INTERNATIONAL STANDARD

ISO 9409-2

Second edition
2002-11-01

Manipulating industrial robots — Mechanical interfaces —

Part 2: **Shafts**

Robots manipulateurs industriels — Interfaces mécaniques —

Partie 2: Interfaces à queue

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this part of ISO 9409 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 9409-2 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 9409-2:1996), of which it constitutes a minor revision. Clause 7 has been revised.

ISO 9409 consists of the following parts, under the general title *Manipulating industrial robots — Mechanical interfaces*:

— *Part 1: Plates*

— *Part 2: Shafts*

Introduction

This part of ISO 9409 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, performance criteria and related test methods, terminology, and robot programming. It is noted that these standards are interrelated and also related to other International Standards.

Manipulating industrial robots are steadily growing in importance in industrial automation. Depending on the type of application, they may require removable end effectors such as grippers or tools which are attached to the mechanical interface.

Manipulating industrial robots — Mechanical interfaces —

Part 2: Shafts

1 Scope

This part of ISO 9409 defines the main dimensions, designation and marking for a shaft with cylindrical projection as mechanical interface. It is intended to ensure the exchangeability and to keep the orientation of hand-mounted end effectors.

This part of ISO 9409 does not contain any correlation of load-carrying ranges.

The mechanical interfaces specified in this part of ISO 9409 will also find application in simple handling systems which are not covered by the definition of manipulating industrial robots, such as pick-and-place or master-slave units.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 9409. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 9409 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 286-1:1988, *ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits*

ISO 286-2:1988, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*

ISO 1101:—[1)], *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

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

ISO 9409-1:1996, *Manipulating industrial robots — Mechanical interfaces — Part 1: Plates (form A)*

ISO 9787:1999, *Manipulating industrial robots — Coordinate systems and motion nomenclatures*

3 Terms and definitions

For the purposes of this part of ISO 9409, the terms and definitions given in ISO 8373 apply.

1) To be published. (Revision of ISO 1101:1983)

4 Dimensions

4.1 General

It is recommended that the dimensions for a shaft with cylindrical projection as mechanical interface be specified in accordance with Figure 1 and Table 1 (Type 1, without a slot for end effector orientation) or Figure 2 and Table 2 (Type 2, with a slot for end effector orientation).

It is recommended that series 1 dimensions be used. The supplementary series 2 shall be used only in special applications where series 1 dimensions are not suitable for the intended use.

The reference plane is defined as shown in Figures 1 and 2. The end effectors are positioned against the reference plane (see the note in clause 5).

4.2 Coordinate system

The origin of the mechanical interface coordinate system as defined in ISO 9787 is the intersecting point of the centre axis of the shaft and the reference plane.

The $+Z_m$ axis points away from the origin towards the end of the shaft.

The flat surface and the slot (optional) is aligned to the $+X_m$ axis as shown in Figures 1 and 2. The flat surface is a place where a set screw is seated to fix an end effector. The slot is used for mating a pin mounted on an end effector to maintain end-effector orientation (see clause 5).

4.3 Tolerances

The mechanical interface dimensions shall be toleranced in accordance with ISO 286. Geometric tolerances shall be interpreted in accordance with ISO 1101. The shaft diameter, d_1, shall be the datum for all geometrical tolerances (see Figures 1 and 2).

4.4 Load-carrying capacity and shaft material

The mechanical interface of the shaft specified in this part of ISO 9409 is suitable for robots of relatively small load capacity and for applications where end effectors are expected to move with narrow clearance between peripherals.

The use of a plate as mechanical interface (ISO 9409-1) is recommended when a shaft is not sufficient for bearing expected loads.

5 End effector requirements

The dimensions and related tolerances of the mating surface of the end effector shall be compatible with those specified in this part of ISO 9409.

The slot on the interface, $b \times l_5$ (optional; see Figure 2 and Table 2), is intended for mating a location pin mounted on an end effector to maintain end effector orientation. A parallel (cylindrical) pin is recommended for this purpose. The pin axis shall be aligned to the $+X_m$ axis.

The shaft, $d_1 \times l_1$, shall be of sufficient length and strength to bear an end effector coupled with friction, for example an end effector attached by clamping.

The threaded hole on the shaft end can be used to fix end effectors.

NOTE The shaft end should not be used as a dimensional reference; the end effectors should be positioned against the reference plane.

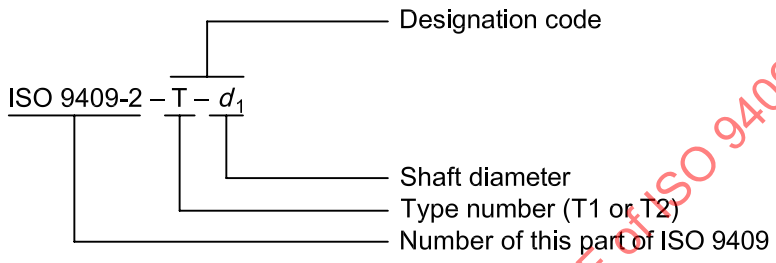
6 Recommended practices — Provisions for routing service lines

A threaded hole can be made as a through hole for cabling or piping, or for exhausting surrounding air.

