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TMX-4000ST

New B-axis Multi Tasking Machine with various automation and high precision

TMX-4000ST

Takisawa Multi-Tasking Machine

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TMX-4000ST
(120 tools magazine / option)

『 Index 』

【1】Market trend and background to development

In recent years, there has been an increasing demand for machine tools that contribute to process integration, such as multi-tasking machines that integrate turning and milling, as well as multi-tasking machines that include a tool spindle and enable five-axis machining.

On the next page, there are tables and graphs that summarize the statistics of orders received for lathe multi-tasking machines and 5-axis machining centers for three years from 2016 to 2018. It can be seen that the order value of this machine is increasing year by year.

As the market expands and diversifies, the number of processed lots will be variable.

Future market trends, including the automotive field, are expected to be smaller in lot numbers.

In other words, the demand for a process-intensive multi-tasking machine suitable for a wide variety of products and small lots is increasing.

In addition, rising labor costs and labor shortages have increased awareness of automation.

To meet these needs, the TMX-4000 was developed as a multi-tasking machine with a B-axis that can propose various automations.

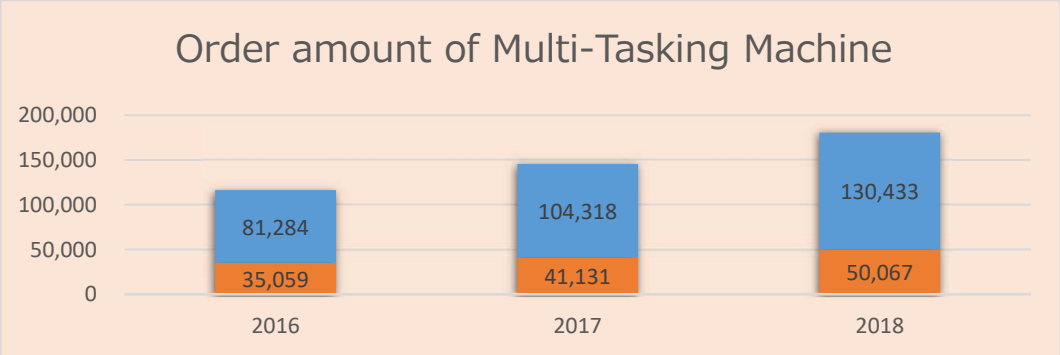
Our aim is to expand its market share by fully entering this field, which is at the top of the market pyramid.

Although the unit price of the machine will be higher, we will build a win-win relationship where customers, distributors, and manufacturers can each benefit by proposing high added value.

Demands of Multi-Tasking machine is increasing !!

Order amount by model based on Japanese Machine Tool Builder's Association (Unit : Million Yen)

		Lathe	of which, Multi-Tasking machine	Horizontal	of which, Multi-Tasking machine	Vertical	of which, Multi-Tasking machine
2016	Domestic demands	156,294	35,059	140,636	32,691	15,658	2,359
	External demands	244,420	81,284	226,990	73,417	17,430	7,867
	Total	400,714	116,334	367,626	106,108	33,088	10,226
2017	Domestic demands	185,364	41,131	169,208	38,750	16,156	2,381
	External demands	306,670	104,318	290,450	97,786	16,220	6,532
	Total	492,034	145,449	459,658	136,536	32,376	8,913
2018	Domestic demands	237,700	50,067	217,719	47,521	19,981	2,546
	External demands	358,521	130,433	339,825	121,923	18,696	8,510
	Total	596,221	180,500	557,544	169,444	38,677	11,056



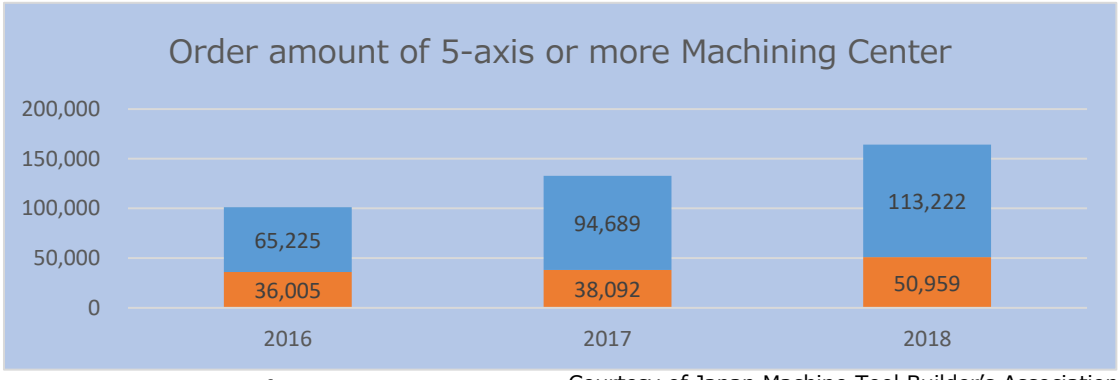
Target : Japanese manufacturers

Courtesy of Japan Machine Tool Builder's Association

Demands of 5-axis machine is increasing !!

Order amount by model based on Japanese Machine Tool Builder's Association (Unit : Million Yen)

		Machining Center	of which, 5-axis or more	Vertical	of which, 5-axis or more	Horizontal	of which, 5-axis or more	Other	of which, 5-axis or more
2016	Domestic demands	190,143	36,005	105,315	23,345	52,256	10,771	32,572	1,889
	External demands	312,502	65,225	177,812	47,217	119,583	16,890	15,107	1,118
	Total	502,645	101,230	283,127	70,562	171,839	27,661	47,679	3,007
2017	Domestic demands	229,979	38,092	124,184	27,225	69,863	9,419	35,932	1,448
	External demands	509,099	94,689	307,630	65,878	177,138	26,957	24,331	1,854
	Total	739,078	132,781	431,814	93,103	247,001	36,376	60,263	3,302
2018	Domestic demands	262,533	50,959	147,073	37,951	81,099	11,718	34,361	1,290
	External demands	480,807	113,222	258,024	90,903	197,643	20,608	25,140	1,711
	Total	743,340	164,181	405,097	128,854	278,742	32,326	59,501	3,001



Target : Japanese manufacturers

Courtesy of Japan Machine Tool Builder's Association

【2】What is a 5-axis Multi-Tasking machine ?
Advantages of a 5-axis Multi-Tasking machine.

5-axis multi-tasking machine is a machine that combines three linear axes of X, Y, and Z axes and rotary axes of C and B axes.

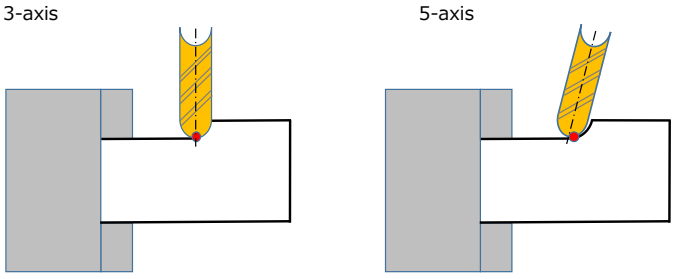
- 5-axis indexing machining
  Position the 2 axes of the additional rotation axis at an arbitrary angle, and process with the 3 axes of the linear axis.
- Simultaneous 5-axis machining
  Machining a three-dimensional curved surface by synchronizing the two additional rotation axes and the three linear axes.
  It is used for machining complex parts such as impellers, blisks, aircraft parts such as turbine blades, artificial joints in the medical field, etc.

The TMX-4000 is a machine that has both the functions of a usual lathe and the functions of a machining center.
In addition, by adding the simultaneous 5-axis specification, there are the following advantages compared to the machining with the 2-axis lathe and the 3-axis machining center that had been done so far.

1) Machining cost can be reduced
   Reason : Since complex shape can be machined with one chucking, change over can be reduced.
   In addition, no special jig is required.

2) Improvement of machining quality and machining accuracy
   Reason : Depending on the workpiece, it may be necessary to use long tools to avoid interference between the tool holder and the work piece.
   In that case, the rigidity of the tool decreases and the machining accuracy cannot be maintained.
   However, with a 5-axis Multi-Tasking machine, you can machine with a short tool by tilting the tool. It also reduces the cost of the tool.
   And, since 5-axis machining can be done with one chucking, workpiece mounting errors that often occur during change over are also eliminated.

3) It can avoid the cutting speed becoming zero.
   Reason : When machining with a ball end mill, the cutting speed of tip of the tool becomes zero, so no one want to use that tip as a machining position, but in the case of a 3-axis machine, the tip of the tool must be used.
   On the other hand, 5-axis Multi-Tasking machines can avoid machining using the tip of the tool.



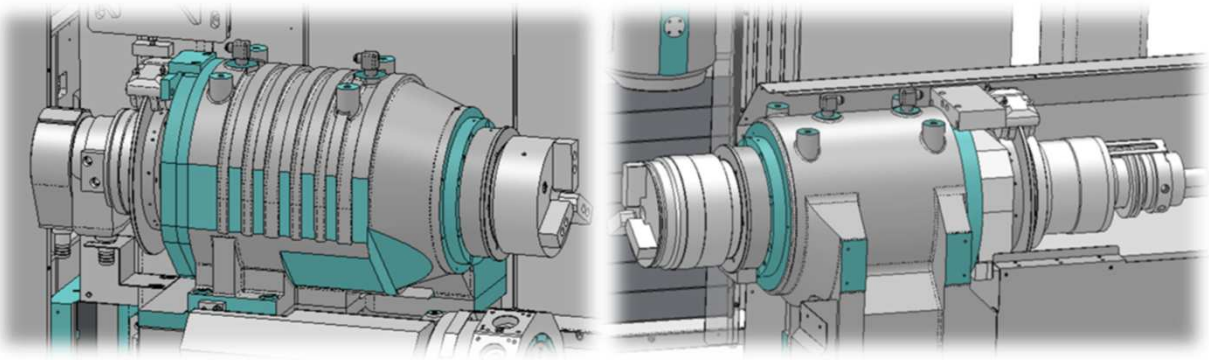
【3】Concept to development

『A new multi-tasking machine with a B-axis that responds to added value needs with various automation and high precision, and enhances customer appeal』

【4】Feature

(1) High-precision left and right headstock

The minimum indexing accuracy for C-axis positioning is 0.0001 ° for both the left and right spindles. By equipping the left and right spindles with built-in motors and αiCz, which has 10 times the resolution and positioning accuracy of αiBz sensors as standard, highly accurate Cs axis contour control and high-quality machining are possible regardless of the left and right spindle sizes.

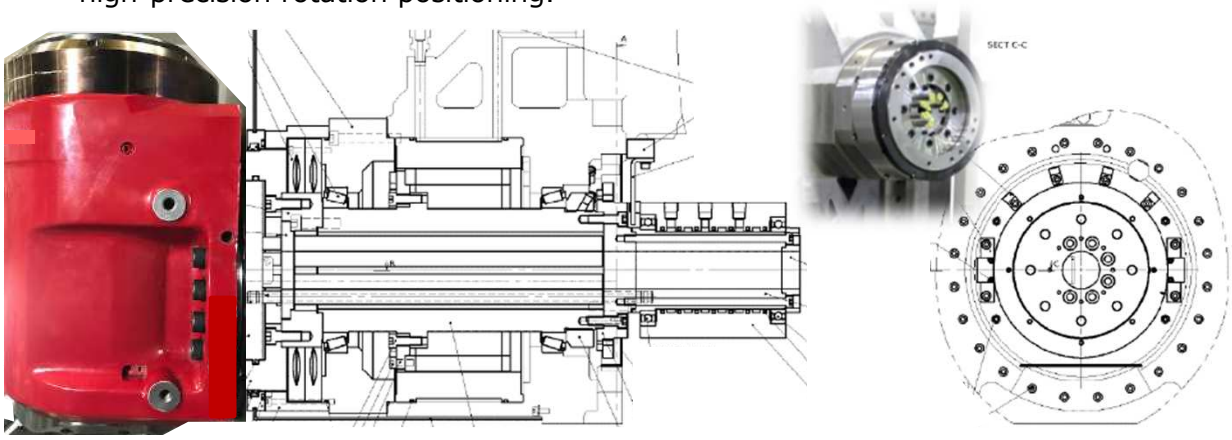


(2) Linear scale and pitch error compensation as standard

Linear scale and pitch error compensation are standard equipment for the feed axis (X1, Y1, Z1 axis) of the tool spindle and the feed axis (X2 axis) of the lower turret. As a result, precise positioning is possible since backlash or lead errors of the ball screw, axial expansion / contraction (deflection) due to load and errors due to thermal deformation can be ignored.

(3) High-speed, high-precision B-axis with step-less clamping

Minimum indexing accuracy for B-axis positioning is 0.0001 °
The B-axis rotation motor uses a direct drive motor that achieves no backlash, and the clamp mechanism uses a diaphragm brake to achieve high-speed, high-precision rotation positioning.



【Direct drive】

A method or mechanism that directly transmits the rotational force of a motor to the drive target without passing through an indirect mechanism (gearbox, etc.).

<Advantage>

- High efficiency
  Minimize frictional losses on belts, chains, gears and gearboxes.
- Low noise
  It is a simple mechanism with few contact parts.
  The number of parts that cause contact and vibration is reduced, so noise can be reduced.
- Long life and high reliability
  Since the number of operating mechanism parts is reduced, the frequency of maintenance and replacement is reduced, and the frequency of failures is also reduced.
- High torque can be obtained even at low speed.

<Disadvantage>

Since there is no mechanical structure, the motor is directly affected by the load.

- If a sudden load occurs due to the influence of disturbance, the motor may transmit.
  → It can be improved by improving control.
- Since the load is directly received, the output required for the load resistance is large and heat is easily generated.
  → During machining, it is possible to improve by cooling the outer cylinder of the brake and motor.

【Diaphragm Brake】

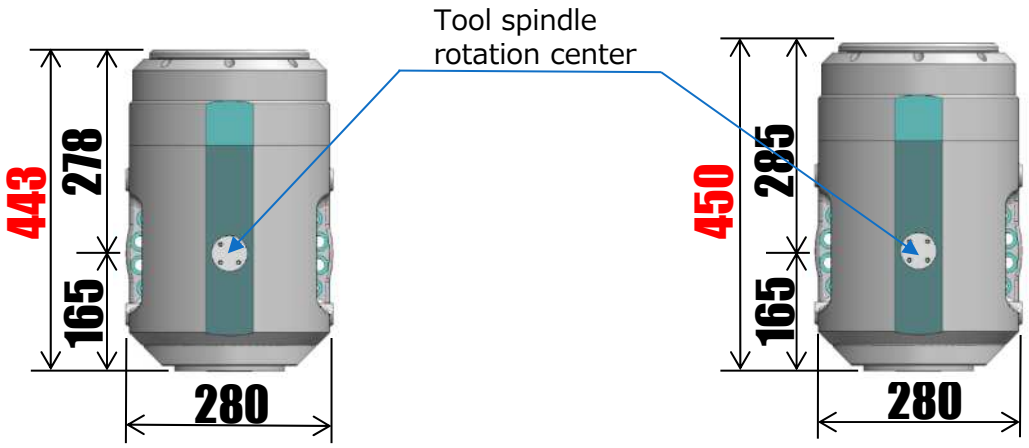
A diaphragm is a membrane that displaces in response to pressure.
The diaphragm brake clamps the B-axis with the force generated by the diaphragm due to air pressure.

<Feature> (From the HEMA website)

- Pneumatic drive
  Compared with hydraulic drive, costs including peripheral equipment can be reduced.
- Compact body
  It is characterized by its thin thickness, providing flexibility in mechanical design.
- High holding torque
  A tandem type that stacks multiple sheets is used to improve holding torque.

(4) Shorter tool spindle

The overall length of the tool spindle has been shortened to 443 mm.
It is 110mm shorter than the existing TMM-250M3 tool spindle.
Since the working range is expanded by shortening the tool spindle,
it is possible to handle a wide variety of work-pieces.



Tool spindle length 443mm

Induction motor(std.)

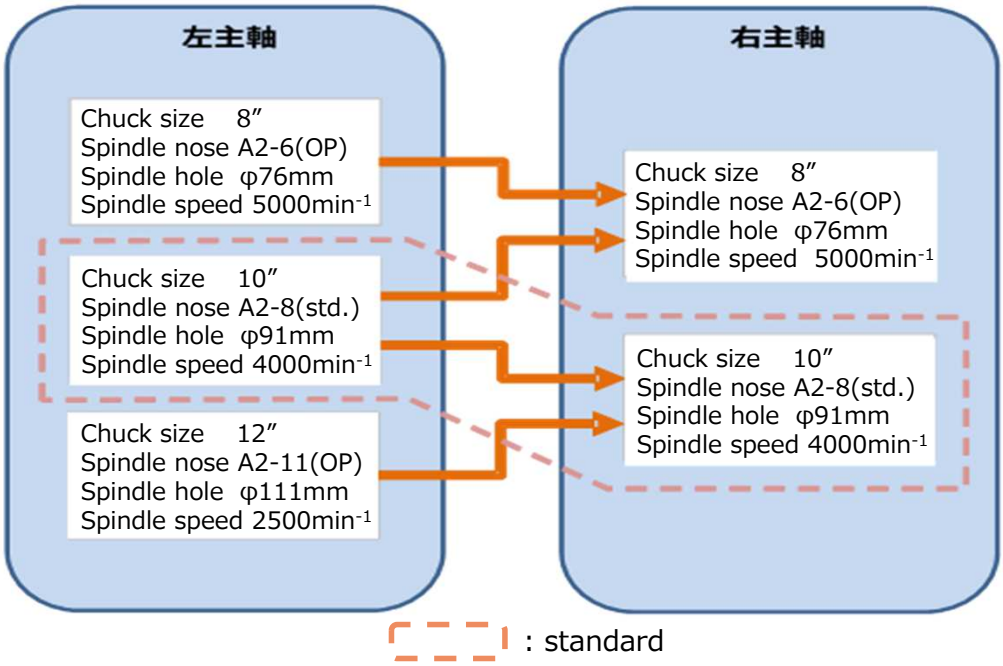
Tool spindle length 450mm

Synchronous motor.(op)

*See page 38 for the advantages and disadvantages of induction motors and synchronous motors

(5) Expansion of spindle variations

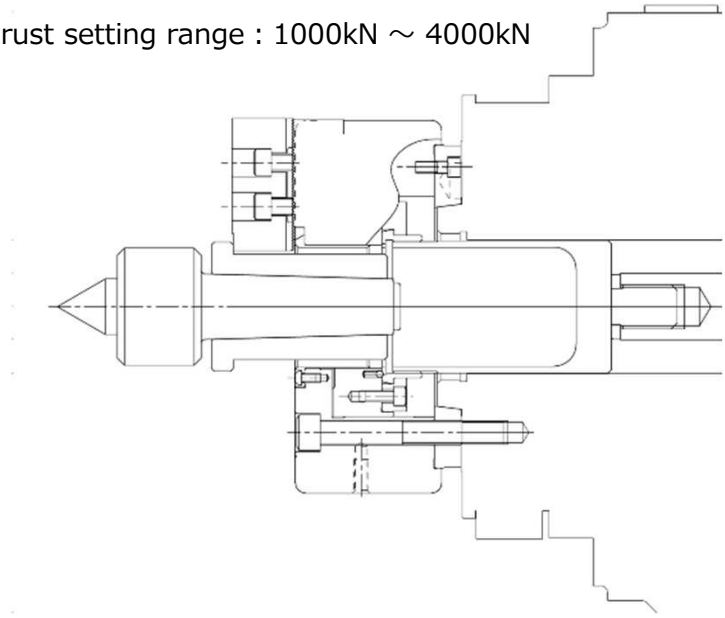
A2-8, 10inch chucks are standard for both L and R spindle.
Four types of variations are prepared according to customer needs to achieve flexible responses.



(6) The right spindle can be pushed with any thrust

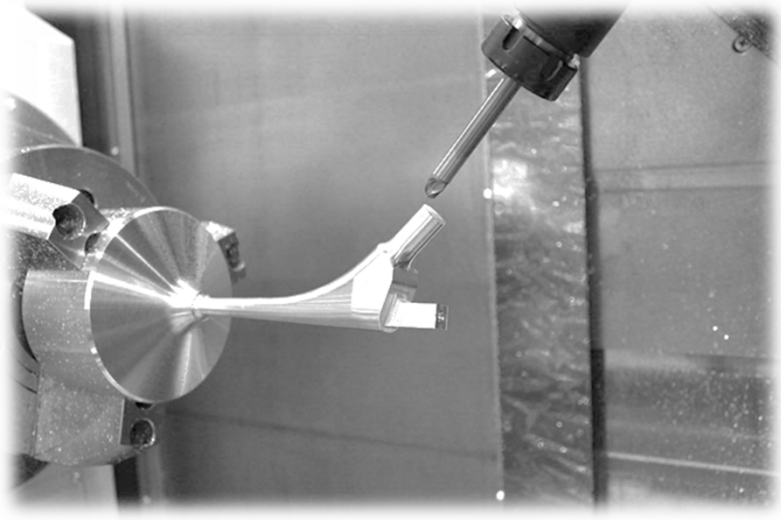
Shaft machining is possible by chucking the center on the right spindle and use it as a tailstock. Thrust can be set in 1.0N units by performing torque control. To prevent the right spindle from retreating in the event of an emergency stop, power off, or unexpected power outage, the right spindle A-axis motor is equipped with a brake as standard.

Thrust setting range : 1000kN ～ 4000kN



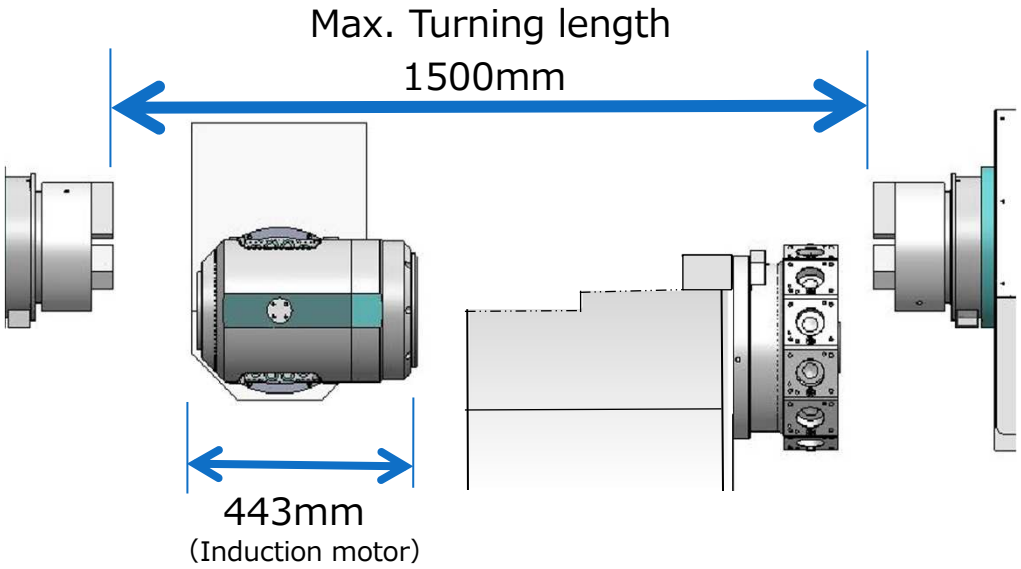
(7) 5-axis simultaneous control is standard equipped

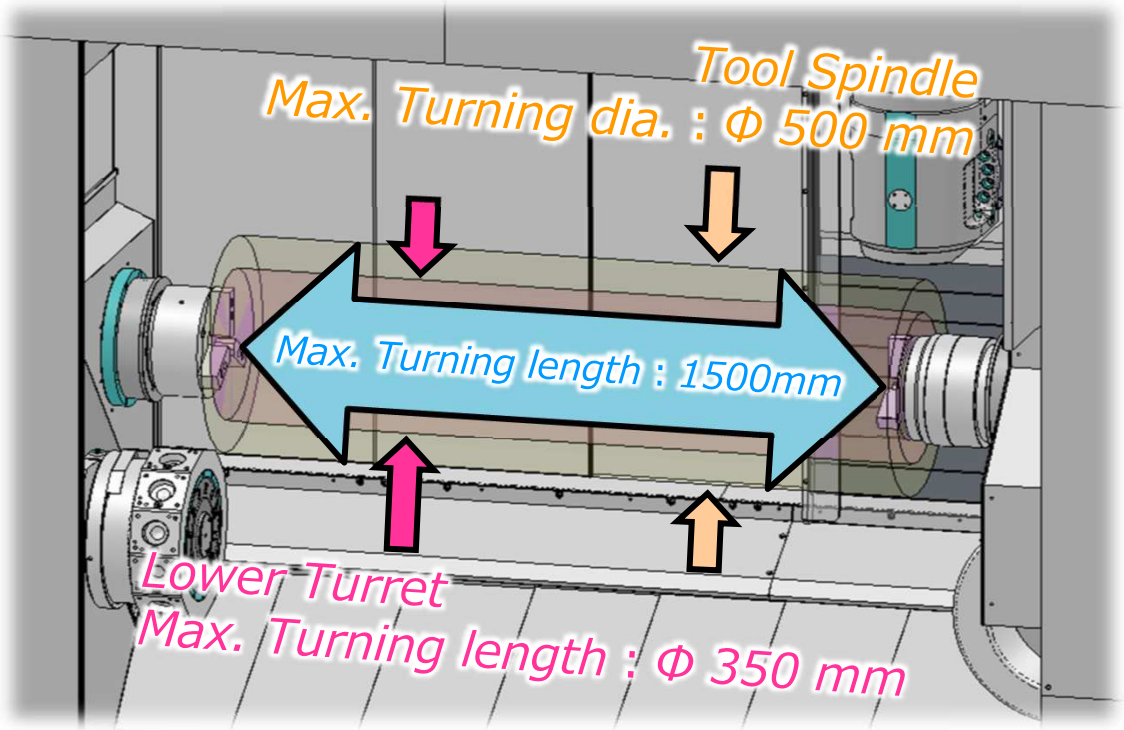
The B-axis mechanism is equipped with a direct drive motor and a diaphragm brake as standard.
Standard specifications are simultaneous 5-axis control, which enables multi-surface and multi-axis machining with one chucking.



(8) Center distance sufficient for simultaneous machining of tool spindle and lower turret

The between center is 1500 mm so that machining can be performed without interference even when the tool spindle and lower turret are used together.





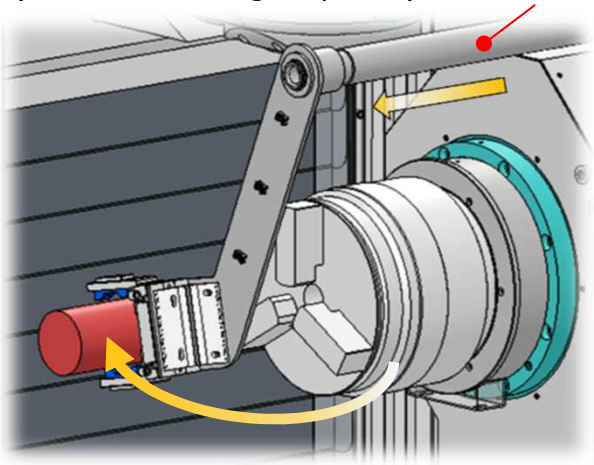
(9) Standard design for automation (option)

Incorporating automation in consideration of workpiece supply / discharge into the standard structure design makes it possible to easily respond to automation.

