

ACCURACY TEST RESULTS

MODEL	NH4000
MFG. No.	NH401EC0499
PURCHASER	
TEST DATE	APR / 05 / 2005

QUALITY ASSURANCE LEADER

M. Yamamoto

QUALITY ASSURANCE MANAGER

y. ita

DATE

MORI SEIKI ENGINEER

CUSTOMER

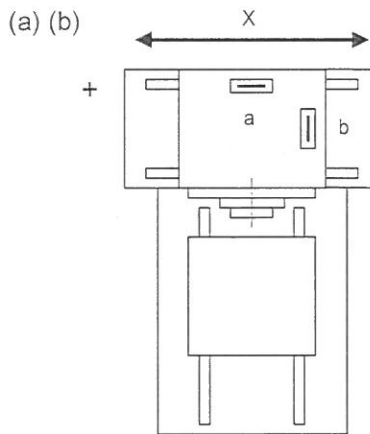
MORI SEIKI

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Test Item	Straightness of the column X-axis movement (a) In the X-Y plane (In the X-axis direction) (b) In the Y-Z plane (In the Y-axis direction) (c) In the Z-X plane (In the X-axis direction)	
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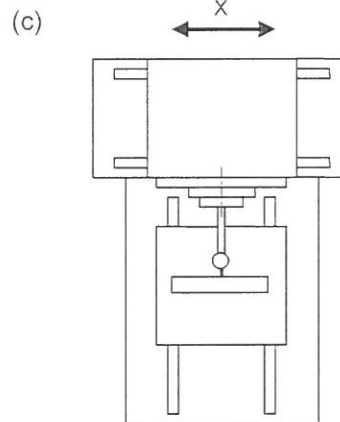
Measurement Procedure/Diagram

- (a) (b) Set the spindle head at the upper end of movement in the Y-axis direction.
 Place a precision level gage at the end (operation position side) of the Y-axis slideway and move the column in the X-axis direction.
 Read the precision level gage at least three positions - at the center and at both ends.
 Take the maximum difference in the readings as the test result.
- (c) Place a straightedge on the table and fix a dial indicator to such as the spindle head.
 Set the probe in contact with the straightedge.
 Move the column in the X-axis direction and read the dial indicator.
 Take the maximum difference in the readings as the test result.



Axis position at test

X	0	-560 (-22.05)
Y	-280 (-11.02)	
Z	-315 (-12.40)	



Axis position at test

X	-130 (-5.12)	-330 (-13.00)
Y	-280 (-11.02)	
Z	-315 (-12.40)	

[NOTE]

Place a straightedge on the table so that the reading of the dial indicator at both ends agrees with each other.

[+] indicates direction of machine bedway distortion.

[JIS B 6336:1986]

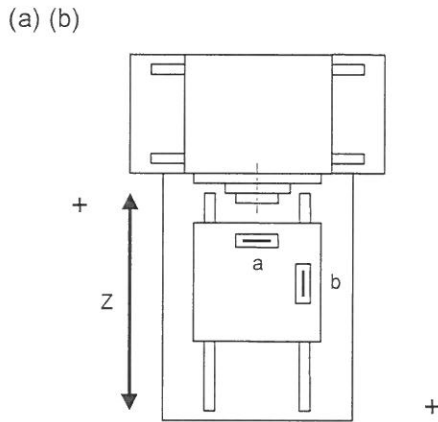
Test Equipment		Tolerance	Test Results
Precision level gage Dial indicator Straightedge Leveling block Auxiliary block	(a) In the X-Y plane	0.03 (0.0012)/m or less	0.004
	(b) In the Y-Z plane	0.01 (0.00039)/m or less	0.002
	(c) In the Z-X plane	0.01 (0.00039) or less per 500 (19.69)	0.003

Unit: mm (in.)

Test Item	Straightness of the table Z-axis movement (a) In the X-Y plane (In the X-axis direction) (b) In the Y-Z plane (In the Z-axis direction) (c) In the Z-X plane (In the Z-axis direction)	
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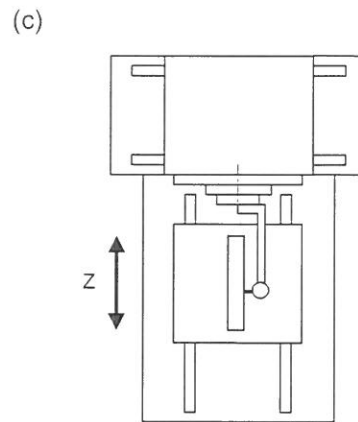
Measurement Procedure/Diagram

- (a) (b) Place a precision level gage on the table surface and move the table in the Z-axis direction.
 Read the precision level gage at least three positions - at the center and at both ends.
 Take the maximum difference in the readings as the test result.
- (c) Set the column in the center of movement in the X-axis direction and place a straightedge on the table and fix a dial indicator to such as the spindle head.
 Set the probe in contact with the straightedge.
 Move the table in the Z-axis direction and read the dial indicator.
 Take the maximum difference in the readings as the test result.



Axis position at test

X	-280 (-11.02)		
Y	-280 (-11.02)		
Z	0		-630 (-24.80)



Axis position at test

X	-280 (-11.02)		
Y	-280 (-11.02)		
Z	-165 (-6.50)		-465 (-18.31)

[NOTE]

Place a straightedge on the table so that the reading of the dial indicator at both ends agrees with each other.

[+] indicates direction of machine bedway distortion.

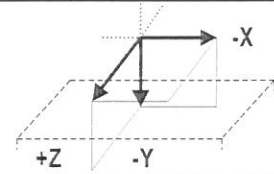
[JIS B 6336:1986]

Test Equipment		Tolerance	Test Results
Precision level gage Dial indicator Straightedge Leveling block Auxiliary block	(a) In the X-Y plane	0.01 (0.00039)/m or less	0.002
	(b) In the Y-Z plane	0.03 (0.0012)/m or less	0.006
	(c) In the Z-X plane	0.01 (0.00039) or less per 500 (19.69)	0.003

Unit: mm (in.)

Test Item

Straightness of the spindle head Y-axis movement
 (a) In the X-Y plane (In the X-axis direction)
 (b) In the Y-Z plane (In the Z-axis direction)



Measurement Procedure/Diagram

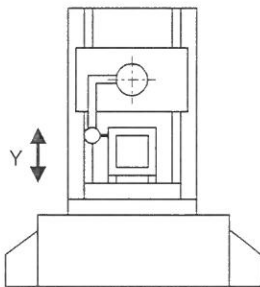
Set the column in the center of movement in the X-axis direction and place a square on the table and fix a dial indicator to such as the spindle head.

Set the probe in contact with the square.

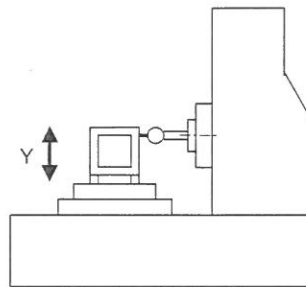
Move the spindle head in the Y-axis direction and read the dial indicator.

Take the maximum difference in the readings as the test result.

(a)



(b)



Axis position at test

X	-280 (-11.02)	
Y	-130 (-5.12)	-430 (-16.93)
Z	-315 (-12.40)	

Axis position at test

X	-280 (-11.02)	
Y	-130 (-5.12)	-430 (-16.93)
Z	-315 (-12.40)	

[NOTE]

Place a square on the table so that the reading of the dial indicator at both ends agrees with each other.

