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Gauge blocks

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Precision Measuring Instruments Association (JMA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS B 7506:1997** is replaced with this Standard.

This Standard has been made based on **ISO 3650:1998** *Geometrical Product Specifications (GPS) — Length standards — Gauge blocks* for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard. Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

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the original JIS is to be the final authority.

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Gauge blocks

Introduction This Japanese Industrial Standard has been prepared based on the first edition of **ISO 3650 Geometrical Product Specifications (GPS) — Length standards — Gauge blocks** published in 1998, the corresponding parts of which are adopted without modification in the technical contents. On the other hand, the items not specified in the International Standard have been added, main contents of which are shown in **a)** to **c)** below.

In this Standard, the portions with sidelines or dotted underlines are the items not contained in the original International Standard or items added. A list of modifications with the explanation is shown in annex 5 (informative).

- a) Reference condition: standard water vapour pressure and standard carbon dioxide content
- b) Correction items for interferometry: carbon dioxide content
- c) Length inspection certificate or grade inspection certificate for gauge blocks

1 Scope This Standard specifies the gauge blocks with rectangular cross section, nominal length ranging from 0.5 mm to 1 000 mm and of calibration grade K and of grade 0, 1 and 2.

The accessories of gauge blocks are specified in annex 1.

Remarks : The International Standard corresponding to this Standard is as follows.

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**.

ISO 3650:1998 *Geometrical Product Specifications (GPS) — Length standards — Gauge blocks* (MOD)

2 Normative references The following standards contain provision which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 0021 *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerancing of form, orientation, location and run-out*

Remarks : **ISO/DIS 1101:1996 Geometrical Product Specifications (GPS) — Geometrical tolerancing — Tolerancing of form, orientation, location and run-out** is identical with the said standard.

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*

Remarks : **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** is identical with the said standard.

JIS Z 2244 *Vickers hardness test — Test method*

Remarks : **ISO 6507-1:1997** *Metallic materials — Vickers hardness test — Part 1: Test method* is equivalent to the said standard.

JIS Z 8103 *Glossary of terms used in measurement*

ISO 1 *Standard reference temperature for industrial length measurements*

3 Definitions and symbols For the purposes of this Standard, the definitions given in **JIS Z 8103** and the following definitions apply.

- a) **gauge block** end standard of rectangular section, made of wear resistant material, with one pair of planar, mutually parallel measuring faces which can be wrung to other gauge blocks or auxiliary plates (plane surfaces)
- b) **length of a gauge block (l)** distance between any particular point of the measuring face and the plane surface of an auxiliary plate of the same material and surface texture upon which the other measuring face has been wrung ⁽¹⁾ (see figure 1)

Note ⁽¹⁾ The length of a gauge block includes the thickness of wringing layer generated in adhesion to the plane surface of auxiliary plate.

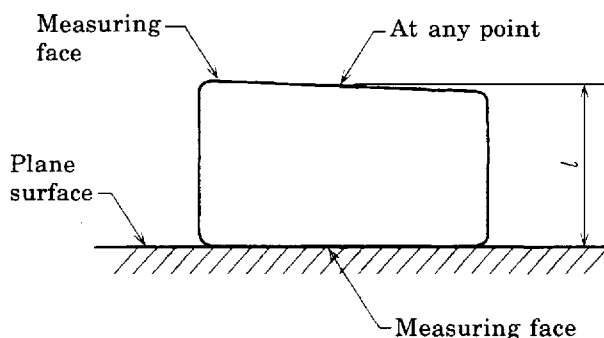


Figure 1 Length of a gauge block

- c) **central length of gauge block (l_c)** length of a gauge block taken at the centre of the measuring face (see figure 2)

Information : When the measuring faces are not parallel, the gauge block has two central lengths l_c and l_{c1} corresponding to the two measuring faces. The difference between l_c and l_{c1} , however, is practically negligible provided that the gauge block has an accuracy specified in this Standard [see figure 2 b)].

