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SERIES

PS155

Professional *U*

MAINTENANCE MANUAL

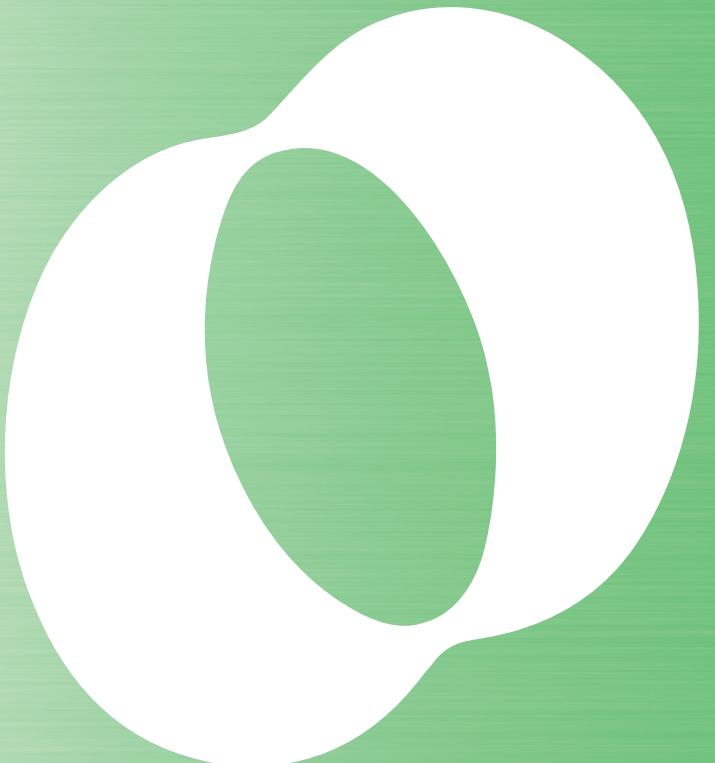
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MAKINO

PS SERIES

Professional *U*

MAINTENANCE MANUAL

PS155



-
1. Do not operate, maintain, or inspect this machine without carefully reading and understanding this manual.
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	English	This manual should only be used by skilled maintenance personnel.
	Japanese	このマニュアルは訓練された保守要員がご使用ください。
	Albanian	Ky manual duhet të përdoret vetëm nga personeli I trajnuar i mirëmbajtjes.
	Bosnian	Ovo uputstvo bi trebalo koristiti samo osoblje obučeno za održavanje.
	Brazilian Portuguese	Este manual apenas deve ser utilizado por técnicos de manutenção qualificados.
	Bulgarian	За използване само от специално обучен персонал за поддръжка.
	Chinese	本手册仅供已经培训的维护人员使用。
	Croatian	Ovaj priručnik namijenjen je samo obučenom osoblju za održavanje.
	Czech	Tato příručka může sloužit k použití pouze pro školený personál údržby.
	Danish	Denne manual må kun anvendes af specielt uddannet servicepersonale.
	Dutch	Dit handboek mag enkel door speciaal opgeleid onderhoudspersoneel gebruikt worden.
	Estonian	Manuaal on mõeldud kasutamiseks ainult vastavate oskustega hoolduspäersonaleile.
	Finnish	Vain koulutetut huoltohenkilöt saavat käyttää täitä ohjekirjaa.
	French	Ce manuel ne doit être utilisé que par du personnel de maintenance compétent.
	German	Dieses Handbuch darf nur durch speziell ausgebildetes Wartungspersonal verwendet werden.
	Greek	Το παρόν εγχειρίδιο πρέπει να χρησιμοποιείται από ειδικά εκπαιδευμένο προσωπικό συντήρησης.
	Hungarian	Ezt a kézikönyvet csak szakképzett karbantartó személyzet használhatja.
	Indonesian	Manual ini harus digunakan hanya oleh petugas pemeliharaan yang berketerampilan.
	Italian	Il presente manuale deve essere utilizzato solo da parte del personale di manutenzione appositamente addestrato.
	Korean	이 작업지도서는 기술이 능수한 정비인원이 사용해 주십시오

	Latvian	Šo rokasgrāmatu drīkst izmantot tikai kvalificēts tehniskās apkopes personāls.
	Lithuanian	Šį vadovą turėtų naudoti tik kompetentingi techninės priežiūros darbuotojai.
	Macedonian	Овој прирачник треба да го користи само квалификуван персонал за одржување.
	Malaysian	Manual ini hendaklah digunakan oleh kakitangan penyenggaraan yang mahir sahaja.
	Norwegian	Denne håndboken skal kun brukes av autoriserte reparatører.
	Polish	Ten podręcznik jest przeznaczony do użytku wyłącznie przez odpowiednio przeszkolony personel konserwacyjny.
	Portuguese	Este manual apenas pode ser utilizado por técnicos de manutenção qualificados.
	Romanian	Acest manual trebuie utilizat numai de personal de întreținere calificat.
	Russian	Это руководство предназначено только для квалифицированного обслуживающего персонала.
	Serbian (cyr)	Ово упутство би требало да користи само особље обучено за одржавање.
	Serbian (lat)	Ovo uputstvo bi trebalo da koristi samo osoblje obučeno za održavanje.
	Slovak	Príručku môže používať len špeciálne vyškolený personál údržby.
	Slovenian	Ta priročnik naj bi uporabljalo le osebje, usposobljeno za vzdrževalna dela.
	Spanish	Este manual sólo puede utilizarlo personal de mantenimiento especialmente cualificado.
	Swedish	Denna handbok får endast användas av speciellt utbildad underhållspersonal.
	Thai	คู่มือนี้ควรใช้โดยเจ้าหน้าที่ซ่อมบำรุงที่เชี่ยวชาญเท่านั้น
	Turkish	Bu kullanım kılavuzu sadece özel eğitim almış uzman bakım personeli tarafından kullanılmalıdır.
	Ukrainian	Ця настанова призначена лише для кваліфікованого обслуговуючого персоналу.
	Vietnamese	Tài liệu hướng dẫn này chỉ nên sử dụng bởi nhân viên bảo trì lành nghề.

Introduction

This machine is an NC machine tool (machining center) that incorporates an automatic tool change function and performs a wide range of machining operations such as milling, drilling, and tapping without changing how the workpiece is mounted.

Operation of the machine in optimum condition requires meeting of various needs for the machine itself, workpiece, utilities, operating environment conditions, and operator skills.

This manual is provided to ensure that the customer understands the correct operating procedures and uses this machine safely and efficiently.



- 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.

Warranty and Disclaimer

The information contained in the purchase agreement exchanged with the customer serves as the warranty with Makino.

For details about the warranty, see the purchase agreement.

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 describes 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 Machine Controller

This chapter describes the overview of the machine controller and the mechanisms of the components.

Chap. 3 Machine Maintenance

This chapter describes the overview of the machine maintenance and the mechanisms of the components.

Chap. 4 Spindle Head

This chapter describes the overview of the spindle head and the mechanisms and adjustment procedures of the components.

Chap. 5 Feed Axes

This chapter describes the overview of the feed axes and the mechanisms and adjustment procedures of the components.

Chap. 6 ATC Unit

This chapter describes the overview of the ATC unit and the mechanisms of the components.

Chap. 7 Spindle Cooler

This chapter describes the overview of the spindle oil temperature controller unit and the mechanisms of the components.

Chap. 8 Automatic Grease Supply Unit

This chapter describes the overview of the automatic grease supply unit and the mechanisms of the components.

Chap. 9 Spindle Hydraulic Unit

This chapter describes the overview of the spindle hydraulic unit and the mechanisms of the components.

Chap. 10 Fixture Hydraulic Unit (Option)

This chapter describes the overview of the fixture hydraulic unit and the mechanisms of the components.

Chap. 11 Pneumatic System

This chapter describes the overview of the pneumatic unit and the mechanisms of the components.

Chap. 12 Chip Disposal and Conveyor

This chapter describes the overview of the chip disposal, conveyor and the mechanisms of the components.

Chap. 13 Cutting Fluid Supply Unit and Tank

This chapter describes the overview of the cutting fluid supply unit, tank and the mechanisms of the components.

Chap. 14 Splash Guard

This chapter describes the overview of the splash guard and the mechanisms of the components.

Chap. 15 Mist Collector (Option)

This chapter describes the overview of the mist collector and the mechanisms of the components.

Chap. 16 Air Dryer (Option)

This chapter describes the overview of the air dryer and the mechanisms of the components.

Chap. 17 Signal Tables

This chapter describes the input and output signal list.

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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.

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- 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.

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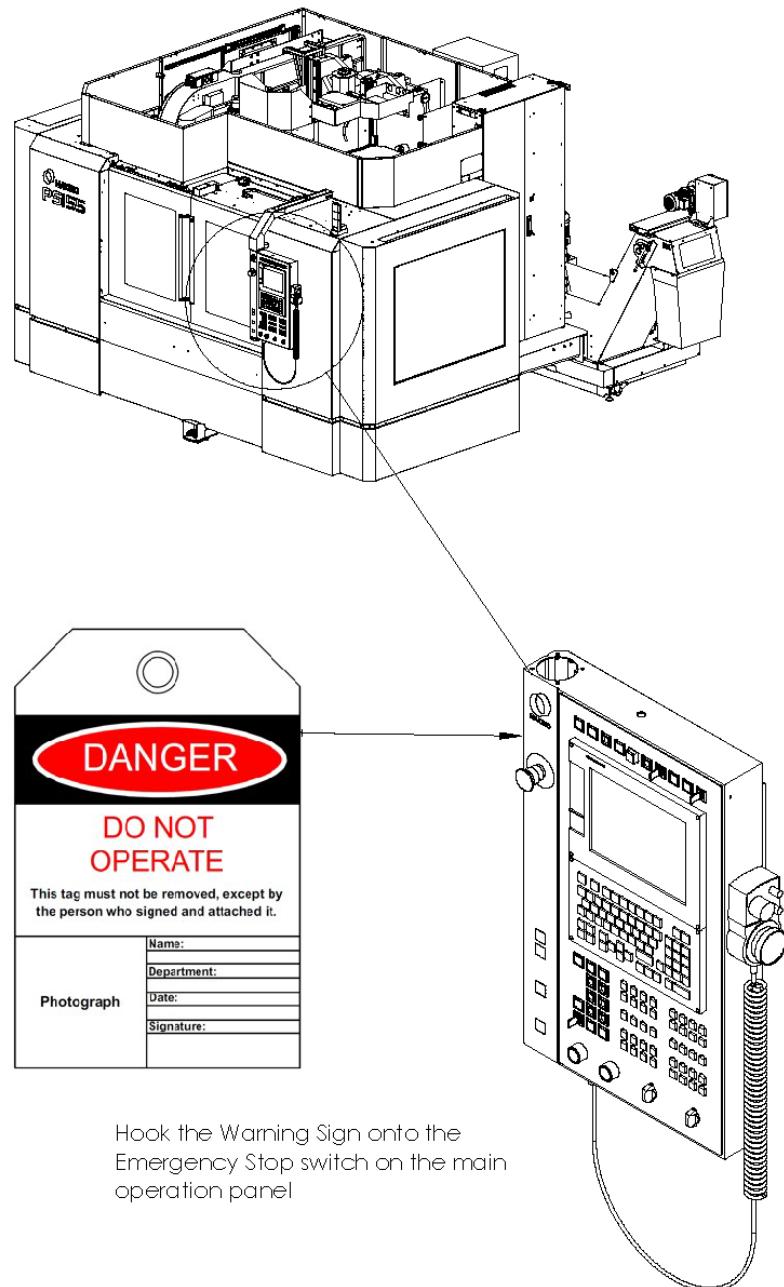


Figure 1.1 Implementing Lock-out & Tag-out

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.

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- 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
	<p>This warning label is affixed to parts where touching the internal high-voltage components may result in electrical shock.</p> <p>Workers who are not qualified electrical engineers must not access the parts where this warning label is affixed.</p>
	<p>This warning label is affixed to parts that may become extremely hot.</p> <p>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.</p>

2.4 Warning Labels Locations

2.4.1 Warning Labels Locations on Standard Machine

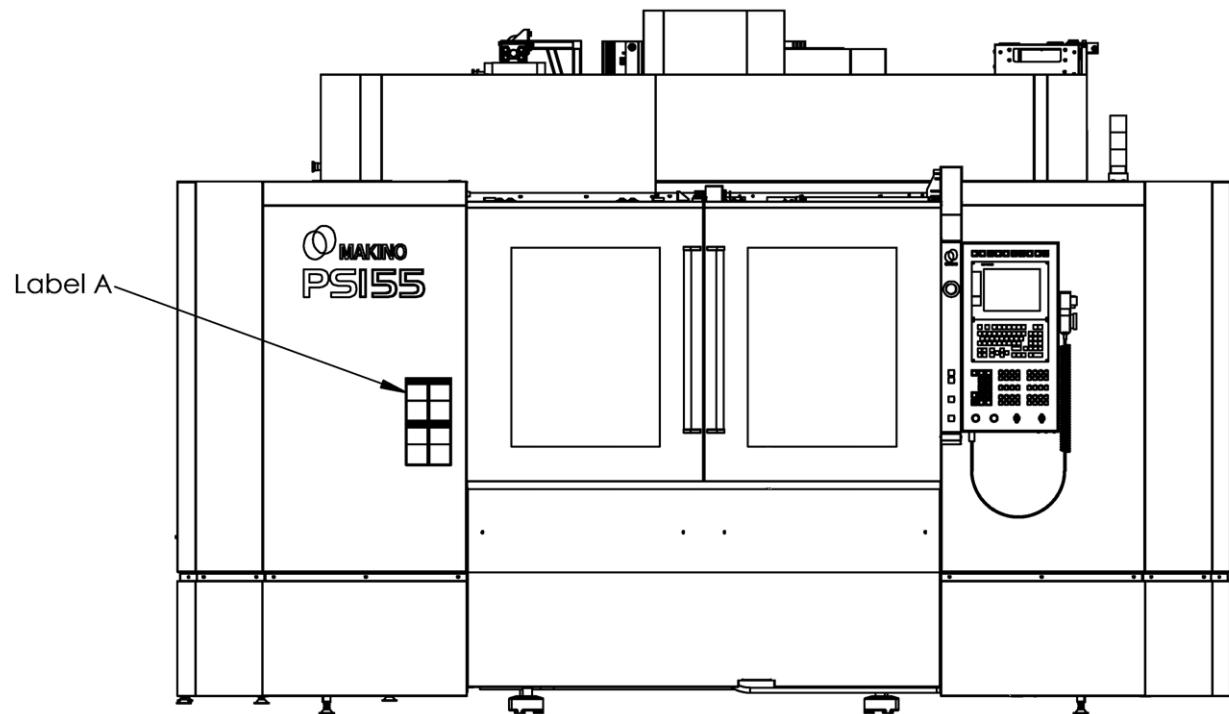


Figure 2.1 Warning Labels Location

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).

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

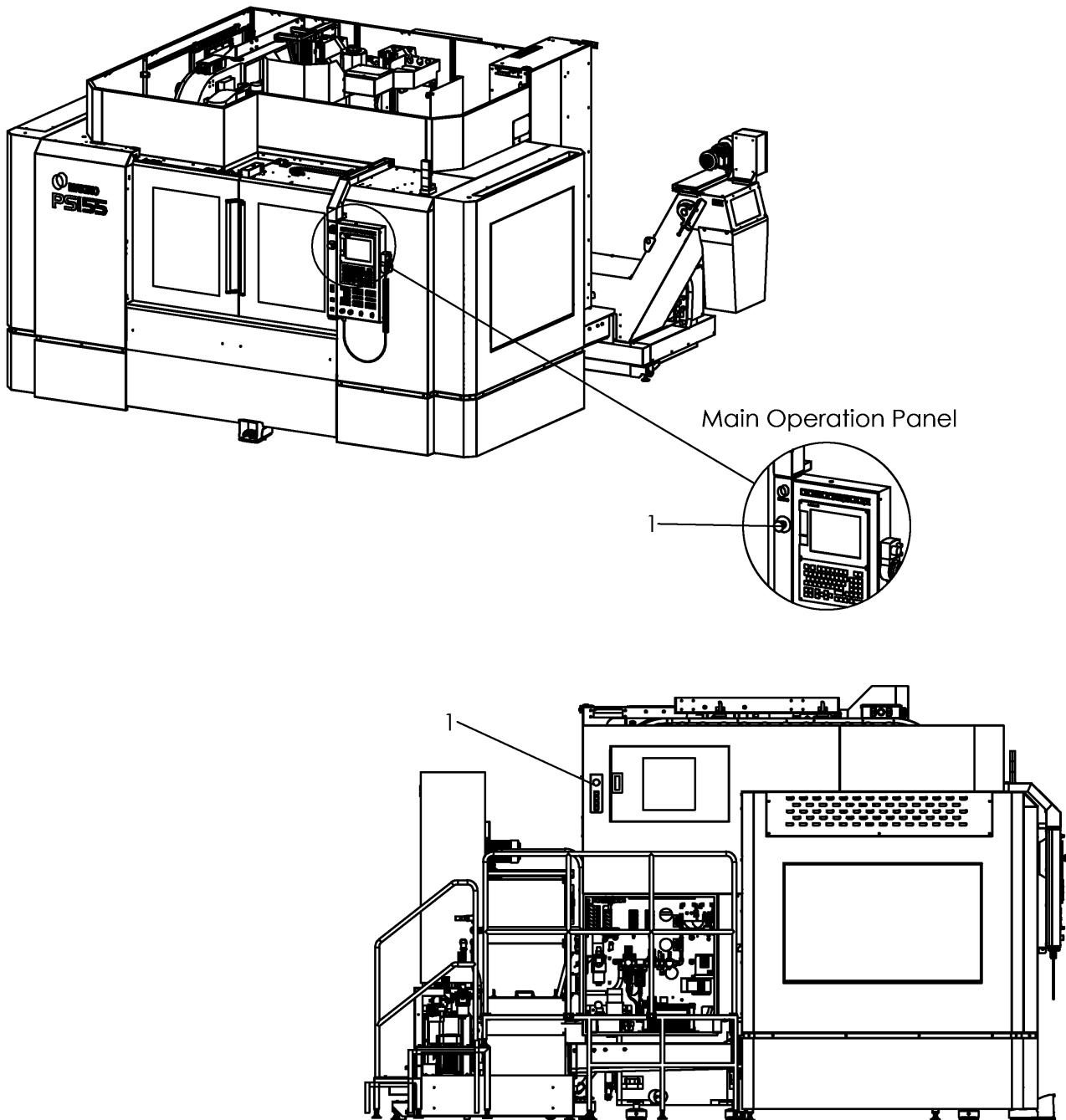


Figure 3.1 "Emergency Stop" Switch 1

No.	Name
1	"Emergency Stop" Switch

Portable Manual Pulse Generator

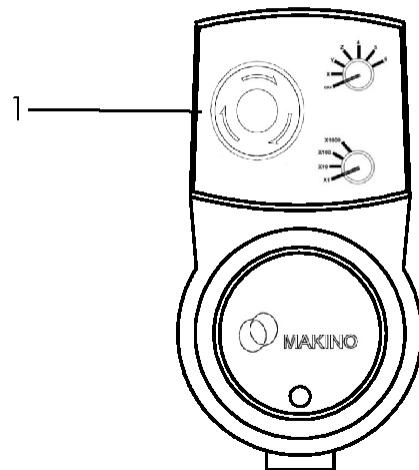


Figure 3.2 "Emergency Stop" Switch 2

No.	Name
1	"Emergency Stop" Switch

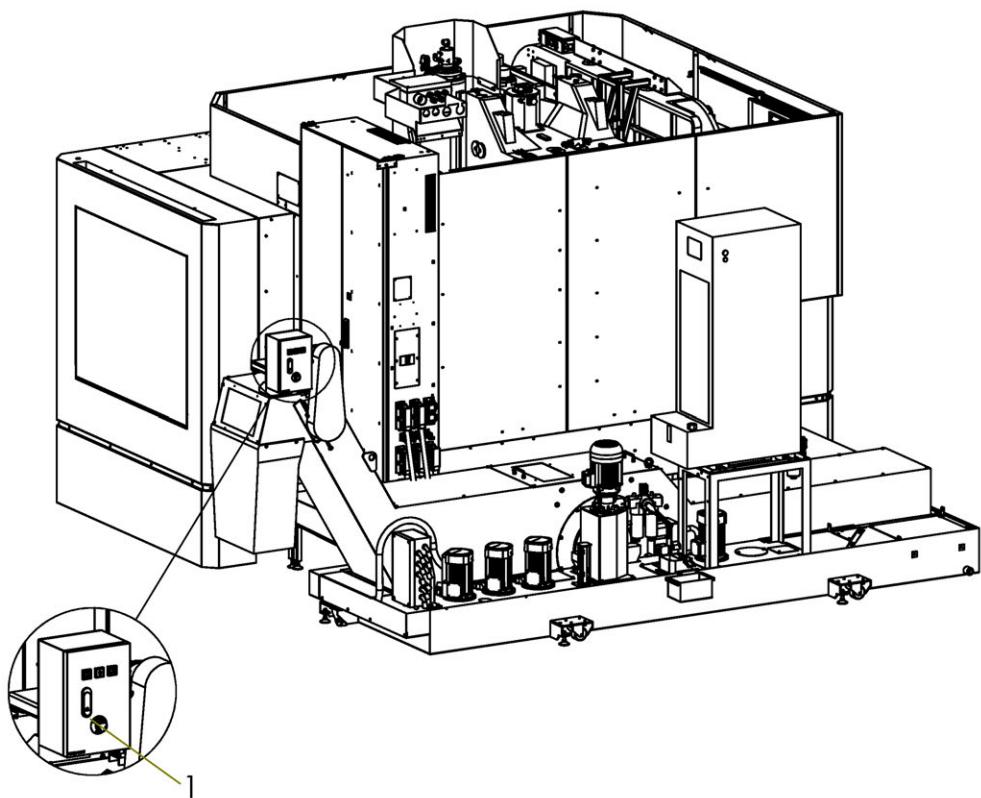


Figure 3.3 "Emergency Stop" Switch (Options)

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 machine controller controls the machine in accordance with instructions in NC programs and software. It communicates with the machine tool cabinet to control each device in the machine. This machine tool cabinet houses the electrical components that drive each device and other equipment.

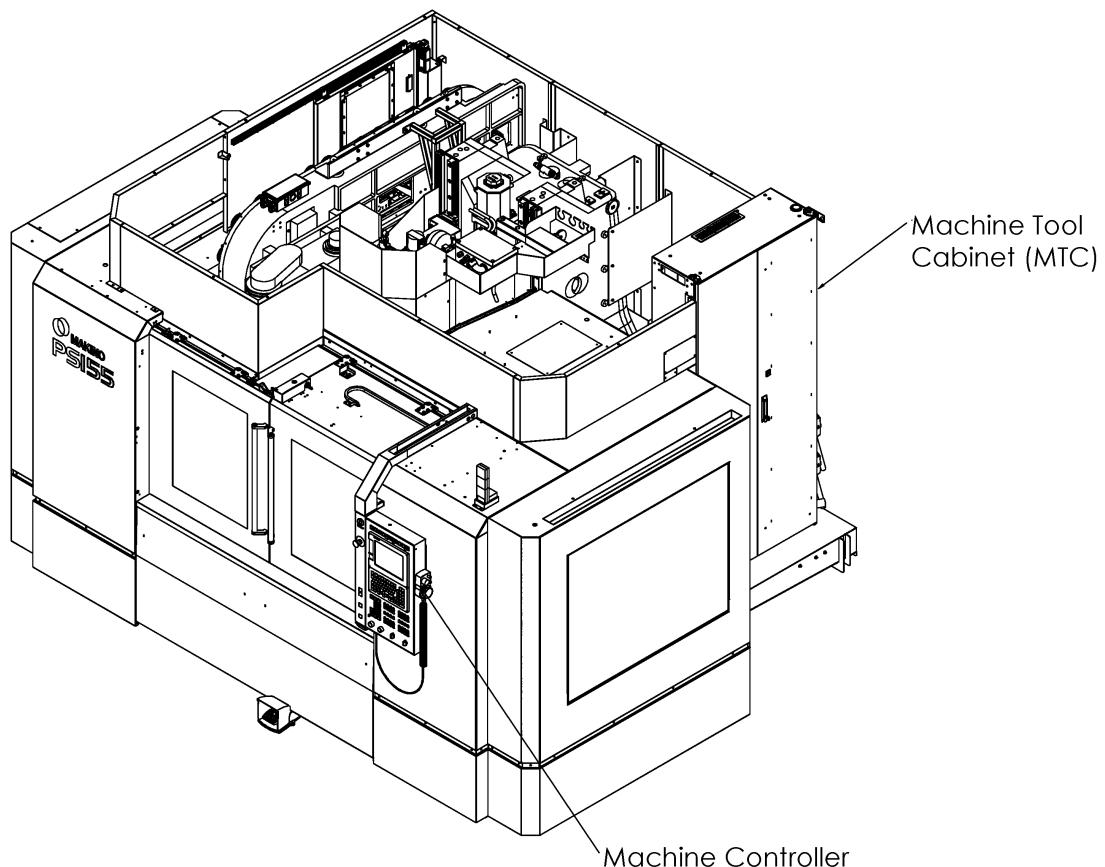


Figure 1.1 Overview

1.1 Component Name

The layout of each part of the machine tool cabinet varies depending on the specifications of machine (the figure shows the layout for available options and specifications).

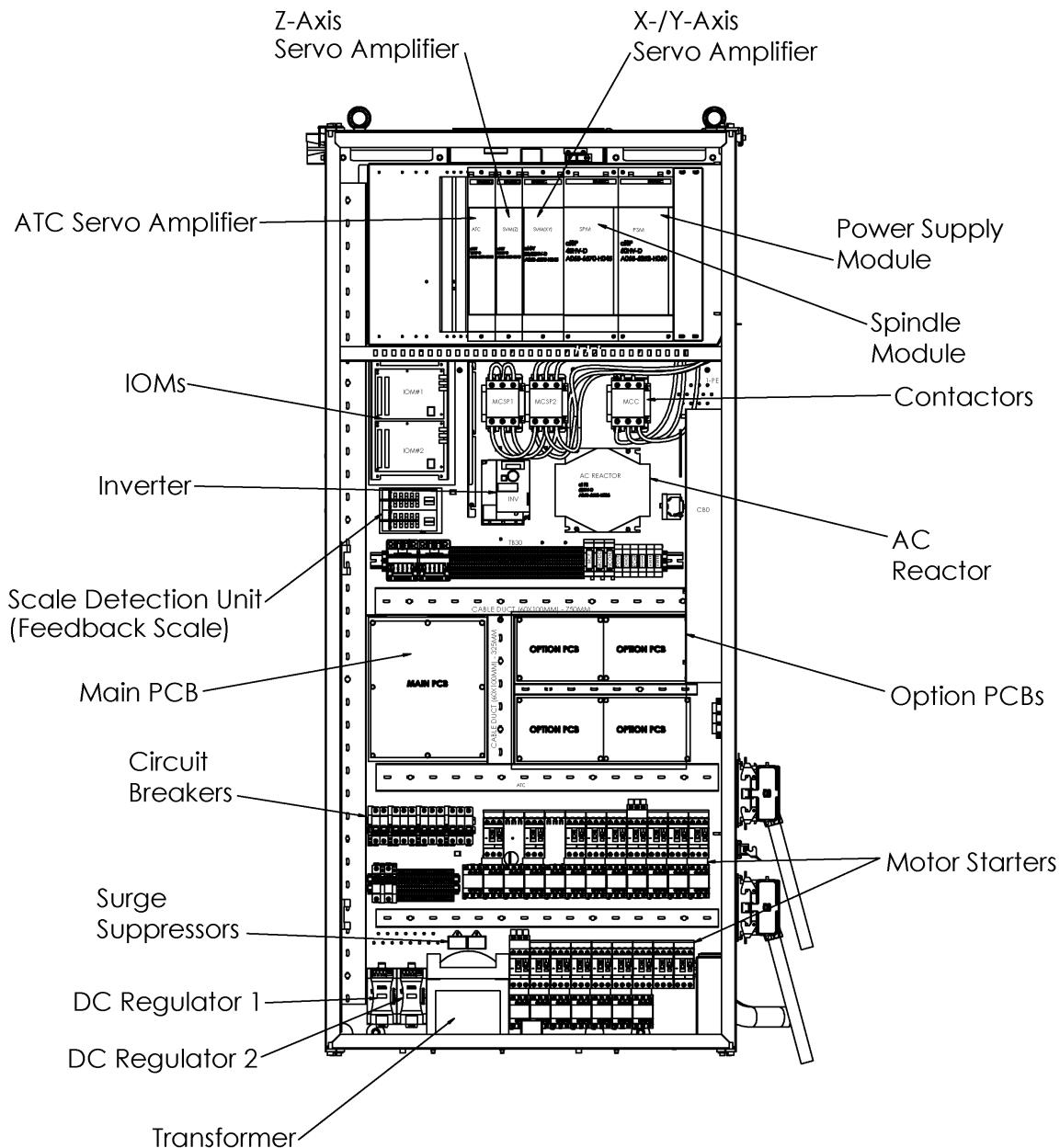


Figure 1.2 Machine Tool Cabinet

1.2 Professional *u*

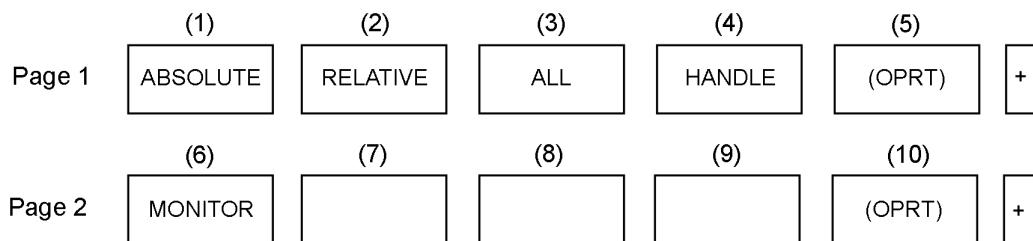
The machine controller Professional *u* (Pro *u*) includes a numerical controller (FANUC Series 0i-MF+) and Makino-developed control software. This unit controls automatic machine operations, electrically controlled components, axis servomotors and the spindle motor.

2 NC Screen

The NC screens that are frequently used during adjustment and maintenance are outlined in this section.

2.1 Position Display Screen

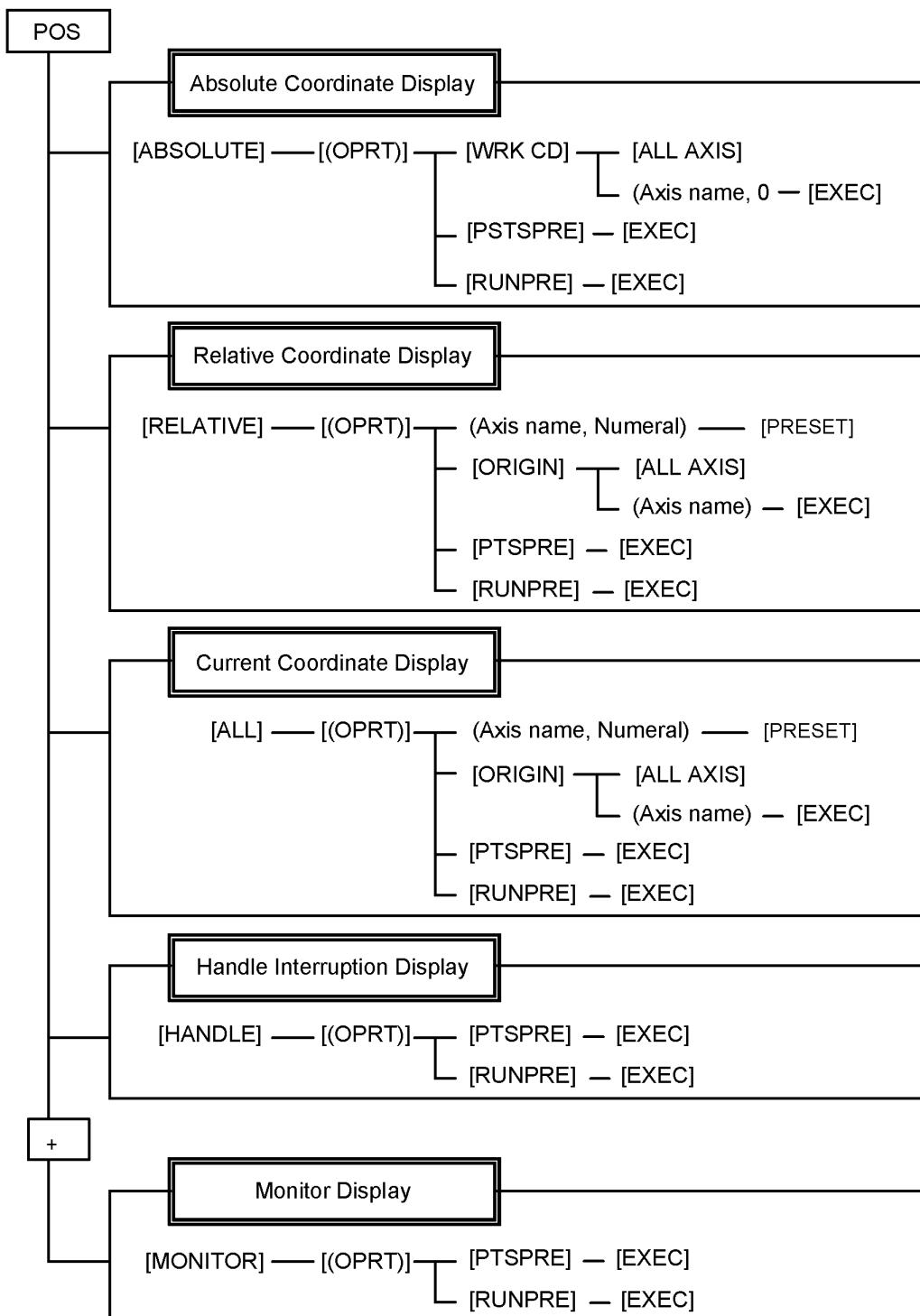
The screens listed below can be displayed on the Position Display screen by pressing the [POS] key on the MDI panel. The selection buttons (soft keys) for each screen are described below.



