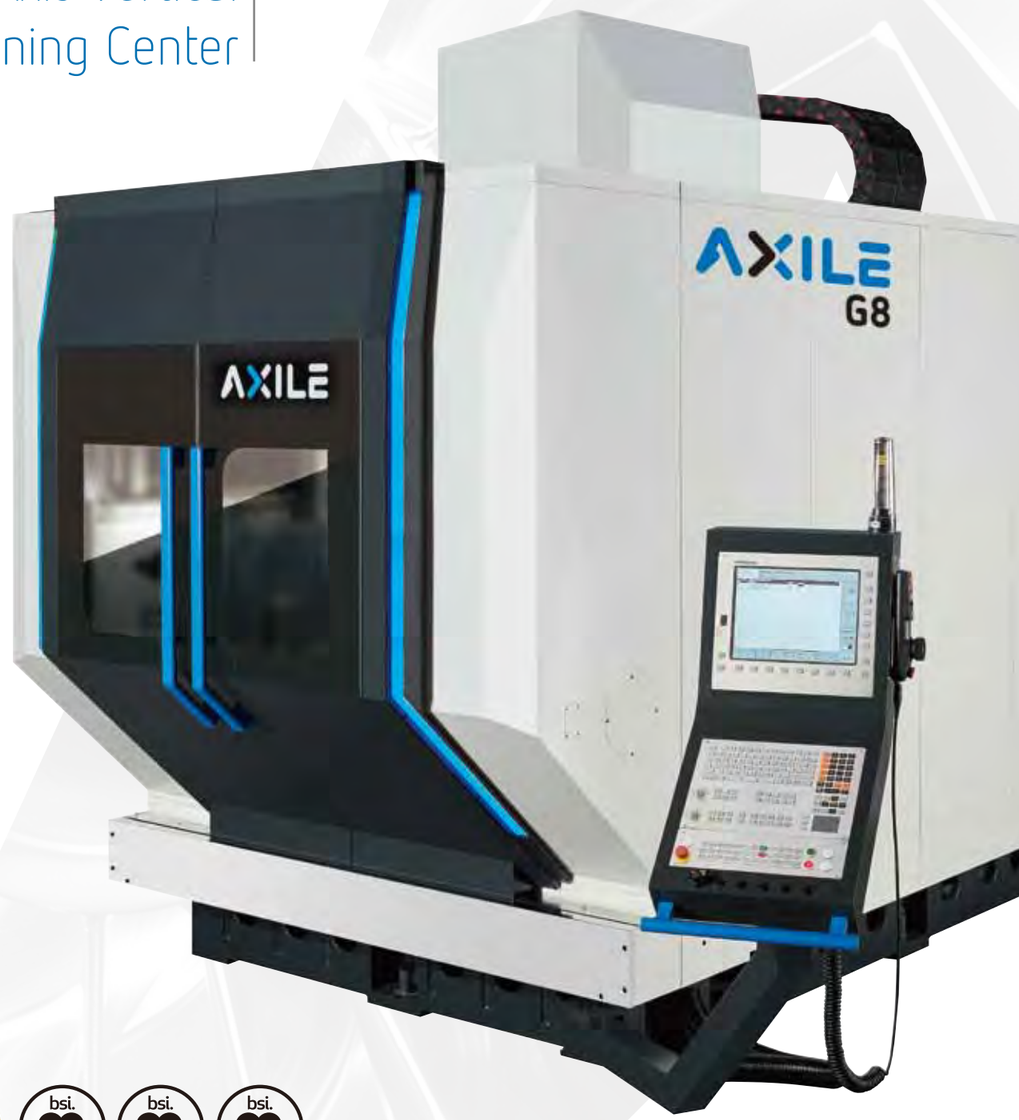
AXILE®

G8 Series

G8 Standard
G8 MT

Gantry type 5-Axis Vertical Machining Center



TQM Award Three-star Medal

National Award of Outstanding

ISO 9001:2015 FM 538421

ISO 14001:2015 EMS 546518

ISO 50001:2011 ENMS 642457

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AXILE /'æksail/, stands for "agile"

Agility is the best word to define the identity of **AXILE**. Motor agility is the ability to move quickly and precisely, which is the essence of **high-speed machining**. Mental agility is the ability to think and understand quickly, to be **smart** in other words.

AXILE provides **agile smart machining.**

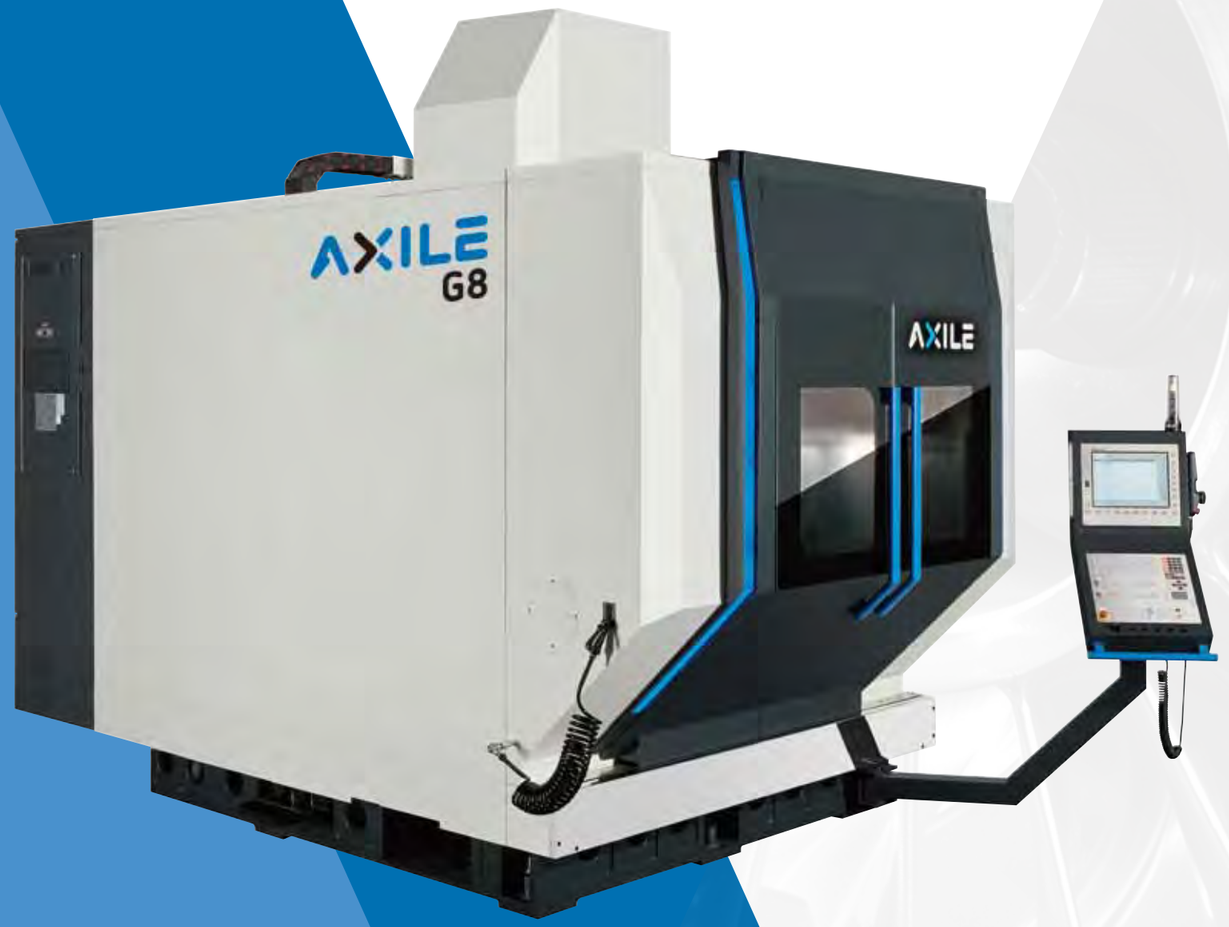
Highly sophisticated part manufacturers face the same problems everywhere: lower selling prices every day, higher costs and a shortage of specialized labour. AXILE propose highly productive machines based on **high-speed and 5-axis technologies at very competitive prices**.

