OPERATION MANUAL

Applicable Model

NZ-S1500

Applicable NC Unit

MSC-700
MSC-701

Before starting operation, maintenance, or programming, carefully read the manuals supplied by Mori Seiki, the NC unit manufacturer, and equipment manufacturers so that you fully understand the information they contain.

Keep the manuals carefully so that they will not be lost.

MORI SEIKI
THE MACHINE TOOL COMPANY

OM-NZSMSC700-C3EN

- The contents of this manual are subject to change without notice due to improvements to the machine or in order to improve the manual. Consequently, please bear in mind that there may be slight discrepancies between the contents of the manual and the actual machine. Changes to the instruction manual are made in revised editions which are distinguished from each other by updating the instruction manual number.
- Should you discover any discrepancies between the contents of the manual and the actual machine, or if any part of the manual is unclear, please contact Mori Seiki and clarify these points before using the machine. Mori Seiki will not be liable for any damages occurring as a direct or indirect consequence of using the machine without clarifying these points.
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The product shipped to you (the machine and accessory equipment) has been manufactured in accordance with the laws and standards that prevail in the relevant country or region. Consequently it cannot be exported, sold, or relocated, to a destination in a country with different laws or standards.

The export of this product is subject to an authorization from the government of the exporting country.

Check with the government agency for authorization.

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SIGNAL WORD DEFINITION

A variety of symbols are used to indicate different types of warning information and advice.

Learn the meanings of these symbols and carefully read the explanation to ensure safe operation while using this manual.

<Symbols related with warning>

The warning information is classified into three categories, DANGER, WARNING, and CAUTION.

The following symbols are used to indicate the level of danger.

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

The information described in the DANGER frame must be strictly observed.

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

The information described in the WARNING frame must be strictly observed.

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or damages to the machine.

The information described following the caution symbol must be strictly observed.

<Other symbols>

The format identified by this symbol gives information for programming.

Indicates the items that must be taken into consideration.

Indicates useful guidance relating to operations.

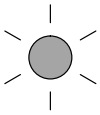
Indicates the page number or manual to be referred to.
The number in ( ) indicates the section number.

Indicates the procedure used for displaying the required screen.

Indicates the example of operations.

<Lamp indication>

Indicates that the indicator is lit.



Indicates that the indicator is blinking.

FOR SAFE OPERATION

This machine is intended for use by persons who have a basic knowledge of machine tools, including cutting theory, tooling and fixtures. Mori Seiki cannot accept responsibility for accidents that occur as a result of operation, maintenance, or programming of the machine by personnel who lack this basic knowledge or sufficient training.

Workpiece materials and shapes vary widely among machine users. Mori Seiki cannot predict the chucking pressure, spindle speed, feedrate, depth of cut, etc., that will be required in each case and it is therefore the user's responsibility to determine the appropriate settings.

Each machine is shipped with a variety of built-in safety devices. However, careless handling of the machine can cause serious accidents. To prevent the occurrence of such accidents, all programmers and other personnel that deal with the machine must carefully read the manuals supplied by Mori Seiki, the NC unit manufacturer, and equipment manufacturers, before attempting to operate, maintain, or program the machine.

Because there are so many "things that cannot be done" and "things that must not be done" when using the machine, it is impossible to cover all of them in the Instruction Manual. Assume that something is impossible unless the manual specifically states that it can be done.

The following manuals are supplied with your NC lathe:

1. Safety Guidelines prepared by Mori Seiki
2. Instruction Manual prepared by Mori Seiki
    - MAINTENANCE MANUAL
    - OPERATION MANUAL
    - PROGRAMMING MANUAL
3. NC unit Operation and Maintenance Manuals prepared by the NC unit manufacturer
4. Instruction Manuals prepared by equipment manufacturers

In addition to these manuals, ladder diagrams, parameter tables and electrical circuit diagrams are also supplied with the machine to help with electrical maintenance. The ladder diagrams are provided in the document box, parameter tables and electrical circuit diagrams are stored in the document compartment inside the electrical cabinet. Please make use of these materials when carrying out maintenance work.

Fundamental safety information is presented in the following pages.

All cautions on operation must be strictly observed when operating the machine, carrying out maintenance work, or writing programs. Failure to observe fundamental safety information can cause accidents in which the operator or other personnel working near the machine are seriously injured, or the machine is damaged. All personnel that deal with the machine must carefully read and thoroughly understand the information in the following pages before attempting programming or operating the machine.

The vocabulary and terms used for machine parts and operations in the warnings, cautions and notes are defined or explained in the manual texts and illustrations.

If you are unsure of the meaning of any word or expression, please refer to the corresponding textual explanation or illustration. If you still cannot understand or are unsure of the meaning, contact Mori Seiki for clarification.

"Operator", as used in these cautions, means not only the operator who operates or supervises a machine tool to perform machining, but also any person, including maintenance personnel who maintain and inspect a machine tool or safety device or safety measures provided with it, and the programmers who create programs used for machining, who are engaged in operations which deal with a machine tool.

Therefore, all persons engaged in these operations must carefully read these cautions and related materials, and thoroughly understand the contents before attempting to operate the machine.

1 CONSIDERATIONS BEFORE OPERATING THE MACHINE

The cautions that must constantly be born in mind when operating the machine are listed below.

1-1 Before Using the Machine

Listed below are important cautions that apply to all machine-related work (machine operation, maintenance, inspection, programming, etc.).

1. ***Never touch a switch, button, or key with wet hands. If it is not properly grounded or is leaking current, you could receive an electric shock.***
2. ***Before starting machine operation, check that there is nobody inside the protective cover or close to rotating or moving parts of the machine. Never touch or stand near the rotating or moving parts of the machine while it is operating; you could be seriously injured by being entangled in the rotating parts or crushed by the moving parts.***
3. ***Never operate the machine with the protective cover removed or while interlocks or other safety devices are ineffective, since the machine could operate in an unexpected manner, causing accidents involving serious injuries. Contact Mori Seiki, the NC unit manufacturer or the relevant equipment manufacturer immediately if the protective cover or safety devices are damaged.***
4. ***Always lock out the power to the machine before carrying out work inside the machine - such as setup work or cleaning the inside of the machine - and before carrying out inspections, maintenance or repairs. In addition, set the main switch to the OFF position and lock it with a padlock, and place "PERSONNEL INSIDE MACHINE" or "UNDER MAINTENANCE" signs around the machine to stop anyone from switching on the power or operating the machine while the work inside the machine is in progress. If work inside the machine or inspection or maintenance work is carried out with the power switched on, machine elements could be moved, and the personnel carrying out the work could be seriously injured by being entangled in the rotating parts or crushed by the moving parts of the machine.***
5. ***Always switch off the power before carrying out inspection or maintenance work in the electrical cabinet or on motors and transformers. If work has to be done while the power is switched on, it must be carried out by a qualified electrical engineer, taking the proper precautions; there is a danger of electric shock.***

6. ***Cover power supply cables that are run along the floor with rigid insulated plates to prevent them from being damaged. Damage to the insulation of the power supply cable could cause electric shocks.***
7. ***Even after the power is turned off, some devices will remain charged and the temperature of motors, lights inside the machine, etc., will remain high. Make sure that the charge has been discharged or the temperature has fallen before carrying out maintenance work or inspections on these devices. If you touch these devices/units carelessly while they are still charged or while the temperature is still high you could receive an electric shock or be burned.***
8. ***Check that all cables are properly insulated before using the machine. There is considerable danger of electric shock if damaged cables are used.***

1. **Keep the floor area around the machine tidy and clean; do not leave things lying on it, and clean up spilled water or oil immediately. If you fail to do this, plant personnel may injure themselves by tripping over or slipping on the floor.**
2. **Before operating the machine, check the area where you will have to stand and walk to make sure you can operate the machine safely. If you do not check your footing beforehand, you could loose your balance while working and injure yourself by putting your hands in a dangerous place while trying to find support, or by falling over.**
3. **Before using a switch, button, or key, check visually that it is the one you intend to use, and then press or set it decisively. Pressing the wrong switch, button, or key by mistake can cause accidents involving serious injuries or damage to the machine.**
4. **Keep the doors closed during machine operation. Leaving the machine running or operating it with doors open could cause accidents involving serious injuries or damage to the machine; plant personnel could be seriously injured by being entangled in the rotating parts of the machine, crushed by its moving parts, struck by broken tools, workpieces or jaws flying out of the machine, hit by flying chips, or splashed with coolant.**
5. **The parameters are set on shipment in accordance with the machine specifications; do not change them without first consulting Mori Seiki. If the parameters are changed without consultation, the machine may operate in an unexpected manner, causing accidents involving serious injuries or damage to the machine.**

6. **The machine specifications are set before shipping so that the machine can deliver its full performance. If the specifications and/or settings have to be changed or the machine has to be modified to meet new machining requirements or due to changes in the operating conditions, consult Mori Seiki. Changing the settings without consultation may lead to accidents involving serious injuries, impaired machine performance, and considerable shortening of the machine service life.**

7. **Before operating or programming the machine, or performing maintenance work, carefully read the instruction manuals provided by Mori Seiki, the NC unit manufacturer and the equipment manufacturers so that you fully understand the information they contain. Keep these instruction manuals safely so that you do not lose them. If you do lose an instruction manual, contact Mori Seiki, the NC unit manufacturer, or the relevant equipment manufacturer. If you attempt to operate the machine without having carefully read the instruction manuals first, you will perform dangerous and erroneous operations which may cause accidents involving serious injuries or damage to the machine.**

8. **Always observe the instructions in the caution labels stuck to the machine. Carefully read the Safety Guidelines supplied with the machine so that you fully understand them. If the writing on the labels becomes illegible, or if the labels are damaged or peel off, contact Mori Seiki. Also contact Mori Seiki if you cannot understand any of the labels. If you operate the machine without observing the instructions on the labels, or without understanding them properly, you will perform dangerous and erroneous operations which may cause accidents involving serious injuries or damage to the machine.**

9. **Never operate, maintain, or program the machine while under the influence of alcohol or drugs. Your concentration will be impaired, you may loose your balance and fall against dangerous parts of the machine, and you may operate the machine incorrectly, causing accidents involving serious injuries or damage to the machine.**

10. **Machine operators and authorized personnel working inside the plant and in the vicinity of the machine must put their clothing and hair in order so that there is no danger they will be entangled in the machine. If you have uncontrolled long hair or loose clothing and it gets caught in the machine, you will be seriously injured by being entangled in the rotating parts of the machine or crushed by its moving parts. Always wear safety shoes, eye protectors and a helmet.**

11. The machine is equipped with interlock functions such as the door interlock, chuck interlock, tailstock spindle interlock (applies only to machines equipped with a tailstock) and electrical cabinet door interlock to ensure the operator's safety. All the interlock functions must be ON when operating the machine. If you have to operate the machine with the interlocks released, you must recognize that there are many hazards involved and pay particular attention to safety while operating the machine in this condition. After finishing the necessary work, you must switch the interlocks back ON.
If the machine is operated with the interlocks released, it may operate in an unexpected manner, causing accidents involving serious injuries or damage to the machine.

12. The door interlock function serves only to protect the machine operator from accidents that can be prevented by inhibiting manual and automatic operation of the spindle, axis movement, and all other operations in automatic operation when the door is opened and while it is open; it will not afford protection against other hazards. For example, each machine user will machine a variety of workpiece types and use a variety of workpiece holding fixtures, cutting tools, and cutting conditions; you are still responsible for ensuring safety with regard to the hazards that can arise from these user-specific conditions.

13. If the door interlock function is released, the machine is able to operate with some limitations while the door is open, exposing you to danger. In daily production operation, the door interlock function must be set "valid" and the key operating the switch must be removed from the switch and kept safely.
When shaping soft jaws, measuring the tool offset data, program check, test cutting or carrying out other setup work, it may be necessary to release the door interlock function. If you have to carry out work while the interlock function is released, you must recognize that there are many hazards involved and pay particular attention to safety. While the door interlock function is released, the warning lamp blinks in red and the warning buzzer beeps intermittently. You must recognize that the door interlock function is in the released state when the warning lamp is blinking in red and the warning buzzer is beeping intermittently. After finishing the necessary work, you must switch the interlock function back valid.

14. Before operating the machine, memorize the locations of the EMERGENCY STOP buttons so that you can press one immediately from any location and at any time while operating the machine. The EMERGENCY STOP buttons are used to stop all operations in the event of an emergency. If there is an obstacle in front of an EMERGENCY STOP button it will not be possible to press it immediately when an emergency occurs and this could cause accidents involving serious injuries or damage to the machine.

15. Always switch the tailstock spindle interlock function ON before carrying out center-work operations. If this function is OFF, it will be possible to start automatic operation when the tailstock spindle is extended, even though it may not support the workpiece correctly. If automatic operation is started in this condition, the workpiece will fly out, causing serious injuries or damage to the machine. (Applies only to machines equipped with a tailstock.)

16. Adjust the position of the tailstock body so that the workpiece is securely held by the tailstock spindle center when the tailstock spindle is extended.
After making this adjustment, clamp the tailstock body to the bed. If the tailstock body is not clamped to the bed, or if the position of the tailstock body is incorrectly adjusted, it will be possible to start automatic operation when the tailstock spindle is extended, even if the workpiece is not supported by the tailstock spindle center. If machining is carried out while the workpiece is not supported by the tailstock spindle center, the workpiece will fly out, causing serious injuries or damage to the machine. (Applies only to machines equipped with a tailstock.)

17. To prevent hazardous situations, the plant or equipment supervisor must bar entry to the plant or the vicinity of the machine to anyone with insufficient safety training. Allowing persons without sufficient safety training unhindered into the plant and the vicinity of the machine could cause accidents involving serious injuries.

18. Because of the inertia of the moving parts of the machine, they may not be stopped immediately when the EMERGENCY STOP button is pressed. Always confirm that all operations have stopped before going near these parts. If you approach the moving parts of the machine without due care you may be entangled in them and seriously injured.

19. Do not leave articles such as tools and rags inside the machine. If the machine is operated with such articles inside it they may become entangled with a tool and thrown out of the machine, and this could cause accidents involving serious injuries or damage to the machine.

20. When the machine is running, operating noise may possibly be produced, depending on the cutting conditions and other factors. When an operator works near the machine, either change cutting conditions to limit generation of noises or the operator must wear protective gear, meeting the level of generated noise, which will not cause inconvenience for performing intended work. Working under noises might impair operator's health, such as hearing.

21. This is not the explosion-proof specification machine. Dangers such as the ejection of a large workpiece or harmful dust or an explosion caused by the machining of metals such as magnesium are not preventable even if the door is closed. Do not rely on door and protective devices alone. Recognition of the dangers involved in machining procedures is required at all times.

1. User programs stored in the memory, parameters set before shipping, and the offset data input by the user, can be destroyed or lost due to incorrect operation or other causes. To protect data against destruction and loss, back it up using an external I/O device (option), or other device.
   If you fail to make backup files, Mori Seiki cannot accept responsibility for any problem resulting from destroyed programs or lost parameter data and/or offset data.
   Keep the parameter table supplied with the machine in a safe place. Note that if the data is destroyed it will take some time to set the parameters again.
2. Never touch chips or the cutting edges of tools with your bare hands since you may be injured.
3. Take care not to stumble over the footswitch since you may be injured.
4. If it becomes necessary to perform a memory clear operation, contact Mori Seiki first. If a memory clear operation is performed without due care, the entire memory contents may be deleted, making the machine in operable.
5. The machine operator must have normal sensory perception. If a person who has an abnormality affecting any sense operates the machine, he/she will not be able to accurately confirm the machine status and surrounding conditions by eye/ear/touch. Sensory confirmation is extremely important when operating the machine and an inability to make such confirmations properly could cause accidents involving serious injuries or damage to the machine.
6. Ensure that the workplace is adequately lit. If there is insufficient light, the operator may trip over something or be unable to perform or check work accurately, and this could cause accidents involving serious injuries or damage to the machine.

7. Remove any obstacles around the machine.
   Secure adequate space around the machine for working and adequate passageway, considering both ease of operation and safety. If there are any obstacles or if there is insufficient space or passageway, the operator may trip and fall or be unable to work properly, and this could causeaccidents involving serious injuries or damage to the machine.
8. Stack products (workpieces) stably. If they are not stacked stably they may fall and injure the machine operator. Unstable stacking may also damage the products (workpieces), causing defects.
9. Keep the area around the machine clean; remove chips and foreign matter near the machine. If left, chips and foreign matter may cause plant personnel to fall and injure themselves.
10. Use a working bench strong and stable enough to support the weight of the workpieces and tools. If an unstable working bench is used the workpieces and tools could fall off and injure the machine operator.
11. Do not use cellular phones, electrical welding equipment, or other devices that generate electromagnetic waves around the machine. If you do so, the machine may operate in an unexpected manner.

If a machine alarm or NC alarm occurs, check its meaning by referring to the alarm list in the instruction manual or ladder diagram, and take the appropriate action. If this is ineffective, consult Mori Seiki or the NC unit manufacturer and take action when you understand clearly what to do.

1-2 Before Operating the Machine

The cautions that you must be aware of before operating the machine are listed below.

1. **Never stand in front of the spindle or other rotating parts. Never stand in front of the chuck, since the workpiece, cutting tools, or chuck jaws might fly out, particularly during test cutting, causing accidents involving serious injuries.**
2. **Specify a spindle speed limit that is lower than the lowest of the individual allowable speed limits for the chuck, fixture, and cylinder. If you do not follow this instruction, the workpiece could fly out of the machine, causing serious injuries or damage to the machine.**
3. **Clamp workpieces and cutting tools securely. Determine the depth of cut and cutting feedrate for test cutting with safe operation as the first priority; do not give priority to productivity when making these determinations. If you fail to observe this warning, the tool or workpiece could fly out of the machine, causing serious injuries or damage to the machine.**
4. **Before starting spindle rotation, check that the workpiece is securely clamped. Or, if performing center-work, check that the tailstock spindle center securely supports the workpiece. (Applies only to machines equipped with a tailstock.)**
   If the workpiece is not securely clamped or supported, it will fly out when the spindle is rotated, causing serious injuries or damage to the machine.
5. **Before starting the spindle in manual operation, set the spindle speed setting switch to the lowest setting. After starting the spindle, increase the spindle speed to the required speed gradually.**
   When stopping the spindle, first lower the spindle speed by setting the spindle speed setting switch to the low speed position and then stop it.
   If the spindle is started at the high speed setting, the workpiece and chuck jaws could fly out, causing serious injuries or damage to the machine.
6. **Do not start the spindle unless the machine's left side cover and cylinder cover are removed. If you fail to observe this warning you could be seriously injured by being entangled in the rotating parts of the machine.**
7. **Never attempt to reach inside the chip conveyor or put your feet in it while it is operating. You could be caught in the chip conveyor and seriously injured. (Applies only to machines equipped with a chip conveyor.)**

8. Never stand near the moving parts of the machine during a zero return operation or rapid traverse operation since each axis is returned to the zero point (or fed) at the rapid traverse rate.
Before starting a zero return operation or rapid traverse operation, always make sure that no one is standing near the moving parts, that the moving parts can be fed to the zero point (or fed) without interference, and that you are moving the axis in the correct direction.
Failure to observe these warnings could cause accidents involving serious injuries or damage to the machine: personnel could be crushed by the moving parts of the machine, and the moving parts could strike obstacles.

9. Never stand near the moving parts of the machine during a jog feed operation since each axis is fed at the jog feedrate set with the feedrate override dial. Before starting jog feed operation, always make sure that no one is standing near the moving parts and that the moving parts can be fed without interference. Failure to observe these warnings could cause accidents involving serious injuries or damage to the machine: personnel could be crushed by the moving parts of the machine, or the moving parts could strike obstacles.

10. For the machine equipped with the proximity switches for the zero return, when the axis feed switch which moves the axis away from the zero point is pressed in the zero return mode, the axis will be fed in the opposite direction of the zero point at the set rapid traverse rate while the switch is pressed; make sure that you feed the axis in the correct direction.
For the machine not equipped with the proximity switches for the zero return, when the axis feed switch which moves the axis away from the zero point is pressed in the zero return mode, the axis will be fed in the direction of the zero point at the set rapid traverse rate while the switch is pressed; make sure that you feed the axis in the correct direction.
Also make sure that you feed the axis in the correct direction whenever you use an axis feed switch to feed an axis at a rapid traverse rate or jog feedrate.
Feeding an axis in the wrong direction could cause accidents involving serious injuries or damage to the machine: personnel could be crushed by the moving parts of the machine, or the moving parts could strike obstacles.

11. Select the appropriate chucking pressure and tailstock spindle thrust force (applies only to machines equipped with a tailstock) for the workpiece shape and material, and the cutting conditions. If you cannot determine the appropriate chucking pressure, contact the chuck manufacturer or cylinder manufacturer. If you cannot determine the appropriate spindle thrust force (applies only to machines equipped with a tailstock), contact Mori Seiki. If the chucking pressure or spindle thrust force (applies only to machines equipped with a tailstock) is not set appropriately in accordance with the shape and material of the workpiece being machined and the cutting conditions, the workpiece could fly out during machining, causing serious injuries or damage to the machine. Incorrect setting could also distort the workpiece.

12. Do not wear gloves when operating the machine. Wearing gloves could cause your hands to get entangled in the rotating parts of the machine.

13. Never remove burrs on a workpiece by hand while it is clamped by the chuck or while it is fixed inside the machine. If the machine were to start for some reason you would be seriously injured: you could be entangled by the rotating parts of the machine or crushed by its moving parts. You could also injure yourself by losing your balance. Always remove the workpiece and perform the work outside the machine.

14. Coordinate values and M, S, T, G, and F codes in the blocks skipped during sequence number search operations do not change the coordinate values or modal M, S, T, G, and F codes in the NC. When searching for a block part way through a machining process and restarting machining from that point, specify the M, S, T, G, and F codes, and workpiece coordinate system, etc., in the MDI mode after carefully checking the status of the machine and the NC. If machining is restarted without specifying this information, the machine may operate in an unexpected manner, causing accidents involving serious injuries or damage to the machine.

15. Always work at a safety margin of at least 20 cm from the window. This window is impact-resistant and could be substantially deformed to ease the impact such as an ejected tool. On a stronger impact, however, the window could break, causing accidents involving serious injuries.

1. When machining bar stock on a machine equipped with a bar feeder or spindle through-hole, use straight workpieces only. When machining bar stock with a diameter smaller than that of the spindle (or draw bar), always use guide bushes in order to prevent vibration. If you use a bent workpiece or fail to use guide bushes, the machine will vibrate and the workpiece will shake; this could cause damage to the machine. It will also seriously affect machining accuracy.
2. Do not touch the lamp that illuminates the interior of the machine since, if a halogen lamp or incandescent lamp is used, it will be very hot and will burn you. Also wait some time before touching the lamp after turning the power OFF.
3. Never operate the machine without the shield cover of the chuck opening/closing footswitch and the lock device in place.
   If you step on the footswitch by mistake, or drop something on it, the chuck will be unclamped and the workpiece that it was gripping will fall out, and this could cause damage to the machine.
4. When using the service outlet (optional) on the operation panel for connecting an external device, the permissible current indicated on the rating plate must not be exceeded. If a device whose capacity exceeds the permissible current is used, the breaker in the electrical cabinet could be tripped, causing damage to the machine or machining defects.
5. In order to open the electrical cabinet door, you must place the main switch in the **OPEN RESET** position. If the main switch is at a position other than **OPEN RESET**, it will not be possible to open the door. Attempting to force the door open in this situation could cause damage to the electrical cabinet door or the main switch.
6. When clamping or unclamping the chuck, pay sufficient care so that hand or fingers will not be caught by the chuck or the chuck jaws. If caught by the chuck or chuck jaws, hand or fingers will be injured.

2 TURNING THE POWER ON AND OFF

2-1 Before Turning the Power ON

Observe the following instructions before turning the power ON in order to prevent accidents involving serious injuries or damage to the machine.

1. **When the main switch is locked with a padlock it means that maintenance is in progress, so do not place the main switch in the [ON] position.**
2. **After pressing the NC power switch [ON], do not touch any of the operation-related keys on the NC operation panel before the screen shows "(WARNING)". If you accidentally press any other key the machine will operate in an unexpected manner, and this could cause accidents involving serious injuries or damage to the machine.**

1. Make sure that all bolts are tightened securely. Operating the machine with insufficiently tightened bolts could cause damage to the machine.
2. Make sure that all connectors are connected securely. Operating the machine with loose connectors could cause machine faults.
3. Make sure that all hydraulic hoses and air pipes are connected securely. If the machine is operated while they are not connected securely, hydraulic oil or air will leak when the power is turned ON, causing machine faults.
4. If the machine is equipped with any optional external equipment (bar feeder, loader, robot, etc.), make sure that the electric cables and hydraulic/pneumatic pipes for this equipment are connected correctly. Operating the external equipment or the machine with incorrect connections will cause equipment or machine faults.
5. Do not place the main switch in the ON position while the primary power is not supplied to the main switch.
   If the main switch is placed in the ON position repeatedly although the primary power is not supplied to the main switch, the main switch will be damaged.

2-2 After Turning the Power ON

1. **To prevent seizure of the chuck and cylinder, repeat the chuck opening and closing operations several times, check that the soft jaws or workpiece holding fixture are securely mounted, and then break in the spindle. If the chuck or cylinder seizes, the chuck gripping force will be reduced and the workpiece could fly out while the spindle is rotating, causing serious injuries or damage to the machine.**
2. **If the machine stops due to a power failure, turn the main disconnect switch OFF immediately. If you do not turn the power OFF the machine will start operating unexpectedly when the power is restored, and this could cause accidents involving serious injuries or damage to the machine.**
3. **The machine cannot operate correctly unless the specified power is supplied. If the power supply is momentarily cut off during machine operation due to a power failure or lightning, the machine may operate unexpectedly and this could cause accidents involving serious injuries or damage to the machine. If abnormal fluctuations in the power supply voltage are likely, for example due to lightning, switch the power OFF.**
4. **Check for oil leaks and check that all gages read the correct values. Operating the machine while there is an oil leak or while gage readings are incorrect will cause accidents involving serious injuries, machine faults or damage to the machine.**

1. After turning the power ON, check that the fans are operating normally. If the machine is operated while the fans are not operating normally the heat inside the machine will not be dissipated and this will cause damage to the machine and machine faults.
2. After turning the power ON, check that the slideway lubrication pump is operating normally. If the machine is operated while the pump is not operating normally, lubricating oil will not be supplied to the slideways and this will cause damage to the machine.
   In order to protect the sliding parts, never feed the axes immediately after turning the power ON; manually operate the slideway lubrication pump to supply lubricating oil to the slideway surfaces first. Feeding the axes while no lubricating oil is supplied will wear the sliding parts and ball screws and cause seizure and other damage to the machine.
3. After turning the power ON, break in the spindle for about 15 minutes. If you do not break in the spindle, the machine's service life and machining accuracy will be adversely affected.

4. To turn the power OFF, follow the sequence below:
   - Check if an alarm or other abnormality has occurred.
   - Press the EMERGENCY STOP button.
   - Press the NC power switch **[OFF]** on the operation panel.
   - Turn the main switch (no fuse breaker) OFF.

   If you turn the main switch OFF during machine operation without following the preliminary steps the machine will operate in an unexpected manner and this could cause damage to the machine.
5. When turning the power ON after the machine has been stopped by a power outage, check that the program, parameter data, offset data, etc. have not been destroyed. If the machine is used with destroyed data, it could cause damage to the machine.

3 SAFETY PRACTICES DURING SETUP

"Setup" is the sequence of operations between turning the power to the machine ON and starting mass production. It includes inputting of the program, shaping of soft jaws, setting of tool offsets, program checking, and test cutting.

1. The machine should normally be operated by one, well-trained person only.
In cases where more than one operator is essential, the operators must cooperate carefully, communicating as fully as possible. If one operator presses buttons on the operation panel or feeds machine axes while another is replacing a workpiece, soft jaws, a fixture, or cutting tool, etc., that operator, or someone standing close by, could be entangled in the machine and seriously injured.

2. In order to ensure operator safety, implement the following safety measures during setup while the door is shut and the door interlock function is released.

<To prevent starting of automatic operation>

1) Select the handle mode with the mode selection switch.

2) Unclamp the chuck.

3) Close the cover over the (START) switch.
(Applies to machines equipped with covered switches.)

4) Set the spindle speed range to "Neutral".
(Applies only to machines equipped with a transmission.)

<To ensure operator safety if automatic operation is started by mistake>

1) Set override switches (spindle speed, rapid traverse, cutting feedrate) to the lowest position.

2) Switch the single block function ON.

3) Switch the machine lock function ON.

4) Establish the coolant OFF mode by pressing the coolant OFF switch for longer than one second.

WARNING

<To prevent starting of the spindle>

1) **Unclamp the chuck.**
2) **Set the spindle speed range to "Neutral".**
   (Applies only to machines equipped with a transmission.)
3) **Close the switch covers of the spindle normal rotation and spindle reverse rotation switches.**
   (Applies to machines equipped with covered switches.)
4) **Set the operation selection key-switch to the "operation disable" position.**
   (Applies to machines equipped with a flat type operation panel.)

<To ensure operator safety if the spindle is started by mistake>

1) **Set the spindle speed adjusting switch to the lowest setting.**

<To prevent turret head indexing (for example when changing a cutting tool)>

1) **Set the turret indexing switch to the station number that is currently indexed.**
2) **Close the switch cover over the turret indexing switch. (Applies to machines equipped with covered switches.)**
3) **Set the operation selection key-switch to the "operation disable" position. (Applies to machines equipped with a flat type operation panel.)**

3. **When using a manually tightened chuck or fixture, always remove the clamp handle or tightening tool from the chuck or fixture after tightening. If the spindle is started with the clamp handle or tightening tool still in place the handle/tool will fly out, causing serious injuries or damage to the machine.**
4. **Always select the most appropriate cutting tool and holder for the material and shape of the workpiece to be machined and cutting method, and check that the workpiece can be machined without any problems.**
   If an inappropriate cutting tool or holder is selected, the workpiece could fly out of the chuck during machining, causing serious injuries or damage to the machine. Machining accuracy will also be adversely affected.
5. **Make sure that the cutting tool, holder, soft jaws, and tailstock (if featured) are all tightened securely. If they are not tightened securely, the cutting tool or workpiece will fly out of the machine during machining, causing serious injuries or damage to the machine.**

WARNING

6. **When mounting a rotary tool holder to the turret head, always mount a tool in the tool holder. If the rotary tool spindle is started while there is no tool mounted in the tool holder, the collet clamping nut will be loosened and the collet clamping nut and collet will fly out during rotation, causing serious injuries or damage to the machine. (Applies to milling specification.)**
7. **The machine has a chuck interlock function that prevents starting of the spindle unless the chuck clamp indicator is lit. Make sure this interlock function works correctly by setting the correct chuck clamping direction for the type of workpiece to be machined. If the spindle starts rotating while the workpiece is not correctly clamped in the chuck, the workpiece could fly out, causing serious injuries or damage to the machine.**
8. **Before starting the spindle, carefully check the workpiece chucking conditions, the chucking pressure, and the spindle speed. If spindle rotation is started when the workpiece is grasped unstably or when the chucking pressure or spindle speed is inappropriate, the workpiece could fly out, causing serious injuries or damage to the machine.**
9. **Be aware that the spindle will start rotating if the spindle normal rotation switch or spindle reverse rotation switch is pressed by mistake while a manual mode is selected and the conditions for spindle rotation are satisfied. If these switches are pressed carelessly the spindle will start rotating unexpectedly and this could cause accidents involving serious injuries or damage to the machine.**
10. **Since forged and cast workpieces have hard chucking portions due to scale, use hard jaws for these workpieces. If the chucking contact has to be a point or line contact, for example when clamping on the draft of a casting, use spikes embedded in the jaws. If three soft jaws are used, shape them so that the workpiece is clamped at six points; avoid face contact between the jaws and workpieces with scale on them.**
11. **Be aware that the turret head will start rotating if the turret head index switch is pressed by mistake while the conditions for turret indexing are satisfied and a manual mode is selected. If this switch is pressed carelessly the turret will start rotating unexpectedly and this could cause accidents involving serious injuries or damage to the machine.**

12. For the machine with the flat type operation panel, always place the operation selection key-switch in the "operation enable" or "operation disable" position after completing program entry. Be aware that the program will be updated if program editing operations are carried out with the operation selection key-switch at the "operation and edit enable" position. If the program is executed after being accidentally updated in this way the machine could operate unexpectedly, causing serious injuries or damage to the machine.

13. For the machine with the discrete type operation panel, always place the edit enable key-switch in the "edit disable" position after completing program entry. Be aware that the program will be updated if program editing operations are carried out with the edit enable key-switch at the "edit enable" position. If the program is executed after being accidentally updated in this way the machine could operate unexpectedly, causing serious injuries or damage to the machine.

14. For the machine with the touch panel, always return the WRITE PROTECT switch (PROGRAM) back to ON after completing program entry. Be aware that the program will be updated if program editing operations are carried out with the WRITE PROTECT switch (PROGRAM) set OFF. If the program is executed after being accidentally updated in this way, the machine could operate unexpectedly, causing serious injuries or damage to the machine.

15. Workpiece materials and shapes vary widely among machine users. Mori Seiki cannot predict the workpiece clamping method, spindle speed, feedrate, depth of cut, and width of cut, etc., that will be required in each case and it is therefore the user's responsibility to determine the appropriate settings.
Note also that the machining conditions determined in automatic programming are the standard conditions, which are not necessarily the most suitable for the user's purposes and may have to be changed in accordance with the workpiece, chuck, etc. The conditions determined in automatic programming are for reference only and the final responsibility for determining the conditions rests with the user. (Conversational NC specification)
If you have difficulty determining these conditions, consult the chuck and cylinder manufacturers and tool manufacturer.
Machining under inappropriate machining conditions can cause the workpiece to fly out of the chuck during machining, causing serious injuries or damage to the machine. It will also adversely affect machining accuracy.

16. The chuck gripping force may be reduced due to a malfunction of the chuck or cylinder or a centrifugal force during high-speed spindle rotation. If machining is performed without securing a sufficient gripping force, the workpiece may fly out, causing serious injuries or damage to the machine. If the chuck gripping force is reduced due to deterioration over time or damage from an accident or inadequate maintenance, contact Mori Seiki Service Department. To prevent the chuck gripping force from lowering, clean and grease the chuck at regular intervals. If the gripping force is reduced due to the centrifugal force applied to the jaws during high-speed spindle rotation, readjust the cutting conditions such as chucking pressure, cutting feedrate or cutting amount. Refer to the manuals prepared by the chuck manufacturer and the cylinder manufacturer.

17. When using the stopper inside the spindle, make sure that the adjusting shaft in the spindle does not protrude excessively from the rear of the spindle (cylinder).
If there is excessive protrusion the adjusting shaft will fly out, causing serious injuries or damage to the machine. (Spindle stopper specification)

18. If the spindle gear range is changed when the spindle is stopped, the spindle may rotate a little. Make sure that this rotation will not cause any interference. (Applies only to machines equipped with a transmission.)

19. When using a machine equipped with a hollow chuck, if machining is carried out without using the chuck through hole, be sure to fit the through hole cover provided as an accessory to the chuck. If machining is carried out without the through hole cover fitted, coolant and chips will get inside the chuck and cylinder, causing their hydraulic circuits and those of other units to malfunction. If machining is carried out under these conditions, the chuck gripping force will be reduced and the workpiece will fly out, causing serious injuries or damage to the machine.

20. When handling (mounting, removing, or moving) a heavy object, use appropriate equipment such as a crane and a hoist.
If you handle a heavy object by your hands without using such equipment, you could be seriously injured or physically disabled due to heavy load.

1. If no tool holders for rotary tools are mounted in the turret head, fit covers to the rotary tool holder mounting holes after checking that the covers are fitted with O rings. If covers are not fitted, chips and coolant will get inside the turret head and may cause machine faults. (Applies to milling specification.)
2. Keep the machine light on during setup to ensure safety. If this light is off it will not be possible to check conditions inside the machine or test cutting properly, and this may cause damage to the machine or machining defects. In addition, operators could be injured while working inside the machine.
3. If the machine is stopped for a day or longer, the oil film on the slideways may be lost. If the machine is started in this condition the slideways and ball screws will be worn and might seize.
   Therefore, if the machine has not been operated for a day or longer, press the manual lubrication pushbutton to forcibly lubricate the slideways.
4. Do not stop spindle rotation while the cutting tool is in contact with the workpiece. This will cause damage to the tool and/or machine.
5. Do not turn the manual pulse generator dial any faster than 5 rotations per second. If you do, the axis will not stop immediately when the manual pulse generator is stopped and the actual amount of axis feed will not coincide with the number of pulses generated. This could cause damage to the machine.
6. When the turret head is rotated with cutting tools mounted in it, tools with long projection lengths could strike the Z-axis protector (cover or tailstock), etc. Before rotating the turret, make sure that the tools in the turret do not interfere with the protector (cover or tailstock), since interference will cause damage to the machine.
7. When mounting an I.D. cutting tool in the turret head, make sure that the tool shank does not project beyond the rear surface of the tool holder. If it does it will interfere with the turret base, etc., during turret head rotation, causing damage to the machine.
8. Remember that the direction of spindle rotation is determined by the tool registration data and the spindle will rotate in the wrong direction if the settings are incorrect. Machining while the tool is rotating in the wrong direction can cause damage to the tool and the machine. (Applies only to milling specification.)
9. When shifting the coordinate system in order to check a center-work program, set the shift direction and shift amount carefully to avoid interference between the turret and tailstock, which could cause damage to the machine. (Applies only to machines equipped with a tailstock.)
10. An extraction bar used when removing the center from the tailstock body is fitted inside the tailstock of some models.
    It functions for shock-proofing when another bar, inserted from the rear of the tailstock body, is tapped to remove the center. It also serves to prevent chips and coolant from entering the tailstock body during machining. Do not operate the machine without the extraction bar fitted inside the tailstock body since this could cause damage to the machine. (Applies only to machines equipped with a tailstock.)

CAUTION

11. Support the workpiece securely before stepping on the chuck clamp/unclamp footswitch to remove it. If you step on the footswitch without taking this precaution the workpiece will fall and this could cause damage to the machine.
12. You will probably use a variety of workpiece shapes and materials, and the chucking method will differ according to the workpiece type. Therefore, when checking a program with the workpiece clamped in the chuck, check for interference carefully, taking the workpiece shape and material, and the chuck gripping force, into account. Depending on these factors, the cutting tool, holder, or turret head might interfere with the workpiece, chuck, fixture, or tailstock (if featured), causing damage to the machine.
13. If the workpiece is supported using the tailstock spindle, carelessly moving the tailstock spindle in or retracting the tailstock body will leave the workpiece held by the chuck alone. The workpiece may fall, causing damage to the machine, if it is held only by the chuck. Therefore, before moving the tailstock spindle in or retracting the tailstock body, ensure that the workpiece is held securely by a crane or other appropriate means. (Applies only to machines equipped with a tailstock.)
14. Mount cutting tools to the turret head in a well-balanced manner, and ensure that there will be no interference between the cutting tools/holders and the workpiece or machine. If a cutting tool projects too far it will interfere with the Z-axis protector, tailstock (if featured), or workpiece, etc., when the turret head is rotated, causing damage to the machine.
15. Whenever mounting or removing a tool to or from a rotary tool holder, remove the rotary tool holder from the turret head and mount or remove a tool to or from the rotary tool holder outside the machine. If a tool is mounted or removed to or from the rotary tool holder mounted in the turret head, it could cause damage to the machine. (Applies only to milling specification.)
16. When mounting a tool to a rotary tool holder using a collet, do not tighten the collet clamping nut excessively. If the collet clamping nut is tightened excessively, the nut will be damaged, which causes the tool and the machine to be damaged. (Applies only to milling specification.)
17. In the case of machines equipped with a live center as the tailstock spindle center, a live center must also be used for the tailstock spindle center. If the workpiece is supported with a tailstock spindle center other than a live center, the center will seize when the spindle is started, causing damage to the machine. (Applies only to machines equipped with a tailstock.)
18. If the  (START) switch is pressed at the background edit screen under the conditions that the automatic operation (program) cycle has completed and the memory mode is selected, the program called in the foreground starts. Therefore, the machine operates in a manner different from the program displayed on the screen (background area).

NOTE When mounting a rotary tool holder which is fixed on the turret head by bolting at two faces, pay sufficient care on the order of tightening the bolts. If the tool holder is not closely fit to the two mating faces of the turret head leaving a gap, accurate machining will be impossible. (Applies only to milling specification.)

4 SAFETY PRACTICES WHEN MOUNTING/REMOVING A CHUCK

1. **When mounting a chuck, chuck cylinder, or connection rod to the spindle, read the instruction manuals provided by Mori Seiki, the chuck manufacturer, and the chuck cylinder manufacturer. The considerations that must be attended to are given in the instruction manuals. If the chuck, chuck cylinder, or connection rod is mounted to the spindle without understanding these considerations, the chuck, chuck cylinder or connecting rod will be damaged, and if machining is carried out after such damage has occurred, a workpiece, the chuck, and/or chuck jaw could fly out, causing accidents involving serious injuries or damage to the machine.**
2. **If a workpiece holding fixture other than the chuck supplied with the machine is used, be sure to contact Mori Seiki to prevent accidents. Mori Seiki is not responsible for accidents caused by the use of a fixture prepared by the customer without consulting Mori Seiki.**
3. **If the chuck supplied with the machine is removed from the machine and a specially prepared fixture is used instead of the chuck to hold a workpiece, remove the chuck cylinder and the connecting rod if they do not operate due to the mounting of the special fixture. If the spindle is started with the chuck cylinder and the connecting rod still mounted, the connecting rod will vibrate and the connecting rod and the chuck cylinder could become detached, causing accidents involving serious injuries or damage to the machine.**
4. **Leave the pilot bush mounted in the chuck.**
   If the machine is operated with the pilot bush removed, a master jaw or a jaw of the chuck could fly out, causing accidents involving serious injuries or damage to the machine.
5. **The socket hole in the hex. socket head cap bolts used for mounting chuck jaws and fixtures will become enlarged over a long period of use. Check these hex. socket head cap bolts at regular intervals and if a hex. wrench does not fit in the socket hole, replace the bolt with new one.**
   If there is an excessive gap between the socket hole and hex. wrench, the bolt cannot be torqued correctly. If the machine is operated while a bolt is not torqued correctly, a workpiece, chuck jaw or a fixture could fly out, causing accidents involving serious injuries or damage to the machine.

6. The chuck or fixture that holds the workpiece must be secured to the spindle using the threaded holes in the spindle nose. Do not mount another chuck or fixture in a chuck or fixture that is mounted directly on the spindle. If a workpiece is held by a second chuck or fixture mounted in this way, it will not be held securely when the spindle rotates due to the centrifugal force acting on it, and the chuck or fixture will fly out. This could cause accidents involving serious injuries or damage to the machine.
If it is necessary to mount a chuck or fixture to hold a workpiece in the chuck or a fixture which is directly mounted to the spindle, contact Mori Seiki or the chuck manufacturer for the measures that should be taken.

5 SAFETY PRACTICES WHEN CHUCKING A WORKPIECE

The workpiece gripping capacity of a chuck is lowered as the gripping faces of the chuck jaws become worn. Furthermore, the workpiece holding capacity of the chuck jaws is greatly influenced by the nature of the workpiece.

1. Heavy workpieces with a large diameter apply a large force to the chuck jaws and the force applied to the chuck jaws can exceed their workpiece holding capacity in some cases.
2. As the spindle speed increases, the forces acting on the workpiece to cause it to fly out of the chuck increase.
3. Improper maintenance, foreign matter, rusting, and inadequate greasing cause reduction of the workpiece holding capacity of the chuck.
   Finally, the machining method determines both the exact force that will be applied to the workpiece and the chuck jaws, and whether this force exceeds the workpiece holding capacity of the chuck jaws.
   Therefore, review the workpiece holding capacity of the chuck each time the job changes or at regular intervals if the same job is carried out continuously. Machining which generates forces exceeding the workpiece holding capacity of the chuck will cause the workpiece to fly out while the spindle is rotating, causing serious injuries or damage to the machine.

1. A limit is imposed on chuck plunger thrust. If the plunger thrust exceeds the allowable value, the chuck could be damaged and the workpiece and chuck jaws could fly out of the chuck, causing serious injuries or damage to the machine.
For the allowable plunger thrust, refer to the instruction manuals prepared by the chuck and cylinder manufacturers.

2. The allowable chucking pressure must be set to a value lower than the cylinder pressure that generates the cylinder thrust allowable for the chuck, or the allowable cylinder pressure, whichever is the lower. If this restriction is not observed, the chuck and cylinder may be damaged. If the damage occurs while the spindle is rotating, the workpiece and chuck jaws will fly out, causing serious injuries or damage to the machine.
For the allowable maximum pressure of the chuck or the cylinder, refer to the instruction manuals prepared by the chuck and cylinder manufacturers.

3. Use only the specified bolts to mount the chuck and chuck jaws and tighten them to the specified torque. Check at regular intervals that the bolts are securely tightened. If the bolts are not tightened to the specified torque the workpiece might fly out, causing serious injuries or damage to the machine, and the chuck could be damaged.

WARNING

4. **If a thrust exceeding the allowable cylinder thrust is applied to the chuck, the component parts or bolts of the chuck will be damaged, causing loss of chuck gripping force. If this happens while the spindle is rotating, the workpiece or chuck jaws will fly out, causing serious injuries or damage to the machine.**
   For the allowable cylinder thrust, refer to the instruction manuals prepared by the chuck and cylinder manufacturers.
5. **Take the height of the top jaw into consideration when determining the chucking pressure. If the height is greater than the standard height, reduce the cylinder thrust. If you fail to observe this warning, large forces will act on the top jaw mounting bolts and the master jaw, which could cause damage to the top jaw or master jaw. If trouble of this nature occurs while the spindle is rotating, the workpiece or chuck jaws will fly out, causing serious injuries or damage to the machine.**
   For the relationship between top jaw height and allowable cylinder thrust, refer to the instruction manuals prepared by the chuck and cylinder manufacturers.
6. **When clamping or unclamping a workpiece in the chuck, ensure that your hands will not be trapped by the workpiece, soft jaws, or tailstock (if featured). If you work without sufficient care you could be seriously injured.**
7. **When machining long workpieces, always hold the free end of the workpiece securely with the tailstock (if featured) or a steady rest (if featured). If you do not support the free end the workpiece could bend or shake while the spindle is rotating, causing accidents involving serious injuries or damage to the machine.**
8. **Before clamping a workpiece in the chuck, check using a pressure gage that the correct hydraulic or air pressure is supplied to the cylinder that actuates chuck operation. If no pressure is supplied or the pressure level is low, the workpiece will fly out when the spindle is started, causing serious injuries or damage to the machine.**
9. **The T-nuts in the chuck must not protrude from the master jaw. If they do the master jaw or T-nuts may be damaged, and machining accuracy will be impaired. Breakage of the T-nuts or master jaw while the spindle is rotating could cause accidents involving serious injuries or damage to the machine.**
10. **Mount soft jaws in the chuck in a well-balanced manner. Poor balance will cause runout of the spindle and could cause the soft jaws to fly out while the spindle is rotating, causing serious injuries or damage to the machine. It will also adversely affect machining accuracy.**

11. When clamping a workpiece in a 3-jaw chuck, the workpiece (finished faces) cannot be clamped stably if contact is only made at three points. If a workpiece is machined while clamped in this very unstable way, it may fly out due to cutting resistance, causing serious injuries or damage to the machine.
The workpiece must be clamped at six points, or with face contact (jaws shaped to the shape of the workpiece).

12. Do not use top jaws with a serration of a different pitch from that of the master jaws. If such top jaws are used, the serration may be damaged when the workpiece is clamped in the chuck due to insufficient length of the areas of engagement. If the spindle is rotated after such damage has occurred, the workpiece and top jaws will fly out, causing serious injuries or damage to the machine.

13. Do not use excessively heavy jaws. If the spindle is rotated with top jaws heavier than the standard soft or hard jaws fixed to the chuck, the loss of chuck gripping force due to centrifugal force will be larger than the loss seen with standard chuck jaws; the loss increase is equal to the increase in centrifugal force corresponding to the difference in mass between the standard and heavy jaws. If the workpiece is machined under such conditions, it will fly out, causing serious injuries or damage to the machine.

14. Always use the T-nuts specified by the chuck manufacturer. If the bolts used to mount the top jaws cannot be screwed a sufficient depth into the T-nuts, the T-nuts may break. Conversely, if the bolts protrude past the bottom faces of the T-nuts, it will not be possible to secure the top jaws by tightening the bolts. If one of these problems exists while the spindle is rotating, the workpiece and top jaws will fly out, causing serious injuries or damage to the machine.

15. Clamp workpieces at the center of the master jaws' stroke or within their appropriate stroke range. If a workpiece is clamped in the chuck with the jaws positioned near the stroke end it will not be possible to clamp the workpiece securely and it may slip and fly out of the chuck as a result of impact during cutting, causing serious injuries or damage to the machine.

16. The machine user must take responsibility for setting the rotational speed of the chuck.
The allowable maximum speed of the chuck specified in the instruction manual or catalog prepared by the chuck and cylinder manufacturers is intended for reference purposes only. It will not guarantee safety under all operating conditions. The appropriate speed is influenced by the shape and mass of the top jaws, the chuck gripping force, the workpiece dimensions and shape, cutting force, and how the chuck is maintained and inspected. The machine user has responsibility for all these factors. If the spindle is rotated too fast under the given conditions the workpiece will fly out, causing serious injuries or damage to the machine.

WARNING

17. If there is a gap between the workpiece rear end face and the chuck locator face or the jaw face on which the workpiece should be seated, and the workpiece rotation center line is tilted with respect to the chuck rotation center line, or if the workpiece has burrs on it (cast or forged workpiece), the depth of cut will exceed the planned amount and the cutting force will therefore exceed the workpiece holding capacity of the chuck. If such conditions apply while the spindle is rotating, the workpiece will fly out, causing serious injuries or damage to the machine. If such a problem is anticipated, carry out test cutting at a low spindle speed to ensure safety.

18. Never leave the top jaws and/or T-nuts in the chuck after they have been loosened. If the spindle is started with the loose top jaws and T-nuts left in the chuck they will fly out, causing serious injuries or damage to the machine.

19. Lubricate the chuck every day with the specified grease. If the chuck is not lubricated properly, problems such as reduced gripping force, abnormal chuck jaw wear, and seizure will occur. If machining is carried out under such conditions, the workpiece will fly out, causing serious injuries or damage to the machine. Also note that the use of grease other than the specified grade will accelerate corrosion or wear, causing loss of gripping force.

20. Clean out any chips that accumulate inside the chuck.
Accumulation of chips inside the chuck reduces the gripping force and shortens the jaw stroke. If machining is carried out under such conditions the workpiece will fly out, causing serious injuries or damage to the machine.

21. Give full consideration to the type of chuck and cylinder used when setting the chucking pressure. Even if the same hydraulic pressure is applied to the chuck, the chuck gripping force will vary according to the manufacturer and type of chuck and cylinder.
For details on the chuck gripping force, consult the chuck and cylinder manufacturers.
If the chuck gripping force is different from that intended, the workpiece could fly out when the spindle is started, causing serious injuries or damage to the machine.

22. Only a qualified technician should perform hoisting work.
Operation of the crane by a person unfamiliar with safe operation practices could cause accidents involving serious injuries or damage to the machine.

23. When two or more people are involved in workpiece hoisting work, they must cooperate carefully, communicating as fully as possible. If one worker moves a machine element or operates the crane without noticing that there is another worker inside or near the machine, he could seriously injure that worker.

24. Use only wires, shackles and jigs of the dimensions specified in the manual. They must be strong enough to support the weight of the workpiece. If the workpiece is hoisted using equipment that cannot bear its weight, it will fall, causing serious injuries or damage to the machine.

25. Before lifting the workpiece, check that it is held securely. If it is not it will fall when hoisted, causing serious injuries or damage to the machine.

26. Make sure that the workpiece is well balanced in both the crosswise and lengthwise directions after hoisting it a little above the floor. If you continue to hoist the workpiece although it is not properly balanced, it will fall, causing serious injuries or damage to the machine.

27. Deburr soft jaws after shaping them. Switch off the power before starting the deburring work. If you do not switch the power off the machine could operate unexpectedly if someone carelessly interferes with the machine controls, causing serious injuries or damage to the machine.

28. Do not machine the counterbore depth of the soft jaw mounting bolts. This will weaken the soft jaws. In addition, the mounting bolts will contact the bottom of the master jaw T groove, making it impossible to hold the soft jaws securely. If machining is carried out in this condition the workpiece and soft jaws will fly out, causing accidents involving serious injuries or damage to the machine.

29. After forming soft jaws, close the front door while a workpiece is gripped in the chuck, set the spindle speed setting switch to the lowest setting, rotate the spindle in manual operation, gradually increase the spindle speed to the maximum speed used in the program, and check whether the workpiece gripping conditions are appropriate: check that the workpiece does not come out of the chuck, and that no vibration is generated. If machining is carried out although the workpiece gripping conditions are inappropriate, the workpiece will fly out, causing accidents involving serious injuries or damage to the machine. It will also seriously affect machining accuracy.

1. When soft jaws are used, they must be made of a softer material than the workpiece. If they are harder, the workpiece could be distorted or scratched.
2. Do not modify the chuck unnecessarily since this will adversely affect accuracy and functions and reduce the chuck service life.
3. When machining is carried out using a bar feeder or bar supporter, close the front door while a workpiece is gripped in the chuck, set the spindle speed setting switch to the lowest setting, rotate the spindle in manual operation, gradually increase the spindle speed to the maximum speed used in the program, and check if any vibration is generated, If there is any vibration, take the following measures to eliminate it.
   a. If bar materials to be machined is bent to an extent that exceeds the allowable range specified by the bar feeder manufacturer, correct the bend.
   b. Change the maximum spindle speed used in the program to a speed that does not cause vibration of the machine body or the bar feeder.
   c. Adjust the alignment of the machine and bar feeder.
   d. Check that appropriate guide bushes are used in the spindle through-hole.

   If the vibration cannot be eliminated by taking the measures listed above, contact the bar feeder manufacturer or Mori Seiki. If machining is carried out under vibration being generated, this will cause damage to the machine. It will also seriously affect machining accuracy.
4. Never subject the chuck, chuck jaws, or workpiece to shock by tapping them with a hammer, etc., since this will adversely affect accuracy and functions and reduce the chuck service life.
5. When stopping the machine for a long time after switching the power off, always remove the workpiece from a holding device. If the workpiece is left held in the holding device after the power has been switched off, its weight will cause the jaws of the chuck or fixture to open or the tailstock spindle or the tailstock body (programmable tailstock specification) to retract if the workpiece is held using the tailstock, and the workpiece will fall causing damage to the machine. Leaving the workpiece in the holding device will give adverse affect to the life of the chuck and the clamp mechanism of the tailstock.
6. Choose the machining conditions with particular care when shaping soft jaws, since this work involves intermittent machining. Inappropriate machining conditions could cause damage to the cutting tool or cause machining defects.

6 SAFETY PRACTICES DURING MACHINE OPERATION

1. **Do not insert bar stock into the spindle while the spindle is rotating or you will be entangled in the machine. The length of the bar stock must be shorter than the spindle length unless a bar feeder is used. If the bar stock protrudes from the spindle it will increase spindle runout, and could bend, causing accidents involving serious injuries or damage to the machine.**
2. **While the spindle is rotating, never open the front door to remove chips or touch the workpiece or cutting tools, since you could become entangled in the machine and seriously injured. You may also be injured by chips wrapped around the workpiece.**
3. **Do not lean against the machine while it is operating. If, for example, the workpiece or chuck jaws fly out of the chuck and strike a cover while you are leaning against it, you will receive the full impact of the blow and be injured.**
4. **After completion of a cycle, always check that the cycle start indicator is not lit and that the program end indicator is lit before removing the machined workpiece and setting a new workpiece. Remember that the program execution does not stop when a cycle is completed and the machine could start operating and seriously injure you.**
5. **Before pressing the (START) switch to start automatic operation, make sure that the dry run function is invalid (OFF) and that all other switches, such as the spindle override switch, the rapid override switch, and the feedrate override switch are set to the proper position. If automatic operation is started with the dry run function valid (ON) or any of the override switches set incorrectly, the axes could be fed in an unexpected manner and the spindle could be rotated at an unexpected speed, causing accidents involving serious injuries or damage to the machine.**
6. **Never leave any objects on any moving part of the machine. Objects left on moving parts may be crushed, or may damage the machine. In addition, objects left on top of the machine may fall off due to machine vibration etc., injuring plant personnel.**
7. **A machine with special specifications must be operated in accordance with those specifications. If it is operated incorrectly it may operate in an unexpected manner, causing accidents involving serious injuries or damage to the machine.**

WARNING

8. **Some switches have transparent covers to prevent them from being pressed by mistake. Keep these covers closed except when actually pressing the switches. If a switch cover gets broken contact Mori Seiki.**
   If these covers are kept open or are removed and a switch is pressed unintentionally, the machine will operate in an unexpected manner, causing accidents involving serious injuries or damage to the machine.
9. **Pressing the feed hold switch during automatic operation stops axis movement but does not stop spindle rotation. Therefore, select a manual mode and confirm that spindle rotation has stopped before opening the door. If you open the door while the spindle is rotating you may be entangled with the spindle and seriously injured.**
10. **Always stop the machine before removing chips inside it during operation. Also stop the machine and coolant supply before adjusting the direction or volume of coolant supply. If you attempt these operations while the machine is operating you could be seriously injured by being entangled in the revolving parts of the machine or crushed by its moving parts.**
11. **Before opening the front door to remove chips from inside the machine during machining operation, make sure that the door interlock function is valid. After removing the chips, close the front door before restarting machine operation. If the machine interlock function is invalid, it will be possible to open the door while the machine is operating, and this could cause accidents involving serious injuries or damage to the machine.**
12. **Be aware that the machine will start automatic operation if the**  **(START) switch is pressed by mistake while the conditions required to start automatic operation are satisfied and an automatic mode is selected. If this switch is pressed carelessly, automatic operation will start unexpectedly, and this could cause accidents involving serious injuries or damage to the machine.**
13. **If the single block function is made valid during automatic operation, the next block is stored in the buffer register.**
    To stop the process currently being executed in order to execute another process in this condition (i.e., with the data for the next block stored in the buffer register), clear the data in the buffer register by pressing the reset key. If you attempt to execute another process while the data is still stored in the buffer memory, the machine will operate in an unexpected manner, and this could cause accidents involving serious injuries or damage to the machine.