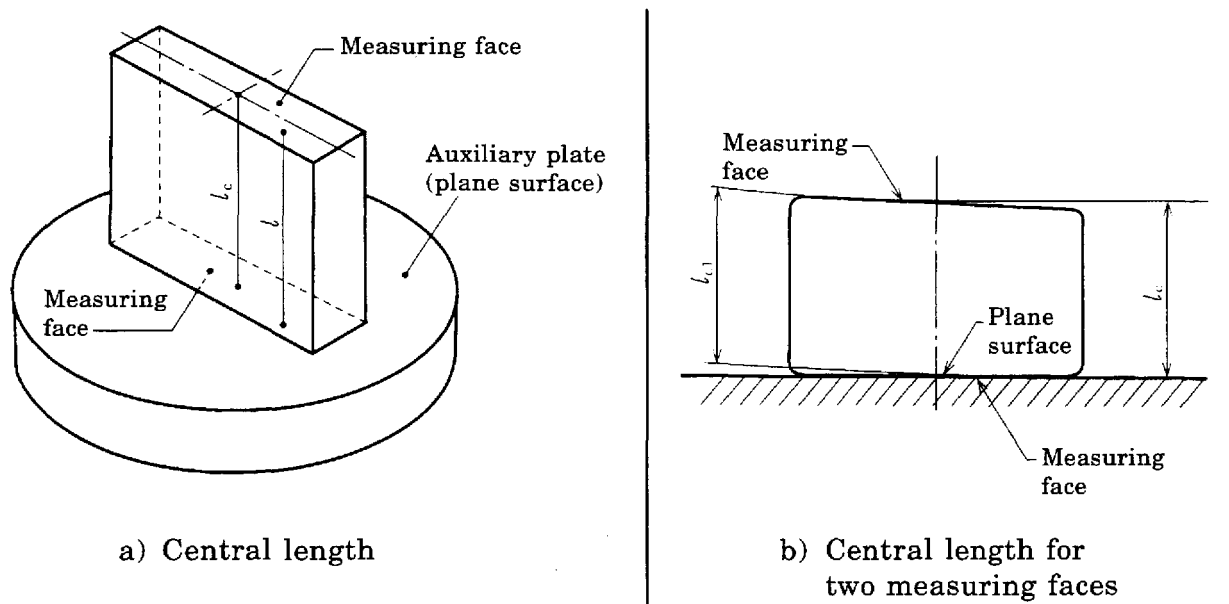
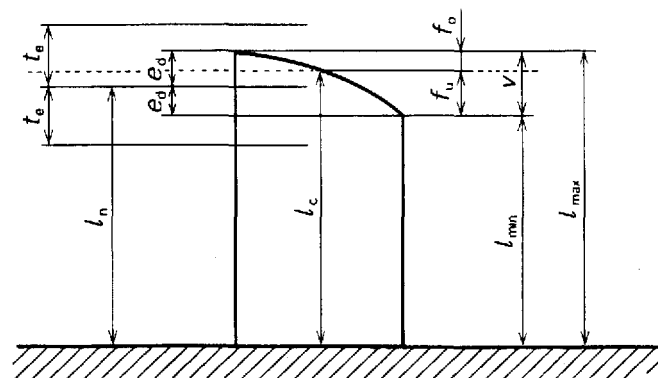


Figure 2 Central length of a gauge block

- d) **deviation of the length at any point from nominal length(e)** algebraic difference $l - l_n$

Remarks : Maximum deviation of length (e_d) from nominal length is the larger value of either $l_{\max} - l_n$ or $l_n - l_{\min}$ (see figure 3).



Remarks : t_e : length tolerance from nominal length.

Figure 3 Deviation length of a gauge block

- e) **limit deviation of the length of a gauge block(t_e)** permissible deviation of the length of the gauge block from nominal length at any point of measurement (see figure 3)
- f) **variation in length(v)** difference between the maximum length $l_{\max}$ and the minimum length $l_{\min}$

Information : The variation in length is equal to the sum of deviations f_o and f_u from central length (see figure 3).