The new AXILE line is built with **standard high-tech design and components** from world-class suppliers to **ensure the best quality and reliability**. AXILE patented **SMT technology** attains reaching high levels of accuracy and embraces **Industrie 4.0 technologies, reliability** is upgraded, maintenance costs minimized and downtime avoided.

AXILE products are proudly designed and manufactured at Buffalo´s facilities, one of the leading technology manufacturers in **Taichung (Taiwan)**. Taichung is the world's biggest **cluster of machine tool builders**, thanks to abundant specialized workforce and a component supply chain far more efficient than in any other country. The rationalized range of 3X and 5X high-speed VMC's covers only the most requested sizes to reach economies of scale to maintain reasonable market prices.

AXILE is conceived to conquer the premium market of 3X and 5X high-speed vertical machining centers. Such markets will grow and AXILE will be the real Asian big player amongst its European competitors.

AXILE, motor and mental agility at a competitive price.



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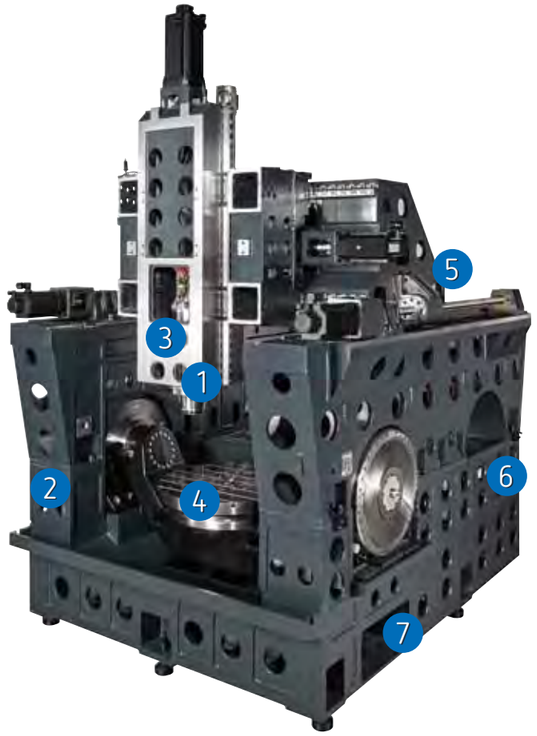
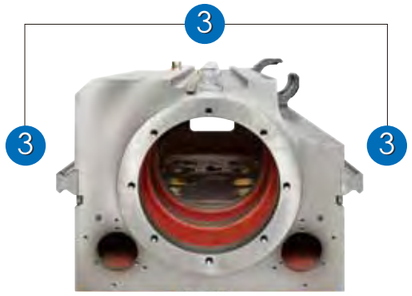
Design concept

The structure

1 Spindle moved by 3 linear axes	No rotary axis between the tool and the machine body, for better machining rigidity.
2 Perfect U-shape closed-gantry design	Same stability in all travels of X and Y axes Excellent accessibility to working area
3 3-guided headstock	Highest rigidity in roughing processes with high torque in spindle
4 Table moved by swivelling-rotary axes	Best accuracy with fixed relative position between 2 rotary axes.
5 Massive gantry sliding on 2 symmetric synchronized axes	Best servo response to any milling forces
6 All body made of high-quality casting	Optimal damping of machining vibrations Homogeneous thermal behaviour
7 Integrated chip disposal channel directly under the table	Quick evacuation of chips for high chip volume machining

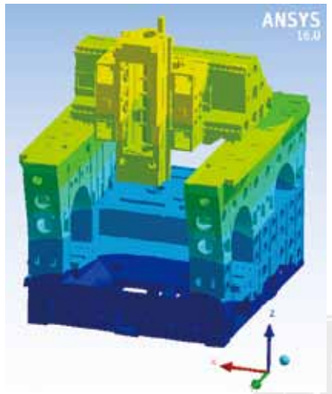




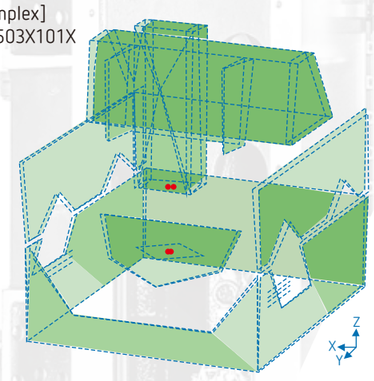
"Gantry: best dynamics, accuracy and ergonomics for 5X machines"

