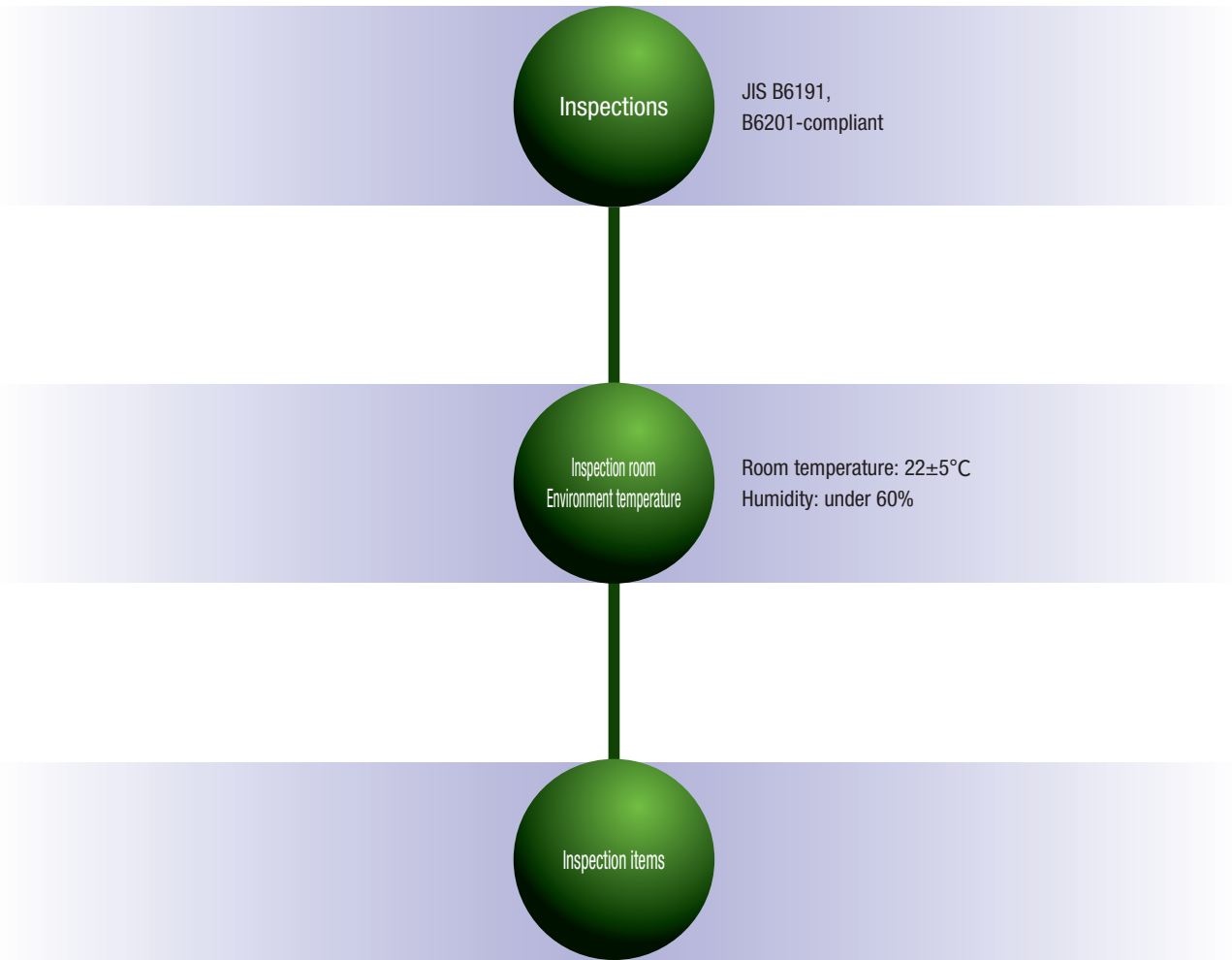


Inspection Items

Every our products undergoes a close scrutiny when factory shipping. Capable of obtaining traceability for each serial number. Please contact us if you need it.

Quality assurance

Inspection instruction



We check based on below items for our inspections.

■ Difference of positioning

Positioning error is that a difference between a targeted position and an actual location of a selected point after traveling.

- Uni-directional positioning
- Repeatability
- Lost motion(reversal positioning accuracy)

■ Travel accuracy

When a traveling part moves linearly, there will be angle deviation around crossing 3-axis. At the same time, there will be linear deviation in 2-axis crossing in driving directions. Including these, it is described as traveling accuracy.

- Pitching
- Yawing
- Straightness (Horizontal, vertical direction)

■ Parallelism

There are parallelisms about shape and traveling motion to the base of line or surface.

