



NC Lathe

TT-2600

INSTRUCTION MANUAL

Please read each manual and
understand contents enough.
Then keep these manuals handy for
answers to any questions you may
have and to check.

MACHINE TOOLS
TAKISAWA



PREFACE

As the owner of this TT-2600 of NC Lathe you have a product supreme in its class which will maintain its high standard of performance throughout many years of use, with the minimum of attention. This manual will help you to install the machine completely and execute machine functions sufficiently. Understand each mechanism and maintain the machine carefully.

Make an optimum program so that the NC Lathe will machine the workpiece correctly and also, standardize a setup method so as to cope with variously different workpieces at a minimum set-up change.

The following manuals are attached to this manual.

Also, carefully read the manuals of the control unit maker and each attachment maker, and understand their contents to operate the machine well.

Keep these manuals handy for answers to any questions you may have and to check before calling the serviceman if service becomes necessary.

If you have any questions or thoughts you would like to share with us-we would like to hear from you.

Instruction Manual List

- * MACHINE INSTRUCTION MANUAL
(GANTRY LOADER MACHINE INSTRUCTION MANUAL)
- * OPERATION MANUAL (GANTRY LOADER OPERATION MANUAL)
- * PROGRAMMING MANUAL
- * TOOLING MANUAL
- * ADJUSTMENT AND INSPECTION OF WORKPIECE FEEDER (CHAIN TYPE)
- * PARTS LIST

NC Lathe
TT-2600

SAFETY GUIDE

XZ04010-101

Please read each manual and understand contents enough. Then keep these manuals handy for answers to any questions you may have and to check.

MACHINE TOOLS
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IMPORTANT NOTICE

- Be sure to read each instruction manual before operating the machine.
Be sure to observe the safety precautions in the instruction manuals and the contents of warning labels adhered to the machine. If ignored, an accident resulting in injury or death or machine malfunction may be caused.
There are many [DISABLE] or [MUST NOT DO] conditions.
Unless [ABLE] is written in the instruction manual, consider it [DISABLE].
- Some illustrations in the instruction manual are given without cover or door to illustrate the detailed parts. In actual operation, it is necessary to mount the cover or door.
- Keep instruction manuals handy for ready reference as it will help you operate the machine and equipment to their full advantage.
- When any instruction manual is required again, contact your agent with the number of the instruction manual (or model name, manual name).
- Japanese laws prohibit this machine from being used to develop or manufacture "weapons of mass destruction" or "conventional arms", as well as from being used to process parts for them.
Export of the product may require the permission of governmental authorities of the country from where the product is exported.
Should you wish to resell, transfer or export the product, please notify Takisawa Machine Tool Co., Ltd. or our distributor in advance.
- Observe the laws and regulations established by the national and local governments.
- Observe the laws and regulations established by the national and local government for disposal of machines and waste oil.

- Software copyright is held by us.
- No part of the software is allowed to use, copy, or modify without written permission of us.
- This instruction manual is copyrighted, and all rights are reversed. No part of the drawings and technical descriptions contained in this instruction manual may be disclosed, photocopied, translated to another language or copied to any readable electronic devices and apparatus without the prior written consent.
- The contents in this instruction manual are subject to change without notice.
- All brand names and product name listed in this instruction manual are trademarks or registered trademarks of their respective companies.
- This instruction manual is prepared for native English-speakers. When the machine is operated by non-native English speakers, please provide safety instruction for the operators by customers. In addition, please provide warning labels in their native language.
- Be sure to attach this instruction manual in case of reselling this machine.
- The manual is written for people who have a basic knowledge of machine tools.
TAKISAWA disclaims all responsibility for damage or accidents arising due to people with insufficient knowledge or training with machine tools, attempting to operate, maintain or program said tools.
- When replacing the parts, use the parts specified by company.
TAKISAWA disclaims all responsibility for damage or problems occurring due to using parts other than those specified.
If the specified parts are not used, not only the machine function is reduced but also safety is compromised, thus possibly causing an accident resulting in injury or death or machine malfunction.

- There are many kinds of coolants.

Though TAKISAWA does not specify the coolant, select the coolant by consulting with maker about the following items.

TAKISAWA disclaims all the responsibility for trouble incurred by the coolant.

- Contact us for requesting an installation, modification, and specification change, and dismantlement of the machine. If the machine is installed, modified, or its specification is changed by customer, not only the performance of the machine may be lost but also the safety of the customer may not be secured.

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1 PRECAUTIONS FOR SAFETY

This machine is equipped with a variety of safety equipment for the purpose of protecting the user and the machine from dangers arising from an expected accident.

Careless operation or misuse of the machine may result in an accident.

Therefore operators should thoroughly read the instruction manuals of company and control unit makers before carefully operating and maintaining the machine.

If there is any function that is not explained in the manual for this machine, please do not hesitate to contact our technical service department.

The instruction manuals packed together with this machine are as follows.

(1) MACHINE INSTRUCTION MANUAL

(GANTRY LOADER MACHINE INSTRUCTION MANUAL)

(2) OPERATION MANUAL (GANTRY LOADER OPERATION MANUAL)

(3) PROGRAMMING MANUAL

(4) TOOLING MANUAL

(5) PARTS LIST

(6) ELECTRIC DIAGRAM

(7) LADDER DIAGRAM

(8) NC Operation manual

(9) NC Maintenance manual

2 DEFINITIONS AND DANGER OF WARNING SYMBOLS

2-1 Warning

The degree of danger is classified in the order of DANGER, WARNING and CAUTION.

DANGER is the highest level.



Indicates an imminently hazardous situation, which will result in death or serious injury.



Indicates a potentially hazardous situation, which can result in death or serious injury.



Indicates a potentially hazardous situation, which may result in minor or moderate injury and property damage if proper safety procedures and instructions are not adhered to.

The contents described for precautions must be securely observed for the machine operation and maintenance. If ignored, there is a danger of serious injury or damage to operators or machine.

For handling the machine, be sure to follow the instruction.

2-2 Notices

NOTICE

Instructions for acquiring information and avoiding errors or mistakes.

3 WARNING LABELS

3-1 Precautions for warning labels

- (1) Since the warning label is adhered to each part of machine for performing the work safely, understand the contents of warning labels sufficiently before operating the machine.
- (2) Keep the warning labels clean so as to be clearly visible.
If any label is stained, wipe it clean.
- (3) Never remove the warning label.
If it is removed, adhere it again to the original position.
- (4) Don't adhere or mount any thing on the label or coat the label with other paints.
- (5) The warning label is made considering durability.
However, if it is hard to read or it is lost, please place an order for the required label by sending the number written on the right lower of warning label to the following address.
A new label may be sent.

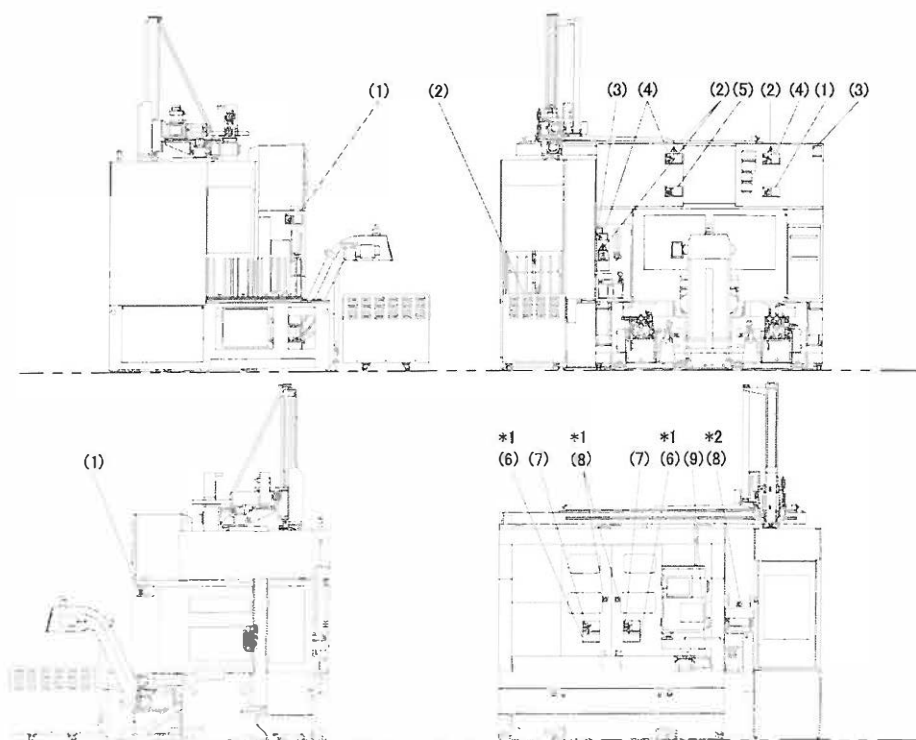
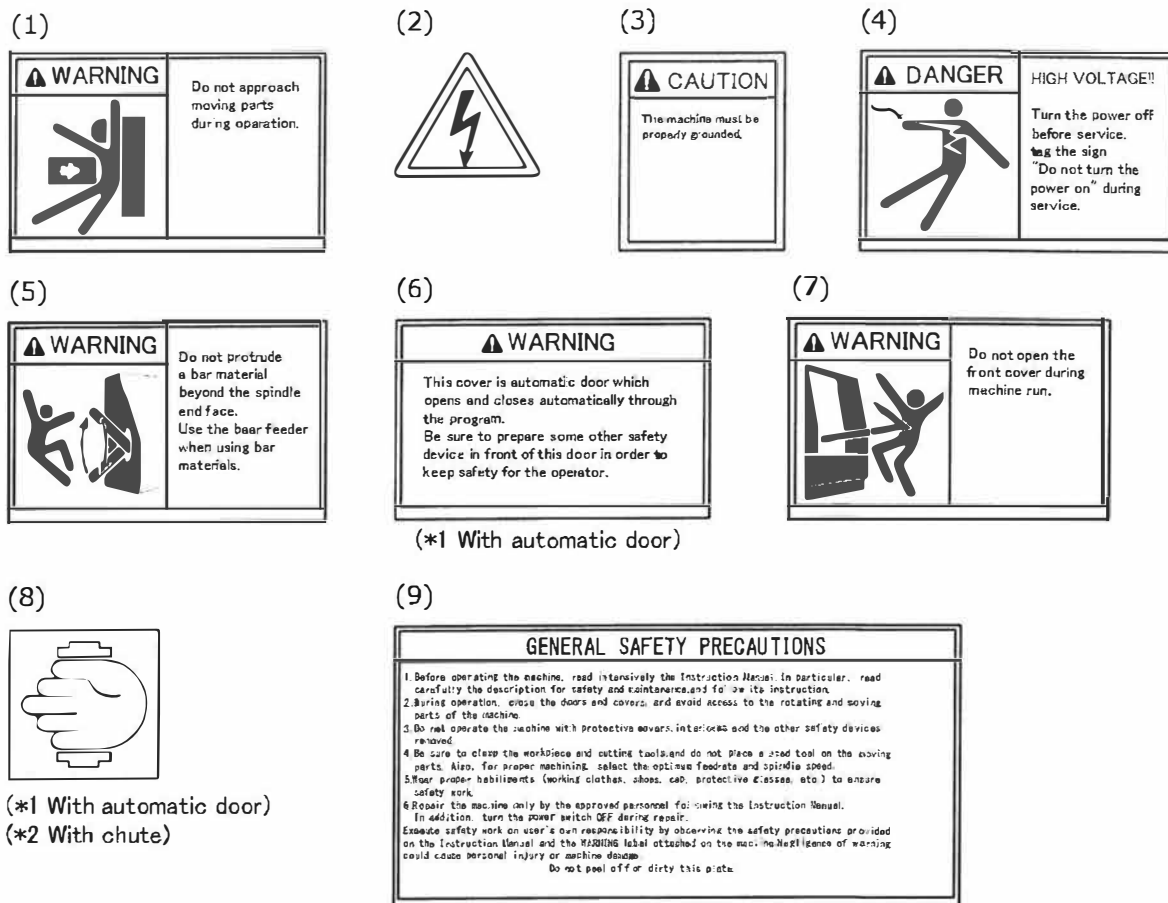
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3-2 Mounting positions of warning labels



4 BASIC PRECAUTIONS



- (1) Understand the contents of warning labels adhered to the machine and observe the instructions.

If the instructions of warning labels are not observed or the machine is used without understanding the contents of warning labels, the machine may be misused or miss-operated, thus possible causing an accident resulting in injury or death or machine malfunction.

- (2) Do not touch the inside of control panel, transformer, motor or relay box as high voltage terminals are contained. If you touch the high voltage terminal, there is a danger of an electric shock.

- (3) Do not touch switches with set hands. If an earth wire fails or leaks out, there is a danger of an electric shock.

- (4) Do not remove or modify the safety units.

If any safety unit is damaged, be sure to contact our Technical Service Dept.

If the machine is operated with the safety unit removed or modified, the machine may malfunction, thus possibly causing an accident resulting in injury or death.



- (5) When performing a joint work by two or more of persons, sign and confirm each step of work.

With the machine maintained on the inside of machine or around the machine, when the machine is started carelessly, an accident resulting in injury or death may be caused.



- (1) When the loading units of robot, etc., may be mounted onto the machine at site, be sure to provide a [SAFETY FENCE] for safety around the loading units.

Mount the [SAFETY SWITCH WITH LOCK] to the door of safety fence so as not to open the door when the loading units and the machine are in operation.

Adhere the warning label on the door or around the door so as to warn workers.

If the door of safety fence is opened while the machine is operating, command an emergency stop mode in order to stop the loading units and the machine immediately.

- (2) In the machine with an automatic door, when there is a possibility that any person will enter in a hazardous area during automatic operation, provide [SAFETY UNIT] additionally at the user side to prohibit the door OPEN/CLOSE.

Since the terminal board is provided inside of control panel so as to prohibit the door OPEN/CLOSE, route the wire for the safety unit.

The hazardous area means all around the front face of automatic door and the movable part of additional equipment near this machine, thus, the area where an accident resulting in injury or death may be caused.



- (3) When a highly inflammable workpiece or coolant is used, consider a cutting condition and provide enough fire extinguishing appliances.

If the machine ignites for any reason, there is a danger of an accident resulting in injury or death or machine malfunction.

- (4) If the workpiece that harmful matter occurs is handled, wear personal protective equipment and arrange circumference facilities, as there is a danger of worker's health.

- (5) Remember the position of [Emergency stop switch] so as to operate it reflex whenever any emergency occurs.
The [Emergency stop switch] is provided to stop all actions of machine in emergency.

If there is any obstruction in the front of [Emergency stop switch] the switch cannot be pressed in the emergency situation, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (6) Turn OFF power before replacing the fuse.

If the fuse is replaced with power ON, there is a danger of an electric shock.

- (7) Confirm the positions and functions of switches in order to operate them without fail.

If touched to incorrect switch, the machine may malfunction, thus possibly causing an accident resulting in injury or death or machine malfunction.



- (8) Do not touch the switch unconsciously.

The machine may malfunction, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (9) The facility manager shall save and manage the keys of [Edit switch] and [Front door interlock switch], etc.

- (10) When working, observe circumstances to keep enough space where workers can work in safety.

If any worker loses balance in adequate space, an accident resulting in injury or death may be caused.

- (11) Keep conditions in order and clean the floor so as not to place any obstruction and water or oil on the floor around the machine where someone might slip and an accident resulting in injury or death may be caused.

- (12) If the machine stops because of power interruption, turn OFF the main breaker immediately.

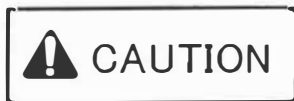
If the power is not turned OFF, the machine may malfunction, thus possibly causing an accident resulting in injury or death or machine malfunction when the power interruption is released.



- (13) Since the parameters, volumes and other electric set values have already been set in accordance with each specification before shipping the machine, do not change them without due cause.

If it is necessary to change them, be sure to contact our Technical Service Dept.

If they are changed without due cause, the machine may malfunction, thus possibly causing an accident resulting in injury or machine malfunction.



- (1) Place the stable bench having enough strength on around the machine. Also, consider providing the non-slip mechanism on the matter-placed surface.

If the unstable bench is used, the workpiece and tool may fall, there is fear of worker's injury.

- (2) Use the specified hydraulic oil, lubrication and grease or equivalent to them.

Do not use the oil mixed with impurities or deteriorated oil as the machine may malfunction.

- (3) When replacing the fuse with a new one, use the fuse with the correct rated current.

- (4) Do not shock the NC unit, operation panel or enclosure because machine trouble or miss-operation may be caused.



- (5) Do not splash water on the NC unit, operation panel or enclosure, and also don't let dust get into the unit, panel or enclosure.

Be sure to close the doors and covers because the machine may malfunction if water or dust enters the unit, panel or enclosure.

5 PRECAUTION IN MACHINE INSTALLATIONS

5-1 Environment of installation place



- (1) Keep conditions in order and clean the floor so as not to place any obstruction, water or oil on the floor around the machine where someone might slip causing an accident resulting in injury or death.



- (1) Secure the draft and maintenance area of chip conveyor and chip box.

If sufficient maintenance area is not secured, adequate maintenance work becomes impossible and may have a harmful influence upon the machine service life.

- (2) Install the machine and NC unit in a place where they are not exposed to direct sunlight.

If the machine is exposed to direct sunlight, the heat displacement by machine temperature rise may have a harmful influence upon machining accuracy.

- (3) Install the machine in a place which is free of a heat source (ambient temperature : 0~35 degrees) and dewdrop (humidity : 75% RH or less) to prevent the machine from malfunctioning due to problems in the electric system of the machine or peripheral equipment.



- (4) Install the machine away from vibration (0.5G or more) to avoid machine malfunction.

And also, it may have a harmful influence upon machining accuracy.

- (5) Install the machine on the ground where there is an adequate strength and no slope and unevenness.

If the machine is installed on uneven ground, machine twisting may result in impaired accuracy.

- (6) Many cooling fans are provided inside the machine.

Therefore, install the machine in a place free from dust, mist, etc.

If the dust, mist, etc., does enter, insufficient cooling may occur resulting in machine malfunction.

5-2 Input power supply



- (1) Be sure to entrust power work to the experts in electric work. If any person who has not sufficient experience relative to safety for electric work performs the electric work, there is a danger of electric shock.

- (2) Power cables and wires shall be covered with strong insulation covers. Check that power cables and wires are safely covered before starting the machine.

If the covers of power cables or wires are damaged, there is a danger of electric shock.



- (1) For machine power, route the wire directly from the input power supply.

If the power voltage drops excessively because of insufficient capacity of shop power, the machine may be miss-operated, thus possibly causing an accident resulting in injury or death or machine malfunction.

Concrete data

- 1) Nominal power voltage is (AC 200/220V) +10%~-10%
- 2) Frequency is (50/60Hz) +1Hz~-1Hz.
- 3) Voltage instantaneous interruption is 10mm sec., or less.
- 4) Voltage impulse at peak value of effective value (rms value) of line voltage is 1.5mm sec., or less.
- 5) Alternating current power voltage is 7% or less of wave strain.
- 6) Unbalance of line voltage is 5% or less.



- (2) Install the machine where noises of electric welders, electric discharge machines, etc., do not occur.
- If a stable voltage is not supplied, the machine is miss-operated, thus possibly causing an accident resulting in injury or death or machine malfunction.

5-3 Earth



- (1) Use the earth wire as short as possible and same size as input wire.

Earth of class D Earth resistance 100 ohm or less

There is a danger of an electric shock because the earth wire fails.



- (1) Ground the earth wire independently without using the earth wires of electric welder, electric discharge machine, etc.

If not done, the machine is miss-operated by noises from other equipment, thus possibly causing an accident resulting in injury or death or machine malfunction.

5-4 Compressed air



- (1) Connect the air hose securely.

If the hose is disconnected, it may cause injury.

- (2) When the machine is equipped with the compressor, the supply volume of compressed air is to be greater than the specified value.

If the compressed air supply is less than the specified value, the compressor is miss-operated, thus possibly causing the machine malfunction.

- (3) Use clean and dry compressed air.

If the moistened air or air mixed with dust is used, the compressor is miss-operated, thus possibly causing the machine malfunction.

5-5 Precautions in machine installation



(1) Any qualified persons for crane and slinging work shall perform the hoisting work of crane. If any persons who have insufficient knowledge relative to crane safety and slinging work perform the crane and slinging work, it may cause an accident resulting in injury or death or machine malfunction.

(2) When hoisting the machine, use the wire ropes, shackles, hoisting jigs capable of with standing the machine weight sufficiently at specified sizes.

If the machine is hoisted by attachments, which cannot withstand to the machine weight, the machine may fall, thus possibly causing an accident resulting in injury or death or machine malfunction.

(3) Check that each required part is fixed before hoisting the machine. If the machine is hoisted with each part inadequately fixed, the machine may be damaged.

(4) Check that any tool, waste, etc., are not left inside of machine before hoisting the machine because the tool, etc., may fall from the machine and may cause an accident resulting in injury or death or machine malfunction.



- (5) Check the machine balance by hoisting a little and watching the balance in cross and longitudinal directions. If the machine is hoisted with the machine unbalanced, the machine may fall and there is a danger of an accident resulting in injury or death or machine malfunction.

- (6) When performing a joint work by two or more of persons, sign and confirm each step of work.

With the machine maintained on the inside or around the machine, when the machine is started carelessly or the crane is operated, an accident resulting in injury or death may be caused.



- (1) If rust preventives are coated on the slideway, remove it completely.

If the rust preventives are not completely removed, a servo alarm occurs after turning power ON.

- (2) The fixtures are mounted on the machine for transportation.

Be sure to remove them before turning the power ON.

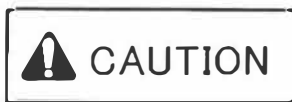
If the axis is moved with fixtures for transportation mounted, the machine may be damaged.

- (3) Be sure to level the machine after installation and adjust the machine so that crown or torsion of machine is within values of inspection result table packed together with the machine. Machining the workpiece with the machine level incorrectly adjusted may have a harmful influence upon machining accuracy.

5-6 Checking items before first turning ON power



- (1) Check the voltage and phase sequence of input powers, L1, L2 and L3. If the phase sequence is mistaken, the machine will malfunction, with a danger of an accident resulting in injury or death or machine malfunction.



- (1) Check that bolts on each part are completely tightened.
If the machine is operated with bolts incompletely tightened, the machine may be damaged.

- (2) Check that each connector is completely connected.
If the machine is operated with each connector incompletely connected, the machine may be damaged.

- (3) Check that hydraulic piping and pneumatic piping are completely tightened.
If the machine is operated with piping incompletely tightened, the hydraulic oil and compressed air leak out with the power on, thus possibly causing the machine malfunction.

- (4) Check that wiring and piping for external attachments (loader, robots, etc.) of particular specifications are correctly connected.
If the external attachments or machine are operated with the wiring and piping incorrectly connected, the external attachments or machine may be malfunctioned.

5-7 Checking items after first turning ON power



- (1) Check that oil does not leak and the indication of each instrument is correct.

If the machine is operated under the conditions that the oil leaks and each instrument does not indicate a correct value, there is a danger of an accident resulting in injury or death or machine malfunction.

- (2) To prevent the seizure of chuck cylinder, clamp and unclamp the chuck several times and check that jaws are securely tightened before the running in of spindle.

If the chuck cylinder is sized, the clamping force of chuck reduces and the workpiece may fly or scatter when the spindle is rotated, thus possible causing an accident resulting in injury or death or machine malfunction.



- (1) To protect the slideway, operate the lubrication pump manually without operating the machine promptly in order to supply lubrication to the slideway.

If the axis is traveled under the condition that the lubrication is not supplied, the slideway and ball screw may be worn, sized and the machine may malfunction.

- (2) Remove all fixed metals, which are not removed before power supply is not turned ON.



- (3) Perform the running in enough to avoid the spindle from seizure.

Separate the spindle speed to 5 stages from low speed to high speed and rotate the spindle 20-minute by 20-minute in order from the lower speed.

If the running in is insufficient, it may have a harmful influence upon the machine service life and machining accuracy.

6 PRECAUTIONS IN POWER ON/OFF



- (1) When the machine is operated, check that any person or obstruction is not in the inside of protection cover and around the rotary part and movable part.

When working by two or more workers, give a signal or make a sign each other.

If any person touches or approaches the rotary part or movable part during operation, an accident resulting in injury or death may be caused.



- (1) If the machine stops because of power interruption, turn the main breaker OFF immediately.

If the power is not turned OFF, the machine may malfunction when the power interruption is released, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (2) If there is a possibility that the power voltage varies remarkably because of lightning, stop the machine and turn the power supply OFF.

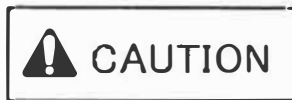
Supply the correct power to operate the machine correctly.

If the power supply is turned OFF because of power interruption or lightning during operation, the machine may malfunction when the power interruption is released, thus possibly causing an accident resulting in injury or death or machine malfunction.



- (3) Check that the value of each instrument (hydraulic, lubrication, air, etc.) is correct.

If the machine is operated under the conditions that oil leaks or each instrument does not indicate a correct value, an accident resulting in injury or death or machine malfunction or damage may be caused.



- (1) When pressing [Operation ready ON switch] on the operation panel, check that the [Operation ready ON switch] lights.

- (2) Check that each fan is correctly run after turning the power supply ON.

If the machine is operated under the condition that each fan is incorrectly run, the machine may malfunction or damage because the heat inside of machine cannot be exhausted.

- (3) Check that the slideway lubrication pump is correctly operated after the power is turned ON.

