Measuring microscopes

1. Scope This Japanese Industrial Standard specifies the measuring microscopes to measure lengths, angles, profiles, etc. (see Attached Fig. 1).

Remarks 1. The standards cited in this Standard are given in the following:

JIS B 7184 Measuring projectors

JIS B 7432 Optical polygons for angle standards

JIS B 7526 Squares

JIS B 7536 Electrical comparators

JIS B 7538 Autocollimators

JIS B 7541 Standard scales

2. In this Standard, units and numerical values given in { } are in accordance with the conventional units, and are appended for informative reference.

2. Definitions The definitions used in this Standard are in accordance with the following:

(1) observing microscope A microscope having a reticle, and having function to make up an image produced through an objective lens to a projected image or pictorial image.

(2) X-axis An axis in left and right directions of the table perpendicular to the optical axis of the objective lens.

(3) Y-axis An axis in front and rear directions of the table perpendicular to the optical axis of the objective lens.

(4) objective lens for profile measurement An objective lens, being combined with the template eyepiece, for measuring the profile of shape or the like.

(5) measuring accuracy In the practical measuring conditions, the accuracy being obtained when a length standard has been measured by the measuring microscope.

3. Grades The grades of the measuring microscopes shall be two grades of grade 0 and grade 1 according to the performance.

4. Performances The performances shall be in accordance with Table 1. The permissible values shall be those of at 20°C.

Table 1. Performances

No.	Item		Measuring method	Explanatory Figure	Measuring instruments	Permissible values
1	Parallelism or run out of upper face in respect to table travelling	X-axis direction	Attach the electrical comparator or the like to the objective lens attaching part, apply the electrical comparator or the like to the upper face of object glass, and obtain the maximum value of the run out of indications when the table has been allowed to travel.	Attached Fig. 2	Electrical comparator (that has been specified in JIS B 7536) or that having performances in accordance with this, as appropriate.	Respective directions of upper face of object glass Grade 0 (7.5 +0.025 L) μm or under Grade 1 (15.0 + 0.050 L) μm or under L is the displacement of table (mm) and is applicable to the overall measuring range.
		Y-axis direction				
		Rotational direction				
2	Straightness in the horizontal plane of table travelling	X-axis direction	Place the precision straightedge on the upper face of table with its working face vertical and parallel to the travelling direction, apply the electrical comparator or the like being attached to the objective lens attaching part, and obtain the maximum value of the run out of indications, when the table has been allowed to travel.	Attached Fig. 3	Precision straightedge (that has been calibrated by the accuracy of $1/5$ or under the permissible value), and electrical comparator (that is more precise than 0.2 μm specified in JIS B 7536) or that having performances in accordance with this, as appropriate.	In both directions Grade 0 (0.5 + 0.01 L) μm or under Grade 1 (1.0 + 0.02 L) μm or under L is the displacement of table (mm) and is applicable to the overall measuring range.
		Y-axis direction				
3	Perpendicularity of travelling direction in X-axis to travelling direction in Y-axis of table		Place the working surface of precision straightedge in parallel to the travelling direction in X-axis on the table upper surface, apply the electrical comparator or the like being attached on the objective lens attaching part to the working surface of another side, and obtain the maximum value of run out of indication, when the table has been allowed to travel in Y-axis direction.	Attached Fig. 4	Precision square (that has been calibrated its squareness to the accuracy of $1/5$ or under of permissible value), and electrical comparator (that is more precise than 0.2 μm specified in JIS B 7536) or that having performances in accordance with this, as appropriate.	Grade 0 (1.5 + 0.02 L) μm or under Grade 1 (3.0 + 0.04 L) μm or under L is the displacement of table (mm) and is applicable to the overall measuring range.

