



100 Years of Reliability & Precision

OKK CORPORATION



**OKK Aerospace Solutions**

# 100 years of Reliability and Precision

Since 1915, customers across the globe have praised the reliability and precision of OKK horizontal, vertical and 5 axis machine tools.

It is our philosophy to assure 100% quality control by producing all key components in house.

OKK original parts include all spindles, mechanical gears, and our precision box ways plus special controller features.

# OKK

## Aerospace Industry for OKK

- + The aerospace industry is a key industry for OKK. Our unique technology allows us to excel at the many challenges created by aerospace manufacturing.
- + Large part sizes and complex parts are simplified with our 5 axis machine solutions.
- + OKK's traditional rigid machine structure enables efficient machining of difficult to cut materials.
- + Considerable attention to common maintenance issues such as chip evacuation yield less downtime.
- + OKK works to overcome your challenges.



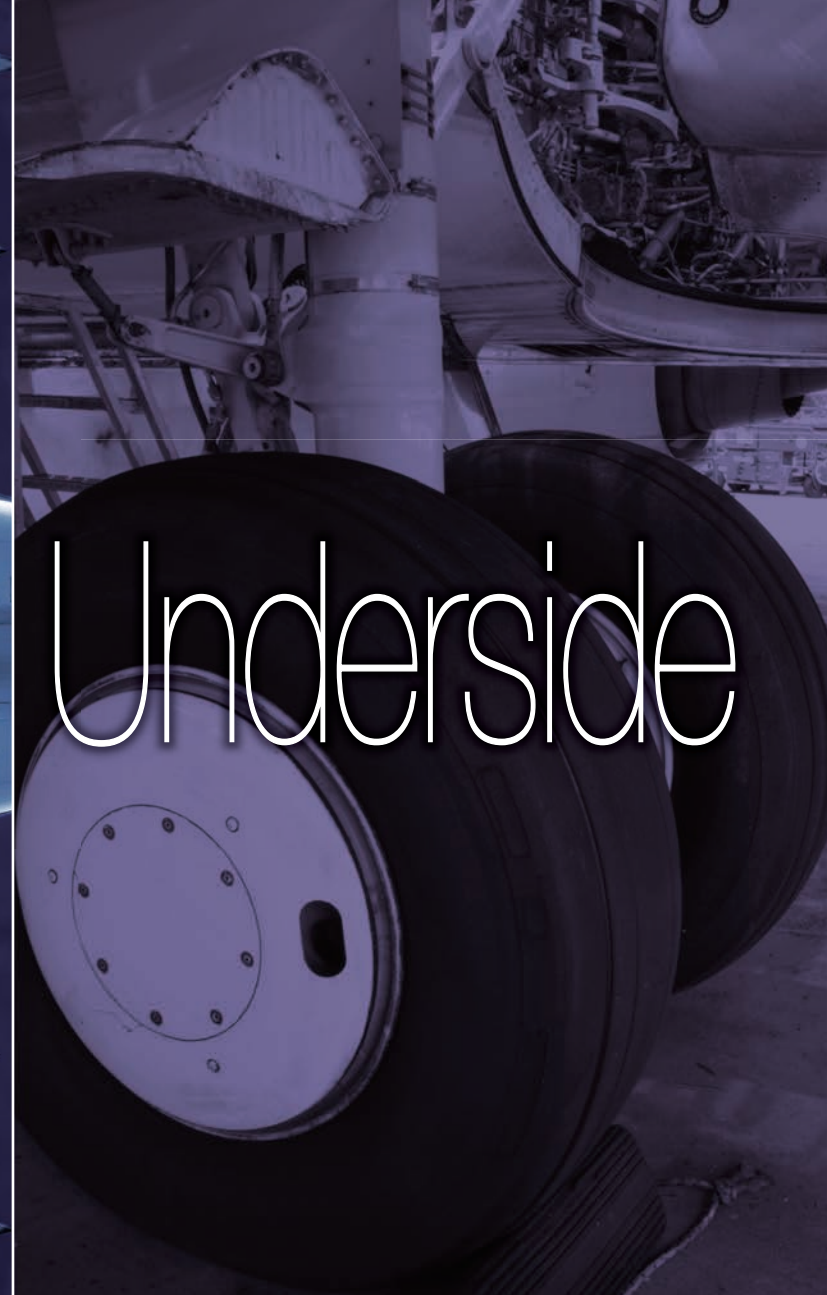
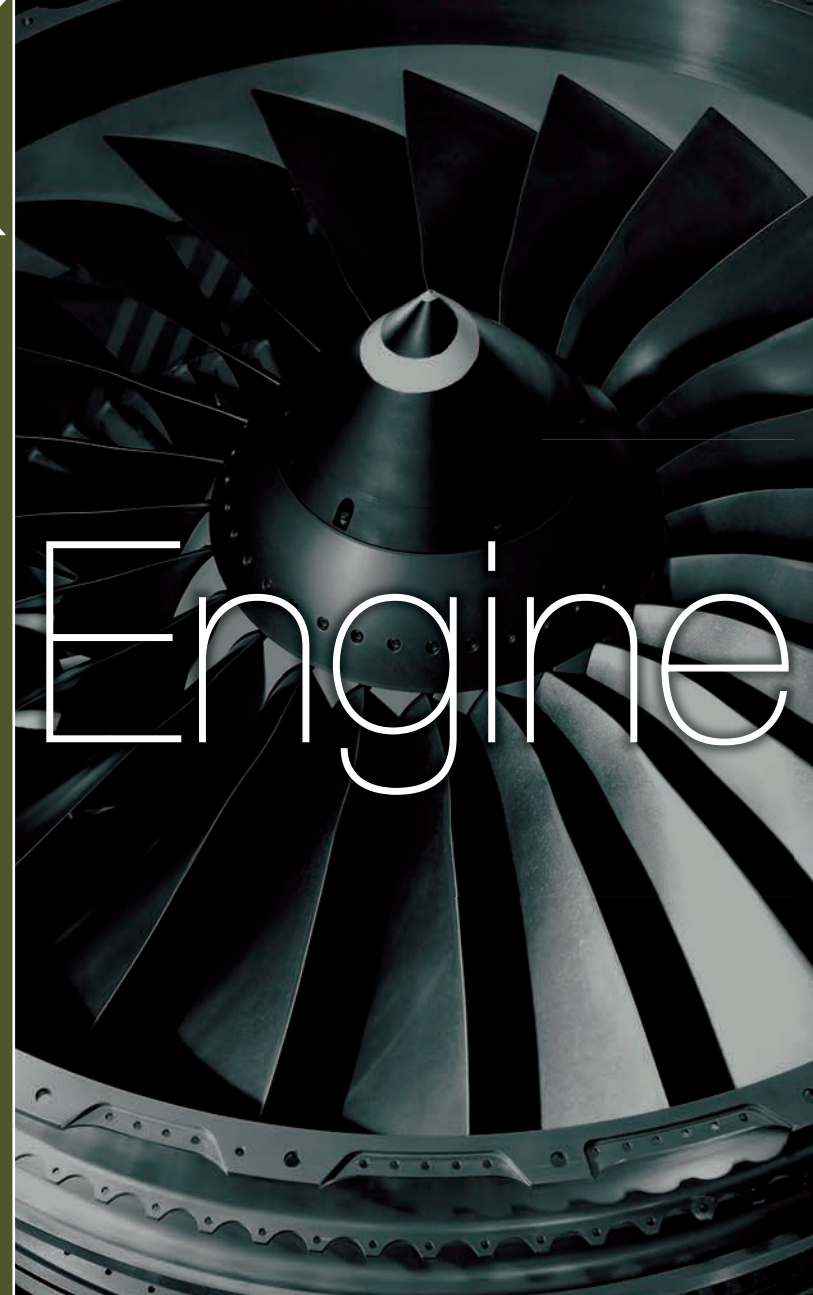


