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FH SERIES Horizontal Spindle Machining Centers

FH1000SX
FH1250SX
FH1250SW
FH1600SW5i



<http://www.jtekt.co.jp>

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In order to observe laws and regulations and prevent inappropriate export, re-sale and relocation, JTEKT has equipped all of our NC machine tools with devices that detect relocation. If this device is activated, the machine will cease operation and will not restart until it has been checked by JTEKT. JTEKT may refuse to restart the machine should it be deemed that such an action would amount to the inappropriate export of a commodity or technology, or violate export regulations. In such a case, JTEKT will not be liable for any damages arising from the refusal to restart machine operation and do not bear any liability to perform services pertaining to product warranty. Please contact your JTEKT representative for details. Always read manuals carefully before using any machinery to ensure safe and proper use.

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Type of Machinery: Machining Center
Model Number: FH1000SX, FH1250SX, FH1250SW, FH1600SW5i
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JTEKT
JTEKT CORPORATION

JTEKT
Koyo TOYODA



Optimal for machining large parts for any industry

Energy-related industry, aerospace industry, construction machine and transport machine

Top-level performance in machining large-size parts of every industry

Large size horizontal machining center equipped with quill spindle

The FH1250SW and FH600SW5i, which are equipped with a quill spindle, have integrated machining processes which in the past would have required a bridge-type machining center as well as a horizontal boring machine. This achievement of integration into a single machine can reduce setup change time and improve production efficiency, in addition to raising the machining accuracy of single-clamp machining. The FH1250SW and FH600SW5i feature a pallet changer, magazine unit that can set multiple tools, feedrate with high-speed performance, and other characteristics of a machining center, and also achieve a high level of productivity through an original JTEKT high-rigidity quill spindle.

Bridge-type
machining center + Boring
machine = FH1250SW
or
FH1600SW5i



FH1250SW / FH1600SW5i

Large size horizontal machining center

The FH1000SX / FH1250SX contains a dual ball screw drive (Y-axis and Z-axis), and a spindle that enables the user to choose from high-speed machining to heavy-duty cutting to suit their needs. In addition, the bed and column maintain sufficient rigidity and accuracy to support fast and highly accurate machining of large workpieces.



FH1000SX / FH1250SX

maximum & fastest

■ Workpiece range, the largest in the class

Maximum workpiece swing, maximum workpiece height and maximum stroke are realized to be the largest in the class.

■ Rapid feed rate, the fastest in the class

More than double speed performance is realized compared with large-size machine tools such as horizontal boring and milling machine and 5-face machining center.

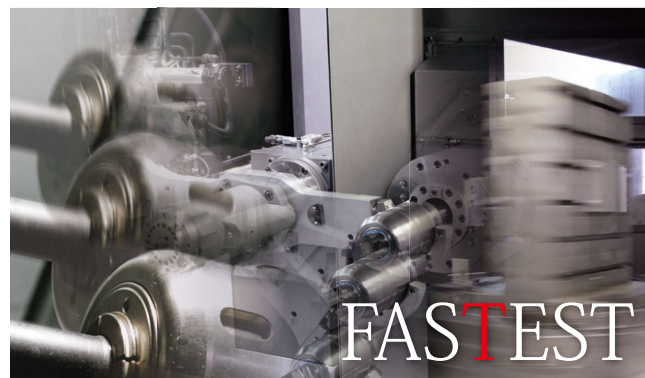
maximum & fastest

MAXIMUM



	Maximum workpiece range	Maximum load on pallet	Stroke (X×Y×Z)
FH1000SX	φ1,800mm×1,600mm	3,000kg	1,600mm×1,400mm×1,850mm
FH1250SX	φ2,400mm×1,800mm	5,000kg	2,200mm×1,600mm×1,850mm
FH1250SW	φ2,400mm×1,800mm	5,000kg	2,200mm×1,500mm×1,850mm
FH1600SWSi	φ3,200mm×2,200mm	8,000kg	3,000mm×1,900mm×2,100mm

FASTEST



	Rapid feed rate	Tool changing time (C-C)	Table indexing time (90° indexing)
FH1000SX	54m/min	4.4 sec.	4.0 sec.
FH1250SX	42m/min	4.4 sec.	5.6 sec.
FH1250SW	42m/min (Z-axis)	6.0 sec.	5.6 sec.
FH1600SWSi	40m/min (Y,Z-axis)	23.2 sec.*	6.0 sec.

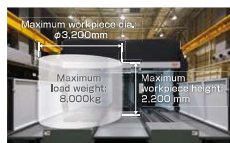
* Includes time for main arm shift.

maximum

The largest in the class New world of machining center

In recent years, efforts to combat environmental problems such as global warming have been hastening the development of eco-friendly diesel engines for trucks and agricultural construction machinery, as well as fuel-efficient compact jet aircraft. While advancements have been accelerating within renewable energy sources such as wind power, demands have increased for equipment used in plants which supply new types of energy, such as shale gas. Equipment and devices used within these fields have a tendency to be designed larger to improve energy efficiency, which brings a demand for machines with a wider machining range and high productivity which can produce larger parts more efficiently.

The FH1250SX has a maximum workpiece swing of φ2,400 mm, and can hold a maximum load of 5,000 kg. The FH1600SWSi has a maximum workpiece swing of φ3,200 mm, and can hold a maximum load of 8,000 kg, making it capable of supporting large workpieces of the maximum standard size class, for which it has the necessary and sufficient machine stroke. The FH1250SW and FH1600SWSi are equipped with a quill spindle that allows better accessibility to the inner areas of workpieces, enabling machining of deeper areas.



fastest

Boasting the best speed performance in the class while maintaining rigidity

In the past, box way slide machines with high damping performance well sustainable for high-load production were widely used for machining large-size parts. Recently, however, demands for higher productivity resulted from higher speed are growing stronger even in large machining centers.

The high-speed and high-rigidity feed enables the adoption of a cylindrical roller-type linear guide, making the rapid feedrate 42 m/min. (X, Y, and Z axes) on the FH1250SX, and 40 m/min. (Y and Z axes) and 35 m/min. (X-axis) on the FH1600SWSi. Y and Z axes, which are most susceptible to machining load, have a dual-drive system which is made up of two ball screws. Major components supporting the axes, such as bed, column, and table, are designed by CAE to have the optimal layout of rib, thereby to give sufficient rigidity. Furthermore, the rigidity of the machine's Y-axis has been improved by maintaining high rigidity through the utilization of six linear guide blocks on the Y-axis, and creating the optimal layout for the linear guide and ball screw. In addition, a larger spindle extension amount has decreased the distance from the table center to the spindle nose.



FH1000SX / FH1250SX / FH1250SW / FH1600SWSi





The performance of the machining center depends on the **Spindle**.
The spindle serves as a core of the machining center. JTEKT sticks to the spindle, which is important because it is located nearest the cutting point, to keep stable cutting accuracy.

List of spindles

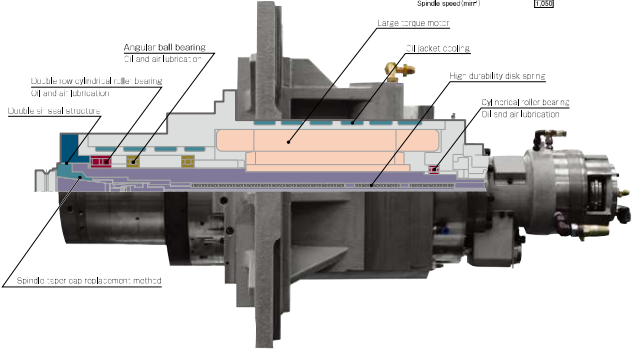
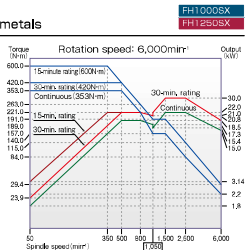
Application	Spindle speed	Holder compatibility	Spindle motor (short-time/continuous)	Spindle diameter (front bearing bore)	Max. torque	Quill spindle stroke	Applicable models
Best for high-efficiency cutting of cast parts	6,000min ⁻¹	BT50 BT50 HSKA100 CAT50 DIN50	30/22kW	φ110	600N·m	—	FH1000SX FH1250SX
Best for heavy duty cutting at low speeds with large diameter cutters	6,000min ⁻¹		37/30kW	φ110	1,009N·m	—	
Best for a wide variety of products with high speeds and large torques	15,000min ⁻¹		37/30kW	φ120	530N·m	—	
Quill spindle enables optimal deep hole grinding and boring of iron/cast metal parts	3,000min ⁻¹		45/37kW	φ180	1,313N·m	550mm	FH1250SW
Quill spindle enables optimal deep large-diameter hole grinding and boring of iron/cast metal parts	4,000min ⁻¹		55/37kW	φ200	2,115N·m	750mm	FH1600SWSi

Details of functions < Spindle

Each and every spindle is backed by its own specific type of outstanding technology.

