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Micrometers

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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 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 7502**:1994 is replaced with this Standard.

JIS B 7502:1994 may be applied in the **JIS** mark certification based on the relevant provisions of Article 19 Clause 1, etc. of the Industrial Standardization Law until August 21, 2017.

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.

Micrometers

Introduction

This Japanese Industrial Standard has been prepared based on the second edition of **ISO 3611** published in 2010 with some modifications of the technical contents in order to correspond to the practical manufacture 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 JB.

This Standard is one of geometrical product specifications (GPS) under the GPS Basic Standard (see **ISO/TR 14638** : 1995) and related to the chain link 5 for the chain of standards on size. The details on the relation between this Standard and other GPS Standards are given in Annex D.

1 Scope

This Standard specifies micrometer for external measurements, bar-shaped micrometer for internal measurements, micrometer for span measurements of teeth, and micrometer head (hereafter referred to as micrometer, unless otherwise specified), equipped with analogue indication, mechanical or electronic digital indication.

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

ISO 3611 : 2010 *Geometrical product specifications (GPS) — Dimensional measuring equipment : Micrometers for external measurements — 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 standards (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 conformity or nonconformity with specifications*

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 B 7430 *Optical flats*

JIS B 7431 *Optical parallels*

JIS B 7506 *Gauge blocks*

JIS B 7536 *Electrical comparators*

JIS B 7538 *Autocollimators*

JIS C 0920 *Degrees of protection provided by enclosures (IP Code)*

NOTE : Corresponding International Standard : IEC 60529 *Degrees of protection provided by enclosures (IP Code)* (IDT)

JIS Z 8103 *Glossary of terms used in measurement*

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 micrometer for external measurements

measuring instrument which gives the evaluation of a dimensional quantity of an external feature of a workpiece on the basis of movement of a spindle with a measuring face, moving relatively to a material measure and a fixed anvil, with the movement generated by a screw thread

NOTE 1 The guiding elements of the spindle and of the anvil are connected by a frame.

NOTE 2 Usually, micrometers for external measurements have a thread as a material measure with the anvil, spindle and screw mechanism arranged linearly.

3.2 bar-shaped micrometer for internal measurements

measuring instrument which gives the evaluation of a dimensional quantity of an internal feature of a workpiece on the basis of movement of a spindle with a measuring face, moving relatively to an adjusting anvil fixed on the body, with the movement generated by a screw thread (hereafter referred to as "micrometer for internal measurements")

This type of micrometers does not include extendable micrometers whose measuring range can be expanded.

NOTE 1 An adjusting anvil and an anvil fixed on the spindle have a spherical

measuring face.

NOTE 2 Micrometers for internal measurements have a screw thread as a material measure with the adjusting anvil, anvil, spindle and screw mechanism arranged linearly.

3.3 micrometer for span measurements of teeth

micrometer for external measurements to be mainly used for the measurement of the base tangent length of the involute gear

NOTE : The micrometer has a disc-shaped measuring face.

3.4 micrometer head

measuring instrument which gives the evaluation of a displacement of a workpiece on the basis of movement of a spindle with a measuring face, with the movement generated by a screw thread

NOTE 1 The micrometer head has a mounting part to fix the instrument.

NOTE 2 The micrometer head has the spindle and screw mechanism arranged linearly.

3.5 measuring face contact

contact between the measuring face and a feature of a workpiece

3.5.1 full measuring face contact

contact between the full area of the measuring face and a feature of a workpiece

3.5.2 partial measuring face contact

contact between a partial area of the measuring face and a feature of a workpiece

3.6 error of indication

indication of a micrometer minus a true value of the corresponding input quantity

NOTE : The conventional true value is used because it is impracticable to determine a true value.

4 Design specification (design characteristics)

4.1 General

The general design specification (design characteristics) of the micrometer shall be such that its metrological characteristics comply with the requirements of this Standard under all operational orientations, unless otherwise specified by the manufacturer (supplier).

NOTE : An example of data sheet for specification marking in the case of providing the information for users is given in Annex C.

4.2 Names of main parts

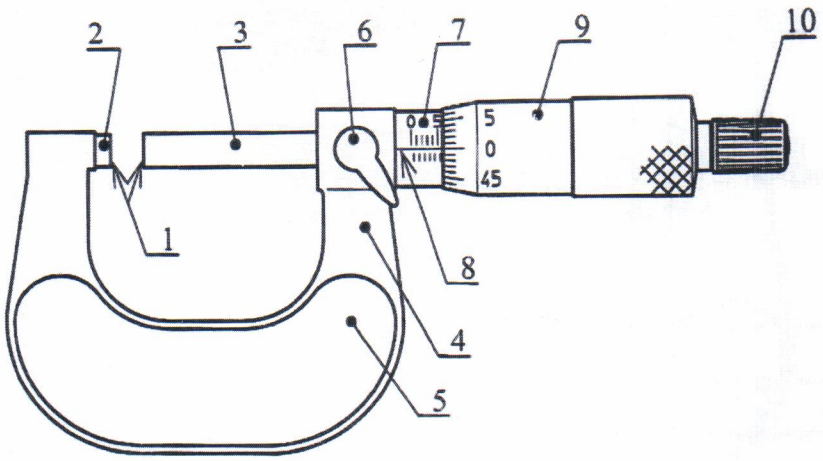
The names of main parts of micrometer shall be as given in Table 1.

The figures are intended to indicate the names but not intended to give the design

details.

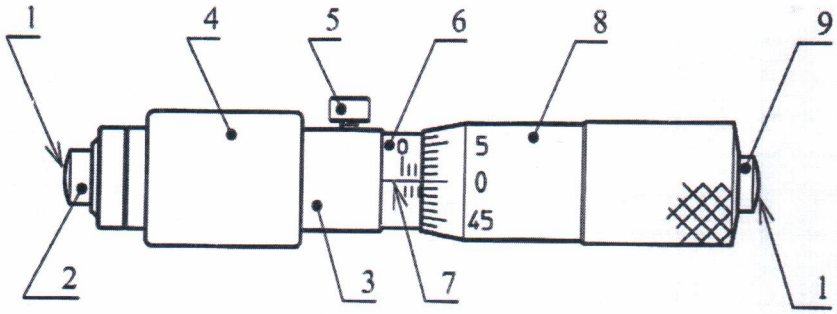
Table 1 Names of micrometer

Classification	Main parts shown in :
Micrometer for external measurements	Figure 1
Micrometer for internal measurements	Figure 2
Micrometer for span measurements of teeth	Figure 3
Micrometer head	Figure 4



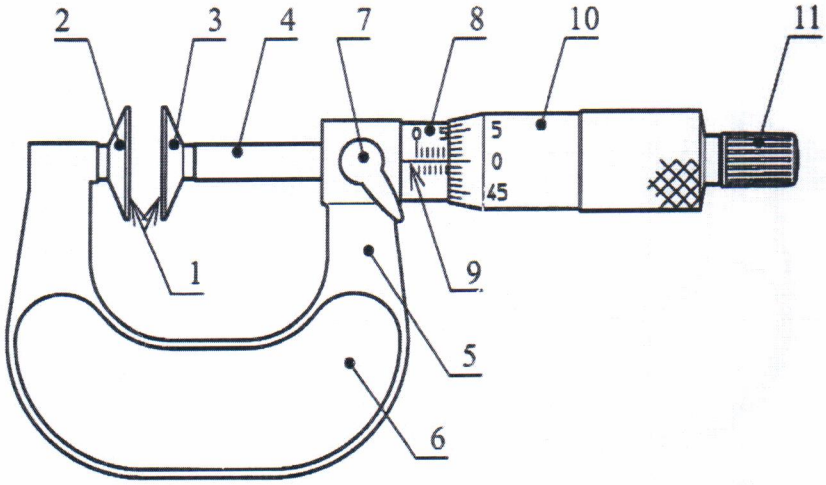
1 measuring face
2 anvil
3 spindle
4 frame
5 thermally insulating plate
6 clamp
7 sleeve
8 fiducial line
9 thimble
10 fast drive (measuring-force limiting device)

