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Robots for industrial environments — Automatic end effector exchange systems — Vocabulary

Robots manipulateurs industriels — Systèmes de changement automatique de terminal — Vocabulaire

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Foreword

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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, *Robotics*.

This second edition cancels and replaces the first edition (ISO 11593:1996), which has been technically revised.

The main changes are as follows:

— references, terminology and drawings have been updated;

— the Scope and the Introduction have been updated;

— reference documents have been moved from the Normative references clause to the Bibliography;

— the document has been restructured and Annex A has been removed.

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.

Introduction

This document is one of a family of standards dealing with the requirements of components of robot systems for industrial environments.

This document contains the vocabulary for end-effector exchange systems. This document does not contain any details for the development and design of these systems.

For the terms related to coupling and releasing forces (see 3.4), all permissible maximum values for the load characteristics are valid for the sum of both static and dynamic loads and all load characteristics are stated for the reference plane.

For the terms related to magazine interfaces of the tool-mounted part (see 3.7), the performance criteria should be used in the same sense as those used in the terms related to the external shape and main dimensions of the exchange system (see 3.2). The defined coordinate system is still valid even if the direction of insert movement into the magazine is different from the coupling direction at the exchange of the tool. They differ in their value and their direction as well as in the force of coupling work which is required to assemble or release the tool part from the robot part of the interface.

Robots for industrial environments — Automatic end effector exchange systems — Vocabulary

1 Scope

This document defines terms relevant to automatic end-effector exchange systems used as a part of robot systems in accordance with ISO 10218-2.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 General terms and definitions

3.1.1
automatic end-effector exchange system
coupling device between the mechanical interface and the end-effector enabling automatic exchange of end-effectors, made up of a *robot-mounted part* (3.1.2) and one or more *tool-mounted parts* (3.1.3)

Note 1 to entry: Also referred to as tool changer, quick-change device, automatic tool changer, robotic tool changer or robot coupler.

3.1.2
robot-mounted part
part of an *automatic end-effector exchange system* (3.1.1) that is attached to the mechanical interface of a manipulator

Note 1 to entry: Also referred to as master or robot side.

3.1.3
tool-mounted part
part of an *automatic end-effector exchange system* (3.1.1) that is attached to the end-effector

Note 1 to entry: Also referred to as slave or tool side.

3.1.4
couple, verb
join the *robot-mounted part* (3.1.2) to the *tool-mounted part* (3.1.3)

3.1.5
uncouple, verb
release the *tool-mounted part* (3.1.3) from the *robot-mounted part* (3.1.2)

3.1.6
lock, verb
actuate the locking elements to secure the *tool-mounted part* (3.1.3) to the *robot-mounted part* (3.1.2)

3.1.7
unlock, verb
actuate the locking elements to allow the uncoupling of the *robot-mounted part* (3.1.2) from the *tool-mounted part* (3.1.3)

3.1.8
dock, verb
couple (3.1.4) and *lock* (3.1.6) the *robot-mounted part* (3.1.2) to the *tool-mounted part* (3.1.3) when the tool-mounted part is held in the *magazine* (3.1.10)

3.1.9
undock, verb
unlock (3.1.7) and *uncouple* (3.1.5) the *tool-mounted part* (3.1.3) from the *robot-mounted part* (3.1.2) when the tool-mounted part is held in the *magazine* (3.1.10)

3.1.10
magazine
storage means of end-effectors that are *docked* (3.1.8) and *undocked* (3.1.9) from the associated *robot-mounted parts* (3.1.2)

Note 1 to entry: Also referred to as tool stand, tool storage rack or nest.

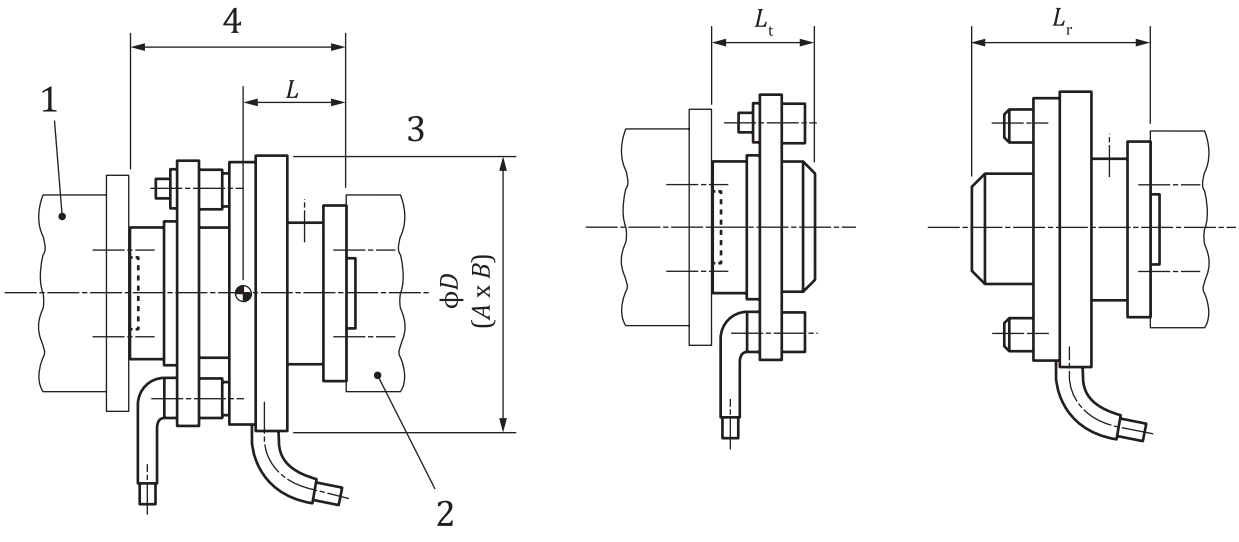
3.1.11
interface for robot side and tool side
description and marking for robot part and tool part in accordance with ISO 9409-1:2004, Clause 6, and ISO 9409-2:2002, Clause 8