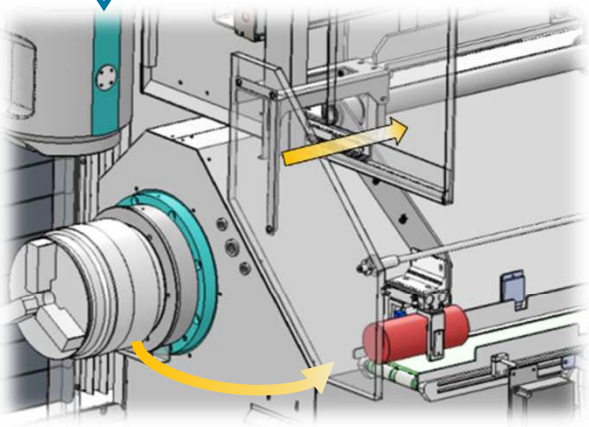
(Work Unloader＋Work conveyor / option)

《 Spec. of Work Unloader》
Max. work dia. Φ80mm
Max. work length Φ200mm
Max. work weight 3 kg

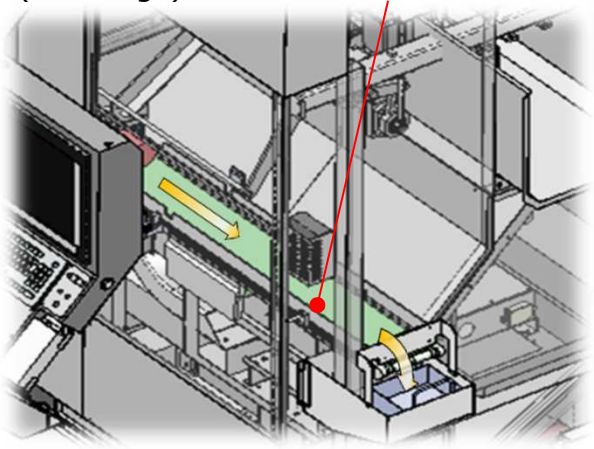
(take out from right spindle) Work Unloader



(Conveyed by work conveyor)

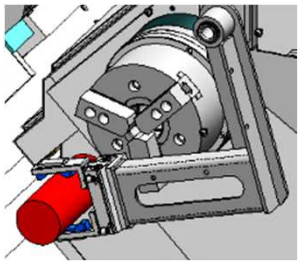


(Discharge) Work conveyor



- The travel axis can be positioned freely by servo motor
- Hand position can be freely changed according to the length and shape of the workpiece

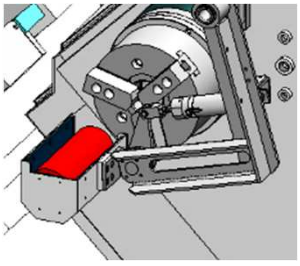
Hand type



Two jaw hand type and bucket type are available for unloader

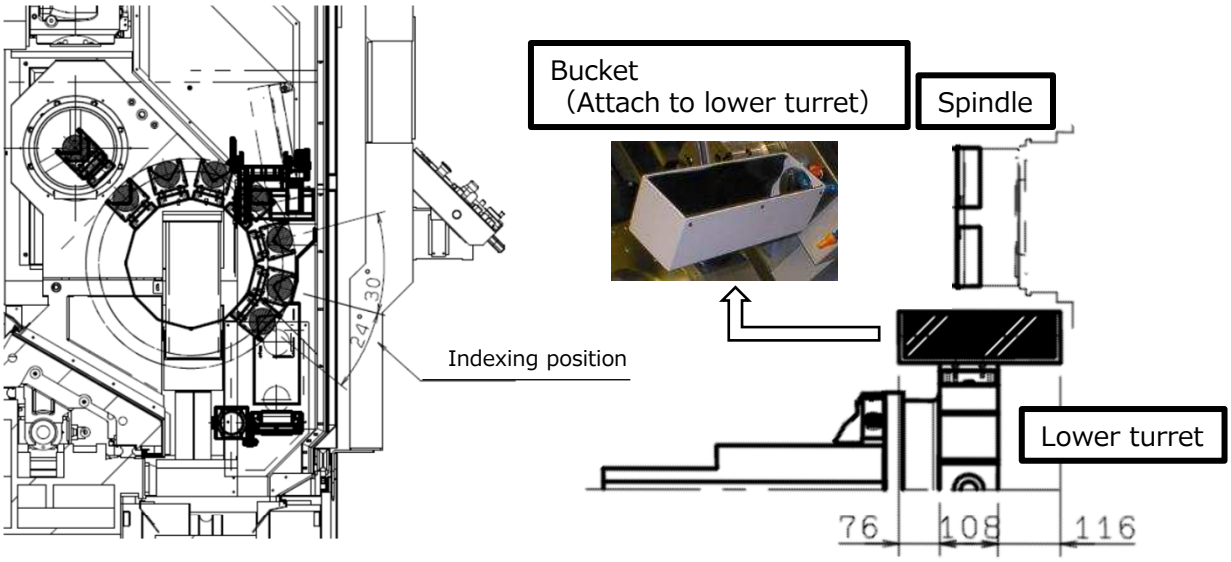
Work handling size is the same in both cases

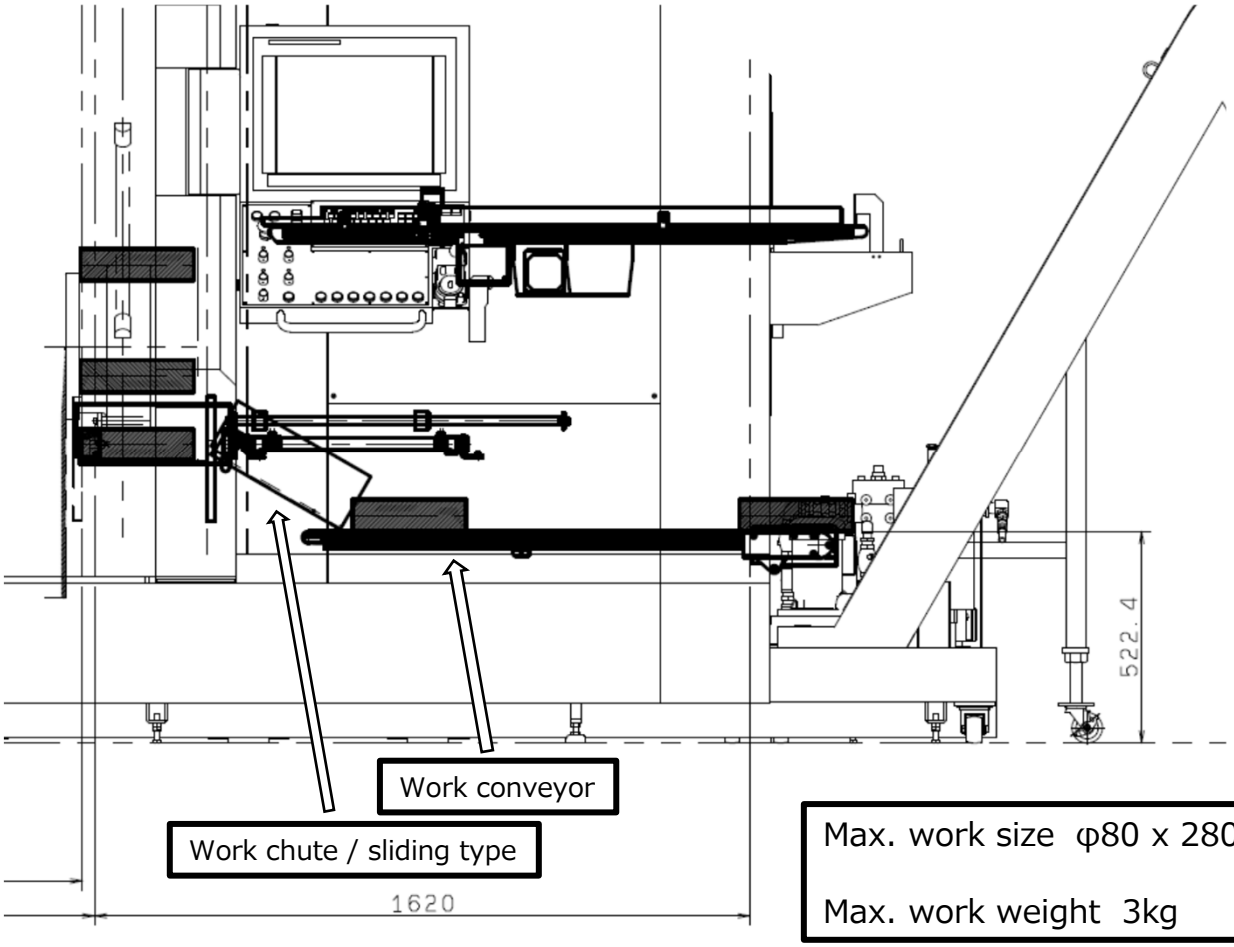
Bucket type



(Parts catcher for L/R spindle＋Work conveyor / option)

A parts catcher that is less expensive than an work unloader can also be used.
It is also possible to discharge the remaining bar material.
The bucket attached to the lower turret catches the work and discharges it to the in-machine conveyor.





Max. work size φ80 x 280L

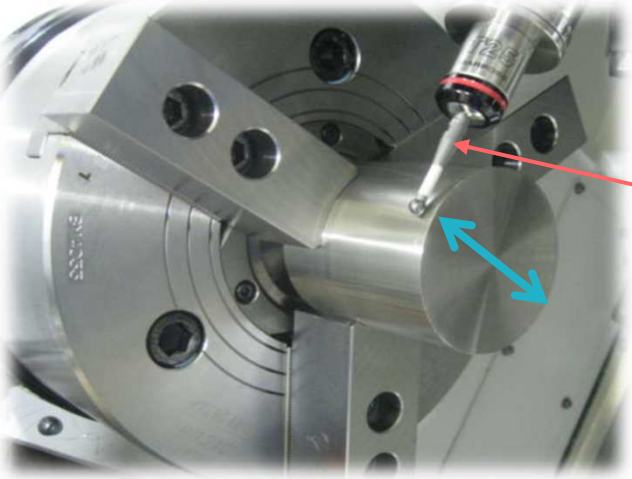
Max. work weight 3kg

(Machine inside measuring unit / option)

Fully automated long-hours machining by performing wear compensation

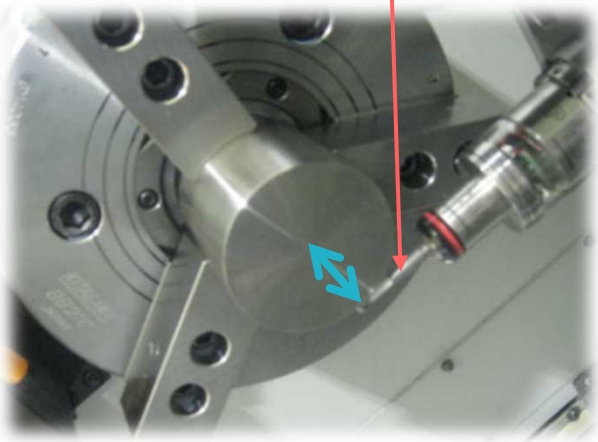
TMX-Series

- Automatic shape measurement with touch probe while the condition under grasping workpiece
- Automatic compensation of workpiece shape error due to tool wear
- Automatic change to spare tool when excessive wear is detected
- Enables stable machining for a long hours without checking the dimensions by the operator



Touch probe

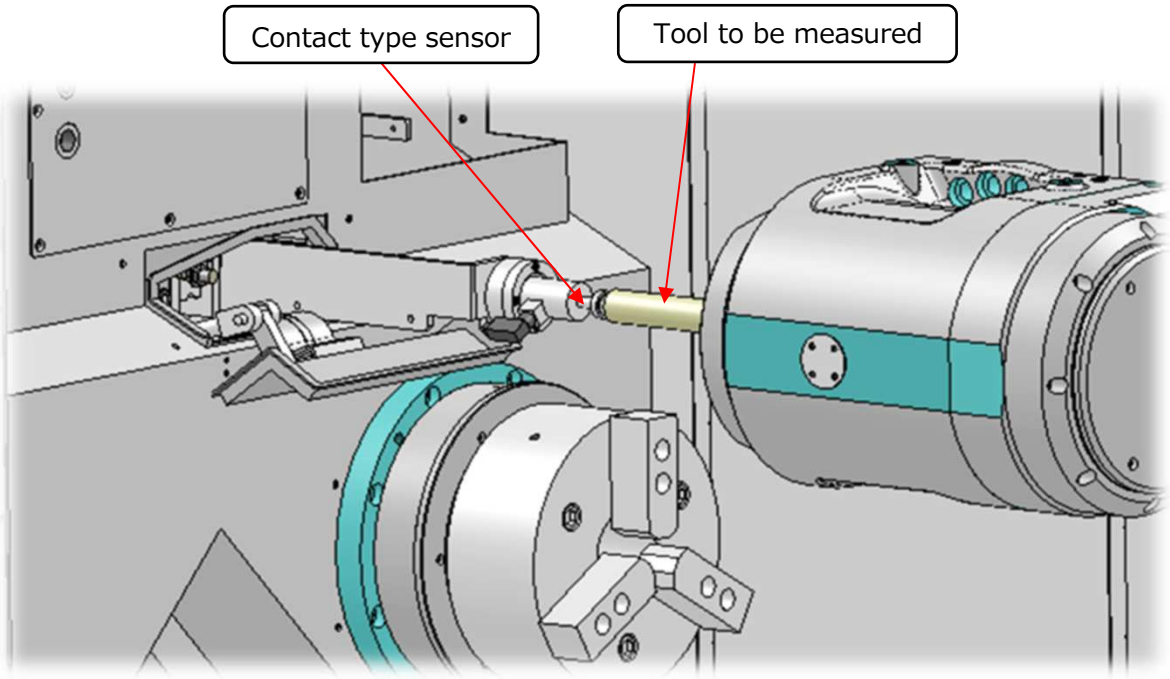
(Radial measurement)



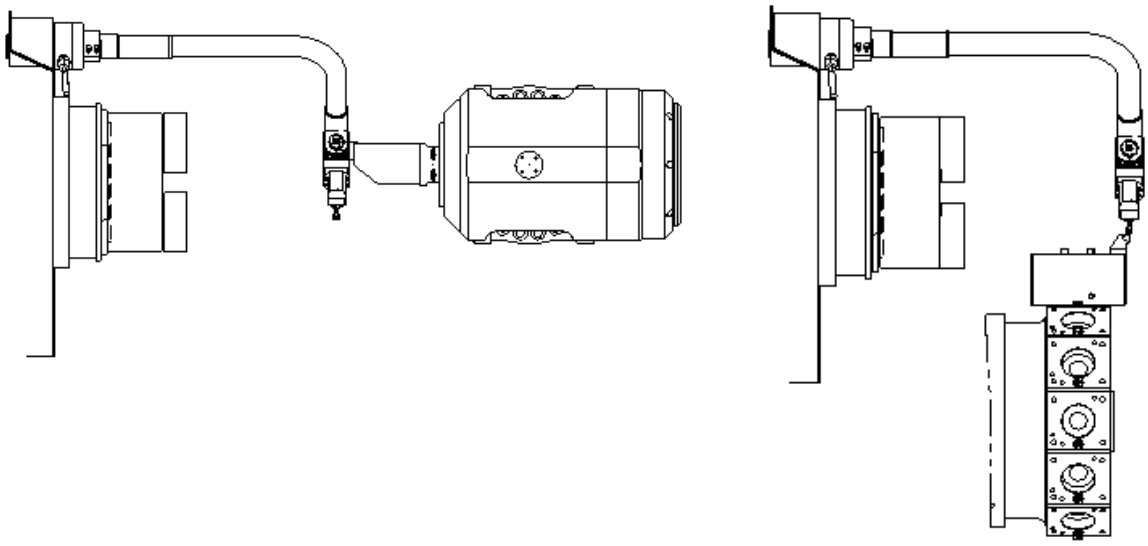
(Axial measurement)

(10) Removable tool setter and Automatic tool setter can be installed as option

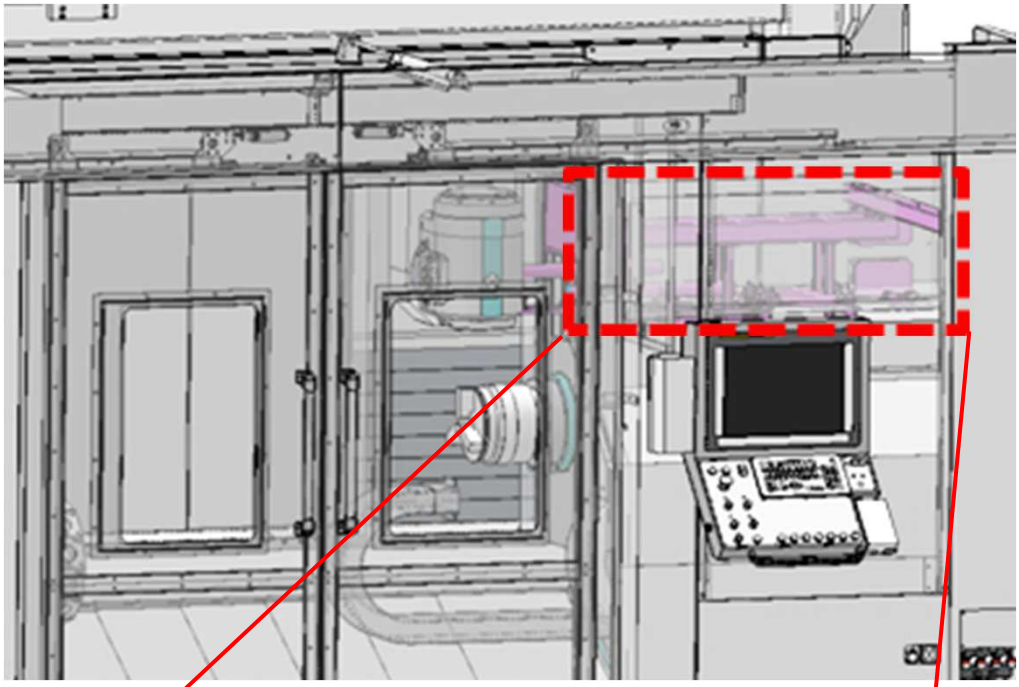
Automatic tool setter : Only the tool on the tool spindle can be measured



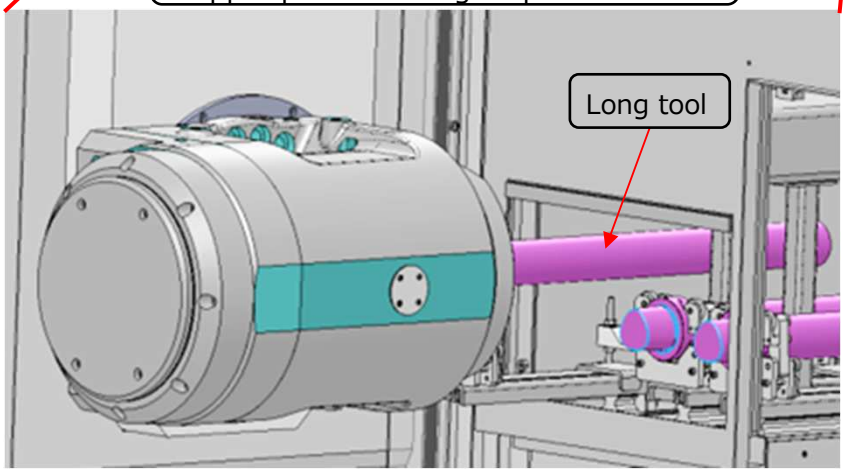
Removable too setter : Tool spindle tool and lower turret tool can be measured



(11) Compatible with long tool specifications (optional) / Can store long tools that cannot be installed in ATC magazine

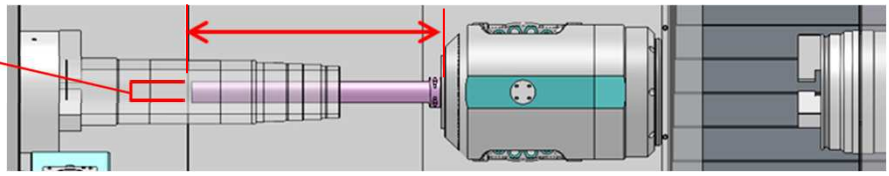


Up to three tools can be stored in the upper part of the right spindle



Max. Tool length 500mm

Max. Tool dia. Φ45mm
Max. Tool weight 10kg



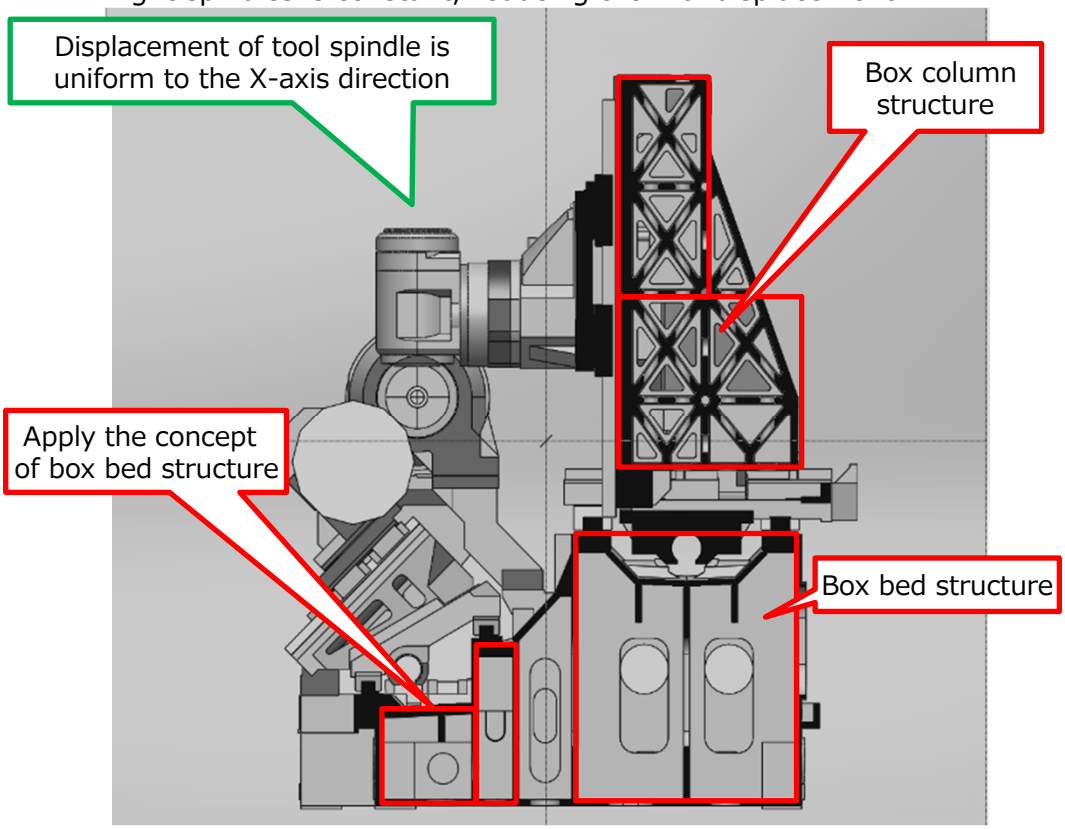
＊Not available with gantry loader specifications

(12) Common use of long delivery parts and main parts

Various parts such as spindle, turret, feed axis, hydraulic and pneumatic parts, etc. are shared with existing models to reduce the number of parts.

(13) Suppression of thermal displacement by heat source isolation and adoption of basic structure design with high robustness against environmental temperature change.

In addition to completely isolating heat sources such as oil controller, hydraulic units, and hydraulic drain hoses that cause thermal displacement from the machine, the other heat sources such as the left and right spindles and servomotors for each axis, and the mechanical structure caused by environmental temperature changes By adopting the “box bed structure and box column structure” with the intention of “geometric symmetry,” the relative distance between the center of the tool spindle and the center of the left and right spindles is constant, reducing thermal displacement.



(Bed & Column)

By using a box bed, the displacement becomes symmetric, and the direction and amount of deformation can be easily predicted.

(14) Design considering environmental load and reduction of running cost (Initiatives for energy conservation)

By adopting grease lubrication for all axis, the frequency of replenishment is reduced (the replenishment interval is lengthened), and the reduction of oil costs and the longevity of cutting oil are realized.

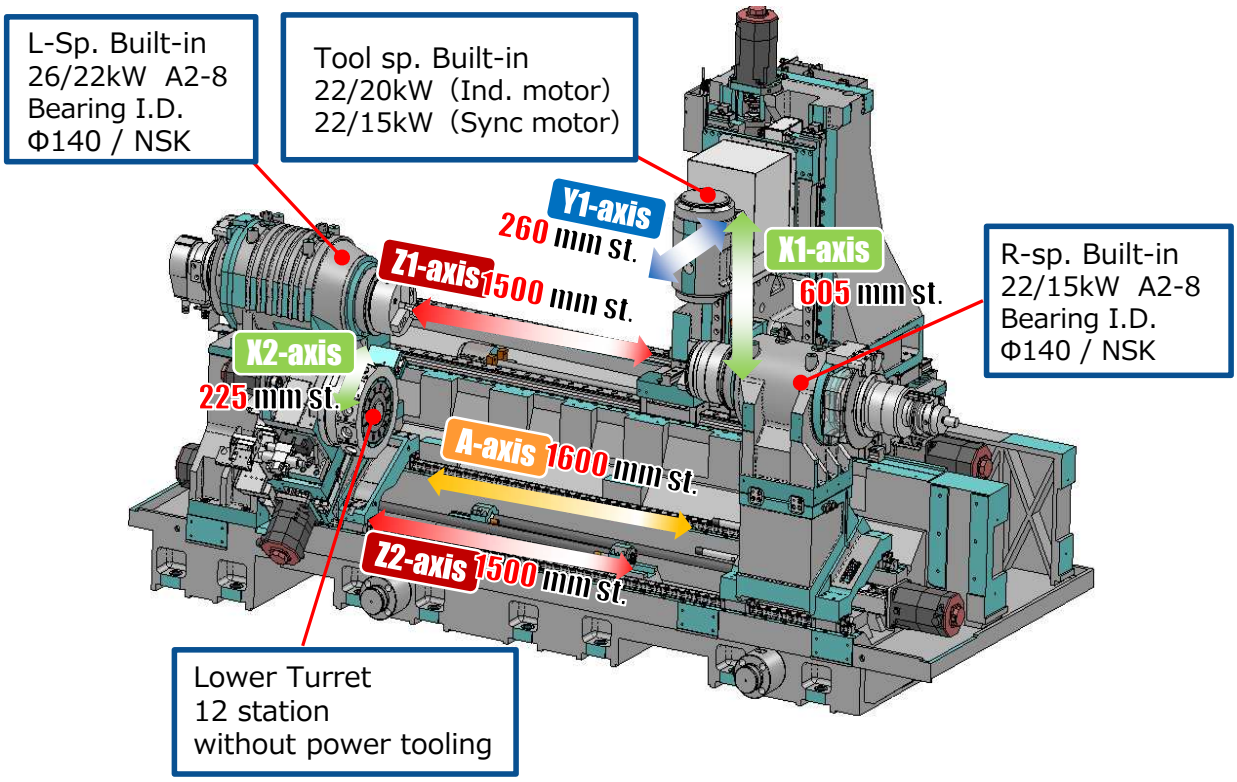
In addition, energy-saving effects are achieved by adopting a high-efficiency motor in peripheral devices such as an hydraulic/pneumatic device and a chip conveyor, and by implementing energy-saving control during standby.

