INTERNATIONAL STANDARD

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Third edition
2017-10

Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment —

Part 1: Decision rules for verifying conformity or nonconformity with specifications

Spécification géométrique des produits (GPS) — Vérification par la mesure des pièces et des équipements de mesure —

Partie 1: Règles de décision pour contrôler la conformité ou la non-conformité à la spécification

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.

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*, in collaboration with Technical Committee CEN/TC 290, *Dimensional and geometrical product specification and verification*.

This third edition cancels and replaces the second edition (ISO 14253-1:2013), which has been technically revised with the following changes:

— The content applies ISO/IEC Guide 98-4 and gives recommendation for simplification by using intervals representing the underlying probability. As a consequence, the default coverage factor $k = 2$ has been replaced with a default conformance probability of 95 %. This makes the risk constant, regardless of the relationship between the specification interval and the measurement uncertainty. See Annex A for additional information.

— Some terminology has been updated.

— The explanation for the population specification modifier has been removed and can now be found in ISO 18391.

A list of all parts in the ISO 14253 series can be found on the ISO website.

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Introduction

This document is a geometrical product specifications (GPS) standard and is to be regarded as a general GPS standard (see ISO 14638). It influences the chain link D of all chains of general GPS standards.

The ISO/GPS Matrix model 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 this document apply in ISO/GPS, unless otherwise indicated.

For more detailed information on the relation of this document to other standards and the GPS matrix model, see Annex B for additional information.

The estimated measurement uncertainty is to be taken into account when verifying conformity or nonconformity with specification.

The problem arises when a measured value falls close to the upper or lower specification limit. In this case, verification of conformity or nonconformity with specifications is not possible: the measurement uncertainty induces a probability that a true value of the characteristic is out of specification even if the measured value falls inside the specification zone, or is in specification even if the measured value falls outside.

Therefore, suppliers and customers should agree in advance in a method to resolve any issues that may arise. This document explains how to define default acceptance and rejection zones (i.e. decision rules) for verifying conformity or nonconformity with specifications.

It is not the intention of this document to consider any prior knowledge of the possible values of the measurand(s), e.g. the variability of the measured objects, which may influence the probability of making the correct decision on verification [in mathematical terms, an a priori unconstrained maximum entropy distribution (12) is assumed].

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Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment —

Part 1:
Decision rules for verifying conformity or nonconformity with specifications

1 Scope

This document establishes the rules for verifying the conformity or nonconformity with a given tolerance for a characteristic of a workpiece (or a population of workpieces) or with a given maximum permissible errors for a metrological characteristic of a measuring equipment, including when the measured value falls close to the specification limits, taking measurement uncertainty into account.

This document applies to specifications defined in general GPS standards (see ISO 14638), i.e. standards prepared by ISO/TC 213, including:

— workpiece specifications and population specifications (usually given as an upper specification limit or a lower specification limit or both);

— measuring equipment specifications (usually given as maximum permissible errors).

This document only applies for characteristics and maximum permissible errors expressed as quantity values.

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 3534-2, *Statistics — Vocabulary and symbols — Part 2: Applied statistics*

ISO 9000, *Quality management systems — Fundamentals and vocabulary*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 98-4, *Uncertainty of measurement — Part 4: Role of measurement uncertainty in conformity assessment*

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 3534-2, ISO 9000, ISO/IEC Guide 98-3, ISO/IEC Guide 98-4 and 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

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

NOTE 1 "Probability density function (PDF)" is defined in ISO 3534-1.

NOTE 2 "Specification limit", "upper specification limit (USL)", "lower specification limit (LSL)", "specified tolerance" and "population" are defined in ISO 3534-2.

NOTE 3 "Maximum permissible measurement error", "measurement uncertainty", "standard measurement uncertainty", "combined standard measurement uncertainty", "coverage interval" and "coverage probability" are defined in ISO/IEC Guide 99.

NOTE 4 "Acceptance limit", "acceptance interval", "rejection interval", "conformance probability" and "guard band" are defined in ISO/IEC Guide 98-4.

NOTE 5 "Conformity" and "nonconformity" are defined in ISO 9000.

NOTE 6 For the purposes of this document, "characteristic" is used to express either a workpiece characteristic, a workpiece population characteristic, or a metrological characteristic of measuring equipment. Because conformity assessment involves measurement, these characteristics are also referred to as measurands.

3.1
specification zone
interval of values, of the workpiece characteristic or population characteristic or the maximum permissible error (MPE) of a metrological characteristic of a measuring equipment, fulfilling the specification

Note 1 to entry: A specification refers to or includes drawings, patterns or other relevant documents.

