SLOVENSKI STANDARD
oSIST prEN ISO 10360-5:2018

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Specifikacija geometrijskih veličin izdelka (GPS) - Preskusi za sprejemljivost in ponovno overjanje koordinatnih merilnih strojev (KMS) - 5. del: Koordinatni merilni stroji, uporabljeni kot enotipalni in večtipalni sondirni sistemi z uporabo diskretne točke in/ali načina merjenja skeniranja (ISO/DIS 10360-5:2018)

Geometrical product specifications (GPS) - Acceptance and reverification tests for coordinate measuring systems (CMS) - Part 5: CMMs using single and multiple stylus contacting probing systems using discrete point and/or scanning measuring mode (ISO/DIS 10360-5:2018)

Geometrische Produktspezifikation (GPS) - Annahmeprüfung und Bestätigungsprüfung für Koordinatenmessgeräte (KMG) - Teil 5: Prüfung der Antastabweichungen von KMG mit berührendem Messkopfsystem im Einzelpunkt- und/oder Scanningbetrieb (ISO/DIS 10360-5:2018)

Spécification géométrique des produits (GPS) - Essais de réception et de vérification périodique des systèmes à mesurer tridimensionnelles (MMT) - Partie 5: MMT utilisant des systèmes de palpage à stylet simple ou à stylets multiples (ISO/DIS 10360-5:2018)

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Geometrical product specifications (GPS) — Acceptance and reverification tests for coordinate measuring systems (CMS) —

Part 5:
CMMs using single and multiple stylus contacting probing systems using discrete point and/or scanning measuring mode

Spécification géométrique des produits (GPS) — Essais de réception et de vérification périodique des systèmes à mesurer tridimensionnelles (MMT) —

Partie 5: MMT utilisant des systèmes de palpage à stylet simple ou à stylets multiples

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

This third edition cancels and replaces the second edition ISO 10360-5:2010, which has been technically revised.

It also incorporates with a technical revision the tests contained within ISO 10360-4:2000 and as such it cancels and replaces ISO 10360-4:2000

The main changes compared to the previous edition are as follows:

(to be confirmed)

A list of all parts in the ISO 10360- series can be found on the ISO website.

Introduction

This document is a general GPS standard (see ISO 14638). For more detailed information about the relation of this document to other standards and the GPS matrix model see Annex G.

The ISO/GPS Masterplan given in ISO 14638 gives an overview of the ISO/GPS system of which this document is a part. The fundamental rules of ISO/GPS given in ISO 8015 apply to this document and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this document, unless otherwise indicated.

The acceptance and reverification tests described in this document are applicable to coordinate measuring machines (CMMs) that use contacting probes, with or without multiple styli or multiple articulated-probe positions, when measuring using discrete point and/or scanning mode.

Experience has shown that the multi-stylus errors calculated using this document are significant and, at times, the dominant errors in the CMM. Owing to the virtually infinite variety of modern CMM probing system configurations, the description of the tests specified by this document provide a testing protocol for the specification but the actual test coverage has been limited to provide a practical subset of tests which are intended to reveal typical errors associated with probing configurations in a limited amount of time. The tests are intended to provide information on the ability of a CMM to measure a feature or features, using a contacting probe and, when relevant, using multiple styli, multiple probes or multiple articulated-probe positions.

The situations to which they are applicable include:

— single-stylus probing systems,

— multiple styli connected to the CMM probe (e.g. a star),

— installations using an articulating probing system (motorized or manual) that can be prequalified,

— installations using a repeatable probe-changing system,

— installations using a repeatable stylus-changing system,

— installations including a scanning probe and capable of being used in a scanning measuring mode, and

— multi-probe installations.

It is believed that the procedures given in this document will be helpful in identifying CMM system uncertainty components for specific measurement tasks, and that the user will be able to reduce errors by removing contributing elements such as long probe extensions and styli, then retesting the new configuration set.

The tests in this document are sensitive to many errors attributable to both the CMM and the probing system, and are to be performed in addition to the length-measuring tests given in ISO 10360-2.

The primary objective is to determine the practical performance of the complete CMM and probing system. Therefore, the tests are designed to reveal measuring errors which are likely to occur when such a combined system is used on real workpieces, e.g. errors generated by the interaction between large probe-tip-offset lengths and uncorrected CMM rotation errors. The errors found here differ from those found in the EL tests in ISO 10360-2:2009, because with multiple styli the net CMM travel may be very different from the measured length. See Annex C for more information.