【5】Basic structure

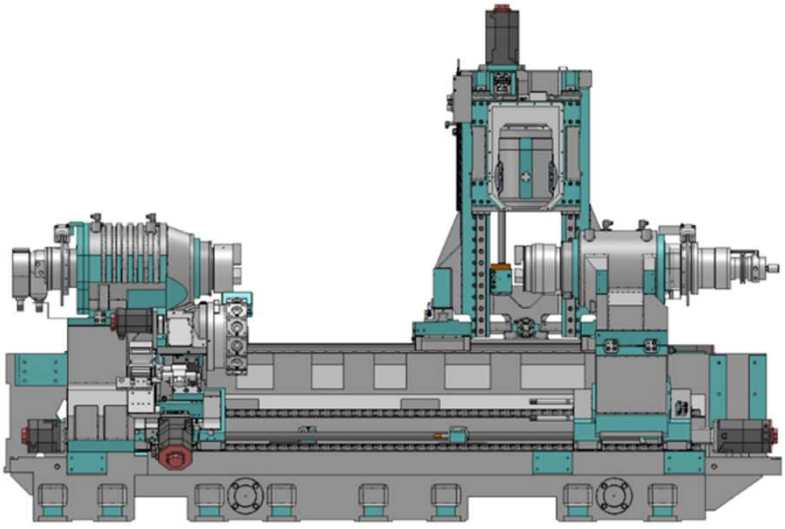
(1) Built-in motors for left / right spindles and tool spindle

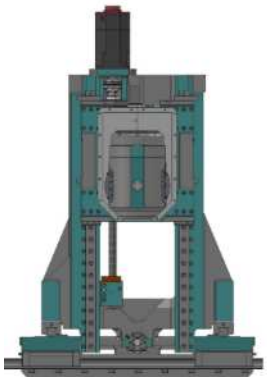
(2) Tool spindle power

Induction motor	15/11kW	(S3/S6 25%/Cont.) Low speed winding
	22/15kW	(S3/S6 25%/Cont.) High speed winding
Synchronous motor	22/20kW	(S6 15%/Cont.) / option No winding



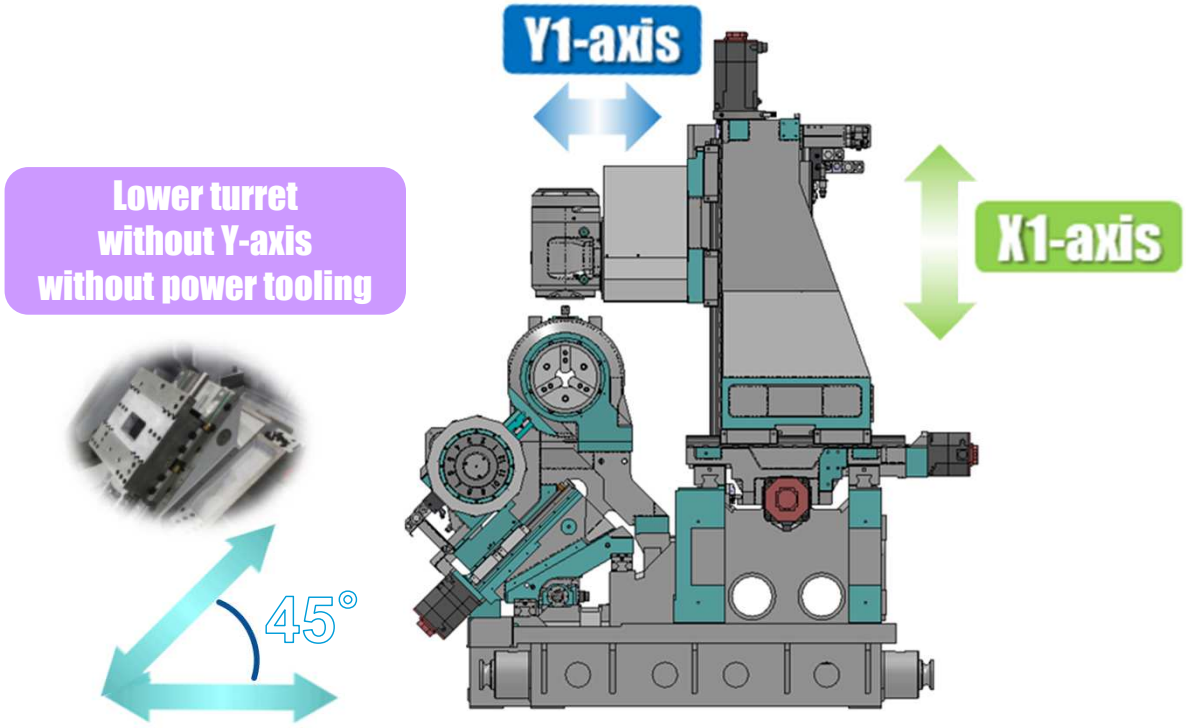
The tool spindle and X1 saddle are located in the center of the column to improve balance.





(3) X1-axis and Y1-axis configurations on the tool spindle side is orthogonal axes

(4) Lower turret is 45 degree slant structure
without Y-axis, without power tooling

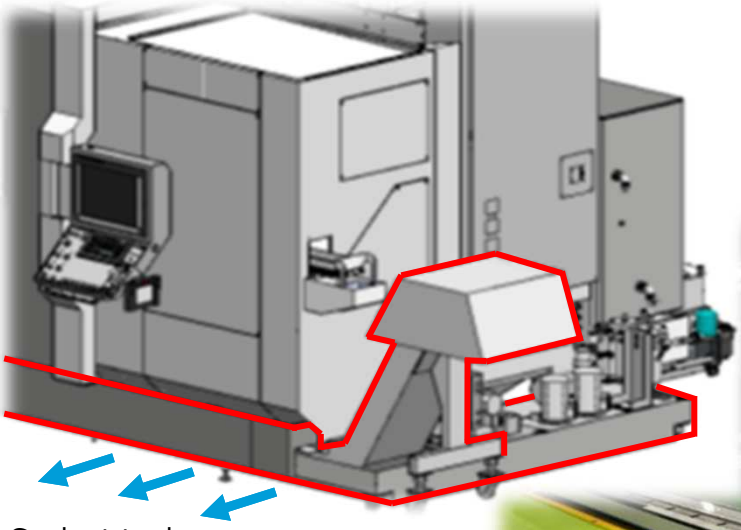


(5) High-performance wide roller guides are used for all axes for high rigidity and high-speed machining.

	size	Rapid speed	Ball screw
X1-axis :	#55	Max. 40 m/min	Φ 40mm x P10
Y1-axis :	#55	Max. 40 m/min	Φ 40mm x P16
Z1-axis :	#65	Max. 40 m/min	Φ 50mm x P20
A-axis :	#45	Max. 30 m/min	Φ 40mm x P16
X2-axis :	#35	Max. 20 m/min	Φ 32mm x P10
Z2-axis :	#45	Max. 40 m/min	Φ 40mm x P20

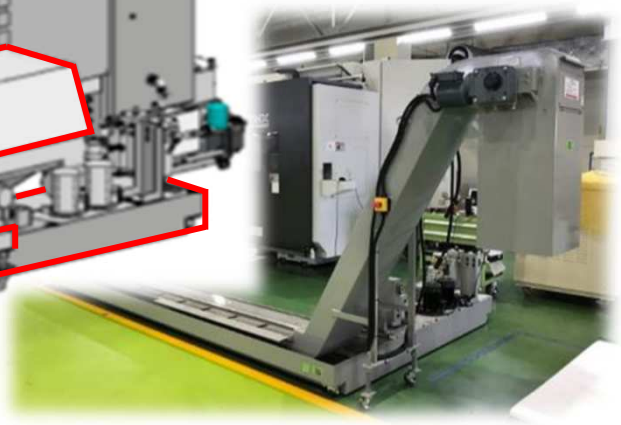
(Roller guides and Ball screw are both made by HIWIN)

(6) Chip conveyor is supported only on the right side
(standard equipment / Hinge type)



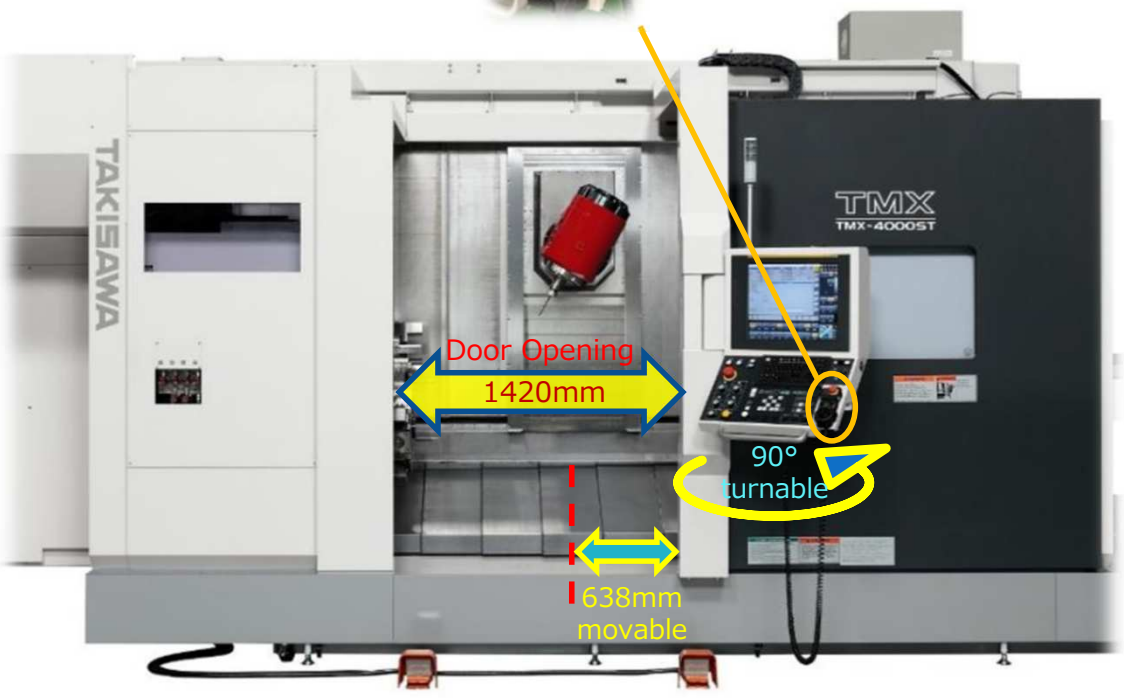
Coolant tank
Pull-out to the front

The picture shows a
chip-conveyor hinge
type with CE



(7) Wide door opening and
flexible movement of
operation panel

Pendant type
Manual pulse generator



(8) 40 tools magazine is standard equipment
(expandable to 80 and 120 as an option)

40 tools magazine

ATC shuttle

ATC arm

120 tools magazine
(40 tools magazine x 3 rows)

80 tools magazine
(40 tools magazine x 2 rows)

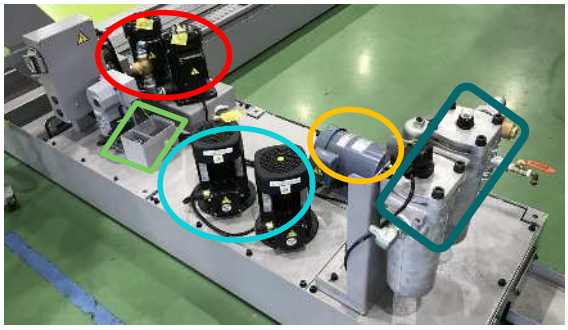
Magazine Operation panel

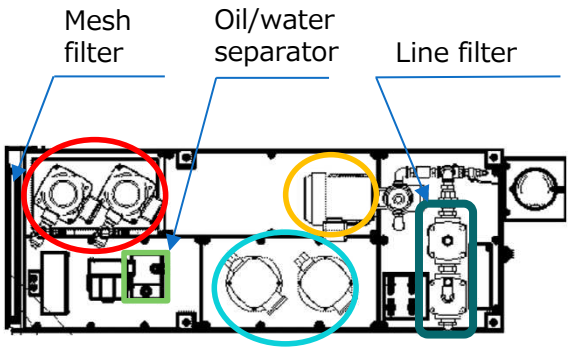
(8) 15 bar of through coolant in the tool spindle is standard equipment
70 bar high pressure coolant (with pressure adjustment mechanism) as option

70 bar high pressure / option

(9) 550W coolant pump is provided as standard on the lower turret side

(Arrangement of standard coolant pump)





L-side / for chips cleaning 400w MTA120-280-A-W-A-T / Grundfos
R-side / for chips cleaning 400w MTA120-280-A-W-A-T / Grundfos

For tool spindle outside 550w MTH2-6 / Grundfos
For lower turret 550w MTH2-6 / Grundfos

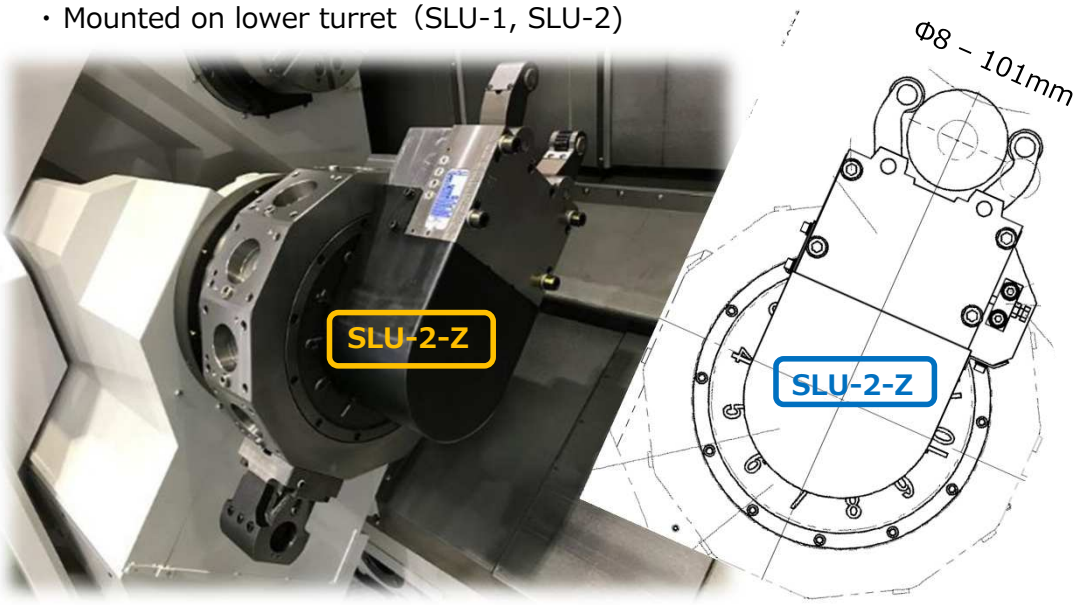
For tool spindle though coolant 750w TOP-2MY750-210HWMPVBE / NOP Trochoid pump

Line filter

Oil/water separator

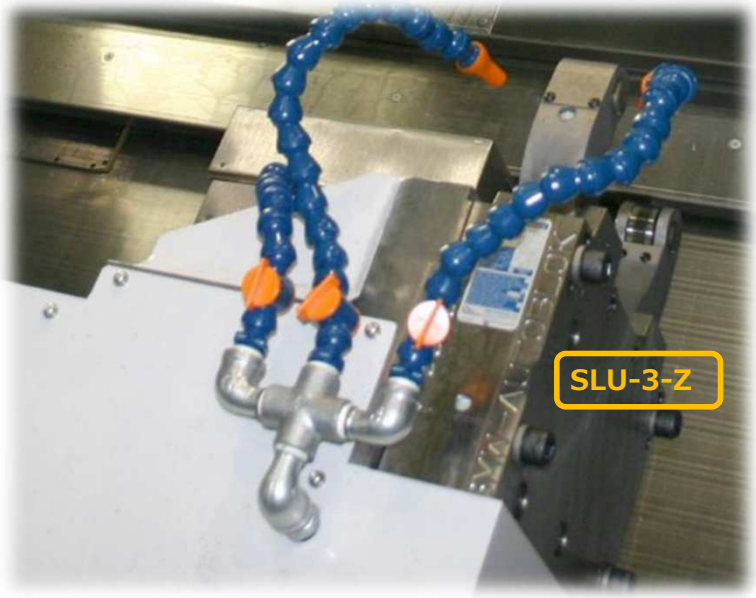
(10) Steady rest as option

・Mounted on lower turret (SLU-1, SLU-2)



(Mount SLU-2-Z on lower turret / option)

・Remove lower turret and mount steady rest (SLU-3, SLU-4)



(Remove lower turret and mount SLU-3-Z / option)

SLU-1Z	(φ4 - φ64)
SLU-X-1Z	(φ6 - φ70)
SLU-A-1Z	(φ4 - φ52)
SLU-2Z	(φ8 - φ101)
SLU-X-2Z	(φ8 - φ101)
SLU-A-2Z	(φ8 - φ80)
SLU-3Z	(φ12 - φ152)
SLU-3.1Z	(φ20 - φ165)
SLU-3.2Z	(φ50 - φ200)
SLU-X-3Z	(φ12 - φ152)
SLU-X-3.1Z	(φ20 - φ165)
SLU-X-3.2Z	(φ50 - φ200)
SLU-A-3Z	(φ12 - φ130)
SLU-A-3.1Z	(φ22 - φ150)
SLU-4Z	(φ30 - φ245)
SLU-X-4Z	(φ30 - φ245)
SLU-A-4Z	(φ30 - φ220)

(11) Flexible response to customer needs with abundant open variations

● : Std.
○ : OP .
– : No conf.

TMX-Series

	Gantry Loader	Unloader + Work Conveyor	Parts catcher + Work Conveyor	Automatic Tool setter	Steady Rest	For Long tool
TMX-4000ST	○	○	○	○	○	○
TMX-4000STG	●	–	–	○	○	–

Configuration	Tool spindle Motor		Lower Turret	Left spindle				Right spindle				Fanuc iHMI	
	Induction	Synchronous		C-axis	A2-6	A2-8	A2-11	C-axis	A2-6	A2-8	A2-11	15″ screen	19″ screen
TMX-4000ST	●	○	●	●	○	●	○	●	○	●	–	●	○
TMX-4000STG	●	○	●	●	○	●	○	●	○	●	–	●	○

(Standard)
※ 5-axis Simultaneous
※ R-side chip conveyor hinge type
※ Tool spindle through coolant 15 bar

(Option)
※ Machine Collision Avoidance
※ 80, 120 tools ATC Magazine
※ Conversational function for lathe
※ In-machine measuring system

【6】Advantages over competitive models

(1) Competitive models

The following are the competitive models of TMX-4000ST.

- Mazak Integlex i-200ST / U1500
- Mazak Integlex i-300ST / U1500
- BIGLIA Smart Turn S
- DMG Mori NTX-2000 / 1500SZM
- DMG Mori CTX Beta 1250TC 4A
- DMG Mori CTX Beta 1250TC / Linear
- Nakamura Tome NTRX-300
- Okuma Multus U3000 L1500

Among the above, Mazak Integlex i-200ST/U1500 and Integlex i-300ST/U1500, which are regarded as the top in the market of multi-tasking machines with B-axis, were listed as competitive models.

※ Overview of Mazak "Integlex i-200ST/U1500" and "Integlex i-300ST/U1500"

- Inexpensive multi-tasking machine with B-axis equipped with lower turret
- The NC equipment is a self-manufactured MAZATROL Smooth X, which creates high value-added operability and control functions to differentiate itself from competitors.
- The product lineup and automatic transfer equipment options are substantial, and they are often sold in the European market where demand for B-axis machining is high.

(2) Advantages over Integlex

a) High-precision positioning is possible by equipping the linear scale on the feed axis (X1, Y1, Z1 axis) for the tool spindle side and on the feed axis (X2 axis) for the lower turret side as standard equipment.
➡ Integlex i series has ball screw shaft core cooling as standard only for X1 axis.

b) The C-axis of the right spindle has a high-precision indexing of 0.0001 ° as standard, enabling high-precision C-axis positioning.
➡ The standard for the right spindle of the Integlex i series is 0.001° index without C axis control.

c) The bearing size of the left and right spindles is φ140. Load capacity is high due to large bearing size.
➡ The bearing size of Integlex i series is φ130.

d) Continuous rated torque of the tool spindle is 68 N･m
➡ Integlex i series is 45.7 N･m

e) The pressure of the standard pump for tool spindle through coolant is 1.5MPa.
➡ Integlex i series is 0.5MPa

f) Right side layout chip conveyor hinge type is standard equipment
➡ Integlex i series is option

【7】Comparison of specification

(1) TMX-4000ST and existing models

Item				TMX-4000ST	TMX-2000	TMM-250 M3
Capability Capacity	Max. turning dia. / length		mm	φ500/1500	φ500/610	φ500/1300
	Distance between L/R spindles	max	mm	1840	1315	1630
		min		240	295	330
	Bar capacity	L	mm	φ80	φ65	φ76.2
		R		φ80	φ51	φ50.8
Spindle	Drive system			Built-in	Built-in	Built-in
	Spindle speed	L	min-1	4000	5000	4000
		R		4000	5000	4000
	Spindle nose	L		A2-8	A2-6	A2-8
		R		A2-8	A2-6	A2-6
	Through hole dia.	L	mm	φ91	φ77	φ86
		R		φ91	φ63	φ63
	Bearing inside dia.	L	mm	φ140	φ120	φ120
		R		φ140	φ100	φ100
	Chuck size	L	inch	10"	8"	10"
		R		10"	8"	8"
Turret	Type of turret	Upper		Tool spindle (CAPTO C6)	Tool spindle (CAPTO C6)	Tool spindle (CAPTO C6/KM)
		Lower		12 station turret (Bolt)	-	15 station turret (VDI)
Feed axis	Travel	X1	mm	605	630	560
		Y1		260(±130)	230(±115)	260(±130)
		Z1		1500	690	1300
		A		1600	1020	1300
		X2		225	-	228
		Z2		1500	-	1260
		B	deg	230(±115)	230(±115)	230(±115)
	Rapid speed	X1	m/min	40	40	30
		Y1		40	40	20
		Z1		40	40	40
		A		30	20	30
		X2		20	-	20
		Z2		40	-	30
ATC magazine	Tool storage capacity	Upper		1(ATC 40)	1(ATC 40)	1(ATC 30)
		Lower		12	-	15
Tool	Tool shank	Upper	mm	CAPTO C6	CAPTO C6	CAPTO C6
		Lower		□25 / φ40	-	□25 / φ40 AR32(φ3～20)
Power tooling	Spindle speed	Upper	min-1	12000	12000	8000
		Lower		-	-	4000

(2) TMX-4000ST and Mazak Integlex i series

Item			Takisawa TMX-4000ST	Mazak Integlex i-200ST/U1500	Mazak Integlex i-300ST/U1500
NC equipment			FS31i-B5 (PANEL-iH)	MAZATROL SmoothX	MAZATROL SmoothX
Max. turning dia.		mm	φ500（※2）	φ658（※1）	φ658（※1）
Max. turning length		mm	1500	1519	1519
Distance between L/R spindles		mm	1840	-	-
Bar capacity	L	mm	φ80	φ65	φ80
	R	mm	φ80	φ65	φ80
Spindle drive type			Built-in	Built-in	Built-in
Spindle speed	L	min^{-1}	4000	5000	4000
	R	min^{-1}	4000	5000	4000
Min. index angle	L	deg.	0.0001	0.0001	0.0001
	R	deg.	0.0001	0.001	0.001
Spindle nose	L		A2-8	A2-6	A2-8
	R		A2-8	A2-6	A2-8
Through hole dia.	L	mm	φ91	φ76	φ91
	R	mm	φ91	φ76	φ91
Bearing inside dia.	L	mm	φ140	φ120	φ130
	R	mm	φ140	φ120	φ130
Chuck size	L		10″	8″	10″
	R		10″	8″	10″
Spindle motor	L	kW	26 / 22	22 / 15	30 / 22
			(30min./Cont.)	(30min./Cont.)	(30min./Cont.)
		N･m	512	239	609
			(Cont.)	(Cont.)	(Cont.)
	R	kW	22 / 15	18.5 / 15	26 / 22
			(15min./Cont.)	(30min./Cont.)	(30min./Cont.)
		N･m	263	238	341
			(Cont.)	(Cont.)	(Cont.)

（※1） The notation of the maximum turning diameter of Mazak Integlex is the same as the diameter of the maximum swing.
（※2） The notation of the maximum turning diameter of TMX-4000 is the maximum diameter that can be machined with the vertical attitude of the tool spindle (B-axis angle = 0 °) and the tool protrusion amount of 65 mm.

Item			Takisawa TMX-4000ST	Mazak Integlex i-200ST/U1500	Mazak Integlex i-300ST/U1500
Travel	X1	mm	605	615	615
	Y1	mm	260 (±130)	260 (±130)	260 (±130)
	Z1	mm	1500	1585	1585
	A	mm	1600	1539	1539
	X2	mm	225	230	230
	Z2	mm	1500	1388	1388
	B	deg.	230 (±115)	240 (±120)	240 (±120)
Rapid speed	X1	m/min	40	50	50
	Y1	m/min	40	40	40
	Z1	m/min	40	50	50
	A	m/min	30	30	30
	X2	m/min	20	40	40
	Z2	m/min	40	40	40
Type of turret	Upper		Tool spindle	Tool spindle	Tool spindle
			CAPTO C6	HSK-A63	HSK-A63
	Lower		12 station turret	9 station turret	9 station turret
			□25/φ40	□25/φ32	□25/φ32
ATC	Max. dia.	mm	φ90 (No adjacent tool) φ125	φ90 (No adjacent tool) φ125	φ90 (No adjacent tool) φ125
	Max. length	mm	400	400	400
	Max. weight	kg	10	12	12
Tool spindle motor		kW	22/15 (H-speed winding)	22 / 15	22 / 15
			(S3/S6 25%/Cont.)	(30min./Cont.)	(30min./Cont.)
		N·m	68	45.7	45.7
			(Cont.)	(Cont.)	(Cont.)
Tool spindle speed		min^{-1}	12000	12000	12000
Floor size	width	mm	6950	6294	6294
(incl. chip conveyor)	depth	mm	3000	2800	2800
(incl. operation panel)	height	mm	3160	2720	2720
Floor to spindle center height		mm	1340	-	-

(3) TMX-4000ST and competitive models from DMG/MORI

Item			Takisawa	DMG MORI	DMG MORI	DMG MORI
			TMX-4000ST	NTX-2000 1500SZM	CTX beta 1250TC 4A	CTX beta 1250TC linear
NC equipment			FS31i-B5	FS 31i-B	Siemens	Siemens
			(PANEL-iH)		840D	
Max. turning dia.		mm	φ500 (※2)	φ610	φ500	φ470
Max. turning length		mm	1500	1540	1200	1250
Distance between L/R spindles		mm	1840		1470	1470
Bar capacity	L	mm	φ80	φ65	φ67	φ65
	R	mm	φ80	φ65	φ67	φ65
Spindle speed	L	min^{-1}	4000	5000	5000	5000
	R	min^{-1}	4000	5000	5000	6000
Min. index angle	L	deg	0.0001		0.001	
	R	deg	0.0001		0.001	
Spindle nose	L		A2-8		170h5	170h5
	R		A2-8		170h5	140h5
Through hole dia.	L	mm	φ91	φ73		
	R	mm	φ91	φ73		
Bearing inside dia.	L	mm	φ140	φ120	φ130	φ130
	R	mm	φ140	φ120	φ130	φ100
Chuck size	L		10″			
	R		10″			
Spindle motor	L	kW	26 / 22	22 / 18.5	32	34
			(30min./Cont.)	(30min./Cont.)	(40% ED)	(40% ED)
		N・m	512		360	380
			(Cont.)			
	R	kW	22 / 15	22 / 18.5	32	27
			(15min./Cont.)	(30min./Cont.)	(40% ED)	(40% ED)
		N・m	263		360	170
			(Cont.)			

(※2) The notation of the maximum turning diameter of TMX-4000 is the maximum diameter that can be machined with the vertical attitude of the tool spindle (B-axis angle = 0 °) and the tool protrusion amount of 65 mm.