[JIS B 6336:1986]

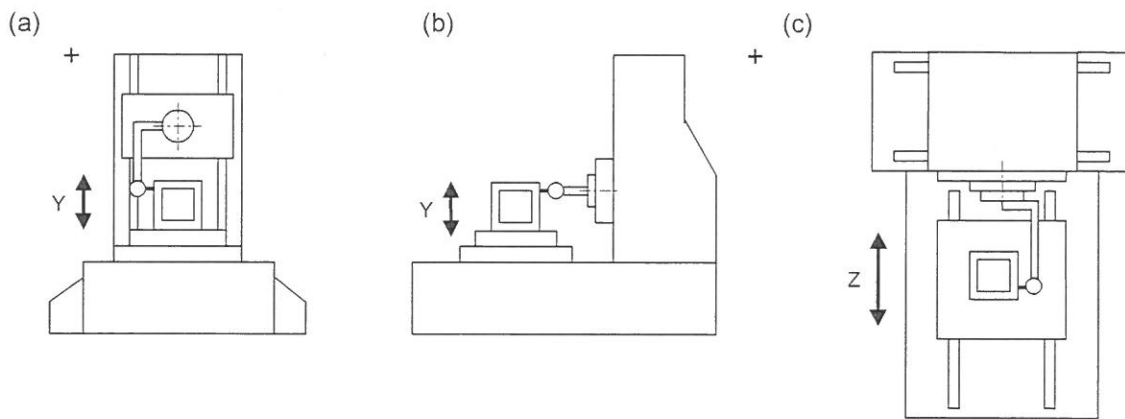
Test Equipment		Tolerance	Test Results
Dial indicator Precision square block gage Leveling block Auxiliary block	(a) In the X-Y plane	0.01 (0.00039) or less per 500 (19.69)	0.003
	(b) In the Y-Z plane	0.01 (0.00039) or less per 500 (19.69)	0.003

Unit: mm (in.)

Test Item	Squareness between mutual axis movements (a) X- and Y-axes (b) Y- and Z-axes (c) Z- and X-axes	
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Measurement Procedure/Diagram

- (a) Set the column in the center of movement in the X-axis direction.
 Place a square on the table upper surface and set one edge of the square parallel to movement in the X-axis direction of the column.
 Fix a dial indicator to such as the spindle head.
 Set the probe in contact with another edge and move the spindle head in the Y-axis direction.
 Take the maximum difference in the readings as the test result.
- (b) Set the column in the center of movement in the X-axis direction.
 Place a square on the table upper surface and set one edge of the square parallel to movement in the Z-axis direction of the table.
 Fix a dial indicator to such as the spindle head.
 Set the probe in contact with another edge and move the spindle head in the Y-axis direction.
 Take the maximum difference in the readings as the test result.
- (c) Set the column in the center of movement in the X-axis direction.
 Place a square on the table upper surface and set one edge of the square parallel to movement in the X-axis direction of the column.
 Fix a dial indicator to such as the spindle head.
 Set the probe in contact with another edge and move the table in the Z-axis direction.
 Take the maximum difference in the readings as the test result.



Axis position at test

X	-280 (-11.02)		
Y	-130 (-5.12)	-430 (-16.93)	
Z	-315 (-12.40)		

Axis position at test

X	-280 (-11.02)		
Y	-130 (-5.12)	-430 (-16.93)	
Z	-315 (-12.40)		

Axis position at test

X	-280 (-11.02)		
Y	-280 (-11.02)		
Z	-165 (-6.50)	-465 (-18.31)	

[NOTE]

[+] indicates column pitch direction (pitch of column).

MORI SEIKI	Test No. 4-2 (Static Accuracy Test)	Page 7 / 35
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Test Item	Squareness between mutual axis movements (a) X- and Y-axes (b) Y- and Z-axes (c) Z- and X-axes	
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[JIS B 6336:1986]

Test Equipment		Tolerance	Test Results
Dial indicator Precision square block gage	(a) X- and Y-axes	0.006 (0.00024) or less per 300 (11.81)	0.004
	(b) Y- and Z-axes	0.008 (0.00031) or less per 300 (11.81)	0.002
	(c) Z- and X-axes	0.008 (0.00031) or less per 300 (11.81)	0.002

Unit: mm (in.)

MORI SEIKI	Test No. 5 (Static Accuracy Test)	Page 8 / 35
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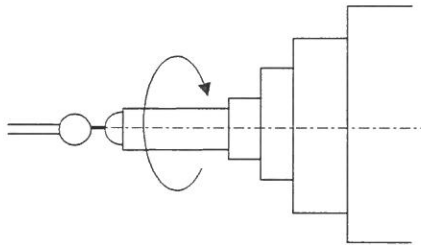
Test Item	Spindle play in the Z-axis direction	
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Measurement Procedure/Diagram

Fit a test bar into the spindle hole and insert a steel ball at the front edge of the test bar.

Set the dial indicator probe to the steel ball and read the dial indicator while rotating the spindle at 10 min⁻¹.

Take the maximum difference in the readings as the test result.



Axis position at test

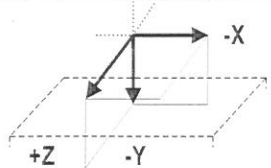
X	-280 (-11.02)
Y	-280 (-11.02)
Z	-300 (-11.81)

[JIS B 6336:1986]

Test Equipment	Tolerance	Test Results
Dial indicator Test bar Steel ball	0.005 (0.00020) or less	0.003

Unit: mm (in.)

MORI SEIKI	Test No. 6 (Static Accuracy Test)	Page 9 / 35
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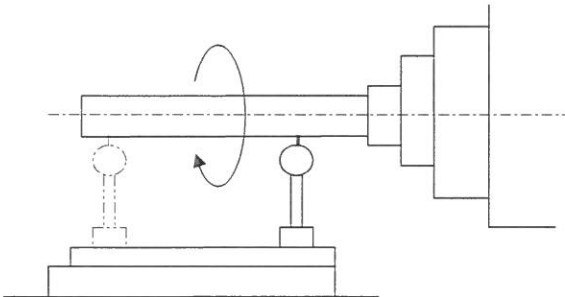
Test Item	Run-out of spindle hole (a) At the base (b) At 300 (11.81) away from the base	
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Measurement Procedure/Diagram

Fit a test bar into the spindle hole and set the dial indicator probe in contact with the test bar at the base and front.

Rotate the spindle to read the dial indicator.

Take the maximum difference in the readings as the test result.



Axis position at test

X	-280 (-11.02)	
Y	-280 (-11.02)	
Z	-200 (-7.87)	-500 (-19.69)

[JIS B 6336:1986]

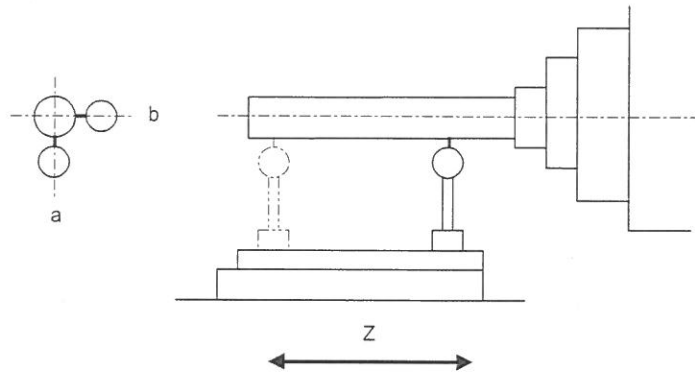
Test Equipment		Tolerance	Test Results
Dial indicator Test bar	(a)	0.003 (0.00012) or less at the base	0.002
	(b)	0.01 (0.00039) or less at 300 (11.81) away from the base	0.005

Unit: mm (in.)