No.	Button	Description
1	ABSOLUTE	Selects the absolute coordinate display screen.
2	RELATIVE	Selects the relative coordinate display screen.
3	ALL	Selects the overall coordinate display screen.
4	HANDLE	Selects the operation screen for manual handle interruption operation.
6	MONITOR	Selects the screen for displaying the servo axis load meter and serial spindle load meter.
5,10	(OPRT)	Operation selection key.

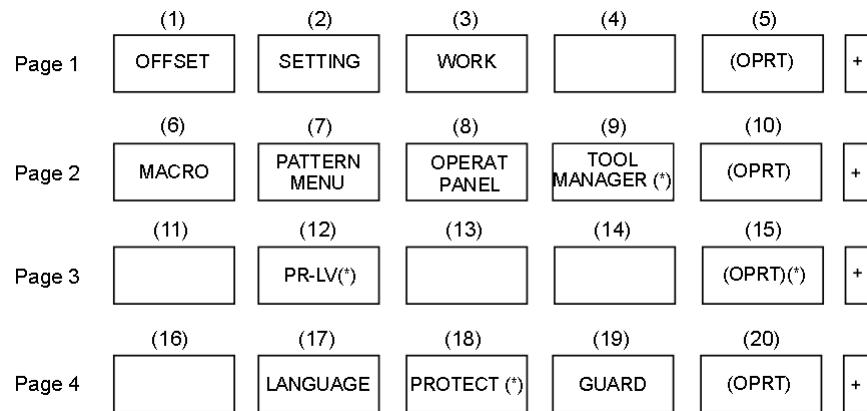
Chapter 2 Machine Controller

Transition sequence after pressing the [POS] key.



2.2 Offset/Setting Screen

The screens listed below can be displayed on the Offset/Setting screen by pressing the [OFFSET] key on the MDI panel. Displaying or setting of tool compensation values and data can be performed on this screen. The selection buttons (soft keys) for each screen are described below.

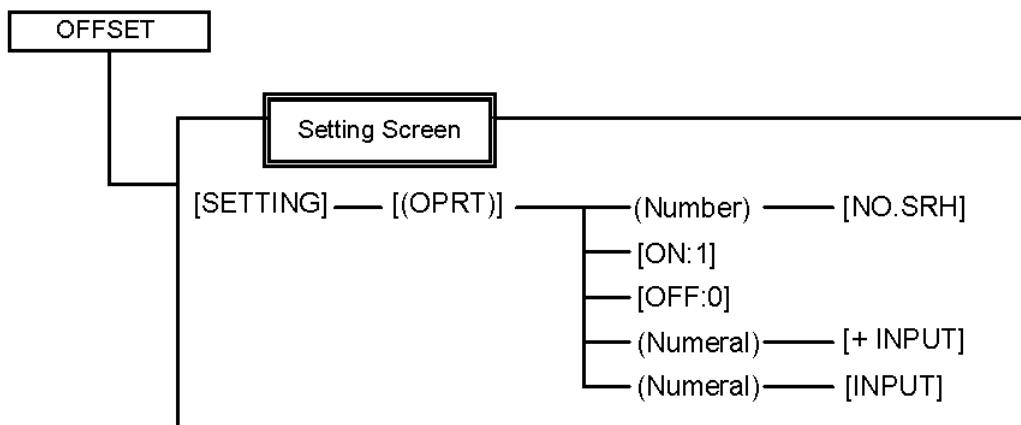


The buttons denoted by (*) may or may not be displayed depending upon the machine specifications.

Chapter 2 Machine Controller

No.	Button	Description
1	OFFSET	Selects the screen tool offset values.
2	SETTING	Selects the screen for setting parameters.
3	WORK	Selects the screen for setting the workpiece coordinate system offset.
6	MACRO	Selects the screen for setting the macro variables.
8	OPERAT PANEL	Selects the screen for operating some operating switches on the main operation panel as soft keys on the MDI panel.
9	TOOL MANAGER (*)	Selects the screen for setting the data related to tool management.
12	PR-LV (*)	Selects the screen for setting the precision level.
17	LANGUAGE	Selects the screen for setting the display language.
18	PROTECT	Selects the screen for setting data protection.
19	GUARD	Selects the screen for setting wrong operation prevention.
5,10,15,20	(OPRT)	Operation selection key.

Transition sequence after pressing the **[OFFSET]** key is shown below.



2.3 System Screen

The screens listed below can be displayed on the System screen by pressing the [SYSTEM] key on the MDI panel. Information confirmation, adjustment and setting of the machine control system can be performed on this screen. The selection buttons (soft keys) for each screen are described below.

Page 1	(1) PARAMETER	(2) DIANOYSIS	(3)	(4) SYSTEM	(5) (OPRT)
Page 2	(6)	(7) PITCH ERROR	(8) SERVO SETTING	(9) SPINDLE SETTING	(10) (OPRT)
Page 3	(11) WAVE DIAG	(12) ALL IO	(13)	(14) OPERAT HISTORY	(15) (OPRT)
Page 4	(16) PMC MAINT	(17) PMC LADDER	(18) PMC CONFIG.	(19) P.MATE MGR.	(20) (OPRT)
Page 5	(21) COLOR	(22) PERIOD MAINT	(23) MAINTE INFO	(24)	(25) (OPRT)
Page 6	(26)	(27) FSSB	(28) PARAM SET	(29)	(30) (OPRT)
Page 7	(31) EMBED PORT	(32) PCMCIA LAN	(33) ETHNET BOARD (*)	(34) PROFI-BUS MST (*)	(35) (OPRT)
Page 8	(36) ID-INF	(37)	(38)	(39)	(40) (OPRT)

The buttons denoted by (*) may or may not be displayed depending upon the machine specifications.

Chapter 2 Machine Controller

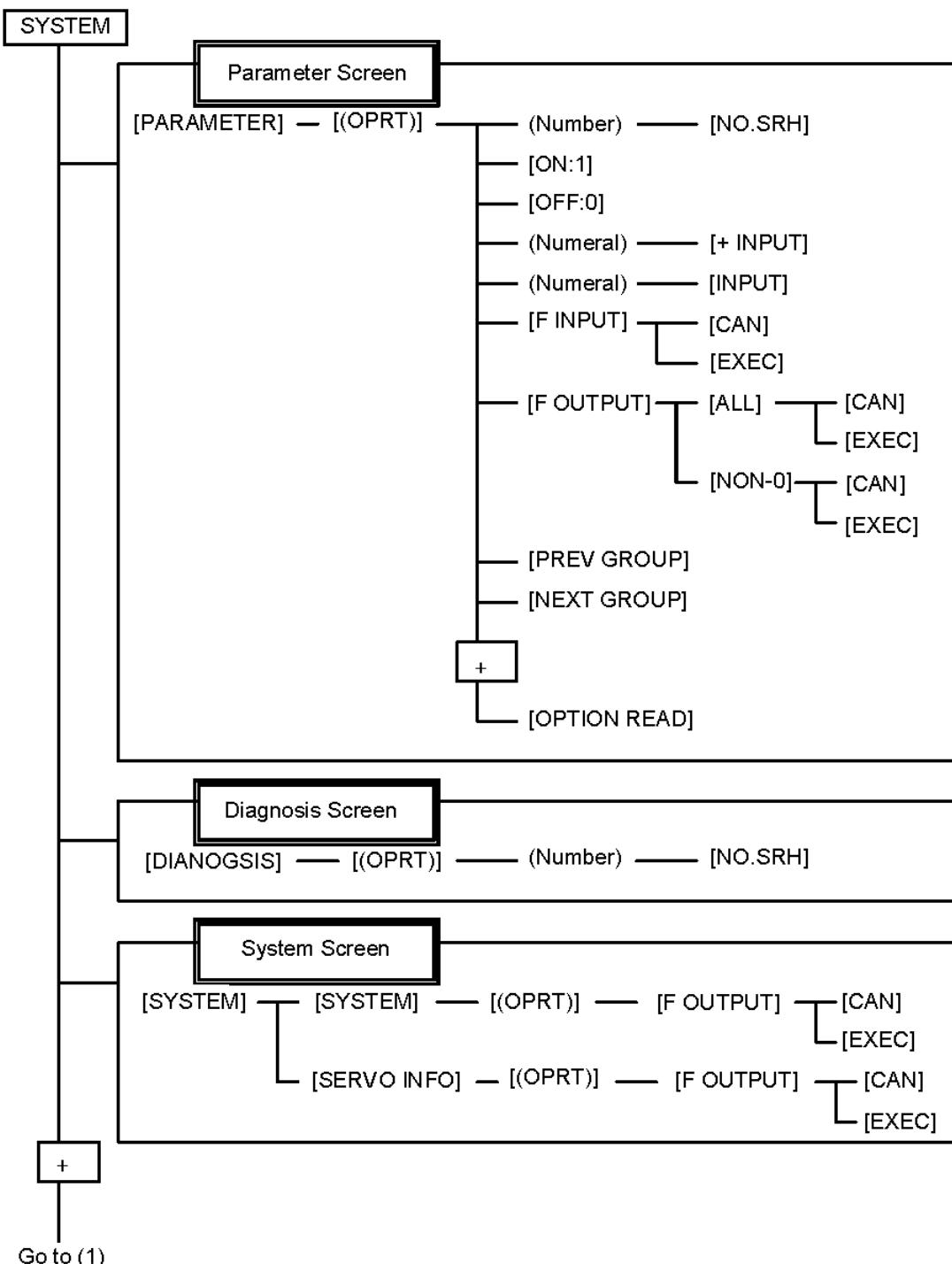
No.	Button	Description
1	PARAMETER	Selects the screen for setting parameters.
2	DIAGNOSIS	Selects the screen for displaying the CNC status.
4	SYSTEM	Selects the screen for displaying the current system status.
7	PITCH ERROR	Selects the screen for setting pitch error compensation.
8	SERVO SETTING	Selects the screen for setting the servo-related parameters.
9	SPINDLE SETTING	Selects the screen for spindle-related setting.
11	WAVE DIAG	Selects the screen for displaying data such as servo positional deviation values, torque values, machine signals as graphs.
12	ALL IO	Selects the screen for data input to and output from the memory card.
14	OPERAT HISTRY (*)	Selects the screen for displaying the history of operations performed by the operator and issued alarms.
16	PMC MAINTENANCE	Selects the screen related to PMC maintenance such as PMC signal status monitoring and tracing and PMC parameter display/editing.
17	PMC LADDER	Selects the screen related to ladder display/editing.
18	PMC CONFIG	Displays the screen for display/editing data other than ladders that comprise sequence programs and for setting the PMC function.
19	P.MATE.MGR.	Selects the screen for showing Power Mate NC Manager functions.
21	COLOR	Selects the screen for setting colors to be used on the screen.
22	PERIOD MAINTENANCE	Selects the screen for setting maintenance items to be managed periodically.
23	MAINTENANCE INFO	Selects the screen for displaying information about maintenance performed.
27	FSSB	Selects the screen for making settings related to the high-speed serial servo bus (FSSB: Fanuc Serial Servo Bus).
28	PARAM SET	Selects the screen for setting parameters necessary for start-up and tuning.
31	EMBED PORT	Selects the screen for making settings related to the embedded ethernet (embedded port).
32	PCMCIA LAN	Selects the screen for making settings related to the embedded ethernet (PCMCIA Ethernet card).
33	ETHNET BOARD (*)	Selects the screen for making settings related to the fast ethernet/fast data server.

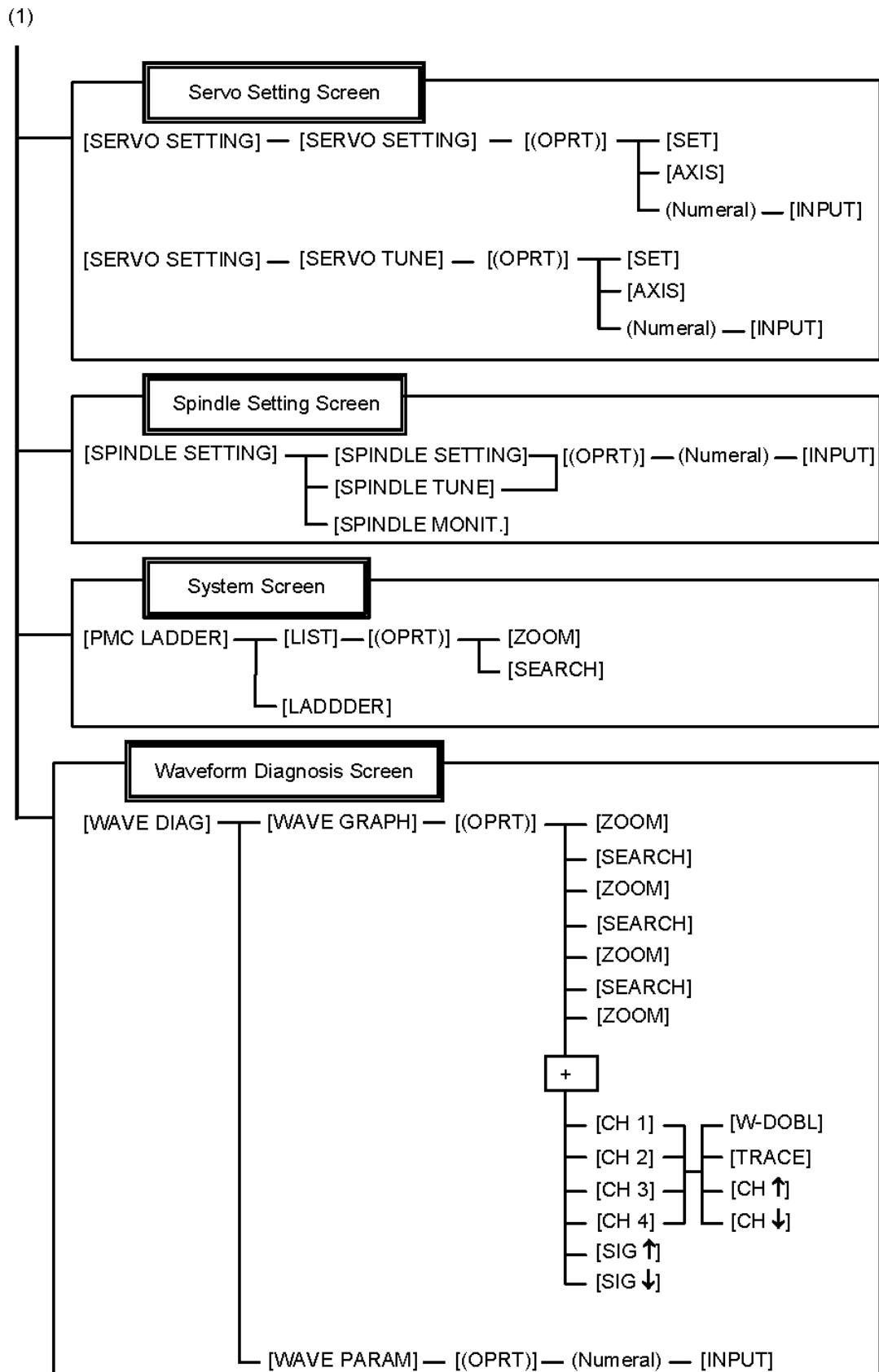
Chapter 2 Machine Controller

No.	Button	Description
34	PROFI-BUS MST (*)	Selects the screen for making setting related to the Profibus master/slave function.
36	ID-INF	Selects the screen for showing NC ID information.
5,10,15,20,25 ,30,35, 40	(OPRT)	Operation selection Key.

Chapter 2 Machine Controller

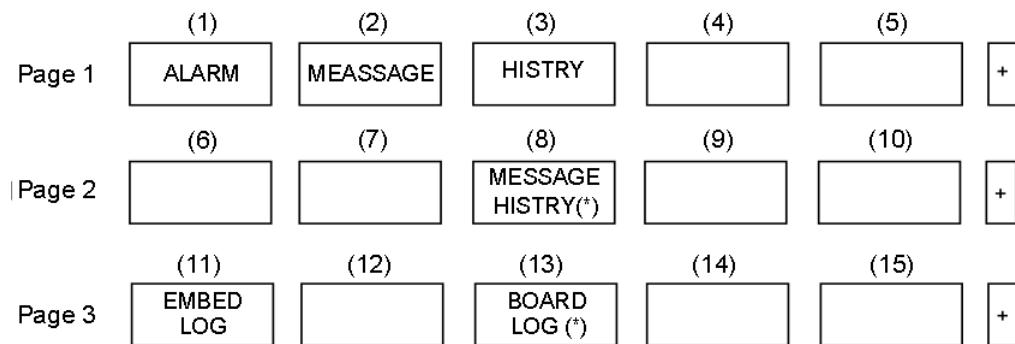
Transition sequence after pressing the [SYSTEM] key is shown below.





2.4 Message Screen

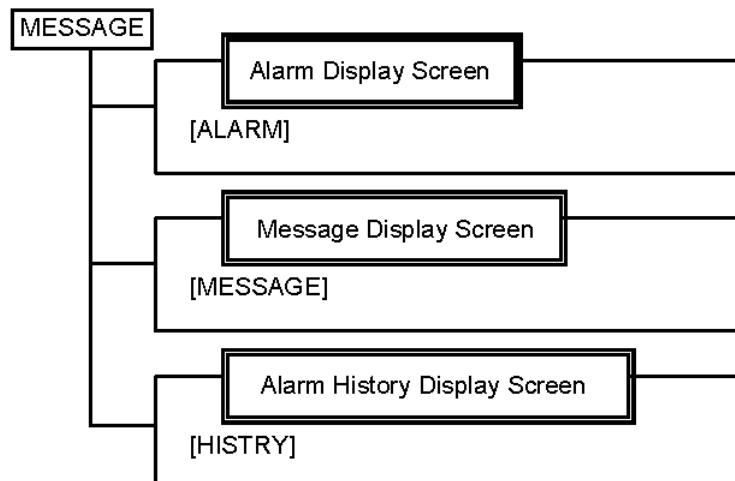
The screens listed below can be displayed on the Message screen by pressing the [MESSAGE] key on the MDI panel. The selection buttons (soft keys) for each screen are described below.



The buttons denoted by (*) may or may not be displayed depending upon the machine specifications.

No.	Button	Description
1	ALARM	Selects the alarm message screen.
2	MESSAGE	Selects the warning message screen.
3	HISTORY	Selects the screen for displaying the details of alarms issued (alarm message history screen).
8	MESSAGE HISTRY (*)	Selects the screen displaying warning message history.
11	EMBED LOG	Selects the screen for displaying error messages related to the embedded ethernet.
13	BOARD LOG (*)	Selects the screen for displaying error messages related to the fast ethernet/fast data server.

Transition sequence after pressing the [MESSAGE] key is shown below.



2.5 NC Parameter Screen Display/Input/Modification Procedure

NC parameter setting and modification are performed using the Parameter screen.

Display and Input/Modification Procedure

- 1) Ensure that the user level has the privilege to edit NC parameters. If necessary, please login with password.
 - Refer to the Instruction Manual Chapter 4, “4.12 User Management Screen” for user login procedure.
 - By default, Supervisor and Makino logins are able to edit the NC parameters.
 - To display parameter without editing, no login is required.
- 2) Parameter writing enable alarm (SW0100) may appear, press both the **[CAN]** and **[NC RESET]** keys on MDI panel to reset the alarm.
- 3) Press the **[SYSTEM]** key on the MDI panel.
- 4) Press the **[PARAMETER]** soft key on the screen. If the soft key does not appear, press the **[+]** soft key until **[PARAMETER]** is displayed.
- 5) Display the parameter using either of the following procedures:
 - a) Enter the parameter number and press the **[NO.SRH]** soft key.
 - b) Move the cursor to the parameter number using the page keys **[PAGE ↑]** **[PAGE ↓]** and/or the arrow keys **[↑]** **[→]** **[↓]** **[←]**.
- 6) Enter the setting value using the numeric keys in the MDI mode and press the **[INPUT]** key.
- 7) Log out the user level to disable NC parameter editing.

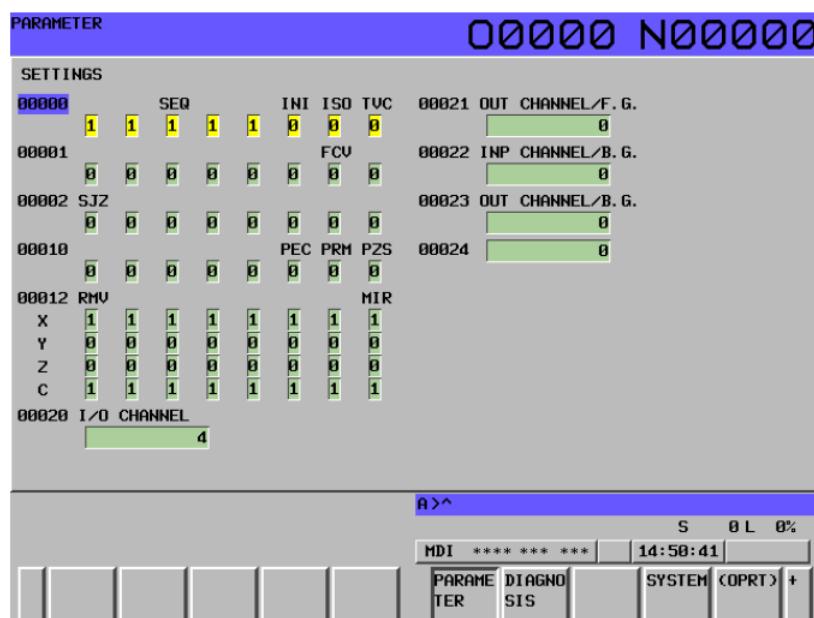


Figure 2.1 NC Parameter Screen

2.6 Ladder Screen

When performing maintenance on the machine, the running status of the ladder program can be checked on the Ladder screen.

Display Procedure

- 1) Press the [SYSTEM] key on the MDI panel.
- 2) Press the [+] soft key on the screen until the [PMC LADDER] soft key is displayed.
- 3) Press the [PMC LADDER] soft key to display the Ladder screen.

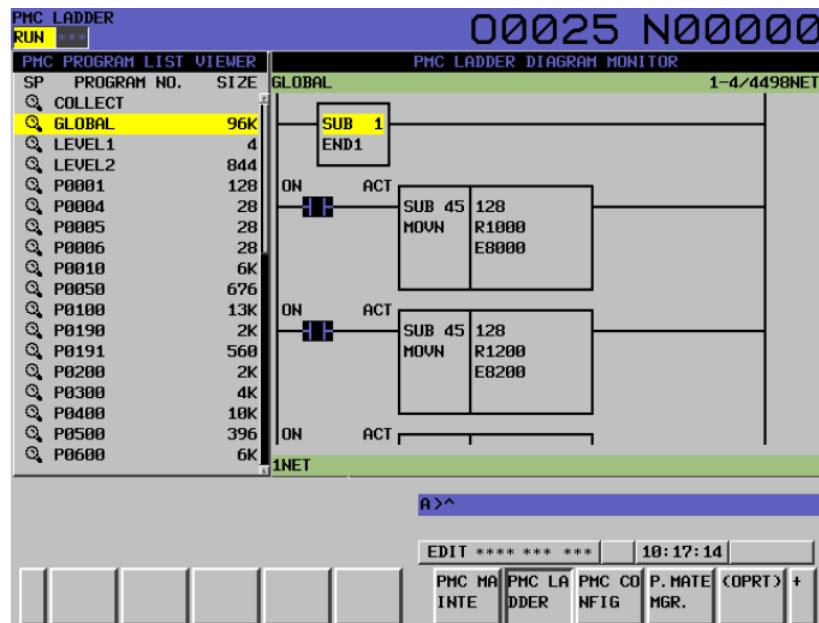


Figure 2.2 Ladder Screen

3 Parameter, Program and Data Input/Output Procedure

3.1 Machine Data Input/Output Procedure

3.1.1 NC Parameter

NC parameters can be loaded to the CNC memory from an external device. The loaded parameter replaces the existing parameter in the CNC memory.

Input Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Ensure the user level privilege is enabled to edit NC parameters.
 - Login is necessary.
 - Alarm SW0100 may appear. Press both the **[CAN]** and **[NC RESET]** keys on the MDI panel to reset the alarm.
- 3) Press the **[SYSTEM]** key on the MDI panel. Select the **[PARAMETER]** soft key on the screen.
- 4) Select Edit mode on the main operator panel.
- 5) Select the **[(OPRT)]** soft key. Then press the **[+]** soft key until the **[F INPUT]** soft key appears. Select the **[F INPUT]** soft key.
- 6) Type the input file name.
 - If the input file name is omitted, a default name “CNCPARA.TXT” is assumed.
- 7) Press the **[EXEC]** soft key.
 - This starts reading the parameter and the word “INPUT” blinks in the lower right of the screen. To cancel the input of the parameter, press the **[CAN]** soft key.
- 8) Power Off the machine. Then power On the machine.

This completes the NC parameter input procedure.

Output Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Press the **[SYSTEM]** key on the MDI panel. Select the **[PARAMETER]** soft key on the screen.
- 3) Select Edit mode on the main operator panel.
- 4) Select the **[(OPRT)]** soft key. Then press the **[+]** soft key until the **[F OUTPUT]** soft key appears. Select the **[F OUTPUT]** soft key.
- 5) If all parameters are to be output, press the **[ALL]** soft key. If only the parameters with non-zero values are to be output, press the **[NON-0]** soft key.
- 6) Type the output file name.
 - If the output file name is omitted, a default name “CNCPARA.TXT” is assumed.
- 7) Press the **[EXEC]** soft key.
 - This starts reading the parameter and the word “OUTPUT” blinks in the lower right of the screen. To cancel the output of the parameter, press the **[CAN]** soft key.

This completes the NC parameter output procedure.

3.1.2 Tool Offset Data

Tool offset data can be loaded to the CNC memory from an external device. The loaded offset data replaces the existing data in the CNC memory.

Input Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Ensure the user level privilege is enabled to edit Tool Offset data.
 - Login is necessary.
- 3) Press the **[OFFSET/SETTING]** key on the MDI panel. Select the **[OFFSET]** soft key on the screen.
- 4) Select Editor mode on the main operator panel.
- 5) Select the **[(OPRT)]** soft key. Then press the **[+]** soft key until the **[F INPUT]** soft key appears. Select the **[F INPUT]** soft key.
- 6) Type the input file name.
 - If the input file name is omitted, a default name “TOOLOFST.TXT” is assumed.
- 7) Press the **[EXEC]** soft key.
 - This starts reading the data and the word “INPUT” blinks in the lower right of the screen. To cancel the input of the data, press the **[CAN]** soft key.

This completes the tool offset data input procedure.

Output Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Press the **[OFFSET/SETTING]** key on the MDI panel. Select the **[OFFSET]** soft key on the screen.
- 3) Select Editor mode on the main operator panel.
- 4) Select the **[(OPRT)]** soft key. Then press the **[+]** soft key until the **[F OUTPUT]** soft key appears. Select the **[F OUTPUT]** soft key.
- 5) Type the output file name.
 - If the output file name is omitted, a default name “TOOLOFST.TXT” is assumed.
- 6) Press the **[EXEC]** soft key.
 - This starts reading the data and the word “OUTPUT” blinks in the lower right of the screen. To cancel the output of the data, press the **[CAN]** soft key.

This completes the tool offset data output procedure.

3.1.3 Pitch Error Compensation Data

Pitch error compensation data can be loaded to the CNC memory from an external device. The loaded data replaces the existing data in the CNC memory.

Input Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Ensure the user level privilege is enabled to edit Pitch Error Compensation data.
 - Login is necessary.
 - Alarm SW0100 may appear. Press both the **[CAN]** and **[NC RESET]** keys on the MDI panel to reset the alarm.
- 3) Press the **[SYSTEM]** key on the MDI panel. Press the **[+]** soft key until the **[PITCH ERROR]** soft key appears. Select the **[PITCH ERROR]** soft key.
- 4) Select Edit mode on the main operator panel.
- 5) Select the **[(OPRT)]** soft key. Then press the **[+]** soft key until the **[F INPUT]** soft key appears. Select the **[F INPUT]** soft key.
- 6) Type the input file name.
 - If the input file name is omitted, a default name “PITCH.TXT” is assumed.
- 7) Press the **[EXEC]** soft key.
 - This starts reading the data and the word “INPUT” blinks in the lower right of the screen. To cancel the input of the data, press the **[CAN]** soft key.
- 8) Power Off the machine. Then power On the machine.

This completes the pitch error compensation data input procedure.

Output Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Press the **[SYSTEM]** key on the MDI panel. Press the **[+]** soft key until the **[PITCH ERROR]** soft key appears. Select the **[PITCH ERROR]** soft key.
- 3) Select Edit mode on the main operator panel.
- 4) Select the **[(OPRT)]** soft key. Then press the **[+]** soft key until the **[F OUTPUT]** soft key appears. Select the **[F OUTPUT]** soft key.
- 5) Type the output file name.
 - If the output file name is omitted, a default name “PITCH.TXT” is assumed.
- 6) Press the **[EXEC]** soft key.
 - This starts reading the data and the word “OUTPUT” blinks in the lower right of the screen. To cancel the output of the data, press the **[CAN]** soft key.

This completes the pitch error compensation data output procedure.

3.1.4 Custom Macro Common Variables

Custom macro common variables can be loaded to the CNC memory from an external device. The loaded data replaces the existing data in the CNC memory.

Input Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Ensure the user level privilege is enabled to edit Custom Macro Common Variables.
 - Login is necessary.
- 3) Press the **[OFFSET/SETTING]** key on the MDI panel. Select the **[MACRO]** soft key on the screen.
- 4) Select Edit mode on the main operator panel.
- 5) Select the **[(OPRT)]** soft key. Then press the **[+]** soft key until the **[F INPUT]** soft key appears. Select the **[F INPUT]** soft key.
- 6) Type the input file name.
 - If the input file name is omitted, a default name “MACRO.TXT” is assumed.
- 7) Press the **[EXEC]** soft key.
 - This starts reading the data and the word “INPUT” blinks in the lower right of the screen. To cancel the input of the data, press the **[CAN]** soft key.

This completes the custom macro common variables input procedure.

Output Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Press the **[OFFSET/SETTING]** key on the MDI panel. Select the **[MACRO]** soft key on the screen.
- 3) Select Editor mode on the main operator panel.
- 4) Select the **[(OPRT)]** soft key. Then press the **[+]** soft key until the **[F OUTPUT]** soft key appears. Select the **[F OUTPUT]** soft key.
- 5) Type the output file name.
 - If the output file name is omitted, a default name “MACRO.TXT” is assumed.
- 6) Press the **[EXEC]** soft key.
 - This starts reading the data and the word “OUTPUT” blinks in the lower right of the screen. To cancel the output of the data, press the **[CAN]** soft key.

This completes the custom macro common variables output procedure.

3.1.5 Workpiece Coordinate System Data

Workpiece coordinate system data can be loaded to the CNC memory from an external device. The loaded data replaces the existing data in the CNC memory.

Input Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Ensure the user level privilege is enabled to edit Workpiece Coordinate System data.
 - Login is necessary.
- 3) Press the **[OFFSET/SETTING]** key on the MDI panel. Select the **[WORK]** soft key on the screen.
- 4) Select Edit mode on the main operator panel.
- 5) Select the **[(OPRT)]** soft key. Then press the **[+]** soft key until the **[F INPUT]** soft key appears. Select the **[F INPUT]** soft key.
- 6) Type the input file name.
 - If the input file name is omitted, a default name “EXT_WKZ.TXT” is assumed.
- 7) Press the **[EXEC]** soft key.
 - This starts reading the data and the word “INPUT” blinks in the lower right of the screen. To cancel the input of the data, press the **[CAN]** soft key.

