Nanotech®

Moore Nanotechnology Systems

M600

A New Path in Ultra Precision Jig Grinding

MOORE TOOLS

Table of Contents

Why is Repeatability Important When Selecting a Machine Tool?

Repeatable

Accurate

Repeatable and Accurate

Accuracy (hitting the middle of the specification) and precision (repeatable results) are the two main elements to achieve superior manufacturing processes.

While accuracy is important, unless it is repeatable, value is rapidly reduced as part / system design moves from Research and Development phase into Production phase. When selecting a machine system, repeatability often becomes a major influencing factor.

Repeatability plays an essential role in any production manufacturing process.

Conventional jig grinding has historically provided a repeatable process. Repeatable (1 - 5 micron) ranges could be achieved under extraordinary care and commitment from a machine operator.

Consumer demand for higher value, lower cost products have pushed the specification in die, mold and precision component manufacturing. These demands, coupled with already expensive finishing operations (requiring hard to find human skill sets) have created the need for another level of repeatability in a machine tool and process. As a result, machine tool builders have needed to develop and advance technology to meet these ever-increasing needs and challenges.

Introducing the M600. A Truly Revolutionary New Jig Grinding System.

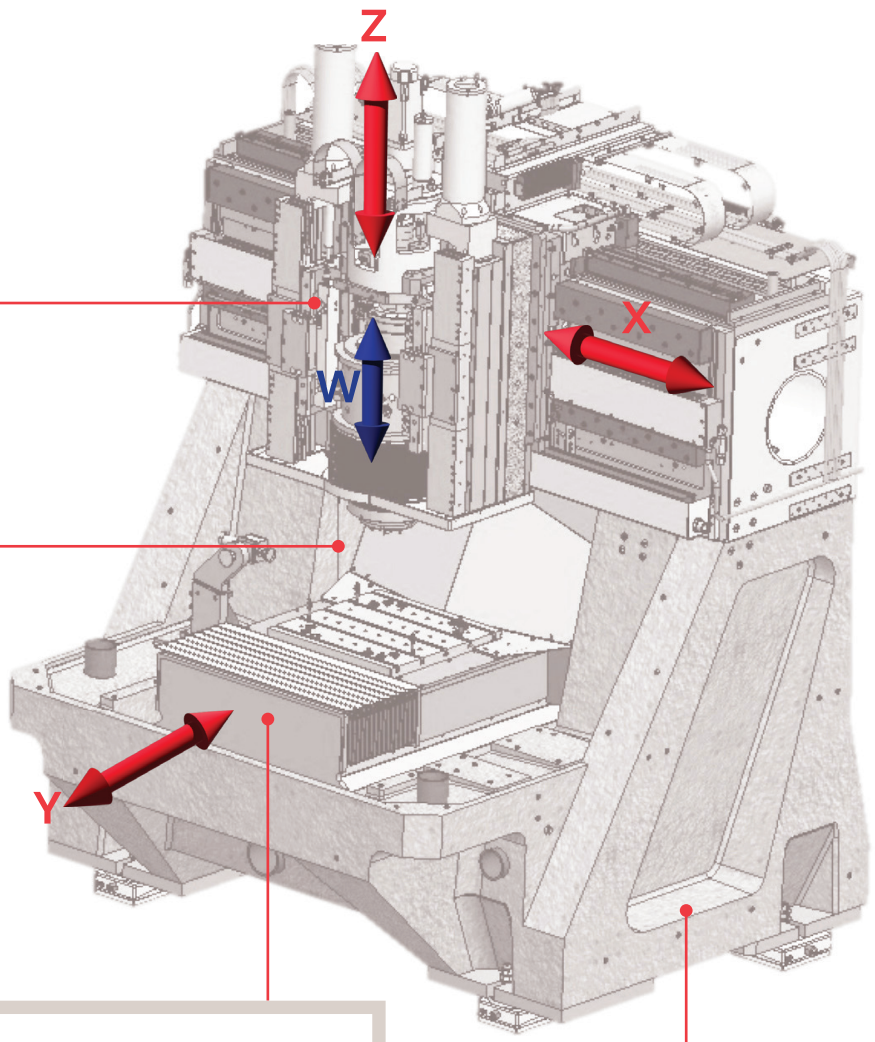
Moore Nanotechnology Systems have developed an ultra-precision jig grinding machine that is **capable of running completely unattended** (roughing through finishing) while achieving sub-micron form and positional accuracies in a wide variety of hardened steels, metals and other materials requiring precision and ultra precision grinding.

Precision Machine Structure Layout - Critical Components

The M600 was developed based on a comprehensive understanding of conventional jig grinding methodologies and has been completely designed and built from the ground up, utilizing today's most advanced technologies, systems, materials and precision engineering practices.

