TECHNICAL INFORMATION

For the

Hardinge Quest GT & CHNC

SUPER-PRECISION®

CNC Horizontal Turning Centers

Guard doors may be shown open for clarity – Specifications are subject to change without notice
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Section 1

MACHINE CONFIGURATION
1 Machine Configuration

1-1 General

The Quest GT 27, Quest GT27BB, Quest CHNC 27 and CHNC 42 (SUPER-PRECISION®) CNC turning centers are designed for accuracy, speed and productivity. They are built to provide years of dependable machining on parts requiring consistent tolerances and fine surface finishes. An extremely rigid Polymer Composite base, high precision linear guideways and ballscrews for axis motion, the modular construction of major components make the Quest GT 27 and Quest CHNC 27/42 machines best in class and stand above all competitive turning centers worldwide.

Quest series horizontal turning centers feature:

- 1 year warranty is offered on the machine
- 2 year warranty is offered on the control

Higher end features have been designed into the Quest series machines, while streamlining overall cost to provide a very cost competitive machine for the higher end market. Some of the features which make the Quest series machines best in class are:

- A2-4” 5C and A2-5” 16C Collet ready spindles are available for reduced spindle tooling changeover times
- High resolution control and closed loop axis feedback systems for increased overall machine accuracy
- Fast rapid travels and indexing times
- Extended tool life due to overall machine rigidity
- Thru-Spindle coolant, air blast and high pressure (125PSI) coolant systems are available to allow higher production rates
1-2 Machine Model Configurations
The Quest Series of machines are offered in four models.

- Quest GT 27  Gang Tool  A2-4” 5C Spindle
- Quest GT 27BB  Gang Tool  A2-5” 16C Spindle
- Quest CHNC 27  Turret  A2-4” 5C Spindle
- Quest CHNC 42  Turret  A2-5” 16C Spindle

1-3 Standard Machine Features

- Fully enclosed hardened and precision ground, pre-loaded ball bearing ANSI A2-4” spindle, featuring a 1-1/16” (27mm) 5C through hole collet capacity ready system. (Optional big bore A2-5” 16C with 1 5/8” or 42mm through hole capacity) Maximum gripping capacity for 5C step chucks is 6” (152.4mm). A 4” (101mm) jaw chuck is available for A2-4” systems and a 6” (152mm) jaw chuck is available for A2-5” systems.

- A low pressure air purge system and labyrinth seal is incorporated to keep coolant and chip contamination out of the spindle bearings.

- Cast iron headstock housing

- AC digital drive and motor delivers 7.5Hp (5.5KW) continuous and 10Hp (7.5KW) intermittent. Speeds are fully programmable in 1 RPM increments from 80 to 8,000 rpm on the 27mm machines and from 50 to 5,000 rpm on the 42mm version machines.

- A pneumatic caliper style disk brake is located on the rear of the spindle to provide maximum clamping force and braking.

- Pneumatic collet closer design permits gripping of thin-walled and small delicate parts.
• The super-stable Harcrete base is 10% stiffer and more rigid than cast iron for improved dynamic stability at the spindle and 30% or more increased tool life allows high precision tolerances and fine surface finishes while reducing tool cost.

• Interchangeable gang tool style top plate to reduce setup time on the Quest GT series and interchangeable 4 or 8 station top plates on the Quest CHNC series.

• Linear guideways allow less friction, less heat and less thermal growth when compared to conventional slide systems.

• Absolute encoders are utilized on all axes to eliminate reference return procedures on power up.

• Grease lubrication is featured on all sliding elements and ball screws to minimize coolant contamination.

• Machine is completely enclosed by reinforced guarding. Main guard and collet access doors are auto cycle interlocked.

• Coolant system pump is rated at 32gpm flow rating.

• 20 gallon capacity sump. Large diameter casters permit the tank to be conveniently moved for cleaning.

• Hardinge Fanuc 32i series control system.

• Complete machine/CNC unit documentation package, including manuals, parts list and wiring diagram.
1-4 Base Construction

The base is a one-piece construction with cast iron bed grouted directly into the Hardinge Harcrete base. The headstock riser block is bolted onto the cast iron bed. The carriage is mounted to the bed through linear guides, thus providing a unitized bed construction for maximum utilization of thermal rigidity and structural stability. The way surfaces for mounting of the linear guideway modules are ground and the headstock riser block is scraped at assembly insuring optimum accuracy. The base sets directly on the floor with four antivibration pads between the base and floor. This provides a solid four point suspension system.

1-4-1 Polymer Composite Base

The base was designed using FEA (finite element analysis) techniques to provide superior machining performance. Polymer composite (synthetic granite) provides higher degree of dampening and stiffness over cast iron. This design also provides isolation from external vibrations resulting in better part repeatability and surface finish. The super-stable Harcrete base is 10% stiffer and more rigid than cast iron for improved dynamic stability at the spindle and 30% or more increased tool life allows high precision tolerances and fine surface finishes while reducing tool cost. The polymer composite base with grouted in bed included weighs in at 1,800 lbs (818kg).
1-5 Sheet Metal Enclosure

The machine enclosure is fabricated from 14-gage [.075” (1.9mm) thick] sheet metal. Access to the machine’s interior is conveniently accomplished through removable covers and hinged access doors. The main guard door permits adequate visibility of the machine’s interior and slides open and closed with finger pressure. The main guard door and collet closer doors are auto cycle interlocked. The rear and right-end doors key-locked and are intended for service access only.
1-6 Ease of Maintenance

Maintenance was a major criteria while designing the Quest Series machines. So as to provide our customers with minimal downtime in the event service is required, monitoring sensors have been built into the machine’s pneumatic, lubrication and control systems for ease in troubleshooting a problem. Circuit breakers have replaced fuses, providing instant visual confirmation of the circuit status. I/O (input/output) modules feature LEDs (Light Emitting Diodes) for verification of switch condition.
1-7 World Safety Standard

Operator safety is a top priority of Hardinge that also begins in the design stages of the machine tool and Hardinge has taken a proactive stance to be a world leader in this area. The Quest Series of machines incorporate the latest in the Hardinge World Safety Standards, which includes Dual Check Safety (DCS). DCS, in short, is a FANUC System which monitors the machines safety devices. If a safety device fails, or has a fault, DCS will shut the machine down to prevent injuries to the operator. The DCS system requires main operator guard doors ne verified upon power up to ensure they are working correctly, it also disallows operation of such things such as spindle rotation and turret indexing while the main guard door is open. Additionally once any operator accessible door is opened the machine is placed in an E-Stop condition to ensure safety of any persons working within the machine enclosure.

The noise level specification is 80 decibels.

LATEST US AND CE SAFETY STANDARDS
• Directives: 2006/42/EC (Machinery Directive)
  2004/108/EC (EMC Directive)
  2006/95/EC (Low Voltage Directive)
• ISO 23125:2010 (Machine tools -Safety –Turning)
• ANSI B11.22–2002
• NFPA 79:2007
• CSA: NA
• UL: Would need to be reviewed by UL inspector. UL was not part of the design criteria.
Section 2

MAIN SPINDLE & HEADSTOCK ASSEMBLY
2 Main Spindle Configurations

2-1 Spindle Configurations

The A2-4” 5C (27mm) spindle permits bar work up to 1-1/16” (27mm) in diameter, chucking work up to 6” (152.4mm) in diameter with step chucks, and chucking work up to 4” (101mm) in diameter with Thru-Hole power jaw chuck.

The A2-5” 16C (42mm) spindle permits bar work up to 1-5/8” (42mm) in diameter, chucking work up to 6” (152mm) in diameter with step chucks, and chucking work up to 6” (152mm) in diameter with Thru-Hole power jaw chuck. Maximum hang weight on the spindle is 75lbs (34Kg).

The spindle is hardened and ground and of one-piece construction. It is mounted in a solid, cast iron headstock housing and bolted to the headstock riser block. The riser block is bolted to a cast iron insert cast into the Harcrete base for maximum rigidity. The housing is heavily ribbed to minimize heat buildup and protect the spindle bearings from overheating. There is an opening in the base and the riser block that allows a cooling fan to maintain a constant temperature for better size control.
2-1-1  Labyrinth Seal and Air Purge

A labyrinth seal system and low-pressure air system between the labyrinth seals and bearings keep coolant out of the bearings. The Thru-Spindle Coolant Option and Optional Air Blast System are available to help minimize chip build-up.