Standard spindle optimum for machining of iron and cast metals

[Spindle speed] 6,000min⁻¹
[Spindle nose shape] BT No.50
[Spindle motor (short-time/continuous)] 30/22kW
[Max. torque] 600N·m
[Spindle diameter (front bearing bore)] φ110mm
Both axial and radial rigidity is sought after in spindles operating with large cutters. To satisfy both requirements, the 6,000min⁻¹ spindle is equipped with a double row cylindrical roller bearing on its front. This bearing has a large radial load capacity and is therefore able to withstand heavy duty loads and impacting loads.



High efficiency cutting of iron and cast metals

Elevator parts

[Workpiece material] FCD450

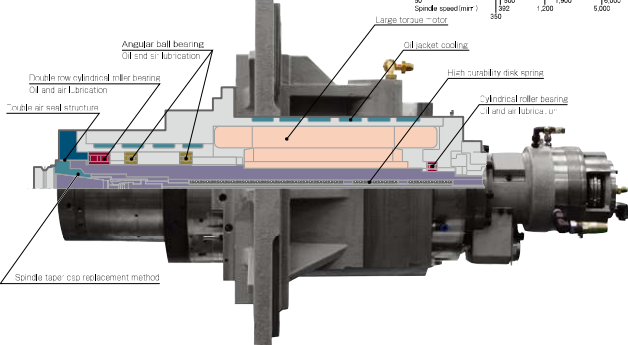
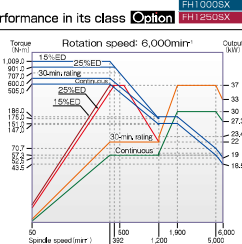
Milling
[Tool] φ125 face mill
[Spindle speed] 640min⁻¹
[Cutting feed rate] 1,400mm/min



Large torque 6,000min⁻¹ spindle achieving the best performance in its class **Cotton**

[Spindle speed] 6,000min⁻¹
[Spindle nose shape] BT No.50
[Spindle motor (short-time/continuous)] 37/30kW
[Max. torque] 1,009N·m
[Spindle diameter (front bearing bore)] ϕ 110mm

Both axial and radial rigidity is sought after in spindles operating with large cutters. To satisfy both requirements, the 6,000min⁻¹ spindle is equipped with a double row cylindrical roller bearing on its front. This bearing has a large radial load capacity and is therefore able to withstand heavy duty loads and impacting loads. This machine has a high-torque spindle of 1,009 Nm, with double the cutting ability in low speed ranges (under 500 min⁻¹) compared to standard spindles.



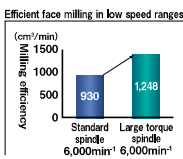
Best cutting performance in its class with a 1,009N·m large torque spindle

Model piece

[Workpiece material] HPM7

■Milling
[Tool] ϕ 160 face mill
[Spindle speed] 400min⁻¹
[Feed rate] 1,600mm³/min
[Depth of cut/width] 6/130mm

■Bore hole machining
[Tool] ϕ 92 Boring
[Spindle speed] 500min⁻¹
[Feed rate] 200mm³/min

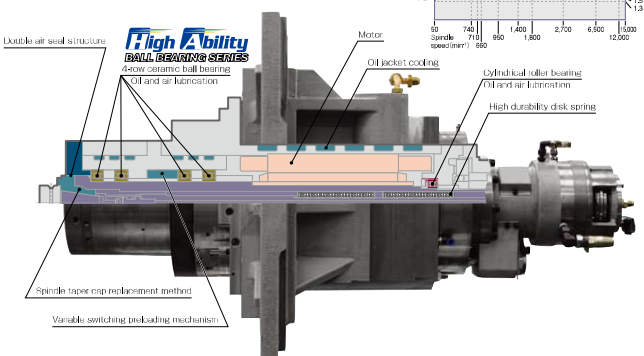
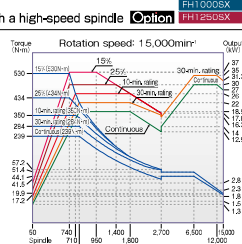


Large torque 15,000min⁻¹ spindle

Multi-use spindle that achieves 530N·m in low speed ranges, even with a high-speed spindle **Cotton**

[Spindle speed] 15,000min⁻¹
[Spindle nose shape] BT No.50
[Spindle motor (short-time/continuous)] 37/30kW
[Max. torque] 530N·m
[Spindle diameter (front bearing bore)] ϕ 120mm

This is a multi-use type spindle that boasts high rigidity and rotational accuracy, enabling the machining of a wide range of workpieces, from the slow cutting of steel to the fast cutting of aluminum. This spindle utilizes a newly developed preloading adjustment mechanism that stabilizes high torque in low speed ranges and accuracy in high speed ranges.



High-efficiency and high-accuracy machining with 15,000min⁻¹ large torque spindle

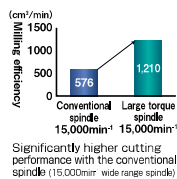
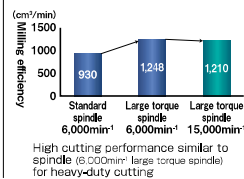
Test piece

[Workpiece material] S45C

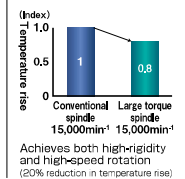
■Milling [Tool] ϕ 125 face mill
[Feed rate] 2,688mm³/min

[Spindle speed] 800min⁻¹
[Depth of cut/width] 4.5/100mm

Efficient face milling in low speed ranges



Minimizes heat generation in the high speed ranges (front bearing exhaust temperature)





Long stroke,
high rigidity quill spindle

We at JTEKT have used our advantage as a bearing maker to successfully combine the two contradicting properties 'long' and 'strong'. Demonstrates powerful machining with the quill (W axis) extended.

Details of functions < Spindle

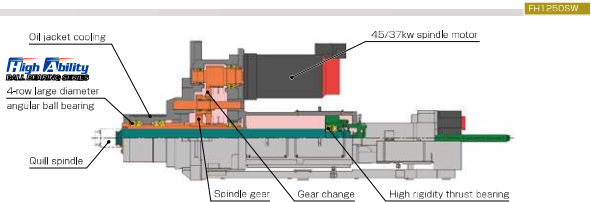
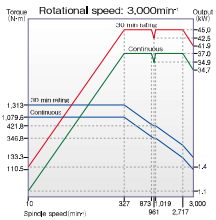
A high rigidity Quill-axis (W-axis) with the longest stroke in its class.

This newly developed gear-driven quill spindle is optimal for and exhibits powerful deep large-diameter hole drilling and

cutting iron and cast metal parts, boring.

