2. Machine Specifications

2.1 Standard Specifications

	Specifications		TUD-16	Remarks
Capacity	Table diameter	mm(in)	1,600 (63)	
	Maximum swing	mm(in)	2,000 (78.7)	
	Maximum height from table top to ram bottom	mm(in)	1,800(70.9)	High column
	Maximum cutting height	mm(in)	1,600 (63)	
	Maximum cutting diameter	mm(in)	2,000 (78.7)	
	Maximum cutting force of ram	N (lbf)	30,000 (6,600)	
	Maximum load on table	kg(lb)	10,000 (22,000)	
Travel	Horizontal travel of rail head	mm(in)	-805～1,120 (-31.7～44.1)	X-axis
	Vertical travel of ram	mm(in)	1,500 (59)	Z-axis Option
	Vertical travel of crossrail	mm(in)	500 (19.7)	Not NC-axis
Table	Table speed	$min.^{-1}$ {rpm}	1～300	Option
	Number of table speed ranges		2 ranges	Hydraulic gear shift
	Maximum table torque	N·m {ft·lb}	21,570{15,875}	

	Specifications			TUD-16	Remarks
Feedrate	Rapid traverse rate of rail head		mm/min (ipm)	12,000 (472)	X-axis
	Rapid traverse rate of ram			8,000 (315)	Z-axis
	Feedrate			1～2,000 (0.04～78.7)	X and Z-axis
	Vertical travel speed of crossrail			300 (11.8)	
Ram	Type			Ram type	
	Guideway			4 guideways closed type	
	Section		mm(in)	220X220 (8.66X8.66)	
Tool	Type of tool shank			7/24 taper No. 55	
	Type of pull stud			55P (JIS B 6339-1992)	
	Force of clamp		kN(lbf)	60 (13,000)	
Motors	Table drive motor		kW (HP)	VAC55/45(73.8/60)	30-min. rating/ continuous rating
	Feed motors			X-axis: AC3.3(4.4), Z-axis: AC3.3(4.4)	
	Hydraulic pump motor			AC4P 2.2(3)	
	Guideway lubricant pump motor			AC4P 0.025(0.03)	
	Table main gear box lubricant pump motor			AC4P 0.75(1) , AC4P 0.4(0.5)	
Power sources	Electrical power supply			AC200V±10%,50Hz±1Hz	
	Power capacity		kVA	90	
	Compressed air supply	Pressure	MPa (psi)	0.5 ～0.8 (72.5～116.0)	
	(The air must not contain oil, water and contaminant.)	Flowrate	L/min	300 (Air compressor 2.2kW)	

	Specifications		TUD-16	Remarks
Machine size	Machine height	mm(in)	See attached drawing	
	Floor space	mm(in)	See attached drawing	
	Machine weight (Not include option)	kg(lb)	19,000 (41,800)	
Accuracy	Positioning accuracy of linear axis (X & Z axes): Repeatability of linear axis(X & Z axes):		X axis: ±0.0076 mm per 300 mm (Uni-direction, with linear scale) ±0.0025mm	The testing method is as per the KYUSHU TOSHIBA MACHINE's standard.
Coating color	Exterior (Urethane painting)		Custom painting color (Depend on customer's sample)	For the procured devices, the painting colors are as per each Manufacturer's standard.
	Interior		Munsell 10YR8/4	

2.2 Standard Accessories

(1)	Installation parts:	1 set
(2)	Special service tools:	1 set
(3)	Automatic slideway lubricating unit:	1 set
(4)	Crossrail step-positioning unit:	1 set
(5)	Locally operated 4-jaw chuck (4 pcs.):	1 set
(6)	Telescopic crossrail slide cover:	1 set
(7)	Automatic power OFF device	1 set
(8)	Table lubricant oil cooling unit	1 set

