



TUD series

Vertical Boring & Turning Mills

Shibaura Machine

View the Future with You



ISO 9001



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* We reserve the right to change any of specifications in this catalog without notice in order to effect improvements.

The TUD Series of Vertical Boring and Turning Mills for unrivaled efficiency in boring and turning operations.



- The thick-walled, cast iron column and bed is thermal symmetrically designed for high precision and heavy-duty machining.
- The 220 mm (8.66 in) square ram is solidly encased in a monobox structure which is incorporated with an automatic tool-locking mechanism.
- A step positioning mechanism moves the crossrail a maximum of 500 mm (19.6 in) vertically in 250 mm (9.84 in) steps [750 mm (29.5 in) for TUD-20] for virtually all workpiece heights.
- Special options, such as an automatic tool changer (ATC) and an automatic pallet changer (APC) are available for even greater degrees of automation and labor saving.



Photo: TUD-16 with optional accessories.
(ATC, APC, ATC jib crane and chip conveyor.)

TUD series

Vertical Boring & Turning Mills

Outstanding machine features for improved machining performance

Table load-capacity diagram



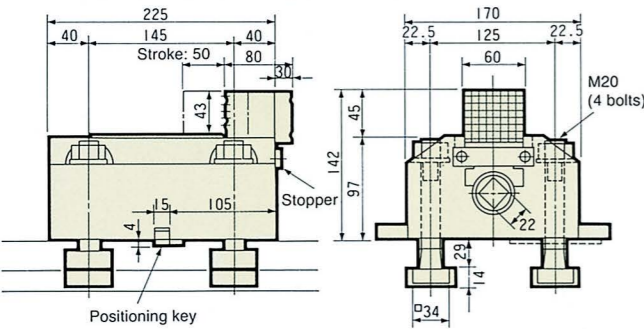
1 Table and bed

All of the major machine components are constructed of high-grade castings. The table has been provided with ample strength and size and is supported on a large-diameter thrust ball bearing and tapered roller bearing arrangement. This type of arrangement assures adequate support to extremely efficient, high speed heavy machining. In addition, the table is equipped with 4 independent manually-operated jaws and T-slots that guide and hold the workpiece in the required position.

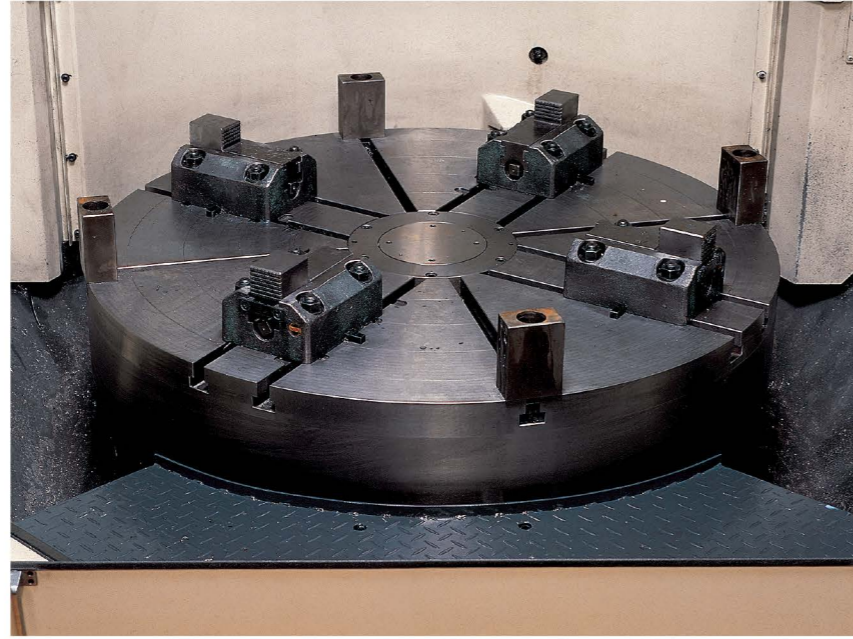
Independent manually-operated jaws

Four jaws with the following specifications are supplied as standard accessories.

- Maximum clamping force: 4 metric tons (8,800 lbs) (clamping torque 18.5 kgf-m [133 ft-lbs])
- Weight (one jaw): 28 kg (61.6 lbs)



Thermal deformation is minimized by the standard-type lubricating-oil cooling system and the thermally symmetric layout of the machine bed which supports the table. Additionally, the table-drive mechanism is built into the rear section of the bed, and column is standing on the bed.



Maximum load on table

(Data does not apply to eccentrically placed loads)

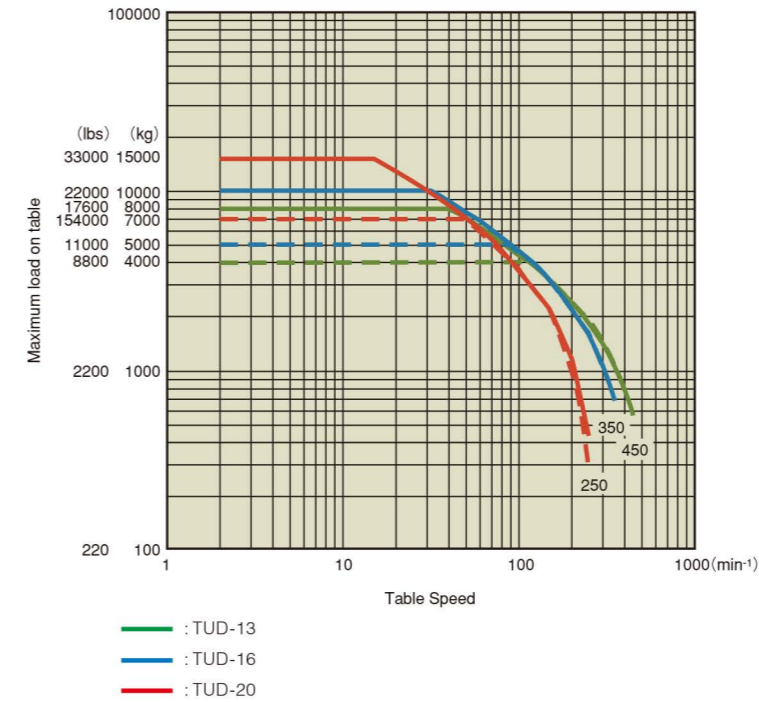
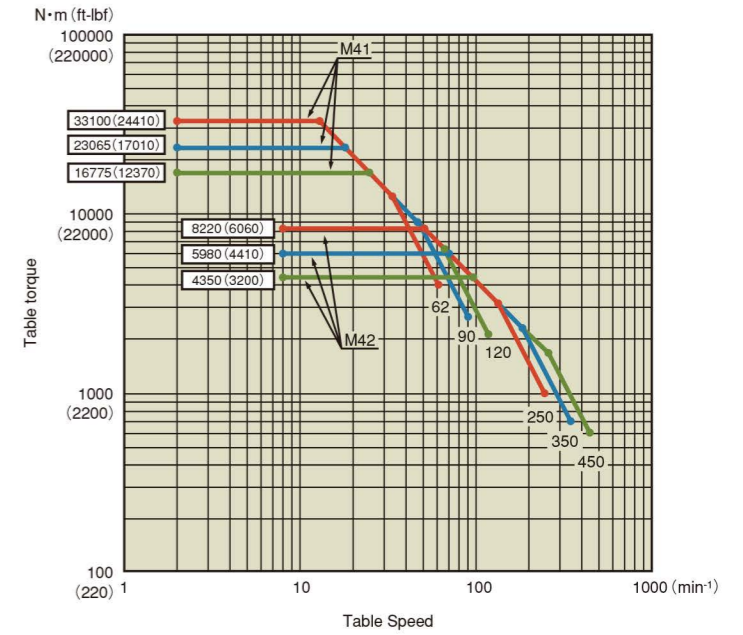


