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Manipulating industrial robots — Presentation of characteristics

Robots manipulateurs industriels — Présentation des caractéristiques

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Contents

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9946 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Sub-Committee SC 2, *Robots for manufacturing environment*.

Annexes A and B of this International Standard are for information only.

Introduction

ISO 9946 is one of a series of International Standards dealing with manipulating industrial robots. Other documents cover such topics as safety, performance criteria and related testing methods, coordinate systems, terminology, and mechanical interface. It is noted that these standards are interrelated and also related to other International Standards.

The number of manipulating industrial robots used in a manufacturing environment is constantly increasing and this has underlined the need for a standard format for the specification and presentation of robot characteristics.

The objective of ISO 9946 is to assist users and manufacturers in the understanding and comparison of various types of robots.

Annex A of this International Standard provides a recommended format for the presentation of robot specification.

Annex B provides a description of the symbols of performance criteria.

NOTE — For the purposes of this International Standard, the term "robot" means "manipulating industrial robot".

Manipulating industrial robots — Presentation of characteristics

1 Scope

This International Standard specifies requirements for how characteristics of robots shall be presented by the manufacturer.

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 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/TR 8373 : 1988, *Manipulating industrial robots — Vocabulary.*

ISO 9283 : —[1], *Manipulating industrial robots — Performance criteria and related test methods.*

ISO 9409-1 : 1988, *Manipulating industrial robots — Mechanical interfaces — Part 1: Circular (form A).*

ISO 9787 : —[1], *Manipulating industrial robots — Coordinate systems and motions.*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO/TR 8373 apply.

4 Units

Unless otherwise stated, all dimensions are as follows:

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

5 Characteristics

5.1 General

The manufacturer shall provide information related to the various characteristics and requirements as described in this clause as part of the robot documentation.

5.2 Application

The manufacturer shall specify the main type(s) of application(s) for which the robot is intended.

Examples of typical applications are

- material handling;
- assembly;
- spot welding;
- arc welding;
- machining;
- spray painting/coating;
- adhesive/sealant application;
- work inspection/verification.

5.3 Power source

The manufacturer shall specify all external power sources, including type (e.g. electrical, hydraulic, pneumatic or combination) required for proper operation of the robot (mechanical structure motion actuators, control, auxiliary equipment, etc.), together with the maximum power consumption required from each. These specifications shall also include permissible ranges and fluctuations.

The manufacturer shall also specify the type of power utilized to control axis and auxiliary motion (e.g. electric, hydraulic,

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pneumatic). Where more than one type of power is utilized, the manufacturer shall include a breakdown by individual motion.

5.4 Mechanical structure

The manufacturer shall specify the type of the mechanical structure and the number of mechanical axes. An outline drawing of the structure shall be provided detailing the axis motions. This drawing may be part of the diagram required for working space (see 5.5).

Examples of mechanical structures:

- rectangular or cartesian robot;
- cylindrical robot;
- polar robot;
- revolute robot;
- gantry robot;
- pendular robot;
- spine robot;
- scara robot.