Table 1. (continued)

No.	Item		Measuring method	Explanatory Figure	Measuring instruments	Permissible values
4	Run out of center of rotation of angle rotary table		Place the index of cross lines or the like at the center of upper face of angle rotary table, rotate the angle rotary table while observing by the observation microscope, carry out centering until its run out becomes minimum, and obtain the maximum value of displacement of the index at this time by the displacement of table.	Attached Fig. 5		10 μm or under
5	Perpendicularity of table travelling direction to up and down direction of body tube	X-axis direction	Place the working surface of square on the upper face of table in parallel to the travelling direction of the table, apply the detector of electric comparator or the like which has been fitted to the objective lens attaching part of body tube onto the position of parfocal distance of objective lens, on the working surface of the other side, allow to travel it from the upper surface of table upwards, and obtain the maximum value of run out on the indication of electric comparator.	Attached Fig. 6	Square (Type I Grade 1 specified in JIS B 7526), and electric comparator (specified in JIS B 7536) or that having performances in accordance with this, as appropriate.	In both directions Grade 0 (2.5 + 0.1 L) μm or under Grade 1 (5.0 + 0.2 L) μm or under L is the displacement of body tube (mm) and is applicable to the overall measuring range.
		Y-axis direction				

Table 1. (continued)

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Measuring method</th><th>Explanatory Figure</th><th>Measuring instruments</th><th>Permissible values</th></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Magnification of objective lens for profile measurement</td><td>X-axis direction</td><td rowspan="2">Place standard scale on the upper face of table in parallel to its travelling direction, read out the difference between the scale for ocular magnification inspection and the image of standard scale graduation by the displacement of table, and consider its percentage to be the measured value.</td><td rowspan="2">Attached Fig. 7</td><td rowspan="2">Standard scale (Grade 01 specified in JIS B 7541 or that has been calibrated to the accuracy of 1 μm) or that having performances in accordance with this, as appropriate.</td><td>Unit: %
<table><tr><th>Overall magnification (Ocular, 10 magnifications)</th><th>Range Within $^2/_3$ in visual field</th></tr><tr><td>100 magnifications or less</td><td>±0.25</td></tr><tr><td>More than 100 to less than 500 magnifications</td><td>±0.5</td></tr><tr><td>500 magnifications or more</td><td>Not specified</td></tr></table></td></tr>
<tr><td>Y-axis direction</td></tr>
<tr><td>7</td><td colspan="2">Resolving power by transmitted illumination of observing microscope</td><td>Place the chart for resolving power inspection on the upper face of object glass, observe by the transmitted illumination of observing microscope, and consider the minimum value of discernible chart to be the measured value.</td><td></td><td>Chart for resolving power inspection (that has been specified in JIS B 7184) or that having performances in accordance with this, as appropriate.</td><td>Unit: μm
<table><tr><th>Overall magnification (Ocular, 10 magnifications)</th><th>Range Within $^2/_3$ in visual field</th></tr><tr><td>10 magnifications or more to less than 30 magnifications</td><td>20</td></tr><tr><td>30 magnifications or more to less than 100 magnifications</td><td>10</td></tr><tr><td>100 magnifications or more</td><td>5</td></tr></table></td></tr>
<tr><td>8</td><td colspan="2">Concentricity of cross lines of goniometer eyepiece in respect to center of rotation</td><td>Place the index of cross lines or the like on the upper face of the table, rotate the cross line plate of goniometer eyepiece while observing by the observing microscope, and confirm that the displacement of the cross lines of goniometer eyepiece during its rotation is the line width or under.</td><td>Attached Fig. 8</td><td></td><td>The line width or less the cross lines of ocular.</td></tr>
</table>

Table 1. (continued)