14. While the machine is temporarily stopped during machining - for example when checking a program, performing test cutting, or cleaning chips out of the machine - do not feed the axes or index the turret head in manual operation. Or, if it is absolutely necessary to do so, be sure to return the axes and turret to their original positions before restarting the program. If machining is restarted without returning them to their original positions, the turret will move in unexpected directions, causing collisions between the cutting tools, holders, or turret head and the workpiece, chuck, or tailstock (if featured), which could cause serious operator injuries or damage the machine. The workpiece could also be machined with the wrong tool, and the cutting tool could be damaged.

15. Before switching the machine lock function from "valid" to "invalid", wait until one program operation cycle has been completed. After switching from "valid" to "invalid", always execute a zero return operation. Switching between "valid" and "invalid" during program execution will create a discrepancy between the position designated in the program and the actual machine position, which could cause accidents involving serious injuries or damage to the machine.

16. When carrying out unmanned operation over extended periods, or machining using an inflammable coolant such as oil-based coolant or an inflammable workpiece, there is a likelihood of fire to occur. If a fire were to develop in the machine, it could cause accidents involving serious injuries or damage to the machine.
Mori Seiki will not accept responsibility for the loss due to a fire. Install automatic fire extinguishing equipment and operate the machine using great caution for the prevention of fire.

17. If the door interlock function is "released" while the single block function is valid, it constitutes very danger situation since the door is unlocked permitting the door to be opened even while the machine is operating, independent of the DOOR UNLOCK switch state (lock or unlock), the selected mode, or executed operation (automatic operation and manual operation). If the necessary operation requires work to be carried out with the door open while the machine is operating, this work must be limited only to that which is absolutely necessary and must be carried out very carefully.
Work which is carried out with the door open while the machine is operating will cause injuries due to the operator being entangled in the rotating parts of the machine, crushed by its moving parts, being struck by a workpiece or chuck jaws that have flown out of the machine, or being splashed by chips and coolant.

1. Before starting mass production, always check the program and perform test cutting in the single block mode. If you fail to do this the workpiece could collide with the cutting tool during machining, causing damage to the machine. Machining defects could also be caused.
2. In the case of machines that feature a hard-overtravel function, when a hard-overtravel alarm has occurred, the interlock axis movement interlock can be released by pressing the 2nd O.T. release button. Be very careful not to move the axis in the wrong direction after pressing this button. If the axis is fed further in the direction in which hard overtravel occurred, the turret head and carriage may collide with the covers, causing damage to the machine. For the sake of safety, feed the axes using handle feed ($\times$1) until the hard-overtravel alarm has been cleared.
3. Be aware that the program will be executed at an unexpected feedrate if the dry run function is made valid mistakenly during automatic operation, and this could cause damage to the machine.
4. When the EMERGENCY STOP button or reset key has been pressed to stop the machine during a threading operation or a hole machining operation, especially a tapping operation, carefully feed the axes after checking the workpiece and cutting tool carefully for damage. If you feed the axes without due care, the workpiece and cutting tool may collide or interfere with each other, and this could cause damage to the machine.
5. Keep the chip conveyor operating all the time during automatic operation. If chips accumulate on the conveyor it will not be possible to expel them and the chip conveyor could be damaged. (Applies only to machines equipped with a chip conveyor.)
6. Do not press the reset key during background editing since automatic operation will be reset and the machine will stop suddenly: this could cause damage to the machine.
7. Before positioning the saddle to join it with the tailstock, first retract the X-axis in the positive direction so that the turret head and other machine elements will not interfere with the tailstock when the saddle is moved to the joint position. Interference could cause damage to the machine. (Applies only to machines with a programmable tailstock.)
8. Check that no abnormal noise or vibration is generated during machine operation. If there is any abnormal noise or vibration, determine the cause and take appropriate action.
   Continuing to operate the machine without taking any action could cause machine faults. It will also adversely affect machining accuracy.
9. Never move the axes or rotate the turret head manually while the automatic operation is temporarily stopped. If it becomes necessary to do these manually, always return the axes or the turret to the previously located position before restarting the automatic operation.
   If the automatic operation is restarted after indexing other tool or without returning to the previous position, a tool may be hit against the workpiece or the chuck, or other problem may occur, causing damage to the machine.

10. If abnormal vibration or chattering is generated during machining due to improper combination among jig, cutting tool, workpiece material, etc., change the machining conditions to proper values. If machining is continued forcibly under the machining conditions with improper values, it will bring critical problems for the machine and accuracy such that the bearings is damaged quickly and cutting tool is worn excessively will take place.

7 TO ENSURE HIGH ACCURACY

The accuracy of the finished product cannot be maintained unless the following points are observed when operating the machine. Failure to observe these points can also cause accidents involving serious injuries and damage to the machine. Study these points carefully before operating the machine.

1. **Provide a chucking allowance that is large enough to ensure that the workpiece will not come out of the chuck due to cutting forces or the centrifugal force generated by spindle rotation. Depending on the shape of the workpiece, it may need to be supported by the tailstock (applies only to machines equipped with a tailstock). If the workpiece flies out of the chuck during machining it could cause serious injuries or damage to the machine.**
2. **If the center of gravity of the workpiece does not coincide with the center of rotation for the chuck (non-circular workpieces, eccentric workpieces, etc.), fit a balancing weight to correct the balance and choose machining conditions such as spindle speed carefully. If the workpiece is rotated without correcting the balance it could fly out of the chuck, causing and serious injuries or damage to the machine. Failure to correct the balance will also adversely affect machining accuracy. If a balancer is fitted, do not rotate the spindle with no workpiece mounted to it. This will cause wear or seizure of the spindle bearing, causing machine faults.**
3. **Workpiece materials and shapes vary widely among machine users, and Mori Seiki cannot predict the requirements for individual cases. Give full consideration to the workpiece material and shape in order to set the appropriate machining conditions. If inappropriate settings are used, the workpiece or cutting tool could fly out during machining, causing accidents involving serious injuries or damage to the machine. Inappropriate settings will also adversely affect machining accuracy.**

When setting the tooling, refer to the turret interference diagram and axis travel diagram in the maintenance manual (DRAWINGS or PARTS LIST published separately) so as to avoid interference. In the case of machines with two spindles, also make sure there will be no interference during workpiece transfer. Careless tooling will lead to interference between the tools and the workpiece, chuck, chuck jaws, covers, tailstock (if featured) or headstock 2 (if featured), which could cause damage to the machine.

1. When chucking or supporting a workpiece, take the rigidity of the workpiece into account when determining the chucking or supporting method and chucking pressure or tailstock thrust force (if a tailstock is featured), so as not to distort the workpiece. If the workpiece is distorted the machining accuracy will be adversely affected.
2. If any chips become entangled with the workpiece or cutting tool, machining accuracy will be adversely affected. Select a cutting tool and machining conditions which do not cause entangling of chips.
3. When starting work and prior to machining, break in the spindle and each controlled axis. Using the machine without breaking it in first will cause thermal displacement, which will adversely affect machining accuracy.

8 PRECAUTIONS WHEN OPERATING SPECIAL SPECIFICATION MACHINES

8-1 Industrial Robot Specification

Only properly authorized persons trained and approved in accordance with local regulations may operate robots.
Unauthorized persons may not operate a robot for any reason, including teaching and inspection. Anyone working with the robot operators must also be properly authorized.

WARNING DISPLAY ON TURNING ON POWER

The cautions to be observed in order to ensure safe machine operation are indicated on the caution labels fixed at appropriate locations on the machine. They are also stated in the Instruction Manual supplied with the machine.

Failure to follow these safety instructions will cause operator injuries and/or damage to the machine. To impress upon the operator that the safety instructions must be strictly observed, a message to this effect is displayed on the screen when the power is turned on.

The screen displays the message with the following contents when power is turned on:

(WARNING)

The machine is designed and manufactured for well-trained operators who have a basic knowledge of machine operation. DO NOT operate this machine unless this applies to you. To avoid accidents, you are required to read and understand the information on the caution labels, in the manuals and follow instructions carefully. Failure to follow these instructions may result in injury, or damage to the machine. Being aware of this warning, press [OK] soft-key.

NOTE The contents of the displayed message may vary depending on NC models.

<Operation procedure>

CAUTION Before pressing the **[OK]** soft-key, read the message carefully.

1) Read and understand the contents of the message. Then, press the **[OK]** soft-key.
2) Turn the power on after that.

For detail of turning on the power, refer to "Turning on the Power" in this manual.

<For weekly timer specification>

In the case of machines equipped with the weekly timer, this message confirmation step after turning on the power is not required in order to set the machine in the ready status to allow a cycle start initiated by the weekly timer. In this case, cycle start by using the (START) switch or manual operation is not possible.

NOTE To start the cycle by using the (START) switch or operate the machine manually, carry out the message confirmation step.

PREFACE

This manual provides the information necessary to operate the machine. Information explained in each chapter is briefly described below.

DOOR INTERLOCK FUNCTION

The door interlock function is provided to ensure the operator's safety.
This chapter deals with the purpose and specifications of the door interlock function.
Before operating the machine, read this chapter carefully.

A: OPERATION PANELS

Switches used to turn on/off the power supply, the functions and operational procedure of the switches and keys on the operation panel are explained.

B: MANUAL OPERATION

The procedure used to turn on/off the power supply, and to stop the machine in emergency cases are described.

This chapter also provides the procedure to feed the axes or to start/stop the spindle manually.

C: CHUCKING

This chapter explains the cautions for chucking a workpiece and the procedure for adjusting the chucking pressure.

The soft jaw shaping procedure is also explained.

D: SETTING OF COORDINATE SYSTEM

This chapter explains the coordinate system used in creating programs and machining workpieces.
There are two kinds of coordinate system settings as follows:

- The coordinate system set using the tool geometry offset function (G00 T_;)
- The work coordinate system (G54 to G59)

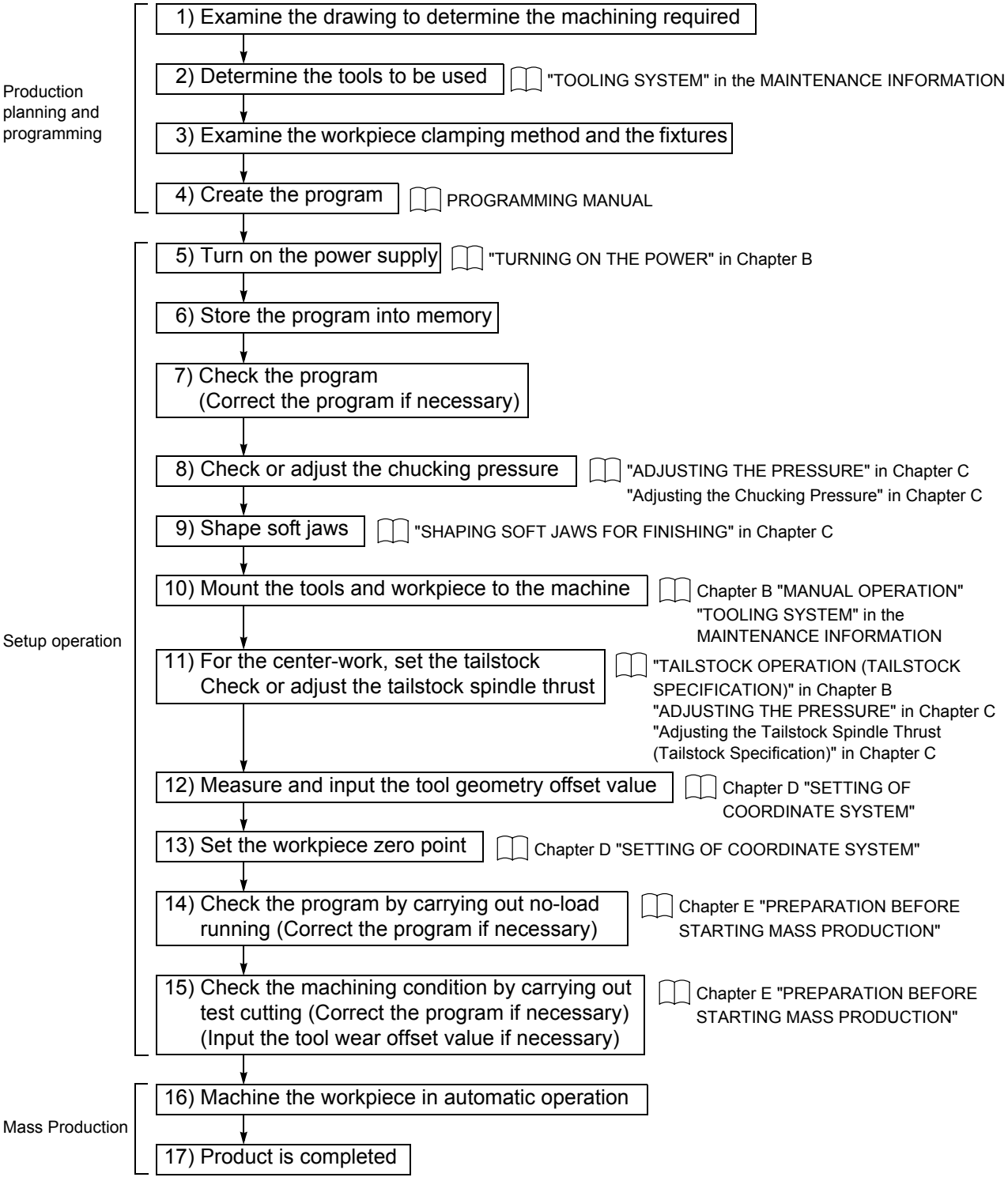
E: PREPARATION BEFORE STARTING MASS PRODUCTION

This chapter explains the procedures for checking a program and finishing a workpiece within the specified tolerance before starting mass production. The checkups before starting mass production are also explained.

FLOW UNTIL THE PRODUCT IS COMPLETED

General operation flow to finish a product is shown below along with the reference sections. Follow and understand the flow so that the operation can be performed smoothly.

Describes the instruction manual or item to be referred to.



DOOR INTERLOCK FUNCTION

The door interlock function is provided to ensure the operator's safety while operating the machine.

This chapter deals with the purpose and specifications of the door interlock function.

Before operating the machine, read this chapter carefully.

The door interlock function serves only to ensure the safety of the machine operator by inhibiting manual operations (spindle rotation, axis feed, etc.) and all automatic operations when and while the door is open with the interlock ON; it will not afford protection against hazards that could occur as the result of erroneous operation.

If the door interlock function is released, single block operation, MDI operation and all manual mode operations are permitted even when the door is open, and if the door interlock function is released after setting the single block function ON, the door can be opened even if the machine is operating.

The customer must understand the specifications of the door interlock function, recognize potential hazards, and operate the machine with safety always in mind and without relying on the door interlock function too much.

To ensure safety in operation, the customer is requested to promote safety and not rely solely on the interlocks provided by the door interlock function, e.g. by giving appropriate safety training to operators and maintenance technicians, etc.

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1 DOOR INTERLOCK FUNCTION

This section describes the outline of the door interlock function and the potential hazards which exist in the door interlock function.

The door interlock function is developed to ensure the operator's safety during machine operation.

Before starting the machine operation, make sure that the door interlock function is valid. When the door interlock function is made valid, machine operation is enabled or disabled in response to the closing or opening of the machine door. Spindle (or rotary tool spindle) rotation, turret indexing, axis feed and other manual operations excluding mounting and removing of a workpiece and all automatic operations are inhibited when and while the door is opened.

Although it is possible to release the door interlock function unavoidably, the operators must understand that there are potential hazards, which will lead to serious injury or death, in carrying out intended operation while the door is open. For this purpose, the indicator blinks in red and the electronic buzzer beeps while the door interlock function is released.
This indicator and buzzer indication is given until the door interlock function is made valid again. The operators must understand that there are various dangers when carrying out maintenance or other work while the door interlock function is released and they must pay sufficient care under such conditions. After completing the intended work with the door interlock function released, make the door interlock function valid. Restart machine operation only after making sure that the door interlock function is valid.

For details of the operation of the door interlock function and the restrictions on machine operation, refer to page P-10 (4).

For the potential hazards (accidents caused by improper operation and those occurring unexpectedly) that will occur if the machine is operated with the door open, the caution label as indicated below is attached to the machine (front) door so that the operator may recognize the fact that the door must be kept closed.

Explanation concerning the potential hazards and the meaning of the caution label is given in the brochure titled "SAFETY GUIDELINES".

(H42245)

(WARNING label "Do not operate without shutting door.")

<Potential hazards which are anticipated in the door interlock function and examples of possible accidents>

1. When the door interlock function is "RELEASED"
2. When the single block function is set valid and the door interlock function is "RELEASED" during automatic operation

When the door interlock function is "RELEASED" machine operation is permitted even when the door is open. Due to this fact, the following human-caused or unexpected accidents described below will occur.

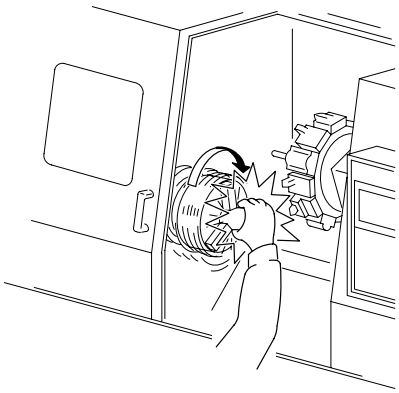
In addition, with the door interlock function, if the single block function is made valid and the door interlock function is "RELEASED" the door can be operated even while the machine is operating, which causes the occurrence of the following human-caused or unexpected accidents described below.

To prevent occurrence of such accidents and to allow safe operation of the machine, Mori Seiki recommends to set the door interlock function to "VALID" when the machine is operated.

Anticipated danger and possible accidents, which exist or will likely occur are described below.

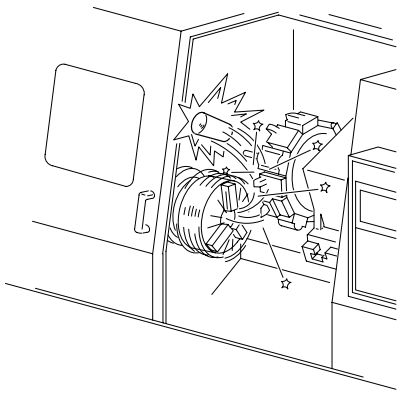
WARNING

Customers will machine a variety of workpiece types, and will therefore use a variety of workpiece holding fixtures and cutting tools. Cutting methods and cutting conditions will also vary depending on the customer's own know-how and Mori Seiki cannot predict the details of machining in all cases. It is, therefore, the customer's responsibility to determine the relevant factors and ensure safe operation by avoiding dangers that will otherwise occurring in machining.



1. The operator will become entangled with the spindle if the spindle starts while the operator is touching the chuck or workpiece.
2. The operator will become entangled with the spindle if the operator touches the chuck or the workpiece while the spindle is rotating.

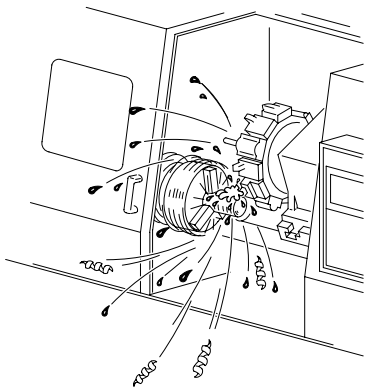
The accidents described above, in which the operator becomes entangled with the rotating parts of the machine, will result in serious injury or death.



3. A workpiece will fly out if the spindle rotation is started while the workpiece is not clamped correctly.
4. A workpiece and/or chuck jaw will fly out if the cutting tool (turret) is hit against the workpiece due to programming error.
5. A workpiece will fly out due to excessively heavy cutting force or lowered workpiece gripping force of the chuck caused by centrifugal force.

As described above, a workpiece or a chuck jaw, disengaged from the chuck due to some reason, flies out to hit the operator or a person standing near resulting in serious injury or death.

6. The operator will be caught or entangled by moving parts such as turret during axis feed or indexing motions, resulting in serious injury or death.



7. The operator or a person standing near the machine will be splashed with chips and coolant during machining, resulting in injury or health problems (particularly if chips or coolant get into the eyes).

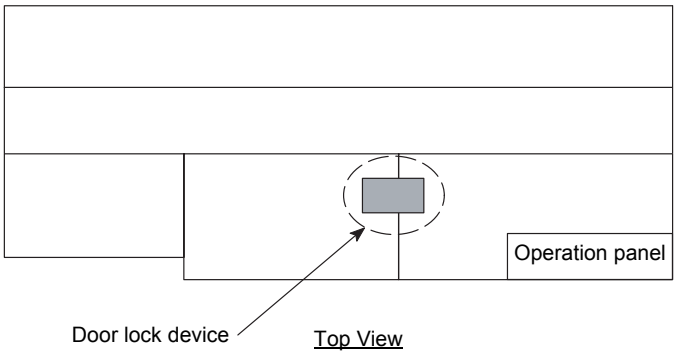
2 DOOR INTERLOCK FUNCTION CONTROLS AND THE FUNCTIONS

The machine is equipped with the controls, such as the DOOR INTERLOCK key-switch, the status indicator, the electronic buzzer, and the caution label, used to operate the door interlock function. It is also equipped with the door lock device which locks the door when the door is closed under certain conditions.

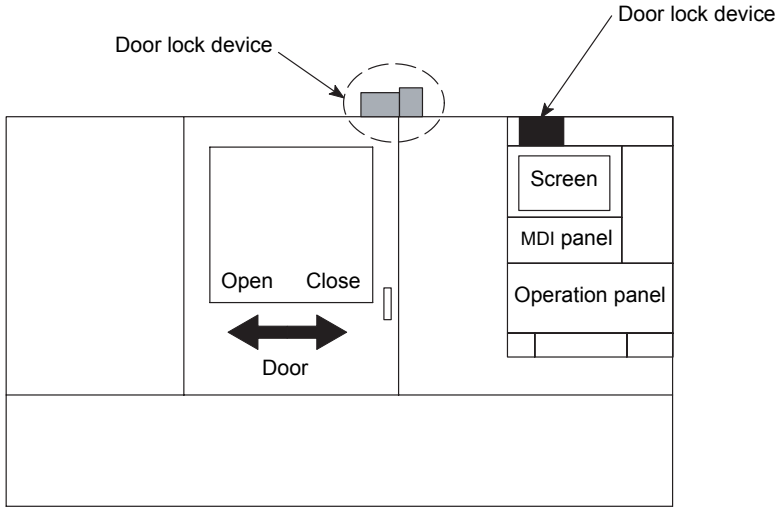
This section explains the installation position of the controls related with the door interlock function and the door lock device as well as the functions of the controls.

<Installation positions>

The switches and other controls for the door interlock function are mounted on the operation panel and the door lock device is mounted to the door.



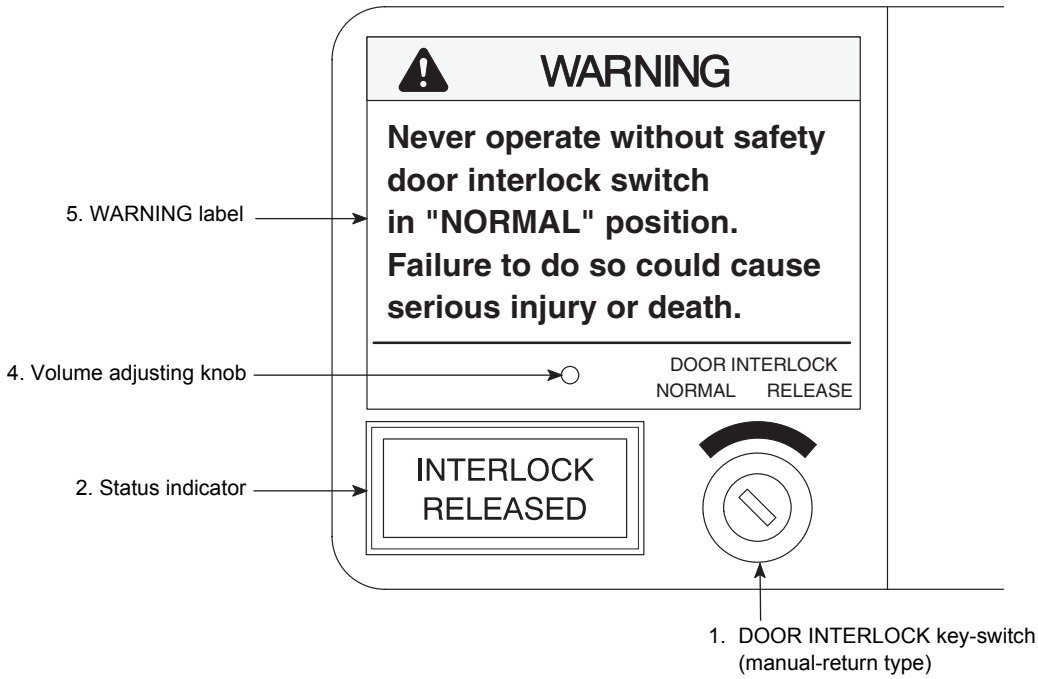
Top View



Front View

NOTE The specifications and the installation positions of the door interlock function controls and the door lock device will vary according to the machine model and specification. For details, contact Mori Seiki.

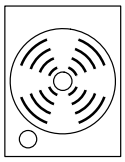
<Door interlock function controls>

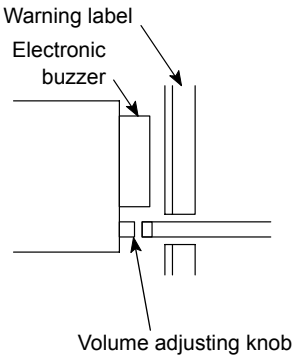


NOTE The arrangement of the controls for the door interlock function will vary according to the machine model and specification.

The functions of the controls are summarized below:

No.	Control	Function
1.	DOOR INTERLOCK key-switch 	Makes the door interlock function valid, invalid (partly), and invalid. **<NORMAL>** When the DOOR INTERLOCK key-switch is placed in the **NORMAL** position, the door interlock function is made valid. Keep the DOOR INTERLOCK key-switch in the **NORMAL** position. **<RELEASE>** When the DOOR INTERLOCK key-switch is placed in the **RELEASE** position, the door interlock function is partially made invalid. Under such condition, there are potential hazards in operating the machine. To warn this state, the status indicator **[INTERLOCK RELEASED]** blinks in red and the electronic buzzer beeps. Pay sufficient care if it becomes necessary to operate the machine under such condition. NOTE 1. Make sure that the status indicator **[INTERLOCK RELEASED]** blinks in red and the electronic buzzer beeps when the DOOR INTERLOCK key-switch is placed in the **RELEASE** position. 2. If the disconnection of the status indicator or electronic buzzer circuit is detected, the door interlock function cannot be released even if the DOOR INTERLOCK key-switch is placed in the **RELEASE** position.

No.	Control	Function
2.	Status Indicator 	The status indicator blinks in red under any of the following conditions to give warning (interlock released, or abnormal state) to the operator. 1. The DOOR INTERLOCK key-switch is placed in the **RELEASE** position. 2. The electronic buzzer circuit disconnection is detected. 3. An abnormal state of the control system of the door interlock function is detected. NOTE 1. The status indicator **[INTERLOCK RELEASED]** blinks in red rapidly if the electronic buzzer circuit disconnection or abnormal state of the control system is detected, or if the power is turned on while the DOOR INTERLOCK key-switch is in the **RELEASE** position. 2. If power is turned on while the DOOR INTERLOCK key-switch is in the **RELEASE** position, press the EMERGENCY STOP button and return the DOOR INTERLOCK key-switch into the **NORMAL** position. After that turn on power again.
3.	Electronic buzzer 	The electronic buzzer beeps under any of the following conditions to give warning (interlock released, or abnormal state) to the operator. 1. The DOOR INTERLOCK key-switch is placed in the **RELEASE** position. 2. The status indicator circuit disconnection is detected. 3. An abnormal state of the control system of the door interlock function is detected. NOTE 1. The electronic buzzer beeps rapidly if the status indicator circuit disconnection or abnormal state of the control system is detected, or if the power is turned on while the DOOR INTERLOCK switch is in the **RELEASE** position. 2. If power is turned on while the DOOR INTERLOCK key-switch is in the **RELEASE** position, press the EMERGENCY STOP button and return the DOOR INTERLOCK key-switch into the **NORMAL** position. After that turn on power again. 3. The electronic buzzer is attached to the rear of the WARNING label.

No.	Control	Function
4.	Volume adjusting knob  	The knob adjusts buzzer beep volume. Use a fine flat head screwdriver to turn the adjusting knob from externals. CW rotation: Increases volume. CCW rotation: Decreases volume. The knob is set at 40° position in the CW direction from the minimum volume position. CAUTION Do not decrease volume excessively. If buzzer beeps only faintly, the warning beeps might not be recognized during interlock release or abnormal state, constituting hazards.
5.	WARNING label	The WARNING label gives information related with the door interlock function. Read and follow the instruction printed on the label. CAUTION Never remove or make the label dirty. Place an order with Mori Seiki for the label, if the letters on the label become dirty, or if the label is damaged or lost. Use the WARNING label in the language understandable to the operators.

3 PRECAUTIONS ON USING THE DOOR INTERLOCK FUNCTION

This section indicates the items to be carefully attended to when using the door interlock function. Please read carefully and understand the cautionary items indicated below.

If the door interlock function is released, the machine is able to operate with some limitations while the door is open, exposing you to danger. In daily production operation, the door interlock function must be set "valid" and the key operating the switch must be removed from the switch and kept safely.

When shaping soft jaws, measuring the tool offset data, program check, test cutting, or carrying out other setup work, it may be necessary to release the door interlock function. If you have to carry out work while the interlock function is released, you must recognize that there are many hazards involved and pay particular attention to safety.
While the door interlock function is released, the warning lamp blinks in red and the warning buzzer beeps intermittently. You must recognize that the door interlock function is in the released state if the warning lamp is blinking in red and the warning buzzer is beeping intermittently. After finishing the necessary work, you must switch the interlock function back "valid".

1. If an abnormality such as a disconnection of the door lock status indicator or electronic buzzer occurs, stop using the machine and contact Mori Seiki Service Department. Since the door interlock control circuit is equipped with the disconnection detection function, the error is displayed until the NC power is shut off. If you operate the machine before canceling the error, the machine may operate in an unexpected manner, causing accidents involving serious injuries or damage to the machine.
2. If power is turned on while the DOOR INTERLOCK key-switch is set in the **RELEASE** position, the status indicator **[INTERLOCK RELEASED]** blinks in red and the electronic buzzer beeps rapidly to warn that the machine is in the abnormal state.
   1) Return the key-switch to the **NORMAL** position.
   2) Press the EMERGENCY STOP button and turn off power.
   3) Turn on power again.

In the Mori Seiki's OPERATION MANUALs, all operation procedures are explained assuming that the door interlock function is valid and the door is closed.

4 USING THE DOOR INTERLOCK FUNCTION

This section describes how the door interlock function should be used for the machine equipped with a manual door and also for the machine equipped with an automatic door.

1. Door interlock function for the machine equipped with a manual door

Page P-11 (4-1)

2. Door interlock function for the machine equipped with an automatic door

Page P-14 (4-2)

NOTE The automatic door is optional. When the machine is equipped with the automatic door, the door interlock function operates in different manner between the machine not equipped with a robot (operation is assumed to be performed by an operator) and the machine equipped with a robot (operation is assumed to be performed by the robot). Refer to the manual dealing with the machine of the same type as installed to the customer's shop.

WARNING

If the door interlock function is "released", this constitutes a very dangerous situation since the following operations are permitted, which may lead to injuries.

1. **Even when the door is open, automatic operation with the single block function valid (single block operation) is permitted. (MDI mode operation)**
2. **Even when the door is open, all operations are permitted in the manual mode.**
3. **If the door interlock function is "released" while the single block function is valid, the door is unlocked permitting the door to be opened even while the machine is operating, independent of the selected mode or the operation presently carried out (automatic operation, manual operation).**

To ensure safety in operation, the customer is requested to promote safety and not rely solely on the interlocks provided by the door interlock function, e.g. by giving appropriate safety training to operators and maintenance technicians, etc.

If the necessary operation requires work to be carried out with the door open or the door to be opened while the machine is operating after releasing the door interlock function, this work must be limited only to that which is absolutely necessary and must be carried out very carefully.

Mori Seiki recommends the customer to use the machine with the door closed and the door interlock function valid.

4-1 Door Interlock Function of Manual Door

The specifications of the available door interlock function for the machines equipped with the manual door are explained in details below along with the procedure for using the door interlock function.

<Manual and automatic operation (door interlock function valid)>

If the DOOR INTERLOCK key-switch is placed in the **NORMAL** position while the door is open, only the following manual operations are permitted.

1. Inching and IN/OUT operation of the tailstock spindle (tailstock specification)

When holding a workpiece using the tailstock, do not move the tailstock spindle out in the tailstock spindle "out" operation without first making sure that your hand will not be caught by the tailstock spindle. If the tailstock spindle is moved out without taking adequate care, there is a danger that your hand will be caught between the tailstock spindle and the workpiece.

2. Clamp/unclamp operation of the chuck

All operations are enabled when the door is closed.

<Manual and automatic operation (door interlock function released)>

If the DOOR INTERLOCK key-switch is placed in the **RELEASE** position while the door is open, automatic operation is permitted conditionally.
In manual operations, there are no restrictions with an exception that rapid traverse rate for axis movement is clamped at a certain value.

Status		Door Opened DOOR INTERLOCK key-switch: **RELEASE**
Automatic operation		Possible under certain conditions[*2]
Manual operation	Rotation of spindle (rotary tool spindle[*1])	Possible
	Jogging of spindle (rotary tool spindle[*1])	Possible
	Turret indexing	Possible
	Axis feed	Possible under certain conditions[*3]
	Coolant supply	Possible
	Chip conveyor[*1]	Possible
	C-axis selection[*1]	Possible

NOTE

*1 Some of specifications and options may not be featured on your machine, depending on the model and specifications.

*2 Automatic operation is possible only while the single block function is valid or MDI mode is selected.

For the machine equipped with the loader, even if the workstocker front door is open, automatic operation is possible while the single block function is valid or MDI mode is selected.

*3 Rapid traverse rate for rapid traverse operation and that in zero return operation are clamped at 5 m/min. For jog and pulse handle feed operation, no such restriction is provided.

<Restrictions on operations>

1. With the door opened, it is possible to carry out such operations as shaping soft jaws and measuring the tool offset data by rotating the spindle and indexing the turret head in the manual mode (handle, jog, rapid traverse, zero return).

NOTE

1. Since the rapid traverse rate of the axis which has the fastest rapid traverse rate is clamped at 5 m/min, the clamp feedrate of other axes may be lower than 5 m/min.
2. When moving an axis after releasing the door interlock function, if the DOOR INTERLOCK key-switch is placed in the **NORMAL** position while the axis is moved at a rate faster than 500 mm/min, the door interlock function becomes valid and the axis is stopped. In this case, excessive servo error alarm may occur.

   This alarm does not occur when the DOOR INTERLOCK key-switch is placed in the **NORMAL** position after axis movement is stopped by releasing the axis feed switch.

2. With the door opened, it is possible to check the program or carry out test cutting in the memory (tape) mode by making the single block function valid.

NOTE

If automatic operation is executed with the door open and the single block function set valid, rapid traverse rate is clamped at 5 m/min. For cutting feedrate, no such restriction applies.

For the machine equipped with the loader, the axis feedrate of the loader is also clamped at 5 m/min.

3. With the door opened, it is possible to execute the MDI mode operation.

<Precautions on automatic operation>

NOTE

If the single block function is made invalid during automatic operation under the following conditions, the machine is placed in the feed hold mode and the error message is displayed (EX2029 CYCLE START PERMISSION IMPERFECT).

- The door is open.
- The DOOR INTERLOCK key-switch is placed in the **RELEASE** position.
- The single block function is valid.

The machine can restart by pressing the  (START) switch after making the single block function valid.

<Potential hazards>

Please also refer to pages 2 and 3, where several examples of potential hazards and possible accidents are described.

If the door interlock function is "released", this constitutes a very dangerous situation since single block operation, MDI operation and manual operations (restriction applies on rapid traverse rate for axis movement) are permitted while the door is open, which may lead to injuries.

If the door interlock function is "released" while the single block function is valid, the following danger exists since the door is unlocked permitting the door to be opened even while the machine is operating, independent of the selected mode or the operation presently carried out (automatic operation, manual operation).

Since serious human accidents including death could be caused due to the danger described above, sufficient care must be paid.
Anticipated danger and possible accidents, which exist or will likely occur, are described below.

1. **The operator becomes entangled in the rotating parts of the machine because the spindle starts rotating while the operator is touching the chuck or the workpiece or the operator touches the chuck or the workpiece while the spindle is rotating.**
2. **A workpiece or chuck jaw that becomes disengaged from the chuck while the spindle is rotating due to some reason (e.g. mischucking, lowered workpiece gripping force caused by excessively heavy cutting force or centrifugal force, interference of a cutting tool with the workpiece caused by programming error or incorrect program check) flies out and strikes the operator or a person standing nearby.**
3. **The operator is caught by, or entangled in, the moving or rotating turret.**
4. **The hand or foot of an operator comes into contact with the chip conveyor while it is operating and becomes entangled with the conveyor.**
5. **The operator or a person standing near the machine is splashed with chips and coolant, or chips and coolant get into the eyes.**

For other danger, the customer is required to pay due attention.

4-2 Door Interlock Function of Automatic Door

The specifications of the available door interlock function for the machine equipped with the automatic door are explained in details below along with the procedure for using the door interlock function.

NOTE The automatic door is optional. When the machine is equipped with the automatic door, the door interlock function operates in different manner between the machine not equipped with a robot (operation is assumed to be performed by an operator) and the machine equipped with a robot (operation is assumed to be performed by the robot). Refer to the manual dealing with the machine of the same type as installed to the customer's shop.

4-2-1 For the Machine not Equipped with Robot

The specifications of the available door interlock function for the machine equipped with the automatic door (without robot), which is assumed to be operated by an operator, are explained in details below along with the procedure for using the door interlock function.

<Manual operation (door interlock function valid)>

If the DOOR INTERLOCK key-switch is placed in the **NORMAL** position while the door is open, only the following manual operations are permitted.

1. Inching and IN/OUT operation of the tailstock spindle (tailstock specification)

CAUTION When holding a workpiece using the tailstock, do not move the tailstock spindle out in the tailstock spindle "out" operation without first making sure that your hand will not be caught by the tailstock spindle. If the tailstock spindle is moved out without taking adequate care, there is a danger that your hand will be caught between the tailstock spindle and the workpiece.

2. Clamp/unclamp operation of the chuck

All operations are enabled when the door is closed.

<Automatic operation (door interlock function valid)>

If the DOOR INTERLOCK key-switch is placed in the **NORMAL** position, automatic operation can be executed even while the door is open. However, the codes executable with the door opened are restricted to M00, M01, M02, M30, and automatic door open/close M codes (M85/M86), and other M codes, S codes, T codes and axis movement commands cannot be executed unless the door is closed.

<Manual and automatic operation (door interlock function released)>

If the DOOR INTERLOCK key-switch is placed in the **RELEASE** position while the door is open, automatic operation is permitted conditionally. In manual operations, there are no restrictions with an exception that rapid traverse rate for axis movement is clamped at a certain value.

Status		Door Opened DOOR INTERLOCK key-switch: **RELEASE**
Automatic operation		Possible under certain conditions*2
Manual operation	Rotation of spindle (rotary tool spindle*1)	Possible
	Jogging of spindle (rotary tool spindle*1)	Possible
	Turret indexing	Possible
	Axis feed	Possible under certain conditions*3
	Coolant supply	Possible
	Chip conveyor*1	Possible
	C-axis selection*1	Possible

NOTE

*1 Some of specifications and options may not be featured on your machine, depending on the model and specifications.

*2 Automatic operation is possible only while the single block function is valid or MDI mode is selected.

For the machine equipped with the loader, even if the workstocker front door is open, automatic operation is possible while the single block function is valid or MDI mode is selected.

*3 Rapid traverse rate for rapid traverse operation and that in zero return operation are clamped at 5 m/min. For jog and pulse handle feed operation, no such restriction is provided.

<Restrictions on operations>

1. With the door opened, it is possible to carry out such operations as shaping soft jaws and measuring the tool offset data by rotating the spindle and indexing the turret head in the manual mode (handle, jog, rapid traverse, zero return).

NOTE

1. Since the rapid traverse rate of the axis which has the fastest rapid traverse rate is clamped at 5 m/min, the clamp feedrate of other axes may be lower than 5 m/min.
2. When moving an axis after releasing the door interlock function, if the DOOR INTERLOCK key-switch is placed in the **NORMAL** position while the axis is moved at a rate faster than 500 mm/min, the door interlock function becomes valid and the axis is stopped. In this case, excessive servo error alarm may occur.

   This alarm does not occur when the DOOR INTERLOCK key-switch is placed in the **NORMAL** position after axis movement is stopped by releasing the axis feed switch.

2. With the door opened, it is possible to check the program or carry out test cutting in the memory (tape) mode by making the single block function valid.

NOTE

If automatic operation is executed with the door open and the single block function set valid, rapid traverse rate is clamped at 5 m/min. For cutting feedrate, no such restriction applies.

For the machine equipped with the loader, the axis feedrate of the loader is also clamped at 5 m/min.

3. With the door opened, it is possible to execute the MDI mode operation.

<Precautions on automatic operation>

NOTE

If the single block function is made invalid during automatic operation under the following conditions, the machine is placed in the feed hold mode and the error message is displayed (EX2029 CYCLE START PERMISSION IMPERFECT).

- The door is open.
- The DOOR INTERLOCK key-switch is placed in the **RELEASE** position.
- The single block function is valid.

The machine can restart by pressing the  (START) switch after making the single block function valid.

<Potential hazards>

Please also refer to page 2 and 3, where several examples of potential hazards and possible accidents are described.

If the door interlock function is "released", this constitutes a very dangerous situation since single block operation, MDI operation and manual operations (restriction applies on rapid traverse rate for axis movement) are permitted while the door is open, which may lead to injuries.

If the door interlock function is "released", and the automatic door open command (M85 or AUTOMATIC DOOR OPEN switch) is given while the single block function is valid, the following danger exists since the door is unlocked permitting the door to be opened even while the machine is operating, independent of the selected mode or the operation presently carried out (automatic operation, manual operation).

Since serious human accidents including death could be caused due to the danger described above, sufficient care must be paid. Anticipated danger and possible accidents, which exist or will likely occur, are described below.

1. **The operator becomes entangled in the rotating parts of the machine because the spindle starts rotating while the operator is touching the chuck or the workpiece or the operator touches the chuck or the workpiece while the spindle is rotating.**
2. **A workpiece or chuck jaw that becomes disengaged from the chuck while the spindle is rotating due to some reason (e.g. mischucking, lowered workpiece gripping force caused by excessively heavy cutting force or centrifugal force, interference of a cutting tool with the workpiece caused by programming error or incorrect program check) flies out and strikes the operator or a person standing nearby.**
3. **The operator is caught by, or entangled in, the moving or rotating turret.**
4. **The hand or foot of an operator comes into contact with the chip conveyor while it is operating and becomes entangled with the conveyor.**
5. **The operator or a person standing near the machine is splashed with chips and coolant, or chips and coolant get into the eyes.**

For other danger, the customer is required to pay due attention.

4-2-2 For the Machine Equipped with Robot

The specifications of the available door interlock function for the machine equipped with the automatic door, which is assumed to be operated according to the robot operation, are explained in details below along with the procedure for using the door interlock function.

<Manual operation (door interlock function valid)>

If the DOOR INTERLOCK key-switch is placed in the **NORMAL** position while the door is open, only the following manual operations are permitted.

1. Inching and IN/OUT operation of the tailstock spindle (tailstock specification)

When holding a workpiece using the tailstock, do not move the tailstock spindle out in the tailstock spindle "out" operation without first making sure that your hand will not be caught by the tailstock spindle. If the tailstock spindle is moved out without taking adequate care, there is a danger that your hand will be caught between the tailstock spindle and the workpiece.

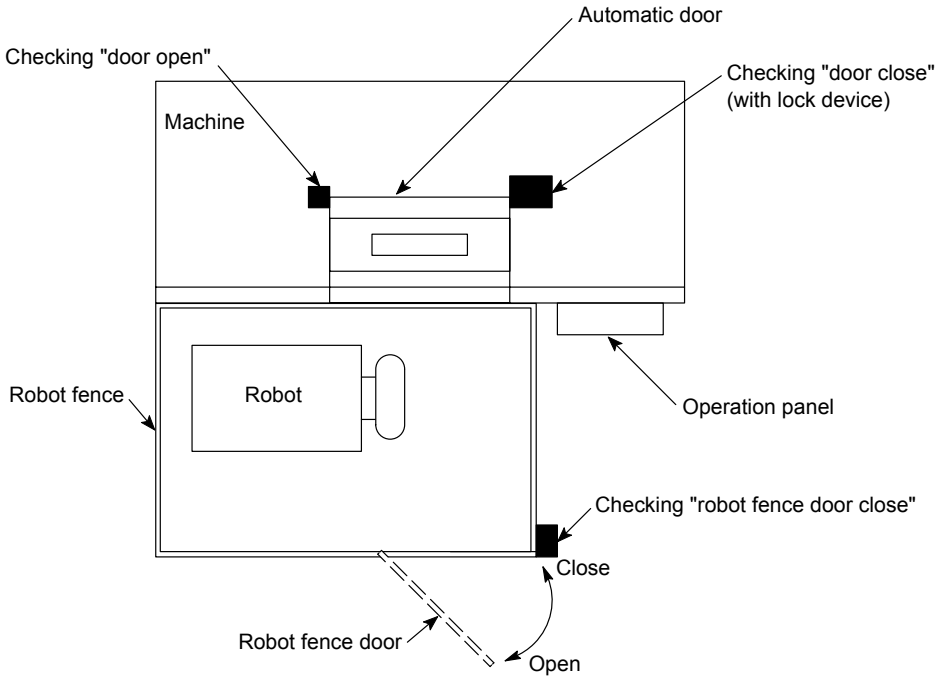
2. Clamp/unclamp operation of the chuck

All manual operations are enabled when the machine door is closed.

<Automatic operation (door interlock function valid)>

The explanation is given below assuming that the robot fence is installed as shown in the illustration below.

When the DOOR INTERLOCK key-switch is placed in the **NORMAL** position, contents of operation differ depending on whether or not the robot fence door is open.



1. If the robot fence door is open

   Automatic operation can be executed even while the machine door is open. However, the codes executable with the machine door opened are restricted to M00, M01, M02, M30, and automatic machine door open/close M codes (M85/M86), and other M codes, S codes, T codes and axis movement commands cannot be executed unless the machine door is closed.

2. If the robot fence door is closed

   Automatic operation (includes MDI mode operation) can be executed while the machine door is open under the following restrictions.

   a. Spindle start command (M03, M04) cannot be executed.

   b. Rotary tool spindle start command (M13, M14) cannot be executed.

<Manual and automatic operation (door interlock function released)>

If the DOOR INTERLOCK key-switch is placed in the **RELEASE** position while the machine door is open, automatic operation is permitted conditionally.

In manual operations, there are no restrictions with an exception that rapid traverse rate for axis movement is clamped at a certain value.

The following table shows the permitted and prohibited operations if the DOOR INTERLOCK key-switch is placed in the **RELEASE** position while the machine door is open.

Status		Machine Door Opened DOOR INTERLOCK key-switch: **RELEASE**
Automatic operation	Robot fence door open	Possible under certain conditions*2
	Robot fence door close	Possible under certain conditions*2
Manual operation	Rotation of spindle (rotary tool spindle*1)	Possible
	Jogging of spindle (rotary tool spindle*1)	Possible
	Turret indexing	Possible
	Axis feed	Possible under certain conditions*3
	Coolant supply	Possible
	Chip conveyor*1	Possible
	C-axis selection*1	Possible

NOTE

*1 Some of specifications and options may not be featured on your machine, depending on the model and specifications.

*2 Automatic operation is possible only while the single block function is valid or MDI mode is selected.

*3 Rapid traverse rate for rapid traverse operation and that in zero return operation are clamped at 5 m/min. For jog and pulse handle feed operation, no such restriction is provided.

<Restrictions on operations>

1. With the machine door opened, it is possible to carry out such operations as shaping soft jaws and measuring the tool offset data by rotating the spindle and indexing the turret head in the manual mode (handle, jog, rapid traverse, zero return).

NOTE

1. Since the rapid traverse rate of the axis which has the fastest rapid traverse rate is clamped at 5 m/min, the clamp feedrate of other axes may be lower than 5 m/min.
2. When moving an axis after releasing the door interlock function, if the DOOR INTERLOCK key-switch is placed in the **NORMAL** position while the axis is moved at a rate faster than 500 mm/min, the door interlock function becomes valid and the axis is stopped. In this case, excessive servo error alarm may occur.

   This alarm does not occur when the DOOR INTERLOCK key-switch is placed in the **NORMAL** position after axis movement is stopped by releasing the axis feed switch.

2. With the machine door opened, it is possible to check the program or carry out test cutting in the memory (tape) mode by making the single block function valid.

NOTE

If automatic operation is executed with the machine door open and the single block function set valid, rapid traverse rate is clamped at 5 m/min. For cutting feedrate, no such restriction applies.

3. With the machine door opened, it is possible to execute the MDI mode operation.

<Precautions on automatic operation>

NOTE

If the single block function is made invalid during automatic operation under the following conditions, the machine is placed in the feed hold mode and the error message is displayed (EX2029 CYCLE START PERMISSION IMPERFECT).

- The machine door is open.
- The DOOR INTERLOCK key-switch is placed in the **RELEASE** position.
- The single block function is valid.

The machine can restart by pressing the  (START) switch after making the single block function valid.

<Potential hazards>

Please also refer to page 2 and 3, where several examples of potential hazards and possible accidents are described.

If the door interlock function is "released", this constitutes a very dangerous situation since single block operation, MDI operation and manual operations (restriction applies on rapid traverse rate for axis movement) are permitted while the machine door is open, which may lead to injuries.

If the door interlock function is "released", and the automatic door open command (M85 or AUTOMATIC DOOR OPEN switch) is given while the single block function is valid, the following danger exists since the machine door is unlocked permitting the machine door to be opened even while the machine is operating, independent of the selected mode or the operation presently carried out (automatic operation, manual operation).

Since serious human accidents including death could be caused due to the danger described above, sufficient care must be paid. Anticipated danger and possible accidents, which exist or will likely occur, are described below.

1. **The operator becomes entangled in the rotating parts of the machine because the spindle starts rotating while the operator is touching the chuck or the workpiece or the operator touches the chuck or the workpiece while the spindle is rotating.**
2. **A workpiece or chuck jaw that becomes disengaged from the chuck while the spindle is rotating due to some reason (e.g. mischucking, lowered workpiece gripping force caused by excessively heavy cutting force or centrifugal force, interference of a cutting tool with the workpiece caused by programming error or incorrect program check) flies out and strikes the operator or a person standing nearby.**
3. **The operator is caught by, or entangled in, the moving or rotating turret.**
4. **The hand or foot of an operator comes into contact with the chip conveyor while it is operating and becomes entangled with the conveyor.**
5. **The operator or a person standing near the machine is splashed with chips and coolant, or chips and coolant get into the eyes.**

For other danger, the customer is required to pay due attention.

5 DOOR LOCK AND UNLOCK

This section describes how the door is locked and unlocked for the machine equipped with a manual door and the machine equipped with the automatic door.

1. Lock and unlock of manual door

Page P-23 (5-1)

2. Lock and unlock of automatic door

Page P-26 (5-2)

NOTE The automatic door is optional.

5-1 Lock and Unlock of Manual Door

For the machine equipped with the manual door, the door is locked and cannot be opened when the door is closed with the indicator above the DOOR UNLOCK switch not lit. To open the door, unlock the door by using the DOOR UNLOCK switch.

WARNING

If the door interlock function is "released" while the single block function is valid, it constitutes very danger situation since the door is unlocked permitting the door to be opened even while the machine is operating, independent of the DOOR UNLOCK switch position (lock or unlock) or the selected mode. If the necessary operation requires work to be carried out with the door open while the machine is operating, this work must be limited only to that which is absolutely necessary and must be carried out very carefully.

Work which is carried out with the door open while the machine is operating will cause injuries due to the operator being entangled in the rotating parts of the machine, crushed by its moving parts, being struck by a workpiece or chuck jaws that have flown out of the machine, or being splashed by chips and coolant.

NOTE

1. The machine recognizes that the door is closed when the door is closed and locked. Even if the door is closed, the machine does not recognize it closed unless it is locked. Such status is recognized as the door is open.

   In the manuals published by Mori Seiki, the expression "door is closed" means that the door is closed and locked.

2. When power is turned on, the NC checks the functions of the door lock device and those of the contactor for spindle/axis drive motors.
   After turning on the power, open the door once and close it again. The machine does not get ready unless the door is opened and closed after turning on power.

5-1-1 Door Unlock Switch (Manual Door Type)

The DOOR UNLOCK switch, provided on the operation panel, is used to release the door lock device.

NOTE

1. The door cannot be opened unless the door lock is released.
2. Switch configuration may differ depending on the machine.
3. With the automatic door type machine, this switch has no function even when it is pressed.

Door Unlock	Function
On	The door lock is released. The door can be opened in this state. The door lock is also released when the M02 or M30 command in a program is read. The indicator of the switch is lit and the door can be opened. NOTE Even if the M02 or M30 command is executed in the MDI mode, the door lock cannot be released.
Off	The door is locked. In this state, the door cannot be opened. If the door is closed again after being opened once, the indicator of the switch goes off and the door is locked.

5-1-2 Interlock when the Door Is Unlocked (Manual Door Type)

The door cannot be unlocked even when the DOOR UNLOCK switch is pressed under the following status.

1. While the spindle (rotary tool spindle) is rotating
2. During automatic operation
3. During turret head indexing
4. Parts catcher extended (parts catcher specification)
5. While the spindle mode is being changed to the C-axis (milling specification)

5-1-3 Releasing the Door Interlock Function (Manual Door Type)

If it becomes necessary to carry out a work with the door opened after releasing the door interlock function, follow the steps indicated below.

1) Press the DOOR UNLOCK switch.
   The indicator of the switch is lit and the door lock is released.
2) Open the door.
3) Place the DOOR INTERLOCK key-switch in the **RELEASE** position.
4) Set the single block function ON for executing an automatic operation to check the program or carry out test cutting.
5) Carry out necessary work.

NOTE If the DOOR INTERLOCK key-switch is placed in the **NORMAL** position while carrying out operation in the door interlock released state, all machine operations stop.

6) After completing the necessary work, set the door interlock function ON.
   a) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
   b) Return the single block function to invalid if the operation has been executed with the single block function set ON.
   c) Close the door.

The indicator of the DOOR UNLOCK switch goes off and the door is locked.

5-1-4 Emergency Stop and Door Unlock (Manual Door Type)

When the machine enters the emergency stop state, the door is placed in the unlocked state.
When the emergency stop state is reset while the door is closed (not locked), the door is locked.

NOTE If the emergency stop state is reset while the door is open, the following message is displayed.
"EX4002 OPEN THE DOOR THEN CLOSE"
In this case, the alarm is released when the door is closed and locked.

5-2 Lock and Unlock of Automatic Door

For the machine equipped with the automatic door, the door is locked and cannot be opened when the door is closed. To open the door, either execute the door open M code (M85) in the automatic operation mode (includes MDI mode) or open it manually in the manual mode using the AUTOMATIC DOOR OPEN switch. By the execution of the M85 code or by the operation of the AUTOMATIC DOOR OPEN/CLOSE switch, the door is unlocked and opened.

1. The automatic door is optional.
2. The machine recognizes that the door is closed when the door is closed and locked. Even if the door is closed, the machine does not recognize it closed unless it is locked. Such status is recognized as the door is open.

   In the manuals published by Mori Seiki, the expression "door is closed" means that the door is closed and locked.
3. When the power is turned on, the NC checks the function of the door lock device and those of the contactor for the spindle/axis drive motors. If the door is closed when the power is turned on, the function check is automatically executed and the machine is set ready.
   If the door is open when the power is turned on, close the door by using the AUTOMATIC DOOR CLOSE switch. The machine does not get ready unless the door is closed after turning on the power.

5-2-1 Opening/Closing the Door (Automatic Door Type)

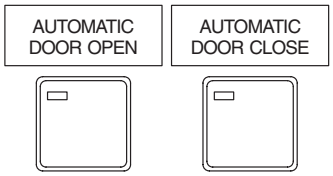
The door can be opened or closed either by executing the door open/close M code (M85/M86) or operating the AUTOMATIC DOOR OPEN/CLOSE switch.

<Using the door open/close M codes>

When opening/closing the automatic door in automatic operation (includes MDI operation), execute the M codes (M85/M86).

Door	Command	Function
Unlock	Door open (M85)	When this command is executed, the door is automatically unlocked and opened.
Lock	Door close (M86)	When this command is executed, the door is closed and after the completion of door closing, it is locked automatically.

<Using the AUTOMATIC DOOR OPEN/CLOSE switch>



The AUTOMATIC DOOR OPEN/CLOSE switch, provided on the option panel, is used to open/close the automatic door manually.

NOTE The AUTOMATIC DOOR OPEN/CLOSE switch is not operative when the PANEL key-switch is placed in the (OFF) position.

Switch	Function
	When this switch is pressed, the door is unlocked and opened.
	When this switch is pressed, the door is closed and after the completion of door closing, the door is locked.

5-2-2 Interlock When the Automatic Door is Opened (Automatic Door Type)

The door cannot be opened even when the automatic door open switch is pressed under the following status.

1. While the spindle (rotary tool)* is rotating
2. During automatic operation
3. During turret head indexing
4. While the spindle mode is being changed to the C-axis*

NOTE * M/MC specifications

5-2-3 Releasing the Door Interlock Function (Automatic Door Type)

If it becomes necessary to carry out a work with the door opened after releasing the door interlock function, follow the steps indicated below.

1) Open the door by executing M85 (door open command) or by pressing the AUTOMATIC DOOR OPEN switch.

NOTE This door opening operation is not necessary if the program has been ended after the execution of M85.

2) Place the DOOR INTERLOCK key-switch in the **RELEASE** position.
3) Set the single block function ON for executing an automatic operation to check the program or carry out test cutting.
4) Carry out necessary work.

NOTE If the DOOR INTERLOCK key-switch is placed in the **NORMAL** position while carrying out operation in the door interlock released state, all machine operations stop.

5) After completing the necessary work, set the door interlock function ON.
   a) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
   b) Return the single block function to invalid if the operation has been executed with the single block function set ON.
   c) Close the door by executing M86 (door close command) or by pressing the AUTOMATIC DOOR CLOSE switch.

   The door is locked.

NOTE This door closing operation is not necessary if the program begins with the door close command (M86).

5-2-4 Emergency Stop and Door Unlock (Automatic Door Type)

When the machine enters the emergency stop state, the door is placed in the unlocked state.

When the emergency stop state is reset while the door is closed (not locked), the door is locked.

NOTE If the emergency stop state is reset while the door is open, the following message is displayed.