2-1-2  Spindle Centerline Height and Reach

The main spindle centerline height is 42.25” (1073mm) from the floor and the reach is 23” (584mm) from the edge of the main guard door. This ideal height provides operator convenience when loading and unloading workpieces.
2-1-3 Bearing Configuration

There are four angular contact ball bearings used in the spindle for optimum smoothness and machining accuracy. Two bearings are located at the front and two at the rear of the spindle. The 15 degree, initial contact angle of the bearing is designed to operate at low temperatures within a wide range of speeds and operating loads. A high degree of rigidity in both axial and radial directions is featured and preloading of the bearings minimizes end play. Bearing classification is ABEC-7. Maximum spindle runout will not exceed .000015” (.00038mm) on 27mm versions and .000025” (.00063mm) on 42mm versions. Maximum allowable weight on the spindle is 75 lb (34 kg), including workholding device(s).

Bearing Sizes are as follows:
A2-4” 5C (27mm) Spindles – 70mm ID x 110mm OD x 20mm Wide
A2-4” 16C (42mm) Spindles – 70mm ID x 110mm OD x 20mm Wide
2-1-4 Spindle Nose Extension

The spindle nose ring is required for mounting chucks. The ring may be removed when using collets and allows for additional tool clearance. The extended spindle nose configuration allows for maximum tool clearance while working on small parts. The spindle nose extends 1-11/16” (42.86mm) from the spindle shoulder. Thus collet work pieces can be very small.
2-2  AC Digital Spindle Drive and Motor

The AC digital spindle drive and motor are more accurate and responsive than analog spindle drives and motors. The motor is also more reliable and requires minimal maintenance, since it is fan cooled, brushless, sealed and lubricated. Power is transmitted to the spindle via a single multi-section vee-belt, which minimizes vibration transfer as compared to a geared system.

The Fanuc αi6/10000 spindle drive and motor offer spindle speed range of 80 to 8,000 rpm for 5C (27mm) equipped machines and 50 to 5,000 rpm for 16C (42mm) equipped machines, both models have speeds fully programmable in 1 rpm increments. Maximum continuous torque rating of 25.8ft\(\text{lb}\) (35Nm) @ 7.5 Hp (5.5Kw) and develops a maximum 30 minute torque rating of 35.4ft\(\text{lb}\) (48Nm) @ 10 Hp (7.5Kw). Torque is constant at base speed of 1500 rpm.
2-2-1 Spindle Power and Torque Curves

Spindle Horsepower Curve

Spindle Torque Curve

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2-2-2 Spindle Compartment Fan

A cold air duct system is used to draw air from the floor level via an intake fan and then pass this air around the spindle housing to help maintain ambient temperature. This air is then vented through the top of the machine enclosure via an exhaust fan.
2-3  Spindle Encoder

The spindle encoder is timing belt driven from the spindle with a 1:1 ratio and is used for spindle feedback in threading and orientation.

2-4  Constant Surface Speed

The constant surface speed programming feature eliminates the need to program spindle speed changes for varying part diameters, resulting in uniform, close tolerance machining and fine surface finishing. The CSS feature allows for constant chip load, permitting greater tool life.
2-5  Spindle Brake

The pneumatically-operated twin spindle disc brake is located directly on the outer-end of the main spindle, providing a more positive braking method compared to brakes located on the motor.
2-6  Pneumatic Collet Closer

The pneumatic collet closer is designed to provide optimum gripping force over a wide range of workpiece configurations. Manual adjustment of the closer chucking pressure is accomplished by turning a valve located on the front left side of the operator panel. Pressure adjustment ranges from 20 psi min. to 90 psi max. In the event of power failure, a pneumatic fail safe condition automatically puts the machine into an ‘E-stop’ condition, while allowing the pneumatic system to continue operating. The collet closer offers 1/2” stroke.
2-6-1 Draw Bar Force Charts

### Collet Closer Draw Bar Force (5C Spindle)

<table>
<thead>
<tr>
<th>Gauge Pressure (psi)</th>
<th>Force (lbs)</th>
<th>Gauge Pressure (bar)</th>
<th>Force (daN)</th>
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### Collet Closer Draw Bar Force (16C Spindle)

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<th>Force (lbs)</th>
<th>Gauge Pressure (bar)</th>
<th>Force (daN)</th>
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2-7 Spindle Tooling

A complete line of 5C and 16C spindle tooling is available from Hardinge. This includes collets in round, square, hexagon – smooth and serrated – as well as specialty sizes and shapes. Also available are Sure Grip jaw chucks, step chucks, dead length collet, force limiting step chucks and Sure Grip expanding collets to meet all you spindle tooling requirements. Select the appropriate hyper-link below to view the available spindle tooling for your configuration machine.

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Section 3

GT AND CHNC INTERCHANGEABLE TOP PLATES

Guard doors may be shown open for clarity – Specifications are subject to change without notice
3 GT and CHNC Interchangeable Top Plates

3-1 GT Interchangeable Top Plates

Interchangeable top plates can be pre-set with tooling for a range of jobs and then stored away, along with the part program, for future job runs. The top plate features a dovetail configuration which provides maximum structural rigidity and clamping of tools during machining operations. All tool holders also feature a dovetail clamping configuration which is far superior to conventional T-bolt clamping methods. Dovetail clamping, along with a non-indexing top plate, provides a completely rigid machine structure, allowing fine surface finishing and extremely close tolerance machining. Round and square shank tool holders are easily mounted on the top plate (dovetail in line) in the desired position. Each tool holder is provided with a gib and socket-head screw clamping arrangement, allowing quick tool holder change and reduced set-up times.

The following are a few of the advantages of the Hardinge top plate:

- Quick top Plate Change-remove and replace top plate in less than 1 minute.
- Top plate interchange repeatability within .0002”.
- Dovetail mounted tooling-provides the most rigid tooling available.
- Shorter set-up times with replaceable top plate.
- Faster cycle times without the need for indexing.
3-1-1  A2-4” 5C Top Plate Travel Specifications and Work Envelope

Figure A1.1 - Tooling Top Plate Travel Specifications (Machines Equipped with Standard 5C Spindle)

NOTES:
1. All dimensions are shown in inches [millimeters].
2. All measurements for X are diameter values from the spindle centerline.
3. All measurements for Z are from the face of the spindle (Z0).
4. Full travel on the X axis is 23.93600 inches [607.9744 millimeters], measured on the diameter.
5. Full travel on the Z axis is 11.06295 inches [280.9989 millimeters].

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3-1-2 A2-5” 16C Top Plate Travel Specifications and Work Envelope

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3-1-3 Swing Over Way Covers

Note: English [Metric] Dimensions
3-1-4 Swing Over Top Plate

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3-1-5 GT Top Plate Tooling

The following tooling may be used on the Quest GT Machine using the same top plate:

- 1/2” square shank
- 3/8” square shank
- 12mm square shank
- 3/4” round shank
- 5/8” round shank
- 16mm round shank
- 20mm round shank

There is a selection of tool holders available for each of the shank sizes listed. However, the unique modular base of the square shank and cut-off tool holders allows for a different shank-size tool to be mounted in any holder, simply by using the applicable wedges and shim. This feature helps the customer reduce tooling costs. For example, the double square shank adjustable tool holder assembly for 1/2”, 12mm, and 3/8” square tooling use the same body. Additional wedges and shims may used to bring the tool to proper center height. Additionally, the square shank tool holders may be used on the front or rear of the spindle centerline, simply by inverting the shim. This allows the customer to eliminate the changing of spindle direction. An exclusive feature of the Quest GT Machine is that the tools can be removed from any location on the top plate without having to remove any other tool.
Guard doors may be shown open for clarity – Specifications are subject to change without notice
3-2  CHNC Turret Index and Interchangeable Top Plates

The CHNC utilizes a new and improved turret top plate indexing system as compared to the previous versions. The top plate is pneumatically raised and then bi-directionally indexed utilizing a Fanuc βiS4/4000 .75Kw ac digital, brushless servo motor via a worm gear and then located and clamped on a 4 position key plate for accuracy. Indexing repeatability is .000010” (.0025mm) with a station to station indexing time of .20 seconds.
3-2  Continued

4 and 8 station interchangeable top plates can be pre-set with tooling for a range of jobs and then stored away, along with the part program, for future job runs. The top plate features T-slot design for clamping of tools during machining operations and provides a completely rigid machine structure, allowing fine surface finishing and extremely close tolerance machining. Round and square shank tool holders are easily mounted on the top plate in the desired position. All existing CHNC tooling and top plates from previous version machines are completely interchangeable. Tool holders and top plates are available for 3/8” and 1/2” square shank tooling.

The following are a few of the advantages of the Hardinge top plate:

- Quick top Plate Change-remove and replace top plate in less than 1 minute.
- Top plate interchange repeatability within .0002”.
- Shorter set-up times with replaceable top plate.
3-2-1 A2-4” 5C Top Plate Travel Specifications

NOTES:
1. All dimensions are shown in inches [millimeters].
2. All measurements for X are diameter values from the spindle centerline.
3. All measurements for Z are from the face of the spindle (Z0).
4. Full travel on the X axis is 25.52500 inches [648.3350 millimeters], measured on the diameter.
5. Full travel on the Z axis is 11.55000 inches [293.3700 millimeters].

