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Dial test indicators (lever type)

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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 according to the proposal for revision of Japanese Industrial Standard submitted by Japan Precision Measuring Instruments Manufacturers Association (JMA)/ Japanese Standards Association (JSA) 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 7533**:1990 is replaced with this Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public or utility model rights.

Dial test indicators (lever type)

Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **ISO 9493** published in 2010 with some modifications of the technical contents to ensure suitability for actual production and use.

The portions given sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies the design specification and characteristics of dial test indicators.

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

ISO 9493 : 2010 *Geometrical product specifications (GPS) — Dimensional measuring equipment : Dial test indicators (lever type) — Design and metrological characteristics* (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

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standard (including amendments) indicated below 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 : Corresponding International Standard : ISO 14253-1 *Geometrical Product Specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 1 : Decision rules for proving conformance or non-conformance with specifications* (IDT)

JIS B 0642 *Geometrical product specifications (GPS) — General concepts and requirements for GPS measuring equipment*

NOTE : Corresponding International Standard : ISO 14978 *Geometrical product specifications (GPS) — General concepts and requirements for GPS measuring equipment* (MOD)

JIS B 0680 *Geometrical Product Specifications (GPS) — Standard reference temperature for geometrical product specification and verification*

JIS Z 8103 *Glossary of terms used in measurement*

ISO 14253-2 *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 2 : Guidance for the estimation of uncertainty in GPS measurement, in calibration of measuring equipment and in product verification*

ISO/TR 14253-6 *Geometrical product specifications (GPS) — Inspection by measurement of workpieces and measuring equipment — Part 6 : Generalized decision rules for the acceptance and rejection of instruments and workpieces*

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

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS B 0641-1**, **JIS B 0642**, **JIS Z 8103**, and the following apply.

3.1 dial test indicator (lever type)

measuring instrument in which the displacement of a pivoting stylus is transmitted and magnified by suitable mechanical means to a pointer which rotates in front of a circular scale

3.2 error of indication

value obtained by subtracting the true value as a corresponding input quantity from the indicated value of dial test indicator

NOTE : For the true value, since it can not be determined, an agreed true value is used.

3.3 fixed zero method

method to determine error of indication of dial test indicator, which determines and expresses errors of indication between displacements by setting the starting point close to the rest point in each displacement of stylus as its reference point where the error of indication and indication itself are adjusted to zero

3.4 arbitrary reference point

reference point in general manner to measure displacement by adjusting an arbitrary point in the indication range of the dial test indicator to be zero, according to the size of object to be measured

NOTE : Dial test indicators are often used for comparative measurement by using an arbitrary reference point.

3.5 transferring zero method

performance evaluation method by data processing, which determines the error of in-

dication by data processing to displace the reference point to the measurement point where the maximum error of indication or the minimum error of indication is obtained on the diagram illustrated by fixed zero method

3.6 error of indication per entire measuring range in forward direction

error of indication evaluated in the entire measuring range in the forward direction

3.7 error of indication per 10 scale divisions

error of indication evaluated in the range of every adjacent 10 scale divisions

3.8 error of indication per one revolution

error of indication evaluated in the range of every one revolution

3.9 hysteresis error

maximum of the difference between indications at the same point of the stylus when the stylus is operated in the forward direction and backward direction

3.10 repeatability

repeatability of indications when it is measured several times repeatedly at the same arbitrary point in the measuring range

4 Design characteristics

4.1 General

The specification of dial test indicators shall comply with the requirements of this Standard under all orientations of operation.

4.2 Type

Dial test indicators are commonly manufactured in three types [see Figure 1 a), b) and c)]. These types have the following names.

a) **Type S (Standard)** Where the dial face is mounted on the body of the dial test indicator, in a plane perpendicular to the plane in which the stylus moves.

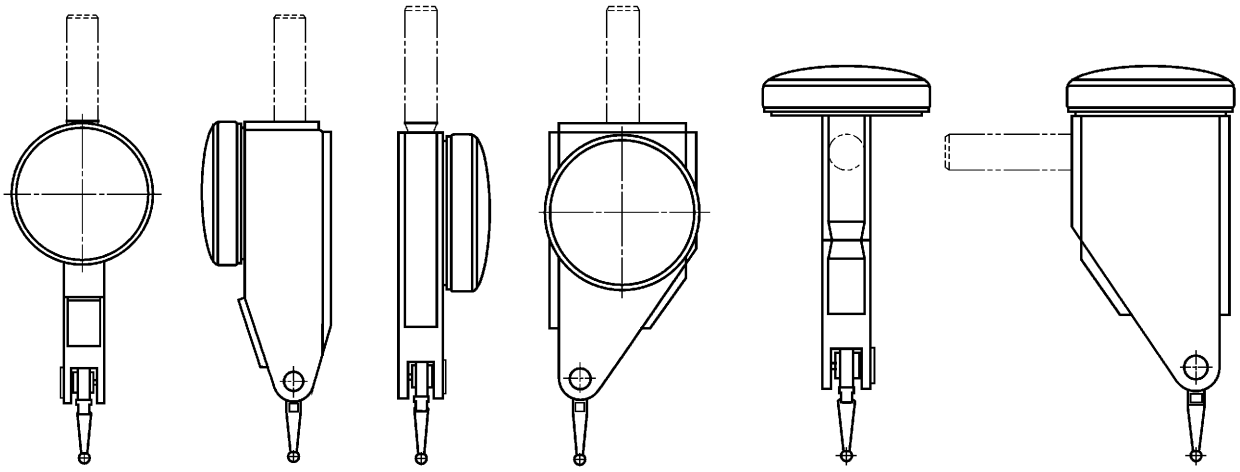
b) **Type H (Horizontal)** Where the dial face is mounted on the body of the dial test indicator, in a plane parallel to the plane in which the stylus moves.

c) **Type V (Vertical)** Where the dial face is mounted at the end of the dial test indicator opposite that of the stylus.

NOTE 1 The above-mentioned list of three named types **a)** to **c)** includes those that are the most common. Although less common, configurations of dial test indicators, which do not fall into the above three categories, exist.

NOTE 2 Stems are shown by the two-dot chain line.

NOTE 3 Some dial test indicators have the ability to measure in both directions without external adjustments and some dial test indicators are provided with a bias lever to change the measuring direction.