If the machine is operated under the condition that the pump is incorrectly operated, the machine may malfunction or damage because the lubrication cannot be supplied to the slideway.



- (4) To protect the slideway, operate the lubrication pump manually without operating the machine promptly in order to supply lubrication to the slideway.

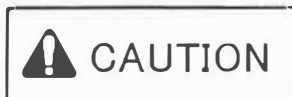
If the axis is traveled under the condition that the lubrication is not supplied, the slideway and ball screw may be worn, seized and the machine may malfunction.

- (5) Turn OFF the power in order of the following items.

- 1) [Emergency stop switch]
- 2) [Operation ready OFF switch] on the operation panel.
- 3) Main breaker (non-fuse breaker).

If the main breaker is immediately turned OFF during machine operation, the machine may malfunction thus possibly causing an accident resulting in injury or death or machine malfunction.

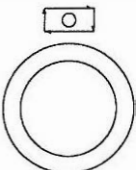
- (6) When leaving from the machine due to work interruption, turn the power supply OFF.

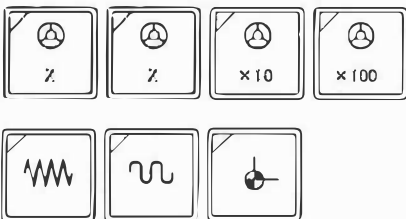


(7) When stopping the machine during automatic operation, press the switch to serve its purpose among the following methods.

1)  When pressing the [Emergency stop switch] on operation panel, all function stop.

2)  When pressing the [Reset key] on MDI panel, all function stop.

3)  When pressing the [Feed hold switch] on operation panel, automatic operation stops.

4) 

When pressing the [Manual operation mode select switches] automatic operation stops.

5)  Press [Operation ready OFF switch].

7 PRECAUTIONS IN SET-UP CHANGES



- (1) Do not touch switches with wet hands.

If earth effect is inadequate or current leaks, there is a danger of an electric shock.



- (1) The operator who is sufficiently trained shall operate the machine only alone.

When working by two or more workers, give signal or make a sign each other.

While any worker is replacing the workpiece, jaw, jig, tool, etc., if another person will operate the machine, there is the danger of an accident resulting in injury or death involving workers or persons around the machine.

- (2) Turn OFF the power when the set-up work is performed.

If workers must be with the power supply ON unwilling, set the switches on the operation panel to the following positions in order to secure workers' safety.

- 1) Press the [Handwheel feed mode select switch] for mode select switches.
- 2) Unclamp the chuck.
- 3) Set [Spindle override manual] to the lowest speed (1%).
- 4) Set both [Feedrate override select dial] and [Rapid traverse override select switch] to LOWEST each other.



- (3) Arrange clothes and bind hair so as not to be caught in the machine.

Also, be sure to wear safety shoes and safety goggles.

Do not operate the machine with gloves put on.

Long hair, slovenly clothes, gloves may cause an accident resulting in injury or death.

- (4) Workers shall never stand in the rotary direction of spindle and other parts, and also, never allow the human body to approach in the rotary direction of chuck.

Especially, the workpiece, tool and jaw may project or fly during set-up and machining, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (5) When using the chuck and jig, which are manually tightened, be sure to remove the chuck the handle and tightening tool after tightening.

If the spindle is rotated with the chuck handle and the tightening tool set, the chuck handle and the tightening tool protrude or fly through air, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (6) In spindle speed, command a lowest speed among allowable speeds of chuck, cylinder and jig.

If this is not observed, the workpiece may fly or scatter while machining, thus possibly causing an accident resulting in injury or death or machine malfunction.



- (7) Set the chuck pressure to values corresponding to machining conditions.

If not done, the workpiece may fly or scatter while machining, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (8) Clamp the workpiece and tool securely.

Start the in feed and feed for cutting from a low stage.

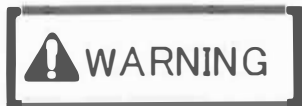
If not done, the workpiece may fly or scatter while machining, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (9) Examine the material and form of workpiece sufficiently before selecting an optimum tool.

If not done, the workpiece may fly or scatter while machining, thus possibly causing an accident resulting in injury or death or machine malfunction, and also, it may have a harmful upon machining accuracy.

- (10) Check that the workpiece is securely clamped.

If the workpiece is inadequately clamped or it is incorrectly supported, the workpiece may fly when the spindle is rotated, thus possibly causing an accident resulting in injury or death or machine malfunction.



- (11) Check that the holder, tool and jaws are securely fixed.

Also, take care so that they interfere with the workpiece and the main machine body. If they are incompletely fixed, the workpiece may fly or scatter while machining, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (12) Check the positions and functions of switches and operate them without fail.

If any operator touches different switches, the machine may malfunction, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (13) When rotating the spindle manually, rotate the spindle from the lowest speed (1%) of [Spindle override manual]. Also, turn to the lowest speed (1%) when stopping the spindle.

If the spindle is rotated at a high-speed form beginning, the workpiece and jaws may fly and scatter, thus possibly causing an accident resulting in injury or death or machine malfunction.



- (1) When loosening the bolt, make preparations to turn it.

The worker may lose balance when the bolt is loosened, thus possibly causing an injury.

Also, don't tighten the bolts more than they are needed.

- (2) Mount the cutting tool to the slide carefully so that the cutting tool will not interfere with any obstruction.

8 PRECAUTIONS IN MACHINE OPERATION



- (1) When operating the machine, check that any person or obstruction is not in the inside of protection cover and around the rotary part and movable part.

When working by two or more workers, give a signal or make a sign each other.

If any person touches or approaches the rotary part or movable part during operation, an accident resulting in injury or death may be caused.

- (2) Do not touch switches by wet hands.

If an earth wire fails or leaks out, there is a danger of an electric shock.

- (3) Be sure to turn the power supply OFF before working inside of machine because of set-up work, inspection, cleaning etc.

To prevent that any person turns on the power supply by mistake, put the notice board of [Machine work in progress] or [Maintenance work in progress].

If worked with power supply on, there is a danger of electric shock or an accident resulting in injury or death since the machine may be operated for any reason.



(1) Do not rotate the spindle with the cylinder cover or rear cover removed because an accident resulting in injury or death may be caused.

(2) When machining the bar longer than the spindle length, be sure to use the bar feeder.

Do not insert the bar into the spindle hole during spindle rotation because the bar may be bent and an accident resulting in injury or death may be caused.

(3) Be sure to close the front cover during machine operation.

If the machine is operated with the front cover opened, an accident resulting in injury or death may be caused as a rotary part or movable part is uncovered.

Also, because the workpiece, jaws, etc., may fly and chips or coolant scatters or splashes, an accident resulting in injury or death or machine malfunction may be caused.

(4) Do not discharge chips with the front cover opened and touch the workpiece and tool during spindle rotation.

If touched to the workpiece or tool during machine operation, an accident resulting in injury or death may be caused.

Also, any worker may injury by the chip wound onto the workpiece.



- (5) Workers shall never stand in the rotary directions of spindle and other parts, and also, never allow the human body to approach in the rotary direction of chuck.

Especially, the workpiece, tool and jaw may project or fly during set-up and machining, it may cause an accident resulting in injury or death or machine malfunction.

- (6) Do not operate the machine with covers removed.

Because the rotary part and movable part are uncovered, an accident resulting in injury or death may be caused.

Also, because the inside of machine may be covered with dust and splashed with coolant, thus possibly causing the machine malfunction.

- (7) Do not remove and modify the safety units.

If any safety unit is damaged, be sure to contact our Technical Service Dept.

If the machine is operated with the safety unit removed or modified, the machine may malfunction, thus possibly causing an accident resulting in injury or death.

- (8) Arrange clothes and bind hair so as not to be caught in the machine.

Also, be sure to wear safety shoes and safety goggles.

Don't operate the machine with gloves put on.

Long hair, slovenly clothes, gloves will cause an accident resulting in injury or death.



- (9) Do not lean on the machine during machine operation.

Especially, in the cover, if the workpiece or jaws are extruded for any reason, because any shock may be directly conducted, thus possibly causing an accident resulting in injury or death.

- (10) In spindle speed, command a lowest speed among allowable speeds of chuck, cylinder and jig.

If this is not observed, the workpiece may fly or scatter while machining, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (11) When the workpiece is replaced with a new one after machining completely, check that the cycle start lamp goes out.

If the program is not finished even if the machining is completed, there is a possibility that the machine is operated as it, thus possibly causing an accident resulting in injury or death.

- (12) Check that the workpiece is securely clamped before rotating the spindle.

When the center is used for workpiece, check that the center supports the workpiece securely.

If the workpiece is inadequately clamped or it is incorrectly supported, the workpiece may fly when the spindle is rotated, thus possibly causing an accident resulting in injury or death or machine malfunction.



- (13) Set the chuck pressure to values corresponding to machine conditions.

If not done, the workpiece may fly or scatter while machining, thus possibly causing an accident resulting in injury or death or machine malfunction.

Also, the deformation of workpiece may be caused.

- (14) When the chip conveyor is running, don't enter hands or legs inside of conveyor because winding in the chip conveyor may cause an accident resulting in injury or death.

- (15) Clamp the workpiece and tool securely.

Start the infeed and feed for cutting from a low stage.

If not done, the workpiece may fly or scatter while machine, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (16) When the machine is used for an actual cutting, check that [Spindle override automatic] and [Feedrate override select dial] are set correct positions before pressing the [Cycle start switch]. If the machine is started under inadequate conditions, any axis may travel at unexpected speed, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (17) Do not touch switches without due cause during automatic operation because the machine may malfunction, thus possibly causing an accident resulting in injury or death or machine malfunction.



- (18) When rotating the spindle, start it from the lowest speed of [Spindle speed override select dial]. Also, turn the dial to the lowest speed when stopping the spindle.

If the spindle is rotated at high speed from beginning, the workpiece and jaws may fly and scatter, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (19) Do not place the tool, measuring instrument, etc., on the machine movable part or operation panel because they are caught in the movable part, thus possibly causing the machine malfunction. Also, anything falls from the machine, thus possibly causing an accident resulting in injury or death.

- (20) Confirm the positions and functions of switches in order to operate them without fail.

If touched to incorrect switch, the machine may malfunction, thus possibly causing an accident resulting in injury or death or machine malfunction.

- (21) In the machine for special specifications, use the machine according to their specifications. If the machine is misused, the machine may malfunction, thus possibly causing an accident resulting in injury or death.

- (22) Be sure to stop the machine before adjusting the coolant nozzle or replacing the tip. If the machine is adjusted or replaced during operation, there is a danger of an accident resulting in injury or death.



- (1) Check the program number for the first memory operation and operate the machine carefully by using a single block mode without shifting a continuous operation immediately.

- (2) Do not touch chips or tools with bare hands because there is a danger of injury.

9 PRECAUTIONS IN DAILY INSPECTION

9-1 Inspection for start work



- (1) Check the belt tension.

At this time, take care so that the hand will not wound between the belt and pulley.

- (2) Be sure to turn OFF the power supply before inspection.
Take extreme care when inspecting the machine with the power ON unwillingly because an accident resulting in injury or death may be caused.



- (1) Check the value of pressure gauge is correct.

If the pressure is incorrect, the machine may cause damage.

- (2) Check that any noise is not heard from the motor, gearbox and other parts.

If there is any noise, check the cause and cope with its noise clearly.

If the machine is continuously operated, the machine may malfunction.



- (3) Check that lubrication is supplied on each slideway.

If the axis is traveled under the condition that the lubrication is not supplied on the slideway, the ball screw is seized and the slideway will also be worn, thus possibly causing a bad influence on the machine service life and machining accuracy.

- (4) Check that each safety cover is securely closed and the safety unit is effectively functioned.

- (5) Advise facility manager of notice points for inspection.

- (6) Check that the fan inside of enclosure is correctly run.

If the machine is operated under the condition that the fan is incorrectly run, the machine may malfunction or damage because the heat inside of machine cannot be exhausted.

9-2 Warming up



- (1) Perform the warming up of spindle and feed axis before start work and machining.

If not done, the heat displacement of machine may have a harmful influence upon machining accuracy.



- (1) Incorporate the functions of equipment into the program for automatic operation and check their functions additionally.

- (2) When starting the machine after stopping it for a long period of time, be sure to perform the warming up.
If not done, the slideway or spindle bearing may be seized because oil film is eliminated.

9-3 Inspection at work finish



- (1) Check the belt tension.

At this time, take care so that the hand will not wound between the belt and pulley.

- (2) Clean the machine and equipment.

Remove chips, put things in order and wipe the dirt or cover check port so that the machine will not cause trouble.

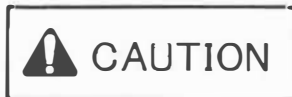
- (3) Do not use a compressed air for cleaning the inside of machine because chips are caught into the headstock and slideway.

- (4) Check that the conditions of machine and equipment are initial conditions same as start work.

- (5) Check that the wiper is not broken and replaces it with a new one if required.

- (6) Check the dirt of coolant, hydraulic oil and lubrication.
Replace the remarkably used oil with a new one.
If dirty oil is used, the machine may cause malfunction.

- (7) Ask professional trader of waste oil disposal.



(8) Check each level of coolant, hydraulic oil and lubrication.
If the oil is shortened, replenish it.

(9) Clean the filter located on the oil pan.
If the filter is not cleaned, the machine may malfunction.

(10) When leaving from the machine after finishing the work,
be sure to turn OFF the power supply.

10 PRECAUTIONS ON MAINTENANCE INSPECTION

10-1 Preparation before maintenance



(1) Supervisor shall instruct workers before starting the work.

(2) Facility manager shall be alert to machine conditions via the workers who perform the daily inspection.

NOTICE

(1) Make a plan of working area and work content by investigating the situation.

(2) Understand the construction and function of repairing part.

(3) Arrange the parts required for replacing and repairing in advance.

10-2 Maintenance



- (1) Electrical maintenance engineers appointed at shop shall maintain the electric apparatuses.

If any person with insufficient knowledge relative to the safety of electric work performs the electric work, there is a danger of electric shock.

- (2) In the maintenance work accompanied with danger with the power ON, be sure to turn OFF the power supply and lock the main breaker.

To prevent any person turning on the power supply by mistake, put the notice board of [No power ON] or [Maintenance work in progress].

If the maintenance is performed with power supply ON, there is a danger of electric shock or an accident resulting in injury or death since the machine may be operated for another reason.

- (3) Do not remove or modify the interlock switch, over-travel switch, etc., for safety.

If any safety unit is damaged, be sure to contact our Technical Service Dept.

If the machine is operated with the safety unit removed, the machine may malfunction, thus possibly causing an accident resulting in injury or death.



- (4) When performing a joint work by two or more of persons, sign and confirm each step of work.

While some workers are working on the inside of machine or around the machine, when the machine is started carelessly, an accident in injury or death may be caused.



- (1) When working in a high place, use the ladder or bench.

Do not climb the machine in case of loss of balance causing a fall from the machine.

As a result, there is a danger of an accident resulting in injury or death.

- (2) When handling the heavy thing, work with two or more persons or use the crane.

If only one person works, the lower back may be damaged or an accident resulting in injury or death may be caused because heavy thing falls.

- (3) When replacing the parts, use the parts specified by company.

TAKISAWA disclaims all responsibility for damage or problems occurring due to using parts other than those specified.

If the specified parts are not used, not only the machine function is reduced but also safety is compromised, thus possibly causing an accident resulting in injury or death or machine malfunction.



- (1) Lubricate each part, replace oil and clean filters periodically according to the [Machine Instruction Manual].

If not done, the machine may cause malfunction, and also, it may have a negative impact on machining accuracy.

- (2) Use the specified hydraulic oil, lubrication and grease or equivalent to them.

Don't use deteriorated oil or oil with impurities mixed in order to maintain the machine properly.

- (3) Clean the tank or filter of each lubrication system periodically and check that equipment and piping are not damaged.

If the equipment and piping are damaged, the machine may malfunction.

- (4) Do not open the doors of enclosure, control unit and operation panel unless otherwise required because dust or humidity may enter, thus possibly causing miss-operation and machine problems.

- (5) Perform the daily inspection and periodical inspection according to [Machine Instruction Manual].

If the daily inspection and periodical inspection are not performed, it may have a harmful influence upon a machine service life and machining accuracy.

10-3 Operation after maintenance



- (1) Arrange and keep maintained parts and working environment in order and make the working environment safety by wiping up water or oil.



- (1) Dispose of unnecessary parts, drain with the instruction of a supervisor.

- (2) After maintenance, the machine operation is checked in the presence of the person in charge of maintenance.

NOTICE

- (1) Be sure to record the contents of maintenance inspection for reference later.

11 PRECAUTIONS FOR MACHINING ACCURACY

When using the NC lathe, the following items must be satisfied in order to keep the machining accuracy of products.

Therefore, it is necessary to consider deeply and examine because there is a danger of accident or machine damage.



- (1) Provide sufficient clamping allowance so that the workpiece does not fly by the centrifugal force occurred through a cutting force or spindle rotation during machine.

If the workpiece does fly during machining, there is a danger of an accident resulting in injury or death or machine malfunction.

- (2) When clamping the workpiece, examine a clamping method, chuck pressure by considering the rigidity of workpiece itself so that it will not be distorted because it may have a harmful influence upon machining accuracy.

- (3) When the center of gravity for workpiece is not in the rotary center because it is eccentric for deformed workpiece, balance it by attaching the balance weight. If not done, the workpiece may fly, thus possibly causing an accident resulting in injury or death or machine malfunction.

Also, the vibration of machine itself may have a bad influence upon machining accuracy of workpiece.



- (4) Perform the warming up for spindle and axis travel when starting the work and machining.

If not done, the heat displacement of machine may have a harmful influence upon machining accuracy.

- (5) Select the tool so that the chip will not wound or adhered to the workpiece and tool.

If the chip is wound or adhered to the workpiece or tool during cutting, it may have a harmful influence upon a surface rough accuracy.

- (6) Workpiece comes in many forms and materials.

Therefore, examine the material and form thoroughly and set an optimum cutting condition.

If the optimum cutting condition is not set, the workpiece may fly during machining, thus possibly causing an accident resulting in injury or death or machine malfunction.

And also, it may have a harmful influence upon machining accuracy.



- (1) When tooling, take care so that the tool will not interfere with other obstructions.

Since it is supposed that each tool will interfere with the workpiece, chuck, jaw, cover, etc., take extreme care before starting the automatic operation so as not to cause the machine malfunction.

NOTICE

- (1) When the material of workpiece is a forging or casting, there is various clamping allowance for the product form. Make the program to anticipate the allowance in advance or uniform the allowance at former machining.

12 PRECAUTIONS IN COOLANT SELECTION

There are many kinds of coolants.

Though TAKISAWA does not specify the coolant, select the coolant by consulting with maker about the following items.

TAKISAWA disclaims all the responsibility for trouble incurred by the coolant.



- (1) Use a coolant, which does not contain ingredients having a harmful influence on the human body such as malodor or rash.

If the coolant contains ingredients having a harmful influence on human body, workers and all around may ruin their health and an accident resulting in injury or death may be caused.

- (2) Use a coolant that does not change in quality during storage.

If the coolant changes in quality, a cooling function and lubrication function may be reduced, thus having a bad influence on machining accuracy.

- (3) Use a coolant containing ingredients that does not cause the machine to rust, thereby damaging the machine.

- (4) Use a coolant containing ingredients that does not damage the machine by causing the paint to peel.



(5) Use a coolant containing ingredients that may cause the rubber to harden or swell, thus damaging the machine.

(6) Use a coolant containing ingredients that does not reduce machine accuracy.

13 SAFETY UNITS

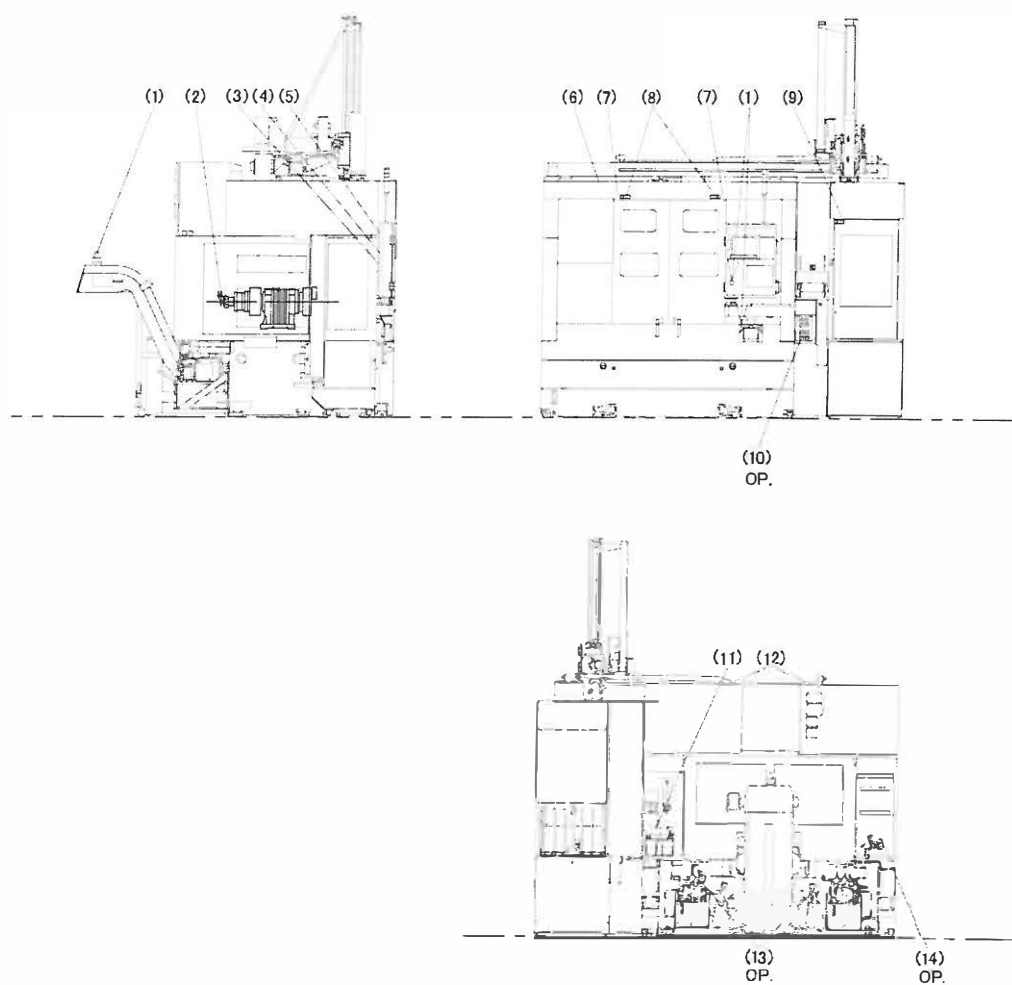
13-1 Kinds of safety units

The machine is equipped with a variety of safety units to maintain workers' safety and to prevent the machine from trouble.

Check their installation places, and also, understand their functions.

No.	Safety unit	Function	Installed place
(1)	Emergency stop switch	Machine stop in emergency	Operation panel
(2)	Chuck stroke end switch	Clamp check of workpiece	Chuck rotary cylinder
(3)	Loader X, Y, Z-axes soft limit	Setting of loader X, Y, Z-axis stroke	NC unit
(4)	Chuck barrier	Prevention of interference for tool and chuck	NC unit
(5)	X·Z-axis soft limit	Setting of X·Z-axis stroke	NC unit
(6)	Cover	Prevention from movable part	Each movable part
(7)	Front door	Prevention of scattering and splashing chip and coolant	Front door
(8)	Front door interlock	Emergency stop with door opened during automatic operation	Front door
(9)	Work feeder cover interlock	Emergency stop with door opened during automatic operation	Work feeder cover
(10)	Chuck pressure alarm	Clamp check of workpiece	Hydraulic operation panel
(11)	Lubrication alarm	Prevention of wear and seizure of slideway	Lubrication unit
(12)	Control panel door interlock	Electric shock prevention, main breaker OFF	Control panel
(13)	Main hydraulic pressure alarm	Emergency stop in hydraulic pressure reduced	Hydraulic connection block
(14)	Main pneumatic alarm	Emergency stop as pneumatic lowered	Main air pressure panel

13-2 Installation place of safety units



OP. : Option

Fig. 13-2 Installation place of safety units

13-3 Maintenance and inspection of safety device

DANGER

- * **Do not remove or modify the safety device.**
- * **Contact us immediately when the safety device is broken.**
- * **Operation of the machine with the safety device removed or modified may result in unexpected operation of the machine and cause injury accident.**

It is necessary to perform periodical maintenance and inspection in order for the safety device to function correctly.

Perform maintenance and inspection periodically referring to the following table.

No.	Safety device	Inspecting method	Troubleshooting	Inspection period
(1)	Cover	1. Check if the screws fixing the cover are not loose or damaged.	Retighten the screws. Contact us for parts order if they are damaged.	Every 200 hours
(2)	Front door	1. Make sure that the front door opens and closes smoothly. 2. Make sure that the door is mounted without strain with the front door closed.	Contact us if it is strained.	Every 200 hours
(3)	Front door interlock switch	1. Activate the door interlock switch and execute "M3S100;" in MDI mode with the front door open at 2 to 3cm. * Spindle could rotate. Pay special attention to it. 2. Make sure that the alarm No. 1027 [CLOSE THE SAFETY DOOR] is displayed.	If the alarm No. 1027 is not displayed, check the fixing status of the switch and detecting dog. If the alarm is not displayed even when they are fixed, change the door interlock switch.	Every 200 hours
(4)	Emergency stop switch	1. Press the emergency stop switch in operation preparation status and make sure that "--EMG--" blinks on the NC screen.	Contact us if it does not blink.	Every 200 hours

No.	Safety device	Inspecting method	Troubleshooting	Inspection period
(9)	Pneumatic pressure switch (option)	1. Operate the pressure reducing valve of the air combination unit and make sure that the pressure switch operates when the main pressure is reduced below the setting pressure of the pressure switch. 2. Make sure that the alarm No. 1081 [MAIN PNEUMATIC FAILS] is displayed when the pressure is below the setting pressure. 3. Make sure to set the main pressure to the original pressure after checking the operation.	If the pressure switch does not operate, change the pressure switch. If the alarm No. 1081 [MAIN PNEUMATIC FAILS] is not displayed, the pressure switch is damaged. Change the pressure switch.	Every 200 hours

14 ZERO ENERGY STATE

Generally, the machine contains various types of energy such as electric energy, hydraulic and pneumatic energy, compression energy, and heat energy.