Figure 9 - Turret Top Plate Travel Specifications: QUEST® CHNC® Lathe Equipped with 5C (27 Millimeter) Spindle

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3-2-2  A2-5” 16C Top Plate Travel Specifications
3-2-3 Top Plate Dimensions

Figure A1.3 - Turret Top Plate Dimensions
(Standard Eight Station Turret Top Plate)

NOTE:
All dimensions are shown in inches [millimeters].

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3-3  Coolant System Standard

The coolant system consists of a coolant/chip tank, pump and various coolant outlet provisions based on the machine configuration. Either water or oil based coolants may be used. Optional hi-pressure systems are also available and are outlined in the Optional Equipment Section number 6.

3-3-1  Coolant Pump

The coolant pump is a Fuji Electric 1/2Hp system which carries a 32gpm (121lpm) rating and supplies coolant to all coolant output areas. Coolant pressure is dependent upon the number of coolant ports in operation. A quick disconnect coupling is used to connect the removable coolant/chip tank to the pump.
3-3-2 Headwall Coolant (Standard GT and CHNC Models)

Two fully-adjustable coolant nozzles located on the headwall above the spindle properly direct coolant to the cutting area. The ball and socket segments are easily snapped in or out for exact length adjustment. A check valve is used to eliminate back flow in the lines which reduces coolant lag time to the cutting area when the coolant is commanded to turn on.

3-3-3 Cross Slide Coolant Nozzles (Standard on GT models only)

Four fully adjustable coolant nozzles are located on the cross slide for precise directional flow of coolant to the machining area. This will also allow for lines to be plumbed to the back of the tool for a through the tool coolant flow.
3-3-4 Coolant Flush Feature (*Standard on GT and CHNC Models*)

To eliminate chip buildup on the back tray in the cutting area, a coolant flush is used. This feature is located at the back of the work cutting area.

On/off valve for flush

Flush Plate

Top Plate feed
3-3-5 Coolant Tank

A quick-disconnect coupling allows the coolant tank can be disconnected from the machine for cleaning. Large 3” (76mm) casters allow the coolant tank to be conveniently moved for proper chip disposal and cleaning. Coolant tank capacity is 20 U.S. gal. (76 liters).

Standard tank

Tank for optional chip conveyor (longer)
3-4 Tool Storage Compartment

Conveniently located storage compartment with a rubber lined shelf for tools parts or other miscellaneous items.
Section 4

CARRIAGE & CROSS SLIDE

Guard doors may be shown open for clarity – Specifications are subject to change without notice
4 Carriage and Cross Slide

4-1 Heavy Duty Linear Guideways

All X and Z-axis movements of the slides are accomplished on heavy-duty linear guideways. This approach to axial movement produces less friction, less heat, and less machine growth compared to friction slides. The result is faster traverse rates for reduced cycle times, less machine wear, longer machine life, and greater positioning for overall machining consistency. Movement is accomplished with ball screws on the X and Z-axis.

4-1-1 Linear Way Module Structure and Features

The linear modules consist of slide members (guide trucks) and linear rails to provide large load rating, stable accuracy, high rigidity and low friction. The spacing between the Z-axis rails provides optimum stiffness for the overall machine design. Lubrication is provided to the rear of the trucks with grease by means of a conveniently located Zerk™ fitting block. THK model SHS25L size 25 caged ball units are utilized on X and Z-axis.
4-1-2 Guidelines for Bearing Selection

Ball Groove Design

The linear recirculating ball bearing and guideway assemblies (X, and Z) are preloaded to provide stiff and rigid system. Their low friction characteristics allow very high accelerations and velocities. The illustration below shows that the upper and lower ball rows have a contact angle of 45 degree and carry comprehensive, tensile and lateral loads.
4-2 X- and Z-axis Ball Screws

The 1” (25mm) diameter ball screws feature a preloaded double ball nut arrangement, the X-axis ball screw is a 6mm pitch and the Z-axis is 8mm pitch, both are Class C1 rated. With this arrangement, one nut takes the load in one direction and the other nut takes the load in the opposite direction. The reaction-load lines of the balls in the nuts converge toward the common center of the screw, as shown in the illustration below. Preloading is increased by increasing the thickness of the shims between the nuts. To obtain very close tolerance workpieces, super precision X- and Z-axis ball screws and linear guides are used. The positioning accuracy for the total travel in the X- and Z-axis is .0001”. The straightness for total travel X- and Z-axis is .0002”. The repeatability for positioning for both axes is .00005”. The repeatability and positioning accuracy are tested by laser per Hardinge method. The ambient temperature used is 68 degrees F, + or – 4F.

![Ball Nut Arrangement](image-url)
4-3  X- and Z-axis Drive Systems

The use of direct axis drive digital servomotors improves reliability since the need for timing belts and pulleys is eliminated. An encoder is built into each axis drive motor. This allows adjustment of the servomotor by performing a parameter change at the CRT. The Z-axis thrust is 780 lbs (3470N). Maximum traverse rate is 472 ipm (12mpm) for the X-axis and 630 ipm (16mpm) for the Z-axis for the CHNC model. Maximum traverse rate is 708 ipm (18mpm) for the X-axis and 945 ipm (24mpm) for the Z-axis for the GT model. Both models utilize a Fanuc αC4/3000i 1.34Hp (1.0Kw) motor for both x and Z-axis.
4-4 Lubrication System

Grease lubrication is provided for all ballscrews and linear guide truck bearings. Grease lubrication provides several advantages over way lube oil systems:

- No oil skimmer required
- No degradation of water-base coolants
- Environmentally Friendly-no need to dispose of contaminated oil
- Improves machine maintenance

Access panel removed to show the lubrication ports. (right side of carriage)
Section 5

Hardinge\Fanuc 32i
CNC Control System
5 Hardinge/Fanuc 32i-A Control

The control panel is custom-designed to be user friendly especially in the placement of the buttons and identifying nomenclature. The control module is fixed stationary for convenient user access. Large 10.4” color LCD display screen aids in viewing the various programming and function pages.
5-1  Fanuc 32iT CNC Control Features

General
Two Interpolating Axis
Programmable Resolution (.00001”/.0001mm)
Tool Offset Capability (.00001”/.0001mm)
Inch/Metric Data Selection by G-Code
64Kb (160 Meters) Part Program Storage
Part Program Storage**
(320, 640 or 1,280 meters total)
Data Input/Output
MDI (Manual Data Input) Operation
Reader/Punch Interface
RS-232 Software/Hardware
Flash Card (PCMCIA) Capability
Embedded Ethernet Connection

Programming Functions
Absolute/Incremental Programming
Additional Tool Offsets (64 Total)**
Additional Custom Macro Variables**
Auto Coordinate System Setting
Auto Acceleration/Deceleration
Background Editing
Canned Cycles (Drilling)
Chamfer/Corner Rounding
Constant Surface Speed Programming
Continual Thread Cutting
Coordinate System Setting (G50)
Custom Macro B
Decimal Point Programming
Diameter/Radius Programming
Direct Drawing Dimension Programming
Extended Part Program Edit (Copy/Paste)
External Workpiece Number Search
Hardinge Safe Start Format
Input of Offset Value by Programming (G10)
Interpolation (Linear/Circular)
Multiple Repetitive Canned Cycles I (Turning)
Multiple Repetitive Canned Cycles II (Pockets)
Optional **

Programming Functions (cont’d)
Program Number Search
Reference Point Return
Registered Part Programs (125 total)
Registered Part Programs (200 total)**
Rigid Tapping
Sequence Number Search
Single Block Operation
Stored Stroke Check
Thread, Synchronous Cutting
Tool Life Management
Tool Nose Radius Compensation
Variable Lead Thread Cutting

Operation
Block Delete
Dry Run
Dwell Time
Emergency Stop
Feed Hold
Feedrate Override (0 to 150%)
Incremental Jog
Jog Feed
Machine Lock
Manual Pulse Generator (MPG Handwheel)
On-Screen Spindle & Axis Load Meters
Option Stop
Rapid Traverse Override (Low 25-50-100%)
Spindle Speed & T-Code Displays on all Screens
Tool Geometry & Tool Wear Offsets (32 Pairs)

Miscellaneous
Actual cutting Speed Display
Alarm Display
C-Axis with Polar & Cylindrical Interpolation **
Clock Function

Guard doors may be shown open for clarity – Specifications are subject to change without notice
Miscellaneous Continued
English Color LCD Display with Full Keyboard
French/German, Italian or Spanish **
Ladder Diagram Display
Mechanical Run Meter
On-Screen “Help” Function for Alarms
One-Degree Spindle Orient
Program Protect
Run Time & Parts Counter
Self-Diagnosis Function
Optional **

Standard Features Include:

• Worklight
• Headwall Coolant
• Custom Macro B
• Rigid Tapping
• Run Time/Parts Counter

Optional Features Include:

• Tool Touch Probe
• Part Probe
• Parts Catcher
• Air Blast (Headwall & Cross slide)
• Thru-Spindle Coolant
• Chip Conveyor
• Auto Door
• High Pressure Coolant Pump (125 psi)
• Fanuc Automation Package
5-2 Conversational Programming (Manual Guide I)

The MGI (Manual Guide I) feature allows less-experienced programmers to easily create part programs from part drawings. Experienced programmers can also benefit from MGI by using the desired features in their part programs. Manual programming knowledge is required to utilize the MGI feature.