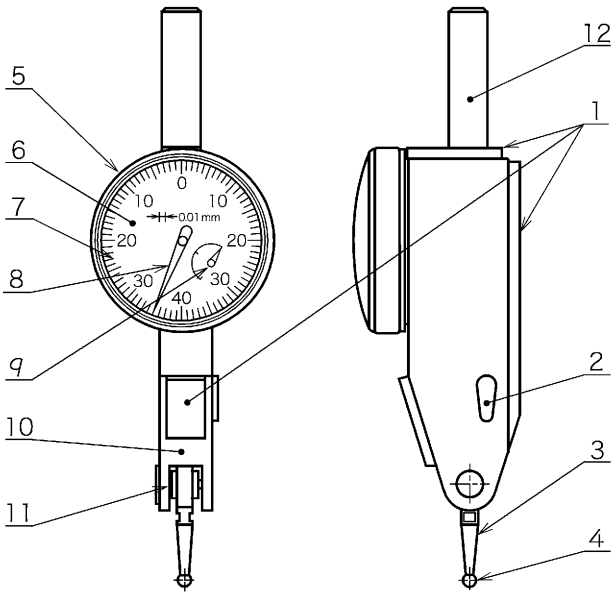


a) Type S b) Type H c) Type V

Figure 1 Types of dial test indicators

4.3 Nomenclature

Design features of dial test indicators are shown in Figure 2. The descriptions in this Standard use the nomenclature shown in Figure 2.



1 dovetail segments
2 bias lever (to change the measuring direction)
3 stylus
4 stylus tip
5 bezel
6 dial
7 scale
8 primary } pointer
9 secondary }
10 housing
11 fixing part of stylus (friction or ratchet drive)
12 stem (screw, dovetail, etc.)

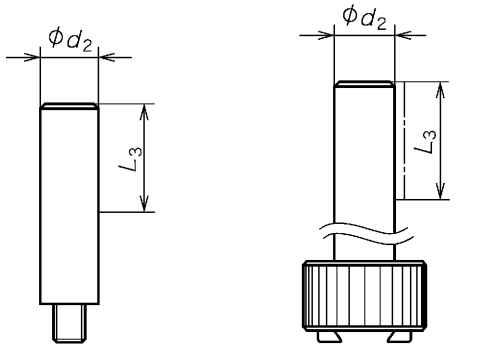
Figure 2 Nomenclature of main parts of dial test indicators

4.4 Shapes and dimensions of stem and dovetail segment

Dial test indicators shall be provided with a means to facilitate attachment to test stands or similar devices. This is often accomplished by means of screw stem (see Figure 3 a) and dovetail stem (see Figure 3 b).

Diameters of clamping stems include 6 mm and 8 mm. A portion of the stem L_3 no shorter than 12 mm shall be held to the fit tolerance h8 (see Figure 3 and Table 2).

The location of these dovetail segments whose stem is clamped on the body is left to the manufacturer's discretion (for dimensions of dovetail segments, see Figure 4).



a) Screw stem b) Dovetail stem

Figure 3 Examples of clamping stem

Unit: mm

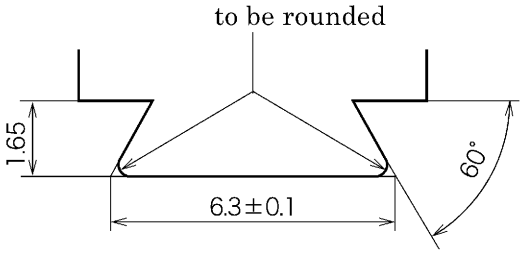


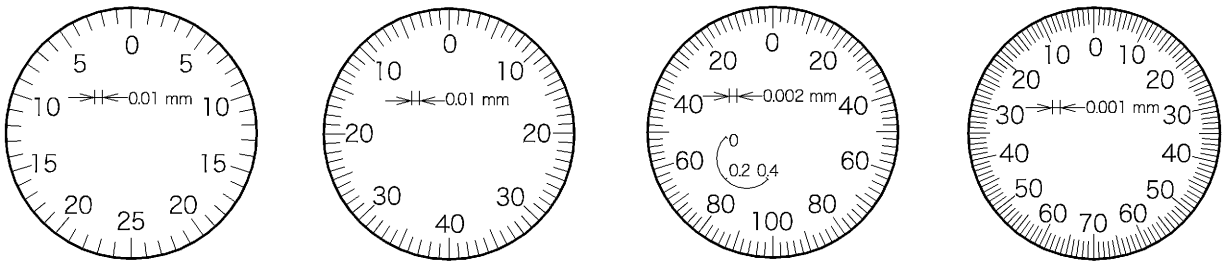
Figure 4 Dimensions of dovetail segment

4.5 Scale and primary pointer

The scale interval and its unit shall be labelled in the dial. Examples of scale layouts are shown in Figure 5 (scale intervals of 0.01 mm, 0.002 mm, and 0.001 mm). At rest, the primary pointer shall be revolution counterclockwise at least five graduations from the point representing the beginning of measuring. This beginning point is normally the 12 o'clock or the 6 o'clock position on the dial. The primary pointer shall move at least one full revolution beyond this beginning point of the measuring range, to the next occurrence of this point, plus at least another five graduations of revolution before reaching the end of its travel. This range before the measuring range begins is called pre-span, and the range after one full revolution is called post-span. The pre-span and post-span movements shall not be considered in the measuring range of the dial test indicator.

NOTE 1 The width of graduation line and that of the primary pointer tip should be equal.

NOTE 2 The width of the primary pointer tip should not be exceeding 20 % of the width of one graduation, considering the distance between graduation lines is read.



Example 1 Example 2 Example 3 Example 4

Figure 5 Example of scale layout

4.6 Secondary pointer

When a secondary pointer is provided, the secondary pointer shall indicate the appropriate division on its scale within ±25 % between graduation lines when the primary pointer is at the beginning point (the 12 o'clock or the 6 o'clock) on each of the revolutions.

4.7 Revolution direction of primary pointer

The relation between moving direction of stylus and revolution direction of primary pointer of dial test indicator shall be in accordance with Table 1.

Table 1 Relation between moving direction of stylus and revolution direction of primary pointer

Type	Revolution direction
Type S	The primary pointer rotates clockwise when stylus is operated from back to front of dial face.
Type H	The primary pointer rotates clockwise when stylus is operated from right to left of dial face.
Type V	The primary pointer rotates clockwise when stylus is operated from the screw stem attached side to the opposite side.
When the stylus is operated toward the opposite direction to the above, the primary pointer may rotate clockwise or counterclockwise.	

4.8 Stylus

4.8.1 General

The stylus shall be easily interchangeable.

The stylus shall have a spherical stylus ball. The stylus ball shall be manufactured from hard, wear-resistant material. It shall be well finished and free of flats or other irregularities which could affect the accuracy of the instrument.

The length of the stylus is an integral part of the accuracy of the instrument. When replacing the stylus, the user shall ensure that the replacement stylus is of the same length as the original.

