

Renishaw Ballbar Test Data

Renishaw Ballbar testing in 2 planes gives a full analysis of 23 different machine errors. Below are some of the most common problems.

Backlash or Lost Motion

Play in the drive system of the machine. This is typically caused by ball-screw end float or play in the guide ways of the machine causing a dwell in motion when the direction in which the machine is being driven changes.

Scaling Error

Scaling Error is the difference in the measured travels of the axes during the test. For example, if the machine is performing a circle in the XY plane; the X and Y axes should move over exactly the same distance.

Reversal Spike

When an axis is being driven in one direction and then has to reverse and move in the opposite direction, instead of reversing smoothly it may pause momentarily at the turnaround point.

Squareness

2 axes of the machine at 90 degrees to each other.

Straightness

A straightness error is caused by a lack of straightness in the machine guideways. There may be an overall guideway misalignment in the machine. This may be the result of wear in the guideways, an accident which has damaged the machine guideways or caused them to become misaligned, or poor machine foundations which may be the cause of a bowing effect in the whole machine.

Renishaw diagnostic software calculates and produces the following machine performance evaluation.

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Ballbar diagnostics (%)

RENISHAW

XY 360deg 150mm Calibrated Kruaki 3253 12-21-10

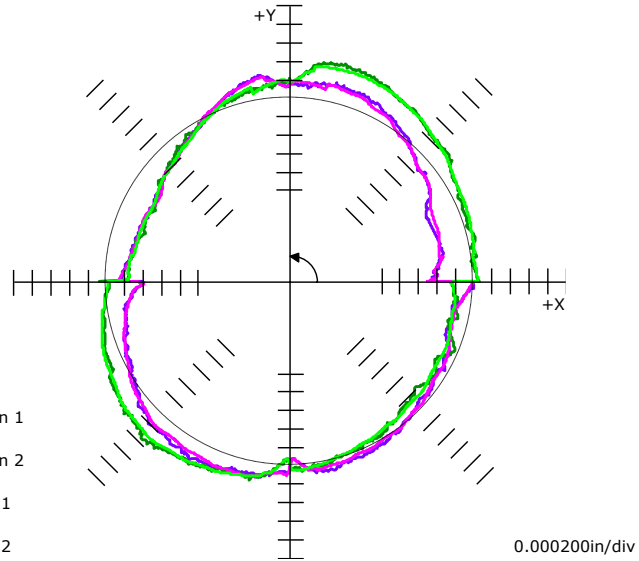
Operator: J Potter TMS
Date: 2010-Dec-21 13:10:00

Machine: Quick check
QC10: H50678, Last calibrated: 2010-10-24

21% Scaling mismatch	-0.000685in
17% Squareness	-0.000047in/in
14% Backlash X	▶ -0.000232in ◀ -0.000217in
10% Straightness X	-0.000327in
9% Reversal spikes Y	▲ -0.000071in ▼ -0.000157in

Positional tolerance	0.002945in
Best fit radius	5.905094in
Circularity	0.000906in

- Run 1
- Run 2
- Fit 1
- Fit 2



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Ballbar diagnostics (in)