- A variety of menus are offered for various tool paths
- Three-D part and part blank simulation
- Tool and tool path graphics
- MGI program to NC program convertor
- Includes cut, copy and paste features
Guard doors may be shown open for clarity – Specifications are subject to change without notice
### 2. Various features to support screen operation

#### Icon menu

All menus are displayed with icon soft-keys
The soft-keys form a line, without any levels
Operator can select functions easily by intuition

(Soft-keys for turning process)

#### Application of Pop-up window

All data is displayed on one screen without screen switching
Supplemental data which cannot be displayed on one screen is displayed in an additional pop-up window

(All-in-one screen)  (Pocket Cycle)
3. Merit of ISO code programming

By adopting ISO code format, widely used in part programming.

Simple motions such as line and arc are entered by ISO code directly.
Complex motions can be entered easily in a sub-cycle machining block.

Example of entered part program (Square pocket)
O7000 (SAMPLE PROGRAM);
... M3 S1500;
G0 X50. Y125.;
G0 Z30.;
G1040 T0.5 J3. H0.2 K0.5 ... ;
G1020 H120. V50. U37. W68. ... ;
C0 Z80. ;
M5 ;
...
Guard doors may be shown open for clarity – Specifications are subject to change without notice
5. Advanced part program editor

Comfortable functions reduce editing time at the shop floor

Source FANUC America – Not all features may be available on all machine models
Guard doors may be shown open for clarity – Specifications are subject to change without notice

Source FANUC America– Not all features may be available on all machine models
Guard doors may be shown open for clarity – Specifications are subject to change without notice

Source FANUC America– Not all features may be available on all machine models
Guard doors may be shown open for clarity – Specifications are subject to change without notice
Guard doors may be shown open for clarity – Specifications are subject to change without notice
6. Cycle machining with High-ability

Programmation time can be reduced

Cycle machining menus for both of lathe machining and milling are available

- Drilling
- Bar roughing (including preformed work-piece)
- Bar finishing
- Threading
- Grooving
- (General purpose thread, metric, etc.)
- (Standard, Trapezoidal)

Cycle for Milling

- Drilling
- Surfacing
- Contour
- Pocketing
- Slot
- (Points, Line, Arc, Square, Grid)
- (Square, Circle, Track, Free form)
- (Square, Circle, Track, Free form)
- (Square, Circle, Track, Free form)
- (Square, Circle, Track, Free form)

Source FANUC America – Not all features may be available on all machine models

Guard doors may be shown open for clarity – Specifications are subject to change without notice
Guard doors may be shown open for clarity – Specifications are subject to change without notice

Source FANUC America– Not all features may be available on all machine models
Guard doors may be shown open for clarity – Specifications are subject to change without notice
7. Realistic Machining Simulation

- Realistic drawing of both turning and milling with 3-D solid models are available.
- Milling on a slanted surface can be simulated.
- Cutter mark according to tool tip shape can be expressed.
- Tool path drawing is available

Reducing time for checking machining program

Source FANUC America—Not all features may be available on all machine models
8. Tool Data Management Function

The tool database is constructed by adding Manual Guide i data to conventional CNC tool data.

- Tool Offset Data (Standard CNC tool data)
- Tool Type (General, Threading, Grooving, Drilling, Tapping, End Mill, etc.)
- Tool Setting (OD, ID, Right, Left, etc.)
- Tool Shape Data (Tool Nose Radius, Cutting Angle, Grooving width, Grooving length, Threading Angle, etc.)

- Automatically referenced for animation
- Automatically referenced when Cycle Command is executed

Source FANUC America – Not all features may be available on all machine models
5-3 Programming Feature Descriptions

**Constant Surface Speed Feature**

The constant surface speed programming feature eliminates the need to program speed changes for varying part diameters, resulting in uniform, close tolerance machining and fine surface finishing. The CSS feature allows proper speed at the cutting tip, resulting in constant chip load and permitting greater tool life.

**Hardinge Safe Start Format**

Machine cycle times can be further reduced by programming the turret to index at a safe index position in front of the part by using the Hardinge Safe Start Format. The turret does not have to return to home position to be indexed as is often the case on competitive machines.

**Rigid Tapping**

Rigid tapping capability eliminates the need for expensive tension and compression tap holders or collets and provides for faster tapping speeds and improved depth control. This is accomplished by synchronizing spindle rotation with axis motion, including acceleration and deceleration. This feature may be use with the Main, Sub or Live Tool Spindles.

**Chamfer or Corner Rounding:**

With this feature a corner can be chamfered with a simple ,R or ,C command.

**Coordinate System Setting (G50):**

The ability to set a work coordinate position through the program. Hardinge does not teach this method of programming for axis pre-setting, it is used with constant surface speed.
Custom Macro B:

Allows the programmer the ability to use and manipulate variables with custom macros for specialized machining cycles. Hardinge has programmed and stored automatic cycles which the programmer may recall and execute in his part program, reducing programming time.

Direct Drawing Dimension Programming (Blueprint Assist):

Difficult calculations of arc-to-angle and angle-to-angle can be accomplished directly from the dimensions shown on the part print. This eliminates the need to perform calculations usually required to find intersection points. It is also possible to insert chamfering and corner rounding between straight lines and arbitrary angles.

Exact Stop:

Forces the machine to move with a specific tolerance of the exact position programmed. This eliminates floating around a corner at fast axis feed rates.

Extended Part Program Edit:

Gives you the ability to copy, move, and replace parts of a program similar to cut, copy and paste functions.

Input of Offset Value via Program (G10 Command):

A G10 command can be used in the part program to change workshift, tool geometry and tool wear offset values in either absolute or incremental.

Multiple Repetitive Canned Cycles I:

Simplified programming for turning, boring, drilling, grooving and threading cycles. Useful when large amounts of stock need to be removed from the work piece.
Stored Stroke Check:

Allows setting up through parameters, a forbidden zone so as to not allow a cutting tool into this defined area. For example this could be used to set up a forbidden zone around a 3 jaw chuck.

Data Input and Output:

Uploading and downloading of data to the machine control can be done thru the PCMCIA (ATA Flash) Card slot or the RS232C plug or the Ethernet port.

DNC (Direct Numerical Control):

Allows extremely large programs to be drip fed into the control for automatic operations. This may be performed thru the PCMCIA (ATA Flash) card slot or the RS232C port. Additional external software may be required depending on the method used.

Part Program Storage:

64 Kbyte program storage is available. Extended memory available as an option.

Registered Programs (125 Total):

Up to 125 different program numbers may be stored in program directory, this is dependent on available memory and the length of the programs. Additional program numbers are available as an option.

Auto Power Off:

For use with barfeed systems to turn machine off when the barfeed signals that there is no more stock to feed.
Actual Feed Display:

The LCD screen will display the actual feed rate of an axis in ipm or mmpm (depending on machine setting). Feed rate may vary depending on where the feedrate override switch is set.

Auto Coordinate System Setting:

The axis will return to the coordinate when a “Manual Rapid Reference” function is executed.

Background Editing:

While a active part program is being executed, another part program may be called up for editing by the operator without interrupting production.

Dry Run:

With the dry run switch on, all programmed feedrates (including rapid) are set to 40 inches per minute. Machine axis motion may be stopped by pressing feed hold or turning the feed rate override switch to zero.

Edit Rapid Override (G00 button):

After a program edit has been made, the machine will go into a “slow mode” rapid override to allow the operator a chance to stop operation if start up of program was not incorrect position in the program or an edit change was incorrect.

Graphic Part and Tool Path Display (MGI):

Allows the tool path to be simulated on the LCD screen to verify for accuracy.
MDI (Manual Data Input) Operation:

MDI allows the operator to input program commands, for “one shot” operations. Program is loaded in one block at time into the control using the keyboard. This function can be used to start spindles, index the turret and etc. Program commands once executed are dumped from the control memory.

Machine Lock:

The machine movements, spindles and axis, can be “locked” while executing the program. This feature permits the operator to check the program for format errors.

Manual Pulse Generator (MPG):

The operator can control all axis motion at varying increments, using the hand wheel on the operator’s panel.

