

## Cylinder Gauges

### 1. Scope

This Japanese Industrial Standard specifies the cylinder gauges with measuring range of 18 mm up to and including 400 mm.

The interchangeable rods and collars to be used for the cylinder gauges shall comply with Appendix.

Remark: The units and numerical values in { } in this standard are in accordance with the gravitational system of units, and are appended for reference only.

### 2. Definitions

The terms used in this standard are as defined in JIS Z 8103 as well as in the following:

- (1) cylinder gauge A bore measuring instrument which reads the displacement of plunger mechanically transmitted at a right angle, with a gauge, such as a dial gauge, mounted on itself by making comparison with the standard of length.
- (2) effective measuring range The operating range of plunger within which the performance of the cylinder gauge is warranted. In general, it is the range from the origin, that is the position where the plunger is pushed in by 0.1 mm, to the position where the plunger is pushed in further by 1.2 mm.
- (3) wide range accuracy The difference in ordinate between the highest and lowest points in the error diagram within the effective measuring range when the plunger is pushed in (see Attached Figure).
- (4) adjacent error The difference in error between two positions 0.1 mm distant from each other within the effective measuring range when the plunger is pushed in (see Attached Figure).
- (5) repeated accuracy The difference between the maximum and minimum values, when measurements are repeated in any position within the effective measuring range, while the gauge is swung in a plane including the axes of the plunger and the barrel, inside the ring gauge, with the plunger and the interchangeable rod kept in contact with the inside wall.
- (6) error due to guide plate The difference in indication between when the guide plate is placed in contact with the ring gauge and when not.

- (7) standard indicator The indicator that is to be used when the performance of cylinder gauge is examined.
- (8) instrumental error of standard indicator The remainder of the reading of the standard indicator subtracted by the true value that the indicator should indicate, with the position into which the long pointer has moved 0.1 mm off its settling point while the spindle of the standard indicator is pushed in being taken as the origin.

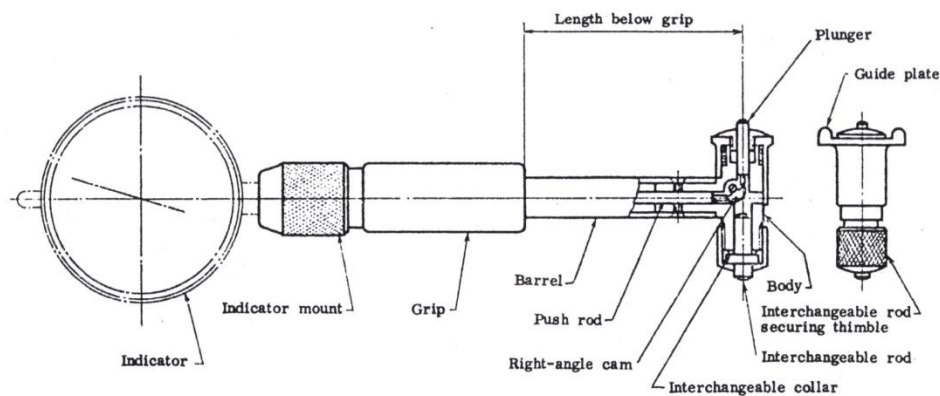
3. Grade

The cylinder gauges are classified into two grades, A and B, by the performance.

4. Names

The names of principal parts of the cylinder gauge are as given in Fig. 1.

Fig. 1. Names of Principal Parts



Remark: This drawing is intended not to show the standard of shape and dimensions but to give the names only.

5. Measuring Range

The measuring range and the length below grip of the cylinder gauge shall comply with Table 1, as a rule.

Table 1. Measuring Range  
Unit: mm

Measuring range	Length below grip
18 to 35	50, 100, 150
35 to 60	
50 to 100	
100 to 160	150, 250, 400
160 to 250	
250 to 400	

# 6. Performance

The performance of the cylinder gauge shall comply with Table 2.