4.8.2 Friction linkage force

The stylus of a dial test indicator is affixed to a friction linkage or ratchet mechanism, which allows the stylus to be positioned over a wide range of possible positions.

The linkage force by the friction or ratchet mechanism shall be sufficiently higher than the measuring force, so as to allow use of the dial test indicator at any position of the stylus or any orientation of the body, without introducing errors to the measurement.

NOTE : The linkage force (friction force) without introducing errors to the measurement, means the force to work upon the stylus ball, and is usually 2 N to 8 N.

4.8.3 Range of adjustment

The dial test indicator shall have a mechanism that allows for positioning of the stylus at any position within a range from –90° to 0° up to +90° as shown in Figure 6.

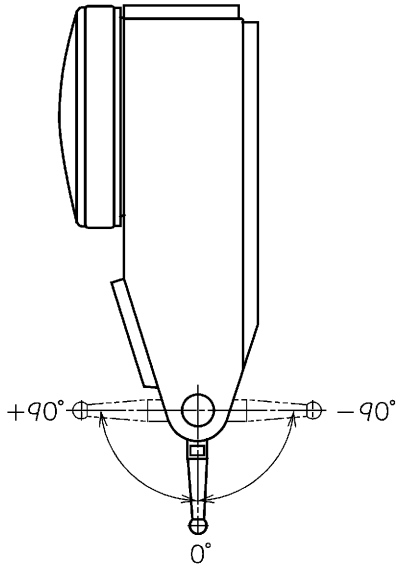


Figure 6 Range of adjustment

4.9 Zero adjustment

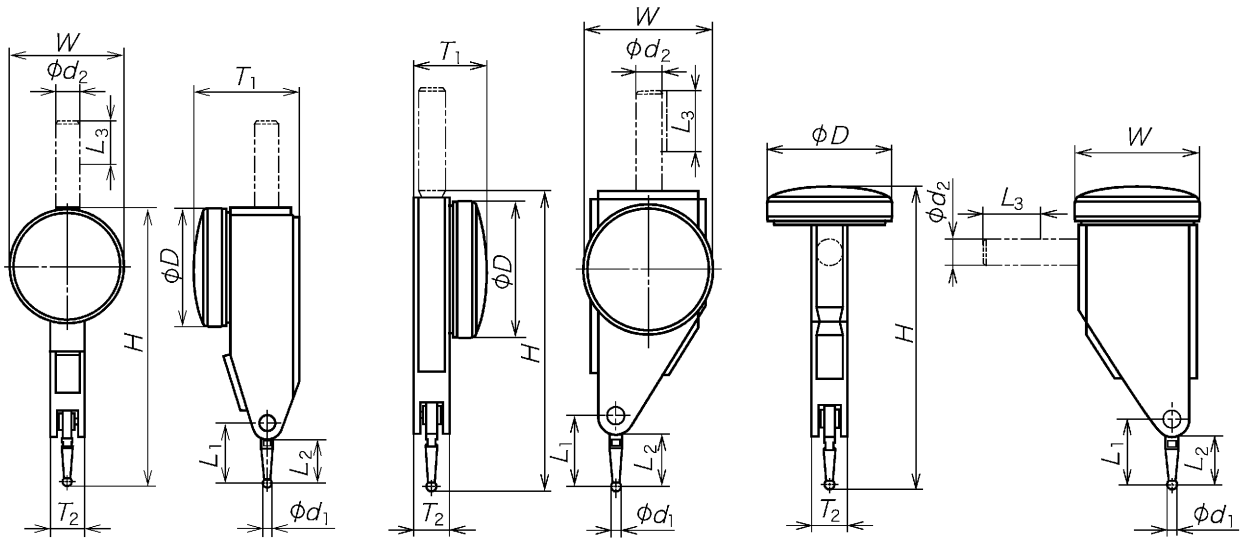
Each dial test indicator shall be provided with means for setting the indicator to zero. When this is achieved by rotating the bezel with dial face, the setting shall be adjustable easily. In general, the bezel with frictional resistant mechanism is used.

4.10 Design characteristics by manufacturer (or supplier)

As a minimum requirement, the manufacturers (or suppliers) shall specify the design characteristics in **4.11**.

4.11 Design characteristics of main parts

Design characteristics of main parts are shown in Figure 7 and Table 2.



a) Type S (Standard) b) Type H (Horizontal) c) Type V (Vertical)

Figure 7 Dimensions

Table 2 Design characteristics

Unit: mm

Type	Type S (Standard), Type H (Horizontal), Type V (Vertical), and others	—
Overall dimensions	Overall height	H
	Width	W
	Overall thickness (if different from W)	T_1
	Body thickness	T_2
	Stylus length (ball centre to pivot axis)	L_1
	Stylus length (ball centre to shoulder)	L_2
	Stylus ball diameter	ϕd_1
	Bezel diameter (if different from W)	ϕD
	Stem diameter	ϕd_2
	For example : ϕ6h8, ϕ8h8	
	Minimum length of stem diameter	L_3
Measuring range	For example : 0.8	—
Scale interval	For example : 0.01	—
Presence of bias lever	Yes/No	—

5 Characteristics

5.1 Maximum permissible error and maximum permissible limit

The manufacturer (or the supplier) shall specify the maximum permissible error (MPE) and maximum permissible limit (MPL) information for the dial test indicator characteristics listed in Table 3. Unless otherwise specified by the manufacturer (or the supplier), the static response of the dial test indicator shall comply with these hys-

teresis error, repeatability and error of indication MPE values and measuring force MPL values specified in Table 3, at any position within the measuring range and at any orientation of the dial test indicator. It shall comply in both displacement directions of the stylus.

Table 3 Characteristics (MPE/MPL)

Scale interval (mm)		0.001/0.002			0.01			
Number of revolutions		One revolution	Greater than one revolution		One revolution			Greater than one revolution
Measuring range (mm)		0.3 and under	Over 0.3 up to and incl. 0.5	Over 0.5 up to and incl. 0.6	0.5 and under	Over 0.5 up to and incl. 1.0		Over 1.0 up to and incl. 1.6
						$L_1 \leq 35$ a)	$35 < L_1$ a)	
Error of indication (μm) (MPE)	Entire measuring range in forward direction	4	6	7	6	9	10	16
	One revolution	—	5		—	—	—	10
	10 scale divisions	2	2		5	5	5	5
Hysteresis of error of indication (μm) (MPE_H)		3	4		4	4	5	5
Repeatability of error of indication (μm) (MPE_R)		1	1		3	3	3	3
Measuring force (N) (MPL)	Maximum	0.5	0.5		0.5	0.5	0.5	0.5
	Minimum	0.01	0.01		0.01	0.01	0.01	0.01
Note a) Stylus length								

5.2 Measuring forces

Measuring forces shall be given as the maximum measuring force and the minimum measuring force. MPL may be in accordance with Annex E.

