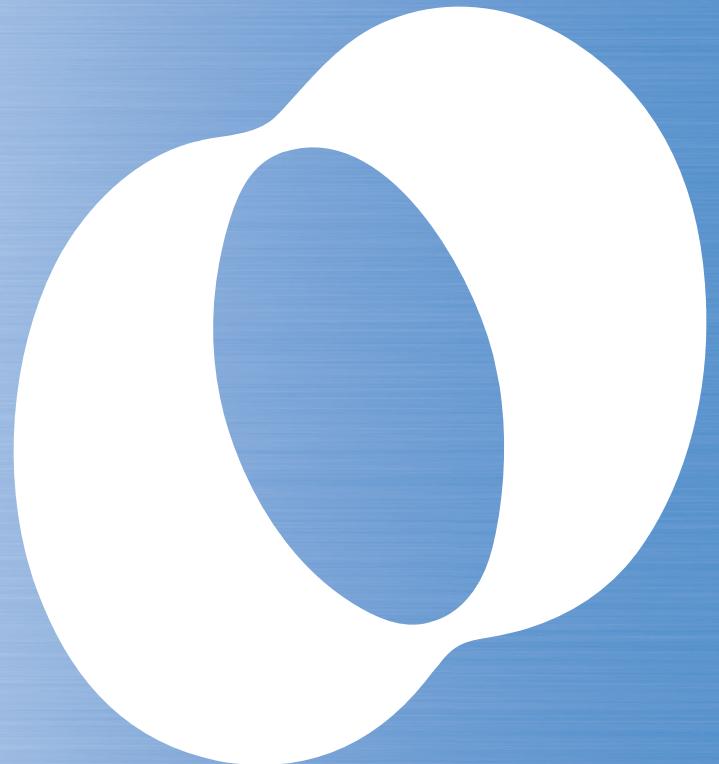


PS SERIES

PS155

Professional *u*

INSTRUCTION MANUAL



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PS SERIES

PS155

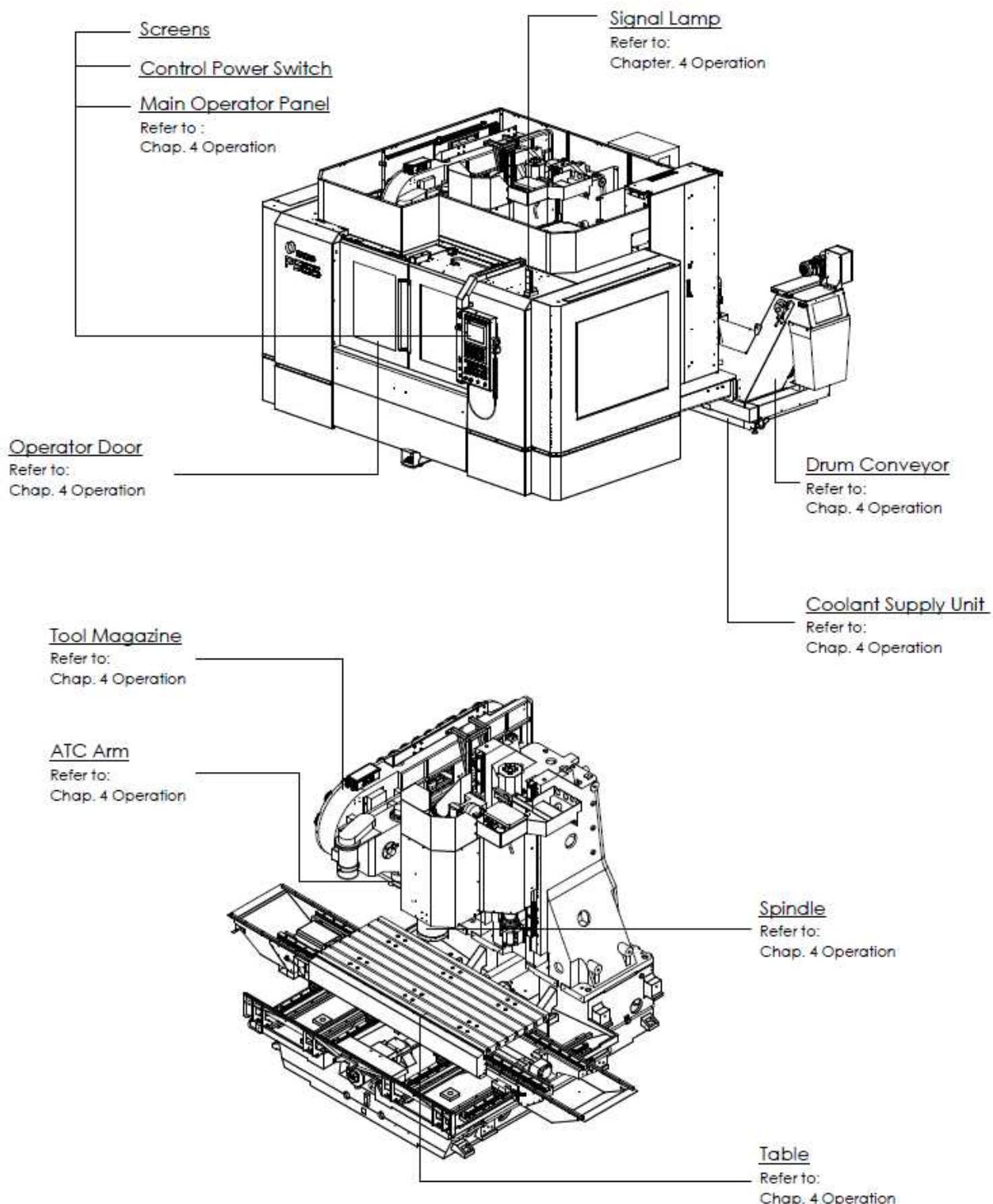
Professional *u*

INSTRUCTION MANUAL

1. Do not operate, maintain, or inspect this machine without carefully reading and understanding this manual.
2. Store this manual in a clearly marked location for easy reference.
3. All rights reserved. No part of this document may be reproduced, copied, or modified in any form or any means without direct permission of MAKINO ASIA PTE LTD.

Operation Route Map

Before performing any operation, ensure that you have read and understood the information provided in the Safety Chapter. Refer to [Chapter 1 Safety](#).¹



Important Information

General

- Do not attempt to modify the machine.
- Operation, maintenance, and inspection of this machine must be performed by staffs who have received technical training for the machine, training in machine hazards and their prevention, and safety training.
- Observe the laws, regulations, and other rules of the relevant national and local administrative agencies.
- This machine, including technical data and software, may be subjected to local and international laws governing trade and import/export.
Prior to any resale, transfer or re-export of controlled items, contact Makino to obtain any required authorization or approval.
- The specifications and design are subject to change without prior notice.

This manual

- This manual is provided to ensure that the customer understands the correct operating procedures and uses this machine safely and efficiently.
- This manual was prepared for usage by experienced operators. For this reason, it does not include safety precautions for operators who do not have mechanical or technical knowledge of machine operation, programming, and maintenance.
- If the machine is operated by persons who are not native speakers of the language in this manual, the customer must ensure that the operators receive complete safety training. Also, warning labels must be affixed in a language that the operators can understand.
- The copyright for the entire content of this manual belongs to MAKINO ASIA PTE LTD. The copying, reproduction, or transfer of this manual, in whole or in part, without the express written permission of MAKINO ASIA PTE LTD, is strictly prohibited.
- Illustrations and other details may differ from the actual machine due to the selected options, modified specifications, or other reasons.
- Store the manuals needed for operation, maintenance, and inspection of this machine in a location where they can be easily accessed by the operator.
- Be sure to perform periodic inspection and maintenance of the machine according to the periodic maintenance manual or the legend plate to prevent breakdown of the machine.

Important points for work safety

- Familiarize yourself with the safety precautions and functions before attempting to operate, maintain, or inspect the machine.
- The points that the operator must observe when performing machine operation and maintenance vary depending on the situation. All possible points cannot be covered in the content of this manual. Be sure to fully understand the machine, and remain constantly aware of safety and the potential hazards while doing work.
- If the safety devices or protective devices do not operate properly, stop operation of the machine and notify the supervisor or manager. The supervisor or manager must immediately notify your authorized Makino dealer or Makino service representative.
- When the machine is stopped due to an unknown cause, immediately contact the supervisor or manager, and wait for permission before restarting operation.

Maintenance of machining accuracy

- After installing the machine, to maintain machining accuracy, conduct periodic inspection such as performing level adjustments.
- If the stability level of the machine changes, high-accuracy machining cannot be performed. In addition, normal machining cannot be performed if the machines vibrates.
- For approximately six months after installation, it is possible for the stability level of the machine to change significantly, while the foundation stabilizes due to the machine weight.
- Depending on the condition of the foundation or the machine usage frequency, conduct inspection and adjustment approximately every six months or every year.



- Be sure to fully understand the information in the Safety Chapter before starting any work, and perform work according to the instructions provided.
- Be sure to thoroughly read and understand this manual before attempting to operate, maintain, or inspect the machine.

Manuals and How to Use Them

Manuals belonging to this machine.

Name	Description
Instruction Manual	This manual includes the basic information (overview, specifications) needed for operation, practical operating procedures (operation), and troubleshooting procedures.
Periodic Maintenance Manual	This manual explains the intervals for periodic maintenance and work that is required for maintaining optimum performance of this machine.
Peripheral Device Manual	This manual describes the operating procedures for the peripheral devices connected to the machine body.
FANUC Set of NC Manuals	These manuals describe the operating procedures for FANUC equipment.
Maintenance Manual	This manual describes the mechanisms of the machine and how to perform the maintenance and adjustment work.
Installation Manual	This manual describes the preparation, transportation, and installation procedures for setup of the machine.
Electrical Schematic Manual	This manual is the circuit diagram of the Machine, for reference during machine maintenance and service.
Parts Manual	This manual provides the list of parts used in the machine for reference during maintenance and service. Order of spare/replacement parts can be made to your Makino Service Representative using the part numbers indicated in this Manual.
Other manuals for options	These manuals describe the operating procedures for the optional devices.

These manuals are provided in softcopy format with the machine.

In addition, the following manuals are provided in hardcopy format:

- Instruction Manual
- Periodic Maintenance Manual
- Electrical Schematic Manual

-NOTE-

Illustrations and other details may differ from the actual machine because the machine configuration is different depending on the specifications.

Notation used in this manual

 DANGER	Indicates an imminent hazard which, if not avoided, will result in death or serious injury.
 WARNING	Indicates a potential hazard which, if not avoided, will result in death or serious injury.
 CAUTION	Indicates a potential hazard which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a potential hazard which, if not avoided, may result in physical damage to the machine or adversely affect the work environment.
-NOTE-	Indicates supplemental information for appropriate and efficient work or better understanding of the operation.

General Contents

Chap. 1 Safety

This chapter describes the safety devices and warning labels, work and operating precautions, and other information for ensuring safety operation of the machine. Be sure to read this chapter before using the machine.

Chap. 2 Specifications

This chapter describes the basic configuration and specifications of the machine.

Chap. 3 Preparation for Installation

This chapter describes the environment/conditions required for machine installation and installation precautions.

Chap. 4 Operation

This chapter describes the operating procedures for each unit.

Chap. 5 Troubleshooting

This chapter describes the troubleshooting procedures for each part.

Chap. 6 Appendix

This chapter provides other miscellaneous information related to the machine.

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1 Safety Precautions

- Disregarding the specific instructions or precautions included in this manual may result in serious injury or death to the operators or surrounding workers, or damage to the machine.
- Only qualified personnel who have adequate mechanical and technical knowledge are allowed to operate and maintain the machine.
- Never disable or remove any safety device. Operating the machine while the safety devices are disabled may result in serious injury, death, or damage to the machine.
- Observe the safety precautions provided in this manual at all times and fully implement safety measures.
- Inspect and maintain the machine regularly to keep it in optimum operating condition. Do not run the machine if it shows any signs of abnormal operation.
- The keys (release key for door switch, machine controller panel key, etc.) which are not necessary for regular operation and maintenance must be removed from the machine and managed by supervising personnel.
- The lubricating oil, cutting fluid, and other chemical substances used with the machine must be arranged by supervising personnel.
- Workpiece materials such as magnesium and titanium may cause a fire if mishandled, so be particularly careful when machining workpieces and handling cutting chips from these materials.

1.1 Operators Checks

- Only qualified personnel who have adequate mechanical and technical knowledge are allowed to operate and maintain the machine.
- Only qualified electrical engineers may perform electrical work.
- Only qualified personnel may use a crane or forklift.
- Wear suitable work clothes whenever operating or maintaining the machine. Do not operate the machine while wearing loose-fitting clothes, a necktie, jewelry, or any other clothing or objects which may become entangled with the moving parts of the machine.
- Tie up long hair, wear a hat.
- Wear safety glasses, safety shoes, safety helmet, and safety gloves as needed.



Safety goggles



Safety shoes



Safety helmet



Safety gloves

- Protective gear should be worn to protect hearing when excessive noise may be generated during operation or maintenance.
- Never operate any machinery while under the influence of alcohol or drugs.
- The operator should be in proper physical condition. If the operator suffers from a condition that impairs judgement, it may result in serious injury or death.

1.2 Work Environment Checks

- Make sure the machine and surrounding area are fully lighted.
- Make sure the machine and surrounding area are tidy and clean at all times.
- Clean up any oil, cutting fluid, or chips scattered around the machine.
- When performing work at high locations, use a stable footstool or stepladder.
- Keep all flammable substances away from the work area.
- Maintain adequate working space.

1.3 Precautions for Potential Fire Hazards

Use the machine by following the precautions below to protect the machine equipment, plant, and surrounding environment from the danger of fire and to ensure the safety of operators.

- 1 When using cutting fluid, be sure to use a water-soluble cutting fluid (type A1).

There is no fire hazard when using water-soluble cutting fluids (except when using them with special materials).
- 2 Oil-based cutting fluids present a potential fire hazard.

If an oil-based cutting fluid must be used due to unavoidable circumstances, be sure to observe the precautions below.

 - Do not run the machine in an unmanned operation mode.
 - Install the proper fire-extinguishing equipment near the machine.
 - Provide alarm devices to detect a fire, automatic fire-extinguishing devices, and other equipment to the greatest extent possible.
 - Do not create situations which may potentially start a fire.
 - Machine under the proper cutting conditions.
 - Perform proper tool management to prevent the occurrence of abnormal frictional heat and sparks.
 - Do not allow chips to accumulate in the machining chamber.
 - Check that a constant and full supply of cutting fluid is provided.
 - Always clean up and organize the area around the machine, and do not place flammable objects in the area.
- 3 Precautions for machining of flammable solids, resins, wood, and other flammable materials.

When machining flammable solids or other special materials, be sure to fully implement safety measures after gaining a thorough understanding of the material properties. Be sure to also pay careful attention to safety when machining resins, wood, and other materials.

When machining materials that generate dust and powder, be sure to provide equipment that takes into account the danger of a dust explosion for certain material types.
- 4 Precautions for machining while blowing air.

Because air blowing has weak cooling performance, the chips that spray and fly out in the surrounding area are extremely hot. Do not place flammable objects in the machining chamber or in the area surrounding the machine.

1.4 Confirmation of Machine Status

- Machine inspections and maintenance must be performed regularly to maintain optimum machining accuracy and long-term performance, and increase machine operating efficiency.
- Confirm that all safety devices are functioning normally.
- Make sure the operator knows the location of the "Emergency Stop" switches to enable easy access in the event of an abnormal or dangerous situation (Refer to [3.1 Emergency Stop Switch](#)^[18]).
- Check for any loose, damaged, or worn parts on the machine. Operating the machine in a condition in which any of the parts has an abnormality may cause abnormal noises or damage to the machine during machine operation.
- Check for any loose or damaged piping or wiring. Operating the machine with the piping or wiring left damaged may cause oil leakage, electrical shock, or fire during machining operation.
- Use the most appropriate cutting tool, tool holder, retention knob, and workpiece, and make sure that they are all secured firmly in place. Otherwise, the workpiece may fall or the tool may fly out, and this may result in damage to the machine, serious injury, or death.
- Check that the tool numbers are registered correctly. Otherwise, the spindle may rotate at a speed outside the allowable range, the tool may fly out, and this may result in damage to the machine, serious injury, or death.

1.5 Pre-operation Checks

- Be sure that you fully understand the work procedures and precautions before operating and maintaining the machine. Never operate any machinery if you are unsure about any points.
- Check that the clothes you are wearing are suitable for operation.
- Perform periodic maintenance.
- Confirm that all safety devices are functioning properly before operating and maintaining the machine.
- Periodically back up the parameters when the machine was shipped and the program and offset data that have been prepared by the customer. Makino is not liable for any program or offset data that is corrupted or lost.
- Makino does not accept responsibility for any trouble caused by apparatus or programs prepared by the customers, such as damage to workpieces or the machine.
- For details on replacement parts, contact your Makino service representative. Use of improper parts may result in reduced machine performance or safety, damage to the machine, or operator injuries.
- Perform the lock-out and tag-out procedures.
- Make sure the operator knows the location of the "Emergency Stop" switches for each device so that they can be easily operated in the event of an abnormal or dangerous situation.
- Be sure to observe the information on the warning labels. Contact your Makino service representative if a warning label comes off or becomes illegible.
- When handling a hazardous or toxic material (oils, cutting fluids, and other chemical substances), obtain the safety data sheet (SDS), and follow the instructions. The safety data sheet (SDS) contains information about the safe handling of hazardous and toxic materials, and emergency measures.
- For models with graphite specifications, do not suck in anything other than dust (graphite) into the dust collector. Failure to observe this precaution may result in a dust explosion. It may also result in filter damage.

Chapter 1 Safety

- For models with graphite specifications, to prevent health hazards due to dust (graphite), observe the following:
 - After machining a workpiece (product), wait until floating dust is collected into the dust collector to open the operator door.
If you open the operator door immediately after machining, floating dust scatters outside the machining chamber.
 - To perform any of the operations below, be sure to wear a high efficiency dust proof mask. (Recommended: 99.9% or higher particle collection efficiency)
Sucking in dust may cause pneumoconiosis.
 - When opening or closing the operator door
 - When working with the operator door being open
 - When replacing a tool in the tool magazine
 - When handling dust
 - While the dust collector is running, do not remove the dust car or the chip bucket. Otherwise, dust scatters around.

1.6 Implementing Lock-out and Tag-out

Lock-out consists of shutting down the power source to the machine or devices and locking it.

Example: Set the main power switch to the "OFF" position and secure it using a padlock or a lockout device such as a cover.

Tag-out consists of placing a warning tag to prevent anyone from turning ON the power supply.

Example: Place a "Do Not Operate" or "Under Maintenance" sign with the operator's name and department and indicating that machine operation is prohibited on the main power switch and main operation panel.

Lock-out/tag-out should be performed to prevent inadvertent operation and ensure operator safety.

- Performing lock-out/tag-out alone does not completely ensure operator safety. The operator must read and thoroughly understand the work procedures and safety precautions, and always be aware of potential hazards.

Each operator should perform lock-out or tag-out by himself or herself. Perform this procedure before starting the work, and release the lock and remove warning tag yourself after finishing work. Never release a lock and remove a sign without confirming with the operator or without the presence of the operator himself or herself.

- Be sure to clearly define and implement the lock-out and tag-out procedures of your company.

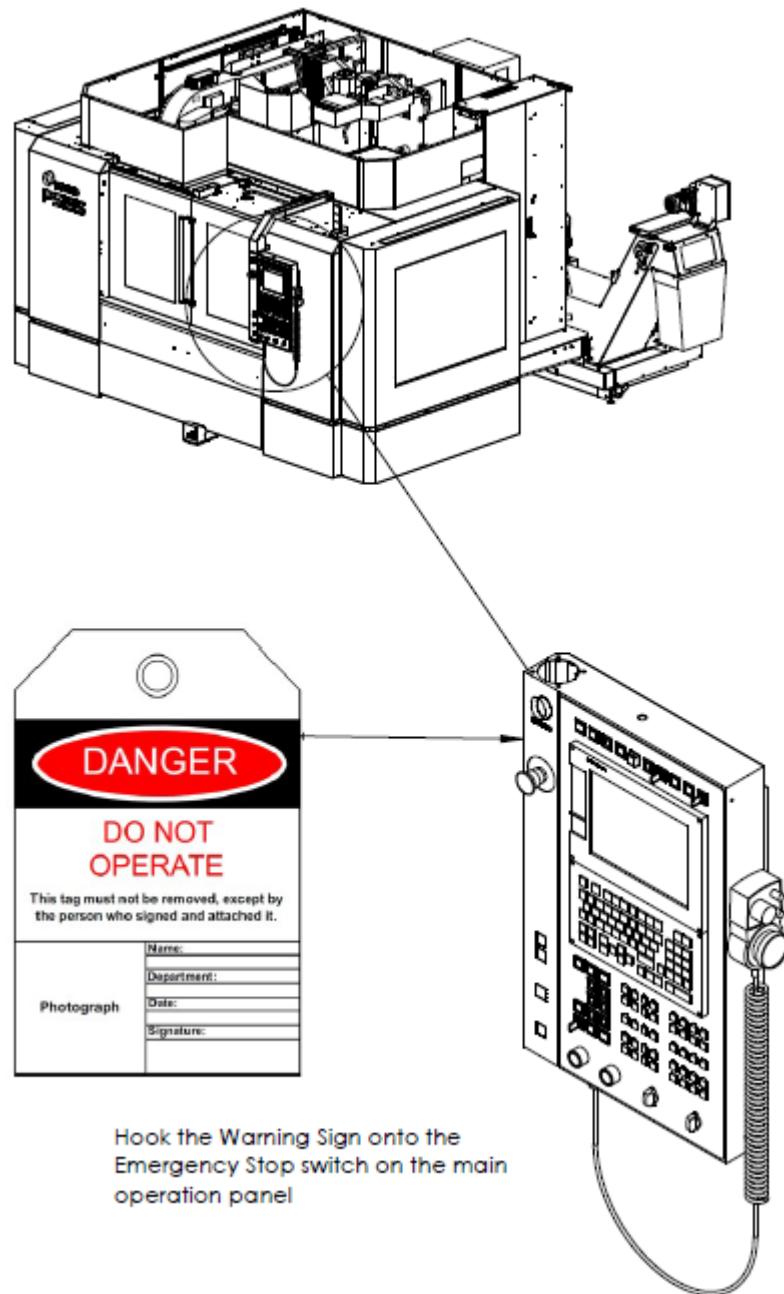


Figure 1.1 Implementing Lock-out & Tag-out

1.7 During Work

- Turn OFF the power before performing maintenance of the machine. When work must be performed with the machine power ON, confirm that all machine operations are completely stopped. Check that any residual energy in the machine is completely discharged.
- Never go near the moving parts of the machine. If you must approach moving parts to perform maintenance, be sure to take adequate safety precautions. Inadequate attention to safety may result in death or another serious accident.
- Always keep the doors and covers closed during operation. If you must work with a door or cover open when performing maintenance, be sure to take adequate safety precautions. Inadequate attention to safety may result in death or another serious accident.
- If an operator gets trapped inside the machine, press the "Emergency Stop" switch regardless of whether the machine power is ON or OFF.
- If the machine is stopped by a power failure or power supply fault, turn OFF the machine power. If the power is not turned OFF, the machine may start operating unexpectedly when the power is restored, and this may result in serious injury, death, or damage to the machine.
- If the machine is stopped by a power outage or fault in the power supply, check that the parameter, program, and offset data have not been corrupted. The machine may be damaged if it is operated using corrupted data.
- Be aware of the movement range of the machine and auxiliary components (each axis stroke, rotation range, etc.), and keep all body parts clear of moving components.
- When two or more people are required for maintenance work, be sure to maintain clear communication at all times to ensure operator safety. When performing work, be ready to press the "Emergency Stop" switch at any time.
- Be sure to always pay attention to the safety precautions listed on the warning labels affixed to the machine (Refer to 2 Warning Labels ^[13]).
- Do not move the switches or change the circuits except for adjustment purposes. In particular, operating the machine with the interlock(s) or other safety devices or functions disabled is extremely dangerous and may result in death or damage to the machine.
- If a circuit or other component needs to be changed for adjustment purposes, be sure to return it to the original setting after adjustment is completed.
- The optimum values for the NC parameters and machine parameters are set when the machine is shipped. Do not change any parameter setting unless it is described in the manual. Also, be sure that you fully understand the function of a parameter before attempting to change the parameter setting, and return the parameter to its original setting after the work is completed. If you try to operate the machine without the proper settings, the machine may operate unexpectedly, and this may result in serious injury, death, or damage to the machine.

Chapter 1 Safety

- If the memory clear operation needs to be performed, be sure to contact your Makino service representative beforehand.
- If an alarm is triggered, eliminate the cause of the alarm using the appropriate procedure. If the remedy procedure is unclear, contact your Makino service representative.
- Never climb onto the covers. This may deform the covers or result in injury.
- When using a stepladder or stool, it should be sturdy, safe, and have anti-slip surfaces.
- If any oils or cutting fluids get into your eyes, body, or on your skin surface, they may cause severe health problems. Wear safety gloves, mask, safety glasses, and other safety equipment.
- Wear safety gloves whenever handling chips, tools, and workpieces.
- Protective gear should be worn to protect hearing when excessive noise may be generated during operation or maintenance.
- If lubricating oil, grease, cutting fluid, or other substances are spilled on the floor, it may result in slippage, causing injury. Wipe up any spilled fluids as soon as possible.
- Never touch a switch, button, or key while your hands are wet. Failure to observe this precaution may result in electric shock.
- Some devices (motors, lighting equipment, valves, etc.) may become very hot while the machine is operating and remain hot soon after the power is turned OFF, so be careful to avoid burns.
- Do not subject the machine to sudden impact or jolts. This may cause the machine to perform an unexpected motion or damage it.
- Do not use the machine for operation outside the specifications or exceeding the performance range. This may cause the machine to perform an unexpected motion or result in serious injury, death, or damage to the machine.
- Use the most appropriate cutting tool, tool holder, retention knob, and workpiece, and make sure that they are all secured firmly in place. Otherwise, the workpiece may fall or the tool may fly out, and this may result in damage to the machine, serious injury, or death.
- Be careful that you do not leave objects such as tools or jigs inside the machine.
- Do not place the tools, workpiece, or other parts on an unstable location.
- When a lifting sling or attachment is necessary, verify that it is strong enough to support the weight of the parts. Confirm that no one is close to the machine and the parts are well balanced, and be careful not to hit the machine.
- Never go under a load that is being lifted. While transferring the machine, constantly pay careful attention to the hoisted load during the operation.
- Check that the tool numbers are registered correctly. Otherwise, the spindle may rotate at a speed outside the allowable range, the tool may fly out, and this may result in damage to the machine, serious injury, or death.

- Never insert hands or feet into the lift-up chip conveyor or internal chip conveyor. They may be pulled in, and this may result in death or another serious accident.
- When machining material that generates dust particles, to prevent health hazards due to inhaling the dust particles, observe the following:
 - After machining a workpiece (product), wait until floating dust has settled or cleared before opening the operator door.
If you open the operator door immediately after machining, floating dust scatters outside the machining chamber.
 - To perform any of the operations below, be sure to wear a high efficiency dust proof mask.
(Recommended: 99.9% or higher particle collection efficiency)
Sucking in dust may cause pneumoconiosis.
 - When opening or closing the operator door
 - When working with the operator door being open
 - When replacing a tool in the tool magazine
 - When handling dust

1.8 Handling of Hazardous and Toxic Materials

Handlers of hazardous and toxic materials (such as oils and cutting fluid) must receive information, education, and training in accordance with your local laws and regulations.

Particular attention must be paid to the following points.

- Be sure that there is adequate ventilation in areas where hazardous and toxic materials are used.
- Hazardous and toxic materials must be handled and stored based on the handling procedures recommended by the manufacturer.
- Identify hazardous and toxic materials by affixing labels to their containers.
- Assign a person in charge to handle the hazardous and toxic materials, and provide education and training in emergency response procedures and handling procedures.
- Before handling any hazardous or toxic material, be sure to check the safety data sheet (SDS). The safety data sheet (SDS) contains detailed information on health and safety hazards, safe handling procedures, and responses to emergency situations.

2 Warning Labels

Warning labels are affixed to machine parts that are potentially hazardous to warn operators about the hazard and its level of danger and ensure the safety of operators.

The warning labels include symbols to indicate the source of the danger, signal words to indicate the level of danger, and warning text to describe how to prevent the danger. When working at a location where a warning label is affixed, make sure that you fully understand the warning label information and definitions and follow the warning text that is provided. Failure to observe the information in the warning labels may result in death or another serious accident or damage to the machine.

2.1 Signal Word Definitions

Signal words are divided into four classes based on the degree of expected risk.

Signal Word	Description
 DANGER	Indicates an imminent hazard which, if not avoided, will result in death or serious injury.
 WARNING	Indicates a potential hazard which, if not avoided, will result in death or serious injury.
 CAUTION	Indicates a possible hazard which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a potential situation which, if not avoided, may result in physical damage to the machine or adversely affect the work environment.

2.2 Using Warning Labels

- Do not cover up or peel off the warning labels.
- Confirm that the operators and maintenance personnel are familiar with the language on the labels. If labels in other languages are required, contact your Makino service representative.
- Check that all the information in the warning label is legible. If any portion of the warning text or symbol is not visible, clean by wiping with a soft cloth dipped in water or household cleanser. Do not use organic solvents or gasoline. These may damage the surface of the warning label.
- Replace the warning label if the information in the warning label is no longer visible. To obtain new warning labels, contact your Makino service representative.
- If a part is replaced where a warning label was affixed, obtain a new warning label and affix it at the same position as before on the new part. To obtain new warning labels, contact your Makino service representative.

2.3 Information Contained in Warning Labels

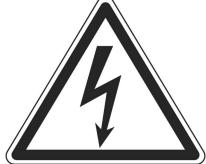
The two types of warning labels are shown below.

- Labels with warning text and a warning mark
- Labels with a warning mark only

2.3.1 Warning Labels with Warning Text

Signal Word	Symbol	Description
DANGER		Entering enclosed spaces during operation can cause serious injury or death. Turn OFF the main power before opening door.
WARNING		Carelessness when removing workpiece can cause serious injury. Machined edges are sharp and can cut. Exercise extreme care when removing workpiece.
CAUTION		Ensure that tool holder is orientated properly before inserting into tool pot. Orientation notch should be as shown.

2.3.2 Warning Labels with Warning Marks Only

Symbol	Description
 A triangular warning sign with a lightning bolt symbol inside, indicating high voltage.	This warning label is affixed to parts where touching the internal high-voltage components may result in electrical shock. Workers who are not qualified electrical engineers must not access the parts where this warning label is affixed.
 A triangular warning sign with three wavy lines inside, indicating a hot surface.	This warning label is affixed to parts that may become extremely hot. Do not touch parts where this warning label is affixed. Be particularly careful immediately after operation because these parts are extremely hot at this time.

2.4 Warning Labels Locations

2.4.1 Warning Labels Locations on Standard Machine

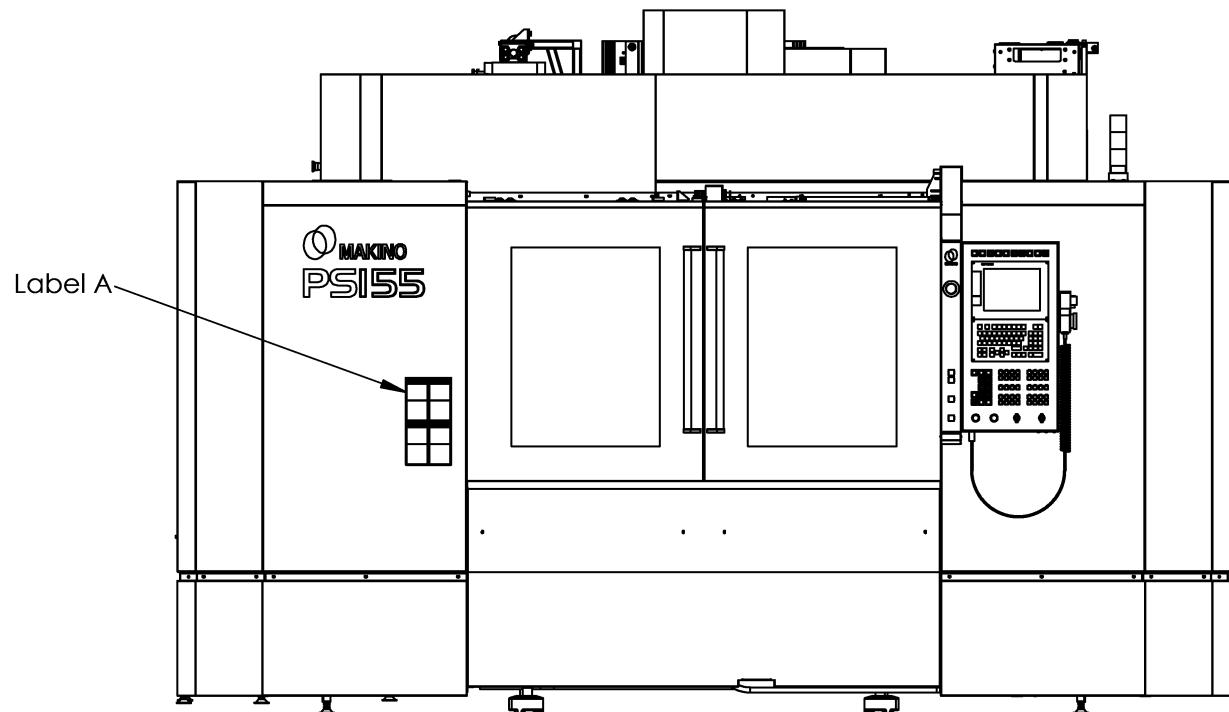


Figure 2.1 Warning Labels Location

2.4.2 Labels



Label A

-NOTES-

- 1 Locations and types of labels differ depending on the machine type or specifications (the above diagram is an example) and subject to revision and change.
- 2 Confirm the Warning labels on the actual machine.

3 Safety Devices



- Never disable or remove any safety device.

Safety devices are installed on the machine to protect operators and maintenance personnel. The safety devices also include ones that function on the condition that the operator observes the safety procedures.

3.1 Emergency Stop Switch



- Make sure operators know the locations of all the "Emergency Stop" switches prior to performing machine operation or maintenance to enable use in an abnormal or dangerous situation.

The machine goes to the following status when the "Emergency Stop" switch is pressed:

- Feeding of the axes is stopped immediately.
- Spindle rotation stops if it is rotating.
- The spindle is clamped if it has been unclamped.
- When orientation of the spindle has been performed, orientation is reset.
- When a tool is being changed or the tool magazine is operating, operation stops immediately (even during motion).
- The lift-up chip conveyor and internal chip conveyor come to an immediate stop during operation.
- The hydraulic unit is stopped.
- The cutting fluid supply is stopped.
- The air supply of air blow inside the machining chamber is stopped.
- Energizing of all solenoid valves is reset.
- The NC is reset.

Once the "Emergency Stop" switch is pressed, it is locked in the pressed position. The lock can be released by turning the switch in the direction indicated by the arrow or pulling out the switch. Then, pressing the **[CONTROL POWER ON]** switch cancels the emergency stop state.

For details on recovery procedures following machine operation stopped by pressing the "Emergency Stop" switch (Refer to Instruction Manual Chapter 5 2.2 Recovery from Emergency Stop).

Chapter 1 Safety

"Emergency Stop" switches are installed at the following locations. All buttons function identically.

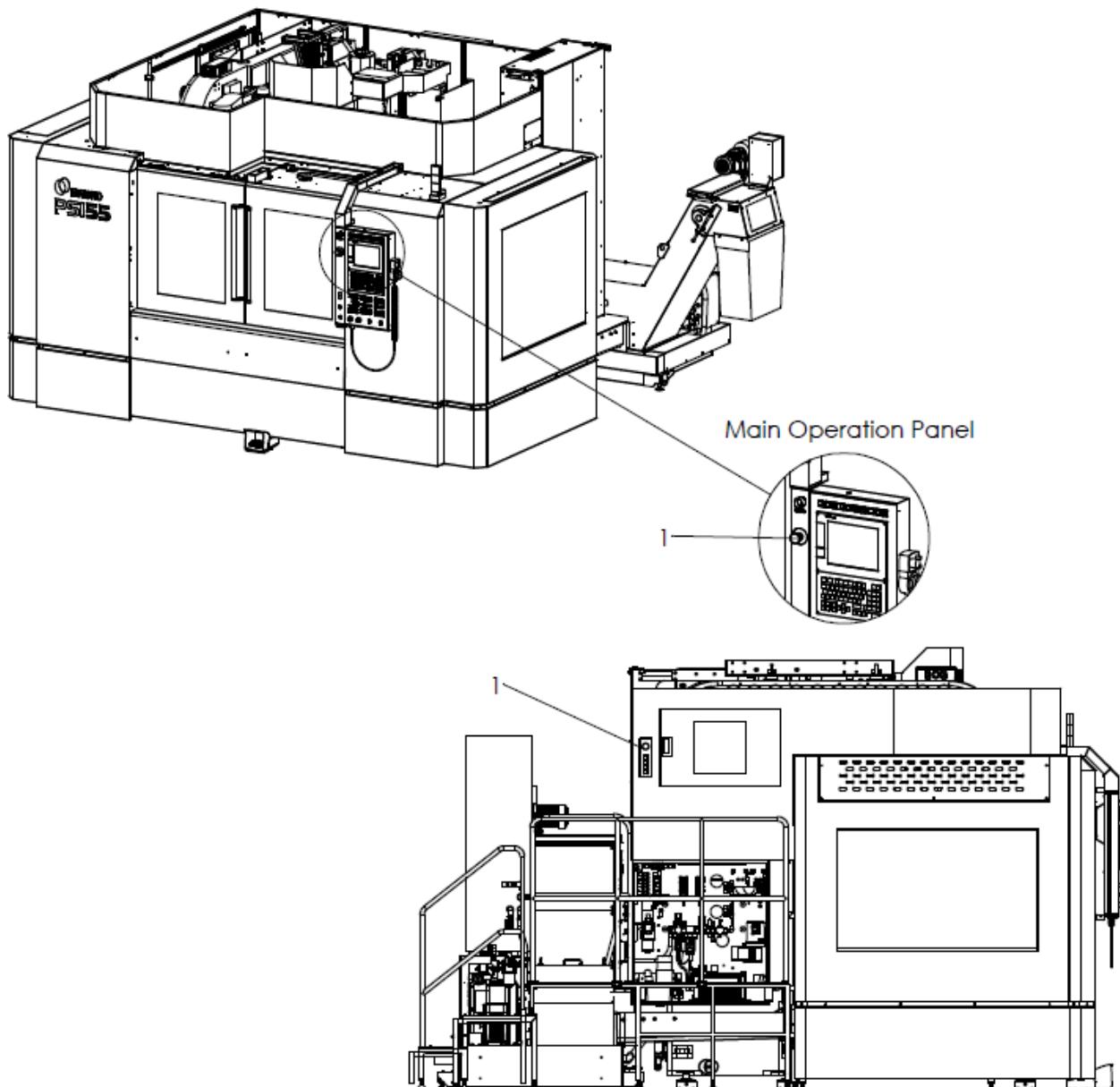


Figure 3.1 "Emergency Stop" Switch 1

No.	Name
1	"Emergency Stop" Switch

Portable Manual Pulse Generator

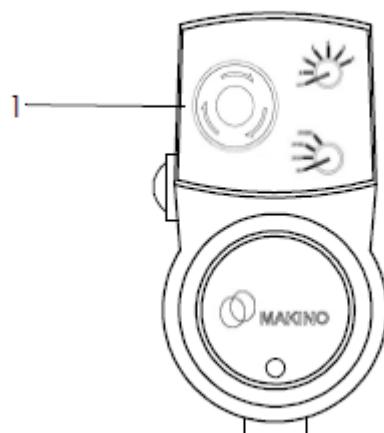


Figure 3.2 "Emergency Stop" Switch 2

No.	Name
1	"Emergency Stop" Switch

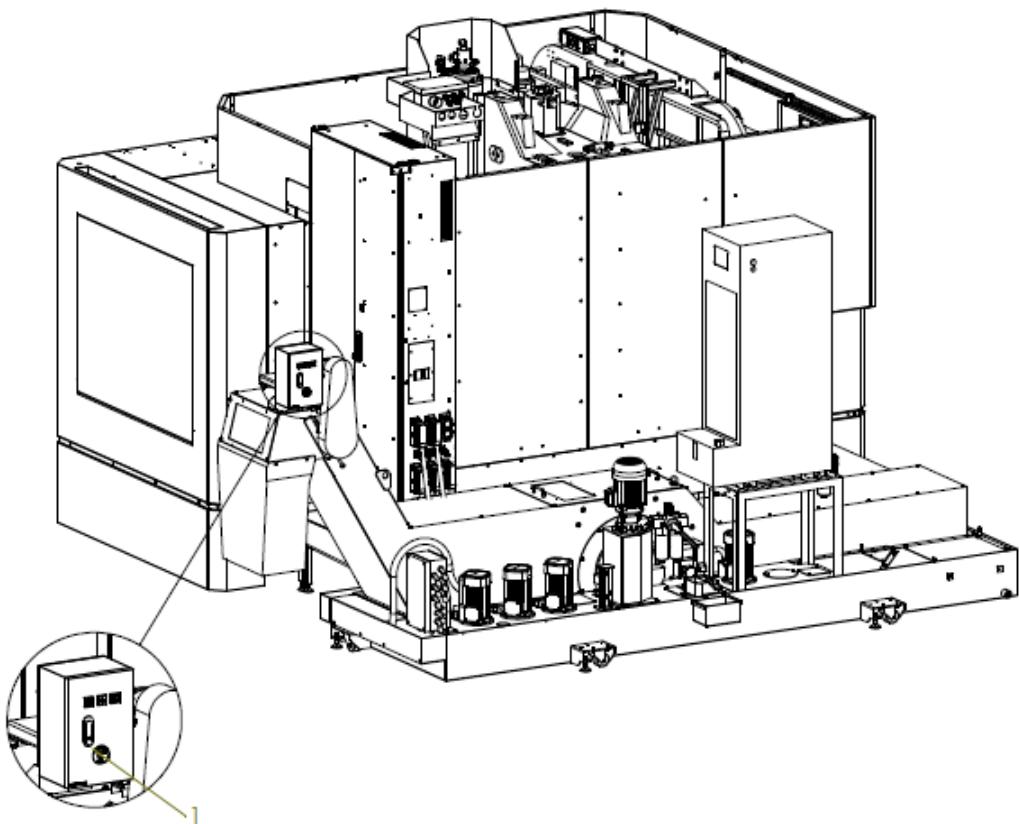


Figure 3.3 "Emergency Stop" Switch (Options)

No.	Name
1	"Emergency Stop" Switch

4 Work Hazards

The following tables list examples of hazardous actions and situations during machine operation and maintenance and examples of the resulting accidents and incidents that may occur.

The points that the operator must observe when performing machine operation and maintenance vary depending on the situation. All possible points cannot be covered in the content of this manual. Operators and maintenance personnel must have a thorough understanding of the machine and must constantly be aware of safety and potentially dangerous situations when performing operation.

Improper operation may result in death or damage to the machine.

4.1 Area Surrounding Machine

Action/Situation	Result
Tripping over cables, piping, or change in height	Falling
Operator working on oily floor	Fall, bone fracture, injury
Bringing an open flame into the area	Fire, burn
Improper handling of chemical substances	Skin lesions, eye injury, or respiratory problems

4.2 Electrical System

Action/Situation	Result
Performing inspection or maintenance operation without turning OFF the machine power (Refer to NOTES ^[23])	Electric shock, breakdown of the machine, abnormal operation, fire
Touching a device with residual voltage (Refer to NOTES ^[23])	Electrical shock
Miswiring	Breakdown of the machine, abnormal operation, fire
Loose screw in terminal block or other location	Breakdown of the machine, abnormal operation, fire
Machine controller door or junction box cover is left open	Electric leakage, breakdown of the machine, abnormal operation, fire
Touching switches with wet hands	Electrical shock
Damage to wiring on floor surrounding machine	Electric leakage, breakdown of the machine, abnormal operation, fire
Operation or maintenance by non-qualified personnel	Breakdown of the machine

-NOTES-

- Prior to performing maintenance of the servo amplifiers, spindle amplifiers, and inverters, turn OFF the main power switch and confirm that the LED which indicates charging (red) for each amplifier and inverter is off.
- High voltage current flows through components inside the junction box.
- High voltage current continues to flow on the primary side of the main power switch even after the main power supply is turned OFF.
- Electrical current continues to flow to lamps and outlets in the machine controller even after the main power supply is turned OFF.

4.3 Parameters

Action/Situation	Result
Changing NC/machine parameters not listed in manual	Injury or death, workpiece damage, breakdown of the machine
Forgetting to return the parameter to its original value after adjustment	Injury or death, workpiece damage, breakdown of the machine

4.4 Inside the Machining Chamber

Action/Situation	Result
Working without performing lock-out and tag-out	Injury or death, damage to the machine
Operator entering machining chamber with safety devices or functions disabled	Injury or death
Getting near the operating range of an axis when the power is turned ON or during axis feeding	Injury, bone fracture, bruises
Replacing the gravity axis motor without using the fixing jig	Injury or death, damage to the machine
Rotating spindle prior to cleaning of tapered section while operator door is open	Injury or death, damage to the machine
Rotating unbalanced tool at high speed while operator door is open	Injury or death, damage to the machine
Hand or other body part becomes wedged in operator door when it is opened or closed	Injury, bone fracture, bruises
Operator touching rotating spindle	Hands or fingers cut off, body part becomes entangled, or other serious injury or death
Touching a feed axis motor	Burns
Workpiece has not been clamped	Injury, bone fracture, bruises
Operator being struck by ATC Mechanism	Injury or death
Touching operating Machine shutters	Injury
Getting entangled in the internal chip conveyor belt	Body part pulled in, resulting in injury or death
Climbing on top of covers	Fall, bone fracture, injury
Climbing on top of the movable covers, inserting your hand into the gaps	Injury, bruises
Operator working on oily floor	Fall, bone fracture, injury
Touching the wipers	Cuts to hands
Operator touching bladed tools	Cuts, injuries to hands
Holding a heavy tool	Strained back, hands become wedged between tool and object
Operator being struck by chips and cutting fluid/dust scattered during machining	Damage to eyes, cuts or burns to skin
Operator being splashed by cutting fluid dripping from ceiling in machining chamber	Damage to eyes, skin irritation
Operating machine while there is abnormal vibration or abnormal noise	Damage to the machine
Operating machine with a tool incorrectly clamped	Injury or death, damage to the machine

Action/Situation	Result
Opening the operator door and entering the machining chamber while mist is still present	Respiratory problems
Cleaning without wearing protective gloves	Cuts to hands
Fastening tools or implementing other work during spindle orientation	Injury, bone fracture, bruises

When machining materials that generate dust particles:

Action/Situation	Result
Opening the operator door and entering the machining chamber while dust is still air borne in chamber	Respiratory problems
Going inside the machining chamber without a dust proof mask	Respiratory problems
Breathing in dust	Respiratory problems

4.5 Tool Magazine

Action/Situation	Result
Working without performing lock-out and tag-out	Injury or death, damage to the machine
Operator entering the tool magazine without turning OFF the power	Injury or death
Operator entering the tool magazine with the safety devices and functions disabled	Injury or death
Manually changing tools by entering inside the tool magazine	Injury or death
Performing T command or tool change while tool blade or tool is mounted incorrectly	Injury or death, damage to the machine
Tool number is registered incorrectly	Damage to the machine
Operator inserting hands into tool magazine during tool magazine operation	Cuts, bone fracture of hands
Touching the tool magazine motor	Burns
Operator working on oily floor	Fall, bone fracture, injury
Operator touching bladed tools	Cuts, injuries to hands
Holding a heavy tool	Strained back, hands become wedged between tool and object
Operator working at elevated locations	Fall, bone fracture
Hand or other body part becomes stuck in tool magazine door when it is opened or closed	Injury, bruises
Leaving a safety guard or maintenance cover opened or removed	Injury
Performing cleaning or maintenance while a tool is stored in the tool magazine	Cutting or stabbing of hand or body
Cleaning without wearing protective gloves	Cutting or stabbing of hand

4.6 Cutting Fluid Supply Unit/Chip Disposal Device/Cutting Fluid Temperature Controller/Dust Collector (Graphite Specifications)

Action/Situation	Result
Working without performing lock-out and tag-out	Injury or death, damage to the machine
Inserting hands or feet into conveyor or tank without turning OFF the power	Serious injury due to body part becoming entangled, or cuts to hands and feet
Touching part or component immediately after operation	Burns
Operator touching moving parts when chip discharge outlet cover is removed	Serious injury due to body part becoming entangled
Stepping on a tank that is not fixed	Fall, bone fracture, injury
Operating with low levels of cutting fluid	Fire, damage to the machine
Touching cutting fluid or chemical additives	Skin irritation
Touching chips	Cuts, injuries, burns to hands
Replacing the filter without prior cleaning	Cuts, injuries to hands
Inhaling large quantities of cutting fluid mist	Respiratory problems
Mixing different brands of oils	Breakdown of the machine
Failing to properly clean or collect flammable cutting chips or sludge	Fire
Mixing cutting chips made from different materials	Fire
Performing operation without wearing protective gloves	Cuts, injuries to hands
Breathing in dust particles from machining	Respiratory problems

4.7 Spindle Lubricant Controller/Feed Axis Temperature Controller/Hydraulic Unit

Action/Situation	Result
Touching part or component immediately after operation	Burns
Oil temperature exceeds flash point Flash point of Mobil Veloce No. 3: >76°C, Flash point of standard hydraulic oil: Approximately 200°C	Fire
Changing filters without reducing the internal pressure	Injury or death, damage to the machine
Performing operations without safety gloves, mask, and other protective gear	Damage to eyes, skin irritation, accidental ingestion, or respiratory system damage
Mixing different brands of oils	Breakdown of the machine

4.8 Pneumatic Unit

Action/Situation	Result
Removing the pneumatic unit source piping on the machine side or disassembling the primary-side line filter without shutting off the air supply from the factory facilities	Injury due to flying off of parts or impact
Removing the pneumatic unit source piping on the machine side or disassembling the primary-side line filter without releasing the residual pressure in the air piping (inside the air circuit)	Injury due to flying off of parts or impact

4.9 Splash Guard

Action/Situation	Result
Working without performing lock-out and tag-out	Injury or death, damage to the machine
Operator entering splash guard with the safety devices and functions disabled	Injury or death
Operating the machine with the covers removed	Injury or death
Operator working on oily floor	Fall, bone fracture, injury
Operator working at elevated locations	Fall, bone fracture

4.10 Other Peripheral Equipment

Action/Situation	Result
Performing operation without turning OFF the machine power	Injury or death, electric shock

5 Occupational Health and Safety Management

5.1 Safety Device Inspection

Perform periodic maintenance and inspection of the safety devices used on this machine in order to ensure that they continue to function normally. Make sure that all maintenance staff fully understand the types of safety devices, functions, and locations described in [3 Safety Devices](#)¹⁹ before performing any maintenance work.

Before starting operation or maintenance work, inspect the safety devices, and if any are not functioning properly, abort machine operation.

5.2 Noise

The noise level of the machine is shown below.

- Noise level: 80 dB maximum (A-weighted sound level)

These values are measured values at full operation (maximum rotation of the spindle without machining a workpiece) with the safety guards and covers correctly mounted and all doors closed.



- When a workpiece is machined, noise at 80 dB or higher may occur under certain customer cutting conditions. When performing work near the machine during machining, be sure to wear ear protection and other equipment to ensure that your health is not harmed.
Performing work without wearing ear protection may lead to hearing loss.

-NOTE-

The above noise level is measured at a location that is a distance of 0.5 m from the machine and a height of 1.2m above the floor.

5.3 Personal Protective Equipment

When conducting installation, operation, and maintenance work on the machine, be sure to protect your body from the following potential hazards.

- Mechanical hazards
- Hazardous and toxic materials
- Heat
- Noise

Be sure to always use protective equipment to protect your body from these hazards. Some examples of protective equipment are shown below.

Protected Body Part	Hazard Type	Protective Equipment	Work Requiring Protective Equipment
Head	Bruises and cuts	Helmet	<ul style="list-style-type: none">• Work where parts or other objects may fall on the head• Work where the head may get hit
Eyes, nose, mouth, face	Flying out of dust, chips, chippings, and other substances Splashing of mist, lubricants, grease, and other oils	Protective glasses, dust-proof masks	<ul style="list-style-type: none">• Work where objects may spray or fly out
Ears	Noise	Earplugs	<ul style="list-style-type: none">• Work where the environment constantly generates noise above the stipulated level
Hands	Cuts, burns, and adhesion of chemical substances	Protective gloves, heat-resistant gloves, chemical-resistant gloves	<ul style="list-style-type: none">• Work where the hands must be protected
Feet	Bruises	Safety shoes	<ul style="list-style-type: none">• Handling and transporting of heavy objects
Torso	Falling from high locations	Safety belt	<ul style="list-style-type: none">• Work at locations 2 meter or higher

5.4 Disposal of Waste Products

5.4.1 Disposal of Waste Oil, Waste Fluids and Waste Materials

Dispose of liquids such as cutting fluid, grease, hydraulic oil and lubricant, and chips or graphite dust, all of which are discharged during operation of this machine, in accordance with the laws, regulations, and ordinances established in your country.

Also, separate and dispose of recyclable materials properly.

5.4.2 Disposal of This Machine

When disposing of this machine or its parts, disassemble and dispose of them in accordance with the laws, regulations, and ordinances established in your country.

Also, separate and dispose of recyclable materials properly.

1 Overview

The PS155 vertical machining center enables high precision machining for high volume machining line. A wide range of peripherals devices and accessories are available to meet diverse machining demands and requirements.

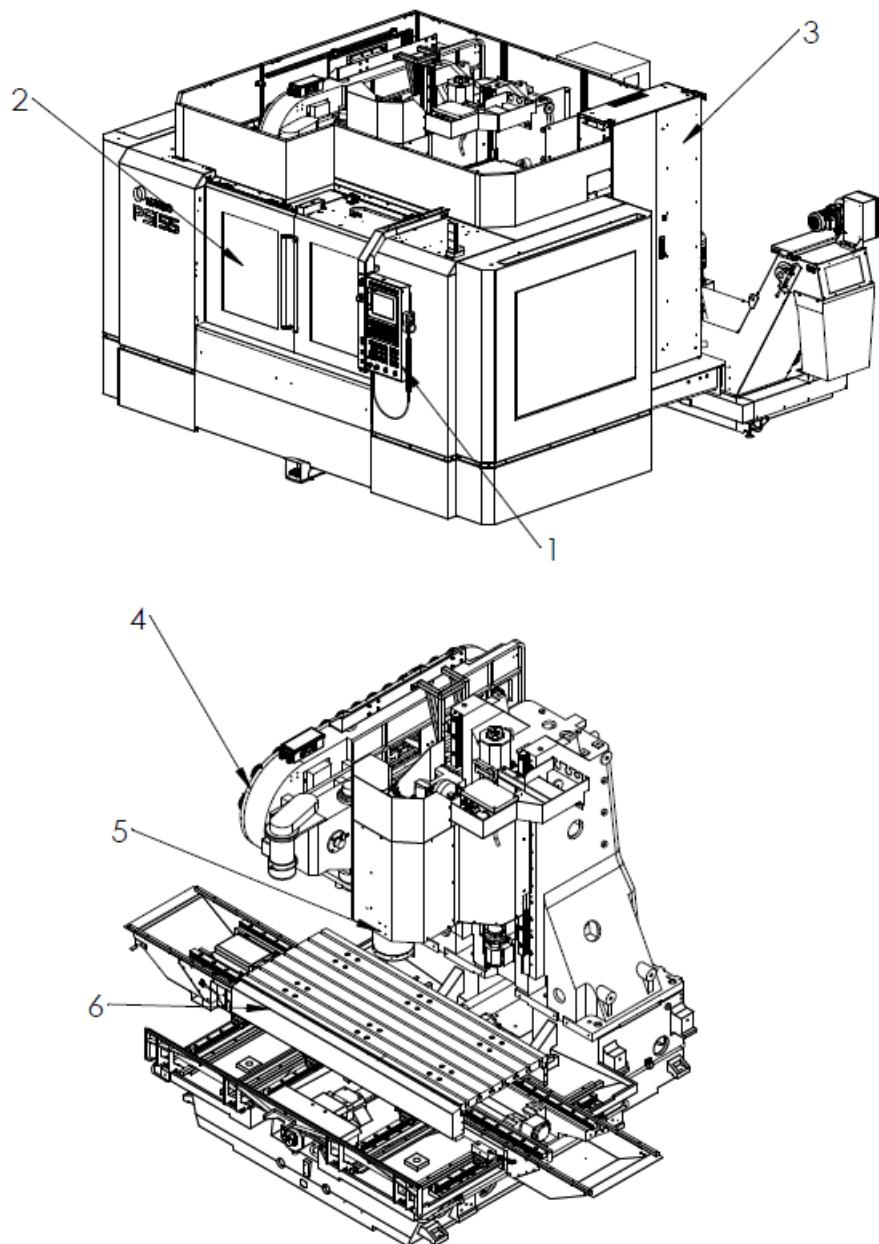


Figure 1.1 Overview 1

No.	Name	No.	Name
1	Main Operation Panel	4	ATC Magazine
2	Operator Door	5	Spindle
3	Machine Tool Cabinet (MTC)	6	Table

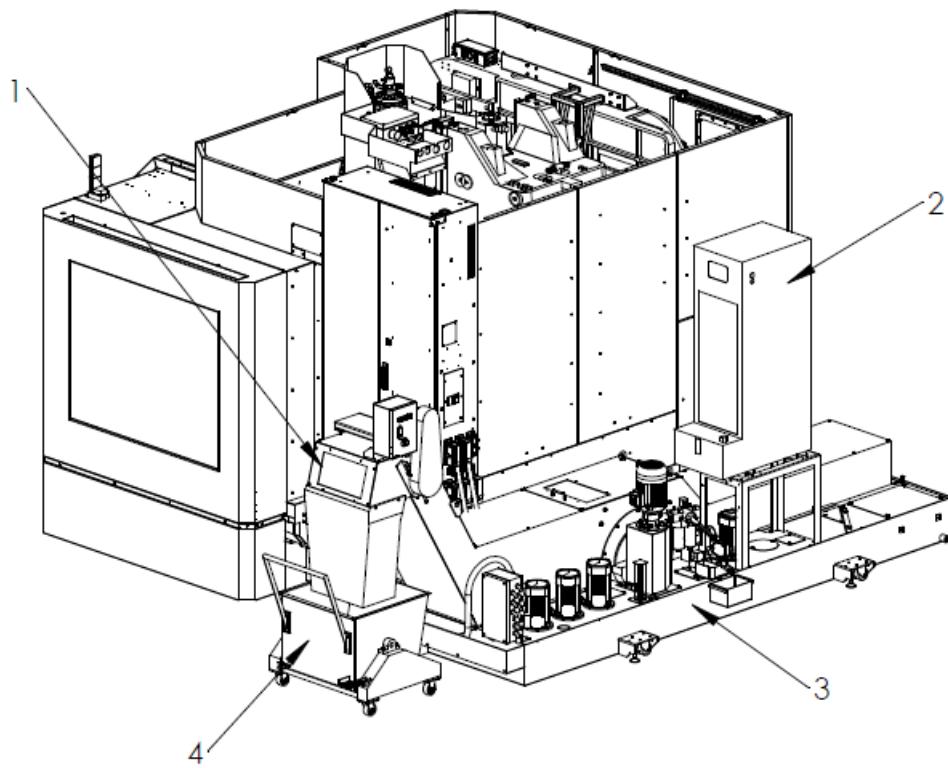


Figure 1.2 Overview 2 (Back view)

No.	Name	No.	Name
1	Drum Conveyor (Option)	3	Coolant Tank
2	Spindle Cooler	4	Chip Trolley (Option)

2 Machine Structure/Components

2.1 Axis Configuration

- X-axis: Horizontal movement (left/right) of the saddle along the bed.
- Y-axis: Back and forth saddle movement on machine bed.
- Z-axis: Vertical movement (up/down) of the spindle head on the column.

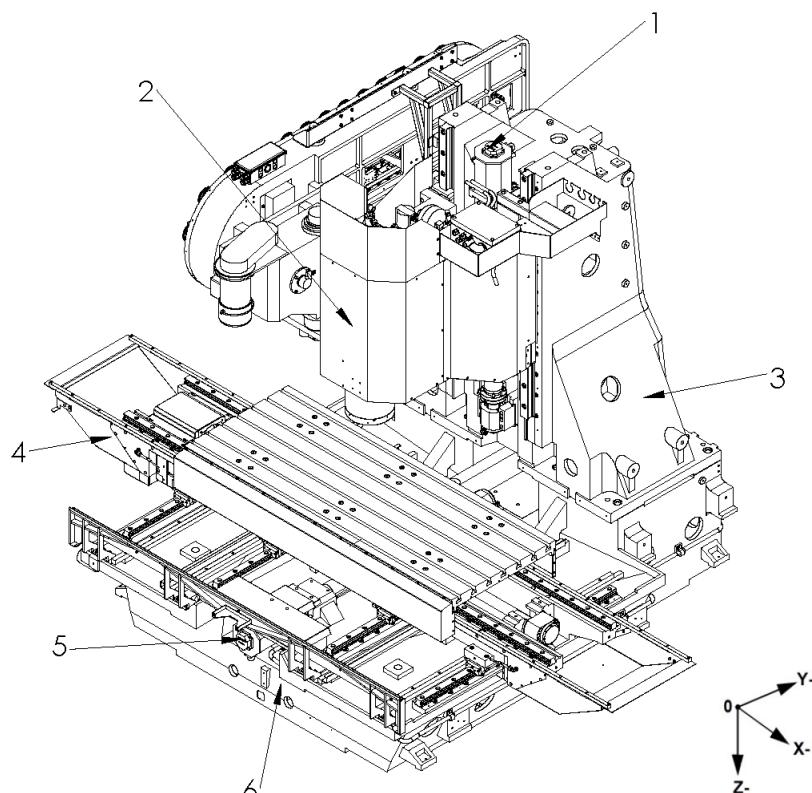


Figure 2.1 Axis Configuration

No.	Name	No.	Name
1	Z-Axis Servomotor	4	Saddle
2	Spindle Head	5	Y-Axis Servomotor
3	Column	6	Bed

2.2 Machine Primary Components

The machine configuration and features are described in this section.

- **Spindle**

The spindle head is mounted onto the column. The spindle head moves up and down to form the Z-axis.

A built-in AC motor drives the spindle.

The spindle bearings are lubricated with grease/oil+air (option) for life time. The spindle head and motor is jacket-cooled and the generated heat is removed by coolant from the Spindle Cooler Unit.

- **Bed**

The bed is of high-strength structure consisting of multiple ribs. The linear guideways for the Y-axis are mounted on the bed.

A six-point support structure is employed to improve installation accuracy and stability.

- **Column**

The column is sitting on the bed casting and carries the Z-axis.

- **Table**

The table is sitting on the saddle and moves along the X-axis and Y-axis. It comes with T-slots to facilitate clamping of fixture/component for machining.

- **Automatic Tool Changer (ATC)**

The Automatic Tool Changer (ATC) consists of tool pockets to accommodate the tools and uses an arm for tool pick-up and loading from ATC to spindle. Magazine indexing is done by servomotor through intermediate gearbox.

- **Spindle Oil Cooler**

The spindle cooling oil temperature controller circulates cooling oil through the spindle head outer cylinder and absorbs the generated heat to adjust the temperature of the spindle to that of the machine bed.

- **Grease Supply Unit**

The grease supply unit supplies grease to the drive units of the machine components. As a standard scope, machine is supplied with auto greasing system, greasing takes place automatically and the grease cartridge is to be replaced when alarm is triggered by the system.

- **Hydraulic Unit**

The hydraulic unit supplies hydraulic oil to the spindle head for tool clamp/unclamp function.

- **Chip Disposal Device**

Cutting chips are flushed away from the machining point using coolant discharge from the nozzles provided on spindle head. Cutting chips on the inside chamber of the machine are carried out by the spiral conveyors and discharged into a chip bucket (or through the drum conveyor - option).

- **Machine Controller**

The machine controller controls the overall machine operations and functions, including management of tool/workpiece data required for controlling devices such as the Automatic Tool Changer (ATC) for machining.

- **NC (Numerical Control) Unit**

The NC unit executes NC programs and controls axes servomotors and spindle drive motor.

3 Machine Basic Specifications

3.1 PS155 (SPD-14K) Machine General Specification

Travel	X-Axis x Y-Axis x Z-Axis	1,550 mm × 700 mm × 660 mm
Feed Rates	Rapid Feed Rate (X/Y/Z-Axis)	X: 0 to 36,000 mm/min Y: 0 to 36,000 mm/min Z: 0 to 36,000 mm/min
	Cutting Feed Rate (X/Y/Z-Axis)	1 to 30,000 mm/min
	Jog Feed Rate (X/Y/Z-Axis)	0 to 8,000 mm/min
Machine Size	Machine Height	2,618 mm (Standard) 2,768 mm (HC - Option)
	Weight	12,000 kg
	Floor Space with Chip Tray (Not include Chip Bin and Maintenance Space)	4,040 mm x 4,125 mm
	Floor Space with Drum Conveyor, Option (Not include Chip Bin and Maintenance Space)	4,920 mm x 4,125 mm
Power	Electrical Power Supply	380V ~ 415V, 3P, 50Hz/60Hz, 50kVA
Accuracy	Positioning with scale/without scale	±0.0025 (JIS B 6336); < 0.006 (ISO230.2-2006)/ ±0.0050 (JIS B 6336); < 0.010 (ISO230.2-2006)
	Repeatability with scale/without scale	±0.0015 (JIS B 6336); < 0.004 (ISO230.2-2006)/ ±0.0030 (JIS B 6336); < 0.006 (ISO230.2-2006)

-NOTE-

The values other than the spindle rotation speed are for the standard specifications. For special specifications, refer to the catalog or specifications published by Makino.

3.2 PS155 (SPD-10k Option) Machine General Specification

Travel	X-Axis x Y-Axis x Z-Axis	1,550 mm × 700 mm × 660 mm
Feed Rates	Rapid Feed Rate (X/Y/Z-Axis)	X: 0 to 36,000 mm/min Y: 0 to 36,000 mm/min Z: 0 to 36,000 mm/min
	Cutting Feed Rate (X/Y/Z-Axis)	1 to 30,000 mm/min
	Jog Feed Rate (X/Y/Z-Axis)	0 to 8,000 mm/min
Machine Size	Machine Height	2,618 mm (Standard) 2,768 mm (HC-Option)
	Weight	12,500 kg
	Floor Space with Chip Tray (Not include Chip Bin and Maintenance Space)	4,040 mm × 4,125 mm
	Floor Space with Drum Conveyor, Option (Not include Chip Bin and Maintenance Space)	4,920 mm × 4,125 mm
Power	Electrical Power Supply	380V ~ 415V, 3P, 50Hz/60Hz, 50kVA
Accuracy	Positioning with scale/without scale	±0.0025 (JIS B 6336); < 0.006 (ISO230.2-2006)/ ±0.0050 (JIS B 6336); < 0.010 (ISO230.2-2006)
	Repeatability with scale/without scale	±0.0015 (JIS B 6336); <0.004 (ISO230.2-2006)/ ±0.0030 (JIS B 6336); <0.006 (ISO230.2-2006)

-NOTE-

The values other than the spindle rotation speed are for the standard specifications. For special specifications, refer to the catalog or specifications published by Makino.

3.3 PS155 Table Specification

Specification	Measurement
Table Working Surface	1800 mm x 700 mm
Fixing Screw	18H7 T-slot
Maximum Pay-Load	1500 kg
Loading Height	950 mm

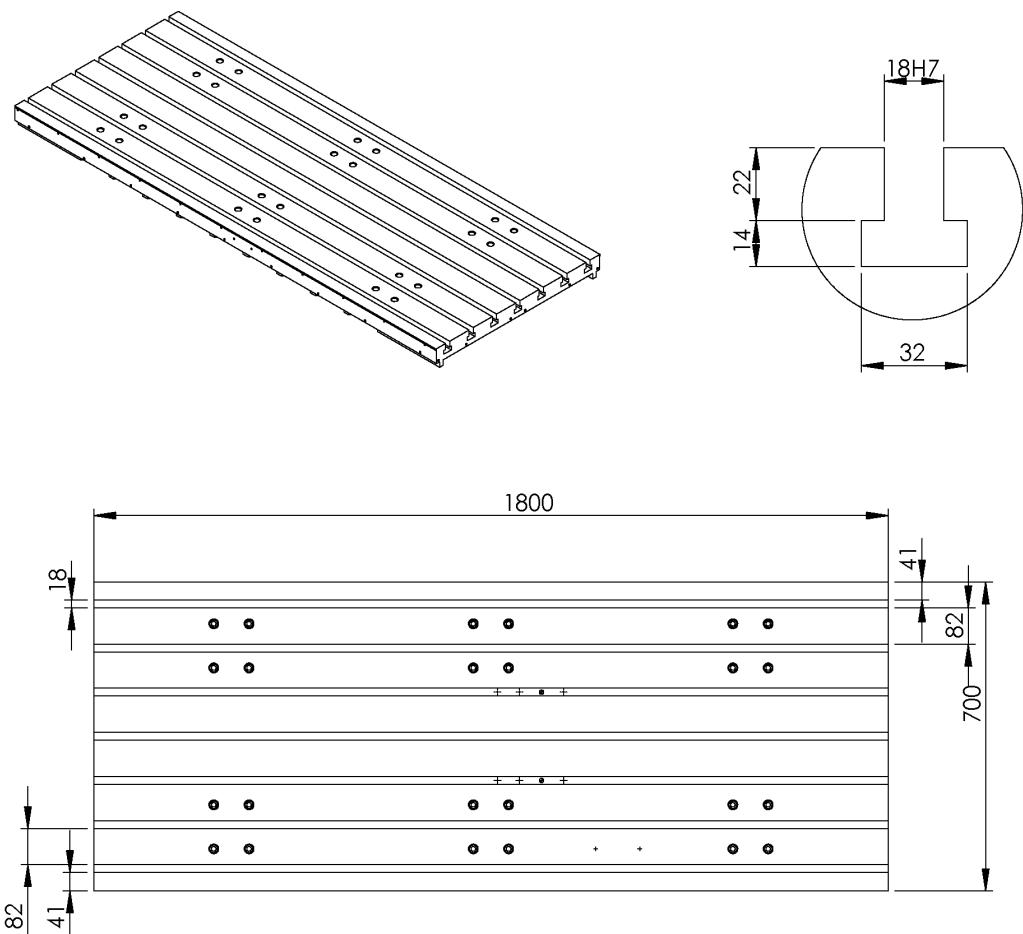


Figure 3.1 PS155 Table Specification

3.4 14K Spindle Specification

Specification	Measurement & Description
Maximum Power at 25% ED	30 kW
Maximum Power at Continuous Rated	18.5 kW
Maximum Output Torque at 15% ED	175.1 Nm
Maximum Output Torque at Continuous Rated	95.5 Nm
Base Speed (15% ED/Continuous)	1,500 rpm
Built-in Thermal Overload Detection	Yes
Tool Clamping Force	9.8 ±10% kN (7/24 taper #40) 18 ±10% kN (HSK-A63)
Speed Range	50 rpm to 14,000 rpm
Tool Shank & Retention Knob	MAS403 BT40 (JIS B6339 40T) + MAS403 P40T-1 (no TSA/TSC) (Standard) MAS403 BT40 (JIS B6339 40T) + JIS B6339-40P (no TSA/TSC) (Option) DIN69871-A40 + DIN69872-19 (no TSA/TSC) (Option) DIN69871-A40 + T13M-1272D (TSA/TSC) (Option) V-CAT NO.40 + T13M-0414D (no TSA/TSC) (Option) V-CAT NO.40 + T13M-2151D (TSA/TSC) (Option) HSK DIN69893-HSK-A63 (no TSA/TSC) (Option) HSK DIN69893-HSK-A63 + T13M-2702D (TSA/TSC) (Option)
Cooling Method	Jacket Cooling

-NOTES-

1. Ensure cutting tools used are balanced to avoid spindle damage.
2. Recommended value G2.5 and below. (ISO 1940-1)

3.5 10K Spindle (Option) Specification

Specification	Measurement & Description
Maximum Power at 25% ED	37 kW
Maximum Power at Continuous Rated	25 kW
Maximum Output Torque at 25% ED	426 Nm
Maximum Output Torque at Continuous Rated	294 Nm
Base Speed	1,850 rpm
Built-in Thermal Overload Detection	Yes
Tool Clamping Force	$9.6 \pm 10\%$ kN (BT50) $44.1 \pm 10\%$ kN (HSK-A100)
Speed Range	50 rpm to 10,000 rpm
Tool Shank & Retention Knob	MAS403 BT50 + MAS403 P50T-1 JIS B6339 50T + JIS B6339 50P DIN69871 Nr.50 + DIN69872 Nr.50 VCAT MF2560 No.50 + VCAT SP MAS403 P50T HSK DIN 69893-HSK-A100
Cooling Method	Jacket Cooling

-NOTES-

1. Ensure cutting tools used are balanced to avoid spindle damage.
2. Recommended value G2.5 and below. (ISO 1940-1)

3.6 Automatic Tool Changer (HSK A-63 ATC #30) Specification

Specification	Measurement & Description
	HSK A-63
Tool Change Type	Spindle Direct Pick-Up
ATC Magazine Motor Power	2 kW
Max. Tool Diameter for Continuous Loading	\varnothing 75 mm
Max. Tool Diameter with Adjacent Pot Empty	\varnothing 125 mm
Max. Tool Length	300 mm
Max. Tool Weight	8 kg
Max. Tool Moment	9.8 Nm
Max. Total Tool Mass	120 kg

-NOTE-

This is the random pot type ATC magazine system. ATC can be converted to Fixed Pot Type by performing two tool changes, parameter setting.

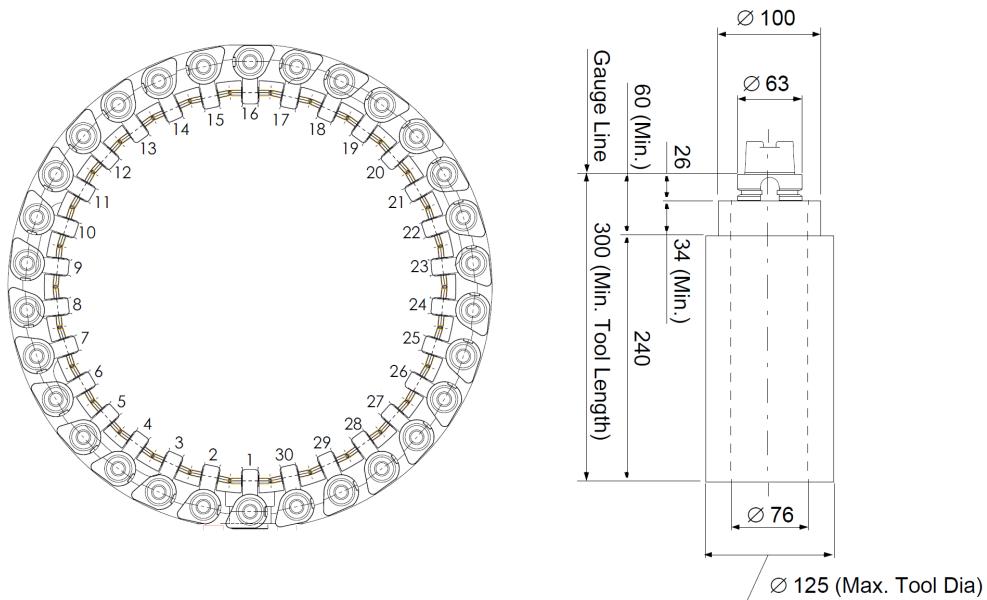


Figure 3.2 Automatic Tool Changer (HSK A-63 ATC #30) Specification

3.7 Automatic Tool Changer (HSK A-100 ATC #30) Specification

Specification	Measurement & Description
	HSK A-100
Tool Change Type	Spindle Direct Pick-Up
ATC Magazine Motor Power	2 kW
Max. Tool Diameter for Continuous Loading	Ø 125 mm
Max. Tool Diameter with Adjacent Pot Empty	Ø 299 mm
Max. Tool Length	260 mm / 400 mm
Max. Tool Weight	20kg / 13kg
Max. Tool Moment	25.48 Nm
Max. Total Tool Mass	300 kg

-NOTE-

This is the random pot type ATC magazine system. ATC can be converted to Fixed Pot Type by performing two tool changes, parameter setting.

