NX 4500 / 5500 / 6500
High-Precision High-Speed Vertical Machining Center
High-Precision High-Speed Vertical Machining Center

The NX Series of machines takes performance and strength to a whole new level. With its double column design and high speed spindle, it provides the best stability and rigidity possible for today's market demand for high-precision high-efficiency part machining.
NX 4500 / 5500 / 6500 features a fully enclosed mechanical structure combined with a high-speed low-vibration spindle, a thermal displacement reduction system and a high-speed tool processing.
The precision dynamic balanced spindle of the NX Series is a result of years of machining industry experience. Assures lasting performance, high-stiffness and thermal control.

### Spindle

**Spindle power-torque diagram**

- **Max. Spindle Speed**: 20000 r/min
- **Spindle motor**: 22 kW (29.5 HP)
- **Max. Spindle Speed**: 30000 r/min
- **Spindle motor**: 18.5 kW (24.8 HP)

#### High-stiffness low vibration spindle

Spindle strength and stiffness has been increased while reducing vibration through bearing optimization and spindle length reduction.

#### 0.1 degree control oil cooler

To minimize the bearing and motor heat a high-precision oil cooler controls the temperature to 0.1 degree.

#### Oil air lubrication

An optimal amount lubrication oil is applied by high-pressure air to the bearings.

#### Dual face contact tooling system

The dual contact system offers simultaneous contact between the machine spindle face and the tool holder flange.
**Structure NX 4500 / 5500 / 6500**

Its double column design and robust base give the NX Series an excellent foundation for high-performance, high-accuracy machining.

**Rigidity**

Thermal analysis of the symmetrical structure and minimal overhang shows the rigidity of the enclosed design thus providing the optimal solution for high-speed / high-precision processing.

**Center weight**

By minimizing the distance between weight center and the feed drive center, the inertia movement is reduced allowing for faster feed rates and a more precise part.

**High output / High inertia motor**

Through overall axial load / motor inertia ratio of less than 50%, we have improved the responsiveness of feed drive.

**ATC & Magazine**

<table>
<thead>
<tr>
<th>Number of tools in possession</th>
<th>Tool Transfer Time (T-T-T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 ea (NX 4500)</td>
<td>1.5 s</td>
</tr>
<tr>
<td>30 ea (NX 5500/6500)</td>
<td></td>
</tr>
</tbody>
</table>

**High strength feed drive**

- **Roller guide applied**
- **Rigid coupling**
- **Ball screw nut cooling**
  - Feed axis thermal displacement largely reduced
  - Feed drive strength maintained in stable condition
Optimized tool processing solution  NX 4500 / 5500 / 6500

Superior surface finishes and machining accuracy are achieved through using standard processing solutions such as high-speed / high-precision contour control and thermal displacement compensation.

High-speed / high-precision contour control

- DSQ : Doosan Super Quality

DSQ3
- ACC2
- 600 Block Look ahead
- Selection of processing condition
- High-speed Data Server 1GB
- High-speed CPU mounted

Machining condition selection function

It is possible to change machining condition in 10 steps by using R code at the program.
- Improving productivity (high speed at rough machining, high precision at precision machining)
NC parameter such as maximum feed and acceleration time constant can be set automatically

<table>
<thead>
<tr>
<th>Machining condition</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
<th>R6</th>
<th>R7</th>
<th>R8</th>
<th>R9</th>
<th>R10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td>Normal</td>
<td>Long</td>
<td>High speed</td>
<td></td>
<td>Good</td>
<td>Normal</td>
<td>High quality</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thermal displacement compensation

- DHC : Doosan Heat Control

We materialized the minimization of thermal displacement so as to maintain high-precision in spite of long-time processing.

Calibration of static displacement of spindle

It enables to calibrate the change in position of tool through the expansion of spindle shaft at high-speed rotation.

Calibration of dynamic displacement of spindle

Spindle thermal displacement calibration and compensation is performed through spindle rotation measurement analysis and adjustment within 5 algorithms.