The measuring force characteristics shall be based on a two-sided specification given in **7.5.5** of **JIS B 0642**.

6 Proving of conformance with specification

6.1 General

For the proving of conformance or non-conformance with specifications, **JIS B 0641-1** or **ISO/TR 14253-6** applies.

Uncertainty evaluation should be performed in accordance with **ISO 14253-2** and

ISO/IEC Guide 98-3.

6.2 Measurement method

Measurement method shall be in accordance with Annex A. Examples of a diagram of errors of indication illustrated based on the value of errors of indication obtained by measurement is shown in Annex C.

6.3 Evaluation for characteristics

Evaluation method for characteristics of dial test indicator shall be in accordance with Annex B.

6.4 Transferring zero method by data processing

Dial test indicators are often used for comparative measurement to measure the dimensions of parts at an arbitrary reference point. The transferring zero method which performs data processing by transferring the reference point (zero point), for evaluating characteristics, based on the measured values of errors of indication obtained by fixed zero method, is shown in Annex D.

This method is a means to perform data processing focusing on the maximum and minimum values in the diagram of errors of indication in Annex C, and is able to evaluate characteristics of dial test indicators.

6.5 Standard temperature

Each characteristic specified in this Standard shall be assumed as values at the standard temperature 20 °C specified in JIS B 0680.

7 Marking

Any marking shall be easily readable and permanent placing on dial test indicators in a way that does not impair the quality of the equipment. The serial number shall be recognized with serialized alpha-numeric identification.

a) Serial number (serialized alpha-numeric identification)

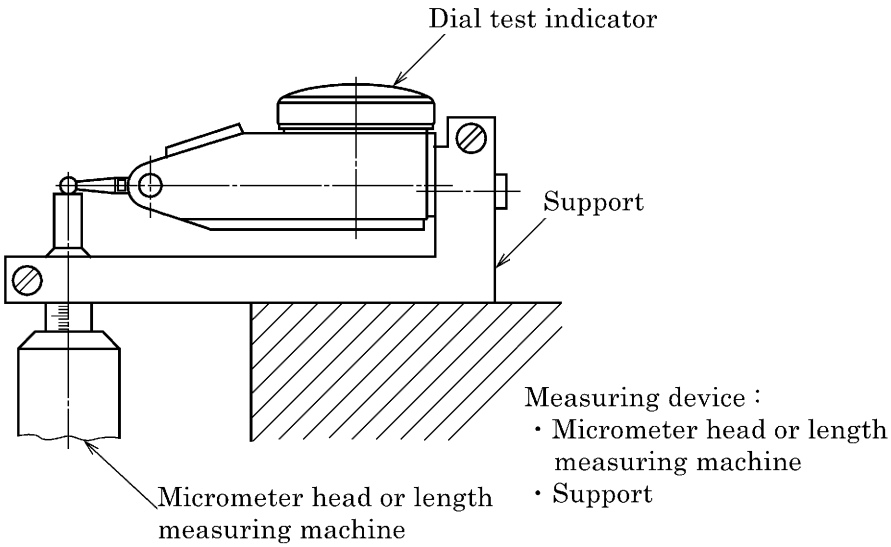
b) Name of manufacturer (or supplier) or its abbreviation

Annex A (normative)
Measurement method

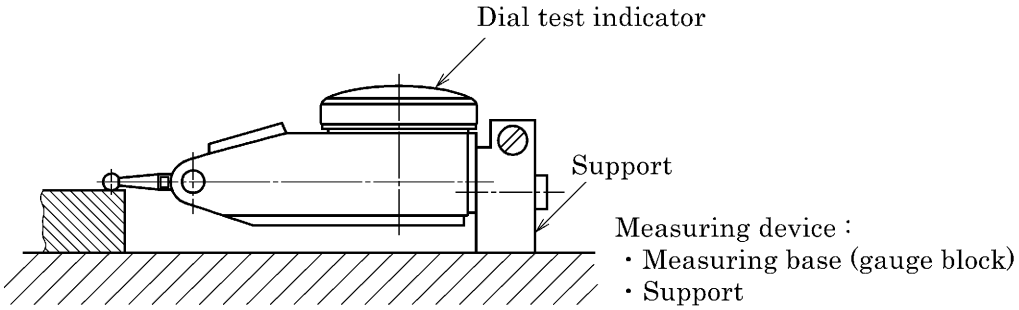
Measurement method for characteristics of dial test indicators shall be in accordance with Table A.1.

Table A.1 Measurement method for characteristics

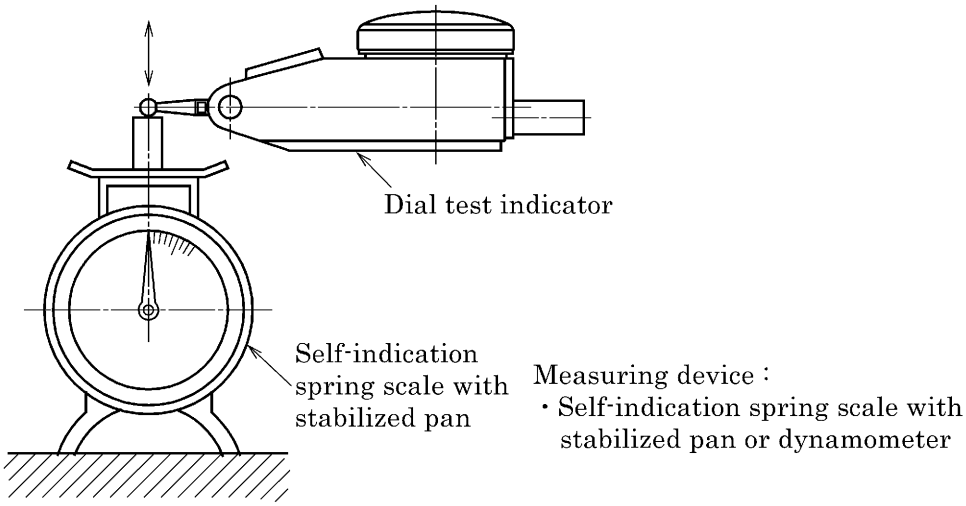
Measurement item	Measurement method	Measurement point	Reference table
(1) Errors of indication Errors of indication by fixed zero method	Sustain the dial test indicator, and after setting the starting point close to the rest point of stylus as its reference point so that errors of indication and indication itself are adjusted to zero, move the stylus in forward direction, and read errors of indication at each measuring point [a)]. Then after moving the stylus by three scale divisions or over from the end of the measuring range, move the stylus in backward direction, and read errors of indication at the same point of the forward direction. (Forward direction means that the stylus of dial test indicator moves against the measuring force, while backward direction means that the stylus moves in the direction of measuring force.)	Per each 10 scale divisions of both forward and backward directions from the starting point to the end point	Figure A.1 a)
(2) Repeatability	Sustain the dial test indicator with the stylus being parallel to upper plane of measuring base, operate the stylus rapidly or gently five times at an arbitrary point in the measuring range, and read the indicated value at each time.	Arbitrary points in the measuring range	Figure A.1 b)
(3) Measuring forces	Sustain the dial test indicator, move the stylus continuously and gradually in forward and backward directions respectively, and read the measuring force.	The starting point and the final point within the measuring range	Figure A.1 c)
Note [a)] For reading errors of indication, either of the following may be chosen: reading the input quantity of measuring device by the primary pointer to scale line, or reading the indication of dial test indicator by replacement of measuring device.			