Figure 1 Main parts of micrometer for external measurements



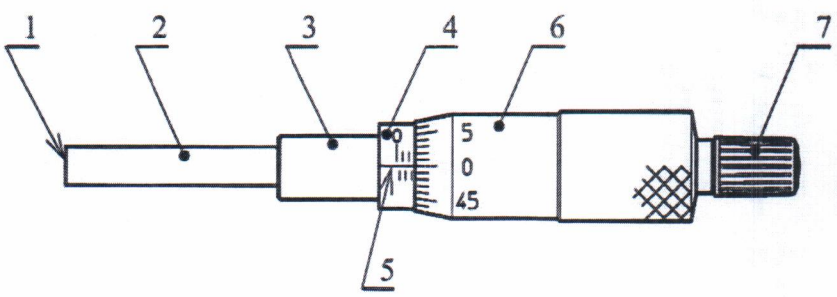
1 measuring face
2 adjusting anvil
3 body
4 grip (thermally insulating part)
5 clamp
6 sleeve
7 fiducial line
8 thimble
9 anvil

Figure 2 Main parts of micrometer for internal measurements



1 measuring face
2 anvil disc
3 spindle disc
4 spindle
5 frame
6 thermally insulating plate
7 clamp
8 sleeve
9 fiducial line
10 thimble
11 fast drive (measuring-force limiting device)

Figure 3 Main parts of micrometer for span measurements of teeth



1 measuring face
2 spindle
3 attaching face
4 sleeve
5 fiducial line
6 thimble
7 fast drive (measuring-force limiting device)

Figure 4 Main parts of micrometer head

4.3 Dimensions

The main shapes and dimensions of the micrometer shall be as follows.

a) Micrometer for external measurements shall be as given in Table 2.

b) Micrometer for internal measurements shall be as shown in Figure 5.

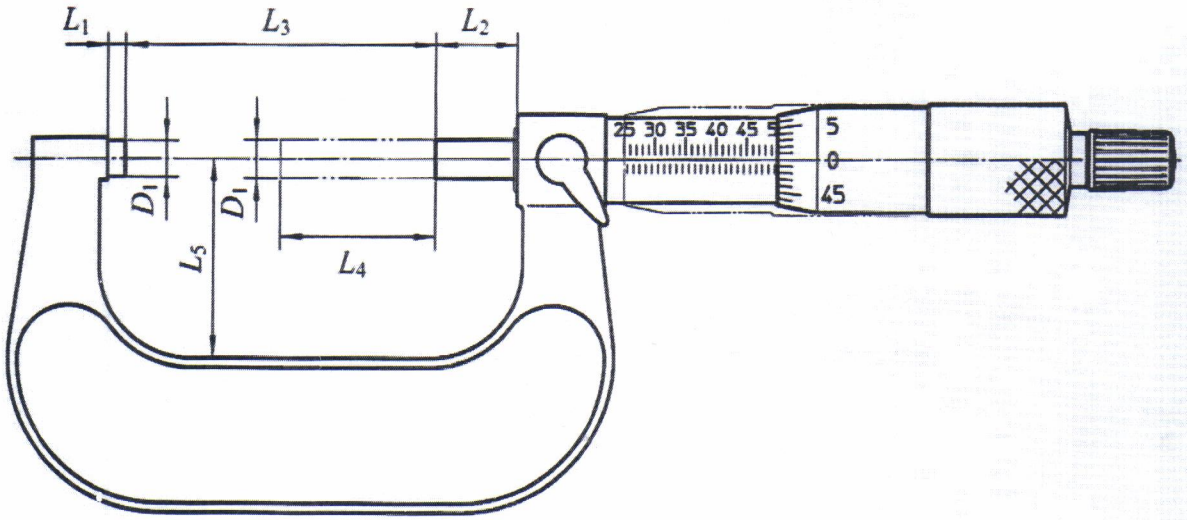
c) Anvil disc and spindle disc of micrometer for span measurements of teeth shall be as given in Table 3.

d) The mounting part of micrometer head shall be as shown in Figure 6.

The clearance between the spindle and the guide hole of micrometer for external

measurements, micrometer for span measurements of teeth and micrometer head shall be as given in Table 4.

Table 2 Shape and dimensions of micrometer for external measurements



Dimensions	Nominal value
Anvil length, L_1	—
Spindle length in end position, L_2	—
Maximum measurable dimension, L_3	—
Measuring span, L_4	25 mm [a]
Frame depth, L_5 [b]	—
Spindle and anvil diameter, D_1	6.35 mm, 6.5 mm, 7.5 mm, 8 mm [a]

NOTE : D_1, L_1 and L_2 dimensions are important as a compatibility of device to be attached on the measuring face.

Notes [a] At the manufacturer's discretion. Other diameters are possible.

[b] Usually, L_5 is determined to permit the measurement of the diameter of the cylinder equal to the maximum measurable dimension.

Unit: mm

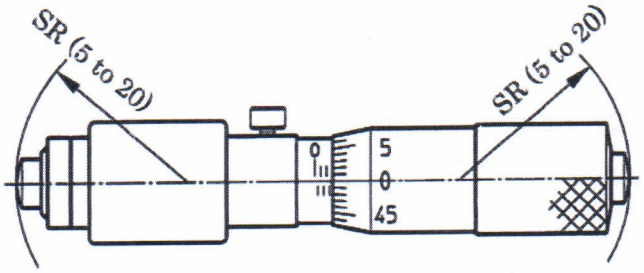
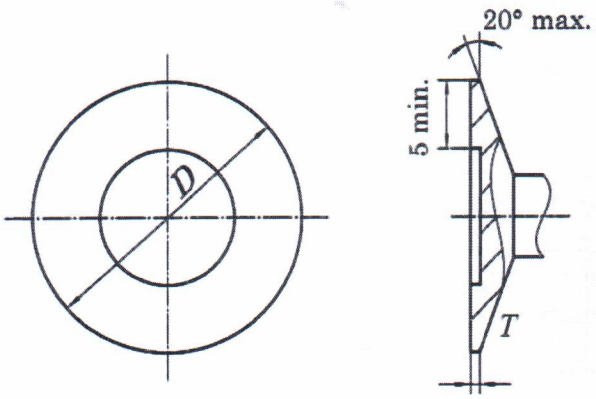


Figure 5 Radius of curvature of measuring face of micrometer for internal measurements

Table 3 Shapes and dimensions of anvil disc and spindle disc of micrometer for span measurements of teeth

Unit: mm



Maximum measurable dimension	*D*	*T*
50 or under	15 to 20	0.5 to 1.0
over 50 up to and incl. 100	18 to 25	0.5 to 1.2
over 100 up to and incl. 200	20 to 30	0.7 to 1.5
over 200 up to and incl. 300	20 to 40	0.7 to 2.0
Anvil discs and spindle discs of other maximum measurable dimensions shall be as agreed between the parties concerned with delivery.		

Unit: mm

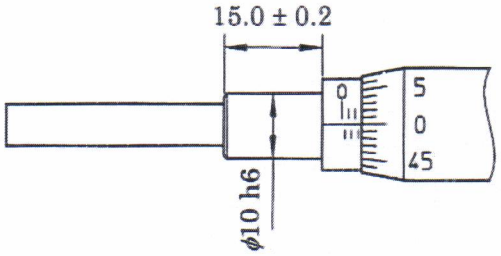
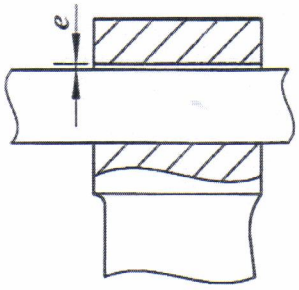


Figure 6 Shape and dimensions of mounting part of micrometer head

Table 4 Clearance between a spindle and its guide hole



Unit: mm

Classification	Clearance
Micrometer for external measurements	e = 0.01 max.
Micrometer for span measurements of teeth	
Micrometer head	e = 0.015 max.

4.4 Measuring range

The types of measuring ranges of the micrometer shall be as given in Table 5.

Table 5 Types of measuring ranges

Unit: mm

Measuring range			
Micrometer for external measurements	Micrometer for internal measurements	Micrometer for span measurements of teeth	Micrometer head
0 to 25	—	0 to 25	0 to 25
25 to 50		25 to 50	—
50 to 75	50 to 75	50 to 75	
75 to 100	75 to 100	75 to 100	
100 to 125	100 to 125	100 to 125	
125 to 150	125 to 150	125 to 150	
150 to 175	150 to 175	150 to 175	
175 to 200	175 to 200	175 to 200	
200 to 225	200 to 225	200 to 225	
225 to 250	225 to 250	225 to 250	
250 to 275	250 to 275	250 to 275	
275 to 300	275 to 300	275 to 300	
300 to 325	300 to 325	—	
325 to 350	325 to 350		
350 to 375	350 to 375		
375 to 400	375 to 400		
400 to 425	400 to 425		
425 to 450	425 to 450		
450 to 475	450 to 475		
475 to 500	475 to 500		
Micrometers having other measuring ranges shall be as agreed between the parties concerned with delivery.			