This completes the workpiece coordinate system data input procedure.

Output Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Press the **[OFFSET/SETTING]** key on the MDI panel. Select the **[WORK]** soft key on the screen.
- 3) Select Editor mode on the main operator panel.
- 4) Select the **[(OPRT)]** soft key. Then press the **[+]** soft key until the **[F OUTPUT]** soft key appears. Select the **[F OUTPUT]** soft key.
- 5) Type the output file name.
 - If the output file name is omitted, a default name “EXT_WKZ.TXT” is assumed.
- 6) Press the **[EXEC]** soft key.
 - This starts reading the data and the word “OUTPUT” blinks in the lower right of the screen. To cancel the output of the data, press the **[CAN]** soft key.

This completes the workpiece coordinate system data output procedure.

3.1.6 Input/Output Data Using All I/O Screen

The procedures mentioned in section 3.1.1 to 3.1.5 can also be done using the All I/O screen. However, the All I/O screen can only be operated if a memory card interface is selected as an external I/O device.

The procedure to input/output data using the All I/O screen is similar to the ones mentioned in section 3.1.1⁴⁷ to 3.1.5⁵².

Display Procedure

- 1) Press the **[SYSTEM]** key on the MDI panel.
- 2) Press the **[+]** soft key until the **[ALL IO]** soft key appears. Select the **[ALL IO]** soft key.

This completes the display procedure for All I/O screen.

3.2 NC Program Input/Output Procedure

This section explains how to input/output a NC program from an external device to the CNC memory. There are 2 methods can be used.

Method 1: Using Program Editing or Program Folder Screen

Input Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Ensure the user level privilege is enabled to edit NC programs.
 - Login is necessary.
- 3) Press the **[PROG]** key on the MDI panel.
- 4) Select Edit mode on the main operator panel.
- 5) Select the **[(OPRT)]** soft key. Then press the **[+]** soft key until the **[F INPUT]** soft key appears. Select the **[F INPUT]** soft key.
- 6) Type the input file name. Press the **[F-NAME]** soft key.
 - To specify the input program number, type the program number and press the **[O SET]** soft key. For explanation of the operations to be done if a file name or a program number is omitted, please refer to the table below.
- 7) Press the **[EXEC]** soft key.
 - This starts reading the NC program and the word “INPUT” blinks in the lower right of the screen. To cancel the input of the NC program, press the **[CAN]** soft key.

This completes the NC program input procedure.

[F-NAME]	[O SET]	Input File Name	Input Program	Input Program Number
BLANK	INPUT	File for the program number specified with [O SET].	All programs in the program specified with [O SET].	Continuous program numbers starting at one specified with [O SET].
INPUT	BLANK	File name set with [F-NAME].	All programs in the program specified with [F-NAME].	File name at the time the file is saved.
INPUT	INPUT	File name set with [F-NAME].	All programs in the program specified with [F-NAME].	Continuous program numbers starting at one specified with [O SET].

Output Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
- 2) Press the **[PROG]** key on the MDI panel.
- 3) Select Editor mode on the main operator panel.
- 4) Select the **[(OPRT)]** soft key. Then press **[+]** soft key until the **[F OUTPUT]** soft key appears. Select the **[F OUTPUT]** soft key.
- 5) Type the output program number. Press the **[O SET]** soft key.
 - To specify an output file name, type the file name and press the **[F-NAME]** soft key.
 - If no output file name or output program number is specified, the main program or the program being subjected to background editing is output.
 - For explanation of the operations to be done if the output file name or the output program number is omitted, please refer to the table below.
- 7) Press the **[EXEC]** soft key.
 - This starts reading the NC program and the word “OUTPUT” blinks in the lower right of the screen. To cancel the output of the NC program, press the **[CAN]** soft key.

This completes the NC program output procedure.

[F-NAME]	[O SET]	Output File Name	Output Program
BLANK	BLANK	Main program or program number being subjected to background editing.	Main program or program being subjected to background editing.
BLANK	-9999	ALL-PROG.TXT	All programs in the program memory that are displayed in the program list.
BLANK	INPUT	Program number set with [O SET].	Program in the NC that is set with [O SET].
INPUT	BLANK	File name set with [F-NAME].	Main program or program being subjected to background editing.
INPUT	-9999	File name set with [F-NAME].	All programs in the program memory that are displayed in the program list.
INPUT	INPUT	File name set with [F-NAME].	Program in the NC that is set with [O SET].

Method 2: Using All I/O Screen

Input Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
 - Ensure NC I/O channel is set to 4.
- 2) Ensure the user level privilege is enabled to edit NC programs.
 - Login is necessary.
- 3) Press the **[SYSTEM]** key on the MDI panel. Then press the **[+]** soft key until the **[ALL IO]** soft key appears. Select the **[ALL IO]** soft key.
- 4) Press **[PROGRAM]** on the All I/O screen.
- 5) Select Editor mode on the main operator panel.
- 6) Select the **[(OPRT)]** soft key. Then press the **[N INPUT]** soft key.
- 7) Type the input file name and press the **[F-NAME]** soft key.
 - If the input file name is omitted, a default name “ALL_PROG.TXT” is assumed.
- 8) Type the program number to be used and press the **[O SET]** soft key.
 - If no program number is specified, the program number in the file is adopted as it is.
- 9) Press the **[EXEC]** soft key.
 - This starts reading the NC program and the word “INPUT” blinks in the lower right of the screen. To cancel the input of the NC program, press the **[CAN]** soft key.

This completes the NC program input procedure.

Output Procedure

- 1) Ensure the NC unit and the external device are ready for reading/writing.
 - Ensure NC I/O channel is set to 4.
- 2) Press the **[SYSTEM]** key on the MDI panel. Then press the **[+]** soft key until the **[ALL IO]** soft key appears. Select the **[ALL IO]** soft key.
- 3) Press **[PROGRAM]** on the All I/O screen.
- 4) Select Editor mode on the main operator panel.
- 5) Select the **[(OPRT)]** soft key. Then press the **[F OUTPUT]** soft key.
- 6) Type the output program number and press the **[O SET]** soft key.
 - If –9999 is typed, all programs in the memory are output.
- 7) Type the output file name and press the **[F-NAME]** soft key.
 - If no file name is specified, the output file name is assumed to be “O” or “number” if a single program number is specified. If –9999 is specified, the output file name is assumed to be “ALL-PROG.TXT”.
- 8) Press the **[EXEC]** soft key.
 - This starts reading the NC program and the word “OUTPUT” blinks in the lower right of the screen. To cancel the output of the NC program, press the **[CAN]** soft key.

This completes the NC program output procedure.

3.3 SRAM Data Backup

SRAM data includes NC parameters, tool offset data, pitch error compensation data, common macro variables and other data. SRAM data can be used for the following purpose.

- To restore the machine condition after a CNC power (battery) in SRAM is lost.
- When some serious problems occurred, it may be necessary to send SRAM data to Makino service representative to confirm NC internal processing status.

Backup Procedure

- 1) Power Off the machine. Insert a memory card into the PCMCIA port on the main operator panel.
- 2) Turn On the main circuit breaker.
- 3) Press the **[CONTROL POWER ON]** switch by holding down the **[6]** and **[7]** keys on the MDI panel. The main system boot screen is displayed.
- 4) Use the arrow **[↑]** and **[↓]** keys on the MDI panel to navigate the menu selection. Select “7. SRAM DATA UTILITY”.
- 5) Press the **[2]** key or the **[INPUT]** key on the MDI panel to enter the selection.
- 6) Select “1. SRAM BACKUP (CNC → MEMORY CARD)”. Then press the **[3]** key or the **[INPUT]** key to start the backup.
 - Press the **[4]** key to cancel the backup.
- 7) A file with default name “SRAM_BAK.001” is created in the memory card.
 - If the data can not be save entirely into a single memory card, “SET MEMORY CARD NO. 002” message is displayed. With the power still On, insert the second memory card and press the **[3]** key or the **[INPUT]** key to resume the backup.
 - Press the **[4]** key to cancel the backup.
- 8) Select “4. END” and then press the **[2]** key or the **[INPUT]** key to go back to main system boot screen.
- 9) Select “1. END” to end the backup operation and NC boots up normally.

This completes the SRAM data backup procedure.

1 Overview

The maintenance screens are used to modify machine settings, restore operations and perform adjustments when the machine is stopped due to an abnormal condition.

Below is the Maintenance Menu screen available in Professional u controller.

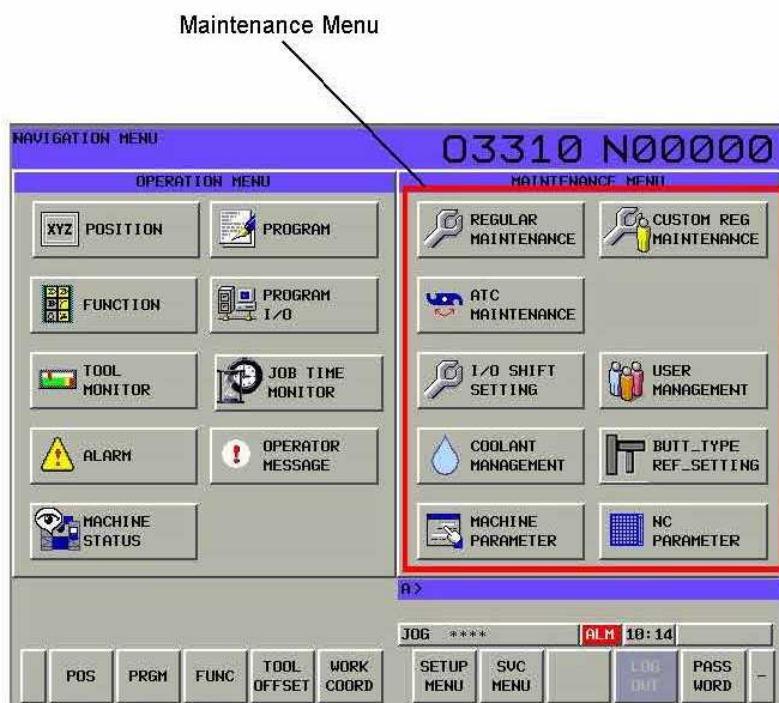


Figure 1.1 Maintenance Menu Screen

-NOTE-

Machine operator may need to login the user privilege level before he/she can activate certain maintenance functions. (Refer to [Instruction Manual Chapter 4, 4.12 User Management Screen](#))

2 Automatic Tool Changer (ATC)

The Automatic Tool Changer (ATC) is an integral part of the machine and needs to be properly maintained to preserve it in good working condition. The ATC system has been designed with features and functions to assist the operator in performing these operations easily and efficiently. The operator should familiarize with the maintenance procedures to minimize the downtime of the machine during maintenance or recovery operations.

2.1 ATC Maintenance Items

By controlling the ATC Maintenance items listed below, the operator is able to perform maintenance operations or recover the ATC from abnormal stop conditions.

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

2.2 ATC Maintenance Screen

The ATC Maintenance screen is used for each of the following units:

- ATC solenoid maintenance
- ATC magazine solenoid maintenance
- ATC magazine servo maintenance
- ATC arm maintenance

ATC Maintenance mode enable can be protected by password in the User Management screen.

Display Procedure

- 1) Ensure the user level privilege is enabled for ATC Maintenance mode.
 - Login is necessary.
- 2) Press the **[CUSTOM2]** key on the MDI panel to display the Navigation Menu screen.
- 3) Press the **[MAINT MENU]** soft key. Then press the **[ATC MAINTENANCE]** button on screen.
- 4) On the ATC Maintenance screen, press the **[MAINT MODE]** soft key to activate ATC maintenance mode.
- 5) If a warning “EX2040 MACHINE NOT STOP” appears, reset the warning and press the **[NC RESET]** key on MDI panel. Then try the above steps again.

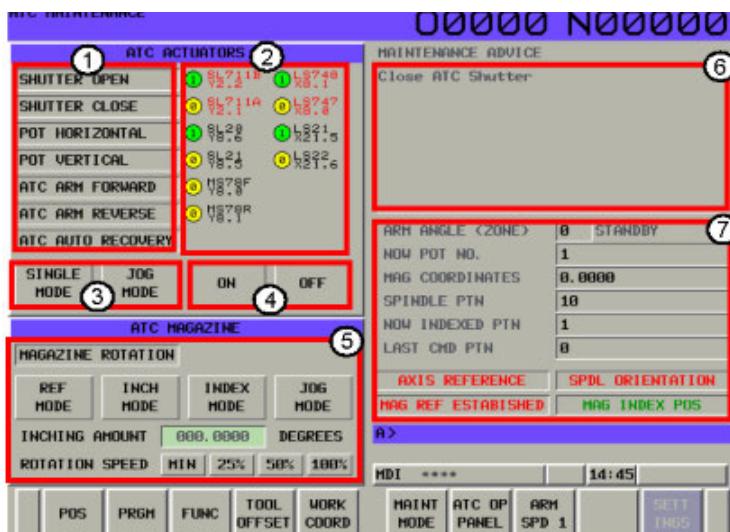


Figure 2.1 ATC Maintenance Screen

Display Content

1	Maintenance Item List The items which maintenance can be performed individually with the following solenoids/actuators.
2	Solenoid/Limit Switch Status The current status, symbol and address of each actuator/solenoid and limit switch are displayed.
3	Action Mode Single Mode: Movement is performed to the end point (single step) when the [ON] button is pressed. Jog mode: Movement is performed while the [ON] button is held down and stops when it is released.
4	Action Press the [ON]/[OFF] button to perform the maintenance operation.
5	ATC Magazine Information ATC magazine operation mode selections and status are displayed.
6	Maintenance Advice Provides operation advice when the maintenance operation could not be performed.
7	ATC Maintenance Information Information required for operating the ATC arm and magazine are displayed.

Operation Procedure

- 1) Observe the following conditions before doing the ATC maintenance operation.
 - Ensure the ATC arm and the ATC magazine are in stop condition.
 - Ensure all the feed axes (X, Y, Z, 4, 5) are in the safe position.
 - Press the [NC RESET] key on the MDI panel.
 - Release ATC Manual Intervention mode on the ATC operation panel.
 - Release the Tool Call mode on the Tool Data Management screen.
 - Press the [MAINT MODE] soft key on the ATC Maintenance screen.
- 2) In normal situation, the Z-axis need to move to the 2nd reference position and a spindle orientation is required.
- 3) If step 2 is not established due to the ATC arm position not in standby, press the [OT RELEASE] button on the main operator panel while activating the ATC maintenance item.

2.3 Confirming Signal Status

ATC signal status can be viewed from the ATC Maintenance screen.

The current value of the input and output are represented by the yellow and green circles.

- when the value is 0, the circle is yellow.
- when the value is 1, the circle is green.

ATC status:

- when the symbols and addresses are in black colour, the ATC is in Standby/Home condition.
- when the symbols and addresses are in red colour, the ATC is not in Standby/Home condition.

ATC ACTUATORS			
SHUTTER OPEN	(1) SL711B Y2.2	(1) LS748 X8.1	
SHUTTER CLOSE	(0) SL711A Y2.1	(0) LS747 X8.0	
POT HORIZONTAL	(1) SL20 Y8.6	(1) LS21 X21.5	
POT VERTICAL	(0) SL21 Y8.5	(0) LS22 X21.6	
ATC ARM FORWARD	(0) MS78F Y8.0		
ATC ARM REVERSE	(0) MS78R Y8.1		
ATC AUTO RECOVERY			

Figure 2.2 Confirming Signal Status

2.4 Confirming Maintenance Advice

The maintenance advice can be viewed from the ATC Maintenance screen. Based on the operation being performed, the advice will automatically update to inform the required conditions to activate the selected operation.

When a maintenance advice is shown on the screen, the selected operation cannot be activated. To override this condition, press the [OT RELEASE] button.

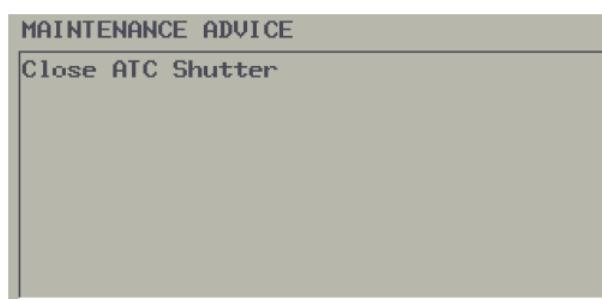


Figure 2.3 Confirming Maintenance Advice

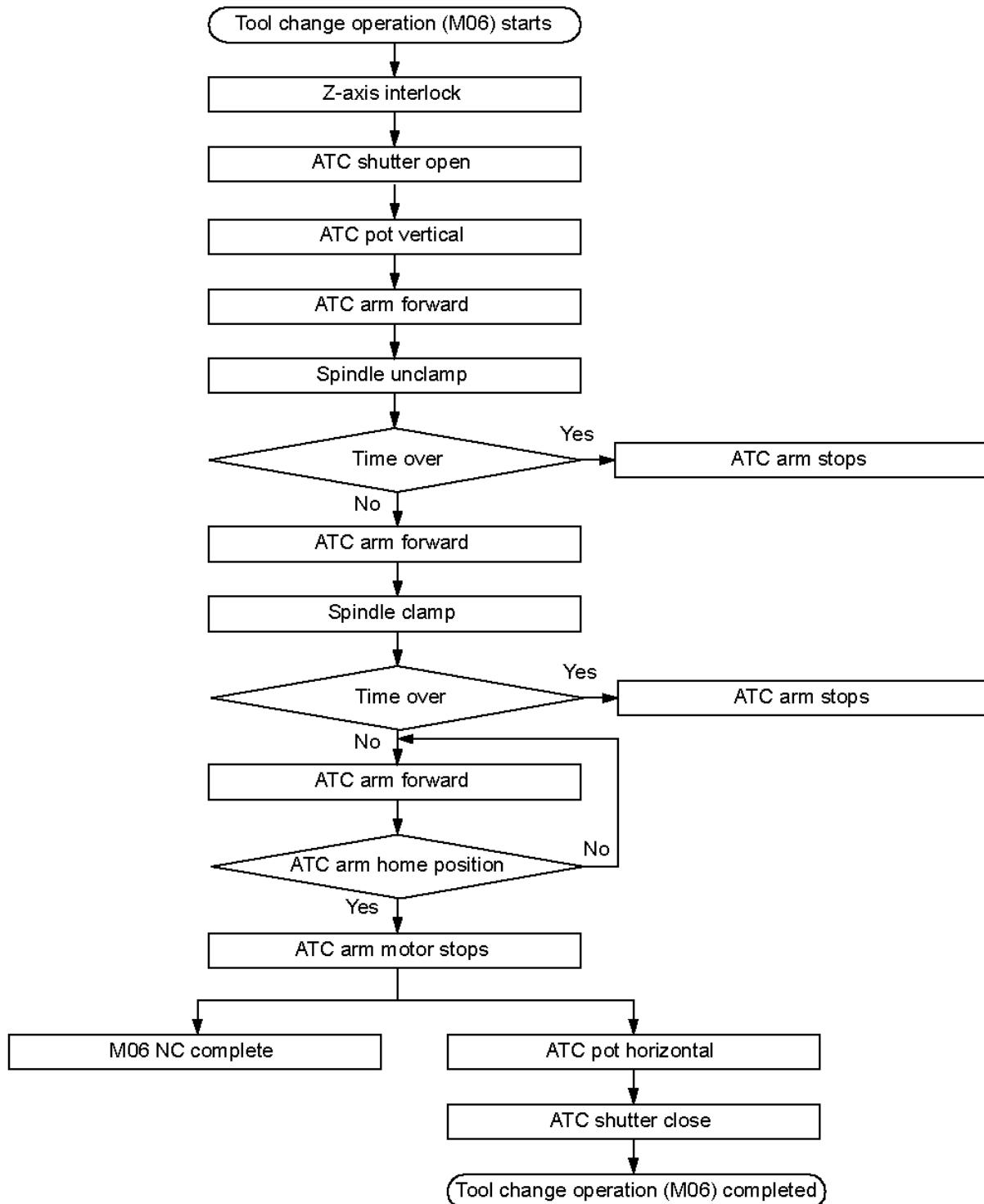
2.5 Tool Change Operation Overview

A single tool change process involves the operation of many mechanisms in a synchronized sequence. The basic outline of the ATC operation is:

- 1 Z-Axis move to 2nd Reference Position
- 2 Spindle Orientation
- 3 Coolant Off
- 4 ATC Shutter Open
- 5 ATC Pot Vertical
- 6 ATC Arm Forward
- 7 Spindle Unclamp
- 8 ATC Arm Forward
- 9 Spindle Clamp
- 10 ATC Arm Forward
- 11 ATC Arm Stop at Standby Position
- 12 ATC Pot Horizontal
- 13 ATC Shutter Close

This is a basic overview of the ATC operation. The actual tool change sequence on the machine may differ based on the options selected.

2.5.1 Tool Change Operation Sequence



2.6 ATC Recovery Operation

To restore the ATC to standby position manually during an abnormal stoppage requires understanding of the ATC operation sequence. To facilitate ease of operation, an Auto Recovery function is available for the operator.

Observe the following conditions before doing the ATC maintenance operation.

- Ensure the ATC arm and the ATC magazine are in stop condition.
- Ensure all the feed axes (X, Y, Z, 4, 5) are in the safe position.
- Press the **[NC RESET]** key on the MDI panel.
- Release ATC Manual Intervention mode on the ATC operation panel.
- Release the Tool Call mode on the Tool Data Management screen.
- Press the **[MAINT MODE]** soft key on the ATC Maintenance screen.

-NOTE-

After any operation of the ATC in Maintenance mode, always check and ensure that the tool data is correct.

2.6.1 ATC Manual Recovery Operation

To return the ATC to standby condition requires the following conditions to be established.

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

ATC shutter close operation requires the following conditions to be established.

- ATC Pot Horizontal
- ATC Arm Home Position

ATC pot horizontal operation requires the following conditions to be established.

- ATC Shutter Open
- ATC Arm Home Position

To return the ATC arm to home position requires the following conditions to be established.

- ATC Shutter Open
- ATC Pot Vertical
- Spindle Orientation
- Spindle Clamp or Unclamp, depending on the current ATC arm position.

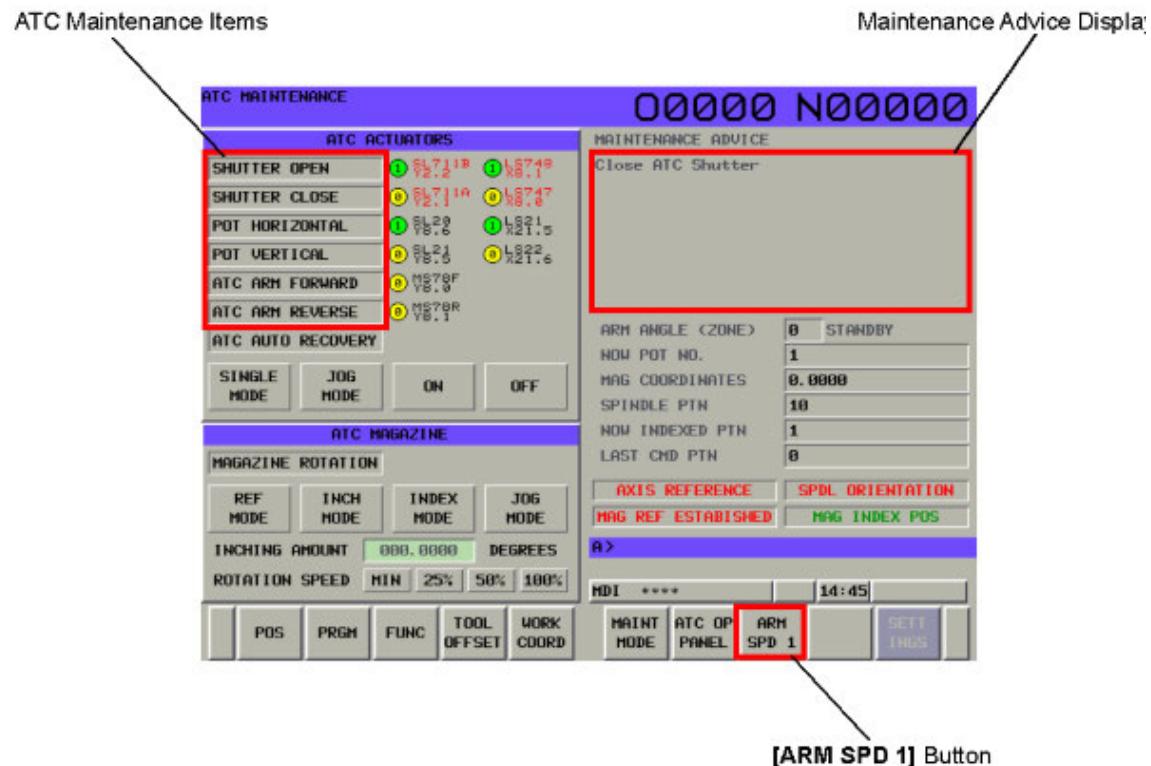


Figure 2.4 ATC Manual Recovery Procedure

- Select each item on the ATC Maintenance screen and refer to the maintenance advice to recover the ATC to standby position.
- For ATC arm forward and reverse operations refer to the arm angle (zone) display.
- To adjust the ATC arm speed, press the **[ARM SPD 1]** button on the ATC Maintenance screen.
- Press the **[OT RELEASE]** button on the main operation panel to bypass the interlock condition if necessary.

-NOTE-

Take additional care when operating under OT Release mode.

2.6.2 ATC Auto Recovery Operation

The ATC Auto Recovery function is a one-touch function that checks the current positions of every ATC limit switches and sensors and automatically controls the appropriate solenoids/actuators to return the ATC to standby position.

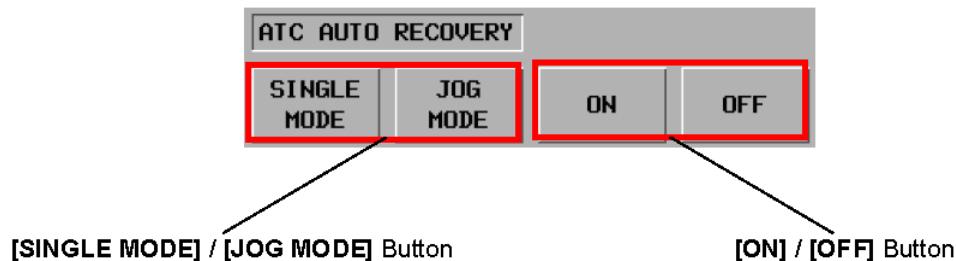


Figure 2.5 ATC Manual Recovery Operation

Single Mode Operation

- 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 Operation

- 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.

After the Auto Recovery operation, always check and ensure the tool data is correct.

3 ATC Magazine

3.1 ATC Magazine Maintenance Screen

The ATC magazine maintenance items are incorporated together with the ATC actuators into the ATC Maintenance screen.

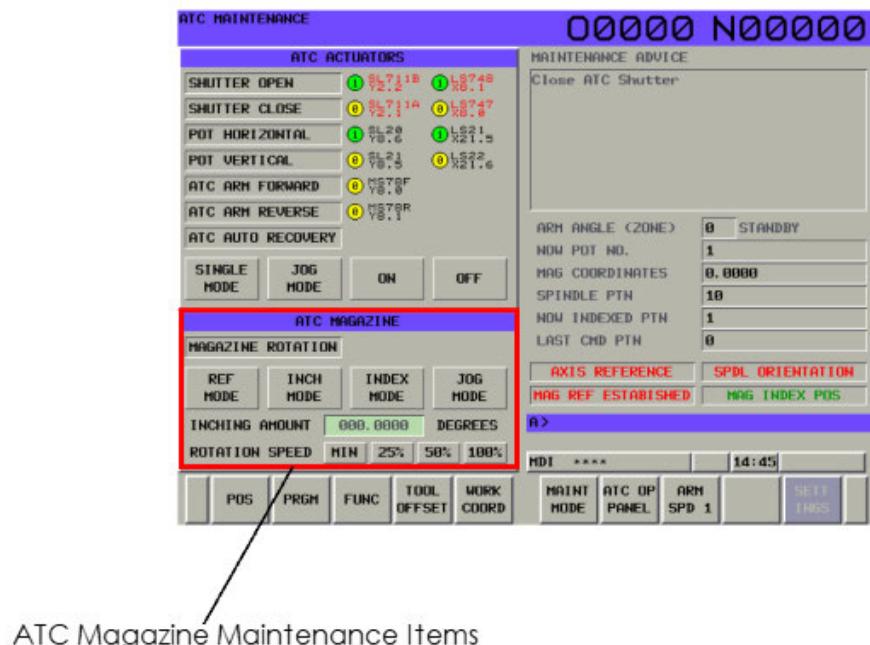


Figure 3.1 ATC Magazine Maintenance Screen

3.2 ATC Magazine Operation Overview

The ATC magazine is a ring type magazine that can rotate clockwise or counter-clockwise. As the ATC magazine cannot be viewed when the operator is standing at the main operator panel, the clockwise (CW) and counter-clockwise (CCW) buttons are located at the ATC operator panel, (Refer to [Instruction Manual Chapter 4, 9.5.3 ATC Operation Panel \(ATC Magazine Side\)](#)).

The ATC magazine can operate in the following modes:

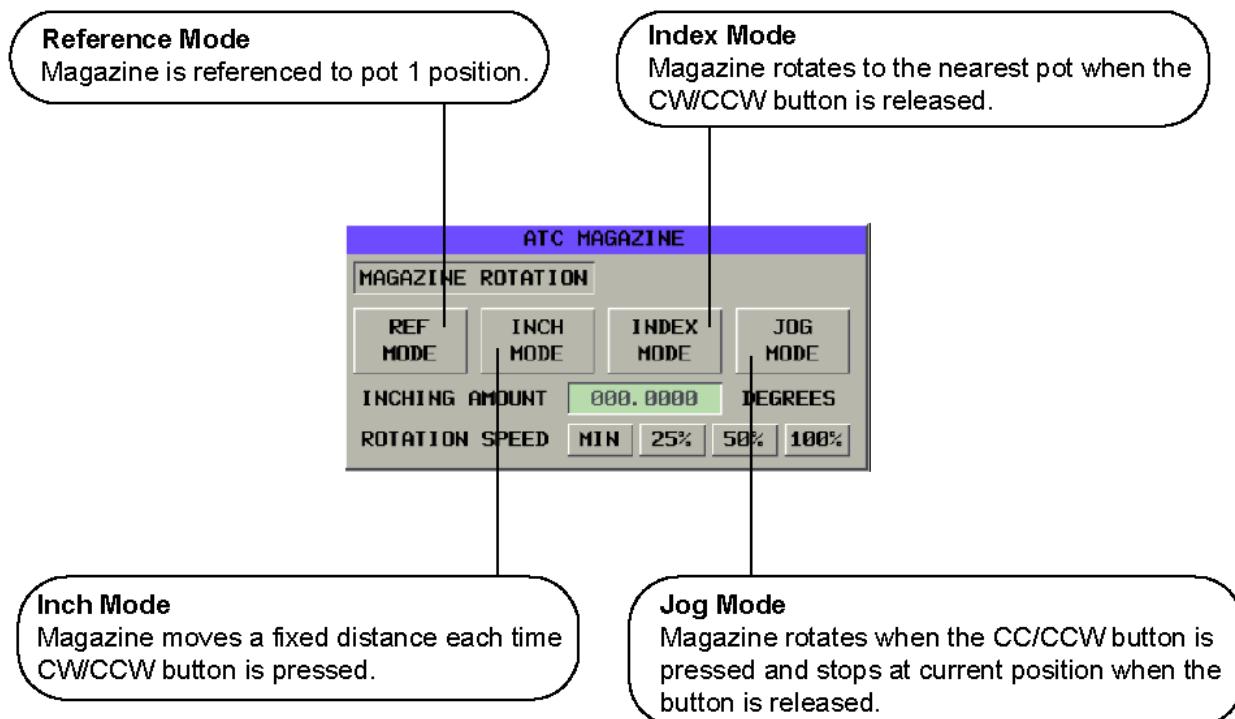


Figure 3.2 ATC Magazine Operation Overview

3.3 ATC Magazine Operation Procedure

To operate the ATC magazine, perform the following procedure.

Operation Procedure

- 1) Enable **[MAINT MODE]**.
- 2) Enable **[ATC OP PANEL]**.
- 3) Select “MAGAZINE ROTATION”.
- 4) Select an operation mode (REF/INCH/INDEX/JOG).

