OPERATION MANUAL

◼ Applicable Model ◼

ZL-153	**ZL-153S**
ZL-153MC	**ZL-153SMC**
ZL-203	**ZL-203S**
ZL-203MC	**ZL-203SMC**
ZL-253	**ZL-253S**
ZL-253MC	**ZL-253SMC**

◼ Applicable NC Unit ◼

MSG-501

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.

OM-ZLFMSG501-A0E

- 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.

> 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.

990730

Machine Information

Description of machine: CNC lathe
Model name:
Machine serial No.:
Manufacturing date:

Representative:
Business hours: 8:30 - 17:30

CONTENTS

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 CNC 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 the instruction manual, ladder diagrams and parameter tables are also supplied with the machine to help with electrical maintenance, and there is an electrical circuit diagram in the document compartment inside the electrical cabinet. Please make use of this material 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.).

DANGER

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, 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.*

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.*

DANGER

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.

WARNING

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. Always keep the front door closed during machine operation. Leaving the machine running or operating it with the front door 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 or crushed by its moving parts, struck by a workpiece or soft jaws if they fly out of the chuck, 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.

WARNING

6. The machine specifications are set before shipping so that the machine can deliver its full performance. Changing the settings without consultation may lead to accidents involving serious injuries, impaired machine performance, and considerable shortening of the machine service life. 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.

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.

WARNING

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.

WARNING

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.**

WARNING

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.**

CAUTION

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.

CAUTION

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 cause accidents 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.

NOTE 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.

WARNING

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.)

WARNING

⚠

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.

WARNING

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.**

CAUTION

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.

CAUTION

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. The service outlet on the operation panel (option) is provided for connection of external I/O devices and must not be used to connect electric apparatus used for maintenance and inspection. Do not connect external I/O devices with a current capacity that exceeds the permissible current.
    If maintenance or inspection apparatus or an external I/O device whose current capacity exceeds the permissible current is connected to the outlet, the breaker in the electrical cabinet could be tripped. If this happens while the machine is operating, it could damage the machine or cause 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.

> **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 switches and 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 cause accidents involving serious injuries or damage to the machine.**

CAUTION

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

WARNING

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.**

CAUTION

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.

CAUTION

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.

WARNING

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 automatic operation (cycle 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.

WARNING

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.

WARNING ⚠️

16. **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.

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.

CAUTION ⚠

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. In order to protect the lubrication pump motor, do not hold down the manual lubrication pushbutton for longer than one minute when supplying lubricating oil to the slideways manually. If the pushbutton is held down for longer than a minute, the lubrication pump motor may fail.

5. 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.

6. 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.

7. 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.

8. 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.

9. 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.)

10. 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.)

CAUTION

11. 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.)

12. When setting the coordinate system using the machine coordinate system setting function, any mistake in specifying the X and Z values in the G50 block will cause interference between the cutting tool, tool holder, or turret head, and the workpiece, chuck, fixture, or tailstock (if featured), damage to the machine, or will cause the cutting tool failing to reach the cutting position.

13. 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.

14. 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.

15. 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.)

16. 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.

17. 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.)

18. 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.)

CAUTION

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19. 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.)

20. If the automatic operation (cycle 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

WARNING

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.

WARNING

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.

> **WARNING**
>
> 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

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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.

WARNING

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

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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.

WARNING

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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.**

CAUTION

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

WARNING

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 automatic operation (cycle 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

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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 automatic operation (cycle 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.

WARNING

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.

CAUTION

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.

CAUTION ⚠

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.

WARNING

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.**

CAUTION

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.

NOTE

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

WARNING

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.

8-2   Stacker Crane Specification

WARNING

The stacker crane used with the machine has a capacity of less than 5 tons. Only properly authorized persons may operate the stacker crane.

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, i n
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 automatic operation switch ⟨cycle start⟩ (cycle start) or manual operation is not possible.

NOTE To start the cycle by using the automatic operation switch ⟨cycle start⟩ (cycle start) 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.

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.

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.

CHAPTER 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.

CHAPTER D : PROGRAM EDITING

> This chapter explains the procedure used to input programs to the NC and to edit the program stored in the NC memory. The procedure for inputting/outputting NC program using an external I/O device is also explained. Note that the programming procedure is not explained in this chapter, refer to the programming manual for the programming procedure.

CHAPTER E : SETTING OF COORDINATE SYSTEM

> This chapter explains the coordinate system used in creating programs and machining workpieces.
> There are the following three kinds of coordinate system settings:

> - The coordinate system set using the tool geometry offset function (G00 T_ ;)

> - The coordinate system set using the coordinate system setting function (G50 X_ Z_ ;)

> - The work coordinate system (G54 to G59)

> The procedures for setting the above coordinate systems are explained.
> The operating procedure for the manual in-machine tool presetter is also explained.

CHAPTER F : 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.

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.

DANGER ⚠	*Indicates <u>an imminently hazardous situation</u> which, if not avoided, will result in death or serious injury.* *The information described in the DANGER frame must be strictly observed.*

WARNING ⚠	**Indicates <u>a potentially hazardous situation</u> which, if not avoided, could result in death or serious injury.** **The information described in the WARNING frame must be strictly observed.**

CAUTION ⚠	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>

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.

<Lamp indication>

Indicates that the indicator is lit.
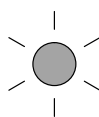
Indicates that the indicator is blinking.

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.

Production planning and programming

1) Examine the drawing to determine the machining required

2) Determine the tools to be used 📖 "TOOLING SYSTEM" in the MAINTENANCE INFORMATION

3) Examine the workpiece clamping method and the fixtures

4) Create the program 📖 PROGRAMMING MANUAL

Setup operation

5) Turn on the power supply 📖 "TURNING ON THE POWER" in Chapter B

6) Store the program into memory 📖 Chapter D "PROGRAM EDITING"

7) Create the program using the conversational programming function 📖 OPERATION MANUAL FOR CONVERSATIONAL PROGRAMMING

8) Check the program using the simulation function (Correct the program if necessary) 📖 OPERATION MANUAL FOR CONVERSATIONAL PROGRAMMING

9) Check or adjust the chucking pressure 📖 "ADJUSTING THE PRESSURE" in Chapter C
"Adjusting the Chucking Pressure" in Chapter C

10) Shape soft jaws 📖 "SHAPING SOFT JAWS FOR FINISHING in Chapter C

11) Mount the tools and workpiece to the machine 📖 Chapter B "MANUAL OPERATION"
"TOOLING SYSTEM" in the MAINTENANCE INFORMATION

12) For the center-work, set the tailstock Check or adjust the tailstock spindle thrust 📖 "Tailstock Operation in Chapter B
"ADJUSTING THE PRESSURE" in Chapter C
"Adjusting the Tailstock Spindle Thrust" in Chapter C

13) Measure and input the tool geometry offset value 📖 Chapter E "SETTING OF COORDINATE SYSTEM"

14) Set the workpiece zero point 📖 Chapter E "SETTING OF COORDINATE SYSTEM"

15) Check the program by carrying out dry run operation (Correct the program if necessary) 📖 Chapter F "PREPARATION BEFORE STARTING MASS PRODUCTION"

16) Check the machining condition by carrying out test cutting (Correct the program if necessary) (Input the tool wear offset value if necessary) 📖 Chapter F "PREPARATION BEFORE STARTING MASS PRODUCTION"

Mass Production

17) Machine the workpiece in automatic operation

18) Product is completed

NOTE

1. Operation steps 4) and 6) above should be skipped when a program is created using the conversational programming function.

2. Operation step 7) above should be skipped when the conversational programming function is not used for creating a program.

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.

WARNING

⚠

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

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.

CONTENTS

DOOR INTERLOCK FUNCTION

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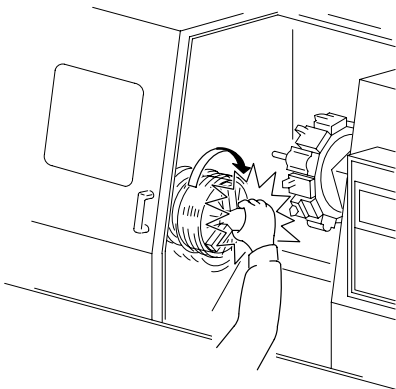
1. The operator will become entangled with the spindle if the spindle starts while the operator is touching the chuck or workpiece.

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.
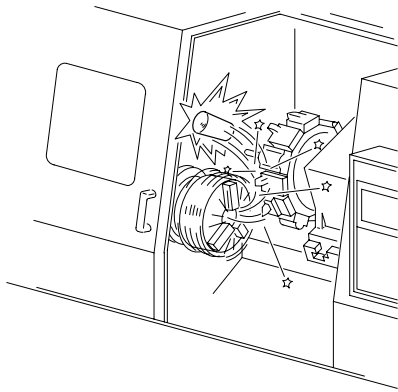
3. A workpiece will fly out if the spindle rotation is started while the workpiece is not clamped correctly.

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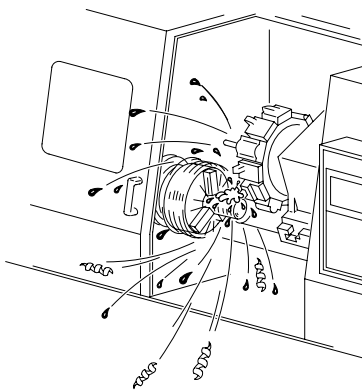
7. The operator or a person standing near the machine will be splashed with chips and coolant during machining, resulting in injury or health problems (particularly if chips or coolant get into the eyes).

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.

Door lock device   Top View

Door lock device

Door lock device

Door unlock switch

Screen

MDI Panel

Open   Close

Operation panel

Door

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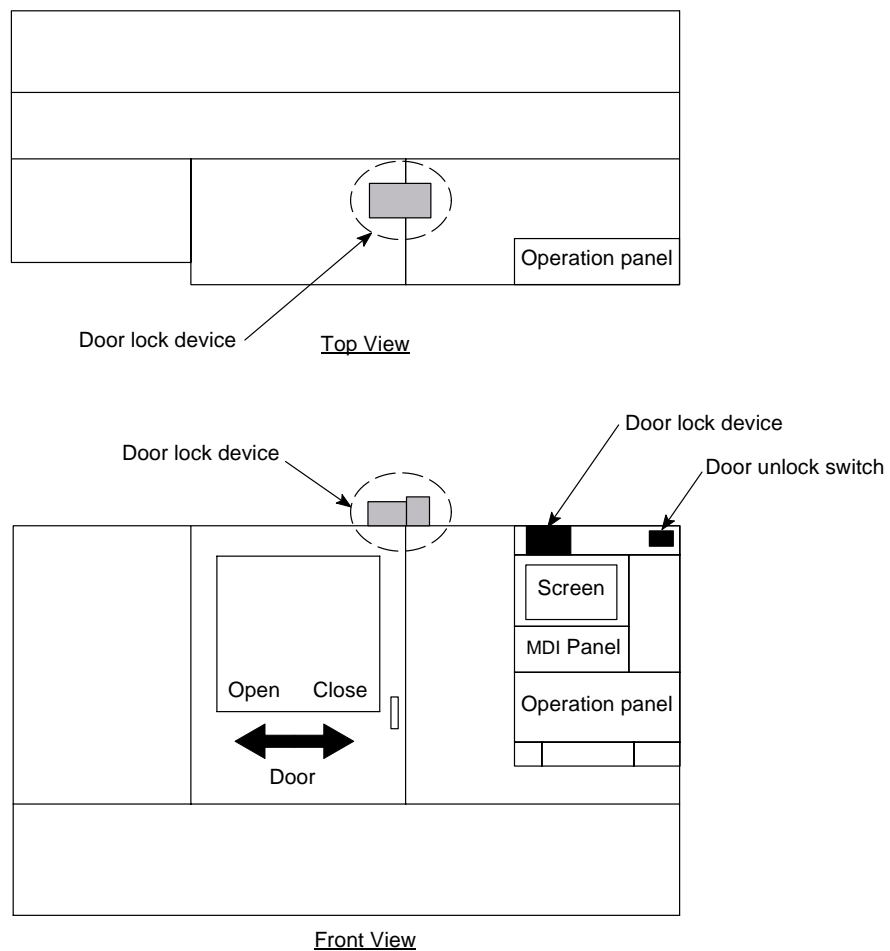
NOTE The specifications and the installation positions of the door interlock function controls and the door lock device will vary according to the machine model and specification. For details, contact Mori Seiki.

<Door interlock function controls>

5. WARNING label

⚠ WARNING

Never operate without safety door interlock switch in "NORMAL" position. Failure to do so could cause serious injury or death.

DOOR INTERLOCK
NORMAL   RELEASE

4. Volume adjusting knob

2. Status indicator

INTERLOCK
RELEASED

1. DOOR INTERLOCK key-switch
   (manual-return type)
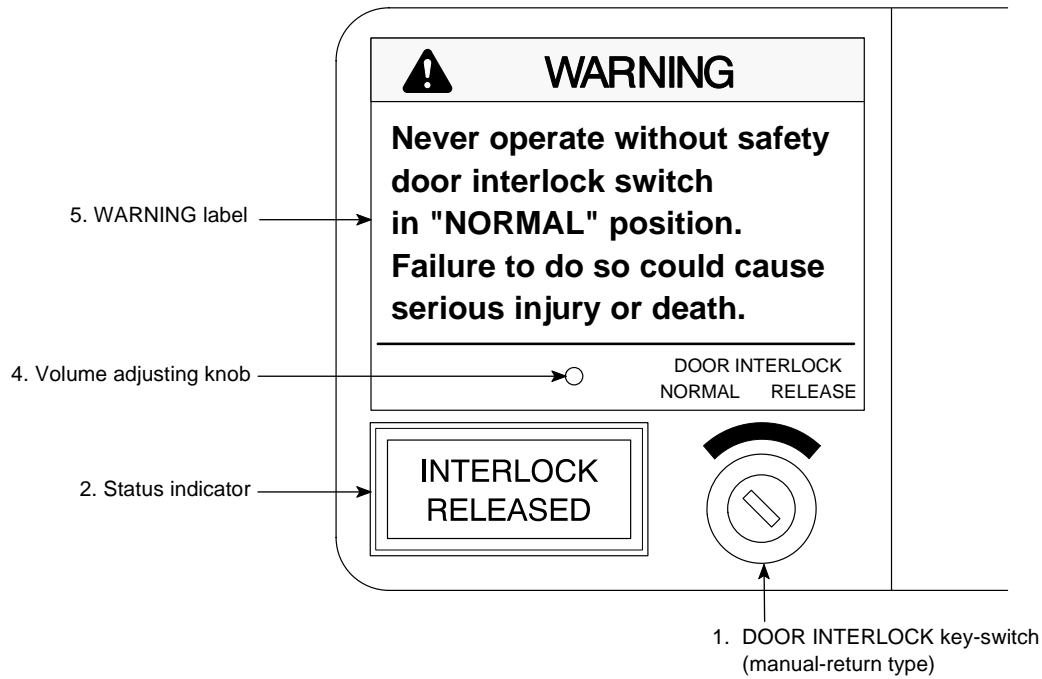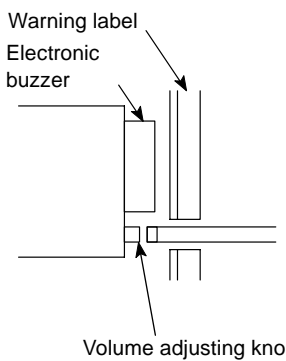
NOTE The arrangement of the controls for the door interlock function will vary according to the machine model and specification.

The functions of the controls are summarized below:

No.	Control	Function
1.	DOOR INTERLOCK key-switch DOOR INTERLOCK NORMAL RELEASE <Part No.> E61133	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 INTERLOCK RELEASED \<Part No.\> E54065	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 \<Part No.\> E36013	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 Warning label Electronic buzzer Volume adjusting knob <Part No.> E36013	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 **<Part No.>** Japanese H45417 English H45418 German H45419 French H45420 Italian H45421 Spanish H45422 Portuguese H45423 Danish H45424 Dutch H45425 Swedish H45426 Norwegian H45427 Finnish H45428 Chinese H45429	The caution 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.

NOTE The <Part No.> indicates the part number of each component parts. Use these numbers to order the controls if they are damaged, or if the label become dirty, damaged, or lost.

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.

WARNING

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".

CAUTION

1. If disconnection of the status indicator circuit or the electronic buzzer circuit is detected, or if abnormality of the door interlock control system is found, contact Mori Seiki.

   Remove the cause of the abnormality, and turn on power supply after pressing the EMERGENCY STOP button or turning off power supply once, then the error indication will be cleared.

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.

NOTE

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

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

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.**

2. **Even when the door is open, automatic operation is permitted under the MDI mode (MDI mode operation).**

3. **Even when the door is open, all operations are permitted in the manual mode.**

4. **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)

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

3.   Changing the spindle speed range to the neutral (transmission specification)

All operations are enabled when the door is closed.

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

| DOOR INTERLOCK |
| NORMAL   RELEASE |

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
	Spindle gear range change[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 manual pulse generator 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 automatic operation (cycle start) 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.

WARNING

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)>

DOOR INTERLOCK
NORMAL   RELEASE

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

3. Changing the spindle speed range to the neutral (transmission specification)

All operations are enabled when the door is closed.

<Automatic operation (door interlock function valid)>

DOOR INTERLOCK
NORMAL   RELEASE

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)>

DOOR INTERLOCK
NORMAL   RELEASE

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
	Spindle gear range change[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 manual pulse generator 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 automatic operation (cycle start) 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.

WARNING

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)>

DOOR INTERLOCK
NORMAL   RELEASE

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

3.   Changing the spindle speed range to the neutral (transmission specification)

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

<Automatic operation (door interlock function valid)>

DOOR INTERLOCK
NORMAL   RELEASE

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.
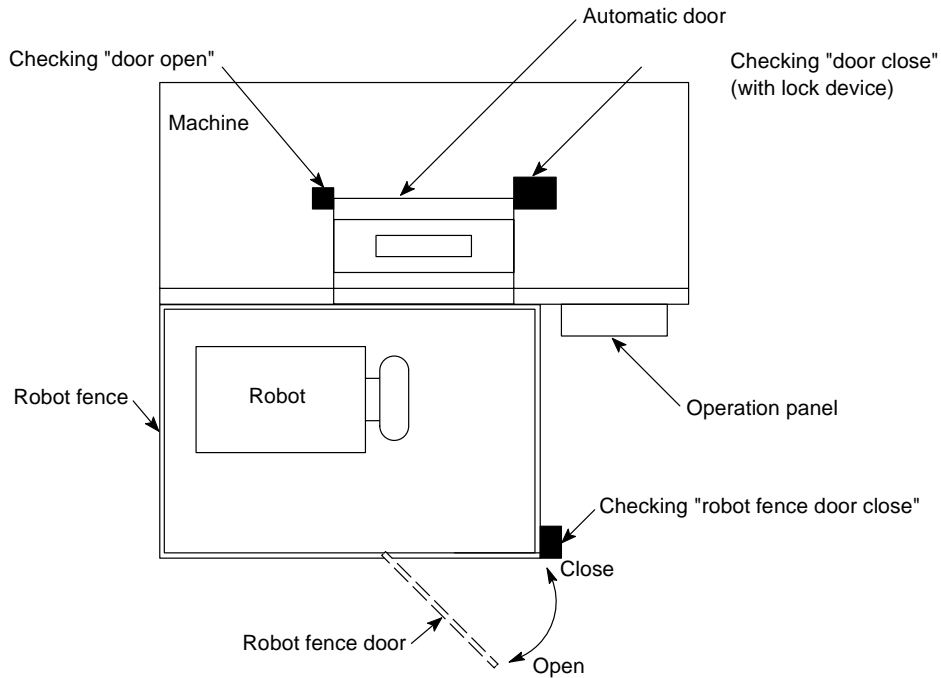
1. If the robot fence door is open

    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)>

DOOR INTERLOCK
NORMAL   RELEASE

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		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
	Spindle gear range change[*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 manual pulse generator 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 automatic operation (cycle start) 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.

WARNING

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

2. Lock and unlock of automatic door

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)

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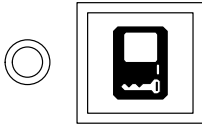
The DOOR UNLOCK switch, provided on the operation panel, is used to release the door lock device.

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	Function
Unlock	When the DOOR UNLOCK switch is pressed, the indicator of the switch is lit and 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 status 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.
Lock	When the DOOR UNLOCK switch is pressed while the indicator of the switch is lit with the door closed, the indicator goes off and 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)

6. While the spindle range is being changed (transmission 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.

DOOR UNLOCK
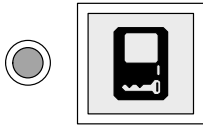
1) Press the DOOR UNLOCK switch.

   The indicator of the switch is lit and the door lock is released.

2) Open the door.

DOOR INTERLOCK
NORMAL   RELEASE

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.

DOOR INTERLOCK
NORMAL   RELEASE

   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.

NOTE

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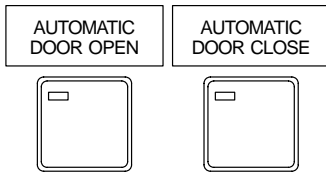
The AUTOMATIC DOOR OPEN/CLOSE switch, provided on the option panel, is used to open/close the automatic door manually.

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

Switch	Function
AUTOMATIC DOOR OPEN	When this switch is pressed, the indicator in the switch is lit and the door is unlocked and opened.
AUTOMATIC DOOR CLOSE	When this switch is pressed, the door is closed and after the completion of door closing, the indicator in the switch is lit and the door is locked.

5-2-2   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).

DOOR INTERLOCK
NORMAL   RELEASE

DOOR INTERLOCK
NORMAL   RELEASE

5-2-3   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

Since the machine is equipped with the door lock device, the door is automatically locked when it is closed and if the door is locked it is not possible to open the door from the inside of the machine (inside of the door). To keep the DOOR UNLOCKed when the door is closed with a person working inside the door for setup, cleaning, inspection, or repair, a door lock prevention key is provided.

NOTE   Depending on the machine models, the door lock prevention key may not be provided.

Door lock prevention key
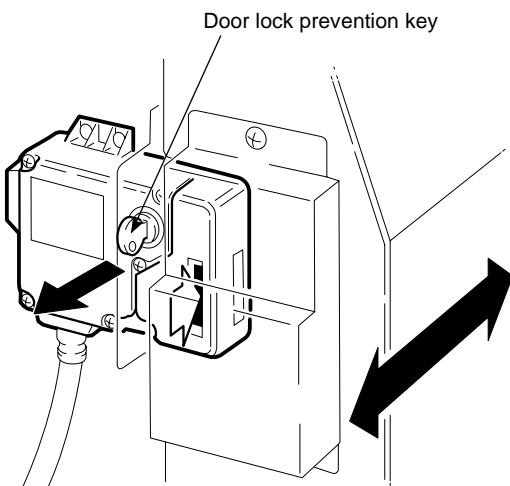
Turn the key counterclockwise and the door is not locked.

When the door is closed with the door lock prevention key turned counterclockwise, the door is not locked.

NOTE   The specifications and the installation positions of the door lock device will vary according to the machine model and specification.

WARNING   **The door is automatically locked when it is closed and the locked door cannot be opened from the inside of the machine (inside of the door). To carry out maintenance or inspection work inside the machine, make the lock device invalid by turning the door lock prevention key; remove the key and bring it with you when you enter the machine. To prevent the door being locked by mistake, lock a padlock in the hole at the end of the door lock hasp. If the door is closed by mistake while the door lock device is valid, the door is locked and you may be cooped up 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.**

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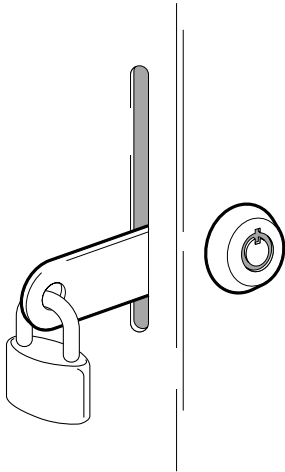
If an operator is cooped up in the machine, follow the steps below to save the cooped operator.

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.

5-4   Door Unlock Lever

Door lock device

Door unlock lever

Front cover
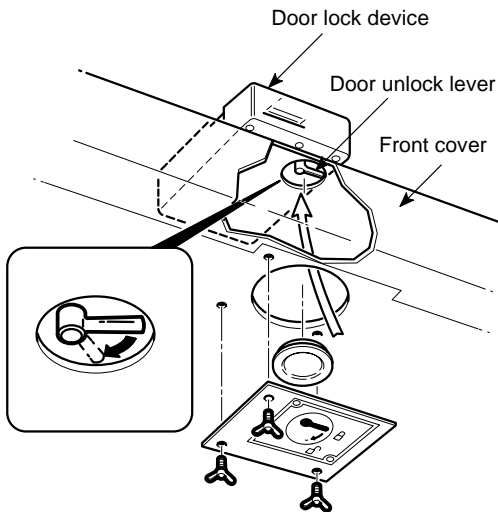
When the door is closed with a person being inside the machine, the door is locked. To make the door lock invalid, follow the steps indicated below.

1) Remove the cover at in-machine side of the door lock device equipped position.

2) When the DOOR UNLOCK lever in the lock device is turned on, the door is unlocked to open the door.

NOTE

1. Depending on the machine models, the DOOR UNLOCK lever may not be provided.

2. Make sure the door lock device position beforehand, since it varies with the machine models.

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 [AXIS DIRECTION] ⬚ ⬚ ⬚

Valid mode

CAUTION
⚠
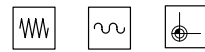
1. Please note that accessories and functions of the machine given in the explanation in this manual are not always available with your machine according to its delivery.
    Also please note that some of these accessories and functions cannot be installed after the installation of the machine. For details, 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.

CONTENTS

A : OPERATION PANELS

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.*

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 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 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.
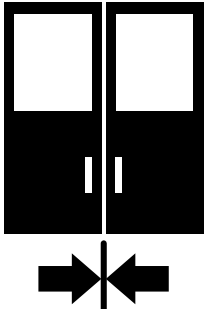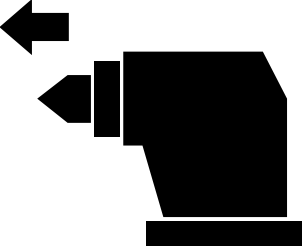
1. Ensure that the workplace is adequately lit.

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-35 (5-6-8)
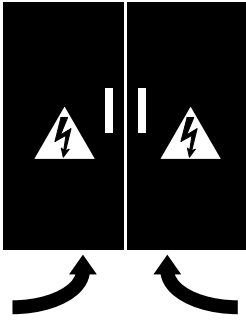
<Electrical cabinet door interlock>	When the electrical cabinet door interlock key-switch is valid, power cannot be turned ON while the electrical cabinet door is open.
	The electrical cabinet door interlock function protects the operator from sustaining an electrical shock by touching a live device inside the electrical cabinet after turning on the power while the electrical cabinet door is open. Page A-10 (4-2-2)

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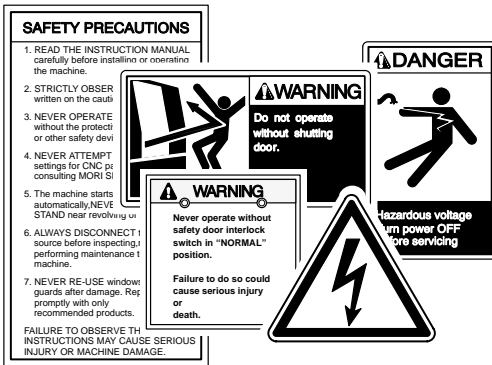
Contains the safety related information that sets out basic rules for the operator to follow in order to operate the machine safely.

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

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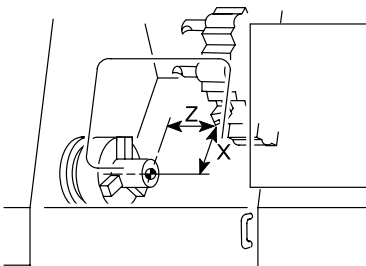
Contains operation procedures, setup methods, and the functions of the switches and keys used for machine operation. (This manual)

<Programming manual>
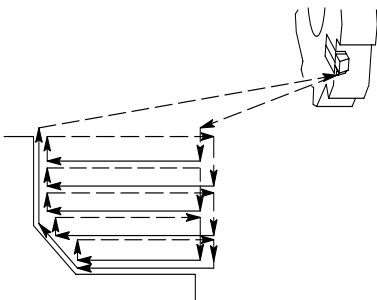
Contains NC language and coding rules for creating programs.

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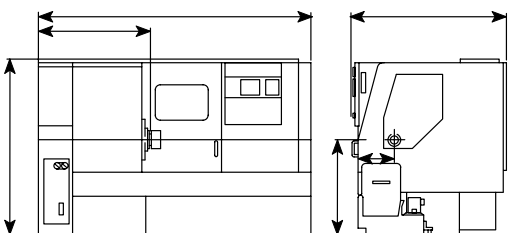
Contain information about machine dimensions and specifications, as well as descriptions of adjustment procedures for major machine units.

<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.

Machine Front

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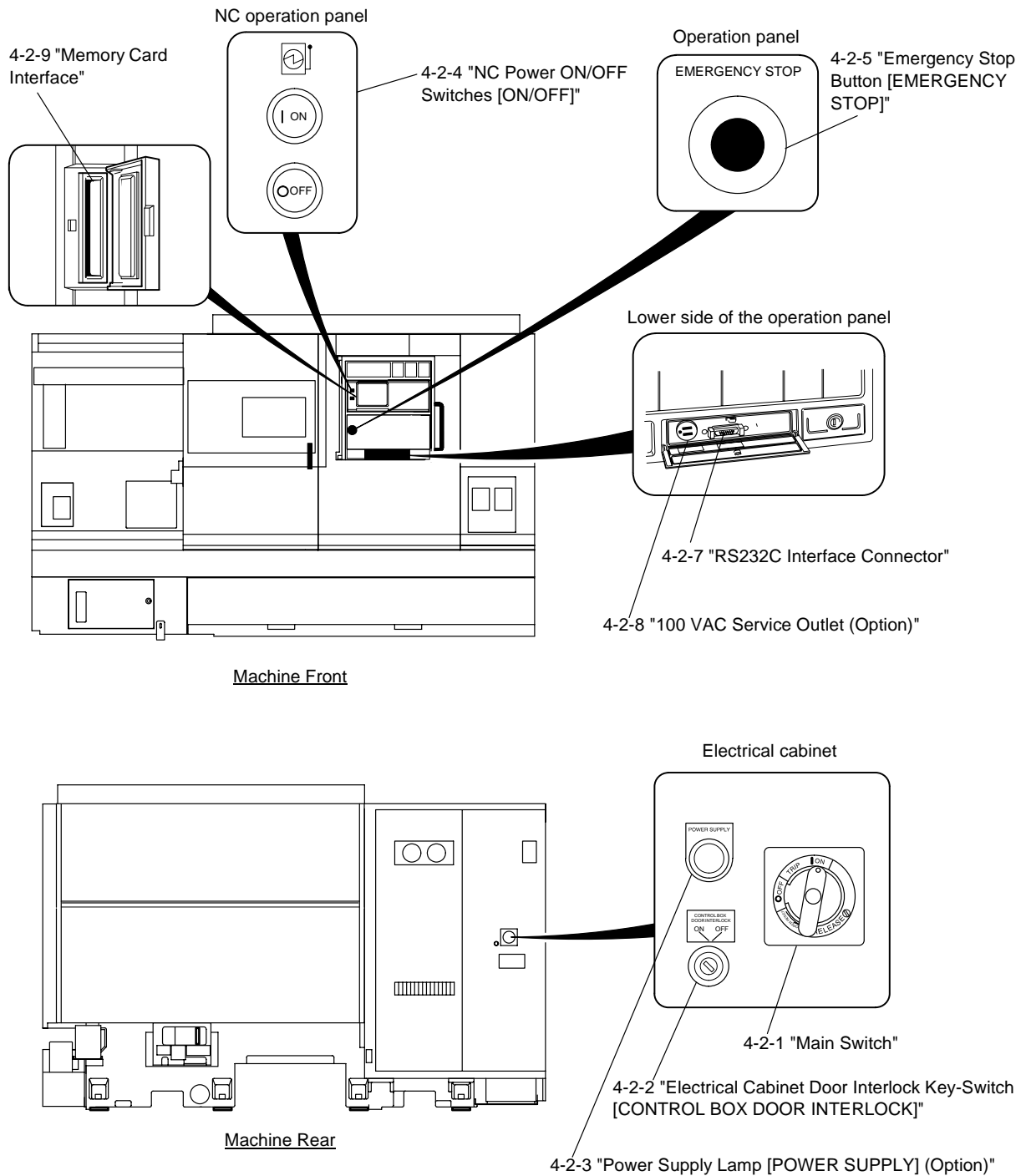
The position and shapes of switches may differ according to the machine model and specifications.

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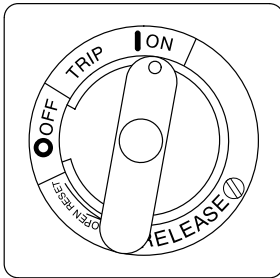
The main switch, located on the electrical cabinet door, is used to turn the machine power supply on and off.

It also works as a non-fused circuit breaker.

NOTE The arrangement and shapes of the main switches may vary 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.
O 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 O **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.

4-2-2   Electrical Cabinet Door Interlock Key-Switch [CONTROL BOX DOOR INTERLOCK]

CONTROL BOX
DOOR INTERLOCK
ON   OFF
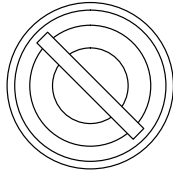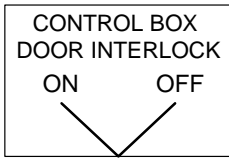
This key-switch is provided to protect the operator from electrical shock if he/she touches an energized part inside the electrical cabinet when the power is turned ON while the electrical cabinet door is open.

NOTE
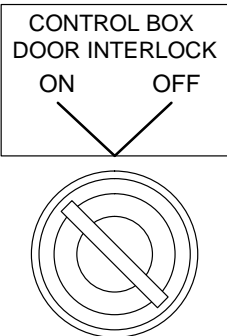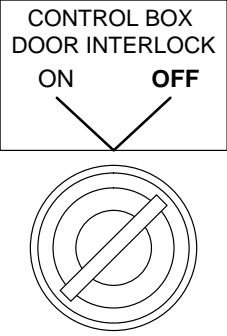
1.   For daily operation, set the key-switch in the **ON** position and keep the key removed.

2.   This key-switch is for the electrical cabinet door.

      For the front door interlock function, refer to "DOOR INTERLOCK FUNCTION".

3.   The switch configuration and switch name differ according to the machine model and specifications.

Interlock	Switch Position	Function
Valid	CONTROL BOX DOOR INTERLOCK ON OFF	The electrical cabinet door interlock function is valid when this key-switch is placed in this position. The power supply cannot be turned on while the electrical cabinet door is open. **NOTE** Normally, the CONTROL BOX DOOR INTERLOCK key-switch should be placed in the **ON** position for operating or maintaining the machine.
Invalid	CONTROL BOX DOOR INTERLOCK ON **OFF**	The electrical cabinet door interlock function is invalid when this key-switch is placed in this position. The power supply can be turned on while the electrical cabinet door is open.

DANGER

Always switch off the power before carrying out inspection or maintenance work in the electrical cabinet. 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.

4-2-3   Power Supply Lamp [POWER SUPPLY] (Option)

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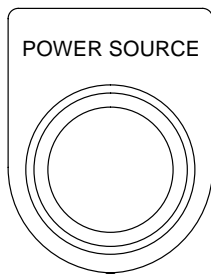
This lamp indicates whether or not power is being supplied to the machine. The lamp is lit when power is supplied.

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-14 (4)
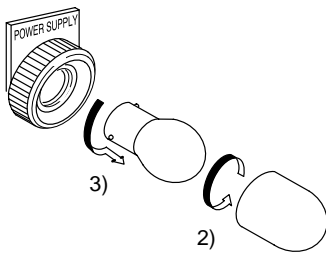
2) Remove the cap; turn it counterclockwise.

3) Remove the bulb; turn it counterclockwise.
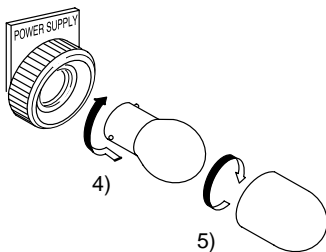
4) Set the new bulb; turn it clockwise.

5) Set the cap; turn it clockwise.

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

4-2-4   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 shapes of NC operation panels and the arrangement and shapes of the NC power ON and OFF switches may vary according to the machine model and specifications.

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.

4-2-5   Emergency Stop Button [EMERGENCY STOP]
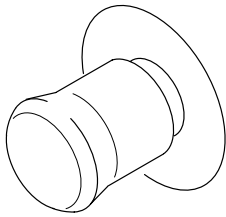
The EMERGENCY STOP button is used to stop the machine immediately, for example when an emergency requiring an immediate machine stop occurs.

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.

4-2-6   2nd O.T. Release Button [2nd O.T. RELEASE] (ZL-253)
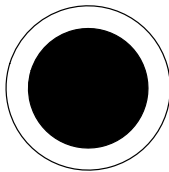
The 2nd O.T. RELEASE button is used to clear the hard-overtravel alarm state.

Hold down this button while moving an axis from the overtravel zone.

📖   Page B-29 (6-6)

2nd O.T. RELEASE

<Hard-overtravel>

In order to avoid interference between the carriage and the tailstock, this machine has a limit switch which is actuated if the carriage comes too close to the tailstock, establishing the emergency stop state and preventing further axis movement.

<In hard-overtravel state>

1.   The axis stops moving.

2.   The STATUS indicator **[MRDY]** goes off.

3.   The message "EMG" blinks on the screen.

4-2-7   RS232C Interface Connector
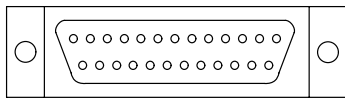
INTERFACE

The INTERFACE connector is used to connect an external I/O device that has an RS232C interface.

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

📖   Page D-41 (5)

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

4-2-8   100 VAC Service Outlet (Option)
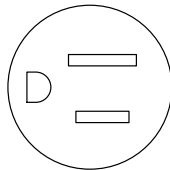
AC 100V 1A

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 ⚠ The service outlet on the operation panel (option) is provided for connection of external I/O devices and must not be used to connect electric apparatus used for maintenance and inspection. Do not connect external I/O devices with a current capacity that exceeds the permissible current.
If maintenance or inspection apparatus or an external I/O device whose current capacity exceeds the permissible current is connected to the outlet, the breaker in the electrical cabinet could be tripped. If this happens while the machine is operating, it could damage the machine or cause machining defects.

4-2-9   Memory Card Interface
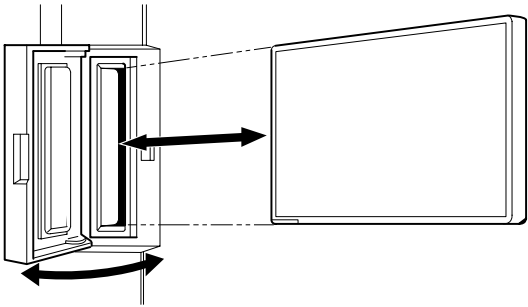
The memory card interface is used to input/output the programs, offset data, parameters and other data using a memory card.

> **NOTE**
>
> 1. A memory card is optional.
>
> 2. For a memory card, an ATA flash memory card or an SRAM card should be used.
>
>   When placing an order, please specify the following part numbers.

16 MB ATA flash memory card	E77091
40 MB ATA flash memory card	E77155

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.

4-2-5 "Emergency Stop Button [EMERGENCY STOP]"

5-18 "Tailstock Spindle Switches [TAILSTOCK] (Tailstock Specification)"

5-2 "Head Selection Switches [HEAD CHANGE]"

5-14 "Turret Indexing Switches [TURRET]"

5-4 "Mode Selection Switches [MODE]"

5-17 "Chip Conveyor Switches [CHIP CONVEYOR]"

5-6 "Function Switches [FUNCTION]"

5-15 "Coolant Switches [COOLANT]"

5-7 "Status Indicators [STATUS]"

5-13 "Handle Switches [HANDLE]"

5-10 "Axis Feed Switches [AXIS DIRECTION]"

5-9 "Spindle Switches [SPINDLE]"

5-5 "Automatic Operation Switches [CYCLE]"

5-12 "Rapid Traverse Rate Override Switches [RAPID OVERRIDE]"

5-16 "Machine Light Switch [LIGHT]"

5-11 "Feedrate Override Dial [OVERRIDE]"

\<Option panel\>

DOOR UNLOCK

5-20 "Door Unlock Switch [DOOR UNLOCK]"

PANEL

5-3 "Panel Key-Switch [PANEL]"

ON

OFF

PANEL
/EDIT

\<Operation panel for turret 2\>

NOTE Concerning the switches and indicators not provided on the operation panel for turret 2, those provided on the operation panel for turret 1 are used in common.

STATUS

2

○ ERR   ○ M00/M01   ○ X

○ TRCL   ○ M02/M30   ○ Z

5-7 "Status Indicators [STATUS]"

5-11 "Feedrate Override Dial [OVERRIDE]"

OVERRIDE

50   100

0   150
             %

FUNCTION

OSP   BDT

5-6 "Function Switches [FUNCTION]"

COOLANT

ON   OFF

5-15 "Coolant Switches [COOLANT]"

\<Option panel\>

TSCLP   TSUCLP

5-21 "Programmable Tailstock Switches (Option)"

TSTMOD   SPINDLE NEUTRAL

5-9-3 "Spindle Neutral Gear Switch [SPINDLE NEUTRAL] (Transmission Specification)"

<MC type>

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

> **NOTE**
>
> 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.

5-10 "Axis Feed Switches [AXIS DIRECTION]"

5-7 "Status Indicators [STATUS]"

5-19 "Milling Switches [MILLING] (MC Type)"

AXIS DIRECTION

Y

–C   +C

Y

STATUS

① ②
O C   O C
O Y   O Y

MILLING

SP   MIL

UCL   CL

<S type>

5-23 "Parts Catcher Switches [PARTS CATCHER OUT/IN] (Parts Catcher Specification)"

5-10 "Axis Feed Switches [AXIS DIRECTION]"

PARTS CATCHER OUT | PARTS CATCHER IN

±B | +B

5-7 "Status Indicators [STATUS]"

B-AXIS ZERO POINT

HEADSTOCK 2 CHUCK CLAMP

<Steady rest specification>

5-22 "Steady Rest Switches (Steady Rest Specification)"

STEADY REST 1 OPEN | STEADY REST 1 CLOSE

STEADY REST MANUAL MODE

<Parts catcher specification>

5-23 "Parts Catcher Switches [PARTS CATCHER OUT/IN] (Parts Catcher Specification)"

PARTS CATCHER OUT | PARTS CATCHER IN

5-2   Head Selection Switches [HEAD CHANGE]

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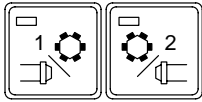
The HEAD CHANGE switches are used to select the turret to be operated between turret 1 (upper turret) and spindle 1 (left spindle), and turret 2 (lower turret) and spindle 2 (right spindle) in the manual operation mode. They are also used to select the process when inputting or editing a program as well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

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

5-2-1   In the Memory Mode

HEAD CHANGE
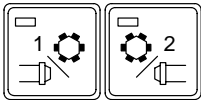
Both turrets are selected when the power is turned on.

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

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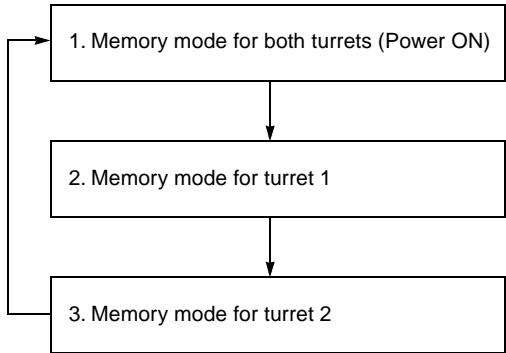
NOTE   When the memory mode is selected: Present turret selection does not change if the HEAD CHANGE switch (head 1) or (head 2) is pressed.

1. Memory mode for both turrets (Power ON)

2. Memory mode for turret 1

3. Memory mode for turret 2

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

HEAD CHANGE
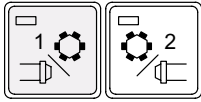
$\boxed{\text{1}\mathcal{Q}}$ (head 1)

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

HEAD CHANGE
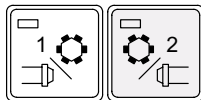
$\boxed{\mathcal{Q}\text{2}}$ (head 2)

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

NOTE Pressing the HEAD CHANGE switches $\boxed{\text{1}\mathcal{Q}}$ (head 1) and $\boxed{\mathcal{Q}\text{2}}$ (head 2) simultaneously has no effect.

The currently selected turret number is displayed in the upper or lower right area of the screen.

NOTE In this OPERATION MANUAL, generally, the display screen is given assuming head 1 is selected.

HEAD1

HEAD2

HEAD1

HEAD2
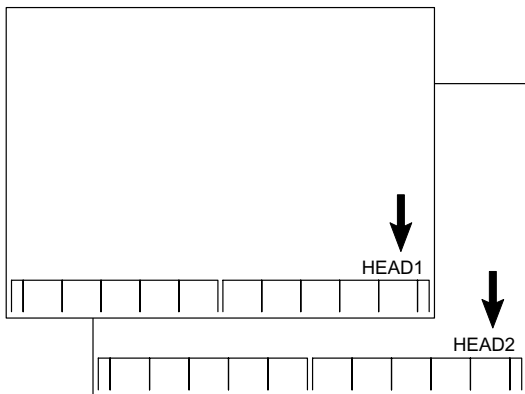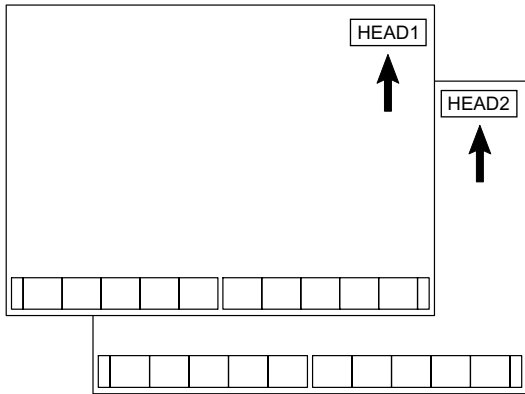
5-3   Panel Key-Switch [PANEL]
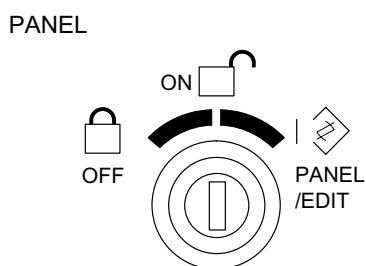
PANEL

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. Cycle start is impossible in the memory mode. The key cannot be removed when the PANEL key-switch is placed in this position.

5-4   Mode Selection Switches [MODE]
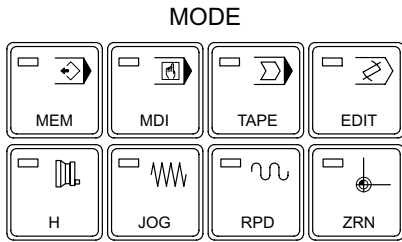
MODE

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.
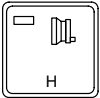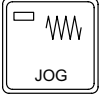
Operation modes are classified into the following three main groups:

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
 EDIT	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 the background editing, refer to page D-2 (1-2). **NOTE** The above operations are possible with the PANEL key-switch placed in the (PANEL/EDIT) position.

Switch	Function
MEM	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.
MDI	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) 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

Switch	Function
▭ Σ▶ TAPE	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. 3. The RS232C connector at the lower area of the operation panel cannot be used for tape mode operation. To perform tape mode operation, set the NC parameters following the steps indicated below. 1) Connect the cross-cable to the RS232C connector in the electrical cabinet. 2) Set the I/O channel. I/O channel: NC parameter No. 20 = 0 3) Set the communication parameters. Communication parameters: NC parameter No. 101, 102, 103
▭ 〚 H	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.
▭ ⋀⋀ JOG	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 DIRECTION switch is held down at the feedrate set with the OVERRIDE dial. Setting is possible in 15 steps in the range of 0 to 1260 mm/min. **NOTE** Close the front door before carrying out jog feed operation.
▭ ⌁ RPD	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 DIRECTION switch is held down. **NOTE** Close the front door before carrying out rapid traverse operation.
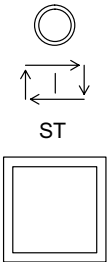
Switch	Function
ZRN	When this switch is pressed, the indicator in the switch is lit and the zero return mode is selected. In the zero return mode, an axis is manually returned to the zero point. **NOTE** Close the front door before carrying out zero return operation.

5-5   Automatic Operation Switches [CYCLE]

CYCLE

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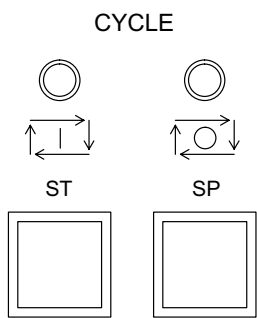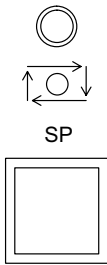
The CYCLE switches are used to start an automatic operation and stop the axis movement temporarily.

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 (ST) switch.

Switch	Function
ST	This switch is used to start an automatic operation in the memory, MDI or tape mode. The indicator above this 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 (ST) 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 F-1 (1)

Switch	Function
◯ ↱◯↓ SP ▢	This switch is used to temporarily stop axis movement during automatic operation. The indicator above 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 ↥↧ (ST) switch again.

5-6   Function Switches [FUNCTION]

FUNCTION

▣▶	⟲▶	▨▷
SBK	OSP	BDT
🎛	⊕▸	⩗▶
PSM	PST	DRN
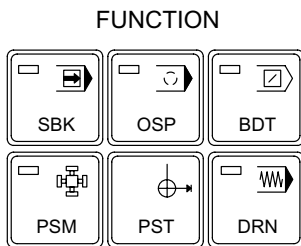
The FUNCTION switches are used for the following purposes.

1. To carry out test cutting in the automatic mode

2. To check programs in the automatic mode

3. To use the in-machine tool presetter

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 [ST] 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 [ST] 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] (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 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. 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.

<When the single block function is invalid>

The program is executed continuously when the ⟨ST⟩ (ST) 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.

NOTE The valid and invalid status of the optional stop function changes simultaneously when either of the optional stop switches ▨ provided for turret 1 and turret 2 respectively is pressed to change valid/invalid status.

<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>

STATUS

○ ERR   ○ MRDY

◉ M00/M01   ○ TRCL

○ M02/M30   ○ X ⌐

○ CHCL   ○ Z ⌐

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

The STATUS indicator **[M00/M01]** is lit.

To continue the interrupted operation, press the ⟳ (ST) 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]   ⟨⋄⟩   ⟨⬚⟩   ⟨Σ⟩
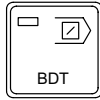
When this switch is pressed, the indicator in the switch is lit and the block delete function becomes valid.

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

NOTE

1. 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.

2. The valid and invalid status of the block delete function changes simultaneously when either of the block delete switches ⟨⬚⟩ provided for turret 1 and turret 2 respectively is pressed to change valid/invalid status.

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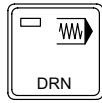
When this switch is pressed, the indicator in the switch is lit and the dry run function becomes valid.

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 15 steps.
Setting range: 0 to 1260 mm/min

NOTE The dry run function is valid even during thread cutting.

<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 (ST) switch.

5-6-5   Machine Lock

The machine lock function is made valid or invalid on the OPERATION PANEL screen, which is displayed by pressing the function selection key [SETTING] (SETTING).

Page A-126 (7-7-1)

NOTE To set the machine lock function valid or invalid for turret 2, display the OPERATION PANEL screen for turret 2 by pressing the HEAD CHANGE switch [⊡] (head 2).

<Machine lock function>

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

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

<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.

5-6-6   Presetter Switches [PSM/PST]

Two kinds of presetter switches (presetter mode switch and presetter measurement switch) are provided.

For details on the operation procedure of the in-machine tool presetter, refer to page E-29 (7).

<Presetter mode switch>

This switch is pressed to use the in-machine tool presetter. When it is pressed, the tool presetter mode is set.

<Presetter measurement switch>

This switch is used to set the distance between the tentative work zero and the actual work zero on the WORK OFFSET screen.

5-6-7   Chuck Clamp Direction

No.	MENU	CONDITION	
1	SPINDLE OFF MODE	INVALID	VALID
2	CHUCK DIRECTION	O.D.	I.D.
3	TAILSTOCK ILK.	OFF	ON
4	WORK COUNTER	ST.ILK	BDT
5	MACHINE LOCK	OFF	ON
6	AUX. F. LOCK	OFF	ON
7	CHUCK FOOT SWITCH	VALID	INVALID
8	CHUCK STROKE END	VALID	INVALID

EDIT *** *** ***   0mm/min   0%   0min-1   O0001 N00001   23:58:53   HEAD1

OPERATION PANEL (1/2)

< BDT   EXIT >

The chuck clamp direction is set as O.D. or I.D. on the OPERATION PANEL screen, which is displayed by pressing the function selection key [SETTING] (SETTING).

Page A-126 (7-7-1)

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.

<Chuck clamp direction function>

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.

<When O.D. is selected>

When O.D. is selected for the chuck clamp direction, the STATUS indicator **[CHCL]/ [HEADSTOCK 2 CHUCK CLAMP]** 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]/[HEADSTOCK 2 CHUCK CLAMP]** 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]/[HEADSTOCK 2 CHUCK CLAMP] 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.

5-6-8   Tailstock Spindle Interlock (Tailstock Specification)

MEM	***	***	***		0mm/min			
				0%	0min-1	O0001 N00001		

OPERATION PANEL (1/2)   23:58:53   HEAD1

No.	MENU	CONDITION	
1	SPINDLE OFF MODE	INVALID	VALID
2	CHUCK DIRECTION	O.D.	I.D.
3	TAILSTOCK ILK.	OFF	ON
4	WORK COUNTER	ST.ILK	BDT
5	MACHINE LOCK	OFF	ON
6	AUX. F. LOCK	OFF	ON
7	CHUCK FOOT SWITCH	VALID	INVALID
8	CHUCK STROKE END	VALID	INVALID

| < | BDT | | | | | | | EXIT | > |

The tailstock spindle interlock function is made valid or invalid on the OPERATION PANEL screen, which is displayed by pressing the function selection key [SETTING] (SETTING).

📖   Page A-126 (7-7-1)

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

<Tailstock spindle interlock function>

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.

<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.

5-6-9   Work Counter (Option)

The work counter function is used to set ST. ILK (start interlock) or BDT (block delete) on the OPERATION PANEL screen, which is displayed by pressing the function selection key ⌨ (SETTING).

📖 Page A-126 (7-7-1)

NOTE
1. For the machine not equipped with the work counter, the cursor does not move to No. 4 item.

2. The work counter functions of turret 1 and turret 2 change at the same time if the setting is changed for either of the tool spindle and turret 2 work counters.

3. Due to the limitations in the number of display characters on the screen, ST. ILK is used to indicate the start interlock.

<Work counter function>

The work counter function is used together with an optional PC work counter or external work counter to set the response for the count-up (the M89 command* is read as many times as the number set for the work counter.). Selection is possible from two choices: start interlock, and block delete.

* M89 command: Count-up of the work counter

<When the start interlock is selected>

When the M89 command is read as many times as the number set for the work counter, the current program is continuously executed to the end and then the machine stops.

NOTE If the ⎙ (ST) switch is pressed in this condition, an alarm message is displayed on the screen and cycle start is disabled.

<When the block delete (BDT) function is selected>

When the M89 command is read as many times as the number set for the work counter, the block delete function becomes valid.

NOTE If the ⎙ (ST) switch is pressed, the program is executed but the CURRENT quantity data is not updated.

5-6-10   Auxiliary Function Lock

The auxiliary function lock function is made valid or invalid on the OPERATION PANEL screen, which is displayed by pressing the function selection key [SETTING] (SETTING).

📖 Page A-126 (7-7-1)

NOTE The valid and invalid status of the auxiliary function lock function changes simultaneously when the status is changed for either of turret 1 and turret 2.

<Auxiliary function lock function>

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.

<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

```
EDIT  ***  ***  ***              0mm/min       O0001 N00001
                        0%       0min-1
OPERATION PANEL (1/2)                    23:58:53    HEAD1

        No.          MENU              CONDITION
         1   SPINDLE OFF MODE        INVALID   VALID
         2   CHUCK DIRECTION         O.D.      I.D.
         3   TAILSTOCK ILK.          OFF       ON
         4   WORK COUNTER            ST.ILK    BDT
         5   MACHINE LOCK            OFF       ON
         6   AUX. F. LOCK            OFF       ON
   ➡     7   CHUCK FOOT SWITCH       VALID     INVALID
         8   CHUCK STROKE END        VALID     INVALID



     <   BDT                                      EXIT  >
```

The chuck opening/closing footswitch is made valid or invalid on the OPERATION PANEL screen, which is displayed by pressing the function selection key

⌨ (SETTING).

📖   Page A-126 (7-7-1)

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

<Chuck footswitch interlock function>

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

<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 chuck jaw stroke end detection function is made valid or invalid on the OPERATION PANEL screen, which is

displayed by pressing the function selection key [SETTING] (SETTING).

Page A-126 (7-7-1)

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)

```
EDIT  ***  ***  ***        0mm/min
                    0%     0min-1      O0001 N00001
OPERATION PANEL (1/2)                23:58:53   HEAD1

    No.         MENU           CONDITION
     1   SPINDLE OFF MODE      INVALID   VALID
     2   CHUCK DIRECTION       O.D.      I.D.
     3   TAILSTOCK ILK.        OFF       ON
     4   WORK COUNTER          ST.ILK    BDT
     5   MACHINE LOCK          OFF       ON
     6   AUX. F. LOCK          OFF       ON
     7   CHUCK FOOT SWITCH     VALID     INVALID
  →  8   CHUCK STROKE END      VALID     INVALID


  <  BDT                                    EXIT  >
```

<Setting the chuck jaw stroke end detection function>

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 setting can be switched to INVALID to allow the spindle to rotate without a workpiece mounted in the chuck; shaping the chuck jaws or checking a program without mounting a workpiece, etc. require the spindle to be rotated with no workpiece mounted in the chuck.

For the chuck jaw stroke end detection function, refer to page C-32 (5).

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.

WARNING	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

The zero point adjustment function is made valid or invalid on the OPERATION PANEL screen, which is displayed by pressing the function selection key [SETTING] (SETTING).

Page A-126 (7-7-1)

NOTE
1. Usually, "INVALID" is set.

2. The valid and invalid status of the zero point adjustment function changes simultaneously when the status is changed for either of turret 1 and turret 2.

<Zero point adjustment function>

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.

<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 [WW] (fine feed).

CAUTION
If "VALID" is set for ZERO POINT 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 the 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 POINT 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.

5-6-14 Tailstock Position Adjustment (ZL-253)

No.	MENU	CONDITION	
9	ZERO POINT SET	INVALID	VALID
10	TLSTCK POS.ADJ.	INVALID	VALID
11	CHUCK2 DIRECTION	O.D.	I.D.
12	CHUCK2 FOOT SW.	VALID	INVALID
13	CHUCK2 STROKE END	VALID	INVALID
14	AUTO DOOR OPEN	BOTH	ONE
15			
16			

OPERATION PANEL (2/2)   23:58:53   HEAD1

O0001 N00001

EDIT *** *** ***   0mm/min   0%   0min-1

EXIT

The tailstock position adjustment function is made valid or invalid on the OPERATION PANEL screen, which is displayed by pressing the function selection key [SETTING] (SETTING).

Page A-126 (7-7-1)

NOTE
1. Usually, "INVALID" is set.
2. With ZL-153 and 203, "NOT USED" is displayed at No. 10 position.

<Tailstock position adjustment function>

With ZL-253, the tailstock joint position is set using a parameter. If the tailstock connection is impossible at the set joint position due to some reasons, axis movement becomes impossible.

The tailstock position adjustment function is used to allow axis movement to connect the tailstock under the condition that the tailstock joint is impossible at the preset tailstock joint position.

For the tailstock joint position adjustment procedure, refer to page B-68 (13-6).

<When the tailstock position adjustment function is valid>

When the tailstock position adjustment function is valid, axis movement is enabled even if the tailstock joint position is not stored to memory. It is also possible to extend the joint pin at positions other than the tailstock joint position.

CAUTION
If "VALID" is set for TLSTCK POS. ADJ., interlocks related with axis movement are all cancelled.

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

NOTE
When the tailstock is connected to the saddle, the setting for TLSTCK POS. ADJ. is automatically returned from "VALID" to "INVALID".

<When the tailstock position adjustment function is invalid>

Axis movement is not permitted if the tailstock cannot be connected to the saddle at the set position.

5-6-15   Spindle OFF Mode Function

The spindle OFF mode function is made valid or invalid on the OPERATION PANEL screen, which is displayed by pressing the function selection key [SETTING] (SETTING).

📖 Page A-126 (7-7-1)

NOTE The valid and invalid status of the spindle OFF mode function changes simultaneously when the status is changed for either of turret 1 and turret 2. (S type)

```
MEM  ***  ***  ***          0mm/min      O0001 N00001
                       0%   0min-1
OPERATION PANEL (1/2)                    23:58:53   HEAD1

     No.       MENU           CONDITION
 →    1   SPINDLE OFF MODE    INVALID  VALID
      2   CHUCK DIRECTION     O.D.     I.D.
      3   TAILSTOCK ILK.      OFF      ON
      4   WORK COUNTER        ST.ILK   BDT
      5   MACHINE LOCK        OFF      ON
      6   AUX. F. LOCK        OFF      ON
      7   CHUCK FOOT SWITCH   VALID    INVALID
      8   CHUCK STROKE END    VALID    INVALID



  <  BDT                                   EXIT  >
```

<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 mounting 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) (MC type)
M14	Rotary tool spindle start (reverse) (MC type)
M19	Spindle orientation (option)
M34	Phase synchronous operation ON (S type)
M35	Speed synchronous operation ON (S type)
M41	Spindle gear 1st range (transmission specification)
M42	Spindle gear 2nd range (transmission specification)
M43	Spindle gear 3rd range (transmission specification)
M44	Spindle gear 4th range (transmission specification)
M64	Robot service call (robot specification)
M70	Bar feeder operation (bar feeder specification)
M80	Cut-off check (S type)
M203	Spindle 2 start (normal) (S type)
M204	Spindle 2 start (reverse) (S type)
M219	Spindle 2 orientation (option) (S type)

M Code	Function
M319	Rotary tool spindle zero point return (MC type)
M382	Chip removal coolant ON (option)
M384	Spindle orientation and ceiling shutter open (option)
M387	Spindle 2 orientation and ceiling shutter open (option) (S type)

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.

📖 For the procedure to check a program without chucking a workpiece, refer to page F-11 (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 [⟳] (SP) 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

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

2. Since M329 is an M code that is processed at the NC unit, programs that include an M329 command cannot be used in the spindle OFF mode.

<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 [⟳] (SP) switch and the indicator in the dry run switch [⋙] go off.

In this state, normal operation is possible.

5-7   Status Indicators [STATUS]

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

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.

<Operation panel>

STATUS

○ ERR   ○ MRDY

○ M00/M01   ○ TRCL

○ M02/M30   ○ X ⌐

○ CHCL   ○ Z ⌐

<Option panel>

STATUS

○ C ⌐   ○ C ⌐

○ Y ⌐   ○ Y ⌐

<S type>

◎ B-AXIS ZERO POINT

◎ HEADSTOCK 2 CHUCK CLAMP

<Turret 2>
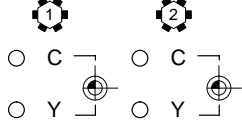
STATUS

○ ERR   ○ M00/M01   ○ X ⌐

○ TRCL   ○ M02/M30   ○ Z ⌐

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.
○ M00/M01	The STATUS indicator **[M00/M01]** is lit and the machine stops in the following cases: 1. When an M00 command (program stop) is read. 2. When an M01 command (optional stop) is read while the optional stop function is valid. **NOTE** 1. The M01 command in a program is ignored when the optional stop function is invalid, and the program proceeds to the next block without halting. 2. In a program, specify the M00/M01 command in an independent block.

Status indicator	Contents of Indication
○ M02/M30	The STATUS indicator **[M02/M30]** is lit and the machine stops in the following cases: 1. When an M02 command (program end) is read. 2. When an M30 command (program end and rewind) is read. **NOTE** In a program, specify the M02/M30 command in an independent block.
○ 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 spindle cannot rotate unless this indicator is lit. **NOTE** If automatic operation cannot be started, check whether or not this indicator is lit.
○ HEADSTOCK 2 CHUCK CLAMP	The status indicator **[HEADSTOCK 2 CHUCK CLAMP]** on the option panel is lit when chuck 2 is in the clamp state. (S type) Automatic operation is impossible unless chuck 2 is in the clamp state. The status indicator **[HEADSTOCK 2 CHUCK CLAMP]** is not lit when chuck 2 is in the unclamp state. The spindle cannot rotate unless this indicator is lit. If automatic operation cannot be started, check whether or not this indicator is lit.
○ MRDY	After turning on of the power supply, the lamp lights 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.
○ TRCL	The STATUS indicator **[TRCL]** shows whether the turret head is clamped correctly or not. Automatic operation is impossible unless this indicator is lit. 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.
○ B-AXIS ZERO POINT	The status indicator **[B-AXIS ZERO POINT]** on the option panel is lit when the B-axis has been returned to the zero point. (S type) This indicator is used to check if the axis has returned to the zero point.

Status indicator	Contents of Indication
\<MC 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
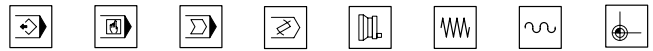
The footswitch is used to clamp/unclamp the chuck manually.

NOTE The footswitch is provided for chuck 1 and chuck 2 independently. Use the footswitch for the chuck to be operated. (S type)

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]**/the status indicator **[HEADSTOCK 2 CHUCK CLAMP]** is lit when the chuck operates in the direction the workpiece is clamped in it.

Page B-39 (7-4)
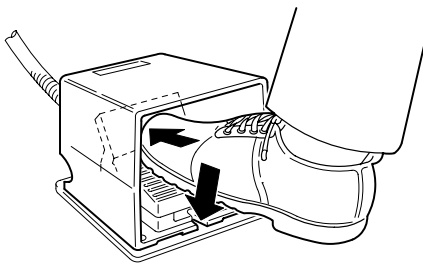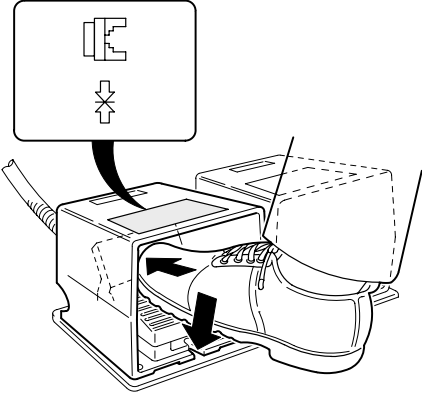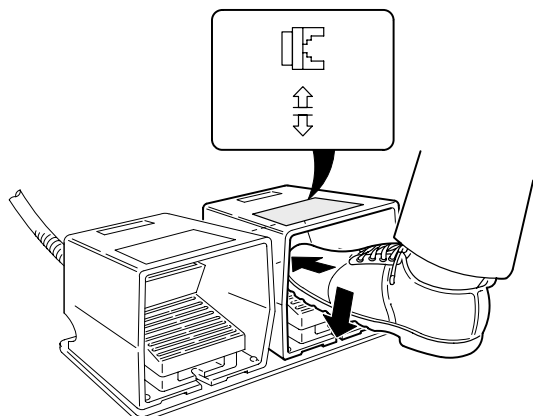
<Footswitch>

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.
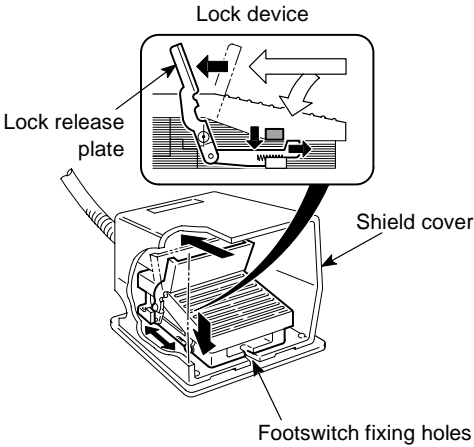
<Construction of the footswitch>

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. Use these holes when fixing the footswitch in place.

<Construction of the twin footswitch (option)>
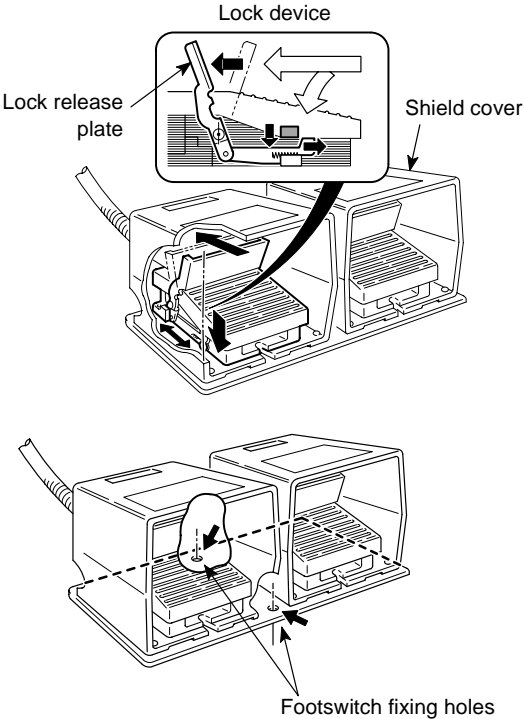
By pushing the lock release plate forward, the lock is released and the footswitch pedal can be stepped on.

At the center of the footswitch base plate, holes are provided. Use these holes when fixing the footswitch in place.

5-9   Spindle Switches [SPINDLE]
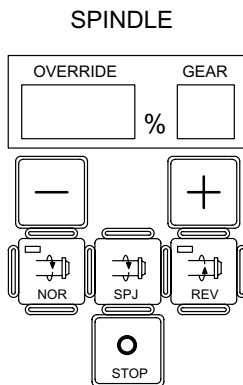
SPINDLE

The SPINDLE switches are used to start and stop the spindle manually.

The spindle or the rotary tool spindle (MC 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.**
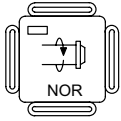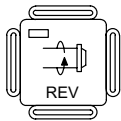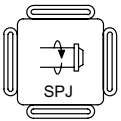
For the condition for spindle starting, refer to page B-31 (7-1).

NOTE

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

2. Close the front door before pressing these switches.

<Valid mode>

Switch	Function
NOR	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 $\boxed{+}$ (increase) and $\boxed{-}$ (decrease). Increase the spindle speed gradually after ensuring safety.
REV	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 $\boxed{+}$ (increase) and $\boxed{-}$ (decrease). Increase the spindle speed gradually after ensuring safety.
O **STOP**	The spindle stops when this switch is pressed.
SPJ	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
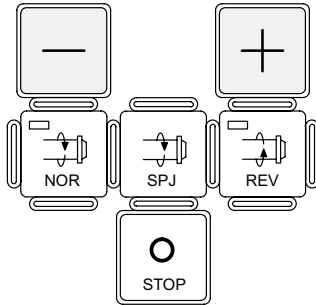
The spindle speed setting switches are used to set a spindle speed.

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.

Page A-53 (5-9-2)

<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 O (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 O (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 $\boxed{+}$ (increase) + $\boxed{-}$ (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 [OVERRIDE]

$\boxed{/\ \square\ \square}$ %
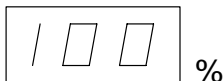
The OVERRIDE meter indicates the spindle speed override data set using the spindle speed setting switches $\boxed{+}$ (increase) and $\boxed{-}$ (decrease) (in the automatic mode) and the spindle speed (in the manual mode).

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

NOTE With the S type machines, the spindle speed override data (for automatic operation) and the spindle speed data (for manual operation) are used in common to spindle 1 and spindle 2, and it is not allowed to set different data for these two spindles.

5-9-3   Spindle Neutral Gear Switch [SPINDLE NEUTRAL] (Transmission Specification)
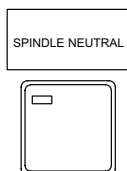
SPINDLE NEUTRAL

The SPINDLE NEUTRAL switch, provided on the option panel, is used to manually select the neutral position of the spindle.

NOTE Switch operation is impossible with the PANEL key-switch placed in the $\boxed{\bigcap}$ (OFF) position.

1.   When pressing this switch while the spindle is stopped, the spindle is put in neutral and the indicator in the switch is lit.

2.   When pressing this switch again while the front door is closed and the indicator in the switch is lit, the spindle gear is returned to the previously selected gear position before neutral position and the indicator in the switch goes off.

3.   When changing the operation mode from manual to automatic while the front door is closed and the indicator in the switch is lit, the spindle gear is returned to the previously selected gear position before neutral position and the indicator in the switch goes off.

NOTE Gear position is canceled when M02 or M30 command is executed before the spindle is put in neutral by pressing this switch. In this state, the spindle gear is not returned to the previously selected gear position before neutral position even if pressing the switch again and changing the operation mode from manual to automatic.

5-9-4   Spindle Gear Position Display Unit [GEAR] (Transmission Specification)

GEAR

1
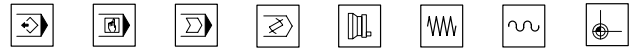
A number displayed on the display unit shows the currently selected gear range.

For spindle drive gear selection, M codes are used.

0 . . . . M40 (neutral)

1 . . . . M41 (1st range)

2 . . . . M42 (2nd range)

3 . . . . M43 (3rd range)

NOTE

1. The number of spindle gear ranges varies depending on the machine models and specifications.

2. For the machine not equipped with the transmission, nothing is displayed on the spindle GEAR position display unit.

5-10   Axis Feed Switches [AXIS DIRECTION]   〔∿∿〕 〔∿〕 〔⊕〕

The AXIS DIRECTION 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.

\<Standard\>

AXIS DIRECTION

\<B-axis (S type)\>
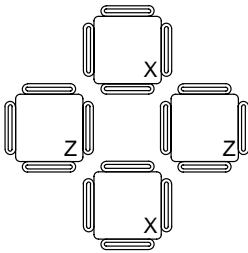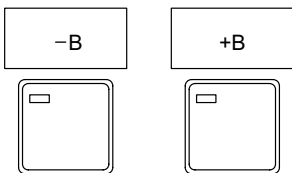
NOTE   The axis feed switches for the B-axis are provided on the option panel.

\<MC type\>

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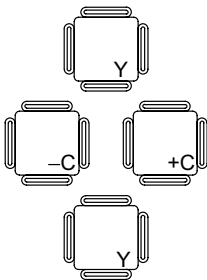
With the MC type machine, the ⎣−C⎤ (−C) and ⎣+C⎤ (+C) switches on the option panel are used to move the C-axis at jog feedrate or rapid traverse rate and also to return it to the zero point.

NOTE   1.   The ⎣−C⎤ (−C) and ⎣+C⎤ (+C) switches are valid only when turret 1 is selected by pressing the HEAD CHANGE switch 〔⇨〕 (head 1).

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]   ⟳   ▣   ∑   〰
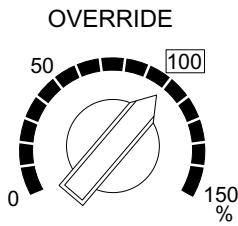
OVERRIDE

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% position, all axis movement stops.

CAUTION ⚠

Do not stop axis feed by setting the OVERRIDE dial in the "0"% position. To suspend axis feed, press the ⟲ (SP) 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 ⟲ (SP) 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 (15 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 [RAPID OVERRIDE]

RAPID OVERRIDE
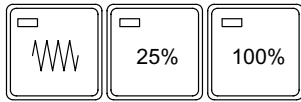
The RAPID OVERRIDE switches are used to adjust rapid traverse rate.

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.

The rapid traverse rate is adjusted in three steps; ∿ (fine feed), 25%, and 100% (set rapid traverse rate).

NOTE

1. When the power is turned on, ∿ (fine feed) is selected to ensure safety.

2. For manual operation, the maximum allowable override value is 50%. Therefore, if the 100% (100%) switch is pressed, the override value is 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 [HANDLE]

HANDLE

Axis selection switches

Axis feed amount selection switches

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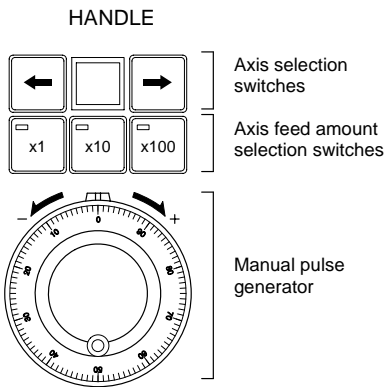
The handle switches - which comprise the axis selection switch, the axis feed amount selection switches, and the manual pulse generator - are used to carry out handle feed operations.

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

5-13-1   Axis Selection Switches
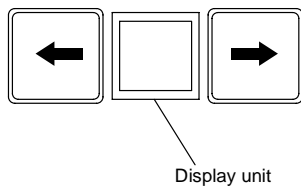
Display unit

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** 1. With the MC type machines, when this switch is pressed, the axis is selected in the order of X, Z and C. 2. With the S type machines, when this switch is pressed, the axis is selected in the order of X, Z, and B.
	The switch is used to select the X-axis. **NOTE** 1. With the MC type machines, when this switch is pressed, the axis is selected in the order of C, Z and X. 2. With the S type machines, when this switch is pressed, the axis is selected in the order of B, Z, and X.

5-13-2   Axis Feed Amount Selection Switches
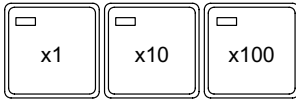
The axis feed amount selection switches are used to determine the axis feed amount per pulse when an axis is moved with the manual pulse generator.

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

<Axis feed amount per pulse>

Setting	X-, Z- and B-axes (S type)	C-axis (MC 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 x1 (×1) is selected to ensure safety.

2. When the operation mode is changed from automatic to manual, the axis feed amount selection switch x1 (×1) is selected to ensure safety.

5-13-3   Manual Pulse Generator
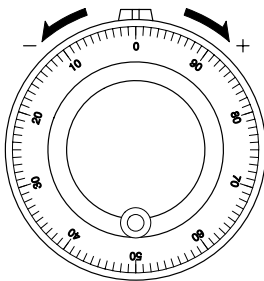
The manual pulse generator is used to move an axis in the handle mode.

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.
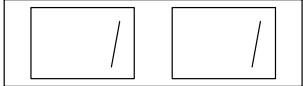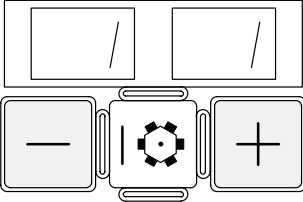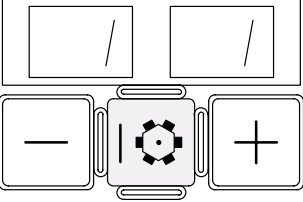
5-14   Turret Indexing Switches [TURRET]   ⊞   ⟨W⟩   ⟨∿⟩   ⊕
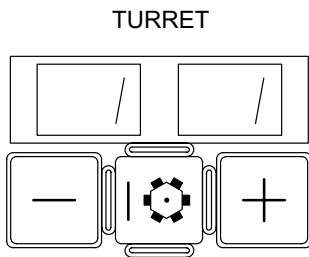
TURRET

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
TURRET 	The display unit shows the presently indexed turret number. **NOTE** The turret station number of turret 1 is displayed in the left display unit and that of turret 2 is displayed in the right display unit.
TURRET 	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 $\boxed{+}$ (increase) is pressed and released, the target station number is increased by one. 2. When the turret station setting switch $\boxed{-}$ (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 CHANGE switches (head 1) and (head 2). 2. The set target station number blinks in the display unit.
TURRET 	This switch is used to index the turret head manually. After setting the target station number with the turret station setting switches $\boxed{+}$ (increase) and $\boxed{-}$ (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-41 (8).

5-15   Coolant Switches [COOLANT]

COOLANT
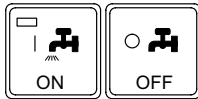
The COOLANT switches are used to manually operate the coolant.

NOTE

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

2.   The (OFF) switches for turret 1 and turret 2 are turned on or off simultaneously.

Switch	Function
ON	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 (ON) switch is lit and coolant is automatically supplied.
OFF	When this switch is pressed while coolant is being supplied, the coolant supply stops and the indicator in the (ON) switch goes off. **NOTE** Pressing this switch for 1 second or more while coolant is not being supplied causes the indicator in the (ON) 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 blink state>** 1. Press the (ON) switch. The indicator in the switch lights and the coolant is supplied. 2. Press the (OFF) switch. The indicator in the (ON) switch goes off and the coolant is not supplied.

5-16   Machine Light Switch [LIGHT]

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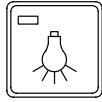
The LIGHT switch is used to turn the machine light on/off.

Machine 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]

CHIP CONVEYOR

FOR   STOP   BACK
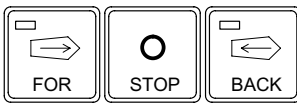
The CHIP CONVEYOR switches are used to manually operate the chip conveyor.
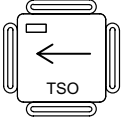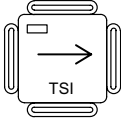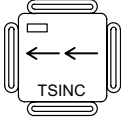
NOTE
Close the front door before operating the chip conveyor.

Switch	Function
FOR	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.
STOP	When this switch is pressed, the chip conveyor stops.
BACK	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] (Tailstock Specification)
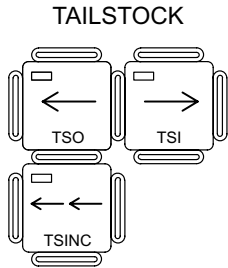
TAILSTOCK

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
TSO	When this switch is pressed, the tailstock spindle moves out and the indicator in the switch is lit.
TSI	When this switch is pressed, the tailstock spindle moves in and the indicator in the switch is lit.
TSINC	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.

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

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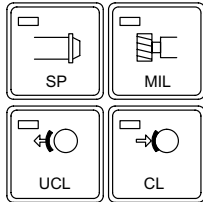
The MILLING switches are provided for the machine equipped with the milling function and they are used to operate the C-axis.

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 when the rotary tool spindle is selected. The indicator in the switch is lit when the main spindle is clamped. **NOTE** Pressing this switch while the main spindle is selected causes the rotary tool spindle to be selected.
UCL	Press this switch to unclamp the main spindle when the rotary tool spindle is selected. The indicator in the switch is lit when the main spindle is unclamped.

5-20   Door Unlock Switch [DOOR UNLOCK]

DOOR UNLOCK
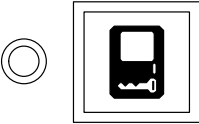
The DOOR UNLOCK switch is used to release the front door lock device.

NOTE

1. The front door cannot be opened unless the door lock is unlocked.

2. With the automatic door type machine, this switch has no function even when it is pressed.

For details, refer to page P-24 (5-1) in Chapter "DOOR INTERLOCK FUNCTION".

Front Door	Function
Unlock	When the DOOR UNLOCK switch is pressed, the indicator at the left side of the switch is lit and the door lock is released. The front door can be opened in this state.
Lock	When the DOOR UNLOCK switch is pressed with the door closed while the indicator at the left side of the switch is lit, the indicator goes off and the door is locked. In this state, the front door cannot be opened.

5-21   Programmable Tailstock Switches (Option)

TSCLP   TSUCLP

TSTMOD
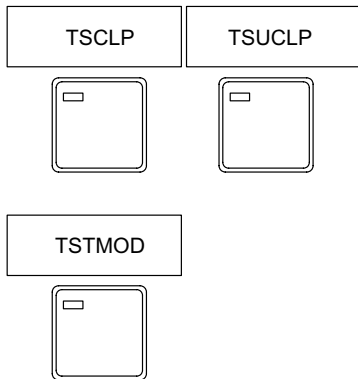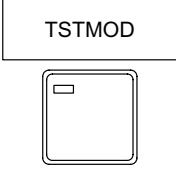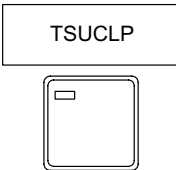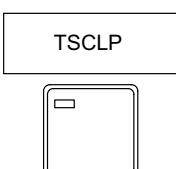
The programmable tailstock switches on the optional panel are used for manual tailstock operations such as placing the tailstock in the joint mode and clamping and unclamping the tailstock body.

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

2.   Press the HEAD CHANGE switch (head 1) to select the turret 1, before pressing the programmable tailstock switches. The programmable tailstock does not operate unless the turret 1 is selected.

<Valid mode>

- Joint mode switch

- Clamp/Unclamp switch

Switch	Function
TSTMOD	When this switch is pressed, the tailstock is placed in the joint mode and the indicator in the switch blinks. Pressing the switch again causes the indicator to go off and the joint mode is canceled. After selecting the joint mode by pressing the switch, move the saddle to the tailstock joint position by pressing either the positive or negative direction AXIS DIRECTION switch Z (Z). When the saddle is positioned at the joint position, the indicator in the switch stops blinking and is lit.
TSUCLP	When this switch is pressed after positioning the saddle at the joint position, the tailstock is unclamped and the joint pin extends from the tailstock so that it is connected to the saddle. The indicator in the switch is lit.
TSCLP	When this switch is pressed while the tailstock is connected to the saddle, the tailstock is clamped and it is disconnected from the saddle. The indicator in the TSUCLP switch goes off and the indicator in this switch is lit.

5-22   Steady Rest Switches (Steady Rest Specification)
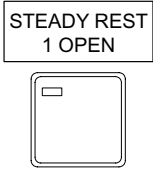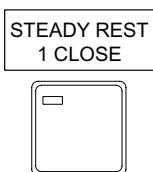
STEADY REST
1 OPEN

STEADY REST
1 CLOSE

STEADY REST
MANUAL MODE
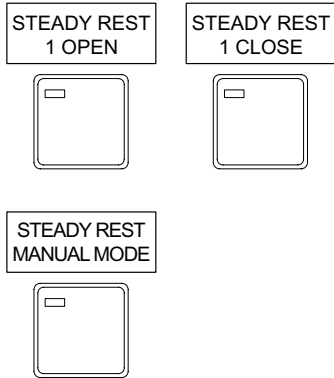
The steady rest switches on the optional panel are used to manually open and close the steady rest.

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

Switch	Function
STEADY REST MANUAL MODE	When this switch is pressed, the steady rest is placed in the manual mode. The indicator in the switch is lit and manually opening/closing the steady rest is possible. Pressing the switch again causes the indicator to go off and the steady rest manual mode is canceled.
STEADY REST 1 OPEN	When this switch is pressed in the seady rest manual mode, the steady rest is opened and the indicator in the switch is lit.
STEADY REST 1 CLOSE	When this switch is pressed in the steady rest manual mode, the steady rest is closed and the indicator in the switch is lit or blinks. The indicator blinks when the steady rest close is completed while the turret 2 X-axis is at the zero point. The indicator is lit when the steady rest close is completed while the turret 2 X-axis is not at the zero point.

5-23   Parts Catcher Switches [PARTS CATCHER OUT/IN]

(Parts Catcher Specification)
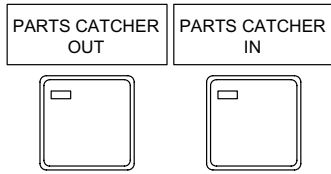
The PARTS CATCHER OUT/PARTS CATCHER IN switches are used to manually extend and retract the parts catcher.

NOTE Before pressing the PARTS CATCHER OUT/ PARTS CATCHER IN switches, close the front door.

Switch	Function
PARTS CATCHER OUT	When this switch is pressed, the parts catcher moves out. The indicator in the switch is lit at the completion of parts catcher OUT operation.
PARTS CATCHER IN	When this switch is pressed, the parts catcher moves in. The indicator in the switch is lit at the completion of parts catcher IN operation.

5-24   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.
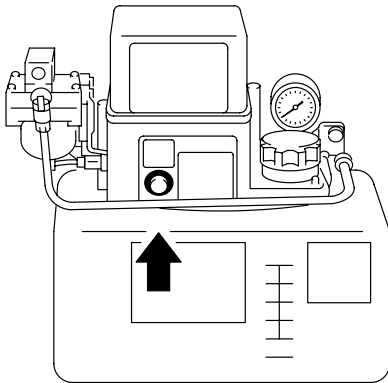
Hold down the pushbutton to supply lubricating oil to the slideways.

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

For details, refer to the DRAWINGS.

CAUTION In order to protect the lubrication pump motor, do not hold down the manual lubrication pushbutton for longer than one minute when supplying lubricating oil to the slideways manually. If the pushbutton is held down for longer than a minute, the lubrication pump motor may fail.

5-25   Chucking Pressure Adjustment Handle

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

📖   Page C-7 (2-1)
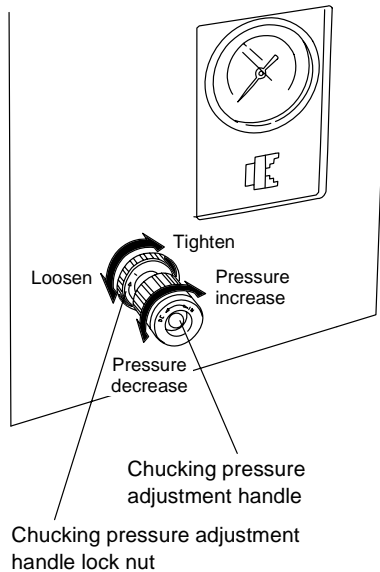
Loosen the chucking pressure adjustment handle lock nut and turn the handle to adjust the chucking pressure.

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

> **NOTE**
> The type and installation position of the chucking pressure adjustment handle varies depending on the machine model.
>
> For details, refer to the DRAWINGS.

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

5-26   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).

📖   Page C-8 (2-2)

NOTE   Take the center hole size of the workpiece into consideration when determining the tailstock spindle thrust.
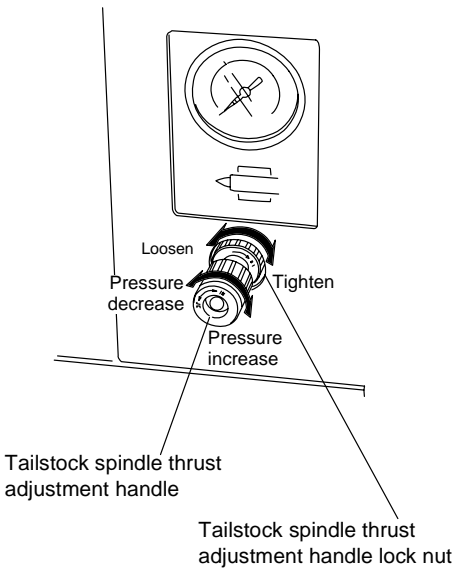
Loosen the tailstock spindle thrust adjustment handle lock nut and turn the handle to adjust the tailstock spindle thrust.

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

Loosen

Pressure decrease   Tighten

Pressure increase

Tailstock spindle thrust adjustment handle

Tailstock spindle thrust adjustment handle lock nut

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.

- CCW rotation.... Pressure decrease

- CW rotation ...... Pressure increase

5-27   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.
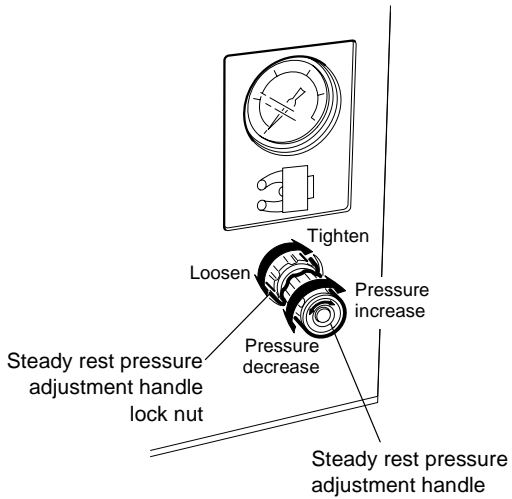
Loosen the steady rest pressure adjustment handle lock nut and turn the handle to adjust the steady rest pressure.

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.

Tighten

Loosen

Pressure increase

Pressure decrease

Steady rest pressure adjustment handle lock nut

Steady rest pressure adjustment handle

6   NC OPERATION PANEL

This section describes the NC operation panel.

Explanations of keys and function can be found in the sections indicated by the illustration given below.
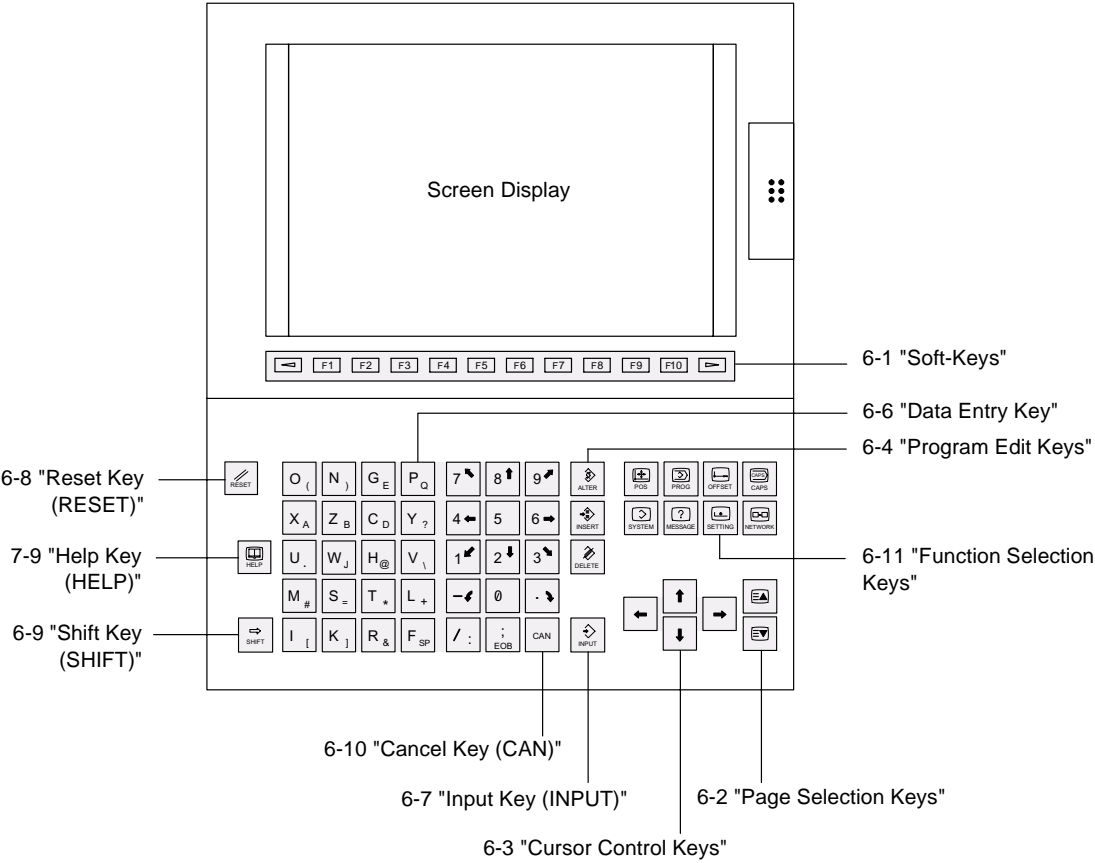
6-1   Soft-Keys

These keys are called soft-keys and they are assigned a variety of functions that depends on the operation step currently being executed. The functions currently available for each of the individual soft-keys are displayed on the bottom line of the screen.