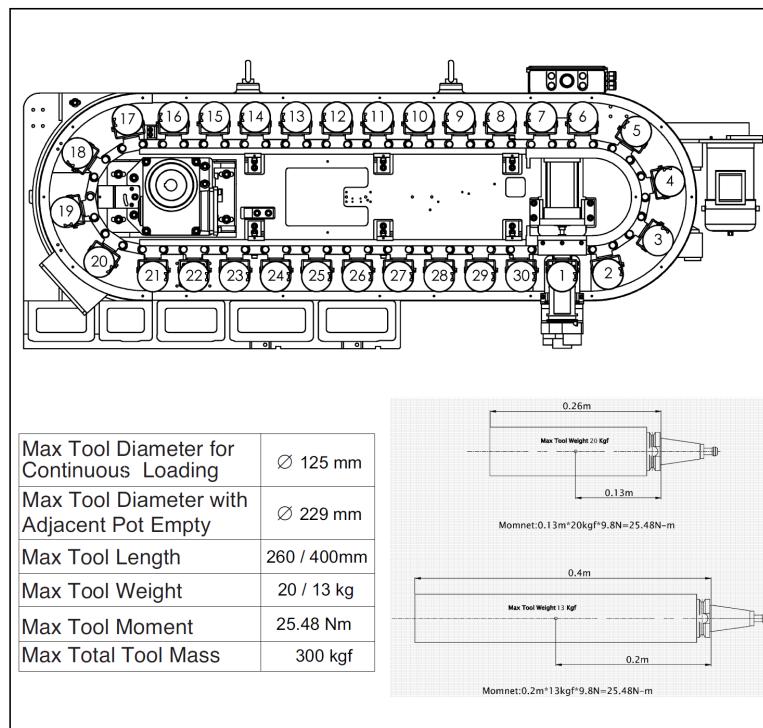


Figure 3.3 Automatic Tool Changer (HSK A-100 ATC #30) Specification

3.8 Tank Capacity

Specification	Measurement (Litre)
Coolant Tank (Total volume available for filling)	674
Coolant Tank (Effective total volume available for pump)	400
Spindle Cooler Tank Capacity	25
Spindle Hydraulic Power Pack	4
ATC Cam Oil Capacity	5
Fixture Hydraulic Power Pack (Option)	6
Automatic Grease Cartridge (Option)	0.7

3.9 Coolant Tank Unit Pump Layout & Specification

Main Coolant Tank				
S/N	Type	Pump Part No.	Pump Model	Make
MS2	Nozzle / Work Wash Pump	Z615D2800114	MTH4-4/4 A-W-A-AQKV	GRUNDFOS
MS16	Flush Coolant	Z615D2800114	MTH4-4/4 A-W-A-AQKV	GRUNDFOS
MS16A	Fixture Coolant Pump (Option)	Z615D2800114	MTH4-4/4 A-W-A-AQKV	GRUNDFOS
MS6A	LUCC Backwash Coolant Pump (Option)	Z615D2800114	MTH4-4/4 A-W-A-AQKV	GRUNDFOS
MS10	Shower Coolant	Z615D2800114	MTH4-4/4 A-W-A-AQKV	GRUNDFOS
MS8	TSC Pump 1.5 MPa (Option)	Z615Z1100015	TH421A590	BRINKMANN
MS8	TSC Pump 3.0 MPa (Option)	Z615Z-0022-00	BFS232-30-G61ZX	BRINKMANN
MS8	TSC Pump 7.0 MPa (Option)	Z615Z-0023-00	BFS232-70-G61ZX	BRINKMANN
MS71	Secondary Tank Transfer Pump (Option)	Z615D2800114	MTH4-4/4 A-W-A-AQKV	GRUNDFOS

* LUCC - Lift-Up Chip
TSC - Through Spindle

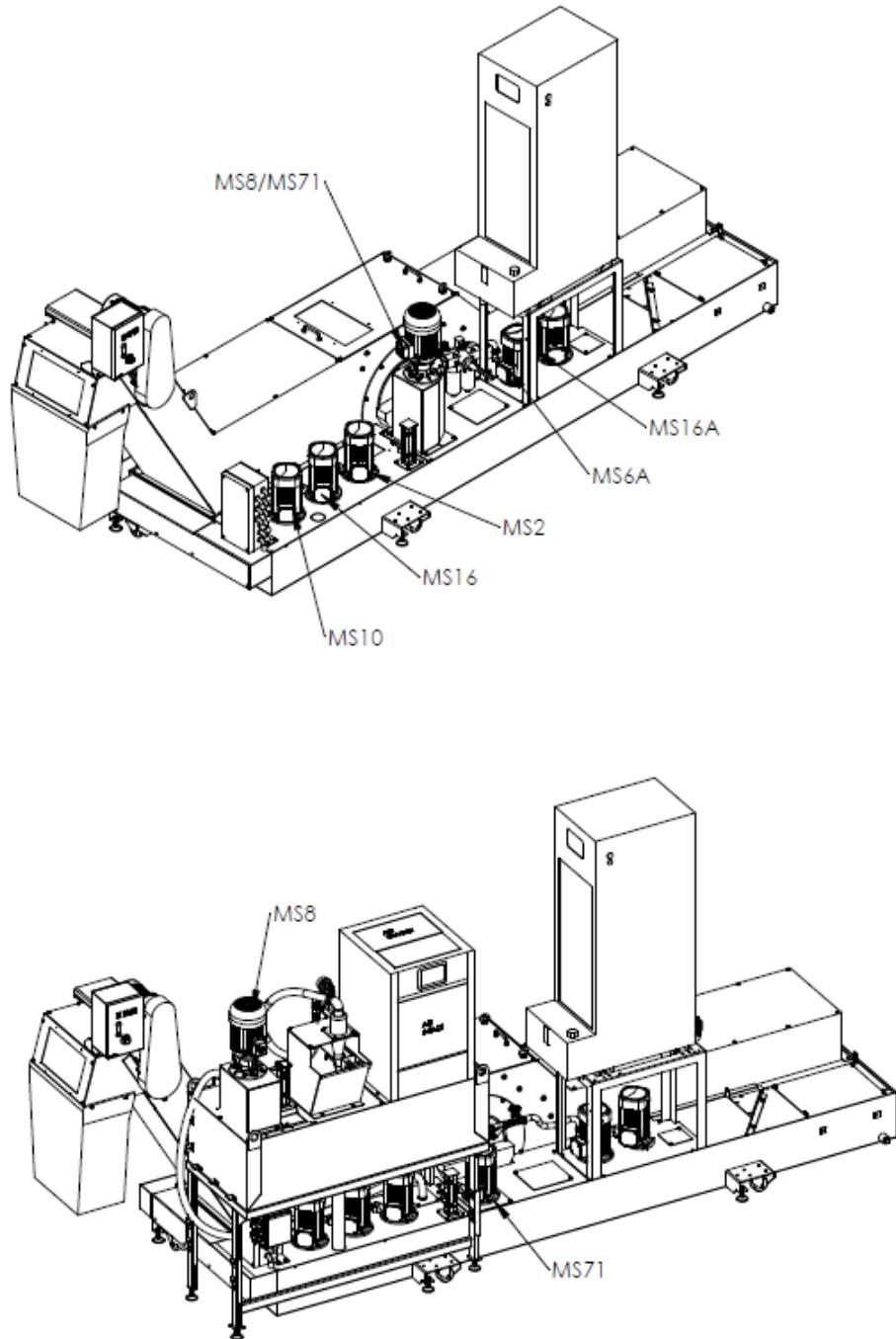


Figure 3.4 Coolant Tank Pump Layout & Specification

3.10 MS2, MS16A, MS16, MS6A, MS71 Pump Specification

Specification	Measurement
Input Voltage (3-Phase)	400 V (50Hz/60Hz)
Pump Motor Power	1.1 kW (50Hz/60Hz)
Rated Flow Rate	83.3 l/min
Maximum Pressure	1 MPa

3.11 MS8 Pump Specification (1.5 MPa)

Specification	Measurement
Input Voltage (3-Phase)	400 V (50Hz/60Hz)
Pump Motor Power	2.2 kW (50Hz/60Hz)
Rated Flow Rate	40 l/min
Maximum Pressure	1.7 MPa

3.12 MS8 Pump Specification (3.0 MPa)

Specification	Measurement
Input Voltage (3-Phase)	400 V (50Hz/60Hz)
Pump Motor Power	2.5 kW (50Hz/60Hz)
Rated Flow Rate	25 l/min
Maximum Pressure	3.0 MPa

3.13 MS8 Pump Specification (7.0 MPa)

Specification	Measurement
Input Voltage (3-Phase)	400 V (50Hz/60Hz)
Pump Motor Power	4.6 kW (50Hz/60Hz)
Rated Flow Rate	23 l/min
Maximum Pressure	7.0 MPa

Chapter 2 Specifications

3.14 Oil/Grease Specification

Specification	Description
Grease for both Ball-Screw & Linear Guide	Lube LHL-X100 Cartridge
Recommended Oil for Hydraulic Power Pack	Castrol HySpin AWS32, Mobile DTE24
Recommended Oil for Spindle Oil-Air Lubrication	Castrol HySpin AWS32, Mobile DTE24
Recommended Oil for ATC Cam Gear Box	Castrol ALPHA SP150
Recommended Oil for 10K/14K Spindle Cooling	Mobil Velocite No. 3

3.15 Drum Conveyor (Option) Specification

Specification	Measurement & Description
Manufacturer	AVEX-SG Technology Inc.
Electrical Power Supply (3-Phase)	380V - 415V (50Hz/60Hz)
Motor Power	0.18 kW (50Hz/60Hz)
Width of Steel Belt	414 mm
Speed	2 m/min
Chip Discharge Rate	3074 cm ³ /min for cast iron
Drum Filter Filament Size	178 micron mesh filter
Out Lined Cable Length	3.4 m

3.16 Pneumatic Supply Unit Specification

Specification	Measurement	Unit
Air Pressure	0.5 ± 0.05	MPa
Average Air Consumption (No Options)	60	l/min
Peak Air Consumption Rate (No Options)	400	
Minimum Inner Air Hose Diameter (Main Inlet Air Hose)	15~16	mm

-NOTE-

Air quality is equivalent to grade ISO 2.5.2 specified by ISO 8573-1/JIS 8392-1.

3.17 Spindle Hydraulic Unit Specification

Specification	Measurement & Description
Manufacturer	HAWE Hydraulik
Power Supply (3-Phase)	400 V (50Hz)/460 V (60Hz)
Motor Power	0.37 kW (50Hz)/0.44 kW (60Hz)
Working Oil Pressure for 8K/14K Spindle	8 MPa

3.18 Fixture Hydraulic Unit (Option) Specification

Specification	Description
Manufacturer	Hydac
Power Supply (3-Phase)	415 V (50Hz/60Hz)
Motor Power	2.2 kW (50Hz/60Hz)

3.19 Coolant Temperature Controller (14K) Specification

Specification	Description
Manufacturer	Harbor Precision Industry Co., Ltd
Input Voltage (AC, 3-Phase)	380 V (50Hz) to 415 V (60Hz)
Motor Power/Fan Power	0.75kw (50Hz), 0.75kW (60 Hz)
Ambient Temperature Conditions	5°C ~ 45°C
Oil Temperature Conditions	5°C ~ 45°C
Cooling Capacity	1700kW (50Hz), 2100 kW (60 Hz)
Detecting Accuracy	Change with ±2°C (stability condition)
	Ambient temperature tolerance fluctuation value within ±5°C

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3.20 Coolant Temperature Controller (10K - Option) Specification

Specification	Description
Manufacturer	Harbor Precision Industry Co., Ltd
Input Voltage (AC, 3-Phase)	380 V (50Hz) to 415 V (60Hz)
Motor Power/Fan Power	0.56kw (50Hz), 0.56kW (60 Hz)
Ambient Temperature Conditions	5°C ~ 45°C
Oil Temperature Conditions	5°C ~ 45°C
Cooling Capacity	3700kW (50Hz), 4400 kW (60 Hz)
	Change with ±2°C (stability condition)
Detecting Accuracy	Ambient temperature tolerance fluctuation value within ±5°C

3.21 Mist Collector (Option) Specification

Specification	Description
Manufacturer	Filtermist
Construction	Mild Steel & Powder Coated Grey RAL 7035
Power Supply (AC, 3-Phase)	380 ~ 480 V (50Hz/60Hz)
Motor Power	2.2 kW (50Hz/60Hz)
Flow Rate	2000m³/hr (50Hz)/2400m³/hr (60Hz)
Weight	34 kg
Noise	73 dba

3.22 Air Dryer (Option) Specification

Specification		Description
Manufacturer		SMC Corporation
Condenser		Plate fin tube type with forced air cooling
Refrigerant		HFC134a
Working Fluid		Compressed Air
Inlet Outlet		Rc1/2
Specification		Description
Electrical	Power Source (50Hz/60 Hz)	Single Phase AC 200 V (Voltage fluctuation ±10%)
	Power Consumption (NOTES: 2)	0.180 kW (50Hz)/0.202 kW (60Hz)
	Starting Current (NOTES: 2)	9A (50Hz)/8A (60Hz)
	Operating Current (NOTES: 2)	1.2A (50Hz)/1.3A (60Hz)
	GFCI	Rated Current 5A; Sensitive Current: 30mA
Rated Condition	Air Flow Rate (NOTES: 1)	50Hz: 0.75 m ³ /min (ANR)/60Hz: 0.82 m ³ /min (ANR)
	Operating Pressure	0.7 MPa
	Inlet Air Temperature	35°C
	Ambient Temperature	32°C
	Pressurized Dew Point	10°C
Operating Range	Inlet Air Temperature	5°C to 50°C
	Minimum Inlet Pressure	0.15 MPa
	Maximum Inlet Pressure	1.0 MPa
	Ambient Temperature	2°C to 40°C (Relative Humidity of 85% or less)
Refrigerant Charge		200 g ±5 g
Drain Connection		10 mm
Weight		26 kg
Applicable Compressor Standard		5.5 kW

-NOTES-

- 1 The data for m³/min (ANR) is referring to the conditions of 20°C, 1atm. pressure & relative humidity of 65%.
- 2 The value indicated is as per the specified condition in brackets.

3.23 Operating Conditions

Confirm the following operating conditions location and environmental conditions prior to machine operations.

Operating Location & Environment Conditions	
Ambient Temperature	5°C to 40°C (Optimum Temperature: 20 ±1°C)
Relative Humidity	35% to 70% (No Condensation)
Temperature Fluctuation	1°C or less/30 minutes (Range within does not influence machining)
Free from direct sunlight	
Appropriate distance from factory air ducting/inlets (Air Flow)	

4 Introduction to Electrical Control Functions

The components were functionally grouped into the following categories:

4.1 CNC Unit

The term CNC unit mentioned in this manual refers to the Fanuc Controller FS0i-MF+ series.

Servo Amplifier Module (SVM) and Power Supply Module (PSM)

The axis AC servomotors are driven by the FANUC Alpha Series Servo Amplifier Module (or SVM). The built-in type spindle motor is driven by a Spindle Amplifier Module (or SPM) with a serial interface to the CPU. A central Power Supply Module (PSM) supplies the power to the SVM and SPM.

4.2 Motors

These include axis AC servomotors, spindle motor, ATC magazine motor, coolant pump motors, etc.

4.3 Peripherals

The supporting components include:

Device	Function
Spindle Cooler	Cools the Spindle Unit.
Machine Light	LED light provides work area illumination.
Nozzle Coolant	Liquid coolant system for the machining process.
Air Blow	An air blow coolant system for the machining process.
ATC	Automatic Tool Changer.
Signal Light	Signals machine status (running, machining finished, operator attention and machine in alarm state).
Rotary Work Head Table (Option)	Provides an additional indexing axis on the machine table.
Through Spindle Coolant (Option)	Liquid coolant introduced into the machining process through the tool.
Coolant Flush	Flushes the chips off the machining chamber area.
Drum Conveyor (Option)	An efficient chip disposal system.
Hydraulic Fixture (Option)	Provides hydraulic fixture clamping for the workpiece.
Air Seat Check (Option)	For checking the proper seating/position of the workpiece.
Broken Tool Sensor - BTS (Option)	For detecting a broken tool.
Linear Scales (Option)	Improve position accuracy.

Many other options are possible depending on the machining equipment.

4.4 Sensors & Solenoid Valves

Sensors are of different kind with plunging type, pressure switch, flow switch, gap switch etc. Solenoid valves are used for activating control valves as well as hydraulic type.

Limit Switches

LS No.	Description	Location
LS1319	Coolant Tank Empty Detect	Coolant: Tank
LS1340	Through Spindle Union Abnormal Detection	Coolant: TSC
LS170	Spindle Lubrication Oil Flow Switch	Spindle Cooling Oil Temperature Controller
LS905	Air Pressure Switch	MTL
L151	Additional 1st Axis Clamp	4/5 Axis
L152	Additional 1st Axis Unclamp	4/5 Axis
L154	Additional 2nd Axis Clamp	4/5 Axis
L155	Additional 2nd Axis Unclamp	4/5 Axis
LS00	Tool Clamp	Spindle Head
LS01	Tool Unclamp	Spindle Head
LS137-2	Auto Front Door Close	Spindle Head
LS138-2	Auto Front Door Open	Spindle Head
LS1698	Auto Grease Injector Pressure Up	Auto Grease
LS1781	Air Seat Sensor 1	Air Seat Panel
LS1782	Air Seat Sensor 2	Air Seat Panel
LS1783	Air Seat Sensor 3	Air Seat Panel
LS1784	Air Seat Sensor 4	Air Seat Panel
LS1785	Air Seat Sensor 5	Air Seat Panel
LS1786	Air Seat Sensor 6	Air Seat Panel
LS1787	Air Seat Sensor 7	Air Seat Panel
LS1788	Air Seat Sensor 8	Air Seat Panel
LS184	Secondary Tank Empty Detect	Coolant: 2nd Tank
LS190	Secondary Filter Tank Clogged	Coolant: 2nd Tank
LS191	Secondary Filter Tank Upper Float	Coolant: 2nd Tank
LS192	Secondary Filter Tank Lower Float	Coolant: 2nd Tank
LS193	TSC Flow Switch	Coolant: TSC
LS2064	Auto Grease Supply Unit Level Switch	Auto Grease

Chapter 2 Specifications

LS No.	Description	Location
LS2340	Rotary Axis Chiller Unit Flow Switch	4/5 Axis
LS2603	Hydraulic Oil Level Float Switch	Hydraulic Unit
LS2604	Hydraulic Oil Temperature Sensor	Hydraulic Unit
LS601	Spindle Tool Seating	Spindle
LS602	Spindle Tool Confirm Sensor	Spindle
LS912	Operator Door Interlock LS	Splash Guard
LS968	Hydraulic Unit Pressure Switch (High)	Hydraulic Unit
LS969	Hydraulic Unit Pressure Switch (Low)	Hydraulic Unit
*OT2X	Over Travel X	X-Axis
*OT2Y	Over Travel Y	Y-Axis
*OT2Z	Over Travel Z	Z-Axis
PS2601	Hydraulic Pressure Switch 1	Hydraulic Fixture
PS2602	Hydraulic Pressure Switch 2	Hydraulic Fixture
PS2603	Hydraulic Pressure Switch 3	Hydraulic Fixture
PS2604	Hydraulic Pressure Switch 4	Hydraulic Fixture
PS2605	Hydraulic Pressure Switch 5	Hydraulic Fixture
PS2606	Hydraulic Pressure Switch 6	Hydraulic Fixture
PS2607	Hydraulic Pressure Switch 7	Hydraulic Fixture
PS2608	Hydraulic Pressure Switch 8	Hydraulic Fixture
PS2701	Hydraulic Pressure Switch 101	Hydraulic Fixture
PS2702	Hydraulic Pressure Switch 102	Hydraulic Fixture
PS2703	Hydraulic Pressure Switch 103	Hydraulic Fixture
PS2704	Hydraulic Pressure Switch 104	Hydraulic Fixture
PS2705	Hydraulic Pressure Switch 105	Hydraulic Fixture
PS2706	Hydraulic Pressure Switch 106	Hydraulic Fixture
PS2707	Hydraulic Pressure Switch 107	Hydraulic Fixture
PS2708	Hydraulic Pressure Switch 108	Hydraulic Fixture
LS1639	Tool Clamp / Unclamp Power Pack Oil Level (Low)	Spindle Power Pack
LS1306	Drum Conveyor Slip	Drum Conveyor
SYSPS	Hydraulic Fixture Power Pack System Pressure	Fixture Power Pack

Chapter 2 Specifications

Solenoid Valves

SL No.	Description	Location
SL01A	Spindle Tool Clamp Solenoid	Pneumatic Panel
SL01B	Spindle Tool Unclamp Solenoid	Pneumatic Panel
SL09	Taper Cleaning Air 1	MTL
SL130	Robot Door Close	Splash Guard
SL131	Robot Door Open	Splash Guard
SL132A-1	Auto Front Door Close	Splash Guard
SL132B-1	Auto Front Door Open	Splash Guard
SL150	4th Axis Unclamp	4/5 Axis
SL151	5th Axis Unclamp	4/5 Axis
SL912	Front Door Unlock	Splash Guard
SL1781	Air Seat Check Solenoid 1	Air Seat Panel
SL1782	Air Seat Check Solenoid 2	Air Seat Panel
SL1783	Air Seat Check Solenoid 3	Air Seat Panel
SL1784	Air Seat Check Solenoid 4	Air Seat Panel
SL1801	Fix. Coolant Solenoid 1	MTL
SL1802	Fix. Coolant Solenoid 2	MTL
SL181	Air Blow	Hydraulic Panel
SL192	Through Spindle Air	Coolant: TSA
SL2601	Hydraulic Solenoid 1	Hydraulic Fixture
SL2602	Hydraulic Solenoid 2	Hydraulic Fixture
SL2603	Hydraulic Solenoid 3	Hydraulic Fixture
SL2604	Hydraulic Solenoid 4	Hydraulic Fixture
SL2605	Hydraulic Solenoid 5	Hydraulic Fixture
SL2606	Hydraulic Solenoid 6	Hydraulic Fixture
SL2607	Hydraulic Solenoid 7	Hydraulic Fixture
SL2608	Hydraulic Solenoid 8	Hydraulic Fixture
SL2701	Hydraulic Solenoid 101	Hydraulic Fixture
SL2702	Hydraulic Solenoid 102	Hydraulic Fixture
SL2703	Hydraulic Solenoid 103	Hydraulic Fixture
SL2704	Hydraulic Solenoid 104	Hydraulic Fixture
SL2705	Hydraulic Solenoid 105	Hydraulic Fixture
SL2706	Hydraulic Solenoid 106	Hydraulic Fixture
SL2707	Hydraulic Solenoid 107	Hydraulic Fixture
SL2708	Hydraulic Solenoid 108	Hydraulic Fixture

Chapter 2 Specifications

SL No.	Description	Location
SL301	Tool Length Measuring Sensor Cleaning Air	Pneumatic Panel
SL302	Tool Cleaning Air	Pneumatic Panel
SL303	Purge Air	Pneumatic Panel
SL304	Laser Shutter Open	Pneumatic Panel
SL905	Master Solenoid (Main Pneumatic)	MTL
DEC1	1st Axis Ref. Rtn Decel	X-Axis
DEC2	2nd Axis Ref. Rtn Decel	Y-Axis
DEC3	3rd Axis Ref. Rtn Decel	Z-Axis
DEC4	4th Axis Ref. Rtn Decel	ATC Magazine Axis
DEC5	5th Axis Ref. Rtn Decel	A-Axis
DEC6	6th Axis Ref. Rtn Decel	B-Axis

5 CNC Unit

The CNC control system used in the machine is FS0i-MF+ series and is mounted on the main operator panel. The following components and printed circuit boards are associated with the CNC system.

5.1 DI/DO Boards

The digital inputs and digital outputs for the machine control are performed through these boards. The number of digital inputs and outputs depend on the machine configuration and options available.

These I/O modules are mounted on the main chassis inside the MTC and operator panel and handles all the I/O's from the machine.

5.2 Main CPU Boards

The “brain” of the control system is the main CPU board. It has multiple modules on the printed circuit board, which perform various functions including:

- CNC operation command control
- CNC program data and machine parameter storing
- RS-232 serial communication
- Manual Pulse Generator (MPG) control
- LCD display control (non-graphic)
- Execution of Programmable Machine Controller (PMC) program
- Servo control for axis 1 to 4
- Spindle control with serial interface
- The program data and machine parameter were stored in the main CPU board’s static RAM area, which requires battery back up, under power off condition.

5.3 LCD Display Unit

A 10.4 inch LCD screen unit is used for Professional *u* controls as a standard feature.

5.4 Manual Data Input

The MDI unit is a half key type keypad for data entry and screen selection.

5.5 Function Keys & Rotary Switches

The function keys and rotary switches are used to control the machine operation consisting of push buttons with illumination, keyed switches and rotary switches.

6 Electric Specification

10K Spindle Motor		Specification
Model		400V, βi I 160LL/13000-B
Manufacturer		Fanuc
Manufacturer's Part Number		A06B-2726-B130#2231

14K Spindle Motor		Specification
Model		400V, βi I 112L/15000-B
Manufacturer		Fanuc
Manufacturer's Part Number		A06B-2675-B131#7231

Control & Control Cabinet		Specification
Maximum Power Consumption		35 kW
Input Voltage To The Control Cabinet		3-Phase, 50Hz/60Hz, 380V ~ 415V
No-Fuse-Breaker Rating At Incoming		100 A

X,Y, Z-Axis AC Servomotor		Specification
X-Axis Motor Type		ais 30/4000HV-D
Y-Axis Motor Type		ais 30/4000HV-D
Z-Axis Motor Type		ais 22/4000HV-D, WITH BRAKE
X-Axis Motor Rated Power		5.5 kW
Y-Axis Motor Rated Power		5.5 kW
Z-Axis Motor Rated Power		4.3 kW
X-Axis Motor Rated Torque		30 Nm
Y-Axis Motor Rated Torque		30 Nm
Z-Axis Motor Rated Torque		22 Nm
Manufacturer for X, Y, Z-Axis Motor		Fanuc
Manufacturer's Part Number for X-Axis Motor		A06B-3145-B100
Manufacturer's Part Number for Y-Axis Motor		A06B-3145-B100
Manufacturer's Part Number for Z-Axis Motor		A06B-3135-B400
Type of Pulse Code for All Axis Motors		Fanuc βi A1000 (Serial Type)
Resolution of Pulse Coder		1 Million Pulse/Revolution

Chapter 2 Specifications

ATC Axis AC Servomotors	Specification
ATC Axis Motor Type	ais 2/5000HV-D
ATC Axis Motor Rated Power	0.75 kW
ATC Axis Motor Rated Torque	2 Nm
Manufacturer for ATC Axis Motor	Fanuc
Manufacturer's Part Number for ATC Axis Motor	A06B-3055-B200
X, Y, Z-Axis AC Servomotor Amplifiers	Specification
X, Y Axis Motor Amplifier Type	αiSV 80/80 HV-D
Z-Axis Motor Amplifier Type	αiSV 80 HV-D
Manufacturer for X, Y, Z-Axis Motor Amplifier	Fanuc
Manufacturer's Part Number for X, Y-Axis Motor Amplifier	A06B-6590-H245
Manufacturer's Part Number for Z-Axis Motor Amplifier	A06B-6590-H145
Rated Output Current (rms)	22.5 A/22.5A/22.5 A
Maximum Current for Each Axis (peak)	80A/80A/80A
ATC Axis Servo Amplifier	Specification
ATC Motor Amplifier Type	αiSV 10 HV-D
Manufacturer for ATC Motor Amplifier	Fanuc
Manufacturer's Part Number for ATC Motor Amplifier	A06B-6290-H122
Rated Output Current (rms)	3.2 A
Maximum Current of the Amplifier (peak)	10 A

7 CNC Control Specification

The table below shows the CNC control specification of the machine. The following symbols are used:

- Standard Item
- Optional Item - Option enabled, but additional hardware required. Possible to be retrofitted when the machine is out of factory.
- Optional Item - Possible to be retrofitted when the machine is out of the factory.

The actual configuration of your machine maybe different from what has listed since your machine maybe equipped with additional option or the configuration of the machine for your market was different. Please confirm with your distributor the functions/features available for your machine.

Specification Item	G-code	Opt	Specification
Controller/Axes			
Controller	-	■	CNC FS0i-MF+ series Makino Professional <i>U</i>
3 Simultaneously Controllable Axes	-	■	-
4 Simultaneously Controllable Axes	-	○	-
4 + 1 Controllable Axes (4 Simultaneous)	-	○	-
Input Command			
Programming Unit	mm	■	0.0001
Automatic Recognition of EIA/ISO Tape Code	-	■	-
Maximum Programmable Dimension	-	■	+/- 99999.9999
Decimal Point/Calculator Type Decimal Programming	-	■	-
Least Input Increment	-	■	0.1μ (m) / 0.01μ (inch)
Absolute/Incremental Programming	G90, G91	■	-
Programming Plane Selection	G17, G18, G19	■	-
Inch/Metric Conversion	G20, G21	■	-
Interpolation			
Positioning	G00	■	-
Linear Interpolation	G01	■	-
Circular Interpolation	G02, G03	■	-
Cylindrical Interpolation (Require Rotary Table)	G07.1	■	-
Helical Interpolation	G02, G03	■	-

Chapter 2 Specifications

Specification Item	G-code	Opt	Specification
Feed			
F 1-digit code feed (F1~F9)	-	■	-
Dwell (per second)	G04	■	-
Feed Rate Override Cancel	M48/M49	■	-
Inverse Time Feed	-	■	-
AI Contour Control II (AICC II)	-	○	-
Part program storage & editing			
Part Program Storage Memory - 1280m (512KB)	-	■	-
Part program storage memory - 5120m (2048KB)	-	○	-
Number of Registrable Program - 400	-	■	-
Number of Registrable Program - 1000	-	○	-
Background Editing	-	■	-
Extended Part Program Editing	-	■	-
I/O device & function			
Data Input/Output Interface - Channel 1 (RS-232C)	-	●	Punch panel is required
DNC Operation	-	■	-
Fast Ethernet Functions	-	○	-
Data server 1GB	-	○	-
Data server 2GB	-	○	-
Data server 4GB	-	○	-
Tool compensation			
Tool Length Compensation	G43, G44/G49	■	-
Tool Offset Pairs - 400	-	■	-
Tool Offset Memory C (Geometry/Wear, Cutter/Tool Length)	-	■	-
Tool Offset	-	■	-
Cutter Compensation C	G41, G42/G40	■	-

Specification Item	G-code	Opt	Specification
Coordinate System			
Reference Position Return	G28	■	-
2nd Reference Position Return	G27	■	-
3rd/4th Reference Position Return	G30	■	-
Machine Coordinate System Selection	G30 P3/G30 P4	■	-
Machine Coordinate System Selection	G53	■	-
Workpiece Coordinate System Selection	G54~G59	■	-
Workpiece Coordinate System Preset	G92.1	■	-
Addition of Workpiece Coordinate System - 48pairs	G54.1(P1~P4)	■	-
Automatic Return from Reference Position	G29	■	-
Local Coordinates Setting	G52	■	-
Work Coordinate System Setting	G92	■	-
Polar Coordinate Command	-	■	-

Chapter 2 Specifications

Specification Item	G-code	Opt	Specification
Operation Support Function			
Additional Block Skip - 9 blocks	-	■	-
Manual Absolute On and Off	-	■	-
Auxiliary Function Lock	-	■	-
Run-hour and Part Count Display	-	■	-
Tool Length Measurement	-	■	-
Mirror Image for X-axis and Y-axis	M21, M22/M23	■	-
Optional Stop	M01	■	-
Program Stop	M00	■	-
Z-axis Feed Neglect	-	■	-
Program Restart	-	■	-
10.4 inch LCD screen	-	■	-
Dry Run	-	■	-
Single Block	-	■	-
Manual Handle Interruption	-	■	-
Manual Pulse Generator on Operator Panel	-	■	-
Skip	G31	■	-
High-speed Skip	-	■	Connection cable is required
Sequence Number Comparison and Stop	-	■	-
Manual Intervention and Return	-	■	-
Multi-language display - English	-	■	-
Multi-language display - German	-	■	-
Multi-language display - French	-	■	-
Multi-language display - Portuguese	-	■	-
Multi-language display - Chinese	-	■	-
Multi-language display - Italian	-	■	-
Multi-language display - Spanish	-	■	-
Multi-language display - Czech	-	■	-
Multi-language display - Polish	-	■	-
Multi-language display - Japanese	-	■	-
Multi-language display - Korea	-	■	-

Specification Item	G-code	Opt	Specification
Program Support Function			
Normal Direction Control	G41.1, G42.1/G40.1	■	-
Programmable Data Input (Offset, Parameter)	G10	■	-
Custom Macro	-	■	-
Custom Macro Common Variables #100~#199	-	■	-
Addition of Custom Macro Common Variables #500~#999	-	■	-
Interruption Type Custom Macro	-	■	-
Small-hole Peck Drilling Cycle	-	■	-
Canned Cycle for Drilling	-	■	-
Scaling	G51/G50	■	-
Coordinate System Rotation	G68, G69	■	-
Programmable Mirror Image	G51.1/G50.1	■	-
Rigid Tapping	G84.2, G84.3, M135	■	-
Rigid Tapping Retract	-	■	-
Playback	-	■	-
Tapping Mode	G63	■	-
Chamfering Corner R	-	■	-
Cutting Mode	G64	■	-
Exact Stop Mode	G61	■	-
Exact Stop	G09	■	-
Automatic Corner Override	-	■	-
Accuracy compensation			
Stored Pitch Error Compensation	-	■	-
Backlash Compensation	-	■	-
Single Direction Positioning	-	■	-
Safety Maintenance & Other Functions			
Auto Power Out	-	■	-
Interlock	-	■	-
Self-diagnosis Function	-	■	-
Alarm History Display	-	■	-
Emergency Stop	-	■	-
Stored Stroke Check 1	-	■	-
Stored Stroke Check 2,3	-	■	-
ATC & APC Recovery	-	■	-

1 Confirmation of Preparations for Installation

Perform the following preparations to ensure that all installation conditions are satisfied prior to machine installation. For details, refer to the respective section in this chapter.

- Preparations for Installation Space (Refer to [2 Preparation of Installation Space](#))^[68]
- Preparation of Transport Route and Installation Equipment (Refer to [3 Preparation of Transport Route & Installation Equipment](#))^[68]
- Confirmation of Set-Up Conditions (Refer to [4 Set-Up Conditions](#))^[70]
- Preparation of Foundation (Refer to [5 Recommended Foundation Conditions](#))^[71]
- Preparation of Electric Source (Refer to [6 Air & Power Sources](#))^[73]
- Preparation of Air Source (Refer to [6 Air & Power Sources](#))^[73]
- Preparation of Required Manpower for Installation (Refer to [7 Required Manpower for Installation](#))^[74]
- Safety Precautions and Other Confirmation (Refer to [8 Checks/Precautions When Performing Transportation/Installation Work](#))^[75]

Table 1.1 Check List for Installation Preparation

Check	Item
	Preparation of Installation Space
	Preparation of Transport Route
	Confirmation of Set-Up Conditions
	Preparation of Foundation
	Preparation of Electric Source
	Preparation of Air Source
	Preparation of Transport Equipment

2 Preparation of Installation Space

Refer to the figures showing the general view and layout drawing for the respective machine specifications to confirm the space requirements and prepare the required installation space.

Note the following:

- The maintenance area is the maintenance space required after installation.
- The maintenance area varies depending on the machine specifications.

Refer to Installation Manual Chapter 2 Preparation & Installation for the figures showing the general view and layout drawings.

3 Preparation of Transport Route & Installation Equipment

Refer to Installation Manual Chapter 2 Preparation & Installation for sizes of other devices.

Prepare equipment such as the crane, forklift, skates, capable of supporting the size and withstanding the weight on the machine prior to machine transport.

When transport equipment is required, contact Makino service representative for further assistance.

Table 3.1 Required Equipment

Parts/Tools to Be Prepared
Transfer Equipment: Crane, Forklift, Lifting Apparatus
Necessary Tools: Tools supplied standard with the machine
Measurement Tools: Precision Level, Dial Indicator

Table 3.2 PS155 (SPD-14K) Individual Machine Component Weight

Machine Model	Machine Overall Weight
Standard Machine	12,000 kg (Approximately)
High Column Machine	13,500 kg (Approximately)

Chapter 3 Preparations for Installation

Table 3.3 PS155 (SPD-10K Option) Individual Machine Component Weight

Machine Model	Machine Overall Weight
Standard Machine	12,500 kg (Approximately)
High Column Machine	14,000 kg (Approximately)

Table 3.4 Individual Option Component Weight

Machine Model	Machine Overall Weight
Coolant Tank with Chip Tray and 1.5MPa TSC	520 kg (Approximately)
Coolant Tank with Drum Conveyor (Option) and 1.5MPa TSC	995 kg (Approximately)
Secondary Coolant Tank and 1.5/3/7MPa TSC	290 kg (Approximately)
Coolant Temperature Controller (Option)	100 kg (Approximately)
Air Dryer (Option)	30 kg (Approximately)

4 Set-Up Conditions

Confirm the following set-up location and environmental conditions prior to machine set-up.

Table 4.1 Set-Up Conditions

Set-Up Location & Environment Conditions	
Ambient Temperature	5°C to 40°C (Optimum Temperature: 20 ±1°C)
Relative Humidity	35% to 70% (No Condensation)
Temperature Fluctuation	1°C or less/30 minutes (Range within does not influence machining)
Well-illuminated	
Free from direct sunlight	
Dust-free	
Available space for storing raw materials, finished workpiece and tools	
Available space for maintenance work	
Adequate space around machine to open doors completely	
Required electrical power sources	
A level foundation strong enough to support the weight of the machine	
Appropriate distance from factory air ducting/inlets (Air Flow)	

5 Recommended Foundation Conditions

Construct an appropriate foundation, by referring to the tables and figures in this session.

Table 5.1 PS155 Recommended Foundation Conditions

Items	Description
Foundation Thickness (Standard/High column)	350 mm
Allowable Soil Bearing Captivity (Standard/High column)	49 KPA (5 tonne/m ²)
Concrete (Standard/High column)	FC250 or more
Machine Support Point (Standard/High column)	6 points
Vertical & Horizontal Reinforcing Steel (Standard/High column)	More than Ø16 mm
Rubbles (Standard/High column)	Medium or large size crushed stones
Leveling Concrete Thickness (Standard/High column)	50 mm
Concrete Weight (Standard/High column)	5.3 tonne (Specify Gravity: 2.3g/cm ³)
Approximate Machine Weight on the Foundation (Standard Machine)	12 tonne (Standard Machine) / 13.5 tonne (SPD-10K Option)
Approximate Machine Weight on the Foundation (High column)	12.5 tonne (Standard Machine) / 14 tonne (SPD-10K Option)
Maximum allowable floor vibration	RMS 0.01G

Chapter 3 Preparations for Installation

-NOTES-

- 1 The above conditions are reference/recommended values.
 - 2 Dimensions indicated in the following foundation drawing are the minimum requirements for a good solid installation foundation. The foundation drawings shown are only recommended values.
 - 3 During machine operations vibration are generated, which may affect the surrounding area depending upon the foundation and ground conditions. Consult a professional civil engineer to determine the final foundation dimension requirements as they vary according to actual ground conditions and possible influence on the surrounding area.

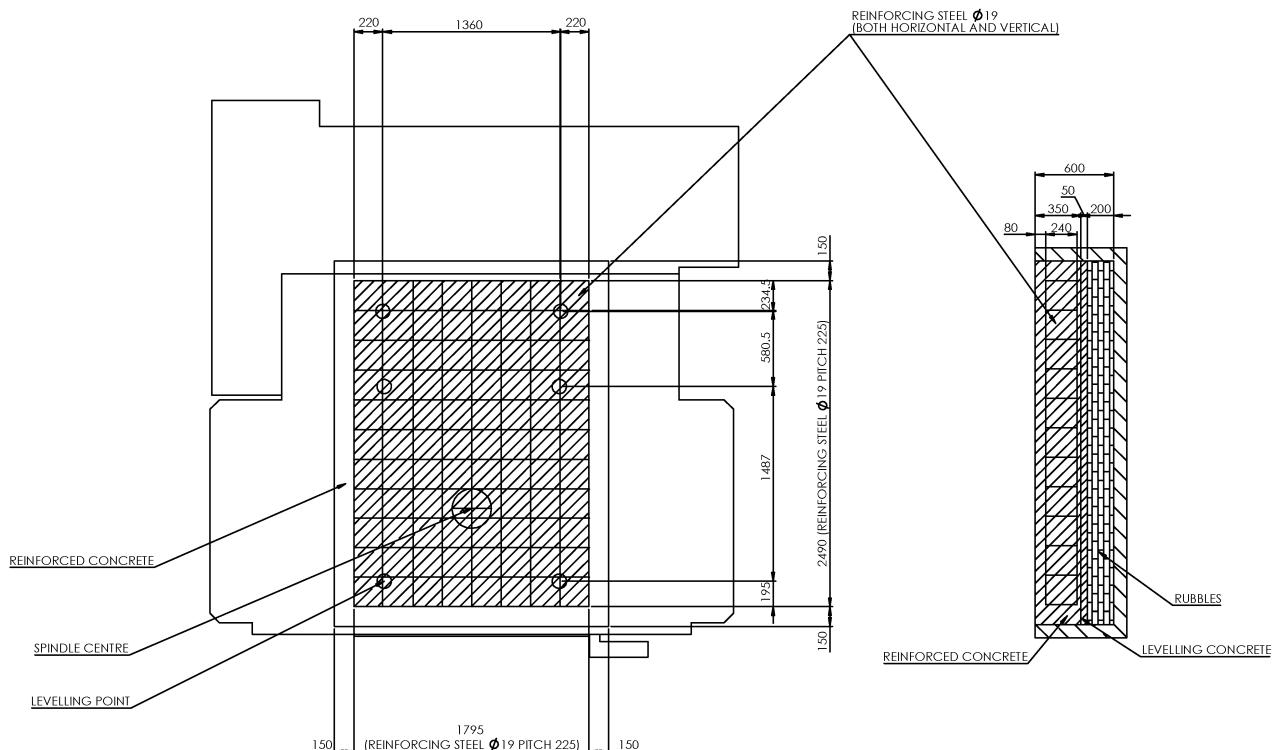


Figure 5.1 Recommended Foundation Condition

6 Air & Power Source

Table 6.1 Air & Power Sources

Item	Description
Voltage of Incoming Power to Machine Control Cabinet	380V~415V, 3-Phase, 50Hz/60Hz
Main Electrical Power Capacity	Installation: 50 kVA
Main Power Transformer Capacity	50 kVA
Circuit Breaker	100 A
Main Electrical Power Cable Size	16 mm ² with 415V input
Main Power Connection Terminal For R, S, T	M8
Main Power Connection Terminal For Earth	M8
Air Source	Pressure: 0.5 ± 0.05 Mpa Dew point temperature: -20°C or less Recommended Air Quality: Equivalent to grade ISO 2.5.2 Specified by ISO 8573-1/JIS 8392-1 Maximum particles number/1m ³ : 100 or less(diameter: $0.001 < x \leq 0.005$ mm) Maximum particles number/1m ³ : 6,000 or less(diameter: $0.0005 < x \leq 0.001$ mm) Maximum particles number/1m ³ : 400,000 or less(diameter: $0.0001 < x \leq 0.0005$ mm) Dew point at maximum pressure: +7°C or less(Absolute Pressure: 0.8 MPa) Max. oil concentration: 0.1 mg/m ³ or less The machine requires the above air quality. The air filters are installed as a standard feature. Periodic maintenance must be performed to maintain an optimum air supply. However, when maintenance of the filters is neglected, filter pollution and damage to the filter may occur in a short period of time.
Rate of Air Supply (Maximum / Average)	400/130 L/min for Std (No option) 600/220 L/min for Std + TSC + Feedback Scale
Air Source Connection	PT 3/8"
Minimum Air Hose Inner Ø	15 mm
Air Dryer	200 V
Air Filter	$5 \mu\text{m} \pm 0.01 \mu\text{m}$

-NOTE-

The air quality varies according to the factory circumstances. Use a particle counter to confirm that the air quality values satisfy the required values.

7 Required Manpower for Installation

The following table shows the minimum required manpower, time and the number of days for installation. Prepare/reserve manpower necessary for the installation by referring to the [Table 7.1](#) ⁷⁴.

This work schedule may change for different installation environments and machine options.

Table 7.1 Manpower for Installation

Work Item	Required Manpower	Time Needed Per Person	Day Required Per Person
Installation of Machine	1	5 Hours	1 Day
Coolant Tank	1	1 Hours	
Drum Conveyor (Option)	1	1 Hours	
Operation Checks After Installation	1	1 Hours	

Conditions for the above data:

- 1) Machine is already placed properly on the leveling pads at the installation site.
- 2) Customer is ready with the necessary pre-installation activity such as stabilizer, transformer, electrical connections, air connections etc.
- 3) Operator & Maintenance Training activity is separate (4 hours) and not included in the above chart.

8 Checks/Precautions When Performing Transportation/Installation Work



- Some installation procedures can only be performed by moving the machine.
- Except for some work which must be performed with the power turned off, make sure to stop the machine and turn off the control power and main power source before performing work.
- Make sure to place a warning tag on each operation panel, main power switch and other locations when performing work to ensure that other personnel do not turn On the power inadvertently which could result in the machine being operated. (Refer to [Chap. 1 Safety 1.6 Implementing Lock-out and Tag-out](#)^[7]).

The previous Chapter 1 describes the safety precautions for machine operation, maintenance and inspection in general. Read that chapter thoroughly prior to installation.

This section specifically describes safety precautions for installation as well as what needs to be checked when performing installation. Read and understand this section and Chapter 1 thoroughly and observe the safety precautions to ensure safety.

8.1 Inspection Prior to Installation

Confirm the following points prior to installation work:

- Inspect for any machine damage.
- Check all attachments and accessory units with the shipping and packaging check list.

8.2 Handling of Heavy Components

A. Unassisted Lifting

Avoid the lifting of heavy machine components by one person alone. Lift them with the help of two or more people according to the circumstances. Use mechanical equipment such as a crane, electrical forklift stacker, pallet trolley, or cart chain block depending on the requirements.

B. Lifting with a Crane

The breakage of wire rope during the lifting of heavy components can result in the balance of heavy components being lost, and them falling. The falling of heavy components may cause irreparable damage to the components and may result in injury or death. Pay careful attention to the following points:

- Forklift must always be operated by qualified personnel only.
- Do not attempt to go under the lifted machine. Exercise extreme caution for the lifted machine while it is being transferred.
- Safety helmet and safety shoes must be worn at all times.
- All hook and linking tasks required for crane lifting must only be performed by qualified personnel only.
- Use the crane within the range of its rated capacity.

Chapter 3 Preparations for Installation

- Use specialized tools where prescribed.
- Confirm the weight of the component to be lifted. Then, considering the presumed position of the center gravity, attach wires guaranteed to carry the weight of the component and lift slowly, keeping the weight as stable as possible.
- Clearly indicate off-limit zones and keep all unauthorized personnel from entering these areas.

C. Forklift Lifting

When using a forklift to carry heavy components, there is a danger of the load falling from the forks or overturning the forklift. Pay careful attention to the following points:

- Safety helmets and safety shoes must be worn at all times.
- Forklift must always be operated by qualified personnel only.
- Use the forklift within the range of its rated capacity.
- Widen the forks as much as possible to allow the weight to be raised as stable at a convenient height.
- Do not attempt to balance an un-balanced load with extra personnel riding on the opposite side of the forklift.

8.3 Working at Elevated Locations

Falling from high places can result in serious injury. Pay extra attention to the following points:

- Safety helmets and safety shoes must be worn at all times.
- Use stable steps or a stepladder. Do not stand on a pail, cans or boxes stacked one on top of the other.
- Extreme care should be taken to avoid slipping from oily surfaces, etc. Ensure that you are in a stable position while using both hands to perform a task.
- Use a safety rope when performing tasks on top of the splash guard.

8.4 Working in Confined Spaces

When working in lower confined spaces, take care to avoid striking your head, shoulders or arms or catching clothing on protruding machine parts. Proper work attire, safety helmet and safety shoes must be worn at all times.

8.5 Working in a Group

When working in a group, lack of communication when turning On the main power or operating the machine may result in death due to accidents such as electric shock, falling or being caught between moving parts. Pay careful attention to the following points:

- Confirm the location and tasks being performed by other personnel and give a clearly audible warning when starting to operate the machine.
- Clearly display work description warnings and signs in front of the crane operational panel, the main power switch and the main operation panel etc. so that the content of work can be understood.

1 Main Operation Panel Screen

The main operation panel is used to perform the basic machine operations and consists of switches and lamps. Standard specifications and CE specifications have minor differences.

The primary functions include the following:

- Manual operations
- NC program related operations
- Spindle, coolant supply and other frequently used machine related operations
- Operations in event of error or malfunction

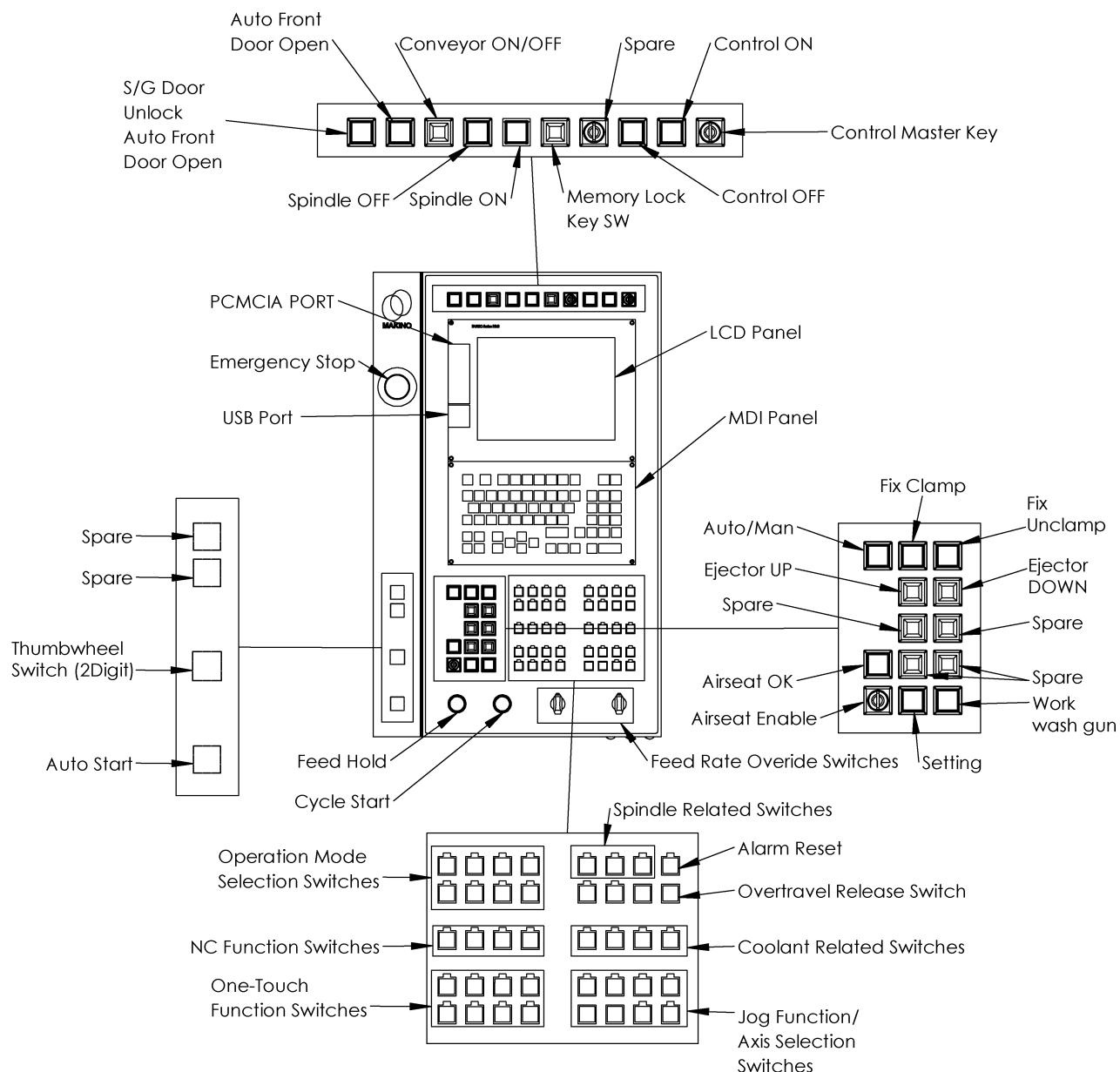


Figure 1.1 Main Operation Panel

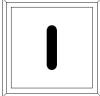
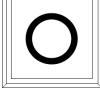
Chapter 4 Operation

Switches/Pilot LED	Functions of Individual Switches/Pilot LED
Control Power (On/Off)	Refer to 2.1 NC Program Related Operation Switches [79]
NC Program Start/Stop	
Operation Mode Selection	Refer to 2.2 Main Mode Setting Switches [80]
NC Function	Refer to 2.3 NC Function Switches [82]
One-Touch Function	Refer to 2.4 One-Touch Function Switches [83]
Coolant Related Function	Refer to 2.5 Coolant Related Switches [84]
Spindle Start/Stop	
Spindle Override	Refer to 2.6 Spindle Related Operation Switches [85]
Emergency Stop	
Alarm Reset	
Mode Unlock	
Memory Unlock	Refer to 2.7 Malfunction/Accident Prevention Switch/Key Switches [86]
Over Travel Release	
Door Interlock Release	
Axis Selection	Refer to 2.7.1 Manual Axis Feed Switches [88]
Feed Rate/Override Switches	Refer to 2.7.2 Feed Rate/Override Switches [89]
Manual Data Input (MDI) Panel	Refer to 2.8 MDI Panel [90]
LCD Panel	Refer to 4 Screens [93]

2 Switches on Main Operation Panel

2.1 NC Program Related Operation Switches

A. Control Power On/Off

No.	Name	Symbol	Description
1	[POWER ON] Switch		<p>Press this switch to turn on the control power. When the control power is on, the lamp built into the button is illuminated. When the [POWER OFF] switch is pressed, the [POWER ON] switch lamp is extinguished after a certain amount of time.</p> <p>-NOTES-</p> <ol style="list-style-type: none"> Turn on the control power after turning on the main power on the machine controller. When an "Emergency Stop" switch is on, the built-in lamp will not be illuminated even when the control power is turned on.
2	[POWER OFF] Switch		<p>Press this switch to turn off the control power.</p> <p>-NOTES-</p> <ol style="list-style-type: none"> When this switch is pressed, in the specified time the [POWER ON] switch lamp is turned off and the main power supply is automatically turned off. <ul style="list-style-type: none"> Standard specification: 10 seconds. When the [POWER OFF] switch is pressed again before 10 seconds elapse, the power off sequence is cancelled and the main power supply is not turned off. The [POWER OFF] switch's lamp flashes when it is pressed and then turned off when the main power supply is off.

B. Starting/Stopping NC Programs

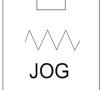
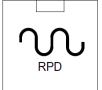
No.	Name	Symbol	Description
1	[CYCLE START] Switch		<p>Press this switch to start NC programs. The green lamp is illuminated while the NC program is running. This switch is enabled in the MDI (Manual Data Input), Memory and External Input modes.</p>
2	[FEED HOLD] Switch		<p>Press this switch to stop the NC programs. The red lamp is illuminated while the NC program is stopped. When this switch is pressed, the machine goes to the Feed Hold status. However, the M/S/T functions continue running until completion, after which the program finally stops.</p> <p>-NOTES-</p> <ol style="list-style-type: none"> During the Feed Hold status, the following operations continue: <ul style="list-style-type: none"> Spindle rotation Tool change Coolant supply Some canned cycles

2.2 Main Mode Setting Switches

A. Automatic Operation Modes

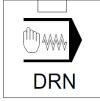
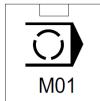
No.	Name	Symbol	Description
1	[MDI] Mode Switch		<p>This switch selects the MDI (Manual Data Input) mode. This mode is used to perform a simple operation such as axis feed and M/S/T function commands by manually inputting a program consisting of one to several blocks instead of using programs stored in the memory.</p> <p>-NOTES-</p> <ol style="list-style-type: none"> 1 The program entered in this mode is cleared when the NC unit is reset and is not stored in the NC memory. 2 When To execute the last program again, press the [MDI Last Program Edit] screen operation button on the Insert button menu on the Program Edit screen
2	[External Input] Mode Switch		This switch selects the External Input mode. This mode is used to run programs by DNC or tape for automatic operation.
3	[MEMORY] Mode Switch		This switch selects the Memory mode which is used to perform automatic operation with registered programs. The registered program is searched for and automatic operation is started when the [CYCLE START] switch is pressed.
4	[EDITOR] Mode Switch		This switch selects the Editor mode. Select this mode to register programs in the NC memory and to edit programs.

B. Manual Operation Modes

No.	Name	Symbol	Description										
1	[JOG] Mode Switch		Select this mode to move an axis at the jog feed rate. Press this switch and one of Feed Axis Selection switches enables the selected axis to be moved by pressing one of the Direction switches (refer to 2.7.1 Manual Axis Feed Switches [88]).										
2	[HANDLE] Mode Switch		Select this mode to move an axis with the Manual Pulse Generator (MPG). Press this switch, select the axis to be moved with the switch on the MPG and rotate the handle to move the axis (refer to 2.7.1 Manual Axis Feed Switches [88]).										
3	[RAPID] Mode Switch		This mode enables the axis movement in rapid traverse. By selecting the axis using axis selection button, the axis can be moved in rapid traverse by using the direction push button. The relation between rapid traverse feed rate and the rapid override rotary switch setting is shown below.										
			<table border="1"> <thead> <tr> <th>Selection</th> <th>X/Y/Z</th> </tr> </thead> <tbody> <tr> <td>100%</td> <td>36,000 mm/min.</td> </tr> <tr> <td>50%</td> <td>18,000 mm/min.</td> </tr> <tr> <td>25%</td> <td>9,000 mm/min.</td> </tr> <tr> <td>0%</td> <td>0 mm/min.</td> </tr> </tbody> </table>	Selection	X/Y/Z	100%	36,000 mm/min.	50%	18,000 mm/min.	25%	9,000 mm/min.	0%	0 mm/min.
Selection	X/Y/Z												
100%	36,000 mm/min.												
50%	18,000 mm/min.												
25%	9,000 mm/min.												
0%	0 mm/min.												
4	[REFERENCE] Mode Switch		This mode is used to return the axis to the reference position manually. The speed at which the axis moves during reference point return is controllable by the rapid override rotary switch.										

2.3 NC Function Switches

Four NC function switches [**SINGLE BLOCK**], [**BLOCK SKIP**], [**DRY RUN**] and [**OPTIONAL STOP**] are allocated to the main operation panel. When a switch is pressed, the corresponding function is turned on (switch lamp illuminated). When the switch is pressed again, the function is turned off (switch lamp extinguished).

No.	Name	Symbol	Description
1	[SINGLE BLOCK] Switch		This switch turns the Single Block mode on/off. When the Single Block mode is on, programs are executed in single blocks and operation stops after each block in the program is executed. Operation can be continued by pressing the [CYCLE START] switch.
2	[BLOCK SKIP] Switch		This switch turns the Block Skip mode on/off. When the Block Skip mode is on, blocks in the program with a “ / ” (slash) at the beginning are ignored.
3	[DRY RUN] Switch		<p>This switch turns the Dry Run mode on/off. Dry Run refers to test-running the machine for the purpose of checking programs. When this mode is on, the Dry Run feed replaces the cutting feed rate specified in the program.</p> <p>-NOTES-</p> <ol style="list-style-type: none"> 1 To enable this mode, this switch must be turned on before the program is started. To turn on this mode during program operation, turn on the [SINGLE BLOCK] mode, then turn on the [DRY RUN] function after the single block is executed. 2 When the [DRY RUN] switch is turned on while performing measurement using the Automatic Workpiece Measuring unit or the Automatic Tool Length Measuring unit, accurate measurement results cannot be obtained. Therefore, make sure to disable the Dry Run mode during measurement.
4	[OPTIONAL STOP] Switch		This switch turns the Optional Stop mode on/off. Turning the Optional Stop mode on enables operation to be stopped by M01 codes in the program. The [CYCLE START] switch blinks while the operation is suspended by M01. Operation can be continued by pressing the [CYCLE START] switch.

2.4 One-Touch Function Switches

One-Touch functions allow multiple operations to be performed by selecting and starting the function (single-touch utilization of switches). The One-Touch functions are valid regardless of the operation mode. Refer to below for details on how to operate One-Touch functions.

Switches on Main Operation Panel (Standard Specifications)

No.	Name	Symbol	Description
1	[AUTO ZERO] Switch		This switch automatically returns all axes (except the Tool magazine axes) to their respective reference positions. The spindle and coolant supply are stopped. The respective axes are moved at rapid feed to their respective reference positions. -NOTE- Only the basic axes are moved to their respective reference positions. The tool magazine axes will not be moved to their respective reference positions when the [AUTO ZERO] switch is pressed.
2	[SET UP POS RET] (Setup Position Return) Switch		This switch automatically moves the X/Y/Z-axes (executed by program O9912).
3	[CUS FUNC] (Special Customise Function) Switch		This switch automatically executes the program set inside the dedicated macro program O9914 set for custom application. The program can be edited if necessary.
4	[SPEC TL CHG] (Special Tool Change) Switch		This switch automatically calls the tool in the tool magazine specified by machine parameter and exchanges it with the spindle tool. The spindle and coolant supply are stopped at this time.
5	[ONE TOUCH START] Switch		This switch starts the selected One-Touch function.
6	[ONE TOUCH STOP] Switch		This switch stops the selected One-Touch function. This switch is valid while the One-Touch function is being performed.

2.5 Coolant Related Switches

With the Standard specifications, four coolant related switches are allocated to the main operation panel. These switches are valid regardless of the operation mode. When a switch is pressed, the corresponding function is turned on (switch lamp illuminated). When the switch is pressed again, the function is turned off (switch lamp extinguished).

The functions not allocated to the main operation panel are turned on/off on the Function screen. These switches can also be allocated to main operation panel with the Flexible Switch function.



WARNING

- Do not discharge coolant when a tool is not clamped in the spindle. Failure to observe this precaution may result in a breakdown of the machine.

No.	Name	Symbol	Description
1	[COOLANT ON/OFF] Switch		When this switch is turned on, all coolant being discharged is temporarily stopped. When the switch is turned off, coolant discharge restarts.
2	[COOLANT NOZZLE] Switch	NZL	This switch turns on the nozzle coolant and shower cleaning coolant. When the switch is turned off, operation is stopped.
3	[THROUGH SPINDLE] Switch	TSC	When this switch is turned on, Through Spindle Coolant operation is started. When the switch is turned off, operation is stopped. -NOTES- 1 Even while this switch is on, when the next M06 (tool change) command is sent, Through Spindle Coolant is automatically turned off. Through Spindle Coolant is not automatically turned back on. 2 The Through Spindle Coolant is also turned on by M26.
4	[AIR BLOW] Switch	AIR	When this switch is turned on, Air Blow operation is started. When the switch is turned off, operation is stopped. -NOTE- The Air Blow is also turned on by M07.

2.6 Spindle Related Operation Switches



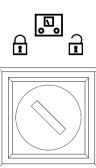
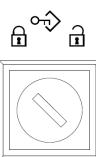
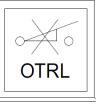
WARNING

- Do not start the spindle without clamping a tool in it. Failure to observe this precaution may result in a breakdown of the machine.

No.	Name	Symbol	Description
1	[SPINDLE START] Switch		<p>Turning on this switch while the spindle is stopped or during spindle orientation starts the spindle in the clockwise direction. This switch is valid regardless of the current operation mode.</p> <p>-NOTE-</p> <p>Pressing the [SPINDLE START] switch will start the spindle running in the previous direction spun.</p>
2	[SPINDLE STOP] Switch		<p>Pressing this switch stops the spindle. This switch is valid regardless of the current operation mode.</p> <p>-NOTE-</p> <p>Pressing this switch during automatic operation activates the Feed Hold status.</p>
3	[SPINDLE ORIENTATION] Switch		<p>This switch is to orientate the tool clamped to the spindle head. Pressing the switch will turn the current tool to the reference position.</p> <p>-NOTE-</p> <p>The button is available during manual operation modes (Handle, Reference, Rapid or Jog).</p>
4	[SPINDLE OVERRIDE] Switch		<p>This switch is to increase the rotational speed set by the program or default speed set when the [SPINDLE START] switch is on.</p> <p>The range of Spindle Override is 50% -120%, in steps of 10%. When this button is pressed, the active screen will automatically change to the Machine Status screen, which shows the current Spindle Override value and it reverts back to the original screen after few seconds. The overridden spindle rotation speed cannot exceed the maximum rotation speed.</p> <p>-NOTE-</p> <p>The switch is invalid when Spindle Override has been canceled by M59. The M58, Spindle Override valid status, is automatically selected when the power is turned on.</p>
			<p>This switch is to decrease the rotational speed set by the program or the default speed set when the [SPINDLE START] switch is on</p>

2.7 Malfunction/Accident Prevention Switch/Key Switches

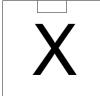
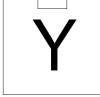
No.	Name	Symbol	Description
1	[EMERGENCY STOP] Switch		<p>When the “Emergency Stop” switch is pressed, axis feed, spindle rotation and all other machine functions stop immediately. Once this switch is pressed, it is locked in this position. The lock can be released by turning the switch in the direction indicated by the arrow.</p> <p>-NOTES-</p> <ol style="list-style-type: none"> 1 The machine goes to the following status when the “Emergency Stop” switch is pressed: <ul style="list-style-type: none"> • Feed of all axes is immediately stopped. • Spindle is stopped if it is rotating. • If unclamped, the spindle tool is clamped. • When spindle orientation has been performed, orientation status is released. • When a tool change is being performed, operation stops immediately (even in mid-motion). • When the tool magazine is operating, it is stopped immediately (even in mid-motion). • NC unit goes to Reset status. • Coolant supply is stopped. 2 For details on the restore procedure from the Emergency Stop status (refer to Chapter 5 Troubleshooting 2.2 Recovery from Emergency Stop^[228]). 3 “Emergency Stop” switches are also located on the following parts in addition to the main operation panel: (refer to Chapter 1 Safety 3 Safety Devices^[19]). <ul style="list-style-type: none"> • Feed of all axes is immediately stopped. • Spindle is stopped if it is rotating. • If unclamped, the spindle tool is clamped. 4 The machine is in the Emergency Stop status and will not be started up until the lock is released by turning the switch in the direction indicated by the arrow and the [POWER ON] switch is then pressed.
2	[ALARM RESET] Switch		<p>Pressing this switch will deactivate any current PMC alarm that occurred during operation.</p> <p>-NOTE-</p> <p>Alarm Reset can also be done on the screen. NC alarm reset: Press [NC RESET]</p>

No.	Name	Symbol	Description
3	[MODE UNLOCK] Key Switch (only for CE specifications)		<p>When this key switch is turned to the right it is enabled, allowing the operation mode to be changed. After an operation mode is selected, turning this key switch to the left disables the mode. Remove the key to ensure operator safety.</p> <p>-NOTE-</p> <p>When the Operator Door is open, the operation mode cannot be changed.</p>
4	[MEMORY UNLOCK] Key Switch		<p>This switch turns Memory Protect Release mode on/off. When the memory is unlocked, the following operations are enabled:</p> <ul style="list-style-type: none"> • Program entry and editing • Tool offset value entry • Absolute coordinate presetting • Registration of NC program in memory from external device. • Position offset value entry • Macro variable entry.
5	[OT RELEASE] Key Switch		<p>This switch is used for the following purposes:</p> <ul style="list-style-type: none"> • When the Emergency Stop status has been triggered by overtravel (OT2) of a feed axis, that axis is moved in the opposite direction back within its stroke while holding down this switch. The Emergency Stop status is released while this switch is pressed. • When the machine stops during the tool change or other operation and all the feed axes are in the Interlock status, use this switch to release the interlock and move the axes. The Interlock is released while this switch is pressed. Only the Handle mode and Jog mode are enabled at this time (refer to 11.2 Jog Feed¹⁷⁰, 11.3 Handle Feed¹⁷¹). <p>This switch is used to release the Interlock when performing maintenance operation.</p>
6	[S/G Door Unlock] Switch		<p>This switch is used for opening the Operator Door when the door lock system is activated:</p> <ul style="list-style-type: none"> • To release the door lock, press the [S/G DOOR UNLOCK] switch. The door interlock release indicator is turned on. • To reinstate the door lock, close the Operator Door.

2.7.1 Manual Axis Feed Switches

The Jog function switches are used to select the axis and direction of axes movement for the Reference Position Return/Jog/Rapid/Handle mode. The feed rate is selected with the “Rapid Traverse Override” switch in the Reference Position Return mode and with the “Jog Feed” switch in the Jog mode (Refer to [2.7.2 Feed Rate/Override Switches](#) [89] & [11 Manual Operation](#) [165]).

A. Axis Selection Switches

No.	Name	Symbol	Description
1	“X-Axis Selection” Switch		This switch selects the X-axis for the Jog function. By selecting the X-axis, the table will move horizontally, left or right during the Jog function.
2	“Y-Axis Selection” Switch		This switch selects the Y-axis for the Jog function. By selecting the Y-axis, the table will move backward or forward during the Jog function.
3	“Z-Axis Selection” Switch		This switch selects the Z-axis for the Jog function. By selecting the Z-axis, the spindle head will move vertically, up or down during the Jog function.
4	“4th-Axis Selection” Switch		This switch selects the optional 4th-axis for the Jog function which can be a rotational axis.
5	“5th-Axis Selection” Switch		This switch selects the optional 5th-axis for the Jog function which can be a rotational axis.
6	“CS-Axis Selection” Switch		This switch selects the optional CS-axis for the Jog function which can be a rotational axis.

B. Direction of Axes Movement Switches

No.	Name	Symbol	Description
1	'+' Direction Switch		This switch moves the selected axis in the '+' direction. Press and hold to constantly move the axis with the selected feed rate.
2	'-' Direction Switch		This switch moves the selected axis in the '-' direction. Press and hold to constantly move the axis with the selected feed rate.

2.7.2 Feed Rate/Override Switches

No.	Name	Symbol	Description
1	"Handle Feed" Switch		This rotary switch is used to specify the feed per pulse in Handle mode. (Refer to 11.3 Handle Feed)
2	"Rapid Traverse Override" Switch		Reference position return is performed at the rapid feed override (0 - 100%). The Rapid Traverse Limit function can be used to limit the Rapid feed rate to 25% (standard) during automatic and manual operation. This function can be enabled/ disabled with M172 and on the Function screen. When this function is enabled, the background color of the Machine Condition lamp on the screen is displayed in yellow.
3	"Jog Feed" and "Cutting Feed Rate Override" Switch		Jog Feed (Inner Scale) This rotary switch is used to specify the Jog feed rate. It is valid in the following cases: <ul style="list-style-type: none">• When the Jog mode is selected.• When the Dry Run mode is on during automatic operation. Cutting Feed Rate Override (Outer Scale) This rotary switch applies an override to the specified cutting feed rate during automatic operation. This switch, however, is invalid when the Dry Run mode is selected. At this time, the Jog feed rate switch is valid instead. During a G84 Tapping Cycle and M49 Override Cancel, the feed rate is fixed at 100%. When M132 is specified, the override rate is limited to 100% or less. Any override value exceeding 100% is invalid.

2.8 MDI Panel

The keyboard on the main operation panel is called the MDI (Manual Data Input) panel. The MDI panel is used for entering data and changing the screen displays.

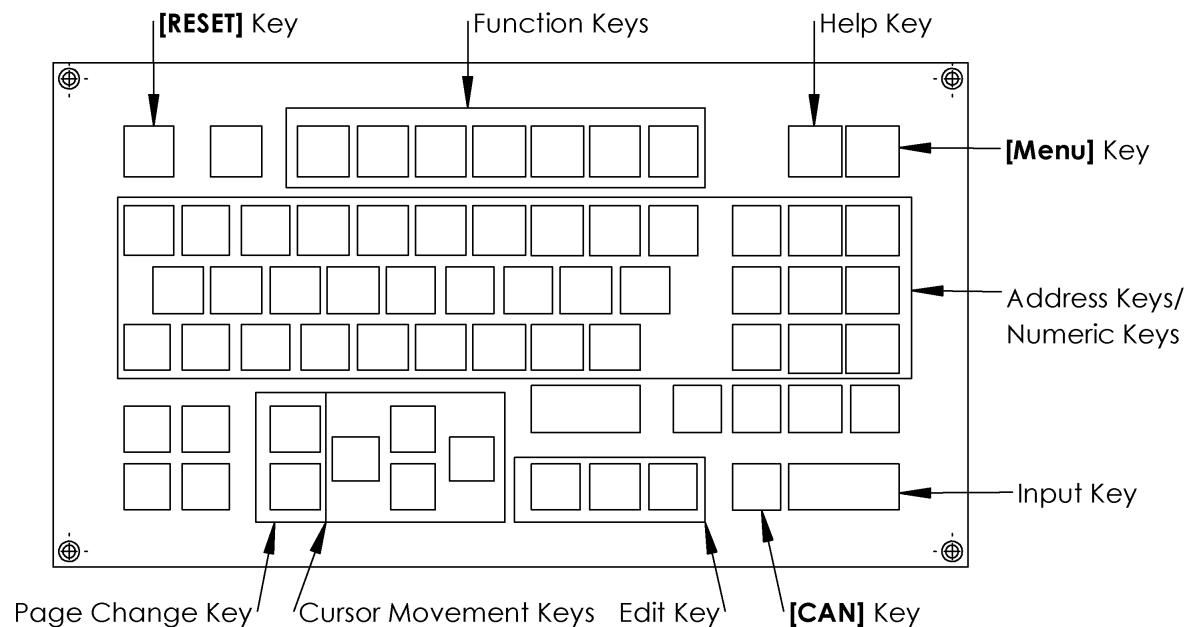


Figure 2.1 MDI Panel Layout

3 Portable Manual Pulse Generator

3.1 Overview

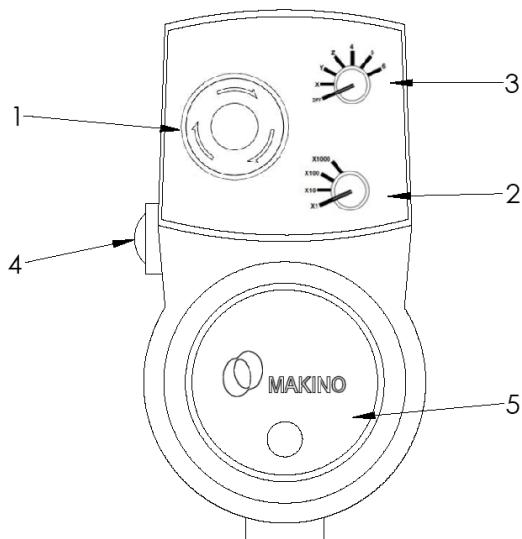


Figure 3.1 Portable Manual Pulse Generator

No.	Name	No.	Name
1	Emergency Stop Switch	4	Deadman Switch
2	Magnification Selection Rotary Switch	5	Pulse Coder
3	Axis Selection Rotary Switch	-	-

3.2 Switches on Portable Manual Pulse Generator

No.	Name	Symbol	Description
1	"Emergency Stop" Switch		This "Emergency Stop" switch has the same function as the one on the main operation panel. (Refer to 2 Switches on Main Operation Panel [79])
2	"Handle Feed" Rotary Switch		This rotary switch, also known as "Magnification Selection" rotary switch, is used to specify the feed per pulse in Handle mode. (Refer to 11.3 Handle Feed [171])
3	"Axis Selection" Rotary Switch		This rotary switch is used to select the axis for movement in Handle mode.
4	"Deadman" Switch		This switch has a 3-stage structure. The switch will only be activated if it is pressed halfway or to the middle level. It will not be activated if it is pressed fully. This acts as a safety feature to prevent any unintentional axis movement.
5	Pulse Coder		Axis movement is enabled only with the rotation of the Pulse Coder and pressing the Deadman switch. The Pulse Coder sends electrical pulses to the NC unit to move the selected axis in the '+' (CW) or '-' (CCW) direction. The feed of the axis movement depends on the amount selected by the Handle Feed rotary switch. The axis does not move if the machine is in axis-interlocked state or if an Alarm has occurred. The Pulse Coder generates 100 pulses per one full rotation and a click is emitted each time a pulse is generated.

4 Screens

The basic procedures for manipulation of Makino Custom Screen are explained in this chapter.

4.1 Operation of Screens

To navigate to custom Main Menu Screen, press [MENU] key on MDI panel.



Figure 4.1 Custom Screen Function Key

4.2 Main Menu Screen

By pressing the Makino icon, the Main Menu Screen is displayed.

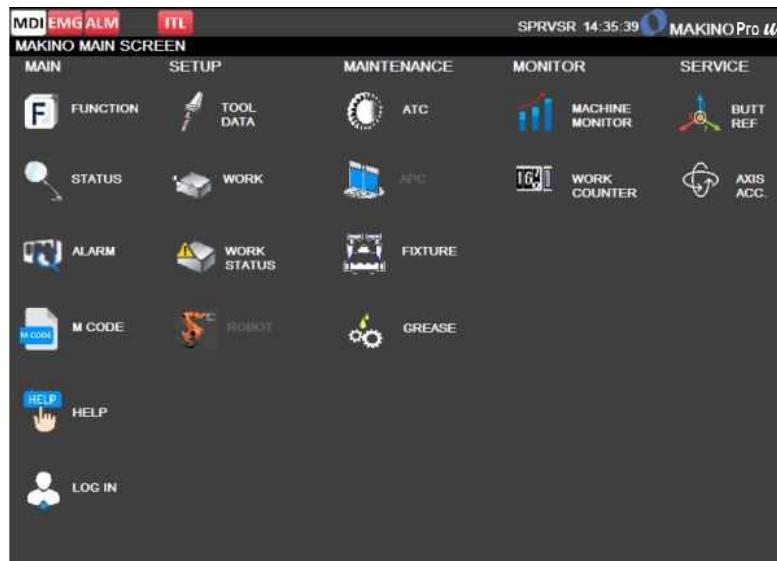


Figure 4.2 Main Menu Screen

For selection the screen under each menu, press the icon displayed against each screen menu.

Example:

Navigating to M-Code List.

- 1) Press the icon for M-Code List.
- 2) M-Code List is displayed.

4.3 Function Screen

Machine functions can be enabled or disabled on the Function Screen.

To navigate to Function Screen, press [MENU] → press Makino icon → Main Menu Screen is displayed → press Function Screen icon → Function Screen is displayed.

To turn ON or OFF a function, press the icon beside the Function.

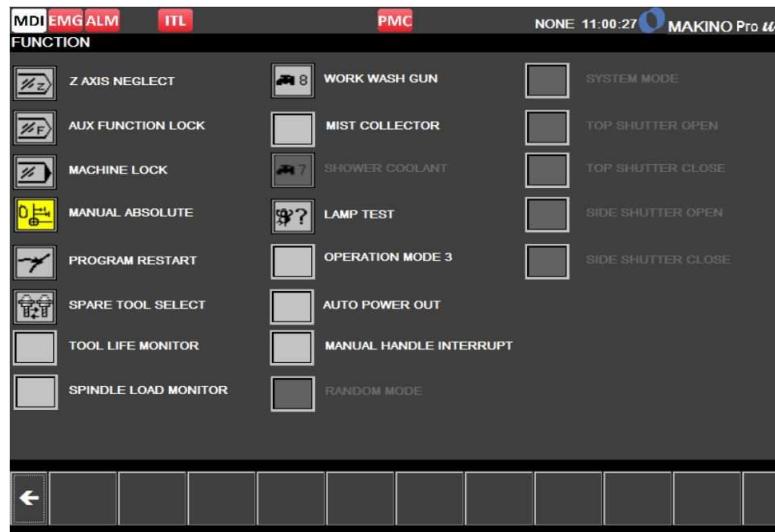


Figure 4.3 Function Screen

4.4 Machine Status Screen

The Machine Status Screen displays the reasons for Emergency conditions, Interlock conditions, Feed Hold conditions and machine current status.

To navigate to Machine Status Screen, press [MENU] → press Makino icon → Main Menu Screen is displayed → press Machine Status → Machine Status Screen is displayed.



Figure 4.4 Machine Status Screen

4.5 Alarm Detail Screen

When an Alarm has occurred, the Alarm details are displayed on the Alarm Detail Screen.

To navigate to Alarm Detail Screen, press [MENU] → press Makino icon → Main Menu Screen is displayed → press Alarm Detail Screen icon → Alarm Detail Screen is displayed.