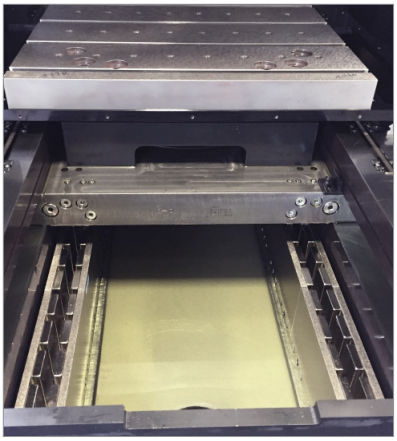
Advanced Reciprocation Axis

To enable vibration free reciprocation of the W-axis while chop grinding, both Z and W-axes are coaxially arranged. During W-axis reciprocation, the Z-axis moves in the opposing direction to the W-axis, generating a counter reacting inertia force. This innovative arrangement enables higher contouring and surface finish accuracy during chop grinding.



Continuous Thermal Stability

Over long grinding cycles, low thermal drift and high stabilities of the spindle in X and Y directions are achieved through thermal natural coaxial arrangement of the Z, W, and spindle axes and by implementing controlled coolant zones surrounding the spindle.



Proven Oil Hydrostatic Slide Technology

All machine axes are fully hydro-static constrained bearing enabling ultra-precision motion accuracies during contour operations due to the friction free motion. Further, to minimize thermal influences during high acceleration and speed cycles, all critical positioning axes (X, Y, Z) are actuated through dual ironless linear motors.

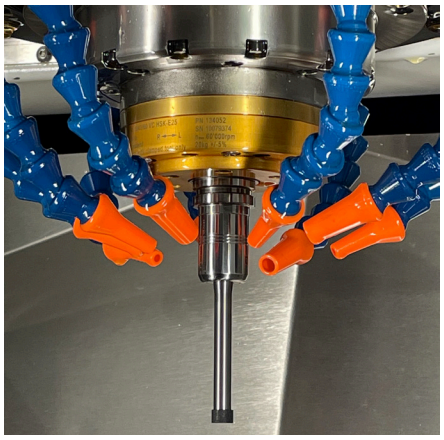
Monolithic Machine Base

The machine base, columns, and bridge are polymer cast, designed as a single monolithic structure, eliminating joint surface influences for increased static and dynamic machine stability.

Robust End-to-End Process Support System

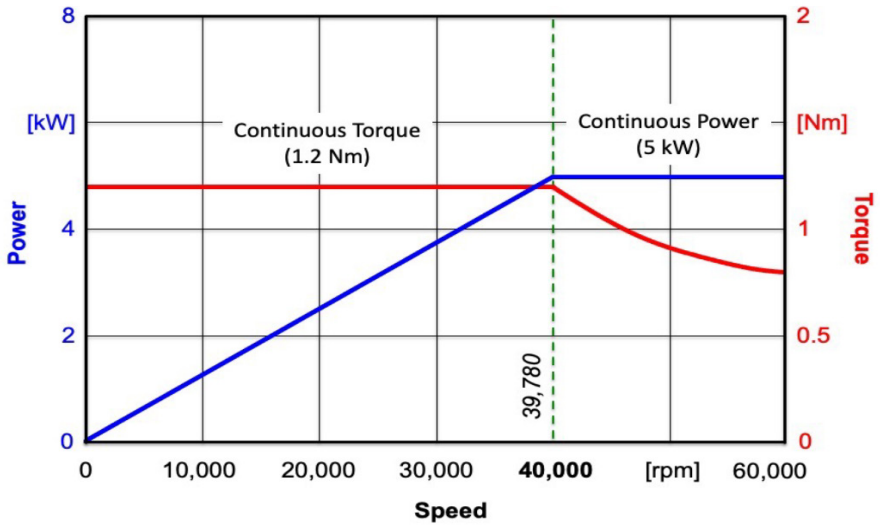
The 60,000 rpm high speed precision spindle with 5 kW (1.2 Nm) of continuous power supports a large diversity of grinding applications. Combined with the HSK-E25 tool interface, high process stability can be achieved, enabling an ultra-precision jig-grinding operation.

Advanced temperature control and robust tool interface



Shown: ø8 mm grinding wheel with 110 mm tool length

Spindle torque/power range

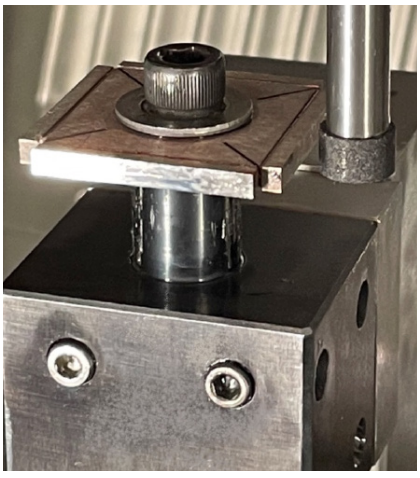


Automatic Tool-Changer (ATC)

The ATC magazine can hold 30 HSK-E25 tools with a maximum diameter of 50 mm and a tool length of 125 mm. Through innovative dual gripper action, a 5 second tool-to-tool change is achieved.

AutoSize

A four-sided AutoSize blade enables measuring tool diameter to an accuracy of less than 0.25 microns and ensures a precise tool location relative to the workpiece.