MORI SEIKI		Test No. 7 (Static Accuracy Test)	Page 10 / 35
Test Item	Parallelism between table Z-axis movement and spindle center line (a) In the Y-Z plane (b) In the Z-X plane		

Measurement Procedure/Diagram

- Set the column in the center of movement in the X-axis direction.
- Fix a dial indicator on the table.
- Fit a test bar into the spindle hole.
- Set the dial indicator probe in contact with the test bar.
- Move the table in the Z-axis direction and read the dial indicator.
- Take the maximum difference in the readings as the test result.



Axis position at test

X	-280 (-11.02)	
Y	-280 (-11.02)	
Z	-200 (-7.87)	-500 (-19.69)

[NOTE]

This test should be carried out after determining the spindle position in the following manner.

With the dial indicator probe set into contact with the test bar in the specified measuring plane, rotate the spindle to find the spindle position where the dial indicator reading is the median of the run-out.

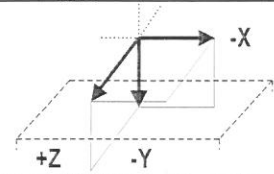
[JIS B 6336:1986]

Test Equipment		Tolerance	Test Results
Dial indicator Test bar	(a) In the Y-Z plane	0.008 (0.00031) or less per 300 (11.81)	0.002
	(b) In the Z-X plane	0.008 (0.00031) or less per 300 (11.81)	0.004

Unit: mm (in.)

Test Item

Squareness in index table positioning



Measurement Procedure/Diagram

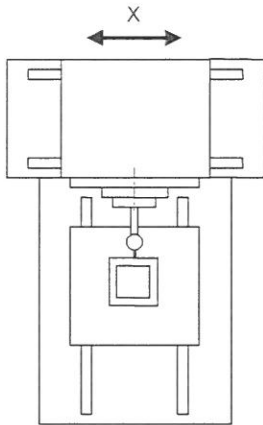
Place a square on the index table and set one edge of the square parallel to movement in the Z-axis direction of the table.

Fix a dial indicator to such as the spindle head.

Set the probe in contact with another edge and move the column in the X-axis direction.

Repeat this measurement at four positions (90° intervals) by indexing the table.

Take the maximum difference in the readings as the test result.



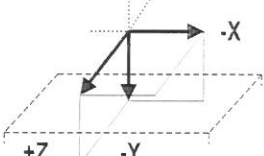
Axis position at test

X	-130 (-5.12)	-430 (-16.93)
Y	-280 (-11.02)	
Z	-315 (-12.40)	

[JIS B 6336:1986]

Test Equipment	Tolerance	Test Results
Dial indicator Precision square block gage	0.007 (0.00028) or less per 300 (11.81)	0.003

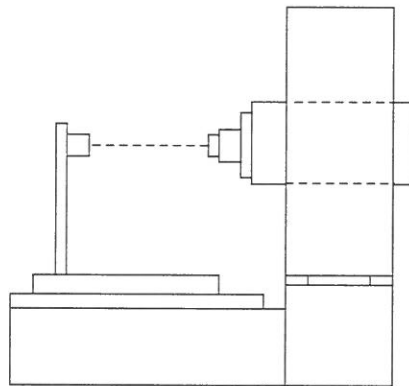
Unit: mm (in.)

Test Item	Checking of positioning accuracy of axes with rectilinear motion	
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Measurement Procedure/Diagram

Position a moving body at one end of an axis travel by moving it in either the plus or minus direction. Then, move it 1 mm in the reverse direction to establish the reference point. From this reference point, carry out a series of positioning operations in the same direction using the incremental method, at the specified intervals and at a rapid traverse rate. At each positioning point, measure the distance through which the moving body has actually moved and calculate the difference between the actually moved distance and the distance that should be moved. Take the result obtained by statistical processing conducted on the differences obtained at all positioning points in conformance with JIS B6192 (ISO 230-2) as the test result.

Repeat this test five times over the entire axis travel range and in both directions. Carry out this test for the X-, Y- and Z-axis directions.



Axis positions for X-axis

X	0	-560 (-22.05)	
Y	-280 (-11.02)		
Z	-425 (-16.73)		

Axis positions for Y-axis

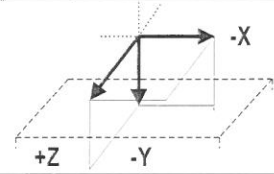
X	-280 (-11.02)		
Y	0	-560 (-22.05)	
Z	-375 (-14.76)		

Axis positions for Z-axis

X	-280 (-11.02)		
Y	-280 (-11.02)		
Z	0	-630 (24.80)	

Test Item

Checking of positioning accuracy of axes with rectilinear motion



JIS B 6336-4 (2000)
ISO 10791-4 (1998)

Test Equipment		Tolerance for X, Y, and Z axes	X-axis test results	Y-axis test results	Z-axis test results
Bidirectional accuracy of positioning	A	0.025	0.0078	0.0036	0.0030
Unidirectional accuracy of positioning	A↑ and A↓	0.02	0.0078	0.0036	0.0028
Bidirectional repeatability of positioning	R	0.015	0.0047	0.0018	0.0030
Unidirectional repeatability of positioning	R↑ and R↓	0.008	0.0039	0.0015	0.0017
Reversal value	B	0.01	0.0010	0.0005	0.0016
Mean reversal value	\bar{B}	0.006	0.0004	0.0001	0
Bidirectional systematic deviation of positioning	E	0.018	0.0046	0.0023	0.0021
Unidirectional systematic deviation of positioning	E↑ and E↓	0.012	0.0046	0.0023	0.0021
Range of the mean bidirectional positional deviation	M	0.012	0.0040	0.0019	0.0009

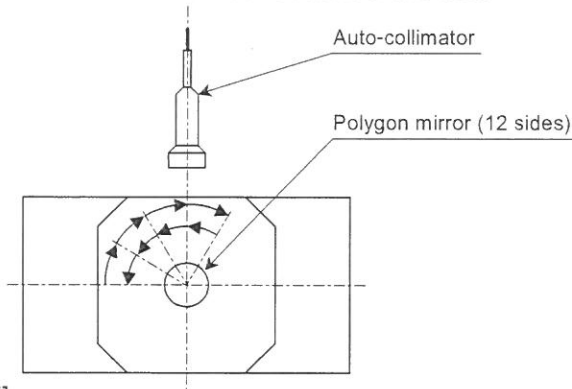
Unit: mm (in.)

Test Item	Positioning accuracy in rotary movements (indexing accuracy of an index table) (a) In the plus direction (b) In the minus direction	
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Measurement Procedure/Diagram

Positioning accuracy test must be carried out in both the plus and minus directions of rotation.

- To measure: Make a reference point by rotating the table in the plus (or minus) direction and stopping. From this point, carry out a series of positioning in the same direction of movement as the movement for establishing the reference point at the intervals of 30° at a rapid traverse rate.
- At the respective points, measure the difference between the angle which must be rotated and the angle which had actually been moved.
- Take the maximum difference among the differences obtained through one turn of the table as the result of the test.