4.5 Types of indicating devices

4.5.1 General

The types of indicating devices shall be as follows.

a) Analogue indicating devices

b) Digital indicating devices with mechanical digital display

c) Digital indicating devices with electronic digital display

On micrometers with analogue indicating devices, the scale interval and its unit shall be labelled.

On micrometers with a digital indicating device, the unit of the indication shall be labelled.

NOTE : Combinations of analogue and digital indicating devices are possible.

4.5.2 Analogue indicating devices

4.5.2.1 General

The spindle shall have a thread pitch of 0.5 mm or 1 mm. In the case of micrometers with spindles having a pitch of 0.5 mm, the 0.5 mm graduation lines on the main scale shall be clearly distinguishable from the 1 mm graduation lines by means of their arrangement above and below the fiducial line. The secondary scale on the thimble shall have a scale graduated with 50 (pitch 0.5 mm) or 100 (pitch 1 mm) graduation lines, each scale interval representing 0.01 mm.

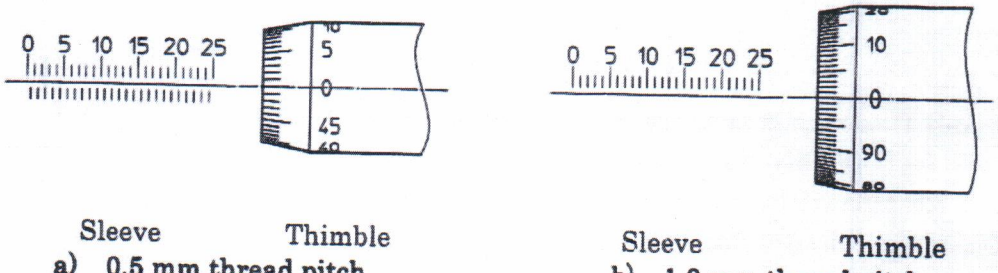
4.5.2.2 Graduation

The graduation of sleeve and thimble shall be as given in Table 6 and Figure 7, unless otherwise specified.

Table 6 Graduation

Unit: mm

Thread pitch	Thimble	Sleeve
0.5	50 divisions	Scale interval 0.5
1.0	100 divisions	Scale interval 1.0



Sleeve Thimble — a) 0.5 mm thread pitch

Sleeve Thimble — b) 1.0 mm thread pitch

Figure 7 Graduation (measuring range 0 mm to 25 mm)

4.5.2.3 Fiducial line and graduation line

The thickness of sleeve fiducial line and thimble graduation line shall be as given in Table 7, unless otherwise specified.

Table 7 Thickness of graduation line

Unit: mm

Item	Thickness	Unevenness in thickness
Sleeve fiducial line	0.08 to 0.20	0.03 max.
Thimble graduation line		
NOTE : The thickness of thimble graduation line should be equal to that of sleeve fiducial line.		

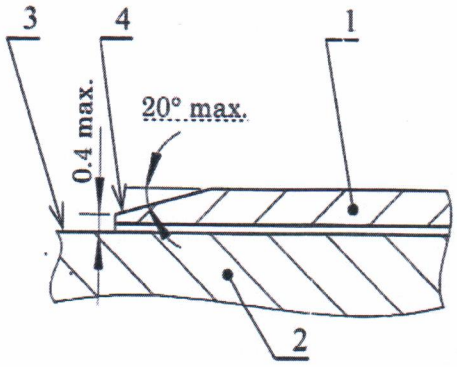
4.5.2.4 Scale spacing of thimble

The centre distance between the adjacent thimble graduation lines shall be 0.8 mm or over.

4.5.2.5 Arrangement of scales

The arrangement of sleeve's main scale and thimble's secondary scale, and the dimensions of thimble scales shall be as shown in Figure 8.

Unit: mm

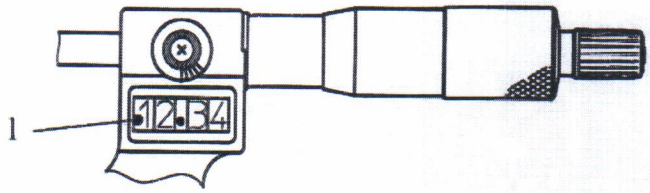


1 thimble
2 sleeve
3 main scale (sleeve)
4 secondary scale (thimble)

Figure 8 Arrangement between main scale and secondary scale, and the dimensions of thimble scales

4.5.3 Mechanical digital display

The example of mechanical digital display is shown in Figure 9. The mechanical digital display shall have a digital step of 0.01 mm or 0.001 mm. The digits of the display shall provide a good contrast with the background.



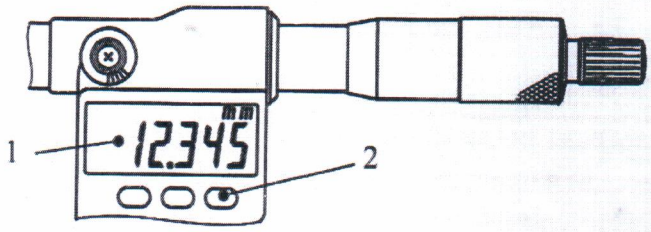
1 mechanical digital display

Figure 9 Example of mechanical digital display

4.5.4 Electronic digital display

4.5.4.1 General

The example of electronic digital display is shown in Figure 10. The electronic digital display shall have a digital step of 0.01 mm or 0.001 mm.



1 electronic digital display
2 control buttons

Figure 10 Example of electronic digital display

4.5.4.2 Error messages

Micrometer with electronic digital indication shall include a device capable of displaying all operation and system error messages when rapid spindle rotation could cause the wrong indication or when power-supply voltage declines.

4.5.4.3 Interface

In the case of micrometer with electronic digital indication having an interface, the manufacturer shall describe the transmission format of the data outputs (interface) with as much detail as possible in product documentation.

4.6 Protection of electronic digital indication for field use

When micrometer with electronic digital indication guarantees fluid and dust protection, the manufacturers shall indicate clearly which kind of fluid and dust protection (IP code, according to JIS C 0920) in the body or in product documents.

4.7 Insulating plate

For hand-held micrometers, the frame or the body (micrometer for internal measurements) should be insulated to prevent hand heat from being transmitted.

4.8 Measuring faces

Measuring faces shall have a wear-resistant and suitable surface finish. The hardness of measuring faces shall be not less than 700 HV or 60 HRC, and the measurement shall be carried out on the measuring face or on the cylinder surface within 1 mm away from the measuring face.

4.9 Measuring-force limiting device

Micrometer for external measurements and micrometer for span measurements of teeth shall be provided with a measuring-force limiting device (ratchet stop or friction stop) integrated in the thimble or in the fast drive. Micrometer heads without measuring-force limiting device are possible. The measuring-force limiting device shall function smoothly.

The measuring force generated by the measuring-force limiting device shall be measured as given in **5.3.2.4**, and shall supersede the frictional force of the spindle. Usually, the micrometers have a measuring force between 5 N and 15 N. The measuring force dispersion shall be not more than 3 N.

4.10 Adjustment devices

Micrometer for external measurements, micrometer for internal measurements and micrometer for span measurements of teeth shall be provided with user-accessible means for setting the micrometer to zero or to the reference point.

An adjustment device shall be provided to compensate for wear of the spindle and nut threads.

NOTE 1 To set the reference point, the reference point setting bars or gauge blocks should be used.

NOTE 2 The dimensional tolerance on nominal dimension of reference point setting bar is obtained by the following formula.

$$\Delta L = \pm\left(1 + \frac{L}{50}\right)$$

where, ΔL : dimensional tolerance on nominal dimension of reference point setting bar (μm)

L : nominal dimension of reference point setting bar (mm)

On a conspicuous position of reference point setting bar, the nominal dimension and dimensional tolerance shall be described.

4.11 Spindle

The hardness of spindle thread shall be not less than 700 HV or 60 HRC, and it shall be measured on the thread or on the neighbouring cylinder surface. The hardness of stainless steel thread shall be not less than 530 HV or 51 HRC.