- Parallelism
- Motion parallelism
- Vertically

■ Eccentricity amount

■ Runout

■ Heights of the center of rotation (Work distance)

■ Squareness

■ Backlash

■ Check the stroke and limit motion

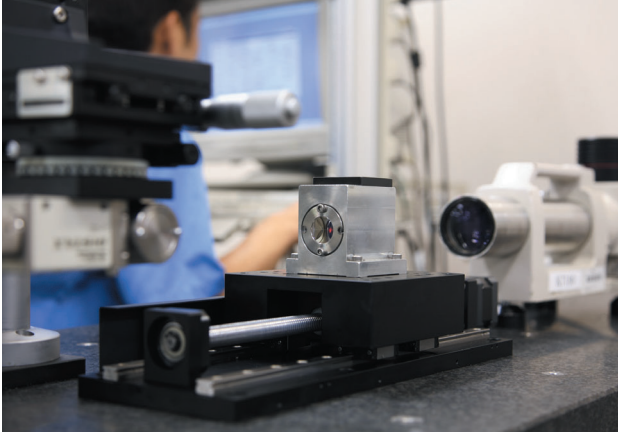
◎Amount shows a performance in each specification.

Quality Assurance

■ Product quality

Suruga Seiki conducts measuring inspection of static and dynamic accuracies at the time of stage assembly completion. Only the products that passed our strict inspection standards are to be delivered to customers.

▶ Please see P.2-187~ for more details.



■ Guarantee certificate

Guarantee certificate is attached to all the products.

Please let us know the both of product number and serial number if you have question.

■ Marking

The serial number is marked on all of our products.

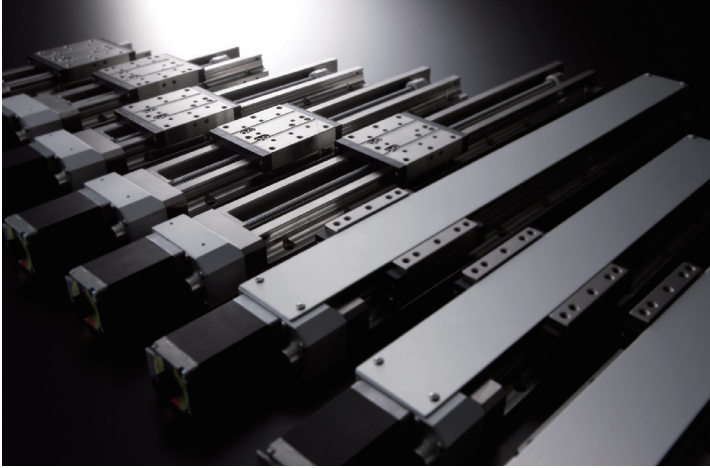
■ Inspection data

When requiring the measured inspection data, please make a request at the time of ordering so that we can attach it to a product by the time of delivery.

When requiring the data after delivery, please contact us with model number and serial number of the product. We will send it for free of charge.

All accuracy of specifications are based on a single-axis data.

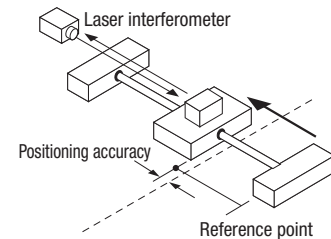
Linear Stage Inspection Instruction



■ The uni-directional positioning accuracy [Unit:μm]

Measuring equipment: Laser interferometer

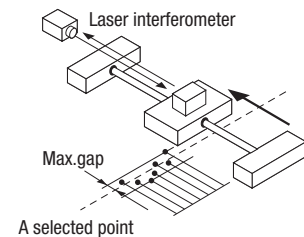
Positioning from a reference point (stroke end) to the point that is divided equally an effective stroke. Then, the gap between an actual measurement (an actual position reached after traveling from a reference point) and a theoretical measurement (a targeted position with the motion command) will be measured within a full stroke range. The maximum difference of those measurements shall be the “uni-directional positioning accuracy”.



■ Repeatability positioning accuracy [Unit:±μm]

Measuring equipment: Laser interferometer

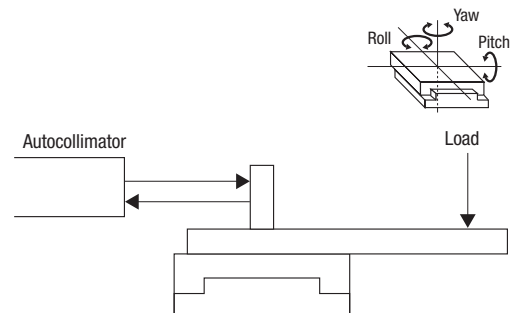
Targeted toward an arbitrary point, positioning operations are repeated 7 times in one direction in order to measure stopping positions. The largest reading differential is multiplied by 1/2. As a rule, this measurement process is repeated at the midpoint of the stroke, and then in the vicinity of either stroke extremity. The largest of all obtained values is taken as measurement data of Repeatability.



■ Moment rigidity [Unit: °/N · cm]

Measuring equipment: Auto-collimator

Regarding the rigidity at the time when a moment load indicated from the center position of traveling surface is applied, angle of inclination slope per 1N · cm in directions of pitching, yawing and rolling shall be the “moment rigidity.”