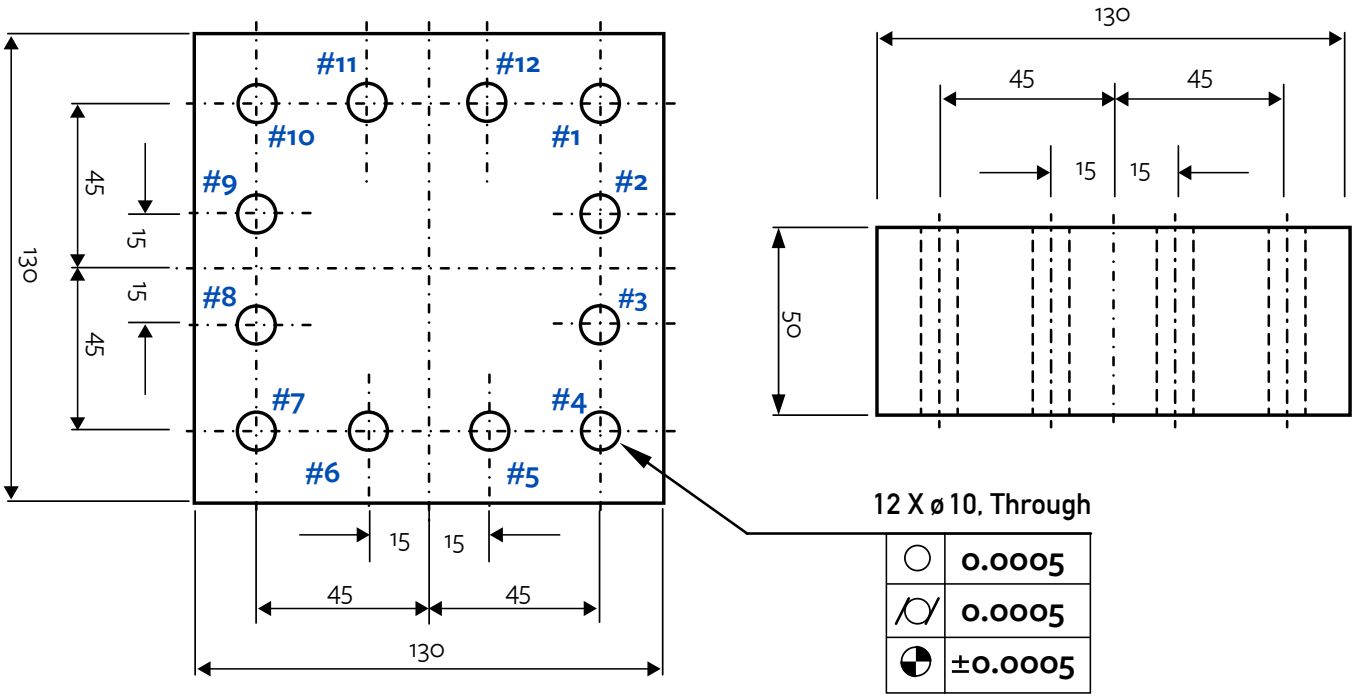


Rotary Dressing

A 12,000 rpm rotary dressing spindle with a precision balanced dressing wheel insure a quality dress of your grinding wheels. An optional imbedded acoustic sensor allows the monitoring of the dressing operation.

Repeatability – The Foundation for Accuracy and Quality

Mold Plate Example

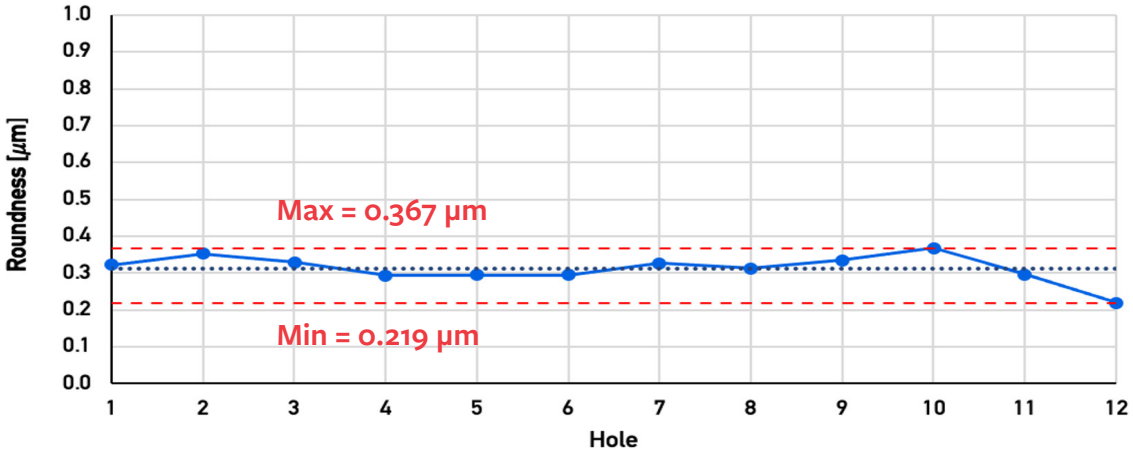


The M600 enables a highly repeatable jig-grinding operation of high accuracy parts without human intervention. Every step along the process cycle can be electronically monitored and controlled.