No.	Item		Measuring method	Explanatory Figure	Measuring instruments	Permissible values
9	Measuring accuracies of respective axes	X-axis direction	Place the standard scale at the center of upper face of the table in parallel to its travelling direction, feed the table while measuring by the observing microscope, obtain the difference between the reading of measuring microscope and displacement of standard scale on its overall measuring range, and obtain the maximum value of the opening between arbitrary two points (L).	Attached Fig. 9	Standard scale (Grade 01 specified in JIS B 7541 or that has been calibrated at the accuracy of 1 μm) or that having performances in accordance with this, as appropriate.	In both directions Grade 0 ($2 + 0.01\ L$) μm or under Grade 1 ($4 + 0.02\ L$) μm or under L is the measuring length (mm) and is applicable to the overall measuring range.
		Y-axis direction				
10	Indication accuracy of revolving angle	Goniometer eyepiece	Place the optical polygons for angle standards carrying the marked line plate on the center of rotary table, align the cross lines of goniometer eyepiece with this marked line, then revolve the cross lines of goniometer eyepiece at each 30° in its reading, take the readings of autocollimator when the marked lines have been aligned by revolving the optical polygons for angle standard on each time, and obtain the maximum difference.	Attached Fig. 10	Optical polygons for angle standards (12-sided reflector Grade 0 specified in JIS B 7432), marked lines plate and autocollimator (that of scale interval 1" or less specified in JIS B 7538).	Both of goniometer eyepiece and angle rotary table Minimum reading value: Permissible value Those of 1' or under: 2' or under Those of exceeding 1': Two times or under of minimum reading value
		Angle rotary table	Place the optical polygons for angle standards on the center of angle rotary table, take the readings of autocollimater when the angle rotary table has been revolved at each 30° in its reading, and obtain the maximum difference thereof.	Attached Fig. 11	Optical polygons for angle standards (12-sided reflector Grade 0 specified in JIS B 7432) and autocollimator (that of scale interval 1" or under specified in JIS B 7538).	

5. Appearance, structure and function The appearance, structure and function shall be as given in the following:

(1) The measuring microscope shall consist of the observing microscope and precision cross moving table, and the base, column and the like which are supporting them.

(2) Respective parts shall all be made of materials excellent in strength and durability, and be so constructed as not to cause wearing and deformation easily.

(3) The coating and plating on respective parts shall be rigid and shall not be liable to cause fading, peeling or rusting easily.

(4) The actuation of each part shall be smooth, reliable according to the purposes thereof and shall not cause malfunction easily.

(5) The optical components shall be free from insufficient adhesive, clouding and fungus; and harmful bubbles, striae, flaws, sand marks, tarnish, dust, etc., as well as be free from harmful unevenness, flaws, etc. on the reflection preventive diaphragm.

(6) The optical system shall be free from impedimental aberration in practice, and the observing microscope shall be capable of observing a plane substance clearly over the whole visual field.

(7) The attaching and detaching of objective lens, ocular and other accessories shall be reliable and easy.

(8) Respective graduation lines shall be clear, and be easy to read.

(9) The light source shall not become a heat source harmful to measurement.

(10) The diopter adjusting range of ocular shall be +2 m^{-1} to −6 m^{-1} {+2 Dptr to −6 Dptr} or over.

(11) The upper surface of object glass shall not be lower than the metallic surface of table.

(12) The display device of measuring microscope in which the displacement of cross moving table is displayed digitally shall conform to the following requirements:

(a) The display shall be clear and be easy to read out.

(b) Under the normal working conditions, the displaying functions shall sufficiently follow the travel of cross moving table so as not to cause malfunctions.

(c) It shall work stably against the changes of the temperature and humidity of normal working conditions.

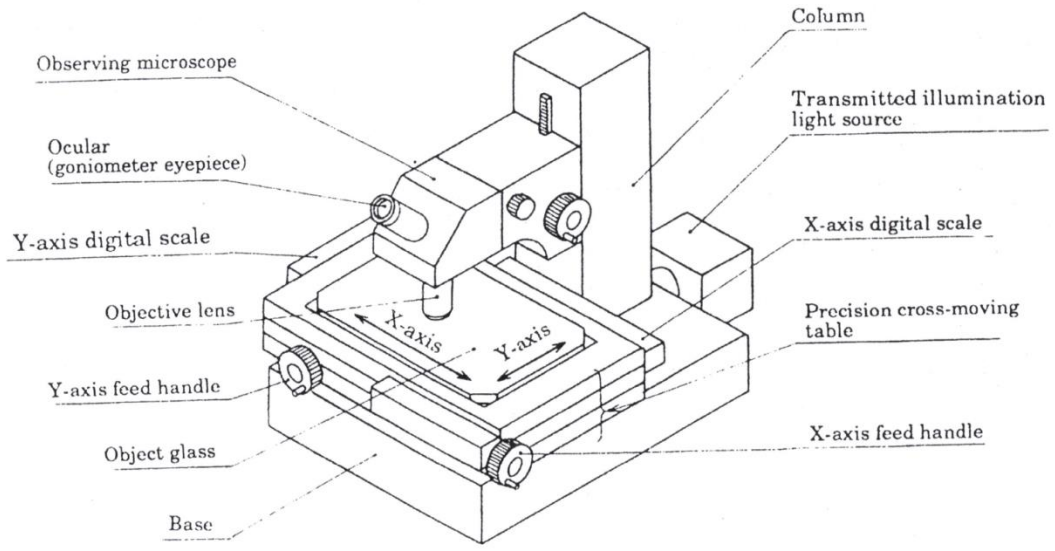
(d) It shall not cause malfunctions easily due to the electrical noises of surroundings.