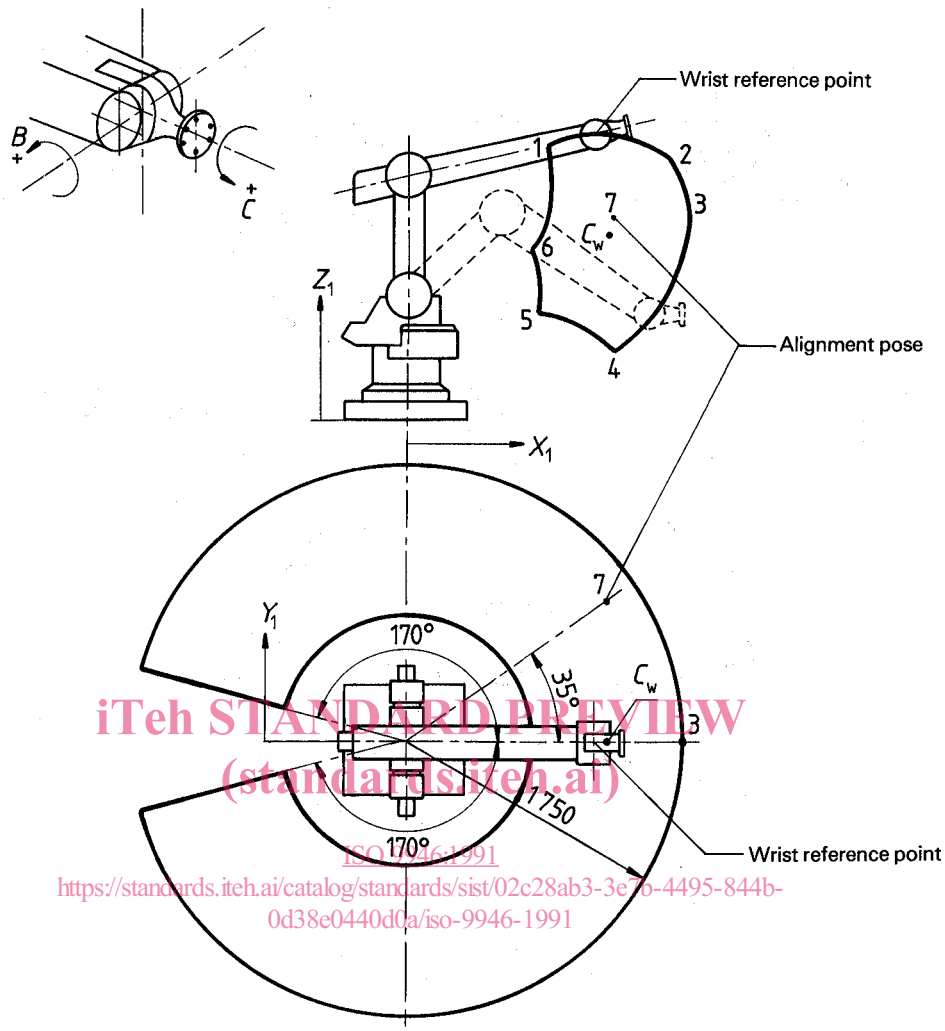
If the robot is mobile, the way which it is guided shall be indicated.

5.5 Working space

The boundaries of the working space including the alignment pose and centre of the working space (C_w) shall be illustrated in a diagram with at least two views (one the projection of the locus of the maximum reach of the robot arm on the X_1 Y_1 plane — see ISO 9787 — and the other the projection of the locus of the maximum reach of the arm on the X_1 Z_1 plane). The diagram shall also provide information on any limitation of secondary axis motion at any point(s) in the working space (see figure 1 for an example of a 5-axis robot and figure 2 for an example of a 6-axis robot).

In the diagrams, it is recommended that the details of the working space and range of movement of secondary axes are given in tabular form as shown in the examples of figures 1 and 2.