Mechanical Run Meter:

Monitors the amount of time the main disconnect switch has been in the “On” position.

On Screen Spindle and Axis Load Meters:

Allow monitoring of the axis and spindle load conditions during cutting operations. A bar graph is displayed on the LCD screen.

Program Protect:

A key switch on the control used to protect programs that are in the control’s memory from unintentional changes.

Rapid Traverse Override Switch:

A switch used to allow the operator to manually override a programmed rapid move from Low - 25% - 50% - 100%.
Rapid Reference Push Button:

Allows the operator to quickly reference an axis to its reference position.

Run Time Parts Counter:

The LCD screen will provide run time (total time the machine runs in automatic operation), cycle time (run time of a single cycle in auto mode, reset at cycle start) and parts counter (counts the number of parts machined from the start of the job, this can be set to automatically stop the machine after a predetermined number of parts have been produced).

Single Block:

With the single block push button on or the operational mode selector switch set to single block, the control will only read and execute on block of information each time the cycle start button is pressed.

Tool Offsets:

There are 99 pairs of tool offsets for each axis (depending on options), included are both geometry and wear files. Geometry offsets are used to compensate for different tool sizes and lengths. Wear offsets are used to compensate for cutting tool wear, allowing the operator to maintain parts size.

Tool Life Management:

The ability to control the time a tool is used, either by number of cycles or amount of cutting time. Once the tool life has been expended a new tool can be called automatically or the machine will generate an alarm and stop production.
Programming Feature Options:

Additional Custom Macro Variables:

This option expands the available number of macro variable locations the control can use for macro b programming. This expands the common variables from #100 - #149 up to #199 and #500 - #531 up to #999.

Additional Part Program Storage:

Expands the available part program storage capabilities. This option can reduce the need to upload and download programs. Refer to section 5-1.

Additional Registered Part Programs:

Expands the available number of part programs to reside within the control. Refer to section 5-1.

Multiple Repetitive Canned Cycles II (Pocketing):

Simplified programming for turning, boring, drilling, grooving and threading cycles. Useful when large amounts of stock need to be removed from the work piece. This option also expands the cycle to include machining of pockets.

Continuous Thread Cutting:

Special thread cutting operations can be performed where the lead and shape of the thread change midway thru the thread.

Variable Lead Thread Cutting:

Allows an increasing or decreasing lead for single point thread cutting. Used for self locking style of threads.
Work Coordinate System:

Allows user to access the work coordinate system locations G54 thru G59.

Operational Feature Options:

Thread Cutting Cycle Retract:

Allows operator to press feed hold during a threading pass and have the cutting tool immediately retract from the cut and return back to the start point.
5-3-1 C-Axis Contouring Feature

The live tooling “M” option includes the C-Axis contouring feature, which provides +/- .001 degree resolution, for performing a variety of machining operations. Positioning accuracy of +/- 1 arc minute and repeatability of 1.75 arc minute. Maximum programmable speed is 200rpm. A Fanuc BZ sensor is incorporated for positioning feedback.

**NOTE:** Polar and cylindrical programming functions are an additional option to C axis and are not included with C axis option.
Polar Interpolation

This feature is used to perform milling operations on the face of a work piece that requires synchronous movement of the spindle and the live tool (cutting with X and C-axis simultaneously).

Cylindrical Interpolation

This feature is used to perform milling operations on the outside diameter of a work piece that requires synchronous movement of the spindle and the live tool (cutting with Z and C-axis axis simultaneously).

Three Axis Linear Interpolation

This feature used to machine in all 3 axis : X, Z and C when in the G1 linear mode. Circular cutting cannot be accomplished in all 3 axis simultaneously, this type of cutting requires Helical Interpolation feature. If used for positioning only the spindle brake does not engage unless it is programmed to do so.

1 Degree Spindle Orientation

1 degree spindle orient is standard on all live tool (M) version machines and allows the spindle to be indexed in whole 1 degree increments only. The brake will automatically clamp and unclamp as required in this mode. Position accuracy and repeatability is +/- 30 arc minutes.
5-4 Communications Features

Part programs can be loaded through the RS-232C (serial) interface, PCMCIA (ATA Flash Card slot) or the remote Ethernet Port. Edited part programs can also be downloaded through the above for storage. The RS-232C interface and Ethernet Port may require 3rd party software to function.

The PCMCIA (ATA Flash Card) Slot is located on the front of the CNC control unit.

The RS-232C Interface and the **optional** Ethernet Port are located on the left side of the control on the machine to eliminate movement in hard wired cables.
5-5 Mechanical Run Meter

A mechanical run time meter is located on the back power case door. Additionally the control has internal timers to record power on time, operations time and run times.

5-6 Machine and CNC Control Power Case

Guard doors may be shown open for clarity – Specifications are subject to change without notice.
Section 6

MACHINE OPTIONS

Guard doors may be shown open for clarity – Specifications are subject to change without notice
6 Optional Accessories And Equipment

The majority of the optional accessories and equipment listed in this section can be field retrofitted if required. Where an optional accessory or equipment cannot be field retrofitted it will be noted in the summary write up section for that feature.

6-1 Parts Removal System

The parts removal system uses a chute which directs cut-off parts into a door-mounted storage basket. Access to the completed workpieces is through a flip-out door that may be opened while the machine is cycling. This allows the machine to operate at maximum efficiency.

Key features of the Parts Removal System:

- Air-activated chute extension and retraction.
- Variable speed controlled by a flow control valve.
- Fine adjustment provided for chute stroke
- Adjustable for use with or without chuck.
- Lined chute reduces part marring.
- Removable chute cover reduces accumulation of chips and coolant.
6-1 Parts Removal System Continued

6-2 X and Z Axis Scales

Heidenhain linear scales are an option provided on the X on all GT and CHNC models for high machining accuracy over a large number of parts. The closed-loop linear scale system for positioning accuracy provides direct measurement for thermal growth and wear over the life of the machine. Feedback resolution for the X-axis is 0.000002” (0.00005mm). All axis have a programmable resolution of 0.00001” (0.0001mm). Note machines run in metric (.0001mm resolution) would equate to .000004” inch resolution.
6-3 Renishaw Tool Touch Probe

The optional Tool Touch Probe is detachable style Renishaw probe which is mounted on the headstock and is manually positioned in front of the main spindle to provide a known reference point for establishing the position of the top plate tooling. To ensure proper clearance between the probe and the workholding device, the maximum size Thru-Hole Jaw Chuck that can be used is 4-7/8” (123.8mm).

6-4 In Process Part Probe

No Information at time of printing

6-5 Air Blast System (Headwall and Cross Slide)

Note: Cross Slide Air Blast Available on GT Models Only

The Air Blast System can provide cost reduction through reduced cycle time because chips are removed from the workholding device and a cleaner gripping surface is available to receive each part. Also for materials that cannot be contaminated by coolant. The Air Blast system carries a force of air through the headwall and/or the cross slide by the standard machine air supply system. When the machine’s air system is active, an air blast can efficiently clean chips from the workholding device. An adjustable air tube is mounted by a flange on the headwall. A set screw in the flange allows the tube to be positioned closer to
6-5 Air Blast System Continued

or away from the headwall, and to be rotated for an optimum blast angle to clean the area. Standard brass elbow fittings form a “T” fitting and flexible cooper tubing directs air at any position desired by the operator. The thru-headwall and cross slide air lines are added to the exiting air system, and is activated by a solenoid valves when an “M” code is programmed to turn the function on or off.

Headwall

Cross Slide

“A” -Set screw in collar
“B”- Brass “T” fitting
“C”- Flexible copper tubes

“D” Flexible copper tubes

Guard doors may be shown open for clarity – Specifications are subject to change without notice
6-6  High Pressure Coolant System (125PSI)

The 125psi (8.6bar) High-Pressure Coolant option permits:

- Higher permissible speeds and feeds for improved deep-hole drilling, reaming, turning and boring applications
- Improved chip removal
- Reduced cycle times/better production rates
- Cooler running and longer tool life
- Smoother surface finishes

For additional higher pressure coolant systems, please consult the Hardinge Custom Solution Team for a specials quotation.

6-7  Chip Conveyor

The chip removal system facilitates automatic removal of chips from the machining area, reducing down time for cleaning and maintenance. Tank capacity with chip conveyor is 14 gallons. Pictured below shows the 4 screws that when removed the conveyor will slide out for tank cleaning. A variable speed control allows operator to control chip removal rate depending on chip loads. Conveyor discharge height is 39.” and removes chips from the right side of machine.
6-8  Coolant Chiller

To further reduce heat a Turmoil model OCO-75 model Coolant Chiller system is an optional feature offered on all Quest Series SUPER-PRECISION® (SP) machines. This standalone unit allows the temperature of the liquid (coolant) being used to be maintained at a constant delta temperature relative to fluctuating ambient temperature. In other words, this controller allows the liquid temperature to track the ambient temperature, up or down, at a constant differential to maintain stable coolant temperature.

