

SPEC NO. CX86810

FOR H53291

CUSTOMER: NASA JET PROPULSION LABORATORIES

MITSUBISHI 5 AXES MACHINING CENTER

MOD EL : **M-H60D-5T**

SPECIFICATIONS



MECH. DSGN.

ELEC. DSGN.

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- | | |
|----------------------|-------------|
| : Foundation Drawing | 004CD083702 |
| : General View | 001CD083601 |

1. PREFACE**1. PREFACE**

This machine is constructed by Mitsubishi's standard horizontal machining center DIACENTER M-H60D as the base machine and standard pallet tilting table as 5th axis table unit.

Mitsubishi 5 axes machining center series have 4 types as the following.

TYPE A: The 4th and 5th axes are mounted on spindle unit.

This type is applied mainly for large size machining centers such as horizontal boring mill and plano machining center, gantry type milling machine.

TYPE B: The 4th axis is equipped on spindle head and the 5th axis on work table.

This type is also applied mainly for large size machining centers.

TYPE C: Tilting table contains the 4th and 5th axes.

This type is applied mainly for middle size horizontal machining centers.

Rotary table is mounted on tilting indexing table.

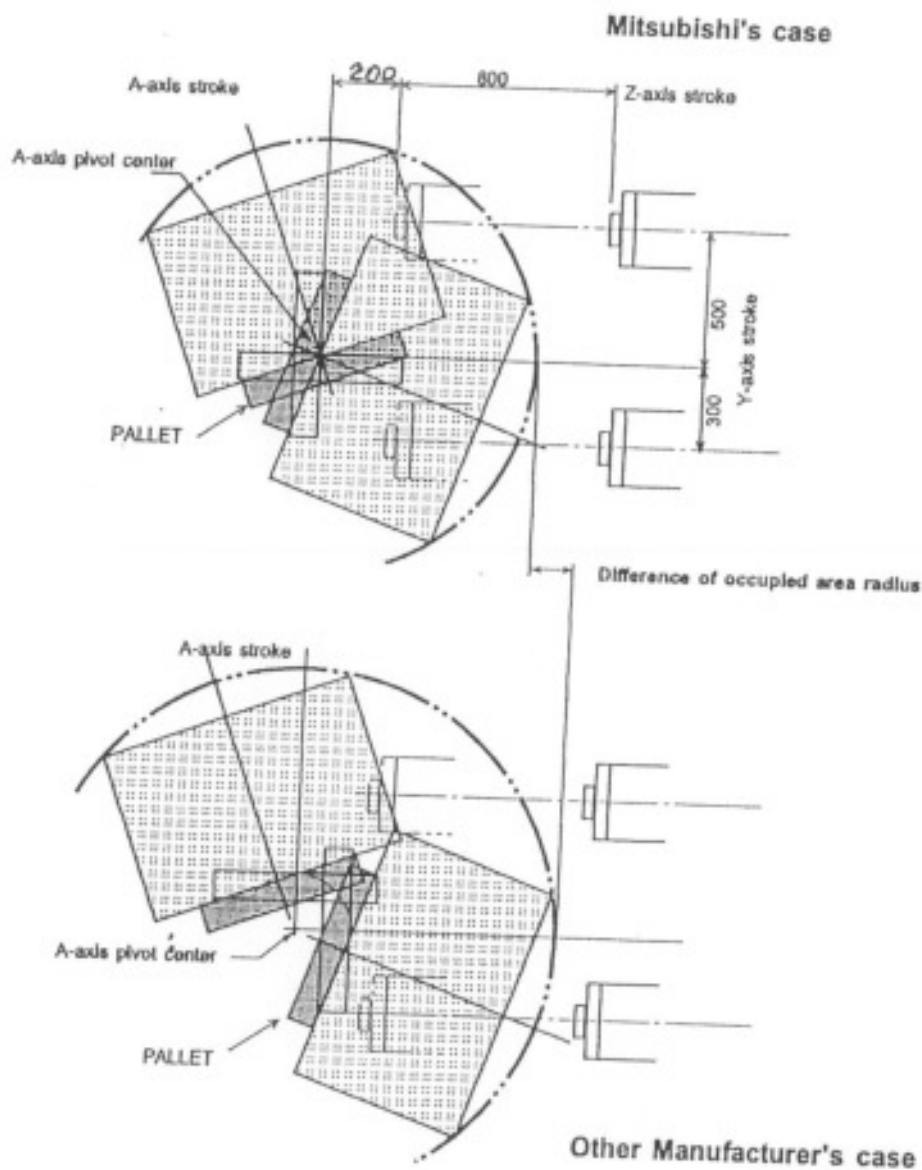
TYPE D: Tilting table as the 5th axis is mounted on horizontal table as the 4th axis.

Special Type: Usual 3 axes type machine plus tilting work table.

This type is usually used as the forth tilting axis is indexed and clamped. The advantage of this application is easier programming (usual machining center programmer can do the programming) and used mainly at Die manufacturing.

2. FEATURES

2.1 WIDER MACHINING AREA - BY LOCATING A-AXIS CTR ON PALLET FACE -



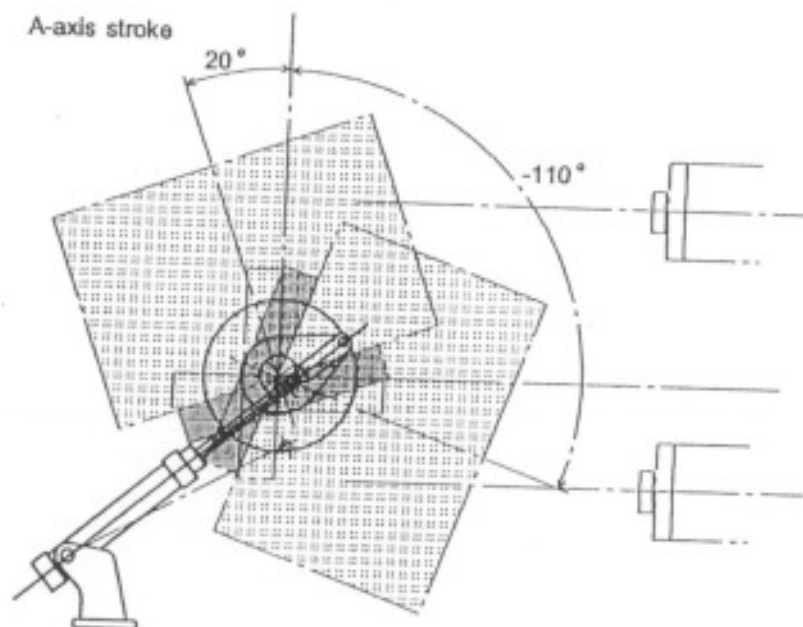
1) The pallet surface height at horizontal position is the same line of the tilting center, therefore either the pallet is horizontal or vertical position, enough Y and Z axis stroke can be obtained for wider variety of parts and machining.

2) An APC (automatic pallet changer) is equipped as a standard. Therefore, the part setup for the next pallet can be carried out while the previous part is being machined.

2. FEATURES

2.2 BALANCING for A-AXIS ROTATION

A balancing mechanism system by hydraulic cylinder is equipped on the A axis drive mechanism. This mechanism makes good balance for large weight part during its tilting motion. Therefore, accurate positioning can be obtained on any tilting angle.



Note 1: The A-axis direction's load varies by the fixture, part and A-axis tilted angle. At Mitsubishi's machine, the unbalancing load to the rotating center is supported by the above BALANCE cylinder. Therefore, there is no Zero load zone where the drive mechanism's backlash influences to the smoothness at continuous motion.

Note 2: Besides the above, Mitsubishi machine applies double helical gears and double lead worm gear set to prevent any harmful backlash.

2. FEATURES

2.3 PRECISION SCALE ON ALL AXES

The Mitsubishi Precision Scale (MP scale) liner type on X, Y, Z axis, together with Mitsubishi Precision Scale Rotary type for A, B axis and Mitsubishi's unique Thermal Distortion Compensation System (TDC system) for Y and Z axes are equipped as the standard.

Therefore, higher positioning accuracy can be expected in usual environment conditions.

Note: The advantage of above TDC system is, same size of parts can be obtained at usual different temperature conditions.

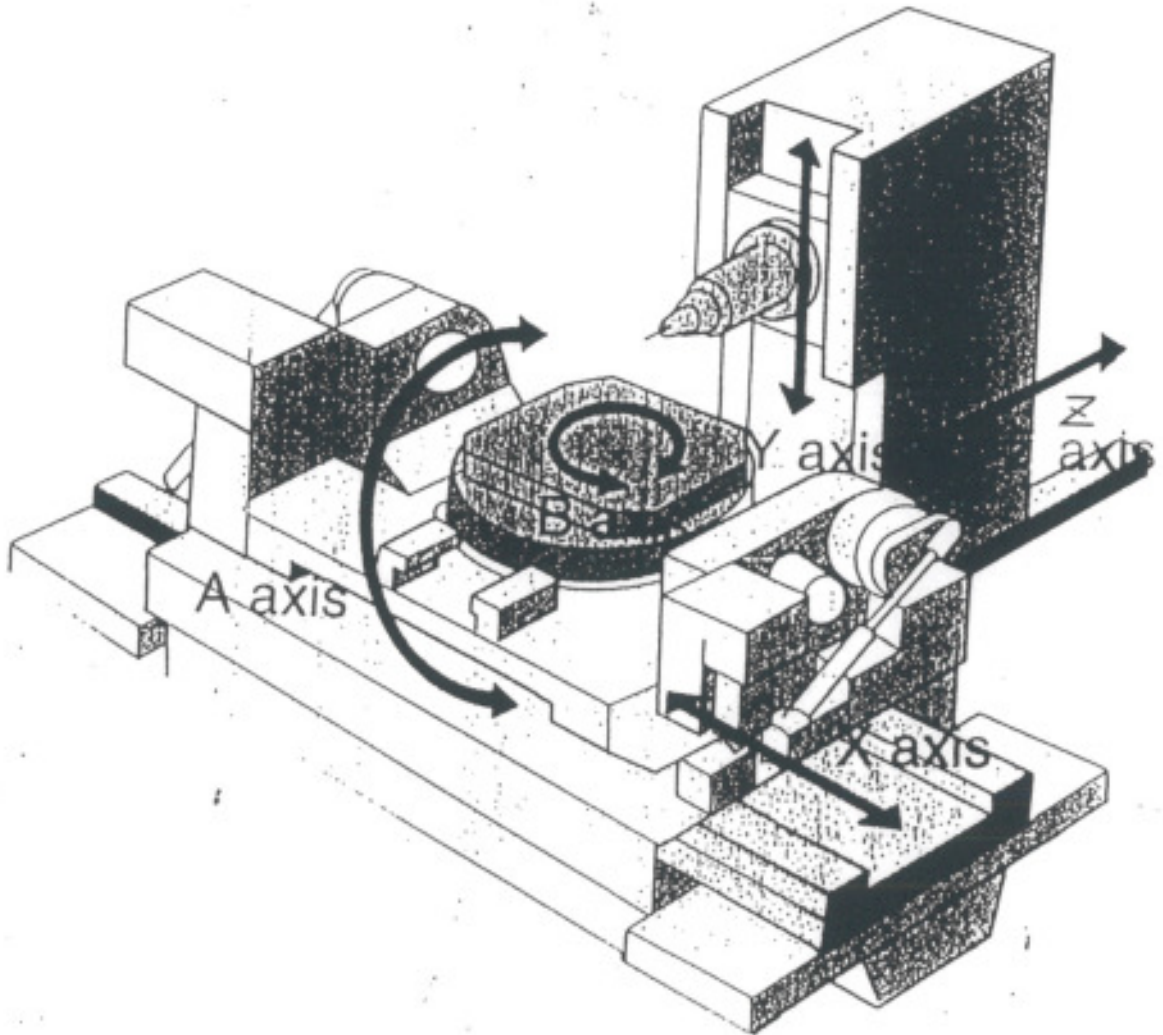
The scales for A and B axis is equipped on the tail end of the end drive shaft, therefore, there is no influence from the drive mechanism backlash or wind-up and easy for maintenance.