2.3 Optional Accessories

No.	Specifications	Required /Not required
1	Coolant unit (Only water-soluble coolant can be used.) Coolant pump motor — AC 2P 2.2kW(3HP)×1 Coolant pump — 30 L/min(7.9gal/min) Coolant tank capacity — 550 L(145gal) Oil skimmer Additional suction filter Built-in type chip bucket Coolant gun Splash guards	Required
2	Automatic tool changer(ATC) ・No. of tools: 12 ・Type of tool shank: 7/24 taper No.55T ・Type of pull stud: 55P (JIS B6339-1992) ・Maximum tool size: 350Tx 150Tx400L mm (13.7Wx 5.9Tx17.7L in) ・Maximum tool weight: 50 kg(110 lbs) ・Method of tool selection: Soft tool pot address ・Tool changing time: 30 sec (Tool-to-tool, time when crossrail is at the bottom.) ・Total tool weight: 360kg (793lbs)	Required
3	ATC jib crane Maximum lifting mass 50 kg (110 lbs)	Required
4	Coolant washer Used to clean the table surroundings and recover chips.	Required
5	Operator call lamp This lamp is mounted on top of the column. Green: Illuminated during automatic operation. Yellow: Illuminated when M00, M01, M02, M30 or M52 has been executed, Red: Illuminated at NC alarm or machine alarm generation.	Required
6	Work light — Halogen lamp 50W	Required

No.	Specifications	Required /Not required
7	Through tool coolant function When a coolant-through tool is used together with this unit, coolant can be delivered to the tool tip. Pressure : 9.3 kg/cm^2 (27 psi)	Required
8	Automatic measuring device Minimum measuring diameter of internal (mm) {in} ϕ380 {ϕ14.96} See the attached drawing S-7938. Connection of the electric wire for this Device to the machine rail head is by manual.	Required
9	Automatic measuring data acquisition system This system consists of IBM compatible personal computer, printer, high-speed data link(HSSB), cabinet for equipment, and data control (receive from the automatic measuring device, and store) software. GEES needs to give Toshiba Machine software information. GEES prepares the exclusive power source for this system. (Outlet on the NC cabinet is not available.)	Required
10	Hand rail and ladder on column for maintenance	Required
11	Vertical travel of ram 1,500mm(59in)	Required
12	High type column +250mm(9.84in) Vertical travel of crossrail 500mm(19.7in)	Required
13	Tool holders FM55-ST-160-OH-J 4 pcs. FM55-ST-200-OH-J 4 pcs. FM55-ST-250-OH-J 3 pcs.	Required
14	Table drive motor 55/45 kW(73.8/60HP) Table speed : 2 to 300 min^{-1}	Required
15	X axis linear scale feedback	Required
16	Custom painting color NC cabinet, operating panel, motors ,and table lubrication oil cooling unit are painted as per each manufacturer's standard.	Required

No.	Specifications	Required /Not required
17	GEES standard ・Name plate ・Indicator for gauge ・Flow sensor for lubrication oil after line filter ・Lever action limit switch for travel end ・ID plate for electric, hydraulic, and pneumatic equipment ・Easy-access cover for daily maintenance point ・Oil pan for hydraulic unit	Required

①

3. Numerical Controller (FANUC Series 150-TB)

3.1 Basic Specifications

3.1.1 Axis control

Controlled axis	2 axes
Simultaneous controllable axes	2 axes
Axis name	X, Z
Least input increment	0.001 mm Diametrical designation For X-axis)
Machine lock	All axes
Emergency stop	
Overtravel	1st : Stored stroke check 2nd : Emergency stop
Stored stroke check 1	
Mirror image	Each axis
Follow-up	At emergency stop
Backlash compensation	
Backlash compensation for each rapid traverse and cutting feed	

3.1.2 Operation

Automatic operation	Memory operation MDI operation
Cycle start / feed hold	
Program stop / Program end	
Reset / rewind	
Program number search	
Sequence number search	
Dry run	
Single block	
Manual continuous feed (JOG)	22 steps, 0 , 1.0～ 1,000 mm/min
Manual reference position return	

3.1.3 Interpolation

Positioning	G00 Linear interpolation type positioning is possible.
Exact stop mode	G61
Cutting mode	G64
Exact stop	G09
Linear interpolation	
Circular interpolation	
Dwell	The stop time is specified by G04 code. (Max. 99999.999 s)
Thread cutting, per revolution feed	Equal lead thread cutting Inch thread cutting Continuous thread cutting
Reference point return	G27, G28, G29

3.1.4 Feed function

Rapid traverse rate	X-axis Z-axis	12,000 mm/min 8,000 mm/min
Rapid traverse override		0～100%, 10%step
Feed per minute		1～2,000 mm/min
Feed per revolution		0.01～500.00 mm/rev (Not exceeding 2,000 mm/min)
Tangential speed constant control		
Cutting feedrate clamp		
Automatic acceleration/deceleration		Rapid traverse: linear or exponential Cutting feed: linear or exponential
Feedrate override		0～200%, 10% step (Not exceeding 2,000 mm/min)
Jog override		0～100%, 10%step
Override cancel		

