Shibaura Machine

BTD-110H.R13,R16

BTD-110H.R13,R16

Table-Type Horizontal Boring and Milling Machine

Catalog BTD11118-CED-08

Shibaura Machine

View the Future with You

ISO 9001

GOTEMBA plant

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

URL : https://www.shibaura-machine.co.jp

SM19087-1100-SZ
Printed in Japan

Designed and built with functions for bet ter cutting performance

BTD-110H R13,R16

Accuracy movements and reliable Movements

A closed-loop control system for the X, Y, Z and B axes with standard 1 μm linear scales and rotaly scale provides the following guaranteed accuracies.

- **Roundness for boring : 0.005 mm (0.0002 in)**
- **Positioning accuracy**
  - **Linear axes (X, Y, Z) :** ± 0.005 mm (± 0.0002 in) / full stroke
  - **Table indexing :** ± 3 sec / arbitrary angle
- **Repeatability**
  - **Linear axes (X, Y, Z) :** ± 0.003 mm (± 0.00012 in)
  - **Table indexing :** ± 1.5 sec

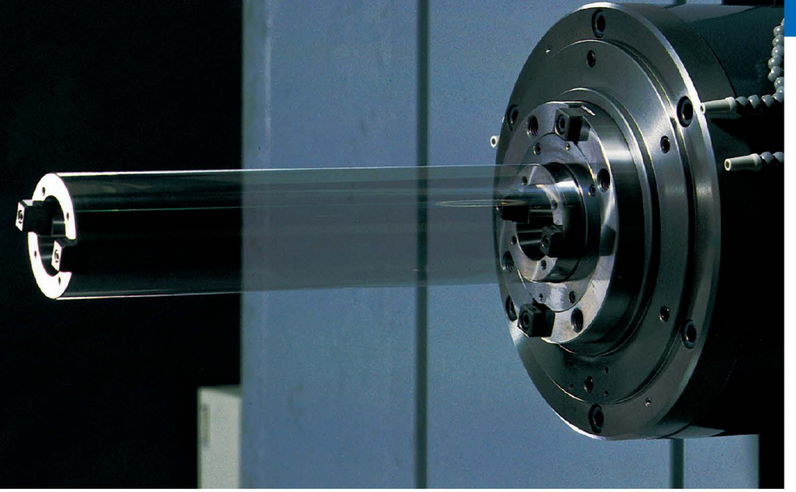
Main specifications

		BTD-110H.R13	BTD-110H.R13 (APC)
Axis travel (X, Y, Z, W)	mm (in)	1 600×1 250×1 130×500 (63×49.2×44.5×19.7)	
Table working surface	mm (in)	1 120×1 250 (44.1×49.2)	
Table loading capacity	kg (lbs)	4 000 (8 800)	3 000 (6 600)
Spindle speedrange	min^{-1}	5~3 000	
Spindle drive motor (30-min. rating/cont. rating)	kW (HP)	AC 15/11 [AC 22/18.5 AC 30/22] (AC 20/15 [AC 30/25 AC 40/30])	
Tool storage capacity	tools	38 [60 90]	
CNC system		TOSNUC 999	
Mass of machine	kg (lbs)	22 000 (48 400)	26 500 (58 300)

		BTD-110H.R16	BTD-110H.R16 (APC)
Axis travel (X, Y, Z, W)	mm (in)	2 000×1 500×1 450×500 (78.7×59.1×57.1×19.7)	
Table working surface	mm (in)	1 400×1 600 (55.1×63)	
Table loading capacity	kg (lbs)	6 300 (13 860)	4 500 (9 900)
Spindle speedrange	min^{-1}	5~3 000	
Spindle drive motor (30-min. rating/cont. rating)	kW (HP)	AC 15/11 [AC 22/18.5 AC 30/22] (AC 20/15 [AC 30/25 AC 40/30])	
Tool storage capacity	tools	38 [60 90]	
CNC system		TOSNUC 999	
Mass of machine	kg (lbs)	28 000 (61 600)	33 000 (72 600)

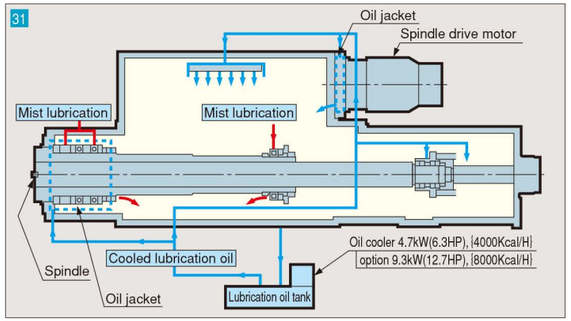
Note: Value in brackets [ ] refer to the options.

Numerals within ■ represents option number.



A newly developed spindle for optimum high speeds, assurance of high accuracy and heavy duty machining.

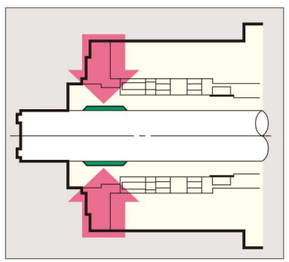
BTD-110H R13,R16



Minimal thermal displacement of spindle head

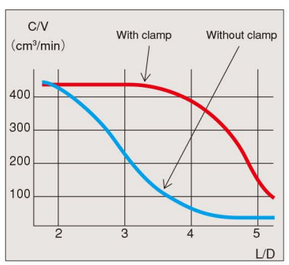
Use of an oil jacket and constant lubrication air mist volume for stabilized high accuracy cutting operations.

・Spindle bearings constant mist lubrication



Automatic spindle clamp (pat. pending)

This new clamping mechanism greatly increases the cutting force. Additionally, the spindle can be NC positioned at any location over its entire extension.