2.4 OTHERS

1. If the machine is used for Aluminum cutting, enough coolant showering and screw type chip conveyor both sides of the column (Z-axis) are equipped as an option for **better chip removal**.
2. This machine can be integrated into an **FMS** system by adding an FMS kit option for higher total utilization efficiency.
3. Mitsubishi Heavy Ind. Ltd. is one of the largest manufacturer and user of machine tools, therefore, enough tooling technologies can be serviced to the customer including **5 axis programming service**.

3. MACHINE SPECIFICATIONS

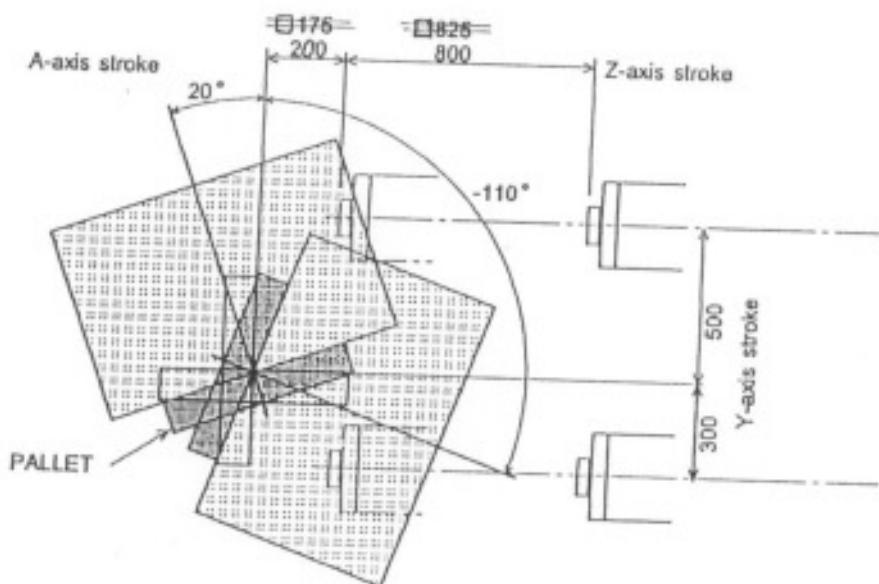
3.1 NAME OF AXES



3. MACHINE SPECIFICATIONS

3.2 AXES MOVEMENT AREA

800-532-1722



is movement

- B axis :	Horizontal indexing	0 ~ 360deg
- A axis :	Vertical indexing	20 ~ -110deg
- X-axis travel for table	Total travel	1,000mm
	From spindle center	± 500mm
- Y axis travel for head stock	Total travel	800mm
	Above pallet face	-300 ~ +500mm
- Z-axis travel for column	Total travel	800mm
	From spdl face to table ctr. Std.	200-1,000mm
		<input type="checkbox"/> 175-1,000mm
- Rapid traverse rate	X	12,000m/min
	Y	20,000m/min
	Z	15,000m/min
	B	1,200degrees/min
	A	600degrees/min
- Cutting feed rate	X,Y,Z	std. 1 - 4,000mm/min
		<input checked="" type="checkbox"/> 1-10,000mm/min
	B	0.1-720degrees/min
	A	0.1-360degrees/min

3. MACHINE SPECIFICATIONS

3.3 MAIN SPINDLE

■ Standard □ Optional ☑ Quoted

SPEED

4 choices are provided

- | | | |
|--|-------------------|-----------------------|
| <input checked="" type="checkbox"/> Standard | 30 to 4,000 rpm | (infinity variable) |
| <input type="checkbox"/> High speed | 40 to 6,000 rpm | (") |
| <input checked="" type="checkbox"/> Super high speed | 200 to 10,000 rpm | (") |
| <input type="checkbox"/> Heavy cut | 10 to 3,200 rpm | (") |

POWER

2 choices are provided

- | | | |
|--|------------|-----------------------|
| <input checked="" type="checkbox"/> Standard | AC 18.5 kw | (30 minutes rating) |
| <input type="checkbox"/> For Heavy cut only | AC 22 kw | (") |

SPINDLE NOSE

4 Choices are provided

- | | | |
|--|----------------|---------------------|
| <input checked="" type="checkbox"/> Standard | ISO N.T. No.50 | (MAS-2 pull stud) |
| <input checked="" type="checkbox"/> NMTBA | NMTBA C.V. 50 | (MAS-2 pull stud) |
| <input type="checkbox"/> DIN | DIN | |
| <input type="checkbox"/> Other special requirement | | |

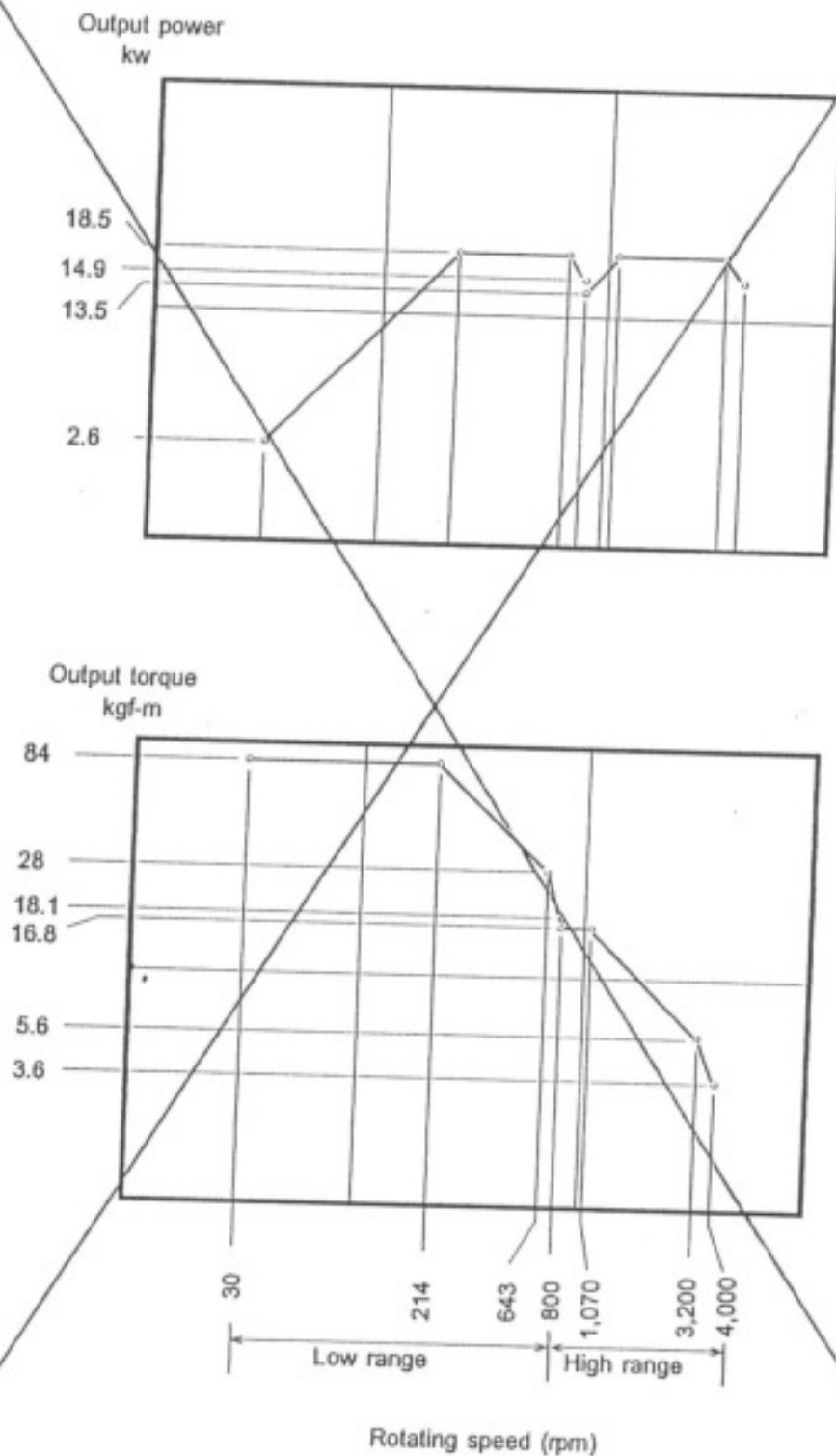
NOTES:

- Spindle diameter is 100 mm as the standard
- 120 mm for Heavy Cut type and
- 80 mm for Super High speed type
- Spindle cooling unit is attached to all types spindle as the standard.