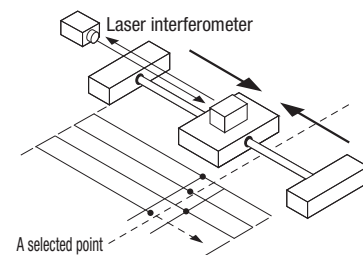
■ Lost motion (Reversal positioning accuracy) [Unit:μm]

Measuring equipment: Laser interferometer

Positioning in the positive direction, and measure its position (l_1). And let the pulse move to same direction, then positioning the pulse from its position to the negative direction, and that is measured (l'_1). Move to the negative direction with the same pulse, then give the same pulse to the positive direction from that position for measuring the position. (l_2). Repeat the same measurement process for seven times in both positive and negative directions, and calculate the difference between the average values of each direction. This process is to be done at three points (the center of stroke and both ends) and the maximum value shall be the “lost motion”.

《Lost motion measuring value》

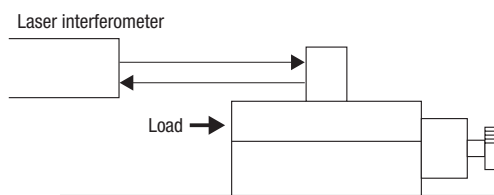
$$= \left| \frac{1}{7} (l_1 + l_2 + l_3 + \dots + l_7) - \frac{1}{7} (l'_1 + l'_2 + l'_3 + \dots + l'_7) \right| \max$$



Backlash [Unit:μm]

Measuring equipment: Laser interferometer

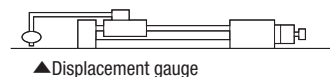
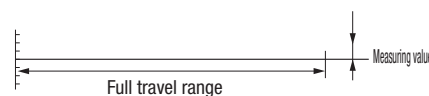
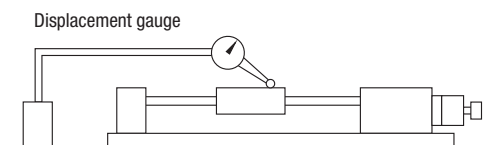
Set the position where upper surface of a stage traveled to the motor side and stopped as a reference point, add a fixed amount of load in the same direction. The difference between measured data after removing the load and the reference point shall be the backlash data.



Parallelism [Unit:μm]

Measuring equipment: Displacement gauge

Fix a stage on a base surface, measure parallelism of a whole traveling surface against a base surface. Calculate the maximum difference among the values and it shall be the "Parallelism".



▲ Displacement gauge

Driving parallelism [Unit:μm]

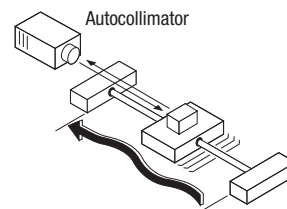
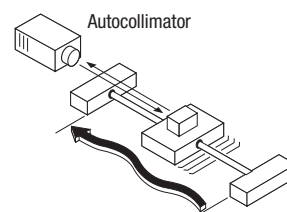
Measuring equipment: Displacement gauge

Fix a stage on a base surface, and positioning from a reference point (stroke end) at a fixed interval in one direction. Measure displacement values between a base surface and a gauge fixed on a traveling surface at every location of positioning. The maximum difference among the values shall be the "Driving parallelism".

Pitching [Unit:"]

Measuring equipment: Auto-collimator

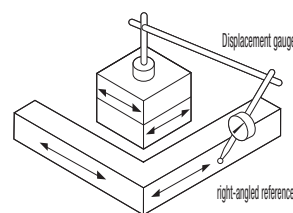
Positioning shall be conducted from the reference point (stroke end) at fixed intervals in a single direction. Indication in the vertical direction at each positioning point shall be measured over a full-stroke range. The maximum angular gap shall be the pitching measured value.



Yawing [Unit:"]

Measuring equipment: Auto-collimator

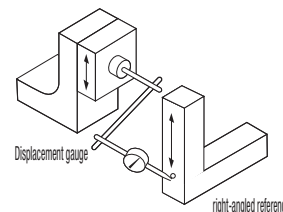
Positioning shall be conducted from the reference point (stroke end) at fixed intervals in a direction. Indication in the horizontal direction at each positioning point shall be measured over a full-stroke range. The maximum angular gap shall be the yawing measured value.



Squareness [Unit:μm]

Measuring equipment: Displacement gauge and right-angle standard

Set a right-angle standard and XY-axis stage on a base surface properly. Adjust the setting so that trajectory of one traveling axis and the right-angle standard become parallel. Positioning of other axis stage from a reference point (stroke end) at a fixed interval in one direction. Measure displacement values between a right-angle standard and a gauge fixed on a traveling surface at every location of positioning. The maximum difference among the values shall be the "Squareness".



Perpendicularity [Unit:μm/Full stroke]

Measuring equipment: Displacement gauge

Fix a Z-axis stage or right-angle standard on the surface. The displacement gauge will be put to the right-angle standard. Move the effective stroke based on the stroke end. The maximum difference among the values shall be the "Perpendicularity".

Limit motion check

Check if the display panel of Suruga Seiki standard stage controller indicates Limit detection sign and a stage stops when the stage traveled to the stroke end.