Hardened and ground spindle

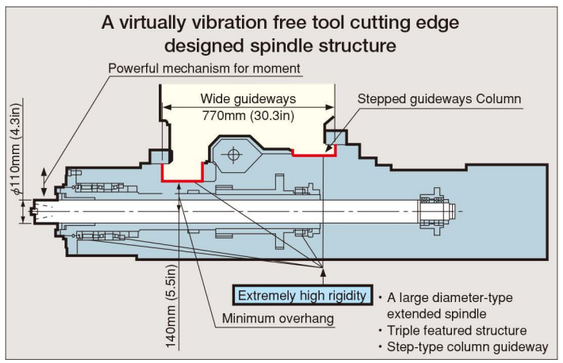
In addition air-oil mist over-sized spindle bearing, the entire unit is nitrided, hardened and precision ground to assure accuracy over the life of the machine.

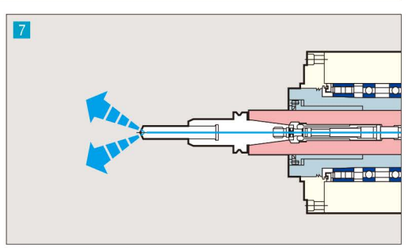
Step-type column guideways

Extra wide guideways that withstand the cutting force moment for assuring powerful machining with virtually no thermal displacement.

Spindle construction designed for deep hole boring

Spindle designed with extremely rigid, long-span type bearings and an automatic spindle end clamp for increased cutting force and positioning not found on other machining centers.



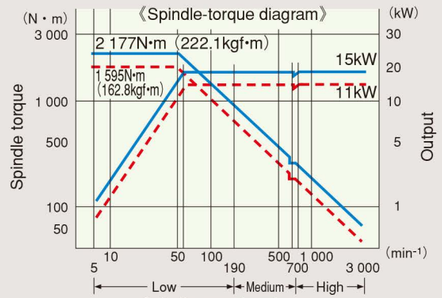


■Through-spindle type coolant (option)

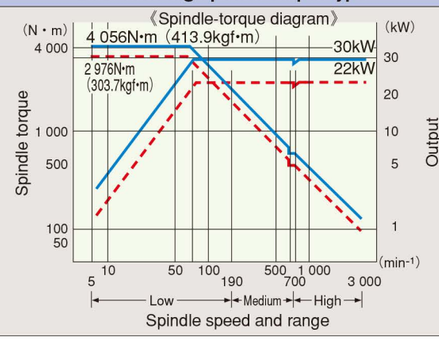
Spindle variations

Spindle-torque diagram

BTD-110H standard type



40 BTD-110H high power output type

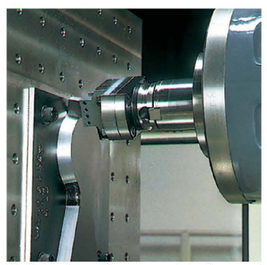


Minimal thermal displacement

BTD-110 standard type spindle thermal displacement after 7 hours of continuous no-load operation in a temperature controlled room at 1 000 min^{-1}.

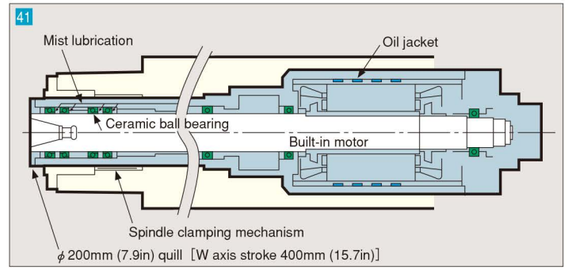
X-axis direction : -1 μm (-0.04 μin)
Y-axis direction : -14 μm (-0.55 μin)
Z-axis direction : 23 μm (0.91 μin)

Spindle normal direction control ((spring necked turning)) (option)



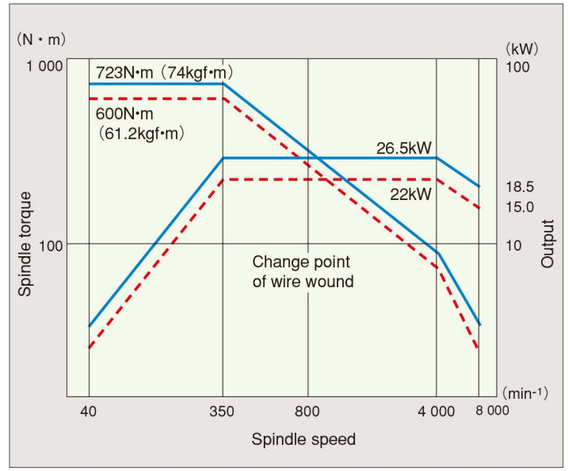
Composite machining of any shape such as cutoff and hale type finishing on an arc or along a straight line on any plane is possible with this C axis spindle control. Simple-type programs and tooling available for the machining of complex seal surfaces on the slots of such workpieces as vacuum devices.

High speed spindle (option)



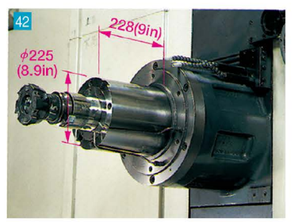
40 ～ 8 000 min^{-1}
(use of a special type built-in motor)

High speed, high torque spindle



Capable of a variety of machining ranging from the rough cutting of steel alloys to precision machining of aluminum

Long nose type spindle head (option)



A long spindle head nose allows easy access to the workpiece, assuring stabilized accuracy even during heavy-duty machining operations.
(The spindle extension is 500 mm (19.7 in) same as standard.)

Note : Detailed of option specifications to be decided at a separate meeting.

Precision made structural components.

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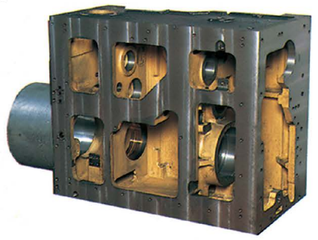
All major components are made of top-grade casting in a design based on fundamental machine tool building concepts. These slideways are also hardened and ground.