Axis position at test

X	-280 (-11.02)
Y	-280 (-11.02)
Z	-315 (-12.40)

[NOTE]

- The positioning accuracy tests should be carried out using the pitch error compensation function, backlash compensation function and other compensation function, if available.
- During the test, there must be no load on the table.
- The distance an axis is moved at a rapid traverse rate must be longer than the distance that includes the distance for automatic acceleration/deceleration.

[JIS B 6336:1986]

Test Equipment		Tolerance	Test Results
Auto-collimator Polygon mirror (12 sides)	(a) In the plus direction	1 degree index table Within $\pm 3''$	-----
		Full 4 th axis rotary table Within $\pm 7''$	4''
	(b) In the minus direction	1 degree index table Within $\pm 3''$	-----
		Full 4 th axis rotary table Within $\pm 7''$	4''

Unit: mm (in.)

MORI SEIKI	Test No. 11 (Positioning Accuracy Test)	Page 15 / 35
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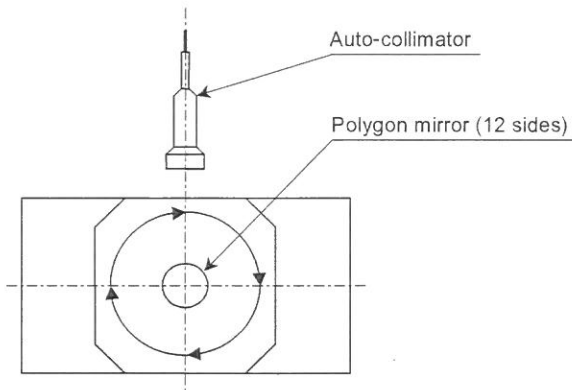
Test Item	Repetitive positioning accuracy in rotary movements (indexing accuracy of an index table)	
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Measurement Procedure/Diagram

At each of 90° interval table positions (4 positions), repeat positioning 7 times at a rapid traverse in the same direction.

Measure the stop position and find the maximum difference among the readings.

Take the half of the maximum value of the four maximum differences, each obtained at each testing position, and preceded by the "±" sign as the test result.



Axis position at test

X	-280 (-11.02)
Y	-280 (-11.02)
Z	-315 (-12.40)

[NOTE]

The positioning accuracy tests should be carried out using the pitch error compensation function, backlash compensation function and other compensation function, if available.

During the test, there must be no load on the table.

The distance an axis is moved at a rapid traverse rate must be longer than the distance that includes the distance for automatic acceleration/deceleration.

[JIS B 6336:1986]

Test Equipment	Tolerance	Test Results
Auto-collimator Polygon mirror (12 sides)	± 5"	±5.0000 "

Unit: mm (in.)

Test Item	Straightness of pallet surface (a) In the X-Y plane (In the X-axis direction) (b) In the Y-Z plane (In the Z-axis direction)	
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Measurement Procedure/Diagram

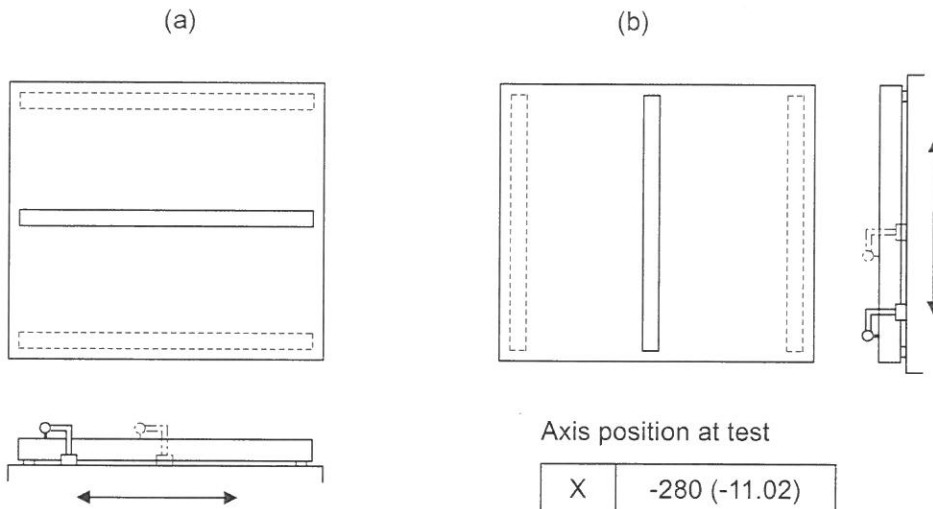
Index the pallet to the home position.

Place a straightedge at the center and both ends of the pallet.

Set the dial indicator probe in contact with the straightedge and move the dial indicator along the pallet surface to read the dial indicator.

Take the maximum difference in the readings as the test result.

Repeat this at three positions (center and both ends of the pallet) and take the maximum value of the taken values as the test result.



Axis position at test

X	-280 (-11.02)
Y	-280 (-11.02)
Z	-315 (-12.40)

[NOTE]

Place a straightedge on the pallet in parallel to the X-axis or Z-axis and the reading of the dial indicator at both ends agrees with each other.

This measurement can be replaced with a similar measurement based on the chain method using a precision level gage or auto-collimator.

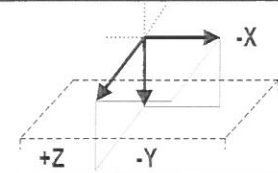
[JIS B 6336:1986]

Test Equipment	Tolerance	Test Results	
		(a) In the X-axis direction	(b) In the Z-axis direction
Dial indicator	0.008 (0.00031) or less per 500 (19.69)	(1)	0.008
Straightedge		(2)	0.008
Leveling block		(3)	0.008
Auxiliary block		(4)	0.008
(Precision level gage)			
(Auto-collimator)			

Unit: mm (in.)

Test Item

Parallelism between the pallet surface and X- or Z-axis movement
 (a) In the X-axis direction
 (b) In the Z-axis direction



Measurement Procedure/Diagram

Index the pallet to the home position and place a straightedge at the center of the pallet in parallel to the X-axis.

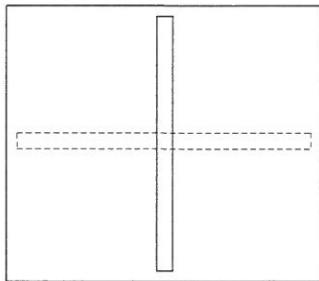
Fix a dial indicator to such as the spindle head.

Set the probe in contact with the straightedge.

Move the table in the X-axis direction and read the dial indicator.

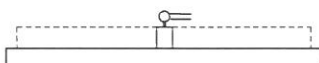
Take the maximum difference in the readings as the test result.

Repeat the same test by placing the straightedge at the center of the pallet in parallel to the Z-axis.



(a) Axis position at test

X	-100 (-3.94)	-480 (-18.90)
Y	-280 (-11.02)	
Z	-315 (-12.40)	



(b) Axis position at test

X	-280 (-11.02)	
Y	-280 (-11.02)	
Z	-125 (-4.92)	-505 (-19.88)

[NOTE]

It is allowed to set the probe in direct contact with the pallet surface without using a straightedge.

[JIS B 6336:1986]

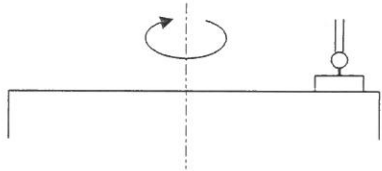
Test Equipment	Tolerance	Test Results		
		(a) In the X-axis direction	(b) In the Z-axis direction	
Dial indicator Straightedge	0.01 (0.00039) or less per 500 (19.69)	(1)	0.002	0.006
		(2)	0.002	0.005
		(3)	0.002	0.005
		(4)	0.002	0.005

Unit: mm (in.)