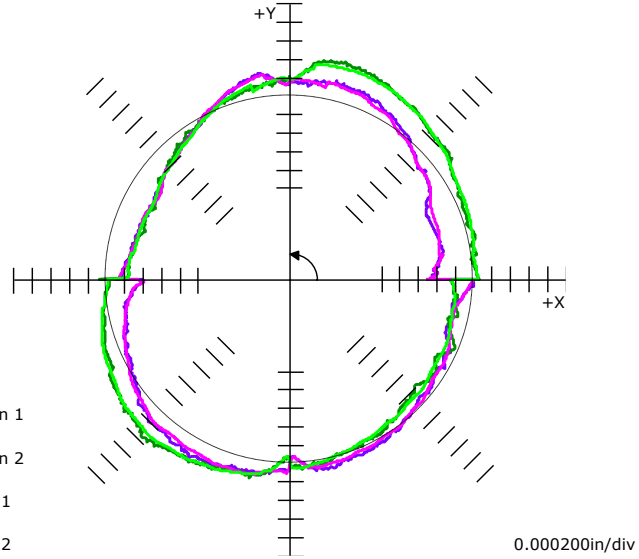


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Date: 2010-Dec-21 13:10:00

Machine: Quick check
QC10: H50678, Last calibrated: 2010-10-24

Backlash (in)	
X	▶ -0.000232 ◀ -0.000217
Y	▲ 0.000079 ▼ -0.000031
Reversal spikes (in)	
X	▶ 0.000024 ◀ -0.000051
Y	▲ -0.000071 ▼ -0.000157
Lateral play (in)	
X	▶ -0.000154 ◀ 0.000067
Y	▲ -0.000193 ▼ -0.000067
Cyclic error (in)	
X	↑ 0.000039 ↓ 0.000047
Y	↑ 0.000024 ↓ 0.000035
Other features	
Servo mismatch	0.05ms
Squareness	-0.000047in/in
Straightness X	-0.000327in
Straightness Y	-0.000004in
Scaling error X	-99.8ppm
Scaling error Y	-41.6ppm
<hr/>	
Positional tolerance	0.002945in
Best fit radius	5.905094in
Circularity	0.000906in



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Ballbar diagnostics table



XY 360deg 150mm Calibrated Kruaki 3253 12-21-10

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QC10: H50678, Last calibrated: 2010-10-24

Error	Magnitude		Independent circularity	Ranking	
Backlash X	▶ -0.000232	◀ -0.000217in	0.000232in	(14%)	(3)
Backlash Y	▲ -0.000079	▼ -0.000031in	0.000079in	(5%)	(8)
Reversal spikes X	▶ 0.000024	◀ -0.000051in	0.000051in	(3%)	(9)
Reversal spikes Y	▲ -0.000071	▼ -0.000157in	0.000157in	(9%)	(5)
Lateral play X	▶ -0.000154	◀ 0.000067in	0.000087in	(5%)	(7)
Lateral play Y	▲ -0.000193	▼ -0.000067in	0.000142in	(9%)	(6)
Cyclic error X	↑ 0.000039	↓ 0.000047in	0.000047in	(3%)	(10)
Cyclic error Y	↑ 0.000024	↓ 0.000035in	0.000031in	(2%)	(12)
Servo mismatch	0.05ms		0.000047in	(3%)	(11)
Squareness	-0.000047in/in		0.000276in	(17%)	(2)
Straightness X	-0.000327in		0.000165in	(10%)	(4)
Straightness Y	-0.000004in		0.000000in	(0%)	(13)
Scaling mismatch	-0.000685in		0.000343in	(21%)	(1)
Scaling error X	-99.8ppm				
Scaling error Y	-41.6ppm				
Cyclic pitch X	0.885827in				
Cyclic pitch Y	1.771654in				
Calculated feedrate	59.24in/min				
Centre offset X	0.001866in				
Centre offset Y	0.000965in				
Positional tolerance	0.002945in				
Best fit radius	5.905094in				
Circularity	0.000906in				

Test parameters

Radius	5.905512in
Feedrate	39.37in/min
Start/End/Overshoot	0°/360°/180°
Run sequence	CCW CW
Test position	
Sample rate	27.778Hz

Pre-test comment

XY with pallet.

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Test conditions



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Test parameters

Test specification	XY 360deg 150mm Calibrated
Plane under test	XY
Radius	5.905512in
Ballbar length	5.905512in
Feedrate	39.37in/min
Test position	
NC Program ID	
Ballbar length calibrated	Yes
Machine expansion coefficient	12.0ppm/°C
Spindle number	1
Start angle	0°
End angle	360°
Overshoot angle	180°
Sample rate	27.778Hz

Run 1

Run direction	CCW
Machine temperature	20.0°C

Run 2

Run direction	CW
Machine temperature	20.0°C

Pre-test comment

XY with pallet.

Ballbar details

Manufacturer	Renishaw
Model	QC10
Serial number	H50678
Scale factor	1.0009
Certificate number	
Last calibrated	2010-Oct-24

Calibrator details

Manufacturer	Renishaw
Model	ZERODUR
Serial number	G92205
Certificate number	
Last calibrated	2010-Oct-24