Machine Specification Instruction

Model	:	UC Series
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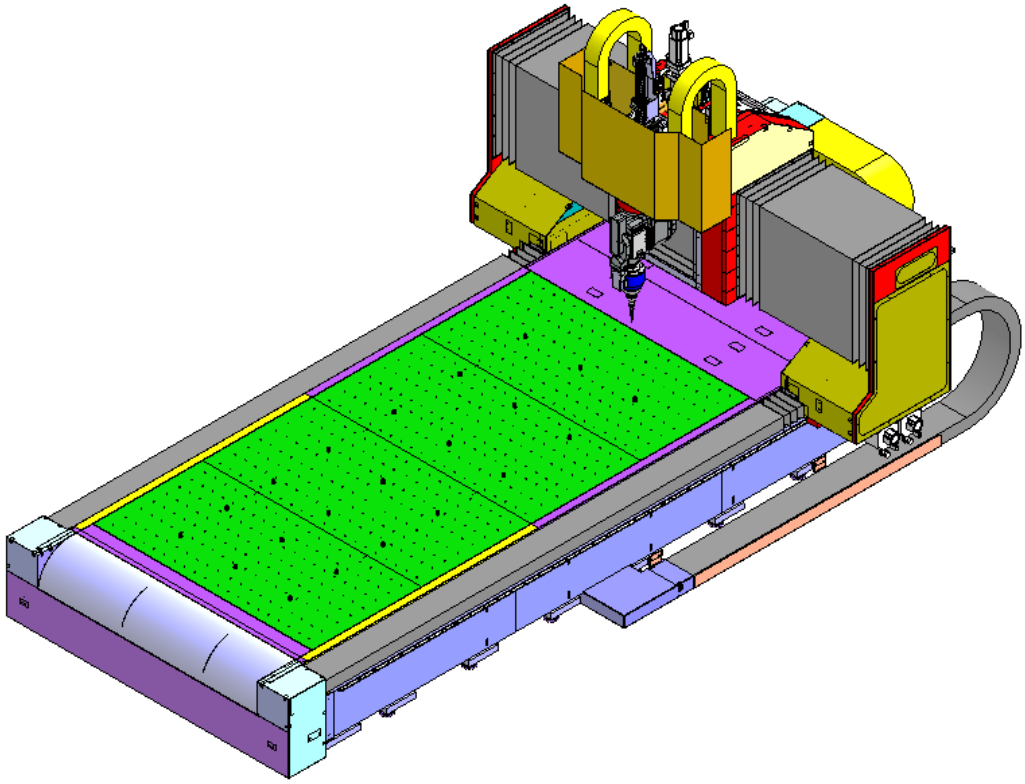
Released Date	:	2019/09



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Version history table：

Version	Date	Page	Change summary	Revised By
18-CA0	2018.08.15		Initial Release.	Dennis.Haung
19-CA0	2019.02.14		Revised power supply.	Dennis.Haung
19-CA0	2019.07.19		Revisesd specification, tool magazine, space, power of three axis motor, foundation type and accuracy inspection report	Andy.Guo

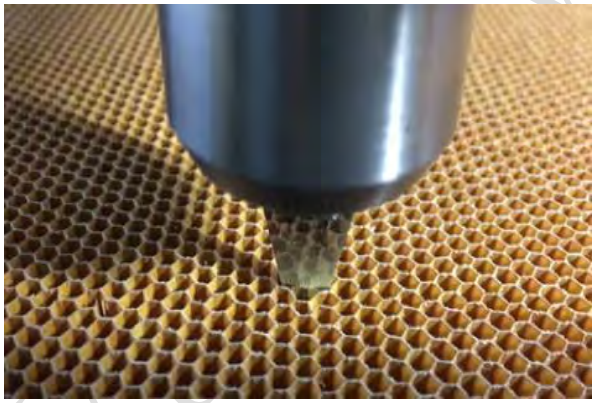
Table of contents

01. Machine Introduction

1.1 High-performance wide applications

In recent years, composite materials have been gradually used in aerospace industry, automobile industry, semiconductor industry, sports industry, biomedical industry and traditional industries. Among them, aerospace structural parts have been modified from the original 70% aluminum alloy structure. For the replacement of composite materials with light weight and high strength, at present, the ratio of new aircraft composite materials has exceeded 50%. The aerospace composite materials include honeycomb structure and laminated composite materials. The honeycomb composite material is also supported by the wing. The main structure, the development of its processing technology is an important issue. The UC series models mainly use honeycomb structure processing as the main design, which can efficiently perform honeycomb structure cutting with different inclinations, and produce various structural shapes that meet the customer’ s need.

A. Industrial processing application examples：

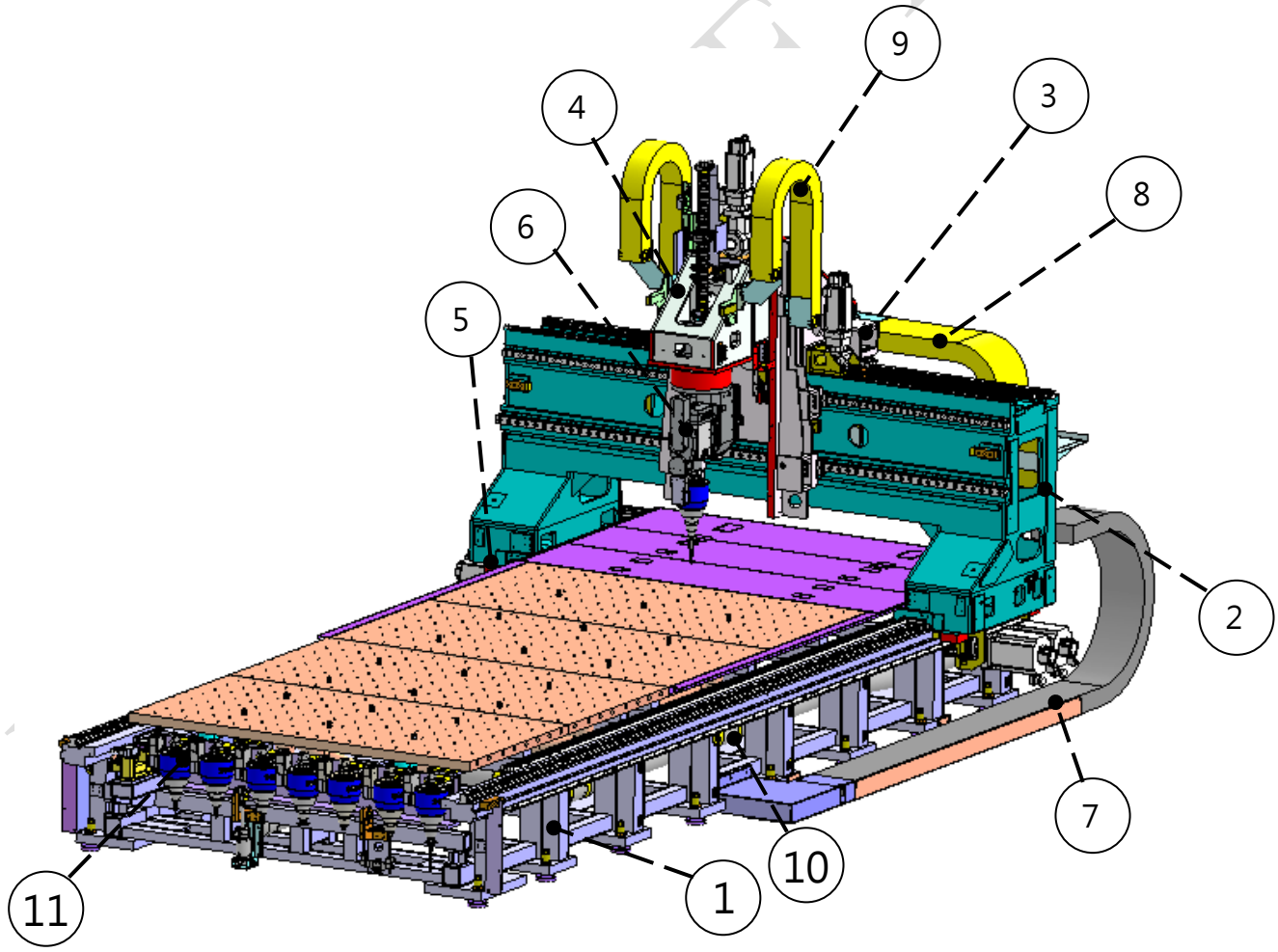
Composite paper honeycomb angle processing - Blade tool processing	
	
Composite paper honeycomb angle processing - Disc tool processing	

1.2 Machine composition

Highly lightweight design, the main components are: column, saddle, head, spindle system, vacuum table

1.3 Major units

No.	Item	No.	Item
1.	Base	9.	Y-axis telescopic cover
2.	Columns	10.	Z-axis telescopic cover
3.	Saddle	11.	Vacuum system
4.	Head seat	12.	ATC/magazine
5.	Vacuum table	13.	
6.	Spindle system(5 axis head)	14.	
7.	X-axis telescopic cover	15.	



02. Specification

2.1 UC-4020 Series

No.	Model	Unit	UC-4020
1	Travel		
1-1	X travel	mm	4,000
1-2	Y travel	mm	2,000
1-3	Z travel	mm	550
1-4	Distance from spindle nose to table	mm	66- 616
2	Table		
2-1	Dimension	mm	4,000 x 2,000
2-3	Workbench trench matrix	mm	20 x 20
2-4	Sealing strip diameter	mm	Ø3.5
3	Spindle(HSD)		
3-1	Spindle model (two axis head + spindle)	-	HS673+ES779L
3-2	Spindle motor	-	HSD
3-3	B/C axis motor	-	SIEMENS
3-4	Spindle speed	rpm	24,000
3-5	Spindle power(S_1/S_6)	kW(HP)	22 / 25
3-6	Spindle taper	-	HSK A63
3-7	B axis rotation angle	°	± 120
3-8	C axis rotation angle	°	± 360
3-9	Two axis head+Spindle weight	kg	100
4	Ultrasonic Oscillator		
4-1	Maximum output power	W	600
4-2	Frequency	Hz	20k±0.3K
5	Feed		
5-1	Rapid feed rate	mm/min	X,Y:40,000 Z:12,000
5-2	Cutting feed rate	mm/min	X,Y,Z:12,000
5-3	X,Y,Z Servo motor (Power / quantity)	kW	X:6.5/4(pcs) Y:2.18/2(pcs) Z:1.30/1(pcs)
6	ATC		
6-1	Tool magazine	-	Flat type
6-2	Tool taper	-	HSK-A63 Ultrasonic Tool
6-3	Capacity	pcs	7
6-4	Ultrasonic-Blade Tool (Shared GFM machine with the same specification blade)	mm	40
6-5	Ultrasonic-Disc Tool (Shared GFM machine with the same specification blade)	mm	Ø50
6-6	Max tool weight	kg	15

7-1	Positioning accuracy(VDI3441)	mm	X: P0.06 Y: P0.06 Z: P0.06
7-2	Repeatability(VDI3441)	mm	X: Ps0.02 Y: Ps0.02 Z: Ps0.02
8	Other		
8-1	Power requirement (Note 1)	kVA	90
8-2	Pneumatic requirement	bar	6
8-3	Machine net weight	kg	8,000
8-4	Space dimension (L*W*H)	m	10 x 6 x 3

* **Note 1:** The total power demand is divided into two parts: the machine and the vacuum pump power:

(1) The power part of the machine contains electrical box and peripheral equipment. The voltage of the electrical box is 400V, and the voltage of peripheral equipment is 220V. It can be converted by 440V transformer, and its connection load is 70kVA.