6-9  Thru-Spindle Coolant

Thru spindle coolant is a feature which can be used to evacuate chips from the work holding device in an automated application, normally this feature will out-perform the air blast feature. Additionally in through hole applications this will also out-perform air blast in evacuating chips from the part.

Shown above is the supply tube for the Through Spindle Coolant feature. Labeled “A” and “B” are the two support rings that locate the supply tube on center with the
6-9 Thru Spindle Coolant Option Continued

spindle draw tube, with the rotary union labeled “C”. Coolant on / off is M code activated and is delivered through the coolant supply fitting. The end of the tube is threaded so the customer can make any type of small deflector to direct coolant in a direction of their choice. **This option REQUIRES the 125psi High Pressure coolant pump option.**

6-10 Collet Closer Foot Switch

The single pedal foot switch provides hands-free operator convenience when loading and unloading workpieces in the main spindle.

6-11 Auto Door

The light touch auto door feature allows for automatic opening of the main guard door at the end of the cycle to minimize operator fatigue on short cycle times or may be used with an automation package. The auto door is closed via dual “light touch” sensors and automatic operation will restart once the door has been closed via the system.
6-12 Live Tooling

**Note: The Live Tooling Option is only available on the GT model of machines**

The live tooling feature provides milling/drilling capabilities for either face/end (axial) or cross (radial) features. A 3 spindle attachment is used for face/end working operations; while a single spindle attachment is for cross working operations (one short top plate is included with the 3 spindle unit). The 6,000 rpm attachments are easy to mount and can be removed to allow the use of the standard length top plates. The disc type spindle brake clamps the spindle following orientation; one degree spindle orient is standard. Full C Axis contouring is available as an option.

6-13 C Axis Contouring Option

The C Axis feature provides spindle positioning in increments of .001 degree. Three dimensional contouring, complex round and prismatic machining, square shoulder and lettering are accomplished by synchronizing the spindle (C) with the X and Z Axis. **Note polar and cylindrical programming functions are an additional option.**

Refer to section 5-4-1 for additional specifications.
6-14 Barfeed Interface

Hardinge offers our standard barfeed interface which is configured to work with most major barfeed suppliers. It is the sole responsibility of the Distributor and the barfeed supplier to insure that proper installation, training, functions and safety criteria are all met following installation. Barfeed interface information can be obtained from the Hardinge Service Team.
Section 7

MACHINE ACCURACY APPLICATIONS (SP, SP²)
7 Machine Accuracy Applications

7-1 Machine Accuracy and Applications

The following chart outlines typical guidelines for machined part accuracies and the machine type required to achieve the required tolerances. As one may note there are several overlapping instances on the chart for turning and grinding, however with the advent of SUPER-PRECISION® and SP², Hardinge is now encroaching upon grinding tolerances in many applications.

7-2 Standard Inspection Examples for All Machine Models

All Hardinge Quest SUPER-PRECISION® series of machines undergo a rigorous inspection procedure to ensure that all machines are manufactured to exacting specifications. Following are some examples of those inspection procedures,
Spindle Run-Out Example

Spindle run-outs are inspected to ensure that the three front grind areas, which include the collet seat, chuck seat, end face as well as spindle end play are within specified limits. A Federal® model EAS139 electronic indicator mounted on the top plate is used to indicate the actual spindle surfaces after assembly and typical inspection specifications are less than .000015” (.00038mm) on 27mm versions and .000025” (.0007mm) TIR on 42mm versions. The drawing illustrates the typical indicator locations for inspection checks.

Overall Repeatability Example

Overall system repeatability incorporates a two axis (X and Z) move along with a turret index. This test is cycled 10 times at 6 IPM and then averaged. A Federal® model EAS139 electronic indicator mounted on the spindle is used to indicate a fixture mounted to the top plate. The inspection specification is .000050” (.0012mm), however on average the machines typically inspect around .000020” (.0005mm) or less. The drawing illustrates the typical indicator locations for inspection checks.
Carriage to Spindle Alignment Example

To verify proper carriage to spindle alignment, an 8” (203mm) alignment arbor, which is ground in a solid collet body and locates on the collet seat, is installed in the spindle. A Federal® model EAS139 electronic indicator is mounted on the top plate and then the carriage is moved towards the headstock a total of 8” (203mm) to verify both parallel and perpendicular planes. The inspection specification is .00025” (.006mm), however on average the machines typically inspect around .0001” (.0025mm) or less. The drawing illustrates the typical indicator locations for inspection checks.

Additional Inspection Examples:
- Turret indexing repeatability (dependent upon machine model)
- Overall axis backlash
- Axis repeatability
- Cross slide to spindle (tram) alignment
- Turret alignment (dependent upon machine model)
- Turret centerline (dependent upon machine model)
- Complete control and operator panel functionality
- Various test cuts (threading, turning, facing, etc)

7-3 SUPER-PRECISION® Defined

SUPER-PRECISION® is a combination of best practice design engineering, high precision manufacturing, high quality purchased components, complex software development and integration, intense testing and certification combined with the Hardinge Global knowledge and experience of producing the most difficult parts and processes known to industry. These combined factors are then integrated into a machine tool that ultimately delivers the highest level of precision parts for
production turning centers that require the least amount of human intervention in today’s competitive marketplace. The Quest Series SUPER‐PRECISION® turning centers are designed and built for the ultimate in superior part roundness, surface finish and minimal total part variation in diameter, making them the most accurate production turning center in the market.

Key differentiators which set Hardinge SUPER‐PRECISION® turning centers apart and set the benchmark for turning can be separated into the following areas:

- **Design Integrity**
  - High degree of machine stiffness qualified by FEA
  - Polymer composite reinforced cast iron base
  - Collet ready spindle configuration

- **Assembly Techniques**
  - Matched high precision spindle bearings
  - Dynamic balancing of the spindle assembly
  - Hand scraping of critical mating components
  - Time proven alignment techniques

- **Inspection Processes**
  - High surface finish capability of 12 micro-inch (.3 microns) or better
  - High roundness capability – TIR of .000015” (.38 microns) on 27mm versions and .000025” (.63 microns) on 42mm versions or better
  - Ball bar testing for superior geometric accuracy
  - High axis repeatability - .000050” (1.2microns)
  - Laser inspection – straightness, positioning, repeatability and accuracy
  - SUPER‐PRECISION® test specimen
• Control Technology
  o Control package with .000010” (.0001mm) resolution
  o Lead screw error compensation
  o Straightness compensation
  o High accuracy closed loop direct measurement system

As a result of the above, Hardinge Quest SUPER-PRECISION® Series machine models are capable of maintaining typical tolerances such as:

• Total tolerance of .0002” (.005mm) or better on diameter, in production
• Cylindricity of .000040” (.001mm) or better
• Part roundness of .000015” (.00038mm) or better
• Surface finish of 12Ra (.3 microns) or better
• Ability for the operator to “split a tenth” due to control resolution and offset capability of .000010” (.0001mm)
• Ability to accurately machine sub-micron steps
7-4 SUPER-PRECISION® Inspection and Testing

All Quest series SUPER-PRECISION® machines undergo the following tests in addition to the standard inspection requirements:

- Pitch error compensation to the X and Z axis to correct for positioning and offset errors at the tool tip.
- Straightness error compensation (using laser measurement technology) for the X and Z axis.
- Renishaw® ball bar testing to measure accuracy of X and Z axis interpolation and overall machine geometry.
- CMA (continuous machining accuracy) test cutting. Machined component inspection on the diameter must yield a total variation of less than .00012” (.003mm).
- Hardinge SUPER-PRECISION® test specimen.
- Accuracy certification, signed by the President of Hardinge Inc., is provided as assurance that the machine has completed all SUPER-PRECISION® testing protocol.
7-4-1 Testing Results and Certification Documentation

Following are some examples of the testing results for the above that are included with every Quest SUPER-PRECISION® machine.

**Pitch Error Compensation X and Z Axis**

Errors caused by the machine axis movements due to lead error of the ball screw are compensated within the control, this results in more accurate machining precision. Compensation intervals are set within the machines parameter files for each axis. Hardinge performs this testing in accordance with ISO 230-2 standard utilizing a Hewlett Packard® Laser System.

![Accuracy and Repeatability Graph](image-url)
Straightness Error Compensation X and Z Axis

Machine tools with deviations in straightness between axis may affect the machining accuracy. For this reason, when an axis moves, other axis can be compensated to improve straightness. This improvement results in better machining accuracy. As a moving axis moves (ie: Z), compensation is applied to the compensation axis (ie: X). Typically this compensation is based on the pitch of the ball screw. Hardinge performs this testing in accordance with ISO 230-2 standard utilizing a Hewlett Packard® Laser System.