Table torque

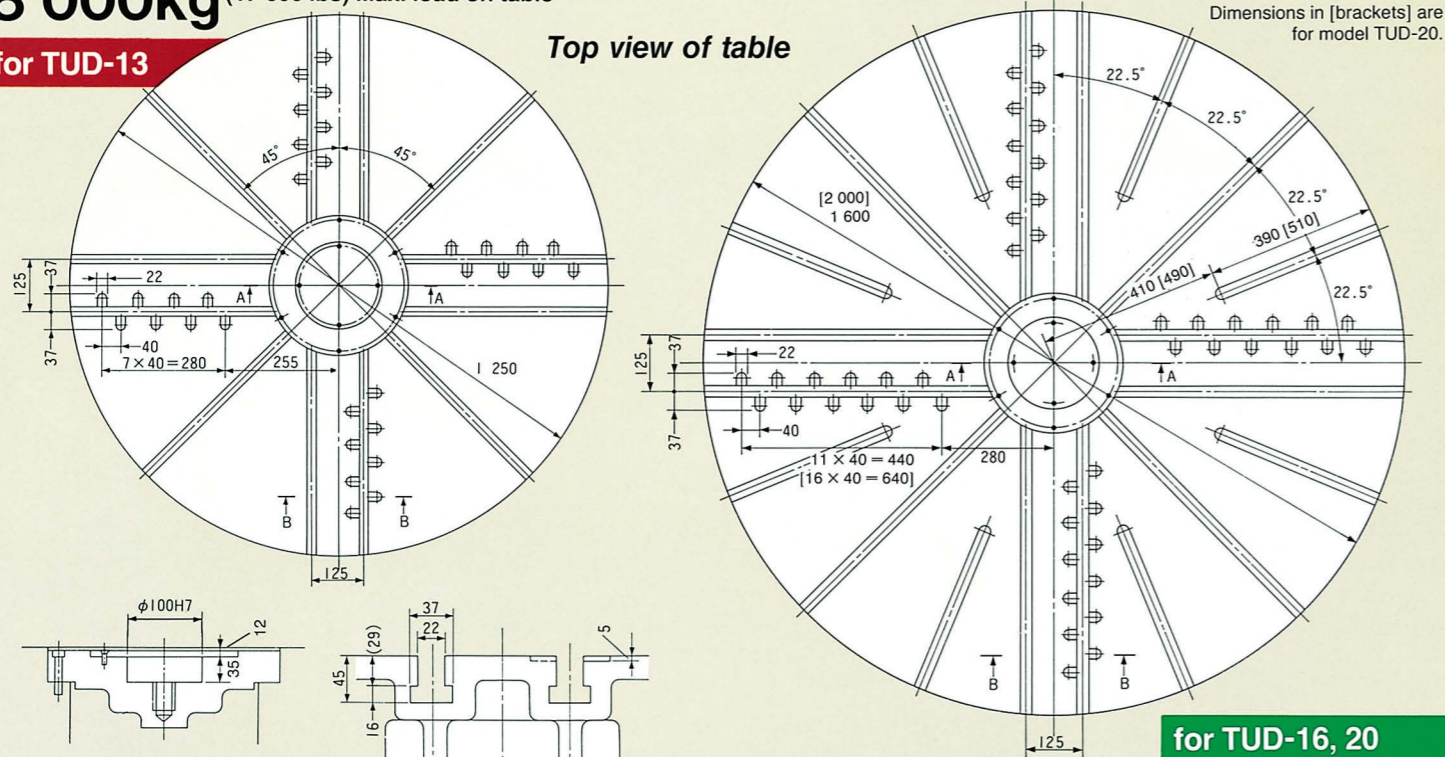
(Motor power: efficiency variation not included)



8 000kg (17 600 lbs) Max. load on table

for TUD-13

Top view of table



for TUD-16, 20

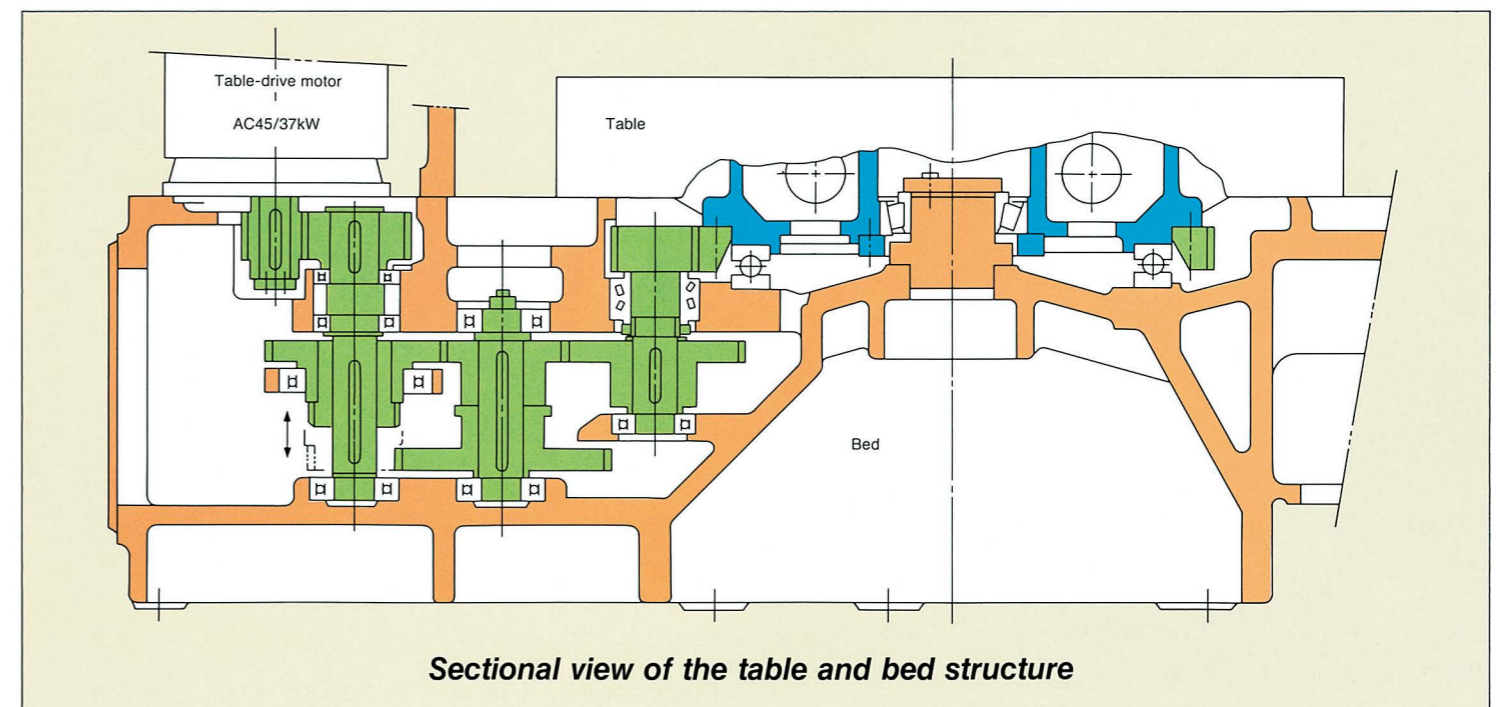
Detail of section A-A

Detail of section B-B

Max. load on table:
10 000 kg (22 000 lbs): TUD-16 15 000 kg (33 000 lbs): TUD-20