Spindle head

Improved access of the machine to the workpiece by employing a nose type spindle head construction which also assures stability during heavy-duty cutting operations.

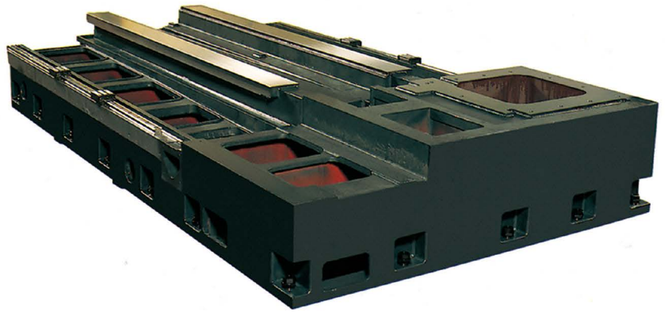


Saddle

The saddle is structurally designed and built to assure maximum straightness and paral-lelism of crosswise and longitudinal move-ments of the table.

Bed

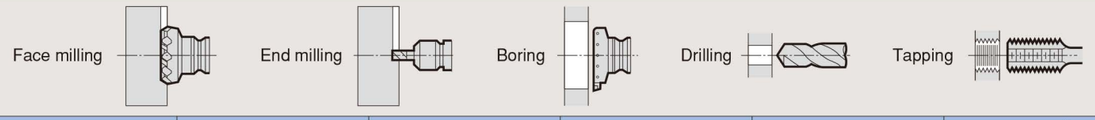
Rigidity is a must for the bed supporting the entire machine. Sturdy and 4-way guideway construction of the bed assures high accuracy, rigid support.



L/D=3.5 Heavy cutting

(Example of machining data)
Face mill : 160 mm (6.3 in)
Workpiece material : S48C (Carbon steel)
L/D=3.5 [Spindle extension : 250 mm (9.8 in)]
V=120 m/min (393.7 fpm)
F=550 mm/min (21.7 ipm) [0.38 mm (0.015 in)/tooth]
W=120 mm (4.7 in)
t=6 mm (0.24 in)
Vo=400 cm³/min

Example of machining data, material : AISI 1055 (Carbon steel)

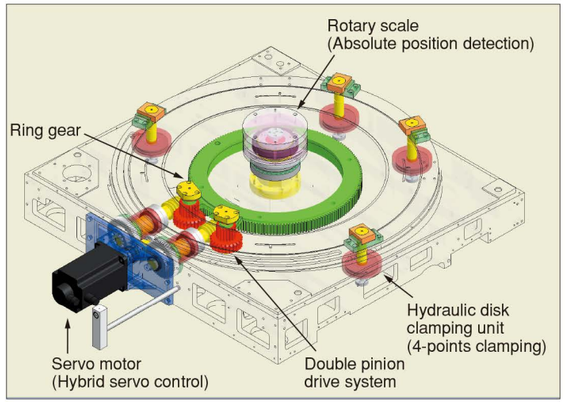


	Tool diameter mm (in)	Cutting speed m/min (fpm)	Feedrate mm/min (ipm)	Depth of cut mm (in)	Volume of cutting cm³/min (cipm)
Face milling	160 (6.3)	130 (426.5)	870 (34.3)	6 (0.23)	630 (25)
End milling	80 (3.1)	120 (393.6)	540 (21.3)	50×20 (2×0.8)	540 (33)
Boring	600 (23.6)	100 (328.1)	28 (1.1)	7 (0.27)	355 (22)
Drilling	69.5 (2.7)	22 (72.2)	60 (2.4)	—	—
Tapping	M3～M100	6～10 (19.7～32.8)	—	—	—

※Cutting data may vary according to such factors as the machine model, work piece fixture, machining position, cutter and tool holders used.

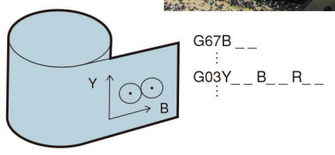
High speed precision machining is achieved through the use of a new B-axis drive mechanism (pat. pending).

B-axis positioning time: 14 sec. (0°～90° indexing), 37 sec. (0°～360° indexing)
The revolutionary type of clamp is standard with a highly rigid double pinion-type drive system and rotary scale for stabilized precision table indexing.



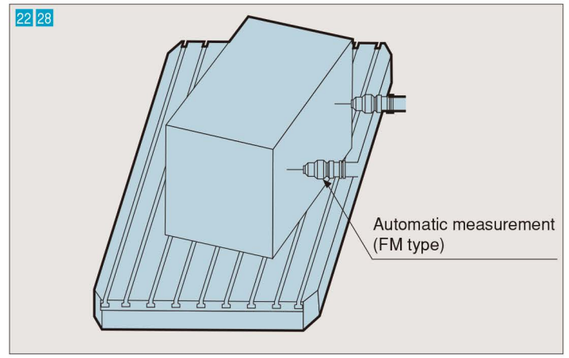
Efficient NC rotary milling (option)

Cylindrical and end surfaces can be machined continuously by the B-axis continuous indexing function, eliminating the need for an optional independent-type NC rotary table. Cylindrical surface machining is easily programmed in the manual programming by the cylindrical interpolation function.



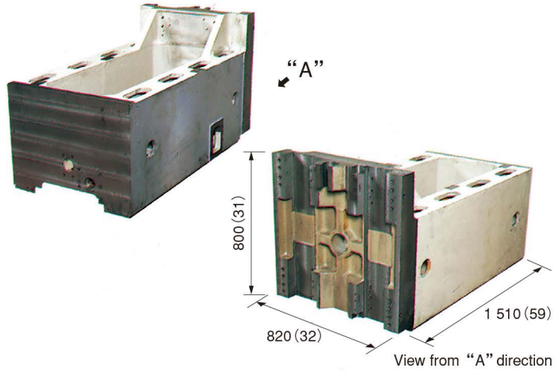
Set-up compensation function (option) eliminates manual workpiece centering!