Test Item	Waviness on pallet upper face	
-----------	-------------------------------	---

Measurement Procedure/Diagram

Fix a dial indicator to the spindle head.
 Set the probe of the dial indicator in contact with the block gage set on the pallet.
 Taking the pallet rotation zero point as the reference, index the pallet in intervals of 90° and, at each indexed position, read the dial indicator.
 Take the maximum difference in the readings as the test result.



Axis position at test

X	-280 (-11.02)
Y	-280 (-11.02)
Z	-75 (-2.95)

[JIS B 6336:1986]

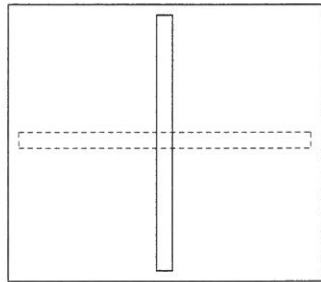
Test Equipment	Tolerance	Test Results	
Dial indicator Block gage	0.013 (0.00051) or less per 500 (19.69) in diameter	(1)	0.004
		(2)	0.002
		(3)	0.003
		(4)	0.003
		(1)	0.004
		(2)	0.002
		(3)	0.003
		(4)	0.003

Unit: mm (in.)

Test Item	Parallelism between the pallet surface and X- or Z-axis movement (90° indexing operation) (a) In the X-axis direction (b) In the Z-axis direction	
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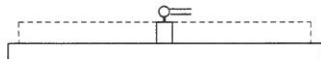
Measurement Procedure/Diagram

After the completion of test No. 14, index a pallet 90° and carry out the same test as explained in test No. 14.



(a) Axis position at test

X	-100 (-3.94)	-480 (-18.90)
Y	-280 (-11.02)	
Z	-315 (-12.40)	



(b) Axis position at test

X	-280 (-11.02)	
Y	-280 (-11.02)	
Z	-125 (-4.92)	-505 (-19.88)

[NOTE]

It is allowed to set the probe in direct contact with the pallet surface without using a straightedge.

[JIS B 6336:1986]

Test Equipment	Tolerance	Test Results		
Dial indicator Straightedge	0.01 (0.00039) or less per 500 (19.69)	(a) In the X-axis direction	(b) In the Z-axis direction	
		(1)	0.002	0.004
		(2)	0.002	0.002
		(3)	0.002	0.004
		(4)	0.002	0.002

Unit: mm (in.)

MORI SEIKI		Test No. 16 (Pallet Accuracy Test)	Page 20 / 35
Test Item	Parallelism between the X-axis movement and longer edge locator (workpiece mounting reference surface)		

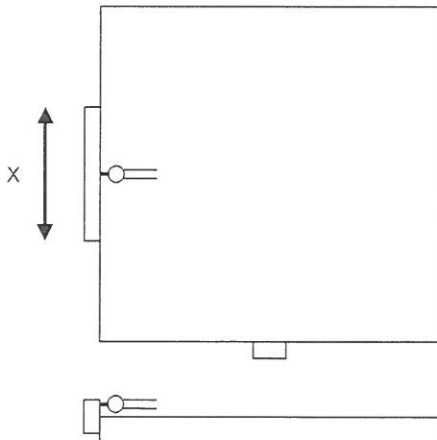
Measurement Procedure/Diagram

Fix a dial indicator to such as the spindle head.

Set the probe in contact with the reference surface of the longer edge locator.

Move the X-axis and read the dial indicator.

Take the maximum difference in the readings as the test result.



Axis position at test

X	-155 (-6.10)	-305 (-12.01)
Y	-280 (-11.02)	
Z	-315 (-12.40)	

[JIS B 6336:1986]

Test Equipment	Tolerance	Test Results	
Dial indicator	0.007 (0.00028) or less per 250 (9.84)	(1)	0.005
		(2)	0.006
		(3)	0.004
		(4)	0.003
		(1)	
		(2)	
		(3)	
		(4)	

Unit: mm (in.)

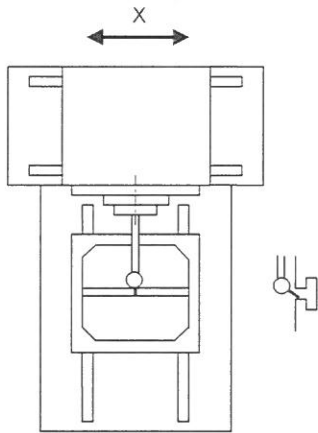
Test Item	Parallelism between the X-axis movement and the side of reference slot of the pallet	
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Measurement Procedure/Diagram

Fix a dial indicator to such as the spindle head.

Set the probe in contact with the side of reference slot of the pallet and move the column in the X-axis direction.

Take the maximum difference in the readings taken in entire axis movement distance as the test result.

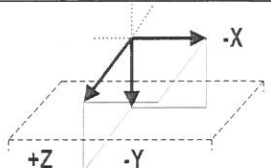


Axis position at test

X	-90 (-3.54)	-470 (-18.50)
Y	-280 (-11.02)	
Z	-315 (-12.40)	

Test Equipment	Tolerance	Test Results	
Dial indicator	0.015 (0.00059) or less per 500 (19.69)	(1)	-----
		(2)	-----
		(3)	-----
		(4)	-----

Unit: mm (in.)

Test Item	Distance between the reference face of the edge locator and the center of rotation	
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Measurement Procedure/Diagram

Index the pallet to the zero point of pallet rotation.

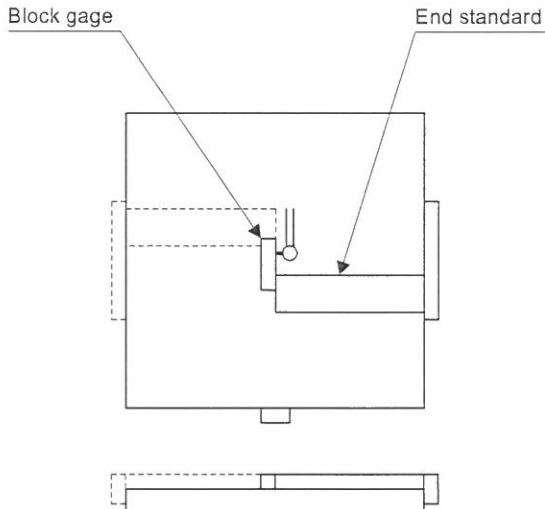
Place a measuring device (end standard) on the pallet with one end set on the reference face of the edge locator.

Set the probe of the dial indicator, fixed on such as the spindle head, in contact with the other face of the end standard in the Z-axis direction.

(Use a block gage if necessary.)

Read the dial indicator by indexing the pallet to the 0° and 180° positions alternately and take the half of the difference in the readings as the test result, with the plus (+) sign or minus (-) sign preceding the value; use the plus sign when the values show tendency to get apart and the minus sign when they show the tendency to get closer.

This measurement should be made for both the longer and shorter edge locators.