Introduction | Product Outline

OKK has developed machine lines ideal for cutting titanium or aluminum aerospace parts.

We have chosen to focus on building machines capable of efficiently machining titanium and high temperature alloys. These advanced materials are being used within the aerospace industry to increase component strength and improve airplane fuel efficiency.

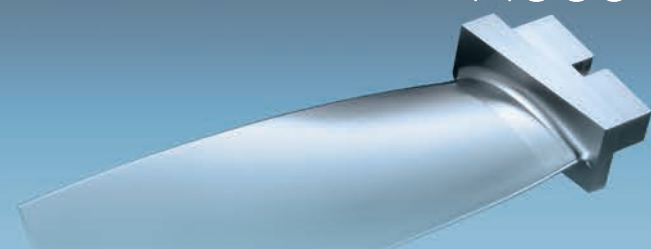
OKK offers 5 axis machines that cover large size aerospace components up to 138 inches (3500mm) in length.



# OKK Aerospace Solutions

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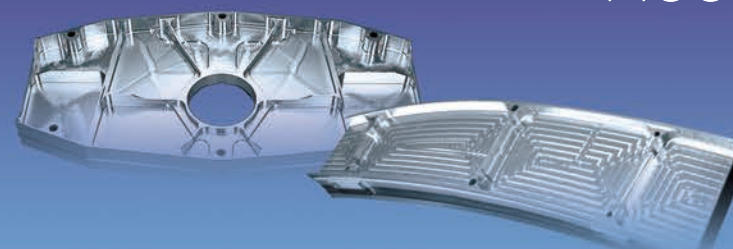
Engine | Turbine Blades ——— P.009



Engine | Blisk ——— P.013



Wing parts | Aluminum flat large parts — P.005



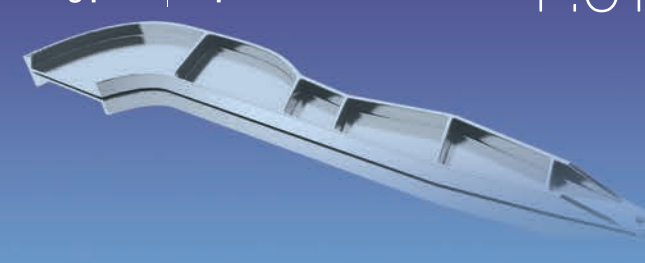
Wing parts | Titanium Bracket parts — P.007



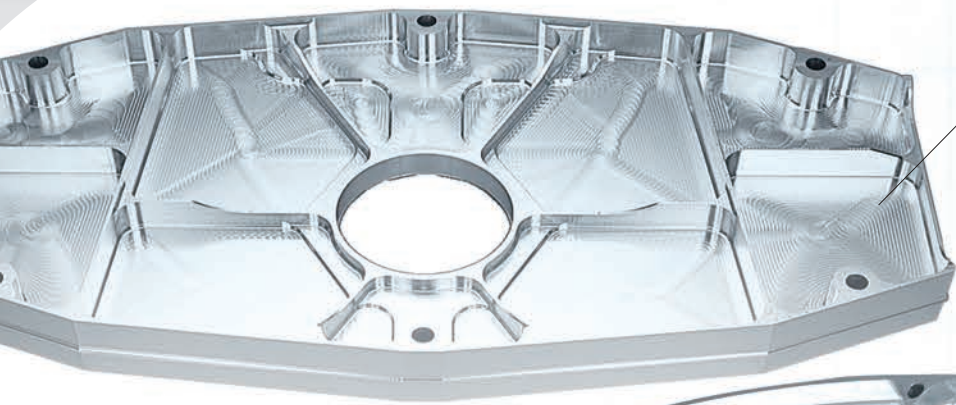
Under side | Landing gear ——— P.011



Wing parts | Flap track ——— P.015







Sample Parts

Material: Aluminum  
Tooling: Φ50mm(2") Cutter  
Cutting condition: S12000



Sample Parts

Material: Aluminum  
Tooling: Φ80 (3") Cutter  
Cutting condition: S8000

Large flat aluminum parts machined with KCV 5AX series!

