

---

---

**Robotics — Safety design for  
industrial robot systems —**

**Part 1:  
End-effectors**

*Robotique — Conception de sécurité pour les systèmes de robots  
industriels —*

*Partie 1: Organe terminal effecteur*



This document is a preview generated by ERS



# **COPYRIGHT PROTECTED DOCUMENT**

© ISO 2018

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Fax: +41 22 749 09 47  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

<b>Foreword</b>	<b>iv</b>
<b>Introduction</b>	<b>v</b>
<b>1 Scope</b>	<b>1</b>
<b>2 Normative references</b>	<b>1</b>
<b>3 Terms and definitions</b>	<b>1</b>
<b>4 Risk assessment</b>	<b>2</b>
4.1 General	2
4.2 Limits of the end-effector(s)	3
4.3 Hazard identification	4
4.3.1 General	4
4.3.2 Examples of hazards from end-effectors and workpieces	4
4.4 Risk estimation	4
4.5 Risk evaluation	5
4.6 Residual risks	5
<b>5 Safety requirements and risk reduction</b>	<b>5</b>
5.1 General	5
5.2 Risk reduction measures	5
5.2.1 Shape and surfaces	5
5.2.2 Protective devices and safety-related functions	5
5.2.3 Robot application design	7
5.2.4 Risk reduction measures implemented by the user	7
5.3 Safety-related control system performance	7
5.4 Gripper end-effectors	7
5.4.1 General	7
5.4.2 Grasp-type grippers	8
5.4.3 Vacuum grippers	8
5.4.4 Magnet grippers	8
5.5 Application-specific end-effectors	9
5.5.1 General	9
5.5.2 Examples of applications	9
5.5.3 Risk reduction	9
5.6 End-effectors for hand-guiding robots	10
5.6.1 General	10
5.6.2 Risk reduction	10
5.7 End-effector exchange systems (tool changers)	11
<b>6 Verification and validation</b>	<b>11</b>
<b>7 Information for use</b>	<b>11</b>
7.1 General	11
7.2 Instructions	11
<b>Annex A (informative) Practical examples for end-effector risk assessment</b>	<b>13</b>
<b>Annex B (informative) Examples of gripper designs and their safety performance</b>	<b>18</b>
<b>Annex C (informative) Examples of hazards, their potential origins and consequences</b>	<b>19</b>
<b>Annex D (informative) Examples of hazards by function of the end-effector</b>	<b>22</b>
<b>Bibliography</b>	<b>24</b>

## 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 document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://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 document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://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](http://www.iso.org/iso/foreword.html).

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

A list of all parts in the ISO 20218 series can be found on the ISO website.

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](http://www.iso.org/members.html).

## Introduction

This document applies to industrial robot systems as described in ISO 10218-2:2011 and ISO/TS 15066:2016.

This document provides guidance for end-effectors in robot systems, including collaborative applications where a robot system and operators share the same workspace. In such collaborative applications, the end-effector design is of major importance, particularly characteristics such as shapes, surfaces and application function (e.g. clamping forces, residual material generation, temperature).

A comprehensive risk assessment is required by ISO 10218-2:2011. This document provides additional guidance specific to end-effectors that can be helpful when performing the risk assessment in accordance with ISO 10218-2:2011.



# Robotics — Safety design for industrial robot systems —

## Part 1: End-effectors

### 1 Scope

This document provides guidance on safety measures for the design and integration of end-effectors used for robot systems. The integration includes the following:

- the manufacturing, design and integration of end-effectors;
- the necessary information for use.

This document provides additional safety guidance on the integration of robot systems, as described in ISO 10218-2:2011.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 10218-1:2011, *Robots and robotic devices — Safety requirements for industrial robots — Part 1: Robots*

ISO 10218-2:2011, *Robots and robotic devices — Safety requirements for industrial robots — Part 2: Robot systems and integration*

ISO 11593, *Manipulating industrial robots — Automatic end effector exchange systems — Vocabulary and presentation of characteristics*

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

ISO 14539:2000, *Manipulating industrial robots — Object handling with grasp-type grippers — Vocabulary and presentation of characteristics*

ISO/TS 15066:2016, *Robots and robotic devices — Collaborative robots*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100, ISO/TS 15066:2016, ISO 10218-1:2011, ISO 10218-2:2011, ISO 14539:2000, ISO 11593 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

#### 3.1

##### **compliant**

exhibiting deformation of material or mechanism when subjected to a force

EXAMPLE Compliant linkage, compliant surface.