

TURNING

QUEST® Shape-Compliant
Hydraulic Chuck System



TURNING MILLING GRINDING WORKHOLDING
www.hardinge.com

 **HARDINGE**
EXPECT MORE™

Hardinge® has the machine and workholding combination for maintaining high-accuracy roundness of thin-wall, thru-hardened parts...



The machine tool.

Hardinge® QUEST® Multi-tasking CNC Lathes



The gripping solution.

Hardinge Shape-Compliant Hydraulic Chuck

The Total Package... The QUEST® Shape Compliant Chuck System.

Rugged, versatile, high-speed, high production, multi-tasking machine with hard turning and Super-Precision® capability – equipped for thin-wall hardened and out-of-round part finishing.

Introducing the Super-Precision® Shape-Compliant Hydraulic Chuck by Hardinge – the answer to maintaining high-accuracy roundness on thin-wall hardened and out-of-round parts. The patent-pending design grips the part at multiple locations with equal force to maintain the part's original shape for optimum finished roundness.

Tests indicate a 9- to 11-times improvement when comparing the average final machined roundness to the beginning workpiece roundness. OD and ID gripping models available.

Machine	Spindle Nose	OD Grip Range	ID Grip Range	Length	Diameter
QUEST 8/51, 10/65	A2-6	.5" to 6" 12.7 to 152.4mm	.5" to 5" 12.7 to 127mm	4.314" 109.57mm	6.210" 157.73mm
QUEST 6/42	A2-5	.5" to 5" 12.7 to 127mm	.5" to 4" 12.7 to 101.6mm	4.000" 101.6mm	5.000" 127mm
QUEST GT27SP	A2-4	.5" to 3" 12.7 to 76.2mm	.5" to 2.5" 12.7 to 63.5mm	4.000" 101.6mm	4.000" 101.6mm

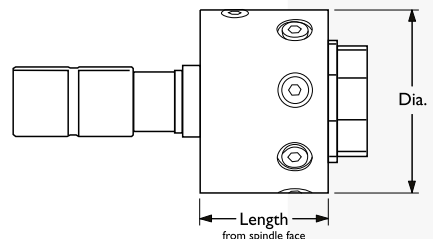
Models available for other Hardinge machines – on application.

The Hardinge Shape-Compliant Chuck is designed for finish turning on a Hardinge QUEST® Multi-tasking CNC Lathe or a QUEST Super-Precision Gang-tool CNC Lathe.

The chuck is ideal for turning thin-wall hardened or soft parts of a fragile nature that require high accuracy in final roundness such as bearing races. Generally a workpiece not over a 3" (76mm) length is appropriate. Best results can be achieved when the workpiece is held to a size variation and roundness combination of under .006" (152.4µm).

Internal (ID) or external (OD) gripping solutions can be provided. The chuck body can accommodate various attachable jaws to allow a range of workpiece sizes. Best results can be achieved by turning/grinding the newly (re)installed jaws in place.

Hardinge Shape-Compliant Chucks are manufactured to order by application according to applied force levels, operational speed range, grip points, jaw requirements, workpiece condition, accuracy levels and robot loading requirements.



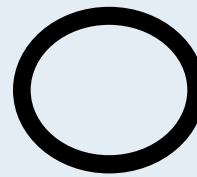
BEARING RACE CASE STUDY



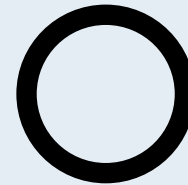
Part: Bearing Race
60-64 Rockwell thru-hardened

Problem: Cannot achieve required finished roundness using conventional workholding methods

Unacceptable Test Results: Using Conventional Step Chuck with lowest possible gripping pressure setting on the machine. 1.35-times improved roundness from beginning free state — part is "rounding up" when gripped.

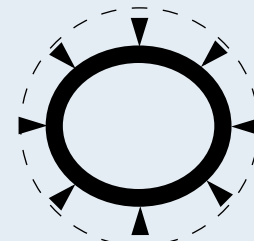


Out-of-Round Free State



Round Up during Conventional Grip

Solution: Hard bore on Hardinge QUEST® CNC Lathe with a Shape-Compliant Hydraulic Chuck made by Hardinge. Part maintains original out-of-round state during the cutting process.