High speed 5 axis machining will reduce cycle time

Excellent chip evacuation reduces down time

Easy accessibility aids setup of large parts up to 138" (3500mm) long



KCV-800-5AX  
Head tilt 5 axis Vertical Machining Center  
KCV-1000-5AX  
Head tilt 5 axis Vertical Machining Center

Performance

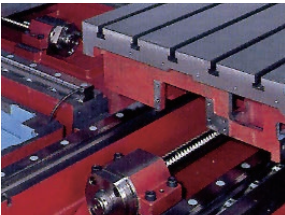
High Speed cutting

Smooth 5 axis movement is essential to enable high speed cutting and processing of thin ribs. The combination of worm gears for the spindle axis mechanism and rigid linear guide XYZ feed system enables a high-speed response and powerful cutting performance. The powerful 101HP 50 taper spindle will process large aluminum workpieces quickly.

Tilting and swiveling structure of the spindle (±40 degree)



Rigid Linear guide feed system



101HP 50 Taper 12,000RPM Spindle



Excellent Chip evacuation

When 95% of a large aluminum block becomes chips it is very important to handle all of these chips to prevent machine problems and reduce maintenance time. Chips on the front face of the column and both sides of the X axis shutter are flushed out into the 4 chip augers located right and left of the column and on the front and back sides of the table.



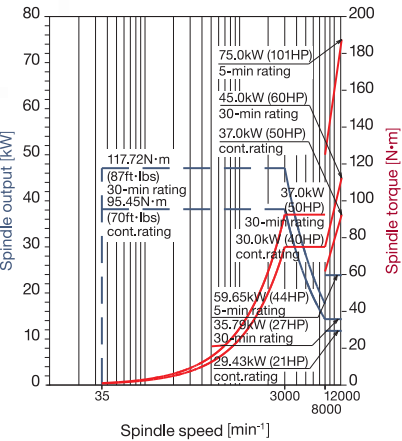
The picture shows KCV1000

Very easy accessibility

The column traverse structure ensures the operator enjoys easy accessibility. In other machines long workpiece setup can be a challenge but our structure will reduce this challenge increasing the operator's performance.



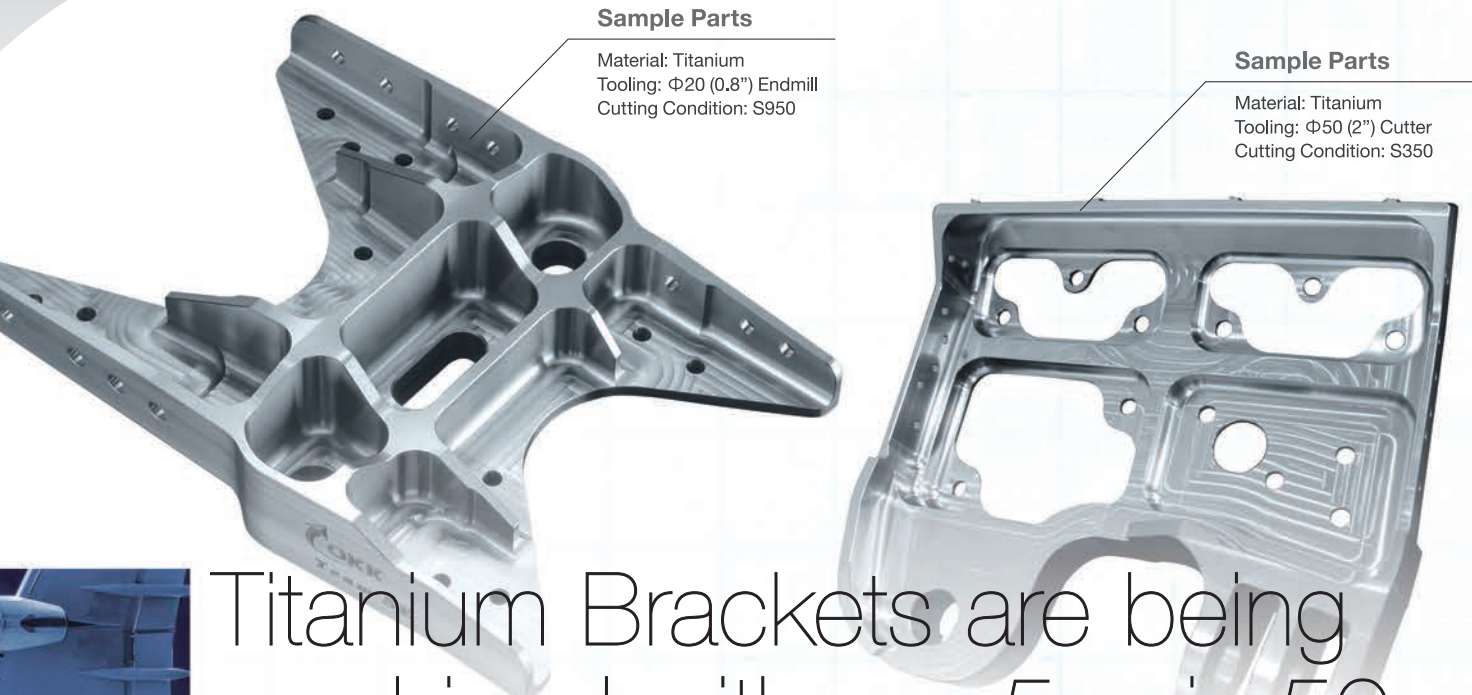
Highest Horse Power Spindle in its class



Machine Specification

Type		Head tilt 5 axis Vertical Machining Center	
Model		KCV800 5AX	KCV1000 5AX
Table size	mm	3300(130") x 820(32")	3800(150") x 1020(40")
Travel (X/Y/Z)	mm	3050(120") / 820(32") / 720(28")	3500(14") / 1020(40") / 720(28")
Travel (A/B)	deg.	±40	±40
Spindle	min <sup>-1</sup>	12000	12000





Sample Parts

Material: Titanium  
Tooling: Φ20 (0.8") Endmill  
Cutting Condition: S950

Sample Parts

Material: Titanium  
Tooling: Φ50 (2") Cutter  
Cutting Condition: S350

Titanium Brackets are being machined with our 5 axis 50 tapers and boxway horizontals!