It complements: ISO 10360-7 (CMMs equipped with imaging probing systems), ISO 10360-8 (CMMs with optical distance sensors), ISO 10360-9 (CMMs with multiple probing systems) and ISO 10360-2.

Geometrical product specifications (GPS) — Acceptance and reverification tests for coordinate measuring systems (CMS) —

Part 5: CMMs using single and multiple stylus contacting probing systems using discrete point and/or scanning measuring mode

1 Scope

This document specifies acceptance and periodic reverification tests of CMM performance with contacting probing systems and is only applicable to CMMs using:

— any type of contacting probing system, and

— spherical or hemispherical stylus tip(s).

NOTE CMM probing performance tests are specified by the maximum permissible errors (MPEs), due to the impracticality of isolating the performance of the probing system from that of the CMM, even on a small artefact such as a test sphere.

This document applies to CMMs supplied with any of the following:

a) single-stylus probing system;

b) multi-stylus probing systems with fixed multiple styli attached to a single probe (e.g. “star” stylus);

c) multiple probing systems such as those with a stylus for each of their probes;

d) systems with articulating probing systems;

e) stylus and probe changing systems;

f) manual (non-driven) as well as automated CMMs;

g) installations including a scanning probe and capable of being used in a scanning measuring mode.

This document is not applicable to non-contacting probing systems, which require different testing procedures.

The terms “multi-stylus size error”, etc., should strictly be written “combined CMM and multi-stylus probing- system size error”, etc. For convenience, the wording has been truncated.

If it is desired to isolate the probing-system performance as far as is practical, the influence of the CMM can be minimized but not eliminated. See Annex C for more information.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10360-1:2000, *Geometrical Product Specifications (GPS) — Acceptance and reverification tests for coordinate measuring machines (CMM) — Part 1: Vocabulary*

ISO 10360-2:2009, *Geometrical product specifications (GPS) — Acceptance and reverification tests for coordinate measuring machines (CMM) — Part 2: CMMs used for measuring linear dimensions*

ISO 14253-1, *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 1: Decision rules for verifying conformity or nonconformity with specifications*

ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10360-1, ISO 14253-1, ISO/IEC Guide 99 and the following apply.

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

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

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

Note 1 to entry This clause contains fifteen definitions (3.7-3.9, 3.11-3.15, 3.21-3.23, 3.25 and 3.27-3.29) which supersede eighteen similar definitions in Clause 9 of ISO 10360-1:2000. Some of these revised definitions are required to avoid ambiguities which would otherwise have been introduced with this standard. Others effectively supersede identical definitions in ISO 10360-1, because the symbols used have been revised and expanded for clarification. The superseded definitions are 9.3, 9.4 and 9.11 to 9.26.

Note 2 to entry All the symbols used in this document are listed in Clause 9.

Note 3 to entry The definitions in this clause are intended to concisely state the meaning of terms. For metrological characteristics that have numerical values, the complete description of the procedure and derivation of test results in Clause 6 are to be followed in determining values.

3.1
rated operating condition
operating condition that needs to be fulfilled during measurement in order that a measuring instrument or measuring system performs as designed

Note 1 to entry: Rated operating conditions generally specify intervals of values for a quantity being measured and for any influence quantity.

[SOURCE: ISO/IEC Guide 99:2007, 4.9]

Note 2 to entry: Within the ISO 10360- series, the term “as designed” means as specified by MPEs.

Note 3 to entry: If an MPE specification is thought of as a function (where different MPE values could be given for different conditions), then the rated operating conditions define the domain of that function.

3.2
inferred probing-system qualification
probing-system qualification method where the parameters for each probing system attached to an articulation system are inferred by interpolation, extrapolation, or other relevant model, for significantly different angular position(s) from parameters acquired by empirical probing-system qualification (3.3) at a few angular positions

3.3
empirical probing-system qualification
probing-system qualification method where the parameters for each probing system attached to an articulation system need to be acquired by measurement of the reference sphere at each angular position used

3.4
effective diameter
stylus diameter used with the tip correction vector, for compensating stylus centre points to obtain surface points

Note 1 to entry: For the position of the tip correction vector, see ISO 10360-1:2000, Figure 4.

Note 2 to entry: The effective stylus tip diameter may be a parameter established by a probing-system qualification.

3.5
multi-stylus probing system
fixed orientation single probe that carries star styli or which through stylus changing can present styli at the relevant orientations to be equivalent to a star stylus

Note 1 to entry: See Figure 6.