Multiple OD Gripping Locations with Independent Travels

Excellent Test Results:

10.9-times improved roundness from beginning free state.

	ID	OD
Roundness before machining:	.0011" (27.94 μm)	.0013" (33.02 μm)
Roundness after machining:	.000084" (2.13 μm)	.000070" (1.77 μm)
ID Finish: micro-inch (μm)	8.8 (.223 μm)	8.3 (.210 μm)
ID-to-OD Concentricity's:	.000033" (.83 μm)	

* Speeds were maintained at 400 SFM (940 rpm) using CBN tooling and processed with two passes each having a DOC of .003" (76.2 μm). IDs were measured beneath the gripping surface both before and after machining in the free state.

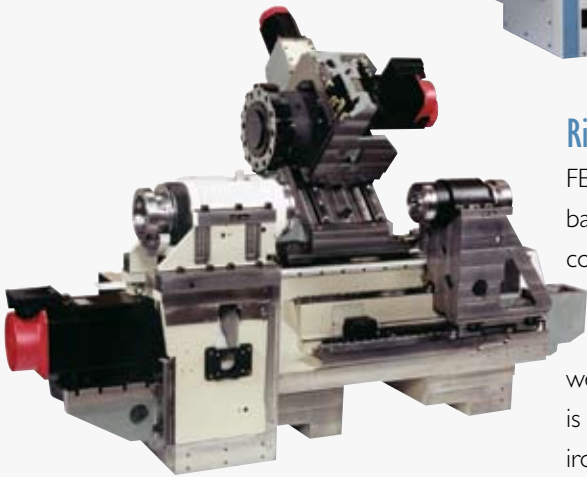
A typical application is to process a hardened part that has undergone heat treat having a distorted inside diameter (ID) and/or outside diameter (OD). Conventional workholding techniques tend to overpower the workpiece and cause it to become round when gripping. When released, the workpiece springs back to its original out-of-round shape resulting in poor roundness measurements.

The Hardinge **Shape-Compliant Hydraulic Chuck** grips the part "as is" and enables machining of the OD or ID without the part distorting after being released.

- Multiple gripping locations at the radial position of the out-of-round part with the same force on each leaf
- Independent travel distance for each gripping location eliminates distortion
- Automatic centering of the part
- Lower and adjustable gripping forces
- High levels of damping
- Eliminates need for slower, finish grinding
- Rapid actuation

QUEST® Multi-Tasking and Hard Turning CNC Lathes

QUEST 10/65
QUEST 8/51
QUEST 6/42



Rigid machine base

FEA (finite element analysis) techniques were used to design a rigid, structurally balanced machine. Our rugged cast iron bases with HARCRETE® polymer composite (synthetic granite) reinforcement offer added stiffness with superior damping characteristics of vibration to the workpiece for finer surface finishes and increased tool life. HARCRETE is strategically located in the base cavities as well as directly above the feet to assure maximum rigidity. What you end up with is a superior machine structure compared to machines made solely with a cast iron base.



Powerful and rigid spindles

Our powerful main spindle drive provides all the power and torque you'll need to do heavy roughing operations and fine surface finishing. Hardinge-built spindles are hardened & ground and of one-piece construction. They are mounted in a high-strength ductile cast iron headstock housing and mounted to the HARCRETE-reinforced cast iron base for optimum stiffness, rigidity and damping. The unique spindle design allows the preferred method of cutting operations close to the spindle bearings, resulting in superior performance and rigidity.



Heavy-duty linear guideways, ball screws and axis drives

Wide-spaced, oversized linear guideways provide optimum stiffness with less friction, less heat and less thermal growth for faster traverse rates, longer machine life and greater positioning accuracy. Oversized hardened and ground, double-nut ball screws are used for X and Z axis movements. Torque limiters are provided for most axes to minimize machine damage in the event of a crash—easily reset for maximum uptime.