Modal analysis vs. Modal testing

1st mode (roll)_19.5Hz



View: 3D View [Complex]
SHP: Shape Table_503X101X
Freq: 19.5 (Hz)
Damp: 4.45%

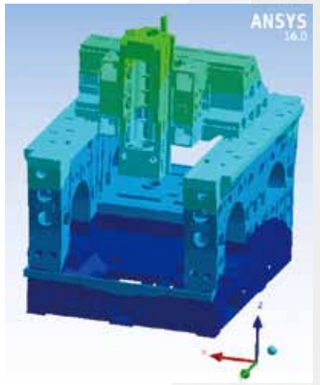


Modal Analysis

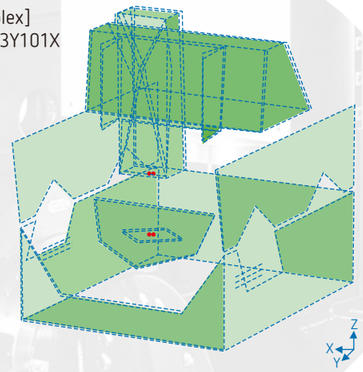
Modal Testing

Modal analysis vs. Modal testing

2nd mode (pitch)_ 22.6Hz



View: 3D View [Complex]
SHP: Shape Table_503Y101X
Freq: 22.6 (Hz)
Damp: 4.96%



Modal Analysis

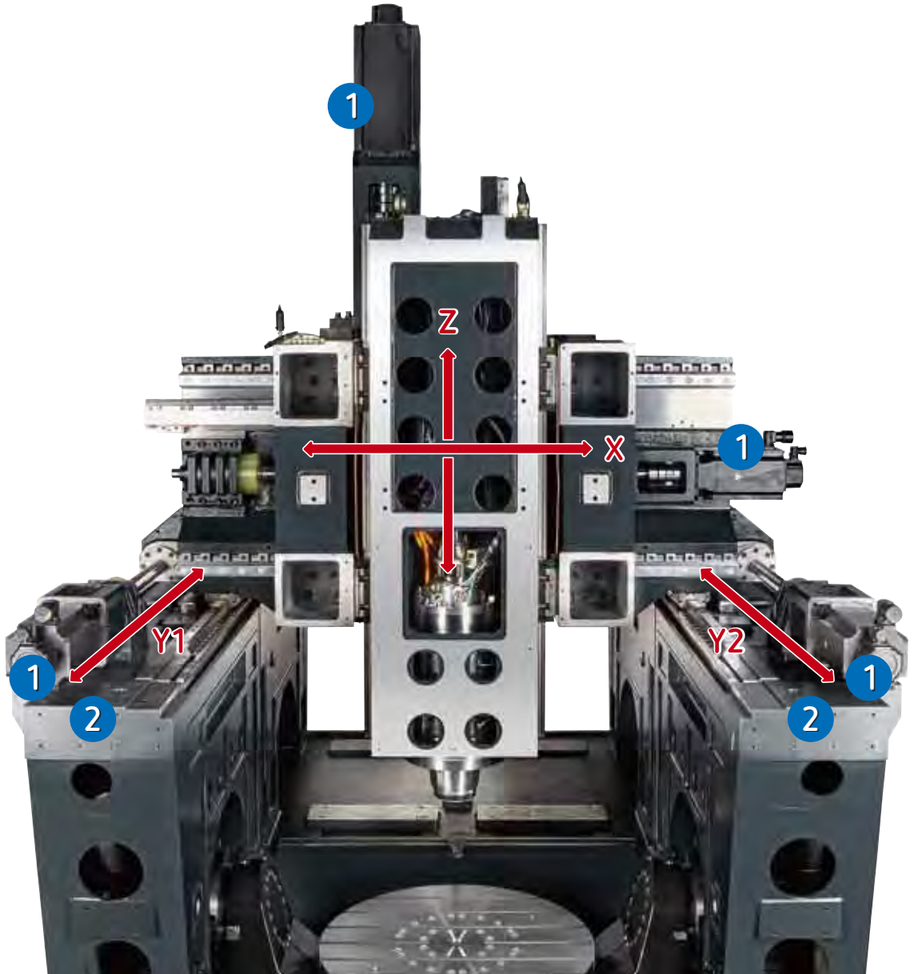
Modal Testing

Agility

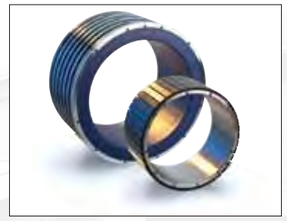
Linear axes

Direct driven servomotors (no belts/gears)	Best dynamic and minimal elasticity in the driving system

Double symmetric and synchronized axes (Y1, Y2)	Best dynamic for the gantry no matter the position of the machining force
Linear scales with 0,1 µm resolution in X, Y1, Y2 and Z axes	Ensures optimal synchronization in Y1 and Y2 axes, and best accuracy for ALL axes
Double roller type linear guideways	Best high-feed movement and vibration damping
Double pre-loaded double-nut ballscrews	Minimized back-lash allowing high-feed movements



Swivelling-rotary axes

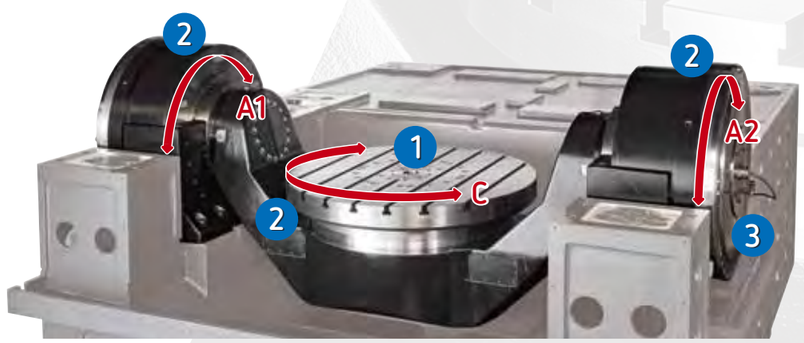


Integrated and ready-to-use hydraulic and pneumatic ports	Simplifying parts clamping process

Torque motor-driven rotary axis (C)	Highest dynamics
Dual torque motor-driven swivelling axis (A)	Highest accuracy

Brakes in every shaft	High-repetibility in 4+1x operation when using the brakes

High-resolution, direct absolute rotary measuring system	Zero-backlash and high accuracy



G8 Standard table

G8 MT table

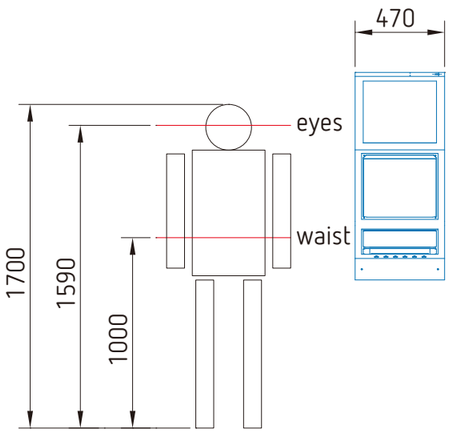
G8 MT

Mill-turn for those looking for the maximum integration of metal-cutting processes in a single step, reducing complexity of the process and chance of error in the clamping.