3.1.12
cable routing
position and dimension of routing and tracking of cable for robot part and tool part in one drawing

3.2 Terms related to the external shape and main dimensions of the exchange system

3.2.1
structural shape
overall dimensions of device comprising external diameter (or width), depth, length of the individual *robot-mounted part* (3.1.2), and length of the individual *tool-mounted part* (3.1.3)

Note 1 to entry: See Figure 1.



a) exchange systems coupled **b) exchange systems uncoupled**

Key

1	tool-mounted part	D	external diameter (circular shape) (mm)
2	robot-mounted part	A	width (for other) (mm)
3	surface	B	depth (for other) (mm)
4	total length of the coupling (when coupled)	L	length from the robot mounting flange to the coupling flange (mm)
		L_r	length of the robot-mounted part (mm)
		L_t	length of the tool-mounted part (mm)

Figure 1 — External shape and main dimensions of the exchange system when coupled and uncoupled

3.2.2
face-to-face dimension
distance measured from the robot interface to the tool interface

Note 1 to entry: See Figure 1 a), item 4.

Note 2 to entry: The tolerance of the coupling length of the robot part (L_{cr}) and the coupling length of the tool part (L_{ct}) has a significant effect on the pose accuracy of the complete system when using different tools. The length of the coupled system is calculated as $L_{total} \pm \Delta$.

3.3 Terms related to positioning and orientation in coupling

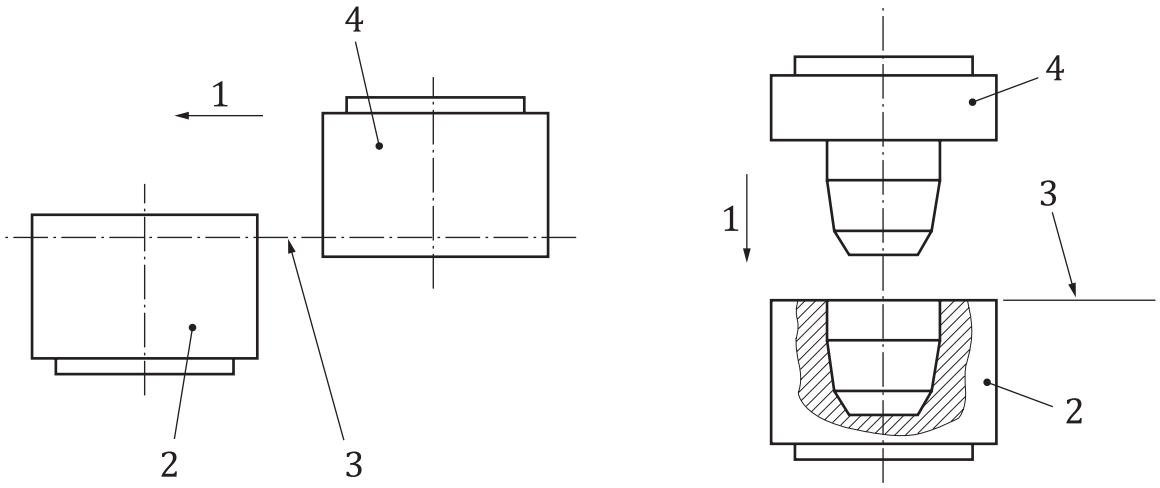
3.3.1
coupling direction
direction in which the *robot-mounted part* (3.1.2) and/or the *tool-mounted part* (3.1.3) are moved to each other

Note 1 to entry: See Figure 2.