3.6
multi-probe system
system in which multiple probes having different fixed orientations are carried simultaneously

Note 1 to entry: See Figure 7.

3.7
multi-stylus form (measurement) error
$P_{\mathrm{Form.Sph.5\times25:}j\mathrm{:Tact}}$
error of indication of the form of a test sphere the measurements being taken with five different styli each taking 25 points (5x25) on the one test sphere using the discrete-point probing mode

Note 1 to entry: See ISO 10360-1:2000, Figure 15.

Note 2 to entry: The character P in $P_{\mathrm{Form.Sph.5\times25:}j\mathrm{:Tact}}$ indicates that the error is associated with the system performance when local sampling, and the subscript Form indicates that it is a form error. The subscript Sph indicates that the test is performed using a Sphere as a test artefact. The subscript Tact indicates that the probing system conforms to Clause 1 of this document (i.e. tactile), thus enabling any alternative probing system to be clearly identified by the use of a different set of characters at *in $P_{\mathrm{Form.Sph.5\times25:}j\mathrm{:}*}$

Note 3 to entry: There are four multi-stylus form errors based on different probing systems and methods of operation. These are designated as follows:

j = Emp, an articulating probing system using empirical qualification;

j = Inf, an articulating probing system using inferred qualification;

j = MS, a fixed multi-stylus probing system;

j = MP, a fixed multi-probe system.

3.8
multi-stylus size error
$P_{\mathrm{Size.Sph.5\times25:}j\mathrm{:Tact}}$
error of indication of the diameter of a test sphere, the measurements being taken with five different styli each taking 25 points on the one test sphere by a CMM using the discrete-point probing mode

Note 1 to entry: The subscript Size in $P_{\mathrm{Size.Sph.5\times25:}j\mathrm{:Tact}}$ indicates that it is a diameter size error.

Note 2 to entry: Where *j* is replaced by Emp, Inf, MS or MP as applicable.

3.9
multi-stylus location error
$L_{Dia.5\times25:j:Tact}$
error of indication of the location of a test sphere as measured using the discrete-point probing mode from five different orientations

Note 1 to entry: The character L in $L_{Dia.5\times25:j:Tact}$ indicates that it is a location error.

Note 2 to entry: Where j is replaced by Emp, Inf, MS or MP as applicable.

3.10
opposing-styli projected location error on a sphere
$L_{Dia.Proj.Sph.2\times25:j:Tact}$
error of indication of the location of a test sphere as measured using discrete-point probing from opposing orientations

Note 1 to entry: This gives the user an indication as to the performance of the system when measuring for example co-axiality of crank shaft journals using styli from opposing orientations.

Note 2 to entry: Where j is replaced by Emp, Inf, MS or MP as applicable.

3.11
single-stylus form error
$P_{Form.Sph.1\times25:SS:Tact}$
error of indication of the form of a test sphere, the measurements being performed by a CMM with a single stylus (SS), using the discrete-point probing mode taking 25 points on a single sphere (1x25)

Note 1 to entry: See ISO 10360-1:2000, Figure 15.

Note 2 to entry: The subscript SS in $P_{Form.Sph.1\times25:SS:Tact}$ indicates use of a single stylus.

3.12
single-stylus size error
$P_{Size.Sph.1\times25:SS:Tact}$
error of indication of the diameter of a test sphere, the measurements being performed by a CMM with a single stylus, using the discrete-point probing mode

3.13
scanning mode form error on a sphere
$P_{Form.Sph.Scan:k:Tact}$
the observed form of a test sphere, the measurements being performed by a CMM with a single stylus, using scanning mode

Note 1 to entry: Where k is replaced by the following designates as applicable k = PP or NPP depending on system scanning mode, predetermined path (PP) or non-predetermined path (NPP).

3.14
scanning mode size error on a sphere
$P_{Size.Sph.Scan:k:Tact}$
error of indication of the size of a test sphere, the measurements being performed by a CMM with a single stylus, using scanning mode

Note 1 to entry: Where k is replaced by the following designates as applicable k = PP or NPP depending on system scanning mode, predetermined path or non-predetermined path.

3.15
scanning mode time
$\tau_{Sph.Scan:k:Tact}$
time taken to perform the scanning test

Note 1 to entry: Where k is replaced by the following designates as applicable k = PP or NPP depending on system scanning mode, predetermined path or non-predetermined path.