2 Table driving mechanism

The table is driven by a 2-step gear speed-change motor with a large-diameter helical gear located beneath the table. Speed changes are carried out by the 2-stage hydraulic shifting in combination with the variable speed AC motor. Excellent rigidity and minimum heat generation is assured by the simplified and thermally symmetric arrangement of the gear-train.

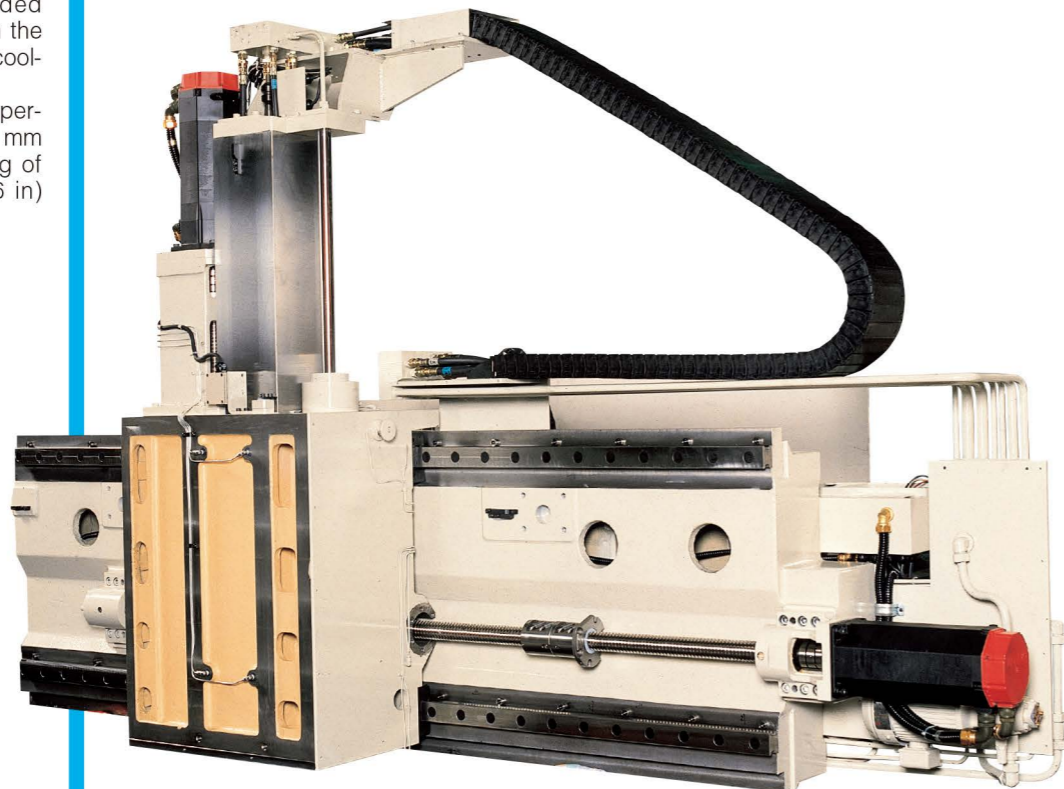


Sectional view of the table and bed structure

3 Column and crossrail

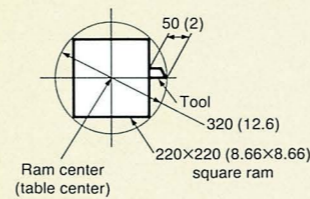


■ The column is a highly rigid symmetrical box-shaped structure that is provided with 2 slideways. The linear-guide on the crossrail is protected from chips and coolant by steel covers. The vertical travel of the crossrail is performed by a hydraulic cylinder in 250 mm (9.84 in) steps for precise positioning of up to a maximum of 500 mm (19.6 in) [750 mm (29.5 in) for TUD-20].



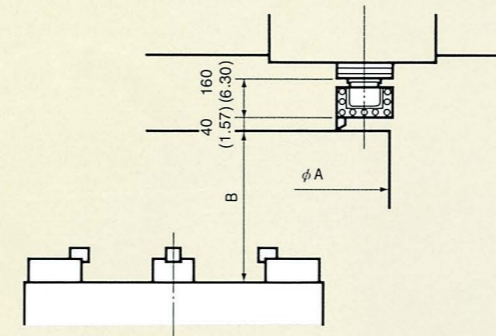
4 Rail head

■ The 220 mm (8.66 in) square ram is securely supported on all 4 sides within a one-piece structure. Large-diameter ballscrews are employed for positioning in the horizontal (X-axis) and vertical (Z-axis) directions. Quick and precise positioning is possible by the special angular ball bearings supporting the ball-screws and the rolling linear guides for the X-axis slideway. The ISO No. 55 taper 7/24 and a collet-type pull-stud mechanism enables the clamping of tools on the ram automatically. Heavy duty cutting capability is assured by the powerful 6-metric ton clamping force.



■ Minimum bore to be machined

● If the machining bore is less than 320 mm (12.6 in), please select the most suitable boring-tool holder from the types listed on page 12.



Units: mm (in)

	TUD-13		TUD-16		TUD-20	
	Standard	With APC	Standard	With APC	Standard	With APC
MAX. WORK DIA. (A)	1 600 (63)	1 600 (63)	2 000 (78.7)	2 000 (78.7)	2 500 (98.4)	2 500 (98.4)
Max. cutting height (B)	1 100 (43.3)	900 (35.4)	1 350 (53.1)	1 150 (45.3)	1 600 (63)	1 350 (53.1)

■ Maximum machining range

This dimensions in brackets () are values in parentheses signify the maximum workpiece swing on the other pallet.

Machining example

Cutting direction X-axis ←

Ram extension 355 mm (14")

Machining diameter 670 mm (26.4")

Table speed Constant surface speed

Surface speed 100 m/min. (328 sfm)

Depth of cut 10 mm (0.4")

Feedrate 1.3 mm/rev. (0.05"/rev.)

Material S48C (carbon steel)

Estimated cutting force on ram 2 600 kgf (5 720 lbs)

Efficient operation panel



Manual operations

These CNC-type machines can also be operated manually from the pendant panel which contains all the controls necessary for such operations as table movement, feed direction for horizontal and vertical movements, mode selection, and feed-rate and table-speed override. This pendant panel is also equipped with a manual pulse generator (MPG) for the observing of the toolpoint during machining in the same manner as that employed on conventional manual machines.