(2) Vacuum pumped power section, voltage 220V, connected load 20kVA

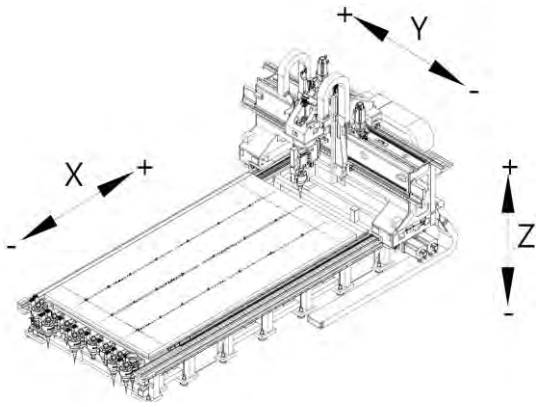
2.2 Standard accessories functions

A. Standard accessories and functions(CNC please refer to manuals of controllers)

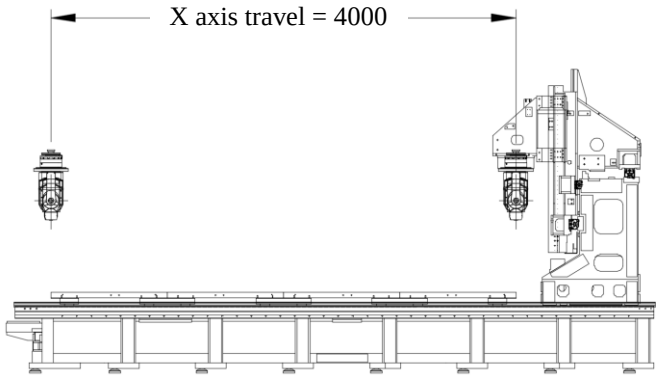
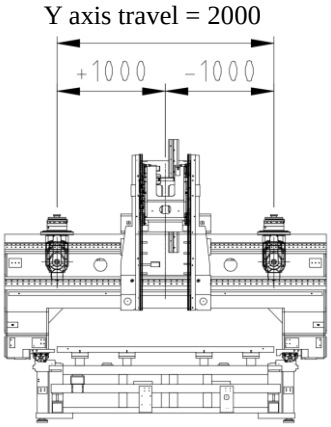
Item	Note
1. HEIDENHAIN iTNC 640 Controller	
2. 24,000rpm HSK-A63 Spindle	HSD-HS673+ES779
3. ATC(Auto Tool Change)	Flat type HSK-A63
4. Ultrasonic Oscillator	Ultrasonic-BladeTool, Ultrasonic-Disc Tool
5. Air blast through spindle	
6. Switch for tool clamping	
7. Independent lubrication oil collector	
8. Centralized auto lubrication system	
9. Landing movement type operation panel	
10. Movable manual pulse generator	
11. X/Y/Z axis linear scale feedback	
12. X/Y/Z axis travel hard limit protection	
13. Vacuum system	Vacuum device
14. Cover fence	Automatic switching device
15. Air conditioner for electrical cabinet	
16. Operation cycle finish and alarm light	
17. RJ45 interface	
18. M30 Auto power off function	
19. Foundation Pads And Bolts Kits	
20. Technical Manuals	Operation,Maintenance Manual and Circuit Diagram

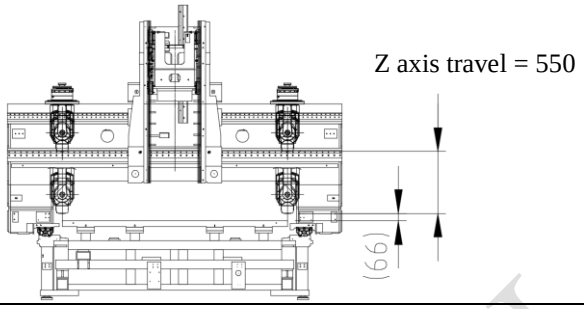
03. Working Range and Appearance Configurations

3.1 Working range of UC-4020(Unit：mm)

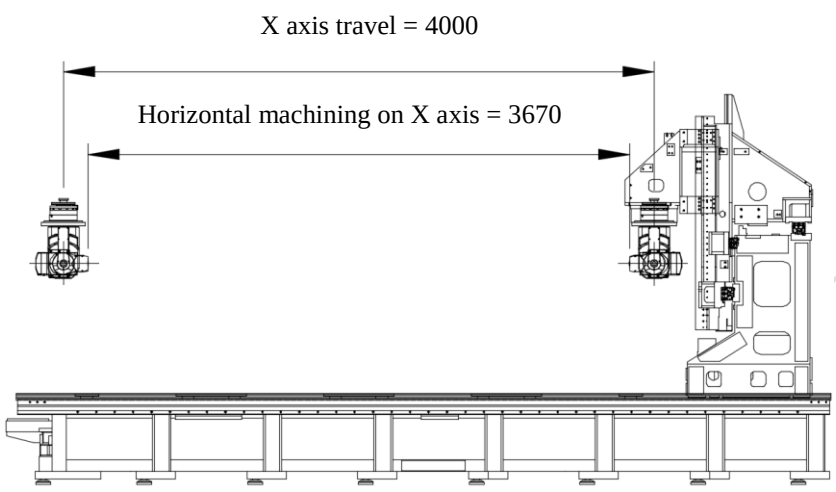
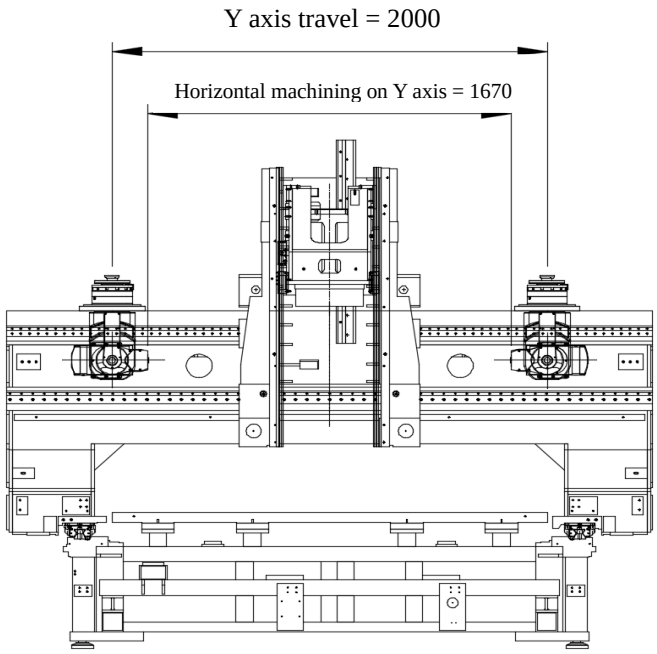
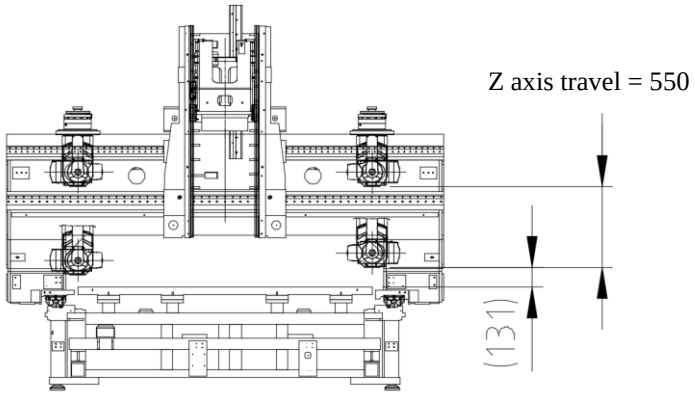


3.1.1 Vertical Machining

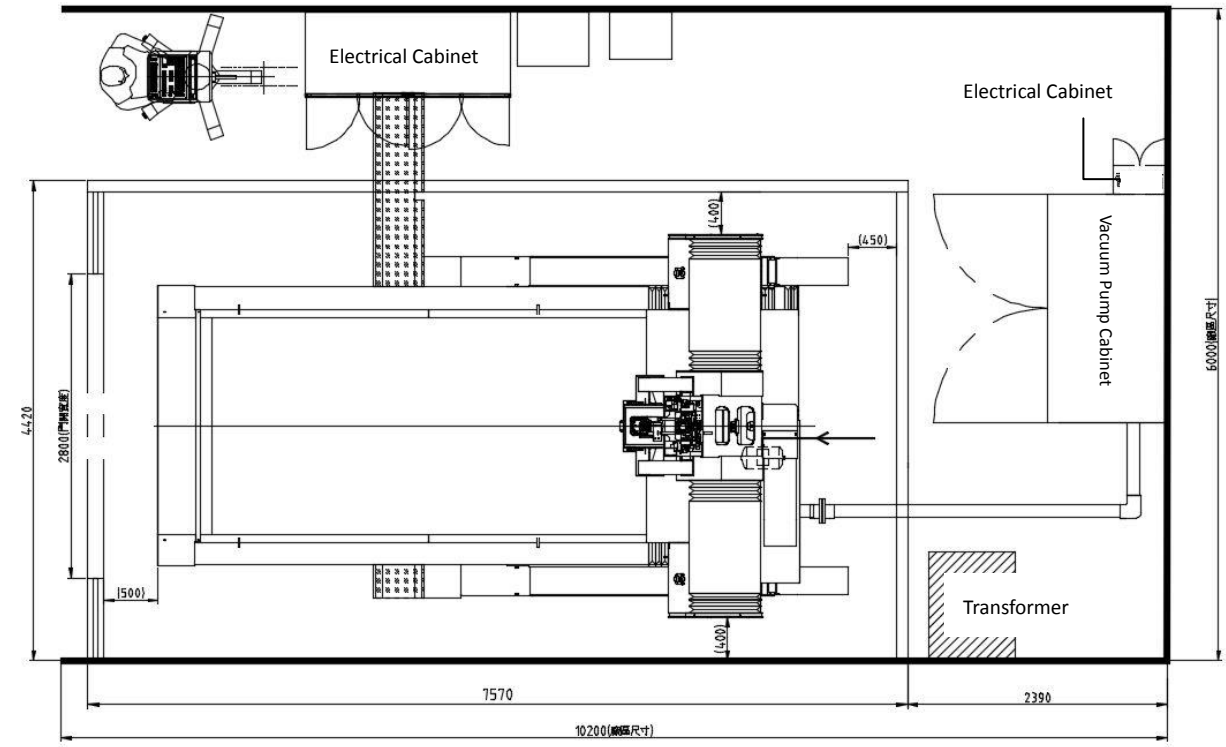
Axis	Rotation Angle	Three Axis Travel
X	B 0°/C 0°	
Y	B 0°/C±90°	