- g) **tolerance for the variation in length of a gauge block(t_v)** permissible value for the variation in length of a gauge block (v)

- h) **flatness of measuring face**(f_a) minimum distance between two parallel planes between which all points of the measuring face lie (see figure 4 and **JIS B 0021**)

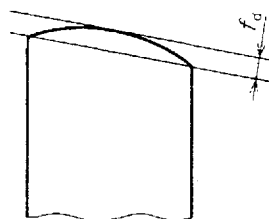


Figure 4 Flatness of a measuring face

- i) **wringing** property of the measuring faces of gauge blocks to adhere to other measuring faces or to faces with similar surface finish as a result of molecular forces.

4 Nomenclature The nomenclature of faces of a gauge block is given in figure 5.

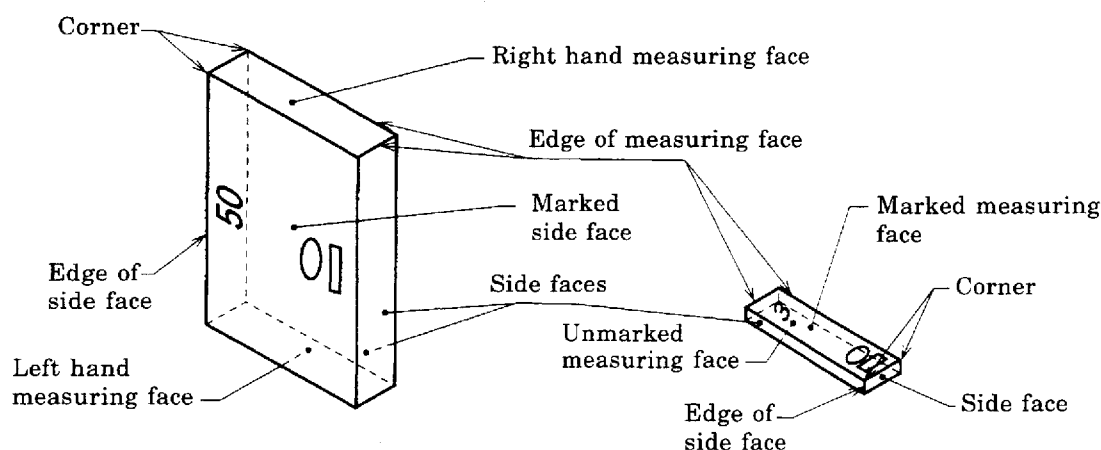


Figure 5 Nomenclature of faces of a gauge block

5 Grades The gauge block shall be classified according to accuracy into four grades of grade K, grade 0, grade 1 and grade 2. The gauge block of grade K shall be calibrated by the method of interferometry to be used for calibration of the other grade block gauges, and shall be always used together with the correction by the values indicated in the inspection certificate. The grade 0, grade 1 and grade 2 gauge blocks shall be calibrated by comparison measurement method.

6 Accuracy requirements

6.1 General Each gauge block shall conform to the requirements of its grade.

The estimated uncertainty of calibration is contained in limit deviation of length and tolerance for variation in length, and considered within their permissible limit values (see **JIS B 0641-1**).

The accuracy requirements apply to the measuring faces of the gauge block omitting a border zone with a maximum width of 0.8 mm as measured from the plane of the side faces. In this border zone the surface shall not lie above the plane of the measuring face.

6.2 Limit deviation of the length The limit deviation of the length of gauge blocks (t_e) shall be as specified in table 1.