Item			Takisawa TMX-4000ST	DMG MORI NTX-2000 1500SZM	DMG MORI CTX beta 1250TC 4A	DMG MORI CTX beta 1250TC linear
Travel	X1	mm	605	495 (470+25)	450	450
	Y1	mm	260 (±130)	250 (±125)	200(±100)	±100
	Z1	mm	1500	1560 + 215	1200	1300
	A	mm	1600	1500	1200	
	X2	mm	225	160	195	
	Z2	mm	1500	1402	1200	
	B	deg	230 (±115)	240 (±120)	220(±110)	
Rapid speed	X1	m/min	40		30	30
	Y1	m/min	40		30	30
	Z1	m/min	40		45	30
	A	m/min	30		45	
	X2	m/min	20		30	
	Z2	m/min	40		45	
	Y2	m/min			30	
Type of turret	Upper		Tool spindle	Tool spindle	Tool spindle	Tool spindle
			CAPTO C6	CAPTO C6	HSK-A63 / C6	HSK-A63
	Lower		12 station turret	10 station turret	VDI 12 station turret	
			□25/φ40	□20		
Tool magazine			40	38	24	24
Tool spindle motor		kW	22/15 (H-speed winding)	30 / 11	29	22
			(S3/S6 25%/Cont.)	(10min./Cont.)	(40% ED)	(40% ED)
		N·m	68		79	100
			(Cont.)			
Tool spindle speed		min^{-1}	12000	12000	12000	12000
Floor size	width	mm	6950	5595	5953	5671
(incl. chip conveyor)	depth	mm	3000	3116	3124	2971
(incl. operation panel)	height	mm	3160	2658	2393	2067
Floor to spindle center height		mm	1340	1345	1310	1040

(4) TMX-4000ST and BIGLIA, NAKAMURA-TOME, OKUMA

Item			Takisawa	BIGLIA	Nakamura-Tome	OKUMA
			TMX-4000ST	SMART TURN S	NTRX-300	MULTUS U3000 L1500
NC equipment			FS31i-B5	FS 31i-B5	FS31i-A5	OSP-P300S
			(PANEL-iH)			
Max. turning dia.		mm	φ500 (※2)	φ500	φ640	φ650
Max. turning length		mm	1500	1280	1100	1500
Distance between L/R spindles		mm	1840	1460	1350	1888
Bar capacity	L	mm	φ80	φ94	φ65	
	R	mm	φ80	φ65		
Spindle speed	L	min^{-1}	4000	3000	4500	5000
	R	min^{-1}	4000	4000	4500	5000
Min. index angle	L	deg.	0.0001	0.001		0.0001
	R	deg.	0.0001	0.001		0.0001
Spindle nose	L		A2-8	A2-8		A2-6
	R		A2-8	A2-6		A2-6
Through hole dia.	L	mm	φ91			φ80
	R	mm	φ91			φ62
Bearing inside dia.	L	mm	φ140			φ120
	R	mm	φ140			φ100
Chuck size	L		10″	10″	10″	8″
	R		10″	8″		8″
Spindle motor	L	kW	26 / 22	38 / 30	15 / 11	22 / 15
			(30min./Cont.)			
		N･m	512	1014		427
			(Cont.)			
	R	kW	22 / 15	40 / 30	15 / 11	22 / 15
			(15min./Cont.)			
		N･m	263	286		420
			(Cont.)			

(※2) The notation of the maximum turning diameter of TMX-4000 is the maximum diameter that can be machined with the vertical attitude of the tool spindle (B-axis angle = 0 °) and the tool protrusion amount of 65 mm.

Item			Takisawa	BIGLIA	Nakamura-Tome	OKUMA
			TMX-4000ST	SMART TURN S	NTRX-300	MULTUS U3000 L1500
Travel	X1	mm	605	515	700	645
	Y1	mm	260 (±130)	210(-90,+120)	250(±125)	250(±125)
	Z1	mm	1500	1280	1125	1600
	A	mm	1600	1130	1100	1584
	X2	mm	225	-		235
	Z2	mm	1500	-		1584
	B	deg.	230 (±115)	210 (±105)	225(-120,+105)	240 (±120)
Rapid speed	X1	m/min	40			50
	Y1	m/min	40			40
	Z1	m/min	40			50
	A	m/min	30			30
	X2	m/min	20			40
	Z2	m/min	40	-		25
	Y2	m/min	-	-	-	-
Type of turret	Upper		Tool spindle	Tool spindle	Tool spindle	Tool spindle
			CAPTO C6	HSK-A63	CAPTO C6	HSK-A63
	Lower		12 station turret	-	-	12 station turret
			□25/φ40			□25/φ40
Tool magazine			40	40	40	40
Tool spindle motor		kW	22/15 (H-speed winding)	20 / 18	18.5 / 11	22 / 15 / 11
			(S3/S6 25%/Cont.)			(3min./15min./Cont.)
		N･m	68	110		120
			(Cont.)			
Tool spindle speed		min^{-1}	12000	8000	8000	12000
Floor size	width	mm	6950	5890	4460+チップコン	5425
(incl. chip conveyor)	depth	mm	3000	2274	2670	3082
(incl. operation panel)	height	mm	3160	2574	2615	3018
Floor to spindle center height		mm	1340	1060		

【8】Machine performance

(1) Turning accuracy

Unit (μm)

			Pass / fail criteria for machine performance evaluation items	TMX-4000ST Measured value
Tool spindle + Left spindle	Turning accuracy	Roundness	3	0.7
		Surface roughness Rz	5	3.7
	Taper cutting	Surface roughness Rz (O.D.)	5	3.1
	Arc cutting accuracy (Spherical deviation)	Roundness in X1-Z1 interpolation	20	9.6
Tool spindle + Right spindle	Turning accuracy	Roundness	3	0.9
		Surface roughness Rz	5	3.6
	Taper cutting	Surface roughness Rz (O.D.)	5	3.0
	Arc cutting accuracy (Spherical deviation)	Roundness in X1-Z1 interpolation	20	8.5
Lower turret + Right spindle	Turning accuracy	Roundness	3	0.3
		Surface roughness Rz	5	3.0
	Taper cutting	Surface roughness Rz (O.D.)	5	2.3
	Arc cutting accuracy (Spherical deviation)	Roundness in X2-Z2 interpolation	20	8.9

(2) – 1) Milling accuracy（X1-Y1）

Unit (μm)

Flat contour machining by milling				JIS	Pass / fail criteria for machine performance evaluation items	TMX-4000ST Measured value			
Tool spindle + Left spindle	X-Y plane	Center hole	Cylindricity	10	8	4.6			
			Perpendicularity to datum plane	10	8	3.0			
		Square	Side straightness	30	8	1.8	2.4	3.2	1.6
			Perpendicularity	40	15		1.0		1.2
			Parallelism	40	15			7.1	
		Rhombus	Side straightness	30	15	5.4	5.9	4.1	3.4
			Gradient （60°）	40	15	5.5	5.8	7.8	4.5
		Circle	Roundness	30	10	3.8			
			Position with center hole	40	20	2.6			
		Slope plane	Side straightness	30	15	2.7		2.2	
			Gradient	40	15	2.6		2.3	
		Four boreholes	Position with center hole	50	30	7.0	1.6	7.9	1.4
			Concentricity of large and small holes	20	10	1.0	3.3	4.5	3.2

(2) – 2) Milling accuracy (X1-C1)

Unit (μm)

Flat contour machining by milling				JIS	Pass / fail criteria for machine performance evaluation items	TMX-4000ST Measured value			
Tool spindle + Left spindle	X-C plane	Center hole	Cylindricity	10	10	3.3			
			Perpendicularity to datum plane	10	10	1.5			
		Square	Side straightness	30	30	4.6	2.4	4.7	5.5
			Perpendicularity	40	30		0.9		1.7
			Parallelism	40	30			1.4	
		Rhombus	Side straightness	30	30	6.0	5.1	5.4	4.7
			Gradient (60°)	40	30	7.5	4.6	5.2	5.5
		Circle	Roundness	30	30	2.2			
			Position with center hole	40	40	1.0			
		Slope plane	Side straightness	30	30	3.6		2.7	
			Gradient	40	30	3.8		3.0	
		Four boreholes	Position with center hole	50	50	7.9	8.4	15.4	18.0
			Concentricity of large and small holes	20	20	3.2	3.6	3.7	3.9

(3) Circular interpolation accuracy

Unit (μm)

Tool spindle + Left spindle			TTS-03003G		TMX-4000ST
			Pass / fail criteria	Internal target value	Measured value
2 axes Simultaneous (3 orthogonal planes)	X-Y plane		30	10	8.5
	Y-Z plane		30	10	8.7
	Z-X plane		30	10	5.7
5 axes Simultaneous	Table coordinate system	Half apex angle 15°	80	40	67.2
		Half apex angle 45°	80	40	65.3
	Work coordinate system	Half apex angle 15°	80	40	68.7
		Half apex angle 45°	80	40	66.2

(4) B-axis indexing angle accuracy

Unit (sec.)

		Pass / fail criteria for machine performance evaluation items	TMX-4000ST Measured value
Angle error	30 deg. plane	15 (4.2×10^{-3}deg.)	9
	45 deg. plane		4
	60 deg. plane		4
	90 deg. plane		2

(5) Heavy cutting ability (Tool spindle)

Flange work S45C φ100×L80

Machining detail		Pass / fail criteria for machine performance evaluation items	Cut. dia. (mm)	Cut. depth (mm)	Revolution (min^{-1})	Cut. speed (m/min)	Feed rate (mm/rev)	Cutting volume (ml/min)	Load (%)	Cutting result		
									Spindle	A	B	C
U-drill (φ50)	L-sp.	No chatter or vibration with 100% load on the spindle motor	50	-	1435	225	0.13	366	56	Good	Good	Good
	R-sp.								105	Good	Good	Good
O.D.	L-sp.	No chatter or vibration with 100% load on the spindle motor	Φ60 →50	5	1401	220	0.5	605	78	Good	Good	Good
	R-sp.								139	Good	Good	Good
Grove	L-sp.	Groove with 6mm blade width	Φ60 →50	width 6	955	150	0.15	146	31	Good	Good	Small chatter noise
	R-sp.								23	Good	Good	Good

Cutting result A: Chattering on the machined surface
B: Vibration during machining
C: Noise and chattering noise during machining.

Flange work S45C φ100×L80

Machining detail		Pass / fail criteria for machine performance evaluation items	Cut. dia. (mm)	Cut. depth (mm)	Revolution (min^{-1})	Cut. speed (m/min)	Feed rate (mm/rev)	Cutting volume (ml/min)	Load (%) milling	Cutting result		
										A	B	C
U-drill (φ40)	L-sp.	No chatter or vibration with 100% load on the spindle motor	40	35	1194	150	0.12	180	50	Good	Good	Good
Drill (φ20)			21	50	379	25	0.15	-	18	Good	Good	Good
Tap (M24X3.0)			24	35	332	-	3	-	56	Good	Good	Good

Machining detail		Pass / fail criteria for machine performance evaluation items	Cut. dia. (mm)	Cut. depth (mm)	Revolution (min^{-1})	Cut. speed (m/min)	Feed rate (mm/rev)	Cutting volume (ml/min)	Load (%) milling	Cutting result		
										A	B	C
Face mill (φ63 6-flutes)	L-sp.	No chatter or vibration with 100% load on the spindle motor	60	3	1768	350	2122	382	61	Good	Good	Good
End mill (φ25 3-flutes)			20	5	2546	200	1146	115	20	none	Good	Small chatter noise

Cutting result A: Chattering on the machined surface
B: Vibration during machining
C: Noise and chattering noise during machining.

(6) Spindle acceleration and deceleration time

Unit (sec.)

	Condition	Calculated value	Tolerance (within x 1.1)	Measured value	
					Average
L-spindle (A2-8)	0～4000 min^{-1}	5.612	within 6.173	7.043	5.974
	4000～0 min^{-1}			4.904	
R-spindle (A2-8)	0～4000 min^{-1}	4.083	within 4.491	4.090	3.900
	4000～0 min^{-1}			3.710	
Tool spindle (Synchronous)	0～12000 min^{-1}	1.406	within 1.547	1.209	1.286
	12000～0 min^{-1}			1.363	

(7) Feed axis acceleration and deceleration time

Unit (sec.)

	Condition	Calculated value	Tolerance (within x 1.1)	Measured value	
					Average
X1-axis	0～40 m/min	0.300	within 0.33	0.304	0.305
	40～0 m/min			0.306	
Y1-axis	0～40 m/min	0.300	within 0.33	0.301	0.305
	40～0 m/min			0.309	
Z1-axis	0～40 m/min	0.300	within 0.33	0.308	0.315
	40～0 m/min			0.322	
X2-axis	0～20 m/min	0.300	within 0.33	0.302	0.305
	20～0 m/min			0.308	
Z2-axis	0～40 m/min	0.300	within 0.33	0.302	0.308
	40～0 m/min			0.314	
A-axis	0～30 m/min	0.300	within 0.33	0.320	0.314
	30～0 m/min			0.308	
B-axis	0～30 min^{-1}	0.300	within 0.33	0.298	0.296
	30～0 min^{-1}			0.293	

(8) Lower turret index time

Unit (sec.)

	Condition			Calculated value	Tolerance (within x 1.1)	Measured value
						Two pcs. of holders are mounted on the turret
1 position	T1	→	T2	0.293	within 0.322	0.322
6 position (180° rotation)	T4	→	T10	0.752	within 0.827	0.728

(9) ATC (tool change) time

Unit (sec.)

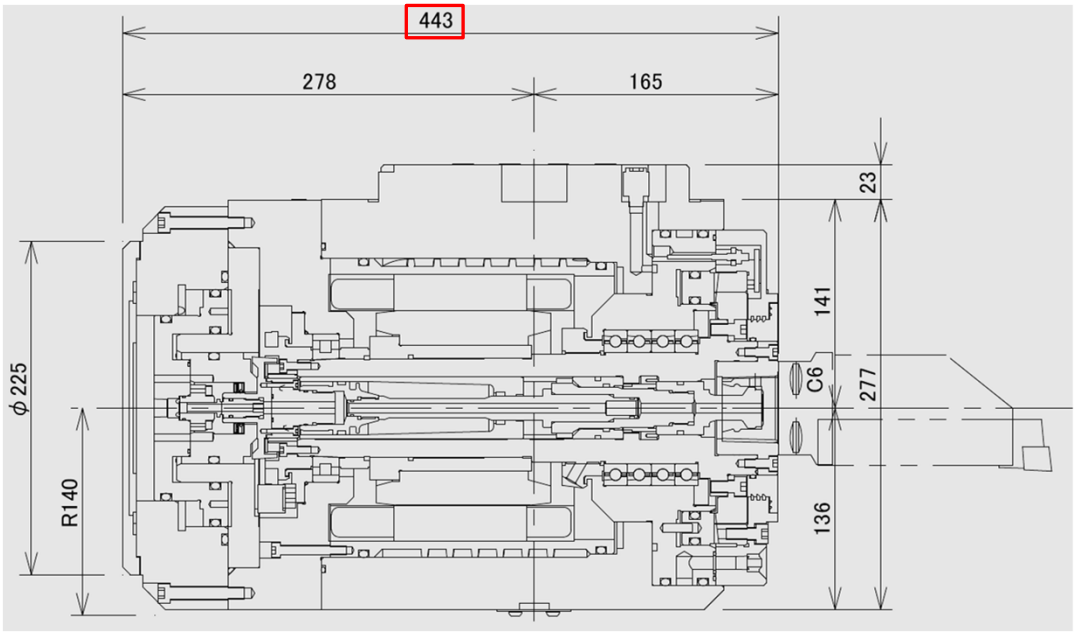
	Condition	Measured value
Tool to tool	M126 → ATC cam box motor rotation completed	2.08
	M126 → Tool spindle tool clamp completed	2.32
Chip to chip	Rotary tool → Rotary tool	11.6
	Turning tool → Turning tool	17.5
	Rotary tool → Turning tool	15.1
	Turning tool → Rotary tool	14.1

【9】Structure of tool spindle and L/R spindle

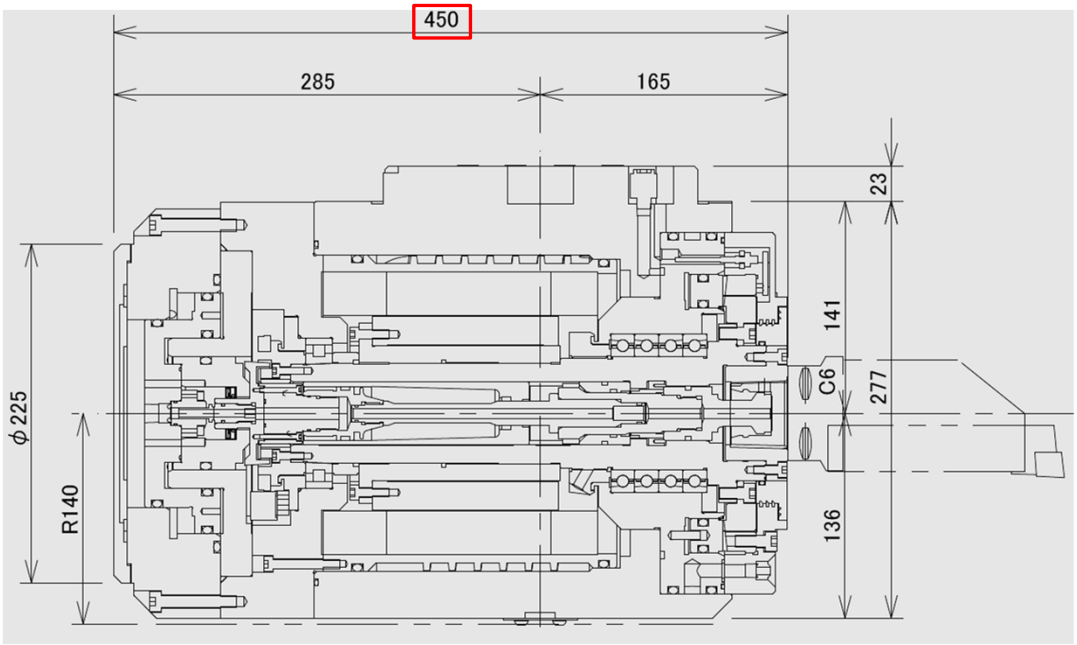
(1) Structure of tool spindle

The tool spindle can be equipped with an induction motor as standard and a synchronous motor as an option.
Grease which is maintenance-free and ecology compared to oil lubrication is filled to lubricate the spindle.

『Induction motor / standard』

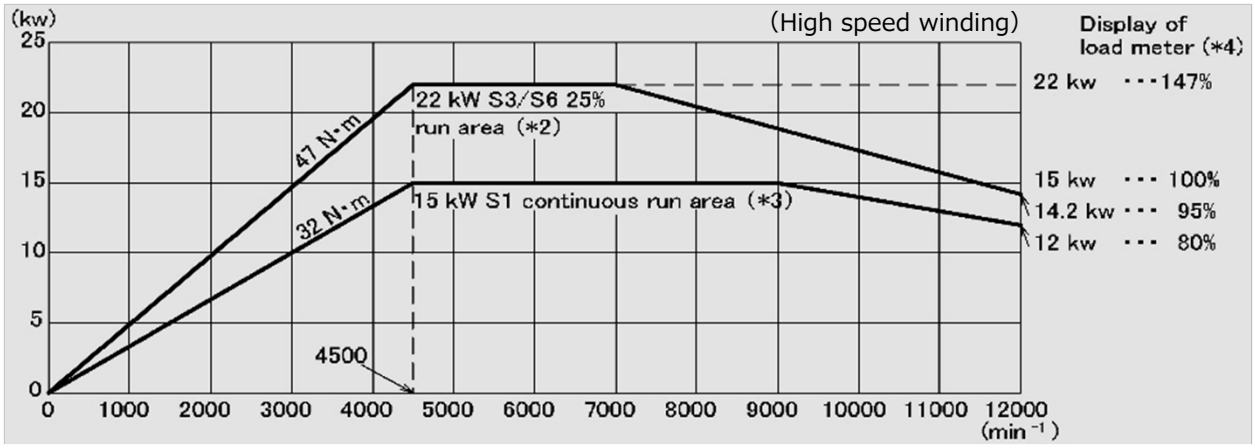


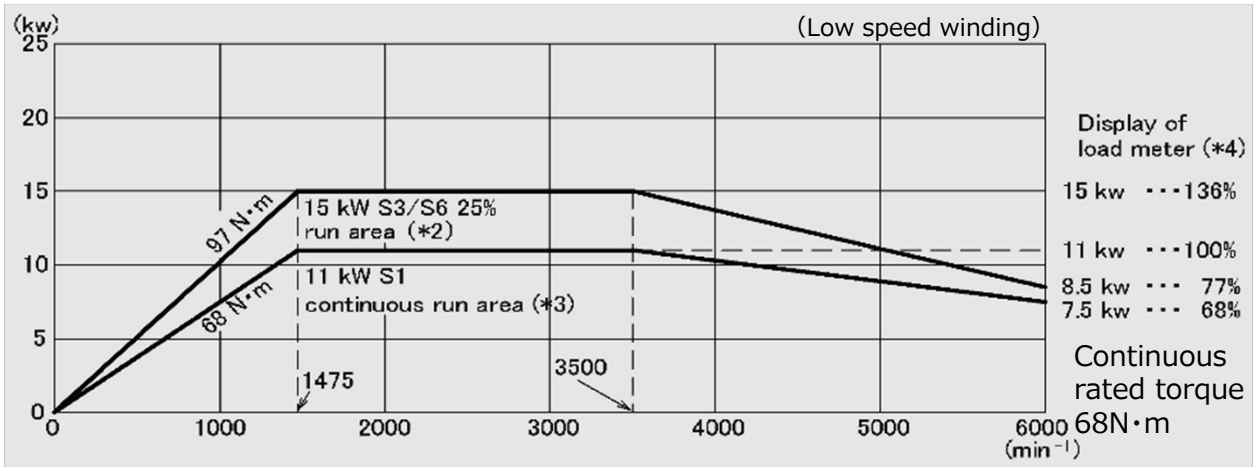
『Synchronous motor / option』



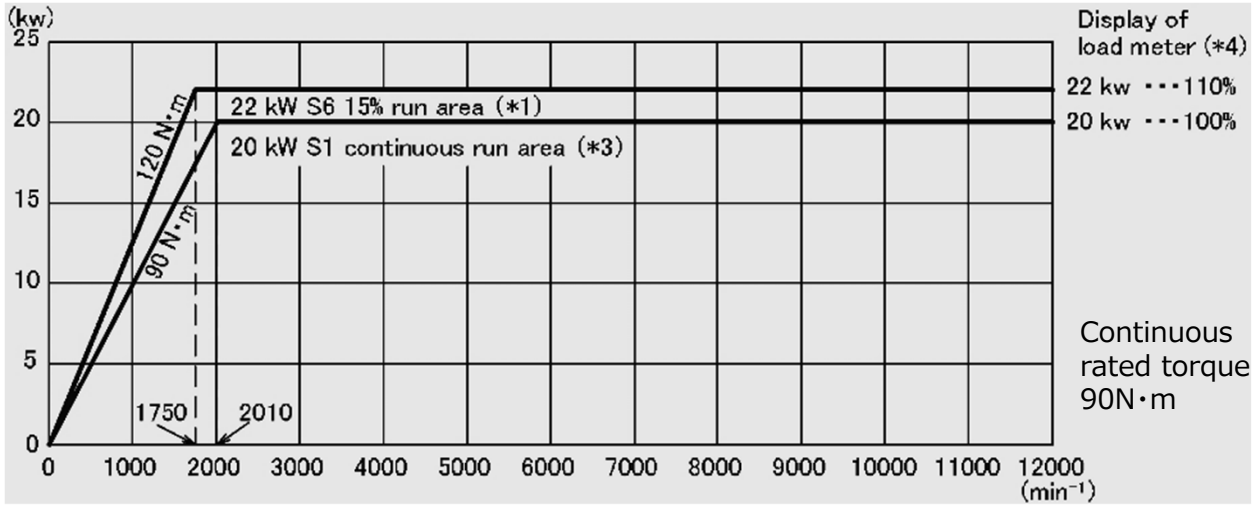
(2) Tool spindle speed / output diagram

12000 min^{-1} Fanuc BiI 132S (induction motor) / std.





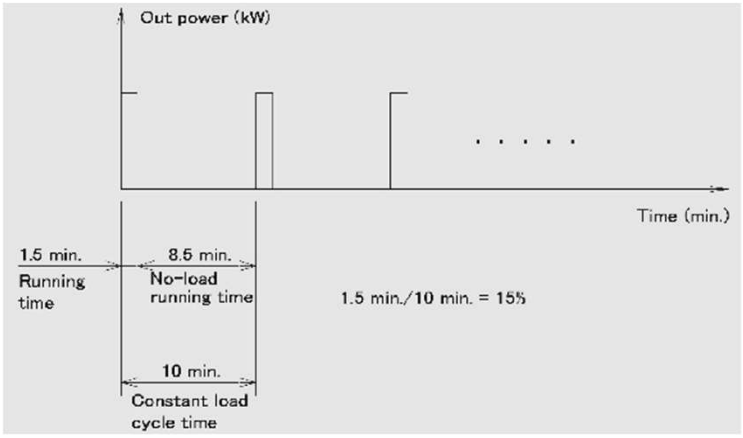
12000 min^{-1} Fanuc BiS 132L2 (synchronous motor) / option



(Supplementary explanation of output diagram)

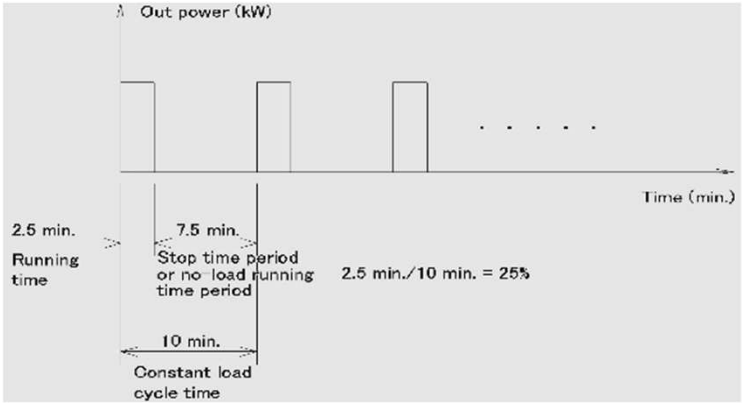
＊1 : [S6 15%] indicates that when constant load running and no-load running are repeated alternatively in a certain cycle, continuous machining is possible under following conditions.

Condition : The constant load cycle time is max. 10min.
The constant load running is 15%, that is 1.5 min. of the constant load cycle time.
The stopping time is last 8.5 min.



＊2 : [S3/S6 25%] indicates that when constant load running and stop or constant load running and no-load running are repeated alternatively in a certain cycle, continuous machining is possible under following conditions.

Condition : The constant load cycle time is max. 10min.
The constant load running is 25%, that is 2.5 min. of the constant load cycle time.
The stopping time is last 7.5 min.



＊3 : [S1 Continuous run area] is shown constant running with some constant load.

＊4 : The load meter of NC CRT is shown 100% for out put as continuous run area. But no display with cutting load.

(Advantage and disadvantage for optional induction motor of Tool spindle)

The tool spindle can be equipped with an optional synchronous motor, but the advantages and disadvantages compared to the standard installed induction motor are as follows.

<Advantage>

- Tact time becomes short because there is no winding switching
- Tact time becomes short because acceleration / deceleration time becomes faster.
- The efficiency is high in the low speed area.
- Since stable constant speed rotation is possible, it is superior in machining requiring constant speed such as gear skiving.

<Disadvantage>

- Large heat generation during long-time rotation.
- Generates heat even without load.
- The efficiency is low in the high speed area.
- When the tool spindle is forcibly turned from the outside, it operates as a generator.