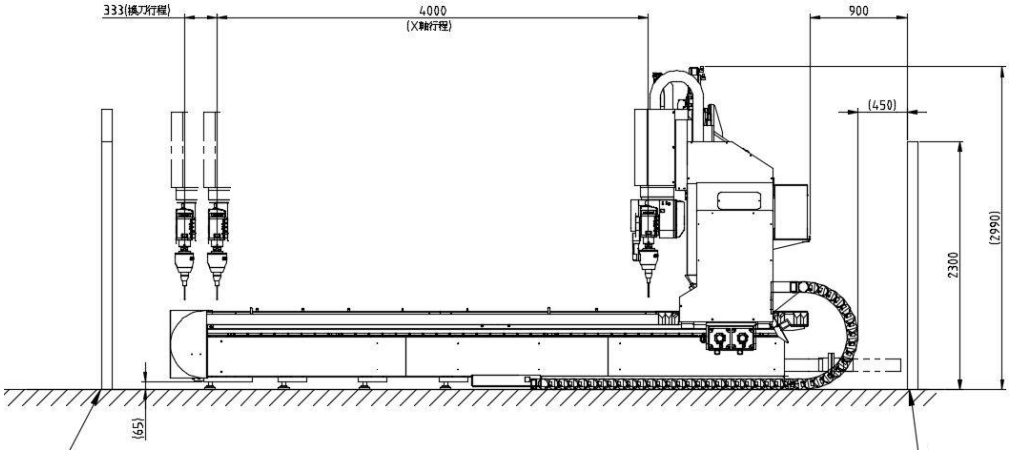
Z	B 0°/C±90°	

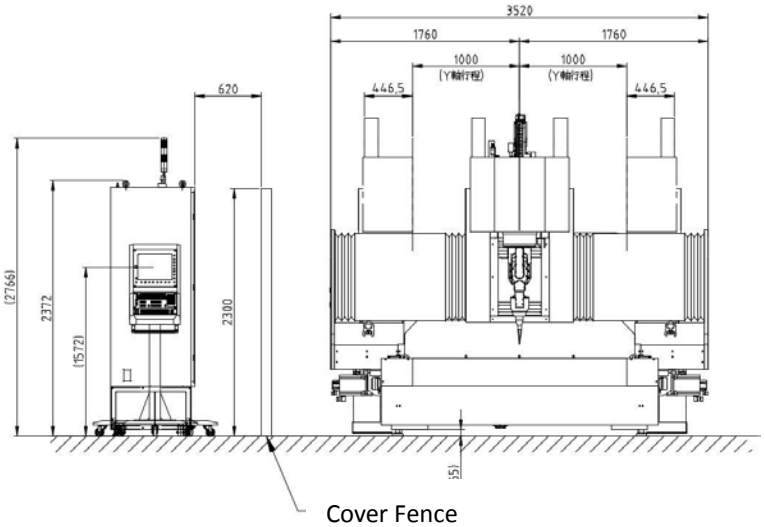
3.1.2 Horizontal Machining

Axis	Rotation Angle	Three Axis Travel
X	B±90°/C 0°	
Y	B±90°/C±90°	
Z	B±90°/C±90°	

3.2 Drawings for UC-4020(Unit：mm)

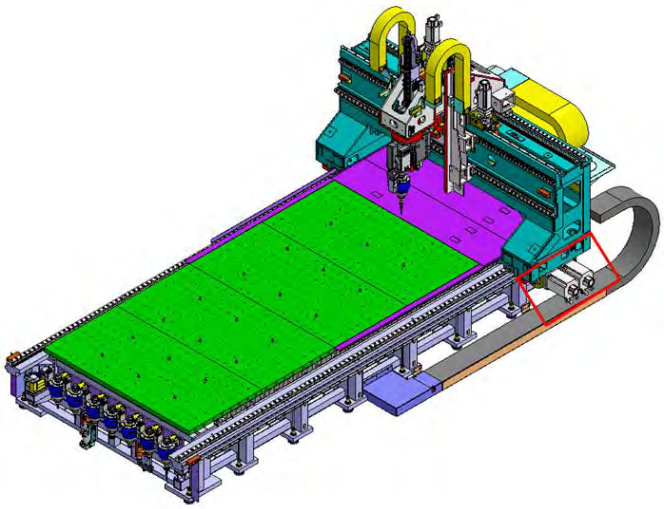


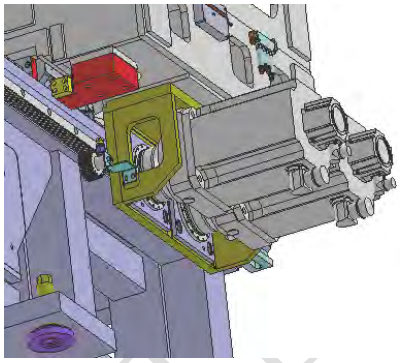




04. Main Technical Specifications

4.1 X -axis Precision Transmission Mechanism





4.1.1 Design Features

(1) With lightweight and dynamic column structure, combined with precision gears and racks, the movement is fast, ensuring the best feed speed.

(2) In order to deal with the oil-free pollution of advanced materials, the slide rail adopts a full grease lubrication device, which provides a small amount of grease lubrication at regular intervals, and designs a grease discharge concentrating device.

(3) The feed system adopts the European standard precision gear row transmission device. The single rail is equipped with two servo motors to eliminate the backlash by electric pre-compression of the motor and has high feed rigid position accuracy.

(4) The feed axis is matched with the high-precision optical scale feedback system, and the low thermal deformation coefficient optical scale position precision control ensures that the linear feed axes are optimally subjected to the ambient temperature and the feed mechanism to drive the optimal thermal displacement.

(5) The feed axis adopts a roller type linear guideway to ensure sufficient accuracy while maintaining long-term operation.

4.1.2 Feed properties

Controllers	Model	Servo Motor Specifications	Power kW	Force kN (Rated/Max.)	Acceleration m/s^2
HEIDENHAIN	UC-4020	QSY 190C EcoDyn	6.5	4.1/14	3

4.1.3 X major configurations

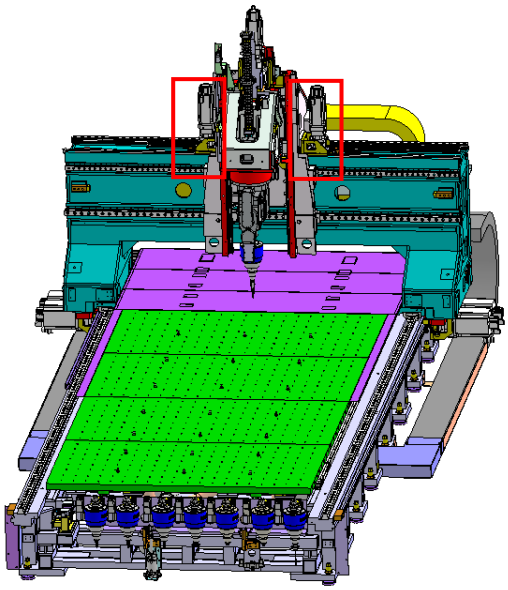
A. Feed axis gear and row specifications:

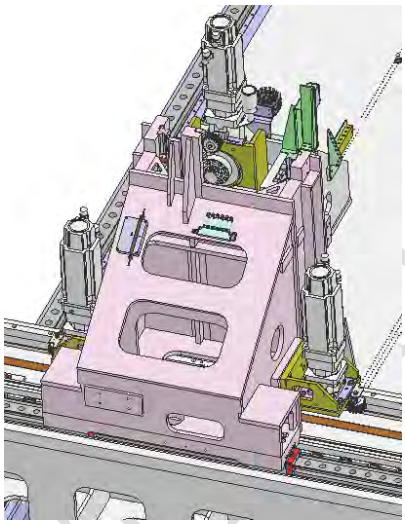
Feed Axis	Specification	Accuracy	Tooth type	Modulus	Pressure Angle (°)	Length (mm)
X axis	Gear：ZTR314S PH521F0100 MEL/38	Q5	Involute Spiral	3	19.5283	5,000
	Row：ATLANTA2930100	Q6				

B. Feed axis linear way specifications:

Feed Axis	Way Width (Units: mm)	Way Quantity	Block Quantity	Block Quantity	Class	Lubrication
X axis	53	2	Heavy loading roller type	4	G2	Oil

4.2 Y -axis precision transmission mechanism





4.2.1 Design Features

(1) In order to deal with the oil-free pollution of advanced materials, the slide rail adopts a full grease lubrication device, which provides a small amount of grease lubrication regularly, and designs a grease discharge concentrating device.

(2) The feed system adopts the European standard precision gear row transmission device, with 2 servo motors, to eliminate backlash with electric pre-compression of the motor, and has high feed rigid position accuracy.

(3) The feed axis can be matched with a high-precision optical scale feedback system, and the low thermal deformation coefficient optical scale position accuracy control ensures that the linear feed axes are optimally subjected to the ambient temperature and the feed mechanism to drive the optimal thermal displacement.

(4) The feed axis adopts a roller type linear guideway to ensure sufficient accuracy while maintaining long-term operation.

4.2.2 Feed properties

Controller	Model	Servo Motor Specifications	Power kW	Force kN (Rated/Max.)	Acceleration m/s^2
HEIDENHAIN	UC-4020	QSY 116J	2.18	0.5/2.9	3

4.2.3 Y -axis major configurations

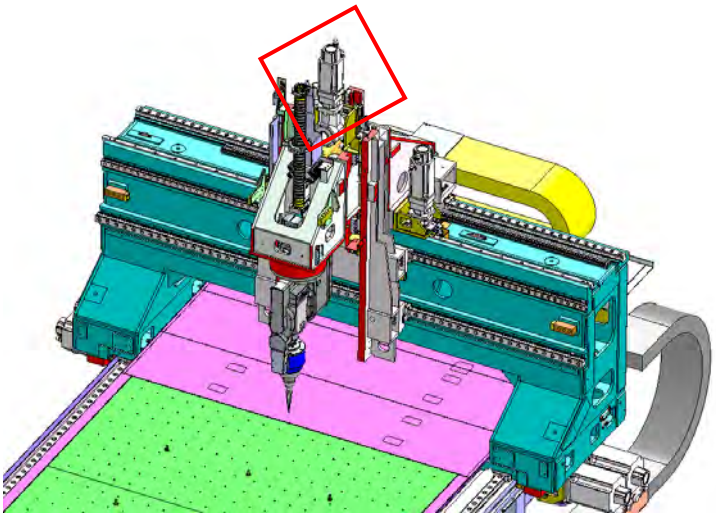
A. Feed axis gear and row specifications:

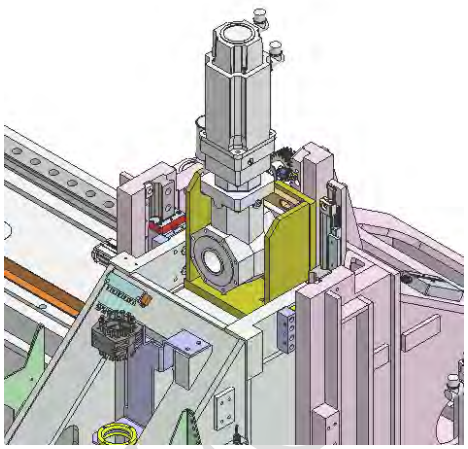
Feed Axis	Specification	Accuracy	Tooth type	Modulus	Pressure Angle (°)	Length (mm)
Y axis	Gear : ZV318SSPH522_0200 ME/24	Q5	Involute Spiral	3	19.5283	3,000
	Row : ATLANTA2930105	Q6				

B. Feed axis linear way specifications:

Feed Axis	Way Width (Units: mm)	Way Quantity	Block Quantity	Block Quantity	Class	Lubrication
Y axis	45	2	Heavy loading roller type	4	G2	Oil

4.3 Z -axis Precision Transmission Mechanism





4.3.1 Design features

(1) In order to deal with the oil-free pollution of advanced materials, the slide rail adopts a full grease lubrication device, which provides a small amount of grease lubrication regularly, and designs a grease discharge concentrating device.

(2) The feed system adopts the European standard precision gear row transmission device with high feed rigid position accuracy.

(3) The feed axis can be matched with a high-precision optical scale feedback system, and the low thermal deformation coefficient optical scale position accuracy control ensures that the linear feed axes are optimally subjected to the ambient temperature and the feed mechanism to drive the optimal thermal displacement.

(4) The feed shaft adopts a roller type rail to ensure sufficient accuracy while maintaining long-term operation.

4.3.2 Feed properties

Controller	Model	Servo Motor Specifications	Power kW	Force (Rated/Max.) kN	Acceleration m/s^2
HEIDENHAIN	UC-4020	QSY 116C	1.30	0.2/0.6	3

4.3.3 Z-axis major configuration

A. Feed axis gear and row specifications:

Feed Axis	Specification	Accuracy	Tooth type	Modulus	Pressure Angle (°)	Length (mm)
Z axis	Gear：ZTR316S PH722F0400 ME/24	Q5	Involute Spiral	3	19.5283	1,000
	Row：ATLANTA2930105	Q6				

B. Feed axis linear way specifications:

Feed Axis	Way Width (Units: mm)	Way Quantity	Block Quantity	Block Quantity	Class	Lubrication
Z axis	34	2	Heavy loading roller type	4	G2	Oil

4.4 Vacuum Table Specification：

Unit:mm

Total Table Dimension	4,000 mm(X Direction) x 2,000 mm(Y Direction)
Single Table Dimension	1,000 mm(X Direction) x 2,000 mm(Y Direction)
Table Quantity	4
Total PIN Quantity	21(For Fixture)
Groove Pitch	20 x 20 mm
Sealing Strip Diameter	Ø 3.5 mm
Table Material	Aluminum
Number of Suction Holes on the Top of Table	160 PCS