3.2
conformance probability limit
agreed minimum value of conformance probability when verifying conformity

Note 1 to entry: The conformance probability limit effectively sets the criterion for acceptance when verifying conformity.

Note 2 to entry: A conformance probability limit of p corresponds to a risk of false acceptance less than or equal to $(1 - p)$.

3.3
default conformance probability limit
conformance probability limit (3.2) set by this document as default

3.4
lower nonconformance probability
probability that a value of a characteristic is below the lower specification limit

Note 1 to entry: A lower nonconformance probability exists only if a lower specification limit exists.

Note 2 to entry: Conformance probability, lower nonconformance probability and upper nonconformance probability sum up to unity.

3.5
upper nonconformance probability
probability that a value of a characteristic is above the upper specification limit

Note 1 to entry: An upper nonconformance probability exists only if an upper specification limit exists.

Note 2 to entry: Conformance probability, lower nonconformance probability and upper nonconformance probability sum up to unity.

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3.6
nonconformance probability limit
agreed minimum value of either the *upper nonconformance probability* (3.5) or the *lower nonconformance probability* (3.4) when verifying nonconformity

Note 1 to entry: The nonconformance probability limit effectively sets the criterion for rejection when verifying nonconformity.

Note 2 to entry: A nonconformance probability limit of p implies a risk of false rejection not exceeding $(1 - p)$.

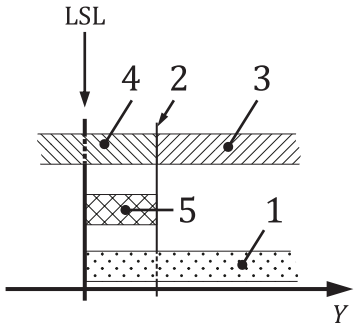
3.7
default nonconformance probability limit
nonconformance probability limit (3.6) set by this document as default

3.8
acceptance zone
set of one or more acceptance intervals

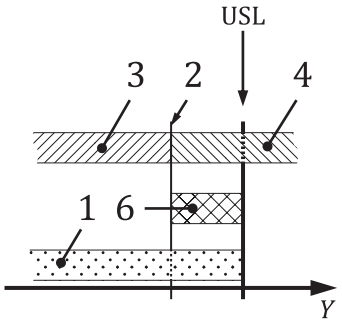
3.9
default acceptance zone
acceptance zone (3.8) based on the *default conformance probability limit* (3.3)

Note 1 to entry: See Figure 1.

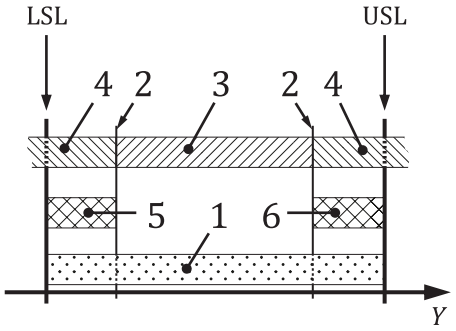
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a) Specification defined only by a lower specification limit



b) Specification defined only by an upper specification limit



c) Specification defined by a lower and an upper specification limit

Key

1 specification zone
2 acceptance limits
3 acceptance zone
4 rejection zone
5 guard band g_{LA} at lower specification limit
6 guard band g_{UA} at upper specification limit
Y value of characteristic
LSL lower specification limit
USL upper specification limit

NOTE In most cases, the probability density function (PDF) associated with the measured value of the characteristic is considered to be symmetrical, so that g_{UA}, g_{LA} have the same width.

Figure 1 — Acceptance zone and rejection zone when verifying conformity

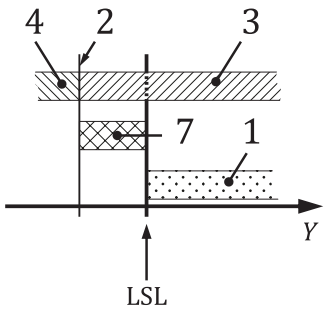
3.10
rejection zone
set of one or more rejection intervals

Note 1 to entry: The rejection zone is the complement to the *acceptance zone* (3.8).

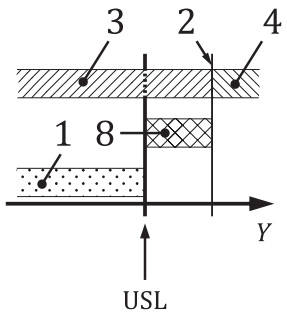
3.11
default rejection zone
rejection zone (3.10) based on the *default nonconformance probability limit* (3.7).

Note 1 to entry: See Figure 2.

