TWIN SPINDLE TURNING CENTER

# LT10-M

## OPERATION & MAINTENANCE MANUAL
## (7th Edition)

Pub. No. 4039-E-R6 (LE11-095-R7) Oct. 1998

OKUMA

# SAFETY PRECAUTIONS

The machine is equipped with safety devices which serve to protect personnel and the machine itself from hazards arising from unforeseen accidents. However, operators must not rely exclusively on these safety devices: they must also become fully familiar with the safety guidelines presented below to ensure accident-free operation.

This instruction manual and the warning signs attached to the machine cover only those hazards which Okuma can predict. Be aware that they do not cover all possible hazards.

## 1. BEFORE TURNING ON THE POWER

(1) Make sure that the doors to the operation panel and the electric control cabinet are closed.

(2) Make sure that there are no obstacles around the machine.

(3) Turn on the main power disconnect switch before turning on the CONTROL ON switch on the operation panel.

## 2. CHUCK PRECAUTIONS

(1) Always close the front shield before starting the spindle or cutting operations.

(2) Always observe the spindle speed maximums for the installed chunk.

Never run the spindle exceeding the maximum allowable spindle speed.

(3) If a chunk or fixture is unique to your application, check the maximum allowable spindle speed and stay within the limit. Also, take note of the workpiece gripping force and balance.

(4) The maximum spindle speed can be limited by inputting a G50 command with the spindle speed. The G50 command helps to ensure safety in operation.

(5) If the spindle must be rotated close to the maximum allowable spindle speed, observe the following points:

- Make sure that the workpiece clamped in the chunk is balanced.
- Apply the allowable maximum amount of pressure to grip the workpiece because centrifugal force reduces the chuck gripping force.

The maximum allowable spindle speed and application pressure are indicated on the name plate on the front shield and on the chuck body. The allowable maximum speed and the applicable pressure ensure a chucking force that is more than one-third over the original chunk gripping force with the standard soft-top jaw set in line with the periphery of the chuck body.

(6) If special jaws (larger than standard soft-top jaws) are used, observe the following points:

- Lower the spindle speed because centrifugal force and lower efficiency reduce the chuck gripping force.
- If the jaw tightening nut (jaw nut) is outside of the periphery of the chuck, only one tightening bolt is holding the jaws in place. This is a potentially dangerous condition. Jaw nuts must always be within the periphery of the chuck.
- Machine the jaws to the workpiece shape.

(7) Securely tighten the bolts on the chuck body, the jaws, and the block to the specified torque. Use lubrication oil. Make sure that the torque is at least 392 to 490 N [40 to 50 kgf (88 to 110 lbf )].

## 3. GENERAL CHECKS

(1) Check the amount of lubricating oil every day before starting operation.

(2) Always use the specified brand of lubricating oil.

(3) Use the recommended type of cutting fluid (coolant) when possible.

(4) It is recommended to use a water-soluble coolant to prevent fire. Do not attempt unmanned operation if a non-soluble coolant is used.

(5) Change and replenish the lubricating oil and coolant in each reservoir according to the schedules in the manual.

(6) Clean the filters according to the schedules in the manual.

(7) Make sure that each pressure gauge on the air and hydraulic lines display the correct value as described in this manual.

(8) Always turn off the power before beginning any work inside the front shield. In addition, turn off the power before beginning work at the back of the machine that requires an operator to enter the machine operating zone.

# 4. BEFORE STARTING OPERATION

(1) Always follow the instructions in the operation manual.

(2) Never operate the machine with all of the protective covers and shields in place.

(3) Always close the front shield before starting operation.

(4) Never attempt to run a new program without checking its operation. Run the program without a workpiece set in the chuck and make sure that there is no interference. After making sure that the program has no bugs, cut a workpiece in the single block mode. If no problems are discovered, automatic operation may be started.

(5) Before attempting the following operations, make sure that they can be accomplished safety.
- Spindle rotation
- Turret indexing
- Axis movement

(6) Never touch chips or the workpiece while the spindle is rotating.

(7) Never attempt to stop a moving object by hand or with a tool.

(8) Check the jaw installation conditions, the hydraulic pressure, and the maximum allowable spindle speed for the power chuck.

(9) Check the installation and arrangement of the tools.

(10) Check the tool offset settings.

(11) Check the zero offset settings.

(12) Make sure that the spindle speed and feedrate override settings are at 100%.

(13) Before feeding the turret, check the software limit setting and the emergency limit LS (limit switch) dog positions for both the X- and Z-axes.

(14) Check the turret index/rotation position.

(15) Check the tailstock body position.

(16) Make sure the cutting operation is within the allowable transmission power and torque ranges.

(17) Make sure that the workpiece securely fitted in the chuck or fixture.

(18) Check the cutting fluid nozzle positions. They must be set to properly supply cutting fluid to the appropriate points.

## 5. PRECAUTIONS AGAINST FIRE

(1) Use meticulous care to prevent fire especially when performing untended operation.

(2) Use nonflammable coolant.

(3) Do not leave any flammables around the machine.

(4) Do not heap up chips.

(5) Check the tool cutting edge, cutting conditions, and tool life.

## 6. SETUP

(1) Make sure that setup is complete.

(2) If the setup is changed, operate the machine step-by-step to make sure that cutting can performed without any problems.

(3) Before changing the chuck and/or chuck jaws, make sure that the chuck fits the intended jog.

(4) If two or more workers must work together, establish signals so that they can communicate (for example, when lifting or setting heavy objects). Each worked should be aware when a new process is about to begin.

(5) Use the crane or equivalent tool to handle heavy objects.

(6) When attempting an unfamiliar setup, recheck the setup before beginning operation.

## 7. WORKPIECE LOADING AND UNLOADING

(1) Make sure that workpieces are loaded and unloaded securely.

(2) Before loading or unloading a workpiece, retract the turret so that the cutting tools in the turret cannot injure the operator.

(3) Before loading and unloading a workpiece, make sure that the spindle has come to a complete stop.

(4) Before running a new program, rotate the spindle to make sure that the workpiece is securely clamped in the chuck.

(5) Before machining an irregularly-shaped workpiece, make sure that it is balanced properly.

(6) When handling heavy workpieces, use the a crane, hoist, or other similar tool.

(7) Before loading a workpiece, make sure that the workpiece has a portion that can be used for proper chucking.

## 8. AT THE END OF THE DAY

(1) Clean the machine.

(2) Move the turret to the predetermined retraction position.

(3) Turn off the CONTROL ON switch on the operation panel, before turning off the main power disconnect switch.

(4) Make sure all power switches are turned off.

## 9. WHEN A PROBLEM OCCURS

(1) Stop the machine immediately by pressing the EMERGENCY STOP switch on the operation panel.

(2) Consult with the person in charge of maintenance to determine what corrective measures need to be taken.

(3) If two or more workers must work together, establish signals so that they can communicate (for example, when lifting or setting heavy objects). Each worked should be aware when a new process is about to begin.

(4) Only use specified replacement parts and fuses.

## 10. GENERAL PRECAUTIONS

(1) Wear appropriate clothing.

(2) Keep the machine and the area around it clean and organized.

(3) Never touch controls or switches with wet hands.

# 11. SAFETY DEVICES AND FUNCTIONS

| Contents | Location | Remark |
|---|---|---|
| 1. Front shield with grated glass and polycarbonate | Machine | |
| 2. Shield open/close interlock | Machine | |
| 3. Chuck interlock | Electric control cabinet | |
| 4. Tailstock spindle interlock | Electric control cabinet | |
| 5. Tailstock spindle position confirmation | Electric control cabinet | optional |
| 6. Foot pedal protection cover | Machine | optional |
| 7. Emergency limit setting LS (limit switch) | Machine | |
| 8. Software limit | Operation panel | |
| 9. Chuck barrier | Operation panel | |
| 10. Turret barrier | Operation panel | |
| 11. Tailstock barrier | Operation panel | optional |
| 12. Emergency stop button | Operation panel | |
| 13. Slide hold button | Operation panel | |
| 14. Alarm display | Operation panel | |
| 15. Leakage circuit breaker | Electric control cabinet | optional |
| 16. Self-lock cylinder for chuck | Machine | |
| 17. Cycle start requiring simultaneous depression of both buttons | Machine | optional |
| 18. Turret rotation at low speeds (manual) | Machine | |

## 12. SYMBOLS

The following warning indications are used in this manual to draw attention to information of particular importance.

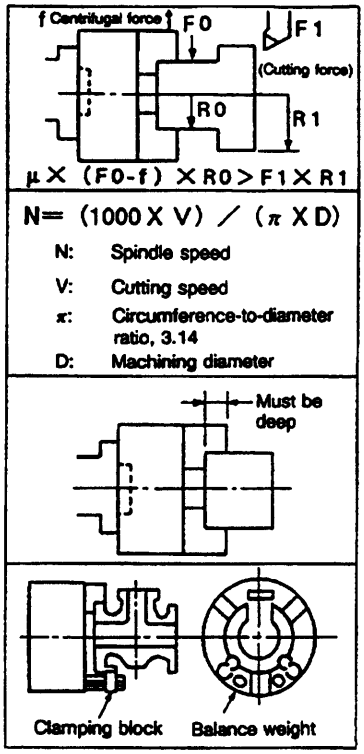
**DANGER** : Indicates an imminent hazard which, if not avoided, will result in death or serious injury.

**WARNING** : Indicates hazards which, if not avoided, could result in death or serious injury.

**CAUTION** : Indicates hazards which, if not avoided, could result in minor injuries or damage to NC unit or other equipment.

**NOTICE** : Indicates precautions relating to NC unit operations.

## 13. FOR SAFE CHUCK WORK

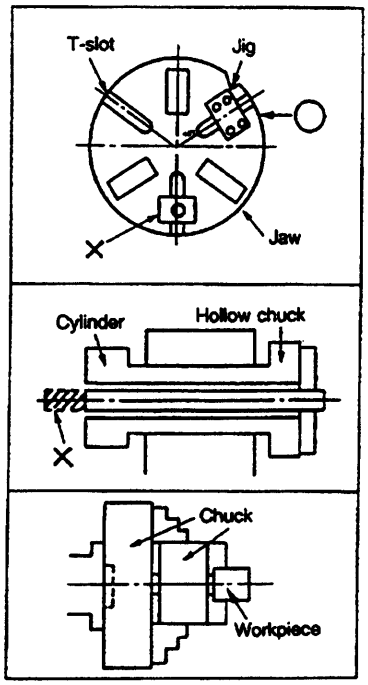



1. Set the chuck gripping force by ensuring sufficient factor of safety (2 to 3 or over). Run the spindle within the allowable speed range set at this time.

2. In constant peripheral speed cutting, calculate the actual machining speed before designating G50 (max. speed limit function).

3. Secure the jaw gripping depth as much as possible.

4. Before machining an unbalanced workpiece, carry out balancing of the workpiece weight by gradually changing the spindle speed.




5. Never attempt to install jigs using T-nut.

   Be sure to fix the jigs with bolts.

   No chucks prepared by Okuma have T-groove.

6. When inserting a bar material into the hollow chuck, ensure that the bar does not protrude from the rear end of the cylinder.

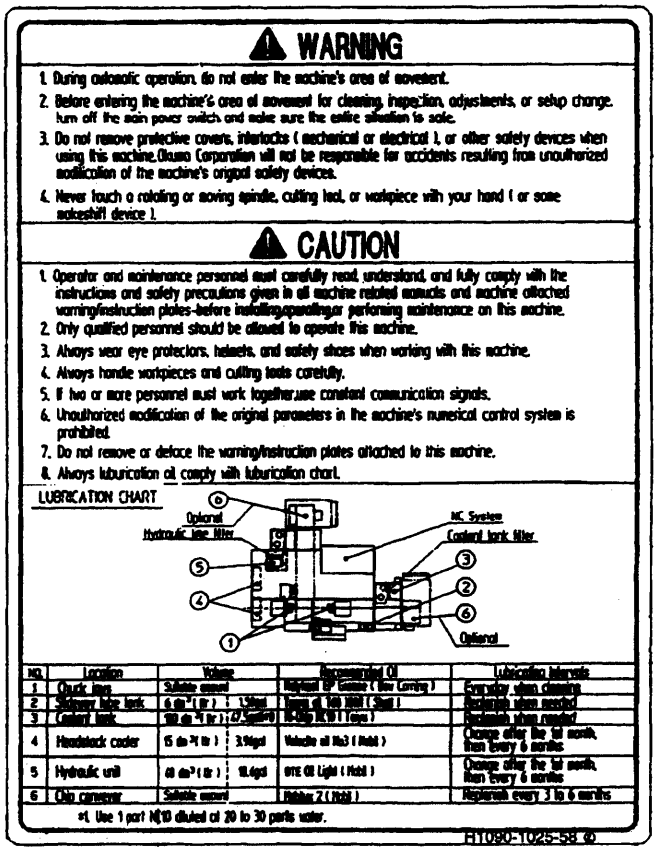
7. Never use double chucking method.

# 14. CAUTION PLATE

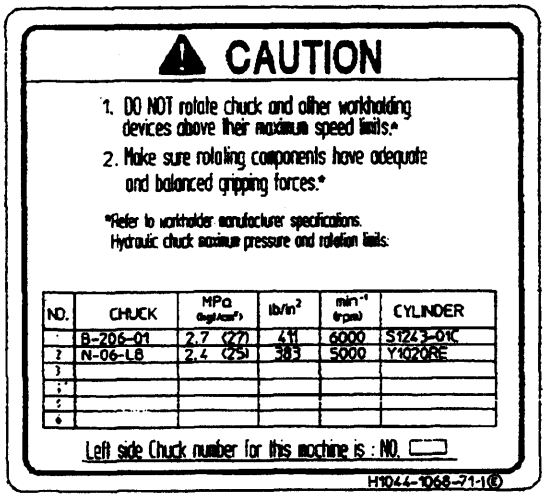
- The machine and its components are fitted with various caution plates. Carefully read these plates and follow the instructions described there.
- Do not tear or damage the caution plates. In case a plate has been lost or become illegible, ask us for a new plate, quoting the Okuma part number written in this manual.

(4) Caution Plates and Okuma Part Numbers

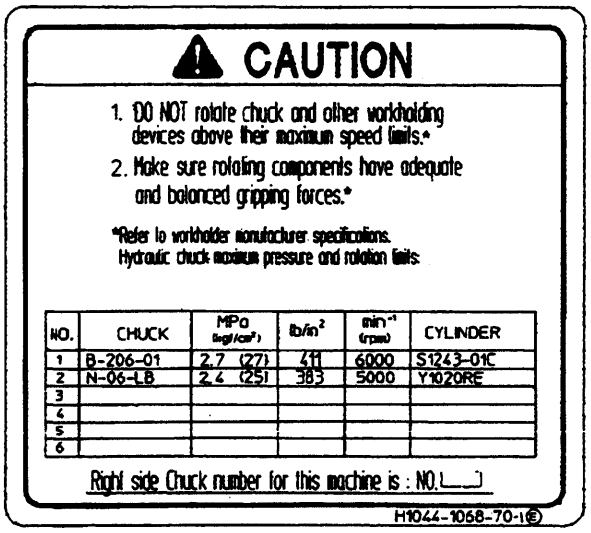
1) Okuma Part No. H1090-1025-58



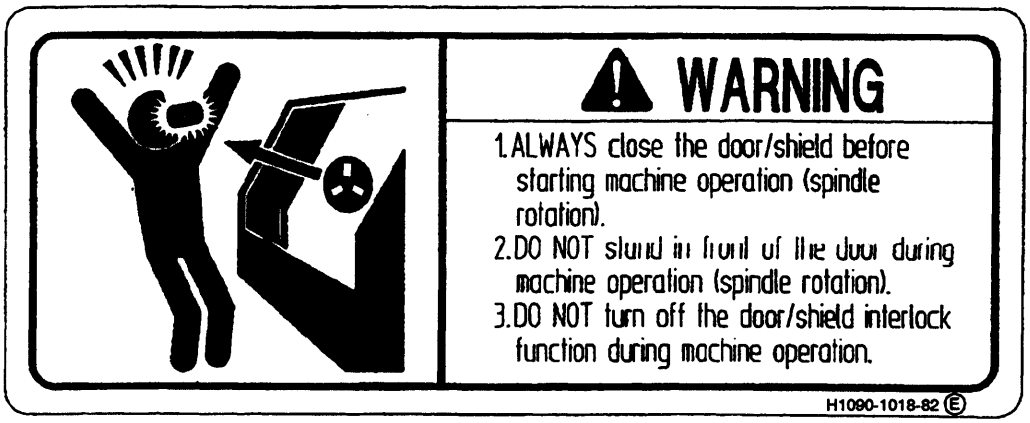
2) Okuma Part No. H1044-1068-71-1



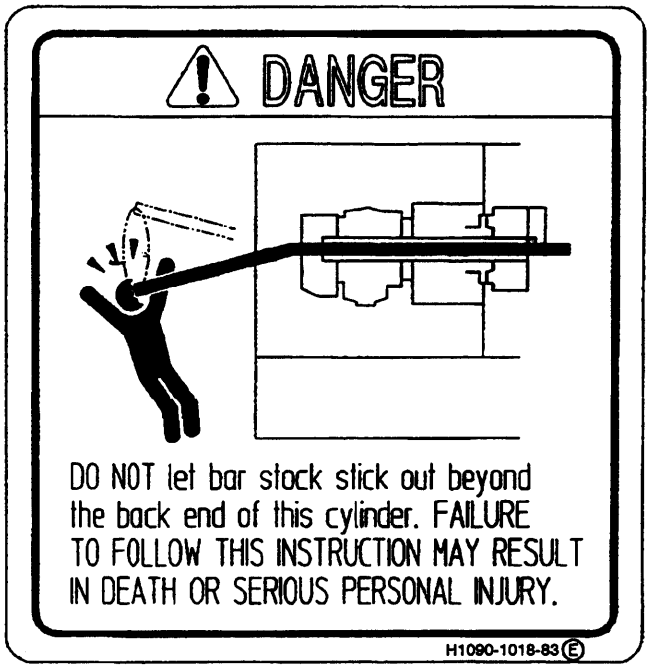

3) Okuma Part No. H1044-1068-70-1



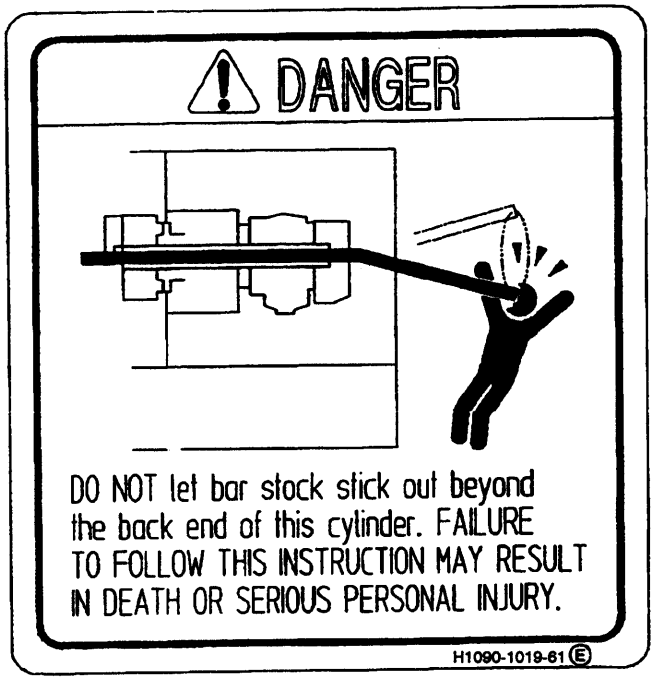
4) Okuma Part No. H1090-1018-82



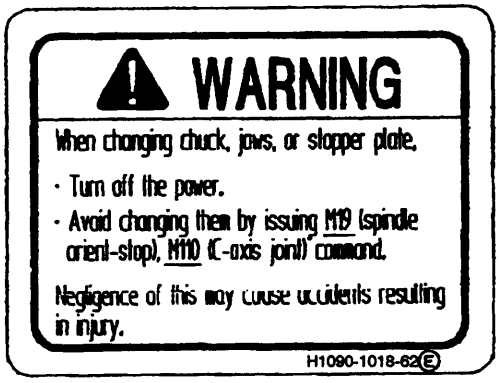

5) Okuma Part No. H1090-1018-83



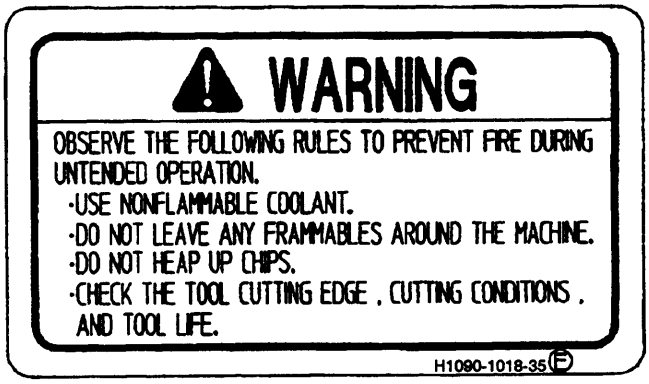
6) Okuma Part No. H1090-1019-61



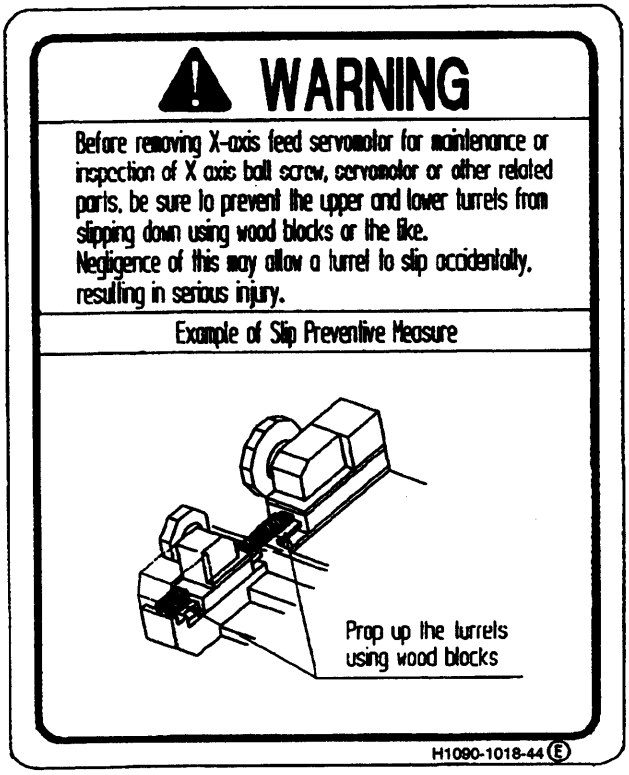

7) Okuma Part No. H1090-1018-62



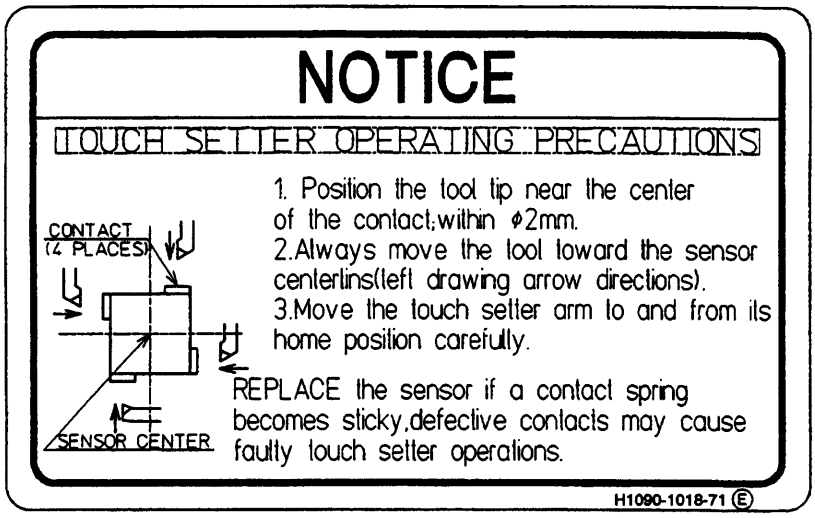
8) Okuma Part No. H1090-1018-35




9) Okuma Part No. H1090-1018-44



10) Okuma Part No. H1090-1018-71



# INTRODUCTION

Thank you for choosing an Okuma Model LT10-M Turning Center. We are proud to have you among our Okuma family of users.

This instruction manual contains concise information on the installation, setup, operation and maintenance of your Model LT10-M Turning Center. To make the most of its outstanding performance over a long period, the machine must be properly installed, and operating and maintenance procedures must be clearly understood and carefully followed. You are encouraged to study this instruction manual carefully before the machine is installed and to keep it on file for future reference.

TABLE OF CONTENTS

PAGE

PAGE

# SECTION 1 OVERVIEW

## 1. MACHINE SPECIFICATIONS

### 1-1. Features

The LT10-M has a unique construction which allows each of the upper turret to serve L- and R-spindles.

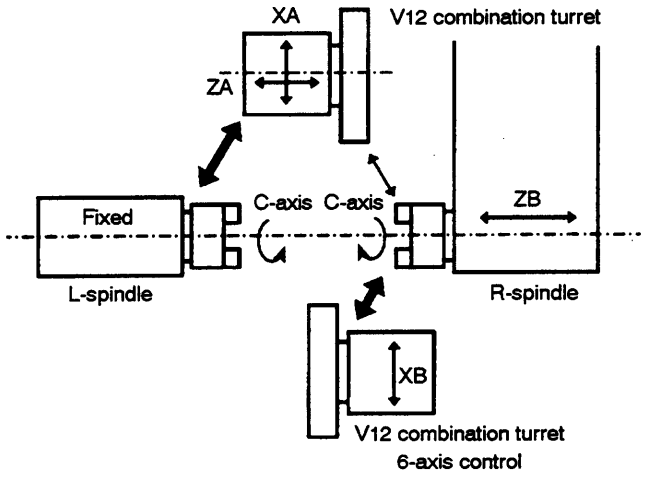



Fig. 1-1 Machine Specifications

Since L- and R-spindles, and upper and lower turrets have equal capabilities, high-power cutting is possible by any combination of a spindle with a turret.

Normally, the workpiece in the L-spindle is machined by tools mounted on the upper turret and the workpiece mounted in the R-spindle is machined by tools mounted on the lower turret. With the R-spindle, however, both upper and lower turrets can be used.

The LT10-M enables ideally balanced 1st and 2nd process machining and assures excellent productivity.

**NOTICE** : (1) The standard spindle/turret combination is as illustrated above. The clamping direction of toolholders and the parallelism between the spindle center line and the carriage movement along the Z-axis are considered on the basis of the standard combination.

(2) When operation such as turret indexing, rapid feed, or heavy cutting is performed at one spindle while finish machining is in progress at the other spindle, there are cases in which short lines which are scarcely visible are left on the finished surface of the workpiece. To avoid this, delay opposing motion.

## 1-2. Specification Table

| MODEL | Unit | LT10-M |
|---|---|---|
| CAPACITY | | |
| Swing over carriage | mm (in.) | 400 (15.75) |
| Distance between noses | mm (in.) | Max. 960 (37.80) |
| Max. turning diameter | mm (in.) | 210 (8.27) |
| Max. turning length | mm (in.) | 130 (5.12) |
| TRAVEL | | |
| X-axis travel | mm (in.) | XA/XB: 192 (7.56) [175 + 17 (6.89 + 0.67)] |
| Z-axis travel | mm (in.) | ZA: 700 (27.56), ZB: 730 (28.74) |
| C-axis travel | | 360° (rotary axis control angle 0.001°) |
| SPINDLE | | |
| Spindle speed range | $min^{-1}$ {rpm} | L, R: 50 to 6000 |
| No. of spindle speed ranges | | L, R: Auto 2-step (VAC motor winding changeover) |
| Spindle nose type | | L, R: ϕ140 (5.51) flat |
| Through-spindle hole | mm (in.) | L, R: ϕ53 (2.09) |
| TURRET | | |
| Type | | Upper/lower: V12 combination NC non-lift |
| No. of tools | | Upper/lower 12 tools (L and M) |
| Diameter of OD tool shank | mm (in.) | □20 × 20 (0.79 × 0.79)<br>[VDI holder shank dia. ϕ30 (1.18)] |
| Diameter of ID tool shank | mm (in.) | 32 (1.26)<br>[VDI holder shank dia. ϕ30 (1.18)] |
| M-TOOL | | |
| Spindle speed | $min^{-1}$ {rpm} | Upper/lower: 50 to 6000 |
| No. of spindle speed range | | Infinitely variable |
| Rapid traverse rate (X, Z) | mm/min (ipm) | X: 15000 (590.55), Z: 20000 (787.40) |
| Rapid traverse rate (C) | $min^{-1}$ {rpm} | C: 200 (control by spindle VAC motor) |
| MOTOR | | |
| Spindle drive motor | kW (HP) | L, R: VAC built-in 7.5/5.5 (10/7.5) (30 min/cont.) |
| M-tool motor | kW (HP) | Upper/lower: VAC 2.2/1.1 (3/1.5) (13 min/cont.) |
| Axis feed motor | kW (HP) | XA: BL3 (4.02), XB: BL2 (2.68) |
| | | ZA/ZB: BL3 (4.02) |
| Coolant motor | kW (HP) | 0.25 (0.34) × 2 |

| MODEL | Unit | LT10-M |
|---|---|---|
| MACHINE DIMENSIONS | | |
| Center height | mm (in.) | 1000 (39.37) |
| Machine Height | mm (in.) | 1780 (70.08) |
| Floor Space Required | mm (in.) × mm (in.) | 2660 × 2100 (104.72 × 82.68) |
| Machine weight (including CNC unit) | kg (lb) | 6000 (13200) |

## 1-3. Dimensional Drawings

Unit: mm (in.)

* Chip conveyor: L-type
  Dimension [ ]: For H-type

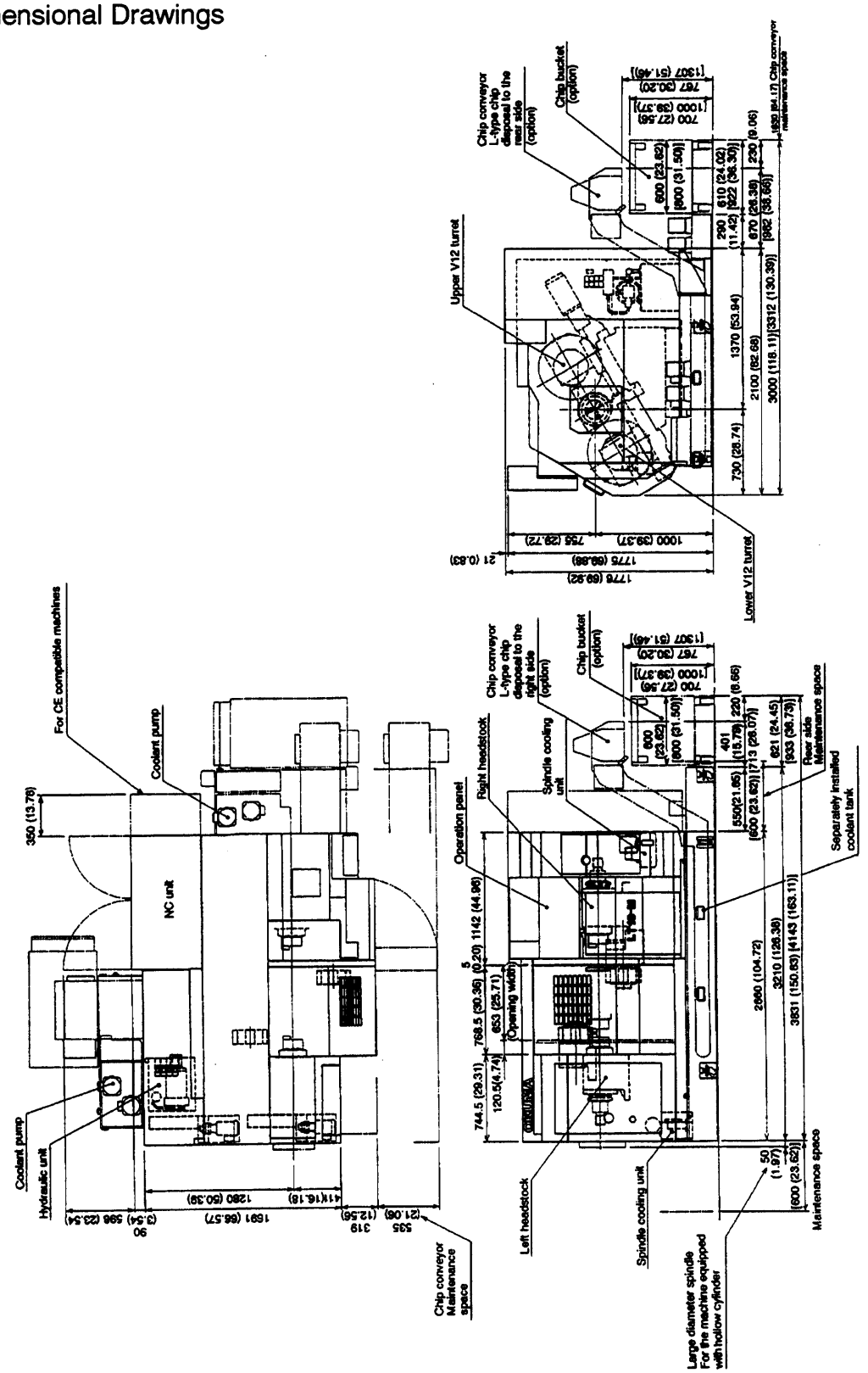



Fig. 1-2 Dimensional Drawings

# SECTION 2 HANDLING AND INSTALLATION OF MACHINE

## 1. GUIDE TO SELECT A INSTALLATION SITE

In order to ensure high machine accuracy and performance, the following points should be considered with regard to the installation site.

(1) Foundation work is advised for sites where the subsoil is soft, to prevent the machine from tilting or sinking after installation.

For details regarding foundations, refer to SECTION 2, 3. of the Operation Manual.

(2) The installation site should be as far as possible from vibration sources such as roads, stamping/press equipment, or planer machine tools.

If nearby sources of vibration are unavoidable, prepare dampening pits around the foundation to reduce the vibration effects.

(3) NC malfunctions could result from the proximity of high-frequency power generators, electric discharge machines, and electric welding machines, or when power is supplied from the same distributor panel as these machines.

For wiring details, consult our service engineer dispatched to assist with installation.

(4) The ideal operating environment calls for an ambient temperature of 20°C, with humidity between 40 and 75%.

(5) Keeping the ambient temperature at a constant level is an essential factor for accurate machining.

(6) In order to maintain static machine accuracy within guaranteed values, the machine installation site should be located so that it is unaffected by air currents within the factory.

Although air-conditioning is not required, the optimal ambient temperature range is 17°C to 25°C.

(7) To maintain static machine accuracy at levels even higher than the standard guaranteed values:

c) Keep the ambient temperature variance for 24 hours (1 day) within ±2°C.

d) Ambient temperature variances from floor level to a height of about 5 meters should be held within 1°C.

## 1-1. Care in Handling a Precision Machine

The Turning Center consists of four major components: the machine, the electric control box, the hydraulic unit and the Turning Center. Model LT-10M Turning Center is built in one unit and it can be easily moved without separating it into consisting units. (Note that the coolant tank is installed separately.)

Lifting and moving machine:

There are two different methods for moving the entire machine to any desired location; by an overhead crane, using lifting hooks supplied together with the machine and by rolls over which the machine is pushed by manual labor.

(1) Machine Lifting

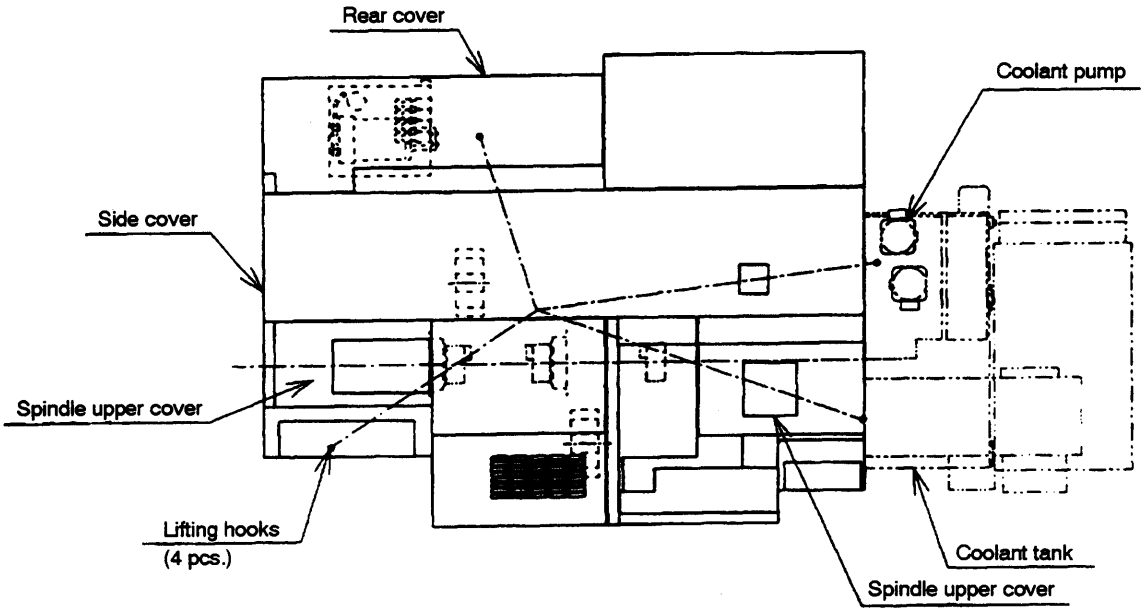



Fig. 2-1 Machine Lifting

Procedure:

a) Move the right headstock to the center (Move the right Z-axis (ZB-axis) approximately 600 mm (23.62 in.) left from the travel end in the positive direction.)

b) Move both the upper and lower turrets to the travel end in the positive direction.

c) Remove the right and left side covers, rear cover, and right and left spindle upper covers.

d) Disconnect the cables and hoses from the coolant pump at the right hand side of the machine.

e) Pull out the coolant tank.

f) Attach the lifting hooks supplied with the machine to the specified positions.

The machine is now ready for lifting.

(2) Precautions for Lifting

**WARNING**

: (1) The cables should have a nominal diameter of 20 mm (0.79 in.) or larger.

(2) Change an angle formed by each cable line so that the cables will not contact the finished surfaces of the machine. (The cables may not form an angle larger than 40 degrees between the perpendicular.)

(3) Check for balance and be very careful when lifting the machine.

(4) Use extra care to lower the machine gently onto the floor; NEVER APPLY SHOCKS TO THE MACHINE WHEN PLACING IT ON THE FLOOR.

(5) Securely tighten the bolts which fix the lifting device. Make sure that they are not loose.

| Approximate Weight of Machine |
|---|
| 6000 kg (13200 lb) |

(Including the hydraulic power unit, the electrical control box and CNC unit.)

(3) Rolling

**WARNING**

: Be careful that the machine does not tip over on any side so that the machine base may not strike the ground.

# 2. FOUNDATION REQUIREMENTS

General Precautions for Building a New Foundation:

**NOTICE**

: If the following conditions are satisfied, no foundation work is required for general machining activities, and foundation bolts are not necessary.

- The subsoil must be solid.
- The concrete floor thickness must be approximately 200mm (7.87 in.).
- There must be no gap between the floor and the subsoil.

For long-maintained accuracy and where sub-soil or ground under the floor is not strong enough, a new concrete foundation should be set up in accordance with the Foundation Plan attached to this Manual. (See 5.)

(1) Foundation requirements vary depending on the characteristics of the sub-soil. Under any soil conditions, it is important that sub-soil should be well compacted to keep the foundation from unsettling once the machine has been installed.

(2) Where sub-soil is too soft, it is necessary to drive concrete piles into the sub-soil.

(3) The Foundation Plan attached to this Manual is prepared for laying a typical concrete foundation specifically for the machine. The concrete thickness or depth should be determined in terms of the ground condition in each case.