  Since the sub-module SM is installed as a safety device, there is usually no problem.

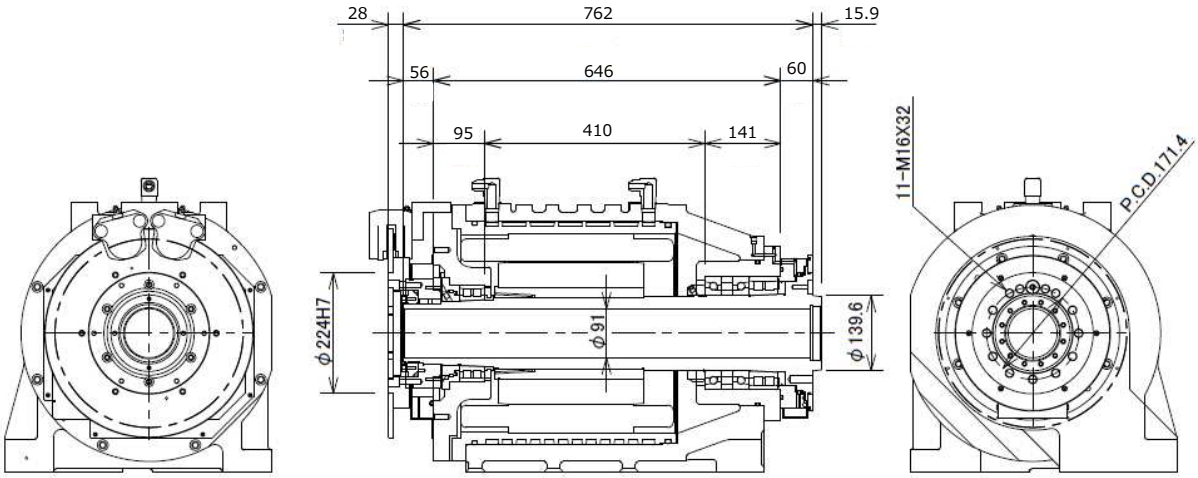
  However, when the sub-module SM fails, the failure can be detected when the power is turned on, but cannot be detected when the power is turned off. Therefore, when the tool spindle is forcibly turned, power is generated.

  So, it is better to avoid forcibly turning the tool spindle by hand when the power is turned off.

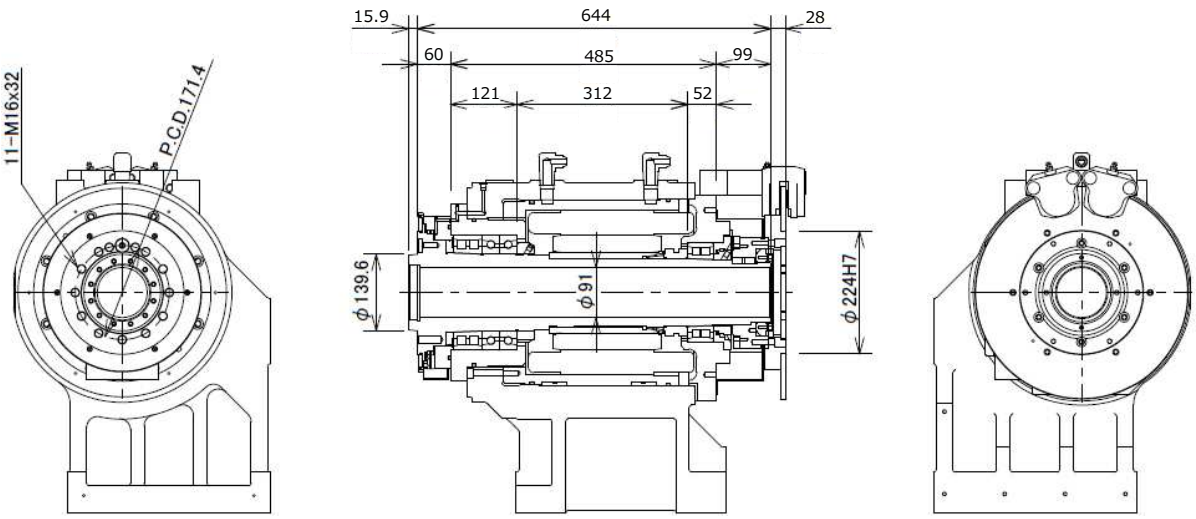
- It is necessary to detect the magnetic pole every time the power is turned on.
- The total length of the tool spindle increases by 7 mm.

(3) Structure of L/R spindle

The left and right spindle structures and main dimensions are shown below. Grease which is maintenance-free and ecology compared to oil lubrication is filled to lubricate the spindle.



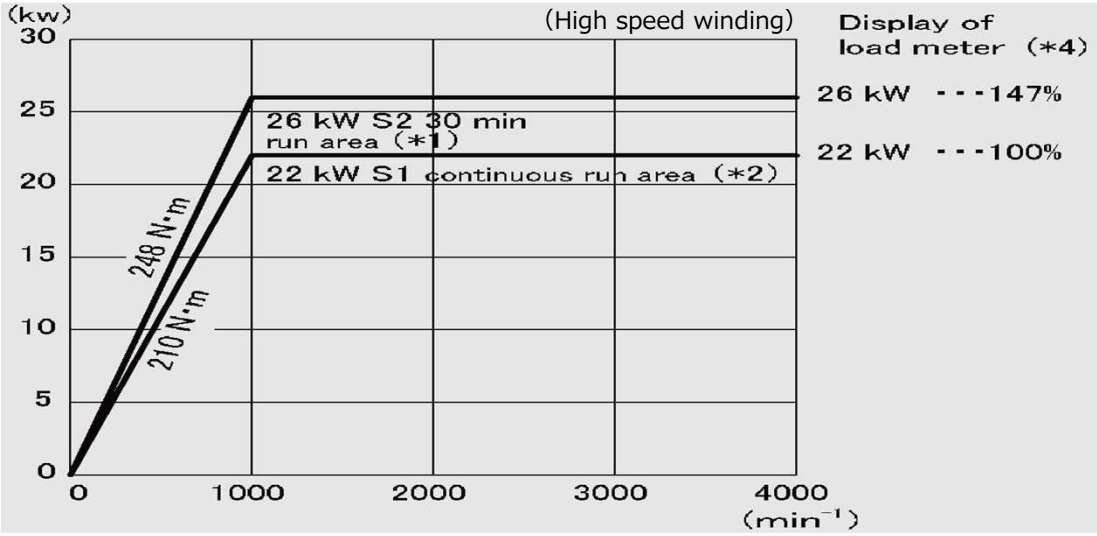
(Main dimensions of left spindle)

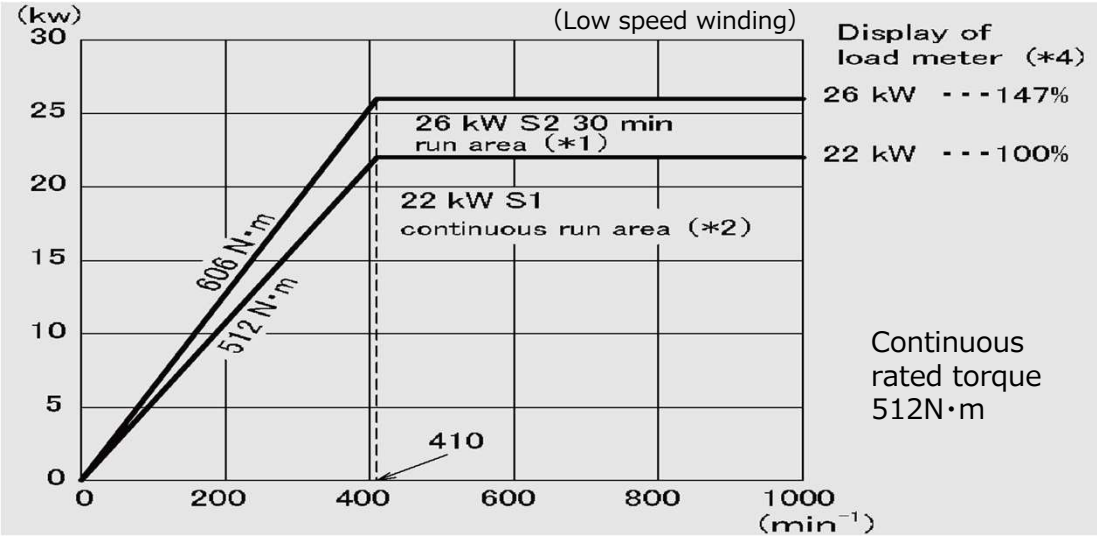


(Main dimensions of right spindle)

(4) Spindle speed / output diagram

Left spindle 4000 min^{-1} Fanuc BiI 250S



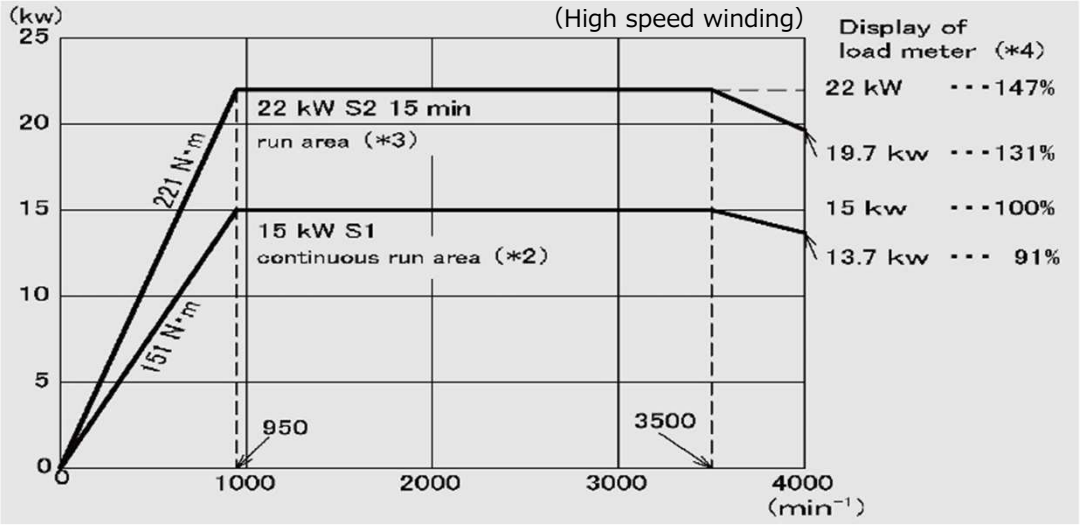


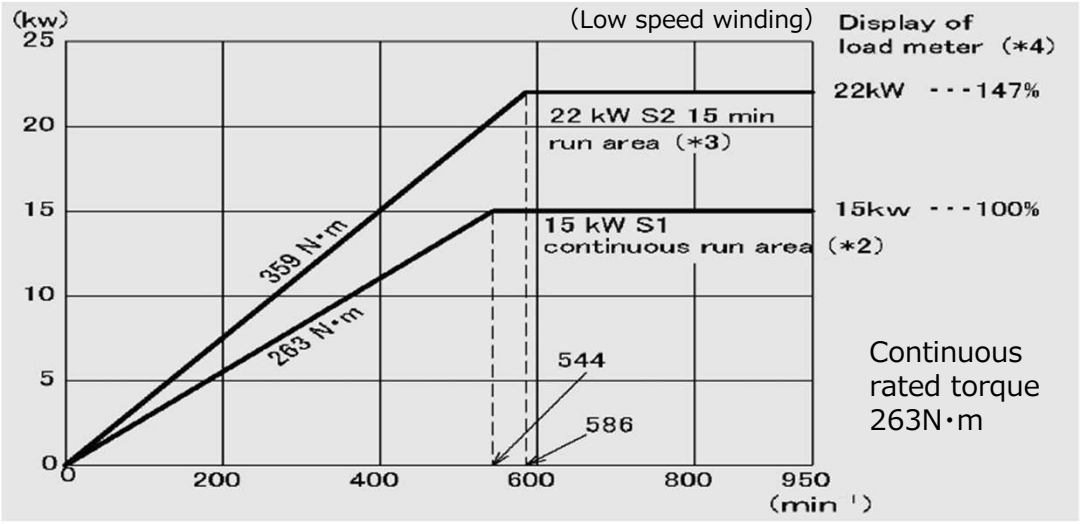
＊1 : [S2 30 min.] is meaning case of constant load on machine.
It is shown 30 min. possible of machine running from starting around temperature.

＊2 : [S1 Continuous run area] is shown constant running with some constant load.

＊4 : The load meter of NC CRT is shown 100% for out put as continuous run area. But no display with cutting load.

Right spindle 4000 min^{-1} Fanuc BiI 200S





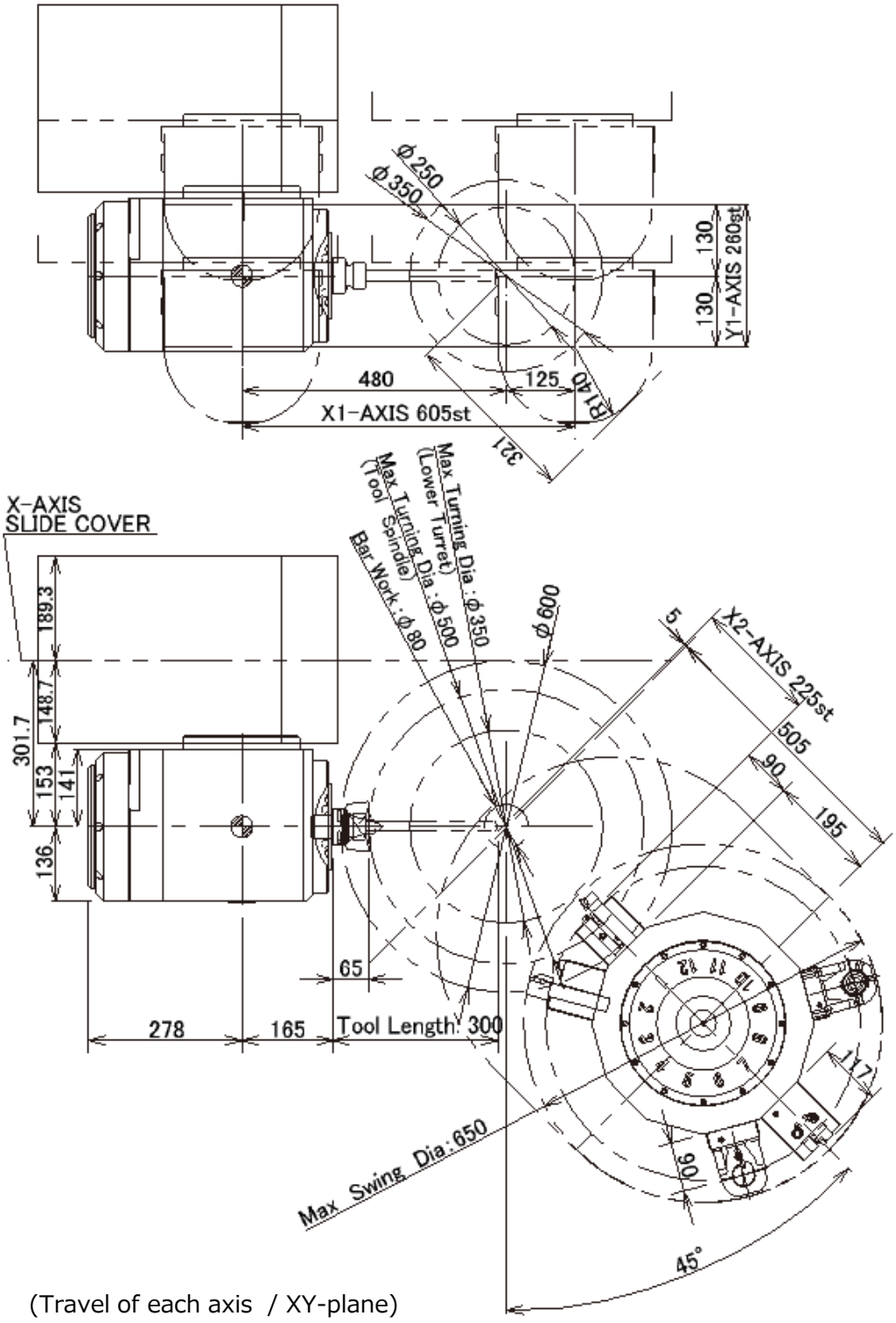
＊2：[S1 Continuous run area] is shown constant running with some constant load.

＊3：[S2 15 分] is meaning case of constant load on machine.
It is shown 15 min. possible of machine running from starting around temperature.

＊4：The load meter of NC CRT is shown 100% for out put as continuous run area. But no display with cutting load.

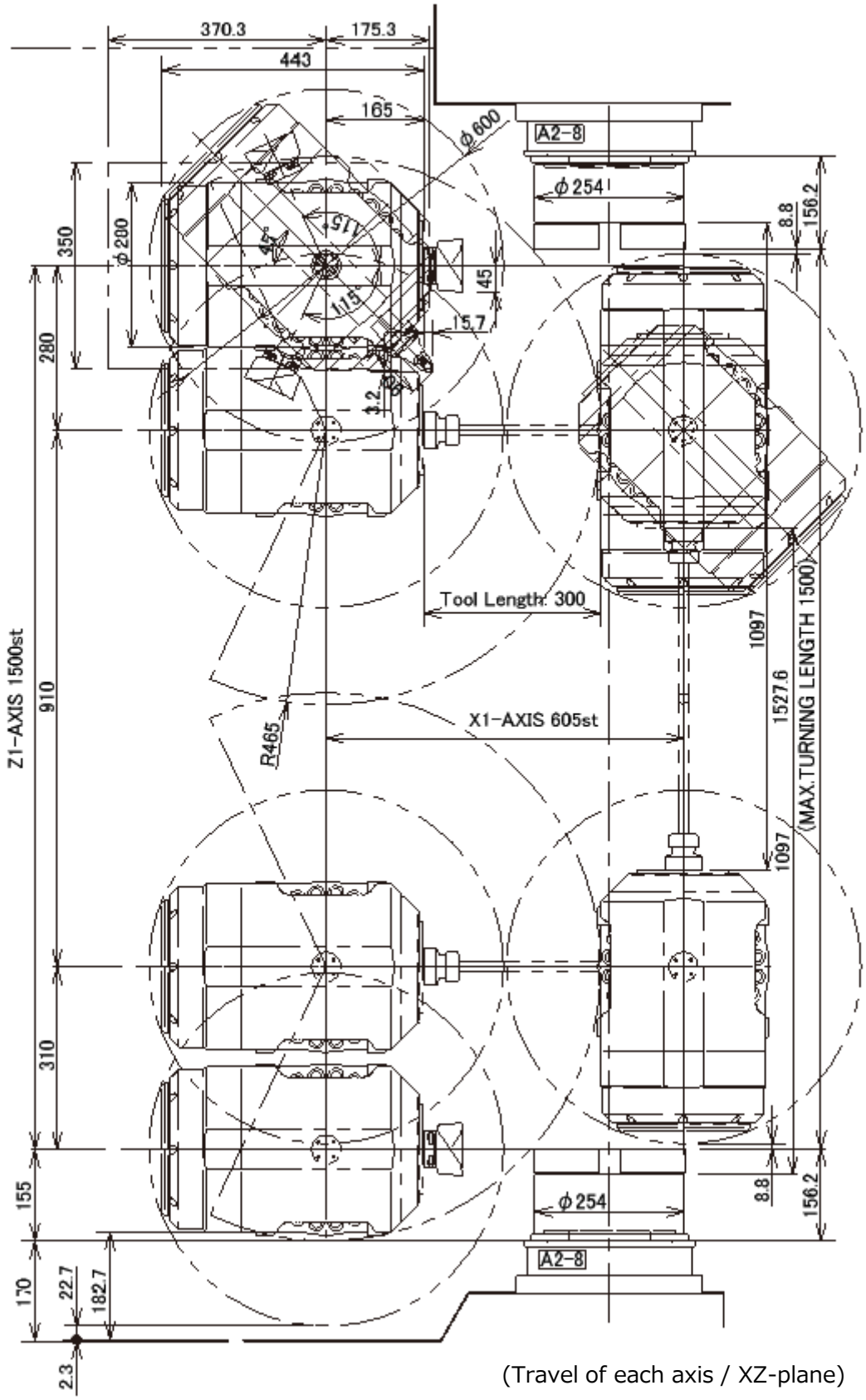
【10】Travel of each axis (tool interference range)

(mm)

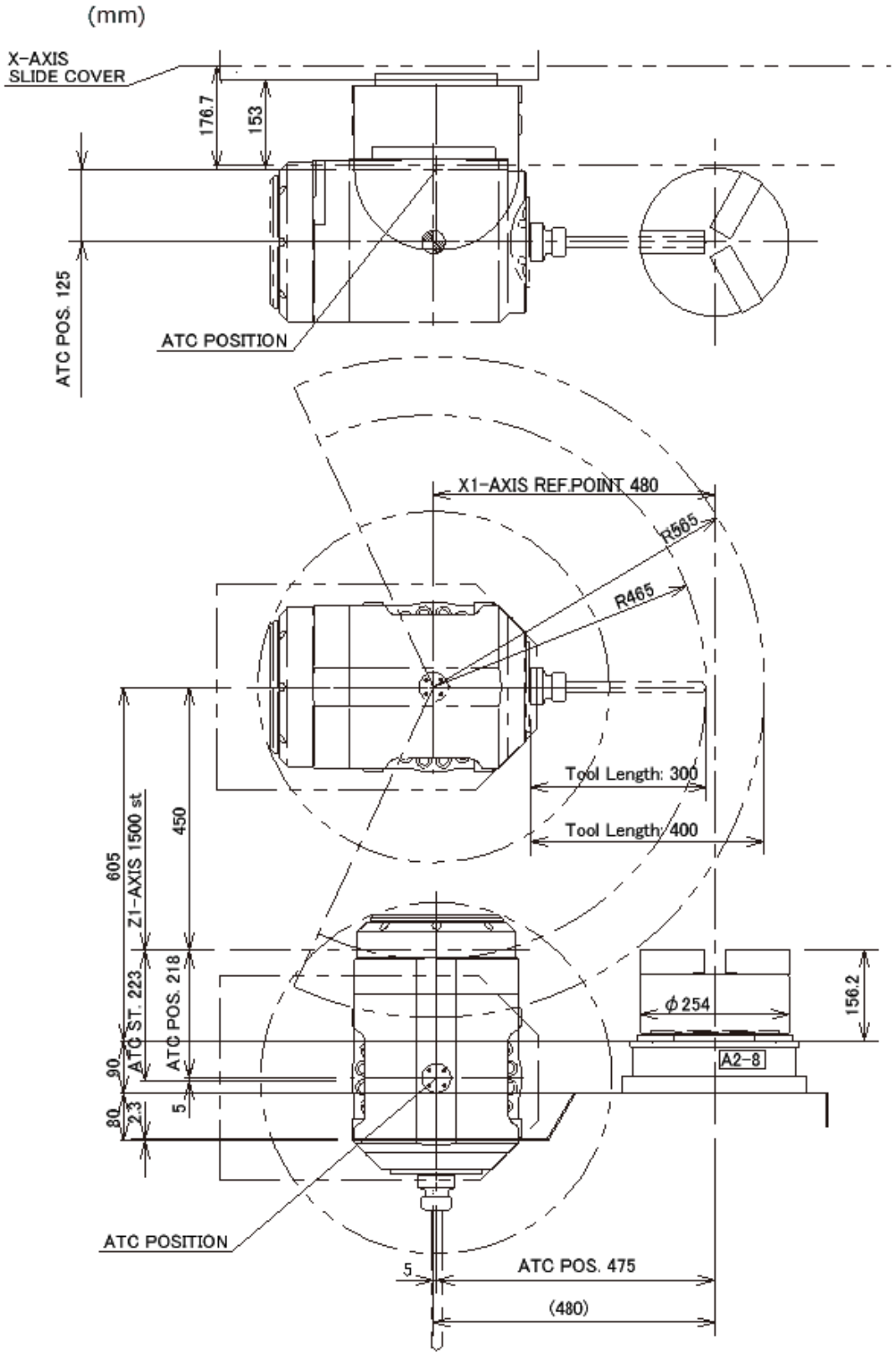


(Travel of each axis / XY-plane)

(mm)

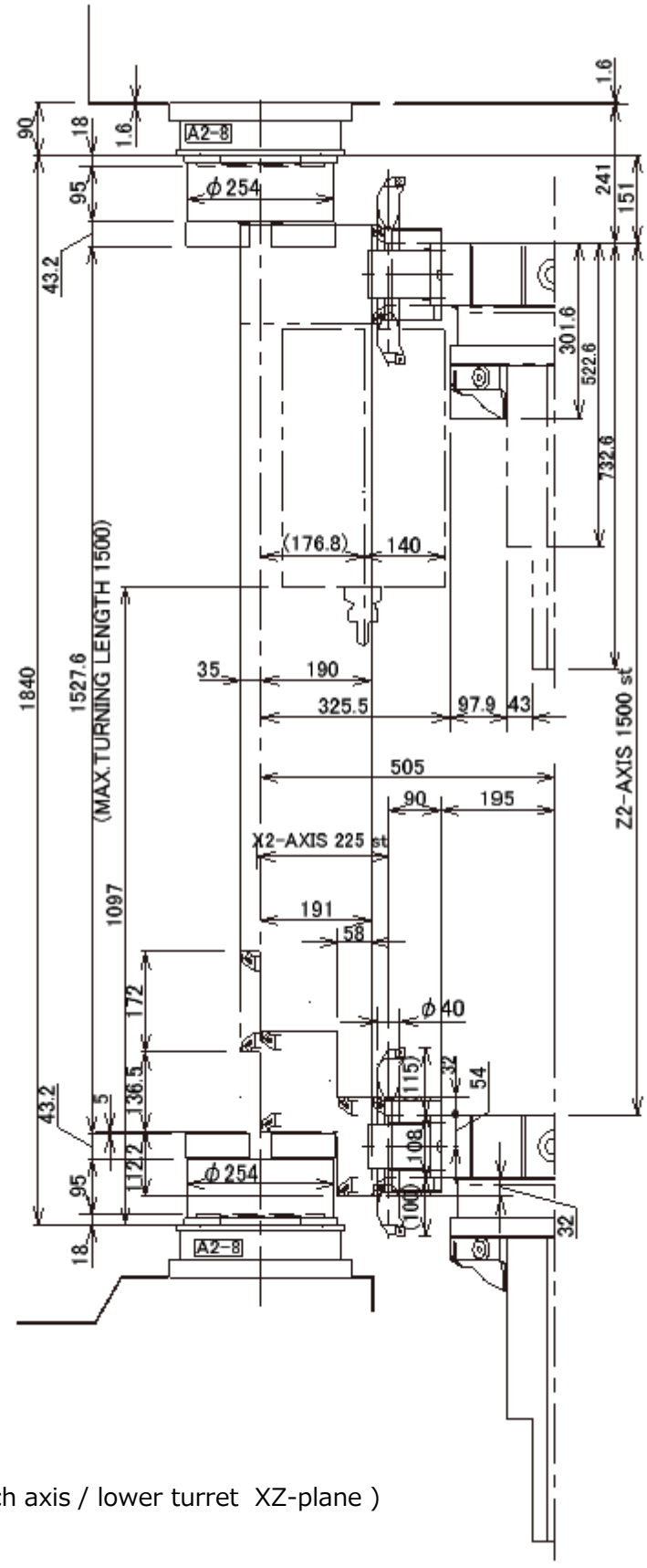


(Travel of each axis / XZ-plane)