NOTE When procedures are explained in this manual, expressions of the form "press the [   ] soft-key" are used, but what you must actually do is to press the corresponding function key (F1 to F10) beneath the screen.

1. Soft-keys (F1 - F5)

2. Soft-keys (F6 - F10)

General information

Soft-keys assigned functions

Function keys

3. Menu selection key

4. Menu selection key
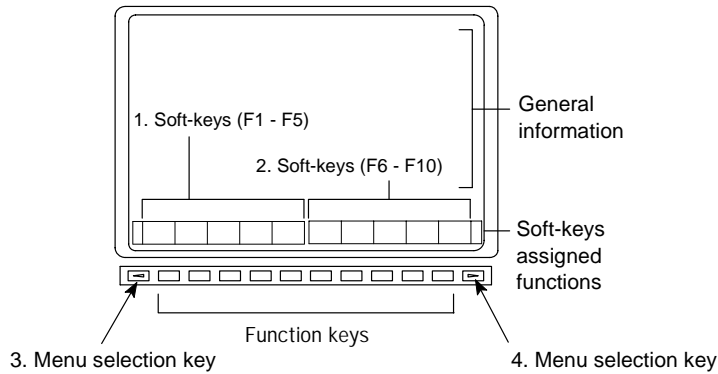
1. Soft-keys (F1 to F5)

    If the display is changed by pressing a function selection key, soft-keys are displayed to select the screen accessible in the selected mode.

2. Soft-keys (F6 to F10)

    Soft-keys F6 to F10 are used to carry out operation at the screen called by the function selection key and the soft-keys (F1 to F5).

3. Menu selection key **[<]**

    This key is used to display more sets of menu items that are assigned to soft-keys (F1 to F5).

4. Menu selection key **[>]**
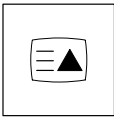
    This key is used to display more sets of menu items that are assigned to soft-keys (F6 to F10).

\<Soft-key configuration\>

Screen selection menu   Operation selection menu
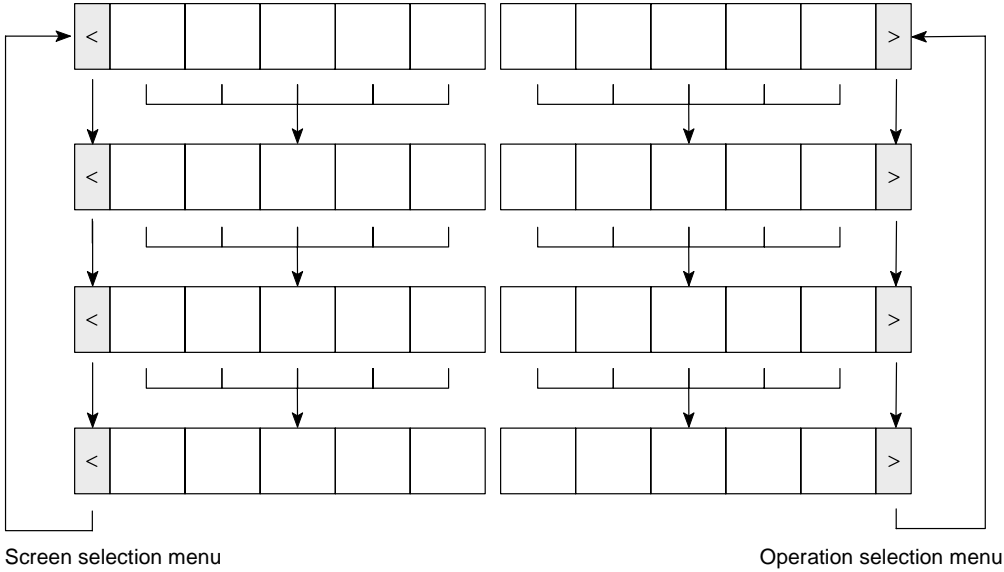
6-2   Page Selection Keys
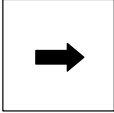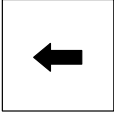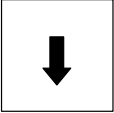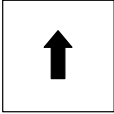
The page selection keys are used to change the display pages.
Each of the display pages provide the information related with the called function. If the function has the information to be displayed on two or more pages, use these keys to change the display page.

There are two page selection keys.

Page	Key	Function
Return	≡▲	This key is used to return the display page to the previous page.
Advance	≡▼	This key is used to advance the display page to the next page.

6-3   Cursor Control Keys

The cursor control keys are used to move the cursor on the screen.
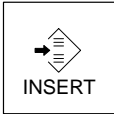
There are four cursor control keys.

Cursor	Key	Function
Forward (small unit)	➡	This key moves the cursor to the right by the small unit (forward).
Reverse (small unit)	⬅	This key moves the cursor to the left by the small unit (reverse).
Forward (large unit)	⬇	This key moves the cursor down by the large unit (forward).
Reverse (large unit)	⬆	This key moves the cursor up by the large unit (reverse).

6-4   Program Edit Keys

The program edit keys allow words and blocks of data in a program to be altered, inserted, or deleted.

There are three program edit keys, ALTER, INSERT and DELETE.

Program edit	Key	Function
Alteration	ALTER	This key is used to alter words (addresses and data). In other words, the key is used to replace an existing word with a new word.
Insertion	INSERT	This key is used to insert a new word or block between two existing words. It is also used to write a program to the NC memory.
Deletion	DELETE	This key is used to delete words, blocks and programs. **NOTE** Before pressing the key, check the words, blocks, or programs to be deleted. Once the key is pressed and the words, blocks, or programs are deleted, there is no way to restore them.

6-5   Key Input Buffer Area
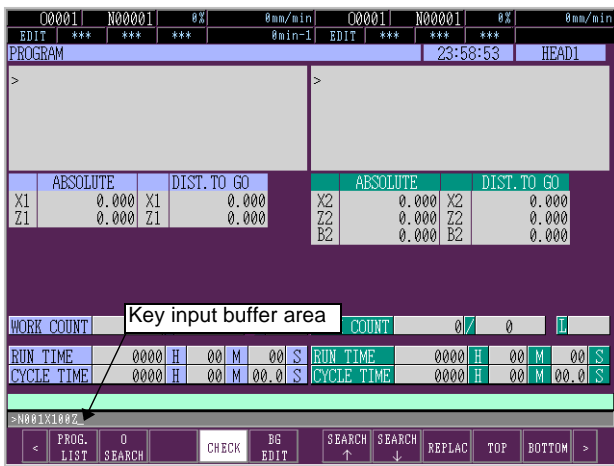
The data entered using the data entry keys are first entered to the buffer area, called the key input buffer. The data in the buffer area is displayed in the lower part of the screen.

The ">" symbol is displayed at the head of the data to identify that the data is entered using the keys. At the end of the data, the underline cursor is displayed to indicate the next data entry position.

<Procedure to edit the data in the key input buffer area>

1) Press the [⇨ SHIFT] (SHIFT) key.

2) Move the data entry position using the cursor control keys [←] and [→].

    The underline cursor is displayed at the data entry position.

    - If the cursor control key [←] is pressed, the data entry position is moved in reverse by one letter.

    - If the cursor control key [→] is pressed, the data entry position is moved forward by one letter.

3) Repeat steps 1) and 2) and move the data entry position where the data is to be edited.

4) Edit the data.

    - If the data is entered using the data entry keys, a letter above the underline cursor and the letters after its letter are written over.

    - If the [CAN] (CAN) key is pressed, the letters before the underline cursor are cleared in reverse.

6-6   Data Entry Key

O (	N)	G E	P Q	7 ↘	8 ↑	9 ↗
X A	Z B	C D	Y ?	4 ←	5	6 →
U .	W J	H @	V \	1 ↙	2 ↓	3 ↘
M #	S =	T *	L +	− ∕	0	· ↘
I [	K]	R &	F SP	/ :	; EOB	

Alphabetic characters   Numeric characters
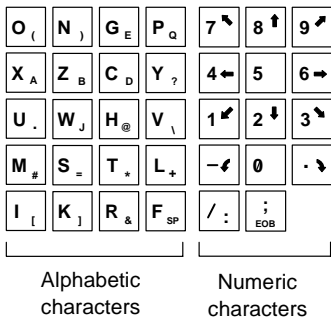
The data entry keys are the letter keys and number keys used to input alphabetic and numeric characters.

6-7   Input Key [INPUT] (INPUT)
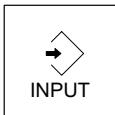
[INPUT]

When data entry keys are pressed, the corresponding data is entered to the key input buffer and displayed on the screen.

When the [INPUT] (INPUT) key is pressed, the information entered to the key input buffer is set to a memory area, such as the offset register.

6-8   Reset Key [RESET] (RESET)
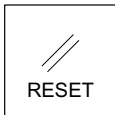
[RESET]

The [RESET] (RESET) key is used to reset the NC, for example in order to clear an alarm state.

NOTE Modal information already executed is not cleared when the [RESET] (RESET) key is pressed to reset the NC.

6-9   Shift Key ⇨ (SHIFT)
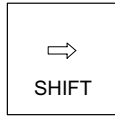
Each key on the NC operation panel contains two characters; the ⇨ (SHIFT) key is used to input the character located in the lower right hand corner of the keys.

<Example> To key in "A"
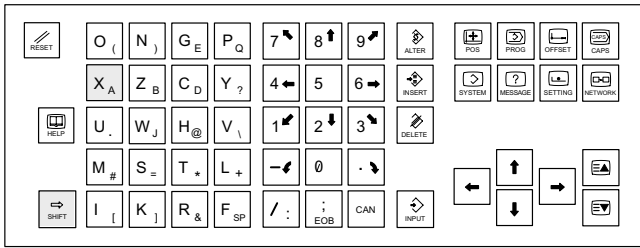
1) Press the ⇨ (SHIFT) key.

   "^" is displayed on the key input buffer (on the second line but one from the bottom).

2) Press the X A key.

NOTE "A" is not displayed when the X A key is pressed while holding the ⇨ (SHIFT) key.

6-10   Cancel Key CAN (CAN)
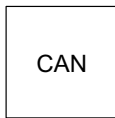
The CAN (CAN) key is used to delete the data entered in the key input buffer (displayed above the soft-keys) character by character from right to left.

<Example>
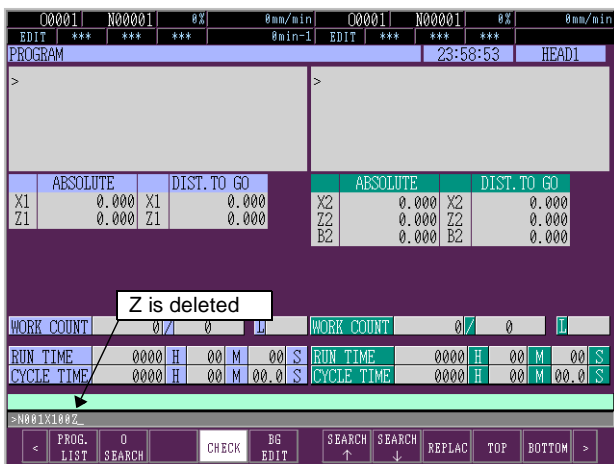
Z is deleted

If the CAN (CAN) key is pressed while the key input buffer data currently displayed is "N001X100Z", the last character "Z" is deleted and the display changes to "N001X100".
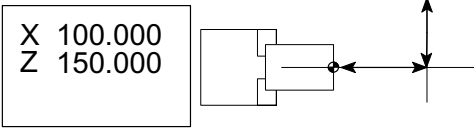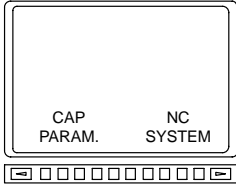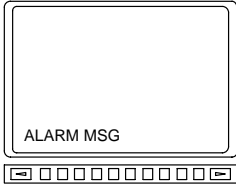
NOTE The program data already stored in the NC memory cannot be deleted using the CAN (CAN) key.

6-11   Function Selection Keys
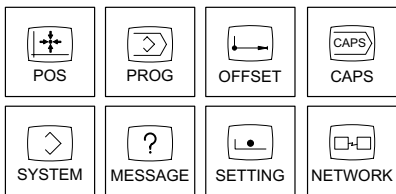
The function selection keys allow the operator to select the type of screen to be displayed.

Using these keys, screens with 8 different functions can be accessed.

Page A-81 (7)

POS	**[POS]** Used to access the screen that displays: - actual position data X 100.000 Z 150.000	SYSTEM	**[SYSTEM]** Used to access the screen that displays: - the self-diagnosis data, parametric data, etc. CAP NC PARAM. SYSTEM
PROG	**[PROG]** Used to access the screen that displays: - program edit screen - MDI program screen - list of the program presently executed	MESSAGE	**[MESSAGE]** Used to access the screen that displays: - NC alarm - PLC alarm ALARM MSG
OFFSET	**[OFFSET]** Used to access the screen for display and setting of: - offset data - work coordinate system, etc.	SETTING	**[SETTING]** Used to access the screen that displays: - operation panel - rotary tool (MC type) - PC work counter - tool life management - load monitor - setting - timer - weekly timer - communication parameter
CAPS	**[CAPS]** Used to access the screen that displays: - conversational program - tool file - conversational programming parameter, etc.	NETWORK	**[NETWORK]** With the machines not equipped with the network function, the function is not called even when the switch is pressed.

7   FUNCTION SELECTION KEYS AND DISPLAY SCREENS

This section deals with the screens which are displayed when the function selection keys on the NC operation panel are pressed.

7-2 "Function Selection Key (PROG)"   7-3 "Function Selection Key (OFFSET)"

7-1 "Function Selection Key (POS)"   7-4 "Function Selection Key (CAPS)"

| POS | PROG | OFFSET | CAPS |
| SYSTEM | MESSAGE | SETTING | NETWORK |

7-5 "Function Selection Key (SYSTEM)"   7-8 "Function Selection Key (NETWORK)"

7-6 "Function Selection Key (MESSAGE)"   7-7 "Function Selection Key (SETTING)"

<Example>

Actual position
(ABSOLUTE)

Actual position
(INCREMENTAL)

Actual position
(total position data)

Operation monitor

Handle interruption

1. In the explanation given below, the screens accessible by pressing a function selection key are indicated as shown to the left.

    The screens depicted with ——— are standard screens and the one depicted with — · — is an optional screen.

2. Soft-keys are indicated like this: **[KEY-NAME].**

3. ▬ indicates the procedure used for displaying the required screen.

NOTE The MC type machines are equipped with the C-axis. Therefore, the coordinate value of the C-axis is displayed on the screen.

7-1   Function Selection Key ⊞ (POS)

The function selection key ⊞ (POS) is used to display position data on any of the following the position data screens.
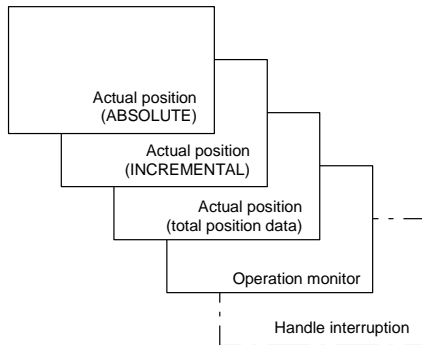
Actual position
(ABSOLUTE)

Actual position
(INCREMENTAL)

Actual position
(total position data)

Operation monitor

Handle interruption

To change the display screen, press the soft-key corresponding to the screen to be accessed.

To display the handle interruption screen, press the menu selection key **[<]**, and then the **[HANDLE]** soft-key.

NOTE The HANDLE INTERRUPTION screen is displayed only when the optional handle interruption function is selected.

7-1-1   Actual Position (ABSOLUTE) Screen

Function selection key ⊞ (POS) ⟶ **[ABS.]**
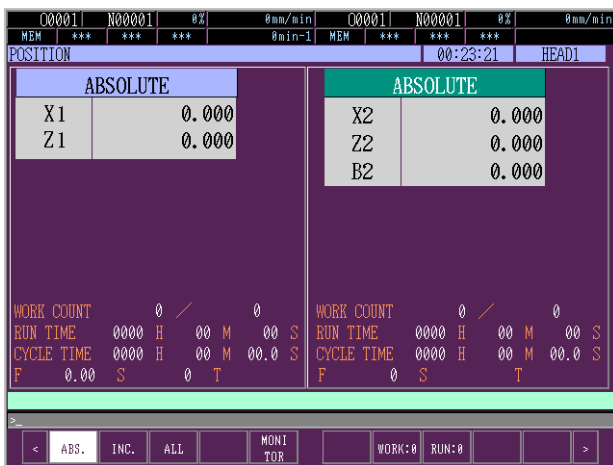
This screen displays the position in reference to the workpiece zero point.

This position data includes the following values:

1.   Work coordinate system (work shift) setting values

2.   Tool geometry offset data

3.   Tool wear offset data

Using this screen, it is possible to clear the run time data and the part count data.

<Transition of soft-keys>

<	ABS.	INC.	ALL		MONI TOR		WORK:0	RUN:0			>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

7-1-2   Actual Position (INCREMENTAL) Screen

Function selection key [⊞ POS] (POS) ⟶ **[INC.]**

```
O0001  N00001   0%    0mm/min  O0001  N00001   0%    0mm/min
MEM   ***   ***   ***       0min-1 MEM   ***   ***   ***
POSITION                         00:23:24    HEAD1
       INCREMENTAL                   INCREMENTAL
    X1        0.000             X2        0.000
    Z1        0.000             Z2        0.000
                                B2        0.000



WORK COUNT      0  /      0   WORK COUNT      0  /      0
RUN TIME    0000 H   00 M   00 S  RUN TIME    0000 H   00 M   00 S
CYCLE TIME  0000 H   00 M  00.0 S CYCLE TIME  0000 H   00 M  00.0 S
F    0.00  S      0  T        F      0  S        T

>_
 <  ABS.  INC.  ALL      MONI              PRESET ORIGIN  >
                        TOR
```

This screen displays the actual position data in incremental values referenced to the arbitrary position where the operator has set the data to "0".

<Transition of soft-keys>

<	ABS.	INC.	ALL		MONI TOR				PRESET	ORIGIN	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

<	ABS.	INC.	ALL		MONI TOR		WORK:0	RUN:0			>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

<Procedure to reset the actual (incremental) position data>

1) Select the turret for which the actual position data is to be reset to "0" by pressing the HEAD CHANGE switch [1] (head 1) or [2] (head 2).

2) Press the address key (X or Z) corresponding to the axis for which the actual (incremental) position data is to be reset to "0".

   The display of the pressed address key will blink.

3) Press the **[ORIGIN]** soft-key.

   The actual (incremental) coordinate position data is reset to "0".

<	ABS.	INC.	ALL		MONI TOR				PRESET	ORIGIN	>

| ◁ | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | ▷ |

<Resetting the actual (incremental) position data for all the axes at the same time>
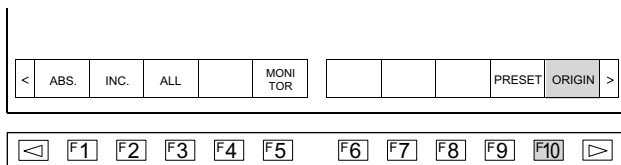
Follow the steps below to simultaneously reset all the axes (X and Z).

1) Select the turret for which the actual position data is to be reset to "0" by pressing the HEAD CHANGE switch ⌈1⌀⌉ (head 1) or ⌈⌀2⌉ (head 2).

2) Press the **[ORIGIN]** soft-key.

<	ABS.	INC.	ALL		MONI TOR				PRESET	ORIGIN	>

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |
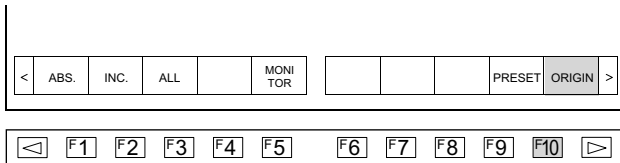
3) Press the **[TOTAL AXIS]** soft-key.

This resets the actual (incremental) coordinate position data (X and Z).

							TOTAL AXIS		

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |
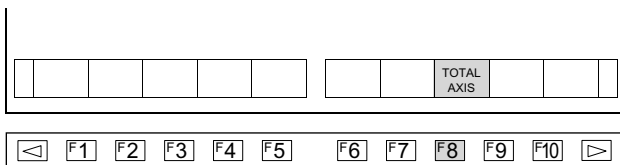
NOTE With the MC type machines, the actual position data of the C-axis is also reset to "0" if the **[TOTAL AXIS]** soft-key is pressed.

<Procedure to preset the actual (incremental) position data>

1) Select the turret for which the position data should be preset by pressing the HEAD CHANGE switch ⌈1⌀⌉ (head 1) or ⌈⌀2⌉ (head 2).

2) Press the address key (X or Z) of the axis to be preset.

3) Input the numerical data to be set using the data entry keys.

4) Press the **[PRESET]** soft-key.

The input numerical data is set for the incremental coordinate values.

<	ABS.	INC.	ALL		MONI TOR				PRESET	ORIGIN	>

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |

<Procedure to clear the run time data and the part count data>
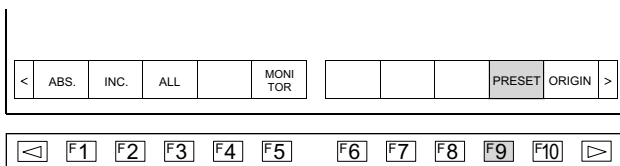
1)   Select the turret for which the data should be cleared by pressing the HEAD CHANGE switch (head 1) or (head 2).

2)   Press the menu selection key **[>]**.

| < | ABS. | INC. | ALL | | MONI TOR | | | | PRESET | ORIGIN | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | ▷ |
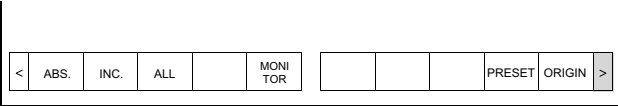
3)   Press the **[WORK:0]** or **[RUN:0]** soft-key.

The PART COUNT data or the RUN TIME data is reset to "0" respectively.

| < | ABS. | INC. | ALL | | MONI TOR | WORK:0 | RUN:0 | | | | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | ▷ |
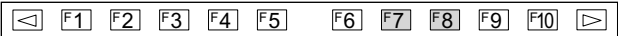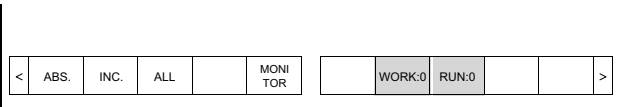
7-1-3   Actual Position (Total Position Data) Screen

Function selection key (POS) ⟶ **[ALL]**

The following position data is displayed on one screen.

1. Actual position
    (INCREMENTAL)

    Position data in reference to the zero reset point

2. Actual position
    (ABSOLUTE)

    Position data in reference to the work zero point

3. Position in the machine coordinate system
    (MACHINE)

    Position data in reference to the machine zero point

4. Remaining distance (DIST. TO GO)

    The remaining distance is only displayed when the machine is operating in the memory, MDI, or tape mode.

NOTE

1. The remaining distance is only displayed when the machine is operating in the memory, MDI, or tape mode.

2. During execution of the G04 (dwell) command, the remaining time is indicated in the X-axis display field.

Using this screen, it is possible to reset and preset the actual position data in the relative coordinate system, and clear the run time data and the part count data.

<Transition of soft-keys>

<	ABS.	INC.	ALL		MONI TOR					PRESET	ORIGIN	>
	F1	F2	F3	F4	F5		F6	F7	F8	F9	F10	

<	ABS.	INC.	ALL		MONI TOR			WORK:0	RUN:0			>
	F1	F2	F3	F4	F5		F6	F7	F8	F9	F10	
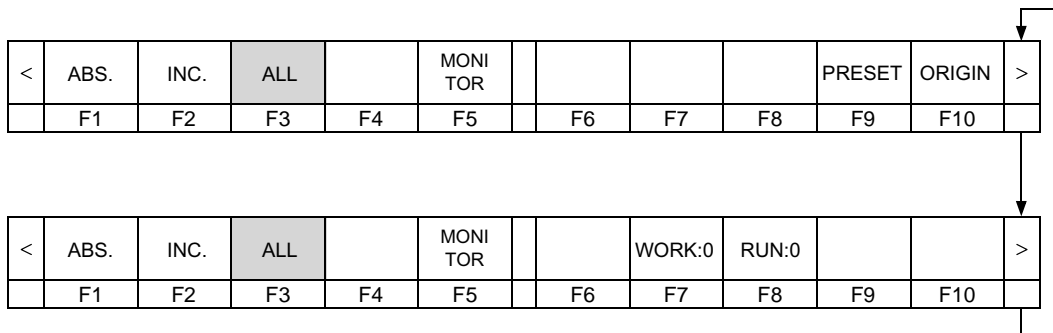
7-1-4   Operating Monitor Screen

Function selection key ⊞ (POS) ⟶ **[MONITOR]**

This screen displays the load of the servomotor, the spindle drive motor, and maximum value of load.
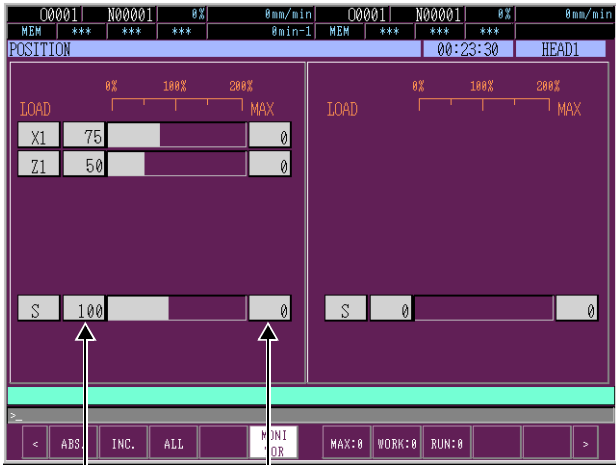
Present load   Maximum load

1. Bar graphs and numeric values at the left of bar graphs indicate the present load.

2. Numeric values at the right of bar graphs indicate the maximum load detected up to now since the power was turned on last.

<Load display>

X1: X-axis servo motor

Z1: Z-axis servo motor

B: B-axis servo motor (turret 2) (S type)

S: Spindle drive motor

<Transition of soft-keys>

<	ABS.	INC.	ALL		MONI TOR	MAX:0	WORK:0	RUN:0			>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

<Procedure for clearing the max. load value>
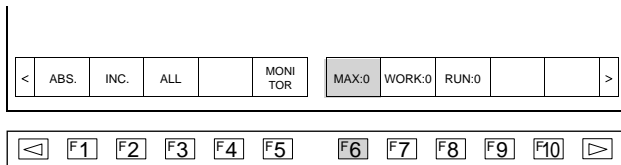
1) Press the **[MAX:0]** soft-key.

The load value (max. value) is cleared to "0".

NOTE

1. The load value (max. value) is cleared to "0" when the power is turned off.

2. The load value (max. value) is cleared to "0" when the display screen is changed.

7-1-5   Handle Interruption Screen (Option)

Function selection key [POS] (POS) ⟶ **[<]** ⟶ **[HANDLE]**

This screen displays the axis movement distance moved by turning the manual pulse generator when the optional handle interruption function is selected.

The axis movement distance value is cleared to "0" when an axis reaches the zero point.

<Transition of soft-keys>

<	HANDLE				2 HEAD				PRESET	ORIGIN	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

<	ABS.	INC.	ALL		MONI TOR		WORK:0	RUN:0			>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	
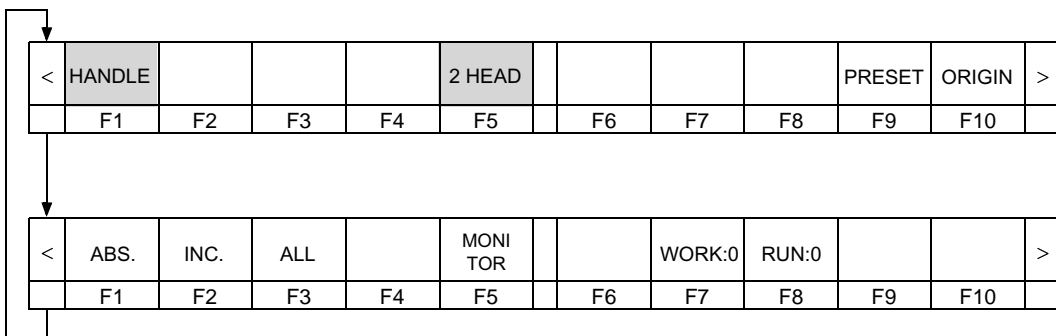
7-2   Function Selection Key ⌨ (PROG)

The function selection key ⌨ (PROG) is used to display the program list and directory of the programs in the memory, the program command presently executed, the MDI program screen, etc.

The accessible screens vary depending on the selected mode.

MODE	Screen	Refer to
Edit	Program (edit) screen	7-2-1
	Program directory and memory used size screen	7-2-2
	Background program edit screen	7-2-1
Memory Tape	Program (display) screen	7-2-3
	Program directory screen	7-2-2
	Background program edit screen	7-2-1 to 7-2-3
MDI	Program (MDI) screen	7-2-4
	Background program edit screen	7-2-1
Handle, Jog Rapid traverse Zero return	Program (display) screen	7-2-3
	Background program edit screen	7-2-1

7-2-1   Program Edit Screen

- ▣ ▧ (edit) ⟶ function selection key ▣ (PROG)

- ▣ Function selection key ▣ (PROG) ⟶ **[BG EDIT]**

This screen is used to edit the program. Program editing is possible only when the edit mode or background program edit is selected.

> The background program edit screen is accessible in any mode other than the edit mode.
> Usually, the background program edit function is used to input/output another program or edit a program during automatic operation in the memory mode.

<Information displayed at upper right area>

Program number   Sequence number
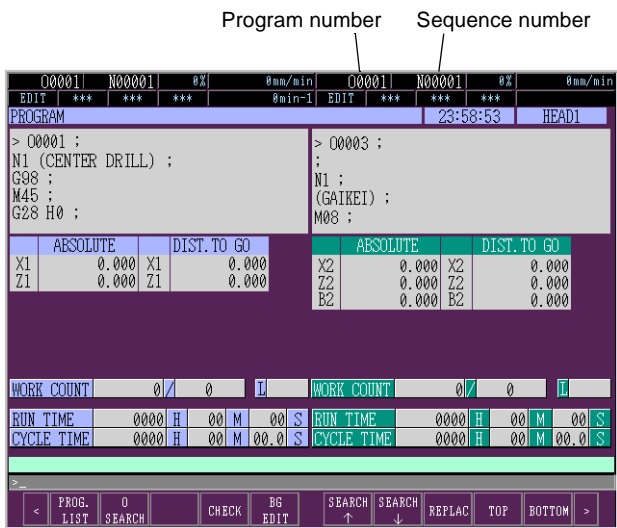
1. During program editing in the edit mode:

   Program number of the program presently being edited
   Sequence number of the program block immediately preceding the cursor

2. Other than program editing in the edit mode:

   Program number and sequence number of the program block edited last

3. Right after search (program number, sequence number) operation:

   Searched program or sequence number

<Foreground edit screen>
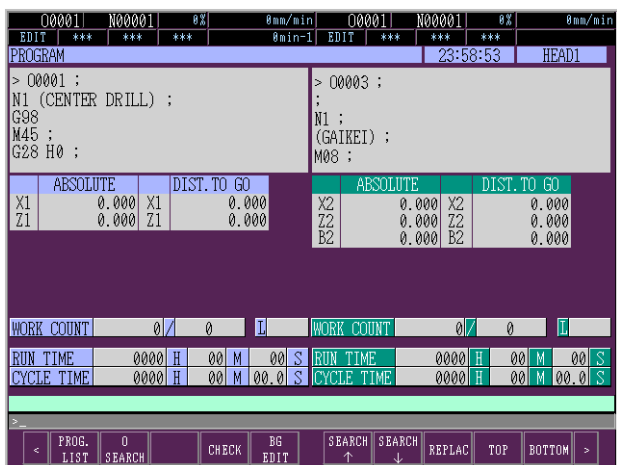
The program is displayed in the left-half area of the screen.

Displayed at the right-half area of the screen are coordinate values (absolute or incremental), remaining distance, and modal information.

NOTE During foreground editing operation, it is not possible to display two programs.

At the foreground edit screen, the functions of the soft-keys change as shown below.

<Transition of soft-keys>

<	PROG. LIST	O SEARCH		CHECK	BG EDIT	SEARCH ↑	SEARCH ↓	REPLAC	TOP	BOTTOM	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

<	PROG. LIST	O SEARCH		CHECK	BG EDIT	LINE EDIT	SELECT	COPY	CUT	PASTE	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	
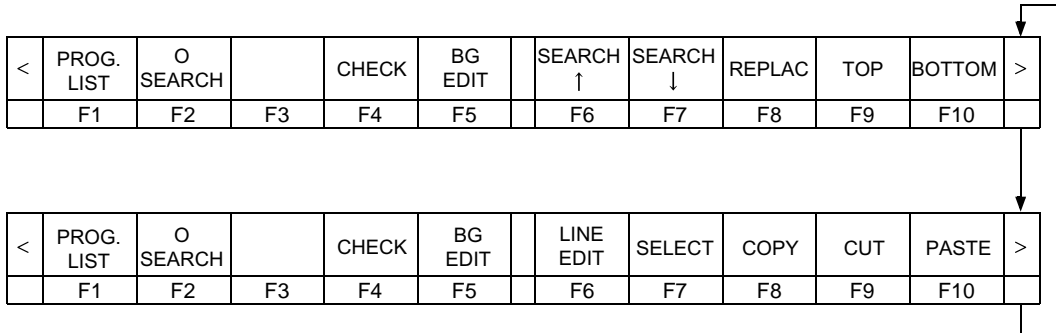
NOTE The background edit screen is called when the **[BG EDIT]** soft-key is pressed.

<Background edit screen>
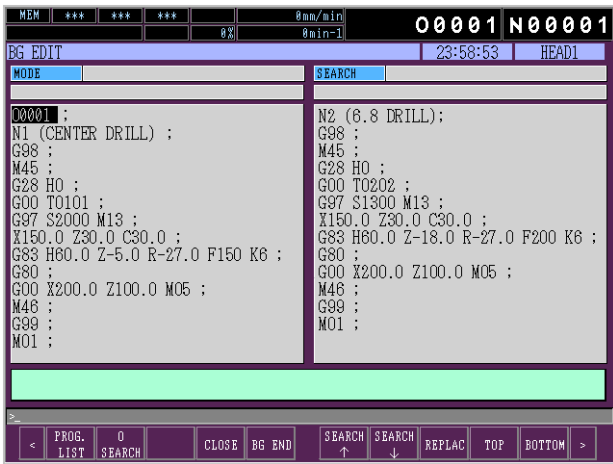
The screen is split into two windows and it is possible to select if one program should be displayed or two programs should be displayed.

NOTE When the background edit function is selected, the screen displays "BG EDIT".

At the background edit screen, the functions of the soft-keys change as shown below.

<Transition of soft-keys>

<	PROG. LIST	O SEARCH	PROG. SELECT	CLOSE	BG END	SEARCH ↑	SEARCH ↓	REPLAC	TOP	BOTTOM	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

<	PROG. LIST	O SEARCH	PROG. SELECT	CLOSE	BG END	LINE EDIT	SELECT	COPY	CUT	PASTE	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	
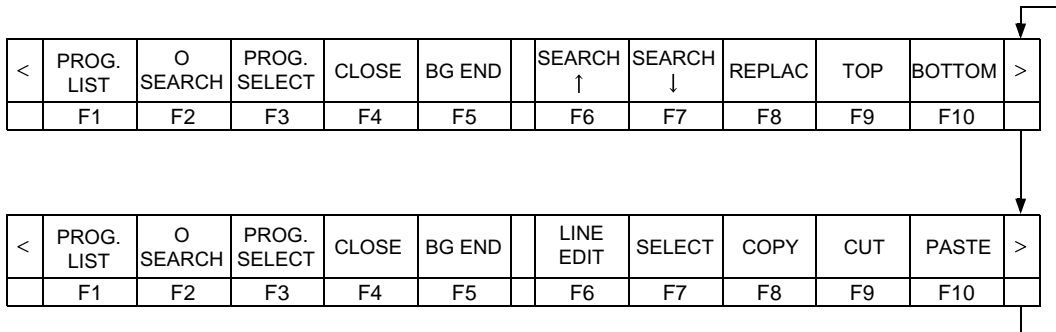
NOTE
1. The background edit screen ends when the **[BG END]** soft-key is pressed.
2. The **[PROG. SELECT]** soft-key is displayed only when two programs are displayed.

<Program display patterns in the background edit screen>

1.   One-program display mode
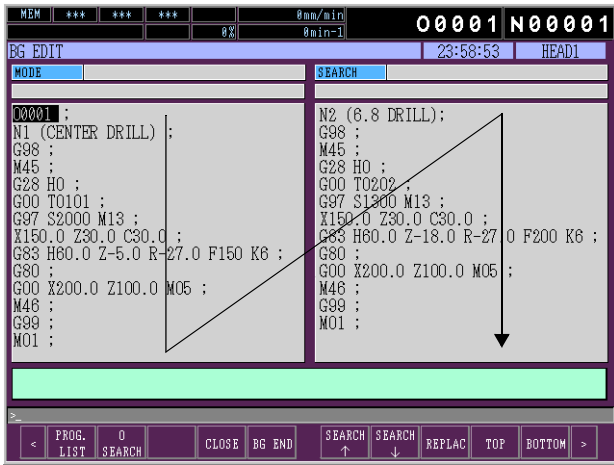
If one program is displayed, it is displayed in two windows.

In the state the screen displays one program, the screen changes to the two-program display mode if either of the following operations is performed.

- Pressing the **[O SEARCH]** soft-key after inputting the program number of the program to be displayed.

- Selecting the program to be displayed in the PROGRAM directory screen after pressing the **[PROG. LIST]** soft-key.

2.   Two-program display mode
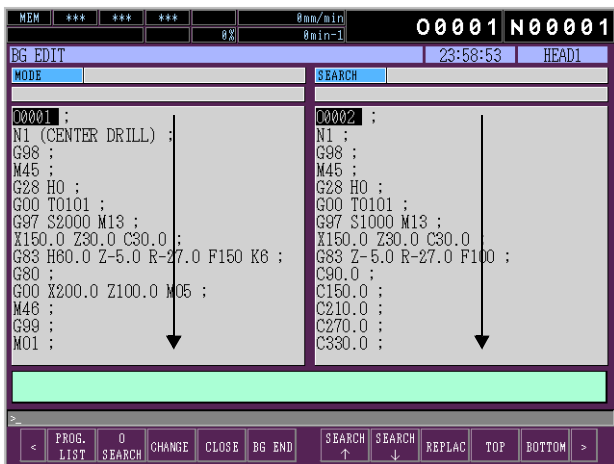
When two programs are displayed, two windows display the individual programs.

Select the program to be edited by pressing the **[PROG. SELECT]** soft-key.

If the **[CLOSE]** soft-key is pressed while the screen is in the two-program display mode, it changes to the one-program display mode.

7-2-2   Program Directory Screen

- ▤ Function selection key 🖵 (PROG) ⟶ **[PROG. LIST]**

NOTE In the foreground edit operation, the PROGRAM directory screen can be displayed only in the edit, memory, or tape mode.

- ▤ Function selection key 🖵 (PROG) ⟶ **[BG EDIT]** ⟶ **[PROG. LIST]**

The directory of registered programs and memory used size are displayed. This screen is used to check the programs registered in the memory, the number of registered programs, and the free memory size.

In the edit mode or in background edit operation, the screen is used for selecting the program to be edited. In the memory mode, it is used for selecting the program to be executed.

The contents of a program can be displayed on the screen by following the steps indicated below.

1) Move the cursor to the desired program using the cursor control keys ⬆ and ⬇.

2) Press the 🖮 (INPUT) key.

The contents of the selected program is displayed.

The display items are explained below:

1. AVAILABLE (byte/m)

Allowable size of programs that can be additionally stored in memory is displayed.

☞ The unit (byte/m) of the AVAILABLE is allowed to change by setting the parameters.

2. POSSIBLE REGIST. PROGRAMS (num.)

Allowable number of programs that can be additionally stored in memory is displayed.

NOTE Creation of a new program or editing a program to add commands are not allowed if there is no free area in memory even when the number of registered programs is smaller than the maximum storable number of programs.

3. REGIST. PROGRAMS (num.)

The number of registered programs is displayed.

4. PROGRAM directory

The program numbers of registered programs, comments and the size of the individual program are displayed.

NOTE To create a new program, use a program number that is not displayed in the table of PROGRAM directory.

The unit (byte/m) of the program size stored in memory is allowed to change by setting the parameters.

\<Transition of soft-keys\>

<						COPY	DELETE	RENAME		EXIT	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

<									PUNCH	READ	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	
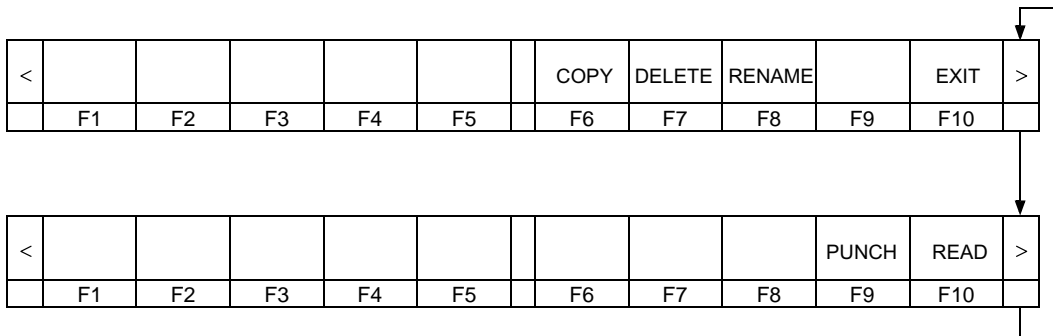
7-2-3   Presently Executed Program Screen

▣   ⟐ (memory) ⟶ function selection key ▣ (PROG)
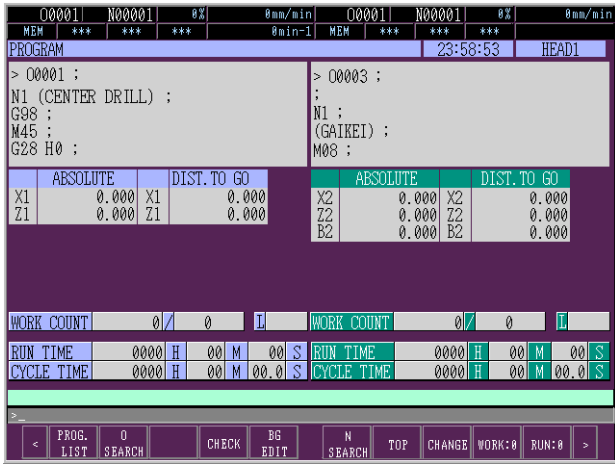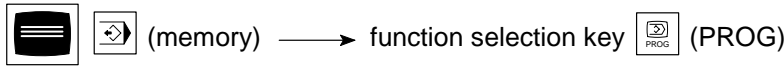
The program which is executed presently, remaining distance, and coordinate values (absolute or incremental) are displayed.

The contents of display can be changed by pressing an appropriate soft-key.

During the execution of a program, the block presently executed is highlighted. This feature is used for checking the contents of a program.

<Selecting the display information by pressing a soft-key>
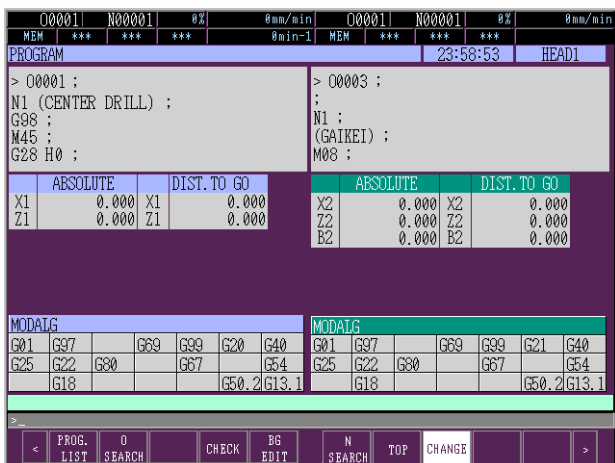
On the PROGRAM screen (in modes other than the edit mode), the information on the previously executed modal G code can be displayed by pressing the **[CHANGE]** soft-key.

7-2-4   MDI Mode Operation Screen

▣   ◨ (MDI) ⟶ function selection key ▣ (PROG)
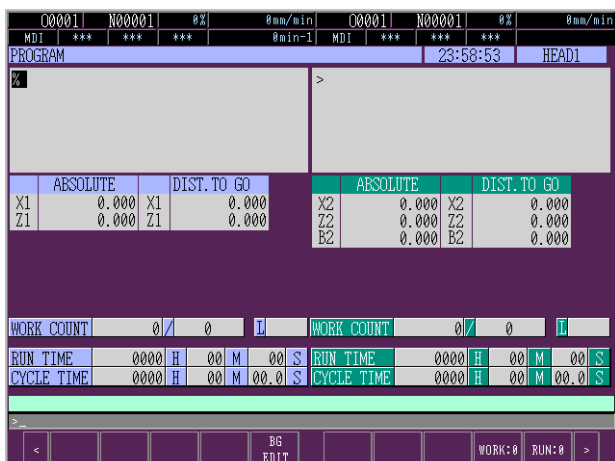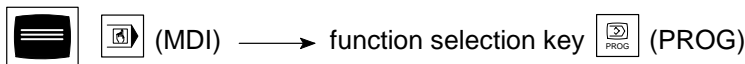
This screen is used to input the MDI commands.

7-3   Function Selection Key ⌨ (OFFSET)

The function selection key ⌨ (OFFSET) is used for setting the tool geometry/wear offset data and the work coordinate system.
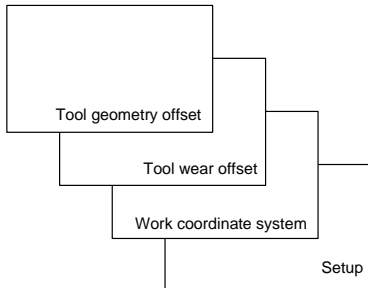
To change the display screen, press the soft-key corresponding to the screen to be accessed.

Tool geometry offset

Tool wear offset

Work coordinate system

Setup

<Functions>

1. Offset amount input interlock function

    This function sets valid/invalid status of offset amount input operations for tool geometry offset data, tool wear offset data and work offset data in the MDI mode. To validate or invalidate the input operation, set CAP parameters No. 140 or No. 142.

    Contents of the interlock function is determined by the value set to the parameters as shown below.

Set Value	CAP Parameter	
	No. 140	No. 142
0	Interlock function is invalid. (Input operation for tool geometry offset data, tool wear offset data and work offset data is valid.)	
1	Input operation for tool geometry offset data is invalid.	
2	Input operation for tool wear offset data is invalid.	
3	Input operation for tool geometry offset data or tool wear offset data is invalid.	
4	Input operation for work offset data is invalid.	
5	Input operation for tool geometry offset data or work offset data is invalid.	
6	Input operation for tool wear offset data or work offset data is invalid.	
7	Input operation for tool geometry offset data, tool wear offset data and work offset data is invalid.	
8	Input operation for work offset data[1] is invalid.	—
9	Input operation for tool geometry offset data or work offset data[1] is invalid.	—
10	Input operation for tool wear offset data or work offset data[1] is invalid.	—

Set Value	CAP Parameter	
	No. 140	No. 142
11	Input operation for tool geometry offset data, tool wear offset data or work offset data[*1] is invalid.	—
12	Input operation for work offset data is invalid.	—
13 or greater	Interlock function is invalid. (Input operation for tool geometry offset data, tool wear offset data and work offset data is valid.)	—

NOTE

1. The setting made for CAP parameter No. 142 is in effect only when the PANEL key-switch is placed in positions other than the $\boxed{\text{↑◈}}$ (PANEL/EDIT) position.

2. CAP parameters No. 140 and No. 142 are set to "0" at shipment.

3. [*1] Input operation for work offset data is invalidated only in automatic operation.

2. Macro variable input interlock function

This function sets valid/invalid status of macro variable input operations in the MDI mode.
To validate or invalidate the input operation, set CAP parameters No. 141.

Contents of the interlock function is determined by the value set to the parameter as shown below.

Set Value	CAP Parameter
	No. 141
0	Interlock function is invalid. (Input operation for macro variables is valid.)
1	Input operation for macro variables is invalid.
2	Input operation for macro variables is invalid in other than MDI mode.

7-3-1   Tool Geometry Offset Data Setting Screen

Function selection key [OFFSET] (OFFSET) ──────▶ **[GEOM.]**

MDI	***	***	***		0mm/min		O 0 0 0 1	N 0 0 0 1
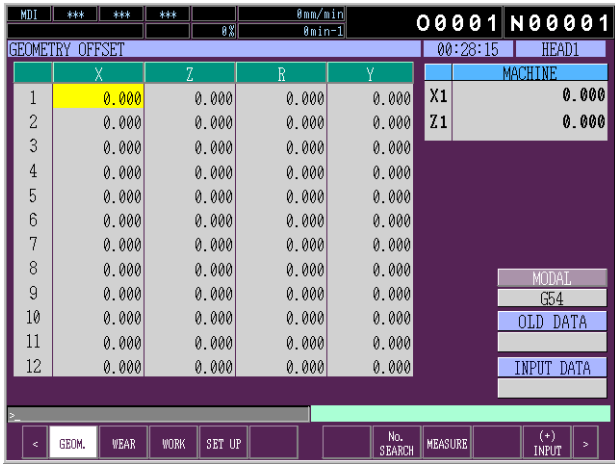
This screen is used to directly input the tool position offset data of tools mounted in the turret.

Move the cursor to the wear offset number to be set, using the page selection keys and the cursor control keys.
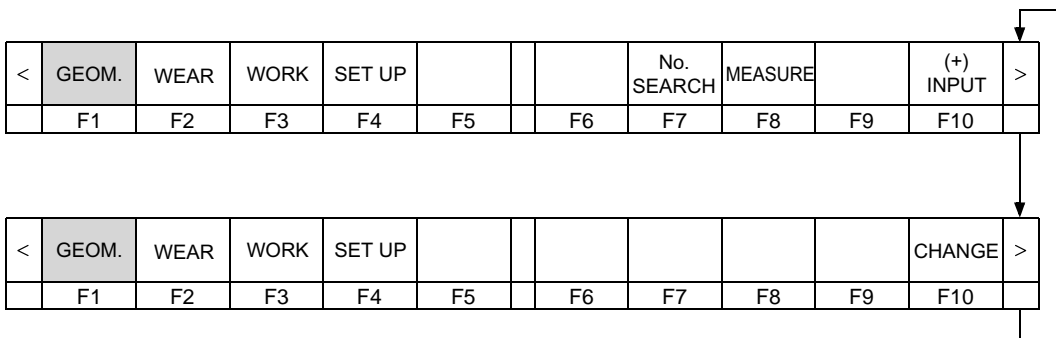
GEOMETRY OFFSET

	X	Z	R	Y
1	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000

MACHINE
X1   0.000
Z1   0.000

MODAL
G54
OLD DATA

INPUT DATA

| < | GEOM. | WEAR | WORK | SET UP | | | No. SEARCH | MEASURE | | (+) INPUT | > |

<Transition of soft-keys>

<	GEOM.	WEAR	WORK	SET UP				No. SEARCH	MEASURE		(+) INPUT	>
	F1	F2	F3	F4	F5		F6	F7	F8	F9	F10	

<	GEOM.	WEAR	WORK	SET UP							CHANGE	>
	F1	F2	F3	F4	F5		F6	F7	F8	F9	F10	

Press the **[CHANGE]** soft-key and the coordinate system name displayed on the screen changes in the following sequence at each pressing of this soft-key.

───▶ MACHINE ────▶ INCREMENTAL ────▶ ABSOLUTE ───
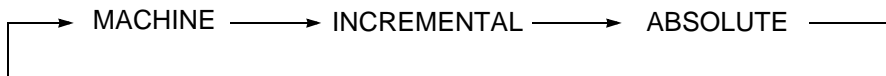
7-3-2   Tool Wear Offset Data Setting Screen

Function selection key [OFFSET] (OFFSET) ⟶ **[WEAR]**

MDI *** *** ***		0mm/min					
		0%	0min-1		O 0 0 0 1	N 0 0 0 0 1	
WEAR OFFSET					00:28:15	HEAD1	

	X	Z	R	C	Y		MACHINE
1	0.000	0.000	0.000	0	0.000	X1	0.000
2	0.000	0.000	0.000	0	0.000	Z1	0.000
3	0.000	0.000	0.000	0	0.000		
4	0.000	0.000	0.000	0	0.000		
5	0.000	0.000	0.000	0	0.000		
6	0.000	0.000	0.000	0	0.000		
7	0.000	0.000	0.000	0	0.000		
8	0.000	0.000	0.000	0	0.000		
9	0.000	0.000	0.000	0	0.000		
10	0.000	0.000	0.000	0	0.000		OLD DATA
11	0.000	0.000	0.000	0	0.000		
12	0.000	0.000	0.000	0	0.000		INPUT DATA

| < | GEOM. | WEAR | WORK | SET UP | | | No. SEARCH | +0.005 | -0.005 | (+) INPUT | > |

This screen is used to input the offset data so that continuously machined workpieces are finished within the tolerance specified in the drawing.

Move the cursor to the geometry offset number to be set, using the page selection keys and the cursor control keys.
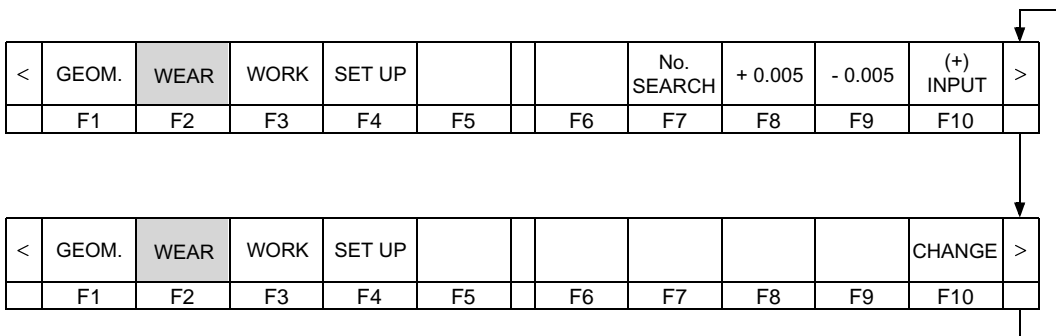
<Transition of soft-keys>

<	GEOM.	WEAR	WORK	SET UP				No. SEARCH	+ 0.005	- 0.005	(+) INPUT	>
	F1	F2	F3	F4	F5		F6	F7	F8	F9	F10	

<	GEOM.	WEAR	WORK	SET UP							CHANGE	>
	F1	F2	F3	F4	F5		F6	F7	F8	F9	F10	

Press the **[CHANGE]** soft-key and the coordinate system name displayed on the screen changes in the following sequence at each pressing of this soft-key.

MACHINE ⟶ INCREMENTAL ⟶ ABSOLUTE

<Functions>

1. Maximum wear offset input amount/+Maximum input amount limiting function

    If the absolute offset value input to WEAR OFFSET exceeds the value set as the limit, the message "OUT OF RANGE" is displayed.

    CAP parameter   No. 330 = Max. input value ("0": No limits) (1/1000 mm)
    No. 331 = +Max. input value ("0": No limits)

2. Fixed amount input function

    The function adds or subtracts the fixed amount, set for a parameter, to or from the presently set offset data by soft-key operation; **[F8]** for addition and **[F9]** for subtraction.

    CAP parameter   No. 332 = Fixed amount ("0": Function is disregarded) (1/1000 mm)

NOTE   Numbers displayed at soft-keys (**[F8]** and **[F9]**) represent the fixed amounts to be added or subtracted from the present offset data.

7-3-3   Work Coordinates Data Setting Screen

▣ Function selection key 🔲 (OFFSET) ⟶ **[WORK]**

The shift data of the work coordinate systems is displayed. This function is used to select the work coordinate system using the codes G54 to G59.

- The function is also used to shift the coordinate system which is already set in the following cases:
  The coordinate system set using the work coordinate system setting function (G54 to G59) or the automatic coordinate system setting function (G50), does not agree with the coordinate system assumed when programming.

- To execute a program check
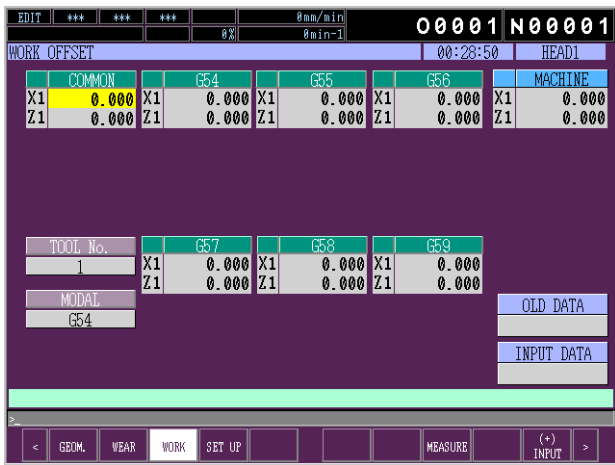
Move the cursor to the work coordinate system number (NO.) to be set, using the page selection keys and the cursor control keys.

⚠ **CAUTION**

Make sure to set "0" at the DATA (coordinate system shift data) column of the work coordinate system NO. "00 (EXT)" on the WORK COORDINATES screen.

If the work coordinate system shift data is set for NO. "00 (EXT)", the work coordinate system is shifted in the same direction disregarding of the spindle (spindle 1 and spindle 2) to be used, which causes the turret to interfere with the workpiece resulting in machine damage.

<Transition of soft-keys>

<	GEOM.	WEAR	WORK	SET UP					MEASURE		(+) INPUT	>
	F1	F2	F3	F4	F5		F6	F7	F8	F9	F10	

<	GEOM.	WEAR	WORK	SET UP							CHANGE	>
	F1	F2	F3	F4	F5		F6	F7	F8	F9	F10	

Press the **[CHANGE]** soft-key and the coordinate system name displayed on the screen changes in the followin sequence at each pressing of this soft-key.

MACHINE ⟶ INCREMENTAL ⟶ ABSOLUTE
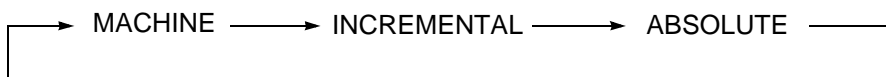
7-3-4   Setup (Tooling) (Conversational Programming) Screen

Function selection key ⬚ (OFFSET) ⟶ **[SET UP]** ⟶ **[TOOL LIST]***

NOTE * Usually, the TOOLING screen is displayed without pressing the **[TOOL LIST]** soft-key since the TOOLING screen is the initial screen of the setup mode.
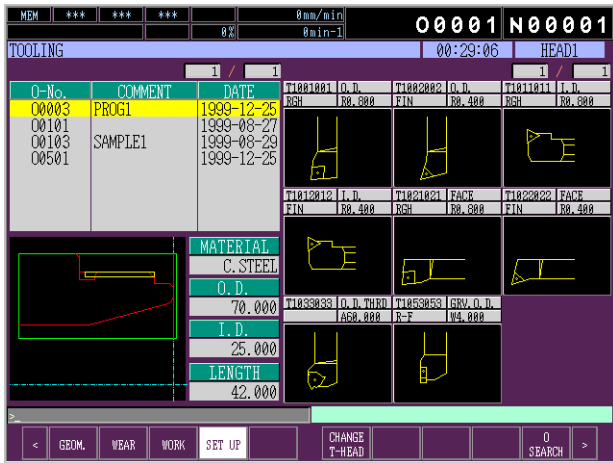
The TOOLING screen is used for tooling.

Index the turret to the desired position and mount a tool.

Select the program to be displayed by either of the following operations.

- Use the cursor control keys ⬆ and ⬇.

- Use the program number search function.
  To select the program using the program number search function, press the **[O SEARCH]** soft-key, input the program number (O-No.) then press the **[O SEARCH]** soft-key again.

If ten or more tools are registered, **[T. FORM PAGE]** and **[T. NEXT PAGE]** soft-keys are displayed.

NOTE The display switches between the spindle 1 (head 1) side and spindle 2 (head 2) side each time the **[CHANGE T-HEAD]** soft-key is pressed. (S type)

<Transition of soft-keys>

<	GEOM.	WEAR	WORK	SET UP		CHANGE T-HEAD				O SEARCH	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

<	TOOL LIST	JAW CUT		CHANGE POS.		CHANGE T-HEAD				O SEARCH	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	
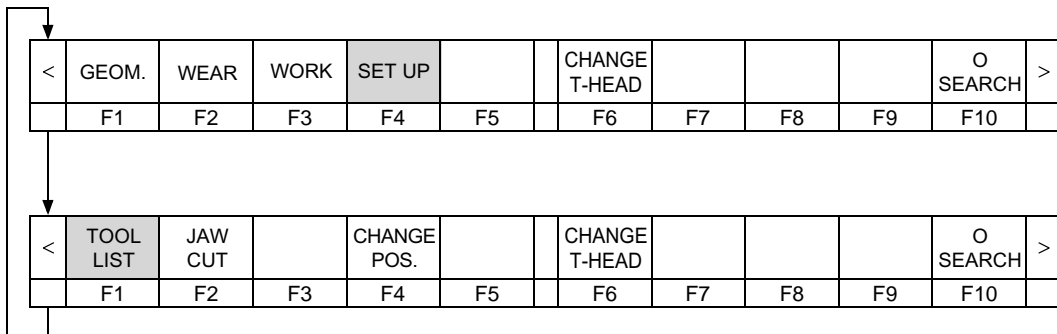
7-3-5   Setup (Jaw Cutting) Screen

Function selection key [OFFSET] (OFFSET) ⟶ **[SET UP]** ⟶ **[JAW CUT]**
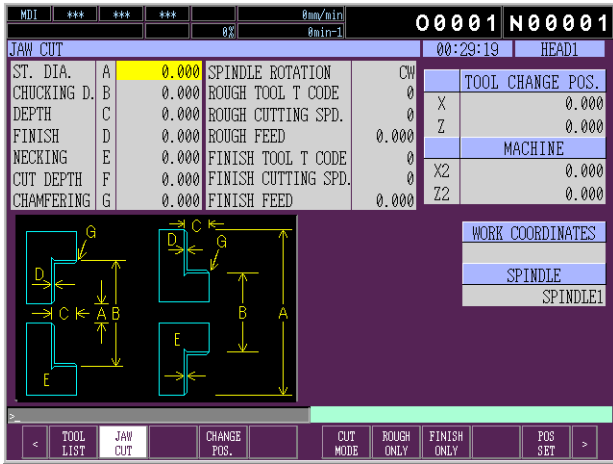
The JAW CUT screen is used for automatically shaping soft jaws.

Set the shape data of the soft jaws and the cutting conditions, and the soft-jaw shaping program is automatically generated.

📖 For details of soft-jaw cutting conditions, refer to page C-27 (4)

📝 Select the head (turret (head 1) or turret 2 (head 2)) to be used for machining by pressing the HEAD CHANGE switch.

<Transition of soft-keys>

<	GEOM.	WEAR	WORK	SET UP			CUT MODE	ROUGH ONLY	FINISH ONLY		POS SET	>
	F1	F2	F3	F4	F5		F6	F7	F8	F9	F10	

<	TOOL LIST	JAW CUT		CHANGE POS.			CUT MODE	ROUGH ONLY	FINISH ONLY		POS SET	>
	F1	F2	F3	F4	F5		F6	F7	F8	F9	F10	
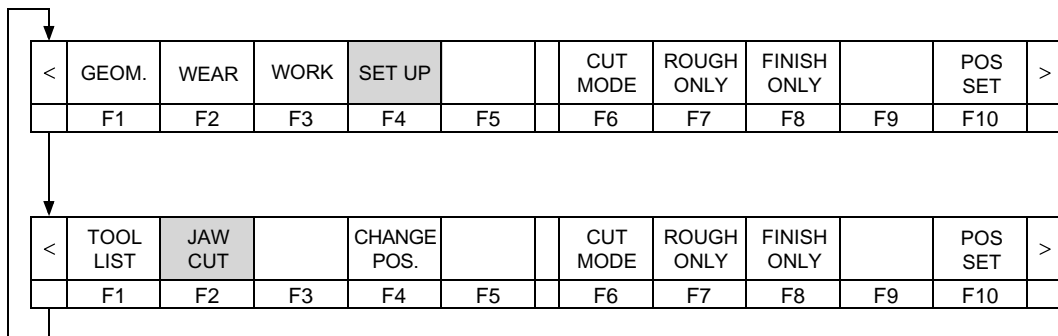
7-3-6   Setup (Tool Change Position Setting) (Conversational Programming) Screen

Function selection key [OFFSET] (OFFSET) ⟶ **[SET UP]** ⟶ **[CHANGE POS.]**
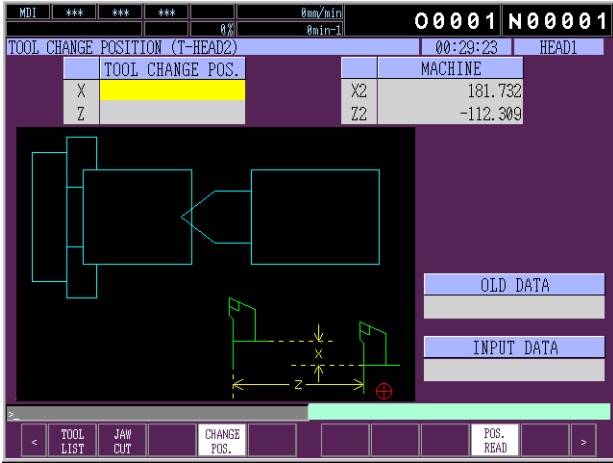
The TOOL CHANGE POSITION screen is used for setting the tool change position.

Manually move the turret to the desired tool change position.

Press the **[POS. READ]** soft-key and the present turret position is set as the tool change position.

NOTE Select the turret (turret 1 or turret 2) to be used for setting the tool change position by pressing the HEAD CHANGE switch.

<Transition of soft-keys>

<	GEOM.	WEAR	WORK	SET UP					POS READ		>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

<	TOOL LIST	JAW CUT		CHANGE POS.					POS READ		>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	
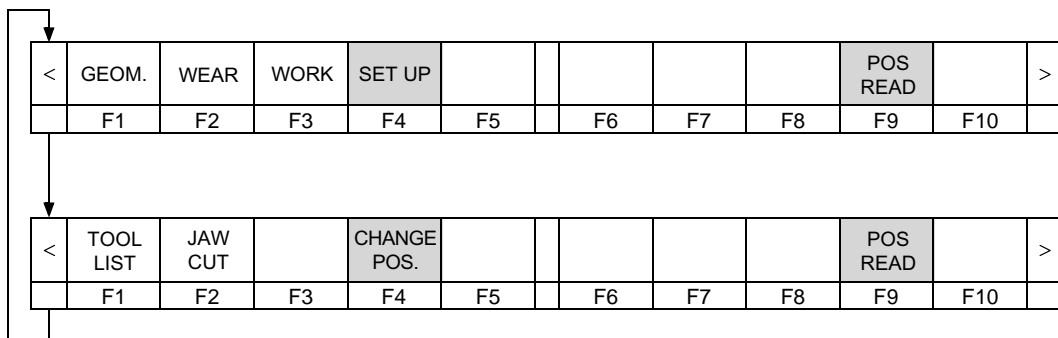
7-4   **Function Selection Key 🔲 (CAPS)**

The function selection key 🔲 (CAPS) is valid for the machine equipped with the conversational automatic programming function (CAPS) and it is used for creating a program and also for drawing the programmed paths.

📖   For details of the conversational programming operation, refer to the OPERATION MANUAL FOR CONVERSATIONAL PROGRAMMING.

7-5   **Function Selection Key 🔲 (SYSTEM)**

The function selection key 🔲 (SYSTEM) is used to input/output the data, to check or set parameters, to display the system data of the NC unit and the peripheral devices (servo motors, PMC) and to operate the files stored in the memory card.
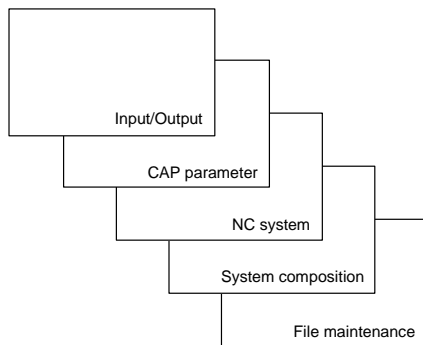
To change the screen, press the soft-key corresponding to the screen to be accessed.

Input/Output
CAP parameter
NC system
System composition
File maintenance

7-5-1   Input/Output Screen

Function selection key [SYSTEM] (SYSTEM) ──────▶ **[IN/OUT]**

```
MEM   ***   ***   ***            0mm/min      O0001 N00001
                       0%        0min-1
IN/OUT                                 00:30:37    HEAD1
┌NC┐                        ┌DIALOG┐
     NC PROGRAM                   DIALOG ALL
     OFFSET                       DIALOG PROGRAM
     PARAMETER                    TOOL FILE
     MACRO VARIABLE               DIALOG PARAMETER

     PITCH ERROR



FOLDER      E:¥
INPUT/OUTPUT MEMORY CARD


>
  <  IN/OUT  CAP    NC    SYSTEM  COM            PUNCH  READ   >
            PARAM. SYSTEM COMPO.  SET
```
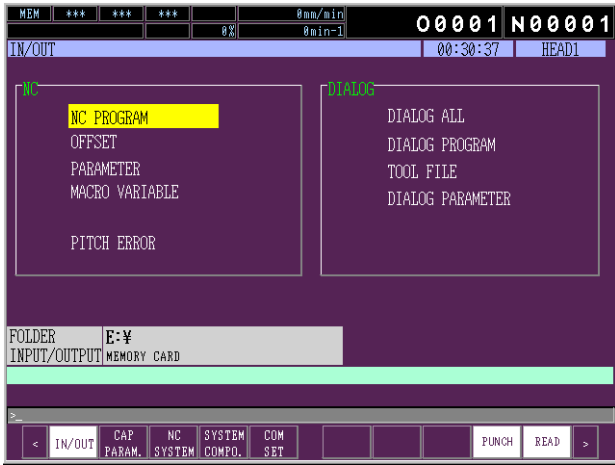
The IN/OUT screen is used for inputting (reading) and outputting (punching) the data such as program, file, and parameter.

NOTE

1. Input/output of the conversational programming data is possible only using a memory card.

2. If "RS232C" is selected as the I/O device, the DIALOG display is not available.

Soft-Keys	Function
[PUNCH]	This soft-key is used to output the selected data.
[READ]	This soft-key is used to input the selected data.

<Outputting the data>
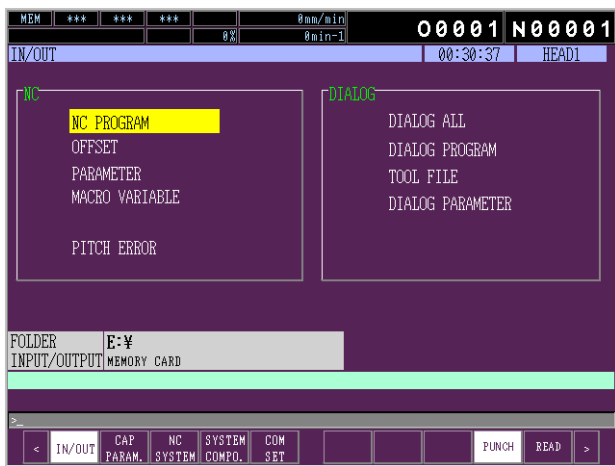
1) Insert a memory card to the card slot.

2) On the IN/OUT screen, move the cursor to the data kind to be output using the cursor control keys [↑], [↓], [←] and [→].

```
MEM   ***   ***   ***            0mm/min      O0001 N00001
                       0%        0min-1
IN/OUT                                 00:30:37    HEAD1
┌NC┐                        ┌DIALOG┐
     NC PROGRAM                   DIALOG ALL
     OFFSET                       DIALOG PROGRAM
     PARAMETER                    TOOL FILE
     MACRO VARIABLE               DIALOG PARAMETER

     PITCH ERROR



FOLDER      E:¥
INPUT/OUTPUT MEMORY CARD


>
  <  IN/OUT  CAP    NC    SYSTEM  COM            PUNCH  READ   >
            PARAM. SYSTEM COMPO.  SET
```

3) Press the **[PUNCH]** soft-key.

```
  <  IN/OUT  CAP    NC    SYSTEM         EXEC. FOLDER            CANCEL  >
            PARAM. SYSTEM COMPO.

    ◁  F1   F2   F3   F4   F5     F6   F7   F8   F9   F10   ▷
```
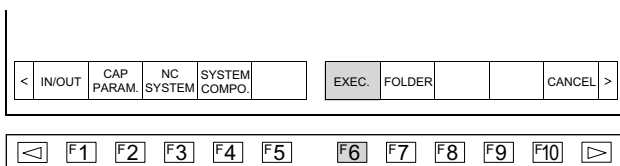
4) Press the **[EXEC.]** soft-key.

The selected data is output to the memory card.

<Inputting the data>
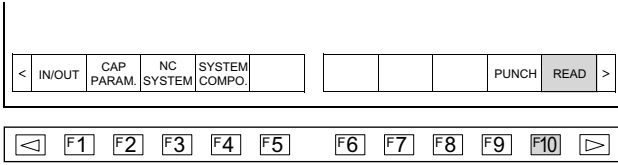
1) Insert the memory card that holds desired data to the card slot.

2) Press the **[READ]** soft-key.

   For inputting the conversational programming data, the data stored in the memory card is displayed.

| < | IN/OUT | CAP PARAM. | NC SYSTEM | SYSTEM COMPO. | | | | | PUNCH | READ | > |

◁ F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 ▷

3) On the IN/OUT screen, move the cursor to the data to be input using the cursor control keys ↑ and ↓ .

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

   The selected data is input to the memory area.

| EDIT | *** | *** | *** | | 0mm/min | | | O0001 N00001 |
| | | | | 0% | 0min-1 | | |

IN/OUT   23:58:53   HEAD1

PROGRAM NAME	SIZE	DATE
DISP0012.RLE	310842	2000.12.14
DISP0013.RLE	310842	2000.12.14
PROG_L.ND	4879	1999.05.11
DISP0014.RLE	310842	2000.12.14
DISP0015.RLE	310842	2000.12.14
DISP0016.RLE	310842	2000.12.14
DISP0017.RLE	310842	2000.12.14
DISP0018.RLE	310842	2000.12.14
DISP0019.RLE	310842	2000.12.14
DISP0020.RLE	310842	2000.12.14

FOLDER   E:¥
INPUT/OUTPUT MEMORY CARD

READ

| < | IN/OUT | CAP PARAM. | NC SYSTEM | SYSTEM COMPO. | COM SET | | EXEC. | FOLDER | | | CANCEL | > |

7-5-2   CAP Parameter Screen

Function selection key (SYSTEM) ⟶ **[CAP PARAM.]**

The CAP parameters can be set and displayed. This screen is used to check the setting of the CAP parameters by displaying them.

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.

| MEM | *** | *** | *** | | 0mm/min | | | O0001 N00001 |
| | | | | 0% | 0min-1 | | |

CAP PARAMETER   00:30:39   HEAD1

	Data		Data		Data		Data
0	1	16	0	32	0	48	1
1	0	17	0	33	0	49	0
2	0	18	0	34	0	50	0
3	0	19	0	35	0	51	0
4	0	20	0	36	0	52	0
5	1	21	1	37	0	53	1
6	0	22	1	38	0	54	0
7	0	23	1	39	1	55	0
8	1	24	1	40	0	56	0
9	1	25	0	41	1	57	0
10	2	26	0	42	0	58	0
11	0	27	1	43	0	59	14
12	0	28	0	44	0	60	1
13	43	29	0	45	0	61	1
14	0	30	0	46	0	62	1
15	0	31	0	47	0	63	1

| < | IN/OUT | CAP PARAM. | NC SYSTEM | SYSTEM COMPO. | COM SET | | No. SEARCH | DATA SET | | | > |
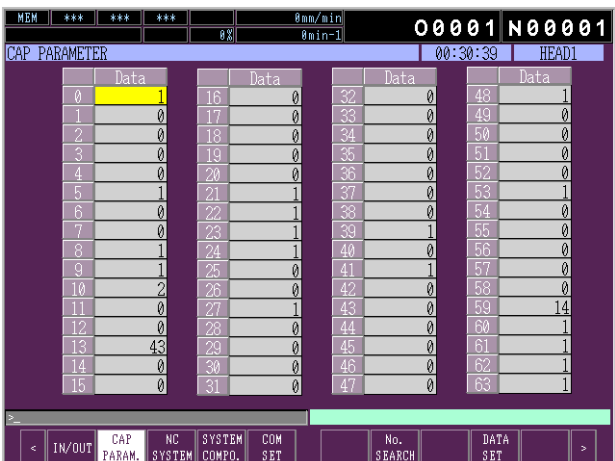
Use the following procedure for parameter search operation.

1) Key in the parameter number using the data entry keys.

2) Press the **[No. SEARCH]** soft-key.

   The page can be also changed using the page selection keys.

7-5-3   NC System Screens

Function selection key ⌷ (SYSTEM) ⟶ **[NC SYSTEM]**

The NC system screens display the system data of the NC unit and its optional devices (servo motor, PMC).
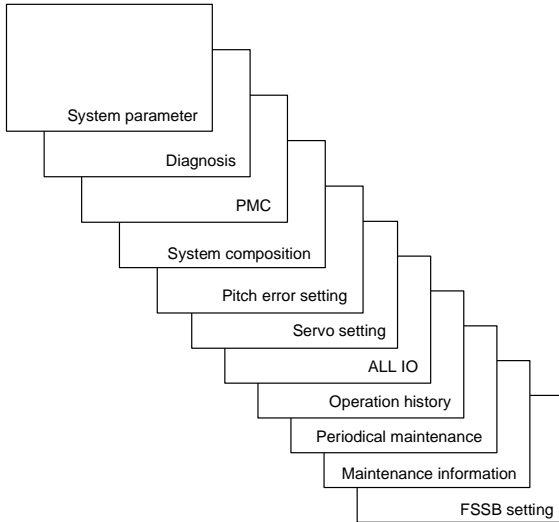
System parameter
Diagnosis
PMC
System composition
Pitch error setting
Servo setting
ALL IO
Operation history
Periodical maintenance
Maintenance information
FSSB setting

To change the screen, press the soft-key corresponding to the screen to be accessed.

To display the pitch error setting screen or the servo setting screen, press the **[PITCH]** or **[SV-PRM]** soft-key after pressing the continuous menu key **[+]**.

To display the ALL IO screen or the operation history screen, press the **[ALL IO]** or **[OPEHIS]** soft-key after pressing the continuous menu key **[+]** two times.

NOTE   Pressing the **[ALL IO]** soft-key has no effect.

To display the periodical maintenance screen or the maintenance information screen, press the **[MAINTE]** or **[M-INFO]** soft-key after pressing the continuous menu key **[+]** three times.

To display the FSSB setting screen, press the **[FSSB]** soft-key after pressing the continuous menu key **[+]** four times.

<Parameter setting screen>

Function selection key ⌨ (SYSTEM) ──────▶ **[NC SYSTEM]** ──────▶ **[PARAM]**

The system parameters of the CNC can be set and displayed. This screen is used to check the setting of the system parameters by displaying them.

> **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.**
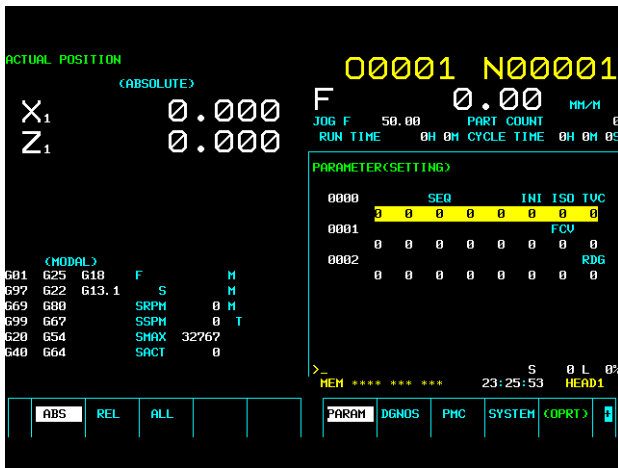
Use the following procedure for parameter search operation.

1) Key in the parameter number using the data entry keys.

2) Press the **[NO. SRH]** soft-key.

   The entered parameter number appears at the top of the screen.

   ☞ The page can be also changed using the page selection keys.

<CNC internal state display screen>

Function selection key ⌨ (SYSTEM) ──────▶ **[NC SYSTEM]** ──────▶ **[DGNOS]**

This screen is used to check the internal state of the NC unit.
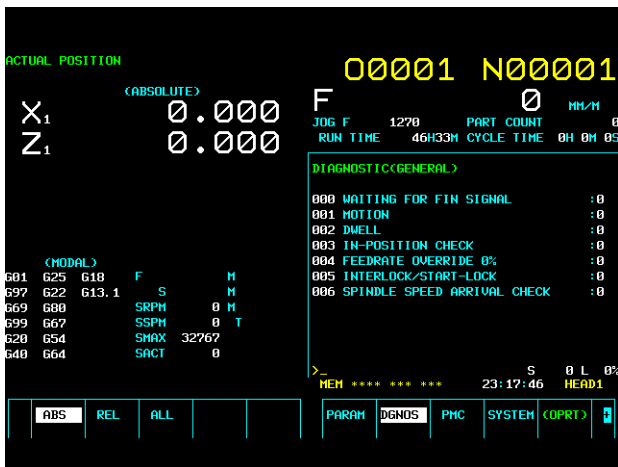
Use the following procedure for self-diagnosis data search operation.

1) Key in the required diagnostic number using the data entry keys.

2) Press the **[NO. SRH]** soft-key.

   The entered diagnostic number appears at the top of the screen.

   ☞ The page can be also changed using the page selection keys.

<PMC screen>

Function selection key ⊡ (SYSTEM) ⟶ **[NC SYSTEM]**

⟶ **[PMC]** ┬⟶ **[PMCLAD]**
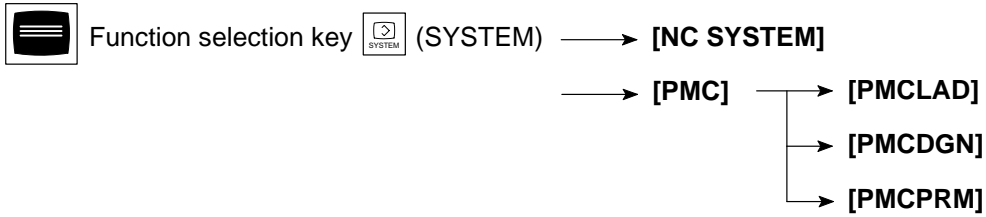
├⟶ **[PMCDGN]**

└⟶ **[PMCPRM]**

NOTE Soft-keys other than **[PMCLAD]**, **[PMCDGN]**, and **[PMCPRM]** are provided for maintenance purposes. These soft-keys should not be used during normal operation.
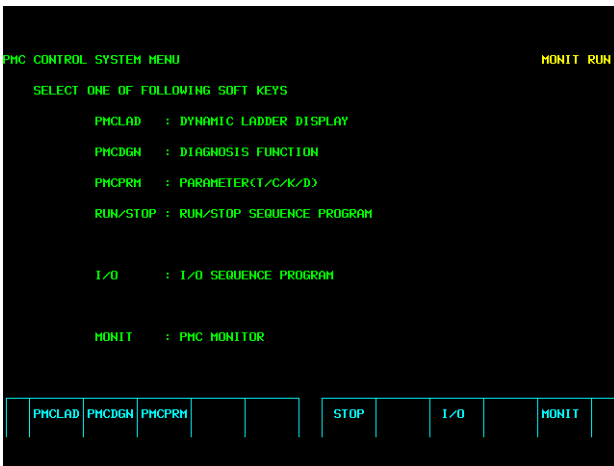
This screen is used to check the PMC status, and to change its parameters.

```
PMC CONTROL SYSTEM MENU                          MONIT RUN

    SELECT ONE OF FOLLOWING SOFT KEYS

        PMCLAD   : DYNAMIC LADDER DISPLAY

        PMCDGN   : DIAGNOSIS FUNCTION

        PMCPRM   : PARAMETER(T/C/K/D)

        RUN/STOP : RUN/STOP SEQUENCE PROGRAM


        I/O      : I/O SEQUENCE PROGRAM


        MONIT    : PMC MONITOR



  PMCLAD PMCDGN PMCPRM        STOP     I/O      MONIT
```

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.**

[PMCLAD]

The PMC ladder diagram is displayed.

[PMCDGN]

The PMC self-diagnosis screen is displayed.

[PMCPRM]

The setting screen for the timer, counter, keep relay, and data table for the PMC is displayed.

<System configuration screen>

Function selection key ⊡ (SYSTEM) ⟶ **[NC SYSTEM]** ⟶ **[SYSTEM]**

This screen is used to check the NC unit system configuration.

```
ACTUAL POSITION
                                 O00001  N00001
      (ABSOLUTE)           F            0      MM/M
 X₁      0.000      JOG F   1270   PART COUNT     0
 Z₁      0.000      RUN TIME  46H33M CYCLE TIME 0H 0M 0S

                           SYSTEM CONFIG(SLOT)
                                              PAGE:01

                           SLOT MODULE_ID SERIES VERSION
                            00   32E8 :40  B1F2   0011
                            09   71AA :5E
                            0A   001F :49  5F01   0004
      (MODAL)
G01  G25  G18    F        M
G97  G22  G13.1    S       M
G69  G80      SRPM    0 M
G99  G67      SSPM    0 T
G20  G54      SMAX 32767
G40  G64      SACT     0
                                            S   0 L  0%
                           MEM **** *** ***   23:18:30  HEAD1

  ABS   REL   ALL      PARAM DGNOS  PMC  SYSTEM (OPRT)
```

<Pitch error setting screen>

Function selection key [SYSTEM] (SYSTEM) ⟶ **[NC SYSTEM]** ⟶ **[+]**

⟶ **[PITCH]**

This screen is used to compensate the pitch error when the error occurs to machine feed.

<Servo data setting screen>

Function selection key [SYSTEM] (SYSTEM) ⟶ **[NC SYSTEM]** ⟶ **[+]**

⟶ **[SV-PRM]**
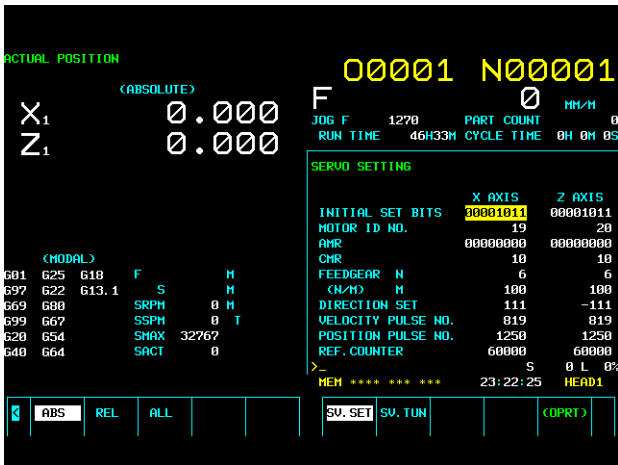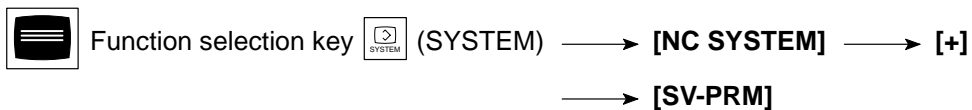
The servo setting and servomotor tuning screens are used to edit the servo related data.

The **[SV. SET]** and **[SV. TUN]** soft-keys are used to select the display screen.

<Operation history screen>
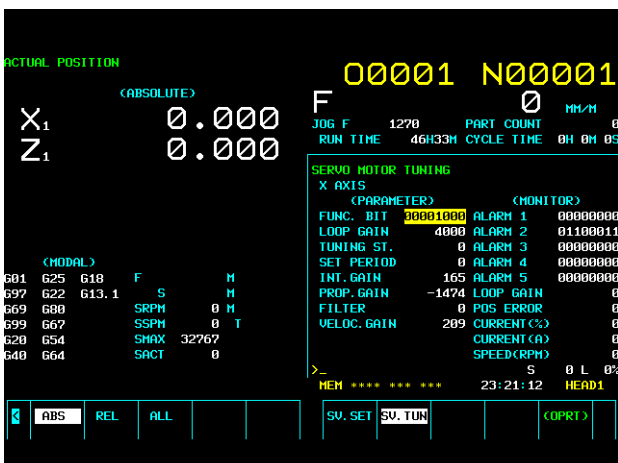
When NC unit faults or alarms have occurred, this screen can be used to display a history of information on the keys that the operator pressed or the signal operations that occurred, and the alarms that occurred.

The operation history includes the following information.

1. Details on the sequence of key operations followed by the operator at the NC operation panel

2. Details on changes in the ON/OFF status of input signals and output signals (selected signals only)

3. Details of alarms

4. Time (date and hour of operation, date and hour of occurrence)

Function selection key [SYSTEM] (SYSTEM) ⟶ **[NC SYSTEM]** ⟶ **[+]**

⟶ **[OPEHIS]** ⟶ **[OPEHIS]**
                               OPERATION HISTORY
                               screen

                               [SG-SEL]
                               OP_HIS SIGNAL SELECT
                               screen

<Operation history screen>
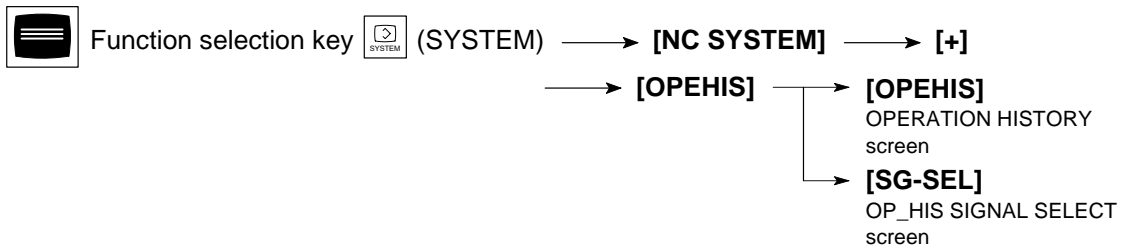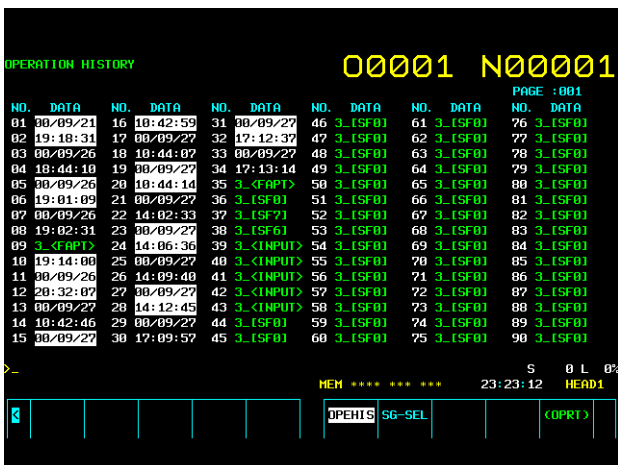
This screen displays a history of operation details.

The smaller the page number and number within the page, the older the record.

Display the required page by using the page selection keys, and check the screen information.

NOTE No operation history information is recorded while the operation history screen is displayed.

For further details on the information displayed, refer to the instruction manual prepared by the NC manufacturer.

<Operation history signal selection screen>
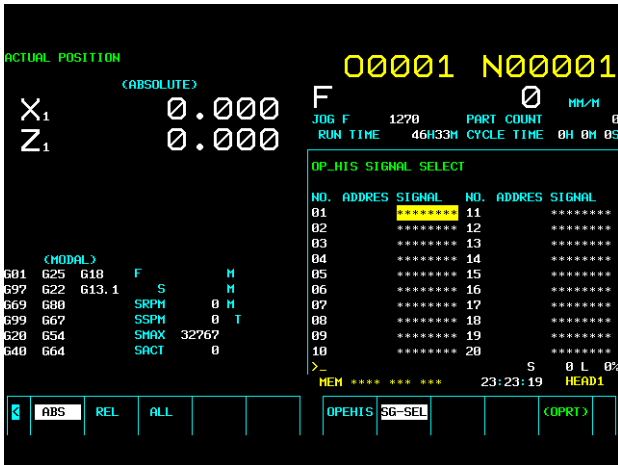
This screen displays input signals and output signals that are relevant to the operation history.

Signals can be checked and set on this screen.

NOTE No operation history signal selection information is recorded while the operation history signal selection screen is displayed.

For further details on the information displayed, refer to the instruction manual prepared by the NC manufacturer.

<Periodical maintenance screen>

This screen is used to check and set the data related to periodical maintenance such as oiling, inspection, and replacing parts (consumable parts).