# 3. GENERAL PROCEDURE FOR INSTALLATION

## 3-1. Procedure for Installation

(1) Place leveling plates, 150 mm × 150 mm × 19 mm (5.91 × 5.91 × 0.75 in.) over individual foundation bolt-holes.

Refer to the Foundation Plan.

(2) Place foundation washers (furnished together with the machine) on the leveling plates and then place the machine on them.

(3) Pass foundation bolts through the hole in the leveling plate and a center bore through the built-in jack screw assembly.

Secure each foundation bolt carefully, using a washer and a nut on its upper end.

(4) Use wedge pieces, shims, or leveling blocks under the machine base to level the machine approximately.

(5) Pour mortar into the foundation bolt holes and allow it to set.

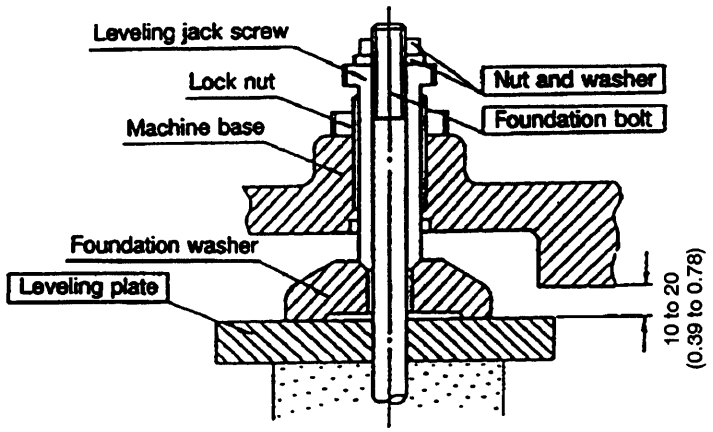
(6) After the mixture has become hard enough, remove the shims or leveling blocks from under the machine base, and level the machine within the specified limits.

## 3-2. Precautions for Installation

(1) Keep the underside of the leveling plates free from any oily substance.

(2) With leveling jack screws resting on foundation washers, the bottom surfaces of the machine base casting should be about 10 to 20 mm (0.39 to 0.78 in.) above concrete floor level.

(3) Fill the foundation bolt holes with mortar so as to reach the underside of the respective leveling plates. Be sure to compact the mortar thoroughly.




Unit: mm (in.)

The part names shown in [ ] are not supplied as standard equipment.

Fig. 2-2 Precautions for Installation

# 4. LEVELING THE MACHINE

The machine must be carefully leveled because the accuracy of the level at the initial installation will greatly affect the working accuracy and the service life of the machine.

| No. of Leveling Jack Screws | Remarks |
|---|---|
| 8 | Pass foundation bolt. |

## 4-1. Leveling Procedure

(1) Measure the machine level at both right and left ends of bedways in the X- and Z-axis directions.

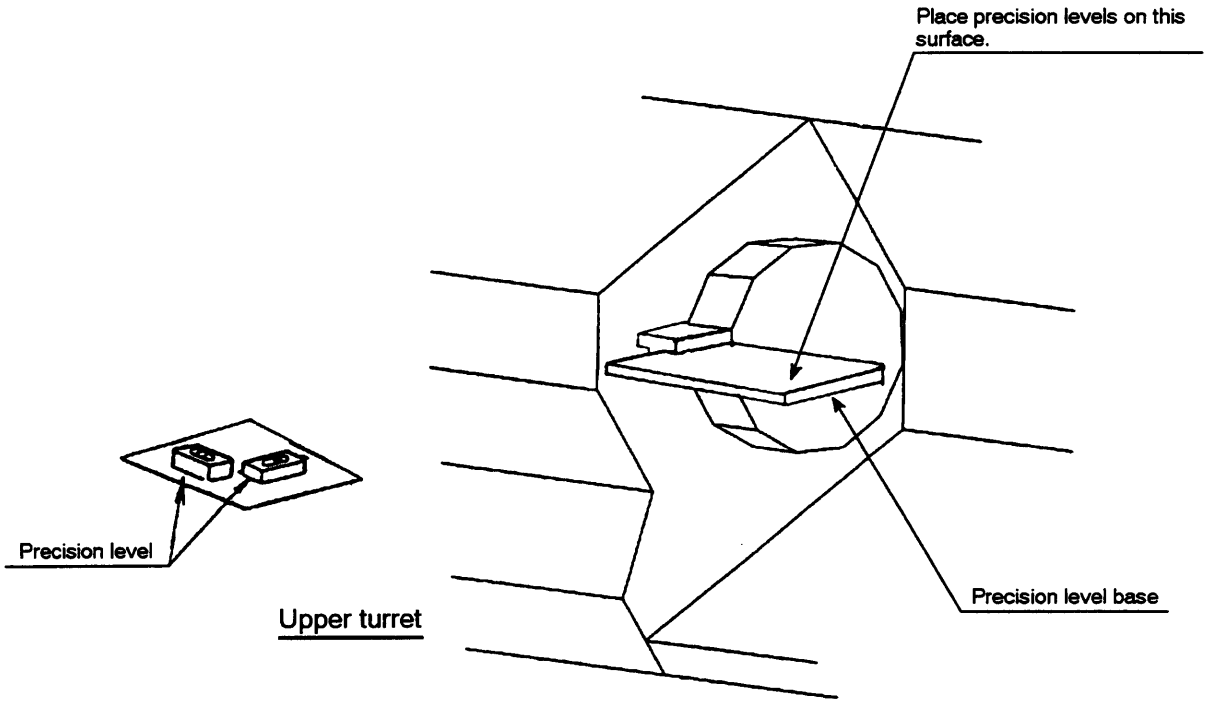



Fig. 2-3 Leveling the Machine

(2) Readings are taken on both longitudinal and transverse directions while both the leveling jack screws and the foundation bolt nuts are tightened firmly.

| | | |
|---|---|---|
| Tolerance | : | 0.02 mm per 1000 mm (0.00026 in./ft) |
| Accuracy of level | : | 1 div. = 0.01 mm per 1000 mm (0.00013 in./ft) |

# 5. FOUNDATION PLAN

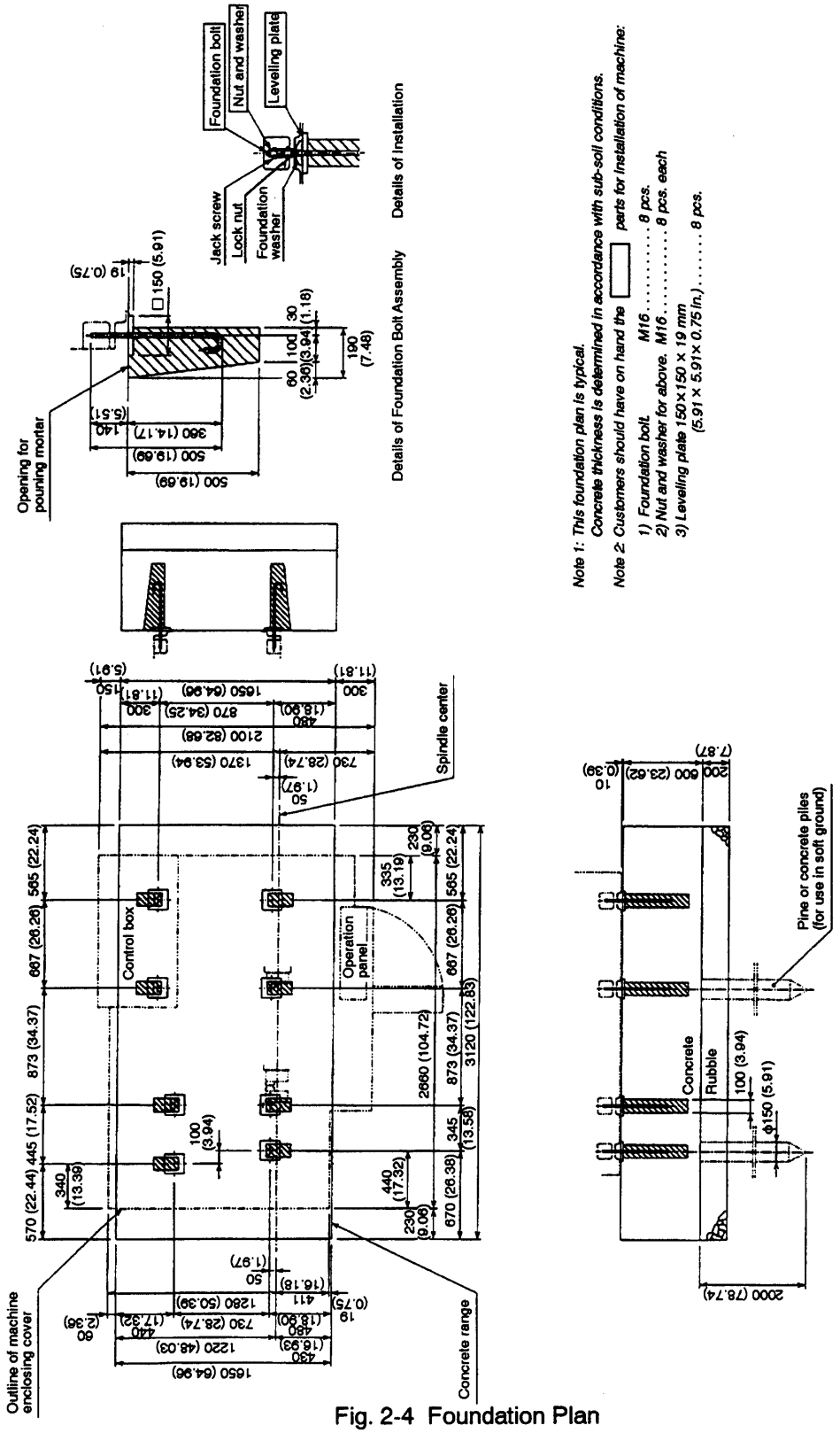



Fig. 2-4 Foundation Plan

# 6. POWER REQUIREMENTS

Power source: 3-phase, 200 V ±10%, 50/60 Hz

| Main motor: | AC 7.5/5.5 kW (10/7.5 HP) | 100 A min. |
|---|---|---|

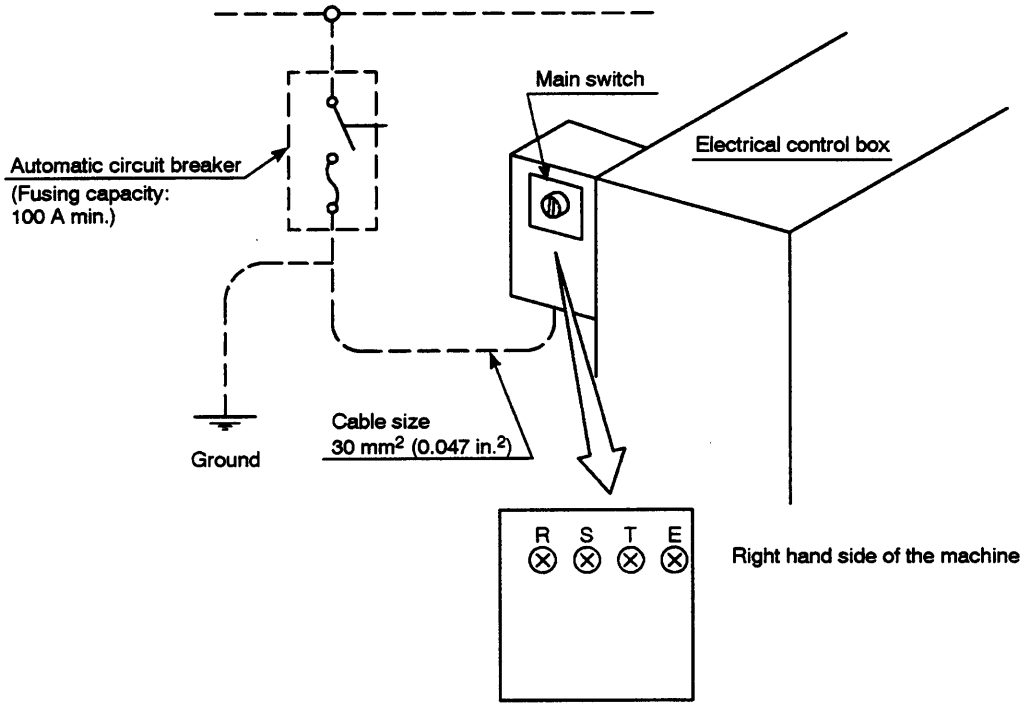



Fig. 2-5 Power Requirements

## 6-1. Inspection of Cable Connection

The operator can check correctness of cable connection by reading the pressure gauge whether it indicates the specified pressure level.

Confirm that the pressure gauge indicates the set pressure {4.4 MPa [45 kgf/cm$^2$ (640 psi)]}. When it indicates the specified pressure level, the electrical connection is correct.

## 6-2. Electrical Work

**CAUTION**

: (1) Connect the ground to the external protector connection terminal (PE) located inside the control box.

(2) Do not connect the power cord and the grounding wire in serial; if attempted, it will give adverse affect to other equipment or cause malfunctioning of the leak breaker, etc.

(3) When a leak breaker is used, select the one meeting the following rating.

- For inverter circuit use
- Sensitive current of 100 mA or more
- Middle-sensitivity high-speed inverter type

(4) If more than one machine tool is connected to the same single power source, the value of "inductance of power source" for each machine is obtained by dividing the value in the table by the number of machine tools to be connected.

(5) Wiring inductance in 50 m (164.05 ft) cable is approximately 12 μH when general KIV cable is used.

(6) The momentary voltage variation ratio is calculated in the manner as explained below.

If the "excessive voltage variation ratio" warning function which functions if power source inductance is higher than the allowable limit does not give warning signal and if the momentary voltage variation ratio is lower than the value indicated in the table above, then it is assumed that the power source inductance is lower than the limit.

(7) For further information on the momentary voltage variation ratio and power source inductance, please contact your local Okuma service representative.

Calculating momentary voltage variation ratio:

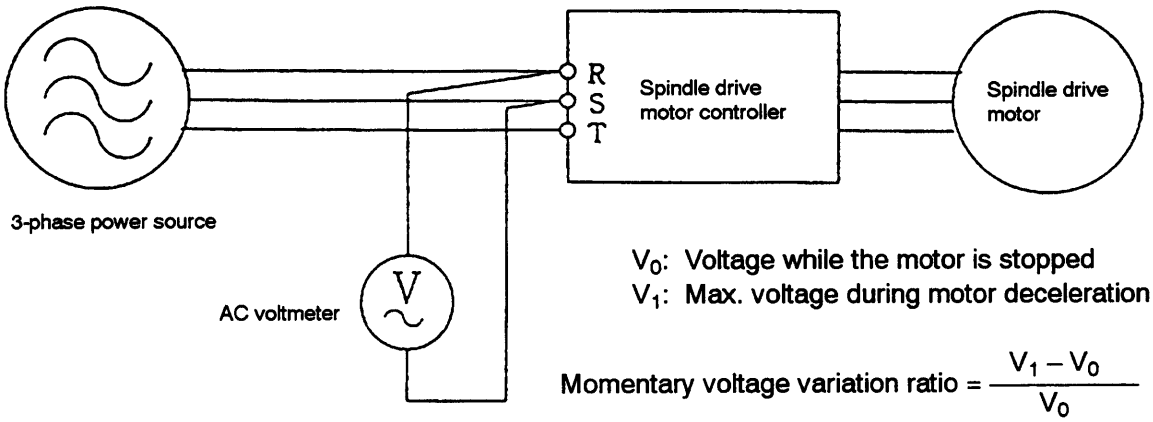



Fig. 2-6

(1) As indicated in the illustration above, connect the AC voltmeter to the power supply terminals at the spindle drive motor controller or the machine.

(2) Measure the voltage while the spindle drive motor is stopped. Take this value as "$V_0$".

(3) Measure the voltage while the spindle drive motor is decelerating. Take this value as "$V_1$".

(4) Calculate the momentary voltage variation ratio using the following formula:

Momentary voltage variation ratio = $(V_1 - V_0)/V_0$

*Note 1: Since a digital AC voltmeter has slow response, momentary voltage variation ratio obtained using the voltage measured with the digital AC voltmeter is lower than the actual value. To obtain the precise value, it is recommended to use an analog voltmeter.*

*Note 2: Voltage "$V_1$" cannot be measured accurately if motor decelerating time is short. Therefore, it is recommended to start deceleration from as high spindle speed as possible.*

*Note 3: If the "excessive voltage variation ratio" warning function which functions if power source inductance is higher than the allowable limit gives a warning, output is restricted by the spindle drive motor controller. Therefore, the momentary voltage variation ratio calculated using voltage which has been measured under such situation does is not reliable.*

# 7. LUBRICANT OIL REQUIRED AT INSTALLATION

The user is responsible for supplying the lubricant oil specified in SECTION 4 of this manual (Lubrication Chart and Lubricating Oil Specification).

(For optional specification systems, contact your OKUMA representative regarding the appropriate lubricant oil.)

# SECTION 3 MACHINE OPERATION

## 1. BEFORE STARTING OPERATIONS

This section deals mainly with the operating procedures of your Turning Center under manual control. So the information given here is essential to every operator, whether you are new to a Turning Center or an "old pro".

Follow these three points:

(1) Actually operate the Turning Center by yourself in reference to this Instruction Manual.

(2) Learn the symbols for the numerical control terms.

(3) After you have a general idea of how your Turning Center operates, read this manual repeatedly and also the Programming Manual.

**⚠CAUTION** : Turn off the main switch to bring the machine to complete stop before performing operations inside the chip guard, such as setup or adjustments.
The main switch should also be turned off before working inside the rear of the machine.

### 1-1. NC Operation

Before you begin to operate the machine automatically by tape, -make it a rule to check the following points against a process sheet, a program manuscript, or any other chart giving detailed machining instructions:

(1) Setting of hydraulic chuck jaws and their gripping pressure

(2) Installation and arrangement of individual cutting tools with respect to their operating sequence

(3) Setting of sub spindle position

(4) Setting of tool offsets

(5) Setting of zero offsets

(6) Setting of feedrate override to 100%

(7) Setting of softwired limit positions for each axis

(8) Positioning of the turrets to the turret indexing position

(9) Setting of a dummy holder to the empty turret station of the combination turret

All essential information on the setup and check-up procedures is described in the sections that follow.

## 1-2. Setting Zero Offsets

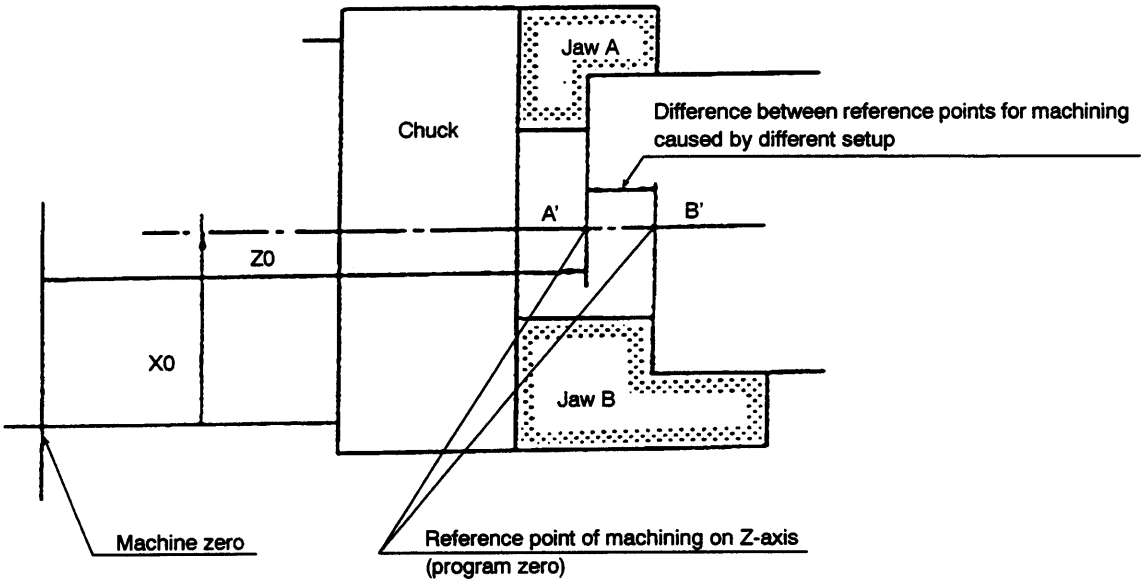
(1) What is Zero Offset?

The common coordinate position from which a complete program is made for a particular component is termed "zero point or program zero".

The programming zero is located at the fixed position (center of the spindle) on the X-axis. However, the program zero on the Z-axis will vary depending on the setup (incl. chuck, jaws, etc.).

With the NC lathe, the program origin (program starting point) is fixed anywhere on the Z-axis, that is, on the longitudinal axis of the spindle. It may vary with respect to the direction of Z-axis, according to the chucking requirements. As shown below, there is a difference in the coordinate position of zero points between one program using jaws A and another program using jaws B. This is caused by the difference in jaw sizes used in respective programs.

The zero offset feature provides for shifting the zero point of the program with respect to the zero point of the machine to match differences in individual workpieces or setups.

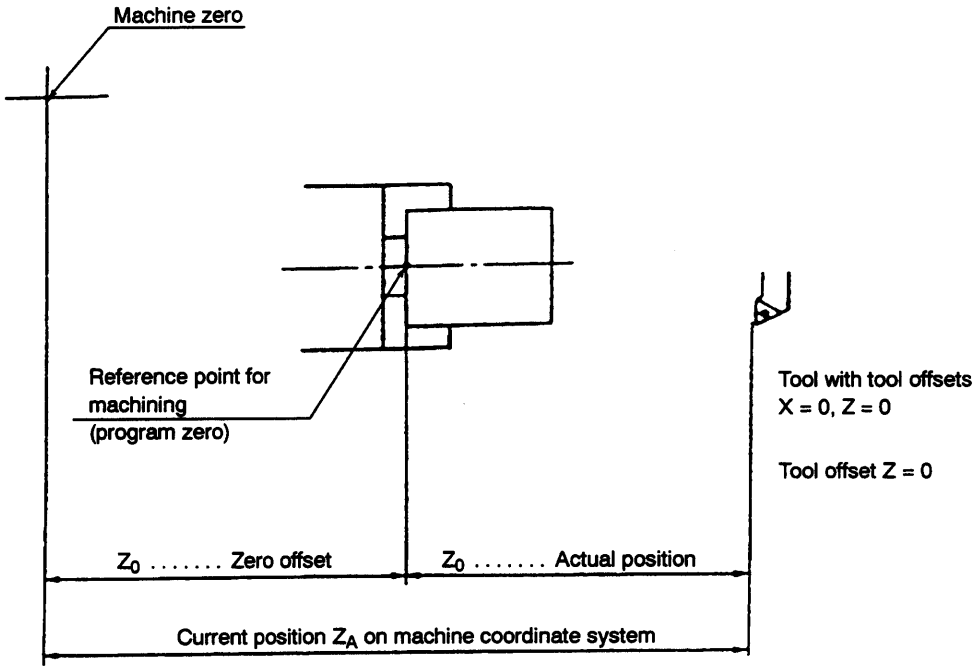



The operator can establish the reference point for machining (zero point of a program) by entering $X_0$ and $Z_0$ through the keyboard dimensioned from the fixed zero point of the machine.

"$X_0$, $Z_0$" is called Zero Offset Values.

(2) Relation between Machine Zero, Program Origin, Zero Offset Value and Actual Position

Shown below is the positional relationship between the factors involved in the zero offset function:




Current position $Z_A$ on machine coordinate system

The NC machining program needs distance Z as absolute position of the tool at A.

The control always performs calculation "$Z_A5 - Z_05$" to obtain distance Z, i.e., the absolute position of the tool.

The operator can set the reference point of machining (machining origin) at any desired point by entering zero offset value $Z_0$.

(3) Setting Zero Offset Values

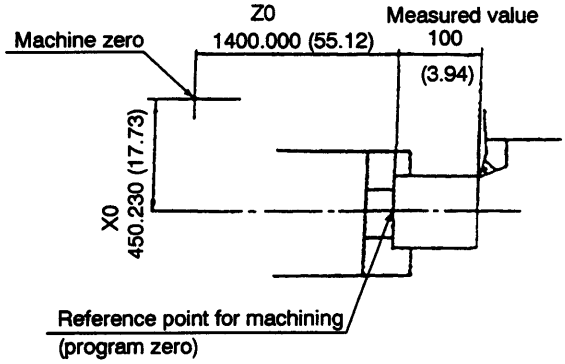
There are three possible cases for entering zero offset values:

a) Where zero offset values are unknown, as in cutting the first workpiece for instance.

b) Where zero offset values are known, as in cutting workpieces of repetitive lots.

c) Where the stored offset values are modified.

Explanation for each case is provided in this paragraph with the following example.



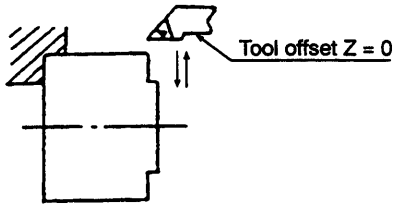

a) Case where zero offset value is unknown:

The explanation below is provided with 1 mm (0.04 in.) unit system.

To set the zero offset value of Z-axis, proceed as follows.

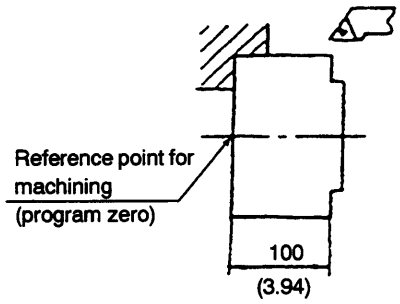
Procedure:

1) Turn the end face of the part with a proper depth of cut in the manual mode.

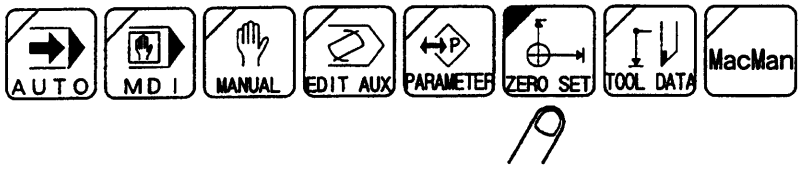



2) Measure the workpiece length to obtain the actual position of the tool dimensioned from the program zero.

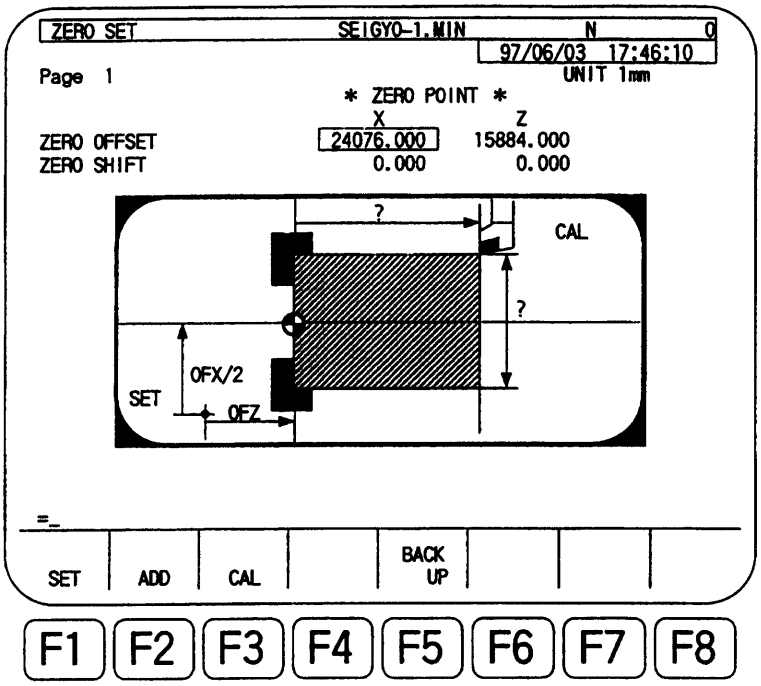
Assume this dimension is measured as 100 mm (3.94 in.) (100.000).



3) Select the ZERO SET mode by pressing the ZERO SET key.

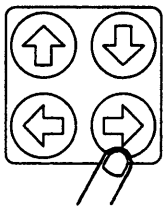


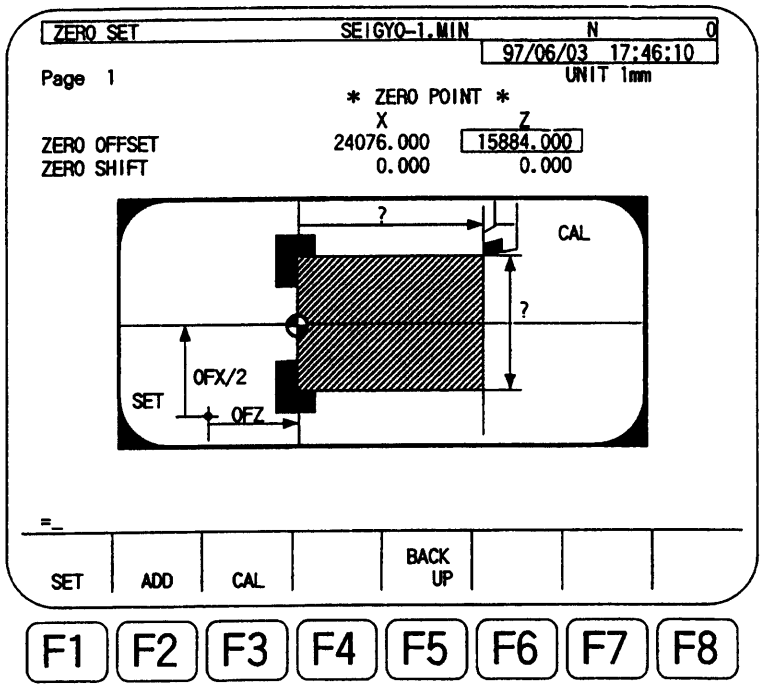

4) The display screen is as shown below.




5) Select the turret, either A- or B-turret (for two-saddle and two-turret models).
Each time [A] or [B] is pressed, turret A and B is selected alternately.

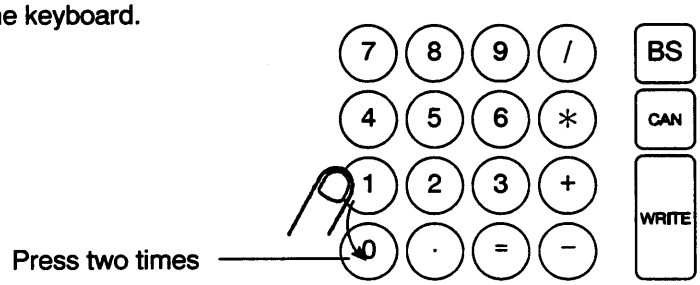
6) With the cursor control keys, move the cursor to the data column of ZERO OFFSET - ZA.

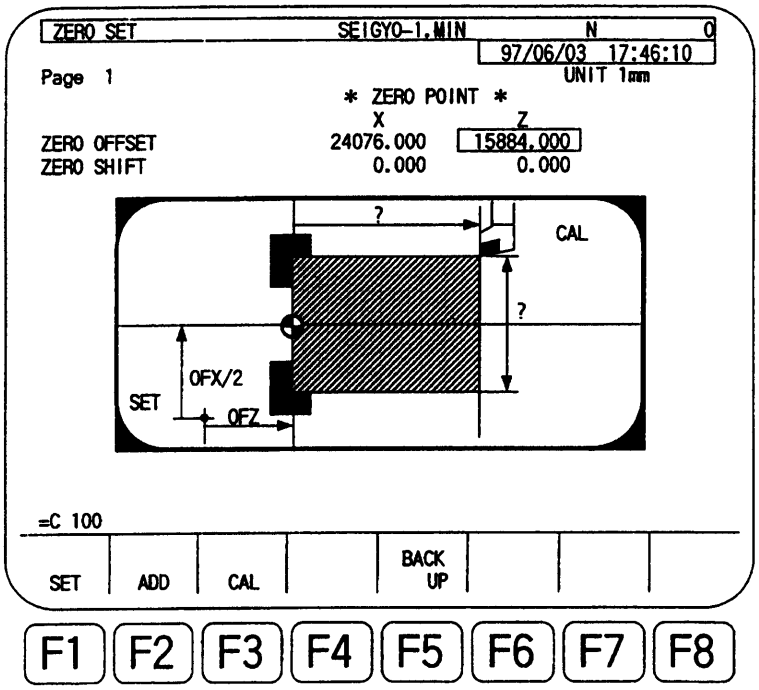




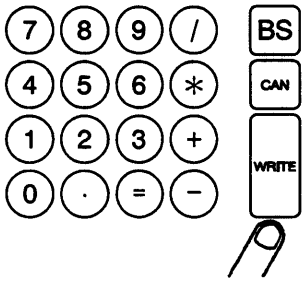

7) Press function key [F3] (CAL).

8) Key-in [1][0][0] through the keyboard.



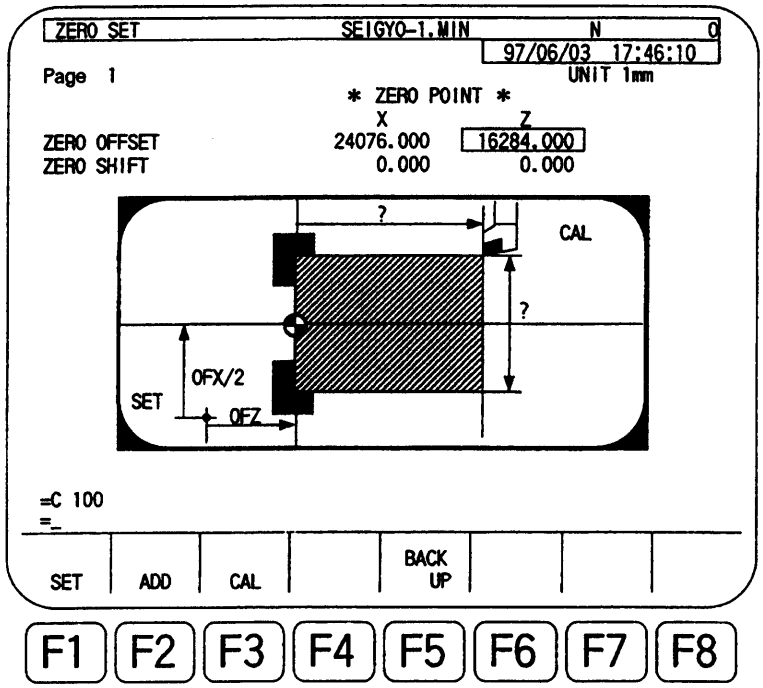



9) Press the WRITE key.




With this, the coordinate system is established so that the present tool position takes coordinate value Z100 mm.

10) The display screen displays the results of calculation or set value.




11) This completes setting the zero offset value.

**CAUTION**

: (1) Never move the turret in the Z-axis direction until zero offset setting is complete.

(2) For the X-axis, the reference point does not change even when the checking method or setup changes. Therefore, there is no need to carry out zero offset each time the set up changes.

(3) Use a tool with offset values of X = 0, Z = 0, where practicable, for zero offset setting. If the tool offset values are not zero, the zero offset setting procedure will differ from the procedure indicated above. Refer to the following page.

When a tool with tool offset values is used to set the zero offset value:

The numeral data to be entered through the keyboard is the sum of "measured valuer" and "tool offset value".

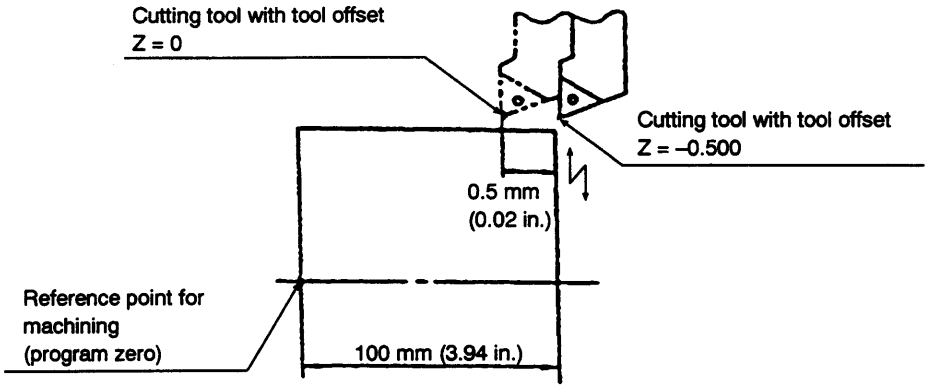
| Setting value = Measured value + Tool offset value |
|---|

Example: A tool with a tool offset value of Z = –0.500 is used.

The zero offset value is calculated as

100.000 + (–0.500) = 99.500

Setting value
Tool offset value
Measured value




If the workpiece length is 100 mm (3.94 in.)when it has been cut using a tool with a tool offset of Z = –0.500 mm (0.02 in.), the position of the tool with a tool offset of Z = 0 is 99.5 mm (3.92 in.) from the reference point (program zero).

A procedure that does not require a modification of the set zero offset value is described below.

1) Carry out steps 1) and 2) as explained before.

2) Enter tool offset data to tool offset #1 register.

   To enter tool offset, refer to 3-2-3.

3) Cut the end face of the part by moving only the X-axis in the MDI mode with T01 01 active. (Refer to 3-3.)

   T01 01

Tool No. Tool offset No.

4) Carry out steps 3) through 9) as explained before.

With the procedure above, it is not necessary to modify the set zero offset value by taking the tool offset value into consideration.

[Supplement] : Never reset the control after cutting the part in the MDI mode.

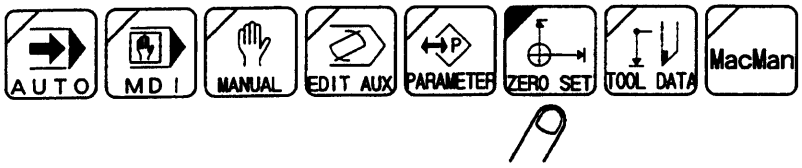
b) Where the zero offset value is known:

To set zero offset value of X-axis, proceed as follows:

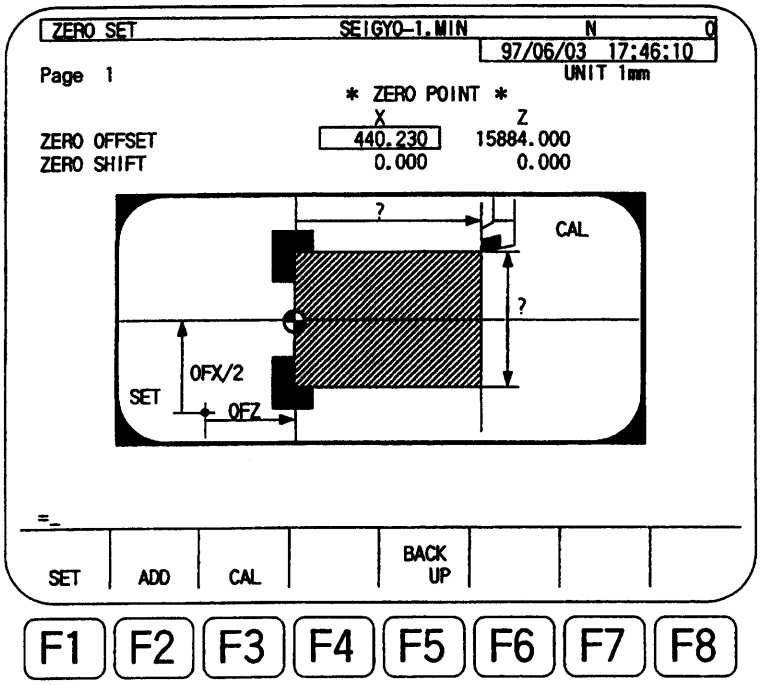
Example: $X_0$ = 450.230
$Z_0$ = 1400.000

Procedure:

1) Select the ZERO SET mode by pressing the ZERO SET key.



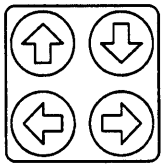

2) The display screen is as shown below.