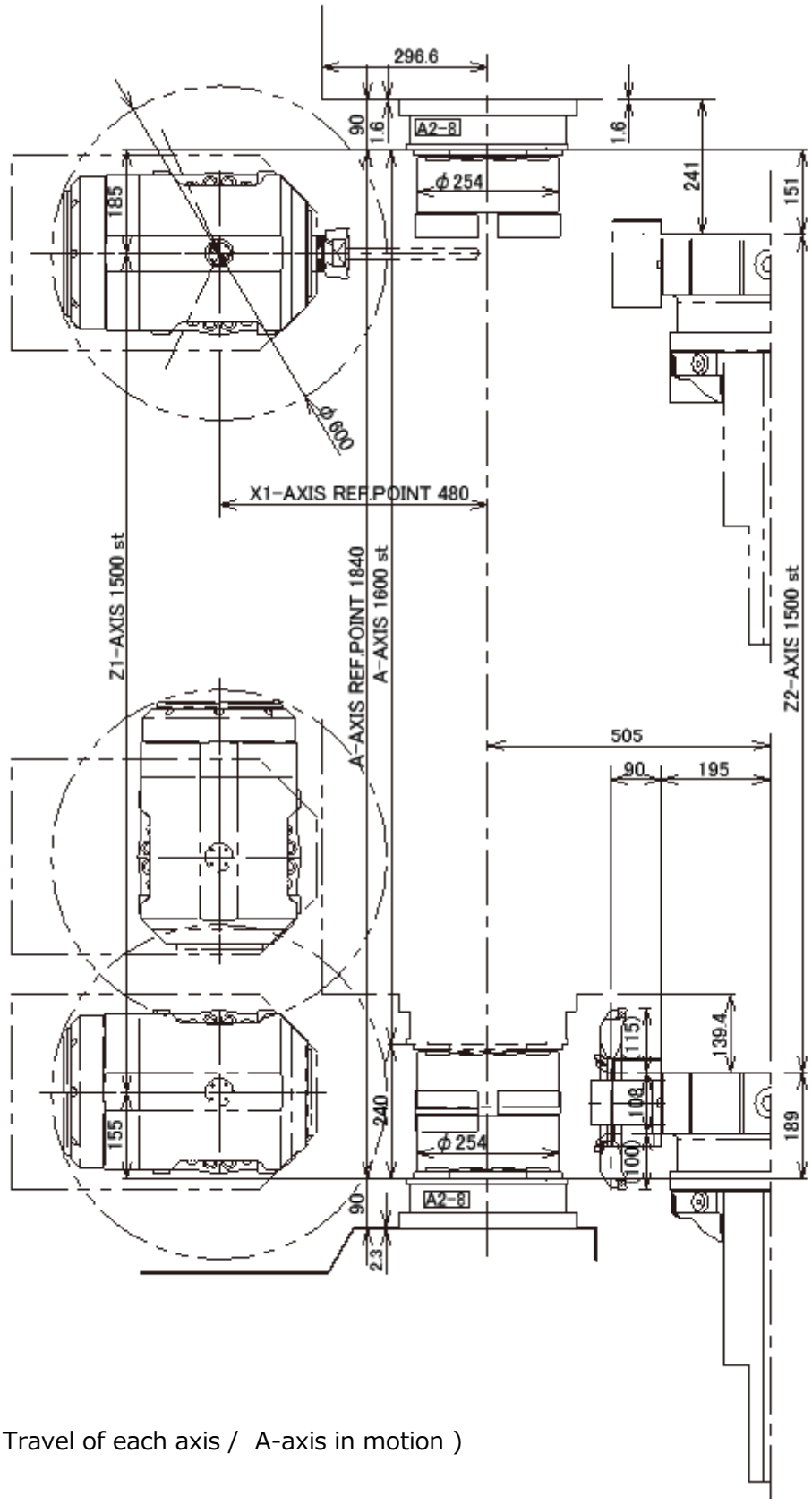
(Travel of each axis / Tool spindle during ATC)

(mm)

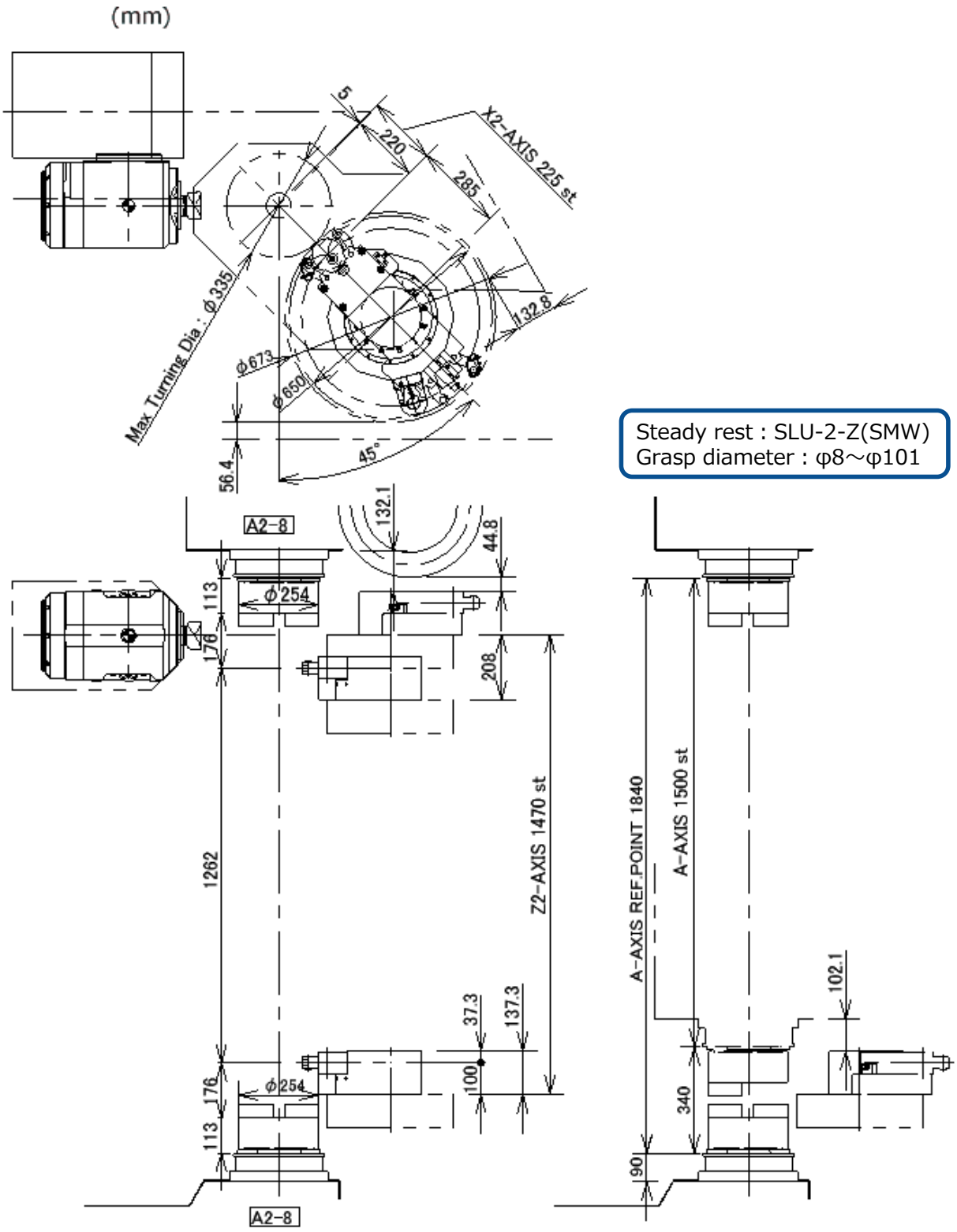


(Travel of each axis / lower turret XZ-plane)

(mm)



(Travel of each axis / A-axis in motion)



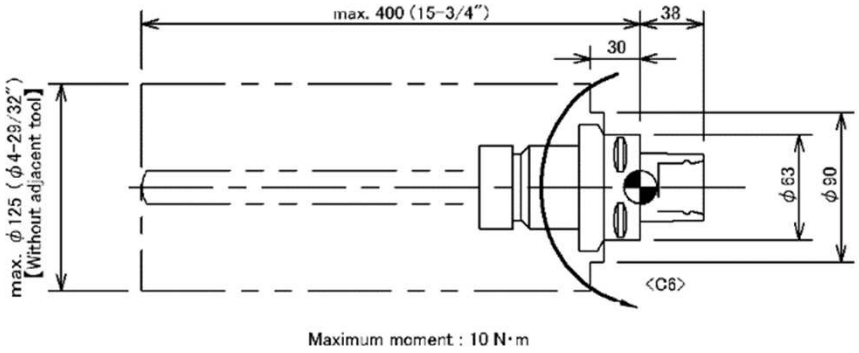
(Travel of each axis / mount SLU-2-Z on the lower turret)

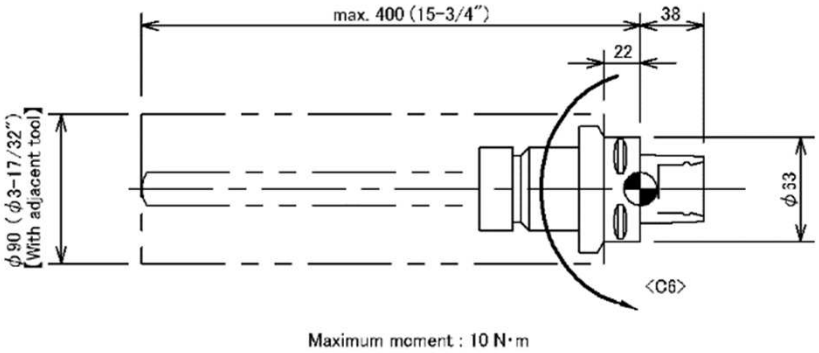
【11】Tooling system

(1) Tool spindle (Rotary tool and Turning tool)

Tool specification (ATC and magazine restrictions)

Shank type	CAPTO-C6	【SANDVIK】
Max. tool dia.	φ 125 mm φ 90 mm	【 Without adjacent tool 】 【 With adjacent tool 】
Max. tool length	400 mm	【From C6 end face】
Max. tool weight	10 kg	
Max. moment	10 N·m (102 kgf·cm)	

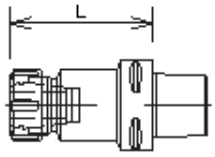
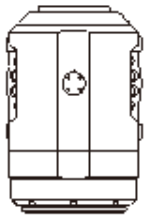
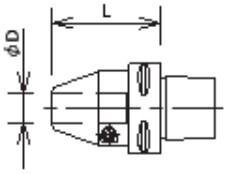
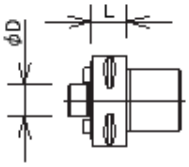
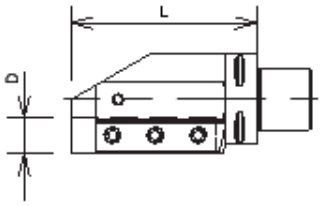
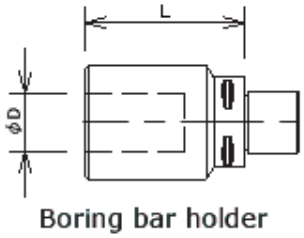




(Shank type of the tool / ATC and magazine restrictions)

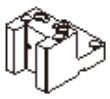
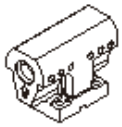
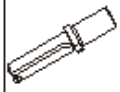
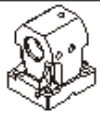
<Reference> Model: SANDVIK

(mm)

Drill  Tap 	Holder : C6-391.14-32 100 (ER32, L=100) Holder : C6-391.14-25 060 (ER25, L=60)	 Collet chuck holder	 Tool spindle
Drill 	Holder : C6-391.CGA-32 084A (ϕ D= ϕ 32, L=84) Holder : C6-391.CGA-25 080 (ϕ D= ϕ 25, L=80)	 Straight collet chuck holder	
	Holder : C6-391.05-32 025A (ϕ D= ϕ 32, L=25) Holder : C6-391.05-27 025A (ϕ D= ϕ 27, L=25)	 Face mill adapter	
Tool holder 	Holder : C6-ASHR-38130-25 (D=25, L=130, right-handed) Holder : C6-ASHL-38130-25 (D=25, L=130, left-handed)	 Turning holder	
Boring bar 	Holder : C6-131-00112-40 (ϕ D= ϕ 40, L=112) Holder : C6-131-00098-25 (ϕ D= ϕ 25, L=98)	 Boring bar holder	

(2) 12 station lower turret

(mm)

Tool holder 	25x25		 Turning holder JB22050-001B (L)  Facing holder (End face) JB22052-001B (L/R)  Double-turning holder JB22051-001C  Cut off holder JB22053-001B (L/R)	 Rotary tool type 12-Station turret JK21001-001B
Boring bar 	φ40(STD)		 Boring bar holder JB22054-001B (L/R) Gauging JB22055-001C (L/R)  Double-boring bar holder JB22057-001B	
	Bush 	φ6 :NC30101-001A		
		φ8 :NC30102-001A		
		φ10 :NC30103-001A		
		φ12 :NC30104-001A		
		φ14 :NC30151-001A		
		φ16 :NC30105-001A		
		φ18 :NC30152-001A		
		φ20 :NC30106-001A		
		φ25 :NC30107-001A		
		φ30 :NC30153-001A		
		φ32 :NC30108-001A		
Drill 	Socket 	MT.4 :NC00007-038		
		MT.3 :NC00007-037		
		MT.2 :NC00007-036		
		MT.1 :NC00007-035		
U-drill 	φ40(STD)		 U-drill holder JB22056-001C (L/R)	
	Socket 	φ16 :NC32204-001		
		φ20 :NC32201-001A		
		φ25 :NC32202-001A		
		φ32 :NC32203-001A		

【12】Machine standard specification
NC specification
Standard accessorries
Optional accessories

(1) Machine standard specification

Items		Unit	Specifications
			TMX-4000ST
Machine Composition	Right Spindle		Standard
	Lower turret T12		Standard
Capability・Capacity	Max. turning diameter	mm	500
	Max. turning length *1	mm	1500
	Bar capacity *2	mm	φ80
Travel	X1-axis travel (tool spindle)	mm	605
	Y1-axis travel (tool spindle)	mm	260 (±130)
	Z1-axis travel (tool spindle)	mm	1500
	A2-axis travel (right spindle, tailstock) *3	mm	1600
	B1-axis swivel range (tool spindle)	deg	230 (±115)
	B1-axis min. index angle (tool spindle)	deg	0.0001
	C-axis swivel range	deg	360
	X2-axis travel (turret)	mm	225
	Z2-axis travel (turret) *4	mm	1500

* Y is indicated as Y1, B is as B1 and A is as A.

Items		Unit	Specifications
			TMX-4000ST
L-spindle	Chuck size	inch	10
	Max. spindle speed *5	min^{-1}	4000
	Min. index angle	deg	0.0001
	Spindle nose (nom, code)		A2-8
	Through hole diameter	mm	91
	Bearing inside diameter	mm	140
R-spindle	Chuck size	inch	10
	Max. spindle speed *5	min^{-1}	4000
	Min. index angle	deg	0.0001
	Spindle nose (nom,code)		A2-8
	Through hole diameter	mm	91
	Bearing inside diameter	mm	140
Tool spindle	Type of turre		Tool spindle with ATC
	Number of attachable tool	pcs.	1
	Spindle speed	min^{-1}	12000
	Type of tool shank		CAPTO C6
	Bearing inside diameter	mm	75
Lower turret	Type of turret		12-Station turret
	Number of attachable tool	pcs.	12

* Y is indicated as Y1, B is as B1 and A is as A.

Items		Unit	Specifications
			TMX-4000ST
ATC magazine	No. of tools stored		40(OP. 80, 120)
	Max. tool diameter (without adjacent tool)	mm	90(125)
	Max.Tool length from gauge line	mm	400
	Max. tool weight	kg	10
	ATC time (T to T)	sec	2
	Magazine tool selecting system		Fixed address
Rapid traverse rate	X1/Y1/Z1-axis (tool spindle)	m/min	40/40/40
	X2/Z2-axis (turret)	m/min	20/40
	A-axis (right spindle)	m/min	30
Motors	Left spindle motor	kW	22/26 (S2 30min/S1 cont.)
	Right spindle motor	kW	22/15 (S2 15min/S1 cont.)
	Tool spindle motor (ind. motor)	kW	22/15 (High), 15/11 (Low) (S3/S6 25%/cont.)
	For feed axes (X1/Y1/Z1)	kW	5.5/3.0/3.0
	For feed axes (X2/Z2)	kW	2.5/2.5
	For feed axes (A)	kW	2.5
	Hydraulic pump motor	kW	2.2
	Coolant pump motor	kW	0.55 x 2, 0.4X2

* Y is indicated as Y1, B is as B1 and A is as A.

Items		Unit	Specifications
			TMX-4000ST
Power sources	Electric power	kVA	120
	Air pressure source	MPa	0.4
Tank capacity	Hydraulic unit tank	L	20
	Spindle cooling unit	L	70
	Lubricant tank (grease)	L	0.7
	Coolant tank	L	540
Machine size	Machine height	mm	3160
	Floor to spindle center height	mm	1340
	Required floor space	mmxmm	6950x4490
	Machine weight	kg	17000

*1 : Max. turning length varies by the type of chuck.
When a workpiece is protruding by 1100 mm or more from the spindle end face, end face machining range is limited.

*2 : Showing max ability when hollow chuck is used.

*3 : 1500 mm, if the machine is equipped with a steady rest (turret installation).

*4 : 1470 mm, if the machine is equipped with a steady rest (turret installation).

*5 : The spindle speed is limited by the specification of chuck.

(2) NC specification

● : Standard ◎ : Special option ○ : Option — : No setting

Items	Specifications	TMX-4000ST NC unit 31i-B	TMX-4000ST NC unit 31i-B5	Remarks
NC unit	31i-B LCD (integrated type) 15" PANEL iH	●	—	
	31i-B LCD (separate type) 19" PANEL iH Pro	○	—	
	31i-B5 LCD (integrated type) 15" PANEL iH	—	○	
	31i-B5 LCD (separate type) 19" PANEL iH Pro	—	○	
	Number of controlled axes (Path-1 + Path-2)	5+4		
	Number of simultaneously controlled axes (Path-1 + Path-2)	4+4	5+5	
Software	iHMI	●		
	iHMI process cycle	●		
	Tiwap-1	○		
	RAKU RAKU MONITOR 3	○		
	MEASUREMENT MONITOR 3	◎		I/O addition and PC change are necessary.
	FANUC iCAPT	○		PANEL iH Pro is necessary.
	Machine collision avoidance	○		PANEL iH Pro is necessary.
Safety unit	Front door interlock	●		
	Front door locking mechanism	●		
	Dual check safety	●		
	Circuit panel breaker with tripper	●		

● : Standard ○ : Option ◎ : Special option — : No setting

▲ : Parameter setting is required.

5 axes : Simultaneous 5 axes type standard specification.

Items	Specifications	TMX-4000ST	Remarks
Controlled axis	Increment System	●	0.0001 mm 0.00001 inch 0.0001 deg
	Maximum programmable dimension	●	±99999.9999
	Cs contouring control	●	
	Increment System C	●	IS-C 0.0001 mm 0.00001 inch 0.0001 deg
	Synchronous/composite control	●	
	Inch/metric conversion	○	
	Interlock	●	
	Machine lock	○	
	Emergency stop	●	
	Stored stroke check 1	●	
	Stored stroke check 2, 3	○	Not coexistent with chuck tailstock barrier.
	Storke limit check before move	○	
	Chuck and tail stock barrier	○	
	Mirror image (Each axis)	▲	
	Chamfering ON/OFF	●	
	Unexpected disturbance torque detection function	○	Required when RAKU RAKU MONITOR 3 is used.
	Position switch	●	
Operation	Automatic operation (Memory)	●	
	MDI operation	●	
	DNC operation	○	DNC run mode transfer switch is required.
	DNC operation with memory card	○	DNC run mode transfer switch is required. CF card and adaptor is required.
	Program number search	●	
	Sequence number search	●	

● : Standard ○ : Option ◎ : Special option — : No setting

▲ : Parameter setting is required.

5 axes : Simultaneous 5 axes type standard specification.

Items	Specifications	TMX-4000ST	Remarks
Operation	Sequence number comparison and stop	○	
	Program restart	◎	
	Manual intervention and return	○	
	Wrong operation prevention	●	
	Retraction for Rigid Tapping	●	
	Buffer register	●	
	Dry run	●	
	Single block	●	
	Manual continuous feed (JOG)	●	
	Manual reference position return	●	
	Reference position setting without DOG	●	
	Manual handle feed, 1 unit	●	
	3-dimensional manual feed	5 axes	
	Manual handle retrace	◎	
Interpolation function	Nano interpolation	●	
	Positioning (G00)	●	
	Linear interpolation (G01)	●	
	Circular interpolation (G02/03)	●	
	Dwell (G04)	●	
	Polar coordinate interpolation	●	
	Cylindrical interpolation	●	
	Helical interpolation	●	
	Thread cutting, synchronous cutting	●	
	Multiple threading	●	
	Thread Cutting Retract	●	
	Continuous threading	●	

● : Standard ○ : Option ◎ : Special option — : No setting

▲ : Parameter setting is required.

5 axes : Simultaneous 5 axes type standard specification.

Items	Specifications	TMX-4000ST	Remarks
Interpolation function	Variable lead thread cutting	○	
	Circular thread cutting	○	
	Polygon machining with two spindles	○	
	Skip (G31)	○	Used for touch sensor, etc.
	High-speed skip	5 axes	
	Torque limit skip	●	
	Reference position return (G28)	●	
	2nd reference position return (G30)	●	
	3rd/4th reference position return	●	
	Balanced cutting	○	
Feed functions	Rapid traverse override	●	0%, F0, 25%, 50%, 100%
	Feed per minute	●	
	Feed per revolution	●	
	Constant tangential speed control	●	
	Cutting feedrate clamp	●	
	Automatic acceleration/ deceleration	●	
	Rapid traverse bell-shaped acceleration/deceleration	●	
	Bell-shaped acceleration/ seceleration after cutting feed interpolation	5 axes	
	Linear Acceleration/ deceleration before cutting feed interpolation	○	
	Feedrate override	●	21 steps
	Jog override	●	21 steps
	Override cancel	●	

● : Standard ○ : Option ◎ : Special option — : No setting

▲ : Parameter setting is required.

5 axes : Simultaneous 5 axes type standard specification.

Items	Specifications	TMX-4000ST	Remarks
Feed functions	Manual per Revolution Feed	▲	
	AI contour control I	○	
	AI contour control II	5 axes	
	Bell-type Acceleration/ seceleration before look ahead interpolation	○	
	Jerk control	○	AI contour control II is required.
Program input	Program code	●	
	Label skip	●	
	Parity check	●	
	Control IN/OUT	●	
	Optional block skip: 1 piece	●	
	Optional block skip: 2 to 9 pieces	◎	
	Program file name: 32 characters	●	
	Sequence number: N8-digit	●	
	Absolute/incremental programming	●	
	Decimal point programming/ Pocket calculator type decimal point programming	●	
	Diameter/radius programming	●	X-axis
	Plane selection (G17, G18, G19)	●	
	Rotary axis designation	●	
	Rotary axis roll-over	●	
	Coordinate system setting (G50)	●	Cannot be used when Tiwap-1.
	Workpiece coordinate system	●	
	Workpiece coordinate system preset	●	

● : Standard ○ : Option ◎ : Special option — : No setting

▲ : Parameter setting is required.

5 axes : Simultaneous 5 axes type standard specification.

Items	Specifications	TMX-4000ST	Remarks
Auxiliary function/ spindle speed function	M-function	●	M3-digit programming
	Waiting function	●	
	Multiple Command of Auxiliary Function	●	3 pieces
	Spindle speed function (S-function)	●	
	Constant surface speed control	●	
	Spindle override	●	
	Spindle orientation	●	
	Spindle synchronous control	●	It is synchronous control at the turning.
	Rigid tap (Spindle center)	●	
	Rigid tap (Tool spindle)	●	
Tool function/ tool offset function	Tool function	●	
	Tool offset pairs 400 pairs	●	
	Tool offset pairs 499 pairs	◎	
	Tool offset pairs 999 pairs	◎	
	Tool offset pairs 2000 pairs	◎	
	Tool offset	●	
	Y-axis offset	●	
	Tool radius/Tool nose radius compensation	●	
	Tool geometry/ wear compensation	●	
	Tool offset value counter input	●	
	Direct input of tool offset value measured	●	
	Direct input of tool offset value measured B	○	Tool setter is required.

● : Standard ○ : Option ◎ : Special option — : No setting

▲ : Parameter setting is required.

5 axes : Simultaneous 5 axes type standard specification.

Items	Specifications	TMX-4000ST	Remarks
Tool function/ tool offset function	Tool life management	○	Cannot be used when RAKU RAKU MONITOR is installed.
	Tool offset memory switching function	●	Required when program coordinate system switching.
Accuracy compen-sation function	Backlash compensation	▲	
	Backlash compensation for each rapid traverse and cutting feed	▲	
	Smooth backlash compensation	▲	
	Stored pitch error compensation	●	
	Interpolation type pitch error compensation	●	
Editing	Part Program storage size 2 Mbyte	●	
	Part Program storage size 4 Mbyte	○	
	Part Program storage size 8 Mbyte	○	
	Number of registered programs expansion 2	●	
	Part program editing	●	
	Program protect	●	
	Extended part program editing	●	
	Playback	◎	
	Machining time stamp	○	
	Background editing	●	
	Multi part program editing	●	
Setting/ Display	Status display	●	
	Clock function	●	
	Current position display	●	
	Program comment display	●	31 characters

● : Standard ○ : Option ◎ : Special option — : No setting

▲ : Parameter setting is required.

5 axes : Simultaneous 5 axes type standard specification.

Items	Specifications	TMX-4000ST	Remarks
Setting/ Display	Parameter setting and display	●	
	Alarm display	●	
	Alarm log display	●	
	Operation history display	▲	
	Run hours and parts count display	●	
	Actual cutting feedrate display	●	
	Display of dpindle dpeed and T code at all screens	●	
	Servo setting screen	●	
	Spindle adjustment screen	●	
	Maintenance information screen	●	
	Software operator's panel	◎	
	Data protection key, 1 kind	●	
	Erase CRT Screen Display	●	
	Parameter set supporting Screen	●	
	Machining condition selecting function	◎	AI contour control I or II is required.
	Help function	●	
	Self-diagnosis function	●	
	Periodical maintenance screen	●	
	Graphic indication	●	
	Automatic data backup	●	
	Machine operation menu	◎	
Multi-language display	Japanese	●	Cannot be simultaneous display the other languages.
	English	●	Cannot be simultaneous display the other languages.

● : Standard ○ : Option ◎ : Special option — : No setting

▲ : Parameter setting is required.

5 axes : Simultaneous 5 axes type standard specification.

Items	Specifications	TMX-4000ST	Remarks
Multi-language display	German	●	Cannot be simultaneous display the other languages.
	French	●	Cannot be simultaneous display the other languages.
	Spanish	●	Cannot be simultaneous display the other languages.
	Italian	●	Cannot be simultaneous display the other languages.
	Chinese (traditional characters)	●	Cannot be simultaneous display the other languages.
	Chinese (simplified characters)	●	Cannot be simultaneous display the other languages.
	Korean	●	Cannot be simultaneous display the other languages.
	Portuguese	●	Cannot be simultaneous display the other languages.
	Dutch	●	Cannot be simultaneous display the other languages.
	Danish	●	Cannot be simultaneous display the other languages.
	Swedish	●	Cannot be simultaneous display the other languages.
	Hungarian	●	Cannot be simultaneous display the other languages.
	Czech	●	Cannot be simultaneous display the other languages.
	Polish	●	Cannot be simultaneous display the other languages.
	Russian	●	Cannot be simultaneous display the other languages.