After placing workpiece on a suitable location on the table surface, workpiece paralleling is simply completed by the automatic measuring and recording of workpiece position dimensions which is then used to precision index the table. Table will then be precision indexed to bring it in parallel with the X axis.



Improved machining efficiency due to easier operation

(machining example)



Time Comparison		BTD-110H.R16	Conventional-type machine
Number of tools used		16	16
Setup time/Number of setups		24 min / 2	48 min / 4 (with inclined stand)
Machining time	1 st workpiece	185 min	345 min
	2 nd workpiece	111 min	290 min
	3 rd workpiece	102 min	246 min
Average machining time / workpiece (including setup time)		157 min (2.6 hrs)	342 min (5.7 hurs)
Number of measurements		1 (automatic)	3

TOSNUC 999 (Triple nine) permits quick switching between manual, MDI and Automatic operation modes.

Automatic mode

Manual mode

MDI mode

Full teaching

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●Customizing keys

1.Memorize a series of input operations beforehand in one of the special keys (⚀ ⚁ ⚂ ⚃ ⚄ ⚅) and press these keys to execute operations continuously.

2.Memorize a combination of NC standard displays such as main, sub and window displays in one of the special keys (♠ ♥ ♦ ♣). By pressing these keys it displays the combination memorized.

●Supporting both USB flash drive and compact flash (CF)

TOSNUC 999 is standard equipped with USB port and CF card slot in response to capacity enlargement of NC programs.

Full screen program editing function helps create an NC program easily.

●Multi-window triple display

The display of TOSNUC 999 can be divided into three separate screens where simultaneous display of two different programs and offset data necessary for machining is possible. Also, data entry and editing can be done separately on each screen.

●Multi-editing function

A new program can be easily created by referring to and utilizing a previously made program on the multi-window display.

Visual program check function (option)

During programmed operation (i.e., background operation), an NC tape image of another program can be checked graphically. After program check, relevant tool path is drawn.

Triple teaching function for simultaneous machining and NC programming (option)

TOSNUC 999 stores in its memory all data created by the operator as NC programs. Programming is very easy by combining these programs, using various teaching functions.

●Manual teaching function

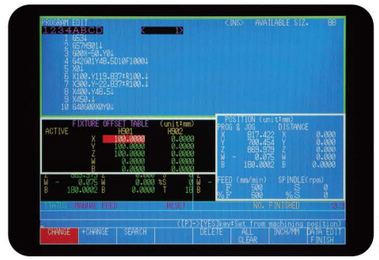
All machining data such as tool path, spindle speed and feedrate as obtained in the manual mode are stored automatically as an NC program.

●MDI teaching function

When machining processes are executed one by one consecutively in the MDI mode, all such data are stored automatically as an NC program.

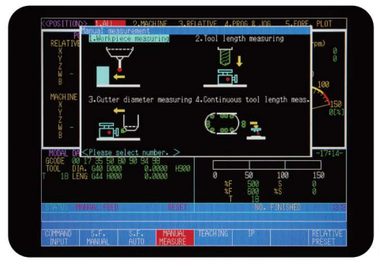
●Auto teaching function

In the AUTO or DNC mode, any data which has been modified can be fed back to the memory automatically.



Multi-window triple display

NC drawing function



Manual measurement

Various functions shown above significantly improve operability

●Manual alignment (centering) function

The touch sensor or master tool comes into contact with the measured surface of a workpiece according to the interactive screen, inner and outer diameters and angle of inclination of the specific workpiece that automatically calculates set-up.

Machine Specifications

Machine Specifications				BTD-110H.R13	BTD-110H.R16
Travel	X-axis travel (Cross movement of table)		mm (in)	1 600 (63)	2 000 (78.7)〔2 500 (98.4)〕
	Y-axis travel (Vertical movement of spindle head)		mm (in)	1 250 (49.2)	1 500 (59.1)〔1 800 (70.9)〕
	Z-axis travel (Longitudinal movement of table)		mm (in)	1 130 (44.5)	1 450 (57.1)
	W-axis travel (Spindle extension)		mm (in)	500 (19.7)	
	Distance from table surface to spindle center		mm (in)	0~1 250 (0~49.2)	0~1 500 (0~59.1)〔0~1 800 (0~70.9)〕
	Distance from table center to milling spindle gauge plane		mm (in)	410~1 540 (16.1~60.6)	550~2 000 (21.6~78.7)
Table	Table working surface		mm (in)	1 120×1 250 (44.1×49.2)	1 400×1 600 (55.1×63)
	Table loading capacity		kg (lbs)	4 000 (8 800)	6 300 (13 860)〔10 000 (22 000)〕
	Table surface configuration (Pitch of T-slots 160 mm, size 22 mm)			7T-slots	9T-slots
	Minimum table indexing angle (B-axis)			0.0001°	
Spindle	Spindle diameter		mm (in)	110 (4.3)	
	Spindle speed range		min^{-1}	5~3 000	
	Milling spindle nose diameter		mm (in)	225 (8.9)	
	Type of spindle taper hole			7/24 taper No.50	
Feedrate	Rapid traverse rate	X, Y, Z	mm/min (ipm)	12 000 (472.4)	
		W	mm/min (ipm)	5 000 (196.9)	
		B	deg/min	720	
	Feedrate	X, Y, Z	mm/min (ipm)	1~6 000 (0.04~236.2)	
Automatic tool changer (ATC)	Type of tool shank			MAS BT50	
	Type of retention knob			MAS P50T-1(45°)	
	Tool storage capacity			38〔60 90 120〕tools	
	Maximum tool diameter	When adjacent pots are filled	mm (in)	125 (4.9)	
		When adjacent pots are empty	mm (in)	240 (9.4)/T type bar φ400 (15.7)	
	Maximum tool length		mm (in)	400 (15.7)	
	Maximum tool mass		kg (lbs)	25 (55)	
	Tool selection			Pot address random short-cut	
Spindle drive motor	(30 min./cont. rating)		kW (HP)	AC 15/11 (AC 20/15)〔AC 22/18.5 AC 30/22 (AC 30/25 AC 40/30)〕	
Power source	Electrical power supply			AC 200/220 V±10%, 50/60 Hz ± 2%	
	Power capacity		kVA	45〔62〕	
	Compressed air supply	Pressure	MPa (psi)	0.5~0.8 (72.5~116)	
		Flowrate	Nℓ/min (Ngal/min)	800 (211)	
Machine size	Machine height		mm (in)	3 750 (147.6)	4 000 (157.5)〔4 300 (169.3)〕
	Floor space		mm (in)	5 050×5 470 (198.8×215.4)	5 130×6 560 (202×258.3)〔5 730×6 560 (225.6×258.3)〕
	Mass of machine (including NC equipment)		kg (lbs)	22 000 (48 400)	28 000 (61 600)〔29 000 (63 800)〕
Accuracy	Positioning accuracy	X, Y, Z	mm (in)	±0.005 (±0.0002)/full length	
		W	mm (in)	±0.010 (±0.00039)/full length	
	Repeatability	X, Y, Z	mm (in)	±0.003 (±0.00012)	
		W	mm (in)	±0.008 (±0.00031)	
	Table indexing accuracy	(arbitrary angle)	sec	±3	
	Table indexing repeatability	(arbitrary angle)	sec	±1.5	
Painting color				R4-383 (Munsell 5Y8.4/0.5) and N2.5 (For the NC system, servo motors and cooler, each maker's standard colors shall apply)	