Calibration of structure thermal displacement

It calibrates inconsistent bending or expansion owing to the change in external temperature using a number of temperature sensors.
Performance of processing NX 4500 / 5500 / 6500

Test results prove greater workpiece precision and shorter cycle times.

Comparison of processing time & examples of processing

<table>
<thead>
<tr>
<th>Processed goods</th>
<th>Processing time</th>
<th>Materials and tools</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile Phone</td>
<td>Previous 699 min</td>
<td>NAK 80</td>
<td>ø1 Ball 20000 r/min Feed 2200 mm/min.</td>
</tr>
<tr>
<td></td>
<td>NX 4500 450 min</td>
<td></td>
<td>4 ea</td>
</tr>
<tr>
<td></td>
<td>Saving 36%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pocket</td>
<td>Previous 90 min</td>
<td>NAK 80</td>
<td>ø6 Ball 20000 r/min Feed 2000 mm/min.</td>
</tr>
<tr>
<td></td>
<td>NX 4500 60 min</td>
<td></td>
<td>1 ea</td>
</tr>
<tr>
<td></td>
<td>Saving 34%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pet Bottle</td>
<td>Previous 98 min</td>
<td>NAK 80</td>
<td>ø4 Ball 20000 r/min Feed 2200 mm/min.</td>
</tr>
<tr>
<td></td>
<td>NX 4500 66 min</td>
<td></td>
<td>2 ea</td>
</tr>
<tr>
<td></td>
<td>Saving 33%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Door Knob</td>
<td>Previous 396 s</td>
<td>SKD 61</td>
<td>ø6 Ball 20000 r/min Feed 3000 mm/min.</td>
</tr>
<tr>
<td></td>
<td>NX 4500 290 s</td>
<td></td>
<td>1 ea</td>
</tr>
<tr>
<td></td>
<td>Saving 27%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example of processing needle pin

<table>
<thead>
<tr>
<th>Company</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOOSAN NX 4500</td>
<td>2 hours 27 minutes</td>
</tr>
</tbody>
</table>

Example of processing cellular phone key pad

<table>
<thead>
<tr>
<th>Micron Cutting Depth : 1~10 µm</th>
</tr>
</thead>
</table>

Example of processing needle pin

<table>
<thead>
<tr>
<th>Processing condition of needle pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dia</td>
</tr>
<tr>
<td>0.2 mm</td>
</tr>
</tbody>
</table>

Processing condition of needle pin

<table>
<thead>
<tr>
<th>Processed goods</th>
<th>Size</th>
<th>Material</th>
<th>Tool</th>
<th>r/min (min⁻¹)</th>
<th>Feed (m/min.)</th>
<th>Processing time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Pad</td>
<td>40 x 60 x 30</td>
<td>NAK 80</td>
<td>D1 Bem</td>
<td>20000</td>
<td>850</td>
<td>1hr 13 min.</td>
</tr>
</tbody>
</table>
**Operation**

Improved work efficiency and convenience through ergonomic design analysis.

**Operating Console**

- 10.4" Color TFT LCD Monitor
- ATC operating button
  - Magazine: CW
  - Magazine: CCW
- Monolever
- Swivel-type operating panel
  - Operating panel on screen can be rotated up to 90° raising the convenience of the operator.
- Mobile MPG
- LCD Portable MPG Handle

**Excellent accessibility**

<table>
<thead>
<tr>
<th>Unit: mm (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
</tr>
<tr>
<td>NX 4500 826 (32.5)</td>
</tr>
<tr>
<td>NX 5500 790 (31.1)</td>
</tr>
<tr>
<td>NX 6500 970 (38.2)</td>
</tr>
<tr>
<td><strong>B</strong></td>
</tr>
<tr>
<td>NX 4500 350 (13.8)</td>
</tr>
<tr>
<td>NX 5500 240 (9.44)</td>
</tr>
<tr>
<td>NX 6500 326 (12.8)</td>
</tr>
<tr>
<td><strong>C</strong></td>
</tr>
<tr>
<td>NX 4500 770 (30.3)</td>
</tr>
<tr>
<td>NX 5500 860 (33.9)</td>
</tr>
<tr>
<td>NX 6500 780 (30.7)</td>
</tr>
</tbody>
</table>

**Convenient absolute feeding**

It remembers its position of the machinery; due to the installation of battery which works with power off, and therefore you can operate immediately without returning to the original point when turning the equipment on.