Function selection key [SYSTEM] (SYSTEM) ⟶ **[NC SYSTEM]** ⟶ **[+]** ⟶ **[+]** ⟶ **[+]** ⟶ **[MAINTE]**[*1] ⟶ **[(OPRT)]** ⟶ **[CHANGE]**[*2]

[*1]   PERIODICAL MAINTENANCE (STATUS) screen

[*2]   PERIODICAL MAINTENANCE (SETTING) screen

The screen toggles between the periodical maintenance (status) and periodical maintenance (setting) screens when the **[(OPRT)]** and **[CHANGE]** soft-keys are pressed.

<Periodical maintenance (status) screen>
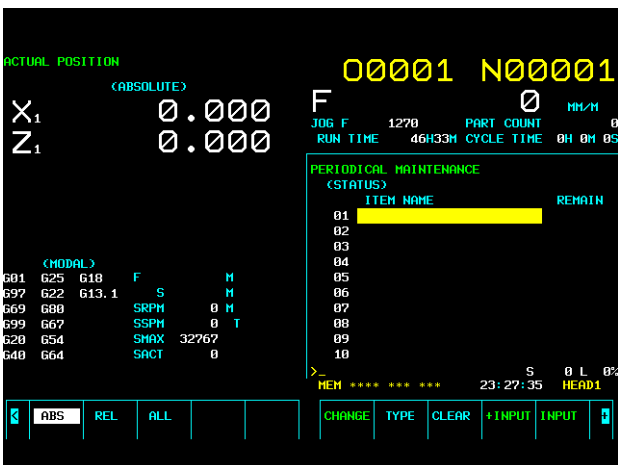
On this screen, life expiration of parts can be checked from the machine operating hours. It is also possible to register and delete the periodical maintenance item.

1)   Move the cursor to the item which should be registered or deleted using the cursor control keys.

2)   Press the **[(OPRT)]** soft-key.

3)   Register or delete the maintenance item using the data entry keys and soft-keys.

\<Periodical maintenance (setting) screen\>

```
ACTUAL POSITION
       (ABSOLUTE)         O00001  N00001
 X₁      0.000    F              0    MM/M
 Z₁      0.000    JOG F   1270    PART COUNT       0
                  RUN TIME   46H33M CYCLE TIME  0H 0M 0S

                  PERIODICAL MAINTENANCE
                   (SETTING)
                        LIFE    REMAIN   COUNT TYPE
                   01
      (MODAL)       02
 G01  G25  G18  F         M    03
 G97  G22  G13.1  S        M    04
 G69  G80   SRPM    0 M    05
 G99  G67   SSPM    0 T    06
 G20  G54   SMAX 32767      07
 G40  G64   SACT    0      08
                   09
                   10
                  >_           S    0 L  0%
                  MEM **** *** ***    23:27:41  HEAD1

  < ABS  REL  ALL  |    | CHANGE ENTRY CLEAR +INPUT INPUT  >
```
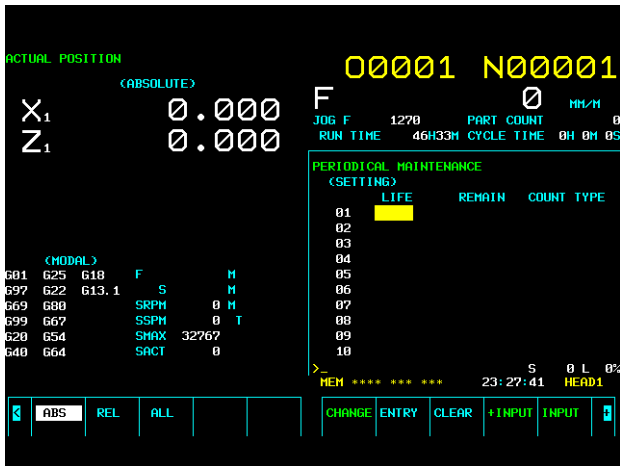
This screen is used to set the detailed data of the maintenance item set on the PERIODICAL MAINTENANCE (STATUS) screen.

1) Move the cursor to the LIFE data of the item to be set using the cursor control keys

```
 < ABS  REL  ALL  |    |  | CHANGE ENTRY CLEAR +INPUT INPUT >
 ◁ F1 F2 F3 F4 F5   F6 F7 F8 F9 F10 ▷
```
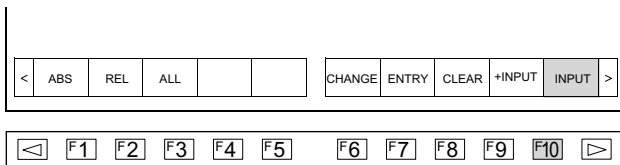
2) Input the LIFE data using the data entry keys and press the **[INPUT]** soft-key.

3) Move the cursor to the REMAIN data of the item to be set using the cursor control keys.

```
 < ABS  REL  ALL  |    |  | CHANGE ENTRY CLEAR +INPUT INPUT >
 ◁ F1 F2 F3 F4 F5   F6 F7 F8 F9 F10 ▷
```
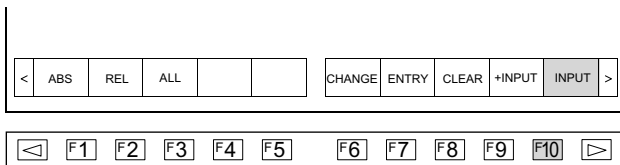
4) Input the REMAIN data using the data entry keys and press the **[INPUT]** soft-key.

5) Move the cursor to the COUNT TYPE data of the item to be set using the cursor control keys.

```
 < ABS  REL  ALL  |    |  | CHANGE ENTRY CLEAR +INPUT INPUT >
 ◁ F1 F2 F3 F4 F5   F6 F7 F8 F9 F10 ▷
```
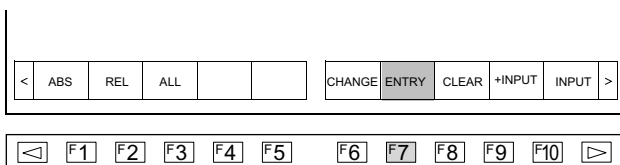
6) Press the **[ENTRY]** soft-key.

   The soft-keys used for setting the type of counting are displayed.

7) Set the type of counting using the soft-keys.

📖   For further details on the information displayed, refer to the instruction manual prepared by the NC manufacturer.

<Maintenance information screen>

Function selection key ⬚(SYSTEM) ⟶ **[NC SYSTEM]** ⟶ **[+]**

⟶ **[+]** ⟶ **[+]** ⟶ **[M-INFO]**

```
ACTUAL POSITION
        <ABSOLUTE>            O0001  N00001
X₁      0.000          F            0      MM/M
Z₁      0.000          JOG F   1270    PART COUNT      0
                       RUN TIME  46H33M CYCLE TIME 0H 0M 0S

                       MAINTENANCE INFORM
                       A03B-0815-C003       :  1
                       A20B-2002-0520       :  1
                       _____
                       A02B-0124-K001       :  1
    <MODAL>            A02B-0265-K100       :  1
G01  G25  G18   F      M     A03B-0815-K001  :  1
G97  G22  G13.1   S    M     A03B-0815-K002  :  1
G69  G80   SRPM    0 M        A03B-0815-K100 :  2
G99  G67   SSPM    0 T        _____
G20  G54   SMAX 32767         ***** END OF DATA SHEET *****
G40  G64   SACT    0
                                READ FREE:62884    96:1
                                          S    0 L  0%
                       MEM **** *** ***   23:24:47  HEAD1

    ABS   REL   ALL               MAINTE M-INFO      (OPRT)
```
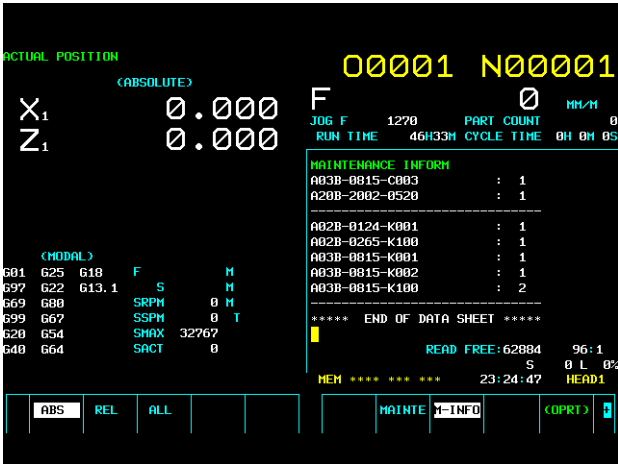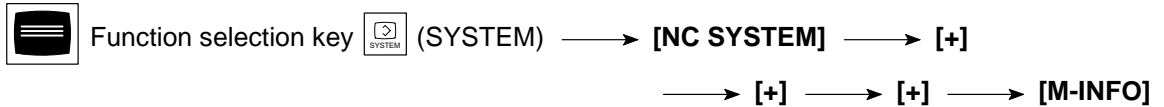
This screen is used to record the history of maintenance performed by a service person of the NC unit manufacturer or Mori Seiki.

The soft-keys used for setting the maintenance information are displayed when the **[(OPRT)]** soft-key is pressed at this screen.

📖 For details, refer to the instruction manuals prepared by the NC manufacturer.

<FSSB setting screen>

These screens are used to change or confirm the setting related to the amplifier and axes.

Function selection key ⬚(SYSTEM) ⟶ **[NC SYSTEM]** ⟶ **[+]** ⟶ **[+]**

⟶ **[+]** ⟶ **[+]** ⟶ **[FSSB]** ⟶ **[AMP]**
AMPLIFIER SETTING screen

⟶ **[AXIS]**
AXIS SETTING screen

⟶ **[MAINTE]**
AMPLIFIER MAINTENANCE screen

<Amplifier setting screen>

```
ACTUAL POSITION
        <ABSOLUTE>            O0001  N00001
X₁      0.000          F            0      MM/M
Z₁      0.000          JOG F   1270    PART COUNT      0
                       RUN TIME  46H33M CYCLE TIME 0H 0M 0S

                       AMPLIFIER SETTING
                       NO. AMP  SERIES UNIT CUR.  AXIS  NAME




    <MODAL>
G01  G25  G18   F      M
G97  G22  G13.1   S    M
G69  G80   SRPM    0 M        NO. EXTRA TYPE PCB ID
G99  G67   SSPM    0 T
G20  G54   SMAX 32767
G40  G64   SACT    0
                       >_              S    0 L  0%
                       MEM **** *** ***   23:25:53  HEAD1

    ABS   REL   ALL        AMP   AXIS  MAINTE     (OPRT)
```

The screen displays the amplifier setting information.

The soft-keys for setting the amplifier information are displayed when the **[(OPRT)]** soft-key is pressed.

<Axis setting screen>
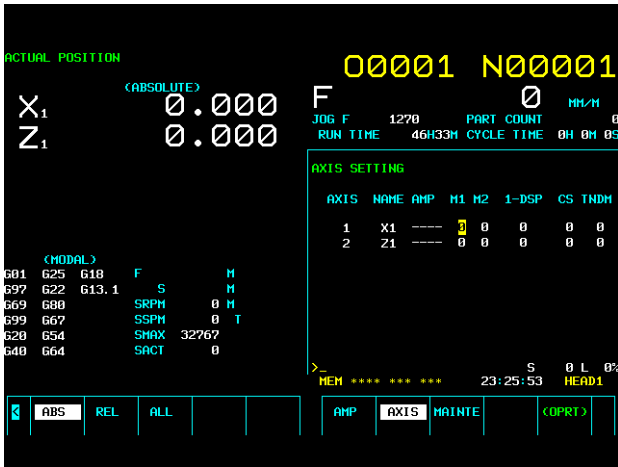
The screen displays the axis related information.

The soft-keys for setting the axis related information are displayed when the **[(OPRT)]** soft-key is pressed.

<Amplifier maintenance screen>
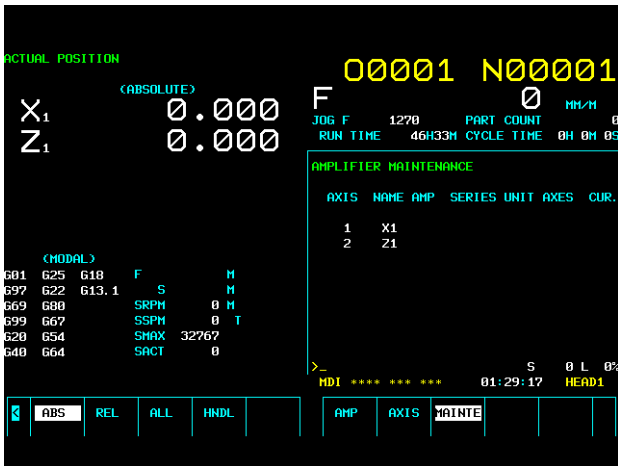
The screen displays the amplifier maintenance information.

7-5-4   System Composition Screen

 Function selection key (SYSTEM) ⟶ **[SYSTEM COMPO.]**
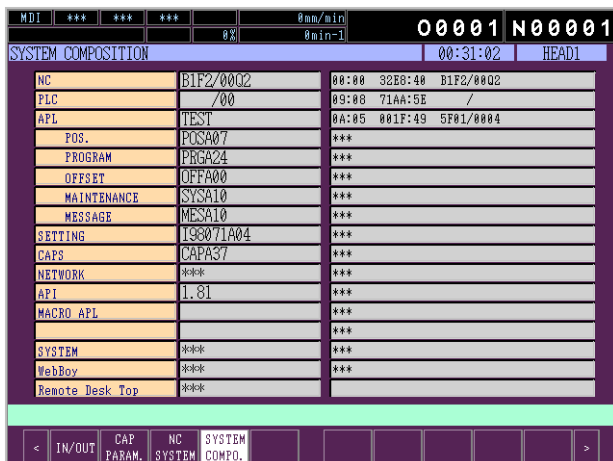
This screen is used to check the NC unit system configuration.

7-5-5   File Maintenance Screen

Function selection key [SYSTEM] (SYSTEM) ⟶ **[<]** ⟶ **[FILE MNT]**
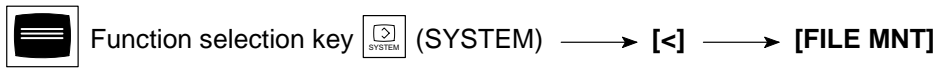
It is possible to operate the files stored in the memory card which is inserted into the card slot.

<Transition of soft-keys>

<	IN/OUT	CAP PARAM.	NC SYSTEM	SYSTEM COMPO.					PUNCH	READ	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

<	FILE MNT								PUNCH	READ	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	
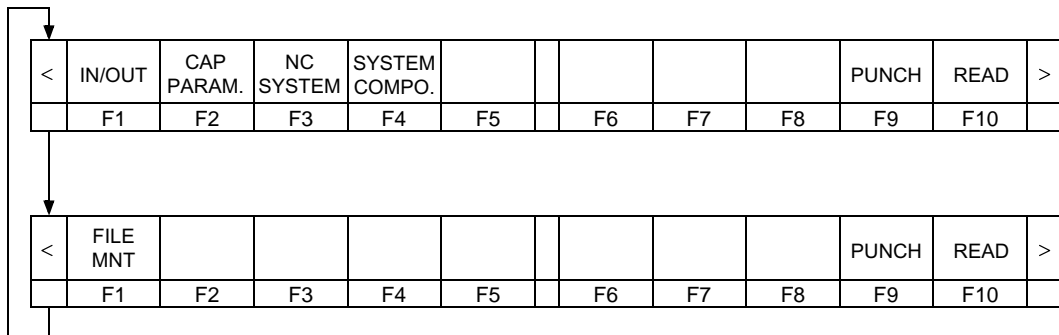
1) Insert a memory card to the card slot.

2) Press the **[LIST]** soft-key.

   The FILE MAINTENANCE screen that shows the list of files is displayed.

<Making a folder>

| < | FILE MNT | | | | FOLDER MAKE | COPY | RENAME | CLEAR | CARD FORMAT | > |

F1 F2 F3 F4 F5   F6 F7 F8 F9 F10
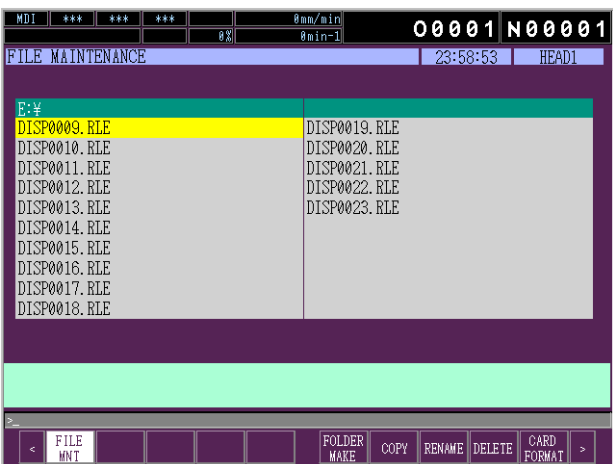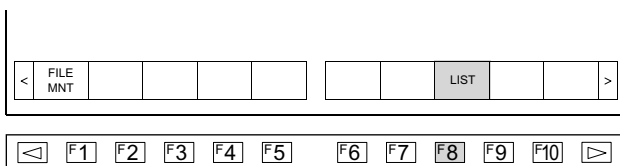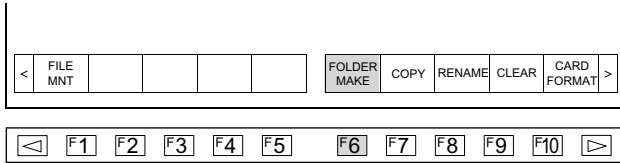
1) Press the **[FOLDER MAKE]** soft-key.

2) Key in the new folder name using the data entry keys.

| < | FILE MNT | | | | EXEC. | | | CANCEL | > |

F1 F2 F3 F4 F5   F6 F7 F8 F9 F10
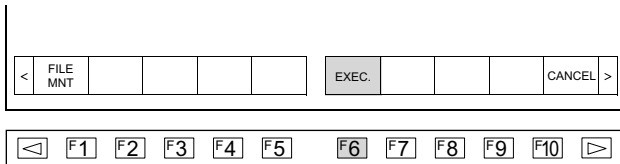
3) Press the **[EXEC.]** soft-key.

A folder is made.

To cancel the operation to make a folder, press the **[CANCEL]** soft-key.

<Copying>

| < | FILE MNT | | | | FOLDER MAKE | COPY | RENAME | CLEAR | CARD FORMAT | > |

F1 F2 F3 F4 F5   F6 F7 F8 F9 F10
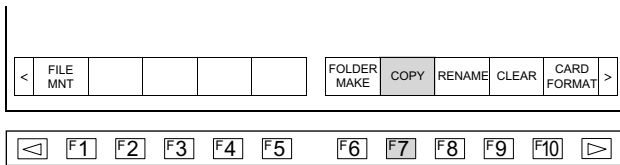
1) Press the **[COPY]** soft-key.

2) Move the cursor to the file to be copied using the cursor control keys.

NOTE   It is not possible to copy a folder.

3) Key in the file name of the destination where the file should be copied using the data entry keys.

To copy a file to the presently displayed folder, simply key in a file name.

Designation of a full path is allowed.

To copy the file to the route of drive E:
E:¥ABC.DEF

To copy the file to the presently displayed folder:
¥[sub-folder-name]¥file-name

| < | FILE MNT | | | | EXEC. | | | CANCEL | > |

F1 F2 F3 F4 F5   F6 F7 F8 F9 F10
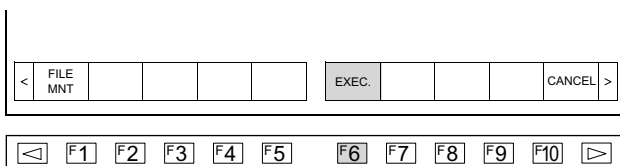
4) Press the **[EXEC.]** soft-key.

The file is copied.

To cancel the operation to copy a file, press the **[CANCEL]** soft-key.

<Renaming>

| < | FILE
MNT | | | | FOLDER
MAKE | COPY | RENAME | CLEAR | CARD
FORMAT | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |
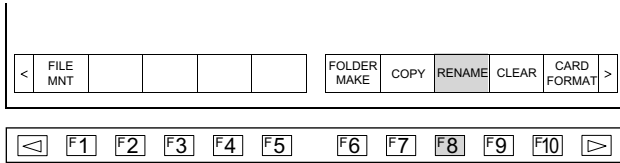
1) Press the **[RENAME]** soft-key.

2) Move the cursor to the file that should be renamed using the cursor control keys.

Renaming of a folder is possible.

3) Key in the desired folder name from the keyboard using the data entry keys.

| < | FILE
MNT | | | | EXEC. | | | | CANCEL | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |

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

The file name is changed.

To cancel the operation to rename a file, press the **[CANCEL]** soft-key.

<Deleting>

| < | FILE
MNT | | | | FOLDER
MAKE | COPY | RENAME | CLEAR | CARD
FORMAT | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |
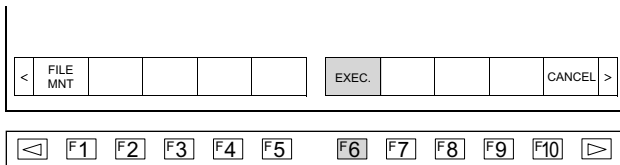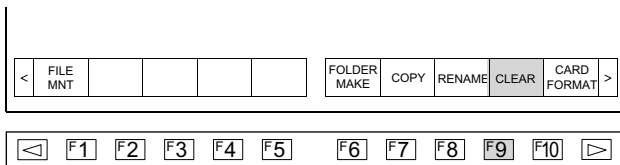
1) Press the **[DELETE]** soft-key.

2) Move the cursor to the file that should be deleted using the cursor control keys.

NOTE A folder that does not hold a file can be deleted.

If an attempt is made to delete a folder that holds a file, an error occurs and the folder is not deleted.

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

The file is deleted.

To cancel the operation to delete a file, press the **[CANCEL]** soft-key.

| < | FILE
MNT | | | | EXEC. | | | | CANCEL | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |
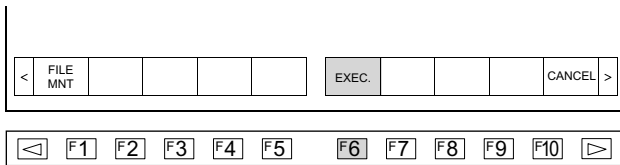
NOTE Once deleted, the file cannot be restored.

<Formatting a memory card>

| < | FILE
MNT | | | | FOLDER
MAKE | COPY | RENAME | CLEAR | CARD
FORMAT | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |
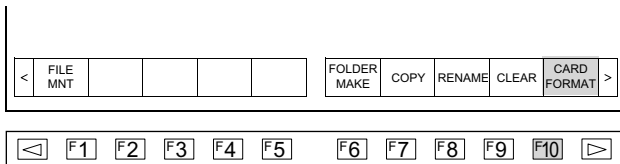
1) Press the **[CARD FORMAT]** soft-key.

| < | FILE
MNT | | | | EXEC. | | | | CANCEL | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |

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

The memory card is formatted.

To cancel the operation to format a memory card, press the **[CANCEL]** soft-key.
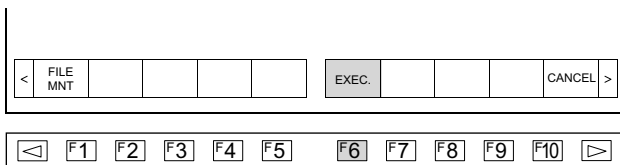
NOTE All data stored in the memory card is lost when it is formatted.

7-6   Function Selection Key [?] MESSAGE (MESSAGE)

The function selection key [?]MESSAGE (MESSAGE) is used for displaying and checking the alarm message of the NC and the PLC and also for displaying and setting the data at the periodical maintenance screen of them.
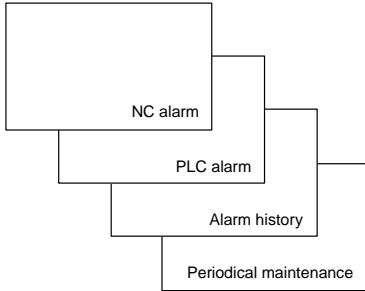
To change the screen, press the soft-key corresponding to the screen to be accessed.

NC alarm
PLC alarm
Alarm history
Periodical maintenance

7-6-1   NC Alarm Message Screen

Function selection key [?]MESSAGE (MESSAGE) ⟶ **[NC ALARM]**

```
MEM   ***   ***   ***              0mm/min        O 0 0 0 1 N 0 0 0 0 1
                              0%   0min-1
NC ALARM                                  23:58:53   HEAD1
HEAD1                                                      ■
   No.     MESSAGE
   0100    PARAMETER WRITE ENABLE
   0000    PLEASE TURN OFF POWER



HEAD2
   No.     MESSAGE






 <  NC    PC    ALARM INSPEC                              >
    ALARM ALARM HISTRY TION
```
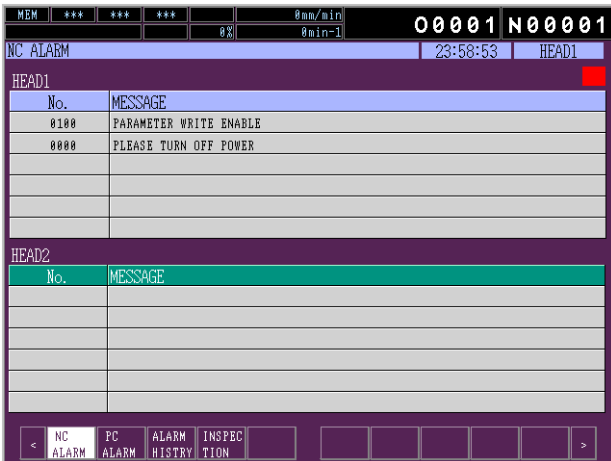
If an NC alarm occurs, the screen automatically changes to the NC ALARM screen where the alarm number and the message are displayed.

The NC ALARM screen is also displayed by pressing the soft-key as indicated above.

NOTE A red blinking box is displayed at the upper right area of the screen if a PLC alarm occurs while the NC ALARM screen is displayed.

7-6-2   PLC Alarm Message Screen

Function selection key [?]MESSAGE (MESSAGE) ⟶ **[PC ALARM]**

```
MEM   ***   ***   ***              0mm/min        O 0 0 0 1 N 0 0 0 0 1
                              0%   0min-1
PC ALARM                                  23:58:53   HEAD1
                                                          ■
   No.     MESSAGE
   EX0570  LUBRICANT OIL LEVEL LOW













 <  NC    PC    ALARM INSPEC                              >
    ALARM ALARM HISTRY TION
```
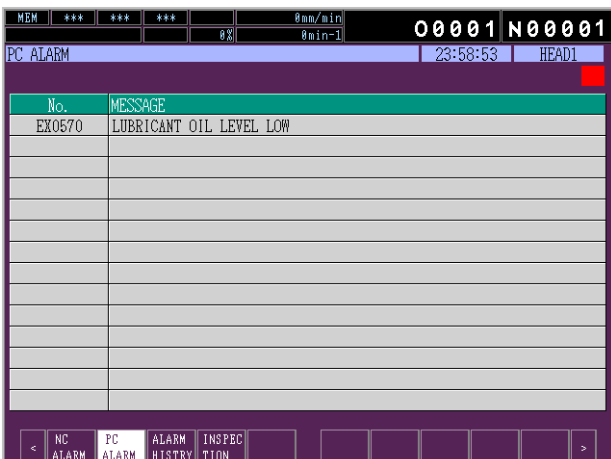
If a PLC error occurs, the screen automatically changes to the PC ALARM screen where the error number and the message are displayed.

The PC ALARM screen is also displayed by pressing the soft-key as indicated above.

NOTE A red blinking box is displayed at the upper right area of the screen if an NC alarm occurs while the PC ALARM screen is displayed.

7-6-3   Alarm History Screen

Function selection key [MESSAGE] (MESSAGE) ⟶ **[ALARM HISTORY]**

MDI	***	***	***		0mm/min				
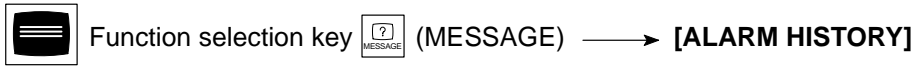
```
MDI   ***   ***   ***        0mm/min     O0001 N00001
                        0%   0min-1
ALARM HISTORY                          23:58:53    HEAD1
HEAD1                                              1 / 4
    DATE        No.   ALARM MESSAGE
2000/05/19 08:15:15   EX0099 PANEL ALARM
2000/05/09 18:14:48   EX0099 PANEL ALARM
2000/04/19 19:04:49   EX0099 PANEL ALARM
2000/04/19 18:24:23   EX0099 PANEL ALARM
2000/04/19 17:50:10   EX0099 PANEL ALARM
2000/04/19 17:42:10   EX0099 PANEL ALARM
2000/04/19 15:23:42   EX0099 PANEL ALARM
2000/04/19 14:41:47   EX0099 PANEL ALARM
1999/05/11 14:42:44   0100 PARAMETER WRITE ENABLE
1999/05/11 14:39:24   0000 PLEASE TURN OFF POWER
1999/05/11 14:39:24   0100 PARAMETER WRITE ENABLE
1999/05/11 14:39:12   0100 PARAMETER WRITE ENABLE
1999/05/11 14:01:13   0000 PLEASE TURN OFF POWER
1999/05/11 14:01:13   0100 PARAMETER WRITE ENABLE
1999/05/11 14:01:03   0100 PARAMETER WRITE ENABLE
1999/05/10 22:55:04   0000 PLEASE TURN OFF POWER

  <  NC    PC    ALARM INSPEC        CHANGE CLEAR      DATE  KIND  >
     ALARM ALARM HISTRY TION
```

This screen displays alarms in order from the latest alarm. Past alarms not displayed in this screen can be checked by pressing the page selection key [⊟▼] (advance).

The following types of alarm information are displayed.

1. Date and time

2. Alarm No.

3. Alarm message

NOTE The right end section of a PLC alarm message may be omitted at the ALARM HISTORY screen.

If an alarm occurs while the ALARM HISTORY screen is displayed, the information on the ALARM HISTORY screen is not updated. To update the displayed alarm history information, change the screen to any other screen once then change it back to the ALARM HISTORY screen. Then, the latest alarm history information is displayed.

```
MDI   ***   ***   ***        0mm/min     O0001 N00001
                        0%   0min-1
ALARM HISTORY                          23:58:53    HEAD1
HEAD1                                              1 / 5
    DATE        No.   NC ALARM
1999/05/11 14:42:44   0100 PARAMETER WRITE ENABLE
1999/05/11 14:39:24   0000 PLEASE TURN OFF POWER
1999/05/11 14:39:24   0100 PARAMETER WRITE ENABLE
1999/05/11 14:39:12   0100 PARAMETER WRITE ENABLE
1999/05/11 14:01:13   0000 PLEASE TURN OFF POWER
1999/05/11 14:01:13   0100 PARAMETER WRITE ENABLE
1999/05/11 14:01:03   0100 PARAMETER WRITE ENABLE
1999/05/10 22:55:04   0000 PLEASE TURN OFF POWER
1999/05/10 22:55:04   0100 PARAMETER WRITE ENABLE
1999/05/10 22:54:55   0100 PARAMETER WRITE ENABLE
    DATE        No.   PC ALARM
2000/05/19 08:15:15   EX0099 PANEL ALARM
2000/05/09 18:14:48   EX0099 PANEL ALARM
2000/04/19 19:04:49   EX0099 PANEL ALARM
2000/04/19 18:24:23   EX0099 PANEL ALARM
2000/04/19 17:50:10   EX0099 PANEL ALARM
2000/04/19 17:42:10   EX0099 PANEL ALARM

  <  NC    PC    ALARM INSPEC        CHANGE CLEAR      DATE  KIND  >
     ALARM ALARM HISTRY TION
```

Pressing the **[DATE]** soft-key displays alarms in maximum of four display pages in the order of occurrence (date and time).

Pressing the **[KIND]** soft-key displays alarms in two categories (NC alarm and PLC alarm) in maximum of five display pages in the order of occurrence (date and time).

Pressing the **[EXEC.]** soft-key after pressing the **[CLEAR]** soft-key clears alarm history.

7-6-4   Periodical Maintenance Screen

Function selection key ⌨ (MESSAGE) ⟶ **[INSPECTION]**

This screen is used to check, set, and display the data related to periodical maintenance such as oiling, inspection, and replacing parts (consumable parts).

<TYPE>

Indicates the counter type. Five types of counters are provided (1 to 5).

- Type 1:   Counts the total time.

- Type 2:   Counts the time in which the power is ON.

- Type 3:   Counts the run time. The STATUS is STOP if the machine is not in automatic operation status although the counter is operating.

- Type 4:   Counts the time in which the PLC outputs the counter operation signal while the PLC counter is operating. (Option)

- Type 5:   The STATUS changes to "ALM" when the PLC judges that the life has been expired. (Option)

<STATUS>

Indicates the counter status.

1. OFF: Immediately after the setting for ITEM, LIFE, or TYPE is changed.

2. ON: The counter is operating and counting time.

3. STOP: The counter is operating but not counting time.

4. The counter stops counting time if the **[COUNT STOP]** soft-key is pressed while a counter is operating.

NOTE

1. Type 1 or 5: STATUS changes to "OFF" and the counter is reset.

2. Type 2, 3 or 4: STATUS changes to "HOLD" and the counter is not reset.

3. If the **[COUNT START]** soft-key is pressed in the "HOLD" status, the counter restarts counting time.

5. If the remaining life (REMAIN) reaches 10% of the set LIFE value, the STATUS column changes to yellow indicating that the life will be expired soon.

6. If the life is expired, "ALM" is displayed in the STATUS column to give an operator the alarm information.

<Setting the counter data>

Five types of counters are used and the counter is operated according to the setting for ITEM, LIFE and TYPE.

1) Move the cursor to the ITEM column of the counter data to be set using the cursor control keys.

2) Press the **[SET]** soft-key.

NOTE
Setting is not possible if a counter is operating. Stop the counter by pressing the **[COUNT STOP]** soft-key.

3) Input the counter name using the data entry keys.

4) Press the **[EXEC.]** soft-key or the (INPUT) key. To stop data setting, press the **[EXIT]** soft-key.

5) Move the cursor to the LIFE column of the item to be set using the cursor control keys.

6) Input the LIFE data using the data entry keys and press the **[EXEC.]** soft-key or the (INPUT) key. To stop data setting, press the **[EXIT]** soft-key.

NOTE
LIFE data cannot be set unless a counter name (ITEM) is set.

7) Move the cursor to the TYPE column of the item to be set using the cursor control keys.

8) Input the counter type using the data entry keys and press the **[EXEC.]** soft-key or the [INPUT] key. To stop data setting, press the **[EXIT]** soft-key.

NOTE TYPE data cannot be set unless LIFE data is set.

9) Press the **[COUNT START]** soft-key.
   The STATUS changes to "ON" and the counter starts operating.

| < | NC ALARM | PC ALARM | ALARM HISTRY | INSPEC TION | | EXEC. | COUNT START | | | EXIT | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |

<Stopping the counter>

1) Move the cursor to the item for which counting should be stopped using the cursor control keys.

2) Press the **[COUNT STOP]** soft-key.

| < | NC ALARM | PC ALARM | ALARM HISTRY | INSPEC TION | | EXEC. | COUNT START | | | EXIT | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |
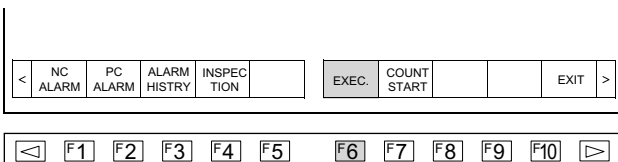
3) Press the **[EXEC.]** soft-key.
   The counter stops counting time and the STATUS changes as follows:
   Type 1 or 5:   OFF
   Type 2, 3 or 4:   HOLD

<Deleting the counter>

1) Move the cursor to the item which should be deleted using the cursor control keys.

2) Press the **[DELETE]** soft-key.

| < | NC ALARM | PC ALARM | ALARM HISTRY | INSPEC TION | | EXEC. | COUNT START | | | EXIT | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |
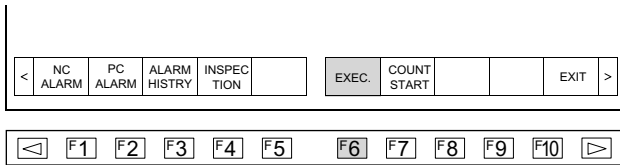
3) Press the **[EXEC.]** soft-key.

The set counter is deleted.

NOTE The counter cannot be deleted if it is operating. Stop the counter by pressing the **[COUNT STOP]** soft-key.

<Clearing the counter>

MDI	***	***	***		0mm/min			O0001	N00001
			0%		0min-1				
PERIODIC INSPECTION						23:58:53			HEAD1

	ITEM	LIFE	REMAIN	TYPE	STATUS
1	AIR-FILTER	9999	666.3	2	ON
2	COOLANT	3	0.0	3	ALM
3					
4					
5					
6					
7					
8					
9					
10					

| < | NC ALARM | PC ALARM | ALARM HISTRY | INSPEC TION | | | SET | COUNT STOP | DELETE | STATUS CLEAR | > |
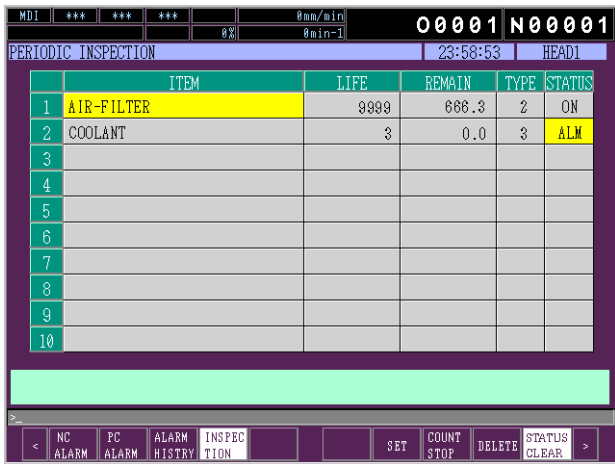
1) Move the cursor to the item for which the status should be cleared using the cursor control keys.

2) Press the **[STATUS CLEAR]** soft-key.

| < | NC ALARM | PC ALARM | ALARM HISTRY | INSPEC TION | | EXEC. | COUNT START | | | EXIT | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |
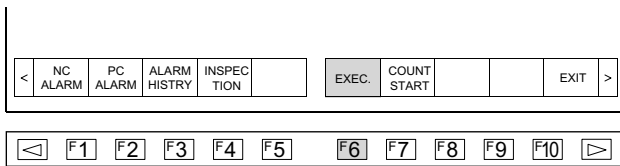
3) Press the **[EXEC.]** soft-key.

The counter is reset and starts counting time.

NOTE The counter cannot be cleared if it is operating. Stop the counter by pressing the **[COUNT STOP]** soft-key.

7-7   Function Selection Key ⌨ (SETTING)

The function selection key ⌨ (SETTING) is used to display the PCMDI menu and SETTING menu screen.

<PCMDI menu and setting menu screen>
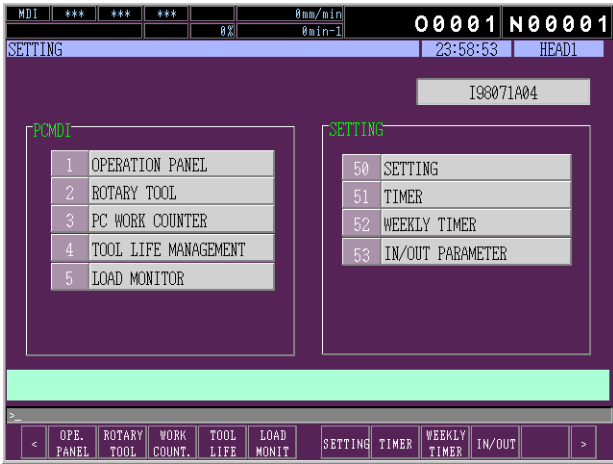
On the PCMDI menu, the menu is displayed to call following screens.

- OPERATION PANEL screen
- ROTARY TOOL screen
- PC WORK COUNTER screen (option)
- TOOL LIFE MANAGEMENT screen
- LOAD MONITOR screen

On the SETTING menu, the menu is displayed to call following screens.

- SETTING screen
- TIMER screen
- WEEKLY TIMER screen
- IN/OUT PARAMETER screen

To change the screen, press the soft-key corresponding to the screen to be accessed.
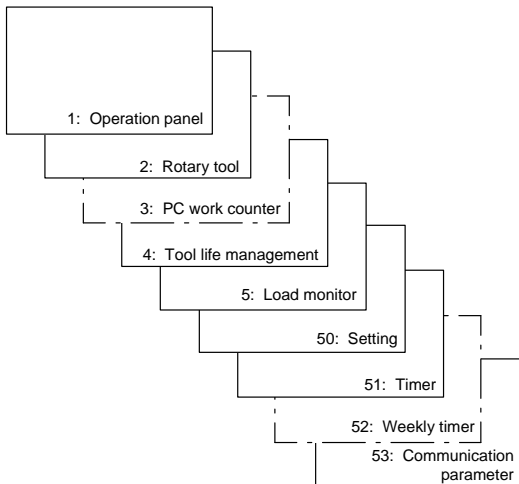
It is possible to access the required screen directly by using the data entry key. For this, input the menu number of the required screen and press the ⌨ (INPUT) key.

No.	Menu	Soft-Keys	Refer to
1	OPERATION PANEL	**[OPE. PANEL]**	7-7-1
2	ROTARY TOOL	**[ROTARY TOOL]**	7-7-2
3	PC WORK COUNTER	**[WORK COUNTER]**	7-7-3
4	TOOL LIFE MANAGEMENT	**[TOOL LIFE]**	7-7-4
5	LOAD MONITOR	**[LOAD MONIT]**	7-7-5
50	SETTING	**[SETTING]**	7-7-6
51	TIMER	**[TIMER]**	7-7-7
52	WEEKLY TIMER	**[WEEKLY TIMER]**	7-7-8
53	IN/OUT PARAMETER	**[IN/OUT]**	7-7-9

7-7-1   Operation Panel Screen

Function selection key ⌨ (SETTING) ⟶ **[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
CHUCK DIRECTION	5-6-7 Chuck Clamp Direction (page A-34)
TAILSTOCK ILK.	5-6-8 Tailstock Spindle Interlock (Tailstock Specification) (page A-35)
WORK COUNTER	5-6-9 Work Counter (Option) (page A-36)
MACHINE LOCK	5-6-5 Machine Lock (page A-32)
AUX. F. LOCK	5-6-10 Auxiliary Function Lock (page A-37)
CHUCK FOOT SWITCH	5-6-11 Chuck Footswitch (page A-38)
CHUCK STROKE END	5-6-12 Chuck Jaw Stroke End Detection Switch (page A-39)
ZERO POINT SET	5-6-13 Zero Point Adjustment (page A-41)
TLSTCK POS. ADJ.	5-6-14 Tailstock Position Adjustment (ZL-253) (page A-42)
SPINDLE OFF MODE	5-6-15 Spindle OFF Mode Function (page A-43)

The screen consists of two pages. The desired page can be called by pressing the page selection keys.

<Setting procedure>

No.	MENU	CONDITION	
1	SPINDLE OFF MODE	INVALID	VALID
2	CHUCK DIRECTION	O.D.	I.D.
3	TAILSTOCK ILK.	OFF	ON
4	WORK COUNTER	ST.ILK	BDT
5	MACHINE LOCK	OFF	ON
6	AUX. F. LOCK	OFF	ON
7	CHUCK FOOT SWITCH	VALID	INVALID
8	CHUCK STROKE END	VALID	INVALID

OPERATION PANEL (1/2)

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 [→].

NOTE The **[BDT]** soft-key is displayed for some optional specifications.

No.	MENU	CONDITION	
9	ZERO POINT SET	INVALID	VALID
10	TLSTCK POS.ADJ.	INVALID	VALID
11	CHUCK2 DIRECTION	O.D.	I.D.
12	CHUCK2 FOOT SW.	VALID	INVALID
13	CHUCK2 STROKE END	VALID	INVALID
14	AUTO DOOR OPEN	BOTH	ONE
15			
16			

OPERATION PANEL (2/2)

No.	MENU	CONDITION	
1	BLOCK DELETE 2	INVALID	VALID
2	BLOCK DELETE 3	INVALID	VALID
3	BLOCK DELETE 4	INVALID	VALID
4	BLOCK DELETE 5	INVALID	VALID
5	BLOCK DELETE 6	INVALID	VALID
6	BLOCK DELETE 7	INVALID	VALID
7	BLOCK DELETE 8	INVALID	VALID
8	BLOCK DELETE 9	INVALID	VALID

BLOCK DELETE

When the **[BDT]** soft-key is pressed, the BLOCK DELETE screen (block delete 2 to 9) is displayed.

7-7-2   Rotary Tool Setting Screen (MC Type)

Function selection key 🔳 (SETTING) ⟶ **[ROTARY TOOL]**

MEM	***	***	***	0mm/min		O0001 N00001
				0%	0min-1	

ROTARY TOOL   00:23:24   HEAD1

STATION	DIREC.	STATION	DIREC.
1	X	7	TURN-
2	Z	8	X
3	TURN-	9	TURN-
4	Z	10	Z
5	X	11	TURN-
6	TURN-	12	TURN-

X

Z

| < | X | Z | | Z CCW | TURN-ING | | | | | EXIT | > |
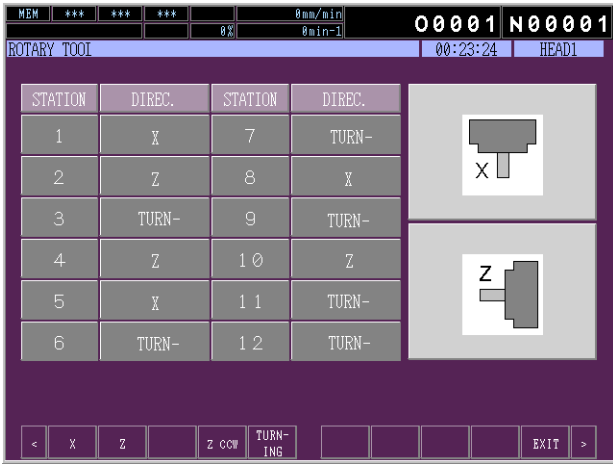
This screen is used to set the rotary tool mounting direction for MC type machine.

NOTE The **[Z CCW]** soft-key is used by the S type machines.

📖 For the procedure used for setting, refer to page B-77 (14-1).

7-7-3   PC Work Counter Screen (option)

Function selection key 🔳 (CUSTOM) ⟶ **[WORK COUNT.]**

This screen is used to set or reset the work counter function.

NOTE The PC WORK COUNTER of turret 1 and turret 2 operate simultaneously.

<Setting procedure>

MEM	***	***	***	0mm/min		O0001 N00001
				0%	0min-1	

PC WORK COUNTER   00:32:46   HEAD1

	PRESET	CURRENT
1	0000	0000
2		
3		
4		
5		
6		
7		
8		

>_

| < | CLEAR 1 | | | | | | | | EXIT | > |

1) Move the cursor to the required item using the cursor control keys ⬅ and ➡ .

2) Key in the data using the data entry keys.

3) Press the 🔳 (INPUT) key.

<Resetting the counter after count-up>

When the CURRENT data (count data) reaches the PRESET data on the PC WORK COUNTER screen, cycle start for the next cycle is made in the following manner (1. and 2.).

NOTE   The processing called at the count-up of the work counter varies depending on the setting for the work counter on the OPERATION PANEL screen.

1. When the start interlock is selected

    If the (ST) switch is pressed again, an alarm message is displayed on the screen and cycle start is disabled.

2. When the block delete (BDT) function is selected

    The block delete function (/) becomes valid.

    If the (ST) switch is pressed again, the program is executed but the CURRENT quantity data is not updated.

To cancel these states, it is necessary to reset the CURRENT data to "0".

1) Press the **[CLEAR 1]** soft-key.

    The CURRENT data is reset to "0".

7-7-4   Tool Life Management Screen

Function selection key 🔲 (SETTING) ⟶ **[TOOL LIFE]**

⟶ **[DETAIL]**[*1] ⟶ **[SET]**[*2]
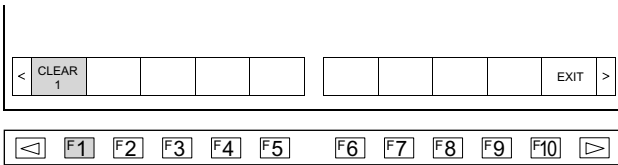
[*1]   TOOL DETAIL screen

[*2]   TOOL LIFE MANAGEMENT FUNCTION SELECT screen

\<Tool life management screen\>

This screen is used to display the tool used status of the tool life management data.

The tool type, preset value, current value, selected tool and remaining time are displayed for eight groups on each page.

📖 For details of the tool life management function, refer to the PROGRAMMING MANUAL "TOOL LIFE MANAGEMENT FUNCTION".

\<Transition of soft-keys\>

<	G.SRCH	G.RSET	SKIP	IN/OUT	DETAIL					EXIT	>
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

\<Tool detail information screen\>

When the **[DETAIL]** soft-key is pressed, the TOOL DETAIL screen is displayed.

<Tool life management function selection screen>

No.	MENU	CONDITION	
1	SET TOOL LIFE BY TOOLS	INVALID	VALID
2	OVERLOAD-TOOL SKIP FUNCTION	INVALID	VALID
3	OP.STOP AT TOOL LIFE EXPIRE	INVALID	VALID
4	OFFSET NO. SHIFT FUNCTION	INVALID	VALID
5			
6			
7			
8			

When the **[SET]** soft-key is pressed while selecting the setting area on the right side of the TOOL DETAIL screen, the TOOL LIFE MANAGEMENT FUNCTION SELECT screen is displayed.

This screen is used to set tool life management functions valid or invalid.

7-7-5   Load Monitor Screen

The load monitor screens display the variation in motor load during cutting. It is also used to set and change the warning and alarm levels of the individual interval groups.

The load monitor function B compares the actual motor load within a specified group interval with the preset warning and alarm levels of the same group interval to control machine operation. If the actual load exceeds the warning level, the function disables cycle start of the next automatic operation and if the actual load exceeds the alarm level, the function places the CNC in the feed hold state.

For details of the load monitor function B, refer to page F-31 (9).

Function selection key [⌷ SETTING] (SETTING) ⟶ **[LOAD MONIT]**[*1]

⟶ **[SETING]**[*2]

[*1]   LOAD MONITOR screen

[*2]   LOAD MONITOR SETTING screen

<Load monitoring screen>

This screen is used to check the load information and select the operation mode (teaching mode or monitoring mode).

NOTE   With the Y-axis specification machines, Y-axis is also displayed.

<Load monitoring data setting screen>

This screen is used to check and set the load information for each monitoring group.

NOTE   With the Y-axis specification machines, Y-axis is also displayed.

7-7-6   Setting Screen

 Function selection key [SETTING] (SETTING) ⟶ **[SETTING]**

The screen consists of two pages.

The desired page can be called by pressing the page selection keys.

The screen is used for setting "valid" of "invalid" for changing the CAP and NC parameters and also for setting "ON" or "OFF" for the input unit, tape format, sequence stop and mirror image.

CAUTION ⚠ When changing the CAP parameters or NC parameters, be sure to return the setting for "CAP PARAMETER WRITE" and "NC PARAMETER WRITE" to "0" (INVALID) after changing them.

NOTE Setting of the CAP parameters and NC parameters can be changed in the MDI mode with the NC in the reset or emergency stop state.

<Sequence stop>

This function suspends execution of a program by setting a program or sequence number.

Once the sequence stop is executed, setting is disabled.

Setting is also disabled when the [RESET] (RESET) key is pressed.

7-7-7   Timer Screen

Function selection key (SETTING) ⟶ **[TIMER]**

This screen is used for checking or setting the date/time, number of machined workpieces, NC operating hours, cycle time, etc.

\<Setting procedure\>

1) Move the cursor to the desired item using the cursor control keys.

2) Key in the data using the data entry keys.

3) Press the (INPUT) key.

NOTE

For WORK COUNT M, the M codes to be counted varies as follows depending on its setting.

"0":   M02, M30

Positive value: Specified M code only

Negative value: Specified M code, M02 and M30

Setting Value	Screen Display	M Codes to be Counted
0	02, 30	M02, M30
10	10	M10
−10	10, 02, 30	M10, M02, M30

7-7-8   Weekly Timer Screen (Option)

Function selection key (SETTING) ⟶ **[WEEKLY TIMER]**
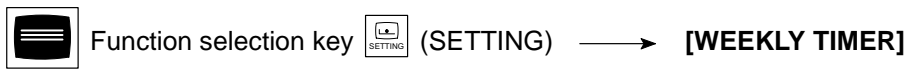
Set the program number of the program which is executed in response to the operation of the weekly timer.

7-7-9   Communication Parameter Screen

⬛ Function selection key 🔲 (SETTING) ⟶ **[IN/OUT]**

The COMMUNICATION PARAMETER screen is used to set communication parameters.

NOTE If the IO device is a "memory card," no setting items are displayed below the port.

<Setting procedure>

1) Move the cursor to the required item using the cursor control keys ⬆ and ⬇.

2) Move the cursor to the item to be set (the selected item is highlighted) using the cursor control keys ⬅ and ➡.

3) Press the **[SET]** soft-key.

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

7-7-10   Parts Catcher Setting/Operation Screen

Function selection key ⌨ (SETTING) ⟶ **[OPE. PANEL]** ⟶ **[PCMDI MENU]**

⟶ **[IN-MC LOADER]** [*1] ⟶ **[MANUAL OPERAT]** [*2]
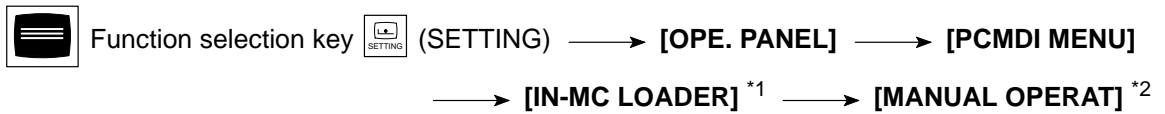
[*1]   Parts catcher position setting screen

[*2]   Manual independent parts catcher operation screen

<Parts catcher position setting screen>

```
[SET ARM POS.]
              SET(1000 : 1mm)
                    0
  DESCENT POS. 1    -1800000
  CLAMP POS. 1      (NOT USED)
  RETURN POS. 1     (NOT USED)
  DESCENT POS. 2    -1800000
  CLAMP POS. 2      (NOT USED)
  RETURN POS. 2     (NOT USED)




NUM=
                                  S   0 L  0%
                  MDI **** *** ***  00:32:23  HEAD1

  EXIT              EXEC.
```
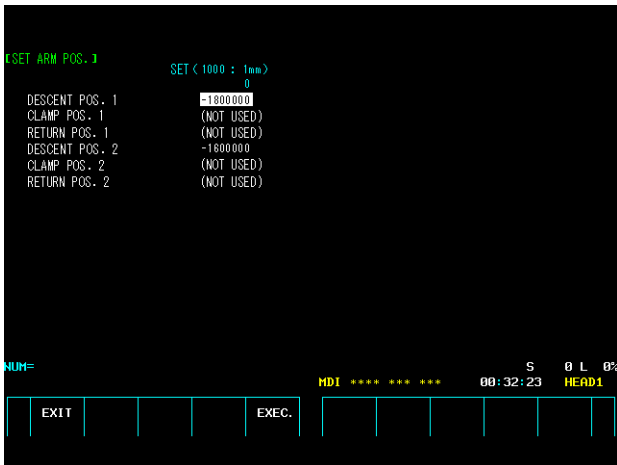
This screen, displayed for spindle 2 side operation, is used to set the parts catcher positions.

NOTE For the bucket specification, "(NOT USED)" is displayed for "CLAMP POS. 1", "RETURN POS. 1", "CLAMP POS. 2" and "RETURN POS. 2".

📖 For the procedure used for setting, refer to page B-100 (16-1).
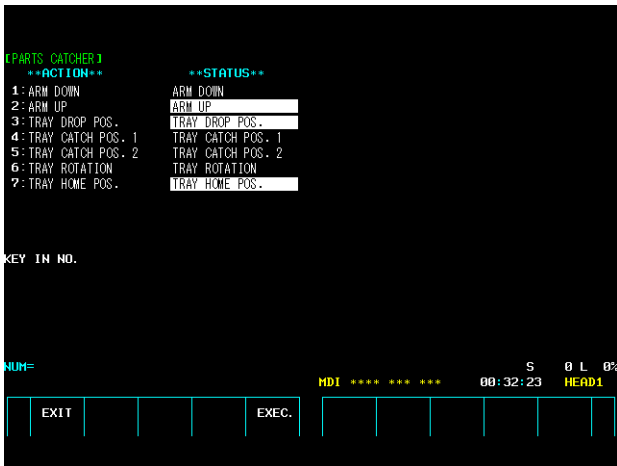
<Manual independent parts catcher operation screen>

```
[PARTS CATCHER]
   **ACTION**         **STATUS**
 1:ARM DOWN          ARM DOWN
 2:ARM UP            ARM UP
 3:TRAY DROP POS.    TRAY DROP POS.
 4:TRAY CATCH POS. 1 TRAY CATCH POS. 1
 5:TRAY CATCH POS. 2 TRAY CATCH POS. 2
 6:TRAY ROTATION     TRAY ROTATION
 7:TRAY HOME POS.    TRAY HOME POS.


KEY IN NO.



NUM=
                                  S   0 L  0%
                  MDI **** *** ***  00:32:23  HEAD1

  EXIT              EXEC.
```

This screen is used to check and set the load information for each monitoring group.

NOTE The screen shown in the left is for the bucket specification.

📖 For the procedure used for operating the parts catcher, refer to page B-105 (16-5).

7-8   Function Selection Key ⌨ (NETWORK)

The function selection key ⌨ (NETWORK) is invalid since the machine is not equipped with the network function.

7-9   Help Key ⌨ (HELP)

The ⌨ (HELP) key is invalid since the machine is not equipped with the help function.

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.

WARNING	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.

CONTENTS

B : MANUAL OPERATION

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 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

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.

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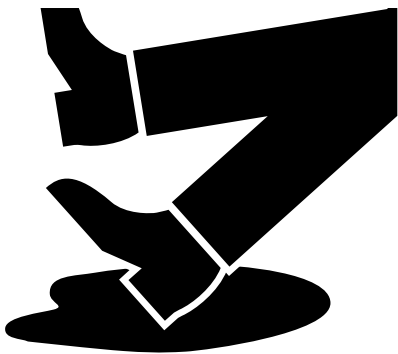
3) Make sure that the floor around the machine is clean. There should be no oil or coolant on the floor.

2-2   Turning On the Power

The method for turning on the power to the machine is described here.
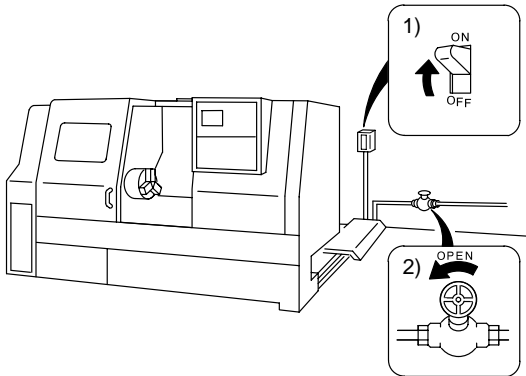
1) If power is not supplied, turn on the main breaker on the shop power distribution board.

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.
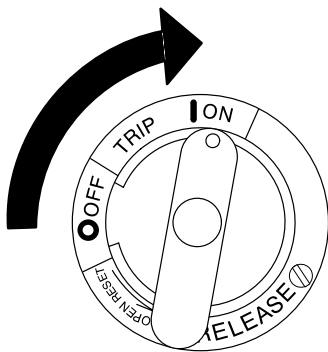
4) Turn on the main switch.

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.
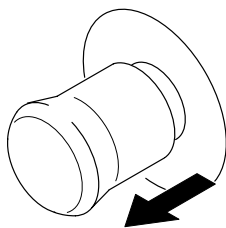
7) Pull out all the EMERGENCY STOP buttons to reset the emergency stop state.

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.

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".

(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, i n 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.

---

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.

OK

⊲ F1 F2 F3 F4 F5   F6 F7 F8 F9 F10 ⊳

The instruction message 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 The machine ready state is not established until the front door is opened and then closed: before this neither automatic nor manual operation is possible.

The front door is locked, and the STATUS indicator **[MRDY]** is lit.

STATUS

○ ERR   ◉ MRDY

○ M00/M01   ○ TRCL

○ M02/M30   ○ X

○ CHCL   ○ Z

The POSITION (ABSOLUTE) screen or the PCMDI MENU screen is displayed.

NOTE 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.

WARNING **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) key>

All machine operation stops.

NOTE The power is not turned off.

<Press the 🔄 (SP) 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.
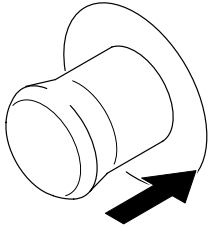
1)   Press the EMERGENCY STOP button.

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 (MC 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.
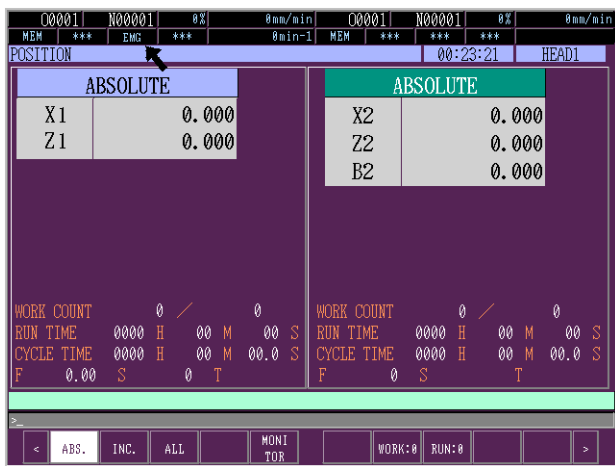
The screen displays the information that the machine has been stopped in the emergency stop state.
The message "EMG" blinks on and off on the screen.

<To restart operation>
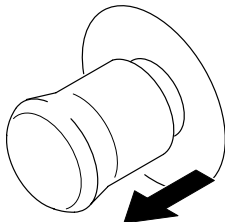
1)   Close the front door.

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.
If the alarm cannot be cleared, contact Mori Seiki.

STATUS

○ ERR   ● MRDY

○ M00/M01   ○ TRCL

○ M02/M30   ○ X ⌐⊕

○ CHCL   ○ Z ⌐⊕

MODE

MEM	MDI	TAPE	EDIT
H	JOG	RPD	ZRN
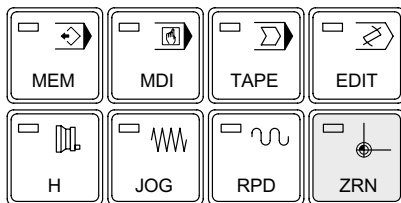
4) Carry out the zero return operation.

Page B-19 (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.
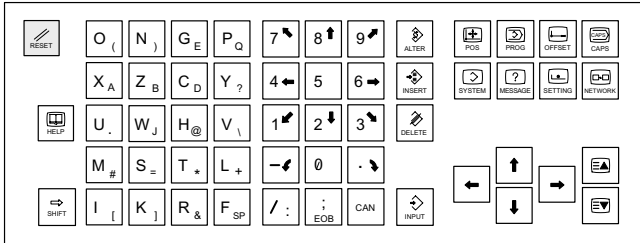
1) Press the [RESET] (RESET) key.

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 (MC 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

When restarting the operation after searching a block in the middle of a program, 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.

MODE

1) Select the memory mode ( ) with the MODE selection switch.
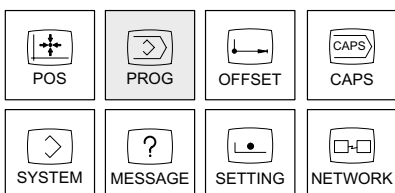
2) Press the function selection key (PROG).

The PROGRAM (memory) screen is displayed.
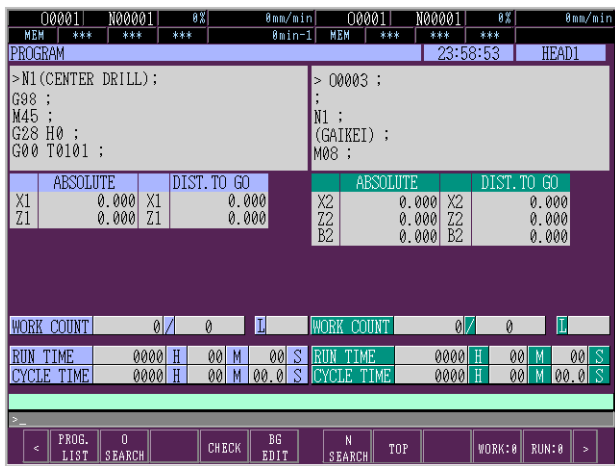
MODE

3) Press the **[TOP]** soft-key and 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-19 (6-1)
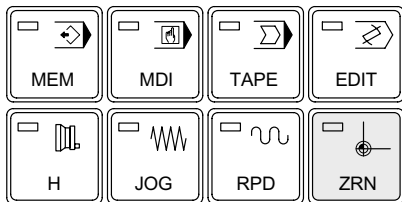
3-3   Feed Hold Switch

The procedures for stopping the machine with the [SP] (SP) switch and restarting automatic operation from the temporary stop state are described here.

> **WARNING**
>
> Pressing the [SP] (SP) 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.

CYCLE

ST   SP
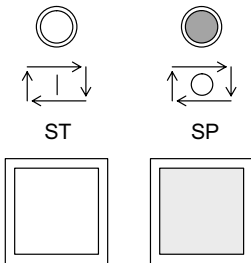
1) Press the [SP] (SP) switch.

   The indicator above the switch is lit and axis feed stops.

NOTE

1. If the [SP] (SP) 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 [SP] (SP) 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 [SP] (SP) 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 [SP] (SP) switch is pressed in the tapping cycle (MC 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 [ST] (ST) switch.

   The indicator above the switch is lit.
   The rest of the program is executed.

CYCLE

ST   SP
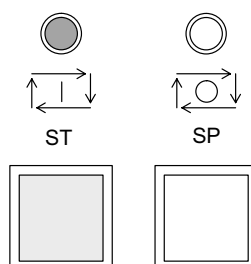
4   TURNING OFF THE POWER

This section describes the procedure for turning off the power to the machine.

CYCLE

ST   SP
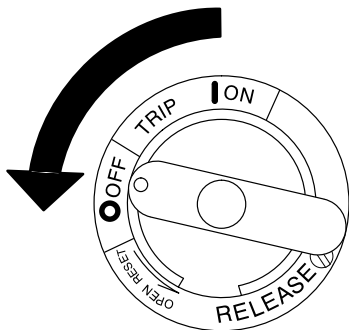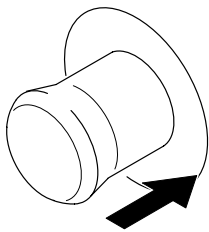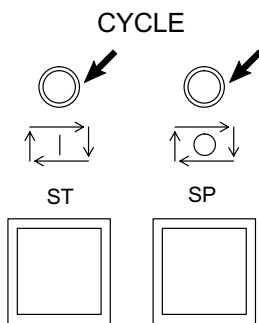
1) Make sure that the indicator above the [↕] (ST)

   switch and the indicator above the [↺] (SP) switch
   on the operation panel are not lit.

   NOTE If the indicator is lit, press the [RESET] (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.
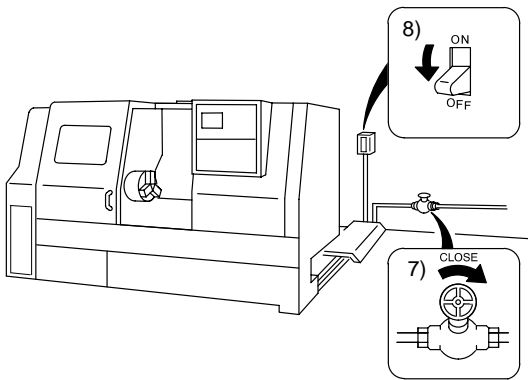
7) If the machine uses pneumatically-actuated equipment, turn off the compressed air supply.

8) Turn off the main breaker on the shop power distribution board.
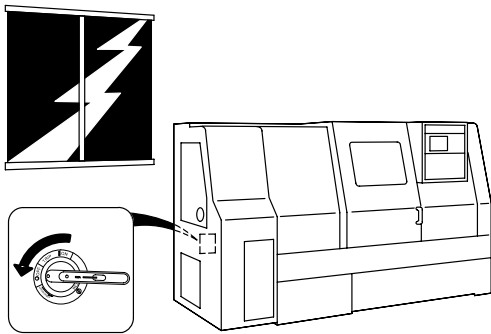
WARNING

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
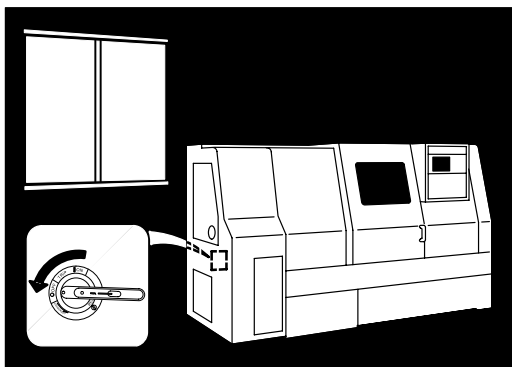
When turning on the power after the machine has been stopped by a power outage, check that the program, parameter data, offset data, etc. have not been destroyed. If the machine is used with destroyed data, it could lead to accidents involving damage to the machine.

5   SELECTING TURRET AND HEADSTOCK

Select turret 1 (spindle 1) or turret 2 (spindle 2) to be operated manually with the HEAD CHANGE switch ⬚ (head 1) or ⬚ (head 2).
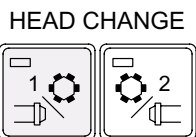
HEAD CHANGE

When the HEAD CHANGE switch ⬚ (head 1) is pressed, the indicator in the switch is lit and turret 1 and spindle 1 are selected.
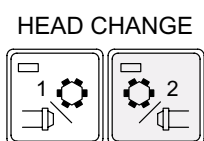
HEAD CHANGE

When the HEAD CHANGE switch ⬚ (head 2) is pressed, the indicator in the switch is lit and turret 2 and spindle 2 are selected.

NOTE When the manual mode is selected after turning on the power, turret 1 and spindle 1 are selected.

6   AXIS MOVEMENT OPERATION

<Standard>

The directions of the controlled axes of this machine are determined as follows.

Axis	Unit	+ and − Direction	
X	Turret 1	+ direction:	up, viewing from machine front
X	Turret 2	+ direction:	down, viewing from machine front
Z	Turret 1	+ direction:	right, viewing from machine front
Z	Turret 2		
C (MC type)	Headstock	+ direction:	CCW rotation, viewing the workpiece from the spindle side

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.

Turret 1

Headstock

Turret 2

<S type>
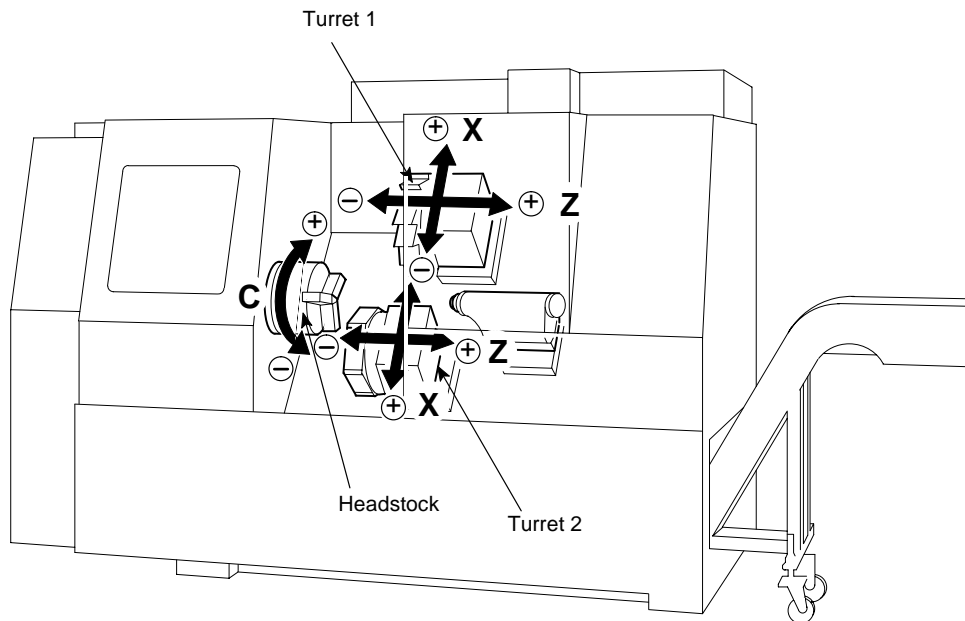
The directions of the controlled axes of this machine are determined as follows.

Axis	Unit	+ and − Direction	
X	Turret 1	+ direction:	up, viewing from machine front
	Turret 2	+ direction:	down, viewing from machine front
Z	Turret 1	+ direction:	right, viewing from machine front
	Turret 2		
C (MC type)	Headstock 1	+ direction:	CCW rotation, viewing the workpiece from the spindle 1 side
	Headstock 2	+ direction:	CW rotation, viewing the workpiece from the spindle 2 side
B	Headstock 2	+ direction:	right, viewing from machine front

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.

Turret 1

Headstock 2 (Chuck)

Turret 2

Headstock 1 (Chuck)
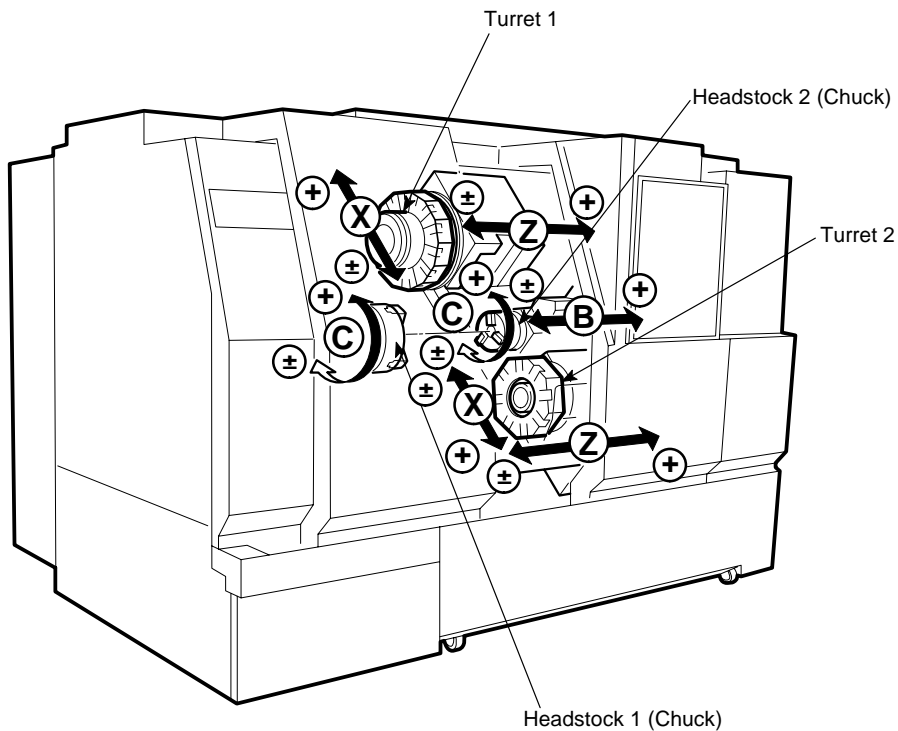
6-1   Zero Return Operation

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 published separately.

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 reseting an alarm state

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.**
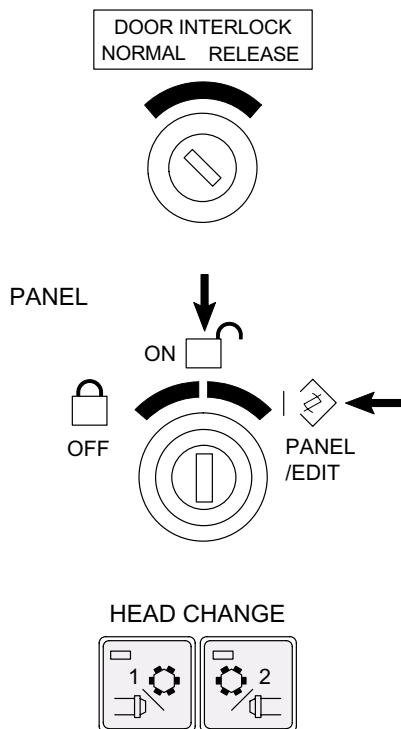
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

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 CHANGE switch (head 1) or (head 2) to select the required turret.
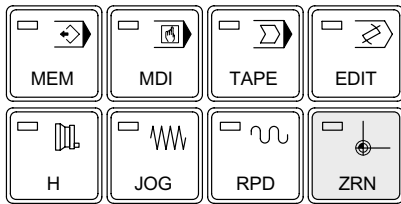
MODE

RAPID OVERRIDE
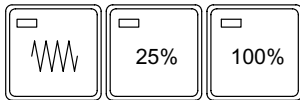
<Standard>

AXIS DIRECTION

<B-axis (S type)>

−B   +B

STATUS

○ ERR	○ MRDY
○ M00/M01	○ TRCL
○ M02/M30	● X
○ CHCL	● Z

<B-axis (S type)>
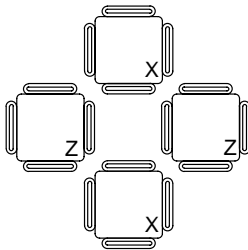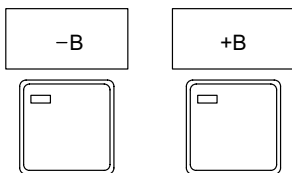
◉ B-AXIS ZERO POINT

○ HEADSTOCK 2 CHUCK CLAMP

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 OVERRIDE switches.

NOTE   For manual operation, the maximum allowable override value is 50%. Therefore, if the 100% (100%) switch is pressed, the override value is 50%.

7) Press and hold down the AXIS DIRECTION 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 DIRECTION 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, or the status indicator **[B-AXIS ZERO POINT]** (S type) on the option panel is lit when the axis has been returned to the zero point.

📖   For the C-axis zero return operation, refer to page B-85 (14-5). (MC 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)
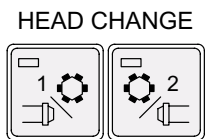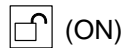
4) Press the HEAD CHANGE switch (head 1) or (head 2) to select the required turret.

5) Select the rapid traverse mode ($\sim$) with the MODE selection switch.

RAPID OVERRIDE
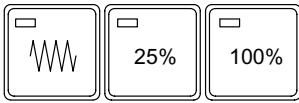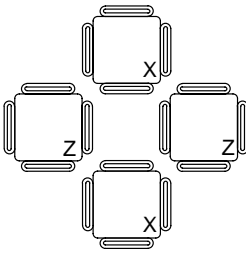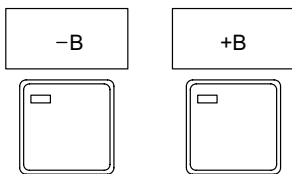
WW   25%   100%

<Standard>

AXIS DIRECTION

X

Z   Z

X

<B-axis (S type)>

−B   +B

6) Set the rapid traverse rate to be used for zero return operation using the RAPID OVERRIDE switches.

NOTE   For manual operation, even if the 100% (100%) switch is pressed, the actual override value is fixed at 50%.

7) Press and hold down the AXIS DIRECTION 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-86 (14-6). (MC 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 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)
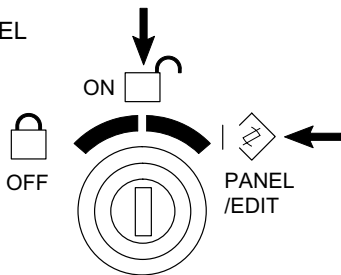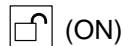
4) Press the HEAD CHANGE switch (head 1) or (head 2) to select the required turret.
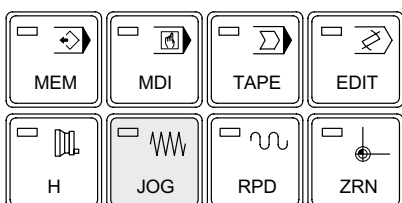
5) Select the jog mode ( ) with the MODE selection switch.
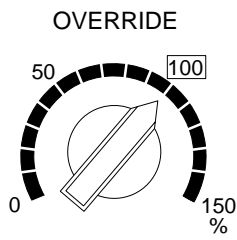
OVERRIDE

50   100

0   150
%

<Standard>

AXIS DIRECTION

X

Z   Z

X

<B-axis (S type)>

−B   +B

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-56 (5-11).

NOTE When the OVERRIDE dial is placed in the **0** position, the axis is not fed even when an AXIS DIRECTION switch is pressed.
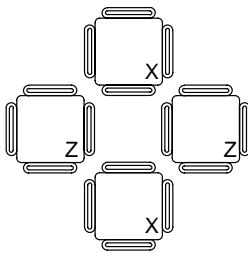
7) Press and hold down the AXIS DIRECTION switch for the axis to be fed.

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-88 (14-7). (MC type)
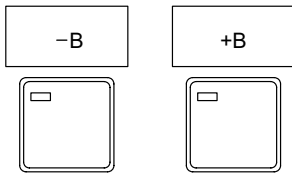
6-4   Handle Feed Operation

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.
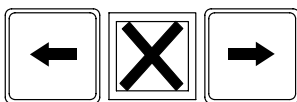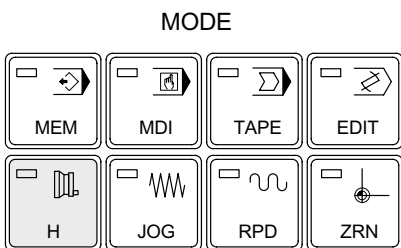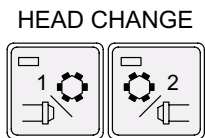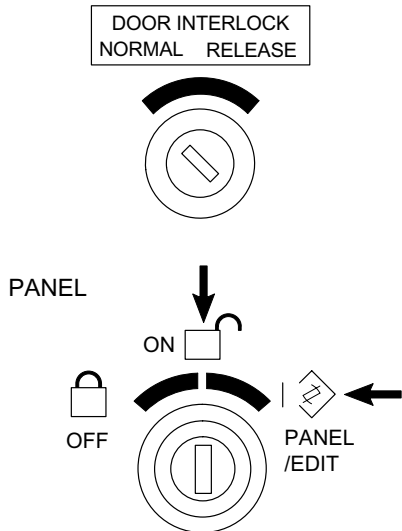
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

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 CHANGE 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.

8) 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
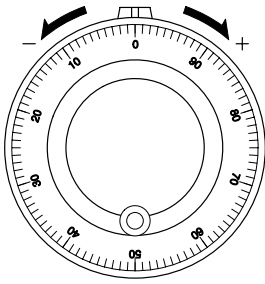
9) Turn the manual pulse generator in the direction (+/
    −) in which the selected axis is to be fed.

📖 For the C-axis handle feed operation, refer to
    page B-89 (14-8). (MC 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 500	The X-axis has been moved beyond stored stroke limit 1 in the positive direction.
Alarm 501	The X-axis has been moved beyond stored stroke limit 1 in the negative direction.
Alarm 500	The Z-axis has been moved beyond stored stroke limit 1 in the positive direction.
Alarm 501	The Z-axis has been moved beyond stored stroke limit 1 in the negative direction.
Alarm 500	The B-axis has been moved beyond stored stroke limit 1 in the positive direction.
Alarm 501	The B-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 CHANGE switch (head 1) or (head 2) to select the required turret.

MODE

MEM	MDI	TAPE	EDIT
H	JOG	RPD	ZRN

5) Select any of the following modes with the MODE selection switch.

[handle] (handle)   [jog] (jog)

[rapid traverse] (rapid traverse)

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] (RESET) key.

The alarm state is cleared.
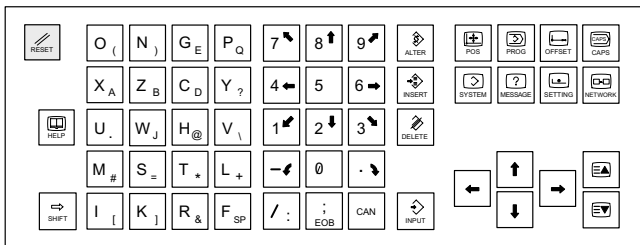
6-6   Releasing the Hard-overtravel Alarm (ZL-253)

In order to avoid interference between the carriage and the tailstock, this machine has a limit switch which is actuated if the carriage comes too close to the tailstock, establishing the emergency stop state and preventing further axis movement.

In such a case, the STATUS indicator **[MRDY]** goes off, the message "EMG" blinks on the screen.

Use the procedure indicated below to release the alarm state.
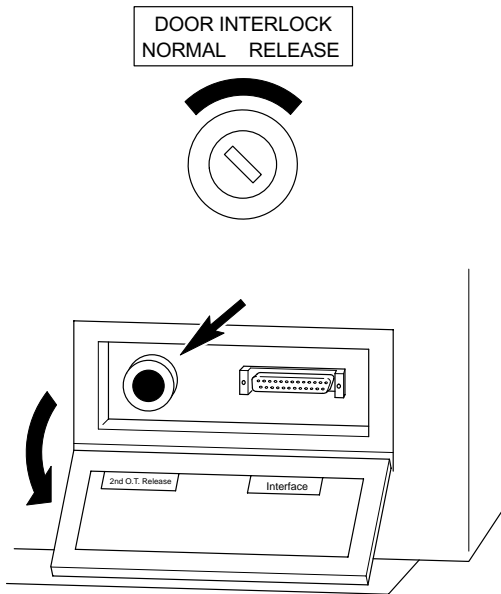
<To release the alarm state>

DOOR INTERLOCK
NORMAL   RELEASE

1)   Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2)   Close the front door.

2nd O.T. Release   Interface

3)   Open the cover under the operation panel.

4)   Press and hold down the 2nd O.T. RELEASE button.

NOTE   Hold down the 2nd O.T. RELEASE button until steps 4) to 7) are completed. If the button is released during these steps, the ready signal is turned off and it becomes necessary to repeat the operation from step 4) again.

5)   Press the NC power switch (|) (ON).

| ON

O OFF

STATUS

○ ERR   ◉ MRDY

○ M00/M01   ○ TRCL

○ M02/M30   ○ X

○ CHCL   ○ Z

The STATUS indicator **[MRDY]** is lit.

MODE

MEM	MDI	TAPE	EDIT

H	JOG	RPD	ZRN

x1	x10	x100

← | Z | →

NOTE The MODE selection switch ▥ (H) is selected.

To ensure safety, do not select other modes until the hard-overtravel alarm state is cleared.

NOTE The HANDLE switch x1 (×1) is selected.

To ensure safety, do not select other multiplication ratio until the hard-overtravel alarm state is cleared.

6) Select the Z-axis with the axis selection switch.

7) Turn the manual pulse generator in the negative direction.

CAUTION When a hard-overtravel alarm has occurred, the axis movement interlock can be released by pressing the 2nd O.T. RELEASE button. Be very careful not to move the axis in the positive direction after pressing this button. If the axis is moved further in the positive direction, the carriage may collide with the tailstock, causing damage to the machine.

8) After the axis has been returned to within its limits, release the 2nd O.T. RELEASE button.

7 SPINDLE OPERATION

This section describes the spindle related operations - spindle start and stop.

> **⚠ WARNING**
>
> **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 STATUS indicator **[M02/M30]** is not lit.

6. The chuck is clamped.
   (The STATUS indicator **[CHCL]** is lit.)

7. The machine is not in the reset state.

8. The machine is not in the M00 or M01 state.

9. The spindle or rotary tool spindle (MC type) is not rotating.

10. The spindle or rotary tool spindle (MC type) is not jogging.

11. The spindle OFF mode function is invalid.

12. The spindle gear range is in any of the 1st to 4th position.
    (only for transmission specification)

13. There is no spindle or rotary tool spindle (MC type) related alarm.

14. External spindle interlock signal (the signal which disables spindle or rotary tool spindle (MC type) rotation) is not input.

15. The tailstock spindle is not in the inching state.

16. The tailstock is clamped.

17. The spindle brake is released (MC type).

18. The turret head is set in the position to index the rotary tool mounting station
    (only for MC type) (only in the spindle and rotary tool spindle simultaneous operation mode).

19. The selected rotary tool is mounted in the Z-axis direction (only for MC type) (only in the spindle and rotary tool spindle simultaneous operation mode).

20. The C-axis is not connected. (MC type)

21. The protection cover of the tool presetter arm is mounted to the base.

22. The bar feeder or bar puller is not in the emergency stop state (only for bar feeder, bar puller specification).

7-2   Starting and Stopping Spindle Rotation

The procedures for starting and stopping spindle rotation in manual operation are described here.

<Starting spindle rotation>
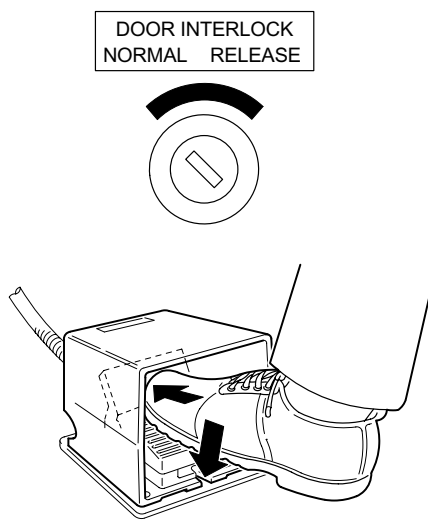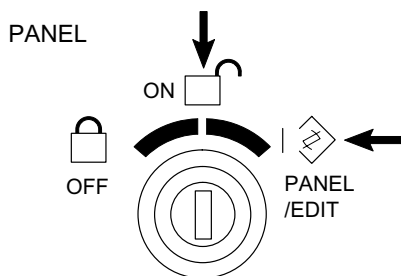
DOOR INTERLOCK
NORMAL   RELEASE
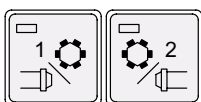
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

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-36 (7-3)

STATUS

○ ERR   ○ MRDY

○ M00/M01   ○ TRCL

○ M02/M30   ○ X

● CHCL   ○ Z

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.

PANEL

ON

OFF   PANEL/EDIT

5) Place the PANEL key-switch in one of the positions indicated below.

　　(ON)　　　　(PANEL/EDIT)

HEAD CHANGE

1   2
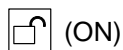
6) Press the HEAD CHANGE switch (head 1) or (head 2) to select the spindle to be rotated. (S type)

GEAR

1

7) Make sure that the GEAR indicating unit displays any of the "1" (first gear range) to "4" (fourth gear range).

NOTE The step 7) should be followed only for transmission specification machines.

8) Change the spindle gear range.

NOTE Step 8) should be followed when the spindle gear is in the neutral position for transmission specification machines.

<Example>

When changing the spindle gear to the first gear range

MODE

MEM	MDI	TAPE	EDIT
H	JOG	RPD	ZRN

a) Select the MDI mode (🔲) with the MODE selection switch.

b) Display the PROGRAM (MDI) screen.

📖 Page A-95 (7-2-4)

c) Input "M41;" using the data entry keys.

M# 4← 1← ; EOB (EOB)

d) Press the 🔷 INSERT (INSERT) key.

e) Press the ↰ (ST) switch.

The gear range is changed.
"1" is displayed in the GEAR display unit.

MODE

MEM	MDI	TAPE	EDIT
H	JOG	RPD	ZRN

9) Select any of the following modes with the MODE selection switch.

▥ (handle)   ⩗⩗ (jog)

∿ (rapid traverse)   ⊕ (zero return)

SPINDLE

OVERRIDE   GEAR

$/$ %

— +

NOR   SPJ   REV
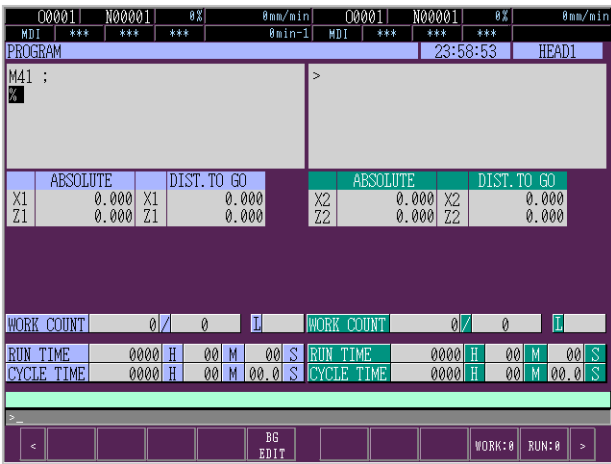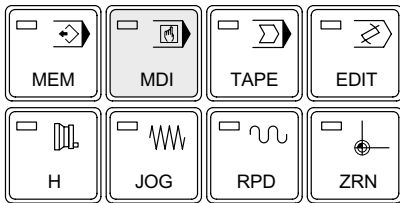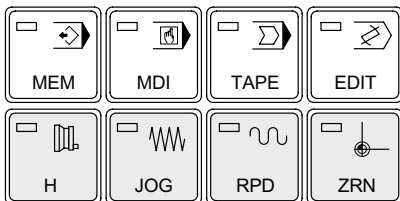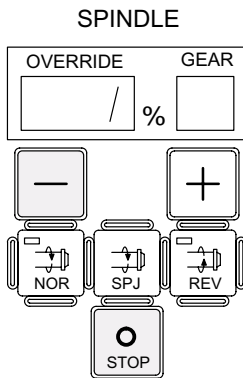
○ STOP

10) Set the spindle speed to the minimum value (1% of the maximum spindle speed) by pressing the spindle speed setting switch $-$ (decrease) and the $\bigcirc$ (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 $\bigcirc$ (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.
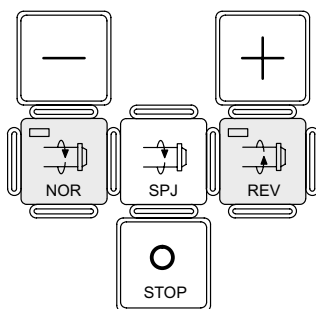
11) Close the front door.

12) Start the spindle.

<Normal direction>

Press the ⬚ (NOR) switch.

<Reverse direction>

Press the ⬚ (REV) switch.