Linear Stage Inspection Instruction

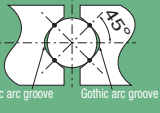

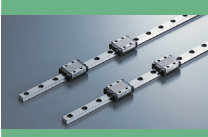
■ Straightness [Unit: μm]

Measuring equipment: Straightness measuring tool or dial gauge+linear ruler

Straightness indicates how much it winds its way against ideal traveling when a linear stage travels in a range of full-stroke.

The maximum shifting value of either in the horizontal and vertical direction from the ideal axis shall be the measured data for straightness.

■ Straightness at single axis

Mechanism	Model	Stroke (mm)	Straightness (Within μm)											Horizontal load capacity kgf [N]				
			1	2	3	5	7	9	10	15	20	25	30					
 <p>Gothic arc groove Gothic arc groove</p>	Linear ball guide	KXT04015	15														10 [98]	
		KXT06015	15															10 [98]
		PG413	13															10 [98]
		PG513	13															10 [98]
		PG615	15															10 [98]
		PG715	15															10 [98]
		PG430	30															10 [98]
		PG530	30															10 [98]
		PG650	50															10 [98]
		PG750	50															10 [98]
		KXG06020	20															5 [49]
		KXG06030	30															5 [49]
		KXL06030	30															12 [117.6]
		KXL06050	50															12 [117.6]
		KXL06075	75															12 [117.6]
		KXL06100	100															12 [117.6]
		KXL06150	150															12 [117.6]
		KXL06200	200															12 [117.6]
		KXL06300	300															12 [117.6]
	Cross roller guide	KXC04015	15														5 [49]	
		KXC06020	20															5 [49]
		KS101-30	30															5 [49]
		KX0725	25															10 [98]
		KX0830	30															15 [147]
		KX1040	40															20 [196]
		KX1250	50															25 [245]
	Slide guide	KXS18100	100														30 [294]	
		KXS18200	200														30 [294]	
		KXS18300	300														30 [294]	
		KXS18400	400														30 [294]	
		KXS18500	500														30 [294]	

Note) XY-axis, Z-axis and XYZ-axis are combinations of the above single axis(X-axis) stages. Refer to the value of single axis for straightness.

Sample Measuring Data

The charts below are graphical plots of KS102-70 Cross-roller type linear stage's actual measured data for following items.

- Uni-directional positioning accuracy
- Lost motion
- Repeatability positioning accuracy

Measurement of lost motion and repeatability were conducted at three points near the center of stroke and both ends of stroke (near CW limit and CCW limit).

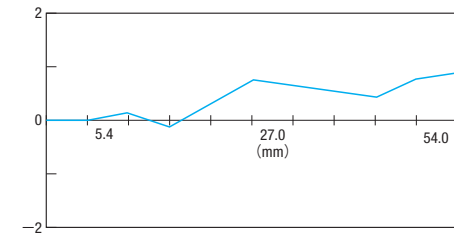
These measurements are conducted for each single axis stage of all ordered motorized stages and the obtained data is stored.

CCW-limit is a limit when a stage travels towards motor side.

CW-limit is a limit when a stage travels away from motor.

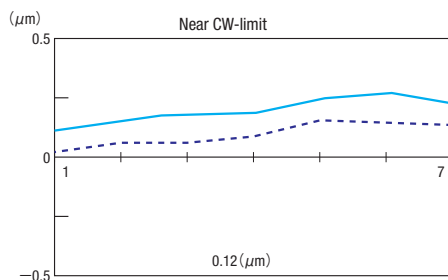
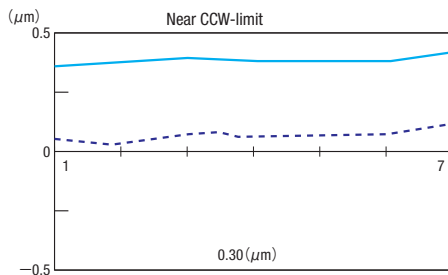
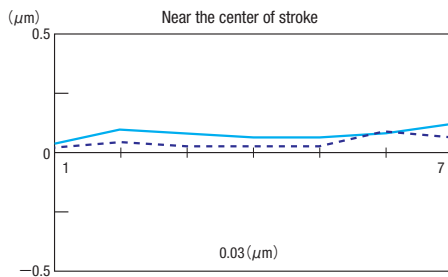
Uni-directional positioning accuracy

Measurement result: 0.99 (μm)



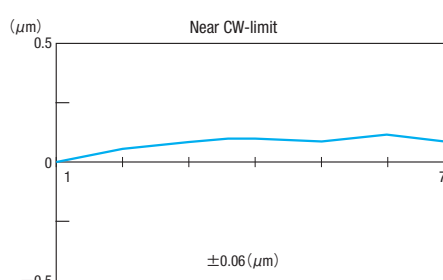
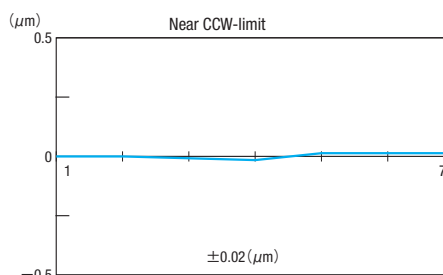
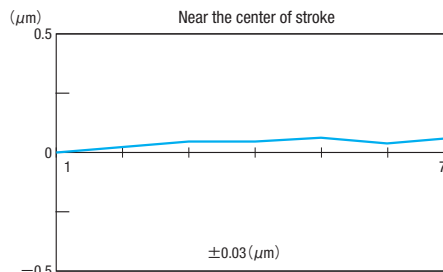
Lost motion