It is very dangerous if energy is supplied unexpectedly when working with a part of entire body in the range of movement of the machine for maintenance and inspection purpose.

Therefore, it is necessary to shut off all the energy sources to the machine and maintain the machine in the state with the accumulated energy completely dissipated (zero energy state).

This state is called zero energy state.

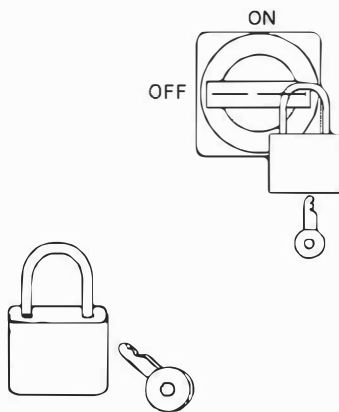
15 LOCKOUT AND TAGOUT

Practice of lockout and tagout can prevent operation errors of the machine and secure the safety of all personnel working in the range of movement.

In USA, practice of lockout for machines and devices is required by OSHA for safety purpose for the personnel in the plant. In addition, the minimum safety requirement for lockout and tagout of energy sources is stipulated as American Standard for worker protection by ANSI.

Generally, the energy sources which require lockout and tagout include the pipes for the electric system and mechanical system, hydraulic and pneumatic pipes, breaker for the electric system, coupler for the air pipe, and pipe valve.

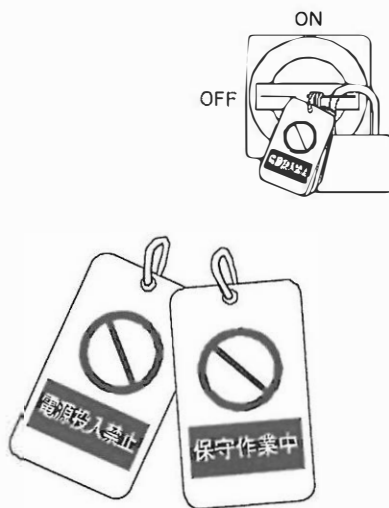
15-1 Lockout



Lockout is to shut off the energy source to the machine and device by using a lock. Thus, lockout is not only to shut off the energy source to the machine by simply switching off but also to lock the switch to disable the operation of the switch with such as a padlock.

The breaker handle of the main breaker for this machine is provided with a locking function. Please provide a lock.

15-2 Tagout



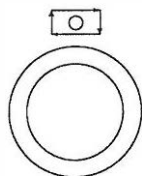
Tagout is to warn other personnel to prohibit the operation of the energy interrupting device during the interruption of the energy source by using a tag. The tag indicates warning messages such as NO OPERATION ALLOWED, DO NOT STARTUP, or DO NOT OPEN.

The purpose of tagout is only to warn other personnel not to operate the energy source and it is not for stopping the interrupting device.

15-3 Procedure of lockout and tagout

(1) Notify all the personnel concerned and the personnel around the machine of the machine stop.

(2) Stop the machine in either of the following procedures.



< Automatic operation mode >

- 1) Press the [Feed hold switch] on the main operation panel. (Automatic operation stops.)
- 2) Press the [Reset key] on the MDI panel. (All functions stop.)



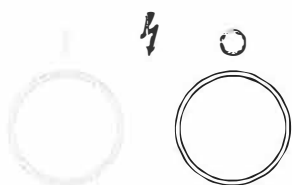
< Manual operation mode >

- 1) Stop the operation of the device. (Manual operation stops.)

NOTE : Procedure for manual operation stop differs according to each device.
Refer to the [Operation manual] for details.



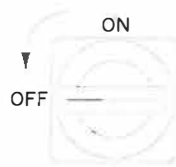
- 2) Press the [Reset key] on the MDI panel. (All functions stop.)



- (3) Press the [Operation ready OFF switch] on the operation panel.

By pressing this switch, the power of the NC unit, hydraulic unit, lubricating unit, coolant oil unit, and coolant oil pump is shut off.

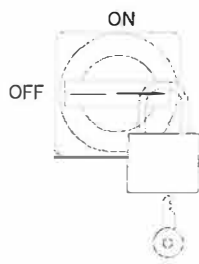
Once the power is shut off, the light of the [Operation ready OFF switch] turns off.



- (4) Set the main breaker (no-fuse breaker) to the [OFF] side to shut off the electric energy source. The electricity is discharged in a few seconds.

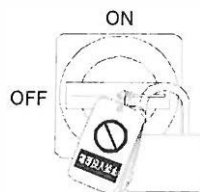
- (5) Remove the coupler of the air inlet and shut off the pneumatic energy source.

- (6) Open the open valve to release the pneumatic energy.



- (7) Lock the main breaker to prevent the power from turned on. (Lockout)
Each personnel entering the range of movement of the machine must practice lockout with own lock.

Never borrow, lend or share the lock.



- (8) Place a tag at the main breaker and open valve to prevent power from tuned on by other personnel during the work. (Tagout)

- 1) Display a warning message of either [DO NOT POWER ON] or [MAINTENANCE WORK IN PROGRESS].

- 2) Display a warning message of [MAINTENANCE INSPECTION IN PROGRESS].

Each personnel entering the range of movement of the machine must practice tagout as well as lockout. Include the name of the personnel, date, and work descriptions on the tag.

(9) Check if all the switches are off or in the neutral position.

After making sure that the machine is completely shut off from the energy source and in stop, a work in the range of movement of the machine can be started.

15-4 Release of lockout and tagout

After the work is completed, the own personnel must unlock and remove the tag when leaving the hazardous zone.

No other personnel must unlock or remove the tag.

If other personnel necessarily releases the lockout and tagout, release them upon checking or presence of the own personnel.

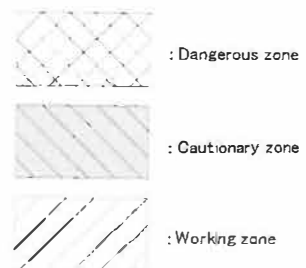
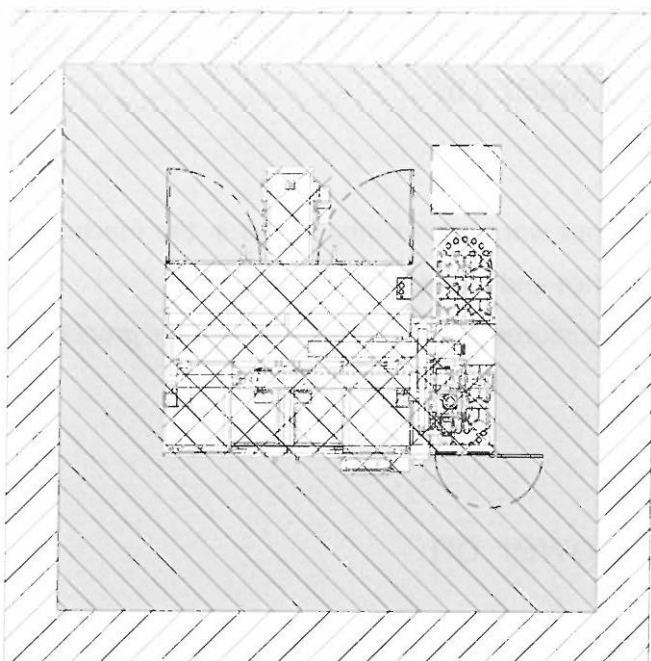
16 DANGEROUS ZONE

The working zone is categorized in the following three areas according to the level of hazard.

Please observe the instructions of each area upon working.

Area	Descriptions
Dangerous zone 	Dangerous zone indicates the area where exists possibility of injury accident by the moving parts of attached device around the machine if personnel approximate the machine in operation. (Area in front of the automatic doors is included in case of the machine with automatic doors.) Do not enter the area unless preparation, maintenance and inspection, or emergency work for troubleshooting purpose. Make sure to shut off the power when performing the above works. If necessarily working with the power on, work with care and follow the work procedures in [17-2 Entering with power on].
Cautionary zone 	Cautionary zone indicates the area where does not exists possibility of injury accident by machine such as getting caught in the machine but requires caution at entry. There is a possibility of injury accident or machine damage by work pieces, clamps, and tools popped out from the machine or sputtered chips and coolant.
Working zone 	Working zone indicates the area where personnel can work safely while the machine is in operation. (It indicates the area at 1.5m away from the machine.)

8-inch type back eject



10-inch type back eject

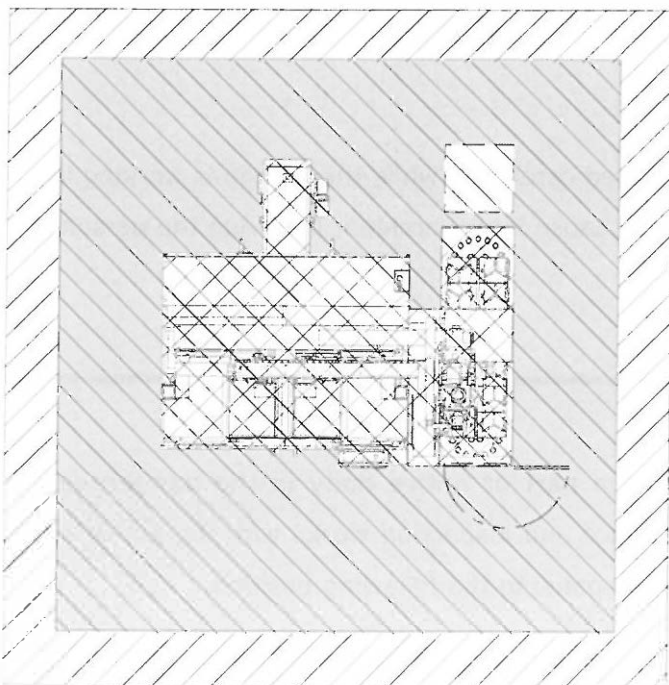


Fig. 16 Dangerous zone

17 ENTERING DANGEROUS ZONE

17-1 Entering with power off

Practice lockout and tagout when performing works in the machine such as a preparation, maintenance and inspection, or cleaning.

Please refer to [15-3 Procedures of lockout and tagout] for procedures.

17-2 Entering with power on

WARNING

Give out signs and check at each step of the procedures when working with more than two persons.

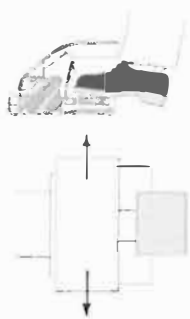
- * If the machine is operated carelessly while the person is working in or around machine, it may cause injury accident involving the person or personnel around.

If necessarily placing a part or entire body in the dangerous zone for preparation, maintenance and inspection works with the power on, set the switch on the operation panel to the following position.



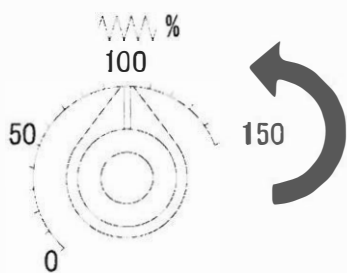
- (1) Select the mode selector switch [Hand wheel feed select switch of each axes].

NOTE : Do not press the [Memory mode switch] at this time.



- (2) Step on the [Chuck jaw clamp/unclamp foot switch], and unclamp the chuck.

- (3) Set the [Spindle override manual] in the right and left of machine operation screen to 1%.



- (4) Turn the [Feedrate override select switch] and [Rapid traverse speed override select switch] counterclockwise completely.

18 PREVENTION AND COUNTERMEASURES FOR EMERGENCY

Build a structure for emergency prevention and countermeasures.

The important key of this structure is a specification of the possibility of disasters and emergency situations and that is mentioned in the relevant risk prevention of Occupational Health and Safety (OHS).

Plan the structure according to the size of the business establishment and its description of business.

The requirements are as follows:

- To secure that the information required for protecting all personnel, internal communication (message), and collaboration are provided in case of emergency at site
- To provide required information and communication (message) to relevant organizations, neighbors, and emergency service agency
- To mention the first aid, emergency assistance, fire extinction and evacuation procedure for all personnel at site
- To provide the information and training including periodical training for prevention and countermeasures for emergency situation to personnel at all levels

Prepare arrangements for procedures of prevention and countermeasures for emergency situation collaborating with external emergency service agency and other organizations if possible.

Injuries resulted by accident, earthquake, and lightening include caught-in, crush, cut, trapped-under, and electric shock.

The victim may not be moved in some cases depending on the level of injury.

Provide a training of first aid and rescue for each case.

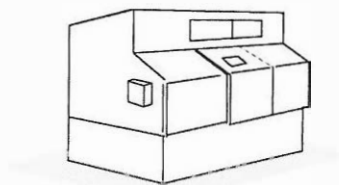
18-1 Countermeasures for injury accident

Please perform the following countermeasures in case of injury accident.

NOTE : Disassembly and dismantle may be necessary depending on a place and situation of the accident.

The machine has a complicated structure and a quick disassembly and dismantle of the machine requires special knowledge.

Please make sure to ask for rescue and contact the our company or customer service for immediate rescue of the victim. (Refer to [22 CONTACT] for our contact.)



(1) Stop the machine.

(2) Shut off the power.

(3) Rescue the victim.

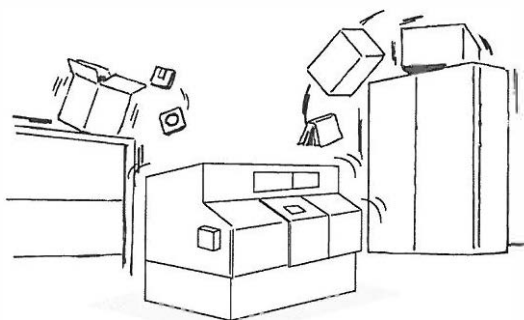


(4) Contact each regulatory authority (city, office, etc.)

18-2 Countermeasures for earthquake

Please perform the following countermeasures in case of earthquake.

NOTE : Please contact us if any error is recognized at operation restart.



- (1) Stop the machine if it can be stopped safely.
- (2) Transfer the victim in a safe place and perform appropriate medical procedure.

NOTE : The victim may not be moved in some cases depending on the level of injury.

- (3) The supervisor must guide all personnel to a safe place following the company rules.

< Recovery procedure >

After making sure that the machine can be restarted, the operation can be restarted.

Check the following items according to [6 PRECAUTIONS IN POWER ON/OFF].

< Check items before operation restart >

- (1) Damage on the machine
- (2) Numeric value on gauges (hydraulic, lubricating oil, and air, etc.)
- (3) Oil leakage

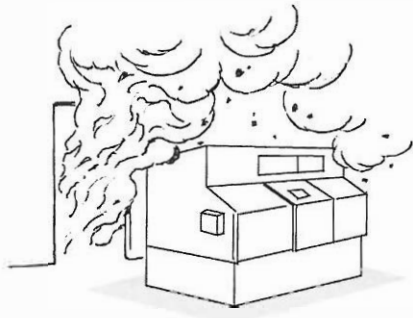
< Check items after power-on >

- (1) Proper operation of fan
- (2) Proper operation of sliding side lubricating pump

18-3 Countermeasures for fire breaking

Please perform the following countermeasures in case of a fire breaking.

NOTE : Please avoid placing flammable articles around the machine unless necessary.



- (1) Warn the personnel around out loud.
- (2) Transfer the victim in a safe place and perform appropriate medical procedure.
- (3) Contact the fire department.
- (4) Stop the machine.
- (5) Extinguish the fire with appropriate extinguisher according to the cause of the fire.
- (6) If the fire extinction is suspected, evacuate immediately.
- (7) The supervisor must contact us or our service customer.
(Refer to [22 CONTACT] for our contact.)

18-4 Countermeasures for lightning strike

Please perform the following countermeasures in case of a lightning strike.

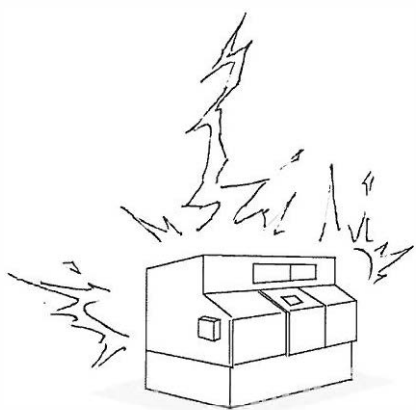
WARNING

Stop the machine and shut off the power if there is a possibility of an abnormal change in the power voltage due to lightning strike.

The machine does not operate properly unless there is a proper power supply.

* If the power is shut off by blackout or lightning strike during its operation, the machine may operate unexpectedly, and it may cause injury accident or machine damage.

NOTE : Please contact us if any error is recognized at operation restart.



(1) Stop the machine immediately.

(2) Stay away from the machine to avoid electric shock.

< Recovery procedure >

After making sure that the machine can be restarted, the operation can be restarted.

Check the following items according to [6 PRECAUTIONS IN POWER ON/OFF].

< Check items before operation restart >

- (1) Damage on the machine
- (2) Numeric value on gauges (hydraulic, lubricating oil, and air, etc.)
- (3) Oil leakage

< Check items after power-on >

- (1) Proper operation of fan
- (2) Proper operation of sliding side lubricating pump

19 HANDLING OF HAZARDOUS MATERIALS

WARNING

Handle chemical substance according to the MSDS (Material Safety Data Sheet).

- * Inappropriate handling of chemical substance may cause a danger to public health and environment.

19-1 Handling of chemical substance



Some chemical substance may cause a serious health hazard such as burn, inflammation, cancer, or cardiac disease if it is contacted with the human body or inhaled by mistake.

Other than the health hazard, it may cause a fire by ignition or explosion or damage ecosystem such as aquatic and soil contamination by external effluence.

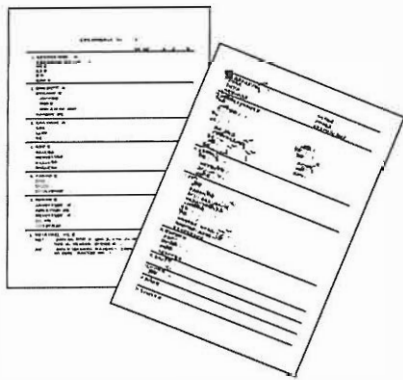
Observe the handling and storage procedure instructed by the manufacturer of the chemical substance. General precautions for handling chemical substances are listed below.

- Attach a label indicating the contents of the chemical substance and store it away from heat, moisture, fire and sparks.
- Check the MSDS before use.
- Wear personal protective equipment such as gloves as necessary.
- Ventilate as necessary.
- Be sure to wash hands after handling chemical substance.

19-2 Related laws and regulations

For handling chemical substance, observe the laws and regulations established by the national and local governments.

19-3 MSDS (Material Safety Data Sheet)



Detailed information regarding the safety of chemical substance is listed in MSDS.

Obtain MSDS from the manufacturer at purchase, and store it at accessible place.

MSDS provides information about health and environmental hazard by the chemical substance, proper handling, and countermeasures for emergency situation.

Use and store it according to the description.

Also, in case of receiving health affect by chemical substance, provide the MSDS to the physician for an appropriate treatment.

Additionally, communication, instruction, and training are required for the handler by ISO11014.

Listed contents of the MSDS stipulated by ISO11014 are attached on the following pages.

Material Safety Data Sheet

Prepared/revised on

1. Chemical Substance and Company Information

Name of chemical substance (Product code) :

Company name :

Person in charge :

Address :

Tel. :

2. General Description of Hazard

Important hazard :

Health hazard :

Environmental hazard :

Physical and chemical hazard :

Special hazard :

3. Information on Composition and Ingredients

IUPAC Name :

CAS No. :

Other name :

4. Emergency Measures

Inhaled :

Attached on skin :

Entered in eyes :

Swallowed :

5. Fire-fighting Measures

Extinguishing agent :

Extinguishing measures :

Protection for firefighters :

6. Measures for Leakage

Precaution for health :

Personal protective equipment and emergency measures :

Precaution for environment :

Collection and neutralization :

Preventive measures for secondary disaster :

7. Handling and Storing Precautions

Handling : Technical measures, partial ventilation and general ventilation, and precautions for aerosol and dust prevention, special safe handling precautions

Storage : Storage condition (appropriate storage condition and inappropriate storage condition), safe package material (recommended material and inappropriate material)

8. Exposure Prevention and Protective Measures

Allowable density :	Gloves :
Measures for facilities :	Safety goggles :
Respirator :	Skin and body personal protective equipment :

9. Physical and Chemical Properties

Appearance	
Physical condition :	
Color :	
Smell :	Vapor density :
Ph :	Ratio :
Fusing point and congealing point :	Solubility :
Boiling point, initial boiling point and boiling range :	Spontaneous ignition temperature :
Burning point :	Decomposition temperature :
Explosive range : Lower limit :	Higher limit : Flammability :
Vapor pressure :	

10. Safeness and Reactivity

Safeness :
Hazard reactivity :
Condition to be avoided :
Mixed hazard substance :

11. Toxicity Information

Acute toxicity
Skin corrosivity and dermal irritancy :
Optic severe damage and irritancy :
Respiratory sensitization and skin sensitization :
Germline mutagenic property :
Carcinogen :
Reproductive toxicity :
Particular target organ and systemic toxicity (single exposure) :
Particular target organ and systemic toxicity (repeated exposure) :
Aspiration respiratory toxicity :

12. Environmental Hazard

Eco toxicity :
Persistence and resolvability :
Bioaccumulation potential :
Soil-mobility :

13. Precaution for Disposal

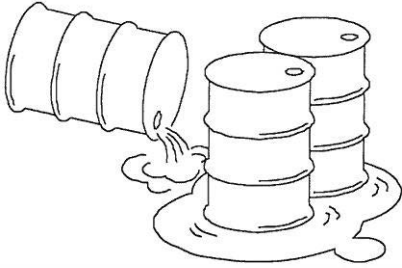
14. Precaution for Transportation

International regulations :

15. Applicable Laws and Regulations

16. Other Information

19-4 Disposal



Chemical substance and rags used to clean chemical substance must be disposed properly to avoid health and environmental affect.

Establish appropriate company standards for disposal as industrial waste.

Dispose chips, unnecessary parts, coolant oil, hydraulic oil, and lubricating oil used in the machine under the instruction of the supervisor according to the national and local laws and regulations.

NOTE : Dispose chemical substance and industrial waste according to the laws and local ordinance.

Unauthorized dumping is subject to penalties due to environmental effect.

20 SAFETY EDUCATION

20-1 Understanding and observances of instruction manual

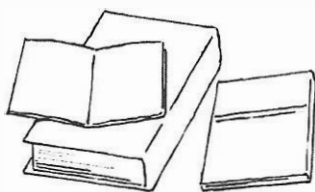


It is important to be familiar with the functions of the machine to avoid potential hazards.

Make sure that the operator understands the items listed in this instruction manual completely before operating the machine.

Also, the supervisor must make sure that the operator observes the items listed in the instruction manual.

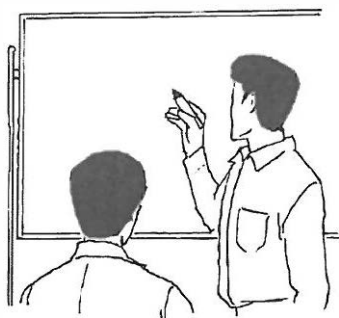
20-2 Preparation of safety manual



Prepare a [Safety manual] including the control criterion and operation.

The supervisor and operator must understand the [Safety manual] in advance to ensure the safety.

20-3 Safety education



The skill for danger avoidance can be improved as with other work skills by training.

Please include safety related items in the training provided at the customer.

Safety measures are explained during our training for the machine operation; however, this is not sufficient.

It is important not only to observe the procedures but also to recognize the potential hazards and make effort to raise the awareness of the safety.

By raising the awareness of the safety of each operator, the operator will judge each situation, removing potential hazard avoiding hazardous actions and areas, and protect himself from hazards.

21 PERSONAL PROTECTIVE EQUIPMENT

It is important to wear clothes providing a safe workable condition for protection.
Observe the followings in working.

- (1) The personal protective equipment differs depending on a plant environment and work such as operation, troubleshooting, or maintenance and inspection.
Establish the regulations and wear necessary personal protective equipment.



< Basic personal protective equipment >

- Work clothes (long sleeves and long pants)
- Protective shoes
- Protective hats
- Protective glasses

< Additional personal protective equipment by plant environment and work >

- Leggings
- Hard hats
- Earplugs (hearing protection device)
- Dust masks
- Gloves

- (2) Wear clothes appropriate for safety.

Work in appropriate clothes prevents caught-in the machine or electric shock.

- Wear work clothes with long sleeves and pants.

Spattered chips or contact with a part of the machine may cause injury (burn or laceration, etc.).

- Wear tight work clothes and close the cuffs.
- Do not wear gloves to avoid getting caught in the machine when operating the machine.
- Long hairs may hinder vision or get caught in the machine, causing injury accident.