— +

NOR   SPJ   REV

○ STOP
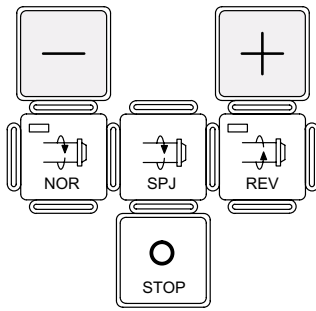
13) Increase the spindle speed gradually to the required speed.

<Spindle speed setting switch $\boxed{-}$ (decrease)>

The override value decreases in units of 1%.

<Spindle speed setting switch $\boxed{+}$ (increase)>

The override value increases in units of 1%.

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<Stopping spindle rotation>
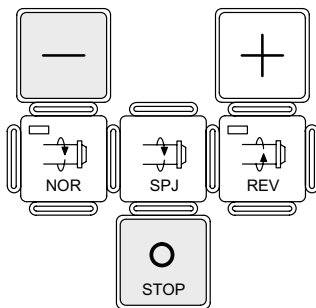
1) Decrease the spindle speed gradually to the lowest speed with the spindle speed setting switch $\boxed{-}$ (decrease).

2) Press the $\boxed{\bigcirc}$ (STOP) switch.

NOTE To change the spindle rotating direction, stop the spindle by pressing the $\boxed{\bigcirc}$ (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

1.   The footswitch is provided for chuck 1 and chuck 2 independently. Use the footswitch for the chuck to be operated. (S type)

2.   While the spindle is rotating, chuck clamp/unclamp operation is disabled by the chuck interlock function.

<Procedure>

1)   Make sure that the spindle (rotary tool spindle) rotation is stopped.

2)   Select the chucking direction (I.D. or O.D.).
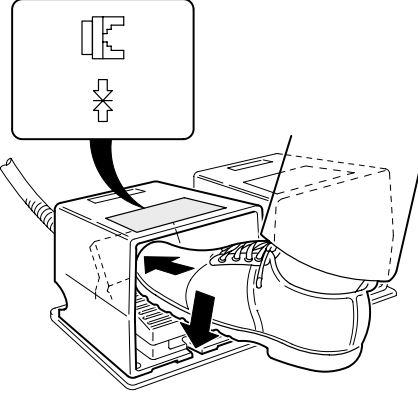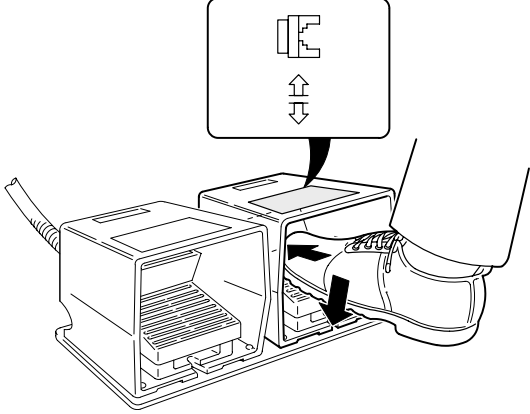
3)   Clamp and unclamp the chuck with the chuck opening/closing footswitch.

<Footswitch>
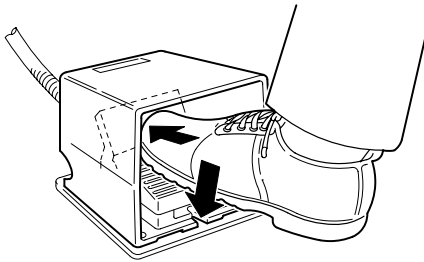
Step on the footswitch pedal while pushing the lock release plate forward with your toes.

<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.

📖   Page A-126 (7-7-1)

b)   Set "INVALID" for the CHUCK STROKE END (chuck jaw stroke end detection function) by using the cursor control keys.

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

c)   Step on the footswitch pedal to clamp the chuck.

No.	MENU	CONDITION	
1	SPINDLE OFF MODE	INVALID	VALID
2	CHUCK DIRECTION	O.D.	I.D.
3	TAILSTOCK ILK.	OFF	ON
4	WORK COUNTER	ST.ILK	BDT
5	MACHINE LOCK	OFF	ON
6	AUX. F. LOCK	OFF	ON
7	CHUCK FOOT SWITCH	VALID	INVALID
8	CHUCK STROKE END	VALID	INVALID

STATUS

○ ERR   ○ MRDY

○ M00/M01   ○ TRCL

○ M02/M30   ○ X ⌐
                    ⊕
● CHCL   ○ Z ⌐

<B-axis>

◎ B-AXIS ZERO POINT

◉ HEADSTOCK 2 CHUCK CLAMP

5) Check if the STATUS indicator **[CHCL]**/the status indicator **[HEADSTOCK 2 CHUCK CLAMP]** is lit or not.

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. The spindle rotation can be started in the manual and automatic operation only when the STATUS indicator **[CHCL]**/the status indicator **[HEADSTOCK 2 CHUCK CLAMP]** 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]**/the status indicator **[HEADSTOCK 2 CHUCK CLAMP]** 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.

📖   Page A-126 (7-7-1)

2) Move the cursor to "CHUCK1 DIRECTION" using the cursor control key ↑ or ↓.

NOTE   For the selection of chuck 2 clamp direction, page 2 of the OPERATION PANEL screen is used. (S type)

<For O.D. chucking>

Press the cursor control key ←.
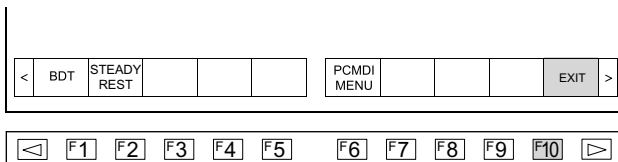
<For I.D. chucking>

Press the cursor control key →.

```
EDIT   ***  ***  ***              0mm/min        O0001  N00001
                           0%     0min-1
OPERATION PANEL (1/2)                        23:58:53  | HEAD1
     No.         MENU              CONDITION
      1   SPINDLE OFF MODE       INVALID   VALID
   ➜  2   CHUCK DIRECTION        O.D.      I.D.
      3   TAILSTOCK ILK.         OFF       ON
      4   WORK COUNTER           ST.ILK    BDT
      5   MACHINE LOCK           OFF       ON
      6   AUX. F. LOCK           OFF       ON
      7   CHUCK FOOT SWITCH      VALID     INVALID
      8   CHUCK STROKE END       VALID     INVALID

   <  BDT                                      EXIT  >
```

<	BDT	STEADY REST				PCMDI MENU			EXIT	>

◁ F1 F2 F3 F4 F5   F6 F7 F8 F9 F10 ▷

3) Press the **[EXIT]** soft-key.

4) Manually perform the chuck clamp/unclamp operation.
   Make sure that the chuck is correctly clamped or unclamped by checking the STATUS indicator **[CHCL]**.

NOTE   For chuck 2, make sure that the chuck is correctly clamped or unclamped by checking the status indicator **[HEADSTOCK 2 CHUCK CLAMP]** on the option panel. (S type)

STATUS

○ ERR   ○ MRDY

○ M00/M01   ○ TRCL

○ M02/M30   ○ X

◉ CHCL   ○ Z

<B-axis (S type)>

◎ B-AXIS ZERO POINT

◎ HEADSTOCK 2 CHUCK CLAMP

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.
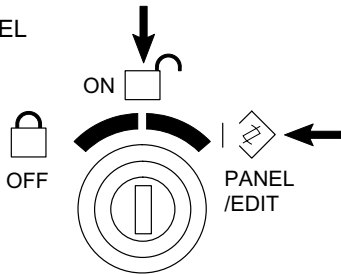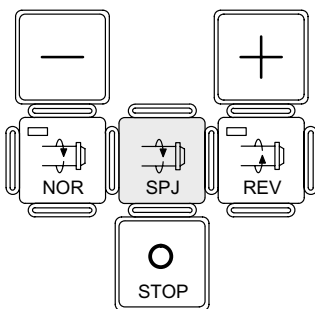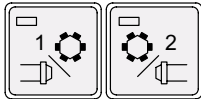
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

3) Place the PANEL key-switch in one of the positions indicated below.
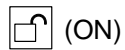
    ⬜ (ON)   ◇ (PANEL/EDIT)

4) Press the HEAD CHANGE switch [1] (head 1) or [2] (head 2) to select the spindle to be rotated. (S type)

5) Press the [SPJ] (SPJ) switch.
    The spindle starts in the normal direction at the jog feedrate.

6) Release the [SPJ] (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.
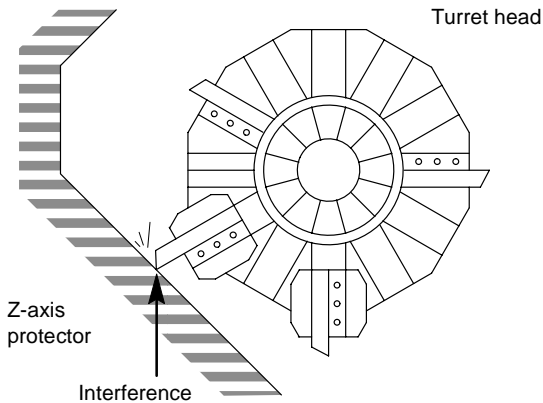
CAUTION   When the turret head is rotated with cutting tools mounted in it, tools with long projection lengths could strike the Z-axis protector (cover or tailstock), etc. Before rotating the turret head, make sure that the tools in the turret head do not interfere with the protector (cover or tailstock), since interference will damage the machine.
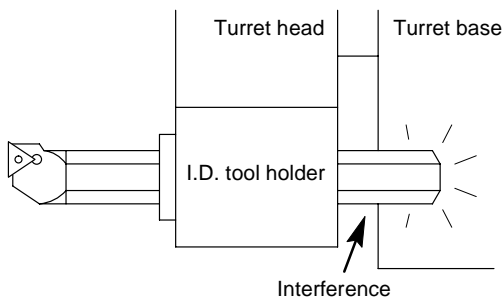
CAUTION   When mounting an I.D. cutting tool in the turret head, make sure that the tool shank does not project beyond the rear surface of the tool holder. If it does it will interfere with the turret base, etc., during turret head rotation, damaging the machine.

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 performing a synchronized tapping operation (MC type).

9. The zero point of the turret indexing servo motor is established.

10. The tailstock is clamped.

11. The zero point of the rotary tool spindle drive servomotor is established (MC type).

12. The B-axis has returned to the zero point (only for turret 2). (S type)

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.
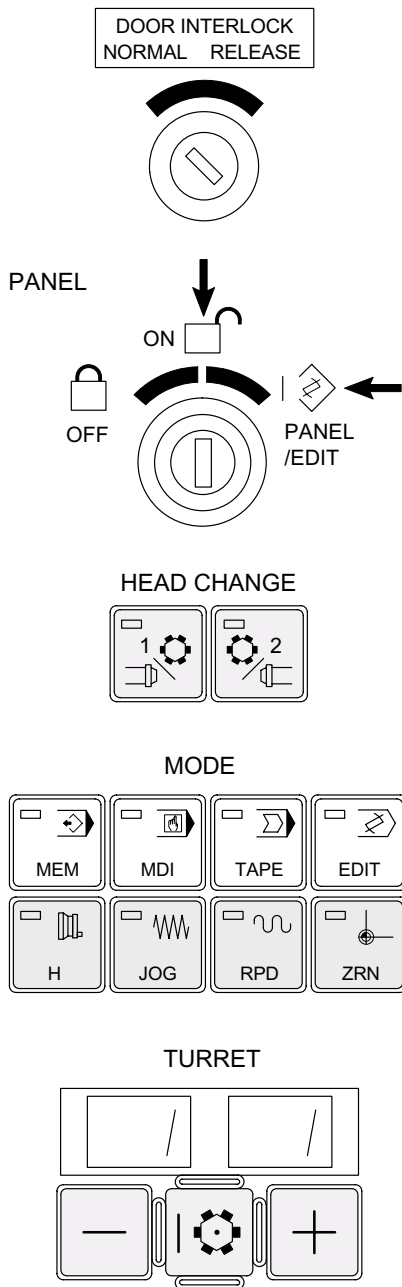
DOOR INTERLOCK
NORMAL   RELEASE

1)   Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2)   Close the front door.

PANEL

ON

OFF

PANEL
/EDIT

3)   Place the PANEL key-switch in one of the positions indicated below.

    (ON)   (PANEL/EDIT)

HEAD CHANGE

1   2

4)   Press the HEAD CHANGE switch (head 1) or (head 2) to select the required turret.

MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN

5)   Select any of the following modes with the MODE selection switch.

    (handle)   (jog)

    (rapid traverse)   (zero return)
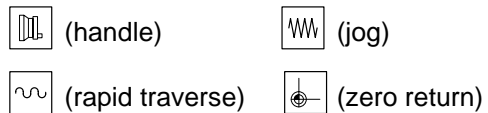
TURRET

6)   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 turret display area.

7) Press the turret indexing switch [I○].

The turret is indexed to the set station number.

If the indexing is completed normally, the station number in the 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 [I○] 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.
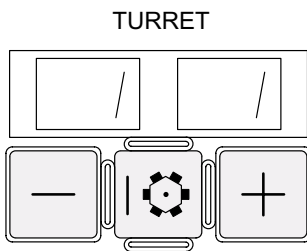
TURRET

1) Press the turret station setting switch [+]

(increase) and the turret indexing switch [I○] 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 [I○] 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.

NOTE It is not possible to index both the turret heads of turret 1 and turret 2 at the same time.

8-3   Designating the Spindle and Turret Combinations

Machining by any combination between the turret and spindle is possible.

Before the execution of machining, it is necessary to designate which of the turrets is used for the designation of a T code and to which of the turrets the designated T code is sent. A T code is used for this designation.

There are four possible combinations between the turret and the spindle as shown below.
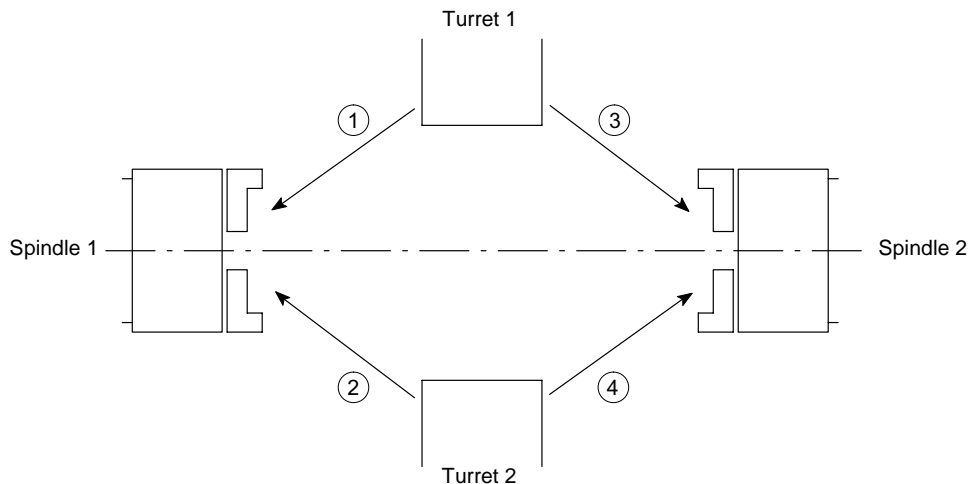
1.   Turret 1 for spindle 1

    T0100 - T1200

    M03 (M04), M13 (M14) (MC type)

2.   Turret 2 for spindle 1

    T0100 - T1200

    M03 (M04), M13 (M14) (MC type)

3.   Turret 1 for spindle 2

    T3100 - T4200

    M203 (M204), M13 (M14) (MC type)

4.   Turret 2 for spindle 2

    T3100 - T4200

    M203 (M204), M13 (M14) (MC type)

If an illegal combination of T and M codes is specified, an alarm occurs and the following error message is displayed.

    EX1321 CUTTING DIRECTION NOT MATCHED

A turret station number is displayed in the range from "1" to "12" and which of the spindles is selected can be known from the T code number displayed on the screen.

9   TURNING ON THE 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 published separately.

The machine light can be operated regardless of the position of the PANEL key-switch and the selected mode.
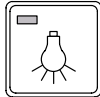
LIGHT
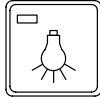
1)   Press the 🔆 (LIGHT) switch on the operation panel.

The machine light is lit; the indicator in the switch also is lit.

LIGHT

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 revolving 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.

Manual mode	Coolant ON		
	ON switch	Press the (ON) switch.	The indicator in the (ON) switch is lit and the coolant supply starts.
	Coolant OFF		
	OFF switch	Press the (OFF) switch while coolant is being supplied.	The indicator in the (ON) switch goes off and the coolant supply stops.
Automatic mode	Coolant ON/OFF		
	M08....	Coolant supply starts when M08 (coolant ON) command is read.	ON switch — The indicator in the (ON) switch is lit.
	OFF switch	Press the (OFF) switch to stop the coolant supply during automatic operation.	ON switch — The indicator in the (ON) switch goes off.
	Coolant OFF mode		
	ON switch	Press and hold the (OFF) switch for one second or more to make the indicator in the (ON) switch blink and coolant OFF mode valid.	M08.... — The coolant is not supplied even when M08 command is read.
	ON switch	Press the (ON) switch. The indicator in the switch is lit and the coolant supply starts.	ON switch OFF switch — The indicator in the (ON) switch remains blinking.

11   CHIP CONVEYOR

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.

CHIP CONVEYOR

| ⇨ FOR | ○ STOP | ⇦ BACK |
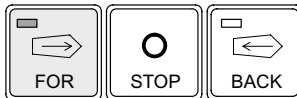
1)   Press the ⇨ (FOR) switch and the chip conveyor operates in the forward direction.
The indicator in the switch is lit.

CHIP CONVEYOR

| ⇨ FOR | ○ STOP | ⇦ BACK |
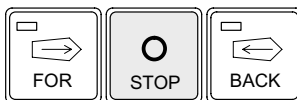
2)   Press the ○ (STOP) switch while the chip conveyor is operating and it stops operating.

CHIP CONVEYOR

| ⇨ FOR | ○ STOP | ⇦ BACK |
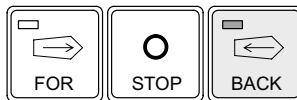
3)   Press the ⇦ (BACK) switch and the chip conveyor operates in the backward direction.

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   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.

WARNING

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.

CAUTION

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.

12-1   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-23 (6-3)

3) Carry out inching operation of the tailstock spindle to hold the workpiece with the tailstock spindle center.

   Page B-51 (12-2)
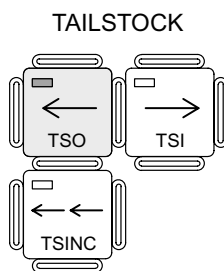
TAILSTOCK

4) Press the $\leftarrow$ (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.

TAILSTOCK

2) Press the $\rightarrow$ (TSI) switch.

   The tailstock spindle moves in and the indicator in the switch is lit.

12-2   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>
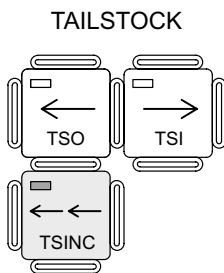
TAILSTOCK

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>
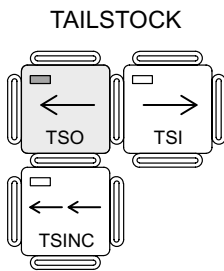
TAILSTOCK

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>
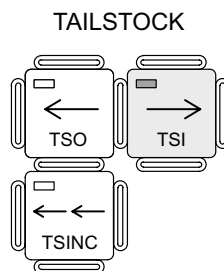
TAILSTOCK

To retract the tailstock spindle into the tailstock body,

press the → (TSI) switch.

12-3   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.

WARNING	**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.**

1) Display the OPERATION PANEL screen.

   Page A-126 (7-7-1)

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.
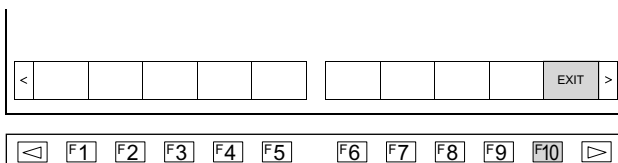
12-4   Fitting the Tailstock Spindle Center

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.
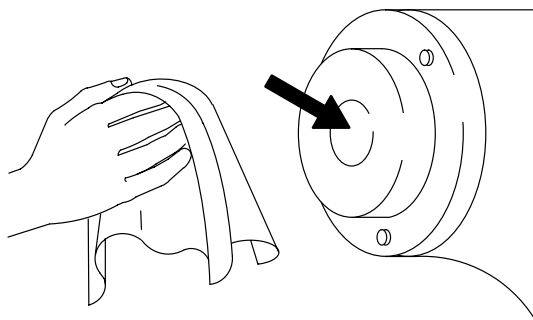
1)   Clean the tapered hole in the tailstock spindle.
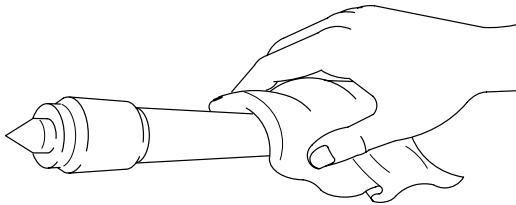
2)   Clean the tapered face of the center.
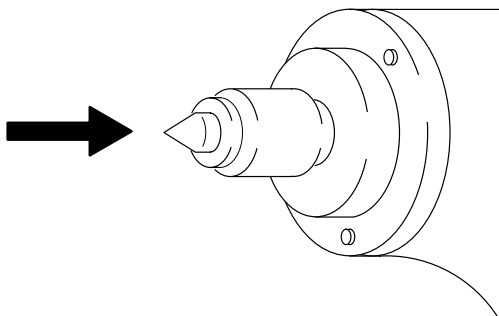
3)   Fit the center into the center hole.

12-5   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

An extraction bar used when removing the center from the tailstock body is fitted inside the tailstock.

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.
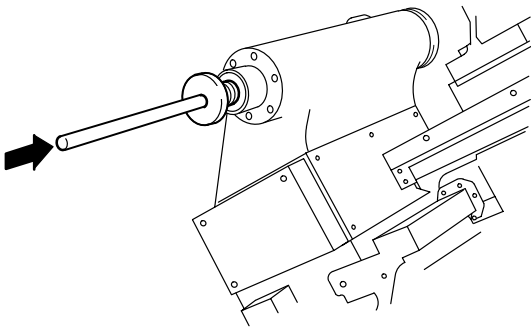
1) Insert a proper bar into the piston stroke adjustment bolt hole at the rear of the tailstock body.
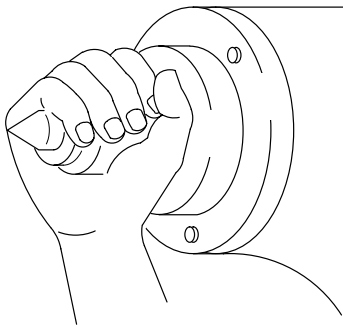
2) Hold the center by hand.
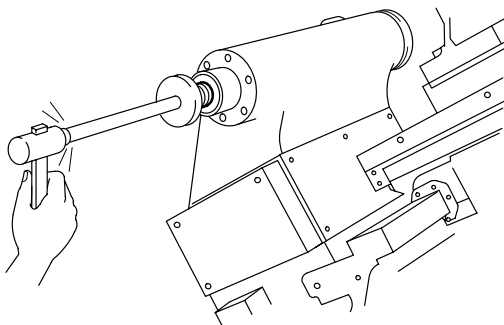
3) Tap the bar to remove the center.

12-6   Adjusting the Tailstock Spindle Stroke

The tailstock spindle retract end position can be adjusted.
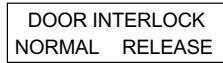
DOOR INTERLOCK
NORMAL   RELEASE
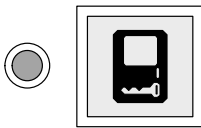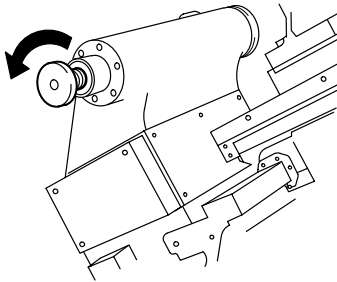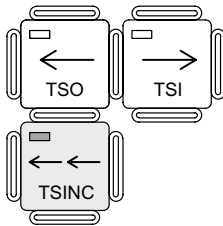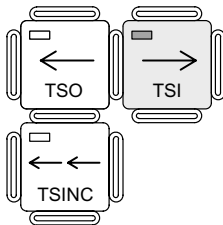
1)   Place the DOOR INTERLOCK key-switch in the
NORMAL position.

DOOR UNLOCK

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.

TAILSTOCK

TSO   TSI

TSINC

3)   Press the (TSINC) switch to move the tailstock
spindle out to the proper position.

4)   Turn the piston stroke adjustment bolt
counterclockwise to loosen it.

TAILSTOCK

TSO   TSI

TSINC

5)   Press the (TSI) switch.

The tailstock spindle moves in the tailstock body.
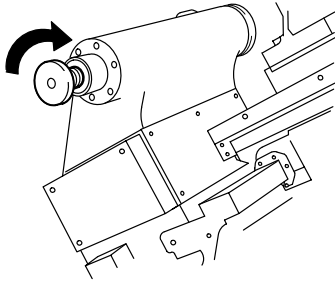
6) Turn the piston stroke adjustment bolt clockwise until the bolt touches the piston end.

TAILSTOCK
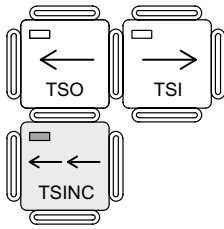
7) Press the ←← (TSINC) switch to move the tailstock spindle out to the proper position.
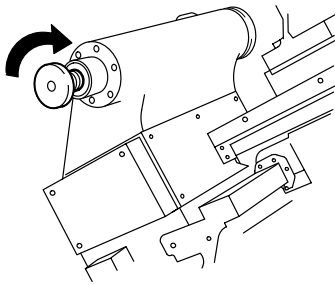
8) Turn the piston stroke adjustment bolt clockwise to advance it to the required piston retract end position.

13   MOVING THE TAILSTOCK BODY

This section explains the tailstock moving operation, which can be moved to an arbitrary position in the tailstock program.

13-1   Cautions when Moving the Tailstock

<Conditions required for unclamping the tailstock>

When unclamping the tailstock, the necessary conditions must be satisfied. If the tailstock cannot be unclamped although the unclamp procedure is correctly followed, check if the following conditions are all satisfied.

1. The spindle or rotary tool spindle (MC type) is not rotating.

2. Turret 1 or turret 2 is not being indexed. (The STATUS indicator **[TRCL]** is lit.)

3. The tailstock spindle is not in the inching state.

4. The tailstock spindle is in the IN position. (The indicator in the $\boxed{\rightarrow}$ (TSI) switch is lit.)

5. The Z-axis is not moving.

6. The protection cover of the tool presetter arm is mounted to the base.

7. The tailstock and saddle 1 are at the joint position.

<Other Conditions>

1. The spindle (rotary tool spindle) cannot be rotated while the tailstock is unclamped.

2. The tailstock spindle cannot be moved out, if the tailstock is unclamped.

3. The tailstock cannot be unclamped while the tailstock spindle is in the OUT position or the inching state.

4. The turret 1 X-axis movement (automatic and manual operation) is not possible while the tailstock is unclamped.

5. The tailstock can be clamped only after the turret 1 Z-axis is positioned in the negative direction.

6. For the manual operation, the tailstock cannot be placed in the tailstock joint mode even when pressing the TSTMOD switch in the handle mode. Once the tailstock is connected to the saddle 1 in other mode, the handle mode can be used to move the tailstock.

13-2   Tailstock Movement by Manual Operation

The procedure for moving the tailstock to the target position using manual operation is described here.

CAUTION Before positioning the saddle 1 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 1 is moved to the joint position. Interference could cause damage to the machine.

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.
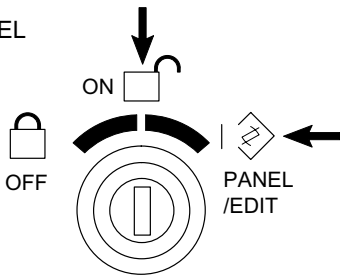
3) Place the PANEL key-switch in one of the positions indicated below.
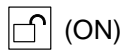
   (ON)   (PANEL/EDIT)
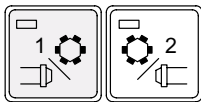
4) Press the HEAD CHANGE switch (head 1) to select turret 1.
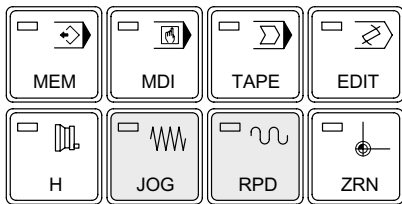
5) Select any of the following modes with the MODE selection switch.
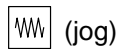
   (jog)   (rapid traverse)
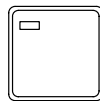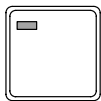
6) Press the TSTMOD switch.
   The indicator in this switch blinks.
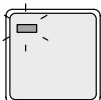
   NOTE If the TSTMOD switch is pressed again while the indicator is blinking, the indicator goes off.

AXIS DIRECTION

TSCLP   TSUCLP

TSTMOD
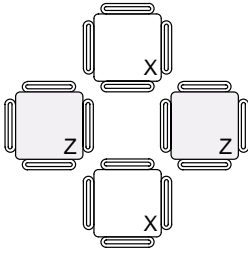
AXIS DIRECTION

7) Press and hold down either the positive or negative direction AXIS DIRECTION switch **Z** (Z) which moves the saddle to the joint position to bring the saddle 1 close to the tailstock with jog feed or rapid traverse operation.

NOTE If the **Z** (Z) switch is released while the saddle 1 is moving, it stops moving. Keep the switch pressed, until the saddle 1 reaches the joint position.

When the saddle 1 reaches near the tailstock, it decelerates and stops.

The indicator in the TSTMOD switch turns to lighting from blinking when the saddle 1 stops.
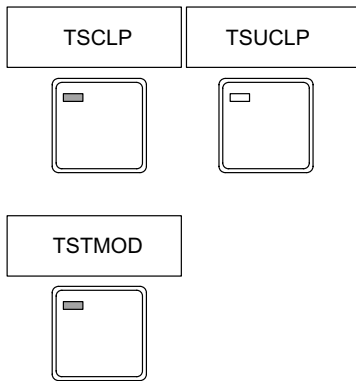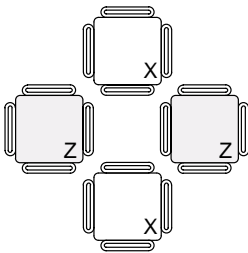
NOTE If the indicator in the TSTMOD switch is not lit after the saddle 1 has stopped, follow the procedure below.

1. Press the negative direction AXIS DIRECTION switch **Z** (Z) to place the saddle 1 away from the tailstock sufficiently.

2. Press the **RESET** (RESET) key.

3. Press the TSTMOD switch again.

   The indicator in this switch blinks.

4. Press and hold down the positive direction AXIS DIRECTION switch **Z** (Z) again until the joint position is reached.
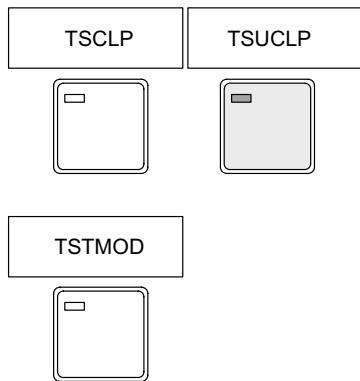
8) Press the TSUCLP switch.

The tailstock is unclamped and the joint pin extends from the tailstock so that it is connected to the saddle 1.

The indicator in the TSCLP switch goes off and the indicator in the TSUCLP switch is lit.
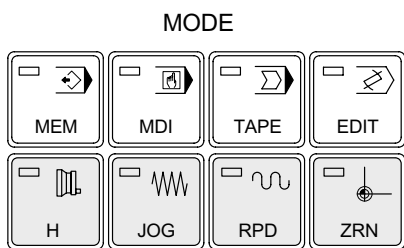
9) Select any of the following modes with the MODE selection switch.

$\boxed{\text{Ⅲ}}$ (handle) $\boxed{\text{WW}}$ (jog)

$\boxed{\sim}$ (rapid traverse) $\boxed{\oplus}$ (zero return)

Once the tailstock is unclamped, the tailstock can be moved by the saddle 1 in any of the above modes.
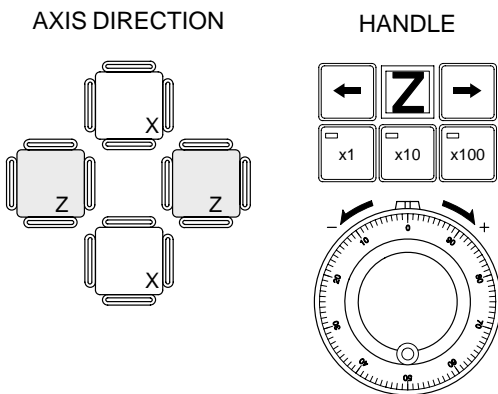
10) Move the tailstock to the required position by moving the Z-axis with zero return, rapid traverse, jog feed, or handle feed operation.

NOTE
When moving the tailstock to the required position, its motion direction for positioning should be only in the negative direction.

If positioning is completed with motion in the positive direction, it will not be possible to perform a clamp operation subsequently.
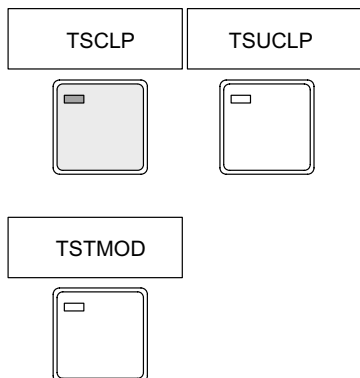
11) Press the TSCLP switch.

The tailstock is clamped; it is disconnected from the saddle 1.

The indicator in the TSUCLP switch goes off and the indicator in the TSCLP switch is lit.

13-3   Tailstock Movement by Automatic Operation

It is possible to move the tailstock using a program. A macro program is used for controlling a series of positioning operation.

NOTE Always close the front door before carrying out this automatic operation.

<Command format>

G479 V ○○ . ;

Target position for positioning
(machine coordinate)

<Processing by macro program>

Program

Macro program

1. Positioning of the saddle 1 (Z-axis) to the position where the saddle 1 can be connected the tailstock.

G479 V ○○ . ;

2. The M79 command (unclamp of tailstock body) is executed.

   The tailstock is unclamped and, at the same time, the joint pin extends from the tailstock to connect it with the saddle 1.

3. Positioning of the tailstock body (Z-axis) to the programmed target position.

   The tailstock body is carried to the position specified by a V command (position defined in the machine coordinate system).

4. The M78 command (clamp of tailstock body) is executed.

   The tailstock is clamped and, at the same time, the joint pin extracts to disconnect the tailstock from the saddle 1.

Exit

NOTE

1. Before moving the tailstock, close the front door.

2. The target position (V command) for positioning must be specified using a coordinate value in the machine coordinate system.

3. For moving the tailstock using the G479 command, the following conditions must be satisfied.

   • The spindle (rotary tool spindle) is stopped.

   • The turret is not rotating.
     (The STATUS indicator TRCL is lit.)

   • The tailstock spindle must be IN.

     (The indicator in the →| (TSI) switch is lit.)

<Machine coordinate>

The coordinate value (V command) used to indicate the target position for positioning should be specified in mm or inches according to the dimensioning unit system of the NC.

<When V is not specified>

G479 ;

In this case, only the positioning of the saddle 1 (Z-axis) is executed to the position where the tailstock can be connected with the saddle 1. Therefore, separate program is necessary for executing the rest of operation such as unclamp, positioning and clamp.

<Program example>

```
            ⋮
            ⋮
G479 ; . . . . . . . . . . . . . . . . . . . . . . . . . . Positioning of the saddle 1 (Z-axis) to the joint position

M79 ; . . . . . . . . . . . . . . . . . . . . . . . . . Unclamp command

G00 Z ◯◯ . ; . . . . . . . . . . . . . . . . . . . . Positioning to the target position

M78 ; . . . . . . . . . . . . . . . . . . . . . . . . . . Clamp command
            ⋮
            ⋮
```

13-4   Interference Check

It is necessary to determine the axis movable range (turret 1 Z-axis) of the tailstock for the operation when it is moved by the saddle 1.

If a command given to move the connected unit causes positioning outside the movable range determined by the NC, an NC alarm is generated and axis motion stops.

Alarm 500   Overtravel exceeding the stored stroke limit in the +Z direction

Alarm 501   Overtravel exceeding the stored stroke limit in the –Z direction

Alarm 506   Overtravel exceeding the stored stroke limit in the +Z direction

Alarm 507   Overtravel exceeding the stored stroke limit in the –Z direction

<Example>

Z-axis − overtravel   Z-axis + overtravel

Connect

Movable range
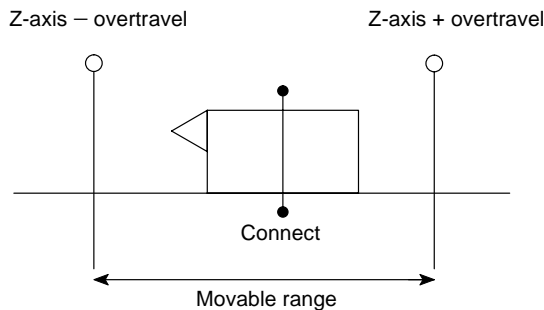
If the alarm 500, 501, 506 or 507 is displayed while the tailstock is moving, reset the alarm using the procedure indicated below.

<To reset 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.

HEAD CHANGE
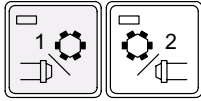
MODE

AXIS DIRECTION   HANDLE

4) Press the HEAD CHANGE switch (head 1) to select turret 1.
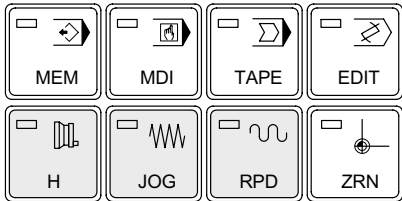
5) Select any of the following modes with the MODE selection switch.

(handle)   (jog)
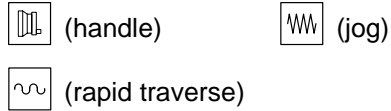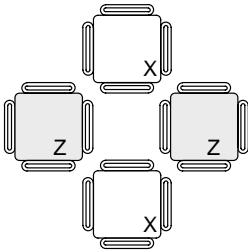
(rapid traverse)
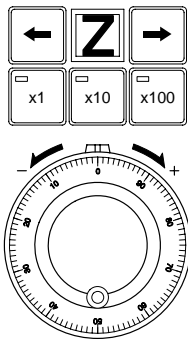
6) Move the Z-axis in the direction opposite to the direction the overtravel alarm has occurred using the AXIS DIRECTION switch or the manual pulse generator.
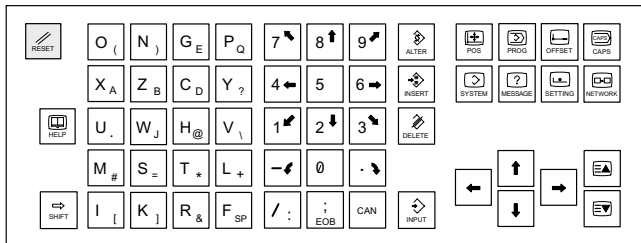
7) Press the (RESET) key.
The alarm state is cleared.

13-5   Store the Clamp Position Data (ZL-153, 203)

The clamp position of the tailstock body is written to the data table (retained if power is turned off) and is updated automatically as the tailstock is moved.

If the memory area is cleared or joint pin operates erroneously to connect the tailstock and the saddle 2, it is necessary to set the clamp position data correctly.

NOTE The clamp position data must be set correctly. If the setting is incorrect, the tailstock cannot be connected with the saddle 2 correctly.

13-5-1   Resetting the Clamp Position Data

The procedure to set the clamp position data, for the tailstock, is indicated below.
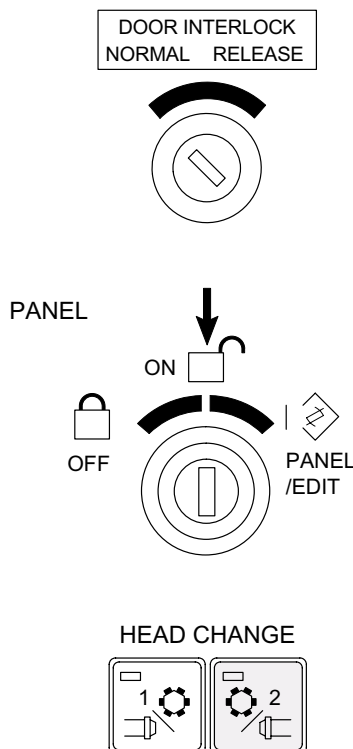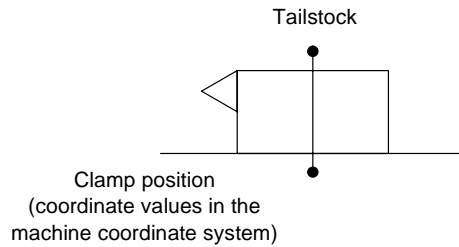
<Example>

Tailstock

Clamp position
(coordinate values in the
machine coordinate system)

DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF

PANEL
/EDIT

3) Place the PANEL key-switch in the (ON) position.

HEAD CHANGE

1   2

4) Press the HEAD CHANGE switch (head 2) to select turret 2.

MODE
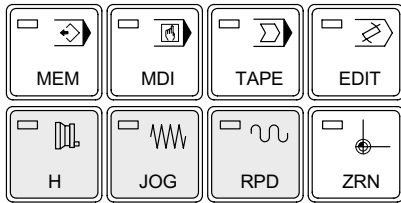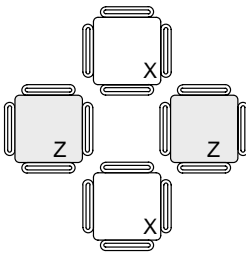
MEM	MDI	TAPE	EDIT
H	JOG	RPD	ZRN

AXIS DIRECTION

HANDLE

← Z →

x1 | x10 | x100

TSCLP | TSUCLP

TSTMOD

5) Select any of the following modes with the MODE selection switch.
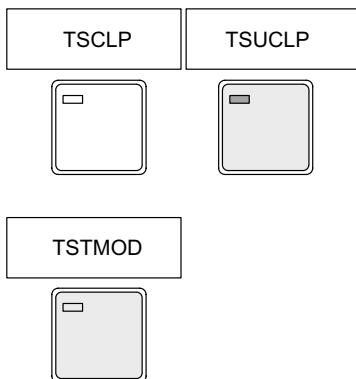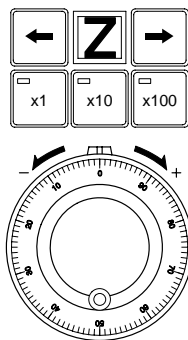
⬛ (handle)   ⎍ (jog)
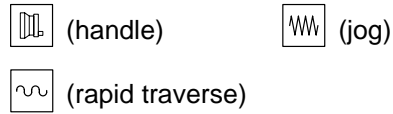
〜 (rapid traverse)

6) Move the saddle 2 to the position where the tailstock can be connected with the saddle 2 by moving the Z-axis with rapid traverse, jog feed, or handle feed operation.

7) Press the TSUCLP switch and the TSTMOD switch simultaneously.

8) Release the TSTMOD switch and then TSUCLP switch in order.

The tailstock is unclamped and the joint pin extends from the tailstock so that it is connected to the saddle 2.

The indicator in the TSUCLP switch is lit.

NOTE If the indicator in the TSUCLP switch is not lit when the above operation is executed, the following message is displayed on the screen.

"EX0380 TAILSTOCK CLAMP/UNCLAMP TIME OVER"

In this case, follow the procedure below.

1. Press the ✎(RESET) key to clear the alarm state.

2. Repeat steps 6) to 8) again.

AXIS DIRECTION

HANDLE

TSCLP   TSUCLP

TSTMOD
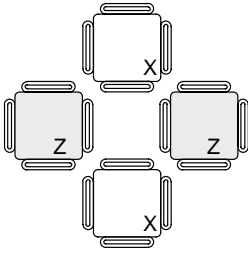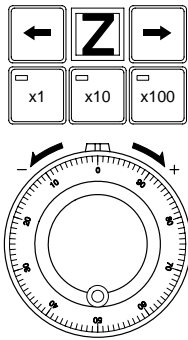
9) After making sure that the indicator in the TSUCLP switch has been lit, move the tailstock to the required position in the selected operation mode (rapid feed, jog feed, handle feed).

NOTE When moving the tailstock to the required position, its motion direction for positioning should be only in the negative direction.

If positioning is made in the positive direction, the tailstock may not operate normally after it is clamped.
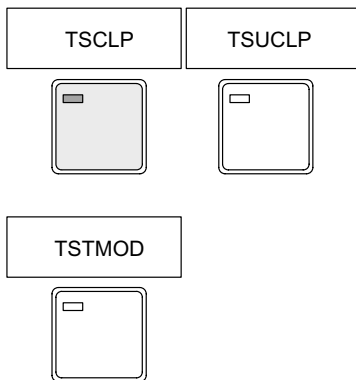
10) Press the TSCLP switch.

The tailstock is clamped; it is disconnected from the saddle 2.

The indicator in the TSUCLP switch goes off and the indicator in the TSCLP switch is lit.

When the tailstock is clamped, the connective position data for storing is automatically updated.

13-6   Tailstock Joint Position Adjustment (ZL-253)

The tailstock joint position is set using a parameter. If the tailstock joint is impossible at the set joint position due to some reasons, the following alarm occurs disabling axis movement.

EX0380 TAILSTOCK CLAMP/UNCLAMP TIME OVER

In this case, adjust the tailstock joint position by following the procedure indicated below.

<Adjustment procedure>
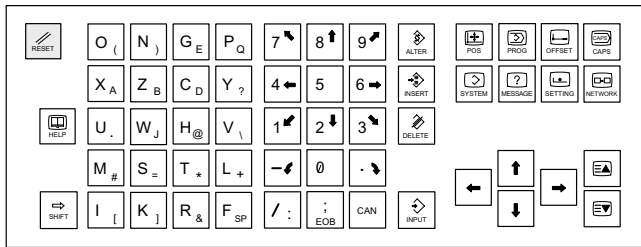
1) Press the ▨ (RESET) key.

The following alarm message is displayed.

EX1324 ADJUST TAILSTOCK JOINT POSITION

HEAD CHANGE
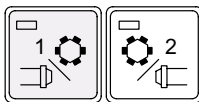
2) Press the HEAD CHANGE switch ▨ (head 1) to select turret 1.

3) Display the OPERATION PANEL screen.

📖   Page A-126 (7-7-1)

4) Set "VALID" for TLSTCK POS. ADJ. using the cursor control keys.

CAUTION ⚠   If "VALID" is set for TLSTCK POS. ADJ., interlocks related with axis movement are all cancelled.

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

MODE

5) Select any of the following modes with the MODE selection switch.

▨ (handle)   ▨ (jog)

▨ (rapid traverse)

AXIS DIRECTION
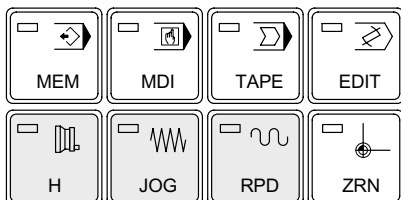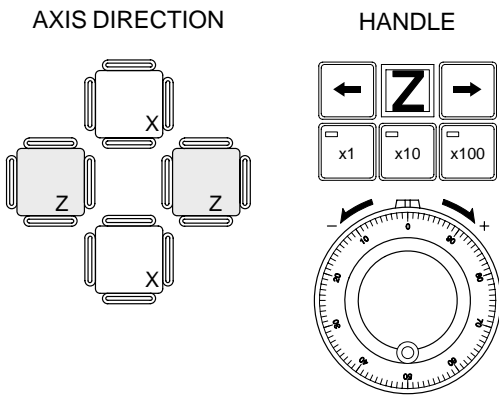
HANDLE

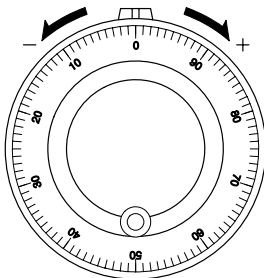6) Move the tailstock to the tailstock joint position by moving the turret 1 Z-axis with rapid traverse, jog feed, or handle feed operation.

**NOTE** For this operation, rapid traverse rate is clamped at $\boxed{\text{⩜}}$ (fine feed) to ensure safety.

Turret 1 — Saddle right side cover

Tailstock

When the tailstock is moved to the position where the scribed line (marker) on the upper face of the tailstock is aligned with the front edge of the saddle right side cover of turret 1, the tailstock is positioned at the joint position.

TSCLP	TSUCLP

TSTMOD
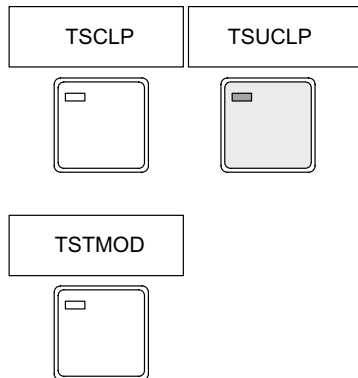
7) Press the TSUCLP switch.

The tailstock is unclamped and the joint pin extends from the tailstock so that it is connected to the saddle 1.

The indicator in the TSUCLP switch is lit.

NOTE When the tailstock is connected to the saddle 1, the setting for "TLSTCK POS. ADJ." on the OPERATION PANEL screen is automatically returned from "VALID" to "INVALID".

13-7   Turret 1 Z-axis Zero Point Adjustment (ZL-253)

If it becomes necessary to adjust the zero point of turret 1 Z-axis due to the occurrence of trouble or other reasons, the tailstock joint position cannot be established, either. In this case, establish the tailstock joint position by following the procedure indicated below.

 CAUTION   If it becomes necessary to adjust the zero point of turret 1 Z-axis, always establish the tailstock joint position by following the procedure indicated below. If an axis is moved before establishing the tailstock joint position, the tailstock might be hit against the turret causing damage to the machine.
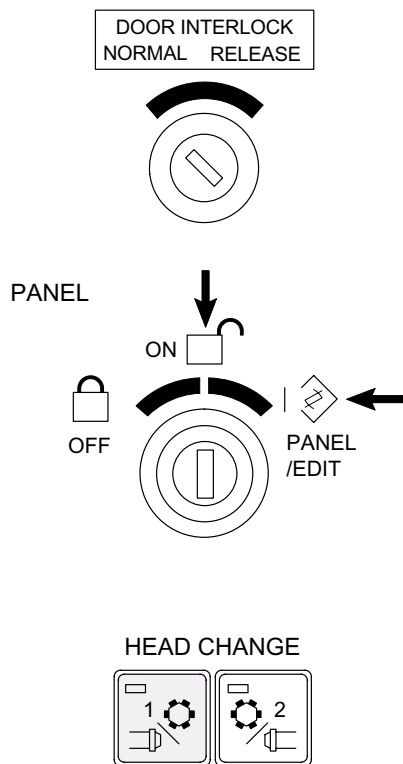
<Adjustment procedure>

DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF

PANEL
/EDIT

3) Place the PANEL key-switch in one of the positions indicated below.

    (ON)   (PANEL/EDIT)

HEAD CHANGE

1   2

4) Press the HEAD CHANGE switch   (head 1) to select turret 1.

5) Display the OPERATION PANEL screen.

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6) Set "VALID" for ZERO POINT SET using the cursor control keys.

MODE

AXIS DIRECTION   HANDLE
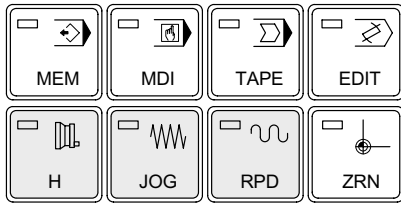
MODE
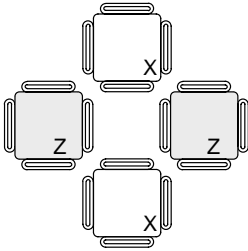
7) Select any of the following modes with the MODE selection switch.
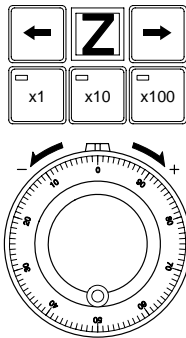
⊞ (handle)   ⋙ (jog)
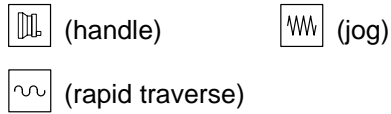
∿ (rapid traverse)

8) Move the Z-axis near the center of the travel in rapid traverse, jog feed, or handle feed operation.

NOTE For this operation, rapid traverse rate is clamped at ⋙ (fine feed) to ensure safety.

CAUTION If "VALID" is set for ZERO POINT 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 tailstock or the cover causing damage to the machine.
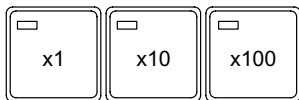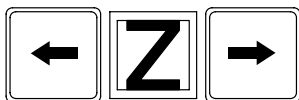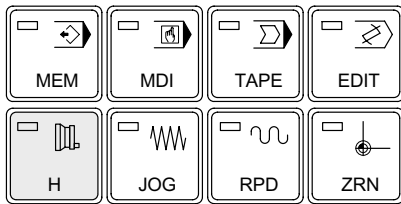
9) Select the handle mode (⊞) with the MODE selection switch.

10) Select the Z-axis with the axis selection switch.

11) Set the feed amount per pulse using the axis feed amount selection switch.

12) Move the turret 1 Z-axis to the tailstock joint position by using the manual pulse generator.
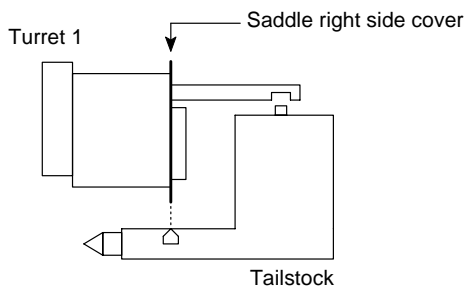
When the tailstock is moved to the position where the scribed line (marker) on the upper face of the tailstock is aligned with the front edge of the saddle right side cover of turret 1, the tailstock is positioned at the joint position.
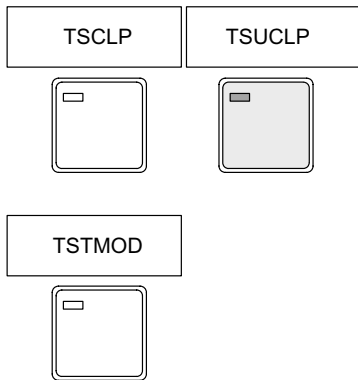
13) Press the TSUCLP switch.

The tailstock is unclamped and the joint pin extends from the tailstock so that it is connected to the saddle.

The indicator in the TSUCLP switch is lit.
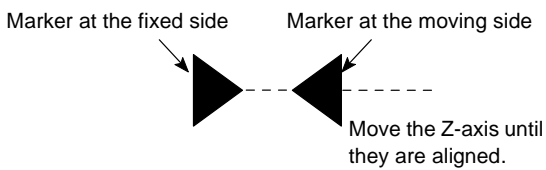
14) By turning the manual pulse generator, move the turret 1 Z-axis until the marker at the moving side is correctly aligned with the marker at the fixed side, which indicates the near zero point.

NOTE The marker is provided for each of the axes.
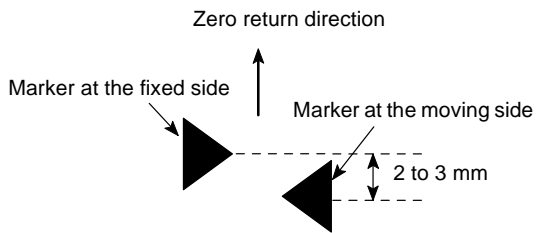
15) Move the turret 1 Z-axis 2 to 3 mm (approximately a half of ball screw lead) in the direction opposite to the zero return direction by turning the manual pulse generator.
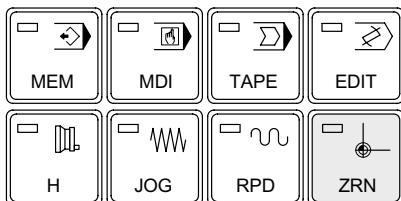
16) Select the zero return mode (⊕—) with the MODE selection switch.

AXIS DIRECTION

X

Z   Z

X
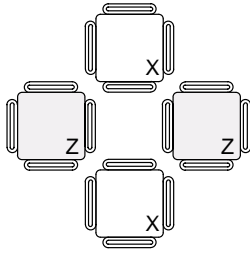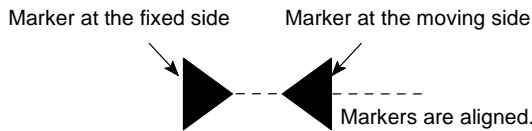
17) Press and hold the AXIS DIRECTION switch of Z-axis zero return.

As the axis approaches the zero point at the rapid traverse rate, it decelerates automatically and stops at the zero point.

NOTE Zero return must be carried out only after unclamping the tailstock.

Axis movement is not possible in the zero return mode unless the tailstock has been unclamped.

STATUS

○ ERR   ○ MRDY

○ M00/M01   ○ TRCL

○ M02/M30   ○ X ⌐

              ⊕

○ CHC   ● Z ⌐

The STATUS indicator **[Z]** is lit when the turret 1 Z-axis has been returned to the zero point.

Marker at the fixed side   Marker at the moving side

Markers are aligned.

The markers at the fixed side and the moving side are aligned.
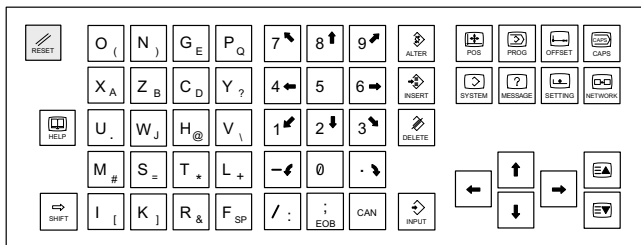
18) Press the [RESET] key.

The alarm message prompting zero return is cleared and the setting for ZERO POINT ADJ. on the OPERATION PANEL screen is automatically returned to "INVALID".

NOTE The markers give only approximate zero point position. Check to be sure that the zero point is at the correct position after the completion of zero return operation by referring to the axis travel diagram.

📖 The axis travel diagram is included in the DRAWINGS provided separately.
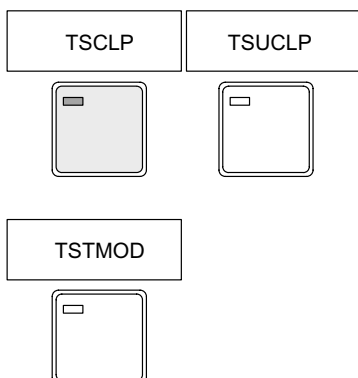
19) Press the TSCLP switch.

The tailstock is clamped; it is disconnected from the saddle.

The indicator in the TSCLP switch is lit.

The tailstock joint position is established.

TSCLP   TSUCLP

TSTMOD

13-8   PC Parameters Related with Tailstock

This section deals with the PC parameters related with the tailstock.

> **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.**

Name	Description
Tailstock clamp	1: Clamp is enabled after turret 1 Z-axis movement in the positive direction (manual mode) 0: Clamp is disabled after turret 1 Z-axis movement in the positive direction (manual mode) **NOTE** Standard setting is "0".
Rapid override while tailstock is unclamped	1: Rapid override is 25% or lower while tailstock is unclamped. 0: Rapid override is 50% or lower while tailstock is unclamped. **NOTE** Standard setting is "0".
Manual rapid traverse rate while tailstock is unclamped	1: Manual rapid traverse rate is fixed at fine feed while tailstock is unclamped. 0: Manual rapid traverse rate while tailstock is unclamped is set according to the rapid override while tailstock is unclamped. **NOTE** Standard setting is "0".
Tailstock feed deceleration switch	1: Tailstock feed deceleration switch is not used. 0: Tailstock feed deceleration switch is used. **NOTE** Standard setting is "0".

13-9   Alarms Related with Tailstock

This section deals with the alarms related with the tailstock.

NOTE If the alarm cannot be cleared even when the specified measures are taken, contact Mori Seiki.

Error Code	Error Message	Contents of Alarm and Action to Take
EX0380	TAILSTOCK CLAMP/ UNCLAMP TIME OVER	Tailstock clamp/unclamp operation has not completed within the preset length of time.
EX0381	TAILSTOCK CLAMP SIGNAL OFF	The clamp check signal is turned off while the tailstock is clamped.
EX0396	TAILSTOCK DECELERATION SW ERROR	The tailstock feed deceleration switch is not turned on although the tailstock has reached the joint position.
EX0398	Z-AXIS POSITION IMPERFECT	The positioning travel is short, after the tailstocks connected to the saddle. Move the tailstock by the manual operation.
EX1310	IMPROPER CONNECTION POSITION	This alarm is generated if the tailstock unclamp command is specified while the tailstock is not at the joint enabled position. If this alarm is generated, move the tailstock to the joint enabled position.
EX1324	ADJUST TAILSTOCK JOINT POSITION	The tailstock joint position is offset. Adjust the tailstock joint position.

14   ROTARY TOOLS (MC TYPE)

The procedure used for registering a rotary tool for the MC type, and for C-axis operation, is explained below.

<S type>

CAUTION ⚠

1. When a rotary tool spindle is selected manually or when spindle clamp operation is carried out manually, selection of a rotary tool spindle or spindle clamp is made for both spindle 1 and spindle 2.
   Concerning the chuck interlock, however, it is valid only for the spindle selected by the HEAD CHANGE switches. Since the chuck interlock is invalid for the spindle not selected by these switches, use only the selected spindle for the operation that uses a rotary tool.

   If rotary tool is used at the spindle not selected with the HEAD CHANGE switches, the workpiece may come out of the chuck and cause damage to the machine.

2. When the following M codes are specified in a block, the chuck interlock is valid only for the spindle related to the M code specified last.

   M45 . . . . spindle 1 side C-axis clamp
   M245 . . . . . . spindle 2 side C-axis clamp
   M68 . . . . spindle 1 side spindle brake clamp
   M268 . . . . . . spindle 2 side spindle brake clamp

   Since the chuck interlock is invalid for the spindle related with other specified M codes, the rotary tool must be used only for the spindle related to the M code specified last.
   If a rotary tool is used at the spindle other than the one for which the last M code was specified, the workpiece may come out of the chuck and cause damage to the machine

3. If operation mode is returned to automatic after manual operation for rotary tool spindle selection or spindle clamp with spindle 1 or spindle 2 selected by the

   HEAD CHANGE switch [⬚] (head 1) or [⬚] (head 2), the chuck interlock becomes valid only for the spindle related to the M code specified last in automatic mode.

   Since the chuck interlock is invalid for the spindle selected in the manual mode, the rotary tool must be used only for the spindle related to the M code specified last in the automatic mode.
   If a rotary tool is used at the spindle other than the one for which the last M code was specified in the automatic mode, the workpiece may come out of the chuck and cause damage to the machine.

14-1   Registering Rotary Tools

Display the ROTARY TOOL screen and register the tool type (O.D. cutting or face milling) before mounting a rotary tool in the turret.

CAUTION
⚠️ 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 damage the tool and the machine.
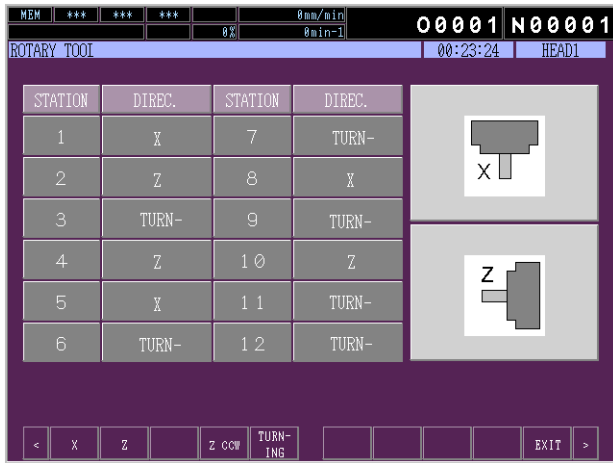
1) Display the ROTARY TOOL screen.

📖 Page A-128 (7-7-2)

2) Move the cursor to the station number where a rotary tool is mounted.

MEM	***	***	***	0mm/min			
			0%	0min-1	O0001 N00001		

ROTARY TOOL   00:23:24   HEAD1

STATION	DIREC.	STATION	DIREC.
1	X	7	TURN-
2	Z	8	X
3	TURN-	9	TURN-
4	Z	10	Z
5	X	11	TURN-
6	TURN-	12	TURN-

| < | X | Z | | Z CCW | TURN-ING | | | | | EXIT | > |
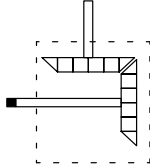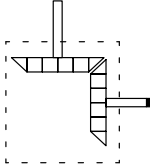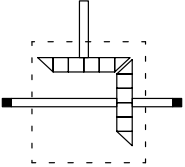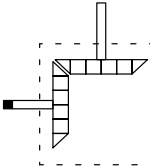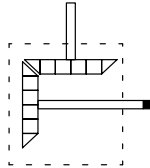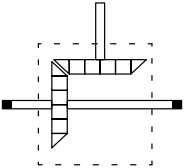
3) Register a rotary tool using the soft-keys.

Soft-keys	Contents
[X]	When this soft-key is pressed, "X" is displayed in the "DIREC." column in the screen and the rotary tool for O.D. cutting is registered.
	🔵**NOTE** With the rotary tool offset holder for O.D. cutting, rotating direction is reversed from ordinary rotary tool for O.D. cutting. For tool registration, the same setting as the rotary tool for face milling must be registered.
[Z]	When this soft-key is pressed, "Z" is displayed in the "DIREC." column in the screen and the rotary tool for face milling or back-face milling is registered. With this tool holder, the tool rotates in the opposite direction of a rotary tool spindle motor.
[Z CCW]	When this soft-key is pressed, "Z CCW" is displayed in the "DIREC." column in the screen and the rotary tool for face milling or back-face milling is registered. With this tool holder, the tool rotates in the same direction of a rotary tool spindle motor.
[TURNING]	When this soft-key is pressed, "TURNING" is displayed in the "DIREC." column in the screen and the turning tool is registered. If the rotary tool is not used, register the turning tool.

🔵**NOTE** If the command specifies the rotary tool spindle rotation (M13 or M14) is executed with the turning tool registered, the alarm (EX4415) occurs and the rotary tool does not rotate.

<For setting the rotary tool holder in Z-axis direction>

Setting	Face Milling	Back-face Milling	Both Face Milling
Rotary tool spindle rotates in the direction opposite to motor rotation direction. Set "Z".			
Rotary tool spindle rotates in the same direction as motor rotation direction. Set "Z CCW".			

14-2   Spindle Selection

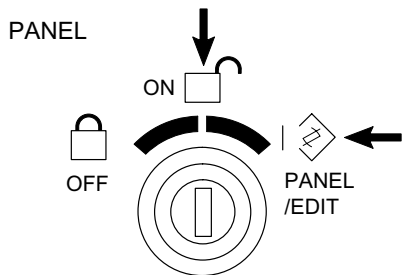The rotary tool specification machine requires the selection of the spindle mode (main spindle or rotary tool spindle).

NOTE While the spindle is rotating, it is not allowed to change the spindle 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)
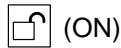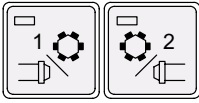
HEAD CHANGE

4) Select the spindle (spindle 1 side or spindle 2 side) to be operated by the HEAD CHANGE switch (head 1) or (head 2). (S type)

NOTE It is not possible to select spindle 1 or spindle 2 in the state the rotary tool spindle has been selected. For the selection of spindle 1 or spindle 2, press the (SP) switch to select the main spindle and then select spindle 1 or spindle 2 by the HEAD CHANGE switch (head 1) or (head 2).
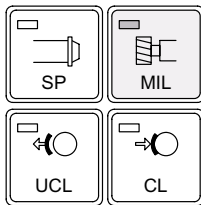
MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN

5) Select any of the following modes with the MODE selection switch.

(handle)   (jog)

(rapid traverse)   (zero return)

MILLING

SP   MIL

UCL   CL
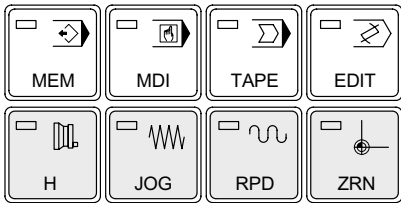
6) Select the main spindle or rotary tool spindle.

<Rotary tool spindle>

Press the (MIL) switch.

The rotary tool spindle is selected.
The indicator in the switch is lit.

MILLING

SP   MIL

UCL   CL

<Main spindle>

Press the (SP) switch.

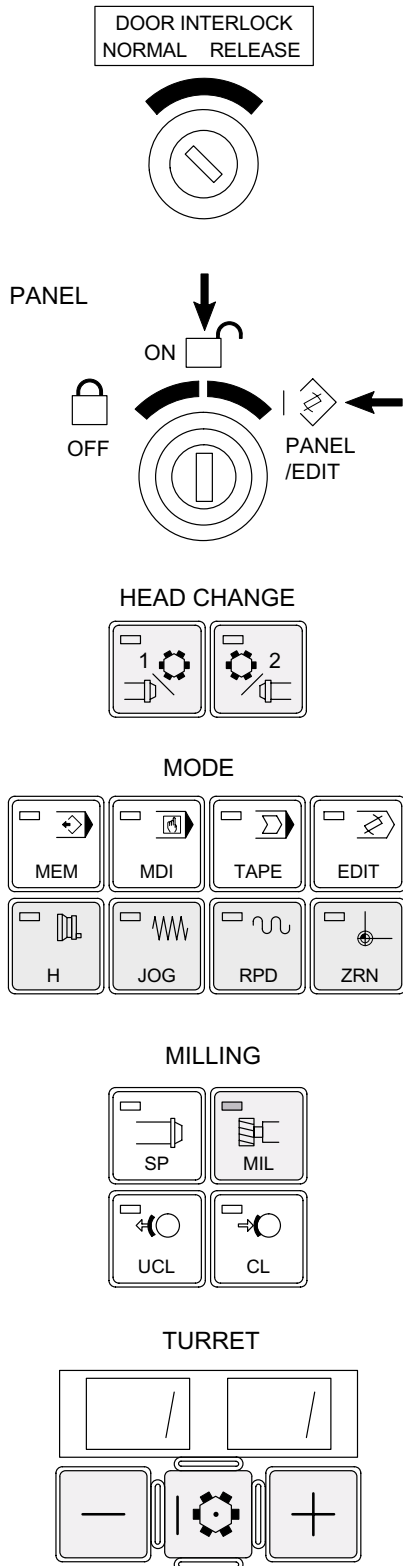The main spindle is selected.
The indicator in the switch is lit.
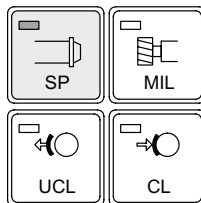
14-3   Starting and Stopping Rotary Tool Spindle

The procedures for starting and stopping rotary tool spindle rotation in manual operation are described here.

<Starting the rotary tool spindle>

DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF

PANEL /EDIT

3) Place the PANEL key-switch in one of the positions indicated below.

⌐⌐ (ON)   ⌐⌐ (PANEL/EDIT)

HEAD CHANGE

1   2

4) Select the spindle (spindle 1 side or spindle 2 side) to be operated by the HEAD CHANGE switch (head 1) or (head 2). (S type)

MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN

5) Select any of the following modes with the MODE selection switch.

⌐⌐ (handle)   ⌐⌐ (jog)

⌐⌐ (rapid traverse)   ⌐⌐ (zero return)

MILLING

SP   MIL

UCL   CL

6) Press the (MIL) switch to select the rotary tool spindle.

TURRET

/   /

—   ⌖   +

7) Index the turret station number where a rotary tool is mounted using the turret indexing operation.
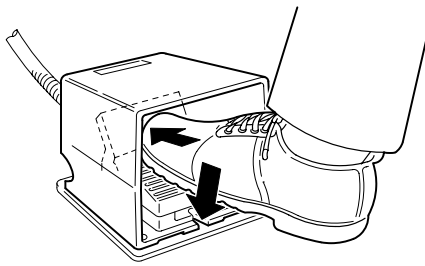
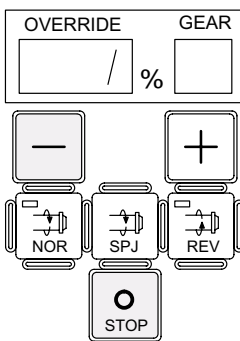8) Step on the footswitch to set the chuck in the clamped state.

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STATUS

○ ERR   ○ MRDY

○ M00/M01   ○ TRCL

○ M02/M30   ○ X

● CHCL   ○ Z

The STATUS indicator **[CHCL]** is lit.

NOTE When spindle 2 side is selected in step 4), the status indicator **[HEADSTOCK 2 CHUCK CLAMP]** on the option panel is lit.

SPINDLE

OVERRIDE   GEAR

/ %

—   +

NOR   SPJ   REV

○
STOP

9) Set the minimum rotary tool spindle speed (1% of the maximum rotary tool spindle speed) by pressing the spindle speed setting switch $\boxed{-}$ (decrease) and the $\boxed{○}$ (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 rotary tool spindle speed using the spindle speed setting switch $\boxed{-}$ (decrease) and the $\boxed{○}$ (STOP) switch. After starting the rotary tool spindle, increase the rotary tool spindle speed to the required speed gradually.
When stopping the rotary tool spindle, first lower the rotary tool 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.
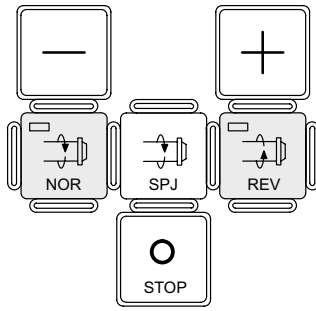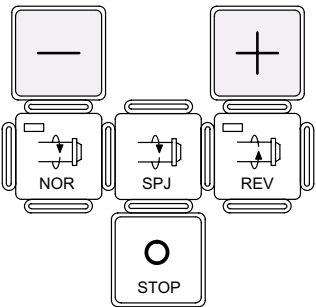
10) Start the rotary tool spindle.

<Normal direction>

Press the ⊡ (NOR) switch.

<Reverse direction>

Press the ⊡ (REV) switch.

11) Increase the rotary tool spindle speed gradually to the required speed.

<Spindle speed setting switch │−│ (decrease)>

The override value decreases in units of 1%.
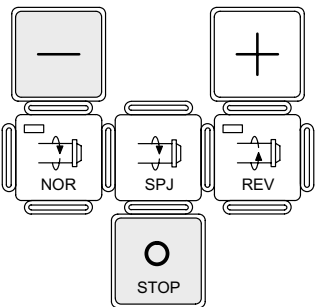
**<Spindle speed setting switch │+│ (increase)>**

The override value increases in units of 1%.

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<Stopping the rotary tool spindle>

1) Decrease the rotary tool spindle speed gradually to the lowest speed with the spindle speed setting switch │−│ (decrease).

2) Press the │○│ (STOP) switch.

NOTE
1. To change the rotary tool spindle rotating direction, stop the rotary tool spindle once by pressing the │○│ (STOP) switch before selecting a new rotating direction.

2. If turret 2 is selected by pressing the HEAD CHANGE switch (head 2) while the rotary tool spindle is rotating, the rotary tool spindle does not stop.

14-4   Spindle Clamp/Unclamp Operation

While the rotary tool spindle is selected, the spindle can be clamped and unclamped manually.

NOTE Spindle clamp/unclamp operation is not possible while the spindle is rotating, the rotary tool spindle is rotating, or the C-axis is being indexed.
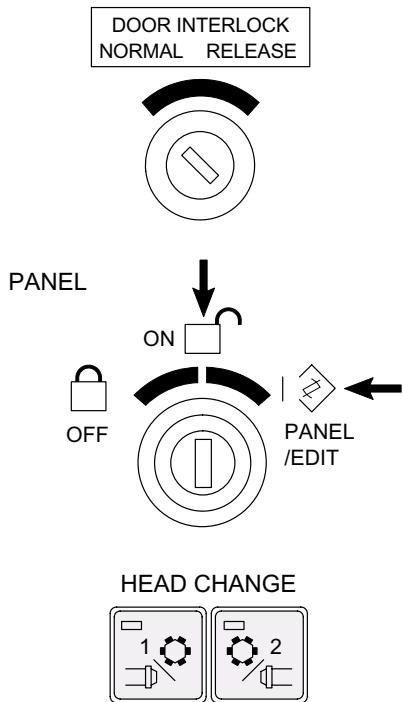
DOOR INTERLOCK
NORMAL   RELEASE

PANEL

ON

OFF   PANEL
/EDIT

HEAD CHANGE

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 spindle (spindle 1 side or spindle 2 side) to be operated by the HEAD CHANGE switch (head 1) or (head 2). (S type)

NOTE It is not possible to select spindle 1 or spindle 2 in the state the spindle has been clamped.
For the selection of spindle 1 or spindle 2, press the (UCL) switch to unclamp the main spindle and then select spindle 1 or spindle 2 by the HEAD CHANGE switch (head 1) or (head 2).

MODE

| MEM | MDI | TAPE | EDIT |
| H | JOG | RPD | ZRN |

5) Select any of the following modes with the MODE selection switch.

   (handle)   (jog)

   (rapid traverse) (zero return)

MILLING

MILLING
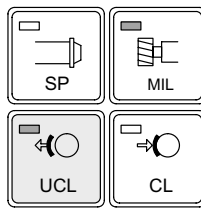
6)   Clamp or unclamp the spindle.

\<Clamp\>

Press the ⬚ (CL) switch.

The spindle is clamped.
The indicator in the switch is lit.

\<Unclamp\>

Press the ⬚ (UCL) switch.
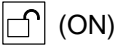
The spindle is unclamped.
The indicator in the switch is lit.

14-5   C-axis Zero Return Operation

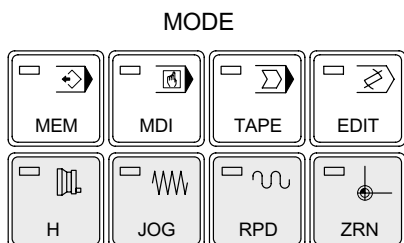While the rotary tool spindle is selected, the C-axis can be returned to the zero point.
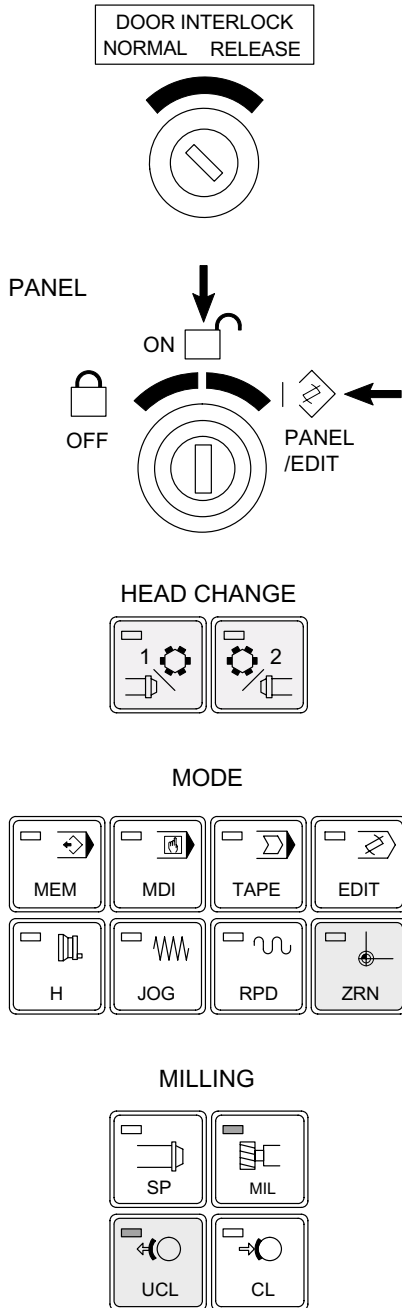
1)   Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2)   Close the front door.

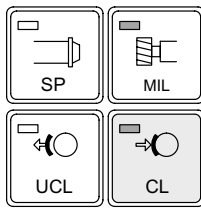3)   Place the PANEL key-switch in one of the positions indicated below.

  ⬜ (ON)   ⬜ (PANEL/EDIT)

4)   Select the spindle (spindle 1 side or spindle 2 side) to be operated by the HEAD CHANGE switch (head 1) or (head 2). (S type)

5)   Select the zero return mode (⊕─) with the MODE selection switch.

6)   Press the ◄○ (UCL) switch.
     The spindle is unclamped.

DOOR INTERLOCK
NORMAL   RELEASE

PANEL

ON

OFF

PANEL
/EDIT

HEAD CHANGE

1   2

MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN

MILLING

SP   MIL

UCL   CL
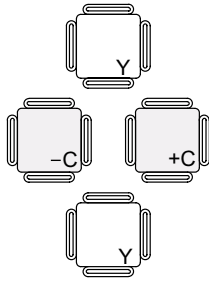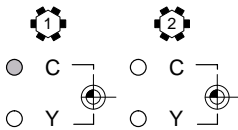
AXIS DIRECTION

7) Press and hold one of the following AXIS DIRECTION switches.

$\boxed{+C}$ (+C) $\boxed{-C}$ (−C)

NOTE The zero return operation of C-axis is executed at the rapid traverse rate of 100% setting independent of setting of RAPID OVERRIDE switches.

STATUS

The STATUS indicator **[C]** is lit when the C-axis has been returned to the zero point.

14-6   C-axis Rapid Traverse Operation

While the rotary tool spindle is selected, the C-axis can be fed with set rapid traverse rate.

DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL
ON
OFF
PANEL /EDIT

3) Place the PANEL key-switch in one of the positions indicated below.

$\boxed{}$ (ON) $\boxed{}$ (PANEL/EDIT)

HEAD CHANGE

4) Select the spindle (spindle 1 side or spindle 2 side) to be operated by the HEAD CHANGE switch $\boxed{}$ (head 1) or $\boxed{}$ (head 2). (S type)

MODE

MEM	MDI	TAPE	EDIT
H	JOG	RPD	ZRN

5) Select the rapid traverse mode ($\boxed{\sim\!\sim}$) with the MODE selection switch.

MILLING

SP   MIL

UCL   CL

RAPID OVERRIDE

/WW   25%   100%

AXIS DIRECTION

Y

−C   +C

Y
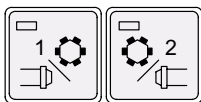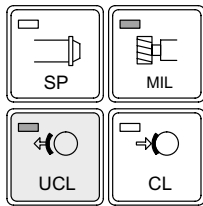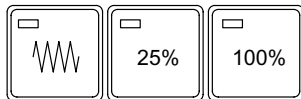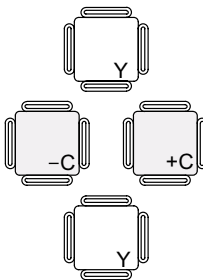
6)   Press the ◄○ (UCL) switch.

The spindle is unclamped.

7)   Set the feedrate to be used for rapid traverse
operation using the RAPID OVERRIDE switches.

NOTE   For manual operation, the maximum allowable

override value is 50%. Therefore, if the 100%

(100%) switch is pressed, the override value is
50%.

The feedrate set for rapid traverse operation using
the RAPID OVERRIDE switches varies depending
on the machine model and specifications.

8)   Move the C-axis.

**<Counterclockwise rotation, viewing the
workpiece from the spindle side>**

Press the +C (+C) switch.

NOTE   In the case of spindle 2, press the −C (−C)
switch. (S type)

**<Clockwise rotation, viewing the workpiece from
the spindle side>**

Press the −C (−C) switch.

NOTE   In the case of spindle 2, press the +C (+C)
switch. (S type)

The C-axis moves at the set rapid traverse rate.

14-7   C-axis Jog Feed Operation

While the rotary tool spindle is selected, the C-axis can be fed with set jog feedrate.

DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF

PANEL
/EDIT

3) Place the PANEL key-switch in one of the positions indicated below.

⌐ (ON)   ⌐ (PANEL/EDIT)

HEAD CHANGE

1   2

4) Select the spindle (spindle 1 side or spindle 2 side) to be operated by the HEAD CHANGE switch (head 1) or (head 2). (S type)

MODE

| MEM | MDI | TAPE | EDIT |
| H | JOG | RPD | ZRN |

5) Select the jog mode (WW) with the MODE selection switch.

MILLING

| SP | MIL |
| UCL | CL |

6) Press the (UCL) switch.
   The spindle is unclamped.

OVERRIDE

50   100

0   150
       %

7) Set the feedrate to be used for jog feed operation using the OVERRIDE dial.

Setting is possible in 15 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

AXIS DIRECTION
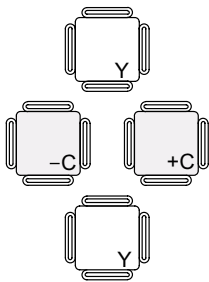
8) Move the C-axis.

<Counterclockwise rotation, viewing the workpiece from the spindle side>

Press the `+C` (+C) switch.

NOTE In the case of spindle 2, press the `-C` (−C) switch. (S type)

<Clockwise rotation, viewing the workpiece from the spindle side>

Press the `-C` (−C) switch.

NOTE In the case of spindle 2, press the `+C` (+C) switch. (S type)

The C-axis moves at the set jog feedrate.

14-8   C-axis Handle Feed Operation

While the rotary tool spindle is selected, the C-axis can be fed with set feedrate using the manual pulse generator.
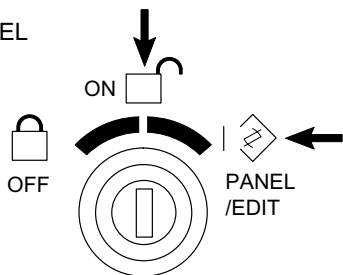
DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF   PANEL
             /EDIT

3) Place the PANEL key-switch in one of the positions indicated below.
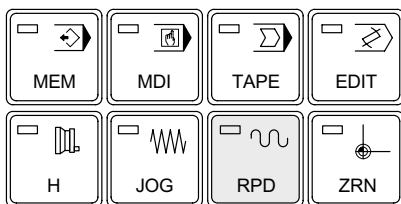
(ON)   (PANEL/EDIT)

HEAD CHANGE

4) Select the spindle (spindle 1 side or spindle 2 side) to be operated by the HEAD CHANGE switch ⬚ (head 1) or ⬚ (head 2). (S type)

MODE

MEM	MDI	TAPE	EDIT
H	JOG	RPD	ZRN

5) Select the handle mode (⬚) with the MODE selection switch.

← **C** →
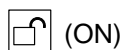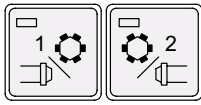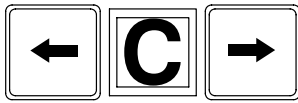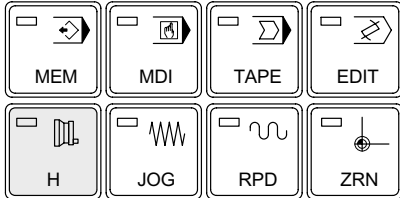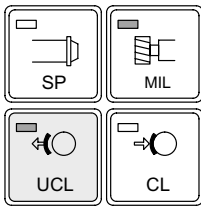
6) Select the C-axis with the axis selection switch.

MILLING

SP	MIL
UCL	CL

7) Press the ⬚ (UCL) switch.
The spindle is unclamped.

x1	x10	x100

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.

NOTE In the case of spindle 2, turn the pulse handle counterclockwise. (S type)

<Clockwise rotation, viewing the workpiece from the spindle side>

Turn the manual pulse generator counterclockwise.

NOTE In the case of spindle 2, turn the pulse handle clockwise. (S type)

The C-axis moves at the selected speed.

14-9   C-axis Zero Return Operation in MDI Mode

The procedure for returning the C-axis to the zero point using MDI operation is described here.
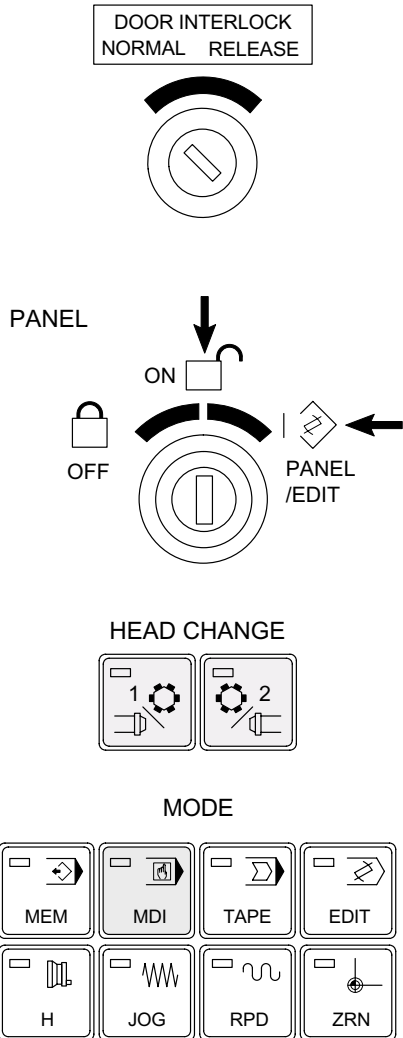
DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF

PANEL
/EDIT

3) Place the PANEL key-switch in one of the positions indicated below.

    (ON)   (PANEL/EDIT)

HEAD CHANGE

1   2

4) Select the spindle (spindle 1 side or spindle 2 side) to be operated by the HEAD CHANGE switch (head 1) or (head 2). (S type)

MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN

5) Select the MDI mode ( ) with the MODE selection switch.

6) Display the PROGRAM (MDI) screen.

    Page A-95 (7-2-4)
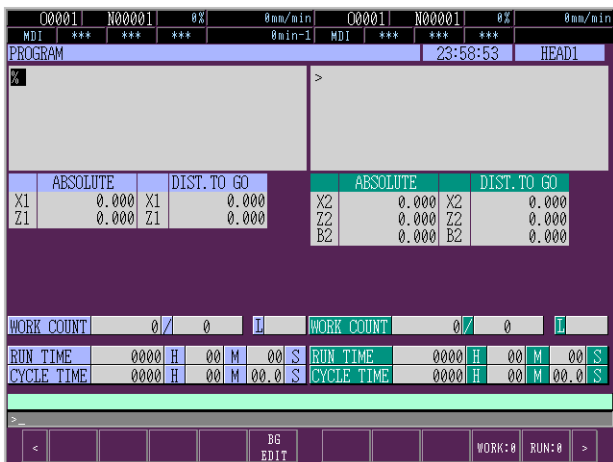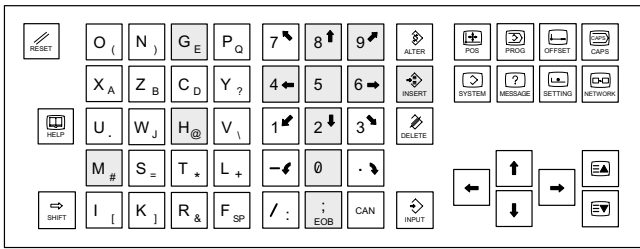
7) Input "M45; M69; G28 H0;" using the data entry keys.

| M # | 4← | 5 | ; EOB | (EOB) |

| M # | 6→ | 9↗ | ; EOB | (EOB) |

| G E | 2↓ | 8↑ | H @ | 0 | ; EOB | (EOB) |
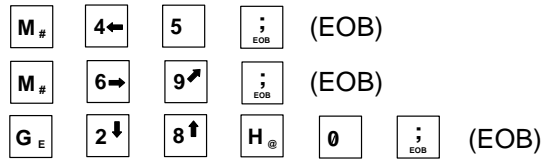
NOTE   In the case of C-axis zero return of spindle 2, press the following keys in order (S type):

| M # | 2↓ | 4← | 5 | ; EOB | (EOB) |

| M # | 6→ | 9↗ | ; EOB | (EOB) |

| G E | 2↓ | 8↑ | H @ | 0 | ; EOB | (EOB) |
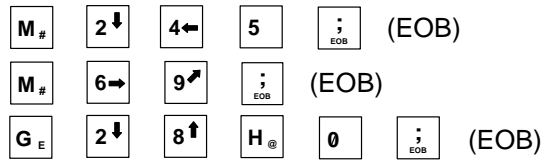
8) Press the ⟨INSERT⟩ key.

9) Press the ⟨ST⟩ switch.

The C-axis returns to the zero point.

CYCLE

ST   SP
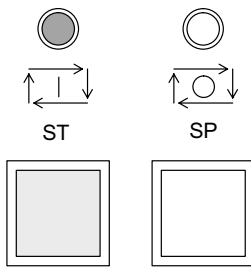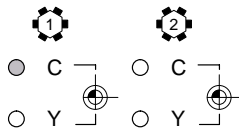
STATUS

The STATUS indicator **[C]** is lit when the C-axis has been returned to the zero point.

14-10   C-axis Positioning Operation in MDI Mode

The procedure for positioning on the C-axis at the rapid traverse rate using MDI operation is described here.
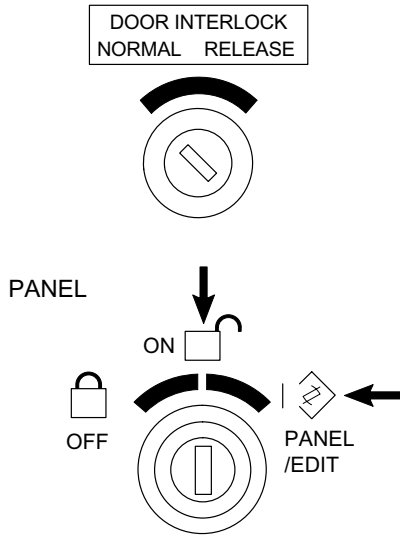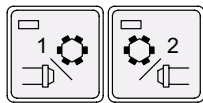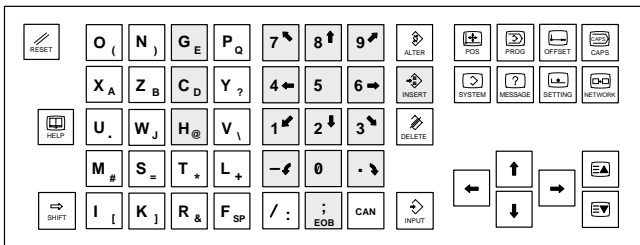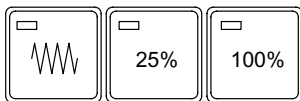
DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF   PANEL /EDIT

3) Place the PANEL key-switch in one of the positions indicated below.