Example: INCH MODE

- a) Enter the inching amount.
- b) Select a rotation speed.
- c) Press the CW or CCW button on the ATC operator panel.

This completes the ATC magazine operation procedure.

4 Fixture Operation

This chapter contains the specifications of the hydraulic fixture interface and the basic operation procedures used during operation and maintenance.

4.1 Basic Mechanical Specifications

The following items are available for hydraulic fixture option:

- Up to 4 hydraulic lines (2 double acting cylinders)
- Up to 4 air seat sensors
- Up to 2 additional position sensors
- 1 fixture coolant
- Two-hand push buttons
- Striker switch
- Area sensor
- Intermittent or Continuous operation hydraulic power pack

4.2 Basic Software Specification

Hydraulic fixture option is only available from the following PRO *u* software version.

C Exe Software	P12C-AA07 or later
PMC1 Ladder Software	P12L-AA07 or later
FP Software	P12S-AA07 or later

The sequence logic for work load/unload and fixture clamp/unclamp can be modified to customer requirements.

The following can be customized:

- Fixture Main Clamp/Unclamp Sequence
- Fixture Auxiliary Clamp/Unclamp Sequence
- M Code (M530/M531) Sequence
- Work Load/Unload Sequence

4.3 Parameters

The MC parameters available for customer adjustment are listed below.

No.	Description	Setting
14003	Fixture Coolant On Time If fixture coolant is activated during the work load sequence, this parameter controls how long the fixture coolant is to remain turned On.	Default setting: 3 Units: sec
14005	Seat Monitor Stab Time Set the minimum time the seat check signal must be Off before a warning/alarm is triggered.	Default setting: 1000 Units: msec
14009	Seat Monitor During Machining Set the work seating is monitored during machining.	Default setting: 1 0: No 1: Yes

-NOTES-

MC parameters can be accessed from the MC Parameter screen after password login or from the Fixture Setting screen.

4.4 M Codes

The following M codes are available for fixture control.

M Code	Description
M530	Fixture Code 1
M531	Fixture Code 2
M534	Fixture Coolant Off
M535	Fixture Coolant On
M508	Operator Door Close
M509	Operator Door Open

4.5 Fixture Manual Operation

There are two ways to operate the fixture manually:

- Fixture Manual Operation Panel (Option)
- Fixture Maintenance Screen

The standard fixture interface comes with the Fixture Maintenance screen as a standard. Customer who prefer a hardware interface can purchase the fixture manual operation panel separately. If the hardware is installed, the software screen is disabled.

Both methods allow the control of the fixture manually. However, the Software Maintenance screen will provide more functionality as well as operation advice to the operator.

4.5.1 Fixture Manual Operation Panel (Option)

The fixture manual operation panel is located at the bottom of the main operation panel.

The following functions are available:

- Auto Manual Mode
- Fixture Clamp
- Fixture Unclamp
- Door Open
- Door Close
- Ejector Up (Auxiliary Fixture Clamp)
- Ejector Down (Auxiliary Fixture Unclamp)

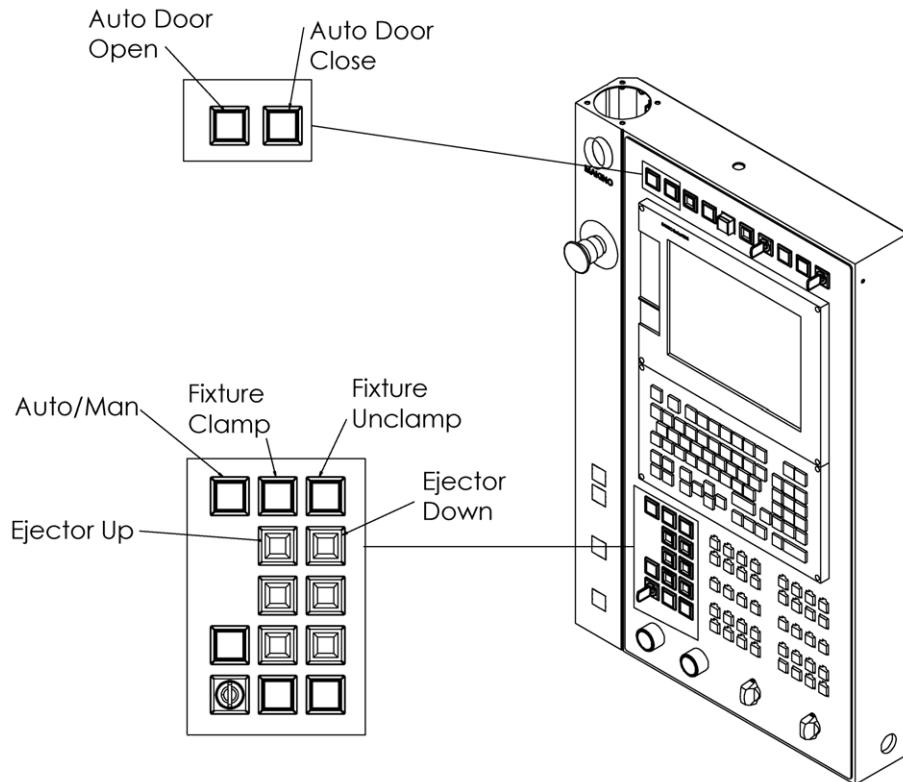


Figure 4.1 Fixture Panel Operation Panel (Option)

The lamps of each button will indicate the current status of the fixture. Manual mode must be enabled for the buttons on the fixture operation panel to be functional. The **[AUTO/MAN]** button will be lighted when Manual mode is turned On.

4.6 Fixture Maintenance Screen

To access the Fixture Maintenance screen, press the **[MAINT MENU]** soft key on the main Navigation Menu screen. The Maintenance Menu is displayed, press the **[FIXTURE MAINTENANCE]** button.

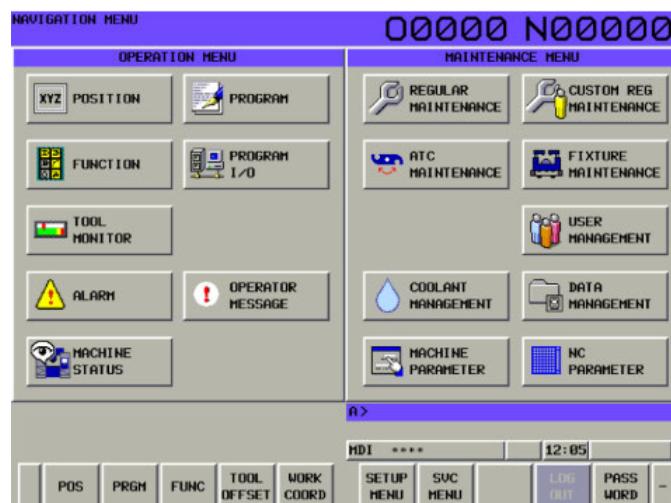


Figure 4.2 Fixture Maintenance Button on Navigation Menu Screen

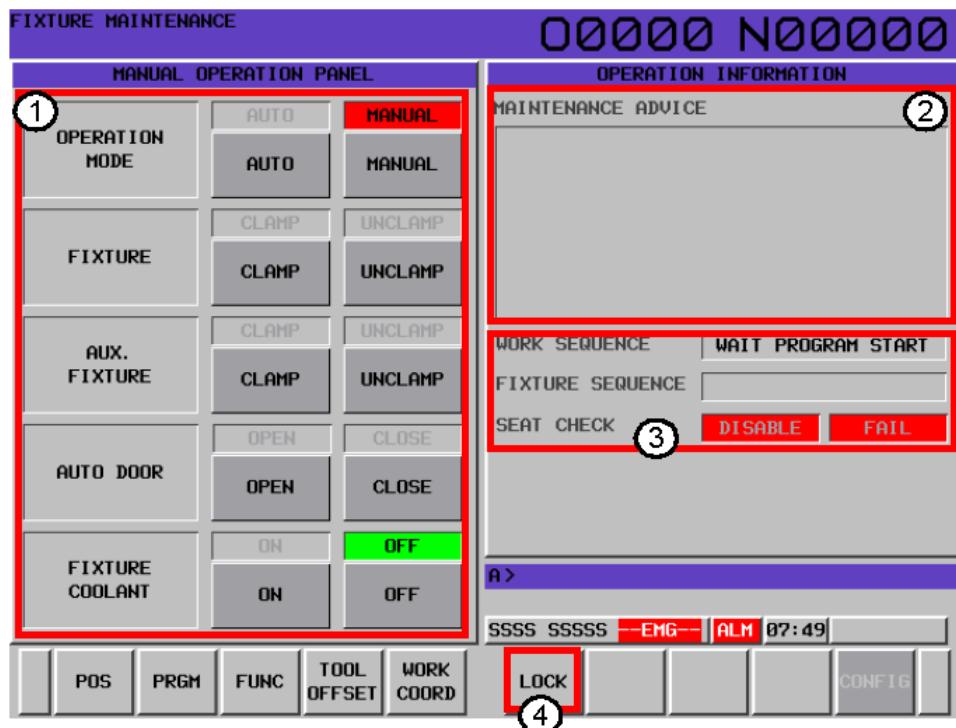


Figure 4.3 Fixture Maintenance Screen

Display Content.

1 Fixture Operation Setting

The following items can be operated in the Fixture Maintenance screen:

- Operation Mode (Auto/Manual)
- Fixture Clamp/Unclamp
- Auto Door Open/Close
- Fixture Coolant On/Off

For safety, only one item can be operated at one time.

2 Maintenance Advice

Basic maintenance advice is displayed to assist in fixture operation.

3 Step Sequence

The current step in the Work Load/Unload sequence and the Fixture Clamp/Unclamp sequence are displayed here. Seat Check Enabled/Disabled status as well as Seat Check Pass/Fail status is also displayed.

4 Lock

It is necessary to unlock the screen by pressing the **[LOCK]** button. When pressed, the button will light up and display **[UNLOCK]**, allowing the operator to use the buttons on the screen.

-NOTE-

The screen shown above is for reference only (Refer to [Figure 4.3](#)). In the actual machine, options not installed will not appear. Example; Auto Door, Fixture Coolant, Air Seat, etc.

4.7 Manual Operation Panel

The following control items are provided for manual operation:

- Operation Mode
- Fixture
- Aux. Fixture
- Auto Door
- Fixture Coolant

Only one item can be enable (controlled) at any one time. Press the button to select the item. The button will be highlighted in yellow once it is enabled.

-NOTE-

- 1 According to machine fixture configuration, some of the control items may not exist.
- 2 The control item can only be selected when the screen is in “Unlock” mode.

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For each control item, there is a pair of indication lamps and control buttons. The control buttons are only enabled when the corresponding item is selected.

1 Operation Mode

Auto Lamp : Indicate fixture is in Auto mode if the lamp becomes green

Manual Lamp : Indicate fixture is in Manual mode if the lamp becomes red

Auto Button : Switch fixture mode to Auto

Manual Button : Switch fixture mode to Manual

2 Fixture

Clamp Lamp : Indicate fixture is clamped if the lamp becomes green

Unclamp Lamp : Indicate fixture is unclamped if the lamp becomes red

Clamp Button : Manually execute fixture clamp

Unclamp Button : Manually execute fixture unclamp

3 Aux. Fixture

Clamp Lamp : Indicate aux. fixture is clamped if the lamp becomes green

Unclamp Lamp : Indicate aux. fixture is unclamped if the lamp becomes red

Clamp Button : Manually execute aux. fixture clamp

Unclamp Button : Manually execute aux. fixture unclamp

4 Auto Door

Open Lamp : Indicate auto door is opened if the lamp becomes red

Close Lamp : Indicate auto door is closed if the lamp becomes green

Open Button : Manually execute auto door open

Close Button : Manually execute auto door close

5 Fixture Coolant

- On Lamp : Indicate fixture coolant is On if the lamp becomes red
- Off Lamp : Indicate fixture coolant is Off if the lamp becomes green
- On Button : Manually turn On fixture coolant
- Off Button : Manually turn Off fixture coolant

Fixture Manual Clamping Procedure

- 1) Press the **[LOCK]** soft key to unlock fixture manual control.
- 2) Press the **[FIXTURE]** button, follow the Maintenance Advice to meet the requirement for manual fixture control.
- 3) Press the **[CLAMP]** button to do manual clamping.

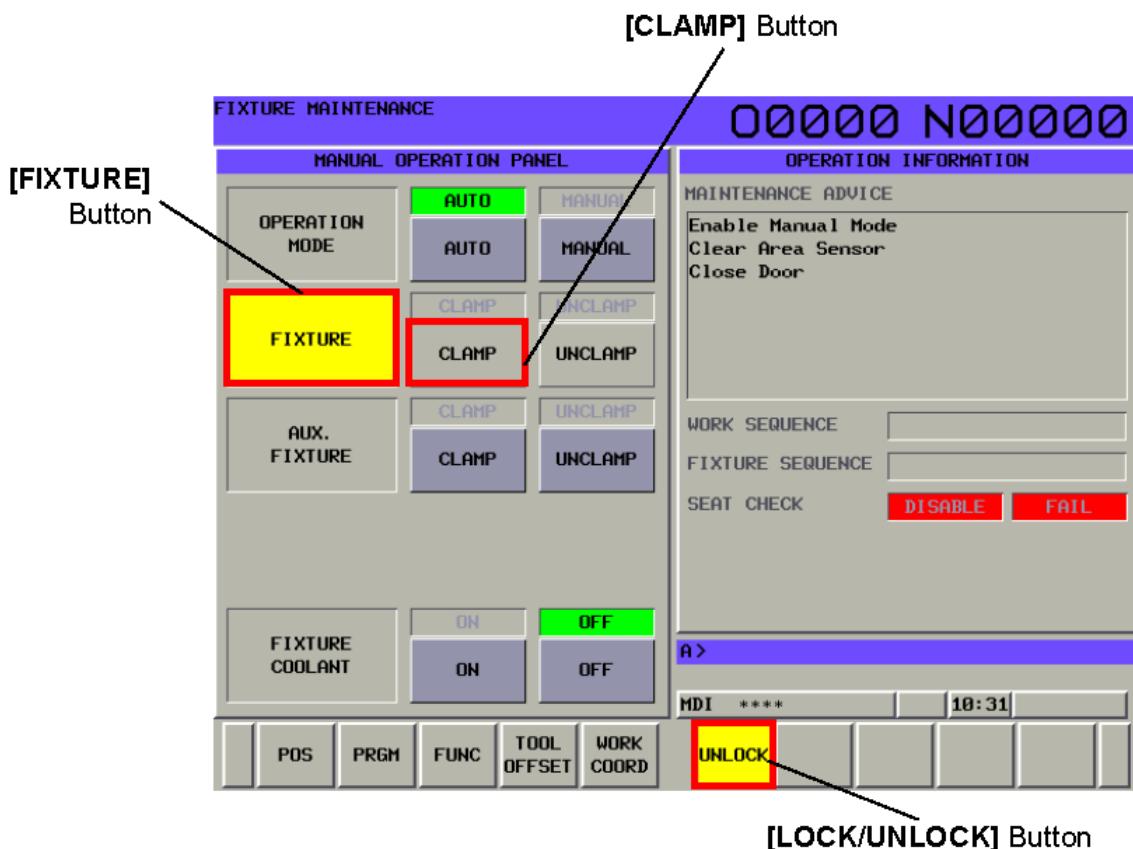


Figure 4.4 Fixture Manual Clamping Operation Procedure

5 Control Specification

5.1 Air Seat Check (Option)

Air seat check (option) is used to ensure that the component is securely held by the fixture for safety as well as to ensure good surface finish. The air seat panel is located at the top of main operator panel. A key is provided for the operator to enable/disable air seat check.

4 seat check signals are available: 7

Seat Check	Symbol	Address
1	LS1781	X0064.4
2	LS1782	X0064.5
3	LS1783	X0064.6
4	LS1784	X0064.7

These seat check signals can only be used for 1 fixture. 1 to 4 signals can be assigned to the fixture and each signal can be set to N.O. or N.C.

Seat check is checked after the fixture is clamped during work setup. Seat check can also be set to monitor continuously during machining.

Seat check performed during work loading, it is possible to enable “Seat Retry”. This will allow the seat check operation to be attempted one more time before the Seat Check Failed alarm is triggered. During seat retry, the fixture will unclamp for 1sec then clamp back and perform the seat check again.

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The following alarm will occur if the seat check fails:

No.	Description	Details
EX1642	Seat Check Failed	Seat Check Pass Status not established during work loading. Replace the workpiece and retry. If problem repeats, check the fixture for defect.

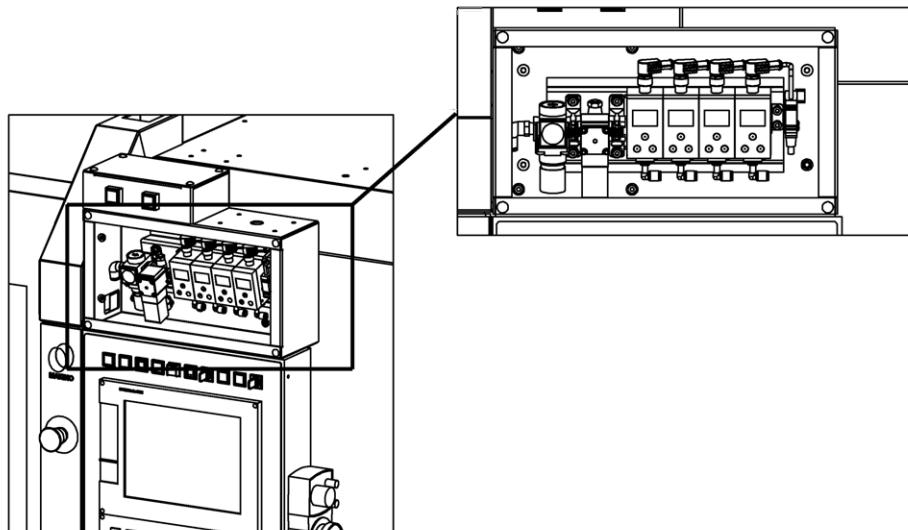


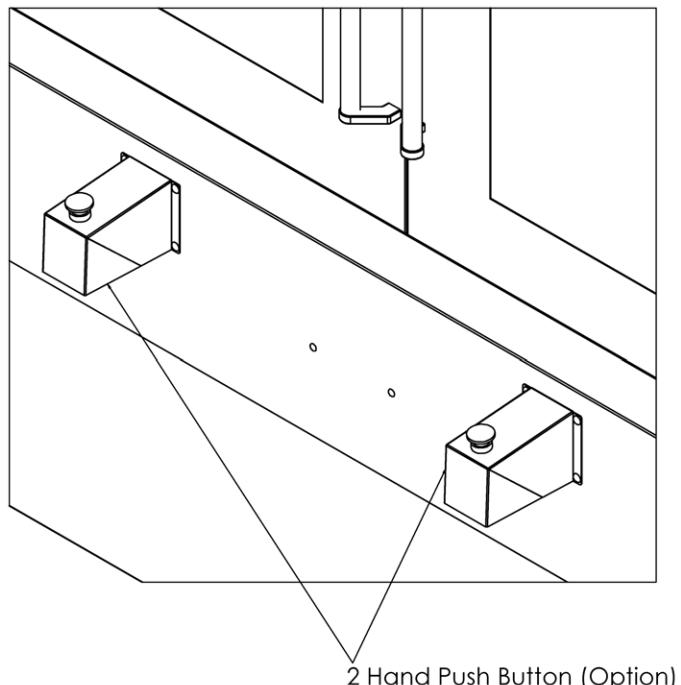
Figure 5.1 Air Seat Control Panel

5.2 Work Load Trigger Type

There are two main methods to trigger work loading:

- 2 Hand Push Button (Option)
- Striker Switch (Option)

Activating either one will trigger work loading to start. Both items are options and must be ordered separately from the hydraulic fixture. It is also possible to install both options and split the work loading process into two steps (Refer to [5.6 Work Load/Unload](#) [91]).



2 Hand Push Button (Option)

Figure 5.2 2 Hand Push Button (Option)

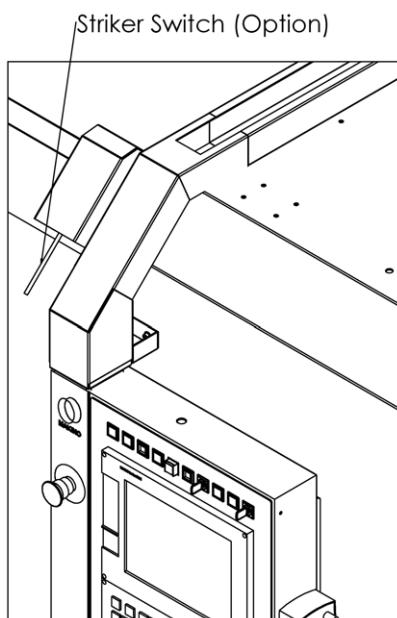


Figure 5.3 Striker Switch (Option)

5.3 Hydraulic Power Pack

The hydraulic power pack is used to supply hydraulic fluid to the fixture to operate the solenoids. The power pack can be controlled in two ways, intermittent or continuous On. Optional to the power pack, a level sensor and temperature sensor for the oil can be added.

Base on the type of hydraulic power pack selected, the control of the power pack will varies. the following are alarms and warnings applicable to the power pack.

Alarms

No.	Description	Details
EX1697	HYD MTR OVLD (M260)	The thermal relay (TH260) of the hydraulic motor has tripped. Open the MTC cabinet and reset the thermal switch. Allow the machine to cool and restart the machine.
EX1698	HYD OIL LEVEL LOW	Hydraulic oil level is low. Stop the machine and refill the hydraulic fluid.
EX1699	HYD OIL TEMP HIGH	Hydraulic oil temperature is high. Switch Off the machine. Allow the oil to cool and restart the machine.
EX1700	HYD MTR ON TIME OVER	The intermittent control power pack is On for too long. Pressure is not building up in the power pack. Check for leakage in the manifold and pipes.

Warnings

No.	Description	Details
EX2188	HYD OIL LEVEL LOW	Hydraulic oil Level is low. Stop the machine and refill the hydraulic fluid.
EX2189	HYD OIL TEMP HIGH	Hydraulic oil temperature is high. Switch Off the machine. Allow the oil to cool and restart the machine.

5.4 Fixture Clamp/Unclamp

The fixture clamp/unclamp operation can be divided into main and auxiliary. Auxiliary clamp/unclamp is usually used for pre-positioning before the main clamp/unclamp is engaged. It can also be used as an ejector to displace the workpiece from the fixture. Auxiliary clamp/unclamp function is optional and must be enabled by parameter to function.

Main Clamp/Unclamp and Auxiliary Clamp/Unclamp can control the following signals.

Item	Address	Symbol	Description
Hydraulic Line 1	X0060.4	PS2601	HYD PRESSURE SWITCH 1
	Y0060.4	SL2601	HYD SOLENOID 1
Hydraulic Line 2	X0060.5	PS2602	HYD PRESSURE SWITCH 2
	Y0060.5	SL2602	HYD SOLENOID 2
Hydraulic Line 3	X0060.6	PS2603	HYD PRESSURE SWITCH 3
	Y0060.6	SL2603	HYD SOLENOID 3
Hydraulic Line 4	X0060.7	PS2604	HYD PRESSURE SWITCH 4
	Y0060.7	SL2604	HYD SOLENOID 4
External Input 1	X0062.4	LS1881	POSITION SENSOR 1
External Input 2	X0062.5	LS1882	POSITION SENSOR 2

Each operation has a fixed number of steps that can be processed when it is triggered.

The specification of each step can be customized for each customer.

Operation	No. of Steps
Main Clamp	4
Main Unclamp	3
Auxiliary Clamp	2
Auxiliary Unclamp	1

5.4.1 Fixture Clamp/Unclamp Start Condition

The following conditions must be met for clamp/unclamp operation to execute:

- Maintenance mode Off
- ATC standby position
- Door close
- Door Interlock key released
- Area sensor clear (Option)
- Machine not running

When operating the fixture manually using manual panel or maintenance screen, the following additional conditions are required:

- NC Manual Mode
- Fixture Manual Mode

Alarms are generated if the conditions are not satisfied. Check that all required conditions are satisfied, reset the alarm and try the operation again.

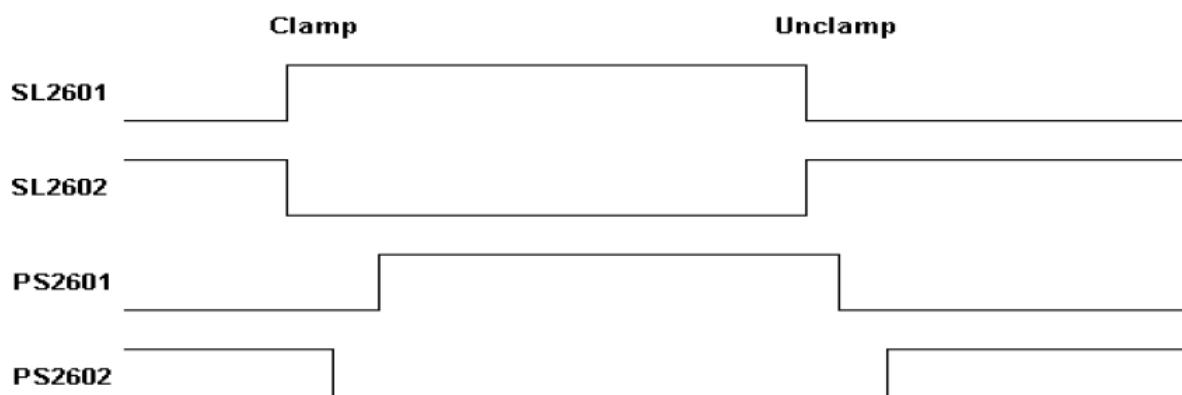
No.	Description	Details
EX1664	MAINT MODE NOT OFF	Turn Off maintenance mode.
EX1665	OPERATOR DR NOT CLOSE	Close operator door.
EX1666	ATC ARM NOT STANDBY	Return the ATC arm to home position.
EX1667	Fixture 1 CLAMP TIME OVER	Fixture main clamp limit time exceeded.
EX1668	Fixture 1 UNCLMP TIME OVER	Fixture main unclamp limit time exceeded.
EX1669	AUX CLAMP TIME OVER	Auxiliary clamp limit time exceeded.
EX1670	AUX UNCLAMP TIME OVER	Auxiliary unclamp limit time exceeded.

5.4.2 Fixture Default Configuration

Below is the fixture default configuration.

Item	Step Signal	Main Clamp				Main Unclamp		
		1	2	3	4	1	2	3
Hydraulic Line 1	PS2601				On			Off
	SL2601				On			Off
Hydraulic Line 2	PS2602				Off			On
	SL2602				Off			On
Hydraulic Line 3	PS2603							
	SL2603							
Hydraulic Line 4	PS2604							
	SL2604							
External Input 1	LS1881							
External Input 2	LS1882							

This setup is for a standard double acting solenoid in a basic clamp unclamp fixture. The behavior of the solenoids is as follows:



There is no default setting for auxiliary fixture as it is an option.

5.4.3 Customized Clamp/Unclamp Specification

The specification customized for your operation is:

Main Clamp/Unclamp

Item	Step Signal	Main Clamp				Main Unclamp		
		1	2	3	4	1	2	3
Hydraulic Line 1	PS2601							
	SL2601							
Hydraulic Line 2	PS2602							
	SL2602							
Hydraulic Line 3	PS2603							
	SL2603							
Hydraulic Line 4	PS2604							
	SL2604							
External Input 1	LS1881							
External Input 2	LS1882							

Auxiliary Clamp/Unclamp

Item	Step Signal	Auxiliary Clamp		Auxiliary Unclamp
		1	2	1
Hydraulic Line 1	PS2601			
	SL2601			
Hydraulic Line 2	PS2602			
	SL2602			
Hydraulic Line 3	PS2603			
	SL2603			
Hydraulic Line 4	PS2604			
	SL2604			
External Input 1	LS1881			
External Input 2	LS1882			

Entered By	
Date	

5.5 M530/M531

M530/M531 sequence allows configuration of the same 4 hydraulic lines and 2 external inputs (sensor) in a sequence up to 3 steps M code finish conditions is not mentioned after the M code is completed.

Each M code has 3 steps that can be processed when it is triggered. The specification of each step can be customized.

Operation	No. of Steps
M530	3
M531	3

There is no default setting for M codes.

5.5.1 Customized M Code Specification

The specification customized for your operation is:

Main Clamp/Unclamp

Item	Step Signal	M530			M531		
		1	2	3	1	2	3
Hydraulic Line 1	PS2601						
	SL2601						
Hydraulic Line 2	PS2602						
	SL2602						
Hydraulic Line 3	PS2603						
	SL2603						
Hydraulic Line 4	PS2604						
	SL2604						
External Input 1	LS1881						
External Input 2	LS1882						

Entered By	
Date	

5.6 Work Load/Unload

Work loading sequence is the process of preparing the part for machining and starting the machining process. Work unloading sequence is the process of unclamping the fixture to allow the part to be removed and a new part to be loaded.

Work load can be triggered by the following:

- 2 Hand Push Button
- Left Hand Push Button
- Right Hand Push Button
- Striker Switch

Work unloading sequence is triggered by M30.

5.6.1 Work Loading/Unloading Start Conditions

The following conditions are necessary for work load to start:

- Fixture auto mode On
- NC automatic operation mode (MEM/MDI/DNC)
- Door close (if no auto door option)
- Maintenance mode Off
- No program running
- Servo ready
- No machine alarms/warnings
- No fixture alarms/warnings
- ATC arm in standby position

The following are warnings triggered if the conditions above are not met.

No.	Description	Details
2178	NOT AUTO MODE	Fixture not in auto mode.
2179	WORK LOAD NOT COMPLETE	Work loading operation is not complete.
2180	MACHINE NOT STOP.	Machining program not stop. Reset NC.
2182	MANUAL MODE NOT ON	Fixture not in manual mode.
2183	SERVO NOT READY	Axis servo not ready (SA).
2184	AREA SENSOR TRIGGERED	Area sensor has been triggered.
2185	FIXTURE ALARMS NOT CLEARED	Fixture alarms triggered.
2187	MANUAL DOOR NOT CLOSED	Fixture cannot operate as door is not closed.
2193	UNLOAD JOB NOT COMPLETE	Work unloading job is not complete.
2198	MACHINE ALARM./WARNING	Machine alarm/warning status not cleared.
2199	MAINTENACE MODE NOT OFF	Fixture cannot operate as maintenance mode is not Off.