3. MACHINE SPECIFICATIONS

SPINDLE OUTPUT CHARACTERISTIC 1/3

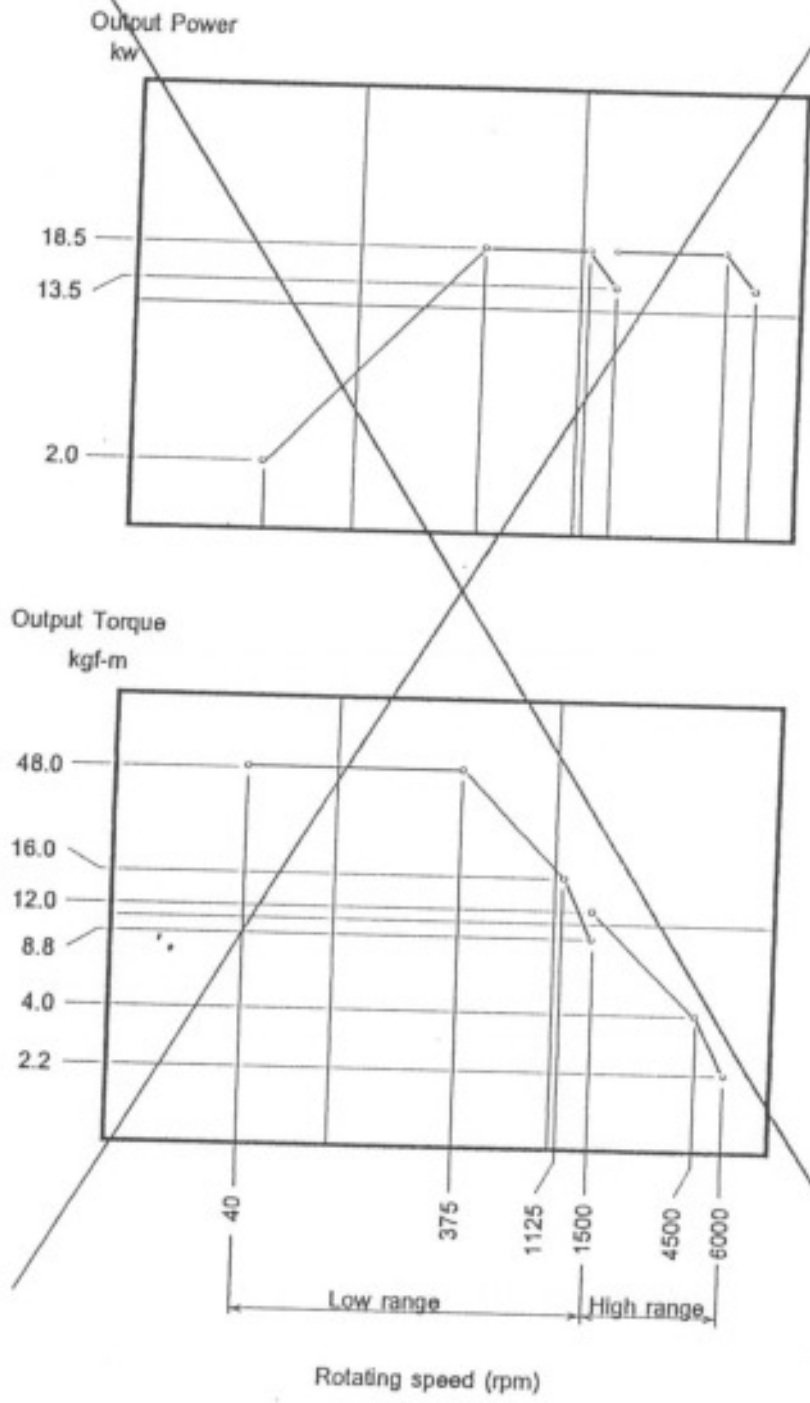
30 minutes rating



3. MACHINE SPECIFICATIONS

SPINDLE OUTPUT CHARACTERISTIC 2/3

30 minutes rating

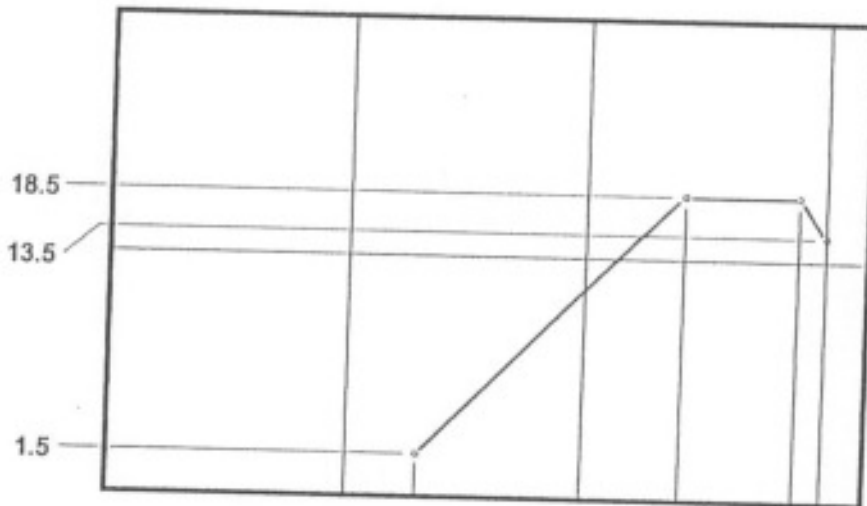


3. MACHINE SPECIFICATIONS

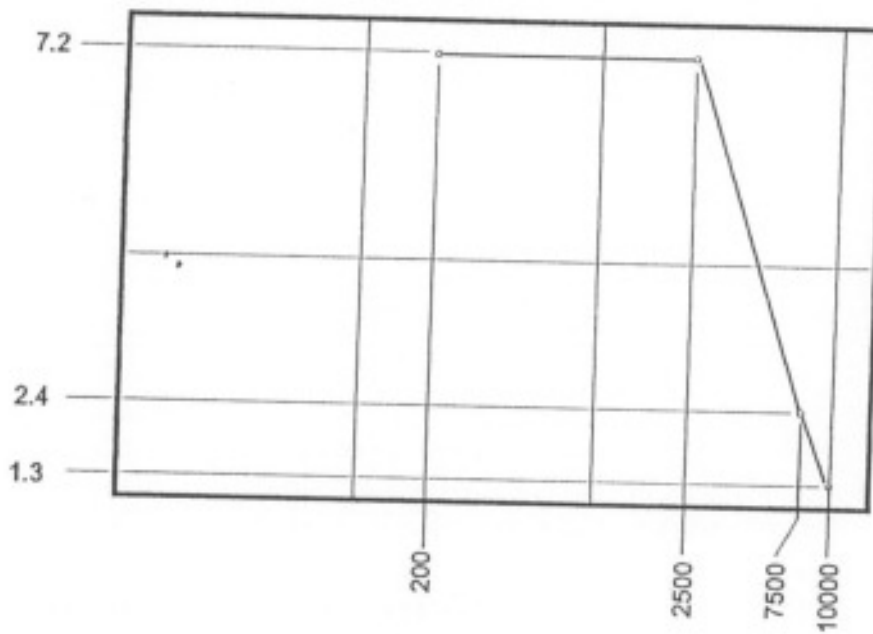
SPINDLE OUTPUT CHARACTERISTIC 3/3

30 minutes rating

Output Power
kw



Output Torque
kgf-m



Rotating speed (rpm)

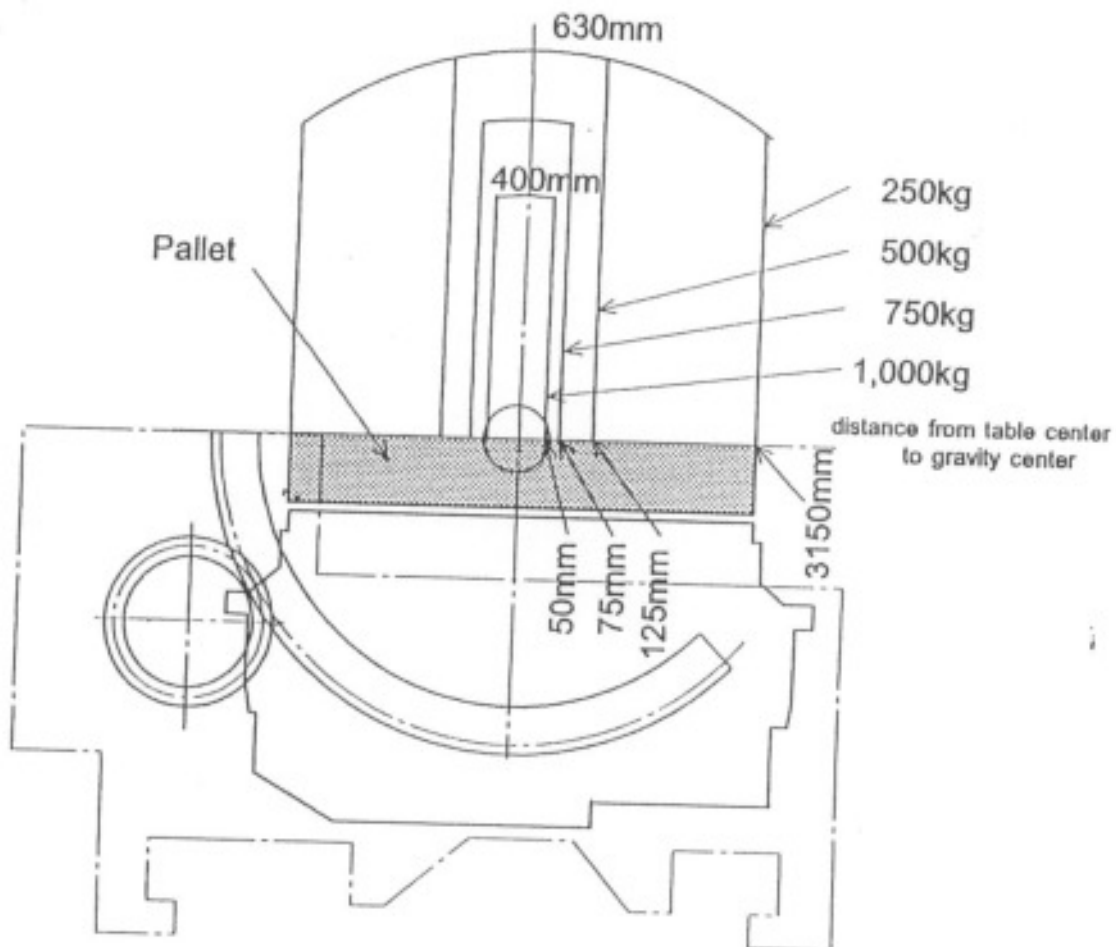
. MACHINE SPECIFICATIONS

3.4 WORK TABLE

3.4.1 APPLICABLE LOADS

- 1) X-AXIS THRUST FORCE : 1,000 kg
- 2) Y-AXIS THRUST FORCE : 1,000 kg
- 3) APPLICABLE LOAD MOMENT

The mounted materials weight and its gravity center position are limited as the following illustration. The load is expected to be supported more than 4 points and the each supporting loads are uniform as far as possible

