



Ballbar Test Results

ADDENDUM TO SR12611

Customer: Massiv Die Form
Machine: Okuma MA-650VB SN: #335
Date: January 24,2020
Scan: **As Found** Final (Post-service)

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XY PLANE "AS FOUND"

Ballbar diagnostics (%)

RENISHAW

XY 360deg 150mm Calibrated 20200124-075237

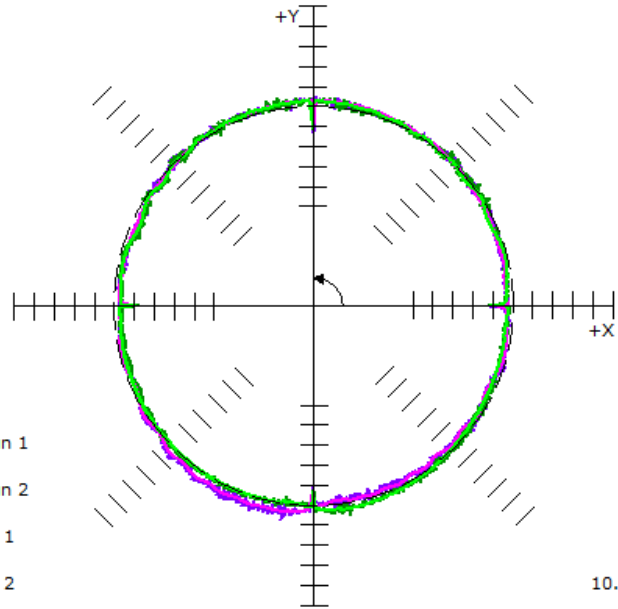
Operator: Toughbook
Date: 2020-Jan-24 07:52:37

Machine: MDF 335
QC20-W: 1CMT68, Last calibrated: 2018-09-28

- 38% Reversal spikes Y
 - ↔ -13.4 μ m
 - ↔ -8.5 μ m
- 20% Reversal spikes X
 - ↔ -6.3 μ m
 - ↔ -7.1 μ m
- 14% Scaling mismatch
 - 9.9 μ m
- 10% Backlash Y
 - ↔ -0.6 μ m
 - ↔ 3.6 μ m
- 7% Cyclic error X
 - ↑ 0.5 μ m
 - ↓ 2.5 μ m

Positional tolerance 27.6 μ m
Best fit radius 149.9963mm
Circularity 21.3 μ m

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



10.0 μ m/div

Ballbar diagnostics table



XY 360deg 150mm Calibrated 20200124-075237

Operator: Toughbook

Machine: MDF 335

Date: 2020-Jan-24 07:52:37

QC20-W: 1CMT68, Last calibrated: 2018-09-28

| Error | Magnitude | Independent circularity | Ranking |
|----------------------|--------------|-------------------------|------------------|
| Backlash X | ▶ 0.0 | ◀ 0.2µm | 0.2µm (1%) (12) |
| Backlash Y | ▲ -0.6 | ▼ -3.6µm | 3.6µm (10%) (4) |
| Reversal spikes X | ▶ -6.3 | ◀ -7.1µm | 7.1µm (20%) (2) |
| Reversal spikes Y | ▲ -13.4 | ▼ -8.5µm | 13.4µm (38%) (1) |
| Lateral play X | ▶ 0.4 | ◀ -0.3µm | 0.2µm (1%) (11) |
| Lateral play Y | ▲ 0.3 | ▼ -0.8µm | 0.5µm (1%) (8) |
| Cyclic error X | ↑ 0.5 | ↓ 2.5µm | 2.4µm (7%) (5) |
| Cyclic error Y | ↑ 0.5 | ↓ 0.5µm | 0.5µm (1%) (9) |
| Servo mismatch | 0.00ms | 0.0µm | (0%) (13) |
| Squareness | -9.1µm/m | 1.4µm | (4%) (6) |
| Straightness X | -0.8µm | 0.4µm | (1%) (10) |
| Straightness Y | -1.8µm | 0.9µm | (3%) (7) |
| Scaling mismatch | -9.9µm | 4.9µm | (14%) (3) |
| Scaling error X | -41.1µm/m | | |
| Scaling error Y | -8.2µm/m | | |
| Cyclic pitch X | 20.0000mm | | |
| Cyclic pitch Y | 44.4500mm | | |
| Calculated feedrate | 1997.5mm/min | | |
| Centre offset X | 19.4µm | | |
| Centre offset Y | 15.8µm | | |
| Positional tolerance | 27.6µm | | |
| Best fit radius | 149.9963mm | | |
| Circularity | 21.3µm | | |

Test parameters

| | |
|---------------------|--------------|
| Radius | 150.0000mm |
| Feedrate | 2000.0mm/min |
| Start/End/Overshoot | 0°/360°/180° |
| Run sequence | CW CCW |
| Test position | |
| Sample rate | 52.632Hz |