![Straightness Error Compensation Graph]

<table>
<thead>
<tr>
<th>Least-squares fit</th>
<th>Axis: Z</th>
<th>Accuracy: 3.84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine: CQ</td>
<td>Location:</td>
<td>Uni-dir. Rep: 1.32</td>
</tr>
<tr>
<td>Serial No: 111</td>
<td>Slope: 110.0036 µm/m</td>
<td></td>
</tr>
<tr>
<td>Date: 11:49 Dec 31 2010</td>
<td>Str. Error: 2.82</td>
<td></td>
</tr>
<tr>
<td>By: JP</td>
<td>Target (millimetres)</td>
<td></td>
</tr>
</tbody>
</table>

Guard doors may be shown open for clarity – Specifications are subject to change without notice.
Renishaw® Ball Bar Test

Ballbar testing verifies every motion affecting error that exists in the axes under test. These errors can include backlash, reversal spikes, lateral play, cyclic error, servo mismatch, scaling errors and geometry errors such as squareness and straightness. Ballbar testing is included in a number of standards for machine tool accuracy testing, including ASME B5.54 and ISO 230.

ISO 230-4:1996(E) Circular Deviation
CQ-111
Operator: JPierce
Date: 2010-Dec-31 13:15:31
Instrument: QC10 Ballbar

Circular Deviation (CCW)
Value 2.5µm

Test Parameters
Radius 50.0000mm
Sample rate 83.333Hz
Feedrate 1000.0mm/min
Run Direction CCW
Plane under test ZX
Test position
Start angle 0°
End angle 360°
Overshoot angle 180°

Run 1 5.0µm/div
CMA Test Cutting

The Continuous Machining Accuracy (CMA) test is a test developed by Hardinge to determine a machine's ability to machine a series of parts over a continuous period of time to determine the accuracy of the machine. Typically this test is run with a 1/2 hour warm up period and consists of machining a series of test specimens over the course of 6 hours. Maximum deviation of the parts cut must be less than .0002” (.003mm). Below are typical cutting parameters and test results.

<table>
<thead>
<tr>
<th>Cutting Conditions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Workpiece Material</td>
<td>Brass</td>
</tr>
<tr>
<td>Tool</td>
<td>Diamond</td>
</tr>
<tr>
<td>Spindle Speed</td>
<td>2500 rpm 1200 rpm</td>
</tr>
<tr>
<td>Cutting Depth on a Side</td>
<td>.005 inch .0025 inch</td>
</tr>
<tr>
<td>Feedrate</td>
<td>.002 ipr .0005 ipr</td>
</tr>
<tr>
<td>Coolant (Water Based)</td>
<td>On    On</td>
</tr>
<tr>
<td>Ambient Temp.</td>
<td>71.3°F to 75.7°F</td>
</tr>
</tbody>
</table>

![Charted CMA Results Diameter Deviation](chart.png)
SUPER-PRECISION® Test Specimen Information

As final validation of the above inspection results, all T Series SUPER-PRECISION® machines produce a machined test artifact which is then inspected for the criteria outlined on the Performance Summary form below. Once all inspection data is collected from above, the test artifact, inspection data and a certificate of accuracy are then packaged and shipped to the customer along with the machine. Following is an example of the Performance Summary and Certificate of Accuracy.

SUPER-PRECISION® Certification Package
### SUPER-PRECISION® Performance Summary

#### Machine Geometry Verification

<table>
<thead>
<tr>
<th>Certification Test</th>
<th>Spec.</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straightness X-Axis</td>
<td>2.00 µm</td>
<td>1.38 µm</td>
</tr>
<tr>
<td>Accuracy / Repeatability X-Axis</td>
<td>1.50 µm</td>
<td>µm</td>
</tr>
<tr>
<td>Accuracy / Repeatability Z-Axis</td>
<td>1.50 µm</td>
<td>µm</td>
</tr>
<tr>
<td>Angular Deviation - Clockwise</td>
<td>0.25 µm</td>
<td>µm</td>
</tr>
<tr>
<td>Ball Bar Contour Accuracy</td>
<td>0.20 µm</td>
<td>µm</td>
</tr>
</tbody>
</table>

#### Precision Artifact Verification

<table>
<thead>
<tr>
<th>Certification Test</th>
<th>Spec.</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00&quot; Diameter Sphere (profile tolerance)</td>
<td>1.50 µm</td>
<td>µm</td>
</tr>
<tr>
<td>3 Micro Steps</td>
<td>0.25 µm</td>
<td>µm</td>
</tr>
<tr>
<td>1 Degree Taper</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Certification Test</th>
<th>Spec.</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>260° Arc (profile tolerance)</td>
<td>0.70 µm</td>
<td>µm</td>
</tr>
<tr>
<td>1.50° Cylinder (cylindricity)</td>
<td>1.00 µm</td>
<td>µm</td>
</tr>
</tbody>
</table>

SUPER-PRECISION® T-42
Serial Number: CQ-111-SP
Date: 2/4/2011

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Guard doors may be shown open for clarity – Specifications are subject to change without notice.
Certificate of SUPER-PRECISION® Accuracy

Machine Serial Number: CQ-111-SP

Congratulations, you have purchased one of the finest, most accurate cutting machine tools available in the world today. You can be assured that your Hardinge SUPER-PRECISION® CNC Lathe is capable of maintaining extremely close tolerances, generating highly accurate part profiles, and machining very fine surface finishes with a minimal amount of human intervention. Hardinge SUPER-PRECISION® CNC Lathes are created with a holistic process of design, engineering, manufacturing, assembly and alignment all carried out according to stringent requirements necessary to build in SUPER-PRECISION® accuracy and repeatability.

Your SUPER-PRECISION® lathe was subjected to a rigorous battery of testing and validation procedures to ensure that it meets our SUPER-PRECISION® machine specifications. A summary of your machine’s performance is herein documented.

This machine is therefore certified as having met all of the pertinent requirements necessary to be deemed Hardinge SUPER-PRECISION®. You can be proud to own and showcase this fine work of precision engineering and craftsmanship, and you can rely on it to produce your most accurate, most difficult to machine parts for years to come.

Richard L. Simons
President / CEO
Section 8

FLOOR PLAN AND SPECIFICATIONS
8-1 Floor Plan

Figure 1 - Machine Floor Plan: Front View

Guard doors may be shown open for clarity – Specifications are subject to change without notice
Guard doors may be shown open for clarity – Specifications are subject to change without notice
Guard doors may be shown open for clarity – Specifications are subject to change without notice.
Guard doors may be shown open for clarity – Specifications are subject to change without notice
8-1-1 Foundation Requirements

Quest series lathes do not require a special foundation. Do not locate the machine near equipment that causes vibration. Poor surface finishes or damage to the control may result from vibration transmitted to the machine. Avoid placing the machine over floor expansion joints.

Recommended

A 4 inch (101 mm) thick concrete floor as large as the machine footprint. The machine footprint is the overall dimensions, length and width, of the machine.

Approximate Weights

GT Machine weight: 5220 lb (2367 Kg)
CHNC Machine weight: 5700 lb (2585 Kg)

For further information refer to “Installation and Extended Storage Instructions” publication #M-500.

8-2 Lubrication Requirements

Axis Way Lubrication:
KLUBER ISOFLEX NCA 15 Grease

8-3 Electrical Power Connection

-Caution-

Customer must provide transformer protection per local code. Power entrance to the case must comply with local electrical codes. Due to the variation of local electrical
codes, Hardinge recommends that the local utility supply company be consulted to determine exact service and wiring requirements.

Machine Electrical Requirements

Input Voltage: 230
FLA (Full Load Amps): 33

8-4 Air Requirements

An inline air regulator and lubricator are included as standard equipment.