Note : Dimensions in brackets〔 〕are option.
Note : Dimensions in brackets〔 〕are wide stroke type (option).
Note : When measuring accuracy, there shall be no load on table.

The values in the specifications indicate the maximum capacity. If a continuous operation is required at the maximum capacity, please contact us for consultation.

Accessories (Machine)

BTD-110H R13,R16

Standard Accessories

1. Numerical control system TOSNUC 999
2. Machine operation box (pendant type)
3. Automatic tool changer tool storage capacity 38
4. Automatic spindle clamping unit
5. Spindle orientation stop function
6. Spindle speed drop monitoring function
7. Constant volume mist unit for spindle bearing lubrication
8. Spindle head cooling unit (main bearings, motor flange oil jacket)
9. Spindle centering unit
10. Handwheel feed unit (portable) for X, Y, Z, W and B axes
11. Scale feedback for X, Y, Z and B axes
12. Automatic table random angle indexing unit (every 0.0001°)
13. Automatic table clamping unit (hydraulic)
14. Table oil pan
15. Saddle slideway cover
16. Bed slideway cover
17. Auxiliary slideway cover
18. Column front cover
19. ATC rail cover
20. Tool-magazine front cover
21. Coil conveyor (built in bed)
22. Work light (spotlight)
23. Hydraulic unit for spindle head hydraulic pressure and lubrication (including cooling unit)
24. Plug socket for connecting an external device (100 V AC, 5 A)
25. Assembly and reassembly tools for maintenance
26. Installation parts
27. Operator call lamp (1 color; yellow)
28. Auto power OFF unit

Options (Machine)

1. Extended X-axis travel (Cross movement of table) 2 500mm(98.4in)
2. Extended Y-axis travel (Vertical movement of spindle head) 1 800mm(70.9in)
3. Table Loading Capacity 10ton
4. Flood coolant set
   - Lift-up chip conveyor (incorporating coolant tank)
     Mainly used for cast and steel milling chips.
     Processing capability 3 ℓ/min (0.8 gal/min)
   - Flood coolant unit
     Pump capacity 50 ℓ/min, head 5m (13.2 gal/min, head 16.4 ft)
     Tank capacity 330 ℓ (87.1 gal)
5. Through-tool type coolant set
   - Flood coolant set
   - Through-tool type coolant unit
     Pump capacity 1.2 MPa (170 psi)
6. Coolant/Air blow set
   [It's necessary to attach air compressor 15 kW (20 HP)]
   - Flood coolant set
   - Through-tool type coolant set
   - Coolant/Air blow unit
7. Through-spindle type coolant set
   - Flood coolant set
   - Through-spindle type coolant unit (with large sized coolant tank)

   Note : In this case, spindle head unit is changed.
   Coolant set cannot be selected at the same time, Please select either one.
8. Chip blow air unit
   [It's necessary to attach air compressor 15 kW (20 HP)]
9. Intermittent coolant unit
10. Chip bucket (C) Capacity 1.8m^3 (6.3ft^3)
11. Type of retention knob MAS P50T-2 (30°)
12. Attached retention knob MAS P50T-1 (45°), P50T-2 (30°)
13. Automatic tool changer
    - Tool storage capacity 60, 90, 120
      (When installing a 60-tool, 90-tool and 120-tool magazine, the required floor space exceeds the standard one.)
14. Automatic pallet changer
    - Table loading capacity max 4 500 kg (9 900 lbs)
15. Spindle lock device (at random angle)
16. Angle head (spindle taper hole: JIS 7/24taper No.50)
17. Rotating facing head C
    - Outer diameter 600 mm (23.6 in)
    - Tool slide travel 150 mm (5.9 in)
18. Rotating facing head CS
    (accuracy improved type possible to do spherical surface boring)
    - Outer diameter 430 mm (17 in)
    - Tool slide travel 80 mm (3.1 in)
19. Tool holder for rotating facing head C
20. Telescopic tool holder for rotating facing head C
21. Tool holder for rotating facing head CS
22. Automatic measuring function and dedicated touch probe (FM ware type)
    - Program storage capacity reduces approximately 50 m (164 ft)
23. Calibration block (for automatic measuring function)
24. Automatic tool length measuring function
25. Reference tool (for automatic tool length measuring function)
26. Test bar φ60×310mm (2.4×12.2 in)
27. Table reference piece
28. B-axis setup compensation function (Shift of workpiece setup position in B-axis direction is automatically measured and compensated.)
    Automatic measuring function option is required.
29. Continuous table indexing device 0.0001° (NC rotary milling operation)
30. Z axis thermal displacement compensation
31. High accuracy method
    (Low level thermal displacement, during spindle rotate also in high speed)
    - Hydraulic unit with 9.7kW (13.2HP), {8 000 kcal/H} inverter controlled oil cooler
    - Z axis thermal displacement compensation
32. Out side auxiliary slideway (Z axis) [BTD-110H. R16]
33. Chip cover A (simple and detachable)
34. Chip cover B
35. Tool-magazine guard B
36. Coil conveyor B (fixed on saddle)
37. External M code 8 types
38. High power type spindle drive motor AC 22/18.5 kW (30/25 HP); 30 min/cont.
39. High power type spindle drive motor AC 30/22 kW (40/30 HP); 30min/cont.
40. High speed type spindle
    - Spindle speed range 40~8 000 min^{-1}
    - Spindle drive motor AC26.5/22kW(35/30HP);30min/cont.
41. Long nose type spindle head [extension is 200mm (7.9in)]
    [The spindle extension is 500mm (19.7in) same as standard.]
42. Operator call lamp (3 colors)
43. Residual current operated protective device.
44. Customer's specified painting color
    - Submit a color sample to us.
    - For internal painting color, however, our standard color shall govern.
45. Safety specification conformity with CE mark.
46. Safety specification conformity with CSA (CANADA).