Example
Planetary Grinding of a 12 Cavity Plate
Hole Dimensions: ø10 mm x 50 mm Deep,
Stavax D2-Steel, Hardness: 54 HRC

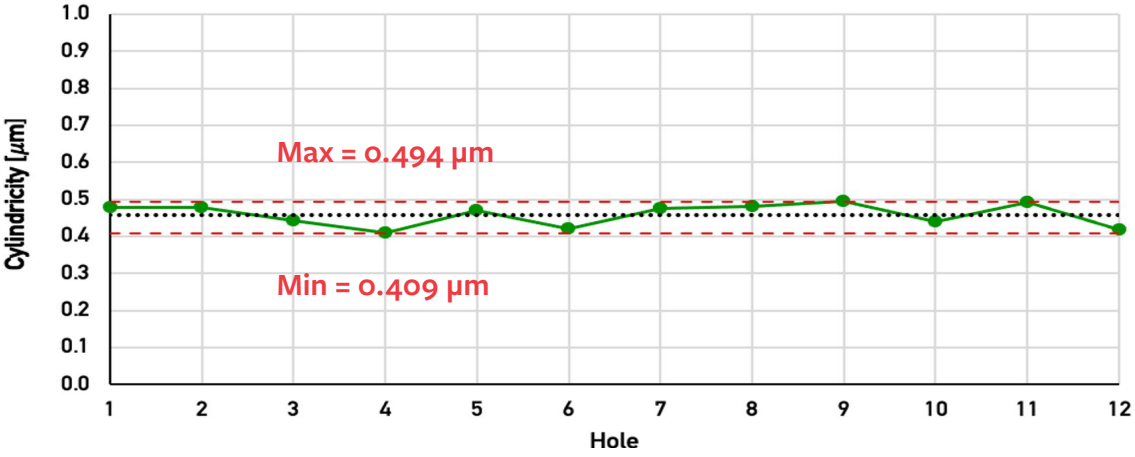
Sub-Micron Accuracy Without Human Intervention

Roundness



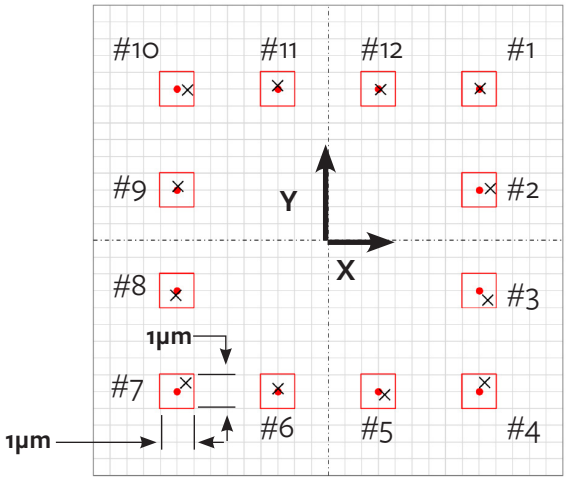
Average m: 0.312 µm

Cylindricity



Average m: 0.458 µm

Positioning



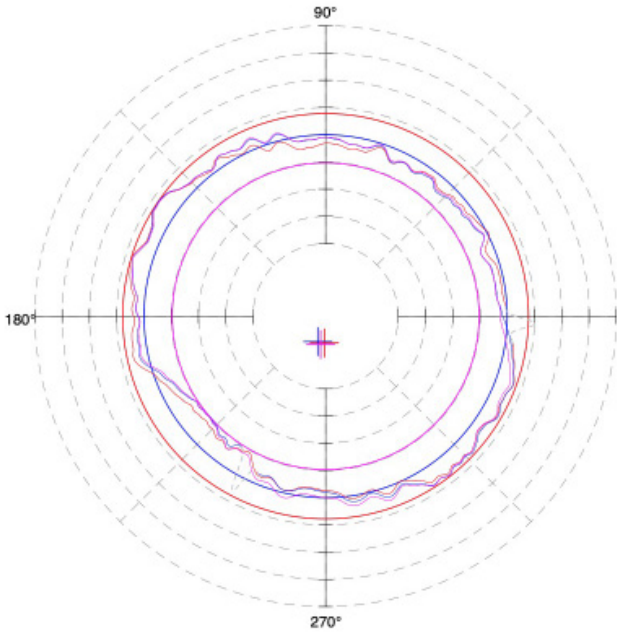
Location	Positional Error [µm]	
	X	Y
#1	0.036	0.012
#2	0.331	0.038
#3	0.265	-0.282
#4	0.171	0.269
#5	0.183	-0.089
#6	0.014	0.087
#7	0.257	0.254
#8	-0.044	-0.137
#9	0.022	0.102
#10	0.307	-0.025
#11	-0.010	0.103
#12	0.074	-0.008