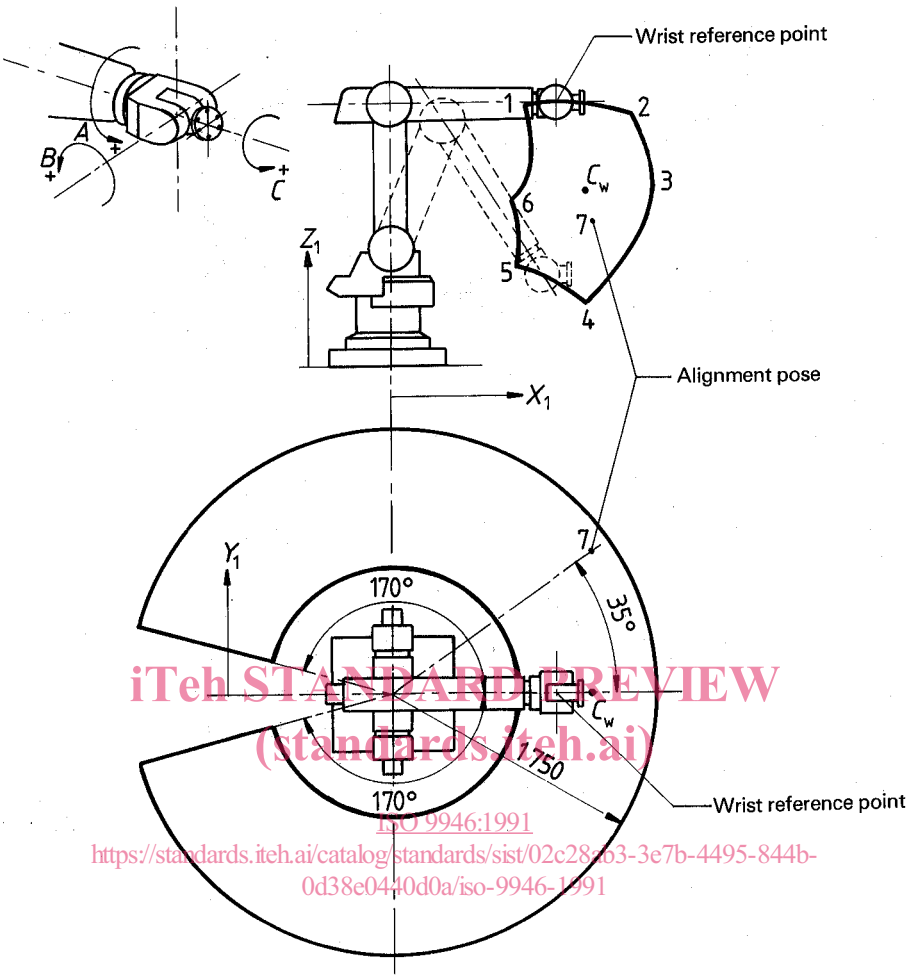
Dimensions in millimetres



Point in space	Working space		Range of movement of secondary axes	
	X_1	Z_1	B	C
1	925	1 635	+ 75° − 90°	+ 170° − 150°
2	1 610	1 550	+ 75° − 90°	± 180°
3	1 750	1 140	+ 75° − 105°	± 180°
4	1 310	345	+ 45° − 120°	± 180°
5	870	600	+ 45° − 120°	+ 150° − 170°
6	840	1 000	+ 75° − 120°	+ 140° − 150°
7	1 350	750	—	—

Figure 1 — Example of 5-axis robot working space

Dimensions in millimetres



Point in space	Working space		Range of movement of secondary axes		
	X_1	Z_1	A	B	C
1	925	1 635	±210°	+ 75° − 90°	+170° −150°
2	1 610	1 550	±210°	+ 75° − 90°	±180°
3	1 750	1 140	±210°	+ 75° −105°	±180°
4	1 310	345	±210°	+ 45° −120°	±180°
5	870	600	±210°	+ 45° −120°	+150° −170°
6	840	1 000	±210°	+ 75° −120°	+140° −150°
7	1 350	750	—	—	—

Figure 2 — Example of 6-axis robot working space

5.6 Coordinate systems

The manufacturer shall specify base and mechanical interface coordinate systems in accordance with ISO 9787. Any deviations to ISO 9787 shall be stated by the manufacturer.

5.7 External dimensions and mass

The manufacturer shall specify external dimensions in millimetres (mm), and mass in kilograms (kg) of the mechanical structure and control unit.

5.8 Base mounting surface

The manufacturer shall provide the base mounting surface description (for example in a drawing) and recommendations on the mounting of the robot base necessary to ensure that safe operation and rated performances are obtained.

The permissible mounting positions of the robot should be specified together with any limitations on safety or performance relative to each position.

5.9 Mechanical interface

The manufacturer shall provide the mechanical interface description including any drawings, specifications and recommendations necessary for mounting the end effector to the robot arm. Where applicable, reference to appropriate International Standard(s) shall be provided (see, for example, ISO 9409-1).

5.10 Control

The manufacturer shall specify

- Control unit type and all relevant information, for example its capability, special provisions (e.g. control schemes).
- Program storage:
  nominal (base configuration)
  maximum capacity
- Basic motion control type:
  pose-to-pose
  continuous path
- Motion control:
  servo
  non-servo
- Interpolation method (where applicable):
  linear
  circular
  parabolic
  other
- Pendant/operator control(s)
- Input/output interfaces:
  signal type(s) and level(s)
  continuous or multiplexed
- Data/network interfaces:
  physical characteristics
  data/control formats

5.11 Programming methods

The manufacturer shall specify the type of programming method.

Example of programming methods are

- Manual Data Input
- Teach
  manually leading the robot end effector
  manually leading a mechanical simulating device
  using a teach pendant
- Explicit
- Goal directed

5.12 Environment

The manufacturer shall specify the limits of environmental conditions within which the rated performances can be achieved, or the degree of protection of the robot against environmental conditions.

The manufacurer shall specify the limits for storage and operation without damage when different.

Environmental conditions include but are not necessarily limited to

- Temperature (operating and storage/transport) (degrees Celsius) (° C)
- Relative humidity (per cent) (%)
- Altitude limit (metres) (m)
- Electromagnetic interference
- Atmospheric contaminants
- Vibration

5.13 Load

The various load characteristics shall be specified in terms of

- mass (kilograms) (kg)
- moment (newton/metres) (N·m)
- moment of inertia (kilograms/metres squared) ($kg \cdot m^2$)
- thrust (newtons) (N)
- torque (newton/metres) (N·m).

These values should be stated in terms of the mechanical interface coordinate system.

The manufacturer shall specify the rated load of the robot. It is recommended that the position and the maximum moment of