An abundant array of invaluable CNC functions for simplified and diverse machining operations.

Such useful functions as constant surface-speed control, fixed cycles for compound machining, and custom macros are available in a basic optional function package.

CNC Unit (FANUC Series 31i-B*)

Basic Specifications

Axis control	
Controlled axis (total)	2 axis
Simultaneous controllable axis	2 axis
Axis name	X, Z
Least input increment	X, Z-axis 0.001 mm (0.0001 in)
	Diametrical designation for X-axis

Interlock	
Machine lock	All axis
Emergency stop	
Over travel	
Stored stroke check 1	
Mirror image	Each axis
Follow-up	At emergency stop
Servo off	

Chamfering on/off	
Automatic operation	Memory operation

Operation	
Automatic operation	Memory operation
MDI operation	
DNC operation	Reader/puncher interface is required.
DNC operation with memory card	

CF card and PCMCIA card attachment is required.	
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Program number search	
Sequence number search	
Wrong operation prevention	

Buffer register	
Dry run	

Single block	
Manual continuous feed (JOG)	21 steps, X, Z-axis
	0 ~ 2000 mm/min (78.74 inch/min)

Manual reference position return	
Reference position return speed set	
Reference position shift	

Interpolation	
Positioning	G00
	Linear interpolation type positioning is possible.

Exact stop mode	
Cutting mode	G61
Exact stop	G09

Linear interpolation	
Circular interpolation	G03, G04
Dwell	The stop time is specified by G04 code.
	(Max. 99999.999)

Thread cutting, synchronous cutting	
Multi threading	Equal lead thread cutting
Continuous threading	

Skip	
Reference position return	G28
Reference position return check	G27
2nd reference position return	G30

Feed function	
Rapid traverse rate	Refer to specification "page-5".
Rapid traverse override	0~100%, 10% step
Feed per minute	1~2000 mm/min (0.039~78.740 inch/min)
Feed per revolution	
	0.01~500.00 mm/rev (Not exceeding 2000 mm/min)

Tangential speed constant control	
Cutting feedrate clamp	
Automatic acceleration/deceleration	
	Rapid traverse:linear
	Cutting feed:linear or exponential

Rapid traverse bell-shaped acceleration/deceleration	
Feedrate override	
	0~200%, 10% step (Not exceeding 2000 mm/min)

Override cancel	
Linear acc/dec after cutting feed interpolation	

Program input	
Tape code	EIA RS244, ISO840 automatic recognition
Label skip	
Parity check	Horizontal and vertical parity
Control in/out	
Optional block skip	1 pc.

Max. programmable dimension	
	±99999.999 mm (±9999.9999 inch) ±9999.9999 deg

Program number / program file name	
	Program number : 04-digit
	Program file name : 32 characters
Sequence number	N8 digit

Absolute / incremental programming	
	Combined use in the same block

Decimal point programming	
Diameter programming	X-axis

Coordinate system setting	
Automatic coordinate system setting	
Manual absolute on	
G code system	System A

Programmable data input	
Programmable parameter input	G10

Sub program call	
	Subprogram: 10 folds nested

Canned cycles for turning	
Circular interpolation by R programming	
Coordinate system shift	
Direct input of coordinate system shift	

Auxiliary/spindle speed function	
Miscellaneous function	M2-digits
Auxiliary function lock	
High-speed M,S,T,B interface	
Multiple command of auxiliary function	

Spindle speed function	
Spindle override	0~120%, 5% step

Tool function/Tool compensation	
Tool function	T2+2digits
Tool offset memory	32 pairs
Tool offset	
Tool offset value counter input	

Accuracy compensation	
Backlash compensation	
Backlash compensation for each rapid traverse and cutting feed	
Smooth backlash compensation	

Editing operation	
Part program storage size	64Kbyte
	(approximately 160m)
	(Among 64Kbyte, standard machine already uses 2Kbyte for sequence.)

Registerable programs	
	63pcs.
	(Among 63pcs, standard machine already uses 9 programs for sequence.)

Part program editing	
Program protect	
Extended part program editing	
Memory card program edit & operation	Max.63 programs
	The tool on PC is required to convert and store files.

Setting and display	
Status display	
Clock function	
Current position display	
Program comment display	
Parameter setting and display	
Alarm display	
Alarm history display	
Operation history display	
Actual cutting feedrate display	
Display of spindle speed and T code at all screens	
Operating monitor screen	
Servo setting screen	
Spindle setting screen	
Servo waveform display	
Maintenance information screen	
Input / output device setting screen	
Self-diagnosis function	
Dynamic display language switching	
Data protection key	
Erase CRT screen display	
Parameter set supporting screen	
Help function	

Self-diagnosis function	
Periodic maintenance screen	
Display of hardware and software configuration	
Servo information screen	

Data input/output	
External key input	
External workpiece number search	
Memory card input/output	
Screen hard copy	
Automatic data backup	

Interface function	
Embedded Ethernet	

Others	
Status output signal	
Control unit incorporated type display unit	10.4 in. color LCD
MDI unit	Separate MDI

Servo motor	
	FANUC AC servo motor
	X-axis : Model α30/3000i
	Z-axis : Model α30/3000i (With brake)

Servo amp.	
	FANUC AC servo amp. αi series SVM

Connectable position detector	
	Pulse coder / optical scale (2-pulse pulse interface)

Spindle motor	
	FANUC AC spindle motor Table
	Model αi40/6000

Spindle amp.	
	FANUC AC spindle amp. αi series SPM

Environmental conditions (At operation)	
	Ambient temperature : 0°~58°C
	Relative humidity: 95% or less

S Function	
	Low-Speed Range(M41)
	High-Speed Range (M42)

TUD-13	S2-S120(2~120 min ⁻¹)
	S8-S450(8~450 min ⁻¹)

TUD-16	S2-S90 (2~90 min ⁻¹)
	S8-S350(8~350 min ⁻¹)

TUD-20	S2-S62 (2~62 min ⁻¹)
	S8-S250(8~250 min ⁻¹)

M Function	
M00	Program stop
M01	Optional stop
M02	End of program
M03	Table forward rotation
M04	Table backward rotation
M05	Table stop
*M08	Coolant ON
*M09	Coolant OFF
M10	Through coolant ON
M11	Through coolant OFF
M18	Table orientation stop
*M20	Chip conveyor forward
*M21	Chip conveyor stop
*M22	Coolant washer ON
*M23	Coolant washer OFF
M30	End of program (Cut off electric power)
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
*M55	Tool nose measuring mode
*M56	Tool nose position detecting sensor advance
*M57	Tool nose position detecting sensor retract
*M06	Tool change
*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

*M83	Crossrail M83 position (TUD-20)
*M84	Crossrail M84 position
M98	Subprogram call
M99	Main program call

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

Inch/metric conversion	
Program restart	
Manual handle feed	1 unit
Manual handle feed rate	x1 : 0.001mm (0.0001in)
	x10 : 0.010mm (0.001in)
	x100 : 0.100mm (0.01in)

Manual handle interruption	
Thread cutting retract	
Optional block skip	(total) 9 pcs.
Workpiece coordinate system	G52~59
Workpiece coordinate system preset	G50.3
G code system	System B
Chamfering / corner R	
Custom macro	
Addition of custom macro common variables	#100~#199, #500~#999

Multiple repetitive cycles for turning	
Automatic corner override	
Tape format for FS15	
Spindle serial output	
Constant surface speed control	
Spindle orientation	
Tool geometry / wear compensation	
Tool nose radius compensation	
Tool management function	64 pairs
Stored pitch error compensation	
Back ground editing	
Multi part program editing	
Operator message history display	
Run hour and parts count display	
Multi language display	Japanese
Graphic function	
Reader/puncher interface	Ch.1
External data input	Including External tool offset, Externalreference position shift and External message

Special Specifications	
Stored stroke check 2,3	G22/G23
Stored limit check before move	
Chuck and tale stock barrier	
Sequence number comparison and stop	
Tool retract and recover	
Variable lead thread cutting	G34
Circular thread cutting	G35/G36
High speed skip function	
	Is necessary for automatic measuring options.