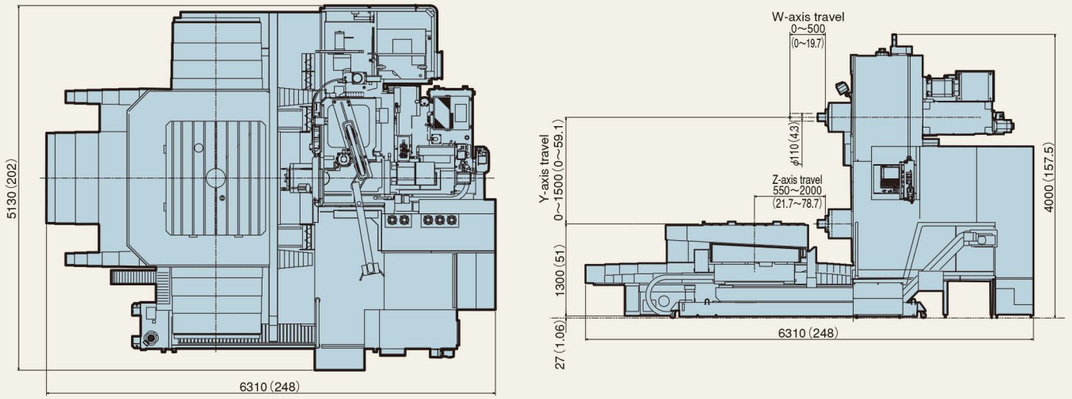
Note : Air source to be supplied by customer.
Note : In case Air compressor (AC200V 7.5kW) is used, customer is required to prepare it's initial power source.
Note : Use a fire-resistant water-soluble coolant.

General views

General views

mm (in)

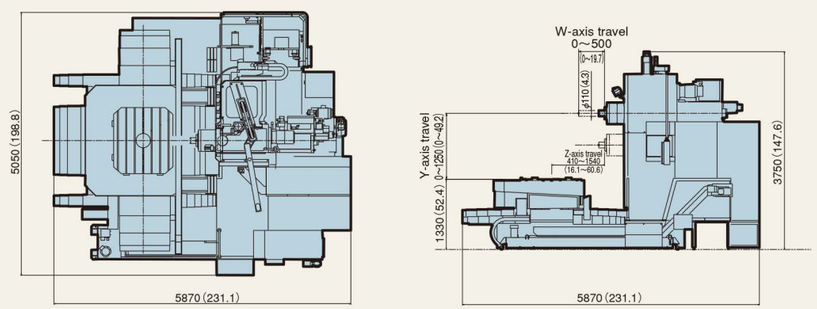
BTD-110H.R16



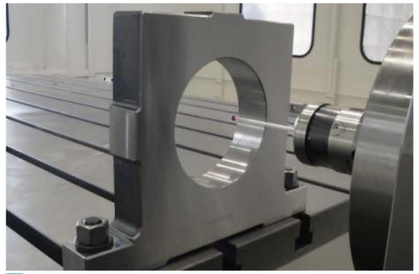
BTD-110H.R16(APC)

Note : Drawing refers to machine with 60 tool magazine and Pack B type chip cover.