5 Metrological characteristics and performance

5.1 General

The metrological characteristics and performance of micrometers specified in this

Standard shall apply only when the reference point is set using the minimum measurable dimension. The metrological characteristics and performance of a micrometer can be measured by a suitable instrument and a measurement standard with clear uncertainty, for example a gauge block specified in JIS B 7506. The measurement standard shall be able to measure the metrological characteristics and performance of a micrometer over the whole measuring range.

NOTE 1 Notes on use are given in Annex B.

NOTE 2 An example of data sheet for specification marking in the case of providing the information for users is given in Annex C.

5.2 Metrological characteristics

5.2.1 Clamping of spindle

When clamped (in cases where the frame is equipped with a clamping device), a spindle shall be tightly secured. The indication shall not change by more than 2 μm.

5.2.2 Maximum permissible error of indication (MPE)

5.2.2.1 General

The error-of-indication characteristics apply to any indications based on the zero setting stated in 5.1. The tolerance on error of indication shall be limited by the maximum permissible error (MPE).

The repeatability (5.2.2.3) applies only when it is required by the manufacturer (or the supplier) based on the design specification (design characteristics).

NOTE : The symbols of error-of-indication characteristics and their corresponding markings are given in Annex JA.

5.2.2.2 Full surface contact error J (maximum permissible error J_{MPE})

a) **Maximum permissible error of indication by full measuring face contact**, as follows.

The full surface contact error refers to the error of indication when full measuring face contact (3.5.1) is employed at any position of the measuring range, and the maximum permissible error J_{MPE} of indication by full measuring face contact of a micrometer shall be as given in Table 8.

Table 8 Maximum permissible error of indication by full measuring face contact J_{MPE}

Unit: μm

Measuring range (mm)	Micrometer for external measurements	Micrometer for internal measurements	Micrometer for span measurements of teeth	Micrometer head
0 to 25	±2	–	±4	±2
25 to 50				
50 to 75		±4	±6	
75 to 100	±3			
100 to 125		±5	±7	
125 to 150				
150 to 175	±4	±6	±8	
175 to 200				
200 to 225				
225 to 250	±5		±9	–
250 to 275		±7		
275 to 300				
300 to 325	±6		–	
325 to 350				
350 to 375		±8		
375 to 400	±7			
400 to 425				
425 to 450		±9		
450 to 475	±8			
475 to 500				

J_{MPE} of the micrometer having other measuring ranges shall be as agreed between the parties concerned with delivery.

b) Measurement of full surface contact error The full surface contact error shall be tested as follows.

1) Measure the full surface contact error using an instrument such as gauge block.

2) When the micrometer has a rotating measuring spindle, the following gauge block dimensions should be used in order to enable the spindle to be measured at points with integer multiple of the thread pitch and at the intermediate positions.

If the minimum measurable dimension is not zero, that value plus the dimension corresponding to the minimum measurable dimension are the preferable gauge block dimension.

2.5 mm, 5.1 mm, 7.7 mm, 10.3 mm, 12.9 mm, 15.0 mm, 17.6 mm, 20.2 mm, 22.8 mm and 25.0 mm

When the measurement is performed using the gauge block dimensions above, the error of indication at various rotational angles of a spindle can be obtained.

3) In the case of large micrometers, it suffices to measure the minimum and maximum measurable dimensions of the micrometer by a gauge block in consideration for the influence of the measuring force on the body, provided that the measuring

head has been measured separately (measurement of spindle screw feed error).

NOTE : Using the error-of-indication curve is the easest method to evaluate the performance of a micrometer, and the effective method to verify the measurement result. An example of an error-of-indication curve is given in Annex A.

4) The full surface contact error shall be measured as given in Table 9.

Table 9 Measurement of full surface contact error

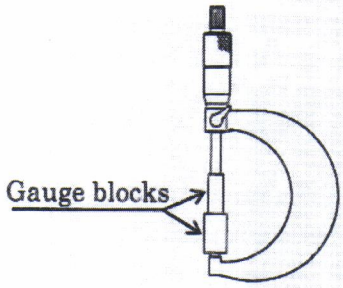
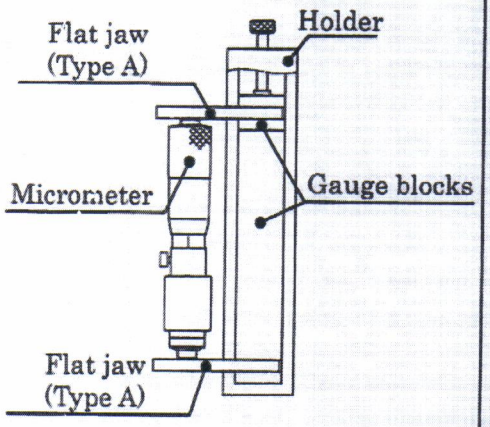
Type	Measuring method	Figure	Measuring instruments
Micrometer for external measurements	After setting the reference point using measuring-force limiting device with the minimum measurable dimension of a micrometer, place each gauge block of a selected length between measuring faces. Subtract the gauge block dimension from the indication of the micrometer using the same device.		Gauge block of grade 0 or 1 specified in **JIS B 7506**, or the gauge equal or superior thereto
Micrometer for internal measurements	Method 1 Bring two flat jaws (Type A) into close contact with the gauge block having the nominal dimension equal to the minimum measurable dimension of the micrometer, and fix them with a gauge block holder. Set the reference point of the micrometer by measuring the distance between the two faces, and measure the dimension using each gauge block of the selected length. Subtract the gauge block dimension from the indication of the micrometer.		Gauge block of grade 0 or 1 specified in **JIS B 7506**, or gauge equal or superior thereto

Table 9 (continued)

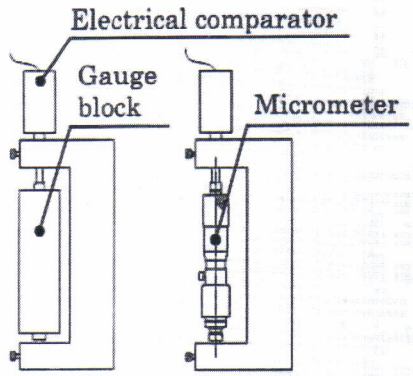
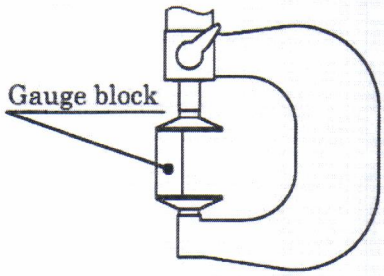
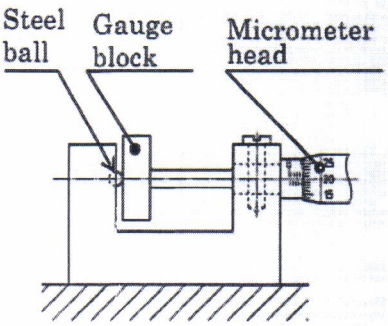
Type	Measuring method	Figure	Measuring instruments
Micrometer for internal measurements (concluded)	Method 2 After setting the reference point of a measuring instrument with the gauge block having the nominal dimension equal to the minimum measurable dimension of the micrometer, set the reference point of the micrometer. Then adjust the scale of the micrometer to any indication, clamp it, and measure the length with the length measuring instrument. Add the minimum measurable dimension to the indication of the length measuring instrument at that time. Subtract that dimension from the indication of the micrometer.		Electrical comparator having the scale interval of 1 μm or less and the instrumental error of ±0.5 μm as specified in **JIS B 7536**, or length measuring instrument having an accuracy equal or superior thereto.
Micrometer for span measurements of teeth	After setting the reference point using measuring-force limiting device with the minimum measurable dimension of a micrometer, and place each gauge block of a selected length between measuring faces (the position indicated in the figure). Subtract the gauge block dimension from the indication of the micrometer using the same device.		Gauge block of grade 0 or 1 specified in **JIS B 7506**, or gauge equal or superior thereto
Micrometer head	Method 1 After setting the reference point at the minimum measurable dimension of a micrometer, place each gauge block of a selected length between the measuring face and the steel ball and subtract the gauge block dimension from the indication of the micrometer head.		Gauge block of grade 0 or 1 specified in **JIS B 7506**, or gauge equal to or superior thereto

Table 9 (concluded)

Type	Measuring method	Figure	Measuring instruments
Micrometer head (concluded)	Method 2 Measure the spindle screw feed of the micrometer head by the length measuring instrument.		Length measuring instrument having the scale interval 1 μm or less and the error of indication ±1 μm or less

5.2.2.3 Repeatability R (maximum permissible error R_{MPE})

This is the closeness of agreement between the results of successive measurements of the same measurand under the same conditions of measurement, when a full measuring face contact (3.5.1) is employed for micrometer for external measurements and micrometer head or when a partial measuring face contact (3.5.2) is employed for micrometer for span measurements of teeth and micormeter for internal measurements.