Wear a protective hat as necessary.

- (3) Observe the instructions of MSDS (19-3 MSDS) for handling the cutting oil, cleaning fluid, and solvent.

Wear gloves when handling.

- (4) Wear gloves when handling swarf and cutting tools.

22 CONTACT

Please contact the following for any questions about this machine or the contents in this instruction manual.

Please provide the model name and the serial number upon contact.

TAKISAWA MACHINE TOOL CO.,LTD

983, Natsukawa, Kita-ku, Okayama-shi, Okayama-prefer, 701-0164

Japan

Telephone : +81-86-293-1500

Fax : +81-86-293-5799

Website : <http://www.takisawa.co.jp>

E-mail : tkj-1@takisawa.co.jp (America)

tkj-2@takisawa.co.jp (Europe)

tkj-3@takisawa.co.jp (Asia)

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in any form without permission.

NC Lathe

TT-2600

MACHINE INSTRUCTION MANUAL

XZ04020-101

Please read each manual and
understand contents enough.
Then keep these manuals handy for
answers to any questions you may
have and to check.

MACHINE TOOLS
TAKISAWA

IMPORTANT NOTICE

- Be sure to read each instruction manual before operating the machine.
Be sure to observe the safety precautions in the instruction manuals and the contents of warning labels adhered to the machine. If ignored, an accident resulting in injury or death or machine malfunction may be caused.
There are many [DISABLE] or [MUST NOT DO] conditions.
Unless [ABLE] is written in the instruction manual, consider it [DISABLE].
- Some illustrations in the instruction manual are given without cover or door to illustrate the detailed parts. In actual operation, it is necessary to mount the cover or door.
- Keep instruction manuals handy for ready reference as it will help you operate the machine and equipment to their full advantage.
- When any instruction manual is required again, contact your agent with the number of the instruction manual (or model name, manual name).
- Japanese laws prohibit this machine from being used to develop or manufacture "weapons of mass destruction" or "conventional arms", as well as from being used to process parts for them.
Export of the product may require the permission of governmental authorities of the country from where the product is exported.
Should you wish to resell, transfer or export the product, please notify Takisawa Machine Tool Co., Ltd. or our distributor in advance.
- Observe the laws and regulations established by the national and local governments.
- Observe the laws and regulations established by the national and local government for disposal of machines and waste oil.

- Software copyright is held by us.
- No part of the software is allowed to use, copy, or modify without written permission of us.
- This instruction manual is copyrighted, and all rights are reversed. No part of the drawings and technical descriptions contained in this instruction manual may be disclosed, photocopied, translated to another language or copied to any readable electronic devices and apparatus without the prior written consent.
- The contents in this instruction manual are subject to change without notice.
- All brand names and product name listed in this instruction manual are trademarks or registered trademarks of their respective companies.
- This instruction manual is prepared for native English-speakers. When the machine is operated by non-native English speakers, please provide safety instruction for the operators by customers. In addition, please provide warning labels in their native language.
- Be sure to attach this instruction manual in case of reselling this machine.
- The manual is written for people who have a basic knowledge of machine tools.
TAKISAWA disclaims all responsibility for damage or accidents arising due to people with insufficient knowledge or training with machine tools, attempting to operate, maintain or program said tools.
- When replacing the parts, use the parts specified by company.
TAKISAWA disclaims all responsibility for damage or problems occurring due to using parts other than those specified.
If the specified parts are not used, not only the machine function is reduced but also safety is compromised, thus possibly causing an accident resulting in injury or death or machine malfunction.

- There are many kinds of coolants.

Since TAKISAWA does not specify the coolant, select your desired coolants by consulting with oil makers sufficiently.

In addition, TAKISAWA shall have no liability for trouble incurred by using coolants.

- Contact us for requesting an installation, modification, and specification change, and dismantlement of the machine. If the machine is installed, modified, or its specification is changed by customer, not only the performance of the machine may be lost but also the safety of the customer may not be secured.

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B. INSTALLATION

C. DAILY CHECK

D. MAINTENANCE

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MAKER

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A. OUTLINE OF MACHINE

This chapter explains the outline of the using purpose, method, feature, etc., of the machine.

CAUTION

Operate the machine with the method, which suits an operating purpose.

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1 PURPOSE AND APPLICATION

The model TT-2600 of NC lathe is a machine tool for turning efficiently by traveling the tool slide controlled with NC (numerical control) unit and rotating the spindle with the metal workpiece mainly chucked to the spindle chuck (plastic, wooden workpiece possible).

Usually, the model TT-2600 features the workpiece machining in a cylindrical form to produce various machine parts accurately at a high speed.

Also, it features the machining functions such as tapering, round bar cutting, drilling, threading, etc. Thus, it has a wide range of machining functions.

The lathe rotates at a high speed, which can be dangerous.

Therefore, it is necessary to machine the workpiece under conditions, which withstand the cutting resistance and centrifugal force for the workpiece.

For the special machining which is troublesome with the single lathe, it copes with an intricate machining by providing the special unit.

In any case, understand completely the machine functions by reading the manuals.

2 OPERATING METHODS

The machining work needs the following conditions.

- (1) Workpiece clamp and supporting methods.
- (2) Tool selection suited to machining method
- (3) Machining conditions by spindle rotation and tool slide travel

This section explains the required machine operating methods including optional functions when machining the workpiece with the model TT-2600 of NC lathe.

2-1 Workpiece clamp

There is the chuck to clamp the workpiece by supplying hydraulic pressure. The chuck is classified into various types according to the workpiece shape or machining method.

It is important to understand and to use these features.

1. Solid chuck

This is the most general chuck to clamp the outer diameter face or inner diameter face of the workpiece.

2. Hollow chuck

This is the through hole chuck, which presses through the bar in machining.

It is recommended to use it together with the bar feeder.

3. Compensating chuck

When chucking the deflection or unevenness workpiece for a center hole, this will chuck the workpiece correctly, oscillating jaws.

4. Index chuck

This chuck features 90° indexing of the workpiece during the chuck rotation.

Thus, four faces can be machined during one chucking of the workpiece.

5. Collet chuck

This chuck clamps the outer workpiece dia. face by pressing the split collet to the workpiece taper face by using thrust.

This chuck is especially suitable when the bar is continuously machined.

6. Eccentric chuck

This chuck is used when requiring the eccentric machining of workpiece in accuracy at one eccentric chucking.

7. Diaphragm chuck

This chuck clamps the workpiece, withdrawing the workpiece with the jaw fixed on the diaphragm by using the elasticity of the diaphragm.

This chuck is suitable to the machining of grinding, boring, turning, etc., which require a high centripetal performance and a chucking accuracy.

2-2 Supporting of workpiece

There is a chucking method that only chuck clamps one end of workpiece before rotating.

2-3 Machine methods

The clamped and supported workpiece is machined with the tool or attachment mounted on the tool slide.

The lathe machines the workpiece with the lathe turning, and attachment also performs plastic machining and grinding.

1. Outer surface machining

The outer workpiece dia. Face is machined with the tool in the cylindrical form.

The workpiece can be machined in the taper or circular arc form by simultaneously controlling the tool slide travel in X-axis and Z-axis directions.

2. End face machining

The end face of the workpiece is machined with the tool.

3. Cutting machining

The workpiece is cut with the cutting tool.

4. Drilling

The workpiece is drilled with the drill.

5. Center drilling

The center hole is drilled with the center drill.

6. Boring

The inner workpiece dia. face is bored with the boring tool.

7. Threading

The workpiece is threaded with the threading tool.

8. Reaming

The workpiece hole is reamed with the reamer.

9. Burnishing

The workpiece machining face is accurately finished with the burnishing tool by using plastic deformation.

10. Roller finishing

The workpiece-machined face is smoothly finished by applying a cold plastic deformation on the workpiece surface with a rolled action, pressing the roller to the workpiece-machined face.

11. Rolling machining

Pressing the rolling tool to the workpiece surface, the knurling, serration of bolt or male screw is formed by the plastic deformation.

12. Grinding

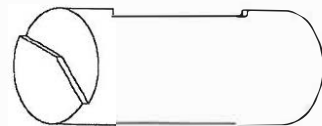
The machined face is accurately finished with the grinding tool, rotating the grinder with the air motor.

13. Rigid tapping (C-axis, Milling)

X-axis (Z-axis) and the rotary tool motor operate synchronously to thread the material with the tap.

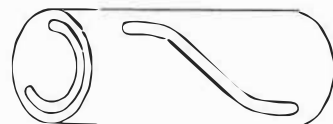
14. Flattening (C-axis, Milling)

Surface is flattened with the rotary tool.



15. Grooving (C-axis, Milling)

Material is grooved with the rotary tool. X-axis (Z-axis) and C-axis rotate synchronously to groove the cylindrical cam.



2-4 Workpiece carrying methods

The method for which the workpiece is carried to/from the machine is divided into two methods (manual and auto carrying methods).

There are various automatically carrying methods.

1. Manual carrying

The workpiece is manually mounted and removed to the chuck.

This is the most popular method.

2. Robot and loader

The workpiece is automatically loaded and unloaded with the robot or loader.

Since a continuous operation is possible, the production is efficiently improved.

3. Parts feeder

When small or many parts are produced, materials are automatically fed, arranging well parts.

The removable function is provided between the parts feeder and the chuck.

4. Reversing device

When a lathe machines the surface and back face of the workpiece continuously, the reversing equipment allows the workpiece to reversibly turn before rechecking.

5. Bar drawing by tool slide

The turret is equipped with a clamp mechanism to clamp the bar. The turret draws the bar from the spindle by traveling in the Z-axis direction and it positions.

2-5 Chip treatment

The following explains the methods to transfer and remove the chips from the space around workpiece and tool to the outside of machine.

1. Manual transferring

This is the simplest method by which chips are manually transferred.

2. Chip conveyor

The chip conveyor automatically conveys chip.

There are chip conveyors of the chain system, screw system, etc., which are properly used by a chip status.

3. Air blow

Chips are removed by blowing pneumatics on the workpiece or tool.

The air blow is used when the chucking part or workpiece measuring part is cleaned.

4. Coolant

Chips are removed by discharging the coolant with the high-pressure coolant pump.

2-6 To use coolant

Since the tool temperature rises while cutting and the workpiece is machined at a high pressure, the coolant is used for the purpose of reducing cutting resistance, restraining a built-up edge, cooling the tool, improving the workpiece finished-face roughness and dimensional accuracy, prolonging a tool life, removing chips, etc.

1. Discharging by coolant pump

Much coolant is directly discharged to the tool or workpiece with the coolant pump.

2. Coolant reservoir

The coolant reservoir is provided on the separate type oil tank.

It is recommended that the reservoir be usually filled with the coolant to prevent the machine from extreme temperature rise and to keep the machining accurate.

2-7 To use special equipment

There are special functions to monitor the tool life.

1. Measuring instrument

This instrument is used for measuring the dimensions of machined workpiece and controlling the machining accuracy by feeding back their data to the NC unit as correction for machining the next workpiece.

It is also used for determining OK or NG of the finished products and controlling the tool life by commanding the tool change period.

2. Tool setter

The tool nose wear is measured with the nose touched to the tool setter sensor by traveling the axis.

The machining accuracy is maintained by feeding back the data to NC unit as correction for machining the next workpiece.

3. Tool breakdown detector

This is the detector for detecting the breakdown status of the tool nose or drill.

This function stops the automatic operation or issues an alarm by detecting the tool failure.

3 LIMITATION OF OPERATION

The following operations or machining methods are inhibited because of hazardous situations, which result in death or serious injury and machine malfunction.

Referring the [SAFETY GUIDE], operate the machine under safe machine conditions.

WARNING

- * Operate the spindle, chuck and hydraulic cylinder within an allowable rotary speed.
If not so, the workpiece may fly out, thus leading to a personal injury or machine malfunction.

- * Close the front door during operation.
Do not operate the machine with the cover removed and movable parts exposed.
If not so, any operator may be wound in rotary members or caught in movable parts, thus leading to a personal injury or machine malfunction.

- * Do not operate the machine with safety unit, safety covers or safety window removed, or after machine modification.
If not so, any operator may be wound in rotary members or caught in movable parts, thus leading to a personal injury or machine malfunction.

- * Do not operate the machine with the bar extruded from the spindle back.
If not so, the spindle rotates, oscillating the bar, thus leading to a personal injury or machine malfunction.

CAUTION

- * When the workpiece is machined with the cutting tool clamped to the spindle, ***never operate the machine for milling the workpiece by traveling the tool slide in the X-axis direction and by rotating the spindle with the milling cutter clamped to the chuck and the workpiece clamped to the tool slide.***

When milling the workpiece, use the milling machine or machining center. If not so, the machine may malfunction.

- * ***Do not perform the shaper machining or keyway milling with tools except rotary tools by traveling the tool slide in the Z-axis or X-axis direction with the spindle still stopped*** and the workpiece clamped to the chuck.

If the above machining is performed, since an abnormal thrust is applied to the ball screw of feed system, such machining will cause the machine to malfunction.

- * Do not remove chips and clean the machine by blowing compressed air. (Not including air blow in machine during automatic operation.)
Chips flied in all directions will be entered in unexpected places, thus resulting in machine malfunction.

- * ***If a highly flammable workpiece or the workpiece in which harmful substance occurs is machined***, consult a specialist, wear the personal protective equipment and arrange the safety facilities or environment.

If the above does not protect, it will lead to a fire accident or a personal injury.

CAUTION

- * Operators shall be educated and guided about the NC lathe.
If not so, a personal injury or machine malfunction will be caused.

- * Maintenance service men shall also be educated and guided about the operation and maintenance of the NC lathe.
Operators shall have the qualification of the electric work, maintenance of NC lathe.
Operators shall have the qualification of the electric work, crane, slinging work, etc., as occasion demands.
If not so, a personal injury or machine malfunction will be caused.

4 FEATURES

General features of the NC lathe are as follows.

- (1) The TAKISAWA brand NC lathe features the adequate workpiece machining without depending on the machine operation by worker's sixth sense or ability.

It is not necessary for a skilled worker to operate the conventional lathe.

- (2) Since the drawing dimensions, machining steps, etc., are coordinated in the program, careless operation can be prevented.

- (3) The machining time and steps are constantly controlled by NC data.
For this reason, the dispersion of machining accuracy is small, the quality of finished products is uniform and defective products are reduced.

- (4) Since there are flexible and general-purpose properties, the NC lathe features the machining of optional shape only by program change even if the workpiece is changed to a different workpiece.
Consequently, the setup workpiece is easy.

- (5) Since the setting cutting conditions conventionally performed by operator are processed with NC data, the direct operation of the machine is reduced and one operator can undertake the operation of many machines.

In addition to the above features, the model TT-2600 of the NC lathe also has unique features to effectively operate the machine.

* Automation:

The unmanned operation such as loader, workpiece feeder, chip conveyor, counter is available.

* High-speed system:

The high speed loader of 3-axis reduces a waiting time for a machining tact of workpiece.

* Chip discharge:

The chip conveyor is arranged just under the spindle.

* C-axis, rotary tool function (C-axis, milling)

The rotary tool and X-C, Z-C axes operate synchronously and easily machine the intricate shape workpiece for the cylindrical cam grooving and linear flatting.

* Retrieving structure of lubrication:

The dividing device incorporated in the bed can retrieve lubrication.

As a result, a coolant service life is lengthened and an oil cost is reduced.

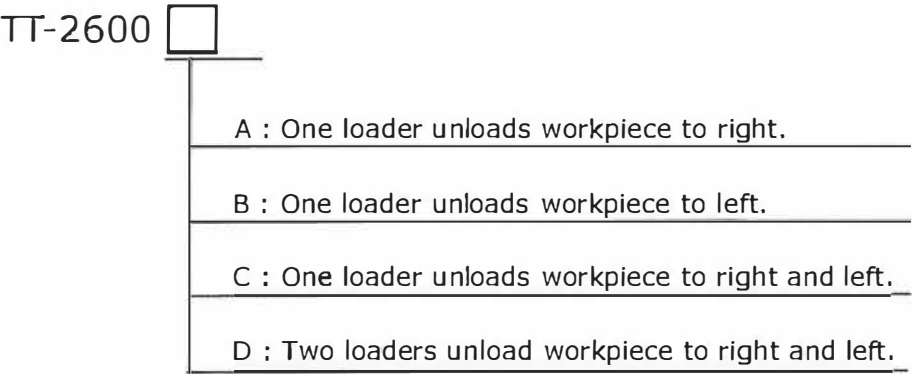
* Environment equipment:

The machining know-how and much optional environment equipment are offered for a special machining.

5 MACHINE SPECIFICATIONS

There are two types of NC lathe TT-2600, 8 inch type and 10 inch type, depending on the chuck size.

There are four types of loader and each type is indicated with an English letter after TT-2600 as shown in the following figure.



Items	Unit	8 inch type		
		Type A, B	Type C	Type D
Capacity				
Max. turning diameter	mm		290	
Distance between spindles	mm		450	
Max. turning length	mm		214	
Spindle				
Number of spindles			2	
Spindle speeds	min ⁻¹		4000 (STD) 3200 2500	
Number of spindle speed ranges			1	
Spindle nose (nominal size, No.)			JIS A2-6	
Through hole diameter	mm		φ 63	
Spindle bearing inner diameter	mm		φ 100	
C-axis				
C-axis travel	deg		360	
Min. spindle indexing angles (C-axis)	deg		0.001	
Rapid traverse (C-axis)	min ⁻¹		50	
Tool slide				
Number of tool slides			2	
Type of tool slide			10-station (All holder)	
Travel of tool slide	mm		X : 230, Z : 250	
Rapid traverse	m/min		X : 24, Z : 24	
Feedrate	mm/min		X, Z : 0 to 20000	

Items	Unit	8 inch type		
		Type A, B	Type C	Type D
Tool slide				
Jog feedrate	mm/min	0 to 1260		
Number of tools on tool slide		10+10		
Square shank height	mm	25 (1")		
Shank diameter of boring bar	mm	ϕ 40 (ϕ 1 • 1/2")		
Indexing time	sec	0.1 class		
Rotary tool				
Number of rotary tool		10+10 (5+5 : Option)		
Rotational speeds	min ⁻¹	25 to 4000		
Max. diameter of tool shank	mm	ϕ 16		
Max. diameter of tap		M16		
Motors				
Spindle motor (30 min/cont.)	kW	11/7.5 (β iI8) 15/11 (β iI12) : Option		
Rotary tool spindle motor (30 min/con.)	kW	5.5/3.7 (β iI3)		
Feed motors	kW	X : 1.4, Z : 2.5, T : 1.4		
Hydraulic pump motor	kW	1.5+1.5		
Lubricant pump motor	kW	0.017		
Coolant pump motor	kW	0.25+0.25 (0.4+0.4 : Option)		
Power sources				
Required electric power	kVA	39 (β iI8) 47 (β iI12) : Option		42 (β iI8) 50 (β iI12) : Option
Required electric voltage	V	200, 220, 380, 415 ± 10%		

Items	Unit	8 inch type		
		Type A, B	Type C	Type D
Power sources				
Required electric frequency	Hz	50/60 ± 1		
Compressed air pressure	MPa	0.4		
Compressed air flow rate	L/min	150		
Tank capacity				
Hydraulic oil tank	L	20+20		
Lubricant tank	L	4 (Effective capacity : 3)		
Coolant tank	L	240		
Machine size				
Height of machine	mm	3629		
Height from floor to spindle center	mm	1075		
Floor space	mm×mm	3150×2938	3961×2938	
Mass of machine	kg	6300		

Items	Unit	10 inch type		
		Type A, B	Type C	Type D
Capacity				
Max. turning diameter	mm		290	
Distance between spindles	mm		450	
Max. turning length	mm		204	
Spindle				
Number of spindles			2	
Spindle speeds	min ⁻¹		3200 4000 : Option 2500 : Option	
Number of spindle speed ranges			1	
Spindle nose (nominal size, No.)			JIS A2-6	
Through hole diameter	mm		φ 73	
Spindle bearing inner diameter	mm		φ 110	
C-axis				
C-axis travel	deg		360	
Min. spindle indexing angles (C-axis)	deg		0.001	
Rapid traverse (C-axis)	min ⁻¹		50	
Tool slide				
Number of tool slides			2	
Type of tool slide			10-station (All holder)	
Travel of tool slide	mm		X : 230, Z : 250	
Rapid traverse	m/min		X : 24, Z : 24	
Feedrate	mm/min		X, Z : 0 to 20000	

Items	Unit	10 inch type		
		Type A, B	Type C	Type D
Tool slide				
Jog feedrate	mm/min		0 to 1260	
Number of tools on tool slide			10+10	
Square shank height	mm		25 (1")	
Shank diameter of boring bar	mm		ϕ 40 (ϕ 1 $\cdot$ 1/2")	
Indexing time	sec		0.1 class	
Rotary tool				
Number of rotary tool			10+10 (5+5 : Option)	
Rotational speeds	min ⁻¹		25 to 4000	
Max. diameter of tool shank	mm		ϕ 16	
Max. diameter of tap			M16	
Motors				
Spindle motor (30 min/cont.)	kW		15/11 (β iI12) 18.5/15 (α iI15) : Option	
Rotary tool spindle motor (30 min/con.)	kW		5.5/3.7 (β iI3)	
Feed motors	kW		X : 1.4, Z : 2.5, T : 1.4	
Hydraulic pump motor	kW		1.5+1.5	
Lubricant pump motor	kW		0.017	
Coolant pump motor	kW		0.25+0.25 (0.4+0.4 : Option)	
Power sources				
Required electric power	kVA		47 (β iI12) 58 (α iI15) : Option	50 (β iI12) 61 (α iI15) : Option
Required electric voltage	V		200, 220, 380, 415 $\pm$ 10%	

Items	Unit	10 inch type		
		Type A, B	Type C	Type D
Power sources				
Required electric frequency	Hz	50/60 ± 1		
Compressed air pressure	MPa	0.4		
Compressed air flow rate	L/min	150		
Tank capacity				
Hydraulic oil tank	L	20+20		
Lubricant tank	L	4 (Effective capacity : 3)		
Coolant tank	L	240		
Machine size				
Height of machine	mm	3718		
Height from floor to spindle center	mm	1075		
Floor space	mm×mm	3335×2938	4335×2938	
Mass of machine	kg	6400		

Items	8 inch type, 10 inch type			
	Type A	Type B	Type C	Type D
Standard accessories				
Splash guarding				
Hydraulic unit				
Foot switch for hydraulic chucking				
Tool holders		5 for each turret		
Coolant pumps		2 sets, 250W		
Interior lighting				
Adjustment tools		1 set		
Instruction manual				
8-inch chucks (10-inch chucks)		2 sets		
Automatic chuck open/close		2 sets		
Chuck air blow		2 sets		
Cycle light indicators		(3 colors), 1 set		
Chip conveyor		Caterpillar, back discharge		
Total counter		RAKURAKU monitor 3 counter function		
Automatic shutdown device		1 set		
Gantry loader		(Hand chuck jaws, loader entrance shutter, safety enclosure, door interlock, removable operation panel)		
Workpiece feeder		8 inch type : 1 set (16 pallets, 3 guide bars) 10 inch type : 1 set (14 pallets, 3 guide bars)		

Items	8 inch type, 10 inch type			
	Type A	Type B	Type C	Type D
Optional accessories				
Tool holder				
Boring bar bush				
Custom chuck				
Spindle motor	8 inch type : 11/7.5 kW, 15/11 kW 10 inch type : 15/11 kW, 18.5/15 kW			
Spindle orientation				
Coolant pump	400W			
Chip conveyor	Caterpillar, side discharge			

6 SPECIFICATIONS OF NUMERICAL CONTROLLER

FANUC series 0i-T/31i

Refer to the instruction manual issued by NC unit manufacturer.