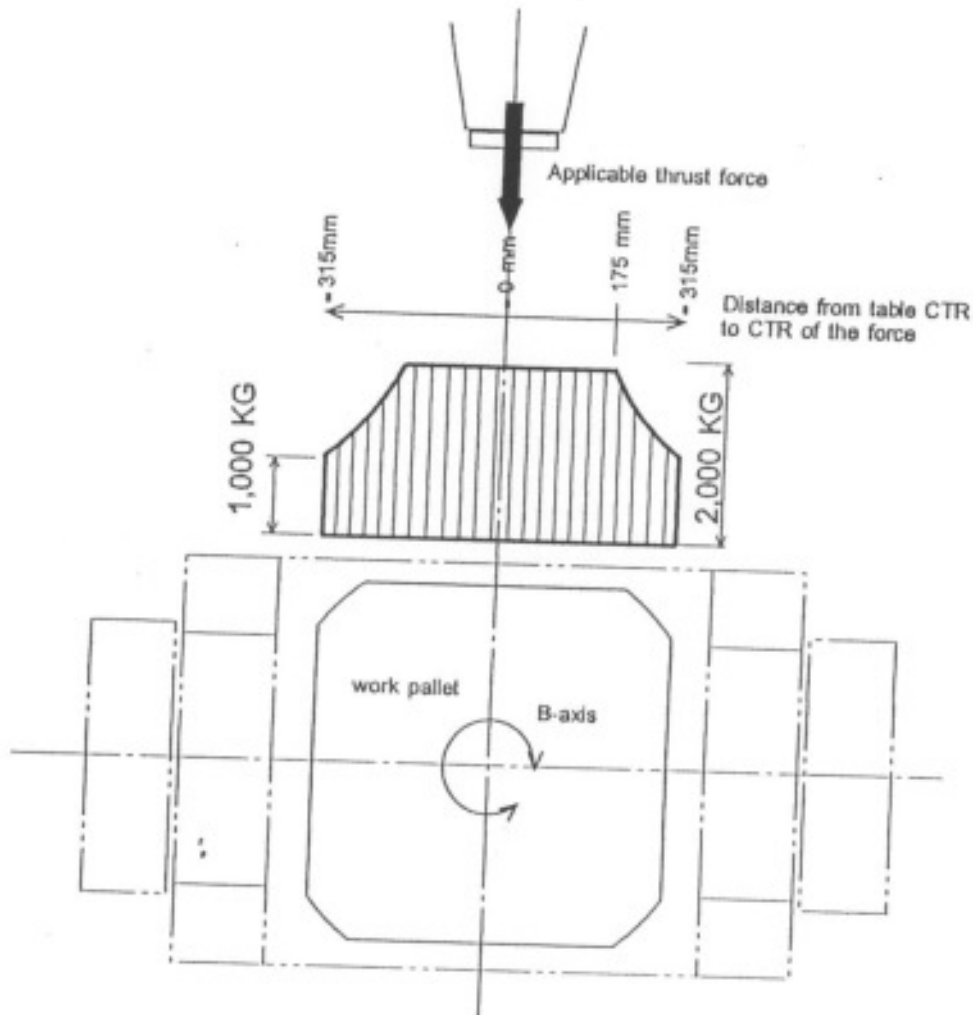


3. MACHINE SPECIFICATIONS

4) B-AXIS THRUST FORCE FORCE

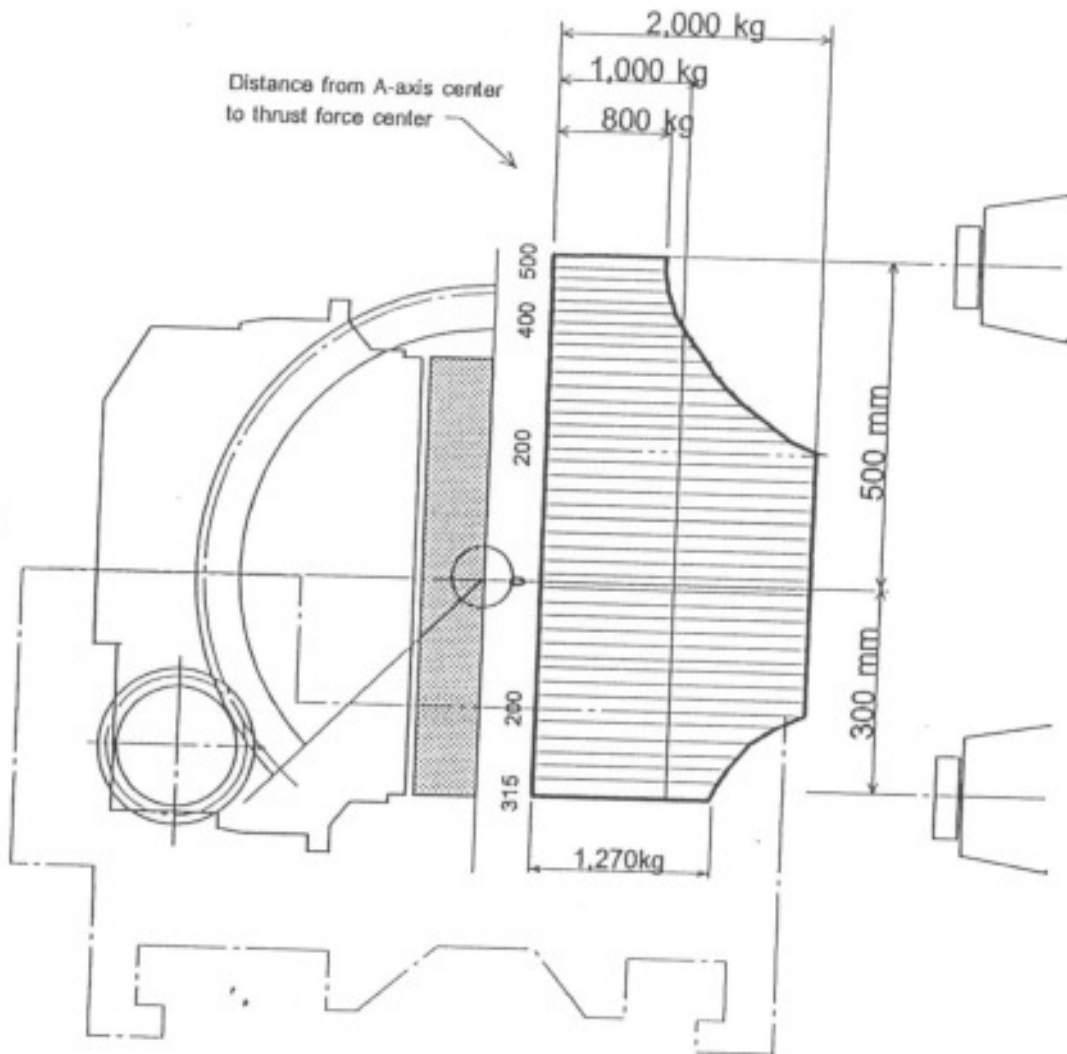
B-AXIS THRUST

The force to the B-axis is limited by the following illustration and the maximum applicable moment is at the B-axis is with clamped condition : 350 kg-m