Table 2. Performance of Cylinder Gauge

Measuring range mm	Permissible value for wide range accuracy $\mu\text{m}$		Permissible value for adjacent error $\mu\text{m}$		Permissible value for repeated accuracy $\mu\text{m}$		Permissible value for error due to rotation of plunger <sup>(1)</sup> $\mu\text{m}$		Permissible value for error due to guide plate $\mu\text{m}$		Measuring force N {gf }
	Grade A	Grade B	Grade A	Grade B	Grade A	Grade B	Grade A	Grade B	Grade A	Grade B	
18 to 35	5	10	2	4	2	3	2	4	1	2	4 max. {408}
35 to 60											
50 to 100											5 max. {510}
100 to 160											
160 to 250									2	3	6 max. {612}
250 to 400											

Note <sup>(1)</sup> To be applied to the rotatable plunger.

Remark: The values in this Table are referred to 20 °C temperature.

## 7. Shapes and Dimensions

7.1 Indicator Mount The depth from the end face of indicator mount to the push rod shall be 31 to 33 mm, and the diameter of hole in it shall be 8 mm or 9.5 mm.

7.2 Plunger The measuring face of the plunger shall be a smooth sphere having a radius of curvature not more than  $1/3$  of the least dimension in the measuring range.

## 8. Appearance and Function

The appearance and function of the cylinder gauge shall meet the requirements described below.

- (1) Painting and plating on every part shall be strong and shall not easily cause fade-out, peeling, rusting, etc.
- (2) Every part shall not yield deviation affecting usual service due to the variation of temperature and humidity under the usual condition of use.
- (3) The shape and finishing condition of every part, and stamping, marking, etc. shall be free from defects.
- (4) The barrel shall have strength enough not to affect measurement, and the grip shall be such as to check the effect of body heat on the measurement in practical use.
- (5) When the cylinder gauge is held in an arbitrary position and the plunger and the guide plate are operated over the whole operating range, their operation shall be smooth and free from detrimental backlash.
- (6) The displacement of the plunger shall be not less than 1.4 mm, and the position where the plunger is pushed in by 0.1 mm is taken as the origin of effective measuring range and the position where the plunger is pushed in further by 1.2 mm as the final limit of effective measuring range.
- (7) The supporting force of guide plate shall be greater than the measuring force, but not so great as to obstruct the measurement.



Reference Table

Measuring range mm	Supporting force of guide plate N {gf}
18 to 35	6 max. {612}
35 to 60	
50 to 100	10 max. {1020}
100 to 160	
160 to 250	15 max. {1530}
250 to 400	
Remark	The supporting force of guide plate is to be measured by pressing the contact faces of guide plate on the "U" shape auxiliary base placed on the pan of a top pan type spring balance.

- (8) The interchangeable rods and collars shall be easy of interchanging and shall be possible of being surely secured.
- (9) Where a steel or sintered hard alloy ball is attached to the plunger, the attaching shall be sure so as not to permit easy rotation or dropping off.
- (10) The mounting of indicator shall be simple and sure so as not to obstruct its performance.

#### 9. Materials and Hardness

The materials and their hardness of the principal parts of cylinder gauge shall be as given in Table 3 or any that is not inferior than them in mechanical properties.

Table 3. Materials and Hardness

Name		Material	Hardness
Plunger		SKS 3 (S Class 3) of JIS G 4404	HV 600 min.
Measuring face of plunger and both ends of right-angle cam	When steel ball is used	JIS B 1501	
	When steel ball is not used	SKS 3 (S Class 3) of JIS G 4404	HV 600 min.
Guide plate		SK 4 (Class 4) of JIS G 4401	HV 600 min. at end
Push rod			HV 600 min. at both ends

10. Measuring Method for Performance

The measuring method for the performance of the cylinder gauge shall be as specified in Table 4.

When performing measurement, the standard indicator shall be mounted. As the standard indicator, a dial gauge with measuring range of 2 mm complying with JIS B 7509, or one at least equivalent thereto, shall be used.

Table 4. Measuring Method for Performance

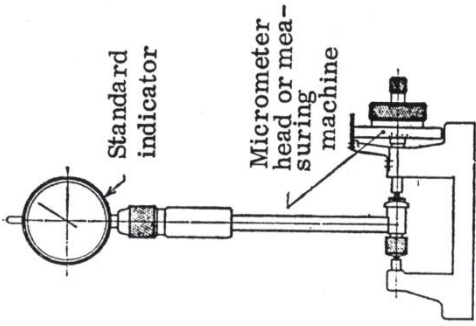
No.	Item	Method of measurement	Illustration, shown for example	Measuring instrument
1	Wide range accuracy	Support the barrel of the cylinder gauge vertically, referring to the reading of the standard indicator, push the plunger 0.1 mm by 0.1 mm starting from the origin to the final limit of effective measuring range, calculate the error by subtracting the reading of the micrometer head or measuring machine, draw an error diagram (see Attached Figure), and obtain the accuracy or error from it.		Micrometer head or measuring machine ( $1\ \mu\text{m}$ or less scale interval, within $\pm 1\ \mu\text{m}$ instrumental error), standard indicator
2	Adjacent accuracy	Before commencing the measurement, fix the body and calibrate the instrumental error of the standard indicator.		