(e) There shall be no incomplete contact over the entire electric system, and it shall work stably against the fluctuation of the power source voltage within the specification.

6. Inspection The inspection of the measuring microscopes shall be carried out on the performances, appearance, structure and functions, and the results shall conform to the requirements of 4. and 5.

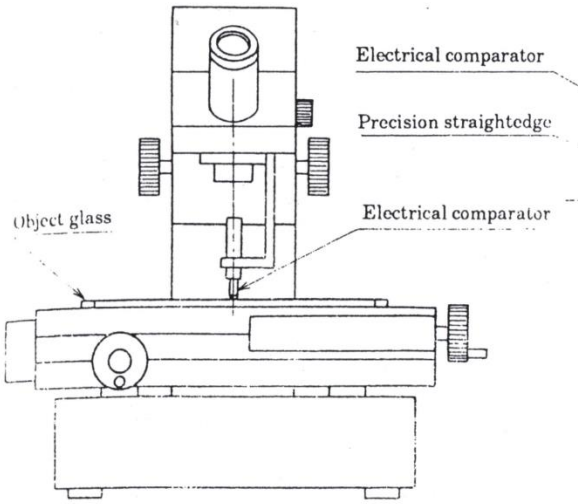
7. Marking The body of the measuring microscope shall be marked with the manufacturer's name or abbreviation and manufacturing number, and the objective lens and ocular with the magnification.

Attached Fig. 1. Measuring microscope

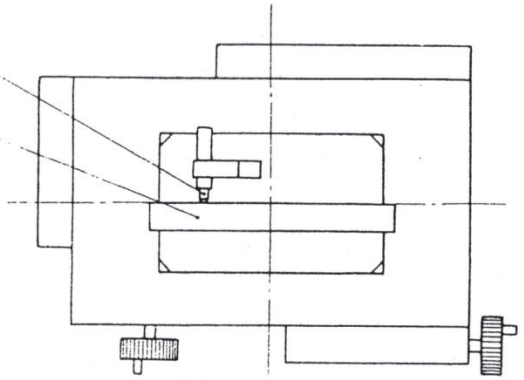


Remarks: This Figure is an explanatory figure and does not give the structure or shape.