(ON)   (PANEL/EDIT)

HEAD CHANGE

1   2
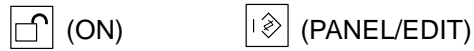
4) Select the spindle (spindle 1 side or spindle 2 side) to be operated by the HEAD CHANGE switch (head 1) or (head 2). (S type)

5) Carry out a C-axis zero return operation.

Page B-85 (14-5)

RAPID OVERRIDE

25%   100%

6) Set the feedrate to be used for rapid traverse operation using the RAPID OVERRIDE switches.

The feedrate set for rapid traverse operation using the RAPID OVERRIDE switches varies depending on the machine model and specifications.

7) Set the rapid traverse mode (positioning: G00).

G E   0   0

8) Key in the positioning data.

<Incremental command>

Input the postiion data following the address H.

H @ [position data] ; EOB (EOB)

<Absolute command>

Input the postiion data following the address C.

C D [position data] ; EOB (EOB)
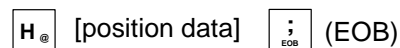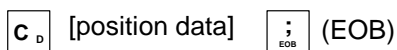
9) Press the (INSERT) key.

CYCLE

ST   SP
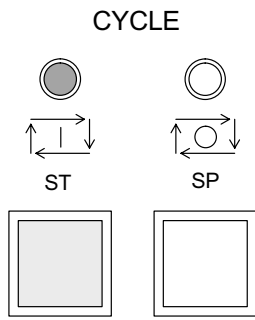
10) Press the ⟦↔⟧ (ST) switch.

The C-axis moves at the set rapid traverse rate.

14-11   C-axis Cutting Feed Operation

The procedure for positioning on the C-axis at the cutting feedrate using MDI operation is described here.
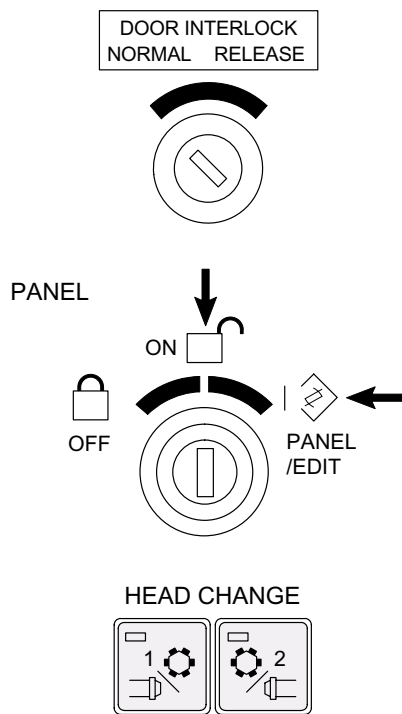
DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF   PANEL
/EDIT

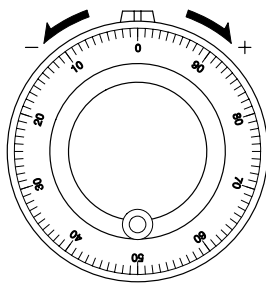3) Place the PANEL key-switch in one of the positions indicated below.

⟦🔓⟧ (ON)   ⟦◇⟧ (PANEL/EDIT)

HEAD CHANGE

1   2

4) Select the spindle (spindle 1 side or spindle 2 side) to be operated by the HEAD CHANGE switch ⟦↗⟧ (head 1) or ⟦◯2⟧ (head 2). (S type)

5) Carry out a C-axis zero return operation.

📖   Page B-85 (14-5)

OVERRIDE

50   100

0   150
          %

6) Set the feedrate to be used for cutting feed operation using the OVERRIDE dial.

☝ Setting is possible in 15 steps in the range of 0 to 150%.
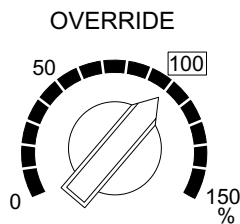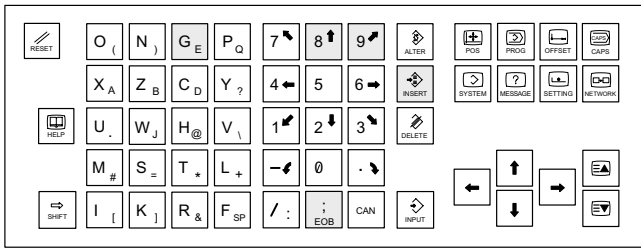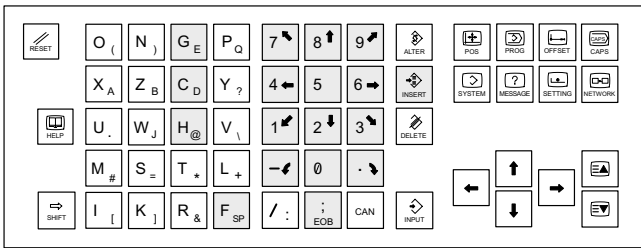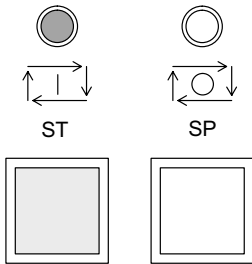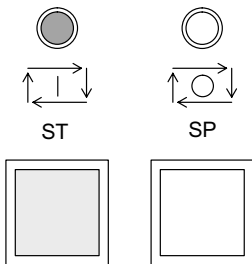
7) Select the feed per minute mode (G98).

   a)   Input "G98;" using the data entry keys.

       $\boxed{G_E}$ $\boxed{9}$ $\boxed{8}$ $\boxed{;}$ (EOB)

   b)   Press the $\boxed{\text{INSERT}}$ (INSERT) key.

CYCLE

   c)   Press the $\boxed{\text{ST}}$ (ST) switch.

ST   SP

8) Set the cutting feed mode (linear interpolation: G01).

    $\boxed{G_E}$ $\boxed{0}$ $\boxed{1}$

9) Key in the axis feed data.

   <Incremental command>

   Input the postiion data following the address H.

    $\boxed{H_@}$ [position data] $\boxed{;}$ (EOB)

   <Absolute command>

   Input the postiion data following the address C.
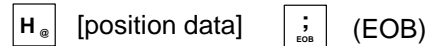
    $\boxed{C_D}$ [position data] $\boxed{;}$ (EOB)

10) Set the cutting feedrate.

    $\boxed{F_{SP}}$ [feedrate] $\boxed{;}$ (EOB)

11) Press the $\boxed{\text{INSERT}}$ (INSERT) key.

12) Press the $\boxed{\text{ST}}$ (ST) switch.

   The C-axis moves at the set cutting feedrate.

CYCLE

ST   SP

15   STEADY REST OPEN/CLOSE OPERATION (STEADY REST SPECIFICATION)

This section explains the steady rest open/close operation and interlocks in opening/closing the steady rest.

15-1   Conditions for Opening/Closing the Steady Rest

To open/close the steady rest manually, the conditions that allow the steady rest opening/closing must be satisfied. If the steady rest cannot be opened/closed although correct operation sequence is followed, check if the following conditions are all satisfied.

<Conditions>

1.   The turret station on which the steady rest is installed is indexed.

2.   The steady rest is placed in the manual mode (only for manual operation).

3.   The spindle or rotary tool spindle (MC type) is not rotating.

4.   The turret head is not being indexed.

15-2   Interlocks for Using the Steady Rest

For using the steady rest, the following interlocks are provided.

1.   To prevent the steady rest from interfere with the workpiece, the turret 2 cannot be indexed under the following states.

- The turret 2 X-axis is not at the zero point.

- The steady rest is not closed.
  (The indicator in the STEADY REST 1 CLOSE switch does not blink.)

2.   To prevent the steady rest from interference with the workpiece, the turret 2 X- and Z-axes cannot be moved unless any of the following states is satisfied.

- When the turret station on which the steady rest is installed is indexed, the steady rest is opened. (The indicator in the STEADY REST 1 OPEN switch is lit.)

- When the turret station on which the steady rest is installed is indexed, the steady rest is at the closing end.

15-3   Opening the Steady Rest
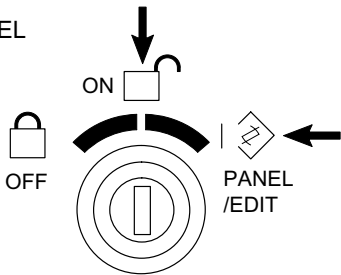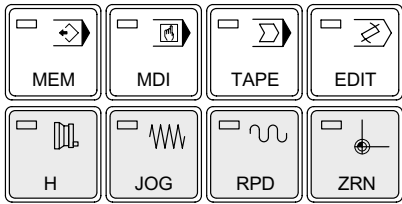
DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF

PANEL
/EDIT

3) Place the PANEL key-switch in one of the positions indicated below.

(ON)   (PANEL/EDIT)

MODE

| MEM | MDI | TAPE | EDIT |
| H | JOG | RPD | ZRN |

4) Select any of the following modes with the MODE selection switch.

(handle)   (jog)

(rapid traverse)   (zero return)

STEADY REST
1 OPEN

STEADY REST
1 CLOSE

STEADY REST
MANUAL MODE

5) Press the STEADY REST MANUAL MODE switch to place the steady rest in the manual mode.

STEADY REST
1 OPEN

STEADY REST
1 CLOSE

STEADY REST
MANUAL MODE
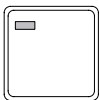
6) Press the STEADY REST 1 OPEN switch.

The steady rest is opened and the indicator in the switch is lit.

15-4   Closing the Steady Rest
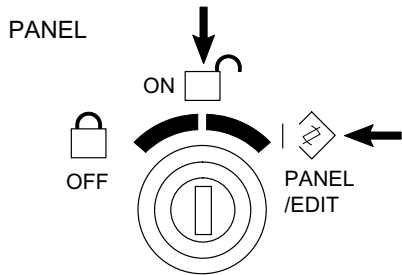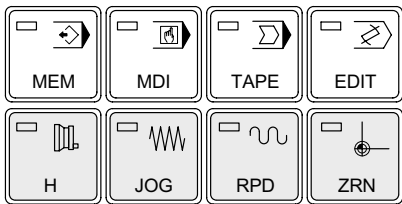
DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF   PANEL
             /EDIT

3) Place the PANEL key-switch in one of the positions indicated below.

  (ON)   (PANEL/EDIT)

MODE

MEM	MDI	TAPE	EDIT
H	JOG	RPD	ZRN

4) Select any of the following modes with the MODE selection switch.

  (handle)   (jog)

  (rapid traverse)   (zero return)
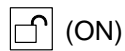
STEADY REST 1 OPEN	STEADY REST 1 CLOSE

STEADY REST
MANUAL MODE

5) Press the STEADY REST MANUAL MODE switch to place the steady rest in the manual mode.

STEADY REST 1 OPEN	STEADY REST 1 CLOSE

STEADY REST
MANUAL MODE

6) Press the STEADY REST 1 CLOSE switch.

The conditions for the completion of the steady rest closing depends on the turret 2 X-axis position.

1. The steady rest closing is completed when the steady rest is at the closing end if the turret 2 X-axis is at the zero point.

   The indicator in the STEADY REST 1 CLOSE blinks.

   NOTE The steady rest closing is not completed when the steady rest clamps the workpiece when the turret 2 X-axis is at the zero point.

2. The steady rest closing is completed when the steady rest clamps the workpiece if the turret 2 X-axis is not at the zero point.

   The indicator in the STEADY REST 1 CLOSE is lit.

   NOTE The steady rest closing is not completed even if the steady rest is at the closing end when the turret 2 X-axis is not at the zero point.

15-5   Alarms Related with Steady Rest

This section deals with the alarms related with the steady rest.

NOTE If the alarm cannot be cleared even when the specified measures are taken, contact Mori Seiki.

Error Code	Error Message	Description
EX1302	TURRET ROTATING	The turret head indexing command and M340/M341 command are specified in the same block.
EX1303	SPINDLE ON	The M340 or M341 command is specified during spindle rotation.
EX1304	SPINDLE OR ROTARY TOOL SPINDLE ON	The M340 or M341 command is specified during rotary tool spindle rotation.
EX1323	X-AXIS NOT IN TURRET INDEX RANGE	The turret 2 X-axis is not within the allowable range to index the turret.
EX1974	ST. REST CLAMP/ UNCLAMP TIME OVER	The steady rest clamp operation has not been completed within the specified time after execting M341 command.
EX1975	ST. REST CLAMP SIGNAL OFF	The steady rest clamp check signal is turned off even though the steady rest open command has not been specified.
EX4901	STATION NO. NOT CORRESPONDED	The M340 or M341 command is specified while the turret station on which the steady rest is not installed has been indexed.
EX4903	REST NOT CLOSED	The turet indexing command is specified when the steady rest has not been closed.

16   SETTING AND OPERATION OF PARTS CATCHER (S TYPE)

The procedure used for setting the parts catcher positions and in/out operation is explained below.

The parts catcher is used to discharge a machined workpiece.

Two kinds of parts catcher specifications are available. They are bucket specification and hand specification.

16-1   Setting Parts Catcher Positions

Set the parts catcher positions by following the procedure indicated below.

The position data is set in the coordinate values (unit: 0.001 mm) in reference to the home position (parts catcher IN end position).

At a spindle 1 side screen, press the function selection key [SYSTEM] (SYSTEM) then press the menu selection key **[>]** several times, and the **[PMM]** soft-key is displayed.

Press the **[PMM]** soft-key and then the **[POS]** soft-key, and the screen displays the coordinate values of the present parts catcher position. Check the displayed coordinate values.
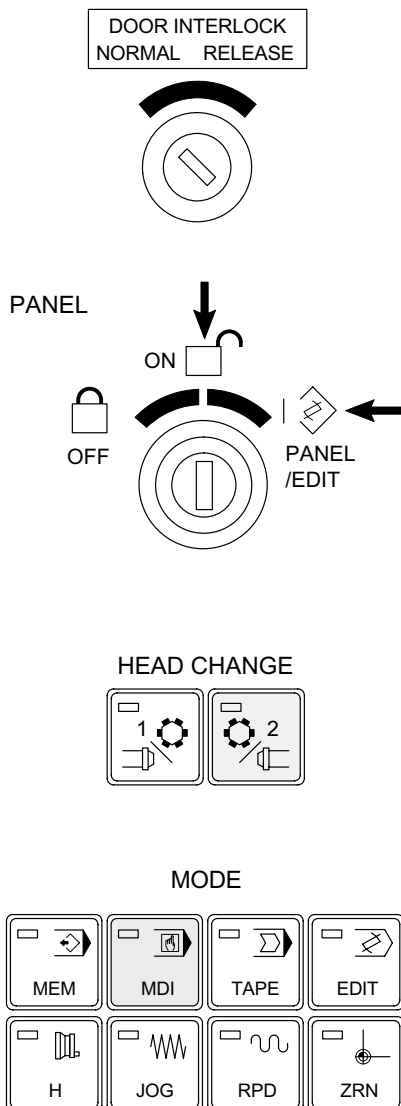
DOOR INTERLOCK
NORMAL   RELEASE

1)   Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2)   Close the front door.

PANEL

ON

OFF

PANEL /EDIT

3)   Place the PANEL key-switch in one of the positions indicated below.

    (ON)   (PANEL/EDIT)

HEAD CHANGE

1   2

4)   Press the HEAD CHANGE switch (head 2) to select the spindle 2 side.

MODE

| MEM | MDI | TAPE | EDIT |
| H | JOG | RPD | ZRN |

5)   Select the MDI mode ( ) with the MODE selection switch.

[SET ARM POS.]   SET(100.0 : 1mm)
                           0
DESCENT POS. 1   -1800000
CLAMP POS. 1   (NOT USED)
RETURN POS. 1   (NOT USED)
DESCENT POS. 2   -1600000
CLAMP POS. 2   (NOT USED)
RETURN POS. 2   (NOT USED)

NUM=   S   0 L 0%
                         MDI **** *** *** 00:32:23 HEAD1

    EXIT   EXEC.
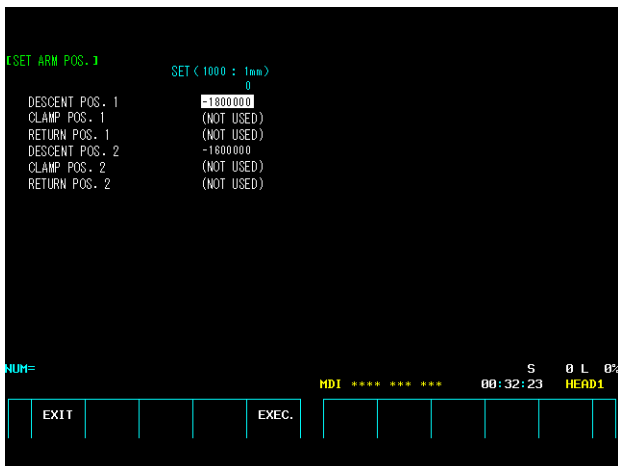
6)   Display the SET ARM POS. screen.

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NOTE

1.   For the bucket specification, "(NOT USED)" is displayed for "CLAMP POS. 1", "RETURN POS. 1", "CLAMP POS. 2" and "RETURN POS. 2".

2.   For the bucket specification, the initial setting values of DESCENT POS. 1 and DESCENT POS. 2 differ from the values shown in the example screen in the left. Their values are "DESCENT POS. 1 = −1844000" and "DESCENT POS. 2 = −1520000".

7)   Input the desired setting value using the data entry keys.

8)   Press the **[SET INPUT]** soft-key or the ⟨INPUT⟩ key.

The input data is set.

If the DESCENT POS. and the CLAMP POS. are at the same position, set the same value for them.

NOTE   Allowable setting range can be set by the following PC parameters.

D2080:   Maximum value (spindle 2 side)
D2084:   Minimum value (spindle 1 side)

16-2   Parts Catcher Operation

The parts catcher operation is shown below.

<Bucket specification>

Parts catcher OUT	Parts catcher IN
Parts catcher moves to the workpiece receiving position	Arm moves up
Arm moves down	Parts catcher moves to the workpiece ejection position
Completion of parts catcher OUT operation	Bucket turns down
	Bucket returns to the home position
	Completion of parts catcher IN operation

<Hand specification>

Parts catcher OUT	Parts catcher IN
Arm moves to the downward movement position	Arm moves to the return position
Arm moves down	Arm moves up
(Arm moves to the workpiece clamp position)	Parts catcher moves to the workpiece ejection position
Hand closes	Hand opens
Completion of parts catcher OUT operation	Completion of parts catcher IN operation

If the hand specification parts catcher stops halfway during its in/output operation due to reset or emergency stop, operation cannot be recovered in manual or automatic operation.

To restore the operation, use the PARTS CATCHER screen for manual independent operation.

16-3   Cautions when Operating the Parts Catcher

When operating the parts catcher by the manual operation or the automatic operation, the necessary conditions must be satisfied. If the parts catcher cannot be operated although the operation procedure is correctly followed, check if the following conditions are all satisfied.

<Conditions required for parts catcher IN/OUT operation>

1. The front door is closed.

2. The STATUS indicator **[MRDY]** is lit.

3. The protection cover of the tool presetter arm is mounted to the base.
   (With the automatic presetter, the presetter arm is at the retracted position.)

4. The holding box is in. (Bucket specification)

5. The B-axis is returned to the zero point.

6. The 2nd X-axis is returned to the zero point.

<Conditions required for parts catcher OUT operation>

1. The 2nd Z-axis is at the position indicated below. (Bucket specification)

	Head 1 Side	**Head 2 Side**
ZL-153S	In the positive side from +180 mm	In the negative side from −200 mm
ZL-203S ZL-253S	In the positive side from +155 mm	In the negative side from −250 mm
ZL-153SMC	In the positive side from +220 mm	In the negative side from −200 mm
ZL-203SMC ZL-253SMC	In the positive side from +200 mm	In the negative side from −250 mm

<Other Conditions>

NOTE
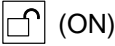
1. Move turret 1 to a position where interference will not occur before starting the parts catcher OUT operation.

2. While the parts catcher is out, the 2nd Z-axis does not move. (Bucket specification)

3. Pay sufficient care when operating axes, since axis movements are possible even if the parts catcher is OUT. (Hand specification)

16-4   Parts Catcher IN/OUT Manual Operation
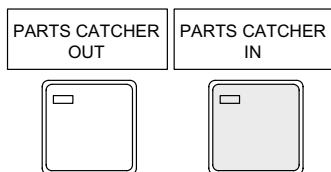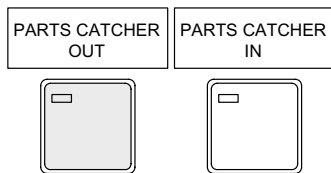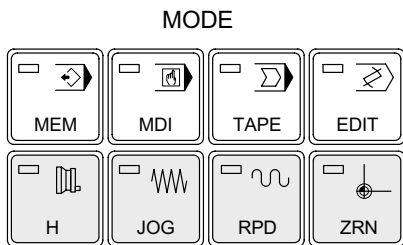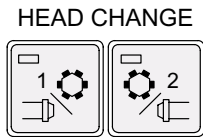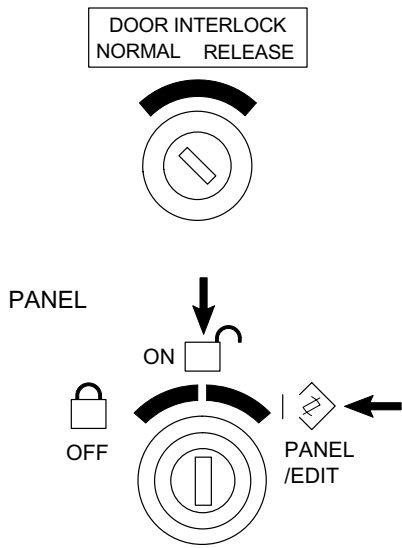
1)   Place the DOOR INTERLOCK key-switch in the
      NORMAL position.

2)   Close the front door.

3)   Place the PANEL key-switch in one of the positions
      indicated below.

      ⬜ (ON)   ⬜ (PANEL/EDIT)

HEAD CHANGE

4)   Select the spindle (spindle 1 side or spindle 2 side)
      to be operated by the HEAD CHANGE switch ⬜
      (head 1) or ⬜ (head 2).

MODE

5)   Select any of the following modes with the MODE
      selection switch.

      ⬜ (handle)   ⬜ (jog)

      ⬜ (rapid traverse)   ⬜ (zero return)

6)   When moving the parts catcher OUT
      Press the **[PARTS CATCHER OUT]** switch.

7)   When moving the parts catcher IN
      Press the **[PARTS CATCHER IN]** switch.

16-5   Manual Independent Operation of Parts Catcher

CAUTION Manual independent operation is allowed only for recovering parts catcher operation from a trouble. Operating the parts catcher carelessly in the manual independent operation mode will cause discrepancy between the actual status and memory-stored status of the parts catcher, and it could cause accidents.

By manual independent operation, a series of parts catcher operation can be performed.

Manual independent operation of the parts catcher is valid only in the MDI mode.
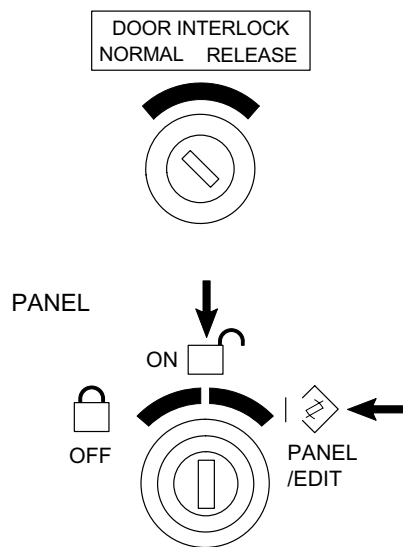
DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF

PANEL
/EDIT

3) Place the PANEL key-switch in one of the positions indicated below.

(ON)   (PANEL/EDIT)

HEAD CHANGE

1   2

4) Press the HEAD CHANGE switch (head 2) to select the spindle 2 side.

MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN
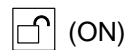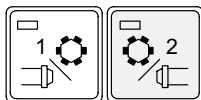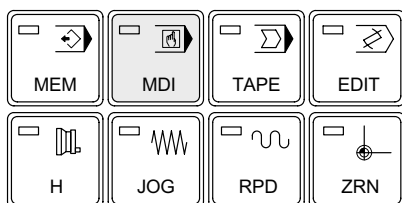
5) Select the MDI mode ( ) with the MODE selection switch.
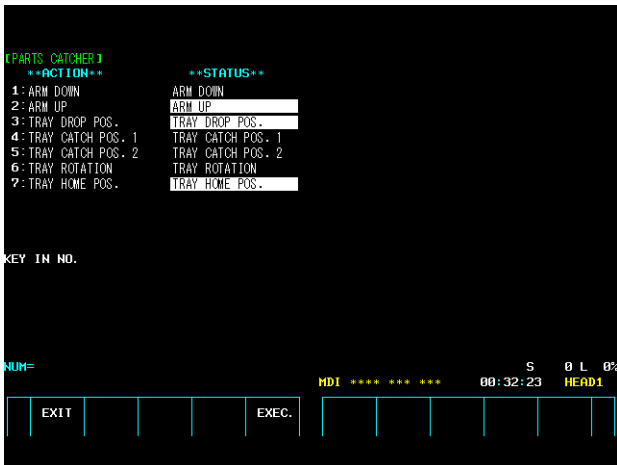
6) Display the PARTS CATCHER screen.

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The reversed display on the right side of the screen indicates that the parts catcher is in that status.

NOTE The screen shown in the left is for the bucket specification.

7) Key in the number heading the required operation.

8) Press the ⟨INPUT⟩ key.

CAUTION ⚠ When operating the parts catcher in manual independent operation, always follow the guidance displayed on the screen.

If you fail to observe this precaution the machine may operate in an unexpected manner, and this could cause damage to the machine.
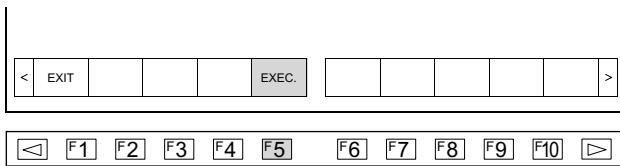
9) Press the **[EXEC.]** soft-key.

The parts catcher carries out the selected step.
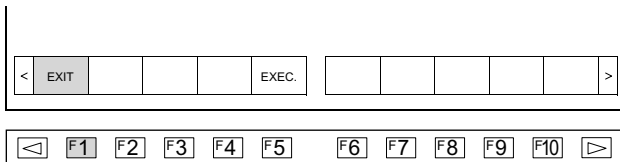
10) After completing manual independent operation, press the **[EXIT]** soft-key.

<Bucket specification>

To operate the parts catcher in manual independent operation, follow the operation sequence indicated below according to the desired in/out operation.
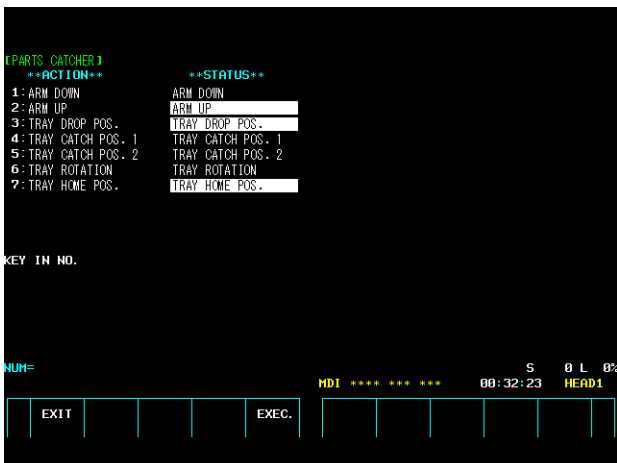
OUT cycle (spindle 1 side)
    7 → 2 → 4 → 1

IN cycle (spindle 1 side)
    2 → 3 → 6 → 7

OUT cycle (spindle 2 side)
    7 → 2 → 5 → 1

IN cycle (spindle 2 side)
    2 → 3 → 6 → 7

Manual independent operation steps are possible when the conditions indicated below are satisfied.

Note that the individual steps are operable even if the operation sequence indicated above is not followed as long as the corresponding conditions are satisfied.

No.	Operation	Status
1	ARM DOWN	The parts catcher is at either TRAY CATCH POS. 1 or TRAY CATCH POS. 2, and the second Z-axis is at the downward movement enabled range.
2	ARM UP	This operation is always enabled.
3	TRAY DROP POS.	The arm is at the ARM UP position with the bucket at the home position (TRAY HOME POS.).
4	TRAY CATCH POS. 1	The arm is at the ARM UP position with the bucket at the home position (TRAY HOME POS.).
5	TRAY CATCH POS. 2	The arm is at the ARM UP position with the bucket at the home position (TRAY HOME POS.).
6	TRAY ROTATION	The parts catcher is at the TRAY DROP position.
7	TRAY HOME POS.	The parts catcher is at the TRAY DROP position.

<Hand specification>

To operate the hand specification parts catcher in manual independent operation, follow the operation sequence indicated below according to the desired in/out operation.
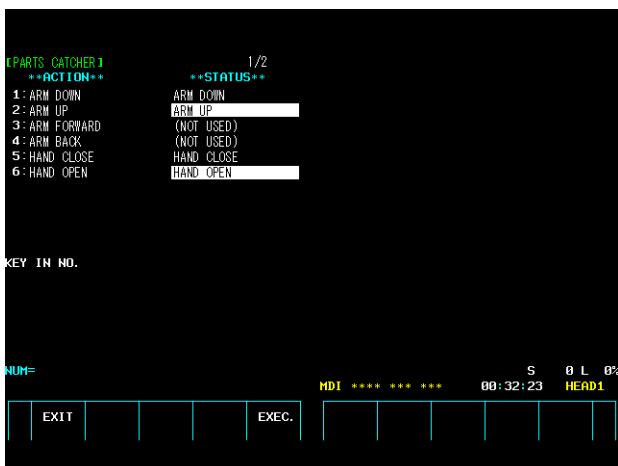
OUT cycle (spindle 1 side)
    $7 \rightarrow 2 \rightarrow 6 \rightarrow 8 \rightarrow 1 \rightarrow 9 \rightarrow 5$

IN cycle (spindle 1 side)
    $10 \rightarrow 2 \rightarrow 7 \rightarrow 6$

OUT cycle (spindle 2 side)
    $7 \rightarrow 2 \rightarrow 6 \rightarrow 11 \rightarrow 1 \rightarrow 12 \rightarrow 5$

IN cycle (spindle 2 side)
    $13 \rightarrow 2 \rightarrow 7 \rightarrow 6$

This screen consists of two pages.

The page can be changed using the page selection keys.
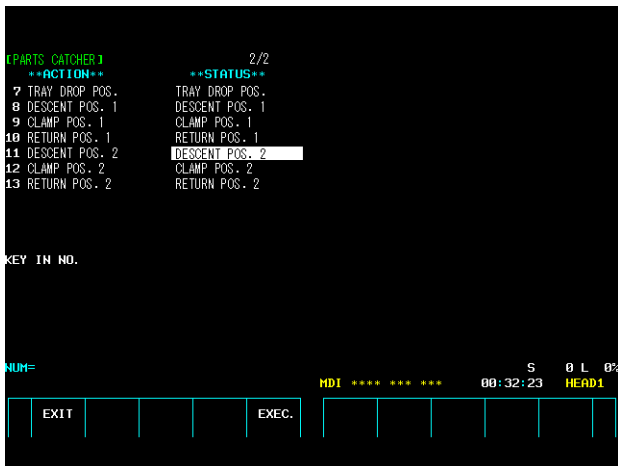
Manual independent operation steps are possible when the conditions indicated below are satisfied.

Note that the individual steps are operable even if the operation sequence indicated above is not followed as long as the corresponding conditions are satisfied.

No.	Operation	Status
1	ARM DOWN	The parts catcher is at any of TRAY DROP POS., DESCENT POS. 1, and DESCENT POS. 2.
2	ARM UP	This operation is always enabled.
5	HAND CLOSE	The parts catcher is at any of TRAY DROP POS., CLAMP POS. 1, and CLAMP POS. 2.
6	HAND OPEN	The parts catcher is at any of TRAY DROP POS., CLAMP POS. 1, and CLAMP POS. 2.
7	TRAY DROP POS.	The arm is at the ARM UP position.
8	DESCENT POS. 1	The arm is at the ARM UP position.
9	CLAMP POS. 1	The arm is at the ARM DOWN position.
10	RETURN POS. 1	The arm is at the ARM DOWN position.
11	DESCENT POS. 2	The arm is at the ARM UP position.
12	CLAMP POS. 2	The arm is at the ARM DOWN position.
13	RETURN POS. 2	The arm is at the ARM DOWN position.

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.

CAUTION ⚠️

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.

CONTENTS

1   CAUTIONS ON CHUCKING A WORKPIECE

When chucking a workpiece, pay attention to the following points.

> **DANGER** ⚠
>
> *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.*

> **WARNING** ⚠
>
> 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 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.**

WARNING

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. (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.

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.

WARNING

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 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 or soft jaws. 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 a workpiece is machined while not clamped stably, it may fly out of the chuck due to cutting resistance, causing serious injuries or damage to the machine.

CAUTION

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).

WARNING

⚠

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.

WARNING

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

1. The type and installation position of the chucking pressure adjustment handle varies depending on the machine model.
    For details, refer to the DRAWINGS.

2. The following procedure is used to adjust the chucking pressure for chuck 1. The valve unit of chuck 2 is installed at the right side of machine front. The chucking pressure for chuck 2 can be adjusted by the same procedure as that for chuck 1. (S type)
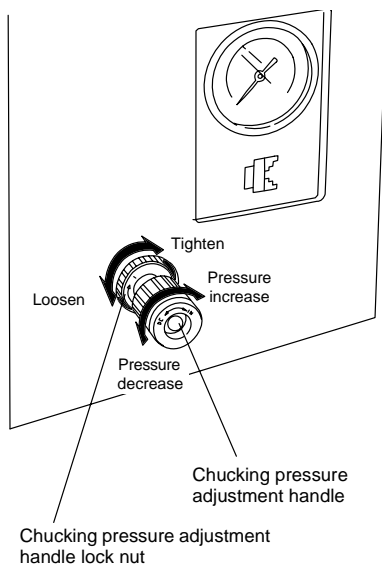
Tighten
Loosen
Pressure increase
Pressure decrease
Chucking pressure adjustment handle
Chucking pressure adjustment handle lock nut

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.
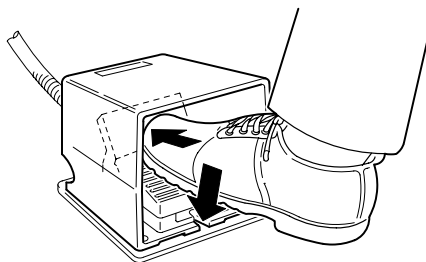
3) Using the chuck opening/closing footswitch, operate the chuck several times to verify the set chucking pressure.

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

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.

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.

Model	Gage Pressure MPa	Tailstock Spindle Thrust N
ZL-153	3.43	6390
ZL-203	3.43	6390
ZL-253	3.43	9898

Loosen   Tighten
Pressure decrease
Pressure increase
Tailstock spindle thrust adjustment handle
Tailstock spindle thrust adjustment handle lock nut
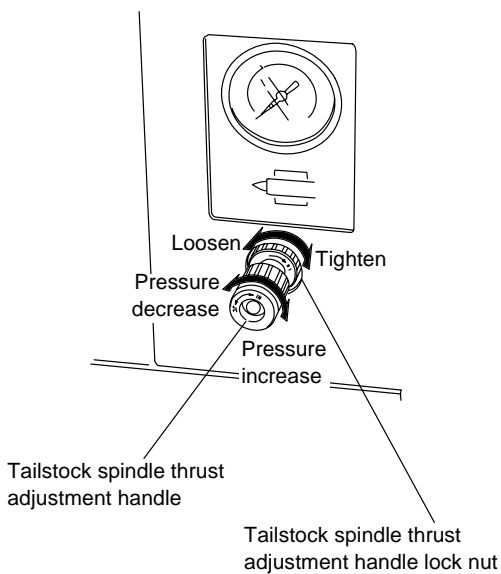
1)   Loosen the tailstock spindle thrust adjustment handle lock nut by turning it counterclockwise.

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 workpiece shape and 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.

WARNING

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.**

CAUTION

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
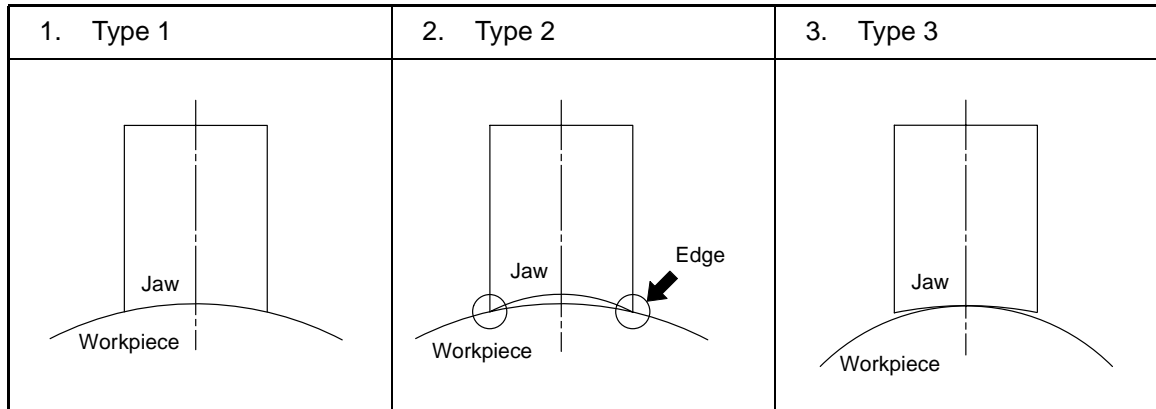
1. Chucking at pre-machined or finished portion (Type 1)

   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 to the left. The workpiece is therefore held at 3 points.
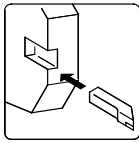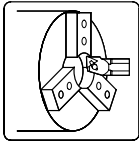
> **WARNING**
>
> **When clamping a workpiece in a 3-jaw chuck, the workpiece cannot be clamped stably if contact is only made at three points. If a workpiece is machined while clamped in this very unstable way, it may fly out of the chuck due to cutting resistance, causing serious injuries or damage 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.

DOOR INTERLOCK
NORMAL   RELEASE
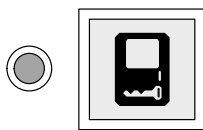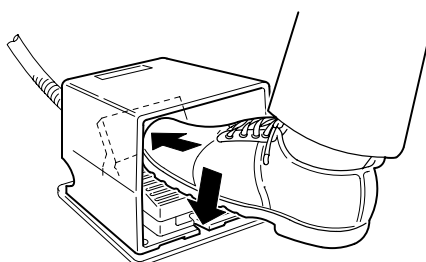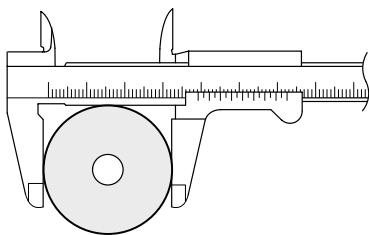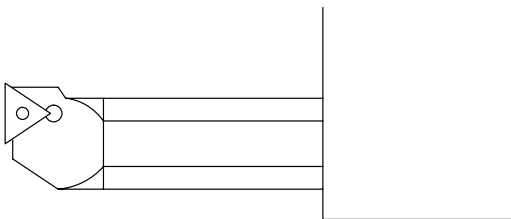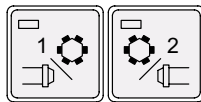
1)   Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

DOOR UNLOCK

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.

HEAD CHANGE

3)   Press the HEAD CHANGE switch ⊞ (head 1) or ⊞ (head 2) to select the required spindle. (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.

📖   Page B-36 (7-3)

9)   Close the front door.

10) Display the OPERATION PANEL screen.

📖   Page A-126 (7-7-1)

11) Set the chuck clamping direction to the I.D. chucking.

NOTE   For chuck 2, page 2 of the OPERATION PANEL screen is used to the selection of clamp direction.

📖   Page B-39 (7-4)

12) Set "INVALID" for CHUCK STROKE END (chuck jaw stroke end detection function) using the cursor control keys.

NOTE   For the selection of valid/invalid of chuck 2 confirmation switch, page 2 of the OPERATION PANEL screen is used.

The STATUS indicator **[CHCL]** is lit.

NOTE   For chuck 2, the status indicator **[HEADSTOCK 2 CHUCK CLAMP]** on the option panel 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.

DOOR UNLOCK

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.

OPERATION PANEL screen (1/2):

No.	MENU	CONDITION	
1	SPINDLE OFF MODE	INVALID	VALID
2	CHUCK DIRECTION	O.D.	I.D.
3	TAILSTOCK ILK.	OFF	ON
4	WORK COUNTER	ST.ILK	BDT
5	MACHINE LOCK	OFF	ON
6	AUX. F. LOCK	OFF	ON
7	CHUCK FOOT SWITCH	VALID	INVALID
8	CHUCK STROKE END	VALID	INVALID

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-32 (7-2)

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 $\times$ 1/2" allows the plug to be clamped at the center of jaw stroke.
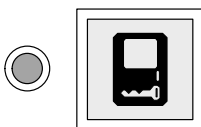
DOOR UNLOCK

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) Display the OPERATION PANEL screen.

   📖   Page A-126 (7-7-1)

```
EDIT  ***  ***  ***          0mm/min      O0001 N00001
                     0%      0min-1
OPERATION PANEL (1/2)              23:58:53   HEAD1

     No.        MENU              CONDITION
      1   SPINDLE OFF MODE      INVALID  VALID
  →   2   CHUCK DIRECTION       O.D.     I.D.
      3   TAILSTOCK ILK.        OFF      ON
      4   WORK COUNTER          ST.ILK   BDT
      5   MACHINE LOCK          OFF      ON
      6   AUX. F. LOCK          OFF      ON
      7   CHUCK FOOT SWITCH     VALID    INVALID
  →   8   CHUCK STROKE END      VALID    INVALID



    <   BDT                                    EXIT  >
```

23) Set the chuck clamping direction to the O.D. chucking.

NOTE For chuck 2, page 2 of the OPERATION PANEL screen is used to the selection of clamp direction.

📖 Page B-39 (7-4)

24) Set "INVALID" for CHUCK STROKE END (chuck jaw stroke end detection function) using the cursor control keys.

NOTE For the selection of valid/invalid of chuck 2 confirmation switch, page 2 of the OPERATION PANEL screen is used.

The STATUS indicator **[CHCL]** is lit.

NOTE For chuck 2, the status indicator **[HEADSTOCK 2 CHUCK CLAMP]** on the option panel 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-32 (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-25 (6-4)

NOTE The diameter of the cutting mark must be smaller than the finishing diameter.

Cutting mark

30) Display the POSITION (INCREMENTAL) screen.

📖 Page A-83 (7-1-2)
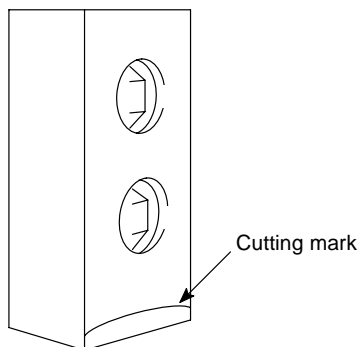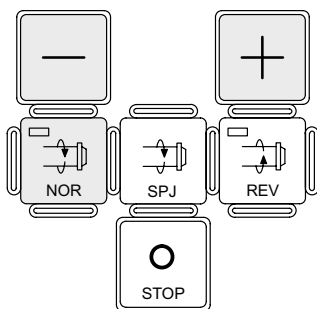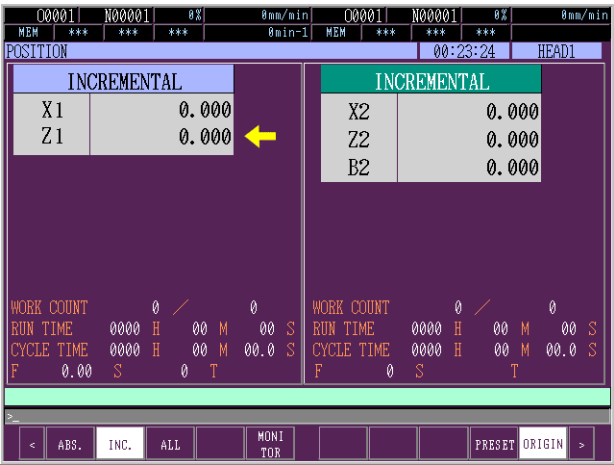
31) Reset the Z1 coordinate value on the POSITION (INCREMENTAL) screen to "0".

   a) Press the Z_B key.

   b) Press the **[ORIGIN]** soft-key.
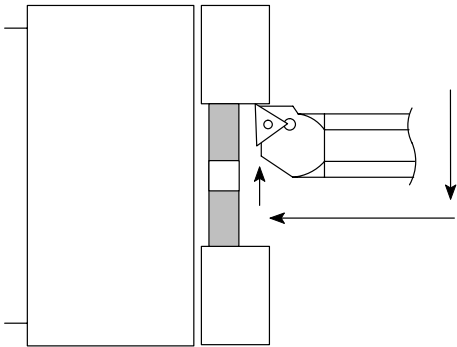
32) Move the I.D. cutting tool using the manual pulse generator to bring it into contact with the inside face of the soft jaw.

   CAUTION ⚠ Ensure that the tool does not strike the soft jaw or plug.
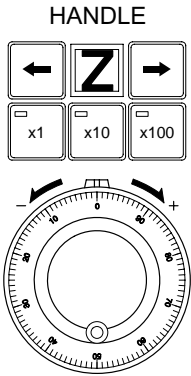
HANDLE

33) 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.
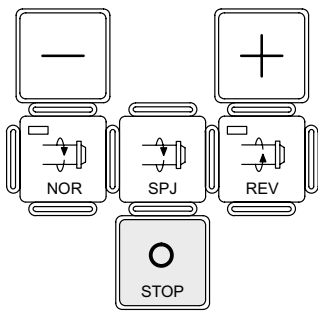
34) Press the $\bigcirc$ (STOP) switch to stop the spindle.

<Example>
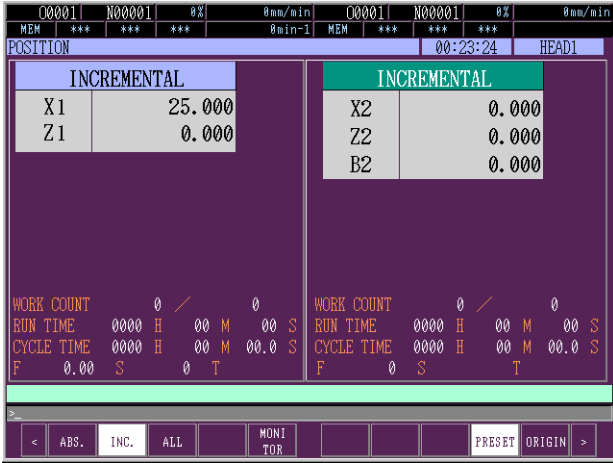
Assume that the outer diameter of the plug measured in step 7) is 25 mm.

35) Set the present position data (incremental) to "25.000" mm for X1.

    a)   Input "X25.0" using the data entry keys.
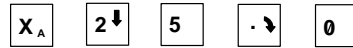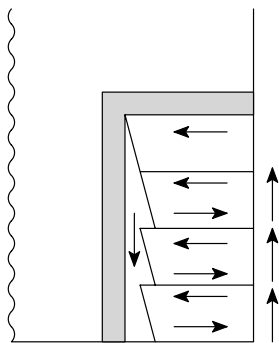
| X_A | 2↓ | 5 | .↘ | 0 |

    b)   Press the **[PRESET]** soft-key.

```
 O0001  N00001    0%    0mm/min  O0001  N00001    0%    0mm/min
 MEM   ***   ***   ***       0min-1  MEM   ***   ***   ***
 POSITION                                      00:23:24      HEAD1
       INCREMENTAL                         INCREMENTAL
    X1          25.000              X2           0.000
    Z1           0.000              Z2           0.000
                                    B2           0.000



 WORK COUNT       0  /       0     WORK COUNT       0  /       0
 RUN TIME    0000 H    00 M    00 S  RUN TIME    0000 H    00 M    00 S
 CYCLE TIME  0000 H    00 M  00.0 S  CYCLE TIME  0000 H    00 M  00.0 S
 F     0.00  S      0  T           F      0  S         T

 >
  <   ABS.   INC.   ALL      MONI                    PRESET ORIGIN  >
                             TOR
```

36) Cut the soft jaws while checking the diameter and depth of cut by referring to the relative coordinate values on the POSITION (INCREMENTAL) 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.

37) 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.

38) 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.

First machining direction

Second machining direction
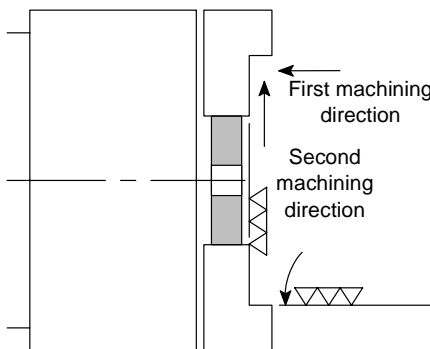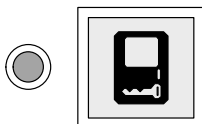
DOOR UNLOCK

39) 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.
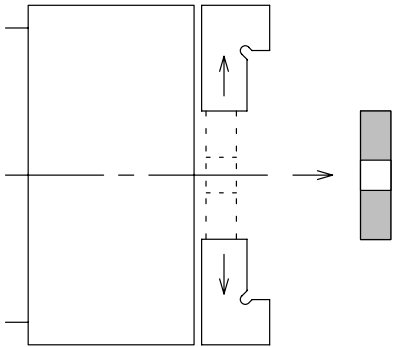
40)   Unclamp the chuck and remove the plug.

> ⚠ **CAUTION**
>
> When removing the plug for shaping the soft jaws, ensure that your fingers will not be caught.
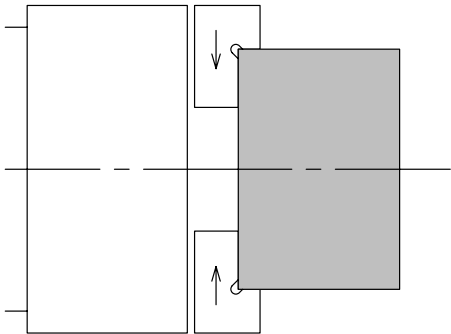
41)   Chuck a workpiece; check the jaw stroke.

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.
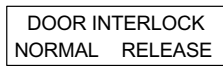
DOOR INTERLOCK
NORMAL   RELEASE
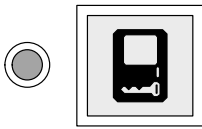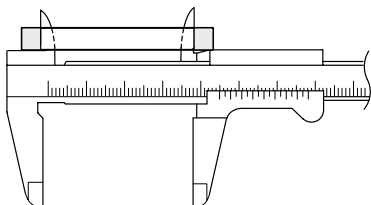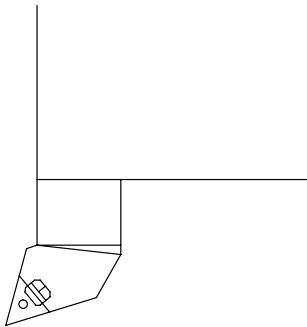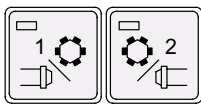
1)   Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

DOOR UNLOCK

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.

HEAD CHANGE

1   2

3)   Press the HEAD CHANGE switch (head 1) or (head 2) to select the required spindle. (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.
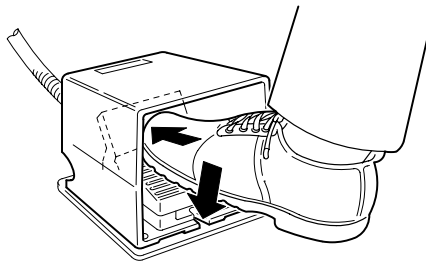
8) Carry out chuck clamp and unclamp operation to close the chuck.

📖   Page B-36 (7-3)

9) Close the front door.

10) Display the OPERATION PANEL screen.

📖   Page A-126 (7-7-1)


```
EDIT   ***   ***   ***              0mm/min
                            0%       0min-1        O0001 N00001
OPERATION PANEL (1/2)                  23:58:53    HEAD1

     No.          MENU              CONDITION
      1    SPINDLE OFF MODE       INVALID   VALID
  →   2    CHUCK DIRECTION          O.D.    I.D.
      3    TAILSTOCK ILK.           OFF      ON
      4    WORK COUNTER           ST.ILK    BDT
      5    MACHINE LOCK             OFF      ON
      6    AUX. F. LOCK            OFF      ON
      7    CHUCK FOOT SWITCH      VALID   INVALID
  →   8    CHUCK STROKE END       VALID   INVALID

 <   BDT                                     EXIT  >
```

11) Set the chuck clamping direction to the O.D. chucking.

🔵 NOTE   For chuck 2, page 2 of the OPERATION PANEL screen is used to the selection of clamp direction.

📖   Page B-39 (7-4)

12) Set "INVALID" for CHUCK STROKE END (chuck jaw stroke end detection function) using the cursor control keys.

🔵 NOTE   For the selection of valid/invalid of chuck 2 confirmation switch, page 2 of the OPERATION PANEL screen is used.

The STATUS indicator **[CHCL]** is lit.

🔵 NOTE   For chuck 2, the status indicator **[HEADSTOCK 2 CHUCK CLAMP]** on the option panel 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.

DOOR UNLOCK

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-32 (7-2)
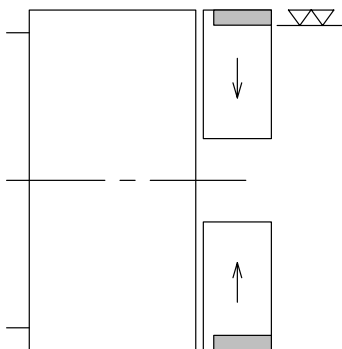
18) Machine the jaws that clamp the ring.

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.
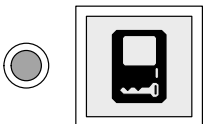
DOOR UNLOCK

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.
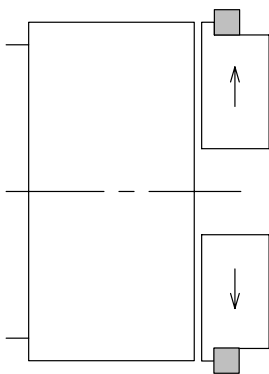
20) Chuck the ring.

⚠️ **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.

📖   Page A-126 (7-7-1)

23) Set the chuck clamping direction to the I.D. chucking.

NOTE   For chuck 2, page 2 of the OPERATION PANEL screen is used to the selection of clamp direction.

📖   Page B-39 (7-4)

24) Set "INVALID" for CHUCK STROKE END (chuck jaw stroke end detection function) using the cursor control keys.

NOTE   For the selection of valid/invalid of chuck 2 confirmation switch, page 2 of the OPERATION PANEL screen is used.

The STATUS indicator **[CHCL]** is lit.

NOTE   For chuck 2, the status indicator **[HEADSTOCK 2 CHUCK CLAMP]** on the option panel 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-32 (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.

No.	MENU	CONDITION	
1	SPINDLE OFF MODE	INVALID	VALID
2	CHUCK DIRECTION	O.D.	I.D.
3	TAILSTOCK ILK.	OFF	ON
4	WORK COUNTER	ST.ILK	BDT
5	MACHINE LOCK	OFF	ON
6	AUX. F. LOCK	OFF	ON
7	CHUCK FOOT SWITCH	VALID	INVALID
8	CHUCK STROKE END	VALID	INVALID

OPERATION PANEL (1/2)   23:58:53   HEAD1

O0001 N00001

Cutting mark

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-25 (6-4)

NOTE The diameter of the cutting mark must be larger than the finishing diameter.

30) Display the POSITION (INCREMENTAL) screen.

📖 Page A-83 (7-1-2)
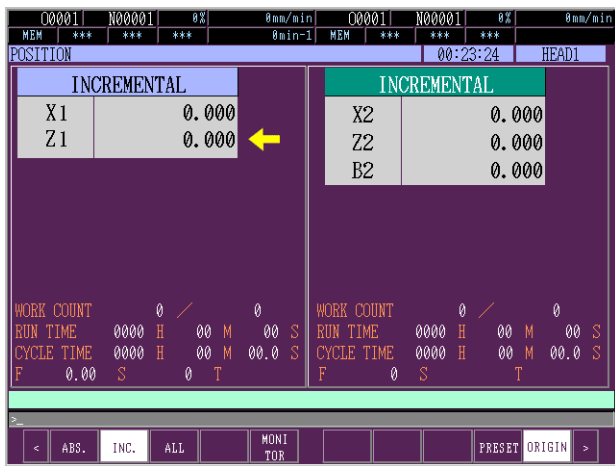
31) Reset the Z coordinate value on the POSITION (INCREMENTAL) screen to "0".

a) Press the Z_B key.

b) Press the **[ORIGIN]** soft-key.
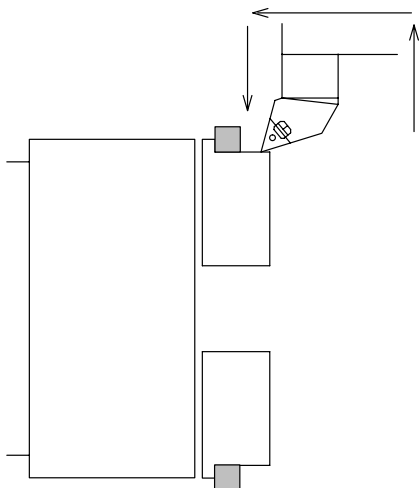
32) Move the O.D. cutting tool using the manual pulse generator to bring it into contact with the outside face of the soft jaw.

CAUTION Ensure that the tool does not strike the soft jaw or plug.
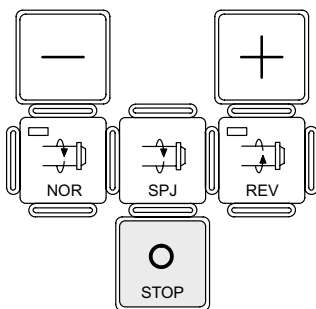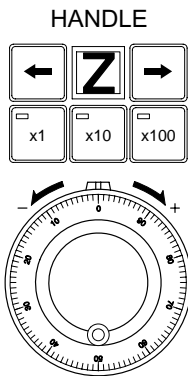
HANDLE

33) 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.

34) Press the ○ (STOP) switch to stop the spindle.

<Example>

Assume that the inner diameter of the plug measured in step 7) is 150 mm.
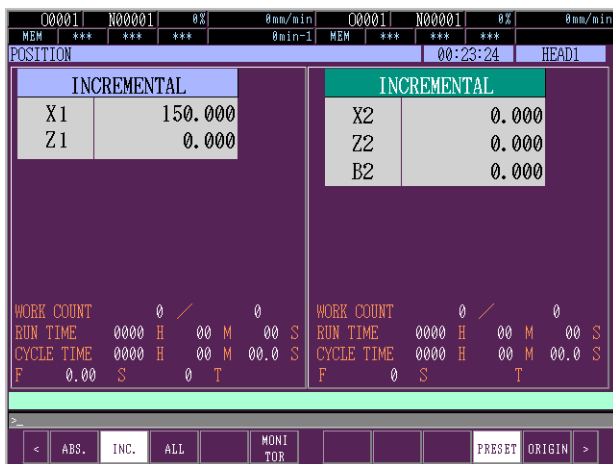
35) Set the present position data (incremental) to "150.000" mm for X.

   a) Input "X150.0" using the data entry keys.
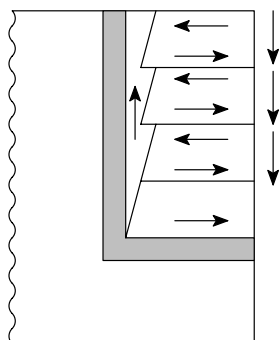
   Xₐ **1** **5** **0** **·** **0**

   b) Press the **[PRESET]** soft-key.

36) Cut the soft jaws while checking the diameter and depth of cut by referring to the relative coordinate values on the POSITION (INCREMENTAL) 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.

37) 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.

Second machining
direction

First machining
direction
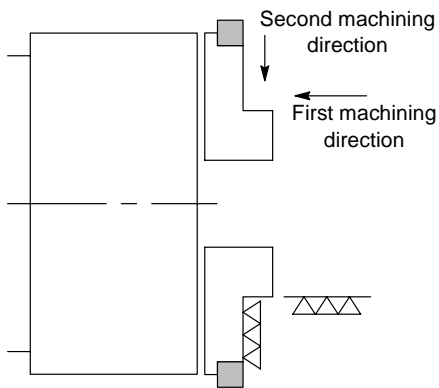
DOOR UNLOCK
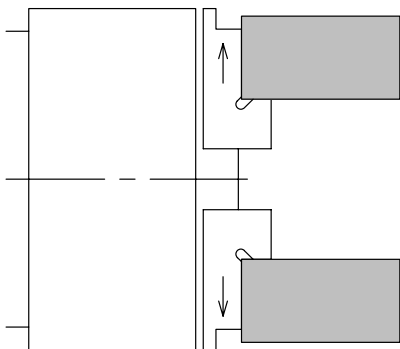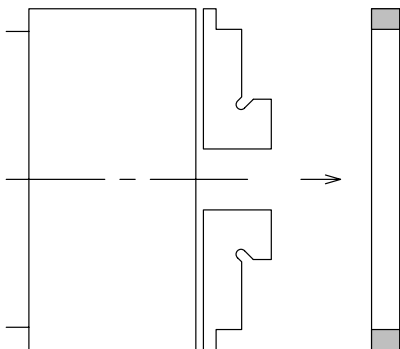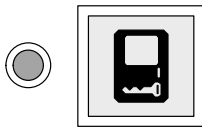
38) Carry out finishing.

    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.

39) 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.

40) Unclamp the chuck and remove the ring.

CAUTION When removing the ring for shaping the soft jaws, ensure that your fingers will not be caught.

41) Chuck a workpiece; check the jaw stroke.

4   AUTOMATIC SOFT-JAW SHAPING

This section describes automatic cutting of soft jaws.

📖 For the items to be attended to and confirmed, refer to page C-9 (3).

⚠️ **CAUTION** Before shaping soft jaws, set the tool geometry offset data and the work offset data. If automatic soft-jaw shaping cycle is executed without setting the offset data, the tool will interfere with the soft jaw or the chuck to cause damage to the tool or the machine.

📖 For the setting procedure of the tool geometry offset data and work offset data, refer to chapter E "SETTING OF COORDINATE SYSTEM".

1) Return the X- and Z-axes to the zero point.

📖 Page B-19 (6-1)

2) Display the JAW CUT screen.

📖 Page A-102 (7-3-5)

3) Select the data setting items (jaw shape and cutting conditions) using the cursor control keys and input the corresponding data.

<Jaw shape>

- ST. DIA. (A)
- CHUCKING D. (B)
- DEPTH (C)
- FINISH (D)
- NECKING (E)
- CUT DEPTH (F)
- CHAMFERING (G)

<Jaw shape>

- SPINDLE ROTATION 1: CW 2: CCW
- ROUGH TOOL T CODE
- ROUGH CUTTING SPD.
- ROUGH FEED
- FINISH TOOL T CODE
- FINISH CUTTING SPD.
- FINISH FEED

4) Select any of the following modes with the MODE selection switch.

 (handle)   (jog)

 (rapid traverse)
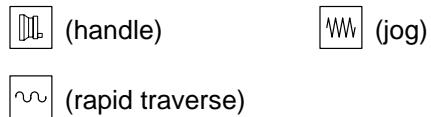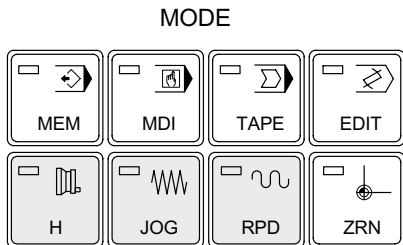
5) Move the turret to the desired tool change position using the HANDLE switches or AXIS DIRECTION switches.

CAUTION Make sure that moving and indexing the turret does not cause interference with the workpiece.
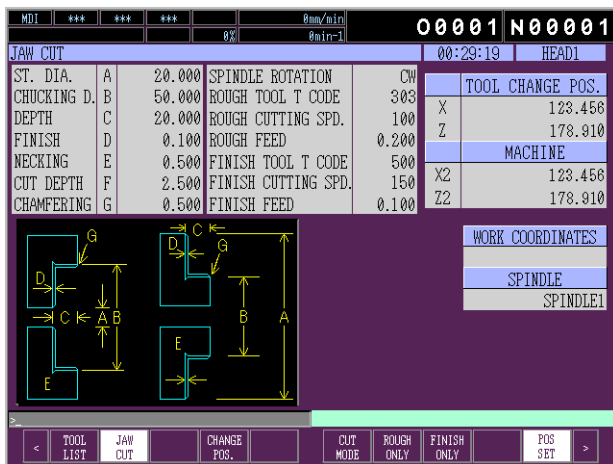
MODE

6) Press the **[POS SET]** soft-key.

The tool change position is set.

The tools are selected at this position for soft-jaw shaping.

MODE

MEM	MDI	TAPE	EDIT
H	JOG	RPD	ZRN
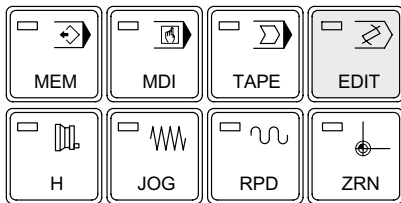
7) Select the edit mode ( ) with the MODE selection switch.
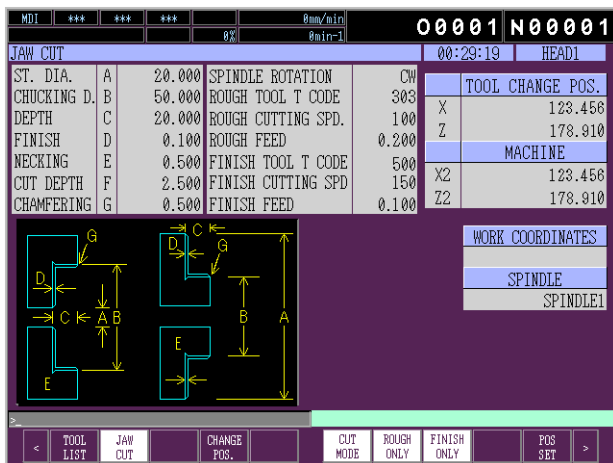
8) Press the **[CUT MODE]** soft-key.

The automatic soft-jaw shaping program is generated according to the input soft-jaw cutting shape data under the O-number set for CAP parameter 310.

<Rough cutting only>

To carry out only rough cutting, press the **[ROUGH ONLY]** soft-key first.

<Finish cutting only>

To carry out only finish cutting, press the **[FINISH ONLY]** soft-key.

9) Display the PROGRAM (edit) screen.

Page A-90 (7-2-1)
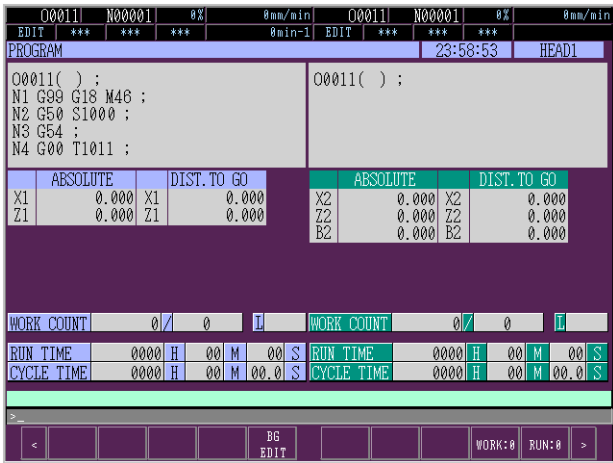
10) Search the program (O-number set for CAP parameter 310) that should be edited.

📖 Page D-8 (3-2)

<Editing the automatically generated program>

To modify "N3 G50 S1000" to "N3 G50 S1200", for example, follow the steps indicated below.
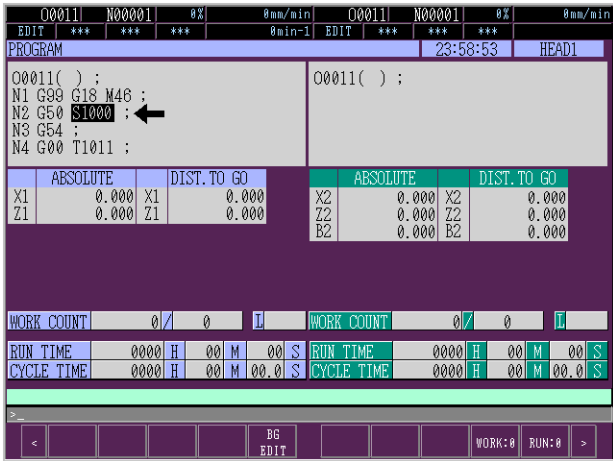
11) Move the cursor to "S1000" using the cursor control keys.
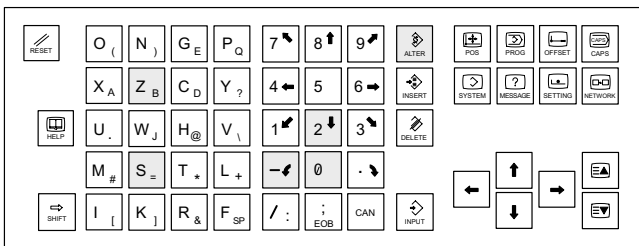
12) Input "S1200" using the data entry keys.
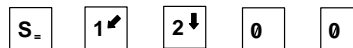
$S_=$ 1 2 0 0

13) Press the (ALTER) key.
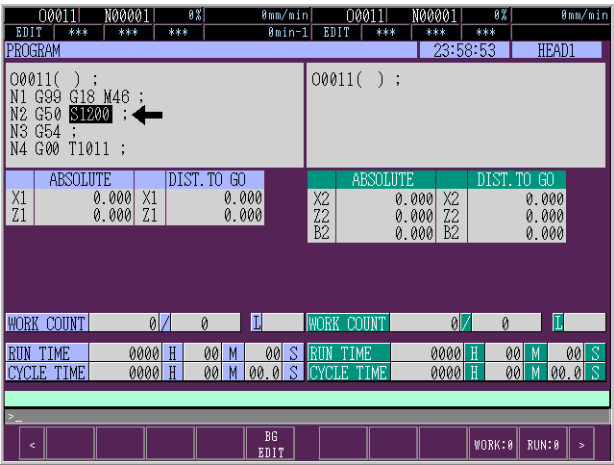
The word "S1000" is changed to "S1200".

NOTE The modified program remains valid until a new program is generated again in the soft-jaw cutting mode.

14) Press the [RESET] (RESET) key.

The cursor moves to the head of the program.

MODE

15) Select the memory mode ([⊡]) with the MODE selection switch.

| MEM | MDI | TAPE | EDIT |
| H | JOG | RPD | ZRN |
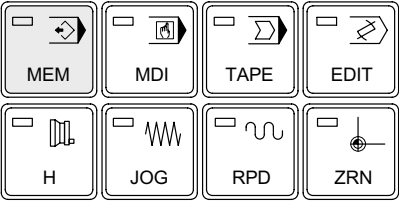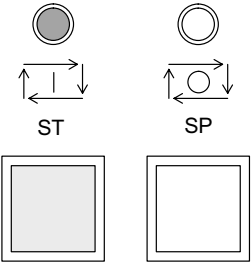
CYCLE

16) Press the [ST] (ST) switch.

Soft-jaw shaping cycle starts.

NOTE During soft-jaw shaping or in the soft-jaw cutting mode, it is not allowed to change the following data.

1. Soft-jaw shape data

2. Soft-jaw cutting conditions

3. Tool change position

ST   SP

5   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
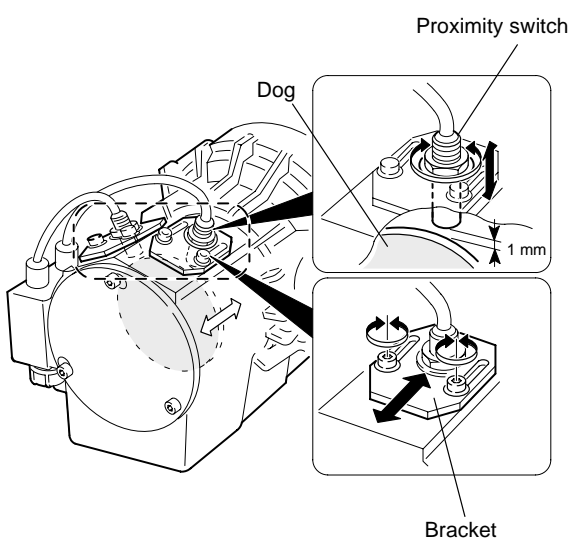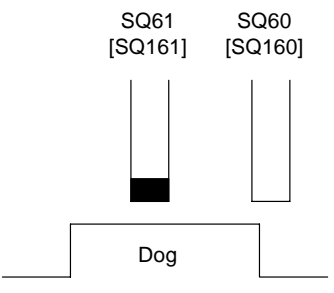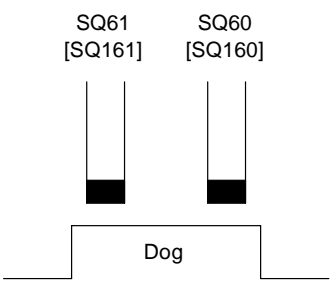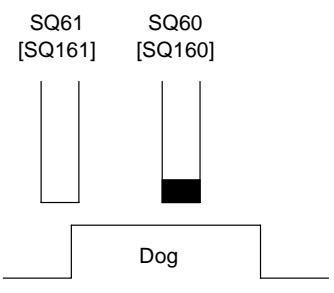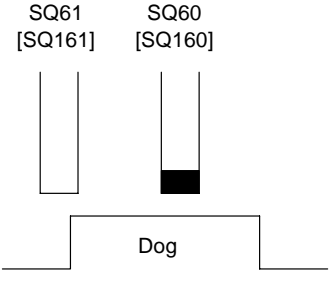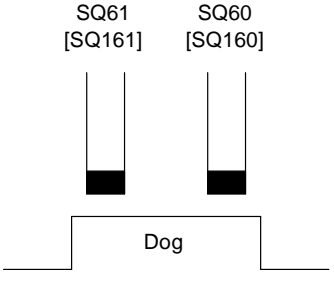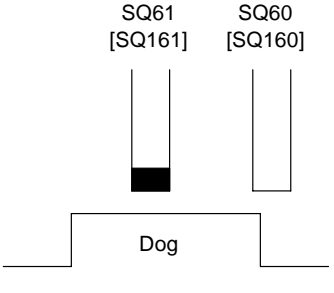
1. The illustration shows the construction of a hollow cylinder. This may be different from the cylinder used in your machine.

2. The detecting switch is adjusted before shipping.

<Relationship between the detecting switches and dog>

- SQ60 [SQ160] . . . . Chuck open detecting switch
- SQ61 [SQ161] . . . . Chuck close detecting switch

NOTE The device codes in [   ] are for spindle 2. (S type)

In the case of state 1., there is a danger that the workpiece comes off 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>
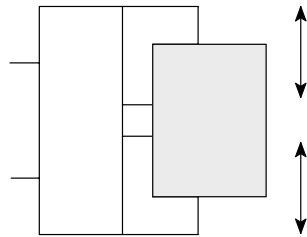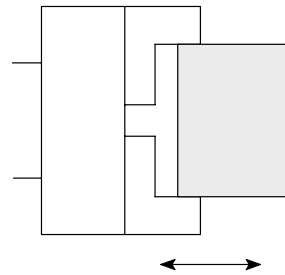
To detect correct holding of a workpiece in the chuck, use the optional holding detection function.

<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 the chuck jaw stroke end detection function valid/invalid>
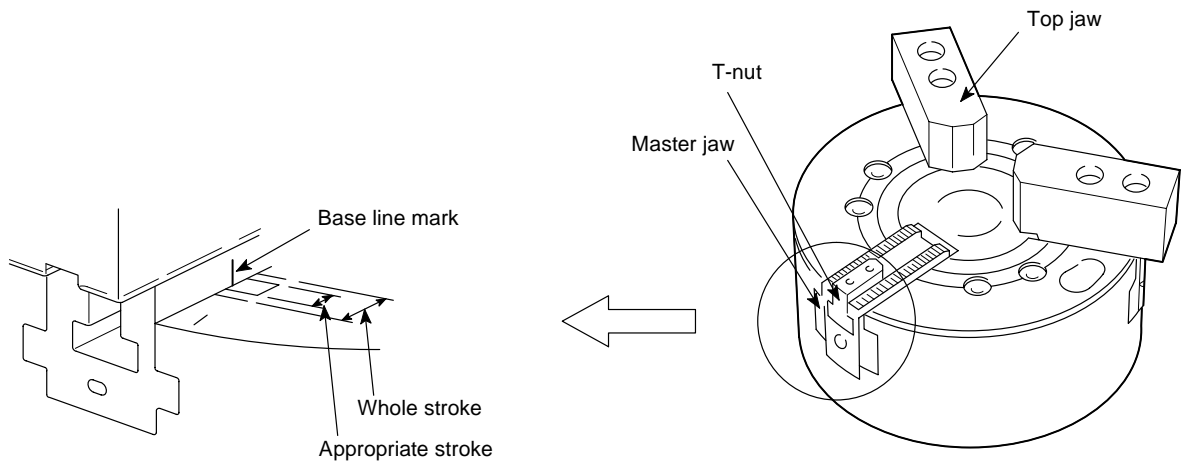
Since the machine is equipped with the chuck jaw stroke end detecting switches, chuck clamp operation is not completed unless the workpiece is clamped by the chuck within an appropriate master chuck jaw stroke range. Accordingly, operation without a workpiece in the chuck, such as shaping the soft jaws and dry run operation 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-39 (5-6-12).

| EDIT | *** | *** | *** | | 0mm/min | | O0001 | N00001 |
| | | | | 0% | 0min-1 | | | |

OPERATION PANEL (1/2)   23:58:53   HEAD1

No.	MENU	CONDITION	
1	SPINDLE OFF MODE	INVALID	VALID
2	CHUCK DIRECTION	O.D.	I.D.
3	TAILSTOCK ILK.	OFF	ON
4	WORK COUNTER	ST.ILK	BDT
5	MACHINE LOCK	OFF	ON
6	AUX. F. LOCK	OFF	ON
7	CHUCK FOOT SWITCH	VALID	INVALID
8	CHUCK STROKE END	VALID	INVALID

| < | BDT | | | | | | | EXIT | > |

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 an alarm 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 the setting for a proper parameter. For details, contact Mori Seiki.

CHAPTER D
PROGRAM EDITING

This chapter describes the following procedure:

1. Storing a program to the NC memory

2. Editing a program stored in the NC memory

3. Inputting/outputting a program to or from the NC memory using an external I/O device

4. Editing a program using the extended program editing function

CONTENTS

1   FOREGROUND AND BACKGROUND

The NC has memory area to store programs.

The memory area is basically divided into two areas: the foreground area, for programs that directly control the machine, and the background area, where the stored data cannot be used to directly control the machine.

1. Register programs used for machining in the foreground area. A program stored in this area cannot be edited during automatic operation.

2. A program stored in the foreground area must be transferred to the background area so it can be edited during automatic operation.

Program editing and program input/output to/from the background area are possible regardless of the selected operation mode.

3. A program input to or edited in the background area must be transferred to the foreground area to be run.
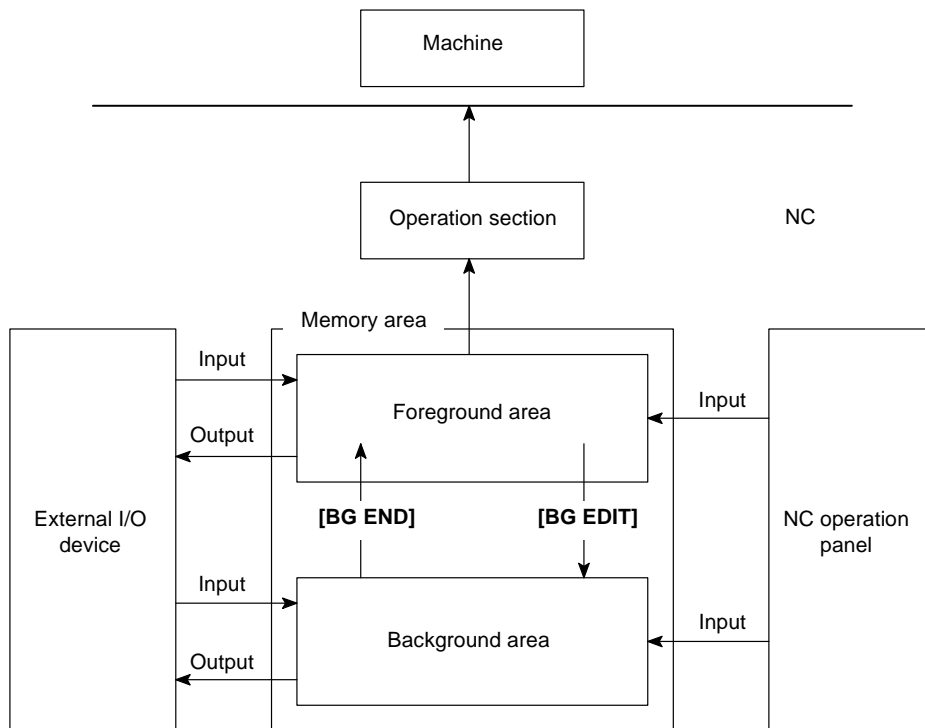
1-1   Foreground Editing

Foreground editing is an operation to edit a program in the foreground area when the edit mode

($\boxed{\gg}$) is selected with the MODE selection switch.

When a program is being edited in the foreground area, automatic operation is not possible.

1-2   Background Editing

Background editing is an operation to edit a program displayed on the screen while executing another program in the automatic mode.

Regardless of the current NC operation mode, whether automatic mode or not, and of the setting of the MODE selection switches, background editing is possible. Any alarms generated during background editing will not influence foreground machine operation and any alarms generated in foreground machine operation will not influence background editing.

Usually, program input or edit operation is executed in the background if such an operation is required during automatic operation.

<Cautions on background operation>

1. Do not press the [✎/RESET] (RESET) key during background editing.

    If the [✎/RESET] (RESET) key is pressed, the NC will be reset.

> **CAUTION** ⚠ Do not press the [✎/RESET] (RESET) key during background editing since automatic operation will be reset and the machine will stop suddenly; this could damage the machine.

2. When finishing background editing, always press the **[BG END]** soft-key.

> **NOTE** If the **[BG END]** soft-key is not pressed, the program edited in the background area cannot be stored in the memory.

3. Background editing is only possible for a program which is not used in the foreground operation.

    If an attempt is made to edit a program in the background while it is being used in foreground operation, the message "FOREGROUND PROGRAM." will be displayed and editing will not be possible.

4. Alarms in the background occur in the same manner as during program editing in the foreground, but they are cleared when any edit operation (pressing a key) is carried out.

5. Pay attention when pressing the [↕] (ST) switch during background editing in the memory mode.
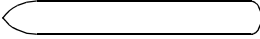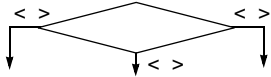
> **CAUTION** ⚠ If the [↕] (ST) switch is pressed at the background edit screen under the conditions that the automatic operation (program) cycle has completed and the memory mode is selected, the program selected in the foreground starts. Therefore, the machine operates in a manner different from the program displayed on the screen (background area).

1-3   Symbols Used in Flowchart

In this chapter, operation procedure is explained using a flowchart.

The symbols used in a flowchart are explained below.

Symbol	Meaning
	Indicates the start and end of operation.
	Indicates an operation of a switch, button, or key on the operation panel. Also indicates what is to be referred to on the page indicated by ▭.
	Indicates the display on the screen.
	Indicates the entry of address or numeric value using data entry keys.
< > < > < >	Indicates the selection of operation. < > indicates the operation method to select an operation.

2   STORING A PROGRAM TO NC MEMORY

Programs created by a programmer should be input to the NC memory area.

This section describes the operating procedure to store a program into the NC memory area using the data entry keys.

1.   Using data entry keys (Foreground)

2.   Using data entry keys (Background)

NOTE

1.   A program can be stored only when the PANEL key-switch is placed in the �◇ (PANEL/EDIT) position.

2.   When a program is input in the foreground edit mode using the ⌨ (INSERT) key, ⌨ (ALTER) key, or ⌨ (DELETE) key, press the ⌨ (RESET) key after completing program entry.

   If the ⌨ (RESET) key is not pressed, the program input cannot be registered to the memory.

3.   After inputting a program in the background edit mode, press the **[BG END]** soft-key to end the background edit mode.

   If the **[BG END]** soft-key is not pressed, the program input in the background area cannot be registered in the foreground area.

WARNING

Always place the PANEL key-switch in the ☐ (ON) or ☐ (OFF) position after completing program entry. Be aware that the program will be updated if program editing operations are carried out with the PANEL key-switch at the ◇ (PANEL/EDIT) 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.

Start of Operation

↓

PANEL key-switch: [⬙] (PANEL/EDIT)

↓

HEAD CHANGE switch: [⬙] (head 1)
[⬙] (head 2)

→ <Background edit>

<Foreground edit>

MODE selection switch: [⬙] (EDIT)	Function selection key: [⬙] (PROG)
Function selection key: [⬙] (PROG)	Soft-key: **[BG EDIT]**
PROGRAM (edit) screen	PROGRAM (background edit) screen

<To start from program number insertion>

<To start from program number search>

Program number

↓

Soft-key: **[O SEARCH]**

Data entry key: [o(]

↓

Program number

↓

Comment*

Insertion key: [⬙] (INSERT)

↓

Insertion key: [⬙] (INSERT)

↓

Program

↓

One block of program input? — No

↓ Yes

Data entry key: [;/EOB] (EOB)

↓

Insertion key: [⬙] (INSERT)

↓

Continue inputting program? — Yes

↓ No

<Background edit> → Soft-key: **[BG END]**

<Foreground edit>

Reset key: [⬙] (RESET)

↓

PANEL key-switch: [⬚] (ON), [⬚] (OFF)

↓

End of Operation
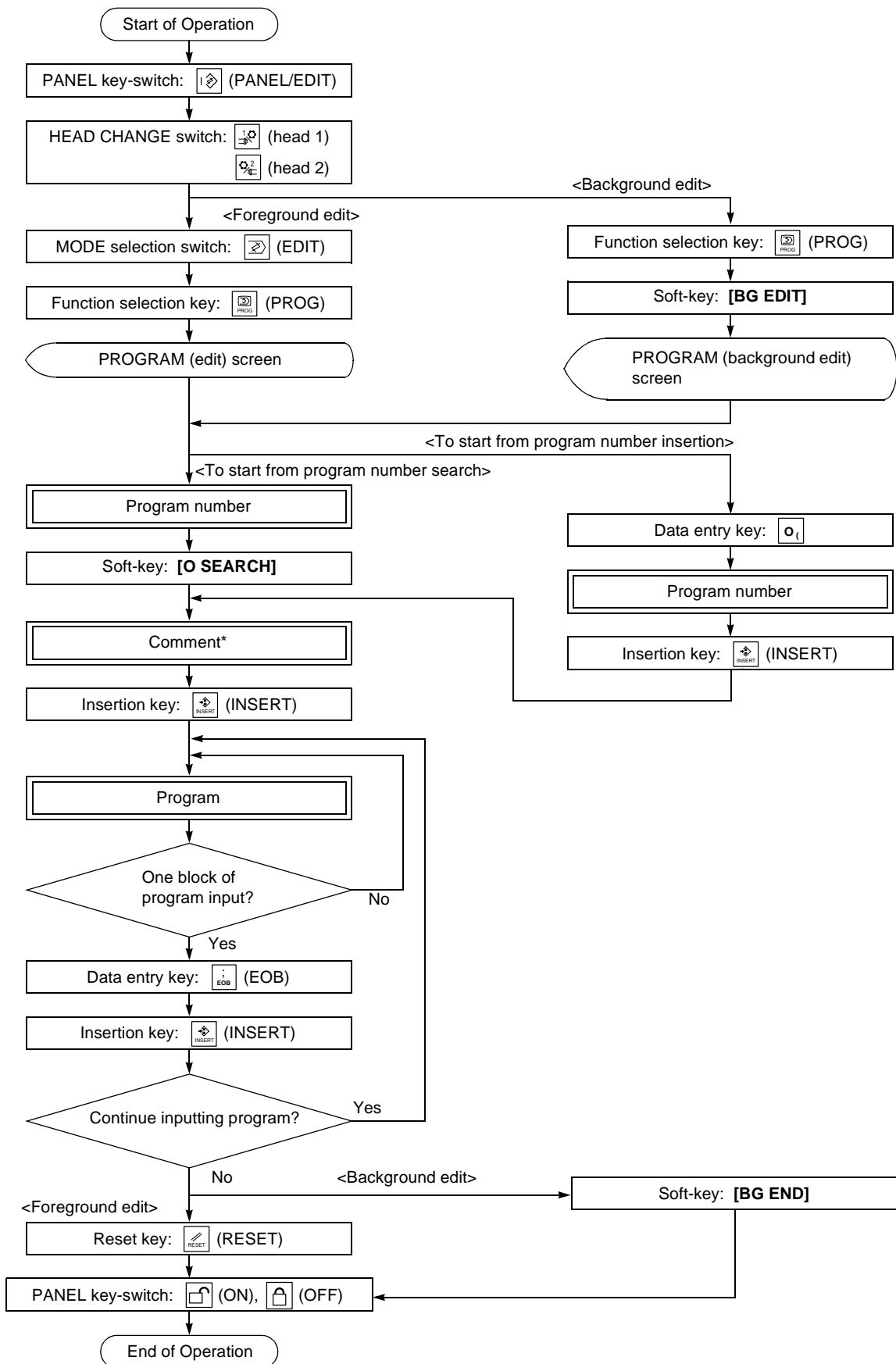
NOTE
*   A comment may not necessarily be input.
    Up to 18 characters may be input as a comment.

3   SEARCH FUNCTION

To edit a program or start a program from a block, locate the program block or word with the search function.

Three different search functions are available:

1. Program number search

2. Sequence number search

3. Word search

3-1   Program Number Search

The program search function can be used in the edit mode or the memory mode.

This function is used to locate the program to be edited in the edit mode and the program to be executed during automatic operation in the memory mode.

This function is also used to search for the head of a program.
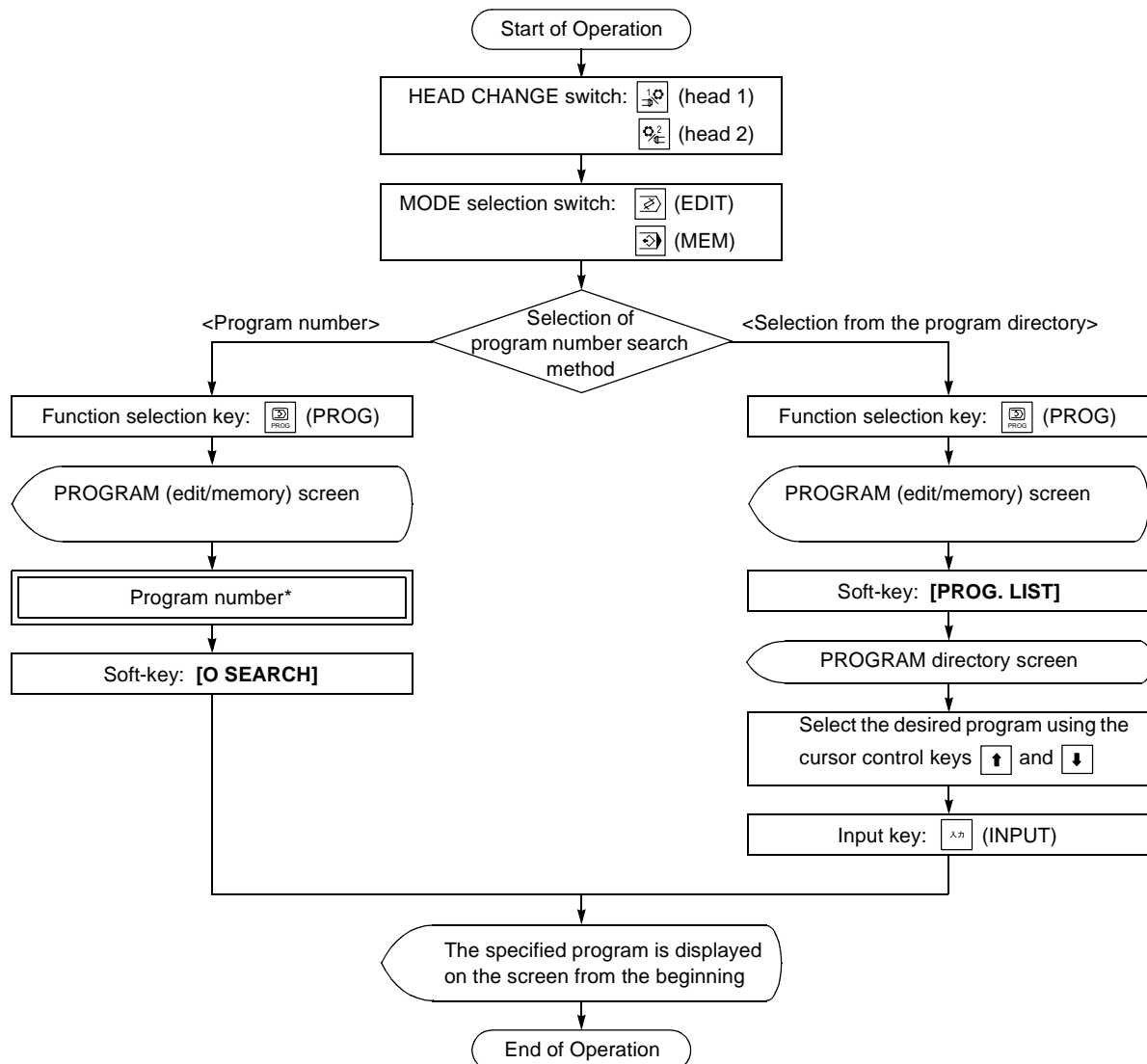
NOTE * In the edit mode or if background editing is selected, if the **[O SEARCH]** soft-key is pressed after inputting an unregistered program number, a program of the input program number is newly created.
When the memory mode is selected, if the **[O SEARCH]** soft-key is pressed after inputting an unregistered program number, the message "PROGRAM NUMBER NOT FOUND." is displayed.

