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**Geometrical product specifications (GPS)
— General concepts and requirements for
GPS measuring equipment**

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry based on the provision of Article 14, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act in response to a proposal for revision of Japanese Industrial Standard with a draft being attached, submitted by Japanese Standards Association (JSA), an accredited standards development organization. This edition replaces the previous edition (**JIS B 0642** : 2010), which has been technically revised.

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Geometrical product specifications (GPS) — General concepts and requirements for GPS measuring equipment

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 14978** : 2018, Edition 2, with some modifications of the technical contents.

The dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JA.

This Standard is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see **JIS B 0661**). It influences chain links F and G for measuring equipment and calibration in the general GPS matrix model (see Annex E).

The GPS matrix model given in **JIS B 0661** gives an overview of the GPS system of which this Standard is a part. The fundamental rules of GPS given in **JIS B 0024** apply to this Standard and the default decision rules given in this Standard apply to GPS specifications made in accordance with this Standard, unless otherwise indicated. See **JIS B 0641-1**, Annex JA for additional information on the selection of alternative decision rules.

For more detailed information of the relation of this Standard to other standards and the GPS matrix model, see Annex E.

This Standard contains guidance for writing the standards for specific GPS measuring equipment.

NOTE GPS measuring equipment includes, for example, micrometers, callipers, gauge blocks and rotary axis form measuring instruments.

This Standard is intended to give the user a basic understanding of the use of **JISs** for GPS measuring equipment. This Standard presents and defines general concepts to be used in connection with GPS measuring equipment to avoid multiple repetitions in the **JISs** for specific GPS measuring equipment. This Standard is also intended as guidance for the manufacturer/supplier to evaluate and present specifications for characteristics for GPS measuring equipment.

This Standard is necessary when reading and using **JISs** for specific GPS measuring equipment.

1 Scope

This Standard specifies the general requirements, calibration, terms and definitions of characteristics of GPS measuring equipment, for example micrometers, callipers, gauge blocks and rotary axis form measuring instruments. This Standard forms the

basis for standards defining and describing the design characteristics and metrological characteristics for measuring equipment and gives guidance for the development and content of standards for GPS measuring equipment.

This Standard is intended to ease the communication between manufacturer/supplier and user/customer and to make the specification phase of GPS measuring equipment more accurate. This Standard is also intended as a tool to be used in companies in the process of defining and selecting relevant characteristics for measuring equipment.

This Standard includes terms which are frequently used in connection with the characterization of specific measuring equipment.

NOTE The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 14978 : 2018 *Geometrical product specifications (GPS) — General concepts and requirements for GPS measuring equipment* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

Part or all of the provisions of the following standards, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and the revisions (including amendments) made thereafter shall not be applied. For those without the indication of the year, the most recent editions (including amendments) shall be applied.

JIS B 0641-1 *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 1 : Decision rules for proving conformance or nonconformance with specifications*

NOTE Normative reference in the corresponding International Standard : 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*

JIS B 0641-5 *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 5 : Uncertainty in verification testing of indicating measuring instruments*

NOTE Normative reference in the corresponding International Standard : ISO 14253-5 : 2015 *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 5 : Uncertainty in verification testing of indicating measuring instruments*

JIS Z 8103 *Glossary of terms used in measurement*

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 : 2012 *Uncertainty of measurement — Part 4 : Role of meas-*

*urement uncertainty in conformity assessment***3 Terms and definitions**

For the purpose of this Standard, the following terms and definitions, and those given in **JIS B 0641-1**, **JIS B 0641-5**, **JIS Z 8103** and **ISO/IEC Guide 98-4 : 2012** apply.

3.1 JIS Z 8103 terms

For the terms shown in Table 1, the definitions from **JIS Z 8103** specifically apply in the use of this Standard. This non-exhaustive list is included to avoid ambiguity with other possible terms and definitions.