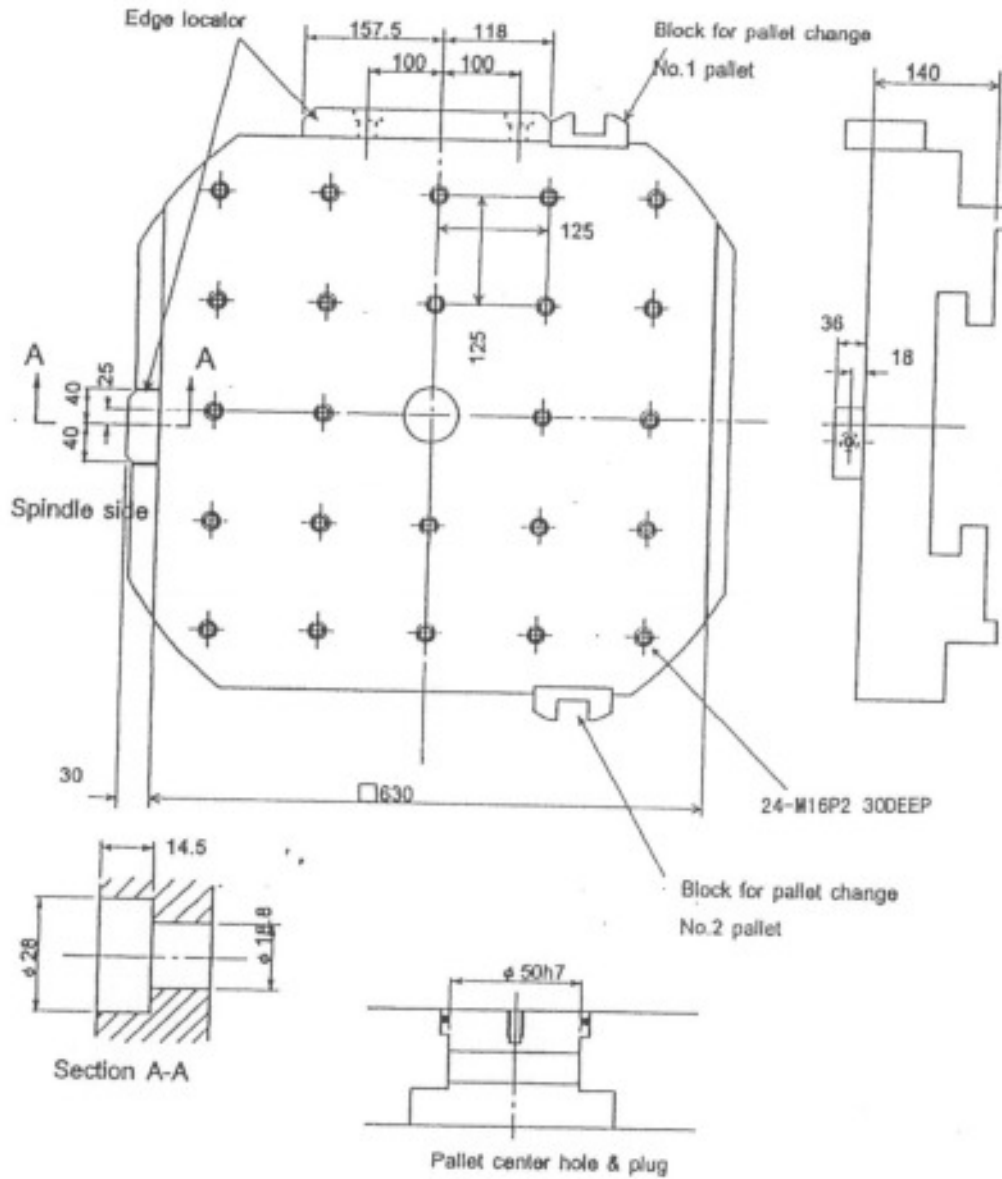
3. MACHINE SPECIFICATIONS

5) A-AXIS THRUST FORCE



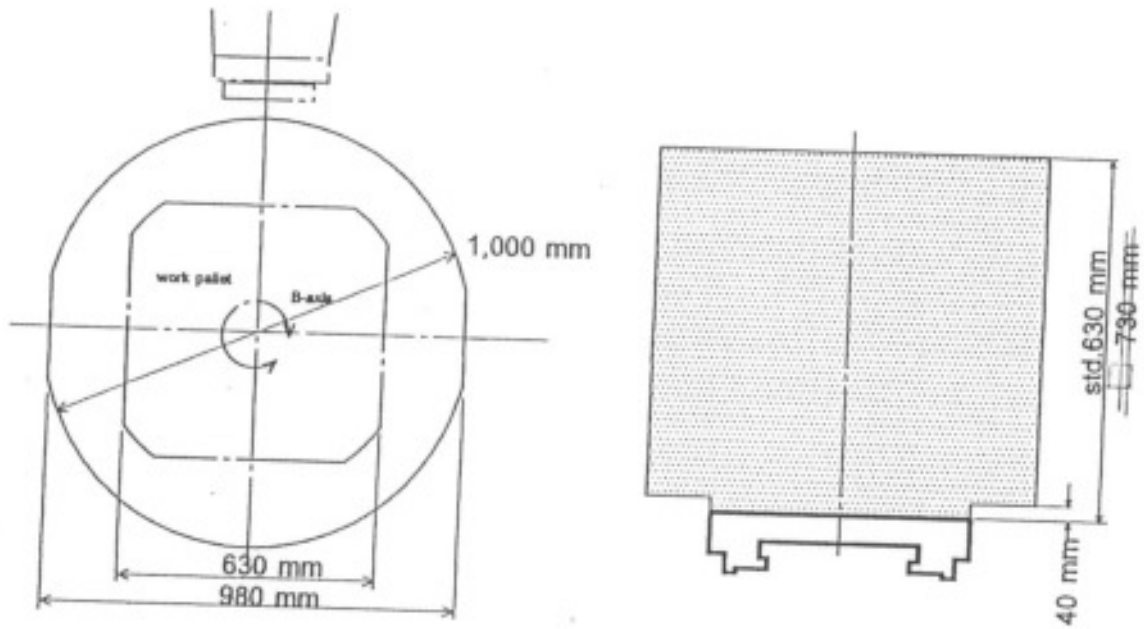
3. MACHINE SPECIFICATIONS

3.4.3 WORK PALLET DIMENSIONS



3. MACHINE SPECIFICATIONS

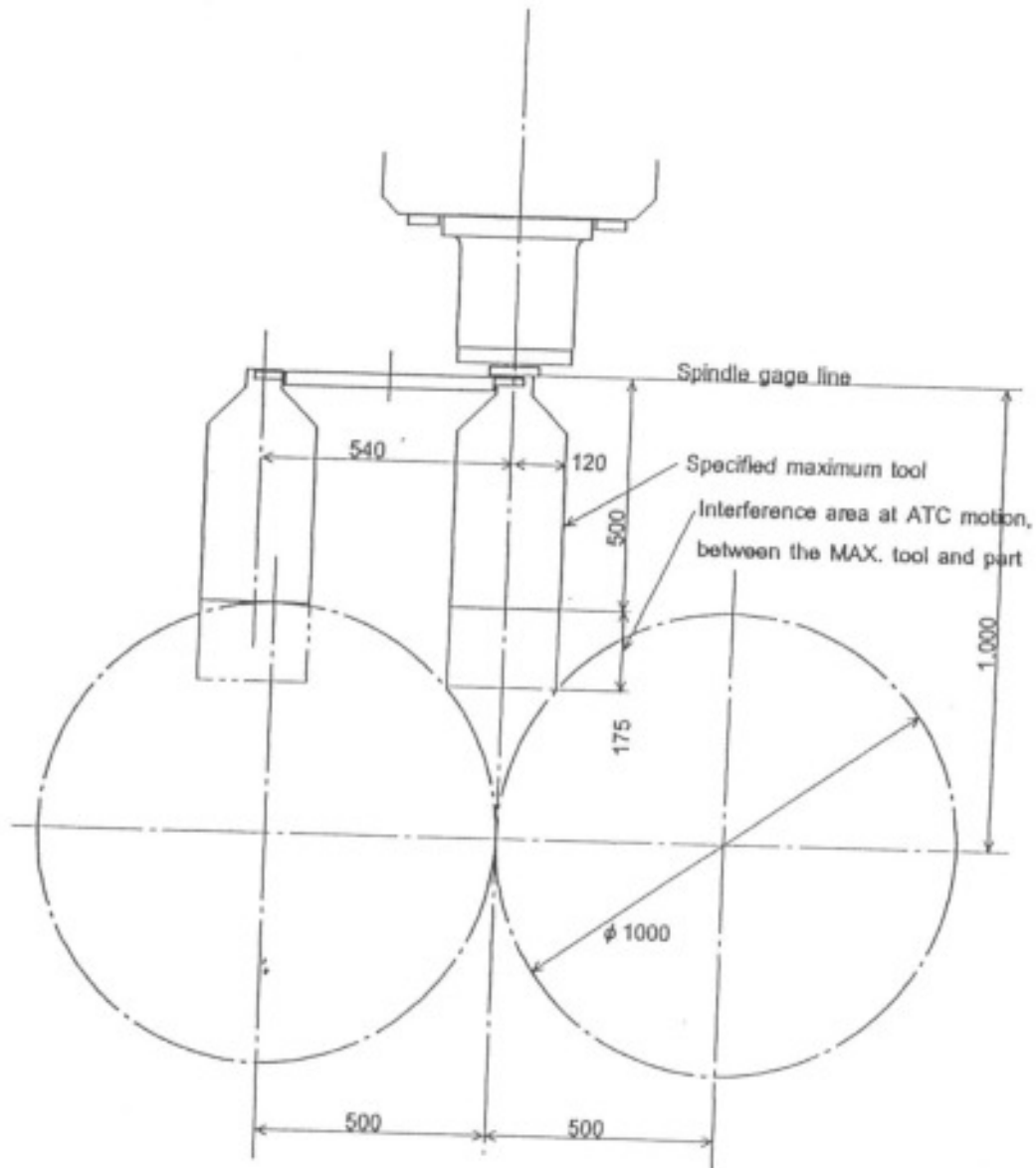
3.4.4 AREA LIMITATION OF PART AND FIXTURE



*: This dimension 40 mm can be eliminated when the edge locator is not used.

3. MACHINE SPECIFICATIONS

3.4.6 ATC POSITION

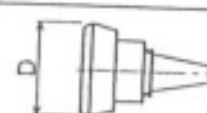
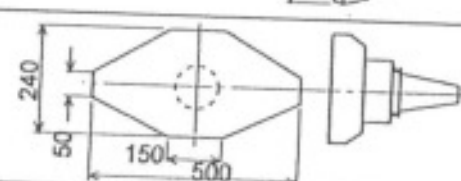

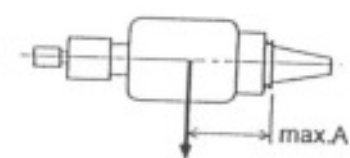


3. MACHINE SPECIFICATIONS

3.5 CUTTING TOOL

The maximum diameter of tools is ϕ 110mm.

If any larger tool is required, the following conditions can be applied under the condition of adjacent tool pots are empty.

ITEM	RESTRICTION	SKETCH									
DIAMETER D	Face Mill : 240 mm										
	Born tool : 500 mm										
LENGTH L	: 500 mm										
WEIGHT W	<table border="0"> <tr> <td></td> <td>W</td> <td>A</td> </tr> <tr> <td>Standard</td> <td>15 kg</td> <td>150mm</td> </tr> <tr> <td>Option</td> <td>30 kg</td> <td>125mm</td> </tr> </table> <p>The weight center of tool is to be within Max. A</p>		W	A	Standard	15 kg	150mm	Option	30 kg	125mm	
	W	A									
Standard	15 kg	150mm									
Option	30 kg	125mm									

Note: 1. If a continuous half of the tool pots are occupied by tools (another half is empty), each tool is to be under 10kg to keep the balancing condition for the chain motion.

2. In case of using NMTBA CV or DIN standard tools, the weight is limited to 20 kg.

3. In case of using heavy tools more than 15 kg as an option, the cycle time of ATC will be increased as follows:

max weight 15kg : Approx. 5 sec

max weight 20 kg : Approx. 6 sec

max weight 30 kg : Approx. 7 sec

4. The total tools weight is limited to;

60 tools : 600 kg, 80 tools: 640 kg, 100 tools: 800 kg

120 tools: 960 kg, 150 tools: 1,200 kg

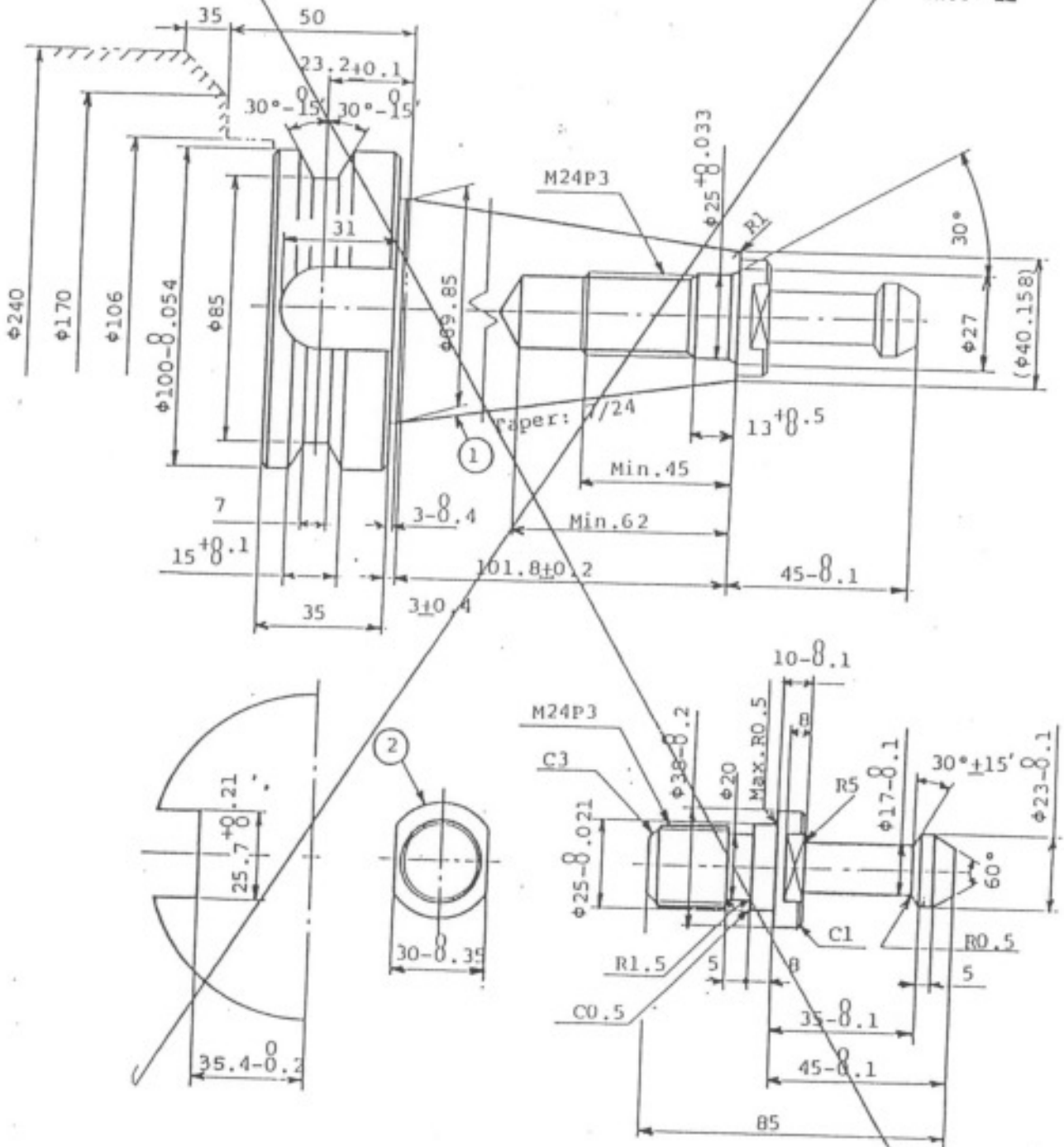
5. The length of a tool could be restricted by the rotating speed because of its difficulty of balancing.