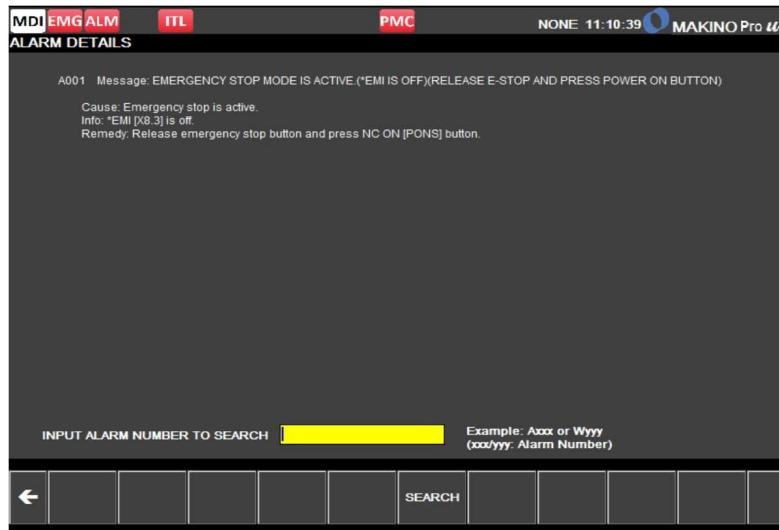


Figure 4.5 Alarm Information Screen

4.6 M-Code List Screen

The M-Code List Screen displays machining NC programs code number and its description.

To navigate to M-Code List Screen, press [MENU] → press Makino icon → Main Menu Screen is displayed → press M-code List Screen icon → M-Code List Screen is displayed.



Figure 4.6 M-Code List Screen

4.7 Help Screen

The Help Screen displays software information and sub-screen for M-Code list.

To navigate to Help Screen, press [MENU] → press Makino icon → Main Menu Screen is displayed
→ press Help Screen icon → Help Screen is displayed.



Figure 4.7 Help Screen

4.8 Login Screen

From the Login Screen machine can be access with different privilege levels.

To navigate to Login Screen, press [MENU] → press Makino icon → Main Menu Screen is displayed → press Login Screen icon → Login Screen is displayed.

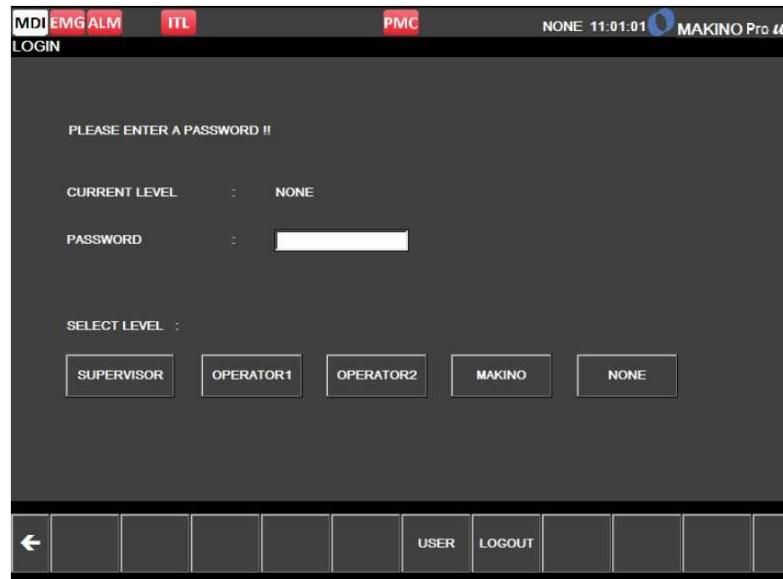


Figure 4.8 Login Screen

4.8.1 Login Method

For login,

- 1) Select the required SELECT LEVEL by pressing the LEVEL key.
- 2) Enter password.
- 3) If password entry is unsuccessful CURRENT LEVEL will be display logged level.
Currently, level NONE / OPERATOR password is not included.

4.8.2 Logout Method

For logout, press [LOGOUT] soft key.

4.8.3 Changing Supervisor Level Password

Supervisor level password can be changed by press [PASSWORD] soft key.

4.9 Tool Data Screen

Items related to Tool management are displayed on the Tool Data Screen.

To navigate to Tool Data Screen, press **[MENU]** → press Makino icon → Main Menu Screen is displayed → press Tool Data Screen icon → Tool Data Screen is displayed.

Tool details can be viewed in Detail mode or List mode. To toggle between Detail and List mode, press **[DETAIL]** / **[LIST]** soft key.

- In Detail mode, individual tools information is displayed.
 - In List mode, multiple tools data items are displayed in table form.

To change data values, press [INPUT] soft key.

MDI		EMG ALM		ITL		PMC		NONE 11:01:30		MAKINO Pro 4	
TOOL MANAGEMENT (DETAIL)											
POT:	1	OFFSET:		TOOL LIFE:		LIFE TYPE:	DISTANCE	ALARM:	0	WARN:	0
PTN:	1	GEOM_H:	0.0000	WEAR_H:	1.2000	WEAR_D:	123.3210	ACTUAL:	0	SPEED MAX:	16000
EXIST:	NO	GEOM_D:		WEAR_D:	10.0000	OFFSET NO:	0	LOAD MAX:	0	LOAD MIN:	0
TYPE:	NONE	BTS LENGTH:	0.0000	BT CHECK:	NO	ROT PROH:	NO	POT PROH:	NO	RET TYPE:	Z0
										TSC TOOL: YES	
SPARE TOOL										STATUS	
GROUP(GR):		0									
SEQUENCE(SQ):		0									
Valid Range 0 ~ 99999999											
<input type="text" value="1"/> ← Input Line											
<input type="button" value="←"/>						<input type="button" value="INPUT"/>	<input type="button" value="LIST"/>			<input type="button" value="RESET"/>	

Figure 4.9 Tool Data Detail View

Chapter 4 Operation

HND		ALM		PMC		SPRVS R 13:45:19				MAKINO Pro U			
										1/3			
POT EXIST		TOOL NO		TYPE		FTN		LENGTH		DIAMETER		OFFSET STATUS	
POT	NO	GR	SQ	GEOM-H	WEAR-H	GEOM-D	WEAR-D	NO					
SP	1	NONE		0	0	741.9630	7.4100	921.8000	7.4100	0			
11	NO	11	NONE	0	0	0.0000	0.0000	0.0000	0.0000	0			
12	NO	12	NONE	0	0	0.0000	0.0000	0.0000	0.0000	0			
13	NO	13	NONE	0	0	0.0000	0.0000	0.0000	0.0000	0			
14	NO	14	NONE	4	0	123.3000	99.0000	100.4560	88.8880	0			
15	NO	15	NONE	0	0	0.0000	0.0000	0.0000	0.0000	0			
16	NO	16	NONE	0	0	0.0000	0.0000	0.0000	0.0000	0			
17	NO	17	NONE	0	0	0.0000	0.0000	0.0000	0.0000	0			
18	NO	18	NONE	0	0	0.0000	0.0000	0.0000	0.0000	0			
19	NO	19	NONE	0	0	0.0000	0.0000	0.0000	0.0000	0			
20	NO	20	NONE	0	0	201.1230	1.7896	789.6540	3.0258	0			
Valid Range 0 ~ 99999999													
11													
<input type="button" value="←"/>	<input type="button" value=""/>	<input type="button" value="INPUT"/>	<input type="button" value="DETAIL"/>	<input type="button" value="←"/>	<input type="button" value="→"/>	<input type="button" value="RESET"/>	<input type="button" value=""/>	<input type="button" value=""/>	<input type="button" value=""/>				

Figure 4.10 Tool Data Detail View - Page 1

HND		ALM		PMC		SPRVS R 13:45:32				MAKINO Pro U				
										2/3				
POT EXIST		TOOL NO		TYPE		FTN		TOOL LIFE		MAX LOAD		STATUS		
POT	NO	GR	SQ	WARN	ALM	ACT	Type	Max Speed	Max Load	Min				
SP	1	NONE		0	0	0	DISTAN	16000	0	0				
11	NO	11	NONE	0	0	0	DISTAN	16000	0	0				
12	NO	12	NONE	0	0	0	DISTAN	16000	0	0				
13	NO	13	NONE	0	0	0	TIME	16000	0	0				
14	NO	14	NONE	4	0	0	TIME	16000	0	0				
15	NO	15	NONE	0	0	0	TIME	16000	0	0				
16	NO	16	NONE	0	0	0	TIME	16000	0	0				
17	NO	17	NONE	0	0	0	DISTAN	16000	0	0				
18	NO	18	NONE	0	0	0	DISTAN	16000	0	0				
19	NO	19	NONE	0	0	0	TIME	16000	0	0				
20	NO	20	NONE	0	0	0	COUNT	16000	0	0				
Valid Range 0 ~ 99999999														
11														
<input type="button" value="←"/>	<input type="button" value=""/>	<input type="button" value="INPUT"/>	<input type="button" value="DETAIL"/>	<input type="button" value="←"/>	<input type="button" value="→"/>	<input type="button" value="RESET"/>	<input type="button" value=""/>	<input type="button" value=""/>	<input type="button" value=""/>					

Figure 4.11 Tool Data Detail View - Page 2

HND	ALM	PMC		SPRVR 13:45:40		MAKINO Pro U						
TOOL MANAGEMENT LIST		POT	EXIST TOOL NO	TYPE	FTN	Z-RET	ROT	POT	BTS	TSC	BTS LENGTH	STATUS
SP	NO	1	NONE		GR	SQ						
11	NO	11	NONE		0	0	NOT Z0	NO	NO	NO	NO	0.0000
12	NO	12	NONE		0	0	NOT Z0	NO	NO	NO	NO	0.0000
13	NO	13	NONE		0	0	NOT Z0	NO	NO	NO	NO	0.0000
14	NO	14	NONE		0	4	Z0	NO	NO	NO	NO	0.0000
15	NO	15	NONE		0	0	NOT Z0	NO	NO	NO	NO	0.0000
16	NO	16	NONE		0	0	NOT Z0	NO	NO	NO	NO	0.0000
17	NO	17	NONE		0	0	NOT Z0	NO	NO	NO	NO	0.0000
18	NO	18	NONE		0	0	NOT Z0	NO	NO	NO	NO	0.0000
19	NO	19	NONE		0	0	NOT Z0	NO	NO	NO	NO	0.0000
20	NO	20	NONE		0	0	NOT Z0	NO	NO	NO	NO	0.0000

Figure 4.12 Tool Data Detail View - Page 3

Items Description

The meaning of items on the Tool Data Screen are described below.

4.9.1 POT NO. (Pot Number)

Pot number indicates the location where the Tools are loaded in the magazine.

4.9.2 PTN (Program Tool Number)

The Tools are identified by PTN number and Tools are called by PTN number in part program.

Example:

T 'PTN' → T_{xxx}; (xxx denotes number)

PTN can be registered from this screen and duplicate PTN registration is not allowed.

4.9.3 TYPE

The type of Tool used is set in this field. When the cursor is placed on TYPE field, on the output line at the bottom of the screen the selectable Tool type figure with selection number is displayed.

Example:

Select the required Tool type, press [2] MDI key → is displayed.



Figure 4.13 Tool Type Selection

4.9.4 EXIST

The presence of Tool for the respective pot is indicated by YES / NO under this field. This status can only be changed during Tool load / unload process.

4.9.5 SPARE TOOL

Indication of original Tool having a replacement when its tool life is attained.

- **Group (GR):** The Tools with same GROUP (GR) are treated as Tools of a same group and if original Tool attains tool life then replacement Tool is called and processing is continued until all Tools of the same group attain life or Alarm status.
- **Sequence (SQ):** If multiple spare Tool of the same group exists in magazine, then this SEQUENCE (SQ) determines the order in which the Tool to be called as replacement Tool in ascending order.

4.9.6 OFFSET

The Tool Offset Data values are entered below.

- **GEOM_H:** Tool length offset.
- **WEAR_H:** Tool length wear.
- **GEOM_D:** Tool diameter.
- **WEAR_H:** Tool diameter wear.

After Tool change and before processing start, the length / diameter values are transferred to Fanuc offset page by M56 command.

4.9.7 OFFSET NO.

Which Fanuc Tool Offset number the length / diameter values need to be transferred (when command M56) to is entered in this field.

4.9.8 Tool Life

LIFE TYPE

Tool life monitoring can be done by COUNT type, DISTANCE type or TIME type. If Tool life is attained, Alarm is generated calling attention to operator for Tool replacement.

Tool life type can be selected in LIFE TYPE field.

- **LIFE TYPE - COUNT:** Tool life is monitored by the number of parts machined and is incremented by M919 or M919 Sxxx.
- **LIFE TYPE - DIST:** Tool life is monitored by the distance moved during cutting. Its value is incremented automatically when Spindle is ON and Tool moves in feed.
- **LIFE TYPE - TIME:** Tool life is monitored by how long the Tool is involved during cutting. Its value is increment automatically when Spindle is ON and Tool moves in feed.

WARN

Warning limit can be set. When Tool attains Warning level, Tool Status is set to Warning and message is displayed.

ALARM

Alarm limit can be set. When Tool attains Alarm level, Tool Status is set to Alarm and message is displayed.

ACTUAL

The current count of Tool life is displayed in this field.

4.9.9 SPEED MAX

Maximum Tool speed can be set. If speed command is greater than the set value, Alarm is generated and Spindle rotation is inhibited.

4.9.10 LOAD MAX

Maximum Spindle load can be monitored. The maximum load value can be entered in this field. When Spindle load exceeds the set value, Alarm is generated indicating excess load.

4.9.11 LOAD MIN

Minimum Spindle load can be monitored. The minimum load value can be entered in this field. When Spindle load falls below set value, Alarm is generated indicating missing Tool.

4.9.12 ROT PROH (Rotation Prohibit)

When ROT PROH is set to YES, Spindle rotation is prohibited. Set to NO, the Spindle rotation is possible.

4.9.13 POT PROH (Pot Prohibit)

When POT PROH is set to YES, Tool change for this pot is prohibited and Alarm is generated. Set to NO, the Tool change for the pot is possible.

4.9.14 BT CHECK (Broken Tool Check)

If a Tool needs BT Check, select YES but when not required select NO for the respective Tool. For the Tool which BTS was set to YES, the check is performed after the cutting process

4.9.15 TSC TOOL (Through Spindle Coolant Tool)

When TCS TOOL is set to YES this can enable TSC for the required Tool only.

4.9.16 BTS LENGTH (Broken Tool Length)

Tool length is entered in this field.

4.9.17 RET TYPE (Retract Type)

In RET TYPE field, Z-axis retract path can be set between Z0 or Not Z0 path.

Z0 - Tool retract to Z0 to clear fixture interface.

Not Z0 - Tool path interpolates during Tool change.

4.9.18 STATUS

The status of Tool is displayed as below under this column for the respective Tool.

WRN - Tool Life Warning

LIFE - Tool Life Attained

BT - Broken Tool

SL UP - Spindle Load Upper Limit Alarm

SL LOW - Spindle Load Lower Limit Alarm

PRBT - Tool Change Prohibit Status

-NOTE-

Tool Data can only be changed in login level MAKINO / SUPERVISOR.

4.10 Work Selection Screen

On the Work Selection Screen up to 10 models can be set per pallet.

To navigate to Work Selection Screen, press [MENU] → press Makino icon → Main Menu Screen is displayed → press Work Selection icon → Work Selection Screen is displayed.



Figure 4.14 Work Selection Screen

Items Description

The meaning of items on the Work Selection Screen are described below.

4.10.1 NO. (Work Model Number)

Work model of up to 10 (model 0 to 9) can be selected. The work model is selected by pressing the respective number. The selected model will be highlighted in yellow.

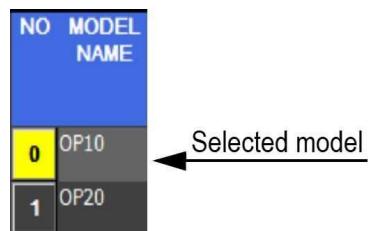


Figure 4.15 Work Model No. 0 is Selected

4.10.2 MODEL NAME

For easy identification model name can be input in this field. Refer to Figure 4.18.



Figure 4.16 Model Name Input

4.10.3 PGM NO. (Program Number)

Program number to be executed for respective model is entered in this field.

4.10.4 AIR SEAT

Air Seat that need monitor for respective model is set in this field. The field which “O” is green in color background indicates that the sensor is checked after the fixture is clamped.

4.10.5 A-RWH POSITION (Angle of Rotary Work Head Position)

At what angle the RWH fixture is to be clamp or unclamp can be set for respective model.

-NOTE-

Work Selection Screen can be changed in login level MAKINO / SUPERVISOR.

4.11 ATC Maintenance Screen

ATC Maintenance screen is provided for performing recovery or maintenance on the ATC and magazine system. It is necessary to turn on Maintenance mode to perform any maintenance operation. When Maintenance mode is on, machine must be stopped.



WARNING

- Tool data is not updated for any ATC arm movements made in Maintenance mode.
- After any ATC Maintenance operation, always check the tool data is correct.

The following conditions must be satisfied for Maintenance mode to be on:

- Not ATC Manual Intervention Mode
- Not Tool Data Screen Tool Call Mode
- Machining Stop (NC Reset)
- Not ATC Magazine Operation
- Not ATC Arm Operation

Alarms and/or warnings will be generated when the conditions are not met.

To view ATC Maintenance screen, press the **[ATC MAINTENANCE]** button [1] on the Navigation Menu screen. The ATC Maintenance screen consist of the maintenance for ATC solenoids and ATC magazine servo.

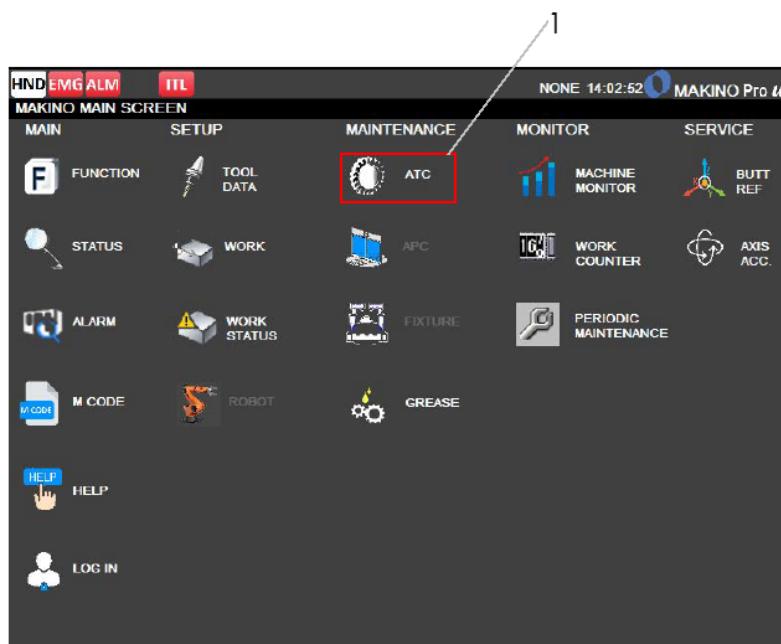


Figure 4.17 ATC Maintenance Button on Navigation Menu Screen

No.	Name
1	[ATC MAINTENANCE] Button

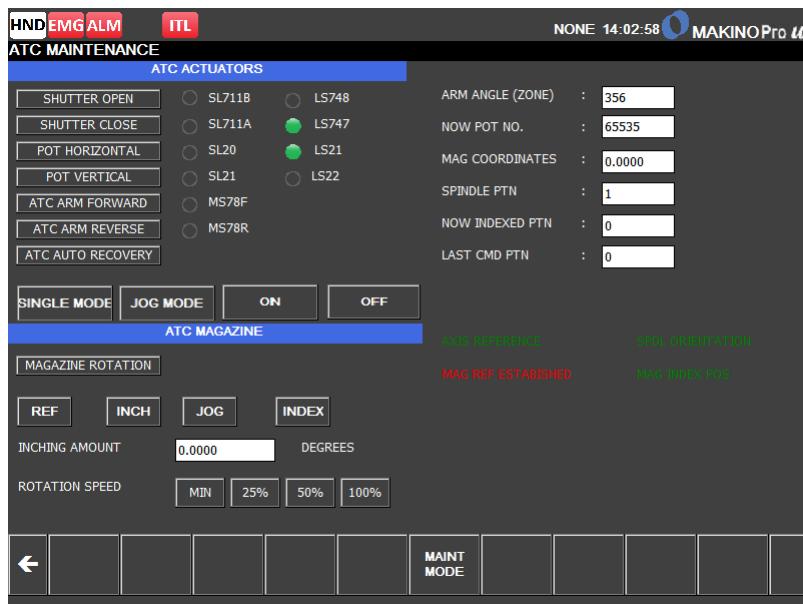


Figure 4.18 ATC Maintenance Screen

In the ATC Maintenance screen, the following functions can be controlled/operated:

- Shutter Open
- Shutter Close
- Pot Horizontal
- Pot Vertical
- ATC Arm Forward (M6 Direction)
- ATC Arm Reverse
- ATC Auto Recovery
- Magazine Rotation

The left panel of the ATC Maintenance screen contains the controls for the ATC actuators and ATC magazine. The right panel provides information and advice for the Maintenance operation. To perform Maintenance operation, Maintenance mode must be on. Pressing the actuator on/off buttons when Maintenance mode is Off has no effect.

-NOTES-

- 1 Maintenance mode can be protected by password in the User Management screen.
- 2 When Maintenance mode is off and machine is not in Emergency status, the output of the actuators will be reset to the status indicated by their respective limit switches.

4.11.1 ATC Maintenance Information

The Maintenance Information displayed information required for operating the ATC arm and magazine.

The displayed information are:

- Current angle of the ATC arm
- Current zone of the ATC arm
- Current magazine coordinates
- Spindle PTN
- Current magazine pot PTN
- Last commanded tool PTN

Machine status shown in red text means that the status is not satisfied. Whereas machine status shown in green text means that the status is satisfied.

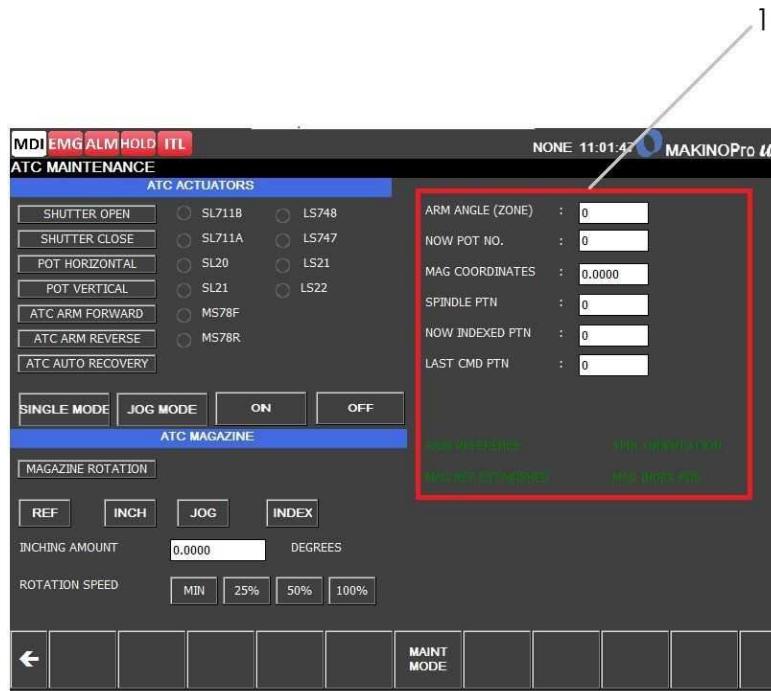


Figure 4.19 ATC Maintenance Information

No.	Name
1	ATC Maintenance Information

4.11.2 ATC Actuator Jog and Single Mode

For ATC actuators there are two operation modes available, Jog and Single.

Jog Mode

In Jog mode, the selected actuator will turn on while the **[ON]** button is pressed. Once the button is released, the actuator will be off. The **[OFF]** button will turn off the selected actuator.

Single Mode

In Single mode, the selected actuator will maintain the status accordingly to the **[ON]** / **[OFF]** button pressed even when the button is released.

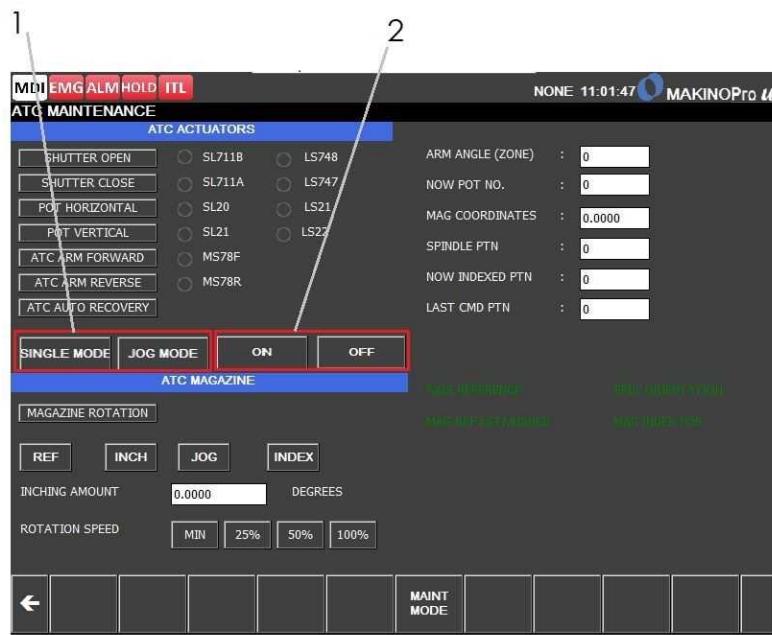


Figure 4.20 ATC Actuator Jog / Single Mode

No.	Name	No.	Name
1	[SINGLE MODE] / [JOG MODE] Button	2	Single / Jog Mode Button [ON] / [OFF]

4.11.3 ATC Actuator Maintenance Operation

ATC actuators refer to the ATC shutter and magazine pot. The current status of each actuators solenoid and limit switch is shown on the screen. When the solenoid symbol and address is highlighted in red, it indicates that it is not in the ATC standby condition.

ATC Actuators Maintenance Operation Procedure

- 1) Enable Maintenance mode.
- 2) Select an actuator item.
- 3) Select an operation mode, Jog or Single.
- 4) Press the [ON] or [OFF] button.

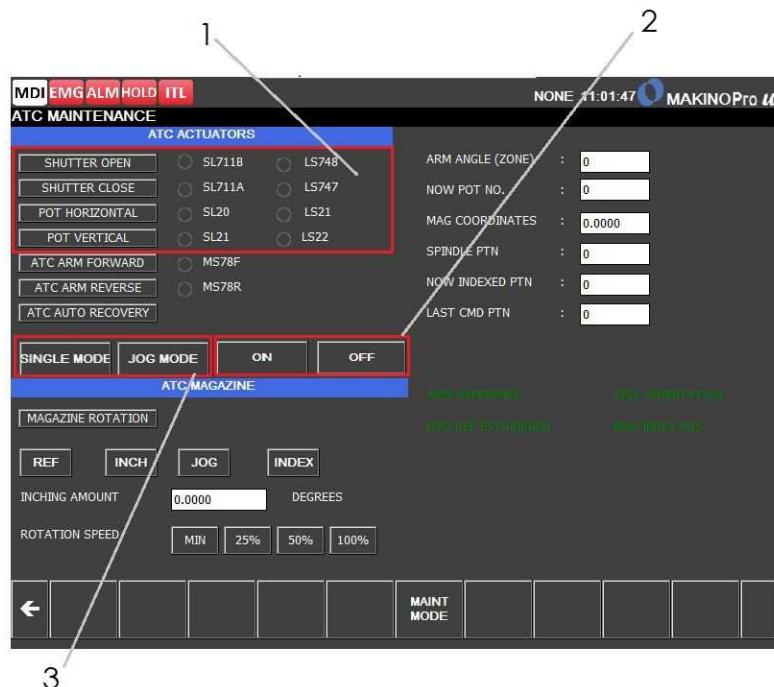


Figure 4.21 ATC Actuator Maintenance

No.	Name	No.	Name
1	ATC Shutter and Magazine Pot Information	3	[SINGLE MODE] / [JOG MODE] Button
2	Single / Jog Mode Button [ON] / [OFF]	-	-

4.11.4 ATC Arm Maintenance Operation

The ATC arm motion path is controlled by a mechanical CAM. The ATC arm CAM can be commanded to move forward or reverse. Forward direction refers to the direction taken by the CAM during automatic operation (M06).

There are no limit switches on the ATC arm CAM, instead the position of the ATC arm CAM is determined by an encoder. The encoder provides the angle that the ATC arm CAM is currently in. The CAM path of the ATC arm is divided into zones and the current zone that the ATC arm is in is also displayed in the ATC Maintenance screen below.

When the ATC arm rotates, the current angle and zone of the ATC is displayed on the Maintenance information screen. The ATC arm will always stop automatically at the spindle and standby positions. It is necessary to command spindle tool Clamp / Unclamp at certain positions of the ATC arm.

In Maintenance mode, the speed of the arm is limited to less than half of Automatic operation (M06).

ATC Arm Maintenance Operation Procedure

- 1) Enable Maintenance mode.
- 2) Select ATC Arm Forward or Reverse.
- 3) Select an operation mode, Jog or Single.
- 4) Press the [ON] or [OFF] button.

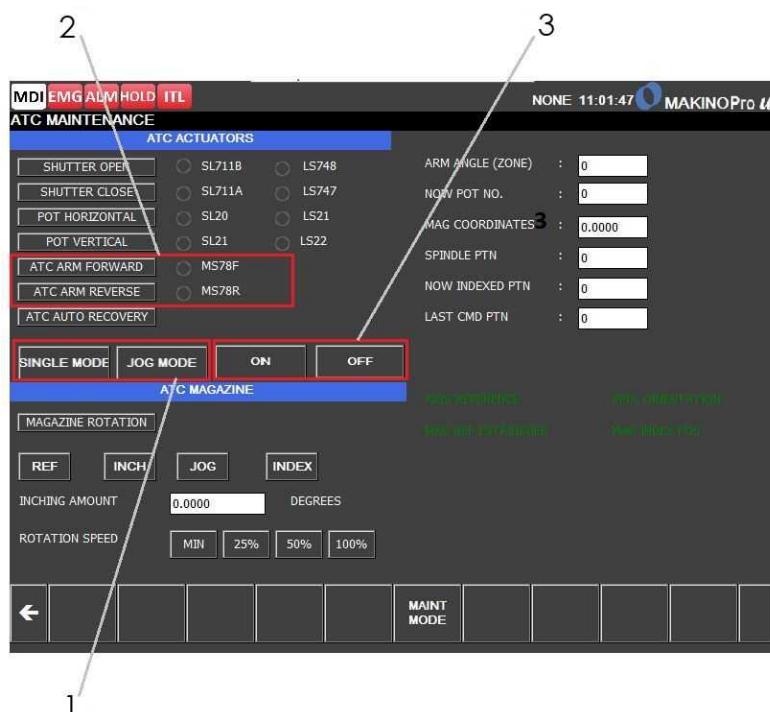


Figure 4.22 ATC Arm Maintenance

No.	Name	No.	Name
1	[SINGLE MODE] / [JOG MODE] Button	3	Single/Jog Mode Button [ON] / [OFF]
2	ATC Arm Information	-	-

-NOTES-

- 1 There may be cases where the ATC arm is unable to move during Maintenance operation. This may be due to the tool being too heavy or there is an obstruction to the arm.
- 2 Check the arm mechanism and spindle for any damage or blockages.
- 3 Do not force the arm to rotate as this may cause damage to the spindle or arm.

4.11.5 ATC Auto Recovery

ATC Auto Recovery function is built into the Maintenance screen to facilitate one touch recovery of the ATC system in the event of any accident or abnormal operation.

When ATC Auto Recovery is activated it will automatically operate all the ATC actuators and the spindle clamp / unclamp solenoids in the correct sequence to return the ATC to standby condition.

ATC Auto Recovery function can be operated in Single mode or Jog mode.

Single Mode

In Single mode, when the **[ON]** button is pressed, the recovery operation will start and complete in a single sequence. The process can only be terminated by pressing the **[OFF]** button or by activating Emergency.

Jog Mode

In Jog mode, when the **[ON]** button is pressed, the recovery operation will start and proceed through the recovery sequence. When the **[ON]** button is released, the recovery operation will terminate immediately.

To start ATC Auto Recovery, the prerequisites for ATC arm movement are required and will be displayed in the Maintenance Advice area similar to other ATC actuators.

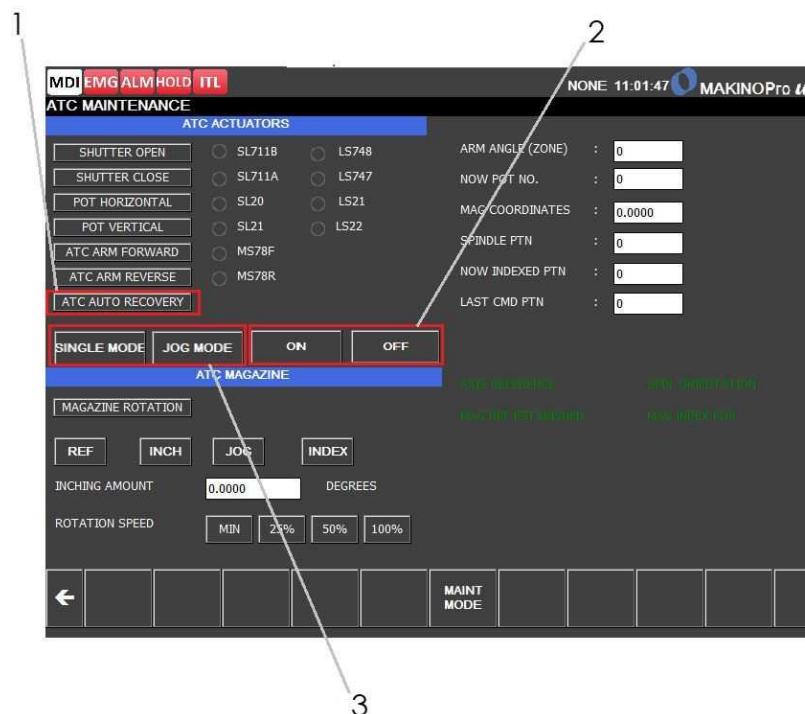


Figure 4.23 ATC Auto Recovery

No.	Name	No.	Name
1	ATC Auto Recovery Display	3	[SINGLE MODE] / [JOG MODE] Button
2	Single/Jog Mode Button [ON] / [OFF]	-	-

-NOTES-

- 1 Auto Recovery does not alter the tool data.
- 2 It is possible to interchange spindle and magazine index tool when moving the ATC arm in Maintenance mode. However, tool data is not updated for arm movements in Maintenance mode.
- 3 After any ATC Maintenance operation, always check and ensure the tool data is correct before proceeding with automatic operation.

4.11.6 ATC Magazine Maintenance Operation

The ATC magazine can be operated in four modes:

- Reference Mode
- Inch Mode
- Index Mode
- Jog Mode

ATC Magazine Reference Mode

This mode allows the operator to perform the magazine reference setting manually. In this mode, magazine rotation speed is locked to the minimum.

ATC Magazine Inch Mode

This mode allows the operator to rotate the magazine by a fixed distance clockwise or anti-clockwise each time the button is pressed.

The inching amount in degrees must be entered in the input box. If no value is set, the magazine does not move. The rotation speed setting is applicable in this mode.

ATC Magazine Index Mode

In this mode, the magazine will rotate when the clockwise or anti-clockwise button is pressed.

These CW and CCW buttons are located the ATC operation panel. Once the button is released, the magazine will automatically rotate the nearest pot to the index position. The rotation speed setting is applicable in this mode.

ATC Magazine Jog Mode

In this mode, the magazine will rotate when the clockwise or anti-clockwise button is pressed. When the button is released, the magazine stops immediately at the current position.

The rotation speed setting is applicable in this mode.

The current magazine coordinates and current indexed pot number are displayed on the right for reference.

The Magazine Reference status as well as the Magazine Pot Indexed status is also displayed below.

The clockwise and anti-clockwise buttons are located on the ATC operation panel on the left of the machine. This is for safety as the operator is unable to see the magazine when operating from the operator panel.

ATC Magazine Maintenance Operation Procedure

- 1) Enable Maintenance mode.
- 2) Select Magazine Rotation.
- 3) Select an operation mode, Ref, Inch, Index or Jog.
- 4) Enter an inching amount if Inch mode is selected.
- 5) Select a rotation speed.
- 6) Press CW or CCW on the ATC operator panel.

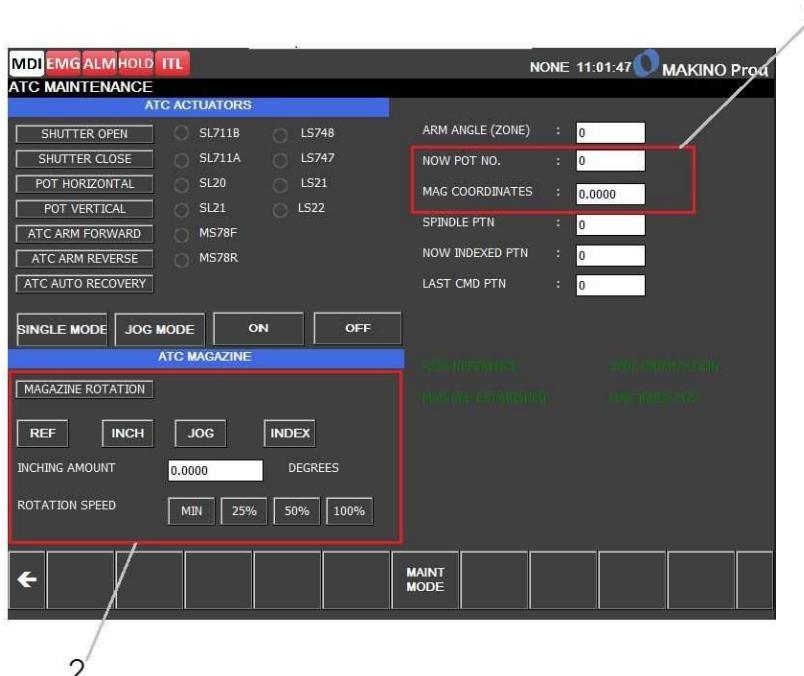


Figure 4.24 ATC Magazine Maintenance

No.	Name	No.	Name
1	Current Pot Information	2	ATC Magazine Information

4.11.7 ATC Operator Panel Enable (Tool Magazine Side)

For safety reasons, the ATC operation panel and ATC Maintenance screen cannot be operated at the same time. When ATC Maintenance mode is on, ATC Manual Intervention mode is off and the buttons on the ATC operation panel cannot be operated.

By pressing the [ATC OP PANEL] button, it is possible to enable the ATC operation panel in Maintenance mode. In this condition, the on and off buttons on the ATC Maintenance screen are disabled but the push buttons on the ATC operation panel are enabled.

5 M Code

This M code list describes all M codes. Please note that there are some M codes that cannot be used depending upon the machine specifications and options that are provided.

5.1 M Code List

M00	Program Stop
M01	Optional Stop
M02	End of Program
M03	Spindle Start in CW Direction
M04	Spindle Start in CCW Direction
M05	Spindle Stop
M06	Automatic Tool Change
M07	Mist Coolant/Air Blow On
M08	Nozzle Coolant On
M09	Coolant Off
M10	4th Axis Clamp
M11	4th Axis Unclamp
M12	5th Axis Clamp
M13	5th Axis Unclamp
M16	4th Axis Mirror Image On
M19	Spindle Orientation
M20	BTS (Broken Tool Detection) Check
M21	X-Axis Mirror Image On
M22	Y-Axis Mirror Image On
M23	Mirror Image Off
M26	Through Spindle Coolant On
M29	Unconditional Power Off
M30	End of Program
M36	Prior Tool Check Mode
M37	Tool Data Register Mode Off
M38	AC/SL Value Temporary Alteration Mode On
M39	AC/SL Value Temporary Alteration Mode Off
M41	SL Coefficient Setting 125%
M42	SL Coefficient Setting 150%
M43	SL Coefficient Setting 200%
M44	SL AC Coefficient 0%

M46	SL Lower Limit Coefficient Setting 125%
M47	SL Lower Limit Coefficient Setting 0%
M48	M49 Mode Cancel
M49	Cutting Feed Rate Override Cancel
M50	AC Coefficient 100%, SL Coefficient 200%
M54	Tool Offset Negative Value Register Mode
M56	Tool Offset Data Transfer Command
M57	Tool Number Registering Mode On
M58	M59 Mode Cancel
M59	Spindle Speed Override Cancel
M77	Through Spindle Air On
M94	Tool Data Delete Mode On
M97	Overhead Shower Coolant On
M98	Sub Program Call
M99	Return To Main Program
M132	Feed Rate Override 100% or Less
M135	Rigid Tap Mode On
M140	First Block Skip On
M141	First Block Skip Off
M142	First Block Skip Return
M150	Block Skip (2 To 9) Off
M152	Block Skip 2 On
M153	Block Skip 3 On
M154	Block Skip 4 On
M155	Block Skip 5 On
M156	Block Skip 6 On
M157	Block Skip 7 On
M158	Block Skip 8 On
M159	Block Skip 9 On
M186	Machined Parts Count
M187	Dry Run Off
M188	Dry Run On
M198	Sub Program Call From External I/O Device
M235	TL Mode Off
M236	TL Mode On
M237	SL Mode Off
M238	SL Mode On

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M250	High Accuracy Mode
M251	High Performance Mode
M276	Stroke Exchange Signal Off
M277	Stroke Exchange Signal On
M302	Confirmation of M303, M304 Operation Finish
M303	Rotate Spindle CW and Start Next Block Before Spindle Reaches Specified Speed
M304	Rotate Spindle CCW and Start Next Block Before Spindle Reaches Specified Speed
M314	Pre-Measurement Spindle Rotation
M318	Spindle Orientation at Externally Specified Angle
M319	Pre-Orientation and Coolant Off
M330	Spindle Reverse Orientation at Externally Specified Angle
M390	Spindle Tool Clamp
M391	Spindle Tool Unclamp
M398	Through Spindle Mist On
M399	Mist Blow On
M436	Signal Lamp 1 Unconditional On
M437	Signal Lamp 2 Unconditional On
M448	Tool Data Register Mode
M466	Read Macro Data (#100)
M508	Operator Door Close
M509	Operator Door Open
M530	Fixture Code 1
M531	Fixture Code 2
M534	Fixture Coolant Off
M535	Fixture Coolant On
M580	M Code for Special User I/O Interface
M581	M Code for Special User I/O Interface
M582	M Code for Special User I/O Interface
M583	M Code for Special User I/O Interface
M584	M Code for Special User I/O Interface
M585	M Code for Special User I/O Interface
M586	M Code for Special User I/O Interface
M587	M Code for Special User I/O Interface
M588	M Code for Special User I/O Interface
M589	M Code for Special User I/O Interface
M590	M Code for Special User I/O Interface
M591	M Code for Special User I/O Interface

M592	M Code for Special User I/O Interface
M593	M Code for Special User I/O Interface
M594	M Code for Special User I/O Interface
M595	M Code for Special User I/O Interface
M709	Stop Coolant Before Axis Positioning Is Completed
M710	Mist Collector Off
M711	Mist Collector On
M712	Through Spindle Air Off
M724	Overhead Shower Coolant Off
M736	Machine Light On
M737	Machine Light Off
M740	Inner Chip Conveyor Off
M741	Inner Chip Conveyor On
M742	Oil Skimmer Off
M743	Oil Skimmer On
M756	Air Blow On
M775	Tool Cleaning Air Off
M776	Tool Cleaning Air On
M786	Fixture Cleaning Coolant Off
M787	Fixture Cleaning Coolant On
M790	Amount of Oil Set To Little (MQL)
M791	Amount of Oil Set To Standard (MQL)
M792	Amount Of Oil Set To Large (MQL)
M793	Mist Pressure Set To High (MQL)
M794	Mist Pressure Set To Standard (MQL)
M919	Machined Piece Count
M920	Tool Length Measurement Data Read
M921	Tool Radius Measurement Data Read
M922	M920, M921 Data Incremental Mode

5.2 M Code Specification

The specifications for each M code are shown below.

-NOTE-

(D) means that this code is executed after axis travel if an axis travel command is issued in the same block.

M00	Program Stop (D)
	<input type="checkbox"/> Program G01 X_Y_F_M00; <input type="checkbox"/> Explanation Automatic operation is stopped after execution of the block in which M00 is issued. At this time, the spindle rotation and the coolant supply are stopped. The [CYCLE START] lamp flashes. If the signal light exists, the signal light is also turned on. Press [CYCLE START] to resume spindle rotation and the cutting fluid supply. The automatic operation is restarted. If the signal light exists, the signal lamp is turned off.
M01	Optional Stop (D)
	<input type="checkbox"/> Program G01 X_Y_F_M01; <input type="checkbox"/> Explanation When the [OPTIONAL STOP] switch is turned on, this performs the same action as with M01. When [OPTIONAL STOP] is turned off, M01 is ignored and NC executes the next block.
M02	End of Program (D)
	<input type="checkbox"/> Explanation Indicates end of program and resets NC. After operating M02, (a) Spindle rotation is stopped. (b) Coolant is stopped. (c) Mirror Image is turned off.
M03	Spindle Start in CW Direction
	<input type="checkbox"/> Program S800 M03 G00 X_Y_; <input type="checkbox"/> Explanation The spindle is rotated in a clockwise direction at the speed specified by S code. If S code has not been issued, an alarm is triggered.
M04	Spindle Start in CCW Direction
	<input type="checkbox"/> Program S800 M04 G00 X_Y_; <input type="checkbox"/> Explanation The spindle is rotated in a counterclockwise direction at the speed specified by S code. If no S code has not been issued, an alarm is triggered.
M05	Spindle Stop (D)
	<input type="checkbox"/> Program G01 X_Y_F_M05; <input type="checkbox"/> Explanation The spindle is stopped after execution of the block in which M05 is issued.

M06 Automatic Tool Change	
	<input type="checkbox"/> Program M06; <input type="checkbox"/> Explanation The spindle tool is changed to the tool indexed at the next tool position in the magazine or in the ATC arm. With M06 the following happens. (a) Coolant stop. (b) Spindle orientation stop. (c) Tool change by ATC arm.
M07 Mist Coolant or Air Blow On	
	<input type="checkbox"/> Explanation Mist coolant or air blow is turned on.
M08 Nozzle Coolant On	
	<input type="checkbox"/> Explanation The nozzle coolant is turned on.
M09 Coolant Off (D)	
	<input type="checkbox"/> Program G01 X_ Y_ F_ M09; <input type="checkbox"/> Explanation Coolant is stopped after execution of the block in which M09 is issued.
M10 4th Axis Clamp	
	<input type="checkbox"/> Program M10; G91 G01 A_ F_ M10; <input type="checkbox"/> Explanation The 4th axis (typically it is a NC rotary table) is clamped after execution of the block in which an M10 is issued.
M11 4th Axis Unclamp	
	<input type="checkbox"/> Program M11; G91 G01 A_ F_ M11; <input type="checkbox"/> Explanation The 4th axis (typically it is a NC rotary table) is unclamped.
M12 5th Axis Clamp	
	<input type="checkbox"/> Program M12; G91 G01 B_ F_ M12;; <input type="checkbox"/> Explanation The 5th axis (typically it is a NC rotary table) is clamped after execution of the block in which an M12 is issued.
M13 5th Axis Unclamp	
	<input type="checkbox"/> Program M13; G91 G01 B_ F_ M13; <input type="checkbox"/> Explanation The 5th axis (typically it is a NC rotary table) is unclamped.

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M16 4th Axis Mirror Image On	
	<input type="checkbox"/> Program G28 B_ M11; M16; G00 B_ M10; <input type="checkbox"/> Explanation The mirror image for 4th axis is turned on (only 4th axis machine). Program an independent block for this function.
M19 Spindle Orientation	
	<input type="checkbox"/> Program G01 X_Y_ M19; <input type="checkbox"/> Explanation Spindle is oriented and stopped after execution of the block in which M19 is issued.
M20 BTS (Broken Tool Detection) Check	
	<input type="checkbox"/> Explanation Command M20 following broken tool detection. If abnormal, a BTS alarm is triggered.
M21 X-Axis Mirror Image On	
	<input type="checkbox"/> Program G28 X_ Y_; M21; G01 X_ Y_ F_; <input type="checkbox"/> Explanation The mirror image for the X-axis is turned on. Program an independent block for this function.
M22 Y-Axis Mirror Image On	
	<input type="checkbox"/> Program G28 X_ Y_; M22; G01 X_ Y_ F_; <input type="checkbox"/> Explanation The mirror image for Y-axis is turned on. Program an independent block for this function.
M23 Mirror Image Off (D)	
	<input type="checkbox"/> Program G28 X_ Y_ M23; G01 X_ Y_ F_; <input type="checkbox"/> Explanation Active Mirror Image for X, Y and/or 4th/5th axis is turned off after execution of the block containing M23.
M26 Through Spindle Coolant On	
	<input type="checkbox"/> Explanation Through Spindle Coolant is turned on.
M29 Unconditional Power Off (D)	
	<input type="checkbox"/> Program G00 Z_; X_ Y_; M29; <input type="checkbox"/> Explanation Power supply is shutdown when Power Off mode has been on. Program an independent block for this function.

M30 End of Program
<p><input type="checkbox"/> Explanation This indicates the end of the program, cancels the following functions, performs program heading and resets the NC.</p> <ul style="list-style-type: none"> (a) Spindle rotation is stopped. (b) Coolant is stopped. (c) Mirror Image is turned off.
M36 Prior Tool Check Mode
<p><input type="checkbox"/> Program M36; T Tool No.; T Tool No.; : M37</p> <p><input type="checkbox"/> Explanation Tool to be used (including spare tools) are all checked for availability before machining. If a tool to be used is assigned to an alarm or is not registered, an alarm is triggered.</p> <p><input type="checkbox"/> Program Example O1234; M36; T1; T2; T3; M37; : (Machining) M30;</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">  After the prior tool life check before machining, execute M37 to terminate the prior tool life check mode. This mode is canceled also by M02, M30, emergency stop and the tool life alarm function. </div>

M37 Tool Data Register Mode Off	
	<p><input type="checkbox"/> Program</p> <p>M_;← Tool No. register mode on such as M57 S_T_;← Tool data registration M37;</p> <p><input type="checkbox"/> Explanation</p> <p>Tool data register mode is turned off. When register mode is activated, other register modes cannot be activated unless the current mode is deactivated. If multiple items of data are to be registered in an NC program, register mode must be deactivated before registering the next data item. If tool data is to be registered in a machining program, register mode must be deactivated to distinguish the tool data from the T or S code. In such cases, use M37 to deactivate the register mode.</p> <p><input type="checkbox"/> Program Example</p> <pre>O1234; M57; ← PTN register mode on S1 T1000; ← PTN 1000 is set to 1st pot magazine S2 T2000; ← PTN 2000 is set to 2nd pot magazine M37; ← Data register mode off M46; SL; ← SL data register mode on T1000 S123; ← SL value 12.3A is set to PTN1000 T2000 S456; ← SL value 45.6A is set to PTN2000 M37; ← Data register mode off : (Machining) M30;</pre>
M38 AC/SL Value Temporary Alteration Mode On	
	<p><input type="checkbox"/> Program</p> <p>M38; S AC data; S SL data; M39;</p> <p><input type="checkbox"/> Explanation</p> <p>AC/SL data for spindle tool is set. First S is for AC data and the second S is for SL data. Specified monitor data is retained until an M06 or M02/M30 is issued. If S9999 is specified, the monitoring data is not altered but the data on the Tool Data screen becomes valid.</p> <p><input type="checkbox"/> Program Example</p> <pre>O1234; M38; S100; ← 10.0 (A) is set to AC of spindle tool S125; ← 12.5 (A) is set to SL of spindle tool M39; (Machining) M30</pre>

M39 AC/SL Value Temporary Alteration Mode Off	
<input type="checkbox"/> Program M38; S AC data; S SL data; M39; <input type="checkbox"/> Explanation AC/SL data temporary alter mode is deactivated and the specified value becomes invalid.	
M41 SL Coefficient Setting 125%	
<input type="checkbox"/> Explanation In study mode, the SL coefficient data is set to 125% (Max. spindle actual load current X 1.25).	
M42 SL Coefficient Setting 150%	
<input type="checkbox"/> Explanation In study mode, the SL coefficient data is set to 150% (Max. spindle actual load current X 1.50).	
M43 SL Coefficient Setting 200%	
<input type="checkbox"/> Explanation In study mode, the SL coefficient data is set to 200% (Max. spindle actual load current X 2.00).	
M44 SL AC Coefficient 0%	
<input type="checkbox"/> Explanation When the SL and AC functions are not performed.	
M46 SL Lower Limit Coefficient Setting 125%	
<input type="checkbox"/> Explanation In study mode, the SL (lower limit) coefficient data is set to 125% (spindle load X 1.25).	
M47 SL Lower Limit Coefficient Setting 0%	
<input type="checkbox"/> Explanation In study mode, the SL (lower limit) coefficient data is set to 0% (spindle load X 0).	
M48 M49 Mode Cancel (D)	
<input type="checkbox"/> Program G01 X_Y_F_M48; <input type="checkbox"/> Explanation Feed rate override is enabled after execution of the block containing M48.	
M49 Feed Rate Override Cancel	
<input type="checkbox"/> Program M49; G01 X_Y_F_; <input type="checkbox"/> Explanation Feed rate override is disabled and fixed at 100% until M48 or M02/M30 is issued.	
M50 AC Coefficient 100%, SL Coefficient 200%	
<input type="checkbox"/> Explanation In study mode, the AC data is fixed at 100% and the SL data is fixed at 200%. AC data = (Max. spindle actual load current X 1.00) SL data = (Max. spindle actual load current X 2.00)	

M54 Tool Offset Negative Value Register Mode	
<input type="checkbox"/> Program	M_; T_; M54; : S_; M37(M30);
	← Tool data register mode on ← Indicates that following data is a negative value
<input type="checkbox"/> Explanation	Used when setting data is a negative value. The command timing, whether in the same block or in the previous block, depends on the item to be set. M54 is effective only for single data items ("one-shot" M code)
<input type="checkbox"/> Program Example	M53; T1; M54; S123456 ; S1234 M30
	← Tool length/radius offset data register mode on ← Indicates that following data is a negative value ← Tool length offset data -123.456 mm for PTN 1 ← Tool radius offset data +1.234 mm for PTN 1 (In inch mode, +0.1234 inch)

M56 Tool Offset Data Transfer Command Program

H Offset No. D Offset No.;
M56;

 Explanation

Tool length and radius offset data for spindle tool is transferred to the specified offset number when M56 is issued.

If the offset number is "0", the data will not be transferred, For example: with "H1 D0" the tool length data is transferred to H1 but not the tool radius data.

Data is sent as follows according to type of tool offset memory.

Tool Offset Memory A

H Number

Tool Length (Geometry (H)) + Tool Length (Wear (H)) → H No. Tool Offset Value

D Number

Tool Radius (Geometry (D)) + Tool Radius (Wear (D)) → D No. Tool Offset Value

Tool Offset Memory B/C

H Number

Tool Length (Geometry (H)) → H No. Geometry

Tool Length (Wear (H)) → H No. Wear

D Number

Tool Radius (Geometry (D)) → D No. Geometry

Tool Radius (Wear (H)) → D No. Wear

 Program Example

O1234;

T1;

M06;

H1 D2;

M56;

← Tool length data is sent to offset No.1 and tool radius data is sent to offset No.2.

(Machining)

T2;

M06;

H3 D0;

M56;

← Tool length data is sent to offset No.3 but tool radius data is not sent.

(Machining)

M30;

 If M56 is issued in the same block as H or D numbers (H_D_M56;), all data may be transferred to the previously commanded H D numbers. For this reason, program an independent block M56.

Chapter 4 Operation

M57 Tool Number Registering Mode On	
	<p><input type="checkbox"/> Explanation Two registering methods; the Sequential Method which registers from pot No.1 upward and the Random Method which registers specifically required pots are provided for tool number registration. The tool number is the reference guide for the registration of all other tool data because tool numbers are required to be registered first. For tool No. "0000", other tool data cannot be registered, excepting through the Tool Detail PC screen.</p> <p>[Sequential Method]</p> <p><input type="checkbox"/> Program M57; T Tool No; : T Tool No; M30;</p> <p>After M57, specify tool numbers to be set with T from the first pot. The number of pots registerable depends on the maximum number of pots in the tool magazine. It is not necessary to specify all the pots, however skipping pot numbers is not possible.</p> <p><input type="checkbox"/> Program Example O1234; M57; T1; ← Tool No.1 for pot No.1 T2; ← Tool No.1 for pot No.2 T3; ← Tool No.1 for pot No.3 : T20; M30;</p>
M58 M59 Mode Cancel (D)	
	<p><input type="checkbox"/> Program G01 X_ Y_ F_; M58; G01 X_ Y_ F_;</p> <p><input type="checkbox"/> Explanation The spindle speed override switch becomes effective.</p>
M59 Spindle Speed Override Cancel	
	<p><input type="checkbox"/> Program S800 M03; M59; G01 X_ Y_ F_;</p> <p><input type="checkbox"/> Explanation The spindle speed override switch is bypassed and fixed at 100%, until M58 is issued. Program as an independent block.</p>
M77 Through Spindle Air On	
	<p><input type="checkbox"/> Explanation Turns on through spindle air blow.</p>

M94 Tool Data Delete Mode On	
	<p><input type="checkbox"/> Program M94; T <u>Tool No.</u>; : T <u>Tool No.</u>; M37(M30);</p> <p><input type="checkbox"/> Explanation After M94, specify a tool number to be deleted with T. By this command, all the tool data of the specified tool number is deleted including the tool number. However, the tool data for tool No. "0000" cannot be deleted.</p> <p><input type="checkbox"/> Program Example O1234; M94; T1; ← Deletes all the data for pot in which tool No. 1 is stored. T2; ← Deletes all the data for pot in which tool No. 2 is stored. M30;</p>
M97 Overhead Shower Coolant On	
	<p><input type="checkbox"/> Explanation Coolant from the overhead (ceiling) shower is turned on.</p>
M98 Sub Program Call	
	<p><input type="checkbox"/> Program M98 P_;</p> <p><input type="checkbox"/> Explanation A sub program specified with P is called up.</p>
M99 Return To Main Program	
	<p><input type="checkbox"/> Program M99;</p> <p><input type="checkbox"/> Explanation Returns to the main program from the program called up by M98P.</p>
M132 Feed Rate Override 100% or Less	
	<p><input type="checkbox"/> Program M132 S100;</p> <p><input type="checkbox"/> Explanation M132 Sxx used in automatic measuring macro program the upper limit of the cutting feed rate override is set to the percentage specified by S. This function is turned off when M02/M30 is specified or NC is reset.</p>
M135 Rigid Tap Mode On	
	<p><input type="checkbox"/> Program S*****; M135 S*****; G84 Z_ R_ F_; G80; M30;</p> <p><input type="checkbox"/> Explanation At the first S command, give the same S code in the M135 block.</p>

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M140 First Block Skip On	
	<input type="checkbox"/> Explanation Used in the macro program for automatic measuring. This M code stores the block skip 1 status and turns on block skip 1.
M141 First Block Skip Off	
	<input type="checkbox"/> Explanation Used in the macro program for automatic measuring. This M code stores the block skip 1 status and turns off block skip 1.
M142 First Block Skip Return	
	<input type="checkbox"/> Explanation Used in the macro program for automatic measuring. This M code returns the status of block skip 1 to its previous status with M140/M141.
M150 Block Skip (2 to 9) Off	
	<input type="checkbox"/> Explanation Block skips 2 to 9 are turned off.
M152 Block Skip 2 On	
	<input type="checkbox"/> Explanation Block skip 2 is turned on.
M153 Block Skip 3 On	
	<input type="checkbox"/> Explanation Block skip 3 is turned on.
M154 Block Skip 4 On	
	<input type="checkbox"/> Explanation Block skip 4 is turned on.
M155 Block Skip 5 On	
	<input type="checkbox"/> Explanation Block skip 5 is turned on.
M156 Block Skip 6 On	
	<input type="checkbox"/> Explanation Block skip 6 is turned on.
M157 Block Skip 7 On	
	<input type="checkbox"/> Explanation Block skip 7 is turned on.
M158 Block Skip 8 On	
	<input type="checkbox"/> Explanation Block skip 8 is turned on.
M159 Block Skip 9 On	
	<input type="checkbox"/> Explanation Block skip 9 is turned on.
M186 Machined Parts Count	
	<input type="checkbox"/> Explanation Increment the product counter. Number to be added to the counter is specified by T and the group of counters to which the value is added is specified by S. If T has not been specified, it is regarded as T1 has been specified. If S has not been specified, all the product counter specified to be added by M186 are added.

M187 Dry Run Off	
	<input type="checkbox"/> Explanation Turns off the dry run mode.
M188 Dry Run On	
	<input type="checkbox"/> Explanation Turns on the dry run mode.
M198 Sub Program Call From External I/O Device	
	<input type="checkbox"/> Program M198 P_; <input type="checkbox"/> Explanation A sub program specified with P is called from an external I/O device.
M235 TL Mode Off	
	<input type="checkbox"/> Explanation Turns off TL mode.
M236 TL Mode On	
	<input type="checkbox"/> Explanation Turns on TL mode.
M237 SL Mode Off	
	<input type="checkbox"/> Explanation Turns off SL mode.
M238 SL Mode On	
	<input type="checkbox"/> Explanation Turns on SL mode.
M250 High Accuracy Mode	
	<input type="checkbox"/> Explanation Turns on high accuracy cutting mode.
M251 High Performance Mode	
	<input type="checkbox"/> Explanation Turns on high performance cutting mode.
M276 Stroke Exchange Signal Off	
	<input type="checkbox"/> Explanation Stroke exchange signal is turned off.
M277 Stroke Exchange Signal On	
	<input type="checkbox"/> Explanation Stroke exchange signal is turned on.
M302 Confirmation of M303, M304 Operation Finish	
	<input type="checkbox"/> Explanation Confirms completion of M303 or M304. Control falls into waiting condition until confirmation. Nothing happens when commanding M302 without M303 or M304.

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M303 Rotate Spindle CW and Start Next Block Before Spindle Reaches Specified Speed	
	<ul style="list-style-type: none"><input type="checkbox"/> Program S2000 M303; G00 G90 Y_ Z_ M302; G01 Z_;<input type="checkbox"/> Explanation Starts the spindle in CW direction and proceeds to the next block without waiting for the spindle to reach the specified speed. In the example above, the Y/Z- axis feed starts before the spindle speed reaches 2000. Always issue M303 and M302 together.
M304 Rotate Spindle CCW and Start Next Block Before Spindle Reaches Specified Speed	
	<ul style="list-style-type: none"><input type="checkbox"/> Program S2000 M304; G00 G90 Y_Z_M302; G01 Z_;<input type="checkbox"/> Explanation Starts the spindle in CCW direction and proceeds to the next block without waiting for the spindle to reach the specified speed. In the example above, the Y/Z- axis feed starts before the spindle speed reaches 2000. Always issue M304 and M302 together.
M314 Pre-Measurement Spindle Rotation	
	<ul style="list-style-type: none"><input type="checkbox"/> Explanation Used in the automatic measuring macro program.
M318 Spindle Orientation At Externally Specified Angle	
	<ul style="list-style-type: none"><input type="checkbox"/> Program #100= Orient angle; M466; M318;<input type="checkbox"/> Explanation Set an angle to macro variable #100 and send it to the machine software with M466. M318 orients the spindle to this angle. The angle for #100 must be above the decimal point. Range: 0.0°~ 360.0° Min.Unit: 0.1°<input type="checkbox"/> Program Example O1234; #100=45.; M466; M318; M30;
M319 Pre-Orientation & Coolant Off	
	<ul style="list-style-type: none"><input type="checkbox"/> Program G91 G30 Z0 M319; G30 X0 Y0; M06;<input type="checkbox"/> Explanation This M code is for decreasing machining time. Coolant stops together with axis movement and spindle orientation starts. Control advances to the next block without waiting for the completion of spindle orientation. Confirmation of spindle stop at the orientation position is performed during M06. Suction/purging of through spindle coolant continues until M06 is completed.

M330 Spindle Reverse Orientation At Externally Specified Angle	
	<input type="checkbox"/> Explanation Used to reverse spindle rotating direction for the “spindle optional angle external orientation” (M318). When M318 is completed, M330 becomes invalid.
M390 Spindle Tool Clamp	
	<input type="checkbox"/> Explanation The tool in the machine spindle is clamped.
M391 Spindle Tool Unclamp	
	<input type="checkbox"/> Explanation The tool in the machine spindle is unclamped. Please command spindle orientation before issuing M391.
 M390 and M391 are only for special machines. If these M codes are used improperly, the tool may drop resulting in machine damage or injury.	
M398 Through Spindle Mist On	
	<input type="checkbox"/> Explanation Through spindle mist is turned on.
M399 Mist Blow On	
	<input type="checkbox"/> Explanation Mist blow is turned on.
M436 Signal Lamp 1 Unconditional On	
	<input type="checkbox"/> Explanation Turns on the signal lamp 1 unconditionally. To turn off, press the [WARNING LIGHT OFF] button on the Function screen.
M437 Signal Lamp 2 Unconditional On	
	<input type="checkbox"/> Explanation Turns on the signal lamp 2 unconditionally. To turn off, press the [WARNING LIGHT OFF] button on the Function screen.

M448 Tool Data Register Mode

- Program
M448 S Tool Data Reg. Mode;
S Pot No. T Setting Value;
:
S Pot No. T Setting Value;
M448 (M37, M30);
- Explanation
Used to register the desired tool data. First, specify the tool data registration mode, then register pot number and individual setting value.
If M448 S0 is specified or M448 is specified without S, the tool data registration mode is turned Off (same as M37 or M30).
Specify the pot number with S command and tool data setting value with T command in the block after M448.
Note:
M448 S4 (S4: tool number) functions is the same as M57 (tool number registration). For the tool data register modes and settings, refer to the table below.

Tool Data Register Mode	Tool Data Unit
3	Pot Type 0: Standard 1: Medium 2: Large 3: Extra Large 4: Empty 5: Dummy
4	Tool No. (PTN) 1~99999999
5	Tool Function (Type) No. (FTN) 1~99999999
9	Through Spindle Coolant 0: Disable 1: Enable
13	Tool Change Prohibit 0: Disable 1: Enable
102	Tool Kind (Type) 0: Standard 1: Drill 2: Ball End Mill 3: End Mill 4: Boring Bar 5: Spring Tool 1 6: Spring Tool 2 7: Tapper 8: Reamer 9: Face Mill 10: Probe 11: Grinding Stone

103	Tool Length (Geometry: H) -99999999~99999999 (0.0001mm/0.0001inch)
104	Tool Length (Wear: H) -99999999~99999999 (0.0001mm/0.0001inch)
105	Tool Diameter (Geometry: H) -99999999~99999999 (0.0001mm/0.0001inch)
106	Tool Diameter (Geometry: H) -99999999~99999999 (0.0001mm/0.0001inch)
108	TL Alarm 0~99999999 (Time: minute Distance: meter Count: piece)
109	TL Warning 0~99999999 (Time: minute Distance: meter Count: piece)
110	TL Current Value 0~99999999 (Time: minute Distance: meter Count: piece)
119	SL Upper Limit 0~20000 (0.01%)
120	SL Lower Limit 0~20000 (0.01%)
121	AC 0~20000 (0.01%)

 Program Example

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M448 S4;           ← Tool register mode
S1 T101;          ← Register tool No.101 for pot No.1
S10 T110;         ← Register tool No.110 for pot No.10
M448 S5;           ← FTN register mode
S1 T101;          ← Register FTN101 for pot No.1
S10 T110;         ← Register FTN110 for pot No.10
M448 S103 T1;     ← Cutter 1 tool length (geometry) register mode
S1 T101;          ← Tool length (geometry) 0.101 is registered for pot No.1 cutter
S10 M54 T110;    ← Tool length (geometry) -0.110 is registered for pot No.10 cutter 1
M448 S103 T2;     ← Cutter 2 tool length (geometry) register mode
S1 T201;          ← Tool length (geometry) 0.201 is registered for pot No.1 cutter 2
M448;             ← Tool data register mode off

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Chapter 4 Operation

M466 Read Macro Data (#100)	
	<input type="checkbox"/> Explanation Data for macro variable #100 is read by machine side control. It is used to specify the position for spindle optional angle orientation M318.
M508 Operator Door Close	
	<input type="checkbox"/> Explanation Operator door is closed.
M509 Operator Door Open	
	<input type="checkbox"/> Explanation Operator door is opened.
M530 Fixture Code 1	
	<input type="checkbox"/> Explanation Fixture clamps.
M531 Fixture Code 2	
	<input type="checkbox"/> Explanation Fixture unclamps.
M534 Fixture Coolant Off	
	<input type="checkbox"/> Explanation Fixture coolant is turned off.
M535 Fixture Coolant On	
	<input type="checkbox"/> Explanation Fixture coolant is turned on.
M580 M Code for Special User I/O Interface	
	<input type="checkbox"/> Program M580; <input type="checkbox"/> Explanation USDO1 signal of special user I/O interface is turned off. Other output signals in the same group are also turned off.
M581 M Code for Special User I/O Interface	
	<input type="checkbox"/> Program M581; <input type="checkbox"/> Explanation USDO1 signal of special user I/O interface is turned on. Other output signals in the same group are also turned off.
M582 M Code for Special User I/O Interface	
	<input type="checkbox"/> Program M582; <input type="checkbox"/> Explanation USDO2 signal of special user I/O interface is turned off. Other output signals in the same group are also turned off.
M583 M Code for Special User I/O Interface	
	<input type="checkbox"/> Program M583; <input type="checkbox"/> Explanation USDO2 signal of special user I/O interface is turned on. Other output signals in the same group are also turned on.

M584 M Code for Special User I/O Interface	<input type="checkbox"/> Program M584; <input type="checkbox"/> Explanation USDO3 signal of special user I/O interface is turned off. Other output signals in the same group are also turned off.
M585 M Code for Special User I/O Interface	<input type="checkbox"/> Program M585; <input type="checkbox"/> Explanation USDO3 signal of special user I/O interface is turned on. Other output signals in the same group are also turned on.
M586 M Code for Special User I/O Interface	<input type="checkbox"/> Program M586; <input type="checkbox"/> Explanation USDO4 signal of special user I/O interface is turned off. Other output signals in the same group are also turned off.
M587 M Code for Special User I/O Interface	<input type="checkbox"/> Program M587; <input type="checkbox"/> Explanation USDO4 signal of special user I/O interface is turned on. Other output signals in the same group are also turned on.
M588 M Code for Special User I/O Interface	<input type="checkbox"/> Program M588; <input type="checkbox"/> Explanation USDO5 signal of special user I/O interface is turned off. Other output signals in the same group are also turned off.
M589 M Code for Special User I/O Interface	<input type="checkbox"/> Program M589; <input type="checkbox"/> Explanation USDO5 signal of special user I/O interface is turned on. Other output signals in the same group are also turned on.
M590 M Code for Special User I/O Interface	<input type="checkbox"/> Program M590; <input type="checkbox"/> Explanation USDO6 signal of special user I/O interface is turned off. Other output signals in the same group are also turned off.
M591 M Code for Special User I/O Interface	<input type="checkbox"/> Program M591; <input type="checkbox"/> Explanation USDO6 signal of special user I/O interface is turned on. Other output signals in the same group are also turned on.

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M592 M Code for Special User I/O Interface	
	<input type="checkbox"/> Program M592; <input type="checkbox"/> Explanation USDO7 signal of special user I/O interface is turned off. Other output signals in the same group are also turned off.
M593 M Code for Special User I/O Interface	
	<input type="checkbox"/> Program M593; <input type="checkbox"/> Explanation USDO7 signal of special user I/O interface is turned on. Other output signals in the same group are also turned on.
M594 M Code for Special User I/O Interface	
	<input type="checkbox"/> Program M594; <input type="checkbox"/> Explanation USDO8 signal of special user I/O interface is turned off. Other output signals in the same group are also turned off.
M595 M Code for Special User I/O Interface	
	<input type="checkbox"/> Program M595; <input type="checkbox"/> Explanation USDO8 signal of special user I/O interface is turned on. Other output signals in the same group are also turned on.
M709 Stop Coolant Before Axis Positioning Is Completed	
	<input type="checkbox"/> Program G01 X_ Y_ F_ M709; <input type="checkbox"/> Explanation All coolant supply is stopped and the suction/purging function turned on without waiting for the axis movement completion signal to be issued.
M710 Mist Collector Off	
	<input type="checkbox"/> Explanation The mist collector is turned off.
M711 Mist Collector On	
	<input type="checkbox"/> Explanation The mist collector is turned on.
M712 Through Spindle Air Off	
	<input type="checkbox"/> Explanation The through spindle air (TSA) is turned off.
M724 Overhead Shower Coolant Off	
	<input type="checkbox"/> Explanation The overhead shower coolant turned off.
M736 Machine Lighting On	
	<input type="checkbox"/> Explanation Machine light is turned on.
M737 Machine Lighting Off	
	<input type="checkbox"/> Explanation Machine light is turned off.

M740	Inner Chip Conveyor Off
	<input type="checkbox"/> Explanation Stops the inner conveyor.
M741	Inner Chip Conveyor On
	<input type="checkbox"/> Explanation Starts the inner conveyor.
M742	Oil Skimmer Off
	<input type="checkbox"/> Explanation Turns off oil skimmer unit.
M743	Oil Skimmer On
	<input type="checkbox"/> Explanation Turns on oil skimmer unit.
M775	Tool Cleaning Air Off
	<input type="checkbox"/> Explanation Turns off the tool cleaning air. It is used in the auto tool length measurement program.
M776	Tool Cleaning Air On
	<input type="checkbox"/> Explanation Turns on the tool cleaning air. It is used in the auto tool length measurement program.
M786	Fixture Cleaning Coolant Off
	<input type="checkbox"/> Explanation Turns off the fixture cleaning coolant.
M787	Fixture Cleaning Coolant On
	<input type="checkbox"/> Explanation Turns on the fixture cleaning coolant.
M790	Amount of Oil Set To Little (MQL)
	<input type="checkbox"/> Explanation Set amount of oil on MQL to little. If the setting of oil amount not possible to adjust by the MQL device installed in the machine, this M code is invalid.
M791	Amount of Oil Set To Standard (MQL)
	<input type="checkbox"/> Explanation Set amount of oil on MQL to standard. If the setting of oil amount not possible to adjust by the MQL device installed in the machine, this M code is invalid.
M792	Amount of Oil Set To Large (MQL)
	<input type="checkbox"/> Explanation Set amount of oil on MQL to large. If the setting of oil amount not possible to adjust by the MQL device installed in the machine, this M code is invalid.
M793	Mist Pressure Set To High (MQL)
	<input type="checkbox"/> Explanation Set mist pressure on MQL to high. If the setting pressure not possible to adjust by the MQL device installed in the machine, this M code is invalid.
M794	Pressure Set To Standard (MQL)
	<input type="checkbox"/> Explanation Set mist pressure on MQL to standard. If the setting pressure not possible to adjust by the MQL device installed in the machine, this M code is invalid.

Chapter 4 Operation

M919 Machined Piece Count	
	<ul style="list-style-type: none"><input type="checkbox"/> Program M919 S <u>Increment/Decrement</u>;<input type="checkbox"/> Explanation Specify an increment or decrement with S in block M919. When such a block is issued, the remaining life on Tool Detail screen is added or subtracted by the specified number. If S is not specified in the M919 block, S1 is default (when the increment is one, S command be omitted).<input type="checkbox"/> Program Example O1234; (Machining) M919; ← Tool life count increased by 1 (Machining) M919 S3; ← Tool life count increased by 3 M30;
M920 Tool Length Measurement Data Read	
	<ul style="list-style-type: none"><input type="checkbox"/> Program #100=<u>Tool length measuring data</u>; #109=<u>Tool number</u>; M920;<input type="checkbox"/> Explanation Data of macro variable #100 is written in "tool length data" in the tool data table for spindle tool or specified tool. For the spindle tool, set the macro variable #109 to "0" or blank or for the special tool to the tool number.<input type="checkbox"/> Program Example O1234; T1M6; #100=123.456; #109=0; M920; ← 123.456 is written in tool length data of spindle tool (Machining) #100=-10.000; #109=1234.0; M920; ← -10.000 is written in tool length data of tool number 1234 M30;

M921 Tool Radius Measurement Data Read

<ul style="list-style-type: none"> <input type="checkbox"/> Program #100=<u>Tool radius measuring data</u>; #109=<u>Tool number</u>; M921; <input type="checkbox"/> Explanation Data for macro variable #100 is written in "tool radius data" in the tool data table for spindle tools or special tools. For the spindle tool, set the macro variable #109 to "0" or blank and for the special tool, set to the tool number. <input type="checkbox"/> Program Example O1234; T1M6; #100=123.456; #109=0; M921; ← 123.456 is written in tool radius data of spindle tool (Machining) #100=-10.000; #109=1234.0; M921; ← -10.000 is written in tool radius data of tool number 1234 M30;

M922 M920, M921 Data Incremental Mode

<ul style="list-style-type: none"> <input type="checkbox"/> Program #100=<u>Tool radius measuring data</u>; #109=<u>Tool specifying</u>; M922; M920 or M921; <input type="checkbox"/> Explanation When the tool data is written with M920 or M921, the mode to add macro variable value to the tool data is activated. As this mode is temporary, this must be specified before M920 or M921 every time. <input type="checkbox"/> Program Example O1234; T1M6; (Machining) #100=-0.010; #109=0; M922; M920; ← -10.000 is added to tool length data of spindle tool (Machining) #100=0.030; #109=0; M922; M920; ← 0.030 is added to tool radius data of spindle tool (Machining) M30;

6 G Code

6.1 G Code List

Code No.	Group	Function
G00	01	Positioning
G01		Linear Interpolation
G02		Circular Interpolation/Helical Interpolation CW
G03		Circular Interpolation/Helical Interpolation CCW
G04	00	Dwell, Exact Stop
G05.1		AI Advanced Control/AI Contour Control
G07.1(G107)		Cylindrical Interpolation
G08		Advanced Preview Control
G09		Exact Stop
G10		Programmable Data Input
G11		Programmable Data Input Mode Cancel
G15	17	Polar Coordinates Command Cancel
G16		Polar Coordinates Command
G17	02	Xp Yp Plane Selection Xp: X axis or its parallel axis
G18		Zp Xp Plane Selection Yp: Y axis or its parallel axis
G19		Yp Zp Plane Selection Zp: Z axis or its parallel axis
G20	06	Input in inch
G21		Input in mm
G22	04	Stored Stroke Check Function On
G23		Stored Stroke Check Function Off
G27	00	Reference Position Return Check
G28		Return To Reference Position
G29		Return From Reference Position
G30		2nd, 3rd and 4th Reference Position Return
G31		Skip Function
G33	01	Thread Cutting

G37	00	Automatic Tool Length Measurement
G39		Corner Offset Circular Interpolation
G40	07	Cutter Compensation Cancel/Three-Dimensional Tool Compensation Cancel
G41		Cutter Compensation Left/Three-Dimensional Tool Compensation
G42		Cutter Compensation Right
G40.1(G150)	19	Normal Direction Control Cancel Mode
G41.1(G151)		Normal Direction Control Left Side On
G42.1(G152)		Normal Direction Control Right On
G43	08	Tool Length Compensation + Direction
G44		Tool Length Compensation - Direction
G45	00	Tool Offset Increase
G46		Tool Offset Decrease
G47		Tool Offset Double Increase
G48		Tool Offset Double Decrease
G49	08	Tool Length Compensation Cancel
G50	11	Scaling Cancel
G51		Scaling
G50.1	22	Programmable Mirror Image Cancel
G51.1		Programmable Mirror Image
G52	00	Local Coordinate System Setting
G53		Machine Coordinate System Selection
G54	14	Workpiece Coordinate System 1 Selection
G54.1		Additional Workpiece Coordinate System Selection
G55		Workpiece Coordinate System 2 Selection
G56		Workpiece Coordinate System 3 Selection
G57		Workpiece Coordinate System 4 Selection
G58		Workpiece Coordinate System 5 Selection
G59		Workpiece Coordinate System 6 Selection
G60	00	Single Direction Positioning

Chapter 4 Operation

G61	15	Exact Stop Mode
G62		Automatic Corner Override
G63		Tapping Mode
G64		Cutting Mode
G65	00	Macro Call
G66	12	Macro Modal Call
G67		Macro Modal Call Cancel
G68	16	Coordinate Rotation/Three-Dimensional Coordinate Conversion
G69		Coordinate Rotation Cancel/Three-Dimensional Coordinate Conversion Cancel
G73	09	Peck Drilling Cycle
G74		Counter Tapping Cycle
G76		Fine Boring Cycle
G80		Canned Cycle Cancel/External Operation Function Cancel
G81		Drilling Cycle, Spot Boring Cycle or External Operation Function
G82		Drilling Cycle or Counter Boring Cycle
G83		Peck Drilling Cycle
G84		Tapping Cycle
G85		Boring Cycle
G86		Boring Cycle
G87		Back Boring Cycle
G88		Boring Cycle
G89		Boring Cycle
G90	03	Absolute Command
G91		Increment Command
G92	00	Setting For Work Coordinate System or Clamp at Maximum Spindle Speed
G92.1		Workpiece Coordinate System Preset
G94	05	Feed Per Minute
G95		Feed Per Rotation
G96	13	Constant Surface Speed Control
G97		Constant Surface Speed Control Cancel
G98	10	Return To Initial Point in Canned Cycle
G99		Return To R Point in Canned Cycle

7 Turning Power Supply On/Off

7.1 Switches/Buttons to Turn Power Supply On/Off

The locations of the switches and buttons for turning the power supply on/off are shown below.