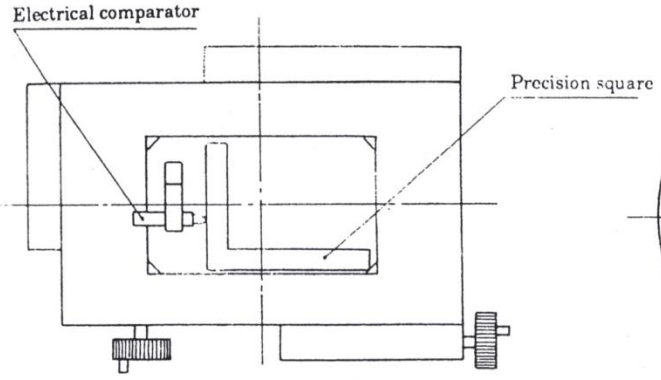
Attached Fig. 2



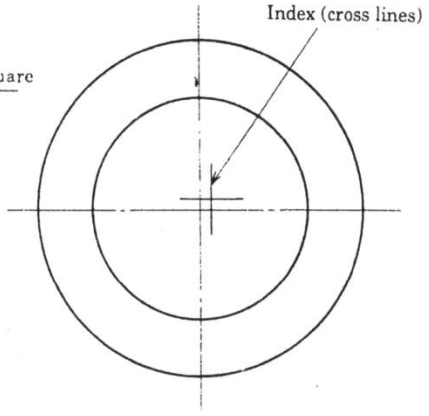
Attached Fig. 3



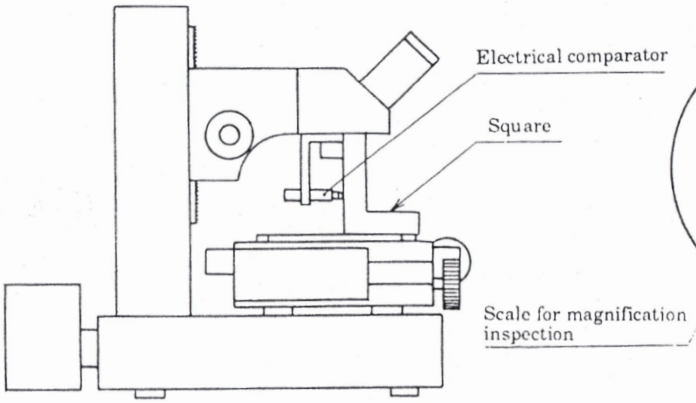
Attached Fig. 4



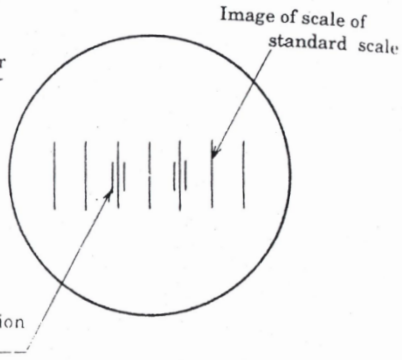
Attached Fig. 5



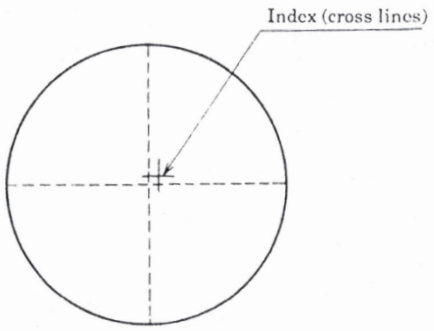
Attached Fig. 6



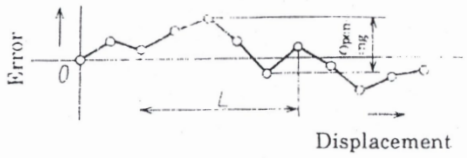
Attached Fig. 7



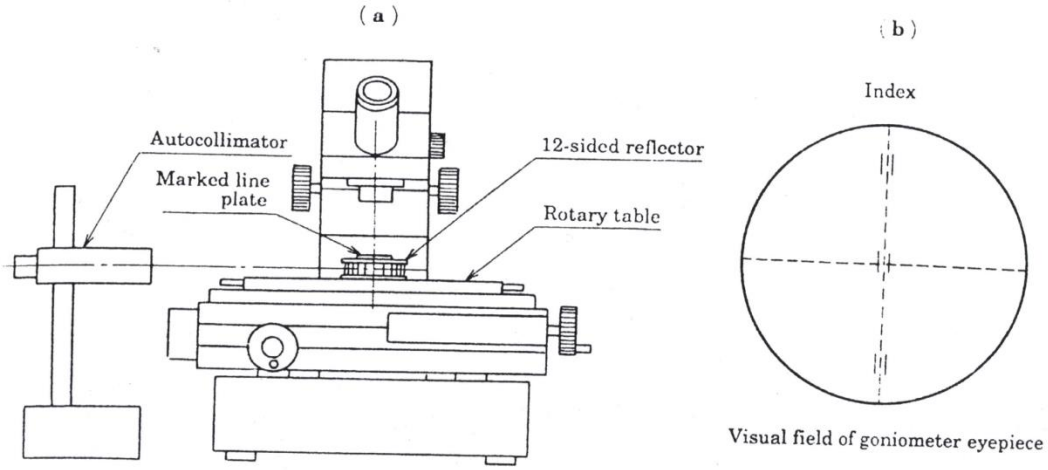
Attached Fig. 8



Attached Fig. 9



Attached Fig. 10



Attached Fig. 11