Table 1 JIS Z 8103 terms

Term	Subclause and entry number in JIS Z 8103
calibration	3.4, 401
indicating measuring instrument	3.6, 614
indication	3.7, 705
material measure	3.6, 616
maximum permissible measurement error, maximum permissible error, limit of error	3.7, 734
measurand	3.3, 301
measured quantity value, measured value	3.5, 502
measurement method	3.3, 304
measurement repeatability (of mono-characteristic measuring equipment) repeatability (of mono-characteristic measuring equipment)	3.5, 519
measurement result, result of measurement	3.5, 501
measurement standard	3.4, 410
measurement uncertainty, uncertainty of measurement, uncertainty	3.5, 526
measuring instrument	3.6, 612
measuring system	3.6, 613
quantity value, value	3.2, 219
rated operating condition	3.7, 716
reference material	3.4, 422
reference measurement standard, reference standard	3.4, 415
reference quantity value, reference value	3.4, 427
resolution	3.7, 721
uncertainty budget	3.5, 528
verification	3.4, 406

3.2 Synonym terms to JIS Z 8103 terms

The terms shown in Table 2, as used in this Standard, are synonyms for the **JIS Z 8103** terms as shown in the table. These synonym terms are used for consistency with previous versions of this Standard.

Table 2 Synonym terms to **JIS Z 8103** terms

Synonym term used in this Standard	NOTES	JIS Z 8103 terms	Subclause and entry number in JIS Z 8103
measuring range	See Figure 5	measuring interval	3.7, 714
nominal range	See Figure 5	nominal indication interval	3.7, 712
nominal span	See Figure 5	range of a nominal indication interval	3.7, 713
error of indication, indication error	—	measurement error	3.5, 505

3.3 ISO/IEC Guide 98-4 : 2012 terms

For the terms shown in Table 3, the definitions from **ISO/IEC Guide 98-4 : 2012** specifically apply in the use of this Standard. This non-exhaustive list is included to avoid ambiguity with other possible terms and definitions.

Table 3 ISO/IEC Guide 98-4 : 2012 terms applicable in the use of this Standard

Term	Subclause in ISO/IEC Guide 98-4
decision rule	3.3.12 documented rule that describes how measurement uncertainty will be accounted for with regard to accepting or rejecting an item, given a specified requirement and the result of a measurement
specified requirement	3.3.3 need or expectation that is stated
tolerance limit, specification limit	3.3.4 specified upper or lower bound of permissible values of a property

3.4 JIS B 0641-5 terms

For the terms shown in Table 4, the definitions from **JIS B 0641-5** specifically apply in the use of this Standard. This non-exhaustive list is included to avoid ambiguity with other possible terms and definitions.

Table 4 JIS B 0641-5 terms applicable in the use of this Standard

Term	Subclause in JIS B 0641-5
test measurand	3.4
test protocol	3.5
test value	3.8
test value uncertainty test uncertainty	3.9

3.5 Terms related to GPS measuring equipment

3.5.1

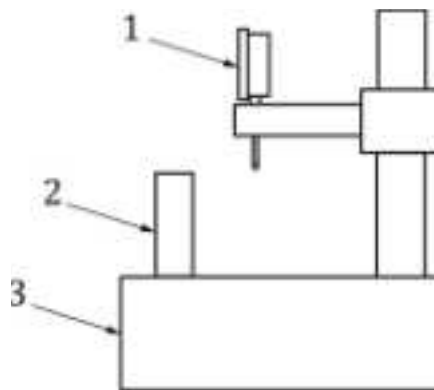
measuring equipment

indicating measuring instrument, material measure, software, measurement standard, reference material or auxiliary equipment used in a measurement

Note 1 to entry This definition is necessarily wider than that of a measuring instrument since it includes all the devices used in a measurement.

Note 2 to entry Measuring equipment should not be confused with a measuring system, which is a set of measuring equipment used together for a specific measurement.

Note 3 to entry See Figure 1.



Key

1 : indicating measuring instrument (dial gauge)

2 : material measure (gauge block)

3 : auxiliary equipment (measuring stand)

Figure 1 A measuring system composed of various pieces of measuring equipment

3.5.2

metrological characteristic

characteristic of measuring equipment, which may influence the results of measurement when using the measuring equipment

- Note 1 to entry The influence on the results of measurement is a contributor to measurement uncertainty (see Clause 6).
- Note 2 to entry The values of a metrological characteristic are expressed in numerical values or as a function and can be evaluated in units other than that of the measurement results.
- Note 3 to entry Measuring equipment usually has several metrological characteristics.
- Note 4 to entry Metrological characteristics can be subject to calibration and verification.