Addition of workpiece coordinate system 48 pairs	
Direct drawing dimension programming	
Multiple repetitive cycles for turning II	
Manual guide i	
Manual guide i basic	
Manual guide i turning cycle	
Manual guide i animation	

Spindle positioning	
Tool offset pair	Total 64 pairs
	Total 99 pairs
	Total 200 pairs
	Total 400 pairs

2nd geometry tool offset	
Tool life management	
Part program storage size	Total 128Kbyte (approx. 1050ft)
	Total 256Kbyte (approx. 2100ft)
	Total 512Kbyte (approx. 4200ft)

Number of registerable programs (*1)	
Expansion 1	
Playback	

Machining time stamp	
Memory card program entry count extension	
Fast data server	
Data server buffer mode	
Fast Ethernet	
Programmable mirror image	
Program number 08-digit	
*1: Total expansion number depends on the part program storage size as follows.	
Part program storage size	Number of registerable programs
64Kbyte	120
128Kbyte	250
256Kbyte	500
512Kbyte	1000

Note 1: M06

Machine Specifications			TUD-13	TUD-16	TUD-20	
Capacity	Table diameter	mm (in)	1 250 (49.2)	1 600 (63)	2 000 (78.7)	
	Maximum swing	mm (in)	1 600 (63)	2 000 (78.7)	2 700 (106.3)	
	Maximum height from table top to ram bottom	mm (in)	1 300 (51.2)	1 550 (61)	1 800 (70.9)	
	Maximum cutting height	mm (in)	1 100 (43.3)	1 350 (53.1)	1 600 (63)	
	Maximum cutting force of ram	N{kgf (lbs)}	30 000 (3 000 (6 600))			
	Maximum load on table	kg (lbs)	8 000 (17 600)	10 000 (22 000)	15 000 (33 000)	
Travel	Horizontal travel of rail head (X-axis)	mm (in)	-630-920 (-24.8-36.2)	-805-1 120 (-31.7-44.1)	-1 005-1 370 (-39.6-53.9)	
	Vertical travel of ram (Z-axis)	mm (in)	800 (31.5)		1 050 (41.3)	
	Vertical travel of crossrail	mm (in)	500 (19.7)		750 (29.5)	
Table	Table speeds	min ⁻¹	2-450	2-350	2-250	
	Maximum table torque	N·m (ft·lb)	16 775 (12 370)	23 065 (17 010)	33 100 (24 410)	
Feedrate	Feedrate of rail head (X- and Z-axes)	mm/min (ipm)	1-2 000 (0.04-78.7)			
	Rapid traverse of rail head (X-axis)	mm/min (ipm)	12 000 (472)		10 000 (393.7)	
	(Z-axis)	mm/min (ipm)	10 000 (393.7)			
Ram	Section	mm (in)	220×220 (8.66×8.66)			
Motor	Table drive motor (30 min/cont.)	kW (HP)	AC 45/37 (AC 60/50)			
Power source	Power capacity※	kVA	80			
Machine size ※	Machine height	mm (in)	4 685 (184.5)	4 935 (194.3)	5 685 (223.8)	
	Floor space	without APC	mm (in)	4 105×5 420 (162×214)	4 565×5 600 (180×221)	5 270×6 660 (208×262)
		with APC	mm (in)	5 840×6 150 (230×242)	6 540×6 900 (258×272)	8 150×8 180 (321×322)
	Machine weight	without APC	kg (lbs)	17 000 (37 400)	19 000 (41 800)	32 000 (70 400)
with APC		kg (lbs)	26 000 (57 200)	28 000 (61 600)	47 000 (103 620)	
Accuracy	Positioning accuracy (X- and Z-axes)	mm (in)	±0.007/500 (±0.0003/20)			
	Positioning repeatability (X- and Z-axes)	mm (in)	±0.003 (±0.0001)			

※ The requirement space of machine (and power capacity) may differ by equipped options.

Standard Accessories

1 Installation parts	1 set
2 Special service tools	1 set
3 Chip guard (When a coolant unit is provided, splash guard serves also as a chip guard.)	1 set
4 Automatic slideway lubricating unit	1 set
5 Crossrail step-positioning unit	1 set
6 Locally operated 4-jaw chuck [Max clamping force: 4 metric tons (8 800 lbs)] (When an APC is provided, jaws included in a pallet serve also as a chuck.)	1 set
7 Telescopic crossrail slide cover	1 set
8 Automatic power OFF device	1 set
9 Table lubricant oil cooling unit	1 set

Optional Accessories

1 Coolant unit (only water-soluble coolant can be used.)

	TUD-13	TUD-16	TUD-20
Pump motor	AC 2P 3.0 kW (4HP)	AC 2P 3.0 kW (4HP)	AC 2P 3.0 kW (4HP)
Coolant pump	30 l/min (7.9 gal/min)		
Coolant tank capacity	500 l (132 gal)	600 l (159 gal)	700 l (190 gal)
Splash guard	When the ATC or APC is provided, auto doors is equipped on the splash guard.		

2 Automatic tool changer (ATC)

Tool storage capacity	12 tools
Total tool weight	360 kg (794 lbs)
Type of tool shank	For turning: 7/24 taper No. 55T
Type of pull stud	JIS 55P
Maximum tool size	350W×150T×450L mm (13.7W×5.9T×17.7L in)
Maximum tool weight	50 kg (110 lbs)
Method of tool selection	Soft tool pot address

3 Circular chip flushing system

4 Chip conveyor Motor: AC 4P 0.4 kW (0.54 HP) 1 pc.

5 Operator call lamp

This lamp is mounted on top of the column.

6 Work light LED 5 W

7 ATC jib crane Maximum lifting mass: 50 kg (110 lbs)

8 Coolant through tool function

Delivery at coolant pump delivery port
15 l/min, 8 kgf/cm² (3.9 gal/min, 113 psi)

9 Automatic pallet changer (APC)

	TUD-13	TUD-16	TUD-20	
Maximum workpiece swing	mm (in)	1 600 [1 400] (62.9 [55.1])	2 000 [1 800] (78.7 [70.8])	2 700 [2 100] (106.3 [82.7])
Pallet changing time (machine dwell time)	min	1.5	2.0	3.0
Pallet (including locally operated 4-jaw chuck)	2 pcs.			
Maximum load on pallet	kg (lbs)	4 000 (8 800)	5 000 (11 000)	7 000 (15 400)
Setup station rotation speed	min ⁻¹	2.5	1.5	1.0

The dimension in brackets [] are values in parentheses signify the maximum workpiece swing on the other pallet.