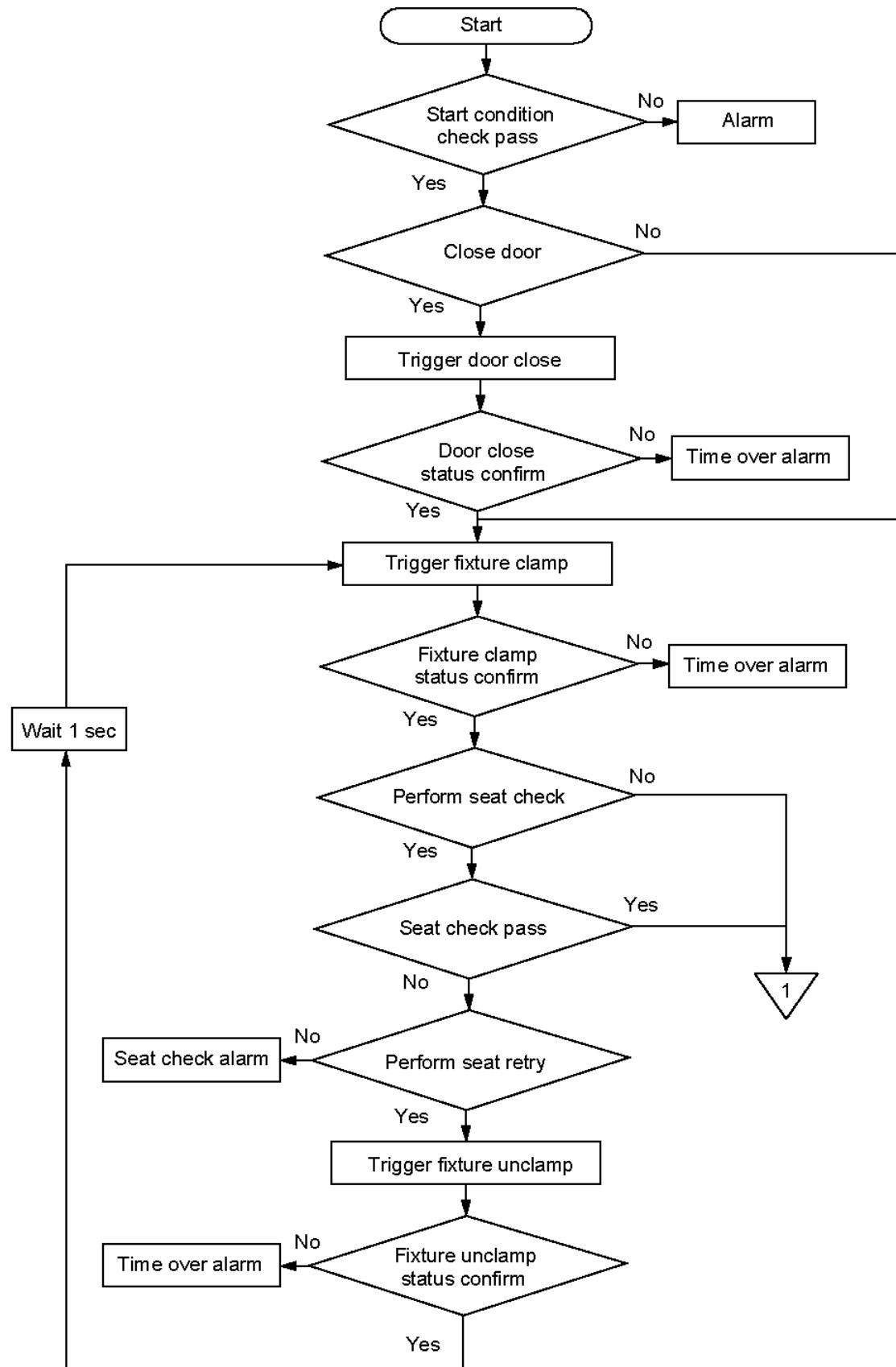
The following are alarms maybe triggered during work loading/unloading sequence:

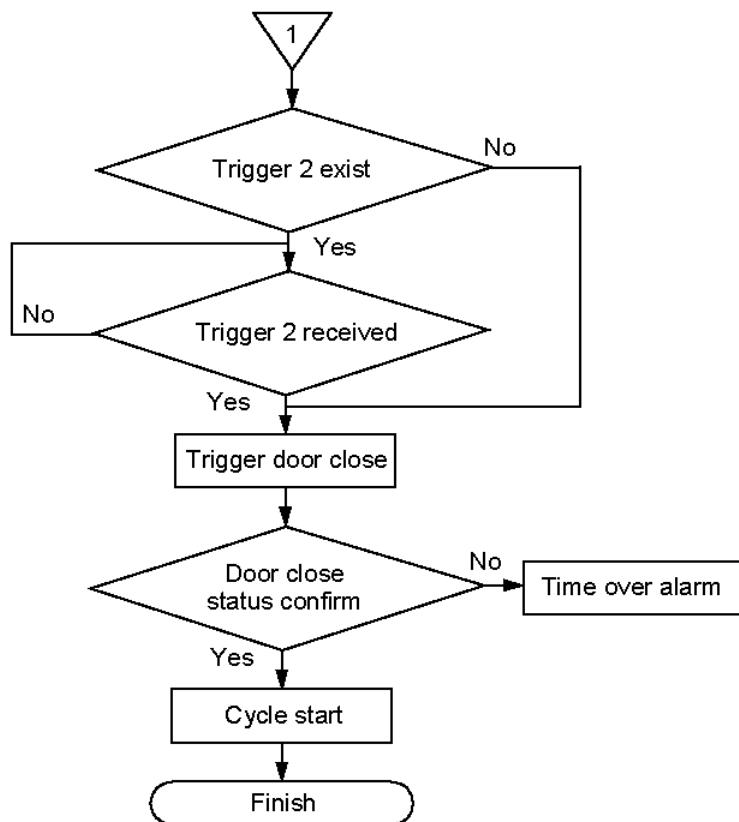
No.	Description	Details
EX1640	MAINT MODE NOT OFF	Turn Off maintenance mode.
EX1641	ATC ARM NOT STANDBY	Return the ATC arm to home position.
EX1642	SEAT CHECK FAILED	Seat check during work loading failed.
EX1643	WORK LOAD/UNLOAD TIME OVR	Work load/unload limit time exceeded
EX1645	AUTO OPERATION NOT STOP	Program not terminated. Press NC Reset.
EX1646	NOT NC PROGRAM RUN MODE	Not MDI. MEM. DNC mode.
EX1647	PROGRAM NOT START	Program did not start. Check program.
EX1717	AUTO DOOR NOT EXIST	Auto door was triggered but option not exist.
EX1719	AREA SENSOR TRIGGERED	Area sensor has been triggered.
EX1720	AUTO DOOR TIME OVER	Auto door motion limit time exceeded
EX1721	COOLANT NOT OFF	Machine coolant not Off.
EX1722	SPINDLE NOT STOP	Spindle rotation not stop.
EX1723	SAFETY DOOR TIME OVER	Safety door motion limit time exceeded.
EX1724	AUTO DOOR SW ABNORMAL	Auto Door Switch Signals abnormal.
EX1725	AXIS NOT STOP	Machine axis not stopped.
EX1742	DOOR NOT CLOSED	Operator door is not closed.
EX1743	Fixture CLNT NOT EXIST	Fixture coolant triggered but option not exist.

There is no standard work load/unload sequence. The operation will depend on the options installed with the fixture. The following are the available options:

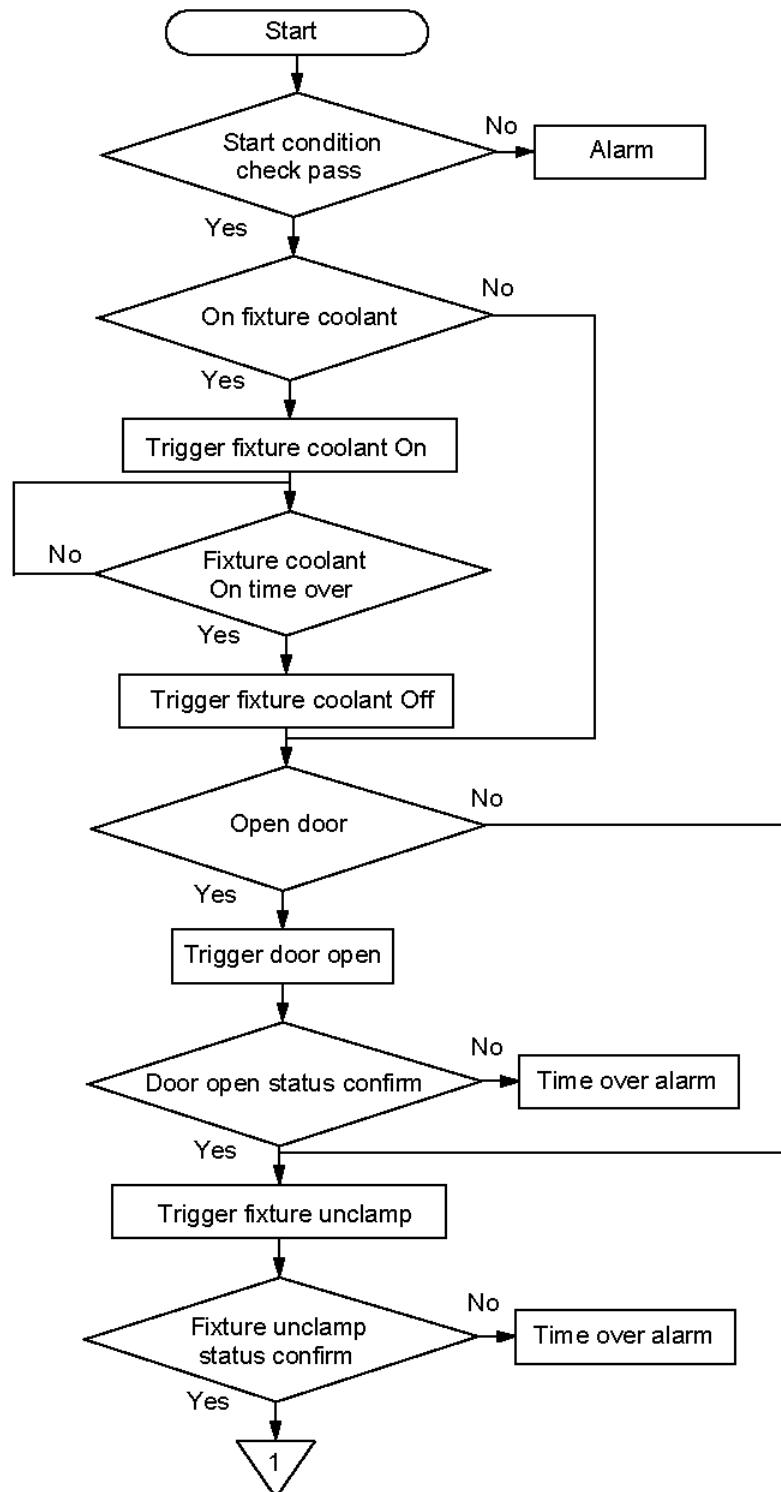
- Auto Door
- Air Seat Check
- Air Seat retry (only one time)
- 2nd Work Load trigger
- Fixture Coolant

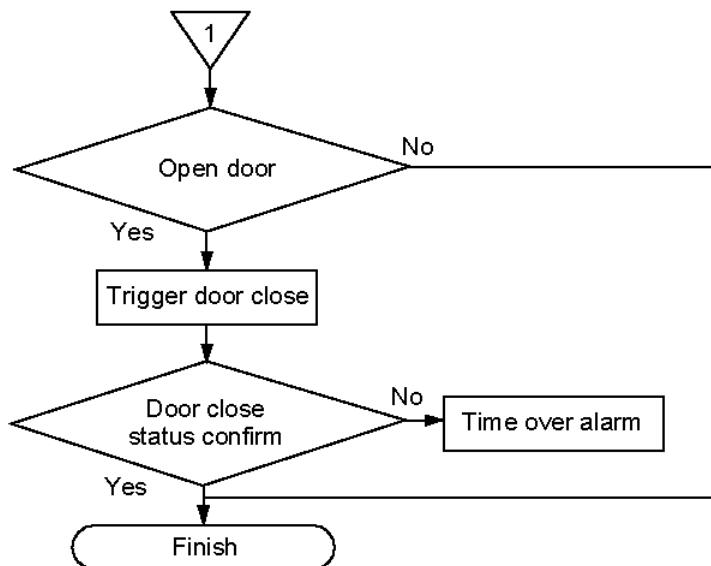
5.6.2 Work Load Sequence





5.6.3 Work Unload Sequence





5.6.4 Customized Work Load Sequence

No.	Operation	Selection
1	Work Load Trigger:	<input type="checkbox"/> None <input type="checkbox"/> 2 Hand Push Button <input type="checkbox"/> Left Hand Push Button <input type="checkbox"/> Right Hand Push Button <input type="checkbox"/> Striker Switch
2	Start Condition	<input type="checkbox"/> None <input type="checkbox"/> Light Curtain Break 1 Time <input type="checkbox"/> Light Curtain Break 2 Time
3	Auto Door Close	<input type="checkbox"/> Auto Door Not Exist <input type="checkbox"/> Auto Door Close <input type="checkbox"/> Wait Finish
4	Fixture Clamp	
5	Air Seat Check	LS1781 <input type="checkbox"/> ON <input type="checkbox"/> OFF LS1782 <input type="checkbox"/> ON <input type="checkbox"/> OFF LS1783 <input type="checkbox"/> ON <input type="checkbox"/> OFF LS1784 <input type="checkbox"/> ON <input type="checkbox"/> OFF
6	Seat Off Wait Time	_____ (msec)
7	Air Seat Retry	<input type="checkbox"/> No <input type="checkbox"/> Yes
8	2nd Work Start Trigger	<input type="checkbox"/> None <input type="checkbox"/> 2 Hand Push Button <input type="checkbox"/> Left Hand Push Button <input type="checkbox"/> Right Hand Push Button <input type="checkbox"/> Striker Switch
9	Door Close	
10	Cycle Start	

Entered By	
Date	

5.6.5 Customized Work Unload Sequence

No.	Operation	Selection
1	Work Unload Trigger: (M30)	
2	Fixture Coolant	<input type="checkbox"/> Fixture Coolant Not Exist <input type="checkbox"/> ON ON TIME: _____ sec
3	Auto Door Open	<input type="checkbox"/> Auto Door Not Exist <input type="checkbox"/> Auto Door Open <input type="checkbox"/> Wait Finish
4	Fixture Unclamp	
5	Auto Door Open	<input type="checkbox"/> Auto Door Not Exist <input type="checkbox"/> Auto Door Open
6	Finish	

Entered By	
Date	

6 Configuration Procedure

6.1 Overview

There are three sub screens for fixture settings, one for each of the following settings.

- Fixture Main and Auxiliary Clamp/Unclamp Sequence
- M530/M531 Sequence
- Work Load/Unload Sequence

The four hydraulic lines and two external inputs (sensors) available are shared between the Fixture Clamp/Unclamp Sequence and M350/M351 Sequence as well as the Auxiliary Clamp/Unclamp Sequence.

Work Load/Unload Sequence allows configuration of the following items.

- Fixture Clamp/Unclamp
- Auto Door
- Seat Check
- Seat Retry
- Fixture Coolant
- Work Load Trigger Type

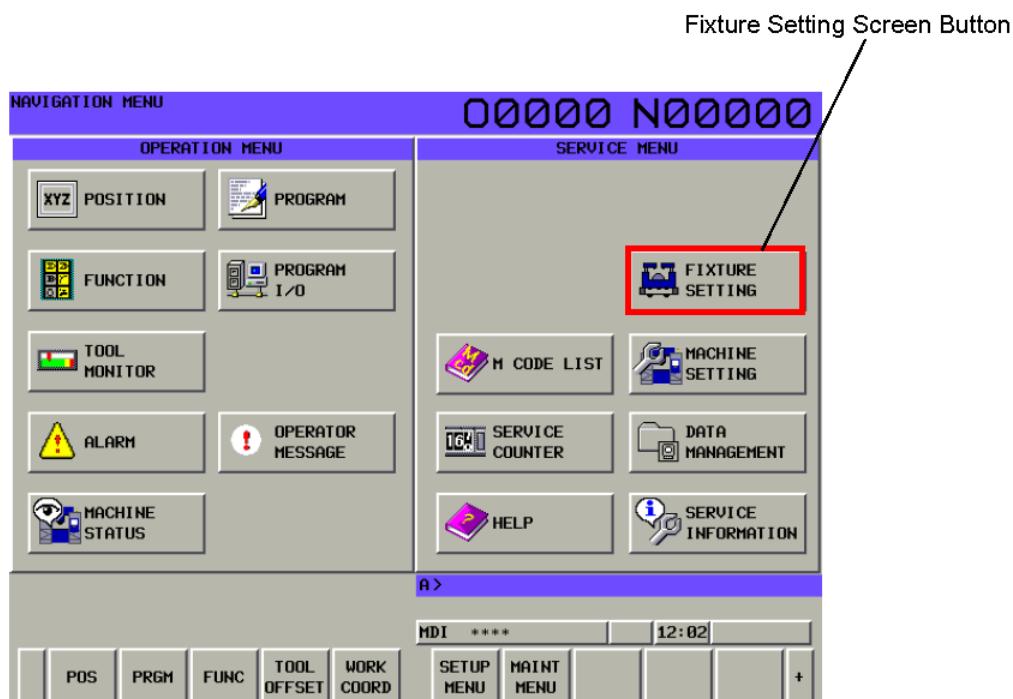


Figure 6.1 Fixture Setting Screen Button

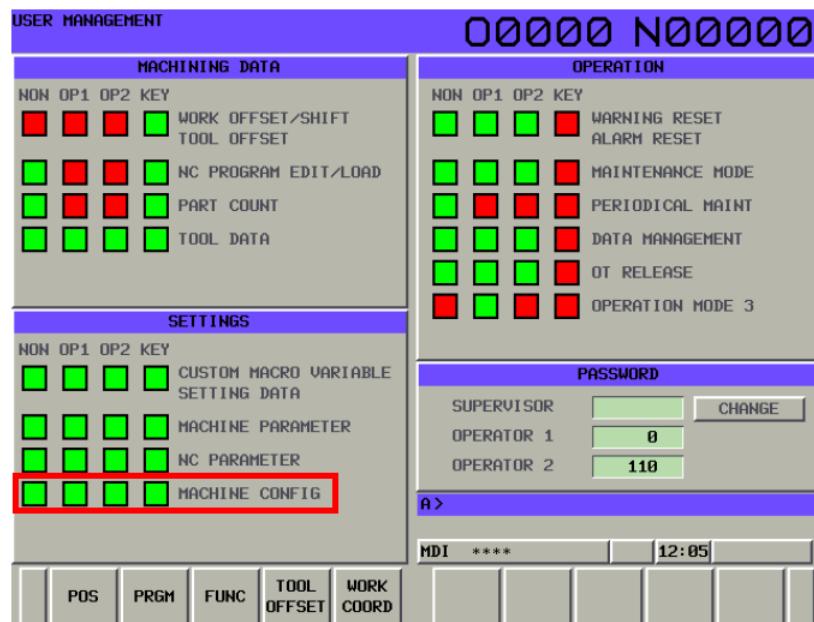


Figure 6.2 Machine Configuration Privilege Setting Screen

-NOTE-

Only user who are assigned privilege to do machine configuration can use this button. Ensure to have the details of the hydraulic circuit design to make the required settings.

6.2 Fixture Clamp/Unclamp Configuration

The procedure to configure Main Clamp, Main Unclamp, Auxiliary Clamp an Auxiliary Unclamp is the similar. The only difference is the number of steps required for each operation.

Configuration Procedure

- 1) Enable **[INPUT MODE]** [1].
- 2) Select a clamp sequence button [2].
- 3) On the clamp step setting panel, input a finish delay time [3].
- 4) If the step is to be used for condition checking only, set “CHK STATUS ONLY” [4] to “YES”. If not set to “NO”.
- 5) Select a Hydraulic Line (LN) or External Input (EI). Press the **[HDY LINE]** or **[EXT INPUT]** button [5] to toggle between LN and EI.
- 6) For LN, set whether the pressure switch is Normally Close (N.C) or Normally Open (N.O) [6] based on the fixture manifold.
- 7) Set the control logic for the selected LN/EI.
 - To set the selected LN or EI turned On, press **[SET ON]** soft key [7]. (The circle colour becomes green [8] and the display symbol is “1”.)
 - To set the selected LN or EI turned Off, press **[SET OFF]** soft key [7]. (The circle colour becomes red [9] and the display symbol is “0”.)
 - To clear the setting for selected LN or EI, press **[CLR SET]** soft key [10]. (The circle is removed.)
- 8) Repeat steps 5 to 7 until all the settings are completed for this step.
- 9) Repeat steps 2 to 8 until all the settings are completed for the sequence.
- 10) Ensure the last step of the sequence is indicated with the letter “F” [11] is always configured with the signals required to determine the completion status of the sequence.

-NOTE-

Ensure the details of the configuration are updated in the [5.4.3 Customized Clamp/Unclamp Specification](#) [88].

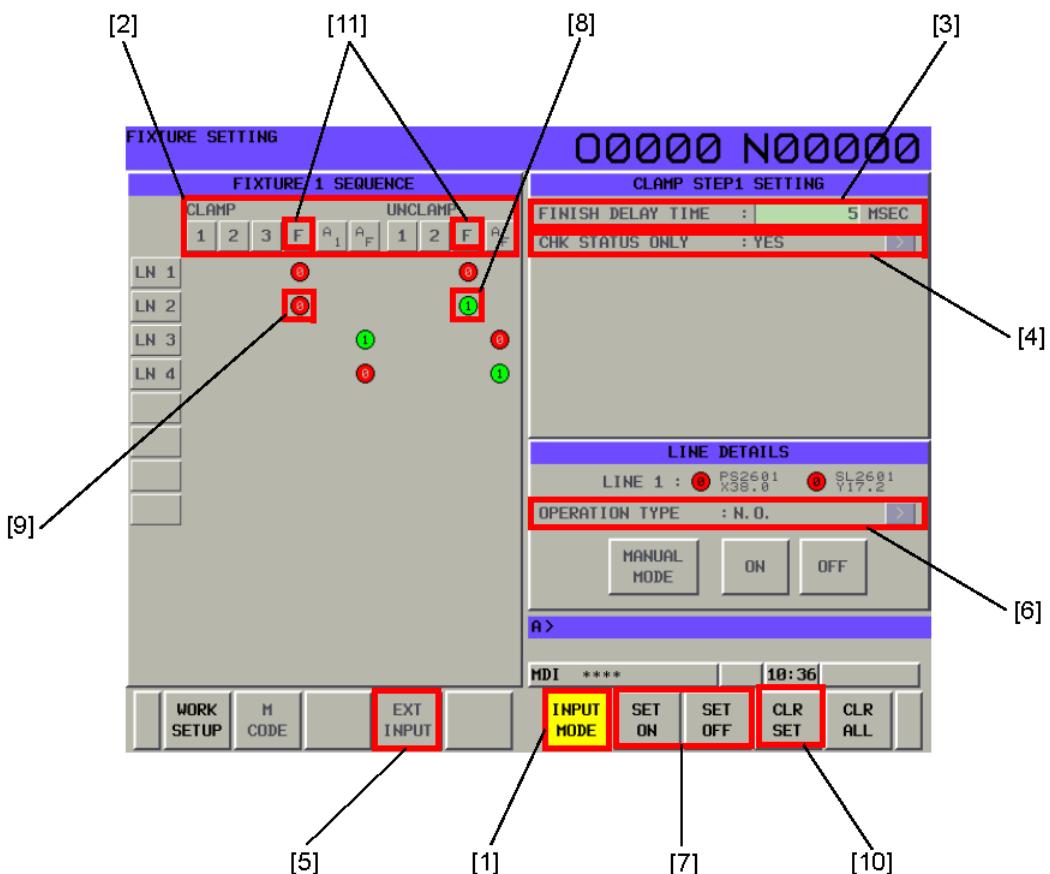
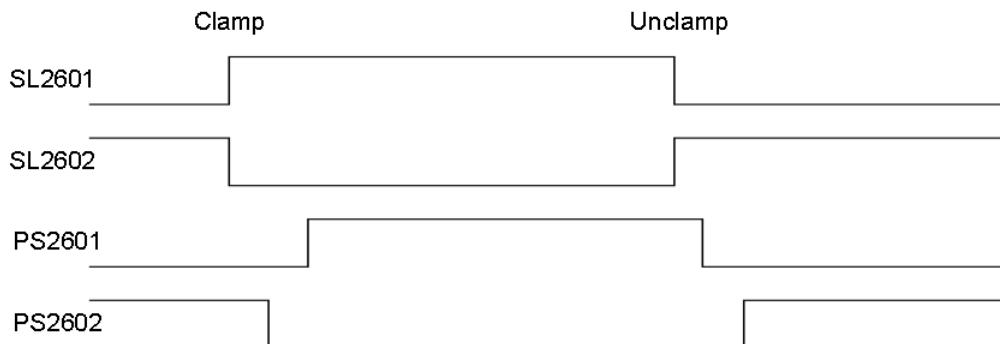


Figure 6.3 Fixture Clamp/Unclamp Configuration Setting

6.3 Hydraulic Line Configuration

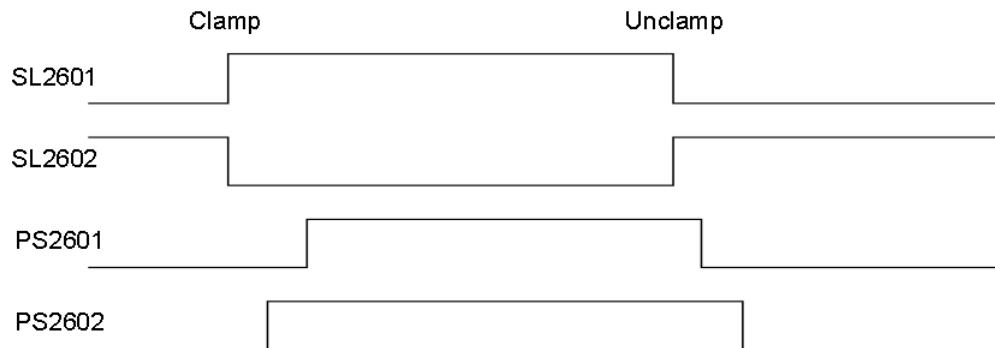
The following examples show the required settings for the SL and PS behavior.

Standard Double Acting Cylinder



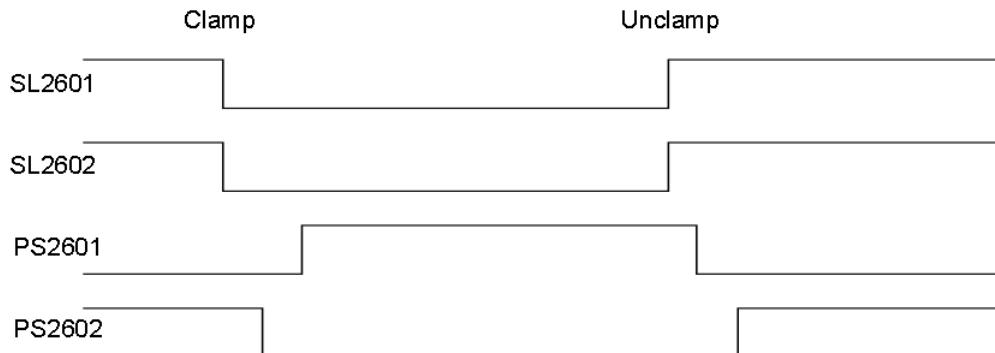
Sequence Setting	Clamp Step 4, Unclamp Step 3
	CHK STATUS ONLY : NO
	Line 1 & Line 2
	OPERATION TYPE : N.O.

Double Acting Cylinder with 2 Clamp Pressure Signals



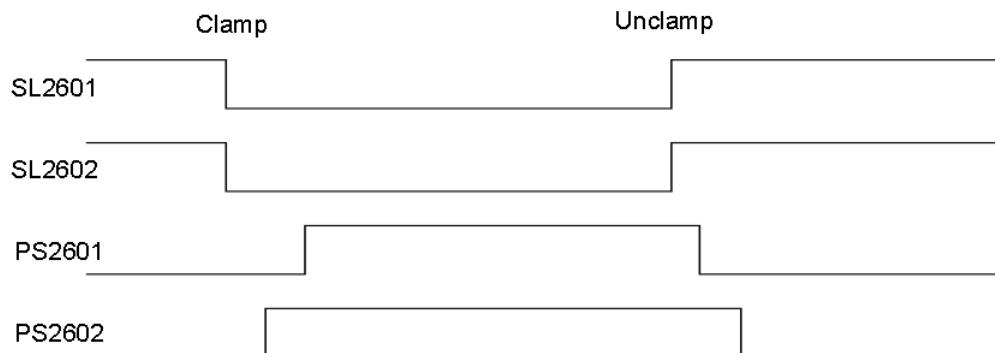
Sequence Setting	Clamp Step 4, Unclamp Step 3
	CHK STATUS ONLY : NO
	Line 1
	OPERATION TYPE : N.O.
	Line 2
	OPERATION TYPE : N.C.

Standard Single Acting (Spring Return) Cylinder



Sequence Setting	Clamp Step 4, Unclamp Step 3
	CHK STATUS ONLY : NO
	Line 1
	OPERATION TYPE : N.C.
	Line 2
	OPERATION TYPE : N.O.

Single Acting (Spring Return) Cylinder with 2 Clamp Pressure Signals



Sequence Setting	Clamp Step 4, Unclamp Step 3
	CHK STATUS ONLY : NO
	Line 1
	OPERATION TYPE : N.C.
	Line 2
	OPERATION TYPE : N.C.

6.4 M Code Configuration

The procedure to configure the M codes M350 and M351 is similar to the fixture clamp/unclamp configuration. There are three steps available for each M code. As there is no status monitoring for M codes, there is no “F” (Finish Step) that must be configured.

Configuration Procedure

- 1) Enable **[INPUT MODE]** [1].
- 2) Select a M code sequence button [2].
- 3) On the M code step setting panel, input a finish delay time [3].
- 4) If the step is to be used for condition checking only, set “CHK STATUS ONLY” [4] to “YES”. If not set to “NO”.
- 5) Select a Hydraulic Line (LN) or External Input (EI). Press the **[HDY LINE]** or **[EXT INPUT]** button [5] to toggle between LN and EI.
- 6) For LN, set whether the pressure switch is Normally Close (N.C) or Normally Open (N.O) [6] based on the fixture manifold.
- 7) Set the control logic for the selected LN/EI.
 - To set the selected LN or EI turned On, press **[SET ON]** soft key [7]. (The circle colour becomes green [8] and the display symbol is “1”.)
 - To set the selected LN or EI turned Off, press **[SET OFF]** soft key [7]. (The circle colour becomes red [9] and the display symbol is “0”.)
 - To clear the setting for selected LN or EI, press **[CLR SET]** soft key [10]. (The circle is removed.)
- 8) Repeat steps 5 to 7 until all the settings are completed for this step.
- 9) Repeat steps 2 to 8 until all the settings are completed for the sequence.

-NOTE-

Ensure the details of the configuration are updated in the [5.4.3 Customized Clamp/Unclamp Specification](#) [88].

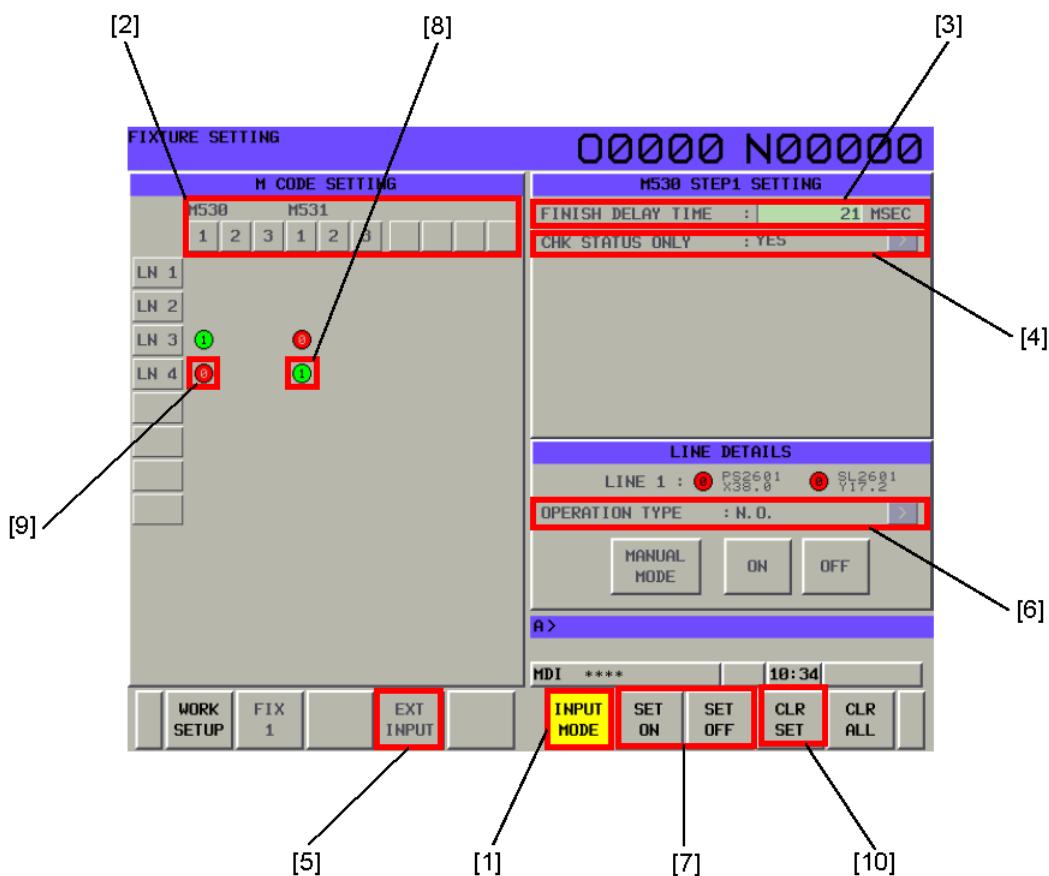


Figure 6.4 M350/M351 Configuration Setting

6.5 Work Load/Unload Configuration

The procedure to configure work load/unload is provided in the form of flow chart on the Fixture Setting screen.

Work Load Configuration Procedure

- 1) Enable **[INPUT MODE]**.
- 2) Select a work load trigger type using the **[>]** button. The available selections are:
 - None
 - Striker Switch
 - 2 Hand PB
 - 2 Hand PB L
 - 2 Hand PB R
- 3) If auto door exist, set whether to close the door before fixture clamp. (If the door is not bypassed, clamp operation cannot start if the door is open.)
- 4) Select whether each air sea check is enabled or not. (If air seat check does not exist, these settings are ignored.)
- 5) Select the check status of each air seat check. (If the seat check pass condition is "High", set to On and if it is "Low", set to Off.)
- 6) Enter the stabilization time of the air seat check signals before a work seating warning or alarm is triggered.
- 7) Select whether the fixture is to perform a seat retry operation if the air seat check fails. (The seat retry operation involves unclamping and clamping the fixture once to retry the seat check. If the seat check fails a second time, an alarm is triggered and the work load process stops.)
- 8) Select the 2nd work load (work start) trigger type using the **[>]** button. The available selections are:
 - None
 - Striker Switch
 - 2 Hand PB
 - 2 Hand PB L
 - 2 Hand PB R

If "None" is selected, the work loading sequence skips this step and proceeds to the next step. If a selection is made, the work loading sequence stops here and waits for the selected trigger signal before proceeding.