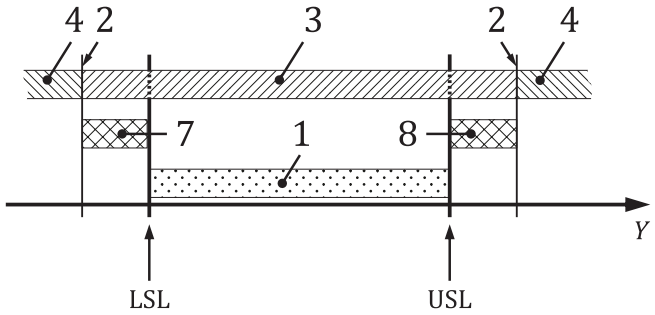
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a) Specification defined only by a lower specification limit



b) Specification defined only by an upper specification limit



c) Specification defined by a lower and an upper specification limit

Key

1 specification zone
2 acceptance limits
3 acceptance zone
4 rejection zone
7 guard band g_{LR} at lower specification limit
8 guard band g_{UR} at upper specification limit
Y value of characteristic
LSL lower specification limit
USL upper specification limit

NOTE In most cases, the probability density function (PDF) associated with the measured value of the characteristic is considered to be symmetrical, so that g_{UR}, g_{LR} have the same width.

Figure 2 — Rejection zone and acceptance zone when verifying nonconformity

3.12
uncertainty zone
set of interval(s) close to the specification limit(s) where neither conformity can be verified according to the *conformance probability limit* (3.2) nor nonconformity can be verified according to the *nonconformance probability limit* (3.6)

Note 1 to entry: The uncertainty zone is located about the specification limit (unilateral specification) or specification limits (bilateral specification).

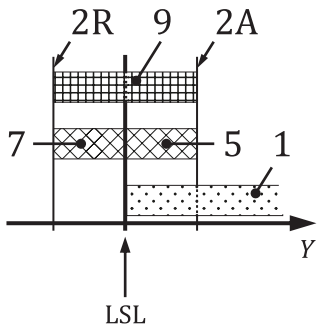
Note 2 to entry: The uncertainty zone on the upper and lower side of a specification limit may be of different magnitudes.

Note 3 to entry: When verifying conformity, the uncertainty zone is part of the *rejection zone* (3.10) and not part of the *acceptance zone* (3.8).

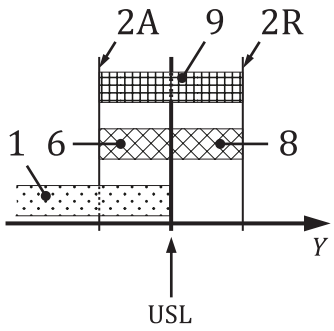
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Note 4 to entry: When verifying nonconformity, the uncertainty zone is part of the *acceptance zone* (3.8) and not part of the *rejection zone* (3.10).

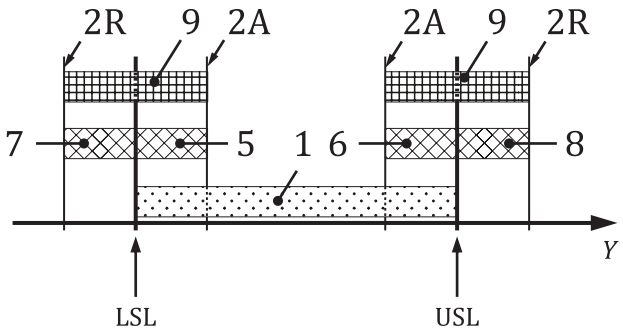
Note 5 to entry: See Figure 3, Figure 4, Figure 5 and Figure 6.



a) Specification defined only by a lower specification limit



b) Specification defined only by an upper specification limit



c) Specification defined by a lower and an upper specification limit

Key

1	specification zone
2A	acceptance limits for verifying conformity
2R	acceptance limits for verifying nonconformity
5	guard band g_{LA} at lower specification limit for verifying conformity
6	guard band g_{UA} at upper specification limit for verifying conformity
7	guard band g_{LR} at lower specification limit for verifying nonconformity
8	guard band g_{UR} at upper specification limit for verifying nonconformity
9	uncertainty zone
Y	value of characteristic
LSL	lower specification limit
USL	upper specification limit

NOTE 1 Figure 3 c) could be seen as a combination of Figure 3 a) and Figure 3 b).

NOTE 2 In most cases, the probability density function (PDF) associated with the measured value of the characteristic is considered to be symmetrical, so that g_{UA}, g_{LA} and g_{UR}, g_{LR} have the same width.

Figure 3 — Uncertainty zone

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