- Relative Dimension

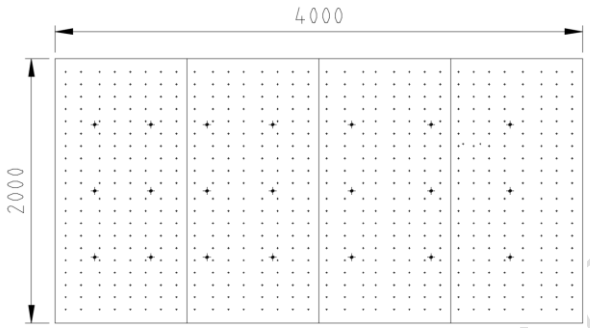
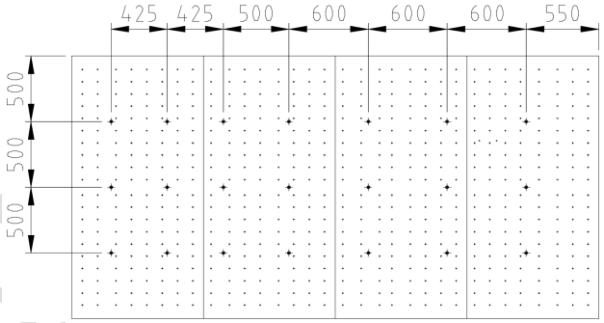
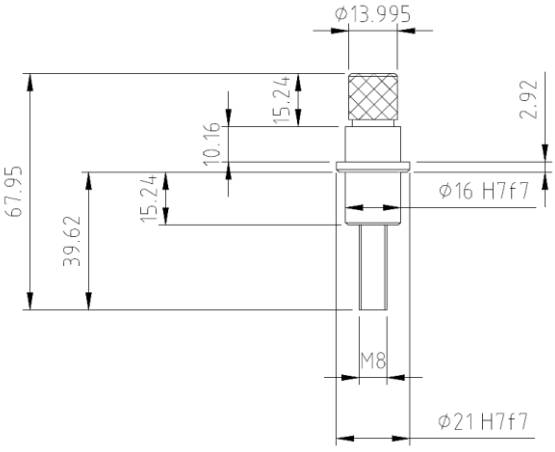


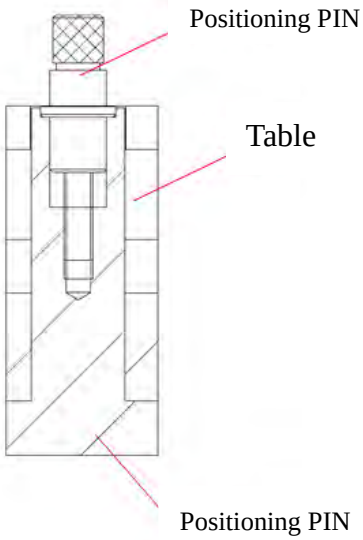
Table Surface Dimension



Positioning PIN Distance



Positioning PIN Size



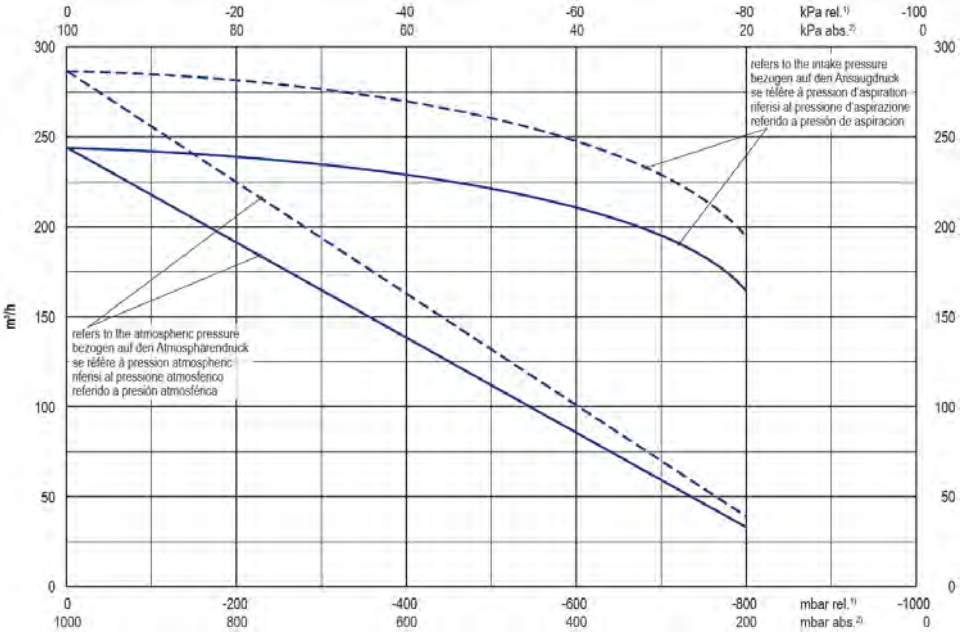
Positioning PIN and Table Assembly

4.5 Vacuum System

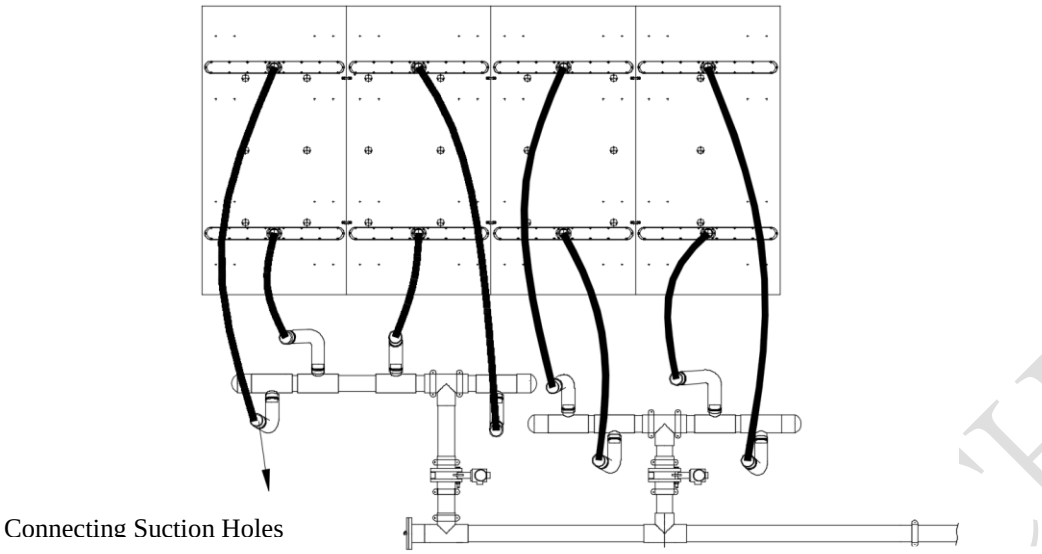
The paper honeycomb structure is under process, and its fixing method is a very important issue. Therefore, the method of holding the paper honeycomb structure is different from the general metal clamping method. The paper honeycomb structure is clamped by using the suction cup below the vacuum table as a clip. The holding device enables the workpiece to be firmly adsorbed on the work surface to achieve the clamping function.

1	Vacuum Pump Device	Brand	BECKER
2	Quantity	pcs	2
2	Voltage Demand	V	220
3	Working Vacuum Absolute Value	mbar	200
4	Work Flow	m³/h	436
5	Negative Pressure Maximum Absolute Value	mbar	800
6	Number of Connected Suction Holes	pcs	8

***Notes:** 2 pcs Vacuum Pum. When working absolute value is 400 mbar, and the maximum amount of inhalation is 570 m³/h.

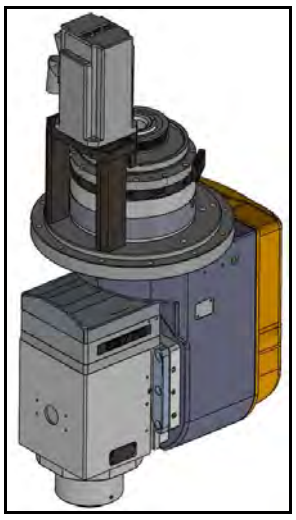


Pressure/Flow Graph (Single Pump)



Vacuum System

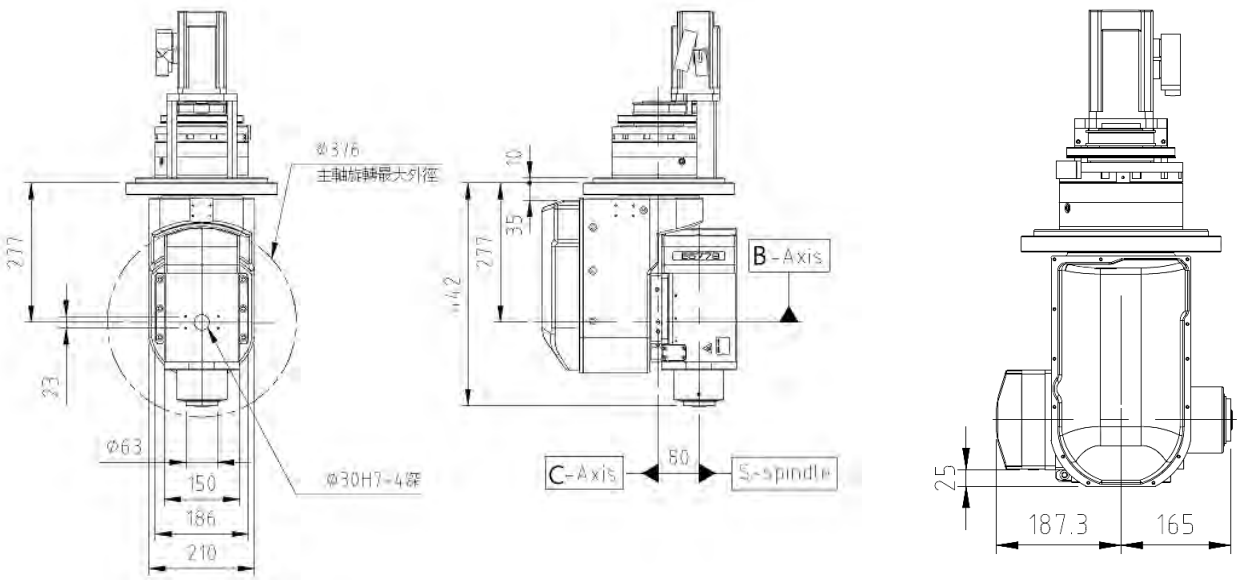
4.6 Spindle System(Two Axis Head)



4.6.1 Two axis head specification：

Supplier	HSD	B axis rotation angle	± 120°
Model	HS673	C axis rotation angle	± 360°
B/C axis motor	SIEMENS	Weight	64 kg

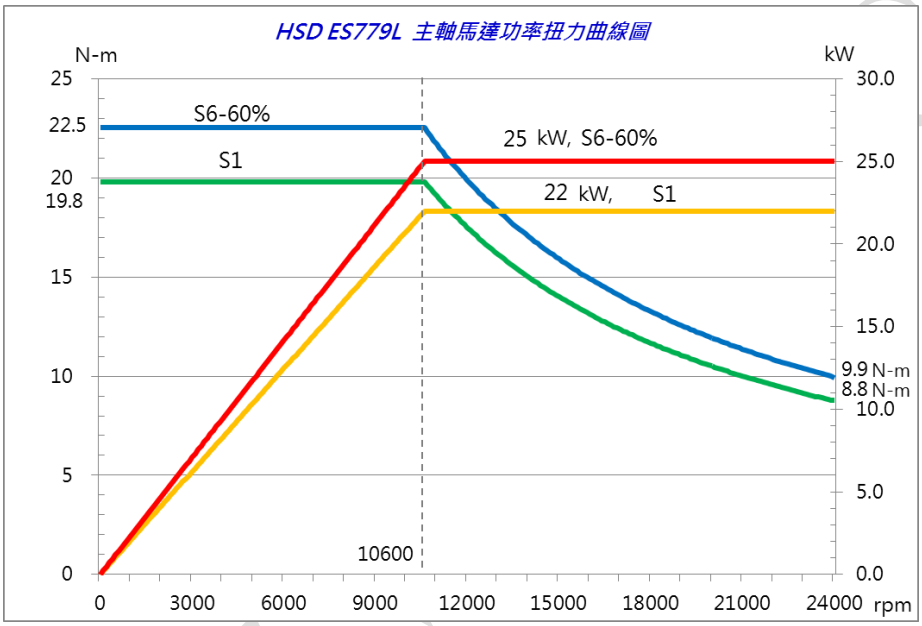
- Drawing for two axis head(Unit：mm)