Pre-test comment

As Found, January 24 2019

XZ Plane "As Found"

Ballbar diagnostics (%)



ZX 360deg 150mm Calibrated 20200124-082402

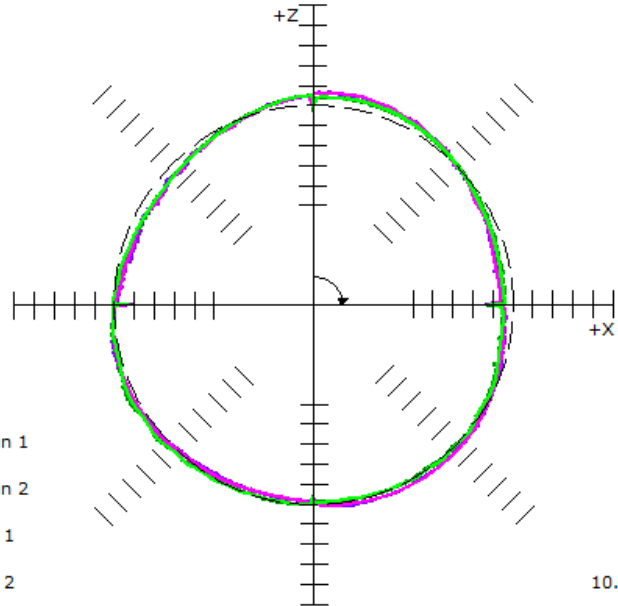
Operator: Toughbook
Date: 2020-Jan-24 08:24:02

Machine: MDF 335
QC20-W: 1CMT68, Last calibrated: 2018-09-28

- 21% Reversal spikes X
 - ▶ -6.7µm
 - ◀ -7.6µm
- 14% Straightness X
 - 10.2µm
- 13% Scaling mismatch
 - 8.9µm
- 12% Straightness Z
 - 8.2µm
- 11% Reversal spikes Z
 - ▲ -4.1µm
 - ▼ -3.2µm

Positional tolerance 31.9µm
Best fit radius 149.9989mm
Circularity 20.3µm

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



Ballbar diagnostics table



ZX 360deg 150mm Calibrated 20200124-082402

Operator: Toughbook

Machine: MDF 335

Date: 2020-Jan-24 08:24:02

QC20-W: 1CMT68, Last calibrated: 2018-09-28

| Error | Magnitude | | Independent circularity | Ranking |
|----------------------|--------------|----------|-------------------------|---------|
| Backlash Z | ↖ -1.6 | ↘ 2.1µm | 2.1µm (6%) | (7) |
| Backlash X | ↗ -0.7 | ↙ 1.2µm | 1.2µm (4%) | (9) |
| Reversal spikes Z | ↖ -4.1 | ↘ -3.2µm | 4.1µm (11%) | (5) |
| Reversal spikes X | ↗ -6.7 | ↙ -7.6µm | 7.6µm (21%) | (1) |
| Lateral play Z | ↖ -0.5 | ↘ -0.6µm | 0.6µm (2%) | (13) |
| Lateral play X | ↗ -0.8 | ↙ -0.9µm | 0.8µm (2%) | (10) |
| Cyclic error Z | ↑ 0.3 | ↓ 0.7µm | 0.6µm (2%) | (12) |
| Cyclic error X | ↑ 0.2 | ↓ 1.6µm | 1.5µm (4%) | (8) |
| Servo mismatch | 0.02ms | | 0.8µm (2%) | (11) |
| Squareness | -16.5µm/m | | 2.5µm (7%) | (6) |
| Straightness Z | 8.2µm | | 4.1µm (12%) | (4) |
| Straightness X | -10.2µm | | 5.1µm (14%) | (2) |
| Scaling mismatch | 8.9µm | | 4.4µm (13%) | (3) |
| Scaling error Z | 7.4µm/m | | | |
| Scaling error X | -22.3µm/m | | | |
| Cyclic pitch Z | 45.0000mm | | | |
| Cyclic pitch X | 20.0000mm | | | |
| Calculated feedrate | 1997.5mm/min | | | |
| Centre offset Z | 45.2µm | | | |
| Centre offset X | 20.8µm | | | |
| Positional tolerance | 31.9µm | | | |
| Best fit radius | 149.9989mm | | | |
| Circularity | 20.3µm | | | |

Test parameters

| | |
|---------------------|--------------|
| Radius | 150.0000mm |
| Feedrate | 2000.0mm/min |
| Start/End/Overshoot | 90°/90°/180° |
| Run sequence | CW CCW |
| Test position | |
| Sample rate | 52.632Hz |

Pre-test comment

As Found, January 24 2020

YZ Plane "As Found"