If the shaft is provided with a hollow centre, the through hole shall have a diameter, d_4, equal to or less than the pilot hole diameter of the threaded hole, d_3.

7 Designation code

The designation of the mechanical interface whose dimensions are in accordance with this part of ISO 9409 shall be as follows:



EXAMPLE A mechanical interface of Type 1 with a shaft diameter, d_1 = 10 mm, shall be designated as follows:

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8 Marking

When the shaft and related end effectors made in accordance with this part of ISO 9409 are marked, they shall be permanently marked with the designation code (see clause 7).

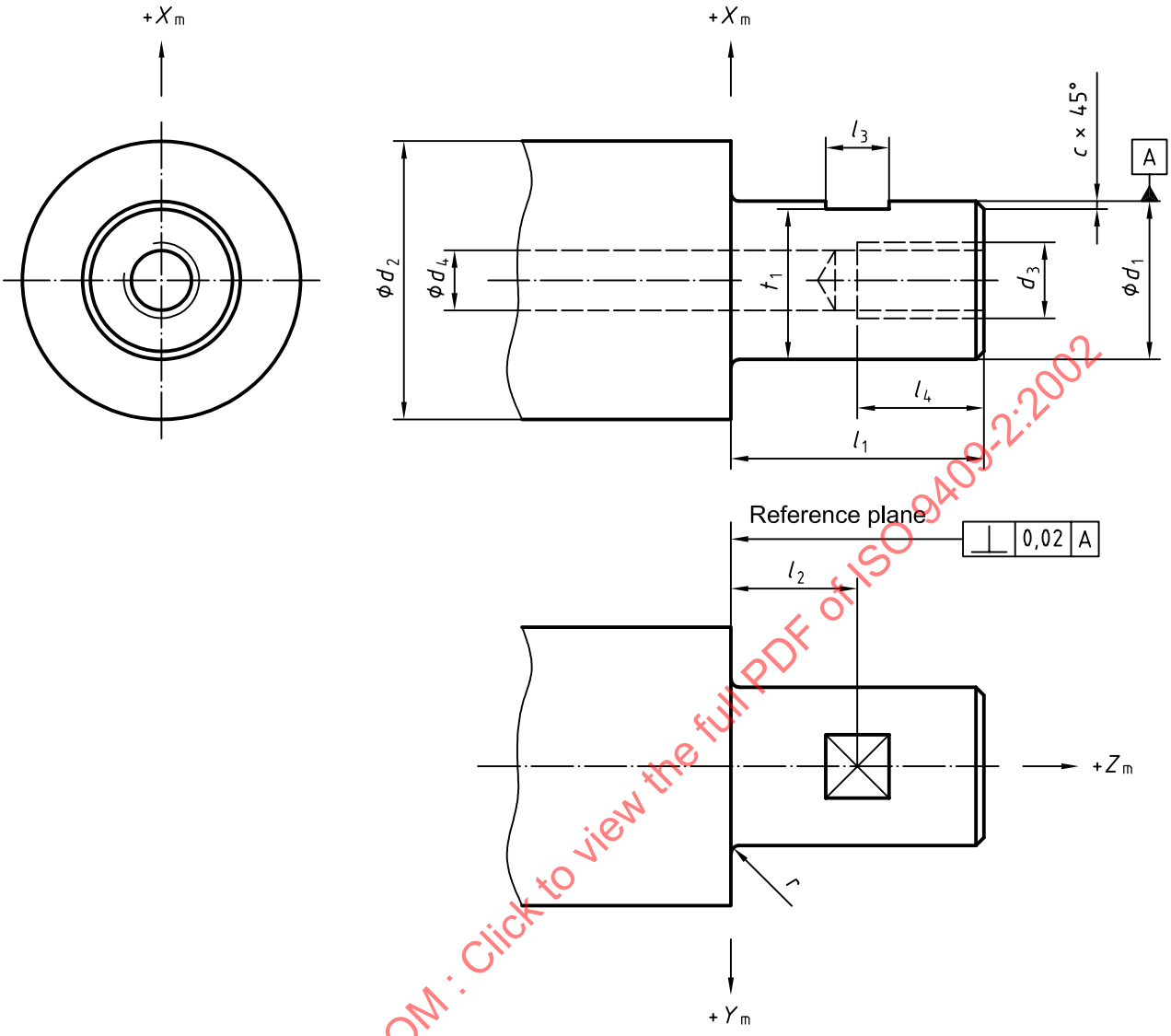

Figure 1 — Basic layout of the shaft mechanical interface Type 1

Table 1 — Preferred series 1 and supplementary series 2 of the shaft mechanical interface Type 1

Shaft diameter d_1 h7		Reference plane diameter d_2	Shaft length l_1	Flat surface			Internal thread		Chamfer c	Rounding r
				Location l_2	Length l_3	Height t_1	Nominal diameter d_3	Depth l_4		
Series 1	Series 2	min.						min.		max.
6		12	20	10	6	5,5	M3	5	1	1
	8	14	22	11		7,5	M4	7		
10		16	25	12,5	8	9	M5	8		
	12	19	28	14		11	M6	10		
	14	21	30	15		13				
16		23	32	16	10	15	M8	13		
	20	27	36	18		19	M10	16		
25		32	40	20		24	M12	20		

NOTE Parameter d_4: see clause 6.