C-axis motor is cooled as in the milling version. Additionally the C-axis bearing is cooled in the inner and outer to ensure the long lasting accuracy and life.

Table diameter: 500 mm
Max turning speed: 1.500 rpm
Max table load:
Turning: 350 kg , Milling: 500 kg

Integrated balancing system that can be monitored from the additional screen located on top of the panel, with the help of a sensor located in the A-axis



SMT™

Smart Machining Technolgy™

High-speed and 5-axis technologies pursue lower manufacturing costs for complex products, but they also represent some serious challenges for accuracy and reliability. This is why Buffalo dedicated almost a decade to research the necessary knowledge to dominate such technologies. We call them SMT™.

Low productivity due to wrong F value selection — **MRRO**

MRRO

How to achieve the best productivity and performance and to optimize the metal removal rate with excellent machining quality?

- **OPTIMAZATION PRODUCTION** — Fully utilize machine capability
- **EXTREMELY FAST PROCESSING TIME** — Maximization of metal removal rate
- **HIGH TOOL DURABILITY & PERFECT SURFACE ROUGHNESS** — Stable cutting force and chatter-free machining

The Maximum Efficiency in Metal Removal Rate and Processing Time

Configuration: Spindle speed 1563rpm, Machining feed rate 2200mm/min

Function On/OFF	Spindle Load (%)	Time(S)	Surface Roughness (um)	Metal Removal Rate (cm³/min)
MRRO OFF	44	197	0.548	133.6
MRRO ON	42	170	0.491	152.8
Comparison	-0.65%	-13.7%	-10.4%	14.3%

Overall performance improved

Prolong Tool Life Under Spindle Overload

Configuration: Spindle speed 1563rpm, Machining feed rate 2200mm/min

Function On/OFF	Spindle Load (%)	Time(S)	Surface Roughness (um)	Metal Removal Rate (cm³/min)
MRRO OFF	110	79	1.412	337.6
MRRO ON	95	85	0.543	270.7
Comparison	-13.6%	+7.5%	-61.5%	-19.8%

Surface Roughness improved 61.5%
Spindle load decrease 13.6%

Spindle thermal growth at high-speed — **TPC**

TPC

How to prevent the inaccuracy caused by temperature rise of sindle and motor under high speed motion?

DISPLACEMENT METER → AMPLIFIER → MPU → CNC (compensation command)

- **HIGH ACCURACY** — Directly measuring expansion
- **REAL-TIME COMPENSATION** — Electrical type sensor
- **BETTER SURFACE FINISH** — 5~6 times accuracy improved

With compensation, the displacement of tool tip is reduced from 65μm to 15μm.

Without compensatio
With compensatio

ACCURACY IMPROVED
5~6 TIMES!

Spindle vibration reduces lifetime — **SVS**

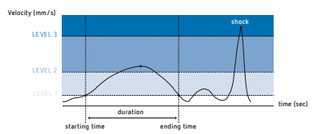
SVS

How to real-time monitor the spindle vibration to remain the machining accuracy under long time operation?

VIBRATION SENSOR → AMPLIFIER → MPU → CNC (compensation command); MPU ↔ MEMORY

- **HIGH FINISH QUALITY** — Spindle Life Time
- **LONGER LIFE TIME** — Wear reduction on spindle bearings and tools
- **EASY FOR MAINTENANCE** — Abnormal vibration data recording

THREE LEVELS FOR SPINDLE VIBRATION MONITORING



LEVEL 1 shows the warning message to notify operator

LEVEL 2 shows the error message and reduces spindle speed and feed rate

LEVEL 3 machine shut down immediately to prevent crash

Angular deformation in machine body causing linear errors — **AAC**

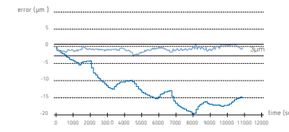
AAC

How to prevent the inaccuracy caused by temperature rise of machine body under long time operation?

temperature sensors → MULTIPLEXER / AMPLIFIER → MPU → CNC (calculation with deformation model)

- **AXIAL THERMO MONITORING** — Integration of temperature sensors and thermal error model
- **HIGH PRECISION** — Thermal induced positioning error compensation

THERMAL ERROR BEFORE AND AFTER COMPENSATION



With thermal compensation system, the thermal error van be reduced from 20μm to 3μm.

Error before compensation
Error after compensation

Industry 4.0

AXILE Reliability Technology™ ART™

ART solution enhances machines to integrate in the smart factory system to ensure the 24/7 automatic operation without unexpected downtime.

Manufacturing Process

MP — ART formulates the application to real-time monitoring of the machine status with data collection and analysis to organize the production schedule proficiency.

Calculate and analyze the utilization rate of each machine and displaying the rate of utilization at any time.

- In cooperation with the third party's task scheduling system to further maximize the productivity and improve the machine utilization rate.
- Facilitate managers to easily identify the production status.

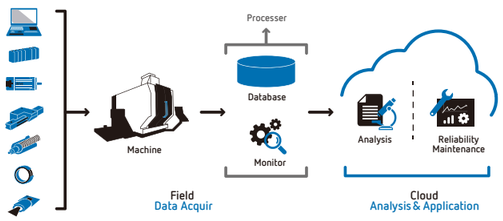
Energy Management

EM — ART monitors the machine energy consumption and usage condition to optimize the energy efficiency.

- Monitor the machine power consumption and track the power usage condition.
- In cooperate with the off-peak electricity rate or contract of control electricity, etc. to moderate the electricity cost.

Reliability Maintenance

RM — The data collected through the multiple sensors located in machine components enables a predictive maintenance and MTBF



Benefits to the production

- Transparency on machine production status
- Increasing machine utilization and accessibility
- Machine performance optimization
- Abnormal condition notice for faster reaction

Benefits to the maintenance and service

- Error message delivery prior to broken
- Lower warranty expenses and service efficiency enhancement
- Reducing inventory of spare parts
- Equipment is always ready to work, no adjustment time or downtime

ART™

Real-time analyzed data and easy access platform

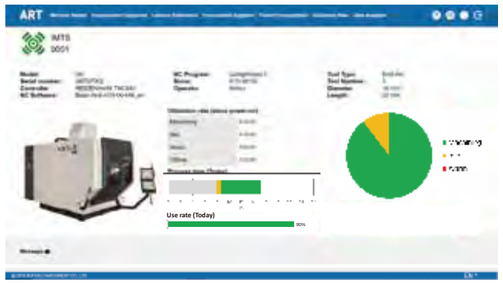
Reliability Maintenance (RM)