"EX4002 OPEN THE DOOR THEN CLOSE"

In this case, the alarm is released when the door is closed and locked by pressing the AUTOMATIC DOOR CLOSE switch.

5-3 Keeping the Door Unlocked

As the machine is equipped with the door lock device, the door is automatically locked when closed. However, the door is not closed completely and not locked with the door lock prevention key turned to CCW. Use the door lock prevention key when performing maintenance work only. Under normal conditions, remove the key at the lock position and store it.

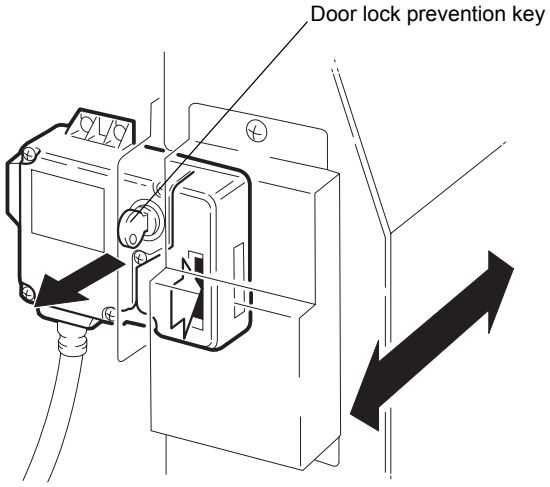


Figure A: Door Lock Device

WARNING

1. **When the door is closed, it is automatically locked and cannot be opened from the inside of the machine (inside of the door). Invalidate the door lock by turning the door lock prevention key; remove the key and carry it when entering the machine to perform maintenance work.**
2. **Turn the coin lock key, remove the key and carry it as shown in figure B above when entering the machine to perform maintenance work. If the door is closed by mistake while the door lock device is effective, an operator may be trapped in the machine.**

   If the machine is started while you are inside the machine, you will be entangled with the rotating part or crushed between sliding parts to be seriously injured.
3. **Insert any suitable key in your possession into the hole in the coin lock lever.**

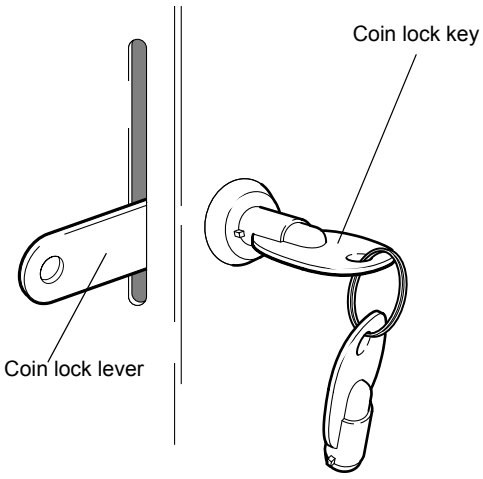


Figure B: Coin Lock

<If an operator is cooped up>

If an operator is cooped up in the machine, follow the steps below to save the cooped operator.

1) Press the EMERGENCY STOP button disregarding the power on/off state.
2) Insert the door lock prevention key into the keyhole at the outside of the door lock device that is installed at the top of the machine cover. Then, turn the key counterclockwise to release the door lock.

   This allows the door to be opened and the operator to leave the machine.

CHAPTER A
OPERATION PANELS

Switches used to turn on/off the power supply, the functions and operational procedure of the switches and keys on the operation panel are explained.

The operation mode in which the switch or operation is valid is indicated by illustration of the mode selection switch.

See the example below.

<Example>

5-10 Axis Feed Switches 

Valid mode

1. Please note that accessories and functions of the machine given in the explanation in this manual are not always available with your machine according to its delivery.
   Also please note that some of these accessories and functions cannot be installed after the installation of the machine. For details, please contact Mori Seiki.
2. Although illustrations of the machine, those of keys, switches, buttons and indicators, and those of the screen display are drawn to actual machines and controls, they could differ from the actual ones due to specification changes or improvements of the machine.
   If illustrations and screen display used in the explanation differ from your machine, making it difficult to understand the explanation, please contact Mori Seiki.

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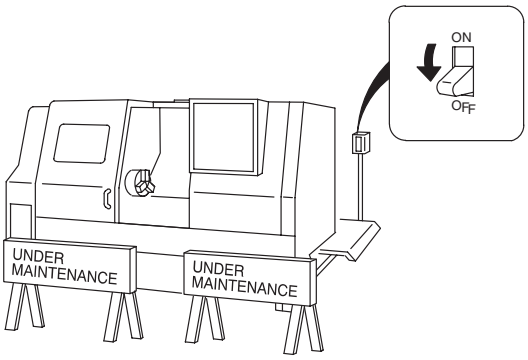
1 SAFETY PRECAUTIONS

The following are the safety precautions that must be kept in mind at all times while operating the machine.

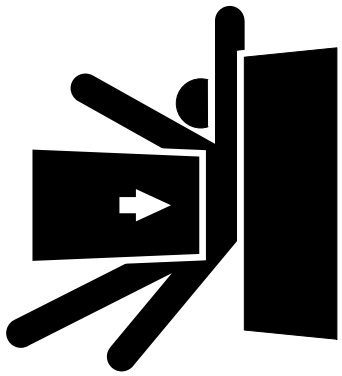
DANGER

Never operate the machine with the protective cover removed or while interlocks or other safety devices are ineffective, since the machine could operate in an unexpected manner, causing accidents involving serious injuries.
Contact Mori Seiki or the relevant equipment manufacturer immediately if the protective cover or safety devices are damaged.



DANGER

Always lock out the power to the machine before carrying out work inside the machine - such as setup work or cleaning the inside of the machine - and before carrying out inspections, repairs, or maintenance work. In addition, set the main switch to the OFF position and lock it, and place "PERSONNEL INSIDE MACHINE" or "UNDER MAINTENANCE" signs around the machine to stop anyone from switching on the power or operating the machine while the work is in progress. If work inside the machine or inspection or maintenance work is carried out with the power switched on, machine elements could be moved, and the personnel carrying out the work could be seriously injured by being entangled in the rotating parts or crushed by the moving parts of the machine.

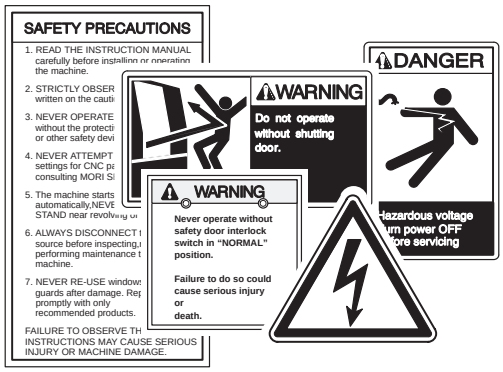


DANGER

Before starting machine operation, check that there are no personnel or obstructions inside the protective cover or close to rotating or moving parts of the machine. Never touch or stand near the rotating or moving parts of the machine while it is operating; you could be seriously injured by being entangled in the rotating parts or crushed by the moving parts.

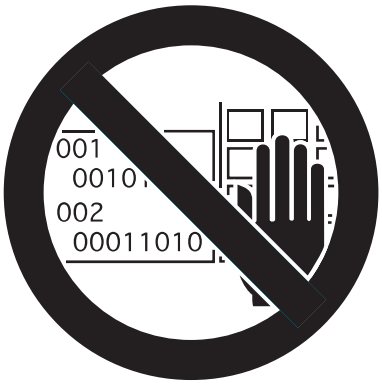
WARNING

Before operating or programming the machine, or performing maintenance work, carefully read the instruction manuals provided by Mori Seiki, the NC unit manufacturer and the equipment manufacturers so that you fully understand the information they contain. Keep these instruction manuals safely so that you do not lose them. If you do lose an instruction manual, contact Mori Seiki, the NC unit manufacturer or the relevant equipment manufacturer. If you attempt to operate the machine without having carefully read the instruction manuals first, you will perform dangerous and erroneous operations which may cause accidents involving serious injuries or damage to the machine.



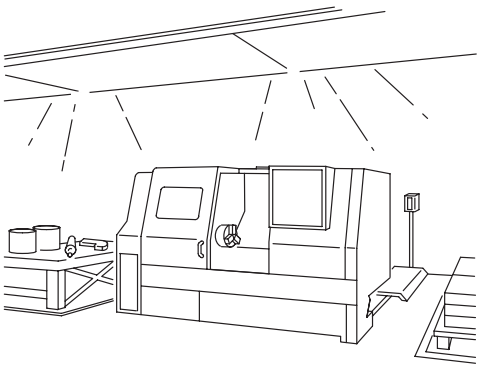
WARNING

Always observe the instructions in the caution labels stuck to the machine. Carefully read the Safety Guidelines supplied with the machine so that you fully understand them. If the writing on the labels becomes illegible, or if the labels are damaged or peel off, contact Mori Seiki. Also contact Mori Seiki if you cannot understand any of the labels. If you operate the machine without observing the instructions on the labels, or without understanding them properly, you will perform dangerous and erroneous operations which may cause accidents involving serious injuries or damage to the machine.



WARNING

The parameters are set on shipment in accordance with the machine specifications; do not change them without first consulting Mori Seiki. If you change the parameters without consultation, the machine may operate in an unexpected manner, causing accidents involving serious injuries or damage to the machine.



CAUTION

Establish a working environment in which you can work safely. Working in an unsuitable environment may cause unexpected accidents.

1. Ensure that the workplace is adequately lit.
2. Remove obstacles from the area around the machine.
3. Change power supply cables or wires if they are damaged.

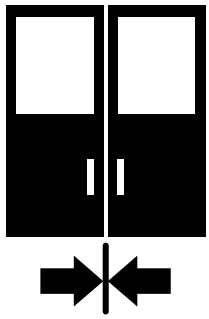
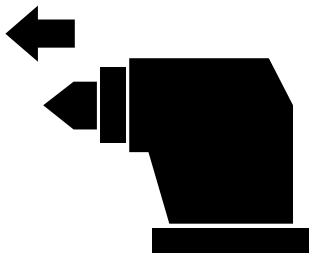
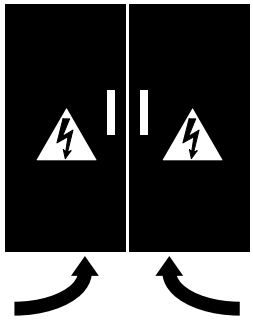
   Damaged cables and wires may leak current and are extremely dangerous.
4. Cover all the cable running on the floor with rigid insulated plates.
5. Do not leave service tools inside the machine.
6. Secure adequate space and passages to carry out the intended work safely.
7. Keep the floor area around the machine tidy and clean; do not leave things lying on it, and clean up spilled water or oil immediately.
8. Use a working bench strong and stable enough to support the weight of the workpieces and tools.
9. If it is necessary to stack workpieces (products), make sure that they are stacked stably.
10. Keep the area around the machine clean; remove chips and foreign matter near the machine.

2 INTERLOCK FUNCTIONS THAT ENSURE SAFE OPERATION

This machine features the following interlock functions to ensure the operators safety.

CAUTION

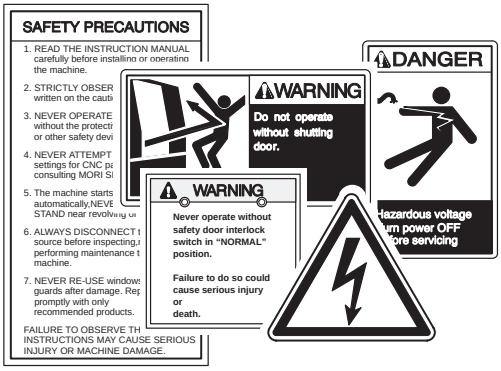
Before starting the machine, always make sure these functions are valid. Mori Seiki is not responsible for accidents that occur as a result of the machine being operated without first validating these interlock functions.

<Front door interlock> 	The front door interlock function disables manual operation such as spindle rotation and the cycle start of automatic operation while the front door is open. If a workpiece flies out of the chuck due to improper clamping or a programming error, the operator will be safe because the front door is closed. The front door interlock function also prevents any accident caused by starting spindle rotation while the operator is touching the chuck or workpiece. DOOR INTERLOCK FUNCTION
<Chuck interlock> 	The chuck interlock function disables spindle rotation and the cycle start of automatic operation while the chuck is unclamped. If the spindle is started while the workpiece is not clamped by the chuck, there is a danger that the workpiece will disengage from the chuck. The tailstock spindle interlock function ensures operator safety by preventing such accidents.
<Tailstock spindle interlock (for machines with tailstock)> 	The tailstock spindle interlock function disables the cycle start of memory (tape) operation when the tailstock spindle is in the IN position (inside the tailstock body) or when it is in the OUT position due to inching operation while the tailstock spindle interlock is valid. If the memory (tape) operation is started while a workpiece is not held by the center (tailstock spindle), there is a danger that the workpiece will disengage from the chuck. The tailstock spindle interlock function ensures operator safety by preventing such accidents. Page A-29 (5-6-7)
<Electrical cabinet door interlock> 	When the electrical cabinet door interlock key-switch is valid, power cannot be turned ON while the electrical cabinet door is open. The electrical cabinet door interlock function protects the operator from sustaining an electrical shock by touching a live device inside the electrical cabinet after turning on the power while the electrical cabinet door is open.

3 MANUALS SUPPLIED WITH THE MACHINE

Before using the machine, carefully read the manuals supplied with it, and make sure you fully understand the information they contain. Store manuals carefully so that they do not get lost.

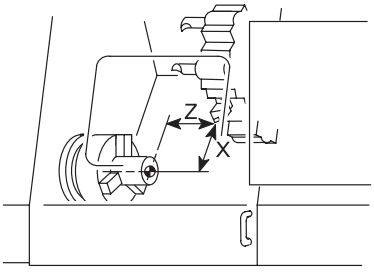
<Safety guidelines>



Contains the safety related information that sets out basic rules for the operator to follow in order to operate the machine safely.

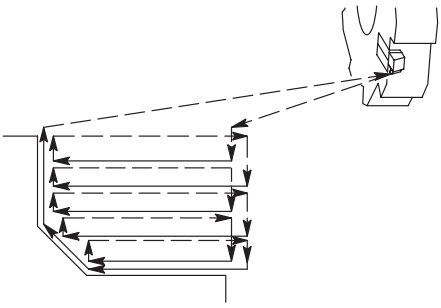
You must read and understand the safety guidelines before using the machine.

<Operation manual>



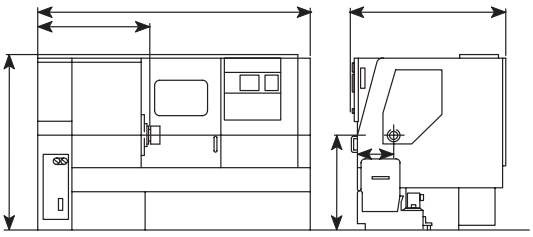
Contains operation procedures, setup methods, and the functions of the switches and keys used for machine operation. (This manual)

<Programming manual>



Contains NC language and coding rules for creating programs.

<Maintenance manuals>



Contain information about machine dimensions and specifications, as well as descriptions of adjustment procedures for major machine units.

<NC operation and maintenance manual (prepared by NC manufacturer)>

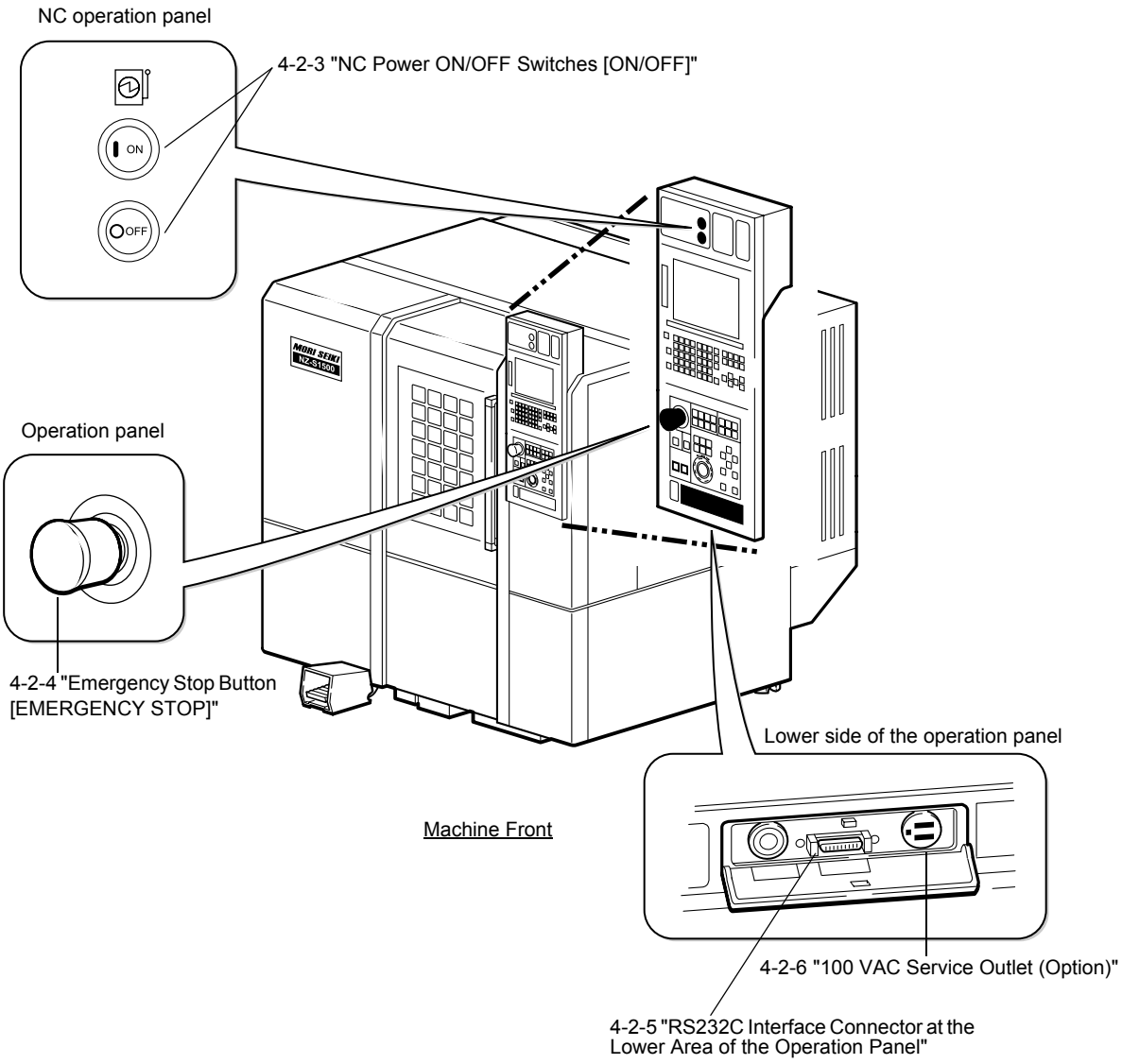
Contains detailed information on programming and NC unit maintenance.

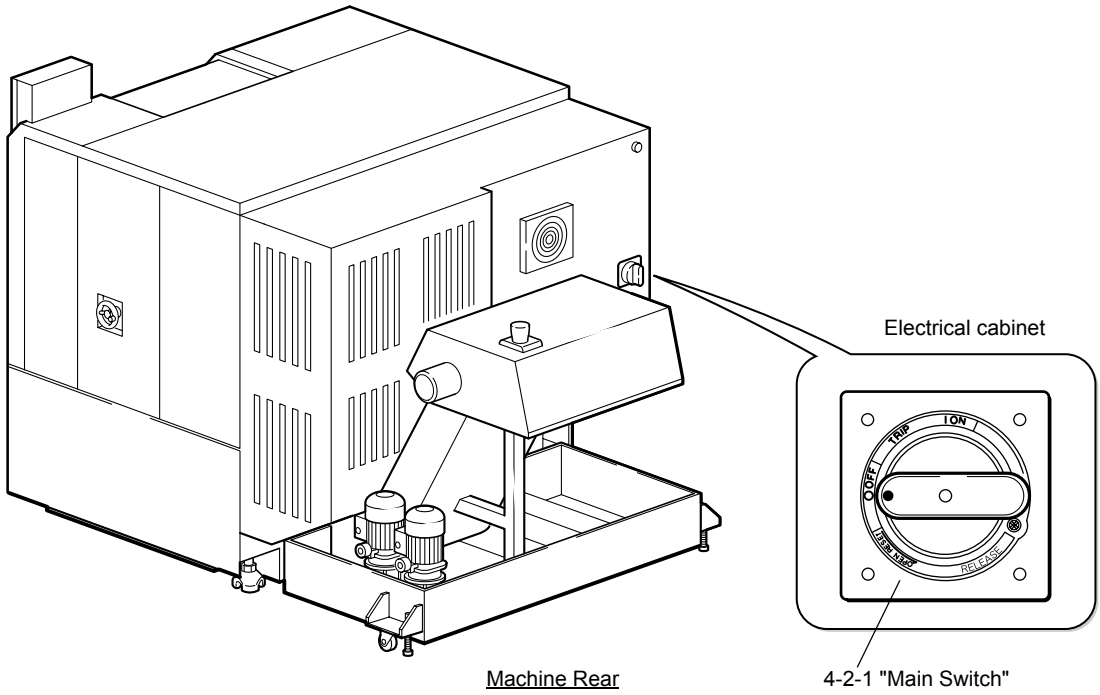
4 SWITCHES FOR POWER SUPPLY

The arrangement of the switches related to the power supply, and their functions, are described here.

4-1 Arrangement of Power Supply Switches

The numbers indicate the subsections where explanations of switches are given.



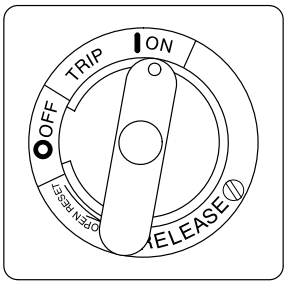


NOTE The position and shapes of switches may differ according to the machine model and specifications.

4-2 Functions of Power Supply Switches

The switches used to turn the power on and off, and the switches related to the power supply, are described here.

4-2-1 Main Switch



The main switch, located on the electrical cabinet door, is used to turn the machine power supply on and off.

It also works as a non-fused circuit breaker.

WARNING

When the main switch is locked with a padlock it means that maintenance is in progress, so do not place the main switch in the ❙ ON position.

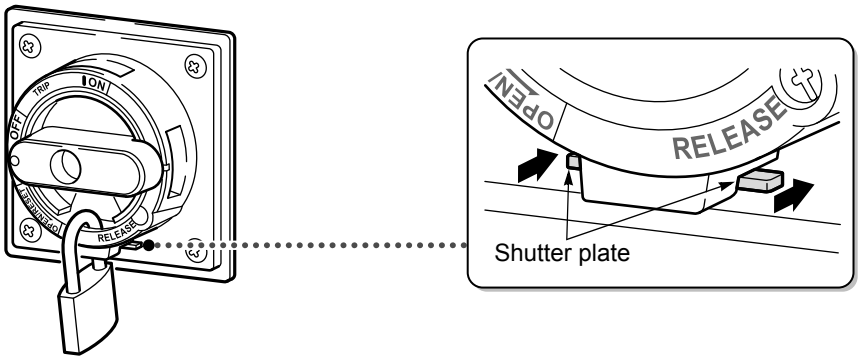
NOTE The position and shape of the main switch may differ according to the machine model and specifications.

Switch Position	Function
❙ ON	Power is supplied to the machine when the main switch is placed in this position. **CAUTION** Do not place the main switch in the **❙ ON** position while the primary power is not supplied to the main switch. If the main switch is placed in the **❙ ON** position repeatedly although the primary power is not supplied to the main switch, the main switch will be damaged.
○ OFF	Power to the machine is turned off when the main switch is placed in this position.
TRIP	The switch functions as a non-fused circuit breaker and returns to the center position between and in the following cases. 1. Power supply is automatically turned off due to overcurrent. 2. Power supply is turned off by the automatic power supply shutoff function. To turn on the machine power supply again, place the main switch in the **○ OFF** position, and then place it in the **❙ ON** position.
OPEN RESET	When opening the electrical cabinet door, place the main switch in the **OPEN RESET** position. **CAUTION** In order to open the electrical cabinet door, you must place the main switch in the **OPEN RESET** position. If the main switch is at a position other than **OPEN RESET**, it will not be possible to open the door. Attempting to force the door open in this situation could cause damage to the electrical cabinet door or the main switch.

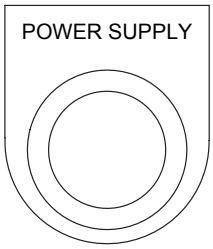
<How to lock the main switch>

Lock the main switch by using the following procedure when performing maintenance procedures considered dangerous if the power is ON.

1) Place the main switch in the ○ **OFF** position.
2) While pushing the shutter plates in the direction shown by the arrows, attach a padlock.



4-2-2 Power Supply Lamp [POWER SUPPLY] (Option)



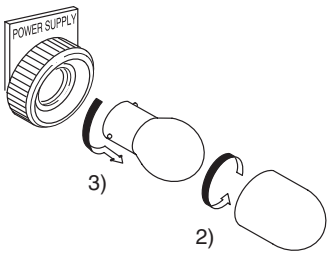
This lamp indicates whether or not power is being supplied to the machine. The lamp is lit when power is supplied.

NOTE If the POWER SUPPLY lamp is not lit although the power is turned on at the shop power distribution board, the lamp may have failed. In this case, replace the lamp using the following procedure.

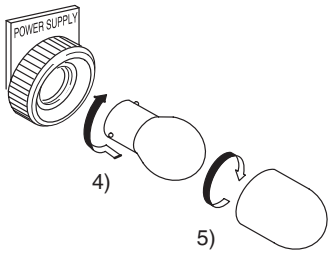
<Replacing the lamp bulb>

1) Turn off the power supply at the shop power distribution board.

Page B-13 (4)



2) Remove the cap; turn it counterclockwise.
3) Remove the bulb; turn it counterclockwise.



4) Set the new bulb; turn it clockwise.

5) Set the cap; turn it clockwise.

6) Turn on the shop power supply and make sure that the lamp is lit.

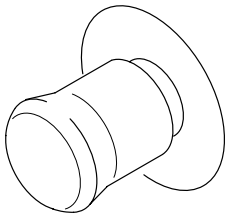
4-2-3 NC Power ON/OFF Switches [ON/OFF]

The NC power ON and OFF switches are on the NC operation panel and used to turn the power to the NC system on and off, respectively.

NOTE The shape of the NC operation panel and the position of the NC power ON and OFF switches may differ according to the model and specifications of the NC unit.

Power Supply to NC	Switch	Function
ON		Power is supplied to the NC when this switch is pressed. This switch is also used as the second power ON switch for turning on the machine ready signal after resetting the emergency stop state.
OFF		Power to the NC is turned off when this switch is pressed.

4-2-4 Emergency Stop Button [EMERGENCY STOP]



The EMERGENCY STOP button is used to stop the machine immediately, for example when an emergency requiring an immediate machine stop occurs.

This button is also used to turn off the power supply on ending operation.

WARNING

The EMERGENCY STOP buttons are used to stop all operations in the event of an emergency. Memorize the locations of the EMERGENCY STOP buttons so that you can press one immediately from any location and at any time while operating the machine. If there is an obstruction preventing operation of an EMERGENCY STOP button it will not be possible to press it immediately when an emergency occurs and this could cause accidents involving serious injuries or damage to the machine.

When the EMERGENCY STOP button is pressed, the power supply to the circuits that control the axis movements and spindle rotation is shut off and the machine stops.

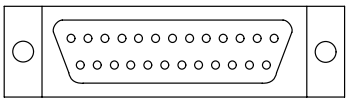
To reset the emergency stop state, pull out the EMERGENCY STOP button from the pushed and locked position then press the NC power switch (ON).

NOTE

Depending on the machine model and specifications, there may be an EMERGENCY STOP button at more than one location.

In this case, all of these EMERGENCY STOP buttons have the same function and pressing any one of them stops the machine. To reset the emergency stop state, it is necessary to pull out all the EMERGENCY STOP buttons from the pushed and locked position.

4-2-5 RS232C Interface Connector at the Lower Area of the Operation Panel



RS232C

The RS232C interface connector at the lower area of the operation panel is used to connect an external I/O device that has an RS232C interface.

CAUTION

When connecting the signal line to the RS232C interface connector or disconnecting it from the RS232C interface connector, turn off the power to the machine and external I/O device. Connecting or disconnecting with the power on may cause malfunction.

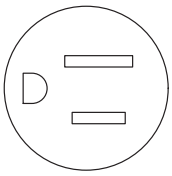
An external I/O device is used in the following cases:

1. To input the data from the external I/O device to the NC memory
2. To output the data from the NC memory to the external I/O device
3. To perform tape operation

NOTE

An external I/O device that has another type of interface connector cannot be connected using the RS232C interface connector.

4-2-6 100 VAC Service Outlet (Option)



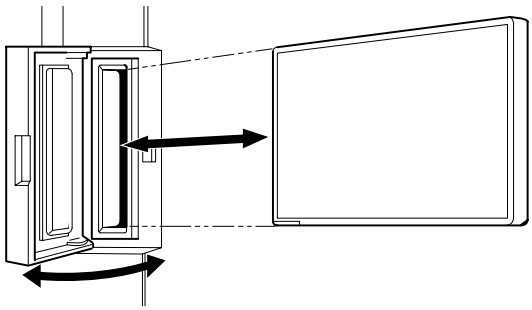
AC 100V 1A

The 100 VAC service outlet is used to connect the power supply cord of an external I/O device to be connected to the NC.

CAUTION

When using the service outlet (optional) on the operation panel for connecting an external device, the permissible current indicated on the rating plate must not be exceeded. If a device whose capacity exceeds the permissible current is used, the breaker in the electrical cabinet could be tripped, causing damage to the machine or machining defects.

4-2-7 Memory Card Interface



The memory card interface is used to input/output the programs, offset data, parameters and other data using a memory card.

For the details, refer to the instruction manual supplied by the NC unit manufacturer.

5 OPERATION PANEL

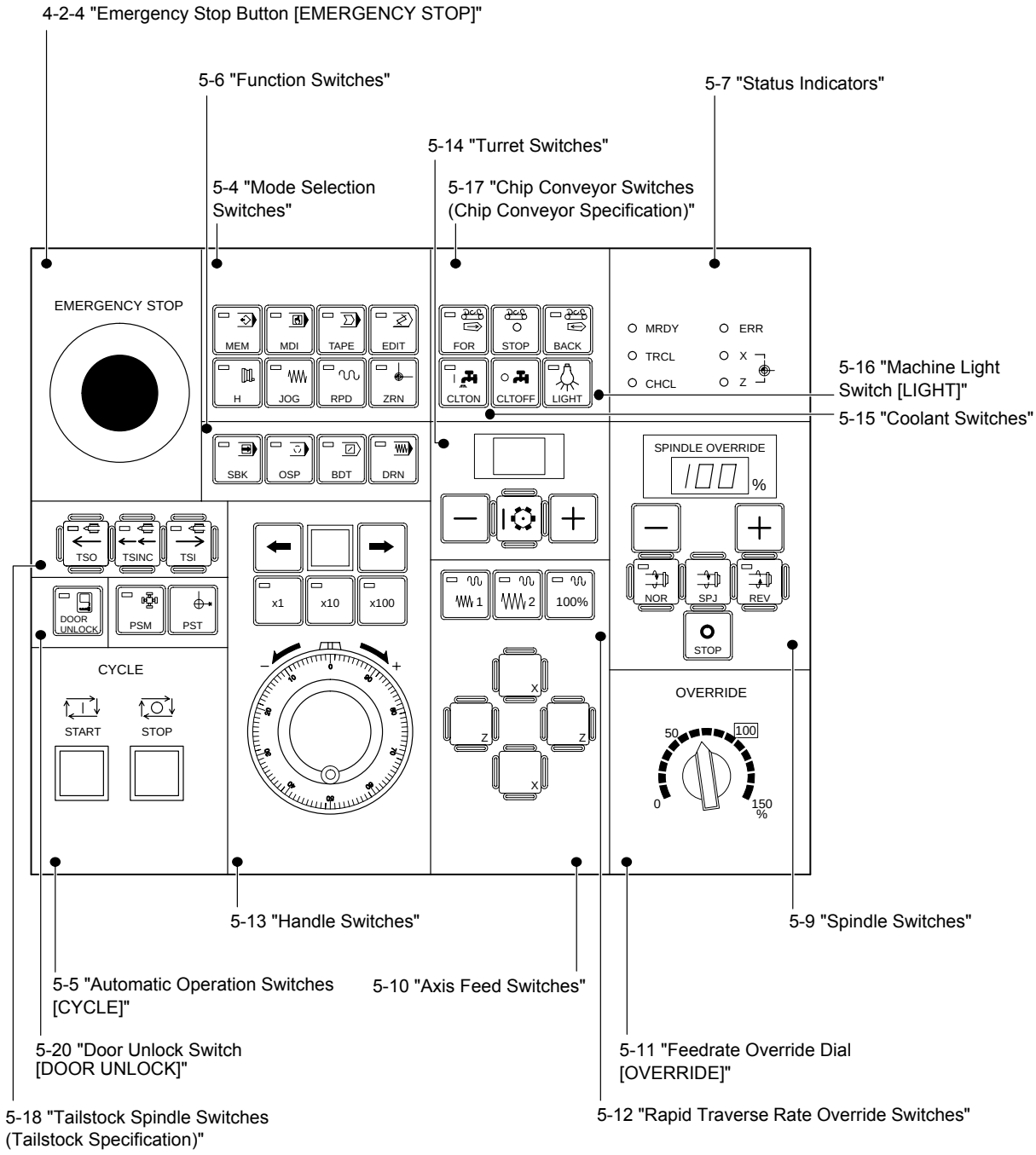
In this section, the functions of the switches and keys arranged on the machine operation panel are explained.

5-1 Arrangement and Names of Switches and Keys on Machine Operation Panel

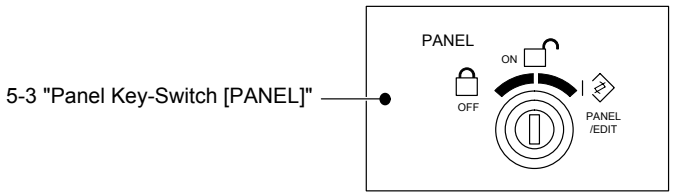
The arrangement of switches and keys on the machine operation panel and their names are indicated below.

The numbers heading the names of the switches and the keys in the following illustrations indicate the subsections where corresponding explanations are given.

NOTE The arrangement and shapes of the switches and keys vary according to the machine model and specifications.


4-2-4 "Emergency Stop Button [EMERGENCY STOP]"
5-6 "Function Switches"
5-7 "Status Indicators"
5-14 "Turret Switches"
5-4 "Mode Selection Switches"
5-17 "Chip Conveyor Switches (Chip Conveyor Specification)"
EMERGENCY STOP
MEM
MDI
TAPE
EDIT
H
JOG
RPD
ZRN
SBK
OSP
BDT
DRN
FOR
STOP
BACK
CLTON
CLTOFF
LIGHT
MRDY
ERR
TRCL
X
CHCL
Z
5-16 "Machine Light Switch [LIGHT]"
5-15 "Coolant Switches"
SPINDLE OVERRIDE
100
%
NOR
SPJ
REV
STOP
TSO
TSINC
TSI
DOOR UNLOCK
PSM
PST
x1
x10
x100
1
2
100%
CYCLE
START
STOP
OVERRIDE
50
100
0
150
%
5-13 "Handle Switches"
5-9 "Spindle Switches"
5-5 "Automatic Operation Switches [CYCLE]"
5-10 "Axis Feed Switches"
5-20 "Door Unlock Switch [DOOR UNLOCK]"
5-11 "Feedrate Override Dial [OVERRIDE]"
5-18 "Tailstock Spindle Switches (Tailstock Specification)"
5-12 "Rapid Traverse Rate Override Switches"

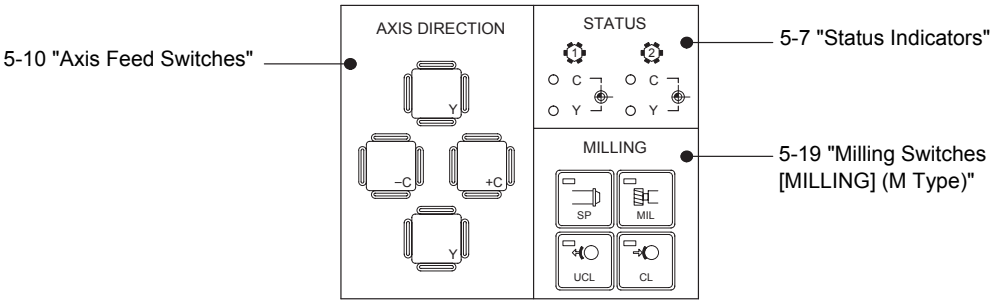
<Option panel>



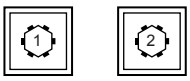
<M type>

For the M type machines, the following switches and status indicators are provided on the option panel.

1. Since this machine has no Y-axis specification, the switches and the indicator related to the Y-axis are not used.
2. The STATUS indicators at the turret 2 side are not used with this machine.



5-2 Head Selection Switches

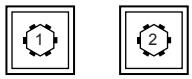


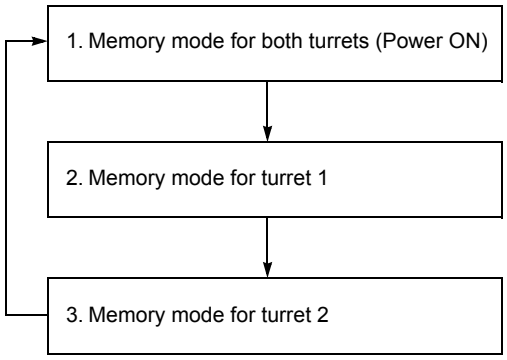
The HEAD CHANGE switches are used to select the turret to be operated between turret 1 (upper turret) and spindle 1 (left spindle), and turret 2 (lower turret) and spindle 2 (right spindle) in the manual operation mode. They are also used to select the process when inputting or editing a program as well as to select the turret and display screen in the memory mode operation.

Because the machine has only one display screen, these switches are used to select the machine units (spindle, turret) for which the data/information is displayed on the screen.

These switches are not operative when the PANEL key-switch is placed in the (OFF) position.

5-2-1 In the Memory Mode





Turret 1 is selected when the power is turned on.

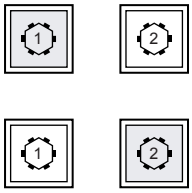
When the power is turned on, the memory mode is selected for both turrets.

Pressing the head selection switches ① (head 1) and ② (head 2) simultaneously selects the turret(s) to be operated as the sequence shown at left.

Turret is selected in the sequence of 2 to 3.

NOTE When the memory mode is selected: Present turret selection does not change if the head selection switch ① (head 1) or ② (head 2) is pressed.

5-2-2 In Modes Other Than the Memory Mode



① (head 1)

Pressing this switch selects turret 1 (turret 1 screen).

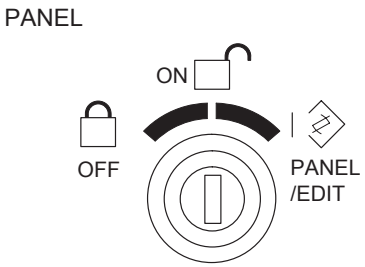
② (head 2)

Pressing this switch selects turret 2 (turret 2 screen).

NOTE Pressing the head selection switches ① (head 1) and ② (head 2) simultaneously has no effect.

Turret 1 or 2 that is currently selected is indicated with "HEAD1" or "HEAD2" on the right side above the soft-key names on the screen.

5-3 Panel Key-Switch [PANEL]



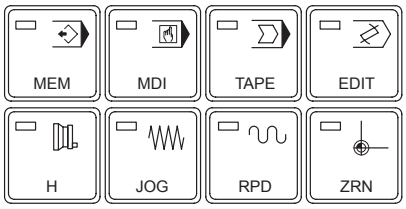
The PANEL key-switch is used to select the operation range of the switches on the machine operation panel and to enable or disable editing of a program.

After turning on the power supply, first check the setting of this key-switch.

Setting the PANEL key-switch to the appropriate position ((OFF), (ON)) protects the stored programs from being changed carelessly and also prevents operation error caused by erroneous switch operation during automatic operation.

Switch Position	Machine Operation, Program Editing	Function
OFF	Operation: Disabled Edit: Disabled	When this position is selected, operation of the switches on the machine operation panel is impossible. Therefore, programs stored in memory cannot be edited. Select this position so that the switches on the machine operation panel will not be used carelessly during automatic operation. The key can be removed when the PANEL key-switch is placed in this position. NOTE When this position is selected, the following switches remain valid: EMERGENCY STOP button, CYCLE switches, OVERRIDE dial, tailstock switches, LIGHT switch, chip conveyor switches and coolant switches.
ON	Operation: Enabled Edit: Disabled	When this position is selected, operation of the switches on the machine operation panel is possible. However, programs stored in memory cannot be edited. The key can be removed when the PANEL key-switch is placed in this position.
PANEL /EDIT	Operation: Enabled Edit: Enabled	When this position is selected, operation of the switches on the machine operation panel is possible. In addition, programs stored in memory can be edited. The key cannot be removed when the PANEL key-switch is placed in this position.

5-4 Mode Selection Switches



Eight mode selection switches are used to select the machine operation mode.
Operation of the machine begins with the selection of the operation mode.

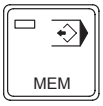
NOTE When the power is turned on, the memory mode is set as the initial mode.

Operation modes are classified into the following three main groups:

Operation Mode Groups		
Automatic operation	Program edit	Manual operation
Memory operation mode MDI operation mode Tape operation mode	Edit mode	Handle mode Jog mode Rapid traverse mode Zero return mode

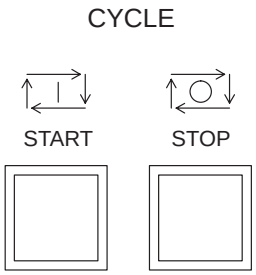
NOTE To carry out operation using tape, an optional I/O device such as a tape reader used for inputting punched program is required.

Switch	Function
	When this switch is pressed, the indicator in the switch is lit and the edit mode is selected. In the edit mode, the following operations are possible: 1. Inputting and storing programs to NC memory 2. Changing or deleting a program 3. Outputting a program stored in the NC memory 4. Using the search function (program number search, sequence number search, etc.) Editing a program in the edit mode, as with the operations above, is called foreground editing. There is another type of program editing called "background editing". For details on background editing, refer to the instruction manual supplied by the NC unit manufacturer. NOTE The above operations are possible with the PANEL key-switch placed in the (PANEL/EDIT) position.

Switch	Function
	When this switch is pressed, the indicator in the switch is lit and the memory mode is selected. In the memory mode, the following operations are possible: 1. Calling and executing a program stored in the NC memory NOTE Before starting operation in the memory mode, close the front door. 2. Searching for a sequence number, etc. of a program stored in the NC memory 3. Editing a program in background mode NOTE When the PANEL key-switch is placed in the [ ] (OFF) position during memory operation, background editing is not possible. Background editing A program that is not currently being executed can be edited by displaying it on the screen while executing another program in the automatic mode.
	When this switch is pressed, the indicator in the switch is lit and the MDI mode is selected. In the MDI mode, the following operations are possible: 1. Operating the machine in the MDI mode Input a program using the data entry keys and execute it. An MDI program is cleared after one execution. **<A program created in the MDI mode is cleared in the following cases>** • After the program is executed • When the [RESET] (RESET) key is pressed • When the power is turned off NOTE Before starting operation in the MDI mode, close the front door. 2. Setting parameters and other data
	When this switch is pressed, the indicator in the switch is lit and the tape mode is selected. In the tape mode, running a program using an external I/O device (tape reader or personal computer) is possible. NOTE 1. An external I/O device (such as a tape reader) is optional. 2. Before starting operation in the tape mode, close the front door.

Switch	Function
	When this switch is pressed, the indicator in the switch is lit and the handle mode is selected. In the handle mode, the axis selected with the axis selection switch is moved as the manual pulse generator is turned. The axis feed amount per pulse conforms to the setting of the axis feed amount selection switches. NOTE Close the front door before carrying out handle feed operation.
	When this switch is pressed, the indicator in the switch is lit and the jog mode is selected. In the jog mode, axes are moved at the jog feedrate. An axis is moved while an axis feed switch is held down at the feedrate set with the OVERRIDE dial. Setting is possible in 16 steps in the range of 0 to 1260 mm/min. NOTE Close the front door before carrying out jog feed operation.
	When this switch is pressed, the indicator in the switch is lit and the rapid traverse mode is selected. In the rapid traverse mode, axes are moved at the rapid traverse rate. An axis is moved at the rapid traverse rate while an axis feed switch is held down. NOTE Close the front door before carrying out rapid traverse operation.
	When this switch is pressed, the indicator in the switch is lit and the zero return mode is selected. In the zero return mode, an axis is manually returned to the zero point. NOTE Close the front door before carrying out zero return operation.

5-5 Automatic Operation Switches [CYCLE]

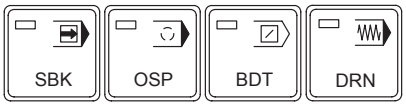


The CYCLE switches are used to start an automatic operation and stop the axis movement temporarily.

NOTE
1. The operation is impossible with the PANEL key-switch placed in the (PANEL/EDIT) position.
2. Close the front door before pressing the (START) switch.

Switch	Function
START	This switch is used to start an automatic operation in the memory, MDI or tape mode. The indicator in the switch is lit during automatic operation. NOTE The automatic operation start signal is output when this switch is released after being pressed. Accordingly, automatic operation will not start while the switch is held down. WARNING **Be aware that the machine will start automatic operation if the (START) switch is pressed by mistake while the conditions required to start automatic operation are satisfied and an automatic mode is selected. If this switch is pressed carelessly, automatic operation will start unexpectedly, and this could cause accidents involving serious injuries or damage to the machine.** For the condition for starting automatic operation, refer to page E-1 (1).
STOP	This switch is used to temporarily stop axis movement during automatic operation. The indicator in the switch is lit while the axis movement is stopped. When a test cutting or program check is carried out, the operator must be ready to press this switch immediately if a problem arises. To restart the automatic operation, press the (START) switch again.

5-6 Function Switches



The function switches are used for the following purposes.

1. To carry out test cutting in the automatic mode
2. To check programs in the automatic mode

NOTE

1. Switch operation is impossible with the PANEL key-switch placed in the (OFF) position.
2. The single block switch, the optional stop switch, and the block delete switch remain set even if the power is turned off.
3. The NC functions are made valid or invalid either by using the switches or by making settings on the OPERATION PANEL screen.

Make sure you thoroughly understand the NC functions explained below before carrying out program checking or test cutting.

5-6-1 Single Block Switch [SBK]

When this switch is pressed, the indicator in the switch is lit and the single block function becomes valid.

When this switch is pressed again, the indicator in the switch goes off and the single block function becomes invalid.

<Single block function>

The single block function executes a program block by block in the automatic mode.

This function is used to check a program block by block in test cutting, etc.

A "block" refers to one line of the program, ending with the EOB code (;), displayed on the screen.

CAUTION

Before starting mass production, always check the program and perform test cutting in the single block mode. If you fail to do this the workpiece could collide with the cutting tool during machining, damaging the machine. Machining defects could also be caused.

<When the single block function is valid>

When the (START) switch is pressed after pressing the single block switch and the indicator in the switch is lit, the machine stops after the execution of one block of commands.

To execute the next block of commands, press the (START) switch again.

WARNING

1. If the single block function is made valid during automatic operation, the next block is stored in the buffer register. To stop the process currently being executed in order to execute another process in this condition (i.e., with the data for the next block stored in the buffer register), clear the data in the buffer register by pressing the (RESET) key. If you attempt to execute another process while the data is still stored in the buffer memory, the machine will operate in an unexpected manner, and this could cause accidents involving serious injuries or damage to the machine.

2. If the door interlock function is "released" while the single block function is valid, it constitutes a very dangerous situation since the door is unlocked and can be opened even while the machine is operating, regardless of the state of the DOOR UNLOCK switch (locked or unlocked), the selected mode, or executed operation (automatic operation and manual operation). If the necessary operation requires work to be carried out with the door open while the machine is operating, this work must be limited only to that which is absolutely necessary and must be carried out very carefully.
Carrying out work with the door open while the machine is operating will cause injuries due to the operator being entangled in the rotating parts of the machine, crushed by its moving parts, being struck by a workpiece or chuck jaws that have flown out of the machine, or being splashed by chips and coolant.

<When the single block function is invalid>

The program is executed continuously when the (START) switch is pressed.

5-6-2 Optional Stop Switch [OSP]

When this switch is pressed, the indicator in the switch is lit and the optional stop function becomes valid.

When this switch is pressed again, the indicator in the switch goes off and the optional stop function becomes invalid.

<Optional stop function>

The optional stop function makes the M01 (optional stop) command written in a program valid.

This function is used to check the conditions of the cutting tool or to remove chips from the machine during automatic operation and to check a program at each process of test cutting.

<When the optional stop function is valid>

In the optional stop mode, spindle rotation, coolant supply, and axis feed stop after the execution of an M01 block.

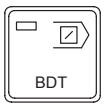
To continue the interrupted operation, press the (START) switch.

NOTE Specify the M01 command in an independent block.

<When the optional stop mode is invalid>

Any M01 command is ignored and the program is executed continuously.

5-6-3 Block Delete Switch [BDT]



When this switch is pressed, the indicator in the switch is lit and the block delete function becomes valid.

When this switch is pressed again, the indicator in the switch goes off and the block delete function becomes invalid.

NOTE The block delete functions (/2 to /9) are optional and whether each of the block delete functions is valid or invalid is set on the OPERATION PANEL screen.

<Block delete function>

The block delete function ignores the blocks preceded by a slash code [/ (/2 to /9)], and the program advances to the next block without executing such blocks.

<When the block delete function is valid>

The block preceded by a slash code [/ (/2 to /9)] is ignored and the next block not containing the slash code [/ (/2 to /9)] is executed.

<When the block delete function is invalid>

All blocks (even those preceded by a slash [/ (/2 to /9)]) are executed.

5-6-4 Dry Run Switch [DRN]

When this switch is pressed, the indicator in the switch is lit and the dry run function becomes valid.

When this switch is pressed again, the indicator in the switch goes off and the dry run function becomes invalid.

<Dry run function>

The cutting feedrate specified in a program is ignored and all axis feed commands are executed at a feedrate set using the OVERRIDE dial.

This function is used to shorten program check time.

CAUTION

Be aware that the program will be executed at an unexpected feedrate if the dry run function is made valid mistakenly during automatic operation, and this could cause accidents involving damage to the machine.

<When the dry run function is valid>

In the dry run mode, the cutting feedrates specified in the program are adjusted by the feedrate set with the OVERRIDE dial.
The OVERRIDE dial setting can be changed in 16 steps.
Setting range: 0 to 1260 mm/min

NOTE

With machines featuring the spindle OFF mode function, the dry run function is valid during thread cutting and tapping (M type).

<When the dry run function is invalid>

All feedrates (cutting feedrates and rapid traverse rate) are executed at the programmed feedrates. The percentage setting (0 to 150%) of the OVERRIDE dial becomes valid when the dry run function is canceled. Therefore, be careful when making the dry run function valid and invalid.

NOTE

If the dry run function valid/invalid state is changed by pressing the dry run switch during automatic operation, the machine stops in the feed hold state to ensure the safety of the machine and the operator. The automatic operation can be restarted by pressing the (START) switch.

5-6-5 Spindle OFF Mode Function

The spindle OFF mode function is used to determine whether or not the following M code functions are actually executed when checking a program without chucking a workpiece in the machine.

M Code	Function
M03	Spindle start (normal)
M04	Spindle start (reverse)
M08	Coolant supply
M13	Rotary tool spindle start (normal) (M type)
M14	Rotary tool spindle start (reverse) (M type)
M19	Spindle orientation (option)
M64	Robot service call (robot specification)
M203	Spindle 2 start (normal) (S type)
M204	Spindle 2 start (reverse) (S type)
M219	Spindle 2 orientation (option) (S type)
M319	Rotary tool spindle zero point return (M type)
M382	Chip removal coolant ON (option)
M384	Spindle orientation and ceiling shutter open (option)

When checking a new program, automatic operation is executed without rotating the spindle and supplying coolant to check tool offset amounts, interference between tools and a chuck, etc.

It is made valid or invalid on the OPERATION PANEL screen.

Function selection key (CUSTOM1) ⟶ **[OPE. PANEL]**

For the procedure to check a program without chucking a workpiece, refer to page E-12 (6).

<When the spindle OFF mode function is valid>

When the spindle OFF mode function is made valid, the dry run function also becomes valid and the indicator above the (STOP) switch and the indicator in the dry run switch blink.

If automatic operation is executed in this state, the program advances to the next block without executing the M code functions indicated in the table above.

Although axis movement commands are executed, the axes are moved at the feedrate set by the OVERRIDE dial since the dry run function is valid.

NOTE It is not possible to execute automatic operation with a workpiece clamped in the spindle chuck when the spindle OFF mode function is valid.

<When the spindle OFF mode function is invalid>

When the spindle OFF mode function is made invalid, the dry run function also becomes invalid and the indicator above the (STOP) switch and the indicator in the dry run switch go off. In this state, normal operation is possible.

5-6-6 Chuck Clamp Direction

This setting is used to indicate whether the chuck clamp is made for O.D. or I.D. of the workpiece according to the shape of workpiece and the portion to be machined. Chuck clamp operation is completed when the chuck is operated in the set chuck clamp direction correctly.

It is set as O.D. or I.D. on the OPERATION PANEL screen.

Function selection key (CUSTOM1) ⟶ **[OPE. PANEL]**

NOTE

1. For chuck 2, page 2 of the OPERATION PANEL screen is used to the selection of clamp direction. (S type)
2. Do not change the chucking direction while the spindle is rotating.

<When O.D. is selected>

When O.D. is selected for the chuck clamp direction, the status indicator **[CHCL]** is lit when the chuck clamps the workpiece on its periphery. Spindle rotation is permitted in this state.

<When I.D. is selected>

When I.D. is selected for the chuck clamp direction, the status indicator **[CHCL]** is lit when the chuck clamps the workpiece from the inside. Spindle rotation is permitted in this state.

WARNING

The machine has a chuck interlock function that prevents starting of the spindle unless the status indicator [CHCL] is lit. Make sure this interlock function works correctly by setting the correct chuck clamping direction for the type of workpiece to be machined.
If the spindle starts rotating while the workpiece is not correctly clamped in the chuck, the workpiece could fly out, causing serious injuries or damage to the machine.

5-6-7 Tailstock Spindle Interlock (Tailstock Specification)

The tailstock spindle interlock function is provided to disable the start of memory (tape) operation while the tailstock spindle is retracted in center-work operation.

In other words, to ensure safety, the memory (tape) operation can be started only when the workpiece is held by the tailstock spindle center. If the cycle of the memory (tape) operation were started while a workpiece was not held by the tailstock spindle center correctly, the workpiece might come out of the chuck, causing hazards.

It is made valid or invalid on the OPERATION PANEL screen.

 Function selection key  (CUSTOM1) ⟶ **[OPE. PANEL]**

For the machine not equipped with the tailstock, this item is not displayed.

<When the tailstock spindle interlock function is valid>

Cycle start of the memory (tape) operation is impossible unless the workpiece is held by the tailstock spindle center with the tailstock spindle moved OUT.

<When the tailstock spindle interlock function is invalid>

Cycle start of the memory (tape) operation is permitted regardless of the tailstock spindle IN/OUT status.

The tailstock spindle interlock function becomes effective when the ← (TSO) or ←← (TSINC) switch is pressed.

5-6-8 Work Counter

The work counter function is used together with an optional PC work counter or external work counter. Set whether the block delete function (BDT) or start interlock function (START LOCK) is made valid when the M89 (count increment) command has been read as many times as the number set for the work counter on the OPERATION PANEL screen.

 Function selection key  (CUSTOM1) ⟶ **[OPE. PANEL]**

For details, refer to CHAPTER E 12 "WORK COUNTER/TOTAL COUNTER SETTING (OPTION)".

5-6-9 Machine Lock

Manual axis movement operation and programmed axis movement commands are ignored. Only position data is updated in response to the operation of an axis feed switch or the execution of an axis movement command.

This function is used to check a program without axis movement operation.

It is made valid or invalid on the OPERATION PANEL screen.

Function selection key (CUSTOM1) ⟶ **[OPE. PANEL]**

<When the machine lock function is valid>

Manual axis movement operation and programmed axis movement commands are ignored.

The display of the current location changes as instructed.

<When the machine lock function is invalid>

Axis movement is carried out normally.

WARNING

Before switching the machine lock function from "valid" to "invalid", wait until one program operation cycle has been completed. After switching from "valid" to "invalid", always execute a zero return operation. Switching between "valid" and "invalid" during program execution will create a discrepancy between the position designated in the program and the actual machine position, which could cause accidents involving serious injuries or damage to the machine.

5-6-10 Auxiliary Function Lock

The auxiliary function lock function is used to select whether or not the M, S, and T (auxiliary function) commands are executed in a program during automatic operation. It is used to check the program in combination with the machine lock function.

It is made valid or invalid on the OPERATION PANEL screen.

Function selection key (CUSTOM1) ⟶ **[OPE. PANEL]**

<When the auxiliary function lock is valid>

In the auxiliary function lock mode, the M, S, and T codes specified in a program are ignored.

Note that the following M commands are executed: M00, M01, M02, M30, M98, M99

<When the auxiliary function lock is invalid>

M, S, and T (auxiliary function) commands are executed as specified in the program.

5-6-11 Chuck Footswitch

The chuck footswitch interlock function is used to set whether or not the chuck is opened/closed when the footswitch is stepped on.

It is made valid or invalid on the OPERATION PANEL screen.

Function selection key (CUSTOM1) ⟶ **[OPE. PANEL]**

NOTE For the selection of valid/invalid of chuck 2 footswitch, page 2 of the OPERATION PANEL screen is used. (S type)

<When the chuck footswitch interlock function is valid>

The chuck is opened/closed when the footswitch is stepped on.

<When the chuck footswitch interlock function is invalid>

The chuck is not opened/closed when the footswitch is stepped on.

This function is made invalid in the following cases to ensure safety:

- When holding a workpiece without opening/closing the chuck, this function is made invalid to avoid troubles incurred by stepping on the footswitch mistakenly.
- After the completion of machining cycle
  In such a case, the workpiece will fall inside the machine if the footswitch is stepped on mistakenly. In such a case, this function is made invalid to avoid troubles incurred by stepping on the footswitch mistakenly.