10 Multi-pallet magazine system

No. of pallets 4, 6 or 8 pallets

Pallet loading capacity kg (lbs)	TUD-13	TUD-16	TUD-20
4	3 000 (6 600)	4 000 (8 800)	4 000 (8 800)
6	3 000 (6 600)	4 000 (8 800)	-
8	3 000 (6 600)	4 000 (8 800)	-

11 Automatic diameter and step difference measuring device (including automatic tool compensation function)

12 Automatic tool tip measuring device (including automatic tool compensation function)

13 X-axis linear scale feedback Optical linear pulse scale

14 Custom painting color Machine exterior

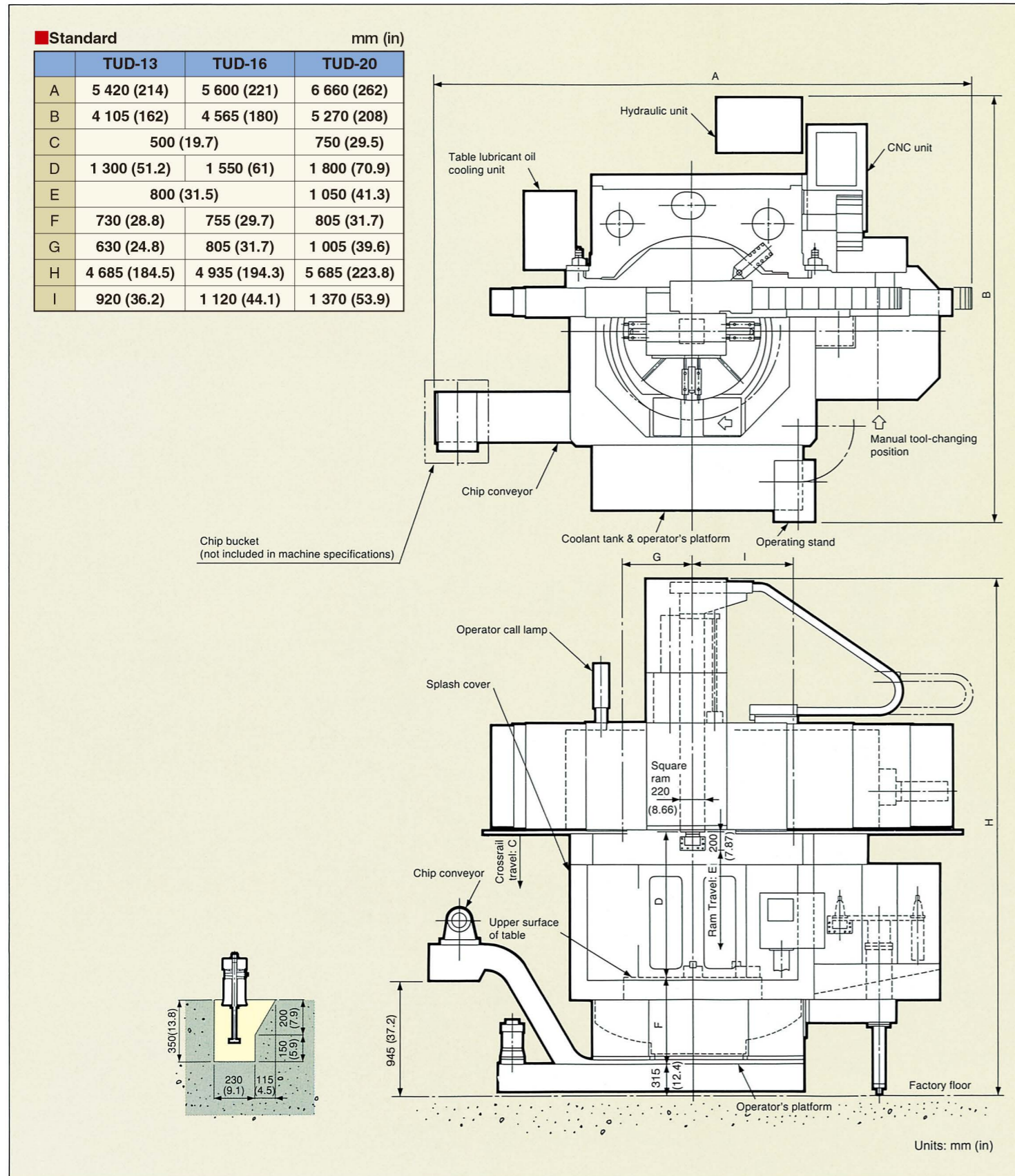
15 Hand rails and ladder for maintenance

16 Various tool holder

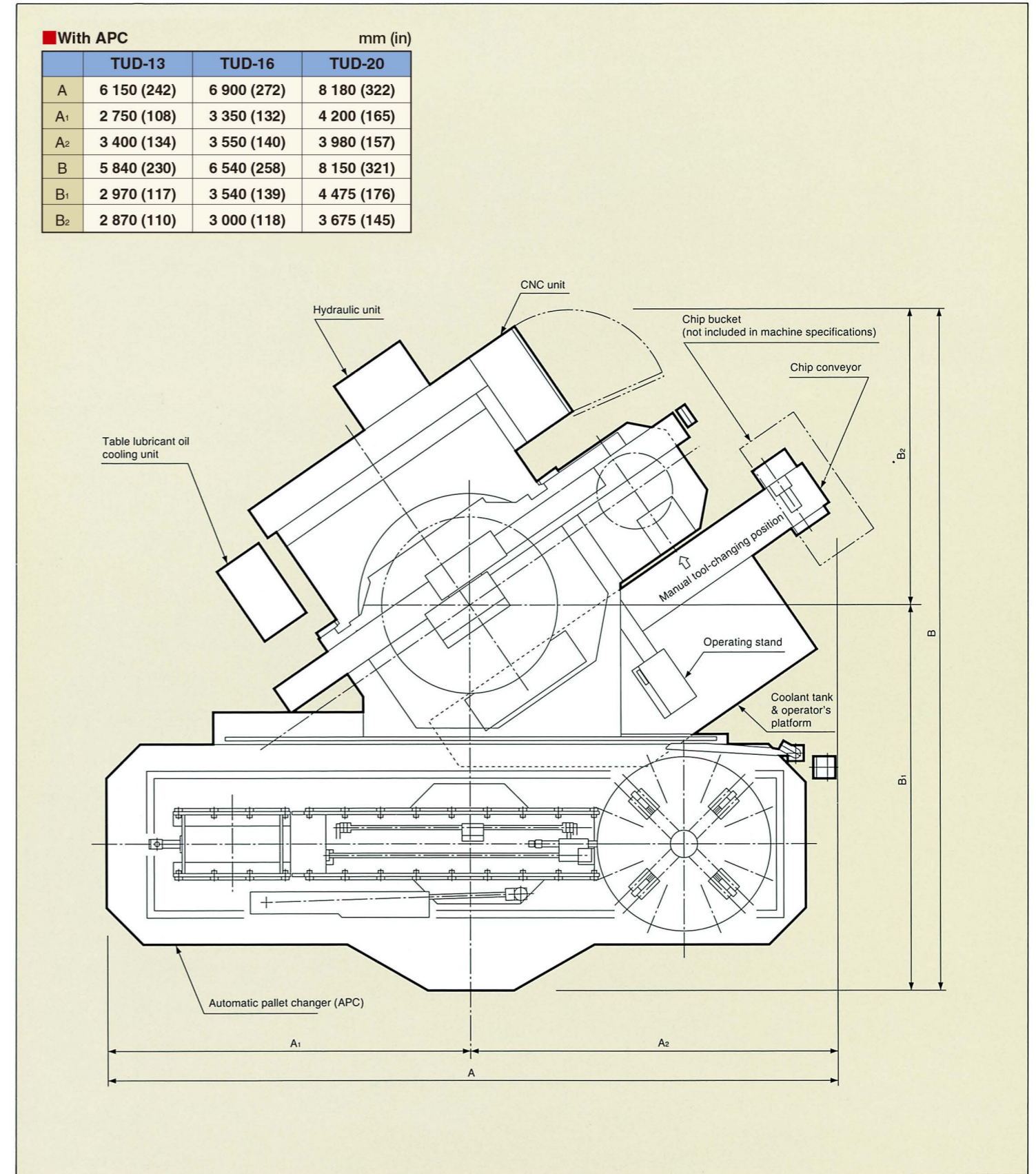
17 Locally operated 4-jaw chuck
[Max. clamping force: 6 metric tons (13 230 lbs)]