Work Unload Configuration Procedure

- 1) Enable **[INPUT MODE]**.
- 2) Select whether to turn On fixture coolant. Alarm will be triggered if “YES” is selected and fixture coolant option does not exist.
- 3) Input the On time of fixture coolant.
- 4) If auto door exist, select whether to open the door before fixture unclamps. (If the door is not bypassed, unclamp operation cannot start if the door is open.)
- 5) If auto door exist, select whether to open the door after fixture unclamps.

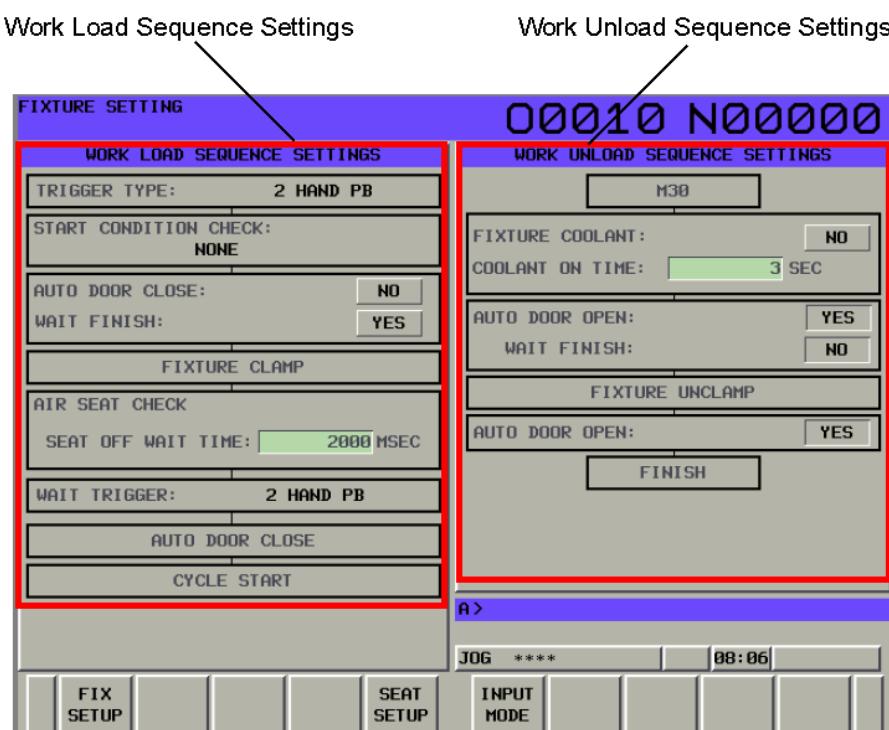


Figure 6.5 Work Load/Unload Configuration Setting

7 Auto Greasing

7.1 Overview

The automatic grease supply unit supplies grease to the drive unit of the machine components. By supplying grease, it smooths the movements of the feed axis. Greasing is done automatically and the greasing period is set in the machine parameters. Replacement of the grease cartridge is necessary when a warning is triggered.

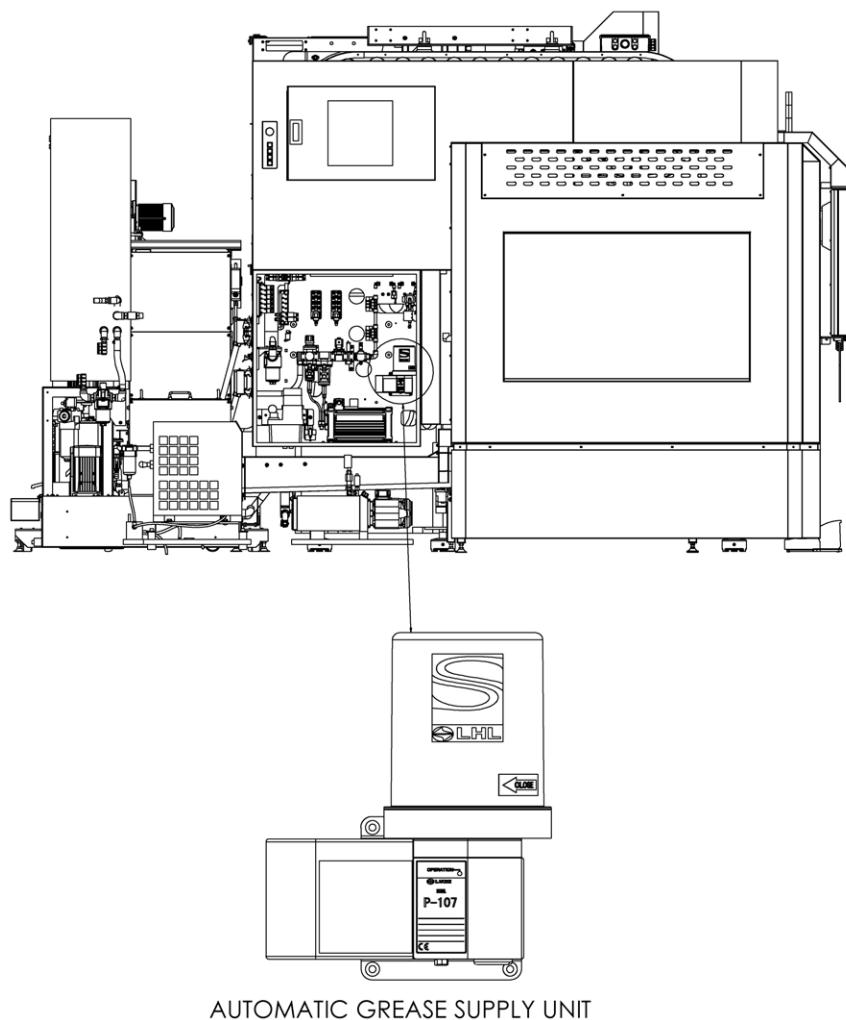
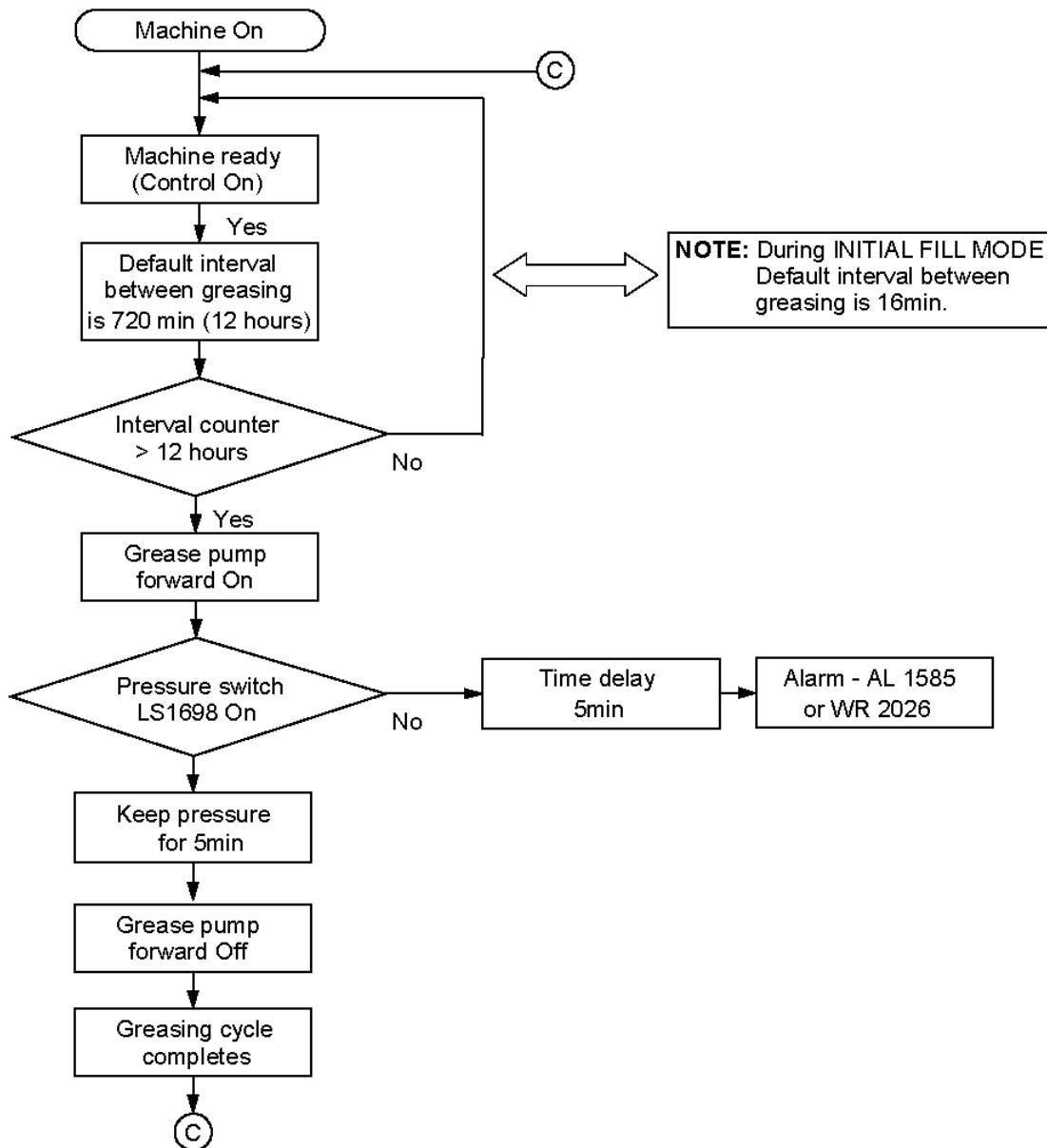


Figure 7.1 Automatic Grease Supply Unit

7.2 Auto Greasing Flow Chart



7.3 Auto Grease Maintenance Screen

The Auto Grease Maintenance screen below displays greasing interval time and the current run time for each axis or spindle.

Display Procedure

- 1) Press the [CUSTOM2] key on the MDI panel.
- 2) Press the [MAINT MENU] soft key on the Navigation Menu screen.
- 3) Select [COOLANT MANAGEMENT].
- 4) Press the [AUTO GREASE] soft key.

Auto Grease Maintenance screen is displayed.

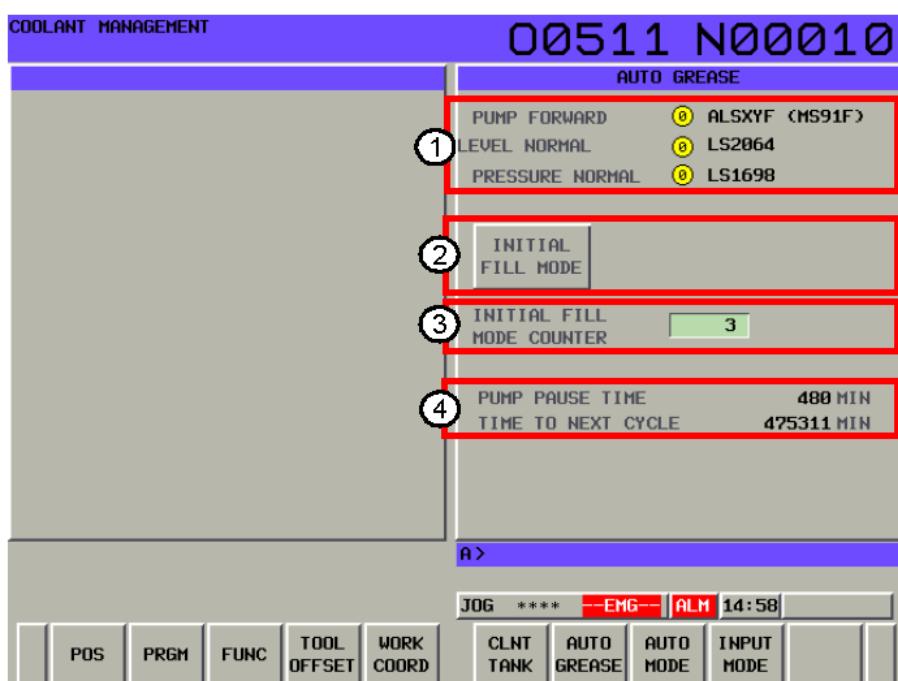


Figure 7.2 Auto Grease Maintenance Screen

Display Content

(1)	I/O Status Display This area displays the current status of lube type auto grease components I/Os.
(2)	Initial Fill Mode Operator can set the initial fill count during first setup of a new machine. Upon an initial fill process is finished once, the count is reduced by 1. Initial Fill mode can be enabled until the count reaches 0.
(3)	Pump Count This area displays the total auto grease time for which auto greasing has been carried out as well as auto grease maximum count set by parameter MC07006 (ATGRMXCT). If the total time reached the maximum count, an alarm (AL1586) or warning (WR2027), Auto Grease Count Over will occur.
(4)	Timing Display This area displays: <ol style="list-style-type: none"> 1) Pump Pause Time: The interval between two consecutive auto greasing processes. Time display is based on whether it is in Normal mode or Initial Fill mode. In Normal mode, pause time can be set by parameter MC07025 (AGPTM1) and in Initial Fill mode, pause time can be set by parameter MC07026 (AGPTM2). 2) Time To Next Cycle: Indicates how much time remaining for the occurrence of next auto greasing process.

7.4 Auto Greasing Signal List

Input Signal

Address	Symbol	Description
X0010.4	LS2089	AUTO GREASE INJECTOR PRESSURE UP
X0010.5	LS2064	AUTO GREASE SPLY UNIT LVL SW

Output Signal

Address	Symbol	Description
Y0004.4	ALSXYR	AUTO GREASE INJECTOR CCW
Y0004.5	ALSXYF	AUTO GREASE INJECTOR CW

1 Overview

The spindle moves vertically on the column forming Z-axis. Built-in AC servomotor is used to drive the spindle. Oil-air lubrication is used for 10,000 and 14,000 rpm spindle bearing lubrication. The spindle housing and motor are cooled by jacket cooling.

Spindle with 14,000 rpm is standard specification and 10,000 rpm is optional. For both 10,000 and 14,000 rpm spindles, Through Spindle Coolant (TSC) function is optional.

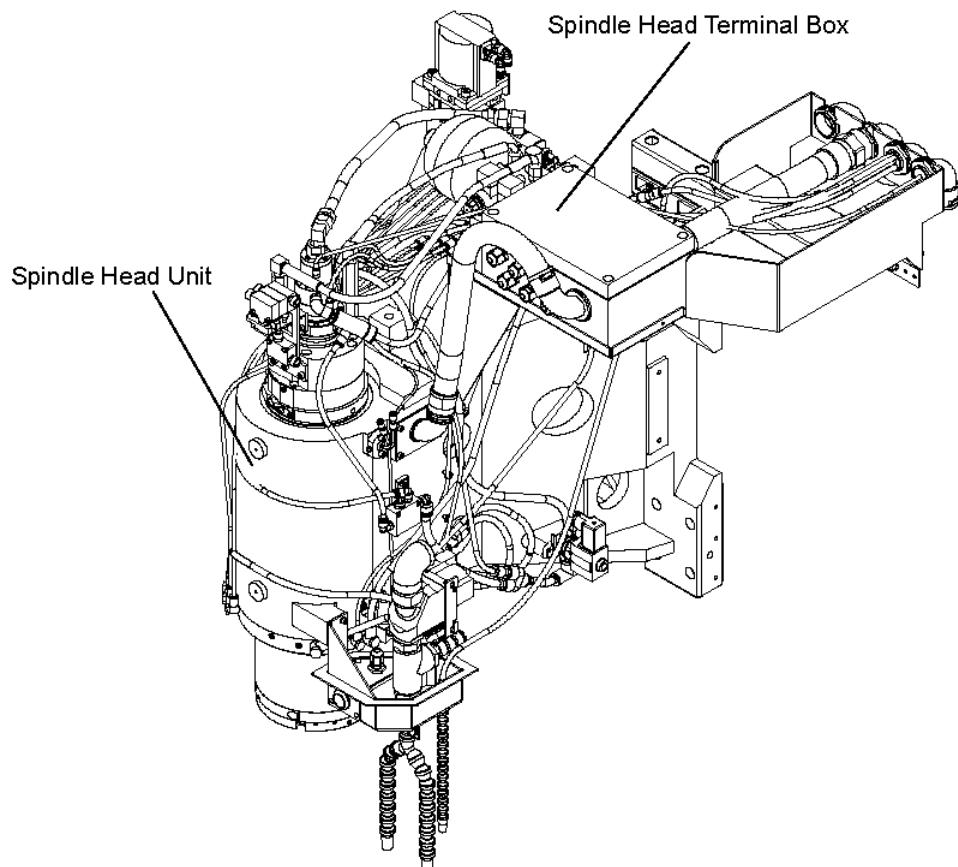


Figure 1.1 General View

No.	Name	No.	Name
1	Spindle Head Unit	2	Spindle Head Terminal Box

1.1 Piping and Wiring

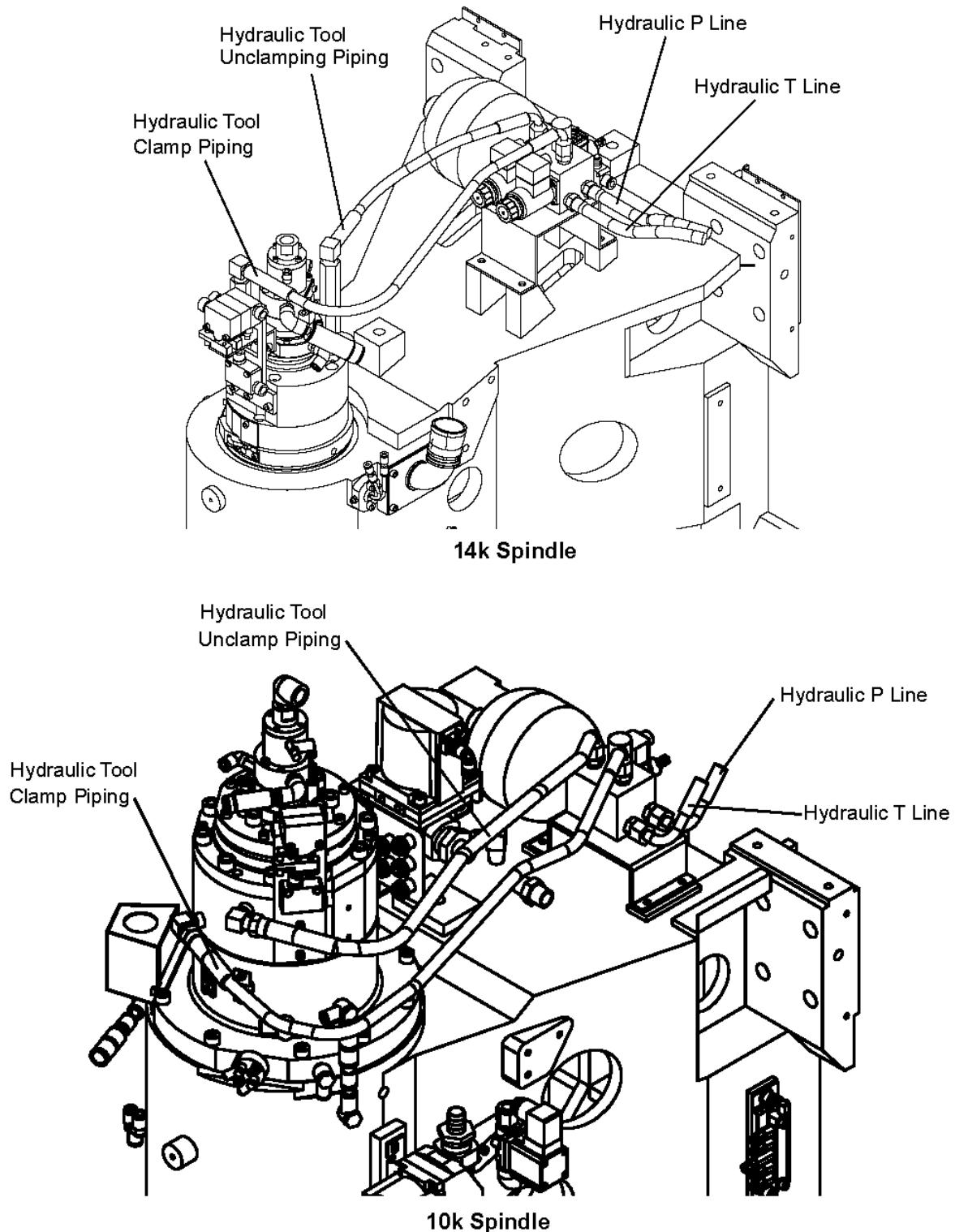


Figure 1.2 Hydraulic Piping

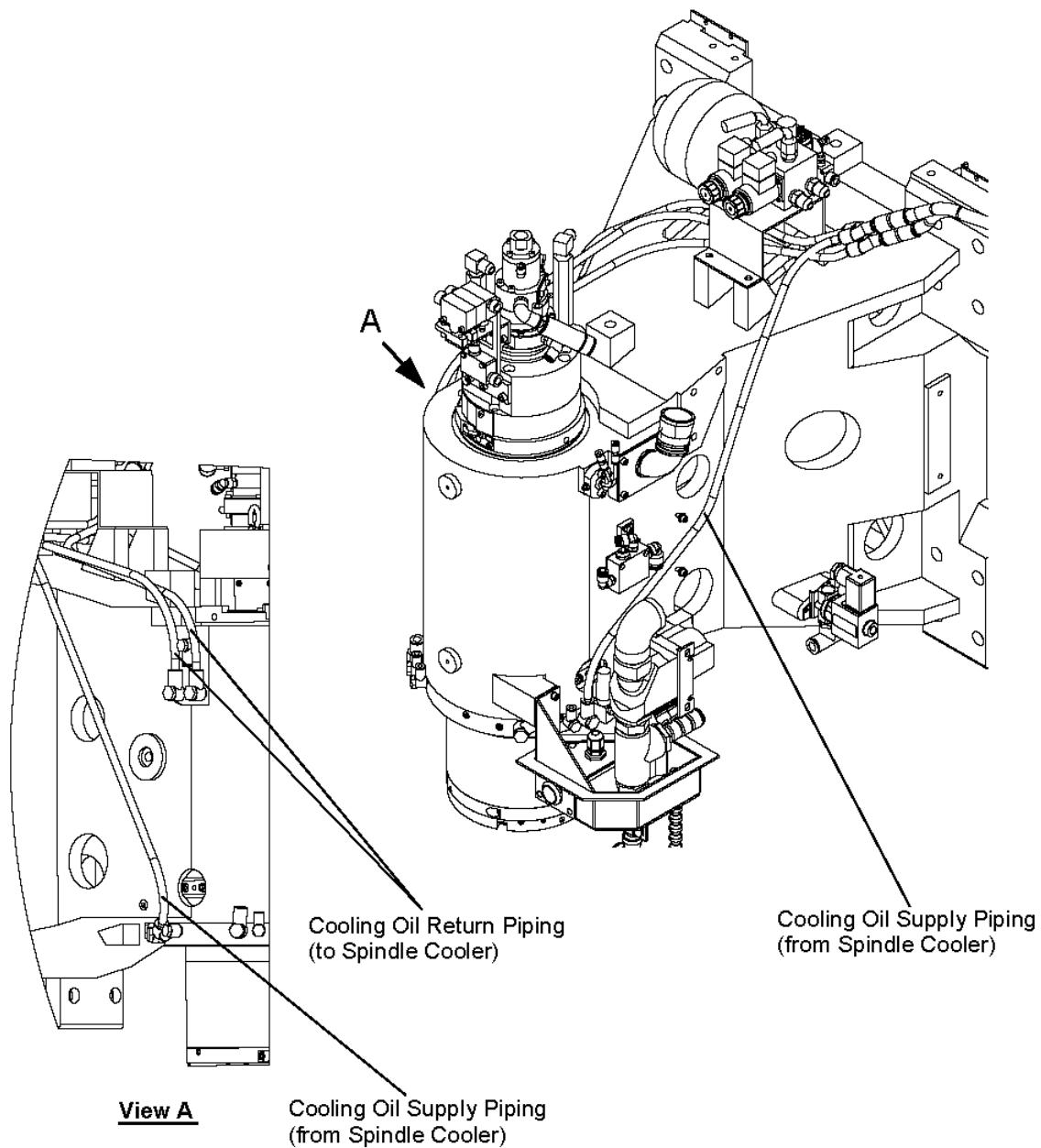


Figure 1.3 14k Spindle Cooling Oil Piping

Chapter 4 Spindle Head

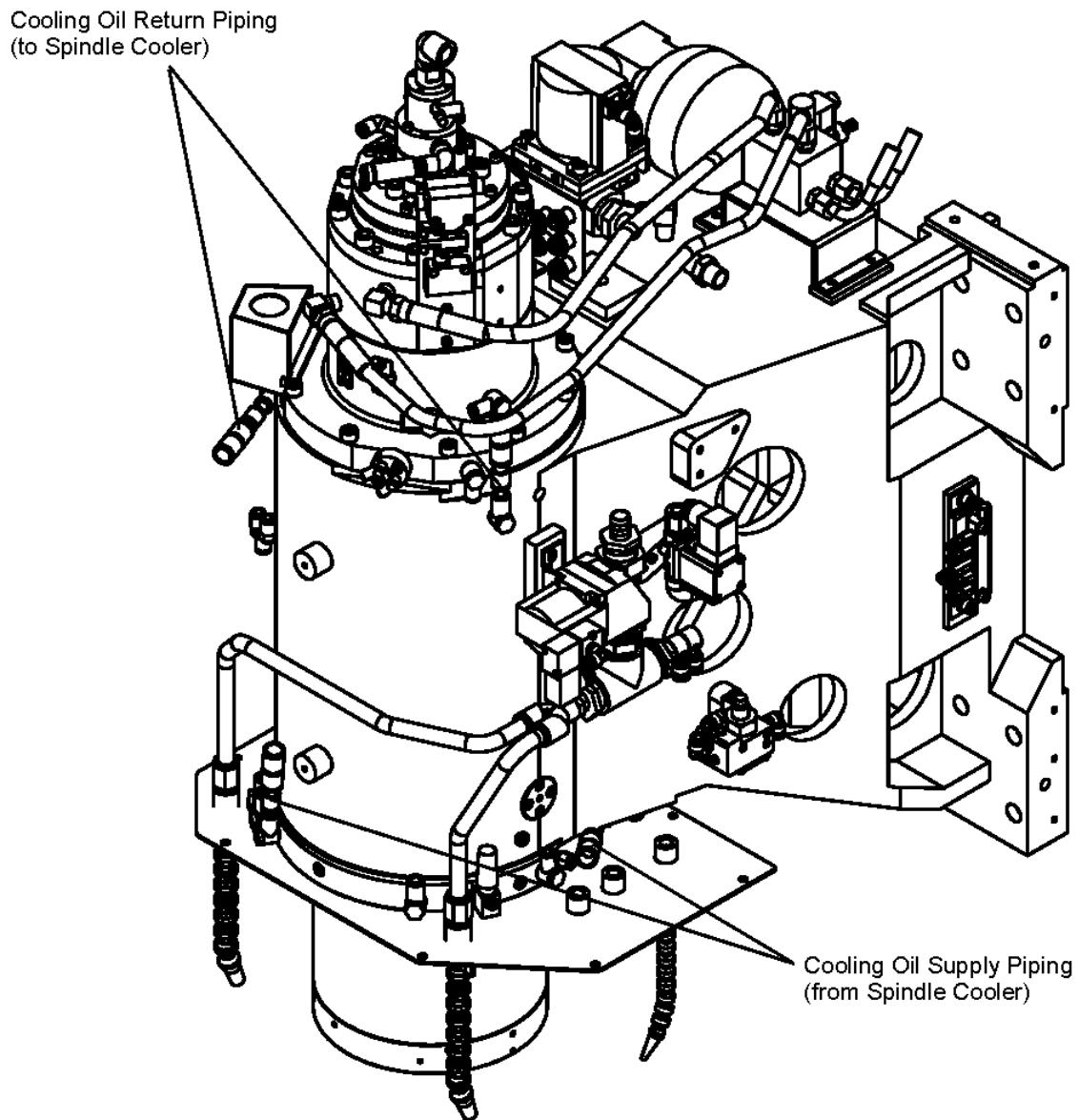
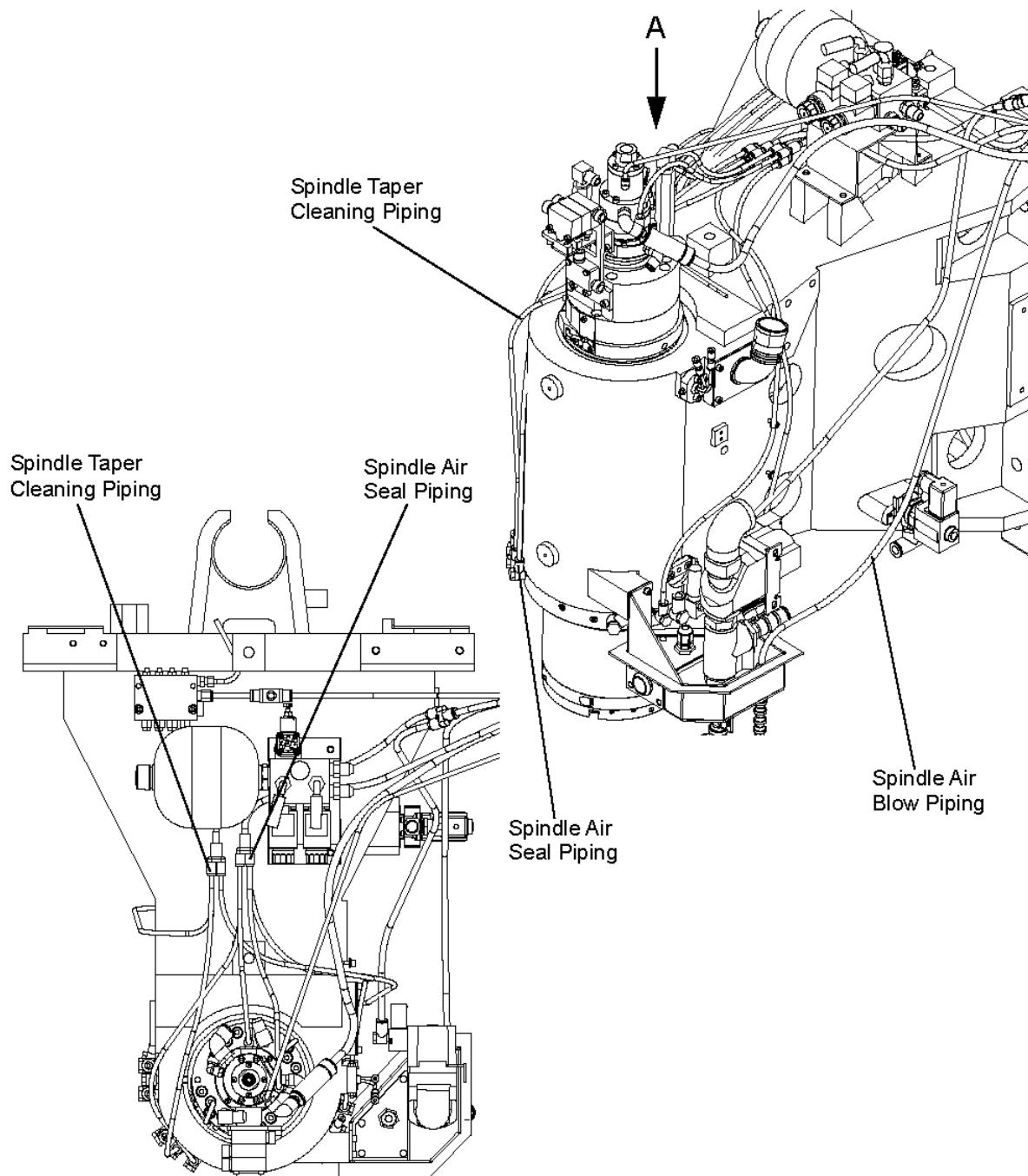