ART™

Real-time analyzed data and easy access platform

Energy Management (EM)

Manufacturing Process (MP)



Data Analysis

Accuracy

"The **Cornerstone** of 5-Axis machining"

Linear axes accuracy

Ballscrew´s thermal growth	0.1µm resolution absolute linear scales in ALL axes

Rotary axes accuracy

Elasticity and backlash of driving system	Direct-driven torque motors with no backlash
Angular error is multiplied by the distance from rotary axis to machining point	+/- 5" accuracy absolute rotary scale feedback

Thermal control

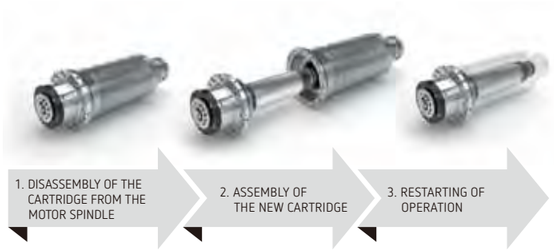
Heat generated by spindle and torque motors	Spindle and torque motors are cooled with a water chiller close-circuit and a cooling unit

Linear-rotary axes relative positioning

The swivelling-rotary table might shift its relative position to the 3 linear axes by many reasons generating an increasing error in the part	CNC embedded compensating functions like Kinematics (Heidenhain), Kinematic chain (Siemens) and Tilted working plane indexing (Fanuc)

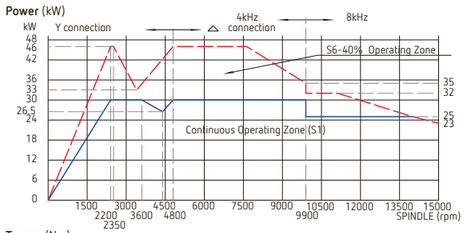
Spindle

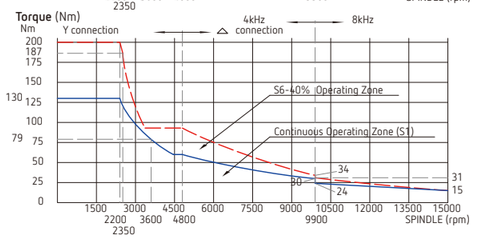
High-performance built-in spindle selection



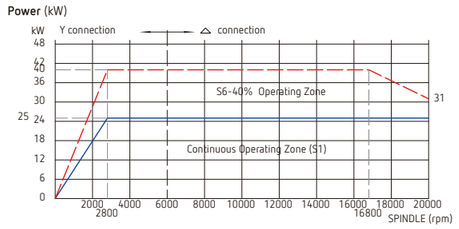
Bearing preload dynamically adaptable to the operation speed	At low speed, bearing pre-load increases to enhance rough cutting. At high speed, bearing pre-load decreases, to enlarge spindle life.
Hydraulic clamping available	For turning operations
Detachable cartridge	Reducing downtime and cost due to spindle breakdown

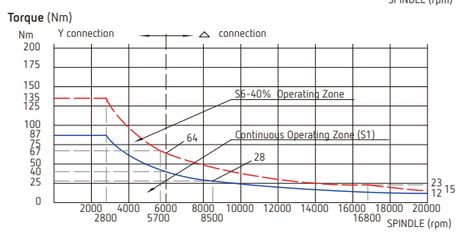
- 15.000 rpm
- HSK A63
- 30/46 kW S1/S6-40%
- Double coil asynchronous motor
- 130/200 Nm S1/S6-40%

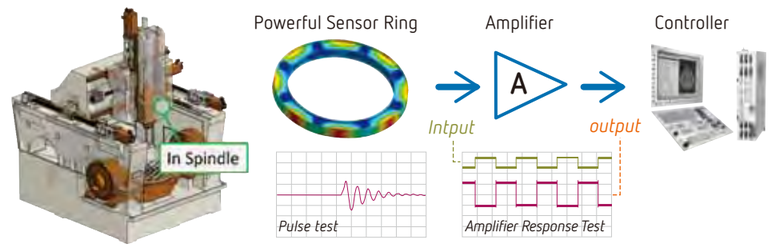




- 20.000 rpm
- HSK A63
- 25/40 kW S1/S6-40%
- Double coil asynchronous motor
- 87/135 Nm S1/S6-40%





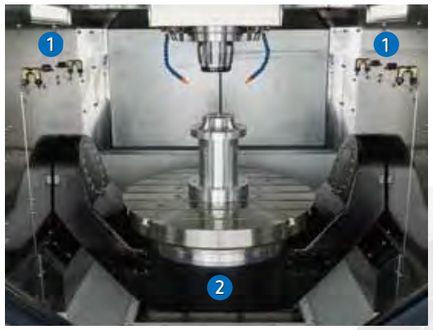


ART™ supported	Notification of repair before spindle damage, reducing waiting time for 90% downtime. Expected shutdowns takes only 1 days to replace or repair the spindle
Embedded sensor ring	Effectively detecting bearing abnormalities

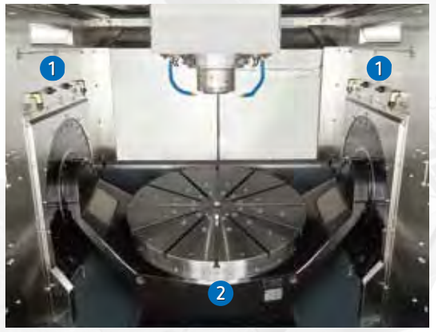
Chip management

Flushing chips away

G8 Standard

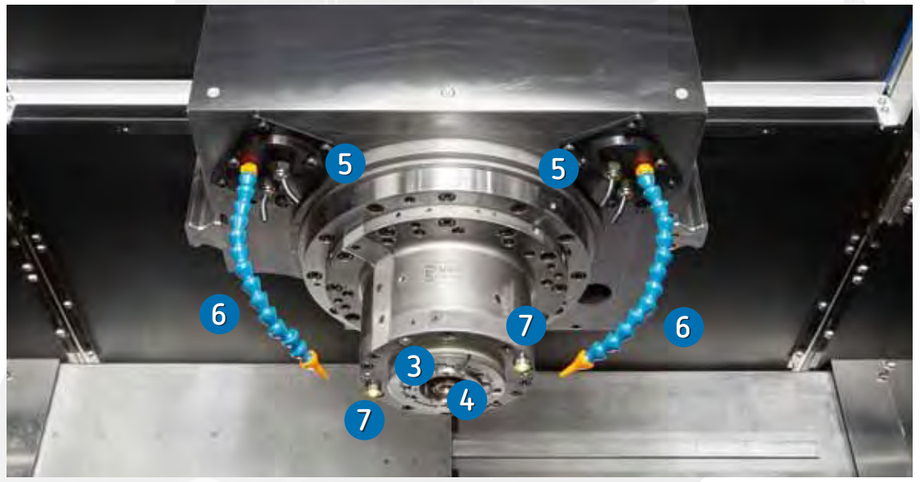


G8 MT



High-quality stainless steel work area	Long-lasting clean operation
Sharp walls and no-corner design	Easier to flush away chips by shower
2 x led lights spindle nose	For optimal illumination of the tool cutting

