INTERNATIONAL
STANDARD

**ISO
9283**

Second edition
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Manipulating industrial robots — Performance criteria and related test methods

Robots manipulateurs industriels — Critères de performance et méthodes d'essai correspondantes

Contents

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. In accordance with ISO/IEC Directives they are approved if two-thirds of the votes cast by the P-members of the technical committee or sub-committee are in favour, and not more than one-quarter of the total number of votes cast are negative.

International Standard ISO 9283 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 2, *Robots for manufacturing environment*.

This second edition cancels and replaces the first edition (ISO 9283:1990 and Amendment 1:1991), of which it constitutes a technical revision.

Annex A forms an integral part of this International Standard. Annexes B and C are for information only.

Introduction

ISO 9283 is part of a series of International Standards dealing with manipulating industrial robots. Other International Standards cover such topics as safety, general characteristics, coordinate systems, terminology, and mechanical interfaces. It is noted that these International Standards are interrelated and also related to other International Standards.

ISO 9283 is intended to facilitate understanding between users and manufacturers of robots and robot systems. It defines the important performance characteristics, describes how they shall be specified and recommends how they should be tested. An example of how the test results should be reported is included in Annex C of this International Standard. The characteristics for which test methods are given in this International Standard are those considered to affect robot performance significantly.

It is intended that the user of this International Standard selects which performance characteristics are to be tested, in accordance with his own specific requirements.

The tests described in this International Standard may be applied in whole or in part, depending upon the robot type and requirements.

The core part of ISO 9283 deals with testing of individual characteristics. Specific parameters for comparison testing is dealt with in Annex A (normative) for pose-to-pose characteristics and path characteristics.

Annex B (informative) of this International Standard provides guidance for selection of tests for typical applications.

Annex C (informative) of this International Standard provides a recommended format of the test report including the minimum required information and the summary of the test results.

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Manipulating industrial robots — Performance criteria and related test methods

1 Scope

This International Standard describes methods of specifying and testing the following performance characteristics of manipulating industrial robots:

- pose accuracy and pose repeatability;
- multi-directional pose accuracy variation;
- distance accuracy and distance repeatability;
- position stabilization time;
- position overshoot;
- drift of pose characteristics;
- exchangeability;
- path accuracy and path repeatability;
- path accuracy on reorientation
- cornering deviations;
- path velocity characteristics;
- minimum posing time;
- static compliance;
- weaving deviations.

This International Standard does not specify which of the above performance characteristics are to be chosen for testing a particular robot. The tests described in this International Standard are primarily intended for developing and verifying individual robot specifications, but can also be used for such purposes as prototype testing, type testing or acceptance testing.

To compare performance characteristics between different robots, as defined in this International Standard, the following parameters have to be the same: test cube sizes, test loads, test velocities, test paths, test cycles, environmental conditions.

Annex A provides parameters specific for comparison testing of pose-to-pose characteristics and path characteristics.

This International Standard applies to all manipulating industrial robots as defined in ISO 8373. However, for the purpose of this International Standard the term "robot" means manipulating industrial robot.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All International Standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 8373:1994, *Manipulating industrial robots — Vocabulary.*

ISO 9787:1990, *Manipulating industrial robots — Coordinate systems and motions.*

ISO 9946:1991, *Manipulating industrial robots — Presentation of characteristics.*

3 Definitions

For the purpose of this International Standard, the definitions given in ISO 8373 and the following definitions apply.

3.1 cluster: Set of measured points used to calculate the accuracy and the repeatability characteristics (example shown diagrammatically in figure 8).

3.2 barycentre: For a cluster of n points, defined by their coordinates $(x_j - y_j - z_j)$, the barycentre of that cluster of points is the point whose coordinates are the mean values $\bar{x}$, $\bar{y}$, $and\ \bar{z}$ calculated by formulae given in 7.2.1.

3.3 measuring dwell: Delay at the measurement point prior to recording data (e.g. time between control signal "in position" and the "start measuring" of the measuring device).

3.4 measuring time: Time elapsed when measurements are recorded.

4 Units

Unless otherwise stated, all dimensions are as follows:

— length in millimetres .... (mm)
— angle in radians or degrees.......................... (rad) or (°)
— time in seconds .... (s)
— mass in kilograms .... (kg)
— force in newtons .... (N)
— velocity in metres per second...................... (m/s),
  degrees per second .... (°/s) or
  radians per second .... (rad/s)

5 Abbreviations and symbols

For the purposes of this International Standard, the following abbreviations and symbols apply.

5.1 Basic abbreviations

A	Accuracy
R	Repeatability
v	Variation
F	Fluctuation
d	Drift
P	Pose
D	Distance
T	Path (trajectory)
V	Velocity
W	Weaving
E	Exchangeability

5.2 Quantities

a, b, c	Orientation (angular components) about the x, y, and z-axis
x, y, z	Linear coordinates along the x-, y-, z-axis
n	Number of measurement cycles
m	Number of measurement points along the path
S	Standard deviation
D	Distance between two points
l	Distance between the attained pose and the barycentre of the attained poses
v	Path velocity
AP	Pose accuracy
RP	Pose repeatability
vAP	Multi-directional pose accuracy variation
AD	Distance accuracy
RD	Distance repeatability
t	Position stabilization time
OV	Position overshoot
dAP	Drift of pose accuracy
dRP	Drift of pose repeatability
AT	Path accuracy
RT	Path repeatability
CR	Cornering round-off error
CO	Cornering overshoot
AV	Path velocity accuracy
RV	Path velocity repeatability