The repeatability shall be measured, for example by using gauge blocks having any dimension (within the measuring span).

NOTE : The manufacturer sometimes provides the details of repeatability upon request from the user.

5.2.2.4 Partial surface contact error E (maximum permissible error E_{MPE})

The partial surface contact error applies to micrometer for span measurements of teeth and micrometer for external measurements. The error of indication applies when partial measuring face contact (3.5.2) is employed on successive measurements of the same measurand, carried out at any position of the measuring faces. If the micrometer has a rotating measuring spindle, the measurements should be carried out at points with integer multiple of the thread pitch and at their intermediate positions.

For the practical purposes, the measurement of the partial surface contact error shall be taken as that of the flatness of measuring face and parallelism of measuring face.

5.3 Performance

5.3.1 Performance of micrometer

5.3.1.1 Micrometer for external measurements

The performance of micrometer for external measurements shall be as given in Table 10, when measured according to **5.3.2.1** to **5.3.2.3** and **5.3.2.5**.

Table 10 Performance of micrometer for external measurements

Unit: μm

Measuring range (mm)	Flatness of measuring face	Parallelism of measuring face	Spindle screw feed error	Frame deflection per 10 N
0 to 25	0.6	2	3	2
25 to 50				
50 to 75				3
75 to 100		3		
100 to 125				4
125 to 150				5
150 to 175				6
175 to 200		4		
200 to 225				7
225 to 250				8
250 to 275				
275 to 300		5		9
300 to 325	1			10
325 to 350				
350 to 375				11
375 to 400		6		12
400 to 425				
425 to 450				13
450 to 475				14
475 to 500		7		15
Performance of micrometer having other measuring ranges shall be as agreed between the parties concerned with delivery.				

5.3.1.2 Micrometer for internal measurements

The performance of micrometer for internal measurements shall be as given in Table 11 when measured according to 5.3.2.3.

Table 11 Performances of micrometer for internal measurements

Unit: μm

Measuring range (mm)	Spindle screw feed error
500 max.	3
Performance of micrometer having other measuring ranges shall be as agreed between the parties concerned with delivery.	

5.3.1.3 Micrometer for span measurements of teeth

The performance of micrometer for span measurements of teeth shall be as given in Table 12 when measured according to 5.3.2.1 to 5.3.2.3 and 5.3.2.5.

Table 12 Performance of micrometer for span measurements of teeth

Unit: μm

Measuring range (mm)	Flatness of measuring face	Parallelism of measuring face	Spindle screw feed error	Frame deflection per 10 N
0 to 25	1	4	3	2
25 to 50				
50 to 75		6		3
75 to 100				
100 to 125	1.3	7		4
125 to 150				5
150 to 175		8		6
175 to 200				
200 to 225	1.6			7
225 to 250		9		8
250 to 275				
275 to 300				9
Performance of micrometer having other measuring ranges shall be as agreed between the parties concerned with delivery.				

5.3.1.4 Micrometer head

The performance of micrometer head shall be as given in Table 13 when measured according to 5.3.2.1, 5.3.2.3 and 5.3.2.6.

Table 13 Performance of micrometer heads

Unit: μm

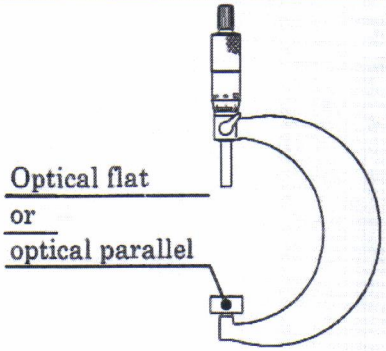
Measuring range (mm)	Flatness of measuring face	Spindle screw feed error	Perpendicularity of measuring face to spindle axial line
0 to 25	2	3	2
Performance of micrometer having other measuring ranges shall be as agreed between the parties concerned with delivery.			

5.3.2 Measurement of performance

5.3.2.1 Flatness of measuring face

The flatness of measuring face shall be measured as given in Table 14.

Table 14 Measurement of flatness of measuring face

Type	Measuring methods	Figure	Measuring instruments
Micrometer for external measurements, micrometer for span measurements of teeth, micrometer head	Bring an optical flat or optical parallel into close contact with the measuring face, and count the number of red interference fringes produced by the white light. Count a red interference fringe as 0.3 μm.		Optical flat of grade 1 or 2 specified in JIS B 7430, or optical parallel of grade 1 specified in JIS B 7431

5.3.2.2 Parallelism of measuring face

The parallelism of measuring face shall be measured as given in Table 15.

Table 15 Measurement of parallelism of measuring face

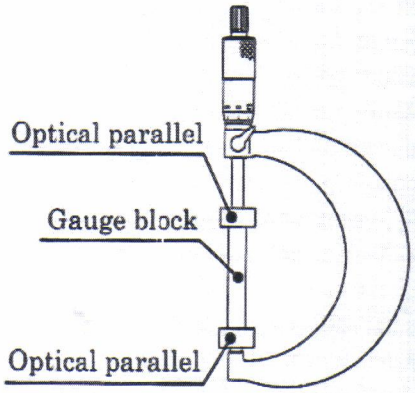
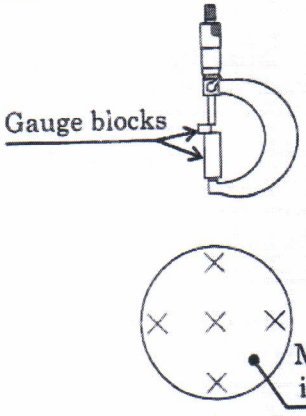
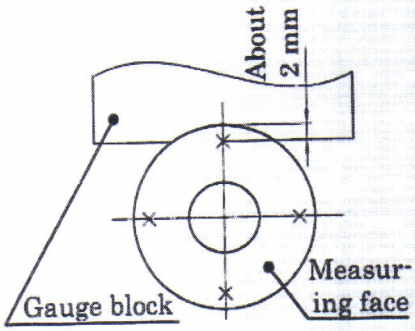
Type	Measuring methods	Figure	Measuring instruments
Micrometer for external measurements	Method 1 Bring a combination of gauge block and optical parallel, or optical parallel into close contact with the measuring face of the anvil (to the degree that a single colour or closed curve of interference fringe is observed). Count the number of red interference fringes produced by the white light on the measuring face of a spindle using a measuring-force limiting device of the micrometer, and take it as a parallelism. It is preferable to obtain the maximum value of successive measurements both at the position of integer rotations of the spindle and at more than one position where the fraction of number of rotations equals to the multiple of a fraction of one rotation. When the maximum measurable dimension exceeds 175 mm, Method 2 may be used.		Optical parallel of grade 1 specified in **JIS B 7431**, and gauge block of grade 0 or 1 specified in **JIS B 7506**, or gauge equal or superior thereto

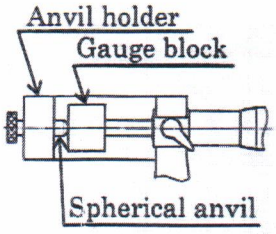
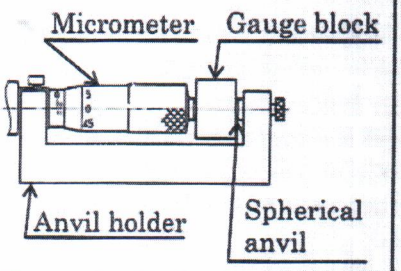
Table 15 (concluded)

Type	Measuring methods	Figure	Measuring instruments
Micrometer for external measurements (concluded)	Method 2 Place a gauge block in the centre of both measuring faces, and read the indication using a measuring-force limiting device of the micrometer. Place separately the gauge blocks in four corners of the measuring face, read each indication, and obtain the maximum difference. Alternatively, bring the gauge block (equal to the minimum measurable dimension) into close contact with the centre of anvil measuring face. Place separately another gauge blocks between the gauge block and the spindle measuring face, in centre and four corners of the measuring face. Read each indication, and obtain the maximum difference.	 The mark × represents a measuring point.	Gauge block of grade 0 or 1 specified in JIS B 7506, or gauge equal or superior thereto
Micrometer for span measurements of teeth	Place separately gauge blocks in four corners of measuring face, read each indication using a measuring-force limiting device of the micrometer, and obtain the maximum difference. Alternatively, bring the gauge block (equal to the minimum measurable dimension) into close contact with the centre of anvil measuring face, place separately another gauge blocks between the gauge block and the spindle measuring face in four corners of measuring face. Read each indication, and obtain the maximum difference.	 The mark × represents a measuring point	Gauge block of grade 0 or 1 specified in JIS B 7506, or gauge equal or superior thereto

5.3.2.3 Spindle screw feed error

The spindle screw feed error shall be measured as given in Table 16.