Accuracy and precision
built from the ground up

Rigid turret, top plate and tooling systems

Our top plates allow fast setup times using simple, rigid round-shank tool holders that locate "on center" and parallel to the spindle centerline. The Hardinge-designed non-lift turret ensures rigid and accurate indexing and contaminant-free operation.

Super-Precision® Machine Models



QUEST 10/65SP
QUEST 8/51SP
QUEST 6/42SP

The Hardinge CNC lathe product line includes Super-Precision models designed to produce parts in the .0002"/5 micron or better diametric tolerance range. Customers frequently choose a Super-Precision model to provide high throughput with less frequent tool replacement and offsets.



Rigorous testing and accuracy certification

All QUEST® Super-Precision machines receive error compensation to the X and Z axes to correct positioning and offset errors at the tool tip, straightness checks (using laser measurement technology) to the X and Z axes, CMA (continuous machining accuracy) tests to verify machining accuracy, and sample checks on part diameters that must yield a total variation of less than .0002"/5 micron. Accuracy certification is supplied.

Designed for accuracy

Super-Precision CNC lathes are designed and manufactured to provide solutions for extremely close tolerances and very fine surface finishes. Heat shields and isolation blocks are built into the spindle motor for controlled thermal growth. Spindle motor and collet closer assemblies are dynamically balanced in two planes to a G-1 specification. X- and Z-axis error compensation is performed to fine tune positioning and compensate offset at the tool tip. Programmable resolution and tool offset capability is .000010"/.00010mm. 8 micro-inch part surface finish is accomplished on all Super-Precision® models.

Spindle assembly

The special-accuracy main spindles for Super-Precision machines are assembled in an environmentally-controlled spindle room to ensure consistent results. After assembly the spindles are finish ground to a TIR (taper runout) of less than 15 millionths/.38 microns on QUEST 6/42SP, 20 millionths/.5 micron on QUEST 8/51SP and 25 millionths/.63 micron on QUEST 10/65SP lathes.

Headstock cooling

The spindle cartridge and headstock casting are designed to allow radial dissipation of heat. A fan is also added to the headstock for additional cooling to ensure that ambient air draws over the thermally-symmetrical headstock frame, allowing heat to dissipate radially as compared to linearly. This design allows the spindle centerline to remain in a "fixed" location. Conventional machine spindles may migrate vertically as a result of thermal growth.

Linear glass scales

Digital glass scales are provided on the X and Z axes for continuous high machining accuracy. The closed-loop linear scale system for positioning feedback provides direct measurement of the slides, eliminating the need to compensate for ball screw thermal growth and wear over the life of the machine.

Actual results may be greater or less than those listed due to a number of factors, including but not limited to speeds, feeds, tooling, machine maintenance, coolant, material, ambient temperature (68° ±3°F) and type of machine foundation.

Hard Turning offers high precision machining results... and grinding-quality parts



Why “Hard Turn” instead of grind?

Because you will reduce your costs in many ways:

- “Soft turn” and “hard turn” on the same machine
- Smaller floor space requirement
- Lower overall investment
- Metal removal rates of 4-to-6 times greater
- Turn complex contours
- Multiple operations in a single setup
- Low micro finishes
- Easier configuration changes
- Lower cost tooling inventory
- Higher metal removal rates
- Easier waste management (chips vs. “swarf”)

Commonly processed “Hard Turned” materials include steel alloys, such as bearing steels, hot and cold-work tool steels, high-speed steels, die steels, case-hardened steels and unique hard materials and aircraft types that fall within the hardness range of 45 to 68 Rc. Go to www.hardinge.com/hardturn for in-depth information on “hardinge turning”.