1. Chip wash down
2. Chip conveyor
3. 4x coolant at spindle nose
4. Coolant through spindle
5. 2x air flushing
6. 2+2 coolant flushing
7. 2 x led lights



Ergonomics

Accessibility to work area

Large front door opening	Comfortable access to work area for workpiece preparation and supervision
Short distance from operator to table	Ergonomic loading and unloding of small parts
Automatic roof to open ceiling working area	Easy loading and unloading of heavy and bulky workpieces by over-head crane

Automatic roof for overhead crane loading and unloading

Roof closed

Automatic sliding of roof

Fold-up the roof

Easy access to table center

Easier tooling management and maintenance

Tools are accessible from back of the machine and stored vertically	Tools can be easily changed during automatic operation
All necessary consumables are located together in the back of the machine	Easier maintenace routine for operator
Smart tool: interface panel is used to select the tool. When finished, the system checks whether all tool holders are in the right position	Avoid human failures when automatically change tool to spindle, protecting spindle and reducing down-time
Comfortable pending panel can be selected in either sides of machine	Layout is optimized and operator ergonomics customized

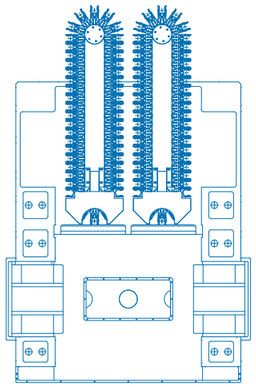
Tool management

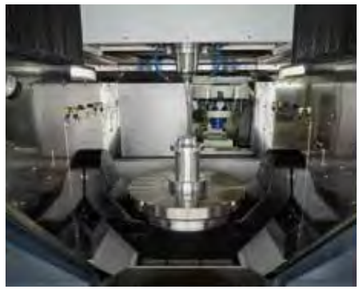
Flexible capacity for every application

Single or twin carrousels of 32, 48 or 60 tools can be selected and capacity doubled to 64, 96 or 120 tools. Up to 96 tools machine layout is not modified.

Sister tools, complex parts and unmanned operation can be executed with no worries on the tool magazine capacity.

"Carrousel-type magazine with **32 to 120 tools** capacity"





Control unit

A controller for every user

Heidenhain TNC640

- Kinematics
- Dynamic Collision Monitoring
- Tool Center Point Management
- Tilted the Working Plane

Siemens 840D sl

- Kinematic chain
- Collision Avoidance
- 5-axis transformation with tool orientation
- Swivel the Coordinate System

Fanuc 31iMB5

- 3D Interference Check
- High Speed Smooth TCP
- Tilted Working Plane indexing

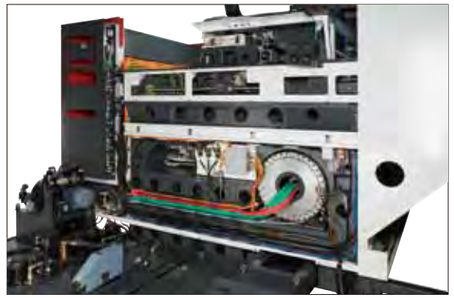
Heidenhain TNC640

Fanuc 31iMB5

Siemens 840D sl

Standard & optional equipment

Standard details of a premium machine



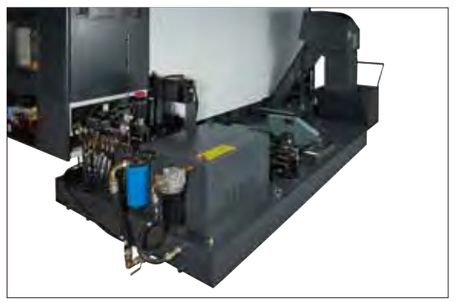
Optional design and organization of electrical connectors and cables

Easier maintenance

High-speed and twisting stress cycles

Major heat generating electrical components like transformer and line filters are kept in a separate cabinet for easier temperature control

Electrical cabinet is maintained at stable temperature using an air conditioner.



Chain-type chip conveyor with chip bucket, oil skimmer and built-in 20 bar through spindle coolant pump are standard equipments.

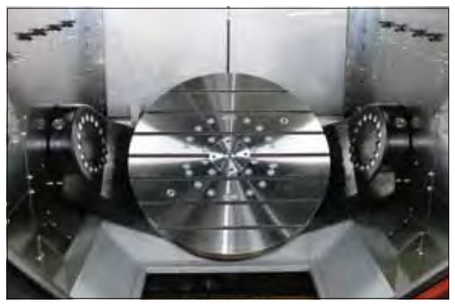
They can be positioned either side of the machine for layout customization.

Integrated and ready-to-use 3 hydraulic and 1 pneumatic port. Clamping and unclamping functions by softkeys in the control panel and/or by M-function.

Optional

- Integrated and ready-to-use 8x hydraulic (80 bar) or pneumatic (6 ports) ports
- 4x vacuum port

Simplifies 5X workpiece clamping.



Customize the machine to your needs

Automatic workpiece measurement (with probe, receiver and reference ball)

Automatic compensation of the linear-rotary axis relative positioning: Kinematics (Heidenhain), Kinematic chain (Siemens) and Tilted working plane indexing (Fanuc)

For accurate workpiece positioning or in-process measuring of some machining features.

U-type embedded in the table (for highest accuracy).
Laser tool measurement. This option is used for:

Turning tool are measured in an additional touch probe, in different angle positions

For accurate tool measurement in length, radius and shape

For in-process tool measurement at working conditions (spindle running at thermal stable conditions)

Separate type cooling unit including:

- Cartridge filter
- Paper filter
- Through spindle 20 bar centrifugal pump or
- Through spindle 70 bar screw type pump with stepless programmable pressure
- Oil skimmer
- Coolant chiller

Recommended for high aluminum or cast iron material

Drum type dual-belt chip conveyor

Chain type conveyor takes bigger and curly chips away. Scrapper type conveyor takes smaller and lighter chips as well as dusty chips away.