Powerful 50 taper spindle will reduce roughing cycle time

5 axis application can integrate processes

Unmanned operation with automatic systems will reduce errors and costs



VG5000  
Vertical 5 Axis

HM-X6000  
Horizontal 5 Axis

MCH5000R  
BOXWAY 3 stepped Gear Horizontal Machine

Performance

Powerful 50 taper spindle

50 Taper 54HP 600Nm  
12,000RPM Spindle on  
VG5000 & HM-X6000



50 Taper 3 stepped gear on MCH5000R



MCH5000R Titanium Cutting Data		
Spindle Speed (min <sup>-1</sup> )	Feed rate mm/min (inch/min)	W.O.C. mm (inch)
240	250 (9.8)	40 (1.57)
D.O.C. mm (inch)	MATL Removal cm <sup>3</sup> /min (inch Cu/min)	Spindle Load (%)
60 (2.4)	600 (36.6)	96



Insert End mill Φ3.15" x5t

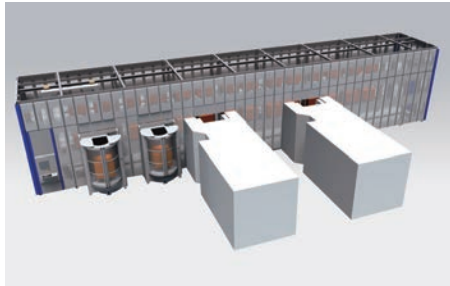
Unmanned Operation

Matrix magazine and FASTEMS multi pallet system is available.  
It is possible to expand the system after installation.

Matrix MG system

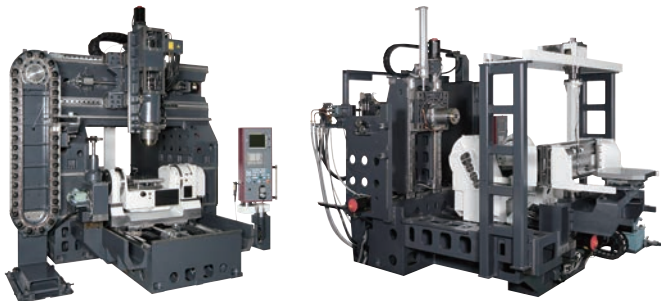


Multi pallet system



Integrate the process with 5AX

5 axis operation eliminates the loss of accuracy and burden on the operators caused by multi-setup operations and shortens lead time through process integration.



Machine Specification

Type	Table trunion 5 axis Vertical Machining Center	
Model	VG5000	
Max work Dia. x Height	mm	Ø700(28") x 550(22")
Travel (X/Y/Z)	mm	760(30") x 900(35") x 610(24")
Travel A (Table turning)	deg.	-120 to 30
Travel C (table turning)	deg.	360
Spindle	min <sup>-1</sup>	12000

Type	Box way Horizontal Machining	
Model	MCH5000R	
Table size	mm	500(20") x 500(20")
Travel (X/Y/Z)	mm	800(32") x 700(28") x 880(35")
Spindle	min <sup>-1</sup>	6000

Type	Table trunion 5 axis HM-X6000	
Model	HM-X6000	
Max work Dia. x Height	mm	600(24") x 600(24")
Travel (X/Y/Z)	mm	1050(41") x 900(35") x 820(32")
Travel A (Table turning)	deg.	20 to -110
Travel B (Table turning)	deg.	360
Spindle	min <sup>-1</sup>	12000



Sample Parts

Material: SUS Alloy  
Tooling: Φ12 R4 Radius endmill  
Cutting condition: S6000

# Cut Turbine Blades efficiently at high speed!

- Eliminate special tooling for shroud
- Efficient roughing process with 30HP powerful spindle
- Eliminate work piece twisting



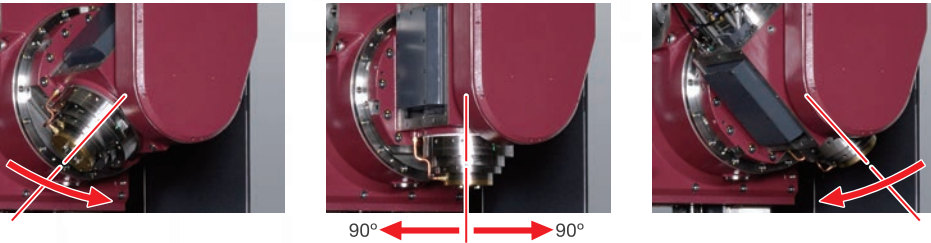
**VM-X53R/250B**  
VM-X53R/250B Head swivel 5 axis Vertical Machining Center

Performance

90 degree swiveling head

The roller gear mechanism used for driving the B axis combines the features of a worm gear and a rolling drive system to support the machine's high torque, high efficiency, smooth movements and high precision machining.

Spindle swiveling structure (±40 degree)



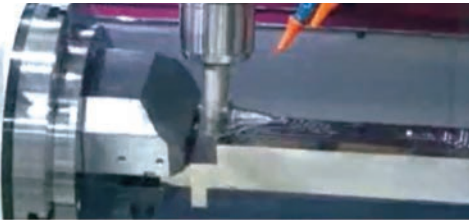
Eliminate special tools for the shroud area

The edge wall of the shroud is very difficult to approach. It normally requires a special shape endmill to make the radius. A swivel head spindle makes it easier to access and shape with a standard ball endmill.



Efficient roughing process

Heavy duty roughing processes are possible with the No.40 12,000RPM 30HP Spindle.