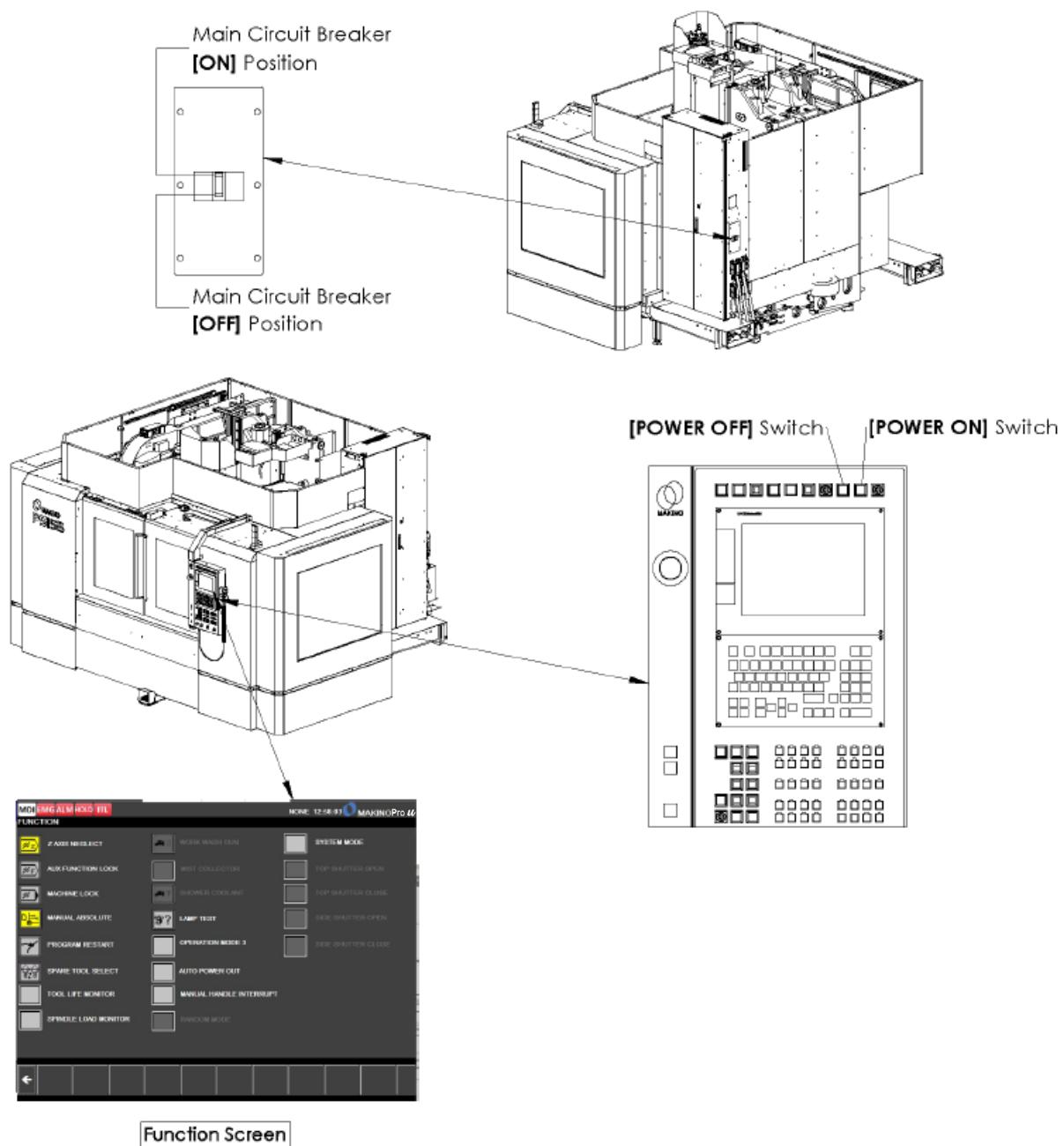


Figure 7.1 Switches/Buttons to Turn Power Supply On/Off

7.2 Turning Power On

Power On Procedure (Refer to Fig 7.1^[149])

- 1) Turn on the main circuit breaker switch. (Refer to NOTE)
- 2) Press the [POWER ON] switch on the main operation panel.

This completes the procedure to turn on the power.

-NOTE-

Lift up the main power switch to the [ON] position, the power is supplied to the machine. The switch acts as a no-fuse breaker. If an over-current condition occurs for any reason, this switch will be automatically tripped to protect the machine. Remove the source of the abnormal current before turning on the switch again.

7.3 Spindle Warm-Up

Rotate the spindle at 1000 min-1 for five minutes in any of the following cases.

- After turning the power supply on.
- The Spindle is stopped for more than 8 hours.



- If spindle warm-up is not done after the spindle is stopped for 8 hours or more, an alarm is triggered. Reset the alarm and run spindle warm-up.

7.4 Turning Power Off

Turn off the power supply using any of the following procedures:

A Manual Operation (Refer to Figure 7.1^[149])

Press the [POWER OFF] switch on the main operation panel once. The main power supply is turned off after a certain amount of time elapses.

-NOTES-

- 1 If the [EMERGENCY STOP] switch is pressed before the [POWER OFF] switch is pressed, the power off time will be less than 10 seconds.
- 2 Pressing the [POWER OFF] switch initiates the power off sequence. During this time, the [POWER OFF] switch lamp blinks. If the [POWER OFF] switch is pressed again, the power off sequence is canceled. The main power supply is not turned off.

B Automatic Operation (Automatic Power Out Function) (Refer to Figure 7.1^[149])

Enable the [POWER OFF] soft key on the Function screen. This activates the auto power off mode. The machine power is automatically turned Off under any of the following situations.

- Machining is completed (execution of M02 or M30 command)
- Emergency stop is activated
- Some alarms are triggered

8 Opening/Closing Doors

8.1 Opening/Closing Operator Door

The following door locking system can be installed on the operator door.

- Door Lock system (Standard)

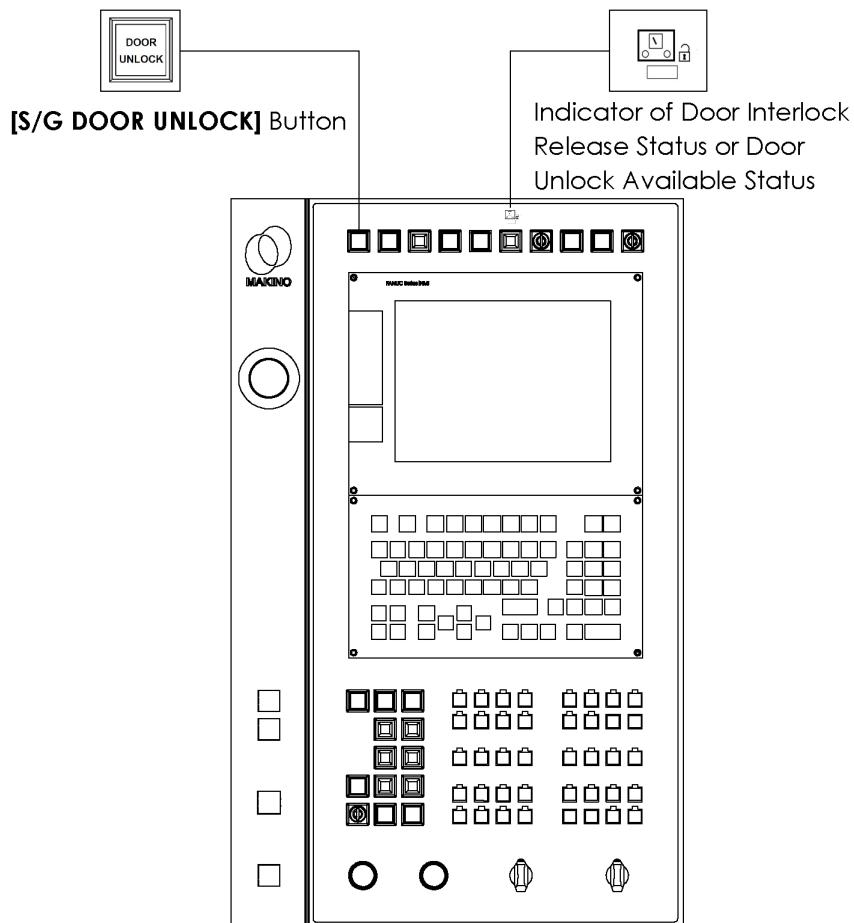


Figure 8.1 Opening/Closing Operator Door

8.1.1 Door Lock System (Standard)

NOTE

The indicator lamp means the door can be unlocked (Door Unlock Available).

Opening Operator Door Procedure

- 1) Confirm the Door Unlock Available indicator is turned on (green).
- 2) Open the operator door while pressing the **[S/G DOOR UNLOCK]** button on the main operation panel.
 - The Door Unlock Available indicator is turned Off during machining.
 - Open the door while pressing the **[S/G DOOR UNLOCK]** button on the main operation panel.

Closing Operator Door Procedure

- 1) Confirm the Door Unlock Available indicator is turned on (green).

8.2 Opening/Closing Tool Magazine Door

The following door locking systems can be installed on the tool magazine door.

- Door Interlock system (Standard)
- Door Lock system (Option/CE Specification)

Opening Tool Magazine Door Procedure

- 1) Press the **[ATC Manual Intervention Mode]** switch on the ATC operation panel.
- 2) Confirm that the lamp of “Manual Intervention” switch is illuminated.
- 3) Open the tool magazine door while pressing the **[ATC DOOR UNLOCK]** switch located near the ATC operation panel (Door Lock system only).

Closing Tool Magazine Door Procedure

- 1) Close the tool magazine door completely.
- 2) Press the “Manual Intervention” switch on the ATC operation panel.
- 3) Confirm that the “Manual Intervention” switch lamp is turned off.

8.3 Machine Tool Cabinet (MTC) Door



- Exercise extreme caution when opening the Machine Tool Cabinet (MTC) with the main power supply on.

The main power supply for this machine is 400VAC 3 phase. A proper electrical protection has been put in place. As additional safety feature, the machine is equipped with Machine Tool Cabinet (electrical cabinet) Door Interlock function.

When the MTC Door Interlock is activated, the main power is turned off (main circuit breaker trips) if the MTC door is opened while the main power is on.

Activate MTC Door Interlock Function

- 1) Turn the **[MTC DOOR INTERLOCK RELEASE]** key switch to the left. It is recommended to keep the key with the supervising personnel.

Opening MTC (Electrical Cabinet) Door

Method 1:

- 1) Turn off the main power supply.
- 2) Open the electrical cabinet door.

Method 2:

- 1) While the main power is on, turn the **[MTC DOOR INTERLOCK RELEASE]** key switch to the right.
- 2) Open the electrical cabinet door.

9 Tool Preparations

9.1 Overview

The tool changing system for this machine includes a tool magazine for storing cutters/tools and a CAM driven arm to perform the tool change.

The tool change process is basically to interchange the tool in the currently indexed pot of the magazine and that in the spindle. This makes the magazine inherently “Random Pot” type. It means each tool does not have a designated pot assigned to it. However, it is possible to have a “Fixed Pot” type Magazine by performing two tool changes in a single tool change command. (Refer to [9.4.1 Fixed Pot Mode/Random Pot Mode](#))^[159]

Automatic Tool Change (ATC) is a sequence to move/call a specified tool to the spindle. T command and M6 command are used for programming of the automatic tool change.

The following modes of operation are available for the tool change system:

- Automatic Operation
- Manual Operation
- Maintenance Operation
- Tool Data Screen Tool Call Mode

9.2 Tool Shape Limits

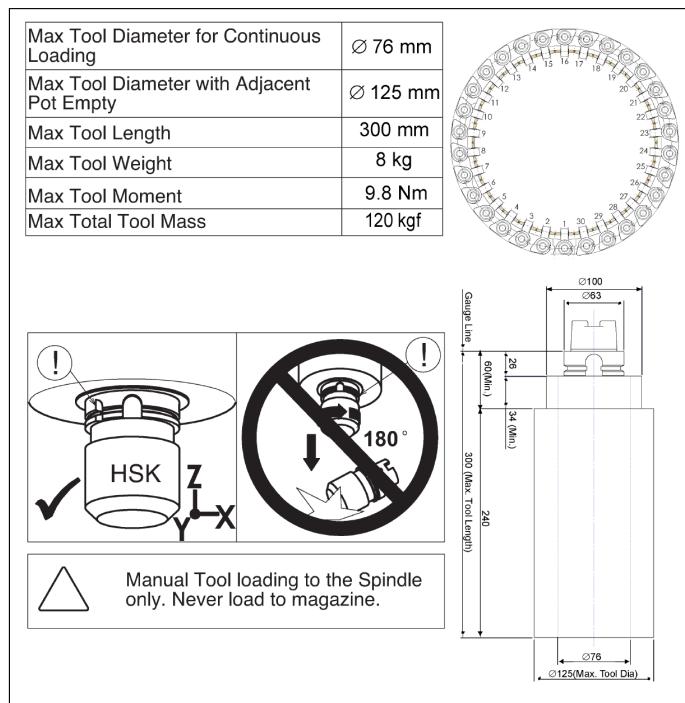


Figure 9.1 Standard HSK A-63 ATC30 Tool Shape Limits

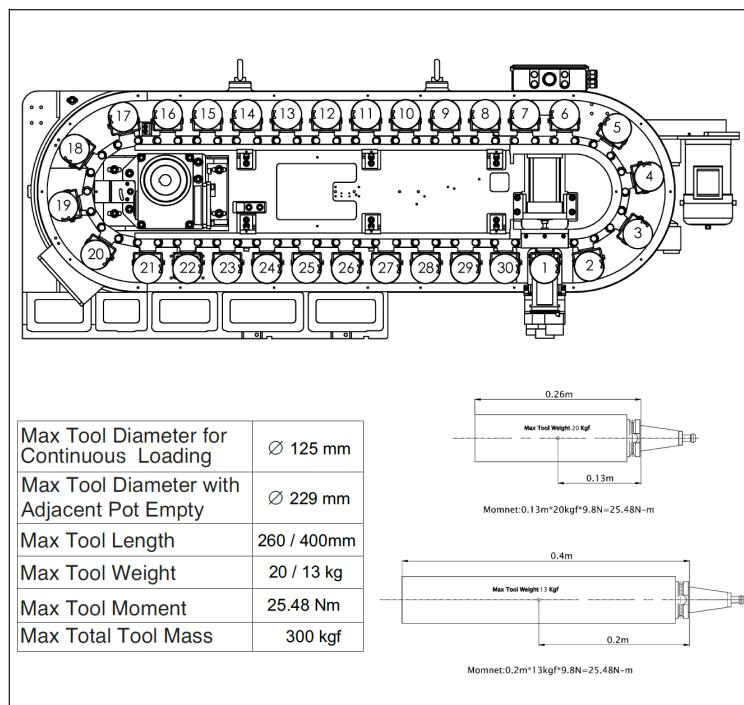


Figure 9.2 Standard HSK A-100 ATC30 Tool Shape Limits

9.3 Tool Change Conditions

9.3.1 Standby of ATC Unit

Machine is ready for automatic operations only if the ATC unit is in the standby condition. When the ATC unit is in standby mode, the ATC standby lamp on the ATC operation panel glows. Therefore, before doing any auto operation, ensure that the ATC is in the standby mode.

In the case that the lamp is off, the ATC is to be brought back to standby mode by manual operation.

Standby Condition includes the following criteria:

- ATC Shutter Close
- ATC Pot Horizontal
- ATC Arm Home

-NOTE-

When ATC Arm is not in home/standby position, machine axes are interlocked.

9.3.2 Tool Indexing Command Start Conditions

The following conditions are required for tool indexing command:

- ATC Manual Intervention Mode Off
- Maintenance Mode Off
- Tool Data Screen Tool Call Mode Off
- ATC Magazine Door Closed
- Magazine Pot Horizontal

Operator messages (warnings) are displayed if the above conditions are not satisfied and tool indexing is not performed.

An alarm is triggered in the following cases:

- Too many digits in the tool number
- Tool number not found (PTN)
- A tool monitor alarm tool is specified and spare tool option is not on.
- A tool monitor alarm tool is specified and no spare tool is found.

9.3.3 Tool Change Command Start Conditions

The following conditions are required for tool change command:

- Z-axis 2nd Reference Position
- Spindle Orientation
- Coolant Off
- ATC Magazine Door Close
- Spindle Tool is Clamped
- Maintenance Mode Off
- ATC Manual Intervention Mode Off
- Tool Data Screen Tool Call Mode Off
- ATC Magazine Index Position

-NOTES-

- 1 Pressing the **[OT RELEASE]** switch on the main operator panel can bypass these conditions during manual and maintenance operations. When the **[OT RELEASE]** button is pressed, safety checks are ignored. Extreme care must be taken by the operator during operations with “OT Release” activated.
- 2 The ATC arm standby position is monitored by the machine controller to confirm that the ATC arm is in a safe position for axes movements. When the ATC arm is not in standby position, axis movement is prohibited by axis interlock. In addition, an alarm is triggered if a tool change operation is commanded.

9.3.4 Tool Change Program

Program Example

```
O1234;  
Taaa;          (Tool aaa is indexed to Magazine Index Position)  
G91 G30 Z0 M319; (Z-axis moves to 2nd reference position, spindle orients, coolant stops  
                   and suction is performed, ATC shutter opens then pot moves to vertical  
                   position)  
G91 G30 X0 Y0;  (X and Y-axis moves to 2nd reference position)  
M06;           (Tool change command, Taaa is moved to spindle)  
Tbbb;          (Tool bbb is indexed to Magazine Index Position)  
M98 Pxxx;      (Machining is performed using Taaa)  
G91 G30 Z0 M319; (Z-axis moves to 2nd reference position, spindle orients, coolant stops  
                   and suction is performed, ATC shutter opens then pot moves to vertical  
                   position)  
G91 G30 X0 Y0;  (X and Y-axis moves to 2nd reference position)  
M6;            (Tool change command, Tbbb is moved to spindle)  
Txxx;          (Tool xxx is indexed to Magazine Index Position)  
M98 Pyyy;      (Machining is performed using Tbbb)  
:  
:  
:             (Machining continues)  
:  
M30;
```

-NOTE-

M319 is a M code used to shorten machining time. For details on using method and cautions of M319 (Refer to [9.4.8 ATC Cycle Time Reduction](#))

9.4 Automatic ATC Operation

Automatic ATC Operation refers to operating the ATC in any of the following NC modes: memory mode, MDI mode or external input mode. Use the T and M06 command to create the tool change program.

When the T command is issued, the tool is moved from the tool magazine to the standby position (next tool). When the machine is powered on or when ATC magazine reference position is not established, any T command will cause the magazine to perform an Auto Reference Operation before proceeding with the tool indexing. When the M06 command is issued, the tool in the standby position is interchanged with the spindle tool.

9.4.1 Fixed Pot Mode/Random Pot Mode

The tool index command and tool change command can operate in two modes:

- Random Pot Mode
- Fixed Pot Mode

When both the spindle tool and the next command tool are not fixed pot type, they will operate in the Random Pot mode. When either the spindle tool or the next command tool is Fixed Pot type, they will operate in the Fixed Pot mode.

Fixed Pot mode can be enabled or disabled using Machine Parameter No. 6001 in the ATC Category of the Machine Parameter screen.

MC Para 6001: Fixed Pot ATC Enable

0: Disable

1: Enable

When Fixed Pot mode is enabled, it is necessary to set the PTN of one pot of the ATC to 99. This PTN 99 serves as a dummy tool, required to setup the magazine for Fixed Pot Tool Change. If PTN 99 is not set, the machine alarm "EX1398 T99 not set in Tool Data" will occur.

9.4.2 Tool Index Command - Random Pot Mode

In this mode, the magazine will immediately rotate the commanded tool to the index position. This commanded tool is then ready for tool change.

9.4.3 Tool Index Command - Fixed Pot Mode

In this mode, the dummy tool T99 will be immediately moved to the index position to wait for the tool change command. If T99 is in the spindle tool, the next commanded tool will be interchanged immediately.

9.4.4 Tool Change Command - Random Pot

In this mode, the magazine index tool and spindle tool will be interchanged immediately.

9.4.5 Tool Change Command - Fixed Pot Mode

The tool index command and tool change command can operate in two modes:

- Dummy tool T99 Interchange with spindle tool
- Pot Horizontal
- Magazine rotate to next command tool
- Pot Vertical
- Next command tool interchange with spindle tool

If T99 is the spindle tool, the next commanded tool will immediately interchange with the spindle tool.

9.4.6 Tool Return Function

Tool return is the process to return all tools to the magazine. To do this, at least 1 pot in the magazine must be empty. Note that the spindle is also considered as a pot, i.e. in a 30 Tool Magazine Machine, there are 31 pots including the spindle pot.

Magazine pots that are not in use should have 0 assigned to the PTN Number. When T0 command is issued, the magazine will index to a pot with PTN number 0. Commanding M6 will return the current spindle tool to the magazine.

9.4.7 Slow Tool Change

During automatic tool change, the arm moves at a very high speed to reduce cycle time. However there are cases where require the tool change to operate at a lower speed. For example, changing of very heavy tools or sensitive tools like measuring probe. This is to prevent damage to the tool or the machine.

The above can be achieved by setting Slow Tool Change for the tool in the Tool Data screen. Refer to [4.9 Tool Data Management Screen](#)^[101] for how to perform this setting. If either the spindle tool or the magazine tool is set as Slow Tool Change, the ATC arm will move in the same motion path but at a much slower speed.

9.4.8 ATC Cycle Time Reduction

Before the ATC arm can move in a tool change cycle, the following machine conditions must be established.

- Z-Axis 2nd Reference Position
- Coolant Off
- Spindle Orientation
- Shutter Open
- Pot Vertical

M319 can be commanded to reduce cycle time by performing the following actions simultaneously:

- Coolant Off
- Spindle Orientation
- Shutter Open then Pot Vertical

Program Example

Taaa;	(Tool aaa is indexed to Magazine Index Position)
G91 G30 Z0 M319;	(Z-axis moves to 2nd reference position, spindle orients, coolant stops and suction is performed, ATC shutter opens then pot moves to vertical position)
G91 G30 X0 Y0;	(X and Y-axis moves to 2nd reference position)
M06;	(Tool change command, Taaa is moved to spindle)

9.4.9 ATC Macro Program O9001

Many conditions are necessary to be satisfied before tool change is allowed to be performed. To facilitate the ease of programming by the operator, a macro program has been prepared to perform the following actions when a M6 is commanded.

- Canned Cycle Cancel
- Mirror Image Off
- Z-Axis 2nd Reference Position
- Coolant Off
- Spindle Orientation
- X & Y-Axis 2nd Reference Position

The standard program sent with the machine is O9001. The operator is allowed to modify this macro program if necessary.

```
O9001;
G80M23;
G30G91Z0M319;
G30G91X0Y0;
M06;
M99;
```

NC Parameter 6071 is set to 6 to enable O9001 call during M6 command. To disable this macro call, set NC parameter 6071 to 0.

9.5 Manual ATC Operation

Manual ATC Operation refers to performing operations when the ATC Manual Intervention mode is turned on. In this mode, it is possible to operate the following:

- Magazine Rotation

9.5.1 ATC Manual Intervention Mode On Conditions

The following conditions are required for turning on ATC Manual Intervention mode:

- Maintenance Mode Off
- Tool Data Screen Tool Call Mode Off

A warning is generated if the above conditions are not satisfied when the ATC Manual Intervention mode button is pressed.

9.5.2 ATC Manual Intervention Mode On/Off Conditions

The following conditions are required for turning on/off ATC Manual Intervention mode:

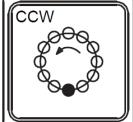
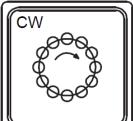
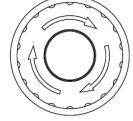
- Not M06 Operation
- Not M319 Operation
- Not ATC Auto Recovery Operation
- Not Magazine Auto Reference Operation
- Not Magazine Auto Return Operation

If the **[ATC Manual Intervention Mode]** push button is pressed and the above conditions are not satisfied, the ATC Manual mode lamp will blink. Once the above conditions are satisfied, the lamp will stop blinking. If the switch is pressed again while the lamp is blinking, the on/off request will cancel and the lamp will stop blinking.

The **[ATC Manual Intervention Mode]** push button is accessible on the ATC operation panel.
(Refer to [9.5.3 ATC Operation Panel \(ATC Magazine Side\)](#))¹⁶³

9.5.3 ATC Operation Panel (ATC Magazine Side)

The following operating push buttons and indicating lamps are incorporated in the ATC operation panel for manual operation of the ATC and maintenance operations. The ATC Magazine Manual Index CW/CCW is enabled to allow movement of magazine when ATC Manual Intervention push button is selected. During manual mode, automatic magazine indexing and tool change is interlocked, resulting in stop of part program when a command block with Txxx or M06 is commanded.

	<p>Magazine Manual Intervention Push Button and Indicator</p> <p>This push button is used to select the ATC Manual Intervention mode, in order to index the magazine manually. During an auto operation of ATC or magazine index, if this button is pressed, manual mode is temporary hold and the incorporated lamp will flicker. After the automatic operation is completed, the hold manual mode is activated and the light will glow continuously.</p> <p>With the manual mode on (i.e. the incorporated lamp of the push button on), and a T code is commanded in an auto mode, the magazine will not index, but the commanded T code will hold. When the Magazine Manual mode is switched off, the magazine is immediately indexed to the commanded tool.</p>
 	<p>Magazine Rotation Push Button</p> <p>During a manual mode, the magazine can be rotated CW or CCW by pressing the respective push button. When the push button is released, the magazine will be stopped to the next pot position.</p> <p>After power on or an emergency stop, the magazine must be zero returned to the reference point before a manual operation. To zero return, press CCW button. Even after the push button is released, the magazine continues to rotate till the completion of zero return.</p> <p>After a power on or an emergency stop, when a tool number is commanded, in auto mode, the magazine will first do the zero return automatically and after that the tool will be indexed to the standby position.</p>
	<p>Emergency Stop Push Button</p> <p>In an Emergency condition press this button to stop all the motions abruptly. Once pressed, the button is locked in the pressed position. Rotate the button in the arrow shown to release the lock. When this button is pressed, the following condition occurs.</p> <ul style="list-style-type: none"> • All moving axis stops immediately. • The spindle stops, if it is running. • The spindle tool will be clamped. • The spindle orientation will be reset. • If ATC is operating, it stops midway. • The CNC will be reset.

10 Workpiece Preparations

10.1 Workpiece Restrictions



- There are limits to the workpieces that can be used. If a workpiece exceeds specifications, the workpiece may collide, resulting in damage to the machine, injury or death.

Maximum Workpiece Weight	PS155 Table
	1500 kg

Refer to Chapter 6, [1.5 PS155 \(SPD-14K\) Machine Stroke Limits & Work Area](#)^[328] & [1.6 PS155 \(SPD-10K Option\) Machine Stroke Limits & Work Area](#)^[330].

10.2 Workpiece Set-Up



- Firmly secure the workpiece with the fixtures.
- Remove any sharp edges on the workpiece with a file prior to set-up.
- When unclamping the workpiece, firmly support it and take adequate precautions to ensure it does not drop.
- Use a crane or a manual lifter to load workpieces too heavy to lift unassisted.

The workpiece set-up/removal and machining ready operation procedures are described in this section.

Mounting/Removal Procedure

- 1) Open the operator door and mount/remove the workpiece.
- 2) When workpiece setup is completed and secured, close the operator door.
- 3) Start machining operation or cleaning routine.

This completes the workpiece mounting/removal procedure.

11 Manual Operation

Manual operation consists of operation of the machine with the operator controls provided on the main operation panel without using an NC program.

The machine units and devices can be manually operated with the operation panel and on the Function screen.

The three types of manual operations are available for the feed axes (X/Y/Z-axes). Operations in these manual operation modes are performed from the main operation panel.

- Manual Reference Position Return Mode (Refer to [11.1 Manual Reference Position Return](#)^[165])
- Jog Feed Mode (Refer to [11.2 Jog Feed](#)^[170])
- Handle Feed Mode (Refer to [11.3 Handle Feed](#)^[171])

In Operation Mode 1, axis feed operation can be performed with the operator door closed.

In Operation Mode 2 or 3, manual operation of axis feed can be performed with the operator door open.

If the machine is provided with the Portable Manual Generator (MPG), axis feed can only be performed with the Portable MPG. The operator door is open by holding down the Deadman switch on the Portable MPG.

If the machine is provided with Standard MPG, axis feed can only be performed by holding down [SAFETY ENABLE] button on the MPG panel.

11.1 Manual Reference Position Return

Each axis can be manually returned to its pre-set machine reference position.

NC Alarm No. DS0300: Reference Position Return Required is triggered when the reference position is not recognized in such cases as when the NC backup battery voltage is lower or a motor cable is disconnected. When this alarm is triggered, perform reference position manually to establish the reference position.



- Moving the axes at high speed is dangerous. Make sure to confirm the axis feed rate that has been set before performing reference position return.
- Exercise extreme caution when operating the machine with the operator door open to prevent being seriously injured.

Each axis can be manually returned to its pre-set machine reference position.

- X-Axis: Minus End of Stroke
- Y-Axis: Plus End of Stroke
- Z-Axis: Plus End of Stroke

The axis reference position return procedure described in this section returns one axis at a time to its reference position.

To return all axes to their respective reference positions simultaneously, use the [AUTO ZERO] One-Touch function switch on the main operation panel. The Z-axis, X-axis and Y-axis are returned to their reference positions in this order (Refer to [2.4 One-Touch Function Switches](#) [83]).

The manual reference position return operation cannot be performed with the operator door open under the following conditions.

- Operation Mode 1 in Operator Door Unlock (Door Lock System)
- Operator Door Lock (Power Out System - Option)



- Exercise extreme caution when operating the machine with the operator door open to prevent being seriously injured.

11.1.1 Machine with Reference Limit Switch

Operation Procedure (Refer to [Figure 11.1](#) [167])

- 1) Select [REFERENCE] mode from the “Machine Mode Selection” switch.
- 2) Adjust the reference position return feed rate using the “Rapid Traverse Override” switch [1] on the main operation panel.

This completes the workpiece mounting/removal procedure.

Axis	Maximum Rapid Feed Rate	Maximum Feed Rate at NC Alarm No. DS0300: Reference Position Return Required
X-Axis	36000 mm/min	4000 mm/min
Y-/Z-Axis	36000 mm/min	4000 mm/min

NOTICE

When the Rapid Traverse Override is set to 100%, the axis is moved at the maximum feed rate. Since the Rapid Traverse Override Limit function is activated with the standard settings, the Rapid Traverse feed rate is limited to 25%.

- 3) Select axis to be referenced to zero position using the “Axis Selection” switch [2]. Press and hold either [+] or [-] “Direction Selection” switch [3]. If the axis is away from home position it moves and stops at the reference point after decelerating. If the axis is at the reference point position, the reference will be selected immediately.
- 4) Release the “Direction Selection” switch [3] after the zero point return is completed for the axis.
- 5) Repeat procedure 2 and 3 for the other axis. Make sure the reference point return completion by referring to Machine Status Display screen by pressing [CUSTOM2] → [MACHINE STATUS] key. When an axis is in reference condition, the Reference Position Return Status will be shaded as shown.

This completes the Manual Reference Position Return procedure.

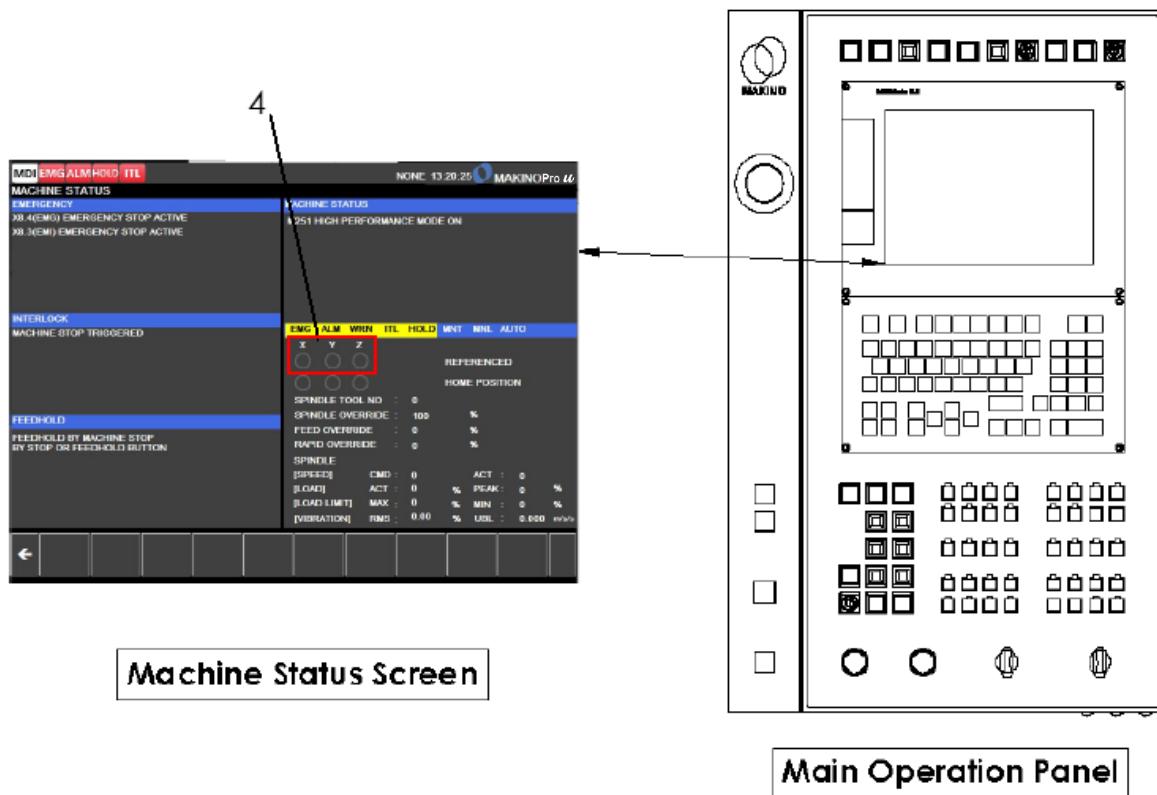


Figure 11.1 Reference Position Return Procedure

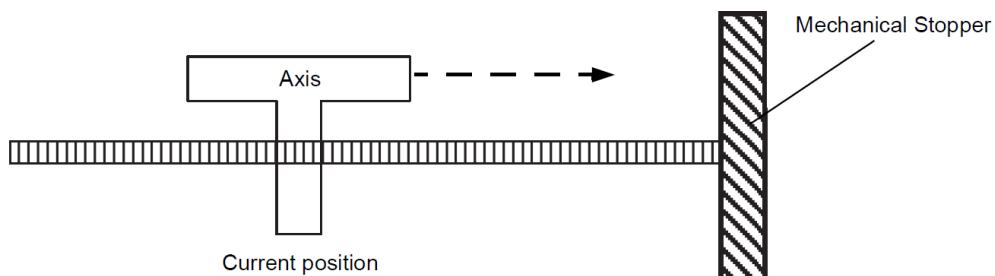
No.	Name	No.	Name
1	Rapid Traverse Override Switch	3	Direction Selection Switches
2	Axis Selection Switches	4	Reference Position Indicator

11.1.2 Machine without Reference Limit Switch (Butt Type Reference)

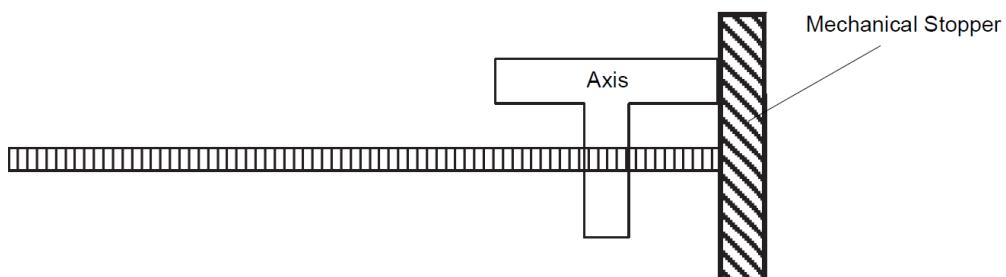
Butt Type Reference method take reference with respect to the mechanical stopper.

Operation Procedure

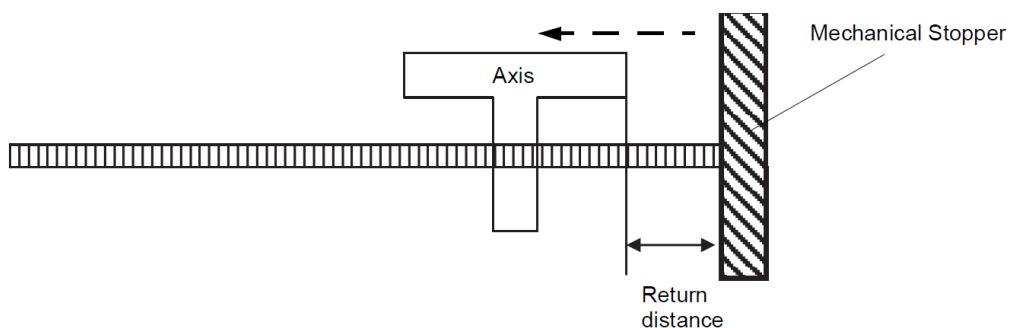
- 1) Select [**REFERENCE**] mode from the “Machine Mode Selection” switch.
- 2) Select the axis which reference position return need to be set.
- 3) Press the [**CYCLESTART**] button.
- 4) The selected axis move towards the mechanical stopper in the direction that have been set in parameter at a constant feedrate.



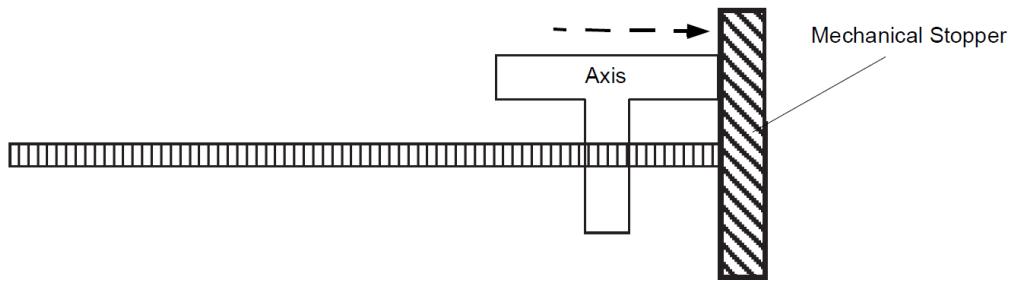
- 5) The axis is butt against the mechanical stopper until the torque limit is set in.



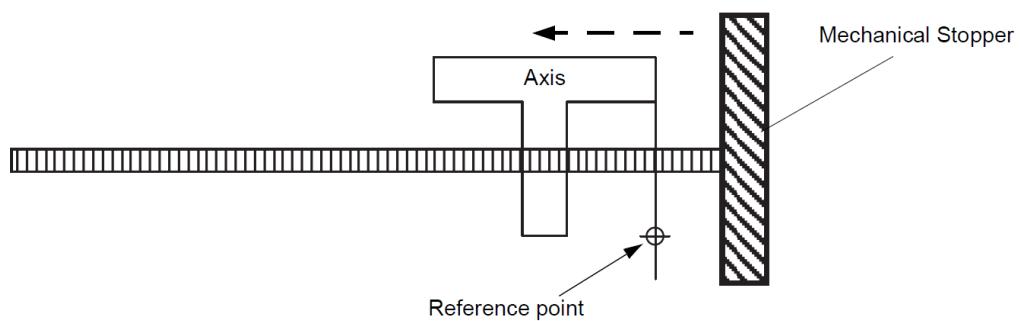
- 6) After the axis butts the mechanical stopper the axis is retracted in opposite direction at the feed rate specified in parameter to the return distance specified in parameter.



- 7) From the return position the axis is again (second time) butt to the mechanical stopper in the direction set in parameter at constant feed rate.



- 8) After the axis butts the mechanical stopper the axis is retracted in opposite direction at the feed rate and distance specified in parameter.



11.2 Jog Feed

The Jog Feed mode (manual continuous feed) is used to confirm the condition of the workpiece during machining operation. In this mode, the selected axis is moved at the specified speed while the “Direction Selection” switch is pressed.

Jog Feed cannot be performed with the operator door open under the following conditions.

- Operation Mode 1 in Operator Door Unlock
- Operator Door Lock (Power Out System - Option)



WARNING

- Exercise extreme caution when operating the machine with the operator door open to prevent being seriously injured.

Operation Procedure

- 1) Press the [JOG] mode switch on the main operation panel.
- 2) Open the operator door.
- 3) Press the “Axis Selection” switch to select the axis to be moved.
- 4) Specify the feed rate using the “Jog Feed” switch.

Press the [+] or [-] “Direction Selection” switch. The axis moves in the selected direction at the specified speed while the direction switch remains pressed.

NOTICE The current position and feed rate can be confirmed on the screen.

This completes the Jog Feed procedure.

11.3 Handle Feed

The axis is moved by using the Manual Pulse Generator (MPG) in the Handle mode. This mode is used for workpiece alignment, machining reference setting and tool adjustment. The standard MPG, is integrated in the control panel. For the portable MPG (Option) is connected to the main operation panel and can be placed on the MPG dock below the main operation panel when not in used.

NOTICE

In the Handle mode, axis feed operation can be performed with the operator door open by holding down the **[SAFETY ENABLE]** button for Standard MPG or Deadman switch for Portable MPG.

WARNING

- Moving the axes at high speed is dangerous. Make sure to confirm the axis feed rate that has been set before performing reference position return.
- Exercise extreme caution when operating the machine with the operator door open to prevent being seriously injured.

Operation Procedure

- 1) Select the **[HANDLE]** switch on the main operation panel.
- 2) Open the operator door.
- 3) Press the “Axis Selection” switch to select the axis to be moved.
- 4) Specify the feed per pulse by using the “Handle Feed” switch.
- 5) Rotate MPG hand wheel while pressing the **[SAFETY ENABLE]** switch.

This completes Handle Feed procedure.

Table 11.1 Feed Rate Setting

Unit	Pulse Multiplier Setting			
	x1	x10	x100	x1000
mm	0.0001	0.001	0.01	0.1
inch	0.00001	0.0001	0.001	0.01
degree	0.0001	0.001	0.01	0.1

12 Automatic Operation

12.1 Overview

Operation of the machine with the NC programs is called automatic operation. The flow of automatic operation is described in this section.



12.2 Automatic Operation Mode

There are three automatic operation modes: MDI, Memory and External Input modes. To perform automatic operation, first select the mode by pressing the desired “Mode Selection” switch on the main operation panel. (Refer to [2.2 Main Mode Setting Switches](#) [80])

12.2.1 MDI Mode

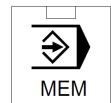
In MDI (Manual Data Input) mode, the operator manually enters the program using the character/numeric keys on the MDI panel. Since the number of blocks that can be input manually is limited to several blocks, this mode is used to perform simple operations. The program entered in this mode is not stored in the NC Memory.



MDI

12.2.2 Memory Mode

In order to perform operation in the Memory mode, an NC program must be first created in the Editor mode or downloaded from an external data input/output device and then registered in the NC Memory. Unlike programs used in the MDI mode, Memory mode operation programs are registered in the NC Memory and can therefore be searched for and executed repeatedly.



MEM

12.2.3 External Input Mode

External Input mode operation is used when automatic operation is performed using programs saved in external data input/output devices with large memory capacities such as floppy disks or a DNC controller. Select this operation mode when using programs punched into paper tape to be read by the tape reader.



EXT

12.3 NC Program Start/Stop/Restart

NC programs are started with the **[CYCLE START]** switch on the main operation panel. (Refer to [12.3.1 NC Program Start](#)^[174]).

When automatic operation is started, the NC program is executed as described below:

- 1) The first block command is read by the specified program.
- 2) The read block command is interpreted.
- 3) Execution of the command is initiated.
- 4) The next block is read.
- 5) The next block is interpreted so that it can be immediately executed (buffering).
- 6) As soon as the execution of the previous block is completed, buffering enables execution of the next block to be immediately started.
- 7) Automatic operation is performed by repeating steps 4 to 6.

The following methods can be used to stop the NC program.

- Specifying the program stop command in the NC program. (Refer to [12.3.2 Program Stop by Stop Commands](#)^[175])
- Press the **[FEED HOLD]** or **[SINGLE BLOCK]** switch on the main operation panel.(Refer to [12.3.3 Program Stop by Switches on Main Operation Panel](#)^[175])

12.3.1 NC Program Start

NC programs are started with the **[CYCLE START]** switch on the main operation panel. The green lamp built into the **[CYCLE START]** switch is on while the NC program is running.

The **[CYCLE START]** switch is enabled when the MDI/Memory/External Input mode is selected.

12.3.2 Program Stop by Stop Commands

Automatic operation is stopped by specifying the program stop or end of program command in the NC program (A, B, C). For details on these commands.

A Program Stop (M00)

Automatic operation automatically stops when a block including the M00 command is executed. This command also stops spindle operation and coolant supply.

- NOTICE**
- Operation is restarted with the [CYCLE START] switch. Spindle rotation and coolant supply are resumed at this time.

B Optional Stop (M01)

Automatic operation automatically stops when a block including the M01 command is executed. This is only effective, however, when the [OPTIONAL STOP] switch on the main operation panel is turned on.

- NOTICE**
- When the [OPTIONAL STOP] switch is off, the machine does not stop and the program proceeds to the next block.

C End of Program (M02/M30)

When the command M02 or M30 that specifies the end of the main program is read, automatic operation is stopped and the NC unit is reset.

- NOTICE**
- When the Automatic Power Out function is on, the power supply is automatically turned off.

12.3.3 Program Stop by Switches on Main Operation Panel

The NC program can be stopped by operating the following switches on the main operation panel:

A [FEED HOLD] Switch

When the [FEED HOLD] switch is pressed while the NC program is being executed, the axes decelerate and come to a complete stop. While the NC program is being suspended, the switch's lamp is turned on.

- NOTICE**
- The spindle rotation and coolant supply are not stopped.
 - The Automatic Tool Change (ATC) and some canned cycles do not come to an immediate stop when the switch is pressed. Each operation stops upon completion.

B [SINGLE BLOCK] Switch

When the [SINGLE BLOCK] switch is pressed while the NC program is being executed, the operation stops after execution of the block commands is complete.

- NOTICE**
- The spindle rotation and coolant supply are not stopped.

12.3.4 Stopping/Restarting Spindle Rotation

When the NC program is stopped with the **[FEED HOLD]** or **[SINGLE BLOCK]** switch, spindle rotation and coolant supply continue and do not stop.

The procedures to stop spindle rotation (Refer to **A**) and restore spindle rotation (Refer to **B**) after it is temporarily stopped is described below.

A Stopping Spindle Rotation Procedure

Press the **[SPINDLE STOP]** switch on the main operation panel to stop the spindle.

- NOTICE**
- Spindle can be stopped immediately if the door is opened during the automatic operation.

B Restarting Spindle Rotation Procedure

Press the **[SPINDLE START]** switch on the main operation panel to start the spindle.

- NOTICE**
- When the spindle is stopped due to door opening, the spindle is automatically restarted if the **[CYCLE START]** switch is turned on after the door is closed. The S code value specified just before the spindle stop is used to determine the spindle rotation speed at this time. The automatic operation is also restarted.

12.3.5 Stopping/Restarting Coolant Supply

When the NC program is stopped with the **[FEED HOLD]** or **[SINGLE BLOCK]** switch, spindle rotation and coolant supply continue and do not stop.

The procedures to stop (Refer to **A**) the coolant supply and restore the coolant supply (Refer to **B**) after it is temporarily stopped is described below.

A Coolant Supply Stop Procedure

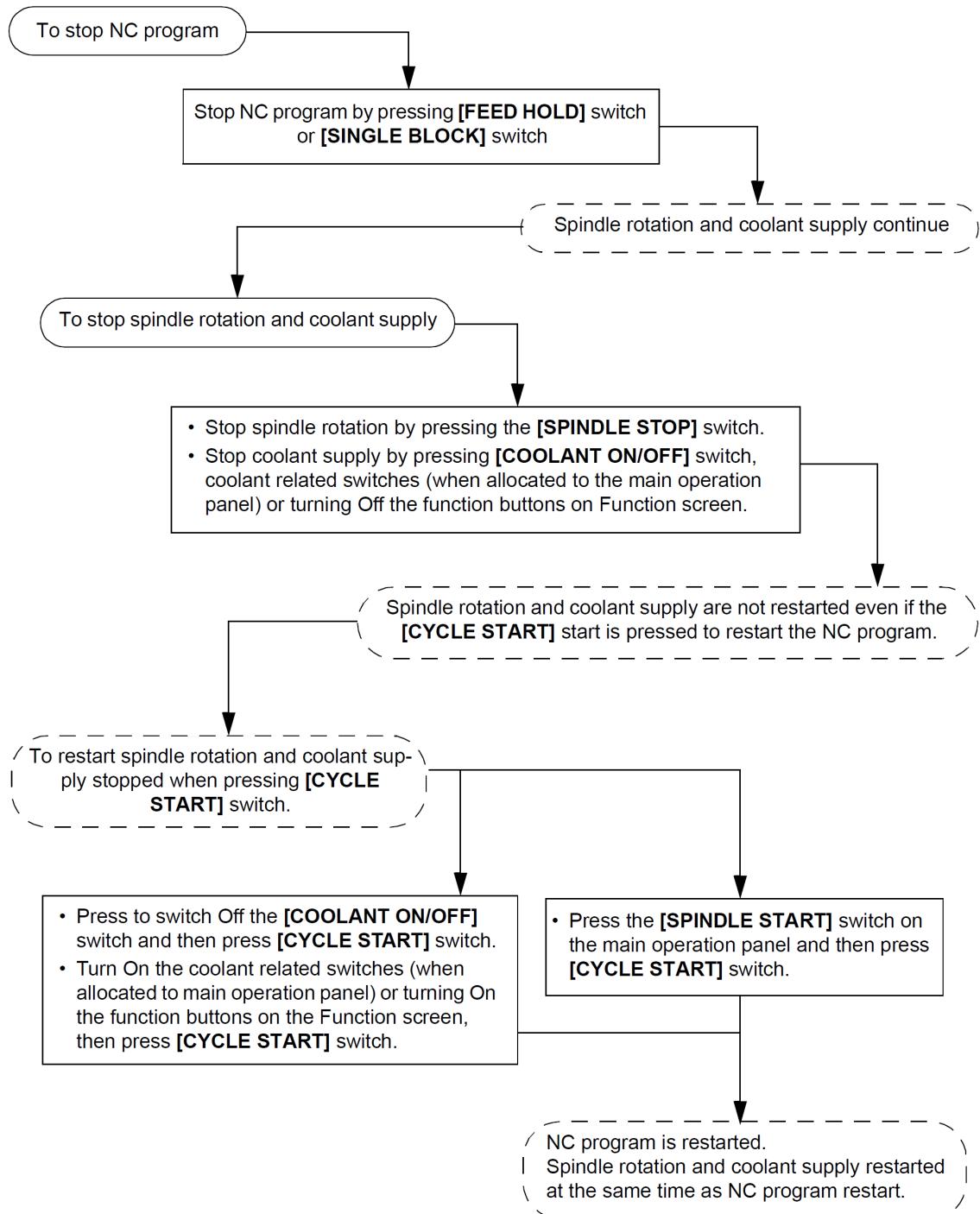
Press the **[COOLANT ON/OFF]** switch on the main operation panel to pause/suspend the coolant supply. When the **[COOLANT ON/OFF]** switch lamp is on, the coolant supply is stopped. The respective coolant related switches on the main operation panel or the Function screen can also be used to turn off the corresponding coolant.

B Restarting Coolant Supply Procedure

- Press the **[COOLANT ON/OFF]** switch on the main operation panel while the **[COOLANT ON/OFF]** switch lamp is on will restart the active coolant mode.
- Turn on the relevant coolant related switches on the main operation panel or the function button on the Function screen.

12.3.6 NC Program Restart from Stop Status

The NC program suspended by the **[FEED HOLD]** or **[SINGLE BLOCK]** switch can be restarted by pressing the **[CYCLE START]** switch on the main operation panel. The flow of the NC program restart procedure from the suspended status is described in the flowchart below.



In the flow chart above, indicates operation procedures and indicates the machine status.

12.4 Machining Modes M250/M251

GI Control allows different machining mode selections for specific purposes by M code. Selection of the most appropriate machining mode enhances GI control performance. This machine provides the following two modes of operation during machining:

- M250 High Accuracy Mode: Used when priority is machining accuracy.
- M251 High Performance Mode: Used when priority is machining speed.

12.4.1 High Accuracy Mode (M250)

M250 is the default machining mode. This mode achieves compatibility between high-accuracy and high-speed in machining. Specify M250 at the beginning of program in individual block.

12.4.2 High Performance Mode (M251)

This mode places emphasis on high-speed machining. Processing in this mode may result in slightly lower quality than in High Accuracy mode depending on the process geometry or programs. Specify M251 at the beginning of program in individual block.

M250/M251 Mode Display

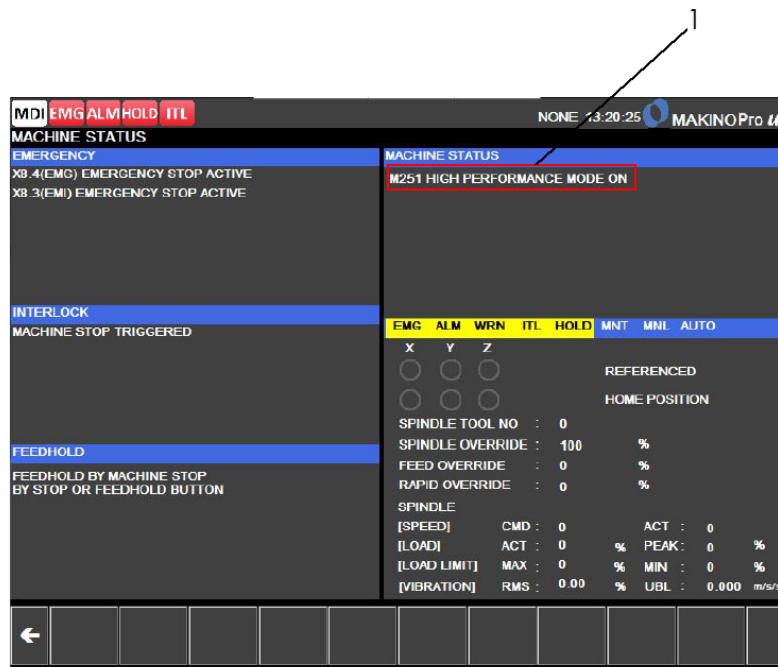


Figure 12.1 M250/M251 Mode Display on Machine Status Screen

No.	Name
1	Machining Mode Display

Issuing of M250, M251

With GI control, issue each M code in an independent block. It is possible to issue these M codes for specific machining purposes within one program.

Program Example

```
O0100;  
:  
:  
M250;           High Accuracy Machining  
G91 G01 Z-10. F200;  
G02 I-10.;  
:  
:  
:  
M251;           High Speed Machining  
G91 G01 Z-10.0 F10000;  
:  
:  
:  
:  
M30
```

13 User M Code Interface

13.1 Overview

The user input/output (I/O) interface enables actuators, production quantity counters and other external devices required by the user to be controlled by M code commands (M580 – M596).

Individual M code functions (control specifications) are specified by machine parameters. The input/output contactors are prepared on the machine control panel. Connecting an external device to these contactors with cables enables the M codes to control the device.

The following operations are performed by the special user I/O interface:

- Output signal is sent from the machine controller to the external device by issuing of M code.
- Output signal starts the operation of the external device.
- Completion of the operation is confirmed when the relevant switch input signal is sent back to the machine controller.

Preparations described in the following page are necessary to utilize the user I/O interface.

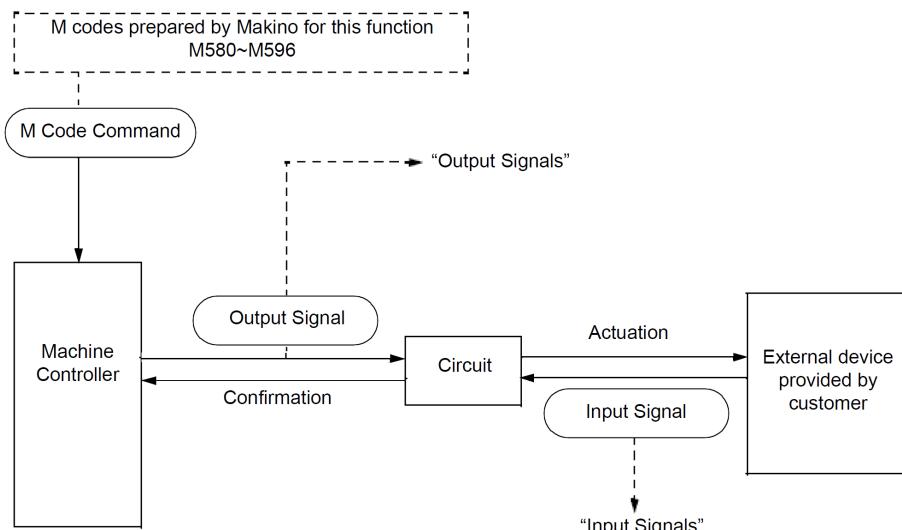


Figure 13.1 System Overview

13.1.1 Preparation for Interfacing

In order to utilize the user I/O interface, the following preparations are necessary:

- 1) Set the machine parameters for each user I/O to specify the usage of the following functions
 - Grouping of user I/O signals
 - Confirmation of conditions at M code start
 - Confirmation of conditions at M code finish
 - M code completion delay time
 - Output signal Off after operation completion
- 2) Connect the machine controller and the external device with cables.
- 3) Confirm the external device functions properly.

13.2 Available Input/Output Signals

There are eight input signals to confirm external device operation and eight output signals to operate external devices. These form eight sets of user I/O signals. Makino offers these sets of user I/O signals in pairs, so there will be 1~4 pairs of user I/O signals available to the customer.

The table below shows the available user I/O signals for each pair.

Pair	Set	Input			Output		
		Address	Symbol	Description	Address	Symbol	Description
1st Pair	Set 1	X0010.0	USDI1	USER DI1	Y0004.0	USDO1	USER DO1
	Set 2	X0010.1	USDI2	USER DI2	Y0004.1	USDO2	USER DO2
2nd Pair	Set 3	X0025.0	USDI3	USER DI3	Y0011.0	USDO3	USER DO3
	Set 4	X0025.1	USDI4	USER DI4	Y0011.1	USDO4	USER DO4
3rd Pair	Set 5	X0025.2	USDI5	USER DI5	Y0011.2	USDO5	USER DO5
	Set 6	X0025.3	USDI6	USER DI6	Y0011.3	USDO6	USER DO6
4th Pair	Set 7	X0025.4	USDI7	USER DI7	Y0011.4	USDO7	USER DO7
	Set 8	X0025.5	USDI8	USER DI8	Y0011.5	USDO8	USER DO8

The “Pairs” indicated in the above table only represent the signals provided when each pair is purchased by the customer. There is no relationship between each set of signals in the same pair.

13.3 Control Methods

13.3.1 Number of Control Signals

Each set of control signals consists of an input signal and an output signal. These sets of signals can be controlled singularly or grouped together in multiple signal control.

Input and output signals are allocated accordingly to the requirements by a device to be controlled such as a single actuator or double solenoid valve. To allocate control signals into groups, specify each signal set into the group allocation parameters. Groups 1 to 4 are available.

Single Signal Control

Input/output signal set not assigned to any group.

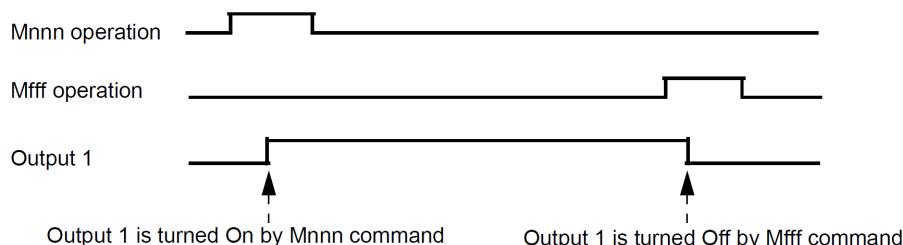


Figure 13.2 Single Signal Control Timing Chart

Single Signal Control

When multiple input/output signal sets are assigned to a group, each M code command affects the outputs of all the signal sets up to eight input/output signals and it can be assigned to the same group. In Multiple Signal Control, only one output in the group can be on at one time. When an "On" M code is commanded for one input/output set in a group, all other output signals in the same group are switched off.

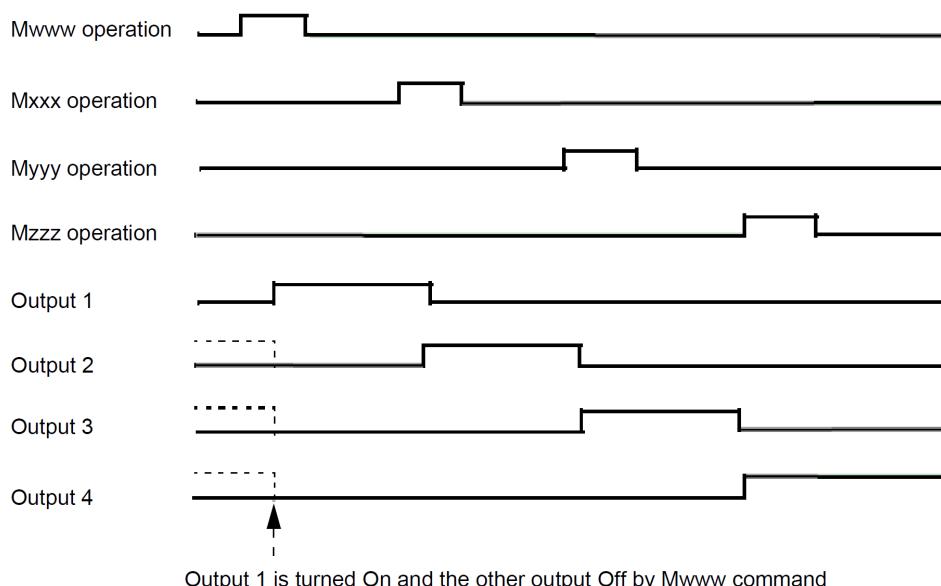


Figure 13.3 Multiple Signal Control Timing Chart

13.3.2 Start Condition Confirmation

This function allows the input/output signal status to be confirmed before the output is turned on or off by the M code commands. An alarm is triggered when the required conditions are not satisfied.

The condition is considered to be satisfied when the input signal corresponds to the output signal, i.e. when the output signal is on, the input signal is also on, or when the output signal is off, the input signal is also off.

For each M code, it is possible to enable the start condition confirmation for the signal user input/output only or for all the user input/outputs assigned to the same group.

13.3.3 Finish Condition Confirmation

This function allows the input/output signal status to be confirmed after the output is turned on or off by the M code commands. An alarm is triggered when the required conditions are not satisfied.

The condition is considered to be satisfied when the input signal corresponds to the output signal, i.e. when the output signal is on, the input signal is also on or when the output signal is off, the input signal is also off.

For each M code, it is possible to enable the finish condition confirmation for the signal user input/output only or for all the user input/outputs assigned to the same group.

13.3.4 Operation Completion Limit Time

This function sets the limit time allowed for each M code operation. One parameter is assigned to each pair of M code allocated for each input/output signal set.

An alarm is triggered if either M codes exceed the time set in this parameter. If "0" is set into this parameter, the alarm is always triggered.

13.3.5 Operation Completion Delay Time

This function allows the M code to be completed after a specified delay time. If “Finish” condition is checked, the delay will start after the specified input and output signals are checked. If “Finish” conditions are not checked, the delay will start after the specified M code output is turned on or off.

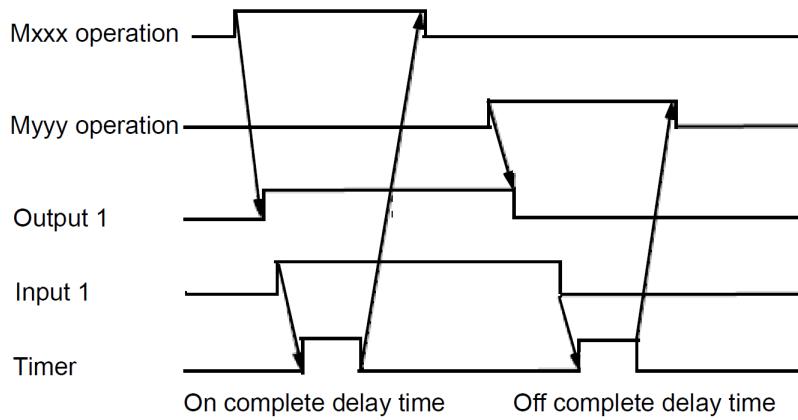


Figure 13.4 Operation Completion Delay Timing Chart

A completion delay time can be specified for each M code command. Setting unit is in 100 milliseconds (ms). When “0” is set, there is no completion delay time.

This function can be used together with the “Output Signal Off Upon Operation Completion” function to turn the specified output on for the specified time.

13.3.6 Output Signal Off Upon Operation Completion

This function turns off the output signal when the M Code command to turn on the output signal is completed. This option can be enabled by parameter for each of the M codes that turn on each set of input/output signals.

This function can be used together with the “Operation Completion Delay Time” function to turn the specified output on for the specified time.

13.3.7 M Code/Function/Machine Parameter

The list of MC parameter numbers used to determine the control methods for each M code outlined in the above sections are described in the table below.

M Code	Output Signal	Unit Signal	Start Condition Confirm		Finish Condition Confirm		Completion Limit Time	Completion Delay Time	Output Signal Off
			Single	Group	Single	Group			
580	USDO1 Off	USDI1 Off	11033	11041	11049	11057	11073	11089	11065
581	USDO1 On	USDI1 On						11081	
582	USDO2 Off	USDI2 Off	11034	11042	11050	11058	11074	11090	11066
583	USDO2 On	USDI2 On						11082	
584	USDO3 Off	USDI3 Off	11035	11043	11051	11059	11075	11091	11067
585	USDO3 On	USDI3 On						11083	
586	USDO4 Off	USDI4 Off	11036	11044	11052	11060	11076	11092	11068
587	USDO4 On	USDI4 On						11084	
588	USDO5 Off	USDI5 Off	11037	11045	11053	11061	11077	11093	11069
589	USDO5 On	USDI5 On						11085	
590	USDO6 Off	USDI6 Off	11038	11046	11054	11062	11078	11094	11070
591	USDO6 On	USDI6 On						11086	
592	USDO7 Off	USDI7 Off	11039	11047	11055	11063	11079	11095	11071
593	USDO7 On	USDI7 On						11087	
594	USDO8 Off	USDI8 Off	11040	11048	11056	11064	11080	11096	11072
595	USDO8 On	USDI8 On						11088	

Chapter 4 Operation

The list of Parameters used to allocate each set of input/output signals to a group is listed below.

	Signal	Group 1	Group 2	Group 3	Group 4
Set 1	USDO1/USDI1	11001	11009	11017	11025
Set 2	USDO2/USDI2	11002	11010	11018	11026
Set 3	USDO3/USDI3	11003	11011	11019	11027
Set 4	USDO4/USDI4	11004	11012	11020	11028
Set 5	USDO5/USDI5	11005	11013	11021	11029
Set 6	USDO6/USDI6	11006	11014	11022	11030
Set 7	USDO7/USDI7	11007	11015	11023	11031
Set 8	USDO8/USDI8	11008	11016	11024	11032

The description or each parameter is detailed in the table below.

Parameter	M Code	Signal	Description
11001	M580/M581	USDO1/USDI1	Group 1 Assignment Parameter Setting for whether each input/output signal set is assigned to Group number 1. Signals assigned to the same group will be controlled when a M code of any assigned signal is commanded. Setting: 0: Not assigned 1: Assigned
11002	M582/M583	USDO2/USDI2	
11003	M584/M585	USDO3/USDI3	
11004	M586/M587	USDO4/USDI4	
11005	M588/M589	USDO5/USDI5	
11006	M590/M591	USDO6/USDI6	
11007	M592/M593	USDO7/USDI7	
11008	M594/M595	USDO8/USDI8	
11009	M580/M581	USDO1/USDI1	Group 2 Assignment Parameter Setting for whether each input/output signal set is assigned to Group number 2. Signals assigned to the same group will be controlled when a M code of any assigned signal is commanded. Setting: 0: Not assigned 1: Assigned
11010	M582/M583	USDO2/USDI2	
11011	M584/M585	USDO3/USDI3	
11012	M586/M587	USDO4/USDI4	
11013	M588/M589	USDO5/USDI5	
11014	M590/M591	USDO6/USDI6	
11015	M592/M593	USDO7/USDI7	
11016	M594/M595	USDO8/USDI8	
11017	M580/M581	USDO1/USDI1	Group 3 Assignment Parameter Setting for whether each input/output signal set is assigned to Group number 3. Signals assigned to the same group will be controlled when a M code of any assigned signal is commanded. Setting: 0: Not assigned 1: Assigned
11018	M582/M583	USDO2/USDI2	
11019	M584/M585	USDO3/USDI3	
11020	M586/M587	USDO4/USDI4	
11021	M588/M589	USDO5/USDI5	
11022	M590/M591	USDO6/USDI6	
11023	M592/M593	USDO7/USDI7	
11024	M594/M595	USDO8/USDI8	
11025	M580/M581	USDO1/USDI1	Group 4 Assignment Parameter Setting for whether each input/output signal set is assigned to Group number 4. Signals assigned to the same group will be controlled when a M code of any assigned signal is commanded. Setting: 0: Not assigned 1: Assigned
11026	M582/M583	USDO2/USDI2	
11027	M584/M585	USDO3/USDI3	
11028	M586/M587	USDO4/USDI4	
11029	M588/M589	USDO5/USDI5	
11030	M590/M591	USDO6/USDI6	
11031	M592/M593	USDO7/USDI7	
11032	M594/M595	USDO8/USDI8	

Chapter 4 Operation

Parameter	M Code	Signal	Description
11033	M580/M581	USDO1/USDI1	Start Condition Check (Single) Setting for whether each M code operation will check the status of the corresponding input/output signals at the start of each M code command. Setting: 0: No Check 1: Check USDI and USDO status the same
11034	M582/M583	USDO2/USDI2	
11035	M584/M585	USDO3/USDI3	
11036	M586/M587	USDO4/USDI4	
11037	M588/M589	USDO5/USDI5	
11038	M590/M591	USDO6/USDI6	
11039	M592/M593	USDO7/USDI7	
11040	M594/M595	USDO8/USDI8	
11041	M580/M581	USDO1/USDI1	Start Condition Check (Group) Setting for whether each M code operation will check the status of all the input/output signals assigned to the same group as the M code commanded at the start. Setting: 0: No Check 1: Check USDI and USDO status the same for all signals of the same group
11042	M582/M583	USDO2/USDI2	
11043	M584/M585	USDO3/USDI3	
11044	M586/M587	USDO4/USDI4	
11045	M588/M589	USDO5/USDI5	
11046	M590/M591	USDO6/USDI6	
11047	M592/M593	USDO7/USDI7	
11048	M594/M595	USDO8/USDI8	
11049	M580/M581	USDO1/USDI1	Finish Condition Check (Single) Setting for whether each M code operation will check the status of the corresponding input/output signals at the end of each M code command. Setting: 0: No Check 1: Check USDI and USDO status the same
11050	M582/M583	USDO2/USDI2	
11051	M584/M585	USDO3/USDI3	
11052	M586/M587	USDO4/USDI4	
11053	M588/M589	USDO5/USDI5	
11054	M590/M591	USDO6/USDI6	
11055	M592/M593	USDO7/USDI7	
11056	M594/M595	USDO8/USDI8	
11057	M580/M581	USDO1/USDI1	Finish Condition Check (Group) Setting for whether each M code operation will check the status of all the input/output signals assigned to the same group as the M code commanded at the end. Setting: 0: No Check 1: Check USDI and USDO status the same for all signals of the same group
11058	M582/M583	USDO2/USDI2	
11059	M584/M585	USDO3/USDI3	
11060	M586/M587	USDO4/USDI4	
11061	M588/M589	USDO5/USDI5	
11062	M590/M591	USDO6/USDI6	
11063	M592/M593	USDO7/USDI7	
11064	M594/M595	USDO8/USDI8	

Parameter	M Code	Signal	Description
11065	M581	USDO1/USDI1	USDO Off After On Operation Complete Setting for each on M code whether to switch off the output once operation is complete. Setting: 0: Not turned off 1: Turned off
11066	M583	USDO2/USDI2	
11067	M585	USDO3/USDI3	
11068	M587	USDO4/USDI4	
11069	M589	USDO5/USDI5	
11070	M591	USDO6/USDI6	
11071	M593	USDO7/USDI7	
11072	M595	USDO8/USDI8	
11073	M580/M581	USDO1/USDI1	M Code Completion Limit Time Limit time for each set of M code. Alarm is triggered if the M code is not completed with the time specified. Units: Seconds (sec) Setting Range: 0 - 32767
11074	M582/M583	USDO2/USDI2	
11075	M584/M585	USDO3/USDI3	
11076	M586/M587	USDO4/USDI4	
11077	M588/M589	USDO5/USDI5	
11078	M590/M591	USDO6/USDI6	
11079	M592/M593	USDO7/USDI7	
11080	M594/M595	USDO8/USDI8	
11081	M581	USDO1/USDI1	On Delay Time Delay time for each on M code completion. M code is not completed until the specified time has passed after on completion conditions are satisfied. Units: 100 milliseconds (msec) Setting Range: 0 - 32767
11082	M583	USDO2/USDI2	
11083	M585	USDO3/USDI3	
11084	M587	USDO4/USDI4	
11085	M589	USDO5/USDI5	
11086	M591	USDO6/USDI6	
11087	M593	USDO7/USDI7	
11088	M595	USDO8/USDI8	
11089	M580	USDO1/USDI1	Off Delay Time Delay time for each off M code completion. M code is not completed until the specified time has passed after off completion conditions are satisfied. Units: 100 milliseconds (msec) Setting Range: 0 - 32767
11090	M582	USDO2/USDI2	
11091	M584	USDO3/USDI3	
11092	M586	USDO4/USDI4	
11093	M588	USDO5/USDI5	
11094	M590	USDO6/USDI6	
11095	M592	USDO7/USDI7	
11096	M594	USDO8/USDI8	

13.4 Operation Timing Charts and Flowcharts

The operation is executed in the following sequence:

- 1) Start Condition Confirmation
- 2) Output Signal On/Off
- 3) Operation Completion Confirmation with Input Signal
- 4) Completion Delay Time
- 5) Output Signal Off Upon Completion

13.4.1 Signal Control Timing Chart

The input/output signals are controlled by signal control when the signal set is not assigned to any group (1 ~ 4) or when the signal set is the only one assigned to a group.

Single signal control is described below with an example case in which USDO1/USDI1 are controlled with M580 and M581.

USDO1 is turned on by M581 and USDO1 is turned off by M580. All other input/output signal sets are controlled in the same manner with different M codes.

The timing chart below shows the operation with the following functions:

- Start Condition Not Confirmed
- Finish Condition Confirmed
- Completion Delay Time Specified
- Output Signal Not Turned Off Upon Completion

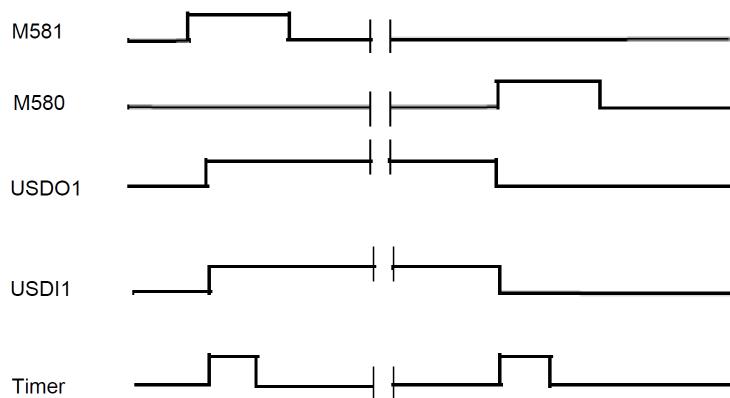


Figure 13.5 Example of Signal Control Timing Chart

13.4.2 Signal Control Flow Chart

The flow chart for the off operation in Signal Control is shown below.