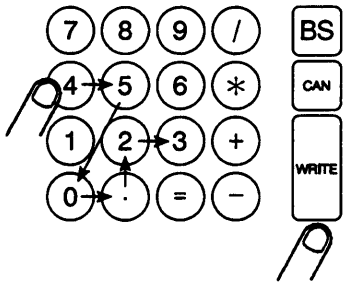

3) Select the turret, either A- or B-turret (for two-saddle and two-turret models).

Each time [A] or [B] is pressed, turret A and B is selected alternately.

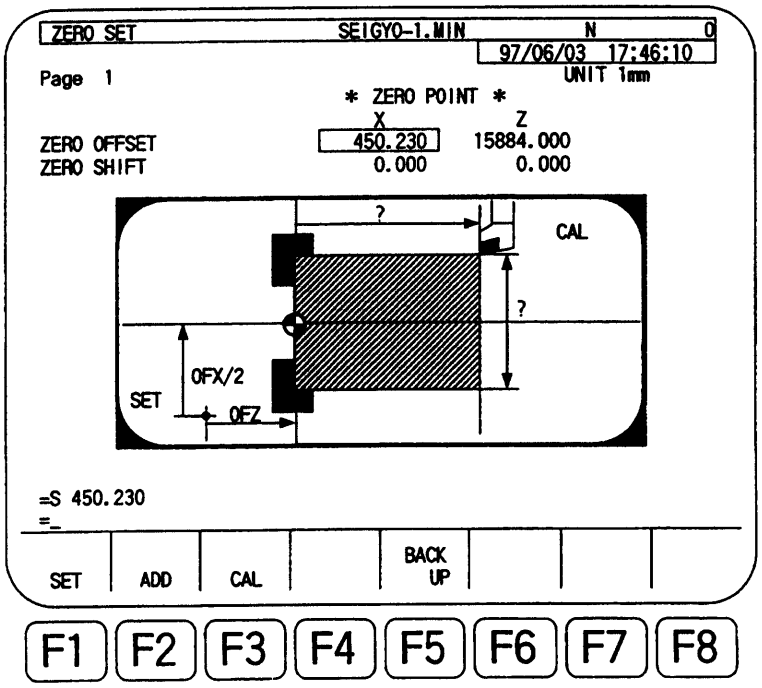
4) With the cursor control keys, move the cursor to the data column of ZERO OFFSET - XA.



5) After pressing function key [F1] (SET), key in [4][5][0][.][2][3] through the keyboard.




6) Press the WRITE key.




With the steps indicated above, keyed-in zero offset value is stored in the zero offset area of the memory.

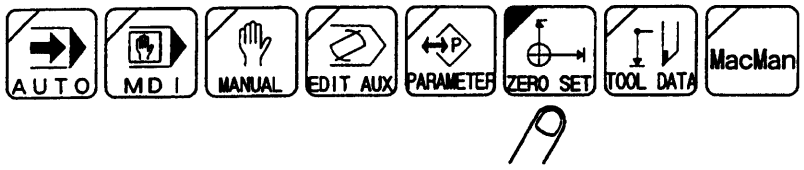
For Z-axis zero offset entry, the same procedure applies.

c) Where the stored zero offset value is to be modified:

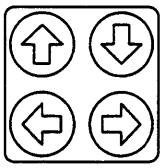
Example: $X_0$ = 450.230 ..... to subtract 10.000
$Z_0$ = 1400.000 ..... to add 10.000

Procedure:

1) Select the ZERO SET mode by pressing the ZERO SET key.

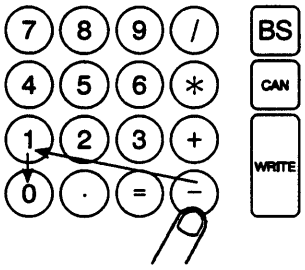



2) With the cursor control keys, move the cursor to the data column ZERO OFFSET - XA.

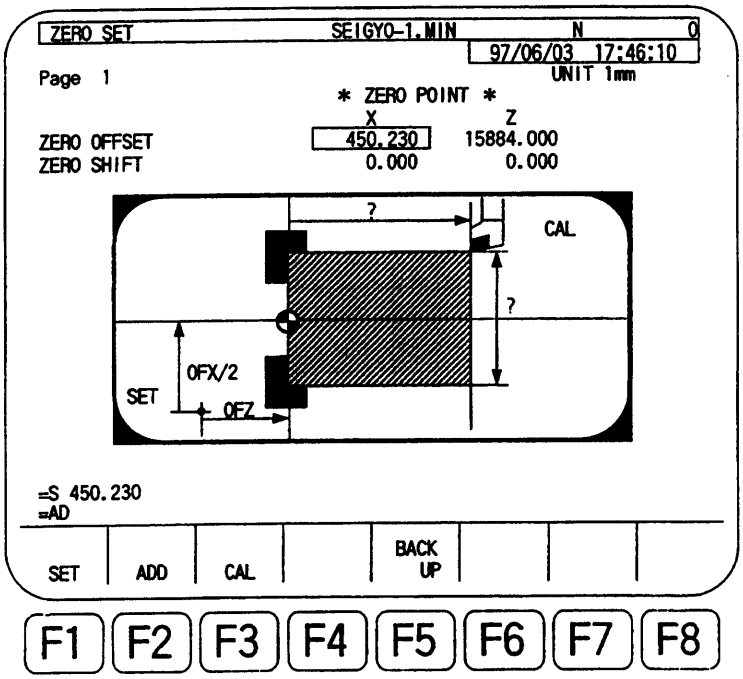


3) Press function key [F2] (ADD).

4) Key in [–][1][0] through the keyboard.



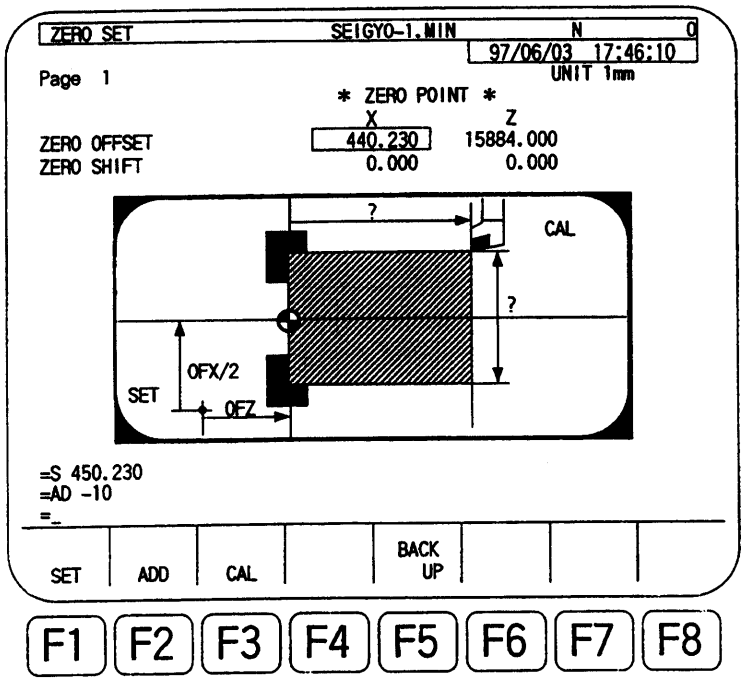
5) The corresponding display screen is:




6) Press the WRITE key, and the display screen changes as shown below.

With the WRITE key pressed, the following calculation is performed in the control and the result is stored as the X-axis zero offset value.

450.230 + (–10.000) = 440.230




For Z-axis zero offset entry, the same procedure applies.

# 2. MACHINE OPERATION

## 2-1. Hydraulic Unit

(1) Overall View

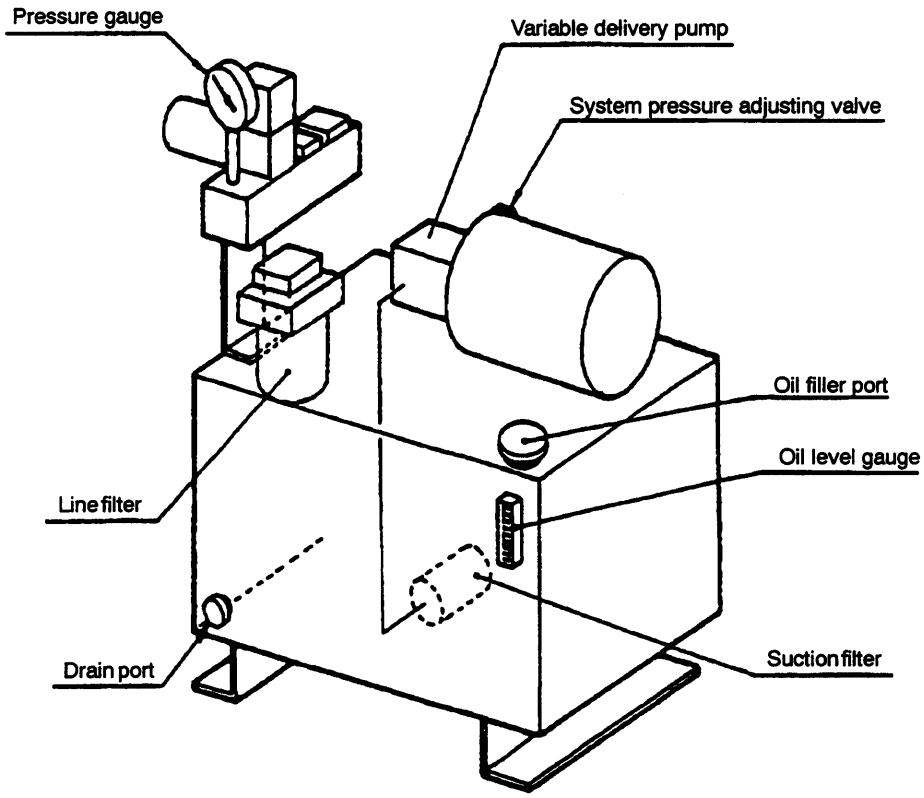



Fig. 3-1

(2) Pressure Indication

Pressure setting for the hydraulic unit should be:

| | |
|---|---|
| Pressure setting | 4.4 MPa [45 kgf/cm$^2$ (640 psi)] |

(3) Adjustment of Hydraulic Pressure

The following outlines the methods of setting individual functional units for operating pressure. Since the pressure lines for the turret(s) have been adjusted at our factory before shipment, they will not require readjustments, during the initial installation and subsequent normal service of the machine.

a) System pressure adjustment (Adjustment is not usually required.)


Fig. 3-2 System Pressure Adjusting Valve (Hydraulic Unit)

b) Hydraulic pressure for hydraulic chuck

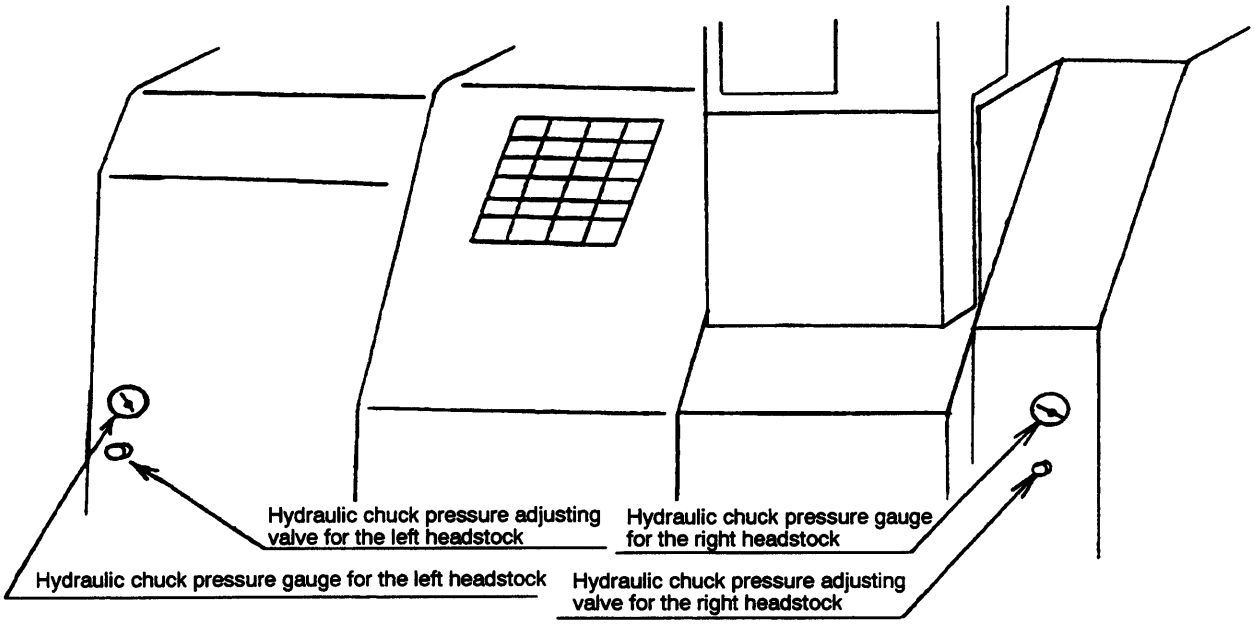



Fig. 3-3 Hydraulic Pressure for Hydraulic Chuck

(4) Hydraulic Oil

| | |
|---|---|
| Oil Specification | HL32 (MAS) |
| Amount | 40 liter (10.56 gal) |
| Oil Change Interval | Change after first month of operation and every 6 months thereafter. |

**NOTICE** : When changing the oil, clean the inside of the tank. Check the pressure for respective actuators. Change the filter when it is clogged. Use of clogged filter, which allows dirty oil to be circulated through the system, leads to serious trouble.

a) Discharge the oil by loosening the nut.

b) Remove the filter element downwards and clean the inside of the case.

c) Change the filter element.

Filter Element Specifications:

| | |
|---|---|
| Maker | Yamashin |
| Type | PX040A |
| Part No. | H0032-0009-96 |

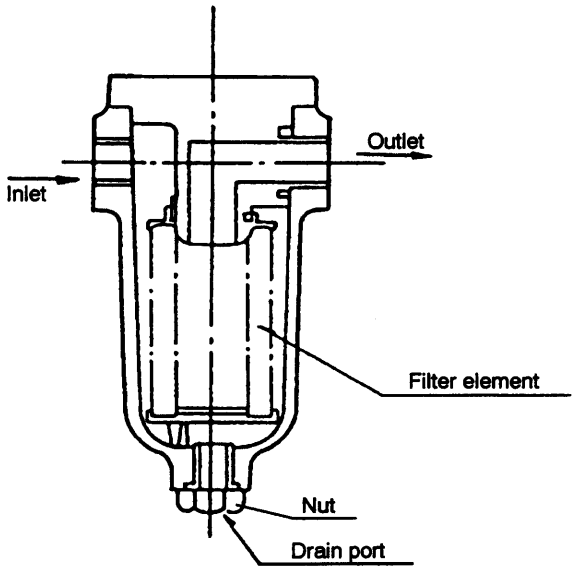
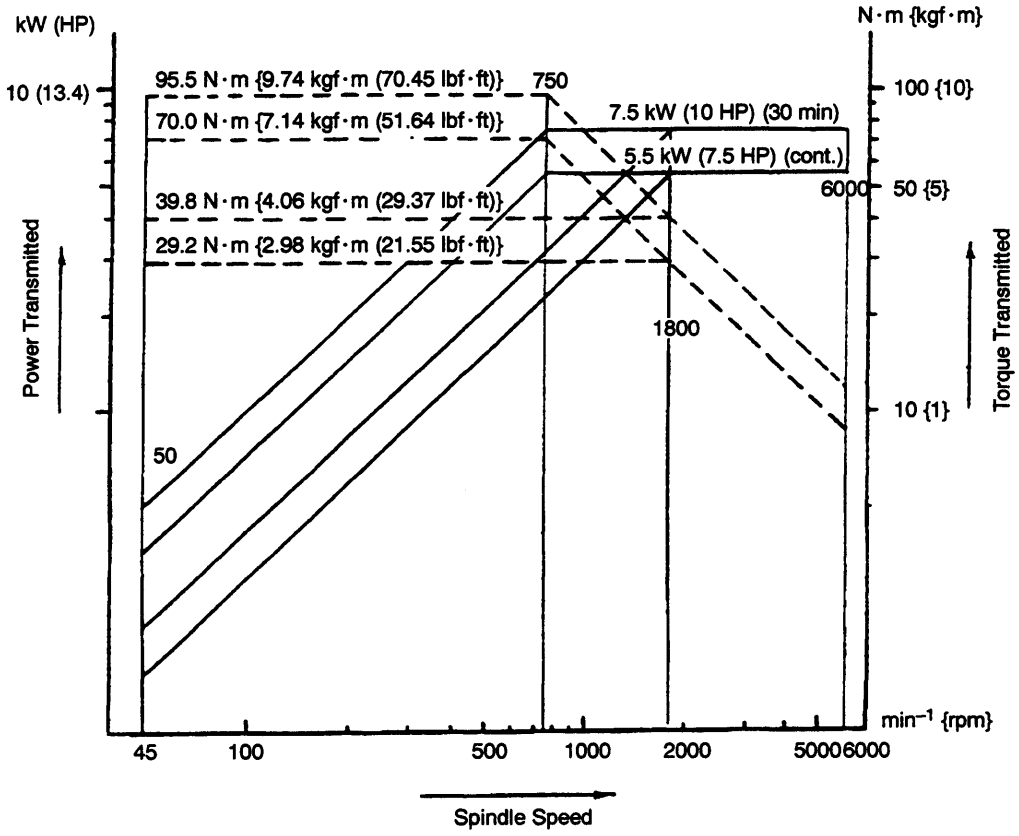



Fig. 3-4 Filter in Hydraulic Circuit

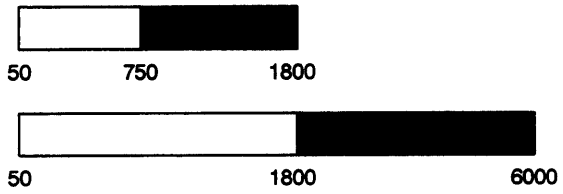
## 2-2. Selection of Spindle Drive Gear Range

(1) Spindle Power Transmission Torque Diagram (Standard Spindle)

- 6000 $min^{-1}$ {rpm} specification




For heavy-duty cutting, select a spindle speed in the shaded area so that cutting is performed within a constant output range.




* The low-speed/high-speed range can be changed by changing the VAC motor coil connection. (This change takes approx. 1 sec.)

Fig. 3-5 Spindle Power Transmission Torque Diagram (Standard Spindle)

## 2-3. Rotary Tool (M-tool) Spindle

- Spindle Power Transmission Diagram

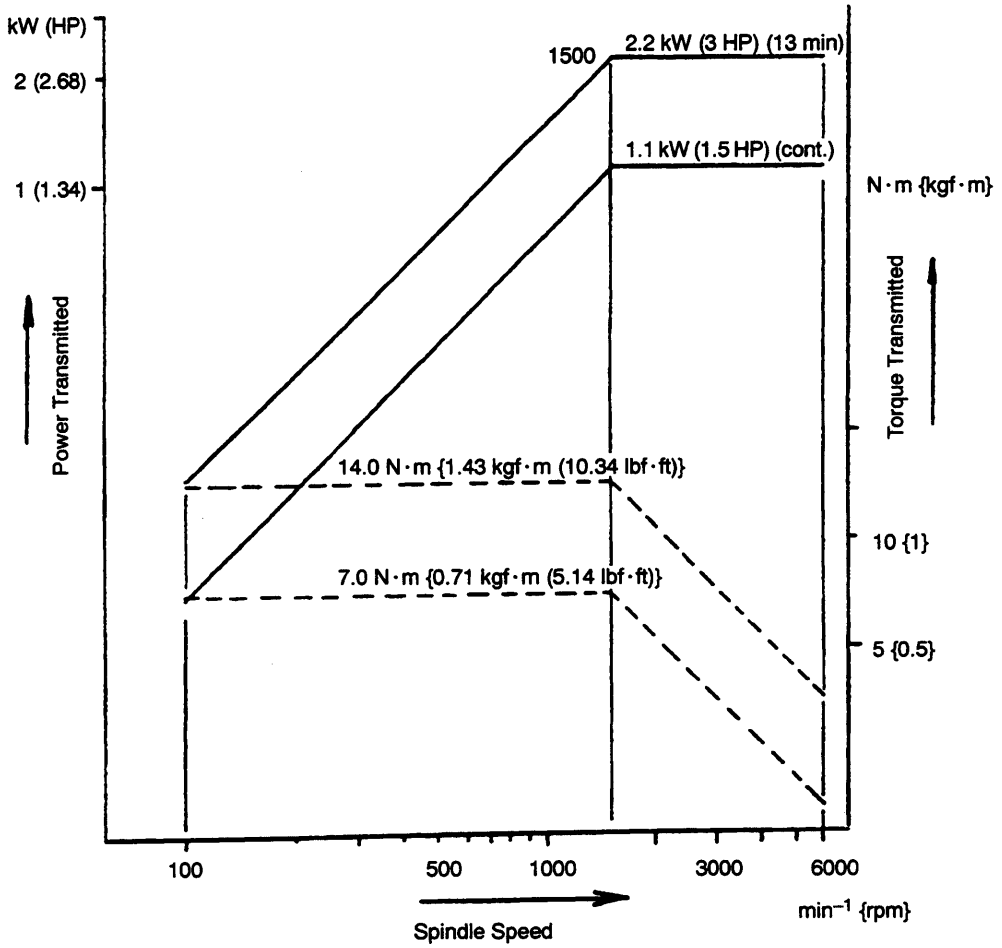



Fig. 3-6 Spindle Power Transmission Diagram (Rotary Tool Spindle)

*Note: With the face drill and end mill holders, the maximum speed is restricted at 4500 $min^{-1}$ (rpm).*

## 2-4. C-axis Brake

**CAUTION** : For the C-axis, three kinds of brakes are applied meeting the machine operation.

(1) C-axis indexing (rapid feed) : Brake free

(2) Cutting while controlling C-axis : Brake pressure: low setting: 0.49 MPa
(profile generation etc.) [5 kgf/cm$^2$ (71.1 psi)]

(3) Cutting while clamping C-axis : Brake pressure: 4.4 MPa [45 kgf/cm$^2$ (640 psi)]
(keyway cutting, etc.)

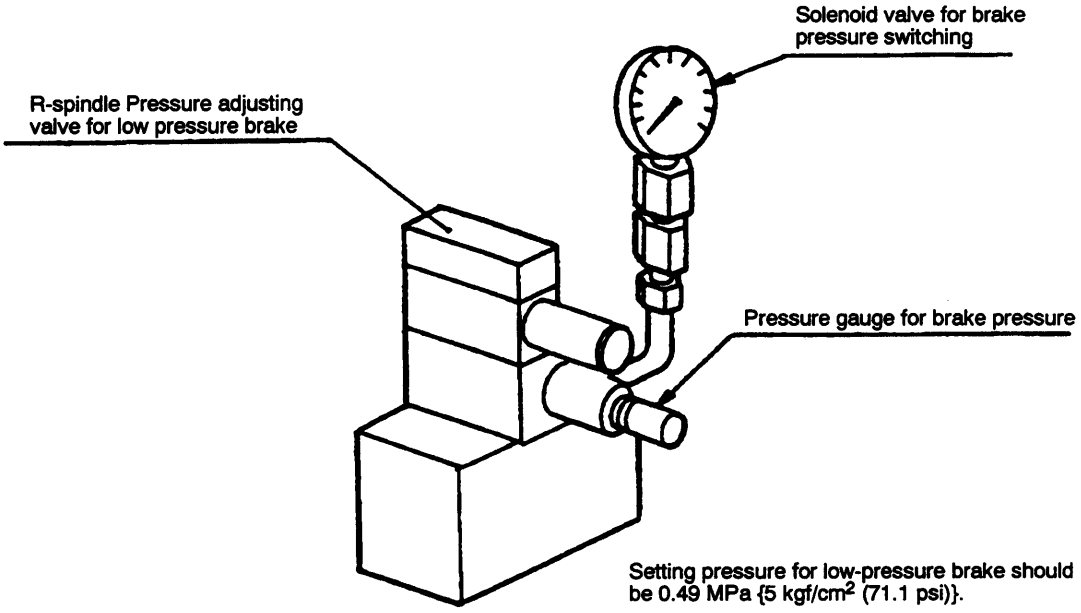



Fig. 3-7 C-axis Brake Related Hydraulics

## 2-5. Hydraulic Chuck

(1) Construction

The construction of hydraulic chuck is shown below.

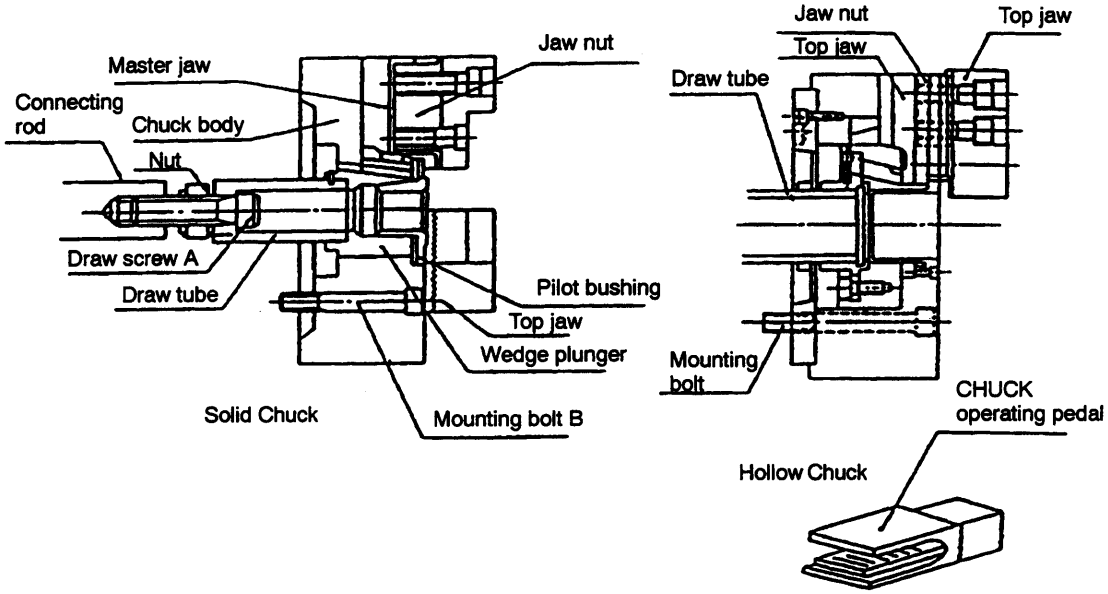



Fig. 3-8 Construction of Hydraulic Chuck

(2) Installation of Hydraulic Chuck

Procedure:

a) Press the CONTROL ON/RESET pushbutton on the operation panel to turn on the machine control circuit, and depress the CHUCK operating foot pedal. This causes the connecting rod in the spindle bore to move forward.

↓ Connecting rod advance

b) Fasten the draw screws A to the connecting rod. Use the Allen wrench furnished with the machine.

↓ Use the Allen wrench furnished with the machine.

c) Secure the chuck body onto the spindle end, using mounting bolts B.

↓

d) Adjust the draw screw A so that the outer ends of the master jaws become flush with the peripheral surface of the chuck body when the top jaws are in the OPEN condition.

The individual chuck jaws can be moved in the "opening" direction as the draw screw A is turned in the counterclockwise direction. Removal of the hydraulic chuck from the spindle is the reverse of installation in steps from c) to b).

**⚠WARNING**

: If you enter the area inside the cover to change the chuck, jaws, contact block, etc.,

- shut off the power and ensure the safety for your work.
- do not carry out your work by using M19 (spindle orientation) or M110 (C-axis joint) command.

(3) Chuck Grip Confirmation

To ensure your safety in using the chuck grip confirmation unit, read the following information carefully to understand the function and construction of the unit and observe the instructions.

a) Solid chuck cylinder

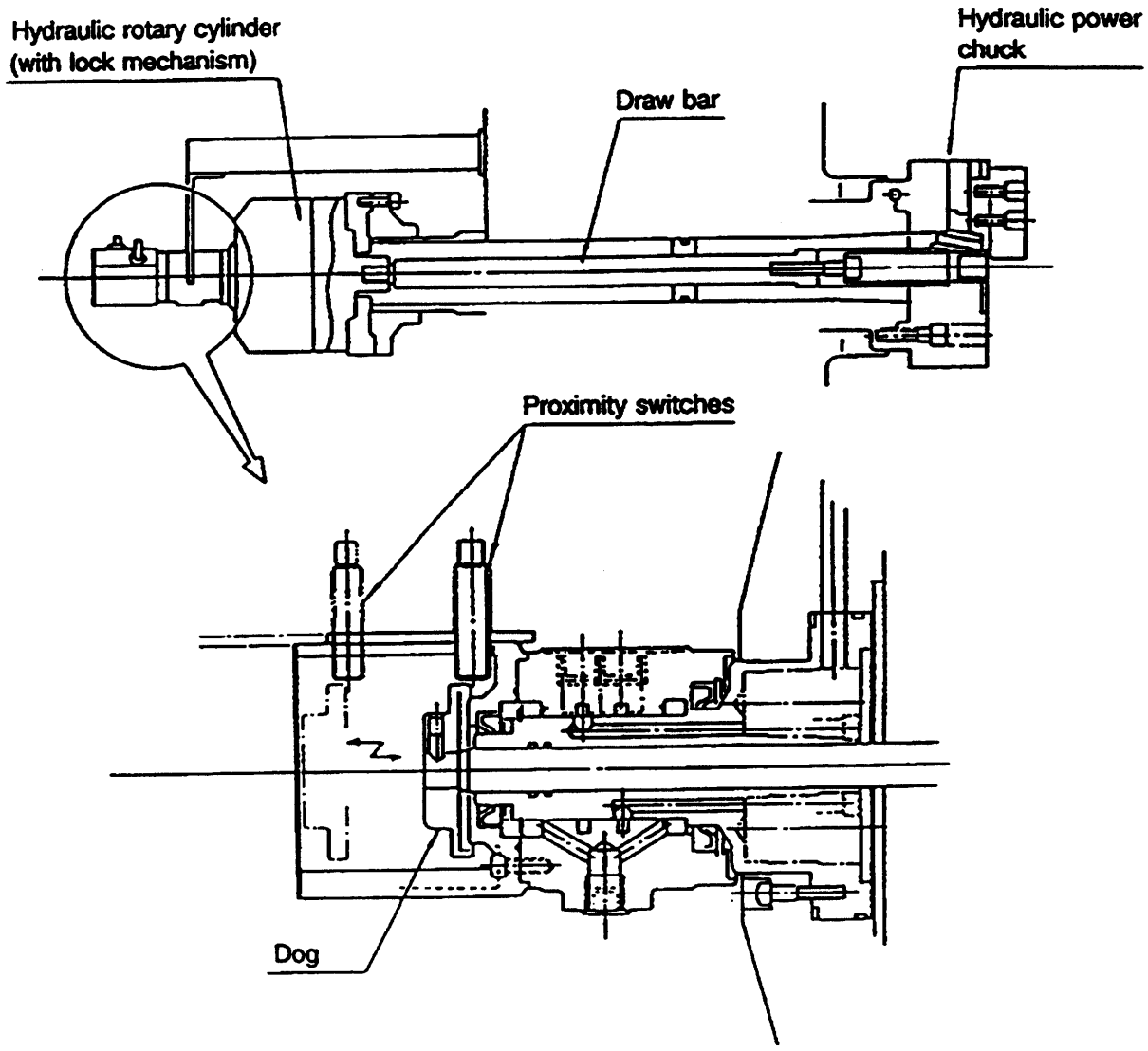



Fig. 3-9 Solid Chuck Cylinder

Position of the dog moving with the hydraulic rotary cylinder piston is detected by the proximity switches to confirm the chuck jaw position. (optional)

b) Hollow chuck cylinder

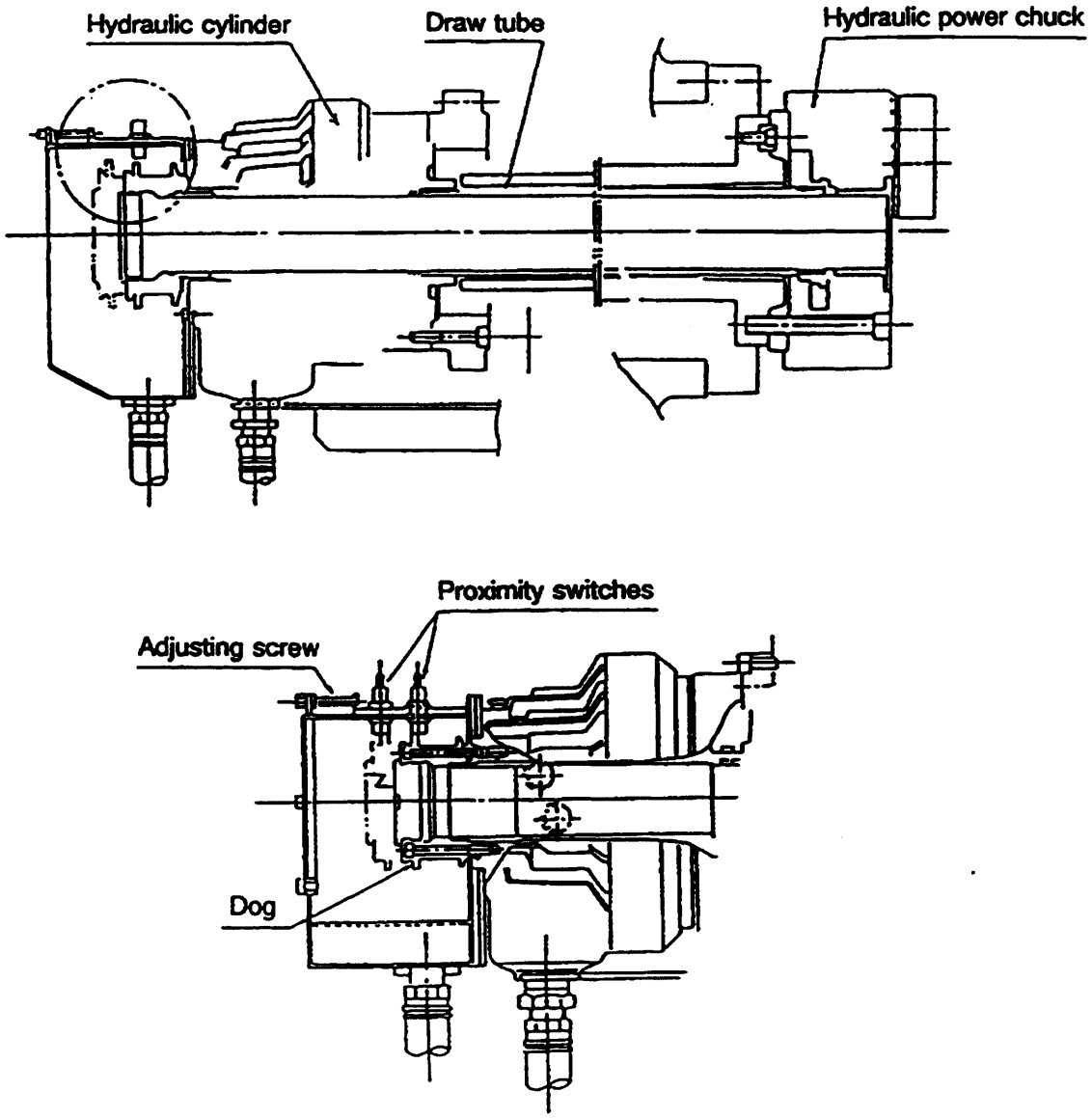



Fig. 3-10 Hollow Chuck Cylinder

Position of the dog moving with the hydraulic rotary cylinder piston is detected by the proximity switches to confirm the chuck jaw position. (optional)

(4) Adjustment of Oil Pressure for Hydraulic Chuck

The gripping pressure of the chuck jaws is dependent upon the working pressure of hydraulic fluid which is determined by the setting of the chuck pressure adjusting valve installed at the front of the machine (See 2-1.).

A clockwise turn of the valve knob increases the working oil pressure directed into the chuck cylinder and counterclockwise turn decreases it.

The allowable maximum pressure is indicated in table below. Adjust the pressure meeting the types of chuck.

(5) Maximum Permissible Spindle Speeds and Oil Pressure Setting

Maximum permissible spindle speed varies depending on types of chuck and cylinder to be used.

See the table below:

| No. | Chuck | MPa {kgf/cm$^2$ (psi)} | min$^{-1}$ {rpm} | Type of Cylinder |
|---|---|---|---|---|
| 1 | Hollow type B-206-01 | 2.7 {27 (383.9)} | 6000 | S1243-01C |
| 2 | Solid type N-06-LB | 2.4 {25 (355.5)} | 5000 | Y1020R |

**CAUTION** : This table indicates the permissible spindle speed for standard chuck. If a chuck other than those indicated above is used, follow the instruction on the name plate at the front cover of the machine.

(6) How to Set Maximum Spindle Speed

The maximum spindle speed to which is to be limited due to chuck specifications, influence of centrifugal force on chuck gripping force, imbalance of workpiece, etc. can be set by program.

Format:

G50 SOOOO ..... To be specified in a block without other command

Specify the required maximum spindle speed.

Programmed maximum spindle speed is effective until another spindle speed is designated.

(7) Adjusting Proximity Switch Longitudinal Position

a) For solid cylinder

Loosen the screws clamping the two proximity switch plates to slide them with the proximity switch to determine the position. After determining the position, tighten the proximity switch plate clamp screws.

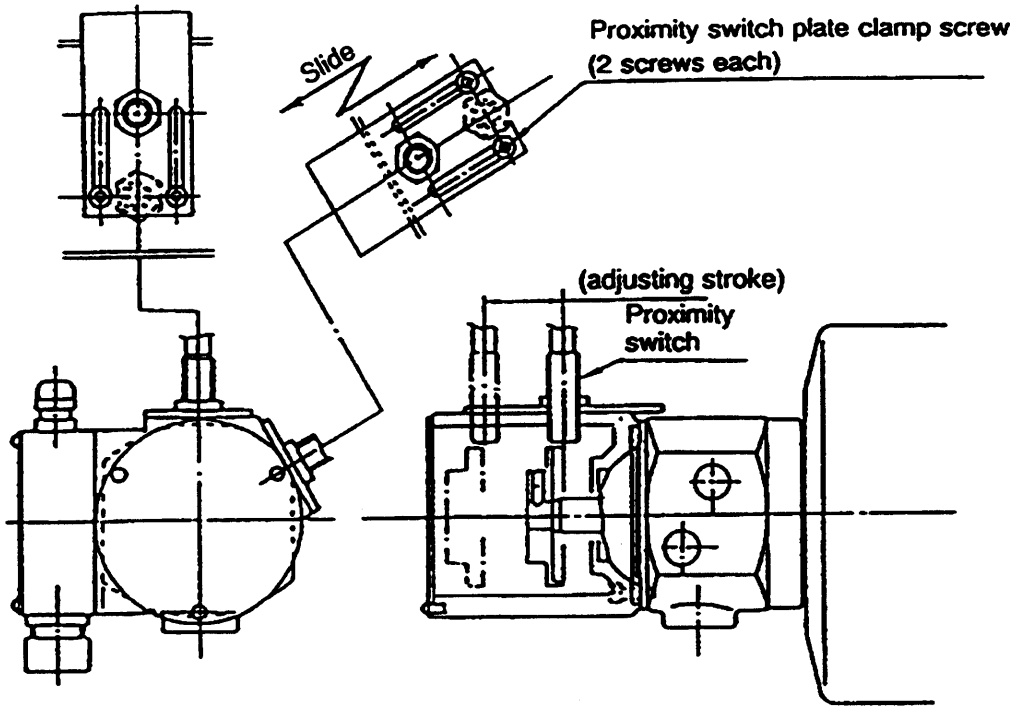



Fig. 3-11 Adjusting Proximity Switch Position (for Solid Cylinder)

**CAUTION** : The proximity switch position is adjusted to provide the required clearance to the dog (1 mm (0.04 in.)) before shipment. Thus, adjustment is not required usually.