Ballbar diagnostics (%)



YZ 360deg 150mm Calibrated 20200124-081045

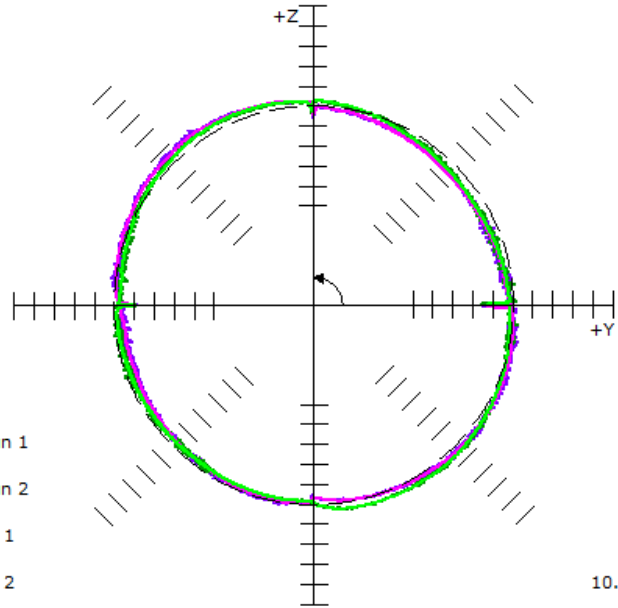
Operator: Toughbook
Date: 2020-Jan-24 08:10:45

Machine: MDF 335
QC20-W: 1CMT68, Last calibrated: 2018-09-28

| | |
|-----------------------|-----------|
| 34% Reversal spikes Y | ▶ -12.6µm |
| | ◀ -8.1µm |
| 19% Squareness | 47.3µm/m |
| 11% Reversal spikes Z | ▲ -4.1µm |
| | ▼ -2.0µm |
| 7% Scaling mismatch | -5.2µm |
| 7% Backlash Z | ▲ -1.6µm |
| | ▼ 2.6µm |

| | |
|----------------------|------------|
| Positional tolerance | 31.6µm |
| Best fit radius | 149.9997mm |
| Circularity | 24.2µm |

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



Ballbar diagnostics (%)



YZ 360deg 150mm Calibrated 20200124-081045

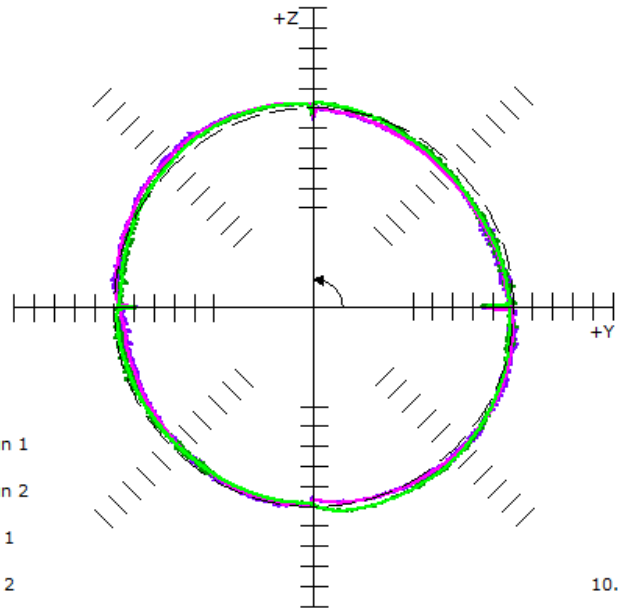
Operator: Toughbook
Date: 2020-Jan-24 08:10:45

Machine: MDF 335
QC20-W: 1CMT68, Last calibrated: 2018-09-28

| | |
|-----------------------|-----------|
| 34% Reversal spikes Y | ▶ -12.6µm |
| | ◀ -8.1µm |
| 19% Squareness | 47.3µm/m |
| 11% Reversal spikes Z | ▲ -4.1µm |
| | ▼ -2.0µm |
| 7% Scaling mismatch | -5.2µm |
| 7% Backlash Z | ▲ -1.6µm |
| | ▼ 2.6µm |

| | |
|----------------------|------------|
| Positional tolerance | 31.6µm |
| Best fit radius | 149.9997mm |
| Circularity | 24.2µm |

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



Report Summary and Recommendations

- There is a slight vibration or resonance in the Y axis movement. It would not be considered serious or major at this time. Continue to monitor.
- There is likely some degradation of the X axis turcrite. The XZ ballbar test was completed on the X positive (RH side from operator view) end of the table. The straightness error may be due to levelling but is most likely attributed to uneven turcrite / boxway wear.
- Reversal spikes are moderate on X and Y axis. Continue to monitor machine condition.
- Machine could be calibrated by laser to remove scaling mismatch between axis.