a) Example of measurement of errors of indication



b) Example of measurement of repeatability



c) Example of measurement of measuring forces

Figure A.1 Example of measuring method

Annex B (normative)
Evaluation method

Evaluation method for characteristics of dial test indicators shall be in accordance with Table B.1.

Table B.1 Transferring zero method

Characteristics	Applicable type	Evaluation method
Errors of indication per entire measuring range in forward direction	One revolution and greater than one revolution	Determine the difference between the maximum and minimum values to errors of indication in forward direction in the entire measuring range read in Table A.1 (1).
Errors of indication per 10 scale divisions		Determine the maximum value of deference of errors of indication to the measuring point per adjacent 10 scale divisions in forward direction from the starting point to the end point read in Table A.1 (1).
Errors of indication per one revolution	Greater than one revolution	Determine the maximum value of deference between the maximum value and the minimum value of errors of indication to the measuring range per one revolution by fixed zero method, in forward direction from the starting point to the end point read in Table A.1 (1).
Hysteresis errors	One revolution and greater than one revolution	Determine the maximum value of difference to errors of indication at the same point in forward and backward directions at the entire measuring point read in Table A.1 (1).
Repeatability		Determine the maximum difference in five measuring values read in Table A.1 (2).
Measuring forces		Determine the maximum value and minimum value to measuring force read in Table A.1 (3).

Annex C (informative)
Example of diagram of errors of indication

Figure C.1 shows an example of diagram of errors of indication by fixed zero method.

Diagram of errors of indication is also called as error diagram.

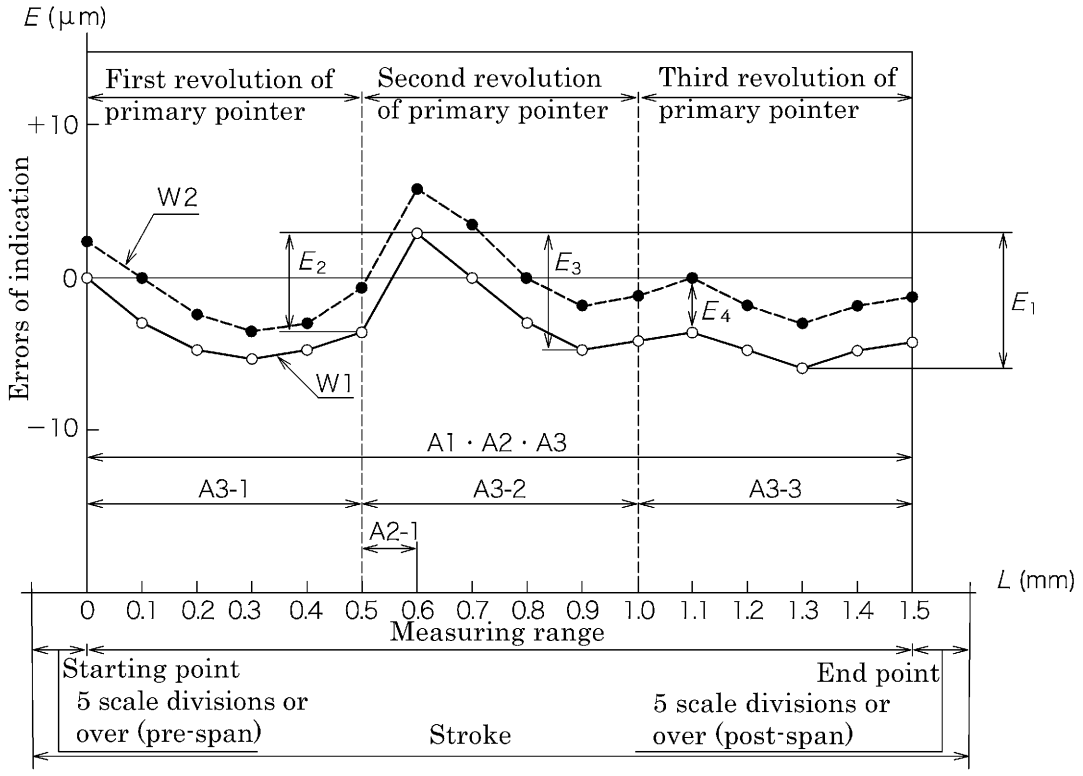


Figure C.1 Example of diagram of errors of indication by fixed zero method

<Applicable type>

・Scale interval	0.01 mm
・Measuring range	1.5 mm
・Measuring length of one revolution	0.5 mm
・Number of revolutions	Three revolutions

L : indicated value (mm)
E : errors of indication (μm)
W1 : error curve in forward direction
W2 : error curve in backward direction
A1 : evaluation range of errors of indication per entire measuring range in forward direction
A2 : evaluation range of errors of indication per 10 scale divisions
A2-1: Evaluation range at a certain point
A3 : evaluation range of error of indication per one revolution
A3-1: evaluation range at the first revolution
A3-2: evaluation range at the second revolutions
A3-3: evaluation range at the third revolutions
E_1: errors of indication per entire measuring range in forward direction
E_2: errors of indication per 10 scale divisions (This figure shows the error at a certain point)
E_3: errors of indication per one revolution (This figure shows the error at the second revolution)
E_4: hysteresis error (This figure shows the error at a certain point)

Annex D (informative)
Transferring zero method (evaluation method for characteristics by data processing)

Dial test indicators are often used for comparative measurement by using an arbitrary reference point. Consequently, in order to obtain errors of indication per entire measuring range in forward direction, the reference point is displaced consecutively within the entire measuring range, and determine the area where errors of indication are dispersed. However, this requires a massive amount of data. Accordingly, the area where errors of indication are supposed to be dispersed can be determined by data processing to displace the reference point to the measurement point where the maximum error of indication or the minimum error of indication is obtained on the diagram illustrated by fixed zero method.