Table 1 Limit deviations of the length at any point from nominal length and tolerances for variation in length

Unit: μm

Nominal length range (mm)		Grade K		Grade 0		Grade 1		Grade 2	
Over	Up to	Limit deviations of length at any point from nominal length t_e ($\pm$)	Tolerance for the variation in length t_v	Limit deviations of length at any point from nominal length t_e ($\pm$)	Tolerance for the variation in length t_v	Limit deviations of length at any point from nominal length t_e ($\pm$)	Tolerance for the variation in length t_v	Limit deviations of length at any point from nominal length t_e ($\pm$)	Tolerance for the variation in length t_v
0.5 ⁽²⁾	10	0.20	0.05	0.12	0.10	0.20	0.16	0.45	0.30
10	25	0.30	0.05	0.14	0.10	0.30	0.16	0.60	0.30
25	50	0.40	0.06	0.20	0.10	0.40	0.18	0.80	0.30
50	75	0.50	0.06	0.25	0.12	0.50	0.18	1.00	0.35
75	100	0.60	0.07	0.30	0.12	0.60	0.20	1.20	0.35
100	150	0.80	0.08	0.40	0.14	0.80	0.20	1.60	0.40
150	200	1.00	0.09	0.50	0.16	1.00	0.25	2.00	0.40
200	250	1.20	0.10	0.60	0.16	1.20	0.25	2.40	0.45
250	300	1.40	0.10	0.70	0.18	1.40	0.25	2.80	0.50
300	400	1.80	0.12	0.90	0.20	1.80	0.30	3.60	0.50
400	500	2.20	0.14	1.10	0.25	2.20	0.35	4.40	0.60
500	600	2.60	0.16	1.30	0.25	2.60	0.40	5.00	0.70
600	700	3.00	0.18	1.50	0.30	3.00	0.45	6.00	0.70
700	800	3.40	0.20	1.70	0.30	3.40	0.50	6.50	0.80
800	900	3.80	0.20	1.90	0.35	3.80	0.50	7.50	0.90
900	1 000	4.20	0.25	2.00	0.40	4.20	0.60	8.00	1.00

Note (2) The nominal length 0.5 mm is included in this length range.

6.3 Variation in length The tolerance for the variation in length (t_v) of gauge blocks shall be as specified in table 1.

6.4 Flatness of measuring face The flatness tolerance (t_{fd}) of the measuring face of gauge blocks shall be as specified in table 2. The gauge blocks 2.5 mm or under in nominal length shall be measured wrung to an auxiliary plate⁽³⁾ having sufficient rigidity and flatness, and in the case of gauge block unwrung, the measuring face shall be flat to within 4 μm .

Note (3) The thickness of the auxiliary plate shall be 11 mm or over.

Table 2 Flatness tolerance of measuring face

Unit: μm

Nominal length range (mm)		Grade K	Grade 0	Grade 1	Grade 2
Over	Up to				
0.5 ⁽⁴⁾	150	0.05	0.10	0.15	0.25
150	500	0.10	0.15	0.18	0.25
500	1 000	0.15	0.18	0.20	0.25

Note (4) The nominal length 0.5 mm is included in this length range.

6.5 Wringing property of measuring face The measuring faces of all gauge blocks shall wring readily. Fine scratches without burrs may be accepted when they do not impair the wringing property.

7 Shapes and dimensions

7.1 Dimensions of cross section The dimension of the cross section parallel to the measuring face of gauge block shall be as given in table 3.

Table 3 Dimension of cross section

Unit: mm

Nominal dimension	Dimension of cross section
0.5 or over up to and incl. 10	$30 \begin{smallmatrix} 0 \\ -0.3 \end{smallmatrix} \times 9 \begin{smallmatrix} -0.05 \\ -0.2 \end{smallmatrix}$
Over 10 up to and incl. 1000	$35 \begin{smallmatrix} 0 \\ -0.3 \end{smallmatrix} \times 9 \begin{smallmatrix} -0.05 \\ -0.2 \end{smallmatrix}$

7.2 Edges The edges of gauge blocks shall have a radius or chamfer of not greater than 0.3 mm. The crossing line of the measuring face and the chamfer shall be under a state free from influencing on wringing property or impairing the opposed measuring face.

