



SLOVENSKI STANDARD
SIST ISO 10360-3:2002

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Geometrical Product Specifications (GPS) -- Acceptance and reverification tests for coordinate measuring machines (CMM) -- Part 3: CMMs with the axis of a rotary table as the fourth axis

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Spécification géométrique des produits (GPS) -- Essais de réception et de vérification périodique des machines à mesurer tridimensionnelles (MMT) -- Partie 3: MMT ayant l'axe de rotation d'un plateau tournant comme quatrième axe

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ICS:

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INTERNATIONAL STANDARD

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Geometrical Product Specifications (GPS) — Acceptance and reverification tests for coordinate measuring machines (CMM) —

Part 3:

**CMMs with the axis of a rotary table as the
fourth axis**

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*Spécification géométrique des produits (GPS) — Essais de réception et de
vérification périodique des machines à mesurer tridimensionnelles
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*Partie 3: MMT ayant l'axe de rotation d'un plateau tournant comme
quatrième axe*



Reference number
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Contents

Page

Foreword.....	iv
Introduction.....	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Requirements for metrological characteristics	2
4.1 Error of indication.....	2
4.2 Environmental conditions.....	2
4.3 Rotary table	2
4.4 Stylus system.....	2
4.5 Operating conditions.....	2
5 Acceptance test and reverification test.....	3
5.1 Principles.....	3
5.2 Measuring equipment.....	3
5.3 Procedure	3
5.4 Obtention of test results.....	5
6 Compliance with specifications.....	8
6.1 Acceptance test	8
6.2 Reverification test.....	8
7 Applications	8
7.1 Acceptance test	8
7.2 Reverification test.....	8
7.3 Interim check.....	8
Annex A (informative) Interim check.....	9
Annex B (informative) Relation to the GPS matrix model	10
Bibliography	12

ISO 10360-3:2000(E)

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.

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 10360 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10360-3 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

ISO 10360 consists of the following parts, under the general title *Geometrical Product Specifications (GPS) — Acceptance and reverification tests for coordinate measuring machines (CMM)*:

- *Part 1: Vocabulary*
- *Part 2: CMMs used for measuring linear dimensions*
- *Part 3: CMMs with the axis of a rotary table as the fourth axis*
- *Part 4: CMMs used in scanning measuring mode*
- *Part 5: CMMs using multiple stylus probing systems*
- *Part 6: Estimation of errors in computing Gaussian associated features*

Annexes A and B of this part of ISO 10360 are for information only.

Introduction

This part of ISO 10360 is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO/TR 14638). It influences link 5 of the chains of standards on size, distance, radius, angle, form, orientation, location, run-out and datums.

For more detailed information on the relationship of this part of ISO 13060 to other standards and the GPS matrix model, see annex B.

The acceptance test and reverification test of this part of ISO 10360 are applicable to CMMs which use a rotary table for the orientation of a workpiece being measured.

The tests specified in this part of ISO 10360 are performed in addition to the size measuring tests according to ISO 10360-2, which are conducted with the rotary table stationary. They are designed to detect the system measuring errors relative to an axis system fixed to the rotary table. It is normally not useful to isolate the rotary table errors from other sources of machine error.

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Geometrical Product Specifications (GPS) — Acceptance and reverification tests for coordinate measuring machines (CMM) —

Part 3: CMMs with the axis of a rotary table as the fourth axis

1 Scope

This part of ISO 10360 specifies the acceptance test which verifies that the performance of four-axis coordinate measuring machines (CMM) is in accordance with that stated by the manufacturer. It also specifies the reverification test, which enables the user to reverify the performance of a four-axis CMM periodically.

The acceptance test and reverification test described in this part of ISO 10360 are applicable only to four-axis machines with three axes for measuring workpiece coordinates, plus a rotary table for orienting the workpiece.

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2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 10360. 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 10360 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 10360-1:—¹⁾, *Geometrical Product Specifications (GPS) — Acceptance and reverification tests for coordinate measuring machines (CMM) — Part 1: Vocabulary.*

ISO 14253-1:1998, *Geometrical Product Specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 1: Decision rules for proving conformance or non-conformance with specifications.*

International Vocabulary of Basic and General Terms in Metrology (VIM). BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML, 2nd edition, 1993.

3 Terms and definitions

For the purposes of this part of ISO 10360, the terms and definitions given in ISO 10360-1, ISO 14253-1 and VIM apply.