This method is referred to as the transferring zero method by data processing.

Further, errors of indication in specific measuring range can be obtained by data processing in its range (see Figures D.1 to D.3).

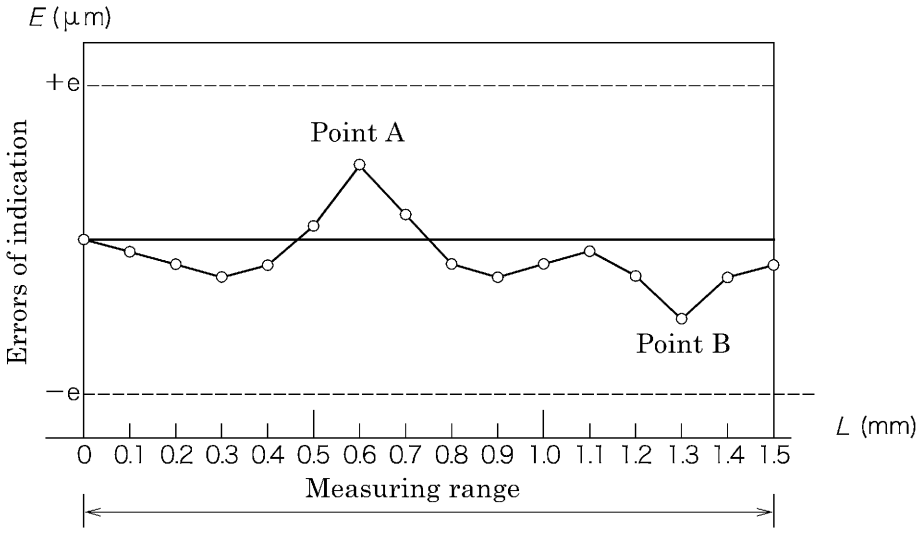


Figure D.1 Example of diagram of errors of indication obtained by measurement of fixed zero method

<Applicable type>

・Scale interval	0.01 mm	・Measuring range	1.5 mm
・Measuring length of one revolution	0.5 mm	・Number of revolutions	Three revolutions

Figure D.1 shows diagram of errors of indication obtained by fixed zero method. Point A is the maximum error of indication and point B is the minimum of error of indication.

NOTE : To avoid complexity, only the forward direction is described.

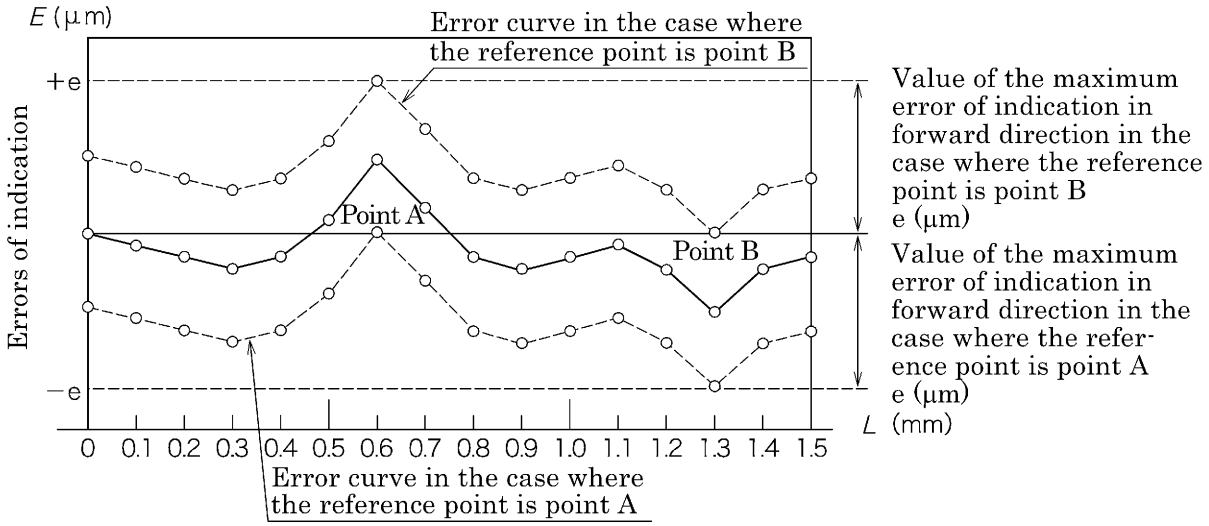


Figure D.2 Example of diagram of errors of indication in the case of displacing reference point to point A and point B

Figure D.2 shows the diagram of errors of indication in the case of displacing reference point to point A and point B, for dial test indicator having characteristics of errors of indication as shown in Figure D.1. Errors of indication measured by displacing the reference point to an arbitrary point are dispersed within the range e (μm), accordingly obtained errors of indication per entire measuring range in forward direction are e (μm).

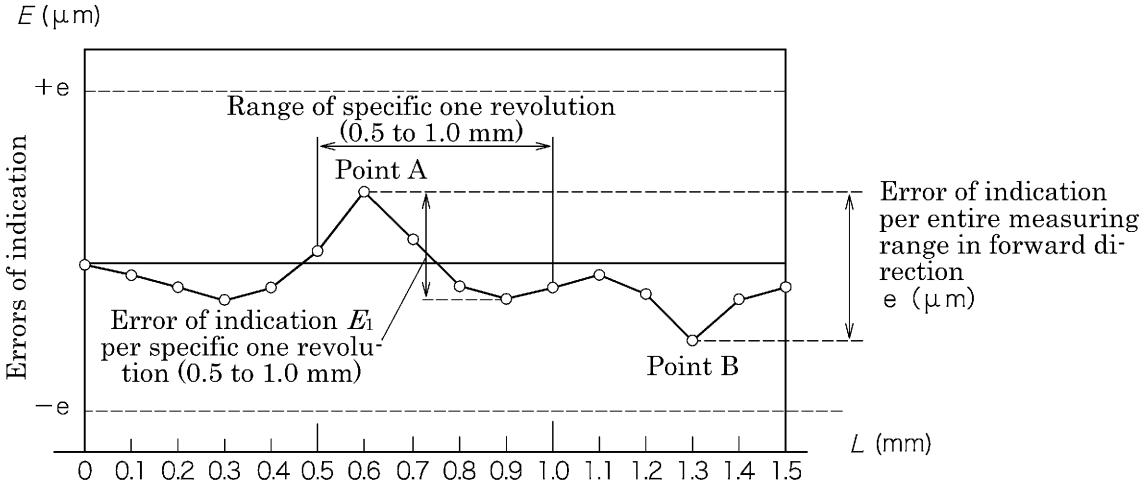


Figure D.3 Example of diagram of obtaining errors of indication by transferring zero method from the diagram of errors of indication by fixed zero method

In order to obtain errors of indication per entire measuring range in forward direction by transferring zero method from the diagram of errors of indication by fixed zero method in Figure D.1, the same value e (μm) is obtained as the value obtained by dis-

placing the reference point in Figure D.2 arbitrary and obtaining difference between the maximum error of indication at point A and the minimum error of indication at point B in Figure D.3.