Sub-Micron Part Results

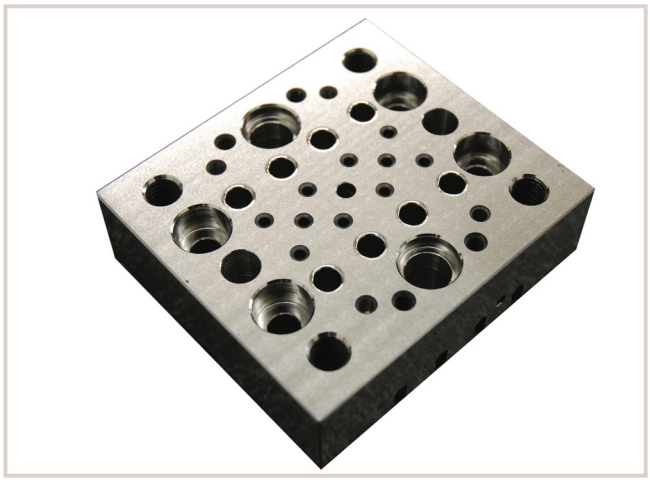
Chop-Grinding Accuracy

Example
Chop Grinding of an 80 mm Tungsten Carbide Punch

Roundness: 0.347 µm

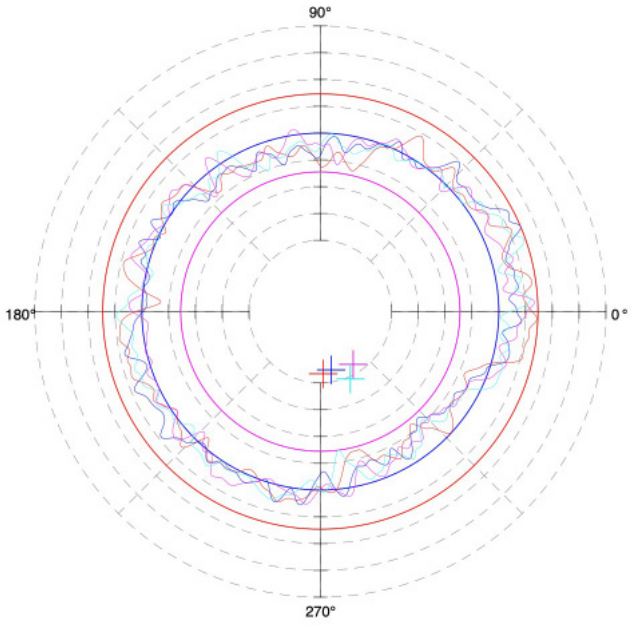


Planetary Grinding Accuracy



Example
Planetary Grinding of an 8 Cavity Optical Mold Plate
Stavax D2-Steel, Hardness 54 HRC

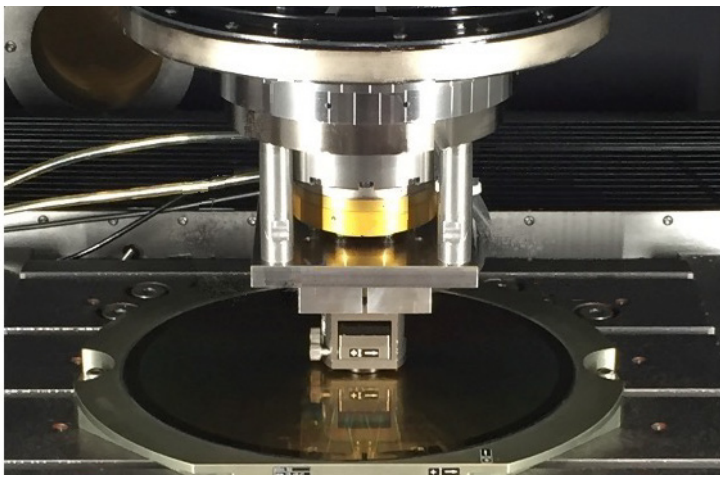
Roundness: 0.219 µm



Nanometer Motion Accuracy

Ultra precision and error-free reversal contouring motion is attained by implementing friction-free hydrostatic bearing technology, 1 nanometer feedback resolution, and adapting dual linear motor arrangement for each axis. This ensures a precise contouring path during chop or planetary grinding operation.

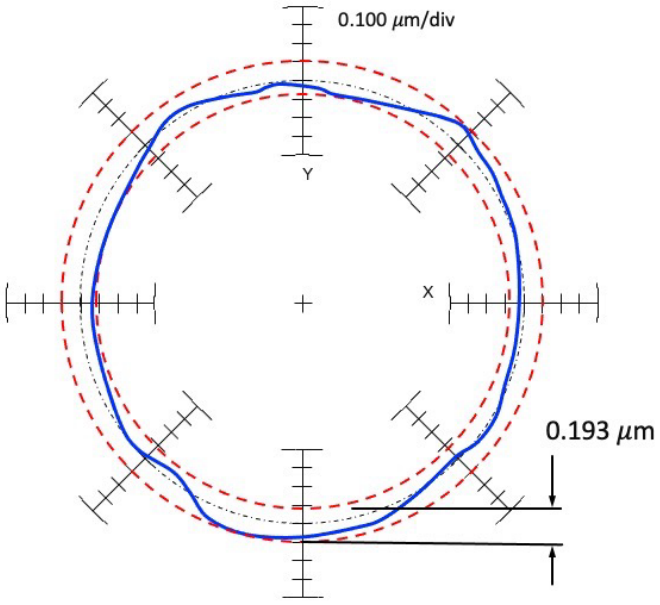
Contouring Accuracy



Heidenhain Grid Encoder

Example
XY Motion Accuracy of ø80 mm Circular Move
(Feedrate 500 mm/min)