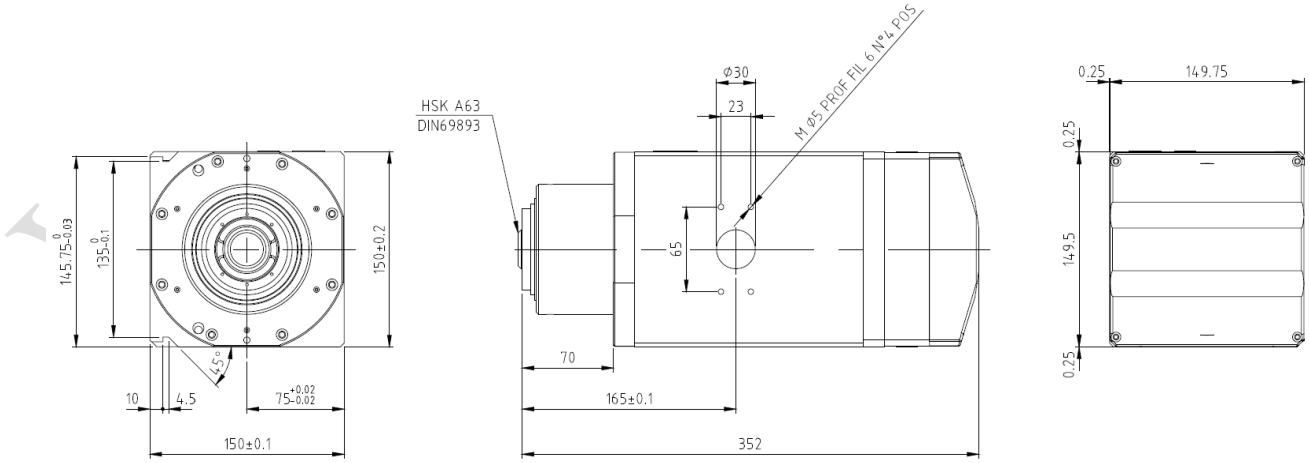
4.6.2 Spindle Technical Specifications

Supplier	HSD	Max. Power	22/25kW
Electric Spindle Model	ES779	Max. Torque	19.8/22.5N-m
Spindle Speed	24,000 rpm	Weight	36 kg
Spindle Taper	HSK-A63		

- Spindle Power and Torque Chart



- Drawing for Spindle Appearance Dimension (Unit：mm)



4.6.3 Two-axis Head Central Monitoring and Protection System

(1) Spindle cutting vibration protection, for the tool's self-heavy balance is insufficient, the cutting vibration load is abnormal, which may cause damage to the spindle bearing, and implement vibration monitoring and shutdown alarm.

(2) Monitoring and limiting rotation of the spindle without clamping.

(3) Working temperature monitoring of spindle bearings and spindle motors, abnormal shutdown alarm protection.

(4) B/C rotary feed shaft motor coil operating temperature monitoring, abnormal shutdown alarm protection.

(5) The spindle tool cutting load software can set the cutting load allowed for each tool.

4.6.4 Spindle cooling system

(1) Function description: This system uses liquid cooling machine to transfer low temperature liquid to the inside of the main spindle for internal circulation cooling, improve the life of the main spindle, and accurately control the temperature of the machining fluid, improve production efficiency and reduce cost.

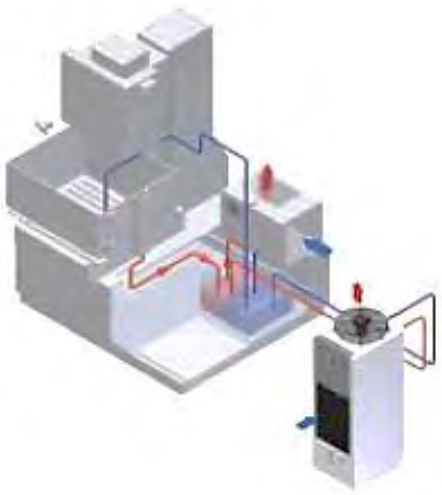
(2) Adopt a completely rust-free water circulation system, a cooling-free water tower, and no cooling fan.

(3) It is recommended to use the brand Vision Wide which is standard in the original factory; if you need to use other brand, please confirm with our company's designers.

(4) Water Cooler - Vertical Water Tank

Brand		Habor	
Voltage Frequency		50/60Hz share	
Tempersture Control		Differential temperature control type (tracing room / machine body temperature, +setting range -9.9~+9.9℃)	
Use Range	**Room Temperature**	10~40℃ (Standard)	
	Water Temperature	10~30℃	
Power		3Ø 200~230V 50/60Hz	
Motor	Compressor	1700W	
	Fan	180W	
	Pump	750W	
Flow of Pump		50Hz：40 L/min	60Hz：40 L/min
Inlet and outlet pipe diameter	Inlet	PT 3/4"	
	Outlet	PT 3/4"	
Tank Capacity		35L	

HWK-1000PTS



Internal circulation cooling system

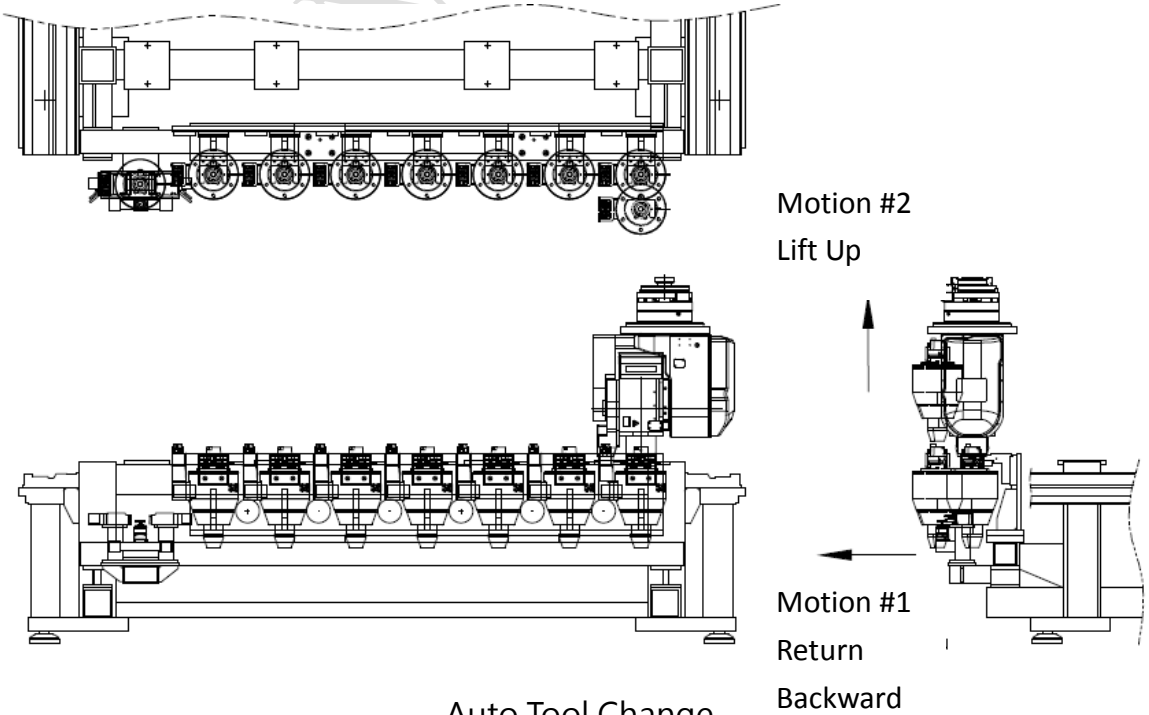
4.7 Auto tool change system

The automatic tool change system includes a tool magazine, a jaw, a tool holder, and a magazine door switch mechanism. User-friendly tool magazine position design, in front of the base, allows the operator to easily perform tool change operations; special jaw design with precise positioning function ensures that the ultrasonic tool handle is aligned with the spindle center during tool change.The design of the automatic tool magazine door switch mechanism utilizes the pneumatic cylinder to telescopically drive the door opening and closing of the tool magazine door, which can improve the efficiency of the tool change time.

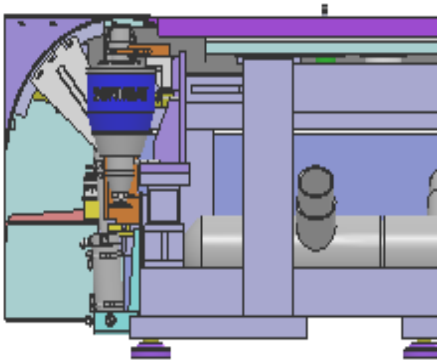
Tool Magazine	Flat Type
Tool Taper	HSK-A63 Ultrasonic Tool
Tool Capacity	7 Tool
Tool Weight	15kg
Blade Tool Specification	40mm
Disc Tool Specification	Ø50mm

***Note:** Ultrasonic tools have corresponding blade specifications and they cannot be mixed.

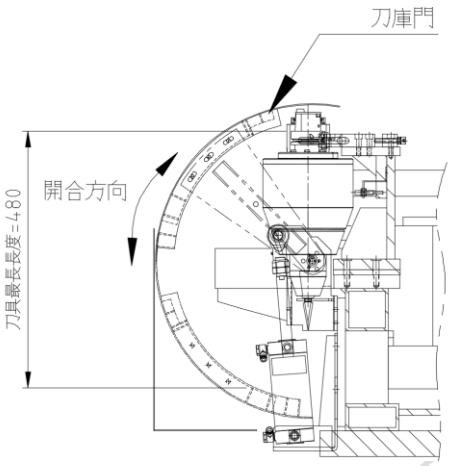
***Note:** The blade is a consumable, can share the same size of the GFM processing machine, or additional purchase from Vision Wide.



Auto Tool Change



Tool magazine location (front of the base)



Automated tool magazine door switch mechanism

4.8 Oscillator

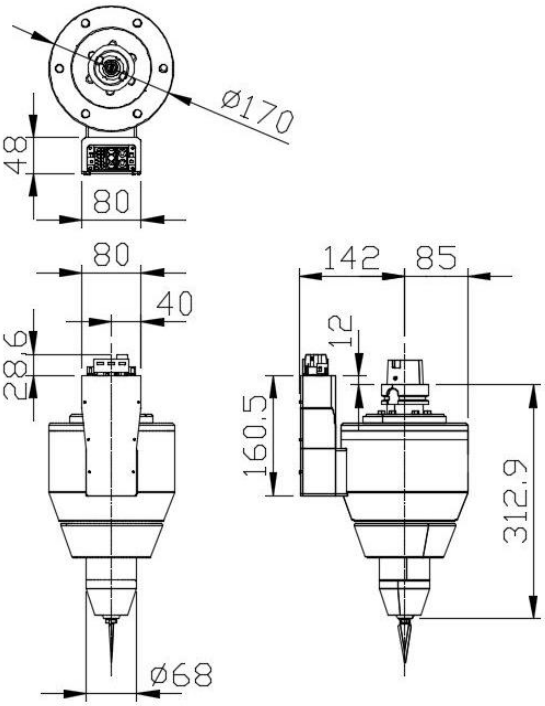
4.8.1 Ultrasonic System

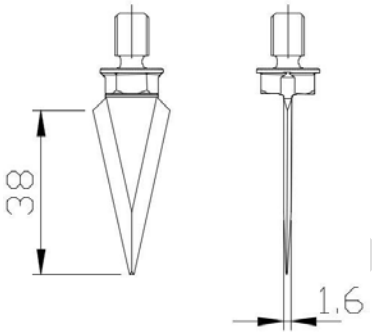
The ultrasonic system includes an ultrasonic host, a signal transmission interface, and an ultrasonic tool handle. The ultrasonic frequency range is 20k ± 300 Hz, and an automatic frequency chasing system is used to ensure that the blade size is variated and can still be automatically excited for processing. When the tool handle is not in the frequency range, the ultrasonic system is not in excitation and the machine is protective.