FH1250SW

[Spindle speed] 3,000min⁻¹
[Spindle nose shape] BT No.50
[Spindle motor (short-time/continuous)] 45/37kW
[Max. torque] 1,313N·m
[Spindle diameter (front bearing bore)] ϕ 180mm
[Quill spindle stroke (W axis travel amount)] 550mm

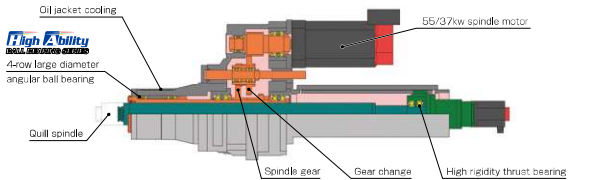
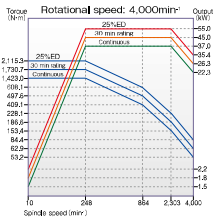


Best cutting performance in its class with a 1,313N·m large torque spindle

Milling example [1] (w=0)	End milling example [2] (w=0)	Drilling example [3]
Chip discharge: 1,248 cm ³ /min	Chip discharge: 366 cm ³ /min	Chip discharge: 918 cm ³ /min
[Material] S48C [Tool used] ϕ 160 [Spindle rotation speed] 400min ⁻¹ [Cutting width] 130mm [Cutting depth] 6mm [Cutting feedrate] 1,600mm/min	[Material] S48C [Tool used] ϕ 40 Throw away [Spindle rotation speed] 1,590min ⁻¹ [Cutting width] 20mm [Cutting depth] 32mm [Cutting feedrate] 572mm/min	[Material] S48C [Tool used] ϕ 160 [Spindle rotation speed] 297min ⁻¹ [Cutting feedrate] 52mm/min

FH1600SW5i

[Spindle speed] 4,000min⁻¹
[Spindle nose shape] BT No.50
[Spindle motor (short-time/continuous)] 55/37kW
[Max. torque] 2,115N·m
[Spindle diameter (front bearing bore)] ϕ 200mm
[Quill spindle stroke (W axis travel amount)] 750mm



Best cutting performance in its class with a 2,115N·m large torque spindle

Milling example [1] (w=0)	Drilling example [2]	Example of boring [3]
Chip discharge: 1,568 cm ³ /min	Chip discharge: 997 cm ³ /min	Chip discharge: 337 cm ³ /min
[Material] S48C [Tool used] ϕ 200 [Spindle rotation speed] 310min ⁻¹ [Cutting width] 140mm [Cutting depth] 16mm [Cutting feedrate] 700mm/min	[Material] S48C [Tool used] ϕ 101.6 [Spindle rotation speed] 280min ⁻¹ [Cutting feedrate] 123mm/min	[Material] S48C [Tool used] ϕ 230 [Spindle rotation speed] 69min ⁻¹ [Cutting depth (radius)] 13mm [Cutting feedrate] 38mm/min

Tool longevity and cutting accuracy to be discussed separately.

JTEKT's spindle promises assurance over a long period and takes maintenance into consideration.

JTEKT's dedicated spindle manufacturing

The spindle is the heart of the machining center, and as such it is manufactured under strict accuracy control. Confirmation checks look at dynamic balance, temperature, vibration, noise, and so forth, and, after ensuring all allowable limits have been maintained, the spindle is installed in the machine.



Dynamic caliper measurement



High-speed spindle running test

Basic design particularly focusing on low vibration.

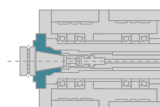
A spindle vibration within 2 microns^① has been accomplished (measurement with a 15,000min^② spindle). FH1000SX FH1250SX

We have developed a low vibration, high speed spindle which suppresses vibration and runout across the entire range up to the maximum speed. This feature contributes not only to the improvement of cutting accuracy but also to the extension of tool life.

The spindle taper cap replacement method takes ease of maintenance into consideration.

FH1000SX FH1250SX FH1600SWS

Even in the rare chance that a failure does occur, a replacement spindle cartridge that has been checked at JTEKT for operation and quality can be installed in its place, keeping restoration time down to a minimum. Furthermore, the separate spindle taper makes individual cap replacement possible as it is integrated with the taper, even in the event of taper damage caused by accidental interference.



① JTEKT's guaranteed value

Technologies which have continuously supported the aerospace industry down through time are materialized in our machining center bearings.

We have been supporting the aircraft and aerospace industry for 30 plus years and our bearings are used in many of the jet engines manufactured in Japan. By providing the latest technology, we keep satisfying every rotation technology need from the ground to outer space. The technology cultivated over this period has been materialized in machining center bearings.



High Ability
BALL BEARING SERIES

High speed limit performance - 1.5 fold
Temperature increase - 30% reduction

In 1984, JTEKT were the first in the world to succeed in the practical use of ceramic bearings. Over the years since, we have gradually built up the processes such as design technology, precision and high-efficiency machining technology and mass production needed to use ceramic materials in roller bearings, and consequently now meet those factors such as speed, reliability and price demanded of machining center spindles.

The High Ability bearing is adapted in 1/4 15,000min^①, 5,000min^②, 4,000min^③ BT 60/20 spindle.



A rigid **Platform** incomparable to any others assures stable production over a long period.

JTEKT's basic approach towards machine design is to minimize displacement caused by external forces that may impact on cutting accuracy. The rigid bed of the FH Series provides the answer towards withstanding large cutting resistance as well as inertial forces of feed acceleration and deceleration.

—The immobile bed is placed as a solid stationary matter and moving bodies such as the column is light-weight but at the same time rigid-simple, yet requiring high level analysis techniques and material technology.



Unrivalled rigid platform allowing the spindle to achieve it's full performance

FCD600 column
featuring both high speed performance and heavy duty cutting capabilities

JTEKT's original high casting technology has made it possible to contribute materials which are not only complex in shape but also large, such as the column, to the creation of the FCD600. As a result, it has been possible to create a light weight machine with a rigid column. Furthermore, using FEM technology, the development of a low center-of-gravity column with satisfactory moving performance was completed. With this, high rapid feed rate and high acceleration are accomplished while a high rigidity against cutting forces is maintained.

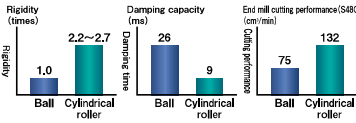
High grade cast iron high rigid bed
keeping machine level stable over a long period

The bed supporting the moving body is designed using FEM analysis technology. And the bed has sufficient rigidity and substantially improved moving level. This feature makes stable axial feed possible with high speed and high acceleration.



A Rigid cylindrical roller slide
able to withstand high speed, high acceleration travel while still maintaining rigidity is adopted

Compared to the ball guide, the cylindrical roller slide features less elastic deformation against loads and smaller displacement caused by load variation, as well as possesses superior vibration damping characteristics. This feature makes it possible to position quickly with smaller orientation changes upon sudden acceleration or stoppages, contributing to a higher level of production efficiency.

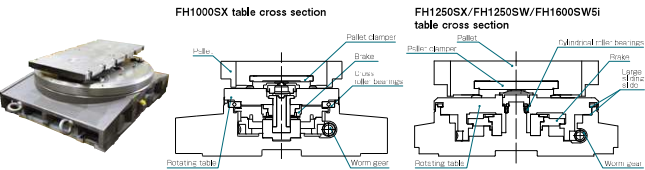


Because of JTEKT's assembling technology which allows for strict mounting face accuracies, the rigid cylindrical roller slide offers the best rapid feed rate and acceleration in it's class.

High rigidity and high accuracy table able to endure the weight of large workpieces

The NC indexing table conducts table indexing in units of 0.001° even with a heavy workpiece loaded onto the pallet. The high-rigidity and high-accuracy cross-roller bearing on the FH1000SX and the large sliding slide on the table periphery of the FH1250SX and FH1600SW5i secure the load and counterbalance the weight of large workpieces with suitable support rigidity. These mechanisms minimize vibration on the pallet and enable accurate machining, even with unbalanced load weights and cutting loads.

	FH1000SX	FH1250SX / FH1250SW	FH1600SW5i
Maximum load on pallet	3,000kg	5,000kg	8,000kg



	NC indexing table	NC indexing table (with NC encoder) CP	1° indexing table CP
Table indexing accuracy	±7sec	±3.5sec	±7sec
Table indexing repeatability	±5basec	±2sec	±3.5basec

CP is a special specification.
* The 1° indexing table is not included on the FH1600SW5i.

Unique Precision technology only achievable with the inside-out knowledge of the cutting field that JTEKT possess.

Various factors can effect cutting accuracy. The FH Series is packed with a number of precision technologies that only JTEKT have had the opportunity to cultivate down through the years with strong involvement in the mass production of automotive parts.