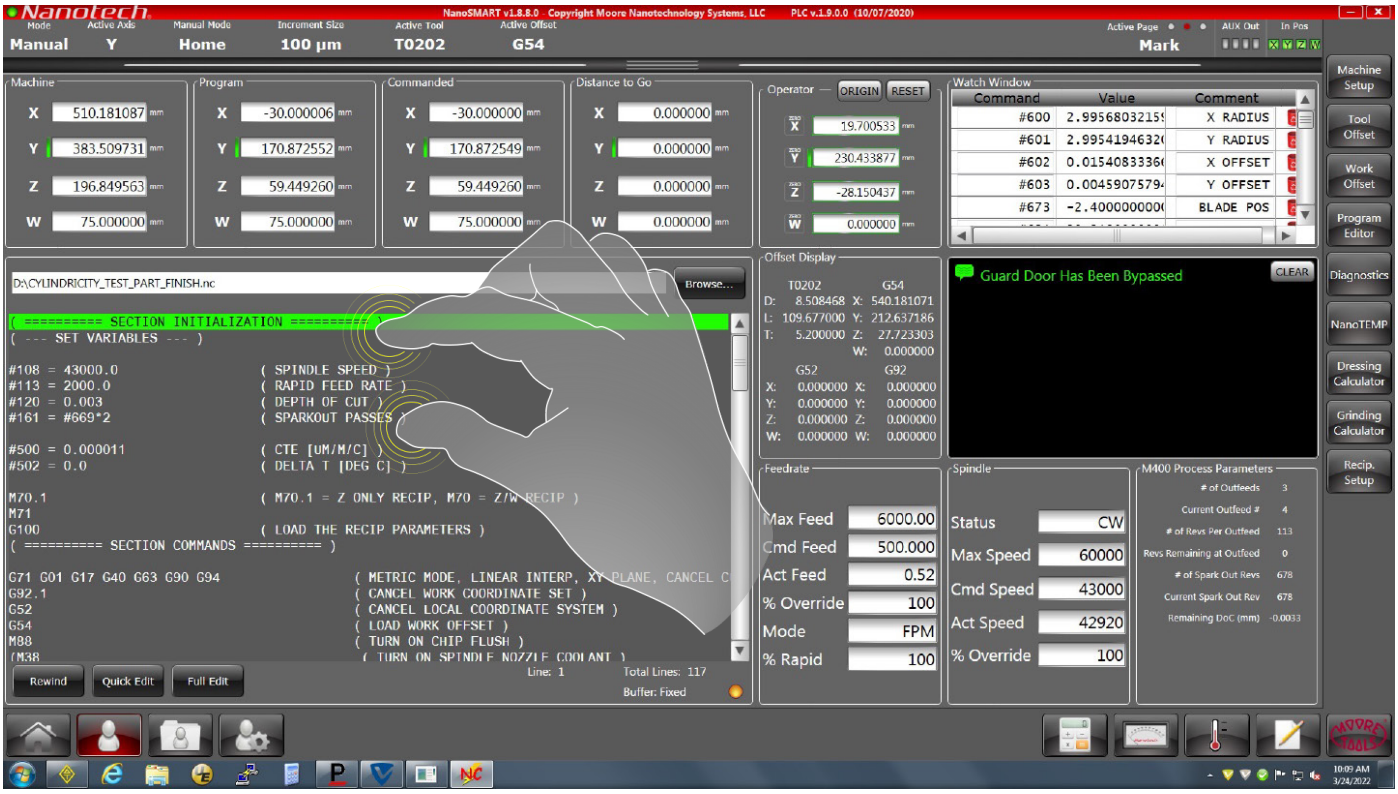
Motion Accuracy: 0.193 µm



NanoSMART® – An Intuitive Machine Operation

NanoSmart's® industry-first, touch-and-swipe, gesture-based, interactive human machine-interface (HMI) supports intuitive machine programming and operation. Dressing cycles, tool metrology, and jig-grinding operations are setup by the operator through conversational programming. Important parameters impacting the process stability are continuously monitored enabling minimum human/process intervention.