3. MACHINE SPECIFICATIONS

MAS tool, MAS pull-stud

Tool holder, MAS BT50, P50T-2

Unit: mm



Pull-stud detail

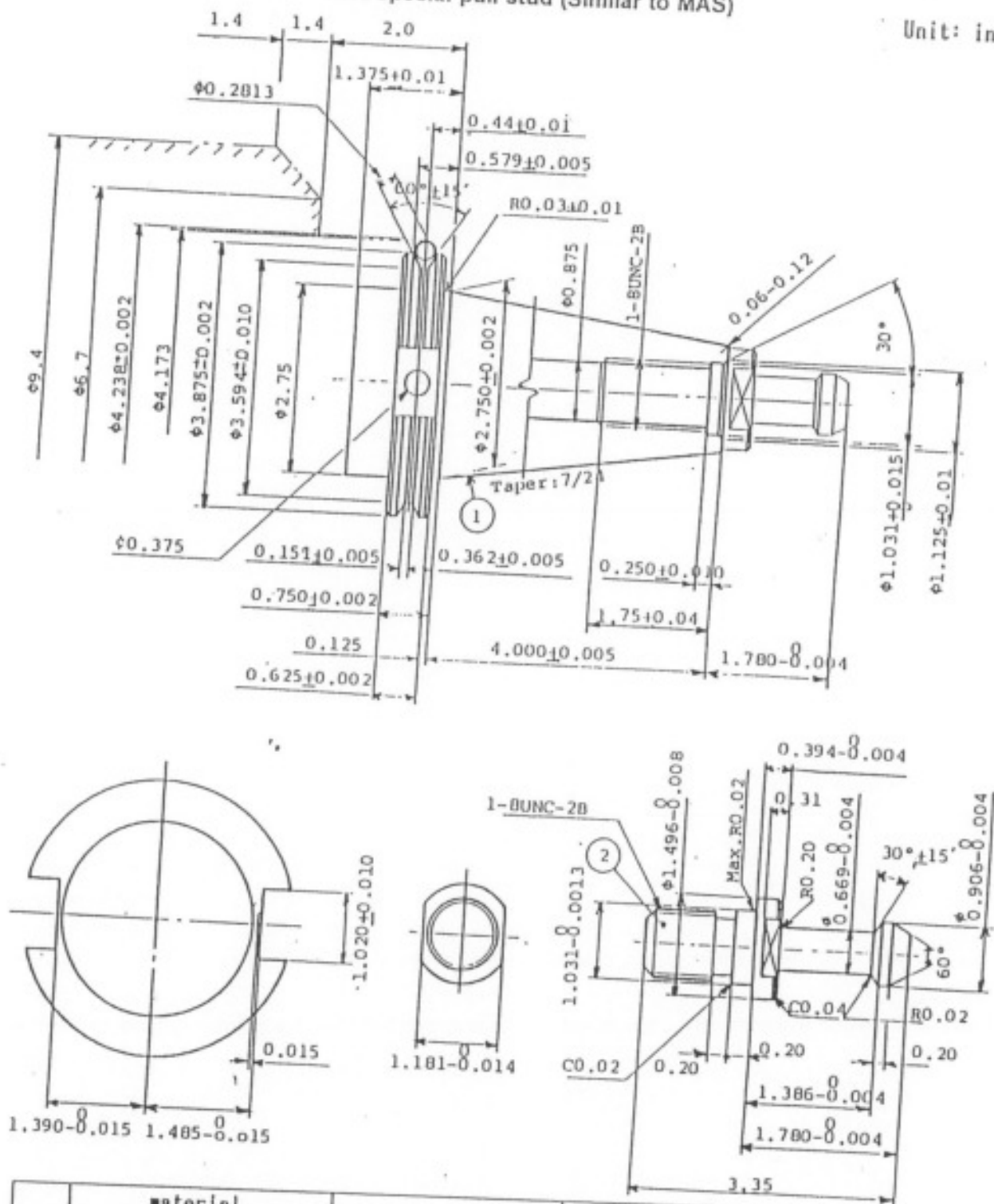
NO.	material		heat treatment	hardness
	JIS	AISI		
1	SHCH430	AISI4340	quenching	HRC: 52-57
2	SCM420	AISI4118	carburizing and case hardening	HRC: 58-62

3. MACHINE SPECIFICATIONS

NMTBA tool, MAS pull-stud

Tool holder, NMTBA CV50 (Caterpillar standard V-flange)
and special pull stud (Similar to MAS)

Unit: inch



NO.	material		heat treatment	hardness
	JIS	AISI		
1	SNCH439	AISI4340	quenching	HRC: 52-57
2	SCH420	AISI4118	carburizing and case hardening	HRC: 58-62

Pull-stud detail

3. MACHINE SPECIFICATIONS

3.6 OTHER HARDWARE

1) ATC

Number of tools :	std.	■ 40
	opt. 1 lane	□ 60, □ 80, □ 100, □ 120, □ 150
	opt. 2 lanes	□ 118, □ 158, □ 238, □ 298
Tool selection		Fixed address pot No.
Maximum tool length :		std. 500mm
	Note: The length could be restricted by its rotating speed for better balancing	
Maximum tool weight :		std. ■ 15kg
		opt. (30kg
Maximum tool diameter :	when next pot is occupied	110mm
	next pot is vacant	240mm
	boring tool	500 x 240mm
Tool change time (tool to tool)		5 sec (for undr 15kg)
		7 sec (for over 15kg)

2) Others

Machine weight (hyd. unit, electric panel, APC are included)		19,000kg
ATC unit weight (additional)	□ 60 tools	2,200kg
	□ 80 tools	2,600kg
	□ 100 tools	3,000kg
	□ 120 tools	3,700kg
	□ 150 tools	4,200kg
	□ 238 tools	6,700kg
Power supply	base machine at AC 200/220V ± 10%, 50/60Hz	50 KVA
	□ 100 ~ 150 ATC magazine	3.5 KVA
	□ high pressure coolant through spindle	3 KVA
	□ coolant temperature controller	3 KVA
Air supply	pressure	5 to 7 kg/cm ²
	capacity	700 NI/min

Note: Clean and dry air (the dew point is minds 18 deg-C) must be used.

Note: "NI" is Natural litter, 700 NI is 700 liters of air under natural pressure.

3. MACHINE SPECIFICATIONS

3.7 STANDARD EQUIPMENT

The following hardware are provided as the standard equipment of the machine.

1. Automatic tool locking device for spindle
2. Spindle orientation (electrical)
3. Automatic lubrication system for all slideways
4. Slide way protectors for all ways
 - Steel covers for X,Z axes and Y axis lower half
 - Wind-up sheet covers for Y axis upper half
5. Air blow for cleaning the spindle taper area
6. Self-diagnosis
 - Display of machine problems
 - Display of pot-number spindle tool or stand-by tool
7. Jack and anchor bolts
8. Maintenance hand tool kit
9. Hydraulic power unit
 - Tank volume 60 litter
 - Delivery 47 l/min
 - Pressure 60 kg/cm²
 - Motor output AC 3.7kw, 4p
10. Flood coolant system with nozzles Reservoir 350 litter
11. Coolant guard
 - Automatic door opening type for APC and ATC sides
12. Top cover for coolant guard
13. APC (Automatic Pallet Change system)
 - with 2 pallets and manual free rotation mechanism of pallet for set-up at loading position
14. Endless tape function
15. Chip conveyor for X axis both sides of table
16. Status light : one color
17. Working area light
18. Meter for spindle load : read by %
19. Automatic power source cut-off
20. Linear scale feedback system for X,Y and Z axes
21. Automatic thermal distortion compensation system for Y and Z axes
22. Spindle cooling unit
23. Spindle speed override : 50-120% (5% step)
24. 100V AC outlet for tape punch device
25. Ready tool number set (M20), Spindle tool number set (M21)

3. MACHINE SPECIFICATIONS

3.8 OPTIONAL EQUIPMENT

:Optional

- 1. Oil hole coolant system LOW pressure
 - Electromagnetic valve for switching
 - Stopper block
 - Additional pump :

Delivery	12 l/min
Pressure	2.5 kg/cm ²
- 2. Oil hole coolant system HIGH pressure
 - Stopper block
 - Additional pump :

Delivery	20 l/min
Pressure	10 kg/cm ²
 - Oil type Water soluble type
- 3. Thru the spindle coolant system LOW pressure
 - Additional pump :

Delivery	20 l/min
Pressure	10 kg/cm ²
 - Oil type Water soluble type
- 4. Thru the spindle coolant system MID pressure with 20 μm filtration system and high capacity basket strainer
 - Additional pump :

Delivery	30 l/min
Pressure	30 kg/cm ²
 - Oil type Water soluble type
- 5. Thru the spindle coolant system HIGH pressure with 20 μm filtration system and high capacity basket strainers
 - Additional pump :

Delivery	30 l/min
Pressure	50 kg/cm ²
 - Oil type Water soluble type
- 6. Remote control nozzle
 - Swing : maximum 60 deg. by M code 4 deg. step
- 7. Manual flushing gun
- 8. Coolant guard for manual flushing gun
- 9. Coolant shower from:
 - Spindle head ceiling
- 10. Oil skimmer
- 11. Coolant temperature controller
- 12. Air blow to clean chip
- 13. Air blow thru tool
- 14. Stopper block for multi-spindle tool or reversible taper
- 15. Multi pallet system (Pallet pool system)

3. MACHINE SPECIFICATIONS

OPTIONAL EQUIPMENT (Cont'd)

16. Chip conveyor (outside the machine)

a) General type (I)... For relatively large steel chips, cast iron, aluminum, etc... ※

Type : Caterpillar type (Hinge belt type)

b) general type (II)... For relatively small chips of steel

Type : Scraper type

c) for aluminum ... For fine chips of aluminum, etc...