3.1.5 Program input

Tape code	EIA RS244, ISO840 automatic recognition
Tape format	Word address format
Label skip	
Parity check	Horizontal and vertical party
Control in/out	
Optional block skip	1 pc
Max. programmable dimension	±99999.999
Program number / program name	Program number : O4-digit Program name : 16 characters
Sequence number	N5-digit
Absolute / incremental programming	Combined use in the same block

Decimal point programming	
Diameter	
Plane selection	G17, G18, G19
Rotary axis roll over	
Workpiece coordinate system change	G50
Workpiece coordinate system preset	G50.3
Local coordinate system setting	G52
Machine coordinate system selection	G53
Workpiece coordinate system selection	G54～59
Manual absolute on	
G code system	A
Main program / sub program	Subprogram : 8 folds nested
Canned cycles for turning	
Circular interpolation by R programming	

3.1.6 Auxiliary/spindle speed function

Miscellaneous function	M2-digit
High-speed M,S,T,B interface	
Spindle speed function	S3-digit

3.1.7 Tool function/Tool compensation

Tool function	T4-digit
Tool offset memory	±6 digits 32 pairs
Tool offset memory A	
Tool offset	
Tool offset value counter input	
Increment offset	

3.1.8 Measurement

Direct input of offset value measured

3.1.9 Editing operation

Part program storage length	80m (Among 80m, 5m is used by KYUSHU TOSHIBA MACHINE for sequence.)
Registerable programs	100 pcs (Among 100pcs, 20 variables are used by KYUSHU TOSHIBA MACHINE for sequence.)
Part program storage & editing	
Back ground editing	
Extended part program editing	
Multi-edit function	

3.1.10 Setting and display

Status display
Clock function
Current position display
Program display
Parameter setting and display
Input / output device setting screen
Self-diagnosis function
Alarm message display
Alarm history display
Operation history display

Help function	
Run hour and parts count display	
Actual cutting speed display	
Directory display punch for each group	
Servo setting screen	
Waveform display	
Load meter display	
Display of hardware and software configuration	
NC format guidance	
Multi-sub screen	14"CRT is required
Multi-language display	English/Japanese
Data protection key	
Calculation key	
Screen saver	
Workpiece zero point manual setting function	

3.1.11 Data input/output

Memory card interface	For data-backup and user program loading

3.1.12 Others

Servo motor	FANUC AC servo motor X axis : Model α30 Z axis : Model α30B (With brake)
Servo amp.	FANUC AC servo amp .(digital servo)
Connectable position detector	Pulse coder/optical scale (2-pause pulse interface)
Spindle motor	FANUC AC spindle motor Model αP50
Spindle amp.	FANUC AC spindle amp. (serial interface spindle amp.)
Feedback	Incremental pulse encoders
Environmental conditions (at operation)	Ambient temperature : 0 ° ～45 ° C Relative humidity : 95% or less

3.2 G, S and M Functions

3.2.1 G Function(G Code System A)

G00	Positioning
G01	Linear interpolation
G02	Circular interpolation CW
G03	Circular interpolation CCW
G04	Dwell
G09	Exact stop
G10	Data setting
G11	Data setting mode cancel
G20	Inch input
G21	Metric input
G27	Reference point return check
G28	Automatic reference point return(return to 1st reference point)
G29	Return from reference point
G31	Skip function
G32	Thread cutting

G40	Tool nose radius compensation cancel
G41	Tool nose radius compensation left
G42	Tool nose radius compensation right
G50	Work coordinate system setting and maximum spindle speed setting
G52	Local coodinate system setting
G53	Machine coodinate system selection
G54	Workpiece coodinate system 1 selection
G55	Workpiece coodinate system 2 selection
G56	Workpiece coodinate system 3 selection
G57	Workpiece coodinate system 4 selection
G58	Workpiece coodinate system 5 selection
G59	Workpiece coodinate system 6 selection
G61	Exact stop mode
G64	Cutting mode
G65	Custom macro simple call
G66	Custom macro modal call A
G66.1	Custom macro modal call B
G67	Custom macro modal call cancel
G70	Finishing cycle
G71	Stock removal in turning
G72	Stock removal in facing
G73	Pattern repeating
G74	Peck drilling in X axis
G75	Grooving in X axis
G76	Threading cycle