18 +250 High type column, +250 Ram travel extend

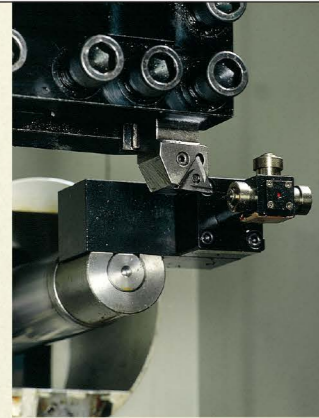
Machine dimensions



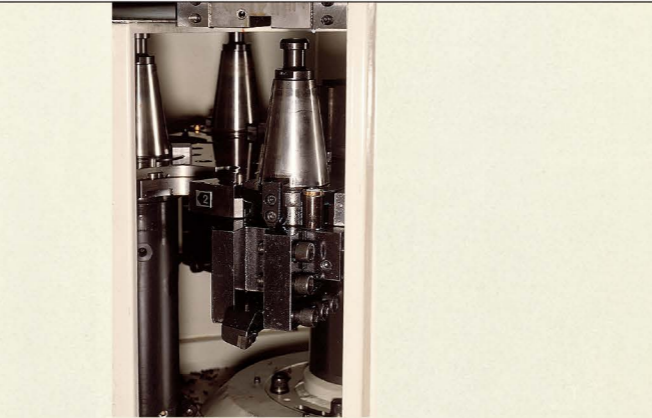
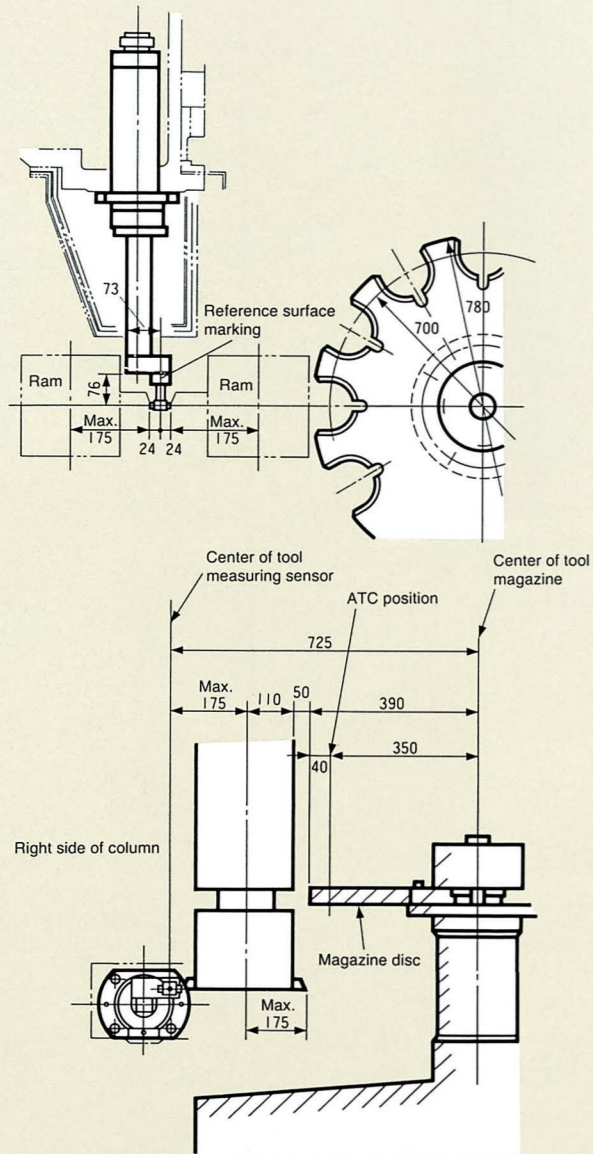
Machine dimensions with APC



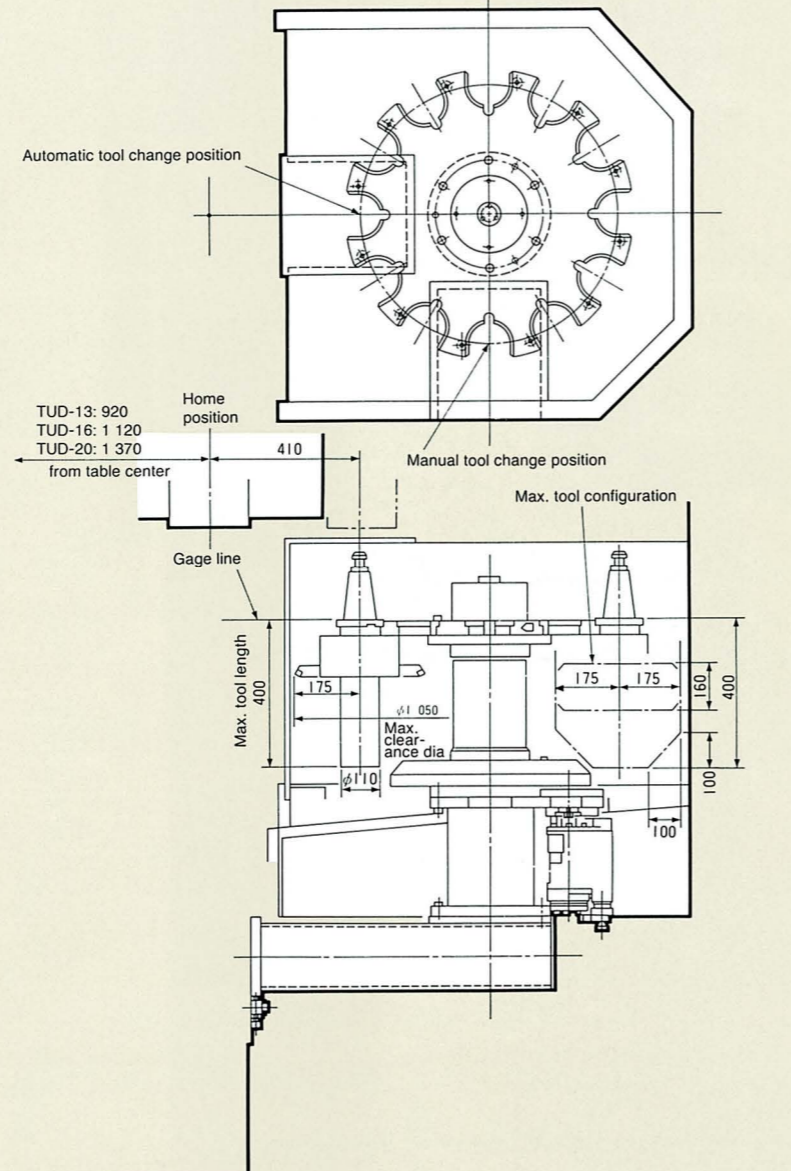
Automated functions (optional)