At the same time, the automatic tool change system is adopted. When the tool holder is replaced, the automatic determination of the tool holder can be performed, and the control of the tool holder excitation can be performed to achieve the intelligent intelligent processing

4.8.2 Ultrasonic-Blade Tool

(1) Drawing for Appearance & Dimension (2) Drawing for Blade

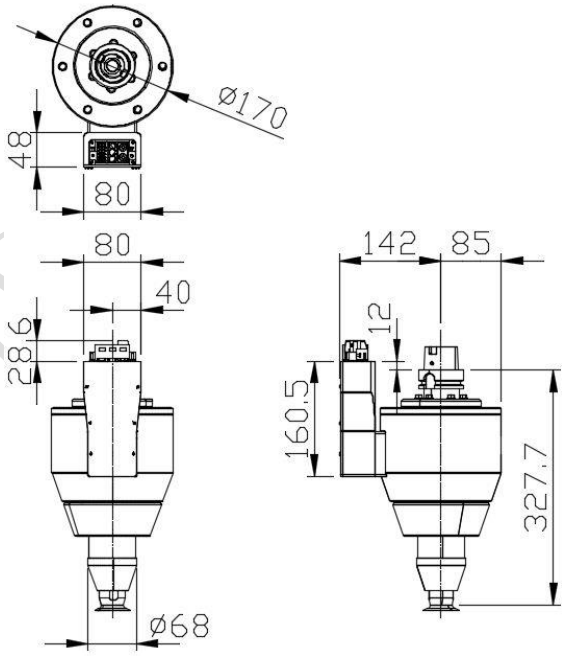


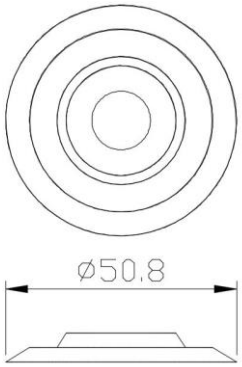


*Can share GFM T4 blade

4.8.3 Ultrasonic-Disc Tool

(1) Drawing for Appearance & Dimension (2) Drawing for Blade





*Can share GFM T23 blade

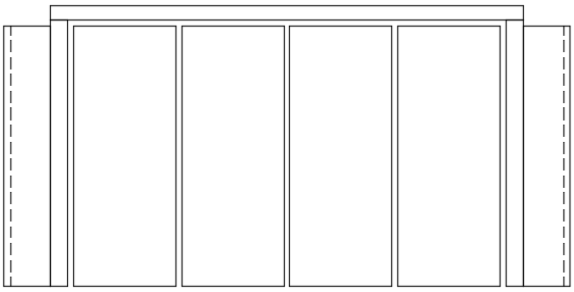
4.9 Feed Axis Lubrication Device

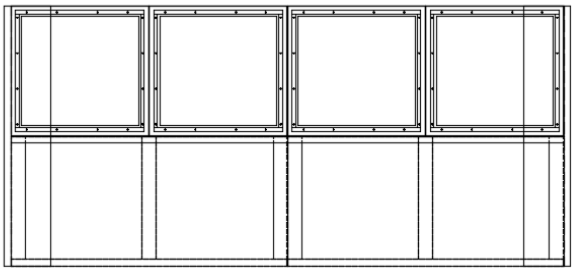
Item	Description
Lubrication Specification	Grease Lubrication
Lubrication Mechanism	Auto Grease Filling Machine
Oil Injector Brand	SHOWA
Oil Injector Lubrication Mechanism	GPMW308EL
Oil Injector Capacity	800 cm^3 Filling
Oil Injector Power	Electric
Lubricating Oil Viscosity	NLGI-1

4.10 Safety Protection Compartment

4.10.1 Appearance

The UC model cover is designed to comply with strict safety standards. The external fence prevents the operator from entering the working range during processing. In addition to the warning nameplate, the operation door also has a safety switch to prevent accidents during operation or maintenance. And it has a large overall window, which is convenient for the operator to understand the condition of the machine running.





4.10.2 Safety Design

(1) When the machine is running, there is a safety door interlock switch, and it is forbidden to open the protective covers to avoid danger.

(2) The safety distance of the window is in compliance with CE regulations to prevent accidents caused by work and cause operator injury.

4.11 Friendly operating device

A. Safe and reliable circuit design.

Electrical cabinet & Circuit module design：

1. Safe and reliable.
2. In accordance with CE regulations.
3. All electronic parts conform to CE regulations.
4. Operated door with interlocks.
5. B/Z-axis power off protection
6. Servo power cable interference protection
7. Motor overloading and phase loss protection.
8. 3-axes overtravel and hardware limit protection.
9. Air conditioner for electrical cabinet
10. Main power input end power protection device

B. The absolute type encoders are used for positioning feedback to keep exact position of the machine. This design lets you use the machine without the home position return procedure for X, Y, Z axes.

C. Swivelable operation panel, movable manual pulse generator provides large range and convenient means of operation.

D. Soft key panel with friendly interface eases the machine operation.

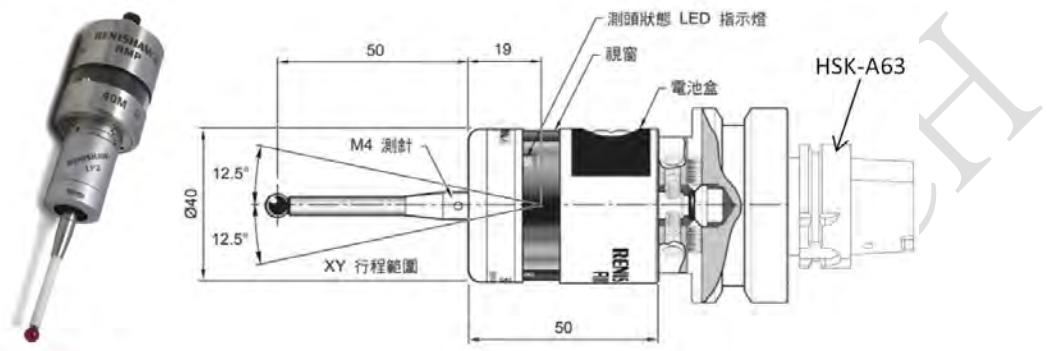
(全新軟鍵式操作面板)

4.12 Measurement Devices

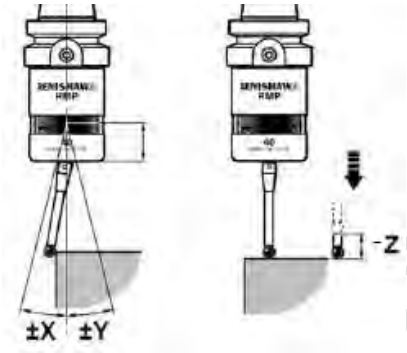
4.12.1 Auto workpiece coordinate measurement

(1) Brand/Specification : RAINSHOW / RMP40

A. Dimensions



B. Probe measurement



Probe overtravel limit		
Length	±X/±Y	-Z
50	12	6
100	22	6

C. Specifications

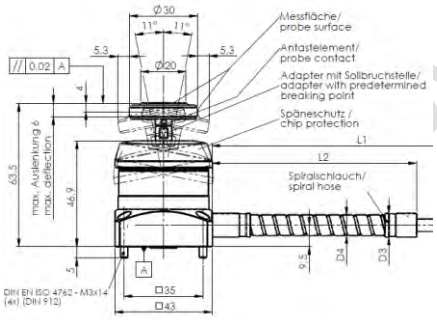
Item	Description	
Approach Direction	±X, ±Y, -Z	
Repeatability accuracy	single direction 1 μm 2σ Performance are tested with a 50 mm stylus at a standard test rate of 480 mm/min.	
Operating Range	15 m (FHSS)	
Repeatability accuracy	Contact type	
Operating Range	50/100mm	
Signal Transmission	Radio (2400MHz~2483.5MHz)	
Ingress Protection	IPX8	
Automatic Detection Function	Vertical	Horizontal
	Circular bore / Cylindrical, Groove / Convex, X.Y.Z end surface, Internal / External corner, 3-point bore / cylindrical, PLD、Feature points, X.Y angle measurement, Angle surface, Concave-Convex angle measurement, Fourth-axis X / Y measurement	Circular bore / Cylindrical, Groove / Convex, X.Y.Z end surface

4.12.2 Automatic tool length measurement

Automatic tool length can measure tool length, diameter and compensation to sharply reduce tool setting time. Automatic tool breakage detection can avoid workpiece damage by cracked tools and reduce costs of poor quality. All measurements are by NC controllers that prevent errors caused by human factors.

(1) Brand/Specification : BLUM / ZX-Speed

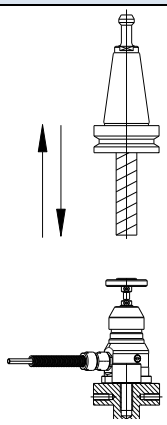
A. Dimensions



B. Specifications

Item	Description
Measurement	Tool length, Tool diameter
Vertical / Horizontal	Vertical
Install position	Table, tool magazine
Repeatability accuracy	±0.4μm 2σ
Detection Mode	Contact type
Disk Probe Diameter	30mm

C. Measurement Schematic

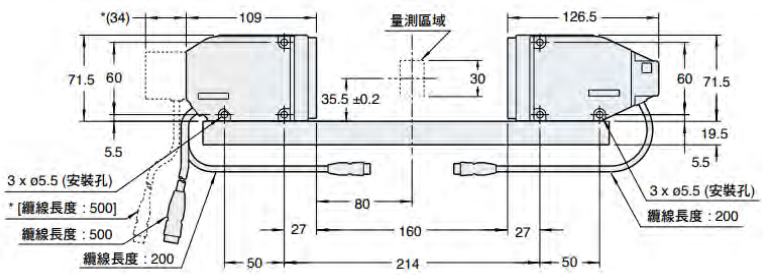
Vertical tool length, Diameter measurement


4.12.3 Triangular tool angle deviation measurement

The triangular tool used in the honeycomb processing is a piece of geometry. When the tool is changed, there will be some slight angular error, which will affect the machining accuracy. Before the machining, the angular deviation measuring device is used to ensure the angular deviation between the spindle and the tool, so that the precision quality of the workpiece is maintained within the standard range.

(1) Brand/Specification : KEYENCE / LS-7030M

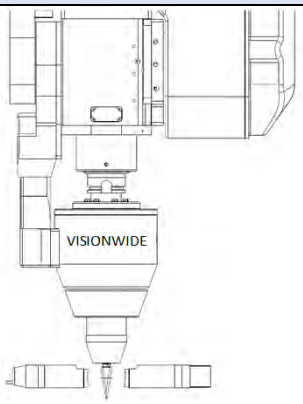
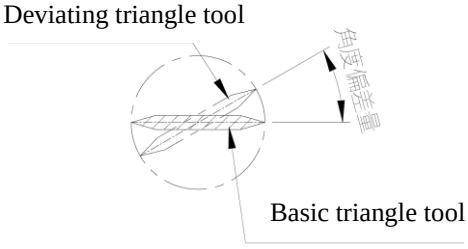
A. Dimensions



B. Specifications

Item	Description
Measurement	Triangular tool angle deviation measurement
Vertical / Horizontal	Vertical
Install position	Base, tool magazine
Repeatability accuracy	±0.15μm
Detection Mode	Non-contact type
Laser Type	Visible green light LED laser (WidTH 0.3~30mm)
Ingress Protection	IP64

C. Measurement Schematic

Triangular tool measurement	Angle deviation tool measurement
	 Spindle and too are not deviation

05. Installation conditions & Foundation Descriptions

5.1 Installation site requirements

(1) If the foundation is soft, the machine will sink and lean. Please reference foundation layouts to prevent the above-mentioned situation.

(2) If the machine is near to roads or near punching devices which generate great vibrations, please place the machine far away from these locations. In case the machine must be installed in these places, ensure placement around the machine of an antivibration bunker to reduce vibrations.

(3) When the machine is near electrical discharge machines or electric welding machines, and all power sources of these devices belong to the same switchboard, these devices will influence the NC of the machine, so please contact with our engineer to install the device properly and safely.

(4) When the machine is used with an AC spindle motor, the NC device circuit should have installed circuit breakers and inverters.

(5) Ambient humidity: 40~50％ (At 20 ℃ ambient temperature)

(6) The stable temperature around the machine is a key point for machine performance accuracy.

(7) The temperature adjustment device of the hydraulic unit is set to 10~45℃, once room temperature drops to below 5℃, because of the changed viscosity and stickiness of the oil , the machine will issue a warning.

(8) To ensure static accuracy of the machine, ensure installation with no air convection is best. If installed without air conditioning, ensure the ambient temperature remains between 17~25℃ at best.

(9) For the best static machine accuracy, ensure the following conditions：

a. Temperature controlled to less than ±2℃ in any one day.

b. Any difference in altitude can affect machine accuracy, so for the range from surface of the table to its 5m height, the temperature difference should be controlled to less than 1℃.