7.3 Flatness tolerance and parallelism tolerance of side faces The flatness tolerance and parallelism tolerance of side faces of a gauge block shall be as specified in table 4.

Table 4 Flatness tolerance and parallelism tolerance of side faces

Unit: μm

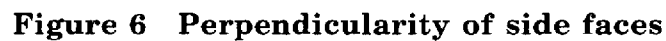
Nominal dimension (mm)	Flatness tolerance	Parallelism tolerance
0.5 or over up to and incl. 100	40	80
Over 100 up to and incl. 1 000	$40+40 \times 10^{-3} \times l_n$	$80+80 \times 10^{-3} \times l_n$

Remarks : l_n : nominal length expressed in mm.

7.4 Perpendicularity tolerance of side faces The perpendicularity tolerance of the side faces of a gauge block shall be as specified in table 5 (see figure 6 and **JIS B 0021**). The angle between adjacent side faces shall be $90^\circ \pm 10'$.

Unit: μm

Note ⁽⁵⁾ The nominal length 10 mm is included in this range of length.



Note (6) Gauge blocks of grade K shall not be combined using coupling holes.



8.1 Material Gauge blocks shall be made of high grade steel or of other similarly wear resistant material capable of being finished with surfaces that will wring readily, and which will have consistent length.

8.2 Coefficient of thermal expansion The coefficient of thermal expansion of steel gauge blocks in the temperature range of 10°C to 30°C shall be $(11.5 \pm 1.0) \times 10^{-6} \text{ K}^{-1}$. The coefficient of expansion, with its estimated uncertainty of determination, of steel grade K gauge blocks, gauge blocks of all grades made of material not in the range of the thermal expansion coefficient, and those made of materials other than steel shall be clearly indicated.

8.3 Hardness The measuring faces of steel gauge block shall have a Vickers hardness of not less than 800HV0.5 (see **JIS Z 2244**).

8.4 Dimensional stability For the dimensional stability of gauge blocks, the change in length by aging shall not exceed the maximum permissible change in length as given in table 6. The dimensional stability shall be confirmed by the test with a sample, and the sample shall be stored under a state wherein the length stability is free from special influences, i.e., exceptional temperature, vibration, shock, magnetic field or mechanical force during that period. The test period shall be long enough for discerning the change in the length, taking the accuracy of length measurement into account.

Table 6 Dimensional stability

Unit: $\mu\text{m}/\text{year}$

Grade	Maximum permissible change in length per year
K, 0	$\pm(0.02 + 0.25 \times 10^{-3} \times l_n)$
1, 2	$\pm(0.05 + 0.5 \times 10^{-3} \times l_n)$

Remarks : l_n : nominal length expressed in mm.

9 Basis of measurement, traceability and reference condition

9.1 Unit of length : metre (information) The metre is defined as the length of the path travelled by light in vacuum in $1/299\,792\,458$ of one second (17th General Conference of Weights and Measures, in 1983). This definition is realized by working wavelength standards recommended by Comité International des Poids et Mesures (International Committee of Weights and Measures).

9.2 Traceability of the length of a gauge block (information) When the measured result is related to the gauge blocks calibrated with an interferometer for which a suitable wavelength standard is used through an unbroken chain of comparison measurements marked with uncertainty, the length of the block gauges maintains traceability with the national or international standard.

9.3 Reference condition The length of block gauges shall be obtained at 20°C reference temperature (see **ISO 1**), 101 325 Pa (= 1.013 25 bar) standard atmospheric pressure, 1 333 Pa standard water vapour pressure, and 0.03 % standard carbon dioxide content⁽⁷⁾.

Note ⁽⁷⁾ The deformation of gauge blocks caused by deviation from standard atmospheric pressure, standard water vapour pressure, and standard carbon dioxide content may be ignored under an ordinary atmospheric condition.