Measurement result: 0.3 (μm)

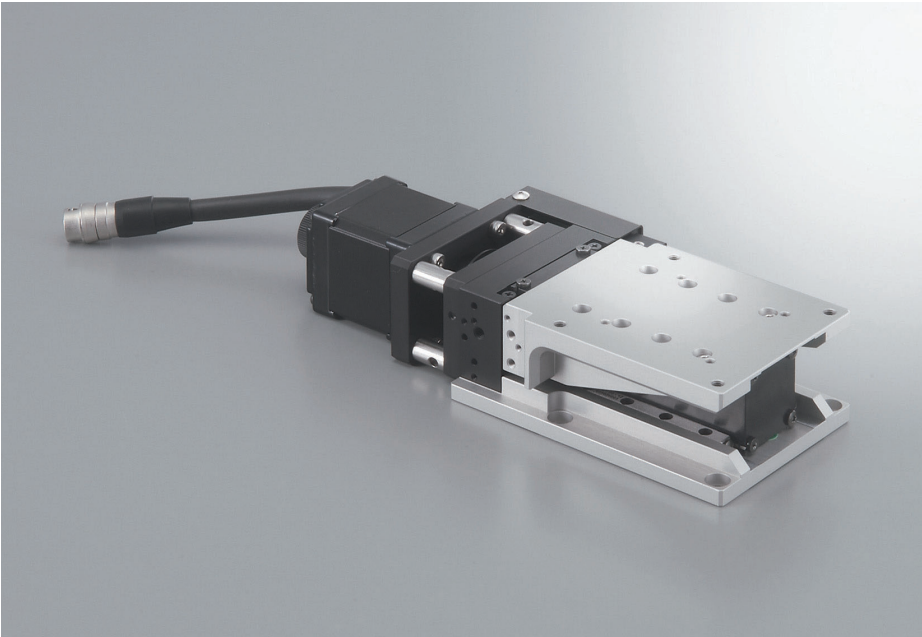


Repeatability positioning accuracy

Measurement result: ± 0.06 (μm)



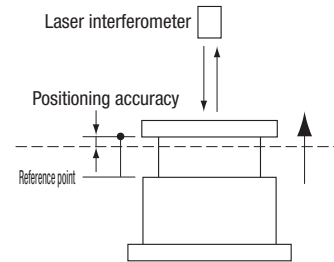
Horizontal Z-axis Stage Inspection Instruction



Uni-directional positioning accuracy [Unit:μm]

Measuring equipment: Laser interferometer

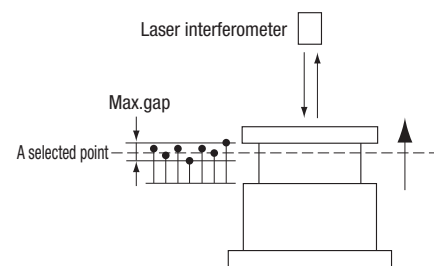
Positioning shall be conducted from the reference point (stroke end) at fixed intervals in a single direction. Then the gaps between the actual measurements (actual positions reached by movement from the reference point) and the theoretical values (command positions specified for movement) at each positioning point shall be measured within the full-stroke range. Finally the maximum value of them shall be the positioning accuracy measured value.



Repeatability positioning accuracy [Unit:±μm]

Measuring equipment: Laser interferometer

Positioning from the same direction shall be repeated seven times on a selected point and the deviation of the stop position shall be measured. The maximum deviation gap shall be halved. The step shall be conducted repeatedly at the center position and two end positions. The maximum value obtained shall be the repeatability positioning accuracy measured value.



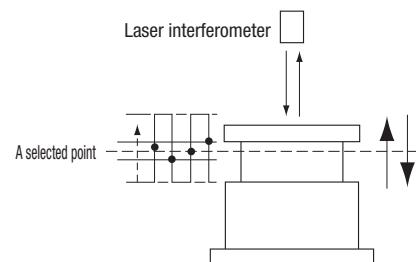
Lost motion (Reversal positioning accuracy) [Unit:μm]

Measuring equipment: Laser interferometer

Positioning in the positive direction, and measure its position (l_1). And let the pulse move to same direction, then positioning the pulse from its position to the negative direction, and that is measured (l'_1). Move to the negative direction with the same pulse, then give the same pulse to the positive direction from that position for measuring the position. (l_2). Repeat the same measurement process for seven times in both positive and negative directions, and calculate the difference between the average values of each direction. This process is to be done at three points (the center of stroke and both ends) and the maximum value shall be the "lost motion".