3 approaches for achieving precision cutting

Suppress heat generation

- [Ball screw shaft cooling] Reduction of heat by cooling the spindle core
- [Spindle oil jacket cooling] Reduction of spindle temperature rise
- [Dual ball screw drive] Reduced heat generation through motor size reduction
- [1,500min⁻¹ large torque spindle] Reduction of spindle temperature rise with a multi switching preloading mechanism **Option**
- [High Ability bearing] 30% reduction of bearing temperature rise **Option**
- [Working oil cooling] **Option**
- [Coolant cooling] **Option**

Elimination of heat transmission

- [Multi trough structure] Suppressing the effects of chips and coolant heat
- [Y-axis motor heat isolation coupling cooling] Suppression of ball screw elongation

Heat effect control

- [Large heat capacity bed] Reducing the effect of thermal displacement
 - [Thermally symmetrical structure] Reducing heat-related column twist
 - [Spindle Thermo Stabilizer function] Direct measurement and correction of spindle elongation **Option**
 - [Scale feedback] **Option**
- | Model | FH1000SX | FH1250SX | FH1600SX | FH1800SX |
|----------------------------------|----------|----------|----------|----------|
| Post drilling accuracy (X, Y, Z) | ±0.005mm | ±0.005mm | ±0.005mm | ±0.005mm |
| Repeatability (X, Y, Z) | ±0.001mm | ±0.001mm | ±0.001mm | ±0.001mm |
| Table indexing accuracy (B) | ±3.5 sec | ±3.5 sec | ±3.5 sec | ±3.5 sec |
| Table indexing repeatability (B) | ±2 sec | ±2 sec | ±2 sec | ±2 sec |
- [Touch sensor function] **Option**

Manufacturing technology for realizing precision cutting



Table reference face after scraping

Accuracy machining of linear guide mounting face

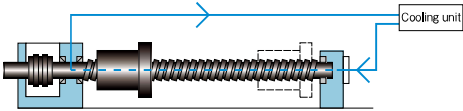
Spindle balancing

Precision assembling work

Ball screw shaft cooling

Spindle core cooling performing stable and high accuracy machining

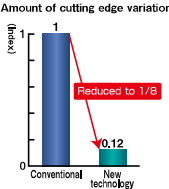
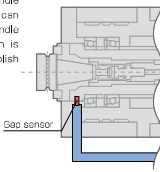
Heat displacement is restrained and stable and high accuracy machining is performed by always discharging the controlled cooling oil to the spindle core of ball screw which has core empty structure in order to follow the bed temperature. Furthermore, this machine is of highly reliable design in which excessive load due to thermal expansion of ball screw is not given against the support bearing restrained by means of double anchor method.



Spindle Thermo Stabilizer function **Option**

Spindle thermal displacement correction function used to correct spindle elongation formed after an extended period of operation

A displacement sensor installed at the end of the spindle is used to directly detect spindle edge position, which can be easily displaced by heat generated inside the spindle during extended operation. Z-axis direction deviation is suppressed as much as possible in order to accomplish precision cutting.



Scale feedback (X, Y and Z axes)

Option

An optical scale makes lasting precision positioning possible.



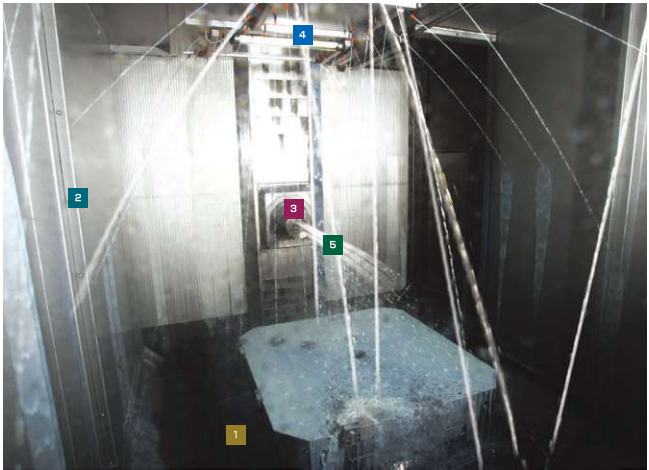
Touch sensor function

Option

The touch sensor is used to align the workpiece.



Reliability starts with chip disposal. The design of a multi trough that makes it possible to deal with chip disposal directly beneath the cutting point.



1 Multi-trough double chip conveyor
To enable smooth processing of chips, three coil conveyors are installed on the FH1000SX, FH1250SX, and FH1250SW, and four coil conveyors are installed on the FH1600SWI.



3 External nozzle coolant
The nozzle installed at the spindle nose supplies coolant to the cutting point.

2 Vertical cover
Chips are processed efficiently by constructing the machining chamber interior from vertical covers. Furthermore, chip accumulation at the work position is prevented by an operation door with a shape that has been carefully designed.

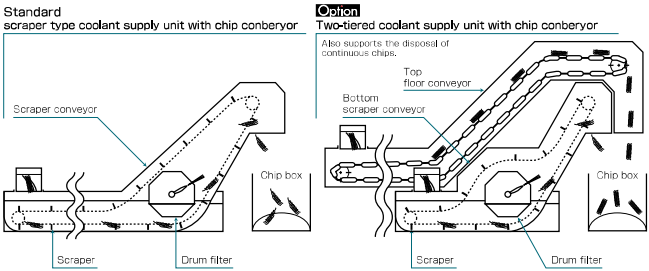


4 Overhead shower coolant
The coolant nozzle installed in the ceiling discharges coolant, keeping chip accumulation inside the machine down to a minimum.

5 Spindle-through coolant
Coolant is supplied through the spindle center to the cutting edge. It is effective for lubrication and cooling of the cutting point, chip disposal and extension of tool life. (Delivery pressure: 3MPa and 7MPa are options.)



Coolant supply unit with take-up chip conveyor
Chips collected in the center trough are transported outside of the machine by the chip conveyor. Two types of chip conveyors are provided to choose from depending on chip shape and material.



Splash gun



Oil skimmer

Option Optional parts
Coolant cooling, chip box, mist collector and other optional accessories can be added.



Coolant cooling



The pursuit of **Reliability** - one of JTEKT's starting points

Stable accuracy and an improved MTBF (mean time between failures) are both necessary in order for the customer to feel assured with reliability. The design of the FH Series pursues high quality, high performance and long life.

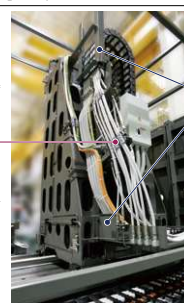


To provide the customer with assured operation, we work hard to make even the unseen portions of the machine more reliable.

Improved reliability in wiring and piping supporting higher speeds and acceleration

The speed and acceleration of axial feed have increased, and consequently the reliability of hoses and wire cables has become very important. As hoses and cables rub against each other, and since the damage to brackets increases, we design machines with careful consideration to the layout of hoses and cables and their wiring and routing, and to the strength and maintainability of brackets.

Piping and wiring cables are tied to reduce sagging - a measure in response to higher speeds and acceleration.



Brackets designed using strength analysis

Concentrated device layout making daily maintenance easier

The central lubrication, hydraulic and pneumatic devices are arranged together for easier daily inspections.



This photo shows F-2503SA.

Improved maintenance workability of electric cables and wires: Wire-saving unit

A substantial decrease in the number of wires and thus less wiring problems have been achieved through the utilization of a wire-saving unit for the wiring of devices that are configured centrally. This wire-saving unit improves maintenance workability by displaying connection status and enabling easy installation and removal of wires and cables.





This photo shows F1125U-SK.

Securing accessibility and work space

Accessible operation door

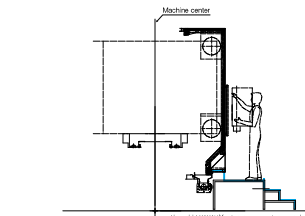
By positioning the operation panel on the left-hand side of the machine, we have created a wide opening and reduced the amount of eye travel required. This in turn reduces the physical strain on the operator by not demanding a constrained physical posture.