Note 2 to entry: Couplings may be either lateral or axial:

— lateral coupling direction [see Figure 2 a)]: the motion of coupling runs parallel to the level of separation of the interface;

— axial coupling direction [see Figure 2 b)]: the motion of coupling runs vertical to the level of separation of the interface.



a) Lateral positioning and orientation in coupling

b) Axial positioning and orientation in coupling

Key

1	coupling direction	3	level of separation
2	tool-mounted part	4	robot-mounted part

Figure 2 — Positioning and orientation in coupling

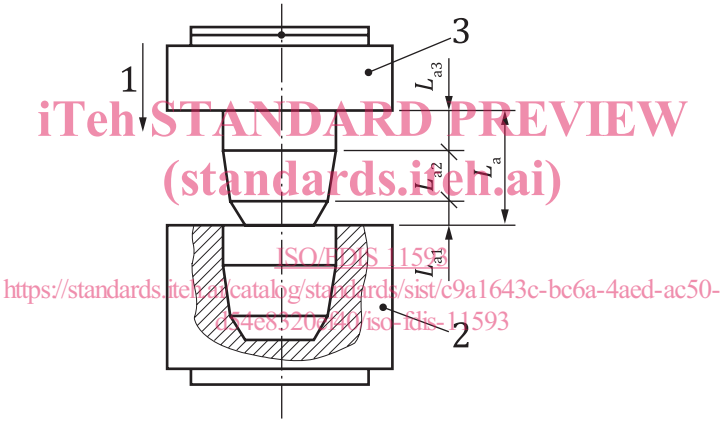
3.3.2
length of the approach distance
L_a
total distance of operation of the *robot-mounted part* (3.1.2) and/or the *tool-mounted part* (3.1.3) in the *coupling direction* (3.3.1) until the complete coupling of both parts

Note 1 to entry: L_a is expressed in millimetres.

Note 2 to entry: $L_a = L_{a1} + L_{a2} + L_{a3}$

Note 3 to entry: For axial coupling direction, the approach distance runs vertical to the *reference plane* (3.6.7). On lateral coupling direction, it runs parallel to the reference plane.

Note 4 to entry: See Figure 3.



Key

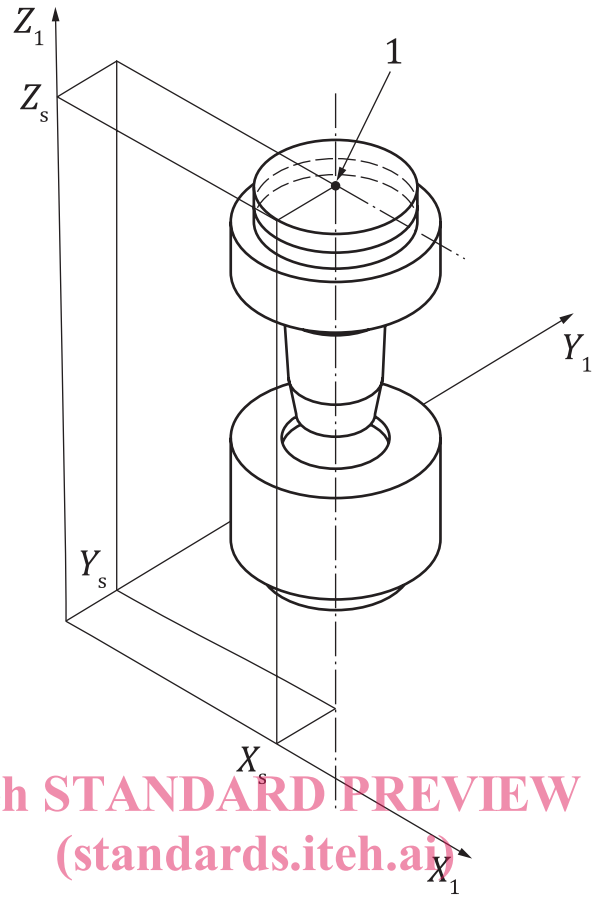
1	coupling direction	L_a	length of the approach distance (mm)
2	tool-mounted part	L_{a1}	distance of operation for precentring (mm)
3	robot-mounted part	L_{a2}	distance of operation for centring (mm)
		L_{a3}	distance of operation thereafter until the complete coupling (mm)

Figure 3 — Axial coupling direction

3.3.3
start position
location of the *robot-mounted part* (3.1.2) of the exchange device in relation to the *tool-mounted part* (3.1.3) shortly before the coupling process begins

Note 1 to entry: The start position can be defined in the Cartesian coordinate system as (X_s, Y_s, Z_s).

Note 2 to entry: See Figure 4.



Key

1	start position (X_s, Y_s, Z_s)	X_1	cartesian coordinate X axis
X_s	start X axis coordinate	Y_1	cartesian coordinate X axis
Y_s	start Y axis coordinate	Z_1	cartesian coordinate X axis
Z_s	start Z axis coordinate		

Figure 4 — Demonstration of axial coupling direction

3.4 Terms related to coupling and releasing forces

3.4.1
coupling force
F_c
force to be applied by the robot in order to *couple* (3.1.4) the *robot-mounted part* (3.1.2) of the exchange system with the *tool-mounted part* (3.1.3)

Note 1 to entry: F_c is expressed in Newtons.

Note 2 to entry: During this process, the tool-mounted part is considered to be held in the tool *magazine* (3.1.10). The coupling force includes all external forces required to couple all mechanical, electrical, hydraulic or pneumatic connectors.

3.4.2
releasing force
F_e
force to be applied by the robot in order to release the *robot-mounted part* (3.1.2) of the exchange system from the *tool-mounted part* (3.1.3)

Note 1 to entry: F_e is expressed in Newtons.