Table 4 (Continued)

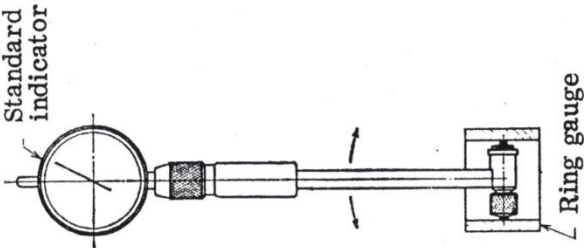
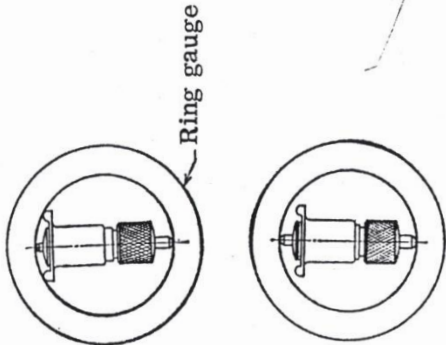
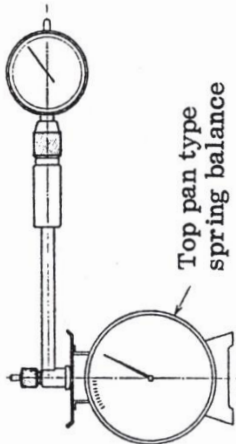
No.	Item	Method of measurement	Illustration, shown for example	Measuring instrument
3	Repeated accuracy	<p>Insert the body into the ring gauge, swing the barrel to make three backward-and-forward motions in the plane including the axes of plunger and barrel, read the minimum indication during each forward (or backward) motion, and remove the body from the ring. Repeat this procedure three times, and determine the difference between the maximum and minimum values among the nine readings taken.</p> <p>When making this measurement, press the cylinder gauge tips at the same places on the inside wall of ring gauge.</p>		Standard indicator, ring gauge
4	Error due to rotation of plunger (2)	<p>In the same way as No. 3 above, swing the barrel to make three backward-and-forward motions, read the minimum value during each motion, and remove the cylinder gauge from the ring gauge.</p> <p>Repeat this procedure turning the plunger axis 90° each time, and determine the difference between the mean values for the respective angular positions.</p>		

Table 4 (Continued)

No.	Item	Method of measurement	Illustration, shown for example	Measuring instrument
5	Error due to guide plate	<p>Make three measurements on the ring gauge under the condition such that the guide plate is touching the ring gauge, and under the condition such that the former is not touching the latter, and determine the difference between the mean values for the respective two cases.</p>		Standard indicator, ring gauge
6	Measuring force	<p>Support the barrel horizontally, continuously push in the plunger, measure the force at the origin and final limit of effective measuring range, and subtract the measuring force of standard indicator to determine the measuring force.</p>		Standard indicator, top pan type spring balance (20 g or less scale interval) or dynamometer (0.2 N {20 gf} or less sensitiveness)

Note (2) To be applied to rotatable plunger.

11. Inspection

The cylinder gauges shall be inspected on measuring range, performance, shape, appearance and function, and material, and they shall prove themselves to meet the requirements of 5., 6., 7., 8. and 9.

12. Designation

The cylinder gauges shall be designated by the number or title of this standard, measuring range, length below grip and grade in this order.