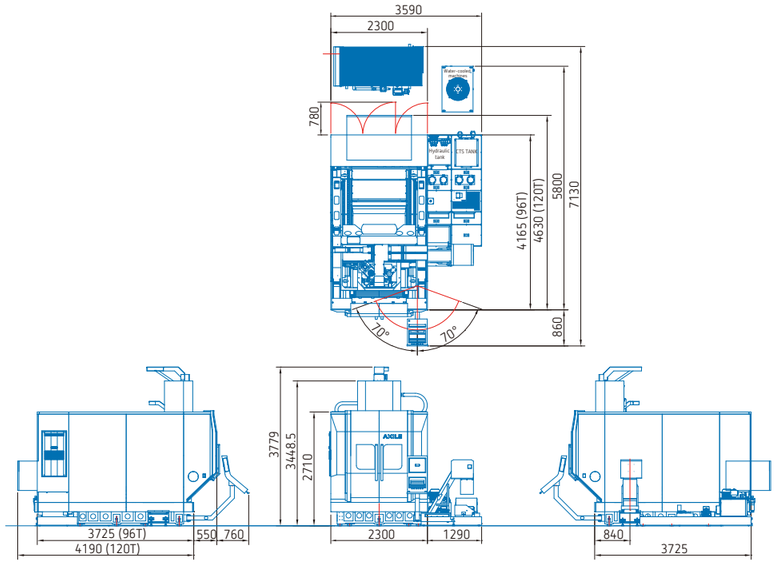
Drum filter takes clean coolant back to tank

Spin window

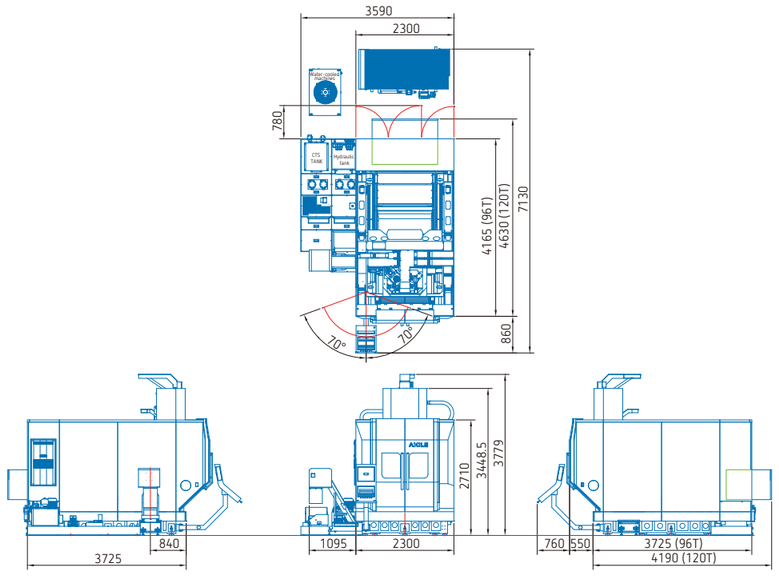
For easier view of working area when huge amount of coolant and chips are produced