**3-step Patrol Lamp**

- Warning light (Indicates unusual condition of the equipment)
- Completion light (Indicates the completion of procession)
- Progress Light (Indicates the processing in progress)

**Chip Disposal**

Through rapid discharge of chips, it maintains the degree of precision in processing, and supports the operator to work in improved environment by providing a variety of chip treatment devices.

**Cutting coolant oil dispenser**

- NX 5500 (Side discharge)
- NX 6500 (Front side discharge)

**Inside screw conveyor**

We adopted 2-row screw. Discharging cutting coolant separately from lubricating oil.

**Oil/Water Separation Structure**

- Side coolant
- Chip air blower
- Cutting coolant residue stopping device
- Spindle section coolant

**Chip conveyor**

- Hinge type
- Scraper type
- Drum filter type

**Coolant Chiller**

The coolant chiller lowers coolant temperature, helping to cool both the workpiece and tool during the machining operation. When using insoluble cutting oils, a coolant chiller is recommended to cool heated oil and preserve machining precision.
Software  

NX 4500 / 5500 / 6500

Machine operation, setup, programing functions and operator efficiency is increased through the use of Fanuc 3i series of control.

Renishaw Gui  
Tool measure

Embodying the function of automatically measuring tool length/diameter and detecting the tool damage in interactive service style.

Tool Load Monitor  

Function of detecting tool wear and damage status through setting up load limits by the spindles and axis during cutting / moving so as to minimize the damage of the apparatus part.

Pattern Cycle  

It automatically generates its pattern cycle program through the method of inputting interactive factor.

Doosan Adaptive Feed Control  

By detecting cutting load at real time basis during processing and subsequently adjusting cutting speed automatically, which can be minimized the damage of the tool and equipment, through enhancing processing productivity.

ATC Recovery Help  

It guides the user to easily restore original condition, when ATC suddenly stops its operation, due to emergency stop or unusual operation.

Operation Rate  

Function of measuring and monitoring of the operation ratio for the equipment by each operator.

Tool Data Registry Table  

Displaying tool information on POT in 2D graphic.
External Dimensions & Table Dimensions

Unit: mm (inch)

<table>
<thead>
<tr>
<th></th>
<th>A(L)</th>
<th>B(W)</th>
<th>C</th>
<th>D(H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX 4500</td>
<td>2270</td>
<td>2756</td>
<td>2592</td>
<td>2870</td>
</tr>
<tr>
<td></td>
<td>(89.4)</td>
<td>(108.5)</td>
<td>(102.0)</td>
<td>(113.0)</td>
</tr>
<tr>
<td>NX 5500</td>
<td>2430</td>
<td>2800</td>
<td>2891</td>
<td>2971</td>
</tr>
<tr>
<td></td>
<td>(95.7)</td>
<td>(110.2)</td>
<td>(113.8)</td>
<td>(117.0)</td>
</tr>
<tr>
<td>NX 6500</td>
<td>2850</td>
<td>3254</td>
<td>2907</td>
<td>3268</td>
</tr>
<tr>
<td></td>
<td>(112.2)</td>
<td>(128.1)</td>
<td>(114.4)</td>
<td>(128.7)</td>
</tr>
</tbody>
</table>