G90	Cutting cycle A
G92	Thread cutting cycle
G94	Cutting cycle B
G96	Constant surface speed control
G97	Constant surface speed control cancel
G98	Feed per minute
G99	Feed per revolution

3.2.2 S Function

Low-Speed Range(M41)	High-Speed Range(M42)
S1～S72 (1～72 min^{-1})	S6～S300 (6～300 min^{-1})

3.2.3 M Function

M00	Program stop
M01	Optional stop
M02	End of program
M03	Table rotation
M04	Table reverse backward rotation
M05	Table stop
M06	Tool change
M08	Coolant ON
M09	Coolant OFF
M10	Through-tool coolant ON
M11	Through-tool coolant OFF
M22	Coolant washer ON
M23	Coolant washer OFF
M30	End of program
M36	Chamfering mode ON
M37	Chamfering mode OFF
M41	Table low-speed range
M42	Table high-speed range
M48	Cancel of M49
M49	Bypass override
M52	Manual tool change command

M63	ATC magazine feed
M64	ATC door open
M65	ATC door close
M66	Tool clamp
M67	Tool unclamp
M80	Crossrail M80 position (Crossrail at lowest position)
M81	Crossrail M81 position
M82	Crossrail M82 position
M98	Subprogram call
M99	End of program

Note 1: M06, M80, M81, and M82 are the M codes calling a custom macro.
Note 2: M63-M67 are commanded during tool change (M06) and need not be specified by the customer.

3.3 NC Options

3.3.1 Pack Specifications

(The following items are standard-equipped for TUD series machines).

(1)	Inch / metric conversion	
(2)	Stored pitch error compensation	
(3)	Program restart	
(4)	Manual handle feed	(x1=0.001mm/1div.,x10=0.010mm/1div.), 1 pc.
(5)	Manual handle interruption	
(6)	Thread cutting cycle retract	
(7)	Optional block skip addition:	4 pcs
(8)	Chamfering, corner R	
(9)	Programmable data input	
(10)	Programmable parameter input	
(11)	Custom macro	Common variables: 100
(12)	Multiple repetitive cycles for turning	G70～G76
(13)	2nd auxiliary function	B
(14)	Spindle serial output	
(15)	Constant surface speed control:	G96, G97
(16)	Tool nose radius compensation:	
(17)	Reader / punch interface	RS232C×1
(18)	External data input/output	

3.3.2 Optional accessories.

No.	Specifications	Required /Not Required
1	Part program storage length: 1,280 m (including standard 80 m)	Required
2	Custom macro common variables Total 600 pcs.	Required
3	Skip function, High speed skip signal input	Required
4	Registered program expansion Total 1,000 pcs.	Required
5	Table orientation One(1) degree increments	Required
6	FANUC 150T-B Hardware of OPEN CNC (A commercially available personal computer connected to a CNC via High-Speed Serial Bus)	Required

4. General Conditions

For the general conditions listed below, see the standard manufacturing conditions and scope of works for large-sized machine tools to be exported (SDE3500) submitted separately except otherwise agreed upon between both parties of customer and KYUSHU TOSHIBA MACHINE.
The items different in between this specifications manual and the general conditions manual are stated in Section 5 which takes precedence over the descriptions in the general conditions manual.

(1) Standard for machine operating environment
(2) Standard for machine production
(3) Procedures
(4) Delivery time
(5) Witnessed inspection at KYUSHU TOSHIBA MACHINE's plant
(6) Witnessed inspection at customer's plant
(7) Submitted documents
(8) Delivery conditions
(9) Installation
(10) Instructions on machine operation and maintenance
(11) Training for programming
(12) Acceptance meeting
(13) Maintenance and scope of responsibility
(14) Copyright
(15) Patent
(16) Change in design
(17) Record on meetings

5. Particulars

5.1 Witnessed Inspection at Customer's Plant

Among the static accuracy tests given in our final test chart, the following tests shall be conducted at the customer's plant.

a. Squareness between table(pallet) centerline and longitudinal movement of rail head
b. Parallelism between table(pallet)centerline and vertical movement of rail head ram

All measuring devices needed for the above tests shall be provided by the customer.