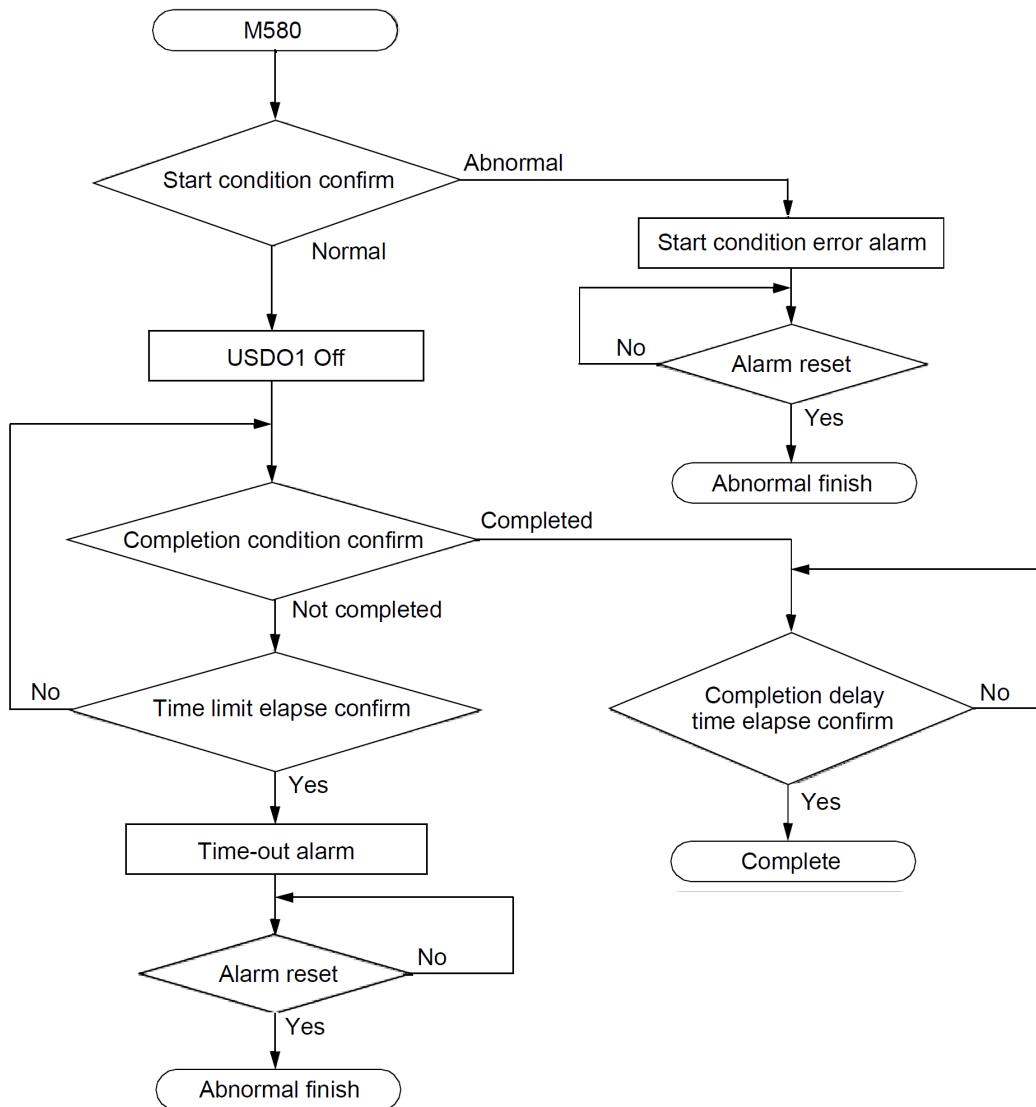


Figure 13.6 Signal Control Off Operation (M580) Flow Chart

Chapter 4 Operation

The flow chart for the on operation in Signal Control is shown below.

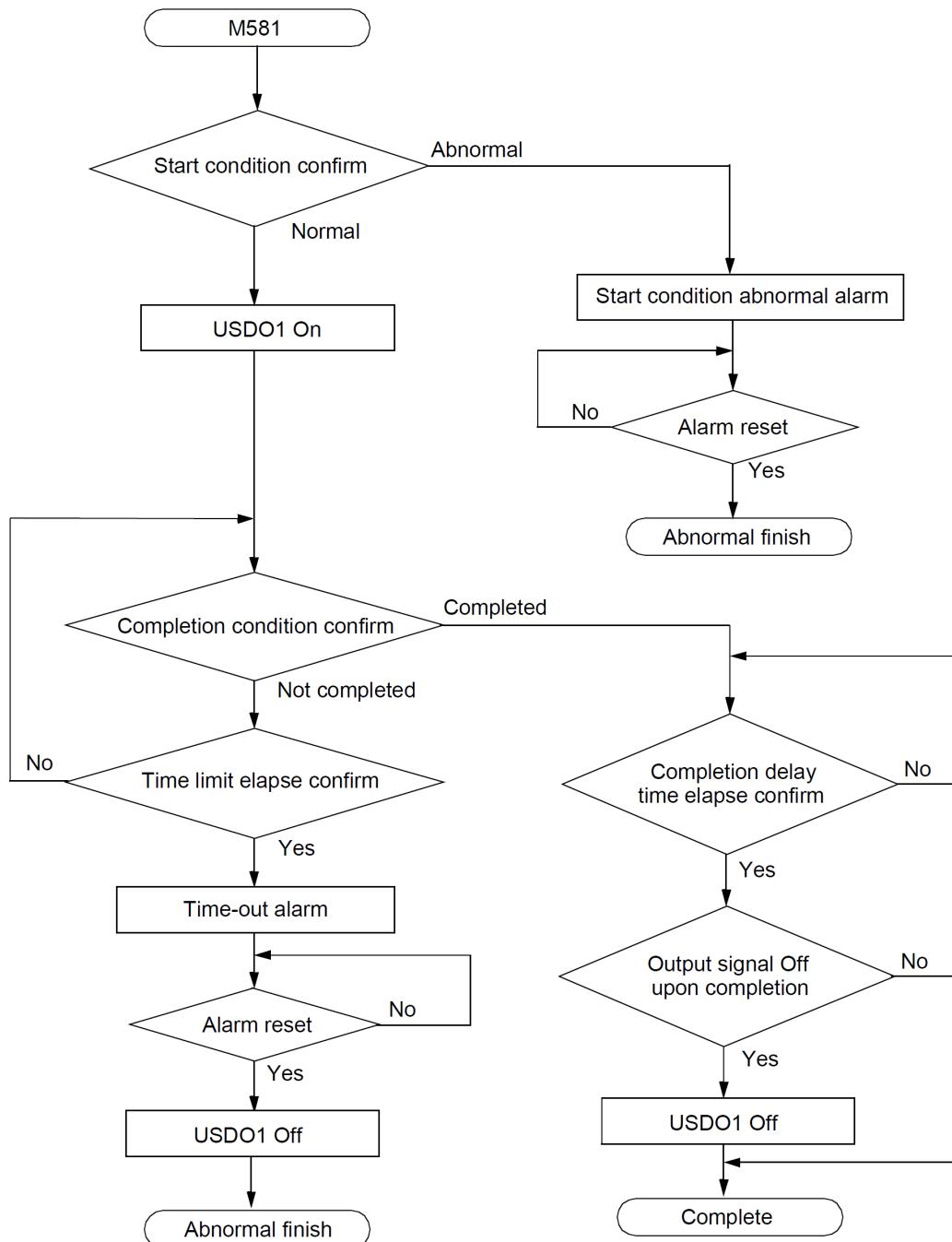


Figure 13.7 Signal Control On Operation (M581) Flow Chart

13.4.3 Two Signal Control Timing Chart

Two signal control is used when two sets of input/output signals are assigned to the same group number. Two signal control is described below with an example case in which USDO1/USDI1 and USDO2/USDI2 are controlled with M581 and M583.

M Code	USDO1 Output Signal	USDO2 Output Signal
M581	On	Off
M583	Off	On

The timing chart below shows the operation with the following functions:

- Start Condition Not Confirmed
- Operation Completion Confirmed
- Completion Delay Time Specified
- Output Signal Not Turned Off Upon Completion

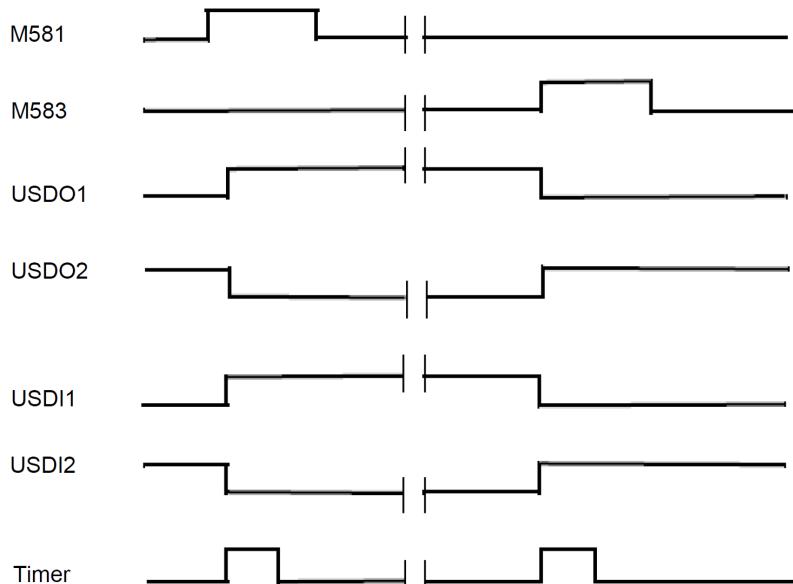


Figure 13.8 Example of Two Signal Control Timing Chart

13.4.4 Two Signal Control Flow Chart

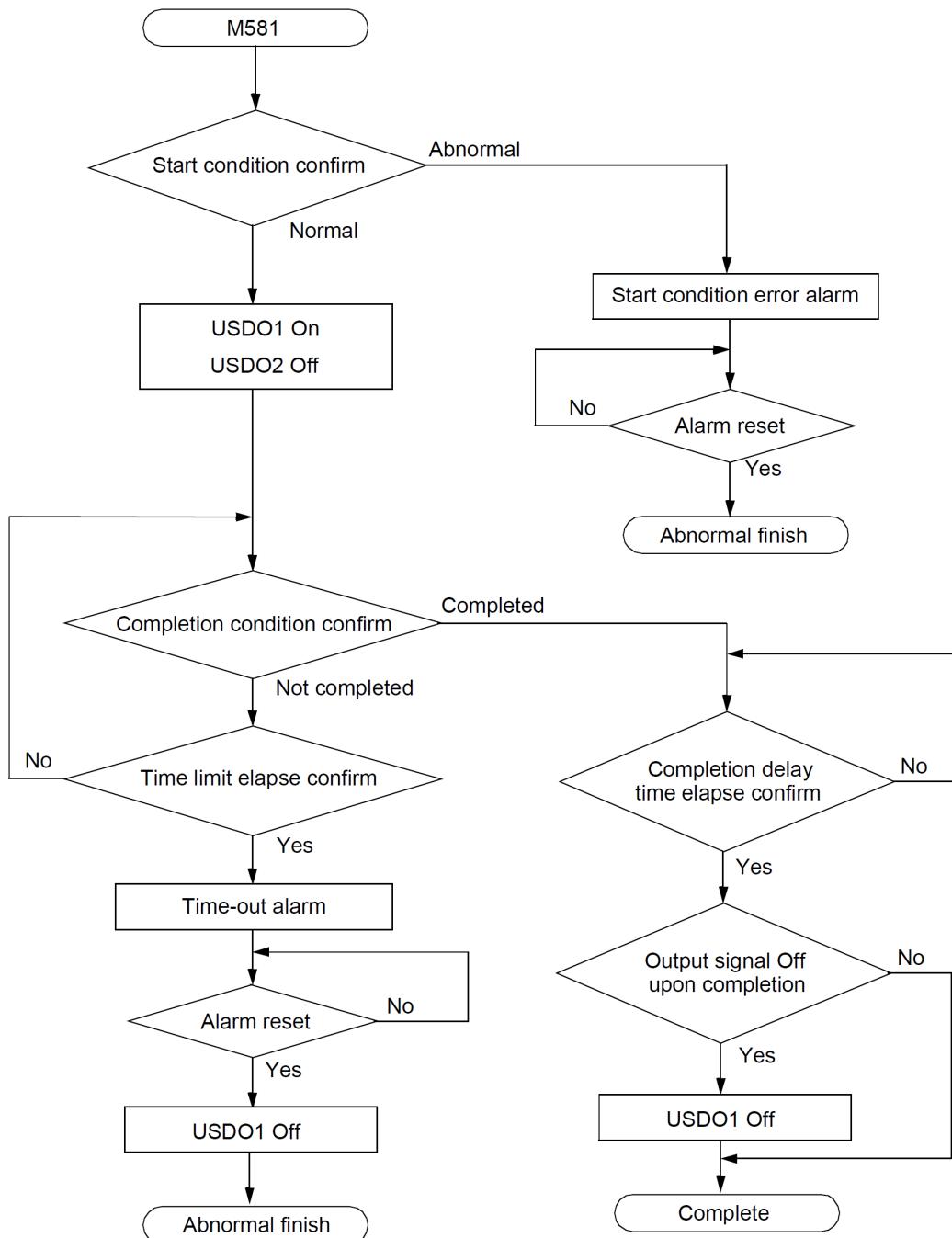


Figure 13.9 Two Signal Control Operation (M581) Flow Chart

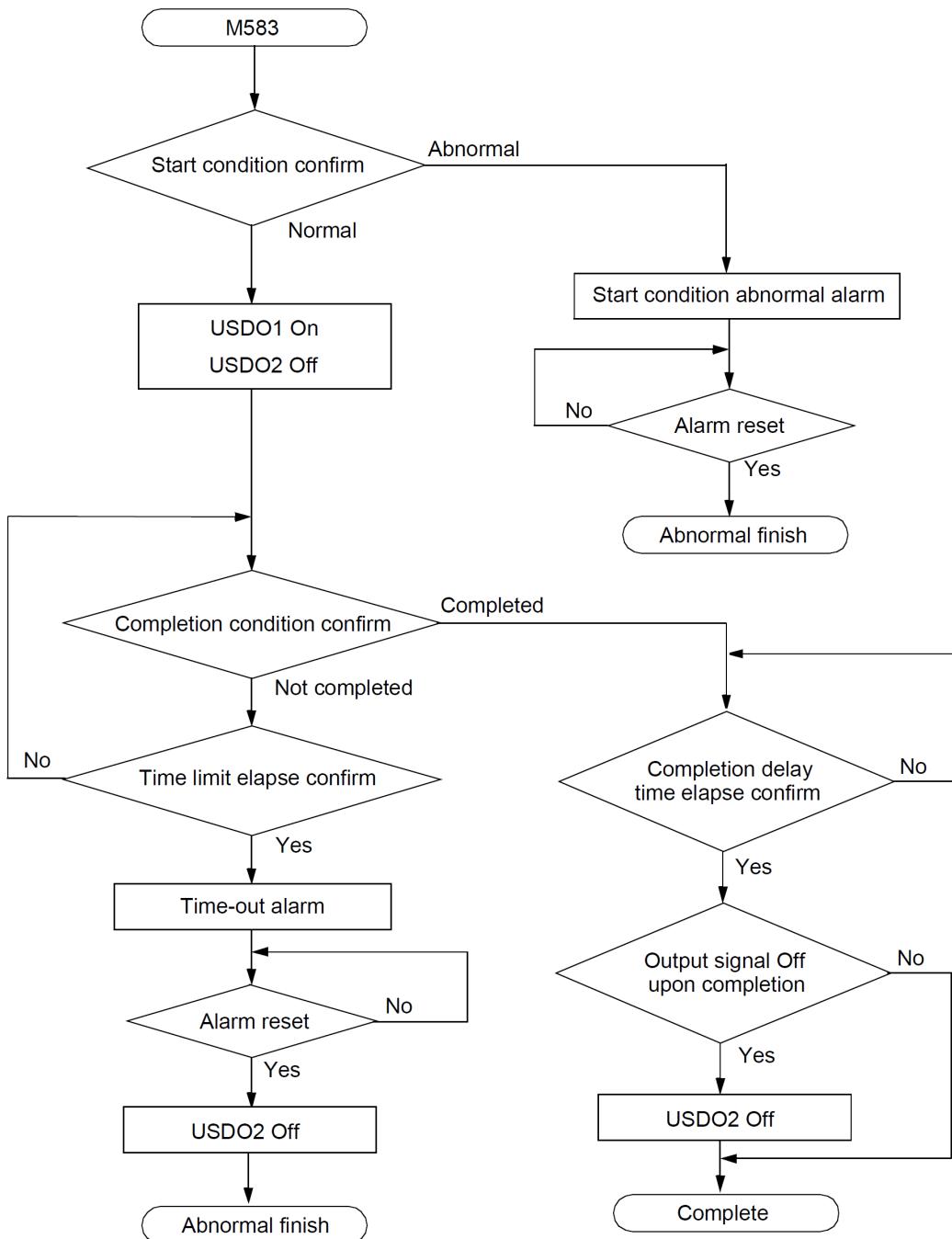


Figure 13.10 Two Signal Control Operation (M583) Flow Chart

13.4.5 Three or More Signal Control Timing

When three or more sets of input/output signals are assigned to the same group, all the signals are controlled by M code commands from any signal set in the group.

Three signal controls are described below with an example case in which three signals USDO1/USDI1 ~ USDO3/USDI3 are controlled with M580 and M581.

M Code	USDO1 Output Signal	USDO2 Output Signal	USDO3 Output Signal
M581	On	Off	Off
M583	Off	Off	Off

The timing chart below shows the operation with the following functions:

- Start Condition Not Confirmed
- Operation Completion Confirmed
- Completion Delay Time Specified
- Output Signal Not Turned Off Upon Completion

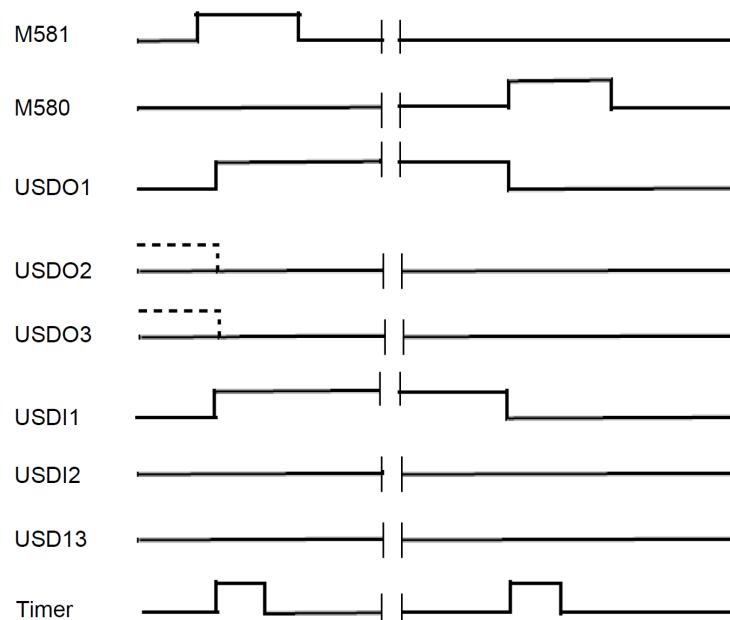


Figure 13.11 Example of Three Signal Control Timing Chart

13.4.6 Three Signal Control Flow Chart

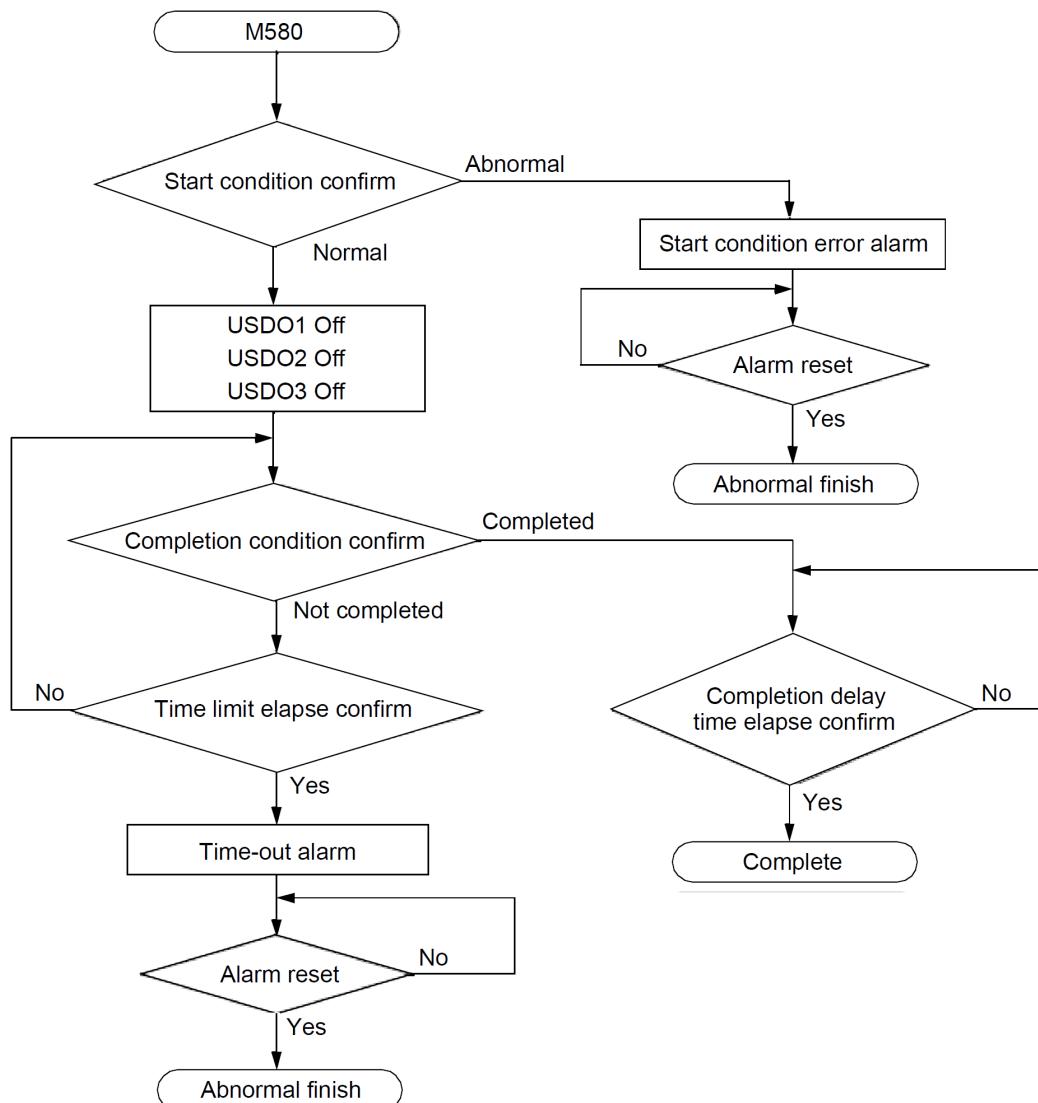


Figure 13.12 Three Signal Control (M580) Flow Chart

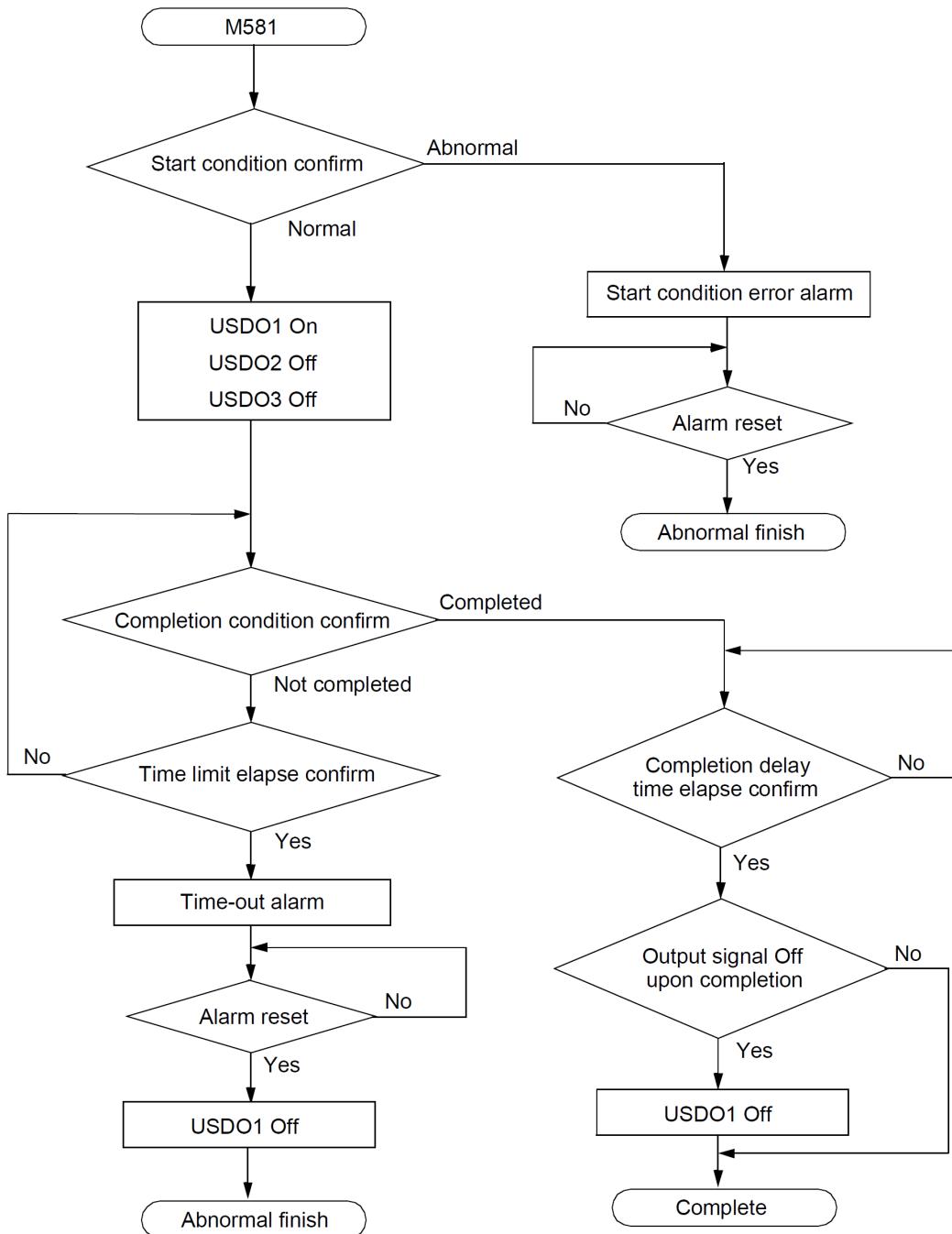


Figure 13.13 Three Signal Control (M581) Flow Chart

13.5 Emergency Processing

13.5.1 Operations at Emergency Stop

When an “Emergency Stop” switch is pressed or the machine enters the Emergency Stop condition due to a servo alarm or other causes, all outputs signals (USDO1 to USDO8) are unconditionally changed to off and operation of special user I/O interface is aborted.

13.5.2 Processing When NC Is Reset

In the event the NC is reset while the user I/O interface function M code is being executed, the M code is reset and program is terminated, but the operation continues. M codes, which not executed yet when NC reset is pressed, will not be executed.

If NC reset is pressed when no user I/O interface functions M codes are being executed, the output status of all output signals remains the same.

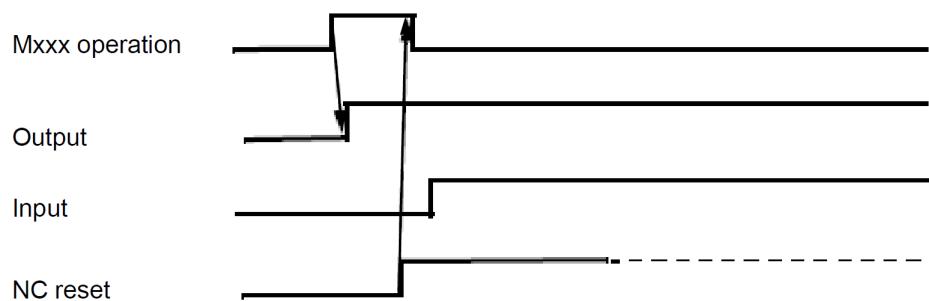


Figure 13.14 Timing Chart When NC Is Reset During Operation

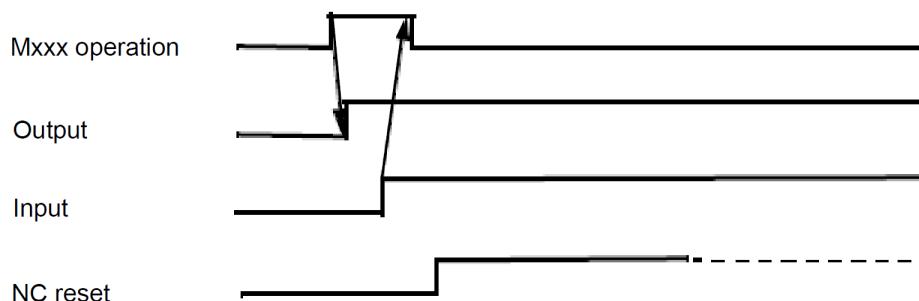


Figure 13.15 Timing Chart When NC Is Reset During No Operation

13.5.3 Operation During Maintenance Mode

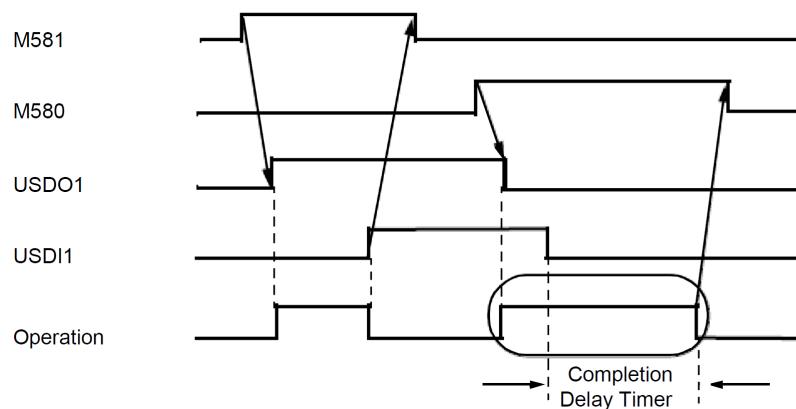
When NC program is operating, Maintenance mode cannot be turned on. When Maintenance mode is on, program cannot be started.

13.6 Usage Examples

13.6.1 Controlling Single Actuator

Control of a single actuator equipped with a single solenoid valve and limit switch is outlined below.

When there are only one limit switch, an operation may not be completed even through the status of the limit switch changes for the operation of the one side. In such a case, the completion delay time function is utilized.



USDO1: Solenoid Valve
USDI1: Limit Switch

Set the delay timer (complete delay time) when operation started by changing USDO1 to 0 (Off) does not complete when USDI1 becomes 0 (Off).

Figure 13.16 Single Actuator Control Timing Chart

Control Procedure Using USDO1/USDI1

- 1) Set the machine parameters as follows:
 - No. 11033 (Start Condition Confirm – Single) 0: Not confirmed
 - No. 11041 (Start Condition Confirm – Group) 0: Not Confirmed
 - No. 11049 (Finish Condition Confirm – Single) 1: Confirmed
 - No. 11057 (Finish Condition Confirm – Group) 0: Not confirmed
 - No. 11073 (Operation Completion Time Limit) 30: 30 [sec]
 - No. 11089 (Off Operation Completion Delay Time) 5: 500 [msec]
 - No. 11081 (On Operation Completion Delay Time) 0: 0 [msec]
 - No. 11065 (USDO1 turn off after operation completion) 0: Not turned off
- 2) Connect the limit switch/solenoid valve and the input/output signal terminal in the machine controller with cables. Connect the solenoid valve to USDO1 and the limit switch to USDI1.
- 3) Issue M580 and M581 in MDI mode to confirm the single actuator operation. Check the operation status and adjust the completion delay time to the optimum value with machine parameter No. 11069 (USDO1/USDI1 Off Operation Completion Delay Time).

13.6.2 Controlling Double Solenoid Valve

The control procedure for a double solenoid valve device consisting of two solenoid valves and two limit switches is described below.

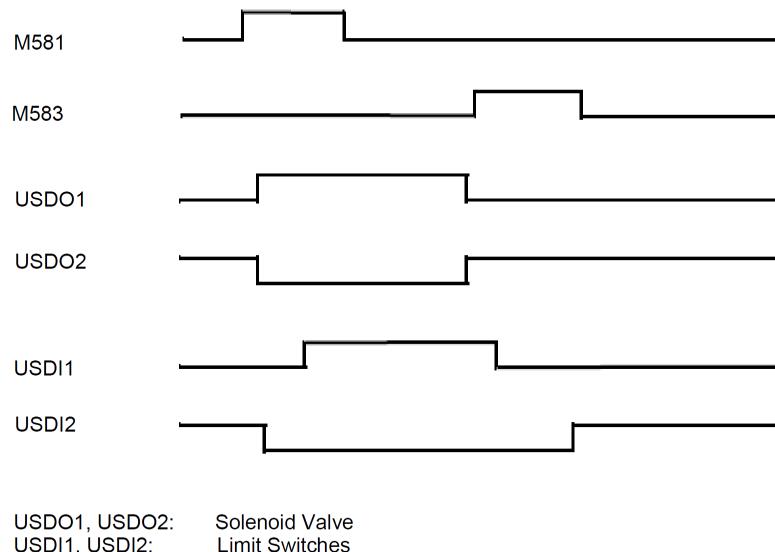


Figure 13.17 Double Solenoid Valve Device Control Timing Chart

Control Procedure Using USDO1/USDI1

- 1) Set the machine parameters as follows:

USDO1/USDI1 Setting

- No. 11001 (USDO1/USDI1 assigned to Group 1) 1: Yes
- No. 11033 (Start Condition Confirm – Single) 0: Not Confirmed
- No. 11041 (Start Condition Confirm – Group) 0: Not Confirmed
- No. 11049 (Finish Condition Confirm – Single) 1: Confirmed
- No. 11057 (Finish Condition Confirm – Group) 1: Confirmed
- No. 11073 (Operation Completion Time Limit) 30: 30 [sec]
- No. 11089 (Off Operation Completion Delay Time) 0: 0 [msec]
- No. 11081 (On Operation Completion Delay Time) 0: 0 [msec]
- No. 11065 (USDO1 turn off after operation completion) 0: Not turned off

USDO2/USDI2 Setting

- No. 11002 (USDO2/USDI2 assigned to Group 1) 1: Yes
- No. 11034 (Start Condition Confirm – Single) 0: Not Confirmed
- No. 11042 (Start Condition Confirm – Group) 0: Not Confirmed
- No. 11050 (Finish Condition Confirm – Single) 1: Confirmed
- No. 11058 (Finish Condition Confirm – Group) 1: Confirmed
- No. 11074 (Operation Completion Time Limit) 30: 30 [sec]
- No. 11090 (Off Operation Completion Delay Time) 0: 0 [msec]
- No. 11082 (On Operation Completion Delay Time) 0: 0 [msec]
- No. 11066 (USDO1 turn off after operation completion) 0: Not turned off

Other Settings

Set parameter from No. 11003 to No. 11008 to “0”

- 2) Connect the limit switch/solenoid valve and the input/output signal terminal in the machine controller with cables. Connect the solenoid valve to USDO1 and USDO2 and the limit switch to USDI1 and USDI2.
- 3) Issue M581 and M583 in MDI mode to confirm the double actuator operation.

13.6.3 Controlling Production Counter

Below is the procedure to control the incremental counter by issuing a start command by sending an external signal (pulse signal).

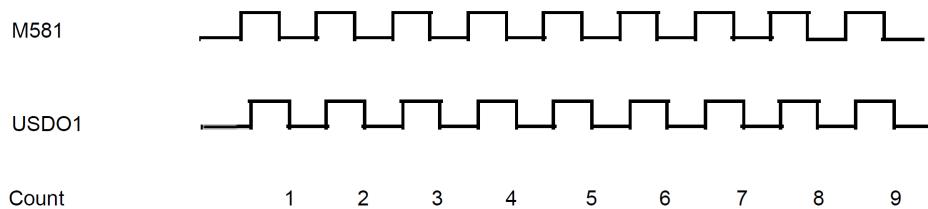


Figure 13.18 Counter Control Timing Chart

Control Procedure Using USDO1/USDI1

- 1) Set the machine parameters as follows:
 - No. 11033 (Start Condition Confirm – Single) 0: Not Confirmed
 - No. 11041 (Start Condition Confirm – Group) 0: Not Confirmed
 - No. 11049 (Start Condition Confirm – Single) 0: Not Confirmed
 - No. 11057 (Finish Condition Confirm – Group) 0: Not Confirmed
 - No. 11073 (Operation Completion Time Limit) 5: 5 [sec]
 - No. 11089 (Off Operation Completion Delay Time) 0: 0 [msec]
 - No. 11081 (On Operation Completion Delay Time) 10: 1000 [msec]
 - No. 11065 (USDO1 turn off after operation completion) 1: Turned off
- 2) Connect the counter and the output signal terminal in the machine controller with cables. Connect the counter to USDO1.
- 3) Issue M581 in MDI mode to confirm the counter operation. check the operation status and adjust the on completion delay time to the optimum value with machine parameter No. 11081 (USDO1/USDI1 On Operation Delay Time).

14 Coolant Supply

14.1 Precautions for Coolant Usage

- Use of non-foaming and water soluble coolant is strongly recommended. The use of A2-class soluble type, A3-class chemical solution type or synthetic type based coolant can damage the machine (Examples: Peeling of paint, deterioration of rubber parts). Consult with the manufacturer before starting use.
- Coolant must be non-corrosive (both to rubber seals and metals).
- Do not use anti-foaming additives unless absolutely necessary to prevent clogging of the drum unit filters. If an anti-foaming additive must be used, the concentration must be properly controlled.
- If use of an oil-based coolant cannot be avoided, a fire extinguishing system must be provided by the customer (Refer to Chapter 1 Safety [1.3 Precautions for Potential Fire Hazards](#)³⁾.
- Follow the manufacturers instructions when diluting coolant. DO NOT dilute in the tank.
- Follow the manufacturers instructions on coolant concentration to prevent the spreading of mold.
- When storing coolant, avoid direct sunlight and keep it in a cool place. Avoid extremely low temperatures in the winter.
- Take measures to prevent mixing with foreign matter, including water.
- Disposal procedures vary depending on the type of the cutting fluid. Confirm the proper disposal procedure and dispose of the coolant or request an authorized company to handle this procedure. Do not dispose of untreated coolant into a sewer or a river under any circumstances.
- Oil recovered by the oil skimmer cannot be reused. Do not return it to the tank, since this may result in machine trouble.



Precautions for Starting/Stopping Frequency of Through Spindle Coolant 1.5MPa

- The frequency of starting and stopping Through Spindle Coolant is controlled/limited by the motor (3.0kW), however the maximum allowable value is 100 starts/stops per hour. Repeated starting/stopping at a high frequency will significantly shorten the life of the electromagnetic connectors, as well as lead to premature damage to the pump. As much as possible, it is recommended that the number of starts/stops be reduced or continuous operation be performed.



Through Spindle Coolant Usage Precautions (For Through Spindle Coolant Specs.)

- For BT Specs.: Use only retention knobs specified by Makino on tools for which the Through Spindle Coolant function is provided.
- For HSK Specs.: Make sure a lubrication pipe is installed on all tools including tools for which Through Spindle Coolant is not provided (An automatic workpiece measuring unit holder cannot be installed with the lubrication pipe.).
- Attach lubrication pipe to all tools. In the event Through Spindle Coolant is discharged without attaching a lubrication pipe, coolant will get inside the Spindle, causing premature damage.



14.2 Overview

Coolant for machining is supplied by the coolant supply unit.

Chips are removed from the recovered coolant by the chip disposal unit and the temperature is controlled by the Coolant Chiller (Option) when it is used (Refer to [15 Chip Disposal](#) [210]).

14.3 Coolant Supply Unit Operation

The supply of coolant fluid can be manipulated with the following methods:

- Operation Using NC Program (M code)
- Manual Operation (Main Operation Panel/Function Screen)

14.3.1 Operation Using NC Program (M Code)

The following M code are used to supply coolant.

M07	: Air Blow On
M08	: Nozzle Coolant On
M09	: Coolant Off
M26	: Through Spindle Coolant On
M77	: Through Spindle Air On
M97	: Overhead Shower Coolant On
M312	: Store Coolant Status and Temporarily Stop All Coolant Supply
M313	: Restart Operation that has been Temporarily Stopped
M710	: Mist Collector Off
M711	: Mist Collector On
M754	: Base Coolant On
M756	: Air Blow On
M786	: Bed Flush Coolant Off
M787	: Bed Flush Coolant On

-NOTES-

- 1 There are some M code that cannot be used depending upon the machine specifications and the options provided.
- 2 In order to discharge Through Spindle Coolant/Air, usage of the Through Spindle must be set on the Tool Data Management screen.

Chapter 4 Operation

MDI EMG ALM HOLD ITL			NONE 14:46:20 MAKINO Pro U 3/3								
POT	EXIST	TOOL NO	TYPE	FTN	Z-RET	ROT	POT	BTS	TSC	BTS LENGTH	STATUS
				GR	SQ						
SP	NO	0	NONE	0	0	NOT Z0	NO	NO	NO	0.0000	
1	NO	100	CHAMFER	0	0	NOT Z0	NO	NO	NO	0.0000	
2	NO	2	BORING BAR	0	0	NOT Z0	NO	NO	NO	0.0000	
3	NO	3	TAP	0	0	NOT Z0	NO	NO	NO	0.0000	
4	NO	4	TAP	0	0	NOT Z0	NO	NO	NO	0.0000	
5	NO	5	BORING BAR	0	0	NOT Z0	NO	NO	NO	0.0000	
6	NO	6	REAMER	0	0	NOT Z0	NO	NO	NO	0.0000	
7	NO	7	REAMER	0	0	NOT Z0	NO	NO	NO	0.0000	
8	NO	80	SPECIAL TOOL1	0	0	NOT Z0	NO	NO	NO	0.0000	
9	NO	9	LIMITED	0	0	NOT Z0	NO	NO	NO	0.0000	
10	NO	10	HALE BITE	0	0	NOT Z0	NO	NO	NO	0.0000	

Figure 14.1 Tool Data Management Screen

14.3.2 Manual Operation (Main Operation Panel/Function Screen)

Manual operation can be performed with the following methods.

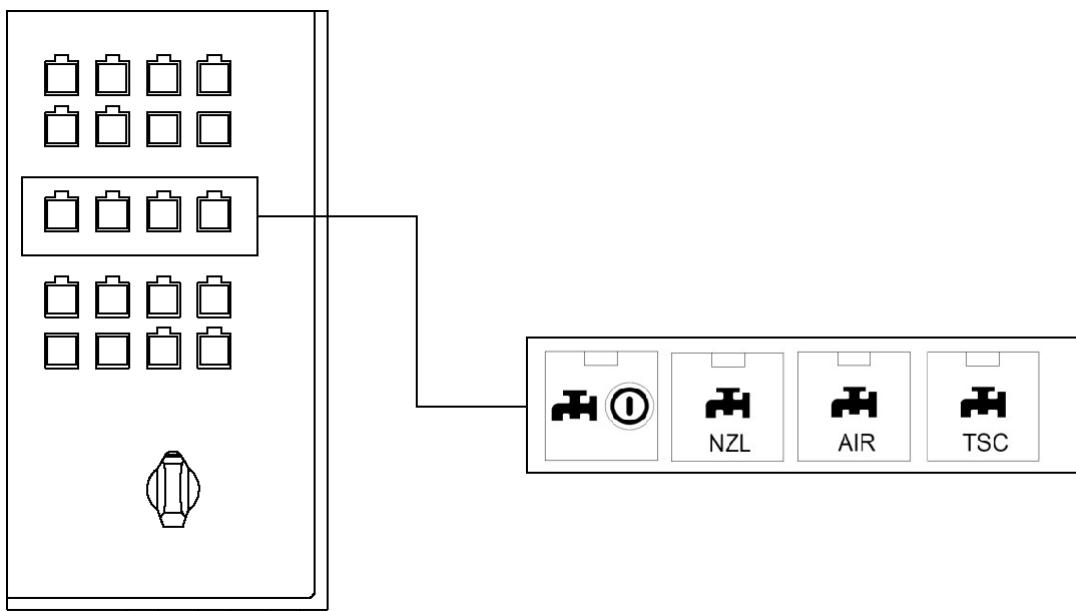
- Operating machine from main operation panel (Refer to A)
- Operating machine from Function Screen (Refer to B)

A Manual Operation from Main Operation Panel

The coolant related function switches are valid regardless of the operation mode. When a switch is pressed, the corresponding function is turned on (lamp illuminated). When pressed again, the function is turned off (lamp extinguished).

For details of coolant related switches. (Refer to 2.5 Coolant Related Switches^[84])

- NOTICE**
- Functions not allocated to main operation panel.
 - The function can be turned on/off on the Function Screen. The flexible switch function can be used to allocate functions to the main operation panel (refer to 2.8 MDI Panel^[90]).



14.2 Coolant Related Function Switches on Main Operation Panel

B Manual Operation from Function Screen

- 1) Press **[MAKINO]** at Main Menu Screen .
- 2) Select **[FUNCTION]** by moving the **[←]** or **[→]** cursor.
- 3) Press the **[ON]** soft key to turn on the selected coolant supply function.
- 4) Press the **[OFF]** soft key to turn off the selected coolant supply function.

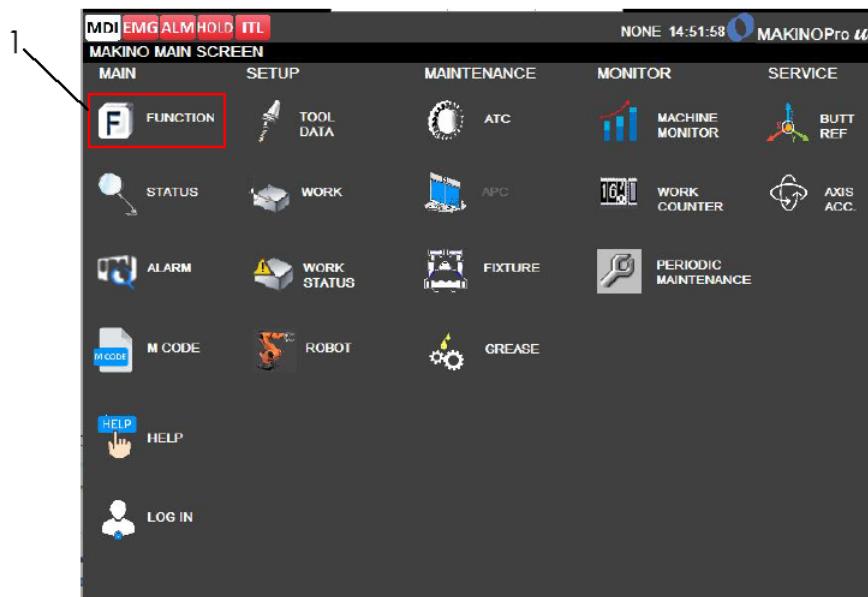


Figure 14.3 Function Button on Navigation Menu Screen

No.	Name
1	[FUNCTION] Button

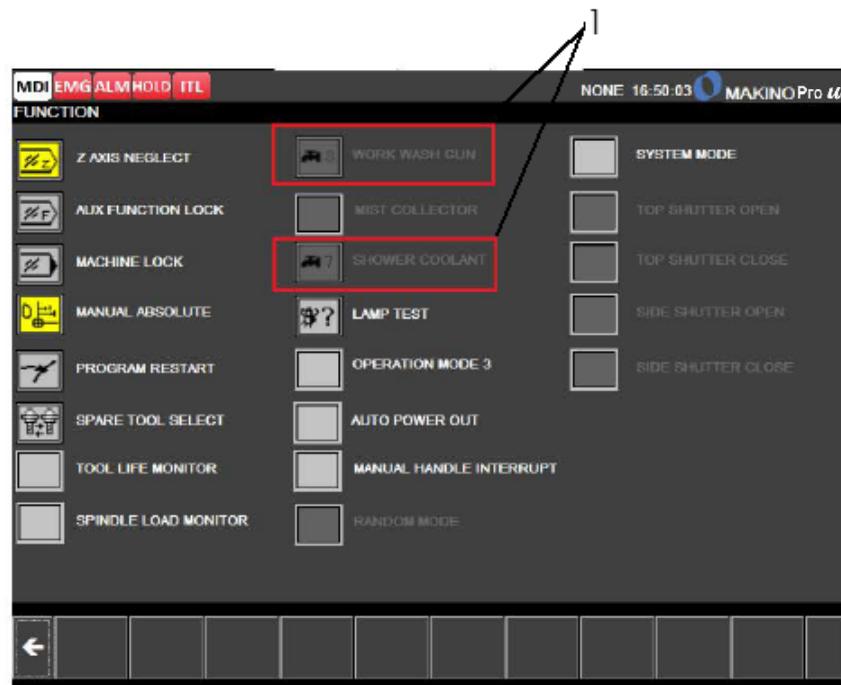


Figure 14.4 Coolant Related Functions on Function Screen

No.	Name
1	Coolant Related Functions

15 Chip Disposal

15.1 Overview

Chips are flushed out into the chip disposal unit and disposed manually using the scraper to remove the chips into the chip bucket.

Manual Chip Disposal

For machines with the standard specifications, the chips disposal is done manually with the following steps. (Refer to [Figure 15.1](#))²¹⁰

- 1) Use the scraper [1].
- 2) Remove the chips following the direction of the arrow [2] and into the chip bucket provided by the operator.

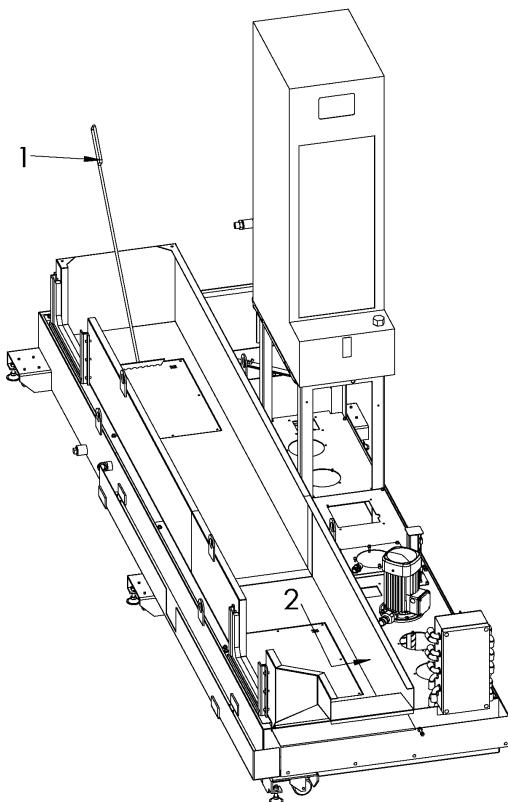


Figure 15.1 Manual Chip Disposal Unit

No.	Name	No.	Name
1	Scraper	2	Direction of arrow

15.2 Drum Conveyor (Option)

Chips generated during workpiece machining are separated from the coolant and recovered by the drum conveyor [1].

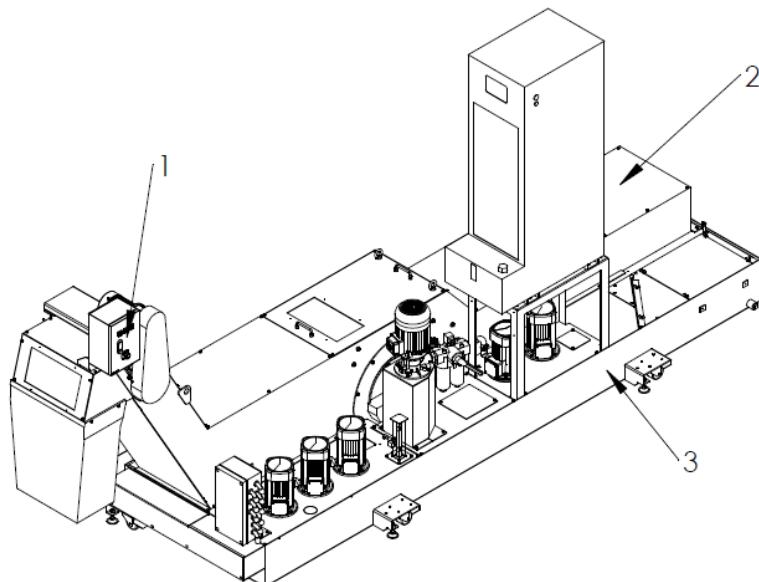


Figure 15.2 Drum Conveyor (Option)

No.	Name	No.	Name
1	Drum Conveyor Operation Pane	3	Coolant Tank
2	Drum Conveyor	-	-

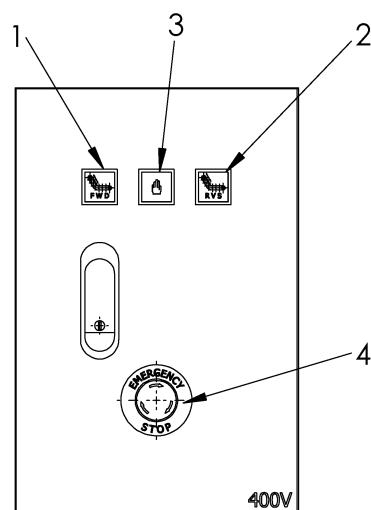


Figure 15.3 Drum Conveyor Control Panel Layout

No.	Name	No.	Name
1	Forward Rotation Start Switch	3	Manual Intervention Switch
2	Reverse Rotation Start Switch	4	Emergency Stop Switch

15.2.1 Automatic Operation

Automatic operation of the drum conveyor are interlinked with discharge of coolant and it can be operated continuously in the forward direction.

15.2.2 Manual Operation

Manual operation of the drum conveyor can be performed with the following methods.

A Procedure to Rotate in Forward Direction During Automatic Operation

- 1) Press the “Manual Intervention” switch. (Manual operation mode)
- 2) Press the “Forward Rotation Start” switch (starts rotation in forward direction).
- 3) Press the “Forward Rotation Start” switch again (stops rotation in forward direction).
- 4) Press the “Manual Intervention” switch. (Automatic operation mode)

B Procedure to Rotate in Reverse Direction During Automatic Operation

- 1) Press the “Manual Intervention” switch. (Manual operation mode).
- 2) Hold down the “Reverse Rotation Start” switch (rotation in reverse direction).
- 3) Release the “Reverse Rotation Start” switch (stops rotation in reverse direction).
- 4) Press the “Manual Intervention” switch. (Automatic operation mode)

-NOTE-

The switches are located on the drum conveyor operation panel (hereafter called operation panel). (Refer to [Figure 15.3](#))

15.2.3 Stop Operation

Stop operation of the drum conveyor can be performed with the following methods.

A Stopped by Emergency Stop Switch

Press the “Emergency Stop” switch on the operation panel. (Refer to [Figure 15.3](#))

All machine operations are stopped, including spindle rotation. (Refer to [2.7 Malfunction/Accident Prevention Switch/Key Switches](#))

B Stopped by Manual Intervention Switch

Press the “Manual Intervention” switch on the operation panel. (Refer to [Figure 15.3](#))

16 Signal Lamp

The signal lamp is provided to inform the operator of the machine status.

Standard Specifications: 3-level signal lamp (red, yellow, green)

Option: Buzzer

16.1 Conditions to Turn On Signal Lamp

Each signal lamp is turned on in the following conditions.

Signal Lamp 1 (Red), Buzzer (Option)

- Alarm triggered
- Emergency Stop

Signal Lamp 2 (Yellow)

- End of Program (M02, M30)
- Program Stop (M00, M01)

Signal Lamp 3 (Green)

- During automatic operation

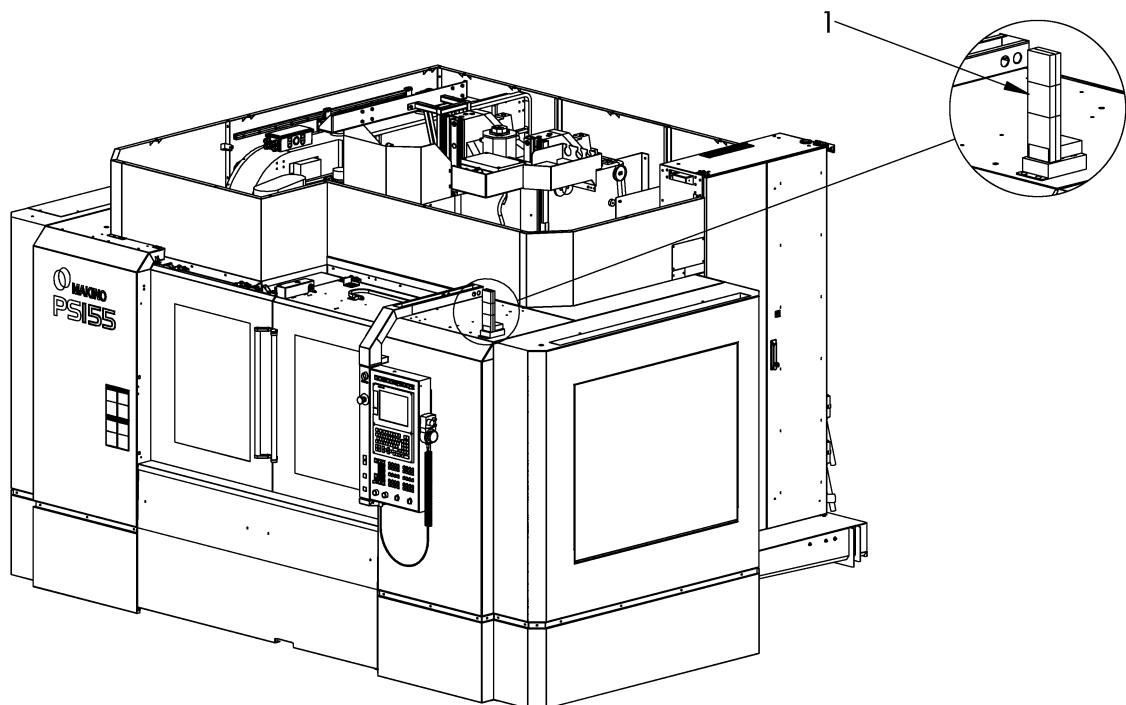


Figure 16.1 Signal Lamp Location

No.	Name
1	Signal Lamp

17 Mist Collector (Option)

The mist collector recovers the air/coolant mixture (mist) generated in the machining chamber. The mist is then filtered and separated into clean air and coolant. The air is discharged from the machine and the coolant is returned to the coolant tank.

17.1 Operation

Mist collector operation (starting/stopping) is controlled with the following methods:

- Manual Operation
- Automatic Operation
- Operation Using M codes



- The use of volatile oils or oils with a low flash point (150°C or less) is prohibited to ensure safety during the mist removal process. The mist collector does not have an explosion-resistant design.
- Do not use it in a flammable environment. This may result in a fire or explosion.



- Immediately stop operation in the event of abnormal vibration, abnormal noise or an abnormal smell. These conditions may indicate the possibility of a fire or serious accident.
- Turn off the main power supply (main circuit breaker) prior to inspections as a safety precaution. If it is not turned off, it may result in an electrical shock.
- Do not disassemble the fans or motors under any circumstance. This may result in electrical shock or a breakdown.
- Do not use the mist collector for exhaust air with a temperature of 60°C or higher, or for processing of water vapor. This may result in a breakdown of the motor.
- Do not use any filter other than the ones specially designed for use with this machine. This may result in a breakdown or a deterioration in performance.
- Do not operate the machine under any circumstance with any of the filters removed. This may result in a breakdown of the fan or motor.
- This unit is secured to a base (casters attached) prior to shipment. If this unit is not attached to the base, mount in place using bolts capable of securing the total unit weight (60 kg) to ensure the unit is secured in place. If it is not, it may fall over or break down due to excessive vibration.
- Do not place items on the mist collector or get on top of it. This may result in deformation of the housing or a breakdown.
- Make sure to stop operation of the unit when changing the filter. Changing the filter with the unit operating may result in injury.
- The voltage supplied to the motor terminals must be within ±10 % of the rated voltage. The fluctuation in voltage between the phases must be within ±3 %. If these conditions are not satisfied, it may result in a fire or accident.

17.1.1 Manual Operation

Manual operation of mist collector (option) from the Function screen.

Manual Operation Procedure

- 1) Press the MDI key [CUSTOM2].
- 2) Select [MAINT MENU] by moving the [\leftarrow] or [\rightarrow] cursor.
- 3) Select Mist Collector by moving the MDI cursor key [\uparrow] or [\downarrow].
- 4) Press the [ON] soft key to turn on mist collector.
- 5) Press the [OFF] soft key to turn off mist collector.

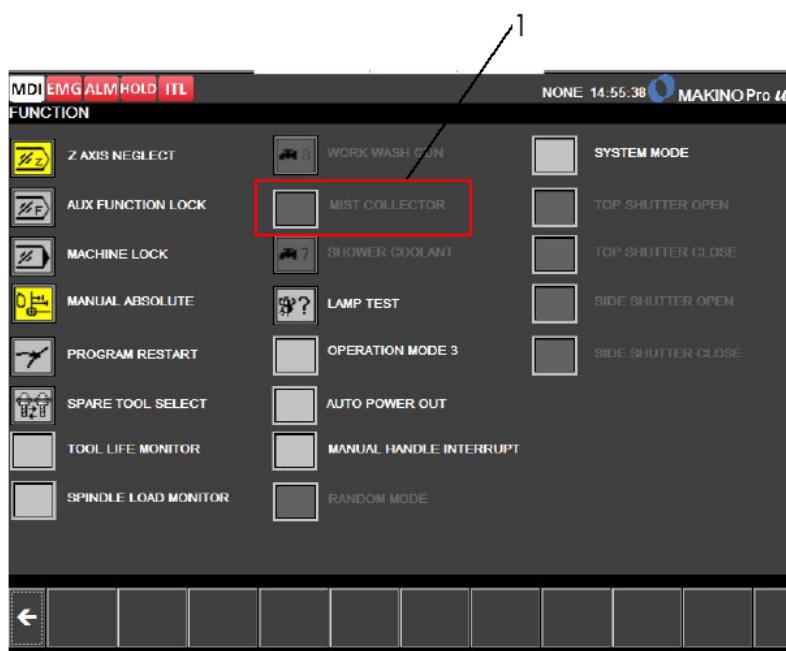


Figure 17.1 Mist Collector Manual Operation

No.	Name
1	[MIST COLLECTOR] Button

17.1.2 Automatic Operation

Operation is not normally started but operation can be automatically started by setting machine parameter No. 7434 /No.7009.

When Synchronized with Coolant

Machine Parameter	Description
MC 7434 = 0	Not synchronized with coolant.
MC 7434 = 1	Synchronized with coolant.
MC 7009 = 15	Sets how many seconds to stop mist collector after coolant is stopped.

18 Air Dryer (Option)

The air dryer unit is used to remove moisture from the air.

18.1 Starting/Stopping Operation

The air dryer is started/stopped at the same time when the main power is turned on/off.

18.2 Warning

Press the [RESET] button [1] on the air dryer to release the Warning status in the event the following Warning is triggered.

-NOTE-

An Alarm is triggered if Air Dryer is not turned on when three or more minutes have elapsed after machine power is turned on.

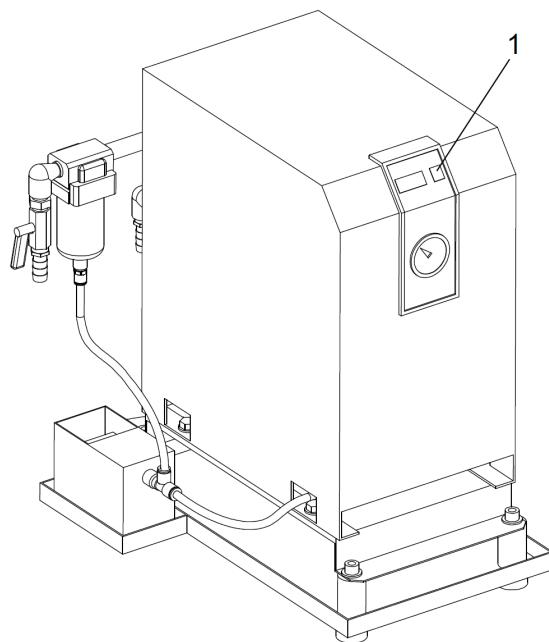


Figure 18.1 Air Dyer (Option)

No.	Name
1	[RESET] Button

19 Alarm Confirmation/Reset

19.1 Alarm Confirmation

The following items indicate that an alarm/warning has occurred.

- Signal Light (Warning Light) – Red and/or Yellow color
- NC status bar
- Machine Status screen
- Alarm screen

The Alarm screen or Operator Message screen is automatically displayed when an alarm or a warning occurs, respectively. (Refer to [4.5 Alarm and Operator Message Screens](#) [97])

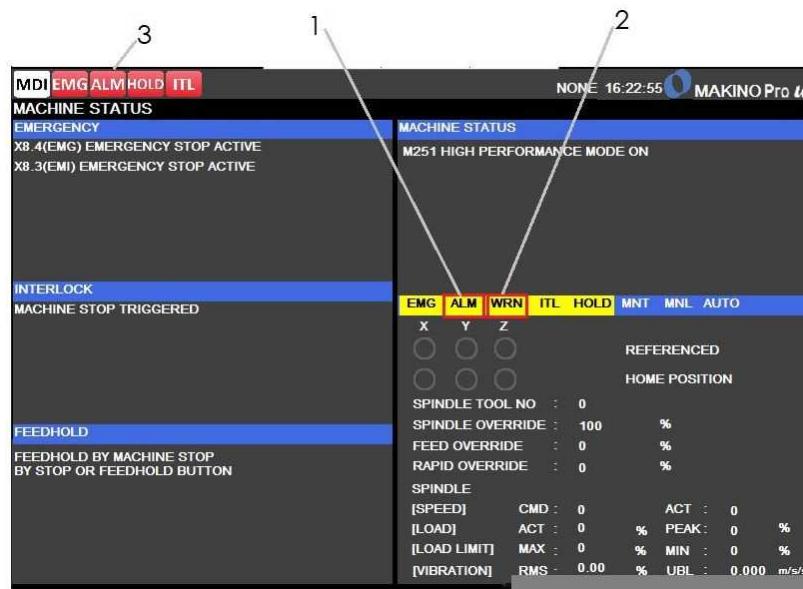


Figure 19.1 Alarm/Warning Display on Machine Status Screen

No.	Name	No.	Name
1	Alarm Indicator	3	NC Status Bar
2	Warning Indicator	-	-

19.2 Alarm Reset

PMC Alarms Reset Procedure

- 1) Press the **[ALARM RESET]** button on the main operation panel. If the conditions causing the alarm are cleared, the alarm is reset.

-NOTE-

PMC alarm reset button can be protected with password in the User Management screen.

NC Alarms Reset Procedure

- 1) When alarm “SW0100 PARAMETER ENABLE SWITCH ON” appears, press the **[NC RESET]** and **[CAN]** keys on the MDI panel to reset the alarm. Alternatively, disable the parameter-editing mode.
- 2) Pressing the **[NC RESET]** key on the MDI panel can reset most of NC alarms. If the conditions causing the alarm are cleared, the alarm is reset. However, some alarms require the main power to be turned off.

20 Common Measurement Interface (Option)

20.1 Overview

The input-output interface for measurement is a function to control the measuring devices by means of system variables and M codes.

A terminal block is provided in the machine electrical cabinet for input and output to be connected. Connection of the measuring device to the terminal block enables M codes to select the SKIP signals and system variables to control the input/output signals.

20.2 Function Description

Standard measurement device providers are allowed to use system variables to control I/O.

DI/DO are controlled by system variables

DI: #1000 ~ #1003

DO: #1100 ~ #1107

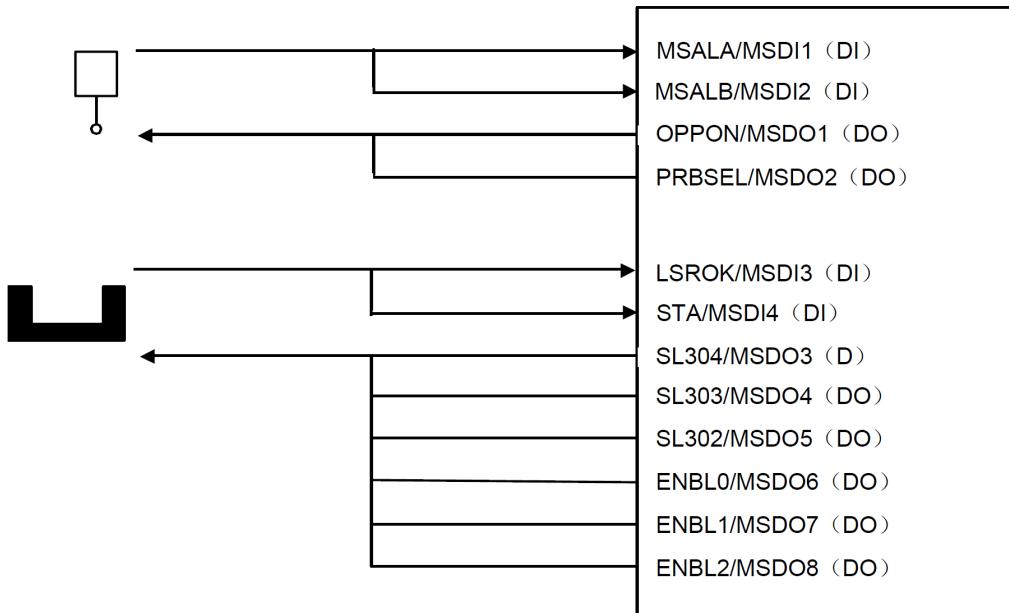


Figure 20.1 I/O System Overview

Chapter 4 Operation

Table 20.1 Signal Table

Input (DI)			Output (DO)		
Signal Name	Address	System Variable	Signal Name	Address	System Variable
MSALA (MSDI1)	X4.5	#1000	OPPON (MSDO1)	Y3.6	#1100
MSALB (MSDI2)	X4.6	#1001	PRBSEL (MSDO2)	Y3.7	#1101
LSROK (MSDI3)	X4.3	#1002	SL304 (MSDO3)	Y3.3	#1102
STA (MSDI4)	X4.4	#1003	SL303 (MSDO4)	Y3.4	#1103
	-	-	SL302 (MSDO5)	Y3.5	#1104
	-	-	ENBL0 (MSDO6)	Y3.2	#1105
	-	-	ENBL1 (MSDO7)	Y3.0	#1106
SKIP	X4.7	#1031	ENBL2 (MSDO8)	Y3.1	#1107
	F122.0-1				

20.3 Electrical Interface

Follow measurement device manufacturer's installation manual for the installation for common measurement interface.

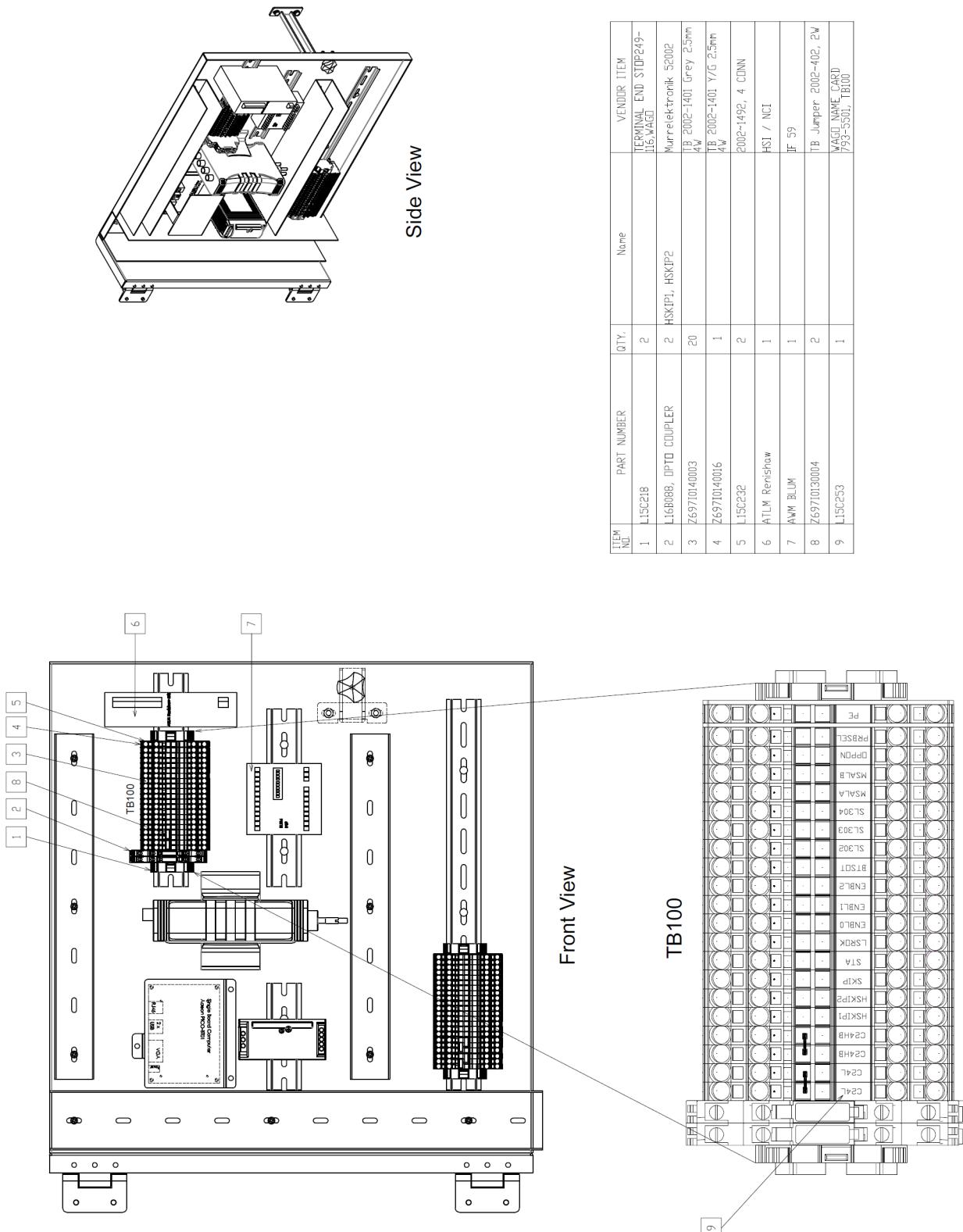


Figure 20.2 Common Measurement Interface TB100 (WAGO Terminal Block)

20.4 Function Specification

20.4.1 Function Enable/Disable

Common measurement interface can be enabled/disabled by specifying the corresponding M codes.

- M1966 - Enables common measurement interface function
- M1965 - Disables common measurement interface function

Enable signal control at the beginning of measurement and disable this function at the end of measurement.

Variables for signal control are also used in other functions. When common measurement interface is enabled, all functions that use variables are disabled until M1965 is issued.

20.4.2 System Variables For Control Signal Input

The signal status can be confirmed by reading the values of system variables #1000 - #1003. 1 is output at 24V, 0 is output at 0V.

Table 20.2 System Variables (Input)

Signal Name	System Variable Number	Symbol	Description
MSDI1	#1000	MSALA	System error
MSDI2	#1001	MSALB	Battery low
MSDI3	#1002	LSROK	Laser ok
MSDI4	#1003	STA	Static
HDIx	#1031		High speed skip
Skip			Normal skip

20.4.3 System Variables For Control Signal Output

The signal status can be confirmed by reading the values of system variables #1100 - #1107. 1 sets 24V, 0 sets 0V.

Table 20.3 System Variables (Output)

Signal Name	System Variable Number	Symbol	Description
MSDO1	#1100	OPPON	Measuring probe power on
MSDO2	#1101	PRBSEL	Probe select
MSDO3	#1102	SL304	Laser shutter open
MSDO4	#1103	SL303	Purge air
MSDO5	#1104	SL302	Tool cleaning air
MSDO6	#1105	ENBL0	Laser clearance
MSDO7	#1106	ENBL1	Enable 1
MSDO8	#1107	ENBL2	Enable 2

20.4.4 Selection of Skip Signals

High speed SKIP signal can be assigned by specifying the corresponding M codes.

- M1962 - Enables the high-speed skip signal for AWM (HSKIP1)
- M1963 - Enables the high-speed skip signal for ATLM (HSKIP2)

High speed skip signals are fixed for ATLM and AWM. HSKIP1 is for AWM, HSKIP2 is for ATLM.

20.4.5 Program Number

O9300-O9399

Follow measurement device manufacturer's programming manual for the details of program.

20.4.6 Macro Variable

No restriction on macro variable numbers to be used.

20.4.7 NC Reset

NC reset doesn't reset DO status.

20.4.8 Emergency

All DO is set to 0 when emergency is triggered.

20.4.9 Others

When the common measurement interface is enabled, system variable #1000 - #1031, #1100 - #1132 is occupied. Other M codes that use these variables, such as M464, are disabled.

20.5 Common Measurement Interface Related M Codes

M1962	Enables the high-speed skip signal for AWM (HSKIP1)
M1963	Enables the high-speed skip signal for ATLM (HSKIP2)
M1966	Enables common measurement interface function
M1965	Disables common measurement interface function
M1960S1	Enables AWM
M1960S2	Enables ATLM
M1960S3	Enables ATLM non-contact type

1 Overview

This chapter describes troubleshooting procedures for each unit.

Prior to Work

- Read and understand Chapter 1 Safety prior to troubleshooting to ensure safe working conditions.
- The machine must be handled by trained personnel.
- Wear appropriate safety equipment.
- Ensure the machine surrounding area is sufficiently illuminated.
- Place “Under Inspection/Maintenance” warning signs at the appropriate locations, including the main operation panel to notify personnel that work is in progress to prevent others from inadvertently operating the machine while work is being performed.
- Prior to maintenance/servicing work, perform troubleshooting thoroughly and be aware as much as possible of the condition in which machine operation was interrupted (machine trouble occurred).
- In the following events, leave the machine as it is and contact your Makino service representative.
Do not attempt to correct the problem yourself.
 - When the tool/tool pot is not clamped correctly (tool/tool pot may fall off the machine).
 - When the nature/cause of the machine problem is not apparent.

During Work

Observe all safety precautions and exercise extreme caution, especially when operating under the following conditions. Careless operation may result in serious injury, death and/or damage to the machine.

Take adequate precautions to ensure the safety of personnel operating the machine.

- When the power must remain on.
- When it is necessary to enter the machine/tool magazine.
- When safety devices such as Interlock system must be released.

2 Machine Abnormal Condition

When the machine has stopped or it does not start due to an Emergency Stop, Interlock or Feed Hold function, these causes can be confirmed on the Machine Status screen.

2.1 Emergency Stop

When the **[EMERGENCY STOP]** switch is pressed, the machine enters the Emergency Stop condition.