Automatic tool measuring unit



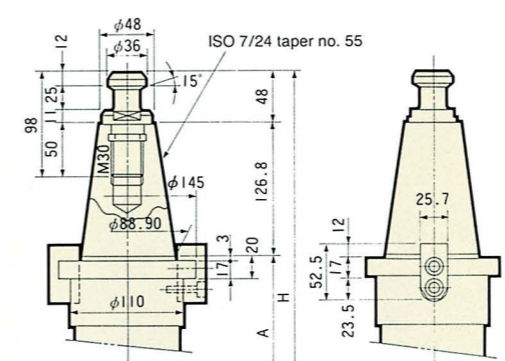
Automatic tool changer (ATC)



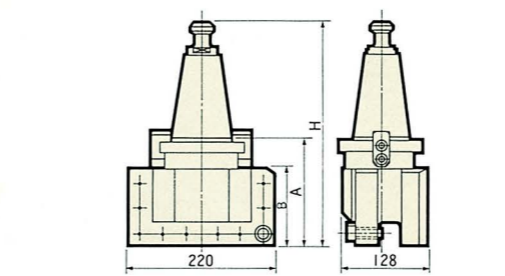
Tool holders (optional)



units: mm

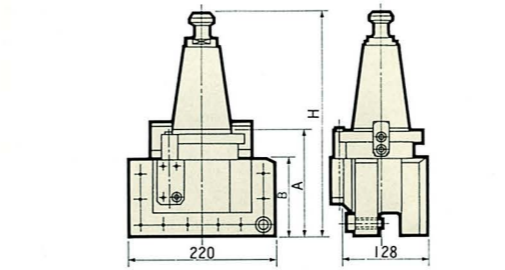


Details of 55T tool shank & pull stud



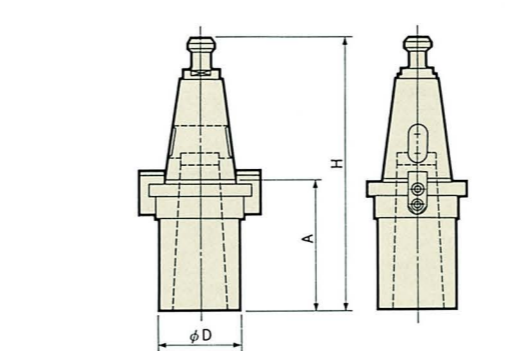
Square tool holders

Model	A	B	H	Applicable tool size
FM55-ST3232-160	160	100	334.8	32×32
-200	200	140	374.8	
-250	250	190	424.8	



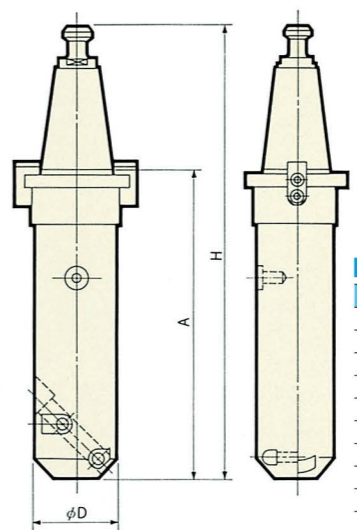
Square tool holders (OH type)

Model	A	B	H	Applicable tool size
FM55-ST3232-160-OH	160	100	334.8	32×32
-200-OH	200	140	374.8	
-250-OH	250	190	424.8	



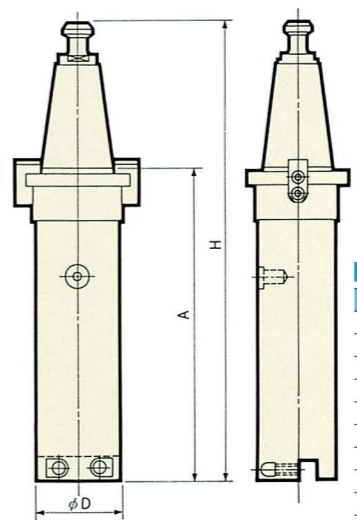
Morse taper holders

Model	Morse taper no.	A	H	D
FM55-CMT5-110	5	110	284.8	85
-CMT5-230	5	230	404.8	85
-CMT6-160	6	160	334.8	100
-CMT6-280	6	280	454.8	100



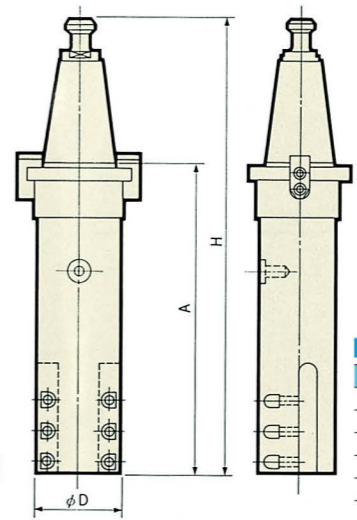
Boring tool holders (BA type)

Model	A	H	D	Applicable tool size	
FM55-BA80	-200	200	374.8	80	20×20
	-250	250	424.8		
	-300	300	474.8		
	-350	350	524.8		
FM55-BA110-200	-200	200	374.8	110	25×25
	-250	250	424.8		
	-300	300	474.8		
	-350	350	524.8		
-400	400	574.8			



Boring tool holders (BF type)

Model	A	H	D	Applicable tool size	
FM55-BF80	-200	200	374.8	80	20×20
	-250	250	424.8		
	-300	300	474.8		
	-350	350	524.8		
FM55-BF110-200	-200	200	374.8	110	25×25
	-250	250	424.8		
	-300	300	474.8		
	-350	350	524.8		
-400	400	574.8			



Boring tool holders (BP type)

Model	A	H	D	Applicable tool size	
FM55-BP80	-200	200	374.8	80	20×20
	-250	250	424.8		
	-300	300	474.8		
	-350	350	524.8		
FM55-BP110-200	-200	200	374.8	110	25×25
	-250	250	424.8		
	-300	300	474.8		
	-350	350	524.8		