5.2 Submitted Documents

Document		No. of Copies	Date of Submission
Instruction manual	Machine, electrical system	5	At training on the customer's Sight
	NC system	5	At training on the customer's Sight
	Parts List	3	With the Machine

The other submitted documents shall be governed by the general conditions and the quotation.

5.3 Machine Installation

(1) Foundation shall be provided by the customer.(Excluded from the quotation.)

(2) Before installing the machine, make sure that the foundation is as per the foundation plan drawings.

(3) Machine installation

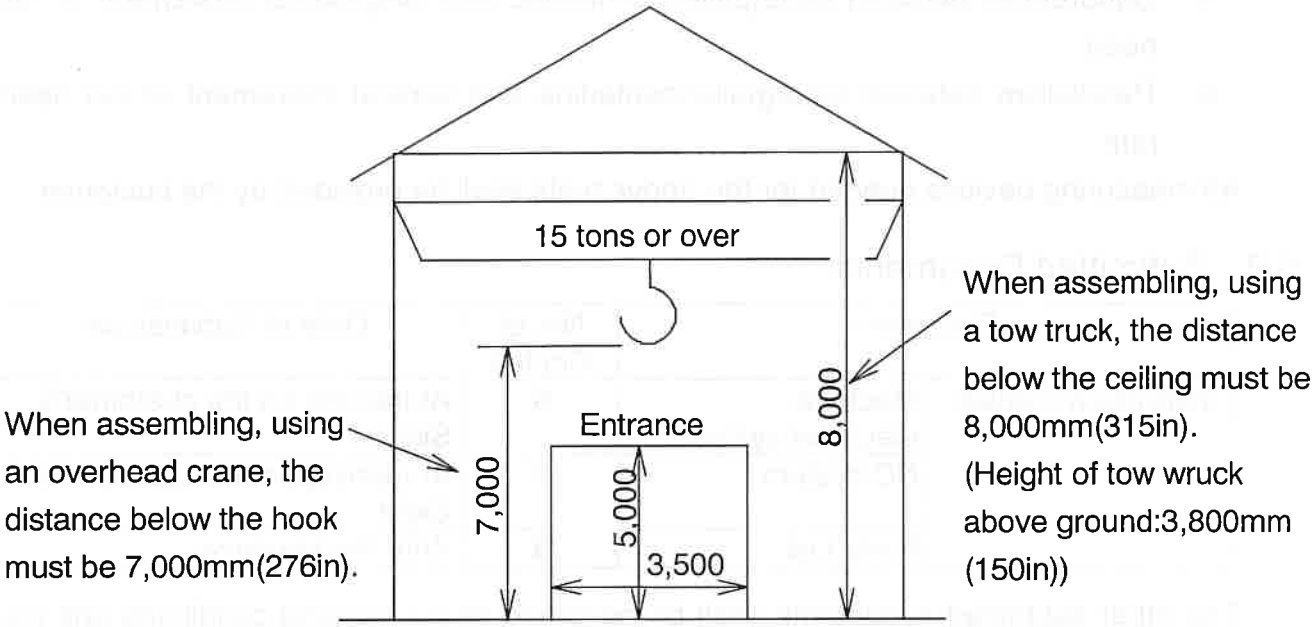
The machine shall be installed under the supervision of our engineer dispatched for on-site erection.

All person, tools and materials stated below, which are needed for the installation shall be provided by the customer at his own expense.

① Grout and grouting personnel
② Personnel in charge of maintenance and electrical work
③ Crane and crane driver
(First priority must be given to the use of them at the time of installation.)
④ Place for machine installation and assembly
⑤ Utilities(power, compressed air and water)
⑥ Wiring on primary side, piping for compressed air
⑦ Hydraulic oil, lubricant oil, kerosene, coolant oil

(4) Building and crane capacity

A building and crane capacity shown below are necessary. Unless these conditions are satisfied, they are subjected to separate quotation.



5.4 Installation on Machine Operation and Maintenance

The instructions on machine operation and maintenance are given during the installation conducted at the customer's plant.
Operation and maintenance instruction shall be conducted in English or in Japanese. If an interpreter for any other language is required, he or she can be employed at the customer's expense.
The contents and the execution of any special training required from the customer shall be determined separately by the parties. However, such a training shall cost extra to the customer.