5-6-12 Chuck Jaw Stroke End Detection Switch

The machine is equipped with chuck jaw stroke end detecting switches. The spindle cannot be started unless a workpiece is mounted within an appropriate master jaw stroke range because the chuck clamp operation does not complete if a workpiece is not clamped within this range.

The chuck jaw stroke end detection switch can be used for rotating the spindle without a workpiece mounted in the chuck when forming soft jaws or checking programs.

It is made valid or invalid on the OPERATION PANEL screen.

Function selection key (CUSTOM1) ⟶ **[OPE. PANEL]**

NOTE For the selection of valid/invalid of chuck 2 jaw stroke end detection switch, page 2 of the OPERATION PANEL screen is used. (S type)

For the chuck jaw stroke end detection function, refer to page C-25 (4).

NOTE
1. The chuck jaw stroke end detection function is available only when the machine is shipped with the chuck and cylinder recommended by Mori Seiki.
2. Depending on the chuck and cylinder specification, optional chuck clamp/unclamp detecting switches may be equipped as a substitute for chuck jaw stroke end detecting switches. With the chuck clamp/unclamping detecting switches, it is not possible to detect clamping of a workpiece if it is clamped in the chuck near the master jaw stroke end.

   Depending on the combination of the selected specifications, the chuck jaw stroke end detection switch function or the chuck clamp/unclamping detection switch function may not be installed. For details, contact Mori Seiki.

<When the chuck jaw stroke end detection function is valid>

The spindle cannot be started unless a workpiece is clamped in the chuck within an appropriate master jaw stroke range.

<When the chuck jaw stroke end detection function is invalid>

The spindle can be started as long as the chuck is in the clamped state even if no workpiece is mounted in the chuck.

If the chuck jaw stroke end detection function is INVALID, the spindle starts even if a workpiece is clamped in the chuck near the master jaw stroke end, thereby allowing the workpiece to fly out causing accidents involving serious injuries or damage to the machine. Therefore, the function must be set "VALID" when a workpiece is mounted in the machine.

5-6-13 Zero Point Adjustment

Since dogless type zero return method is used, axis movement becomes impossible if the present position data is lost due to a trouble or other reasons.

The zero point adjustment function is used to allow axis movement when adjusting the zero point to establish the present position under the condition that the present position data has been lost and axis movement disabled.

It is made valid or invalid on the OPERATION PANEL screen.

Function selection key (CUSTOM1) ⟶ **[OPE. PANEL]**

NOTE Usually, "INVALID" is set.

<When the zero point adjustment function is valid>

When the zero point adjustment function is valid, axis movement is enabled even if the present position data is lost.

However, the rapid traverse rate is clamped at (fine feed).

CAUTION If "VALID" is set for ZERO POSITION SET while the present position data is lost, interlocks related with axis movement are all canceled.

Therefore, move an axis very carefully. If an axis is moved carelessly, the turret or carriage might be hit against the cover causing damage to the machine.

NOTE When the present position is established after the adjustment of the zero point, the setting for ZERO POSITION SET is automatically returned from VALID to INVALID.

<When the zero point adjustment function is invalid>

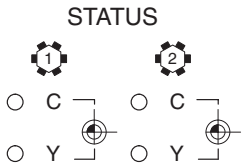
Axis movement is not permitted if the present position data is lost.

5-7 Status Indicators

The status indicators are used to confirm the status of the machine.

<Operation panel>

<Option panel>



The individual status indicators light or blink in the following cases:

1. When the machine is at the reference position for an intended operation.
2. When the machine has stopped during an automatic operation.
3. When an alarm has occurred.

Status Indicator	Contents of Indication
◯ ERR	The status indicator **[ERR]** is lit or blinks if an alarm state is detected. The status indicator **[ERR]** is lit when a program error occurs. The status indicator **[ERR]** blinks when a machine error occurs. NOTE If an alarm occurs, the corresponding alarm message is displayed on the screen.
◯ CHCL	The status indicator **[CHCL]** is lit when the chuck is in the clamp state. In this state, spindle rotation is possible in both automatic and manual operations. The status indicator **[CHCL]** is not lit when the chuck is in the unclamp state. The chuck interlock function disables spindle 1 rotation if this indicator is not lit. When chuck 1 (left) is selected with the head selection switch [1] (head 1), the clamped status is indicated for chuck 1 (left). When chuck 2 (right) is selected with the head selection switch [2] (head 2), the clamped status is indicated for chuck 2 (right). NOTE If automatic operation cannot be started, check whether or not this indicator is lit.
◯ MRDY	After turning on of the power supply, the indicator is lit when the conditions necessary for machine operation are arranged. Machine operation is impossible unless this indicator is lit. NOTE The fact that this indicator is lit means that the electrical system is operating correctly. Start machine operation only after making sure that the operation can be started safely by checking the machine condition, cutting tool(s), workpiece, working environment and program.

Status Indicator	Contents of Indication
○ TRCL	The status indicator **[TRCL]** shows whether the turret head is clamped correctly or not. Automatic operation is impossible unless this indicator is lit. When turret 1 is selected by pressing the head selection switch ① (head 1), this indicator shows the turret 1 clamping status. When turret 2 is selected by pressing the head selection switch ② (head 2), this indicator shows the turret 2 clamping status. The status indicator **[TRCL]** is lit when the turret has been indexed and clamped correctly. The status indicator **[TRCL]** blinks if the turret has not been indexed correctly.
○ X ○ Z	The status indicator **[X/Z]** is lit when the X-/Z-axis has been returned to the zero point. These indicators are used to check if the axes have returned to the zero point. When turret 1 is selected by pressing the head selection switch ① (head 1), this indicator shows that the X- and Z-axes of turret 1 have been returned to the zero point. When turret 2 is selected by pressing the head selection switch ② (head 2), this indicator shows that the X- and Z-axes of turret 2 have been returned to the zero point.
<M type> STATUS ① ② ○ C ○ C ○ Y ○ Y	The STATUS indicator **[C]** on the option panel is lit when the C-axis has been returned to the zero point. This indicator is used to check if the axis has returned to the zero point. NOTE 1. Since this machine has no Y-axis specification, the STATUS indicator **[Y]** is not used. 2. The STATUS indicators at the turret 2 side are not used with this machine.

5-8 Chuck Opening/Closing Footswitch

The footswitch is used to clamp/unclamp the chuck manually.

To clamp or unclamp the chuck, step on the footswitch pedal while pushing the lock release plate forward with your toes.

NOTE Chuck clamp/unclamp operation is impossible while the spindle is rotating.

Change the chucking direction setting between I.D. and O.D. so that the status indicator **[CHCL]** is lit when the chuck operates in the direction in which the workpiece is clamped.

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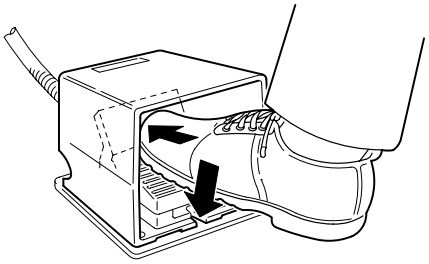
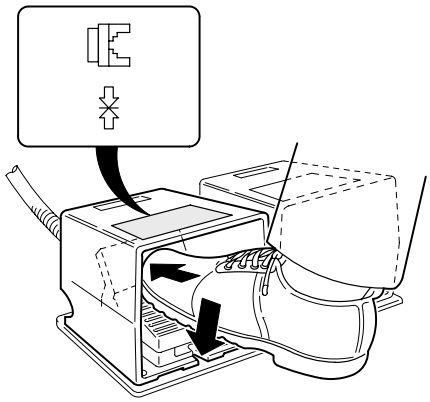
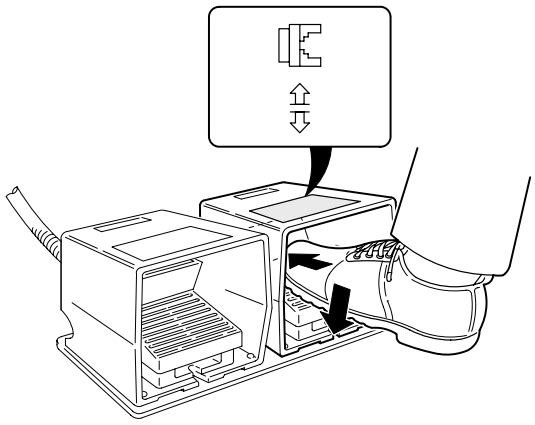
<Footswitch>



To clamp or unclamp the chuck, step on the footswitch pedal while pushing the lock release plate forward with your toes. If the chuck is clamped this operation will unclamp it; if the chuck is unclamped, this operation will clamp it.

<Twin footswitch (option)>

The left footswitch (chuck clamp) is for chuck clamp and the right footswitch (chuck unclamp) is for chuck unclamp operation.

Chuck clamp operation	Chuck unclamp operation
	

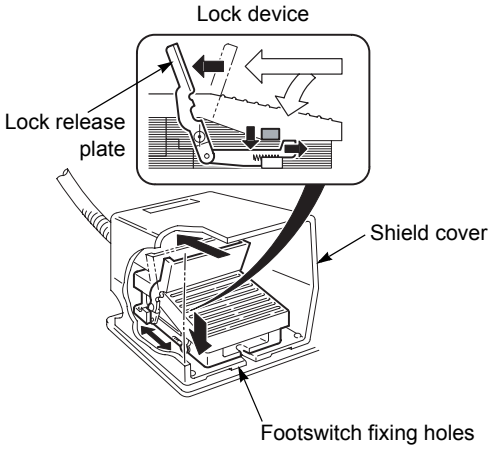
5-8-1 Construction of the Chuck Opening/Closing Footswitch

The footswitch has a shield cover and lock device to prevent the chuck being operated unexpectedly - the footswitch is protected from objects falling onto it and careless foot operation.

CAUTION

1. Never operate the machine without the shield cover and/or the lock device fitted to the chuck opening/closing footswitch. If the footswitch pedal is stepped on carelessly or if an object falls onto the pedal, the chuck will be unclamped and allow the workpiece held in the chuck to fall, causing machine damage.
2. Take care not to stumble over the footswitch since you may be injured.

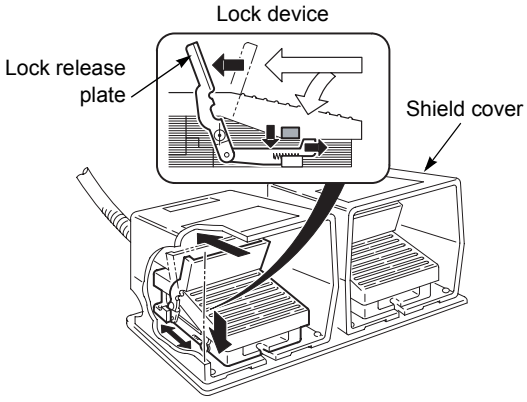
<Construction of the footswitch>



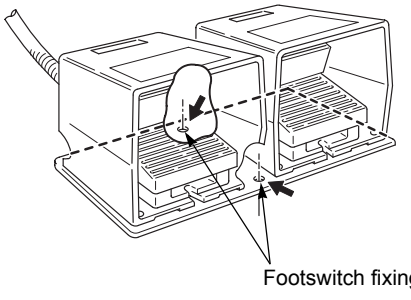
By pushing the lock release plate forward, the lock is released and the footswitch pedal can be stepped on.

At the center of the footswitch base plate, holes are provided at the front and the rear. Use these two holes when fixing the footswitch in place.

<Construction of the twin footswitch (option)>

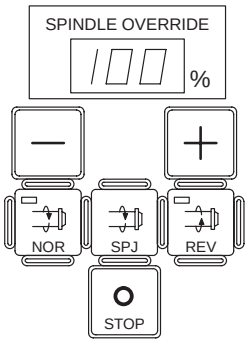


By pushing the lock release plate forward, the lock is released and the footswitch pedal can be stepped on.



At the center of the footswitch base plate, holes are provided at the front and the rear. Use these two holes when fixing the footswitch in place.

5-9 Spindle Switches



The spindle switches are used to start and stop the spindle or the rotary tool spindle (M type) manually.

The spindle or the rotary tool spindle (M type) is manually rotated to cut the rough surface of a workpiece or check workpiece run out.

WARNING

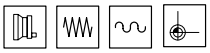
1. **Before starting the spindle, carefully check the workpiece chucking conditions, the chucking pressure, and the spindle speed. If spindle rotation is started when the workpiece is grasped unstably or when the chucking pressure or spindle speed is inappropriate, the workpiece could fly out, causing serious injuries or damage to the machine.**
2. **Be aware that the spindle will start rotating if the (NOR), (REV) or (SPJ) switch is pressed by mistake while a manual mode is selected and the conditions for spindle rotation are satisfied. If these switches are pressed carelessly the spindle will start rotating unexpectedly and this could cause accidents involving serious injuries or damage to the machine.**

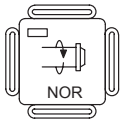
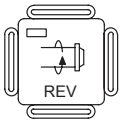
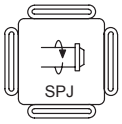
For the condition for spindle starting, refer to page B-27 (7-1).

NOTE

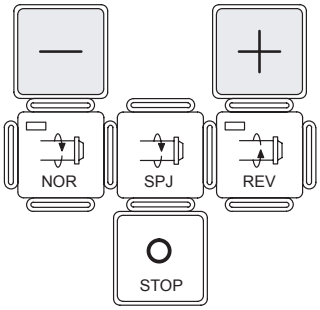
1. Switch operation is impossible with the PANEL key-switch placed in the (OFF) position.
2. Close the front door before pressing the (NOR) or (REV).

<Valid mode>



Switch	Function
	The spindle rotates in the clockwise direction (viewing a workpiece from the spindle) when this switch is pressed. NOTE 1. The spindle start signal is output when the switch is released. Therefore, the spindle will not start if this switch is held down. 2. The spindle speed is set using the spindle speed setting switches + (increase) and − (decrease). Increase the spindle speed gradually after ensuring safety.
	The spindle rotates in the counterclockwise direction (viewing a workpiece from the spindle) when this switch is pressed. NOTE 1. The spindle start signal is output when the switch is released. Therefore, the spindle will not start if this switch is held down. 2. The spindle speed is set using the spindle speed setting switches + (increase) and − (decrease). Increase the spindle speed gradually after ensuring safety.
	The spindle stops when this switch is pressed.
	The spindle rotates at jog speed in the clockwise direction (viewing a workpiece from the spindle) while this switch is held down; it stops when this switch is released.

5-9-1 Spindle Speed Setting Switches



The spindle speed setting switches are used to set a spindle speed.

In the manual mode, a spindle speed is set as a ratio (percentage) in reference to the maximum spindle speed.

In the automatic mode, a spindle speed is set in the range of 50% to 120% of the programmed speed (100%). Setting is possible in increments of 10%.

The set value is indicated in the spindle override display area.

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<In the manual mode>

1. Spindle speed setting switch [+] (increase)
   - Each press and release increases the spindle speed by 1%.
   - Holding the switch down increases the spindle speed continuously in 2% increments.
   - Pressing the [○] (STOP) switch simultaneously with this switch sets the spindle speed to 100%.
2. Spindle speed setting switch [−] (decrease)
   - Each press and release decreases the spindle speed by 1%.
   - Holding the switch down decreases the spindle speed continuously in 2% decrements.
   - Pressing the [○] (STOP) switch simultaneously with this switch sets the spindle speed to 1%.

NOTE In the manual mode, a spindle speed is set as a ratio (percentage) in reference to the maximum spindle speed.

The spindle speed does not exceed the maximum allowable spindle speed.

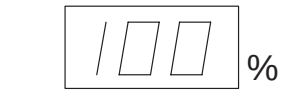
<In the automatic mode>

1. Spindle speed setting switch [+] (increase)
   - Each press and release increases the override data by 10%.
   - Holding the switch down increases the override data continuously in 10% increments up to a maximum of 120%.
2. Spindle speed setting switch [−] (decrease)
   - Each press and release decreases the override data by 10%.
   - Holding the switch down decreases the override data continuously in 10% decrements down to a minimum of 50%.

3. Spindle speed setting switches [+] (increase) + [−] (decrease)
   - Pressing these switches together sets the override data to 100%.

NOTE When the power is turned on, the override value is automatically set to 100%.
The spindle speed does not exceed the maximum allowable spindle speed.

5-9-2 Spindle Override Meter [SPINDLE OVERRIDE]



The SPINDLE OVERRIDE meter indicates the spindle speed override data set using the spindle speed setting switches [+] (increase) and [−] (decrease) (in the automatic mode) and the spindle speed (in the manual mode).

When the power is turned on, 100% is displayed.

5-10 Axis Feed Switches

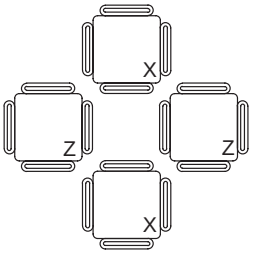
The axis feed switches are used to manually move an axis.

NOTE
1. These switches are not operative when the PANEL key-switch is placed in the (OFF) position.
2. Close the front door before moving the axis.

These switches are used for the following axis feed operations:

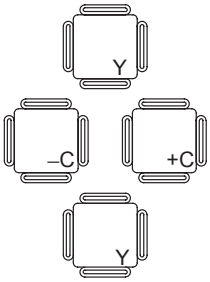
1. Jog feed
2. Rapid traverse
3. Zero return

Select the axis to be moved and the feed direction and initiate axis feed with these switches.



<M type>

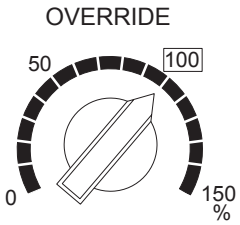
AXIS DIRECTION



With the M type machine, the –C (–C) and +C (+C) switches on the option panel are used to move the C-axis at jog feedrate or rapid traverse rate and also to return it to the zero point.

NOTE
1. The –C (–C) and +C (+C) switches are valid only when turret 2 is selected by pressing the head selection switch (2) (head 2).
2. Since this machine has no Y-axis specification, the Y (Y) switches on the option panel are not used.

5-11 Feedrate Override Dial [OVERRIDE]



The OVERRIDE dial is used to adjust the axis feedrate.

For example, this dial is used to find the most appropriate feedrate during the operation of the machine.

When 100% (126 mm/min) is selected, the indicator in the 100 is lit.

When the dial is set at the 0% (0 mm/min) position, all axis movement stops.

CAUTION

Do not stop axis feed by setting the OVERRIDE dial in the 0% (0 mm/min) position. To suspend axis feed, press the (STOP) switch. If axis feed is suspended using the OVERRIDE dial, an operator cannot recognize how the machine was stopped since no indication is given and, therefore, such operation should be avoided. If axis feed is suspended using the (STOP) switch, the status of the machine can be recognized since the indicator above the switch is lit.

Furthermore, if the dial is quickly operated repeatedly to suspend axis feed, it could cause machine damage.

<In the automatic mode>

The programmed feedrate (F code) is adjusted in the range of 0 to 150% in increments of 10%.

An axis will be moved at the programmed feedrate when the setting is 100%.

<In the manual mode>

In manual operation, the axis feedrate can be set in the range of 0 to 1260 mm/min (16 steps) if the mode selection switch (JOG) is selected.

The relationship between the OVERRIDE dial setting and actual feedrate is indicated below.

Setting	0	10	20	30	40	50	60	70
Feedrate (mm/min)	0	2.0	3.2	5.0	7.9	12.6	20	32
Setting	80	90	100	110	120	130	140	150
Feedrate (mm/min)	50	79	126	200	320	500	790	1260

5-12 Rapid Traverse Rate Override Switches

The rapid traverse rate override switches are used to adjust rapid traverse rate.

For example, these switches are used when a tool is moved at a rapid traverse rate in test cutting.
During test cutting, although positioning is specified at a rapid traverse rate, positioning must be executed at a relatively slow feedrate to ensure safe operation. The switches are used in such a case to lower axis feedrate when executing positioning while checking axis feed operation.

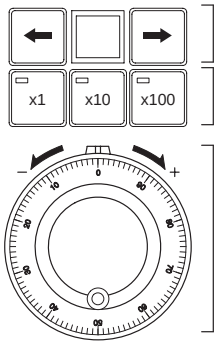
NOTE Switch operation is impossible with the PANEL key-switch placed in the (OFF) position.

Rapid traverse rate is adjusted in two steps, (fine feed) and (slow feed), taking the set traverse rate as 100%.

NOTE

1. When the power is turned on, (fine feed) is selected to ensure safety.
2. For manual operation, even if the rapid override is set to 100%, the actual override value is fixed at 50%.
3. The rapid traverse override function is valid in the dry run mode.
4. When the operation mode is changed from automatic to manual, (fine feed) is selected to ensure safety.

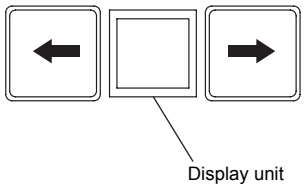
5-13 Handle Switches



The handle switches - which comprise the axis selection switch, the axis feed amount selection switches, and the manual pulse generator - are used to carry out handle feed operations.

NOTE Close the front door before carrying out the handle feed operation.

5-13-1 Axis Selection Switches



The axis selection switches are used to select the axis (X or Z) to be moved in the handle mode.
The selected axis is displayed in the display unit.

Switch	Function
	The switch is used to select the Z-axis. NOTE With the M type machine or the machine equipped with a servo-controlled tailstock, each time this switch is pressed, an axis is selected in order of X, Z, and C (M type) or B (servo-controlled tailstock specification).
	The switch is used to select the X-axis. NOTE With the M type machine or the machine equipped with a servo-controlled tailstock, each time this switch is pressed, an axis is selected in order of B (servo-controlled tailstock specification) or C (M type), Z, and X.

5-13-2 Axis Feed Amount Selection Switches

The axis feed amount selection switches are used to determine the axis feed amount per pulse when an axis is moved with the manual pulse generator.

When the switch is pressed, the indicator in the switch is lit.

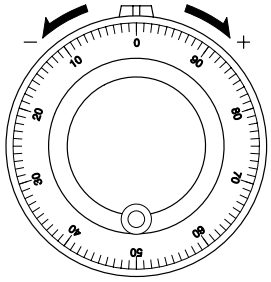
<Axis feed amount per pulse>

Setting	X- and Z-axes B-axis (Servo-controlled Tailstock Specification)	C-axis (M type)
× 1	0.001 mm	0.001°
× 10	0.01 mm	0.01°
× 100	0.1 mm	0.1°

NOTE

1. When the power is turned on, the setting of the axis feed amount selection switch ×1 (×1) is selected to ensure safety.
2. When the operation mode is changed from automatic to manual, the axis feed amount selection switch ×1 (×1) is selected to ensure safety.

5-13-3 Manual Pulse Generator



The manual pulse generator is used to move an axis in the handle mode.

The amount of axis feed per graduation of the manual pulse generator is set with the axis feed amount selection switches.

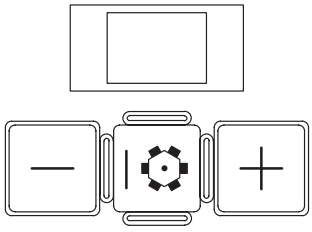
The feed direction is determined by the direction in which the manual pulse generator is turned.

Direction in which Manual Pulse Generator Turned	Axis Travel Direction
Clockwise	+ (positive)
Counterclockwise	– (negative)

CAUTION

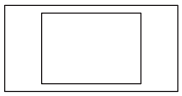
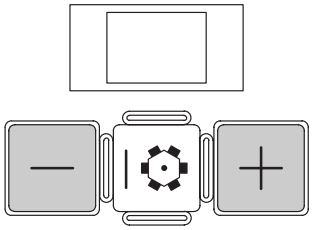
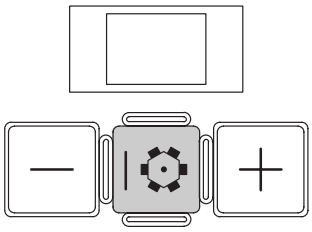
Do not turn the manual pulse generator any faster than 5 rotations per second. If you do, the axis will not stop immediately when the manual pulse generator is stopped and the actual amount of axis feed will not coincide with the number of pulses generated. This could damage the machine.

5-14 Turret Switches



The turret switches are used to index the turret manually.

NOTE
1. Switch operation is impossible with the PANEL key-switch placed in the (OFF) position.
2. Close the front door before pressing the turret indexing switch .

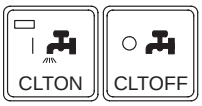
Switch	Function
	The display unit shows the presently indexed turret number. When indexing the turret manually, set the station number to which the turret is to be indexed.
	The turret station setting switches are used to set the target turret station number where the turret is to be indexed manually. 1. When the turret station setting switch + (increase) is pressed and released, the target station number is increased by one. 2. When the turret station setting switch − (decrease) is pressed and released, the target station number is decreased by one. NOTE 1. Selection of turret 1 and turret 2 is made by pressing the head selection switches (head 1) and (head 2). 2. The set target station number blinks in the display unit.
	The turret indexing switch is used to index the turret head manually. After setting the target station number with the turret station setting switches + (increase) and − (decrease), press this switch while the set number is blinking.

WARNING

Be aware that the turret head will start rotating if the turret indexing switch is pressed by mistake while the conditions for turret indexing are satisfied and a manual mode is selected. If this switch is pressed carelessly the turret will start rotating unexpectedly and this could cause accidents involving serious injuries or damage to the machine.

For the condition for turret indexing, refer to page B-36 (8).

5-15 Coolant Switches



The coolant switches are used to manually operate the coolant.

NOTE Close the front door before supplying the coolant so that the coolant will not splash out.

Switch	Function
	When this switch is pressed, the indicator in the switch is lit and coolant is supplied through the nozzles. When the coolant ON M code is read during automatic operation (MDI, memory, or tape mode), the indicator in the (CLTON) switch is lit and coolant is automatically supplied.
	When this switch is pressed while coolant is being supplied, the coolant supply stops and the indicator in the (CLTON) switch goes off. NOTE Pressing this switch for 1 second or more while coolant is not being supplied causes the indicator in the (CLTON) switch to blink and the coolant off mode becomes valid. In this state, the coolant is not supplied even if an M08 command is executed. **<To cancel the coolant off mode>** 1. Press the (CLTON) switch. The indicator in the switch lights and the coolant is supplied. 2. Press the (CLTOFF) switch. The indicator in the (CLTON) switch goes off and the coolant is not supplied.

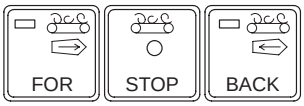
5-16 Machine Light Switch [LIGHT]

The LIGHT switch is used to turn the machine light on/off.

LIGHT	Function
On	Pressing this switch turns on the machine light. At the same time, the indicator in the switch is lit.
Off	Pressing this switch while the machine light is lit turns off the machine light. The indicator in the switch also goes off.

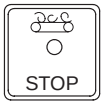
For the procedure for changing the lamp, refer to the MAINTENANCE INFORMATION.

5-17 Chip Conveyor Switches (Chip Conveyor Specification)

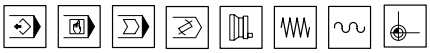


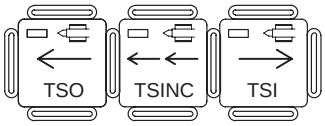
The chip conveyor switches are used to manually operate the chip conveyor.

NOTE Close the front door before operating the chip conveyor.

Switch	Function
	When this switch is pressed, the indicator in the switch is lit and the chip conveyor moves forward to discharge chips. This switch is valid until the ○ (STOP) switch is pressed.
	When this switch is pressed, the chip conveyor stops.
	When this switch is pressed, the indicator in the switch is lit and the chip conveyor moves backward. The chip conveyor moves backward only while this switch is held down.  If the chip conveyor is blocked by chips, press this switch to remove the chips from the chip conveyor.

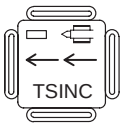
5-18 Tailstock Spindle Switches (Tailstock Specification)





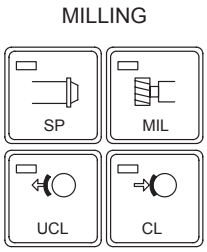
The tailstock switches are used to manually extend and retract the tailstock spindle.

NOTE Tailstock spindle cannot be extended or retracted when the spindle (rotary tool spindle) is rotating and the turret is being indexed.

Switch	Function
	When this switch is pressed, the tailstock spindle moves out and the indicator in the switch is lit.
	When this switch is pressed, the tailstock spindle moves in and the indicator in the switch is lit.
	The tailstock spindle extends from the tailstock body while this switch is held down. Releasing this switch stops the tailstock spindle. The indicator in the switch is lit while this switch is pressed. NOTE After positioning of the tailstock spindle in the inching operation, the cycle start of memory (tape) operation is impossible due to the tailstock spindle interlock function.

The tailstock spindle interlock function becomes effective when the ← (TSO) or ←← (TSINC) switch is pressed.

5-19 Milling Switches [MILLING] (M Type)



The MILLING switches are provided for the machine equipped with the milling function and they are used to operate the C-axis.

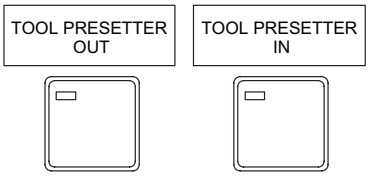
NOTE Switch operation is impossible with the PANEL key-switch placed in the (OFF) position.

Switch	Function
SP	Press this switch to select the main spindle. The indicator in the switch is lit when the main spindle is selected and the main spindle is set in the unclamped state.
MIL	Press this switch to select the rotary tool spindle. The indicator in the switch is lit when the rotary tool spindle is selected. NOTE Depending on the machine model and specifications, the spindle may rotate when the C-axis is connected.
CL	Press this switch to clamp the main spindle. The indicator in the switch is lit when the main spindle is clamped. NOTE 1. Pressing this switch while the main spindle is selected causes the rotary tool spindle to be selected. 2. In the following conditions, the spindle clamp/unclamp operation cannot be performed. • The spindle is rotating or the C-axis is being indexed. • The machine is in the spindle and rotary tool spindle simultaneous operation mode.
UCL	Press this switch to unclamp the main spindle. The indicator in the switch is lit when the main spindle is unclamped. NOTE In the following conditions, the spindle clamp/unclamp operation cannot be performed. 1. The spindle is rotating or the C-axis is being indexed. 2. The machine is in the spindle and rotary tool spindle simultaneous operation mode.

5-20 Door Unlock Switch [DOOR UNLOCK]

For details, see Chapter DOOR INTERLOCK FUNCTION, 5-1-1 "Door Unlock Switch (Manual Door Type)".

5-21 Automatic In-Machine Tool Presetter OUT/IN Switches [TOOL PRESETTER OUT/IN] (Option)

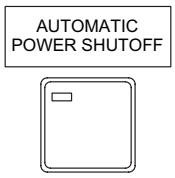


The TOOL PRESETTER OUT/IN switches are provided only on the machine equipped with an automatic in-machine tool presetter.

The TOOL PRESETTER OUT/IN switches are provided on the option panel, and can be used to manually move the tool presetter out of or back into inside the chuck cover.

For the procedure of using the automatic in-machine tool presetter, refer to the INSTRUCTION MANUAL FOR MACRO PROGRAMMING published separately.

5-22 Automatic Power Shutoff Switch [AUTOMATIC POWER SHUTOFF] (Option)



The AUTOMATIC POWER SHUTOFF switch is used to automatically validate the function that shuts the power off after completion of machining.

The power supply circuit is automatically shut off when the M02 (program end) or M30 (program end & rewind) command in the program is read during automatic operation.

When this switch is pressed again while the automatic power shutoff function is valid, the automatic power shutoff function becomes invalid.

NOTE The main switch is placed in the **TRIP** position after the power supply is automatically shut off. To turn the power on again, place the main switch in the ○ **OFF** position once and then place it in the | **ON** position.

When making the following settings, refer to the PC parameter list included in the Ladder Diagrams.

- To use an error output for shutting the power off when the automatic power shutoff function is valid
- To make the automatic power shutoff function valid all the time

5-23 Automatic Door Open/Close Switch [AUTOMATIC DOOR OPEN/CLOSE] (Automatic Door Specification)

The AUTOMATIC DOOR OPEN/CLOSE switches are provided only on the machine equipped with an automatic door.

The AUTOMATIC DOOR OPEN/CLOSE switches are provided on the option panel, and can be used to open and close the automatic door in the manual mode.

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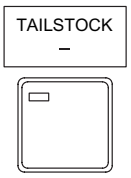
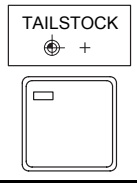
Switch	Function
	When this switch is pressed, the automatic door is opened, and when the door has been opened the indicator in the switch is lit.
	When this switch is pressed, the automatic door is closed, and when the door has been closed the indicator in the switch is lit.

5-24 Tailstock +/– Switches [TAILSTOCK +/–] (Servo-controlled Tailstock Specification)

The TAILSTOCK +/– switches are provided on the option panel and are used to move the servo-controlled tailstock in manual operation.

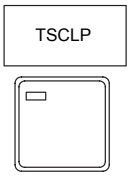
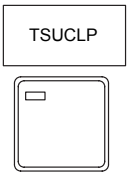
Page B-64 (14)

Switch	Function
	When this switch is pressed, the servo-controlled tailstock is moved in the negative direction. The axis is moved while the switch is held down.
	When this switch is pressed, the servo-controlled tailstock is moved in the positive direction. The axis is moved while the switch is held down. When the tailstock has returned to the zero point, the indicator in the switch is lit.

5-25 The Tailstock Clamp/Unclamp Switches [TSCLP/TSUCLP] (Servo-controlled Tailstock Specification)

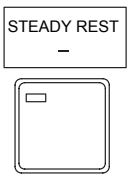
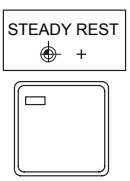
The TSCLP/TSUCLP switches are provided on the option panel and are used to clamp and unclamp the servo-controlled tailstock in manual operation.

Page B-64 (14)

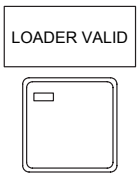
Switch	Function
	When this switch is pressed, the servo-controlled tailstock is clamped, and the indicator in the switch is lit.
	When this switch is pressed, the servo-controlled tailstock is unclamped, and the indicator in the switch is lit.

5-26 Steady Rest Switch [STEADY REST +/–] (Servo-controlled Steady Rest Specification)

The STEADY REST +/– switches are provided on the option panel and are used to move the servo-controlled steady rest in manual operation.

Switch	Function
	When this switch is pressed, the servo-controlled steady rest is moved forward. The axis is moved while the switch is held down.
	When this switch is pressed, the servo-controlled steady rest is moved backward. The axis is moved while the switch is held down. When the steady rest has returned to the zero point, the indicator in the switch is lit.

5-27 Loader Valid Switch (Loader Specification)



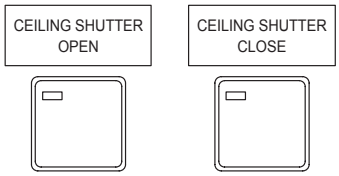
The LOADER VALID switch is provided on the option panel for the loader specification machine.

It is used to make loader operation valid or invalid.

NOTE The operation is impossible with the PANEL key-switch placed in the (OFF) position.

Loader	Function
Valid	When the switch is pressed, the indicator in the switch is lit and loader operation becomes valid.
Invalid	When the switch is pressed while loader operation is valid, the indicator in the switch goes off and loader operation is invalidated.

5-28 Ceiling Shutter Open/Close Switches (Loader Specification)



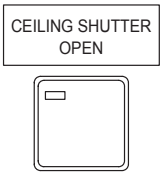
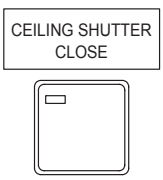
The CEILING SHUTTER OPEN/CLOSE switches are provided on the option panel for the loader specification machine.

They are used to open/close the ceiling shutter manually.

CAUTION Before opening/closing the ceiling shutter, make sure that the shutter can be opened or closed without interference.

If the ceiling shutter is operated (opened, closed) although there is an obstacle in the direction the ceiling shutter is moving, it could cause damage to the ceiling shutter and the machine.

NOTE The operation is impossible with the PANEL key-switch placed in the (OFF) position.

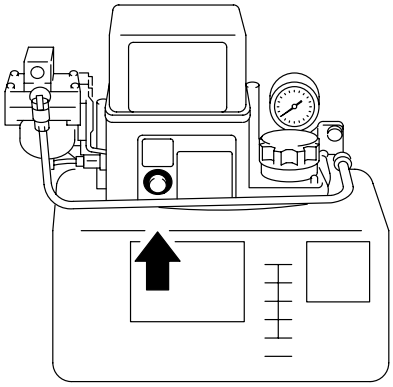
Switch	Function
	When this switch is pressed, the indicator in the switch is lit and the ceiling shutter is opened.
	When this switch is pressed, the indicator in the switch is lit and the ceiling shutter is closed.

5-29 Manual Lubrication Pushbutton

The manual lubrication pushbutton is used to forcibly supply lubricating oil to the slideways manually after the machine has been stopped for a long period or when manual lubricating oil feed is necessary.

CAUTION

If the machine has been stopped for a day or longer, press the manual lubrication pushbutton to forcibly supply lubricating oil to the slideways. If the machine is stopped for a day or longer, the oil film on the slideways may be lost. If the machine is started in this condition the slideways and ball screws will be worn and might seize.



Hold down the pushbutton to supply lubricating oil to the slideways.

NOTE

The type and installation position of the lubrication unit varies depending on the machine model.

For details, refer to the DRAWINGS.

5-30 Chucking Pressure Adjustment Handle

The chucking pressure adjustment handle is used to set the chucking pressure when clamping a workpiece in the chuck.

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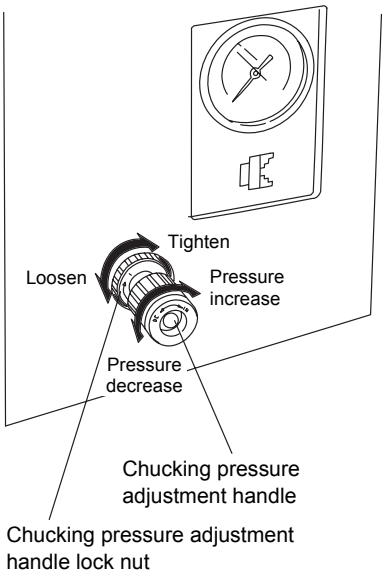

Loosen the chucking pressure adjustment handle lock nut and turn the handle to adjust the chucking pressure.

After adjusting the chucking pressure to the required value, tighten the lock nut to secure the chucking pressure adjustment handle.

- CCW rotation . . . . Pressure decrease
- CW rotation . . . . . Pressure increase

5-31 Tailstock Spindle Thrust Adjustment Handle (Tailstock Specification)

The tailstock spindle thrust adjustment handle is used to set the tailstock spindle thrust applied to the workpiece when holding the workpiece by the tailstock spindle (center).

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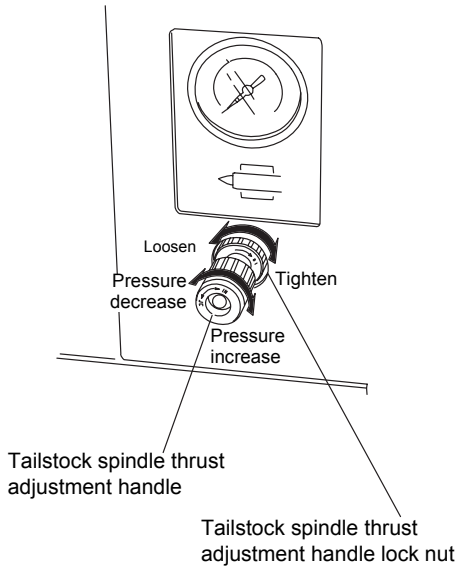
NOTE Take the center hole size of the workpiece into consideration when determining the tailstock spindle thrust.



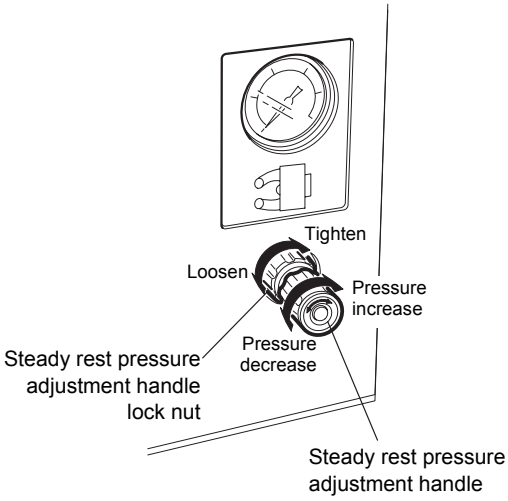
Loosen the tailstock spindle thrust adjustment handle lock nut and turn the handle to adjust the tailstock spindle thrust.

After adjusting the tailstock spindle thrust to the required value, tighten the lock nut to secure the tailstock spindle thrust adjustment handle.

- CCW rotation . . . . Pressure decrease
- CW rotation . . . . . Pressure increase

5-32 Steady Rest Pressure Adjustment Handle (Steady Rest Specification)

This handle is used to set the steady rest pressure when clamping a workpiece in the steady rest.



Loosen the steady rest pressure adjustment handle lock nut and turn the handle to adjust the steady rest pressure.

After adjusting the steady rest pressure to the required value, tighten the lock nut.

- CCW rotation . . . . Pressure decrease
- CW rotation . . . . . Pressure increase

NOTE Exercise due care when setting the pressure.

5-33 Operation Panel Screen

 Function selection key (CUSTOM1) ⟶ **[OPE. PANEL]**

This screen is used to set the following NC functions. For the details of the NC functions, refer to the reference sections indicated in the table.

NC Function	Refer to
SPINDLE OFF MODE	5-6-5 Spindle OFF Mode Function (page A-27)
CHUCK DIRECTION	5-6-6 Chuck Clamp Direction (page A-28)
TAILSTOCK ILK.	5-6-7 Tailstock Spindle Interlock (Tailstock Specification) (page A-29)
WORK COUNTER	5-6-8 Work Counter (page A-29)
MACHINE LOCK	5-6-9 Machine Lock (page A-30)
AUX. F. LOCK	5-6-10 Auxiliary Function Lock (page A-30)
CHUCK FOOT SWITCH	5-6-11 Chuck Footswitch (page A-31)
CHUCK STROKE END	5-6-12 Chuck Jaw Stroke End Detection Switch (page A-31)
ZERO POSITION SET	5-6-13 Zero Point Adjustment (page A-32)

<Setting procedure>

1) Move the cursor to the required item using the cursor control keys ↑ and ↓.

2) Select and set the required status using the cursor control keys ← and →.

5-34 Work Rest/Steady Rest Manual Operation Screen

 Function selection key (CUSTOM1) ⟶ **[STEADY REST]**

This screen is used for manual operation of the work rest and the steady rest.

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Page B-74 (17)

6 DATA INPUT/OUTPUT

By using an external I/O device, data can be written to the NC memory and data in the NC memory can be output. The I/O destination (I/O channel) must be specified in advance.

6-1 Setting the I/O destination (I/O channel)

1) Connect the external I/O device.
2) Display the Setting screen.

    Function selection key (OFS/SET) ⟶ **[SETTING]**

3) Enter the channel number of the connected external I/O device at "I/O CHANNEL".
   If using a memory card, set "4".
4) Press the INPUT key.

Once set, the parameter settings do not need to be changed unless the external I/O device is changed.

6-2 Inputting/Outputting a Program

1. Make sure that the I/O device has been set.
2. If a program is input without designating a program number, the NC data must begin with a program number preceded by "O" or ":". An input error occurs if a program number is not designated.
3. NC data that doesn't contain an O number may be input by designating a program number.
4. If the data to be input has multiple EOB codes followed by O numbers, the programs are registered under the individual O numbers.

6-2-1 Program Input Operating Procedure

<Input from a memory card>

1) Insert a memory card into the card slot.
2) Set the PANEL key-switch to the (PANEL/EDIT) position.
3) Select the mode selection switch (EDIT).
   The edit mode will be selected.
4) Display the PROGRAM EDIT screen or PROGRAM DIRECTORY screen.

    Function selection key (PROG)

5) Press the **[(OPRT)]** → **[+]** → **[READ]** soft-keys.

6) Enter the filename and press the **[EXEC.]** soft-key.

   The program will be read and the indication "INPUT" will flash at the bottom right of the screen. When the read operation ends, the "INPUT" indication disappears.

To cancel the input of the program, press the **[CANCEL]** soft-key.

Programs can also be input by following the method that uses the All I/O Screen described below.

1) Insert a memory card into the card slot.

2) Set the PANEL key-switch to the (PANEL/EDIT) position.

3) Select the mode selection switch (EDIT).

   The edit mode will be selected.

4) Display the All I/O Screen.

   Function selection key (SYSTEM) ⟶ Press **[+]** several times ⟶ **[ALL IO]**

5) Press the **[PRGRM]** soft-key.

6) Press the **[(OPRT)]** → **[N READ]** soft-key.

7) Enter the filename of the program to be read and press the **[F NAME]** soft-key.

8) Press the **[O SET]** soft-key.

9) Press the **[EXEC.]** soft-key.

   The program will be read and the indication "INPUT" will flash at the bottom right of the screen. When the read operation ends, the "INPUT" indication disappears.

To cancel the input of the program, press the **[CANCEL]** soft-key.

6-2-2 Program I/O Alarm Messages

In some cases, an alarm message is displayed on attempting to input a program.

In such cases, resolve the problem by referring to the table below.

Cause of the Alarm	Remedy
Another program is registered with the same program number.	Register the program with an O number that is not registered in the NC.
	Set bit 2 of NC parameter No. 3201 to "1" so that a program can be registered using an O number that is already registered in the NC.
The number of programs that can be registered in the NC memory is set to 0.	Delete unnecessary programs in the NC memory to enable registration of the program. Check the number of programs that can be registered using the PROGRAM DIRECTORY screen.
Not enough memory area is available.	Delete unnecessary programs in the NC memory to free up enough memory area to register the program. Check the available memory area using the PROGRAM DIRECTORY screen.
Bit 0 of NC parameter No. 0 is set to "1" (execute TV check).	Set bit 0 of NC parameter No. 0 to "0" so that no TV check is executed.
An attempt has been made to register a program with an O number for which program editing is restricted (O8000 to O9999).	Register the program by specifying an O number for which program editing is not restricted.
	To enable program editing of O8000 to O8999: Set bit 0 of NC parameter No. 3202 to "0". To enable program editing of O9000 to O9999: Set bit 4 of NC parameter No. 3202 to "0".

6-2-3 Program Output Operating Procedure

<Outputting to a Memory Card>

1) Insert a memory card into the card slot.
2) Set the PANEL key-switch to the  (PANEL/EDIT) position.
3) Select the mode selection switch  (EDIT).
4) Display the PROGRAM EDIT screen or PROGRAM DIRECTORY screen.

    Function selection key  (PROG)
5) Press the **[(OPRT)]** → **[+]** → **[PUNCH]** soft-keys.

6) Type the program number to be output, then press **[EXEC.]**.

1. Enter 0 - 9999 and press the **[EXEC.]** soft-key to output all the programs in the memory.
2. If you press the **[EXEC.]** soft-key without having entered a program number, all of the programs in the memory will be output.

Program output will proceed and the indication "OUTPUT" will flash at the bottom right of the screen. When the read operation ends, the "OUTPUT" indication disappears.

To cancel program output, press the **[CANCEL]** soft-key.

Programs can also be output by following the method that uses the All I/O Screen described below.

1) Insert a memory card into the card slot.
2) Set the PANEL key-switch to the (PANEL/EDIT) position.
3) Select the mode selection switch (EDIT).
4) Display the All I/O Screen.

Function selection (SYSTEM) ⟶ Press **[+]** several times ⟶ **[ALL IO]**

5) Press the **[PRGRM]** soft-key.
6) Press the **[(OPRT)]** → **[PUNCH]** soft-keys.
7) Enter the program number of the program to be output and press the **[O SET]** soft-key.

On entering –9999 all the programs in the memory will be output.

8) Enter the filename after output and press the **[F NAME]** soft-key.

If output is executed without entering a filename, the filename will be as shown below.

- If the data was output as simple program numbers: "O number". TXT
- If the data was output as –9999: ALL-PROG.TXT

9) Press the **[EXEC.]** soft-key.

Program output will proceed and the indication "OUTPUT" will flash at the bottom right of the screen. When the read operation ends, the "OUTPUT" indication disappears.

To cancel program output, press the **[CANCEL]** soft-key.

6-3 Inputting/Outputting Offset Data

6-3-1 Offset Data Input Operating Procedure

<Input from a memory card>

1) Insert a memory card into the card slot.
2) Set the PANEL key-switch to the (PANEL/EDIT) position.
3) Select the mode selection switch (EDIT).
4) Display the TOOL OFFSET screen.

   Function selection key (OFS/SET)
5) Press the **[(OPRT)]** → **[+]** → **[READ]** soft-keys.
6) Enter the filename and press the **[EXEC.]** soft-key.

   The offset data will be read and the indication "INPUT" will flash at the lower right of the screen. When the read operation ends, the "INPUT" indication disappears.

To cancel the input of the program, press the **[CANCEL]** soft-key.

Alternatively, offset data can also be read by following the method using the All I/O Screen described below.

1) Insert a memory card into the card slot.
2) Set the PANEL key-switch to the (PANEL/EDIT) position.
3) Select the mode selection switch (EDIT).

   The edit mode will be selected.
4) Display the All I/O Screen.

   Function selection key (SYSTEM) ⟶ Press **[+]** several times ⟶ **[ALL IO]**
5) Press the **[OFFSET]** soft-key.
6) Press the **[(OPRT)]** → **[N READ]** soft-key.
7) Enter the filename that you want to input and press the **[F NAME]** soft-key.
8) Press the **[EXEC.]** soft-key.

   The offset data will be read and the indication "INPUT" will flash at the lower right of the screen. When the read operation ends, the "INPUT" indication disappears.

To cancel the input of the program, press the **[CANCEL]** soft-key.

6-3-2 Offset Data Output Operating Procedure

<Outputting to a Memory Card>

1) Insert a memory card into the card slot.
2) Set the PANEL key-switch to the (PANEL/EDIT) position.
3) Select the mode selection switch (EDIT).
4) Display the TOOL OFFSET screen.

   Function selection key (OFS/SET)
5) Press the **[(OPRT)]** → **[+]** → **[PUNCH]** soft-keys.
6) Enter the filename of the file to be output and press the **[EXEC.]** soft-key.

   Program output will proceed and the indication "OUTPUT" will flash at the bottom right of the screen. When the read operation ends, the "OUTPUT" indication disappears.

To cancel program output, press the **[CANCEL]** soft-key.

Alternatively, offset data can also be output by following the method using the All I/O Screen described below.

1) Insert a memory card into the card slot.
2) Set the PANEL key-switch to the (PANEL/EDIT) position.
3) Select the mode selection switch (EDIT).
4) Display the All I/O Screen.

   Function selection key (SYSTEM) ⟶ Press **[+]** several times ⟶ **[ALL IO]**
5) Press the **[OFFSET]** soft-key.
6) Press the **[(OPRT)]** → **[PUNCH]** soft-keys.
7) Enter the filename after output and press the **[F NAME]** soft-key.
8) Press the **[EXEC.]** soft-key.

   The offset data will be output and the indication "OUTPUT" will flash at the bottom right of the screen. When the read operation ends, the "OUTPUT" indication disappears.

To cancel program output, press the **[CANCEL]** soft-key.

CHAPTER B
MANUAL OPERATION

The procedure used to turn on/off the power supply, and to stop the machine in emergency cases are described.

This chapter also provides the procedure to feed the axes or to start/stop the spindle manually.

Before using a switch, button, or key, check visually that it is the one you intend to use, and then press or set it decisively. Pressing the wrong switch, button, or key by mistake can cause accidents involving serious injuries or damage to the machine.

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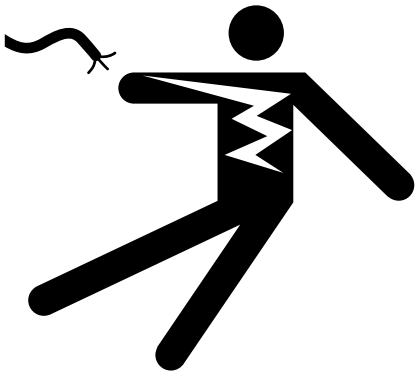
1 SAFETY GUIDELINES

Always observe the following precautions whenever you operate the machine. Failure to follow them might cause you serious injury.



DANGER

Always switch off the power before carrying out inspection or maintenance work in the electrical cabinet or on motors and transformers. If work has to be done while the power is switched on, it must be carried out by a qualified electrical engineer, taking the proper precautions; there is a danger of electric shock.

DANGER

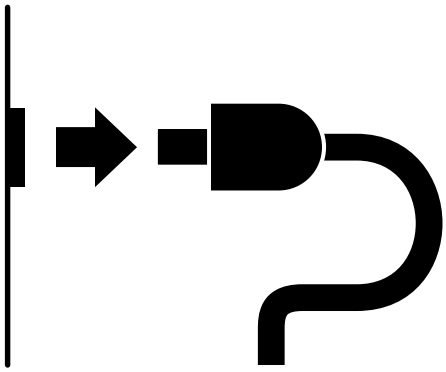
Never touch a switch, button, or key with wet hands.
If it is not properly grounded or is leaking current, you could receive an electric shock.

DANGER

Check that all cables are properly insulated before using the machine. There is considerable danger of electric shock if damaged cables are used.

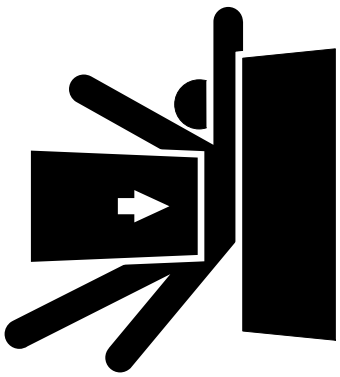
DANGER

Never operate the machine with the protective cover removed or while interlocks or other safety devices are ineffective, since the machine could operate in an unexpected manner, causing accidents involving serious injuries.
Contact Mori Seiki, the NC unit manufacturer or the relevant equipment manufacturer immediately if the protective cover or safety devices are damaged.



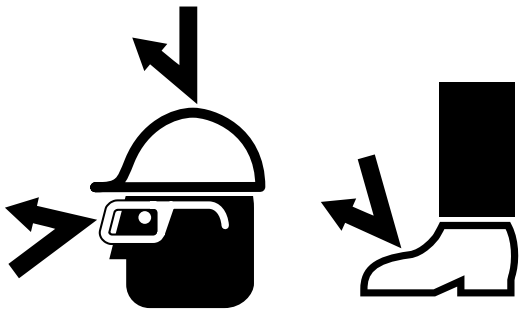
DANGER

Always turn the power OFF before performing maintenance and inspection work. Or, if it is absolutely necessary to carry out the work with the power ON, exercise due caution since there is a danger of serious injury: you could receive an electric shock, be entangled by the rotating parts of the machine, or crushed by its moving parts.



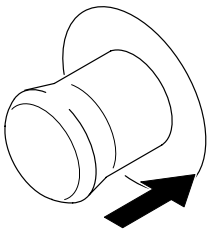
DANGER

Before starting machine operation, check that there are no personnel or obstructions inside the protective cover or close to rotating or moving parts of the machine. Never touch or stand near the rotating or moving parts of the machine while it is operating; you could be seriously injured by being entangled in the rotating parts or crushed by the moving parts.



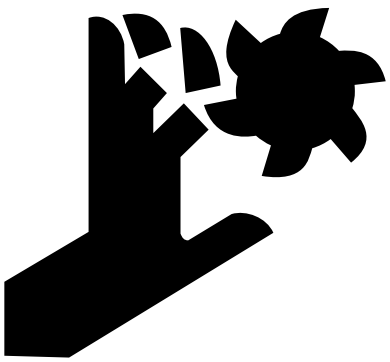
WARNING

Machine operators and authorized personnel working inside the plant and in the vicinity of the machine must put their clothing and hair in order so that there is no danger they will be entangled in the machine. If you have uncontrolled long hair or loose clothing and it gets caught in the machine, you will be seriously injured by being entangled in the rotating parts of the machine or crushed by its moving parts. Always wear safety shoes, eye protectors and a helmet.



WARNING

Before operating the machine, memorize the locations of the EMERGENCY STOP buttons so that you can press one immediately from any location and at any time while operating the machine. The EMERGENCY STOP buttons are used to stop all operations in the event of an emergency. If there is an obstacle in front of an EMERGENCY STOP button it will not be possible to press it immediately when an emergency occurs and this could cause accidents involving serious injuries or damage to the machine.



CAUTION

Never touch chips or the cutting edges of tools with your bare hands since you may be injured.

2 TURNING ON THE POWER

This section describes the points to check before turning on the power to the NC lathe, and the procedure for turning on the power.

2-1 Check Items before Turning On the Power

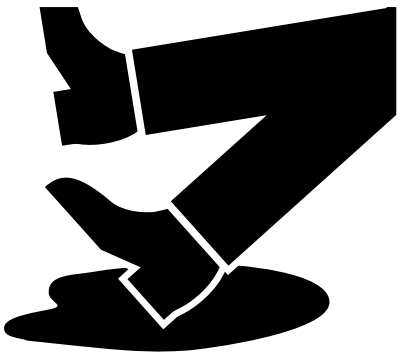
Before turning the power on, check the following points.

1) Make sure that all of the doors to the NC unit and the electrical cabinet are closed.

   If any door is opened, find out why.
   Close the doors after making sure that closing them will not create any problems.

2) Make sure that all of the covers are correctly fitted.

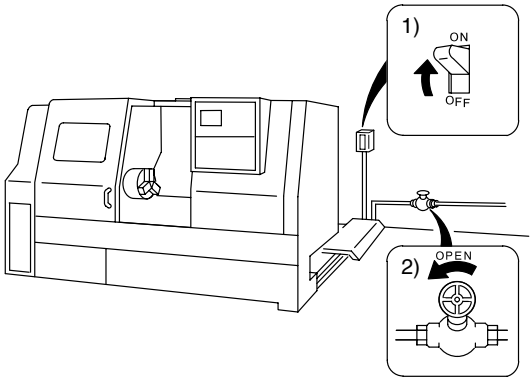
   If any cover is not correctly fitted, find out why.
   Replace the covers after making sure that replacing them will not create any problems.



3) Make sure that the floor around the machine is clean. There should be no oil or coolant on the floor.

2-2 Turning On the Power

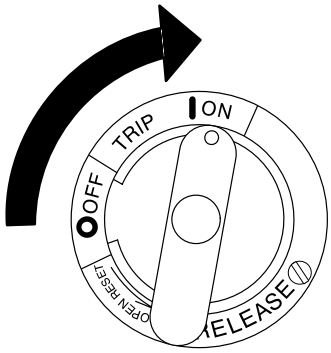
The method for turning on the power to the machine is described here.