1) To be published.

ISO 10360-3:2000(E)

4 Requirements for metrological characteristics

4.1 Error of indication

The errors of indication, FR, FT, FA, as defined in ISO 10360-1, for the three four-axis errors shall not exceed the maximum permissible errors, MPE_{FR} , MPE_{FT} , MPE_{FA} , as defined in ISO 10360-1, as stated by:

- the manufacturer, in case of acceptance tests;
- the user, in case of reverification tests.

The errors of indication (FR, FT, FA) and the maximum permissible errors (MPE_{FR} , MPE_{FT} , MPE_{FA}) are expressed in micrometres.

4.2 Environmental conditions

Limits to be respected for permissible environmental conditions such as temperature conditions, air humidity and vibration at the site of installation that influence the measurements shall be specified by:

- the manufacturer, in case of acceptance tests;
- the user, in case of reverification tests.

In both cases, the user is free to choose the conditions within the specified limits.

4.3 Rotary table

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The maximum permissible errors (MPE_{FR} , MPE_{FT} , MPE_{FA}) apply for any permitted loading, location and orientation of the rotary table on the CMM and for any locations of the test spheres on the rotary table within specified limits.

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4.4 Stylus system

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Limits to be respected for the stylus system configuration, to which the stated values of MPE_{FR} , MPE_{FT} , MPE_{FA} apply, shall be specified by:

- the manufacturer, in case of acceptance tests;
- the user, in case of reverification tests.

In both cases, the user is free to choose the stylus system configuration within the specified limits.

The form deviation of the stylus tip will influence the measurement results and shall be considered when proving conformance or non-conformance with specifications.

4.5 Operating conditions

The CMM shall be operated using the procedures given in the manufacturer's operating manual when conducting the tests given in clause 5. Specific areas in this manual to be adhered to are, for example:

- a) machine start up/warm up cycles;
- b) stylus system configuration;
- c) cleaning procedures for stylus tip and reference sphere;
- d) probing system qualification;
- e) rotary table set-up and qualification.

NOTE The stylus tip and the reference sphere should be cleaned before the probing system qualification so as to leave no residual film which could affect the measuring or test result.

5 Acceptance test and reverification test

5.1 Principles

The principle of the assessment method is to establish whether the CMM is capable of measuring within the stated maximum permissible errors (MPE_{FR} , MPE_{FT} , MPE_{FA}) by determining the variation of the measured coordinates of the centres of two test spheres mounted on the rotary table.

It is noted that on a perfect four-axis CMM, the location of the measured centres of the test spheres would remain fixed in the workpiece coordinate system while the table is rotated.

Each test sphere centre is determined in three directions: radial, tangential and axial. The position of each test sphere centre is represented in the workpiece coordinate system on a rotary table.

The centre of each test sphere, mounted on a rotary table, is measured in a series of measurements with different angular positions of the rotary table.

The errors of indication (FR, FT, FA) are calculated separately for each test sphere as the range between the maximum and minimum measurement results for each of the three directions.

In the following:

- acceptance tests are executed according to the manufacturer's specifications and procedures;
- reverification tests are executed according to the user's specifications and the manufacturer's procedures.

5.2 Measuring equipment

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5.2.1 Two test spheres (A and B), with diameters no less than 10 mm and no greater than 30 mm and with certified form.

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The diameters of the two test spheres, used in these tests as the corresponding input quantities, need not be calibrated since only the centres of the test spheres are used to determine the three four-axis errors. The form of the test spheres must be calibrated since the form deviations influence the test results and shall be taken into account when proving conformance or non-conformance with specifications.

The mounting of the test spheres should be sufficiently rigid to avoid errors due to bending especially when the axis of the rotary table is horizontal.

5.3 Procedure

Position the test sphere A on the rotary table as close as possible to the rotary table surface at a radius r , in accordance with Table 1. Position the test sphere B approximately at the same radius, r , and approximately diametrically opposite the test sphere A at a height, Δh (see Table 1 and Figure 1).

Define a Cartesian workpiece coordinate system on the rotary table (see Figure 1) conforming to the following conditions:

- a) the centre of test sphere B (farthest from the table surface) establishes the origin;
- b) the primary axis which defines the axial direction shall be parallel to the axis of the rotary table;
- c) the secondary axis which defines the radial direction shall lie in a plane that contains the primary axis and the centre of test sphere A.

NOTE 1 The tertiary axis defines the tangential direction.