Type : Scraper type with rolling filter

d) for casting ... For relatively small chips of cast iron, steel etc...

Type : Scraper type with magnetic floor

e) for aluminum/casting ... Type : Scraper type with rolling filter and magnetic floor

※ NOTE) FREQUENT MAINTENANCE MAY NEED WHEN CUT CAST IRON OR ALUMINUM.

17. Chip box

18. Additional pallet

sets

19. Weekly timer

20. Standard square block

21. Standard square block material:

22. Unmanned functions: the details are described at the next page

23. Circuit breaker for earth leakage

24. Automatic fire extinguisher

25. Status indication light : 3 colors

RED: Alarm condition

be put on by an alarm

Yellow: Machining completion

be put on after machining completion

(M0, M1, M2, M30)

Green: On-cycle

be put on during program is running

26. Additional work light

27. Door interlock for coolant guard

28. Coolant reservoir

std.

350 liters

600 liters

29. Mist coolant

3. MACHINE SPECIFICATIONS

OPTIONAL EQUIPMENT (Cont'd)

UNMANNED OPERATION SYSTEM

FUNCTION		DESCRIPTION	SET OPTION	
			<input type="checkbox"/> I	<input checked="" type="checkbox"/> II
Automatic measurement and centering	Automatic workpiece measurement, compensation and automatic workpiece centering	Measure the dimension of workpiece, compensate dimension and compensate the center	YES	YES
	Automatic coordinate rotation centering	Measure tilted workpiece and rotate the coordinate	YES	YES
Load monitor	Load monitor	Detects machining error by load monitoring. The load is displayed on a graphic display		YES
	Simple adaptive control	Feedrate control		YES
Automatic Restoring	Tool life management (*) and spare tool replacement	Count ATC cycles, machining time and prepare a life bar display		YES
	Automatic replacement of defective tool	Replace a defective tool be a spare tool		YES
Tool management	Tool data management	Management by tool number TB-digits, 300 programs can be registered		YES
	Check of stored tool in magazine	Check whether the next tool is in the magazine		YES
	Restoring defective tool to a special tool pot			YES
Data management	Management of machining result (*)			YES
	Management of measurement result	Display the accumulated measured data		YES

Tool breakage detection by limit switch

Tool length measurement by limit switch

Independent option

Independent option

4. NC SYSTEM SPECIFICATIONS

4.1 STANDARD FUNCTIONS

■ Standard □ Optional ☑ Quoted

APPLIED MODEL:

FANUC 16MB

ITEM	DESCRIPTION
DATA I/O, MEMORY STORAGE	
Data I/O interface	RS232C interface
Input data code	Automatic EIA/ISO recognition
Label skip	
Control in/out	Comment in ()
Program memory capacity	80m (262ft), 128 programs
FEED FUNCTION	
F-6 digits direct command	
Interpolation functions	3 axes linear interpolation <input type="checkbox"/> 4 axes linear interpolation (simultaneous 4 axes with B) <input checked="" type="checkbox"/> 5 axes linear interpolation
Circular interpolation	
R-specified circular interpolation	
Control system	<input checked="" type="checkbox"/> X,Y and Z axes MP scale <input type="checkbox"/> B axis (5 deg x 72 pos.) encoder <input type="checkbox"/> B axis (1 deg X360 pos.) encoder <input checked="" type="checkbox"/> A,B axes (free angle) MP scale <input checked="" type="checkbox"/> 5 axes [X,Y,Z,A,B(free angle)] 5 axes
Control axes	
Simultaneous control axes (rapid feed available)	
Plane selection	G17,G18,G19
Synchronous tapping	
Inch/Metric conversion	
Uni-directional positioning	
Auto. acceleration/decel	
Rapid traverse override	1/25/50/100%
Feedrate override	0-200% on/off switchable by M-command
Exact stop check	
Exact stop check mode	
3 - AXIS LOADMETER DISPLAY	

4. NC SYSTEM SPECIFICATIONS

4.1 STANDARD FUNCTIONS (cont'd)

Tapping mode	G63
Cutting mode	G64
Dwell	G04
Spindle function	
S-5 digits direct command	
Spindle speed override	
Tool and compensation function	
Tool function	T 3-digits command
ATC tool registration	
Tool length offsets	G43,G44,G49
Tool position offsets	G45-G48
Cutter compensation	G40-G42
Tool offset memory	32 sets
Program support function	
Program and sequence No. search	
Position command system	G90,G91
Decimal point input I , II	Switchable by control parameter I : 1= 0.001mm II : 1= 1mm
Subprogram control	M98,M99
Mirror image	
Program data input	
Canned cycle	
Automatic reference point return	
2nd reference point return	
Automatic coordinate system setting	
Machine coordinate system	
Workpiece coordinate system offset	
Local coordinate system	
Coordinate system setting	
Program coordinate rotation	
Stored stroke limit I	

4. NC SYSTEM SPECIFICATIONS**4.1 STANDARD FUNCTIONS (cont'd)**

Operating mode

Memory mode

Manual data input (MDI)

Manual handle feed

Background editing

Manual absolute change

Manual tool length measurement, type I

Miscellaneous

Self-diagnosis function

Run time display

Optional block skip

Miscellaneous function

M3-digits

Miscellaneous function lock

Edit lock B,C

Single block

Dry run

Machine lock

Z-axis cancel

Reset and rewind

Manual pulse generator

1 unit

4. NC SYSTEM SPECIFICATIONS

4.2 OPTIONAL FUNCTIONS

Optional Quoted

ITEM	DESCRIPTION
<input checked="" type="checkbox"/> Part program storage (program numbers)	<input type="checkbox"/> 320m(63), <input checked="" type="checkbox"/> 640m(63), <input type="checkbox"/> 1,280m(63)
<input checked="" type="checkbox"/> helical interpolation	<input type="checkbox"/> 2,560m(63), <input type="checkbox"/> 5,120m(63)
<input type="checkbox"/> F1-digit feed command	
<input type="checkbox"/> Automatic corner cutting override	
<input type="checkbox"/> Tool life management	
<input checked="" type="checkbox"/> Additional workpiece coordinate system	Add. tool offsets <input type="checkbox"/> 64, <input type="checkbox"/> 99, <input type="checkbox"/> 200, <input type="checkbox"/> 400 54 sets (TOTAL)
<input checked="" type="checkbox"/> Coordinate system rotation	G68,G69
<input type="checkbox"/> Circular cutting	
<input checked="" type="checkbox"/> Additional common variables	Total 600 sets
<input checked="" type="checkbox"/> Custom macro	G65/G66/G67
<input checked="" type="checkbox"/> Scaling	G50,51
<input type="checkbox"/> Collation stop	
<input type="checkbox"/> DNC link	RS232C
<input checked="" type="checkbox"/> Program restart function	
<input type="checkbox"/> Data protection key	
<input type="checkbox"/> Automatic handle interrupt	
<input type="checkbox"/> Graphic trace	
<input type="checkbox"/> Tape reader with reels	
<input type="checkbox"/> Tool life monitor and spare tool replacement	<input type="checkbox"/> 128sets, <input type="checkbox"/> 512sets
<input type="checkbox"/> Nos. of tool life monitor sets	
<input type="checkbox"/> High speed machining mode	
<input checked="" type="checkbox"/> Skip function	
<input checked="" type="checkbox"/> Additional registerable program	<input checked="" type="checkbox"/> 125 sets, <input type="checkbox"/> 200 sets, <input type="checkbox"/> 400sets 2-9
<input checked="" type="checkbox"/> Additional optional block skip	
<input checked="" type="checkbox"/> Stored stroke check 2	
<input checked="" type="checkbox"/> Tool offset pairs	<input type="checkbox"/> 64 pairs, <input checked="" type="checkbox"/> 200 pairs, <input type="checkbox"/> 400 pairs

4. NC SYSTEM SPECIFICATIONS

4.2 OPTIONAL FUNCTIONS (continued)

Optional Quoted

ITEM	DESCRIPTION
<input checked="" type="checkbox"/> Additional M-code	5-M code
<input checked="" type="checkbox"/> Fanuc handy file	
<input type="checkbox"/> Fanuc floppy cassette	
<input checked="" type="checkbox"/> Stroke limit check before move	
<input checked="" type="checkbox"/> TCP/IP ethernet interface	
	<p>* Mitsubishi to prepare data server hardware for CNC. Software of hostcomputer, IP address in data server, data setting etc... like password to be prepared by customer. * File is transported by FIP in ethernet. * Data server is only used by storage mode. (Remote buffer can not be used.)</p>
<input checked="" type="checkbox"/> Polar coordinate command	
<input checked="" type="checkbox"/> 3-D tool radius compensation	
<input checked="" type="checkbox"/> Interrupt type custom macro	<i>CUSTOMER TO INFORM MHI OF THE PURPOSE TO HAVE MHI MAKE SEQUENCE.</i>
<input checked="" type="checkbox"/> Inverse time	
<input checked="" type="checkbox"/> G33 thread cutting	
<input checked="" type="checkbox"/> MANUAL HANDLE INTERRUPT	
<input type="checkbox"/> CHANGE AXIS --- SPECIFICATION DOES NOT DECIDED	
<input type="checkbox"/> PROGRAMABLE RETRACT AND RETURN --- SPECIFICATION DOES NOT DECIDED	
<input type="checkbox"/> KEY AND PROGRAM INTERRUPT --- SPECIFICATION DOES NOT DECIDED	

5. ACCURACY

5.1 GEOMETRIC ACCURACY

unit: mm (inch)

ITEM		TOLERANCE
1. Straightness of column movement in Z-axis	V	0.04 / 1000 (0.0016/40)
2. Straightness of table movement in X-axis	H	0.008 / 500 (0.00032/20)
3. Straightness of headstock movement in Y-axis direction	X-Y Y-Z	0.008 / 500 (0.00032/20)
4. Straightness of pallet surface	X-Y Y-Z	0.015 / 500 (0.0006/20)
5. Squareness in each plane	X-Y,Y-Z Z-X	0.015 / 300 (0.0006/12)
6. Parallelism of table and column movement to pallet surface	X Z	0.025 / 500 (0.001/20)
7. Runout of pallet surface		0.025 / ϕ 500 (0.001/ ϕ 20)
8. Parallelism of table movement to reference surface of pallet edge locator	X	0.01 / 250 (0.0004/10)
9. Runout of spindle end surface		0.005 (0.0002)
10. Runout of spindle taper	root point 12" test bar end	0.008 (0.00032) 0.015 (0.0006)
11. Parallelism of column movement to spindle center		0.015 / 300 (0.0006/12)
12. Offset of the reference surface (pallet edge locator) to the rotating center		0.020 (0.0008)
13. Accuracy of repeatability of pallet change	X,Y,Z	0.005 (0.0002)
14. Inter-pallet difference relative to pallet change	Y	0.020 (0.0008)

Note: The test conforms to Japanese Industrial Standards (JIS B6336).