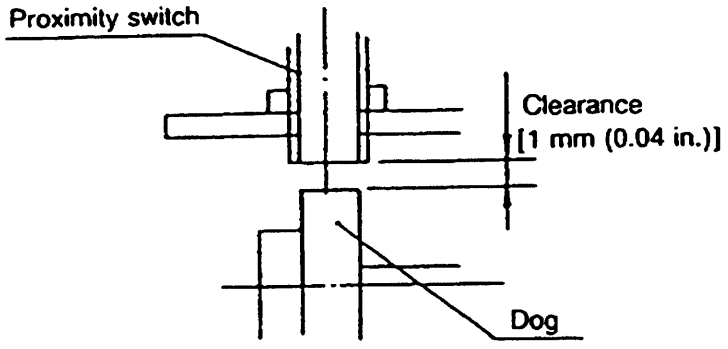



Fig. 3-12 Clearance between Proximity Switch and Dog

b) For hollow cylinder

Loosen the screws clamping the two proximity switch plates to slide them with the proximity switch to determine the position. After determining the position, tighten the proximity switch plate clamp screws.

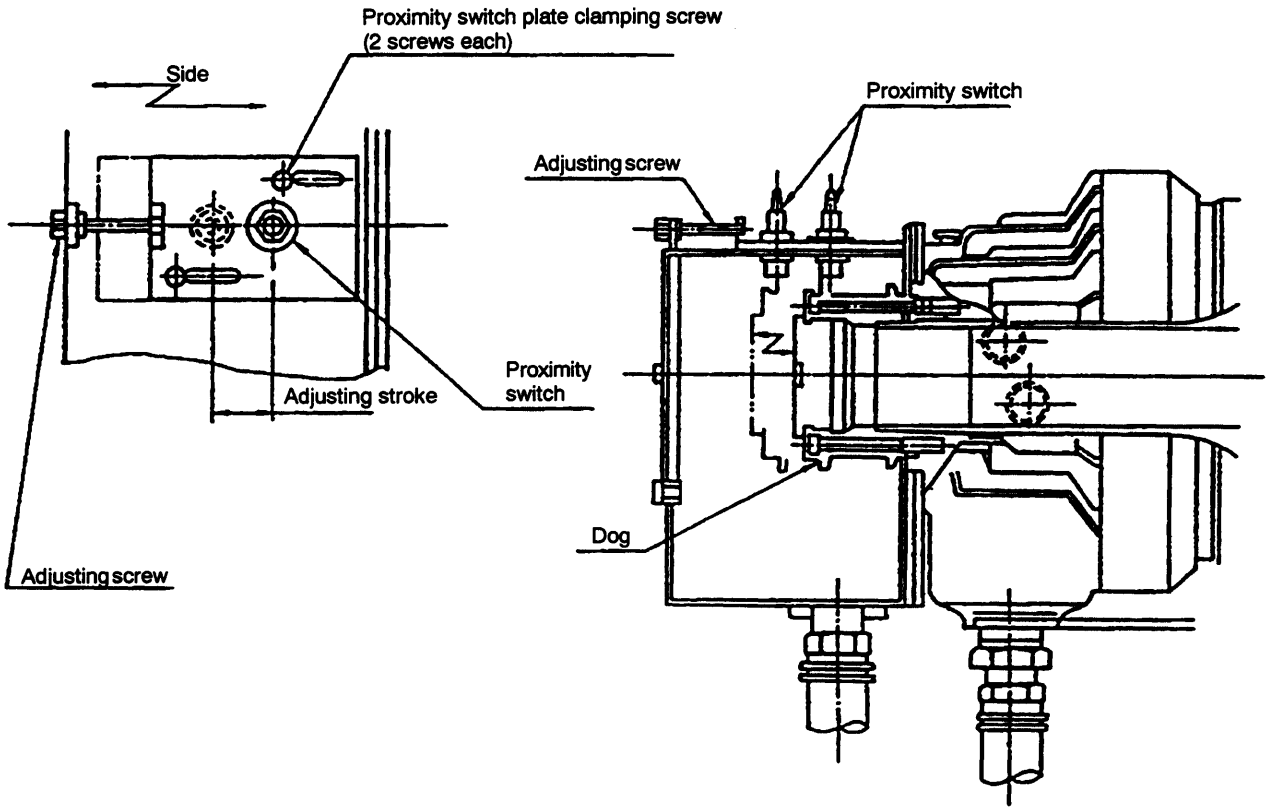
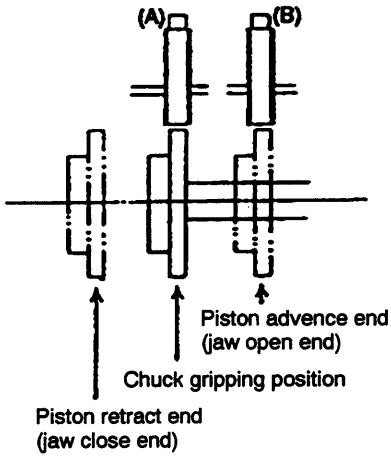



Fig. 3-13 Adjusting Proximity Switch Position (for Hollow Cylinder)

(8) Setting Proximity Switches

a) OD chucking

Set the proximity switches at the positions as indicated below:



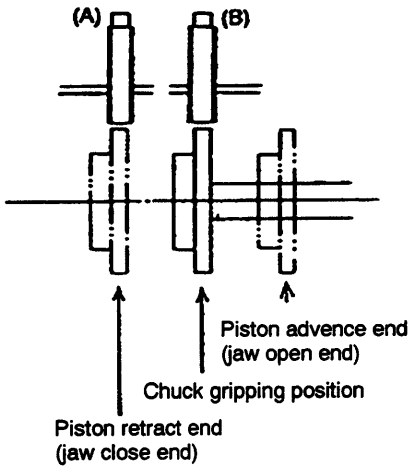

Proximity switch (A): Piston retract end

Proximity switch (B): Chuck gripping position

Fig. 3-14 Setting Proximity Switches (OD Chucking)

b) ID chucking

Set the proximity switches at the positions as indicated below:




Proximity switch (A): Chuck gripping position

Proximity switch (B): Piston advance end

Fig. 3-15 Setting Proximity Switches (ID Chucking)

*Note: According to the OD/ID chucking, the proximity switch to be set at the chuck gripping position differs.*

| CAUTION | : Always clamp the workpiece to set the proximity switch at the chuck gripping position. |
|---|---|

(9) Confirmation Signals

a) Signal input status display

Whether or not the proximity switches are set correctly and corresponding signals are input can be checked by the check data display screen.

For the procedure to display the CHECK DATA screen, refer to OSP MAINTENANCE MANUAL.

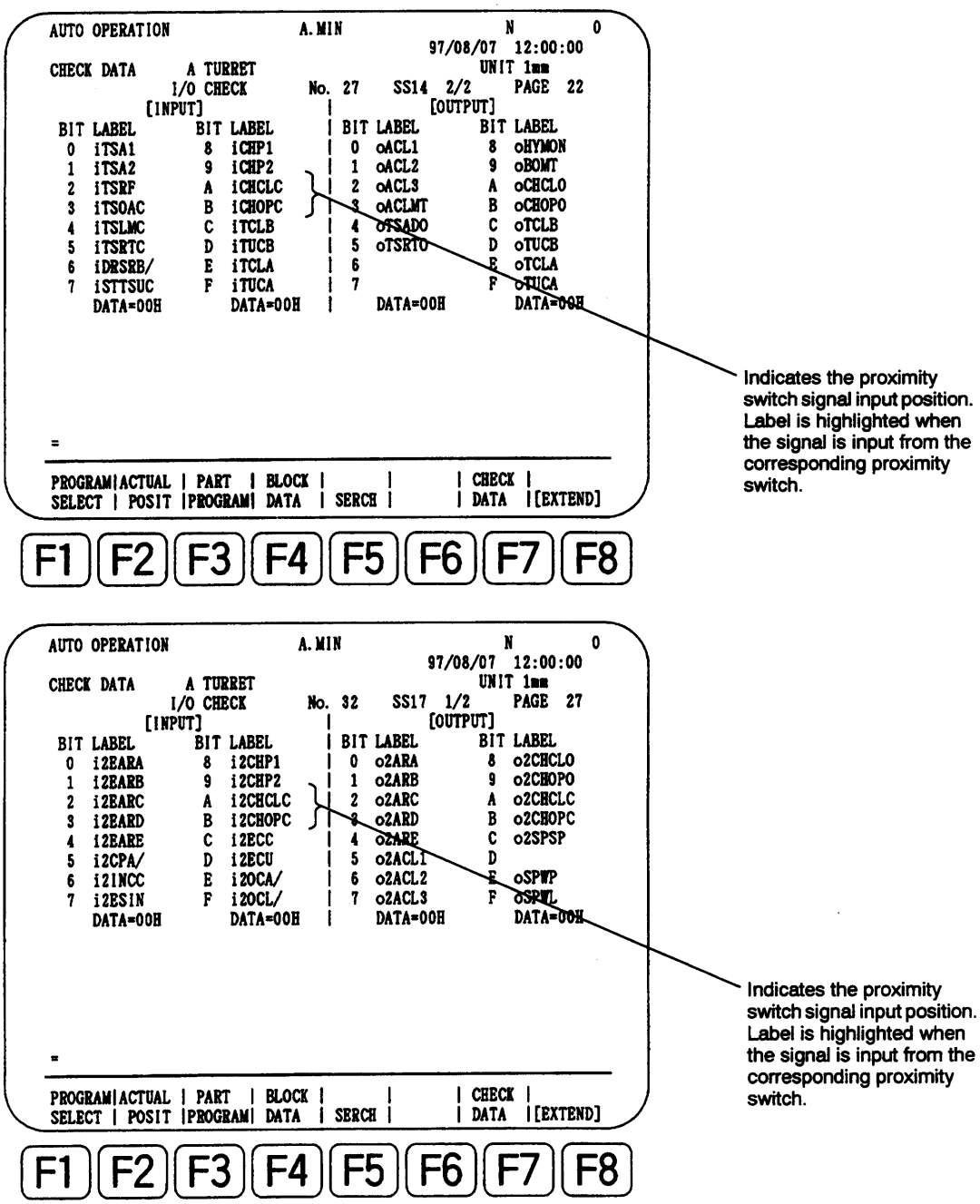



Fig. 3-16 Signal Input Status Display

b) Checking input signals

When the proximity switches are set in the correct position, the signals change as indicated below according to the chuck status.

OD chucking:

At chuck gripping position

| L-spindle side: | R-spindle side: |
|---|---|
| iCHOPC ... 0 | i2CHOPC .... 0 |
| iCHCLC .... 1 | i2CHCLC .... 1 |

At piston retract end position

| L-spindle side: | R-spindle side: |
|---|---|
| iCHOPC ... 1 | i2CHOPC .... 1 |
| iCHCLC .... 0 | i2CHCLC .... 0 |

ID chucking:

At chuck gripping position

| L-spindle side: | R-spindle side: |
|---|---|
| iCHOPC ... 1 | i2CHOPC .... 1 |
| iCHCLC .... 0 | i2CHCLC .... 0 |

At piston advance end position

| L-spindle side: | R-spindle side: |
|---|---|
| iCHOPC ... 0 | i2CHOPC .... 0 |
| iCHCLC .... 1 | i2CHCLC .... 1 |

c) Operation completion confirmation delay timer

There may be cases in which the chuck open/close is not completed even if the corresponding signal is input. For such cases, timer function can be used to delay the confirmation of the chuck operation after the input of the signal.

The timer is set using the following parameters.

MC USER PARAMETER (CHUCK)

Chuck clamp answer time

The timer to set the delay duration after the input of the signal from the chuck gripping position proximity switch to confirm the chuck close state.

MC USER PARAMETER (CHUCK)

Chuck unclamp answer time

The timer to set the delay duration after the input of the signal from proximity switch detecting the piston retract end (for OD chucking) or the piston advance end (for ID chucking) to confirm the chuck open state.

Setting is made in units of 0.01 sec. The default values for these parameters are indicated below.

Chuck clamp answer time: 100 (1 sec)

Chuck unclamp answer time: 0

For the procedure to set the data for MC USER PARAMETER, refer to OSP OPERATION MANUAL.

(10) Hydraulic Chuck Clamping Force Characteristics Diagram

a) Chuck speed - clamping force diagram for solid chucks

Unit: mm (in.)

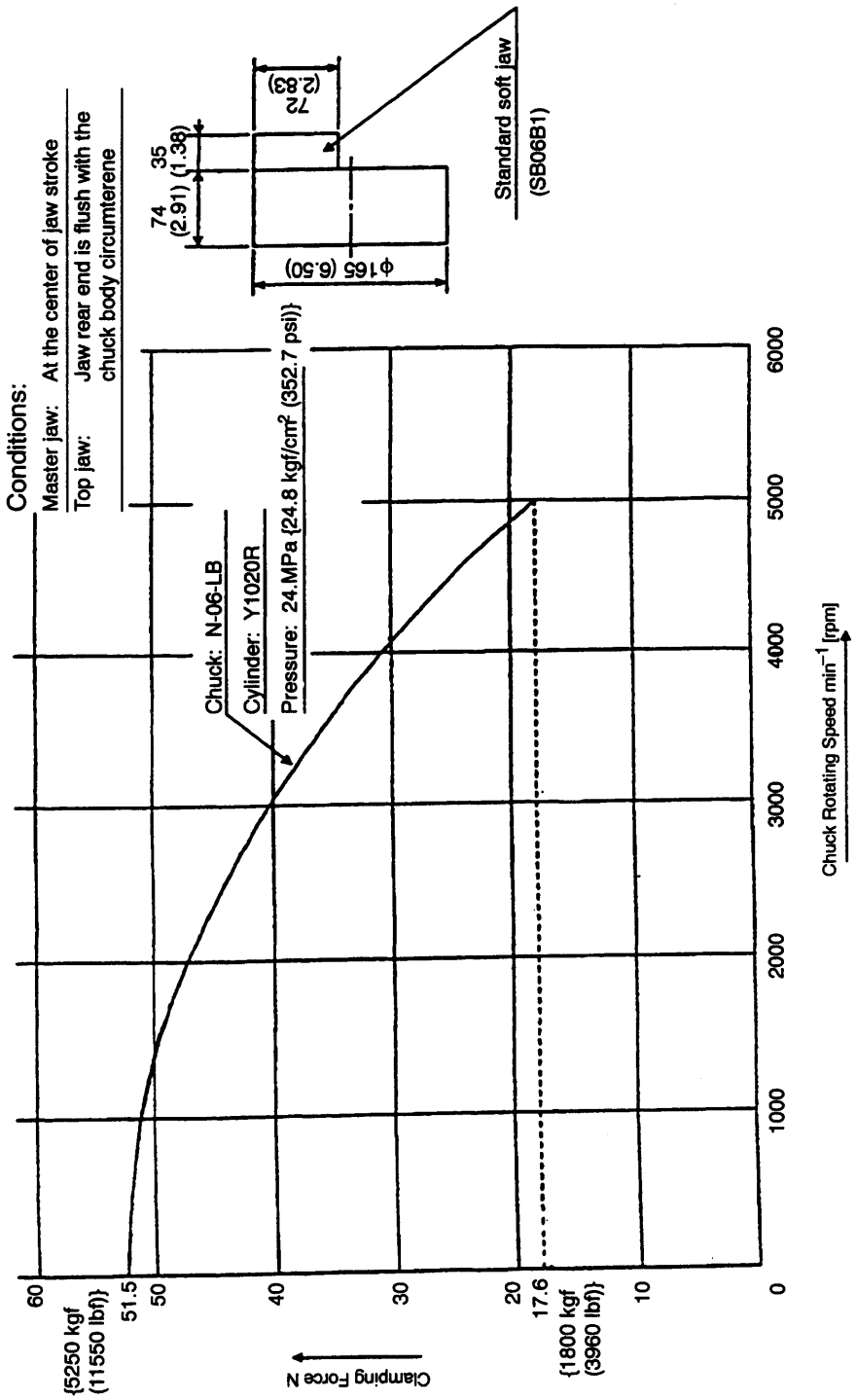



Fig. 3-17 Chuck Speed - Clamping Force Diagram for Solid Chucks

b) Chuck speed - clamping force diagram for hollow chucks

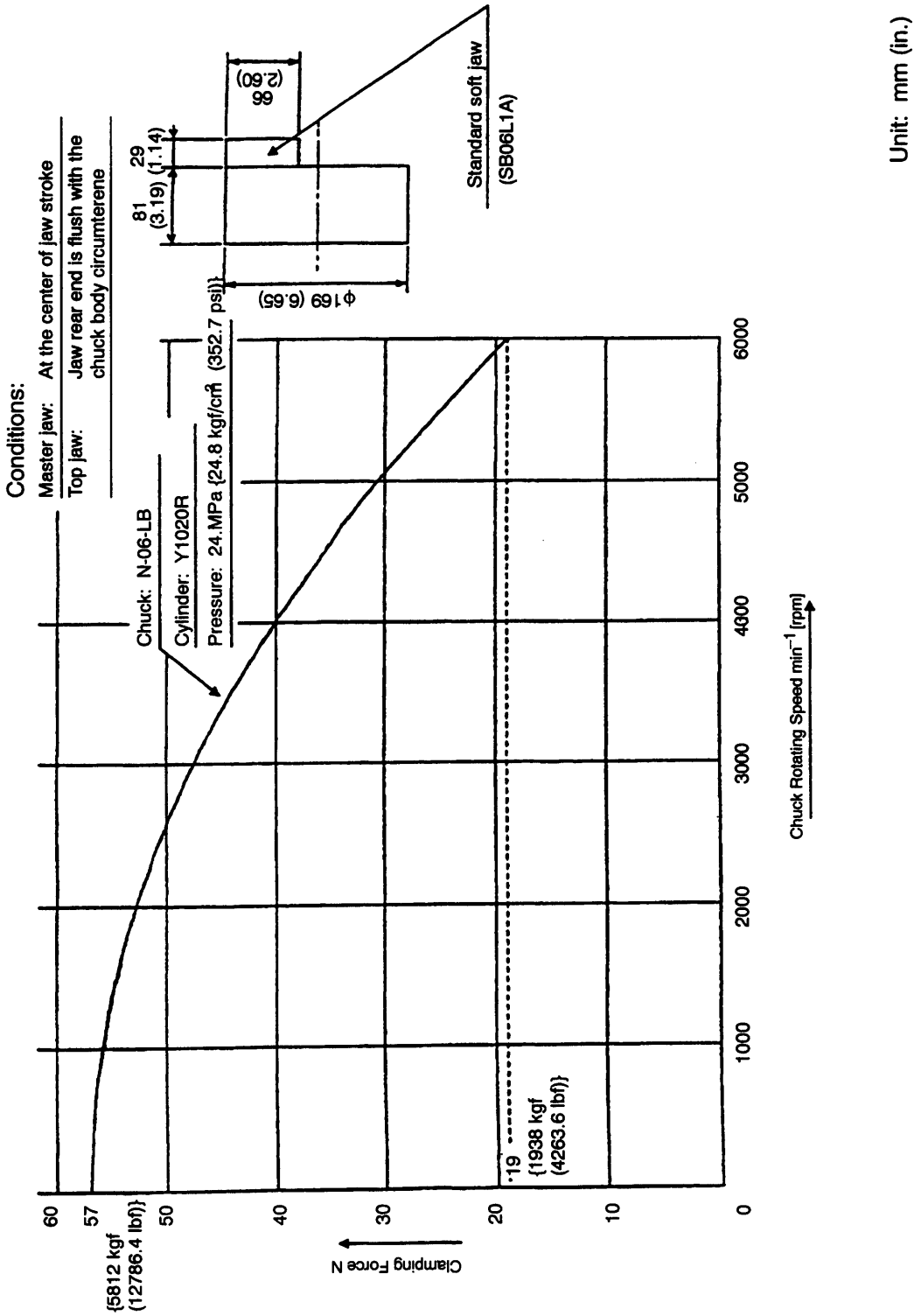



Fig. 3-18 Chuck Speed - Clamping Force Diagram for Hollow Chucks

(11) General Precaution for Using Hydraulic Chucks

**⚠CAUTION** : In order to insure maximum safety in operation, the following points call for your special notice:

a) Select the right chuck that matches the machine's capacity.

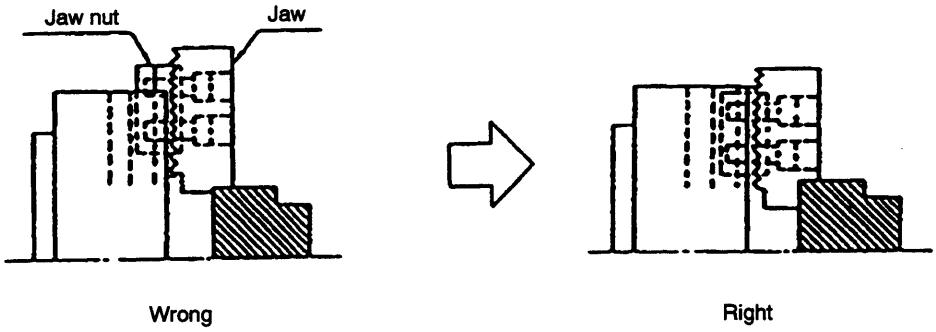
b) Workpieces should be clamped in the chuck without imbalance. Selection of cutting conditions must be made referring to (10) "Hydraulic chuck Clamping Force Characteristics Diagram" since chuck jaw gripping force varies depending on the spindle speed.

The maximum spindle speed and maximum allowable pressure limit (maximum setting) are indicated on the instruction plate attached to the front of the chip guard.

The maximum spindle speed refers to the speed at which the chuck can be turned, with its gripping force maintained more than one-third of its rating, while the outer ends of the individual top jaws are positioned evenly with the peripheral surface of the body.

c) When soft top jaws larger than standard ones provided with the machine are prepared by the customer and used with the chuck, keep in mind that developing centrifugal force and decreasing efficiency may reduce the actual gripping force. Be sure to reduce the spindle speed accordingly.

d) Where jaw nuts shown below go beyond the peripheral surface of the body, only one bolt secures the corresponding jaw and a very dangerous condition is created. Always locate the jaw nuts within the periphery of the body as shown below. It is a good and safe practice to use soft top jaws that are made to fit the actual work configuration.




e) Before starting spindle rotation, be sure to close the front door.

(12) Change of Chuck Gripping Direction - ID/OD Gripping

Gripping direction of the hydraulic chuck - ID gripping and OD gripping - can be changed by the parameter.

The change of gripping direction may be made only while the spindle stops.

(13) Greasing

**⚠CAUTION** : The chuck has grease nipples either on the chuck front face or on its periphery. Apply grease (XM2, MAS) to the nipples every day.

Since chips and foreign matter accumulate on the jaw moving surfaces on the chuck, clean them every day and lubricate them with the hydraulic oil (HG68, MAS).

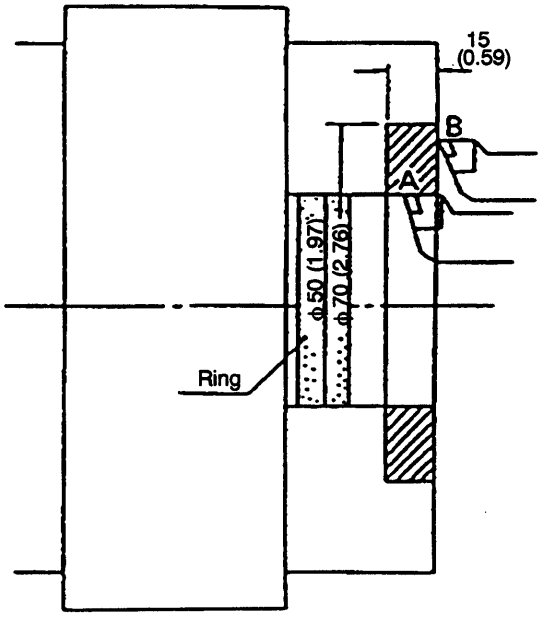
## 2-6. Cutting Soft Top Jaws of Hydraulic Chuck

There are three different methods applied in cutting soft top jaws of chuck jaws for chucking a particular lot of parts.

- by pulse feed handwheel
- by tape
- by manual data input (MDI)

They are all basically the same operations, and it is advisable to use the tape or the manual data input when a good finish on the chucking surfaces of the jaws is essential.

Now let's explain the steps necessary to produce the top jaws for chucking the diameter of 70 mm (2.75 in.) with a depth of 15 mm (0.6 in.) by use of the manual data input.




Unit: mm (in.)

Fig. 3-19 Cutting Soft Top Jaws

Procedure:

a) Grip a ring of proper diameter in the chuck.

$\phi$50 mm (2 in.) ring for instance

b) Locate the tool tip point at point A and set the zero offset value so that the actual position of X-axis is equivalent to the ring diameter; 50 mm (2 in.) in this case.

Actual position: X = 50.000 mm
(X = 2.0000 in.)

c) Locate the tool tip point at point B and set the zero offset value so that the actual position of Z-axis is equivalent to the required chucking depth of length; 15 mm (0.6 in.) in this case.

Actual position: Z = 15.000 mm
(Z = 0.6000 in.)

d) Proceed with cutting by entering the following commands block by block.

In the example, the depth of cut is 5 mm (0.2 in.) and the feedrate is 0.1 mm/rev (0.004 ipr). The spindle speed must be selected to suit the operation.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| G13 | or | G14*1 | | | | | |
| G150 | or | G151 | | | | | |
| G50 | | | | SOOO | | | |
| G00 | | X60 | Z 18 | | SOOO | M41 | M03 |
| G01 | | | Z 0.1 | F0.1 | | | |
| G00 | | X58 | Z 18 | | | | |
| | | X69.6 | | | | | |
| G01 | | | Z 0.1 | | | | |
| G00 | | X67 | Z 18 | | | | |
| | | X70 | | | | | |
| G01 | | | Z 0 | | | | |
| | | X48 | | | | | |
| G00 | | | Z500 | | | | M05 |

*1: Designate the spindle/turret combination.

For details, refer to the Operation Manual.

## 2-7. Precautions for Turret

**⚠CAUTION**

: (1) The M-tool spindle drive unit is incorporated in the upper turret. To protect the drive unit, observe the precautions below.

a) Mount a dummy holder to the empty turret station.

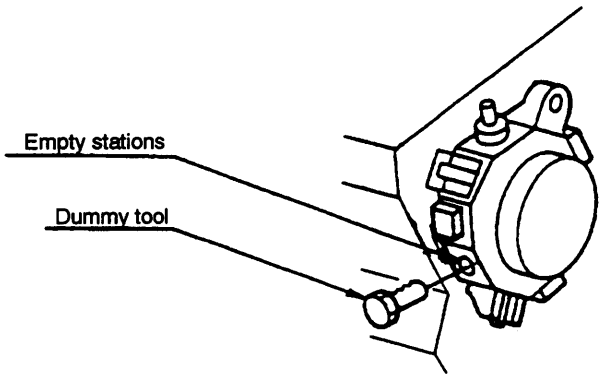



Fig. 3-20 Precautions for Turret

b) When changing the toolholder, be careful that chips or coolant do not enter the turret through the toolholder mounting hole.

Never use the air blower or coolant to remove the chips with the toolholders removed.

c) When changing the toolholder for an M-tool, index the turret station mounted with the toolholder at other than the cutting position.

d) To rotate the M-tool spindle, be sure to index it to the cutting position.

If it is rotated while not indexed to the cutting position, the drive mechanism inside the turret operates to be damaged.

(2) When indexing the turret, move the turret to a location where tools on the turret do not interfere with the workpiece and the chuck.

Do not perform cutting within 0.5 seconds after turret indexing. The turret might not be clamped securely.

When creating part programs, care must be exercised to the workpiece and the chuck at the other side.

## 2-8. Interlock

**NOTICE**

: The machine has the following interlock functions as standard. Since these interlock functions are very important functions to ensure operator's safety, understand the explanation given below thoroughly before operating the machine.

(1) Maximum Spindle Speed Interlock Function

To limit the spindle speed, the maximum spindle speed (G50) or the allowable chuck speed should be set and the spindle speed is clamped at a lower speed. The spindle cannot be started unless the maximum spindle speed is set in a program. For details of the setting procedure and setting value, refer to the OSP OPERATION MANUAL.

(2) Door Interlock E Function

If the spindle or the turret is operated at a high speed while the door is open, it could constitute dangerous situation to the machine operator and persons nearby. To avoid danger, the function restricts permissible operations to the following if the door is open.

- Spindle rotation ..... Max. 50 $min^{-1}$
- Axis feed ..... Max. 2 mm/min (0.08 ipm)
- Turret rotation ..... Step by step only in manual mode
  (turret rotation is not permitted in other than manual mode.)

For more details, refer to SAFE OPERATION FUNCTIONS.

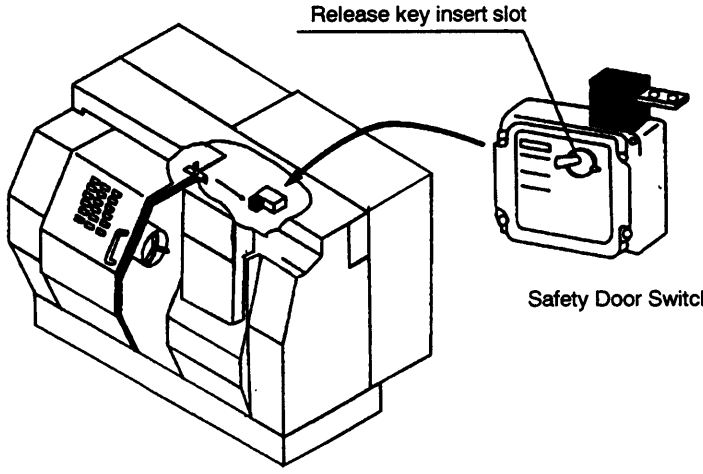
(3) Safety Door Switch

The function is provided to prevent the door from being opened by mistake by an operator while the machine is operating.

While the machine is operating, the safety door switch provided at the top of the door locks it in the closed operation so that the door will not be opened.

Open the front door only after making sure that the machine has been stopped. If the door is going to be opened forcibly although it is locked, the safety door switch may be damaged.

The door is also kept locked while the power is off. Therefore, to open the door with the power off in such as power failure, release the lock using the release key supplied with the safety door switch.



## 2-9. After Completion of A Day's Operation

(1) Press the CONTROL OFF button on the operation panel.

(2) Turn the main switch on the control box to OFF.

(3) Clean the machine and keep the surrounding area neat and in order.

## 2-10. Manually Operated Chuck

(Four-Jaw Independent Chuck (Kitagawa))

(1) Inspection

Check the model name indicated on the chuck body, possible damages during transportation, and accessories.

(2) Standards

The four-jaw independent chucks (Kitagawa) are manufactured in strict adherence to the standards stipulated in JIS B6154 (Independent chucks). The standards applied in manufacturing and inspection of the chucks are provided on the following pages.

IC Type

Unit: mm (in.)

| Type | | Maximum Chucking Diameter | | Run-out of Chuck Body Circumference and Front Face | Adaptor Installation Section Dimensions | | Bolts | |
|---|---|---|---|---|---|---|---|---|
| inch | mm | ID Chucking | OD Chucking | | | | P.C.D. | No. of Bolts × Bolt Size |
| 4 | 100 | 40 (1.57) | 90 (3.54) | Within 0.030 (0.00118) | 75 (2.95) | +0.030 (0.00118) 0 | 86 (3.39) | 4-M8 |
| 8 | 150 | 60 (2.36) | 140 (5.51) | | 130 (5.12) | +0.040 (0.00157) 0 | 115 (4.53) | 4-M10 |
| 8 | 200 | 75 (2.95) | 185 (7.28) | | 175 (6.88) | | 155 (6.10) | 4-M12 |
| 10 | 250 | 95 (3.74) | 220 (8.66) | | 150 (5.91) | | 125 (4.92) | 4-M12 |
| 12 | 300 | 125 (4.92) | 265 (10.43) | | 170 (6.69) | | 140 (5.51) | 4-M12 |
| 14 | 350 | 155 (6.10) | 310 (12.20) | Within 0.035 (0.00138) | 190 (7.48) | +0.046 (0.00181) 0 | 160 (6.30) | 4-M12 |
| 16 | 400 | 190 (7.48) | 360 (14.17) | | 210 (8.27) | | 180 (7.09) | 4-M16 |
| 18 | 450 | 220 (8.66) | 405 (15.94) | | 230 (9.06) | | 200 (7.87) | 4-M16 |
| 20 | 500 | 250 (9.84) | 450 (17.72) | Within 0.040 (0.00157) | 250 (9.84) | | 220 (8.66) | 4-M16 |
| 22 | 550 | 290 (11.42) | 500 (19.69) | | 275 (10.83) | +0.052 (0.00205) 0 | 240 (9.45) | 4-M20 |
| 24 | 600 | 320 (12.60) | 550 (21.65) | | 300 (11.81) | | 260 (10.24) | 4-M20 |
| 26 | 660 | 370 (14.57) | 610 (24.02) | Within 0.045 (0.00177) | 325 (12.80) | +0.089 (0.00350) 0 | 275 (10.83) | 8-M26 |
| 28 | 710 | 385 (15.16) | 650 (25.59) | | 350 (13.78) | | 300 (11.81) | 8-M20 |
| 30 | 762 | 435 (17.13) | 700 (27.56) | | 375 (14.76) | | 325 (12.80) | 8-M20 |
| 32 | 813 | 485 (19.09) | 750 (29.53) | Within 0.050 (0.00197) | 400 (15.75) | | 350 (13.78) | 8-M20 |
| 36 | 915 | 555 (21.85) | 850 (33.46) | | 450 (17.72) | +0.097 (0.00382) 0 | 400 (15.75) | 8-M24 |
| 40 | 1000 | 630 (24.80) | 940 (37.01) | Within 0.060 (0.00236) | 500 (19.69) | | 450 (17.72) | 8-M24 |

IA Type

Unit: mm (in.)

| Spindle Nose | Type | Maximum Chucking Diameter | | Run-out of Chuck Body Circumference and Front Face |
|---|---|---|---|---|
| | | ID Chucking | OD Chucking | |
| A-5 | IA5-200 | 75 ( 2.95) | 185 ( 7.28) | Within 0.030 (0.00118) |
| | IA5-250 | 95 ( 3.74) | 220 ( 8.66) | |
| | IA5-300 | 125 ( 4.92) | 265 (10.43) | |
| A-6 | IA6-205 | 75 ( 2.95) | 185 ( 7.28) | |
| | IA6-250 | 95 ( 3.74) | 220 ( 8.66) | |
| | IA6-300 | 125 ( 4.92) | 265 (10.43) | |
| | IA6-350 | 155 ( 6.10) | 310 (12.20) | Within 0.035 (0.00138) |
| | IA6-400 | 190 ( 7.48) | 360 (14.17) | |
| | IA6-450 | 220 ( 8.66) | 405 (15.94) | |
| | IA6-500 | 250 ( 9.84) | 450 (17.72) | Within 0.040 (0.00157) |
| A-8 | IA8-250 | 95 ( 3.74) | 220 ( 8.66) | Within 0.030 (0.00118) |
| | IA8-300 | 125 ( 4.92) | 265 (10.43) | |
| | IA8-350 | 155 ( 6.10) | 310 (12.20) | Within 0.035 (0.00138) |
| | IA8-400 | 190 ( 7.48) | 360 (14.17) | |
| | IA8-450 | 220 ( 8.66) | 405 (15.94) | |
| | IA8-500 | 250 ( 9.84) | 450 (17.72) | Within 0.040 (0.00157) |
| | IA8-550 | 290 (11.42) | 500 (19.69) | |
| | IA8-610 | 320 (12.60) | 550 (21.65) | |
| A-11 | IA11-400 | 190 ( 7.48) | 360 (14.17) | Within 0.035 (0.00138) |
| | IA11-450 | 220 ( 8.66) | 405 (15.94) | |
| | IA11-500 | 250 ( 9.84) | 450 (17.72) | Within 0.040 (0.00157) |
| | IA11-550 | 290 (11.42) | 500 (19.69) | |
| | IA11-610 | 320 (12.60) | 550 (21.65) | |
| | IA11-710 | 385 (15.16) | 650 (25.59) | Within 0.045 (0.00177) |
| | IA11-750 | 435 (17.13) | 700 (27.56) | |
| | IA11-800 | 485 (19.09) | 750 (29.53) | Within 0.050 (0.00197) |
| | IA11-915 | 555 (21.85) | 850 (33.46) | |
| | IA11-1000 | 630 (24.80) | 940 (37.01) | Within 0.060 (0.00236) |

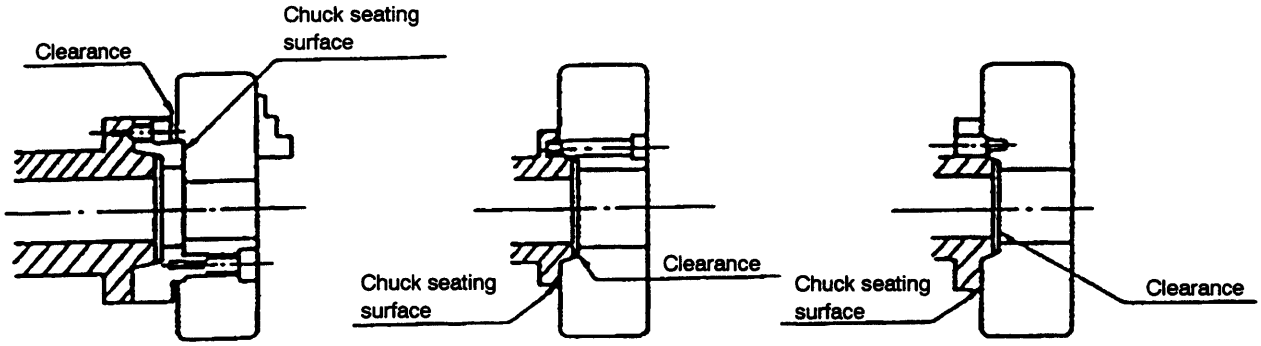
(3) Installing Chuck

a) Accuracy of adaptor installation section has direct influence to the workpiece chucking accuracy. Therefore, machine the adaptor very carefully. Required accuracy is within 0.005 mm (0.00020 in.) for run-out on circumference, face run-out, and flatness.

b) Any damages such as score or foreign matter on fitting parts and installation surfaces will deteriorate chuck installation accuracy. Install the chuck only after cleaning both the chuck and the adaptor.

After the installation of the chuck, measure run-out of the chuck body circumference and face. Run-out must be within 0.020 mm (0.00079 in.).

c) Insert the chuck onto the spindle with the chuck drive pin hole aligned with the spindle pin. Tighten the chuck clamping bolts gradually and uniformly. After the installation, the chuck fits on the spindle end face in the following manner as illustrated below.

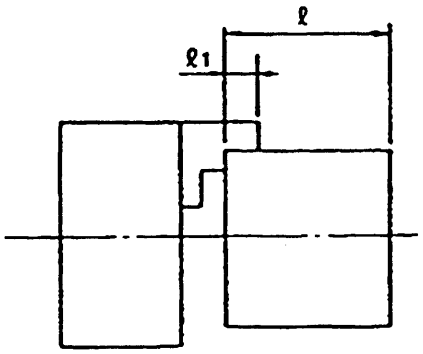



d) To clamp a workpiece, use only the handle supplied with the chuck. If a workpiece is clamped forcibly by inserting a pipe into the handle hole, chucked part will be distorted causing shorter life and deteriorated accuracy.

If higher clamping force is required for your turning operation, use a larger chuck.

**⚠CAUTION**

: e) To hold a long workpiece, always use a tailstock or work rests to support the free end of the workpiece.




$\ell = \ell_1 + (\ell_1 \times 3.5)$

The workpiece whose length "$\ell$" is longer than the value calculated using the formula above, it is recommended to use a tailstock.

f) Never tap a workpiece held in the chuck.

g) Select the chuck size meeting the intended machining operation.

(4) Lubrication and Cleaning

**NOTICE** : To ensure high accuracy for a long period, clean the fitting portions between the chuck body and the chuck jaws, and between the chuck jaw serration and a screw. For the cleaning, remove the jaws.

Supply oil once or twice a day.

(5) Maximum Speed

**CAUTION** : Each chuck has its allowable maximum speed. If a chuck is rotated at a speed exceeding this limit, it will create hazard to both operators and the machine.

Always tighten or clamp the workpiece at the torque specified in the table below and use the chuck at a speed lower than the indicated maximum speed.