Errors of indication per one revolution can be also obtained within the range in the same way as above (E_1 indicates errors of indication per one revolution for measuring length 0.5 mm to 1.0 mm).

Annex E (informative)

Example of indication on the specifications of design and characteristics

The following shows an example when the manufacturers provide the user with the product information by a catalogue or brochure, etc.

These items are often indicated as a dimensional drawing and list.

Name of equipment :.....
Detailed characteristics :.....

☐ Design characteristics
Type :.....
Overall dimensions
Overall height (H) :.....mm Width (W) :.....mm
Overall thickness (T_1) :.....mm Body thickness (T_2) :.....mm
Stylus length (ball centre to pivot axis) (L_1) :.....mm
Stylus length (ball centre to shoulder) (L_2) :.....mm
Stylus ball diameter (ϕd_1) :.....mm Bezel diameter (ϕD) (if different from W) :.....mm
Stem diameter (ϕd_2) :.....mm Minimum length of stem (L_3) :.....mm
Measuring range :.....mm
Scale interval :.....mm

☐ Metrological characteristics
Hysteresis of indication (MPE_H) :.....μm Repeatability of indication (MPE_R) :.....μm
Errors of indication (MPE)
entire measuring range in forward direction :.....μm
10 scale divisions :.....μm
one revolution(where range is greater than one revolution) :.....μm
Measuring force (MPL)
Maximum :.....N Minimum:.....N

Company .....
Date or editions, etc. .....

Annex F (informative)
Notes on use

F.1 General

Attention is given to the following points when dial test indicators are used.

a) A dial test indicator is held with a rigid fixture which is undisturbed by the measuring force of the instrument itself.

b) Dial test indicators are often mounted on indicator stands resting on a datum plane. As a general principle, the indicator stand should be kept stationary on the datum plane and the setting standard and the workpiece should be brought to the indicator. This practice minimizes the effects of an out-of-flat condition of the surface creating the datum plane. Where this practice is not practical, the flatness of the reference surface should be considered when evaluating the quality of the result of the measurement.

c) When using an indicator stand, the distance from the tip of the dial test indicator to the post of the stand should be kept as short as possible.

d) Attention should be paid to the change of orientation during measurement because it may influence the result of the measurement.

e) Any reference device for calibration should be traceable to the national standards.

F.2 Stylus length

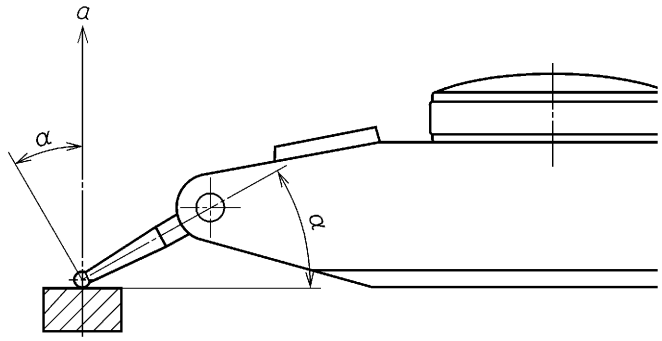
The length of the stylus influences the transmission ratio of the input to the output of the measurement, and thus also influences the result of the measurement. When replacing the stylus, only stylus having the same length should be used.

F.3 Correction for angles of inclination

The stylus should be kept so that the centre of stylus is perpendicular to the direction of measurement.

If it is not perpendicular, it should be corrected by the following formula (see Figure F.1 and Table F.1).

$$\text{Result of measurement} = \text{indication} \times \cos \alpha$$



a : result of measurement

Figure F.1 Angle a of inclination

Table F.1 Correction for angles of inclination

Angle (a)	cos a
5°	0.996
10°	0.985
15°	0.966
30°	0.866
45°	0.707
60°	0.500

Annex G (informative)
GPS matrix

G.1 General

For full details about the GPS matrix model, see **ISO/TR 14638**.

G.2 Information about this Standard and its use

This Standard specifies the most important design and metrological characteristics of dial test indicators.

Those design characteristics are items that affects interchangeability.

G.3 Position in the GPS matrix

This Standard is a general GPS standard, which influences the chain link 5 of the chains of standards on size, distance, form of line independent of datum, form of line dependent on datum, form of surface independent of datum, form of surface dependent on datum, orientation, location, circular run-out and total run-out in the general GPS matrix, as graphically illustrated in Figure G.1.

Fundamental GPS Standards

GPS common standards

GPS General standards matrix

Chain link number	1	2	3	4	5	6
Size					X	
Distance					X	
Radius						
Angle						
Form of line independent of datum					X	
Form of line dependent on datum					X	
Form of surface independent of datum					X	
Form of surface dependent on datum					X	
Orientation					X	
Location					X	
Circular run-out					X	
Total run-out					X	
Datums						
Roughness profile						
Waviness profile						
Primary profile						
Surface profile						
Edges						

NOTE : The meaning of chain link numbers are as follows.
Chain link number 1 : Document instructions of products — coding
Chain link number 2 : Definitions of tolerance — theoretical definitions and numerical values
Chain link number 3 : Definitions of real form — characteristics or parameters
Chain link number 4 : Evaluation of deviation of parts — comparison with tolerance limits
Chain link number 5 : Requirements for measuring equipment
Chain link number 6 : Requirements for measurement — measurement standard

Figure G.1 GPS matrix

G.4 Related Standards

The related standards are those of the chains of standards indicated in Figure G.1.