6-1 Specifications

Items	Specifications
Controlled axes	
Primary control axes	2 axes (X, Z) 3 axes (X, Z, C) ^{*1}
Simultaneously control axes	2 axes (X, Z) 3 axes (X, Z, C) ^{*1}
Input command	
Programmable unit	Least input increment X: 0.001 mm (diametrical command) Z: 0.001 mm C: 0.001 degrees ^{*1} Least command increment X: 0.0005 mm Z: 0.001 mm C: 0.001 degrees ^{*1} Max. programmable dimension X: ±99999.999 mm Z: ±99999.999 mm C: ±99999.999 degrees ^{*1}
Programming unit system	Inch/metric conversion Increment system 1/10 0.0001 mm ^{*2}
NC machine program	EIA/ISO automatic recognition Control IN/OUT Program number : O4-digit Sequence number : N5-digit G code system A G code system B/C ^{*2}

Items	Specifications
Input command	
Programming numeric value	Absolute/Incremental programming Decimal point programming/ Pocket calculator type decimal point programming Diameter/radius programming (X-axis : diametrical command)
Buffer register	Buffer register
Interpolation	
Positioning	Positioning (G00)
Linear/Circular interpolation	Linear interpolation (G01) Circular interpolation (G02/G03) : Multi-quadrant is possible Polar coordinate interpolation *1 Cylindrical interpolation *1
Feed	
Feedrate	Rapid feedrate Jog feedrate Cutting feedrate
Commands of feed	Feed per minute : mm/min Feed per revolution : mm/rev Tangential speed constant control
Override	Rapid traverse override F ₀ (400) mm/min, 25%, 50%, 100% Cutting feedrate clamp Cutting feedrate override 0~150% in increment of 10% Jog override 0~1260 mm/min Feedrate override cancel

Items	Specifications
Feed	
Acceleration/deceleration	Rapid traverse bell-shaped acceleration/deceleration Linear acceleration/deceleration after cutting feed interpolation
Threading	Chamfering ON/OFF Threading, synchronous cutting (G32) Multiple threading Continuous threading Variable lead threading Rigid tapping (Main spindle) Rigid tapping (Rotary tool) * ¹
Manual feed	Jog feed Manual rapid traverse Manual handwheel feed (1 manual pulse generator) Manual feed per revolution * ² Incremental feed * ²
Dwell	Dwell (G04)
Part program storage and editing	
Storage capacity	Part program storage capacity: 1 Mbyte (incl. 262 Kbyte for loader) Registered programs: (0i-T) 800(incl. 150 for loader) Registered programs: (31i) 1000(incl. 150 for loader)
Editing	Part program editing Part program protection Background editing Extended pat program editing

Items	Specifications
Operation and display	
Operation and display panel	10.4 inch color LCD/MDI
Operation methods and functions	Automatic operation (memory) MDI
Displayed items	Status display Clock function Current position display Program display Parameter setting and display Help function Actual cutting feedrate display Display of spindle speed and T-code at all screens Directory display of floppy cassette Directory display and punch for each group Display of hardware and software configuration Graphic display
Native language display	Japanese (Chinese character) English *2, German *2, French *2, Italian *2, Chinese (Traditional Chinese) *2, Chinese (Simplified Chinese) *2, Spanish *2, Korean *2, Portuguese *2, Polish *2, Hungarian *2, Swedish *2, Czech *2, Russian *2, Turkish *2, Dutch *2, Danish *2, Bulgarian *2, Romanian *2

Items	Specifications
I/O functions and devices	
I/O interface	RS-232-C (Reader/puncher) DNC operation *2 PCMCIA (memory card) USB memory DNC operation with memory card *2 Data server *2
Spindle speed, tool and miscellaneous functions	
Spindle-speed function (S function)	S4-digits Constant surface speed control Spindle override: 50 to 150%
Position control	Orientation
Tool function (T function)	T2 + 2-digits
Miscellaneous function (M function)	M3-digits High speed M/S/T/B interface Plural number of M command in one block : 3
Second miscellaneous function (B)	B8-digits
Tool offset/compensation	
Number of tool offsets	Tool offset pairs: 64 pairs
Tool length	Tool offset
Tool radius	Tool nose radius compensation (G40 to G42)
Function of offset/compensation	Tool geometry/wear compensation Tool offset value counter input Direct input of tool offset value measured Direct input of tool offset value measured B (Tool setter) *2

Items	Specifications
Coordinate system	
Coordinate system type and setting	Machine coordinate system Coordinate system setting (G50) Automatic coordinate system setting Coordinate system shift Direct input of coordinate system shift Workpiece coordinate system (G54 to G59) * ² Workpiece coordinate system preset * ²
Return to reference position	Manual reference position return Automatic reference position return (G28) Reference position return check (G27) 2nd reference position return (G30) 3rd/4th reference position return (Previous arrangement is required.) * ²
Operation support functions	
Program skip and stop	Label skip Single block Optional stop (M01) Optional block skip (/) Optional block skip : 2 to 9 * ² Program stop (M01) Program end
Program test	Dry run Machine lock * ²

Items	Specifications
Operation support functions	
Program call, start and stop	Cycle start Feed hold Reset/rewind Program number search Sequence number search Sequence number collation and stop Program restart *2
Interruption	Threading retract Manual intervention and return *2 Manual absolute ON/OFF (Ordinary ON) *2 Manual handle interruption *2
Programming support function	
Program	Sub program call : 4 folds nested
Macro program	Custom macro B Addition of custom macro common variables Interruption type custom macro *2
Fixed cycle/canned cycle	Canned cycles Multiple repetitive cycle (G70 to G76) Multiple repetitive cycle II Canned cycle for drilling
Mirror image function	Mirror image (Each axes)
Drawing dimensions input	Chamfering, corner R Direct drawing dimension programming *2
Programmable data input	Programmable data input
Machine error compensation	
Static error compensation	Backlash compensation Backlash compensation for each rapid traverse and cutting feed *2

Items	Specifications
Machine error compensation	
Dynamic error compensation	Feed forward control
Automatic support function	
External data input/output	External tool compensation/offset input * ² External data input * ² External key input * ² External workpiece number search * ² External coordinate system shift * ²
Measuring function	Skip * ² High-speed skip * ² Torque limit skip * ²
Monitoring function	Tool life management Unexpected disturbance torque detection function * ² Run hour and parts count display Position switch * ²
Safety and maintenance	
Safety operations	Emergency stop Data protection key (1 kind) Data protection key (4 kinds) * ²
Safety and maintenance display	Alarm display NC alarm External operator message Operation history display Periodic maintenance screen Maintenance information screen Alarm history display Operator message history display Servo setting screen

Items	Specifications
Safety and maintenance	
Safety function	Interlock Stored stroke check 1 Stored stroke check 2, 3 * ² Stored limit check before move * ² Chuck and tailstock barrier * ²
Diagnostics	Parity check Self-diagnostics function
Enclosure and installation	
Enclosure	Sealed dust-proof type
Power supply	Voltage (AC 200V +10% to -15%) Frequency (50/60Hz +1Hz to -1Hz) Voltage (AC 220V + 10% to -15%) Frequency (60Hz +1Hz to -1Hz)
Environment and installation	Ambient temperature At operating: 0~55 degrees At storage, transportation: -20 to 60 degrees Temperature variation Maximum 1.1 deg./min Ambient relative humidity Normally: Less than 75% Short term (within one month) : Less than 95% Vibration Less than 0.5G

Items	Specifications
Servo system (hardware)	
Feed drive system	Servo motor : AC servo motor β is series Servo drive amplifier : Servo amplifier α i series Position sensor : Serial pulse coder
Spindle	AC spindle motor β iI series, α iI series Spindle amplifier: Spindle amplifier series α i
Machine control support functions	
Programmable controller	Built-in PMC
Customize	
	Macro executor

*1: When C-axis and milling specification.

*2: Option

6-2 Memory card

The NC programs and the data inside of CNC can be input and output by using the memory card interface of a NC unit.

NOTE : * Use the memory card recommended by FANUC.

- * In some types of CNC, SRAM card and flash memory card cannot be used.
- * The format type of the memory card is a FAT file system.
- * A high-capacity memory card (1 GB or more) cannot be used.

1. Corresponding memory cards

The following four types are used as corresponding memory cards.

- * Compact flash card (CF card)
- * ATA flash card
- * SRAM card
- * Flash memory card

7 ASSEMBLY DRAWING

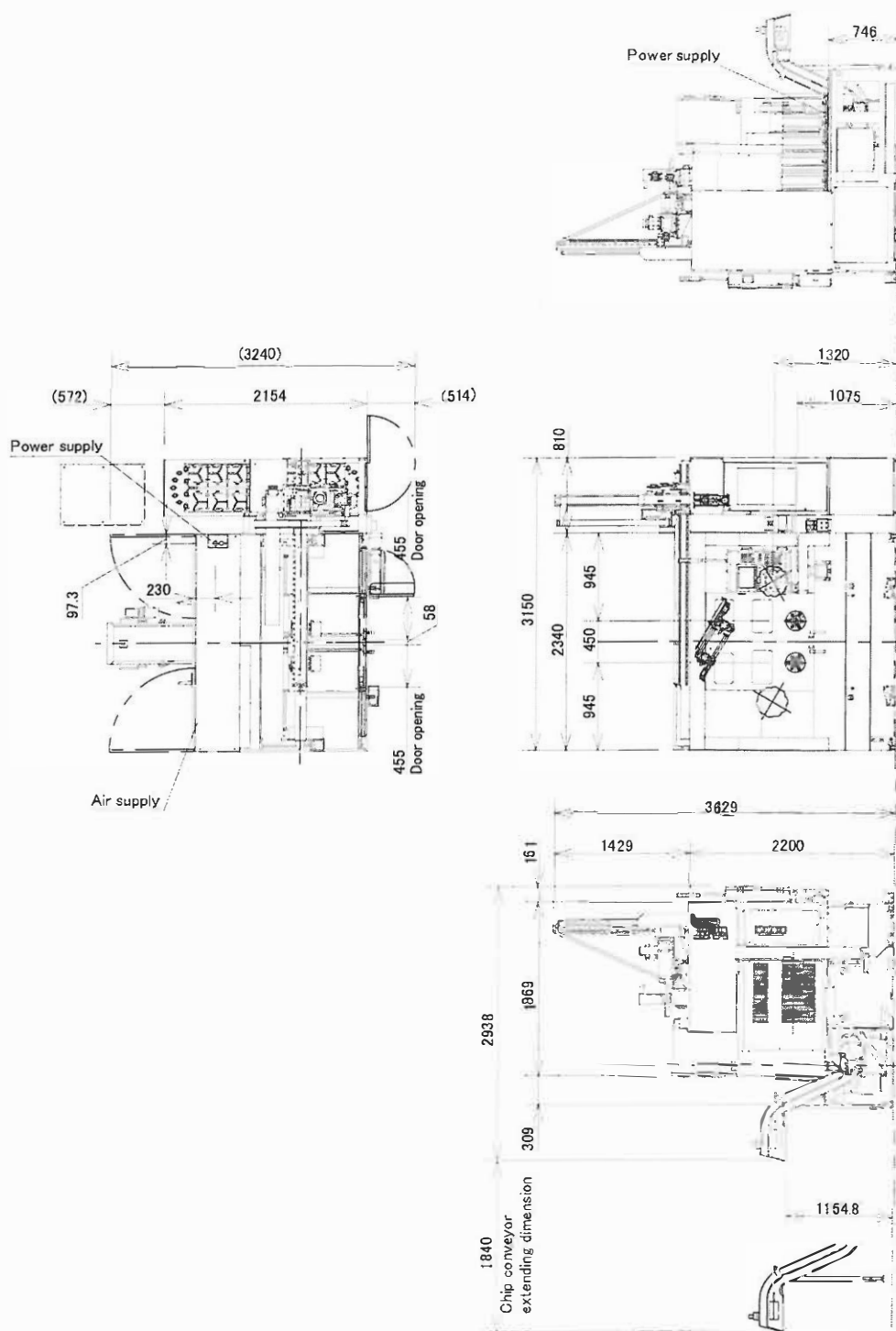


Fig. A7(a) Assembly drawing (8 inch type, Type A)

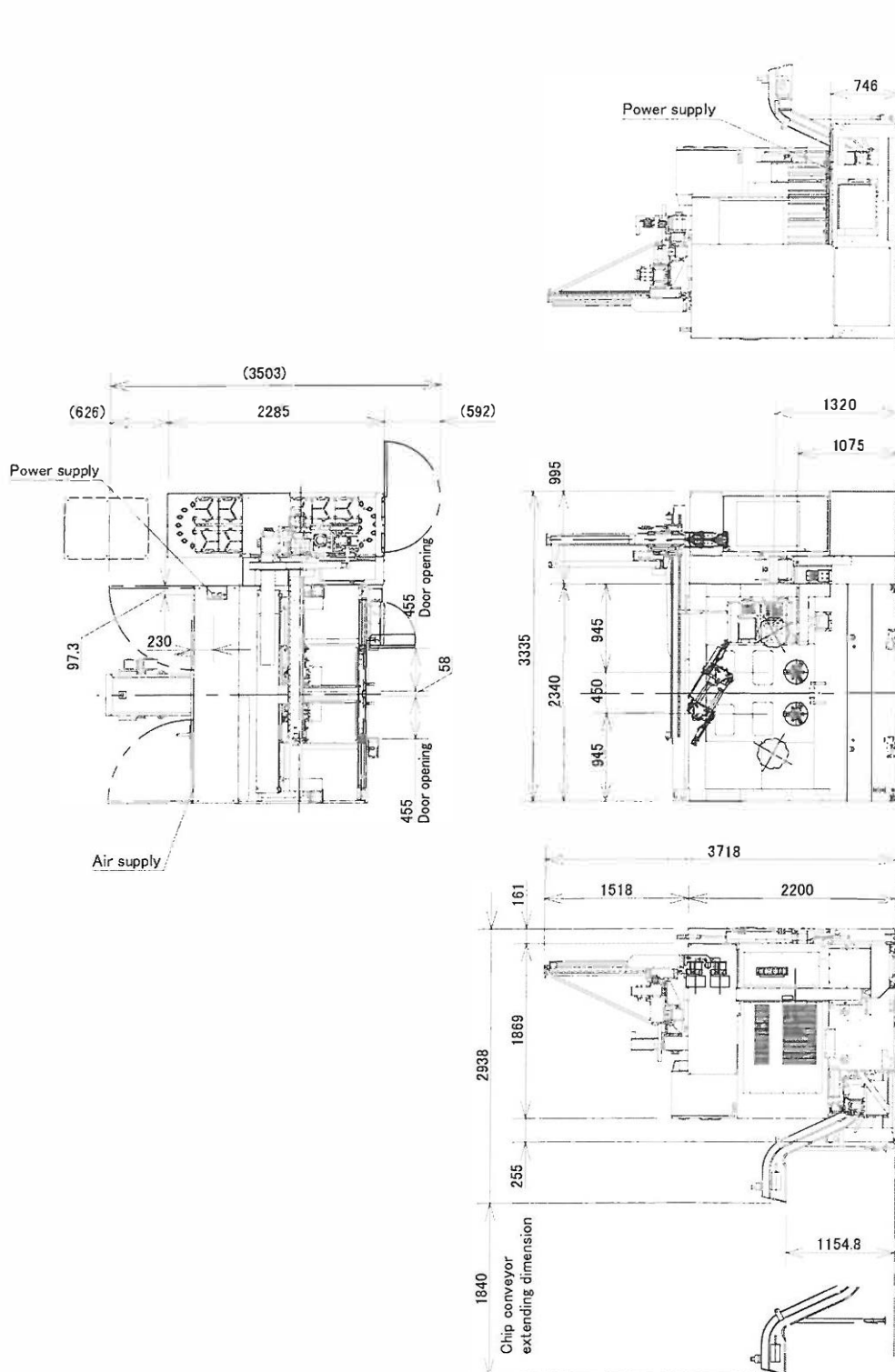


Fig. A7(b) Assembly drawing (10 inch type, Type B)

8 MACHINE COMPONENTS

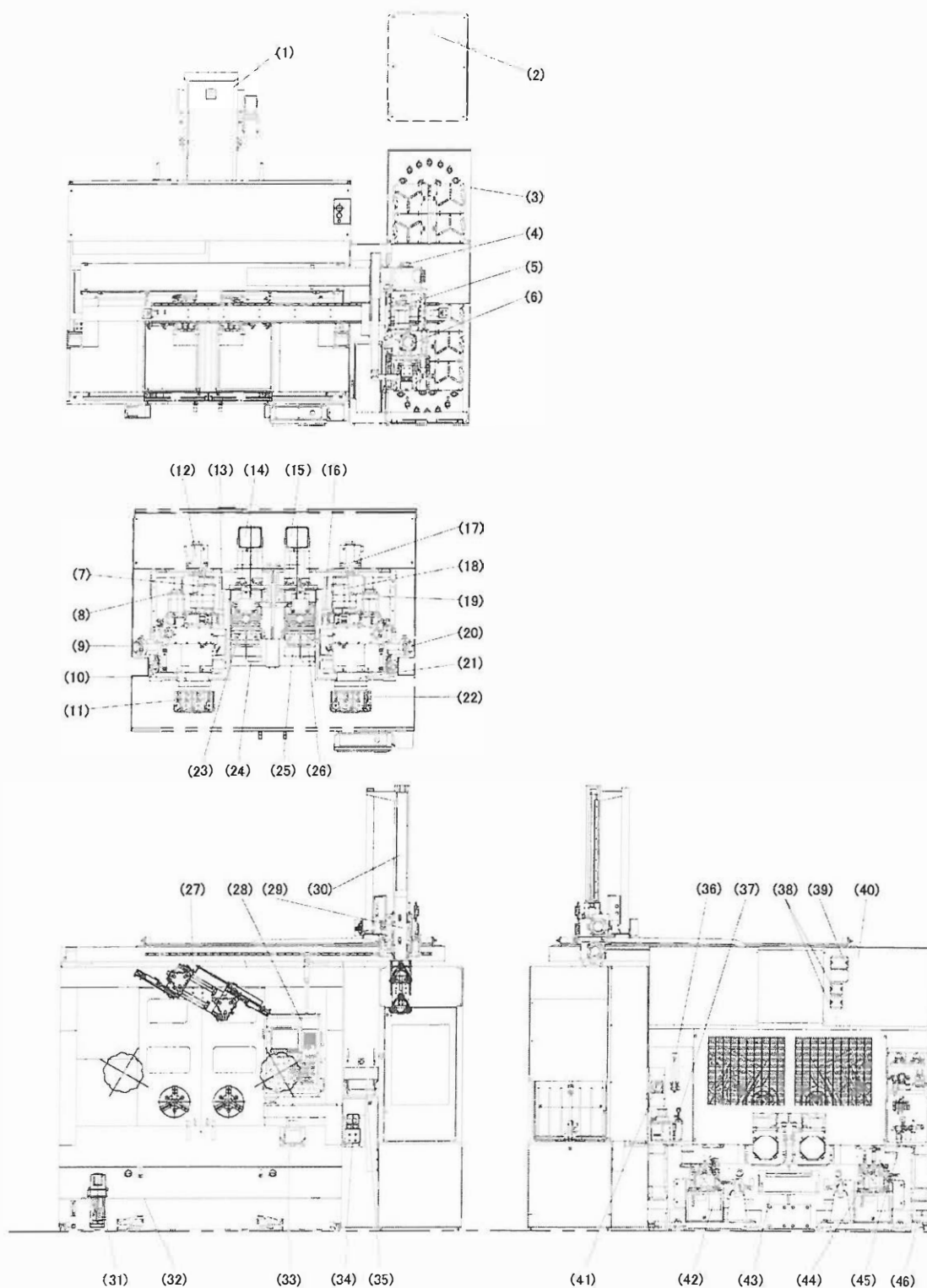


Fig. A8 Machine components (C-axis, milling, Type A)

- | | |
|-----------------------------------|---------------------------------------|
| (1) Chip conveyor | (24) L-chuck |
| (2) Transformer | (25) R-chuck |
| (3) Workpiece feeder | (26) R-headstock |
| (4) L-loader X-axis feed | (27) Reversing equipment |
| (5) L-loader Y-axis feed | (28) R-operation panel |
| (6) L-loader Z-axis feed | (29) Loader air panel |
| (7) L-rotary tool spindle motor | (30) Loader |
| (8) L-turret indexing motor | (31) Coolant pump |
| (9) L-X axis feed motor | (32) Coolant tank |
| (10) L-turret | (33) Loader pendant |
| (11) L-C axis milling type turret | (34) Hydraulic operation panel |
| (12) L-Z axis feed motor | (35) Shute |
| (13) L-saddle, L-cross slide | (36) Loader lubrication pump |
| (14) L-spindle motor | (37) Lubrication unit |
| (15) R-spindle motor | (38) Battery for absolute pulse coder |
| (16) R-saddle, R-cross slide | (39) Battery for NC unit |
| (17) R-Z axis feed motor | (40) Enclosure |
| (18) R-rotary tool spindle motor | (41) Main breaker |
| (19) R-turret indexing motor | (42) R-hydraulic unit |
| (20) R-X axis feed motor | (43) Bed |
| (21) R-turret | (44) L-hydraulic unit |
| (22) R-C axis milling type turret | (45) Main air panel |
| (23) L-headstock | (46) Spindle brake operation panel |

NOTE :The loader or work feeder can be used as twin unit.

B. INSTALLATION

This chapter explains about steps from installation to operation.

WARNING

- * When workers operate the machine together, check signs each other.
If not so, any operator may be wound in rotary members or caught in movable parts, thus leading to a personal injury or machine malfunction.
- * Carefully read [SAFETY GUIDE] to understand machine operations sufficiently before operating the machine because a personal injury and machine malfunction will be caused.
- * Provide the protective fence at the working area and put up the signboard of KEEP OFF to its place.
If not so, it leads to circumference's operator accidents resulting in injury or death.
- * Each operator wears the helmet and safety shoes and clothes suited in safety work.
If not so, it leads to accidents resulting in injury or death, such as damage, bruises, etc.

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 1-1 Installation environment B3

 1-2 Foundation.....B5

2 HOISTING.....B8

3 MACHINE LEVEL B13

4 POWER SUPPLY B14

5 OIL SUPPLY B16

6 CHECK BEFORE OPERATION B17

1 INSTALLATION OF MACHINE

CAUTION

- * Install the machine in a suitable environmental condition.
If not so, it leads to machine malfunction by the troubles of the electric systems of this machine and peripheral equipment, etc.

1-1 Installation environment

The NC lathe is equipped with various precision units.

Therefore, the machine environment arrangement is very important to facilitate good the machine performance and to keep the machine operational for many years.

The lathe is to be installed indoors so as not to be exposed to the weather. Take extreme care so that the room temperature, foreign matter, vibration, noise, etc., do not influence the lathe.

< Notice for environment >

- (1) Protect the machine where exposed to a direct sunlight and ventilation from the air-conditioning equipment.
- (2) Foreign matter and humidity has a bad influence on the slideway and electrical appliance.
- (3) Take care so as not to increase the vibration and noise of the environment equipment.

(4) Environment conditions

Room temperature: 0-35 degree

Temperature variation: 1.1 degree/h. or less

Humidity: 75% or less (under 20°C)

However, the accuracy guarantee temperature of machine ambient temperature is 17 °C - 25 °C , and daily (24-hour) temperature difference is within $\pm 2\text{ }^{\circ}\text{C}$.

Vibration: 0.5G or less

1-2 Foundation

When installing the machine tool, it is necessary to lay a strong foundation for keeping the machining accuracy in the best condition in accordance with the ground character at the site.

REF.: [Fig. B1-2 (a) ~ (b) Foundation drawing]

< Notice for foundation work >

- (1) Usually, lay the shop floor at 300 mm of the concrete thickness and the soil bearing capacity of 0.05 MPa or more.
- (2) The foundation area is to be about 300 mm around the bed.
- (3) Consider the open/close door of control panel, chip conveyor, oil pan, and chip removing and maintenance space before determining the installation space.