3.5.3

task-related calibration

calibration of only those metrological characteristics which influence the measurement uncertainty for the intended use

3.5.4

design characteristic

characteristic of measuring equipment which does not influence the measurement directly, but which may be of interest for other reasons when the measuring equipment is used

- Note 1 to entry Design characteristics can influence, for example, interchangeability, scale mark readability for a straight or circular scale, or wear resistance (see Clause 5).
- Note 2 to entry Some design characteristics can influence the equipment's long-term capacity to make measurements (influencing design characteristics), for example its wear resistance or its environmental resistance. Other design characteristics may have no influence on measurements.
- Note 3 to entry A design characteristic might be expressed as, for example, dimensions, material properties or interface protocols.

3.5.5

maximum permissible limit, MPL

tolerance limit for a metrological characteristic which is not an error of indication

- Note 1 to entry MPE, not MPL, should be used for metrological characteristics associated with errors of indication.
- Example 1 MPL for the measuring force for micrometers for external measurements.
- Example 2 MPL for the size of the gauge element of a plain limit gauge of linear size.

3.5.6

verification test, test

operation that, under specified conditions and with sufficient objective evidence, estab-

lishes that measuring equipment conforms or does not conform to stated specifications

- Note 1 to entry A verification test can be used as the calibration when both the first and second step in the definition of calibration are appropriately satisfied (see 6.1.4).
- Note 2 to entry This definition is consistent with the definition of a test in **JIS B 0641-5**, but is broader in scope as the concept of a test in **JIS B 0641-5** is limited to indicating measuring instruments.
- Note 3 to entry The detailed specification of a verification test is defined in a test protocol.
- Note 4 to entry The specified conditions of a verification test are defined by relevant standards and by the stated rated operating conditions of the measuring equipment.

3.5.7

acceptance test

verification test (3.5.6) agreed upon by the measuring equipment manufacturer/supplier and the user/customer to verify that the performance of the measuring equipment is as stated by the manufacturer/supplier

- Note 1 to entry Acceptance tests are commonly used by the customer in the purchase of measuring equipment.

3.5.8

reverification test

verification test (3.5.6) to verify that the performance of the measuring equipment is as stated by the user

- Note 1 to entry The specifications chosen might or might not be the same as those used in the original acceptance test for the measuring equipment.
- Note 2 to entry Reverification tests are not used in the purchase of measuring equipment.

3.5.9

test point

specific point within the measuring range used in a verification test

- Note 1 to entry Test points are usually defined relative to a reference point.

3.5.10

reference point, setting point

point within the measuring range of measuring equipment where the error of indication is stated or adjusted to be zero whenever permitted by the design of the measuring equipment

- Note 1 to entry Depending on the measuring equipment, the reference point might or might not be considered fixed (established in a perma-

nent manner) for the intended use of the equipment.

3.5.11

hysteresis

difference in indication associated with two different orientations in the specified range (in the entire measuring range if the range is not specified) at any point in the measuring range

3.5.12

digital step

smallest possible change in the least significant digit in a digital indicating device

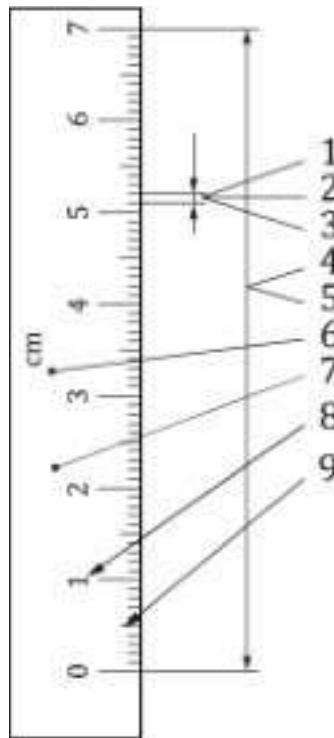
Note 1 to entry For a digital indicating device, the resolution is equal to the digital step.

3.5.13

scale division

space on a scale between any two successive scale marks

Note 1 to entry See Figures 2 and 3.