This photo shows F11250SK.

A step providing easy access to the spindle

By bending the bottom portion of the operation door into the inside and installing a work step, the operator is able to stand close to the spindle and work can be performed safely.



This photo shows F-250SK.

APC door with good accessibility

In make for easy loading/unloading of large workpieces a platform has been provided at the top of the APC. It is possible to stand close to the pallet and work can be carried out safely.



This photo shows F11250SK.

TOYOPUC-Touch

HMI in the IoT* era
Simple, safe and connectable



Renewed operability

J-Operate

Realization of simple operation

J-Navigate

Visualization of equipment status

J-Support

Batch management of equipment information

J-Manage

Equipment diagnosis utilizing IoT

J-Care

*Rather than "IoT", JTEKT utilizes "IoE" ("Internet of Everything"), in which people, objects, information, and services are interconnected.

Renewed operability

J-Operate

Visible and effective operation thanks to batch data display

Consolidates information onto a single large-size display screen, and displays a keypad window when necessary



Operation status screen



Tool list screen



Realization of Inspirational operation

Screen swiping and pinching in/out mimics the operability of a smart phone, making the TOYOPUC-Touch easy to use and easy to learn



Pictures and letters can be made easier to read by enlarging the display

Enables page scrolling and fast list searching

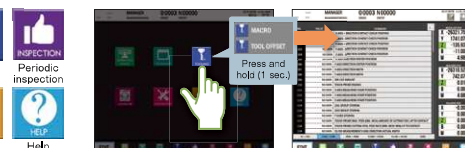


Realization of simple operation

J-Navigate

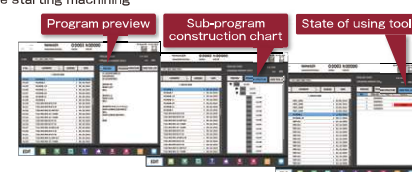
Minimal number of screen calling operations

Iconized menu enables screen calling from any screen in a maximum of two operations



Easy program status check before starting machining

Details, subprogram construction, and tool status can all be checked before starting machining just by selecting a program from the program list screen



Visualization of equipment status

J-Support

Supports operations performed at customer work sites with functions that visualize equipment status

Visualization of inspection

~Periodic inspection function~



Notifies the user of inspection periods and provides reliable inspection support.

- Notification of inspection periods via messages
- Inspection areas and inspection procedures can be viewed without consulting a manual
- Registration of completed past inspections/measurement results

Visualization of longevity

~Longevity management function~



Supports planned maintenance through notifications of when life is almost over.

- Notifies the user of inspections for parts that are nearing the end of their lives
- Minimizes machine stop time through preventive inspection/part preparation
- Inspection areas and inspection procedures can be viewed without consulting a manual

Visualization of status

~Equipment monitor~



Supports maintenance by allowing on-screen assessment of equipment status.

- ON/OFF status of devices can be viewed without having to check devices directly
- Device locations can be identified easily through image enlargement
- Internal ladder circuits can also be viewed easily

Visualization of performance

~Operation monitor~



Supports production control and improvement via graphs showing past operation performance/machining performance.

- Performance can be viewed easily on graphs and tables, and data entry is also possible
- Current performance can be compared with past performance of the selected period
- Performance can be viewed easily by shift

Visualization of energy

~Energy monitoring~



Supports energy saving activities by visualizing energy usage.

- Energy usage can be viewed easily on graphs and tables, and data entry is also possible
- Current energy usage can be compared with past energy usage of the selected period
- Effects of enabling/disabling energy saving settings can be viewed

Batch management of equipment information

J-Manage

Batch management of tool/pallet information



Tool management function

- Allows automatic indexing of the selected tool without having to know the tool installation position
- Protects tools by using ATC speed commands suited to each tool
- Enables prior assessment of abnormal or insufficient tooling



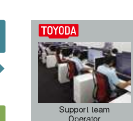
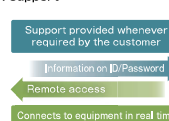
Pallet management function

- Automatically calls the machining programs set for each pallet
- Enables the setting of compensation values for each pallet
- Enables omission of unnecessary machining

Equipment diagnosis utilizing IoT

J-Care

Shortens error recovery time thanks to quick support



Additional functions of TOYOPUC-Touch

● Standard □ Optional

Classification	Function name	Included
J-Navigate	Running status display	●
	Program list display	●
	Program edit	●
	Command list display	●
	Macro list display	●
	Workpiece coordinate display	●
	Operation guidance function	●
	Parameter settings	●
J-Support	Message board	●
	Document browsing	●
	Fault list display	●
	Fault history	●
	Operation history	●
	Signal status display	●
	System management	●
	Backup function	●
	Operation monitor	●
	Machining performance	●
	Operation performance	●
	Cycle time measurement	●
	Energy saving settings	●
	Energy usage monitoring	□
	Periodic inspection function	●
	Longevity management function	●
	Equipment monitor	●
	Unit maintenance (Easy recovery function)	●
J-Manage	Software diagnosis function	●
	Fault analysis function	●
	Tool number conversion function	●
	Tool offset function	●
	Tool longevity management function	●
	ATC variable speed function	●
	Offset updating function	●
	AC condition setting function	●
	Machining condition setting function	●
	Stored tool data save function	●
	Abnormal tool list display	●
	Spare tool list display	●
	Tool position display	●
	Tools in use list display	●
	High-performance magazine operation panel	□
	Automatic indexing function for tools that require change	□
	Data updating function at tool mounting/removal	□
	Tool ID function	□
J-Care	APC management	●
	Pallet compensation	●
	Multiple workpiece mounting	●
	Diagnosis data collection function	●
J-Care	Remote support	□
	Remote diagnosis function	□

A convincing before-after sales system centered on a permanent exhibition site

JTEKT's Customer Center was opened in Kariya, Aichi Pref. in 1999 as one of the largest permanent exhibition sites in Japan. The sales, before-sales and after-sales service and training school divisions accepting direct contact with customers are integrally located in this center so that the best solution to meet customer's requirements can be found.



Observe

Exhibition

- Exhibition of cells/machines most suited to the customer
- Introduction to leading edge technologies
- Exhibition of total engineering potentials including those of group companies



Touch and confirm

Confirm

- Confirmation of technology by carrying out before-sales service tests
- Operation training at the training school
- Education of SFC, personnel training



Have discussions

Consultation

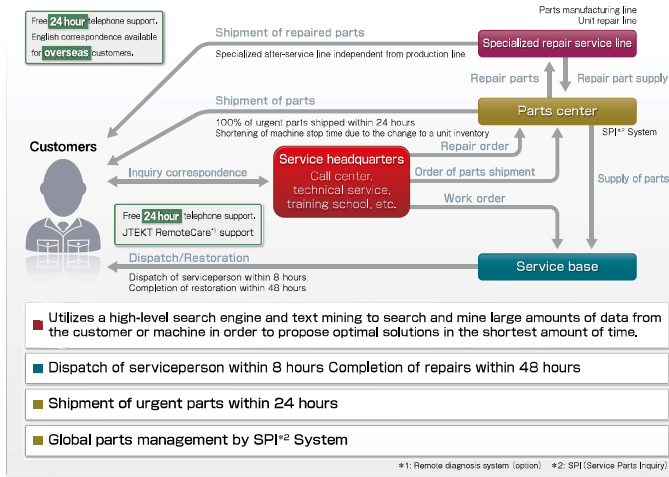
- Technical exchange meeting by DE* utilization
- Exchange of the latest information through events
- Machining consultation before the machines



* DE (Digital Engineering)

Speedy and precise customer correspondence.

We have established Service Headquarters in Kariya to consolidate the management of customer equipment information, and have arranged a system where call centers allow direct correspondence with customers, and parts can be supplied quickly.



Global service extending throughout the World

JTEKT shares a strong cooperation with its overseas base offices, and is able through these offices to provide secure and reliable service on a global scale. Our specialists have received rigorous training in order to support customers in every way, all throughout the world.