《Lost motion measuring value》

$$= \left| \frac{1}{7} (l_1 + l_2 + l_3 + \dots + l_7) - \frac{1}{7} (l'_1 + l'_2 + l'_3 + \dots + l'_7) \right| \max$$



■ Straightness (2 crossing directions in traveling direction) [Unit: μm]

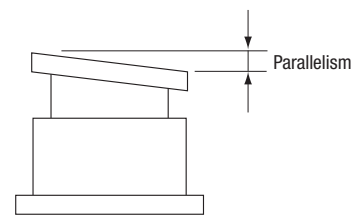
Measuring equipment: Straightness measurement instruments or displacement gauge and straightness standard

Positioning from a reference point (stroke end) at the fixed interval in one direction. Measure straightness deviations of vertical and horizontal direction at every location of the positioning within a full stroke range. The maximum difference from representative line shall be the "straightness".

■ Parallelism of stage surface [Unit: μm]

Measuring equipment: Displacement gauge

Fix the stage on a base surface, and measure parallelism of a whole stage surface against a base surface. Calculate the maximum difference among the values and it shall be the "Parallelism".



■ Perpendicularity [Unit: $\mu\text{m}/\text{Full stroke}$]

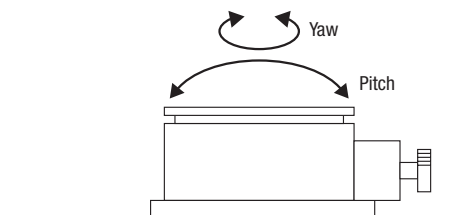
Measuring equipment: Displacement gauge and right-angle standard

Fix a stage or right-angle standard on the surface. Positioning from a reference point (stroke end) in one direction. Measure displacement values between a right-angle standard and a gauge fixed on a stage surface. The maximum difference among the values shall be the "Perpendicularity".

■ Moment rigidity [Unit: "N · cm]

Measuring equipment: Auto collimator

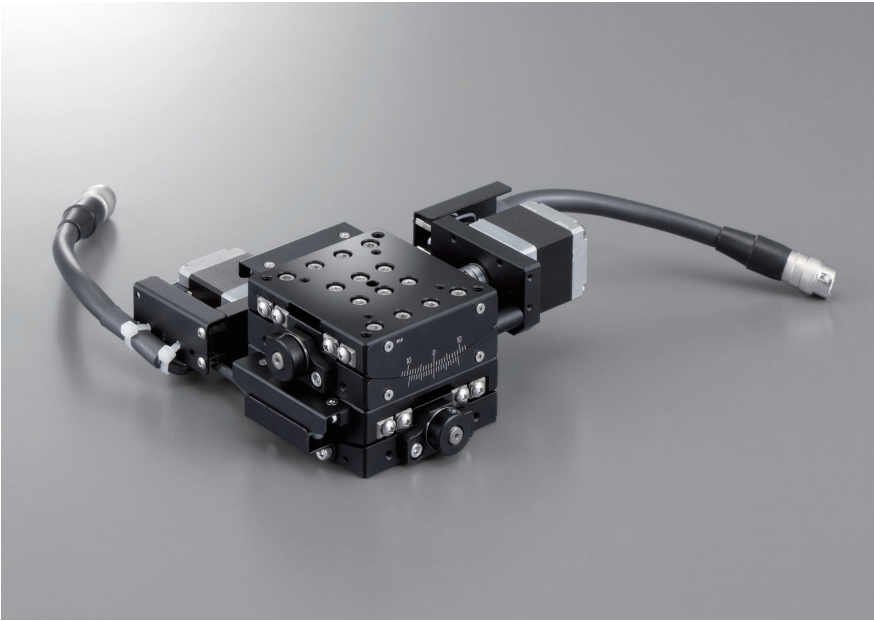
Regarding the rigidity at the time when a moment load indicated from the center position of a stage is applied, angle of inclination slope per 1N · cm in directions of pitching, yawing and rolling shall be the "moment rigidity".



■ Limit motion check

Check if the display panel of Suruga Seiki's standard stage controller indicates limit detection sign and a stage stops when the stage traveled to the stroke end.

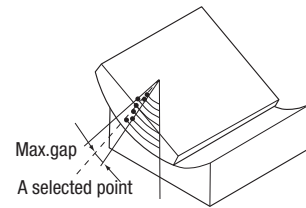
Goniometer Stage Inspection Instruction



Repeatability positioning accuracy [Unit:±°]

Measuring equipment: Rotary encoder

The maximum difference of measuring value will be calculated the positioning from the same direction for a selected point and repeat positioning for 7 times on the center of the stroke and both sides. The calculated half of maximum value with ±mark shall be the “repeatability positioning accuracy”.