Table

**NX 4500**

**NX 5500**

**NX 6500**

Tool Shank

20000 r/min

30000 r/min opt.
## Machine Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>NX 4500</th>
<th>NX 5500</th>
<th>NX 6500</th>
</tr>
</thead>
<tbody>
<tr>
<td>X, Y, Z axis mm (inch)</td>
<td>600 / 450 / 400 (23.6 / 17.7 / 15.7)</td>
<td>900 / 550 / 500 (35.4 / 21.7 / 19.7)</td>
<td>1050 / 650 / 550 (41.3 / 25.6 / 21.7)</td>
</tr>
<tr>
<td>Rapid traverse (X / Y / Z) m/min (ipm)</td>
<td>30 / 30 / 30 (1181.1)</td>
<td>150 ~ 650 (5.9 ~ 25.6)</td>
<td>150 ~ 700 (5.9 ~ 27.6)</td>
</tr>
<tr>
<td>Distance from spindle nose to table top mm (inch)</td>
<td>150 ~ 550 (5.9 ~ 21.7)</td>
<td>150 ~ 650 (5.9 ~ 25.6)</td>
<td>150 ~ 700 (5.9 ~ 27.6)</td>
</tr>
<tr>
<td>Table size mm (inch)</td>
<td>800 x 500 (31.5 x 19.7)</td>
<td>1000 x 550 (39.4 x 21.7)</td>
<td>1200 x 650 (47.2 x 25.6)</td>
</tr>
<tr>
<td>Spindle</td>
<td>20000 (30000)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taper spindle</td>
<td>ISO #40 7/24 (HSK-F63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spindle motor (10min/cont.) kW (Hp)</td>
<td>22 / 11 (29.5 / 14.8) (18.5 / 13 / 24.8 / 17.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. spindle torque (10min) N-m (ft-lbs)</td>
<td>60 (44.3) (5.9 (4.3))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Tools ea</td>
<td>24</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Max. tool Diameter mm (inch)</td>
<td>90 (3.5)</td>
<td>80 (3.1)</td>
<td></td>
</tr>
<tr>
<td>Max. tool diameter without adjacent tools mm (inch)</td>
<td>140 (5.5)</td>
<td>125 (4.9)</td>
<td></td>
</tr>
<tr>
<td>Max. tool Length mm (inch)</td>
<td>250 (9.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. tool Weight kgf lbs</td>
<td>8 (17.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool change time (tool-to-tool) s</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method of tool selection Type</td>
<td>Swing Arm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool Size</td>
<td>2270 x 2756 (89.4 x 108.5)</td>
<td>2430 x 2800 (95.7 x 110.2)</td>
<td>2850 x 3254 (112.2 x 128.1)</td>
</tr>
<tr>
<td>Machine height mm (inch)</td>
<td>2870 (113.0)</td>
<td>2971 (117.0)</td>
<td>3268 (128.7)</td>
</tr>
<tr>
<td>Machine weight kgf lbs</td>
<td>8000 (17637.0)</td>
<td>9000 (19841.6)</td>
<td>10000 (22046.2)</td>
</tr>
<tr>
<td>NC System</td>
<td>Fanuc 31i</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Standard Feature

- Splash Guard
- Portable MPG
- Coolant tank & Chip fan
- Assembly & operation tools
- Automatic tool measurement
- Air blower
- DSQ 3 (AICC2 / 600 Block Look ahead / High-speed Data Server 1GB / High-speed CPU mounted)
- Screw conveyor
- Auto power off
- BIG PLUS Dual Contact Spindle (20000 r/min)
- HSK-F63 Dual Contact Spindle (30000 r/min)
- DHC
  (Thermal Displacement Calibration System)
- Mono-Lever
- Ball Screw Nut Cooling System
- Spindle Cooling System
- Work light

### Optional Feature

- Through spindle coolant
- Mist collector
- 4th / 5th axis preparation
- Chip conveyor & chip bucket
- Air dryer
- Test bar
- DAF
- DTMM
- Graphite Processing Package Operation (NX 5500)
- Coolant Chiller
NC Unit Specifications Fanuc 31i-A