(10) There is no need for thermal isolation of the machine foundation, unless the machine is blow ground, then considers thermal isolation.

5.2 Foundation Type

Well geometric accuracy such as parallelism, squareness, roundness, etcetera are the fundamentals of precision machining. Thus, a firm, stable, and anti-vibration foundation is necessary due to the large dimensions of the machining center and its workpieces. Typical foundations are made of concrete that strength with proper cobble grading is over 3000psi and thickness after drying is more than 600mm. The layout of the foundation should be according to the machine dimensions. The entire foundation has to be isolated from other areas to reduce interference from vibration.

Vision Wide Tech provides three types of foundations: 1. Traditional foundation with J-type

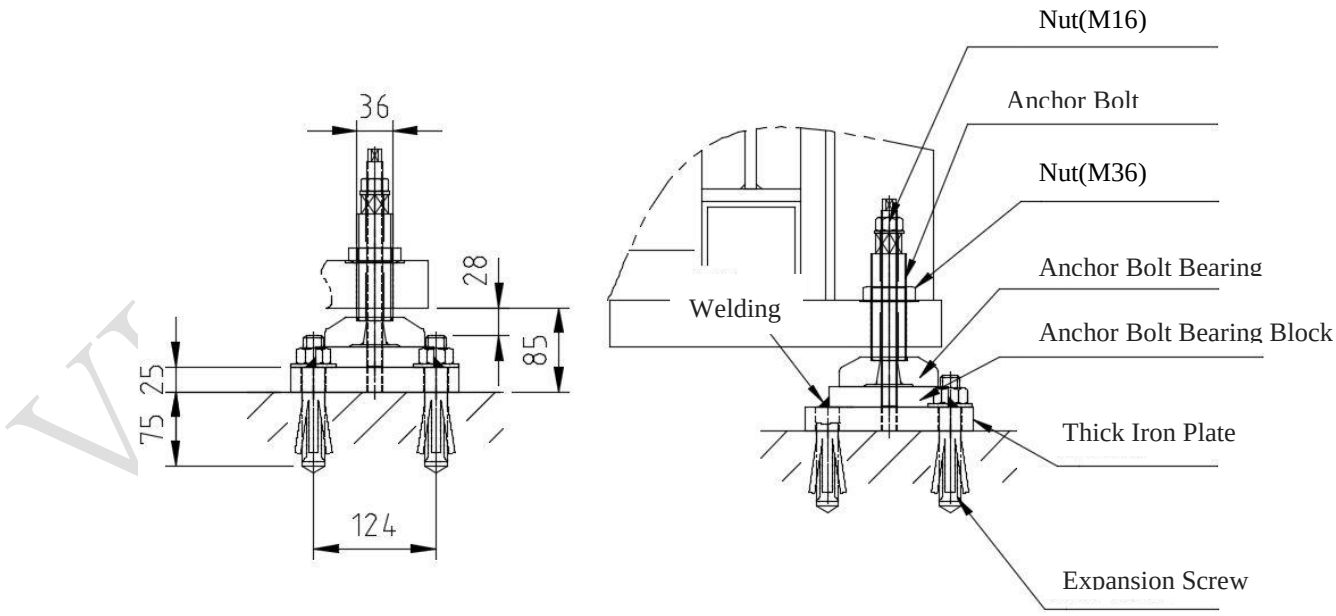
anchor bolds (The foundation has to be filled with concrete twice, so it takes longer to construct.); 2. Foundation made of H-type steel (The foundation is only filled with concrete once). 3. Partial combination (such as the original foundation strength is sufficient, no concrete construction is required, the most convenient, but the fixed strength is the weakest, construction should be carefully considered)

The related constituents and construction procedures are described in the following. For the detailed dimensions of foundations of every model, please refer to the foundation layouts.

5.3 Partially combined foundation construction procedure

Partially combined foundation construction procedure		
Step	Description	Notes
1.	According to the layout for each machine model, start foundation excavation.	Refer to the foundation layouts.
2.	Establish the basic foundation with concrete.	Refer to the foundation layouts.
3.	Move and prepare to install the machine.	Refer to the foundation layouts.
4.	Put a level gauge on the center of the working table of the machine. Then, do the initial level adjustment by lifting the machine with a forklift truck, a crane, or jacks.	Conditions for first level adjustment X direction：within 0.1mm Y direction：within 0.1mm
5.	Use bolts to fix the block to the foundation.	
6	Weld the foot block block to the anchor bolt seat.	
7.	Get on the second installation on the machine.	

Fig. 2: Layout for foundation with anchor bolts, spacers, foundation adjustment blocks, and foundation adjustment block fixing bolts.



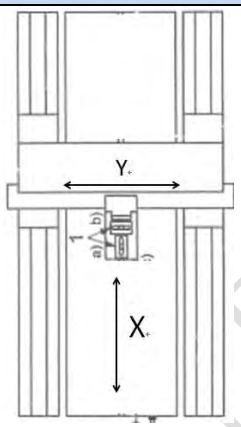
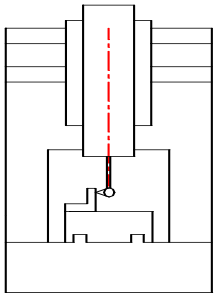
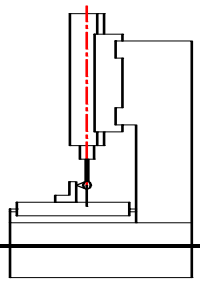
06. Manufacturers for Major Components

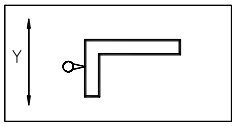
Item	Manufacturers	Place of origin
Structural steel	Jin Ruihong	Taiwan
Linear guideway	BOSCH	Germany
X/Y/Z axis rack and pinion/ Reducer	STOBER	Germany
Two axis head	HSD	Italy
Spindle	HSD	Italy
Ultrasonic tool	SONIMAT	France
Vacuum equipment	BECKER	Germany
Automatic lubricator	SHOWA	Japan
Pneumatic magnetic valve	PISCO/ MINDMAN	Japan
Air cylinder	PISCO / MINDMAN	Japan
Transformer	Shin-shin	Taiwan
Power Supply	MeanWell	Taiwan
Circuit breaker	SHNEIDER	France
Magnetic contactor	SHNEIDER	France
Thermal relay	SHNEIDER	France
Non Fuse Breaker	SHNEIDER / FUJI	Japan
Terminal board	WAGO	Swiss
Relay	OMRON / FINDER / Bore	Japan/ Italy
Air conditioner	HABOR	Germany
Water Chiller	HABOR	Taiwan
Quick connectors	KUKDONG/ HONDA	Korea/ Japan
Cable set	Jing-Fong / Yi-Tai	Taiwan
Warning lamp	Golden Lighting	Taiwan
Working light	Golden Lighting	Taiwan
Limit switch	EUCHNER	Germany
Proximity switch	Carlo Gavazzi / OMRON / METROL	Swiss/ Japan
Linear scale	HEIDENHAIN	Germany
Photoelectric sensor	SICK	Germany
Interlock switch	EUCHNER	Germany

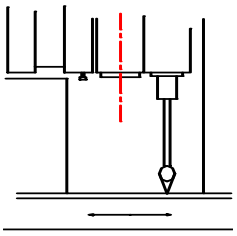
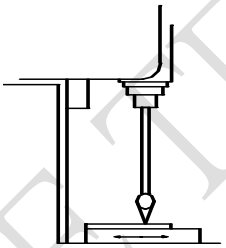
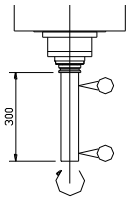
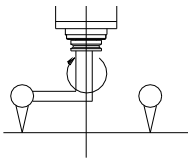
07. Accurayc Inspection

7.1 Geomatric accuracy inspection

(Items & methods of testing reference to ISO-8636-2)(unit : mm) Model:UC-4020

NO.	Item		Method	Illustration	Tolerance	Measured result
1	Pitch and twist angle error under X axis moves.	Y-Z plane	● Move the spindle head to the middle of Y-axis stroke. ● Move the beam to the middle of X-axis stroke. ● Place one level gauge on the center of table and also place the other level gauge (Total 2 pcs) on spindle head based on parallel between X axis and Y axis. Reset the level gauge. ● Move the beam (along X-axial direction) in the middle of travel and reset the level gauge. ● Move the beam (along X-axial direction) to measure the straightness at three positions, center and both edges, at least. ● Read value between X direction and Y direction on table and spindle head and the maximal difference obtained is the measured result.		0.05/full travel (10 second)	
		X-Z plane			0.06/ full travel (12 second)	
2	Squareness between linear movement	Y-Z axis	● Move the spindle head to the middle of table Y-axis stroke. ● Move the beam to the middle of table X-axis stroke. ● Place a square gauge parallel to Y-axial direction on the table. ● Fix a dial gauge on the spindle head and let its stylus touch the square gauge. ● Reset the dial gauge. ● Move spindle head along Z-axial direction and observe the variation of it. ● The maximal difference obtained is the measured result.		0.02/400	
		X-Z axis	● Move the spindle head to the middle of Y-axis stroke. ● Move the beam to the middle of table X-axis stroke ● Place a square gauge parallel to X-axial direction on the table. ● Fix a dial gauge on the spindle		0.02/400	

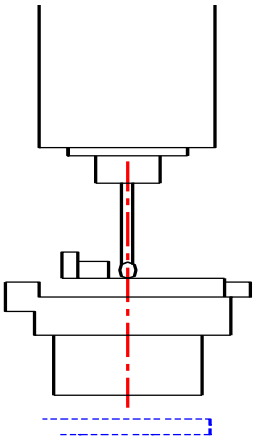
			head and let its stylus touch the square gauge. ● Reset the dial gauge. ● Move spindle head along Z-axial direction and observe the variation of it. ● The maximal difference obtained is the measured result.			
		X-Y axis	● Move the spindle head to the middle of table Y-axis stroke ● Move the beam to the middle of table X-axis stroke. ● Place a square gauge parallel to Y-axial direction on the table. ● Fix a dial gauge on the spindle head and let its stylus touch the square gauge. ● Reset the dial gauge. ● Move spindle head along X-axial direction and observe the variation of it. ● The maximal difference obtained is the measured result.		0.012/400	

NO.	Item		Method	Illustration	Tolerance	Measured result
3	Parallelism between table and Y axis motion.		● Fix a dial gauge on the spindle head, and let its stylus touch the table surface. ● Reset this dial gauge. ● Move spindle head along Y-axial direction, and observe the variation of it. ● The maximal difference obtained is the measured result.		0.06/2000	
4	Parallelism between table and X axis motion.		● Fix a dial gauge on the spindle head, and let its stylus touch the table surface. ● Reset this dial gauge. ● Move spindle head along X-axial direction, and observe the variation of it. ● The maximal difference obtained is the measured result.		0.06/2000	
5	The run-out of internal taper of the spindle	a. the nearest position	● Fix a test bar in the taper on the spindle. ● Place a dial gauge at the nearest position of spindle, and place and other dial gauge at a 280mm distance from the first position. ● Move dial gauge to the center of test bar. ● Rotate the spindle and observe the variation of the gauge.		Runout 0.005	
		b. 280 mm position			Runout 0.02	
6	Perpendicularity between center of spindle and table surface	XZ plane	Way 1： ● Move the beam to the middle of X axis and Y axis. Put a dial gauge on the spindle, the stylus should touch the table surface. Rotate the spindle. The maximum read value from the dial gauge is the measured error. Way 2： ● Or put a gauge in the middle of table parallel to X axis, then, rotate this gauge		0.025/300	
		YZ plane			0.025/300	

			180 degree, read the value. Then, put a gauge in the middle of table parallel to Y axis, then, rotate this gauge 180 degree, read the value.			
7	Run-out of the inside edge of the spindle.		● Place a stylus dial gauge to touch the surface of the inside edge of the spindle. ● Rotate the spindle and observe the variation of the gauge. The maximal difference obtained is the measured result.		0.005	
8	Run-out of the outside edge of the spindle.		● Place a stylus dial gauge to touch the surface of the outside edge of the spindle. ● Rotate the spindle and observe the variation of the gauge. The maximal difference obtained is the measured result.		0.005	