Chuck Specifications - Flat Back Type Chuck

| Type | Gripping Force | | Maximum Gripping Force | | Chuck | | |
|---|---|---|---|---|---|---|---|
| | Handle Torque N·m [kgf·m (lbf·ft)] | Gripping Force/Jaw N [kgf (lbf)] | ID Chucking mm (in.) | OD Chucking mm (in.) | Weight kg (lb) | Inertia $GD^2$ $N·m^2$ [$kgf·m^2$ ($lbf·ft^2$)] | Allowable Max. Speed $min^{-1}$ {rpm} |
| IC-4 | 34.3 [3.5 (25.3)] | 4900 [500 (1100)] | 40 (1.57) | 90 (3.54) | 2.4 (5.3) | 0.10 [0.01 (0.24)] | 2000 |
| IC-6 | 49.0 [5 (36)] | 5884 [600 (1320)] | 60 (2.36) | 140 (5.51) | 6.1 (13.4) | 0.78 [0.08 (1.90)] | 1600 |
| IC-8 | 83.4 [8.5 (61.5)] | 9800 [1000 (2200)] | 75 (2.95) | 185 (7.28) | 14.8 (32.6) | 2.9 [0.3 (7.1)] | 1600 |
| IC-10 | 117 [12 (87)] | 13729 [1400 (3080)] | 95 (3.74) | 220 (8.66) | 21 (46) | 5.8 [0.6 (14.2)] | 1600 |
| IC-12 | 147 [15 (108)] | 15690 [1600 (3520)] | 125 (4.92) | 265 (10.43) | 29.5 (64.9) | 13.7 [1.4 (33.2)] | 1400 |
| IC-14 | 157 [16 (116)] | 16671 [1700 (3740)] | 155 (6.10) | 310 (12.20) | 40 (88) | 28.4 [2.9 (68.8)] | 1400 |
| IC-16 | 215 [22 (159)] | 19613 [2000 (4400)] | 190 (7.48) | 360 (14.17) | 56.5 (124.3) | 44.1 [4.5 (106.8)] | 1200 |
| IC-18 | 215 [22 (159)] | 19613 [2000 (4400)] | 220 (8.66) | 405 (15.94) | 70 (154) | 68.6 [7.0 (166.1)] | 1200 |
| IC-20 | 245 [25 (181)] | 21575 [2200 (4840)] | 250 (9.84) | 450 (17.72) | 90 (198) | 115.7 [11.8 (280.0)] | 900 |
| IC-22 | 245 [25 (181)] | 21575 [2200 (4840)] | 290 (11.42) | 500 (19.69) | 135 (297) | 172.6 [17.6 (417.7)] | 900 |
| IC-24 | 274 [28 (203)] | 22555 [2300 (5060)] | 320 (12.60) | 550 (21.65) | 150 (330) | 248.1 [25.3 (600.4)] | 900 |
| IC-26 | 274 [28 (203)] | 22555 [2300 (5060)] | 370 (14.57) | 610 (24.02) | 176 (387) | 411.9 [42 (997)] | 900 |
| IC-28 | 294 [30 (217)] | 23044 [2350 (5170)] | 385 (15.16) | 650 (25.59) | 247 (543) | 568.8 [58 (1376)] | 900 |
| IC-30 | 294 [30 (217)] | 23536 [2400 (5280)] | 435 (17.13) | 700 (27.56) | 284 (625) | 584.5 [80 (1898)] | 600 |
| IC-32 | 294 [30 (217)] | 23536 [2400 (5280)] | 485 (19.09) | 750 (29.53) | 357 (785) | 1039 [106 (2515)] | 600 |
| IC-36 | 353 [36 (260)] | 23536 [2400 (5280)] | 555 (21.85) | 850 (33.46) | 413 (909) | 1696 [173 (4105)] | 600 |
| IC-40 | 510 [52 (376)] | 29420 [3000 (6600)] | 630 (24.80) | 940 (37.01) | 600 (1320) | 2971 [303 (7190)] | 600 |

## Chuck Specifications - Type A Short Taper Chuck

| Spindle Nose | Type | Gripping Force | | Maximum Gripping Force | | Chuck | | |
|---|---|---|---|---|---|---|---|---|
| | | Handle Torque N·m [kgf·m (lbf·ft)] | Gripping Force/Jaw N [kgf (lbf)] | ID Chucking mm (in.) | OD Chucking mm (in.) | Weight kg (lb) | Inertia $GD^2$ $N·m^2$ [$kgf·m^2$ ($lbf·ft^2$)] | Allowable Max. Speed $min^{-1}$ {rpm} |
| A2-5 | IA 5-200 | 83.4 [8.5 (61 .5)] | 9800 [1000 (2200)] | 75 (2.95) | 185 (7.28) | 14.9 (32.8) | 3.14 [0.32 (7.59)] | 3600 |
| A2-6 | IA 6-250 | 117 [12 (87)] | 14709 [4500 (3300)] | 95 (3.74) | 220 (8.66) | 24.2 (53.4) | 7.35 [0.75 (17.80)] | 3000 |
| | IA 6-300 | 147 [15 (108)] | 15690 [1600 (3520)] | 125 (4.92) | 265 (10.43) | 39.1 (86.0) | 15.7 [1.6 (38.0)] | 2000 |
| | IA 6-350 | 147 [15 (108)] | 15690 [1600 (3520)] | 155 (6.10) | 310 (12.20) | 50.9 (112.0) | 29.4 [3.0 (71.2)] | 2000 |
| | IA 6-400 | 215 [22 (159)] | 19613 [2000 (4400)] | 190 (7.48) | 360 (14.17) | 69.8 (153.6) | 46.1 [4.7 (111.5)] | 1800 |
| | IA 6-450 | 245 [25 (181)] | 22555 [2300 (5060)] | 220 (8.66) | 405 (15.94) | 97.2 (213.8) | 69.6 [7.1 (168.5)] | 1200 |
| | IA 6-500 | 245 [25 (181)] | 22555 [2300 (5060)] | 250 (9.84) | 450 (17.72) | 103.5 (227.7) | 132.4 [13.5 (320.4)] | 1200 |
| A2-8 | IA 8-350 | 215 [22 (159)] | 19613 [2000 (4400)] | 155 (6.10) | 310 (12.20) | 56.2 (123.6) | 30.4 [3.1 (73.6)] | 2000 |
| | IA 8-400 | 245 [25 (181)] | 22555 [2300 (5060)] | 190 (7.48) | 360 (14.17) | 73.8 (162.4) | 49.0 [5.0 (118.7)] | 1800 |
| | IA 8-450 | 245 [25 (181 )] | 22555 [2300 (5060)] | 220 (8.66) | 405 (15.94) | 102.5 (225.5) | 71.6 [7.3 (173.2)] | 1200 |
| | IA 8-500 | 245 [25 (181)] | 22555 [2300 (5060)] | 250 (9.84) | 450 (17.72) | 108.4 (238.5) | 139.2 [14.2 (337.0)] | 1200 |
| | IA 8-550 | 245 [25 (181)] | 22555 [2300 (5060)] | 290 (11.42) | 500 (19.69) | 123 (271) | 157.9 [16.1 (382.1)] | 1200 |
| | IA 8-610 | 274 [28 (203)] | 22555 [2300 (5060)] | 320 (12.60) | 550 (21.65) | 136 (299) | 223.6 [22.8 (541.1)] | 1100 |

(Cont'd)

## Chuck Specifications - Type A Short Taper Chuck

| Spindle Nose | Type | Gripping Force | | Maximum Gripping Force | | Chuck | | |
|---|---|---|---|---|---|---|---|---|
| | | Handle Torque N·m [kgf·m (lbf·ft)] | Gripping Force/Jaw N [kgf (lbf)] | ID Chucking mm (in.) | OD Chucking mm (in.) | Weight kg (lb) | Inertia $GD^2$ $N·m^2$ [$kgf·m^2$ ($lbf·ft^2$)] | Allowable Max. Speed $min^{-1}${rpm} |
| A2-11 | IA 11-500 | 245 [25 (181)] | 22555 [2300 (5060)] | 250 (9.84) | 450 (17.72) | 130 (286) | 165.7 [16.9 (401.0)] | 1200 |
| | IA 11-550 | 245 [25 (181)] | 22555 [2300 (5060)] | 290 (11.42) | 500 (19.69) | 145 (319) | 185.3 [18.9 (448.5)] | 1100 |
| | IA 11-610 | 274 [28 (203)] | 22555 [2300 (5060)] | 320 (12.60) | 550 (21.65) | 204 (449) | 338.3 [34.5 (818.7)] | 900 |
| | IA 11-710 | 392 [40 (289)] | 29420 [3000 (6600)] | 385 (15.16) | 650 (25.59) | 257 (565) | 588.4 [60 (1424)] | 800 |
| | IA 11 -750 | 451 [46 (333)] | 29420 [3000 (6600)] | 435 (17.13) | 700 (27.56) | 300 (660) | 840.4 [85.7 (2033.7)] | 800 |
| | IA 11-810 | 539 [55 (398)] | 29420 [3000 (6600)] | 450 (17.72) | 750 (29.53) | 380 (836) | 1299 [132.5 (3144.3)] | 600 |
| | IA11-915 | 451 [46 (333)] | 29420 [3000 (6600)] | 555 (21.85) | 850 (33.46) | 440 (968) | 1804 [184.5 (4378.3)] | 600 |
| | IA 11-1000 | 657 [67 (485)] | 36282 [3700 (8140)] | 630 (24.80) | 940 (37.01) | 570 (1254) | 2826 [288.2 (6839.1)] | 600 |
| A2-15 | IA15-610 | 441 [45 (325)] | 26456 [2700 (5940)] | 280 (11.02) | 520 (20.47) | 215 (473) | 394.2 [40.2 (954.0)] | 900 |
| | IA 15-710 | 451 [46 (333)] | 27456 [2800 (6160)] | 385 (15.16) | 650 (25.59) | 280 (836) | 799.2 [81.5 (1934.0)] | 800 |
| | IA 15-750 | 451 [46 (333)] | 27456 [2800 (6160)] | 420 (16.54) | 690 (27.17) | 230 (506) | 933.5 [952 (2259.1)] | 600 |
| | IA 15-810 | 539 [55 (398)] | 29420 [3000 (6600)] | 460 (18.11) | 750 (29.53) | 392 (616) | 1394 [136.6 (3241.6)] | 600 |
| | IA 15-915 | 726 [74 (535)] | 29420 [3000 (6600)] | 500 (19.69) | 800 (31.50) | 500 (1100) | 2044 [208.5 (4947.8)] | 500 |
| | IA 15-1000 | 726 [74 (535)] | 29420 [3000 (6600)] | 550 (21.65) | 900 (35.43) | 610 (1342) | 2844 [290 (6882)] | 500 |

# SECTION 4 INSPECTION AND MAINTENANCE OF MACHINE

Your Turning Center is a highly efficient production machine calling for a much higher utilization rate than an engine lathe.

This section deals with the maintenance requirements which must be met by every user in order to insure excellent, trouble-free performance and prolonged life.

It also outlines some basic steps to pinpoint possible causes of trouble, together with troubleshooting hints, if your Turning Center is found out of order in any way, or in need of readjustment or repair.

Generally, NC lathes are used at three to four times higher "utilization" rates than manually controlled engine lathes. To insure a maximum productive time with a minimum of downtime, the machine must be periodically inspected and carefully serviced.

A periodical inspection schedule is presented below. In addition to the regular maintenance items given here, there are some maintenance items which should be checked according to the actual condition of the machine, as described in this section.

Periodical Inspection Schedule

| Frequency | Inspection Items |
|---|---|
| Daily | (1) Check oil level through the oil level gauges in the hydraulic power unit, slideway lubricating oil tank and spindle cooling unit.<br>(2) Check the hydraulic pressure supplied to the turret, chuck, and tailstock.<br>(3) Supply lubricating oil to the hydraulic chuck master jaws. |
| Monthly | (1) Check the bedways for level and straightness.<br>(2) Flush out the hydraulic power unit and change the hydraulic fluid.<br>(3) Change the spindle cooling unit oil.<br>These three items must be carried out after the first month of operation following initial installation of the machine. |
| Every six months | (1) Change hydraulic oil in the hydraulic power unit.<br>(2) Supply lubricating oil to the chip conveyor.<br>(3) Change the spindle cooling unit oil. |

The following details the regular maintenance requirements for your Turning Center.

# 1. LUBRICATION

**NOTICE** : The machine should be completely and correctly lubricated in strict adherence to the directions in the Lubrication Chart in the following page.

(1) Always use the specified lubricating oil.

a) If the oil other than specified is used, the lubrication unit might fail to operate normally.

b) Lubricating oil used in common with coolant or lubricating oil used in common with hydraulic oil might cause corrosion of lubrication unit or mixing of oils to result in lubrication failure, which, in turn, leads to damages on the slideway surfaces.

(2) For coolant, use the specified coolant.

a) Coolant usually contains chemical additives such as activator. If improper coolant is used, lubricating oil will be affected by chemicals and therefore, use the specified coolant so far as possible.

b) If coolant which is not our recommendation is to be used, check to be sure that it will not cause any following problems.

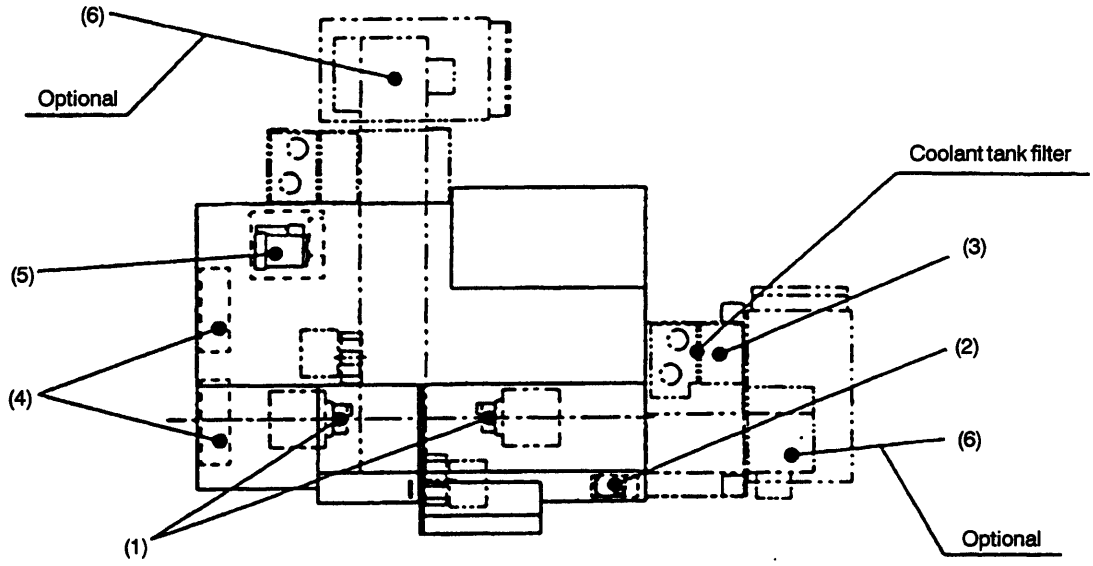
Mixing with lubricating oil, possible parting, peel of paint, rusting, and swelling of packings. If a problem is found during the use of the coolant, avoid the use of such coolant.

(3) Amount of lubricating oil and its discharge condition must be checked everyday.

a) Whether or not lubricating oil is properly supplied can be checked by checking oil level in the tank. For normal oil consumption amount, refer to 1-2. "Slideway Lubrication System" in this section.

b) Prior to shipment of the machine from our plant, the oil and the coolant tanks are flushed out and must therefore be refilled during the initial installation of the machine.

Lubrication Chart




| No. | Oiling Points | Quantity | Oil Used | (MAS) | Remarks |
|---|---|---|---|---|---|
| 1 | Chuck jaw | As needed | Molykoat EP grease (Dow Corning) | — | Everyday when cleaning chuck jaws |
| 2 | Slideway centralized lubrication | 6 liter (1.6 gal) | Tonna Oil T68 XHVI (Shell) | G68 | As needed |
| 3 | Coolant tank | 180 liter (47.5 gal) | Hi-chip NC10 (Taiyu) | — | As needed |
| 4 | Spindle cooling unit | 15 liter (4.0 gal) | Velocite Oil No. 3 (Mobil) | FC2 | In 1 month after initial installation<br>Every 6 months after that |
| 5 | Hydraulic power unit | 40 liter (10.6 gal) | DTE Oil Light (Mobil) | HL32 | In 1 month after initial installation<br>Every 6 months after that |
| 6 | Chip conveyor | As needed | Mobilux (Mobil) | XM2 | Replenish every 3 to 6 months. |

* Use NC10 diluted by 20 to 30 times their volume with tap water or distilled water.

Table 4-1 Lubricating Oil Specification

| Application | Code | Esso | Shell | Mobil |
|---|---|---|---|---|
| Headstock gearbox (spindle gearbox with c-axis) separately installed gearbox | CB32 | Unipower FM32 | Tetra Oil 32 | DTE Oil Light* |
| Cam type turret | CC320 | Spartan EP320* | Omala Oil 320 | Gear Oil 632 |
| Spindle bearing lubrication unit | FC10 | Spinesso 10* | Tetra Oil 10 | Velocite No. 6* |
| Centralized slideway lubrication unit (m-turret, ball screw) | G68 | Febis K68 | Tonna Oil T68* | Vactra Oil No. 2 (SLC) |
| | G220 | Febis K220 | Tonna Oil T220* | Vactra Oil No. 4 (SLC) |
| Hydraulic power unit | HL32 | Unipower 32 | Tetra Oil 32 | DTE Oil Light* |
| M-tool holders | (Grease) | ——— | ——— | Mobilux EP2 |
| Master jaw on chuck | (Grease) | Molykoat EP grease (Dow Corning) or Kitagawa chuck grease for Kitagawa Power chuck.<br>For special chucks, refer to the instruction manual supplied with the chuck. | | |
| Turret ball screw | XM2 (Grease) | Lithtan 2 | Alvania Grease 2 | Mobilux EP2* |

Coolant Specification

| | | | | |
|---|---|---|---|---|
| Headstock cooling unit | | | R&S Coolant | LLC |

*Note 1: The above table is based on the MAS.*

We do not have any experience with oils other than those indicated by an asterisk(*). We recommend that these oils be selected for use. Because slideway lubricating oil contains additives, such as an extreme-pressure additive, a variety of troubles may result in a reaction with other oils or coolant. Therefore, pay special attention to the slide way lubricating oil.

*Note 2: Refer to the Operation and Maintenance Manual of respective machine models for the service point and amount of lubricating oil for the machine.*

*Note 3: Lubricating oil used in common with coolant or lubricating oil used in common with hydraulic oil might corrode the lubrication unit. Turbidness of the oil may result in lubrication failure, which damages the slideway surface or ball screw. (Okuma takes no responsibility for problems caused by using unrecommended lubricating oil.)*

*Note 4: Refer to the Special Instruction Manual supplied with individual accessories for information on the oil replenishment of optional accessories such as special chucks and the chip conveyor.*

*Note 5: When slideway lubricating oil is mixed with coolant and a problem occurs, contact your local Okuma representative. Optional accessories, such as oil skimmer, are available.*

## 1-1. Spindle Lubrication System

All the spindle bearings are lubricated by packed high quality grease, requiring no further greasing.

## 1-2. Slideway Lubrication System

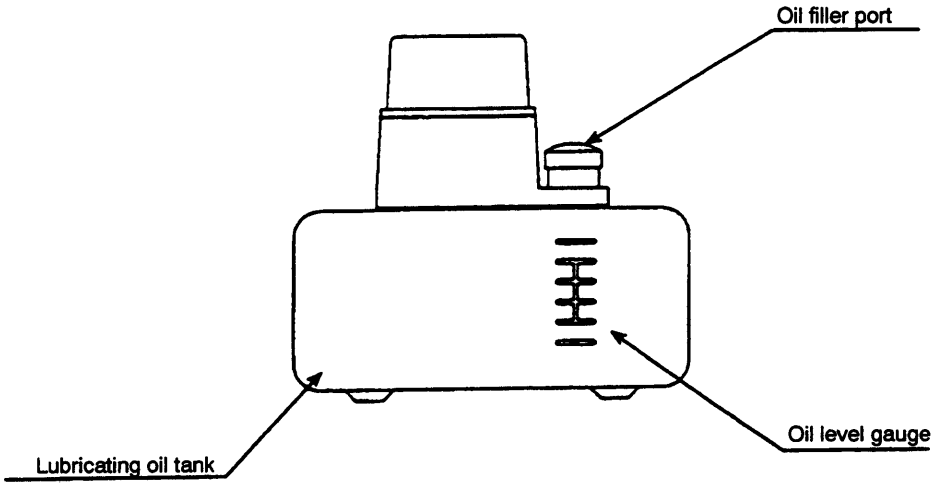



Fig. 4-1 Slideway -Lubrication System

| | |
|---|---|
| Oil Specification | G68 (MAS) |
| Amount | 6 liter (1.59 gal) |
| Oil Change Interval | Replenish as required.<br>Low lubrication level alarm detected by the level switch occurs in approx. 80 hour operation. Check oil level every day and replenish lubricating oil before the alarm occurs. |

**⚠CAUTION**

: Check oil level before starting day's operation.

To forcibly deliver lubricating oil, follow the steps below:

(1) Open the chuck.

(2) Key in the spindle start command (MDI).

(3) Press the CYCLE START button. The alarm indicating lamp will light up.

(4) Press the RESET button.

This delivers lubricating oil.

Repeat the above indicated steps several times.

The centralized lubricating oil tank is accessible by opening the oil filter port cover. The lubricating oil is fed to the bed slideway, the cross-slide slideway, the X- and Z-axis drive ball screws and the tailstock sleeve.

## 1-3. Spindle Cooling Unit

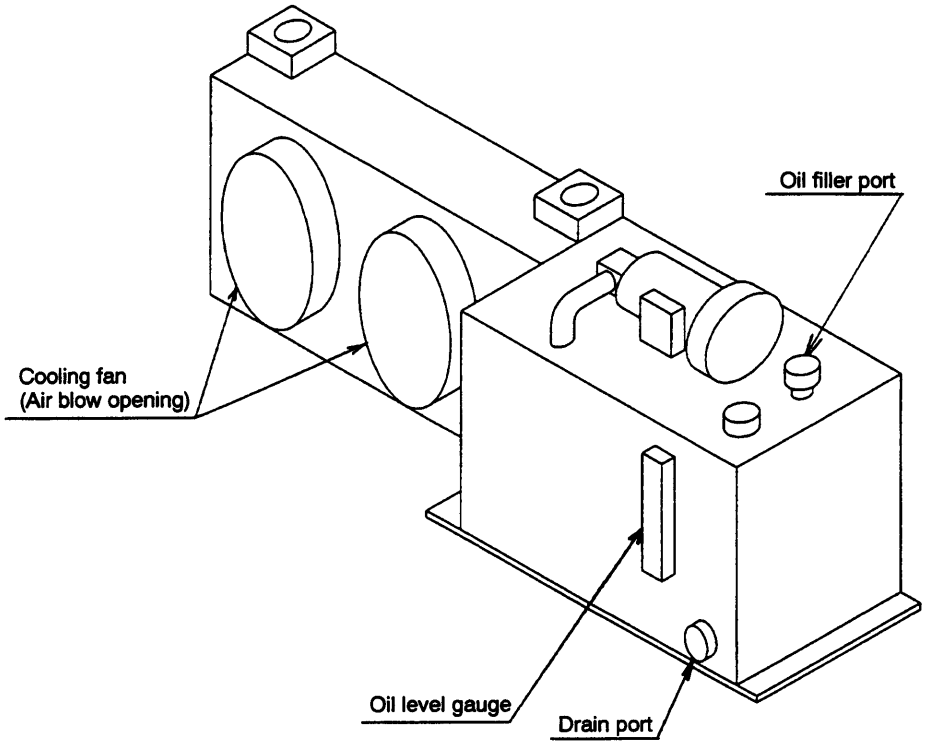



Fig. 4-2 Spindle Cooling Unit

(1) Change the cooling oil in the first month after the installation of the machine and every six months thereafter.

Oil specification: Mobil Velocite Oil No. 3

(2) Check the oil level at the oil level gauge before starting the day's operation.

The machine has the spindle cooling unit for the right and left spindles individually; the spindle cooling unit is located at the left hand side of the machine.

## 1-4. C-axis Disc Brake Lubrication System

**CAUTION** : Cutting feed using C-axis control (G01) is usually executed with the disc brake at the rear of the spindle rotated. There are cases in very low-speed operation where the machined surface of the workpiece is rough due to the inconstant C-axis feed caused by stick-slip of the disc brake.

If this has occurred during machining, apply a small quantity of grease to the disc brake through the grease nipple.

(Grease is applied to the surface of the disc brake before shipment.)

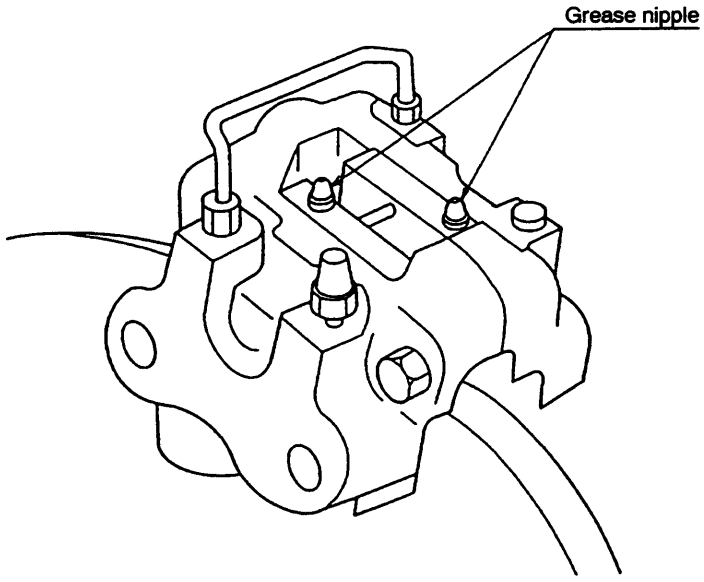



Fig. 4-3 C-axis Disc Brake Lubrication

# 2. ADJUSTING CENTRALIZED LUBRICATION UNIT

(1) Adjusting Pump Delivery

The delivery amount to each lubrication point is controlled by the metering type distribution valve, and no further adjustment is necessary. The metering valves are provided at the rear of the machine (inside the cover) and at the right hand side of the tailstock.

Delivery of lubricating oil can be visually checked from the in/out movements of the shaft. Pay sufficient care when checking if oil is delivered appropriately.

(2) Maintenance and Countermeasure

When no lubricating oil is delivered:

a) Oil level is low.

Replenish the lubricating oil of the same brand.

b) The pump is at a rest: The pump operates intermittently.

The pump operation interval is set at 3 minutes.

c) The suction filter is clogged.

Clean the suction filter at least every six months.

d) The motor does not run.

Check the wiring to the motor.

(3) Other Remarks

a) The lubricating oil to be replenished must be clean and it must be of the same brand as currently used.

b) When cleaning the tank and the filter, NEVER USE THINNER OR TRICHLEN (TRICHLOROETHYLENE) SHOWING HIGH VOLATILE CHARACTERISTICS.

c) Specified Lubricating Oil: G68 (MAS)

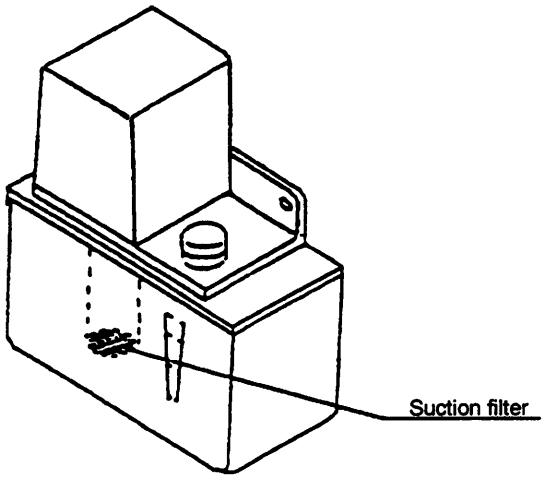



Fig. 4-4 Adjusting Centralized Lubrication Unit

d) Suction filter cleaning procedure

7) Remove the pump (two M5 screws).

8) Take out the pump and clean the suction filter provided at the end of the suction pipe.

9) Mount the pump as before.

# 3. CLEANING COOLANT TANK

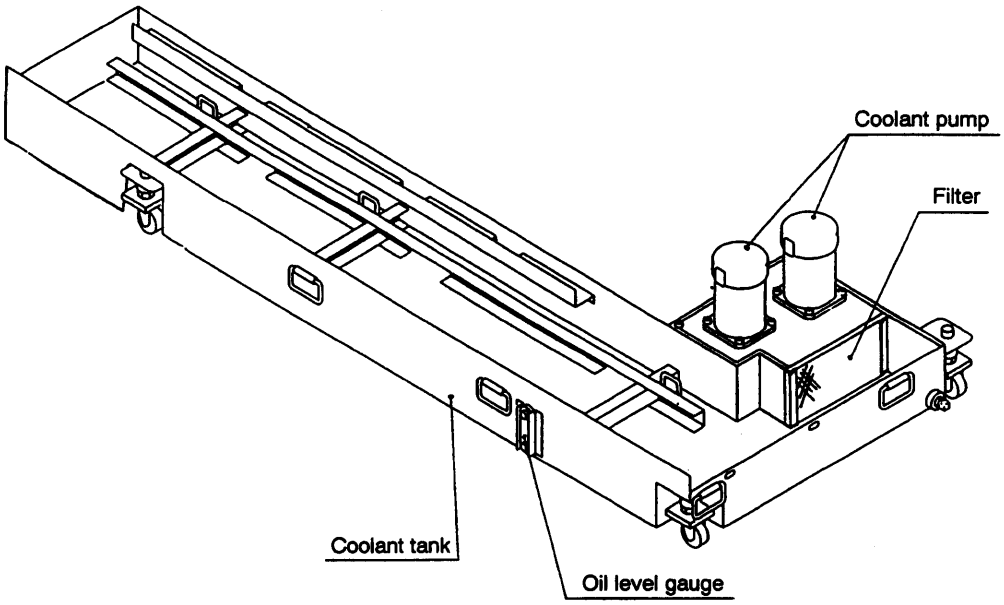



Fig. 4-5 Cleaning Coolant Tank

Procedure:

(1) Draw the coolant out of the tank by the pump.

(2) Disconnect the cables and hoses from the coolant pump.

(3) Pull the chip conveyor to the right until it comes out of the right hand side cover and, after that, pull it out to the front of the machine.

(4) Remove the chip pan or the chip conveyor.

(5) Clean inside the coolant tank,

(6) Clean the filter.

(7) When installing the coolant tank, push the tank until it contacts the front rail.

Align the left end of the coolant tank with the left end of the machine side cover.

If the coolant tank is not installed correctly, coolant will leak.

If coolant delivery is reduced, it is caused by lowered coolant level or the clogged filter.

If coolant level is low, replenish the specified coolant. If the filter is clogged, clean the filter after pulling out the coolant tank.

# 4. TENSIONING BELTS

**WARNING** : As a safety precaution, always turn OFF the machine when adjusting the belt tension or when replacing the belt.

How to Use Tension Meter:

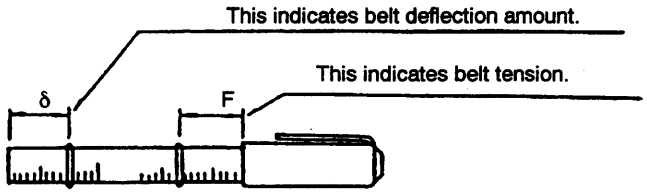



Fig. 4-6 Belt Tension Meter (optional)

## 4-1. Timing Belt for Lower X-axis Servo Motor

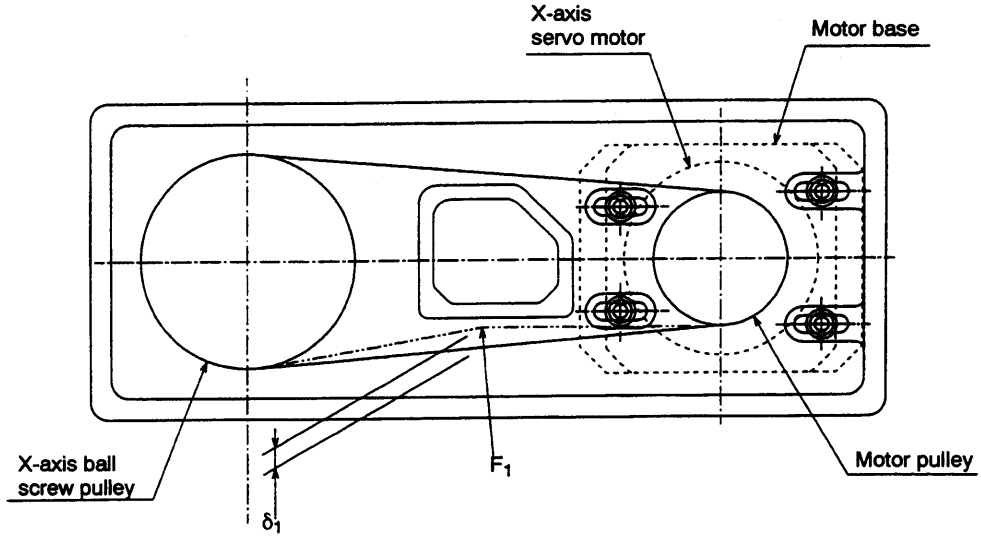



Fig. 4-7 Timing Belt for Lower X-axis Servo Motor

Adjust the belt tension by moving the servo motor base.

| Type of Belt | Type and Size | No. of Belts | Tension $F_1$ N {kgf (lbf)} | $\delta_1$ mm (in.) |
|---|---|---|---|---|
| Timing belt (Lower X-axis) | STS 250S8M848 | 1 | 32.3 {3.3 (7.26)} | 4.3 (0.17) |

## 4-2. Timing Belt for M-tool Spindle Motor on the Multifunction Turret (M-tool Specification)

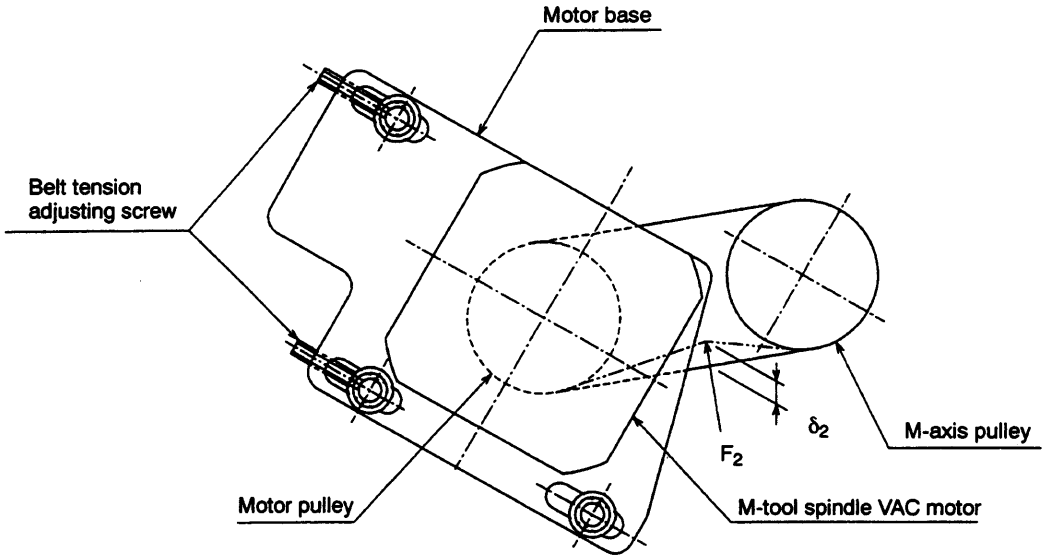



Fig. 4-8 Timing Belt for M-tool Spindle Motor on the Multifunction Turret (M-tool Specification)

Adjust the belt tension by moving the servo motor base.

| Type of Belt | Type and Size | No. of Belts | Tension $F_2$ N {kgf (lbf)} | $\delta_2$ mm (in.) |
|---|---|---|---|---|
| Timing belt (Combination turret) | STS 150S8M520 | 1 | 18.1 {1.9 (4.18)} | 2.2 (0.09) |

# 5. OTHER MAINTENANCE ITEMS

## 5-1. Check the Bed Level

The straightness or level of the bedways will affect the machining accuracy. In case parts cannot be turned to specified tolerances, first check and secure the machine level, then proceed with necessary adjustments. (Refer to Section 2, 4.)

## 5-2. Alignment of Headstock

If taper is generated on the turned workpiece in the chuck work operation, proceed with the alignment of the headstock as follows:

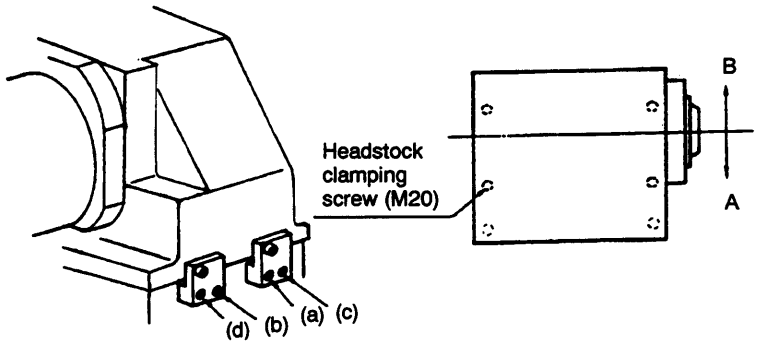



Fig. 4-9 Alignment of Headstock

Procedure:

(1) Loosen the headstock clamping screws (M20, 6 pcs.).

(2) Align the headstock.

a) In A direction

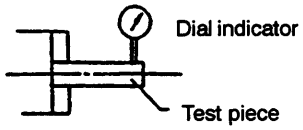
After loosening the adjusting screw (a) and tightening screw (d), secure the tightening screw (c). This shifts the headstock in the A direction.

b) In B direction

After loosening the adjusting screw (b) and tightening screw (c), secure the tightening screw (d). This shifts the headstock in the B direction.

Carry out this adjustment while reading the dial indicator applied at the front end of the test piece.

(3) After the required accuracy is obtained, tighten the six headstock clamping screws. Note that reading of the dial indicator applied at the test piece top end must not change. Then, tighten the tightening screws (c) and (d) and the adjusting screws (a) and (b).




For Your Information

The Japanese Industrial Standard (JIS) specifies that the lathe should turn cylindrically to within 0.015 per 225 mm (0.00059 per 8.86 in.) of finishing length of work held in a chuck without the use of tailstock center to hold the work.

## 5-3. Adjustment of Tapered Gibs on Cross-slide

The machine is shipped after complete adjustment of tapered gibs. Readjustment will become necessary when the gibs are worn or loosened by use, resulting in noticeable irregular feed movement, which adversely affects the working accuracy.

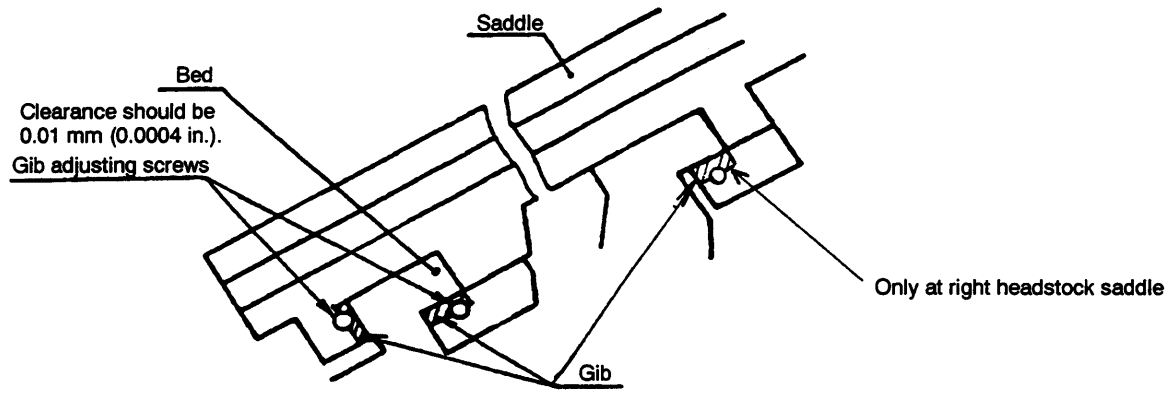



Fig. 4-10 Adjustment of Tapered Gibs on Cross-slide

Remove the right and left saddle covers and adjust the gibs by turning the adjusting screws at both sides of the saddle.