Key

- 1 : scale division
- 2 : scale interval : in this example, 0.1 cm
- 3 : scale spacing : in this example, 0.1 cm
- 4 : scale length : in this example, 7 cm
- 5 : scale range : in this example, 0 cm to 7 cm; scale span : in this example, 7 cm
- 6 : units marked on the scale (in this example, cm)
- 7 : scale face
- 8 : scale numbering : in this example 0, 1,...,7
- 9 : scale mark

Figure 2 Terms related to an analogue straight scale

3.5.14

scale interval

absolute value of the difference between the values corresponding to two successive scale marks, in the units marked on the scale

Note 1 to entry Scale interval should not be confused with resolution, which is not necessarily equal to the scale interval.

Note 2 to entry See Figures 2 and 3.

3.5.15

scale spacing

<analogue straight scale> distance between two successive scale marks

Note 1 to entry See Figure 2.

3.5.16

scale spacing

<analogue circular scale> arc length between two successive scale marks of the circle passing through the centres of all the shortest scale marks

Note 1 to entry See Figure 3.

3.5.17

scale length

<analogue straight scale> length between the first and the last scale marks

Note 1 to entry See Figure 2.

3.5.18

scale length

<analogue circular scale> arc length of the circle passing through the centres of all the shortest scale marks

Note 1 to entry See Figure 3.

3.5.19

scale range

set of values bounded by the extreme indications

Note 1 to entry The lower limit of the scale range is not necessarily zero, for example in the case of an internal micrometer whose scale range starts at 5 mm.

Note 2 to entry See Figures 2 and 3.

3.5.20

scale span

absolute value of the difference between the two limits of a scale range

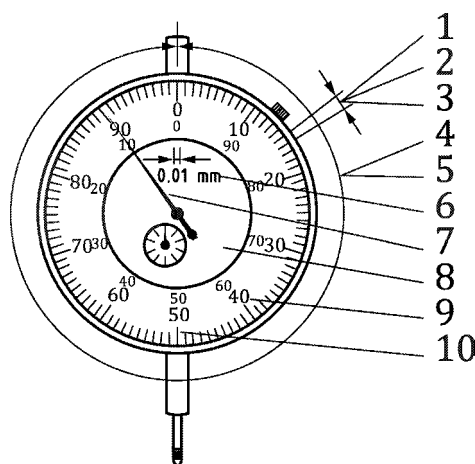
Note 1 to entry See Figures 2 and 3.

3.5.21

index

fixed or movable part of an analogue indicating device whose position with reference to the scale marks enables an indicated value to be determined

Note 1 to entry For some measuring equipment, the index is called the “pointer”.



Key

- 1 : scale division
- 2 : scale interval : in this example, 0.01 mm
- 3 : scale spacing : in this example, approximately 1 mm
- 4 : scale length : in this example, approximately 100 mm (for a diameter of 32 mm)
- 5 : scale range : in this example, 0.00 mm to 1.00 mm; scale span : in this example, 1 mm
- 6 : units marked on the scale [in this example, millimetres (mm)]
- 7 : pointer
- 8 : scale face
- 9 : scale numbering : in this example there are two sets of scale numbering
- 10 : scale mark

Figure 3 Terms related to an analogue circular scale

3.5.22

scale face

surface of measuring equipment that carries the scale

Note 1 to entry See Figures 2 and 3.

3.5.23

scale numbering

ordered set of numbers associated with the scale marks

Note 1 to entry See Figures 2 and 3.

3.5.24

scale mark

lines on the scale face

Note 1 to entry See Figures 2 and 3.

3.5.25

probe

device that generates a signal which is used in the determination of a measured value

Note 1 to entry For some measuring equipment, the probe is called the “sensor” or “detector”.

Note 2 to entry See Figure 4.

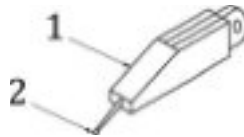
3.5.26

measuring element

element of measuring equipment that interacts with a measured item during a measurement

Note 1 to entry For some measuring equipment, the measuring element is called the “measuring face” or the “stylus tip”.

Note 2 to entry See Figure 4.



Key

1 : probe

2 : measuring element (stylus tip)

Figure 4 . Terms related to a probe

3.5.27

measuring span

absolute value of the difference between the extreme quantity values of a measuring range

Note 1 to entry See Figure 5.

3.5.28

pre-range

range of indications obtainable with a particular setting of measuring equipment from the lowest possible indication to the lower limit of the measuring range

Note 1 to entry See Figure 5.