NOTE 1. The program number search operation is also possible for background edit operation.

2. The program already called in foreground cannot be called in background.

3. In background editing, two programs may be called in the same manner.

3-2   Sequence Number Search

To start the automatic operation from this block

To add program information to this block

Program

NO.130
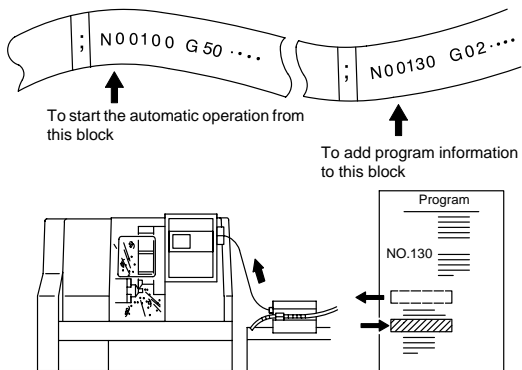
The sequence number search function is used to search for a sequence number in a program in the edit or memory mode.

This function is used to locate a specific block in a program to be edited in the edit mode, or start automatic operation from a specific block while in the memory mode.

NOTE

1.   Enter the sequence number to be searched for exactly as it appears in the program.

     For example, "N7" cannot be used to search for "N00007".

2.   Press the **[SEARCH ↑]** soft-key to search for a sequence number located before the current cursor position.

3.   If the sequence number searched for on the PROGRAM (memory) screen does not exist, the message "N-NUMBER DOES NOT EXIST" is displayed.

4.   If the sequence number searched for on the PROGRAM (edit) screen does not exist, the message "STRING NOT FOUND" is displayed.
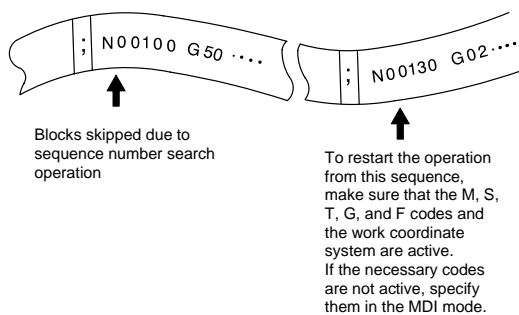
<Cautions for using the sequence number search function for starting automatic operation from the searched block>

Blocks skipped due to sequence number search operation

To restart the operation from this sequence, make sure that the M, S, T, G, and F codes and the work coordinate system are active. If the necessary codes are not active, specify them in the MDI mode.

WARNING

Coordinate values and M, S, T, G, and F codes in the blocks skipped during sequence number search operation do not change the coordinate values or modal M, S, T, G, and F codes in the NC.
When restarting the operation after searching a block in the middle of a program, 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.

<Sequence number search in a sub-program>

To search for a sequence number in a sub-program, search for the sub-program before attempting the sequence number search.

If the sequence number is searched for directly without searching for a sub-program number first, the enabled operation is the same as a sequence number search of the program.

NOTE If the specified sequence number is found in the main program, that block is searched for.

If the specified sequence number is not found in the main program, an alarm occurs.

<Sequence number search operation procedure>

```
                        ┌──────────────────────┐
                        │  Start of Operation  │
                        └──────────────────────┘
                                   │
        ┌──────────────────────────────────────────────────┐
        │  HEAD CHANGE switch:  [⊞] (head 1)               │
        │                       [⊞] (head 2)               │
        └──────────────────────────────────────────────────┘
                                   │
                          ◇ Selection of ◇
      <Edit mode>           operation mode          <Memory mode>
        │                                                 │
  ┌──────────────────────────────┐      ┌──────────────────────────────┐
  │ MODE selection switch: [⊘]   │      │ MODE selection switch: [⊡]   │
  │              (EDIT)          │      │              (MEM)           │
  └──────────────────────────────┘      └──────────────────────────────┘
        │                                                 │
  ┌──────────────────────────────┐      ┌──────────────────────────────┐
  │ Function selection key: [⊡]  │      │ Function selection key: [⊡]  │
  │              (PROG)          │      │              (PROG)          │
  └──────────────────────────────┘      └──────────────────────────────┘
        │                                                 │
  ⟨ PROGRAM (edit) screen ⟩             ⟨ PROGRAM (edit) screen ⟩
        │                                                 │
  ┌──────────────────────────────┐      ┌──────────────────────────────┐
  │ Program search               │      │ Program search               │
  │    Page D-8 (3-2)            │      │    Page D-8 (3-2)            │
  └──────────────────────────────┘      └──────────────────────────────┘
        │                                                 │
  ┌──────────────────────────────┐      ┌──────────────────────────────┐
  │ Data entry key: [N)]         │      │ Sequence number              │
  └──────────────────────────────┘      └──────────────────────────────┘
        │                                                 │
  ┌──────────────────────────────┐      ┌──────────────────────────────┐
  │ Sequence number              │      │ Soft-key: [N SEARCH]         │
  └──────────────────────────────┘      └──────────────────────────────┘
        │                                                 │
  ┌──────────────────────────────┐
  │ Soft-key: [SEARCH ↑] or      │
  │           [SEARCH ↓]         │
  └──────────────────────────────┘
        │                                                 │
  ⟨ The searched sequence number is displayed at the upper right area and the sequence number in
    the program is highlighted ⟩
                                   │
                        ┌──────────────────────┐
                        │   End of Operation   │
                        └──────────────────────┘
```

3-3   Word Search

A word search operation is required when editing a program. First, the program to be edited is called by the program number search operation and, then, the word to be edited is located by the word search operation.

The following three methods are used for the word search operation:

1.   Searching for a word with the cursor control keys

2.   Searching for a word with the page selection keys

3.   Searching for a word using the data entry keys and the soft-keys

<Cautions on word search using data entry keys and soft-keys>

NOTE

1.   If the searched word appears more than once in the program, the first occurrence of the word located after the current cursor position is searched for.

2.   Enter the word to be searched for exactly as it appears in the program.

    For example, "M3" cannot be used to search for "M03".

3.   Press the **[SEARCH ↑]** soft-key or the cursor control key $\boxed{\uparrow}$ to search for a word located before the current cursor position.

4.   If the searched word does not exist, the message "STRING NOT FOUND" is displayed.

<Word search operation procedure>
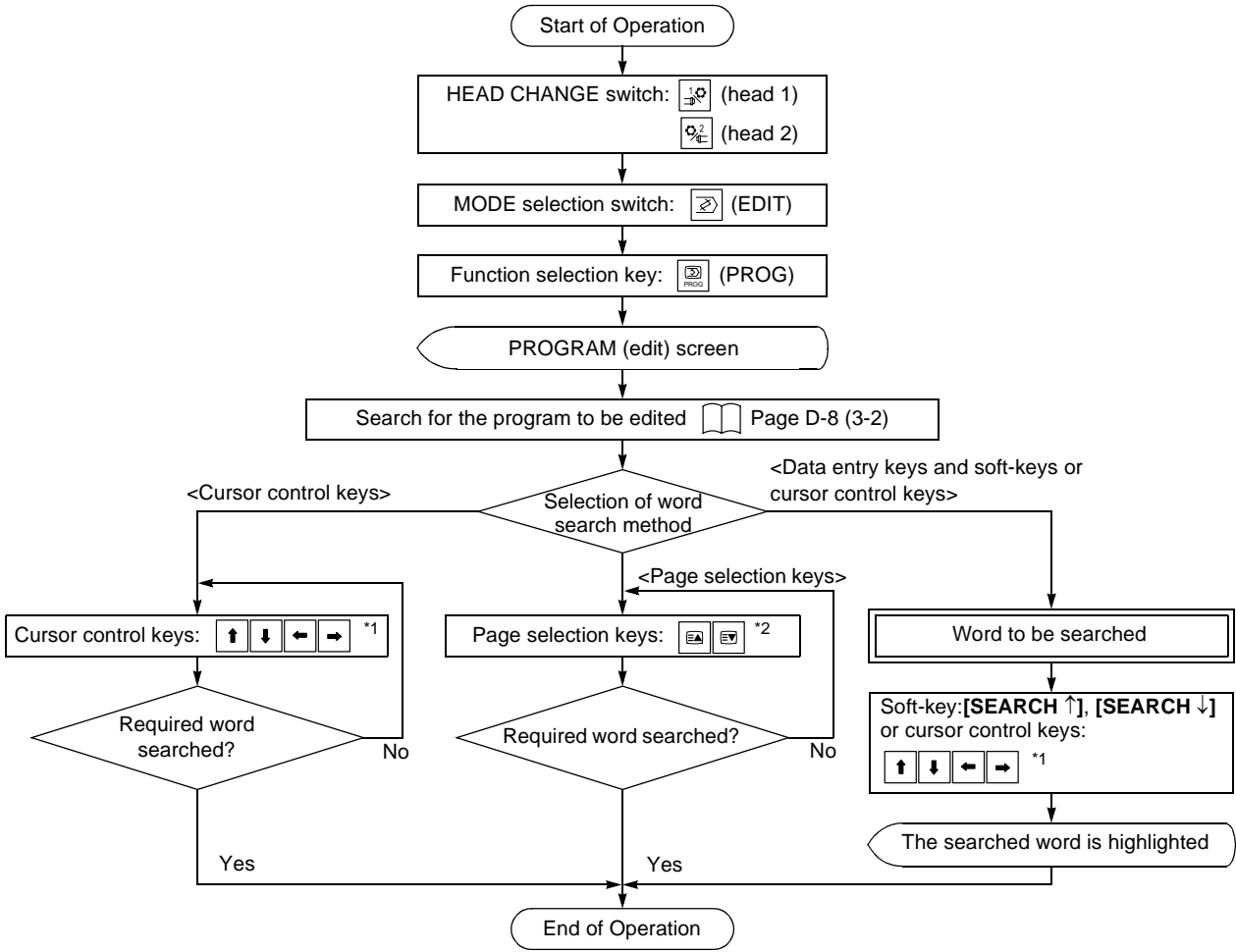
*1 Press the cursor control key and the cursor moves word by word.

↑	The cursor will be located on the first word of the previous block.
↓	The cursor will be located on the first word of the next block.
→	The cursor moves to the right, word by word.
←	The cursor moves to the left, word by word.

*2 Press the page selection key and the pages change.

⊟▲	The previous page is displayed. The cursor will be located on the first word of the page.
⊟▼	The next page is displayed. The cursor will be located on the first word of the page.

3-4   Program Head Search

The program head search function is used to locate the head of a program after editing a program or after the NC is reset during automatic operation.

```
                          ┌──────────────────┐
                          │ Start of Operation│
                          └──────────────────┘
                                   │
         ┌──────────────────────────────────────────────┐
         │ HEAD CHANGE switch:  [⚙] (head 1)             │
         │                      [⚙] (head 2)             │
         └──────────────────────────────────────────────┘
                                   │
   <Edit mode>          ◇ Selection of ◇          <Memory mode>
   ┌─────────────────── operation mode ───────────────────┐
   │                                                       │
   ▼                                                       ▼
┌──────────────────────────────┐          ┌──────────────────────────────┐
│ MODE selection switch: [▱](EDIT)│       │ MODE selection switch: [▱](MEM)│
└──────────────────────────────┘          └──────────────────────────────┘
   │                                                       │
   ▼                                                       ▼
┌──────────────────────────────┐          ┌──────────────────────────────┐
│ Function selection key:[▱](PROG)│       │ Function selection key:[▱](PROG)│
└──────────────────────────────┘          └──────────────────────────────┘
   │                                                       │
   ▼                                                       ▼
  PROGRAM (edit) screen                      PROGRAM (memory) screen
   │                                                       │
   ▼                                                       ▼
┌──────────────────────────────┐          ┌──────────────────────────────┐
│ Program search                │          │ Program search                │
│ 📖 Page D-8 (3-2)             │          │ 📖 Page D-8 (3-2)             │
└──────────────────────────────┘          └──────────────────────────────┘
   │                                                       │
   ▼                                                       ▼
 <Reset key>   ◇ Selection of word ◇  <Soft-key>   ┌──────────────────────┐
   ┌───────────── search method ──────────┐        │ Soft-key: [TOP]      │
   │                                       │        └──────────────────────┘
   ▼                                       ▼                │
┌──────────────────────┐  ┌──────────────────────┐          ▼
│ Reset key: [✎](RESET)│  │ Soft-key: [TOP]      │  ┌──────────────────────────────┐
└──────────────────────┘  └──────────────────────┘  │ The cursor moves to the head of│
   │                       │                          │ the program and the program    │
   └───────────┬───────────┘                          │ number is highlighted          │
               ▼                                       └──────────────────────────────┘
┌──────────────────────────────┐                               │
│ The cursor moves to the head  │                               ▼
│ of the program and the program│                      ┌──────────────────┐
│ number is highlighted         │                      │ End of Operation │
└──────────────────────────────┘                      └──────────────────┘
               │
               ▼
      ┌──────────────────┐
      │ End of Operation │
      └──────────────────┘
```

3-5   Program Bottom Search

The program bottom search function is used to locate the bottom of a program when editing a program.

```
                    ╭─────────────────────╮
                    │  Start of Operation  │
                    ╰─────────────────────╯
                               │
        ┌──────────────────────────────────────────┐
        │ HEAD CHANGE switch:  [⬚] (head 1)          │
        │                      [⬚] (head 2)          │
        └──────────────────────────────────────────┘
                               │
        ┌──────────────────────────────────────────┐
        │ MODE selection switch:  [⬚] (EDIT)         │
        └──────────────────────────────────────────┘
                               │
        ┌──────────────────────────────────────────┐
        │ Function selection key:  [⬚] (PROG)        │
        └──────────────────────────────────────────┘
                               │
        ╭──────────────────────────────────────────╮
        │ PROGRAM (edit) screen                      │
        ╰──────────────────────────────────────────╯
                               │
        ┌──────────────────────────────────────────┐
        │ Program search                             │
        │  ▭ Page D-8 (3-2)                          │
        └──────────────────────────────────────────┘
                               │
        ┌──────────────────────────────────────────┐
        │ Soft-key:  [BOTTOM]                        │
        └──────────────────────────────────────────┘
                               │
        ╭──────────────────────────────────────────╮
        │ The cursor moves to the bottom of the      │
        │ program and the last word is highlighted   │
        ╰──────────────────────────────────────────╯
                               │
                    ╭─────────────────────╮
                    │  End of Operation    │
                    ╰─────────────────────╯
```
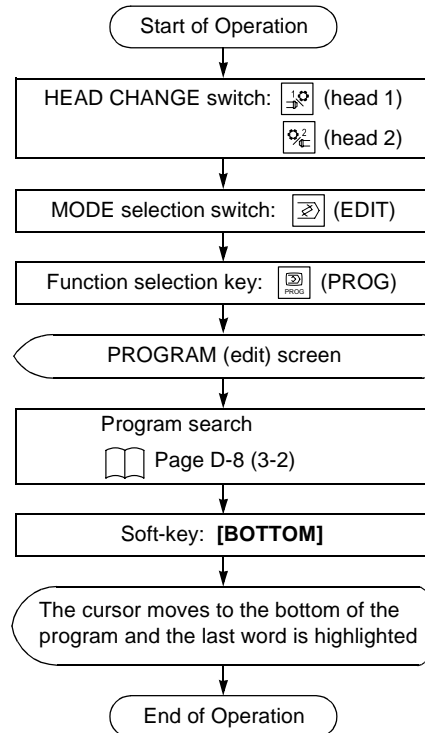
4 PROGRAM EDITING

Editing a program means the procedure to change a part of the program, already stored in memory, into the most appropriate one to meet the intended operation, using the data entry keys, soft-keys, and program edit keys.

<Alteration>

This operation is used to change a word in the program to a new word or block.

<Insertion>

This operation is used to insert a new word or block between words in the program.

<Deleting>

This operation is used to delete a block or word in the program.

NOTE Before deleting the data, make sure that the words, blocks, or programs to be deleted may be deleted. Once the ▨ (DELETE) key is pressed and the words, blocks, or programs are deleted, there is no way to restore them.

<Cautions on editing a program>

WARNING ⚠ **Always place the PANEL key-switch in the 🔓 (ON) or 🔒 (OFF) position after completing program editing. Be aware that the program will be updated if program editing operations are carried out with the PANEL key-switch at the 🖉 (PANEL/EDIT) 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.**

NOTE
1. Before editing a program, select foreground or background editing.

   📖 Page D-1 (1-1) for foreground editing
   Page D-2 (1-2) for background editing

2. Program editing is possible only when the PANEL key-switch is placed in the 🖉 (PANEL/EDIT) position, program editing can be done.

3. When a program is input in the foreground edit mode using the ▨ (INSERT) key, ▨ (ALTER) key, or ▨ (DELETE) key, press the ▨ (RESET) key after completing program entry.

   If the ▨ (RESET) key is not pressed, the program input cannot be registered to the memory.

NOTE

4. After inputting a program in the background edit mode, press the **[BG END]** soft-key to end the background edit mode.

    If the **[BG END]** soft-key is not pressed, the program input in the background area cannot be registered in the foreground area.

5. Press the ⌊CAN⌋ (CAN) key if an error is found in the keyed word or block before pressing the ⌊ALTER⌋ (ALTER) key or ⌊INSERT⌋ (INSERT) key.

6. To alter or insert a block of data, move the cursor to position where the block is to be altered or inserted. Key in the new block and press the ⌊EOB⌋ (EOB) key. Then press the ⌊ALTER⌋ (ALTER) key or ⌊INSERT⌋ (INSERT) key.

7. Letter "@" cannot be used in a program.

8. If "%" code, entered at the end, is included in selected area, copy and move operation are not possible.

9. Program editing is not possible in the emergency stop state.

10. When editing a comment, it is not possible to delete a comment with the cursor positioned at "(" or ")". Use either of following procedures to delete a comment.

    • Move the cursor to "(" and press the ⌊EOB⌋ (EOB) key then the ⌊DELETE⌋ (DELETE) key.

    • After selecting the comment to be deleted by range selection operation, move the cursor to any position after ")" and cut the selected comment.

    Deletion or alteration of a parenthesis "(" or ")" independently is not allowed.

11. When the NC screen display function is used at the personal computer side, do not attempt background editing at the personal computer. If attempted, program editing and MDI operation are disabled at the NC screen.

12. When a word is inserted while the cursor is on or one line above the "%" line, semicolon ";" is appended to the inserted word.
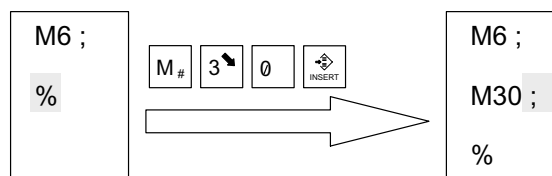
13. When only a number is keyed in before pressing the ⌊ALTER⌋ (ALTER) key in the state the cursor is on the semicolon (;), the keyed in number is appended to the word immediately before the cursor.

\<Program editing operation procedure\>

(A)   <Alteration>

Data to be altered

Alteration key: [ALTER] (ALTER)

Another alteration?   Yes ──── (E)

No

End of edit?   No ──── (D)

Yes

<Background edit>

Soft-key: **[BG END]**

<Foreground edit>

Reset key: [RESET] (RESET)

PANEL key-switch: [unlock] (ON), [lock] (OFF)

End of Operation

B   <Insertion>

<Key in data to be inserted>   Insertion procedure   <Copy data to be inserted>

<Word>   Contents of insertion   <Block>

Move the cursor to the block to be copied using the cursor control keys ↑ and ↓

| Data to be inserted | | Data to be inserted |

Insertion key: [INSERT] (INSERT)

Data entry key: [EOB] (EOB)

Menu selection key **[>]**

Soft-key: **[LINE EDIT]**

Insertion key: [INSERT] (INSERT)

The copied block is displayed on the key input buffer

Cursor located at the position to be inserted?   No

Yes

<Sequential>   Cursor moving method   <Direct>

Move the cursor using the page selection keys and the cursor control keys

Search the word at the position where editing is to be done
📖 Page D-10 (3-3)

Insertion key: [INSERT] (INSERT)

Another insertion?   Yes   E

No

End of edit?   No   D

Yes

<Background edit>

<Foreground edit>

Soft-key: **[BG END]**

Reset key: [RESET] (RESET)

PANEL key-switch: 🔓 (ON), 🔒 (OFF)

End of Operation

```
                                    ( C )   <Deletion>

            <Contents of program>    ◇ Contents of deletion ◇    <Program>

                                                          Data entry key:  [O]

        <Word>          Contents of deletion    <Multiple blocks>
                        ◇               ◇                <Specified program>  Contents of deletion  <All programs>
                          <One block>                           ◇            ◇

  Search for the word   Search for the first   Search for the first    Program number      Data entry key:
  to be deleted         word of the block to   word of the block to    of the program to   [-] [9] [9] [9] [9]
  📖 Page D-10          be deleted             be deleted              be deleted
  (3-3)                 📖 Page D-10 (3-3)     📖 Page D-10 (3-3)

  Deletion key:         Data entry key:        Key in the first word   Deletion key:       Deletion key:
  [DELETE] (DELETE)     [EOB] (EOB)            of the last block to    [DELETE] (DELETE)   [DELETE] (DELETE)
                                               be deleted

                        Deletion key:                                  Message "DELETE     Message "ALL
                        [DELETE] (DELETE)                              OK?" is displayed   DELETE OK?" is
                                                                                            displayed

                                               Deletion key: [DELETE] (DELETE)

                                               Data entry key: [EOB] (EOB)                  Soft-key: [EXEC.]

                                               Deletion key: [DELETE] (DELETE)


                                    ◇ Another deletion? ◇  ——— Yes

                                               No

                                    ◇ End of edit? ◇  ——— No ———( D )

                                               Yes
                                                          <Background edit>   Soft-key: [BG END]
                        <Foreground edit>

                        Reset key: [RESET] (RESET)

             PANEL key-switch: [🔓] (ON), [🔒] (OFF)

                        ( End of Operation )
```
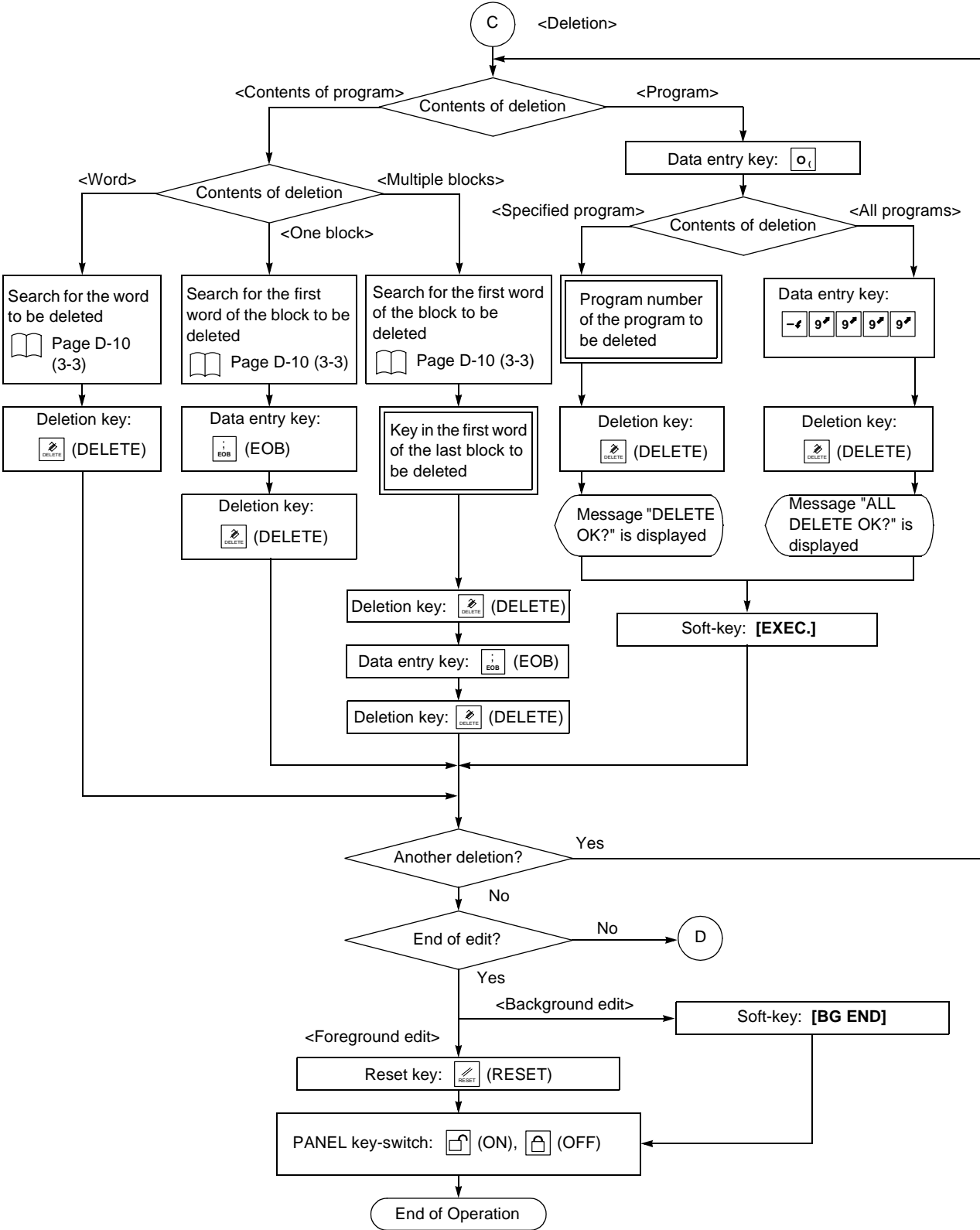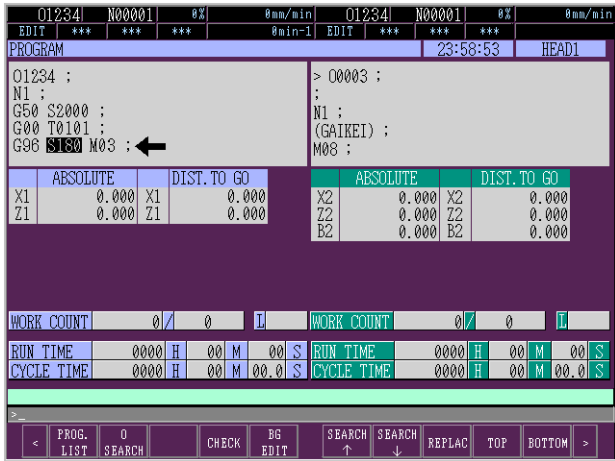
4-1   Command Change Example

In this section, an example in which the program to be edited "O1234" is searched and the word "S180" in this program is changed to "S150".

1) Display the PROGRAM (edit) screen.
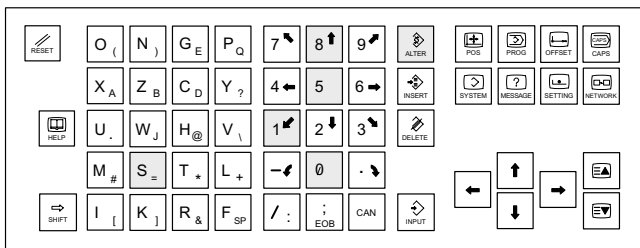
Page A-90 (7-2-1)
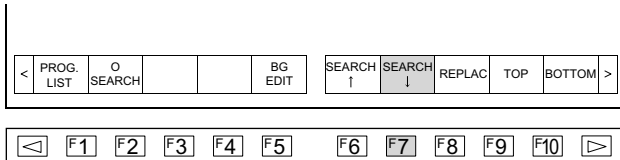
2) Search the program "O1234".

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3) Search for the word "S180".

a) Input "S180" using the data entry keys.
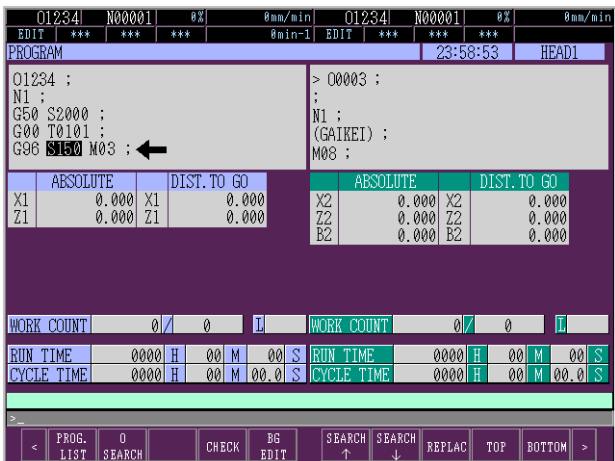

b) Press the **[SEARCH ↓]** soft-key.
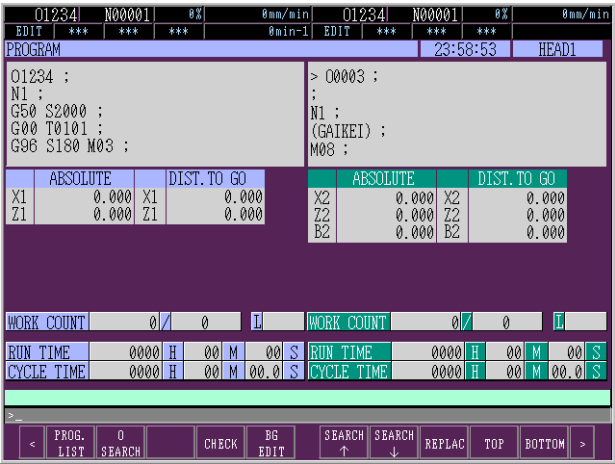
4) Input "S150" using the data entry keys.

5) Press the (ALTER) key.

The word "S180" is changed to the new word "S150".

4-2   Command Insertion Example

The following operation example describes the procedure for searching the program to be edited "O1234" and inserting a word "F0.15" after the word "X10.0" in this program.
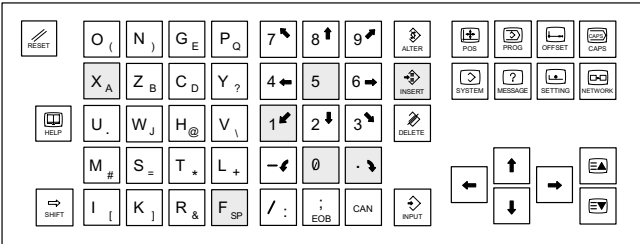
1) Display the PROGRAM (edit) screen.

      Page A-90 (7-2-1)

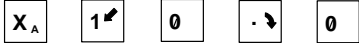2) Search for the program "O1234".

      Page D-8 (3-2)

3) Search for the word "X10.0" that is located just before the word "F0.15" to be inserted.

   a) Input "X10.0" using the data entry keys.

      $\boxed{X_A}$ $\boxed{1}$ $\boxed{0}$ $\boxed{\cdot}$ $\boxed{0}$

   b) Press the **[SEARCH ↓]** soft-key.
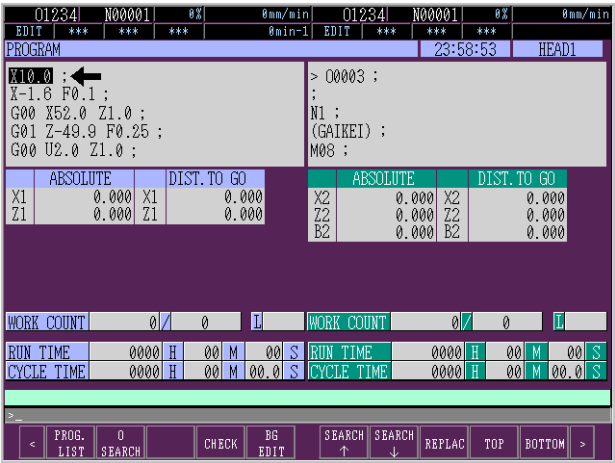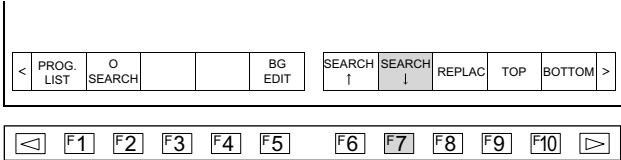
The word "X10.0" is searched for.

4) Input "F0.15" using the data entry keys.

   $\boxed{F_{SP}}$ $\boxed{0}$ $\boxed{\cdot}$ $\boxed{1}$ $\boxed{5}$

5) Press the $\boxed{\text{INSERT}}$ (INSERT) key.

NOTE Press the $\boxed{\text{CAN}}$ (CAN) key if an error is found in the keyed word or block before pressing the $\boxed{\text{INSERT}}$ (INSERT) key.
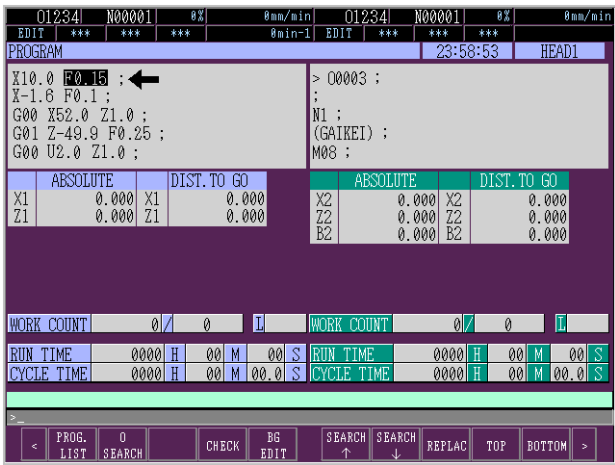
The word "F0.15" is inserted after the word "X10.0".

NOTE To insert a block of data, move the cursor to position where the block is to be inserted. Key in the new block and press the [; EOB] (EOB) key. Then press the [INSERT] (INSERT) key.

4-3   Deletion Examples

The following shows operation example for deleting a word and a block.

4-3-1   Deleting a Word

The following operation example describes the procedure for deleting the word "M08" after searching the program "O1234".
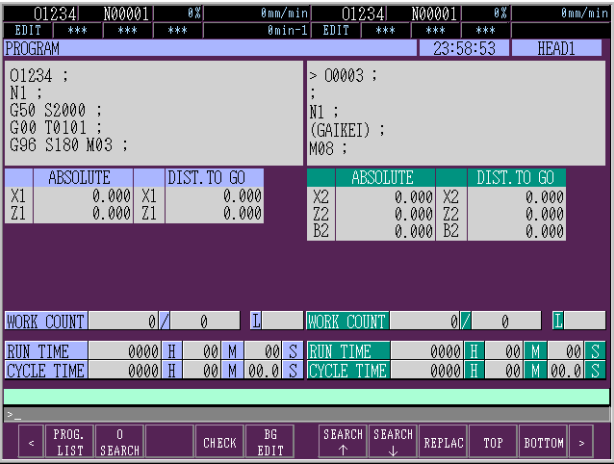
1) Display the PROGRAM (edit) screen.

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2) Search the program "O1234".

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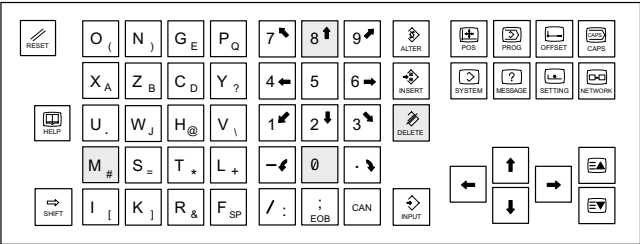
3) Search for the word "M08".

   a) Input "M08" using the data entry keys.
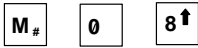
   b) Press the **[SEARCH ↓]** soft-key.
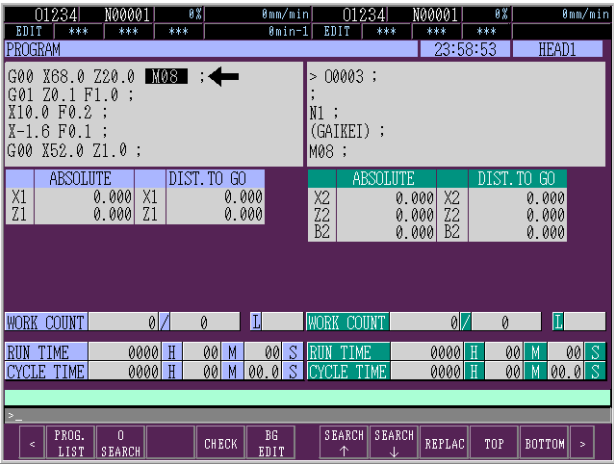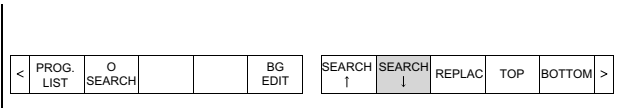
The word "M08" is searched for.

4) Press the (DELETE) key.
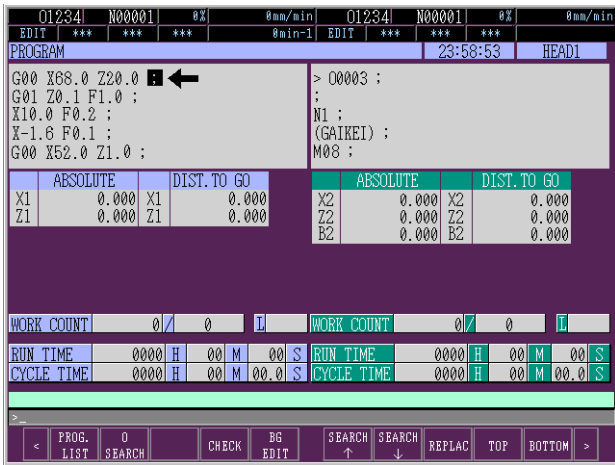
The word "M08" is deleted.

4-3-2   Deleting a Block

The following operation example describes the procedure for searching the program to be edited "O1234" and deleting a block of commands from this program.
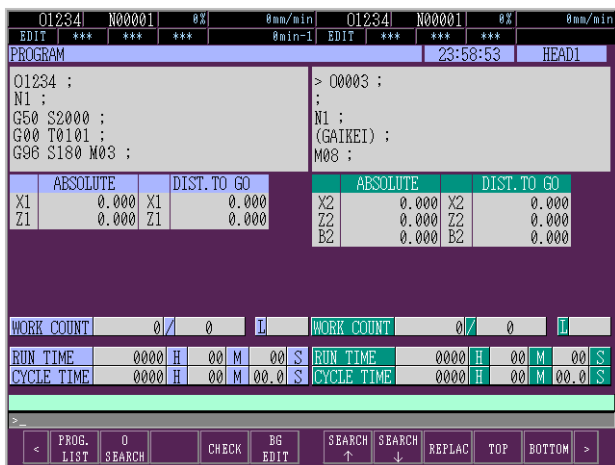
1)   Display the PROGRAM (edit) screen.

📖   Page A-90 (7-2-1)

2)   Search for the program "O1234".

📖   Page A-90 (7-2-1)

To delete the block A
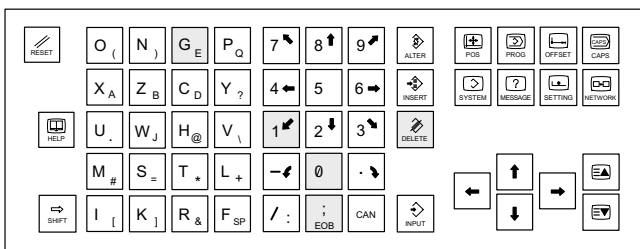
3)   Search for the word "G01" which is the first word of the block to be deleted.

a)   Input "G01" using the data entry keys.

| G_E | 0 | 1 |

b)   Press the **[SEARCH ↓]** soft-key.

The word "G01" is searched for.

4) Press the ⌷; (EOB) key.

```
O1234  N00001    0%     0mm/min  O1234  N00001    0%      0mm/min
EDIT   ***   ***   ***          0min-1 EDIT   ***   ***   ***
PROGRAM                                        23:58:53    HEAD1
G01 Z0.1 F1.0 ;.............. A   > O0003 ;
X10.0 F0.2 ;................. B   ;
X-1.6 F0.1 ;................. C   N1 ;
G00 X52.0 Z1.0 ;                  (GAIKEI) ;
G01 Z-49.9 F0.25 ;                M08 ;
     ABSOLUTE      DIST.TO GO          ABSOLUTE      DIST.TO GO
X1        0.000 X1       0.000   X2       0.000 X2        0.000
Z1        0.000 Z1       0.000   Z2       0.000 Z2        0.000
                                 B2       0.000 B2        0.000


WORK COUNT     0/    0    L   WORK COUNT     0/    0    L
RUN TIME     0000 H   00 M   00 S  RUN TIME     0000 H   00 M   00 S
CYCLE TIME   0000 H   00 M 00.0 S  CYCLE TIME   0000 H   00 M 00.0 S

>_
  <   PROG.   0            CHECK  BG    SEARCH SEARCH  REPLAC  TOP  BOTTOM  >
      LIST  SEARCH               EDIT    ↑      ↓
```

5) Press the ⌷ (DELETE) key.

The block A is deleted.

```
O1234  N00001    0%     0mm/min  O1234  N00001    0%      0mm/min
EDIT   ***   ***   ***          0min-1 EDIT   ***   ***   ***
PROGRAM                                        23:58:53    HEAD1
X10.0 F0.2 ;................. B   > O0003 ;
X-1.6 F0.1 ;................. C   ;
G00 X52.0 Z1.0 ;                  N1 ;
G01 Z-49.9 F0.25 ;                (GAIKEI) ;
G00 U2.0 Z1.0 ;_                  M08 ;
     ABSOLUTE      DIST.TO GO          ABSOLUTE      DIST.TO GO
X1        0.000 X1       0.000   X2       0.000 X2        0.000
Z1        0.000 Z1       0.000   Z2       0.000 Z2        0.000
                                 B2       0.000 B2        0.000


WORK COUNT     0/    0    L   WORK COUNT     0/    0    L
RUN TIME     0000 H   00 M   00 S  RUN TIME     0000 H   00 M   00 S
CYCLE TIME   0000 H   00 M 00.0 S  CYCLE TIME   0000 H   00 M 00.0 S

>_
  <   PROG.   0            CHECK  BG    SEARCH SEARCH  REPLAC  TOP  BOTTOM  >
      LIST  SEARCH               EDIT    ↑      ↓
```

4-4 Copying a Block of Commands

The following operation example describes the procedure for searching for the program "O1234" and copying a block of commands in this program to the specified position in the same program.
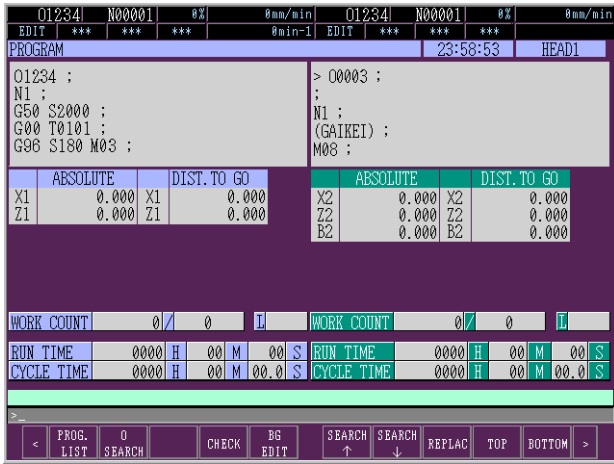

1) Display the PROGRAM (edit) screen.

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2) Search the program "O1234".

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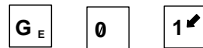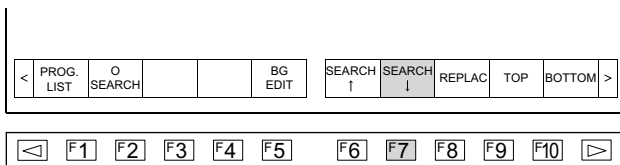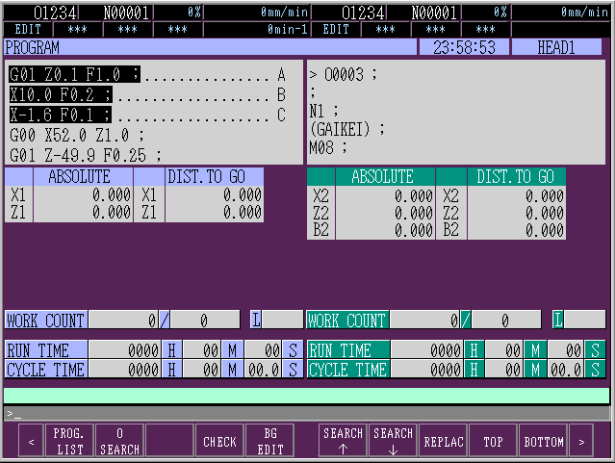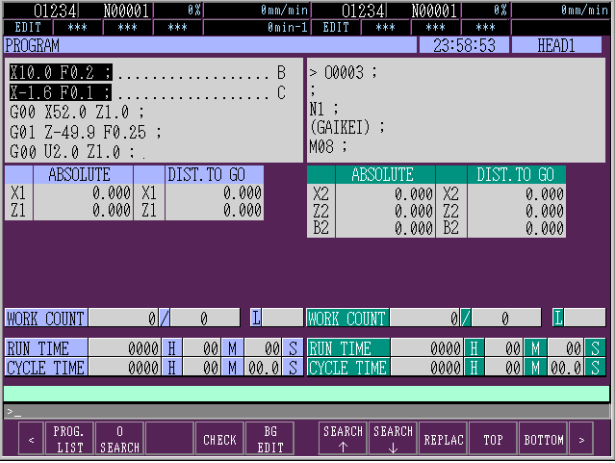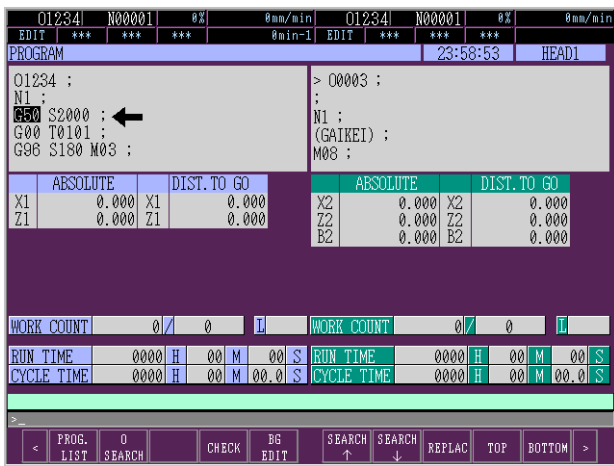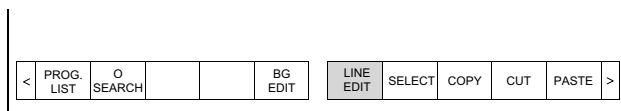3) Move the cursor to the first word in the block to be copied.

4) Press the menu selection key **[>]**.
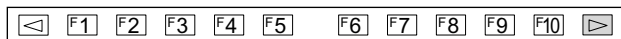
5) Press the **[LINE EDIT]** soft-key.
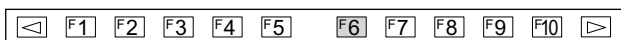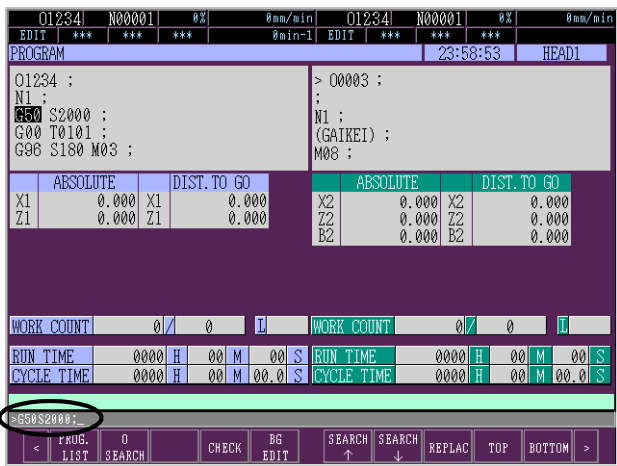
The cursor located block is written into the input buffer and displayed on the screen.
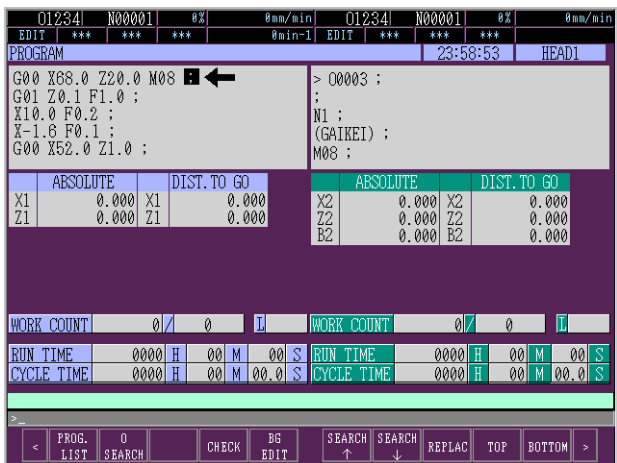
6) Move the cursor to the position immediately before the position where the block of commands written in the input buffer should be inserted.

7) Press the [INSERT] (INSERT) key.
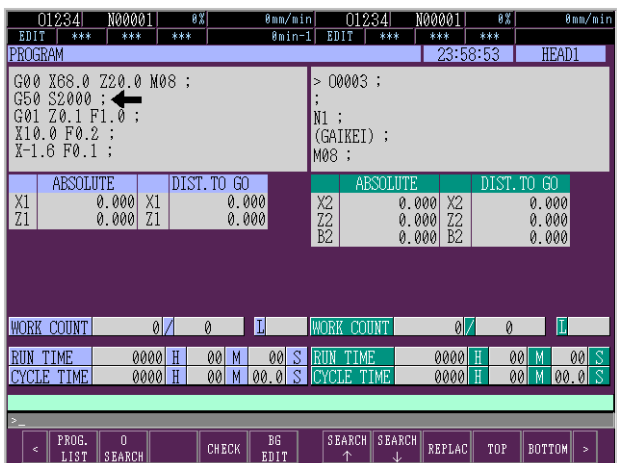
The block of commands written into the input buffer in step 5 is inserted.

NOTE The contents in the input buffer are deleted when the [INSERT] (INSERT) key is pressed.

8) Correct the inserted block of commands as necessary.

4-5   Copying a Program

The procedure for copying a program using the soft-keys is explained below.

Copy source program is O×××× and program O**** is generated by copying the source program.

The copied program is completely the same as the copy source program excluding the program number.
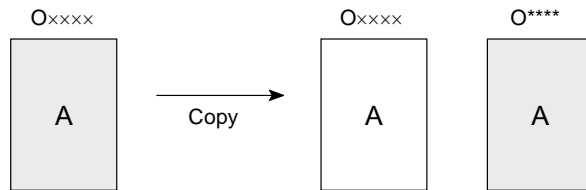
When creating a new program by copying an existing program, the new program number must be the one not found in the PROGRAM directory screen. If an existing program number is assigned as a new program number, the program is not copied.

<Operation procedure>

Start of Operation

PANEL key-switch: ⬚ (PANEL/EDIT)

HEAD CHANGE switch: ⬚ (head 1)
⬚ (head 2)

<Foreground edit>   <Background edit>

MODE selection switch: ⬚ (EDIT)   Function selection key: ⬚ (PROG)

Function selection key: ⬚ (PROG)   Soft-key: **[BG EDIT]**

PROGRAM (edit) screen   PROGRAM (background edit) screen

Soft-key: **[PROG. LIST]**

PROGRAM directory screen   (A)

Select the copy source program using the cursor control keys ⬚ and ⬚

Soft-key: **[COPY]**

Message "INPUT COPY O-NUMBER" is displayed

Program number

Soft-key: **[EXEC.]**

Another program to be copied?   Yes → (A)

No
<Background edit>   Soft-key: **[BG END]**

<Foreground edit>

Reset key: ⬚ (RESET)

PANEL key-switch: ⬚ (ON), ⬚ (OFF)

End of Operation

4-6   Changing a Program Number (Renaming)

The procedure for changing the program number of a program stored in memory using the soft-keys is explained below.

Program number O×××× is changed to O****.

The renamed program is completely the same as the original program excluding the program number.

NOTE When changing a program number, the new program number must be the one not found in the PROGRAM directory screen. If an existing program number is assigned as a new program number, the program is not renamed.
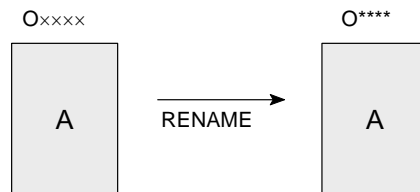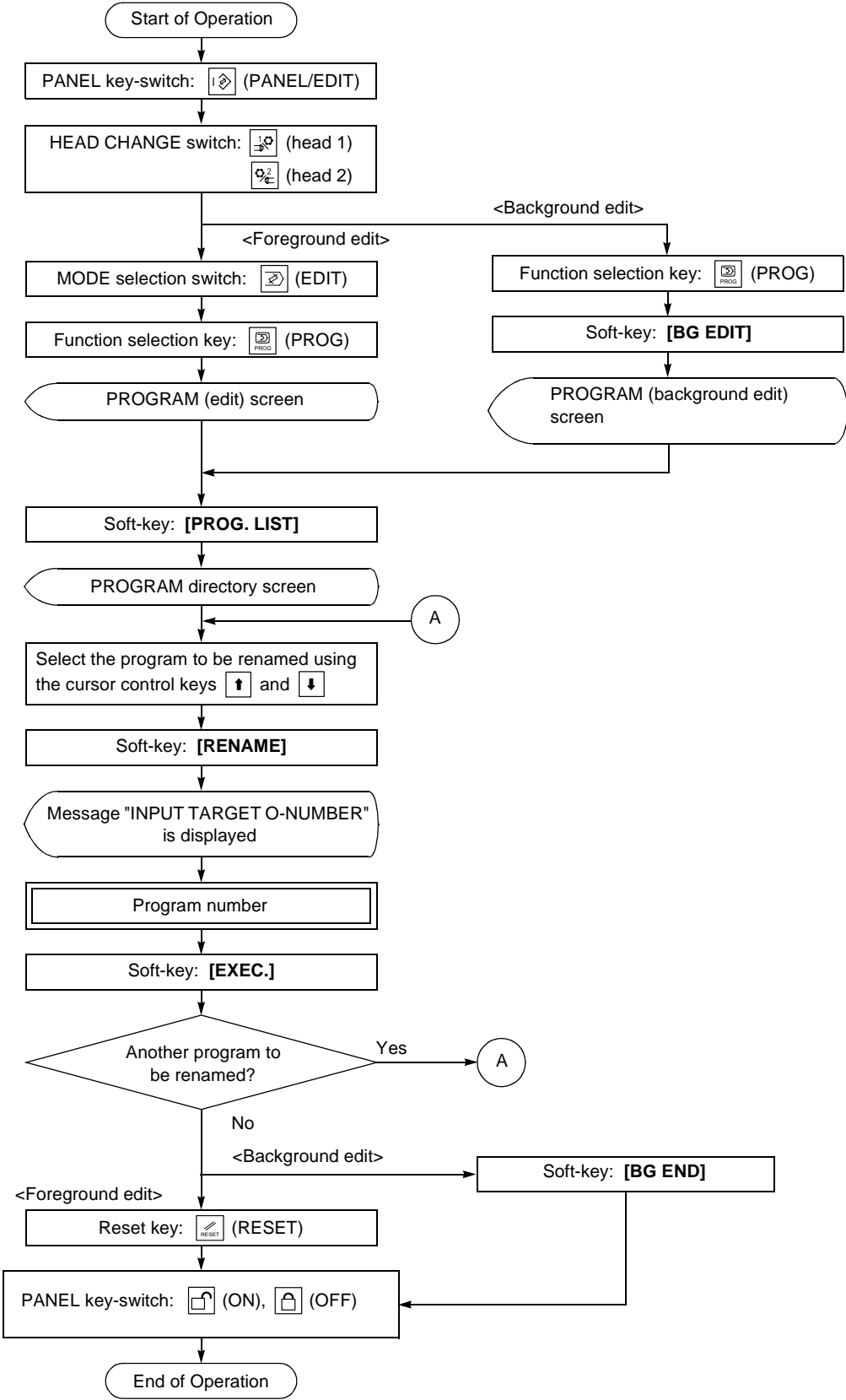
<Operation procedure>

```
              ( Start of Operation )
                       │
   ┌───────────────────────────────────────────┐
   │ PANEL key-switch: [⟨◈⟩] (PANEL/EDIT)        │
   └───────────────────────────────────────────┘
                       │
   ┌───────────────────────────────────────────┐
   │ HEAD CHANGE switch: [↓¹⟳] (head 1)          │
   │                     [⟳²↙] (head 2)          │
   └───────────────────────────────────────────┘
                       │
          ┌────────────┴───────────────────────────<Background edit>─────────┐
   <Foreground edit>                                                          │
   ┌───────────────────────────────┐        ┌───────────────────────────────────┐
   │ MODE selection switch: [✎] (EDIT) │     │ Function selection key: [PROG] (PROG) │
   └───────────────────────────────┘        └───────────────────────────────────┘
                       │                                      │
   ┌───────────────────────────────┐        ┌───────────────────────────────────┐
   │ Function selection key: [PROG] (PROG) │  │ Soft-key: [BG EDIT]               │
   └───────────────────────────────┘        └───────────────────────────────────┘
                       │                                      │
   ( PROGRAM (edit) screen )               ( PROGRAM (background edit) screen )
                       │                                      │
                       └──────────────────◄──────────────────┘
                       │
   ┌───────────────────────────────┐
   │ Soft-key: [PROG. LIST]        │
   └───────────────────────────────┘
                       │
   ( PROGRAM directory screen )
                       │◄──────────────( A )
   ┌───────────────────────────────────────────┐
   │ Select the program to be renamed using    │
   │ the cursor control keys [↑] and [↓]        │
   └───────────────────────────────────────────┘
                       │
   ┌───────────────────────────────┐
   │ Soft-key: [RENAME]            │
   └───────────────────────────────┘
                       │
   ( Message "INPUT TARGET O-NUMBER" is displayed )
                       │
   ┌───────────────────────────────┐
   │ Program number                │
   └───────────────────────────────┘
                       │
   ┌───────────────────────────────┐
   │ Soft-key: [EXEC.]             │
   └───────────────────────────────┘
                       │
              ◇ Another program to be renamed? ◇──── Yes ──( A )
                       │
                      No
                       │────────────────<Background edit>──────┐
   <Foreground edit>                                           │
                       │                         ┌─────────────────────────────┐
   ┌───────────────────────────────┐             │ Soft-key: [BG END]          │
   │ Reset key: [RESET] (RESET)    │             └─────────────────────────────┘
   └───────────────────────────────┘                           │
                       │                                        │
   ┌───────────────────────────────────────────┐               │
   │ PANEL key-switch: [🔓] (ON), [🔒] (OFF)      │◄─────────────┘
   └───────────────────────────────────────────┘
                       │
              ( End of Operation )
```
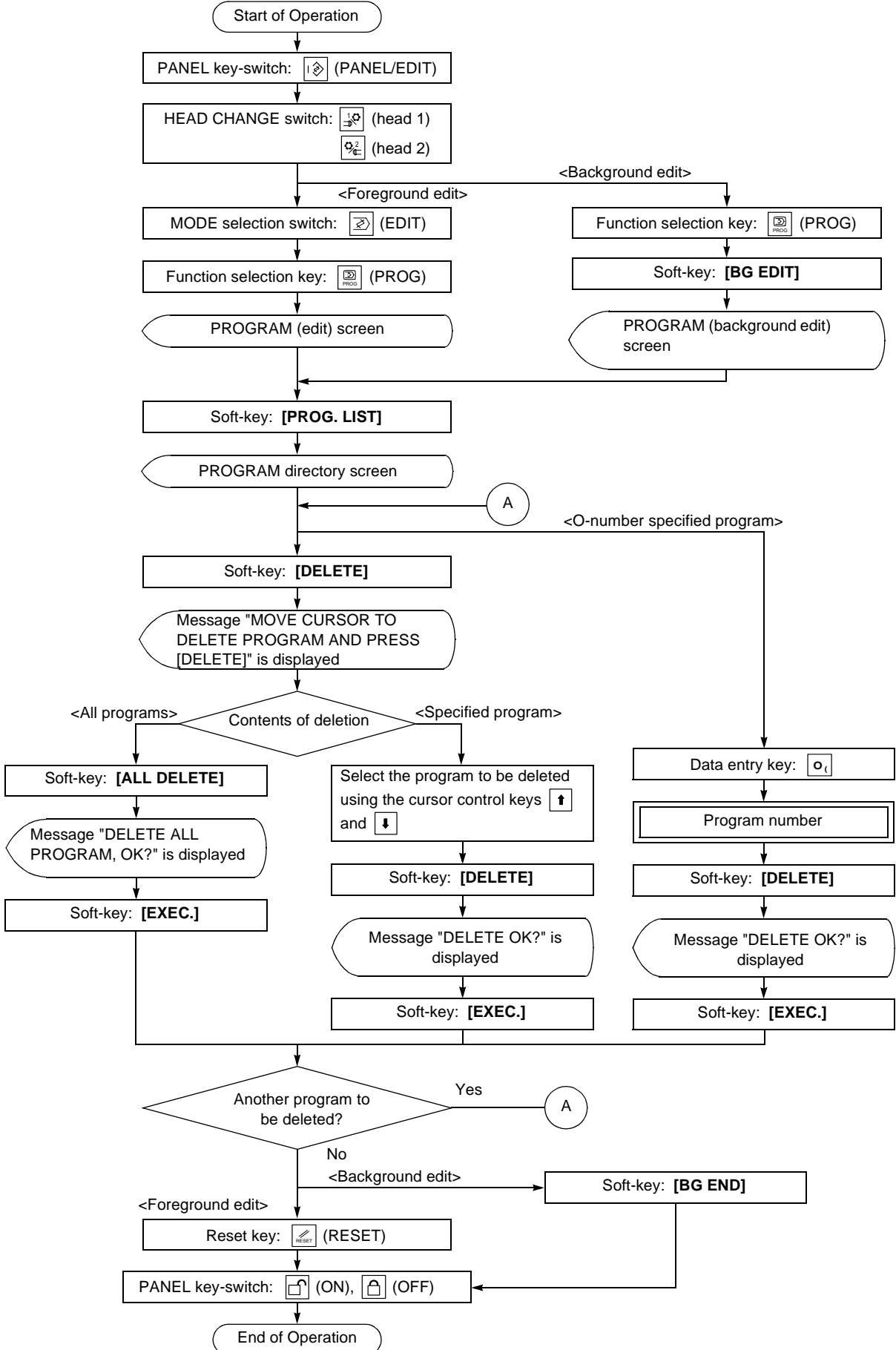
4-7   Deleting a Program

The procedure for deleting a program stored in memory using the soft-keys is explained below.
Program can be deleted in either of the following manners.

1.   Deleting a specified program

2.   Deleting all programs

NOTE Before deleting programs, make sure that the programs going to be deleted are those that may be deleted. Once the ⌦ (DELETE) key is pressed and the programs are deleted, there are no ways to restore them.

<Operation procedure>

Start of Operation

PANEL key-switch: [⌖] (PANEL/EDIT)

HEAD CHANGE switch: [⌖] (head 1)
[⌖²] (head 2)

<Foreground edit>   <Background edit>

MODE selection switch: [⌖] (EDIT)   Function selection key: [PROG] (PROG)

Function selection key: [PROG] (PROG)   Soft-key: **[BG EDIT]**

PROGRAM (edit) screen   PROGRAM (background edit) screen

Soft-key: **[PROG. LIST]**

PROGRAM directory screen

(A)

<O-number specified program>

Soft-key: **[DELETE]**

Message "MOVE CURSOR TO DELETE PROGRAM AND PRESS [DELETE]" is displayed

<All programs>   Contents of deletion   <Specified program>

Soft-key: **[ALL DELETE]**

Message "DELETE ALL PROGRAM, OK?" is displayed

Soft-key: **[EXEC.]**

Select the program to be deleted using the cursor control keys [↑] and [↓]

Soft-key: **[DELETE]**

Message "DELETE OK?" is displayed

Soft-key: **[EXEC.]**

Data entry key: [O]

Program number

Soft-key: **[DELETE]**

Message "DELETE OK?" is displayed

Soft-key: **[EXEC.]**

Another program to be deleted?   Yes   (A)

No
<Background edit>   Soft-key: **[BG END]**

<Foreground edit>

Reset key: [⌖] (RESET)

PANEL key-switch: [⌖] (ON), [⌖] (OFF)

End of Operation

4-8   Copy (Copy and Paste) and Move (Cut and Paste)

This section describes the procedure for copying (copy and paste) or moving (cut and paste) a part of a program using the soft-keys.

Copying and moving a program include the following four kinds of operation.

1.   Copying a part of a program and pasting it in the same program

2.   Copying a part of a program and pasting it in other program

3.   Cutting a part of a program and pasting it in the same program

4.   Cutting a part of a program and pasting it in other program

NOTE

1.   If a part of a program is copied or cut, the copied or cut data is stored in the copy buffer in memory. Once the data is stored in this area, it is retained until another copy or cut operation is carried out or the power is switched off.

2.   Before cutting a part of a program, ensure that it may be cut. Once a part of a program is cut and if it is cleared from the copy buffer, it cannot be recovered.

3.   Copy and move operation is possible in units of word.

4.   The copy buffer area capacity is 4 k bytes to allow handling of up to 4000 characters.

The procedure for the four kinds of copy and move operation are described below

<Copying a part of a program and pasting it in the same program>

To copy portion B of program O×××× and paste it following portion C in the same program.

Copy the program from the copy start block to the copy end block.

The contents of the copied blocks of the program are not changed by the copy function.

<Copying a part of a program and pasting it in other program>
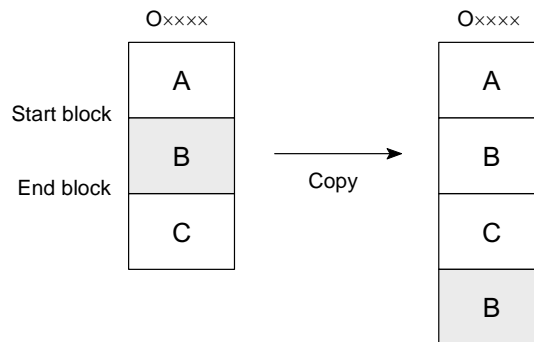
To copy portion B of program O×××× and paste it following portion F in other program.

Copy the program from the copy start block to the copy end block.

The contents of the copied blocks of the program are not changed by the copy function.

O××××	O****		O××××	O****
A	D		A	D
B (Start block / End block)	E	Copy →	B	E
C	F		C	F
				B

<Cutting a part of a program and pasting it in the same program>
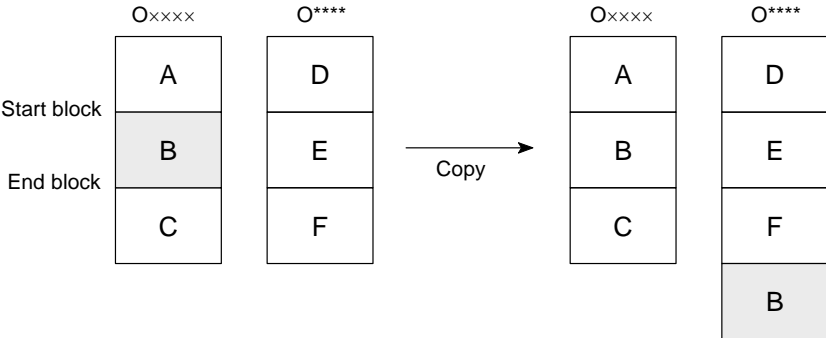
To cut portion B of program O×××× and paste it following portion C in the same program.

Move the program from the move start block to the move end block.

The contents of the cut blocks of the program are not changed by the move function.

O××××		O××××
A		A
B (Start block / End block)	Move →	C
C		B

<Cutting a part of a program and pasting it in other program>
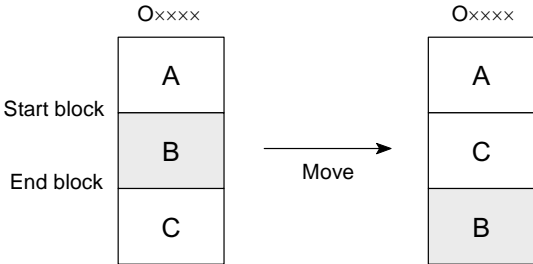
To cut portion B of program O×××× and paste it following portion F in other program.

Move the program from the move start block to the move end block.

The contents of the cut blocks of the program are not changed by the move function.

O××××	O****		O××××	O****
A	D		A	D
B (Start block / End block)	E	Move →	C	E
C	F			F
				B

<Operation procedure>

Start of Operation

PANEL key-switch: ⃞ (PANEL/EDIT)

HEAD CHANGE switch: ⃞ (head 1)

⃞ (head 2)

<Background edit>

<Foreground edit>

MODE selection switch: ⃞ (EDIT)

Function selection key: ⃞ (PROG)

Function selection key: ⃞ (PROG)

Soft-key: **[BG EDIT]**

PROGRAM (edit) screen

PROGRAM (background edit) screen

B

Source of program copy/move?   No

Yes

Search the source of program copy/move

📖 Page D-8 (3-2)

Menu selection key: **[>]**

Copy and move soft-keys are displayed

Search for the first word of the part of program to be copied or moved

📖 Page D-10 (3-3)

Soft-key: **[SELECT]**

Move the cursor to the last word of the part of program to be copied or moved using the page selection keys and cursor control keys

A

A

Contents of edit

<Copy>

Soft-key: **[COPY]**

The copied part is stored in the copy buffer

<Same program>   Copy destination?   <Different program>

Search for the word of copy destination

📖 Page D-10 (3-3)

Search for the program of copy destination

📖 Page D-10 (3-3)

Search for the word of copy destination

📖 Page D-10 (3-3)

Soft-key: **[PASTE]**

<Move>

Soft-key: **[CUT]**

The cut part is stored in the copy buffer

<Same program>   Move destination?   <Different program>

Search for the word of move destination

📖 Page D-10 (3-3)

Search for the program of move destination

📖 Page D-10 (3-3)

Search for the word of move destination

📖 Page D-10 (3-3)

Soft-key: **[PASTE]**

Another part of the program to be copied or moved?   Yes   B

No

<Background edit>   Soft-key: **[BG END]**

<Foreground edit>

Reset key: (RESET)

PANEL key-switch: (ON), (OFF)

End of Operation

4-9   Replacing Words

This section describes the procedure for replacing words in a program using the soft-keys.

Replacing words includes the following three kinds of operation.

1.   Replacing all of the specified word to a new word

2.   Replacing the specified word to a new word or a block

3.   Replacing the specified word to a new word, one by one

NOTE

1.   It is possible to select the objective range for the replacement operation by setting the CAP parameter No. 87.

- CAP parameter No. 87 = 0. . . . . .Replacement operation is performed for all the words and blocks in the selected program.

- CAP parameter No. 87 = 1. . . . . .Replacement operation is performed for the words and blocks after the cursor position in the selected program.

This function is valid for the program being edited in the foreground or background.

The CAP parameter No. 87 is set to "0" at shipment.

2.   If "replace all" is executed, all of the specified word in the program are replaced unconditionally. Before executing this function, ensure that all of the specified words may be replaced.

3.   If more than one word (word string) is specified for replacement at a time, the message "STRING NOT FOUND" is displayed.

4.   A word may be replaced with multiple words (word string).

Start of Operation

PANEL key-switch: [⬗] (PANEL/EDIT)

HEAD CHANGE switch: [⚙] (head 1)

[⚙₂] (head 2)

<Background edit>

<Foreground edit>

MODE selection switch: [⬗] (EDIT)

Function selection key: [PROG] (PROG)

Function selection key: [PROG] (PROG)

Soft-key: **[BG EDIT]**

PROGRAM (edit) screen

PROGRAM (background edit) screen

B

Program where a word should be replaced?   No

Search the program where a word should be replaced 📖 Page D-8 (3-2)

Yes

Move the cursor to the word which should be replaced

Soft-key: **[REPLAC]**

A

(A)

Message "INPUT STRING AND PRESS [SET]" is displayed

Word before replacement
(multiple words may not be specified)

Soft-key: **[SET]**

Message "INPUT CONVERT WORD AND PRESS [SET]" is displayed

Word after replacement
(multiple words may be specified)

Soft-key: **[SET]**

The cursor moves to the first objective word (downstream the cursor position)

<All objective words> ← Replacement objective? → <To confirm one by one>

Soft-key: **[ALL]**

<Yes> ← Replace? → <No>

Soft-key: **[YES]**   Soft-key: **[NO]**

The cursor moves to the next objective

The last objective word in the program? → <No>

<Yes>

Another word to be replaced? → Yes → (B)

No
<Background edit> → Soft-key: **[BG END]**

<Foreground edit>

Reset key: ⬜ (RESET)

PANEL key-switch: ⬜ (ON), ⬜ (OFF)

End of Operation

5   INPUTTING AND OUTPUTTING PROGRAMS USING AN EXTERNAL I/O DEVICE

The programs stored in the NC memory can be output to an external I/O device or programs can be input to the NC memory from an external I/O device. The procedure to input or output a program using an external I/O device is explained in this section.

For program input/output operation, the I/O device to be used must be set first. This I/O device setting procedure is explained in 5-1 "Preparation". After that, program input procedure and program output procedure are explained in the following order:

1.   Inputting a program (foreground, background)

2.   Outputting a program (foreground, background)

5-1   Preparation

Set the parameters as appropriate for the external I/O device to be used. Once set, the parameter settings may not be changed unless the external I/O device is changed.

1)   Connect the external I/O device.

2)   Display the COMMUNICATION PARAMETER screen and set the I/O device.

5-2   Inputting/Outputting a Program

The procedure for inputting and outputting programs by using an external I/O device is described here.

<Cautions on program input/output operation>

WARNING

Always place the PANEL key-switch in the ⬜ (ON) or ⬜ (OFF) position after completing program entry. Be aware that the program will be updated if program editing operations are carried out with the PANEL key-switch at the ⬜ (PANEL/EDIT) 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.

NOTE

1. If an existing program number is used when inputting a new program, an alarm is generated.

2. Program input/output stops when the **[STOP]** soft-key is pressed.

3. Make sure that the I/O device has been set.

4. 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.

5. The NC data not containing an O number may be input by designating a program number.

6. If the data to be input has multiple EOB codes followed by an O number, the programs are registered under the individual O numbers.

5-2-1   Program Input Operation Procedure
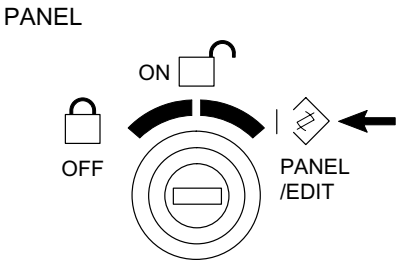
PANEL

1) Place the PANEL key-switch in the ⟨⟩ (PANEL/ EDIT) position.

ON

OFF   PANEL /EDIT

MODE

2) Select any of the following modes with the MODE selection switch.

| MEM | MDI | TAPE | EDIT |

⟨⟩ (memory)   ⟨Σ⟩ (tape)

| H | JOG | RPD | ZRN |

⟨⟩ (edit)

3) Display the PROGRAM (directory) screen.

Page A-93 (7-2-2)

NOTE In background edit operation, display the PROGRAM directory screen after pressing the **[BG EDIT]** soft-key.

```
EDIT   ***  ***  ***          0mm/min        O0001 N00001
                        0%    0min-1
PROGRAM                              23:58:53   HEAD1
O-No.              COMMENT              bytes
     1 TEST-1                             300
     2 TEST-2                             180
     3 TEST-3                             420
     4 TEST-4                              60
     5 TEST-5                            1260
     6 TEST-6                             120
     7 TEST-7                             300
     8 TEST-8                             300
     9 TEST-9                             180
    10 TEST-10                             60
                    AVAILABLE            54780  bytes
FOLDER     E:¥      POSSIBLE REGIST.PROGRAMS   49  num.
I/O DEVICE RS232C   REGIST.PROGRAMS           14  num.

>_
  <              COPY DELETE RENAME     EXIT   >
```

4) Press the menu selection key **[>]**.

| < | | | | | COPY | DELETE | RENAME | | EXIT | > |

◁ F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 ▷

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

When inputting a program using the O number different from the O number assigned to it, designate the desired program number after pressing the data entry key $\boxed{\text{O}_{(}}$. Press the **[READ]** soft-key after that.

<If a memory card is used>
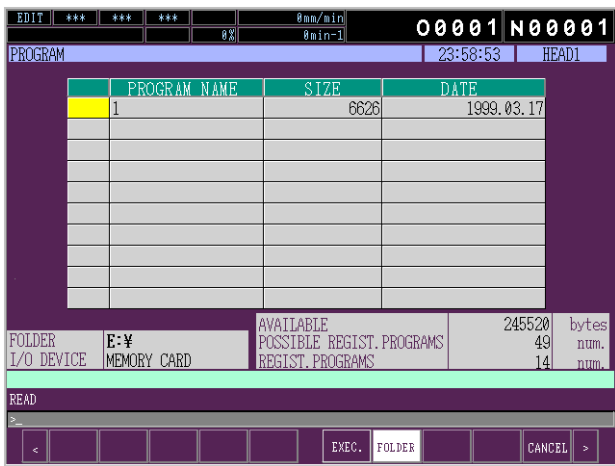
a) The directory of programs stored in the memory card is displayed.

b) Move the cursor to the program name of the program to be input using the cursor control keys $\boxed{\uparrow}$ and $\boxed{\downarrow}$.

c) To select the folder to be input, press the **[FOLDER]** soft-key.
The screen that shows the list of folders is displayed.
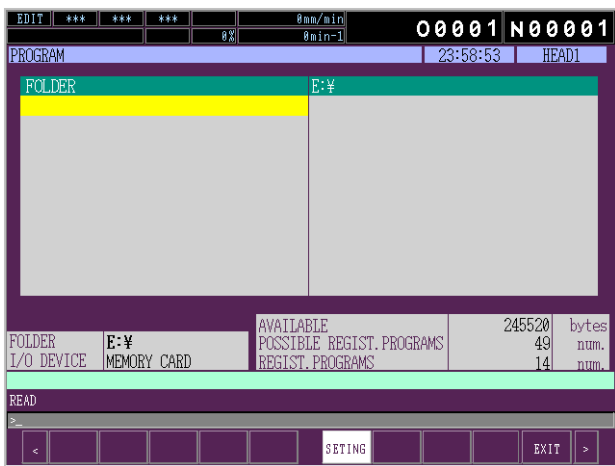
d) Move the cursor to the folder to be input using the cursor control keys $\boxed{\uparrow}$ and $\boxed{\downarrow}$.

e) Press the **[SET]** soft-key.

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

The selected program is input to the memory.
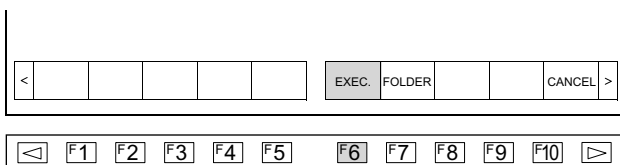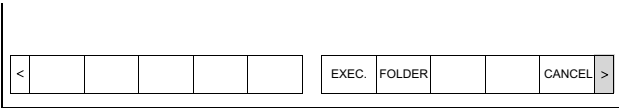
| | | | | | EXEC. | FOLDER | | | CANCEL | > |

< | | | | | |

F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10

7) Press the menu selection key **[>]**.

| | | | | | SET | | | | EXIT | > |

< | | | | |

F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10

8) Press the **[EXIT]** soft-key.

NOTE If the operation has been made in the background edit mode, press the **[BG END]** soft-key.

PANEL

ON

OFF
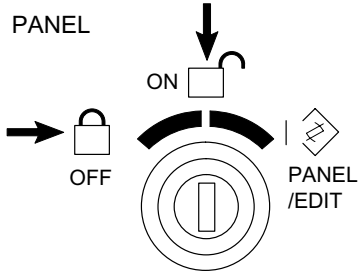
PANEL
/EDIT

9) Place the PANEL key-switch in one of the positions indicated below.

(ON)   (OFF)
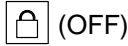
5-2-2   Program Output Operation Procedure

1) Place the PANEL key-switch in one of the positions indicated below.

PANEL

ON

OFF

PANEL /EDIT

⬚ (ON)   ⬚ (PANEL/EDIT)

2) Select any of the following modes with the MODE selection switch.

MODE

| MEM | MDI | TAPE | EDIT |
| H | JOG | RPD | ZRN |

⬚ (memory)   ⬚ (tape)

⬚ (edit)

3) Display the PROGRAM (directory) screen.

📖   Page A-93 (7-2-2)

NOTE In background edit operation, display the PROGRAM directory screen after pressing the **[BG EDIT]** soft-key.

| EDIT | *** | *** | *** | | 0mm/min | | O0001 | N00001 |
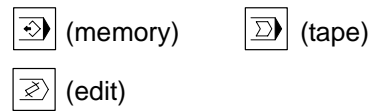
PROGRAM				23:58:53	HEAD1
O-No.	COMMENT	bytes
1	TEST-1	300
2	TEST-2	180
3	TEST-3	420
4	TEST-4	60
5	TEST-5	1260
6	TEST-6	120
7	TEST-7	300
8	TEST-8	300
9	TEST-9	180
10	TEST-10	60

FOLDER	E:¥	AVAILABLE	54780	bytes
I/O DEVICE	RS232C	POSSIBLE REGIST. PROGRAMS	49	num.
		REGIST. PROGRAMS	14	num.

| < | | | | | COPY | DELETE | RENAME | | EXIT | > |

4) Press the menu selection key **[>]**.

| < | | | | | COPY | DELETE | RENAME | | EXIT | > |

◁ F1 F2 F3 F4 F5   F6 F7 F8 F9 F10 ▷

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

   <To output all programs>

   a) Input "−9999" using the data entry keys.

   | −✦ | 9↗ | 9↗ | 9↗ | 9↗ |
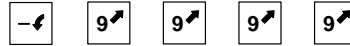
   b) Press the **[PUNCH]** soft-key.

   <To output the designated programs>

   a) Input "OOO - ×××" using the data entry keys.

   b) Press the **[PUNCH]** soft-key.

   NOTE In the designation of a range, the range may contain up to 100 programs.

   <To output the designated programs>

   a) Input "OOO, ×××" using the data entry keys.

   b) Press the **[PUNCH]** soft-key.

   NOTE If the operation explained above is selected, proceed to step 8).

6) Move the cursor to the program number of the program to be output using the cursor control keys

   | ↑ | and | ↓ |.
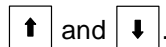
7) Press the **[SELECT ON/OFF]** soft-key.

   The O number is highlighted.

   Repeat steps 6) and 7) to select all desired O numbers.

<If a memory card is used>

a) Press the **[FOLDER]** soft-key to select the folder for outputting programs.
   The screen that shows the list of folders is displayed.
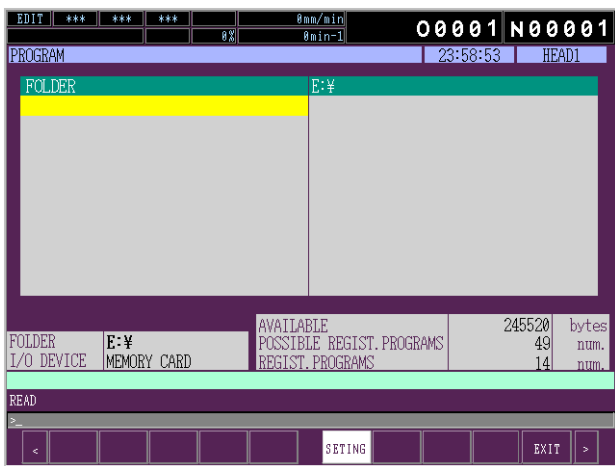
b) Move the cursor to the desired folder using the cursor control keys ↑ and ↓.

c) Press the **[SET]** soft-key.

NOTE To change a file name, input the desired file name using the data input keys. If the **[EXEC.]** soft-key is pressed without inputting a file name, the O number is input as the file name.
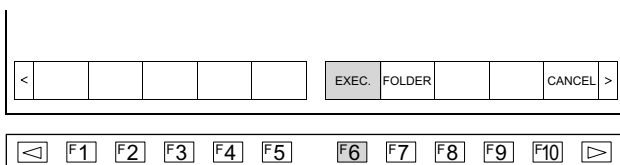
8) Press the **[EXEC.]** soft-key.

   The selected program is output to the external output device.
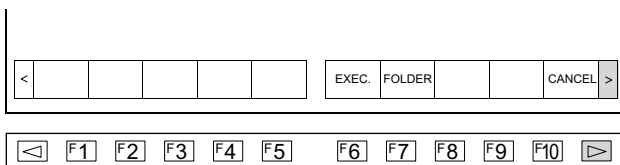
9) Press the menu selection key **[>]**.
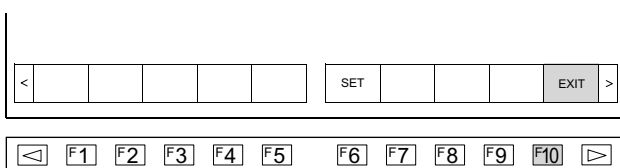
10) Press the **[EXIT]** soft-key.

NOTE If the operation has been made in the background edit mode, press the **[BG END]** soft-key.

PANEL

ON

OFF
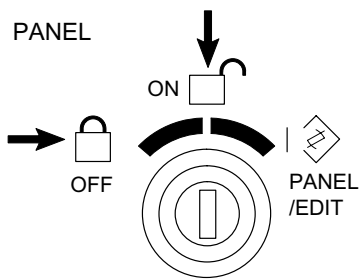
PANEL
/EDIT

11) Place the PANEL key-switch in one of the positions
indicated below.

⬜ (ON)   🔒 (OFF)
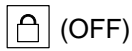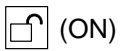
CHAPTER E
SETTING OF COORDINATE SYSTEM

This chapter explains the procedure for setting the coordinate system and tool offset data to be used for creating programs and machining workpieces.

There are the following three kinds of coordinate system settings:

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

- The coordinate system set using the coordinate system setting function (G50 X_ Z_ ;)

- The work coordinate system (G54 to G59)

The procedures for setting the above coordinate systems are explained.

The operating procedure for the manual in-machine tool presetter is also explained here.

CONTENTS

E : SETTING OF COORDINATE SYSTEM

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 tell 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 in the X- and Z-axis zero return position.

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. G50 X____ Z____ ;

    The coordinate system is set by directly designating the coordinate values.

3. 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.

<Standard>
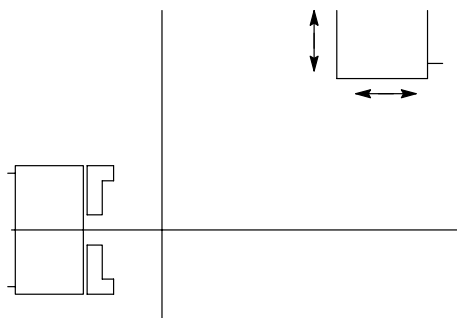
The longitudinal axis is the Z-axis; the axis perpendicular to the Z-axis is the X-axis.
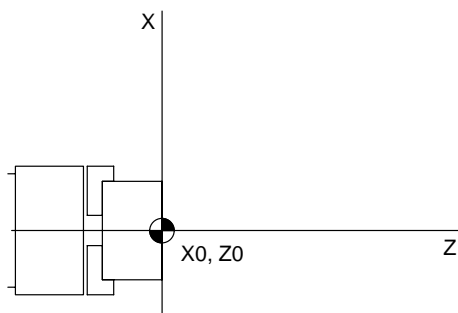
The zero point of the coordinate system is the center of the spindle (X0) and the right end face of the workpiece (Z0).

This point is set as the workpiece zero point.
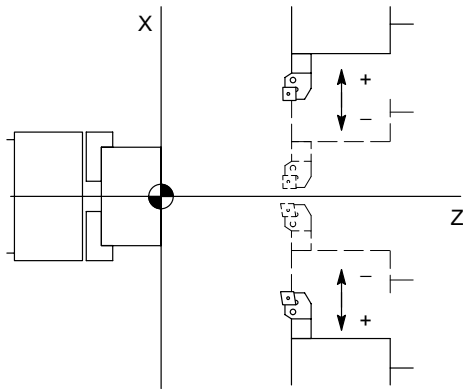
Coordinate system plus/minus sign:

<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>
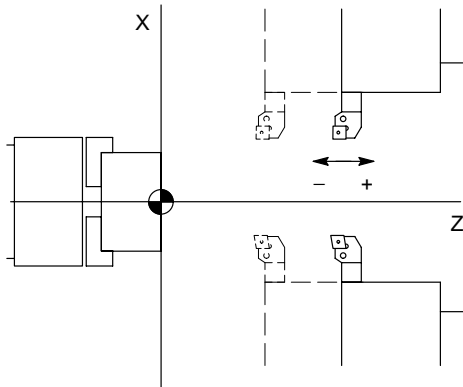
Positive (+)	The direction in which the turret moves away from the workpiece
Negative (−)	The direction in which the turret moves closer to the workpiece
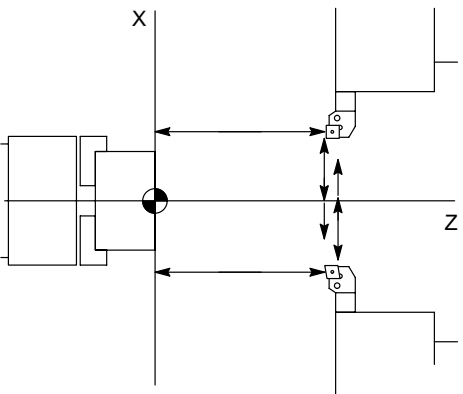
Set the edge position of the cutting tool mounted in the turret in these coordinate systems in the NC.

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>
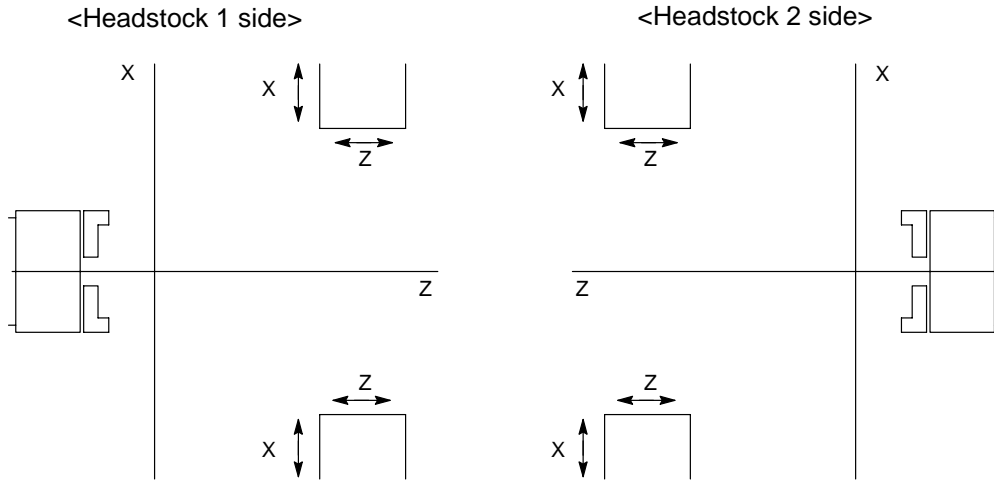
The origin of the coordinate systems is taken at the spindle center and the end face of the workpiece:

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
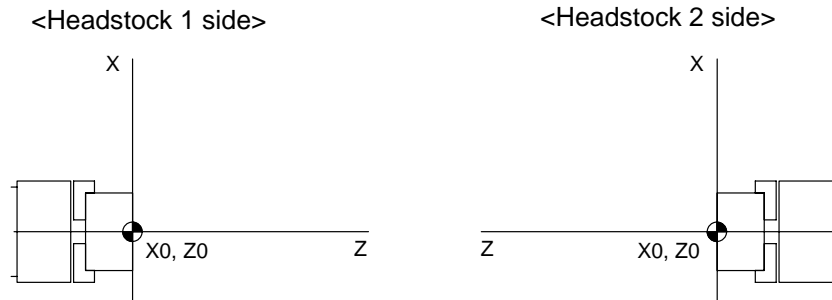
<Headstock 1 side>   <Headstock 2 side>

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.

<Z-axis>

- Headstock 1 side

Positive (+)	Direction in which the turret moves away from the workpiece
Negative (−)	Direction in which the turret moves toward the workpiece

- Headstock 2 side

Negative (−)	Direction in which the turret moves away from the workpiece
Positive (+)	Direction in which the turret moves toward the workpiece

<B-axis>

Negative (−)	The direction in which the headstock 2 moves closer to headstock 1
Positive (+)	The direction in which headstock 2 moves away from headstock 1

<Headstock 1 side>   <Headstock 2 side>
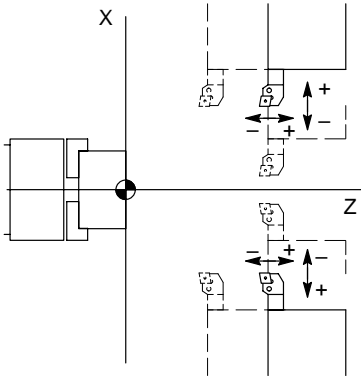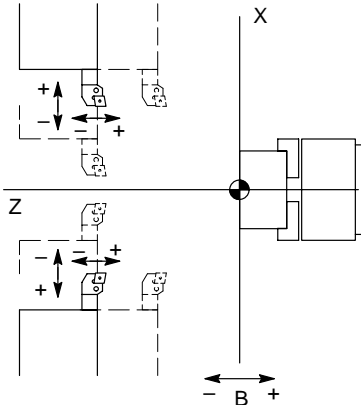
Set the edge position of the cutting tool mounted in the turret on these coordinate systems in the NC.

NOTE Because a diametral command is used for the X-axis, the value to be set is twice the actual distance.