The machine also enters the Emergency Stop condition in the following cases:

- When the feed axis exceeds the stroke limit.
- When an abnormality is detected in the machine controller or servomotor.
- When an abnormality is detected in the hydraulic unit.
- When the power outage detection unit is activated.

Following an Emergency Stop condition, all commands are stopped and the following operations are performed:

- Feeding of each axis is stopped immediately.
- Spindle rotation is stopped immediately.
- Spindle tool is clamped.
- Spindle rotational speed setting (S command) is reset.
- Spindle temperature controller will be switched off.
- All coolant motors will be switched off.
- Tool search (T command) is cancelled.
- Hydraulic pressure supply is stopped.
- NC control is reset.
- All solenoid valves (Pneumatic and Hydraulic) are de-energized.
- When orientation of the spindle has been performed, orientation is released.
- When an Automatic Tool Changer (ATC) or tool magazine operation is being performed, operation stops immediately, even in mid-motion.

Confirm the cause indicated in the cause of emergency stop display on the Machine Status screen and eliminate the cause.

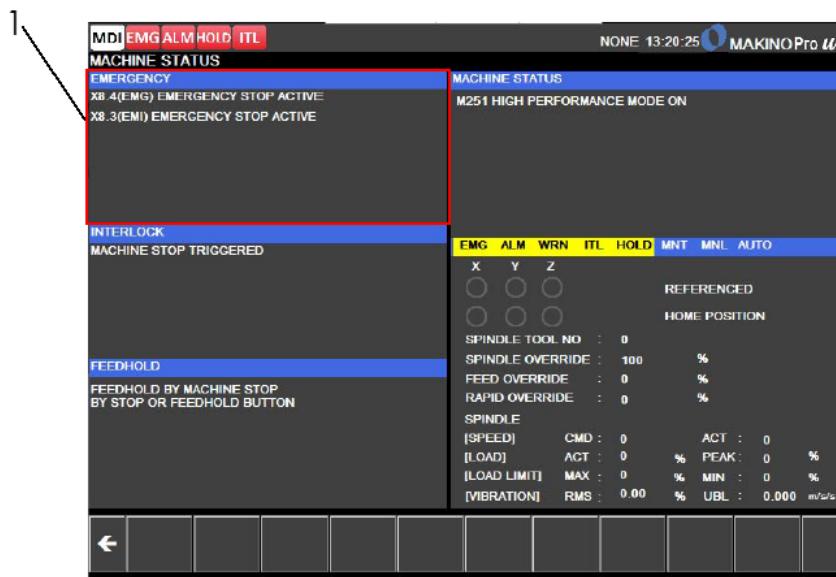


Figure 2.1 Cause of Emergency Stop Display (Machine Status Screen)

No.	Name
1	Cause of Emergency Stop Display

2.2 Recovery from Emergency Stop

The restore procedure differs according to the condition of the machine when Emergency Stop is activated. Prior to releasing the Emergency Stop condition, confirm the cause of the Emergency Stop is corrected and ensure the area surrounding the machine is safe.

Restore machine operation from the Emergency Stop condition using the following procedure.

When overtravel 2 (OT2) switch is activated for a feed axis

- 1) If an NC alarm is triggered, press the **[RESET]** key to release the alarm.
 - Soft OT1 alarm (OT0500 and OT0501) cannot be released by pressing the **[RESET]** key.
- 2) Select Jog Feed mode or Handle Feed mode using “Machine Mode Selection” switches on the main operation panel.
 - If the Jog Feed mode is selected, set the **[JOG FEED OVERRIDE]** switch to a sufficiently slow speed.
- 3) Select the axis for which the OT2 function is activated using “Axis Selection” switches.
 - For machine equipped with portable Manual Pulse Generator (MPG), use the “MPG Axis Selection” on the MPG for axis selection.
- 4) Turn the **[OT RELEASE]** switch until the servo amplifier enters “READY” status (Refer to [NOTES²²⁸](#)).
- 5) While holding down the **[OT RELEASE]** switch, press the **[+]** or **[-]** switch to move the axis until it is within its stroke range.
 - Do not release the **[OT RELEASE]** switch until the axis has moved within its stroke range. If the **[OT RELEASE]** switch is released during the operation, an Emergency Stop is activated again despite recovering from the Emergency Stop condition.
 - When the handle mode is selected, the axis is moved by rotating the “MPG” handle in the CW (+) / CCW (-) direction.

Abnormal condition for controller or servomotor

For NC alarms: Perform the corrective outlined in the “NC User’s Manual”. For machine alarms and warnings: Perform the corrective outlined in the “Alarm List Manual”. Machine alarm’s number is indicated with “EX”. If the cause of the problem can not be determined, contact your Makino service representative for assistance.

-NOTES-

- 1 In the “READY” condition, the cause of the emergency stop indicated on the machine status screen and the “EMG” Indicator on the right lower side of screen disappears.
- 2 Do not change machine modes or select an axis while holding down the **[OT RELEASE]** switch.

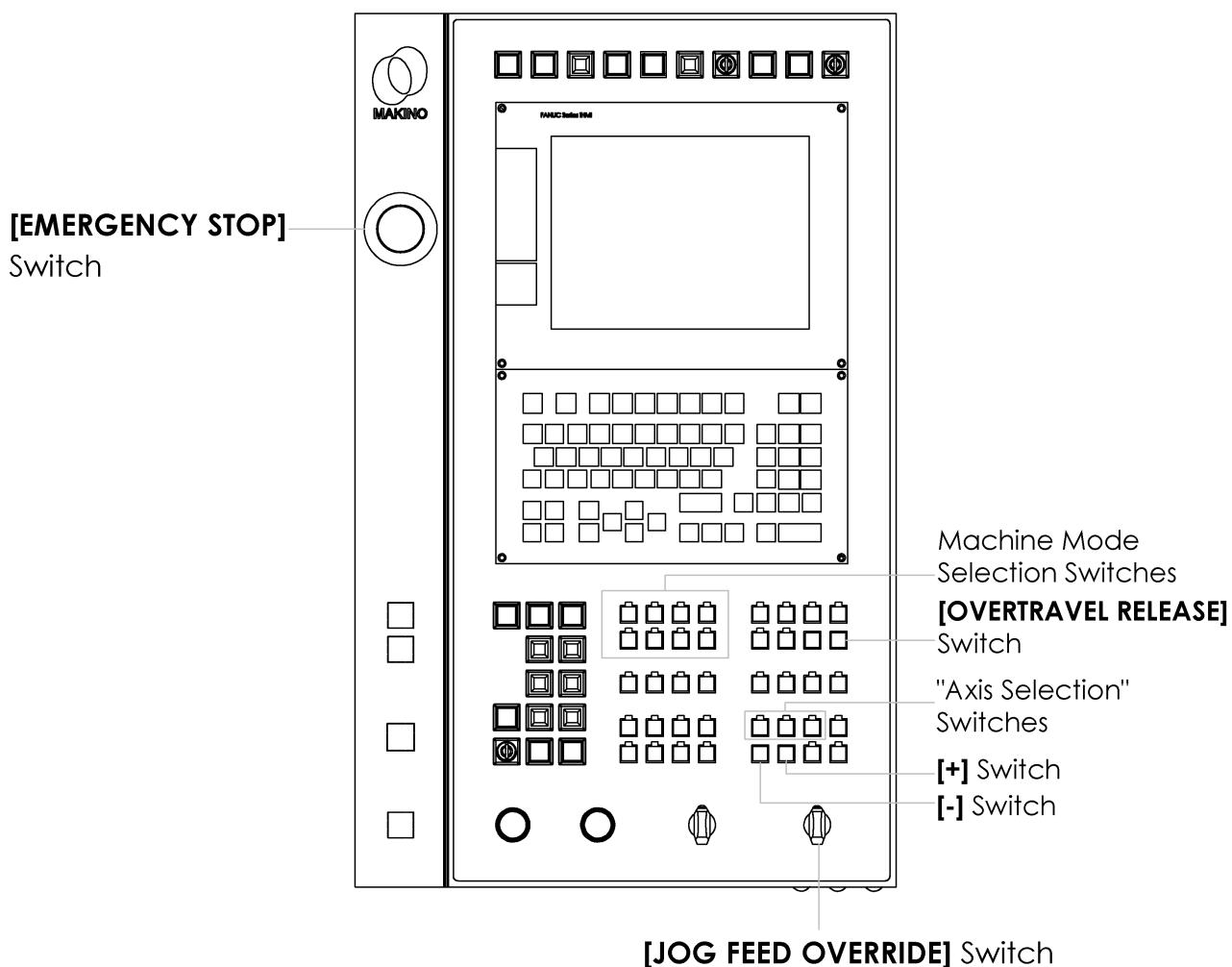


Figure 2.2 Recovery from Emergency Stop

2.2.1 Emergency Stop Switch Is Pressed During ATC Operation

Restore machine operation from the Emergency Stop condition using the following procedure.



WARNING

- Exercise extreme care when recovering the machine from the Emergency Stop condition as serious accidents may occur.
- When working with other personnel, maintain clear communication at all times to prevent serious injury.
- Contact your Makino service representative for assistance if serious damage to the machine has occurred.
- If operation cannot be recovered using the manual recovery procedure, DO NOT attempt to solve the problem. Contact your Makino service representative for assistance.

Recovery Procedure

- 1) Make sure the condition(s) that led to the activation of the **[EMERGENCY STOP]** switch are eliminated.
- 2) Release the Emergency Stop condition.
 - Rotate the **[EMERGENCY STOP]** switch in the direction of arrow to release the lock.
 - Press the **[CONTROL POWER ON]** switch on the main operation panel.
- 3) Restore the ATC condition using the Maintenance screen.
- 4) The ATC operation cannot be performed during the following conditions:
 - Z-axis is not positioned at the 2nd reference position.
 - Spindle is not orientated.
 - Limit switch signal is in a condition where automatic restore procedure is impossible and an alarm is triggered.
- 5) Ensure that the spindle and axis are at the suitable position for tool change to prevent damage to machine or tool during the recovery process.
- 6) Perform the Recovery by selecting each item individually or using the “Auto Recovery Function”.
 - Select “ATC AUTO RECOVERY” button or individual item on the screen.
 - Select “SINGLE MODE” or “JOG MODE”.
 - Press “ON” to start operation. Press “OFF” to stop operation.
- 7) Confirm the pot number on the Tool Data screen. If the pot number indicated on the Tool Data screen is different from the actual machine conditions, the data needs to be updated.

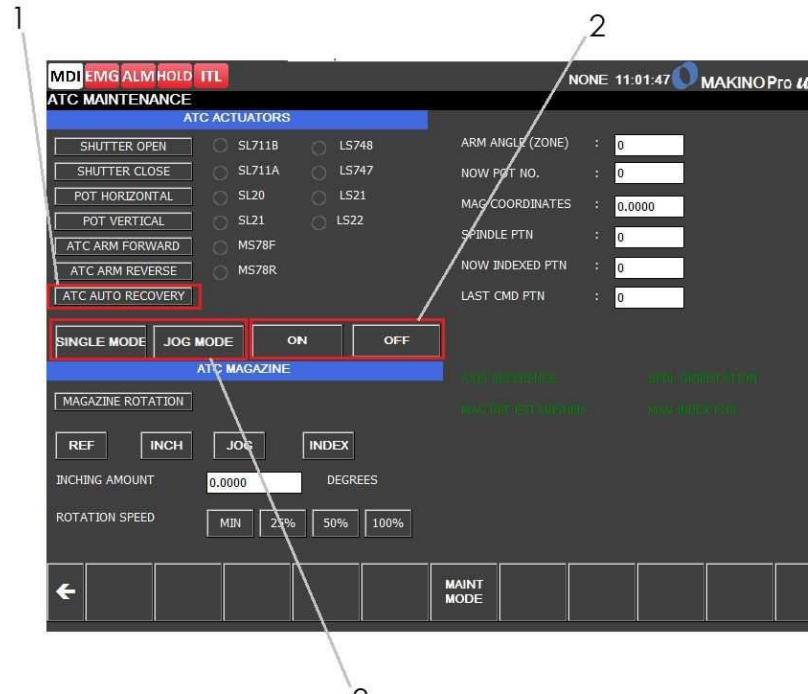


Figure 2.3 Recovery from “Emergency Stop” Switch Pressed During ATC Operation

No.	Name	No.	Name
1	ATC Auto Recovery Display	3	[SINGLE MODE] / [JOG MODE] Button
2	Single/Jog Mode Button [ON] / [OFF]	-	-

2.2.2 Emergency Stop Switch Is Pressed During T Command Operation

The automatic recovery procedure cannot be performed. Restore machine operation from the Emergency Stop condition using the following procedure.



WARNING

- Exercise extreme care when recovering the machine from the Emergency Stop condition as serious accidents may occur.
- When working with other personnel, maintain clear communication at all times to prevent serious injury.
- Contact your Makino service representative for assistance if serious damage to the machine has occurred.
- If operation cannot be recovered using the manual recovery procedure, DO NOT attempt to solve the problem. Contact your Makino service representative for assistance.

Recovery Procedure

- 1) Make sure the condition(s) that led to the activation of the **[EMERGENCY STOP]** switch are eliminated.
- 2) Release the Emergency Stop condition.
 - Rotate the **[EMERGENCY STOP]** switch in the direction of the arrows to release the lock.
 - Press the **[CONTROL POWER ON]** switch.
- 3) Confirm the status of the ATC arm and restore the ATC system using the Maintenance screen if it is not in standby position.
- 4) Issue the T command once again.
- 5) Confirm the tool number on the Tool Data screen. If the tool number indicated on the Tool Data screen is different from the actual machine conditions, the data needs to be updated.

2.2.3 Emergency Stop Switch Is Pressed During Machining (No Workpiece and Tool Contact)

The automatic recovery procedure cannot be performed. Restore machine operation from the Emergency Stop condition using the following procedure.



- Exercise extreme care when recovering the machine from the Emergency Stop condition as serious accidents may occur.
- Confirm the “Machine Lock” and “Auxiliary Function Lock” functions which you may choose to activate prior to entering the machine. Please exercise extreme caution as performing the following procedures in this condition is extremely dangerous.
- When working with other personnel, maintain clear communication at all times to prevent serious injury.
- Contact your Makino service representative for assistance if serious damage to the machine has occurred.

Recovery Procedure

- 1) Make sure the condition(s) that led to the activation of the **[EMERGENCY STOP]** switch are eliminated.
- 2) Release the Emergency Stop condition.
 - Rotate the **[EMERGENCY STOP]** switch in the direction of the arrows to release the lock.
 - Press the **[CONTROL POWER ON]** switch.
- 3) Select the Reference Position Return mode.
- 4) Return each axis to its reference position so that the workpiece does not interfere with the spindle tool.
- 5) Check the tool and workpiece for damage.
 - When the workpiece must be exchanged, start the program from the beginning.
- 6) Restart the program using the method below:
 - Display the Program Edit screen to confirm the modal information is correct. Serious damage to the machine or workpiece may result if a program including incorrect modal information is restarted. If the modal information is incorrect, correct the values in the MDI mode. The modal information may be reset to the original data when the machine enters the Emergency Stop condition.
 - Move the cursor to the block in which the machine entered the Emergency Stop condition.
 - Input the original spindle speed using MDI mode and then press the **[SPINDLE START]** switch or input “Sxxxx M03 (M04)” directly in MDI mode.
 - Reactivate the coolant using the Coolant Function switches on the main operation panel or turn on the Coolant Functions using the Function screen. Each coolant function can also be started by M code in MDI mode.
 - Select Memory mode and then press the **[CYCLE START]** switch.

2.2.4 Emergency Stop Switch Is Pressed During Machining (Workpiece and Tool Contact)

The automatic recovery procedure cannot be performed. Restore machine operation from the Emergency Stop condition using the following procedure.



- Exercise extreme care when recovering the machine from the Emergency Stop condition as serious accidents may occur.
- Confirm the “Machine Lock” and “Auxiliary Function Lock” functions which you may choose to activate prior to entering the machine. Please exercise extreme caution as performing the following procedures in this condition is extremely dangerous.
- When working with other personnel, maintain clear communication at all times to prevent serious injury.
- Contact your Makino service representative for assistance if serious damage to the machine has occurred.

Recovery Procedure

- 1) Make sure the condition(s) that led to the activation of the [EMERGENCY STOP] switch are eliminated.
- 2) Release the Emergency Stop condition.
 - Rotate the [EMERGENCY STOP] switch in the direction of the arrows to release the lock.
 - Press the [CONTROL POWER ON] switch.
- 3) Select the Handle mode.
- 4) Check the position of the spindle tool and workpiece.
 - When the tool and workpiece are in contact but can be separated using the Handle mode, proceed to Step 5.
 - When the tool and workpiece are in contact and can not be separated using the Handle mode, proceed to Step 6.
- 5) Separate the tool from the workpiece using the Handle mode.
 - When the tool has an edge wider than the tool body (ex. boring bar):
 - a) Confirm the part of the tool that has come into contact with the workpiece.
 - b) Move the tool in the X- or Y-axis direction to prevent further interference between the tool and the workpiece. Move the Z-axis in “+” direction until reaching the reference position.
 - When workpiece and tool interference does not occur even when Z-axis is moved:
 - a) Move the Z-axis in “+” direction until reaching the reference position.

- 6) Separate the tool trapped in the workpiece from the workpiece.
 - Activate the “Machine Lock” and “Auxiliary Function Lock” modes.
 - Hold the tool firmly and then loosen the tool holder.
 - Release the “Machine Lock” and “Auxiliary Function Lock” modes after going out of the machining chamber.
 - Move the Z-axis in “+” direction to remove the tool from the holder.
 - Remove the tool trapped in the workpiece.
- 7) If the tool is damaged, replace the tool using the following procedure.
 - Move the Z-axis to the operator comfortable position and remove the tool holder from the spindle.
 - Mount the replacement tool onto the tool holder and insert into the spindle.
 - Measure the tool length and tool radius.
 - Input the tool length and tool radius of the replacement tool on the Tool Data screen.
- 8) Select Reference Position Return mode.
- 9) Return each axis to its reference position in the following order:
 - Z→ X or Y
- 10) Check the tool and workpiece for damage. When the work piece must be exchanged, start the program from the beginning.
 - Restart the program using the method below:
 - a) Display the Program Edit screen to confirm the modal information is correct. Serious damage to the machine or workpiece may result if a program including incorrect modal information is restarted. If the modal information is incorrect, correct the values in the MDI mode. The modal information may be reset to the original data when the machine enters the Emergency Stop condition.
 - b) Move the cursor to the block in which the machine entered the Emergency Stop condition.
 - c) Input the original spindle speed using MDI mode and then press the **[SPINDLE START]** switch or input “Sxxxx M03/(M04)” directly in MDI mode.
 - d) Reactivate the coolant using the Coolant Function switches on the main operation panel or turn on the Coolant Functions using the Function screen. Each coolant function can also be started by M code in MDI mode.
 - e) Select Memory mode and then press the **[CYCLE START]** switch.

3 Spindle Head

3.1 Spindle Does Not Start

Possible Causes	Corrective Measures
Tool change operation is ongoing.	During the tool change operation, spindle operation cannot be started. Wait until the operation is completed.
Rigid tapping is ongoing.	A machine alarm is triggered when the [SPINDLE START] switch is pressed during rigid tapping.
Operator Door Interlock function is activated.	<p>Check door lock switch LS912 (Operator Door Interlock) and other electrical components to identify the location of the problem. Next, perform the following steps:</p> <ol style="list-style-type: none">1. If the problem is caused by faulty adjustment, adjust it properly.2. There is a possibility of damage or malfunction in the electric circuit. Check each cable using the volt meter.<ul style="list-style-type: none">• If door lock switch LS912 (Operator Door Interlock) is malfunctioning, replace the switch.• If the cable is damaged, replace the cable.If any problem is found in the machine controller, repair or replace the malfunctioning parts.
Machine is in the Emergency Stop condition.	Release the Emergency Stop condition.
Alarm is triggered.	Check the alarm content on the Alarm screen and recover operation.

3.2 Spindle Does Not Stop

Possible Causes	Corrective Measures
Tool change operation is ongoing.	During the tool change operation, spindle operation cannot be stopped. Wait until the tool change operation is completed.
Rigid tapping is ongoing.	A machine alarm is triggered when the [SPINDLE STOP] switch is pressed during rigid tapping.

3.3 Abnormal Spindle Rotation Speed or Start/Stop Timing

Possible Causes	Corrective Measures
Bearings inside spindle are damaged.	<p>Rotate the spindle nose by hand while it is stopped, and check whether it rotates easily and smoothly, or not.</p> <p>If the spindle does not rotate or it is hard to rotate or feels like it is catching on something when it is rotated, the spindle bearings may be damaged.</p> <p>The spindle bearing needs to be replaced. Contact your Makino service representative.</p>

3.4 Orientation Malfunction

Check if a machine alarm or an alarm has been triggered.

3.4.1 When Alarm Is Triggered

Confirm the following points and contact your Makino service representative.

- Time when alarm was triggered.
- Machine status when alarm was triggered.
- Alarm code details.

3.4.2 When Alarm Is Not Triggered

Possible Causes	Corrective Measures
Spindle Orientation Stop Position is adjusted incorrectly	Contact your Makino service representative.
Position Control Proportional Gain is adjusted incorrectly	When the spindle moves after the spindle stops at the orientation position; adjustment of the position control proportional gain is necessary. Contact your Makino service representative.

3.5 Servo Alarm Is Triggered During Operation

Possible Causes	Corrective Measures
Spindle rotational speed command value deviates by a large amount.	Load exceeding spindle output likely caused a decrease in the spindle speed. Reduce the cutting load conditions to ensure spindle load does not exceed 100%.
Temperature of the spindle cooler, which is used for cooling the spindle increased to an abnormal level.	Spindle overload will cause the spindle cooler temperature to increase abnormally. Allow the spindle to cool down and reset the alarm. Reduce the cutting load conditions in order to reduce the amount of heat generated by the spindle. (Refer to 7 Spindle Cooler)
Cable for spindle position coder is damaged or decrease in the position coder output signal voltage was detected.	Indicates broken position coder signal wires or breakdown of position coder sensor. Contact your Makino service representative.
Motor power line is shorted.	The spindle cartridge needs to be replaced. Contact your Makino service representative.
Bearings inside spindle are damaged.	Rotate the spindle nose by hand while it is stopped and check whether or not it rotates easily and smoothly. If the spindle does not rotate or it is hard to rotate or feels like it is catching on something when it is rotated, the spindle bearings may be damaged. Contact your Makino service representative.
Cutting tool blade fused, damaged or other problem.	When a problem is found with the cutting tool, replace the cutting tool.
Improper cutting conditions.	Reduce the cutting load conditions to ensure spindle load does not exceed 100%.

3.6 Tool Clamp Malfunction

Possible Causes	Corrective Measures
Use of a non-standard tool shank.	Use standard tool shank.
Hydraulic cylinder for tool clamp/unclamp is not activated.	<p>Check solenoid valve (tool clamp) and other hydraulic components to identify the location of the problem. Next, perform the following steps:</p> <ol style="list-style-type: none">1. If the hydraulic cylinder is malfunctioning, replacement is necessary. Contact your Makino service representative.2. There is a possibility of damage or malfunction in the electric circuit. Check each cable using the volt meter.<ul style="list-style-type: none">• If solenoid valve tool clamp is malfunctioning, replace the valve.• If the cable is damaged, replace the cable.• If any problem is found in the machine controller, repair or replace the malfunctioning part.
Foreign matter is lodged in the tool clamp mechanisms.	Contact your Makino service representative.
Tool clamp mechanism malfunction.	

3.7 Tool Unclamp Malfunction

Possible Causes	Corrective Measures
Spindle orientation has not been completed.	Complete spindle orientation.
Automatic Operation mode (MDI/Memory/Editor mode) is selected.	Select the Manual Operation (Handle) mode and open the operator door. Press the [TOOL UNCLAMP] switch for longer than a second.
Hydraulic cylinder for tool clamp/unclamp is not activated.	<p>Check solenoid valve (tool unclamp) and other hydraulic components to identify the location of the problem. Next, perform the following steps:</p> <ol style="list-style-type: none"> If the hydraulic cylinder is malfunctioning, replacement is necessary. Contact your Makino service representative. There is a possibility of damage or malfunction in the electric circuit. Check each cable using the volt meter. <ul style="list-style-type: none"> If solenoid valve (tool unclamp) is malfunctioning, replace the valve. If the cable is damaged, replace the cable. If any problem is found in the machine controller, repair or replace the malfunctioning parts.
Hydraulic cylinder stroke may be adjusted incorrectly.	Contact your Makino service representative.
Foreign matter is lodged in the tool unclamp mechanisms.	
Tool unclamp mechanism malfunction.	

3.8 Abnormal Noise Is Emitted During Spindle Rotation

Possible Causes	Corrective Measures
Bearings inside spindle are damaged.	Rotate the spindle nose by hand while it is stopped and check whether or not it rotates easily and smoothly.
Seal air malfunction.	If the spindle does not rotate or it is hard to rotate or feels like it is catching on something when it is rotated, the spindle bearings may be damaged. Contact your Makino service representative.
Piping and wiring located at the rear of the spindle are loose.	Abnormal noise emitted during cutting and abnormal noise is not emitted when cutting is not being performed, it indicates noise is generated due to vibration during cutting. If the piping and/or wiring are loose, retighten them.
Tool balance is bad.	When abnormal noise is emitted only during high speed rotation, the tool in the spindle may be unbalanced. Check the spindle tool and replace if necessary.
Spindle and tool rotation balance is bad.	When abnormal noise is emitted only during high speed rotation, the spindle and tool rotation may be unbalanced. Contact your Makino service representative.
Electrical problem.	Contact your Makino service representative.

4 Feed Axis

4.1 Axis Fails to Move in Manual Mode

Possible Causes	Corrective Measures
Operator door has not been closed completely.	Close the operator door completely.
Door switch LS912 (operator door) malfunction.	<p>Check door lock switch LS912 (operator door interlock) and other electrical components to identify the location of the problem. Next, perform the following steps:</p> <ol style="list-style-type: none">1. There is a possibility of damage or malfunction in the electric circuit. Check each cable using the volt meter.<ul style="list-style-type: none">• If door lock switch LS912 (operator door interlock) is malfunctioning, replace the switch.• If the cable is damaged, replace the cable.If any problem is found in the machine controller, repair or replace the malfunctioning parts.
ATC is not in standby status.	Confirm that the ATC arm is in standby position. If not, move the ATC arm in Maintenance mode in the ATC Maintenance screen.
Jog feed speed and rapid feed override readings are "0"	Change the settings for these switches to a value other than "0".

4.2 Servo Alarm Is Triggered During Operation

Possible Causes	Corrective Measures
Workpiece and spindle head come into contact.	Spindle head may be damaged. Contact your Makino service representative for assistance.
Workpiece exceeds specifications (weight).	Use workpiece within specified weight.
Cutting overload.	Confirm the tool is not damaged and machining condition is correct.
Faulty electric circuit.	There is a possibility of a electrical short circuit. Check each cable using the volt meter.
Servomotor wiring (cable) is improperly connected or damaged.	Check the cable is correctly connected. If the cable is damaged, replace the cable.
Circuit breaker is tripped.	Circuit breaker is tripped when the motor load is excessive. Eliminate the cause of the problem and then power on the motor breaker inside the machine controller.
Voltage is low.	Check cause of low voltage and adjust to the proper voltage.
Electromagnetic contactor is improperly connected.	If the electromagnetic contactor is damaged, replacement is necessary. Contact your Makino service representative.
Other servo system malfunction.	Servomotor, servo amplifier, servomotor encoder or scale unit is malfunctioning. Confirm the alarm content and replace the damaged parts if necessary. When replacing the scale unit, contact your Makino service representative.

4.3 Feed Axis Runs Until Hitting Mechanical Stopper

When the feed axis hits the mechanical stopper and stops, the machine accuracy must be confirmed. Contact your Makino service representative. In the event the machine accuracy is not confirmed, the specified level of accuracy will not be achieved.

Possible Causes	Corrective Measures
Servomotor wiring (cable) is improperly connected or damaged.	Check the cable is correctly connected. If the cable is damaged, replace the cable.
Supply voltage is low.	Check cause of low voltage and adjust to the proper voltage.
Axis moved by inertia due to power failure.	Turn on the power supply and then move the axis within the stroke limit.
Other servo system malfunction.	Servo alarm is triggered. Servomotor, servo amplifier, servomotor encoder or scale unit is malfunctioning. Confirm the alarm content and replace the damaged parts if necessary. When replacing the scale unit, contact your Makino service representative.
Improper parameter settings.	Contact your Makino service representative.
Servo Adaptor or scale battery life over.	Replace the battery.

4.4 Positioning Accuracy Not Achieved

Possible Causes	Corrective Measures
Screws securing servomotor and ball screw nut are loose.	Retighten the loose securing screws.
Clamping screws on motor coupling are loose.	If a scale unit is installed, confirm the reference position is correct after changing the NC parameter setting to a machine without a scale unit. When the reference position is incorrect (when the axis stops short of the correct reference position), the clamping screws may be loose. Retighten the clamping screws with a specified torque. If the above causes do not apply, the motor coupling may be worn. Replace the motor coupling.
Axis backlash is excessive.	If a scale unit is installed, measure the backlash after changing the NC parameter setting to a machine without a scale unit. If the backlash is excessive, most likely the causes are as follows: <ol style="list-style-type: none">1. Ball screw nut pre-loading is insufficient. When grease is discolored gray, ball screw nut pre-loading may be insufficient. Ball screw replacement is necessary. Contact your Makino service representative.2. Ball screw or linear motion guide is worn or damaged. Ball screw or linear motion guide must be replaced. Contact your Makino service representative.

4.5 Abnormal Noise or Vibration Is Emitted During Axis Operation

Possible Causes	Corrective Measures
Grease shortage.	Grease supplied to the linear motion guide and ball screw on the feed axis or the support bearings is not sufficient. Check if the automatic grease supply unit is working properly.
Bellows cover is damaged or chips have accumulated in the bellows mechanism.	Confirm chips are not accumulated in the bellows cover. Also confirm the bellows cover is not damaged. If the cover is damaged, replacement is necessary.
Screws securing servomotor and ball screw nut are loose.	Retighten the loose securing screws.
Axis backlash is excessive.	If a scale unit is installed, measure the backlash after changing the NC parameter setting to a machine without a scale unit. If the backlash is excessive, the most likely causes are as follows: 1. Ball screw nut pre-loading is insufficient. When grease is discolored gray, ball screw nut pre-loading may be insufficient. Ball screw replacement is necessary. Contact your Makino service representative. 2. Ball screw or linear motion guide is worn or damaged. Ball screw or linear motion guide must be replaced. Contact your Makino service representative.
Support bearings are worn or damaged.	Support bearing must be replaced. Contact your Makino service representative.
Ball screw run-out is excessive.	Adjust the ball screw run-out.
Other servo system malfunction.	Servo alarm is triggered servomotor, servo amplifier, servomotor encoder or scale unit is malfunctioning. Confirm the alarm content and replace the damaged parts if necessary. When replacing the scale unit, contact your Makino service representative.

5 ATC Unit

When the ATC Arm interferes with other parts and stops. Leave the machine as it is and contact your Makino service representative.

5.1 Tool Change Operation Does Not Start

5.1.1 Machine Controller Does Not Receive M06 Command

Possible Causes	Corrective Measures
Operation mode is not MDI or Memory mode.	Change operation mode.

5.1.2 Machine Controller Has Received M06 Command But Operation Does Not Start

When the machine controller receives the M06 command, the **[CYCLE START]** switch is illuminated. If an alarm is triggered during the operation, M06 is not executed. Eliminate the cause of alarm.

Check for specific alarm generated during tool change. Refer to alarm detail in Alarm Detail screen or refer to [18 Alarm List](#).

5.2 Abnormal Noise Is Emitted During Tool Change Operation

Find the exact location of the noise by using the Maintenance mode to perform the series of tool change operations step by step.

Possible Causes	Corrective Measures
Uses of a non-standard tool or tool shank that results in interference with other components.	Use a standard tool and tool shank. Confirm the tool length, diameter, weight and moment. (Refer to Chapter 4, 9 Tool Preparations [154]).
ATC arm movement is not proper.	Contact your Makino service representative.

-NOTE-

If the trouble is not related to any of the above causes, leave the machine in its current condition and contact your Makino service representative.

5.3 Tool Is Dropped During Tool Change

Possible Causes	Corrective Measures
Uses of a non-standard tool or tool shank.	Use a standard tool or tool shank. (Refer to Chapter 4, 9 Preparations [154])
Loosening of the retention knob.	Tighten the retention knob.
Wear damage to the retention knob.	Replace the retention knob.
Tool exceeds allowable tool moment limitations,	Check tool moment limitations. (Refer to Chapter 4, 9 Preparations [154])
Arm gripper motion is not smooth.	Check for obstruction by chips or other foreign matters around the gripper and plunger pin.
Reference position alignment of magazine position is not proper.	Contact your Makino service representative.
ATC tool change position (X/Y-/Z-axis) are not proper.	Adjust the ATC tool change position.
Spindle orientation position is not proper.	Check and adjust the spindle orientation position.
Tool clamping device (spindle head) malfunction.	Contact your Makino service representative.
Chips enter/adhere to spindle head or tool holder.	Clean the spindle head and tool holder.
Arm gripper plunger is damaged.	Contact your Makino service representative.

-NOTE-

If the trouble is not related to any of the above causes, leave the machine in its current condition and contact your Makino service representative.

6 Tool Magazine

When the tool magazine interferes with other parts and stops, the tool may fall out of the tool magazine. Leave the machine as it is and contact your Makino service representative.

6.1 Tool Indexing (T Command) Operation Does Not Start

Possible Causes	Corrective Measures
Alarm is triggered.	Check the alarm status and recover operation. If a T command was issued simultaneously with other commands that have failed to be completed, the tool search operation cannot start. Issue the T command independently to determine the cause of the problem.
Spindle tool is called.	If an attempt was made to call either the spindle tool (tool clamped in the spindle) or the next tool (tool at the tool change position) or if such tool have been cancelled, tool magazine operation is not performed even when a T command is issued.
Next tool is called.	Spindle tool and next tool numbers can be confirmed on the Tool Data screen.
Spindle tool is Fixed Pot tool.	If spindle tool is fixed pot and current magazine pot is spindle pot, magazine will also not move.

6.2 Servo Alarm Is Triggered During Operation

Possible Causes	Corrective Measures
Tool magazine driver motor malfunction.	Record the alarm number and operating conditions at the time of the alarm and contact your Makino service representative.
Excessive load is applied to drive unit for some reason, resulting in motor overload/overcurrent alarm being triggered.	Record the alarm number and operating conditions at the time of the alarm and check for any obstruction to the magazine rotation. Contact your Makino service representative.
Tool exceeds specifications. (weight)	Use a tool within specified weight. (Refer to Chapter 4, 9 Tool Preparations) <small>154</small>

6.3 Wrong Tool Is Called to Tool Change Position

Possible Causes	Corrective Measures
Actual tool number and stored tool number are different. (Refer to NOTES) <small>249</small>	Correct the registered tool number so that it matches the actual tool number.

-NOTES-

- A spare tool, not a wrong tool, may be called when the Spare Tool Selection function is activated.
- If the trouble is not related to any of the above causes, contact your Makino service representative.

6.4 Time-Out Alarm Is Triggered

Possible Causes	Corrective Measures
Tool magazine interferes with another part and stops.	Tool magazine may have dropped a tool or ATC pot position is improper. Leave the machine as it is and contact your Makino service representative.

7 Spindle Cooler

7.1 When Alarm Is Triggered on Spindle Cooler

1	Explanation	Oil temperature sensor fault.
Sn PV°C OL SV°C	Possible Causes	<ul style="list-style-type: none"> • Broken connection of the oil temperature sensor. • Oil temperature sensor fault. • Temperature controller failure.
	Inspection	<ul style="list-style-type: none"> • Check whether the connection of the oil temperature sensor is broken or not. • If the connection is not broken, chances are either the temperature controller or the sensor has failed.
	Solution	<ul style="list-style-type: none"> • Reconnect the wire connection or replace the wire if necessary. • Replace the faulty parts.
2	Explanation	There is a problem with the ambient or machine body temperature sensor.
Sn PV°C ro SV°C	Possible Causes	<ul style="list-style-type: none"> • The wire connection of the ambient or machine body temperature sensor is broken. • The ambient or machine body temperature sensor has failed. • Temperature controller failure.
	Inspection	<ul style="list-style-type: none"> • Check whether or not the wire for ambient or machine body temperature sensor is connected. • If there are no problems with the connection, chances are either the sensor or the temperature controller is faulty.
	Solution	<ul style="list-style-type: none"> • Reconnect the wire connection or replace the wire if necessary. • Replace the faulty parts.
3	Explanation	Oil temperature is too high for the temperature controller to process.
AH PV°C OL SV°C	Possible Causes	<ul style="list-style-type: none"> • Process load is over the limit of the temperature controller's capacity. • Oil temperature sensor fault. • Refrigerator system failure.
	Inspection	<ul style="list-style-type: none"> • Check whether the ambient and oil temperature are higher than the limit of 45°C. • Check whether or not the temperature controller is capable for the process load. • Check if the temperature sensor is functioning properly or not. • Check if the refrigeration system is in order or not.
	Solution	<ul style="list-style-type: none"> • Keep the oil temperature below 45°C. • Change the temperature controller to a larger cooling capacity. • Replace the oil temperature sensor. • Contact the refrigerator service technician for refrigeration system failure.

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4	Explanation	Oil temperature is too low for the temperature controller to process.
AL PV°C OL SV°C	Possible Causes	<ul style="list-style-type: none"> • Process load is lower than the limit of the temperature controller's capacity. • Oil temperature sensor failure. • Refrigerator system failure.
	Inspection	<ul style="list-style-type: none"> • Check if the ambient and oil temperature are above 5°C. • Check if the temperature sensor is functioning properly or not. • Check if the refrigeration system is in order or not.
	Solution	<ul style="list-style-type: none"> • Keep the oil temperature above 5°C. • Replace the oil temperature sensor. • Contact the refrigerator service technician for refrigeration system failure.
5	Explanation	There is a pressure fault within the refrigeration system.
In PV°C -- SV°C PRESSURE	Possible Causes	<ul style="list-style-type: none"> • Low or over charge of refrigerant. • Obstruction or leakage occurred in the refrigeration system. • Condenser or air filter is dirty. • Poor heat dissipation. • Fan or motor failure.
	Inspection	<ul style="list-style-type: none"> • Check if the copper pipe near the low pressure side of the compressor is not cold. • Check if the fins of the condenser are not hot. • Check if the temperature controller's internal temperature is too high. • Check if the fan or motor is out of order or not.
	Solution	<ul style="list-style-type: none"> • Clean the air filter and the condenser regularly to improve the heat dissipation and remove any obstructions from air intake or exhaust. • Contact the refrigerator service technician for refrigeration system failure.
6	Explanation	There is a fault within the oil pump which trip-out the overload protector.
In PV°C -- SV°C PUMP	Possible Causes	<ul style="list-style-type: none"> • Oil pump motor is faulty. • Oil pressure is too high. • Oil flow is not smooth.
	Inspection	<ul style="list-style-type: none"> • Check if the oil pump is functioning properly or not. • Check if the oil pressure is too high to cause the overload protector to trip-out. • Check if the oil pipe is clogged.
	Solution	<ul style="list-style-type: none"> • Replace the faulty pump. • Reset the overload protector. • Clean the oil circulating system, add a filter if necessary.

7	Explanation	Pressure fault or insufficient amount of oil within the oil circulating system.
In PV°C -- SV°C O.P/FLOW	Possible Causes	<ul style="list-style-type: none"> • No oil flow or flow rate is too low. • Set point of the oil pressure switch is not within the designed specification. • Failure of the oil pressure switch or flow switch. • Air goes into the oil pipes or the diameter of the pipes are too small. • Oil used is not within the viscosity range. • Pump motor faulty.
	Inspection	<ul style="list-style-type: none"> • Check if the oil supply is sufficient. • Check if the pressure switch is set within the designed specification. • Check if the oil pressure switch or flow switch is functioning properly or not. • Check if the pipes diameter are too small. • Check if the oil used is within the viscosity range. • Check the pump motor is functioning properly or not.
	Solution	<ul style="list-style-type: none"> • Supply sufficient amount of oil in the oil circulating system. • Set the pressure switch to the designed specification. • Replace the oil pressure switch or the flow switch. • Increase the pipe diameter or shorten the length of the pipe to avoid oil pressure loss. • Use oil within the viscosity range. • Replace the faulty pump motor.
8	Explanation	Power phase input has been reversed.
In PV°C -- SV°C REV	Possible Causes	<ul style="list-style-type: none"> • Incorrect power phase input. • Reverse-phase relay failure. • Temperature controller failure.
	Inspection	<ul style="list-style-type: none"> • Check if the power cable is connected with correct phase or not. • If the power phase is correct, chances are the reverse-phase relay or the temperature controller has failed.
	Solution	<ul style="list-style-type: none"> • Reconnect the power cable with correct phase. • Replace the faulty parts.
9	Explanation	Compressor temperature is too high.
EF PV°C SV°C	Possible Causes	<ul style="list-style-type: none"> • Compressor air vent is dirty. • Incorrect input power voltage or phase.
	Inspection	<ul style="list-style-type: none"> • Check if the hot air exhaust system is clogged. • Check if the input power or phase is correct.
	Solution	<ul style="list-style-type: none"> • Clean the air vent regularly to improve the heat dissipation and remove any obstructions from air exhaust. • Reconnect the power cable with correct phase.

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10	Explanation	Oil level in tank is too low.
PV°C EC SV°C	Possible Causes	<ul style="list-style-type: none"> • Insufficient oil level. • Oil level switch is faulty.
	Inspection	<ul style="list-style-type: none"> • Check if the oil level is sufficient. • Check if the oil level switch is functioning properly or not.
	Solution	<ul style="list-style-type: none"> • Supply oil sufficiently. • Replace the faulty oil level switch.
11	Explanation	Power phase missing alarm.
EP	Possible Causes	<ul style="list-style-type: none"> • Supply power phase not connected properly. • Temperature controller is faulty.
	Inspection	<ul style="list-style-type: none"> • Check if the supply power phase is connected properly. • Check if the temperature controller is functioning properly or not.
	Solution	<ul style="list-style-type: none"> • Reconnect the supply power phase. • Replace the possible failed temperature controller.
12	Explanation	Fan motor overload.
EE	Possible Causes	<ul style="list-style-type: none"> • Sudden overload of the fan motor. • Fan motor is faulty.
	Inspection	<ul style="list-style-type: none"> • Check if the fan motor is overload. • Check if the fan motor is functioning properly or not.
	Solution	<ul style="list-style-type: none"> • Reset the overload protector. • Replace the faulty fan motor.
13	Explanation	Abnormal heater operation.
EF	Possible Causes	<ul style="list-style-type: none"> • Insufficient or no cooling liquid within the system. • No output contact of the thermal servo.
	Inspection	<ul style="list-style-type: none"> • Check if there is sufficient cooling liquid within the system or if there is liquid flow. • Check the output contact of the thermal servo.
	Solution	<ul style="list-style-type: none"> • Refill the cooling liquid and examine the flow for problems. • Replace the overheating protector.

8 Spindle Lubrication (Oil-Air) Device for Bearing 14K (Option)

Perform the following corrective measures, when a malfunction has occurred.

Problem	Possible Causes	Corrective Measures
Oil not discharged.	Oil level is low.	Add oil to tank.
	Suction filter is clogged.	Clean or replace the suction filter.
	Oil viscosity is too high.	Replace oil with proper oil viscosity (in case of replacement, flush the tank and hose system (piping system) before regular operation).
Pressure does not rise.	Hose system trouble (piping system trouble) <ul style="list-style-type: none"> • Air remains in the hose. • Oil leakage from joints between hoses. • Hose breakage. 	<ul style="list-style-type: none"> • Check for air release at the end of the hose or at the hose joints. • Screw the hose joints closed with sufficient force. • Replace the hose.
	Pressure setting of relief valve is incorrect.	Adjust the set value.
	Pressure valve is malfunctioning <ul style="list-style-type: none"> • Valve seat is clogged. • Valve seat is damaged. 	<ul style="list-style-type: none"> • Disassemble and clean the pressure valve. • Replace the pressure valve.
Noise emitted from pump.	Trapped foreign materials have damaged the pump gear.	Disassemble the pump to confirm the damage. Contact your Makino service representative if the damage has occurred as it is necessary to replace the pump and flush the tank and hose system.
No signal from the float switch.	Oil level is too low.	Add oil to tank to level "L" or higher.
	Float switch is faulty.	It is necessary to replace the float switch. Contact your Makino service representative.
Pump not operating.	Wiring is incorrect.	Check the Electrical wiring.
	Pump malfunction.	Repair or replacement of the pump is necessary. Contact your Makino service representative.

9 Air Dryer (Option)

If any problem occur, inspect the following table and if the problem cannot be solved, shut Off the power supply and contact your Makino service representative.

Problem	Possible Causes	Corrective Measures
Air dryer does not operate and run lamp does not light up, when the circuit breaker is on.	Power cord or plug is loose or not connected to the power source. Circuit breaker is off.	Perform proper connection on the power cord and plug. Confirm whether the proper capacity of the circuit breaker is used. Resume the operation after resetting the circuit breaker to on. If the circuit breaker still trip to off, failure of electrical insulation may have occurred. Remove the power supply and contact your Makino service representative.
Evaporation thermometer indicates higher than green zone and the compressor stops while driving.	Installation place is poorly ventilated. Ambient temperature is too high. The ventilation grilles are obstructed by wall or clogged with dust. Temperature of the compressed air is too high.	Improve the ventilation system to lower the ambient temperature. Install the air dryer more than 16" (40cm) away from the wall. Clean the ventilation grilles once a month. Improve the ventilation system around air or make ambient temperature low. Reduce the temperature of the compressed air by installing an additional after-cooler before the air dryer.
	Supply voltage is not in the following range: AC180~AC220V	Set the voltage to a proper value by installing a transformer or review the electrical wiring.
Evaporation thermometer indicates higher than green zone.	Installation place is poorly ventilated. Ambient temperature is too high. The ventilation grilles are obstructed by wall or clogged with dust. Temperature of the compressed air is too high.	Improve the ventilation system to lower the ambient temperature. Install the air dryer more than 16" (40cm) away from the wall. Clean the ventilation grilles once a month. Improve the ventilation system around the air compressor or make ambient temperature around the air compressor low to lower the temperature of discharge from compressor. Reduce the temperature of the compressed air by installing an additional after-cooler after the air dryer.

10 Minimum Quantity Lubrication (Option)

Problem	Solution
Reduced/no fluid output.	<ol style="list-style-type: none"> 1. Make sure air is being supplied to the applicator. 2. Check pressure gauge, operating range is 0.5 MPa to 1 MPa. 3. Check reservoir level, refill if needed. 4. Make sure the lubricant line is cut and installed correctly. 5. Check the frequency generator and reset it to the correct frequency. 6. Make sure the lubricant control is not at the zero point. 7. Make sure the hose bard outlet is not over-tightened.
Reduced/no air output.	<ol style="list-style-type: none"> 1. Make sure air is being supplied to the applicator. 2. Check pressure gauge, operating range is 0.5 MPa to 1 MPa. 3. Check airflow valve and reset it accordingly.
Fluid leaking.	<ol style="list-style-type: none"> 1. Make sure the lubricant control is not set to the stop point. 2. Make sure the lubricant line is cut and installed correctly.
Frequency generator malfunctioning.	<ol style="list-style-type: none"> 1. Check frequency generator and reset it to the correct frequency. 2. Dirty/oily air can damage the frequency generator, replace damaged internal components with the Frequency Generator Repair Kit. 3. To prevent future problems add a coalescing filter to the air filter regulator/pressure gauge.
Applicator is on but not operating.	<ol style="list-style-type: none"> 1. Check on/off valve or electronic solenoid. 2. Make sure air is being supplied to the applicator. 3. Make sure the air hose and lubricant line are securely installed.
Misting lubricant.	<ol style="list-style-type: none"> 1. Make sure the airflow valve is not set too high.

11 Automatic Grease Supply Unit

11.1 Insufficient Pump Pressure

If the pump discharge pressure does not reach 5 MPa within 2 minutes after the motor starts operating, alarm is triggered.

Possible Causes	Corrective Measures
Excessive internal leaking in distributing valve.	If abnormal volume of grease is overflowing from the lubricating point, replace the distributing valve.
Grease is leaking between the pump and the distributing valve.	Find the locations where grease is leaking and tighten the joints.
Air inside the pump.	Loosen the air venting screw on the pump unit, turn on the power and discharge grease until all air is discharged with the grease.
Air trapped in the grease pipe.	After disconnecting the piping which may contain air in the grease, operate the pump until all grease containing air is removed.
Grease cartridge is empty.	Replace the cartridge.
Cartridge is not tightened adequately.	Firmly tighten the cartridge.
Seal packing is damaged.	Replace the seal packing.
Pump piston unit is worn.	Replace the pump.
Pump cable is damaged.	Check and repair cable.

11.2 Pressure Release Is Abnormal

If pressure switch LS1698 is still “1” even after the pressure is released, an alarm is triggered.

Possible Causes	Corrective Measures
Distributing valve is clogged.	Replace the disturbing valve element.
Malfunction of pump built-in pressure release mechanism.	Replace the pump.

11.3 Abnormal Pressure Detection

If pressure switch LS1698 remains at “0” after motor startup or LS1698 remains at “1” after motor is off, an alarm is triggered.

Possible Causes	Corrective Measures
Malfunction of pump built-in pressure release mechanism.	Replace the pump.

11.4 Cartridge Low Level Alarm

If limit switch LS2064 is triggered, Low Level alarm will occur.

Possible Causes	Corrective Measures
Grease cartridge is empty.	Replace it with a new cartridge.

11.5 Excessively High Grease Consumption Rate

Possible Causes	Corrective Measures
Internal leaking in distributing valve.	If abnormal volume of grease is overflowing from the lubricating point, replace the distributing valve.
Grease is leaking between the pump and the distributing valve.	Find the locations where grease is leaking and tighten the joints.

11.6 Excessively Low Grease Consumption Rate

Possible Causes	Corrective Measures
Distributing valve is clogged.	Replace the distributing valve element.
Grease is not supplied.	

12 Spindle Hydraulic Unit

12.1 Hydraulic Oil Is Not Discharged or Discharge Volume Is Insufficient

Possible Causes	Corrective Measures
Motor is rotating in reverse direction	Reverse connection for two of three pump motor power cables (phases).
Pump cannot draw in oil as oil viscosity is too high.	Replace oil with type of the recommended viscosity range.
Pump draws in air as oil level is insufficient.	Add oil to recommended level.
Hose, filter leakage.	Tighten or replace with new parts.

12.2 Pump Pressure Does Not Increase

After performing checks listed in 12.1 Hydraulic Oil is Not Discharged or Discharge Volume is Insufficient, check the items listed below.

Possible Causes	Corrective Measures
No load on pump discharge side.	Check the hydraulic circuit and repair if necessary.
Pressure setting is low.	Turn the pressure adjustment bolt CW to increase the pressure.
Pump internal part is worn out (drain volume is excessive).	Replacement of damaged parts is necessary. Contact your Makino service representative. Check the hydraulic oil quality.
Pressure gauge malfunction.	Replace the pressure gauge.

12.3 Abnormal Noise Is Emitted from Pump

Possible Causes	Corrective Measures
Oil viscosity is too high/low.	Replace oil with type of the recommended viscosity range.
Oil temperature is too high/low.	Use oil within the recommended temperature range (0 - 60°C).
Pump draws in air as oil level is insufficient.	Add oil to recommended level.
Air is drawn in from the intake system (loose connections or damaged seals).	Tighten the joints. If the seal is damaged, replace the seal.
Parts are broken.	Contact your Makino service representative.

12.4 Full Cut Off Pressure Fluctuation or Cut Off Operation Malfunction

Possible Causes	Corrective Measures
Spring is damaged or fatigued.	Replacement of damaged parts is necessary. Contact your Makino service representative.
Pump drain malfunction.	
Full cut off pressure is too high.	Turn the adjustment bolt CCW to decrease the pressure.
Other hydraulic components in circuit are leaking oil.	Inspect other components and repair/replace if necessary.
Air trapped in the grease pipe.	Bleed air from the piping.

12.5 Overheating

Possible Causes	Corrective Measures
Oil level is insufficient.	Add oil to recommended level.
Case drain has expanded due to excessive wear on pump rotation/sliding parts.	Replacement of damaged parts is necessary. Contact your Makino service representative.

12.6 Oil Is Leaked from Pump

Possible Causes	Corrective Measures
O-ring is worn out or damaged.	Replacement of damaged parts is necessary. Contact your Makino service representative.
Packing is damaged.	

12.7 Oil Is Leaked from Fittings

Possible Causes	Corrective Measures
Fittings are loose.	Tighten the fittings again.
Seal surface is defective.	Confirm the accuracy of and check for any warping or foreign matter on the seal surface and repair/replace as necessary.
Packing is damaged or worn.	Check for damage, tearing, ripping, wear or other problems when inserting gasket/seal and replace the part if necessary.

12.8 Hydraulic Oil Leakage (Entire Machine)

Check the following items for general hydraulic oil leaks from the machine and perform the appropriate procedures.

Possible Causes	Corrective Measures
Leakage from the following items: • Hydraulic unit • Hose • Fitting • Solenoid valve • Manifold	1. Determine the location of oil leakage. If only a small amount of oil is leaking, place a white piece of paper under the suspected part to check or add a trace dye to the hydraulic oil before operating the machine. 2. Check the amount of oil leakage (for example, per day)..
Leakage from the following units supplied with hydraulic oil • Rear of the spindle head	

12.9 Pump Motor Overload

Possible Causes	Corrective Measures
Pump motor malfunction.	Contact your Makino service representative.
Strainer damage caused by foreign matter getting mixed into the pump.	Press the [START] switch on the motor circuit breaker after eliminating the cause of overload.

13 Pneumatic System

If the compressed air supplied to machine does not satisfy the necessary conditions it may cause a malfunction of the pneumatic system and contaminated compressed air will severely damage the major components of the machine; such as the spindle, measurement units and feedback scale units. Clean (replace if necessary) the filter periodically

13.1 Pressure Switch LS905 (Main Air Pressure Switch) Malfunction

13.1.1 Switch Does Not Activate at Set Pressure

Possible Causes	Corrective Measures
Solenoid valve SOL905 (main air on) malfunction.	<p>Check solenoid valve SOL905 (main air on) and other electrical components to identify the location of the problem. Next, perform the following steps:</p> <ol style="list-style-type: none">1. There is a possibility of damage or malfunction in the electric circuit. Check each cable using the volt meter.<ul style="list-style-type: none">• If solenoid valve SOL905 (main air on) is malfunctioning, replace the valve.• If the cable is damaged, replace the cable. <p>If any problem is found in the machine controller, repair or replace the malfunctioning parts.</p>
Air pressure is not supplied or is insufficient.	Apply pressure higher than the set pressure plus hysteresis.
Pressure switch LS905 (main air pressure switch) malfunction.	<p>Check pressure switch LS905 (main air pressure switch) and other electrical components to identify the location of the problem. Next, perform the following steps:</p> <ol style="list-style-type: none">1. If the problem is caused by faulty adjustment, adjust it properly.2. There is a possibility of damage or malfunction in the electric circuit. Check each cable using the volt meter.<ul style="list-style-type: none">• If pressure switch LS905 (main air pressure switch) is malfunctioning, replace the switch.• If the cable is damaged, replace the cable. <p>If any problem is found in the machine controller, repair or replace the malfunctioning parts.</p>

13.1.2 Switch Activates Although Air Pressure Is Below Set Pressure

Possible Causes	Corrective Measures
Pressure gauge is malfunctioning.	Replace the pressure gauge.
Pressure switch LS905 (main air pressure switch) contacts are fused.	Replace the pressure switch LS905 (main air pressure switch).

13.2 Filter Malfunction

13.2.1 Flow Rate Is Insufficient or Excessive Pressure Loss

Possible Causes	Corrective Measures
Filter is clogged.	Clean/replace the filter.
Air supply hose is too small.	Replace with a larger air hose.

13.2.2 Auto Drain Does Not Operate (Auto Drain Specs.) or Air Is Leaked from Drain Port

Possible Causes	Corrective Measures
Auto drain is malfunctioning or clogged.	Stop the compressed air supply and clean or replace the bowl.

13.2.3 Air Is Leaked from Bowl Connection Point

Possible Causes	Corrective Measures
O-ring is damaged or clogged with foreign matter.	Stop the compressed air supply and remove the bowl and clean or replace the o-ring.
Bowl is broken.	Stop the compressed air supply and remove and replace the bowl.

13.2.4 Unable to Regulate Air Pressure

Possible Causes	Corrective Measures
Foreign matter has scarred the rubber surface of valve sheet.	Stop the compressed air supply and disassemble the filter regulator and clean.
Valve stem is clogged with foreign matter (tar) along its sliding surface.	
Foreign matter has scarred the sliding surface of valve sheet and bottom plug.	
Air flow direction is incorrect.	Stop the compressed air supply and reconnect the piping so that air is supplied to the air inlet.
O-ring in valve sliding part is damaged.	Stop the compressed air supply and disassemble the filter regulator and replace the damaged parts.
Diaphragm is damaged.	
Rubber surface of valve sheet is damaged.	

13.2.5 Air Leaked from Diaphragm

Possible Causes	Corrective Measures
Diaphragm is damaged.	Stop the compressed air supply and disassemble the filter regulator and replace the diaphragm.

14 Drum Conveyor (Option)

14.1 Large Chips Accumulate in Clean Tank

Possible Causes	Corrective Measures
Inner and outer bushing unit is damaged or worn.	Replace the brass inner and outer bushing.
Filter of drum unit is not mounted correctly or mounting screws are loose.	Mount the filter of drum unit correctly.
Filter of drum unit is damaged.	Replace the filter of drum unit.

14.2 Chip Sludge Accumulate in Clean Tank

Possible Causes	Corrective Measures
Tank is not cleaned periodically.	Clean the tank periodically.

14.3 Drum Filter Is Clogged

Possible Causes	Corrective Measures
Periodic inspection and maintenance are not performed.	Clean/replace the filter.
Backwash pressure is low (backwash amount is insufficient).	Check for Y-strainer clogging and clean if necessary.
Backwash nozzles immersed due to bubbles in coolant.	Use non-foaming and water soluble coolant and check the coolant concentration (do not use anti-foaming additives unless absolutely necessary to prevent clogging of the filter).
Oil (sludge, antifoaming additives, slime or insufficiently emulsified fluid such as base oil) adheres to the filter of drum unit.	Clean/replace the filter of drum unit. There are the following possible causes for oil adhering to the belt: 1. Coolant is old: Replace the coolant. 2. Coolant supply (dilution) procedure is not correct: Add concentrated solution a little at a time to water and stir well prior to pouring into the tank,
Pump for backwash coolant malfunction.	Pump replacement is necessary. Contact your Makino service representative.
Foreign matter adheres to the pump suction opening for the backwash coolant.	Remove the foreign matter from the pump suction opening.

14.4 Conveyor Is Running in Reverse Direction

Possible Causes	Corrective Measures
Faulty wiring.	Check the wiring.
Electromagnetic switch is malfunctioning.	The electromagnetic switch must be replaced. Contact your Makino service representative.

14.5 Geared Motor Does Not Run

Possible Causes	Corrective Measures
Power supply malfunction.	Confirm power is supplied properly.
Faulty electric circuit.	There is a possibility of a short in the electric circuit. Check each cable using the volt meter.
Geared motor is damaged.	The geared motor must be replaced. Contact your Makino service representative.
The geared motor wiring (cable) is improperly connected or damaged.	Check the cable is correctly connected. If the cable is damaged, replace the cable.
Circuit breaker is tripped.	Circuit breaker is tripped when the motor load is excessive. Eliminate the cause of the problem and then power On the motor breaker inside the machine controller.
Supply voltage is low.	Check cause of low voltage and adjust to the proper voltage.
Electromagnetic contactor is improperly connected.	If the electromagnetic contactor is damaged, replacement is necessary. Contact your Makino service representative.
Gear or bearing is damaged.	Contact your Makino service representative.
Foreign matter is lodged in the Drum Conveyor.	Operate conveyor in reverse rotation and remove the foreign matter.
Protector adjustment is incorrect.	Adjust the protector.

14.6 Excessive Heat Generated from Geared Motor

Possible Causes	Corrective Measures
Overload	Remove the cause of overload.
Overload due to damaged gear or bearing.	Contact your Makino service representative.
Incorrect power supply voltage.	Check and correct the power supply voltage.

14.7 Abnormal Noise Emitted from Geared Motor

Possible Causes	Corrective Measures
Gear or bearing is damaged.	Contact your Makino service representative.

15 Coolant Tank Unit

15.1 Coolant Is Not Discharged (Pump Is Not Running)

Possible Causes	Corrective Measures
For safety reasons, coolant is not discharged for one of the following reasons: <ul style="list-style-type: none">• Operator door is open.• Coolant stop switch is pressed.• During tool change operation.• M00 or M01 (program stop) is executed.	Complete individual operation or release the condition.
Coolant related alarm is triggered.	Check the alarm and restore operation.
Wiring (cable) or piping (hose) connections for pump is incorrect.	Check the connections of cables and hoses.
Thermal alarm is tripped.	Check the alarm triggered on machine side and restore operation.

15.2 Coolant Is Not Discharged (Pump Is Running)

Possible Causes	Corrective Measures
Wiring (cable) and piping (hose) connection for machine unit and pump are incorrect.	Check the connections of cables and hoses.
Incorrect piping between pump and the discharge ports of the coolant.	Check the piping.

16 Coolant Temperature Controller (Option)

The parameter (temperature) for the coolant temperature controller is set prior to shipment. Do not change the parameter setting value. Changing of the initial setting may cause serious damage.

Please take note on the safety precaution before proceeding to any repair works. Only qualified technicians should carry out the repair works.

When Alarm Is Triggered on Coolant Temperature Controller

If an alarm has been triggered on the coolant temperature controller, operation is automatically stopped and an alarm signal is output. Coolant temperature controller alarms can be determined by the alarm code that is displayed on the unit panel. After checking the details of the alarm, turn off the machine power and eliminate the cause of alarm (Refer to [16.1 When Alarm Is Triggered](#)^[268]).

When Alarm Is Not Triggered on Coolant Temperature Controller

The coolant temperature controller cannot operate when coolant is below the low level limit. In this case, refill coolant. If abnormal operation is suspected although an alarm is not triggered for either the coolant temperature controller or machine (Refer to [16.2 When Alarm Is Not Triggered](#)^[272]).

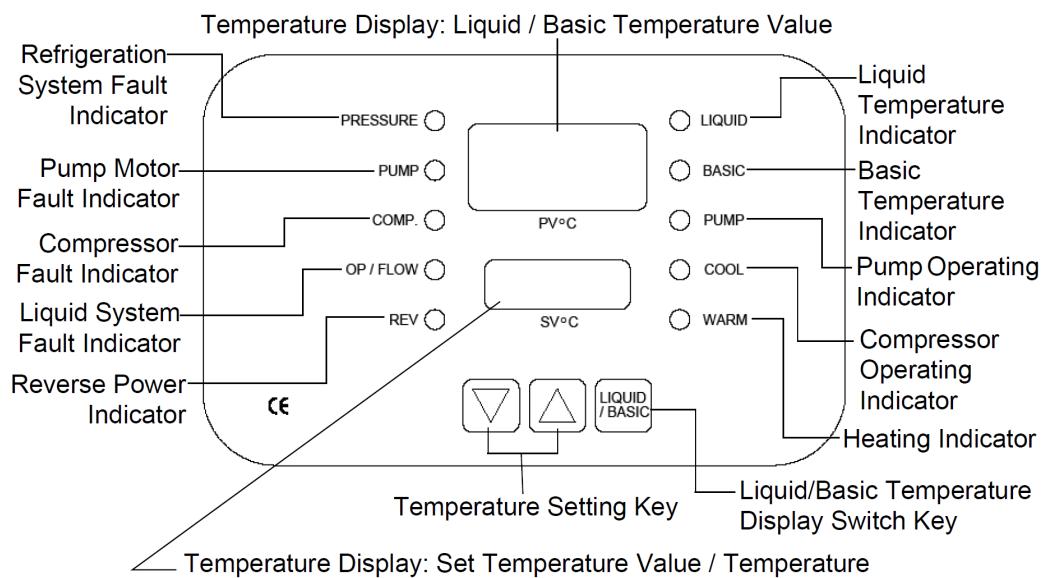


Figure 16.1 Coolant Temperature Controller (Panel Details)

16.1 When Alarm Is Triggered

1	Explanation	Coolant temperature sensor fault.
Sn PV°C OL SV°C	Possible Causes	<ul style="list-style-type: none"> • Broken connection of the coolant temperature sensor. • Coolant temperature sensor fault. • Temperature controller failure.
	Inspection	<ul style="list-style-type: none"> • Check whether the connection of the coolant temperature sensor is broken or not. • If the connection is not broken, chances are either the temperature controller or the sensor has failed.
	Solution	<ul style="list-style-type: none"> • Reconnect the wire connection or replace the wire if necessary. • Replace the faulty parts.
2	Explanation	There is a problem with the ambient or machine body temperature sensor.
Sn PV°C ro SV°C	Possible Causes	<ul style="list-style-type: none"> • The wire connection of the ambient or machine body temperature sensor is broken. • The ambient or machine body temperature sensor has failed. • Temperature controller failure.
	Inspection	<ul style="list-style-type: none"> • Check whether or not the wire for ambient or machine body temperature sensor is connected. • If there are no problems with the connection, chances are either the sensor or the temperature controller is faulty.
	Solution	<ul style="list-style-type: none"> • Reconnect the wire connection or replace the wire if necessary. • Replace the faulty parts.
3	Explanation	Coolant temperature is too high for the temperature controller to process.
AH PV°C OL SV°C	Possible Causes	<ul style="list-style-type: none"> • Process load is over the limit of the temperature controller's capacity. • Coolant temperature sensor fault. • Refrigerator system failure.
	Inspection	<ul style="list-style-type: none"> • Check whether the ambient and coolant temperature are higher than the limit of 45°C. • Check whether or not the temperature controller is capable for the process load. • Check if the temperature sensor is functioning properly or not. • Check if the refrigeration system is in order or not.
	Solution	<ul style="list-style-type: none"> • Keep the coolant temperature below 45°C. • Change the temperature controller to a larger cooling capacity. • Replace the coolant temperature sensor. • Contact the refrigerator service technician for refrigeration system failure.

4	Explanation		There is a pressure fault within the refrigeration system.
In PV°C --- SV°C PRESSURE	Possible Causes	<ul style="list-style-type: none"> • Low or over charge of refrigerant. • Obstruction or leakage occurred in the refrigeration system. • Condenser or air filter is dirty. • Poor heat dissipation. • Fan or motor failure. 	
	Inspection	<ul style="list-style-type: none"> • Check if the copper pipe near the low pressure side of the compressor is not cold. • Check if the fins of the condenser are not hot. • Check if the temperature controller's internal temperature is too high. • Check if the fan or motor is faulty. 	
	Solution	<ul style="list-style-type: none"> • Clean the air filter and the condenser regularly to improve the heat dissipation and remove any obstructions from air intake or exhaust. • Contact the refrigerator service technician for refrigeration system failure. 	
5	Explanation		There is a fault within the compressor which trip out the overload protector.
In PV°C --- SV°C COMP	Possible Causes	<ul style="list-style-type: none"> • Incorrect power voltage input. • Compressor has burned out. • Overload protector trip out. • Poor heat dissipation. • Fan or motor failure. 	
	Inspection	<ul style="list-style-type: none"> • Check if the input power voltage is correct or not. • Check if the compressor has burned out or not. • Check if the overload protector has trip out or not. • Check if the temperature controller's internal temperature is too high or not. • Check if the fan or motor is out of order or not. 	
	Solution	<ul style="list-style-type: none"> • Input the correct power voltage. • Replace burned out compressor. • Reset the overload protector. • Improve the working environment to lower the ambient temperature and create better ventilation. • Replace the fan or motor if out of order. 	
6	Explanation		The power phase input has been reversed.
In PV°C --- SV°C REV	Possible Causes	<ul style="list-style-type: none"> • Incorrect power phase input. • Reverse-phase relay failure. • Temperature controller failure. 	
	Inspection	<ul style="list-style-type: none"> • Check if the power cable is connected with correct phase or not. • If the power phase is correct, chances that the reverse-phase relay or the temperature controller has failed. 	
	Solution	<ul style="list-style-type: none"> • Reconnect the power cable with correct phase. • Replace the faulty parts. 	

Chapter 5 Troubleshooting

7	Explanation	There is a fault within the coolant pump which trip-out the overload protector.
In PV°C -- SV°C PUMP	Possible Causes	<ul style="list-style-type: none"> Coolant pump motor is faulty. Coolant pressure is too high. Coolant flow is not smooth.
	Inspection	<ul style="list-style-type: none"> Check if the coolant pump is functioning properly or not. Check if the coolant pressure is too high to cause the overload protector to trip-out. Check if the coolant pipe is clogged.
	Solution	<ul style="list-style-type: none"> Replace the faulty pump. Reset the overload protector. Clean the coolant circulating system, add a filter if necessary.
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8	Explanation	Pressure fault or insufficient amount of coolant within the coolant circulating system.
In PV°C -- SV°C O.P/FLOW	Possible Causes	<ul style="list-style-type: none"> No coolant flow or flow rate is too low. Set point of the coolant pressure switch is not within the designed specification. Failure of the oil pressure switch or flow switch. Air goes into the coolant pipes or the diameter of the pipes are too small. Pump motor failure.
	Inspection	<ul style="list-style-type: none"> Check if the coolant supply is sufficient. Check if the pressure switch is set within the designed specification. Check if the coolant pressure switch or flow switch is functioning properly or not. Check if the pipes diameter are too small. Check if the pump motor is functioning properly or not.
	Solution	<ul style="list-style-type: none"> Supply sufficient amount of coolant in the coolant circulating system. Set the coolant pressure switch to the designed specification. Replace the coolant pressure switch or the flow switch. Increase the pipes diameter or shorten the length of the pipes to avoid loss of coolant pressure. Replace the faulty pump motor.

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9	Explanation	Compressor temperature is too high.
PV°C EF SV°C	Possible Causes	<ul style="list-style-type: none"> • Compressor air vent is dirty. • Incorrect input power voltage or phase.
	Inspection	<ul style="list-style-type: none"> • Check if the hot air exhaust system is clogged. • Check if the input power or phase is correct.
	Solution	<ul style="list-style-type: none"> • Clean the air vent regularly to improve the heat dissipation and remove any obstructions from air exhaust. • Reconnect the power cable with correct phase.
10	Explanation	Oil level in tank is too low.
PV°C EC SV°C	Possible Causes	<ul style="list-style-type: none"> • Insufficient oil level. • Oil level switch is faulty.
	Inspection	<ul style="list-style-type: none"> • Check if the oil level is sufficient. • Check if the oil level switch is functioning properly or not.
	Solution	<ul style="list-style-type: none"> • Supply oil sufficiently. • Replace the faulty oil level switch.

16.2 When Alarm Is Not Triggered

Situation 1: Main power is input, coolant temperature controller does not run.	
Status	PV°C, SV°C are not display on the control panel.
Possible Causes	<ul style="list-style-type: none"> The main power may not be properly connected or the circuit breaker of the main power source is off. Control circuit board failure. Control circuit fuse has blown. Remote control function is not properly connected. Timer (optical component) failure.
Inspection	<ul style="list-style-type: none"> Check if the main power source is supplying the power properly or not (if the circuit breaker is on). Check if the connecting wire is connected properly or not. Check if the circuit fuse has blown or not. Check the remote control connection. Check if the timer is set properly or not. If all the above are seems to be in order, than it means there is a controller board failure.
Solution	<ul style="list-style-type: none"> Reconnect the main power source. Replace the blown fuse. Replace the controller board. Reset the timer (optional component) or replacement.
Status	PV°C, SV°C display temperature.
Possible Causes	<ul style="list-style-type: none"> Remote control function is not properly connected. Power voltage input is incorrect. Electromagnetic switch faults. Motor failure.
Inspection	<ul style="list-style-type: none"> Check the remote control connection. Check if the power voltage that inputs into the motor is correct or not. Check if the electromagnetic switch is in order or not. Check if the motor is still working properly or not.
Solution	<ul style="list-style-type: none"> Reconnect the remote control function. The power voltage inputs into the motor should be the same as the rated power voltage for the temperature controller. Replace faulty parts.

Situation 2: Coolant temperature controller is operating but there is abnormal condition with the cooling process.	
Status	No cooling is processed.
Possible Causes	<ul style="list-style-type: none"> • The compressor will stop operating when the temperature of the coolant has met the set value (SV°C). • Electromagnetic switch failure. • Poor heat dissipation.
Inspection	<ul style="list-style-type: none"> • Check if the coolant temperature has met the required cooling range or not. • Check if the electromagnetic switch is in order or not. • Check if the coolant temperature controller internal temperature is too high or not.
Solution	<ul style="list-style-type: none"> • It is normal for the compressor to stop operating when the coolant temperature has met the set value. • Replace the electromagnetic switch. • Improve the working environment to lower ambient temperature and create better ventilation.
<hr/>	
Status	Cooling continues even when the set value has reached.
Possible Causes	<ul style="list-style-type: none"> • The process load is over the limit of the temperature controller's capacity. • Poor heat dissipation. • Leakage of refrigerant. • Thermostat failure.
Inspection	<ul style="list-style-type: none"> • Check if the capacity of the coolant temperature controller is suitable for the process load or not. • Check if the coolant temperature controller internal temperature is too high or not. • Check if the refrigeration system for any leakage. • If all the above seem to be in order, than the thermostat fails.
Solution	<ul style="list-style-type: none"> • A larger capacity temperature controller is required. • Improve the working environment to lower ambient temperature and create better ventilation. • Contact the refrigeration service technician. • Replace the thermostat.

Chapter 5 Troubleshooting

Situation 3: Sudden stop of the coolant temperature controller while operating and an alarm signal was sent to the machine tool.	
Status	PV°C & SV°C are properly display on the control panel.
Possible Causes	<ul style="list-style-type: none">• The vibration of the machine tool has loosen the wire connections.• Remote control connection is out.• Coolant temperature controller connection is out.• Coolant temperature controller failure.
Inspection	<ul style="list-style-type: none">• Check the connections of the remote control and the coolant temperature controller.• If the connections are in order, than the coolant temperature controller is faulty.
Solution	<ul style="list-style-type: none">• Reconnect the connections.• Replace the temperature controller.
<hr/>	
Status	PV°C & SV°C are not display on the control panel.
Possible Causes	<ul style="list-style-type: none">• Circuit breaker of the coolant temperature controller may have jumped.• The vibration of the machine tool has loosen the wire connections.• The remote control connection is out.• Thermostat connection is out.• Thermostat failure.• Power supply failure.
Inspection	<ul style="list-style-type: none">• Check if the circuit breaker is trip-off or not.• Check the remote control and the thermostat connections.• Check if the power supply is still operating or not.• If all the above seem to be in order, than the thermostat is faulty.
Solution	<ul style="list-style-type: none">• Set the circuit breaker back on.• Reconnect the remote control and thermostat wires.• Replace faulty parts.

17 Mist Collector (Option)

17.1 Motor Does Not Rotate

Possible Causes	Corrective Measures
Cable is improperly connected or damaged.	Check the cable is correctly connected. If the cable is damaged, replace the cable.
Circuit breaker is tripped.	Circuit breaker is tripped when the motor load is excessive. Eliminate the cause of the problem and then power On the motor breaker inside the machine controller.
Supply voltage is low.	Check the cause of low voltage and adjust to the proper voltage.
Electromagnetic contactor is improperly connected.	Check the electromagnetic contactor (KMS19) for the mist collector. If the electromagnetic contactor is damaged, replacement is necessary. Contact your Makino service representative.
Motor is damaged.	Motor replacement is necessary. Contact your Makino service representative.
Motor seized up or rusted.	Motor replacement is necessary. Contact your Makino service representative.

17.2 Motor Rotates but Does Not Collect Mist

Possible Causes	Corrective Measures
Motor rotation direction is opposite.	Reconnect the wiring so that the motor rotates forward.
Filter is clogged.	When the filter clog indicator is yellow or red (indicating CLEANING), inspect the condition of each filter and clean or replace as necessary.
Connection point of the duct and hose duct is detached.	Check the connection point of the duct and reconnect the duct and the hose duct correctly.
Duct piping is clogged.	Check the inside of the duct pipe and remove the foreign matter from the duct if necessary.
Primary filter is under negative pressure.	Check the first drain piping is correctly connected. A coolant bucket must be attached to the drain piping.

17.3 Motor Load Is Excessive

Possible Causes	Corrective Measures
Supply voltage is too high.	Check the factory-side voltage.
Rotating components contacting with obstruction(s).	Contact your Makino service representative.
Duct piping or filter is clogged.	Check the duct piping and the filter. Remove the foreign matter from inside of the duct piping if necessary. When the filter is damaged, replace the filter.

17.4 Mist Is Not Being Collected

Possible Causes	Corrective Measures
Drain piping is clogged.	Check the inside of the drain pipes and remove the foreign matter from the drain pipes if necessary.
Drain piping is improperly connected or damaged.	Check the drain pipes are connected correctly so that air pockets are not created.
Air pocket in the drain pipes.	Reconnect the drain pipes correctly so that air pockets are not created.
Collection container is installed higher than drain port.	Install the mist collector unit so that the collection container is lower than the drain port.

17.5 Abnormal Noise or Vibration Is Emitted from Motor

Possible Causes	Corrective Measures
Defective installation.	Confirm the mist collector is installed in applicable location. Check the screws securing the mist collector unit and the base. If the screws are loose, retighten them.
Damaged bearing.	Bearing replacement is necessary. Contact your Makino service representative.
Clogged motor.	Must remove foreign matter from the rotating components. Contact your Makino service representative.
Clogged rotating components.	Must remove foreign matter from the rotating components. Contact your Makino service representative.

18 Alarm List

User messages are incorporated in the system, to give a general status of the machine conditions during the operation. However, it is possible that there is a machine status which is not mentioned in this chapter. In that condition, systematic check and proper care must be taken to troubleshoot the machine.