QUEST machines equipped with a HydroGlide® linear guideway system can provide significantly improved machining results, especially when performing “Hard Turning” operations

HydroGlide® linear guideway system

The patented HydroGlide linear guideway system developed by Hardinge is unlike conventional box ways, ball linear guides or roller linear guides. The HydroGlide system features no metal-to-metal contact—the guide trucks move on a thin cushion of hydraulic fluid under high pressure. The end result... ZERO guideway wear and the following significant performance benefits over other “way” systems:

- Superior vibration damping
- Improved “hard turning” capabilities
- Crash protection
- Significantly longer tool life—as much as 36% longer insert life on hardened workpieces with interrupted cuts
- Longer machine life
- Increased axis speeds
- Improved part roundness
- Improved part surface finish—from 5.3 to 3.0 micro-inch (43% improvement)



Parts with interrupted cuts easily produced on QUEST lathes

Request Technical Information Bulletin TIB-228 for complete information.

SPC and “Hard Turning”

Hardinge is the recognized market leader in providing “hard turning” machines, workholding and process support. SPC (statistical process control) for size repeatability, surface finish quality and thermal stability is a hallmark for QUEST® lathes.

All Super-Precision® machines are built and tested to ensure “in-tolerance” parts and surface finishes with predictable tool wear. Inherent design features for SPC control and “hard turning” capabilities include:

- HARCRETE®-reinforced cast iron base and its superior vibration damping
- Spindle tooling mounted directly in the spindle, providing minimum overhang and bearing loading
- Heavy-duty linear guideway systems
- Integrated heat management system—optimized location of ancillary equipment to minimize thermal effects on cutting performance

QUEST® Multi-Tasking and Hard Turning CNC Lathes

A wide range of optional features to enhance your throughput capability



Hardinge manufactures a full line of **Spindle Tooling** for the most demanding workholding applications.

Workholding options include:

Collets

Quick-change Collet Systems

Sure-Grip® Expanding Collets

Step Chucks

Power Jaw Chucks

Shape Compliant Chucks



Multi-tasking is what QUEST CNC lathes are all about. We offer packaged versions with popular multi-tasking features or you can configure your machine with the specific features you want.

Hardinge's unique jaw chuck / collet-ready spindle design requires no spindle adapter to change from through-spindle collet bar work to chucking work using step chucks or jaw chucks.

Live Tooling is available on VDI top plates to work on the main spindle or sub-spindle.

A **High-speed wraparound Main Spindle** is available for the QUEST 8/5 I, 8/5 ISP, 10/65 and 10/65SP models.

An **A2-5 Sub-spindle** is available in a belted or wraparound configuration.

A **Polygon Turning** option in conjunction with the live tooling option allows square, hexagon or other polygon shapes to be cut on the outside diameter of the workpiece on the main spindle or sub-spindle in a fraction of the time associated with traditional live tooling cuts.

Y-Axis is available for performing thread milling and complex off-center milling and drilling operations on the main or sub-spindle.

C-Axis Contouring is available on both the main spindle and sub-spindle and will provide positioning in increments of .001 degree.

HydroGlide® Hydrostatic Linear Guideways are available for significantly improved machining results and hard turning applications.

Additional Options include:

Part Present Sensor (Sub-spindle)

Thru-door Parts Catcher

Basket-type Parts Catcher

Conveyor-type Catcher

Sub-spindle Parts Catcher

Through Sub-spindle Parts Catcher

PC Front-end Control

Automatic Tool Touch Probe

Part Probe

Air Blast System (Main Spindle)

1,000 psi High-Pressure Coolant

Thru-spindle Coolant

Collet Closer Foot Switch

Chip Conveyor

Power Transformers

3-Position Stack Light

Manual VDI Tool Presetter System



Over the past 10 years Hardinge steadily diversified both its product offerings and operations. Today, the company has grown into a globally diversified player with manufacturing operations in the U.S., Switzerland, China and Taiwan. In addition to designing and building turning centers and collets, Hardinge is a world leader in grinding solutions with the addition of the Kellenberger, Hauser, Tripet and Tschudin brands to the Hardinge family. The company also manufactures Bridgeport machining centers and other industrial products for a wide range of material cutting, turnkey automation and workholding needs.

Expect more from your Hardinge products. Choose Hardinge precision and reliability for increased productivity and value!

Call us today, we've got your answer.

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