Eliminate work piece twisting

Optional dual 100RPM direct drive synchronized motor table

The workpiece will be clamped with pretention so that it has increased rigidity and eliminates twisting. Blades of up to 400mm in length are possible on the VM-X53R/250B.



Machine Specification

Type		Head swivel 5 axis Vertical Machining Center
Model		VM-X53R/250B
Machine Table size	mm	1250(49") x 560(22")
Rotary table	Φmm	250(10")
Travel (X/Y/Z)	mm	820(32") x 450(18") x 510(20")
Travel A (Table turning)	deg.	360
Travel C (Head swiveling)	deg.	±90
Spindle	min <sup>-1</sup>	12000





Landing gear components are easily processed in our large capacity 5 axis series machines!

- Complex work is simplified with 5 axis applications
- Effectively handle deep bore cutting
- Excellent contour machining capability



HM1600

Horizontal Machine (1600 x 1250 pallet)

VP9000-5AX

Vertical 5AX machine (Ø800/31.5" swing diameter)

VM940R

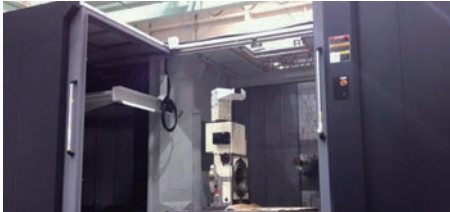
Boxway Vertical machine with 4th axis rotary table

Performance

5 axis application for complex work

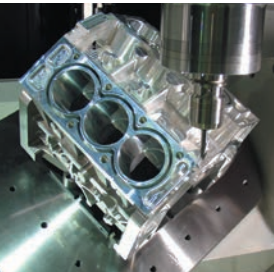
HM1600 with rotary table

Adding a rotary table on the B axis is a popular option for processing complex parts.



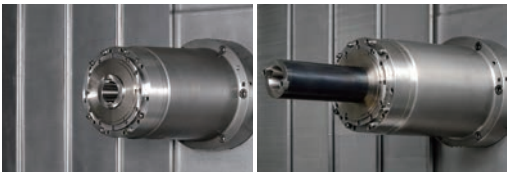
VP9000 5AX for 800mm size work

Capable of high speed 5 axis machining of large 800mm (31.5") diameter work piece by utilizing 25 min<sup>-1</sup> tilt axis feed and 50 min<sup>-1</sup> rotary axis feed.



Excellent for deep bores

The two position locking quill spindle can effectively process parts which would traditionally require two operations or a separate boring machine.



Quill spindle standard position: 0mm(0")  
Quill spindle extended position: 300mm(11.8")

Contour Machining Capability

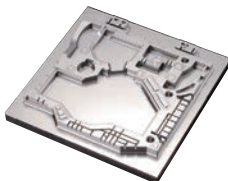
High-accuracy Machining

HQ Control / Hyper HQ Control

**Pre-interpolation acceleration/deceleration function:**  
This function minimizes the machined shape errors and the reduction in the radius error when executing the circular cutting command.

**Optimized corner deceleration function:**  
This function assesses the targeted machining program vector and decelerates at the corners producing highly accurate machined edges.

**Freed forward control function:**  
This function enables the control to minimize servo errors. Combined with the Hyper HQ control, it improves the processing of minute line segment data to machine the free-form surfaces such as dies and enables a substantial increase in speed and accuracy.



Hyper HQ control consists of the high speed processor, used to process data for high-speed, precise machining of workpieces of any shape. This includes a look ahead multiple block (multi-buffer). It automatically detects the corner on parts from the NC part program, and controls the feedrate so that it does not exceed the machine's permissible acceleration rate.

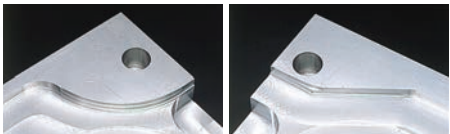
Minute Line Segment Processing Capability: N730

Specification	Line segment processing speed	Command
Hyper HQ control mode B	151m/min (5945 lpm)	G05 P2: ON G05 P0: OFF

Minute Line Segment Processing Capability: F31i-B

Specification	Line segment processing speed	Command
Hyper HQ control mode B	150m/min (5906 lpm)	G05.1 Q1: ON G05.1 Q0: OFF

\*The above values show (theoretical) maximum speeds for processing 1-mm-segment blocks constructing a straight line. Actual processing speeds depend on the type of the machine and NC data.



Machine Specification

Type	Horizontal Machining	
Model	HM1600	
Table size	mm	1600(63") x 1250(49")
Travel (X/Y/Z)	mm	2400(94") x 1650(65") x 1750(69")
Spindle	min <sup>-1</sup>	4000/6000/8000

Type	Boxway Vertical Machining Center	
Model	VM940R	
Machine Table size	mm	2300(91") x 940(37")
Travel (X/Y/Z)	mm	2060(81") x 940(37") x 820(32")
Gear Spindle	min <sup>-1</sup>	4500/6000/8000

Type	Table trunion 5 axis Vertical Machining	
Model	VP9000 5AX	
Max work Dia. x Height	mm	Ø800(31") x 630(25")
Travel (X/Y/Z)	mm	820(32") x 1020(40") x 560(22")
Travel A (Table turning)	deg.	-120 to 30
Travel C (Table turning)	deg.	360
Spindle	min <sup>-1</sup>	12000





# High accuracy 5 axis machining of Blisks!

- Superior 5 axis simultaneous dynamics
- 20,000RPM MS spindle and roller guide will provide stable cutting
- Excellent Accessibility aids set up



**VC-X500**  
Vertical 5 axis machine (Φ700/27.6" swing diameter)

**VP9000-5AX**  
Vertical 5AX Machine (Φ800/31.5" swing diameter)

## Performance

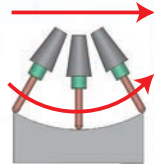
### Superior 5 axis simultaneous dynamics

#### 5 axis Control Function

##### Tool center point control

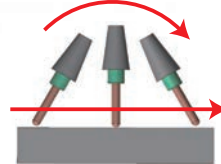
Tool Center Point Control simplifies 5 axis machining by controlling tool movement at the tool center, even if the tool axis direction changes. Tool tip speed is maintained and high-quality surfacing achieved.