Air Pressure Required 70-90 psi (4.8-6.2 bar)

Hardinge recommends adding a heavy-duty air dryer to the incoming air line if excessive moisture is present.
Guard doors may be shown open for clarity – Specifications are subject to change without notice
Section 9

MACHINE SPECIFICATIONS
# 9-1 Quest GT/CHNC Machine Specifications

## Swing Diameter

<table>
<thead>
<tr>
<th>Description</th>
<th>GT Models</th>
<th>CHNC Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Swing Over Way Covers</td>
<td>11.76” (298.7mm)</td>
<td>17.94” (455.6mm)</td>
</tr>
</tbody>
</table>

## A2-4” 5C Spindle

<table>
<thead>
<tr>
<th>Specification</th>
<th>GT Models</th>
<th>CHNC Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Speed</td>
<td>8000-rpm</td>
<td></td>
</tr>
<tr>
<td>Maximum Power Rating (Continuous)</td>
<td>10-hp (7.5kW)</td>
<td></td>
</tr>
<tr>
<td>Maximum Torque (Continuous)</td>
<td>34.5ft.-lbs. (48Nm)</td>
<td></td>
</tr>
<tr>
<td>Maximum Hang Weight</td>
<td>75-lbs (34kg)</td>
<td></td>
</tr>
<tr>
<td>Base Speed</td>
<td>1500-rpm</td>
<td></td>
</tr>
<tr>
<td>Spindle Nose</td>
<td>A2-4/5C</td>
<td></td>
</tr>
<tr>
<td>Chuck Size (Chuck Not Included)</td>
<td>4.00” (101.6mm)</td>
<td></td>
</tr>
<tr>
<td>Maximum Bar Capacity</td>
<td>1.062” (27mm)</td>
<td></td>
</tr>
<tr>
<td>Spindle Bore (Not Bar Capacity)</td>
<td>1.890” (48mm)</td>
<td></td>
</tr>
<tr>
<td>Spindle Center Height GT Models</td>
<td>41.25” (1048mm)</td>
<td></td>
</tr>
<tr>
<td>Spindle Center Height CHNC Models</td>
<td>43.69” (1109mm)</td>
<td></td>
</tr>
<tr>
<td>Spindle Reach</td>
<td>23.00” (584mm)</td>
<td></td>
</tr>
<tr>
<td>Spindle Orient (Standard)</td>
<td>1.0 Degree</td>
<td></td>
</tr>
<tr>
<td>Closer Type</td>
<td>Pneumatic</td>
<td></td>
</tr>
</tbody>
</table>

## A2-5” 16C Spindle

<table>
<thead>
<tr>
<th>Specification</th>
<th>GT Models</th>
<th>CHNC Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Speed</td>
<td>5000-rpm</td>
<td></td>
</tr>
<tr>
<td>Maximum Power Rating (Continuous)</td>
<td>10-hp (11kW)</td>
<td></td>
</tr>
<tr>
<td>Maximum Torque (Continuous)</td>
<td>34.5 ft.-lbs. (147Nm)</td>
<td></td>
</tr>
<tr>
<td>Maximum Hang Weight</td>
<td>75-lbs (34kg)</td>
<td></td>
</tr>
<tr>
<td>Base Speed</td>
<td>1500-rpm</td>
<td></td>
</tr>
<tr>
<td>Spindle Nose</td>
<td>A2-5/16C</td>
<td></td>
</tr>
<tr>
<td>Chuck Size (Chuck Not Included)</td>
<td>6.000” (152.4mm)</td>
<td></td>
</tr>
<tr>
<td>Maximum Bar Capacity</td>
<td>1.625” (42mm)</td>
<td></td>
</tr>
<tr>
<td>Spindle Bore (Not Bar Capacity)</td>
<td>1.890” (48mm)</td>
<td></td>
</tr>
<tr>
<td>Spindle Center Height</td>
<td>41.25” (1048mm)</td>
<td></td>
</tr>
<tr>
<td>Spindle Reach</td>
<td>23.00” (584mm)</td>
<td></td>
</tr>
</tbody>
</table>
### Quest GT\CHNC Machine Specifications Continued

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spindle Orient (Standard)</td>
<td>1.0 Degree</td>
</tr>
<tr>
<td>Closer Type</td>
<td>Pneumatic</td>
</tr>
</tbody>
</table>

### Axis Travels And Feedrates

<table>
<thead>
<tr>
<th>Travel</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum X-Axis Travel</td>
<td>11.968” (304.mm)</td>
</tr>
<tr>
<td>Maximum Z-Axis Travel (GT Models A2-4” 5C)</td>
<td>11.062” (281.0mm)</td>
</tr>
<tr>
<td>Maximum Z-Axis Travel (GT Models A2-5” 16C)</td>
<td>10.412” (264.5.0mm)</td>
</tr>
<tr>
<td>Continuous X-Axis Thrust</td>
<td>1,695lbs. (7,540N)</td>
</tr>
<tr>
<td>Continuous Z-Axis Thrust</td>
<td>780lbs. (3469N)</td>
</tr>
<tr>
<td>X-Axis Rapid Traverse Rate (GT Models)</td>
<td>708-ipm (18m/min)</td>
</tr>
<tr>
<td>Z-Axis Rapid Traverse Rate (GT Models)</td>
<td>945-ipm (24m/min)</td>
</tr>
<tr>
<td>X-Axis Rapid Traverse Rate (CHNC Models)</td>
<td>472-ipm (12m/min)</td>
</tr>
<tr>
<td>Z-Axis Rapid Traverse Rate (CHNC Models)</td>
<td>630-ipm (16m/min)</td>
</tr>
</tbody>
</table>

### Tooling Capacities

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Square Shank Size</td>
<td>1/2” (12mm)</td>
</tr>
<tr>
<td>Maximum Round Shank Size</td>
<td>3/4” (20mm)</td>
</tr>
</tbody>
</table>

### Parts Catcher Option

<table>
<thead>
<tr>
<th>Option</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workpiece Length Maximum (A2-4” 5C)</td>
<td>3” (76.2mm)</td>
</tr>
<tr>
<td>Workpiece Length Maximum (A2-5” 16C)</td>
<td>4” (101.6mm)</td>
</tr>
</tbody>
</table>

### Miscellaneous

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply Requirement</td>
<td>230V/32FLA/3Phase</td>
</tr>
<tr>
<td>Coolant Tank Capacity</td>
<td>20Gal (76Liter)</td>
</tr>
<tr>
<td>Machine Lubrication</td>
<td>Grease</td>
</tr>
<tr>
<td>Machine Communication</td>
<td>RS-232-C/Ethernet</td>
</tr>
<tr>
<td>Machine Length (No Conveyor)</td>
<td>77.0” (1956mm)</td>
</tr>
<tr>
<td>Machine Depth</td>
<td>58.63” (1489mm)</td>
</tr>
</tbody>
</table>

Guard doors may be shown open for clarity – Specifications are subject to change without notice
Machine Height 64.10” (1628mm)

Quest GT\CHNC Machine Specifications Continued

Approximate Shipping Weight (GT Model) 5220lbs. (2368kg)
Approximate Shipping Weight (CHNC Model) 5700lbs. (2586kg)
Air Requirement 70-90 psi (4.8-6.2 bar)

SUPER-PRECISON
Accuracy and Surface Finish Specifications
Overall Axis Repeatability (X,Z) .000050” (1.25 micron)
Part Surface Finish 12 micro-inch (.3 micron)
Part Roundness .000015” (.25 micron)
Total Variation on Diameter .0002” (5 micron)
Program Resolution .00001” (.0001 mm)
Turret Indexing Repeatability .00006” (1.52 micron)

Guard doors may be shown open for clarity – Specifications are subject to change without notice
Section 10

ADDITIONAL PRODUCT SUPPORT INFORMATION
10. Additional Product Support Information

Hardinge offers a tremendous amount of backup and support documentation that is readily available in a number of places including the Distributor SharePoint Portal, Applications, Service, Marketing and Sales teams. Listed below are some of the more pertinent information in reference to the Hardinge T Series of machines.

10-1 Helpful Hints

Helpful Hints are a series of communicators developed by the Hardinge Applications Engineering Team on a variety of subjects which are meant to be an aid to the sales force and customer.

HH001 SUPER-PRECISION® Machines and Maintaining Part Tolerance
HH002 Chip Conveyor Styles and Applications
HH004 Mist Collector Systems – Information To Consider
HH005 Coolant Chillers
HH006 High Pressure Coolant Systems
HH007 Accuracy Definitions

10-2 Standard Machine Documentation Package

The standard documentation package supplied with all T series machines is developed by the Technical Writing Team at Hardinge. In addition to a complete FANUC documentation package, the following documentation supplied and is also available on the Hardinge Service website www.hardingeservice.com:

- M514-A Programmers Manual
- M515-A Operation Manual
- M516-A Maintenance Manual
- M517-A Installation Instructions
- PL-116 Parts List
- T-433 Floor Plan Layout
- M-519 Dual Check Safety
10-3 Elmira Based Training Documentation

The Hardinge Applications Engineering Team creates the training documentation for Elmira based classes. The following documents are available:

- A Programmer Workbook
- A Operators Guide

10-4 Sales and Marketing Documentation

The sales and marketing teams create all machine brochures, trade publication advertisements as well as numerous PowerPoint presentations that are available. Please contact the Sales, Marketing or Applications Teams for information on what is available or if you require something specific.

10-5 Additional Reference Material

- 2349A Custom Workholding Solutions
- 2351F Tool Holder Bushings
- Recommended Spare Parts List
- T351 Force Limiting Step Chuck Brochure

Revisions Log:

1 21 2013 Corrections made to original draft and released to PDF and bookmark with linked files
Guard doors may be shown open for clarity – Specifications are subject to change without notice