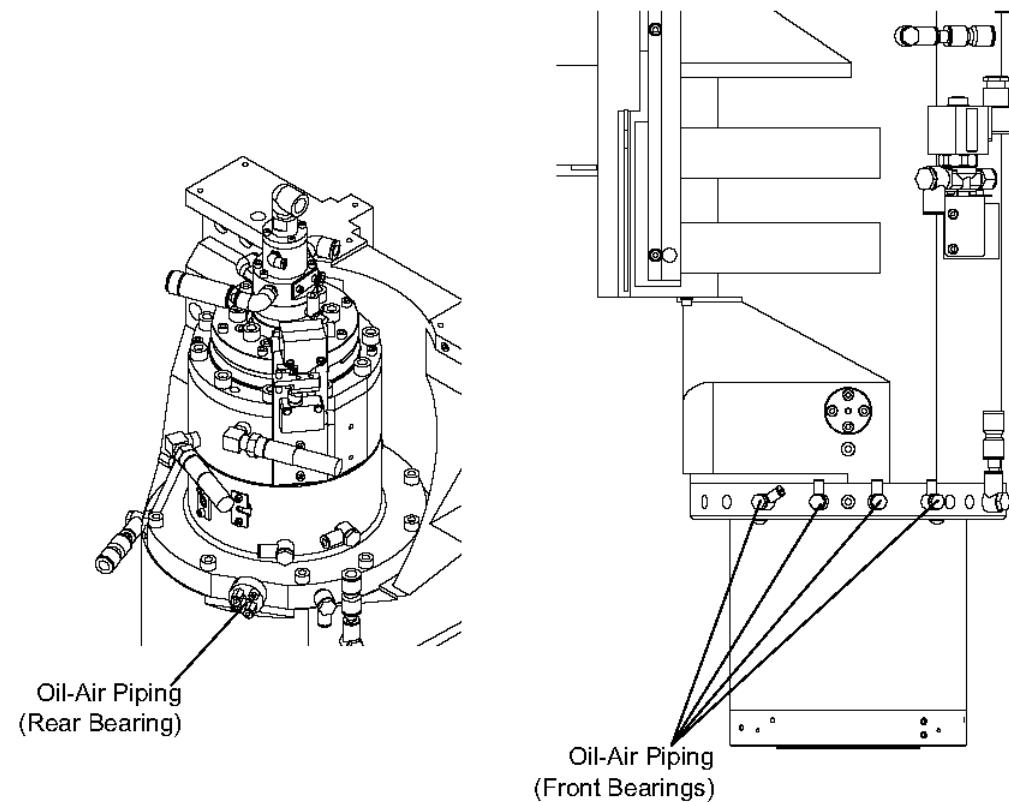
Figure 1.4 10k Spindle Cooling Oil Piping



View A

Figure 1.5 14k Spindle Air Piping

Chapter 4 Spindle Head



Oil - Air Supply Distributor

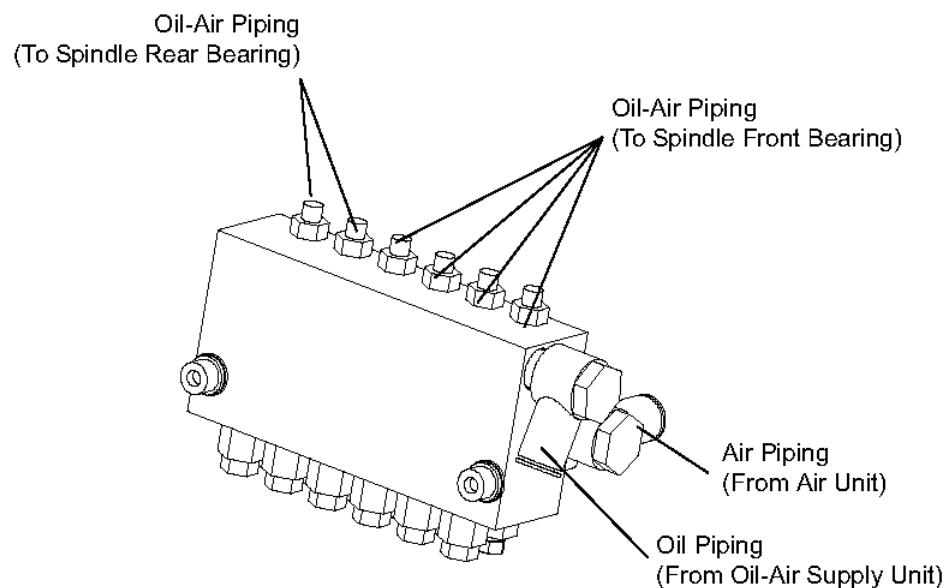


Figure 1.6 10k Spindle Oil-Air Piping

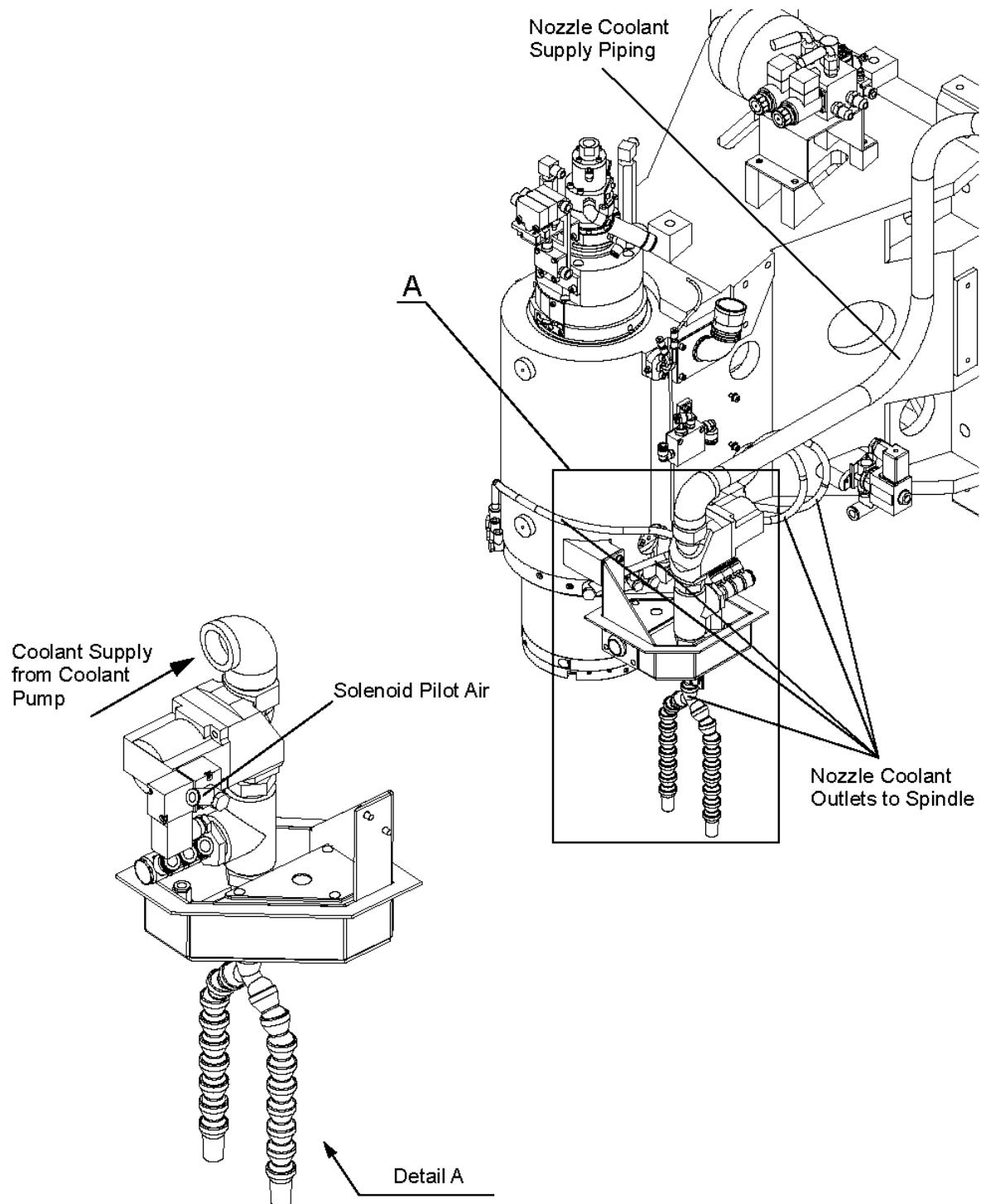


Figure 1.7 14k Spindle Coolant Piping

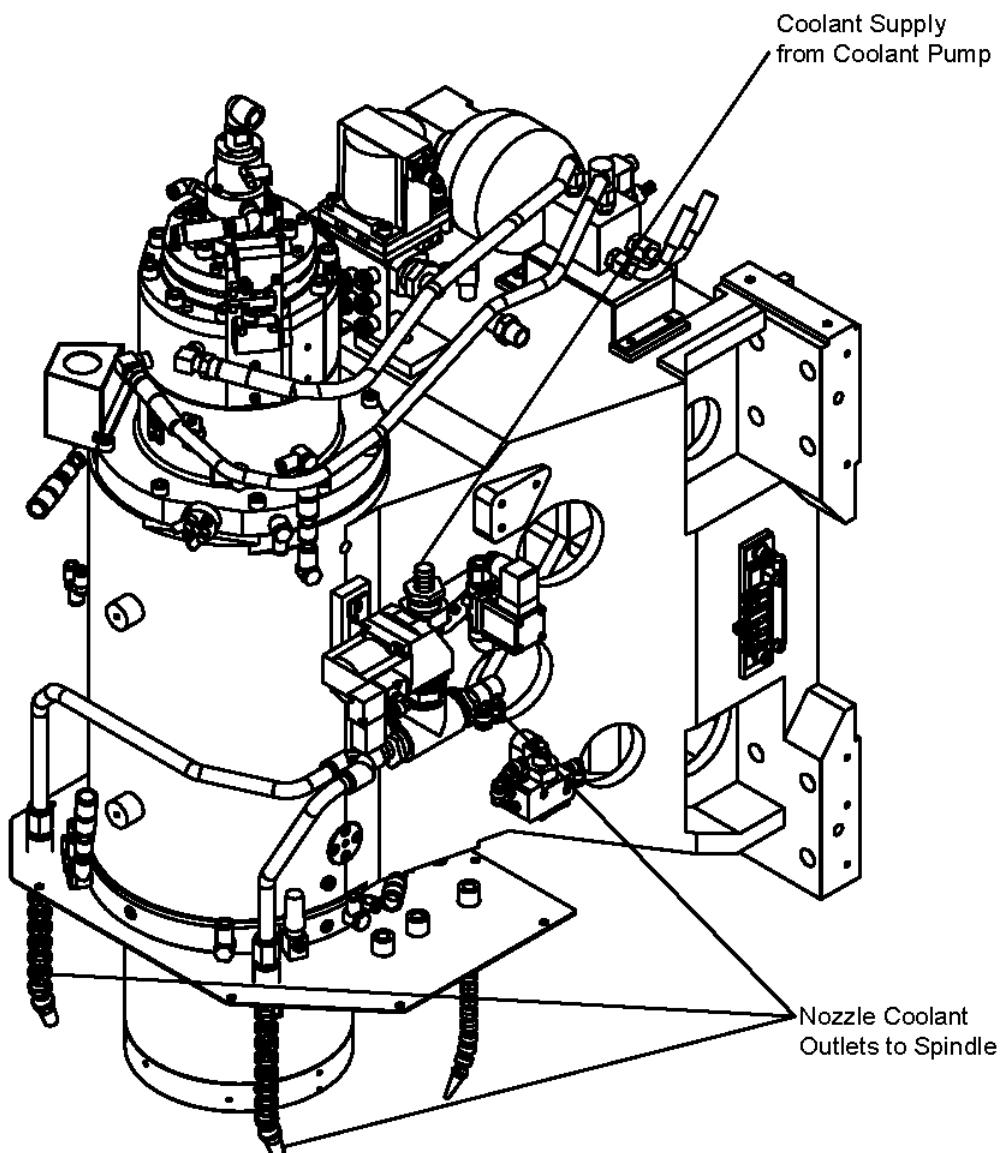


Figure 1.8 10k Spindle Coolant Piping

Table 1.1 Air Piping

Solenoid Valve	Description	Remarks
SL 09	Spindle Taper Cleaning	-
SL 18	Spindle Air Seal	-
SL 182	Through Spindle Air	Option
SL1308	Rotary Union Back Up Air	Option
SL 2300	Oil Air Lubrication	Option
SL 1310	TSC Suction	Option
SL 181	Spindle Air Blow	-

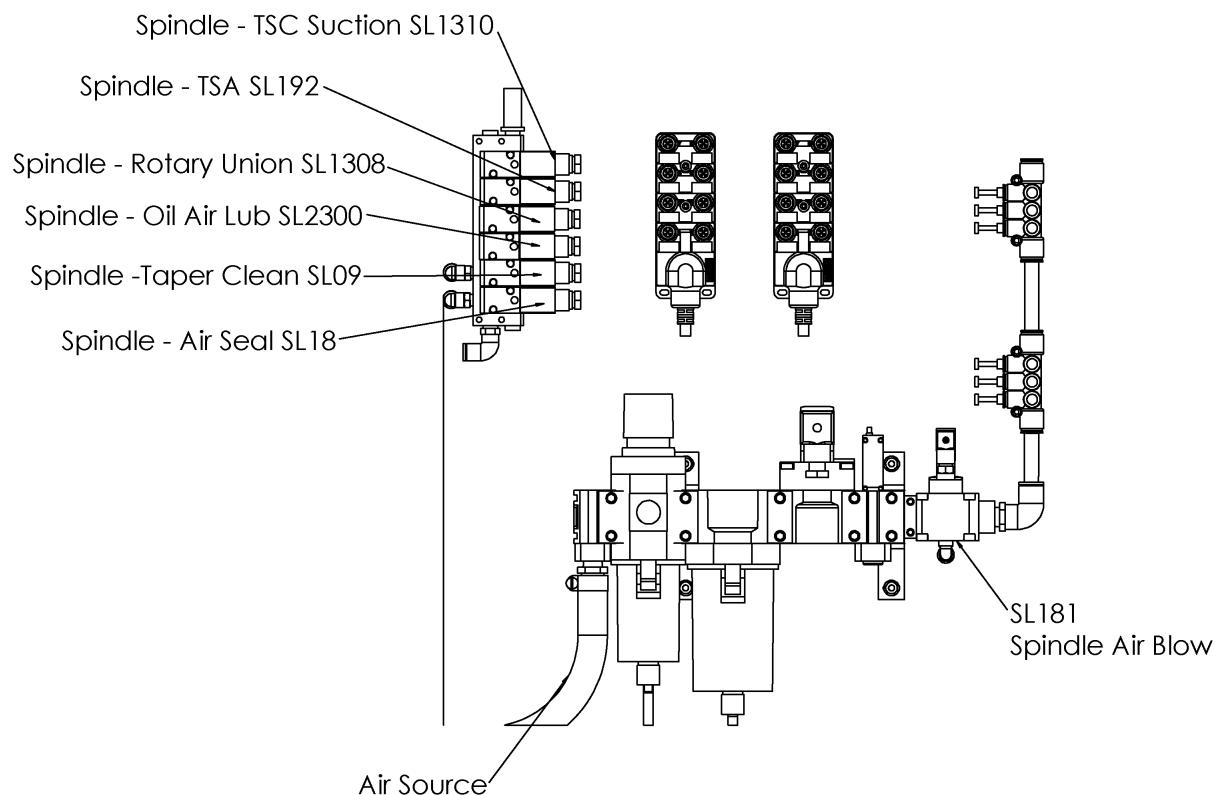


Figure 1.9 Air Piping

Chapter 4 Spindle Head

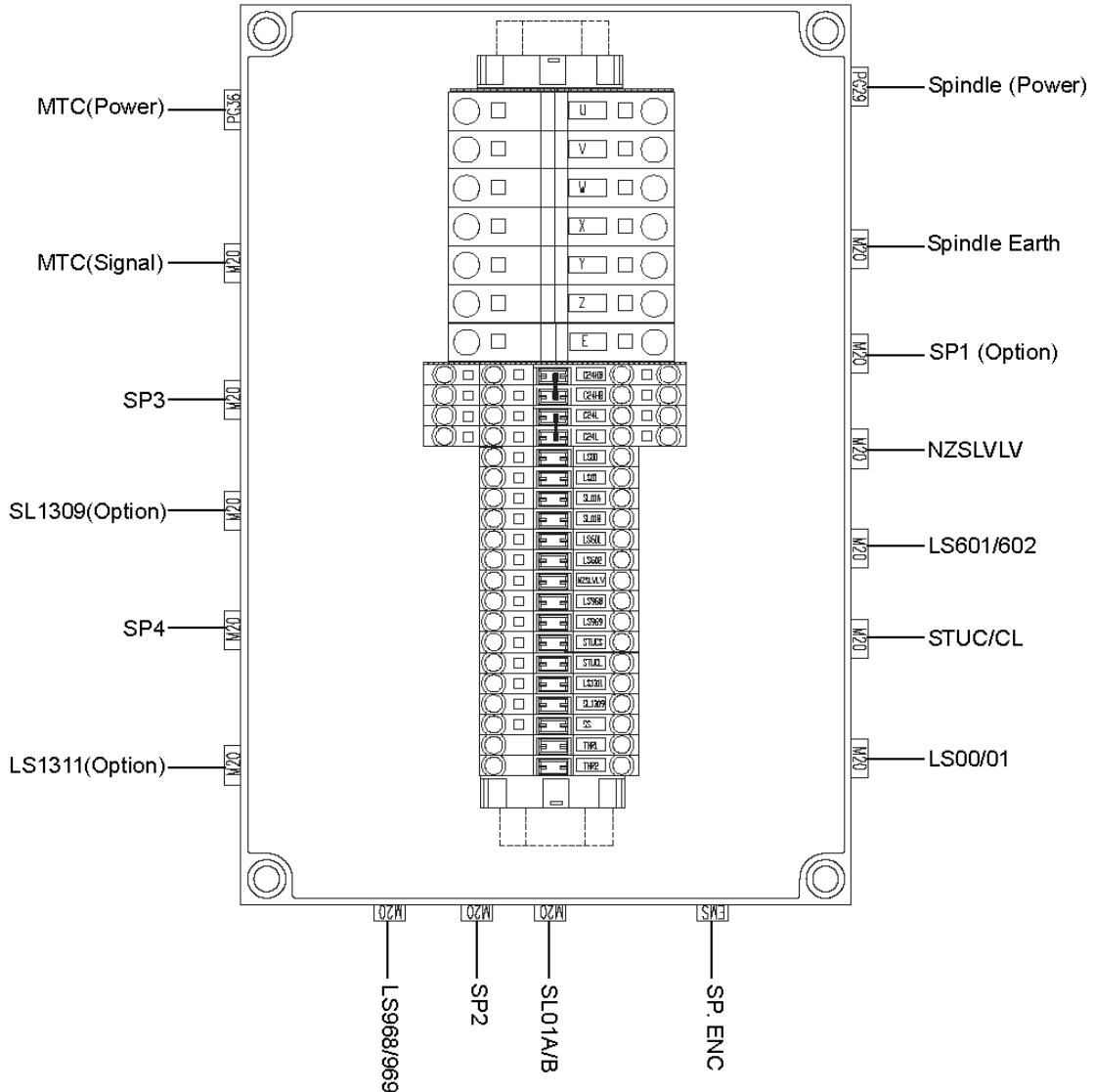
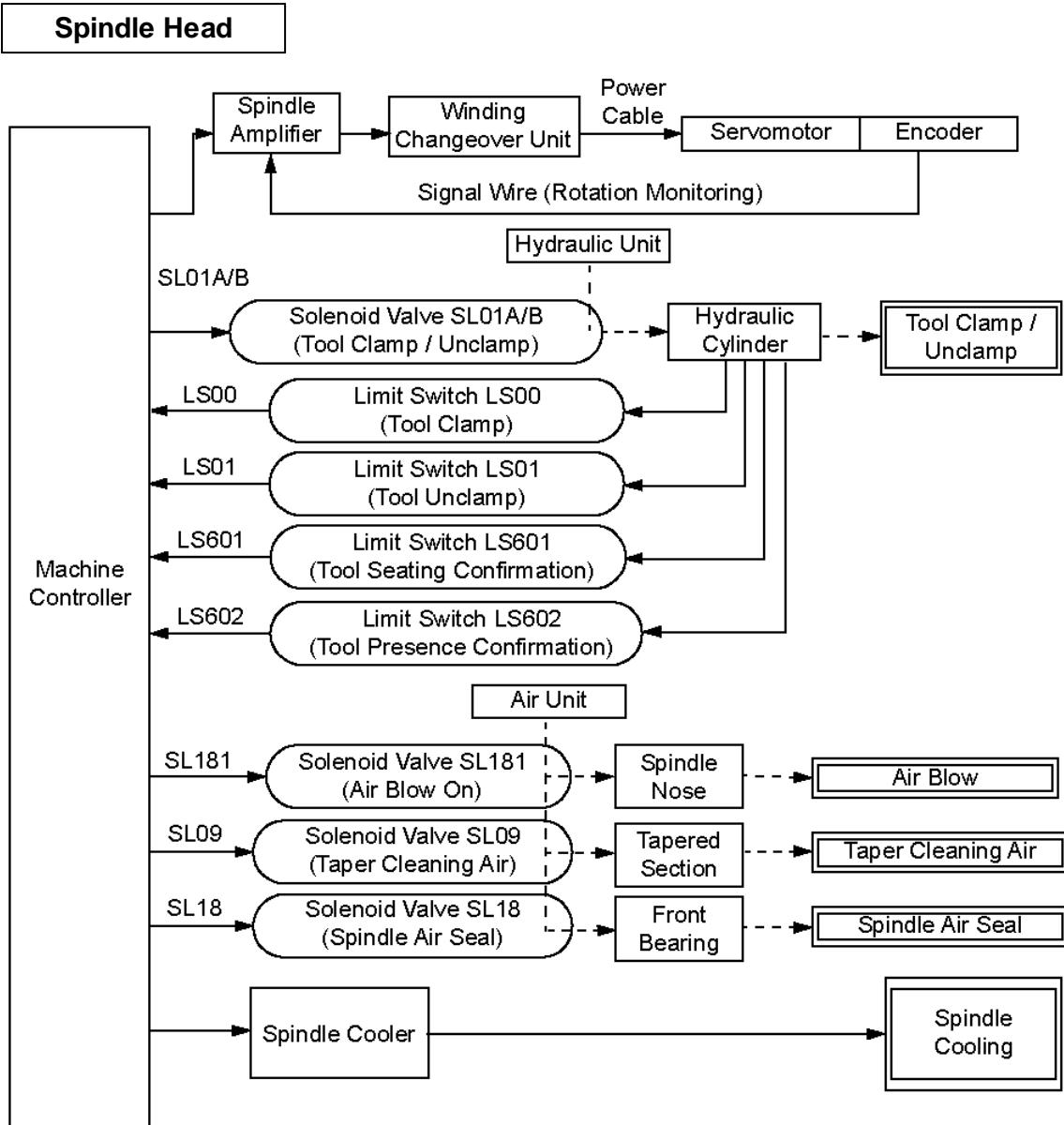
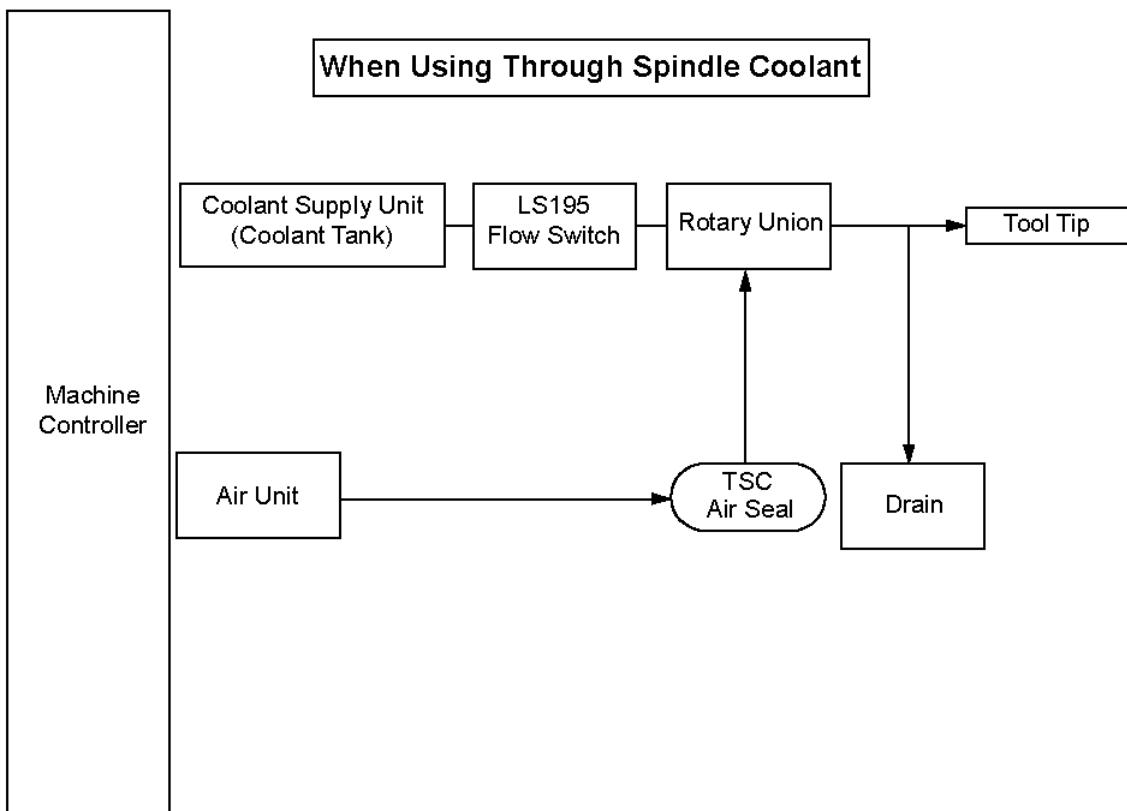


Figure 1.10 Spindle Terminal Box Wiring

2 Spindle Mechanism



Rotary Union



Machine Input/Output Signal Table

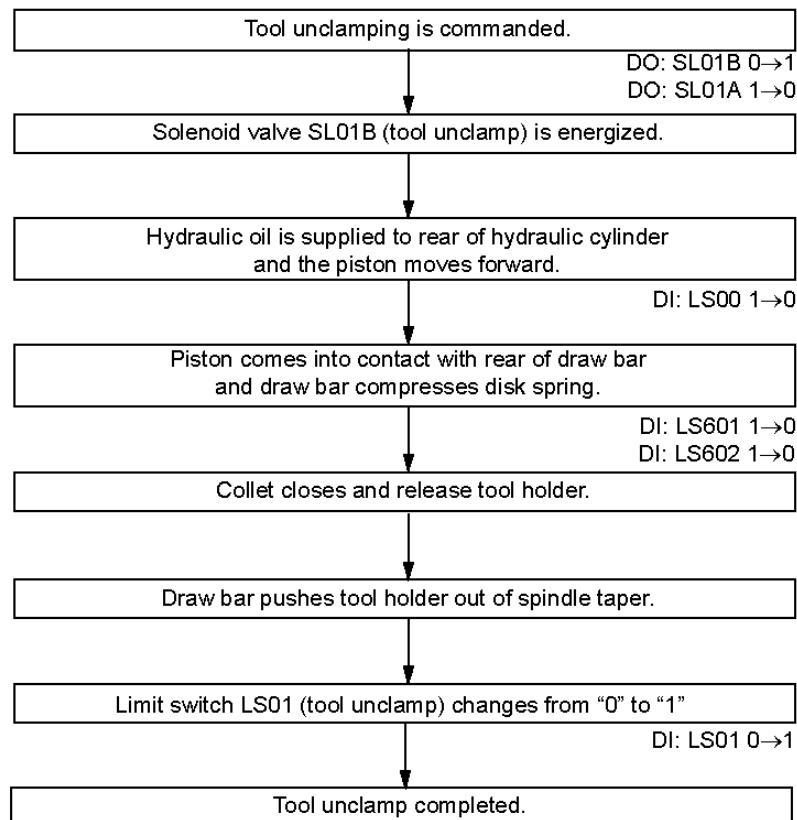
Signal Name	Address	Description
LS00	X0010.0	TOOL CLAMP
LS01	X0010.1	TOOL UNCLAMP
LS601	X0012.2	SPINDLE TOOL SEATING
LS602	X0012.3	SPINDLE TOOL CONFIRM
SL01A	Y0004.0	SPINDLE TOOL CLAMP SOLENOID
SL01B	Y0004.1	SPINDLE TOOL UNCLAMP SOLENOID
SL09	Y0001.1	TAPER CLEANING AIR 1
SL18	Y0001.3	SPINDLE AIR SEAL
SL181	Y0001.0	AIR BLOW

2.1 Tool Clamp/Unclamp

The tool clamp/unclamp mechanism secures (clamps) the tools in the spindle head and releases (unclamps) the tools to enable tool changes. The tool clamp mechanism also confirms that the tool (tool holder) is seated correctly in the Spindle Taper (tool seating confirmation).

The tool clamp/unclamp operations are performed by hydraulic pressure and disk spring.