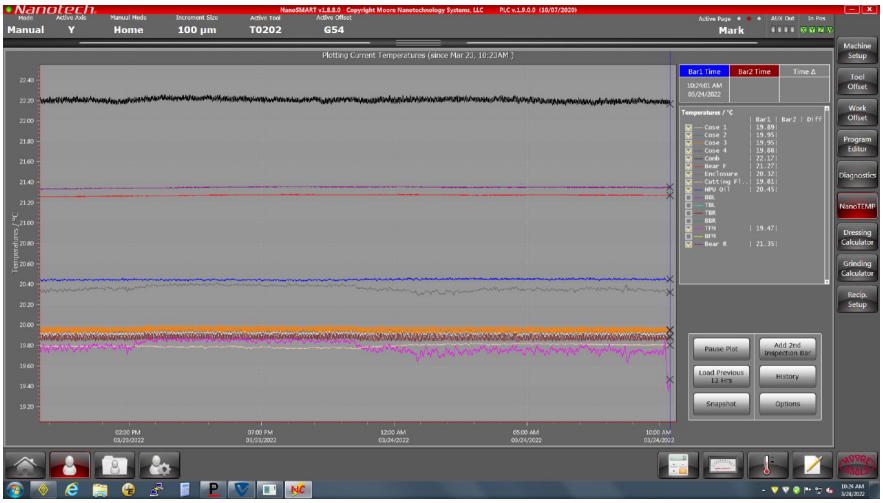
- Windows Based Interface 64-bit
- Processor Type Intel I5 3.2 GHz
- Storage Capacity 5GB SSD
- 2 x Easy USB Port Access
- Delta Tau PMAC Motion Control
- NC-File Size up to 5GB
- 40,000 Blocks Lookahead
- 0.000001mm Programming Resolution
- Fully Networkable
- Remote Connectivity for Service Access



NanoSMART® – Touch Screen Interface

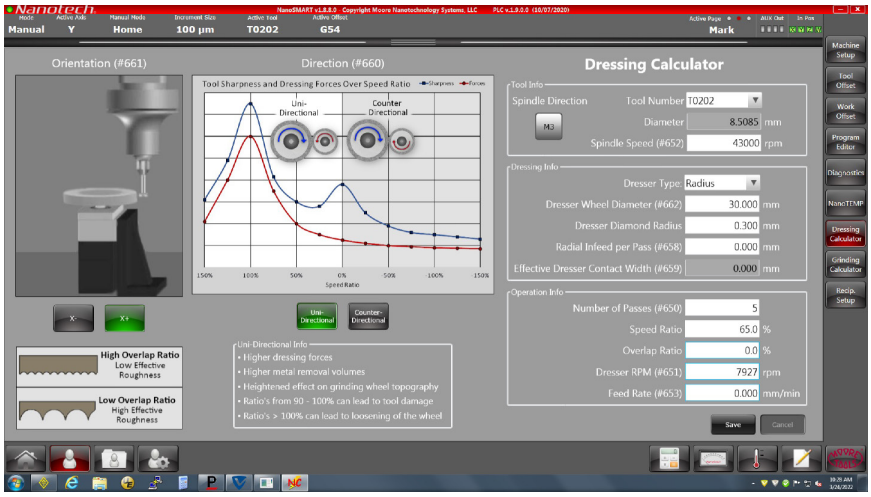
NanoTemp®

- Continuous monitoring and recording of machine and environment temperature



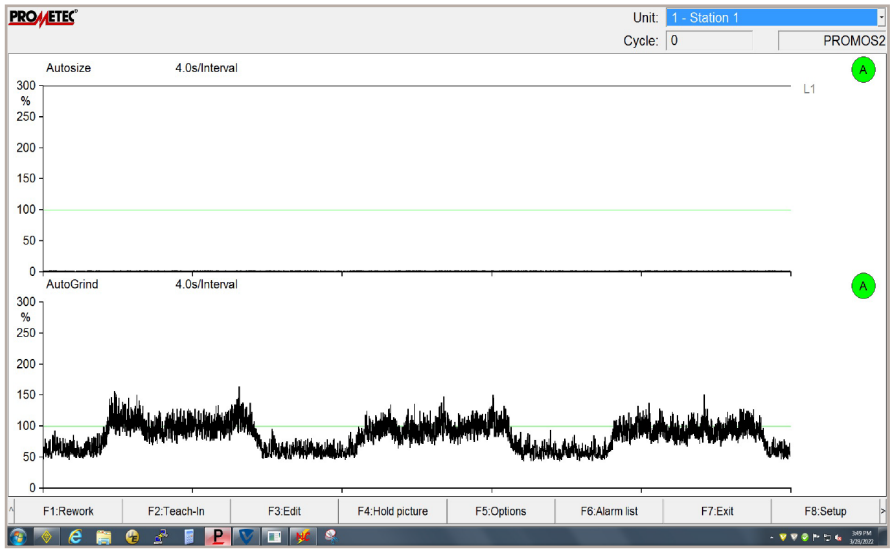
Interactive Dressing Cycle Screen

- Optimize dressing routines based on specific grinding tool materials



Real-time Dressing Quality Signal

- Modifying dressing process based on acoustic feedback



Nanotech M600 – Machine Specification

Mechanical

Ultra-precision four axis jig grinding machining center	X, Y, Z, W
Machine base	Single monolithic polymer cast granite
Slide technology	Fully constrained oil hydrostatic
Slide drive (X, Y, Z Axis)	Dual iron-less linear motors
Slide drive Z Axis)	Precision ball screw
Spindle	60,000 rpm, 5 kW continues power
Spindle/Tool interface	HSK-E25