(1) Gib Adjustment Procedure

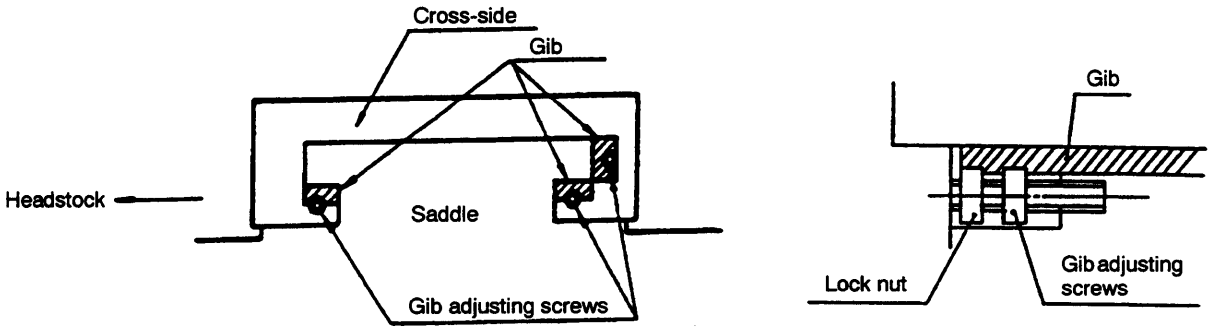
a) Loosen the left hand side adjusting screw.

b) Securely tighten the right hand side adjusting screw and loosen it by a half turn.

c) Tighten the left hand side adjusting screw.

Target clearance: 0.01 mm (0.0004 in.).

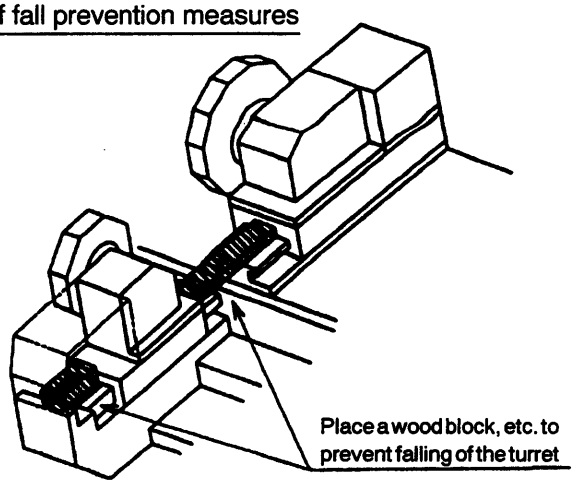
(2) Adjsut the gibs on the cross-slide in the same manner (step a) to c) above).



## 5-4. Cautions on Checking the X-axis Ball Screw and Related Parts

**WARNING** : When removing the X-axis drive servomotor for the purpose of inspection or maintenance of the X-axis ball screw, servomotor, and the related parts, make sure to support the upper/lower turret with a wood block, etc., to prevent it from falling before starting your work.

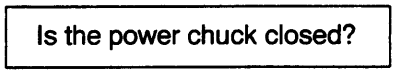
An example of fall prevention measures



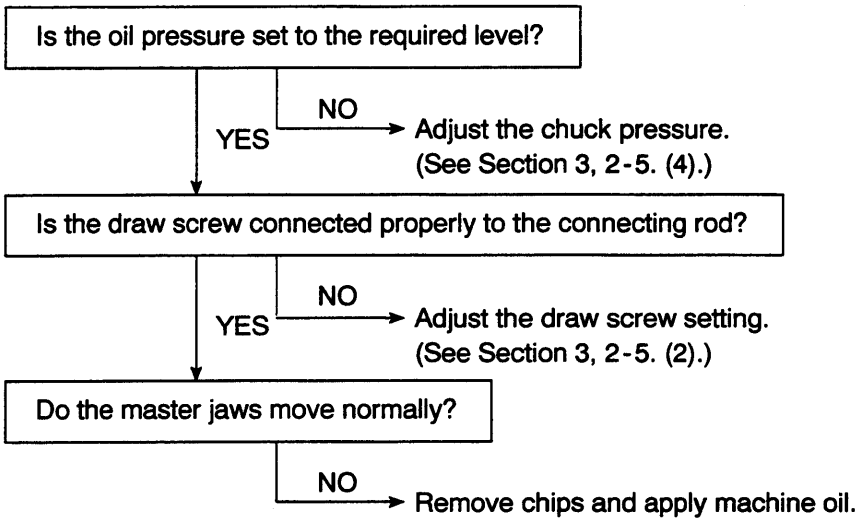
# 6. TROUBLESHOOTING FOR SIMPLE MECHANICAL TROUBLE

## 6-1. Trouble with Headstock

(1) No Spindle Rotation

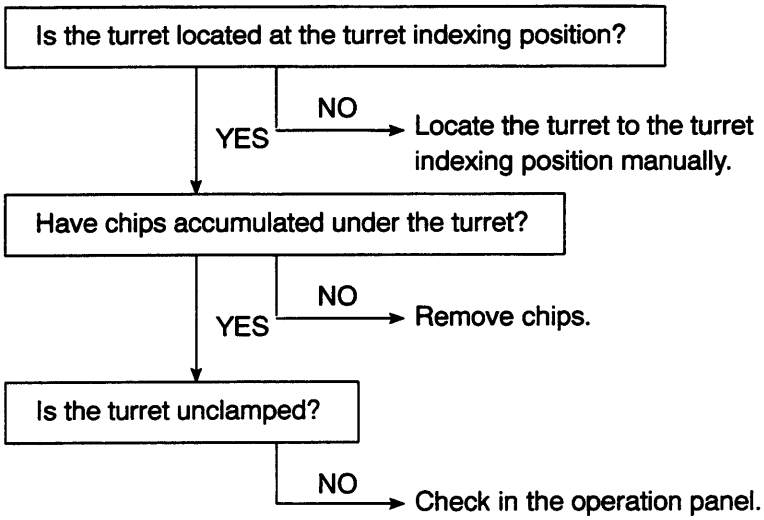



(2) No Chuck Jaw Movement




## 6-2. Trouble with Turret

(1) No Turret Indexing



(2) Weak Turret Clamping Pressure

Is the oil pressure set to the required level?

NO → Adjust the system pressure.
(See Section 3, 2-1. (3).)

(3) After Collision of Turret

a) Checking after turret collision

Misalignment of the turret or the headstock might be caused when the turret is struck against the workpiece or the chuck in rapid feed due to operation error or programming error, or when an abnormally heavy load is imposed on the turret due to axis feed with damaged inserts. The procedure to check the alignment of the turret and the headstock is explained below.

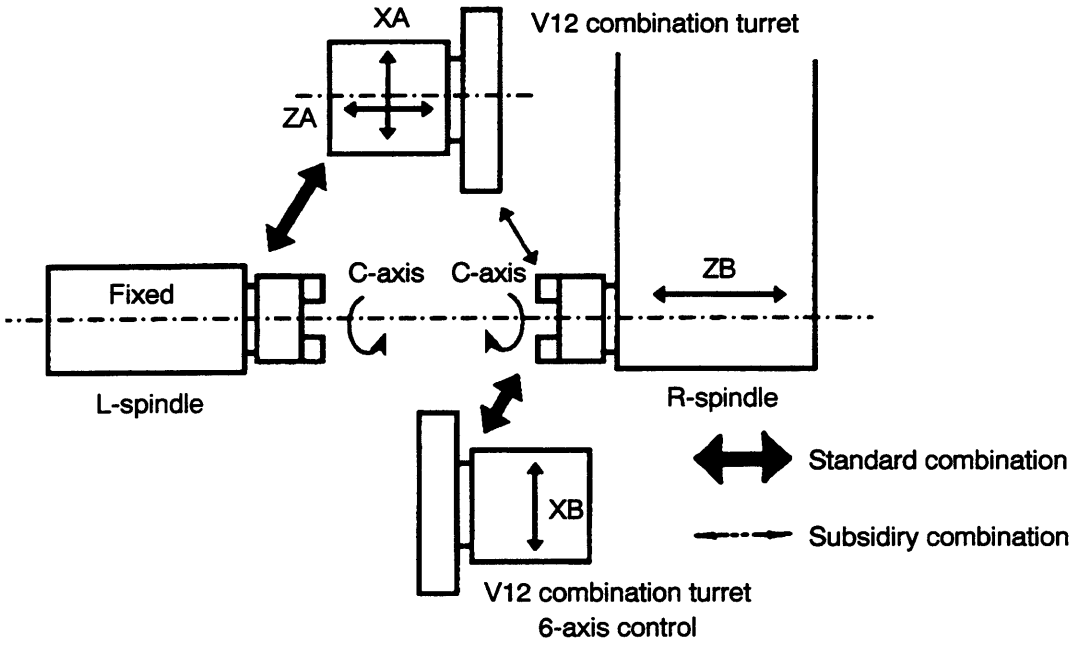



Fig. 4-11 Checking after Turret Collision

**NOTICE** : With the LT10-M, upper turret can serve both L- and R-spindles. However, check the accuracy with the standard combination.

1) Checking turret alignment

Checking turret inclination

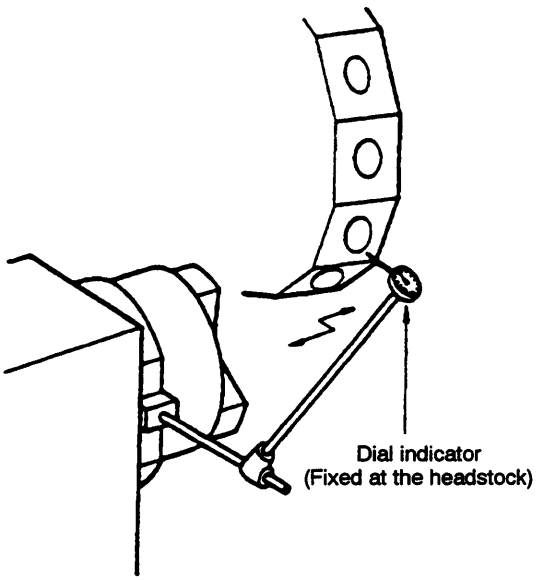



Fig. 4-12

Set the dial indicator as illustrated in Fig. 4-12 and feed X-axis using the pulse handle to check the inclination of the toolholder mounting surface on the turret. If the inclination read by the dial indicator is larger than 0.02 mm (0.0008 in.), correction is required. The procedure to make corrections is explained in Item b).

Checking offset of turret

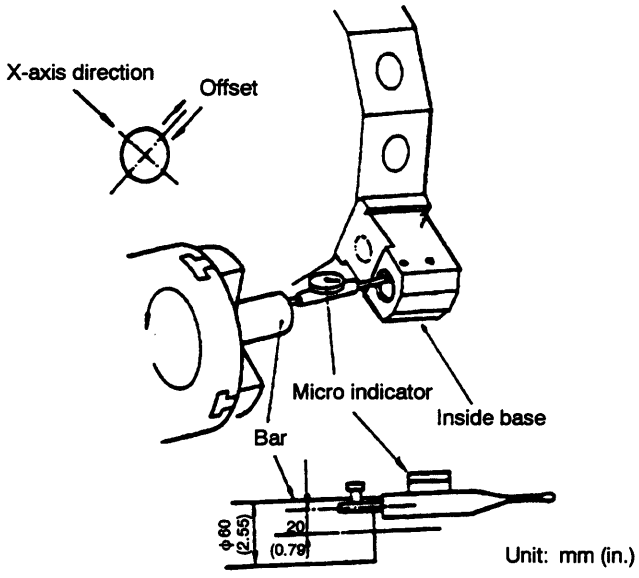
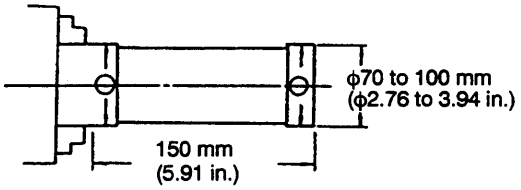



Fig. 4-13

Mount the inside base holder on the turret in the manner as illustrated in Fig. 4-13. Check the center position of the hole on the inside base holder using the micro indicator set in the chuck to check the offset or misalignment of the hole on the inside base holder from the spindle center. Alignment of the spindle center and the inside base holder hole center in the X-axis direction must be adjusted in advance. The offset amount is one half the error read by the micro indicator. If offset amount is larger than 0.05 mm (0.002 in.), make corrections in accordance with the procedure explained in Item c).

2) Accuracy inspection of headstock

Finish a test piece indicated in Fig. 4-14 below in the MDI mode operation to check the cylindricity. If the measured cylindricity is larger than 0.01 mm/150 mm (0.0004 in./5.91 in.), adjustment of the headstock is necessary. For the procedure to adjust the headstock, refer to 4-1. in this section. This adjustment should be carried out in combination with the adjustment for offset in Fig. 4-13.



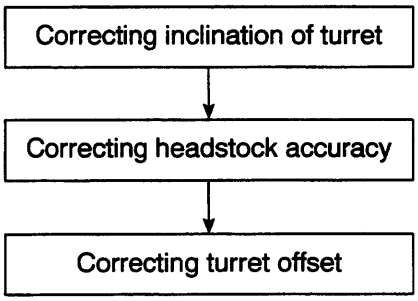

Cutting conditions

| | | |
|---|---|---|
| Material | : | Mild steel (5456, JIS) or cast iron (FC, JIS) |
| Depth of cut | : | ϕ0.2 mm (00.008 in.) |
| Feedrate | : | 0.1 mm/rev (0.004 ipr) |

Fig. 4-14 Accuracy Inspection of Headstock

3) Headstock accuracy

Accuracy adjustment should be carried out in the following order:



b) Correcting turret inclination

If the turret inclination amount is larger than 0.02 mm (0.0008 in.), adjustment should be made as described below (Refer to Fig. 4-15.):

1) Loosen the four turret clamping screws (1). Turret clamping screws (2) and (3) should not be loosened.

2) After loosening the turret clamping screws (2) and (3) satisfactorily, drive in the taper pin into the taper pin hole while tapping the turret with a soft head hammer.

3) Check the turret inclination as per Fig. 4-12 again.

4) When the inclination of the turret is adjusted within the allowable range, secure the turret clamping screws (1), (2) and (3).

This completes the adjustments.

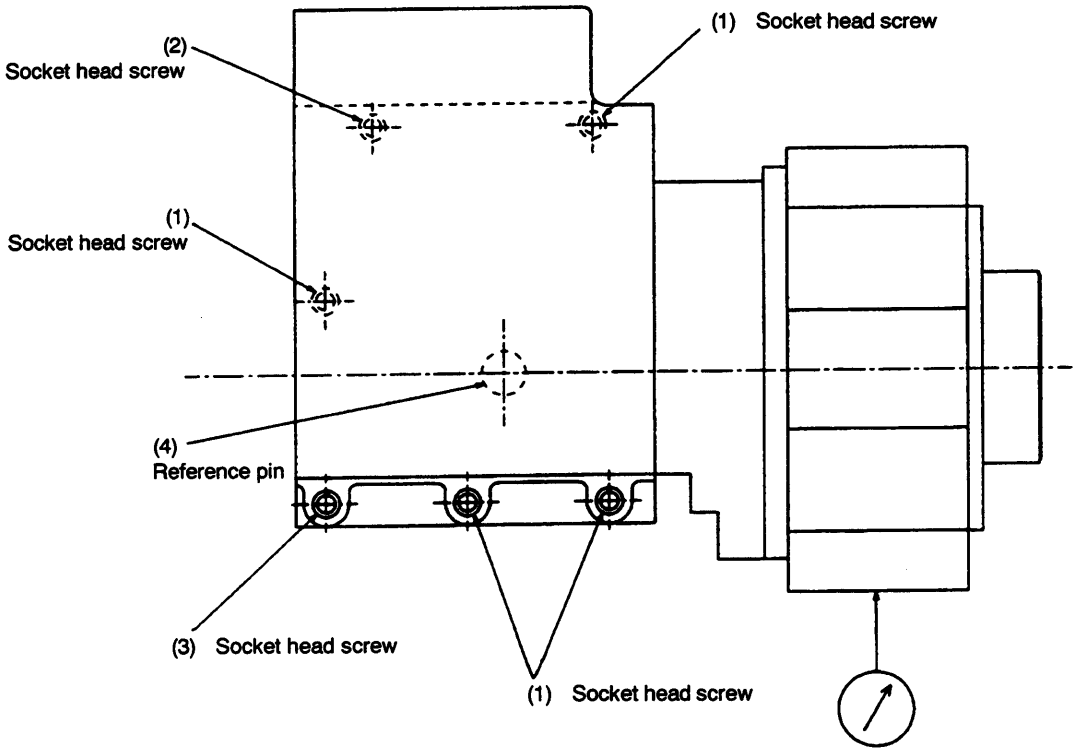



Fig. 4-15 Correcting Turret Inclination

c) Correcting turret offset

If the turret offset amount is larger than 0.05 mm (0.002 in.), adjustments should be made as described below. (Refer to Fig. 4-16.)

1) Press the CONTROL OFF pushbutton switch to turn off the power supply to the NC and then, turn off the main switch.

2) After removing the plug (1) and (2), loosen the bolt (3).

3) Prepare two taper pins with female thread (3), $\phi 6 \times 36$ mm (0.24 × 1.42 in.), and drive fit them while tapping the turret with a soft head hammer. It is recommended to screw the bolt into the female thread of the taper pin in advance.

4) After the two taper pins have been driven into the turret head, secure the turret head clamping screws (3) tight.

5) Turn on the power.

6) Measure the offset amount in the manner as illustrated in Fig. 4-13.

7) If steps 1) through 6) cannot eliminate offset, proceed to the steps below.

8) Set "1" for MC USER PARAMETER, No. 4, TURRET/DOOR, "3. NC turret pulse handle A-side" (for the upper turret) or "4 NC turret pulse handle B-side" (for the lower turret) Then, select the "manual" mode and press the TOOL INDEX switch, and the turret will be unclamped.

9) Press the CONTROL OFF pushbutton switch to turn off the power supply to the NC and then, turn off the main switch. Keep the power off until the turret head is reassembled.

10) Remove screws (5) and detach cap (6).

11) Remove screws (7) and detach collar (8).

12) Remove the bolt (9).

13) Remove the box (10) together with inside parts.

14) Lift up the turret (11) with a jib crane and remove bolt (12).

15) Detach the turret head. (Before removing the tool number plate, mark match marks so that it can be replaced easily.)

16) Remove the bolt (13) and then remove the clutch (14). (Leave marking for matching.)

17) Loosen the bolt (15) and then remove the taper pin (16).

18) Prepare two taper pins with female thread, $\phi 6 \times 25$ mm (0.24 × 0.98 in.) and drive fit them into taper pin holes (17).

19) Tighten the clutch securing screw (15).

20) Finish two taper pin holes (18) with a taper reamer and drive the taper pin $\phi 8 \times 25$ mm (0.31 × 0.98 in.) into the taper pin hole. If the taper pin removed in step 17) is stepped or bent, replace it with a new one. If the taper pin can be inserted too deeply, use a little longer taper pin.

21) Remove the taper pins (4) and (17).

22) Reassemble the turret head by reversing steps 10) to 16).

    Be sure that all O rings have been placed in position.

    Apply grease to the clutch teeth slightly.

23) Turn on the power.

24) Set "0" for MC USER PARAMETER, No. 4, TURRET/DOOR, "3. NC turret pulse handle A-side" (for the upper turret) or "4 NC turret pulse handle B-side" (for the lower turret) Then, select the "manual" mode and press the TOOL INDEX switch, and the turret will be clamped.

25) Measure the offset amount again as illustrated in Fig. 4-14.

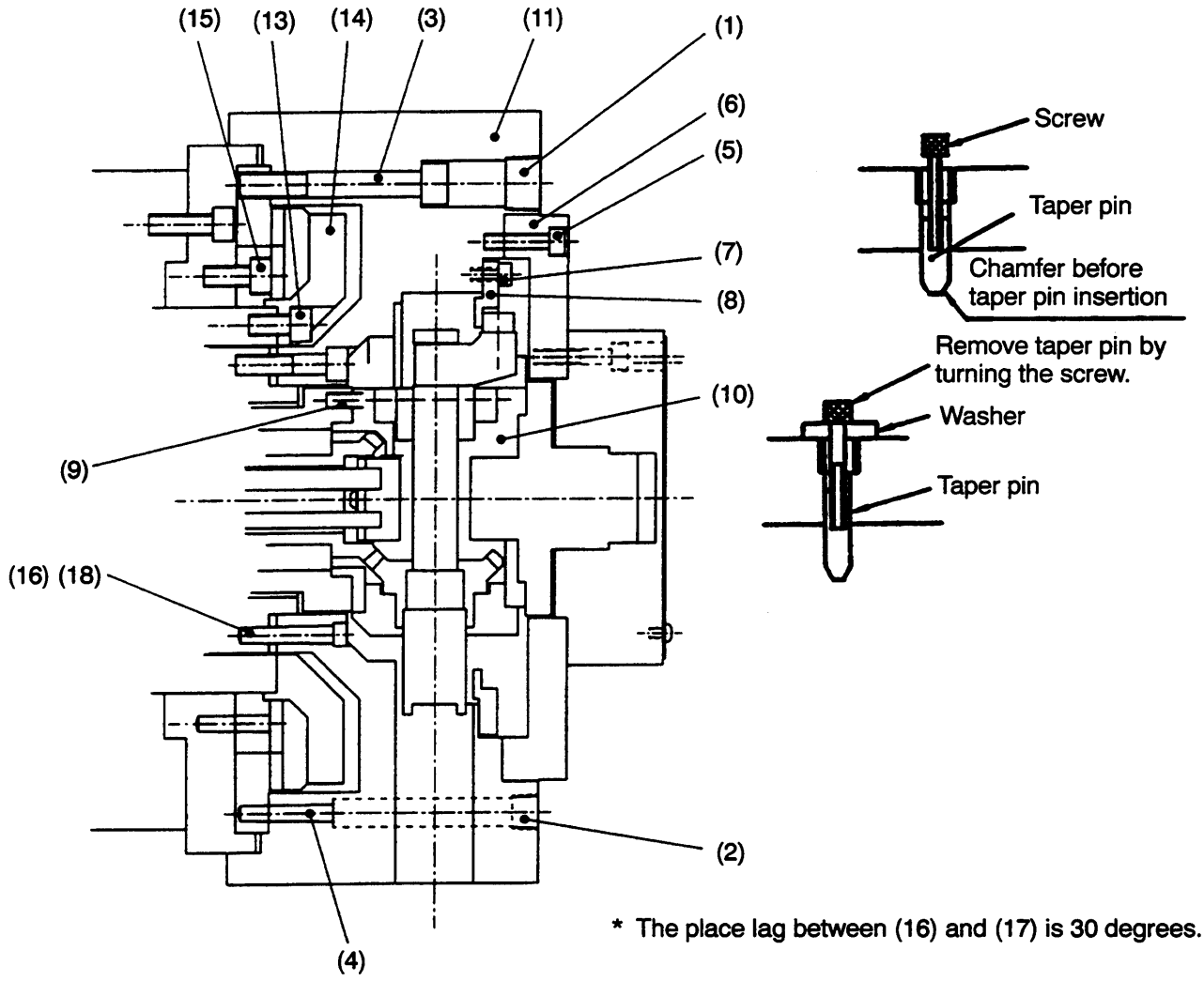
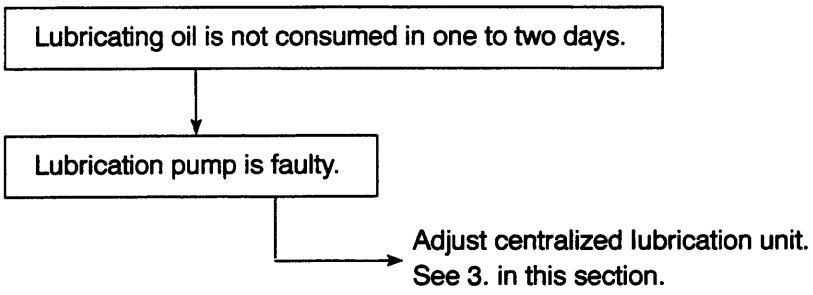


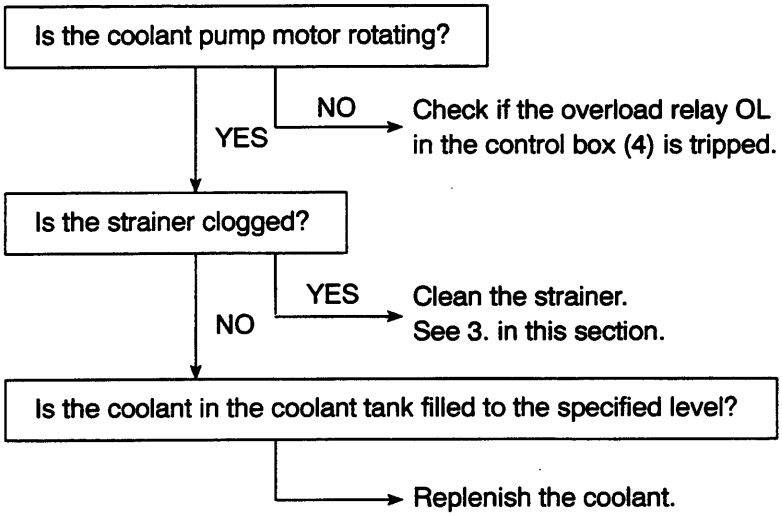

Fig. 4-16 Correcting Turret Offset

## 6-3. Others

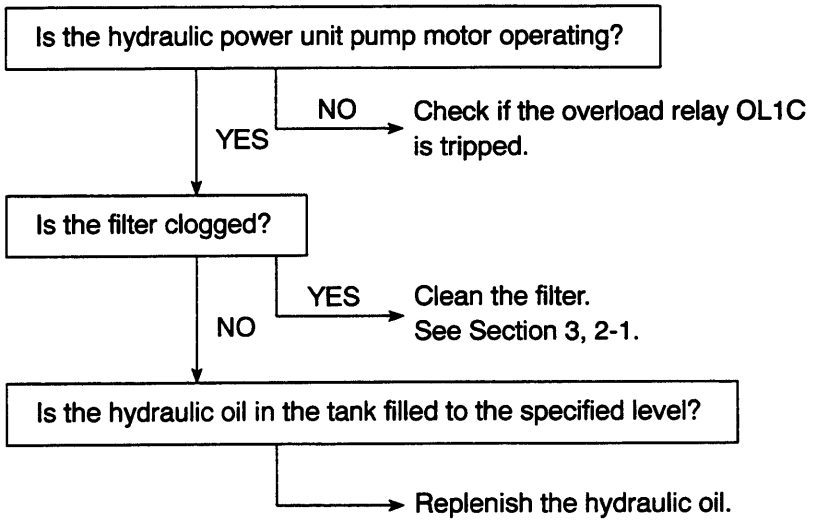
(1) No Lubricating oil Row to X-/Z-axis Slideways




(2) No Coolant Supply




(3) No Pressure Building-up of Hydraulic Power Unit



# SECTION 5 SPARE PARTS LIST

## 1. HYDRAULICS

| No. | Part Name | Maker | Type | Dimension | Q'ty | Use | Okuma Part No. |
|---|---|---|---|---|---|---|---|
| 1 | Solenoid valve | Nachi | SL-G01-A3X-GR-D2-20 | | 1 pc. each | Hydraulic power unit (Upper and lower turrets) | F0001-431-000-83 |
| 2 | Relief valve | Daikin | MR-02P-1-50 | | 1 pc. each | Hydraulic power unit (Upper and lower turrets) | F0010-930-000-03 |
| 3 | Check valve | Daikin | MC-02P-05-50 | | 1 pc. each | Hydraulic power unit (Upper and lower turrets) | F0040-981-000-17 |
| 4 | Line filter | Yamashin | TD04-10 | | | Hydraulic power unit | H0032-0009-94 |
| 4-A | Filter element | Yamashin | PX040A | | 1 | Hydraulic unit | H0032-0009-96 |
| 5 | Suction filter | Daiei | YMD-60615 150 mesh | | 1 | Hydraulic power unit | H0032-0005-74 |
| 6 | Solenoid valve | Nachi | S-G01-B3X-GRZ-D2-32 | | 1 pc. each | Left and right chucks | F0000-431-000-19 |
| 7 | P-port reducing valve | Nachi | OG-G01-PC-K-20 | | 1 pc. each | Left and right chucks | F0011-730-000-06 |
| 8 | Pressure gauge | Nagano Keiki | GV50-173 | | 2 | Hydraulic power unit | T019-400-005-23 |
| 9 | B-port reducing valve | Nachi | OG-G01-B1-K-12 | | 1 pc. each | Right and left C-axis drive unit | F0011-740-000-20 |
| 10 | Solenoid valve | Nachi | S-G01-C6-GRZ-D2-32 | | 1 pc. each | C-axis drive unit | F0000-445-000-04 |
| 11 | Pressure gauge | Nagano Keiki | GV50-123-50 | | 1 pc. each | C-axis drive unit | T019-400-003-34 |
| 12 | Dester block | Showa | DS3Z | 0.08 × 3 | 1 | Upper cross slide | H0019-0003-10 |
| 13 | Dester block | Showa | DS8Z | 0.05 × 7<br>0.08 × 1 | 1 pc. each | Upper left saddle | H0019-0003-73 |
| 14 | Dester block | Showa | DS2Z | 0.08 × 2 | 1 pc. each | Right spindle saddle | H0019-0002-07 |

| No. | Part Name | Maker | Type | Dimension | Q'ty | Use | Okuma Part No. |
|---|---|---|---|---|---|---|---|
| 15 | Dester block | Showa | DS5Z | 0.08 × 4 | 1 | Lower cross-slide | H0019-0003-12 |
| 16 | Dester block | Showa | DS8Z | 0.03 × 3<br>0.08 × 5 | 1 pc. each | Upper cross slide<br>Lower cross-slide | H0019-0003-59 |

# 2. ELECTRICALS (ON MACHINE)

| No. | Part Name | Maker | Type | Dimension | Q'ty | Use | Okuma Part No. |
|---|---|---|---|---|---|---|---|
| 1 | AC motor | Sanyo Denki | 7.5/5.5 kW built-in motor | Rotor Stator | 1 pc. each | Spindle drive motor | E1004-288-038 E1004-288-039 |
| 2 | Coolant pump | Hitachi | HP-025 250 W | | 1 | Coolant | F0130-03-000-71-2 |
| 3 | Lubrication unit | Showa | LCB4-7921 | | 1 | Slideway lubrication | H0120-0005-86 |
| 4 | Limit switch | OMRON | D4EIAION | | 2 | Upper and lower X-axis limit | E3019-397-253 |
| 5 | Limit switch | OMRON | D4EIAION | | 3 | Right and left Z-axis limit | E3019-397-253 |
| 6 | Limit switch | OMRON | D4BL-2CRA | | 1 | Door inter lock | E3049-397-015 |
| 7 | Pressure switch | Nagano Keiki | CP20-213 | Pressure range 14 to 70 kg/cm$^2$ | 1 | Hydraulic power unit | E3040-539-056 |
| 8 | Hydraulic pump | Kitatomi | VPVC-F26 | | 1 | Hydraulic power unit | H0110-0004-60 |
| 8-A | Hydraulic motor | Toshiba | 100 L 2.2 kW | | 1 | Hydraulic unit | H0110-0004-66 |
| 9 | Pump | Tokyo Syouketsu | TS-S200TMT-22 | | 2 | Headstock cooling unit | |
| 10 | Fan motor | Ikura Seiki | 6008B × LTP-5 | | 4 | Headstock cooling unit | |
| 11 | Brushless servomotor | Okuma | BL-MC150E-20SB | 3 kW | 1 | XA-axes | |
| 12 | Brushless servomotor | Okurna | BL-MS150E-20S | 3 kW | 1 pc. each | ZA and ZB-axis | |
| 13 | Brushless servomotor | Okurna | BL-MC75E-20T | 1.35 kW | 1 pc. each | Upper and lower turrets | |
| 14 | Brushless servomotor | Okurna | BL-MC95E-20TB | 2 kW | 1 | XB-axis | |
| 15 | Foot switch | Osaka Jido Denki | OFL-1-SM2C | | 2 | Chuck pedal | E2860-119-001 |
| 16 | Proximity switch | OMRON | TL-T2E1 | | 2 pc. each | Upper and lower turrets | E3020-397-101 |
| 17 | AC motor | Yasukawa | VAC-YMF2.2/ 1.1 R-152 | 2.2/1.1 kW | 1 set, each | M-tool spindle on upper and lower turrets | E1013-892-091 |
| 18 | Fluorescent lamp | Matsushi-ta | FUL18W | U-shaped pipe 100 V 18 W | 1 | Work light | E3582-801-016 |
| 19 | Lamp | Sasaki Electric | STFP 110V15W T20/E12 | | 3 | 3-tier signal tower (option) | E3580-284-002 |

# 3. CONSUMABLE ITEMS

(Exchange interval: Approx. 8000 Hr. or three years)

| No. | Part Name | Maker | Type | Dimension | Q'ty | Use | Okuma Part No. |
|---|---|---|---|---|---|---|---|
| 1 | Timing belt | Bando | 250S8M848 | | 1 | Lower X-axis | M119-0008-59 |
| 2 | Timing belt | Bando | 150S8M520 | | 1 pc. each | M-tool spindle on upper and lower turrets | M119-0016-92 |
| 3 | Packing | NOK | 95AL-1574-R | | 1 pc. each | Upper and lower turrets | H0031-0019-19 |
| 4 | Packing | NOK | IUH 130 × 140 × 6.5 | | 1 pc. each | Upper and lower turrets | H0031-0019-44 |
| 5 | Packing | NOK | USH 136 × 150 × 8.5 | | 1 pc. each | Upper and lower turrets | H0031-0019-45 |
| 6 | Oil seal | NTN | G35 × 45 × 4 | | 4 | Upper and lower turrets | F1113-035-04504 |
| 7 | X ring | Nippon Valqua | R-40 | | 1 pc. each | Upper and lower turrets | H0031-0005-01 |
| 8 | Z ring | NOK | AZ2045G0 | | 1 pc. each | ZA and ZB-axis | H0031-0015-54 |
| 9 | Z ring | NOK | AZ1833E0 | | 1 pc. each | ZA and ZB-axis | H0031-0016-25 |
| 10 | O ring | NOK | G235 | | 1 pc. each | Right and left headstocks | F109-0003-19 |
| 11 | O ring | NOK | G240 | | 1 pc. each | Right and left headstocks | C6110-00G240 |
| 12 | O ring | Nippon Valqua | AS568-024 | | 1 pc. each | Holder | F109-0003-26 |
| 13 | Brake pad | Okuma | | | 4 pc. each | C-axis brake (Right and left headstocks) | |
| 14 | Wiper | Nitta | Slide seal | | 1 | Upper cross-slide (lower slideway) | H1023-0023-27-2 |
| 15 | Wiper | Nitta | Slide seal | | 1 pc. each | Upper cross-slide (upper right slideway) Lower cross-slide (lower left slideway) | H1023-0023-28 |
| 16 | Wiper | Nitta | Slide seal | | 1 pc. each | Upper cross-slide (upper left slideway) Lower cross-slide (lower right slideway) | H1023-0023-29 |

| No. | Part Name | Maker | Type | Dimension | Q'ty | Use | Okuma Part No. |
|---|---|---|---|---|---|---|---|
| 17 | Wiper | Nitta | Slide seal | | 2 | Lower cross-slide (upper slideway) | H1023-0027-92 |
| 18 | Wiper | Nitta | Slide seal | | 1 | Lower cross-slide (upper right slideway) | H1023-0027-93 |
| 19 | Wiper | Nitta | Slide seal | | 1 | Lower cross-slide (upper left slideway) | H1023-0027-94 |
| 20 | Wiper | Bando | Slide seal | | 1 pc. each | Upper left saddle (right front slideway) Rihgt spindle saddle (right front slideway) | H1023-0029-51 |
| 21 | Wiper | Bando | Slide seal | | 1 pc. each | Upper left saddle (left front slideway) Rihgt spindle saddle (left front slideway) | H1023-0029-52 |
| 22 | Wiper | Bando | Slide seal | | 1 | Upper left saddle (right behind slideway) | H1023-0016-21-1 |
| 23 | Wiper | Bando | Slide seal | | 1 | Upper left saddle (left behind slideway) | H1023-0016-19-2 |
| 24 | Wiper | Bando | Slide seal | | 1 | Right spindle saddle (right behind slideway) | H1023-0027-96 |
| 25 | Wiper | Bando | Slide seal | | 1 | Right spindle saddle (left behind slideway) | H1023-0027-95 |
| 26 | Wiper | Nitta | Slide seal | | 1 | XA telescopic cover | H1023-0028-17-1 |
| 27 | Wiper | Nitta | Slide seal | | 1 | XA telescopic cover | H1023-0028-74-1 |
| 28 | Wiper | Nitta | Slide seal | | 1 | XB telescopic cover | H1023-0028-21-1 |
| 29 | Wiper | Nitta | Slide seal | | 2 | XB telescopic cover | H1023-0028-22-1 |
| 30 | Wiper | Nitta | Slide seal | | 1 | XB telescopic cover | H1023-0028-75 |
| 31 | Wiper | Nitta | Slide seal | | 1 | ZAB telescopic cover (upper slideway) | H1023-0028-26-1 |

| No. | Part Name | Maker | Type | Dimension | Q'ty | Use | Okuma Part No. |
|---|---|---|---|---|---|---|---|
| 32 | Wiper | Nitta | Slide seal | | 1 | ZAB telescopic cover (middle slideway) | H1023-0028-27-1 |
| 33 | Wiper | Nitta | Slide seal | | 1 | ZAB telescopic cover (lower slideway) | H1023-0028-28 |
| 34 | Wiper | Nitta | Slide seal | | 1 | Front door upper portion (left slideway) | H1023-0028-35-1 |
| 35 | Wiper | Nitta | Slide seal | | 1 | Left cover (upper turret cover) | H1023-0028-29-1 |
| 36 | Wiper | Nitta | Slide seal | | 1 | Right headstock (front slideway) | H1023-0028-40-1 |
| 37 | Wiper | Nitta | Slide seal | | 1 | Right cover (upper slideway) | H1023-0028-80 |
| 38 | Wiper | Nitta | Slide seal | | 1 | Right cover (front slideway) | H1023-0028-81 |