<Headstock 1 side>   <Headstock 2 side>
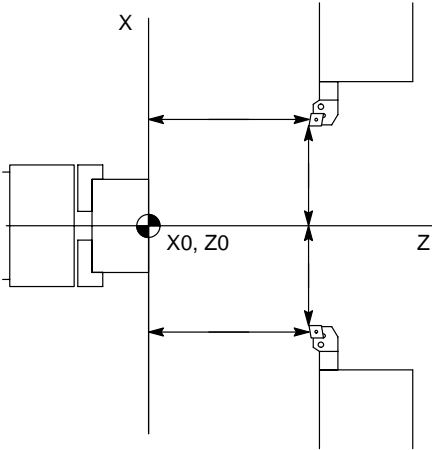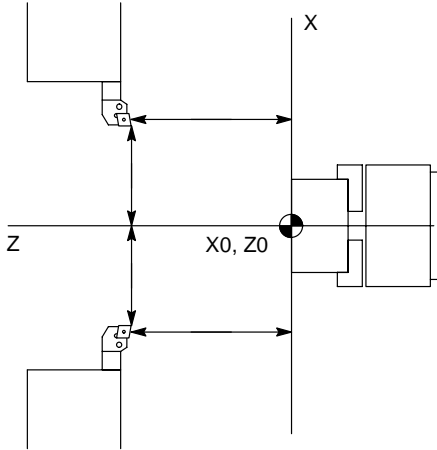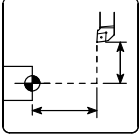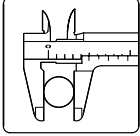
2   CHECK ITEMS WHEN MEASURING AND INPUTTING TOOL OFFSET VALUES

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?	
		Check Items	**Check Column**
Measuring	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?	

3   PREPARATION FOR SETTING THE COORDINATE SYSTEM

This section describes the operation to be carried out before setting the coordinate system.

1. Set the shift amount (common value) and the X and Z values of the work offset amount automatically read as a modal value to "0" on the WORK OFFSET screen.

NOTE The coordinate values X and Z of the No. 01 work coordinate system must be reset to "0" because the G54 work coordinate system is read automatically when power is turned on.

2. Carry out the zero return operation.

3. Machine the datum plane (end face, external/internal face, etc.) in the workpiece.

<Operation procedure>

DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Close the front door.

PANEL

ON

OFF   PANEL
           /EDIT

3) Place the PANEL key-switch in one of the positions indicated below.

   (ON)   (PANEL/EDIT)

HEAD CHANGE

1   2
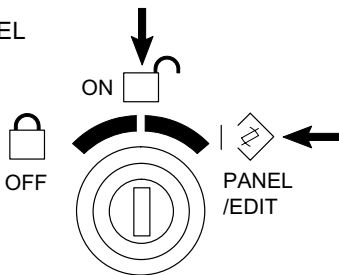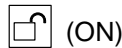
4) Press the HEAD CHANGE switch (head 1) or (head 2) to select the required turret.
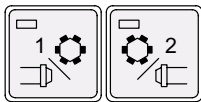
5) Set the values for "X" and "Z" of "COMMON" and any work coordinate systems (G54 - G59) to "0" on the WORK OFFSET screen.
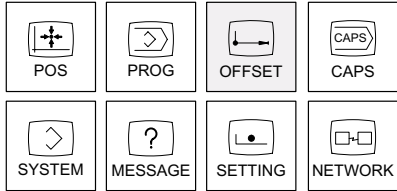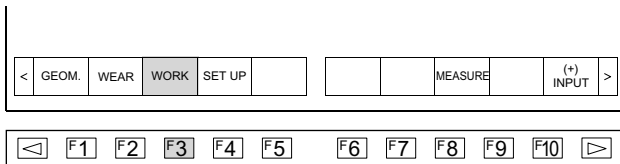
a) Press the function selection key (OFFSET).

b) Press the **[WORK]** soft-key.
The WORK OFFSET screen is displayed.

c) Move the cursor to "COMMON Z1" using the cursor control keys.

d) Press the `0` key.

e) Press the (INPUT) key.

NOTE
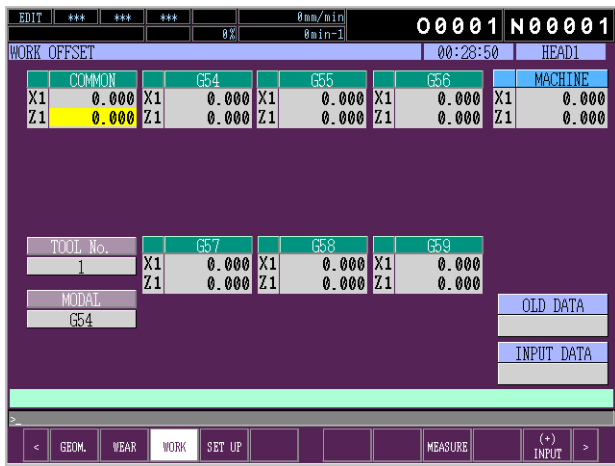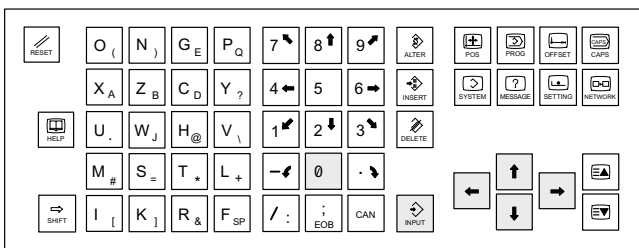
1. If a value other than "0" is displayed for "COMMON X", move the cursor to the data field of "X" and use the steps d) and e) above to reset it to "0".

2. If a value other than "0" is displayed for "X" and "Z" of any work coordinate systems (G54 - G59), move the cursor to the data field of "X" and "Z" and use the steps d) and e) above to reset it to "0".

MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN
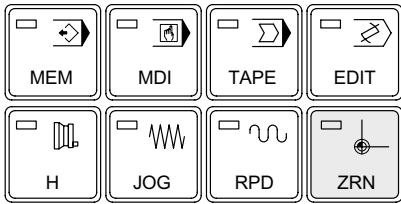
6) Carry out zero return for both X- and Z-axes.

Page B-19 (6-1)
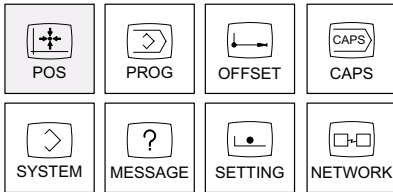
7) Reset the relative coordinate values on the screen to "0".

a) Press the function selection key ⊞POS (POS).
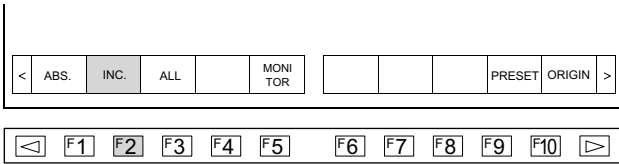
POS   PROG   OFFSET   CAPS

SYSTEM   MESSAGE   SETTING   NETWORK

< | ABS. | INC. | ALL | | MONITOR | | | | PRESET | ORIGIN | >

◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷

b) Press the **[INC.]** soft-key.
   The POSITION (INCREMENTAL) screen is displayed.

```
 O0001  N00001   0%     0mm/min   O0001  N00001   0%     0mm/min
MEM  ***   ***   ***     0min-1  MEM  ***   ***   ***
POSITION                          00:23:24     HEAD1
   INCREMENTAL                       INCREMENTAL
   X1        0.000                   X2        0.000
   Z1        0.000                   Z2        0.000
                                     B2        0.000




WORK COUNT     0  /      0    WORK COUNT     0  /      0
RUN TIME    0000 H    00 M   00 S  RUN TIME    0000 H    00 M   00 S
CYCLE TIME  0000 H    00 M 00.0 S  CYCLE TIME  0000 H    00 M 00.0 S
F     0.00  S     0  T         F     0  S        T

> 

 < | ABS. | INC. | ALL | | MONITOR | | | | PRESET | ORIGIN | >
```

c) Press the X A key.

d) Press the **[ORIGIN]** soft-key.

e) Press the Z B key.
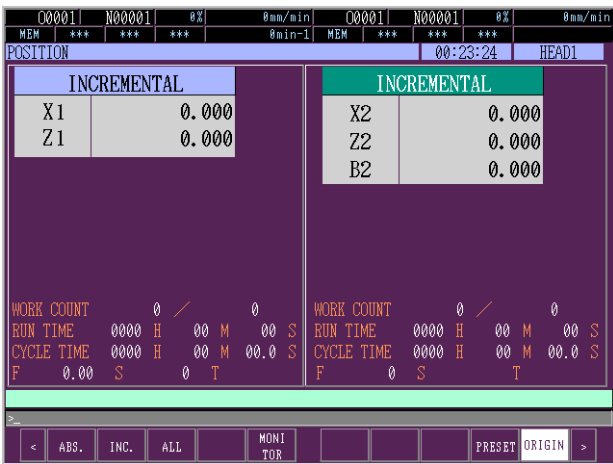
f) Press the **[ORIGIN]** soft-key.

MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN
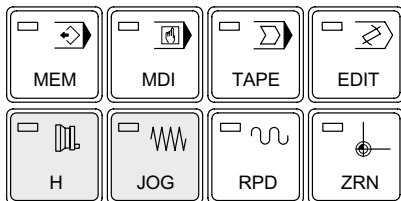
8) Select any of the following modes with the MODE selection switch.

   ▯▯ (handle)   ⋀⋀ (jog)

9) Index the tool used to cut end face, O.D., or I.D.

Page B-41 (8)

NOTE If workpiece I.D. is not machined, it is necessary carry out drilling before I.D. machining.
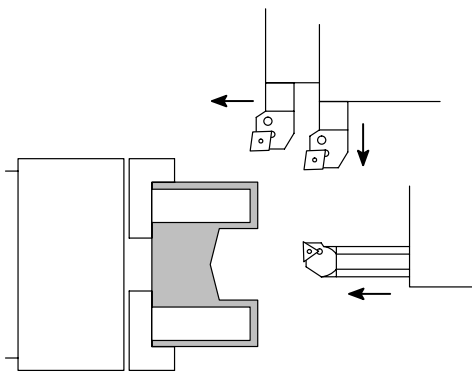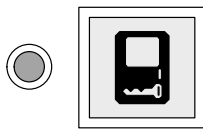
10) Bring the tool close to the workpiece manually while observing the clearance between the workpiece and the tool through the window in the front door.

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.

DOOR UNLOCK

11) 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.

12) Check for possible interference when the spindle is rotated.

   <Example>

   • Interference between the adjacent tools and chuck (workpiece)

   • Interference between the fixture and chuck (workpiece)

13) After making sure that the spindle can be rotated without interference, close the front door.

14) Start the spindle manually, and adjust the spindle speed as appropriate.

   📖 Page B-32 (7-2)
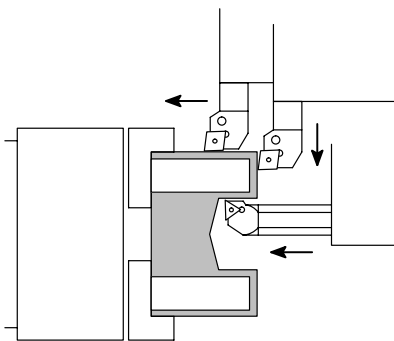
15) Cut the workpiece in the handle feed operation to eliminate run-out on the end face, O.D. and I.D. of the workpiece.

16) Retract the turret to the position where the cutting tool will not interfere with the workpiece when the turret head is rotated.
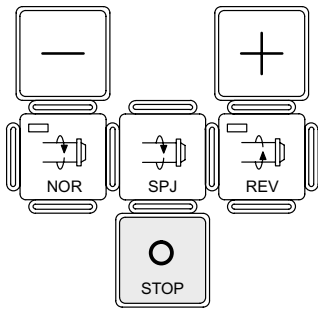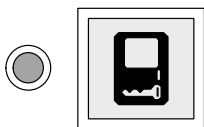
17) Press the ☐ (STOP) switch to stop the spindle.

NOTE Repeat steps 13) to 17) until the end face, I.D. and O.D. of the workpiece are cut.

DOOR UNLOCK

18) 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.

19) Measure and record the O.D. and I.D. of the workpiece.

<Example>

Measured value................O.D.   50.0 mm

Measured value................I.D.   30.0 mm

For the procedure used for setting the coordinate system by the tool using the tool geometry offset function, refer to page E-12 (4).

4   SETTING THE TOOL COORDINATE SYSTEM WITH GEOMETRY OFFSET

This section describes the procedure for setting the distance between the workpiece zero point and the tip point of each tool with the turret returned to the machine zero point.

Clamp a blank workpiece and mount the cutting tools that are actually used for cutting in the turret head before carrying out the following operation.

Before setting the distance indicated above, follow the steps explained in 3 "PREPARATION FOR SETTING THE COORDINATE SYSTEM".

> **NOTE**   For the standard specification, the values to be input for geometry offset are all negative values.

4-1   Example for Setting the Tool Coordinate System with Geometry Offset

This section describes the procedure for setting the coordinate system using the geometry offset data for the workpiece and cutting tools shown below.

<Cutting tool>

T2 (Station No. 2)	T3 (Station No. 3)

<Workpiece>

```
125
```
30 dia.
50 dia.
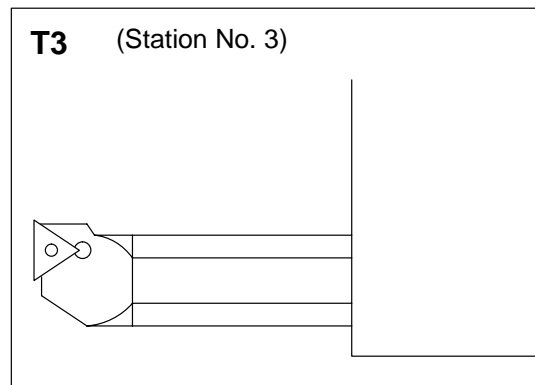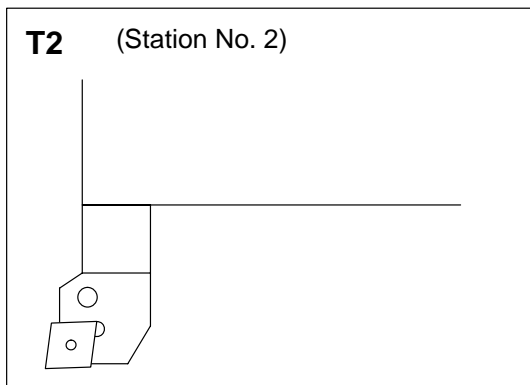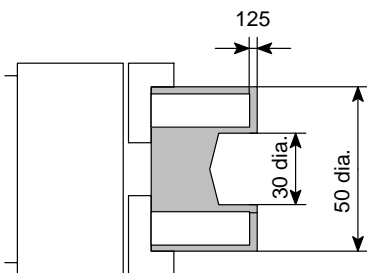
Measured value ......................................O.D. 50 mm

Measured value ......................................I.D. 30 mm

Cutting allowance on end face ....1.25 mm

DOOR INTERLOCK
NORMAL   RELEASE

1)   Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2)   Close the front door.

PANEL

ON

OFF

PANEL /EDIT

HEAD CHANGE

1   2

TURRET

2   1

—   +

POS   PROG   OFFSET   CAPS

SYSTEM   MESSAGE   SETTING   NETWORK

| < | GEOM. | WEAR | WORK | SET UP | | | MEASURE | | (+) INPUT | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | ▷ |

3) Place the PANEL key-switch in one of the positions indicated below.

🔓 (ON)   (PANEL/EDIT)
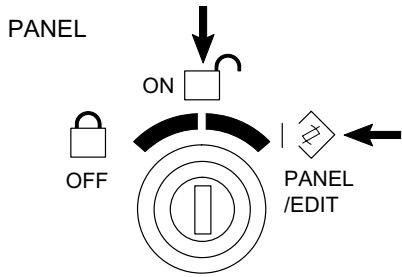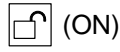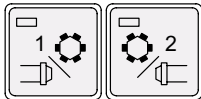
4) Press the HEAD CHANGE switch (head 1) or

(head 2) to select the required turret.
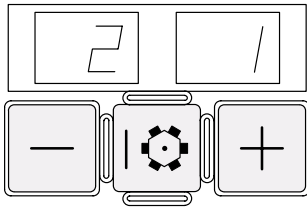
5) Index the turret to the station 2 in which the O.D. cutting tool is mounted.

Page B-41 (8)

6) Display the GEOMETRY OFFSET screen.
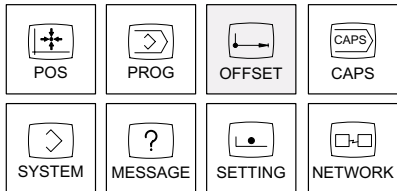
a) Press the function selection key (OFFSET).
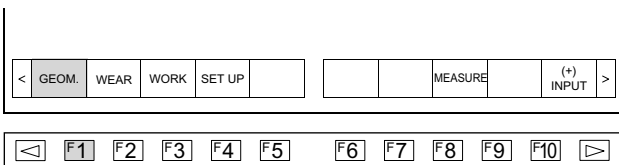
b) Press the **[GEOM.]** soft-key.
The GEOMETRY OFFSET screen is displayed.

MDI	***	***	***		0(mm/min)		O0001 N00001

```
MDI    ***  ***  ***            0(mm/min)
                          0(%)   0(min-1)      O0001 N00001
GEOMETRY OFFSET                            03:38:12   HEAD2
       X        Z        R        Y
 1   0.000    0.000    0.000    0.000         MACHINE
 2   0.000    0.000    0.000    0.000    X2        0.000
 3   0.000    0.000    0.000    0.000    Z2        0.000
 4   0.000    0.000    0.000    0.000
 5   0.000    0.000    0.000    0.000    C2        0.000
 6   0.000    0.000    0.000    0.000
 7   0.000    0.000    0.000    0.000
 8   0.000    0.000    0.000    0.000        MODAL
 9   0.000    0.000    0.000    0.000        G54
10   0.000    0.000    0.000    0.000       OLD DATA
11   0.000    0.000    0.000    0.000
12   0.000    0.000    0.000    0.000      INPUT DATA

 <   GEOM.  WEAR  WORK  SET UP          No.    MEASURE     (+)    >
                                       SEARCH            INPUT
```

7) Move the cursor to the setting column of "No. 2 Z" of the tool geometry offset data using the cursor control keys.

NOTE

1. For the sake of safety, you are recommended to use the tool offset numbers in the range 1 to 12 for tools used in the number 1 (left) spindle, and tool offset numbers in the range 31 to 42 for tools used in the number 2 (right) spindle. (S type)

2. When the tool geometry offset is calculated with the tool presetter, the tool offset numbers are automatically assigned from 1 for the tool at station 1 at the number 1 (left) spindle side, and from 31 for the tool at station 1 at the number 2 (right) spindle side. (S type)

8) Bring the tool close to the workpiece manually while observing the clearance between the workpiece 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.
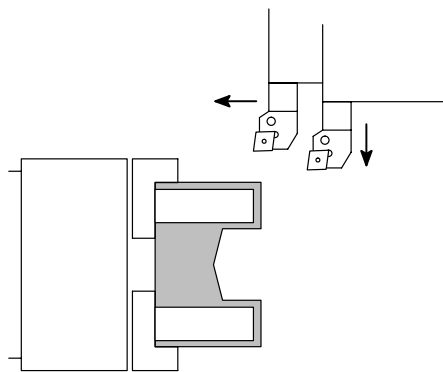
DOOR UNLOCK

9) 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.

10) Check for possible interference when the spindle is rotated.

<Example>

• Interference between the adjacent tools and chuck (workpiece)

• Interference between the fixture and chuck (workpiece)

11) After making sure that the spindle can be rotated without interference, close the front door.

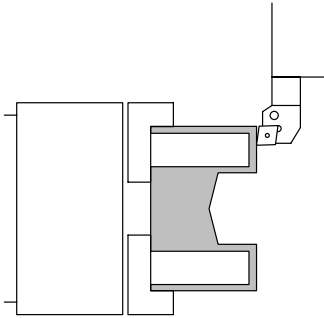12) Start the spindle manually, and adjust the spindle speed as appropriate.

📖 Page B-32 (7-2)

13) Bring the tool tip into light contact with the workpiece end face in the handle feed operation.
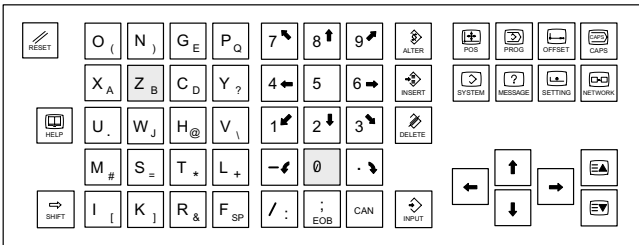
⚠️ **CAUTION** Do not move the tool in the Z-axis direction after the contact. If moved, it could cause the tool to interfere with the workpiece, damaging the tool and machine.
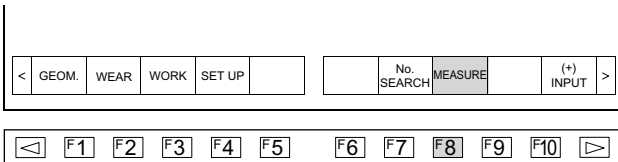
14) Input "Z0" using the data entry keys to set the current Z-axis position to "0".

[Z B] [0]

15) Press the **[MEASURE]** soft-key.

16) Make sure that the value displayed for Z of MACHINE is input.

<Example>

	MACHINE
X1	−139.280
Z1	−282.360

"−282.360" is input.

17) Move the cursor to the setting column of "No. 2 X" of the tool geometry offset data using the cursor control keys.
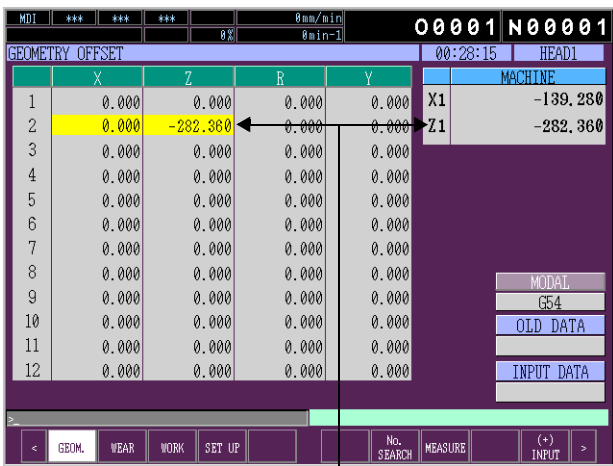
Make sure that the value displayed for Z of MACHINE is input.
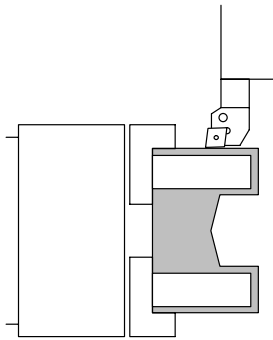
18) Bring the tool tip into light contact with the O.D. in the handle feed operation.

CAUTION Do not move the tool in the X-axis direction after the contact. If moved, it could cause the tool to interfere with the workpiece, damaging the tool and machine.
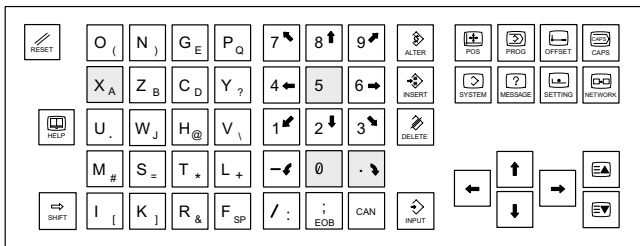
19) Enter the measured O.D. value.
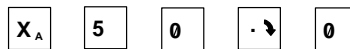
| X_A | | 5 | | 0 | | $\cdot$ | | 0 |

NOTE

1. Be sure to input the decimal point.

2. For the X-axis reversed JIS specification machine, input "X−50.0" using the data entry keys.
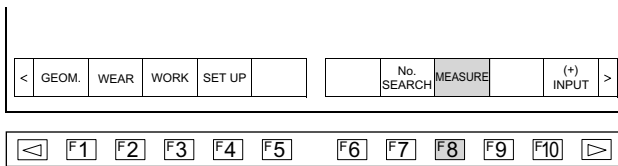
20) Press the **[MEASURE]** soft-key.

21) Make sure that the difference between the value displayed for X of MACHINE and the measured value is input.

<Example>

	MACHINE
X1	−129.280
Z1	−292.360

− 129.280 − 50.0 = "−179.280" is input.
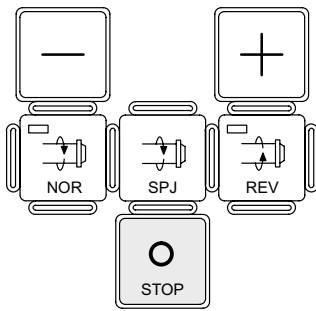
Make sure that the difference between the value displayed for X of MACHINE and the measured value is input.
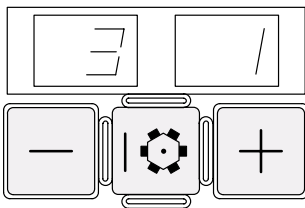
22) Press the ◯ (STOP) switch to stop the spindle.

23) Retract the turret to the position where the cutting tool will not interfere with the workpiece when the turret head is rotated.

TURRET

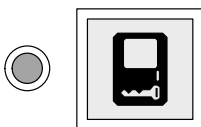24) Index the turret to the station 3 in which the I.D. cutting tool is mounted.

📖 Page B-41 (8)

25) Move the cursor to the setting column of "No. 3 Z" of the tool geometry offset data using the cursor control keys.

MDI	***	***	***		0mm/min		O0001	N00001

GEOMETRY OFFSET

	X	Z	R	Y
1	0.000	0.000	0.000	0.000
2	-179.280	-282.360	0.000	0.000
3	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000

00:28:15   HEAD1
MACHINE
X1   0.000
Z1   0.000

MODAL
G54
OLD DATA
INPUT DATA

| < | GEOM. | WEAR | WORK | SET UP | | No. SEARCH | MEASURE | | (+) INPUT | > |
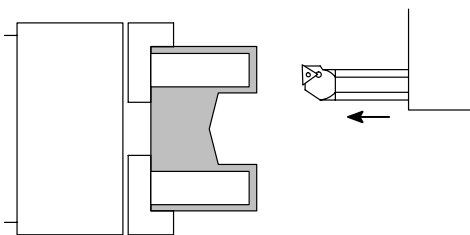
26) Bring the tool close to the workpiece manually while observing the clearance between the workpiece and the tool through the window in the front door.

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.

DOOR UNLOCK

27) 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.

28) Check for possible interference when the spindle is rotated.

   <Example>

   - Interference between the adjacent tools and chuck (workpiece)

   - Interference between the fixture and chuck (workpiece)

29) After making sure that the spindle can be rotated without interference, close the front door.

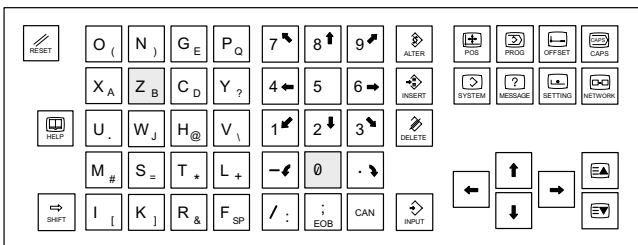30) Start the spindle manually, and adjust the spindle speed as appropriate.
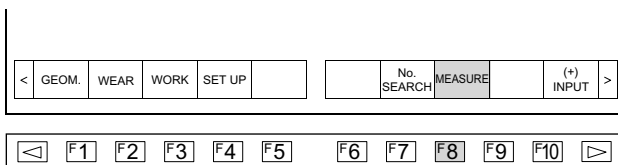
   Page B-32 (7-2)
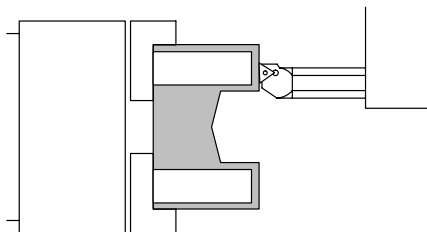
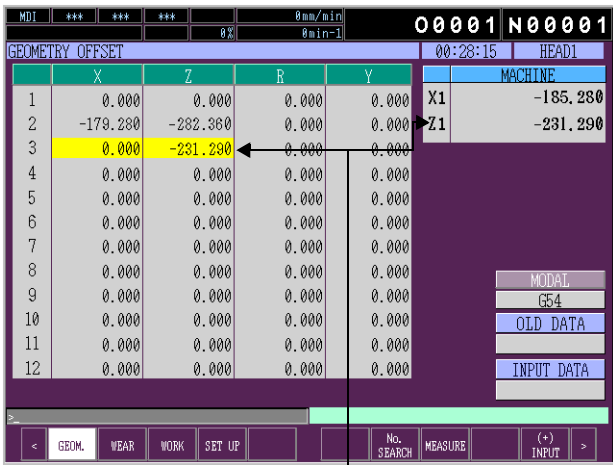31) Bring the tool tip into light contact with the workpiece end face in the handle feed operation.

   CAUTION Do not move the tool in the Z-axis direction after the contact. If moved, it could cause the tool to interfere with the workpiece, damaging the tool and machine.

32) Input "Z0" using the data entry keys to set the current Z-axis position to "0".

   Z B   0

33) Press the **[MEASURE]** soft-key.

Make sure that the value displayed for Z of MACHINE is input.

34) Make sure that the value displayed for Z of MACHINE is input.

<Example>

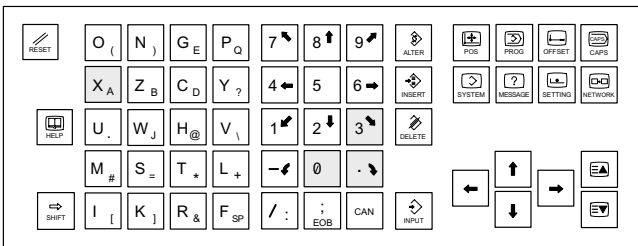|	MACHINE
X1	−185.280
Z1	−231.290

"−231.290" is input.

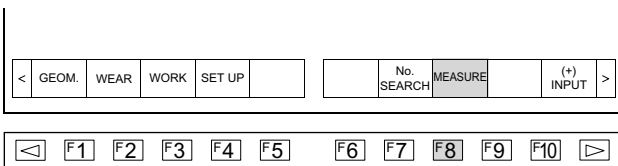35) Move the cursor to the setting column of "No. 3 X" of the tool geometry offset data using the cursor control keys.
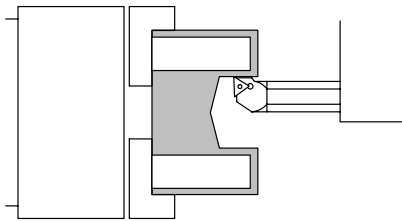
36) Bring the tool tip into light contact with the I.D. in the handle feed operation.

CAUTION

Do not move the tool in the X-axis direction after the contact. If moved, it could cause the tool to interfere with the workpiece, damaging the tool and machine.

37) Enter the measured I.D. value.
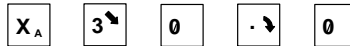
X_A 3   0   ·   0

NOTE

1. Be sure to input the decimal point.

2. For the X-axis reversed JIS specification machine, input "−30.0" using the data entry keys.

38) Press the **[MEASURE]** soft-key.

Make sure that the difference between the value displayed for X of MACHINE and the measured value is input.

39)   Make sure that the difference between the value displayed for X of MACHINE and the measured value is input.

<Example>

	MACHINE
X1	−195.210
Z1	−241.290

− 195.210 − 30.0 = "−225.210" is input

NOTE   Input the tool geometry offset data for all the tools used for machining.

5   INPUTTING THE CUTTING ALLOWANCE ON THE WORKPIECE END FACE

In some cases, the workpiece is not finished to the correct dimensions when it is machined using the set coordinate system due to differences in cutting allowance.
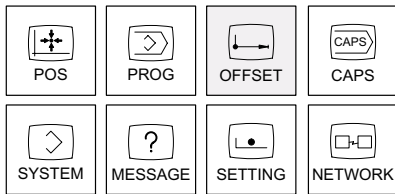
In such cases, shift the work coordinate system by following the procedure indicated below.
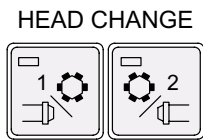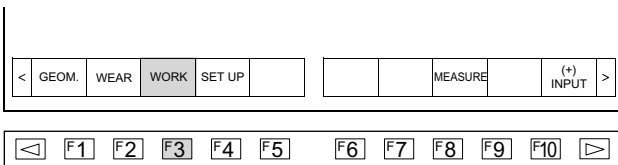
HEAD CHANGE

1) Press the HEAD CHANGE switch [⟳1] (head 1) or [⟳2] (head 2) to select the required turret.

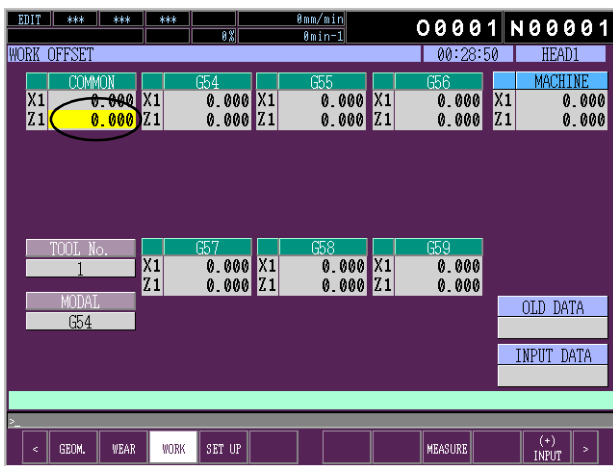2) Display the WORK OFFSET screen.

   a) Press the function selection key [OFFSET] (OFFSET).
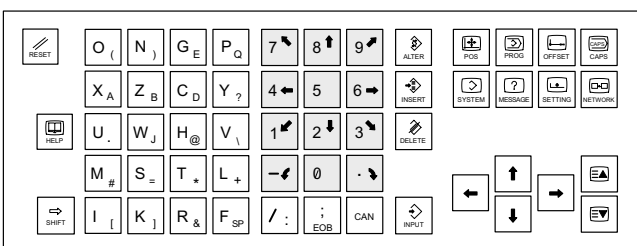
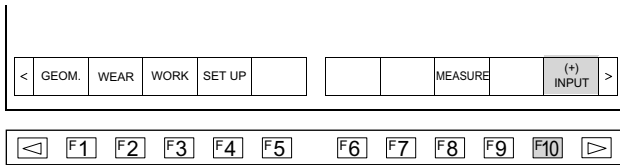   b) Press the **[WORK]** soft-key.
      The WORK OFFSET screen is displayed.

3) Move the cursor to "COMMON Z1" using the cursor control keys.

4) Input the cutting allowance on the end face using the data entry keys.

| < | GEOM. | WEAR | WORK | SET UP | | | | MEASURE | (+) INPUT | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |

5)　Press the **[(+) INPUT]** soft-key.

<Example>

If stock of removal on the end face is 1.25 mm

a)　Input "1.25" using the data entry keys.

| 1 | · | 2 | 5 |

NOTE　To input the cutting allowance on the end face for spindle 2, input "−1.25" using the data entry keys. (S type)

b)　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 work shift offset data (Z-axis). Therefore, make sure to press the **[(+) INPUT]** soft-key.

2.　When inputting a numeric value, pay attention to the sign (+, −) and a decimal point to be input.

3.　To elongate the workpiece length, or to carry out test cutting without actual cutting, input a negative value.

　　|−| [numeric value] **[(+) INPUT]** soft-key

　　To elongate the workpiece length, or to carry out cutting without mounting a workpiece for spindle 2, input a positive value. (S type)

　　[numeric value] **[(+) INPUT]** soft-key

6   MACHINING DIFFERENT WORKPIECES WITHOUT CHANGING TOOLING

When machining different workpieces without changing the tooling, simply shift the workpiece zero point to set the coordinate system.

The distance to be shifted can be calculated from the difference between the previous and present reference surfaces by following the operations indicated below.
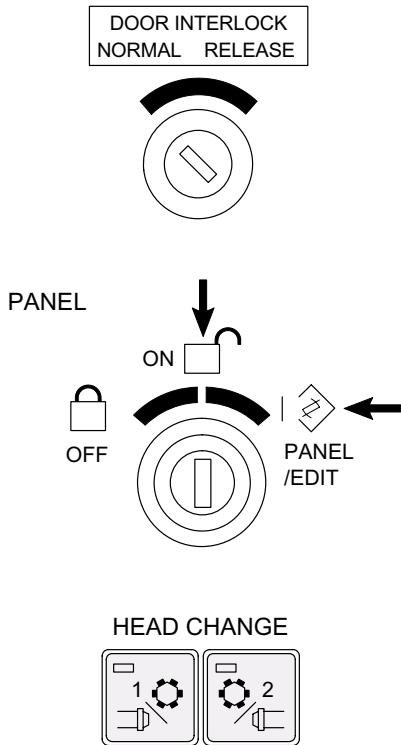
1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Clamp a workpiece in the chuck.

3) Close the front door.

4) Place the PANEL key-switch in one of the positions indicated below.

    ⬚ (ON)   ⬚ (PANEL/EDIT)

5) Press the HEAD CHANGE switch ⬚ (head 1) or ⬚ (head 2) to select the required turret.

6) Retract the turret to the position where the cutting tool will not interfere with the workpiece when the turret head is rotated.
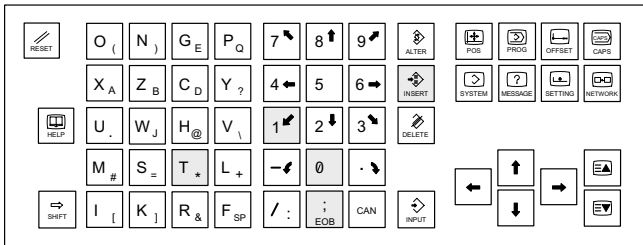
7) Display the PROGRAM (MDI) screen.

    a) Select the MDI mode (⬚) with the MODE selection switch.

    b) Press the function selection key ⬚ (PROG). The PROGRAM (MDI) screen is displayed.
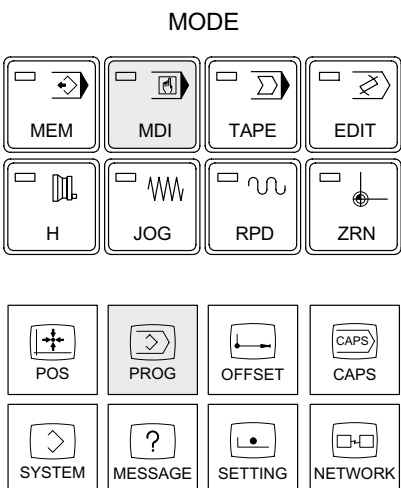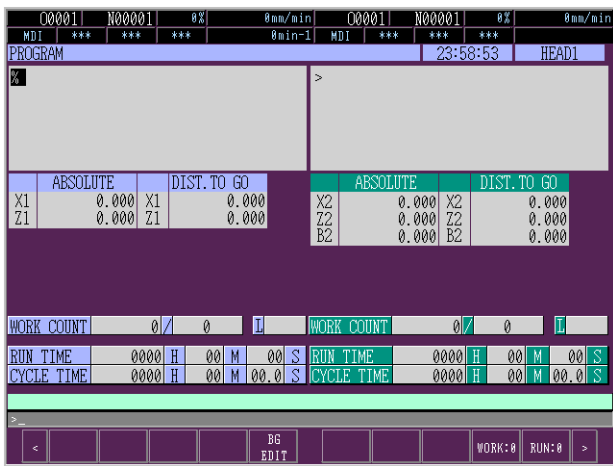
8) Call the cutting tool that can perform facing by inputting its tool number.

a) Press the [T *] key.
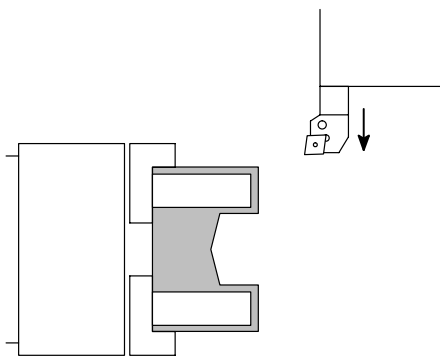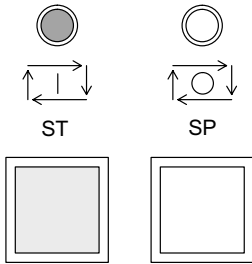
b) Key in a tool number using the data entry keys.

<Example>

To select tool No. 1

[0] [1] [0] [0] [; EOB]   (EOB)

c) Press the [INSERT] (INSERT) key.

d) Press the [ST] (ST) switch.

The turret rotates and tool No. 1 is called.
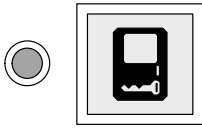

CYCLE

ST   SP

9) Bring the tool close to the workpiece manually while observing the clearance between the workpiece 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.

DOOR UNLOCK

10) 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.

11) Check for possible interference when the spindle is rotated.

   <Example>

   - Interference between the adjacent tools and chuck (workpiece)

   - Interference between the fixture and chuck (workpiece)

12) After making sure that the spindle can be rotated without interference, close the front door.

13) Start the spindle manually, and adjust the spindle speed as appropriate.

   Page B-32 (7-2)
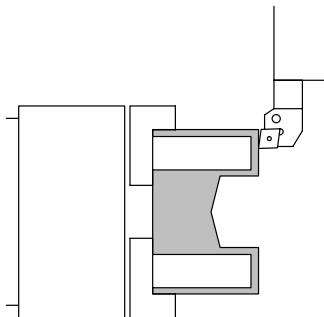
14) Lightly cut the end of the workpiece in the handle feed operation.

   Move the tool only in the X-axis direction, not in the Z-axis direction.

   NOTE With a workpiece whose end face does not need to be cut, it is not necessary to move the tool in the X-axis direction. Bring the tool tip into light contact with the workpiece end face.

15) Move the cursor to "COMMON Z1" using the cursor control keys.

   a) Press the function selection key (OFFSET).
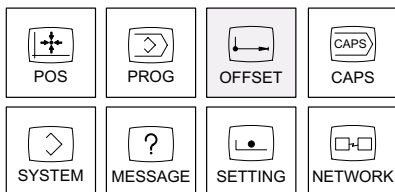
POS	PROG	OFFSET	CAPS
SYSTEM	MESSAGE	SETTING	NETWORK

   b) Press the **[WORK]** soft-key. The WORK OFFSET screen is displayed.

<	GEOM.	WEAR	WORK	SET UP			MEASURE	(+) INPUT	>

| ◁ | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | ▷ |
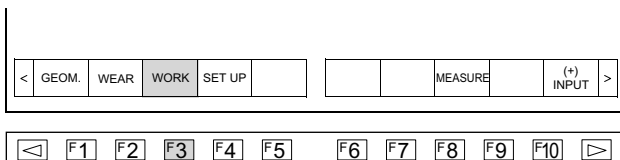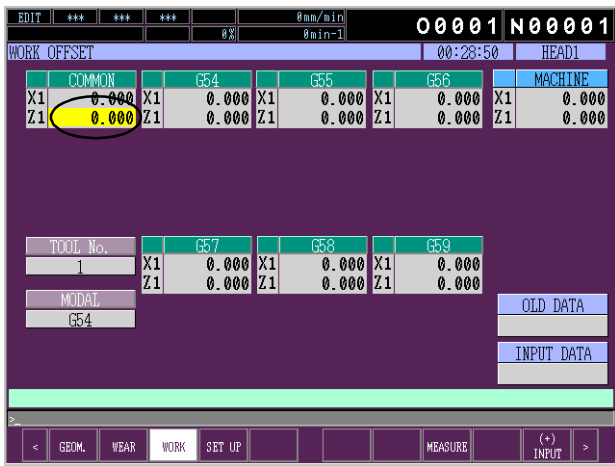
c) Move the cursor to "COMMON Z1" using the cursor control keys.

d) Input "Z0" using the data entry keys.

$$\boxed{Z_B} \quad \boxed{0}$$

e) Press the **[MEASURE]** soft-key.

The work shift data, including the difference between the workpiece zero points of the previous and current workpieces, is set to "COMMON Z1".

NOTE Do not press the (RESET) key while carrying out operation steps 9) to 15).

16) Retract the turret to the position where the cutting tool will not interfere with the workpiece when the turret head is rotated.

17) Press the ○ (STOP) switch to stop the spindle.
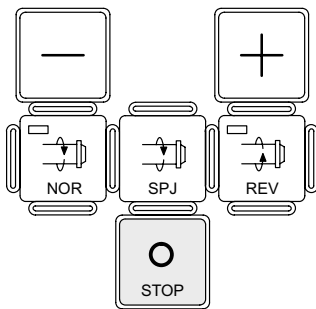
DOOR UNLOCK
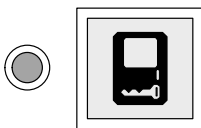
18) With the manual door type machine, press the DOOR UNLOCK switch to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.

19) Measure the length of the workpiece and determine the cutting allowance on the end face.

20) Input the cutting allowance on the end face using the data entry keys.

21) Press the **[(+) INPUT]** soft-key.

   <Example>

   If stock of removal on the end face is 1.25 mm

   a) Input "1.25" using the data entry keys.

   | 1 | . | 2 | 5 |

   NOTE To input the cutting allowance on the end face for spindle 2, input "−1.25" using the data entry keys. (S type)

   b) Press the **[(+) INPUT]** soft-key.

22) Input the work shift amount, presently set for "COMMON Z1" to "Z" of the work coordinate system number to be used by the data entry keys.

   a) Move the cursor to "Z" of the work coordinate system number to be used by the cursor control keys.

   b) Key in the numeric value presently set for "COMMON Z1" using the data entry keys.

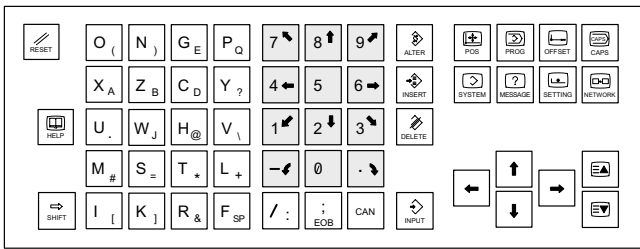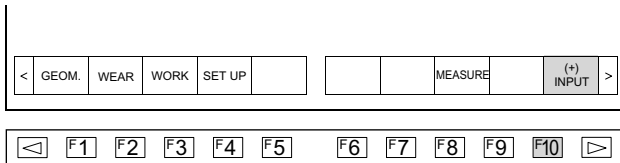   c) Press the **[(+) INPUT]** soft-key.

NOTE

1. If the (INPUT) key is pressed, the value having been input with data entry keys is input for the work shift offset data (Z-axis). Therefore, make sure to press the **[(+) INPUT]** soft-key.

2. When inputting a numeric value, pay attention to the sign (+, −) and a decimal point to be input.

3. To elongate the workpiece length, or to carry out test cutting without actual cutting, input a negative value.

   [−] [numeric value] **[(+) INPUT]** soft-key

   To elongate the workpiece length, or to carry out cutting without mounting a workpiece for spindle 2, input a positive value. (S type)

   [numeric value] **[(+) INPUT]** soft-key

23)   Return the work shift amount set for "COMMON Z1" to "0".

    a)   Move the cursor to "COMMON Z1".

    b)   Press the $\boxed{0}$ key.

    c)   Press the **[INPUT]** soft-key.

⚠ CAUTION

Make sure to set "0" for "COMMON Z1" on the WORK OFFSET screen.

If the work coordinate system shift data is set for "COMMON Z1", the work coordinate system is shifted in the same direction disregarding of the spindle (spindle 1 and spindle 2) to be used, which causes the turret to interfere with the workpiece resulting in machine damage.

7   SETTING THE WORK COORDINATE SYSTEM USING G54 TO G59

This section describes the procedure to set the work coordinate system using G54 to G59.

Define the correspondence between the workpiece type and the G code (G54 to G59) on the WORK OFFSET screen.

Simply specify a program such as G54 X___ Z___, and positioning is carried out in the required work coordinate system.

<Example 1 For multiple workpieces>

<Example 2 For continuous operation of 1st and 2nd processes>
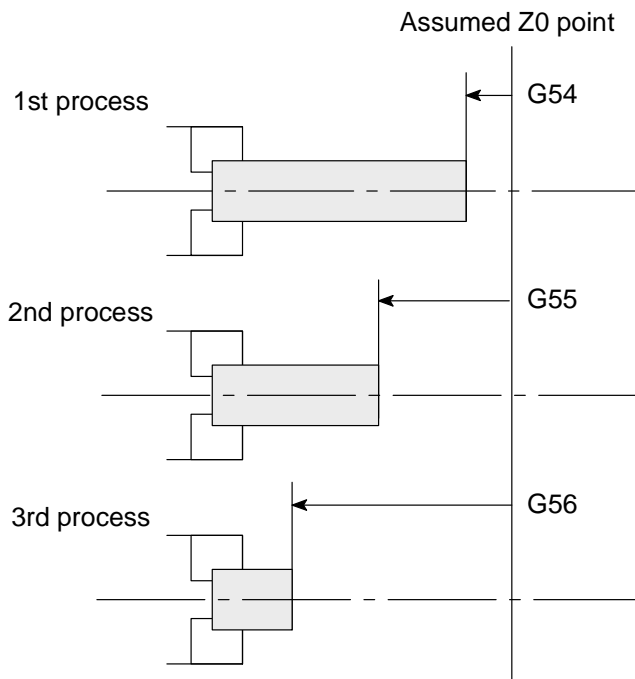
7-1   Setting the Work Coordinate System

This section describes the procedures for setting the work coordinate system using the data entry keys and the **[MEASURE]** soft-key.

⚠️ **CAUTION**

Make sure to set "0" at the DATA (coordinate system shift data) column of the work coordinate system NO. "00 (EXT)" on the WORK COORDINATES screen.
If the work coordinate system shift data is set for NO. "00 (EXT)", the work coordinate system is shifted in the same direction disregarding of the spindle (spindle 1 and spindle 2) to be used, which causes the turret to interfere with the workpiece resulting in machine damage.
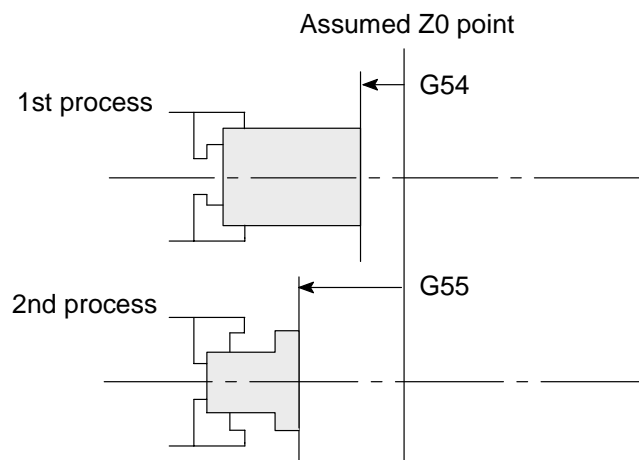
NOTE

Among the coordinate system numbers from 01 (G54) to 06 (G59), set those used for spindle 1 and those for spindle 2 on the WORK COORDINATES screen beforehand.

7-1-1   Setting the Work Coordinate System Using the Data Entry Keys
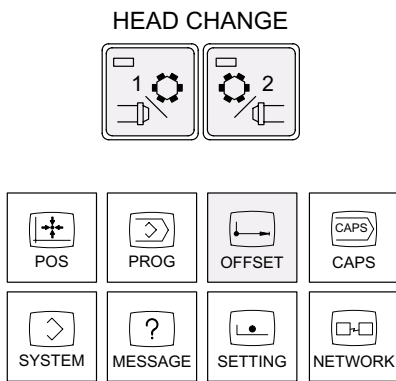
HEAD CHANGE

1) Press the HEAD CHANGE switch (head 1) or (head 2) to select the required turret.

2) Display the WORK OFFSET screen.

   a) Press the function selection key (OFFSET).
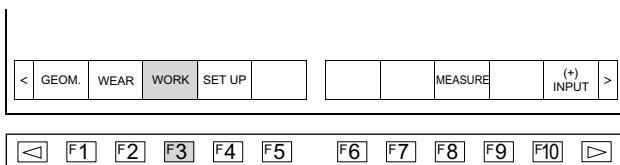
   b) Press the **[WORK]** soft-key.
      The WORK OFFSET screen is displayed.
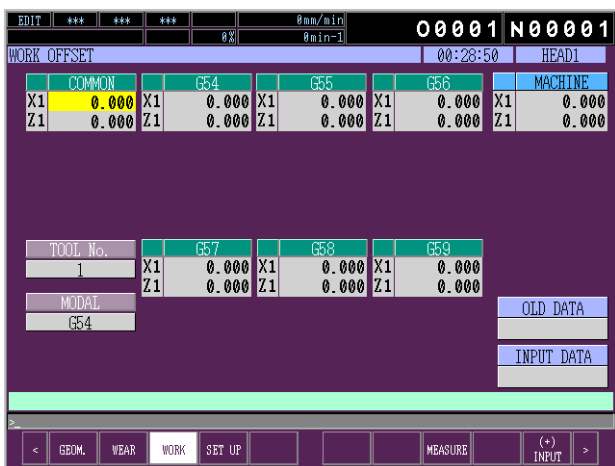
3) Move the cursor to the number (G54 - G59) of the work coordinate system where the data should be input.
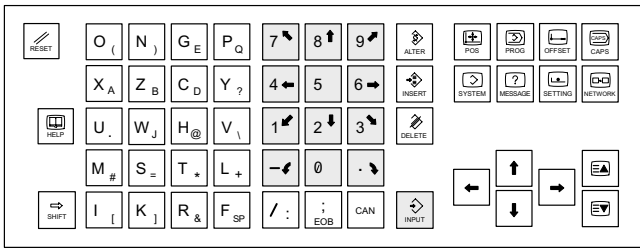
4) Input the relative coordinate values from assumed Z0 point to workpiece zero point using the data entry keys.

5) Press the $\diamondsuit$ INPUT (INPUT) key.

7-1-2   Setting the Work Coordinate System Using the [MEASURE] Soft-Key
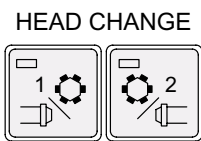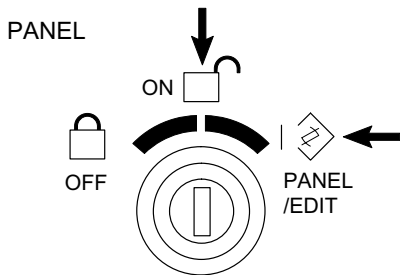
DOOR INTERLOCK
NORMAL   RELEASE

1) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

2) Clamp a workpiece in the chuck.

3) Close the front door.

PANEL

ON

OFF   PANEL
                       /EDIT

4) Place the PANEL key-switch in one of the positions indicated below.

   🔓 (ON)   ⬦ (PANEL/EDIT)

HEAD CHANGE

1   2
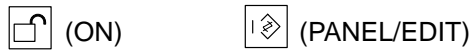
5) Press the HEAD CHANGE switch ⬦ (head 1) or ⬦ (head 2) to select the required turret.

6) Display the WORK OFFSET screen.
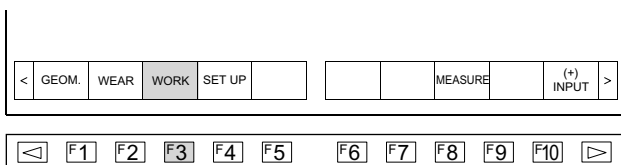
   a) Press the function selection key ⬚ (OFFSET).

POS   PROG   OFFSET   CAPS

SYSTEM   MESSAGE SETTING   NETWORK

   b) Press the **[WORK]** soft-key.
      The WORK OFFSET screen is displayed.

| < | GEOM. | WEAR | WORK | SET UP | | | MEASURE | (+) INPUT | > |

◁ F1 F2 F3 F4 F5   F6 F7 F8 F9 F10 ▷

7) Move the cursor to the number (G54 - G59) of the work coordinate system where the data should be input.

<Example 2 For continuous operation of 1st and 2nd processes>
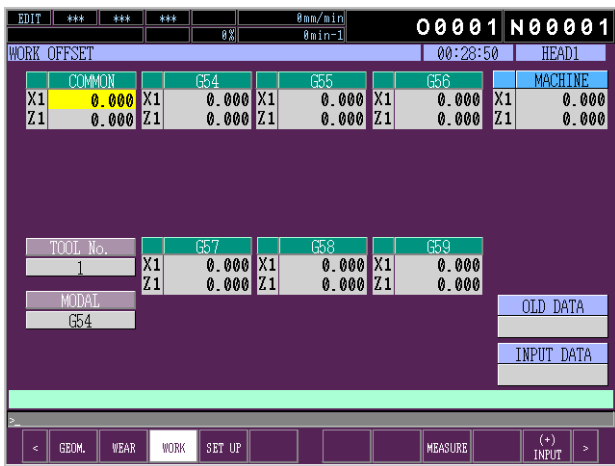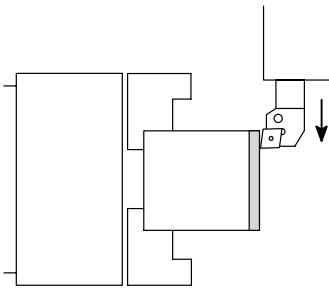
8) Bring the tool tip into light contact with the workpiece end face of 2nd process in the handle feed operation.

> **CAUTION**
>
> Do not move the tool in the Z-axis direction after the contact. If moved, it could cause the tool to interfere with the workpiece, damaging the tool and machine.

9) Input "Z0" using the data entry keys to set the current Z-axis position to "0".
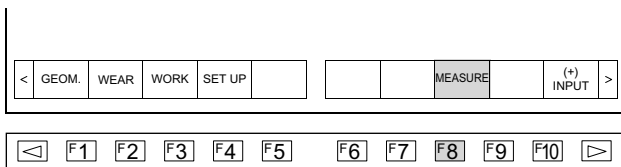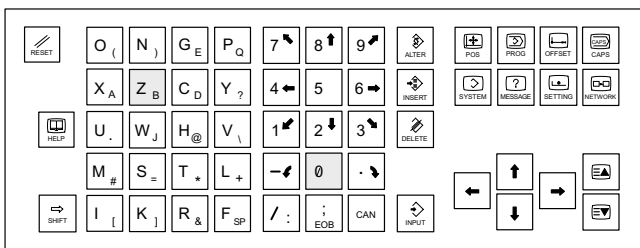
10) Press the **[MEASURE]** soft-key.

The work offset amount is input.

8   SETTING THE COORDINATE SYSTEM USING G50

This section describes the procedure for setting the coordinate system using the G50 coordinate system setting function.

The coordinate system function called by the G50 command sets the distance from the program zero point or workpiece zero point (X0, Z0), which is used as the reference point for absolute programming, to the programmed tool start point of each tool.

It is also possible to specify the clamp speed of the spindle for individual processes.

Before attempting the operation above, follow the operation as explained in 3 "PREPARATION FOR SETTING THE COORDINATE SYSTEM".

<Command format>

G50 X____Z____S____;
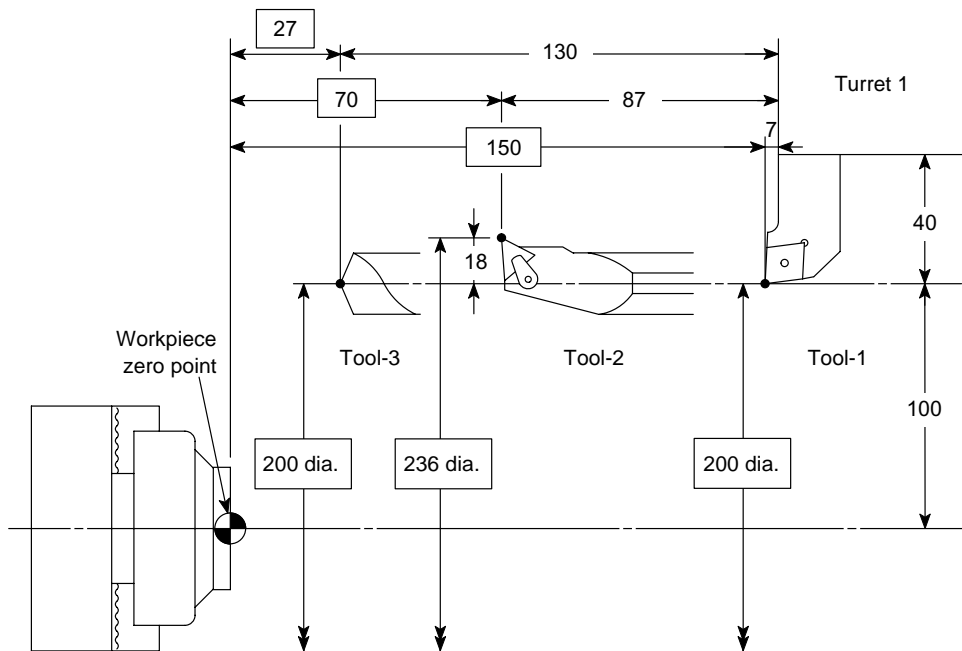
Tool-1	G50	X200.0	Z150.0
Tool-2	G50	X236.0	Z70.0
Tool-3	G50	X200.0	Z27.0

<Cautions on calculating the tool start point distance and clamp speed (G50)>

NOTE

1. The turret (tool and/or tool holder mounting turret face) is located at the same position for all tools.

2. The values to be specified in a G50 block must be preceded by X and Z. In other words, U and W must not be used.

3. Differences in X and Z values among the tools are caused by differences in tool overhang direction, tool overhang amount, tool dimension, tool shape, and tool holder difference among the tools and tool holders being used.

CAUTION When setting the coordinate system using the machine coordinate system setting function, any mistake in specifying the X and Z values in the G50 block will cause interference between the cutting tool, tool holder, or turret head, and the workpiece, chuck, fixture, or tailstock, damaging the machine, or will result in the cutting tool failing to reach the cutting position.

<If X and Z values in a G50 block are larger than actual values>

Correct	G50	X200.0	Z150.0
Incorrect	G50	X250.0	Z180.0

<If X and Z values in a G50 block are smaller than actual values>
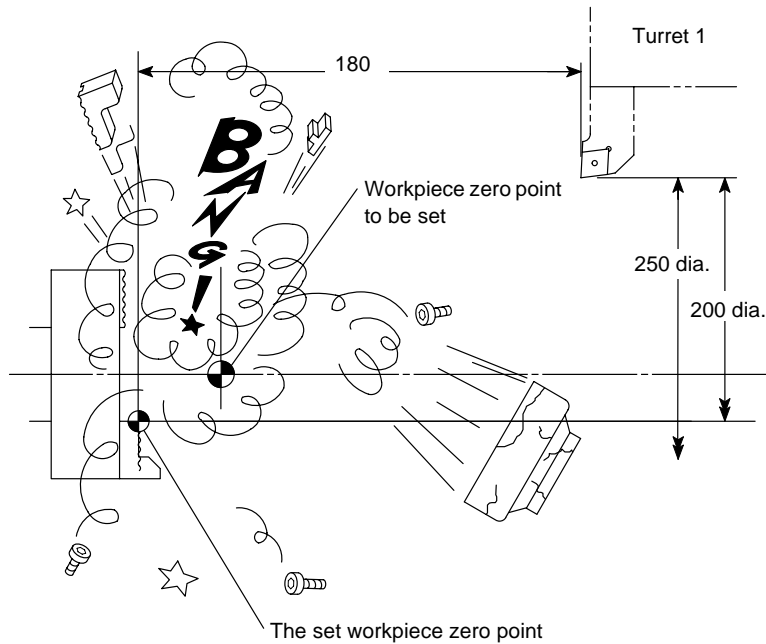
Correct	G50	X200.0	Z150.0
Incorrect	G50	X150.0	Z100.0

NOTE
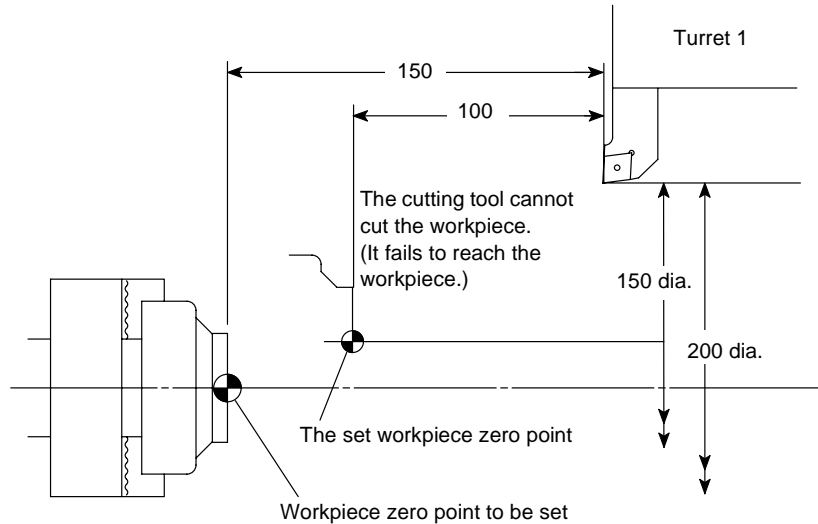
1. An S command specified in a G50 block determines the allowable maximum spindle speed.

   Usually, the limit speed of the spindle to ensure safe operation or a speed a little lower than this is specified when an imbalanced workpiece or fixture is rotated. If end face is machined in the G96 constant surface speed control mode, spindle speed increases to reach the maximum speed as the cutting tool moves toward the center. In such operations, the S command specified in a G50 block clamps the spindle speed at the specified value to ensure safe operation. The spindle speed clamp function is not valid in the G97 mode.

2. The coordinate system setting command "G50 X___Z___ ;" must be set for all tools. The start point of the turret must be in the same position for each tool.

   The return point must be set at the same position as the start point.

   Be sure to cancel the tool offset data before specifying G50 command.

   Never combine the two different methods (tool geometry offset data, G50 command method) to set the coordinate system.

   ```
   G50 X___Z___ ; . . . . . . . . . . . .Start point
   G00 T0202 ; . . . . . . . . . . . . . .Tool index
                                         Wear offset
   G00 X___Z___ ; . . . . . . . . . . . .Return point
   T0200 ; . . . . . . . . . . . . . . . . . .Tool wear offset cancel
   M01 ;
   ```

   Enter the same value.

DOOR INTERLOCK
NORMAL   RELEASE

PANEL

ON

OFF

PANEL
/EDIT

HEAD CHANGE

1   2

POS   PROG   OFFSET   CAPS

SYSTEM   MESSAGE   SETTING   NETWORK

| < | GEOM. | WEAR | WORK | SET UP | | | | MEASURE | | (+) INPUT | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |

MDI	***	***	***		0mm/min		O0001	N00001
				0%	0min-1		00:28:15	HEAD1

GEOMETRY OFFSET

	X	Z	R	Y		MACHINE
1	0.000	0.000	0.000	0.000	X1	0.000
2	0.000	0.000	0.000	0.000	Z1	0.000
3	0.000	0.000	0.000	0.000		
4	0.000	0.000	0.000	0.000		
5	0.000	0.000	0.000	0.000		
6	0.000	0.000	0.000	0.000		
7	0.000	0.000	0.000	0.000		
8	0.000	0.000	0.000	0.000		MODAL
9	0.000	0.000	0.000	0.000		G54
10	0.000	0.000	0.000	0.000		OLD DATA
11	0.000	0.000	0.000	0.000		
12	0.000	0.000	0.000	0.000		INPUT DATA

| < | GEOM. | WEAR | WORK | SET UP | | | No. SEARCH | MEASURE | | (+) INPUT | > |

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 required turret.

5) Retract the turret to the position where the cutting tool will not interfere with the workpiece when the turret head is rotated.

6) Set "0" for the tool geometry offset.

   a) Press the function selection key (OFFSET).

   b) Press the **[GEOM.]** soft-key.
The GEOMETRY OFFSET screen is displayed.

   c) Move the cursor to the number for which the data is set for tool geometry offset using the cursor control keys.

   d) Press the 0 key.

   e) Press the (INPUT) key.

   f) Repeat the above steps of b) to e) to clear all of the tool geometry offset amount.

TURRET
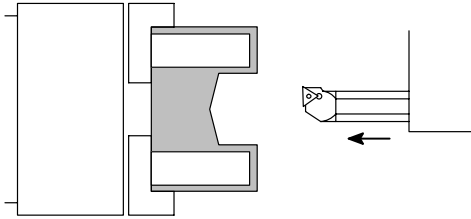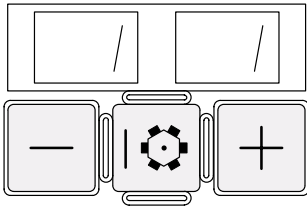
DOOR UNLOCK
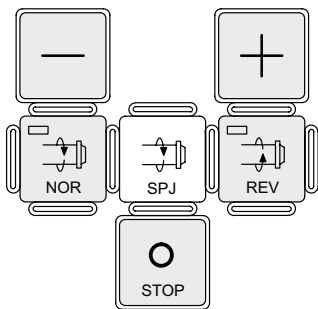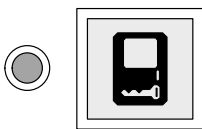
7) Select the cutting tool which has the largest overhang using the turret indexing operation.

📖   Page B-41 (8)

8) Bring the tool close to the workpiece manually while observing the clearance between the workpiece 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.

9) 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.

10) Check for possible interference when the spindle is rotated.

   <Example>

   - Interference between the adjacent tools and chuck (workpiece)

   - Interference between the fixture and chuck (workpiece)

11) After making sure that the spindle can be rotated without interference, close the front door.

12) Start the spindle manually, and adjust the spindle speed as appropriate.

📖   Page B-32 (7-2)

13) Select the cutting tool which has the largest overhang and bring it into light contact with the workpiece end face in the handle feed operation. Then, move the cutting tool to the position where position data (X, Z) is an integer.

14) Press the ⭕ (STOP) switch to stop the spindle.

15) Reset the relative coordinate values on the screen to "0".

POS	PROG	OFFSET	CAPS
SYSTEM	MESSAGE	SETTING	NETWORK

| < | ABS. | INC. | ALL | | MONI TOR | | | | | PRESET | ORIGIN | > |

| ◁ | F1 | F2 | F3 | F4 | F5 | | F6 | F7 | F8 | F9 | F10 | ▷ |

```
 O0001  N00001   0%     0mm/min  O0001  N00001   0%     0mm/min
MEM  ***   ***   ***     0min-1 MEM  ***   ***   ***
POSITION                               00:23:24     HEAD1
        INCREMENTAL                      INCREMENTAL
    X1          0.000               X2          0.000
    Z1          0.000               Z2          0.000
                                    B2          0.000


WORK COUNT      0  /      0    WORK COUNT      0  /      0
RUN TIME   0000 H    00 M   00 S  RUN TIME   0000 H    00 M   00 S
CYCLE TIME 0000 H    00 M 00.0 S  CYCLE TIME 0000 H    00 M 00.0 S
F     0.00 S      0  T         F      0  S          T

>_
  <   ABS.   INC.   ALL        MONI               PRESET ORIGIN  >
                               TOR
```

TURRET

a) Press the function selection key (POS).
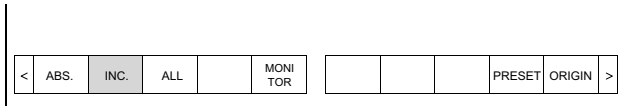
b) Press the **[INC.]** soft-key.
   The POSITION (INCREMENTAL) screen is displayed.
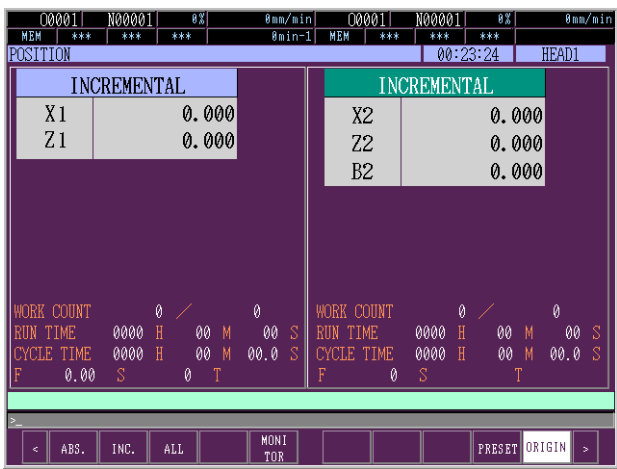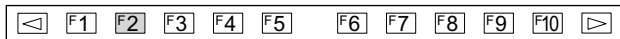
c) Press the X A key.

d) Press the **[ORIGIN]** soft-key.

e) Press the Z B key.

f) Press the **[ORIGIN]** soft-key.
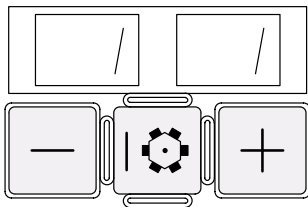
16) Index the cutting tool for which the offset distance is to be set using the turret indexing operation.

Page B-41 (8)

17) Repeat steps 8) to 10) and check interference.

18) After making sure that the spindle can be rotated without interference, close the front door.

19) Start the spindle manually, and adjust the spindle speed as appropriate.

Page B-32 (7-2)

20) Bring the tool tip into light contact with the workpiece end face in the handle feed operation.

21)   Record the coordinate value of Z1, as displayed on the screen.

   <Example>

   The coordinate value of Z1 is 200.000.
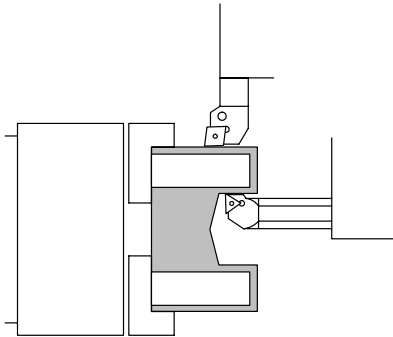
22)   Bring the tool tip into light contact with workpiece O.D. (for O.D. cutting tool) or the workpiece I.D. (for I.D. cutting tool) in the handle feed operation.

   <Example>

   Bring the O.D. cutting tool to the workpiece O.D. (50 mm in diameter) in the handle feed operation.

23)   Record the coordinate value of X1, as displayed on the screen.

   <Example>

   The coordinate value of X1 is 150.000.

24)   When creating a program, specify "G50 X200.0 Z200.0".

9   OPERATION PROCEDURE OF MANUAL IN-MACHINE TOOL PRESETTER

This section describes the procedure used for setting the tool geometry offset and Z-axis work shift offset data by using the manual in-machine tool presetter.

9-1   Interlocks for Using the Manual In-machine Tool Presetter

The manual in-machine tool presetter function is provided with following interlocks.

1. If the GEOMETRY OFFSET screen is not displayed even if the presetter mode switch ⊞ is pressed after the installation of presetter arm, check the following items if they are satisfied.

    *   The X- and Z-axes of both the turret 1 and turret 2 are returned to the zero point.

    *   Both the turret 1 and turret 2 are indexed to the correct position.

    *   A manual mode (handle, jog, rapid traverse, zero return) is selected.

    *   The tailstock is clamped.

    *   The protection cover is mounted to the presetter base of the turret side on which the presetter is not used and the locking lever is not tightened if the protection cover is not mounted to the presetter base.

2. Axis movement is precluded unless the presetter mode switch ⊞ is turned ON after the installation of presetter arm.

3. Cover close state is checked from the installation of the protection cover to the base. When the locking lever is turned to the clamp side, the cover close state is detected. If the cover close check signal is turned off, the operation is suspended in the following manner.

    <Manual mode>

    Spindle rotation and coolant supply are stopped.

    <Automatic mode>

    Alarm message is displayed and automatic operation is suspended. Spindle rotation, axis movement, and coolant supply are stopped.

4. To prevent the interference with the presetter arm, the following operation is not allowed when the presetter arm is installed.

    *   Tailstock spindle IN/OUT and inching operation

    *   Moving the tailstock body

    *   Parts catcher operation (parts catcher specification)

    *   Entry of robot arm into the machine (robot specification)

    *   Entry of loader arm into the machine (loader specification)

5. Axis movement stops if the cutting tool comes into contact with the stylus; after axis movement is stopped, the axis can only be moved in the direction in which the cutting tool is moved away from the stylus.

6. The presetter arm clamp signal is turned on when the locking lever is turned to the lock position with the presetter arm installed to the presetter arm installation base.

Axis movement is enabled when the indicator in the presetter mode switch [⊞] is lit with the presetter arm clamp signal ON. In this case, rapid traverse rate is clamped at 25% or less.

NOTE Axis movement is not allowed even when the locking lever is in the lock position unless the presetter arm or the cover is installed to the presetter arm installation base.

7. If the WORK OFFSET screen is not displayed even if the indicator [⊞] in the presetter mode switch is lit, check the following items if they are satisfied.

   • The protection covers are mounted to the presetter bases on both the turret 1 and turret 2.

   • The locking levers for the protection covers on both the turret 1 and turret 2 are tightened.

9-2 Precautions on Using the Manual In-machine Tool Presetter

The items to be observed when operating the in-machine tool presetter are indicated below.

CAUTION 1. Never attempt mounting/removal of the presetter arm in the presetter mode (the indicator in the presetter mode switch [⊞] is lit). If attempted, the tool geometry offset data could be changed depending on the contact conditions of the connection part at the base and the presetter arm. If machining is executed although the tool geometry offset data has been changed, it will cause interference of the tools, tool holders, and/or turret head with the workpiece, chuck, and/or fixture, causing damage to the machine.

2. Do not press the presetter measurement switch [⊕→] without cutting the workpiece end face under the following status:

   • The presetter arm has been removed from the base.

   • The protection cover is installed to the base.

   • The indicator in the presetter mode switch [⊞] is lit.

   If the presetter measurement switch [⊕→] is pressed in such state, the work shift data cannot be set correctly. If the program is executed while the input work shift data is not correct, the tool, tool holder, and/or the turret head is hit against the workpiece, chuck, or fixture, causing damage to the machine, or the tool may not reach the workpiece.

3. When installing the presetter arm to the machine or removing it from the machine or container, pay sufficient care not to give shocks to the presetter arm, especially to the sensor. If shocks are applied to the sensor or presetter arm, the sensor may be damaged or the presetter arm may be distorted, making it impossible to set the appropriate tool geometry offset data.

NOTE

1. In the presetter mode (the indicator in the presetter mode switch ⊞ is lit), if the tool tip is brought into contact with the stylus by moving two axes simultaneously or if the sensor is turned on although an axis is not moved, the following alarm message is displayed on the screen.

    ALARM 5195 DIRECTION CAN NOT BE JUDGED

    In this case, the alarm state can be cleared by pressing the ⊠ (RESET) key.

    If the tool is in contact with the stylus when the alarm is cleared, the following message is displayed on the screen.

    EX1979 RETRACT TOOL FROM SENSOR

    In this case, check the direction of tool contact with the stylus and move the tool away from the stylus.

2. Keep connection parts of base and presetter arm and the presetter arm to base joint portions away of chips, dust, and other foreign matter. Also protect them from splashing of coolant. Chips, coolant, and foreign matter deteriorate measuring accuracy and thus machining accuracy will be lowered. In addition, there will be cases that the installation of the presetter arm to the base cannot be recognized due to improper contact of the connection parts. If this occurs, the tool presetter cannot be used.

3. Keep the connection part of protection cover away of chips, dust, and other foreign matter and also protect it from splashing of coolant. These will cause improper contact of the connection parts and if the protection cover is installed to the base, it will not be recognized and the cover close check signal is not turned on. In this case, machine operation is made impossible.

4. If the presetter arm is held by hand, it will be thermally expanded. To minimize thermal expansion and to ensure secure holding by preventing slipping, a grip is provided. Therefore, when holding the presetter arm, hold it at the grip. Due to the same reason, do not hold the presetter arm for a long time. If the thermally expanded presetter arm is installed to the base and used for measurement, measuring accuracy is deteriorated and machining accuracy is lowered.

5. The Z-axis work shift offset data can be set only one time by pressing the presetter measurement switch ⊕.

    To set the Z-axis work shift offset data for another tool, turn off the presetter mode switch ⊞ once and then turn it on again.

6. If the presetter arm is mounted to the presetter arm mounting base at either of turret 1 and turret 2, axis movement is not allowed for the other turret.

9-3   Installing and Removing the Presetter Arm

To use the in-machine tool presetter, install the presetter arm to the machine and measure the tool geometry offset data. After completing measurement, remove the presetter arm from the machine.

This section describes the procedure for installing and removing the presetter arm.

CAUTION

1. Never attempt mounting/removal of the presetter arm in the presetter mode (the indicator in the presetter mode switch 🔲 is lit). If attempted, the tool geometry offset data could be changed depending on the contact conditions of the connection part at the base and the presetter arm. If machining is executed although the tool geometry offset data has been changed, it will cause interference of the tools, tool holders, and/or turret head with the workpiece, chuck, and/or fixture, causing damage to the machine.

2. When installing the presetter arm to the machine or removing it from the machine or container, pay sufficient care not to give shocks to the presetter arm, especially to the sensor. If shocks are applied to the sensor or presetter arm, the sensor may be damaged or the presetter arm may be distorted, making it impossible to set the appropriate tool geometry offset data.

<Installing the presetter arm>
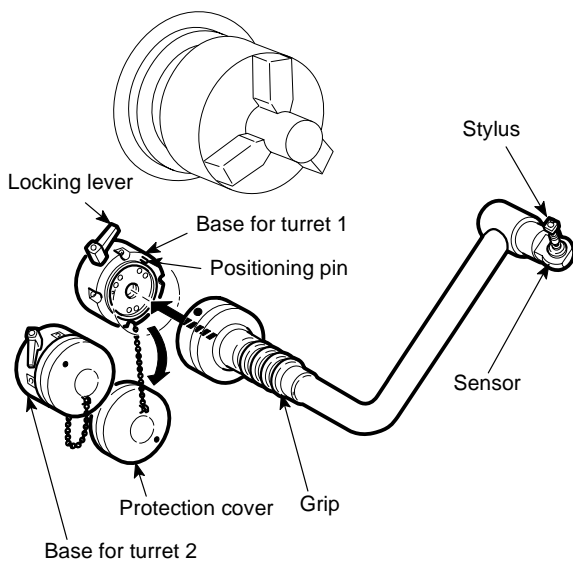
1) Clean the area around the base so that chips and foreign matter will not stick on the base and the removed cover. Also keep them away from coolant.

2) Turn the locking lever counterclockwise to the unlock position (angle of turning: 132°).

3) Remove the protection cover from the base.

4) Take out the presetter arm from the container. When taking out the presetter arm, make sure to hold the grip of it.

NOTE   Do not hold the presetter arm for a long time.
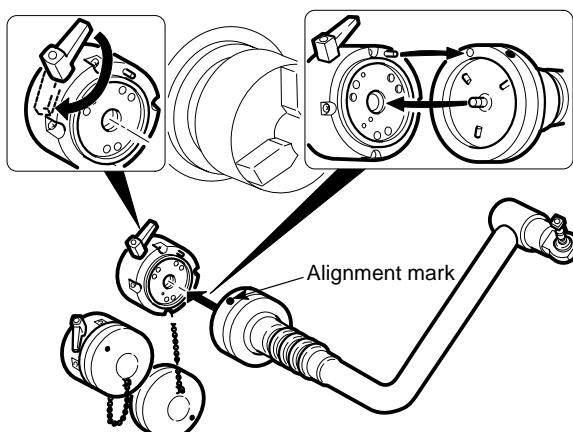
5) Make sure that the connection parts of the presetter arm and the base are free of chips and foreign matter.

CAUTION   When cleaning the base with rag, pay attention so that chips and foreign matter will not enter the hole in the lock mechanism. Entry of foreign matter will cause malfunctioning of the tool presetter.

NOTE   If the connection part is dirty with chips or foreign matter, clean the connection part with rag.

6) Install the presetter arm to the base while positioning the alignment mark to the locking lever on the base.

7) Turn the locking lever clockwise (angle of turning: 132°) until it stops.

\<Removing the presetter arm\>
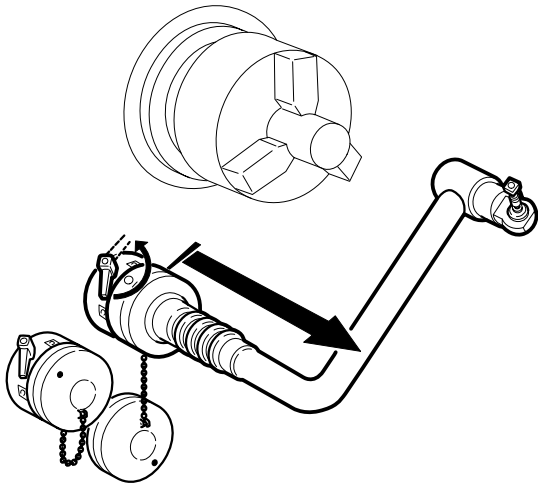
1) Hold the grip of the presetter arm and turn the locking lever counterclockwise to the unlock position (angle of turning: 132°).

2) Pull the presetter arm to remove it from the base.

3) Store the presetter arm in the container.

4) Make sure that the connection parts of the base and the protection cover are free of chips and foreign matter.

> **CAUTION**
> ⚠
> When cleaning the base with rag, pay attention so that chips and foreign matter will not enter the hole in the lock mechanism. Entry of foreign matter will cause malfunctioning of the tool presetter.

> **NOTE**
> If the connection part is dirty with chips or foreign matter, clean the connection part with rag.

5) Insert the protection cover to the base while positioning the alignment mark to the locking lever on the base.

6) Turn the locking lever clockwise (angle of turning: 132°) until it stops.

Alignment mark

9-4   Operation Procedure of Manual In-machine Tool Presetter

This section describes the procedure used for setting the tool geometry offset and Z-axis work shift offset data by using the manual in-machine tool presetter.

```
                        ╭──────────────────────╮
                        │   Start of Operation  │
                        ╰──────────────────────╯
                                    │
        ┌───────────────────────────────────────────────────────┐
        │ Place the DOOR INTERLOCK key-switch in the NORMAL position │
        └───────────────────────────────────────────────────────┘
                                    │
        ┌───────────────────────────────────────────────────────┐
        │                 Close the front door                   │
        └───────────────────────────────────────────────────────┘
                                    │
        ┌───────────────────────────────────────────────────────┐
        │ Press the HEAD CHANGE switche [⚙1] (head 1) or [⚙2] (head 2) │
        │            to select the required turret               │
        └───────────────────────────────────────────────────────┘
                                    │
        ┌───────────────────────────────────────────────────────┐
        │ Carry out manual zero return (X-/Z-axis) [📖] Page B-19 (6-1) │
        └───────────────────────────────────────────────────────┘
                                    │
        ┌───────────────────────────────────────────────────────┐
        │ Press any of the following MODE selection switches: [▯] [⋀⋀] [∿] │
        └───────────────────────────────────────────────────────┘
                                    │
        ┌───────────────────────────────────────────────────────┐
        │ After making sure that the machine is stopped, open the front door │
        └───────────────────────────────────────────────────────┘
                                    │
        ┌───────────────────────────────────────────────────────┐
        │ Install the presetter arm*1  [📖] Page E-43 (9-3)       │
        └───────────────────────────────────────────────────────┘
                                    │
        ┌───────────────────────────────────────────────────────┐
        │                 Close the front door                   │
        └───────────────────────────────────────────────────────┘
                                    │
        ┌───────────────────────────────────────────────────────┐
        │ Press the presetter mode switch [⊞] to turn it ON*2     │
        └───────────────────────────────────────────────────────┘
                                    │
        ╭───────────────────────────────────────────────────────╮
        │    The GEOMETRY OFFSET screen is displayed             │
        ╰───────────────────────────────────────────────────────╯
```

Start of Operation

Place the DOOR INTERLOCK key-switch in the **NORMAL** position

Close the front door

Press the HEAD CHANGE switche [head 1] or [head 2] to select the required turret

Carry out manual zero return (X-/Z-axis) 📖 Page B-19 (6-1)

Press any of the following MODE selection switches: [▯] [⋀⋀] [∿]

After making sure that the machine is stopped, open the front door

Install the presetter arm*1 📖 Page E-43 (9-3)

Close the front door

Press the presetter mode switch [⊞] to turn it ON*2

The GEOMETRY OFFSET screen is displayed

(2) → Index the tool to be measured 📖 Page B-41 (8)

(1) →

Is it possible to bring the tool tip into contact with the stylus? — No → (A)

Yes ↓

Move the tool near the stylus

Is it possible to visually check the gap and positional relationship between the stylus and the tool tip? — Yes →

No ↓

After making sure that the machine is stopped, open the front door

Check the gap and positional relationship between the stylus and the tool tip

Close the front door

Move the tool near the stylus using the manual pulse generator 📖 Page B-25 (6-4)

Do you use the presetter measurement sub mode? — Yes → (B)

No ↓

Bring the tool tip into contact with the stylus*3, *4   (C)

The tool geometry offset data is input to the GEOMETRY OFFSET screen*

(D)

(A)

Type of tool

| Drills, reamers | Rotary tools | Thread cutting tools, straight tools |

Rotary tools → Tool mounting direction

<Z-axis direction>

<X-axis direction>

Drills, reamers:
Input the distance from the spindle center line to the X-axis zero point for the I.D. tool holder or rotary tool to "X" on the GEOMETRY OFFSET screen ***

📖 Page E-55 (9-7)

X-axis direction:
Open the front door and measure the tool diameter with a micrometer or vernier calipers

Close the front door

Move the tool near the stylus

Is it possible to visually check the gap and positional relationship between the stylus and the tool? — Yes

No

Is it possible to visually check the gap and positional relationship between the stylus and the tool tip? — Yes

No

After making sure that the machine is stopped, open the front door

Check the gap and positional relationship between the stylus and the tool

Check the gap and positional relationship between the stylus and the tool tip

Close the front door

Move the tool near the stylus using the manual pulse generator

📖 Page B-25 (6-4)

Do you use the presetter measurement sub mode? — Yes → (B)

No

Bring the largest diameter area of the rotary tool into contact with the stylus *3, *4

Move the tool tip to the same level as the stylus face *3

Open the front door

Press the stylus by your finger *4, *5

(C)

The tool geometry offset data is input to the GEOMETRY OFFSET screen *

Input the diameter of the rotary tool with the negative value to "Z" on the GEOMETRY OFFSET screen **

Close the front door

(D)

(B)

Move the tool to a point within 5 mm from the stylus contact face
using the manual pulse generator

↓

Press the MODE selection switch [�handwavy] (JOG)

↓

Press the AXIS DIRECTION switch corresponding to the axis feed direction
in which the tool is brought into contact with the stylus

↓

Axis stops moving when the tool comes into contact with the stylus****

↓

(C)

(D)

↓

Move the turret to a position where the tools in the turret
will not cause interference with the in-machine tool presetter
even when the turret head is rotated

↓

Has the tool geometry offset data
been set for both X- and Z-axes? ——No——→ (1)

↓ Yes

Is there a next tool to be
measured? ——Yes——→ (2)

↓ No

Press the presetter mode switch [⊞] to turn it OFF

↓

Open the front door

↓

Make sure that the presetter arm can be removed
without causing interference with the cutting tools, etc.

↓

Remove the presetter arm[*1]   📖 Page E-43 (9-3)

↓

Close the front door

↓

Display the WORK OFFSET screen

↓

(E)

```
                                    ( E )
                                      │
                                      ▼
              ◇──────────────────────────────────────────◇   No
              ◇   Work shift offset data setting necessary? ◇─────────┐
              ◇──────────────────────────────────────────◇          │
                                    │ Yes                            │
                                    ▼                                │
          ┌──────────────────────────────────────────────┐          │
          │ Press the presetter mode switch 🔲 to turn it ON │          │
          └──────────────────────────────────────────────┘          │
                                    │                                │
                                    ▼                                │
          ┌──────────────────────────────────────────────┐          │
          │              Open the front door              │          │
          └──────────────────────────────────────────────┘          │
                                    │                                │
                                    ▼                                │
          ┌──────────────────────────────────────────────┐          │
          │ Clamp the workpiece to be machined by the chuck  📖 Page B-36 (7-3) │
          └──────────────────────────────────────────────┘          │
                                    │                                │
                                    ▼                                │
          ┌──────────────────────────────────────────────┐          │
          │              Close the front door             │          │
          └──────────────────────────────────────────────┘          │
                                    │                                │
                                    ▼                                │
          ┌──────────────────────────────────────────────┐          │
          │ Select and index the tool, which can machine the workpiece end face │
          │ from the tools for which geometry offset data has been measured │
          │              📖 Page B-41 (8)                 │          │
          └──────────────────────────────────────────────┘          │
                                    │                                │
                                    ▼                                │
          ┌──────────────────────────────────────────────┐          │
          │ Display the WORK OFFSET screen  📖 Page A-100 (7-3-3) │   │
          └──────────────────────────────────────────────┘          │
                                    │                                │
                                    ▼                                │
          ┌──────────────────────────────────────────────┐          │
          │        Machine the workpiece end face[6]      │          │
          └──────────────────────────────────────────────┘          │
                                    │                                │
                                    ▼                                │
          ┌──────────────────────────────────────────────┐          │
          │ Press the presetter measurement switch  🔲    │          │
          └──────────────────────────────────────────────┘          │
                                    │                                │
                                    ▼                                │
          ⟨──────────────────────────────────────────────⟩          │
          ⟨  The work shift offset data is input to "COMMON Z1" │    │
          ⟨       on the WORK OFFSET screen               ⟩          │
          ⟨──────────────────────────────────────────────⟩          │
                                    │                                │
                                    ▼                                │
          ┌──────────────────────────────────────────────┐          │
          │ Press the presetter mode switch 🔲 to turn it OFF │        │
          └──────────────────────────────────────────────┘          │
                                    │◄───────────────────────────────┘
                                    ▼
          ┌──────────────────────────────────────────────┐
          │ Carry out manual zero return (X-/Z-axis)  📖 Page B-19 (6-1) │
          └──────────────────────────────────────────────┘
                                    │
                                    ▼
              ◇──────────────────────────────────────────◇   No
              ◇       End face cutting allowance          ◇─────────┐
              ◇        setting necessary?                 ◇         │
              ◇──────────────────────────────────────────◇         │
                                    │ Yes                           │
                                    ▼                               │
          ┌──────────────────────────────────────────────┐         │
          │              Open the front door              │         │
          └──────────────────────────────────────────────┘         │
                                    │                               │
                                    ▼                               │
          ┌──────────────────────────────────────────────┐         │
          │ Measure the entire length of the workpiece with a micrometer or vernier calipers, │
          │ then set the cutting allowance on end face    │         │
          └──────────────────────────────────────────────┘         │
                                    │                               │
                                    ▼                               │
          ┌──────────────────────────────────────────────┐         │
          │ Input the cutting allowance on the end face to "COMMON Z1" │
          │ on the WORK OFFSET screen**                   │         │
          └──────────────────────────────────────────────┘         │
                                    │                               │
                                    ▼                               │
          ┌──────────────────────────────────────────────┐         │
          │              Close the front door             │         │
          └──────────────────────────────────────────────┘         │
                                    │◄──────────────────────────────┘
                                    ▼
                       ( End of Operation )
```

⚠ **CAUTION**

[1] When installing the presetter arm to the machine or removing it from the machine or container, pay sufficient care not to give shocks to the presetter arm, especially to the sensor. If shocks are applied to the sensor or presetter arm, the sensor may be damaged or the presetter arm may be distorted, making it impossible to set the appropriate tool geometry offset data.