Machine specifications

Item	Unit	FH1000SX			FH1250SX		
		Standard specifications	Special specifications		Standard specifications	Special specifications	
Table & Pallet	Table dimensions (pallet dimensions)	mm	800 × 1,000 □800 (Pallet)		□1250 (Pallet)		1,250 × 1,600
	Rotary table indexing angle	°	0.001° (NC)		1°		1°
	Pallet height (from floor)	mm	1,300		1,500		
	Max. load on pallet	kg	3,000		5,000		
	Table indexing time (90° indexing)	sec	4.0		5.6		5.3
	Pallet change time	sec	70		85		
Stroke	X-axis	mm	1,600		2,200		
	Y-axis	mm	1,400		1,600		
	Z-axis	mm	1,850		1,850		
	Distance between spindle nose and table center	mm	50~1,900		200~2,050		
	Distance between spindle center and top of pallet	mm	100~1,500		100~1,700		
	Max. workspace swing × Max. workspace height	mm	φ1,800 × 1,600 #1		φ2,400 × 1,800 #1		
Feeds	Rapid feed rate (X, Y and Z)	m/min	54		42		
	Cutting feed rate (X, Y and Z)	m/min	0.001~30		0.001~30		
	Rapid acceleration (X, Y and Z)	m/s ² (G)	4.9(0.5)		2.94(0.3)		
	Ball screw diameter (X, Y and Z)	mm	φ50		φ63(X), φ50(Y, Z)		
	Spindle speed	min ⁻¹	50~6,000 50~6,000 50~15,000		50~6,000 50~6,000 50~15,000		
Spindle	Spindle diameter (front bearing bore)	mm	φ110 φ110 φ100		φ110 φ110 φ100		
	Spindle nose shape		BT No.50 HSK		BT No.50 HSK		
	Spindle motor, short-time/continuous	kW	30/22 37/30 30/25		30/22 37/30 30/25		
	Spindle holding capacity	tool	60 121,180,240,330 #2		60 121,180,240,330 #2		
ATC	Tool selection		Absolute address		Absolute address		
	Tool (dia. × length)	mm	φ120×800 #1		φ120×900 #1		
	Tool mass	kg	35		35		
	Tool change time (Tool-to-Tool)	sec	2.7(15kg) 3.2(15~35kg)		2.7(15kg) 3.2(15~35kg)		
	Tool change time (Chip-to-Chip)	sec	4.4(15kg) 5.0(15~35kg)		4.4(15kg) 5.0(15~35kg)		
	Tools Holder		MAS BT50		MAS BT50		
Dimensions & Weight	Floor space (width × depth)	mm	5,900 × 9,950 #3		6,200 × 9,900 #3		
	Machine height	mm	4,051		4,520		
	Machine weight	kg	31,000		48,000		
Various Capacities	Working oil	L	63		63		
	Slide lubricant	L	5.5		5.5		
	Spindle oil air	L	2.9		2.9		
	Table	L	4		4		
	Spindle coolant	L	20		20		
	Ball screw coolant	L	Also used as spindle coolant		Also used as spindle coolant		
	Power supply capacity	kVA	59 63 59		59 63 59		
	Control voltage	V	AC100 DC24		AC100 DC24		
	Air source capacity	NL/min	900		900		
	Air source pressure	MPa	0.4~0.5		0.4~0.5		
Capability & Performance	Positioning accuracy	#4 mm	±0.003		±0.003		±0.002
	Repeatability	#4 mm	±0.0015		±0.001		±0.001
	Table indexing accuracy	#4 sec	±7		±3.5 (with NC encoder)		±3.5 (with NC encoder)
	Table indexing repeatability	#4 sec	±3.5		±2 (with NC encoder)		±2 (with NC encoder)

#1: For detail shape, refer to the tooling data. #2: The matrix magazine is used for 180-tools or more. #3: For details, refer to the layout plan. #4: According to our inspection method.

Item	Unit	FH1250SW			FH1600SW5i		
		Standard specifications	Special specifications		Standard specifications	Special specifications	
Table & Pallet	Table dimensions (pallet dimensions)	mm	□1250 (Pallet)		1,250 × 1,600		1,600 × 1,250
	Rotary table indexing angle	°	0.001° (NC)		1°		0.001° (NC)
	Pallet height (from floor)	mm	1,500		1,450		
	Max. load on pallet	kg	5,000		8,000		
	Table indexing time (90° indexing)	sec	5.6		5.3		6.0
	Pallet change time	sec	85		200		
Stroke	X-axis	mm	2,200		3,000		
	Y-axis	mm	1,500		1,900		
	Z-axis	mm	1,850		2,100		
	W-axis	mm	550		750		
	Distance between spindle nose and table center	mm	260~2,110		400~2,500		
	Distance between spindle center and top of pallet	mm	200~1,700		100~2,000		
Feeds	Max. workspace swing × Max. workspace height	mm	φ2,400 × 1,800 #1		φ3,200 × 2,200 #2		
	Rapid feed rate	m/min	32 (X, Y), 42 (Z), 51 (W)		35 (X), 40 (Y, Z), 20 (W)		
	Cutting feed rate	m/min	0.001~30 (X, Y, Z), 5.0 (W)		0.001~20		
	Rapid acceleration (X, Y and Z)	m/s ² (G)	2.25 (0.23G)		1.96 (0.20)		
	Ball screw diameter (X, Y and Z)	mm	φ63 (X), φ50 (Y, Z, W)		φ80 (X), φ50 (Y, Z), φ50 (W)		
Spindle	Spindle speed	min ⁻¹	10~3,000		10~4,000		
	Spindle diameter (front bearing bore)	mm	φ180		φ200		
	W-axis quill dia.	mm	φ130		φ150		
	Spindle nose shape		BT No.50		BT No.50		
ATC	Spindle motor, short-time/continuous	kW	45/37		55/37		
	Tool holding capacity	tool	60		120 #1		240, 330 #3
	Tool selection		Absolute address		Absolute address		
	Tool (dia. × length)	mm	φ120 × 800 #1		φ125 × 800 #1		
	Tool (dia. × length)	kg	35		35		
	Tool change time (Tool-to-Tool)	sec	2.7(15kg) 3.2(15~35kg)				
Dimensions & Weight	Tool change time (Chip-to-Chip)	sec	6.0(15kg) 6.5(15~35kg)		23.2 (~8kg) 25.4 (~15kg) 30.8 (~35kg)		
	Tools Holder		MAS BT50		CAT50		MAS BT50
	Pull stud		MAS P501-1		MAS P501-1		
	Floor space (width × depth)	mm	7,450 × 9,900 #4		10,100 × 14,600 #4		
	Machine height	mm	4,520 (APC door open) #4		5,620 (APC door open) #4		
	Machine weight	kg	49,500		75,000		
Various Capacities	Working oil	L	63		100		
	Slide lubricant	L	5.5		16		
	Spindle oil air	L	2.9		2.9		
	Table	L	4		7.5		
	Spindle coolant	L	35		35		
	Ball screw coolant	L	Also used as spindle coolant		20		
	Power supply capacity	kVA	69		104		
	Control voltage	V	AC100 DC24		AC100 DC24		
	Air source capacity	NL/min	900		1,000		
	Air source pressure	MPa	0.4~0.5		0.4~0.5		
Capability & Performance	Positioning accuracy	#5 mm	±0.003		±0.002 (X, Y, Z)		±0.005 ±0.003 (X, Y, Z)
	Repeatability	#5 mm	±0.0015		±0.001 (X, Y, Z)		±0.003 ±0.0015 (X, Y, Z)
	Table indexing accuracy	#5 sec	±7		±3.5 (with NC encoder)		±3.5 (with NC encoder)
	Table indexing repeatability	#5 sec	±3.5		±2 (with NC encoder)		±2 (with NC encoder)

#1: For detail shape, refer to the tooling data. #2: Workspace swing is limited to 2,950 mm in the X-axis direction. Please refer to the tooling data.
#3: The matrix magazine is used for 180-tools or more. #4: For details, refer to the layout plan. #5: According to our inspection method.

