what the protective measures should be.

In recognition of the variable nature of hazards with different uses of industrial robots, the committee working on development of the International Standard divided the requirements into two parts; Part 1 provides guidance for the assurance of safety in design and construction of the robot. Since safety in the application of industrial robots is influenced by the design and integration of the particular robot system, Part 2 provides guidelines for the safeguarding of personnel during robot integration, installation, functional testing, programming, operation, maintenance, and repair. Part 2 of the International Standard has not yet been published and until it is published, the necessary information can be found in the American National Standard ANSI/RIA R15.06-1999.

NOTE Noise as a potential hazard is not dealt with in Part 1. While noise is generally considered a hazard associated with the industrial environment, the robot as defined in 3.18 cannot be considered the final machine, rather the robot system as defined in 3.20 is the machine for noise consideration. This will be fully covered in Part 2.

This National Adoption of an International Standard is not applicable to robots which were manufactured prior to its publication date.

# Robots for industrial environments — Safety requirements —

# Part 1:
# Robot

## 1 Scope

This part of ANSI/RIA/ISO 10218 specifies requirements and guidelines for the inherent safe design, protective measures and information for use of industrial robots, as defined in clause 3. It describes basic hazards associated with robots, and provides requirements to eliminate, or adequately reduce, the risks associated with these hazards.

Noise as a potential hazard is not dealt with in this part of ANSI/RIA/ISO 10218, but will be fully covered in Part 2. See ANSI/RIA R15.06-1999 for further information.

This part of ANSI/RIA/ISO 10218 does not apply to non-industrial robots although the safety principles established in ANSI/RIA/ISO 10218 may be utilized for these other robots. Examples of non-industrial robot applications include, but are not limited to: undersea, military and space robots; tele-operated manipulators; prosthetics and other aids for the physically impaired; micro-robots (displacement <1 mm); surgery or healthcare; and service or consumer products.

NOTE 1 Requirements for robot systems, integration, and installation are covered in ANSI/RIA R15.06-1999.

NOTE 2 Additional hazards may be created by specific applications (e.g. welding, laser cutting, machining). These hazards may need to be considered during robot design.

## 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.

ANSI/RIA R15.06-1999, *Industrial Robots and Robot Systems – Safety Requirements*

ANSI/ASSE Z244.1, *Control of Hazardous Energy – Lockout/Tagout and Alternative Methods*

NFPA 79, *Electrical Standard for Industrial Machinery* which replaces references to IEC 60204-1:2005, *Safety of machinery — Electrical equipment of machines – Part: 1 General requirements*

ANSI/ISO 12100-1:2007, *Safety of machinery — Basic concepts, general principles for design – Part 1: Basic terminology, methodology*

ANSI/ISO 12100-2:2007, *Safety of machinery — Basic concepts, general principles for design – Part 2: Technical principles*

The following referenced international documents are important in understanding the original material from the ISO 10218-1.

ISO 9283:1998, *Manipulating industrial robots – Performance criteria and related test methods*

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

ISO 13850, *Safety of machinery – Emergency stop – Principles for design*

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

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

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards –Immunity for industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6: Generic standards – Section 4: Emission standard for industrial environments*

## 3 Terms and definitions

For the purposes of this document, the definitions given in ANSI/ISO 12100-1 and the following terms and definitions apply.

**3.1**
**actuating control**
a) mechanical mechanism within a control device
EXAMPLE A rod which opens contacts.

b) device which initiates a (un)locking sequence
EXAMPLE Specialized key.

**3.2**
**automatic mode**
operating mode in which the robot control system operates in accordance with the task program

[ISO 8373:1994, definition 5.3.8.1]

**3.3**
**automatic operation**
state in which the robot is executing its programmed task as intended

[ISO 8373:1994, definition 5.5]

**3.4**
**collaborative operation**
state in which purposely designed robots work in direct cooperation with a human within a defined workspace

**3.5**
**collaborative workspace**
workspace within the safeguarded space of the robot work cell, where the robot and a human can perform tasks simultaneously during production operation

**3.6**
**coordinated motion**
control wherein the axes of the robot arrive at their respective end points simultaneously, giving a smooth appearance to the motion and control wherein the motions of the axes are such that the tool center point (TCP) moves along a prescribed path (line, circle, or other)