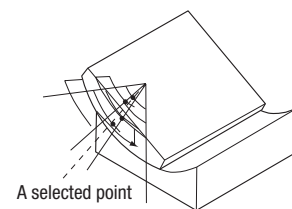
Lost motion (Reversal positioning accuracy) [Unit:°]

Measuring equipment: Laser interferometer

Positioning in the positive direction, and measure its position (l_1). And let the pulse move to same direction, then positioning the pulse from its position to the negative direction, and that is measured (l'_1). Move to the negative direction with the same pulse, then give the same pulse to the positive direction from that position for measuring the position. (l_2). Repeat the same measurement process for seven times in both positive and negative directions, and calculate the difference between the average values of each direction. This process is to be done at three points (the center of stroke and both ends) and the maximum value shall be the “lost motion”.

《Lost motion measuring value》

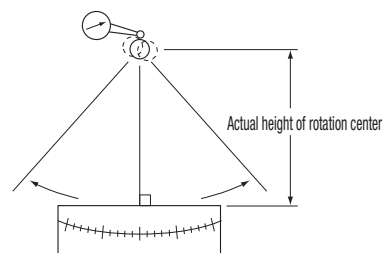
$$= \left| \frac{1}{7} (l_1 + l_2 + l_3 + \dots + l_7) - \frac{1}{7} (l'_1 + l'_2 + l'_3 + \dots + l'_7) \right| \max$$



■ Runout accuracy of rotation center [Unit: mm]

Measuring equipment: Displacement gauge

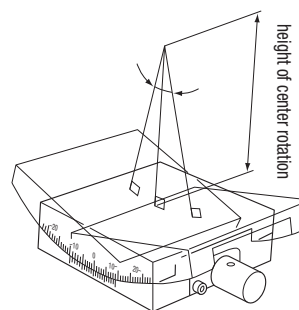
Place a rigid sphere at the height r rotation center (the actual rotation center, not a theoretical one). When there is a full stroke motion, the amount of deflection of a rigid sphere shall be the "Accuracy of rotation center tilt".



■ Height of rotation center [Unit: mm]

Measuring equipment: Hight gauge

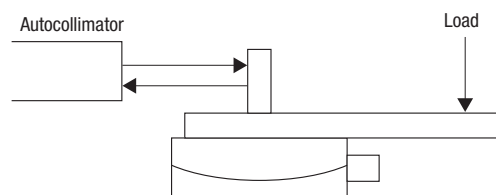
When the runout accuracy of rotation center (the actual rotation center, not a theoretical one) is being measured, it is conducting positioning of a rigid sphere toward the height of actual rotation center. The height of the rigid spheres' center point measuring from a surface that a stage is placed shall be the "height of rotation center".



■ Moment rigidity [$^{\circ}/N \cdot cm$]

Measuring equipment: Autocollimator

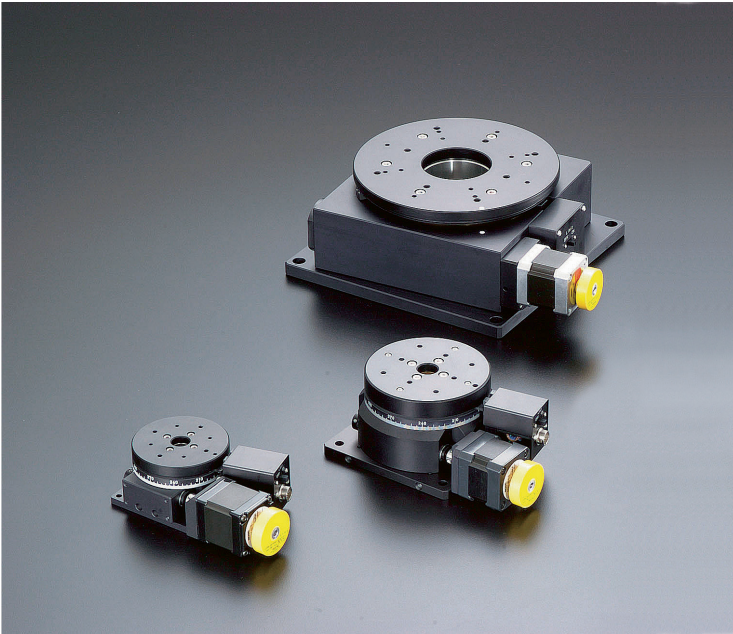
Regarding the rigidity at the time when a moment load indicated from the center position of a stage is applied, angle of inclination slope per $1N \cdot cm$ in directions of pitching, yawing and rolling shall be the "moment rigidity".



■ Limit motion check

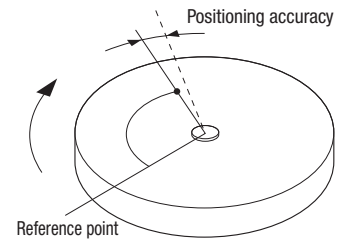
Check if the display panel of Suruga Seiki's standard stage controller indicates limit detection sign and a stage stops when the stage traveled to the stroke end.

Rotary Stage Inspection Instruction



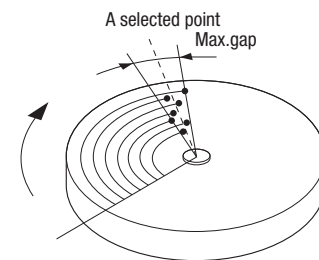
Uni-directional positioning accuracy [Unit:°]

Measuring equipment: Autocollimator and polyhedron mirror
 Positioning each 30 degree based on 0 degree. Measuring difference for polyhedron mirror and the maximum difference of those measurements shall be the “uni-directional positioning accuracy”.