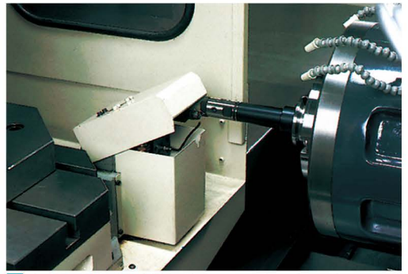
BTD-110H.R13



Available options

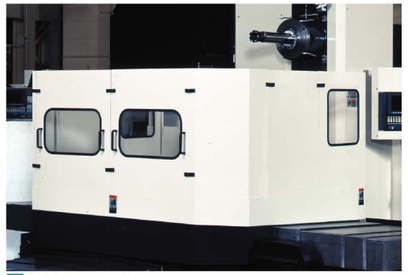


22 Automatic measuring function

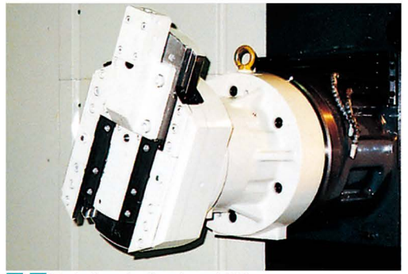


24 Automatic tool length measuring function

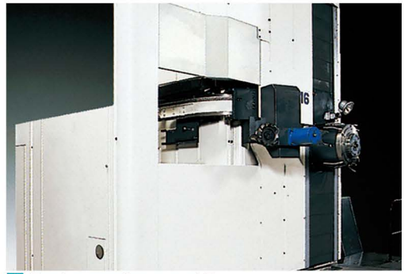
16 Angle head



33 Chip cover A



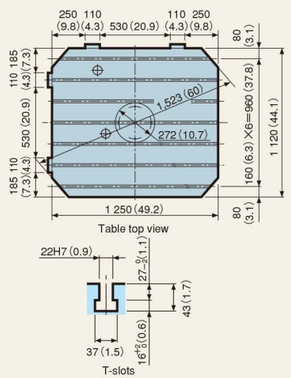
18 21 Rotating facing head CS



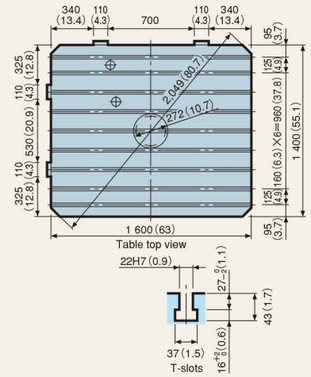
35 Tool-magazine guard B

Table top view

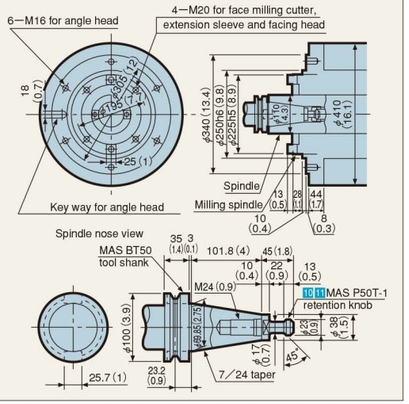
BTD-110H.R13



BTD-110H.R16



Dimension of spindle nose



CNC System TOSNUC 999

BTD-110H R13,R16

User media (option set B)

Very useful device for managing long programs.

Pendant operation box

Manual operations relating to machine movements are separated from the NC operation unit and centrally arranged on the pendant operation box. Thus, combined NC and manual machining operations can be performed smoothly.

CNC System Specifications TOSNUC 999

Standard Specifications

●Controlled Axes

Controlled axes	5 axes : X,Y,Z,W,B
Simultaneously controlled axes	3 axes (X, Y, Z) for positioning (G00) and linear interpolation (G01) 2 axes (any two axes excluding W- and B-axes) for circular interpolation (G02, G03)

●Programmable Methods

Programming resolution	Linear axis : 0.001 mm Rotating axis : 0.0001°
Maximum programmable dimension	Linear axis : ±99999.999mm Rotating axis : ±9999.9999°
Data code	Automatic recognition of ISO/EIA code JIS B6311 ISO 6983/1 EIA RS-358-B EIA RS-244-B
Data format	Variable block with a decimal point word address format
Absolute/incremental programming	G90/G91
Decimal point input	Calculator type/Programming resolution type

●Interpolation

Positioning	G00
Linear interpolation	G01
Circular interpolation	G02/G03: CW/CCW

●Feed

Feedrate	F5-digit programming in mm/min
Dwell	G04 (0 ～ 999.99 sec)
Handwheel feed (portable)	Linear axis : 0.001/0.01/0.1 mm (per division) Rotary axis : 0.0001/0.001/0.01° (per division)
Continuous jog feed	
Rapid traverse rate override	0 ～ 100 % in 10 % increments
Feedrate override	0 ～ 200 % in 10 % increments
Override cancel	M48/M49
Automatic acceleration/deceleration	Linear acceleration or deceleration is effected on rapid traverse rate and jog feedrate.
Automatic acceleration/deceleration for feed	G08/G09 G50/G51

●Part Program Storage and Edit

Program storage	150 m equivalent punched tape (To be reduced as per the attached functions.)
No. of registrable programs	128 (To be reduced as per the attached functions.)
Program edit	Various editing operations are possible for stored programs.
Background edit	Program deletion, insertion and modification are possible in the background edit mode.
Program name	$ (or O)8-digit programming (alphanumeric characters)
Program comment	No. of displayed characters max. 32 (max. 197 for input)
Control in/out	
Sequence number	N5-digit programming
Sequence number search	Bidirectional search is possible.
Program nesting list	
Fixture offset list	
T-code list	
Calendar timer	Program creation date management, time display

●Operation and Display

Operation panel	Display section: 10.4 inch color TFT liquid crystal display Operation section: Keyboard with membrane switches
Customizing keys	A series of key input operations (key pattern) can be registered. (6 types) A combination of screens can be registered. (4 types)
Tool file	Tool information such as tool offset and tool name can be batch-displayed and edited.
Automatic operation	Memory operation and DNC operation
MDI operation	Entry of multiple blocks and restart of an already executed block are possible.
Manual numerical input command	
S.F manual setting	Setting of S and F codes in manual mode.
S.F auto setting	Automatic setting of S and F codes in manual mode.
Spindle drive motor load factor display	Load imposed on spindle drive motor is displayed.
Run hour display	The NC working time is displayed.
Program record	A record of programs already executed is displayed. (Date of program execution, actual time, etc.)
Customized display color tone	

●I/O functions and Devices

RS232C interface port A	Operation via external device, loading and dumping of programs and data are possible.