CNC unit FANUC 311 ● Standard/□ Optional

Division	Name	FH100SX	FH125SX	FH125SW
Axis control	Min. input increment (0.001mm)	●	●	●
	Machine lock	●	●	●
	Absolute position detection	●	●	●
Operation	Freeze switch	□	□	□
	Dry run	●	●	●
	Single block	●	●	●
	Manual handle feed 1 unit	●	●	●
	Program restart	□	□	□
Interpolation function	Manual handle interrupt	□	□	□
	Nano interpolation	●	●	●
	Positioning (G00)	●	●	●
	Exact stop mode (G61)	●	●	●
	Tapping mode (G63)	●	●	●
	Cutting mode (G64)	●	●	●
	Exact stop (G69)	●	●	●
	Linear interpolation (G01)	●	●	●
	Arc interpolation (G02, G03)	●	●	●
	Dwell (G04)	●	●	●
	Helical interpolation	●	●	●
	Reference point return (G29, G29)	●	●	●
	Second reference point return (G30)	●	●	●
	Third and fourth reference point return (G30)	●	●	●
	AI contour control (pre-read 30 blocks)	●	●	●
	F1-digit feed	□	□	□
	AI contour control II (pre-read 200 blocks)	□	□	□
Program entry	Local coordinate system (G52)	●	●	●
	Machine coordinate system (G53)	●	●	●
	Workpiece coordinate system (G54 to G59)	●	●	●
	Additional workpiece coordinate systems (48 sets)	□	□	□
	Additional workpiece coordinate systems (300 sets)	□	□	□
	Custom macro	●	●	●
	Additional custom macro common variables (#100 to #199, #500 to #999)	●	●	●
	Fixed drilling cycle (G73, G74, G76, G80 to G89, G98 and G99)	●	●	●
	Additional optional block skip (9 pieces)	□	□	□
	Automatic corner override	□	□	□
Spindle function	Rigid tap	●	●	●
Tool function	Tool corrections (G9)	●	●	●
	Tool corrections (G20)	□	□	□
	Tool corrections (G40)	□	□	□
	Tool corrections (G49)	□	□	□
	Tool corrections (G99)	□	□	□
	Tool position offset	●	●	●
	Tool diameter and cutter radius compensation	●	●	●
	Tool length compensation (G43, G44 and G49)	●	●	●
	Program storage capacity (128K bytes)	●	●	●
	Program storage capacity (256K bytes)	□	□	□
Editing operation	Program storage capacity (512K bytes)	□	□	□
	Program storage capacity (1M bytes)	□	□	□
	Program storage capacity (2M bytes)	□	□	□
	Program storage capacity (4M bytes)	□	□	□
	Program storage capacity (8M bytes)	□	□	□
	Number of registered programs (250)	●	●	●
	Number of registered programs (500) #Storage capacity 256K bytes compulsory	□	□	□
	Number of registered programs (1000) #Storage capacity 512K bytes compulsory	□	□	□
	Number of registered programs (2000) #Storage capacity 1M bytes compulsory	□	□	□
	Number of registered programs (4000) #Storage capacity 2M bytes compulsory	□	□	□
	Simultaneous multi-program editing (incl. background editing)	●	●	●
Data entry/display	Touch panel control	●	●	●
Communication function	Built-in Ethernet	●	●	●
Others	19" color LCD	●	●	●

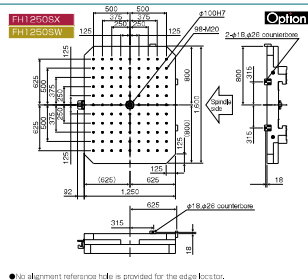
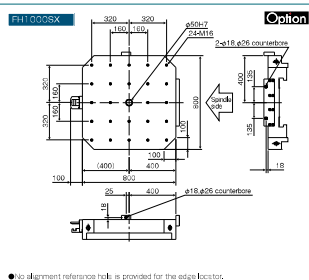
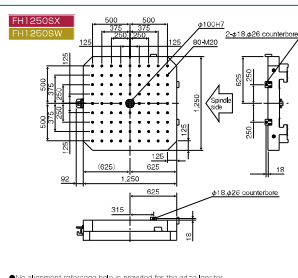
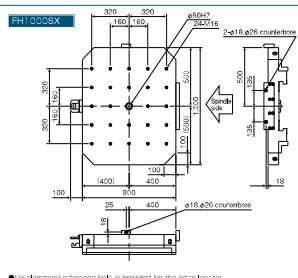
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Accessories ● Standard accessories/□ Optional accessories

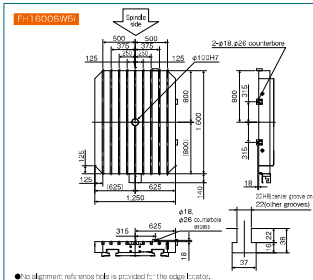
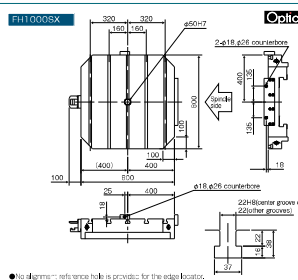
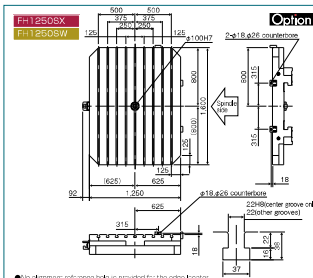
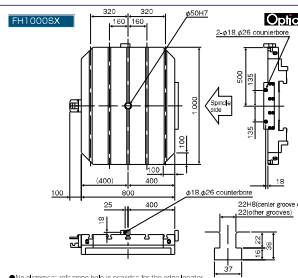
Item	Equipment name	FH100SX	FH125SX	FH125SW	FH1600SW
Table and pallet	Indexing table	●	●	●	●
	Indexing table	□	□	□	□
Pallet	NC indexing table (with encoder)	□	□	□	□
	Standard pallet square hole 800×1,000/□1,250/□1,250	●	●	●	●
	Standard pallet square hole 1,300	□	□	□	□
	Pallet square hole 1,300	□	□	□	□
	Rectangular pallet square hole 1,250 × 1,500	□	□	□	□
	Rectangular pallet square hole 1,250 × 1,500	□	□	□	□
Addition of pallet	Single piece screen rule	□	□	□	□
	Single piece T-square	□	□	□	□
Spindle relations	Speed	●	●	●	●
	6,000mm ³ BT No. 50/30 (25kW) spindle (with spindle-through coolant spec)	□	□	□	□
	6,000mm ³ BT No. 50/37 (30kW) large frame spindle (with spindle-through coolant spec)	□	□	□	□
	15,000mm ³ BT No. 50/37 (30kW) large frame spindle (with spindle-through coolant spec)	□	□	□	□
	3,000mm ³ BT No. 50/45 (37kW) small spindle (with spindle-through coolant spec)	□	□	□	□
	4,000mm ³ BT No. 50/55 (37kW) small spindle (with spindle-through coolant spec)	□	□	□	□
	Filter block for oil hole holder	□	□	□	□
	Positioning block for angle head holder	□	□	□	□
	HSR specifications	□	□	□	□
	8th PLUS specifications	□	□	□	□
Coolant	MAS I	●	●	●	●
	MS	□	□	□	□
	MAS II	□	□	□	□
Tool magazine	Tool capacity	●	●	●	●
	60 tools	□	□	□	□
	120 tools	□	□	□	□
	141 tools	□	□	□	□
	180 tools	□	□	□	□
Coolant relations	240 tools	□	□	□	□
	330 tools	□	□	□	□
	Coolant supply unit	●	●	●	●
	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
External	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
	Coolant supply unit with bleed stop cover (large spindle) high coolant spec/MS through coolant spec	□	□	□	□
Splash guard	External nozzle coolant	●	●	●	●
	Overhead shower coolant	●	●	●	●
	Chip flushing coolant	●	●	●	●
	Internal multi touch	●	●	●	●
	Coolant cooling	□	□	□	□
	Chip bin	□	□	□	□
	Splash gun (APC)	●	●	●	●
	Mist collector	□	□	□	□
	Air blower	□	□	□	□
	External nozzle type	□	□	□	□
Operation control	1Mixer type	□	□	□	□
	Endurance guard	●	●	●	●
	Coil motor in working position	●	●	●	●
	APC door interlock	●	●	●	●
	Internal lighting	●	●	●	●
	Operation control	□	□	□	□
	Ground fault interrupter	□	□	□	□
	Coolant for control cabinet inside	□	□	□	□
	Water saving function (pallet changer (APC))	●	●	●	●
	Spindle cooling	●	●	●	●
Support for high accuracy	Ball screw shaft cooling	●	●	●	●
	Scale feedback (X, Y and Z axis)	□	□	□	□
	Touch sensor function	□	□	□	□
	Optical type (without exaggeration) with alignment and datum face correction functions	□	□	□	□
	Video type (without exaggeration) with alignment and datum face correction functions	□	□	□	□
	Wire type with alignment, datum face correction, gap elimination, and tool backlash detection functions	□	□	□	□
	Automatic tool length measurement function and datum face for measurement (interference area caused)	□	□	□	□
	Automatic measurement correction function	□	□	□	□
	Rotary coordinate system correction function	□	□	□	□
	Rotary coordinate axis correction function	□	□	□	□
Spindle frame	Spindle frame	□	□	□	□
	Spindle frame	□	□	□	□