# SECTION 6 TECHNICAL DATA

## 1. TOOLING SYSTEM

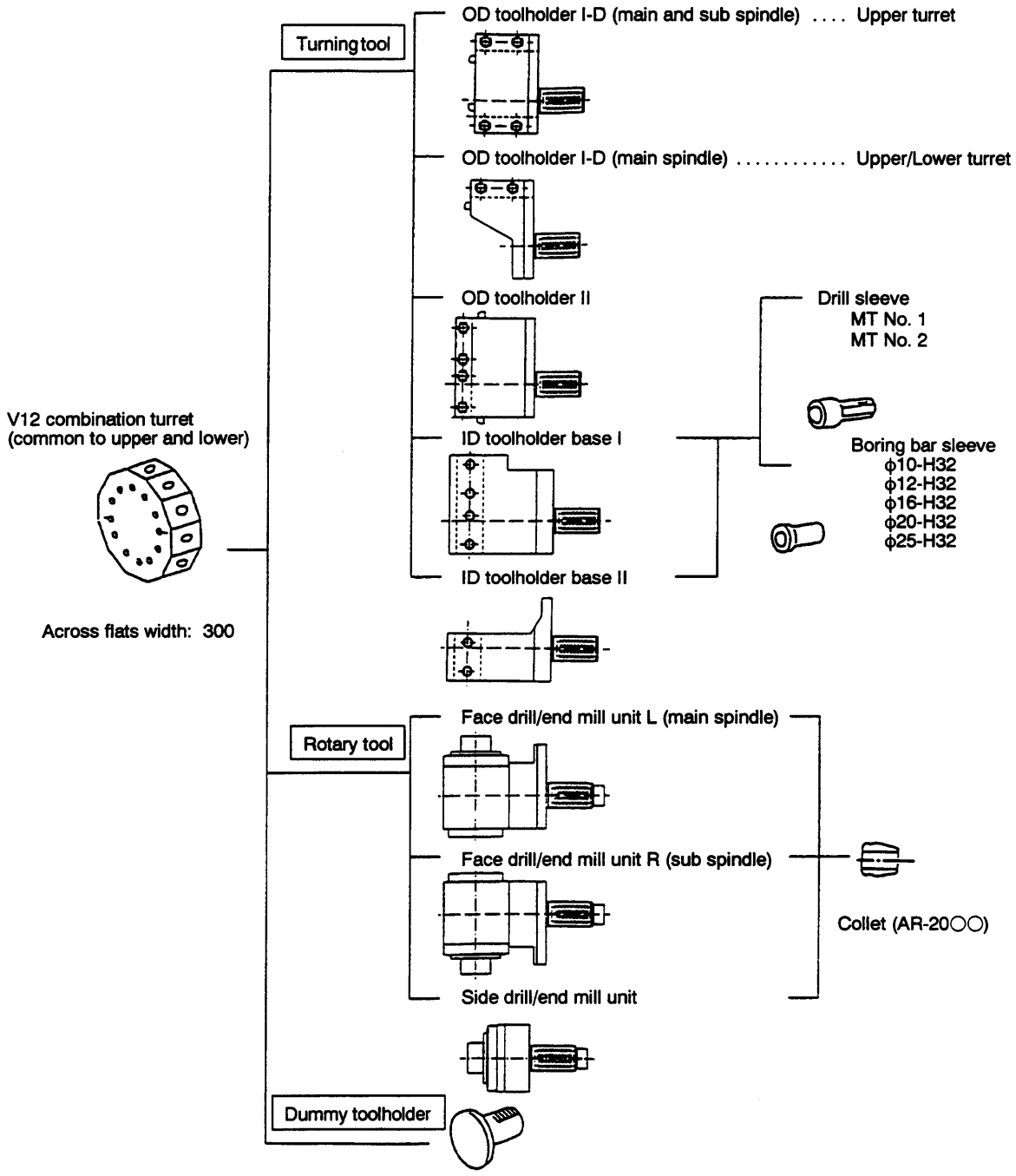



Fig. 6-1 Tooling System

# 2. TOOLHOLDER DIMENSIONS

(1) OD Type I-D Toolholder

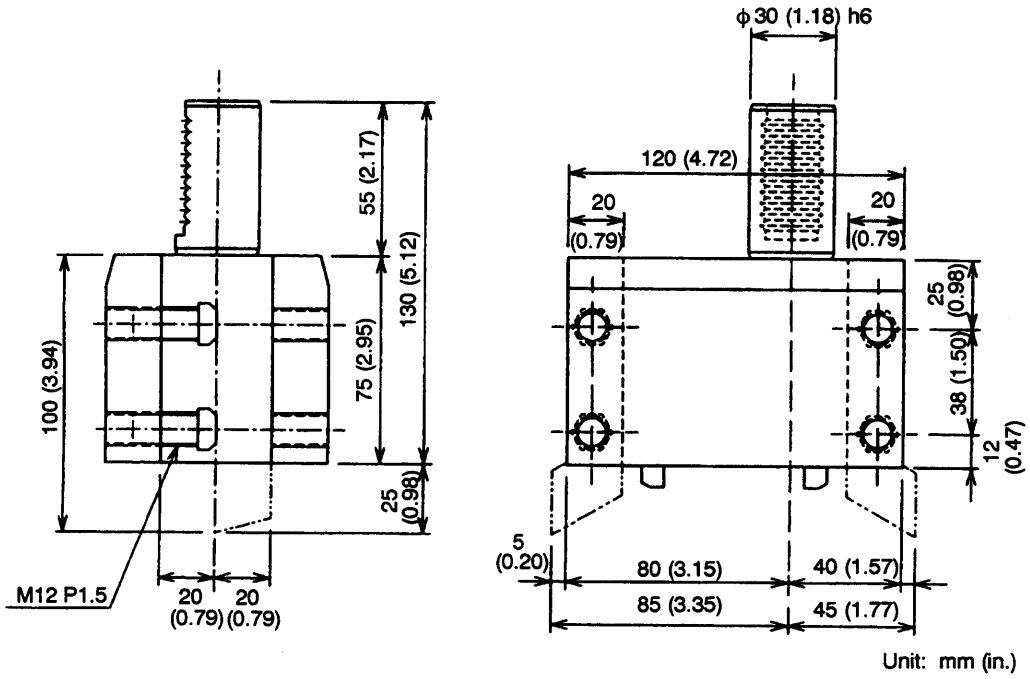



Fig. 6-2 OD Type I-D Toolholder Dimension

(2) OD Type I-S Toolholder

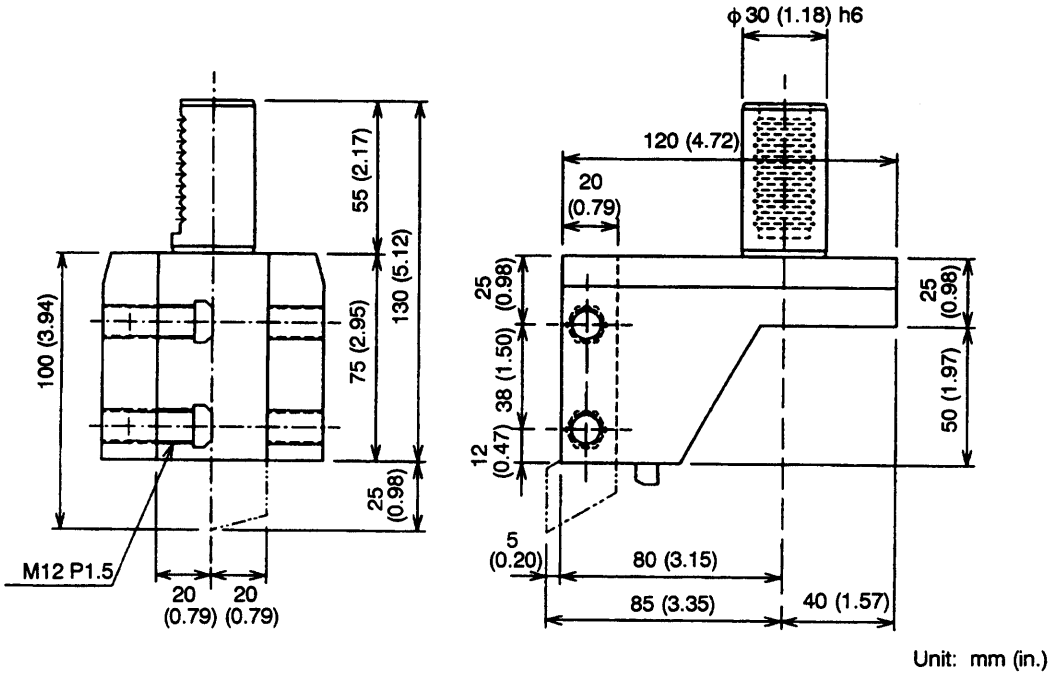
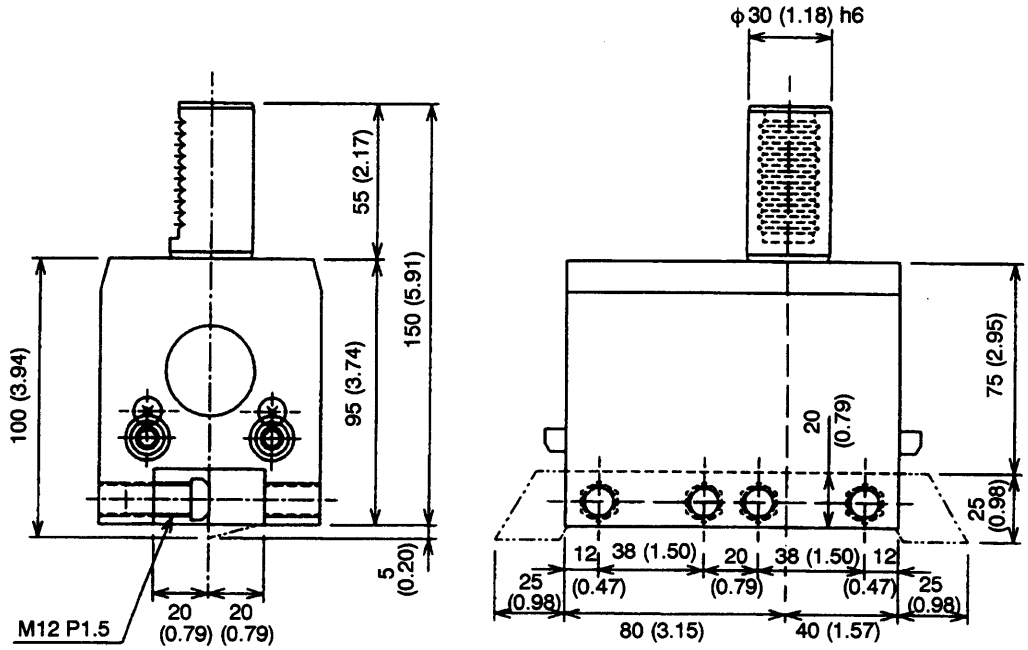



Fig. 6-3 OD Type I-S Toolholder Dimension

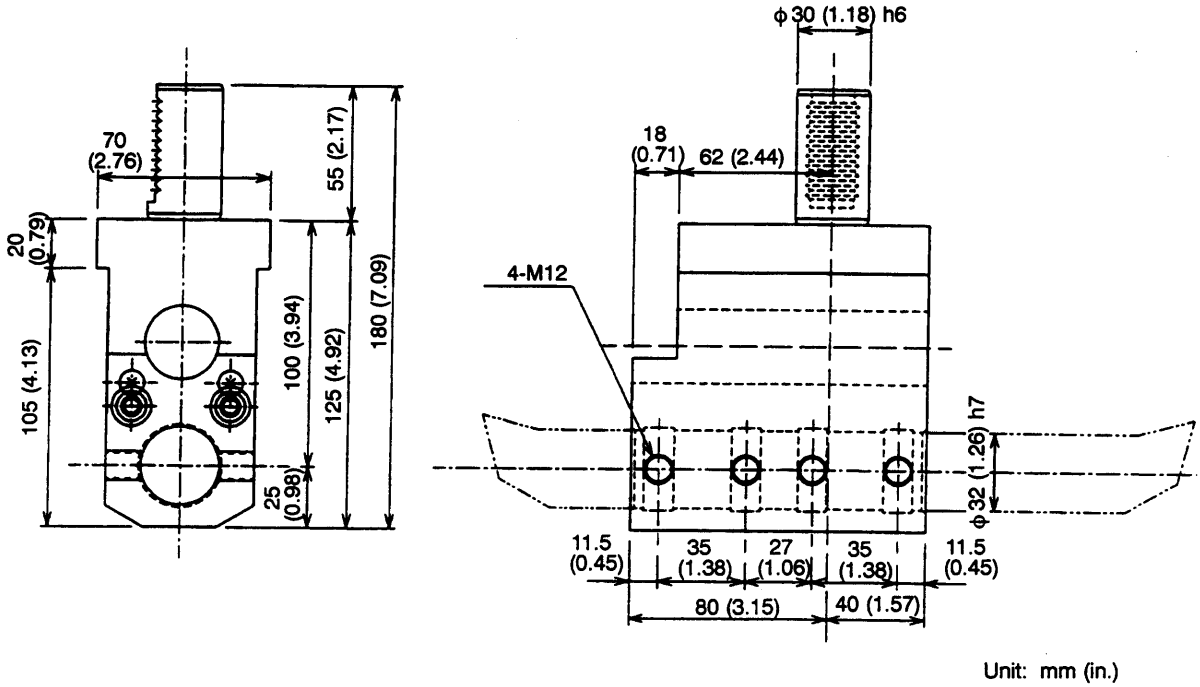
(3) OD Type II Toolholder




Unit: mm (in.)

Fig. 6-4 OD Type II Toolholder Dimension

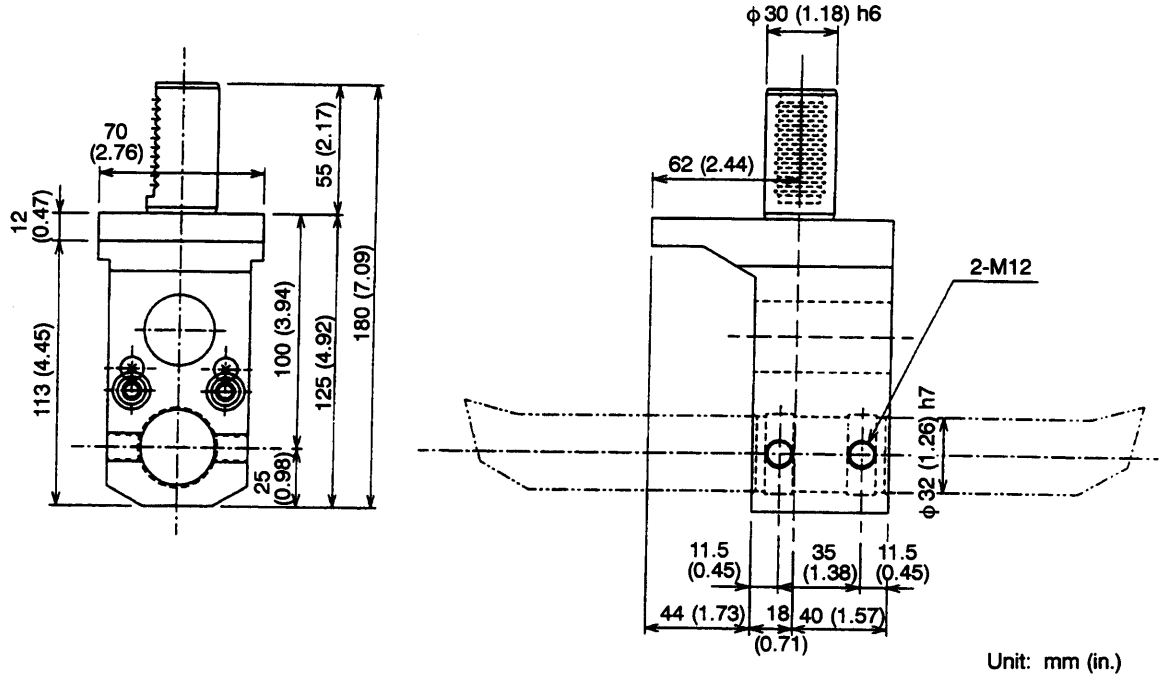
(4) ID Type I Toolholder




Unit: mm (in.)

Fig. 6-5 ID Type I Toolholder Dimension

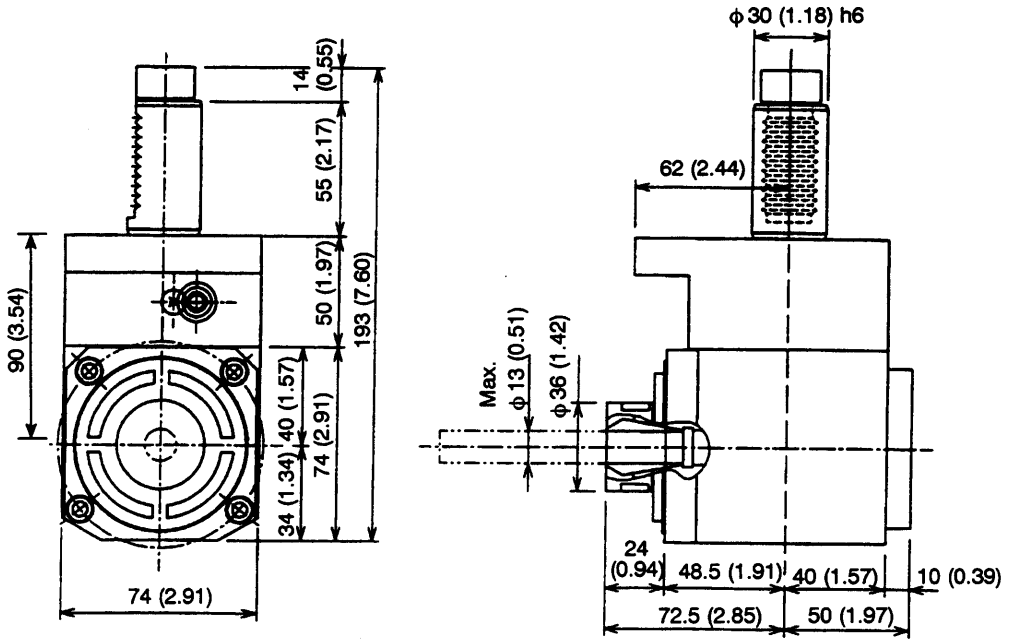
(5) ID Type II Toolholder




Unit: mm (in.)

Fig. 6-6 ID Type II Toolholder Dimension

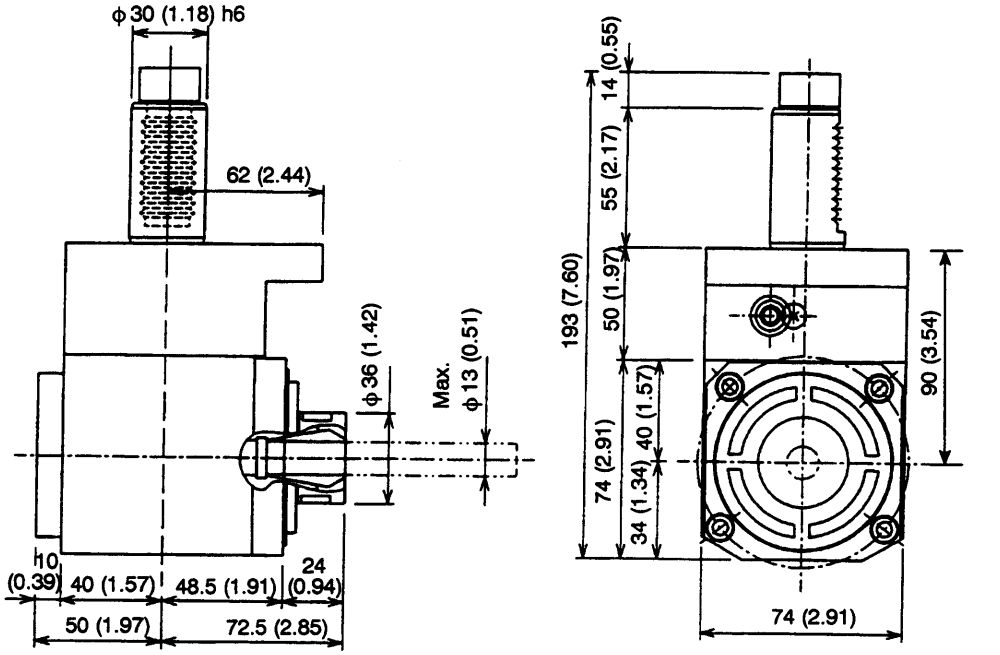
(6) Face Drilling End Milling Toolholder (Main Spindle)




Unit: mm (in.)

Fig. 6-7 Face Drilling End Milling Toolholder Dimension (Main Spindle)

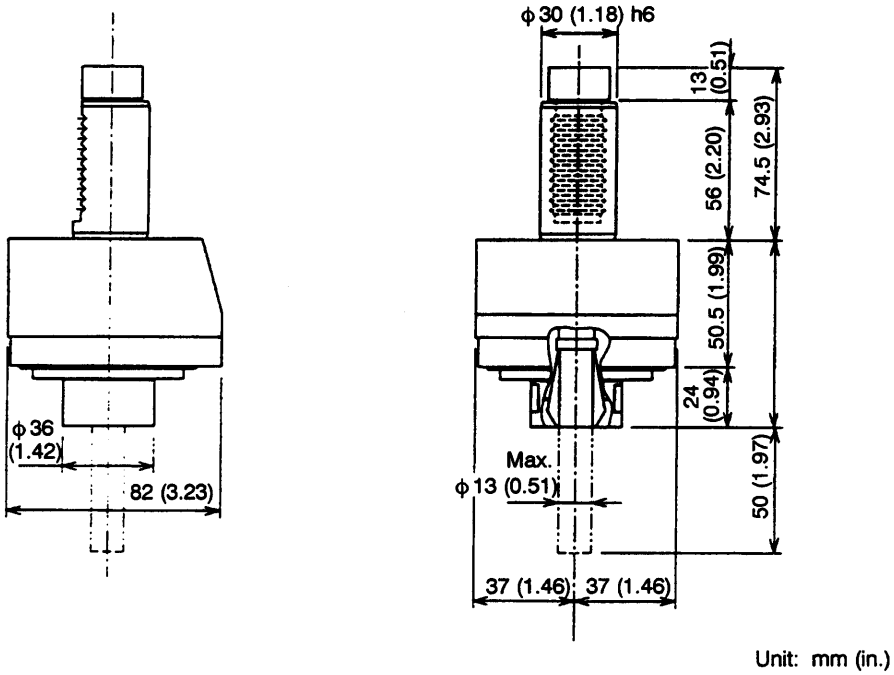
(7) Face Drilling End Milling Toolholder (Sub Spindle)




Unit: mm (in.)

Fig. 6-8 Face Drilling End Milling Toolholder Dimension (Sub Spindle)

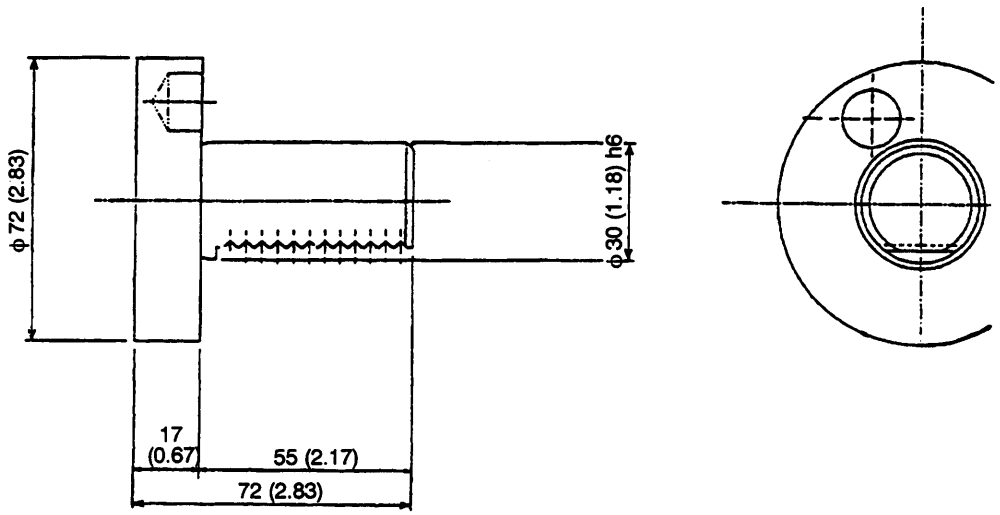
(8) Side Drilling End Milling Toolholder




Unit: mm (in.)

Fig. 6-9 Side Drilling End Milling Toolholder Dimension

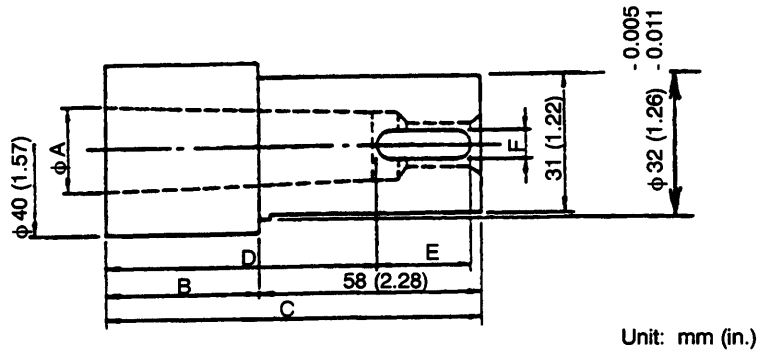
(9) Dummy Toolholder




Unit: mm (in.)

Fig. 6-10 Dummy Toolholder Dimension

(10) Drill Sleeve




Unit: mm (in.)

Fig. 6-11 Drill Sleeve Dimension

| | φA | B | C | D | E | F |
|---|---|---|---|---|---|---|
| MT No. 1 | 12.065 | 20 | 78 | 52 | 19 | 5.4 |
| MT No. 2 | 17.780 | 34 | 92 | 63 | 22 | 6.6 |

(11) Boring Bar Sleeve

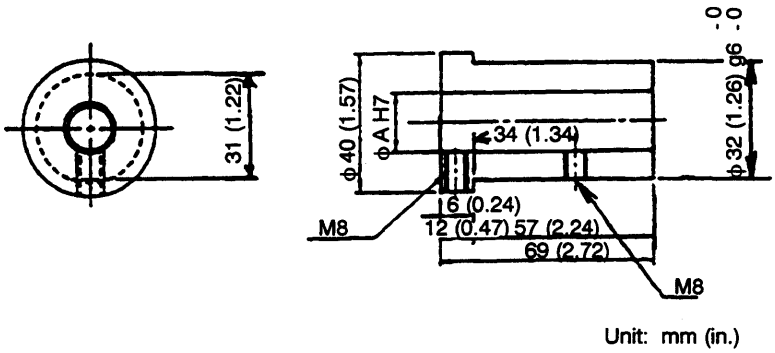



Fig. 6-12 Boring Bar Sleeve Dimension

| | φA |
|---|---|
| φ 8-H32 | 8 |
| φ 10-H32 | 10 |
| φ 12-H32 | 12 |

(12) Boring Bar Sleeve

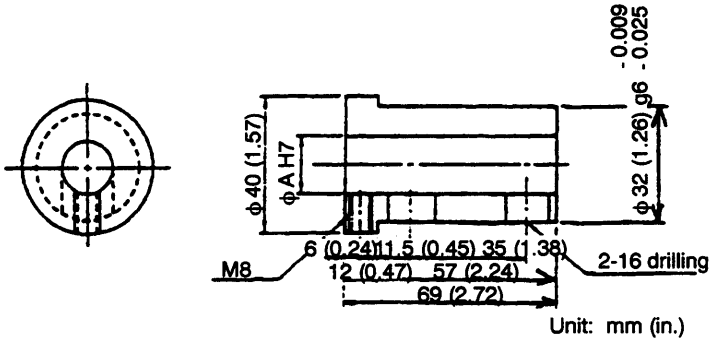
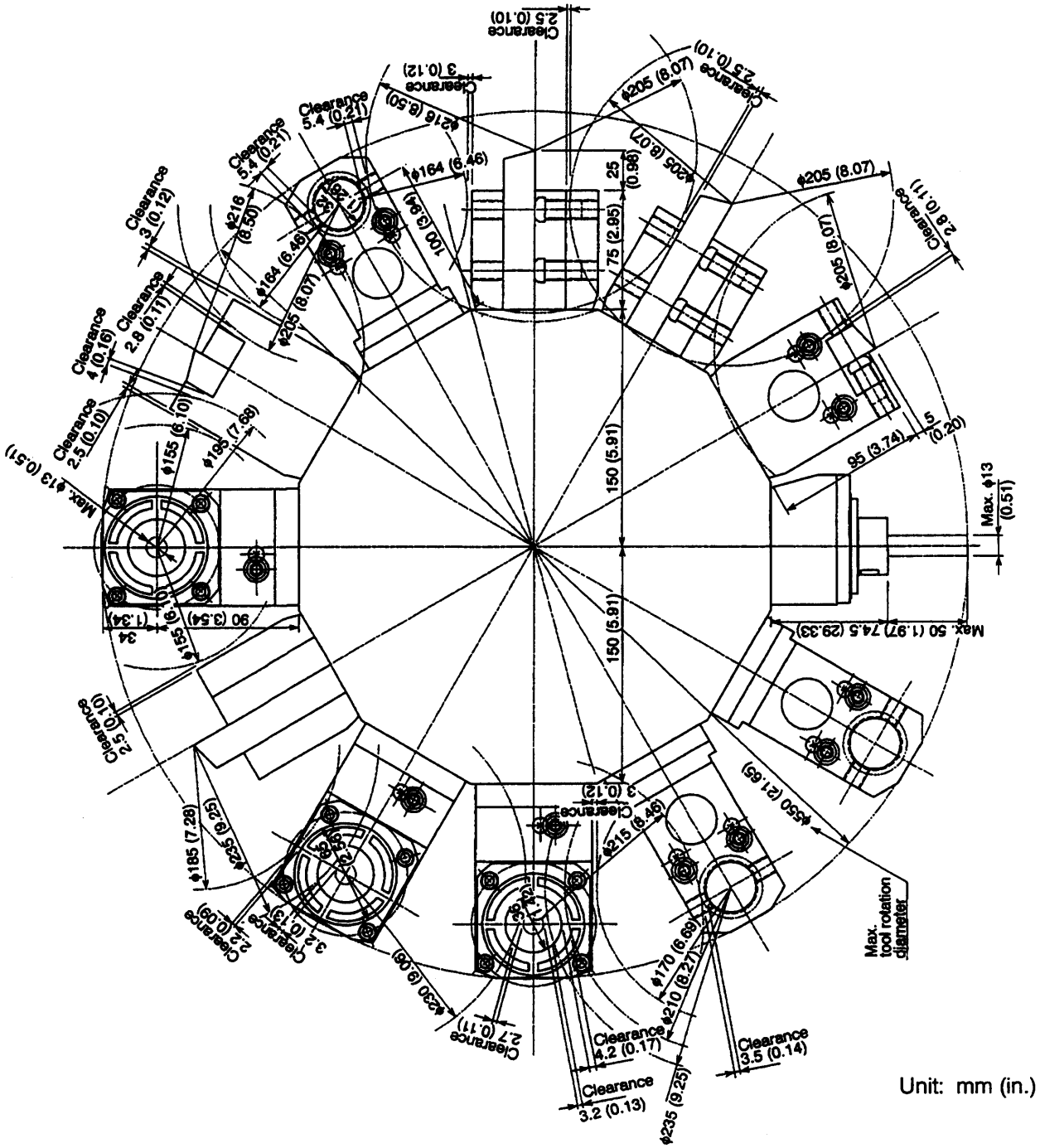



Fig. 6-13 Boring Bar Sleeve Dimension

| | φA |
|---|---|
| φ 16-H32 | 16 |
| φ 20-H32 | 20 |
| φ 25-H32 | 25 |

# 3. TOOL INTERFERENCE DIAGRAM




Unit: mm (in.)

Fig. 6-14 Tool Interference Diagram

# 4. WORKING RANGE DIAGRAM

(1) OD Toolholder

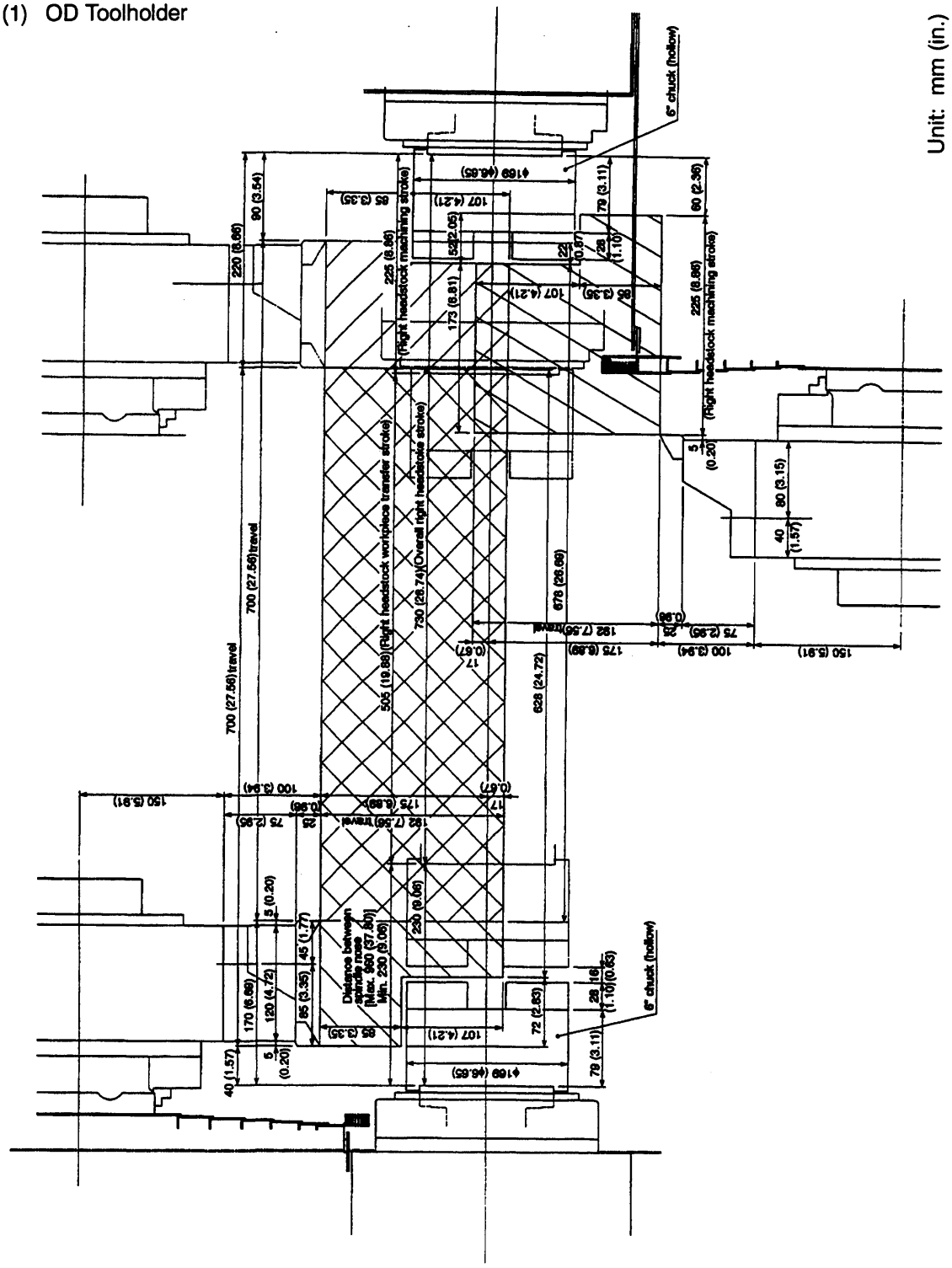



Fig. 6-15 OD Toolholder Diagram

(2) ID Type I Toolholder

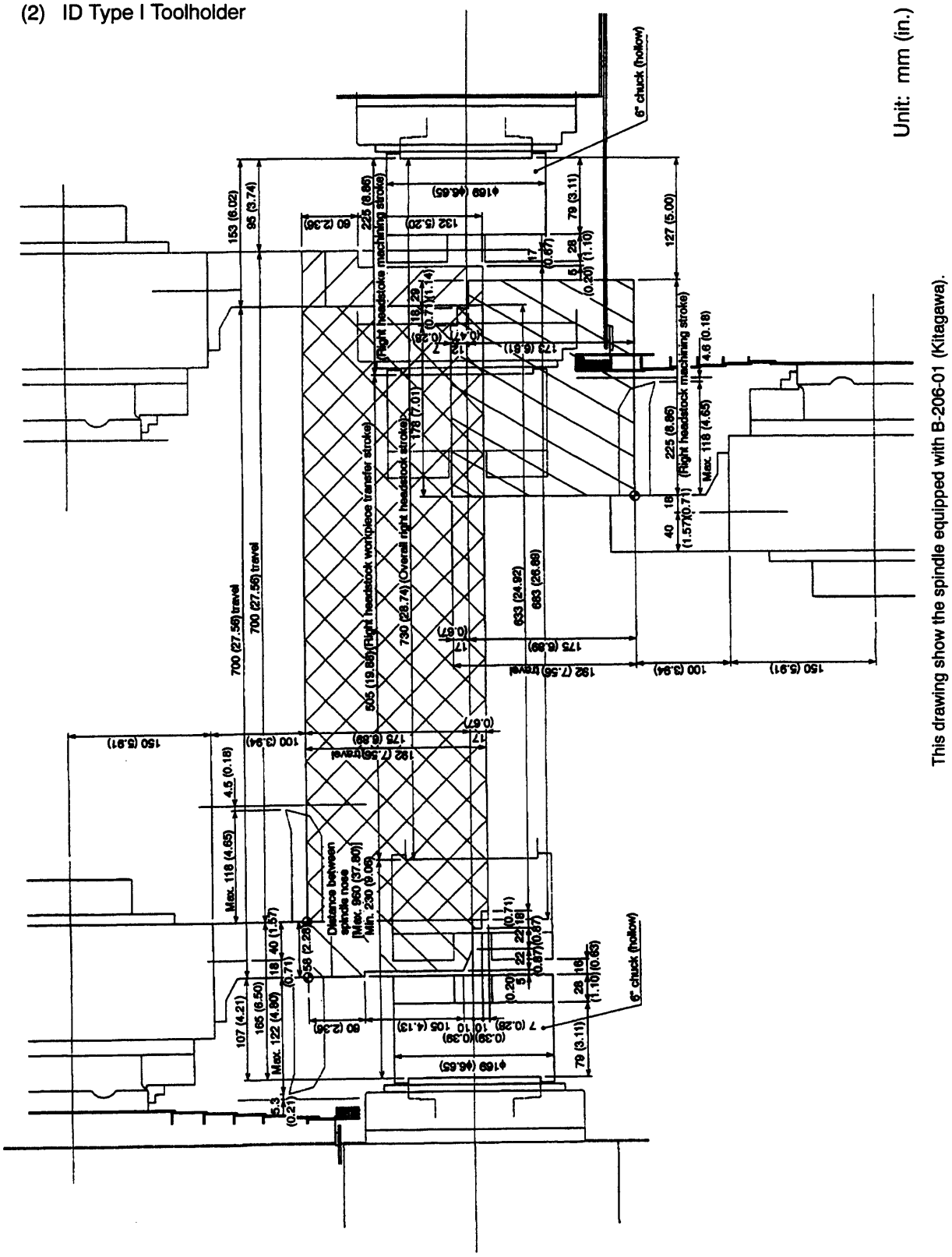



Fig. 6-16 ID Type I Toolholder Diagram

(3) ID Type II Toolholder

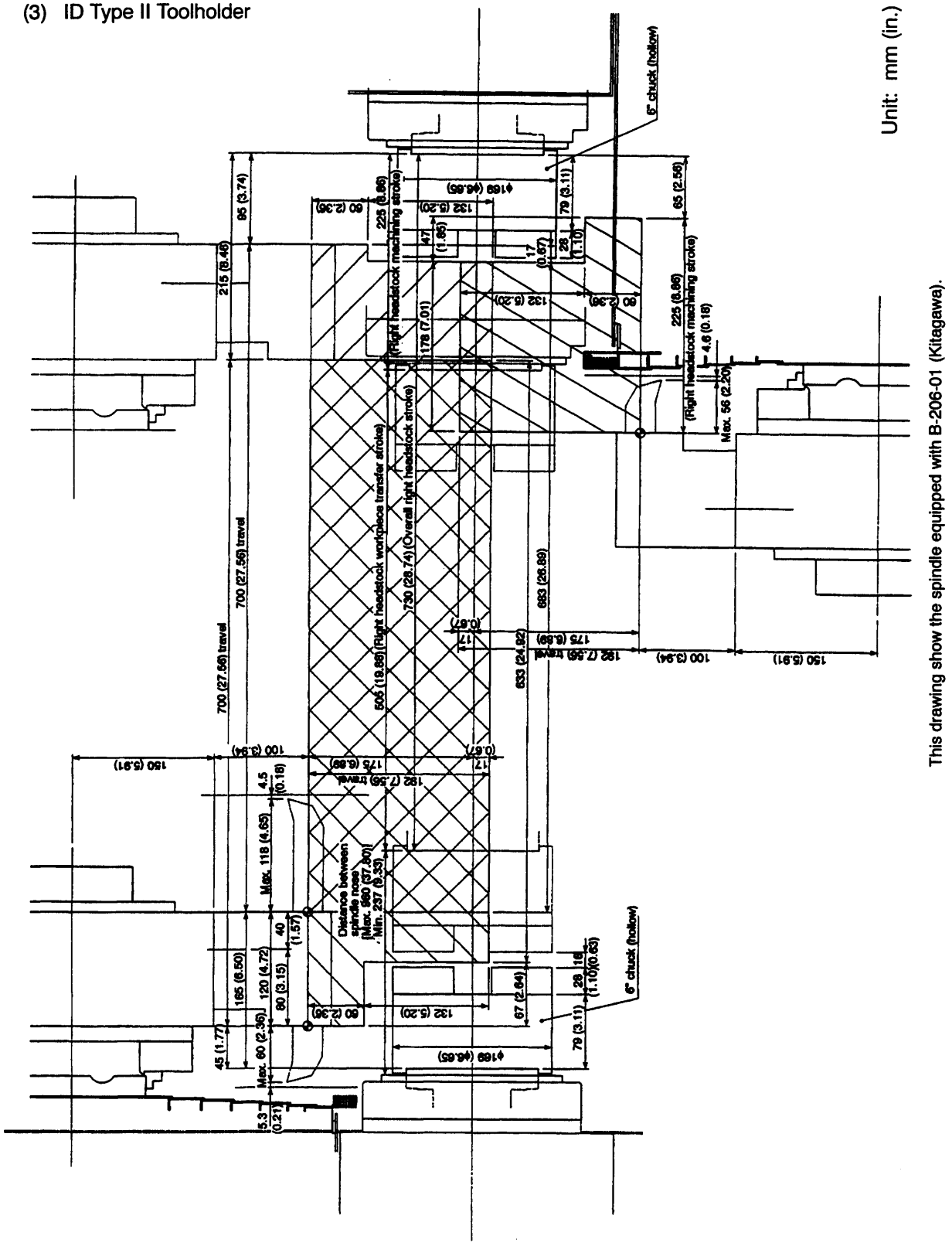



Fig. 6-17 ID Type II Toolholder Diagragram

(4) Face Drilling End Milling Toolholder (Main Spindle)