●S, T and M Functions

Spindle speed function	S5-digit programming
Spindle speed override	50 ～ 200 % (in 10 % increments)
Tool function	T4-digit programming
Miscellaneous function	M4-digit programming

●Tool Offset

Tool length offset	G43/G44/(G49)
Tool offset	G45/G46/G47/G48
Cutter compensation C	G40/G41/G42, point of intersection calculation
No. of tool offsets	60 sets (tool length offset, cutter compensation)

●Coordinate System

Coordinate system setting	G92
Machine coordinate system positioning command	G73
Plane selection	G17/G18/G19
Fixture offset	G53/G57, 9 sets (This function cannot be used together with fixture offset 2.)
Fixture offset 2	G53/G54/G55/G56, 3 sets

●Operation Support Function

Single block	A program can be executed block by block.
Optional stop	
Optional block skip	A block containing a "/" code at the head is ignored.
Dry run	
Machine lock	
Auxiliary function lock	
Z-axis feed cancel	
Manual absolute ON/OFF	
All clear	
Reset	
Feed hold	
Cycle stop	
Program restart	Program restart, block restart
Sequence number collation and stop	
Manual interruption	
Handwheel feed interruption	

●Programming Support Function

Circular interpolation by radius R designation	Radius of a circle can be specified directly, using R code.
Circle cutting	Inner circle cutting: G12/G13, G22/G23 Outer circle cutting: G222/G223
Canned cycle	G77 ～ G89, G98, G99, G100, G186
Subprogram call	G72 (Nesting of up to five levels is possible.)
Macro programming	Single call: G72 Modal call 1: G74/G76 Modal call 2: G75/G76
Automatic corner override	Inside corner automatic override and inside corner cutting speed change.
Pattern cycle	G109 ～ G119 (Drilling pattern) G121 ～ G132 (Milling pattern)
Programming format check function	Program format check
Tapping range selection	G63
Single block suppression	G990/G991
Feed hold suppression	G992/G993
Override suppression	G994/G995
Handwheel feed interruption suppression	G996/G997

●Mechanical Error Compensation

Backlash compensation	
Pitch error compensation	
Pitch error gradient compensation	
Origin correction	X-axis shift from table center is corrected.
Unidirectional positioning	G60
Straightness compensation	
Non-linear type compensation control	

●Automatic Support Function

Tool life management	
・Counting of tool working time	
・Tool wear coefficient function	Tool life and workingtime are counted by multiplying a specified coefficient.
・Spare tool selection	

●Machine Control Support Function

Integrated PLC	TC200
Axis feed interlock	

●Safety and Maintenance

Emergency stop	
Stored stroke limit	
Axis interference area setting and axis interference check	G24/G25, G26/G27
Self-diagnosis function	
Door interlock	

●Servo System

Servo motor	AC servo motors
Position detectors	Absolute encoders (All axes: Absolute position detection) Rotary scale (B-axis)

Special Specifications (Options)

Options - Set B

(1)Helical interpolation	G02/G03 (arc + linear)
(2)Synchronous tapping	M843, M844, M845
(3)Part program storage	300 m equivalent punched tape (No. of registrable programs: 256)
(4)User media	(USB port and compact flash slot) For loading and dumping of NC programs and tool offset data.
(5)No. of fixture offsets	99 sets (including the standard sets)
(6)Random angle chamfering & corner R	
(7)Manual alignment function	Including manual tool length/diameter measurement and coordinate conversion (G10/G11).
(8)Teaching function	Automatic program creation by MDI and manual operations.
(9)W-axis offset function	G173 W-axis extended position is compensated with Z-axis fixture offset.

Other Options

● Controlled Axes

(1)One additional controlled axis	

●Programming Methods

(2)Inch/metric selection	G70/G71

●Interpolation

(3)Parabolic interpolation	G06
(4)Hypothetical axis interpolation (i.e., interpolation with sine curve)	G07
(5)Cylindrical interpolation	G67
(6)Involute interpolation	G105
(7)Spindle normal direction control (Spring necked turning)	G140/G141/G142
(8)Archimedes interpolation (Spiral interpolation)	G102/G103

●Feed

(9)Synchronous thread-cutting	
(10)Per-revolution feed	G95
(11)Per-revolution dwell	G05

●Part Program Storage and Edit

(12)Part program storage	600 m equivalent punched tape (No. of registrable programs: 512) 1,200 m equivalent punched tape (No. of registrable programs: 1024) 3,000 m equivalent punched tape (No. of registrable programs: 1024) 5,400 m equivalent punched tape (No. of registrable programs: 1024) 7,800 m equivalent punched tape (No. of registrable programs: 1536) 10,200 m equivalent punched tape (No. of registrable programs: 1536)
*(13)Mass memory	2 GB

●I/O Functions and Devices

(14)Remote buffer operation	(including port C connection)
*(15)High-speed LAN linkage	File transfer by connecting CNC and LAN.

●Tool Offset

(16)No. of tool offsets	No. of tool length offsets: 499 sets (including the standard sets) No. of cutter compensations: 499 sets (including the standard sets)
(17)Three-dimensional tool compensation	G30/G31

●Operation Support Function

(18)Foreground plotting function	A tool locus of active program is plotted.
(19)Additional number of optional block skips	Max. 9

●Programming Support Function

(20)Programmable mirror image	G62/G66
(21)Programmable data input	Updating of offsets by G58/G59.
(22)Scaling	G64/G65
(23)Plane conversion	G35～G39
(24)Three-dimensional coordinate conversion	G14
(25)Figure copy function	G721/G722
(26)Circle cutting compensation	
(27)Machining time estimate & NC plotting function	Machining time estimate and tool path plotting for non-active program on the background.
(28)Pattern cycle division into NC statements	
(29) W axis travel distance Conversion function	

●Automatic Support Function

(30)Faulty cut detection & feedrate regulation function	Tool breakage and wear detection Feedrate regulation Note)Counting of tool working time and spare tool selection are included in the standard specifications.
(31)Program check & used tool list creation	Check of a program to be executed next and creation of a slated tool list.
(32)Cutting start detection	Used for spot facing, etc.

●Safety and Maintenance

(33)Memory lock	

●High-Accuracy Machining & Servo System

(34)Shape recognition preview positioning control	
(35)NURBS interpolation	

●Cable

(36)RS232C cable	10 m-long