##### Conventional movement



Produces errors due to movement of rotation axis

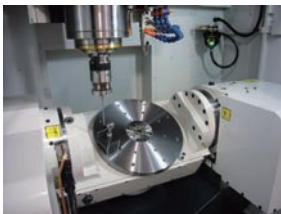
##### This function's movement



Location of the tool tip as instructed

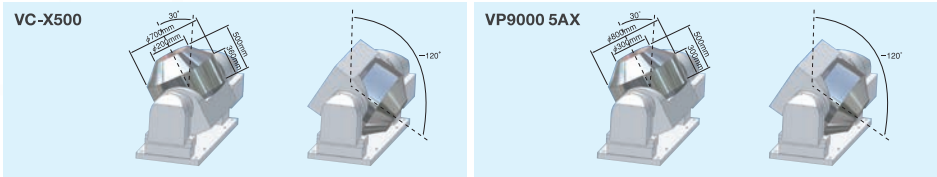
#### A<sup>5</sup> system (Option)

In the machining with the 5 axis machining center, the geometric errors (rotation axis's inclination and displacement) influence the machining accuracy largely. This function automatically measures and corrects the geometric errors with the touch sensor. It makes the high-accuracy 5 axis indexing and the high quality simultaneous 5 axis machining even better.



### Embedded high speed rotary table

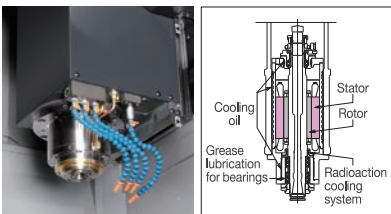
Delivering high-speed 5 axis machining of up to 800mm (31.5") diameter work pieces with a 25 rpm trunnion feed and 50 rpm feed. Rotary encoder is standard on table.



### 20,000RPM MS spindle and oversized roller guides provide stable cutting

#### Standard provision of 12000min<sup>-1</sup> spindle

Cutting performance is largely improved by the use of the motorized spindle (MS) which integrates a motor covering a wide and high output range. Acceleration time of the spindle can be as short as only 1.5 seconds from the non-operating state to the speed of 12000min<sup>-1</sup>. 22/18.5kW (30/25HP) high-power spindle or high-speed spindle of 20000min<sup>-1</sup> can also be adopted optionally.



#### Powerfully Smooth Feed

Utilizing the larger than normal linear roller guides has doubled the guide-way rigidity. The high-rigidity guide combined with the large-diameter ball screws contributes to a vast improvement in cutting performance.



### Excellent Accessibility for set up

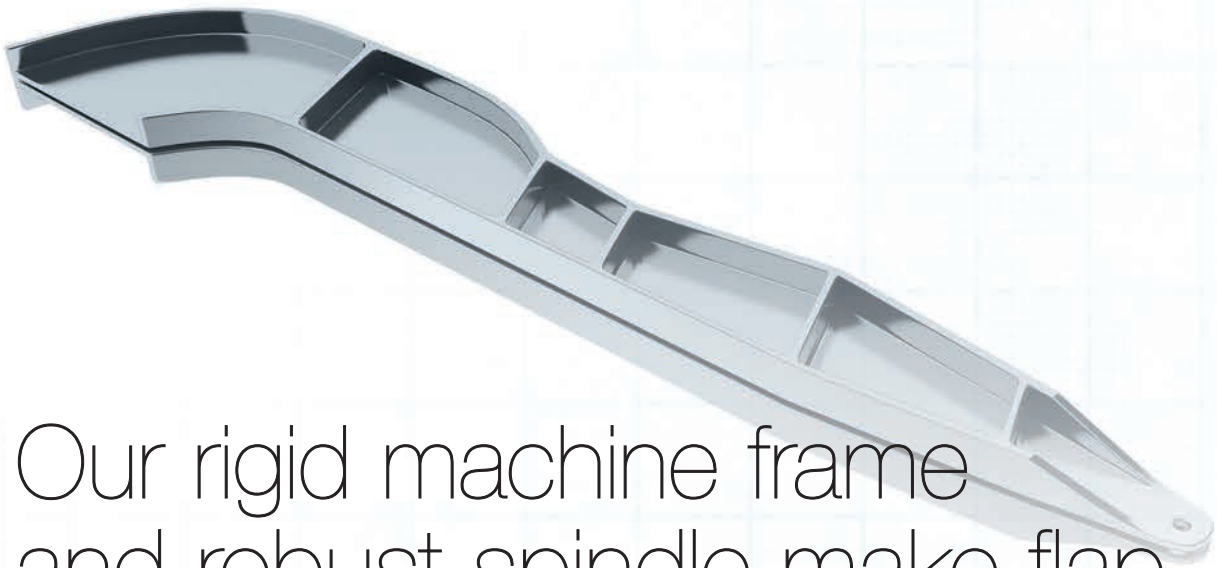


## Machine Specification

Type	Table trunion 5 axis Vertical Machining
Model	VC-X500
Max work Dia. x Height	mm Φ700(28") x 500(20")
Travel (X/Y/Z)	mm 700(28") x 850(33") x 610(24")
Travel A (Table turning)	deg. -120 to 30
Travel C (Table turning)	deg. 360
Spindle	min <sup>-1</sup> 12000/20000

Type	Table trunion 5 axis Vertical Machining
Model	VP9000 5AX
Max work Dia. x Height	mm Φ800(31") x 630(25")
Travel (X/Y/Z)	mm 820(32") x 1020(40") x 560(22")
Travel A (Table turning)	deg. -120 to 30
Travel C (Table turning)	deg. 360
Spindle	min <sup>-1</sup> 12000/20000





Our rigid machine frame and robust spindle make flap track processing simple!