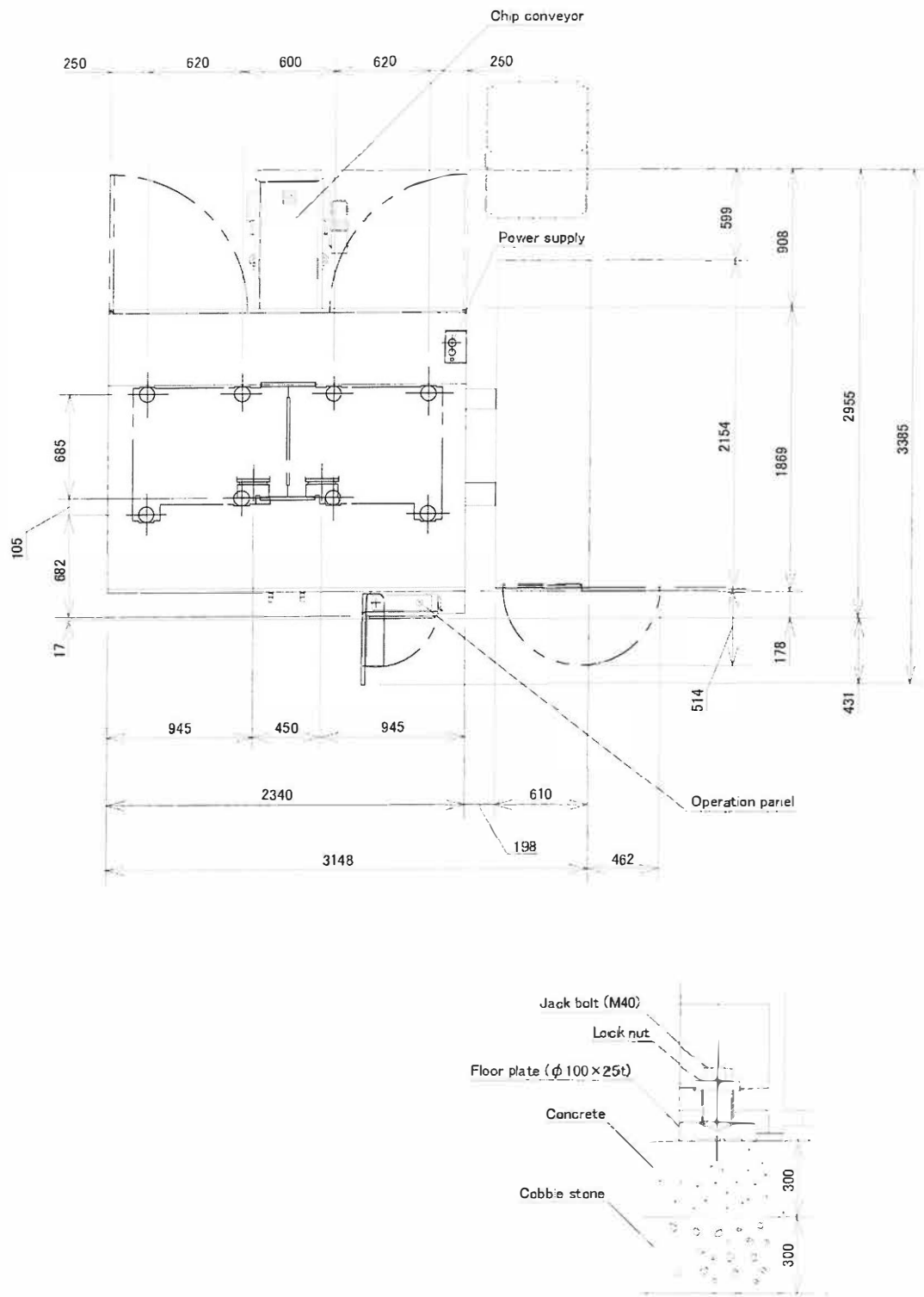


Fig. B1-2 (a) Foundation drawing (8 inch type, Type A)

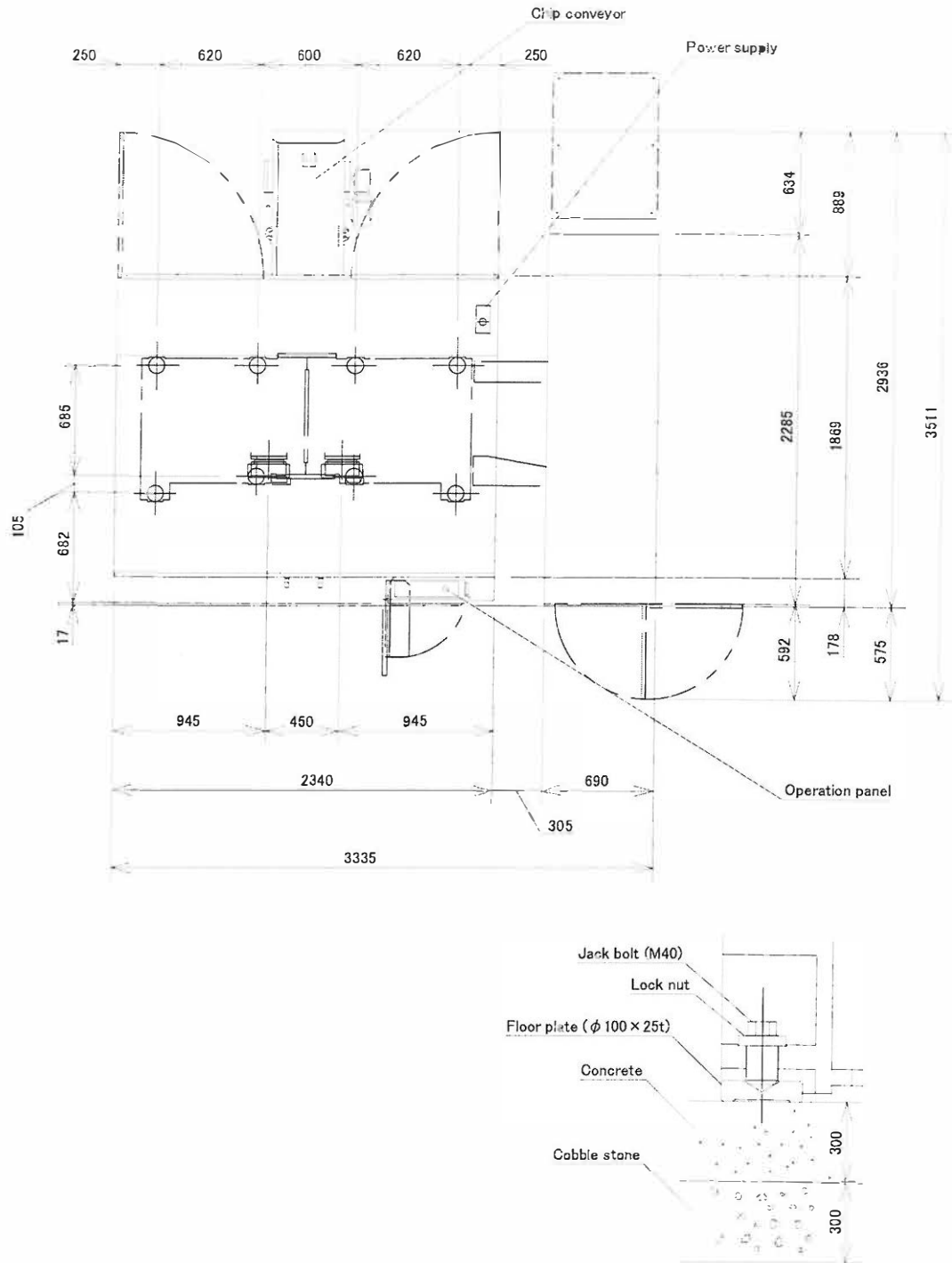


Fig. B1-2 (b) Foundation drawing (10 inch type, Type A)

2 HOISTING

WARNING

- * Qualified persons shall operate the crane and the slinging work for hoisting the machine.
If the persons who have not the knowledge for safety operation of the crane and the slinging work operate the crane and perform the slinging work, it may cause the physical accidents or the damage of machine.
- * Do not use a twisted or string-cut wire rope.
Using inadequate wire ropes or fixtures may cause the physical accidents or the damage of machine because of the machine fall.

CAUTION

- * When transferring the work feeder with the forklift, insert the fork under the frame so that the fork of forklift does not push the lifter part of workpiece. If the lifter is pushed from side, the lifter may be damaged.

The machine is transferred with the crane, etc., for installation.

At this time, take extreme care since the machine is hoisted and lowered through the slinging work and can be dangerous.

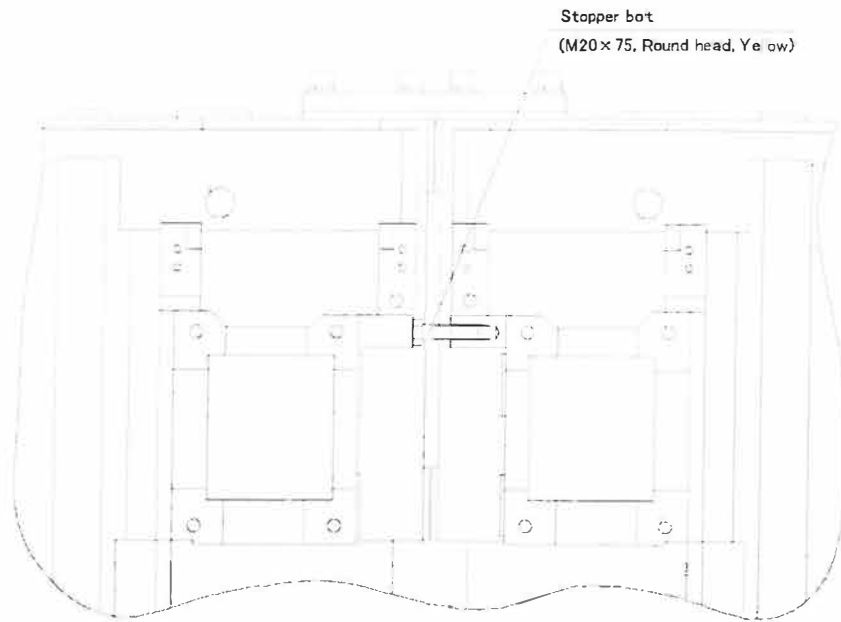
REF.: [Fig. B2(b) Hoisting of machine]

< Note for slinging work >

- (1) Move the loader to R-spindle and lower Y-axis as it will go in the one direction before mounting fixed jig. Also, mount the fixed jig to the main machine.
- (2) Separate the coolant tank and the workpiece feeder from the machine.
- (3) Prepare the hoisting fixture of I-type steel of about 150mm × 125mm.
- (4) The wire rope used for hoisting shall be 16mm or more of diameter.
Mass of machine is approx. 6300kg for 8 inch type and approx. 6400kg for 10 inch type.
- (5) Set the hoisting wire slings so that the center of gravity of the machine will be positioned as shown in [Fig. B2(b)].
If the machine is unbalance, adjust it with shackles, etc.
- (6) When hoisting the machine, gradually hoist it and stop the hoisting once when the wire rope is strained to check the slinging wires.
When the machine rises just from the ground or floor by re-hoisting, also check the slinging wires and the center of gravity of the machine.
When lowering the machine, gradually lower it similarly with the hoisting. Stop the lowering once just before the machine reaches the floor and check the installation position before slowly lowering the machine on the correct position.
After installing the machine, remove jigs (yellow), fixing the saddle and cross slide onto the machine.
- (7) The stopper bolt (yellow) is mounted between the right and left headstocks before shipping the machine from the ship. After installing the machine, tighten the bolt to separate the right and left headstocks.
REF.: [Fig. B2(a) Fixed bolt before shipping]

CAUTION

- * When the machine is operated without executing item (7), vibration on one side spindle is conducted to another spindle, thus resulting in a harmful influence for machining.



→ Tighten the bolt fully to separate the both headstocks so as not to push the opposite spindle.

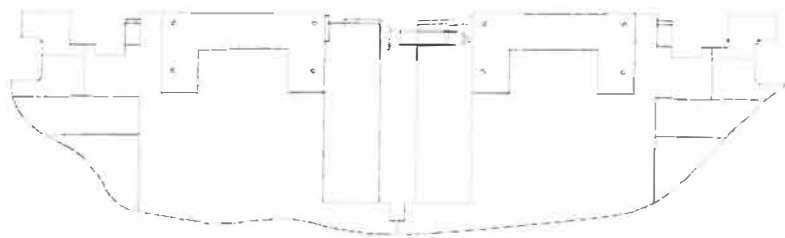


Fig. B2(a) Fixed bolt before shipping

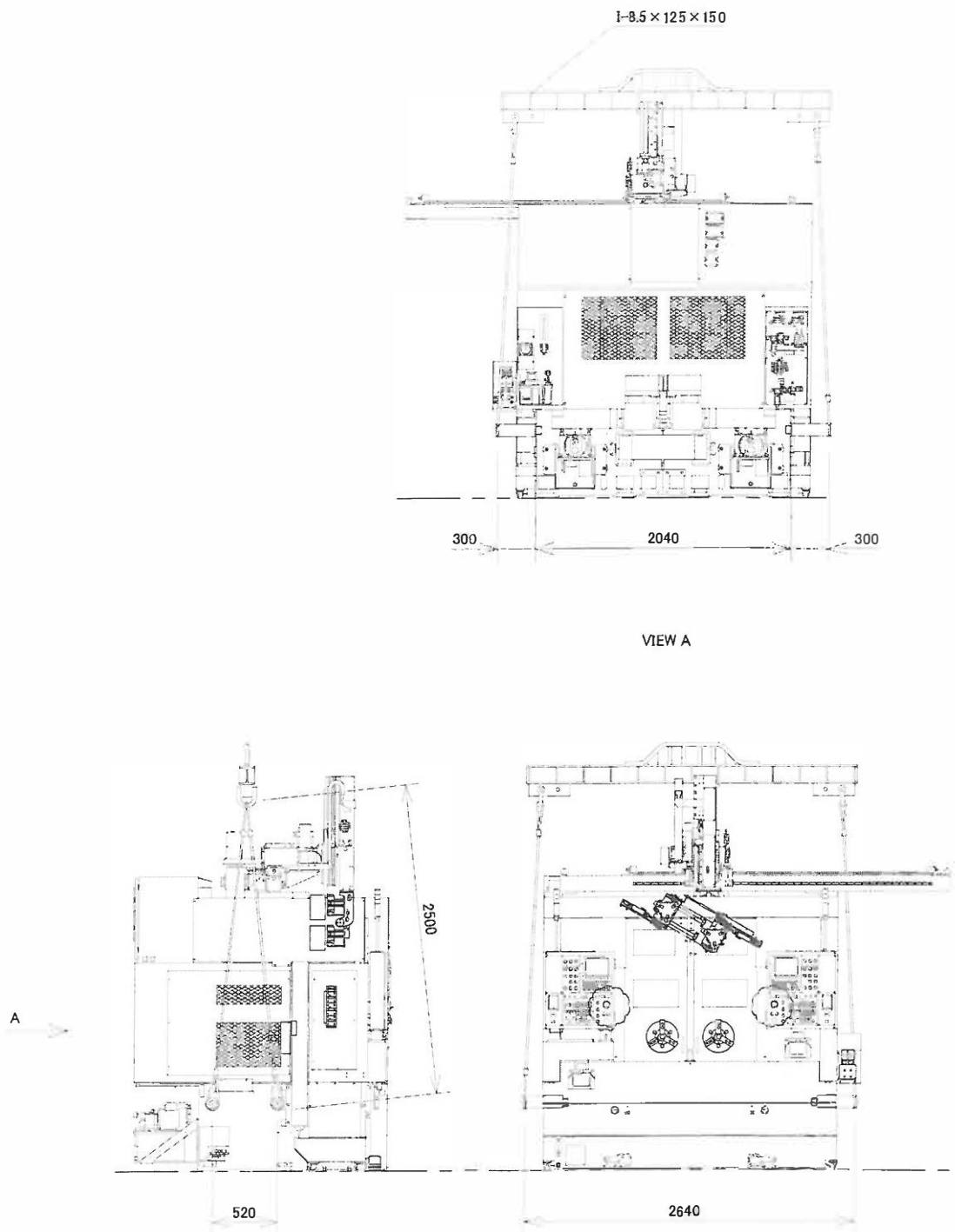


Fig. B2(b) Hoisting of machine

3 MACHINE LEVEL

The machine leveling is most important to maintain machining accuracy and machine service life.

Remove fixed jigs (yellow) before adjusting the machine level.

Next, remove rust preventives coated on each slideway of X-axis and Z-axis and also, remove lapped paper onto the ball screw.

The following procedure is recommended for leveling the machine.

- (1) Place levels (0.02 mm/m sensitivity) adjusted in advance on the bed slideway in the Z-axis and X-axis directions.
- (2) Adjust jack bolts under the bed so that a bubble in the level will be in center.

< Check item >

Level check: Per 1000 hrs

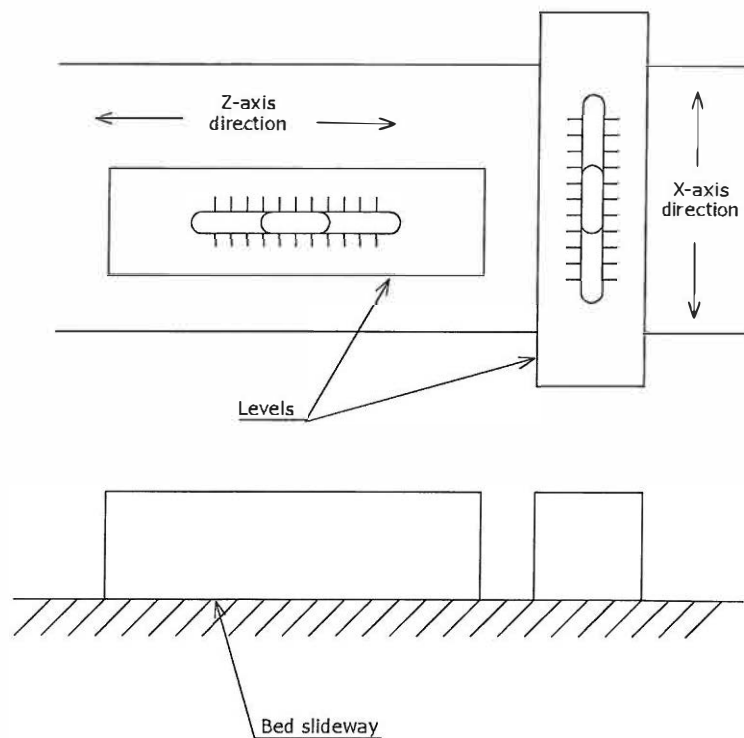


Fig. B3 Machine level

4 POWER SUPPLY

DANGER

- * For electrical work, take extreme care so as not to be shocked by the live part of the machine because there is danger, which could result in death or serious injury from electric shock.**
- * Qualified person shall perform an electric work because there is danger, which could result in death or serious injury from electric shock.**

When installing the machine, route the power cable from the power switch on the shop to the primary side of the main breaker (QF1) in the enclosure on this machine.

Power capacity and the thickness of cable differ by the specifications of machine.
[REF.: Table B4 Power equipment capacity]

Lead in the power cable from the left side face of the enclosure and connect it to the main breaker after checking L1, L2 and L3.

Use the copper electric wire (PE), which has the thickness shown in [Table B4] for earth cable and earth resistance is to be less than 100 ohm.

[REF.: Fig. B1-2(a) to (c) Foundation drawing]

< Power equipment capacity >

* AC three phase

* 200, 220, 230, 380, 415 V $\pm$ 10%

* 50/60 $\pm$ 1 Hz

Type	Spindle motor	Power capacity (kVA)	Power cable sizes	
			200 ~ 230 V (mm ²)	380 ~ 460 V (mm ²)
TT-2600 A/B/C	β iI8	39 kVA	60 mm ²	22 mm ²
	β iI12	47 kVA	80 mm ²	30 mm ²
	α iI15	58 kVA	100 mm ²	38 mm ²
TT-2600 D	β iI8	42 kVA	60 mm ²	22 mm ²
	β iI12	50 kVA	80 mm ²	30 mm ²
	α iI15	61 kVA	120 mm ²	38 mm ²

Type	Spindle motor	Power capacity (kVA)	Earth cable sizes	
			200 ~ 230 V (mm ²)	380 ~ 460 V (mm ²)
TT-2600 A/B/C	β iI8	39 kVA	30 mm ²	22 mm ²
	β iI12	47 kVA	50 mm ²	30 mm ²
	α iI15	58 kVA	50 mm ²	22 mm ²
TT-2600 D	β iI8	42 kVA	30 mm ²	14 mm ²
	β iI12	50 kVA	50 mm ²	30 mm ²
	α iI15	61 kVA	60 mm ²	22 mm ²

Table B4 Power equipment capacity

5 OIL SUPPLY

For supplying the machine lubrication and coolant, refer to [Chapter C, 3 LUBRICATION AND OILING].

At the time of installation, make sure to check the level gauge of each oil tank and fill them up in accordance with a refueling instruction [Table C3-1(a) Oiling control table] and a recommended oil comparison list [Table C3-1(b) Recommended oil table].

Since the spindle has already been greased, it is unnecessary to grease it. However, the user shall supply the coolant.

6 CHECK BEFORE OPERATION

Be sure to check the following items before operating the machine.

For operation, refer to [OPERATION MANUAL].

1. Power voltage

Measure the voltage of each conductor spacing of 3-phase (L1, L2, L3) and check unbalance is within $\pm 10\%$.

2. Power indicate

Turn on the [Main breaker] on the enclosure and check the [Power indicating lamp] lights.

3. Operation ready

Reset the [Emergency stop switch] and press [Operation ready ON switch] to check the [Operation ready ON switch] lights.

4. Rotary direction of each motor

Check the rotary direction of each motor and the traveling direction of each axis by the following operation.

If the direction is reverse, reversibly reconnect any two wires among three wires of power cable.

When pressing any switch of the [Manual operation mode select switch], the manual operation is possible.

* For hydraulic unit

When pressing [Operation ready ON switch] is applied, the motor drives to start the hydraulic unit.

* For coolant

Pressing [Coolant ON switch] discharges the coolant.

At this time, check the rotary direction of the coolant pump.

* For chip conveyor

The conveyor is transferred in the unloading direction by pressing the [Chip conveyor forward switch].

5. Hydraulic unit

Set the main pressure of hydraulic unit to 3.5 MPa.

Usually, this pressure has already been set before shipping.

C. DAILY CHECK

This chapter explains about items to daily check the machine operation.

Since this check is essential for machine diagnosis, be sure to check the machine daily.

WARNING

- * Carefully read [SAFETY GUIDE] to understand machine operations sufficiently before operating the machine because a personal injury and machine malfunction will be caused.
- * Read [OPERATION MANUAL] and [PROGRAMMING MANUAL] to understand operation method.
A personal injury and machine malfunction will be caused if proper safety producers and instructions are not adhered to.

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2	HANDLING OF OIL	C4
2-1	Storage of oil	C5
2-2	Precautions for oiling	C6
2-3	Drain treatment.....	C7
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3-2	Coolant.....	C14
4	CHECK FOR STARTING.....	C16
4-1	Before distributing powers.....	C16
4-2	Check after operation ready	C18
5	CHECK BEFORE AUTOMATIC OPERATION.....	C20
6	WARMING-UP.....	C22
7	CHECK DURING AUTOMATIC OPERATION	C23
8	CHECK AND CLEANING AFTER WORK FINISH.....	C25
9	DAILY CHECK LIST	C27

1 SIGNIFICANCE OF CHECK

To effectively operate the machine, satisfactorily exercising the function and performance of the machine, the operator shall understand the function and performance well.

The machine accuracy and service life are maintained by daily checking and oiling.

Therefore, the operator shall check and maintain the machine according to the daily check items.

Report points noticed during check to the facility manager.

The facility manager shall cope with their points.

If they cannot be coped with, contact your agent or our technical service department.

2 HANDLING OF OIL



CAUTION

Do not leak oil on the working floor. There is danger of slipping and falling.
If leaked, immediately wipe the floor.

2-1 Storage of oil



(1) Store the oil indoors so as not to be exposed to direct sunlight.



(2) Cap the drum can so that foreign matter or water will not enter during storage.

(3) Do not use a deteriorated oil or dust-mixed oil because the machine will malfunction.

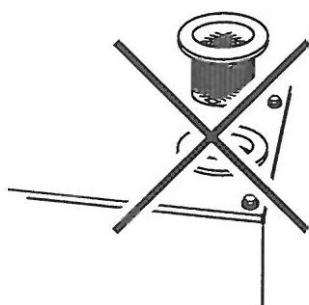
2-2 Precautions for oiling



- (1) Exclusively use the oil jug so as not to mix it with other oil.

Designate the oil name on the jug.

Take care not to allow any foreign object or impure substance such as water, dirt, chip, dust to enter.



- (2) Do not remove the filter set to the oiling port of each tank when oiling.

2-3 Drain treatment



(1) Do not discard drain thoughtlessly.

Low prohibits discarding the industrial waste without permission.



(2) For the drain treatment, consult waste traders or a gasoline station.

3 LUBRICATION AND OILING

3-1 Lubrication

Lubrication and oiling portions of the machine are as shown in [Figs. C3-1 Oiling portions] and [Fig. C3-1 (a) ~ (f)].

If oil is insufficient after checking each oil gauge, replenish the oil according to [Table C3-1 (a) Oil control table] and [Table C3-1 (b) Recommended oil table].

Since the spindle has already been greased, it is unnecessary to grease it.