Layout and workspace

Coolant tank and pending panel at left



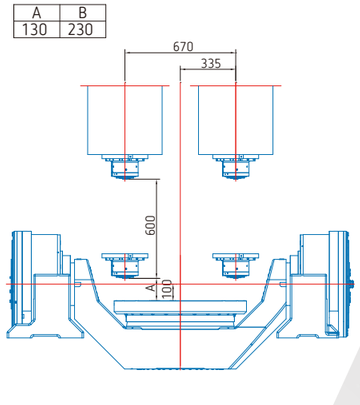
Coolant tank and pending panel at right

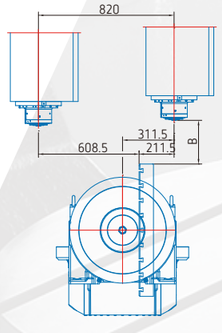


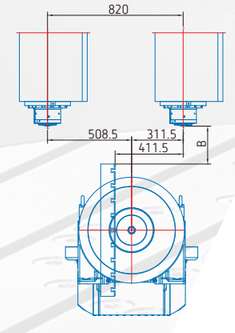
Interference

G8 Standard

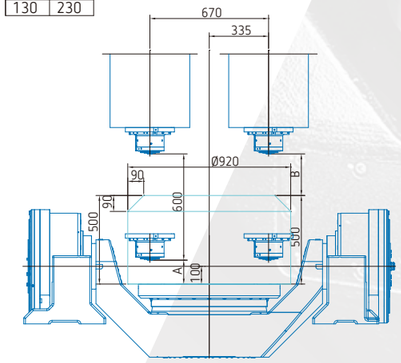
A	B
130	230

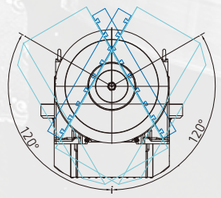


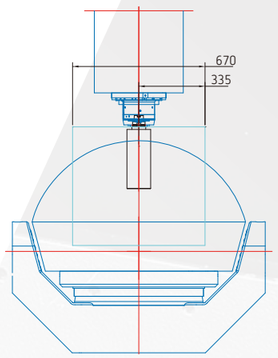


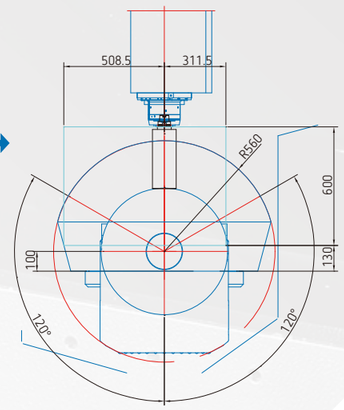


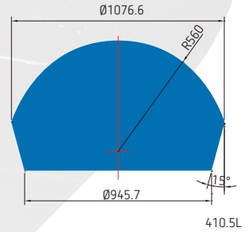
A	B
130	230







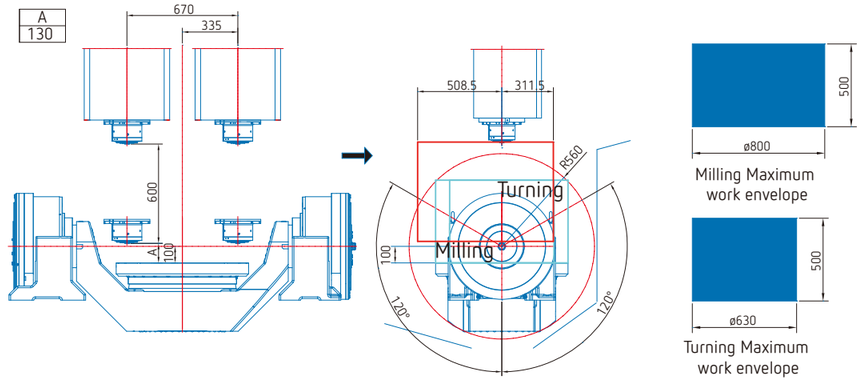




Maximum work envelope

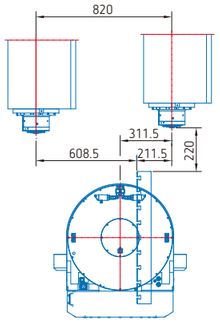
Interference

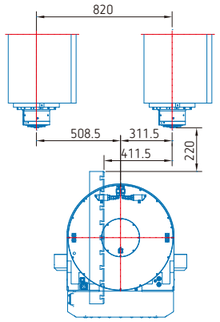
G8 MT

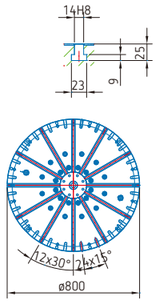


Milling Maximum work envelope

Turning Maximum work envelope







Max table load
Turning: 850 kg
Milling: 1200 kg

Technical data

Common data for G8

TABLE		
Table size (diameter)	mm	Ø800
Number and hydraulic ports		3
Working pressure of hydraulic ports	bar	80
Number and pneumatic ports		1
Working pressure of pneumatic ports	bar	6
LINEAR AXES		
X travel (carriage left and right)	mm	670
Y travel (gantry back and forth)	mm	820
Z travel (head stock up and down)	mm	600 (HSK-A63/ISO40) / 550 (ISO50)
Max feedrate X/Y/Z	m/min	60/60/60
Guideways type		Roller
Guideways size X/Y/Z	mm	55/45/45
Distance between X/Y guides	mm	590/1472
Ballscrew diameter/pitch	mm	45/20
X axis motor power/torque	kW/Nm	6/19.2
Y axis motor power/torque	kW/Nm	6/19.2
Z axis motor power/torque	kW/Nm	8.9/28.4
ROTARY AXES		
A range (swivelling)	deg	±120
C range (rotary)	deg	360
SPINDLE (STANDARD)		
Spindle speed	rpm	20000
Transmission		Built-in
Motor type		Asynchronous
Bearing type (front/rear)		Angular ball
Bearing cooling and lubrication		Oil/Air
Power S1/S6-40%	kW	25/40
Torque S1/S6-40%	Nm	87/135
SPINDLE (OPTIONAL)		
Spindle speed	rpm	15000
Transmission		Built-in
Motor type		Asynchronous
Bearing type (front/rear)		Angular ball
Bearing cooling and lubrication		Oil/Air
Power S1/S6-40%	kW	30/46
Torque S1/S6-40%	Nm	130/200
MEASURING FEEDBACK		
Linear axes type		Linear scale
Linear axes resolution	µm	0.1
Rotary axes type		Rotary scale
Rotary axis accuracy		±5"
TOOL CHANGER		
Change type		Pick-up
Magazine type		Carrousel (x2)
Carousel drving system		(x2) Servomotor and gearbox
Magazine positions		32/64 48/96 60/120
Tool shank type		HSK-A63
Maximum tool length	mm	300
Maximum tool diameter (with adjacent pot empty)	mm	Ø75/Ø120
Maximum tool weight	kg	7

Technical data

Common data for G8

TOOL CHANGER		
Max. loading weight	kg	160(32T), 240(48T), 300(60T) 320(64T),480(96T), 600(120T)
ACCURACY (VDI/DGQ 3441)		
Positionning	mm	0.005
Repeatability	mm	±0.0025
EXTERNAL COOLANT SUPPLY		
Exteral nozzels coolant supply (number) pressure	bar	(4x) 3
External nozzels air supply (number) pressure	bar	(2x) 6
Tank capacity	l	425
SPINDLE THROUGH COOLANT SUPPLY (STANDARD)		
High pressure pump	bar	20
Filter type		Catridge
SPINDLE THROUGH COOLANT SUPPLY WITH SEPARATE TANK(OPTIONAL)		
High pressure pump	bar	20 / 70
High pressure pump with stepless programable pressure	bar	0-70 stepless
Filter type		Catridge and paper band
Additional		Coolant chiller and oil skimmer
CONTROL UNIT		
Heidenhain		TNC 640
Siemens		840D sl
Fanuc		31iMB5
SUPPLIES		
Installed power	kVA	85
DIMEMSION		
Length	mm	3565 (32T/64T) / 4165 (48T/96T) / 4630 (60T/120T)
Width	mm	4410
Height	mm	3779
Weight	kg	18000
Floor Space	mm	3565x4410 (32T/64T) /4165x4410 (48T/96T) /4630x4410 (60T/120T)

Specific data for G8 Standard

WORKPIECE AND TABLE		
Maxium table load	kg	1300
T-slot (w/pitch/no)	mm	14 x 100 x7
SPINDLE		
Spindle taper		HSK-A63
Spindle nose to rotary table clamping surface	mm	130~730
ROTARY AXES		
Maximum sviwelling (A) speed	rpm	80
Maximum rotary (C) speed	rpm	100
Driving system in swivelling (A) axis		Dual torque motor
Driving system in rotary (C) axis		Torque motor
Power & torque of swivelling (A) axis	kW/Nm	15.7/1870x2
Power & torque of rotary (C) axis	kW/Nm	15.7/1870
Brake type of swivelling (A) axis		Hydraulic clamping
Braking torque of swivelling (A) axis	Nm	3500x2
Brake type of rotary (C) axis		Hydraulic clamping
Braking torque of rotary (C) axis	Nm	2500

Specific data for G8 MT

WORKPIECE AND TABLE		
Maxium table load	kg	850(Turning) / 1200(Milling)
T-slot (w/pitch/no)	mm	14 x 30 x 12
SPINDLE		
Spindle taper		ISO40/HSK-T63
Spindle nose to rotary table clamping surface	mm	130~730
ROTARY AXES		
Maximum sviwelling (A) speed	rpm	15(Turning) / 100(Milling)
Maximum rotary (C) speed	rpm	1000(Turning) / 100(Milling)
Driving system in swivelling (A) axis		Dual torque motor
Driving system in rotary (C) axis		Torque motor
Power & torque of swivelling (A) axis	kW/Nm	20.4/1948x2
Power & torque of rotary (C) axis	kW/Nm	55/525
Brake type of swivelling (A) axis		Hydraulic clamping
Braking torque of swivelling (A) axis	Nm	4000x2
Brake type of rotary (C) axis		Hydraulic clamping
Braking torque of rotary (C) axis	Nm	4000