1) If power is not supplied, turn on the main breaker on the shop power distribution board.
2) If the machine uses pneumatically-actuated equipment, turn on the compressed air.
3) If the machine uses pneumatically-actuated equipment, check the pressure of the compressed air.

NOTE Setting pressure varies according to the machine model and specifications.

For details, refer to the MAINTENANCE INFORMATION.



4) Turn on the main switch.

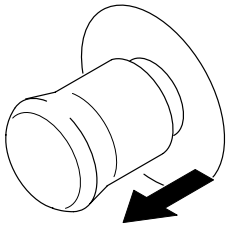
WARNING

When the main switch is locked with a padlock it means that maintenance is in progress, so do not place the main switch in the | ON position.

5) Check the main pressure of the hydraulic unit with the pressure gage in the main hydraulic line.

For the procedure used for setting the main pressure, refer to the MAINTENANCE MANUAL.

6) Make sure that the cooling fans in the operation panel, the NC unit, and the electrical cabinet are operating properly.
7) Pull out all the EMERGENCY STOP buttons to reset the emergency stop state.



NOTE If the machine has more than one emergency stop button, it is necessary to pull out all the EMERGENCY STOP buttons from the pushed and locked position to reset the emergency state.

8) Press the NC power switch (ON).

WARNING

After pressing the NC power switch (ON), do not touch any of the operation-related keys on the NC operation panel until the screen shows "(WARNING)". The NC power switch (ON) is used in combination with some of the keys on the operation panel for purposes related to maintenance and special operations. If you accidentally use one of these combinations the machine will operate in an unexpected manner, and this could result in accidents involving serious injuries or damage to the machine.

The (WARNING) message is displayed on the screen.

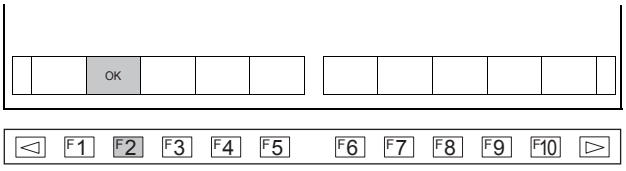
(WARNING)

The machine is designed and manufactured for well-trained operators who have a basic knowledge of machine operation. DO NOT operate this machine unless this applies to you. To avoid accidents, you are required to read and understand the information on the caution labels, in the manuals and follow instructions carefully. Failure to follow these instructions may result in injury, or damage to the machine. Being aware of this warning, press [OK] soft-key.

CAUTION

Before pressing the **[OK]** soft-key, read the message carefully.

For details of the WARNING message, refer to "WARNING DISPLAY ON TURNING ON POWER".



9) Read and understand the contents of the message, then press the **[OK]** soft-key.

NOTE

If the message confirmation step is skipped, the machine does not become ready for operation and neither automatic nor manual operation is possible.

The message "OPEN THE DOOR THEN CLOSE" is displayed on the screen.

10) Open the front door and then close it in accordance with the displayed instruction.

If the front door is already open when the power is turned ON, just close it.

NOTE

1. This step is required to confirm that the electric circuit for door interlock is working correctly by opening and closing the front door. When it is confirmed, the doors are locked and the status indicator **[MRDY]** is lit. The machine is ready for automatic operation and manual operation under this condition.
2. If the NC is in an alarm state when the power is turned on, remove the cause of the alarm before starting any operation.

3 EMERGENCY STOP

To immediately stop machine operation during manual or automatic operation, use one of the following three methods.

NOTE The status of the machine after stopping will differ depending on which method you used. Therefore, you must understand the differences between the three methods.

<Press the EMERGENCY STOP button>

All machine operation stops immediately.

Press this button in case of emergency.

Because of the inertia of the moving parts of the machine, they may not be stopped immediately when the EMERGENCY STOP button is pressed. Always confirm that all operations have stopped before going near these parts. If you approach the moving parts of the machine without due care you may be entangled in them and seriously injured.

NOTE
1. The power supply to the circuits that control the axis movement and spindle rotation is turned off.
2. Depending on the machine model and specifications, there may be an EMERGENCY STOP button at more than one location.

<Press the RESET (RESET) key>

All machine operation stops.

NOTE The power is not turned off.

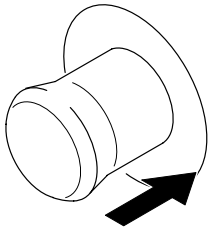
<Press the (STOP) switch>

The axis movement stops. But the spindle keeps on rotating if this switch is pressed while the spindle is rotating.

NOTE The power is not turned off.

3-1 Emergency Stop Button

The procedures for stopping the machine with the EMERGENCY STOP button and resetting the emergency state are described here.



1) Press the EMERGENCY STOP button.

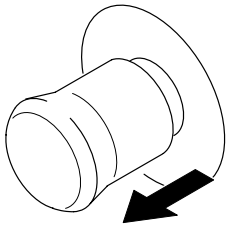
   Regardless of the operation mode (manual or automatic), all machine operation, including axis feed and spindle rotation, stops when the EMERGENCY STOP button is pressed.

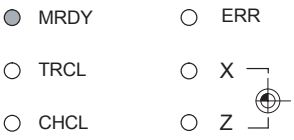
NOTE If the machine has more than one EMERGENCY STOP button, all of these EMERGENCY STOP buttons have the same function and pressing any one of them can stop the machine.

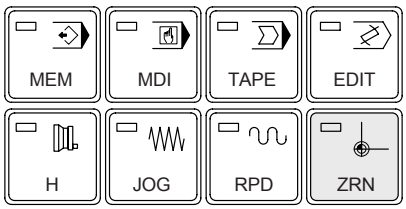
CAUTION When the EMERGENCY STOP button has been pressed to stop the machine during a threading operation or a hole machining operation, especially a tapping operation (M type), carefully move the axes after checking the workpiece and cutting tool carefully for damage. If you move the axes without due care, the workpiece and cutting tool may collide or interfere with each other, and this could damage the machine.

The screen displays the information that the machine has been stopped in the emergency stop state.
The message "EMG" blinks on and off on the screen.

<To restart operation>







1) Close the front door.

2) Pull out all the EMERGENCY STOP buttons to reset the emergency stop state.

NOTE If the machine has more than one EMERGENCY STOP button, it is necessary to pull out all the EMERGENCY STOP buttons from the pushed and locked position to reset the emergency state.

3) Press the NC power switch (ON).

NOTE If the NC power switch (ON) is pressed while the door is open, the following message is displayed.

"EX4002 OPEN THE DOOR THEN CLOSE"

In this case, close the front door.

When the machine is restored to the operation ready condition, the status indicator **[MRDY]** is lit.

NOTE An alarm number is displayed on the screen while the machine is in alarm status.
If the alarm cannot be cleared, contact Mori Seiki.

4) Carry out the zero return operation.

Page B-18 (6-1)

3-2 Reset Key

The procedures for stopping the machine with the [RESET] (RESET) key and clearing the reset status are described here.

1) Press the [RESET] (RESET) key.

When the [RESET] (RESET) key is pressed during automatic operation, the spindle rotation and axis movement stop.
At the same time, the NC is placed in the reset status.

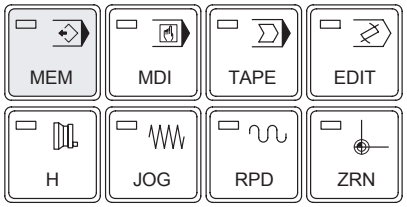
CAUTION

When the [RESET] (RESET) key has been pressed to stop the machine during a threading operation or a hole machining operation, especially a tapping operation (M type), carefully move the axes after checking the workpiece and cutting tool carefully for damage. If you move the axes without due care, the workpiece and cutting tool may collide or interfere with each other, and this could damage the machine.

<To restart operation>

WARNING

To restart the program from a required block after resetting the NC, check the status of the machine and that of the NC and specify the M, S, T, G, and F codes, the work coordinate system, and other necessary information after selecting the MDI mode. If operation is restarted without specifying these data, the machine will operate unexpectedly causing serious injuries or damage to the machine.



1) Select the memory mode ([MEM]) with the mode selection switch.

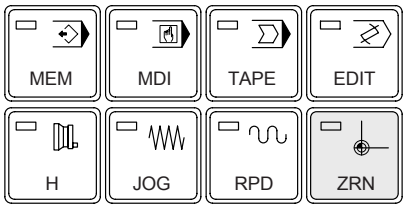
2) The PROGRAM (memory) screen is displayed.

3) Locate the head of the program.
The cursor moves to the head of the program.

4) Close the front door.

5) Carry out the zero return operation.

Page B-18 (6-1)

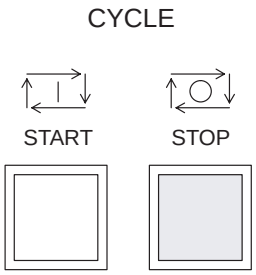


3-3 Feed Hold Switch

The procedures for stopping the machine with the (STOP) switch and restarting automatic operation from the temporary stop state are described here.

WARNING

Pressing the (STOP) switch during automatic operation stops axis movement but does not stop spindle rotation. Therefore, select a manual mode and confirm that spindle rotation has stopped before opening the door. If you open the door while the spindle is rotating you may be entangled with the spindle and seriously injured.

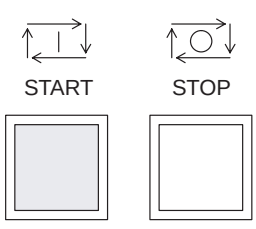


1) Press the (STOP) switch.
The indicator in the switch is lit and axis feed stops.

NOTE

1. If the (STOP) switch is pressed during automatic operation, the spindle keeps rotating while the axes are stopped. To stop the spindle, select the manual mode.
2. In the G32 thread cutting mode, if the (STOP) switch is pressed while a thread is being cut, axis movement stops after executing the first block following the thread cutting mode blocks.
3. In the G92 thread cutting mode, if the (STOP) switch is pressed while a thread is being cut, the cutting tool retracts from the thread immediately in chamfering operation. Then, it returns to the thread cutting start point in the order X-axis then Z-axis, and axis movement stops here.
4. When the (STOP) switch is pressed in the tapping cycle (M type only), axis movement is stopped at the position where a single block stop is valid in the cycle.

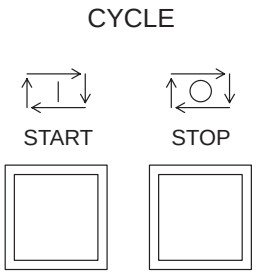
<To restart automatic operation>



1) Close the front door.
2) Press the (START) switch.
The indicator in the switch is lit.
The rest of the program is executed.

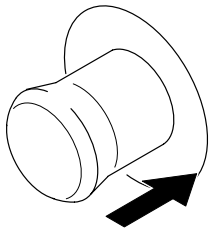
4 TURNING OFF THE POWER

This section describes the procedure for turning off the power to the NC lathe.



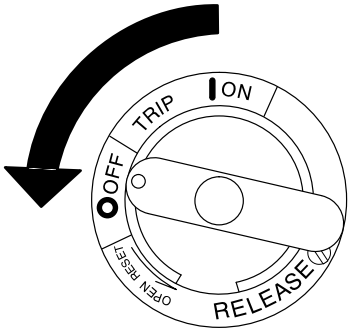
1) Make sure that the indicator in the (START) switch and the indicator in the (STOP) switch on the operation panel are not lit.

NOTE If the indicator is lit, press the (RESET) key on the NC operation panel.

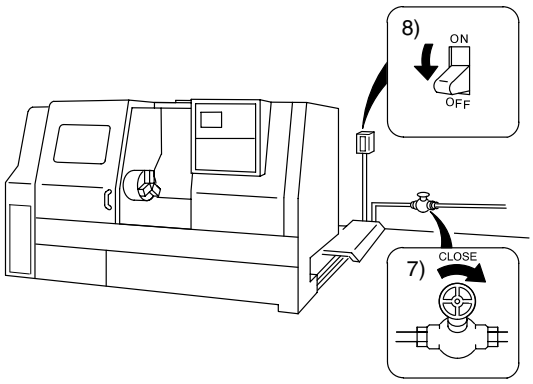


2) Make sure that the machine is stopped.
3) If an external I/O device is connected to the NC, turn off the power to the external I/O device.
4) Press the EMERGENCY STOP button.

5) Press the NC power switch (OFF).

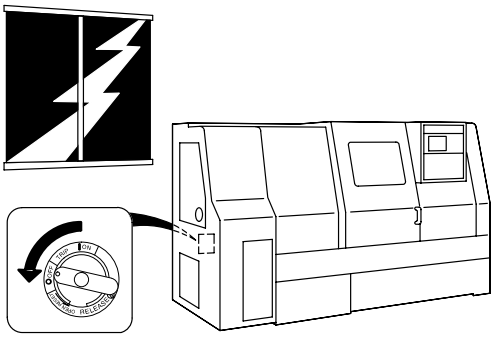


6) Turn off the main switch.



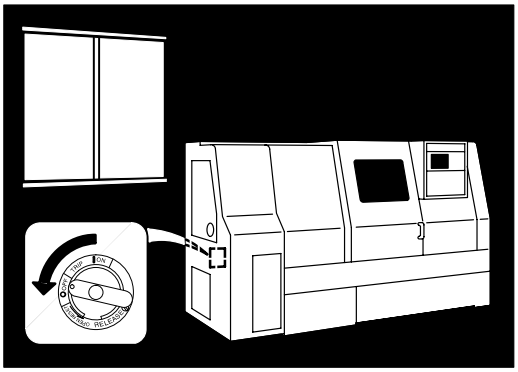
7) If the machine uses pneumatically-actuated equipment, turn off the compressed air supply.

8) Turn off the main breaker on the shop power distribution board



WARNING

The machine cannot operate correctly unless the specified power is supplied. If the power supply is momentarily cut off during machine operation due to a power failure or lightning, the machine may operate unexpectedly and this could cause accidents involving serious injuries or damage to the machine. If abnormal fluctuations in the power supply voltage are likely, for example due to lightning, switch the power OFF.

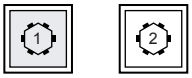


CAUTION

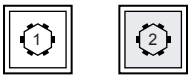
When turning on the power after the machine has been stopped by a power outage, check that the program, parameter data, offset data, etc. have not been destroyed. If the machine is used with destroyed data, it could lead to accidents involving damage to the machine.

5 SELECTING TURRET

Select turret 1 or turret 2 to be operated manually with the head selection switch ① (head 1) or ② (head 2).



When the head selection switch ① (head 1) is pressed, the indicator in the switch is lit and turret 1 is selected.



When the head selection switch ② (head 2) is pressed, the indicator in the switch is lit and turret 2 is selected.

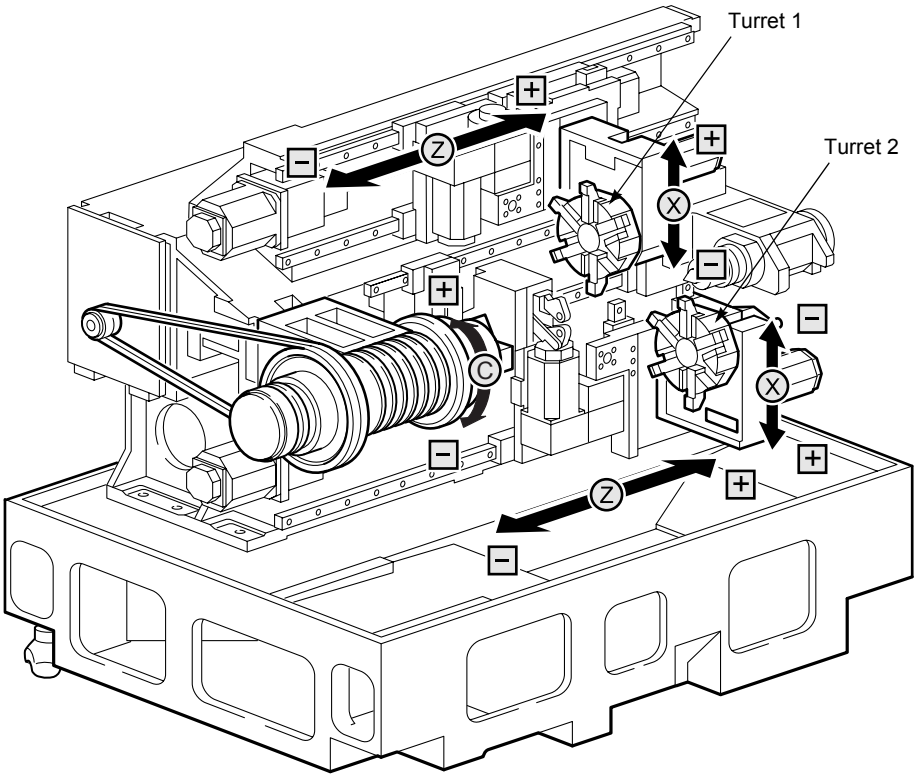
NOTE When the manual mode is selected after turning on the power, turret 1 is selected.

6 AXIS MOVEMENT OPERATION

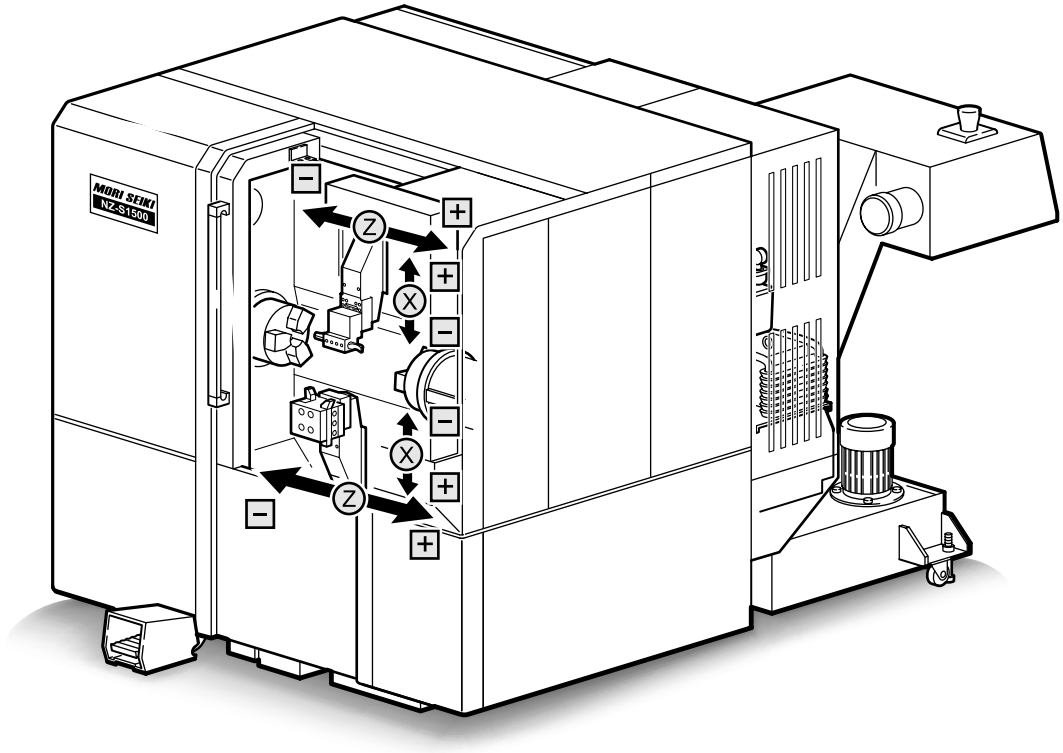
The directions of the controlled axes of this machine are determined as follows.

Axis	Unit	+ and - Direction
X	Turret 1	+ direction: The direction in which the machining diameter increases.
	Turret 2	
Z	Turret 1	+ direction: The direction in which a cutting tool moves away from the spindle.
	Turret 2	
C (M type)	Spindle	– direction: The rotation direction in which the right-hand thread advances when viewing a cutting tool from the spindle.
B (servo-controlled tailstock)	Servo-controlled tailstock	+ direction: The direction in which a cutting tool moves away from the spindle.

NOTE For the X-axis reversed JIS specification machine, positive and negative directions of the X-axis are reversed from those applied to conventional specification machines.



<Specification with a spindle 2>



6-1 Zero Return Operation

In manual operation, each axis is returned to the machine zero point at the set rapid traverse rate.

The machine zero point varies depending on the machine model and specifications. For details, refer to the DRAWINGS.

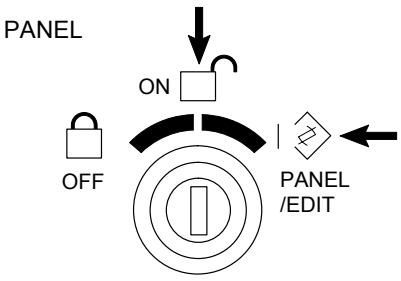
Zero return operation must be carried out in the following cases:

1. After the power is turned on
2. Before setting the tool offset data for newly mounted tools
3. After the machine ready signal has been turned off due to the EMERGENCY STOP button being pressed, etc.
4. After changing the machine lock function setting from "valid" to "invalid"

WARNING

Never stand near the moving parts of the machine during a zero return operation since each axis is returned to the zero point at the rapid traverse rate.
Before starting a zero return operation, always make sure that no one is standing near the moving parts and that the moving parts can be fed to the zero point without interference.
Failure to observe these warnings could result in accidents involving serious injuries or damage to the machine: operators or personnel near the machine could be crushed by the moving parts of the machine, and the turret could strike obstacles.

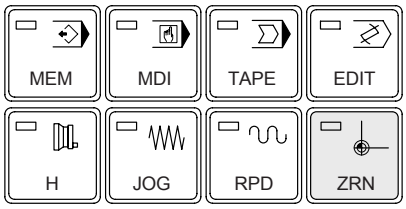
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.



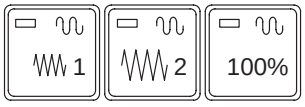
3) Place the PANEL key-switch in one of the positions indicated below.

(ON) (PANEL/EDIT)

4) Press the head selection switch (head 1) or (head 2) to select the required turret.

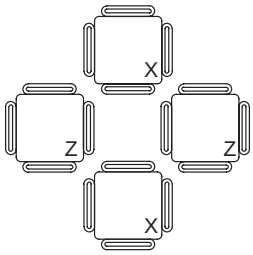


5) Select the zero return mode ( ) with the mode selection switch.



6) Set the rapid traverse rate to be used for zero return operation using the rapid traverse rate override switches.

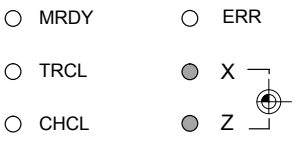
NOTE For manual operation, even if the rapid override is set to 100%, the actual override value is fixed at 50%.



7) Press and hold down the axis feed switch (zero return direction) for the axis which is to be fed to the zero point.

As the axis approaches the zero point, it decelerates automatically and is positioned at the zero point.

NOTE If an axis feed switch that moves the axis in the opposite direction of the zero point is pressed, the axis does not move.



The status indicator **[X]** or **[Z]** is lit, when the axis has been returned to the zero point.

For the C-axis zero return operation, refer to page B-49 (12-5). (M type)

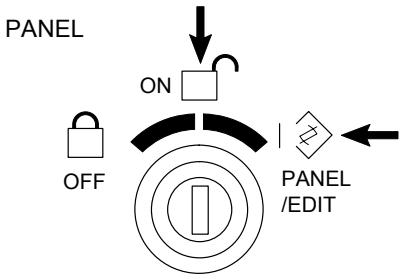
6-2 Rapid Traverse Operation

In the manual operation, each axis is fed with set rapid traverse rate.
Rapid traverse operation is used to position each axis approximately.

WARNING

Never stand near the moving parts of the machine during a rapid traverse operation since each axis is fed at the rapid traverse rate.
Before starting a rapid traverse operation, always make sure that no one is standing near the moving parts, that the moving parts can be fed without interference, and that you are moving the axis in the correct direction.
Failure to observe these warnings could result in accidents involving serious injuries or damage to the machine: operators or personnel near the machine could be crushed by the moving parts of the machine, and the turret could strike obstacles.

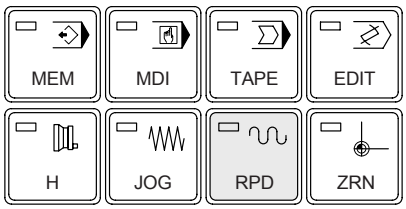
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.



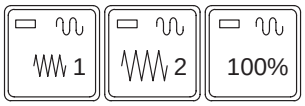
3) Place the PANEL key-switch in one of the positions indicated below.

(ON) (PANEL/EDIT)

4) Press the head selection switch (head 1) or (head 2) to select the required turret.

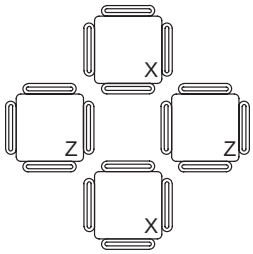


5) Select the rapid traverse mode ( ) with the mode selection switch.



6) Set the rapid traverse rate using the rapid traverse rate override switches.

NOTE For manual operation, even if the rapid override is set to 100%, the actual override value is fixed at 50%.



7) Press and hold down the axis feed switch for the axis to be fed.

   The axis is fed at the rapid traverse rate while the switch is held down.

   To stop axis feed, release the switch.

For the C-axis rapid traverse operation, refer to page B-51 (12-6). (M type)

6-3 Jog Feed Operation

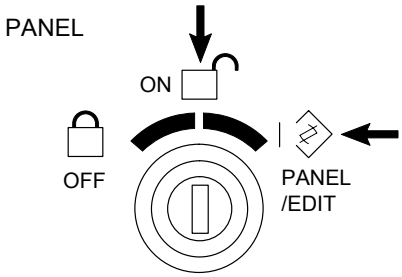
In the manual operation, each axis is fed at the set jog feedrate.

Jog feed operation is used when machining a relatively long soft jaw or removing the rough surface of a workpiece.

WARNING

Never stand near the moving parts of the machine during a jog feed operation since each axis is fed at the jog feedrate set with the feedrate override dial.
Before starting jog feed operation, always make sure that no one is standing near the moving parts, that the moving parts can be fed without interference, and that you are moving the axis in the correct direction.
Failure to observe these warnings could result in accidents involving serious injuries or damage to the machine: operators or personnel near the machine could be crushed by the moving parts of the machine, or the turret strike obstacles.

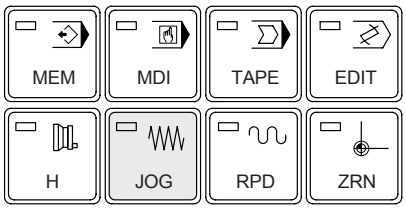
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.



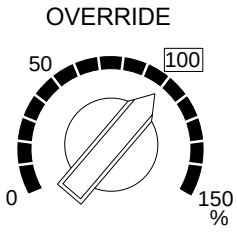
3) Place the PANEL key-switch in one of the positions indicated below.

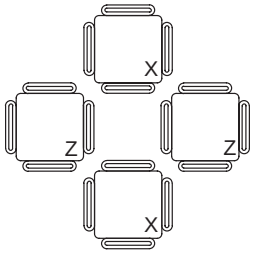
(ON) (PANEL/EDIT)

4) Press the head selection switch (head 1) or (head 2) to select the required turret.



5) Select the jog mode ( ) with the mode selection switch.





6) Set the feedrate to be used for jog feed operation using the OVERRIDE dial.

For the relationship between the OVERRIDE dial setting and actual feedrate, refer to page A-42 (5-11).

NOTE When the OVERRIDE dial is placed in the **0** position, the axis is not fed even when an axis feed switch is pressed.

7) Press and hold down the axis feed switch for the axis to be fed.

The axis is fed at a jog feedrate while the switch is held down.

To stop axis feed, release the switch.

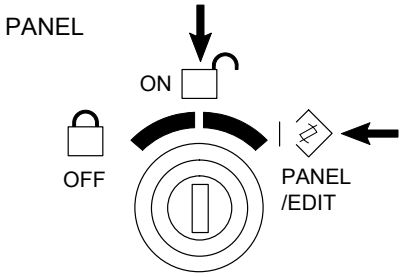
For the C-axis jog feed operation, refer to page B-53 (12-7). (M type)

6-4 Handle Feed Operation

In the manual operation, each axis is fed at the set feedrate using the manual pulse generator.

Handle feed operation is used when machining a soft jaw, removing the rough surface of a workpiece, or performing a fine positioning adjustment.

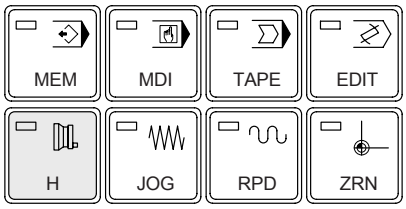
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.



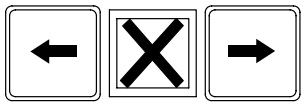
3) Place the PANEL key-switch in one of the positions indicated below.

(ON) (PANEL/EDIT)

4) Press the head selection switch (head 1) or (head 2) to select the required turret.



5) Select the handle mode ( ) with the mode selection switch.

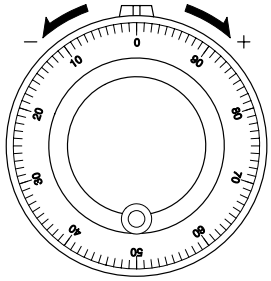


6) Select the axis to be fed with the axis selection switch.

7) Set the feed amount per pulse using the axis feed amount selection switch.

The numbers indicate the multiplication of the smallest increment (0.001 mm).
Feed amount per pulse:

[×1] 0.001 mm
[×10] 0.01 mm
[×100] 0.1 mm



8) Turn the manual pulse generator in the direction (+/−) in which the selected axis is to be fed.

For the C-axis handle feed operation, refer to page B-55 (12-8). (M type)

CAUTION

Do not turn the manual pulse generator any faster than 5 rotations per second.

If you do, the axis will not stop immediately when the manual pulse generator is stopped and the actual amount of axis feed will not coincide with the number of pulses generated. This could damage the machine.

6-5 Releasing the Soft-overtravel Alarm

Software limit positions are set with parameters. If an axis is fed beyond its limit, an alarm occurs, stopping axis feed.

Mori Seiki refers to this alarm as the "soft-overtravel" alarm.

If an axis is fed beyond the software limit position (set individually for each axis), an alarm number (500, 501) is displayed.

Alarm OT500 The X-axis has been moved beyond stored stroke limit 1 in the positive direction.

Alarm OT501 The X-axis has been moved beyond stored stroke limit 1 in the negative direction.

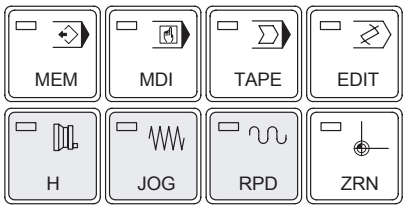
Alarm OT500 The Z-axis has been moved beyond stored stroke limit 1 in the positive direction.

Alarm OT501 The Z-axis has been moved beyond stored stroke limit 1 in the negative direction.

<To release the alarm state>

1) Read the alarm number and message displayed on the screen.
2) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
3) Close the front door.

4) Press the head selection switch (head 1) or (head 2) to select the required turret.



5) Select any of the following modes with the mode selection switch.

   (H) (JOG)

   (RPD)

6) Feed the axis that caused the soft-overtravel alarm in the opposite direction, away from its limit. For this operation, use handle feed, jog feed, or rapid traverse mode.

7) Press the (RESET) key.

   The alarm state is cleared.

7 SPINDLE OPERATION

This section describes the spindle related operations - spindle start and stop.

Before starting the spindle, carefully check the workpiece chucking conditions, the chucking pressure, and the spindle speed. If spindle rotation is started when the workpiece is grasped unstably or when the chucking pressure or spindle speed is inappropriate, the workpiece could fly out, causing serious injuries or damage to the machine.

7-1 Conditions for Starting Spindle Rotation

To rotate the spindle manually, the conditions that allow spindle rotation must be satisfied. If the spindle does not start although correct operation sequence is followed, check if the following conditions are all satisfied.

<Conditions>

1. The front door is closed.

    For details, refer to "DOOR INTERLOCK FUNCTION".

2. The PANEL key-switch is placed in one of the positions indicated below.

    (ON)  (PANEL/EDIT)

3. A manual mode (handle, jog, rapid traverse, zero return) is selected.
4. The status indicator **[MRDY]** is lit.
5. The chuck is clamped. (The status indicator **[CHCL]** is lit.)
6. The machine is not in the reset state.
7. The machine is not in the M00 or M01 state.
8. The spindle or rotary tool spindle (M type) is not rotating.
9. The spindle or rotary tool spindle (M type) is not jogging.
10. The spindle OFF mode function is invalid.
11. There is no spindle or rotary tool spindle (M type) related alarm.
12. External spindle interlock signal (the signal which disables spindle or rotary tool spindle (M type) rotation) is not input.
13. The tailstock spindle is not in the inching state (tailstock specification).
14. The tailstock body is clamped (tailstock specification).
15. The spindle brake is released (M type).
16. The turret head is set in the position to index the rotary tool mounting station (M type) (only in the spindle and rotary tool spindle simultaneous operation mode).
17. There is no turret zero return request (M type) (only in the spindle and rotary tool spindle simultaneous operation mode).
18. The selected rotary tool is mounted in the Z-axis direction (M type) (only in the spindle and rotary tool spindle simultaneous operation mode).

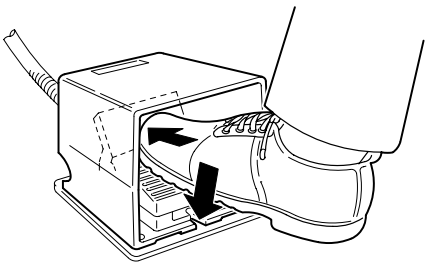
19. The C-axis is not connected (M type).
20. The loader arm is not being extended into the machine (loader specification).
21. The protection cover of the tool presetter arm is mounted to the base (only for in-machine tool presetter specification).
22. The bar feeder or bar puller is not in the emergency stop state (only for bar feeder, bar puller specification).
23. The work rest is in the IN state.
24. The steady rest is in the normal state.

7-2 Starting and Stopping Spindle Rotation

The procedures for starting and stopping spindle rotation in manual operation are described here.

<Starting spindle rotation>

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.



2) Check the chucking pressure with a pressure gage. If it is incorrect, adjust the pressure.

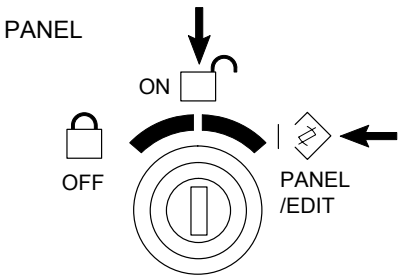
Page C-7 (2-1)

3) Clamp a workpiece in the chuck.

Page B-32 (7-3)

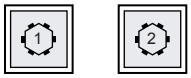
4) Make sure that the status indicator **[CHCL]** is lit.

NOTE If it is not lit, check the workpiece chucking status and the setting for the chucking direction.

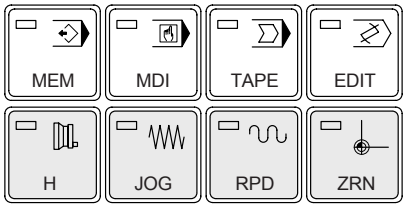


5) Place the PANEL key-switch in one of the positions indicated below.

(ON) (PANEL/EDIT)



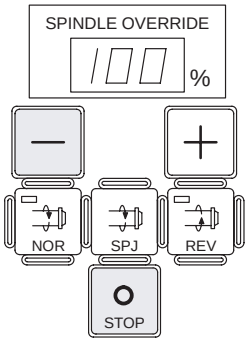
6) Press the HEAD CHANGE switch (head 1) or (head 2) to select the spindle to be rotated. (S type)



7) Select any of the following modes with the mode selection switch.

(H) (JOG)

(RPD) (ZRN)



8) Set the spindle speed to the minimum value (1% of the maximum spindle speed) by pressing the spindle speed setting switch [—] (decrease) and the [○] (STOP) switch at the same time.

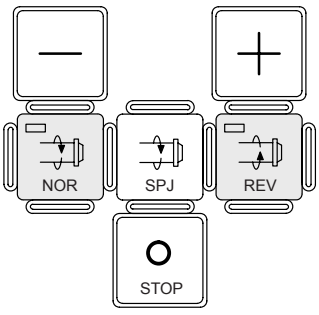
The maximum spindle speed varies depending on the machine model and specifications. Refer to the MAINTENANCE INFORMATION for the maximum spindle speed of your machine.

WARNING

Before starting the spindle in manual operation, set the lowest available spindle speed using the spindle speed setting switch [—] (decrease) and the [○] (STOP) switch. After starting the spindle, increase the spindle speed to the required speed gradually.
When stopping the spindle, first lower the spindle speed and then stop it.
If the spindle is started at the high speed setting, the workpiece and chuck jaws could fly out, causing serious injuries or damage to the machine.

9) Close the front door.

10) Start the spindle.

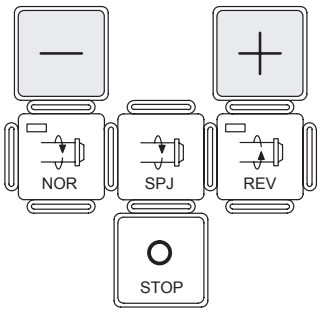


<Normal direction>

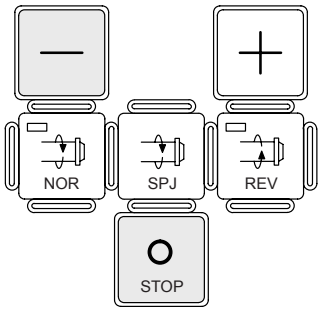
Press the [NOR] switch.

<Reverse direction>

Press the [REV] switch.



<Stopping spindle rotation>



11) Increase the spindle speed gradually to the required speed.

<Spindle speed setting switch [−] (decrease)>

The override value decreases in units of 1%.

<Spindle speed setting switch [+] (increase)>

The override value increases in units of 1%.

Page A-39 (5-9-1)

1) Decrease the spindle speed gradually to the lowest speed with the spindle speed setting switch [−] (decrease).

2) Press the [○] (STOP) switch.

NOTE To change the spindle rotating direction, stop the spindle by pressing the [○] (STOP) switch, then select a new rotating direction.

7-3 Chuck Clamp/Unclamp Operation

Chuck clamp/unclamp operation is controlled with a footswitch in any operation mode.

<Cautions on chuck clamp/unclamp operation>

CAUTION

1. When clamping or unclamping the chuck, ensure that your hands or fingers will not be caught by the chuck or chuck jaws.
2. Hold the workpiece securely before stepping on the footswitch pedal when removing the workpiece from the machine. If the footswitch pedal is stepped on mistakenly, the chuck will be unclamped and the workpiece will fall, causing machine damage.

NOTE While the spindle is rotating, chuck clamp/unclamp operation is disabled by the chuck interlock function.

<Procedure>

1) Make sure that spindle (rotary tool spindle) rotation is stopped.
2) Select the chucking direction (I.D. or O.D.).

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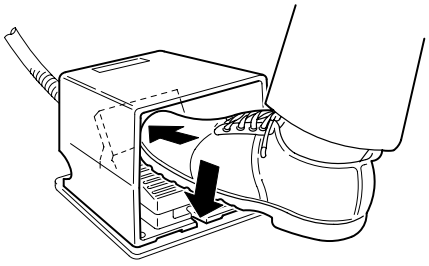
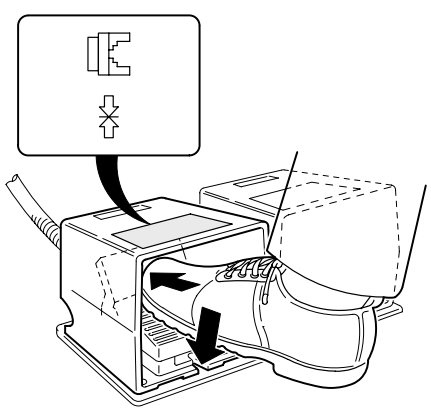
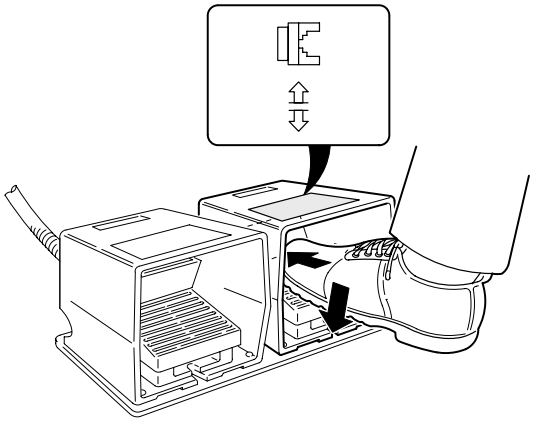
3) Clamp and unclamp the chuck with the chuck opening/closing footswitch.

<Footswitch>



Step on the footswitch pedal while pushing the lock release plate forward with your toes.

<Twin footswitch (option)>

Chuck clamp operation	Chuck unclamp operation
	
Step on the left footswitch pedal (chuck clamp) while pushing the lock release plate forward with your toes.	Step on the right footswitch pedal (chuck unclamp) while pushing the lock release plate forward with your toes.

4) The clamp method varies depending on whether or not a workpiece is mounted in the chuck.

<Clamping the chuck after mounting a workpiece in the chuck>

a) Unclamp the chuck by stepping on the footswitch pedal.

b) Mount a workpiece in the chuck.

c) Step on the footswitch pedal to clamp the chuck.

<Clamping the chuck without a workpiece in the chuck>

a) Display the OPERATION PANEL screen.

Function selection key (CUSTOM1) ⟶ **[OPE. PANEL]**

b) Set "INVALID" for the CHUCK STROKE END (chuck jaw stroke end detection function) by using the cursor control keys.

c) Step on the footswitch pedal to clamp the chuck.

5) Make sure that the status indicator **[CHCL]** is lit.

If it is lit, the chuck is in the clamped state. If it is not lit, the chuck is in the unclamped state.

NOTE

1. Spindle rotation can be started in manual and automatic operation only when the status indicator **[CHCL]** is lit.
2. If the setting for CHUCK STROKE END (chuck jaw stroke end detection function) is "VALID" when clamping the chuck without a workpiece in it, the status indicator **[CHCL]** is not lit even when the chuck is clamped.

7-4 Changing the Chucking Direction

A workpiece is clamped in the chuck using a hole in the workpiece (I.D. chucking) or on its circumference (O.D. chucking).

Before chucking the workpiece, set I.D. or O.D. for the chucking direction.

NOTE Do not change the chucking direction while the spindle is rotating.

1) Display the OPERATION PANEL screen.

   Function selection key (CUSTOM1) → **[OPE. PANEL]**

2) Move the cursor to "CHUCK DIRECTION" using the cursor control key ↑ or ↓.

   <For O.D. chucking>

   Press the cursor control key ← and select "O.D.".

   <For I.D. chucking>

   Press the cursor control key → and select "I.D.".

3) Manually perform the chuck clamp/unclamp operation.
   Make sure that the chuck is correctly clamped or unclamped by checking the status indicator **[CHCL]**.

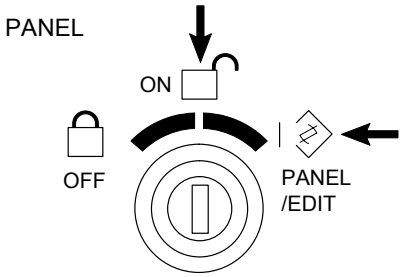
7-5 Spindle Jog Operation

In the manual mode, the spindle can be rotated at the jog feedrate.

Spindle jog operation is possible regardless of the open/closed state of the chuck and the front door.

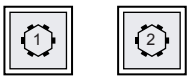
The spindle jog operation is used to check the run-out of the chuck jaws and workpieces clamped in the chuck.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.

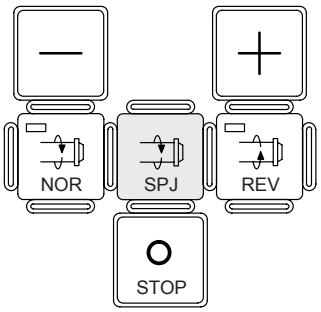


3) Place the PANEL key-switch in one of the positions indicated below.

(ON) (PANEL/EDIT)



4) Press the HEAD CHANGE switch (head 1) or (head 2) to select the spindle to be rotated. (S type)



5) Press the (SPJ) switch.
The spindle starts in the normal direction at the jog feedrate.

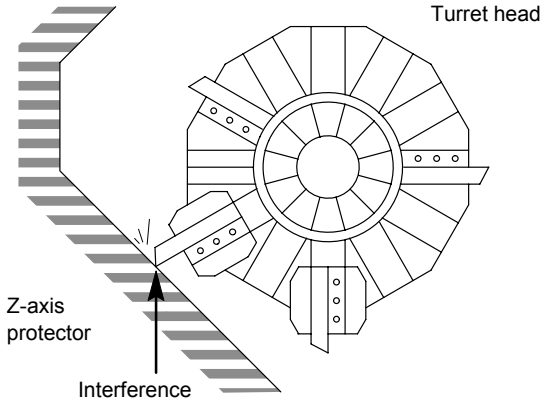
6) Release the (SPJ) switch to stop the spindle.

8 INDEXING THE TURRET HEAD

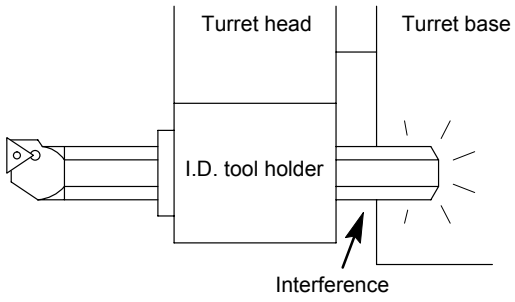
The turret can be rotated manually.

Manual turret indexing is used to mount a tool holder and/or cutting tool in the turret or to set tool offset data.

NOTE Close the front door before indexing the turret head.



CAUTION When the turret head is rotated with cutting tools mounted in it, tools with long projection lengths could strike the Z-axis protector, etc. Before rotating the turret head, make sure that the tools in the turret head do not interfere with the protector, since interference will damage the machine.



CAUTION When mounting an I.D. cutting tool in the turret head, make sure that the tool shank does not project beyond the rear surface of the tool holder. If it does it will interfere with the turret base, etc., during turret head rotation, damaging the machine.

8-1 Conditions for Indexing the Turret Head

To index the turret head manually, the conditions that allow turret head indexing must be satisfied. If the turret head cannot be indexed although the correct operation sequence is followed, check if the following conditions are all satisfied.

<Conditions>

1. The front door is closed.


For details, refer to "DOOR INTERLOCK FUNCTION".

2. The PANEL key-switch is placed in one of the positions indicated below.

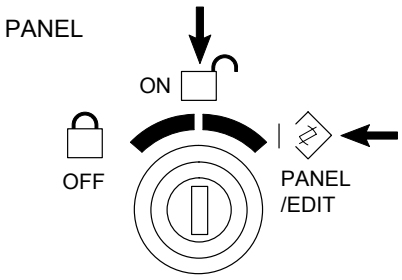
 (ON)  (PANEL/EDIT)

3. A manual mode (handle, jog, rapid traverse, zero return) is selected.
4. The status indicator **[MRDY]** is lit.
5. Turret head indexing has been completed normally.
   (The status indicator **[TRCL]** is lit.)
6. The machine is not in the reset state.
7. There is no turret related alarm.
8. The machine is not in the synchronized tapping operation (M type).
9. The zero point of the turret indexing servomotor is established.
10. The tailstock body is clamped (tailstock specification).
11. The zero point of the rotary tool spindle drive servomotor is established (M type).
12. The loader arm is not being extended into the machine (loader specification).
13. The turret is in the rotation permitted range.

8-2 Indexing the Turret After Setting the Target Station Number

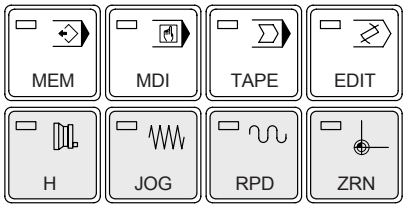
The turret head is indexed in manual operation when mounting and removing tools, and to measure tool compensation values.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.



3) Place the PANEL key-switch in one of the positions indicated below.

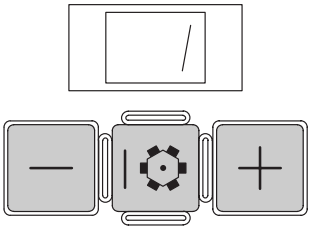
(ON) (PANEL/EDIT)



4) Select any of the following modes with the mode selection switch.

(H) (JOG)

(RPD) (ZRN)



5) Press the turret station setting switch [+] (increase) or [−] (decrease) to set the station number to which indexing is required as the target position.

The set station number will blink in the left turret display area.

6) Press the turret indexing switch [⚙].

The turret is indexed to the set station number.

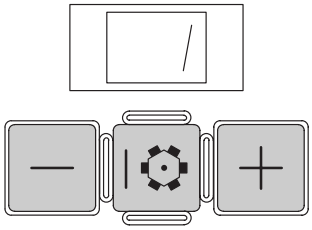
If the indexing is completed normally, the station number in the left turret display area changes from the blinking to the continually on state.

NOTE

1. Usually, the turret is indexed to the set target station in the normal rotation.
2. If the turret indexing switch [⚙] is not pressed within 15 seconds after the set station number starts blinking, the current station number is lit continuously.

<Indexing the turret head to the next or previous station>

The following procedure can be used to index the turret one station at a time.



1) Press the turret station setting switch [+] (increase) and the turret indexing switch [⟳] at the same time to rotate the turret in the forward direction and index it to the station with the number one larger than the present position.

2) Press the turret station setting switch [−] (decrease) and the turret indexing switch [⟳] at the same time to rotate the turret in the reverse direction and index it to the station with the number one smaller than the present position.

9 TURNING ON MACHINE LIGHT

The procedure for turning on the machine light is described here.

Turn on the machine light when necessary.

CAUTION

Keep the machine light on during setup to ensure safety. If this light is off it will not be possible to check conditions inside the machine or test cutting properly, and this may lead to machine damage or machining defects. In addition, operators could be injured while working inside the machine.

NOTE

The lamp is consumable and is not covered by the warranty.

For the procedure for changing the lamp, refer to the MAINTENANCE INFORMATION.

The machine light can be operated regardless of the position of the PANEL key-switch and the selected mode.

1) Press the (LIGHT) switch on the operation panel.

   The machine light is lit; the indicator in the switch also is lit.

2) Press this switch again while the machine light is lit.

   The machine light goes off; the indicator in the switch also goes off.

10 COOLANT SUPPLY

Operations relating to the coolant are described here.

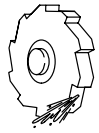
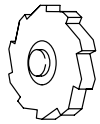
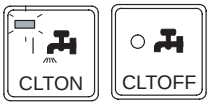
Supply coolant or make the coolant OFF mode valid, as required.

WARNING

Stop the machine and coolant supply before adjusting the direction or volume of coolant supply. If you attempt these operations while the machine is operating you could be seriously injured by being entangled in the rotating parts of the machine or crushed by its moving parts.

NOTE Close the front door before supplying coolant so that the coolant will not splash out.

Coolant can be supplied regardless of the position of the PANEL key-switch and the selected mode.

<table>
<tr><td rowspan="3">Manual mode</td><td colspan="3">Coolant ON</td></tr>
<tr><td> 
</td><td>Press the (CLTON) switch.</td><td>  The indicator in the (CLTON) switch is lit and the coolant supply starts.</td></tr>
<tr><td colspan="3">Coolant OFF</td></tr>
<tr><td></td><td> 
</td><td>Press the (CLTOFF) switch while coolant is being supplied.</td><td>  The indicator in the (CLTON) switch goes off and the coolant supply stopped.</td></tr>
<tr><td rowspan="3">Automatic mode</td><td colspan="3">Coolant ON/OFF</td></tr>
<tr><td> 
</td><td>Coolant supply starts when M08 (coolant ON) command is read.</td><td>  The indicator in the (CLTON) switch is lit.</td></tr>
<tr><td> 
</td><td>Press the (CLTOFF) switch to stop the coolant supply during automatic operation.</td><td>  The indicator in the (CLTON) switch goes off.</td></tr>
<tr><td></td><td colspan="3">Coolant OFF mode</td></tr>
<tr><td></td><td> 
</td><td>Press and hold the (CLTOFF) switch for one second or more to make the indicator in the (CLTON) switch blink and coolant OFF mode valid.</td><td>  The coolant is not supplied even when M08 command is read.
 
  The indicator in the (CLTON) switch remains blinking.</td></tr>
<tr><td></td><td> 
</td><td>Press the (CLTON) switch. The indicator in the switch is lit and the coolant supply starts.</td><td></td></tr>
</table>

11 CHIP CONVEYOR (CHIP CONVEYOR SPECIFICATION)

The operations relating to the chip conveyor are described here.
Operate the chip conveyor when necessary.

WARNING

Never attempt to reach inside the chip conveyor or put your feet in it while it is operating. You could be caught in the chip conveyor and seriously injured.

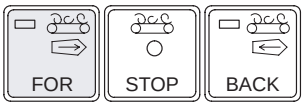
CAUTION

Keep the chip conveyor operating during automatic operation.
If chips accumulate on the chip conveyor, it might be damaged.

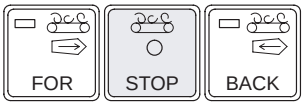
NOTE

1. Close the front door before operating the chip conveyor.
2. When operating the chip conveyor, always pay careful attention to the following three points.
   - Check if there is any foreign matter on the chip conveyor belt.
   - Check if too many chips have accumulated on the chip conveyor belt.
   - Check if there is any abnormal noise during the operation.

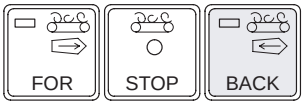
The chip conveyor can be operated regardless of the position of the PANEL key-switch and the selected mode.



1) Press the ⇨ (FOR) switch and the chip conveyor operates in the forward direction.
The indicator in the switch is lit.



2) Press the ○ (STOP) switch while the chip conveyor is operating and it stops operating.



3) Press the ⇦ (BACK) switch and the chip conveyor operates in the backward direction.

NOTE

The chip conveyor operates in the backward direction only while the switch is held down.
The indicator in the switch is lit during this time.

For purposes such as removing chips that have become stuck in the chip conveyor, operate the chip conveyor in the backward direction.

12 ROTARY TOOLS (M TYPE)

The procedure used for registering a rotary tool for a machine of the M type, and for C-axis operation, is explained below.

12-1 Registering Rotary Tools

When the rotary tool is mounted on the turret head, register the machining direction of the tool - the X-axis direction or the Z-axis direction - on the ROTARY TOOL screen.

CAUTION

Machining with a tool rotating in the wrong direction due to incorrect registration can damage the tool and the machine and can cause machining defects. Be sure to check the direction of rotation of each rotary tool.

<Procedure>

NOTE

Set the machining direction of the rotary tool when the rotary tool spindle is stopped.

1) Display the ROTARY TOOL screen.


Function selection key (CUSTOM1) ⟶ **[ROTARY TOOL]**

Or


Function selection key (CUSTOM1) ⟶ Data entry key "4"

⟶ INPUT key

2) Using the cursor keys, move the cursor to the station number where a rotary tool is mounted.

NOTE

A rotary tool can be mounted at station number 1, 3, or 5.

3) Input "1" and press the INPUT key for a tool for machining in the X-axis direction.
Input "0" and press the INPUT key for a tool for machining in the Z-axis direction.

NOTE

1. Rotary tools can be mounted in the X-axis direction only.
2. If a value other than "0" or "1" is input, an alarm occurs.

4) To return to the PCMDI menu screen, press the **[EXIT]** soft-key.

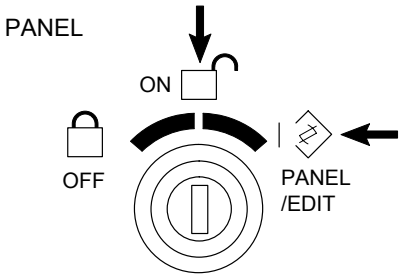
12-2 Spindle Selection

The rotary tool specification machine requires the selection of the spindle mode (main spindle or rotary tool spindle).

NOTE In the following conditions, the spindle mode cannot be changed.

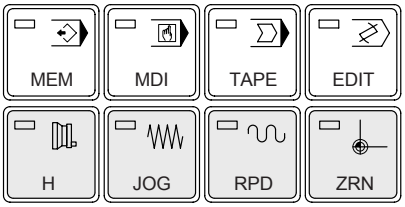
1. The spindle or rotary tool spindle is rotating.
2. The machine is in the spindle and rotary tool spindle simultaneous operation mode.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.



3) Place the PANEL key-switch in one of the positions indicated below.

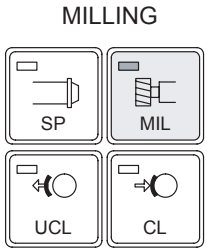
(ON) (PANEL/EDIT)



4) Select any of the following modes with the MODE selection switch.

(H) (JOG)

(RPD) (ZRN)

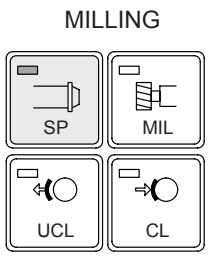


5) Select the main spindle or rotary tool spindle.

<Rotary tool spindle>

Press the (MIL) switch.

The rotary tool spindle is selected.
The indicator in the switch is lit.



<Main spindle>

Press the (SP) switch.

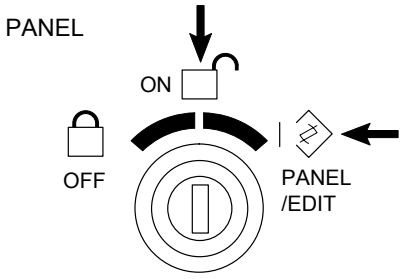
The main spindle is selected.
The indicator in the switch is lit.

12-3 Starting and Stopping Rotary Tool Spindle

The procedures for starting and stopping rotary tool spindle rotation in manual operation are described here.

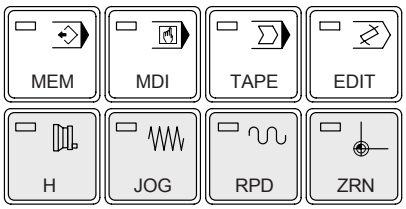
<Starting the rotary tool spindle>

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.



3) Place the PANEL key-switch in one of the positions indicated below.

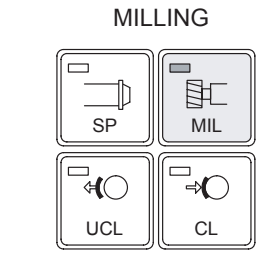
(ON) (PANEL/EDIT)



4) Select any of the following modes with the MODE selection switch.