Note: V = Vertical plane, H = Horizontal plane

5. ACCURACY

5.2 POSITIONING ACCURACY

unit: mm (inch)

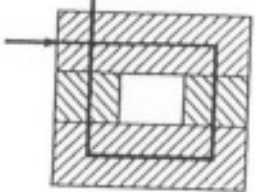
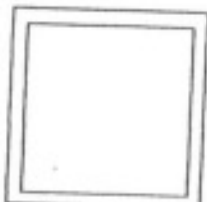
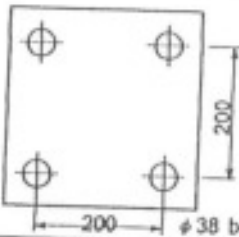

ITEM	AXIS	TOLERANCE
1. Linear axis positioning accuracy	X,Y,Z	± 0.002/full trvl (± 0.00008)
2. Linear axis repeatability	X,Y,Z	± 0.001 (± 0.00004)
3. B-axis positioning accuracy	B	± 7 sec
4. B-axis repeatability	B	± 3 sec
5. A-axis positioning accuracy	A	± 10 sec
6. A-axis repeatability	A	± 5 sec
7. Table and spindle relative positioning error		± 0.010 / day (± 0.0004/day)

Note: The positioning accuracy test conforms to Japanese Industrial Standard (JIS B6336).
The result figures are specified as half of the maximum difference in the specified range and is put on it.

5. ACCURACY

5.3 CUTTING ACCURACY

unit: mm (inch)

No.	ITEM	SKETCH	TOLERANCE
1	Flatness	 <p>Face mill</p>	0.01/□300 (0.0004/□12)
2	Step		0.007 (0.0003)
3	Parallelism	 <p>End mill</p>	0.01/300 (0.0004/12)
4	Squareness		0.007/300 (0.0003/12)
5	Straightness		
6	Hole distance	 <p>200</p> <p>200</p> <p>φ38 boring bar</p>	each direction 0.01/200 (0.0004/8)
7	Hole diameters		0.007/φ38 (0.0003/1.5)
8	Roundness	 <p>φ120</p> <p>End mill F170 φ40</p>	0.01 (0.0004)

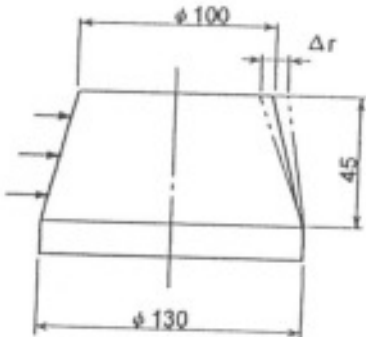
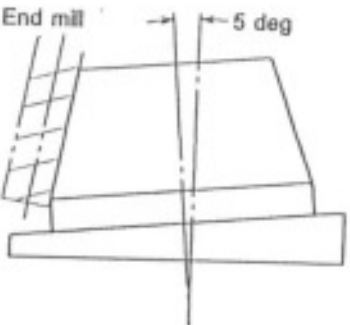
Note1: Cutting accuracy conforms to the JIS B6336.

Note2: Material of test piece shall be cast iron (FC30).

5. ACCURACY

5.4 5 Axis Machining Accuracy Test

Unit: mm (Inch)

	I T E M	METHOD ILLUSTRATION	TOLERANCE
1	Roundness (3 positions)		0.025 (0.001)
2	Inclined angle		Measured by Δ ± 0.015 (± 0.0006)

Material: Alminum

Cutter: $\Phi 40$ ($\Phi 1.57$) End mill

Section 6. DOCUMENTS AND ACCEPTANCE

6.1 Documents to be submitted:

Two copies each of the following data, written in English, will be submitted. These are drawn up by Mitsubishi's standard.

- (1) Accuracy test result sheets (Result sheets covering each kind of accuracy test mentioned in Section 5.)
: At the time of the pre-acceptance test
- (2) Machine instruction manual (Including explanation of programming, maintenance, hydraulic, and air pressure circuit diagrams)
: Two weeks before pre-acceptance test
- (3) NC system instruction manual
(Including maintenance, programming)
: Two weeks before pre-acceptance test
- (4) Electric circuit diagram
: Two weeks after shipment of the machine

6.2 Manufacturing standard:

This machine is designed and manufactured according to the standards set forth by Mitsubishi, and includes both machinery and electric equipment.

Electrical, hydraulic and air pressure parts selected by Mitsubishi will be used.

6.3 Conditions of machine use: to be provided by the customer

- (1) Environmental conditions
 - (a) Ambient temp. 32 to 104°F (0 to 40°C)
 - (b) Ambient humidity 75% or less during normal usage
Maximum of 95% for a short period of time

6.4 Paint

- Mitsubishi's standard color
- Munsell N3.0 - Dark gray
 - Bed, lower unit,
- Munsell 5Y8/1 - Beige
 - Main body including coolant guard and control panel
- H-5-212 Urethan (Nippon Yushi Co.) - Yellow
 - ATC arm, magazine cover

If the customer designates other color than Mitsubishi standard, please furnish appropriate Munsell code and color samples upon placing order. In this case extra cost will be charged.

6.5 Noise of machinery operation

Measured value: 85dB(A) or less

Conditions of measurement:

- (1) No load operation
- (2) Measurement position 40inch (1m) distance from the machine
- (3) Unavoidable instantaneous noises
- (4) No reflection walls or the like nearby
- (5) The background noise is to be 70dB(A) or less

6.6 Pre-acceptance test

Pre-acceptance test will be made at Mitsubishi's plant before shipment (in the presence of the customer or buyer if requested) and will be conducted as follows:

- (1) External appearance check
- (2) Machining accuracy

One testpiece as shown in Section 17.3 will be machined and its cutting accuracies will be measured.

- (3) Optional machining test

In case of any other machining request than the pre-acceptance test, its detail will be discussed mutually and extra cost will be charged to the buyer or the customer.

Note: Any expenses incurred by the customer during this pre-acceptance test shall be paid by the customer.

6.7 Delivery conditions

Site installation and adjustments are done by HMT.
Unloading/transporting to the site are done by the customer.
If these are to be done by HMT, an additional estimate will be prepared.

Note (1) The customer should have the following preparatory work and materials available upon arrival:

- ① Foundation work, primary electrical wiring (from power to machine), primary piping wiring (from pneumatic pressure to machine) (see foundation drawing)

Note (2) Perform class three or greater grounding.

Note (3) When installing ground fault circuit interrupt (GFCI) on the primary side, ensure 100mA or higher rated current sensitivity.

The following must be available before machine delivery.

- ② Lubricating oil, hydraulic oil (HMT recommended oil in item 18.11 of this spec.), waste, washing oil etc.

Note (4) Upon delivery we will require 1-2 people from your company, one who will conduct machine maintenance and one who will be in charge of electrical maintenance.

6.8 Final acceptance test

Final acceptance test will be made at the customer's or the buyer's plant after installation of the machine, and will be conducted as follows (Mitsubishi standard).

- (1) Geometrical control

Measurement and inspection to be conducted as per item 17.1.

- (2) No-load operation test

To be conducted using standard running tape supplied by Mitsubishi.

If the customer has any requirements other than those mentioned above, customer will be charged.

9 Instructions

Operation, maintenance/inspection and NC parameter setting procedures will be explained after installation.

10 Warranty

- (1) MHI MACHINE TOOL U.S.A., INC., herein known as MMT, warrants all equipment against defects in workmanship and materials for twelve months after the date of installation and acceptance; and will repair or replace any defective parts free of charge, provided that the equipment is used under normal operation and proper maintenance conditions.

This warranty is limited to those items contained in this machine. MMT shall not be responsible for the following:

- ① Wear and tear resulting from normal use
 - ② Abuse, misuse, misapplication, or improper maintenance by customer
 - ③ Operation beyond that of machine specifications or design conditions
 - ④ Breakdown due to moisture in air supplied without passing through air dryer
 - ⑤ Inappropriate continued operation when operation should be stopped.
 - ⑥ Secondary damage resulting from failure or breakage
 - ⑦ Failure or breakage resulting from factors irrelevant to MMT.
- (2) If an estimate of operation hours is submitted, MMT will warrant the machine for the amount of time mentioned only. MMT will not warrant for problems or deterioration in performance resulting from usage conditions more severe than those recommended by MMT.
- (3) Numerical control warranty
After MMT's warranty expires, the customer may sign a maintenance contract with the control unit manufacturer for numerical control maintenance.

ANNEX 1: APPLIED OIL LIST

(1) Recommended applicable oil list

Applied unit name	Lubricant	Renewal Service	Reservoir Capacity
Hydraulic unit	Mitsubishi Diamond oil Lube RO32	Yearly	15.9 gal (60 liters)
Slide way X,Y,Z	Mitsubishi Diamond oil Slideway 68	0.25 gal/24 hrs (0.95 liters/24 hrs)	1.6 gal (6 liters)
Ball screw X,Y,Z			
ATC magazine chain for 100 to 150 tools			
Headstock gear			
Table gear box	Mitsubishi Diamond oil Multi purpose No.2	Yearly	0.53 gal (2 liters)
ATC gear box (80 tools)			Grease 0.01 gal
ATC magazine chain (80 tools)	Mitsubishi Diamond oil RO 32	Every month	0.01 gal
Spindle cooling unit	Mitsubishi Diamond oil RO 5	Yearly	5.3 gal (20 liters)
Super High Speed Spindle Head stock gear and bearing	Mitsubishi Diamond oil RO 10	0.034gal/24hrs (0.13 liters/24hrs)	0.71 gal (2.7 liters)

ANNEX 1

(2) List of Brand names of other manufacturers oil

Applied Unit Name	Mitsubishi Oil	Mobil	Shell	ESSO
Hydraulic unit	Mitsubishi Diamond Oil RO 32	DTE oil 24	Tellus oil 32	Teresso 32
Slide way X,Y,Z	Diamond Lube RO 68	Vactra Oil No.2	Tetra Oil 68	Febis 68
Ball screw X,Y,Z				
ATC magazine chain for 100 to 150 tools				
Table gear box	Diamond Multi purpose No.2	Mobilux grease No.2	Alvania No.2	Multi-purpose grease H
ATC gear box (for 80 tools)				
ATC magazine chain	Diamond Lube RO 32	DTE oil 24	Tellus oil 32	Teresso 32
Spindle cooling unit	Diamond Lube RO 5	Velocity oil No.4	Tellus oil C5	Spinesso 5
Super High Speed Spindle Headstock gear and bearings	Diamond Lube RO 10	Velocity oil No.6	Tellus oil C10	Spinesso 10