7.2 Positioning accuracy inspection

(Items & methods of testing reference to JIS-B6333 & ISO-230-2)(unit：mm)

<table>
<tr><th>NO.</th><th colspan="2">Item</th><th>Method</th><th>Illustration</th><th>Tolerance</th><th>Measured result</th></tr>
<tr><td rowspan="7">1</td><td rowspan="7">Rectilinear motion Positioning accuracy inspection</td><td>X</td><td rowspan="3">A. By JIS -B6333 standard
● Move the spindle to positive (ornegative) position and then stop it.
● Take this position as the norm, move the spindle to the same direction at 50% of the highest federate and then measure the accuracy.
● According to the table below, select specified measuring intervals and measure the difference between the actual moving distance from the norm position and the specified moving distance.
● Calculate the maximal difference within the normal distance.
● Based on the method, the maximal difference obtained is the measured result. Then, do this measurement in X, Y, and Z axial directions respectively.
<table><tr><th>Motion range</th><th>Measured distance</th><th>Normal distance</th></tr><tr><td>Less than 1000</td><td>50</td><td rowspan="2">300</td></tr><tr><td>Above 1000</td><td>100</td></tr></table></td><td rowspan="7">  </td><td rowspan="3">A：JIS-B6333 Please refer to positioning accuracy values list for UC series in Table 1.</td><td></td></tr>
<tr><td>Y</td><td></td></tr>
<tr><td>Z</td><td></td></tr>
<tr><td>X</td><td rowspan="3">B. By ISO 230-2 standard
● Do this measure to three axes at 50% of the highest federate. There should be at least 6 measured points in every 1m distance. Do this measurement 5 times continuously.
● Analyze the obtained values statistically.</td><td rowspan="3">B：
ISO 230-2 test methods VDI-3441 measured values of P. See Table 1 UC series models P value for each standard table</td><td></td></tr>
<tr><td>Y</td><td></td></tr>
<tr><td>Z</td><td></td></tr>
<tr><td>2</td><td>Repeatability accuracy</td><td>X</td><td>A. By JIS -B6333 standard
● select one points as normal points
● Move the spindle at 50% of the</td><td></td><td>A：
JIS-B6333 Please refer</td><td></td></tr>
</table>

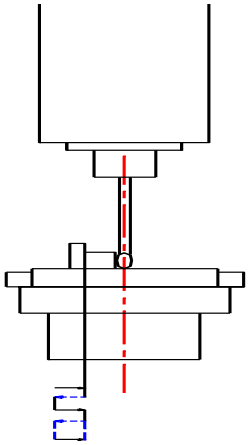
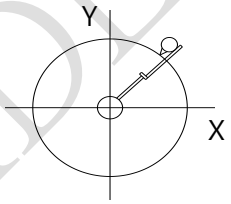
		Y	highest federate under the same setting conditions (direction). Do positioning accuracy inspections 7 times. ● Standard point is choosen on moving center and both ends of stoke. Then, observe the variation of the gauge. The half of maximal difference obtained is the measured result. ● Find the obtained maximal differences. Divide the maximal obtained value. It is the measured result.		to repeatability accuracy values list for UC series in Table 1.	
		Z				
		X	B. By ISO 230-2 standard ● Do this measure to three axes at 50% of the highest federate. There should be at least 6 measured points in every 1m distance. Do this measurement 5 times continuously. ● Analyze the obtained values statistically.		B : ISO 230-2 test methods VDI-3441 measured values of Ps,see Table 1 UC series models Ps value for each standard table	
		Y				
		Z				

Table 1. UC series positioning accuracy & repeatability accuracy (linear scale)

Axis	Unit: mm			
	JIS-B6333 Positioning accuracy	JIS-B6333 Repeatability accuracy	VDI-3441 Positioning accuracy	VDI-3441 Repeatability accuracy
X	±0.03	±0.003	0.06	0.02
Y	±0.03	±0.003	0.06	0.02
Z	±0.03	±0.003	0.06	0.02

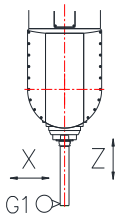
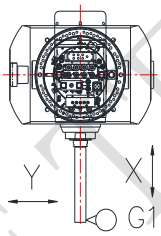
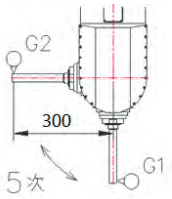
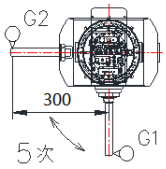
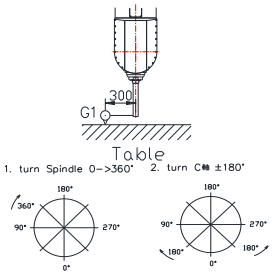
7.3 Circularity Inspection

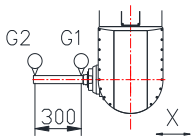
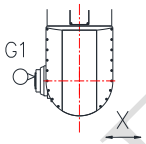
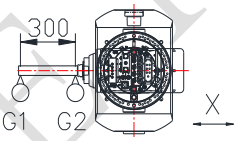
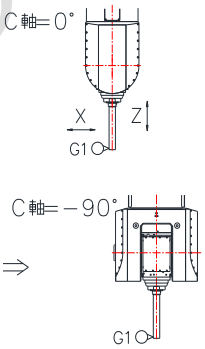
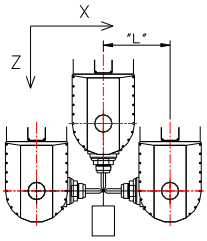
(Items & methods of testing reference to ISO-230-4) (unit：mm)

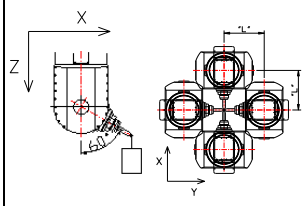
NO.	Item	Method	Illustration	Tolerance	Measured result
1	Circularity inspection	● Place the double bar (DDB) test device on the center of the table. ● At 3000 mm/min feederate speed and with 150mm radius, do this measurement when spindle rotates a circle CW and CCW respectively. ● The difference between the maximal measured diameter and the minimal measured diameter is the measured result.		0.03/300	

7.4 Geomatric accurayc of 2-axis head

Items & methods of testing reference to ISO-10791-2 (Units: mm)

NO.	Item		Method	Illustration	Tolerance	NO.
1	2-axis head Reset	B-axis Reset and check	Start: B-axis=0° (unclamp status), C-axis=0° ; spindle clamping 350L test mandrel, Z-axis travel move up and down 300mm, use dial gauge to measure test mandrel X/Y direction error, when top and bottom G1 value is 0,0, Reset B=0°		0.015/300	
		C-axis Reset and check	Start: B-axis= +90° (unclamp status), C-axis=0° ; dial gauge absorb on the table , X travel direction move 300mm, measure test mandrel Y direction error, when front and back G1 value is 0,0, Reset C=0°		0.015/300	
2	Accuracy of 2-axis head	B-axis Repeatability	Start: B= +90° ; C= 0° adjust G1= 0; Rotate C-axis 0° --> -90° , adjust G2= 0; Reciprocating test 5 times, record G1, G2 value		±0.005	
		C-axis Repeatability	Start: B= +90° ; C= 0° adjust G1= 0; Rotate C-axis 0° --> -90° , adjust G2= 0; Reciprocating test 5 times, record a, b value		±0.005	
		Spindle <--> C-axis parallelism	Start: B= 0° ; C= 0° dial gauge rotation radius 300mm, adjust G1= 0; rotate spindle, record 0° , 45° , 90° , 135° , 180° , 225° , 270° , 315° , 360° G1 value; rotate C-axis(spindle does not rotate) ±180° , record spindle relative angle G1 value, compare the error of two value sets		±0.05	

NO.	Item		Method	Illustration	Tolerance	NO.
2	Accuracy of 2-axis head	Squareness of C-axis and spindle (vertical)	Start:B=+90°, C= 0°, adjust G1= 0, G2=0 ; Rotate B axis from +90° to -90° Rotate C asix from 0° to +180° · Record values of G1 and G2		G1-G2 < 0.03	
		B-C axis runout	Start:B= +90° ; C= 0° Rotate spindle, and adjust G1= 0 ; Move up Z axis 100mm Rotate B axis from +90° to -90° ; Rotate C axis from 0° to +180°. Move down Z axis 100mm Roate spindle, and record G1 value (Can be reached by compensation)		G1-G2 < 0.04	
		Squareness of B-axis and spindle (horizontal)	Start:B= +90° and C= 0° ; adjust G1= 0, G2=0 ; Rotate B axis from +90° to -90°. Rotate C axis from 0° to+180° and record G1 and G2 values.		G1-G2 < 0.04/300	
3	Accuracy of interface	Scrapping accuracy of fixed interface of 2-axis head	Start: B= 0°, C= 0° ; adjust G1=0 ; Move Z-axis up and down 300 mm, and measure error with test bar at X direction (m1) by dial gauge and rotate C axis from 0° to 90°. Move Z-axis up and down 300 mm, and measure error with test bar at X direction (m2) by dial gauge, and move dial gauge from X direction to Y direction, record error as (n1, n2), and repeat once. m1 and m2 is the scrapping accuracy of X direction n1 and n2 is the scrapping accuracy of Y direction		±0.02/300	
4	5-axis synchronous dynamic accuracy	R-test AK1 (X-Z plane moving accuracy)	Start:C= 0° (still); Rotate B axis ±90° and move X/Z axis at the same time and keep tool point at the same point. Use dial gauge probe to measure error on X/Y/Z direction of the test ball.		0.08	

		R-test AK2 (X-Y plane movement accuracy)	Start:B=+45° (fixed) ; Rotate Caxis ±180° and move X/Y axis at the same time, and maintain tool point at the same position Use dial gauge probe to measure error on X/Y/Z direction of the test ball		0.08	
		R-test AK4 (5-axis synchronous dynamic accuracy)	Rotate B/C axis at the same time (B axis ±45° ; C axis ±180°) ; Move X/Y/Z axis at the same tiem and keep tool point at the same position ; Use dial gauge probe to measure error on X/Y/Z direction of the test ball.		0.08	

08. Controller Function Table

HEIDENHAIN iTNC 640 Controller

Controller iTNC640 standard function			
iTNC 640		5 axis(mill)	Product
Controller	iTNC640	●	
Monitor and Operation Panel	15.1" Color	●	
System Card	21GB	●	SSDR TNC 640 E SP
Machine Control Panel	MB720	●	MB 720 machine operating panel
I/O Module	PLB6208	●	PLB6208 CENTRAL MODULE
Handwheels	HR 410	●	
Simultaneous Axis	Servo+Spindle	7+1	Controllable interpolation axes, extension
Warranty	2 years	●	Repair service contract for countries of groups 1-3(with existing general contract); Contract duration in years 2
Controller Unit	CC 6106 6X1Vpp/Endat	●	
Linear Axes Display Accuracy	Accuracy 0.001mm	●	
Rotary Axis Display Accuracy	Accuracy 0.001°	●	
Operate	JOG Mode (JOG)	●	
	Handwheel Override (HANDWHEEL)	●	
	MDA Mode (MDI)	●	
	Automatic Mode (AUTO)	●	
	Single Block (SIGLE BLOCK)	●	
	Spindle 50-150%	●	
	Servo 0-150%	●	
Processing	Indirect Programming	●	
	Kinematics Opt.	●	
	Kinematics Compensation	●	
	Drilling	●	
	Milling	●	
	Pocket Milling	●	
	Measuring	●	
	DCM Collision	●	
	Metric / Inch Switchover	●	
	Selectable Offsets	●	
	Tool List	●	
	Tool Displayed	●	
	Subprogram Levels	●	
	Software option 1(OP1)	Rotate Axes Function	Forth axis is standard AC head is standard

Controller iTNC640 standard function			
iTNC 640		5 axis(mill)	Product
	Software option 2(OP2)	3D Machining	
Communication	UCB	●	
	Ethernet	●	

Controller iTNC640 standard function			
iTNC 640		5 axis(mill)	Product
Operation Language + System Alarm Message	German	●	
	English	●	
	French	●	
	Italian	●	
	Spanish	●	
	Other	○	
PLC Alarm Message	Chinese	●	
	English	●	
	Other	○	
Note：1.● Standard 2.○ Option			