Reduce cycle time with a 3 stepped gear spindle and optimized feed control

Tool damage prevention with Soft AC

Enhanced efficiency due to excellent chip evacuation

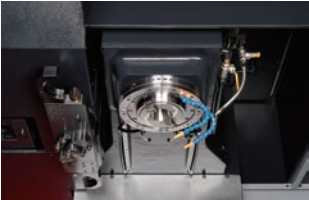


Performance

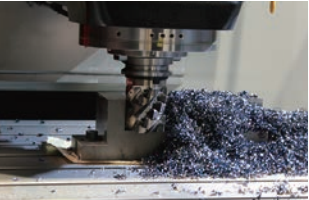
Largest Horse Power Spindle in its class

3 stepped gear spindle will reduce roughing process

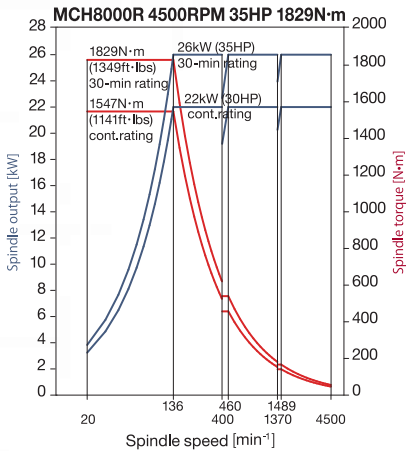
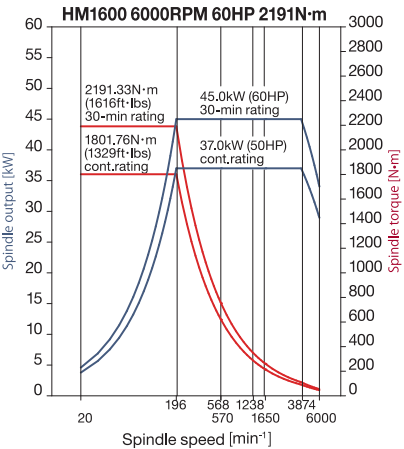
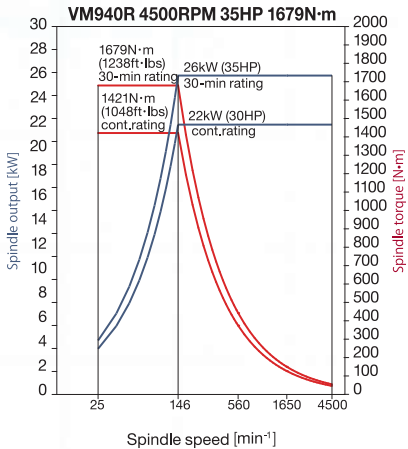
In order to perform at maximum cutting capability, the HM1600 and VM940R have adopted a stepped gear spindle and Large(Φ120mm /dia.4.72") bearing. The HM1600 has a 60HP spindle motor. It exhibits unrivaled cutting capability.



Picture shows VM660R



Picture shows VM660R 3 heavy duty cutting



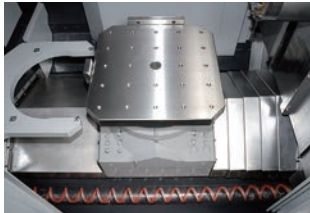
Prevent tools from being damaging and optimize feed rates

Soft AC automatically monitors cutting loads to protect the machine and expand the service life of tools. Furthermore it will reduce cycle times by applying optimized feed rate override control.

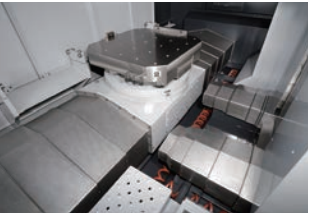


Excellent chip evacuation

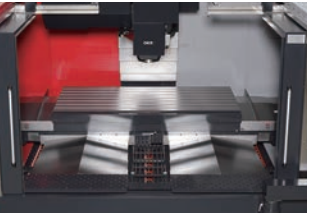
Large volume of chips are evacuated with chip augers.



Picture shows HM5000/6300S



Picture shows MCH8000R



Picture shows VM940R

Machine Specification

Type	Horizontal Machining
Model	HM1600
Table size	mm 1600(63") x 1250(49")
Travel (X/Y/Z)	mm 2400(94") x 1650(65") x 1750(69")
Spindle	min⁻¹ 4000/6000/8000

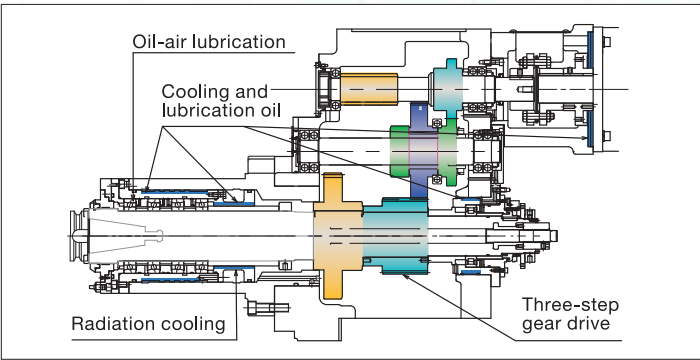
Type	Boxway Horizontal Machining
Model	MCH8000R
Table size	mm 800(32") x 800(32")
Travel (X/Y/Z)	mm 1300(51") x 1200(47") x 1200(47")
Spindle	min⁻¹ 4500/6000

Type	Boxway Vertical Machining Center
Model	VM940R
Machine Table size	mm 2300(91") x 940(37")
Travel (X/Y/Z)	mm 2060(81") x 940(37") x 820(32")
Gear Spindle	min⁻¹ 4500/6000/8000



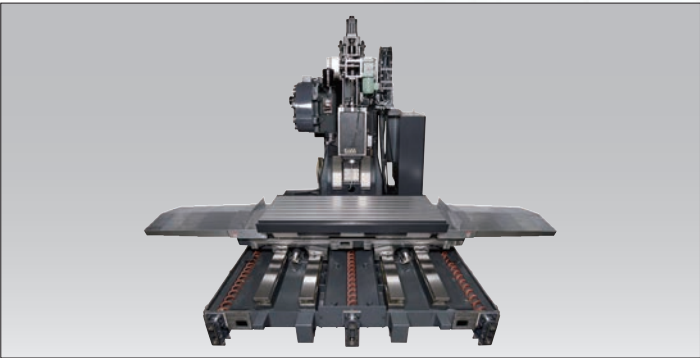
3 stepped Gear Spindle

3 stepped gear provides exceptional torque. On the HM1600 a 60HP spindle motor is available to maximize material removal rates.