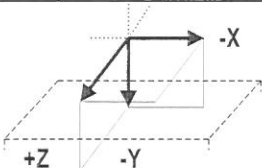
Axis position at test

X	-280 (-11.02)
Y	-280 (-11.02)
Z	-425 (-16.73)

[JIS B 6336:1986]

Test Equipment	Tolerance	Test Results				
Dial indicator End standard Block gage	$\pm 0.01 (\pm 0.00039)$	(1)	Longer	0.0030	Shorter	-0.0030
		(2)	Longer	0.0020	Shorter	0.0010
		(3)	Longer	-0.0080	Shorter	0.0070
		(4)	Longer	0.0080	Shorter	0.0070

Unit: mm (in.)

Test Item	Repeated pallet changing accuracy (a) In the X-axis direction (b) In the Y-axis direction (c) In the Z-axis direction	
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Measurement Procedure/Diagram

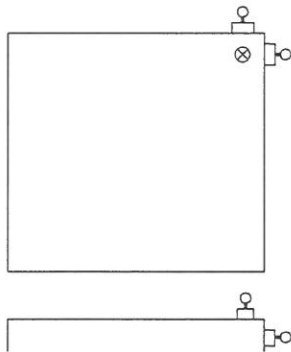
While keeping the machine in the pallet change position, repeat the pallet change cycle.

Fix the dial indicator to the spindle.

Set the dial indicator probe in contact with the block gage set on the pallet in the manner as shown in the diagram.

Carry out measurement following the cycle, and compare the readings for each pallet.

Repeat the test three times for each pallet and take the maximum difference in the readings as the test result.



Axis position at test

X	-280 (-11.02)
Y	-280 (-11.02)
Z	-315 (-12.40)

[JIS B 6336:1986]

Test Equipment	Tolerance	Test Results			
Dial indicator Block gage	0.003 (0.00012) or less	(a) In the X-axis direction	(b) In the Y-axis direction	(c) In the Z-axis direction	
		(1)	0.003	0.003	0.003
		(2)	0.003	0.003	0.003
		(3)	0.003	0.003	0.003
		(4)	0.003	0.003	0.003

Unit: mm (in.)

MORI SEIKI		Test No. 20 (Pallet Accuracy Test)	Page 24 / 35
Test Item	Positional difference between changed pallets		
<p>Measurement Procedure/Diagram</p> <p>Among the readings in the Y-axis direction taken in the test No. 19, compare them for all pallets and take the maximum difference as the test result.</p>			
[JIS B 6336:1986]			
Test Equipment	/	Tolerance	Test Results
	In the Y-axis direction	For 2 or 3 station APC spec 0.015 (0.00059) or less	-----
		For pallet pool spec 0.03 (0.0012) or less	0.002

Unit: mm (in.)

MORI SEIKI	Pallet Accuracy Test Data	Page 25 / 35
Accuracy of independent pallets (to be tested for all pallets) (enter the data if four or more pallets are used.)		

Test Item	Straightness of pallet surface (Test No. 12)								
Test Results	(5)	X	-----	(6)	X	-----	(7)	X	-----
		Z	-----		Z	-----		Z	-----
	(8)	X	-----	(9)	X	-----	(10)	X	-----
		Z	-----		Z	-----		Z	-----
	(11)	X	-----	(12)	X	-----	(13)	X	-----
		Z	-----		Z	-----		Z	-----
	(14)	X	-----	(15)	X	-----	(16)	X	-----
		Z	-----		Z	-----		Z	-----
	(17)	X	-----	(18)	X	-----	(19)	X	-----
		Z	-----		Z	-----		Z	-----

Test Item	Parallelism between the pallet surface and X- or Z-axis movement (Zero point) (Test No. 13)								
Test Results	(5)	X	-----	(6)	X	-----	(7)	X	-----
		Z	-----		Z	-----		Z	-----
	(8)	X	-----	(9)	X	-----	(10)	X	-----
		Z	-----		Z	-----		Z	-----
	(11)	X	-----	(12)	X	-----	(13)	X	-----
		Z	-----		Z	-----		Z	-----
	(14)	X	-----	(15)	X	-----	(16)	X	-----
		Z	-----		Z	-----		Z	-----
	(17)	X	-----	(18)	X	-----	(19)	X	-----
		Z	-----		Z	-----		Z	-----

MORI SEIKI	Pallet Accuracy Test Data	Page 26 / 35
Accuracy of independent pallets (to be tested for all pallets) (enter the data if four or more pallets are used.)		

Test Item	Parallelism between the pallet surface and X- or Z-axis movement (90° indexing operation) (Test No. 14)								
Test Results	(5)	X	-----	(6)	X	-----	(7)	X	-----
		Z	-----		Z	-----		Z	-----
	(8)	X	-----	(9)	X	-----	(10)	X	-----
		Z	-----		Z	-----		Z	-----
	(11)	X	-----	(12)	X	-----	(13)	X	-----
		Z	-----		Z	-----		Z	-----
	(14)	X	-----	(15)	X	-----	(16)	X	-----
		Z	-----		Z	-----		Z	-----
	(17)	X	-----	(18)	X	-----	(19)	X	-----
		Z	-----		Z	-----		Z	-----

Test Item	Waviness on pallet upper face (Test No. 15)					
Test Results	(5)	-----	(6)	-----	(7)	-----
	(8)	-----	(9)	-----	(10)	-----
	(11)	-----	(12)	-----	(13)	-----
	(14)	-----	(15)	-----	(16)	-----
	(17)	-----	(18)	-----	(19)	-----

Test Item	Parallelism between the X-axis movement and longer edge locator (Test No. 16)					
Test Results	(5)	-----	(6)	-----	(7)	-----
	(8)	-----	(9)	-----	(10)	-----
	(11)	-----	(12)	-----	(13)	-----
	(14)	-----	(15)	-----	(16)	-----
	(17)	-----	(18)	-----	(19)	-----

MORI SEIKI	Pallet Accuracy Test Data	Page 27 / 35
Accuracy of independent pallets (to be tested for all pallets) (enter the data if four or more pallets are used.)		

Test Item	Parallelism between the X-axis movement and the side of reference slot of the pallet (Test No. 17)					
Test Results	(5)	-----	(6)	-----	(7)	-----
	(8)	-----	(9)	-----	(10)	-----
	(11)	-----	(12)	-----	(13)	-----
	(14)	-----	(15)	-----	(16)	-----
	(17)	-----	(18)	-----	(19)	-----

Test Item	Distance between the reference face of the edge locator and the center of rotation (Test No. 18)									
Test Results	(5)	Longer	-----	(6)	Longer	-----	(7)	Longer	-----	
		Shorter	-----		Shorter	-----		Shorter	-----	
	(8)	Longer	-----	(9)	Longer	-----	(10)	Longer	-----	
		Shorter	-----		Shorter	-----		Shorter	-----	
	(11)	Longer	-----	(12)	Longer	-----	(13)	Longer	-----	
		Shorter	-----		Shorter	-----		Shorter	-----	
	(14)	Longer	-----	(15)	Longer	-----	(16)	Longer	-----	
		Shorter	-----		Shorter	-----		Shorter	-----	
	(17)	Longer	-----	(18)	Longer	-----	(19)	Longer	-----	
		Shorter	-----		Shorter	-----		Shorter	-----	

MORI SEIKI	Pallet Accuracy Test Data	Page 28 / 35
Accuracy of independent pallets (to be tested for all pallets) (enter the data if four or more pallets are used.)		