Table 16 Measurement of spindle screw feed error

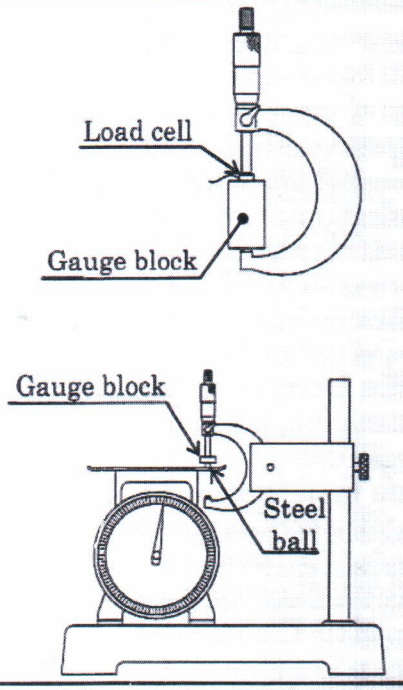
Type	Measuring method	Figure	Measuring instruments
Micrometer for external measurements, micrometer for internal measurements, micrometer for span measurements of teeth	Fix an anvil holder to the frame (body) so that the centre of measuring face of a spindle comes into contact with the centre of the spherical anvil at the position of minimum measurable dimension, apply the measuring force and set the reference point. Place separately gauge blocks of different length between the measuring face of a spindle and the spherical anvil, apply the measuring force and read the indication. Obtain the difference between the maximum and the minimum from the differences between the indications of the micrometer and the dimensions of the gauge block. In the case of the micrometer for external measurements having the maximum measurable dimension of 150 mm or less, the difference between the maximum and the minimum of the full surface contact error (Table 9) may be obtained.	 Example of micrometer for external measurements  Example of micrometer for internal measurements	Spherical anvil, anvil holder, gauge block of grade 0 or 1 specified in JIS B 7506, or gauge equal or superior thereto
Micrometer head	Determine the difference between the maximum and the minimum of the full surface contact error at each measurable dimension obtained by the method in Table 9.	—	—

5.3.2.4 Measuring force and its dispersion

5.3.2.4.1 Measuring force

The measuring force shall be measured as given in Table 17.

Table 17 Measurement of measuring force

Type	Measuring method	Figure	Measuring instruments
Micrometer for external measurements, micrometer for span measurements of teeth, micrometer head	Use a load cell or balance. When using a load cell, arrange the centre of load cell in the centre axil of spindle. When using a balance, place a steel ball between loading point of the balance and the measuring face centre of spindle. Arrange the spindle and the balance so that the spindle axis is vertical and the balance indicates zero. Read the maximum indication of a load cell or balance using a measuring-force limiting device. Repeat this procedure five times, and average the values.		Load cell of sensitivity 0.2 N or less, automatic-indicating spring scale balance of scale interval 20 g or less, or equivalent instrument

5.3.2.4.2 Measuring force dispersion

The measuring force dispersion shall be measured as given in Table 18.

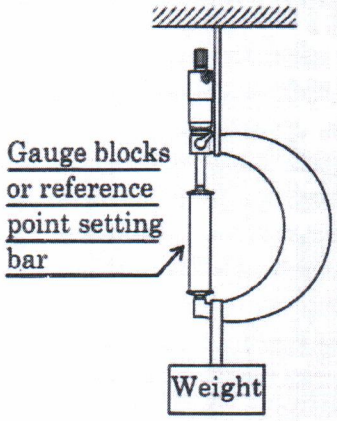
Table 18 Measurement of measuring force dispersion

Type	Measuring method	Figure	Measuring instruments
Micrometer for external measurements, micrometer for span measurements of teeth, micrometer head	Obtain the difference between the maximum and the minimum of measuring force obtained by the method of **5.3.2.4.1**, and take it as a measuring force dispersion.	Same as Table 17	Same as Table 17

5.3.2.5 Frame deflection

The frame deflection shall be measured as given in Table 19.

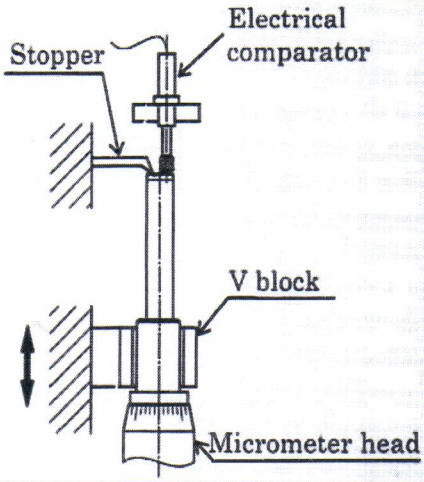
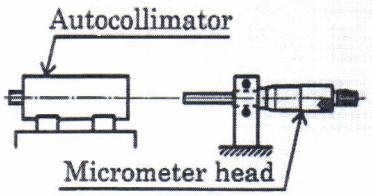
Table 19 Measurement of frame deflection

Type	Measuring method	Figure	Measuring instruments
Micrometer for external measurements, micrometer for span measurements of teeth	Aim the anvil of a micrometer downward and secure the micrometer with the spindle axis kept vertical. Place the gauge block of any length or the reference point setting bar between both measuring faces using a measuring-force limiting device, and read the indication. Apply the load of 50 N (suspend a weight of 5 kg) to the frame of anvil side, place the gauge block or the reference point setting bar using a measuring-force limiting device, and read the indication. Obtain the frame deflection per 10 N from the difference between two indications.		Reference point setting bar or other bar equal or superior thereto Weight

5.3.2.6 Measuring face perpendicularity to spindle axial line

The measuring face perpendicularity to spindle axial line shall be measured as given in Table 20.

Table 20 Measurement of measuring face perpendicularity to spindle axial line

Type	Measuring method	Figure	Measuring instruments
Micrometer head	Method 1 Fix the mounting part of a micrometer head to a slidable V-block. Move the V-block, and read the indication of an electrical comparator when the measuring face is applied to the stopper. Read separately the indications of the electrical comparator, and take a half the maximum difference of indications as a perpendicularity.		Electrical comparator specified in JIS B 7536, or length measuring instrument of an accuracy at least equivalent thereto
	Method 2 Rotate the spindle of a micrometer head, read the runout of measuring face using an autocollimator, and obtain the perpendicularity by the following formula. $y = D_1 \cdot x/400$ where, y: perpendicularity of spindle (μm) D_1: diameter of spindle (μm) x: runout of autocollimator (s)		Autocollimator specified in JIS B 7538

6 Marking on product documents

For reference, the examples of marking the maximum permissible error in product documents or figures are given in Annex JA.

7 Proof of conformance with specifications

7.1 General

For the proof of conformance and non-conformance with specifications, the international acceptance criterion where the specification zone equals the acceptance zone

(simple acceptance) is used.

NOTE : The international acceptance criterion refers to ISO/TR 14253-6 : 2012.

7.2 Measurement standard for calibration of metrological characteristics and performance

A measurement standard shall be properly selected and used according to JIS. When such a measurement standard is not available, the one traceable to national standards shall be used.

7.3 Standard reference temperature

The specifications for performances given in this Standard shall be the values at the standard reference temperature of 20 °C as specified in JIS B 0680.

8 Inspection

The dimensions, measuring range, type of indicating device, measuring face, measuring-force limiting device, spindle, metrological characteristics and performance of micrometer shall be inspected and conform to 4.3 to 4.5, 4.8, 4.9, 4.11 and clause 5. For the micrometers with measuring faces of anvil and spindle made of cemented carbide alloys, the measurements of hardnesses may be omitted.