Bibliography

ISO 286-2 *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 2 : Tables of standard tolerance classes and limit deviations for holes and shafts*

ISO/TR 14638 *Geometrical product specification (GPS) — Masterplan*

Annex JA (informative)
Comparison table between JIS and corresponding International Standard

JIS B 7533 : 2015 *Dial test indicators (lever type)*					ISO 9493 : 2010 *Geometrical product specifications (GPS) — Dimensional measuring equipment : Dial test indicators (lever type) — Design and metrological characteristics* (MOD)		
(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
2 Normative references							
3 Terms and definitions	**JIS Z 8103** error of indication, fixed zero method, arbitrary reference point, error of indication per entire measuring range in forward direction, error of indication per 10 scale divisions, error of indication per one revolution, hysteresis error, repeatability, transferring zero method (evaluation method by data processing)		3	dial test indicators (lever type)	Addition	No technical deviation.	Specify the definition of terms like errors of indication. Modify “floating zero” to “transferring zero method” as inappropriate for measurement.

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
4 Design characteristics	4.2 Type		4.2	Almost identical with **JIS**. Omit fixing position of all screw stems.	Addition	Describe fixing position in figures. No technical deviation.	Designate fixing position of Type V, because stem can not fixed to upper part unlike Type S and Type H.
	4.4 Shapes and dimensions of stem and dovetail segment		4.4	Specify clamping stem only. Type ϕ4, ϕ6 and ϕ8 Tolerance of outside diameter of stem	Alteration	Add screw stem. Delete ϕ4. No technical deviation. Tolerance h8	Add screw stem, because it is mainstream in Japan. ϕ4 stem is generally not used in Japan. Tolerance h8 is sufficient for clamping.
	4.5 Scale and primary pointer		4.5	—	Addition	Add the following NOTES. NOTE 1 : The width of graduation line and that of the primary pointer tip should be equal. NOTE 2 : The width of the primary pointer tip should not be exceeding 20 % of the width of one graduation, considering the distance between graduation lines is read. No technical deviation.	Add for usability to minimize error in reading.

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
4 Design characteristics (continued)				Describe that pre-span or post-span means dial test indicators with under 1/10 revolutions.	Deletion	No technical deviation.	Delete because it is for the specific case.
				Pre-span or post-span means over 1/10 revolutions.	Alteration	Specify five scale divisions or over.	Align with previous standard.
	4.6 Secondary pointer		—	—	Addition	Add “within ± 25 % between scale divisions” No technical deviation.	Add for usability.
	4.7 Revolution direction of primary pointer		—	—	Addition	No technical deviation.	Align with previous standard.
	4.8.2 Friction linkage force		4.6.3	Almost identical with **JIS**.	Addition	Describe specific figures in “NOTE : The linkage force (friction force) without introducing errors to the measurement, means the force to work upon the stylus ball, and is usually 2 N to 8 N”. No technical deviation.	Align with old Standard considering consistency in use. Specify linkage force following previous standard to avoid the force to be extremely week.
	4.9 Zero adjustment		4.7	Almost identical with **JIS**.	Alteration	Describe “the setting shall be adjustable easily”. No technical deviation.	For usability.

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
5 Characteristics	5.1 Maximum permissible error and maximum permissible limit		5.1	Almost identical with **JIS**.	Alteration	Add specific figures (MPE and MPL) corresponding to scale interval and measuring range in table in **JIS**. Delete the item of errors of indication of any 1/2 revolutions.	Specify standard values for usability and to meet requirements. Some products manufactured in Japan have no measurement point corresponding to 1/2 revolutions.
6 Proving of conformance with specification	6.1 General		6.1	Uncertainty evaluation is in accordance with GUM, etc.	Alteration	Recommend GUM, etc. for uncertainty evaluation.	Align with Annex A.7 of **JIS B 0642**.
	6.2 Measurement method		6.2	Almost identical with **JIS**.	Alteration	Specify measuring method for characteristics in Annex A and present an example of diagram of errors of indication in Annex C.	For usability. No technical deviation.
	6.3 Evaluation for characteristics		—	—	Addition	Specify evaluation method for characteristics in Annex B.	No technical deviation.
	6.4 Transferring zero method by data processing		—	—	Addition	Specify transferring zero method by data processing in Annex D.	For usability.
	6.5 Standard temperature		—	—	Addition	Clarify that dimensions and errors are assumed as values at the standard temperature.	For usability.

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
7 Marking			7	Almost identical with **JIS**.	Addition	Add serial number and name of manufacturer. No technical deviation.	For usability.
Annex	Annex A to Annex G			Annex A to Annex E	Alteration	Add additional annexes for measuring method for characteristics, evaluation method, diagram of errors of indication and data processing method, and specify and describe detailed specification.	Explain whole procedures orderly from measurement to data processing for users' understanding of Standard.
Annex A (normative)	Measurement method		Annex C	Describe the measuring method using gauge blocks, micrometer and universal length measuring machines. No description on reading of errors of indication	Alteration	Describe details of measuring method.	For usability.

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
Annex B (normative)	Evaluation method		—	No description.	Addition	Specify clearly for example errors of indication per one revolution, the maximum value of deference between the maximum value and the minimum value of errors of indication to the measuring range per one revolution in forward direction from the starting point to the end point.	For usability, clarify the determination method of errors of indication.
Annex C (informative)	Example of diagram of errors of indication		Annex A	Errors of indication per entire measuring range in forward direction	Alteration	Add “forward” to avoid misunderstanding. Modify Figure C.1. No technical deviation.	Clarify. Replace an example of dial test indicator graduated in 0.01 mm and 0.002 mm with grater than one revolution.
Annex D (informative)	Transferring zero method (evaluation method for characteristics by data processing)		Annex C	Describe calibration by fixed or floating zero by referring to **ISO 14978**.	Alteration	Divide transferring zero method as an individual annex for better understanding.	For usability.
Annex E (informative)	Example of indication on the specifications of design and characteristics		Annex B	Include not only design characteristics, characteristics but also sales information.	Alteration	Clarify that it shows an example when the manufacturers provide the user with the product information.	Provide an example of indication on the specification corresponding to the actual sales (catalogue sales).

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
Annex F (informative)	Notes on use		Annex D	Almost identical with **JIS**.	Addition	Add general precautions. No technical deviation.	Add to get users' attention in measuring.
Annex G (informative)	GPS matrix		Annex E	—	Identical	—	—

Overall degree of correspondence between **JIS** and International Standard (**ISO 9493** : 2010): MOD

NOTE 1 Symbols in sub-columns of classification by clause in the above table indicate as follows:

— Identical : Identical in technical contents.

— Deletion : Deletes the specification items(s) or content(s) of International Standard.

— Addition : Adds the specification item(s) or content(s) which are not included in International Standard.

— Alteration : Alters the specification content(s) which are included in International Standard.

NOTE 2 Symbol in column of overall degree of correspondence between **JIS** and International Standard in the above table indicates as follows:

— MOD : Modifies International Standard.

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