Repeatability positioning accuracy [Unit:±°]

Measuring equipment: Autocollimator and polyhedron mirror
 Positioning the same rotary direction shall be repeated seven times on a selected point and the deviation of the stop position shall be measured. The maximum deviation gap shall be halved. The step shall be conducted repeatedly at four different positions along the periphery. The calculated half of maximum value with ±mark shall be the “repeatability positioning accuracy”.

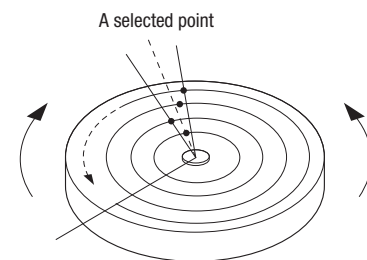


Lost motion(Reversal positioning accuracy) [Unit:°]

Measuring equipment: Autocollimator and polyhedron mirror
 Positioning in the positive direction, and measure its position (ℓ_1). And let the pulse move to same direction, then positioning the pulse from its position to the negative direction, and that is measured (ℓ'_1). Move to the negative direction with the same pulse, then give the same pulse to the positive direction from that position for measuring the position. (ℓ_2). Repeat the same measurement process for seven times in both positive and negative directions, and calculate the difference between the average values of each direction. This process is to be done at three points (the center of stroke and both ends) and the maximum value shall be the “lost motion”.

《Lost motion measuring value》

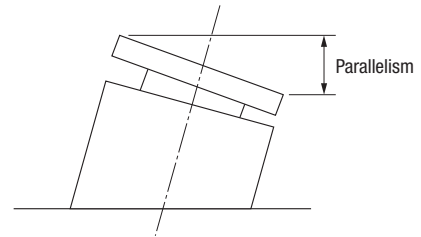
$$= \left| \frac{1}{7} (\ell_1 + \ell_2 + \ell_3 + \dots + \ell_7) - \frac{1}{7} (\ell'_1 + \ell'_2 + \ell'_3 + \dots + \ell'_7) \right| \max$$



■ Parallelism [Unit:μm]

Measuring equipment: Displacement gauge

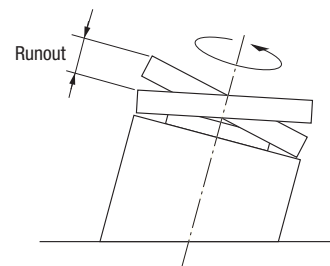
Fix a stage on a base surface, and measure parallelism of a whole traveling surface against a base surface. Calculate the maximum difference among the values and it shall be the "parallelism." At the time of measurement, set the position of surface so that an inclination of traveling surface becomes the maximum against a base surface.



■ Runout [Unit:μm]

Measuring equipment: Displacement gauge

The circumference of stage traveling that is fixed on the standard surface is being the measurement point. The maximum difference per shaft revolution of traveling for standard surface shall be the "runout".



■ Eccentricity [Unit:μm]

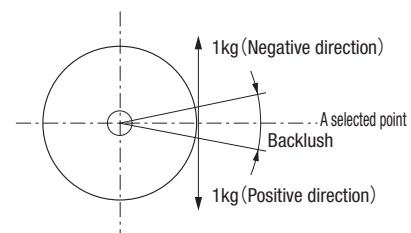
Measuring equipment: Displacement gauge

Displacement of center axis of rotation in horizontal direction shall be "eccentricity".

■ Backlash [Unit:°]

Measuring equipment: Autocollimator and polyhedron mirror

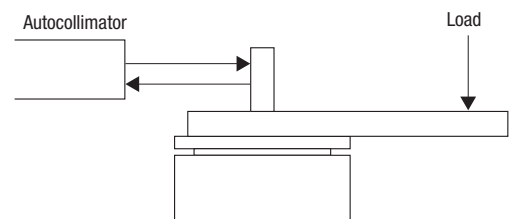
A force of positive (negative) direction shall be applied to a selected point on the periphery first the tangent line direction clockwise. This particular point of force application shall be considered as the reference point. Next, a force of positive (negative) shall be applied in the tangent line direction counterclockwise this time. Then, the angle from the reference point shall be measured. The step shall be conducted at four different positions along the periphery. The maximum value obtained shall be the backlash measured value. The unit of the measurement is angular degrees.



■ Moment rigidity [Unit: "/N • cm]

Measuring equipment: Autocollimator

Regarding the rigidity at the time when a moment load indicated from the center position of traveling surface is applied, angle of inclination slope per 1N • cm in directions of pitching, yawing and rolling shall be the "moment rigidity".



■ Limit and origin motion check

Check if the display panel of Suruga Seiki's standard stage controller indicates limit detection sign and a stage stops when the stage traveled to the stroke end or to the limit dog that was installed at a selected point.