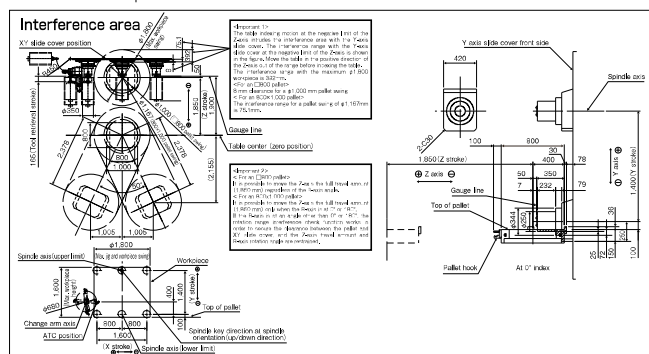
When the scale feedback is equipped, the model name becomes FH1000SX5-L, FH1250SX5-L, FH1250SW5-L and FH1600SW5-L.

Threaded hole pallet

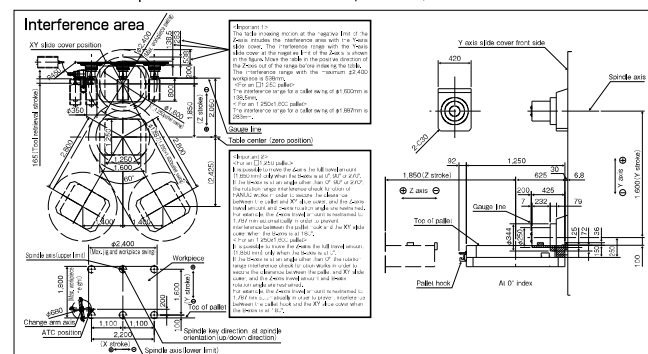
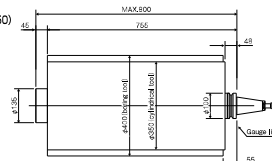


T-groove pallet



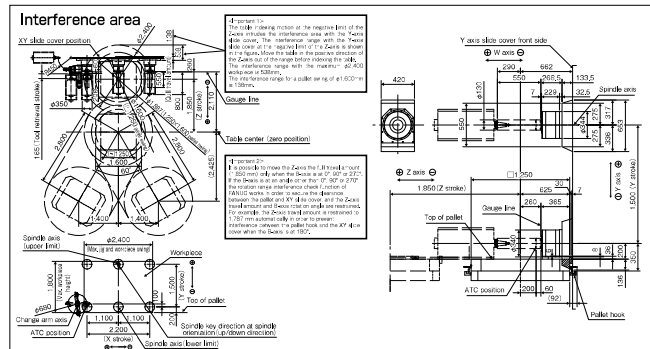


The tool holder is subject to limitations in the shape during ATC (automatic tool change). If the maximum tool diameter exceeds $\phi 100$, the 48mm range from the gauge line must be $\phi 100$ in the outside diameter. The 55mm range from the gauge line must be within $\phi 210$ in the outside diameter. The total mass must be within 35kg and the length from the gauge line must be within 800mm.

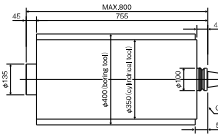


Item	Max. specs
Tool length	800mm
Tool diameter	With 60 tools magazine: $\phi 120\text{mm}$ (with no limitations caused by adjacent tools) With 121 tools magazine: $\phi 130\text{mm}$ (with no limitations caused by adjacent tools) With 180, 240 and 330 tools magazine: $\phi 110\text{mm}$ (with no limitations caused by adjacent tools)
Tool weight	35kg: The moment at the spindle nose must be within 29Nm.
Tool imbalance	$30 \times 10^{-3}\text{mm}$ or less (tools not exceeding $6,000\text{mm}^3$) $12 \times 10^{-3}\text{mm}$ or less (tools between $6,000\text{mm}^3$ and $8,000\text{mm}^3$) $5 \times 10^{-3}\text{mm}$ or less (tools exceeding $8,000\text{mm}^3$)

Tools with diameters exceeding those described above are subject to limitations in the diameter of adjacent tools in the magazine key ground position of the tool holder and so on.

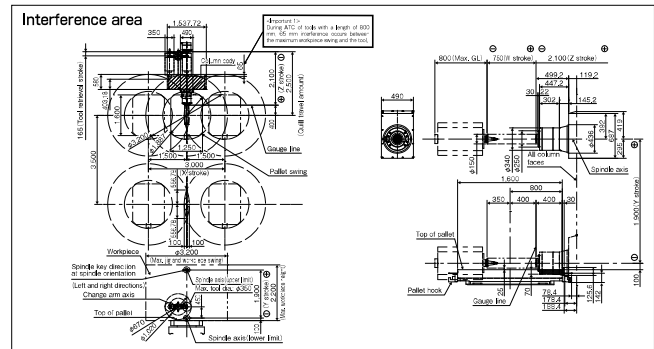


The tool holder is subject to limitations in the shape during ATC (automatic tool change). If the maximum tool diameter exceeds $\phi 100$, the 48mm range from the gauge line must be $\phi 100$ in the outside diameter. The 55mm range from the gauge line must be within $\phi 210$ in the outside diameter. The total mass must be within 35kg and the length from the gauge line must be within 800mm.

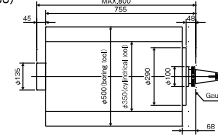


Item	Max. spec
Todd length	600mm
Jodd (diagonal)	With 60 tools magazine: $\phi 120\text{mm}$ (with no limitations caused by adjacent tools)
	With 121 tools magazine: $\phi 130\text{mm}$ (with no limitations caused by adjacent tools)
	With 80, 240 and 320 tools magazines: $\phi 100\text{mm}$ (with no limitations caused by adjacent tools)
Todd weight	35kg. The moment at the spindle nose must be within 290Nm
Todd incidence	$30 \times 10^6 \text{ N/mm}$ or less

The tools with diameters described above are subject to limitations in the diameter of adjacent tools in the magazine, say ground position of the tool holder and so on. Refer to the tool data for spindle rotation speed according to the tool position and the tool data.



The tool holder is subject to limitations in the shape during ATC (automatic tool change). If the maximum tool diameter exceeds $\phi 100$, the 48mm range from the gauge line must be $\phi 100$ in the outside diameter. The 68mm range from the gauge line must be within $\phi 290$ in the outside diameter. The total mass must be within 35kg and the length from the gauge line must be within 800mm.



Item	Vax, spec
Tool length	±00mm
Tool diameter	With 120 tools magazine: ±125mm (with no limitations caused by adjacent tools)
Tool weight	≤5kg. The moment at the spindle nose must be within 25Nm. C-ty O special chain sockets are compatible w/ 50 Nm
Tool imbalance	≤0Kt G/M m or less

Tools with diameters exceeding those described above are subject to limitations in the diameter of adjacent tools in the magazine, key groove position of the tool holder and so on.