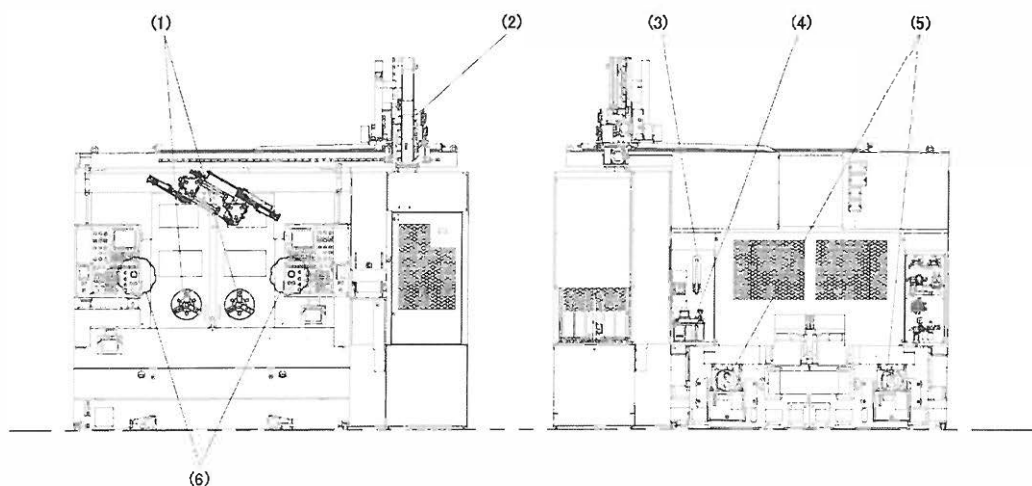


Fig. C3-1 Oiling portions

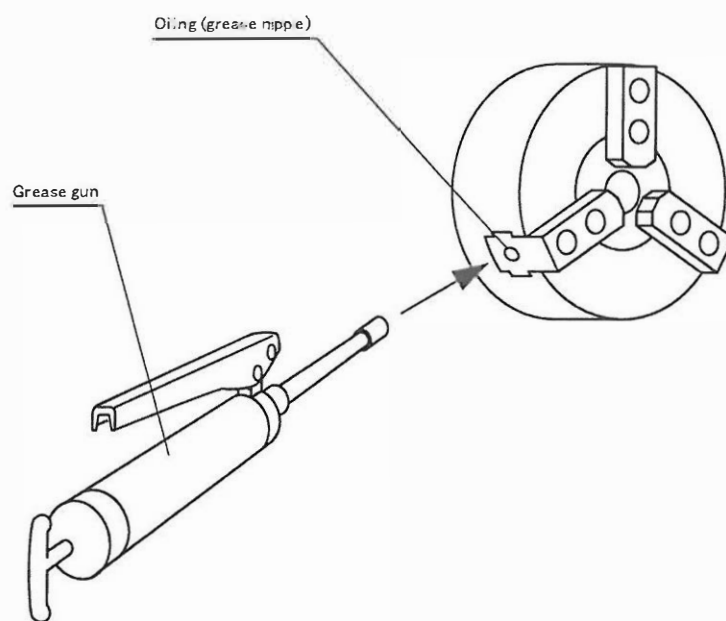


Fig. C3-1(a) (1) Chuck

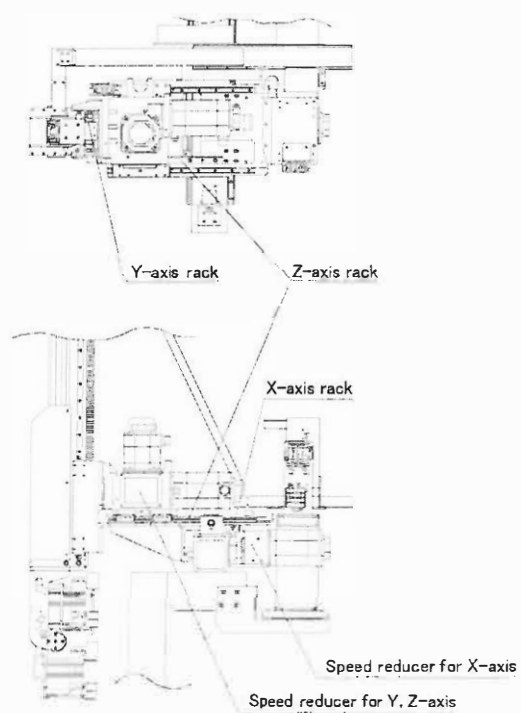


Fig. C3-1(b) (2) Loader gear box, Rack and pinion

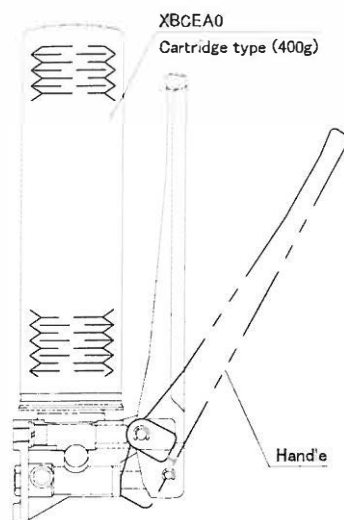


Fig. C3-1(c) (3) Loader guide hand pump

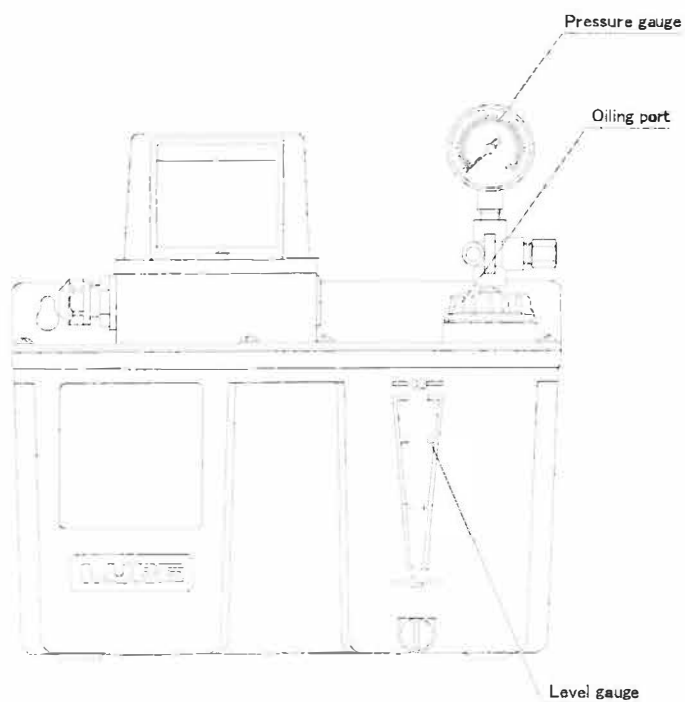


Fig. C3-1(d) (4) Oiling to lubrication unit

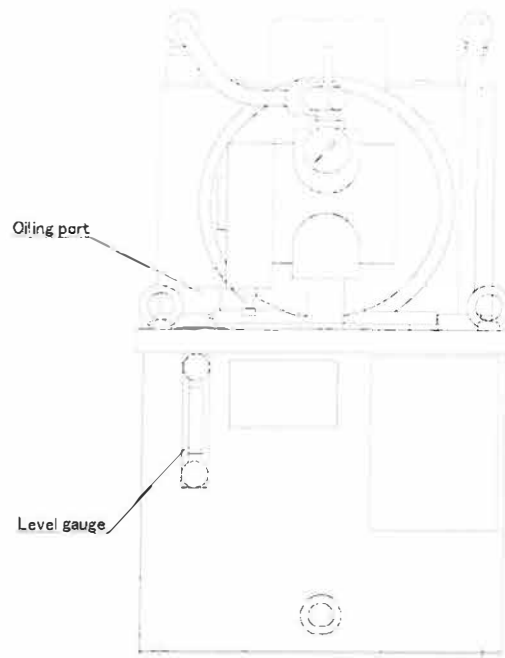


Fig. C3-1(e) (5) Hydraulic unit

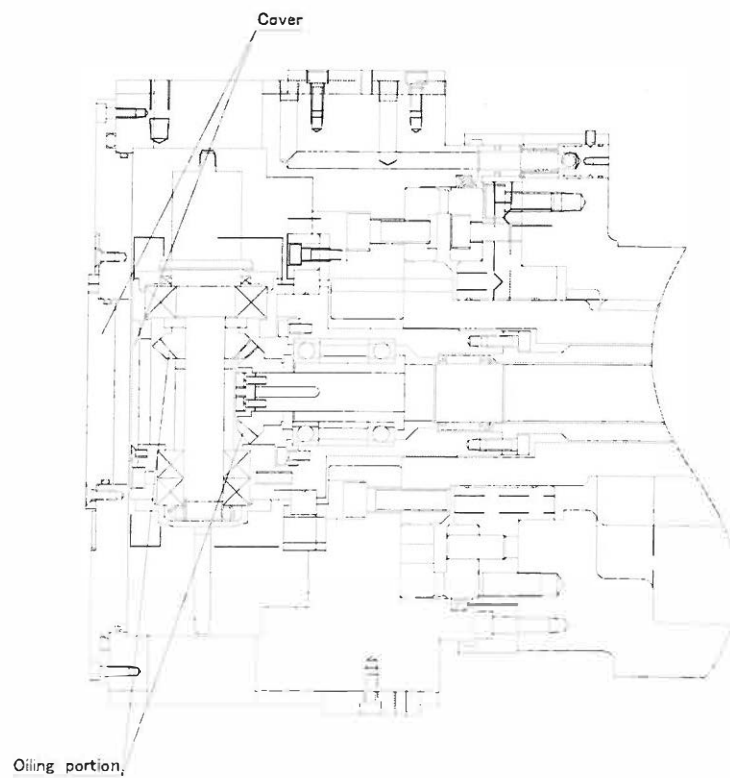


Fig. C3-1 (f) (6) Rotary tool gear

No.	(1)	(2)	(3)
Component	Chuck	Loader gear box Rack and pinion	Loader guide hand pump
Lubrication	Grease gun	Grease gun	Hand pump
Check period	8h	240h	56h
Change period	Daily supply	720h	56h
Replenishing	Proper	Proper	4cm ³ A, B type C (Lever four times operation) Type D (Lever eight times operation)
Lub. Name	—	—	—
	Grease Moricoat EP grease	EXXON Mobil Mobilith SHC100	XBCEA 0 (No.0) Lithium gerase

No.	(4)	(5)	(6)
Component	Lubrication unit	Hydraulic unit	Rotary tool gear (option)
Lubrication	Forcedly	—	Grease gun
Check period	8h	8h	720h
Change period	Daily supply	2000h	720h
Replenishing	3L	19L	20cm ³
Lub. Name	ISO Standards	ISO Standards	—
	VG68	VG32	Grease
	Slideway lub. Oil	Hydraulic oil	ISOFLEX NBU15 (NOK KLUEBER)

Table. C3-1 (a) Oiling control table

Mark Manufacturer	ISO Standards	
	VG68	VG32
EXXON Mobil	Mobil Vactra Oil No.2	Mobil DTE Oil Light
Shell	SHELL TONNA OIL S68	SHELL TELLUS OIL C32

Mark Manufacturer	NLGI Standards
	XBCEA 0 (No. 0)
EXXON Mobil	Mobilux EP 0
Shell	SHELL ALVANIA EP GREASE R 0

- NOTES: (1) Do not use bad deteriorated oil.
- (2) Do not mix the oil with the oil of other manufacturer.
- (3) Clean the inside of the tank and piping immediately if oil other than specified oil is lubricated or other manufacturer's oil is mixed.

Table C3-1 (b) Recommended oil table

3-2 Coolant

The coolant is divided into two kinds (water-soluble and non-water soluble coolant). There are the coolant of the primary quality for increasing the cutting performance, tool life, accuracy of finished surface and the secondary quality for contributing the putrefaction, safety, profitability, etc., of coolant.

Select the coolant by considering the following points so as not to cause the machine from trouble.

(1) Primary quality (increasing cutting performance)

- * This is used for increasing the accuracy of finished surface by reducing the cutting resistance and wearing the nose.
- * The tool life is lengthened by lowering the cutting temperature.

(2) Secondary quality (easy to use)

- * Protects cut metal and workpiece from rust.
- * Protects oil from fume and spraying.
- * Uniformed quality (not deteriorated without making separation and layer status of oil).
- * Innocuous quality for human body (no odor).
- * Prevents painted surface from permeation.

The coolant is prepared by user and then when the coolant can be supplied in the tank, watch out the level gauge of front side oil pan.

Oiling capacity: 240 L

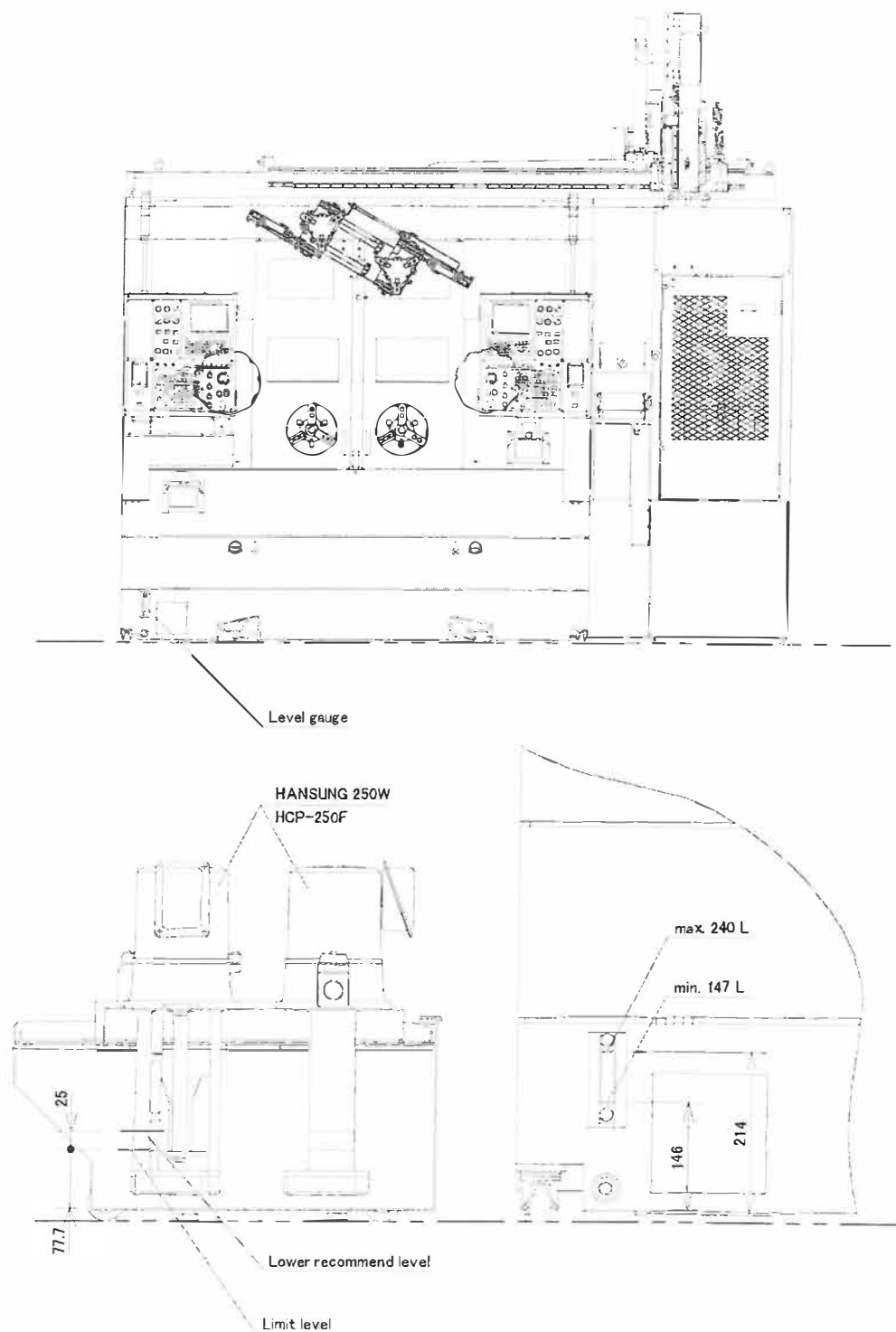


Fig. C3-2 Supply of coolant

4 CHECK FOR STARTING

4-1 Before distributing powers

WARNING

- * If any malfunction is detected on maintenance, do not operate the machine until the machine is repaired completely.
If not so, a personal injury or machine malfunction will be caused.

CAUTION

- * Remove chips certainly.
If chips are not well disposable, the machine may be miss-operated or the workpiece may also be incorrectly machined.



- (1) Check the machine environment is adequate.
 1. Outer piping and duct
 2. Disconnection of cable and breakdown of wire cover
 3. Breakdown of hydraulic and air pneumatic hoses.
 4. Check each door of the machine is not opened.
 - * Enclosure
 - * Front door
 - * Cover removing



(2) Check the floor of the environment equipment.

1. Oil leakage

* Coolant, lubrication, hydraulic oil, etc.

2. Arrangement of obstruction on working floor

* Tools, jigs, measuring instrument, materials, etc.

3. Chip treatment of chip box

(3) Check chips are not adhered or accumulated on the loader hand, reverse rotation hand, shutter, workpiece feeder, etc.



(4) Check the pressure gauge of hydraulic pressure becomes zero (0).

1. Hydraulic unit

2. Hydraulic operation panel

4-2 Check after operation ready

WARNING

* If any malfunction is detected on maintenance, do not operate the machine until the machine is repaired completely.

If not so, a personal injury or machine malfunction will be caused.



(1) Check the sound or noise while the hydraulic unit is operated.



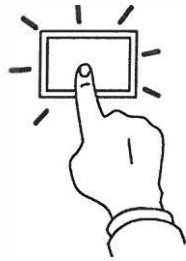
(2) Check the pressure of hydraulic equipment.

- * Main pressure 3.5 MPa of hydraulic unit
- * Pressure of hydraulic cylinder for chuck
- * Pressure of C-axis brake (C-axis, milling)

(3) Check the pneumatic is 0.4 MPa.



(4) Check the operation of the lubrication pump.



(5) Check functions of switches and indicating lamps on the operation panel are adequate.

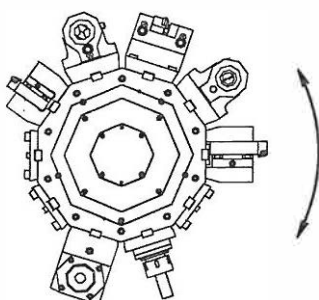


(6) Check alarm message or indication does not appear on the screen.

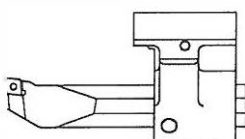
5 CHECK BEFORE AUTOMATIC OPERATION

WARNING

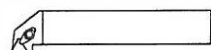
- * If any malfunction is detected on maintenance, do not operate the machine until the machine is repaired completely.
If not so, a workpiece or a jaw flies, thus resulting in a fatal accident or machine damage.



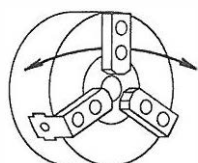
(1) Check each tool holder is adequately mounted.



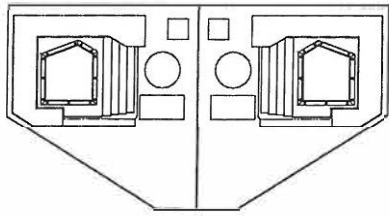
(2) Check tool and boring bar is adequately mounted.



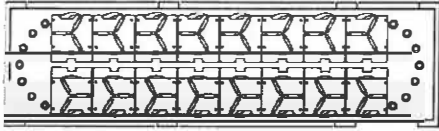
(3) Check tips and wears of tool or boring bar.



(4) Check the top jaw of the chuck is adequately mounted.



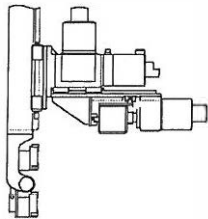
- (5) Check the dust wiper or slide cover is not damaged.



- (6) Check the workpiece or any tool is not placed on the portion except the pallet.

Check the front or the back of workpiece is correctly set.

Check the detection height of photoelectric switch is equivalent to the height of workpiece.



- (7) Check the program corresponding to the workpiece is selected.

Check the loader hand clamps the workpiece correctly.

6 WARMING-UP

To reduce bad influence on the workpiece machining accuracy from heat occurring in the first stage of the automatic operation as much as possible, perform the warming-up of the spindle and axis travel before starting the automatic operation. When preparing the program for the warming-up, program various functions in addition to the spindle rotation (1000 min^{-1}) and rapid traverse modes.

CAUTION

- * If the spindle is immediately rotated after stopping the machine for a long period of time (a week or more), the spindle bearing may be seized because the spindle lubrication is insufficient.

At this time, be sure to perform the warming-up at the spindle speed of 300 min^{-1} and 500 min^{-1} for 30 minutes each.

For details of warming up, please contact our company.

7 CHECK DURING AUTOMATIC OPERATION

WARNING

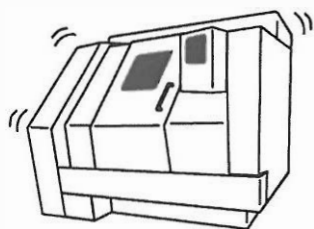
* If a machine malfunction is detected on the maintenance, stop the machine immediately. Do not operate the machine until the machine is recovered or repaired completely.

If not so, a personal injury or machine malfunction will be caused.

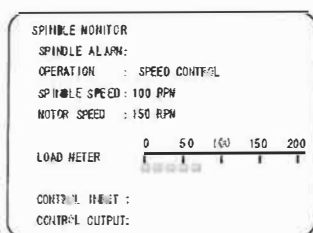


(1) Check the sound or noise and vibration of the spindle.

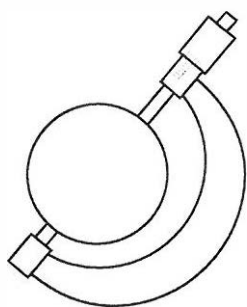
(2) Check the sound or noise of the spindle motor.



(3) Check the vibration of the machine during automatic operation.



(4) Check the loaded condition of the spindle motor.



(5) Check the machining accuracy of the workpiece.

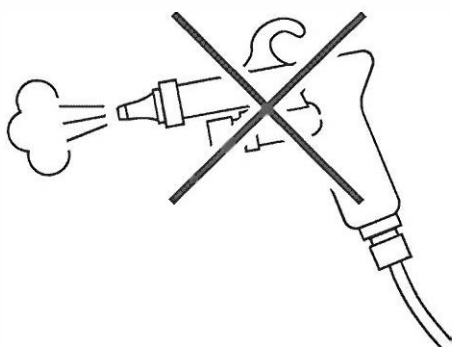
8 CHECK AND CLEANING AFTER WORK FINISH

CAUTION

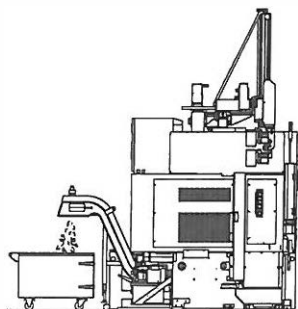
Do not remove chips or coolant with compressed air.

Also, clean the inside of machine with its air.

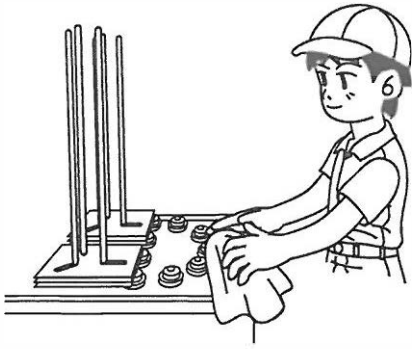
The machine may malfunction because chip, slant, etc., will adhered onto any important mechanism.



- (1) Clean the inside of machine with the brush or the waste.



- (2) Discharge chips on the bed and the chip conveyor to the outside of machine and transport the chips in the chip box to the specified place.



(3) Cleanly remove chips discharged on the shutter part for loader.

(4) Cleanly remove chips discharged on the workpiece feeder.

Especially, the pawl of proximity switch for dog the pallet stop position may be mis-operated if the chips are accumulated.

9 DAILY CHECK LIST

Daily check the machine before operation according to the following checklist.

Checklist (Before power ON)

Components	Check items	Criterion
< Environment of machine >		
Power cables	Check it is not broken.	
Hydraulic and pneumatic hoses	Check they are not broken.	
Each door	Check it is closed.	
Floor	Fats and oils are not leaked.	
	Chips are not scattered.	
	Check there is no obstruction.	
Chip box	Check chips are treated.	
< Lubrication and oiling >		
Oil storage	Check oil storage is adequate.	
Oil jug	Check it is exclusively used and it is not feared that oil is mixed.	
Drain	Check control and treatment for drain is adequate.	
Hydraulic unit	Check level gauge is around HIGH of level.	
Lubrication unit	Check level gauge is around HIGH of level.	
Chuck	Check chuck is greased.	
Coolant	Check level gauge is around HIGH of level.	

Checklist (Before power ON)

Components	Check items	Criterion
< Tool slide and chuck >		
Tool holder	Check tool holder is fixed.	
Tool , Boring bar	Check they are fixed.	
Tip	Check it is onto loosened or worn.	
Chuck	Check jaws are onto loosened.	
	Check jaw-traveling part is cleaned.	
	Check there is no chip in coolant recovery port.	
< Others >		
X and Z-axis cover	Check dust wiper and slide cover are not damaged.	
Hydraulic pressure gauge	Check main pressure gauge becomes zero (0).	
Loader, Reverse rotation device	Check chips are not accumulated.	
Shutter	Check chips are not accumulated.	
Work feeder	Check chips are not accumulated.	
	Check workpiece is not placed on portion except pallet.	

Checklist (After power ON)

Components	Check items	Criterion
Hydraulic unit	Check pump sound is adequate.	
Hydraulic pressure gauge	Check main pressure is 3.0MPa.	
	Check pressure for chuck cylinder is adequate.	
	Check C-axis brake pressure is adequate. (C-axis, milling)	
Pneumatic unit	Check supplied pressure is 0.4MPa.	
Lubrication unit	Check pump runs.	
Operation panel	Check switches are adequately operated.	
LCD	Check error message is not displayed.	

D. MAINTENANCE

This chapter explains about the procedure for maintenance periodically performed to maintain the machine accuracy and service life.

Maintenance men shall perform the maintenance, referring to this manual together with other manuals.

DANGER

**Be sure to turn off a power source before performing a maintenance work.
There is in danger of death from shock by high voltage.**

CAUTION

- * Carefully read [SAFETY GUIDE] to understand machine operations sufficiently before operating the machine because a personal injury and machine malfunction will be caused.
- * Workers shall well understand and observe precautions for the maintenance.
If not observed, there is in danger of causing unexpected injury.

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1 SIGNIFICANCE OF MAINTENANCE CHECK

The machine is maintained for the purpose of improving the working efficiency and productivity of the machine, preventing any machine trouble by finding early failure through the maintenance check.

For this reason, it is important to periodically have maintenance persons perform the maintenance check according the schedule table prepared based upon [Periodical check list].

To cope with the machine conditions follow the advice of an operator who performs the daily check of machine.

For the maintenance work, refer to the OPERATION MANUAL, ELECTRIC DIAGRAM, and LADDER DIAGRAM in addition to this manual.

2 PREPARATION BEFORE MAINTENANCE

The following procedure is recommended for effectively performing the maintenance work.

This daily preparation serves to detect any problems that may require immediate repair.

- (1) Understand the machine condition by following the advice of an operator who operates the machine on site.
- (2) Plan the working area and steps after checking the machine condition.
- (3) Understand the specification, structure and function of the maintaining-component.
- (4) When joint work is performed at the concerned portion, carefully prearrange the working content with joint workers in advance.
- (5) When replacing parts and consumables are required, prepare them in advance.
- (6) Prepare working fixtures such as tools, step-ladder, stool, etc.

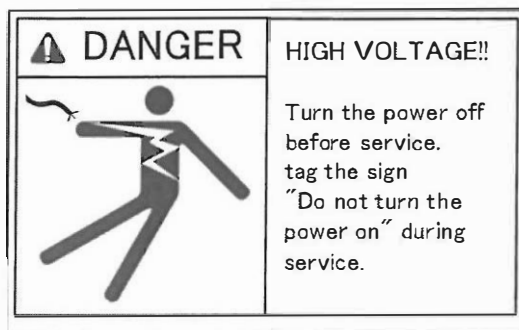
3 PRECAUTIONS FOR MAINTENANCE MAN

Take extreme care because the maintenance work is accompanied by various dangers.

Maintenance persons shall observe the following precautions.