● : Standard ○ : Option ◎ : Special option — : No setting

▲ : Parameter setting is required.

5 axes : Simultaneous 5 axes type standard specification.

Items	Specifications	TMX-4000ST	Remarks
Multi-language display	Turkish	●	Cannot be simultaneous display the other languages.
	Romanian	●	Cannot be simultaneous display the other languages.
	Bulgarian	●	Cannot be simultaneous display the other languages.
	Slovak	●	Cannot be simultaneous display the other languages.
	Finnish	●	Cannot be simultaneous display the other languages.
	Vietnamese	●	Cannot be simultaneous display the other languages.
	Indonesian	●	Cannot be simultaneous display the other languages.
	Dynamic display language switching	●	
Data input/ output	RS-232C interface for 1 ch	◎	
	Fast data server	○	Option board is required.
	Memory card input/output	●	
	USB memory input/output	●	
	Screen hard copy	●	
	One-touch macro call	◎	
Communication function	Embedded Ethernet	●	
	Fast Ethernet	○	Option board is required.
Other	Touch panel	●	

(3) Accessories of standard model

		●:Std. ○:OP
		TMX-4000ST
15" screen operation panel	15" LCD integrated PANEL iH touch panel	
Simultaneous 5-axis		●
(L) Built-in spindle (A2-8 / Bar φ80)	BiI250S/6000-B (26/22KW, 4000min^{-1}) C-axis/Disc brake	●
(R) Built-in spindle (A2-8 / Bar φ80)	BiI200S/6000-B (22/15KW, 4000min^{-1}) C-axis/Disc brake	●
(L) C-axis Min. index angle 0.0001°		●
(R) C-axis Min. index angle 0.0001°		●
Tool spindle (CAPTO C6) Induction motor	BiI132S/15000-B Type-M (22/15kW/High wind.12000min^{-1})	●
(L) 10" Hole thru.chuck + Hole thru.cylinder	Howa H3KT10Y + C1TA165X25	●
(R) 10" Hole thru.chuck + solid cylinder	Howa H01MA-10S-A8 + HH4CB-125	●
(L) Chuck M-function		●
(R) Chuck M-function		●
(L) Chuck air blow by M-function		○
(R) Chuck air blow by M-function		●
(L) Chuck foot switch		●
(R) Chuck foot switch		●
(L) Coolant above spindle		●
(R) Coolant above spindle		●
(L) Spindle air purge		●
(R) Spindle air purge		●
Spindle cooling unit	With flow switch	●
Tool spindle through air blow		●
40 Tool magazine (chain type/CAPTO C6)		●
X1-axis linear scale + pitch error comp.		●
Y1-axis linear scale + pitch error comp.		●
Z1-axis linear scale + pitch error comp.		●
X2-axis linear scale + pitch error comp.		●
12 station lower turret (w/o power tooling)	Bolt type	●
(lower turret) Double OD tool holder	□25mm	● (×1)
(lower turret) Facing tool holder	□25mm	● (×1)
(lower turret) Boring bar holder	φ40mm	● (×1)
15 bar Coolant unit (Tool spindle through)	<NOP>TOP-2MY750-210HWMPVBE (Trochid pump) + Filter	● (×1)
400W Coolant pump (chips cleaning for L/R)	<Grundfos>MTA120-280-A-W-A-T(50Hz/60Hz)	● (×2)
550W Coolant pump (Tool spindle outside)	<Grundfos>MTH2-6/(50Hz)5A-W-A-AQQV/(60Hz)3A-W-A-AQQV	● (×1)
550W Coolant pump (Lower turret)	<Grundfos>MTH2-6/(50Hz)5A-W-A-AQQV/(60Hz)3A-W-A-AQQV	● (×1)
Automatic grease lubrication		●
Oil skimmer	<SOGYO> RB-200A	●
Pneumatic pressure switch		●
Hydraulic pressure switch		●
LED work light in the machine		●
Automatic power off		●
Air conditioner in the electric cabinet		●
Right side outlet chip conveyor / hinge type		●
Work counter (in NC screen)		●
Front door interlock		●
Front door lock function		●
Dual check safety		●
Breaker with trip for control panel		●
Leveling plates		●
Adjusting tools		●
Instruction manuals (CD)		●

(4) Optional accessories

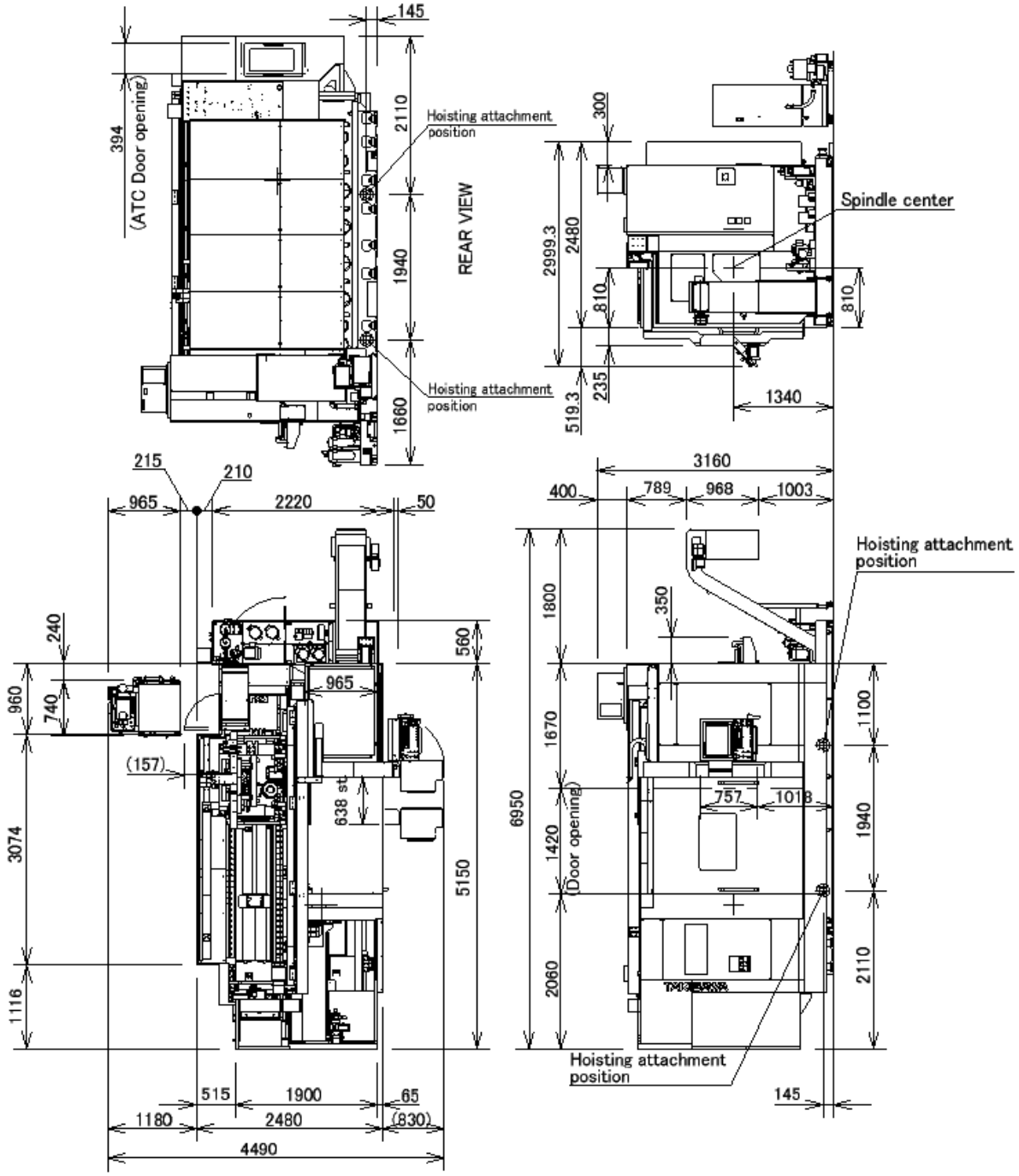
○ Operation panel		
19" screen operation panel (without dialog system)	(19"LCD separate type) PANEL iH Pro with touch panel	
○ Software		
TiwaP-1		
Raku-Raku monitor 3		
Measurement monitor 3 (need Raku-Raku monitor)	※ need additional I/O and PC modification	
	※ Measurement monitor is an option for Raku-Raku monitor	
Fanuc iCAPT	(19"LCD separate type) PANEL iH Pro with touch panel	
Fanuc machine collision avoidance	(19"LCD separate type) PANEL iH Pro with touch panel	
Fanuc iCAPT + Machine collision avoidance	(19"LCD separate type) PANEL iH Pro with touch panel	
If "BCD" is required, "Measurement Monitor BCD Interface" is needed separately.		
○ Spindle		
【note】L) Left spindle R) Right spindle		
(L) Without standard chuck and cylinder	<Howa> H3KT10Y + C1TA165X25 (Hole through)	
(R) Without standard chuck and cylinder	<Howa> H01MA-10S-A8 + HH4CB125 (Hole through + solid)	
(L) Hole through hydraulic chuck	<Kitagawa>BB-210	
(L) Hole through hydraulic cylinder	<Kitagawa>SS1881K	
(L) Chuck plate, draw tube, installation	<TAKISAWA>	
(R) Hole through hydraulic chuck	<北川>BB-210	
(R) Solid hydraulic cylinder	<SMW AUTOBLOK>SIN-S125	
(R) Chuck plate, draw bar, installation	<TAKISAWA>	
(L) Chuck M-function with variable sensor		
(R) Chuck M-function with variable sensor		
(L) Chuck air blow by M-function		
Provided chuck installation		
Stopper inside the spindle (0～200mm adjustable)	For left spindle	
Spindle through air blow by M-function	By rotary valve	
Spindle through coolant by M-function	By rotary valve	
(L) Chuck foot switch		
(R) Chuck foot switch		
【Spindle variation】		
(L) A2-8 (R) A2-6		
(L) A2-6 (R) A2-6		
(L) A2-11 (R) A2-8		
○ Tool spindle and ATC magazine		
Tool spindle (CAPTO C6) Synchronous motor	Continuous rated torque 86N.m	Tool spindle length 450mm
Too spindle outside air blow	(M160/M161)	
80 Tool magazine	Chain type	
120 Tool magazine	Chain type	

○ 12 station Lower turret	Bolt tightening type （□25 / φ40)	
(Compatible with TS-4000T15 and TM-4000T12)		
OD tool holder	(□25)	
Facing holder	(□25)	
Double OD tool holder	(□25)	
Cut off holder	(□25)	
Boring bar holder	(φ40)	
Double boring bar holder	(φ40)	
Boring bar bush		
Drill socket		
U-drill holder	(φ40)	
U-drill socket		
Work pusher（attach to the turret)		
Without lower turret		
○ Steady rest		
【Attach steady rest to lower turret】		
Preparation for steady rest		
Automatic lubrication pump		
Test bar for centering		
【Steady rest】		
SLU-1Z	(φ4 - φ64)	
SLU-X-1Z	(φ6 - φ70)	
SLU-A-1Z	(φ4 - φ52)	
SLU-2Z	(φ8 - φ101)	
SLU-X-2Z	(φ8 - φ101)	
SLU-A-2Z	(φ8 - φ80)	
【Remove lower turret and install steady rest instead】		
Without lower turret	Z2-axis is as it is	
Preparation for steady rest		
Automatic lubrication pump		
Test bar for centering		
【Steady rest】		
SLU-3Z	(φ12 - φ152)	
SLU-3.1Z	(φ20 - φ165)	
SLU-3.2Z	(φ50 - φ200)	
SLU-X-3Z	(φ12 - φ152)	
SLU-X-3.1Z	(φ20 - φ165)	
SLU-X-3.2Z	(φ50 - φ200)	
SLU-A-3Z	(φ12 - φ130)	
SLU-A-3.1Z	(φ22 - φ150)	
SLU-4Z	(φ30 - φ245)	
SLU-X-4Z	(φ30 - φ245)	
SLU-A-4Z	(φ30 - φ220)	

○ Coolant		
	High pressure coolant unit 7.0MPa	<OGURA>OJ-70GC、7.5KW Screw pump
	(Tool spindle through coolant)	Spec.) Discharge pressure 7.0MPa (nozzle dia. Under φ2.0mm)
		Discharge flow rate 26/35L/min (50/60Hz)
		Filtration accuracy 20μm (90 percent)
		with cyclone separator
	Preparation (incl. 250W pump)	<TAKISAWA>
	Coolant oil controller	
	<contents>	
	Oil controller (cooling only, for CE)	<DAIKIN> AKC569-C200 incl. coolant tank
	coolant pump	<TERAL> VKP115A×2
	level switch	<ASK> LSN-100L-AW-11
	cable etc.	
○ Chip conveyor		
	Chip bucket	
	Chip conveyor interface	in case of without std. chip conveyor
		※ wiring is up to terminal block
	Chip conveyor sub operation panel	for 5 function, attach to the chip conveyor body
	Chip conveyor / right to back side with hinge type	Option for gantry model, special oil pan
○ Work counter and signal light		
	Total counter	
	Preset counter	
	Multi. Tool counter	
	Cycle finish light (Rotating light 1 color)	
	Cycle finish light (Signal tower 1 color)	
	Signal tower / 3 colors	
○ Bar feeder		
	Bar feeder	
	Bar feeder interface	
	Filler tube	
	Work unloader (2 jaw hand) + work conveyor	max. φ80mm x max. length 200mm, max weight 3kg
	Parts catcher (bucket type) + work conveyor	max. φ80mm x max. length 200mm, max weight 3kg
	Work discharge for R-spindle (spring type)	
	Work discharge for R-spindle (air cylinder type)	
	Work discharge detection	

○ Others	
Mist collector	<IBS>OMC-N225
Long tool compatible] (Not available with gantry loader specifications)	(φ45mm x length 500mm x weight 10kg) Max. 3 tools
Robot interface	
Automatic front door	
Safety switch for prevention of pinching	Tape switch
Automatic front door + Safety switch	
Automatic power off	
100V outlet	
Light in the electric cabinet	
M-function for spare	
Energy saving circuit	
Manual Tool setter	Detachable
Automatic Tool setter (for tool spindle)	Shuttle type
Energy saving circuit for hydraulic unit	NAGANO> CQ88-221（with pressure switch)
Hydraulic unit line filter	
Transformer for export 120KVA	GE52006-102
Custom machine color	
Tool breakage detection sensor (for tool spindle)	<Metrol> P-11CM-BBH
Touch sensor (for tool spindle)	
<Detail>	
Touch sensor	<Marposs> optical type
- macro software	
- interface	
- special tool holder	for Capto C6
Touch sensor (for lower turret)	
<Detail>	
Touch sensor	<Marposs> optical type
- macro software	
- interface	
- special tool holder and bush	
Touch sensor (for lower turret)	
<Detail>	
Touch sensor	<Renishaw> RLP40
- macro software	
- interface	
- special tool holder and bush	

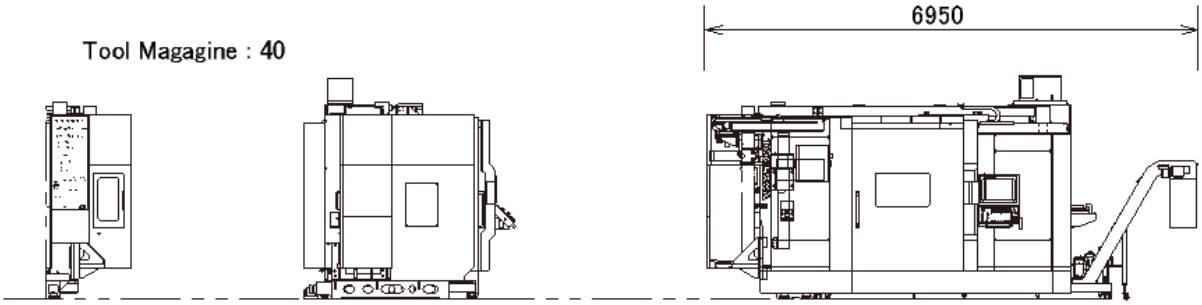
【13】Machine layout drawing



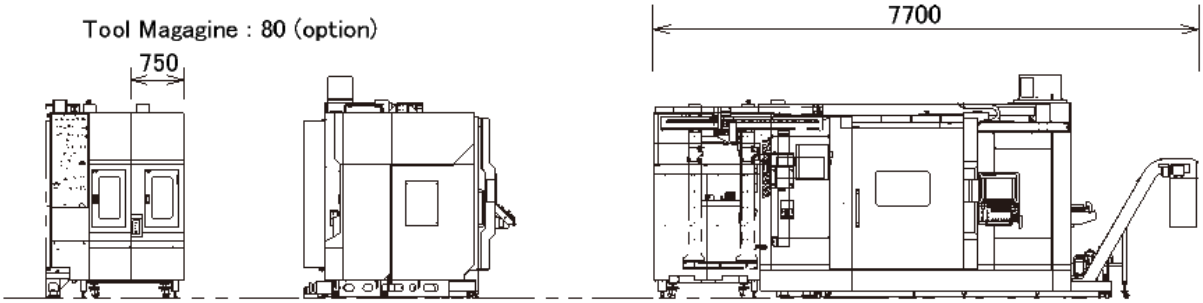
(40 tools magazine / Machine dimensional drawing)

(Machine dimensional drawing by each magazine number)

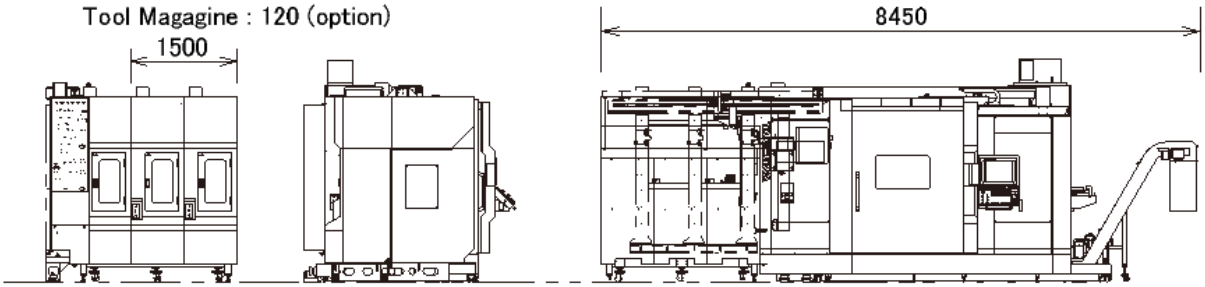
Tool Magagine : 40



Tool Magagine : 80 (option)



Tool Magagine : 120 (option)



【14】Software

1) 『iHMI』(Human Machine Interface)

An easy-to-understand graphical NC screen in the future

2) 『Measurement』(Touch probe)

Measurement while chucking the workpiece

3) MT-LINK i

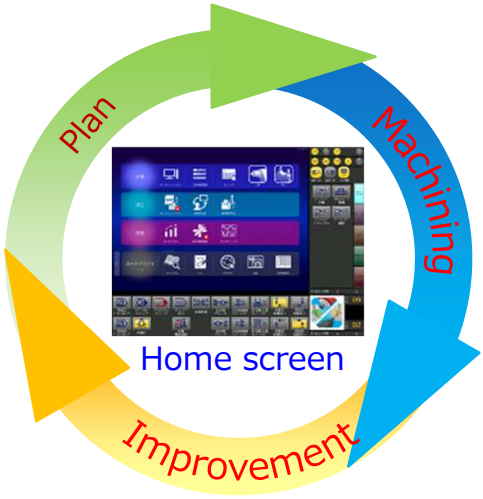
1) 『iHMI』(Human Machine Interface)

An easy-to-understand graphical NC screen in the future

a) iHMI Screen	Program support, Setup, Machining
b) iHMI Various software	NC operation, Tool information management, Calendar, Manual viewer, Servo viewer, Memo, Maintenance information management)
c) iHMI Machining program creation support	Standardize of Machining cycle and Measurement cycle
d) iCAP T (PANEL iH Pro)	
e) iHMI Machine collision avoidance	Detects machine collisions in advance and safely stops
f) Takisawa Original software for maintenance	Tailstock, Steady rest, ATC, Start condition, Signal light
g) Variation of CNC	(PANEL iH / PANEL iH Pro)
h) Installable software	(PANEL iH / PANEL iH Pro)

a) iHMI / Human Machine Interface screen

Provides a bridge between operators and machines to support on-site work.
Easy-to-understand graphical display



・Comfortable and easy operation along the work flow
・15″ screen as standard
・19″ screen as option

・Touch panel operation panel
・Information required for work is consolidated on one screen

It can be operated comfortably and easily along the work flow.
Work can be done smoothly from programming to setup and machining.

・Handle feed direction display

Prevention of simple mistake.
Selection of Coordinate system and path.
Equipped with indicator.

b) iHMI Various software

NC Operation

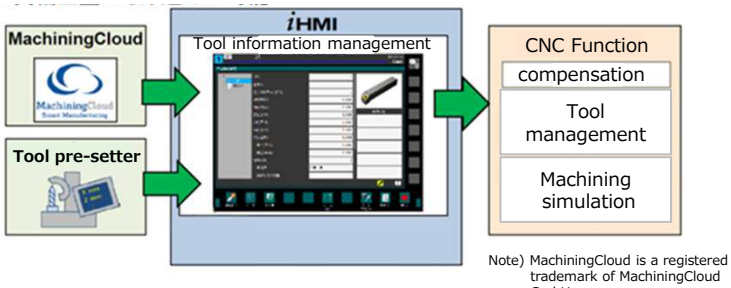
Performs tasks required for machining, such as program editing, operation, and setup.

programming → setup → machining

Tool information management

Collectively manage necessary information at the machining site.

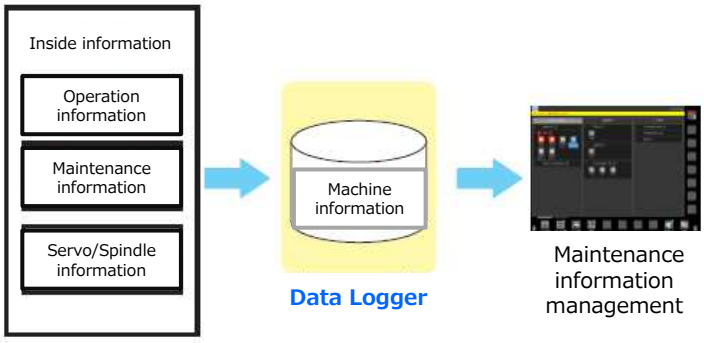
Capable of importing tool information provided by Machining Cloud and tool offset measured by tool pre-setter.



Note) MachiningCloud is a registered trademark of MachiningCloud GmbH.

Data logger
Maintenance information management

Data logger periodically collects various types of CNC data. The collected data can be used by iHMI applications. The data can also be accessed via a network.



Calendar

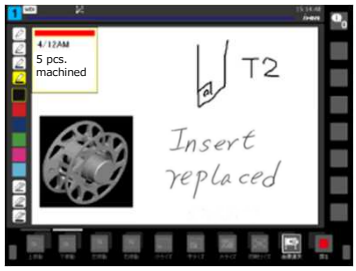
Schedule registration / confirmation / editing is possible.

Manual viewer

Various manuals can be browsed

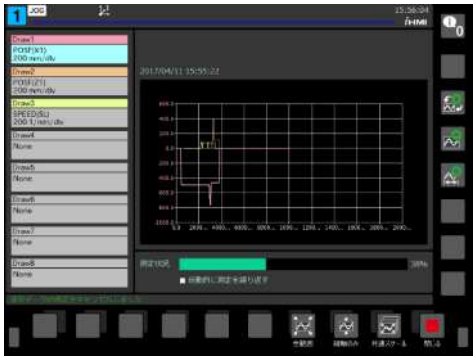
Memo function

Line drawing, note pasting, and image insertion are possible on the whiteboard



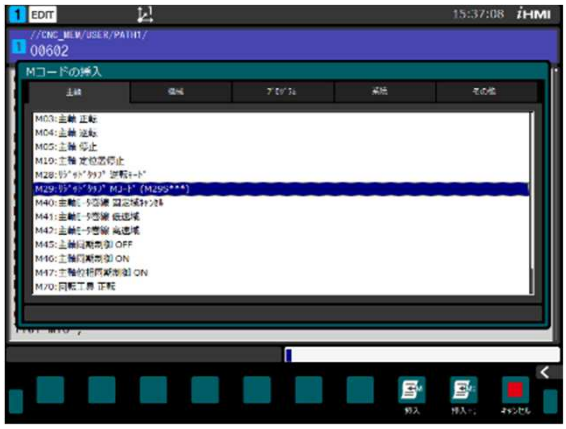
Servo viewer

Servo viewer displays waveforms indicating machine operation according to the position of each feed axis, spindle torque, and others.



c) i HMI Machining program creation support

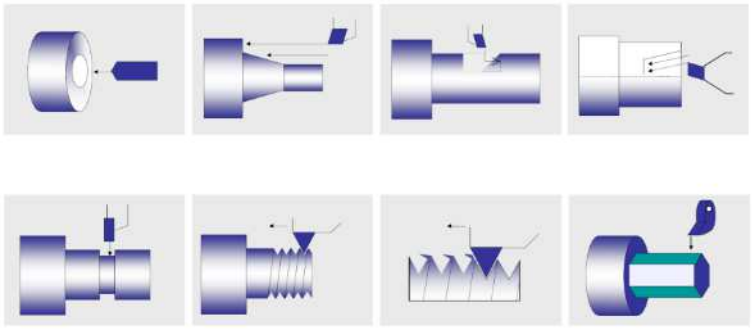
- Display image in program list
- M-code list input
- Fixed phrase selection input
- Syntax check function
- Tool information slide display
- Menu setup
  (MDI command standardization)



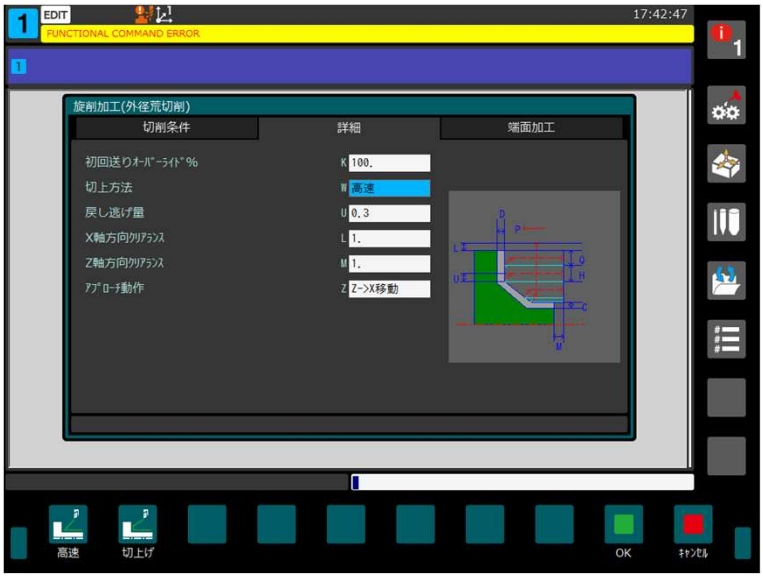
M-code list

Standardization of machining cycle and measurement cycle

Select cycle type
↓
Input cutting condition
↓
Select shape cycle
↓
Element input for shape data
↓
Saving shape data