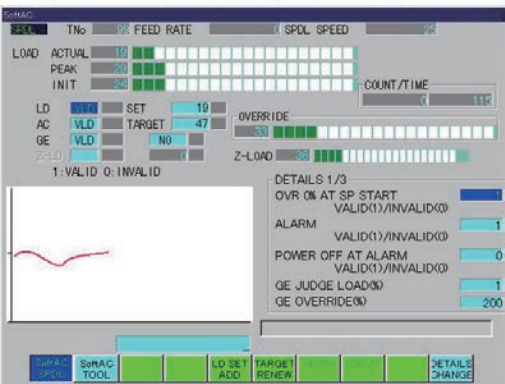
BOXWAY

Box way models are available with enhanced rigidity to absorb cutting vibrations, increasing surface finish and extending tool life.



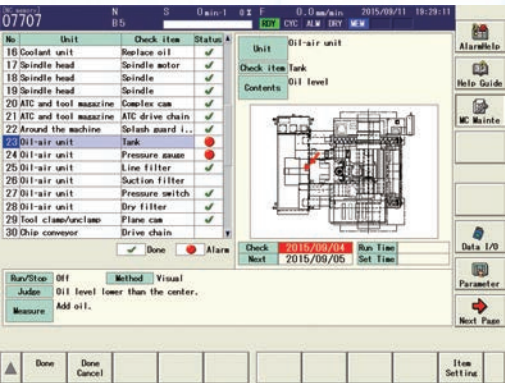
Soft AC

Soft AC automatically monitors cutting load to protect the machine and expand the service life of tools. Furthermore it will reduce cycle times by applying optimized feed rate override control.



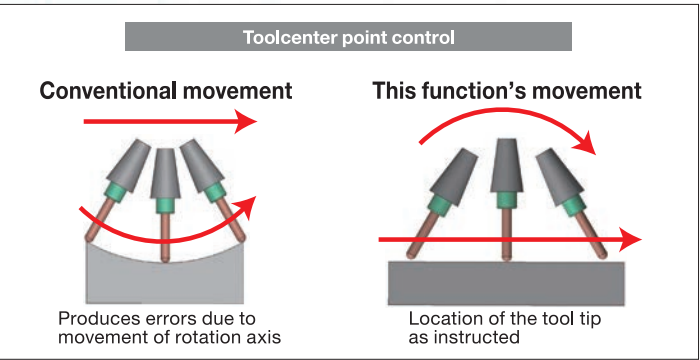
OKK Maintenance Check function

- Displays a to-do list for maintenance.
- Maintenance history will be recorded.
- Warning and alarm will remind customer when machine maintenance is required.



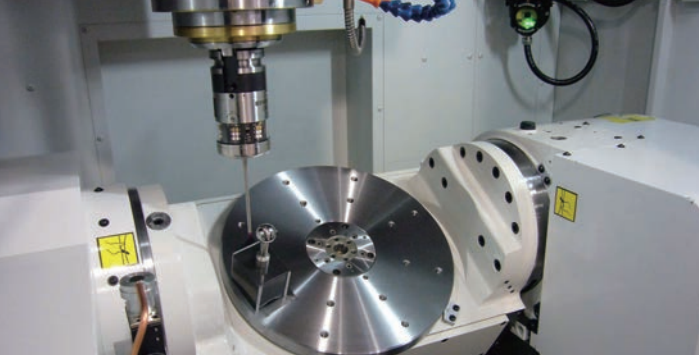
Tool center point control

Tool Center Point Control simplifies 5 axis machining by controlling tool movement at the tool center, even if the tool axis direction changes. Tool tip speed is maintained and a high quality surface is achieved.



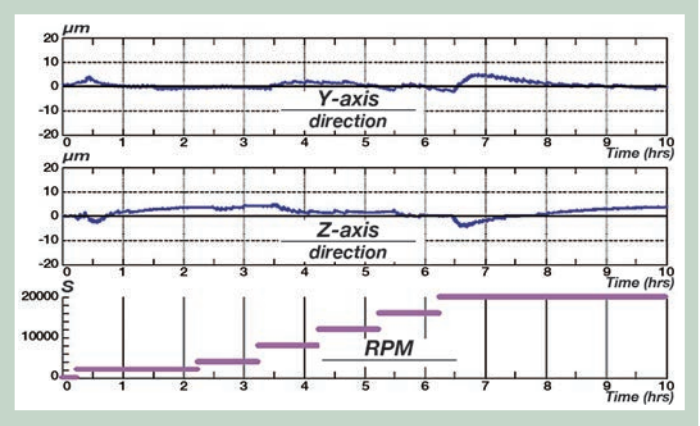
A<sup>5</sup> SYSTEM

In a 5 axis machining center, the geometric errors (rotational axes inclination and displacement) greatly influence accuracy. This function uses a touch sensor to automatically measure and correct for these geometric errors enabling high-accuracy 5 axis indexing and the high quality simultaneous 5 axis machining.



Soft Scale II m

Spindle and axis thermal compensation reduces thermal displacement of the spindle and axes. Soft Scale II m constantly monitors the machine movement and temperature of the spindle to compensate for the thermal displacement of the machine using OKK's proprietary Soft Scale algorithm.



Coolant

Coolant is very important for processing hard cutting material. OKK offers additional customized coolant nozzles.







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