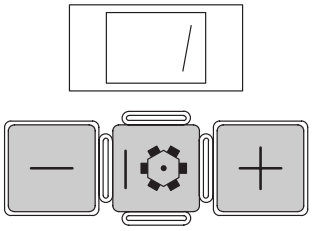
(H) (JOG)

(RPD) (ZRN)



5) Press the MILLING switch (MIL).

The rotary tool spindle is selected.
The indicator in the switch is lit.



6) Index the turret station number where a rotary tool is mounted using the turret indexing operation.

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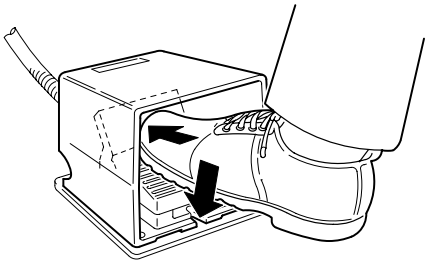

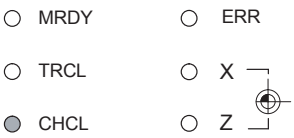

7) Step on the footswitch to set the chuck in the clamped state.

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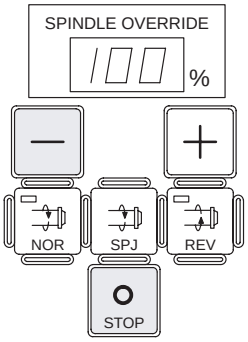
The STATUS indicator **[CHCL]** is lit.

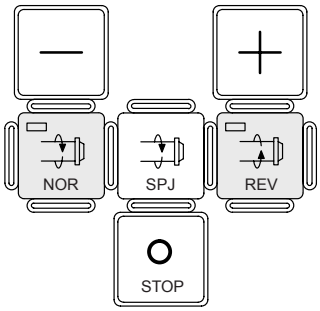


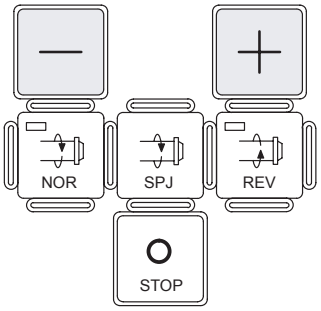
8) Set the spindle speed to the minimum value (1% of the maximum spindle speed) by pressing the spindle speed setting switch [−] (decrease) and the [○] (STOP) switch at the same time.

The maximum rotary tool spindle speed varies depending on the machine model and specifications. Refer to the MAINTENANCE INFORMATION for the maximum rotary tool spindle speed of your machine.

WARNING

Before starting the rotary tool spindle in manual operation, set the lowest available spindle speed using the spindle speed setting switch [−] (decrease) and the [○] (STOP) switch. After starting the spindle, increase the spindle speed to the required speed gradually.
When stopping the rotary tool spindle, first lower the spindle speed and then stop it.
If the rotary tool spindle is started at the high speed setting, the rotary tool could fly out, causing serious injuries or damage to the machine.





9) Start the rotary tool spindle.

<Normal direction>

Press the (NOR) switch.

<Reverse direction>

Press the (REV) switch.

10) Increase the spindle speed gradually to the required speed.

<Spindle speed setting switch (decrease)>

The override value decreases in units of 1%.

<Spindle speed setting switch (increase)>

The override value increases in units of 1%.

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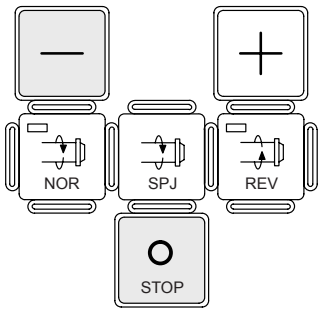
<Stopping the rotary tool spindle>



1) Decrease the spindle speed gradually to the lowest speed with the spindle speed setting switch (decrease).

2) Press (STOP) switch.

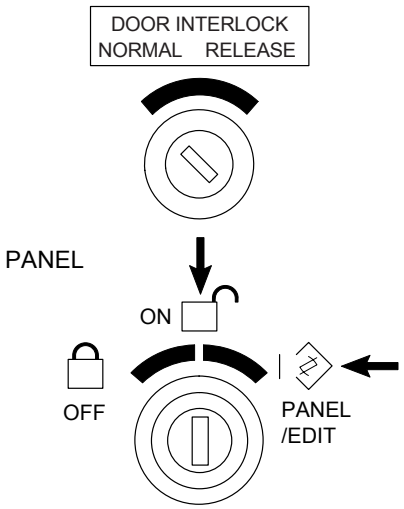
NOTE To change the rotary tool spindle rotating direction, stop the rotary tool spindle by pressing the (STOP) switch, then select a new rotating direction.

12-4 Spindle Clamp/Unclamp Operation

The spindle can be clamped and unclamped manually.

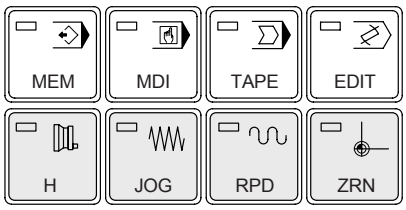
NOTE In the following conditions, the spindle clamp/unclamp operation cannot be performed.

1. The spindle is rotating or the C-axis is being indexed.
2. The machine is in the spindle and rotary tool spindle simultaneous operation mode.



1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.
3) Place the PANEL key-switch in one of the positions indicated below.

(ON) (PANEL/EDIT)



4) Select any of the following modes with the MODE selection switch.

(H) (JOG)

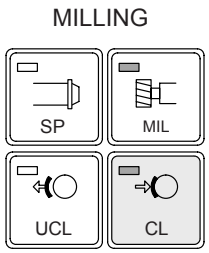
(RPD) (ZRN)

5) Clamp or unclamp the spindle.

<Clamp>

Press the (CL) switch.

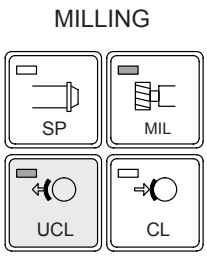
The spindle is clamped.
The indicator in the switch is lit.



<Unclamp>

Press the (UCL) switch.

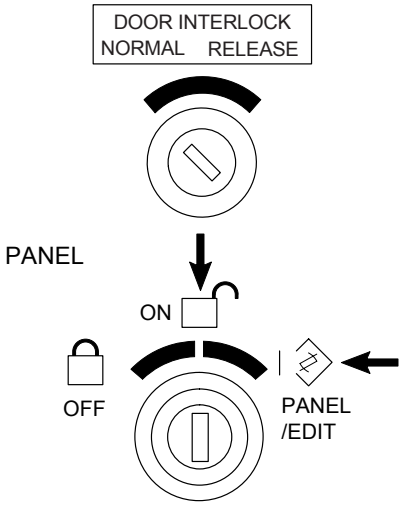
The spindle is unclamped.
The indicator in the switch is lit.



12-5 C-axis Zero Return Operation

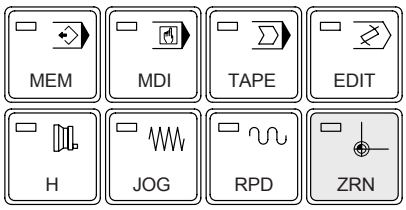
While the rotary tool spindle is selected, the C-axis can be returned to the zero point.

When the rotary tool spindle is selected, the indicator in the MILLING switch (MIL) is lit.



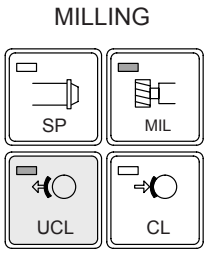
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.
3) Place the PANEL key-switch in one of the positions indicated below.

   (ON) (PANEL/EDIT)



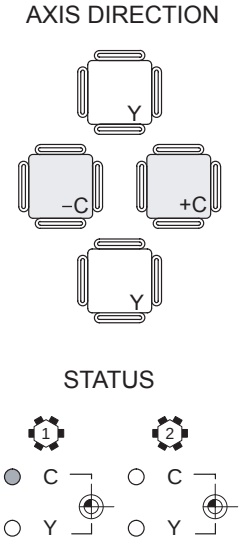
4) Select the zero return mode ( ) with the MODE selection switch.
5) Press the MILLING switch (MIL).

   The rotary tool spindle is selected.
   The indicator in the switch is lit.



6) Press the (UCL) switch.

   The spindle is unclamped.



7) Press and hold one of the following AXIS DIRECTION switches.

[+C] (+C) [−C] (−C)

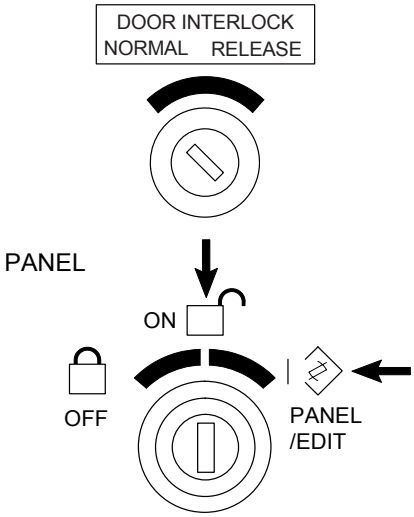
NOTE The feedrate for the first C-axis zero point operation after connecting the spindle as the C-axis is fixed independently of the setting made with the rapid traverse rate override switches.

The STATUS indicator **[C]** is lit when the C-axis has been returned to the zero point.

12-6 C-axis Rapid Traverse Operation

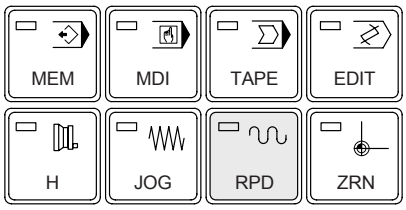
While the rotary tool spindle is selected, the C-axis can be fed at the set rapid traverse rate.

When the rotary tool spindle is selected, the indicator in the MILLING switch (MIL) is lit.

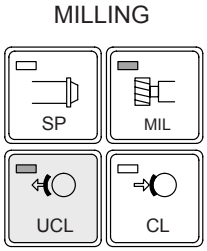


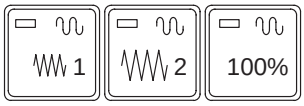
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.
3) Place the PANEL key-switch in one of the positions indicated below.

(ON) (PANEL/EDIT)



4) Select the rapid traverse mode ( ) with the MODE selection switch.
5) Press the MILLING switch (MIL).
   The rotary tool spindle is selected.
   The indicator in the switch is lit.
6) Press the (UCL) switch.
   The spindle is unclamped.



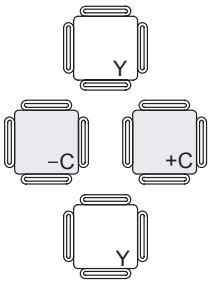


7) Set the feedrate to be used for rapid traverse operation using the RAPID OVERRIDE switches.

NOTE For manual operation, even if the rapid override is set to 100%, the actual override value is fixed at 50%.

The feedrate to be used for rapid traverse operation with RAPID OVERRIDE switch setting varies depending on the machine model and specifications.

AXIS DIRECTION



8) Move the C-axis.

<Counterclockwise rotation, viewing the workpiece from the spindle side>

Press the +C (+C) switch.

<Clockwise rotation, viewing the workpiece from the spindle side>

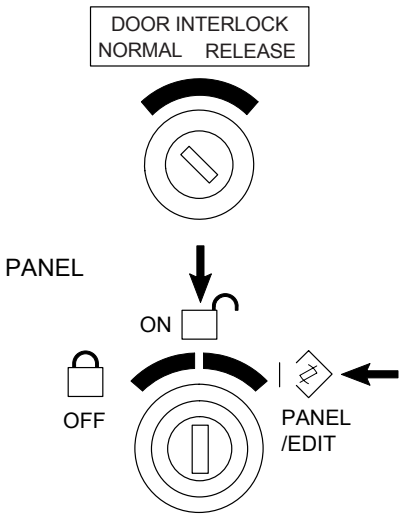
Press the −C (−C) switch.

The C-axis moves at the set rapid traverse rate.

12-7 C-axis Jog Feed Operation

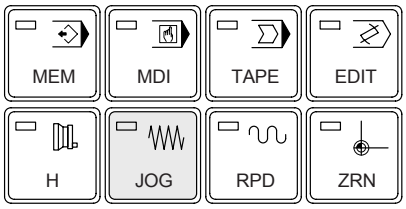
While the rotary tool spindle is selected, the C-axis can be fed at the set jog feedrate.

When the rotary tool spindle is selected, the indicator in the MILLING switch (MIL) is lit.



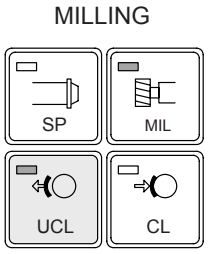
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.
3) Place the PANEL key-switch in one of the positions indicated below.

(ON) (PANEL/EDIT)



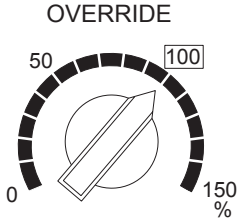
4) Select the jog mode ( ) with the MODE selection switch.
5) Press the MILLING switch (MIL).

The rotary tool spindle is selected.
The indicator in the switch is lit.



6) Press the (UCL) switch.

The spindle is unclamped.

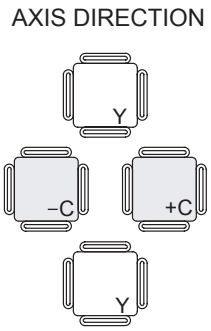


7) Set the feedrate to be used for jog feed operation using the OVERRIDE dial.

Setting is possible in 16 steps in the range of 0 to 3.5 min^{-1} (0 to 1260°/min).

The relationship between the OVERRIDE dial setting and actual feedrate is indicated below.

Setting	0	10	20	30	40	50	60	70
Feedrate (min^{-1})	0	0.006	0.009	0.014	0.022	0.035	0.056	0.089
Setting	80	90	100	110	120	130	140	150
Feedrate (min^{-1})	0.139	0.219	0.35	0.556	0.889	1.389	2.194	3.5



8) Move the C-axis.

<Counterclockwise rotation, viewing the workpiece from the spindle side>

Press the +C (+C) switch.

<Clockwise rotation, viewing the workpiece from the spindle side>

Press the −C (−C) switch.

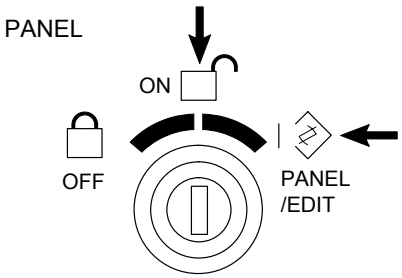
The C-axis moves at the set jog feedrate.

12-8 C-axis Handle Feed Operation

While the rotary tool spindle is selected, the C-axis can be fed at the set feedrate using the manual pulse generator.

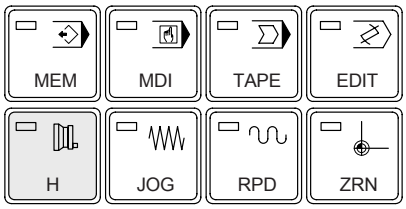
When the rotary tool spindle is selected, the indicator in the MILLING switch (MIL) is lit.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.



3) Place the PANEL key-switch in one of the positions indicated below.

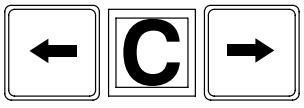
(ON) (PANEL/EDIT)



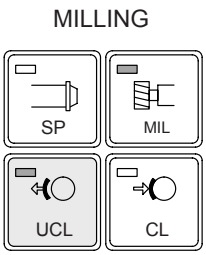
4) Select the handle mode ( ) with the MODE selection switch.

5) Press the MILLING switch (MIL).

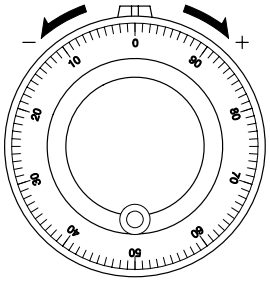
The rotary tool spindle is selected.
The indicator in the switch is lit.



6) Select the C-axis with the axis selection switch.



7) Press the (UCL) switch.
The spindle is unclamped.



8) Set the feed amount per pulse using the axis feed amount selection switches.

   The numbers indicate the multiplication of the smallest increment (0.001°).

   [×1] 0.001°

   [×10] 0.01°

   [×100] 0.1°

9) Turn the manual pulse generator in the direction (+/–) in which the selected axis is to be fed.

   <Counterclockwise rotation, viewing the workpiece from the spindle side>

   Turn the manual pulse generator clockwise.

   <Clockwise rotation, viewing the workpiece from the spindle side>

   Turn the manual pulse generator counterclockwise.

   The C-axis moves at the selected speed.

13 TAILSTOCK OPERATION (TAILSTOCK SPECIFICATION)

When machining a long workpiece, the workpiece cannot be securely supported by the chuck alone.

Secure support of such a workpiece requires the use of the tailstock spindle.

Adjust the position of the tailstock body so that the workpiece is securely held by the tailstock spindle center when the tailstock spindle is extended. After making this adjustment, clamp the tailstock body to the bed. It will be possible to start memory (tape) operation when the tailstock spindle is extended, even if the workpiece is not supported by the tailstock spindle center. If machining is carried out while the workpiece is not supported by the tailstock spindle center, the workpiece will fly out, causing serious injuries or damage to the machine.

1. If the workpiece is supported using the tailstock spindle, carelessly moving the tailstock spindle in or retracting the tailstock body will leave the workpiece held by the chuck alone. The workpiece may fall, damaging the machine, if it is held only by the chuck. Therefore, before moving the tailstock spindle in or retracting the tailstock body, ensure that the workpiece is held securely by a crane or other appropriate means.
2. In center-work operation or machining using spindle 2, the tools or holders adjacent to the tool used may interfere with the tailstock or spindle 2 in cases such as machining a workpiece with a small machining diameter. When mounting tools or holders, confirm that there will be no interference between the tailstock or spindle 2 and the adjacent tools or holder. (Tailstock specifications and Headstock 2 specifications)

13-1 Tailstock Spindle IN/OUT Operation

The tailstock spindle can be moved out or in regardless of the selected operation mode.

The tailstock spindle can be moved in whether the front door is opened or closed.

NOTE However, it is not permissible to move the tailstock spindle while the spindle or rotary tool spindle is rotating or the turret head is being indexed.

<Tailstock spindle OUT>

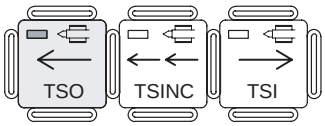
CAUTION When holding a workpiece using the tailstock, do not move the tailstock spindle out in the tailstock spindle "out" operation without first making sure that your hand will not be caught by the tailstock spindle. If the tailstock spindle is moved out without taking adequate care, there is a danger that your hand will be caught between the tailstock spindle and the workpiece.

1) Stop the spindle or rotary tool spindle.
2) Clamp the workpiece with the chuck by performing a chuck clamp operation.

Page B-32 (7-3)

3) Carry out inching operation of the tailstock spindle to hold the workpiece with the tailstock spindle center.

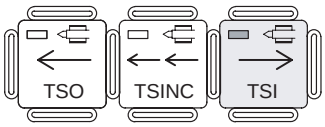
Page B-59 (13-2)



4) Press the ← (TSO) switch.
When the tailstock spindle out operation is completed, the indicator in the switch is lit.

<Tailstock spindle IN>

1) Stop the spindle or rotary tool spindle.



2) Press the → (TSI) switch.
The tailstock spindle moves in and the indicator in the switch is lit.

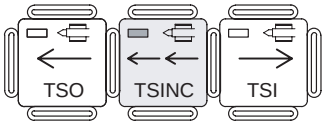
13-2 Tailstock Spindle Inching Operation

The tailstock spindle inching operation is possible regardless of the selected operation mode.

The tailstock spindle can be moved by inching operation whether the front door is opened or closed.

NOTE However, it is not permissible to move the tailstock spindle while the spindle or rotary tool spindle is rotating or the turret is being indexed.

<Tailstock spindle inching>



1) Stop the spindle or rotary tool spindle.

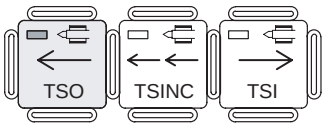
2) Press the [←←] (TSINC) switch.

The tailstock spindle moves out while the switch is held down. The spindle stops moving out when the switch is released. The indicator in the switch is lit.

NOTE

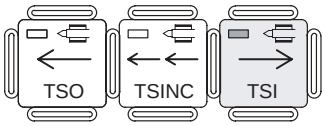
1. The spindle or rotary tool spindle will not rotate while the tailstock spindle is moving out in the inching operation.
2. After positioning of the tailstock spindle in the inching operation, the cycle start of memory (tape) operation is impossible due to the tailstock spindle interlock function.

<Center-work operation in manual mode>



After supporting the workpiece in the inching operation, press the [←] (TSO) switch to hold the workpiece with the tailstock spindle center. The workpiece is then held by the center correctly and manual cutting operation may be started.

<After tailstock spindle inching operation>



To retract the tailstock spindle into the tailstock body, press the [→] (TSI) switch.

13-3 Tailstock Spindle Interlock

By setting the tailstock spindle interlock function (TAILSTOCK ILK.) ON, cycle start is disabled if the tailstock spindle is retracted into the tailstock body. Starting the memory (tape) operation (for center-work) while a workpiece is not supported by the center (tailstock spindle) will cause hazards such as the workpiece flying out. This interlock function ensures safe operation by preventing such hazards.

Always switch the tailstock spindle interlock function ON before carrying out center-work operations. If this function is OFF, it will be possible to start the memory (tape) operation when the tailstock spindle is extended, even though it may not support the workpiece correctly. If memory (tape) operation is started in this condition, the workpiece will fly out, causing serious injuries or damage to the machine.

The tailstock spindle interlock function becomes effective when the ← (TSO) or ←← (TSINC) switch is pressed.

1) Display the OPERATION PANEL screen.

Function selection key (CUSTOM1) ⟶ **[OPE. PANEL]**

2) Move the cursor to "TAILSTOCK ILK." using the cursor control key ↑ or ↓.

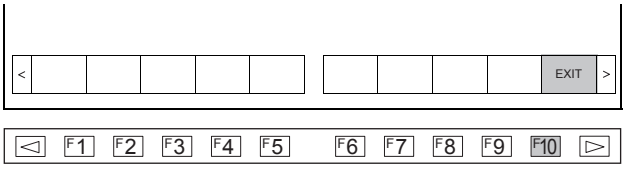
3) Set the tailstock interlock function ON/OFF using the cursor control key ← or →.

<For interlock ON>

Press the cursor control key →.

<For interlock OFF>

Press the cursor control key ←.



4) Press the **[EXIT]** soft-key.

13-4 Moving the Tailstock Body

WARNING

Before moving the tailstock body, turn off the power supply.

If an attempt is made to move the tailstock body while the power is on, the machine may start operating unexpectedly, causing the operator to be entangled with its rotating parts or caught by its moving parts and seriously injured.

<Unclamping the tailstock body>

Pull the tailstock body clamp lever down.

<Moving the tailstock body>

Advance: Turn the tailstock body moving handle counterclockwise.

Retract: Turn the tailstock body moving handle clockwise.

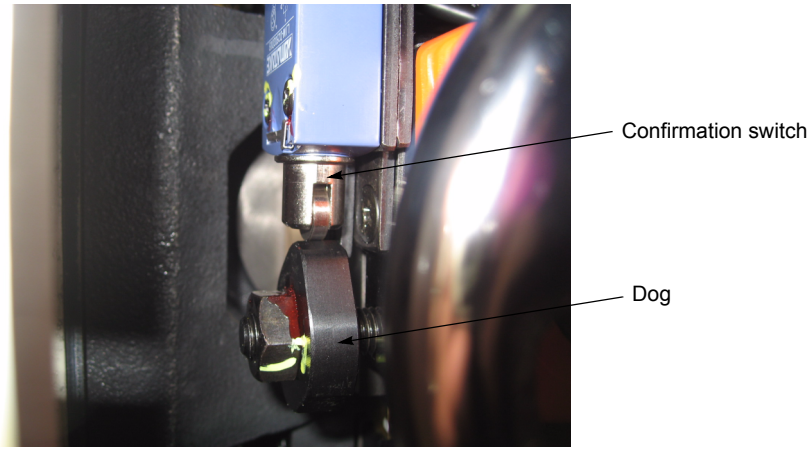
<Clamping the tailstock body>

Pull the tailstock body clamp lever up.

When the tailstock body is clamped, the dog touches the confirmation switch provided above the dog and the switch is turned ON.

NOTE

1. After clamping the tailstock body, check visually that the dog touches the confirmation switch.
2. If the tailstock body is not clamped correctly, automatic operation cannot be executed and an alarm occurs, when the (START) switch is pressed.



13-5 Fitting the Tailstock Spindle Center

The procedure for fitting the tailstock spindle center is described here.

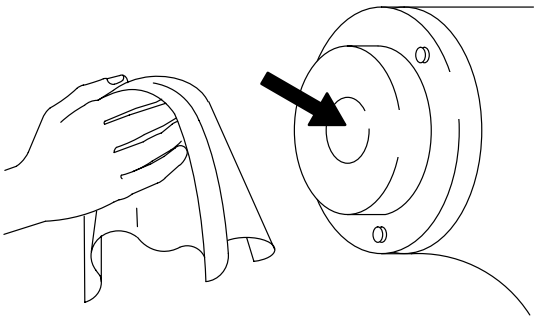
WARNING

Before fitting the tailstock spindle center, turn off the power supply.

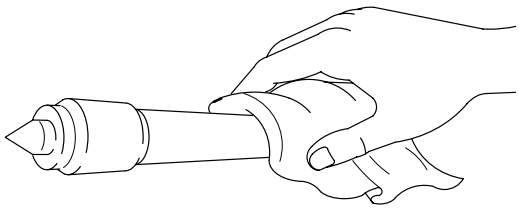
If you attempt to fit the tailstock spindle center while the power is on, the machine may start operating unexpectedly, and you may be entangled in its rotating parts or caught by its moving parts and seriously injured.

CAUTION

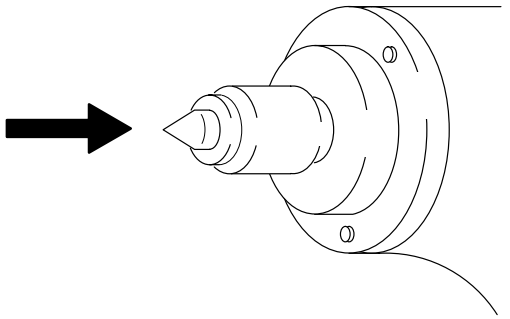
In the case of machines equipped with the tailstock of live center specification, a live center must always be used for the tailstock. If another type of center is used and the spindle is rotated with a workpiece held between the centers, the center will seize, damaging the machine.



1) Clean the tapered hole in the tailstock spindle.



2) Clean the tapered face of the center.



3) Fit the center into the center hole.

13-6 Removing the Tailstock Spindle Center

The procedure for removing the tailstock spindle center is described here.

WARNING

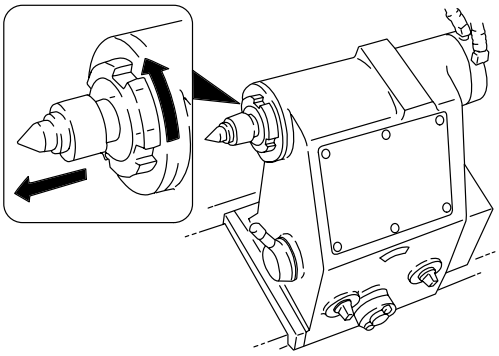
Before removing the tailstock spindle center, turn off the power supply.

If you attempt to remove the tailstock spindle center while the power is on, the machine may start operating unexpectedly, and you may be entangled in its rotating parts or caught by its moving parts and seriously injured.

CAUTION

Do not carry out machining without the tailstock spindle center.

If coolant enters the tailstock spindle center bearing, it may cause damage to the machine.



1) Turn the tailstock spindle center release nut in the direction it is loosened.
2) Remove the tailstock spindle center.

14 MANUAL OPERATION OF THE SERVO-CONTROLLED TAILSTOCK (SERVO-CONTROLLED TAILSTOCK SPECIFICATION)

14-1 Moving the Servo-controlled Tailstock in Manual Operation

The servo-controlled tailstock can be moved in the manual mode.

For the conditions that enable the tailstock to travel, refer to page B-65 (14-1-1).

For the automatic operation, refer to the PROGRAMMING MANUAL published separately.

<In the rapid traverse mode/jog mode>

The servo-controlled tailstock can be moved by using the TAILSTOCK + or – switch provided on the option panel. The tailstock is moved while the switch is held down.

In these modes, the settings of federate override and rapid traverse rate override are valid.

For the manual operation, even if the rapid override is set to 100%, the actual override value is fixed at 50%.

Page A-42 (5-11)
Page A-43 (5-12)

<In the zero return mode>

The servo-controlled tailstock can be returned to the zero point by using the TAILSTOCK + or – switch in the zero return mode.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.
3) Place the PANEL key-switch in either of the positions indicated below.

    (ON)  (PANEL/EDIT)

4) Select the zero return mode () with the MODE selection switch.
5) Set the rapid traverse rate to be used for zero return operation using the RAPID OVERRIDE switches.

For the manual operation, even if this switch is set to 100%, the actual rapid traverse override value is fixed at 50%.

6) Press and hold down the TAILSTOCK + or – switch according to the direction for zero return operation. The tailstock approaches the zero point at a rapid traverse rate, automatically decelerates, and is stopped at the zero point.

If the switch for the direction opposite to the one for zero return operation is pressed, the tailstock does not move.

When the tailstock has returned to the zero point, the indicator in the TAILSTOCK + switch is lit.

<In the handle mode>

The servo-controlled tailstock can be moved in the handle mode.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.
3) Place the PANEL key-switch in either of the positions indicated below.

   (ON) (PANEL/EDIT)

4) Select the handle mode ( ) with the MODE selection switch.
5) Select "B" with the axis selection switch.
6) Set the feed amount per pulse using the axis feed amount selection switch.

   The numeric figure indicates a multiplication of the smallest increment (0.001 mm).
   Feed amount per pulse:

   [× 1] 0.001 mm

   [× 10] 0.01 mm

   [× 100] 0.1 mm

7) Turn the handle of the manual pulse generator in the direction (+/–) in which the selected axis is to be moved.

CAUTION

Do not turn the manual pulse generator any faster than 5 rotations per second.

If you turn the manual pulse generator faster than the above, the axis may not stop immediately when you stop rotating the handle, or the amount of axis feed may not coincide with the number of pulses generated, causing damage to the machine.

14-1-1 Conditions for Moving the Servo-controlled Tailstock in Manual Operation

1. The loader is not entering the machine (loader specification).
2. The lubrication OFF mode is not selected.
3. The status indicator **[MRDY]** is lit.
4. The front door is closed, or the door interlock is released.
5. The presetter arm is at the most raised position (automatic tool presetter specification).
6. The tailstock is unclamped.
7. The tailstock spindle has been retracted.
8. The turret is not indexing.

NOTE

1. For the machine equipped with a work rest, the tailstock stroke in the negative direction is defined with parameters.
2. For the machine equipped with a work rest (without workpiece unloading function), the tailstock spindle cannot be moved in the negative direction beyond the parameter setting value when the work rest is extended.
3. For the machine equipped with a work rest (with workpiece unloading function), the tailstock spindle cannot be moved in the negative direction beyond the parameter setting value when the work rest is extended by rotation or when the work rest is located on the bed side in the Y-axis direction.

NOTE

4. For the machine equipped with a work rest (without workpiece unloading function), the M631 (spindle-side work rest extend) command cannot be specified when the tailstock is located in the negative region with respect to the parameter setting value. If it is specified, the alarm EX2006 is displayed.
5. For the machine equipped with a work rest (with workpiece unloading function), the M631 (work rest extend by rotation) or M647 (work rest Y-axis bed side) command cannot be specified when the tailstock is located in the negative region with respect to the parameter setting value. If it is specified, the alarm EX2006 is displayed.

14-1-2 Releasing Tailstock Hard Overtravel

For the machine equipped with a work rest, the tailstock stroke in the negative direction is defined with parameters. If the axis is moved beyond the stroke limit, the alarm OT 0507 occurs and the axis is stopped.

<Releasing procedure>

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.
3) Place the PANEL key-switch in either of the positions indicated below.

   (ON) (PANEL/EDIT)
4) Select the manual mode.
5) Move the axis in the direction opposite to the overtravel direction using handle feed, jog feed, or rapid traverse operation.
6) Press the RESET (RESET) key.

14-2 Clamping/Unclamping the Servo-controlled Tailstock

The servo-controlled tailstock can be clamped in manual operation by pressing the TSCLP switch on the option panel. Pressing the TSUCLP switch on the option panel unclamps the servo-controlled tailstock in manual operation.

14-2-1 Conditions for Clamping/Unclamping the Servo-controlled Tailstock in Manual Operation

Operation	Conditions
Clamp	1. The tailstock spindle has been retracted.
	2. The door is closed, or the door interlock is released.
	3. The manual mode is selected.
Unclamp	1. The tailstock spindle has been retracted.
	2. The door is closed, or the door interlock is released.
	3. The spindle or rotary tool spindle (M type) is not rotating.
	4. The turret is not indexing.
	5. The presetter arm is at the most raised position (automatic tool presetter specification).
	6. The manual mode is selected.

When the tailstock is clamped, if its clamping position is moved more than the allowable value (D676) by an external force, the alarm EX0382 is displayed.

The parameters are set on shipment in accordance with the machine specifications; do not change them without first consulting Mori Seiki. If you change the parameters without consultation, the machine may operate in an unexpected manner, causing accidents involving serious injuries or damage to the machine.

14-3 Fitting the Center to the Servo-controlled Tailstock

1) Close the front door.
2) Select the manual mode.
3) Press the TSUCLP switch provided on the option panel to unclamp the tailstock.
4) Move the tailstock in manual operation to the position where you can fit the center safely.
5) Press the emergency stop button to place the machine in the emergency stop state.
6) Clean the tapered hole on the tailstock.
7) Clean the tapered surface of the center.
8) Insert the center into the center hole on the tailstock.

Page B-65 (14-1-1)
Page B-67 (14-2-1)

14-4 Removing the Center from the Servo-controlled Tailstock

1) Close the front door.
2) Select the manual mode.
3) Press the TSUCLP switch provided on the option panel to unclamp the tailstock.
4) Move the tailstock in manual operation to the position where you can remove the center safely.
5) Press the emergency stop button to place the machine in the emergency stop state.
6) Remove the center.

Page B-65 (14-1-1)
Page B-67 (14-2-1)

15 MANUAL OPERATION OF THE STEADY REST (STEADY REST SPECIFICATIONS)

The following steady rest manual operation can be performed by using the STEADY REST MANUAL OPERATION screen.

- Steady rest OPEN/CLOSE operation
- Steady rest OUT/IN operation
- Steady rest CLAMP/UNCLAMP operation

NOTE The CLAMP/UNCLAMP operation cannot be performed with the servo-controlled steady rest specification machine.

15-1 Procedure for Steady Rest Manual Operation

1) Select the MDI mode.

2)  Press the function selection key  (CUSTOM1) to display the PCMDI MENU screen.

3) Input "6" with the data entry keys, and press the INPUT key.
The STEADY REST/WORK REST MANUAL OPERATION screen is displayed.

  This screen can also be displayed by pressing the function selection key  (CUSTOM1) and the **[STEADY REST]** soft-key.

4) Input the number of the "ACTION" to be executed by using the data entry keys and press the INPUT key.

5) Press the **[EXEC.]** soft-key.
While the operation is being executed, the item in the "ACTION" field flashes. When the operation has been completed, the item in the "STATUS" field is highlighted.

 Page B-70 (15-2)

15-2 Conditions for Steady Rest Manual Operation

The following conditions must be satisfied for steady rest manual operation.

Operation	Conditions
STEADY REST OPEN/CLOSE	• The machine is not in automatic operation. • The MDI mode is selected. • The door is closed, or the door interlock function is released. • The spindle, spindle 2 (S type), and rotary tool spindle (M type) are not being rotated.
STEADY REST OUT	• The machine is not in automatic operation. • The MDI mode is selected. • The door is closed, or the door interlock function is released. • The spindle, spindle 2 (S type), and rotary tool spindle (M type) are not being rotated. • The steady rest OPEN operation has been completed. • The work rest IN operation has been completed.
STEADY REST IN	• The machine is not in automatic operation. • The MDI mode is selected. • The door is closed, or the door interlock function is released. • The spindle, spindle 2 (S type), and rotary tool spindle (M type) are not being rotated. • The steady rest OPEN operation has been completed.
STEADY REST CLAMP/UNCLAMP (Excluding the servo-controlled steady rest specification)	• The machine is not in automatic operation. • The MDI mode is selected. • The door is closed, or the door interlock function is released. • The spindle, spindle 2 (S type), and rotary tool spindle (M type) are not being rotated.

16 MANUAL OPERATION OF THE SERVO-CONTROLLED STEADY REST (SERVO-CONTROLLED STEADY REST SPECIFICATION)

16-1 Moving the Servo-Controlled Steady Rest in Manual Operation

The servo-controlled steady rest can be moved in manual operation when the following modes are selected.

- Rapid traverse mode
- Jog mode
- Zero return mode

NOTE The following condition must be satisfied to move the steady rest in manual operation.

- The steady rest has been retracted.

For automatic operation, refer to the PROGRAMMING MANUAL published separately.

<In the rapid traverse mode>

In manual operation, the servo-controlled steady rest is moved at the set rapid traverse rate.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.
3) Place the PANEL key-switch in either of the positions indicated below.

    (ON)  (PANEL/EDIT)

4) Select the rapid traverse mode () with the mode selection switch.
5) Set the rapid traverse rate using the rapid traverse rate override switches.

NOTE In manual operation, even if the rapid override is set to 100%, the actual override value is fixed at 50%.

Page A-43 (5-12)

6) Press and hold down the steady rest switch for the direction in which motion is required.
   The steady rest is moved at the rapid traverse rate while the switch is held down.
   To stop axis feed, release the switch.

<In the jog mode>

In manual operation, the servo-controlled steady rest is moved at the set jog feedrate.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.
3) Place the PANEL key-switch in either of the positions indicated below.

   (ON) (PANEL/EDIT)

4) Select the jog mode ( ) with the mode selection switch.
5) Set the feedrate to be used for jog feed operation using the OVERRIDE dial.

NOTE When the OVERRIDE dial is placed in the 0 position, the axis is not fed.

6) Press and hold down the steady rest switch for the direction in which motion is required.
   The steady rest is moved at the rapid traverse rate while the switch is held down.
   To stop axis feed, release the switch.

<In the zero return mode>

In manual operation, the servo-controlled steady rest is returned to the machine zero point at the set rapid traverse rate.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.
3) Place the PANEL key-switch in either of the positions indicated below.

   (ON) (PANEL/EDIT)

4) Select the zero return mode with the mode selection switch ( ).
5) Set the rapid traverse rate using the rapid traverse rate override switches.

NOTE In manual operation, even if the rapid override is set to 100%, the actual override value is fixed at 50%.

6) Press and hold down the steady rest switch for the zero return direction.

NOTE If the switch for the direction opposite to the zero return direction is pressed, the tailstock does not move.

The status indicator of the **[STEADY REST +]** switch is lit when the steady rest has been returned to the zero point.

16-2 Releasing Servo-Controlled Steady Rest Soft-Overtravel

The servo-controlled steady rest stroke is defined in the parameters. If the axis is moved beyond the stroke limit, the alarm OT0500 or OT0501 occurs and the axis is stopped.

<Release procedure>

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
2) Close the front door.
3) Place the PANEL key-switch in either of the positions indicated below.

    (ON)  (PANEL/EDIT)

4) Select the manual mode.
5) Move the axis in opposite direction to the overtravel direction using handle feed, jog feed, or rapid traverse operation.
6) Press the  (RESET) key.

17 MANUAL OPERATION OF THE WORK REST (WORK REST SPECIFICATIONS)

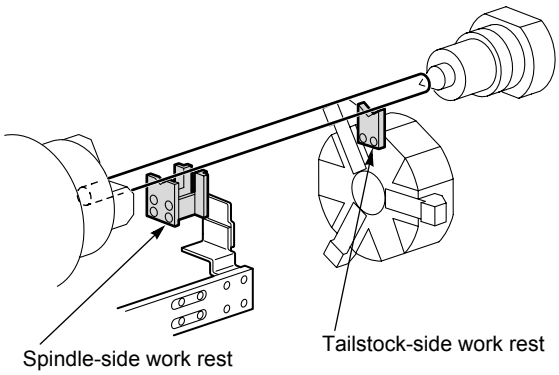
The work rest is used to support the workpiece temporarily when changing the workpiece in shaft work.

The NZ-S1500 can be equipped with two kinds of work rests: with or without work unloading function.

NOTE The work unloading function for the work rest described here is the function that carries the finished product to the position from which it is taken out.

For work rest automatic operation, refer to the programming manual published separately.

17-1 Work Rest (Without Work Unloading Function)



The work rest supports a workpiece with two V-notched jigs. The jig under the spindle is called the "spindle-side work rest" and the one between the tools on turret 2 is called the "tailstock-side work rest".

17-1-1 Manual Operation of the Work Rest (without the Work Rest Function)

For manual operation of the spindle-side work rest, use the STEADY REST/WORK REST MANUAL OPERATION screen. To index the tailstock-side work rest, specify a T code.

For the spindle-side work rest indexing operation, refer to the programming manual published separately.

<Procedure for spindle-side work rest manual operation>

1) Select the MDI mode.

2)  Press the function selection key (CUSTOM1) to display the PCMDI MENU screen.

3) Input "6" with the data entry keys, and press the INPUT key.
The STEADY REST/WORK REST MANUAL OPERATION screen is displayed.

 This screen can also be displayed by pressing the function selection key (CUSTOM1) and the **[STEADY REST]** soft-key.

4) Input the number of the "ACTION" to be executed by using the data entry keys and press the INPUT key.

5) Press the **[EXEC.]** soft-key.
While the operation is being executed, the item in the "ACTION" field flashes. When the operation has been completed, the item in the "STATUS" field is highlighted.

When this type of work rest is provided, the "WORK REST BACKWARD" and "WORK REST FORWARD" operations are not used.

Page B-83 (17-3)

17-1-2 Adjusting the Work Rest (without the Workpiece Unloading Function)

Adjust the work rest position by following the procedure described below.

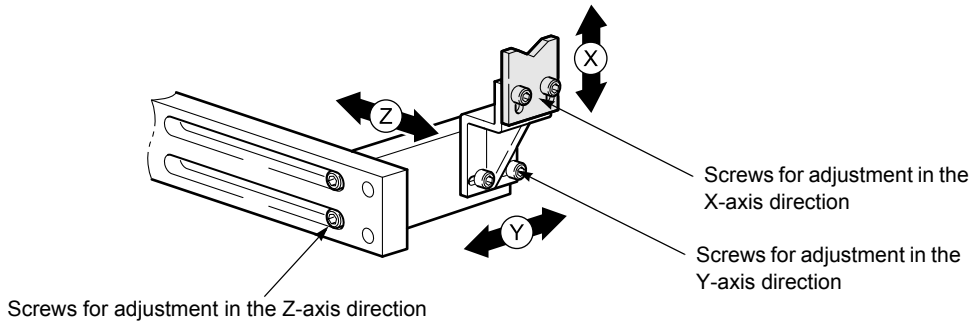
<Procedure>

1) Extend the work rest with no workpiece on it.
   - Use the WORK REST MANUAL OPERATION screen for the spindle-side work rest OUT operation.

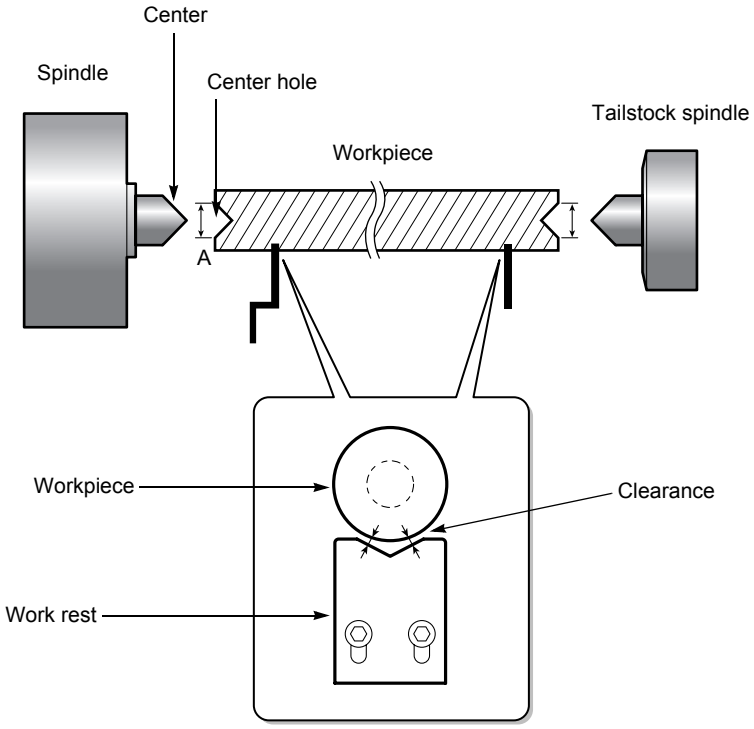
     Page B-75 (17-1-1)
   - Specify the T code for the tailstock-side work rest indexing.

     Refer to the programming manual provided separately.
2) Retract the spindle-side work rest and the tailstock-side work rest to a position where they will not interfere with the workpiece.
   - To retract the spindle-side work rest, loosen the screws for adjustment in the X-/Y-/Z-direction on the work rest.
   - To retract the tailstock-side work rest, move the axis in the X positive direction in handle feed operation.
3) Hold the workpiece with the chuck and the tailstock.
4) Adjust the spindle-side work rest position (X-/Y-/Z- direction).

   Loosen the hexagon socket head cap screws on the spindle-side work rest and adjust the position in each direction.



Adjust the clearance between the work rest and the workpiece so that the center comes into the center hole range indicated by the arrow A in the illustration below. If the clearance is too small, the work rest may interfere with the workpiece.

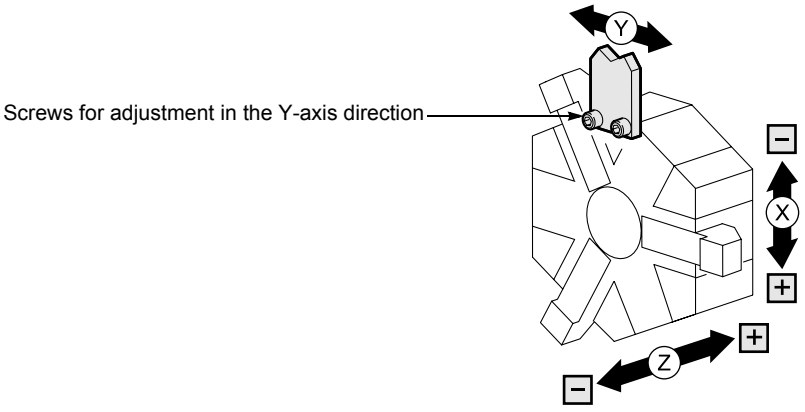


NOTE If the center moves out of the range indicated by the arrow A, there is a danger that it will interfere with the workpiece end face the next time an attempt is made to hold a workpiece.

5) Adjust the tailstock-side work rest position.

a) Z -, and X- axis direction: Adjust the position by handle feed operation.

b) Y-axis direction: Adjust the position by loosening the screws for adjustment in the X-/Y-/Z- direction on the tailstock-side work rest.



Provide a little clearance so that the center comes into the center hole range by using the same procedure as in step 4).

6) Retract the tailstock-side work rest to a safe position.

   Retract the work rest to the X positive direction by handle feed operation. If necessary, retract the work rest in the Z-axis direction.

7) Perform the spindle-side WORK REST IN operation.

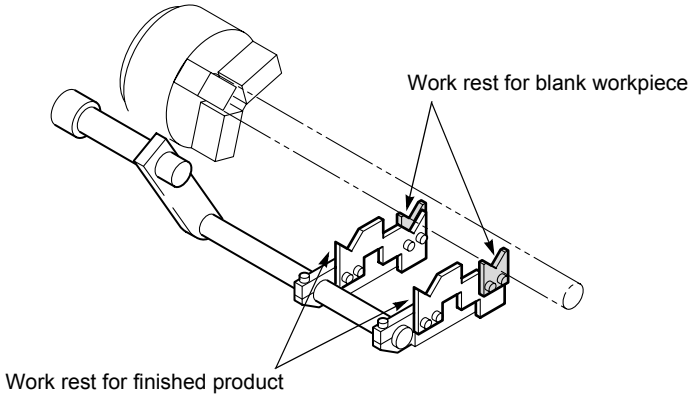
<Check after work rest position adjustment>

Check that the work rest is at the appropriate position.

1) Retract the tailstock spindle.
2) Unclamp the chuck.
3) Hold the workpiece with the work rest.
4) Extend the tailstock spindle.
5) Clamp the workpiece with the chuck.

Check that the center comes into the center hole correctly and that the workpiece is clamped in the normal position.

17-2 Work Rest (With Work Unloading Function)



The work rest is used to support a blank workpiece and a finished product when changing workpieces in shaft work.

The work rest supports workpieces with two jigs attached to the bar extended from the side of the spindle. Each jig is equipped with two V-notches. The jig on the operator' side is used for the finished product and the one in the rear is used for the blank workpiece.

The work rest can carry a finished product by moving in the Y-axis direction to the position from which you can take it out.

NOTE When this type of work rest is provided, the jig between tools on the turret is used not as a work rest but as a tool for pulling out a workpiece.

17-2-1 Manual Operation of the Work Rest (with the Workpiece Unloading Function)

For work rest manual operation, use the STEADY REST/WORK REST MANUAL OPERATION screen. To index the jig for pulling out the workpiece, specify a T code.

For details on indexing the jig for pulling out the workpiece, refer to the programming manual published separately.

<Procedure for work rest manual operation>

1) Select the MDI mode.
2) Press the function selection key (CUSTOM1) to display the PCMDI MENU screen.
3) Input "6" with the data entry keys, and press the INPUT key.
   The STEADY REST/WORK REST MANUAL OPERATION screen is displayed.
4) Input the number of the "ACTION" to be executed by using the data entry keys and press the INPUT key.
5) Press the **[EXEC.]** soft-key.
   While the operation is being executed, the item in the "ACTION" field flashes. When the operation has been completed, the item in the "STATUS" field is highlighted.

Page B-83 (17-3)

17-2-2 Adjusting the Work Rest (with the Workpiece Unloading Function)

Adjust the work rest position by following the procedure described below.

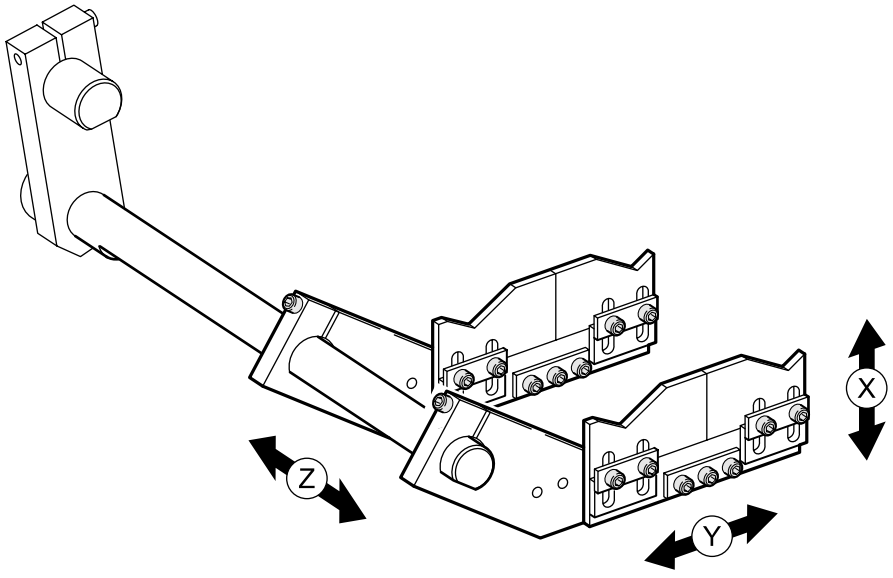
<Procedure>

1) Extend the work rest with no workpiece on it.
   - Perform the work rest OUT operation from the WORK REST MANUAL OPERATION screen.

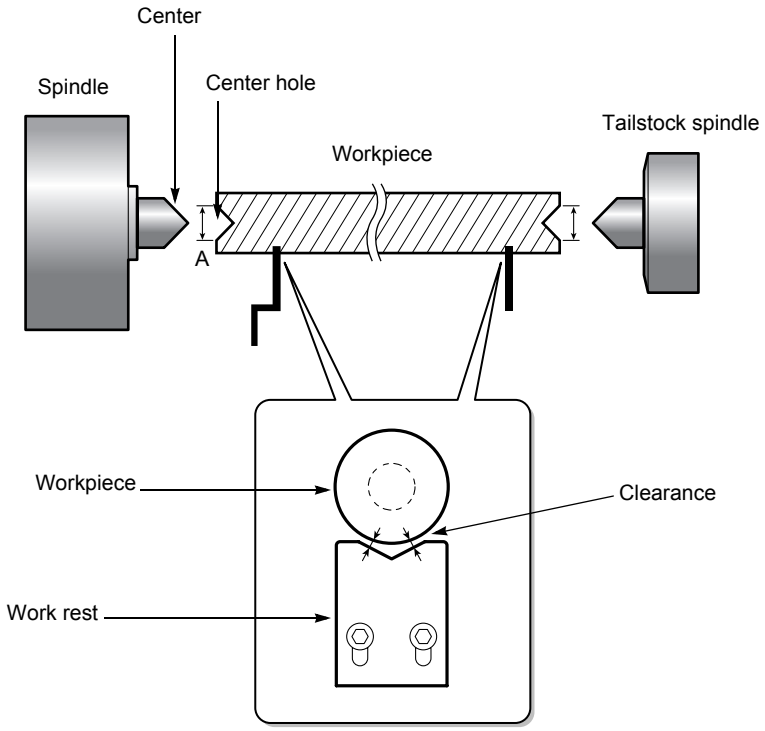
     Page B-76 (17-1-2)
   - Use a T-code to index the jig for pulling out the workpiece mounted between tools on the turret.

     Refer to the programming manual provided separately.
2) Retract both the work rest and jig for pulling out the workpiece to positions where they will not interfere with the workpiece.
   - Loosen the screws for adjustment in the X, Y and Z directions to retract the work rest.
   - Retract the jig for pulling out the workpiece in the X-axis plus direction in handle feed.
3) Hold the workpiece with the chuck and the tailstock.
4) Adjust the position of the work rest (X-/Y-/Z- direction).

   Loosen the hexagon socket head cap screws on the spindle-side work rest and adjust the position in each direction.



Adjust the clearance between the work rest and the workpiece so that the center comes into the center hole range indicated by the arrow A in the illustration below. If the clearance is too small, the work rest may interfere with the workpiece.

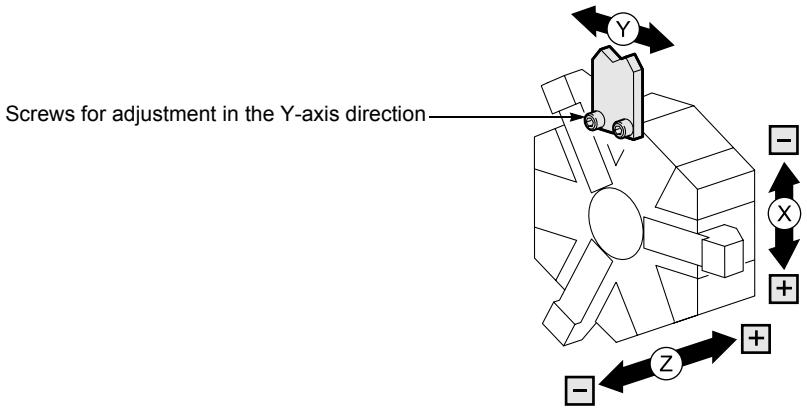


NOTE If the center moves out of the range indicated by the arrow A, there is a danger that it will interfere with the workpiece end face the next time an attempt is made to hold a workpiece.

5) Adjust the position of the jig for pulling out the workpiece.

a) Z -, and X- axis direction: Adjust the position by handle feed operation.

b) Y-axis direction: Loosen the screw for adjustment in the Y-axis direction and adjust the position.



Following the same method as in step 4), adjust the clearance between the work rest and the workpiece so that the center comes within the center hole range.

6) Retract the jig for pulling out the workpiece to a safe position.

Retract the work rest to the X positive direction by handle feed operation. If necessary, retract the work rest in the Z-axis direction.

7) Stow away the work rest.

<Check after work rest position adjustment>

Check that the work rest is at the appropriate position.

1) Retract the tailstock spindle.
2) Unclamp the chuck.
3) Hold the workpiece with the work rest.
4) Extend the tailstock spindle.
5) Clamp the workpiece with the chuck.

Check that the center comes into the center hole correctly and that the workpiece is clamped in the normal position.

17-3 Conditions for Work Rest Manual Operation

The following conditions must be satisfied for work rest manual operation.

Operation	Conditions
WORK REST OUT	• The machine is not in automatic operation. • The MDI mode is selected. • The door is closed, or the door interlock function is released. • The spindle, spindle 2 (S type), and rotary tool spindle (M type) are not being rotated. • The lower turret is positioned where it will not interfere with the work rest. • The servo-controlled tailstock is positioned where it will not interfere with the work rest. (Servo-controlled tailstock specification) • The steady rest base is in the IN state. (Tailstock specification) • The tool presetter is in the IN state. (Tool presetter specification)
WORK REST IN	• The machine is not in automatic operation. • The MDI mode is selected. • The door is closed, or the door interlock function is released. • The spindle, spindle 2 (S type), and rotary tool spindle (M type) are not being rotated.
WORK REST FORWARD	• The machine is not in automatic operation. • The MDI mode is selected. • The door is closed, or the door interlock function is released. • The lower turret is positioned where it will not interfere with the work rest. • The tool presetter is in the IN state. (Tool presetter specification) • The servo-controlled tailstock is positioned where it will not interfere with the work rest. (Servo-controlled tailstock specification) • When the work rest is in the OUT state, the spindle, spindle 2 (S type), and rotary tool spindle (M type) are not being rotated. • When the work rest is in the OUT state, the tailstock center IN operation has been completed. • When the work rest is in the OUT state, the chuck and the chuck 2 (S type) are unclamped. • When the work rest is in the OUT state, the steady rest base is in the IN state. (Steady rest specification)

Operation	Conditions
WORK REST BACKWARD	• The machine is not in automatic operation. • The MDI mode is selected. • The door is closed, or the door interlock function is released. • When the work rest is in the OUT state, the spindle, spindle 2 (S type), and rotary tool spindle (M type) are not being rotated. • When the work rest is in the OUT state, the tailstock center IN operation has been completed. • When the work rest is in the OUT state, the chuck and the chuck 2 (S type) are unclamped. • When the work rest is in the OUT state, the steady rest base is in the IN state. (Steady rest specification)

CHAPTER C
CHUCKING

When a workpiece can be clamped in the chuck stably, the most important step of workpiece setup is considered to be cleared.