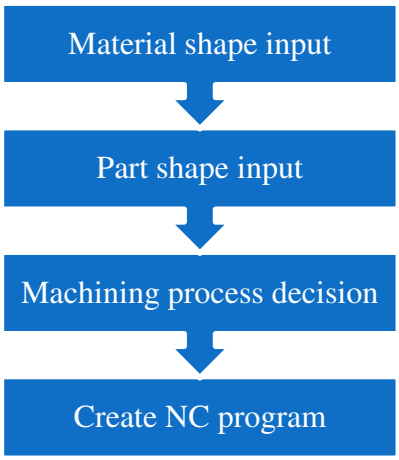


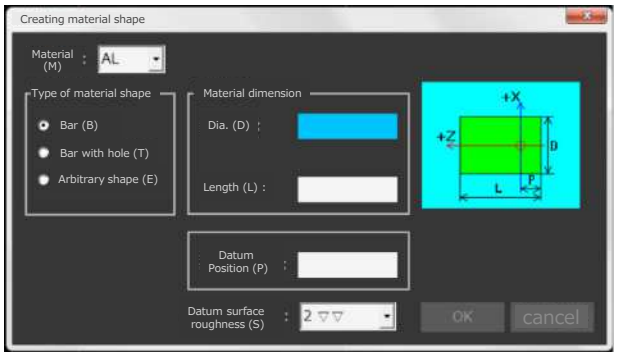
Create turning and milling cycles from the program editing screen

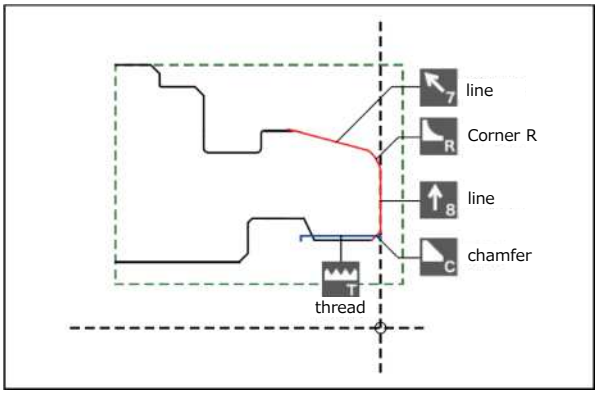


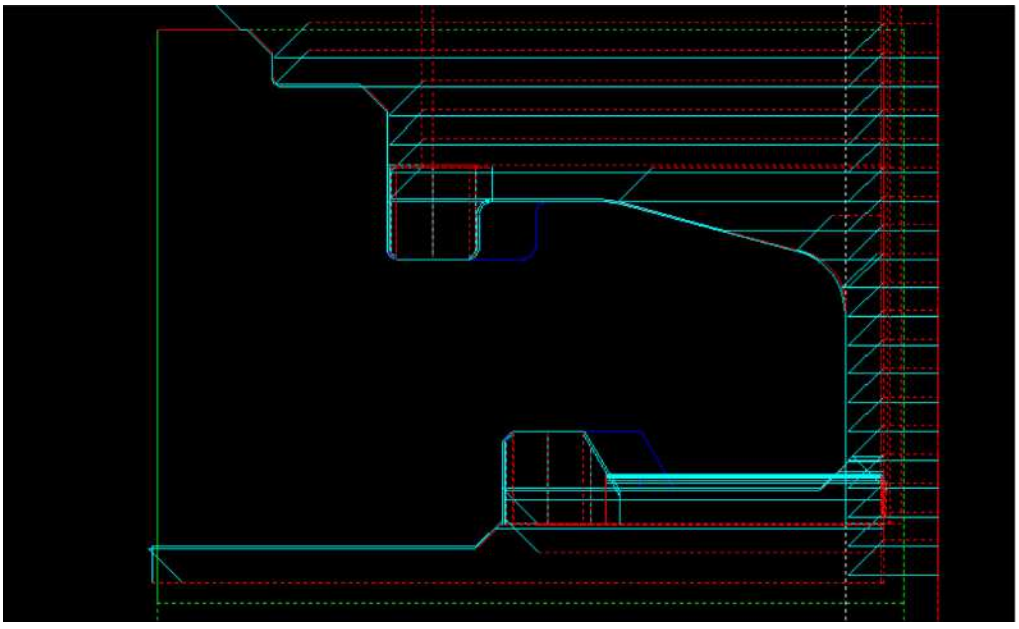
d) iCAP T（PANEL iH Pro）

- CAD data input is possible in addition to symbolic input.
  (2D / 3D DXF format, IGES format)
- In addition to turning, milling including inclined surfaces is also possible.
- Programming time can be greatly reduced by automatic process determination.
- Compatible with the lathe for Path-1 and Path-2.









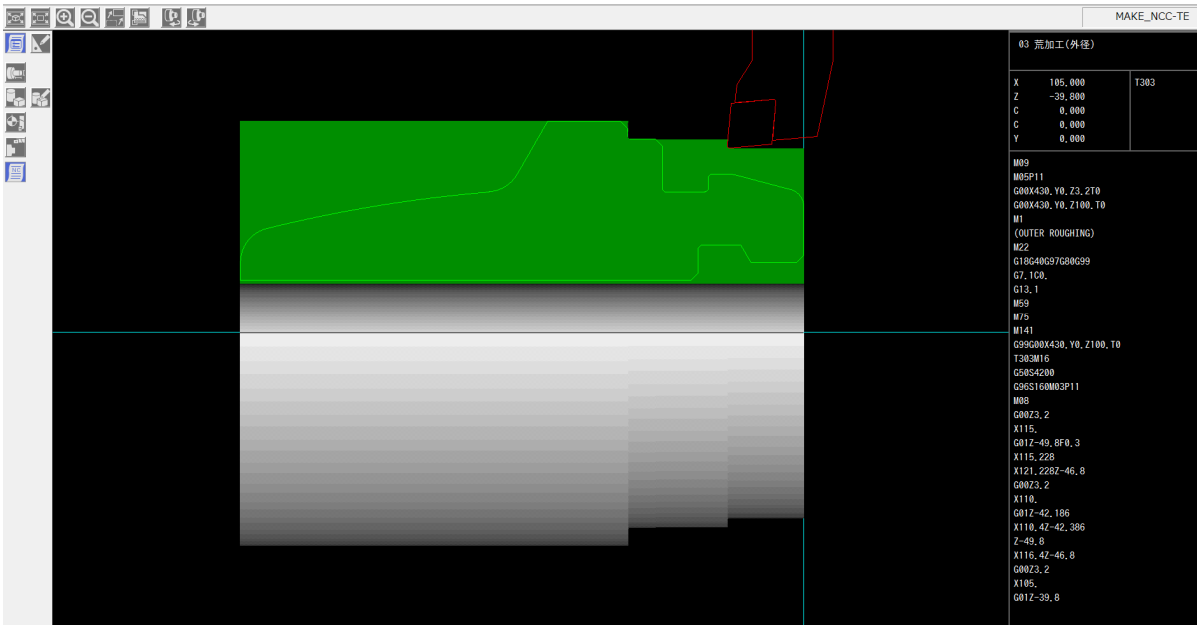
iCAP T（PANEL iH Pro）

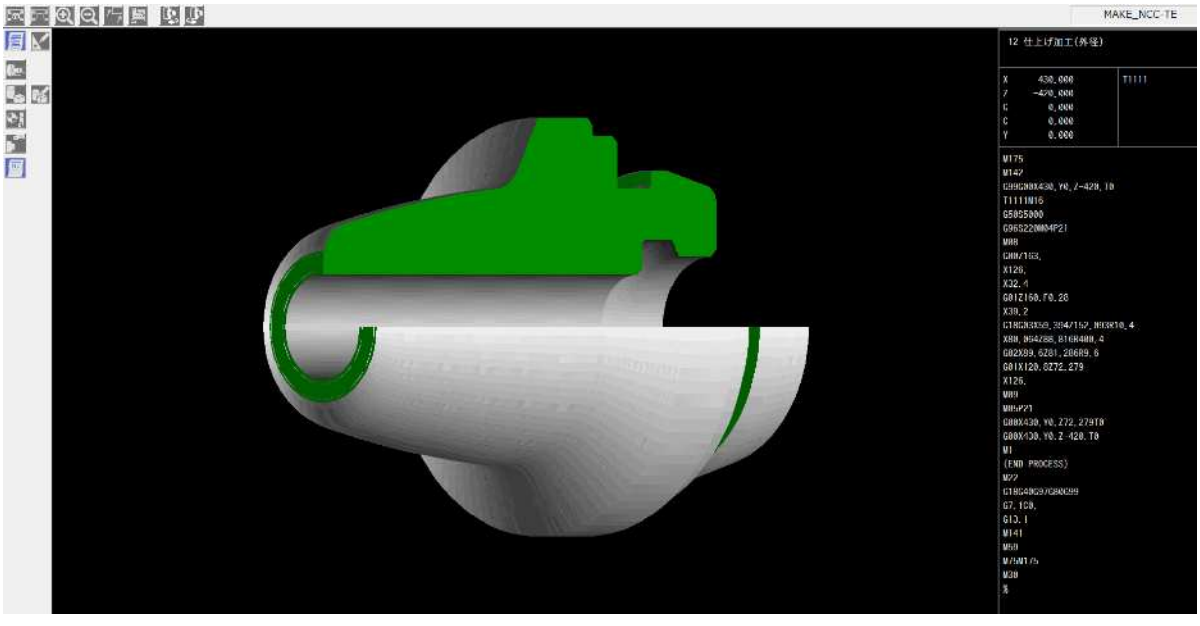
・2D animation function

Animation can be drawn at the same time as NC phrase conversion.

Animation drawing speed can be changed in 10 steps.

After drawing the animation, it is possible to check the shape by rotating the graphic.





(Comparison of Conversational programming)

	iHMI Machining cycle	i CAP T	TiwaP-1	Manual guide i
Conversation	Part conversation	Complete conversation	Complete conversation	Part conversation
How to make	Process	Shape	Process	Process
Feature	G4digit	symbolic	Takisawa	G4digit
Mounting condition	iHMI standard	option PANEL iH Pro	option	option
Knowledge of NC program	Necessary	Unnecessary	Unnecessary	Necessary
Multi-Tasking, Multi-Path	○	○	○	○
Milling compatible	○	○	○	○
Fixed phrase menu	○	×	×	○
M-code menu	○	×	×	○
Animation	○	△ Use iHMI	○	○
Setup support	○	×	×	○
Work process	○	○ Customization	○	△ Supports fixed phrases
NC phrase conversion	○	○	○	○

Tiwap-1 / Takisawa original conversational programming software

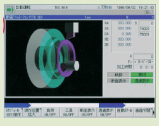
It is possible to create a machining program in a completely dialog format.
Program check by machining simulation is possible.

Program editing screen

Machining simulation

The concepts are "easier", "easier to use" and "faster".
Conversion to G code program is also possible.

(Comparison of conversational programming function with other companies)

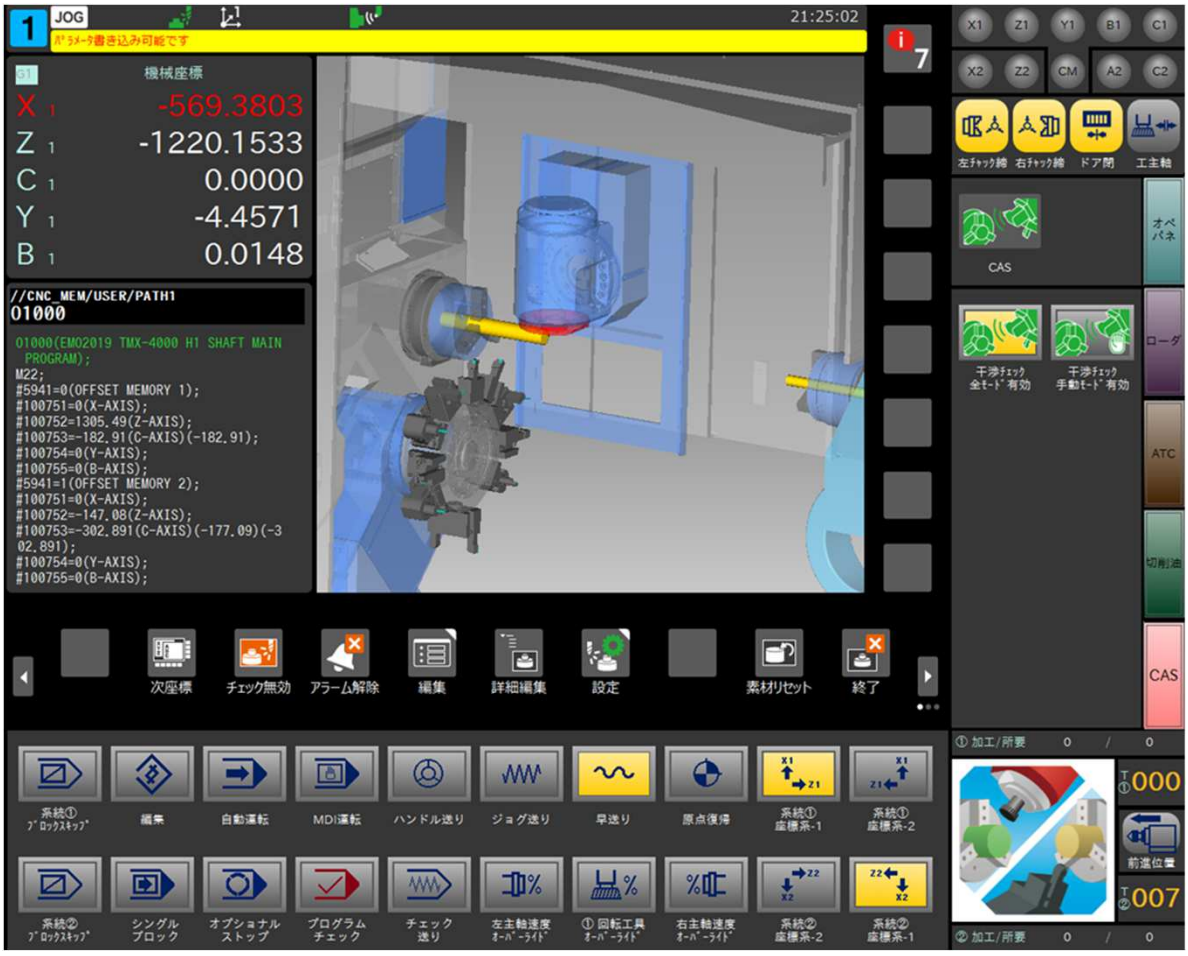
	Mazak	DMG/Mori	Okuma	Siemens
CNC	MAZATROL Smooth X	CELOS	OSP suite	Sinumerik
Screen / platform	19“ Windows	15“/21.5” Windows	19“ unknown	10.4/12/15/19 Windows
Display				
Animation				
How to make	Process	Process	Shape	Process

e) iHMI Machine collision avoidance（manual / automatic）/ PANEL iH Pro

・By a simulation based on the three-dimensional machine model and the preceding position of the machine, it is possible to prevent interference in manual operation such as axis movement and turret rotation and automatic operation.

・It is possible to check at a glance whether interference check is performed.

・Create jig shape and material shape on CNC.
Various models (STL, DXF, etc.) created with standard shapes and CAD can also be used.



f) TAKISAWA original software for maintenance

Switch from vertical soft key to various screens instantly.

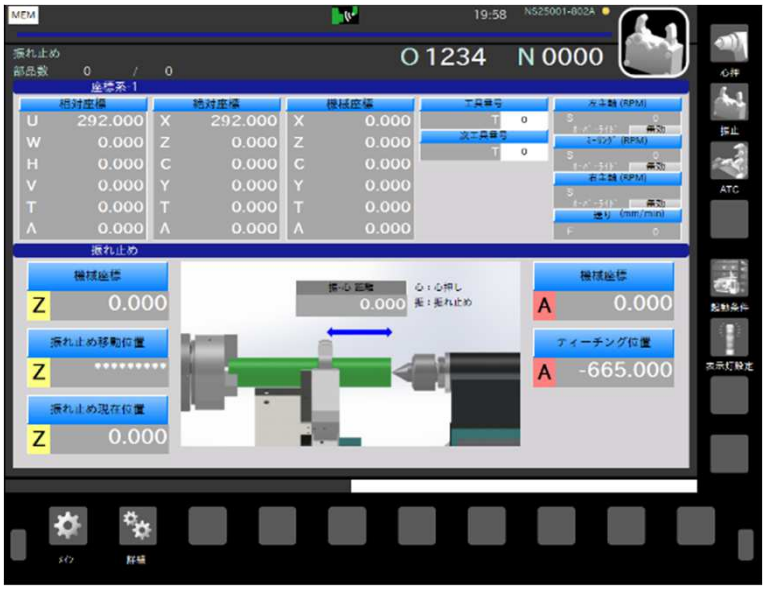
・Easy to set tailstock settings.

Home screen icon

screen

・Easy to set steady rest settings

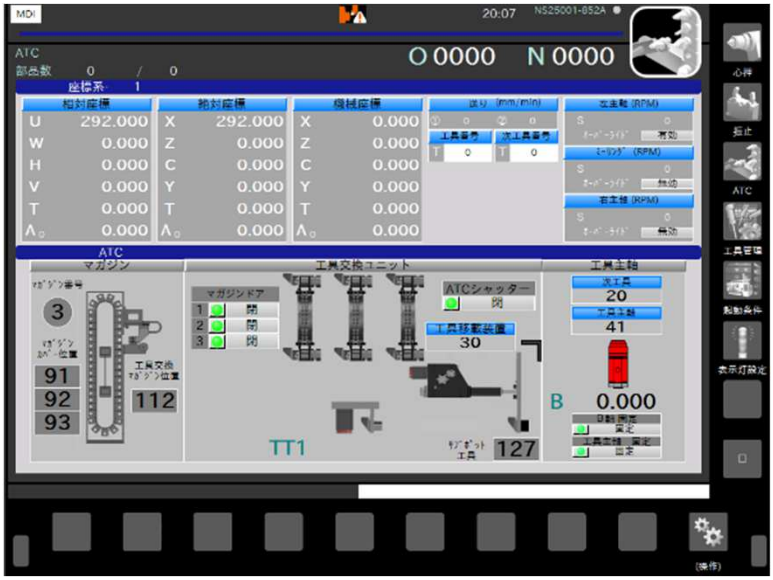
Home screen icon



screen

・It is possible to check the status of ATC

Home screen icon



screen

・In the gantry loader specification, it is possible to check the starting conditions

Home screen icon

screen

・in the gantry loader specification, it is possible to easy set signal tower settings.

Home screen icon

screen

・iHMI Gear Skiving / Gear skiving machining supporting software

It is possible to make programs with simple parameters such as gear diameter, number of teeth, spindle speed, feed rate, etc.
The guide map can be displayed graphically in an easy-to-understand manner.

※ screen image

【Input item】
Work information ・・・ Gear diameter, number of teeth, etc.
Tool information ・・・ Tool diameter , number of teeth, etc.
Cutting condition ・・・ Spindle speed, feed rate, etc.

TAKISAWA Display and keyboard

Switch from vertical soft key to various screens instantly.

・By arranging infrequently used buttons on the screen, the weight of the operation panel is reduced.

g) Variation of CNC

● : Std. – : Not available ○ : OP

	TMX-4 000ST	TMX-2000	TM-4000	TS-3000/4000/5000
32i-B 10.4“ LCD	–	●	–	●
32i-B PANEL iH 19	–	–	–	○
31i-B 10.4“ LCD	–	–	–	–
31i-B PANEL iH 15	●	–	●	–
32i-B PANEL iH 19	–	○	–	–
31i-B PANEL iH Pro 19	○	–	○	–

h) Installable software

● : Std. – : Not available ○ : OP ◎ : Need PANEL iH Pro

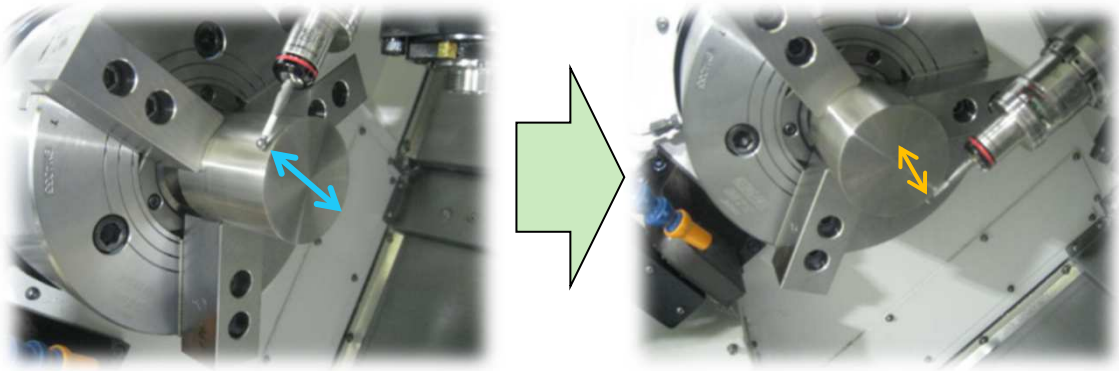
	TMX-4000ST	TMX-2000	TM-4000	TS-3000/4000/5000
iHMI（Std., original）	●	○	●	○
iHMI machining cycle	●	○	●	○
i CAP T	◎	–	◎	–
Machine collision avoidance	◎	–	◎	–
TiwaP-1	○	●	○	●
Manual guide i	○	○	○	○

〈Improved operability with newly designed operation panel〉

・Infrequently used buttons are arranged on the touch panel to realize a simple and easy-to-use operation panel.
・The new seat key improves the visibility of the LED display and switch operability.
・The hand-operated manual pulse generator has been reduced in size and weight.

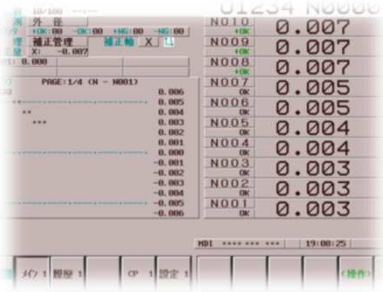
2) 『Measurement』(Touch probe)

・It is possible to measure the workpiece while the condition under grasping.



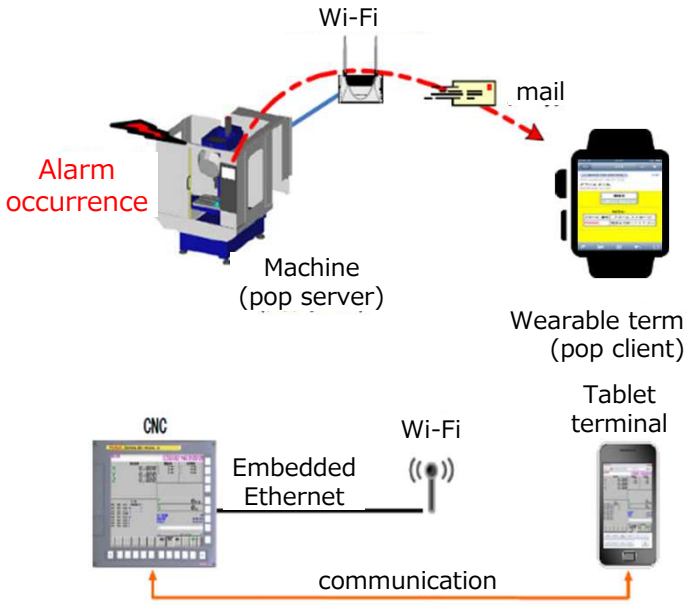
The measured value is displayed on the measurement monitor screen.

The offset is fed back to the next machining.



3) MT-LINK I (Software from Fanuc)

・The status can be notified to the wearable terminal and the status can be checked on the tablet.



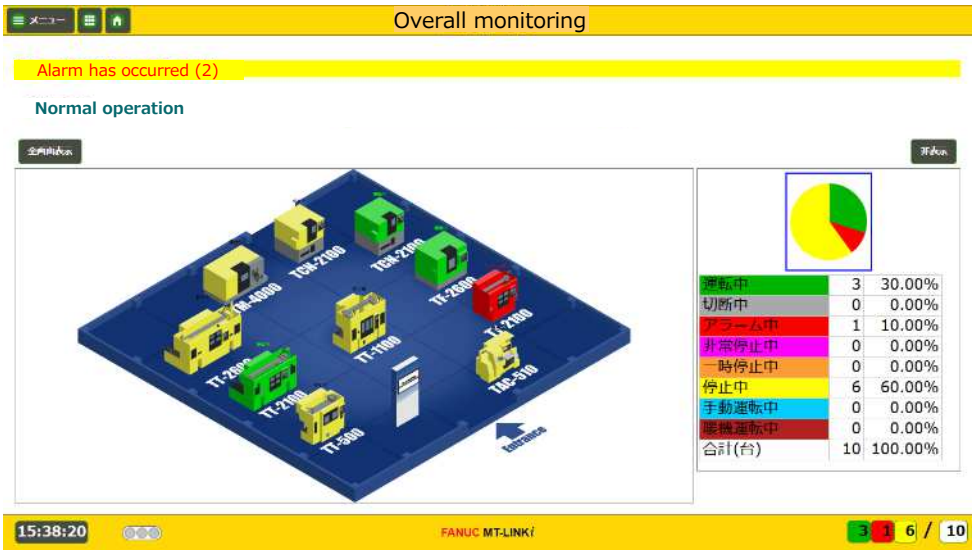
<CNC status notification function >

Notify machine status to remote location.
-Notification of alarm occurrence by e-mail, reducing downtime.
-Notification of machine stop by notification of the number of machined parts.

<CNC screen Web server function>

Check the status of the machine from a remote location.
・The NC screen is displayed as it is and the status is confirmed.
-More convenient in combination with the "CNC status notification function"
Alarm mail ⇒ Check status on screen

・It is possible to collect, manage and visualize various machine information with MT-LINK i.



・Monitoring function : Monitors the operation status, signal status, and alarm of the equipment in the factory.
・Results function : Accumulates and visualizes the actual operation and machining results of the equipment in the factory.
・Diagnosis function : Alarm history, program execution history, and form output of equipment in factory can be output.
・Utility function : Transfer of NC programs and backup of parameters etc. are possible.

【15】 Q & A

Q	A
What size of steady rest can be installed ?	◆When mounting a steady rest on the lower turret Up to φ101mm (SLU-2Z,SLU-X-2Z) ◆When removing the lower turret and installing a steady rest Up to φ245mm (SLU-4Z,SLU-X-4Z)
What is the maximum cutting feed rate for each axis ?	Maximum feed rate is the same as rapid travers rate
Is 30 bar tool spindle through coolant possible ?	70bar tool spindle through coolant is possible
Can the touch probes of HEIDENHAIN or Blum also be used for tool spindles ?	It will be special, but usable
What is the time of tool to tool and the time of chip to chip ?	◆ Tool to tool M126→ ATC Cam box Motor turning complete : 2.08 sec. M126→ Tool spindle Tool clamp complete : 2.32 sec. ◆ Chip to chip Rotary tool → Rotary tool : 11.6 sec. Turning tool → Turning tool : 17.5 sec. Rotary tool → Turning tool : 15.1 sec. Turning tool → Rotary tool : 14.1 sec.
Can the oscillation cut function be installed ?	Yes, it is possible to install
Is Gear Skiving possible with a tool spindle equipped with a standard induction motor ?	Yes, Gear Skiving can also be performed with an induction motor.
How do you handle the remaining material after finishing with the bar feeder ? Is there a parts catcher for discharging the remaining parts ?	An optional parts catcher for left spindle is also available that can handle discharging the remaining materials.
Is it possible to remove the tool from the magazine during automatic operation?	Yes, it is possible
Is it possible to install power tool function on lower turret ?	Power tooling function is not available for lower turret
Is it possible to retrofit Gear Skiving software ?	Yes, it is possible
Is it possible to make gear machining by Invo Milling ?	Yes, with a CAM and the right tools
Is it possible to make Herringbone gear machining ?	Yes, with a CAM and the right tools
Is it possible to install 15 inch chuck on both L and R spindle ?	Can be installed. However, it is necessary to pay attention to the interference with the lower turret and tool spindle.

TAKISAWA®

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