CAUTION ⚠

*2   Make sure that the presetter arm is securely installed to the machine before pressing the presetter mode switch 🔲.

*3   Use the manual pulse generator with the ⌗ x1 (×1) or ⌗ x10 (×10) switch pressed near the stylus to bring the tool into contact with the stylus. The stylus will be damaged if the tool is hit against the stylus.

*4   The tool geometry offset data is set in the direction of the axis which was moved immediately before the sensor is turned on. Never move axes until the sensor is turned on after moving a tool tip onto the contact face of the stylus.
If an axis is moved after the tool tip is brought onto the contact face of the stylus but before the sensor is turned on, the offset data is entered to an unexpected direction.
If automatic operation is started under such status, an interference will occur between the tool, tool holder and turret head, and the workpiece, chuck, and fixture, causing damage to the machine.

*5   An axis can be moved in directions in addition to the tool retracting direction since the tool tip is not brought into contact with the stylus or sensor contact. Therefore, pay attention to the direction the tool is going to be moved. If the tool is moved in a wrong direction, the tool will be hit against the stylus or sensor contact causing damages to the machine.

*6   Do not move the tool in the Z-axis direction after cutting the workpiece end face. If moved, it could cause the tool to interfere with the workpiece, damaging the tool and machine.

*7   Make sure to set "0" for "COMMON Z1" on the WORK OFFSET screen.
If the work coordinate system shift data is set for "COMMON Z1", the work coordinate system is shifted in the same direction disregarding of the spindle (spindle 1 and spindle 2) to be used, which causes the turret to interfere with the workpiece resulting in machine damage.

NOTE ⬛

*   If more than one tool geometry offset amount should be set for a single tool, move the cursor to the second or other such tool's data setting area using the cursor control key and directly key in the offset data. In this case, it is necessary to change the setting for NC parameter QNI beforehand.
However if the setting for NC parameter QNI is changed, it is necessary to move the cursor to the tool number for which the offset data should be set each time the tool is indexed.

**   Always press the **[(+) INPUT]** soft-key after inputting a value.

If the ⬙ (INPUT) key is pressed instead of the **[(+) INPUT]** soft-key by mistake, the input value is recognized as the tool geometry offset data or the work shift data.

***   Press the ⬙ (INPUT) key after inputting a value.

****   If the tool fails to touch the stylus even if it has moved 5 mm, PC alarm message "EX 4917 TOOL DOESN'T TOUCH ON THE SENSOR" is displayed. In this case, clear the alarm state by pressing the ⬔ (RESET) key, press the presetter mode switch 🔲 and perform the operation in the presetter measurement sub mode.

9-5   Sensors, Tools, and Parameters

The relationships between the sensors of the manual in-machine tool presetter and tools and parameters are described here.
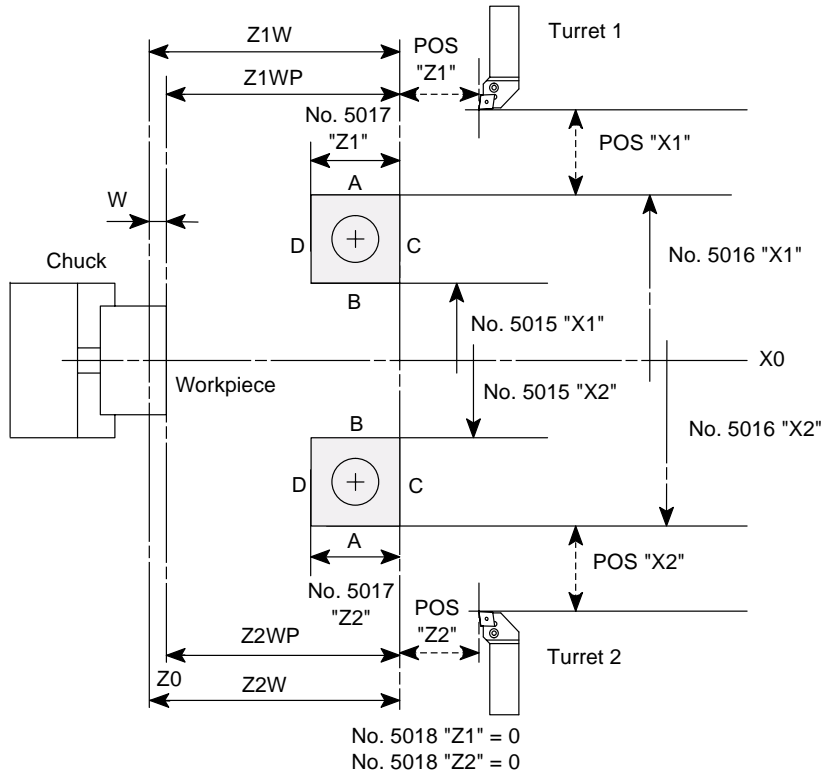
POS "X1", "X2" . . . . X coordinate value where the tool tip comes into contact with face A of the stylus (machine coordinate system)

POS "Z1", "Z2" . . . . Z coordinate value where the tool tip comes into contact with face C of the stylus (machine coordinate system)

No. 5015 "X1", "X2" (NC parameter) . . Set the X coordinate value (in diameter) where the sensor is turned when the tool tip comes into contact with face B of the stylus.

No. 5016 "X1", "X2" (NC parameter) . . Set the X coordinate value (in diameter) where the sensor is turned when the tool tip comes into contact with face A of the stylus.

No. 5017 "Z1", "Z2" (NC parameter). . . Set the distance between the two points where the sensor is turned on when the tool tip comes into contact with face C and face D of the stylus (with minus sign).

No. 5018 "Z1", "Z2" (NC parameter). . . Set the position data of the position where the sensor is turned on when the tool tip comes into contact with face C of the stylus (set zero).

Z1WP, Z2WP . . . . Z-axis work shift data which is set when the presetter measurement switch ⊕→ is pressed

Cutting allowance W . . . . Cutting allowance in Z-axis direction in reference to Z1WP and Z2WP

Z1W, Z2W. . . . . Z-axis work shift data that is a sum of Z1WP, Z2WP and cutting allowance W. This sets the program zero (Z0).

The tool geometry offset data is set in reference to the stylus by bringing the tool tip into contact with the stylus for which the coordinate values are set with NC parameters (No. 5015 to No. 5018) as illustrated above.

For the Z-axis work shift data, set the distance between the face C of the stylus and the program zero (Z0).

9-6   Parameters

The in-machine tool presetter function uses the following parameters. The settings of these parameters do not need to be changed.

The symbol ▰ in the table denotes the initial setting at shipment.

⚠ **CAUTION** For some parameters, their addresses differ depending on machine models. For PC parameters, refer to the ladder diagram.

Contact Mori Seiki when parameter settings must be changed. Mori Seiki is not responsible for accidents that occur as a result of changing of parameter settings without consultation.

1. NC parameter

Data number 1202

7	6	5	4	3	2	1	0
							WZS

Data Type		Bit Type
WZS	0	Direction of the offset data set to "COMMON" on the WORK COORDINATES screen: Opposite to work shift
	1	Direction of the offset data set to "COMMON" on the WORK COORDINATES screen: Same as work shift

Data number 5004

7	6	5	4	3	2	1	0
				TS1			

Data Type		Bit Type
TS1	0	Other than detachable tool presetter Type II
	1	Detachable tool presetter Type II

Data number 5005

7	6	5	4	3	2	1	0
		QNI					

Data Type		Bit Type
QNI	0	In the offset data write mode, the tool offset number is not selected automatically.
	1	In the offset data write mode, the tool offset number is selected automatically.

2.   PC parameter K5

7	6	5	4	3	2	1	0
PSMOK	PSCLP	PSZRN					

Data Type		Bit Type
PSZRN	0	The presetter mode switch ⊞ is invalid until zero return of each axis is completed.
	1	The presetter mode switch ⊞ is valid regardless of completing zero return of each axis.
PSCLP	0	The presetter measurement switch ⊕→ is valid regardless of the chucking condition.
	1	The presetter measurement switch ⊕→ is invalid while the chuck is unclamped.
PSMOK	0	The in-machine tool presetter function is not used.
	1	The in-machine tool presetter function is used.

PC parameter K8

7	6	5	4	3	2	1	0
						PST1	PSERNG

Data Type		Bit Type
PSERNG	0	Alarm check is made for the presetter sensor.
	1	Alarm check is not made for the presetter sensor.
PST1	0	Other than detachable tool presetter Type II
	1	Detachable tool presetter Type II

9-7   Distance from Spindle Center Line to X-axis Zero Point (I.D. Tool Holders and Rotary Tools)

When the tool geometry offset data is set for some types of tools, such as drills, reamers, and rotary tools mounted in the Z-axis direction, sometimes the tool center cannot be brought into contact with the stylus or the sensor contact. For these types of tools, manually input the distance from the spindle center line to the X-axis zero point.

CAUTION

Due to some reasons, the axis position data after zero return does not take the value indicated on the axis travel diagram.

For drilling or reaming operation, start machining only after making sure that the cutting tool (drill, reamer) is positioned at the center of the spindle.

<JIS specification>

Numerical value to be input

= − (distance from spindle center line to the X-axis zero point (in radius) × 2)

<Reversed JIS specification>

Numerical value to be input

= (distance from spindle center line to the X-axis zero point (in radius) × 2)

NOTE

The distance from the spindle center line to the X-axis zero point varies depending on the machine models, specifications, tool kinds (I.D. turning tool, rotary tool), and the turret specification (standard, quick change tooling).

For the distance from the spindle center line to the X-axis zero point, refer to the DRAWINGS.

CHAPTER F
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.

CONTENTS

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 [⟳] (ST) 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. Both the turret 1 and turret 2 are 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.

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 tailstock spindle is not in the inching state.

13. If the tailstock spindle interlock function is valid, the tailstock spindle is in the OUT position.

14. The tailstock body is clamped.

15. The work counter is not in the counted up state (only for work counter specification).

16. The spindle gear range is not being changed (only for transmission specification).

17. If the rotary tool spindle is rotating, the spindle speed attained signal has been turned on (only for MC type).

18. Restart of rotary tool spindle rotation is not valid when the automatic operation is temporarily suspended (only for MC type).

19. The bar stock in the bar feeder is not used up (only for bar feeder specification).

2   CHECK ITEMS WHEN EXECUTING DRY RUN, TEST CUTTING, MEASUREMENT, AND MASS PRODUCTION
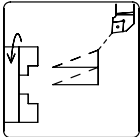
The items that must be carefully checked when checking the program, offset data, and possible interference by executing dry run operation and test cutting for starting mass production are indicated in the table below. Use this table when carrying out the work to ensure correct operation.
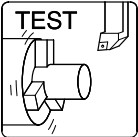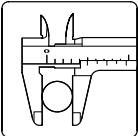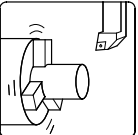
For the items to be checked, also refer to 3 "CHECKS BEFORE STARTING MASS PRODUCTION".

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.

		Check Items	Check Column
Dry Run Operation	1.	Is the chucking pressure checked and adjusted?	
	2.	If performing center-work, is the tailstock spindle thrust checked and adjusted?	
	3.	Is the single block function turned on?	
	4.	Are the feedrate and spindle speed appropriate for operation?	
	5.	Are the feed modes (rapid traverse and cutting feed) used correctly?	
	6.	Is the tool retraction direction after cutting correct?	
	7.	Is tool movement smooth in the calculated area?	
	8.	Are the tools free of interference with the workpiece, jaws, and chuck?	
	9.	Is the turret head indexed at a position where there is no interference with the workpiece?	
	10.	Can the machine be stopped immediately when necessary?	
	11.	Is the front door closed?	

Test Cutting		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.	Is the single block function turned on?	
	4.	Are the feedrate and spindle speed appropriate for operation?	
	5.	Are the order of machining and machining conditions determined in accordance with the shape and material of the blank workpiece?	
	6.	Are cutting tools and replaceable tool tips selected properly?	
	7.	Is the workpiece chucking method correct?	
	8.	Is the progress of cutting been observed?	
	9.	Are coolant supply volume and direction correct?	
	10.	Are the cutting tools free of interference with the workpiece, jaws and chuck?	
	11.	Are the dimensions measured after the rough cutting process?	
	12.	Are the settings for feed override, rapid traverse override and spindle speed override correct?	
	13.	Can the machine be stopped immediately when necessary?	
	14.	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.

> **WARNING** ⚠
>
> **Before pressing the automatic operation (cycle start) 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 Items		Check Column
Check the interlock setting	1.	Chuck interlock	Valid	
	2.	Front door interlock	Valid	
	3.	Tailstock interlock (when holding a workpiece using the tailstock)	Valid	
	4.	Electrical cabinet door interlock	Valid	
	5.	PANEL key-switch	🔒 (OFF)	
		Check Items		**Check Column**
Check the clamped conditions	1.	Tool tip		
	2.	Cutting tool shank		
	3.	Workpiece		
	4.	Tool holder		
	5.	Soft jaws		
	6.	Fixture		
		Check Items		**Check Column**
Check the pressure	1.	Chuck pressure	Appropriate	
	2.	Tailstock spindle thrust force (when holding a workpiece using the tailstock)	Appropriate	
		Check Items		**Check Column**
Check the override switch settings	1.	Rapid traverse rate override value	Appropriate	
	2.	Feedrate override value	Appropriate	
	3.	Spindle speed override value	Appropriate	

		Check Items		Check Column
Check the functions	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		
	2.	Work shift data		
	3.	Tool wear offset data		
Check the program		Check Items		Check Column
	1.	Program No.		
	2.	Program contents		

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.
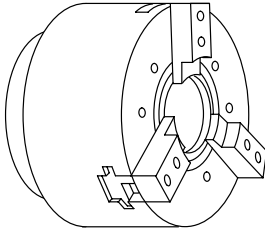
1) Shape the soft jaws appropriately for the material and shape of the workpiece, chucking method (inside chucking or outside chucking), etc.
    It is necessary to shape the soft jaws so that the workpiece can be clamped in the chuck stably.

    Chapter C "SHAPING SOFT JAWS FOR FINISHING"
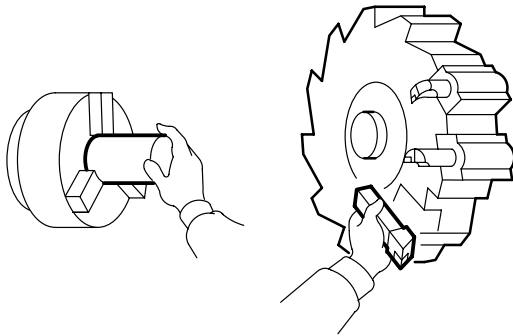
2) Mount the tools and the workpiece in the machine by moving the axes and indexing the turret head manually.

    NOTE For center-work operation, move the tailstock spindle OUT to hold the workpiece.

    - Chapter B "MANUAL OPERATION"
    - "TOOLING SYSTEM" in the MAINTENANCE INFORMATION
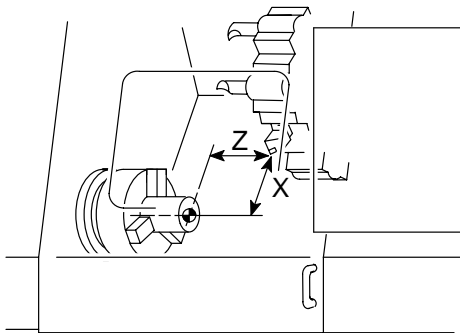
3) Set the workpiece zero point.

    Chapter E "SETTING OF COORDINATE SYSTEM"
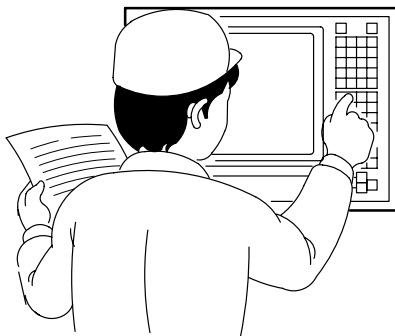
4) Input the created program to the NC memory using the keyboard on the operation panel or the external I/O device.

    Chapter D "PROGRAM EDITING"

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-26 (5-6) to find the details of them.
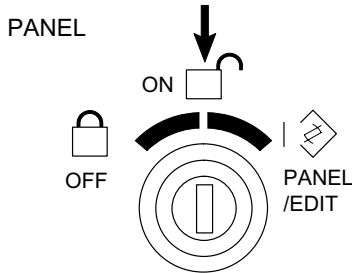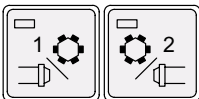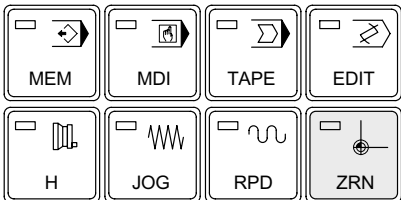
1) Carry out the procedure explained in 4-1 "Preparations for Checking a Program".

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) Press the HEAD CHANGE switch (head 1) or (head 2) to select the required turret.

6) Carry out the zero return operation.

Page B-19 (6-1)

```
EDIT  ***  ***  ***           0mm/min
                        0%    0min-1      O0001 N00001
OPERATION PANEL (1/2)                     23:58:53   HEAD1

      No.          MENU              CONDITION
       1   SPINDLE OFF MODE        INVALID   VALID
       2   CHUCK DIRECTION         O.D.      I.D.
       3   TAILSTOCK ILK.          OFF       ON
       4   WORK COUNTER            ST.ILK    BDT
  →    5   MACHINE LOCK            OFF       ON
       6   AUX. F. LOCK            OFF       ON
       7   CHUCK FOOT SWITCH       VALID     INVALID
       8   CHUCK STROKE END        VALID     INVALID




   <   BDT                                   EXIT   >
```

FUNCTION

| SBK | OSP | BDT |
| PSM | PST | DRN |

COOLANT

| ON | OFF |

MODE

| MEM | MDI | TAPE | EDIT |
| H | JOG | RPD | ZRN |

HEAD CHANGE

| 1 | 2 |

7) Display the OPERATION PANEL screen.

    Page A-126 (7-7-1)

8) Move the cursor to MACHINE LOCK "ON" to make
    the machine lock function valid.

    NOTE For items 9) and 10) below, determine whether or
    not the corresponding function should be used.
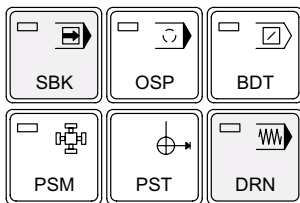
9) Press the single block switch [⮕] to make the
    single block function valid.

10) Press the dry run switch [⋙] to make the dry run
    function valid.
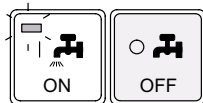
11) If there is an M08 (coolant ON) command in the
    program, press the [∘🚿] (OFF) switch for 1 second
    or more to make the coolant OFF mode valid.
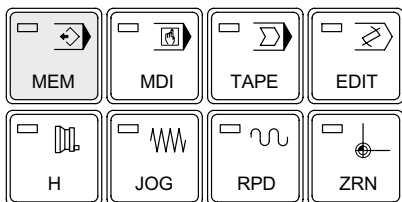
12) Select the memory mode ([⮫]) with the MODE
    selection switch.
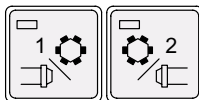
13) Select the turret operation mode by pressing the
    HEAD CHANGE switches [1⚙] (head 1) and [⚙2]
    (head 2) simultaneously.
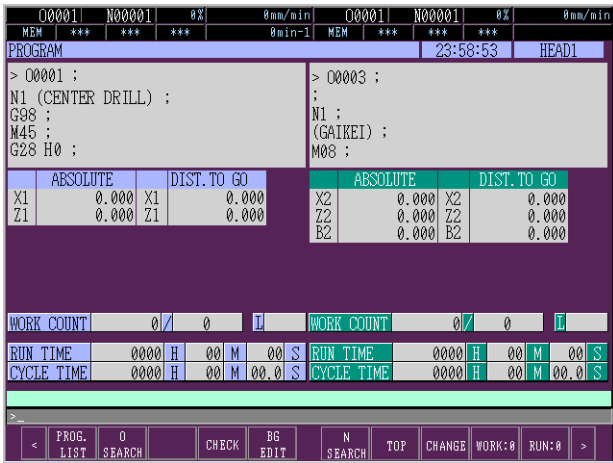
14) Display the PROGRAM (memory) screen.

📖 Page A-95 (7-2-3)

15) Search for the program.

   a) Key in the program number to be searched for using the data entry keys.
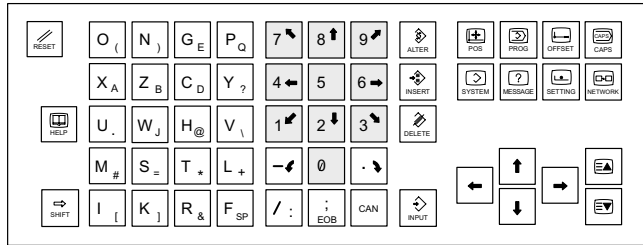
   👆 It is not necessary to press the $O_($ key.

   b) Press the **[O SEARCH]** soft-key.
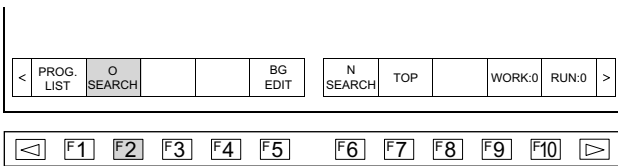
16) With the manual door type machine, press the

   DOOR UNLOCK

   DOOR UNLOCK switch 🔓 to unlock the front door. Then open the front door.
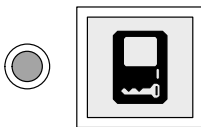
   NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.

17) Operate the chuck to clamp a workpiece.

   📖 Page B-36 (7-3)
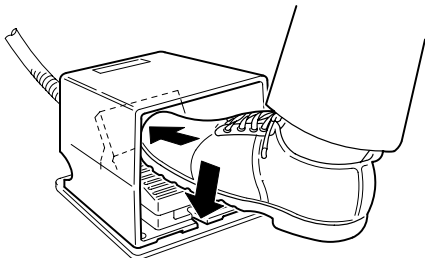
18) Close the front door.

   NOTE Make sure that you can press the EMERGENCY STOP button or the 🔲 (SP) switch immediately if an abnormality occurs.

CYCLE

ST   SP

19) Press the ⬚ (ST) switch.

NOTE
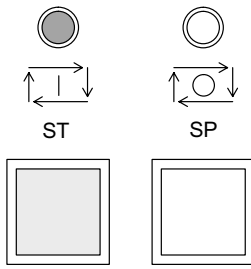
1. Because the machine lock function is valid, the axes do not move even if the program is executed. Only the position data on the screen is updated.

2. When the single block function is valid, program execution stops after each program

   block. To advance to the next block, press the ⬚ (ST) 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 a program 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 is 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 Code	Function
M03	Spindle start (normal)
M04	Spindle start (reverse)
M08	Coolant supply
M13	Rotary tool spindle start (normal) (MC type)
M14	Rotary tool spindle start (reverse) (MC type)
M19	Spindle orientation (option)
M34	Phase synchronous operation ON (S type)
M35	Speed synchronous operation ON (S type)
M41	Spindle gear 1st range (transmission specification)
M42	Spindle gear 2nd range (transmission specification)
M43	Spindle gear 3rd range (transmission specification)
M44	Spindle gear 4th range (transmission specification)
M64	Robot service call (robot specification)
M70	Bar feeder operation (bar feeder specification)
M80	Cut-off check (S type)
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 (MC type)
M382	Chip removal coolant ON (option)
M384	Spindle orientation and ceiling shutter open (option)
M387	Spindle 2 orientation and ceiling shutter open (option) (S type)

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.

NOTE

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 (MC 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 (MC type) is not possible. Note that jogging the spindle and the rotary tool spindle (MC type) is allowed.

5. When the spindle OFF mode function is valid, coolant is supplied when the [⬛] (ON) switch is pressed.

6. When the spindle OFF mode function is valid, an alarm (EX4014) occurs when the [⬛] (ST) 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.

10. If a macro program to check the correct pushing of a workpiece to the chuck is executed in the spindle OFF mode function valid state, the operation completion signal is not output. This does not cause an alarm, however, and the program advances to the next block. (S type)

11. Since M329 is an M code that is processed at the NC unit, programs that include an M329 command cannot be used in the spindle OFF mode.

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-26 (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-39 (5-6-12)

Make the dry run function invalid and coolant off mode valid if considered necessary for the program testing situation.
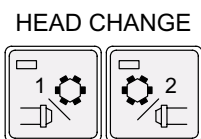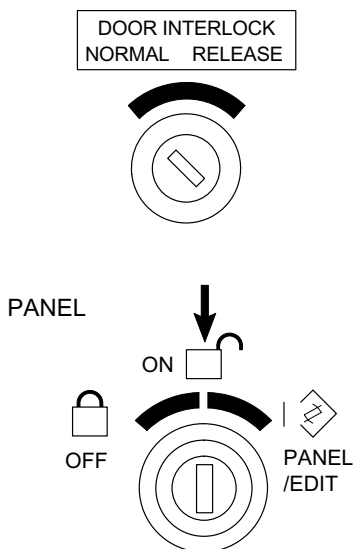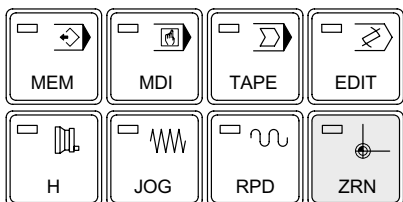
DOOR INTERLOCK
NORMAL   RELEASE

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.

PANEL

ON

OFF

PANEL /EDIT

4) Place the PANEL key-switch in the (ON) position.

HEAD CHANGE

1   2

5) Press the HEAD CHANGE switch (head 1) or (head 2) to select the required turret.

MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN

6) Carry out the zero return operation.

Page B-19 (6-1)

```
MEM   ***  ***  ***              0mm/min      O0001 N00001
                         0%      0min-1
OPERATION PANEL (1/2)                    23:58:53   HEAD1

       No.        MENU              CONDITION
  →    1    SPINDLE OFF MODE      INVALID   VALID
       2    CHUCK DIRECTION         O.D.    I.D.
       3    TAILSTOCK ILK.          OFF     ON
       4    WORK COUNTER          ST.ILK    BDT
       5    MACHINE LOCK            OFF     ON
       6    AUX. F. LOCK            OFF     ON
       7    CHUCK FOOT SWITCH      VALID   INVALID
       8    CHUCK STROKE END       VALID   INVALID




  <  BDT                                      EXIT  >
```

7) Display the OPERATION PANEL screen.

    Page A-126 (7-7-1)

8) Move the cursor to SPINDLE OFF MODE "VALID" to make the spindle OFF mode function valid.

The indicators in the 🔲 (SP) switch and dry run switch 〰️ begin blinking.
The dry run function becomes valid at this time.

FUNCTION

➡️ SBK	↻ OSP	▱ BDT
PSM	⊕ PST	〰️ DRN
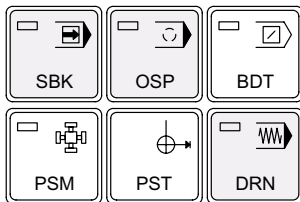
9) Press the single block switch ➡️ to make the single block function valid.

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.

OVERRIDE

```
      50        100
   0           150
              %
```

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-56 (5-11).
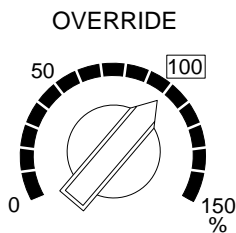
13) Make sure that the rapid traverse rate override and spindle override is set correctly.

14) Select the memory mode (⬦) with the MODE selection switch.

MODE

⬦ MEM	🖐 MDI	Σ TAPE	⬈ EDIT
▥ H	〰️ JOG	∿ RPD	⊕ ZRN
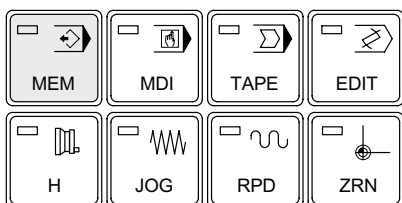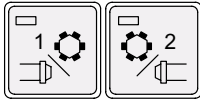
HEAD CHANGE

15) Select the turret operation mode by pressing the HEAD CHANGE switches [⚙2] (head 1) and [⚙2] (head 2) simultaneously.
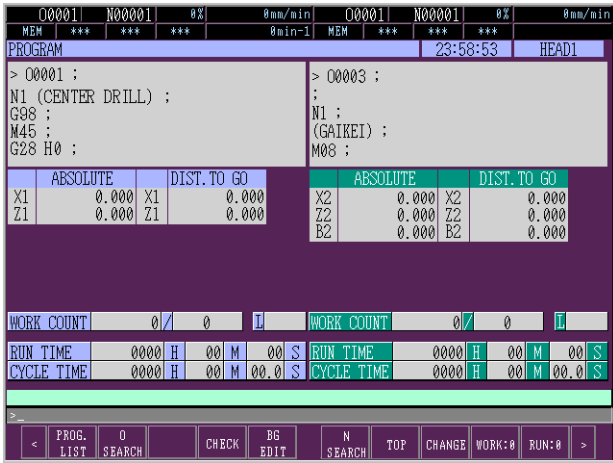
16) Display the PROGRAM (memory) screen.

Page A-95 (7-2-3)

17) Search for the program.

a) Key in the program number to be searched for using the data entry keys.
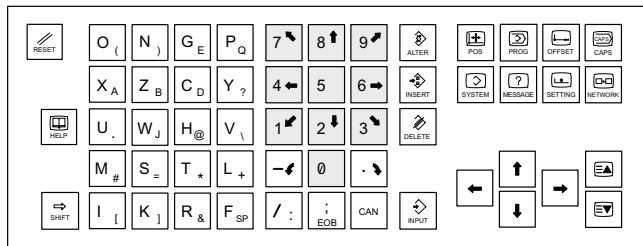
It is not necessary to press the [O(] key.

b) Press the **[O SEARCH]** soft-key.

CYCLE

ST   SP
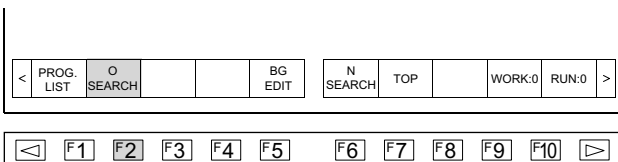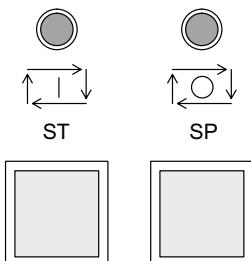
18) Press the [⟲] (ST) and [⟳] (SP) switches alternately. Check the turret motion and the displayed data on the PROGRAM screen.
Check the interference between the tool/chuck and workpiece.

NOTE

1. The program stops at each block since the single block function is valid.

However, press the [⟳] (SP) 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.
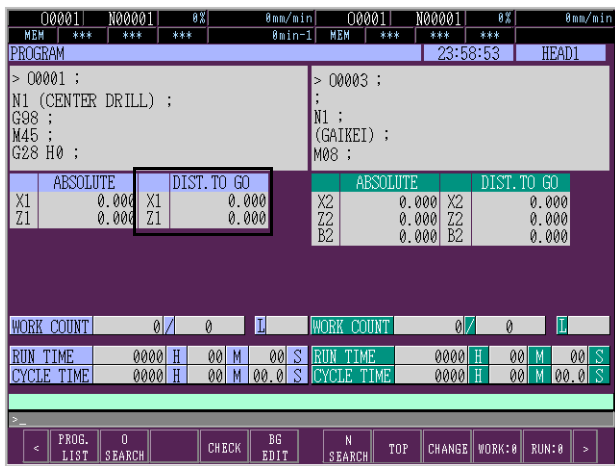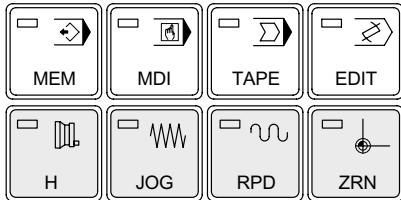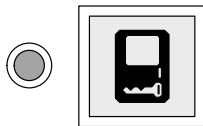
19) Check the clearance between the cutting tool and the chuck in comparison with the data for "DIST. TO GO" which is displayed on the screen.

NOTE If the cutting tool would strike the chuck if the program were executed continuously, stop dry run operation 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.

MODE

$\boxed{\text{III}}$ (handle) $\boxed{\text{WW}}$ (jog)

$\boxed{\sim}$ (rapid traverse) $\boxed{\circ}$ (zero return)

21) With the manual door type machine, press the DOOR UNLOCK switch $\boxed{\blacksquare}$ 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 dry run operation. If the dry run operation 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.

MODE

| MEM | MDI | TAPE | EDIT |
| H | JOG | RPD | ZRN |

24) Select the memory mode ( ) with the MODE selection switch.

CYCLE

ST   SP
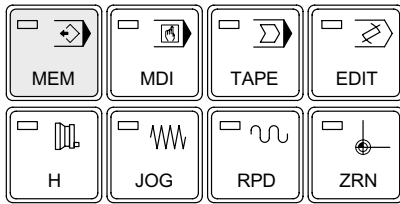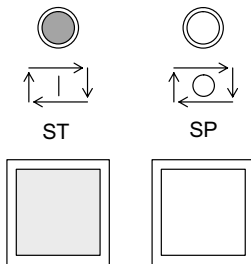
25) Press the (ST) switch.

The dry run operation restarts.

7   CHECKING THE PROGRAM WITH A WORKPIECE CLAMPED IN THE CHUCK

To check the program (tool paths) by executing automatic operation (dry run operation) with a workpiece clamped in the chuck, shift the coordinate system before executing the program.

The direction and the amount to shift the coordinate system vary depending on the workpiece.

In this section, the procedure used to check the program with the dry run function by shifting the coordinate system in 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 carry out dry run operation by shifting the coordinate system 100 mm in the +Z-axis direction
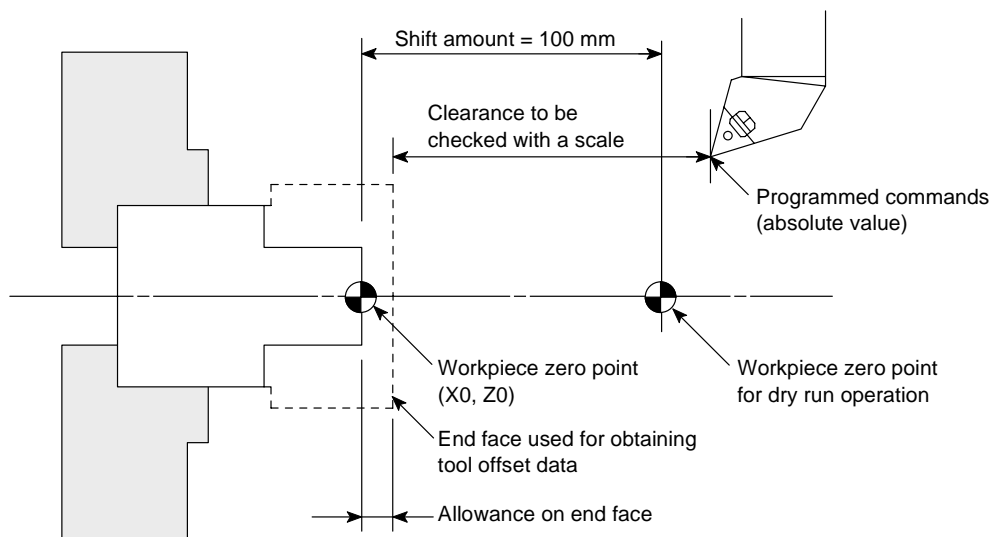
The clearance between the tool nose and the end face used for obtaining the tool offset data is:
[Shift amount (100 mm)] + [Z-coordinate specified in the program] − [allowance on end face]

> **CAUTION**
> ⚠
>
> 1. Make sure to set "0" for the work coordinate system "COMMON Z" on the WORK OFFSET screen. If the work coordinate system shift data is set for "COMMON", the work coordinate system is shifted in the same direction disregarding of the spindle (spindle 1 and spindle 2) to be used, which causes the turret to interfere with the workpiece resulting in machine damage. (S type)
>
> 2. When shifting the coordinate system, determine the appropriate shift amount taking the workpiece shape and conditions into consideration. 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 dry run operation 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-26 (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 dry run operation 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 the shift amount in a negative value. With the S type machines, input the shift amount in positive value for spindle 2.

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:

DOOR INTERLOCK
NORMAL   RELEASE

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.

PANEL

ON

OFF   PANEL /EDIT

4) Place the PANEL key-switch in the (ON) position.

HEAD CHANGE

1   2

5) Press the HEAD CHANGE switch (head 1) or (head 2) to select the required turret.

MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN
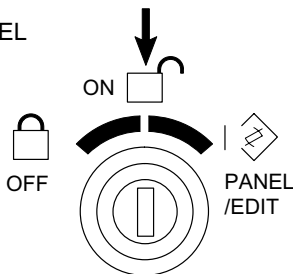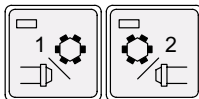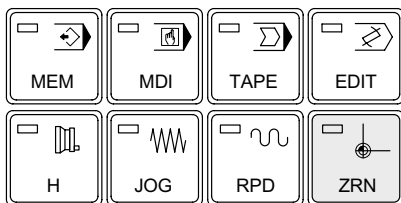
6) Carry out the zero return operation.
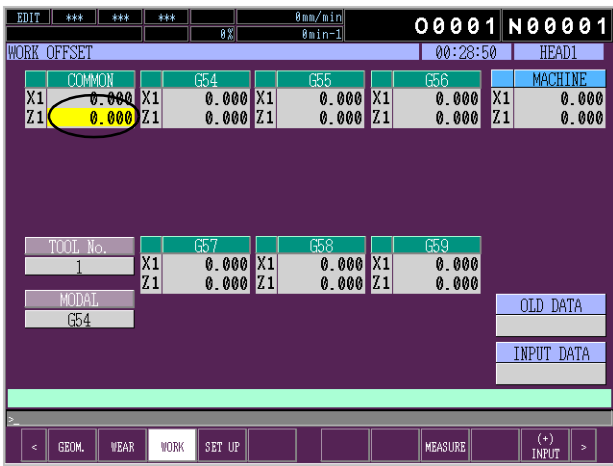
7) Display the WORK OFFSET screen.

📖 Page A-100 (7-3-3)

8) Move the cursor to "COMMON Z1" using the cursor control keys.
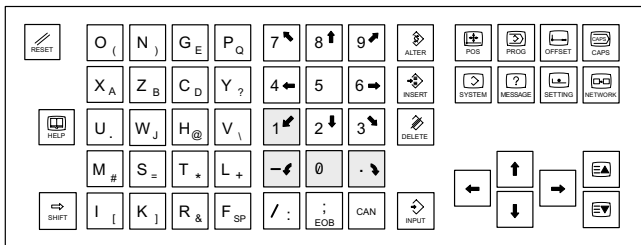
9) Set the Z-axis shift amount of 100 mm.

Input "−100.0" using the data entry keys.

| −✦ | 1 | 0 | 0 | ・ | 0 |

NOTE

1. To input the Z-axis shift amount for spindle 2, press the following keys in order (S type):

| 1 | 0 | 0 | ・ | 0 |
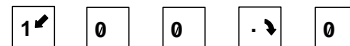
2. Make sure the sign for the entered value is correct.
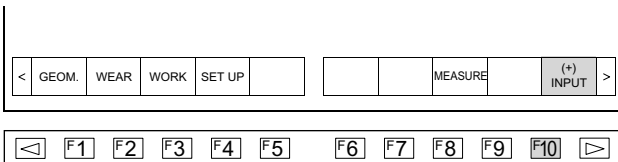
10) Press the **[(+) INPUT]** soft-key.

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.
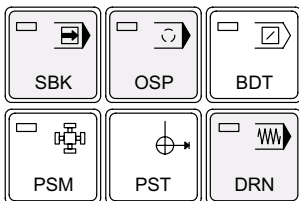
11) Press the single block switch 🔲 to make the single block function valid.

NOTE For items 12) and 13) below, determine whether or not the corresponding function should be used.

12) Press the optional stop switch 🔲 to make the optional stop function valid.

13) Press the dry run switch 🔲 to make the dry run function valid.

14) Make sure that the rapid traverse rate override, feedrate override and spindle speed override is set correctly.
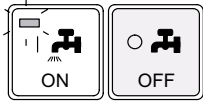
FUNCTION

SBK   OSP   BDT

PSM   PST   DRN

COOLANT

ON   OFF

15) If there is an M08 (coolant ON) command in the program, press the [○▶] (OFF) switch for 1 second or more to make the coolant OFF mode valid.

MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN
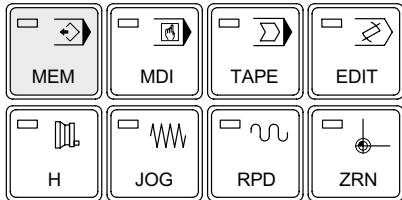
16) Select the memory mode ([⊡]) with the MODE selection switch.

HEAD CHANGE

1   2
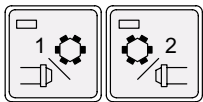
17) Select the turret operation mode by pressing the HEAD CHANGE switches [1] (head 1) and [2] (head 2) simultaneously.

18) Display the PROGRAM (memory) screen.

Page A-95 (7-2-3)

```
  O0001   N00001    0%      0mm/min   O0001   N00001    0%      0mm/min
 MEM   ***   ***   ***         0min-1  MEM   ***   ***   ***
PROGRAM                        23:58:53  HEAD1
> O0001 ;                              > O0003 ;
N1 (CENTER DRILL) ;                    ;
G98 ;                                  N1 ;
M45 ;                                  (GAIKEI) ;
G28 H0 ;                               M08 ;
      ABSOLUTE      DIST.TO GO               ABSOLUTE      DIST.TO GO
X1       0.000 X1       0.000          X2       0.000 X2       0.000
Z1       0.000 Z1       0.000          Z2       0.000 Z2       0.000
                                       B2       0.000 B2       0.000


WORK COUNT      0/    0    L      WORK COUNT      0/    0    L
RUN TIME     0000 H   00 M   00 S RUN TIME     0000 H   00 M   00 S
CYCLE TIME   0000 H   00 M 00.0 S CYCLE TIME   0000 H   00 M 00.0 S

 <  PROG.  O          CHECK  BG     N    TOP  CHANGE WORK:0 RUN:0  >
    LIST  SEARCH            EDIT  SEARCH
```
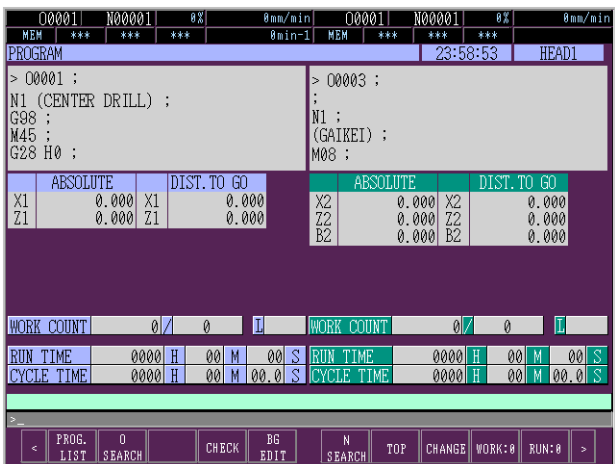
19) Search for the program to be used for machining.

   a) Key in the program number to be searched for using the data entry keys.

   It is not necessary to press the [O₍] key.

```
RESET  O(  N)  GE  PQ  7  8  9  ALTER  POS  PROG  OFFSET  CAPS
       XA  ZB  CD  Y?  4  5  6  INSERT SYSTEM MESSAGE SETTING NETWORK
HELP   U.  WJ  H@  V\  1  2  3  DELETE
       M#  S=  T*  L+  -  0  .  ↑  EA
SHIFT  I[  K]  R&  FSP / :  ;  CAN INPUT  ←  ↓  →  EV
                           EOB
```

   b) Press the **[O SEARCH]** soft-key.

```
 <  PROG.  O           CHECK  BG    N    TOP       WORK:0 RUN:0  >
    LIST  SEARCH             EDIT SEARCH
```

```
◁  F1  F2  F3  F4  F5    F6  F7  F8  F9  F10  ▷
```

DOOR UNLOCK

CYCLE

ST   SP
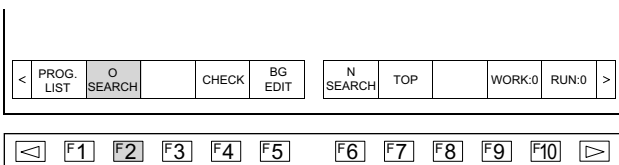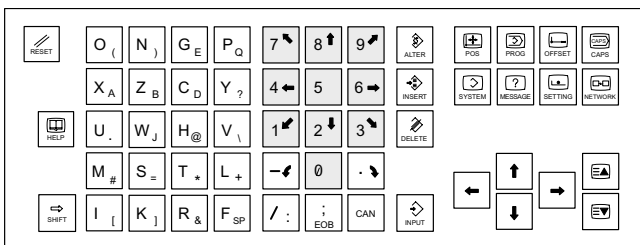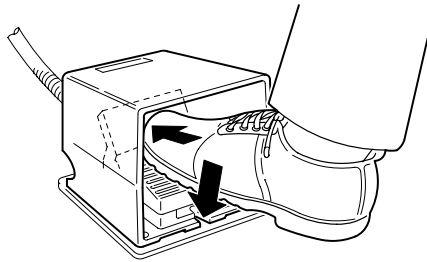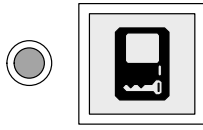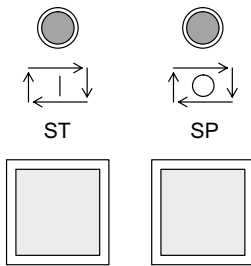
20) With the manual door type machine, press the DOOR UNLOCK switch [ ] to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.

21) Operate the chuck to clamp a workpiece.

- Page B-36 (7-3)
- Page C-7 (2-1)

22) Close the front door.

NOTE Make sure that you can press the EMERGENCY STOP button or the [ ] (SP) switch immediately if an abnormality occurs.

23) Check the tool motion on the PROGRAM screen by pressing the [ ] (ST) and [ ] (SP) switches alternately. Check the interference between the tool and the workpiece or the chuck.

NOTE
1. The program stops at each block as the single block function is valid.

   However, press the [ ] (SP) 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.

24) 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.
The cutting tool to chuck clearance should be checked through the window in the front door.

NOTE If the cutting tool would strike the chuck if the program were executed continuously, stop dry run operation and correct the program. Then, check the program again.

```
 O0001  N00001    0%    0mm/min   O0001  N00001    0%    0mm/min
MEM   ***   ***   ***         0min-1  MEM   ***   ***   ***
PROGRAM                              23:58:53    HEAD1
> O0001 ;                      > O0003 ;
N1 (CENTER DRILL) ;            ;
G98 ;                          N1 ;
M45 ;                          (GAIKEI) ;
G28 H0 ;                       M08 ;
   ABSOLUTE    DIST.TO GO         ABSOLUTE    DIST.TO GO
X1    0.000  X1    0.000      X2    0.000  X2    0.000
Z1    0.000  Z1    0.000      Z2    0.000  Z2    0.000
                              B2    0.000  B2    0.000

WORK COUNT    0/    0    [L]  WORK COUNT    0/    0    [L]
RUN TIME    0000 H  00 M  00 S  RUN TIME    0000 H  00 M  00 S
CYCLE TIME  0000 H  00 M 00.0 S  CYCLE TIME  0000 H  00 M 00.0 S
>
 <  PROG.  0          CHECK  BG     N      TOP  CHANGE WORK:0 RUN:0  >
    LIST SEARCH              EDIT SEARCH
```
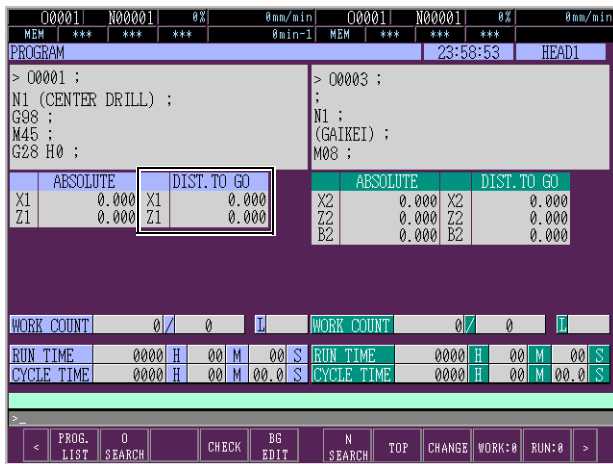
MODE

25) After the completion of the first axis movement block, select any of the following modes with the MODE selection switch.

| ☐ (handle) | ☐ (jog) |
| ☐ (rapid traverse) | ☐ (zero return) |
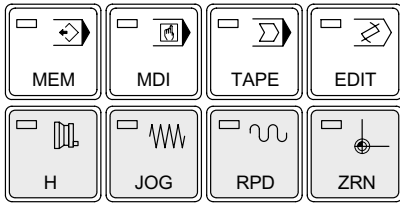
The spindle stops rotating.

DOOR UNLOCK
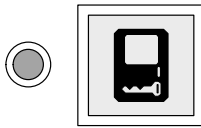
26) With the manual door type machine, press the DOOR UNLOCK switch ☐ to unlock the front door. Then open the front door.

NOTE With the automatic door type machine, open the front door by pressing the AUTOMATIC DOOR OPEN switch.

27) 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 dry run operation. If the dry run operation 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.

28) If the measured clearance is appropriate and there is no possibility of interference, close the front door.

MODE

29) Select the memory mode (☐) with the MODE selection switch.
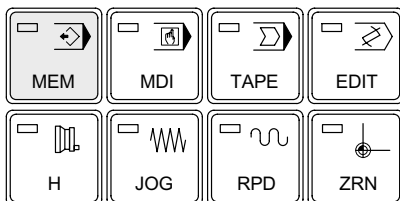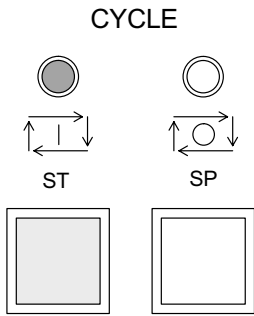
CYCLE

ST   SP

30) Press the ⟨ST⟩ (ST) switch.

The spindle starts rotating at a speed selected before stopping the dry run operation.

31) Press the ⟨ST⟩ (ST) switch again.

The dry run operation restarts.

32) If there are no problems found in dry run operation, reset the shift data to its original value after the completion of the dry run operation.

a) Display the WORK OFFSET screen.

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b) Move the cursor to "COMMON Z1" using the cursor control keys.

EDIT	***	***	***		0mm/min			O0001	N00001

WORK OFFSET   00:28:50   HEAD1

	COMMON	G54	G55	G56	MACHINE
X1	0.000	X1 0.000	X1 0.000	X1 0.000	X1 0.000
Z1	−100.000	Z1 0.000	Z1 0.000	Z1 0.000	Z1 0.000

TOOL No.	G57	G58	G59
1	X1 0.000	X1 0.000	X1 0.000
	Z1 0.000	Z1 0.000	Z1 0.000

MODAL
G54

OLD DATA

INPUT DATA

<	GEOM.	WEAR	WORK	SET UP			MEASURE	(+) INPUT	>
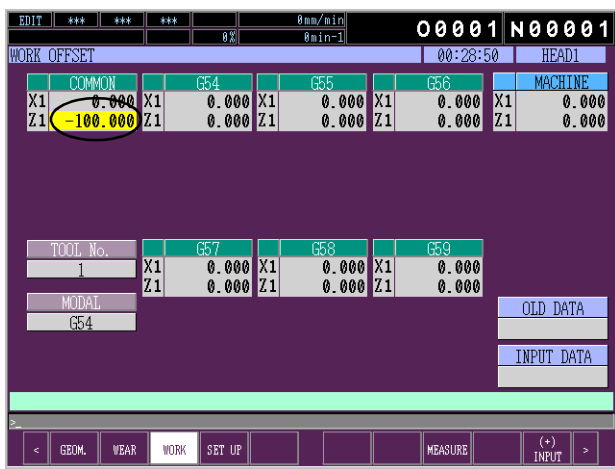
c) Input "100.0" using the data entry keys.

1   0   0   ·   0
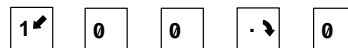
NOTE To reset the shift amount for spindle 2 to "0", press the following keys in order (S type):

−   1   0   0   ·   0

d) Press the **[(+) INPUT]** soft-key.

NOTE If the ⟨INPUT⟩ (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.

<	GEOM.	WEAR	WORK	SET UP			MEASURE	(+) INPUT	>

◁ F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 ▷
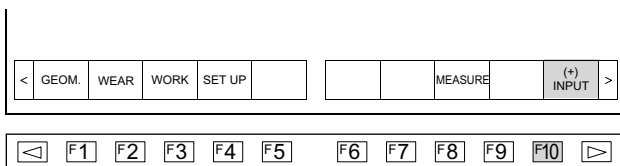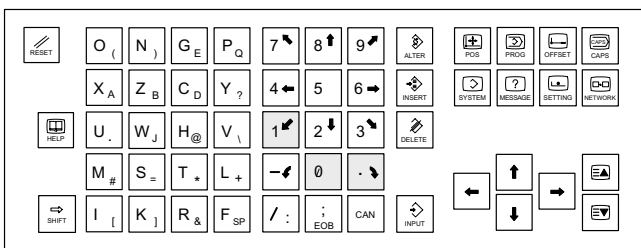
8   TO FINISH A WORKPIECE WITHIN THE SPECIFIED TOLERANCE WITH THE TOOL WEAR OFFSET FUNCTION (TEST CUTTING)

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.

DOOR INTERLOCK
NORMAL   RELEASE
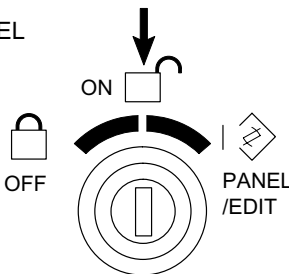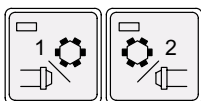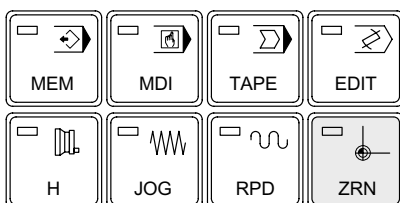
1) Carry out the procedure explained in 4-1 "Preparations for Checking a Program".

2) Place the DOOR INTERLOCK key-switch in the **NORMAL** position.

3) Close the front door.

PANEL

ON

OFF

PANEL
/EDIT

4) Place the PANEL key-switch in the (ON) position.

HEAD CHANGE

1   2

5) Press the HEAD CHANGE switch (head 1) or (head 2) to select the required turret.

MODE

MEM   MDI   TAPE   EDIT

H   JOG   RPD   ZRN

6) Carry out the zero return operation.

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7) Display the WEAR OFFSET screen.

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8) Move the cursor to the tool wear offset number of the tool to be used using the cursor control keys.

NOTE To ensure safe operation, it is recommended to use the following tool offset numbers for tools used for spindle 1 and spindle 2, respectively. (S type)

01 to 12: Tools used for spindle 1

31 to 42: Tools used for spindle 2

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.
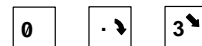
c) Press the **[(+) INPUT]** soft-key.

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.
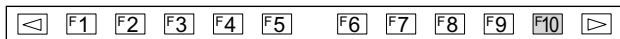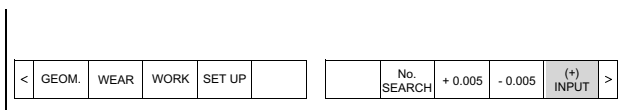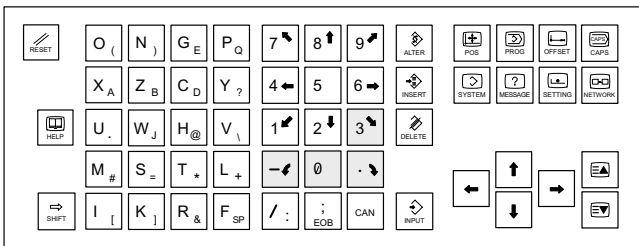
MODE
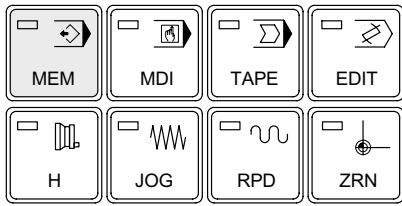
10) Select the memory mode (⟨⟩) with the MODE selection switch.
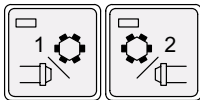
HEAD CHANGE

11) Select the turret operation mode by pressing the HEAD CHANGE switches (head 1) and (head 2) simultaneously.
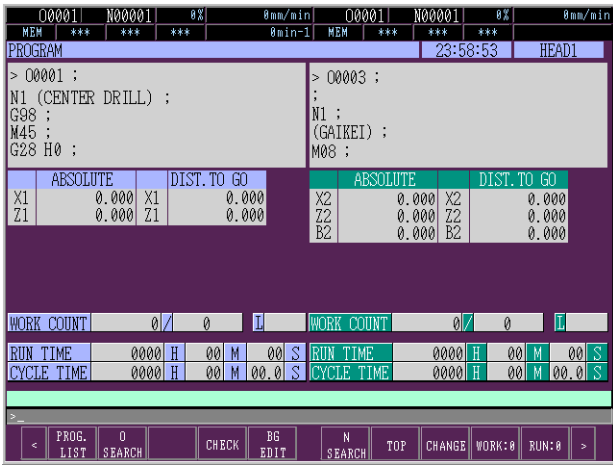
12) Display the PROGRAM (memory) screen.

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13) Search for the program.

   a) Key in the program number to be searched for using the data entry keys.

   It is not necessary to press the **O(** key.

   b) Press the **[O SEARCH]** soft-key.
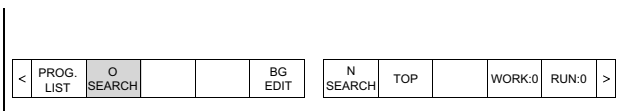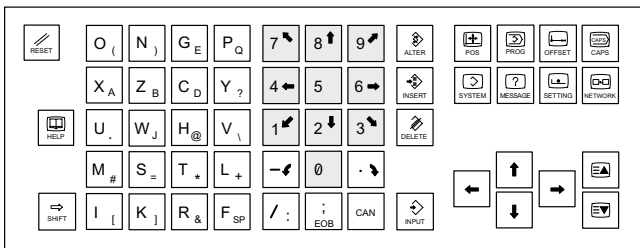
FUNCTION
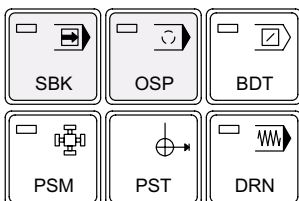
14) Press the single block switch to make the single block function valid.

15) Press the optional stop switch to make the optional stop function valid.

SP

CYCLE

ST   SP
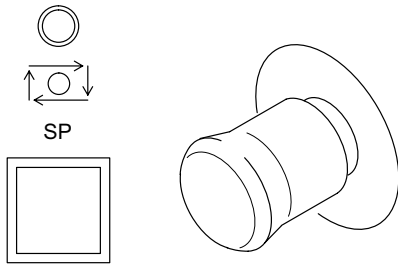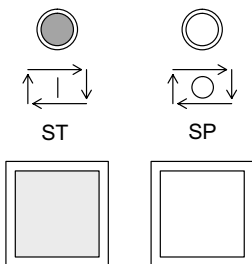
DOOR UNLOCK
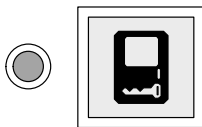
16) Set the rapid traverse rate override, feedrate override, and spindle speed override if necessary.

NOTE Make sure that you can press the EMERGENCY STOP button or the ⌷ (SP) switch immediately if an abnormality occurs.

17) Press the ⌷ (ST) 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. Before opening the front door, change the operation mode to manual with the MODE selection switch.

3. 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.

```
MDI    ***  ***  ***              0mm/min      O0001 N00001
                           0%      0min-1
WEAR OFFSET                                 00:28:15    HEAD1
          X          Z          R      C      Y           MACHINE
 1      0.000      0.000      0.000  0      0.000   X1         0.000
 2      0.000      0.000      0.000  0      0.000   Z1         0.000
 3      0.000      0.000      0.000  0      0.000
 4      0.000      0.000      0.000  0      0.000
 5      0.000      0.000      0.000  0      0.000
 6      0.000      0.000      0.000  0      0.000
 7      0.000      0.000      0.000  0      0.000
 8      0.000      0.000      0.000  0      0.000
 9      0.000      0.000      0.000  0      0.000
10      0.000      0.000      0.000  0      0.000        OLD DATA
11      0.000      0.000      0.000  0      0.000
12      0.000      0.000      0.000  0      0.000       INPUT DATA

  < GEOM. WEAR WORK SET UP          No.    +0.005 -0.005  (+)   >
                                  SEARCH                  INPUT
```

21) After the completion of program execution, display the WEAR OFFSET screen.

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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 19) and the dimension used in programming.

a) Key in difference of the measured dimension using the data entry keys.

```
< GEOM. WEAR WORK SET UP          No.    + 0.005 - 0.005  (+)   >
                                SEARCH                   INPUT
```

```
◁  F1  F2  F3  F4  F5    F6  F7  F8  F9  F10  ▷
```

b) Press the **[(+) INPUT]** soft-key.

<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.
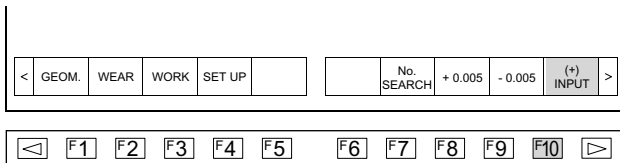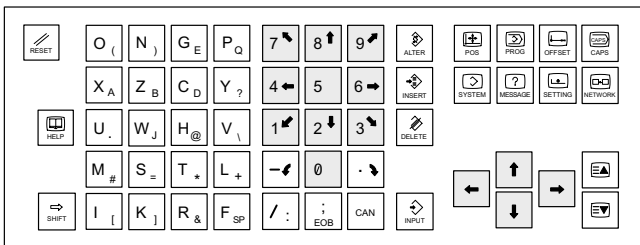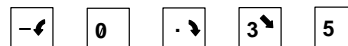
```
−    0    .    3    5
```

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.

MODE
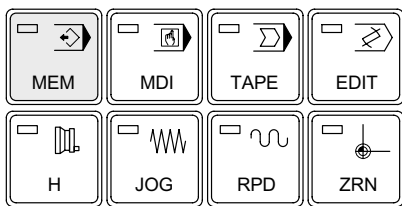
24) Select the memory mode (⟨⟩) with the MODE selection switch.
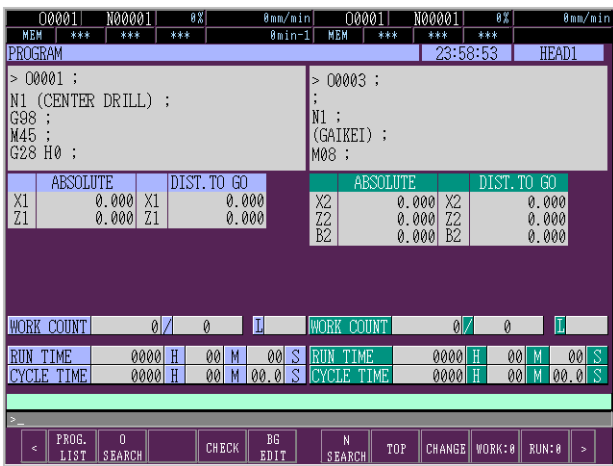
25) Display the PROGRAM (memory) screen.

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26) Press the **[TOP]** soft-key

27) Make sure that the cursor is at the head of the program.

28) Close the front door.

CYCLE

ST   SP
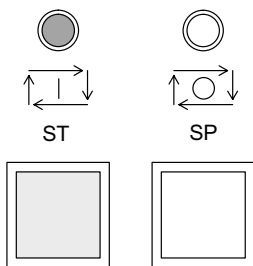
29) Press the ⟨ST⟩ switch to finish the workpiece.

30) After finishing the workpiece, measure the workpiece dimensions again and input the tool wear offset data.

31) 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   LOAD MONITORING FUNCTION B

The operating and setting methods for the load monitoring function B are explained here.

9-1   General

The load monitoring function B is used to detect abnormality of a tool by monitoring the variation in motor load during cutting.

The function includes the following features:

1. Teaching operation

    The teaching operation is used to detect the reference load (maximum value) of the spindle and feed axis during the actual cutting process.

2. Manual setting and display of load monitoring table

    The data necessary for load monitoring can be set and displayed on the LOAD MONITOR SETTING screen.

3. Load meter display

    The load of the spindle or feed axis is displayed on the LOAD MONITOR screen.

    Display mode: Bar graph and numeric value

4. Load monitoring

    The load torque of the spindle or axis drive motor is detected to sense warning and alarm state.

    Warning: Start interlock processing (macro input signal processing is optionally provided).

    Alarm: Feed hold and spindle stop processing

<Cautions on using the function>

NOTE The function is not adequate for machining causing only slight load variation. This includes machining to be performed using the tools like finishing tools, small diameter drills and end mills with which load variation is small. Select the axis to be monitored according to the type of tools and cutting conditions.

9-2   Specifications

The following table shows the specifications of the load monitoring function B.

Item	Description
Objective axes	All axes used for cutting (spindle, rotary tool spindle, X-axis, Z-axis, C-axis, Y-axis) **NOTE** The objective axes differ depending on the machine model and specifications.
Monitoring groups	Max. 24 groups (24 intervals)
Programming (M code)	Start of teaching or monitoring: M92
	End of teaching or monitoring: M93
Operation modes	Teaching mode and monitoring mode are provided. For details, refer to page F-33 (9-2-1).
Setting the threshold levels for detection of warning and alarm	The threshold level to detect warning or alarm is set on the LOAD MONITOR screen. **NOTE** These values are not automatically set by teaching. For details, refer to page F-38 (9-6).

9-2-1   Operation Modes

There are two function operation modes. They are teaching mode and monitoring mode, and the mode selection is possible by pressing the **[MODE]** soft-key on the LOAD MONITOR screen.

These two modes are briefly explained below.

<Teaching mode>

In this mode, the function detects and records the maximum load value during cutting in the specified group interval. The maximum load value obtained in this operation is used as the reference of the value to be set to execute monitoring.

The maximum load value can be obtained by carrying out cutting once with a new tool.

<Monitoring mode>

The function compares the load value detected during cutting in the specified group intervals to the preset warning and alarm detection threshold level values of the same group intervals. The following processing is executed if the detected load value exceeds the preset threshold level value.

Threshold Level	Status	Processing
Warning level **NOTE** Contents of processing to be taken can be selected by parameter setting.	Cutting load value > Warning level	The message (EX1082) is displayed on the screen and cycle start of the next automatic operation is disabled.
		The status is input to the machining program by the macro input signal so that the function can be used for measuring or tool life management function. **NOTE** The custom macro B (optional) is necessary.
Alarm level	Cutting load value > Alarm level	The message (EX1081) is displayed on the screen. The function places the CNC unit in the feed hold state and stops the spindle.

9-3   Operation Flow

The operation flow to use the load monitoring function is described below.

```
                                    ┌──────────────────────┐
                                    │   Start of Operation  │
                                    └──────────┬───────────┘
                                               │
                              ┌────────────────────────────────────────┐
                              │ Create the program for load monitoring   │
                              │   📖 Page F-35 (9-4)                     │
                              └────────────────────┬─────────────────────┘
                                                   │
               Yes                            ◇ Execute teaching? ◇                No
        ┌──────────────────────────────────────/                \──────────────────────────┐
        │                                                                                    │
┌────────────────────────────────┐                                                          │
│ Select the "TEACHING" mode on  │                                                          │
│ the LOAD MONITOR screen         │                                                          │
│   📖 Page F-37 (9-5)            │                                                          │
└───────────────┬─────────────────┘                                                          │
                │                                                                            │
┌────────────────────────────────┐                                                          │
│ Execute the program for load   │                                                          │
│ monitoring                      │                                                          │
└───────────────┬─────────────────┘                                                          │
                │                                                                            │
┌────────────────────────────────┐                                                          │
│ The reference data for load    │                                                          │
│ monitoring is stored            │                                                          │
└───────────────┬─────────────────┘                                                          │
                │                                                                            │
┌────────────────────────────────┐                                                          │
│ Set the data on the LOAD       │                                                          │
│ MONITOR SETTING screen          │                                                          │
│   📖 Page F-38 (9-6)            │                                                          │
└───────────────┬─────────────────┘                                                          │
                │◄───────────────────────────────────────────────────────────────────────────┘
                │
          Yes  ◇ Execute monitoring? ◇  No
   ┌────────────/              \──────────────┐
   │                                          │
┌─────────────────────────────┐   ┌──────────────────────────────────┐
│ Select the "MONITORING" mode │   │ Set the mode selection to "no    │
│ on the LOAD MONITOR screen   │   │ mode" on the LOAD MONITOR screen │
│   📖 Page F-37 (9-5)         │   │   📖 Page F-37 (9-5)             │
└──────────────┬───────────────┘   └────────────────┬─────────────────┘
               │                                     │
┌─────────────────────────────┐                     │
│ Execute the program for load │                     │
│ monitoring                   │                     │
└──────────────┬───────────────┘                     │
               │                                      │
┌─────────────────────────────────────┐              │
│ Detected data is compared to the set │              │
│ data and necessary processing is     │              │
│ executed                             │              │
└──────────────┬───────────────────────┘              │
               │◄─────────────────────────────────────┘
               │
        ┌──────────────────────┐
        │   End of Operation    │
        └──────────────────────┘
```

NOTE If the machine stops or an alarm message is displayed during load monitoring, check the contents of the alarm and take appropriate corrective action.

9-4   Create the Program for Load Monitoring

This section describes the procedure for creating the load monitor program and example of a program.

9-4-1   Designating the Load Monitor Program

COMMAND	**M92 F_.;**
☞	**M93;**

- M92 . . . . .Start of teaching or load monitoring

    NOTE   Specify M92 in a block independently without other commands.

- F_. . . . . .Sets group number (1 to 24).
- M93 . . . . .End of teaching or load monitoring

Ex.

```
O1234;
N00001;
M92 F3.;  ←
    ⋮
    ⋮
    ⋮      Machining program
    ⋮
M93;       ←
N00002;
M92 F2.;
    ⋮
    ⋮
    ⋮      Machining program
    ⋮
M30;
%
```

NOTE
1. Enclose the interval with M codes where load should be monitored by M92 and M93 in units of operation processes.

2. The specified interval may include acceleration/deceleration of the spindle and rapid traverse of the axis.

9-4-2   Example Program
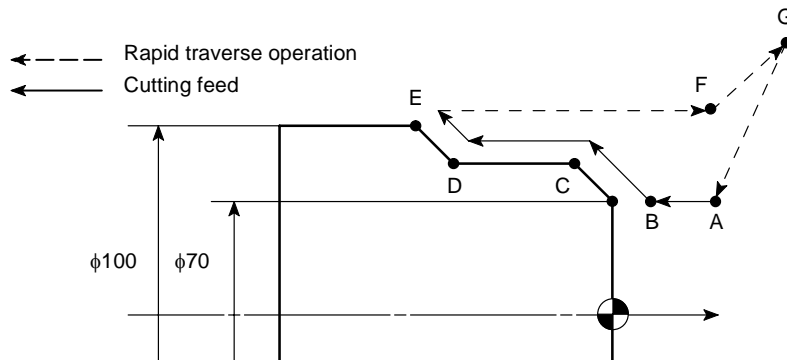
O0001;

M92 F3.; . . . . .Start of load teaching or monitoring

G00 T0101;

G97 S1000 M03;

X68.0 Z10.0; . . . . A

G01 Z1.0 F2.0; . . . . B

X96.0 Z−13.0 F0.2; C

Z−43.0; . . . . D

X102.0 Z−46.0; . . . . E

G00 U1.0 Z30.0;

X200.0 Z150.0;

M93; . . . . .End of teaching or monitoring

M01;

Teaching or monitoring of load is executed for cutting carried out in blocks B, C, D and E.

For the monitoring, data in group 3 is used.

1) Select the TEACHING mode and execute the program indicated above.
   The teaching data is obtained.

2) Set the threshold level values for the detection of warning and alarm.

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3) After the execution of teaching, execute the program in the MONITORING mode.
   Cutting load is monitored based on the set data.

9-5 Contents of Display on the Load Monitor Screen

This section describes the contents of the information displayed on this screen.

<Monitor data display area>

The monitor data display area shows the present status of the machine.

Load values (%) of the axes being monitored are displayed in this area in bar graph and numeric values.

Present load values are displayed in the column left to the bar graph with the maximum load values displayed in the right side column.

<Group information display area>

The information of the group for which teaching or monitoring is presently executed is displayed.

Item	Description
GROUP	The group number of the group for which teaching or monitoring is presently executed is displayed.
STD (%)	The maximum load detected during the cutting of the specified group is displayed. **NOTE** In the teaching mode, the value displayed in this column is updated whenever the maximum load value changes.
WRN (%)	The threshold level value to cause warning is displayed.
ALM (%)	The threshold level value to cause alarm is displayed.

NOTE It is not possible to set or change the values of WRN and ALM.

<Soft-keys>

Soft-Keys	Function
[MODE]	The operation mode changes in the order indicated below when this soft-key is pressed. Teaching mode → Monitoring mode → No mode → The mode name of the selected mode is highlighted. No mode names are highlighted when the mode is not selected.
[SETING]	The LOAD MONITOR SETTING screen is displayed when this soft-key is pressed.
[EXIT]	The screen returns to the PCMDI MENU screen when this soft-key is pressed.

9-6   Setting Items Displayed at the Load Monitor Screen

This section describes the setting items displayed at the LOAD MONITOR SETTING screen.

<Display and Setting>

Display and set the information for each group.

Item	Description
GROUP	The group number of the data presently displayed is displayed. The group number is changed by pressing the page selection keys. The group data is displayed for up to 24 groups.
STD (%)	The maximum load detected during the cutting of the specified group is displayed. NOTE The maximum value is recorded and set by the teaching operation and it is not possible to change the set value.
WRN (%)	Set the threshold level value of warning. Setting is possible in the range from 0 to 999%.
ALM (%)	Set the threshold level value of alarm. Setting is possible in the range from 0 to 999%.

<Cautions on setting the data>

> ⚠️ **CAUTION** For WRN and ALM, values are not set automatically even when teaching is executed. Set appropriate values for these items by referring to the STD value that is automatically set after the completion of teaching. If improper values are set for these items, cutting is continuously executed even if overload is applied to the axes, which will cause damage to the machine and tool.

> 📝 **NOTE**
> 1. If no value is set for WRN and ALM, load monitoring is not executed even when M92 is specified.
> 2. It is not possible to set or change the values for WRN and ALM during the execution of automatic operation.

<Soft-keys>

Soft-Keys	Function
[G. SRCH]	The screen for setting the load monitor data of the specified group is displayed when this soft-key is pressed after inputting the specified group number.
[EXIT]	The screen returns to the LOAD MONITOR screen when this soft-key is pressed.

9-7   Macro Input Signals

If "macro input signal" is selected for the processing after the occurrence of warning, macro variable #1001 is used.

When the detected load value exceeds the preset threshold level value, "1" is set for macro variable #1001.

> 📝 **NOTE**
> 1. Macro variable #1001 returns to "0" when M93 is executed or the ✎ (RESET) key is pressed.
>
>   Specify M93 only after necessary processing for macro variable #1001 is completed after the occurrence of alarm.
> 2. To use the macro input signal as the processing when the detected load value exceeds the preset threshold level value, the custom macro B (optional) must be selected.

9-8   Alarms

The following describes alarms related to the overload monitoring function.

Alarm No.	Message	Description
3029	FORMAT ERROR	Group number (F) is not specified. Check the program.
3030	DATA ERROR	The specified group number is outside the allowable range. Check the program.

> 📖 For other alarms, refer to the material supplied with the ladder diagram.

10   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).
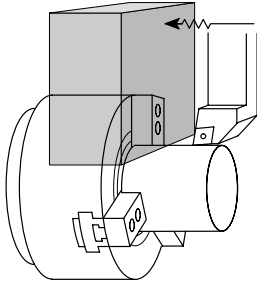
Inhibit the entry of a cutting tool into the zone defined using the stored stroke limit function.

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.

11   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 🔄 (SP) 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 🔄 (SP) 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.

CAUTION

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.

8) Close the front door.

9) Select the memory mode ( ) with the MODE selection switch.

10) Press the (ST) switch.

   The spindle starts rotating at a speed selected before stopping the dry run operation.

11) Press the (ST) switch again.

   The program is restarted.

12 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.

12-1 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-52 (12-3)

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 ⟨ST⟩ (ST) switch to start machining of the workpiece.

9) After the completion of the machining, make sure that the STATUS indicator **[M02/M30]** is lit. 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 11) above.

NOTE The chuck interlock function disables spindle start and cycle start unless the workpiece is clamped in the chuck.

12-2   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.

    Page B-52 (12-3)

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 [↻] (ST) switch to start machining of the workpiece.

13)   After the completion of the machining, make sure that the STATUS indicator **[M02/M30]** is lit. 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.

12-3   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) (INTERLOCK FUNCTIONS THAT ENSURE SAFE OPERATION).

<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 ⟨ST⟩ 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.

13   SYNCHRONOUS OPERATION (S TYPE)

CAUTION ⚠ When a workpiece is transferred from spindle 1 to spindle 2, headstock 2 might interfere with the turret. Make sure that the following conditions are met before carrying out workpiece transfer from spindle 1 to spindle 2.

1.   Move turret 1 to the position where tools in the turret will not interfere with the chucks.

2.   Move turret 2 to the X-axis zero point.

3.   For turret 2, index the No.1 tool.

4.   When carrying out cut-off process, move the turret to the position where tools in turret 1 will not interfere with the chucks after indexing the cut-off tool.

When a workpiece is transferred from spindle 1 to spindle 2, the following methods can be done.

1.   The workpiece is transferred while both spindles are stopped.

2.   The workpiece is transferred while both spindles are rotating.

When a workpiece is to be transferred while both spindles are rotating, the spindle speed of both spindles must be synchronized.

If a workpiece is such as a hexagonal bar, the phase (spindle speed or spindle angular) of both spindles must also be synchronized.

13-1   Preparation before Transferring a Workpiece

Before transferring a workpiece from chuck 1 to chuck 2, it is necessary to position the B-axis at the workpiece transfer position. For this B-axis positioning, G53 command (machine coordinate system) is used.

When positioning the B-axis using the G53 command, it is necessary to check the B-axis coordinate value of the workpiece transfer position in the machine coordinate system.

The procedure used for checking the coordinate value in the machine coordinate system is explained below.

Chuck 1   Workpiece zero point (Z0)   Chuck 2
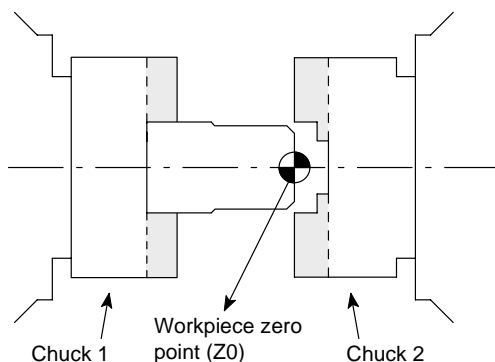
1)   Manually move headstock 2 (B-axis) to Z0 position of the workpiece presently clamped in chuck 1 on headstock 1. See the illustration to the left.

```
 O0001  N00001   0%      0mm/min  O0001  N00001   0%      0mm/min
MEM   ***   ***   ***      0min-1 MEM   ***   ***   ***
POSITION                                     00:23:34    HEAD1
  INCREMENTAL     ABSOLUTE       INCREMENTAL     ABSOLUTE
X1     0.000 X1      0.000     X2     0.000 X2      0.000
Z1     0.000 Z1      0.000     Z2     0.000 Z2      0.000
                              B2  -398.362 B2  -398.362



    MACHINE     DIST.TO GO        MACHINE     DIST.TO GO
X1     0.000 X1      0.000     X2     0.000 X2      0.000
Z1     0.000 Z1      0.000     Z2     0.000 Z2      0.000
                              B2  -398.362 B2  -308.362


F    0.00 S      0 T          F     0 S       T



 <   ABS.   INC.   ALL     MONI                PRESET ORIGIN  >
                           TOR
```

2) After positioning headstock 2 (B-axis) at the workpiece transfer position, display the POSITION screen.

📖   Page A-86 (7-1-3)

3) Record the MACHINE coordinate value of B.

When positioning headstock 2 to the workpiece transfer position using the G53 command, this coordinate value is used as the target position for B-axis positioning.

4) Return headstock 2 (B-axis) to the zero point and clamp it.

📖   Page B-19 (6-1)

NOTE In the following example programs, the G53 command is used for carrying out B-axis positioning.

Set "0" for B of all work coordinate systems on the WORK COORDINATES screen.

13-2   Synchronous Operation Command

<M codes and S codes>

M34 or M234 command.............................Phase synchronous operation
To be programmed for both turrets.
This matches the speed and angular position of
the spindle with the other spindle.

M35 or M235 command.............................Speed synchronous operation
To be programmed for both turrets.
This matches the speed of the spindle with the
other spindle.

M36 command..Cancel of synchronous operation
This command is valid for all of M34, M234,
M35, and M235 commands.
The spindle that has been synchronized with the
other spindle is stopped.

S codes during synchronous operation ....The S code presently specified is valid.

NOTE

1.   Specify M36 command after the completion of cutting off or when either of the two
chucks unclamps a workpiece.

2.   If M34 or M234 command is executed while both chucks are in the clamped state, an
alarm (EX2419) occurs.

3.   Usually, the spindle cannot be started while the chuck is open. Chuck clamp/
unclamp operation is not allowed while the spindle is rotating, either. However, these
operations are allowed in the synchronous operation mode.

13-3   Synchronous Operation (M34, M234, M35, M235)

There are two synchronous operation modes such as phase synchronous operation mode called by M34 or M234 and the speed synchronous operation mode called by M35 or M235.

When executing the synchronous operation, four patterns as shown below are assumed.

1.   To start the synchronous operation in the state both spindle are stopped.

2.   To start the synchronous operation in the state spindle 1 is rotating with spindle 2 stopped.

3.   To start the synchronous operation in the state spindle 1 is stopped with spindle 2 rotating.

4.   To start the synchronous operation in the state both spindles are rotating.

Since operating procedure for patterns 3. and 4. is identical to that for pattern 2., the explanation below gives the procedure for patterns 1. and 2.

As explained before, there are four turret and spindle combinations.

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Based on these combinations, the following two patterns are described.

1.   Both turrets are used for spindle 1

2.   Turret 1 is used for spindle 1 and turret 2 for spindle 2

13-3-1   Starting Synchronous Operation in the State Both Spindles Stopped

The program for starting the synchronous operation in the state both of the spindles are stopped is described below.

<Both turrets are used for spindle 1>

There are following four patterns for specifying the synchronous operation.

The program and the spindle states are indicated below for each of the four patterns.

> **NOTE** It is not possible to specify a spindle start command for spindle 1 and spindle 2 at the same time.

<Pattern 1>

1) Specify M34 (M35) in both of the programs.

2) Specify "M03 (M04) S××××" in the program for turret 1.
    Both spindles rotate in synchronization at the specified speed S××××.

3) Specify "M36" in either of the programs.
    Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Pattern 2>

1) Specify M34 (M35) in both of the programs.

2) Specify "M03 (M04) S××××" in the program for turret 2.
    Both spindles rotate in synchronization at the speed specified at turret 1.

3) Specify "M36" in either of the programs.
    Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Pattern 3>

1) Specify M234 (M235) in both of the programs.

2) Specify "M03 (M04) S××××" in the program for turret 1.
    Both spindles rotate in synchronization at the speed specified at turret 2.

3) Specify "M36" in either of the programs.
    Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Pattern 4>

1) Specify M234 (M235) in both of the programs.

2) Specify "M03 (M04) S××××" in the program for turret 2.
    Both spindles rotate in synchronization at the specified speed S××××.

3) Specify "M36" in either of the programs.
    Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Turret 1 is used for spindle 1 and turret 2 for spindle 2>

There are following four patterns for specifying the synchronous operation.

The program and the spindle states are indicated below for each of the four patterns.

NOTE It is not possible to specify a spindle start command for spindle 1 and spindle 2 at the same time.

<Pattern 1>

1)   Specify M34 (M35) in both of the programs.

2)   Specify "M03 (M04) S××××" in the program for turret 1.
     Both spindles rotate in synchronization at the specified speed S××××.

3)   Specify "M36" in either of the programs.
     Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Pattern 2>

1)   Specify M34 (M35) in both of the programs.

2)   Specify "M204 (M203) S××××" in the program for turret 2.
     Both spindles rotate in synchronization at the speed specified at turret 1.

3)   Specify "M36" in either of the programs.
     Spindle 1 stops while spindle 2 keeps rotating at S××××.

<Pattern 3>

1)   Specify M234 (M235) in both of the programs.

2)   Specify "M03 (M04) S××××" in the program for turret 1.
     Both spindles rotate in synchronization at the speed specified at turret 2.

3)   Specify "M36" in either of the programs.
     Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Pattern 4>

1)   Specify M234 (M235) in both of the programs.

2)   Specify "M204 (M203) S××××" in the program for turret 2.
     Both spindles rotate in synchronization at the specified speed S××××.

3)   Specify "M36" in either of the programs.
     Spindle 1 stops while spindle 2 keeps rotating at S××××.

13-3-2   Starting Synchronous Operation in the State Spindle 1 Is Rotating while Spindle 2 Stopped

The program for starting the synchronous operation in the state spindle 1 is rotating with spindle 2 stopped is described below.

<Both turrets are used for spindle 1>

There are following four patterns for specifying the synchronous operation

The program and the spindle states are indicated below for each of the four patterns.

> **NOTE** An alarm (EX1429) occurs if the direction of spindle rotation does not agree between spindle 1 and spindle 2 when spindle rotation is designated by M03 or M04 for spindle 1 and M203 or M204 for spindle 2.

<Pattern 1>

1) Specify "M03 (M04) S××××" in the program for turret 1.

2) Specify M34 (M35) in both of the programs.
    Both spindles rotate in synchronization at the specified speed S××××.

3) Specify "M36" in either of the programs.
    Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Pattern 2>

1) Specify "M03 (M04) S××××" in the program for turret 2.

2) Specify M34 (M35) in both of the programs.
    Both spindles rotate in synchronization at the speed specified at turret 1.

3) Specify "M36" in either of the programs.
    Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Pattern 3>

1) Specify "M03 (M04) S××××" in the program for turret 1.

2) Specify M234 (M235) in both of the programs.
    Both spindles rotate in synchronization at the speed specified at turret 2.

3) Specify "M36" in either of the programs.
    Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Pattern 4>

1) Specify "M03 (M04) S××××" in the program for turret 2.

2) Specify M234 (M235) in both of the programs.
    Both spindles rotate in synchronization at the specified speed S××××.

3) Specify "M36" in either of the programs.
    Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Turret 1 is used for spindle 1 and turret 2 for spindle 2>

There are following four patterns for specifying the synchronous operation.

The program and the spindle states are indicated below for each of the four patterns.

> **NOTE** An alarm (EX1429) occurs if the direction of spindle rotation does not agree between spindle 1 and spindle 2 when spindle rotation is designated by M03 or M04 for spindle 1 and M203 or M204 for spindle 2.

<Pattern 1>

1) Specify "M03 (M04) S××××" in the program for turret 1.

2) Specify M34 (M35) in both of the programs.
   Both spindles rotate in synchronization at the specified speed S××××.

3) Specify "M36" in either of the programs.
   Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Pattern 2>

1) Specify "M204 (M203) S××××" in the program for turret 2.

2) Specify M34 (M35) in both of the programs.
   Both spindles rotate in synchronization at the speed specified at turret 1.

3) Specify "M36" in either of the programs.
   Spindle 1 stops while spindle 2 keeps rotating at S××××.

<Pattern 3>

1) Specify "M03 (M04) S××××" in the program for turret 1.

2) Specify M234 (M235) in both of the programs.
   Both spindles rotate in synchronization at the speed specified at turret 2.

3) Specify "M36" in either of the programs.
   Spindle 1 keeps rotating at S×××× while spindle 2 stops.

<Pattern 4>

1) Specify "M204 (M203) S××××" in the program for turret 2.

2) Specify M234 (M235) in both of the programs.
   Both spindles rotate in synchronization at the specified speed S××××.

3) Specify "M36" in either of the programs.
   Spindle 1 stops while spindle 2 keeps rotating at S××××.

13-4   Cutting Off Detection (M80)

The function is used to check whether cutting off has been completed or not during synchronous operation.

If cutting off is not completed, the following message is displayed on the screen.

    EX0035 CUT OFF INCOMPLETE

NOTE

1. If the M80 command is executed for spindle 1 while in synchronous mode operation, the synchronous mode is canceled.

    After the completion of the M80 command, the spindle for which a spindle rotation command (M03, M04, M203, M204) is executed keeps rotating at the specified speed.

2. In a block after the execution of the M80 command, it is necessary to specify the M36 command.

14   WORKPIECE PUSHING DETECTION (S TYPE)

14-1   General

When a workpiece is transferred from spindle 1 to spindle 2 and finished in spindle 2, the workpiece will not be finished accurately if it is not securely pushed against the chuck 2 reference surface.

To avoid such a problem, "workpiece pushing" is detected using G38.

If the load current of the B-axis servo motor exceeds the set value in the pushing detection mode, it is judged that the workpiece is correctly pushed against the chuck 2 reference surface and the program proceeds to the next block.

14-2   Command Format

```
      ┌ B__
G38 ─┤ J__ K__ F__ Q__;
      └ V__
```

B/J/V ....Assumed workpiece transfer B-axis position

> Specify B-axis position for workpiece transfer using one of the following coordinate value.
>
> - B: Absolute coordinate value
>
> - J: Incremental coordinate value
>
> - V: Coordinate value in the machine coordinate system
>
> Tolerance is calculated based on this position data.

K ....B-axis return travel from the workpiece pushing detected position (positive value).

> If this command is omitted, the B-axis is returned automatically by servo motor error in the one-direction positioning mode.
>
> When a K command is specified, the B-axis is returned by the specified amount without calculating servo motor error.
>
> **NOTE** In B-axis return controlled by the K command, positioning mode is not one-direction positioning.

F................Skip feedrate for checking the pushing of workpiece

> **NOTE** If the F command is omitted, the feedrate is regarded as "30" mm/min ("1" in./min). (Usually, the F command is omitted.)

Q ....Allowable tolerance for workpiece transfer position

> If the position obtained from the workpiece pushing detection and return operation falls within the range of B (J or V) ± Q, the chuck is clamped and the next process operation continues.
>
> **NOTE**
> 1. If the obtained position is improper, transfer is tried again; if the result is still outside the specified range, an alarm occurs.
>
> 2. If the Q command is omitted, the value is regarded as "1" mm ("0.04" in.).

NOTE Set the approach point, to be specified preceding the G38 command, at a point where the time required by chuck 2 to come into contact is longer than 1 second.

14-3   Operation

1) The B-axis starts positioning at the specified feedrate under torque limited condition to the target position that is obtained by deducting "K + Q + 0.002 mm (0.0002 in.)*" from the position specified with B (J or V).

    * If the target position is set as "B − (K + Q)", the B-axis position reached by returning by "K" from the target position without detecting the pushing, the position finally reached is always within the tolerance and, therefore, alarm state cannot be judged.
       Due to this reason, the target position for is set −0.002 mm (−0.0002 in.) further from the "B − (K + Q)" position. The system judges that the pushing has not been detected if the B-axis stops at this position.

2) When chuck 2 comes into contact with the workpiece, the B-axis servo motor fails to rotate due to torque limit and only servo error increases. When the error reaches the value set for the parameter, the servo motor stops.

3) If the stop position is within 0.1 mm (0.05 in.) from the B-axis movement start point, or if it is the B-axis movement end point, a current detection alarm occurs.

4) B-axis returns the distance specified by K.
    This return travel usually eliminates mechanical workpiece deflection that might be generated by pushing operation.
    If there is no K command, the B-axis returns by "present servo error + 0.1 mm (0.05 in.)" and then moves back 0.1 mm (0.05 in.) in the pushing direction.

5) The torque limited state is cleared.

6) If the returned position is within the allowable tolerance, chuck 2 is clamped and the program advances to the next block.

7) If the returned position is outside the allowable tolerance, steps 1) to 6) are repeated once.
    If the returned position is still outside the allowable tolerance, an alarm occurs.

14-4   Alarm Table

No.	Message	Description
3001	B POSITION ERROR	The position obtained in the pushing detection process is outside the tolerance range.
3003	B, J AND V SPECIFIED	Two or more coordinate values are specified.
3005	B POSITION NOT SPECIFIED	No target position is specified.
3007	SKIP NOT DETECTED	No B-axis current is detected during axis feed up to the end position.
3008	SKIP ALREADY DETECTED	The specified level current is detected at the start or just after the start of Z-axis feed.
3009	RETURN AMOUNT IS NEGATIVE	The specified K value is not positive.

NOTE The pushing detection program is called by G38.

Since this program is written to ROM as a macro executor and not stored in the NC memory, it is not possible to display or edit it.

It is not possible to change the G code.

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