This chapter describes the cautions for chucking a workpiece and the soft jaw shaping procedure.

Since the workpiece material, shape, and machining methods differ largely among the customers, this manual cannot cover all kinds of workpieces.

Since the procedure and the numerical values explained in this chapter may not be the most proper for customer's specific workpiece, take the explanation in this chapter for the reference and find the more proper method for your specific work.

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1 CAUTIONS ON CHUCKING A WORKPIECE

When chucking a workpiece, pay attention to the following points.

Always switch the power OFF before mounting, removing, inspecting, or lubricating the chuck. If you carry out maintenance and inspection work with the power left ON, you could be entangled with the spindle and seriously injured if the spindle starts for some reason.
For details on chuck maintenance, refer to the instruction manuals prepared by the chuck and cylinder manufacturers.

1. **When mounting a chuck, chuck cylinder, or connection rod to the spindle, read the instruction manuals provided by Mori Seiki, the chuck manufacturer, and the chuck cylinder manufacturer. The considerations that must be attended to are given in the instruction manuals. If the chuck, chuck cylinder, or connection rod is mounted to the spindle without understanding these considerations, the chuck, chuck cylinder or connecting rod will be damaged, and if machining is carried out after such damage has occurred, a workpiece, the chuck, and/or chuck jaw could fly out, causing accidents involving serious injuries or damage to the machine.**
2. **If a workpiece holding fixture other than the chuck supplied with the machine is used, be sure to contact Mori Seiki to prevent accidents. Mori Seiki is not responsible for accidents caused by the use of a fixture prepared by the customer without consulting Mori Seiki.**
3. **If the chuck supplied with the machine is removed from the machine and a specially prepared fixture is used instead of the chuck to hold a workpiece, remove the chuck cylinder and the connecting rod if they do not operate due to the mounting of the special fixture. If the spindle is started with the chuck cylinder and the connecting rod still mounted, the connecting rod will vibrate and the connecting rod and the chuck cylinder could become detached, causing accidents involving serious injuries or damage to the machine.**
4. **Leave the pilot bush mounted in the chuck.**
   If the machine is operated with the pilot bush removed, a master jaw or a jaw of the chuck could fly out, causing accidents involving serious injuries or damage to the machine.

WARNING

5. **The socket hole in the hexagon socket head cap bolts used for mounting chuck jaws and fixtures will become enlarged over a long period of use. Check these hexagon socket head cap bolts at regular intervals and if a hexagon wrench does not fit in the socket hole, replace the bolt with new one.**
   If there is an excessive gap between the socket hole and hexagon wrench, the bolt cannot be torqued correctly. If the machine is operated while a bolt is not torqued correctly, a workpiece, chuck jaw or a fixture could fly out, causing accidents involving serious injuries or damage to the machine.
6. **The chuck or fixture that holds the workpiece must be secured to the spindle using the threaded holes in the spindle nose. Do not mount another chuck or fixture in a chuck or fixture that is mounted directly on the spindle. If a workpiece is held by a second chuck or fixture mounted in this way, it will not be held securely when the spindle rotates due to the centrifugal force acting on it, and the chuck or fixture will fly out. This could cause accidents involving serious injuries or damage to the machine.**
   If it is necessary to mount a chuck or fixture to hold a workpiece in the chuck or a fixture which is directly mounted to the spindle, contact Mori Seiki or the chuck manufacturer for the measures that should be taken.
7. **A limit is imposed on chuck plunger thrust. If the plunger thrust exceeds the allowable value, the chuck could be damaged and the workpiece and chuck jaws could fly out of the chuck, causing serious injuries or damage to the machine.**
   For the allowable plunger thrust, refer to the instruction manuals prepared by the chuck and cylinder manufacturers.
8. **Workpiece materials and shapes vary widely among machine users. Mori Seiki cannot predict the chucking pressure, spindle speed, feedrate, depth of cut, etc., that will be required in each case and it is therefore the user's responsibility to determine the appropriate settings.**
   Note also that the machining conditions determined in automatic programming are the standard conditions, which may have to be changed in accordance with the workpiece, chuck, etc., and the final responsibility for determining the conditions rests with the user.
   If you have difficulty determining these conditions, consult the chuck and cylinder manufacturers and tool manufacturer.
   Machining under inappropriate machining conditions can cause the workpiece to fly out of the chuck during machining, causing serious injuries or damage to the machine. It will also adversely affect machining accuracy.

WARNING

9. When mounting or removing the chuck, use eye bolts and a lifting belt, and lift the chuck using a crane. After mounting or removing the chuck, be sure to remove the eye bolts and lifting belt from the chuck. If the spindle is rotated with the eye bolts and/or lifting belt attached to the chuck, they could catch on the operator and entangle him in the chuck, or they could fly out, causing serious injuries or damage to the machine.
For the procedure used to mount the chuck, refer to the instruction manuals prepared by the chuck and cylinder manufacturers.

10. Use only the specified bolts to mount the chuck and chuck jaws and tighten them to the specified torque. Check at regular intervals that the bolts are securely tightened. If the bolts are not tightened to the specified torque the workpiece might fly out, causing serious injuries or damage to the machine, and the chuck could be damaged.

11. When machining long workpieces, always hold the free end of the workpiece securely with the tailstock (if featured), a steady rest (if featured), or a bar feeder (if featured). If you do not support the free end the workpiece could bend or shake while the spindle is rotating, causing accidents involving serious injuries or damage to the machine.

12. When clamping or unclamping a workpiece in the chuck, ensure that your hands will not be trapped by the workpiece, soft jaws, or tailstock (if featured). If you work without sufficient care you could be seriously injured.

13. Periodically disassemble and clean the chuck. Apply grease to the chuck every day. If chips or coolant enter the chuck, or if the grease runs out, the chuck gripping force will be reduced. If the spindle is rotated in this condition the workpiece will fly out, causing serious injuries or damage to the machine.

14. Clean out any chips that accumulate inside the chuck.
Accumulation of chips inside the chuck reduces the gripping force and shortens the jaw stroke. If machining is carried out under such conditions the workpiece will fly out, causing serious injuries or damage to the machine.

15. Since forged and cast workpieces have hard chucking portions due to scale, use hard jaws for these workpieces. If the chucking contact has to be a point or line contact, for example when clamping on the draft of a casting, use spikes embedded in the jaws. If three soft jaws are used, shape them so that the workpiece is clamped at six points; avoid face contact between the jaws and workpieces with scale on them.
If machining is carried out while the workpiece is clamped in very unstable way the workpiece will fly out, causing serious injuries or damage to the machine.

1. Do not modify the chuck unnecessarily since this will adversely affect accuracy and functions and reduce the chuck service life.
2. When stopping the machine for a long time after switching the power off, always remove the workpiece in the chuck. If the workpiece is left held in the chuck after the power has been switched off, its weight will cause the soft jaws to open and the workpiece will fall, causing injuries or damage to the machine. Leaving the workpiece in the chuck will also shorten the life of the chuck.
3. On completing a job, clean the chuck and the inside of the machine. If chips are allowed to accumulate in the machine over long periods, it will lead to machine faults.
4. Make sure that the connection rod (draw bar/tube) between the chuck and cylinder, and other threaded parts, are tightened securely. If the connection rod (draw bar/tube) is not secure enough it will lead to vibration and strength defects, which could damage the machine. It will also adversely affect machining accuracy.
5. When a hollow chuck is used, a coolant drain is provided in the cylinder portion at the rear of the spindle. This drain must be periodically cleaned to prevent blockage by chips. If it becomes blocked, coolant will enter the hydraulic tank from the cylinder drain and this will cause machine faults.

2 ADJUSTING THE PRESSURE

This section describes the procedure used for adjusting the chucking pressure and the tailstock spindle thrust (tailstock spindle specification).

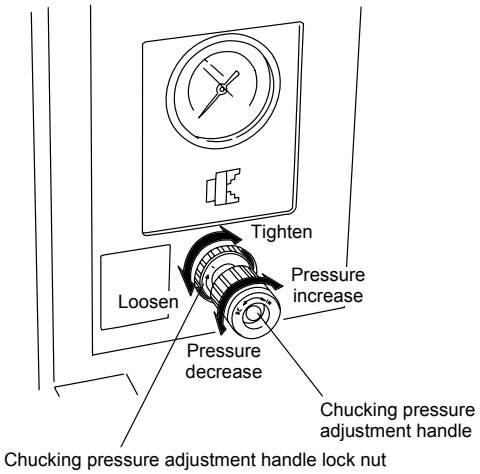
1. **The allowable chucking pressure must be set to a value lower than the cylinder pressure that generates the cylinder thrust allowable for the chuck, or the allowable cylinder pressure, whichever is the lower. If this restriction is not observed, the chuck and cylinder may be damaged. If the damage occurs while the spindle is rotating, the workpiece and chuck jaws will fly out, causing serious injuries or damage to the machine.**
   For the allowable maximum pressure of the chuck or the cylinder, refer to the instruction manuals prepared by the chuck and cylinder manufacturers.
2. **If a thrust exceeding the allowable cylinder thrust is applied to the chuck, the component parts or bolts of the chuck will be damaged, causing loss of chuck gripping force. If this happens while the spindle is rotating, the workpiece or chuck jaws will fly out, causing serious injuries or damage to the machine.**
   For the allowable cylinder thrust, refer to the instruction manuals prepared by the chuck and cylinder manufacturers.
3. **Take the height of the jaws mounted in the chuck into consideration when determining the chucking pressure. If the height is greater than the standard height, reduce the cylinder thrust. If you fail to observe this warning, large forces will act on the jaw mounting bolts and the master jaw, which could cause damage to the jaw or master jaw. If trouble of this nature occurs while the spindle is rotating, the workpiece or chuck jaws will fly out, causing serious injuries or damage to the machine.**
   For the relationship between jaw height and allowable cylinder thrust, refer to the instruction manuals prepared by the chuck and cylinder manufacturers.
4. **Give full consideration to the type of chuck and cylinder used when setting the chucking pressure. Even if the same hydraulic pressure is applied to the chuck, the chuck gripping force will vary according to the manufacturer and type of chuck and cylinder.**
   For details on the chuck gripping force, consult the chuck and cylinder manufacturers.
   If the chuck gripping force is different from that intended, the workpiece could fly out when the spindle is started, causing serious injuries or damage to the machine.

5. Select the appropriate chucking pressure and tailstock spindle thrust force (applies only to machines equipped with a tailstock) for the workpiece shape and material, and the cutting conditions. If you cannot determine the appropriate chucking pressure, contact the chuck manufacturer or cylinder manufacturer. If you cannot determine the appropriate tailstock spindle thrust force (applies only to machines equipped with a tailstock), contact Mori Seiki. If the chucking pressure or tailstock spindle thrust force (applies only to machines equipped with a tailstock) is not set appropriately in accordance with the shape and material of the workpiece being machined and the cutting conditions, the workpiece could fly out of the chuck during machining, causing serious injuries or damage to the machine. Incorrect setting could also distort the workpiece.

2-1 Adjusting the Chucking Pressure

Before chucking a workpiece, the chucking pressure must be adjusted.

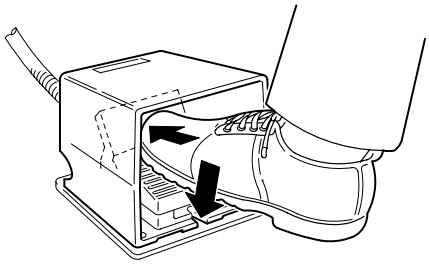
NOTE The type and installation position of the chucking pressure adjustment handle varies depending on the machine model.
For details, refer to the DRAWINGS published separately.



1) Loosen the chucking pressure adjustment handle lock nut by turning it counterclockwise.
2) While reading the pressure gage, adjust the chucking pressure by turning the chucking pressure adjustment handle.

NOTE CCW rotation. . . Pressure decrease
CW rotation . . . . Pressure increase

Exercise due care when setting the pressure.



3) Using the chuck opening/closing footswitch, operate the chuck several times to verify the set chucking pressure.
4) Repeat steps 2) and 3) until the required chucking pressure is obtained.
5) Tighten the chucking pressure adjustment handle lock nut by turning it clockwise.

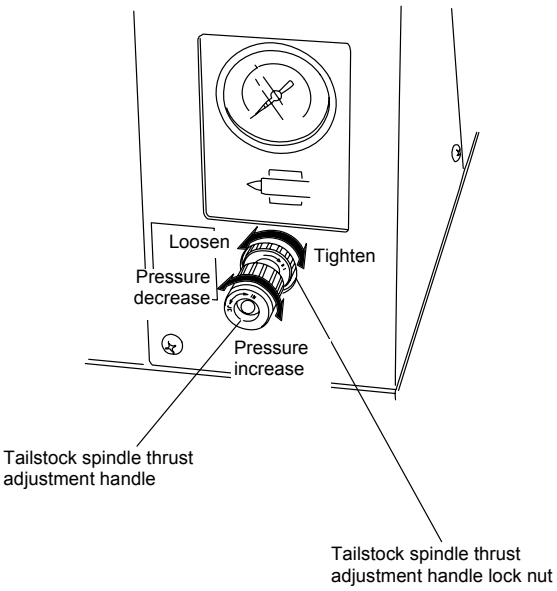
2-2 Adjusting the Tailstock Spindle Thrust (Tailstock Specification)

With machines equipped with a tailstock, the tailstock spindle thrust must be adjusted before chucking the workpiece.

NOTE The type and installation position of the tailstock spindle thrust adjustment handle varies depending on the machine model.
For details, refer to the DRAWINGS published separately.

The table below shows the spindle thrusts when the gage pressure is set to the values given in the middle column using the tailstock spindle thrust adjustment handle. Set the thrust by referring to the table below, taking the workpiece shape and cutting conditions into consideration.

Gage Pressure (MPa)	Tailstock Spindle Thrust (N)
3.43	5419



1) Loosen the tailstock spindle thrust adjustment handle lock nut by turning it counterclockwise.
2) While reading the pressure gage, adjust the tailstock spindle thrust by turning the tailstock spindle thrust adjustment handle.

NOTE
1. CCW rotation . . . . Pressure decrease
   CW rotation . . . . . Pressure increase
   Exercise due care when setting the pressure.
2. Set the thrust force (pressure) taking the size of the center hole in the workpiece into consideration.

3) Tighten the tailstock spindle thrust adjustment handle lock nut by turning it clockwise.

3 SHAPING SOFT JAWS FOR FINISHING

This section describes the cautions to be observed when shaping the soft jaws and the procedure used for shaping the soft jaws for external and internal gripping.

3-1 Cautions on Shaping the Soft Jaws

When shaping soft jaws, pay attention to the following points.

1. **Deburr soft jaws after shaping them. Switch off the power before starting the deburring work. If you do not switch the power off the machine could operate unexpectedly if someone carelessly interferes with the machine controls, causing serious injuries or damage to the machine.**
2. **The T-nuts in the chuck must not protrude from the master jaw. If they do the master jaw or T-nuts may be damaged, and machining accuracy will be impaired. Breakage of the T-nuts or master jaw while the spindle is rotating could cause accidents involving serious injuries or damage to the machine.**
3. **Mount soft jaws in the chuck in a well-balanced manner. Poor balance will cause runout of the spindle and could cause the soft jaws to fly out of, causing serious injuries or damage to the machine. It will also adversely affect machining accuracy.**
4. **Clamp workpieces at the center of the master jaws' stroke or within their appropriate stroke range. If a workpiece is clamped in the chuck with the jaws positioned near the stroke end it will not be possible to clamp the workpiece securely and it may slip and fly out of the chuck as a result of impact during cutting, causing serious injuries or damage to the machine.**
5. **Before shaping jaws, read the instruction manuals supplied by the chuck manufacturer to determine the jaw shaping procedures optimized for the chuck to be used, since the jaw shaping procedures in this manual assume the use of a standard 3-jaw chuck and may be inapplicable to the chuck actually used.**

1. Never subject the chuck, chuck jaws, or workpiece to shock by tapping them with a hammer, etc., since this will adversely affect accuracy and functions and reduce the chuck service life.
2. Choose the machining conditions with particular care when shaping soft jaws, since this work involves intermittent machining. Inappropriate machining conditions could damage the cutting tool or cause machining defects.
3. When soft jaws are used, they must be made of a softer material than the workpiece. If they are harder, the workpiece could be distorted or scratched.

NOTE

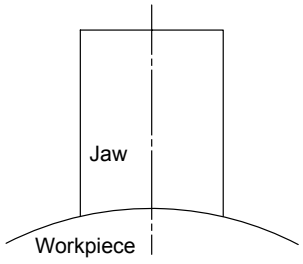
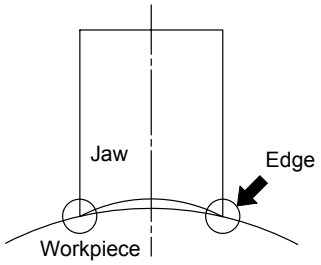
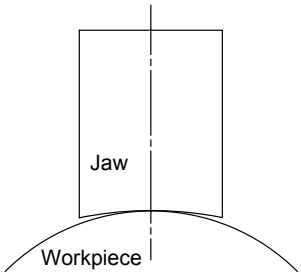
1. Use the same pressure applied when actually machining a workpiece for shaping the soft jaws.
2. Use a plug (ring) to eliminate the chuck master jaw backlash.
3. Make the plug (ring) with the same material as the workpiece.
4. Machine the soft jaws to the diameter of the workpiece to be chucked.
5. The jaw surface which comes into contact with the workpiece must be clean.

   A rough surface causes rapid wear of the jaws. In addition, the surface finished in the 1st process will be damaged during the progress of the 2nd process.
6. To obtain consistent high accuracy, tighten the soft jaws to the specified torque.
7. When replacing the jaws, clean the serration on the master jaw and the jaw nut mating area. If these areas are not clean, run-out accuracy will deteriorate.

3-2 Shaping Soft Jaws

The soft jaw shapes are explained below.

The shapes are generally classified into the following three types.

1. Type 1	2. Type 2	3. Type 3
		

1. Chucking at pre-machined or finished portion (Type 1)

   Shape the soft jaws to the diameter equal to the workpiece diameter. When clamping a workpiece at a pre-machined portion or finished surface, shape the soft jaw diameter to 0.01 to 0.03 mm larger than the workpiece diameter.
   If soft jaws are shaped in this manner, the jaws make contact with the workpiece surface and therefore hold the workpiece most securely, providing good run-out accuracy.
   No scratches are made on the chucking portion (pre-machined portion or surface finished in the first process).

2. Chucking a cast or forged workpiece (Type 2)

   Shape the soft jaws to a diameter a little smaller than the diameter of a workpiece. This shape forms narrow edges on both ends of the jaw. When a workpiece is clamped by the jaws, the jaws contact the workpiece at 6 points. The chuck clamp force is concentrated at these 6 contact points to hold the workpiece securely. The jaws bite the workpiece and this prevents slipping caused by cutting resistance.

   This type is usually used when clamping a cast or forged workpiece or clamping the workpiece at a portion where scratches may be left.

3. Incorrect soft jaw shape (Type 3)

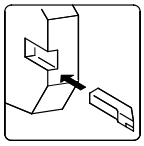
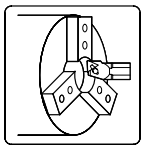
   If the soft jaws are shaped to the diameter larger than the diameter of a workpiece, each jaw comes into contact with the workpiece at one point only as illustrated above. The workpiece is therefore held at 3 points.

WARNING

When clamping a workpiece in a 3-jaw chuck, the workpiece cannot be clamped stably if contact is only made at three points. If a workpiece is machined while clamped in this very unstable way, it may fly out of the chuck due to cutting resistance, causing serious injuries or damage to the machine.
The workpiece must be clamped at six points, or with face contact (jaws shaped to the shape of the workpiece).

3-3 Check Items when Mounting Tools and Shaping Soft Jaws

The items that must be carefully checked when mounting tools and shaping soft jaws are indicated in the table below. Use this table when carrying out the work to ensure correct operation.

	Check Items		Check Column
 Mounting the Tools	1.	Are tool holders and cutting tools cleaned before mounting?	
	2.	Are the replaceable tool tips new?	
	3.	Are the material and shape of replaceable tool tips appropriate?	
	4.	Are replaceable tool tips mounted securely and correctly?	
	5.	Is the tool overhang appropriate?	
	6.	Is the replaceable tool tip mounting angle correct?	
	7.	Are mounting bolts tightened securely and evenly?	
	8.	Is the tool nose center height correct?	
	Check Items		**Check Column**
 Shaping and Mounting the Soft Jaws	1.	Are the soft jaws and master jaws cleaned before mounting?	
	2.	Are the soft jaw mounting positions correct?	
	3.	Are the soft jaw mounting bolts tightened securely and evenly?	
	4.	Is the mounting bolt length appropriate?	
	5.	Is the plug (ring) used for shaping the soft jaws the correct size?	
	6.	Is the chucking pressure checked and adjusted?	
	7.	Are the cutting tools, replaceable tool tip, spindle speed, and feedrate all correct for shaping soft jaws?	
	8.	Is the workpiece contact face area appropriate?	
	9.	Is relief provided at the soft jaw corners?	
	10.	Are run-out on I.D. and end face waviness measured?	

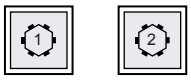
3-4 O.D. Chucking

This section describes the procedure used for shaping the soft jaws which are used for chucking a workpiece by gripping it externally.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.



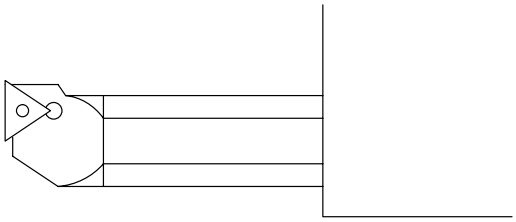
3) Press the HEAD CHANGE switch (head 1) or (head 2) to select the spindle to be rotated. (S type)

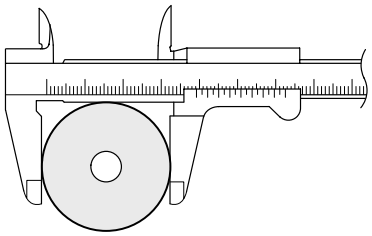
4) Mount the soft jaws to the chuck.

5) Mount the I.D. cutting tool used to cut the soft jaws.

6) Adjust the chucking pressure to the same pressure as used in actual cutting.

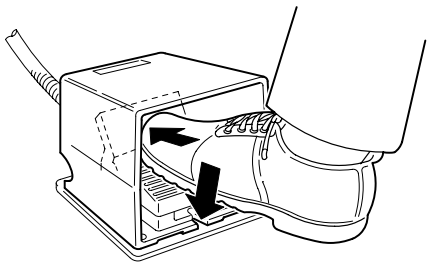
Page C-7 (2-1)





7) Prepare the plug for shaping the soft jaws.
   a) The plug O.D. surface accuracy must be 6S or better.
   b) The plug must be sufficiently thick that it will not be distorted.

Measure and record the plug O.D. with vernier calipers or a micrometer.



8) Carry out chuck clamp and unclamp operation to open the chuck.

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9) Close the front door.

10) Display the OPERATION PANEL screen.

Function selection key (CUSTOM1)

→ **[OPE. PANEL]**

11) Set the chuck clamping direction to the I.D. chucking.

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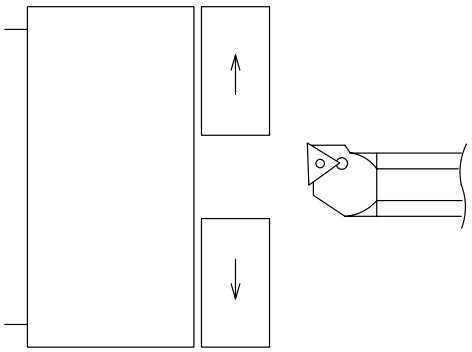
12) Set "INVALID" for CHUCK STROKE END (chuck jaw stroke end detection function) using the cursor control keys.

The status indicator **[CHCL]** is lit.



13) Bring the tool close to the soft jaw manually while observing the clearance between the soft jaw and the tool through the window in the front door.

NOTE When the DOOR INTERLOCK key-switch is placed in the **RELEASE** position, axis movement is possible even if the front door is open. In this case, rapid traverse is restricted to 5 m/min.

14) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.

15) Check for possible interference when the spindle is rotated.

<Example>

- Interference between the adjacent tools and chuck
- Interference between the fixture and chuck

16) After making sure that the spindle can be rotated without interference, close the front door.

17) Start the spindle manually, and adjust the spindle speed as appropriate.

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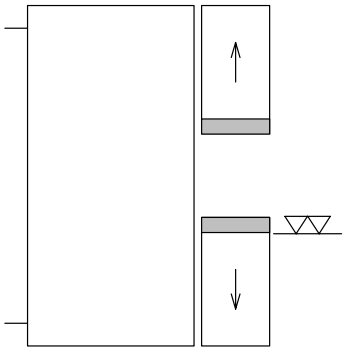


18) Machine the jaws that clamp the plug.

WARNING

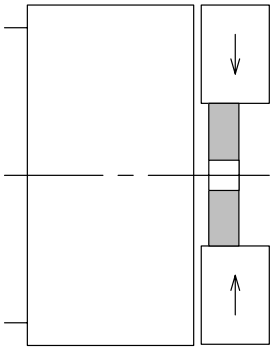
It is dangerous to clamp a workpiece in the chuck with the jaws moved close to the stroke end.

Shape the jaws so that the plug can be clamped within proper jaw stroke range.

Shaping the jaws to "plug diameter + Max. jaw stroke × 1/2" allows the plug to be clamped at the center of jaw stroke.

19) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.



20) Chuck the plug.

CAUTION When chucking the plug for shaping the soft jaws, exercise due care to ensure that your fingers will not get trapped.

NOTE Fit the plug on the chuck so that it is not tilted.

21) Close the front door.

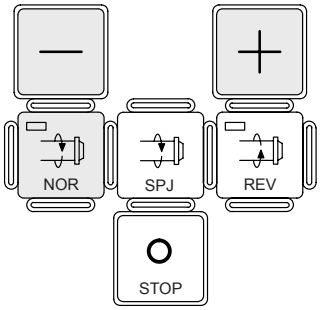
22) Set the chuck clamping direction to the O.D. chucking on the OPERATION PANEL screen.

23) Set "VALID" for CHUCK STROKE END (chuck jaw stroke end detection function) using the cursor control keys.

The status indicator **[CHCL]** is lit.

24) Check for interference by following steps 13) to 15).

25) After making sure that the spindle can be rotated without interference, close the front door.

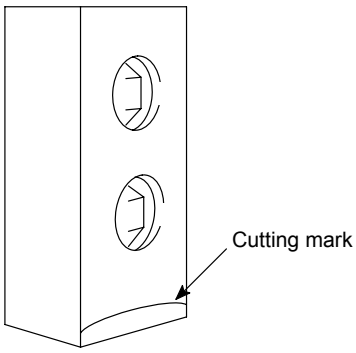


26) Start the spindle manually.

Page B-29 (7-2)

27) Set the required spindle speed.

NOTE Determine the spindle speed by considering the soft jaw height, diameter to be cut, and the tool material.



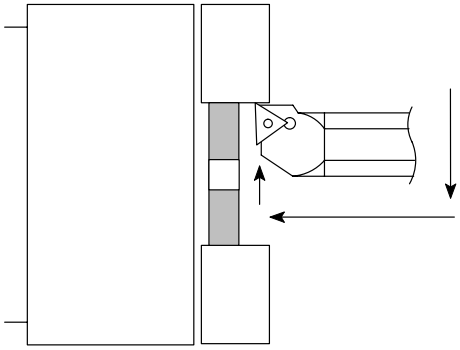
28) Feed the cutting tool on the Z-axis with the manual pulse generator to bring it into contact with and leave a cutting mark on the end faces of the three soft jaws.

Page B-24 (6-4)

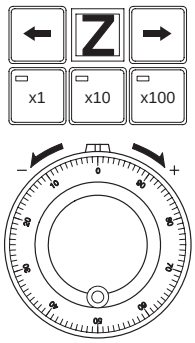
NOTE The diameter of the cutting mark must be smaller than the finishing diameter.

29) Display the POSITION (RELATIVE) screen, and reset the W coordinate value to "0".

30) Move the I.D. cutting tool using the manual pulse generator to bring it into contact with the inside face of the soft jaw.

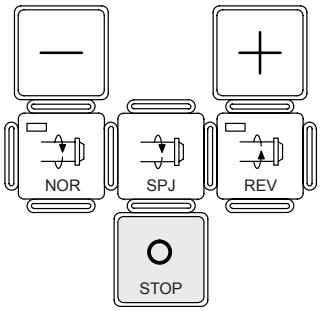


CAUTION Ensure that the tool does not strike the soft jaw or plug.



31) Move the I.D. cutting tool in the +Z direction by handle feed operation.

CAUTION Never move the cutting tool in the X-axis direction. It could interfere with the soft jaws, damaging the tool and machine.



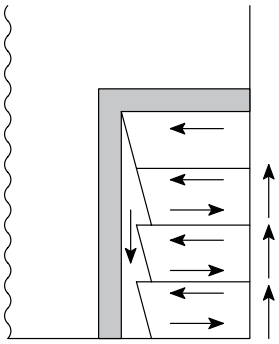
32) Press the ○ (STOP) switch to stop the spindle.

<Example>

Assume that the outer diameter of the plug measured in step 7) is 25 mm.

33) Set the present position data (incremental) to "25.000" mm for U.

34) Cut the soft jaws while checking the diameter and depth of cut by referring to the relative coordinate values on the POSITION (RELATIVE) screen.

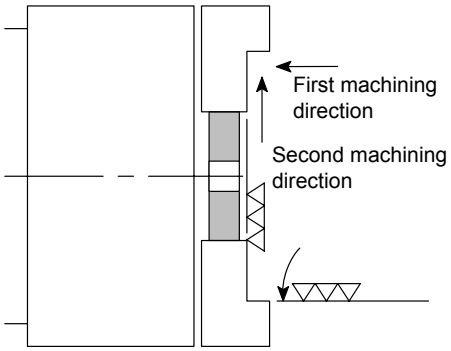


NOTE The depth of cut should be determined according to the tool and tool projecting length. Be careful that the machined I.D. does not exceed the required diameter.

35) Carry out rough cutting, leaving a 0.1 to 0.2 mm finishing allowance.

NOTE After finishing rough cutting, chamfer the edges and remove burrs using a file or similar tool.

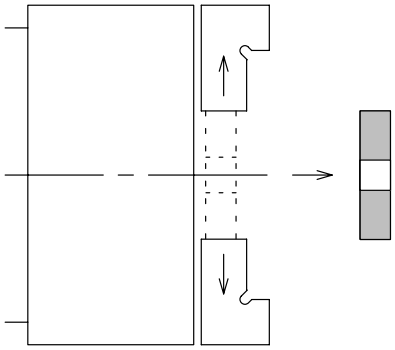
36) Carry out finishing.



a. Use a new tip.
b. Slightly increase the spindle speed.
c. Machine relief at the I.D. edges.
d. Surface roughness must be 6S or better.
e. Chucking diameter dimensional accuracy is approximately H7 (JIS).
f. The run-out of the cut soft jaws must be less than 0.02 mm on the periphery.

37) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

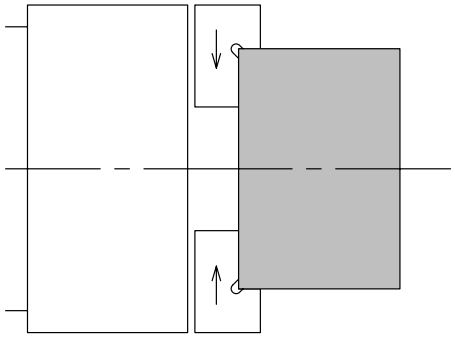
NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.



38) Open the chuck and remove the plug.

CAUTION

When removing the plug for shaping the soft jaws, ensure that your fingers will not be caught.



39) Chuck a workpiece; check the jaw stroke.

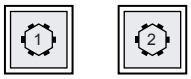
3-5 I.D. Chucking

This section describes the procedure used for shaping the soft jaws which are used for chucking a workpiece by gripping it internally.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.



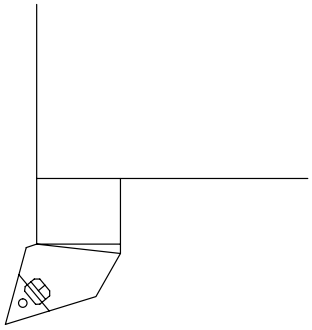
3) Press the HEAD CHANGE switch (head 1) or (head 2) to select the spindle to be rotated. (S type)

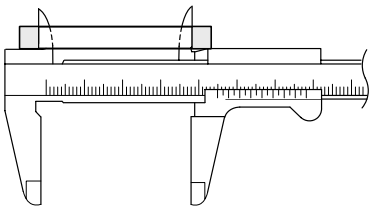
4) Mount the soft jaws to the chuck.

5) Mount the O.D. cutting tool used to cut the soft jaws.

6) Adjust the chucking pressure to the same pressure as used in actual cutting.

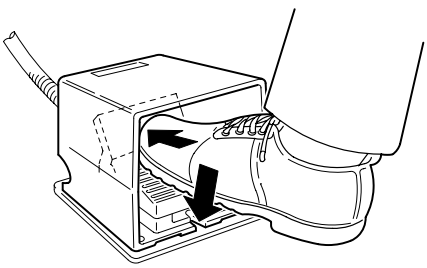
Page C-7 (2-1)





7) Prepare the ring for shaping the soft jaws.
   a) The ring I.D. surface accuracy must be 6S or better.
   b) The ring must be sufficiently thick that it will not be distorted.

Measure and record the plug I.D. with vernier calipers or a cylinder gage.



8) Carry out chuck clamp and unclamp operation to close the chuck.

Page B-32 (7-3)

9) Close the front door.

10) Display the OPERATION PANEL screen.

Function selection key (CUSTOM1)

→ **[OPE. PANEL]**

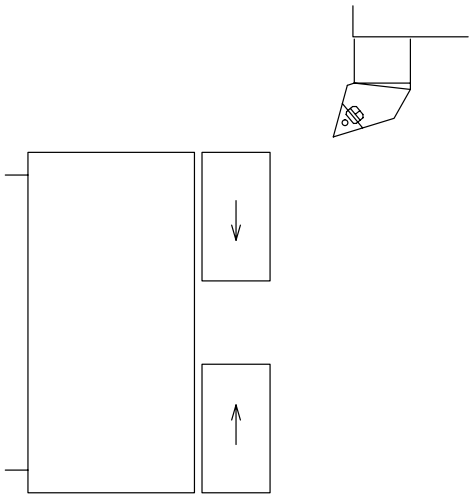
11) Set the chuck clamping direction to the O.D. chucking.

Page B-34 (7-4)

12) Set "INVALID" for CHUCK STROKE END (chuck jaw stroke end detection function) using the cursor control keys.

The status indicator **[CHCL]** is lit.

13) Bring the tool close to the soft jaw manually while observing the clearance between the soft jaw and the tool through the window in the front door.



NOTE When the DOOR INTERLOCK key-switch is placed in the **RELEASE** position, axis movement is possible even if the front door is open. In this case, rapid traverse is restricted to 5 m/min.

14) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.

15) Check for possible interference when the spindle is rotated.

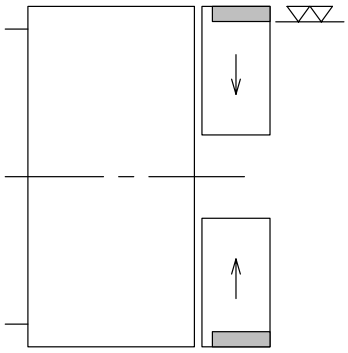
<Example>

- Interference between the adjacent tools and chuck
- Interference between the fixture and chuck

16) After making sure that the spindle can be rotated without interference, close the front door.

17) Start the spindle manually, and adjust the spindle speed as appropriate.

Page B-29 (7-2)



18) Machine the jaws that clamp the ring.

WARNING

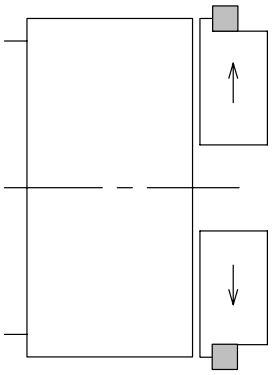
It is dangerous to clamp a workpiece in the chuck with the jaws moved close to the stroke end.

Shape the jaws so that the ring can be clamped within proper jaw stroke range.

Shaping the jaws to "ring diameter − Max. jaw stroke × 1/2" allows the ring to be clamped at the center of jaw stroke.

19) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.



20) Chuck the ring.

CAUTION When chucking the ring for shaping the soft jaws, exercise due care to ensure that your fingers will not get trapped.

NOTE Fit the ring on the chuck so that it is not tilted.

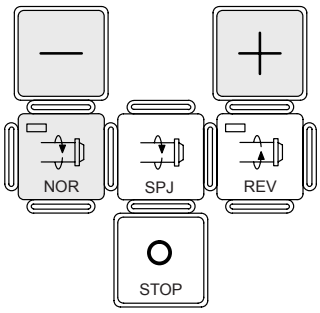
21) Close the front door.

22) Display the OPERATION PANEL screen.

Function selection key (CUSTOM1) → **[OPE. PANEL]**

23) Set the chuck clamping direction to the I.D. chucking.

Page B-34 (7-4)



24) Set "VALID" for CHUCK STROKE END (chuck jaw stroke end detection function) using the cursor control keys.

The status indicator **[CHCL]** is lit.

25) Check for interference by following steps 13) to 15).

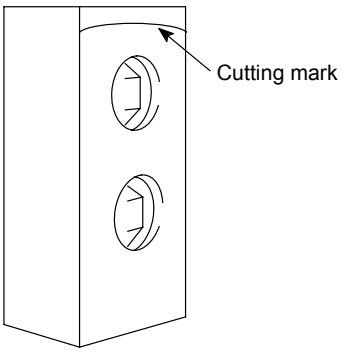
26) After making sure that the spindle can be rotated without interference, close the front door.

27) Start the spindle manually.

Page B-29 (7-2)

28) Set the required spindle speed.

NOTE Determine the spindle speed by considering the soft jaw height, diameter to be cut, and the tool material.



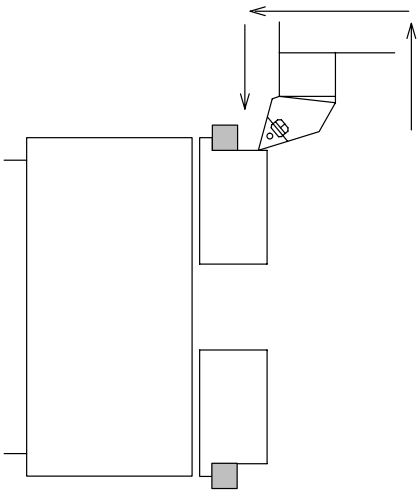
29) Feed the cutting tool on the Z-axis with the manual pulse generator to bring it into contact with and leave a cutting mark on the end faces of the three soft jaws.

Page B-24 (6-4)

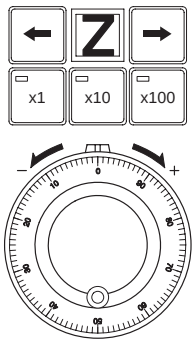
NOTE The diameter of the cutting mark must be larger than the finishing diameter.

30) Display the POSITION (RELATIVE) screen, and reset the W coordinate value to "0".

31) Move the O.D. cutting tool using the manual pulse generator to bring it into contact with the outside face of the soft jaw.



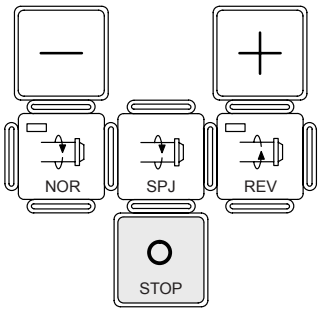
CAUTION Ensure that the tool does not strike the soft jaw or plug.



32) Move the O.D. cutting tool in the +Z direction by handle feed operation.

CAUTION

Never move the cutting tool in the X-axis direction. It could interfere with the soft jaws, damaging the tool and machine.

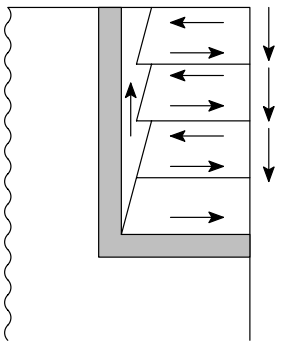


33) Press the ○ (STOP) switch to stop the spindle.

<Example>

Assume that the inner diameter of the ring measured in step 7) is 150 mm.

34) Set the present position data (incremental) to "150.000" mm for U.



35) Cut the soft jaws while checking the diameter and depth of cut by referring to the relative coordinate values on the POSITION (RELATIVE) screen.

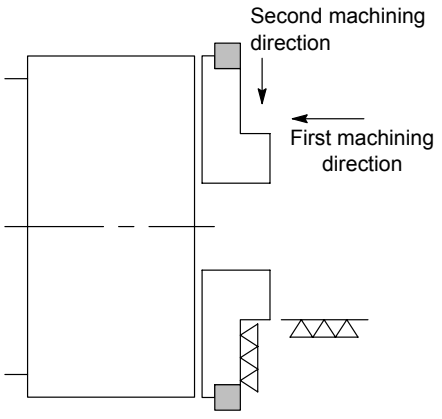
NOTE

The depth of cut should be determined according to the tool and tool projecting length. Make sure that the machined O.D. does not exceed the required diameter.

36) Carry out rough cutting, leaving a 0.1 to 0.2 mm finishing allowance.

NOTE

After finishing rough cutting, chamfer the edges and remove burrs using a file or similar tool.



37) Carry out finishing.

a. Use a new tip.

b. Slightly increase the spindle speed.

c. Machine relief at the O.D. edges.

d. Surface roughness must be 6S or better.

e. Chucking diameter dimensional accuracy is approximately H7 (JIS).

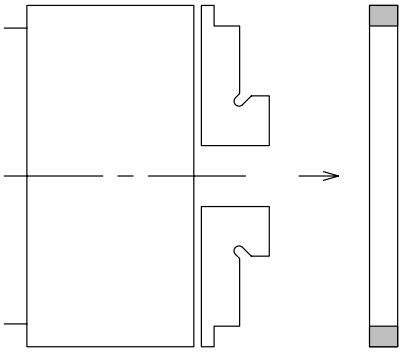
f. The run-out of the cut soft jaws must be less than 0.02 mm on the periphery.

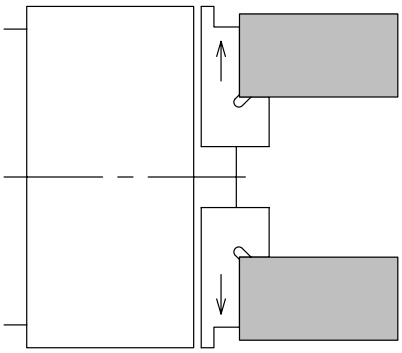
38) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.

39) Open the chuck and remove the ring.

CAUTION When removing the ring for shaping the soft jaws, ensure that your fingers will not be caught.





40) Chuck a workpiece; check the jaw stroke.

4 CHUCK JAW STROKE END DETECTION FUNCTION

When gripping a workpiece, the gripping force of the chuck is low if the workpiece is clamped near the stroke end of the master jaw. Rotating the spindle in this condition is hazardous because the workpiece may disengage from the chuck.

Therefore, the "chuck jaw stroke end detection function" is provided to disable spindle start if a workpiece is clamped by the chuck near the master jaw stroke end. Switches are mounted to the chuck opening/closing cylinder to detect the stroke ends. This prevents the spindle from being started with the workpiece clamped near the master jaw stroke end to ensure the safety of operators.

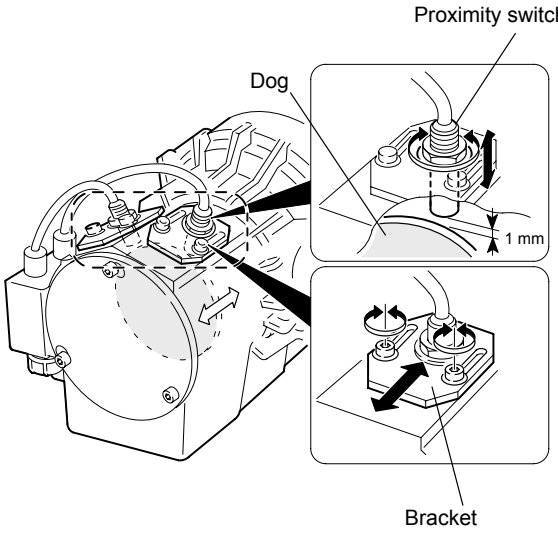
NOTE

1. The chuck jaw stroke end detection function is available only when the machine is shipped with the chuck and cylinder recommended by Mori Seiki.
2. Depending on the chuck and cylinder specification, optional chuck clamp/unclamp detecting switches may be equipped as a substitute for chuck jaw stroke end detecting switches. With the chuck clamp/unclamping detecting switches, it is not possible to detect clamping of a workpiece if it is clamped in the chuck near the master jaw stroke end.

   Depending on the combination of the selected specifications, the chuck jaw stroke end detection switch function or the chuck clamp/unclamping detection switch function may not be installed. For details, contact Mori Seiki.

<Construction>

Location and construction of the detecting switches are shown below.

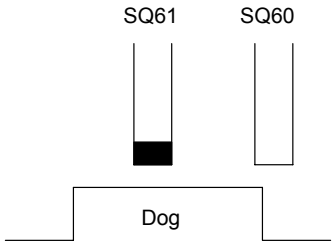
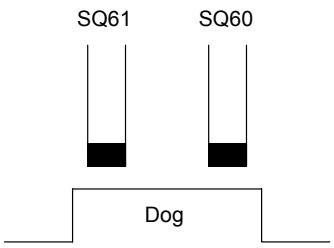
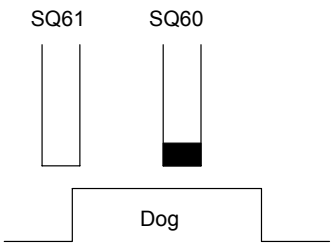
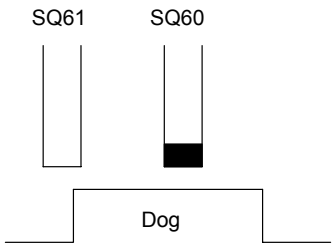
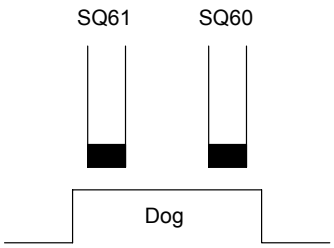
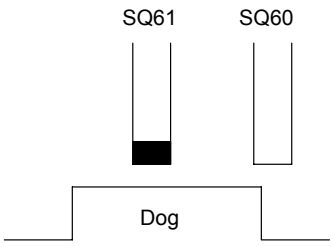


NOTE

1. The illustration shows the construction of a hollow cylinder. This may be different from the cylinder used in your machine.
2. The detecting switch is adjusted before shipping.

<Relationship between the detecting switches and dog>

- SQ60 . . . . . Chuck open detecting switch
- SQ61 . . . . . Chuck close detecting switch

	1. Gripping workpiece near master jaw stroke end	2. Chuck clamp operation	3. Chuck unclamp operation
O.D. chucking			
I.D. chucking			

In the case of state 1., there is a danger that the workpiece will come out of the chuck if the spindle is started because the workpiece is gripped near the master jaw stroke end. Therefore, chuck clamp is not completed in this state.

In the case of state 2., chuck clamp is completed.

In the case of state 3., chuck unclamp is completed.

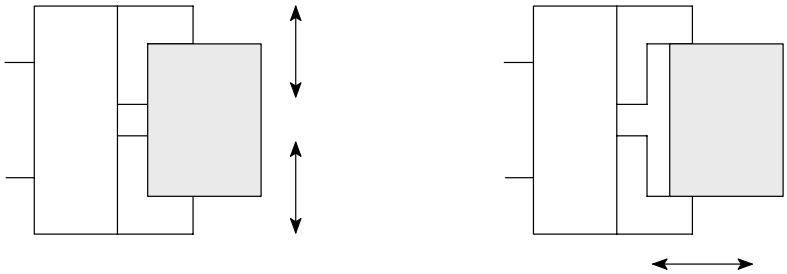
NOTE Since the switches detect the chuck open and close end positions, it is not necessary to adjust the switch positions even when the workpiece type is changed. However, it is necessary to check the switches at regular intervals to determine whether they are functioning correctly.

The position of the switches must be adjusted if the chuck is removed and then mounted again or if the chuck or cylinder is changed.

CAUTION

Although the chuck jaw stroke end detecting switches can detect whether the workpiece is gripped by the chuck within an appropriate master jaw stroke, they cannot detect chucking errors in the chucking face direction; such as not holding on the chuck face correctly, tilting in the chuck, etc.

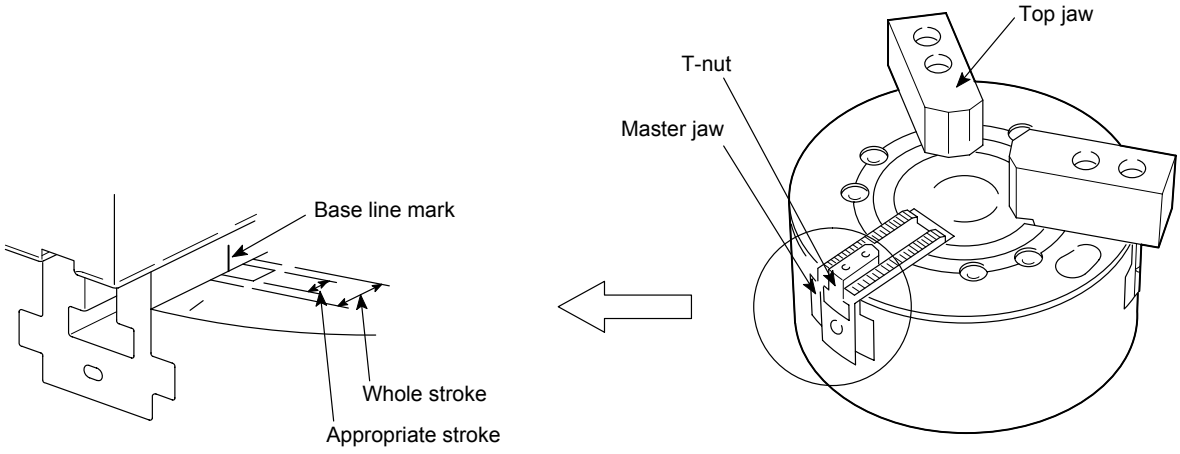
<Detection possible> <Detection impossible>



To detect correct holding of a workpiece in the chuck, use the optional holding detection function.

<Other checking methods>

Some chuck manufacturers supply the chuck with a stroke mark engraved so that the master jaw stroke can be visually checked. If using such a chuck, make sure that the stroke mark is within the appropriate stroke range. For details, refer to the instruction manual supplied by the chuck manufacturer. If no such information is given, consult the chuck manufacturer.



<Setting VALID/INVALID for CHUCK STROKE END>

Since the machine is equipped with the chuck jaw stroke end detecting switches, chuck clamp operation is not completed unless the workpiece is clamped by the chuck within an appropriate master chuck jaw stroke range. Accordingly, operation without a workpiece in the chuck, such as shaping the soft jaws or no-load running of a program, is impossible. To allow operation without a workpiece in the chuck, a function to invalidate the chuck jaw stroke end detection function is provided.

NOTE If the setting for CHUCK STROKE END is changed to "INVALID", the chuck clamp operation is completed in response to the chuck clamp operation disregarding of the signals from the chuck jaw stroke end detecting switches.

The chuck jaw stroke end detection function is made valid or invalid by setting CHUCK STROKE END to VALID or INVALID on the OPERATION PANEL screen.

For the chuck jaw stroke end detection function, refer to page A-31 (5-6-12).

NOTE If the setting for the CHUCK STROKE END is "INVALID", it is automatically changed to "VALID" in the following cases:

1. After the power is turned on
2. After resetting emergency stop state
3. When the M02 or M30 command is read.
4. When the chuck is unclamped.

For 3 and 4, it is possible to make automatic switching to "VALID" impossible by making the appropriate parameter setting. For details, contact Mori Seiki.

CHAPTER D
SETTING OF COORDINATE SYSTEM

This chapter explains the coordinate system used in creating programs and machining workpieces.

There are two kinds of coordinate system settings as follows:

- The coordinate system set using the tool geometry offset function (G00 T_;)
- The work coordinate system (G54 to G59)

CONTENTS

D : SETTING OF COORDINATE SYSTEM

1 COORDINATE SYSTEM D-1

2 CHECK ITEMS WHEN MEASURING AND INPUTTING TOOL OFFSET VALUES D-4

1 COORDINATE SYSTEM

Programs are created based on the coordinate system with the origin (X0, Z0) as the machining zero point.

Therefore, to control tool movement as programmed, it is necessary to inform the NC the physical tool position in the coordinate system at the start of the program.

Usually, the start point is the position that the turret reaches at the zero return position (machine zero point).

This is indicated in the program in the following manner:

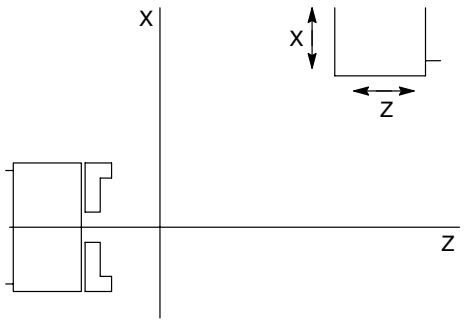
1. G00 T_ ;

   The coordinate system is set using the tool geometry offset function.

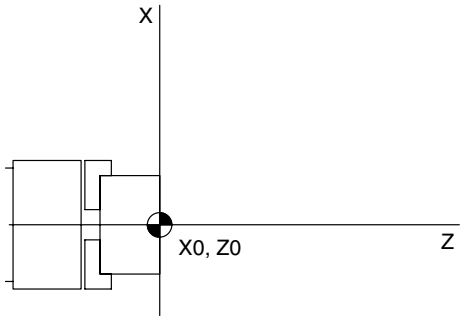
2. G54; - G59;

   The coordinate system is set using the work coordinate system setting G codes (G54 to G59).

This is a brief explanation of a coordinate system.

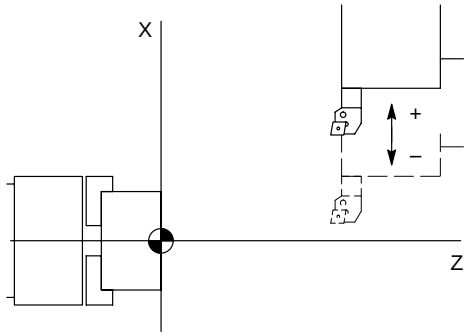


The longitudinal axis is the Z-axis; the axis perpendicular to the Z-axis is the X-axis.



The zero point of the coordinate system is the center of the spindle (X0) and the right end face of the workpiece (Z0).

This point is set as the workpiece zero point.

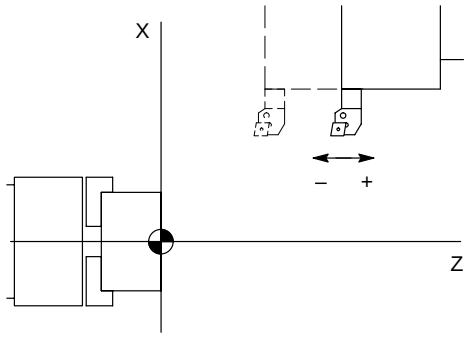


Coordinate system plus/minus sign:

<X-axis>

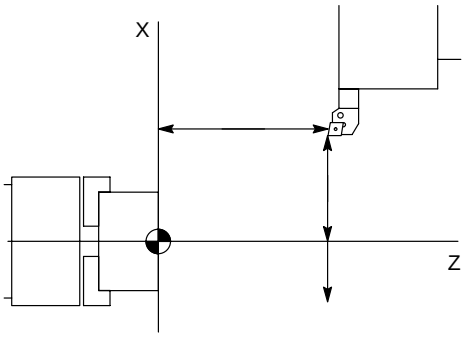
Positive (+)	Direction in which workpiece diameter increases
Negative (–)	Direction in which workpiece diameter decreases

NOTE For the X-axis reversed JIS specification machine, the positive and negative directions of the X-axis are the reverse of those of conventional specification machines.



<Z-axis>

Positive (+)	Direction in which the turret moves away from the workpiece
Negative (–)	Direction in which the turret moves toward the workpiece



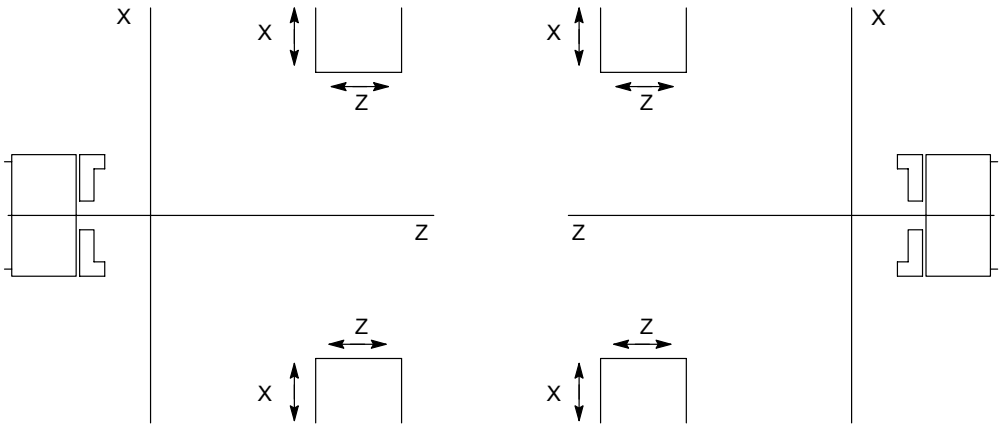
Set the edge position of the cutting tool mounted in the turret in these coordinate systems in the NC.

NOTE Because a diametral command is used for the X-axis, the value to be set is twice the actual distance.

<S type>

The longitudinal axis is the Z-axis; the axis perpendicular to the Z-axis is the X-axis.