Capacity

Travel X axis	1,000 mm
Travel Y axis	400 mm
Travel Z axis	250 mm
Travel W axis	90 mm
Reciprocation stroke (W/Z motion)	0.1 – 65 mm
Distance from table surface to spindle gauge-line	150 – 400 mm
Table size	600 mm x 400 mm
Work envelope	600 mm x 400 mm x 250 mm
Maximum load capacity	250 kg
Table surface configuration	T-Slot – 10–H2 & M8 Tapped Holes

Feeds

Traverse speed: X, Y axis	0 – 6,000 mm/min
Traverse speed: Z axis	4,500 mm/min
Traverse speed: W axis	16,000 mm/min
Reciprocation stroke rate	200 cycles/min

CNC

Control	Delta-Tau 1 GHz Power PMAC
Data storage	5 GB Solid State Drive
Interface	DVD RW Drive / 2 x USB Ports /10/100/1000 Ethernet Connection
Block look-ahead	40,000 blocks
Programming resolution	0.000001 mm
HMI	NanoSMART gesture based touch screen interface

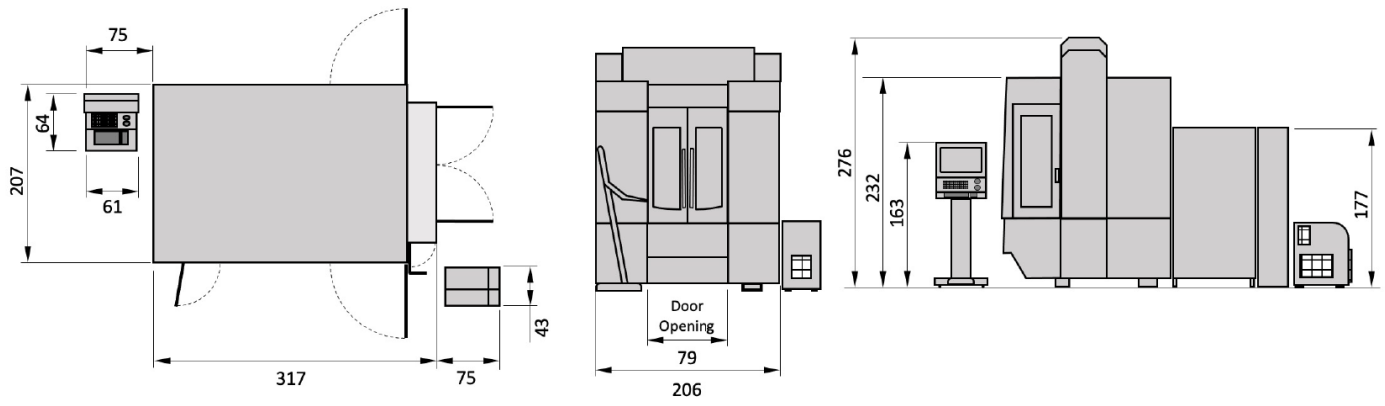
Nanotech M600 – Machine Specification

Accuracy

Bi-Directional Positional Accuracy	
X axis (Central 600 mm)	≤ 0.5 µm
Y axis (Full travel)	≤ 0.5 µm
Z axis (Full travel)	≤ 0.5 µm
Geometry	
Squareness X-Y	≤ 0.5 Arcsec
Squareness X-Z	≤ 0.5 Arcsec
Squareness Y-Z	≤ 0.5 Arcsec
Spindle parallelism, to Z-X & Z-Y plane	≤ 0.5 Arcsec

Optional Accessories

- Automatic tool changer (30 Tools)
- Grinding wheel metrology (AutoSize)
- Bi-directional 12,000 rpm dressing spindle w. balanced dressing wheel
- Temperature controlled flood coolant system
- Mist extraction system
- On machine inspection probing (Renishaw OMP400 touch probe)
- NanoTemp temperature monitoring and recording system
- Electronic gauge amplifier



Small machine footprint:
Required Floor Space = 9.5 m²

Our Global Network

Moore Tool and Nanotech Locations

Distributorship / Agency Locations

www.nanotechsys.com

Moore Nanotechnology Systems, LLC
230 Old Homestead Hwy.
Swanzey, NH 03446
USA

Phone: +1 603 352 3030
Fax: +1 603 352 3363

sales@nanotechsys.com

Global Process Development and Training Center

6510 Northpark Blvd.
Charlotte, NC 28216

www.mooretool.com

Moore Tool Company, Inc.
599 Hollister Ave.
Bridgeport, CT 06607
USA

Phone: +1 203 366 3224
Fax: +1 203 3672 0418

sales@mooretool.com

For more information, visit our websites.

Markets Served