Alarm No.	Message / Cause / Information / Remedy
A001	<p>Message: EMERGENCY STOP MODE IS ACTIVE. (*EMI IS OFF) (RELEASE E-STOP AND PRESS POWER ON BUTTON)</p> <p>Cause: Emergency stop is active.</p> <p>Info: *EMI [X8.3] is OFF.</p> <p>Remedy: Release emergency stop button and press NC ON [PS1] button.</p>
A002	<p>Message: OVER TRAVEL LIMIT SWITCH OF FEED AXIS IS HIT. (OR MEASURING PROBE TOUCHES SOMETHING) [*ESP SIGNAL IS OFF] OR PFM DETECTED POWER DROP.</p> <p>Info: OT2X (X8.5) or OT2Y (X8.6) or OT2Z (X8.7) is hit. Healthy condition is these signals must be OFF or Probe status (MSSW) from measuring probe is ON during non-measurement mode (NMSMD)(Y5.0)=ON</p> <p>Remedy: For OT If axis is in OT zone, then move the respective axis out of OT zone by moving axis in opposite direction. Else Check OT2X (X8.5) or OT2Y (X8.6) or OT2Z (X8.7) must be OFF. Check whether hardware circuit for OT2X or OT2Y or OT2Z are OK. For measuring probe During non measurement mode (NMSMD)(Y5.0)=ON make sure not to do measurement. Or (MSSW) status must be OFF.</p>
A003	<p>Message: ATC TIME OVER. RESET CYCLE BY ALARM RESET BUTTON → PRESS EMERGENCY → PREPARE MACHINE READY → RECOVER.</p> <p>Info: ATC could not complete operation within specified time. The reason could be some of the signals don't operate normally.</p> <p>Remedy: When this alarm happens, check if any other alarm exists along with this message and solve it. Else note the situation (machine condition, block at which program stopped, machine position screen with distance to go page photo) and inform such details to MAKINO customer service. Reset cycle by ALARM RESET button → Press EMERGENCY → Prepare Machine Ready → Recover.</p>
A005	<p>Message: ATC MAGAZINE DATA ERROR! PLEASE SET MAGAZINE TYPE DATA.</p> <p>Cause: ATC magazine type not set. Related parameter: D302 (Refer PMC parameter list for detail or consult Makino).</p> <p>Remedy: Set parameter based on magazine type.</p>
A006	<p>Message: FIXTURE IS NOT AT HOME POSITION SO OPERATION IN AUTO MODE CAN NOT BE STARTED.</p> <p>Cause: For auto cycle start with auto door fixture must be in unclamped.</p> <p>Info: Fixture unclamp lamp LHY1UC [Y8.1] must light up.</p> <p>Remedy: Unclamp fixture and check fixture unclamp lamp LHY1UC [Y8.1] light up.</p>

Chapter 5 Troubleshooting

Alarm No.	Message / Cause / Information / Remedy
A009	<p>Message: FRONT DOOR DOES NOT SATISFY CONDITION TO START AUTO CYCLE.</p> <p>Info: Standard machine: Manual door: Front door must be closed (LS912) must be ON Auto single door: Front door must be open. SL1001=ON; SL1002=OFF; LS2311=OFF; LS2312=ON; Auto double door: Front door must be open. SL1001=ON; SL1002=OFF; LS2311=ON; LS2312=ON; LS912=OFF; APC machine: Stocker side auto door must be open. SL1001=ON; SL1002=OFF; LS2312L=ON; LS2312R=ON; LS966=OFF;</p>
A010	<p>Message: X-AXIS OVERTRAVEL (OT2)</p> <p>Cause: X-Axis hit hard over travel limit switch.</p> <p>Info: X-Axis over travel limit switch OT2X is ON.</p> <p>Remedy: Move the axis out of over travel zone in reverse direction and check OT2X signal must be OFF.</p>
A011	<p>Message: Y-AXIS OVERTRAVEL (OT2)</p> <p>Cause: Y-Axis hit hard over travel limit switch.</p> <p>Info: Y-Axis hard over travel limit switch OT2Y is ON.</p> <p>Remedy: Move the axis out of over travel zone in reverse direction and check OT2Y signal must be OFF</p>
A012	<p>Message: Z-AXIS OVERTRAVEL (OT2)</p> <p>Cause: Z-Axis hit hard over travel limit switch.</p> <p>Info: Z-Axis hard over travel limit switch OT2Z is ON.</p> <p>Remedy: Move the axis out of over travel zone in reverse direction and check OT2Z signal must be OFF.</p>
A014	<p>Message: ATC STANDBY CONDITION MISSING</p> <p>Cause: ATC was not standby (Ready) during cycle start.</p> <p>Info: Feed axis must not be in ATC zone (Y-Axis machine position must be > -150.0) ATC shutter must be closed. (ATC magazine position should be 0 Degree)</p>
A016	<p>Message: CYCLE START ERROR. REFERENCE POINT IS NOT ESTABLISHED.</p> <p>Cause: Reference point of axis not established. Cycle start is inhibited.</p> <p>Remedy: Make sure reference point of all axis is established.</p>
A017	<p>Message: PROGRAM NUMBER TO BE SEARCHED EXCEEDS 9999. CHECK PMC PARAMETER SETTING.</p> <p>Cause: Program number in PMC parameter for program search exceeds 9999.</p> <p>Remedy: Check related PMC parameter setting value falls within range.</p>
A018	<p>Message: EXTERNAL DATA INPUT HAS FAILED.</p> <p>Cause: External data input from PMC to CNC process failed.</p> <p>Remedy: Check if corresponding NC alarm is generated along with this alarm. If so take corrective action after referring Fanuc maintenance manual.</p>
A019	<p>Message: CNC ALARM HAS OCCURRED DURING PROGRAM SEARCH.PROGRAM TO BE SEARCHED MAY NOT EXIST IN MEMORY.</p> <p>Cause: The search program entered in related PMC parameter may not exist in CNC memory.</p> <p>Remedy: Check the related PMC parameter for program number search for different function's and CNC memory for programs registered.</p>

Alarm No.	Message / Cause / Information / Remedy
A022	<p>Message: ATC IS NOT IN STAND-BY POSITION. Cause: ATC was not standby (Ready) during cycle start. Info: Feed axis must not be in ATC zone (Y-Axis machine position must be > -150.0) ATC shutter must be closed. (ATC magazine position should be 0 Degree)</p>
A023	<p>Message: PALLET CHANGER IS NOT IN HOME POSITION. (NOT STAND-BY) Cause: Pallet changer not at home during cycle start process. Info: APC must be either at Clockwise SL101B=ON; SL101A=OFF; LS102=OFF; LS103=ON; or Counter clockwise SL101B=OFF; SL101A=ON; LS102=ON; LS103=OFF; and APC must be down SL100A=ON; LS100=ON; Remedy: Check if APC is at home position and check the signal status match as mentioned above.</p>
A024	<p>Message: SPINDLE TOOL IS NOT CLAMPED. Cause: Spindle tool is not clamped status during auto start process. Info: Spindle clamp status SL01=ON; LS00=ON; LS01=OFF Remedy: Confirm spindle tool clamp and check signal status as above.</p>
A025	<p>Message: OPERATOR DOOR IS NOT CLOSED. Cause: Operator door not closed during auto start process. Info: Standard machine front door close status: Manual door: LS912=ON Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine operator door close status: LS912=ON Remedy: Confirm operator door is closed and check signal status as above.</p>
A026	<p>Message: MACHINE LOCK, Z-AXIS NEGLECT OR AUX. FUNCTION LOCK IS ACTIVATED. Cause: Machine lock, Z-Axis neglect, auxiliary function lock is active during auto start. Remedy: Check in custom "Machine Status Screen" whether any of these functions is active. Deactivate these functions before auto cycle start.</p>
A028	<p>Message: COOLANT MODE IS "OFF". Cause: Coolant mode is OFF status during auto cycle start. Remedy: Check if coolant was in pause status by pressing coolant OFF button on main operation panel. Turn OFF pause state by pressing coolant ON button and check coolant ON button lamp is lit.</p>
A029	<p>Message: ATC OPERATION MODE IS MANUAL. Cause: ATC operation mode is manual during auto start. Remedy: Exit ATC maintenance mode. If ATC shutter is open then close the ATC shutter by commanding M555 in MDI mode.</p>
A030	<p>Message: DRY RUN IS ACTIVATED. Cause: Dry run is active during auto start. Remedy: Check in custom "Machine Status Screen" whether DRY RUN is active. Deactivate dry run mode before auto cycle start.</p>

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Alarm No.	Message / Cause / Information / Remedy
A031	<p>Message: FEED AXIS IS NOT AT AUTO START POSITION AT CYCLE START. Cause: Feed axis is not at auto start position during auto start. Info: X Home F70.0; Y Home F70.1; Z Home F70.2; A RWH Home F70.3 (with A RWH option); B RWH Home F70.4 (with B RWH option) must be ON '1'. Remedy: Return feed axis to home position before auto start.</p>
A032	<p>Message: ERROR HAS OCCURRED DURING EXECUTION OF CNC WINDOW READ/WRITE. Cause: Error occurred during CNC window read/write by PMC software. Remedy: Note down during which command this error occurred. Inform this condition to Makino Service.</p>
A036	<p>Message: ILLEGAL M-CODE COMMAND. Cause: Non existing M-Code is been commanded. Remedy: Reconfirm M-Code that is executed.</p>
A037	<p>Message: ILLEGAL COMBINATION OF M-CODE Cause: Multiple M-Codes that cannot be used at the same time are commanded. Remedy: Reconfirm M-Code that is executed.</p>
A038	<p>Message: CUSTOM MACRO VARIABLE READ/WRITE ALARM Cause: Fail to read the macro variable in M466. (Reading stop position for the angle specific spindle orientation.) Remedy: The data that is specified by the macro variable must be from 0.0000001 to 99999999. Check the value of macro variable #100 and correct part program.</p>
A039	<p>Message: MUST NOT BE SPECIFIED TOGETHER WITH ANOTHER M-CODE. Cause: M-Code which must be used alone has been commanded together with other M-Code at the same block. Remedy: Correct part program so that this M-Code is alone.</p>
A040	<p>Message: PLEASE PUSH NC RESET. Cause: M, S or T Command cannot be completed due to a fault. Remedy: Push NC reset key in order to cancel.</p>
A041	<p>Message: MUST SPECIFY S-CODE. Cause: M-Code which requires S-Code at the same block as an augment was commanded without S-Code. Remedy: Correct part program.</p>
A042	<p>Message: PALLET LOAD CHECK(M84,M95) ALARM. CHECK TABLE PALLET NUMBER. Cause: Pallet number is wrong. Info: Pallet position is not correct when M84 or M95 commanded. Remedy: Check pallet changer arm position and condition.</p>
A043	<p>Message: TOOL CALLED BY T-CODE IS ABSENT STATUS. Cause: The tool specified by T-Code is absent. (The tool is out of the tool magazine.) This message appears if the tool data which has absent mark is called. Remedy: Check the tool status. And change the tool or correct the tool status.</p>
A044	<p>Message: TOOL CALLED BY T-CODE IS ALARM STATUS. NO SPARE TOOL SET OR ALL SPARE TOOLS IN ALARM STATUS. Cause: The tool specified by T-Code is alarm status. Info: This message appears if the tool data that has alarm mark is called. Remedy: Check the tool status. And change the tool or correct the tool status.</p>

Alarm No.	Message / Cause / Information / Remedy
A045	<p>Message: MAINTENANCE MODE IS ACTIVATED OR ATC UNIT IS REMOVED BY PMC PARAMETER.</p> <p>Cause: Maintenance mode is activated or ATC is neglected by parameter.</p> <p>Info: Maintenance mode is activated or ATC unit is neglected by the PMC parameter: ATCNON [K61.4]=0</p> <p>Remedy: Switch OFF the maintenance mode. Check the PMC parameter:K61.4</p>
A046	<p>Message: TOOL CALLED BY T-CODE DOES NOT EXIST IN TOOL DATABASE.</p> <p>Cause: The tool that was called by T-Code is not found in the tool database.</p> <p>Remedy: Confirm the tool database on the Tool Data Screen.</p>
A051	<p>Message: SAFETY LIGHT CURTAIN IS INTERRUPTED</p> <p>Cause: During striker job light curtain was interrupted.</p> <p>Info: LS2315 must be ON.</p> <p>Remedy:</p> <p>Check light curtain is operating properly.</p> <p>Do not block light curtain during cycle start or door close or during pallet changing / fixture clamping (in machines without door).</p>
A052	<p>Message: PART MAY NOT HAVE BEEN SET UP. SEAT CHECK SENSOR DID NOT TURN OFF SINCE LAST CYCLE COMPLETION.</p> <p>Cause: Machined part has not been unloaded and restarted auto cycle. This is to prevent re-machining of finished part.</p> <p>Remedy:</p> <p>Unload the machined part.</p> <p>Check part seating sensor (when unload the part, part seating sensor should be OFF).</p>
A053	<p>Message: PART MAY NOT HAVE BEEN SET UP. SAFETY LIGHT CURTAIN HAS NEVER BEEN INTERRUPTED SINCE LAST CYCLE COMPLETION. SET UP PART OR CHECK LIGHT CURTAIN.</p> <p>Cause: After previous part machining complete auto cycle start was triggered without interrupting light curtain. This is to prevent re-machining of finished part.</p> <p>Remedy:</p> <p>Unload the machined part.</p> <p>Check light curtain.</p>
A056	<p>Message: APC IS NOT IN STANDBY POSITION.</p> <p>Cause: Pallet changer not at home during cycle start process.</p> <p>Info:</p> <p>APC must be either at Clockwise SL101B=ON; SL101A=OFF; LS102=OFF; LS103=ON; or Counter clockwise SL101B=OFF; SL101A=ON; LS102=ON; LS103=OFF; and APC must be down SL100A=ON; LS100=ON;</p> <p>Remedy: Check if APC is at home position and check the signal status match as mentioned above.</p>
A057	<p>Message: ATC IS NOT IN STANDBY POSITION.</p> <p>Cause: ATC was not standby (Ready) during spindle start / spindle orient / rigid tap command.</p> <p>Info: Feed axis must not be in ATC zone (Y-Axis machine position must be > -150.0) ATC shutter must be closed. (ATC magazine position should be 0 Degree)</p>

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Alarm No.	Message / Cause / Information / Remedy
A058	<p>Message: FAIL IN EXECUTION OF M303/M304. Cause: When spindle start status is checked by M302 command, spindle does not start or spindle job does not complete within regulated time (10sec). Info: Spindle start status: SARA [F45.3]=1, ORARA [F45.7]=0, ORCMA [G70.6]=0 In case of forward rotation SFRA [G70.5]=1, In case of reverse rotation SRVA [G70.4]=1</p>
A059	<p>Message: CLAMPING OF SPINDLE TOOL IS NOT COMPLETED IN SPECIFIED TIME. Cause: Spindle tool clamping motion does not complete in regulated time. Info: Spindle tool clamping status LS00=1, LS01=0, SL01=0 Remedy: Check solenoid valve, limit switch and mechanism that are related to spindle tool clamping.</p>
A060	<p>Message: UNCLAMPING OF SPINDLE TOOL IS NOT COMPLETED IN SPECIFIED TIME. Cause: Spindle tool unclamping motion does not complete in regulated time. Info: Spindle tool unclamping status LS00=0, LS01=1, SL01=1 Remedy: Check solenoid valve, limit switch and mechanism that are related to spindle tool clamping.</p>
A061	<p>Message: CALCULATION ERROR HAS OCCURRED IN SPINDLE SPEED PROCESSING. Cause: Calculation error has occurred in conversion spindle speed command into motor speed. Remedy: Check that speed command is correct.</p>
A062	<p>Message: SPINDLE COOLER MOTOR THERMAL ALARM. TH5/TH5A=1. Cause: Spindle cooler motor thermal tripped. Remedy: Remove the cause of the trip and reset the thermal switch.</p>
A063	<p>Message: CALCULATION ERROR HAS OCCURRED IN ORIENTATION ANGLE PROCESSING. Cause: Calculation error has occurred in the spindle multi-angle orientation. Info: Calculation error is occurred when M318, M330 command. Remedy: Check whether specified angle is within the range.</p>
A064	<p>Message: SPINDLE TOOL IS NOT CLAMPED. Cause: Spindle cannot turn because spindle is not tool clamp status. Info: Spindle tool clamp status ⇒ LS00=1, LS01=0, SL01=0. Remedy: Clamp spindle tool.</p>
A065	<p>Message: SPINDLE SPEED HAS NOT BEEN COMMANDED. Cause: Spindle cannot start because no speed command is instructed. Remedy: Instruct S-Code to specify spindle speed.</p>

Alarm No.	Message / Cause / Information / Remedy
A066	<p>Message: OPERATOR DOOR IS NOT CLOSED.</p> <p>Cause: Spindle cannot turn because operator door (side door) or front door is not closing.</p> <p>Info: Standard machine front door close status: Manual door: LS912=ON Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine operator door close status: LS912=ON</p> <p>Remedy: Close the door.</p>
A067	<p>Message: SPINDLE LUBRICATION UNIT IS NOT WORKING.</p> <p>Cause: Spindle cannot turn because spindle lubrication oil temperature controller is not working.</p> <p>Remedy: Confirm that parameter OMOFAS [K61.0]=0</p>
A068	<p>Message: SPINDLE ORIENTATION IS NOT COMPLETED IN SPECIFIED TIME.</p> <p>Cause: Spindle orientation is not completed within 10 seconds.</p> <p>Info: Completion status of spindle orientation: SSTA [F45.1]=1, SARA [F45.3]=0, ORARA [F45.7]=1, SRVA [G70.4]=0, SFRA [G70.5]=0, ORCMA [G70.6]=1</p> <p>Remedy: Check spindle drive amplifier and CNC parameter that is related to spindle.</p>
A069	<p>Message: SPINDLE STOP IS NOT COMPLETED IN SPECIFIED TIME.</p> <p>Cause: Spindle stopping is not completed within 10 seconds.</p> <p>Info: Spindle stopping status: SSTA [F45.1]=1, SARA [F45.3]=0, ORARA [F45.7]=0, SRVA [G70.4]=0, SFRA [G70.5]=0, ORCMA [G70.6]=0</p> <p>Remedy: Check spindle drive amplifier and CNC parameter that is related to spindle.</p>
A070	<p>Message: SPINDLE START IS NOT COMPLETED IN SPECIFIED TIME.</p> <p>Cause: Spindle starting is not completed within 10 seconds.</p> <p>Info: Spindle starting status: SARA [F45.3]=1, ORARA [F45.7]=0, ORCMA [G70.6]=0 In case of forward rotation: SFRA [G70.5]=1, In case of reverse rotation: SRVA [G70.4]=1</p> <p>Remedy: Check spindle drive amplifier and CNC parameter that is related to spindle.</p>

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Alarm No.	Message / Cause / Information / Remedy
A072	<p>Message: CONDITION THAT SPINDLE CAN ROTATE WAS MISSING WHILE SPINDLE IS RUNNING. REASON: [I230,D1368]</p> <p>Cause: Condition that allows spindle rotating has been lost during spindle rotating.</p> <p>Condition that allows spindle rotating:</p> <ul style="list-style-type: none"> - Spindle tool clamer is clamped: <p>Refer explanation of message number A064.</p> <ul style="list-style-type: none"> - Pallet changer is not at home (stand by) <p>Refer explanation of message number A056</p> <ul style="list-style-type: none"> - Machine is not in maintenance mode. - Spindle lubrication oil temperature controller is working: <p>Refer explanation of message number A067.</p> <ul style="list-style-type: none"> - Operator (side) door and front door are closing: <p>Refer explanation of message number A066.</p> <ul style="list-style-type: none"> - ATC home position: <p>Refer explanation of message number A057</p> <p>The cause remains in the address of D1368.</p> <p>Bit 0 LS00 turn OFF</p> <p>Bit 1 LS01 turn ON</p> <p>Bit 2 LS601 turn OFF</p> <p>Bit 3 LS602 turn OFF</p> <p>Bit 4 The automatic tool changer unit became not normal (standby).</p> <p>Bit 5 The machining area door opened.</p> <p>Bit 6 The alarm was generated by the spindle amplifier unit.</p> <p>Bit 7 The spindle temperature controller is abnormal.</p> <p>Please execute the check and the repair to meet the above-mentioned requirement</p>
A073	<p>Message: S-CODE IS NOT IN SPINDLE SPEED RANGE.</p> <p>Cause: Spindle speed command is out of the specified range.</p> <p>Info: Speed range is specified by PMC parameter MAXRPM[D0900] and MINRPM[D0904].</p> <p>Remedy: Command correct speed again. Check the above parameter.</p>
A074	<p>Message: TOOL WAS NOT SEATED PROPERLY INTO SPINDLE.CLEAN THE SPINDLE AND TOOL AND TRY AGAIN.</p> <p>Cause: When the tool is clamped, the tool seating confirmation sensor is not turned ON.</p> <p>Info: Tool seating confirmation sensor ⇒ LS601=1.</p> <p>Remedy: Try to remove the tool from the spindle, clean the spindle and the tool, and clamp. When this message is displayed, it is necessary to adjust the tool seating confirmation sensor in the spindle even if it is clean.</p>
A075	<p>Message: TOOL DOES NOT SEAT</p> <p>Cause: Spindle cannot be started because of the tool seating confirmation sensor is OFF.</p> <p>Info: Tool seating confirmation sensor ⇒ LS601=1.</p> <p>Remedy: Try to remove the tool from the spindle, clean the spindle and the tool, and clamp. When this message is displayed, it is necessary to adjust the tool seating confirmation sensor in the spindle even if it is clean.</p>
A076	<p>Message: NO TOOL IN SPINDLE</p> <p>Cause: Spindle cannot be started because no tool or tool cannot be detected.</p> <p>Info: LS602 is OFF.</p> <p>Remedy: Load tool into spindle.</p> <p>If this message is displayed though spindle has tool, adjust tool presence sensor of spindle.</p>

Alarm No.	Message / Cause / Information / Remedy
A077	<p>Message: SPINDLE DECELERATION TO SWITCH SPINDLE MOTOR WINDING IS NOT COMPLETED WITHIN 10 SECONDS.(SDTA<F45.2> DOES NOT TURN ON)</p> <p>Cause: Deceleration to change over speed to switch spindle motor windings not completed within specified time.</p> <p>Info: Deceleration completion of spindle \Rightarrow SDTA[F45.2]=1</p> <p>Remedy: Check spindle drive amplifier and CNC parameter that is related to spindle. (especially 4023)</p>
A079	<p>Message: SWITCHING OF SPINDLE MOTOR WINDINGS HAS NOT BEEN DONE PROPERLY, SO SPINDLE CAN NOT TURN. (Related signal: RCH1, RCH2) CHECK CONTACTOR TO SWITCH WINDINGS.</p> <p>Cause: Spindle cannot turn because switching of spindle motor windings has not been done properly.</p> <p>Info: Proper status of high speed windings: RCHP=0, RCH1=0, RCH2=1, RSLA[G71.6]=0, RCHA[G71.7]=0, RCHPA[F46.2]=0, RCFNA[F46.3]=0 Proper status of low speed windings: RCHP=1, RCH1=1, RCH2=0, RSLA[G71.6]=1, RCHA[G71.7]=1, RCHPA[F46.2]=1, RCFNA[F46.3]=1</p> <p>Remedy: Check contactor of spindle motor windings.</p>
A080	<p>Message: SWITCHING OF SPINDLE MOTOR WINDINGS DID NOT COMPLETE WITHIN 10 SECONDS. (Related signal: RCH1, RCH2) CHECK CONTACTOR TO SWITCH WINDINGS.</p> <p>Cause: Switching of spindle motor windings did not complete within 10 seconds.</p> <p>Info: Proper status of high speed windings: RCHP=0, RCH1=0, RCH2=1, RSLA[G71.6]=0, RCHA[G71.7]=0, RCHPA[F46.2]=0, RCFNA[F46.3]=0 Proper status of low speed windings: RCHP=1, RCH1=1, RCH2=0, RSLA[G71.6]=1, RCHA[G71.7]=1, RCHPA[F46.2]=1, RCFNA[F46.3]=1</p> <p>Remedy: Check contactor of spindle motor windings.</p>
A081	<p>Message: ROBOT DOOR MUST BE CLOSED TO START SPINDLE.</p> <p>Cause: Robot door must be closed to start spindle.</p> <p>Info: Robot door close status LS201=1; LS202=0; SL201=1; SL202=0;</p> <p>Remedy: Close the robot door.</p>
A082	<p>Message: ROBOT DOOR MUST BE CLOSED TO START COOLANT.</p> <p>Cause: Robot door must be closed to start coolant.</p> <p>Info: Robot door close status LS201=1; LS202=0; SL201=1; SL202=0;</p> <p>Remedy: Close the robot door.</p>
A084	<p>Message: B-AXIS LIMIT SWITCH STATUS IS ABNORMAL [L153, L154].</p> <p>Cause: Both limit switches that confirm index table clamp/unclamp have turned ON at the same time.</p> <p>Info: Both L153, L154 have turned ON.</p> <p>Remedy: Poor adjustment or failure of limit switch. Check limit switch.</p>

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Alarm No.	Message / Cause / Information / Remedy
A085	<p>Message: OPERATOR DOOR IS NOT CLOSED. Cause: Table (B-Axis) cannot move because operator door (side door) or front door is not closed. Info: Standard machine front door close status: Manual door: LS912=ON Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine operator door close status: LS912=ON Remedy: Close the door.</p>
A086	<p>Message: PALLET CHANGER IS NOT IN STAND-BY POSITION. Cause: Pallet changer not at home during cycle start process. Info: APC must be either at Clockwise SL101B=ON; SL101A=OFF; LS102=OFF; LS103=ON; or Counter clockwise SL101B=OFF; SL101A=ON; LS102=ON; LS103=OFF; and APC must be down SL100A=ON; LS100=ON; Remedy: Check if APC is at home position and check the signal status match as mentioned above.</p>
A087	<p>Message: PROGRAM TOOL IS PROHIBITED OR ALARM STATUS. Cause: Tool that was commanded is alarm status. Remedy: Check and solve the alarm generated on the tool before commanding the tool</p>
A088	<p>Message: TOOL CHANGE FOR RETURN TOOL IS PROHIBITED. Cause: Return tool that was commanded is alarm status. Remedy: Check and solve the alarm generated on the return tool before commanding the tool.</p>
A091	<p>Message: TOOL CLAMPING CYL NEUTRAL TIME OUT. Cause: Tool seating signal LS601 is not confirmed while clamping neutral pressure process. Remedy: Check for any chip on tool or tool seating LS601 signal status must be 1.</p>
A100	<p>Message: ATC MAGAZINE DOOR IS NOT CLOSED. Cause: ATC magazine door is not closed. Remedy: Close ATC magazine door from the maintenance screen before commanding ATC.</p>
A102	<p>Message: A-AXIS NOT IN SAFE POSITION FOR ATC OPERATION. Cause: ATC was commanded with AB rotary work head table not at safe position. Info: A-Axis safe position switch CNC signal PSW06. B-Axis safe position switch CNC signal PSW07. Remedy: Move rotary work head table to safe position before commanding ATC.</p>
A103	<p>Message: ATC MAGAZINE DOOR IS NOT CLOSED. Cause: ATC magazine door is not closed at start of ATC cycle. Remedy: Close ATC magazine door by M555.</p>

Alarm No.	Message / Cause / Information / Remedy
A104	<p>Message: SPINDLE TOOL SEATING IMPROPER, ATC OPERATION INHIBIT. Cause: ATC was commanded with spindle tool seating improper. Info: Tool seating confirmation sensor \Rightarrow LS601=1. Remedy: Try to remove the tool from the spindle, clean the spindle and the tool, and clamp. When this message is displayed, it is necessary to adjust the tool seating confirmation sensor in the spindle even if it is clean.</p>
A106	<p>Message: MAINTENANCE MODE IS ACTIVATED OR ATC UNIT IS REMOVED BY PMC PARAMETER. Cause: Maintenance mode is activated or ATC is neglected by parameter. Info: Maintenance mode is activated MTHIMT=1 in Maintenance Screen or ATC unit is neglected by the PMC parameter: ATCNON[K61.4]=0 Remedy: Turn OFF maintenance mode. If ATC unit is neglected, enable ATC by parameter setting.</p>
A107	<p>Message: LS601 AND LS602 STATUS INVALID OR SENSOR IS DISABLED BY PARAMETER. Cause: During ATC, LS601 and LS602 status is invalid (abnormal) status. Info: LS601 and LS602 healthy status. Remedy: Check tool seating LS601 and tool detect LS602 status.</p>
A108	<p>Message: CNC WAS RESET WHEN M6 COMMAND WAS WAITING FOR COMPLETION OF FEED AXIS MOTION. Cause: CNC has been reset during ATC motion, so M6 command cannot continue. Info: CNC reset signal: RST [F1.1]</p>
A109	<p>Message: T-CODE WAS NOT SPECIFIED BEFORE M6 COMMAND. Cause: T-Code was not specified before M6 command. Remedy: Command T-Code prior to M6.</p>
A110	<p>Message: OPERATOR DOOR IS NOT CLOSED. Cause: Operator door is not closed. Info: Standard machine front door close status: Manual door: LS912=ON Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine operator door close status: LS912=ON Remedy: Close the door.</p>
A111	<p>Message: ATC SHUTTER NOT CLOSED. Cause: ATC shutter not closed. Remedy: Close the ATC shutter by M555.</p>
A112	<p>Message: Y-AXIS NOT IN SAFE POSITION FOR MAGAZINE INDEX. KEEP Y-AXIS BETWEEN -400.0 TO -150.0 AND THEN TRY M555. Cause: Magazine indexing was commanded with Y-Axis not in safe position. Remedy: Move the Y-Axis machine position \geq -150.000 before magazine rotation.</p>
A113	<p>Message: Y-AXIS NOT IN SAFE POSITION FOR MAGAZINE INDEX. KEEP Y-AXIS BETWEEN -400.0 TO -150.0 AND THEN TRY M558. Cause: Magazine indexing was commanded with Y-Axis not in safe position. Remedy: Move the Y-Axis machine position \geq -150.000 before magazine rotation.</p>

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Alarm No.	Message / Cause / Information / Remedy
A114	<p>Message: SPINDLE TOOL IS NOT CLAMPED WHEN ATC MOTION IS COMMANDED. Cause: Spindle is not tool clamp status, so ATC cannot perform. Spindle tool clamped status: LS00=1; LS01=0; SI01=0; Remedy: Clamp spindle tool.</p>
A115	<p>Message: NEXT TOOL CALL BY T-CODE FAILED. Cause: Calling of next tool has failed, so ATC cannot perform. The ATC operation instruction was done with T-Code had failed. Remedy: Restore the magazine in maintenance mode and command T-Code again.</p>
A116	<p>Message: INVALID M6 CONDITION (SPINDLE TOOL IS 0 BUT T0 IS CALLED). IF SPINDLE HAS TOOL WHEN THIS ALARM OCCURS, CHECK THE STATUS OF LS602 (X0010.2). Cause: Spindle tool is '0' and program tool is '0'. So cannot find return pot. Info: LS602 status → without tool LS602=0; with tool LS602=1; Remedy: Check whether spindle has tool then check LS602 status.</p>
A117	<p>Message: INVALID M6 CONDITION (THERE IS TOOL IN SPINDLE BUT SPINDLE TOOL NO.= 0). REMOVE THE TOOL FROM THE SPINDLE. Cause: Spindle tool is '0' and program tool is '0'. So cannot find return pot. Info: LS602 status → without tool LS602=0; with tool LS602=1;. Remedy: Check whether spindle has tool then check LS602 status.</p>
A118	<p>Message: MAGAZINE MOTOR TEMPERATURE EXCEED SETTING VALUE. Cause: Magazine motor temperature exceeded the limit. Remedy: Check magazine motor temperature and other mechanism abnormal conditions that cause this error.</p>
A119	<p>Message: ATLM OVERTRAVEL/EMERGENCY. *BTSOT IS OFF. Cause: ATLM hit hard over travel limit switch. Remedy: Move the axis out of over travel zone in reverse direction and check *BTSOT signal must be ON. Possibly the tool could not detect the measurement mode SKIP signal or tool hit the ATLM sensor in non-measurement mode.</p>
A120	<p>Message: ROBOT SHUTTER NOT CLOSED. AXIS MOVEMENT INHIBITED. Cause: Robot shutter is not closed. In machine with top shutter or side shutter for workpiece loading the shutter must be closed for feed axis to move. Remedy: Close robot shutter at function screen before moving the feed axis.</p>
A121	<p>Message: COOLANT IS NOT OFF BEFORE PERFORMING ROBOT DOOR OPEN/CLOSE. Cause: Robot door open was commanded with coolant ON. Remedy: Correct NC program. Before commanding M81/M82 turn OFF coolant.</p>
A122	<p>Message: SPINDLE IS NOT STOPPED BEFORE PERFORMING ROBOT DOOR OPEN/CLOSE. Cause: Robot door open was commanded with spindle ON. Remedy: Correct NC program. Before commanding M81/M82 turn OFF spindle.</p>
A123	<p>Message: AXES ARE NOT IN SAFE POSITION BEFORE PERFORMING ROBOT DOOR OPEN/CLOSE. Cause: Robot door open was commanded with axis not in safe position. Remedy: Correct NC program. Before commanding M81/M82 ensure axis is in safe position.</p>
A124	<p>Message: SPLASHGUARD DOOR IS NOT CLOSED BEFORE PERFORMING ROBOT DOOR OPEN/CLOSE. Cause: Robot door close was commanded with splash guard not closed. Remedy: Make sure operator door is closed.</p>

Alarm No.	Message / Cause / Information / Remedy
A125	<p>Message: ROBOT DOOR OPEN/CLOSE MOTION DID NOT COMPLETE IN SPECIFIED TIME.</p> <p>Info: Robot door status. Robot door close status --> SL201=1; SL202=0; LS201=1; LS202=0; Robot door open status --> SL201=0; SL202=1; LS201=0; LS202=1;</p> <p>Remedy: Check solenoid operation and limit switch status.</p>
A126	<p>Message: ROBOT DOOR IS NOT CLOSED.</p> <p>Cause: During power ON, robot door was neither open nor closed.</p> <p>Info: Robot door status. Robot door close status --> SL201=1; SL202=0; LS201=1; LS202=0; Robot door open status --> SL201=0; SL202=1; LS201=0; LS202=1;</p> <p>Remedy: Check physical robot door status and check solenoid operation and limit switch status.</p>
A127	<p>Message: ROBOT DOOR IS NOT IN CORRECT POSITION.PERFORM ROBOT DOOR OPEN/CLOSE USING M-CODE.</p> <p>Cause: Robot door is neither open nor close status. Hence cannot take open or close command from push button.</p> <p>Info: Robot door status. Robot door close status --> SL201=1; SL202=0; LS201=1; LS202=0; Robot door open status --> SL201=0; SL202=1; LS201=0; LS202=1;</p> <p>Remedy: Perform robot door open or close using M-Code.</p>
A128	<p>Message: OPERATOR DOOR IS NOT CLOSED.</p> <p>Cause: M11 table unclamp was commanded with safety doors not closed.</p> <p>Info: Standard machine front door close status: Manual door: LS912=ON Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine operator door close status: LS912=ON</p> <p>Remedy: Close operator door.</p>
A129	<p>Message: EMERGENCY STOP BUTTON PRESSED (OPERATOR PANEL).</p> <p>Cause: Emergency stop on operator panel is active.</p> <p>Remedy: Release emergency stop button and press NC ON [PS1] button.</p>
A130	<p>Message: EMERGENCY STOP BUTTON PRESSED (LUCC OPERATOR PANEL).</p> <p>Cause: Emergency stop on LUCC operator panel is active.</p> <p>Remedy: Release emergency stop button and press NC ON [PS1] button.</p>
A131	<p>Message: EMERGENCY STOP BUTTON PRESSED (FIXTURE PANEL OR TWO HAND CYCLE START PANEL).</p> <p>Cause: Emergency stop on fixture panel, or two hand cycle start panel is active.</p> <p>Remedy: Release emergency stop button and press NC ON [PS1] button.</p>
A132	<p>Message: EMERGENCY STOP BUTTON PRESSED (STOCKER SIDE PANEL).</p> <p>Cause: Emergency stop on stocker side panel is active.</p> <p>Remedy: Release emergency stop button and press NC ON [PS1] button.</p>
A133	<p>Message: CANNOT USE THIS FUNCTION WHEN AUTO MODE.</p> <p>Cause: Tool call/return function cannot command in auto mode.</p> <p>Remedy: Change machine operation mode.</p>

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Alarm No.	Message / Cause / Information / Remedy
A134	<p>Message: CANNOT USE THIS FUNCTION WHEN ANOTHER NC PROGRAM RUNNING. Cause: Tool call/return function is commanded when other program has been executed. Other program has been executed. Because tool call/return function is a function to be executed by using the CNC program, it is not possible to execute other program. Remedy: T-command after CNC program finish.</p>
A135	<p>Message: CANNOT USE THIS FUNCTION WHEN FEED HOLD CONDITION. Cause: Tool call function is commanded when feed hold condition. Because tool call/return function is a function to execute by using the CNC program, it is not possible to execute in the feed hold state. Remedy: Please remove the cause of the feed hold and instruct again.</p>
A139	<p>Message: Y-AXIS IS IN ATC ZONE.RECOVER Y-AXIS TO (-) DIRECTION BY SLOW JOG. (CONFIRM THE SPINDLE & MAGAZINE POSITION) Cause: Y-Axis is in ATC zone. The machine coordinates of the Y-Axis are on the plus side (> +0.200) from the stroke end of the machine specification. Remedy: Move spindle out of the ATC area in jog feed slowly by pressing OTRS (over ride) switch.</p>
A140	<p>Message: LS25 WAS NEVER ON DURING THE ATC OPERATION. CHECK THE SENSOR. Cause: LS25 is not on. Remedy: Check the sensor LS25.</p>
A141	<p>Message: MOTION OF TOOL PROBE TO CONFIRM THAT NO TOOL EXIST IN GRIPPER FOR RETURN IS NOT COMPLETED WITHIN 10 SECONDS. (RELATED SIGNALS: LS1934,LS1935)CHECK SWITCH, SOLENOID VALVE AND MECHANISM. Cause: The time to confirm that no tool exist in gripper for return is exceed the set time. Remedy: Check the signal LS1934 and LS1935.</p>
A142	<p>Message: WRITING CNC PARAMETER FOR SHORTCUT MOTION OF ATC BY WINDOW FUNCTION HAS BEEN FAILED. Cause: Writing CNC parameter for the shortcut motion of ATC by the window function has been failed.</p>
A143	<p>Message: MAGAZINE POSITION INDEXED TO RETURN SPINDLE TOOL IS NOT CORRECT. CHECK MAGAZINE POSITION BY MAINTENANCE SCREEN. Cause: The indexed tool magazine position for the next tool is not equal to the commanded position.</p>
A144	<p>Message: MAGAZINE POSITION INDEXED FOR NEXT TOOL IS NOT CORRECT.CHECK MAGAZINE POSITION BY MAINTENANCE SCREEN. Cause: The indexed tool magazine position for returning the tool is not equal to the commanded position.</p>
A145	<p>Message: ORDER OF M-CODE FOR ATC MOTION IS ABNORMAL.MACRO PROGRAM:O9020 FOR ATC MAY NOT BE CORRECT. Cause: The order of M-Codes that are used in the macro program for ATC is abnormal. Remedy: Check the macro program O9020. Restore the correct macro program.</p>

Alarm No.	Message / Cause / Information / Remedy
A146	<p>Message: CLAMPING SPINDLE TOOL AT END OF ATC MOTION HAS BEEN FAILED. (Related signal:LS00, LS01)CHECK SOLENOID VALVE, SWITCH AND MECHANISM.</p> <p>Cause: Clamping the spindle tool at the timing of performing M948 (End of ATC) has been failed.</p> <p>Clamp status: ⇒ LS00=1; LS01=0; SL01=0;</p> <p>Remedy: Check solenoid valves, switches and mechanism.</p>
A148	<p>Message: MACHINE LOCK,Z-AXIS NEGLECT FUNCTION ACTIVATED DURING TOOL CHANGE.</p> <p>Remedy: During tool change deactivate Machine Lock, Z-Axis neglect.</p>
A149	<p>Message: POT TO RETURN SPINDLE TOOL IS NOT VACANT.VERIFY THE MAGAZINE POT & SPINDLE POT NUMBER.</p> <p>Remedy: Verify spindle tool and spindle tools return pot in magazine in Tool Data Screen.</p>
A150	<p>Message: TABLE (B-AXIS) IS NOT CLAMPED, SO CUTTING FEED CAN NOT BE PERFORMED.</p> <p>Cause: Because the index table is not clamping, it is not possible to cut.</p> <p>Info: Rotary table clamp status --> L153=1; L154=0; SL150=0;</p> <p>Remedy: Clamp rotary table.</p>
A155	<p>Message: SPINDLE TOOL UNCLAMP CONDITION HAS COME OFF DURING ATC MOTION.</p> <p>Cause: Spindle tool unclamping was lost during the ATC motions.</p> <p>Info: Spindle tool unclamping ⇒ LS00=0, LS01=1</p> <p>Remedy: Adjust the limit switch.</p>
A156	<p>Message: ATC CYCLE WAS INTERRUPTED. RECOVER USING ATC RECOVERY IN MAINTENANCE MODE.</p> <p>Remedy: Check at what stage of ATC the interruption occurred. And take remedial action for the fault. Report Makino Service on the observations. Check any related alarm occurs.</p>
A157	<p>Message: ATC CYCLE WAS INTERRUPTED DURING SPINDLE TOOL UNCLAMP.</p> <p>Cause: ATC interrupted during tool unclamp.</p> <p>Remedy: Bring Y-Axis to save pos (Y-150.0 - Y-400.0). Close ATC shutter (M555). Remove any tool from spindle command TX;M6; "X" Refers to tool number During interruption.</p>
A158	<p>Message: ATC CYCLE WAS INTERRUPTED DURING SPINDLE TOOL CLAMP.</p> <p>Cause: ATC cycle was interrupted during spindle tool clamp.</p> <p>Remedy: Bring Y-Axis to save pos (Y-150.0 - Y-400.0). Close ATC shutter (M555). Remove any tool from spindle. Command TX;M6; "X" refers to tool number during interruption.</p>
A159	<p>Message: ATC WRITING DATA ERROR.</p> <p>Cause: Tool presence in magazine pot is not updated correctly during spindle unclamp in ATC.</p> <p>Remedy: Check tool data integrity on Tool Data Screen. Especially check the pot status of the tool returned to magazine in previous ATC.</p>
A160	<p>Message: ATC WRITING DATA ERROR.</p> <p>Cause: Tool presence in magazine pot is not updated correctly during spindle clamp in ATC.</p> <p>Remedy: Check tool data integrity on Tool Data Screen. Especially check the pot status of the commanded tool in earlier ATC.</p>

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Alarm No.	Message / Cause / Information / Remedy
A161	<p>Message: REQUESTED POT NUMBER IS ILLEGAL.</p> <p>Cause: Pot number that commanded to index tool magazine is out of range.</p> <p>Info: Commanded pot number for indexing must be from 1 to maximum pot number. Maximum pot number = MGMXPN[D0464]</p> <p>Remedy: Check the parameter D0464 (Maximum pot number)</p>
A162	<p>Message: ATC READ TOOL DATA ERROR.</p> <p>Cause: Tool presence in spindle pot cannot be read correctly.</p> <p>Remedy: Check tool data integrity on Tool Data Screen especially check the current spindle pot.</p>
A163	<p>Message: ATC RECOVERY COULD NOT BE DONE AS ATC IS NOT WITHIN LIMIT OR INTERRUPTION STATUS NOT MATCHING, RECOVER ATC MANUALLY.</p> <p>Cause: After ATC interruption, ATC Auto recovery was commanded. But machine position is out of ATC zone or some abnormal condition exists. Cannot do auto recovery.</p> <p>Remedy: Check actual condition of machine and recover manually.</p>
A165	<p>Message: APC RECOVERY COULD NOT BE DONE AS ATC IS NOT WITHIN LIMIT OR INTERRUPTION STATUS NOT MATCHING, RECOVER APC MANUALLY.</p> <p>Cause: After APC interruption, APC Auto recovery was commanded. But machine position is out of ATC zone, or some abnormal condition exists. Cannot do auto recovery.</p> <p>Remedy: Check actual condition of machine and recover manually.</p>
A166	<p>Message: SERVO MOTOR IS SHUT DOWN DUE TO DOOR INTERLOCK.</p> <p>Cause: The servo motor is intercepted for the door interlock.</p> <p>The front door and the operator door close confirmation signals are lost.</p> <p>Info:</p> <p>Standard machine front door close status: Manual door: LS912=ON Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine operator door close status: LS912=ON</p> <p>Remedy: Close the door.</p>
A168	<p>Message: TSC ENABLE WITH NO TOOL IN SPINDLE.</p> <p>Remedy: Load TSC tool in the spindle when execute TSC.</p>
A169	<p>Message: USER M-CODE OPERATION TIME OUT.</p> <p>Remedy: Refer ERP-V09-054 for specification and signal details.</p>
A191	<p>Message: ALARM ON ATC SERVO AXIS. CHECK PMM PAGE FOR DETAILS.</p> <p>Remedy: Refer PMM manual for error on PMM screen and on β-drive.</p>
A192	<p>Message: ALARM OF MAGAZINE SERVO AXIS CONTROL OCCURS. CHECK CNC ALARM MESSAGE.</p> <p>Cause: CNC alarm related with tool magazine PMC axis control has occurred.</p> <p>The alarm of the magazine servo axis control has occurred from the CNC side. (EIALA is ON.)</p> <p>Remedy: Check message at CNC side screen.</p>

Alarm No.	Message / Cause / Information / Remedy
A194	<p>Message: CONDITION TO ALLOW MAGAZINE MOTION IS NOT SATISFIED. Cause: Tool magazine cannot move. Conditions are operator door is not closed. Info: Standard machine front door close status: Manual door: LS912=ON Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine operator door close status: LS912=ON Remedy: Confirm the condition that the tool magazine can be started.</p>
A199	<p>Message: INDEXING MOTION OF MAGAZINE DID NOT COMPLETED WITHIN THE TIME. Cause: Indexing motion of tool magazine does not complete within the time. (30sec) The sequence of the ATC magazine did not complete in normal operation time. Remedy: Check parameter related to tool magazine servo axis.</p>
A204	<p>Message: MODE SELECTOR IS NOT "AUTO" OR NC MODE IS NOT "MEMORY" MODE. AUTO START INHIBITED. Remedy: Change the NC mode to "MEMORY" mode when execute auto start process.</p>
A205	<p>Message: TWO HAND PB ERROR. Cause: Either of the Two hand button are tied. Info: Two hand push button signals --> Left side: THPBL; Right side: THPBR; When not pressed these signals should be '0'. Remedy: Check signal status.</p>
A209	<p>Message: A-AXIS ROTATION CONDITION IS LOST (L152/LS2603) Cause: A-Axis lost unclamping condition during movement. Info: Pneumatic unclamping mechanism signal status – L151=0; L152=1; Hydraulic unclamping mechanism signal status - Single acting type PS2603=0; Double acting type PS2603=0;PS2604=1; Remedy: Confirm poor adjustment or failure of pressure switch. Or failure of table clamping mechanism.</p>
A210	<p>Message: A-AXIS CLAMPING IS NOT COMPLETED WITHIN TIME. Cause: A-Axis clamping not complete even after 5sec has elapsed. Info: Pneumatic clamping mechanism signal status – L151=1; L152=0; Hydraulic clamping mechanism signal status - Single acting type PS2603=1; Double acting type PS2603=1;PS2604=0; Remedy: Confirm poor adjustment or failure of pressure switch. Or failure of table clamping mechanism.</p>
A211	<p>Message: A-AXIS IS NOT UNCLAMPED. USE M11 TO UNCLAMP. Cause: A-Axis table was commanded without unclamping the table. Remedy: Unclamp the table by M11 and then command A-Axis movement.</p>
A212	<p>Message: A-AXIS UNCLAMPING IS NOT COMPLETED WITHIN TIME. Cause: A-Axis unclamping not complete even after 5sec has elapsed. Info: Pneumatic unclamping mechanism signal status – L151=0; L152=1; Hydraulic unclamping mechanism signal status - Single acting type PS2603=0; Double acting type PS2603=0;PS2604=1; Remedy: Confirm poor adjustment or failure of pressure switch. Or failure of table clamping mechanism.</p>

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Alarm No.	Message / Cause / Information / Remedy
A213	<p>Message: A-AXIS INTERLOCK BY FIXTURE.CLAMP FIXTURE TO ROTATE A-AXIS. Cause: A-Axis rotation interlocked by fixture status. Remedy: Clamp the fixture before rotating A-Axis table.</p>
A214	<p>Message: A-AXIS INTERLOCK BY TOOL POSITION. MOVE AXIS TO SAFE POSITION TO ROTATE A-AXIS. Cause: A-Axis table rotation commanded without Z-Axis in safe position. Remedy: Move Z-Axis to home before rotating A-Axis.</p>
A215	<p>Message: A-AXIS ON STOCKER SIDE, CANNOT COMMAND ROTATION. Cause: On APC machine, stocker side table rotation was commanded. Stocker side table rotation not possible.</p>
A216	<p>Message: A-AXIS INTERLOCK BY FIXTURE CLAMP POSITION.RESTORE FIXTURE CLAMP TO ROTATE A-AXIS. Cause: A-Axis rotation interlocked by fixture status. Remedy: Clamp the fixture before rotating A-Axis table.</p>
A217	<p>Message: MAINTENANCE MODE IS ACTIVATED, SO PALLET CHANGING IS IMPOSSIBLE. Cause: Pallet change is commanded when the maintenance mode is active. Remedy: Turn OFF the maintenance mode.</p>
A218	<p>Message: ATC IS NOT STAND-BY STATUS, SO PALLET CHANGING IS IMPOSSIBLE. Cause: Pallet change commanded with ATC not in standby (ready) Info: ATC Standby (ready) status. Feed axis must not be in ATC zone (Y-Axis machine position must be > -150.0) ATC shutter must be closed. (ATC magazine position should be 0 Degree) Remedy: Confirm ATC standby before commanding pallet changer.</p>
A219	<p>Message: B-AXIS IS NOT AT POSITION THAT PERMIT PALLET CHANGING. Cause: Pallet change is commanded when table is not at home position. Remedy: Confirm table home position before commanding pallet changer.</p>
A220	<p>Message: NOZZLE OR THROUGH SPINDLE COOLANT IS WORKING, SO PALLET CHANGING IS IMPOSSIBLE. Cause: Pallet change is commanded when coolant system is active. Some coolant is active. Remedy: Stop the coolant(s). Coolant pause is not coolant stop.</p>
A221	<p>Message: PALLET CLAMP/UNCLAMP MOTION IS NOT COMPLETED IN SPECIFIED TIME. Cause: The pallet clamp/unclamp motion is not completed within the specified time. (5sec) Info: Pallet clamp/unclamp status: Pallet clamp: SL151=0, LS55=1, LS56=1 Pallet unclamp: SL151=1, LS55=0, LS56=0 Remedy: This may indicate a breakdown of the pallet clamp/unclamp mechanism. Check unit conditions and switch.</p>

Alarm No.	Message / Cause / Information / Remedy
A222	<p>Message: APC ARM TURN MOTION IS NOT COMPLETED IN SPECIFIED TIME. Cause: The pallet changer arm turn motion is not completed within the specified time. Info: Pallet arm turn status: Arm CCW: LS102=1, LS103=0, SL101A=1, SL101B=0 Arm CW: LS102=0, LS103=1, SL101A=0, SL101B=1 Arm down: SL100A=1, SL100B=0, LS100=1, LS101=0 Remedy: This may indicate a breakdown of the arm turning mechanism. Check unit conditions and switch.</p>
A223	<p>Message: APC ARM IS NOT AT ENDS OF CW/CCW. Cause: The pallet changer arm is not home position. Pallet changer axis position is not CW or CCW. So pallet up/down is inhibited. Info: Pallet arm turn status: Arm CCW: LS102=1, LS103=0, SL101A=1, SL101B=0 Arm CW: LS102=0, LS103=1, SL101A=0, SL101B=1 Remedy: Return the arm to home position in the maintenance mode.</p>
A224	<p>Message: APC ARM DOWN/LIFT MOTION IS NOT COMPLETED IN SPECIFIED TIME. Cause: The up/down motion of the pallet changer arm is not completed within the specified time. (10sec) Info: Pallet arm up/down status: Arm up: SL100A=0, SL100B=1, LS100=0, LS101=1 Arm down: SL100A=1, SL100B=0, LS100=1, LS101=0 This may indicate a breakdown of the arm up/down mechanism. Check unit conditions and switch.</p>
A225	<p>Message: APC ARM IS NOT AT DOWN POSITION. Cause: Pallet changer is commanded with arm not down. Info: Pallet arm down status: Arm down: SL100A=1, SL100B=0, LS100=1, LS101=0 Remedy: Return the arm to down position in maintenance mode.</p>
A226	<p>Message: APC ARM IS NOT AT LIFT POSITION. Cause: Pallet changer is commanded when arm is not lifted. Info: Pallet up status: Arm lift: SL100A=0, SL100B=1, LS100=0, LS101=1 Remedy: Return the arm to the standby position in the maintenance mode.</p>
A228	<p>Message: AXIS LOCKED, PALLET CHANGE INHIBIT Cause: Axis is locked by machine lock or Z-axis lock in function screen. Remedy: Remove the machine lock or Z-lock before commanding the APC.</p>
A229	<p>Message: Y-AXIS AND Z-AXIS IS NOT AT REFERENCE POINT, SO PALLET CHANGING IS IMPOSSIBLE. Cause: Pallet changer cannot be operated, because X-Axis, Y-Axis or Z-Axis is not at the pallet change position. Info: Pallet change position signals: X-Axis home position: PSW11=1 Y-Axis home position: PSW12=1 Z-Axis reference position: PSW03=1 Remedy: Move axis to pallet change position.</p>

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Alarm No.	Message / Cause / Information / Remedy
A231	<p>Message: BOTH LIMIT SWITCHES OF APC-ARM LIFT/DOWN WERE TURNED ON AT THE SAME TIME.</p> <p>Cause: Pallet changer arm up/down switches both turn on at the same time.</p> <p>Info: Error condition: LS100 LS101 both are ON at same time.</p> <p>Remedy: This may indicate a breakdown of the arm up/down switch. Check the switches.</p>
A232	<p>Message: PALLET IS NOT CLAMPED.</p> <p>Cause: Pallet changer cannot be operated, because the pallet is not clamped.</p> <p>Info: Pallet clamping status : SL151=0, LS55=1, LS56=1</p> <p>Remedy: Clamp the pallet in the maintenance mode.</p>
A233	<p>Message: OPERATOR DOOR IS NOT CLOSED.</p> <p>Cause: Pallet changer cannot be operated, because operator door is not closed.</p> <p>Info: Operator door close status: Standard machine front door close status: Manual door: LS912=ON Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine operator door + front door must be close status: Operator door: LS912=ON and Front auto door: LS2312L=OFF; LS2312R=OFF; LS966=ON; SL1002=ON; SL1001=OFF; or Front manual door: LS966=ON;</p> <p>Remedy: Close the operator door.</p>
A234	<p>Message: FRONT DOOR IS NOT CLOSED.</p> <p>Cause: Pallet changer cannot be operated, because front door is open.</p> <p>Info: Operator door close status: Standard machine front door close status: Manual door: LS912=ON Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine operator door + front door must be close status: Operator door: LS912=ON and Front auto door: LS2312L=OFF; LS2312R=OFF; LS966=ON; SL1002=ON; SL1001=OFF; or Front manual door: LS966=ON;</p> <p>Remedy: Close the front door.</p>
A235	<p>Message: PALLET SEATING CHECK SW ERROR. LS112 WAS NOT TURNED OFF.</p> <p>Cause: Pallet seating check sensor does not turn OFF though the pallet changer is operated.</p> <p>Info: Pallet seating check sensor: LS112 must be OFF during pallet operation.</p> <p>Remedy: Check pallet seating check sensor and pneumatic circuit.</p>
A236	<p>Message: PALLET SEATING CHECK SWITCH (LS112) DOES NOT TURN ON IN SPECIFIED TIME.</p> <p>Cause: Pallet seating check sensor does not turn on though the pallet is clamped.</p> <p>Info: Pallet seating check sensor: LS112</p> <p>Remedy: Cutting chip etc. might have been caught between the pallet and the pallet cone. Clean the pallet and the pallet cone, and try again. If this message appears again, the adjustment of this sensor may be required.</p>

Alarm No.	Message / Cause / Information / Remedy
A237	<p>Message: BOTH LIMIT SWITCHES OF APC-ARM CW/CCW WERE TURNED ON AT THE SAME TIME.</p> <p>Cause: Two turn end switches of the pallet changer arm were turned on at the same time.</p> <p>Info: Error Condition: LS102, LS103 both are ON at the same time.</p> <p>Remedy: There may be a breakdown either of the arm end detection switch.</p>
A239	<p>Message: CNC WAS RESET WHEN M60 COMMAND WAS WAITING FOR COMPLETION.</p> <p>Cause: NC reset was pressed during APC.</p> <p>Remedy: Recover pallet in maintenance mode.</p>
A240	<p>Message: ATC DOOR NOT CLOSED OR ATC NOT IN STANDBY. PALLET CHANGE INHIBIT.</p> <p>Cause: Pallet change commanded with ATC not standby or ATC shutter not closed.</p> <p>Info: Feed axis must not be in ATC zone (Y-Axis machine position must be > -150.0) ATC shutter must be closed. (ATC magazine position should be 0 Degree)</p>
A241	<p>Message: TAP RETRACT POSSIBLE ONLY IN MDI MODE.</p> <p>Cause: Tap retract commanded other then in MDI mode.</p> <p>Remedy: Perform tap retract in MDI mode.</p>
A242	<p>Message: Z-AXIS NOT AT HOME POSITION. CANNOT REFERENCE X AND Y- AXIS.</p> <p>Info: Z-Axis home position signal PSW03=1;</p> <p>Remedy: Reference X and Y-Axis after confirming Z-Axis is at home position.</p>
A243	<p>Message: APC OPERATION INTERRUPTED. RECOVER APC STANDBY USING MAINTENANCE MODE.</p> <p>Cause: APC operation interrupted.</p> <p>Remedy: Recover APC to standby (ready condition) in maintenance mode.</p>
A244	<p>Message: APC OPERATION INTERRUPTED AS OPERATOR DOOR IS OPENED.</p> <p>Info: APC machine operator door + front door must be close status: Operator door: LS912=ON and Front auto door: LS2312L=OFF; LS2312R=OFF; LS966=ON; SL1002=ON; SL1001=OFF; or Front manual door: LS966=ON;</p> <p>Remedy: Recover APC to standby (ready condition) in maintenance mode.</p>
A245	<p>Message: APC OPERATION INTERRUPTED AS STOCKER LIGHT CURTAIN SENSOR IS OFF.</p> <p>Info: Light curtain sensor status: Not interrupted LS2315=1; Interrupted LS2315=0;</p> <p>Remedy: Recover APC to standby (ready condition) in maintenance mode.</p>
A246	<p>Message: ROTARY AXIS(A/B) NOT AT HOME POSITION, SO PALLET CHANGE IS IMPOSSIBLE.</p> <p>Cause: Pallet commanded with AB table not at home position.</p> <p>Info: AB table home position signal status. A-Axis home: PSW04=1; B-Axis home:PSW05=1;</p> <p>Remedy: Before pallet operation confirm AB table is at home position.</p>
A247	<p>Message: STOCKER DOOR NOT CLOSED OR LIGHT CURTAIN IS OFF. PALLET READY INHIBIT.</p> <p>Cause: M69 or pallet ready button commanded with safety door not closed.</p> <p>Info: Safety door close status: operator door LS912=1 + front door LS966=1 or light curtain LS2315=1.</p> <p>Remedy: Confirm door close before commanding M69 or Pallet ready button.</p>

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Alarm No.	Message / Cause / Information / Remedy
A249	<p>Message: B-AXIS ROTATION CONDITION IS LOST (L154/PS2604).</p> <p>Cause: B-Axis lost unclamping condition during movement.</p> <p>Info: Unclamping mechanism signal status - SL151=1; L153=0; L154=1;</p> <p>Remedy: Confirm poor adjustment or failure of pressure switch. Or failure of table clamping mechanism.</p>
A250	<p>Message: B-AXIS CLAMPING IS NOT COMPLETED WITHIN TIME.</p> <p>Info: B-Axis clamp status SL151=0; L153=1; L154=0;</p> <p>Remedy: Confirm poor adjustment or failure of pressure switch. Or failure of table clamping mechanism.</p>
A251	<p>Message: B-AXIS IS NOT UNCLAMPED. USE M13 TO UNCLAMP.</p> <p>Cause: B-Axis table movement commanded without table unclamp condition.</p> <p>Remedy: Unclamp table by M13 before movement command.</p>
A252	<p>Message: B-AXIS UNCLAMPING IS NOT COMPLETED WITHIN TIME.</p> <p>Cause: B-Axis unclamping not completed within specified time (5sec).</p> <p>Info: Unclamping mechanism signal status - SL151=1; L153=0; L154=1;</p> <p>Remedy: Confirm poor adjustment or failure of pressure switch. Or failure of table clamping mechanism.</p>
A253	<p>Message: B-AXIS INTERLOCK BY FIXTURE.CLAMP FIXTURE TO ROTATE B-AXIS.</p> <p>Cause: B-Axis rotation interlocked by fixture status.</p> <p>Remedy: Clamp fixture before rotating B-Axis table.</p>
A254	<p>Message: B-AXIS INTERLOCK BY Z-AXIS POSITION. MOVE Z-AXIS TO HOME POSITION.</p> <p>Cause: B-Axis table rotation commanded without Z-Axis in safe position.</p> <p>Remedy: Move Z-Axis to home before rotating B-Axis.</p>
A256	<p>Message: B-AXIS ON STOCKER SIDE, CANNOT COMMAND ROTATION.</p> <p>Cause: On APC machine, stocker side table rotation was commanded. Stocker side table rotation not possible.</p>
A257	<p>Message: LUCC OVERLOAD (LS1306) OR CONVEYOR MOTOR THERMAL TRIP (TH6).</p> <p>Cause: LUCC motor thermal tripped.</p> <p>Info: LUCC motor thermal TH6 must be '0'.</p> <p>Remedy: Remove the cause of the trip and reset the thermal switch.</p>
A258	<p>Message: LIFT-UP CHIP CONVEYER OVERLOAD.CHECK LIMIT SWITCH "LS1306" ON LUCC.REMOVE OVERLOAD BY USING MANUAL MODE.</p> <p>Cause: Lift-up chip conveyor overloaded.</p> <p>Info: LUCC overload check limit switch LS1306 must be '1',</p> <p>Remedy: Remove the overload by moving conveyor in reverse direction in manual mode and reset the alarm.</p>
A259	<p>Message: PART IS NOT CLAMPED, SO SPINDLE CAN NOT BE STARTED.</p> <p>Cause: Spindle started without fixture clamp.</p> <p>Remedy: Clamp fixture before spindle start.</p>
A260	<p>Message: LIFT-UP CHIP CONVEYER MOTOR THERMAL TRIP.RESET TH6 IN LUCC CONTROL BOX.</p> <p>Cause: LUCC motor thermal tripped.</p> <p>Info: LUCC motor thermal TH6 must be '0'.</p> <p>Remedy: Remove the cause of the trip and reset the thermal switch.</p>

Alarm No.	Message / Cause / Information / Remedy
A263	<p>Message: CLOGGING OF FILTER FOR THROUGH SPINDLE COOLANT WAS DETECTED. (LS190 IS ON).</p> <p>Cause: Through Spindle Coolant filter clogged.</p> <p>Info: LS190 must be '0'.</p> <p>Remedy: Remove abnormality and check LS190 must be '0'.</p>
A264	<p>Message: NOZZLE COOLANT FLOW SWITCH (LS181) DOES NOT TURN OFF IN SPECIFIED TIME THOUGH COOLANT HAS STOPPED.</p> <p>Cause: Nozzle coolant flow switch does not turn off within specified time.</p>
A265	<p>Message: NOZZLE COOLANT FLOW SWITCH (LS181) HAS DETECTED LOW FLOW.</p> <p>Cause: Nozzle coolant flow switch has low flow.</p> <p>Remedy: Check the nozzle coolant flow.</p>
A266	<p>Message: LEVEL OF CLEAN COOLANT TANK IS LOW. (LS196 IS OFF).</p> <p>Cause: Clean coolant tank (Secondary tank) is low.</p> <p>Info: With coolant not low LS196 must be '1'.</p> <p>Remedy: Check coolant level.</p>
A268	<p>Message: ROTARY JOINT FOR THROUGH SPINDLE COOLANT HAS WORN OUT. (LS1340 IS OFF).</p> <p>Cause: The rotary joint of the Through Spindle Coolant wears out. LS1340 is being off longer than 3 seconds.</p> <p>Info: Wear detection of rotary joint healthy condition LS1340 must be '1'</p> <p>Remedy: Replace rotary joint.</p>
A269	<p>Message: LEVEL OF PRIMARY COOLANT TANK IS LOW. (LS1319 IS OFF).</p> <p>Cause: Primary coolant tank level is low.</p> <p>Info: With coolant level not low LS1319 must be '1'</p> <p>Remedy: Check coolant level.</p>
A270	<p>Message: OPERATOR DOOR IS NOT CLOSED.</p> <p>Cause: Coolant ON was commanded with door open.</p> <p>Info: Standard machine front door close status: Manual door: LS912=ON Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine operator door close status: LS912=ON</p> <p>Remedy: Close operator door.</p>
A271	<p>Message: THROUGH SPINDLE COOLANT FLOW SWITCH (LS195) DOES NOT TURN OFF IN SPECIFIED TIME THOUGH COOLANT HAS STOPPED.</p> <p>Cause: Flow switch of the Through Spindle Coolant does not turn OFF longer than 10 seconds though the pump has stopped. LS193 does not turn OFF.</p> <p>Info: Flow switch signal LS195 must be '0' when TSC is OFF.</p> <p>Remedy: Check malfunction of flow switch LS195.</p>
A272	<p>Message: TSC MOTOR OVERLOAD. THERMAL TRIP (TH19)</p> <p>Cause: TSC motor overloaded.</p> <p>Info: TSC motor thermal TH19 must be '0' when not overloaded.</p> <p>Remedy: Remove the abnormality and reset the thermal switch.</p>

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Alarm No.	Message / Cause / Information / Remedy
A273	<p>Message: THROUGH SPINDLE COOLANT FLOW SWITCH (LS195) HAS DETECTED LOW FLOW.</p> <p>Cause: Flow of the Through Spindle Coolant has dropped. LS195 has turned OFF longer than the time specified though the pump is operating.</p> <p>Info: Flow switch signal LS195 must be '1' when TSC is ON.</p> <p>Remedy: Check piping and pump if coolant does not come out. Check malfunction of flow switch LS195 if coolant comes out.</p>
A275	<p>Message: LEVEL OF PRIMARY COOLANT TANK IS HIGH (LS186 IS OFF)</p> <p>Cause: Primary tank level is high.</p> <p>Info: With coolant level not high LS186 must be '1'</p> <p>Remedy: Check coolant level.</p>
A277	<p>Message: LEVEL OF SECONDARY COOLANT TANK IS HIGH (LS197 IS OFF).</p> <p>Cause: Secondary coolant level is high.</p> <p>Info: With coolant level not high LS197 must be '1'</p> <p>Remedy: Check coolant level.</p>
A278	<p>Message: COOLANT TEMPERATURE CONTROLLER UNIT ALARM (CCHAL IS OFF).</p> <p>Cause: Coolant temperature controller alarm.</p> <p>Info: When not alarm CCHAL must be '1'.</p> <p>Remedy: Check coolant temperature controller unit.</p>
A279	<p>Message: OIL TANK OF SPINDLE COOLER UNIT IS LOW LEVEL (LS176 IS OFF).</p> <p>Cause: Oil tank of spindle cooler is low.</p> <p>Remedy: Check oil tank level of spindle cooler unit.</p>
A280	<p>Message: SPINDLE LUBRICATION OIL TEMPERATURE CONTROL IS ABNORMAL.</p> <p>Cause: Spindle lubrication oil temperature controller is abnormal.</p> <p>Info: When not abnormal OMTAL must be '1'.</p> <p>Remedy: Check spindle lubrication oil temperature controller.</p>
A281	<p>Message: AIR DRIER UNIT ALARM OR CP21 IS TRIPPED. (AIRAL IS ON).</p> <p>Cause: Air drier unit alarm.</p> <p>Info: When not alarm AIRAL must be '0'.</p> <p>Remedy: Check Air drier unit.</p>
A282	<p>Message: LOW PRESSURE OF SUPPLIED AIR HAS CONTINUED MORE THAN SPECIFIED TIME.(LS905 IS OFF)</p> <p>Cause: Main air pressure supply is low.</p> <p>Info: When not low pressure LS905 must be '1'.</p> <p>Remedy: Check air pressure source.</p>
A283	<p>Message: EITHER OF CIRCUIT BREAKER CB2A/CB2B/CB2C HAS TRIPPED. CHECK POWER CIRCUIT.</p> <p>Cause: Circuit breaker has tripped.</p> <p>Info: When not tripped CB2 must be '1'.</p> <p>Remedy: Check power circuit. Check the reason for tripping and rectify.</p>
A284	<p>Message: EITHER OF CIRCUIT BREAKER CP4/CP41/CP5/CP51/CP52/CP53 HAS TRIPPED.CHECK CONTROL CIRCUIT.</p> <p>Cause: Thermal relay or fuse has tripped.</p> <p>Info: When not tripped CPTP must be '0'.</p> <p>Remedy: Check control circuit. Check the reason for tripping, rectify and turn ON the circuit protector.</p>

Alarm No.	Message / Cause / Information / Remedy
A285	<p>Message: SPINDLE LUBRICATION OIL FLOW SWITCH DOES NOT TURN ON THOUGH PUMP IS RUNNING. (LS170 SIGNAL IS OFF).</p> <p>Cause: Spindle lub oil flow switch not ON though pump is running.</p> <p>Info: When pump is running LS170 must be '1'</p> <p>Remedy: Check spindle lub oil flow and switch.</p>
A286	<p>Message: SPINDLE LUBRICATION OIL FLOW SWITCH DOES NOT TURN OFF THOUGH PUMP IS STOPPING. (LS170 SIGNAL IS ON).</p> <p>Cause: Spindle lub oil flow switch not OFF though pump is stopped.</p> <p>Info: When pump is stopped LS170 must be '0'</p> <p>Remedy: Check spindle lub oil flow and switch.</p>
A288	<p>Message: MAIN COOLANT PUMP MOTOR THERMAL RELAY HAS TRIPPED. (TH2=1).</p> <p>Cause: Main coolant pump motor thermal is tripped.</p> <p>Info: When not tripped TH2 must be '0'.</p> <p>Remedy: Remove the abnormality and reset TH2.</p>
A289	<p>Message: AUTOMATIC GREASE SUPPLY PUMP PRESSURE DOESN'T GO UP. (LS1698 = 0).</p> <p>Cause: Auto grease pressure does not go UP.</p> <p>Info: When pump is ON LS1698 must be '1'. Pump can be turned ON by M779 for checking purpose.</p> <p>Remedy: Check the pump unit and switch.</p>
A290	<p>Message: AUTOMATIC GREASE SUPPLY PUMP PRESSURE DOESN'T FALL. (LS1698 = 1).</p> <p>Cause: Auto grease pressure does not go fall.</p> <p>Info: When pump is OFF LS1698 must be '0'. Pump can be turned ON by M779 for checking purpose.</p> <p>Remedy: Check the pump unit and switch.</p>
A291	<p>Message: HYDRAULIC UNIT PRESSURE FAIL. LS969 DID NOT TURN ON WITHIN SPECIFIED TIME OF MS4 ON CHECK HYDRAULIC PIPING AND LS969 SETTING.</p> <p>Cause: Tool clamp/unclamp pump MS4 is ON but pressure not build up.</p> <p>Info: When pump MS4 is ON LS969 must be '1'.</p> <p>Remedy: Check the pump and switch.</p>
A293	<p>Message: HYDRAULIC POWER PACK MOTOR THERMAL RELAY HAS TRIPPED. (TH4=1).</p> <p>Cause: Hydraulic power pack thermal relay has tripped.</p> <p>Info: When thermal not tripped TH4 must be '0'.</p> <p>Remedy: Remove the abnormality and reset TH4.</p>
A294	<p>Message: TRANSFER COOLANT PUMP MOTOR THERMAL RELAY HAS TRIPPED. (TH71=1).</p> <p>Cause: Transfer coolant pump motor thermal has tripped.</p> <p>Info: When thermal not tripped TH71 must be '0'.</p> <p>Remedy: Remove the abnormality and reset TH71.</p>
A295	<p>Message: POWER SAVE MODE ON. PRESS ALARM RESET TO RELEASE.</p> <p>Cause: Power saving mode is effective.</p> <p>Remedy: Press [ALARM RESET] button to release power saving mode.</p>
A296	<p>Message: MIST COLLECTOR ALARM, THERMAL TRIP OR UNIT ALARM.</p> <p>Cause: Mist collector thermal has tripped.</p> <p>Info: When thermal not tripped TH300 must be '0'.</p> <p>Remedy: Remove the abnormality and reset TH300</p>

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Alarm No.	Message / Cause / Information / Remedy
A297	<p>Message: MAINTENANCE ALERT - XYZ AXIS REQUIRES GREASING. SET K26.0 = 1 TO RESET ALARM.</p> <p>Cause: Routine greasing request.</p> <p>Info: Routine greasing is very important. Never skip this process. Else it will damage the machine.</p> <p>Remedy: Perform greasing and after greasing complete reset alarm by setting K26.0=1 and press [ALARM RESET] button.</p>
A298	<p>Message: MAINTENANCE ALERT - SPINDLE COLLET REQUIRES GREASING. SET K26.0 = 1 TO RESET ALARM.</p> <p>Cause: Routine greasing request.</p> <p>Info: Routine greasing is very important. Never skip this process. Else it will damage the machine.</p> <p>Remedy: Perform greasing and after greasing complete reset alarm by setting K26.0=1 and press [ALARM RESET] button.</p>
A300	<p>Message: BTS DETECTED TOOL BREAKAGE.</p> <p>Cause: Broken tool detected during broken tool check process.</p> <p>Info: If broken tool detected LS2111 will be '0'.</p> <p>Remedy: Replace broken tool.</p>
A301	<p>Message: BTS DATA OUT OF RANGE.</p> <p>Cause: Tool length for BT check tool entered in Tool Data Screen is not within valid range.</p> <p>Remedy: Enter valid tool length range between 75.000mm to 250.000mm.</p>
A302	<p>Message: BTS LENGTH NOT ENTERED.</p> <p>Cause: Tool length for BT check tool entered in Tool Data Screen is not set (zero).</p> <p>Remedy: Enter valid tool length range between 75.000mm to 250.000mm.</p>
A303	<p>Message: BTS LIMIT SWITCH IS STICKY OR BROKEN. (SKIP=0)</p> <p>Cause: BTS limit switch is sticky or broken.</p> <p>Remedy: Check the condition or actuation condition of BTS limit switch. When the sensor is not actuated SKIP status must be 1.</p>
A304	<p>Message: BROKEN TOOL SENSOR OPTION IS NOT PROVIDED, SO M433 CAN NOT BE PERFORMED.CHECK PMC PARAMETER:K20.6.</p> <p>Cause: BTS option not selected. But BTS M-Code is commanded. Hence alarm.</p> <p>Remedy: Check selected option from OEM.</p>
A308	<p>Message: WORK COUNTER COUNT-UP/RESET ALARM. S-CODE MUST BE FROM 1 TO 8.</p> <p>Cause: The S-Code used with the command to increment or reset the work counter, M438/M439 is not within the proper counter number range.</p> <p>Remedy: Specify a counter number within the proper range. From S1 to S8 will be accepted.</p>
A309	<p>Message: AUTOMATIC WORKPIECE MEASURING ALARM: BATTERY ALARM.</p> <p>Cause: The battery voltage for the automatic workpiece-measuring probe is low. Battery alarm (MSALB) of the automatic workpiece-measuring has been turned ON.</p> <p>Info: Probe battery healthy then MSALB must be '0'.</p> <p>Remedy: Replace the battery.</p>
A310	<p>Message: AUTOMATIC WORKPIECE MEASURING ALARM: BATTERY ALARM.</p> <p>Cause: The battery voltage for the automatic workpiece-measuring probe is low. Battery alarm (MSALB) of the automatic workpiece-measuring has been turned ON.</p> <p>Info: Probe battery healthy then MSALB must be '0'.</p> <p>Remedy: Replace the battery.</p>

Alarm No.	Message / Cause / Information / Remedy
A311	<p>Message: AUTOMATIC WORKPIECE MEASURING ALARM: POWER STILL ON AFTER M911. Cause: The probe power is not OFF after the M911 (measuring head alarm check) command is sent. Reception alarm (*MSALA) of the automatic workpiece measuring is turned ON. Info: When probe is OFF *MSALA must be '0' Remedy: This may indicate a malfunction of the measuring probe. Check probe and related circuit.</p>
A312	<p>Message: EMERGENCY STOP ALARM OCCURRED DURING MEASURING MODE. Cause: An emergency stop was triggered during the M86 (automatic measuring rapid feed) mode. The measuring probe may have come into contact with an object during non measurement mode. Remedy: Carefully move the feed axis to retract the probe.</p>
A313	<p>Message: MEASURING PROBE POWER OFF DID NOT OCCUR IN THE SPECIFIED TIME. Cause: The probe power does not go OFF within the specified time (2sec) when the M963 (Turn OFF measuring probe power & confirm) command is sent. Remedy: This may indicate a malfunction of the measuring probe. Check probe and related circuit.</p>
A314	<p>Message: MEASURING PROBE POWER ON DID NOT OCCUR IN THE SPECIFIED TIME. Cause: The probe power does not go ON within the specified time(2sec) when the M964 (Turn ON measuring probe power & confirm) command is sent. Remedy: This may indicate a malfunction of the measuring probe. Check probe and related circuit.</p>
A315	<p>Message: ILLEGAL SPINDLE LOAD SETTING VALUE. CHECK S-CODE ARGUMENT OF M238. Cause: The spindle load level set by the S-Code is not within the range of 0 to 999 when the M238 (SL mode ON) command is specified. Remedy: Specify a load level with the proper range.</p>
A316	<p>Message: M927(FIRST USE TOOL CHECK) CUSTOM MACRO VARIABLE WRITE ERROR. Cause: An error occurred when writing to the macro variable for the M927 (first use check) command. Writing in the macro data is not complete.</p>
A317	<p>Message: SPINDLE LOAD EXCEEDED SPECIFIED LIMIT VALUE. Cause: The spindle load limit value set for the SL mode was exceeded. Remedy: Check for an abnormal workpiece shape, deviation of the workpiece position, tool problem or incorrect offset value setting.</p>
A318	<p>Message: M919 TOOL LIFE COUNTER COUNT-UP COMMAND ALARM. CHECK SPINDLE TOOL AND S-CODE VALUE. Cause: An error occurred during writing to the tool database by the M919 (increment tool life machining quantity counter) command. Check to see that the spindle tool number is correctly set and for a mistake in the S-Code specified in the same block as the M919 command. Remedy: There is a possibility that the tool data has failed in the update of the current value. Update data manually.</p>
A319	<p>Message: M34 COMMAND INTERNAL ERROR. Cause: An error occurred during writing to the tool database by the M34 (automatic workpiece measurement spare tool call) command. Remedy: Check to see that the spindle tool number is correctly set.</p>

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Alarm No.	Message / Cause / Information / Remedy
A320	<p>Message: ALL TOOLS IN SOME GROUP IS STATUS THAT CAN NOT BE USED. Cause: All tools in the group cannot use due to some alarms. Remedy: Replace tool that has tool alarm.</p>
A321	<p>Message: C-EXE WINDOW ERROR OCCURS WHEN SET INHIBIT STATUS BY SPINDLE LOAD ALARM. Cause: When writing in the macro variable in the window function, the error was caused when the INHIB flag was set by the spindle load monitor (SL monitor). Remedy: Set the prohibition tool from the Tool Data Screen manually when the tool in the spindle is returned to the magazine.</p>
A322	<p>Message: FRONT DOOR DOES NOT CLOSE IN SPECIFIED TIME(10SEC). Cause: Front door did not close within the time. (10sec) Info: Front auto door close status: Standard machine: Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine: Front auto door: LS2312L=OFF; LS2312R=OFF; LS966=ON; SL1002=ON; SL1001=OFF; or Front manual door: LS966=ON; Remedy: Check limit switches, solenoid valve and mechanism.</p>
A324	<p>Message: FRONT DOOR DOES NOT OPEN IN SPECIFIED TIME(10SEC). Cause: Front door did not open within the time.(10sec) Info: Front auto door open status: Standard machine: Auto single door: SL1001=ON; SL1002=OFF; LS2311=OFF; LS2312=ON; Auto double door: SL1001=ON; SL1002=OFF; LS2311=ON; LS2312=ON; LS912=OFF; APC machine: Front auto door: LS2312L=ON; LS2312R=ON; LS966=OFF; SL1002=OFF; SL1001=ON; Remedy: Check limit switches, solenoid valve and mechanism.</p>
A325	<p>Message: SAFETY LIGHT CURTAIN WAS INTERRUPTED. Cause: Safety light curtain is being interrupted, so front door cannot be opened. While opening and closing the front door: LS2315=0. Info: When light curtain is not interrupted LS2315 signal must be '1'. Remedy: Remove an obstacle. Check safety light curtain.</p>
A326	<p>Message: CANNOT OPEN THE DOOR WHEN MACHINING. Cause: Machine is not stopped, so front door cannot be opened. Remedy: Stop the machine or wait for the stop and then command.</p>

Alarm No.	Message / Cause / Information / Remedy
A327	<p>Message: LIMIT SWITCH STATUS IS ABNORMAL [FRONT DOOR CONDITION]. Cause: Limit switches at both ends of front door are ON (The close end and the open end were turned ON at the same time.) Info: Front door healthy status: OPEN: Standard machine: Auto single door: SL1001=ON; SL1002=OFF; LS2311=OFF; LS2312=ON; Auto double door: SL1001=ON; SL1002=OFF; LS2311=ON; LS2312=ON; LS912=OFF; APC machine: Front auto door: LS2312L=ON; LS2312R=ON; LS966=OFF; SL1002=OFF; SL1001=ON; CLOSE: Standard machine: Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine: Front auto door: LS2312L=OFF; LS2312R=OFF; LS966=ON; SL1002=ON; SL1001=OFF; or Front manual door: LS966=ON; Remedy: Check limit switches.</p>
A328	<p>Message: OPERATOR DOOR NOT CLOSED. Cause: Tried to operate the machine without door close. Remedy: Confirm door close before executing any command.</p>
A329	<p>Message: PAPER BAND FILTER UNIT NOT READY. Cause: Paper band filter unit is clogged or alarm status. Info: Paper band unit healthy then LS190 must be '1'. Remedy: Check paper band filter unit, take remedial action and reset alarm.</p>
A330	<p>Message: PAPER BAND FILTER - PAPER EMPTY. Cause: Paper band filter paper is empty. LS197 is ON. Info: Paper not empty then LS197 must be '0'. Remedy: Check paper and switch LS197.</p>
A331	<p>Message: TOOL CLAMP HYDRAULIC POWER PACK OIL LEVEL IS LOW (LS1639 = 0). Cause: Tool clamp hydraulic power pack oil level is low. Info: Oil level OK then LS1639 must be '1'. Remedy: Fill oil and check LS1639.</p>
A332	<p>Message: TOOL CLAMP HYDRAULIC POWER PACK TEMPERATURE IS HIGH (LS1678 = 0). Cause: Tool clamp hydraulic power pack temperature is high. Info: When temperature is normal LS1678 must be '1'. Remedy: Check actual temperature and switch LS1678.</p>
A333	<p>Message: COOLANT INLINE FILTER CLOG - ALARM. SWITCH HANDLE TO CLEAN FILTER SIDE. Cause: Coolant inline filter is clogged. Info: When not clogged LS190 must be '1'. Remedy: Check filter and switch LS190.</p>
A334	<p>Message: OIL SKIMMER MOTOR OVERLOAD. THERMAL TRIP (TH18). Cause: Thermal relay has tripped. Remedy: Check the reason for tripping, rectify and turn ON the circuit protector.</p>

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Alarm No.	Message / Cause / Information / Remedy
A335	Message: SPINDLE TOOL IS NOT TSC TOOL. CHECK TOOL AND TOOL DATA SETTING Cause: Spindle tool is not TSC tool. Remedy: Confirm the tool data setting in tool data
A336	Message: TSC FILTER CLOG 100% ALARM. (TSCCG1 = 0) Cause: TSC filter is clogged. Remedy: Check filter and switch TSCCG1 must be 1
A337	Message: X-AXIS NOT AT HOME POSITION. CANNOT REFERENCE Y-AXIS. Cause: Tried to reference Y-Axis without referencing X-Axis. Remedy: First carry out X-Axis reference. Then Y-Axis.
A338	Message: PAPER BAND FILTER MOTOR THERMAL TRIP (THPF = 1) Cause: Paper band filter motor thermal tripped. Remedy: Remove the cause of the trip and reset the thermal switch. THPF must be 0.
A339	Message: TSC ROTARY JOINT LEAK DETECTED (LS1311) Cause: Leakage is detected at TSC rotary joint. Remedy: Check the root cause for leakage. LS1311 must be 0
A340	Message: INDEX TABLE A IN STOCKER SIDE. CANNOT INDEX Cause: Index table A is on stocker side and is inhibited to rotate. Remedy: Bring the Table A onto table side and command.
A341	Message: INDEX TABLE A CANNOT ROTATE AS FIXTURE IS NOT CLAMPED. Cause: Fixture is not clamped Remedy: Clamp the fixture to allow index table A to rotate
A342	Message: INDEX ANGLE COMMANDED IS INVALID. Cause: Index angle A commanded is out of range or is in incorrect format Remedy: Check the range or format of index angle
A343	Message: INDEX TABLE A INDEXING TIME OUT Cause: Indexing of table A could not complete within specified time Remedy: Check the connection or any abnormality in the unit
A344	Message: INDEX TABLE A NOT CLAMPED Cause: Index table A is not clamp. When there is no command table supposed to be clamped. Remedy: Correct the abnormality and confirm table is clamped when not indexing
A345	Message: INDEX TABLE A ENCODER DATA ERROR (PARITY/WIRE BREAK) Cause: Index table A encoder data error Remedy: Check encoder signals are wired as per circuit diagram and working
A346	Message: INDEX TABLE A MOTOR TH300 TRIPPED. Cause: Index table A motor thermal tripped. Remedy: Remove the cause of the trip and reset the thermal switch.
A347	Message: INDEX TABLE A MOTOR THERMAL TRIP. WAIT FOR MOTOR TO COOL. Cause: Index table A motor thermal tripped. Remedy: Check the reason for motor heat up. Wait for motor to cool and reset the thermal switch.
A348	Message: Z AXIS NOT AT HOME POSITION. INDEX TABLE ROTATION INHIBITED. Cause: Z axis is not in home position. Remedy: Move Z axis to home position.