Test Item	Repeated pallet changing accuracy (Test No. 19)								
Test Results	(5)	X	-----	(6)	X	-----	(7)	X	-----
		Y	-----		Y	-----		Y	-----
		Z	-----		Z	-----		Z	-----
	(8)	X	-----	(9)	X	-----	(10)	X	-----
		Y	-----		Y	-----		Y	-----
		Z	-----		Z	-----		Z	-----
	(11)	X	-----	(12)	X	-----	(13)	X	-----
		Y	-----		Y	-----		Y	-----
		Z	-----		Z	-----		Z	-----
	(14)	X	-----	(15)	X	-----	(16)	X	-----
		Y	-----		Y	-----		Y	-----
		Z	-----		Z	-----		Z	-----
	(17)	X	-----	(18)	X	-----	(19)	X	-----
		Y	-----		Y	-----		Y	-----
		Z	-----		Z	-----		Z	-----

MORI SEIKI		Test No. 21				Page 29 / 35	
Test Item	Checking of accuracy of the feed rate of the linear axes						
Tolerance: $\pm 2\%$							
Programmed feed rate	Direction	X		Y		Z	
		Actual feed	Deviation%	Actual feed	Deviation%	Actual feed	Deviation%
100 mm/min	Positive	101.48	+1.48	100.75	+0.75	100.56	+0.56
	Negative	100.65	+0.65	100.75	+0.75	100.46	+0.46
1000 mm/min	Positive	1001.45	+0.145	1001.16	+0.116	1003.38	+0.338
	Negative	1001.32	+0.132	1001.11	+0.111	1003.27	+0.327
Maximum feed rate mm/min	Positive	5000.8	+0.016	5000.47	+0.009	5006.29	+0.126
	Negative	5000.49	+0.01	5003.75	+0.075	5005.4	+0.108
Rapid traverse mm/min	Positive	50002.3	+0.005	49992.25	-0.015	49994.59	-0.011
	Negative	49995.06	-0.01	49996.8	-0.006	49996.68	-0.007
Specification	Maximum feed rate	5000	mm/min	Rapid traverse	50000	mm/min	
Measuring instruments: Speedometer							
JIS B 6336-6 (2000) ISO 10791-6 (1998)							

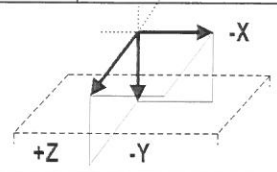
MORI SEIKI

Test No. 22

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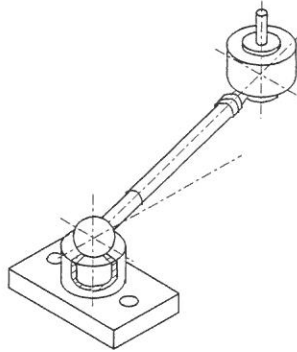
Test Item

Checking of the circular deviation G and the circular hysteresis H of the path generated by circular interpolation of two linear axes (generally in the XY plane) over 360° at one of the following diameters and at two feed rates, as follows: 200 mm diameter
 a) 250 mm/min
 b) 625 mm/min



Measurement Procedure/Diagram

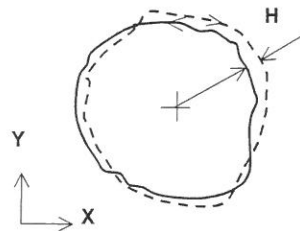
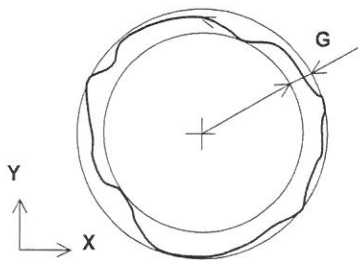
Start the interpolation in one of the four quadrants, avoiding the four reversal points of these quadrants if possible, because the machine may underperform at these points.



Tolerance:

200 mm diameter

- a) 0.010 at 250 mm/min
- b) 0.010 at 625 mm/min



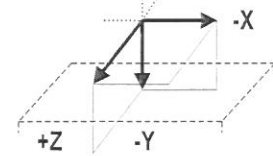
	Circular deviation		Circular hysteresis
	GXY (CW)	GYX (CCW)	HXY
At 250 mm/min	0.0050	0.0061	0.0031
At 625 mm/min	0.0043	0.0054	0.0026

Measuring instruments: Ball joint end bar

JIS B 6336-6 (2000)
 ISO 10791-6 (1998)