9 Marking

On a conspicuous position of a micrometer, the following items shall be indelibly described.

a) Scale interval or minimum digital step

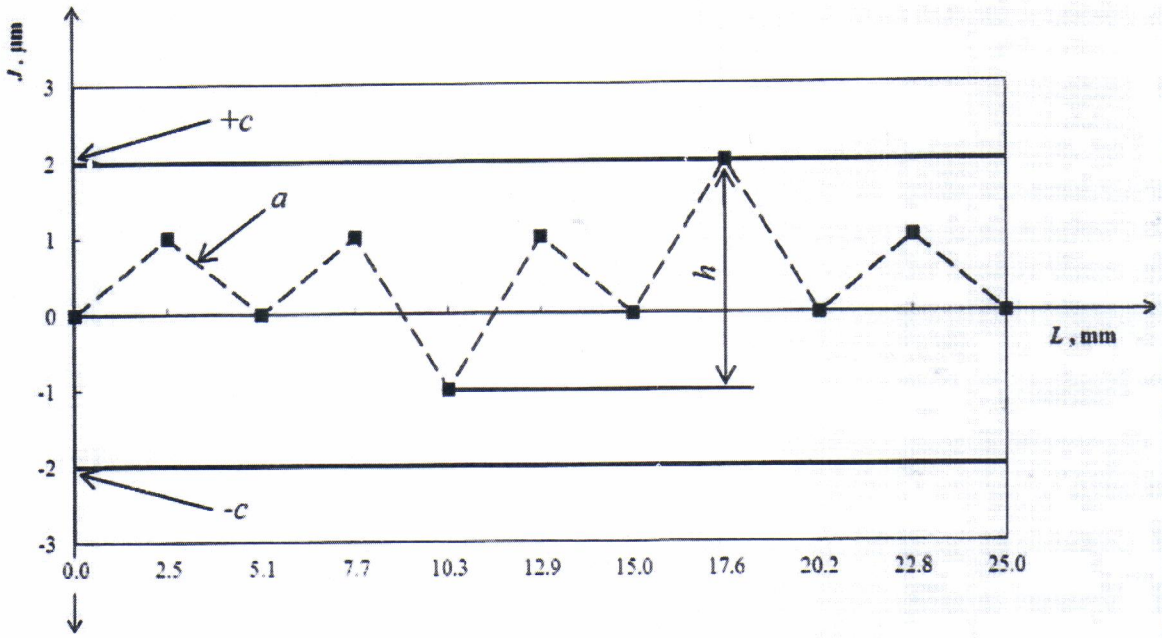
b) Measuring range (see Table 5)

c) Name of the manufacturer (supplier) or its abbreviation

d) Manufacturing number (alphanumeric)

Annex A (informative)
Example of an error-of-indication curve

Figure A.1 shows an example of an error-of-indication curve. This is a simplified data set (for data points) in order to illustrate the characteristics of the micrometer. The details of indicating and specifying metrological characteristics are specified in clause 7 of JIS B 0642 : 2010.



Symbol

L	length indication
J	error of indication
h	error-of-indication span
c	error-of-indication MPE
a	error-of-indication curve

Figure A.1 Error-of-indication curve

Annex B (informative)
Notes on use

B.1 To obtain reliable repeatable measuring values, a measuring-force limiting device, when provided in a micrometer, shall be used to rotate the spindle smoothly.

B.2 In order to avoid heat transfer from the hand, the micrometers shall be held as much as possible by the insulating plate or be used with a micrometer stand.

B.3 The micrometer shall be verified periodically, based on the frequency and conditions of use. The abnormalities of spindle (e.g. sluggish rotation, hesitation), if any, can result from its deformation, dirt in the screw, etc.

B.4 Before use, the micrometer shall be reset to zero or reference point in the posture of use. Gauge blocks or reference point setting bar should be used for this setting.

B.5 In the case of electronic digital indications, pay special attention to environmental factors.

B.6 Attention should be paid to the tendency that measurement at the disc end of a micrometer for span measurements of teeth causes a relatively large error because this type of micrometer does not adhere to the conditions prescribed in the Abbe's Principle.

Annex C (informative)

Typical data sheet for design specification (design characteristics), metrological characteristics and performance

The following data sheet shows an example of product information in catalogues, brochures, etc., provided with the user by the manufacturer (or the supplier). In many cases, these items of information are shown by the forms of dimensional drawings and reference charts.

Name of equipment :.....
Product profile :.....

☐ Design specification (design characteristics)
- Type :.....
- Types of indicating devices :.....
- Minimum reading value / scale interval / minimum digital step :.....mm
- Measuring range :.....to.....mm
- Dimensions
  - Diameter of spindle and anvil (D_1) :.....mm
  - Length of anvil (L_1) :.....mm
  - Depth of frame (L_5) :.....mm
  - Thread pitch of spindle :.....mm

☐ Metrological characteristics and performance
- Maximum permissible error of indication (MPE)
  - Maximum permissible error of indication by full measuring face contact J_{MPE} :.....μm
  - Maximum permissible error of indication by partial measuring face contact E_{MPE}
    - Flatness of measuring face :.....μm
    - Parallelism of measuring face :.....μm
  - Maximum permissible error of repeatability R_{MPE} :.....μm (if necessary)

Company name :.....
Date, number of edition, etc. :.....

Annex D (informative)
Relation to the GPS matrix model

D.1 General

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

NOTE 1 The latest edition of ISO/TR 14638 is ISO 14638 : 2015.

NOTE 2 The chain link 5 corresponds to the chain link F specified in ISO 14638 : 2015.

D.2 Information about this Standard and its use

This Standard provides the most important design specification (design characteristics), metrological characteristics and performance of micrometers equipped with analogue, mechanical or electronic digital indication.

D.3 Position in the GPS matrix model

This Standard is a general GPS standard, which influences the chain link 5 of the chain of standards on size in the general GPS matrix, as shown in Figure D.1.

	Global GPS standards						
	General GPS standards						
Fundamental GPS standards	Chain link number [a]	1	2	3	4	5	6
	Size					×	
	Distance						
	Radius						
	Angle						
	Form of a line independent of datum						
	Form of a line dependent of datum						
	Form of a surface independent of datum						
	Form of a surface dependent of datum						
	Orientation						
	Location						
	Circular run-out						
	Total run-out						
	Datums						
	Roughness profile						
	Waviness profile						
	Primary profile						
	Surface imperfections						
	Edges						

Note [a] The representation of chain link number is as follows.

Chain link 1 : symbols and indications
Chain link 2 : feature requirements
Chain link 3 : Feature properties
Chain link 4 : measurement
Chain link 5 : measurement equipment
Chain link 6 : calibration

Figure D.1 GPS matrix model

D.4 Related Standards

The related standards are included in the chain of standards in Figure D.1.

Annex JA (informative)
Marking on product documents

For better visibility and clarity, the symbols given in this Standard can be replaced by the corresponding symbols given in Table JA.1, which have fewer subscripts.

Table JA.1 Symbols in this Standard and corresponding symbols used for product documents or figures

Symbols in this Standard	Corresponding symbols
J_{MPE}	MPE_J
E_{MPE}	MPE_E
R_{MPE}	MPE_R

Bibliography

[1] ISO/TR 14253-6 : 2012 *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*

[2] ISO/TR 14638 : 2015 *Geometrical product specifications (GPS) — Matrix model*

[3] ISO/TR 14638 : 1995 *Geometrical product specification (GPS) — Masterplan*

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

JIS B 7502 : 2016 *Micrometers*			**ISO 3611** : 2010 *Geometrical product specifications (GPS) — Dimensional measuring equipment : Micrometers for external measurements — Design and metrological characteristics*				
(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	
1 Scope	Specify bar-shaped micrometer for internal measurements, micrometer for span measurements of teeth, and micrometer head in addition to micrometer for external measurements.		1	Specify only micrometer for external measurements in the scope.	Addition	Add bar-shaped micrometer for internal measurements, micrometer for span measurements of teeth, and micrometer head to the scope, in addition to micrometer for external measurements.	Add micrometers actually used in Japan. Addition proposal will be considered to **ISO** as necessary.
2 Normative references							
3 Terms and definitions			3	Almost identical with **JIS**.	Addition	Add bar-shaped micrometer for internal measurements, micrometer for span measurements of teeth, micrometer head, and the requirement for the error of indication.	Addition of terms, and no substantive deviation.