3.5.29

pre-span

absolute value of the difference between the two limits of a pre-range

Note 1 to entry See Figure 5.

3.5.30

post-range

range of indications obtainable with a particular setting of measuring equipment from the upper limit of the measuring range to the highest possible indication

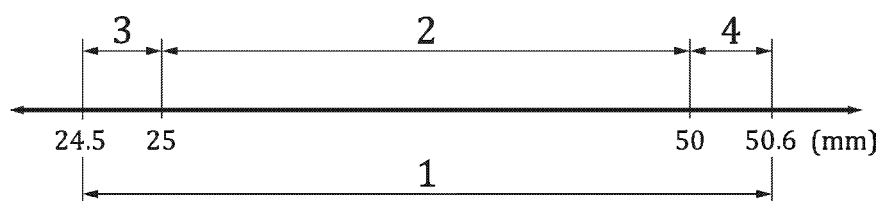
Note 1 to entry See Figure 5.

3.5.31

post-span

absolute value of the difference between the two limits of a post-range

Note 1 to entry See Figure 5.



Key

1 : nominal range : 24.5 mm to 50.6 mm

nominal span : 26.1 mm ($50.6 \text{ mm} - 24.5 \text{ mm} = 26.1 \text{ mm}$)

2 : measuring range : 25 mm to 50 mm

measuring span : 25 mm ($50 \text{ mm} - 25 \text{ mm} = 25 \text{ mm}$)

3 : pre-range : 24.5 mm to 25 mm

pre-span 0.5 mm ($25 \text{ mm} - 24.5 \text{ mm} = 0.5 \text{ mm}$)

4 : post-range : 50 mm to 50.6 mm

post-span : 0.6 mm ($50.6 \text{ mm} - 50 \text{ mm} = 0.6 \text{ mm}$)

NOTE An external micrometer with a measuring range of 25 mm — 50 mm has been used as an example.

Figure 5 Range and span terms

4 Abbreviations

For the purposes of this Standard, the abbreviations in Table 5 apply.

Table 5 Abbreviations

Abbreviation	Term	Reference
MPE	maximum permissible error	JIS Z 8103, 3.7, 734
MPL	maximum permissible limit	3.5.5 of this Standard

5 Design characteristics

5.1 General

5.1.1 Importance of design characteristics

Design characteristics for measuring equipment can be of interest even if they do not

have an influence on the uncertainty of measurement, for example for the sake of interchangeability. Important design characteristics may be subject to specification by the manufacturer/supplier and/or the user/customer of the measuring equipment. The kinds of important design characteristics are dependent on the type, design and intended use of the measuring equipment.

Some design characteristics may have an influence on the equipment's long-term ability to measure, for example wear may influence some of the metrological characteristics.

Design characteristics common to a variety of measuring equipment are as specified in Annex C.

5.1.2 Standards for measuring equipment

Relevant design characteristics are subject to standardization in specific standards concerning the individual types of measuring equipment. This standardization shall be limited to the most important design characteristics so as not to limit development of measurement technology.

The specific standards concerning the individual types of measuring equipment can use two approaches for design characteristics :

- listing of the design characteristics to be explicitly stated by the manufacturer/supplier, including associated values and/or tolerance limit values;

Example 1 Calliper manufacturer/supplier states length of jaws for external measurements (**JIS B 7507**).

- listing of the design characteristics and associated values and/or tolerance limit values to be standardized.

Example 2 Standardized diameter of stem for interchangeability of dial gauges (**JIS B 7503**).

Those design characteristics, if any, which are of uppermost importance and therefore are to be standardised shall be evaluated and decided for the specific measuring equipment. The lists in 5.2 and 5.3 shall be used as guidance for the **JISs** on specific measuring equipment.

5.1.3 Measuring equipment — Commerce

In product documentation, for example data sheets, intended to give customers information on a product, manufacturers and suppliers of GPS measuring equipment shall at least present the suggested design characteristics given in the relevant specific standard.

It may be in the interests of the manufacturer/supplier to supply additional relevant information about design characteristics (see Annex B).

A customer may have special requirements for additional design characteristics. This Standard may be used as a tool to establish those specifications.

5.1.4 Measuring equipment — Internal use in a company