Example: JIS B 7515 35 to 60 x 150 mm A

Cylinder gauge 100 to 160 x 250 mm B

13. Marking

The cylinder gauges shall be marked with the following particulars:

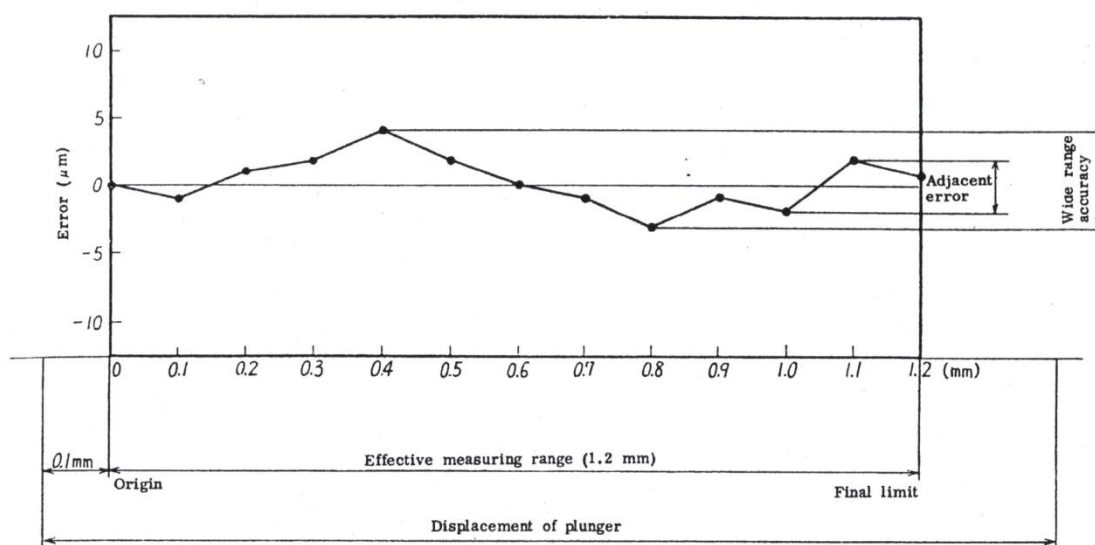
- (1) Grade
- (2) Measuring range
- (3) Serial number
- (4) Manufacturer's name or abbreviation thereof

14. Cautions for Handling

For handling of the cylinder gauges, the following matters are chiefly noteworthy:

- (1) It is recommended that a dial gauge reading in 0.001 mm should be used for Grade A, and one reading in 0.01 mm for Grade B.
- (2) It is recommended that when swinging the barrel for making the measurement, the plunger should be moved, with the tip of interchangeable rod being pressed on the same place inside the ring gauge.
- (3) In measuring the inside diameter by making comparison with the standard of length, if the cylinder gauge has shorter dimension than the standard, the pointer of the indicator turns clockwise contrary to the case of general measurement. It is therefore necessary to take into consideration the determination of plus/minus sign relative to the standard.

Attached Figure. Error Diagram



## Appendix

### 1. Scope

This appendix specifies the interchangeable rods and collars to be used for cylinder gauges.

### 2. Shape and Dimensions

The shape and dimensions of the measuring face of interchangeable rods shall comply with the following requirements:

- (1) The measuring face of interchangeable rods shall be composed of a ball that meets JIS B 1501 or be finished to a smooth sphere.
- (2) The radius of curvature of the measuring face of interchangeable rods shall be not more than 1/3 of the least dimension in the measuring range.

### 3. Nominal Dimension of Interchangeable Rod

The nominal dimension of an interchangeable rod shall be the integral value nearest to the measuring dimension in millimeters, when the plunger is pushed to the midpoint of effective measuring range with the cylinder gauge fitted with that interchangeable rod.



4. Function

The function of interchangeable rods and collars shall comply with the following requirements:

- (1) When the cylinder gauge is fitted with an interchangeable rod and collar, the effective measuring range of that combination is overlapping with that of another interchangeable rod and collar of the next size.
- (2) In an interchangeable rod fitted with a steel ball, the fitting shall be sure and the ball shall not easily rotate or drop off.

5. Material and Hardness

The material of measuring face of an interchangeable rod and its hardness shall be as specified in Appendix Table or one having the mechanical properties at least equivalent thereto.

Appendix Table

—	Material	Hardness
When steel ball is used for measuring face	JIS B 1501	—
When steel ball is not used in measuring face	SKS 3 (S Class 3) of JIS G 4404	HV 600 or over at measuring face

6. Marking

An interchangeable rod shall be marked with the nominal dimension (unit may be omitted). However, when the nominal dimension is marked on the container, it may be substituted by a code therefore.