DANGER

- * **When an electrical maintenance is performed, be sure to turn off the power source and lock the main breaker. If the maintenance work is performed with the power source on, any operator receives an electric shock, is wound in the rotary members and is caught in movable parts, thus resulting in personal injury.**
- * **Hang out the warning sign of [POWER-ON BAN] during maintenance.**



 DANGER

- * Maintain the electric system by responsible electric maintenance person.**
If person who has not the safe knowledge of an electrical work will perform the work, the person receives an electric shock.
- * When the joint work is performed, be sure to give or receive [SIGN] to or from a party.**
When operating the machine without checking a party sign, an operator receives an electric shock, is wound in the rotary members and is caught in movable parts, thus resulting in personal injury.
- * Be sure to turn off the power source when working inside of the machine.**
When performing the maintenance work in the inside of a machine with a power source on, the machine may operate due to the accidental cause. Thus, any operator is wound in the rotary members and is caught in movable parts, thus resulting in personal injury.

WARNING

- * Wear the personal protective equipment and clothes suitable to work in when working.
If not so, it leads to a personal injury, such as a laceration, a blow and being wound into rotary members.
- * Designate [DURING MAINTENANCE] to environment during maintenance.
When worker other than a person concerned operates a machine accidentally, maintenance engineer leads to a personal injury.
- * Use tools suitable for the purpose.
If inadequate tool is used, it leads to a personal injury and a machine malfunction.
- * When handling heavy equipment or parts, use the crane.
Balance is lost during work and any operator is inserted in a falling object. Thus, it leads to a personal injury.
- * Do not use string-cut or twisted wire rope.
A personal injury will be caused because the lifted thing falls.

4 CHECK AND ADJUSTMENT OF FEED SYSTEM

4-1 Check and replacement of slide wiper system

The slide wipers are located on the saddle slideway and cross slideway.

The slide wipers protect the slideway from chip entering and maintain the lubrication film uniformly.

Periodically check slide wipers.

When finding the wear or breakdown of lip, immediately replace it.

< Check item >

Check of slide wipers : Every 1000 hrs. or 6-month

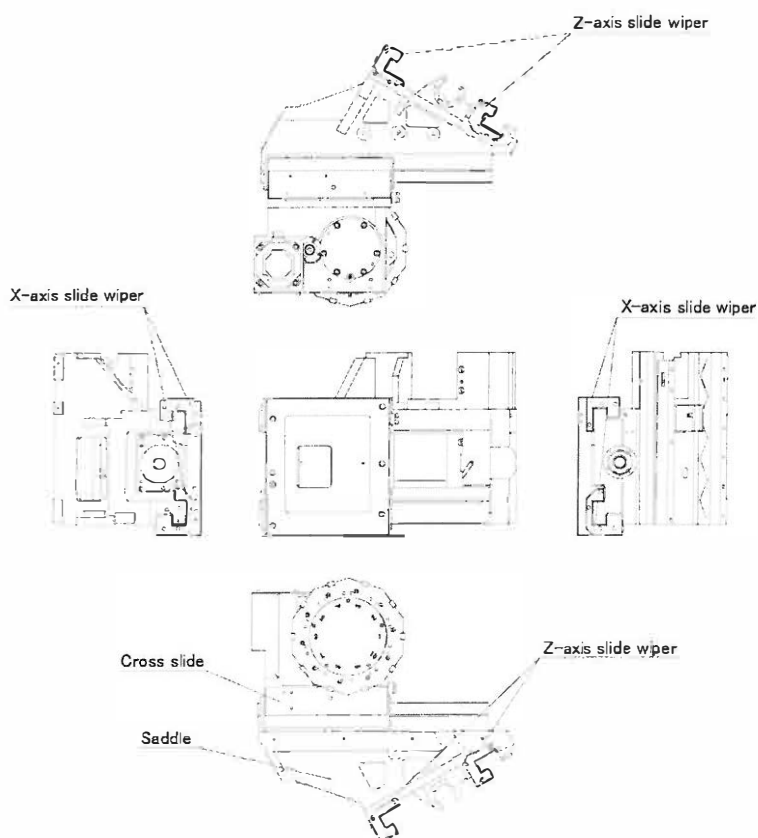


Fig. D4-1 Check and replacement of slide wiper system

4-2 Adjustment of taper gib

Three taper gibs are inserted in the gap between the bed slideway and the saddle in the Z-axis direction and three taper gibs are inserted in the gap between the saddle slideway and the cross slide in the X-axis direction. Similarly, three taper gibs are inserted in the arrow direction. Each gap has already been adjusted before shipping. However, the gap may be increased by the wear and loosening of the taper gib for long-range use.

If the gap of slideway is increased, the machining accuracy will be badly influenced. In this case, it is necessary to adjust the taper gib.

The following explains about inserting methods (1) to (6) of the taper gibs.

REF.: [Fig. D4-2 Adjustment of taper gib]

< Adjust steps >

- (1) Remove the slide wiper on each slideway.
- (2) Loosen [Adjusting screw B] sufficiently.
- (3) Tighten [Adjusting screw A] with the hexagon screwdriver to force the taper gib. At this time, don't tighten the screw strongly.
- (4) Tighten [Adjusting screw B].
- (5) Tighten the [Adjusting screw A] once again to check the taper gibs are completely fixed.

NOTE: Check current values of feed motors of X-axis and Z-axis so that the taper gibs are not too forced.

For adjustment, increase the feedrate in the order of [Handwheel feed], [Feedrate] and [Rapid traverse].

< Inspection period >

When a feeding condition becomes unstable or it has an influence on machine accuracy because a taper gib is worn or loosened for using it for a long period of time, it is necessary to adjust it.

Moreover, check the taper gib once a 3-year.

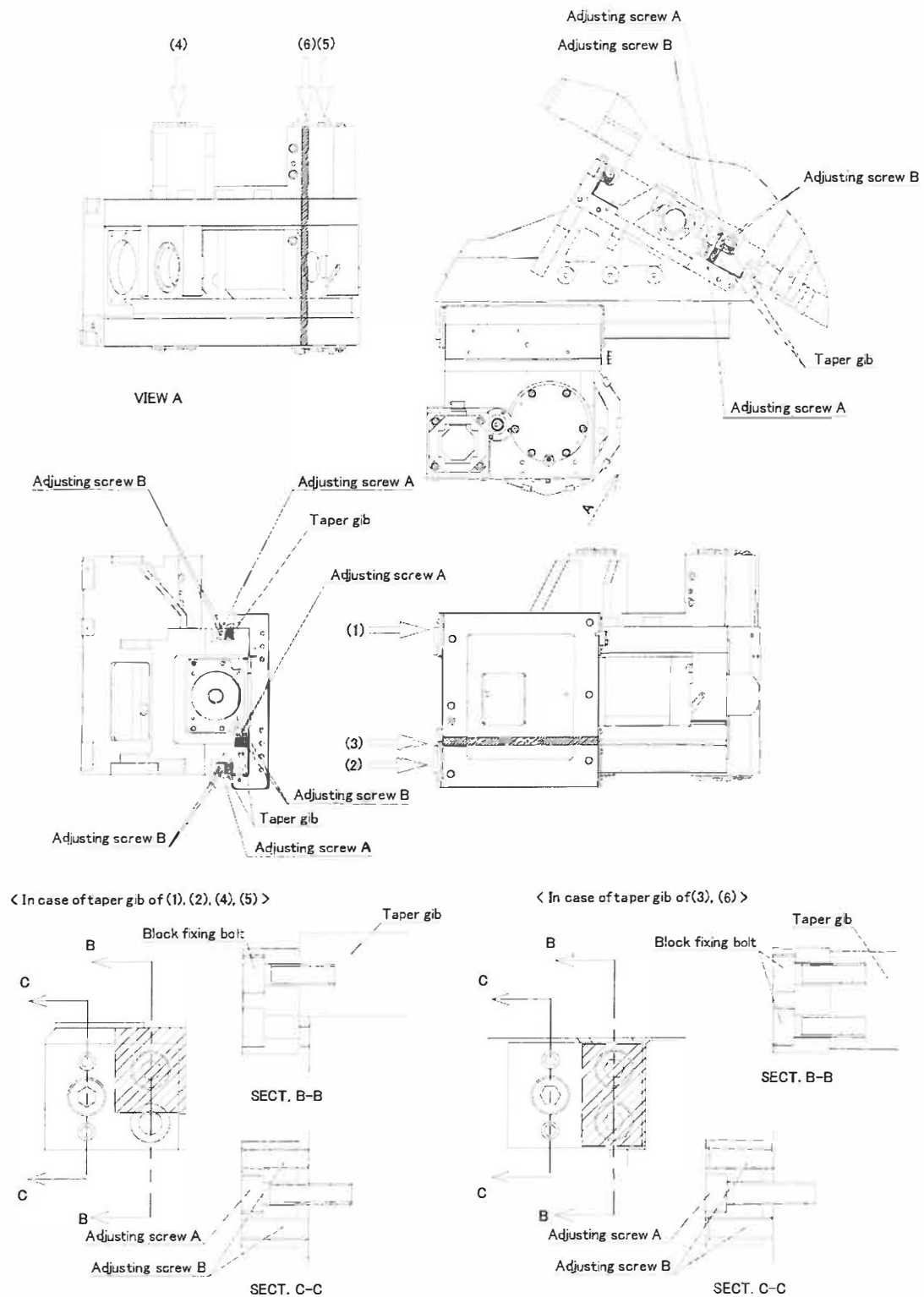


Fig. D4-2 Adjustment of taper gibs

4-3 Backlash

There is a possibility that values commanded to X-axis, Z-axis from NC unit do not correspond to the quantities when the tool slide, spindle travel or rotate actually.

This is caused by the mechanical gap from the feed motor to the feeding drive gear. There are the following backlashes and gap.

- (1) Backlash of ball screw
- (2) Backlash of coupling connected with the motor and ball screw
- (3) Gap of taper gib on slideway

The backlash is caused to the drive system because the above is accumulated.

However, the movable part of the machine needs the some backlash.

If the backlash is too small, the service life such as bearing, ball screw, etc., is shortened and also, noise or vibration will be caused.

To electrically correct the error by backlash of this drive system, the NC unit is equipped with a function correcting the backlash.

The correction may become inadequate long-range use.

At this time, it is necessary to adjust the backlash.

Also check the backlash after adjusting the taper gib.

< Check item >

Check of backlash ... every 1000 hrs.

<Recommended value>

less than 0.030 mm

1. Measuring of backlash

This item explains the measuring method of backlash in X-axis direction.

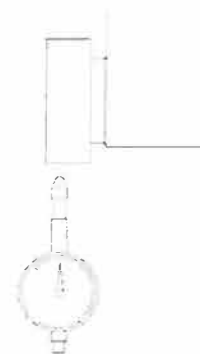
Similarly measure the backlashes in Z-axis direction too.



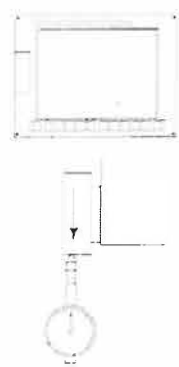
- (1) Press [Handwheel feed select switch of X-axis] of [Handwheel feed select switch of each axes].



- (2) Press [Handwheel feed magnification switch] to let both the $\times 10$ and $\times 100$ switch lamps go out. At this time, one scale of handwheel is equivalent to 0.001 mm.



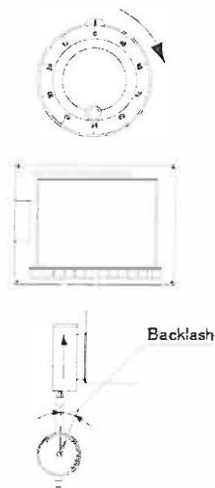
- (3) Mount the dial gauge (0.002 mm) so that its tip is around the end face.



- (4) Touch the turret to the dial gauge by turning the [Handwheel] to the left.
Clear each value of the current position (relative coordinate) on screen to zero (0).
Also, set the scale of the dial gauge to zero (0).



- (5) Turn the [Handwheel] about 20 scales to the left.



- (6) Turn the [Handwheel] to the right to clear the each value of current position (relative coordinate) on screen to zero (0).

At this time, the difference for the dial gauges zero (0) is the backlash.

2. Setting of backlash

Set the compensation of backlash to the parameter of NC unit from MDI panel.

For details, refer to [Parameter Manual] prepared by NC unit manufacturer.



- (1) Press [MDI mode select switch] of [Mode select switch].



- (2) Press [OFFSET/SETTING] key on MDI panel to display [SETTING (Handy)] screen.

- (3) Move the cursor to the position of [Parameter WRITE].

When pressing soft keys of [SETTING], [(OPERATION)], [ON: 1] in order, WRITE is possible.

At this time, [ALM] lamp flickers and the machine is in alarm condition.

- (4) When pressing the [PARAMETER] of the soft key after pressing [SYSTEM] key, the parameter screen appears.

- (5) When pressing the [NO. SEARCH] of the soft key after inputting the parameter No. of the backlash, the parameter is displayed.

Parameter No.: 1851

- (6) Adjust the cursor the position of X, Z or C and
input the compensation of the backlash.
Press [INPUT] key of the soft key.

* Calculation of X-axis backlash compensation

When correcting the following.

Backlash = 0.010 mm

$$\text{Compensation} = \frac{\text{Backlash}}{0.001} = \frac{0.010}{0.001} = 100 \text{ (pulse)}$$

<Example>

X-axis backlash = 0.02 mm

└─> Parameter No.1851 (X) = 400

* Calculation of Z-axis backlash compensation

When correcting the following.

Backlash = 0.013 mm

$$\text{Compensation} = \frac{\text{Backlash}}{0.0001} = \frac{0.013}{0.0001} = 130 \text{ (pulse)}$$

* Calculation of C-axis backlash compensation

When correcting the following.

Backlash = 0.030°

$$\text{Compensation} = \frac{\text{Backlash}}{0.001} = \frac{0.030}{0.001} = 30 \text{ (pulse)}$$

- (7) Press [OFFSET/SETTING] key to display
[SETTING] screen.

When pressing [OFF: 0] of the soft key, write is
impossible.

- (8) When pressing [RESET] key, the alarm condition
is released.



4-4 Establishing of reference position of each axis (X, Z, C-axis)

WARNING

- * When the reference position is deviated or lost because of the position adjustment or replacement of a headstock or tool slide, establish each reference position to a correct position once more.
- * If the machine is operated with each reference position established to incorrect position, the machine may cause unexpected accident or machine trouble.

The absolute pulse coders are used for the servomotors of X-axis and Z-axis. When the reference position is established first, the position is stored. After that, each axis performs the reference position return at high speed. (Memory has already been adjusted before shipping.)

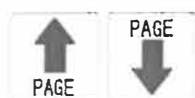
1. To erase reference position memory of each axis



- (1) Press [MDI mode select switch] of [Mode select switch].



- (2) Press [OFFSET/SETTING] key on MDI panel to display [SETTING (Handy)] screen.



- (3) Since there are data on some pages, press [PAGE KEY] several times to display required screen.

SETTING (HANDY)		O0000	N0000
PARAMETER WRITE	= 1	(0: DISABLE	1: ENABLE)
TV CHECK	= 0	(0: OFF	1: ON)
PUNCH CODE	= 1	(0: EIA	1: ISO)
INPUT UNIT	= 0	(0: MM	1: INCH)
I/O CHANNEL	= 0	(0-3: CHANNEL NO.)	
SEQUENCE NO.	= 0	(0: OFF	1: ON)
TAPE FORMAT	= 0	(0: NO CNV	1: F10/11)
SEQUENCE STOP	=	0 (PROGRAM NO.)	
SEQUENCE STOP	=	1 1 (SEQUENCE NO.)	

>_

MDI **** ***SETTING*** 16:18:18

[OFFSET] [**SETTING**] [WORK] [] [(OPRT)]

(4) Set PARAMETER WRITE to number [1].

When setting PARAMETER No.1815 (X,Z) #4 (4-bit) to [0] from [1],
[000 TURN OFF POWER.] appears on the screen.

When turning ON the power again, the following message is displayed.

[300 APC ALARM: X-AXIS ZRN REQUIRED]

[300 APC ALARM: Z-AXIS ZRN REQUIRED]

The above shows that the servo motor loses the reference position.

2. Reference position return for each axis

Press [Handwheel feed axis select switch] for the axis to attempt the reference position return under manual mode in order to approach the axis to the reference position. (At this time, take care of feedrate.)

After that, the axis is finely adjusted to the reference position with [Handwheel (manual pulse generator)].

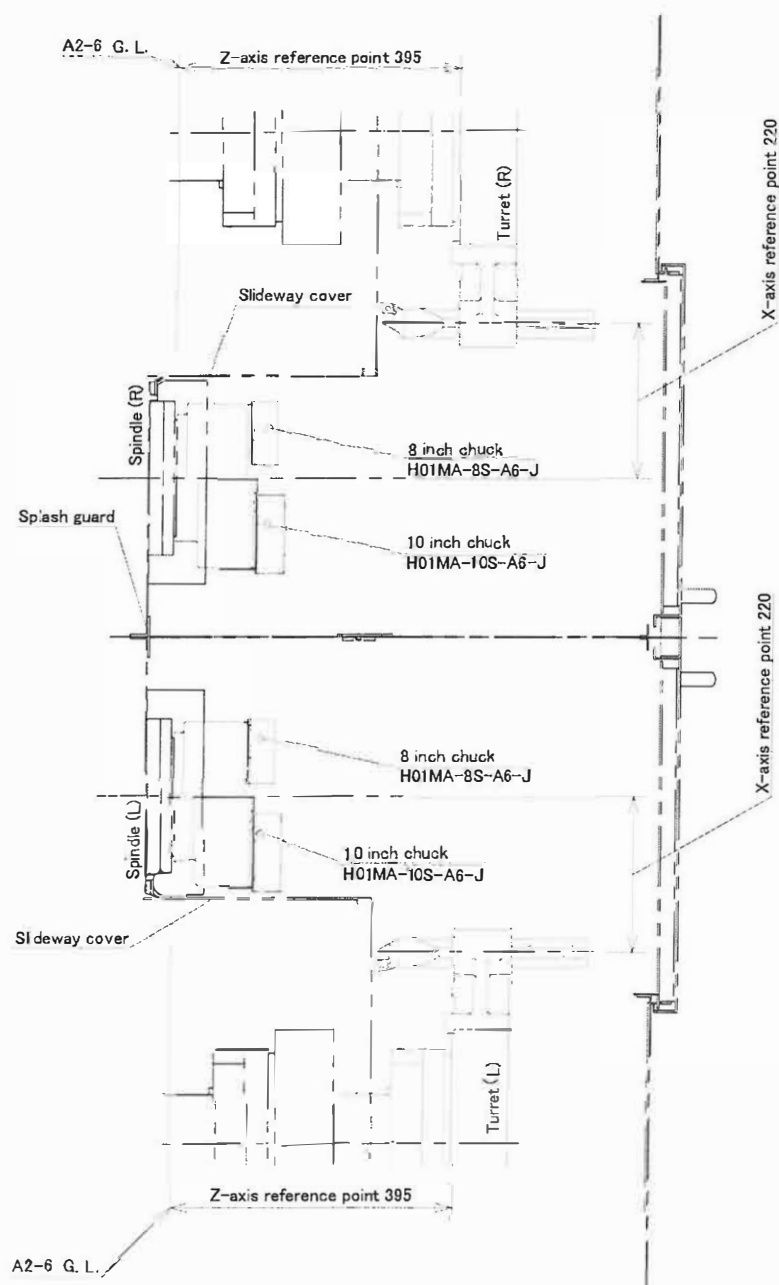


Fig. D4-4 Reference position of each axis

When the tool slide is completely traveled to the reference position as shown in the above [Fig. D4-4], set PARAMETER No.1815 (X, Z) #4 (4-bit) to [1] from [0].

Repower and cancel alarms.

By the above-mentioned procedure, the reference position is established. However, since it may be slipped for the position before shipping, check operation and raise the program and offset to reasonable values.

In the C-axis (Servo motor method), the reference position can also be established by the same method.

When parameter No.1815 (C) #4 (4-bit) is changed to [1] from [0], the phase (angle) of C-axis is the reference position.

5 HEADSTOCK

5-1 Structure of spindle

In the spindle noses is JIS A2-6.

[Fig. D5-1(a) to (d)] shows the spindle structure and major dimensions.

The spindle has already been greased before shipping.

For the maintenance of the spindle, contact our technical dept.

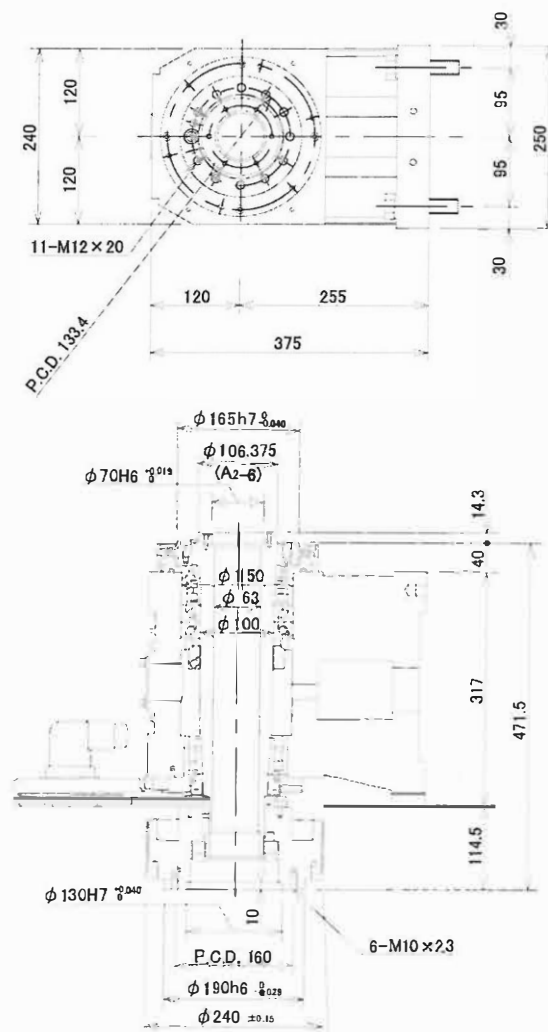


Fig. D5-1(a) Major dimensions of spindle (8 inch type)

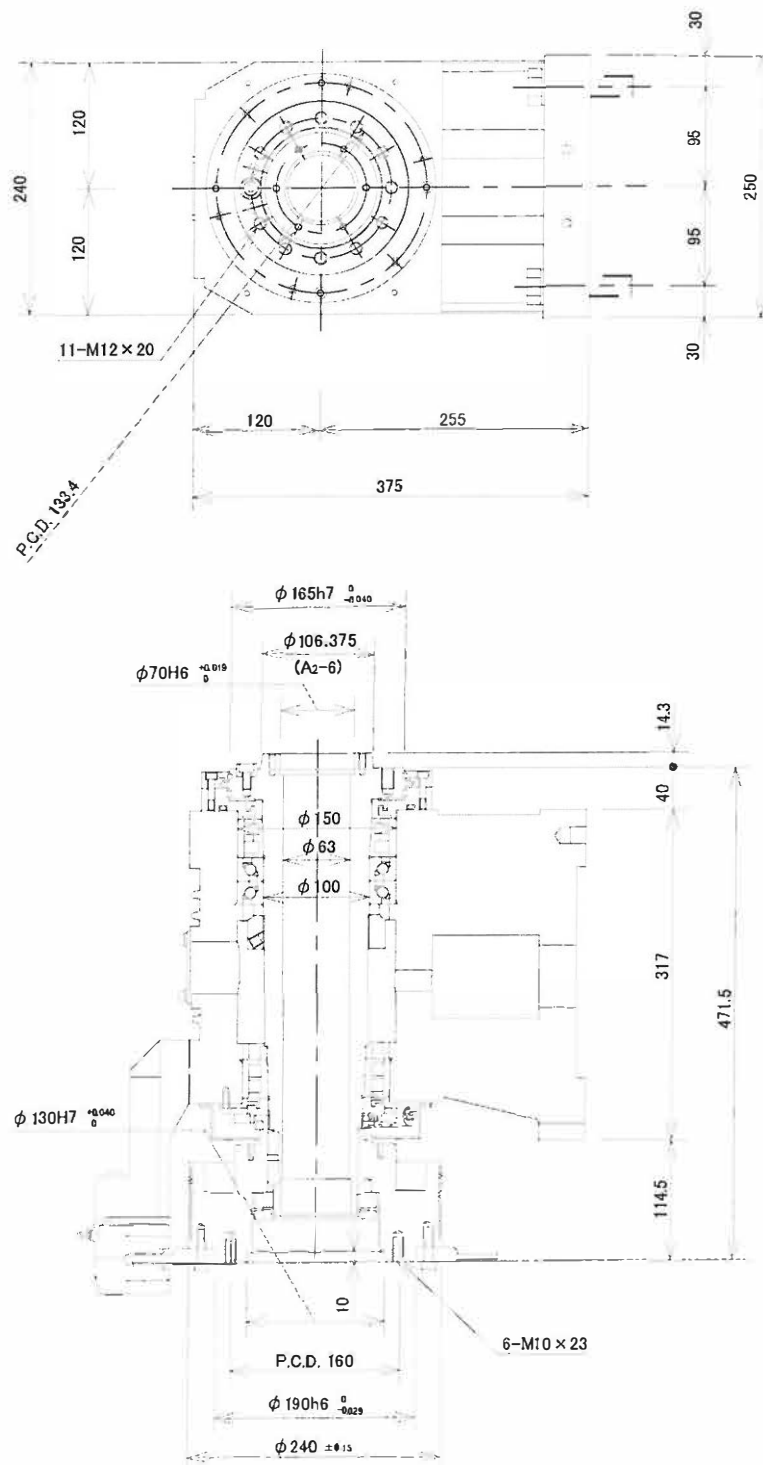


Fig. D5-1(c) Major dimensions of spindle (8 inch type, C-axis, milling)