Alarm No.	Message / Cause / Information / Remedy
A349	Message: OPERATOR DOOR NOT CLOSED. Cause: Index table A was commanded with operator door is open condition. Remedy: Close the operator door.
A350	Message: INDEX TABLE C IN STOCKER SIDE. CANNOT INDEX Cause: Index table C is on stocker side and is inhibited to rotate. Remedy: Bring the Table C onto table side and command.
A351	Message: INDEX TABLE C CANNOT ROTATE AS FIXTURE IS NOT CLAMPED. Cause: Fixture is not clamped. Remedy: Clamp the fixture to allow index table C to rotate.
A352	Message: INDEX ANGLE C COMMAND IS INVALID. Cause: Index angle C commanded is out of range or is in incorrect format. Remedy: Check the range or format of index angle.
A353	Message: INDEX TABLE C INDEXING TIME OUT Cause: Indexing of table C could not completed within specified time. Remedy: Check the connection or any abnormality in the unit.
A354	Message: INDEX TABLE C NOT CLAMPED Cause: Index table C is not clamp. When there is no command table supposed to be clamped. Remedy: Correct the abnormality and confirm table is clamped when not indexing.
A355	Message: INDEX TABLE C ENCODER DATA ERROR (PARITY/WIRE BREAK) Cause: Index table C encoder data error. Remedy: Check encoder signals are wired as per circuit diagram and working.
A356	Message: INDEX TABLE C MOTOR TH301 TRIPPED. Cause: Index table C motor thermal tripped. Remedy: Remove the cause of the trip and reset the thermal switch.
A357	Message: INDEX TABLE C MOTOR THERMAL TRIP. WAIT FOR MOTOR TO COOL. Cause: Index table C motor thermal tripped. Remedy: Check the reason for motor heat up. Wait for motor to cool and reset the thermal switch.
A358	Message: Z AXIS NOT AT HOME POSITION. CANNOT INDEX TABLE. Cause: Z axis is not in home position. Remedy: Move Z axis to home position.
A359	Message: OPERATOR DOOR NOT CLOSED. Cause: Index table C was commanded with operator door is open condition. Remedy: Close the operator door.
A360	Message: INTERRUPTION HAPPEN DURING TAP CYCLE. RECOVER BY TAP RETRACT FUNCTION IN MDI MODE. Cause: Interruption happen during tap cycle. Remedy: Press Tap Retract button in MDI mode for tap tool to retract out of the work piece.
A361	Message: SPINDLE SPEED EXCEEDS LIMIT BY TOOL DATA. Cause: The spindle speed has exceeded the limitation set in tool data. Remedy: Confirm the spindle speed limit set in tool data.

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Alarm No.	Message / Cause / Information / Remedy
A364	<p>Message: M56 IS NOT AVAILABLE Cause: Related parameter not set. Hence not possible to use M56. Info: It is possible to use M56, When a set value of parameter D0008 is '2'. When a setting value of D0008 is '2', the method to transfer the amount of the tool offset of the tool data is done with M56. Remedy: Set D0008=2 or command by M293.</p>
A365	<p>Message: SPINDLE TOOL NUMBER IS ZERO Remedy: Set the spindle tool number in the ATC Maintenance Screen.</p>
A366	<p>Message: SPINDLE LOAD MONITORING ALARM (UNDER) Cause: The spindle load value was lower than M454 S-Code value. It had continued more than the parameter [D0106] setting time. Remedy: Check the spindle tool and the workpiece.</p>
A367	<p>Message: TOOL DATA PROCESS ERROR. Cause: The error was caused in the internal processing of the tool data. Remedy: Check the tool data and spindle tool number.</p>
A368	<p>Message: WINDOW READ/WRITE ERROR. Cause: The error is caused in PMC software window function processing. Remedy: Push the alarm reset button.</p>
A369	<p>Message: TOOL OFFSET NUMBER IS ZERO. Cause: Tool length and tool radius offset numbers are zero. Remedy: Check the tool data.</p>
A370	<p>Message: A-RWH ROTATE BY PMC AXIS MOTION TIME OUT Cause: A-RWH by PMC axis does not complete rotation within specified time. Remedy: A-RWH is driven by PMC axis control during stocker side indexing or multi face part set up or during ATC / RWH parallel function. Check if any other alarm exist during this alarm. Correct it and retry.</p>
A371	<p>Message: A-RWH AXIS COMMAND BY PMC AXIS OUT OF RANGE ERROR Cause: A-RWH axis command by PMC axis is out of range. Remedy: Check the commanded range for A-RWH axis.</p>
A373	<p>Message: C-RWH ROTATE BY PMC AXIS MOTION TIME OUT Cause: C-RWH by PMC axis does not complete rotation within specified time. Remedy: C-RWH is driven by PMC axis control during stocker side indexing or multi face part set up or during ATC / RWH parallel function. Check if any other alarm exist during this alarm. Correct it and retry.</p>
A374	<p>Message: C-RWH AXIS COMMAND BY PMC AXIS OUT OF RANGE ERROR Cause: C-RWH axis command by PMC axis is out of range. Remedy: Check the commanded range for C-RWH axis.</p>
A376	<p>Message: STOCKER SIDE AUTO INDEX TABLE OPERATION TIMEOUT Cause: Stocker side auto index table operation cannot be completed within the specified time. Remedy: Check if any other alarm exist along with this alarm. Rectify it and retry.</p>
A377	<p>Message: WORK SETUP INHIBIT BY STOCKER INDEXER JOB BUSY Cause: Work setup start was triggered when stocker indexing in progress. Remedy: Wait until stocker indexing is complete before work setup start.</p>
A379	<p>Message: SERVO PC MOTION TIME OUT. Cause: Servo PC motion cannot complete within the specified time. Remedy: Check if any other alarm exist along with this alarm. Rectify and retry.</p>

Alarm No.	Message / Cause / Information / Remedy																																																							
A380	<p>Message: SERVO PC INERTIA EST. OUT OF RANGE ERROR. Cause: During Servo PC teaching operation Estimated Inertia was out of range. Remedy: Check if the load on pallet exceeds the recommended maximum load or else report to MAKINO.</p>																																																							
A382	<p>Message: SERVO PC INERTIA EST. OUT OF RANGE ERROR. Cause: During Servo PC teaching operation Estimated Inertia was out of range. Remedy: Check if the load on pallet exceeds the recommended maximum load or else report to MAKINO.</p>																																																							
A383	<p>Message: CANNOT CLAMP/UNCLAMP FIXTURE DURING MACHINING. Cause: Tried fixture clamp/unclamp operation, when machine is busy (machining or cycle running state). Remedy: Try fixture clamp/unclamp after machining complete or by stopping machine.</p>																																																							
A386	<p>Message: PART SEAT SENSOR DID NOT TURN ON, CHECK FOR COMPONENT SEATING. Cause: Seat check did not turn ON. Info: Number of seat check signals varies for each machine depending on fixture configuration and OEM option. Related seat check signals are LS1781 to LS1792. Remedy: Clean workpiece rest pad and check seat check signal.</p>																																																							
A387	<p>Message: PART SEAT SENSOR DID NOT TURN OFF, SINCE LAST TIME. CHECK FOR BLOCKAGES. Cause: Possibility is machined part was not unloaded and tried to cycle start again. This is to prevent refashioning. Or Though machined part was unloaded the seat check sensor did not turn OFF. Check whether seat check is blocked. Info: Number of seat check signals varies for each machine depending on fixture configuration and OEM option. Related seat check signals are LS1781 to LS1792. Remedy: After machining complete unload the machined part and check seat sensor is OFF.</p>																																																							
A388	<p>Message: FIXTURE STACK 1 CLAMP/UNCLAMP OPERATION TIMEOUT [SL2601/SL2602 PS2601/PS2602] Cause: Fixture stack 1 clamps / unclamp operation timeout. Info: Fixture stack 1 operation status:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Operation</th> <th colspan="2" style="text-align: center;">Solenoid type (D401=0; Hydac type)</th> <th colspan="2" style="text-align: center;">Solenoid type (D401=1; Standard)</th> <th colspan="2" style="text-align: center;">Solenoid type (D401=2; Reverse)</th> <th colspan="2" style="text-align: center;">Pressure switch type D406=0 (Clamp side only)</th> <th colspan="2" style="text-align: center;">Pressure switch type D406=1 (Clamp & Unclamp side)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Actuator No</td> <td style="text-align: center;">SL2601</td> <td style="text-align: center;">SL2602</td> <td style="text-align: center;">SL2601</td> <td style="text-align: center;">SL2602</td> <td style="text-align: center;">SL2601</td> <td style="text-align: center;">SL2602</td> <td style="text-align: center;">PS2601</td> <td style="text-align: center;">PS2602</td> <td style="text-align: center;">PS2601</td> <td style="text-align: center;">PS2602</td> </tr> <tr> <td style="text-align: center;">Clamp</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;">Unclamp</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">Neutral</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Remedy: Check for any leakage. Also confirm solenoid and pressure switch status.</p>	Operation	Solenoid type (D401=0; Hydac type)		Solenoid type (D401=1; Standard)		Solenoid type (D401=2; Reverse)		Pressure switch type D406=0 (Clamp side only)		Pressure switch type D406=1 (Clamp & Unclamp side)		Actuator No	SL2601	SL2602	SL2601	SL2602	SL2601	SL2602	PS2601	PS2602	PS2601	PS2602	Clamp	0	0	1	0	0	1	1	NA	1	0	Unclamp	1	1	0	1	1	0	0	NA	0	1	Neutral	1	0	0	0	0	0	0	NA	0	0
Operation	Solenoid type (D401=0; Hydac type)		Solenoid type (D401=1; Standard)		Solenoid type (D401=2; Reverse)		Pressure switch type D406=0 (Clamp side only)		Pressure switch type D406=1 (Clamp & Unclamp side)																																															
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Clamp	0	0	1	0	0	1	1	NA	1	0																																														
Unclamp	1	1	0	1	1	0	0	NA	0	1																																														
Neutral	1	0	0	0	0	0	0	NA	0	0																																														

Chapter 5 Troubleshooting

Alarm No.	Message / Cause / Information / Remedy
A389	<p>Message: OPERATOR DOOR NOT CLOSED OR LIGHT CURTAIN IS OFF.FIXTURE OPERATION INHIBIT</p> <p>Cause: Fixture operated without door close.</p> <p>Info: Door close status.</p> <p>Standard machine: Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine: Front auto door: LS2312L=OFF; LS2312R=OFF; LS966=ON; SL1002=ON; SL1001=OFF; or Front manual door: LS966=ON;</p> <p>Remedy: Close the door.</p>
A390	<p>Message: FIXTURE CLAMP/UNCLAMP PRESSURE SWITCH ALARM.BOTH THE SWITCHES ARE ON.(PS2601/PS2602) OR (PS2603/PS2604) OR (PS2605/PS2606) OR (PS2607/PS2608)</p> <p>Cause: Fixture pressure clamp side and unclamp side both switches are ON simultaneously. This may indicate pressure switch faulty.</p> <p>Info: Related pressure switches (PS2601/PS2602) or (PS2603/PS2604) or (PS2605/PS2606) or (PS2607/PS2608).</p> <p>Example: Stack 1 pressure switches PS2601 and PS2602 should not switch ON at the same time.</p> <p>Remedy: Check pressure switches.</p>
A391	<p>Message: FIXTURE CLAMP SIGNAL MISSING OR FIXTURE UNCLAMPED DURING AUTO CYCLE AND SPINDLE RUNNING.</p> <p>Cause: During machining fixture pressure drop.</p> <p>Info: Actual fixture stack configuration varies between machines. Related solenoid (SL2601 to SL2608); pressure switch (PS2601 to PS2608).</p> <p>Remedy: Check for leakage; accumulator functioning; solenoid functioning and pressure switch setting range.</p>
A392	<p>Message: FIXTURE POWER PACK MOTOR THERMAL RELAY HAS TRIPPED.(TH260=1).</p> <p>Cause: Fixture power pack is overloaded.</p> <p>Info: When power pack is not overloaded TH260 must be '0'.</p> <p>Remedy: Confirm reason for overload, rectify and reset the alarm.</p>
A393	<p>Message: FIXTURE POWER PACK OIL LEVEL IS LOW(LS2603).</p> <p>Cause: Fixture power pack oil level is low.</p> <p>Info: When power pack oil level is not low level then LS2603 must be '0'.</p> <p>Remedy: Fill oil and check LS2603.</p>
A394	<p>Message: FIXTURE POWER PACK OIL TEMPERATURE IS HIGH(LS2604).</p> <p>Cause: Fixture power pack oil temperature is high.</p> <p>Info: When power pack oil temperature is OK then LS2604 must be '1'.</p> <p>Remedy: Check oil temperature and check LS260.</p>
A395	<p>Message: FIXTURE POWER PACK SYSTEM PRESSURE FAIL. CHECK FOR LEAKAGES.</p> <p>Cause: Fixture power pack is ON for more than 15sec.</p> <p>Info: Fixture power pack motor MS260 is ON for more than 15sec, then this alarm happens. This is to protect the intermittent duty pump.</p> <p>Remedy: This may indicate leakages. Check whether pressure is building. Rectify the fault.</p>

Alarm No.	Message / Cause / Information / Remedy
A396	<p>Message: FIXTURE NOT CLAMPED. CYCLE START INHIBIT. Cause: Fixture not clamped or work seat not OK during cycle start. Info: Fixture clamp status lamp LHY1CL must light up. For fixture seating status, to check the lamp on the seat check sensor. Remedy: Confirm fixture clamp before cycle start.</p>
A397	<p>Message: ROTARY AXIS(A/B) NOT AT HOME POSITION. FIXTURE CANNOT UNCLAMP. Cause: Rotary table A/B not at home position. Info: AB table home position signal status. A-Axis home: PSW04=1; B-Axis home:PSW05=1; Remedy: Before fixture unclamp operation confirm AB table is at home position.</p>
A398	<p>Message: FIXTURE OPERATION INTERRUPTED AS OPERATOR DOOR WAS OPENED OR SAFETY LIGHT CURTAIN IS OFF. Cause: Door opened or safety light curtain interrupted. So fixture operation interrupted. Info: Standard machine front door close status: Manual door: LS912=ON Auto single door: SL1001=OFF; SL1002=ON; LS2311=ON; LS2312=OFF; Auto double door: SL1001=OFF; SL1002=ON; LS2311=OFF; LS2312=OFF; LS912=ON; APC machine operator door + front door must be close status: Operator door: LS912=ON and Front auto door: LS2312L=OFF; LS2312R=OFF; LS966=ON; SL1002=ON; SL1001=OFF; or Front manual door: LS966=ON; Light curtain when not interrupted LS2315 must be '1'. Remedy: Confirm door close.</p>
A399	<p>Message: MACHINE NOT IN MEMORY MODE. WORK SETUP INHIBIT. Cause: Cycle start attempted with mode switch not in memory mode. Remedy: Select memory mode before cycle start in auto.</p>
A400	<p>Message: CYCLE RUNNING IN PROGRESS OR ALARM CONDITION. WORK SETUP INHIBIT. Cause: Cycle running or machine in alarm condition. Auto cycle start inhibited. Remedy: If cycle is running wait until cycle is complete. If alarm condition press ALARM reset and NC reset before auto cycle start.</p>
A403	<p>Message: FIXTURE POWERPACK SWITCHES ON/OFF FREQUENTLY > 5TIMES/MIN.CHECK FOR LEAKAGE. Cause: Fixture power pack ON/OFF frequently. Info: Fixture power pack motor MS260 turn ON more than 5 times in 1 minute. Actual fixture stack configuration varies between machines. Related solenoid (SL2601 to SL2608); pressure switch (PS2601 to PS2608). Remedy: This may indicate leakage which lead to pressure drop and subsequent ON/OFF of pump frequently. Check accumulator functioning. Also check system pressure and pressure switch setting as per fixture requirements.</p>
A404	<p>Message: COMPONENT NOT PRESENT, AUTO CYCLE ABORT. [LS1881/LS1882/LS1883/LS1884] Cause: During work setup component not present so cannot clamp workpiece. Info: Component presence sensor related signals LS1881 to LS1884. Remedy: Check component selection D0518 parameter and component presence sensor LS1881 to LS1884.</p>

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Alarm No.	Message / Cause / Information / Remedy																																																																	
A408	Message: STOCKER PALLET NOT KNOWN, CANNOT CLAMP/UNCLAMP FIXTURE. Cause: Pallet not at home position (neither at CW or CCW) position. Info: Stocker side pallet signals: Pallet 1 on stocker side then SL101A=1; SL101B=0; LS102=1; LS103=0; Pallet 2 on stocker side then SL101A=0; SL101B=1; LS102=0; LS103=1; Remedy: Confirm pallet home position and signals.																																																																	
A409	Message: FIXTURE AIR SEAT SIGNAL MISSING DURING AUTO CYCLE RUNNING. Cause: Fixture air seat check signal missing during cycle running. Info: Related signals LS1781 to LS1792 (These differ for each machine). Related parameter D0516 (Pallet 1) and D0517 (Pallet 2). Remedy: Check seating signals.																																																																	
A411	Message: FIXTURE STACK 2 CLAMP/UNCLAMP OPERATION TIMEOUT [SL2603/SL2604 PS2603/PS2604] Cause: Fixture stack 2 clamps/unclamp operation time out. Info: Fixture stack 2 operation status: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Operation</th><th colspan="2">Solenoid type (D402=0, Hydac type)</th><th colspan="2">Solenoid type (D402=1, Standard)</th><th colspan="2">Solenoid type (D402=2, Reverse)</th><th colspan="2">Pressure switch type D407=0 (Clamp side only)</th><th colspan="2">Pressure switch type D407=1 (Clamp & Unclamp side)</th></tr> </thead> <tbody> <tr> <td>Actuator No</td><td>SL2603</td><td>SL2604</td><td>SL2603</td><td>SL2604</td><td>SL2603</td><td>SL2604</td><td>PS2603</td><td>PS2604</td><td>PS2603</td><td>PS2604</td></tr> <tr> <td>Clamp</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>NA</td><td>1</td><td>0</td></tr> <tr> <td>Unclamp</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>NA</td><td>0</td><td>1</td></tr> <tr> <td>Neutral</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>NA</td><td>0</td><td>0</td></tr> </tbody> </table> Remedy: Check for any leakage. Also confirm solenoid and pressure switch status.											Operation	Solenoid type (D402=0, Hydac type)		Solenoid type (D402=1, Standard)		Solenoid type (D402=2, Reverse)		Pressure switch type D407=0 (Clamp side only)		Pressure switch type D407=1 (Clamp & Unclamp side)		Actuator No	SL2603	SL2604	SL2603	SL2604	SL2603	SL2604	PS2603	PS2604	PS2603	PS2604	Clamp	0	0	1	0	0	1	1	NA	1	0	Unclamp	1	1	0	1	1	0	0	NA	0	1	Neutral	1	0	0	0	0	0	0	NA	0	0
Operation	Solenoid type (D402=0, Hydac type)		Solenoid type (D402=1, Standard)		Solenoid type (D402=2, Reverse)		Pressure switch type D407=0 (Clamp side only)		Pressure switch type D407=1 (Clamp & Unclamp side)																																																									
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Clamp	0	0	1	0	0	1	1	NA	1	0																																																								
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Neutral	1	0	0	0	0	0	0	NA	0	0																																																								
A412	Message: FIXTURE STACK 3 CLAMP/UNCLAMP OPERATION TIMEOUT [SL2605/SL2606 PS2605/PS2606] Cause: Fixture stack 3 clamp /unclamp operation time out. Info: Fixture stack 3 operation status: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Operation</th><th colspan="2">Solenoid type (D403=0, Hydac type)</th><th colspan="2">Solenoid type (D403=1, Standard)</th><th colspan="2">Solenoid type (D403=2, Reverse)</th><th colspan="2">Pressure switch type D408=0 (Clamp side only)</th><th colspan="2">Pressure switch type D408=1 (Clamp & Unclamp side)</th></tr> </thead> <tbody> <tr> <td>Actuator No</td><td>SL2605</td><td>SL2606</td><td>SL2605</td><td>SL2606</td><td>SL2606</td><td>SL2606</td><td>PS2605</td><td>PS2606</td><td>PS2605</td><td>PS2606</td></tr> <tr> <td>Clamp</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>NA</td><td>1</td><td>0</td></tr> <tr> <td>Unclamp</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>NA</td><td>0</td><td>1</td></tr> <tr> <td>Neutral</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>NA</td><td>0</td><td>0</td></tr> </tbody> </table> Remedy: Check for any leakage. Also confirm solenoid and pressure switch status.											Operation	Solenoid type (D403=0, Hydac type)		Solenoid type (D403=1, Standard)		Solenoid type (D403=2, Reverse)		Pressure switch type D408=0 (Clamp side only)		Pressure switch type D408=1 (Clamp & Unclamp side)		Actuator No	SL2605	SL2606	SL2605	SL2606	SL2606	SL2606	PS2605	PS2606	PS2605	PS2606	Clamp	0	0	1	0	0	1	1	NA	1	0	Unclamp	1	1	0	1	1	0	0	NA	0	1	Neutral	1	0	0	0	0	0	0	NA	0	0
Operation	Solenoid type (D403=0, Hydac type)		Solenoid type (D403=1, Standard)		Solenoid type (D403=2, Reverse)		Pressure switch type D408=0 (Clamp side only)		Pressure switch type D408=1 (Clamp & Unclamp side)																																																									
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Clamp	0	0	1	0	0	1	1	NA	1	0																																																								
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A413	<p>Message: FIXTURE STACK 4 CLAMP/UNCLAMP OPERATION TIMEOUT [SL2607/SL2608 PS2607/PS2608]</p> <p>Cause: Fixture stack 4 clamp/unclamp operation timeout.</p> <p>Info: Fixture stack 4 operation status:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Operation</th> <th colspan="2" style="text-align: center;">Solenoid type (D404=0, Hydral type)</th> <th colspan="2" style="text-align: center;">Solenoid type (D404=1, Standard)</th> <th colspan="2" style="text-align: center;">Solenoid type (D404=2, Reverse)</th> <th colspan="2" style="text-align: center;">Pressure switch type D409=0 (Clamp side only)</th> <th colspan="2" style="text-align: center;">Pressure switch type D409=1 (Clamp & Unclamp side)</th> </tr> </thead> <tbody> <tr> <td>Actuator No.</td> <td style="text-align: center;">SL2607</td> <td style="text-align: center;">SL2608</td> <td style="text-align: center;">SL2607</td> <td style="text-align: center;">SL2608</td> <td style="text-align: center;">SL2607</td> <td style="text-align: center;">SL2608</td> <td style="text-align: center;">PS2607</td> <td style="text-align: center;">PS2608</td> <td style="text-align: center;">PS2607</td> <td style="text-align: center;">PS2608</td> </tr> <tr> <td>Clamp</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Unclamp</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Neutral</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Remedy: Check for any leakage. Also confirm solenoid and pressure switch status.</p>												Operation	Solenoid type (D404=0, Hydral type)		Solenoid type (D404=1, Standard)		Solenoid type (D404=2, Reverse)		Pressure switch type D409=0 (Clamp side only)		Pressure switch type D409=1 (Clamp & Unclamp side)		Actuator No.	SL2607	SL2608	SL2607	SL2608	SL2607	SL2608	PS2607	PS2608	PS2607	PS2608	Clamp	0	0	1	0	0	1	1	NA	1	0	Unclamp	1	1	0	1	1	0	0	NA	0	1	Neutral	1	0	0	0	0	0	0	NA	0	0
Operation	Solenoid type (D404=0, Hydral type)		Solenoid type (D404=1, Standard)		Solenoid type (D404=2, Reverse)		Pressure switch type D409=0 (Clamp side only)		Pressure switch type D409=1 (Clamp & Unclamp side)																																																										
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Clamp	0	0	1	0	0	1	1	NA	1	0																																																									
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Neutral	1	0	0	0	0	0	0	NA	0	0																																																									
A415	<p>Message: FIXTURE NOT CLAMPED. PROGRAM RUN INHIBIT.</p> <p>Cause: Fixture clamp check by M525 before machining start time out.</p> <p>Actual fixture stack configuration varies between machines. Related solenoid (SL2601 to SL2608); pressure switch (PS2601 to PS2608).</p> <p>Remedy: Check for any leakage. Also confirm solenoid and pressure switch status.</p>																																																																		
A416	<p>Message: WORK SEAT NG. PROGRAM RUN INHIBIT.</p> <p>Cause: Fixture seat check no good when checked by M525 before machining start.</p> <p>Info: Related signals LS1781 to LS1792 (These differ for each machine). Related parameter D0516(Pallet 1) and D0517(Pallet 2).</p> <p>Remedy: Check seating signals.</p>																																																																		
A418	<p>Message: COMPONENT PRESENT, AUTO CYCLE ABORT. [LS1881/LS1882/LS1883/LS1884].</p> <p>Cause: During work setup component not present, so cannot clamp workpiece.</p> <p>Info: Component presence sensor related signals LS1881 to LS1884.</p> <p>Remedy: Check component selection D0518 parameter and component presence sensor LS1881 to LS1884.</p>																																																																		
A419	<p>Message: FIXTURE SEQUENCE SETTING ERROR. CANNOT COMMAND MACHINE SIDE FIXTURE SOLENOIDS.</p> <p>Cause: Fixture sequence setting error.</p> <p>Remedy: Check the setting for fixture sequence</p>																																																																		
A423	<p>Message: FIXTURE NOT CLAMPED. PALLET ROTATION INHIBITED</p> <p>Cause: Fixture is not clamped</p> <p>Remedy: Clamp the fixture before pallet rotation</p>																																																																		
A424	<p>Message: APC TIMEOVER. RESET CYCLE BY ALARM RESET BUTTON → PRESS EMERGENCY → PREPARE MACHINE READY → RECOVER</p> <p>Cause: APC does not complete within setting time</p> <p>Remedy: Check if any other alarm occurred during this alarm. Take corrective measures and recover. To recover Reset the cycle by ALARM RESET BUTTON → PRESS EMERGENCY → PREPARE MACHINE READY → RECOVER</p>																																																																		
A425	<p>Message: MANUAL MECHANICAL ITEM SEATING NG. PALLET CHANGE INHIBITED.</p> <p>Cause: Pallet change is inhibited as mechanical item seating is NG.</p> <p>Remedy: Put the mechanical item in position.</p>																																																																		

Chapter 5 Troubleshooting

Alarm No.	Message / Cause / Information / Remedy
A426	Message: FIXTURE HYD CHILLER ALARM(*OMAL3) Cause: Fixture Hydraulic experience alarm Remedy: Check the condition for fixture hydraulic chiller
A441	Message: COOLANT IS NOT OFF BEFORE PERFORMING ROBOT DOOR OPEN/CLOSE Cause: Coolant is not off when performing robot door open or close Remedy: Off the coolant
A442	Message: SPINDLE IS NOT STOPPED BEFORE PERFORMING ROBOT DOOR OPEN/CLOSE Cause: Spindle is not stopped before performing robot door open or close Remedy: Stop the spindle
A444	Message: SPLASHGUARD DOOR IS NOT CLOSED BEFORE PERFORMING ROBOT DOOR OPEN/CLOSE Cause: Splashguard door is not closed before performing robot door open or close Remedy: Close the splashguard door
A445	Message: ROBOT DOOR OPEN/CLOSE MOTION DID NOT COMPLETE IN SPECIFIED TIME Cause: Robot door open or close motion didn't complete in specified time Remedy: Check the signal of robot door open (LS131L) or close (LS912-2).
A446	Message: ROBOT DOOR IS NOT CLOSED. Cause: Robot door is opened Remedy: Close the robot door
A447	Message: ROBOT DOOR IS NOT IN CORRECT POSITION.PERFORM ROBOT DOOR OPEN/CLOSE USING M-CODE. Cause: Robot door is not in correct position. Remedy: Perform robot door open or close using M-code (M81 or M82) or by function screen operation
A449	Message: FIXTURE STACK 1 CLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3300.0 TO E3303.7 Cause: Fixture stack 1 clamp could not execute because of other fixture stack interlock condition set in fixture condition screen Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks
A450	Message: FIXTURE STACK 1 UNCLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3304.0 TO E3307.7 Cause: Fixture stack 1 unclamp could not execute because of other fixture stack interlock condition set in fixture condition screen Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks
A451	Message: FIXTURE STACK 1 NEUTRAL CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3308.0 TO E3311.7 Cause: Fixture stack 1 neutral could not execute because of other fixture stack interlock condition set in fixture condition screen Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks
A452	Message: FIXTURE STACK 2 CLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3312.0 TO E3315.7 Cause: Fixture stack 2 clamp could not execute because of other fixture stack interlock condition set in fixture condition screen Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks

Alarm No.	Message / Cause / Information / Remedy
A453	<p>Message: FIXTURE STACK 2 UNCLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3316.0 TO E3319.7</p> <p>Cause: Fixture stack 2 unclamp could not execute because of other fixture stack interlock condition set in fixture condition screen</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks</p>
A454	<p>Message: FIXTURE STACK 2 NEUTRAL CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3320.0 TO E3323.7</p> <p>Cause: Fixture stack 2 neutral could not execute because of other fixture stack interlock condition set in fixture condition screen</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks</p>
A455	<p>Message: FIXTURE STACK 3 CLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3324.0 TO E3327.7</p> <p>Cause: Fixture stack 3 clamp could not execute because of other fixture stack interlock condition set in fixture condition screen</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks</p>
A456	<p>Message: FIXTURE STACK 3 UNCLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3328.0 TO E3331.7</p> <p>Cause: Fixture stack 3 unclamp could not execute because of other fixture stack interlock condition set in fixture condition screen</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks</p>
A457	<p>Message: FIXTURE STACK 3 NEUTRAL CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3332.0 TO E3335.7</p> <p>Cause: Fixture stack 3 neutral could not execute because of other fixture stack interlock condition set in fixture condition screen</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks</p>
A458	<p>Message: FIXTURE STACK 4 CLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3336.0 TO E3339.7</p> <p>Cause: Fixture stack 4 clamp could not execute because of other fixture stack interlock condition set in fixture condition screen</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks</p>
A459	<p>Message: FIXTURE STACK 4 UNCLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3340.0 TO E3343.7</p> <p>Cause: Fixture stack 4 unclamp could not execute because of other fixture stack interlock condition set in fixture condition screen</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks</p>
A460	<p>Message: FIXTURE STACK 4 NEUTRAL CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3344.0 TO E3347.7</p> <p>Cause: Fixture stack 4 neutral could not execute because of other fixture stack interlock condition set in fixture condition screen</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks</p>

Chapter 5 Troubleshooting

Alarm No.	Message / Cause / Information / Remedy
A461	<p>Message: FIXTURE STACK 5 CLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3348.0 TO E3351.7</p> <p>Cause: Fixture stack 5 clamp could not execute because of other fixture stack interlock condition set in fixture condition screen.</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks.</p>
A462	<p>Message: FIXTURE STACK 5 UNCLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3352.0 TO E3355.7</p> <p>Cause: Fixture stack 5 unclamp could not execute because of other fixture stack interlock condition set in fixture condition screen.</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks.</p>
A463	<p>Message: FIXTURE STACK 5 NEUTRAL CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3356.0 TO E3359.7</p> <p>Cause: Fixture stack 5 neutral could not execute because of other fixture stack interlock condition set in fixture condition screen.</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks.</p>
A465	<p>Message: FIXTURE STACK 6 CLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3360.0 TO E3363.7</p> <p>Cause: Fixture stack 6 clamp could not execute because of other fixture stack interlock condition set in fixture condition screen.</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks.</p>
A466	<p>Message: FIXTURE STACK 6 NEUTRAL CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3368.0 TO E3371.7</p> <p>Cause: Fixture stack 6 neutral could not execute because of other fixture stack interlock condition set in fixture condition screen.</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks.</p>
A467	<p>Message: FIXTURE STACK 7 CLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3372.0 TO E3375.7</p> <p>Cause: Fixture stack 7 clamp could not execute because of other fixture stack interlock condition set in fixture condition screen.</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks.</p>
A468	<p>Message: FIXTURE STACK 7 UNCLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3376.0 TO E3379.7</p> <p>Cause: Fixture stack 7 unclamp could not execute because of other fixture stack interlock condition set in fixture condition screen.</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks.</p>
A469	<p>Message: FIXTURE STACK 7 NEUTRAL CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3380.0 TO E3383.7</p> <p>Cause: Fixture stack 7 neutral could not execute because of other fixture stack interlock condition set in fixture condition screen.</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks.</p>

Alarm No.	Message / Cause / Information / Remedy
A470	<p>Message: FIXTURE STACK 8 CLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3384.0 TO E3387.7</p> <p>Cause: Fixture stack 8 clamp could not execute because of other fixture stack interlock condition set in fixture condition screen.</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks.</p>
A471	<p>Message: FIXTURE STACK 8 UNCLAMP CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3388.0 TO E3391.7</p> <p>Cause: Fixture stack 8 unclamp could not execute because of other fixture stack interlock condition set in fixture condition screen.</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks.</p>
A472	<p>Message: FIXTURE STACK 8 NEUTRAL CONDITION ALARM. FOR DETIAL CHECK DIAGONISTIC BITS E3392.0 TO E3395.7</p> <p>Cause: Fixture stack 8 neutral could not execute because of other fixture stack interlock condition set in fixture condition screen.</p> <p>Remedy: Check interlock condition set in fixture condition screen and accordingly operate the individual stacks.</p>
A482	<p>Message: TOOL CLAMP CONDITIONS NOT SATISFIED CLAMP/UNCLAMP TOOL MANUALLY BEFORE TOOL CHANGE</p> <p>Cause: Last tool clamping process was not confirmed.</p> <p>Remedy: unclamp the tool in spindle and clamp the tool manually.</p>
A491	<p>Message: AUTO GREASE COUNT OVER</p> <p>Cause: The number of count to check auto grease shots was limit value. This means it is time to change new greasing cartridge.</p> <p>Remedy: Replace the new greasing cartridge and reset the greasing count to 0 in Makino custom greasing screen.</p>
A492	<p>Message: AUTO GREASE CATRIDGE LEVEL LOW. (LS2064)</p> <p>Cause: Auto Grease cartridge level is low.</p> <p>Remedy: Replace the grease cartridge.</p>
A496	<p>Message: SPINDLE MOTION HAS BEEN CANCELED BY MACHINE STOP.</p> <p>Cause: Spindle command is cancelled. The machine is stopped by some machine error.</p> <p>Remedy: Check for any machine alarm and rectify.</p>
A515	<p>Message: BAG FILTER CLOG ALARM [FLC].</p> <p>Cause: Bag filter is clogged. Signal [FLC] is ON (1).</p> <p>Remedy: Correct the error condition and check signal [FLC] must be OFF (0).</p>
A516	<p>Message: RETURN PUMP ABNORMAL ALARM [MR3].</p> <p>Cause: Return pump is abnormal status. Signal [MR3] is ON (1).</p> <p>Remedy: Correct the error condition and check signal [MR3] must be OFF (0).</p>
A545	<p>Message: SINGLE BOARD COMPUTER LOST CONNECTION</p> <p>Cause: Single board computer lost connection</p> <p>Remedy: Connect the single board computer or IP address setting or Ethernet cable between CNC embedded ethernet port and SBC RJ45 port.</p>
A546	<p>Message: DATA TRANSFER ERROR</p> <p>Cause: CT2 data transfer reads error.</p> <p>Remedy: Contact Makino service representative for assistance.</p>

Chapter 5 Troubleshooting

Alarm No.	Message / Cause / Information / Remedy
A547	<p>Message: SPINDLE BEARINGS DAMAGE DETECTED Cause: Spindle condition degrades quickly or some damages in the spindle bearings have been detected. Remedy: Check the spindle health history on the SAC screen. If the graph shows increasing trend or this alarm appears frequently, contact service engineers for spindle diagnosis.</p>
A548	<p>Message: EXCESSIVE SPINDLE VIBRATION Cause: Inappropriate or extremely aggressive cutting condition, Tool has been worn or tool seat failure. Work piece clamping problem. Remedy: Review the event history on SAC screen for more detail. Check tool and clamping conditions. Reduce cutting feed rate or change cutting condition to less aggressive.</p>
A549	<p>Message: EXCESSIVE SPINDLE UNBALANCE Cause: Current tool causes excessive unbalance force on spindle bearings. Remedy: Review the event history on SAC screen for more detail. Check tool balance condition. Check tool holder / tool / cutter conditions. Reduce spindle rotation if possible</p>
A550	<p>Message: SPINDLE/MC COLLISION DETECTED Cause: High impact detected on spindle. Remedy: Review the event history on SAC screen for more detail. Move spindle away from collided object and to a safe position. If alarm happens during non-cutting, check program and obstacle on the table. If alarm happens at tool entrance during cutting, it is required to reduce the cutting feed rate.</p>
A551	<p>Message: ABNORMAL TOOL VIBRATION Cause: Abnormal vibration as compared to learned cycles. Tool may has been worn or tool seat failure. Excessive variance in work piece geometry or material hardness. Remedy: Check tool, work piece and clamping conditions.</p>
A562	<p>Message: ATC SHUTTER NOT CLOSE Cause: ATC shutter is open Remedy: Close the ATC shutter at ATC maintenance screen.</p>
A563	<p>Message: BTS NOT HOME POSITION Cause: BTS is not in home position. Remedy: Move BTS to home position.</p>
A603	<p>Message: THE SERVO LOAD OF Y-AXIS REACHED TO THE ALARM-LEVEL WHEN THE AXIS HAD STOPPED. Cause: The load of Y-Axis reached at the alarm level during ATC. Remedy: Confirm Y-Axis load</p>
A694	<p>Message: A-AXIS LIMIT SWITCH STATUS IS ABNORMAL [L151, L152] Cause: A-Axis over travel limit switch L151, L152 both ON at same time. Remedy: Check L151, L152.</p>
W801	<p>Message: THE CNC BATTERY VOLTAGE IS LOW. PLEASE REPLACE THE BATTERY. Cause: Battery of CNC is low. Remedy: Replace the battery.</p>

Alarm No.	Message / Cause / Information / Remedy
W802	<p>Message: AWM BATTERY UNIT LOW (MSALB)</p> <p>Cause: This alarm is applicable for machine equipped with Auto Workpiece Measurement unit. AWM battery unit low is detected.</p> <p>Remedy: Replace the battery unit.</p>
W805	<p>Message: INDEX TABLE IS NOT CLAMPED.</p> <p>Cause: NC start operation has been commanded though index table is not clamped.</p> <p>Remedy: This is warning message to prevent the cutting with index table in unclamp condition.</p>
W807	<p>Message: PMC PROGRAMMER IS BEING ENABLED. RESTART PMC BEFORE RESETTING E-STOP OTHERWISE MACHINE WILL HAVE FATAL MALFUNCTION.</p> <p>Cause: Parameter K900 bit#1 or K902 bit#2 that is related to PMC (Ladder controller) operation is activated.</p> <p>Remedy: This is warning message for safety. Because fatal malfunction can occurs if PMC stops when machine is active.</p>
W808	<p>Message: SERVO PC NOT TEACHED.</p> <p>Cause: When Unexpected Disturbance Torque Detection NC alarm occurs during PC motion, the IAC Teached status is automatically reset and this warning message is generated.</p> <p>Remedy: Check if the load on pallet exceeds the recommended maximum load or else report to MAKINO.</p>
W810	<p>Message: MTC PANEL COOLER ALARM.</p> <p>Cause: MTC panel cooler alarm. MTCAL is '1'.</p> <p>Info: When MTC panel cooler has no alarm MTCAL must be '0'.</p>
W814	<p>Message: MANUAL MODE NOT SELECTED. MANUAL OPERATIONS INHIBITED.</p> <p>Cause: Auto mode selected.</p> <p>Remedy: Change to manual mode.</p>
W817	<p>Message: OPEN THE DOOR AND HOLD THE TOOL BEFORE UNCLAMPING TOOL.</p> <p>Cause: Warning that spindle tool may be dropped when attempting to perform the unclamp operation with the operator door closed.</p> <p>Info: When operator door is closed LS912 is '1'.</p> <p>Remedy: Open the operator door and hold spindle tool during manual tool unclamping.</p>
W818	<p>Message: SELECT HANDLE MODE WHEN UNCLAMPING TOOL.</p> <p>Cause: The spindle tool unclamping commanded when not in handle mode. The CNC mode is not handle mode.</p> <p>Remedy: Confirm CNC handle mode is selected and then command manual tool unclamp.</p>
W819	<p>Message: ORIENT SPINDLE BEFORE OPENING THE DOOR, TO ENABLE TOOL UNCLAMP</p> <p>Cause: Spindle not oriented. So cannot unclamp tool.</p> <p>Remedy: Spindle orient before tool unclamp command.</p>
W820	<p>Message: ORIENT SPINDLE BEFORE TOOL UNCLAMP.</p> <p>Cause: Spindle not oriented. So cannot unclamp tool.</p> <p>Remedy: Spindle orient before tool unclamp command.</p>
W822	<p>Message: Y-AXIS IS IN ATC ZONE.RECOVER Y-AXIS TO (-) DIRECTION BY SLOW JOG. (CONFIRM THE SPINDLE & MAGAZINE POSITION).</p> <p>Cause: This is a guidance message during manual ATC recovery.</p>

Chapter 5 Troubleshooting

Alarm No.	Message / Cause / Information / Remedy
W825	<p>Message: FEED OVERRIDE OR RAPID OVERRIDE SW IS 0 % DURING AUTO CYCLE START.</p> <p>Remedy: Set feed override or rapid override to be proper no-zero value.</p>
W826	<p>Message: SPINDLE ORIENT BY PUSH BUTTON POSSIBLE IN HANDLE MODE.</p> <p>Cause: This is a guidance message</p>
W830	<p>Message: THE SERVO LOAD OF Y-AXIS REACHED TO THE WARNING-LEVEL WHEN THE AXIS HAD STOPPED.</p> <p>Cause: The load of Y-Axis reached at the warning level during ATC.</p> <p>Remedy: Confirm Y-Axis load and any obstructions.</p>
W831	<p>Message: WAITING FOR LOADER TO UNLOAD THE PART</p> <p>Cause: This is a guidance message for loader.</p>
W832	<p>Message: WAITING FOR LOADER TO LOAD THE PART</p> <p>Cause: This is a guidance message for loader.</p>
W833	<p>Message: RESTART SPINDLE TO ENABLE CYCLE START.</p> <p>Cause: The cycle start is prohibited without turning ON the spindle after spindle was stopped by pressing spindle stop button in memory mode.</p> <p>Info: This function is effective when K0009 Bit 2 is '1'.</p> <p>Remedy: Press spindle start button.</p>
W834	<p>Message: CURRENTLY CHECKING SPINDLE BEARINGS</p> <p>Cause: Machine is performing regular bearing health check.</p> <p>Remedy: This message will disappear automatically after 10 second.</p>
W835	<p>Message: PLEASE CALIBRATE SPINDLE UNBALANCE</p> <p>Cause: Spindle unbalance has not been recorded.</p> <p>Remedy: Please load a small tool and run O8023 to register spindle unbalance.</p>
W836	<p>Message: TOOL UNBALANCE EXCEEDS LIMIT</p> <p>Cause: Current tool unbalance exceeds predefined limit.</p> <p>Remedy: Check the tool holder and inserts.</p>
W837	<p>Message: MACHINE IS LOCKED DUE TO ILLEGAL RESTART FROM MIDDLE OF PROGRAM. (RELEASE BY M160)</p> <p>Cause: This is a guidance message.</p>
W839	<p>Message: COOLANT MODE SELECTOR IS "OFF" POSITION.</p> <p>Cause: Automatic operation cannot be restarted because the mode switch of coolant is turned OFF.</p> <p>The mode switch of coolant is turned OFF at the restart operation in memory mode, return mode and automatic mode.</p> <p>Info: This function is effective when K0009 Bit 2 is '1'.</p> <p>Remedy: Press the cycle start button after changing the mode switch of coolant to ON or AUTO.</p>
W843	<p>Message: COOLANT INLINE FILTER CLOG - WARNING.</p> <p>Cause: Through Spindle Coolant inline filter is clogged. LS197 is '1'.</p> <p>Info: When inline filter is not clogged LS197 must be '0'.</p> <p>Remedy: Check filter and LS197 signal.</p>
W844	<p>Message: PART NOT CLAMPED. HOME AUTO ZERO INHIBITED.</p> <p>Cause: Part not clamped.</p> <p>Remedy: Clamp the part then do home auto zero.</p>
W845	<p>Message: TSC FILTER CLOG 75% (TSCCG2 = 1)</p> <p>Cause: Through spindle filter clogging was detected.</p> <p>Remedy: Change filter.</p>

Alarm No.	Message / Cause / Information / Remedy
W846	Message: DOOR NOT CLOSED. TABLE INDEXING INHIBITED. Remedy: Close the door.
W847	Message: PALLET NOT STAND BY. TABLE INDEXING INHIBITED. Remedy: Prepare pallet stand-by before commanding indexing table.
W851	Message: SEAT CHECK NOT GOOD. FIXTURE CLAMP OR CYCLE START INHIBITED. Remedy: Confirm seat check is OK before auto start or fixture clamp.
W855	Message: OPERATOR DOOR NOT CLOSED. MAGAZINE MOVEMENT INHIBIT. Remedy: Close the operator door.
W856	Message: AUTOMATIC OPERATION ACTIVE. MAGAZINE MOVEMENT INHIBIT. TRY AGAIN AFTER NC RESET. Remedy: Try magazine manual movements after cycle is reset or stopped.
W857	Message: LIFT-UP CHIP CONVEYOR IS MANUAL MODE. Cause: Lift-up chip conveyor is in manual mode. Remedy: Change conveyor mode to auto.
W859	Message: Y-AXIS NOT IN SAFE POSITION FOR MAGAZINE INDEX. KEEP Y-AXIS BETWEEN -400.0 TO +65.0 AND THEN TRY MAGAZINE MANUAL MOVEMENT. Remedy: This is a guidance message.
W860	Message: MANUAL MECHANICAL ITEM SEAT SENSORS NOT OFF BEFORE CYCLE START. Remedy: Turn off the manual mechanical item seat sensor then cycle start.
W861	Message: MANUAL MECHANICAL ITEM SEAT SENSORS NOT ON BEFORE 2ND TIME CYCLE START. Remedy: Turn ON the manual mechanical item seat sensor then 2 nd time cycle start.
W862	Message: OPERATOR DOOR NOT CLOSED DURING AUTO CYCLE START. Remedy: Close the operator door.
W864	Message: ATC/APC RECOVERY ACTIVE. CYCLE START INHIBITED. Remedy: Wait for ATC/APC recovery finish then cycle start.
W865	Message: MAINTENANCE MODE IS ACTIVE. Cause: Maintenance mode is active. Remedy: Turn OFF the maintenance mode after the maintenance operation finished.
W866	Message: WORK QUALITY COUNTER REACHED WARNING VALUE. Cause: Quality check counter has reached warning level. Remedy: Perform quality check and reset the counter.
W867	Message: WORK QUALITY COUNTER REACHED STOP VALUE. Cause: Quality check counter has reached alarm level. Remedy: Perform quality check and reset the counter.
W868	Message: CYCLE TIME MONITOR DETECTED CYCLE TIME EXCEEDING LIMIT VALUE. Remedy: Check the process or settings.

Chapter 5 Troubleshooting

Alarm No.	Message / Cause / Information / Remedy
W869	Message: SOME TOOL REACHED TOOL LIFE LIMIT VALUE. Cause: Some tool has reach tool life alarm. Remedy: Check Tool Data Screen for which tool has reach life alarm. Replace tool and reset the alarm.
W870	Message: LAST TOOL IN SOME GROUP REACHED TOOL LIFE WARNING VALUE. Cause: Tool for which uses sister tools (FTN function) has warning value indicating tools in the same group is going to attain tool life. Remedy: Prepare replacement tool ready and replace tools.
W871	Message: FIXTURE NOT UNCLAMPED. AUTO C.YCLE START INHIBITED. Remedy: Unclamp the fixture before auto start
W872	Message: DOOR DID NOT LOCK IN SPECIFIED TIME. Cause: In the machine with manual door with lock, if auto unlock function is used at M30 and with next auto start the door suppose to lock back and continue to process the work setup job. Possibly door was not closed before auto start Remedy: Close the door and start the auto cycle. If still this alarm appear check lock mechanism and connection.
W873	Message: DOOR UNLOCKED. PRESS ALARM RESET BUTTON TO LOCK BACK. Remedy: This is a guidance message.

1 Program Design Data (PS155)

- Spindle Characteristics
- Spindle Head Dimensions
- Machine Stroke Limits & Work Area

1.1 14K Spindle Characteristics

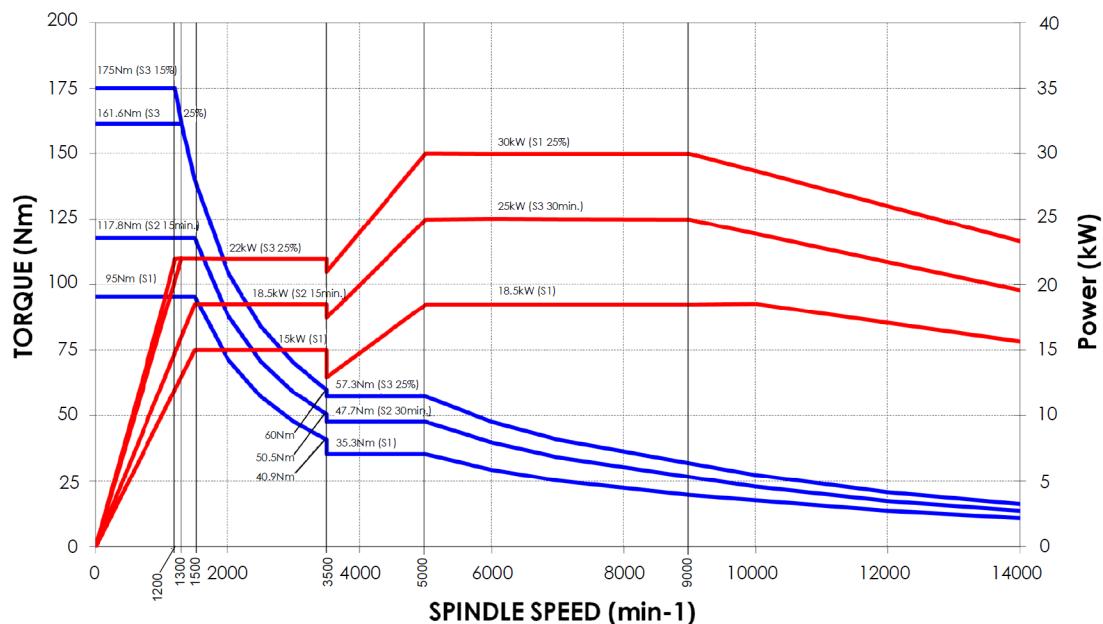


Figure 1.1 14K Spindle Power & Torque Characteristics

1.2 10K Spindle (Option) Characteristics

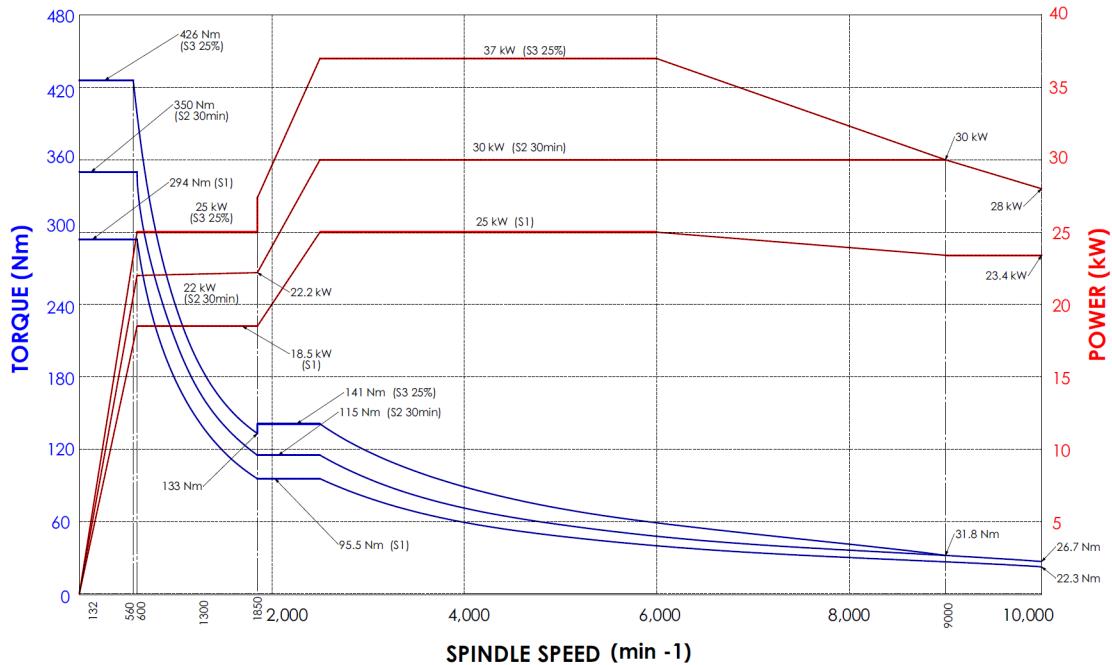


Figure 1.2 10K Spindle Power & Torque Characteristics

1.3 14K Spindle Head Dimensions

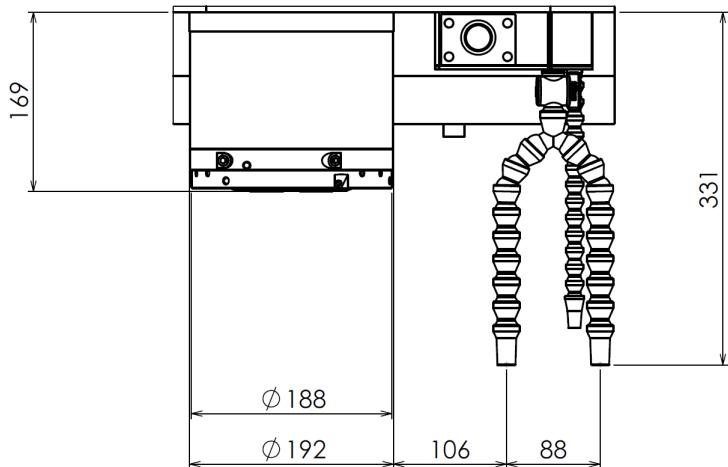


Figure 1.3 14K Spindle Head Dimensions

1.4 10K Spindle Head Dimensions

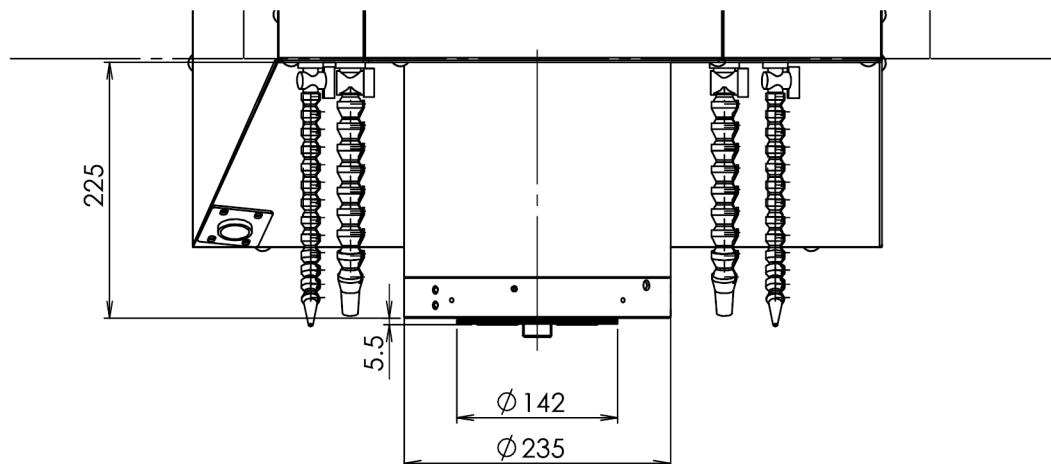


Figure 1.4 10K Spindle Head Dimensions

1.5 PS155 (SPD-14K) Machine Stroke Limits & Work Area

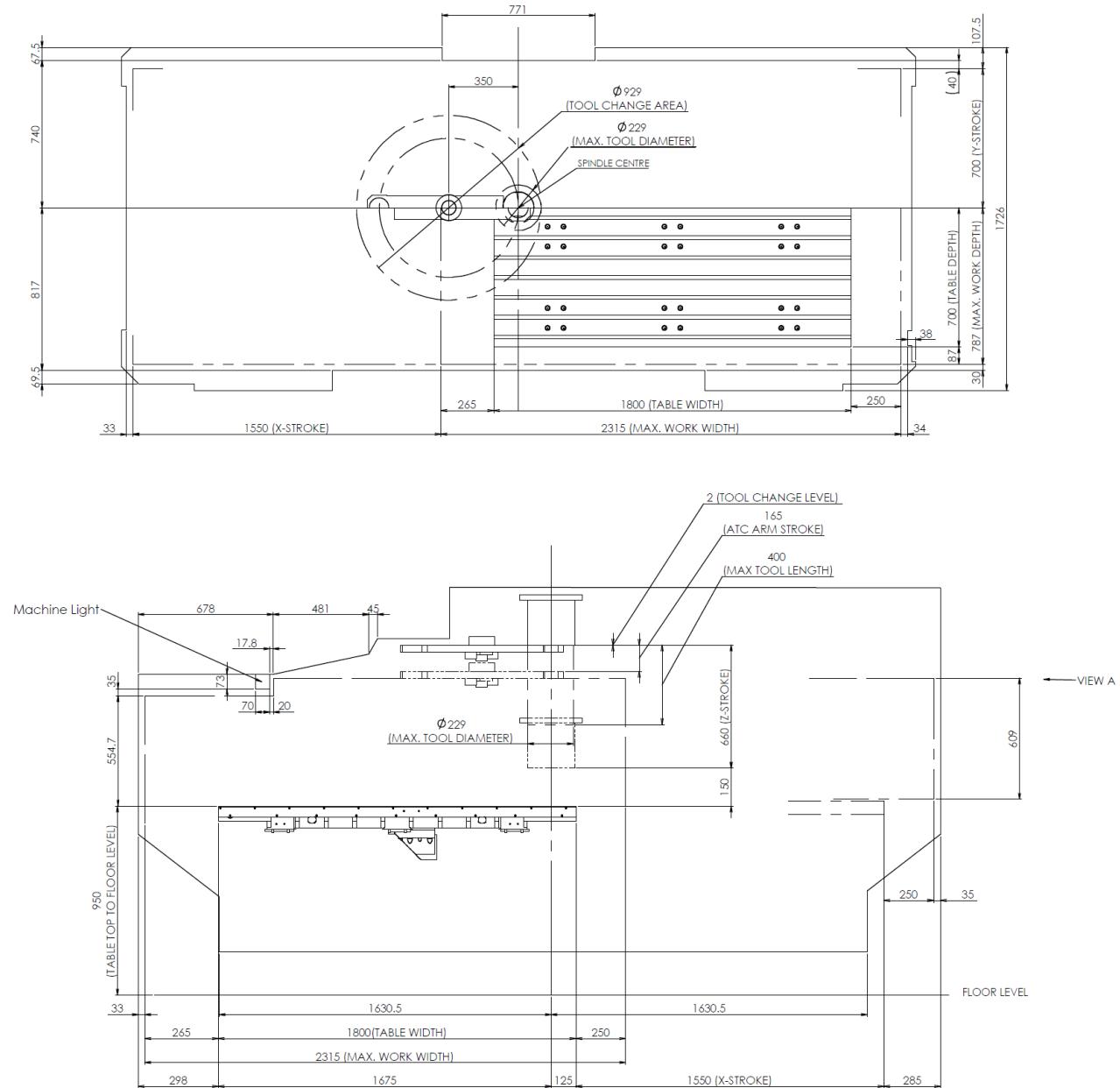


Figure 1.5 PS155 (SPD-14K) Machine Stroke Limits & Work Area 1

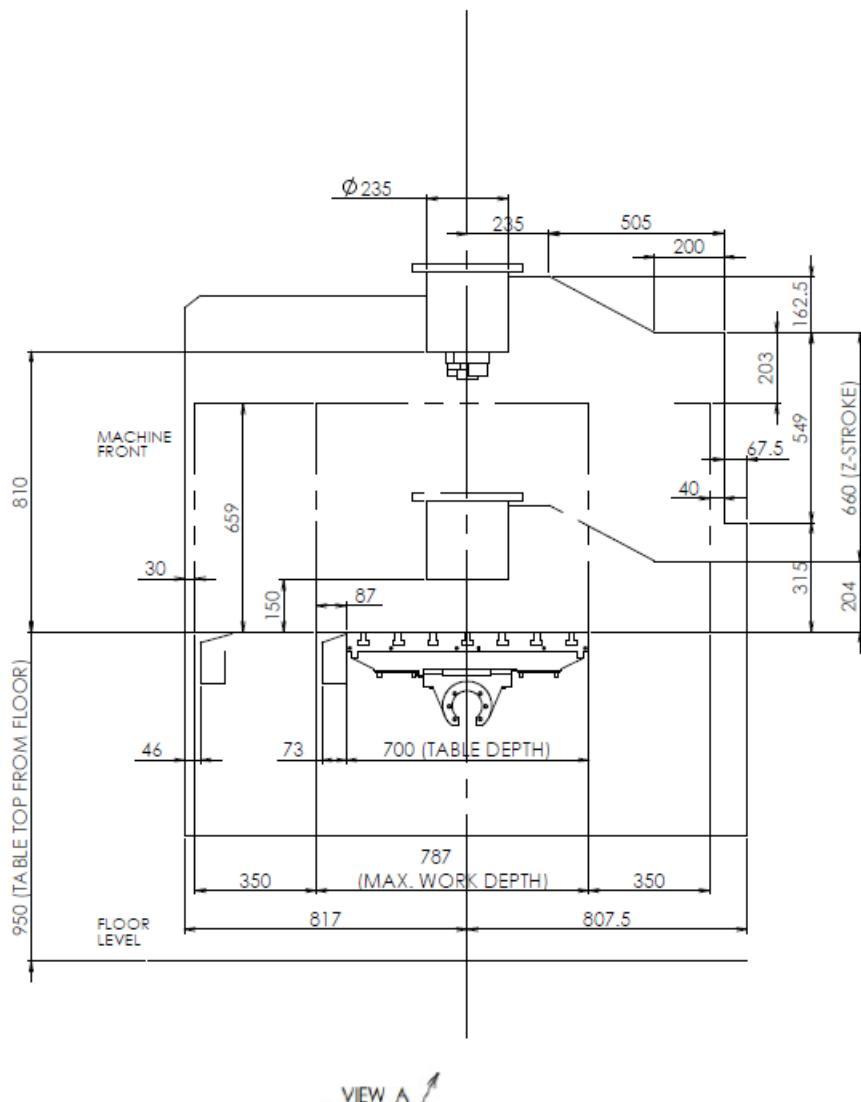


Figure 1.6 PS155 (SPD-14K) Machine Stroke Limits & Work Area 2

1.6 PS155 (SPD-10K Option) Machine Stroke Limits & Work Area

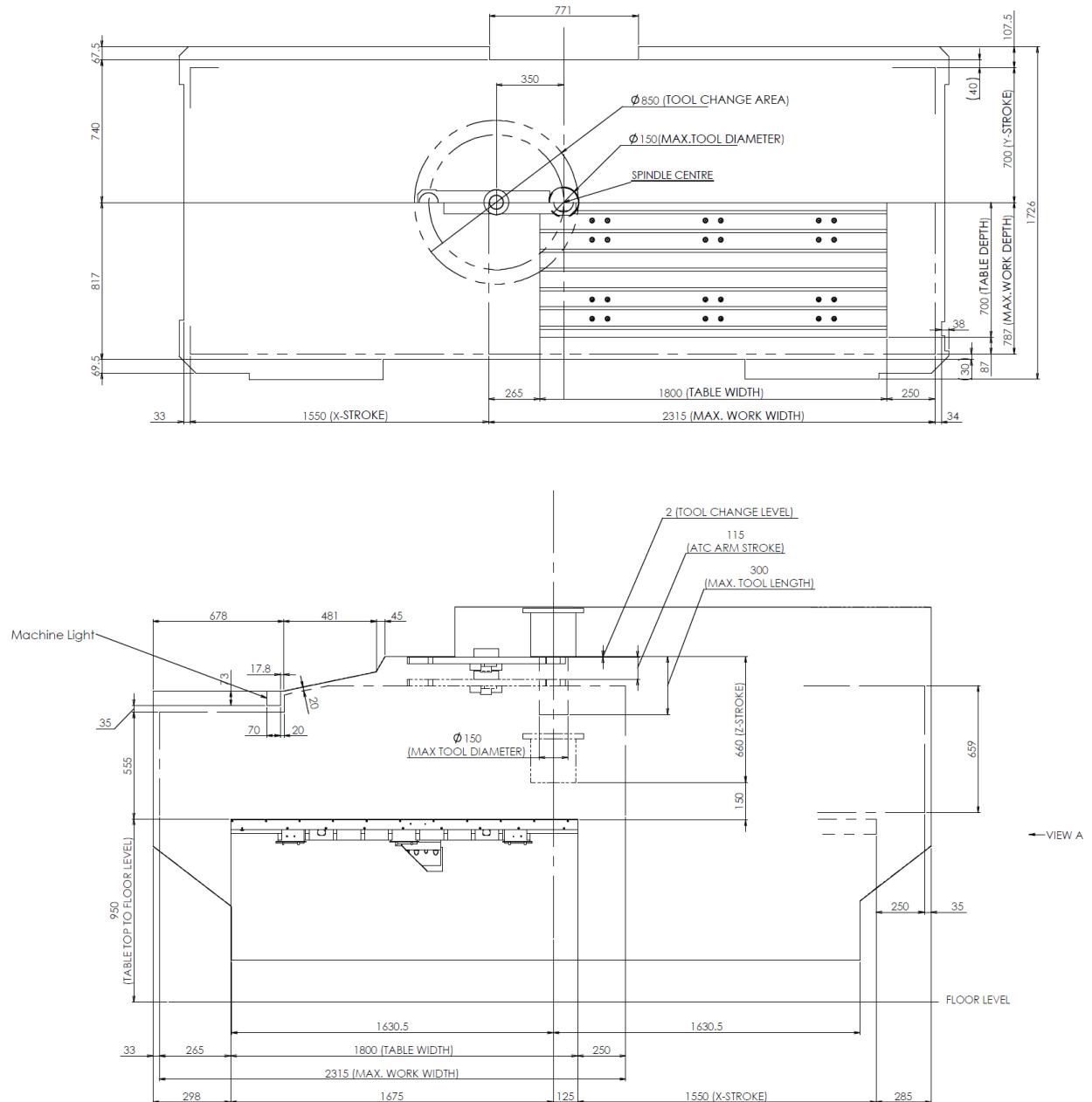


Figure 1.7 PS155 (SPD-10K Option) Machine Stroke Limits & Work Area 1

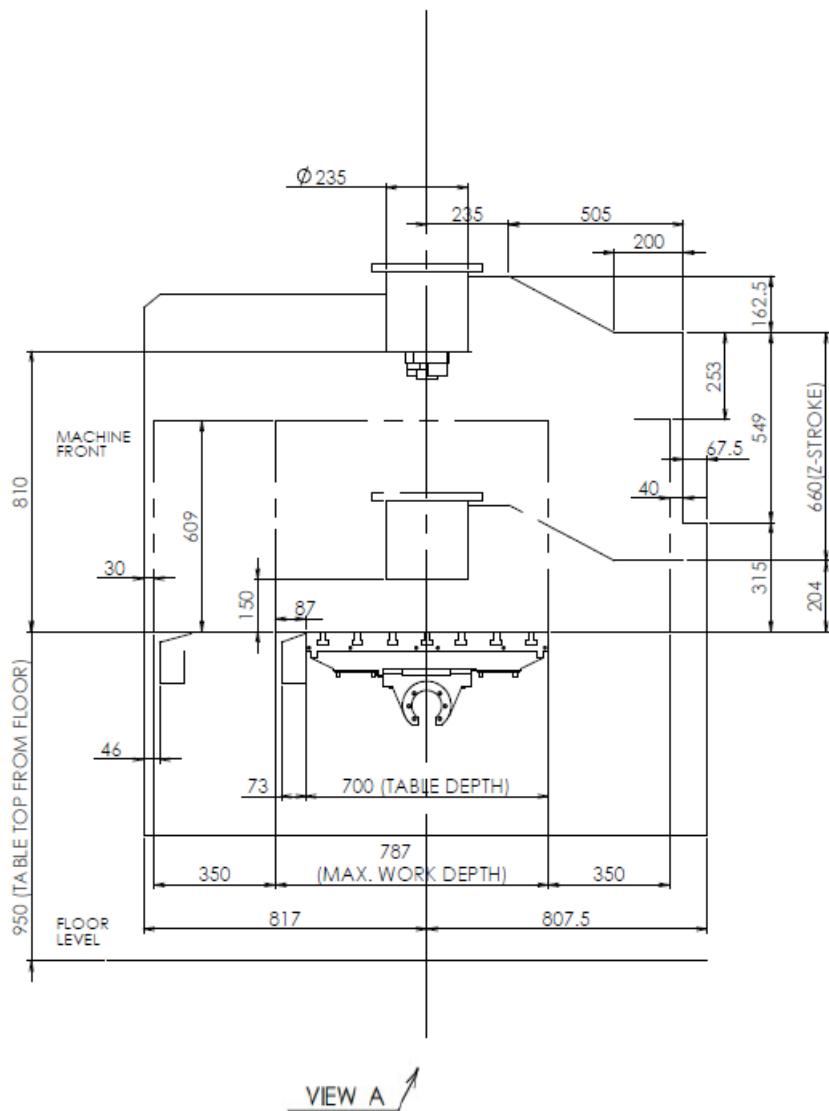


Figure 1.8 PS155 (SPD-10K Option) Machine Stroke Limits & Work Area 2

2 Maximum Workpiece Limitations

To prevent interference between the workpiece (e.g. where the workpiece size is bigger than the table size) and other components, mainly the ATC and splash guard, the movement range of the workpiece is restricted to be within the maximum workpiece limitations (sand pattern hatching) as shown in [Figure 1.3](#) to [Figure 1.6](#).

The automatic tool change operation can be performed with workpieces within the dimensions shown in [Figure 1.3](#) to [Figure 1.6](#) and the conditions below are satisfied.

Conditions:

- When the X/Y/Z-axis is moved, the workpiece must be within the movement range. (Refer to [Figure 1.5](#) to [Figure 1.8](#))
- When the workpiece is in the machining chamber, the tool change operation cannot be performed if tool dimensions do not satisfy the conditions in [Figure 1.3](#) to [Figure 1.6](#).
- A portion of the workpiece shape must be changed for exchanging tools that exceed the tool shape limitation (Refer to [Figure 1.5](#) to [Figure 1.8](#)).

Revision Record

Manual Title	PS155 INSTRUCTION MANUAL Professional <i>u</i>
Manual No.	V360I-I1E-XC

No.	Manual No. (Month/Year Issued)	Contents	Remarks
1	V360I-I1E-XA (06/2024)	New Issue	
2	V360I-I1E-XB (09/2024)	Controller name change from Professional S to Professional <i>u</i> .	
3	V360I-I1E-XC (10/2024)	Controller name change from Professional <i>u</i> to Professional <i>U</i> .	