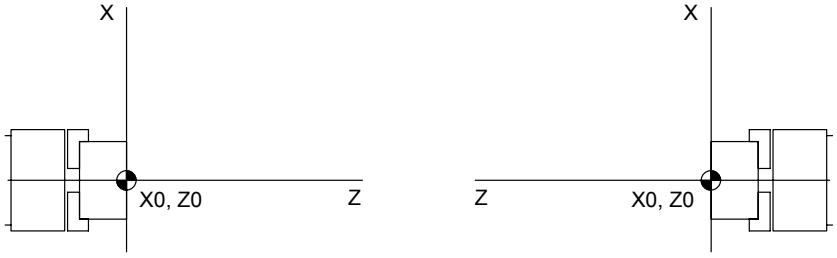
<Headstock 1 side> <Headstock 2 side>



The origin of the coordinate systems is taken at the spindle center and the end face of the workpiece:

The coordinate system for headstock 1:
X0 . . . . .Spindle center
Z0 . . . . .Right end face of the workpiece
The coordinate system for headstock 2:
X0 . . . . .Spindle center
Z0 . . . . .Left end face of the workpiece

<Headstock 1 side> <Headstock 2 side>



Coordinate system plus/minus sign:

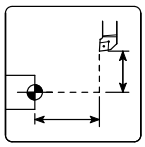
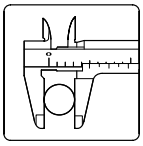
<X-axis>

Positive (+)	Direction in which workpiece diameter increases
Negative (–)	Direction in which workpiece diameter decreases

NOTE For the X-axis reversed JIS specification machine, positive and negative directions of the X-axis are reversed from those applied to conventional specification machines.

2 CHECK ITEMS WHEN MEASURING AND INPUTTING TOOL OFFSET VALUES

The items that must be carefully checked when measuring and inputting the tool offset data are indicated in the table below. Use this table when carrying out the work to ensure correct operation.

		Check Items	Check Column
 Tool Offset	1.	Is due consideration given to possible interference during measurement of tool offset data?	
	2.	Are the spindle speed, feedrate, and depth of cut used for measuring tool offset data appropriate?	
	3.	Is the standard tool selection appropriate?	
	4.	Is the measured dimension correct?	
	5.	Is the calculation for offset data correct?	
	6.	Is the offset direction correct?	
	7.	Is the tool offset number correct?	
	8.	Are the tool geometry offset data, tool wear offset data, and coordinate system used for offset identified correctly?	
 Measuring		**Check Items**	**Check Column**
	1.	Is the measuring instrument functioning correctly?	
	2.	Is the choice of measuring instrument correct?	
	3.	Is the measuring order correct?	
	4.	Is the measuring method appropriate?	
	5.	Is the area to be measured indicated clearly?	
	6.	Is the area to be measured free of chips and coolant?	
	7.	Are the dimensions measured after the rough cutting process?	
	8.	Is the workpiece cool when the dimensions are measured?	

CHAPTER E PREPARATION BEFORE STARTING MASS PRODUCTION

This chapter explains the procedures for checking a program and finishing a workpiece within the specified tolerance before starting mass production. The checkups before starting mass production are also explained.

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E : PREPARATION BEFORE STARTING MASS PRODUCTION

1 CONDITIONS FOR STARTING AUTOMATIC OPERATION E-1

2 CHECK ITEMS WHEN EXECUTING NO-LOAD RUNNING, TEST CUTTING, MEASUREMENT, AND MASS PRODUCTION E-3

3 CHECKS BEFORE STARTING MASS PRODUCTION E-6

4 PROGRAM CHECK E-8

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5 CHECKING A PROGRAM USING MACHINE LOCK FUNCTION E-9

6 CHECKING A PROGRAM WITHOUT CHUCKING A WORKPIECE E-12

6-1 Precautions on Using the Spindle OFF Mode Function E-13

6-2 Checking a Program by Using the Spindle OFF Mode Function E-14

7 CHECKING THE PROGRAM WITH A WORKPIECE CLAMPED IN THE CHUCK . . . E-18

8 TO FINISH A WORKPIECE WITHIN THE SPECIFIED TOLERANCE WITH THE TOOL WEAR OFFSET FUNCTION (TEST CUTTING) E-23

9 SETTING THE INHIBITED TOOL ENTRY ZONE E-28

10 REMOVING CHIPS ENTANGLING WORKPIECE E-29

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12-2 Total Counter (Option) E-36

1 CONDITIONS FOR STARTING AUTOMATIC OPERATION

For carrying out memory (tape) mode operation to check the program, to execute test cutting, or to run the program for mass production, or for carrying out MDI mode operation, the conditions required for automatic operation must be satisfied.

If the automatic operation does not start even if the (START) switch is pressed, check the following items if they are satisfied.

CAUTION

The conditions indicated below are the conditions to turn on the automatic operation start circuit in the NC unit. Workpiece mounted conditions, pressure setting, tool offset setting, etc. must be checked by the customer according to the customer's operation needs.

<Conditions>

1. The front door is closed.

   For details, refer to "DOOR INTERLOCK FUNCTION".

2. The PANEL key-switch is placed in the (OFF) position.
3. An automatic operation mode (memory, tape, MDI) is selected.
4. The chuck is clamped.
   (The status indicator **[CHCL]** is lit.)
5. The NC and the machine are free of program error and machine error.
   (The status indicator **[ERR]** is not lit.)
6. The turret is indexed to the correct position.
   (The status indicator **[TRCL]** is lit.)
7. If the spindle is rotating, the spindle speed attained signal has been turned on.
8. Restart of spindle rotation is not valid when automatic operation is temporarily suspended.*1
9. External start interlock signal (the signal which disables spindle rotation) is not input.
10. All axes have been returned to the zero point after the machine lock function is switched from valid to invalid.
11. The spindle OFF mode function is invalid.
12. The steady rest has been opened/closed.
13. The steady rest has been extended or retracted.
14. For operation in the memory mode, the steady rest base is clamped.

NOTE

It is possible to start automatic operation in the MDI mode.

15. For the manual steady rest specification, the steady rest has been clamped or unclamped.
16. The tailstock spindle is not in the inching state (tailstock specification).
17. If the tailstock spindle interlock function is valid, the tailstock spindle is in the OUT position (tailstock specification).
18. The tailstock body is clamped (tailstock specification).

19. The work counter is not in the counted up state (work counter specification).
20. If the rotary tool spindle is rotating, the spindle speed arrived signal has been turned on (M type).
21. Restart of rotary tool spindle rotation is not valid when the automatic operation is temporarily suspended (M type).
22. The bar stock in the bar feeder is not used up (bar feeder specification).
23. The start interlock is disabled.*2

NOTE

*1 Condition that spindle has stopped by having switched the machine operation mode from automatic to manual. (Reset is not completed)

*2 When the machine is reset during automatic operation in the memory mode (including feed hold state), the start interlock becomes enabled. This interlock function prevents restarting of automatic operation with modal information such as offset data being canceled that may lead to interference between the tool and the workpiece. If an attempt is made to run a program in the memory mode with the start interlock function enabled, the message "EX5004 CHECK PROGRAM START POSITION" is displayed and the automatic operation will not start. To reset the start interlock function, perform any of the following operations.

- Program number search (including work No. search from external devices)
- Operation mode change
  When the operation mode is changed from the memory mode to another mode or when the program edit mode is selected, the start interlock function is disabled.

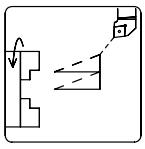
2 CHECK ITEMS WHEN EXECUTING NO-LOAD RUNNING, TEST CUTTING, MEASUREMENT, AND MASS PRODUCTION

The items that must be carefully checked when checking the program, offset data, and possible interference by executing no-load running of a program and test cutting for starting mass production are indicated in the table below. Use this table when carrying out the work to ensure correct operation.

For the items to be checked, also refer to 3 "CHECKS BEFORE STARTING MASS PRODUCTION".

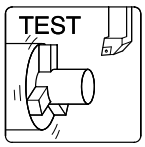
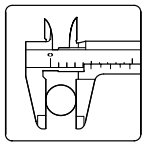
WARNING

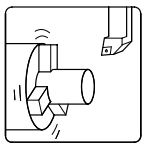
The chuck gripping force is reduced when the spindle is rotated since the rotation applies centrifugal force to the chuck jaws. This reduction of the chuck gripping force could cause the workpiece to fly out of the chuck during machining, causing serious injuries or damage to the machine. Therefore, when checking a program, measure the chuck gripping force that will actually be applied when the spindle is rotated at the speed used for machining by using a gripping force meter. If the measured chuck gripping force value is lower than that required to hold the workpiece safely, change machining conditions such as the chucking pressure, spindle speed, feedrate, and depth of cut.
Periodically measure the chuck gripping force with a gripping force meter to make sure that the required gripping force is maintained. If it is not, consult the chuck manufacturer and cylinder manufacturer.
For details on the relationship between the spindle rotation speed and chuck gripping force, refer to the instruction manuals prepared by the chuck manufacturer and cylinder manufacturer.



No-load Running

	Check Items		Check Column
	1.	Is the chucking pressure checked and adjusted?	
	2.	If performing center-work, is the tailstock spindle thrust checked and adjusted?	
	3.	When performing center-work or machining using spindle 2, is the tailstock or spindle 2 free of interference with tool and holders?	
	4.	Is the single block function turned on?	
	5.	Are the feedrate and spindle speed appropriate for operation?	
	6.	Are the feed modes (rapid traverse and cutting feed) used correctly?	
	7.	Is the tool retraction direction after cutting correct?	
	8.	Is tool movement smooth in the calculated area?	
	9.	Are the tools free of interference with the workpiece, jaws, and chuck?	
	10.	Is the turret head indexed at a position where there is no interference with the workpiece?	
	11.	Can the machine be stopped immediately when necessary?	
	12.	Is the front door closed?	

		Check Items	Check Column
 Test Cutting	1.	Is the chucking pressure checked and adjusted?	
	2.	If performing center-work, is the tailstock spindle thrust checked and adjusted?	
	3.	When performing center-work or machining using spindle 2, is the tailstock or spindle 2 free of interference with tool and holders?	
	4.	Is the single block function turned on?	
	5.	Are the feedrate and spindle speed appropriate for operation?	
	6.	Are the order of machining and machining conditions determined in accordance with the shape and material of the blank workpiece?	
	7.	Are cutting tools and replaceable tool tips selected properly?	
	8.	Is the workpiece chucking method correct?	
	9.	Is the progress of cutting been observed?	
	10.	Are coolant supply volume and direction correct?	
	11.	Are the cutting tools free of interference with the workpiece, jaws and chuck?	
	12.	Are the dimensions measured after the rough cutting process?	
	13.	Are the settings for feed override, rapid traverse override and spindle speed override correct?	
	14.	Can the machine be stopped immediately when necessary?	
	15.	Is the front door closed?	
 Measuring		**Check Items**	**Check Column**
	1.	Is the measuring instrument functioning correctly?	
	2.	Is the choice of measuring instrument correct?	
	3.	Is the measuring order correct?	
	4.	Is the measuring method appropriate?	
	5.	Is the area to be measured indicated clearly?	
	6.	Is the area to be measured free of chips and coolant?	
	7.	Are the dimensions measured after the rough cutting process?	
	8.	Is the workpiece cool when the dimensions are measured?	

 Mass Production	Check Items		Check Column
	1.	Are all NC functions such as single block functions used to check the program turned off?	
	2.	Is dimensional variation checked?	
	3.	Are run-out on I.D. and O.D., and end face waviness measured?	
	4.	Is a target work time established on the basis of the machining time for one workpiece?	
	5.	Is tool nose wear observed?	
	6.	Are the dimensions measured after the rough cutting process?	
	7.	Is the front door closed?	

3 CHECKS BEFORE STARTING MASS PRODUCTION

This section lists the minimum items which must be checked before starting mass production. Always check these items in addition to the working environment before starting automatic operation.

Before pressing the (START) switch to start automatic operation, make sure that the dry run function is invalid (OFF) and that all other switches, such as the spindle override switch, the rapid override switch, and the feedrate override switch are set to the proper position. If automatic operation is started with the dry run function valid (ON) or any of the override switches set incorrectly, the axes could be fed in an unexpected manner and the spindle could be rotated at an unexpected speed, leading to accidents involving serious injuries or damage to the machine.

Check the interlock setting	**Check Items**			**Check Column**
	1.	Chuck interlock	Valid	
	2.	Front door interlock	Valid	
	3.	Tailstock interlock (when holding a workpiece using the tailstock)	Valid	
	4.	PANEL key-switch	(OFF)	
Check the clamped conditions	**Check Items**			**Check Column**
	1.	Tool tip	Appropriate	
	2.	Cutting tool shank	Appropriate	
	3.	Workpiece	Appropriate	
	4.	Tool holder	Appropriate	
	5.	Soft jaws	Appropriate	
	6.	Fixture	Appropriate	
Check the pressure	**Check Items**			**Check Column**
	1.	Chuck pressure	Appropriate	
	2.	Tailstock spindle thrust force (when holding a workpiece using the tailstock)	Appropriate	
Check the override switch settings	**Check Items**			**Check Column**
	1.	Rapid traverse rate override value	Appropriate	
	2.	Feedrate override value	Appropriate	
	3.	Spindle speed override value	Appropriate	

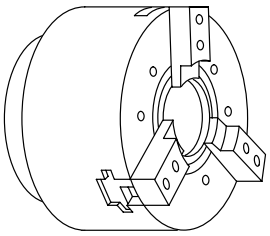
Check the functions	**Check Items**			**Check Column**
	1.	Single block	Invalid	
	2.	Optional stop	Invalid	
	3.	Dry run	Invalid	
	4.	Machine lock	Invalid	
	5.	Auxiliary function lock	Invalid	
	6.	Spindle OFF mode	Invalid	
Check the status indicator lamps	**Check Items**			**Check Column**
	1.	Chuck clamp **[CHCL]**	Lit	
	2.	Turret index completion **[TRCL]**	Lit	
	3.	Machine ready **[MRDY]**	Lit	
	4.	Zero return completed **[X, Z]**	Lit	
Check the tool offset data (Record the work shift data before ending operation for the day. Check the data before starting mass production for the day.)	**Check Items**			**Check Column**
	1.	Tool geometry offset data	Appropriate	
	2.	Work shift data	Appropriate	
	3.	Tool wear offset data	Appropriate	
Check the program	**Check Items**			**Check Column**
	1.	Program No.	Appropriate	
	2.	Program contents	Appropriate	

4 PROGRAM CHECK

After creating a program, it is necessary to check it for the purposes of debugging (to find program errors, wrong tool offset data, interference, etc.).

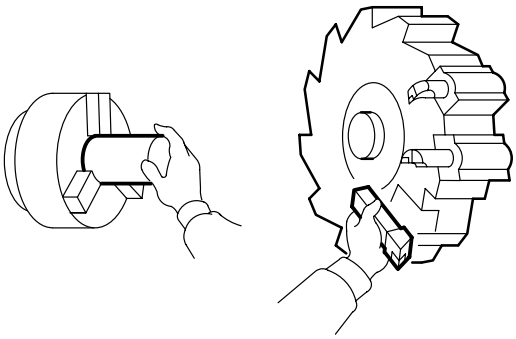
4-1 Preparations for Checking a Program

This section describes the preparatory steps for checking a program.



1) Shape the soft jaws appropriately for the material and shape of the workpiece, chucking method (inside chucking or outside chucking), etc.
It is necessary to shape the soft jaws so that the workpiece can be clamped in the chuck stably.

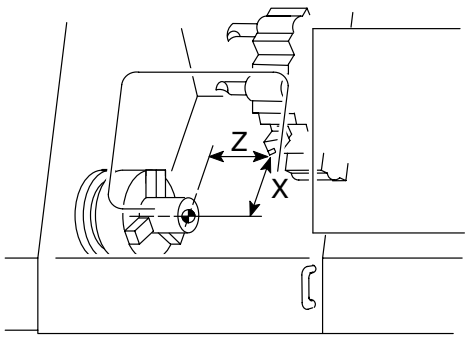
Chapter C "SHAPING SOFT JAWS FOR FINISHING"



2) Mount the tools and the workpiece in the machine by moving the axes and indexing the turret head manually.

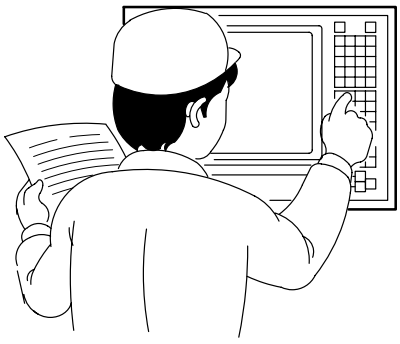
NOTE For center-work operation, move the tailstock spindle OUT to hold the workpiece.

- Chapter B "MANUAL OPERATION"
- "TOOLING SYSTEM" in the MAINTENANCE INFORMATION



3) Set the workpiece zero point.

Chapter D "SETTING OF COORDINATE SYSTEM"



4) Input the created program to the NC memory using the keyboard on the operation panel or the external I/O device.

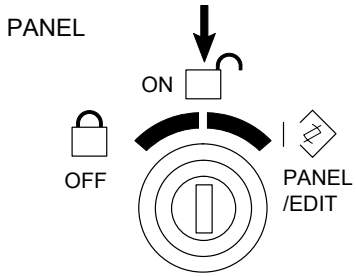
Instruction manual supplied by the NC unit manufacturer

5 CHECKING A PROGRAM USING MACHINE LOCK FUNCTION

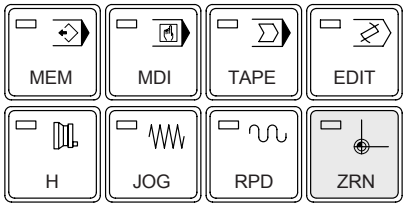
This section describes the procedure used for checking the program stored in the NC by displaying the list of the program on the screen while executing it using the machine lock function. Since the program is executed in the machine lock status, the axes do not move but only the position data on the screen is updated as the program is executed.

NOTE When using the NC functions, refer to page A-23 (5-6) to find the details of them.

1) Carry out the procedure explained in 4-1 "Preparations for Checking a Program".
2) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
3) Close the front door.



4) Place the PANEL key-switch in the (ON) position.



5) Carry out the zero return operation.

Page B-18 (6-1)

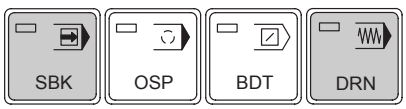
6) Display the OPERATION PANEL screen.

Function selection key (CUSTOM1)

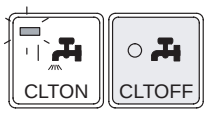
→ **[OPE. PANEL]**

7) Move the cursor to MACHINE LOCK "ON" to make the machine lock function valid.

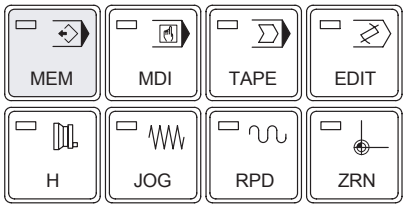
NOTE For items 8) and 9) below, determine whether or not the corresponding function should be used.



8) Press the single block switch to make the single block function valid.
9) Press the dry run switch to make the dry run function valid.



10) If there is an M08 (coolant ON) command in the program, press the (CLTOFF) switch for 1 second or more to make the coolant OFF mode valid.



11) Select the memory mode ( ) with the mode selection switch.

12) Press the head selection switch (head 1) or (head 2) to select the required turret.

13) Display the PROGRAM (memory) screen.

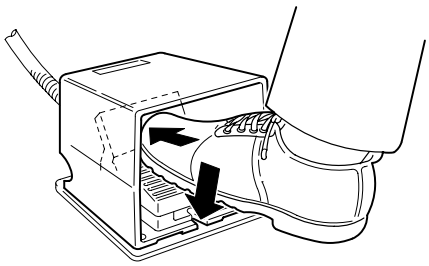
14) Search for the program.

15) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.

16) Operate the chuck to clamp a workpiece.

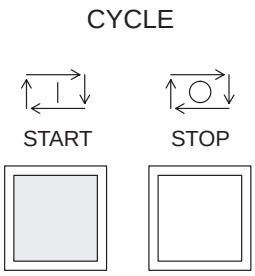
Page B-32 (7-3)



17) Close the front door.

NOTE Make sure that you can press the EMERGENCY STOP button or the (STOP) switch immediately if an abnormality occurs.

18) Press the (START) switch.



NOTE

1. Because the machine lock function is valid, the axes do not move even if the program is executed. Only the position data on the screen is updated.
2. When the single block function is valid, program execution stops after each program block. To advance to the next block, press the (START) switch again.
   The single block function is used to check the following
   - Tool mounting order
   - Spindle speed
3. If the coolant OFF mode is currently valid, coolant will not be supplied even if an M08 (coolant ON) command in the program is carried out.

WARNING

Before switching the machine lock function from "valid" to "invalid", wait until one program operation cycle has been completed. After switching from "valid" to "invalid", always execute a zero return operation. Switching between "valid" and "invalid" during program execution will create a discrepancy between the position designated in the program and the actual machine position, which could cause accidents involving serious injuries or damage to the machine.

6 CHECKING A PROGRAM WITHOUT CHUCKING A WORKPIECE

This section describes the procedure for checking tool paths by executing automatic operation (no-load running) without a workpiece clamped in the chuck.

When checking a program without chucking a workpiece, the spindle OFF mode function should be made valid, and automatic operation executed without spindle rotation and coolant supply to check the tool offset amounts, interference between tools and a chuck (jaws), etc.

When the spindle OFF mode function is valid, the following M code commands are not executed in automatic operation. Although axis movement commands are executed, the axes are moved at the feedrate set by the OVERRIDE dial since the dry run function is valid.

<M codes not available in the spindle OFF mode>

M Code	Function
M03	Spindle start (normal)
M04	Spindle start (reverse)
M08	Coolant supply
M13	Rotary tool spindle start (normal) (M type)
M14	Rotary tool spindle start (reverse) (M type)
M19	Spindle orientation (option)
M64	Robot service call (robot specification)
M203	Spindle 2 start (normal) (S type)
M204	Spindle 2 start (reverse) (S type)
M219	Spindle 2 orientation (option) (S type)
M319	Rotary tool spindle zero point return (M type)
M382	Chip removal coolant ON (option)
M384	Spindle orientation and ceiling shutter open (option)

6-1 Precautions on Using the Spindle OFF Mode Function

The items to be taken into consideration when checking a program by using the spindle OFF mode function are indicated below.

1. The valid/invalid state of the spindle OFF mode function cannot be changed during automatic operation.
2. The spindle OFF mode function is set to invalid when the power is turned on.
3. While the spindle is rotating or while the rotary tool spindle is rotating (M type), it is not allowed to change the spindle OFF mode function valid.
4. When the spindle OFF mode function is valid, manual rotation of the spindle and the rotary tool spindle (M type) is not possible. Note that jogging the spindle and the rotary tool spindle (M type) is allowed.
5. When the spindle OFF mode function is valid, coolant is supplied when the  (CLTON) switch is pressed.
6. When the spindle OFF mode function is valid, an alarm (EX4014) occurs when the  (START) switch is pressed if a workpiece is clamped in the chuck (the status indicator **[CHCL]** is lit).
7. The dry run function is automatically made valid when the spindle OFF mode function is made valid. In this state, it is possible to make the dry run function valid/invalid by pressing the dry run switch  .
8. In the spindle OFF mode function valid state, if an axis move command is executed in the feed per revolution mode with the dry run function made invalid, axis movement stops.
9. If M10 (chuck clamp) command is executed in the spindle OFF mode function valid state, the status indicator **[CHCL]** is lit after the completion of the specified operation.

6-2 Checking a Program by Using the Spindle OFF Mode Function

The procedure to check a program by using the spindle OFF mode function, without a workpiece clamped in the chuck, is described below.

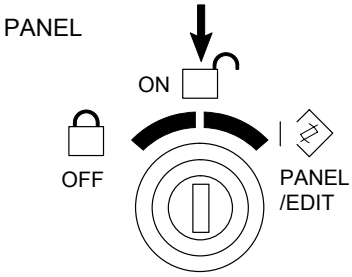
NOTE

1. When using the NC functions, refer to page A-23 (5-6) to find the details of them.
2. After making the spindle OFF mode function invalid, it is also possible to check a program by actually executing it without a workpiece mounted in the machine.
   In this case, set INVALID for CHUCK STROKE END by displaying the OPERATION PANEL screen and place the chuck in the clamped state.

Page A-31 (5-6-12)

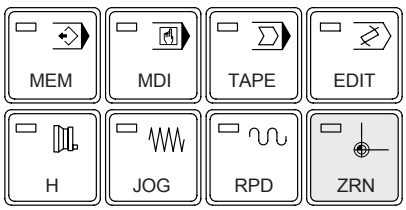
Make the dry run function invalid and coolant off mode valid if considered necessary for the program testing situation.

1) Carry out the procedure explained in 4-1 "Preparations for Checking a Program".
2) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
3) Close the front door.



4) Place the PANEL key-switch in the (ON) position.

5) Press the head selection switch (head 1) or (head 2) to select the required turret.



6) Carry out the zero return operation.

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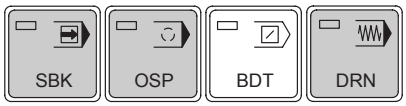
7) Display the OPERATION PANEL screen.

Function selection key (CUSTOM1)

→ **[OPE. PANEL]**

8) Move the cursor to SPINDLE OFF MODE "VALID" to make the spindle OFF mode function valid.

The indicators in the (STOP) switch and dry run switch begin blinking.
The dry run function becomes valid at this time.



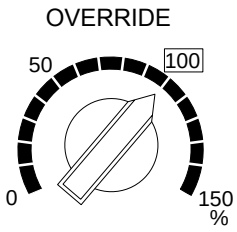
9) Press the single block switch to make the single block function valid.

NOTE For items 10) and 11) below, determine whether or not the corresponding function should be used.

10) Press the optional stop switch to make the optional stop function valid.

11) If the dry run function should be made invalid, for example to check a milling operation program, press the dry run switch to turn the indicator in the switch off.

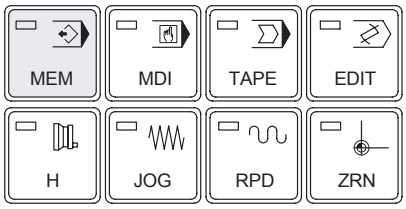
NOTE For programs in which the cutting feedrate is expressed as the amount of feed per revolution of the spindle, a program check is not possible even if the dry run function is made invalid.



12) Set the feedrate to be adopted for axis movements with the OVERRIDE dial.

For the relationship between the OVERRIDE dial setting and actual feedrate, refer to page A-42 (5-11).

13) Make sure that the rapid traverse rate override and spindle override is set correctly.

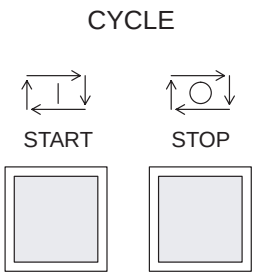


14) Select the memory mode ( ) with the mode selection switch.

15) Select the turret operation mode by pressing the head selection switches (head 1) and (head 2) simultaneously.

16) Display the PROGRAM (memory) screen.

17) Search for the program to be used for machining.

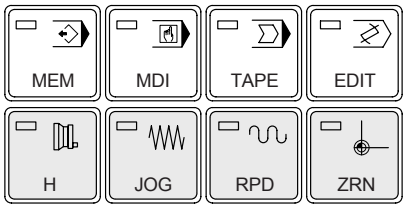


18) Press the (START) and (STOP) switches alternately. Check the turret motion and the displayed data on the PROGRAM screen.
Check the interference between the tool/chuck and workpiece.

NOTE
1. The program stops at each block since the single block function is valid.
   However, press the (STOP) switch if the X- or Z-axis starts moving.
2. Since the spindle OFF mode function is set valid, the M code commands specified to be executed are not executed in this state.

19) Check the clearance between the cutting tool and the chuck in comparison with the data for "DIST. TO GO" which is displayed on the screen.

NOTE If there is a possibility of interference between the tool and the chuck, stop no-load running and correct the program. Then, check the program again.



20) After the completion of the first axis movement block, select any of the following modes with the mode selection switch.

(H) (JOG)

(RPD) (ZRN)

21) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

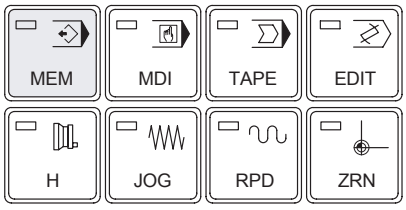
NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.

22) Check the distance between the tools and the distance between the tool or the fixture to the chuck using a scale.

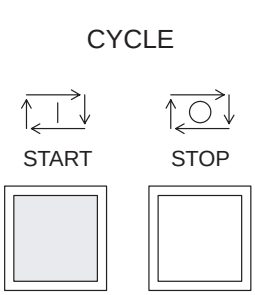
NOTE Measure the distance for all the tools to check for possible interference.

CAUTION When automatic operation has been suspended and the manual mode selected, never move an axis or index the turret manually. If it is necessary to manually move an axis or index the turret, return the axis or the turret to the previous position before restarting the no-load running of the program. If the no-load running is restarted after indexing other tool or without returning to the previous position, a tool may strike the chuck or other problems may occur, causing damage to the machine.

23) If the measured clearance is appropriate and there is no possibility of interference, close the front door.



24) Select the memory mode ( ) with the mode selection switch.



25) Press the (START) switch.

The program restarts.

7 CHECKING THE PROGRAM WITH A WORKPIECE CLAMPED IN THE CHUCK

To check the program (tool paths) by executing automatic operation (no-load running) with a workpiece clamped in the chuck, shift the coordinate system before executing the program.

The procedure to shift the coordinate system and the shift amount vary depending on the workpiece.

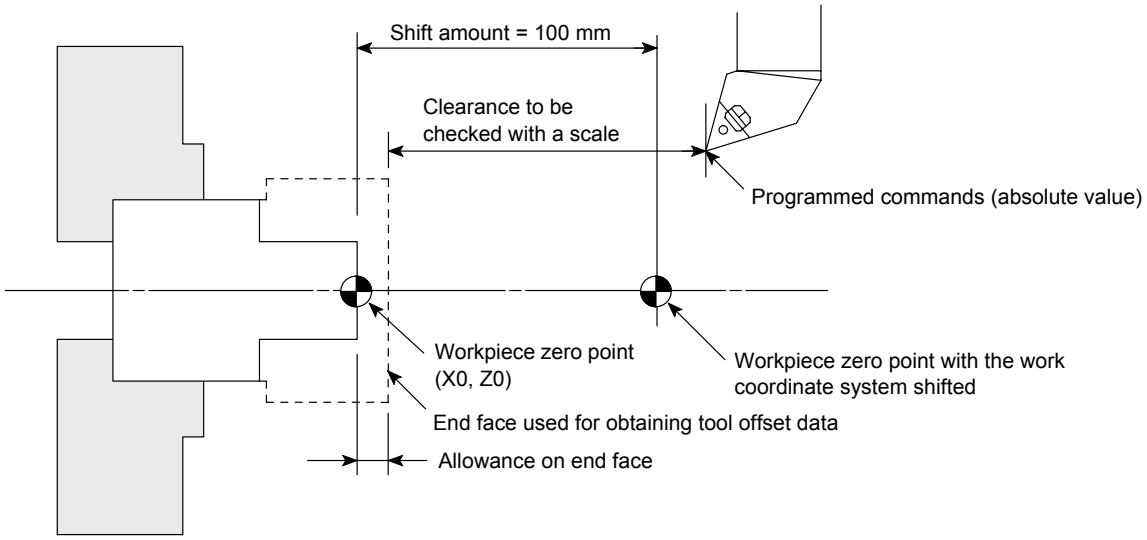
In this section, the procedure used to check a program by shifting the coordinate system in the Z-axis direction is described.

CAUTION

There are variety of types of workpieces which are machined by the customer. Chucking methods will vary according to the workpiece type as well. Therefore, when checking the program with a workpiece clamped in the chuck, pay sufficient attention to interference, taking the workpiece shape and chucking method into consideration.

<Example>

To shift the coordinate system 100 mm in the +Z-axis direction



The clearance between the tool nose and the end face used for obtaining the tool offset data is:
[Shift amount (100 mm)] + [Z-coordinate specified in the program] − [Allowance on end face]

CAUTION

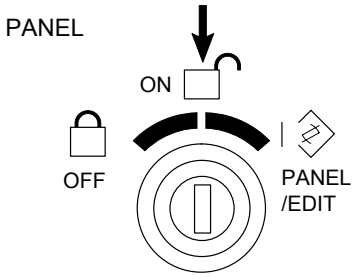
1. When "−100.0" is added to "COMMON Z" with the headstock 2 specification machines, the spindle 2 side is also shifted 100.0 in the plus Z-axis direction, causing possible interference. To shift the spindle 2 side more safely, provide separate coordinate systems for spindle 1 and spindle 2 sides, such as G54 for the spindle 1 side and G55 for the spindle 2 side, and then enter "100.0" for "G54 Z" and "−100.0" for "G55 Z". If the spindle 2 side is shifted using "COMMON Z", pay extra attention to the sign of the entered value.
2. When shifting the coordinate system, determine the appropriate shift amount taking into consideration the workpiece shape and conditions. When a blank workpiece is used for program check, for example, the cutting tool may strike the workpiece if the shift amount is insufficient.
3. When executing no-load running of a program by shifting the work coordinate system, pay attention to the interference of the cutting tool with the tailstock etc.

NOTE

1. When using the NC functions, refer to page A-23 (5-6) to find the details of them.
2. Depending on workpiece shapes and machine specifications, there may be cases that the work coordinate system is shifted in the X-axis direction. There may also be cases that no-load running of a program is executed after removing a workpiece from the chuck instead of entering the work coordinate system shift data.
3. When checking the program by shifting the coordinate system in the Z-axis direction, input a negative value for the shift amount on the spindle 1 side, and input a positive value for the shift amount on the spindle 2 side.
4. Correct the program after program check if necessary.
5. After finishing the program check, always reset the shift amount to its original value.

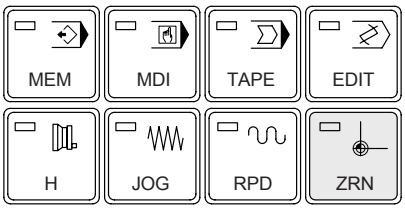
The procedure to check the program by shifting the coordinate system 100 mm in the Z-axis direction is explained below:

1) Carry out the procedure explained in 4-1 "Preparations for Checking a Program".
2) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
3) Close the front door.



4) Place the PANEL key-switch in the [🔓] (ON) position.

5) Press the head selection switch [①] (head 1) or [②] (head 2) to select the required turret.
6) Carry out the zero return operation.



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7) Display the WORK COORDINATES screen.
8) Set the Z-axis shift amount 100 mm for "Z" in the "EXT" column.
Input "−100.0" using the data entry keys.

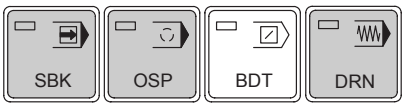
NOTE

1. To input the Z-axis shift amount for spindle 2, press the following keys in order (S type):

[1] [0] [0] [.] [0]

NOTE

2. Make sure the sign for the entered value is correct.
3. If the INPUT key is pressed, the value having been input with data entry keys is input for the work shift offset data (Z-axis). Therefore, make sure to press the **[+ INPUT]** soft-key.



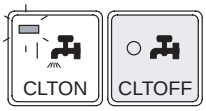
9) Press the single block switch to make the single block function valid.

NOTE For items 10) and 11) below, determine whether or not the corresponding function should be used.

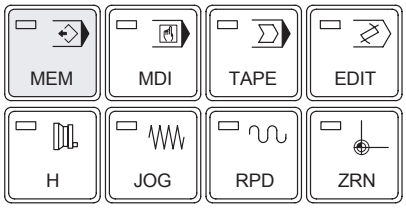
10) Press the optional stop switch to make the optional stop function valid.

11) Press the dry run switch to make the dry run function valid.

12) Make sure that the rapid traverse rate override, feedrate override, and spindle override are set correctly.



13) If there is an M08 (coolant ON) command in the program, press the (CLTOFF) switch for 1 second or more to make the coolant OFF mode valid.



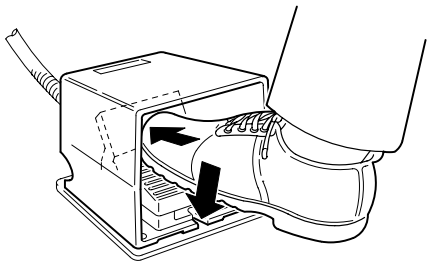
14) Select the memory mode ( ) with the mode selection switch.

15) Select the turret operation mode by pressing the head selection switches (head 1) and (head 2) simultaneously.

16) Display the PROGRAM (memory) screen, and search for the program to be used for machining.

17) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.



18) Operate the chuck to clamp a workpiece.

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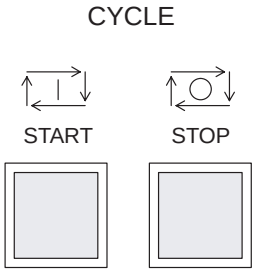
- Page C-7 (2-1)

19) Close the front door.

NOTE Make sure that you can press the EMERGENCY STOP button or the (STOP) switch immediately if an abnormality occurs.

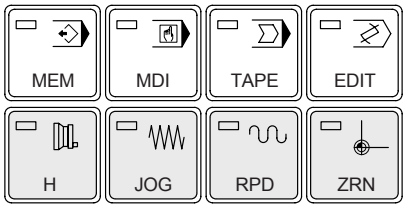


20) Check the tool motion on the PROGRAM screen by pressing the (START) and (STOP) switches alternately.
Check the interference between the tool and the workpiece or the chuck.

NOTE
1. The program stops at each block since the single block function is valid.
   However, press the (STOP) switch if the X- or Z-axis starts moving.
2. If the coolant OFF mode is currently valid, coolant will not be supplied even if an M08 (coolant ON) command in the program is carried out.

21) Check the clearance between the cutting tool and the chuck in comparison with the data for "DIST. TO GO" which is displayed on the screen.

NOTE If there is a possibility of interference between the tool and the chuck, stop no-load running and correct the program. Then, check the program again.



22) After the completion of the first axis movement block, select any of the following modes with the mode selection switch.

(H) (JOG)

(RPD) (ZRN)

The spindle stops rotating when any of these modes is selected.

23) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

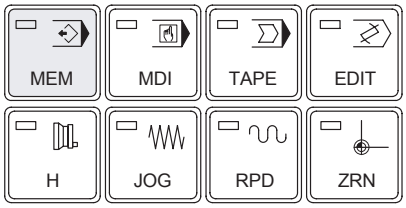
NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.

24) Measure the distance between the tool and the workpiece. Also measure the distance between adjacent tools and the distance between the fixture and the chuck.

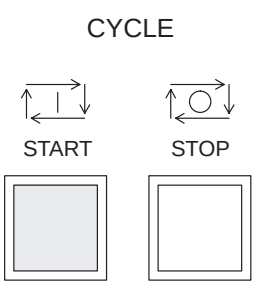
NOTE Measure the distance for all the tools to check for possible interference.

CAUTION When automatic operation has been suspended and the manual mode selected, never move an axis or index the turret manually. If it is necessary to manually move an axis or index the turret, return the axis or the turret to the previous position before restarting the program. If the program is restarted after indexing other tool or without returning to the previous position, a tool may strike the chuck or other problems may occur, causing damage to the machine.

25) If the measured clearance is appropriate and there is no possibility of interference, close the front door.



26) Select the memory mode ( ) with the mode selection switch.



27) Press the (START) switch.

The spindle starts rotating at a speed selected before stopping.

28) Press the (START) switch again.

The program restarts.

29) If there are no problems found in the restarted program, reset the shift data to its original value after the completion of the program.

NOTE If the INPUT key is pressed, the value having been input with data entry keys is input for the work shift offset data (Z-axis). Therefore, make sure to press the **[+ INPUT]** soft-key.

8 TO FINISH A WORKPIECE WITHIN THE SPECIFIED TOLERANCE WITH THE TOOL WEAR OFFSET FUNCTION (TEST CUTTING)

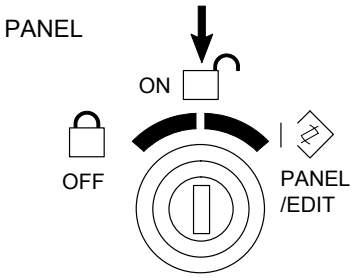
When the cutting tool moves along the programmed tool path, there may be cases where the workpiece cannot be finished within the required accuracy due to cutting resistance, tool deflection, tool nose R, or tool tip wear.

In this case, the programmed path should be shifted in parallel to the X- and Z-axes after completing the test cutting so that the workpiece can be finished within the specified tolerance. Input the amount by which the tool path should be shifted as the tool wear offset data.

CAUTION When machining the first workpiece in test cutting, exercise due care to ensure safety.

NOTE Offset in the Z-axis direction is impossible for thread cutting or grooving.

1) Carry out the procedure explained in 4-1 "Preparations for Checking a Program".
2) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.
3) Close the front door.



4) Place the PANEL key-switch in the (ON) position.

5) Press the head selection switch (head 1) or (head 2) to select the required turret.
6) Carry out the zero return operation.

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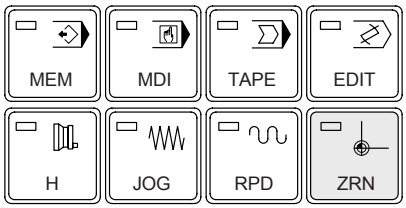


7) Display the OFFSET/WEAR screen.
8) Move the cursor to the tool wear offset number of the tool to be used using the cursor control keys.
9) Input the tool wear offset amount.

NOTE Only when machining a workpiece for the first time, shift the tool path by following the procedure below.

<Example>

To carry out test cutting by shifting 0.3 mm in the radial direction.

a) Move the cursor to the X-axis data of the wear offset number of each tool.

b) For tools used for O.D. cutting, enlarge the diameter position by 0.3 mm by inputting tool wear offset data of 0.3.

Input "0.3" using the data entry keys.

c) Press the **[+ INPUT]** soft-key.

d) For tools used for I.D. cutting, reduce the diameter position by 0.3 mm by inputting tool wear offset data of −0.3.

Input "−0.3" using the data entry keys.

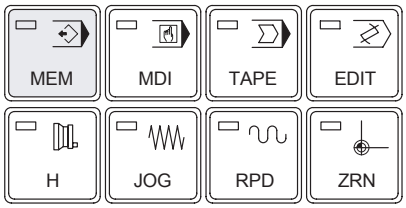
e) Press the **[+ INPUT]** soft-key.

CAUTION

Do not input the offset data in the radial direction for tools such as centering drills and drills for cutting at the center of a workpiece.

NOTE

Repeat steps 8) and 9) for all the tools used for cutting.

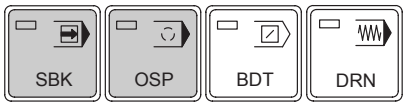


10) Select the memory mode ( ) with the mode selection switch.

11) Select the turret operation mode by pressing the head selection switches (head 1) and (head 2) simultaneously.

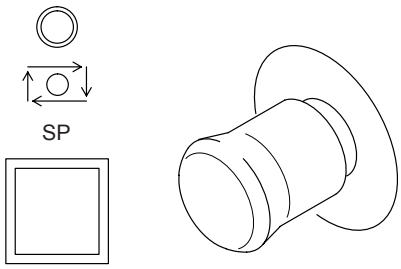
12) Display the PROGRAM (memory) screen.

13) Search for the program.



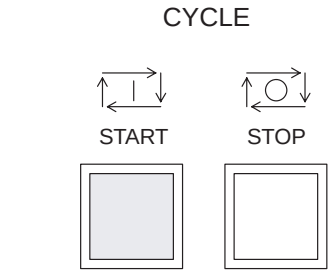
14) Press the single block switch to make the single block function valid.

15) Press the optional stop switch to make the optional stop function valid.



16) Set the rapid traverse rate override, feedrate override, and spindle speed override if necessary.

NOTE Make sure that you can press the EMERGENCY STOP button or the (STOP) switch immediately if an abnormality occurs.



17) Press the (START) switch.

NOTE Proceed machining by observing vibration of the machine, cutting sound, chip discharge condition, and coolant supply condition.

18) With the manual door type machine, when the program stops after executing the M01 (optional stop) command, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE
1. With the automatic door type machine, when the program stops after executing the M01 (optional stop) command, open the front door by pressing the AUTOMATIC DOOR OPEN switch.
2. The machine does not stop if an M01 command is not entered at the end of the program. Programs used for continuous operation may not have the M01 command to shorten cycle time.

19) Measure and record the dimension of the workpiece.

20) Repeat steps 17) to 19) until program end command M30 to measure and record the dimensions.

21) After the completion of program execution, display the OFFSET/WEAR screen.

22) Move the cursor to X or Z of the tool wear offset number of the tool to be used, using the cursor control keys.

23) Enter the difference between the dimension measured in step 20) and the dimension used in programming.

<Example>

If the workpiece is machined to 50.35 mm diameter although the program is intended to machine it 50 mm, follow the steps indicated below. Assume that the tool command used for this machining is T0101 (tool wear offset number 1).

a) Move the cursor to the X-axis offset data field for the wear offset number 1.

b) Calculate the wear offset data.

[Programmed diameter]
− [measured diameter]
= [offset data]

50.0 − 50.35 = −0.35

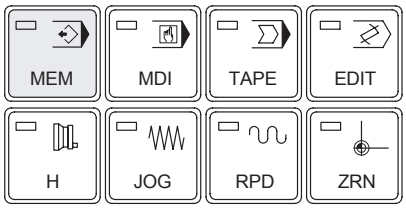
c) Since the diameter is machined 0.35 mm larger than the programmed diameter, the offset data should be input to machine the workpiece 0.35 mm smaller.

Input "−0.35" using the data entry keys.

d) Press the **[+ INPUT]** soft-key.

NOTE

1. If the INPUT key is pressed, the value having been input with data entry keys is input for the tool wear offset data. Therefore, make sure to press the **[+ INPUT]** soft-key.
2. Make sure that the decimal point and the plus or minus sign are input correctly.

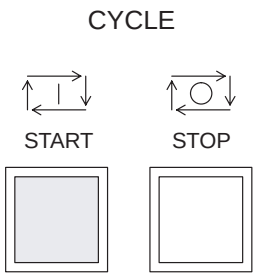


24) Select the memory mode ( ) with the mode selection switch.

25) Display the PROGRAM (memory) screen, and locate the head of the program.

26) Make sure that the cursor is at the head of the program.

27) Close the front door.



28) Press the (START) switch to finish the workpiece.

29) After finishing the workpiece, measure the workpiece dimensions again and input the tool wear offset data.

30) Start automatic continuous operation after obtaining the tool wear offset data precisely for all the tools.

Before starting automatic operation:

a. Invalidate the single block function

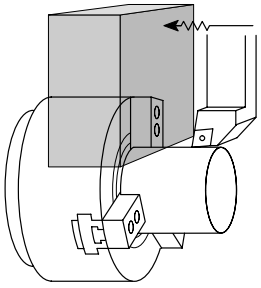
b. Invalidate the optional stop function

c. Invalidate the coolant off mode

NOTE After starting the automatic operation, check the dimensions of several finished workpieces. The dimensions will vary slightly due to initial tool wear, cutting resistance, deflection of cutting tools, and other factors.

9 SETTING THE INHIBITED TOOL ENTRY ZONE

To avoid interference of a cutting tool with the workpiece, chuck, or jaws, set the inhibited tool entry zone using the optional G22 command (stored stroke limit function ON).



Inhibit the entry of a cutting tool into the zone defined using the stored stroke limit function.

If the cutting tool is going to be moved in the zone, the related alarm message is displayed on the screen and the axes stop moving.

NOTE If the axes are stopped due to an alarm, axis feed is possible only in the direction opposite to the direction the axis has been moved.

For details of the procedure to set the inhibited tool entry zone, refer to the PROGRAMMING MANUAL.

10 REMOVING CHIPS ENTANGLING WORKPIECE

The procedure to follow to remove chips entangling a workpiece during machining is explained below.

WARNING

1. **Always stop the machine before removing chips inside it during operation. Also stop the machine and coolant supply before adjusting the direction or volume of coolant supply. If you attempt these operations while the machine is operating you could be seriously injured by being entangled in the revolving parts of the machine or crushed by its moving parts.**
2. **Pressing the (STOP) switch during automatic operation stops axis movement but does not stop spindle rotation. Therefore, select a manual mode and confirm that spindle rotation has stopped before opening the door. If you open the door while the spindle is rotating you may be entangled with the spindle and seriously injured.**
3. **Before opening the front door to remove chips from inside the machine during machining operation, make sure that the door interlock function is ON. After removing the chips, close the front door before restarting machine operation.**
   If the door interlock function is invalid, it will be possible to open the door while the machine is operating, and this could cause accidents involving serious injuries or damage to the machine.

1) Press the (STOP) switch to suspend program execution at a position where chips will be removed from the workpiece easily.
2) Select any of the following modes with the mode selection switch.

   (H) (JOG) (RPD) (ZRN)

   The spindle stops rotating when any of these modes is selected.
3) Make sure that the DOOR INTERLOCK key-switch is placed in the **NORMAL** position.
4) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.

5) For center-work operation, make sure that the tailstock spindle interlock function is valid.

   After that, press the → (TSI) switch to move the tailstock spindle into the tailstock.

CAUTION If the tailstock spindle is retracted, the workpiece is held only by the chuck and the workpiece may fall.

After the completion of the machining, make sure that the workpiece is supported not to fall from the chuck if the tailstock spindle center retracts from the workpiece.

6) Remove chips from the workpiece using a proper hand tool.

1. Never touch chips or the cutting edges of tools with your bare hands since you may be injured.
2. Never move the axes or rotate the turret head manually. If it becomes necessary to do these manually, always return the axes or the turret to the previously located position before restarting the program.

   If the program is restarted from a position, different from the previously located position, an interference will occur between the tool and the workpiece or between the tool and the chuck causing damage to the machine.

7) For center-work operation, move the tailstock spindle OUT to hold the workpiece.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8) Close the front door.

9) Select the memory mode () with the mode selection switch.

10) Press the  (START) switch.

The spindle starts rotating at a speed selected before stopping.

11) Press the  (START) switch again.

The program is restarted.

11 OPERATION PROCEDURE FOR DIFFERENT TYPES OF MACHINING

This machine is used for various types of machining operations.

This section provides operation procedure for typical machining operations on the NC lathe equipped with standard hydraulic 3-jaw chuck.

NOTE The following procedure applies for continuous operations after finishing setting up.

11-1 Chuck Work Operation

In general chuck work machining, the operation flow is as indicated below.

1) Set the tailstock spindle interlock function invalid. (Tailstock specification)

Page B-60 (13-3)

2) Clean the workpiece and chuck by supplying compressed air.
3) Clamp a workpiece in the chuck.
4) Check the following items
   - Make sure that the status indicator **[CHCL]** is lit.
   - Check the workpiece to see if it is correctly clamped in the chuck.
5) Close the front door.
6) Display the PROGRAM (memory) screen and make sure that the cursor is at the head of the program.
7) Check the setting of the switches (mode selection switches, OVERRIDE dial, etc.).
8) Press the (START) switch to start machining of the workpiece.
9) After the completion of the machining, make sure that the M02 or M30 command has been executed.

   Front door lock is released when the M02 or M30 command in the program is executed.
10) Open the front door.
11) Remove the workpiece from the chuck and clean the workpiece and the chuck by supplying compressed air.
12) Measure the workpiece to check if the finished dimensions are within the specified tolerance.
13) Machine and measure the next workpiece in the steps 2) to 12) above.

NOTE The chuck interlock function disables spindle start and cycle start unless the workpiece is clamped in the chuck.

11-2 Center-work Operation (Tailstock Specification)

In general chuck work machining, the operation flow is as indicated below.

1) Set the tailstock spindle interlock function valid.

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2) Clean the workpiece, chuck, and tailstock by supplying compressed air.
3) Clamp a workpiece in the chuck.
4) Check the following items:
   - Make sure that the status indicator **[CHCL]** is lit.
   - Check the workpiece to see if it is correctly clamped in the chuck.
5) Press the ←← (TSINC) switch to hold the workpiece with the tailstock spindle center.
6) Check the workpiece to see if it is correctly clamped in the chuck.
7) Check the following items:
   - Make sure that the status indicator **[CHCL]** is lit.
   - Check the workpiece to see if it is correctly clamped in the chuck.
8) Press the ← (TSO) switch to bring the tailstock spindle into the "OUT" state.
9) Display the PROGRAM (memory) screen and make sure that the cursor is at the head of the program.
10) Check the setting of the switches (mode selection switches, OVERRIDE dial, etc.).
11) Close the front door.
12) Press the (START) switch to start machining of the workpiece.
13) After the completion of the machining, make sure that the M02 or M30 command has been executed.

    Front door lock is released when the M02 or M30 command in the program is executed.
14) Open the front door.
15) Retract the tailstock spindle.

CAUTION

If the tailstock spindle is retracted, the workpiece is held only by the chuck and the workpiece may fall.

After the completion of the machining, make sure that the workpiece is supported not to fall from the chuck if the tailstock spindle center retracts from the workpiece.

16) Remove the workpiece from the chuck and clean the workpiece, chuck, and tailstock by supplying compressed air.
17) Measure the workpiece to check if the finished dimensions are within the specified tolerance.
18) Machine and measure the next workpiece in the steps 2) to 17) above.

NOTE

1. The chuck interlock function disables spindle start and cycle start unless the workpiece is clamped in the chuck.
2. The tailstock spindle interlock function, when made valid, disables cycle start unless the tailstock spindle is in the OUT state.

11-3 Both-center-work Operation (Tailstock Specification)

Generally, for the operation without opening/closing the chuck, the operator must understand the following interlock functions and pay sufficient care for safety.

- Chuck interlock function
  Disables spindle start and cycle start unless the workpiece is clamped in the chuck.
- Tailstock spindle interlock function
  Disables cycle start in the memory (tape) mode unless the tailstock spindle is in the OUT state.

At the same time, the program must be written by using these interlock functions fully and with operation safety taken into consideration.

For interlock functions, refer to page A-5 (2).

<Program example>

```
O0001;
      ⋮
      ⋮          Machining program
      ⋮
M05;
M11;             (Chuck unclamp:  The status indicator [CHCL] goes off.)
M30;
```

When machining a workpiece using the program in the example above, the operator must step on the chuck opening/closing footswitch before starting a new cycle after changing a workpiece to turn on the status indicator **[CHCL]**. Otherwise, the chuck interlock function precludes the cycle start. If the  (START) switch is pressed mistakenly, the machine does not start to protect the operator.

CAUTION

If the center at the spindle side is clamped in the chuck, the center at the spindle side will fall or move to cause the workpiece to fall if the program (M11) indicated above is used. Therefore, do not use this program in such a case.

12 WORK COUNTER/TOTAL COUNTER SETTING (OPTION)

12-1 Work Counter (Option)

The work counter is used for managing tool lives as well as the number of workpieces machined or to be machined.

It is possible to set whether the block delete function (BDT) or start interlock function (STARTLOCK) is made valid when the M89 (count increment) command has been read as many times as the number set for the work counter on the OPERATION PANEL screen.

 Function selection key  (CUSTOM1) ⟶ **[OPE. PANEL]**

<When the block delete (BDT) function is selected>

The block delete function becomes valid when the M89 command is read as many times as the number set for the work counter.

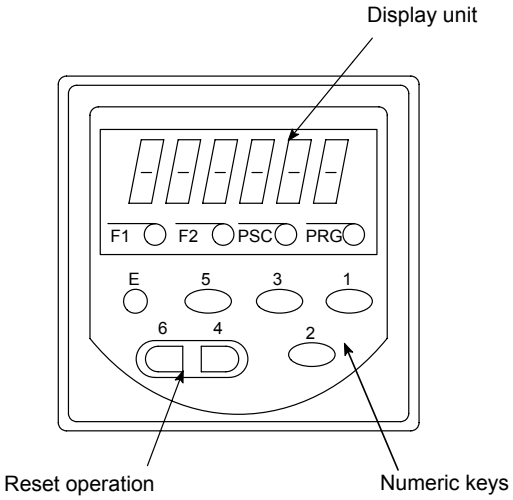
 If the  (START) switch is pressed again, the program is executed; however, the counter is not incremented.

<When the start interlock (START LOCK) function is selected>

When the M89 command is read as many times as the number set for the work counter, the program is executed to the end, and then the machine stops.

 If the  (START) switch is pressed again, an alarm message is displayed on the screen and program operation is disabled.

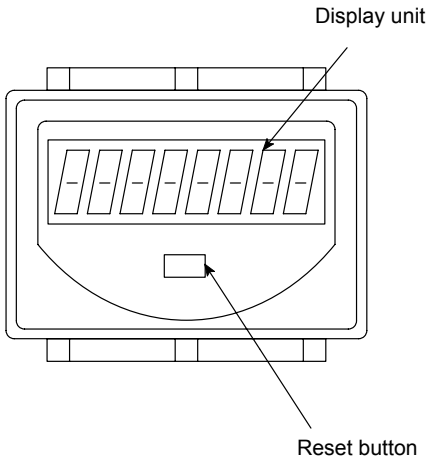
 For the procedure of specifying the M89 command, refer to the PROGRAMMING MANUAL published separately.



Display unit	The display unit indicates the preset value (number of workpieces to be machined) or the count value (number of machined workpieces) up to 6 digits. NOTE Normally the count value is displayed.
To switch between the preset value and count value display	Switching the count value to the preset value: Press the "E" and "1" keys at the same time. Switching the preset value to the count value: Press the "E" key. When 15 seconds has elapsed with the preset value displayed, the display is switched back to the count value display.
To change the preset value	Input the preset value using the numeric keys and press the "E" key. NOTE 1. The numeric keys "1" to "6" correspond to respective digits of the display. Each time a numeric key is pressed, the corresponding digit is incremented by one. 2. If the numeric key is pressed when "9" is displayed, the display returns to "0". 3. When changing the preset value, input a new value and press the "E" key. If the display is switched back to the count value without pressing the "E" key, the preset value is not changed.
When the preset number is reached	When the preset number is reached, the indicator F1 is illuminated. NOTE The "count up" signal is not cleared even if the power is turned off. To clear the "count up" status, perform manual reset operation as described below.
Reset operation	Press the "6" and "4" keys at the same time to reset the value to "0".

12-2 Total Counter (Option)

The total counter retains data including the number of machined workpieces with a built-in battery. Each time the M89 command in the program is read, the total counter is incremented.



NOTE

1. The average service life of the battery is seven years.
2. The battery cannot be replaced. It is necessary to replace the counter when the battery life ends.

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