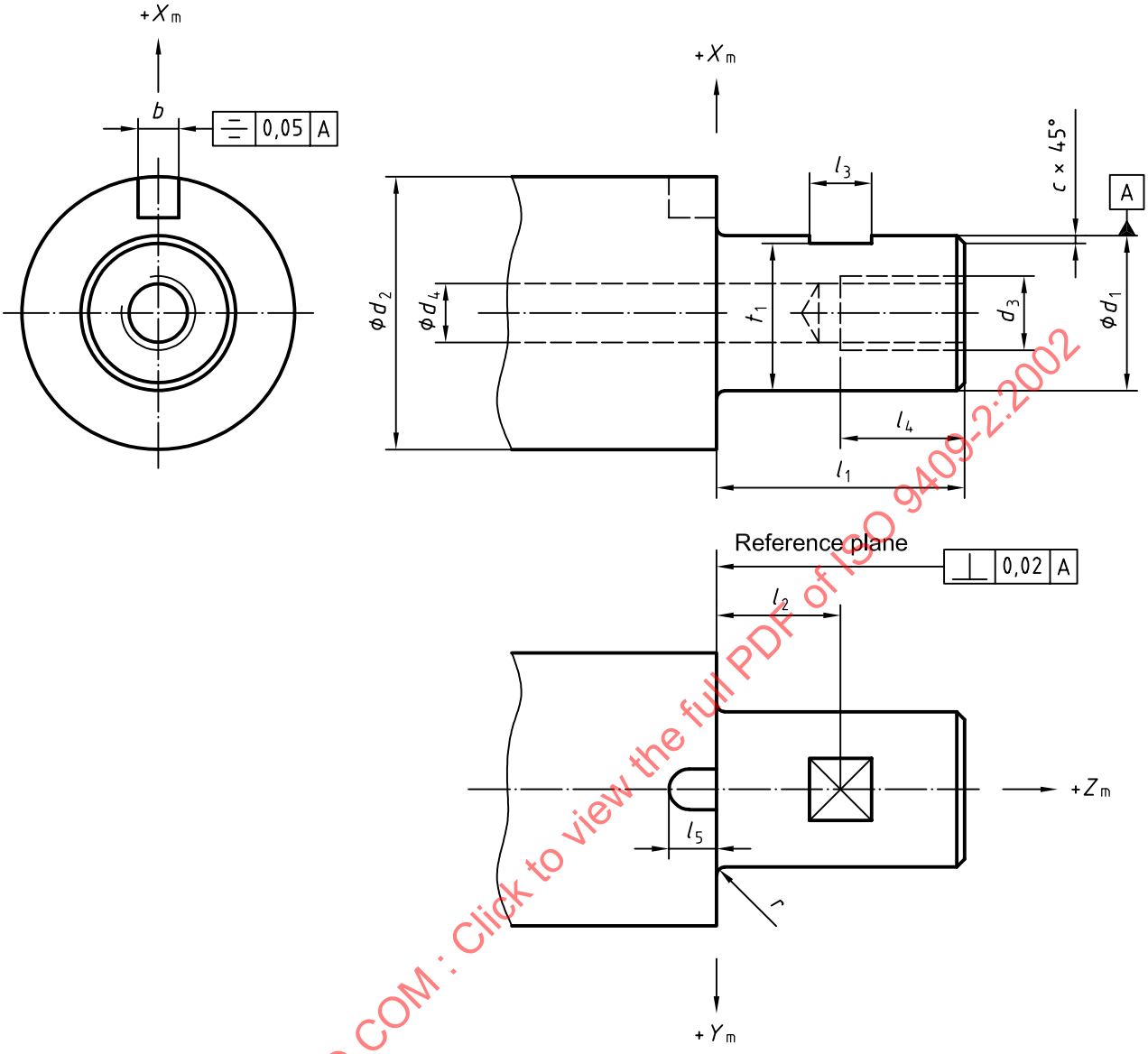

Figure 2 — Basic layout of the shaft mechanical interface Type 2

Table 2 — Preferred series 1 and supplementary series 2 of the shaft mechanical interface Type 2

Shaft diameter d_1 h7		Reference plane diameter d_2	Shaft length l_1	Flat surface			Internal thread		Cham-fer c	Round-ing r	Slot		
				Location l_2	Length l_3	Height t_1	Nominal diameter d_3	Depth l_4			Width b Js9	Depth l_5	Height t_2
Series 1	Series 2	min.								max.		min.	max.
6		15	20	10	6	5,5	M3	5	1	1	3	4,5	4
	8	17	22	11		7,5	M4	7					5
10		22	25	12,5	8	9	M5	8			4	6	7
	12	24	28	14		11	M6	10					8
	14	26	30	15		13							
16		34	32	16	10	15	M8	13			6	9	11
	20	38	36	18		19	M10	16					13
25		44	40	20		24	M12	20					16

NOTE Parameter d_4: see clause 6.