(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 specification (design characteristics)	4.2 Names of main parts		4.1	Almost identical with JIS.	Addition	Individually describe bar-shaped micrometer for internal measurements, micrometer for span measurements of teeth, and micrometer head. Mention that the figures indicate names but not the design details.	For clarification, describe types of micrometers in different subclauses before indicating the names of main parts.
	4.3 Dimensions		4.2	Mark dimensional lines and symbols in the figure of structure, and specify all nominal values of dimensions by symbols in the table.	Addition	Add bar-shaped micrometer for internal measurements, micrometer for span measurements of teeth, and micrometer head in addition to micrometer for external measurements (Figures 5 and 6, Tables 3 and 4).	Add types of micrometers actually used in Japan.
	4.4 Measuring range		—		Addition	Add the table of measuring range for each micrometer.	Add the description in the previous edition to clarify the types of measuring range.
	4.5.2.2 Graduation		4.3.2.2	Exemplify only 0.5 mm of thread pitch.	Addition	Exemplify 1.0 mm of thread pitch in the figure.	Enable more practical use by concrete description.
	—		4.3.2.2	Describe the vernier scale with an interval of 0.001 mm in the figure.	Deletion	Delete the vernier scale with an interval of 0.001 mm.	Deleted because the prevalence of digital products results in a decrease in demand for this type of vernier scale.

(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 specification (design characteristics) (continued)	4.5.2.3 Fiducial line and graduation line		–		Addition	Add the specification for thickness and its unevenness for graduation line.	Specified because they influence the error of indication therefore are important.
	4.5.2.4 Scale spacing of thimble		–		Addition	Add the specification for the centre distance between the adjacent thimble graduation lines.	Specified because it influences the error of indication therefore is important.
	4.5.2.5 Arrangement of scales		4.3.2.4		Addition	Add the bevel angle of thimble ends.	Specified because it affects the visibility for reading of the scale.
	4.5.4.2 Error messages		4.3.4.2	Specify that all error messages of handling and system need to be indicated when an electronic digital display is used.	Alternation	Limit to the cases where rapid spindle rotation could cause the output of wrong indication or where power-supply voltage declines.	Limited for better understanding.
	4.6 Protection of electronic digital indication for field use		4.4		Alternation	Limit the marking of protection code to electronic digital indication with guaranteed fluid and dust protection.	Limited because it is impractical to require the marking of protection code for all types of micrometers.
				Specification for electromagnetic field protection	Deletion	–	Deleted because the indication of electromagnetic field protection is impractical.

(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 specification (design characteristics) (continued)	4.7 Insulating plate		4.5	Frame	Alternation	Delete the specification for the rigidity of frame.	Specify the insulating plate only because the rigidity of frame is specified within the subclause of frame deflection.
	4.8 Measuring face		4.6	Measuring face	Addition	Specify the hardness of measuring face and measurement point.	Add the description in the previous edition to maintain the constant quality.
	4.9 Measuring-force limiting device		4.7	Measuring-force limiting device	Alternation	Add the micrometer for span measurements of teeth and specify that a micrometer head need not be equipped with the measuring-force limiting device. Alter the maximum standard measuring force to 15 N. Specify that the measuring force dispersion shall be not more than 3 N.	Specify micrometers added in the scope. Alter the maximum standard value from 10 N to 15 N for the stability of measurement by a large micrometer. Also specify the measuring force dispersion because it affects the measurement therefore is important.
	4.10 Adjustment equipment Dimensional tolerances on nominal dimensions of reference point setting bar		4.8	Adjustment equipment	Addition	Add micrometer for internal measurements and micrometer for span measurements of teeth.	Specify micrometers added in the scope.
			—		Addition	Define the method to obtain dimensional tolerances on the nominal dimension of reference point setting bar.	Describe the dimensions of reference point setting bar considering their importance for use of micrometers.

(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 specification (design characteristics) (concluded)	—		4.9 Design characteristics (manufacturer's specification)	Manufacturers shall specify the design characteristics (manufacturer's specification) indicated in ISO.	Deletion	Delete the description about data sheet given in ISO.	Impractical to use the data sheet given in ISO.
	4.11 Spindle		—	—	Addition	Add the subclause to specify the spindle thread hardness and its measurement point.	Add the description in the previous edition to maintain the constant quality.
5 Metrological characteristics and performance	5.1 General		5.1	Apply the floating zero point to metrological characteristics.	Alternation	Evaluate metrological characteristics and performance only when the reference point setting at the minimum measurable dimension of a micrometer is performed.	In practical use, the measurement is carried out after the reference point is set.
	5.2.1 Clamping of spindle		5.2	No change in dimensions of the sipndle when it is clamped.	Alternation	Express that the spindle shall be tightly secured.	Achieve the convenience of use by plain description.

(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 Metrological characteristics and performance (concluded)	5.2.2.1 Maximum permissible error of indication (MPE) General		5.3.1	General	Alternation	Application of repeatability depends on the judgement by the manufacturer.	Repeatability largely depends on the skill of the measurer, so specify that the application is at the discretion of the manufacturer.
	5.2.2.2 Full surface contact error		5.3.2	Full surface contact error	Addition	Add the list of maximum permissible errors.	Add the description in the previous edition to maintain the constant quality. Maintain ± symbols, according to ISO and the previous edition of JIS.
	5.2.2.3 Repeatability		5.3.3	Repeatability	Alternation	Specify the contact method.	Reflect each micrometers actually used.
	5.2.2.4 Partial surface contact error		5.3.4	Partial surface contact error	Alternation	Add micrometer for span measurements of teeth.	Reflect each micrometers actually used.
	5.3. Performance		—		Addition	Indicate in the table the tolerances on flatness and parallelism of the measuring face, spindle screw feed error and frame deflection, and their measurement methods.	Add the description in the previous edition to specify other important performance items than metrological characteristics.
	—		5.5	Instrument specification sheet	Deletion	—	Delete the specification because it is impractical to use the instrument specification sheet for making specification agreement with the user.

(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	
6 Marking on product documents	Examples of marking the maximum permissible error in product documents, figures and others		—		Addition	Add the examples (Annex JA) for reference.	Consider the convenience of users. No technical deviation.
7 Proof of conformance with specifications	7.1 General		6	As specified in ISO 14253-1.	Alternation	Alter the acceptance criteria according to ISO/TR 14253-6 : 2012. Delete the description related to the evaluation of uncertainty.	Add more practical acceptance criteria.
	7.2 Measurement standard for calibration of metrological characteristics and performance		—		Addition	When measurement standard conforming to JIS is not available, define that a measurement standard traceable to national standards shall be used.	Add the specification for measurement standard in relation to national standards.
	7.3 Standard reference temperature		—		Addition	Clarify that dimensions and error of indication are values at standard reference temperature.	Enable more practical use by concrete description.
8 Inspection	—		—	—	Addition	Indicate the inspection items which need to conform to the requirements.	Consider JIS certification.
9 Marking	—		7	Almost identical with JIS.	Addition	Add the minimum digital step and the name of the manufacturer (supplier).	Add the marking items in the previous edition which are common in Japan.

(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 C		Deletion	Delete the item of calibration.	Deleted for clarification.
Annex A (informative)	Example of an error-of-indication curve		Annex A		Identical	—	—
Annex B (informative)	Notes on use		Annex E		Alternation	Include other types of micrometers than those for external measurements.	Follow the scope.
Annex C (informative)	Typical data sheet for design specification (design characteristics), metrological characteristics and performance		Annex B	Example of data sheet	Alternation	Replace the data sheet for communication inside a company with that for information from the manufacturer to the user.	Change the data sheet for more practical use.
Annex D (informative)	Relation to the GPS matrix model		Annex F		Identical	—	—
Annex JA (informative)	Marking on product documents		—	Marking method of symbols	Addition	Permit the use of corresponding symbols which have the fewer subscripts (MPE) therefore are more understandable.	Add a table of correspondence showing symbols of metrological characteristics, in consideration for other standards than JIS.

Overall degree of correspondence between **JIS** and International Standard (**ISO 3611** : 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.

Errata for JIS (English edition) are printed in *Standardization and Quality Control*, published monthly by the Japanese Standards Association, and also provided to subscribers of JIS (English edition) in *Monthly Information*.

Errata will be provided upon request, please contact:

Publishing Group, Japanese Standards Association
Mita MT Building, 3-13-12, Mita, Minato-ku, Tokyo, 108-0073 JAPAN
TEL. 03-4231-8550 FAX. 03-4231-8665