**AXES CONTROL**
- Controlled axes \(3 \times (X,Y,Z)\)
- Simultaneously controllable axes \(3 \times (X,Y,Z)\)
- Positioning (G00) / Linear interpolation (G01) - 3 axes
- Backlash compensation
- Least command increment \(0.001 \text{mm} / 0.001\) in
- Least input increment \(0.001 \text{mm} / 0.001\) in
- Machine lock / all axes / Z axis

**INTERPOLATION & FEED FUNCTION**
- Linear ACC / DEC before interpolation
- Automatic corner deceleration (Specify AI Contour control II)
- Rapid traverse bell-shaped acceleration / deceleration
- Linear ACC / DEC after interpolation
- Rapid traverse before bell-shaped acceleration / deceleration
- Smooth backlash compensation

**SPINDLE & M-CODE FUNCTION**
- M-code function \(M 3 \) digits
- Spindle orientation
- Spindle speed command \(55 \) digits
- Spindle speed override : 10% increments 50 - 150%
- Spindle output switching
- Rigid tapping \(G84, G74\)

**TOOL FUNCTION**
- Tool nose radius compensation \(G40, G41, G42\)
- Number of tool offsets 64 ea
- Tool length compensation \(G43, G44, G49\)
- Tool number command 13 digits
- Tool life management
- Tool offset memory C

**PROGRAMMING & EDITING FUNCTION**
- Absolute / Incremental programming \(G90 / G91\)
- Auto. Coordinate system setting
- Background editing
- canned cycle \(G73, G74, G76, G80 - G89, G99\)
- Circular interpolation by radius programming
- Custom macro B
- Addition of custom macro common variables
- inch / metric conversion \(G20 / G21\)
- Label skip
- Local / Machine coordinate system \(G52 / G53\)
- Maximum commandable value \( \pm 9999.999 \text{mm} / \pm 9999.999 \text{inch} \)
- No. of Registered programs 500 ea
- Optional block skip
- Optional stop \(M01\)
- Part program storage 640 m
- Program number 04-digits
- Program skip / end \(M00 / M32, M30\)
- Programmable data input
- Tool offset and work offset are entered by G10, G11
- Sub program
- Tape program \(G52 / G54\) Automatic discrimination
- Work coordinate system \(G54 - G69\)
- Additional work coordinate system \(48 \) Parms
- Coordinate system rotation \(G68, G69\)
- Extended part program editing
- Operation, Setting, & Display, etc.
- Alarm display
- Alarm history display
- Clock function
- Cycle start / Feed hold
- Display of PMC alarm message
- Message display when PMC alarm occurred
- Run hour
- Ethernet function (embedded)
- Graphic display Tool path drawing
- Help function
- Load limit display
- MDI / DISPLAY unit
- 10.4" color LCD, Keyboard for data input, Soft-keys
- Memory card interface
- Operation functions Tape / Memory / MDI / Manual
- Operation history display
- Program restart
- Run hour and part number display
- Search function Sequence NO. / Program NO.
- Self - diagnostic function
- Servo setting screen
- Single block
- External data input
- Multi language display

**OPTIONAL SPECIFICATIONS**
- 3-dimensional coordinate conversion
- 3-dimensional tool compensation
- 3rd / 4th reference return
- Additional tool pairs for tool life management 1024 pairs
- Additional controlled axes : max. 12 axes per path
- Additional tool compensation \(G54.1 - 300 \) Parms
- Additional tool compensation \(G52\)
- Chopping function / Cylindrical interpolation \(G01.1 / G01.7\)
- Dynamic graphic display (This can’t use with the EZ Guide-i)
- Display of high speed skip function
- Machining profile drawing
- Interpolation type pitch error compensation
- EZ Guide i

**TOOL OFFSET & WORK OFFSET**
- Tool offset and work offset are entered by G10, G11

**OTHER FUNCTION**
- Machine condition selection function
- Data server + 1GB
- Position switch
- H/D Code, Geometry / Wear memory

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