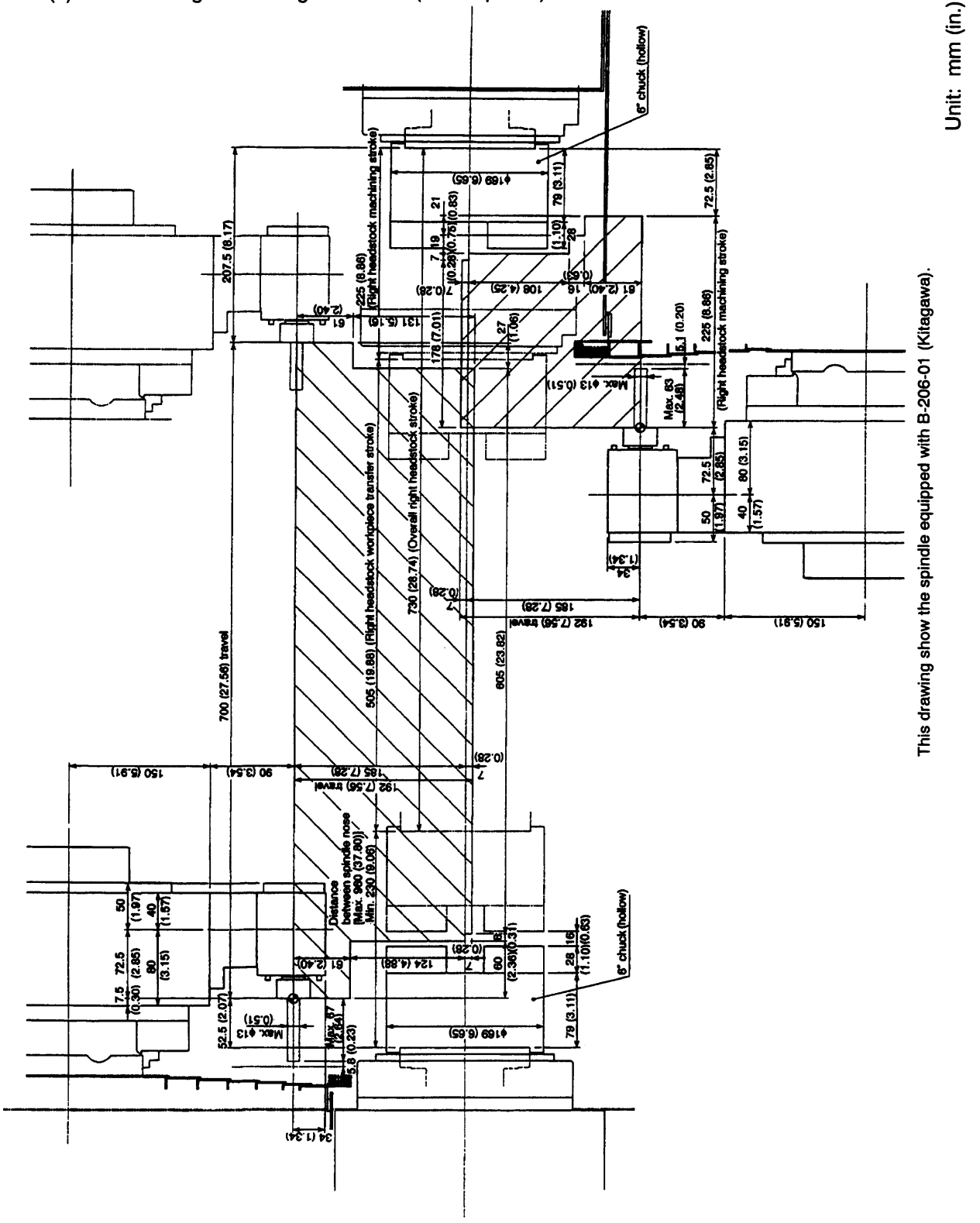



Fig. 6-18 Face Drilling End Milling Toolholder Diagragram (Main Spindle)

(5) Face Drilling End Milling Toolholder (Sub Spindle)

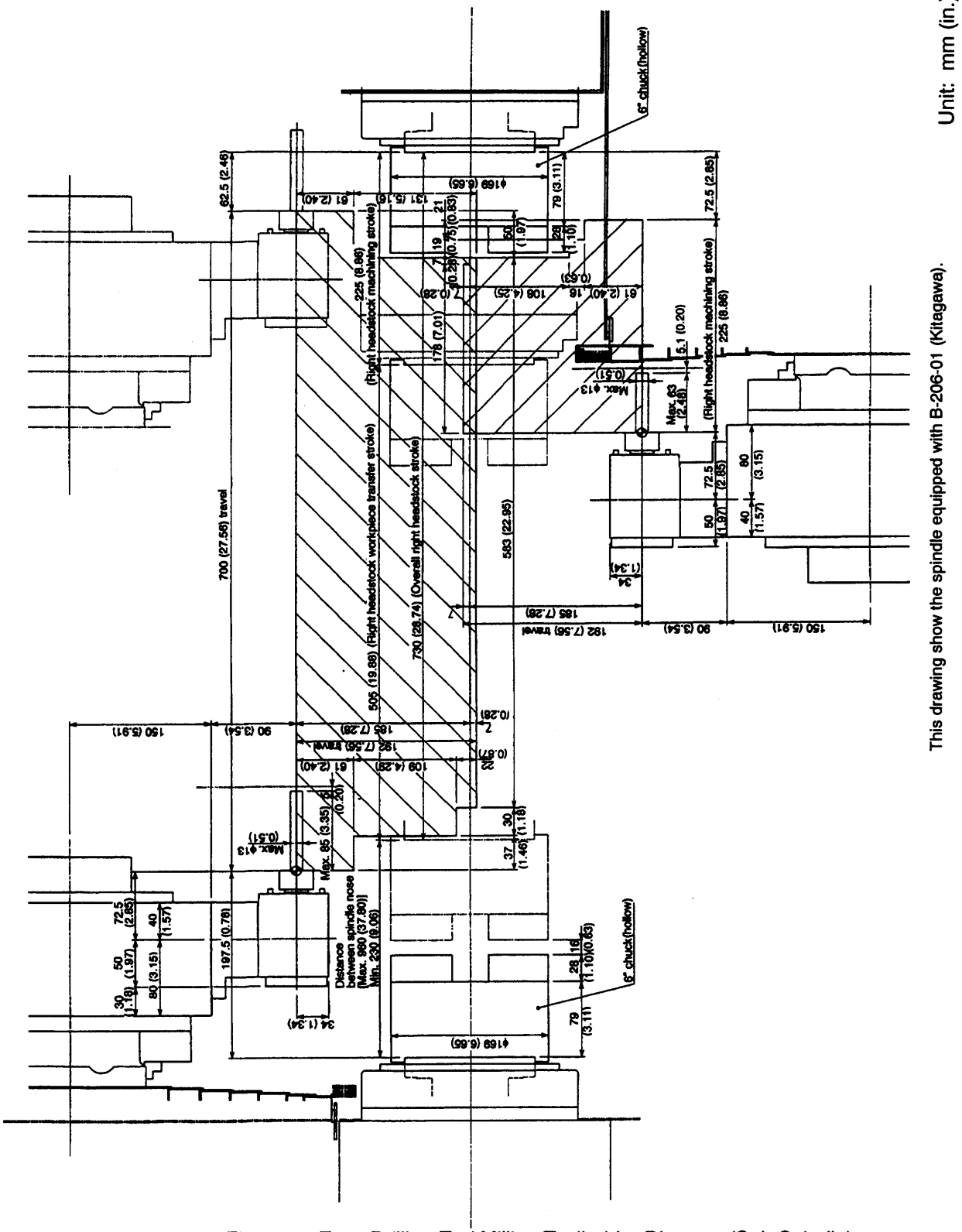



Fig. 6-19 Face Drilling End Milling Toolholder Diagram (Sub Spindle)

(6) Side Drilling End Milling Toolholder

Unit: mm (in.)

This drawing show the spindle equipped with B-206-01 (Kitagawa).

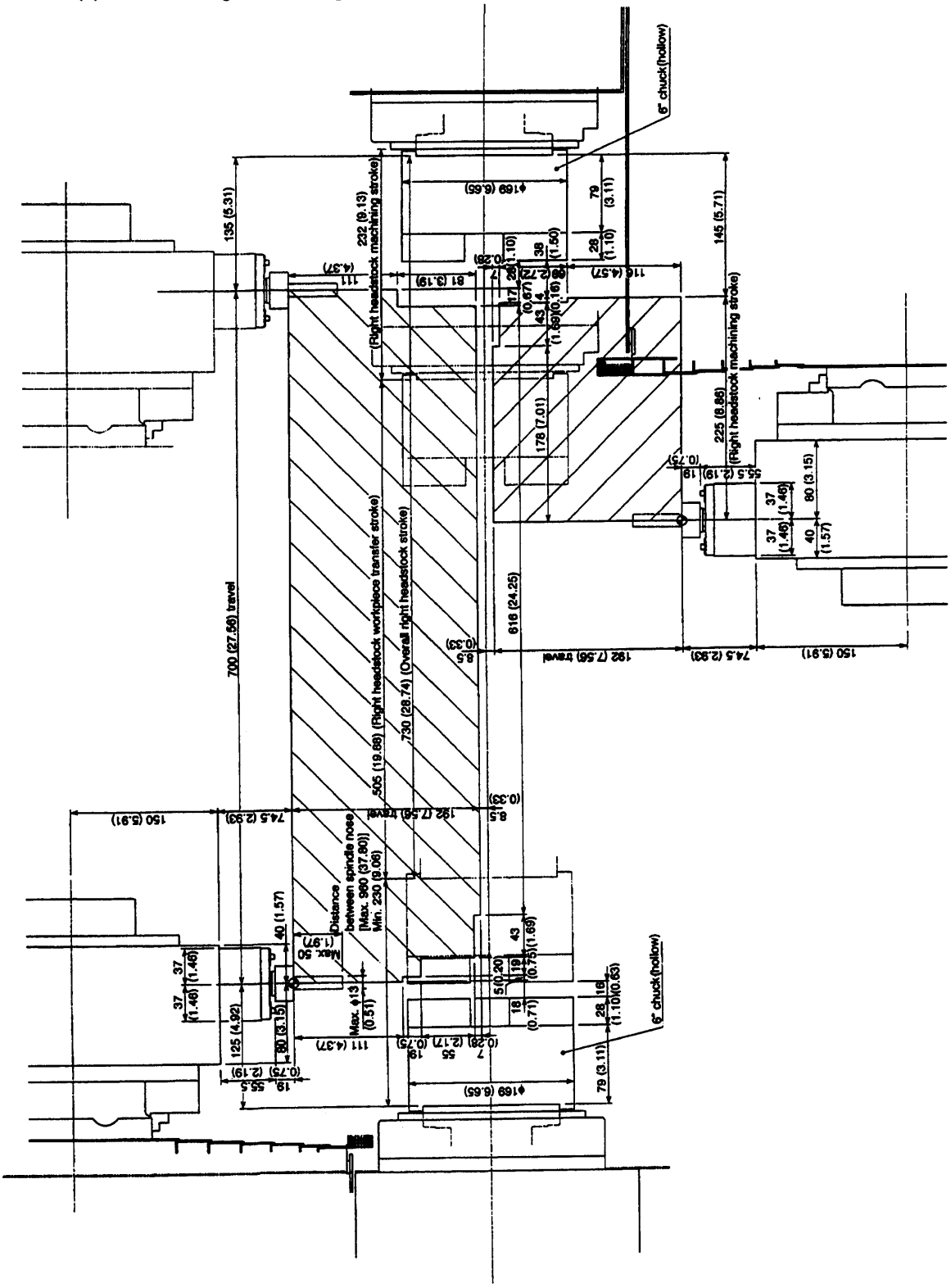



Fig. 6-20 Side Drilling End Milling Diagram Toolholder

(7) Cut-off Toolholder

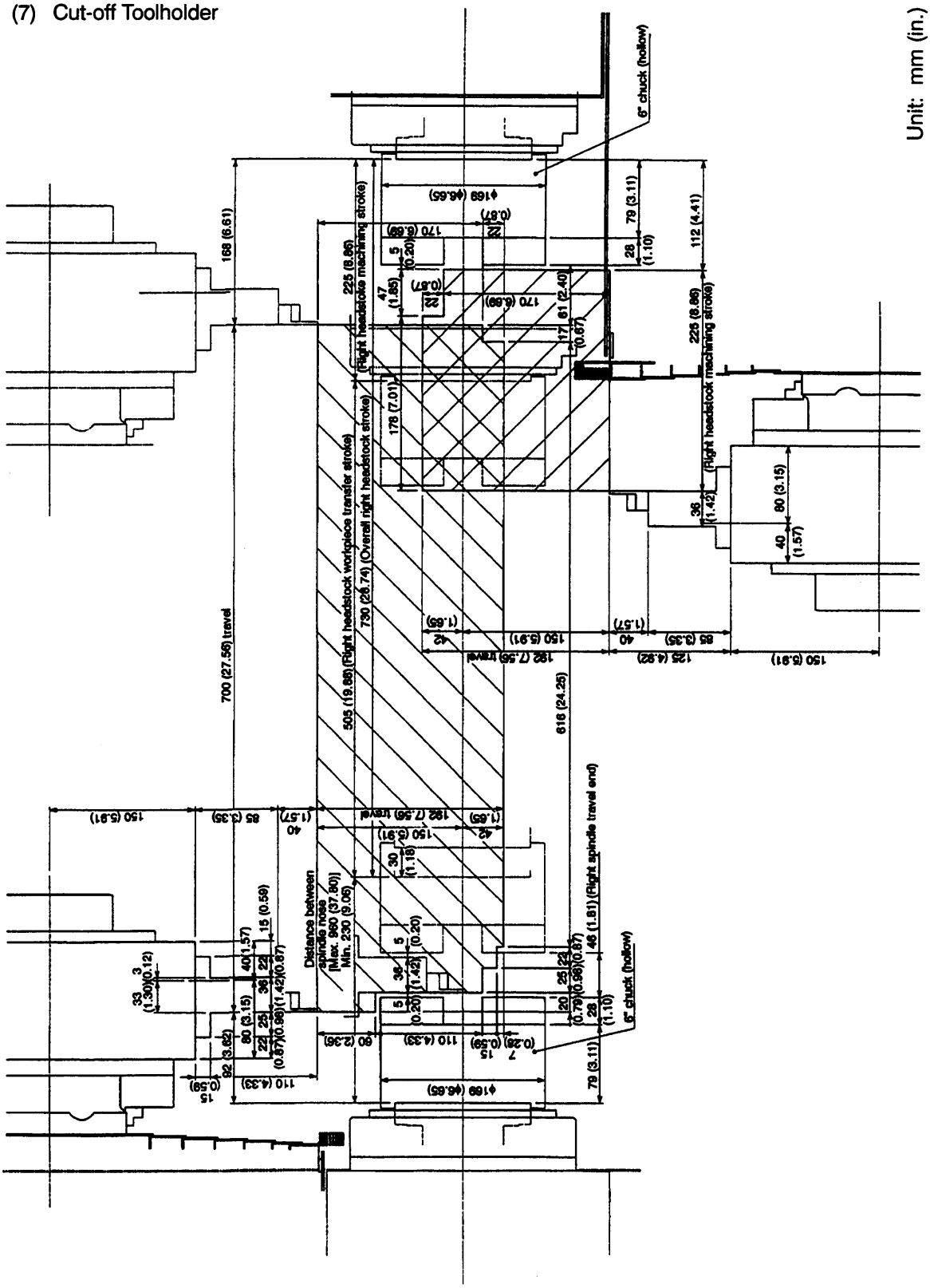
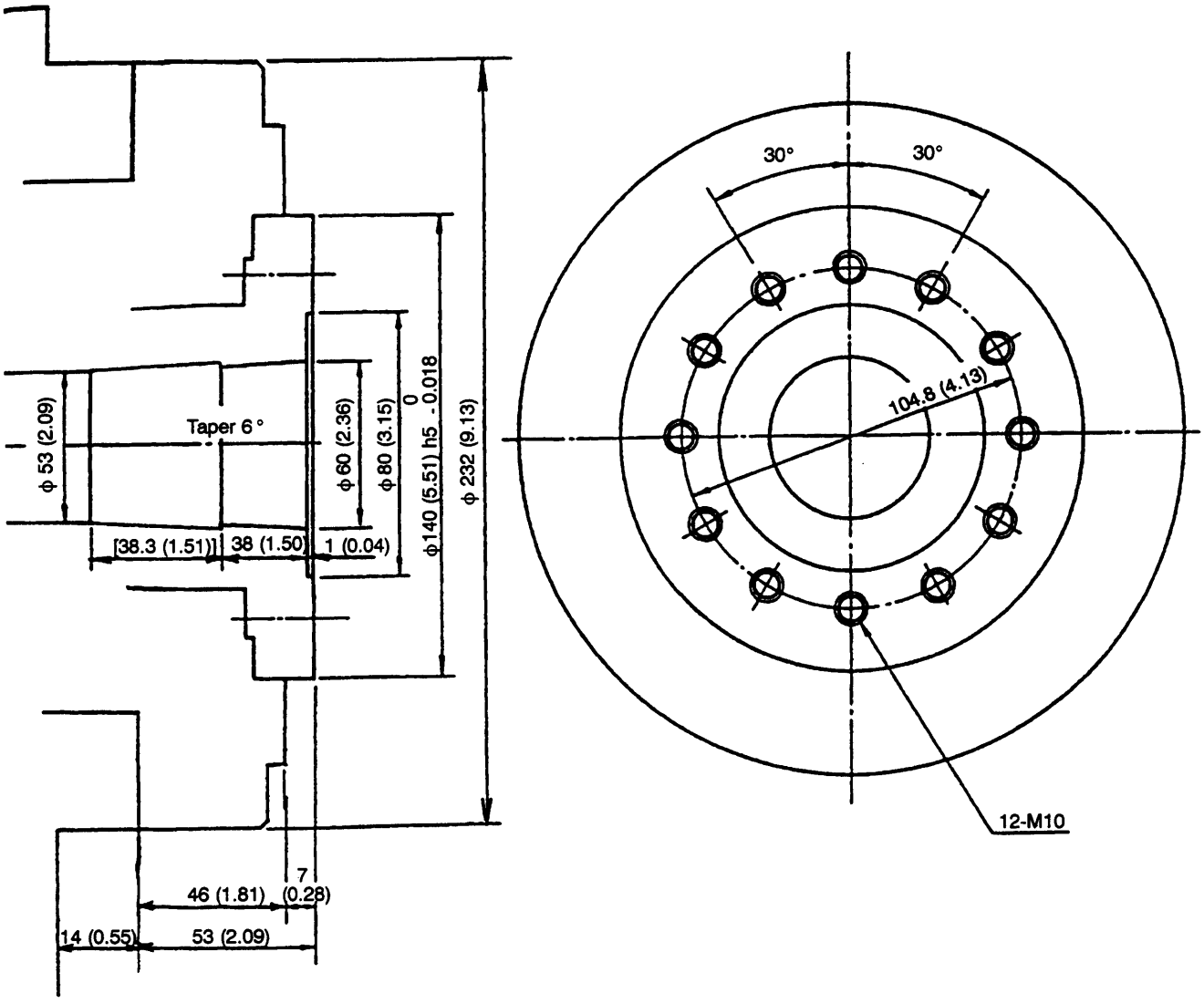



Fig. 6-21 Cut-off Toolholder Diagram

# 5. DIMENSION OF SPINDLE NOSE

φ140 mm (5.51 in.) flat nose

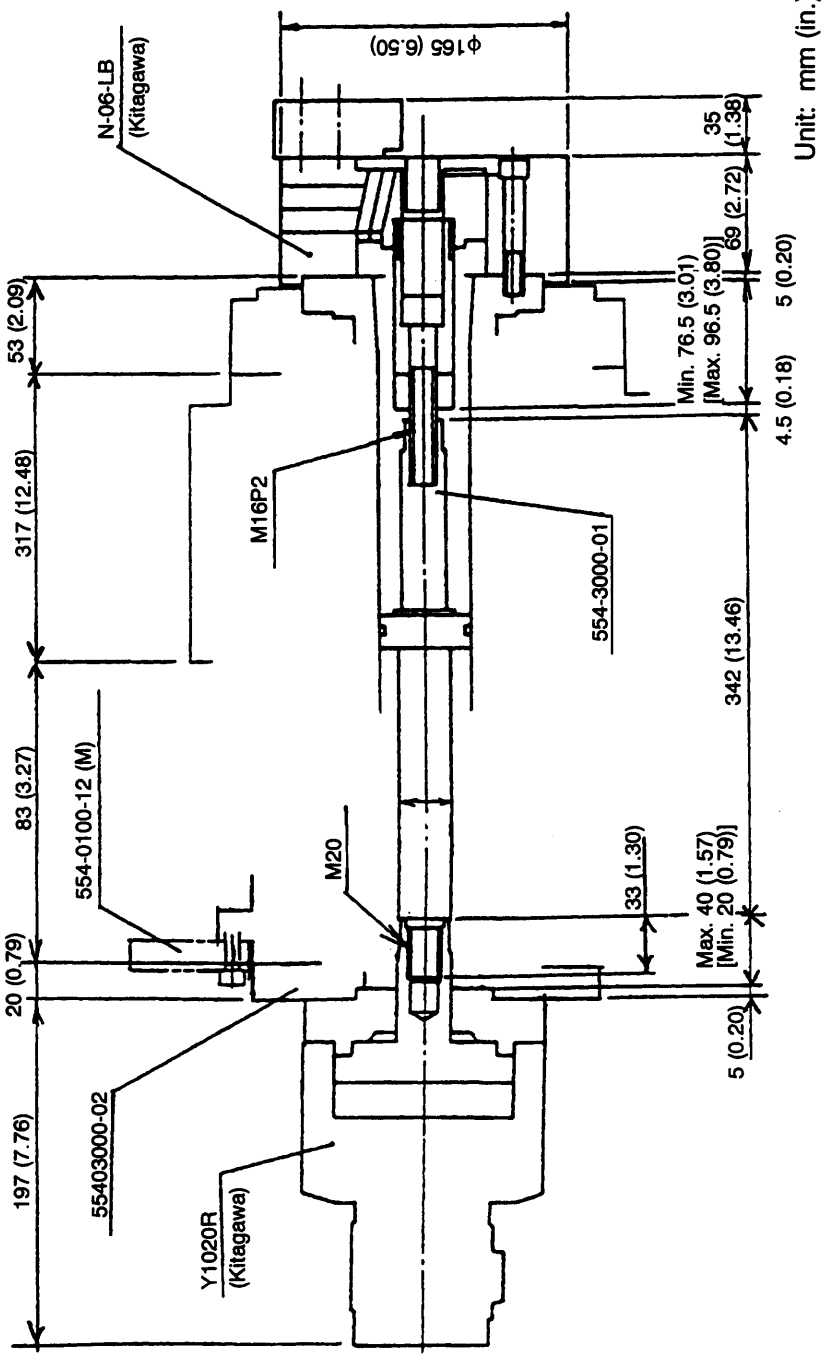



Unit: mm (in.)

Fig. 6-22 Dimension of Spindle Nose (JIS-A2-6)

# 6. HYDRAULIC CHUCK AND CYLINDER WITH GRIPPING CONFIRMATION

(1) Solid Chuck



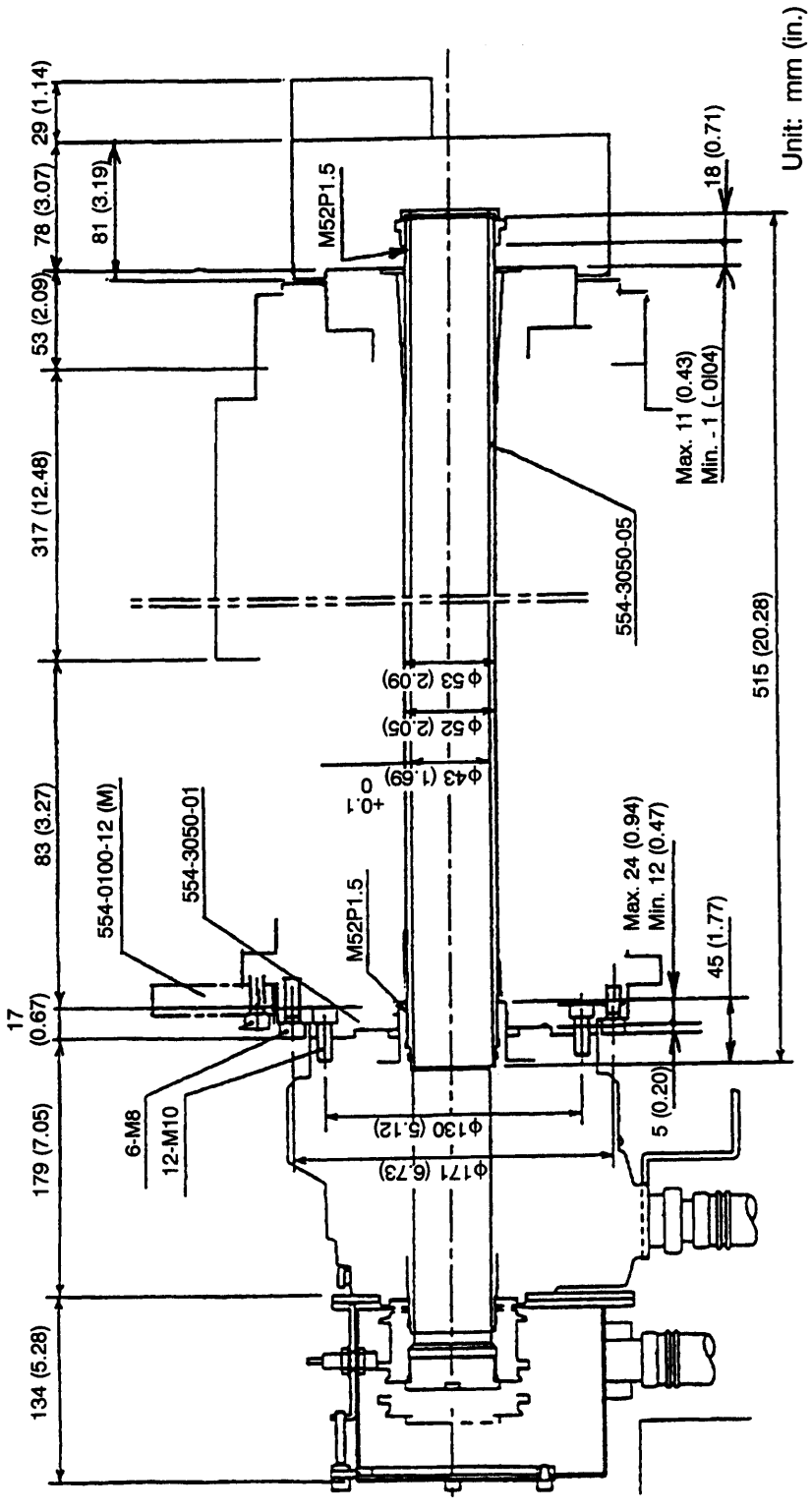

| Specifications When the Chuck and the Cylinder and Combined | |
|---|---|
| Type of Chuck | N-06-LB + Y1020R |
| Max. Speed | 5000 min$^{-1}$ {rpm} |
| Plunger Travel | 20 mm (0.79 in.) |
| Jaw Travel (in diameter) | 8.5 mm (0.335 in.) |
| Gripping Force per Jaw | 51.5 kN [5250 kgf/cm$^2$ (74655 psi)] |
| Pressure | 2.4 MPa [24.8 kgf/cm$^2$ (352.7 psi)] |
| Thrust | 17.7 kN [1800 kgf (3960)] |

| Chuck Specification | |
|---|---|
| Type of Chuck | N-06-LB |
| Max. Speed | 5000 min$^{-1}$ {rpm} |
| Allowable Thrust | 18 kN [1800 kgf (3960 lbf)] |
| Plunger Travel | 20 mm (0.79 in.) |
| Jaw Travel (in diameter) | 8.5 mm (0.335 in.) |
| Gripping Force per Jaw | 51 kN [5250 kgf/cm$^2$ (74655 psi)] |
| Weight | 13 kg (28.6 lb) |

| Cylinder Specification | |
|---|---|
| Type of Cylinder | Y1020R |
| Max. Speed | 6000 min$^{-1}$ {rpm} |
| Piston Thrust | 28 kN [2900 kgf (6380 lbf)] |
| Piston Travel | 20 mm (0.79 in.) |
| Max. Pressure | 3.9 MPa [40.0 kgf/cm$^2$ (568.8 psi)] |
| Weight | 7.1 kg (15.62 lb) |

Fig. 6-23 Chuck Mounting Drawing - Solid Chuck

(2) Hollow Chuck




| Specifications When the Chuck and the Cylinder and Combined | |
|---|---|
| Type of Chuck | B206-01 + S1243-01C |
| Max. Speed | 6000 $min^{-1}$ {rpm} |
| Plunger Travel | 12 mm (0.47 in.) |
| Jaw Travel (in diameter) | 5.5 mm (0.217 in.) |
| Gripping Force per Jaw | 57 kN [5812 kgf/cm2 (82846 psi)] |
| Pressure | 2.7 MPa [27.3 kgf/$cm^2$ (388.2 psi)] |
| Thrust | 22.0 kN [2243 kgf (4934.6 lbf)] |

| Chuck Specification | |
|---|---|
| Type of Chuck | B206-01 |
| Max. Speed | 6000 $min^{-1}$ {rpm} |
| Allowable Thrust | 22 kN [2243 kgf (4934.6 lbf)] |
| Plunger Travel | 12 mm (0.47 in.) |
| Jaw Travel (in diameter) | 5.5 mm (0.217 in.) |
| Gripping Force per Jaw | 57 kN [5812 kgf/$cm^2$ (82846 psi)] |
| Weight | 12 kg (26.4 lb.) |

| Cylinder Specification | |
|---|---|
| Type of Cylinder | S1243-01C |
| Max. Speed | 7000 $min^{-1}$ {rpm} |
| Piston Thrust | 33 kN [3365 kgf (7403 lbf)] |
| Piston Travel | 12 mm (0.47 in.) |
| Max. Pressure | 4.0 MPa [41 kgf/$cm^2$ (583.0 psi)] |
| Weight | 13 kg (28.6 lb) |

Fig. 6-25 Chuck Mounting Drawing - Hollow Chuck

# 7. HYDRAULIC CIRCUIT DIAGRAM

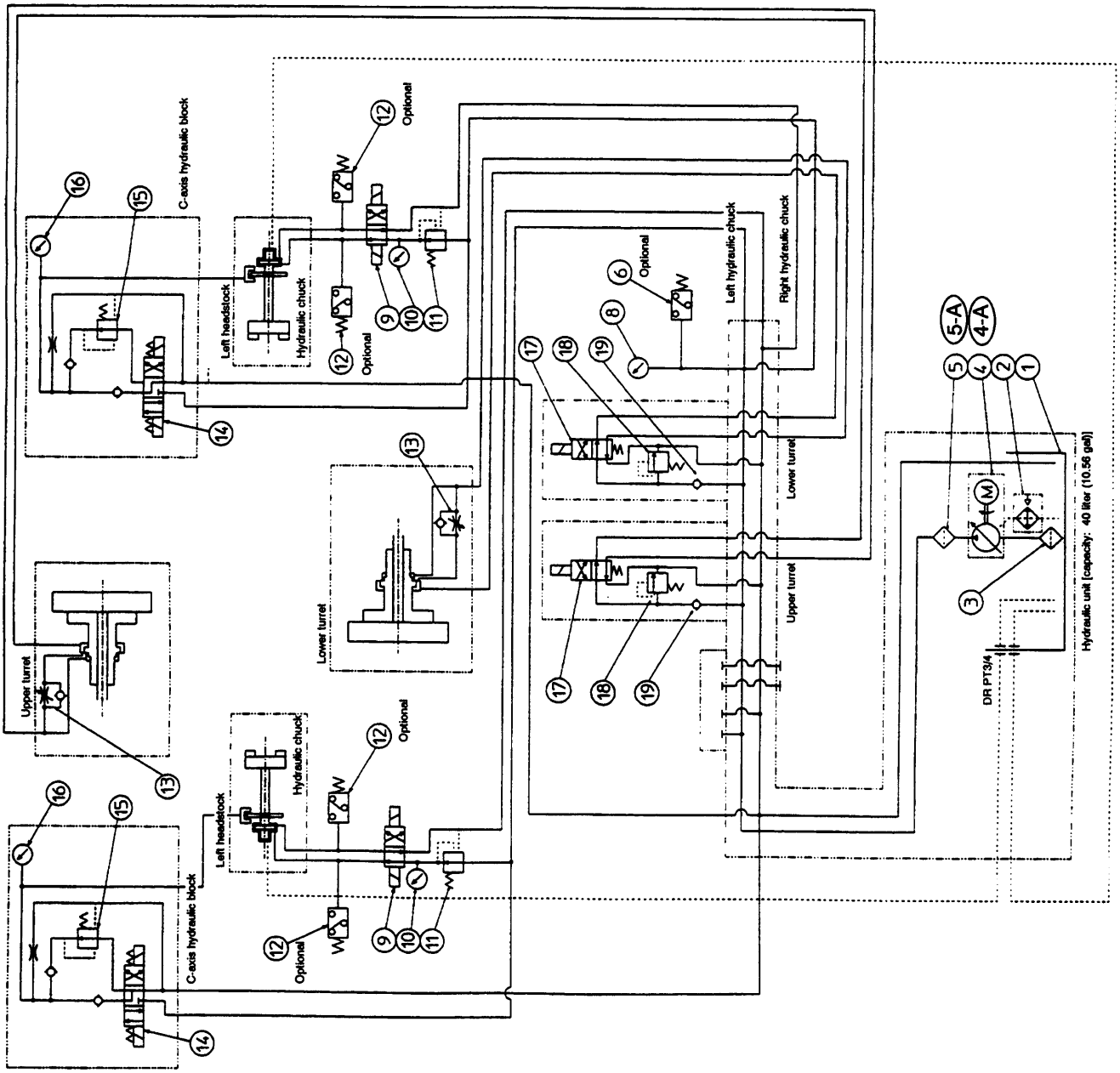



Fig. 6-1 Hydraulic Circuit Diagram

*Note 1: Pressure switches (No. 6 and 12) are optional.*

*Note 2: C-axis hydraulic block is used for the M specification.*

*Note 3: Set pressure of No. 18 relief valve: 5.59 MPa {57 kgf/cm$^2$ (810.54 psi)}*

| No. | Part Name | Use | Maker/Type | Okuma Part No. |
|---|---|---|---|---|
| 1 | Oil tank | Hydraulic unit | OE | |
| 2 | Radiator | Hydraulic unit | W307-01 (Koyo) | H0110-0004-59 |
| 3 | Suction filter | Hydraulic unit | YMD-60615 (Daiei) | H0032-0005-74 |
| 4 | Hydraulic pump | Hydraulic unit | VPVC-F26 (Kitatomi) | H0110-0004-60 |
| 5 | Line filter | Hydraulic unit | TD04-10 (Yamashin) | H0032-0009-94 |
| 6 | Pressure switch | Hydraulic unit | CP20-213 (Nagano Keiki) | E3040-539-056 |
| 7 | | | | |
| 8 | Pressure gauge | For source pressure confirmation | GV50-173 (Nagano Keiki) | T019-400-005-23 |
| 9 | Solenoid valve | Chuck open/close | S-G01-B3X-GRZ-D2-32 (Nachi) | F0000-431-000-19 |
| 10 | Pressure gauge | Chuck pressure | ADGU-60 × 70 K × 1000 PSI (Yodogawa Keiki) | T019-400-004-01 |
| 11 | P-port reducing valve | Chuck gripping force adjustment | OG-G01-PC-K-20 (Nachi) | F0011-730-000-06 |
| 12 | Pressure switch | Chuck pressure | CP20-223 (Nagano Keiki) | E3040-539-034 |
| 13 | Throottle valve | Clamp speed adjustment | (Okuma) | |
| 14 | Solenoid valve | C-axis brake pressure selection | S-G01-C6-GRZ-D2-30 (Nachi) | F0000-445-000-04 |
| 15 | B-port recucing valve | Low-pressure brake | OG-G01-B1-K-12 (Nachi) | F0011-740-000-20 |
| 16 | Pressure gauge | Brake pressure | GV50-123 (Nagano Keiki) | T019-400-003-34 |
| 17 | Solenoid valve | Turret clamp/ unclamp selection | SL-G01-A3X-GR-D2 (Nachi) | F0001-431-000-83 |
| 18 | Relief valve | Turret clamp/ unclamp selection | MR-02P-1-50 (Daikin) | F0010-930-000-03 |
| 19 | Chuck valve | Turret clamp/ unclamp selection | MC-02P-05-50 (Daikin) | F0040-981-000-17 |
| 4-A | Hydraulic motor | Hydraulic unit | 100 L 2.2 kw (Toshiba) | H0110-0004-66 |
| 5-A | Filter element | Hydraulic unit | PX040A (Yamashin) | H0032-0009-96 |

# LIST OF PUBLICATIONS

| Publication No. | Date | Edition | |
|---|---|---|---|
| 4039-E | June 1996 | 1st | |
| 4039-E-R1 | December 1996 | 2nd | B |
| 4039-E-R2 | April 1997 | 3rd | B |
| 4039-E-R3 | June 1997 | 4th | B |
| 4039-E-R5 | May 1998 | 6th | A (U100L) |
| 4039-E-R6 | October 1998 | 7th | B |

This manual may be at variance with the actual product due to specification or design changes.
Please also note that specifications are subject to change without notice.
If you require clarification or further explanation of any point in this manual, please contact your OKUMA representative.

This product is subject to Japanese government regulations under the Foreign Exchange and Foreign Trade Control Act with regard to strategic goods. When further transport of this product to another country is being considered, prior consultation with OKUMA Corporation is required.