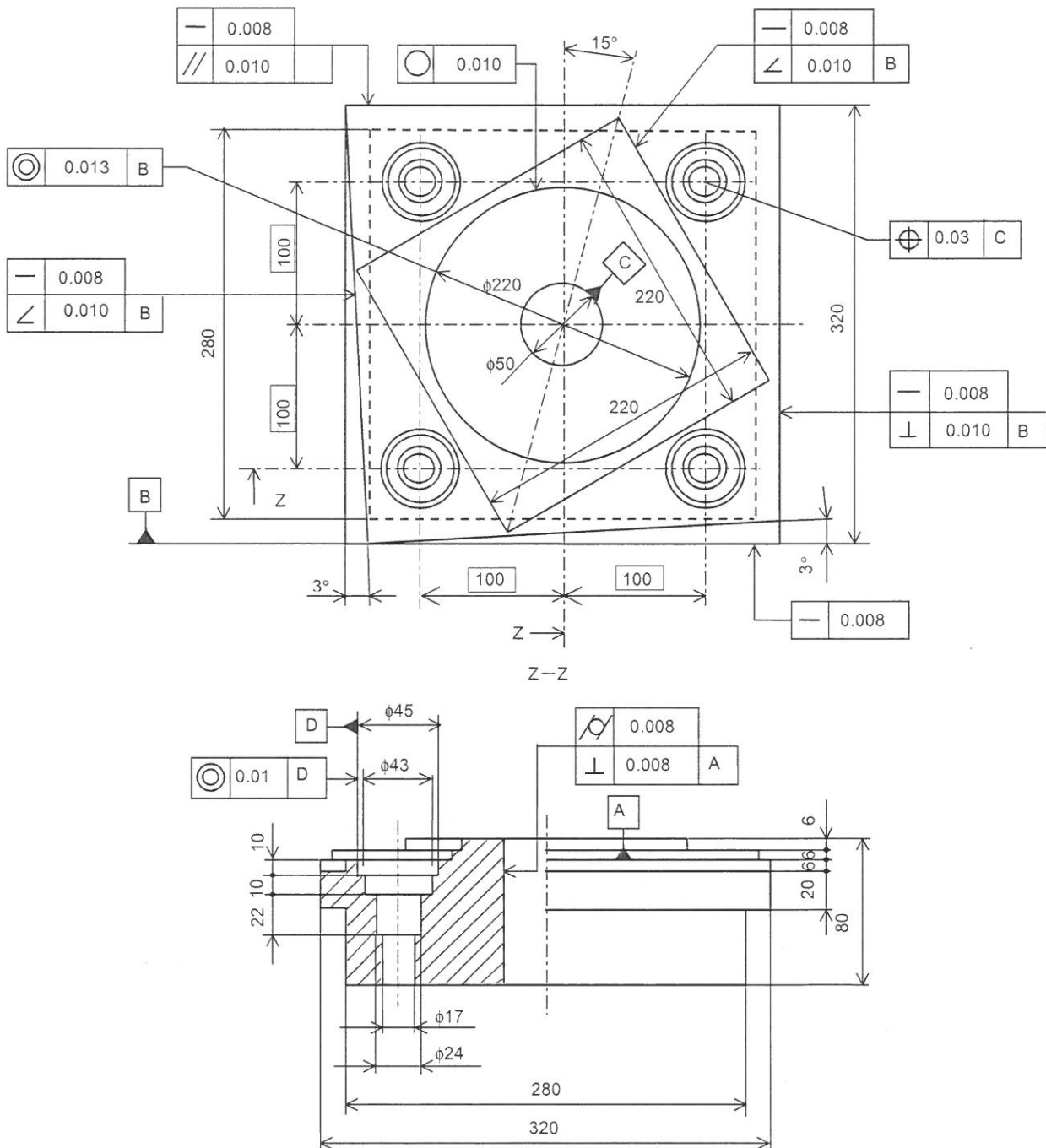
Test Item

Checking of accuracy of a test piece after contouring



Measurement Procedure/Diagram

1. Take the test piece to a coordinate measuring machine (CMM) and make the required measurements.
2. For the straight sides (or the square, diamond and sloping faces), bring the probe into contact with the surface to be measured at at least at ten points in order to obtain the straightness, squareness and parallelism deviations.
3. For the circularity (or cylindricity) test, if the measurement is not continuous, check at least fifteen points (for cylindricity in each measured plane).



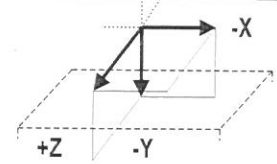
MORI SEIKI

Test No. 23-2

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Test Item

Checking of accuracy of a test piece after contouring



Object		Tolerance	Measured deviation
Central hole	a) Cylindricity	0.008	0.0010
	b) Squareness between the hole axis and the basis A	Φ 0.008	ϕ 0.007
Square	c) Straightness of the sides	0.008	0.0040
	b) Squareness of the adjacent sides to basis B	0.010	0.0060
	e) Parallelism of the opposite side to basis B	0.010	0.0050
Diamond	f) Straightness of the sides	0.008	0.0020
	g) Accuracy of 75° angles to basis B	0.010	0.0010
Circle	h) Circularity	0.010	0.0090
	i) Concentricity of the external circle and the internal bored hole C	Φ 0.013	ϕ 0.007
Sloping faces	j) Straightness of the faces	0.008	0.0020
	k) Accuracy of the angles to basis B	0.010	0.0090
Four bored holes	n) Position of the holes with respect internal bored hole C	Φ 0.03	ϕ 0.019
	o) Concentricity of inner hole to outer hole D	Φ 0.01	ϕ 0.007

Measuring instruments: Coordinate measuring machine

JIS B 6336-7 (2000)
ISO 10791-7 (1998)

Unit: mm (in.)

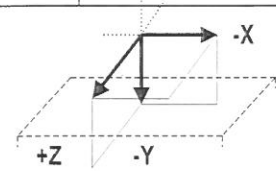
MORI SEIKI

Test No. 24

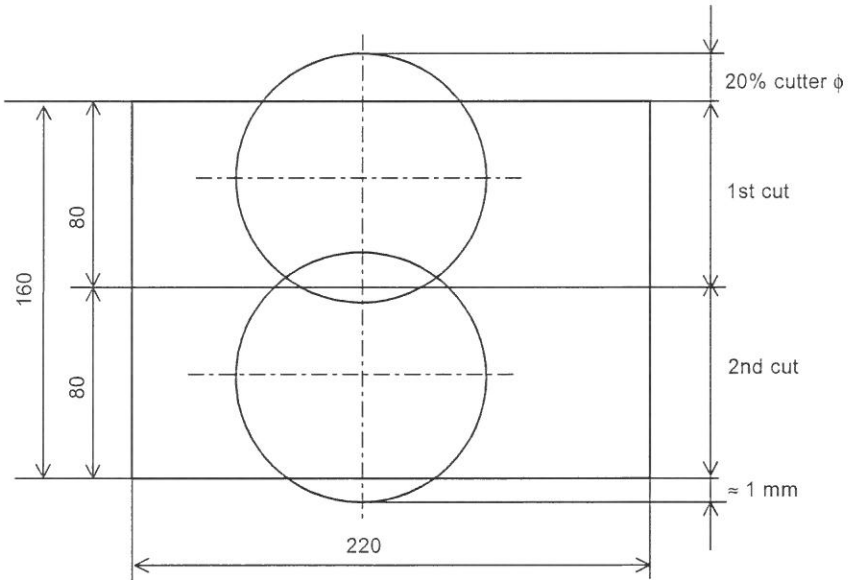
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Test Item

Checking of flatness of the finished surface



Measurement Procedure/Diagram



Measuring instruments

Tolerance

Measured deviation

Coordinate measuring machine

Flatness

0.015

0.0050

JIS B 6336-7 (2000)
ISO 10791-7 (1998)

MORI SEIKI	Cutting conditions used in Machining Accuracy Test		Page 34 / 35
Machining Accuracy Test	Square・Diamond・Circle・Slow Cant	Center Hole・4 boring Hole	
Cutting	Finishing cutting		Finishing cutting
Tool Name	ϕ 30 end mill(4 teeth)	ϕ 45, ϕ 41, ϕ 39 boring	
Tool Material	carbide		carbide
RPM min ⁻¹	3750	2000	
Cutting Speed (m/min)	353	250	
Feedrate (mm/min)	750	200	
Depth of Cutting (mm)	0.1	0.1	
Material of Workpiece (mm)	Aluminum (A5056)		Aluminum (A5056)

Machining Accuracy Test	Flatness of finished surface	
Cutting	Finishing cutting	
Tool Name	ϕ 100Face mill	
Tool Material	Carbide	
RPM min ⁻¹	300	
Cutting Speed (m/min)	94	
Feedrate (mm/min)	200	
Depth of Cutting (mm)	0.1	
Material of Workpiece (mm)	Cast iron (FC250)	

MORI SEIKI		List of Test Equipment		Page 35 / 35
1. Test Equipment used for Static Accuracy Test				
Precision Level Gage		Sling dial indicator		
Manufacturer	Niigata Machinery	Manufacturer	Ozaki Mfg. Co. Ltd	
Type	DL-S3	Type	PCN-2BU	
Scale	0.001mm/m	Scale	0.002mm	
Square block gage		Test bar		
Manufacturer	TOTO Ltd.	Manufacturer	Daishowa Seiki Co. Ltd.	
Type	VAPG55A1Y	Type	NT40, $\phi 40 \times 300$	
Cylinder Square				
Manufacturer	The Fujita Corporation			
Type	No.2411, $\phi 160 \times 600$			
2. Test Equipment used for Positioning Accuracy Test				
Laser Collimator				
Manufacturer	Tokyo Seimitsu Co. Ltd			
Type	DISTAX			
Scale	0.01 μ m			
3. Test Equipment used for Circular interpolation Movement Measurement				
Roundness Measurement equipment				
Manufacturer	Renishaw			
Type	QC10			
Scale	0.1 μ m			
4. Test Equipment used for Machining Accuracy Test				
Sling Dial Indicator		Coordinate Measurement Machine		
Manufacturer	Ozaki Mfg Co. Ltd.	Manufacturer	Carl Zeiss Inc.	
Type	PCN-2BU	Type	PRISMO	
Scale	0.002mm	Scale	0.0001mm	
5. Test Machine used for Spindle Accuracy Measurement				
Manufacturer	SCHENCK			
Type	VIBROBLANCER 41			
6. Test Equipment used for Linear Movement Axis Feed speed Measurement				
Manufacturer	Test Equipment used for Linear			
Type	—			