Tool Unclamp



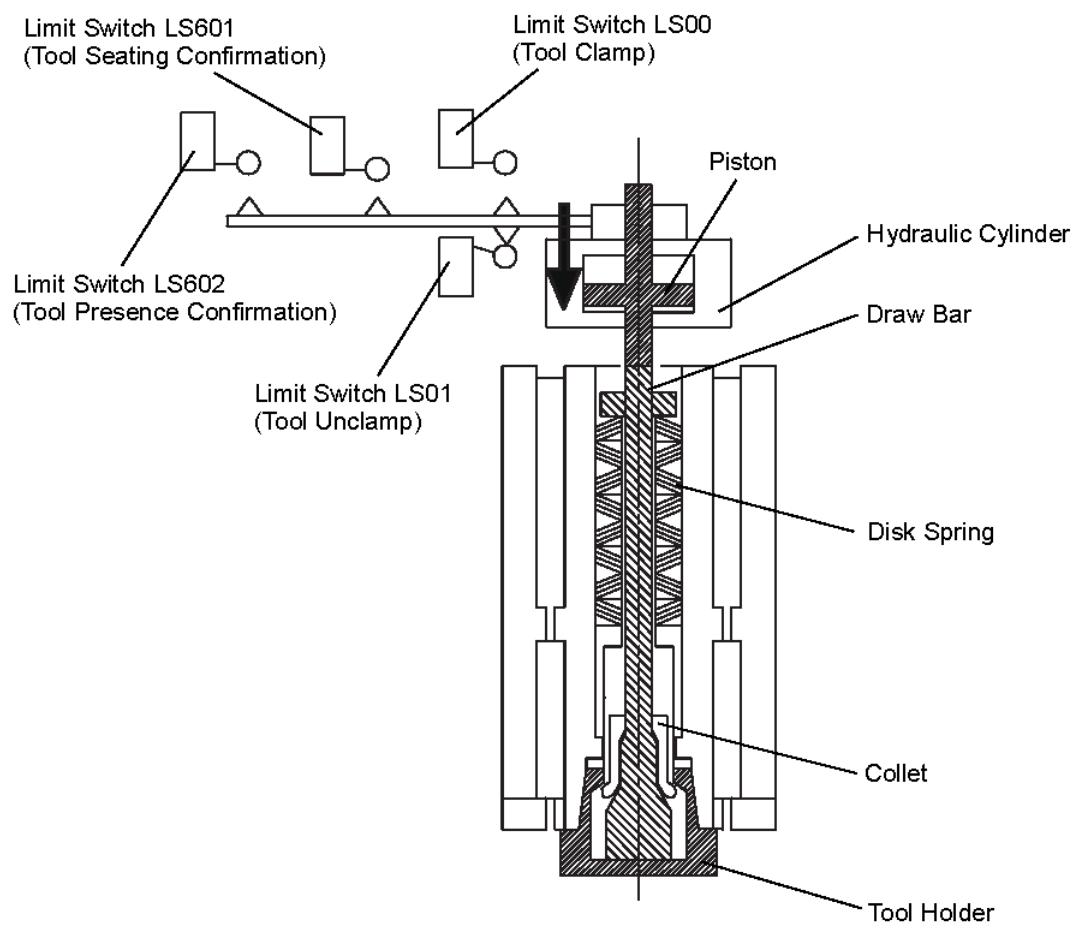
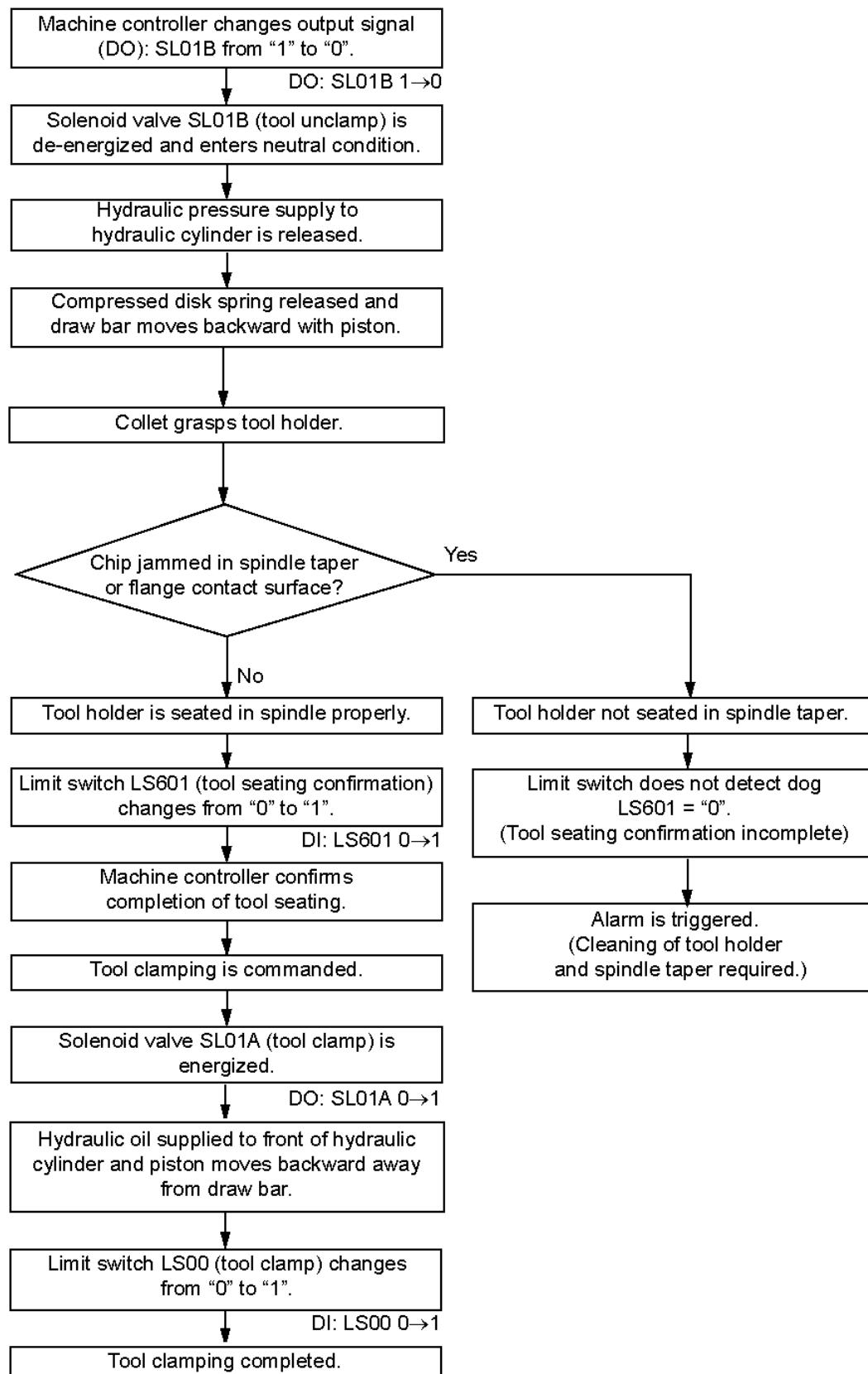


Figure 2.1 Tool Unclamp

Tool Clamp / Tool Seating Confirmation (LS601)

Chapter 4 Spindle Head

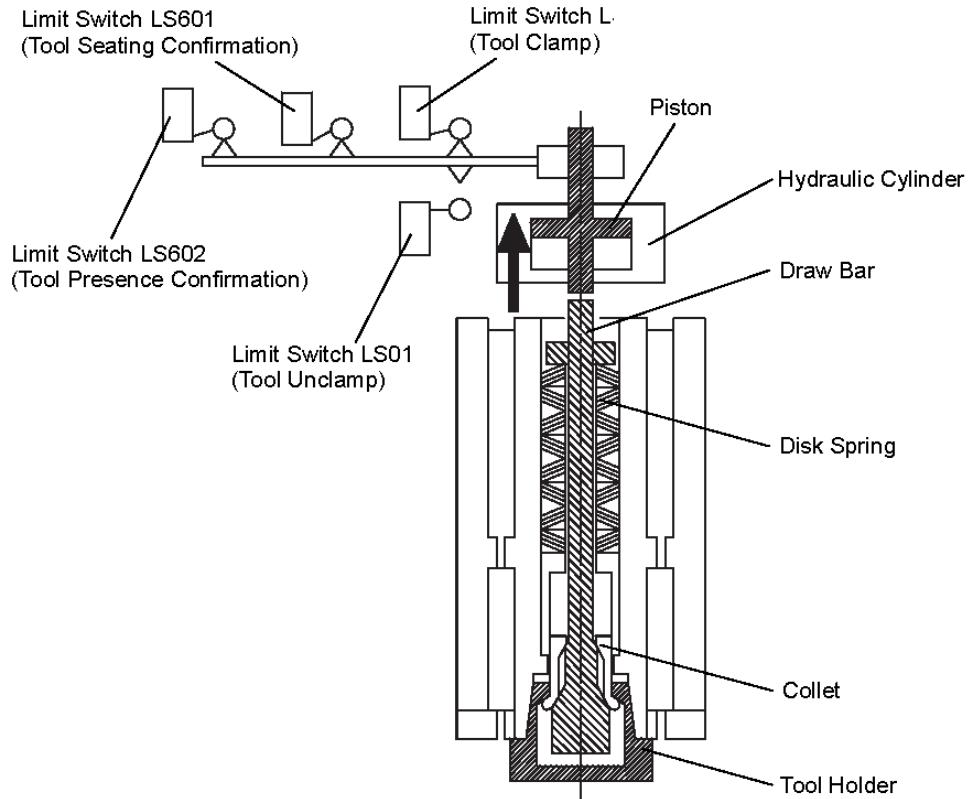
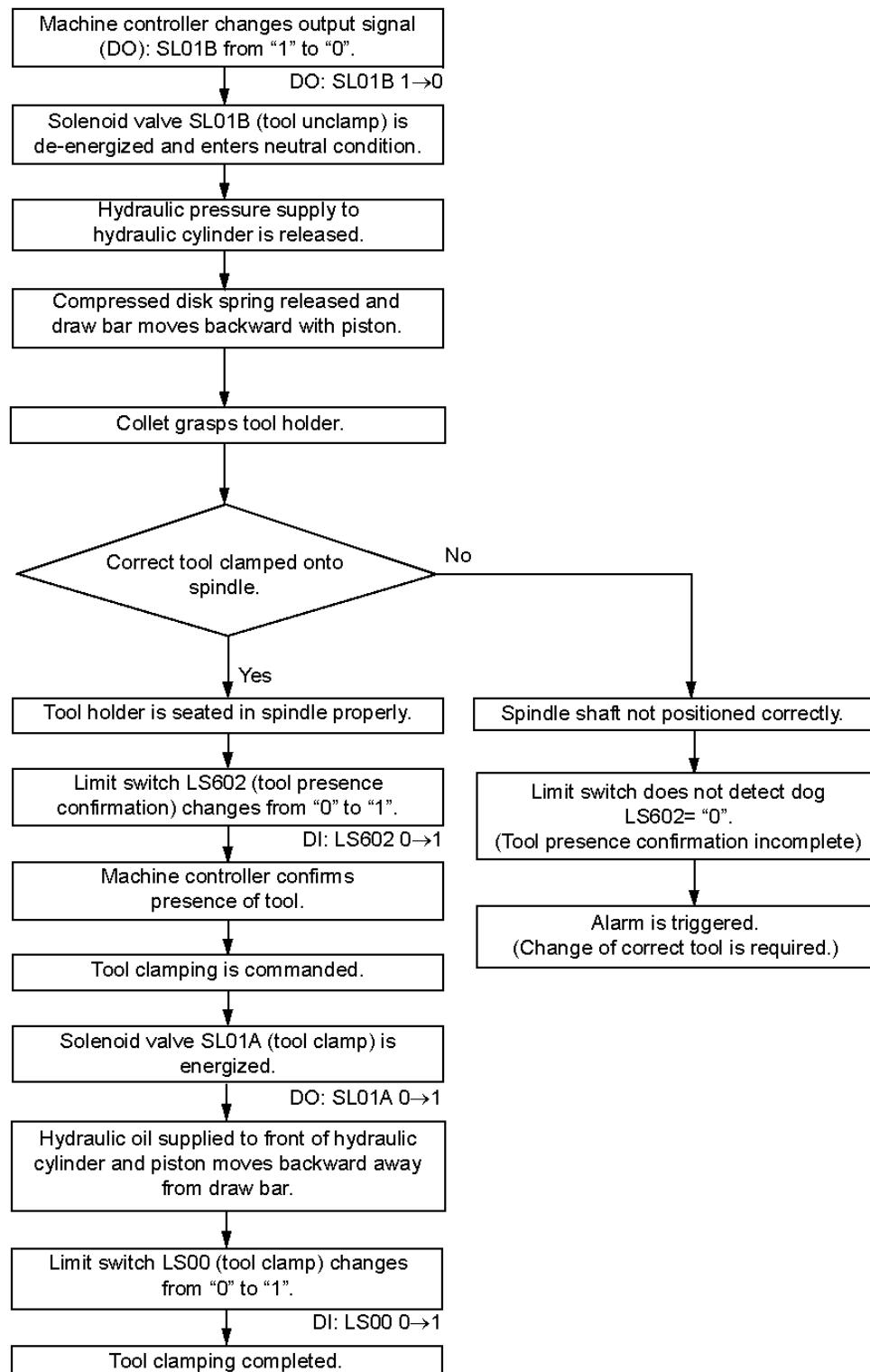


Figure 2.2 Tool Clamp

Table 2.1 Clamp Force

Spindle Specs.	Clamp Force
HSK A63	20 ~ 22 kN
BT40	8.3 ~ 10.5 kN
HSK A100	>31kN
BT50	>16kN

Tool Clamp/Tool Presence Confirmation (LS602)

2.2 Rotary Union Mechanism (Option)

The rotary union supplies coolant to the tip of the rotating spindle. (Refer to [2.3 Through Spindle Coolant \(TSC- Option\) \[135\]](#)).

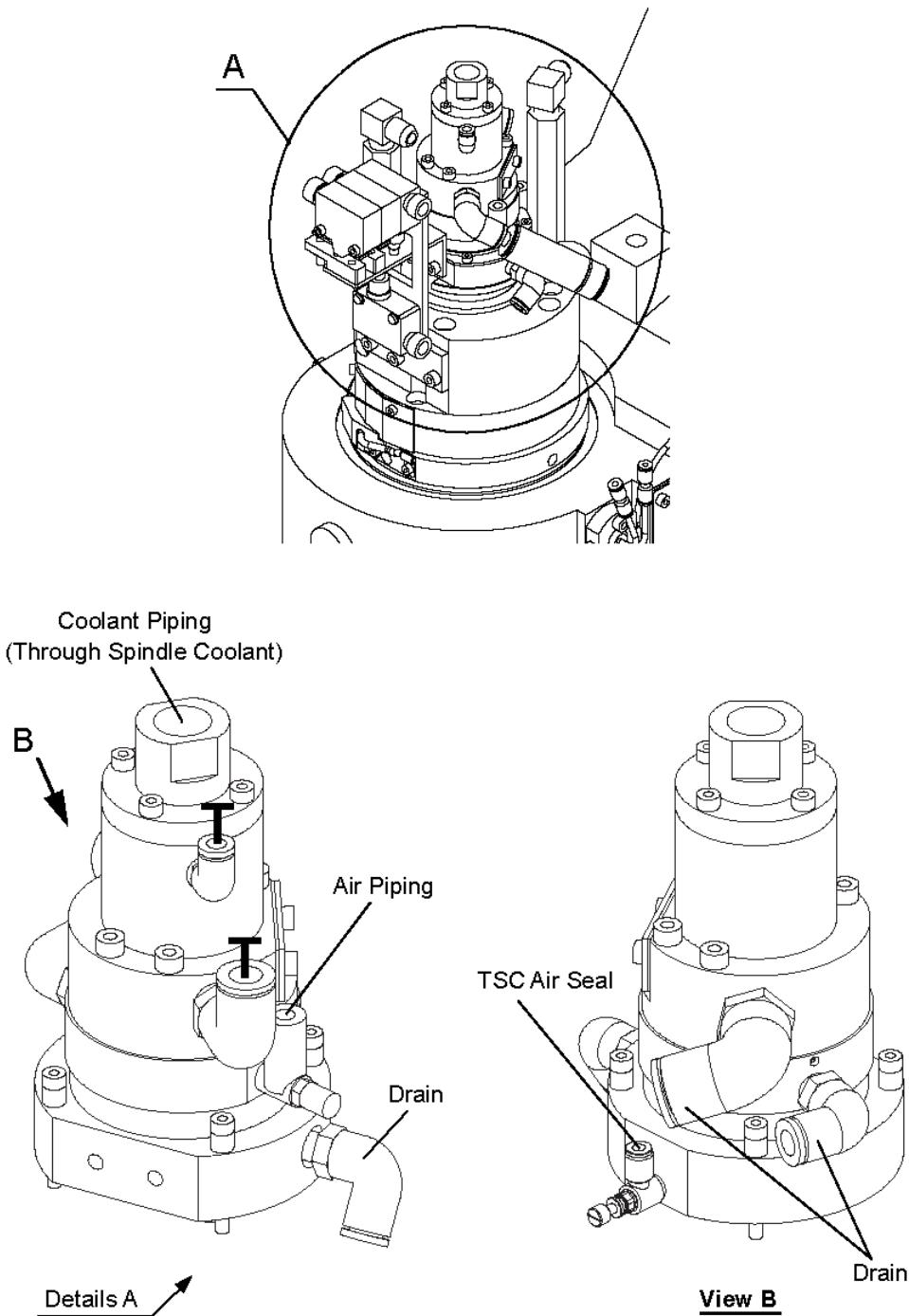
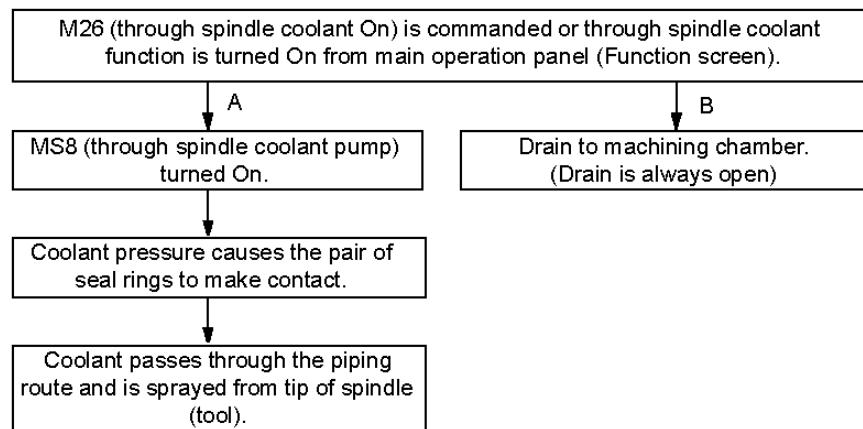


Figure 2.3 Rotary Union Mechanism (Option)

2.3 Through Spindle Coolant (TSC- Option)

Coolant is supplied to the end of the spindle (tool) in order to facilitate the smooth machining of workpiece.

When through spindle coolant function is being used, the piston is moved forward by the pressure of the coolant and the pair of seal rings (rotating ring and fixed ring) come into contact. Coolant is then supplied to the tip of the spindle (tool).



-NOTE-

A small amount of coolant seeps out from the two seal rings contact surfaces in order to lubricate the rings. This is a normal function.

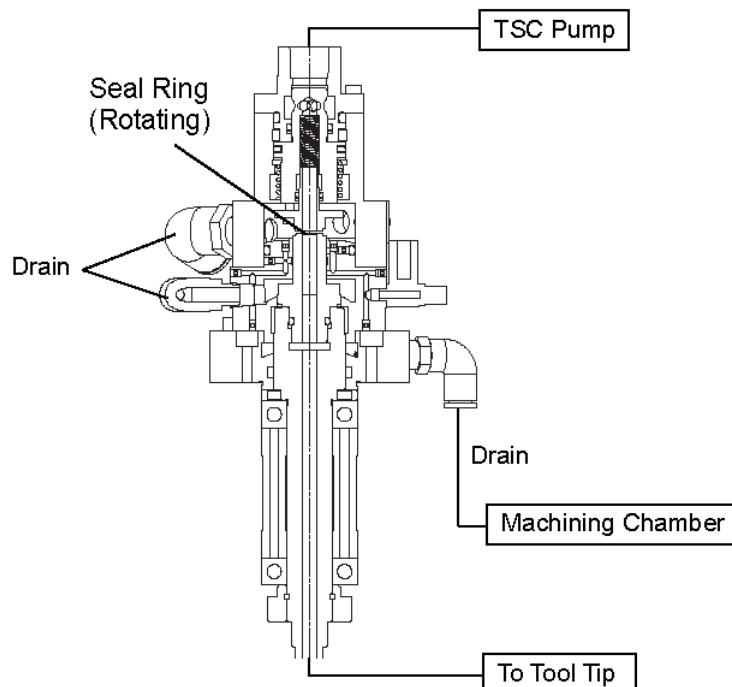
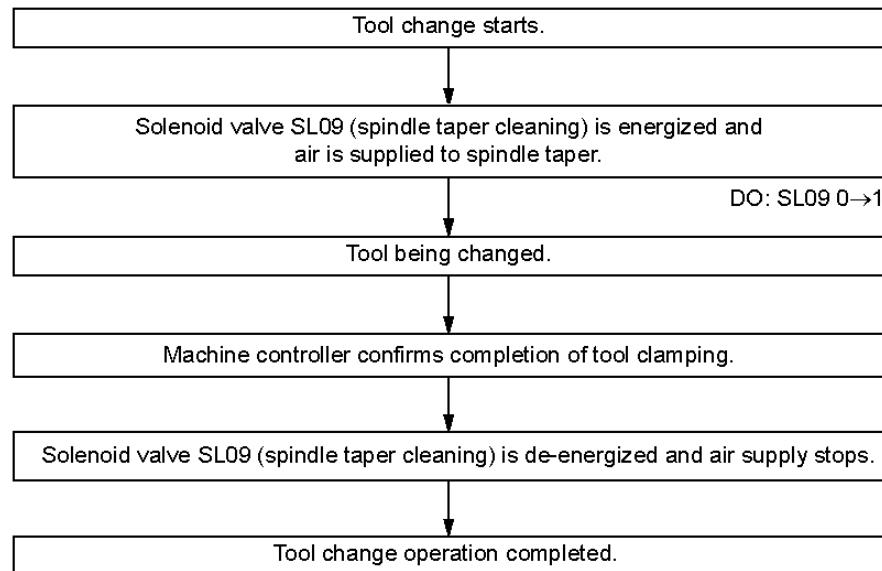


Figure 2.4 Through Spindle Coolant (Option)

2.4 Air Functions

2.4.1 Spindle Taper Cleaning

The spindle taper cleaning function supplies air during tool change to prevent chips and coolant from adhering to the spindle taper. (Refer to NOTE [136])



-NOTE-

Air is not supplied during manual tool clamp/unclamp operation.

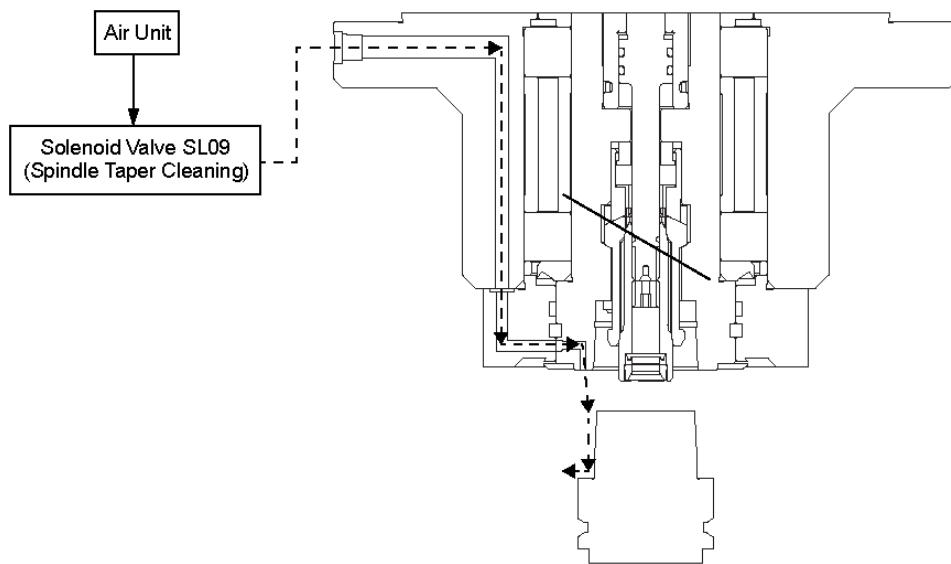


Figure 2.5 Spindle Taper Cleaning

2.4.2 Air Blow

The air blow function supplies air to the tip of the spindle in order to prevent chips from adhering to the tip of the spindle during workpiece machining.

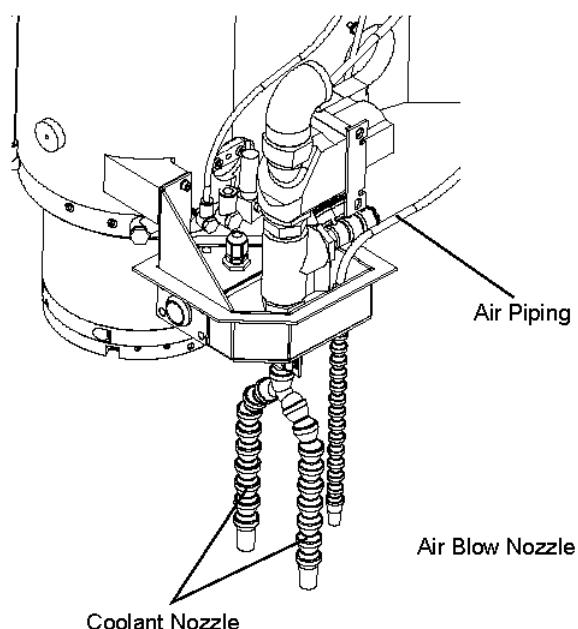
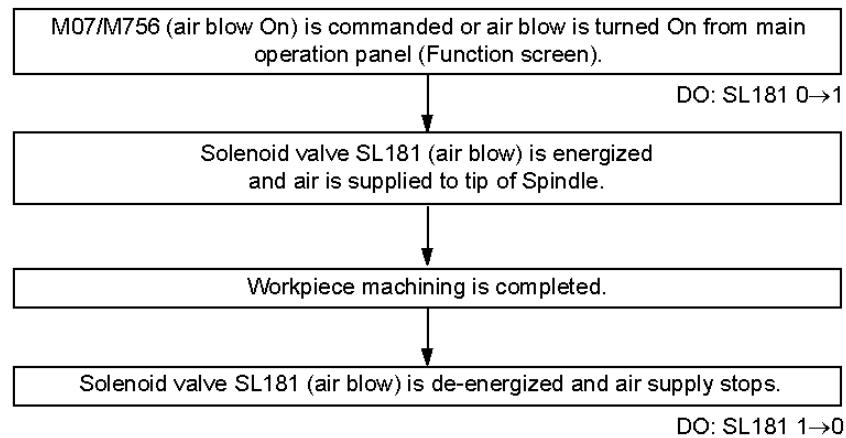


Figure 2.6 14k Spindle Taper Cleaning Air

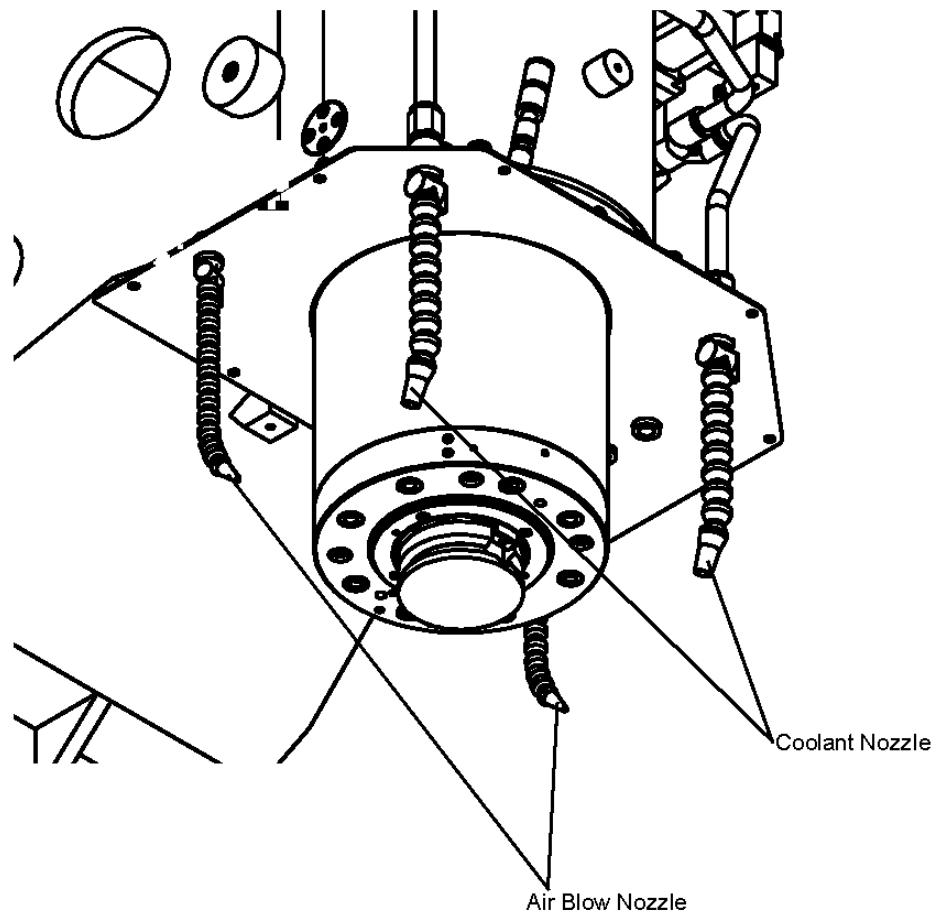


Figure 2.7 10k Spindle Taper Cleaning Air

2.5 Through Spindle Coolant Operation Timing Chart

The M codes and signals used to control the through spindle function are described in the following table.

Table 2.2 Details of M Codes and Signals

Name	Description
MS8 (signal)	Controls the operation of pump motor for through spindle coolant.
M09 (M code)	Stops the coolant supply after execution of the specified block.
M319 (M code)	Stops the coolant supply without waiting for completion of axis travel and starts spindle orientation. This command does not stop the through spindle coolant drawback function (Refer to NOTE [139]). As a result, removal of the coolant inside the tool (via drawback) and axis travel are performed simultaneously, reducing the amount of time it takes.
M06 (M code)	Specifies the tool change. The spindle tool is exchanged with the tool indexed to the next tool position. Axis travel cannot be performed during this process.
M26 (M code)	Through spindle coolant supply is started.

-NOTE-

The machine parameter No. 07051 is set to specify whether or not to stop the through spindle coolant pump after the coolant stop process. This function is used when M319 is specified during discharge of coolant.

Tool change when through spindle coolant is stopped by M06/M09/M319

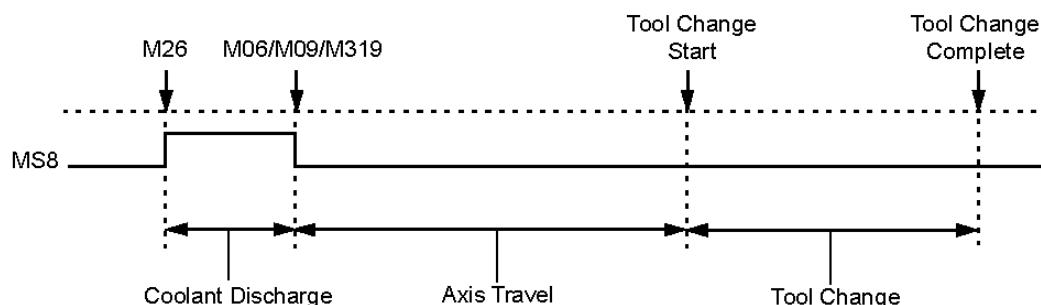


Figure 2.8 Through Spindle Coolant Operating Timing Chart

1 Overview

The transfer axes in X/Y/Z coordinates are called feed axes. Accurate control of these three axes ensures high machining accuracy. A feed axis consists of the following main components and parts.

- Linear Motion Guide
- Ball Screw
- Servomotor
- Feedback Scale Unit (Option)

1.1 Component Name

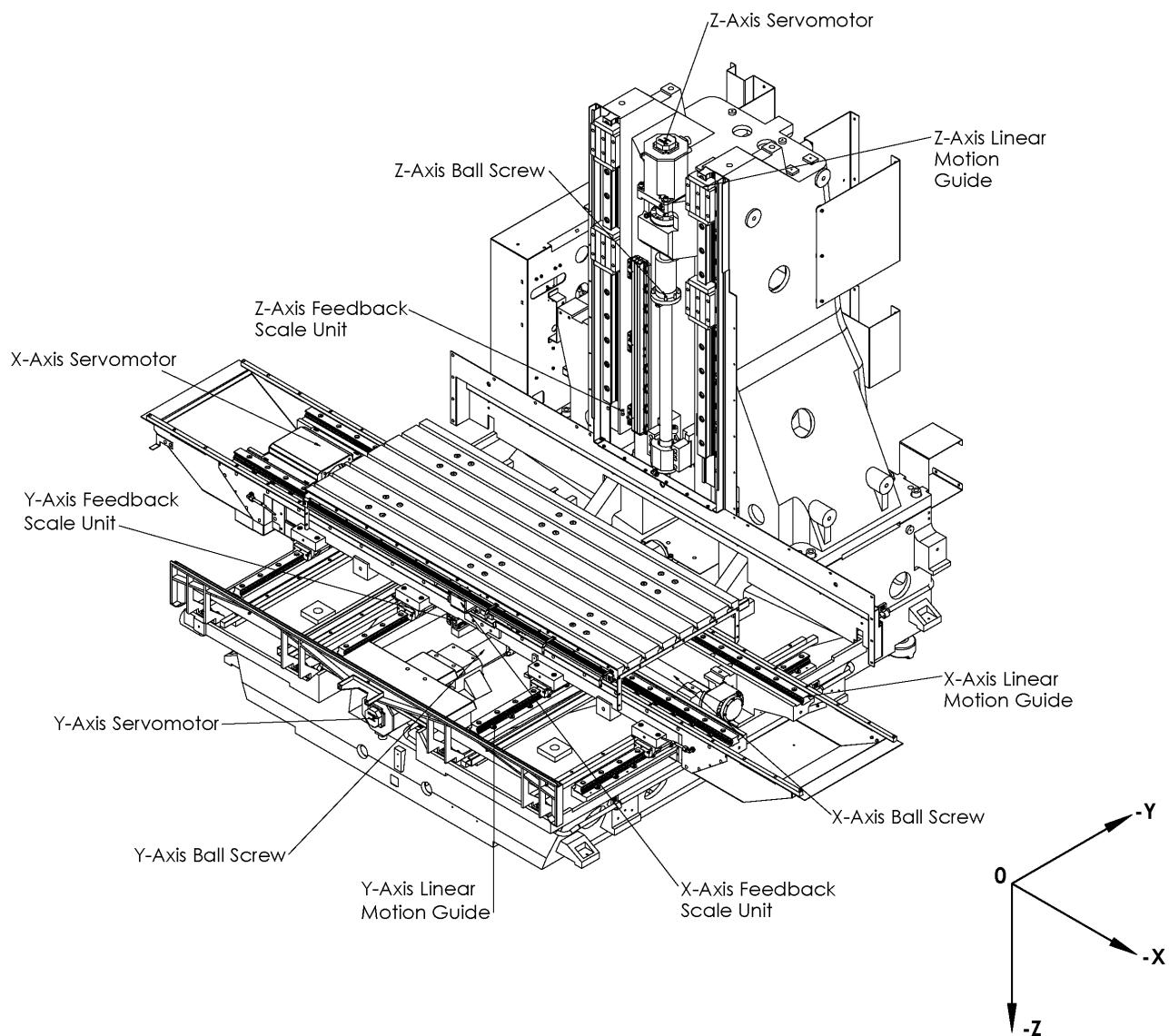


Figure 1.1 General View

1.2 Piping and Wiring

For piping and wiring to machine controller components refer to Chapter 2, [Figure 1.2](#)^[34].

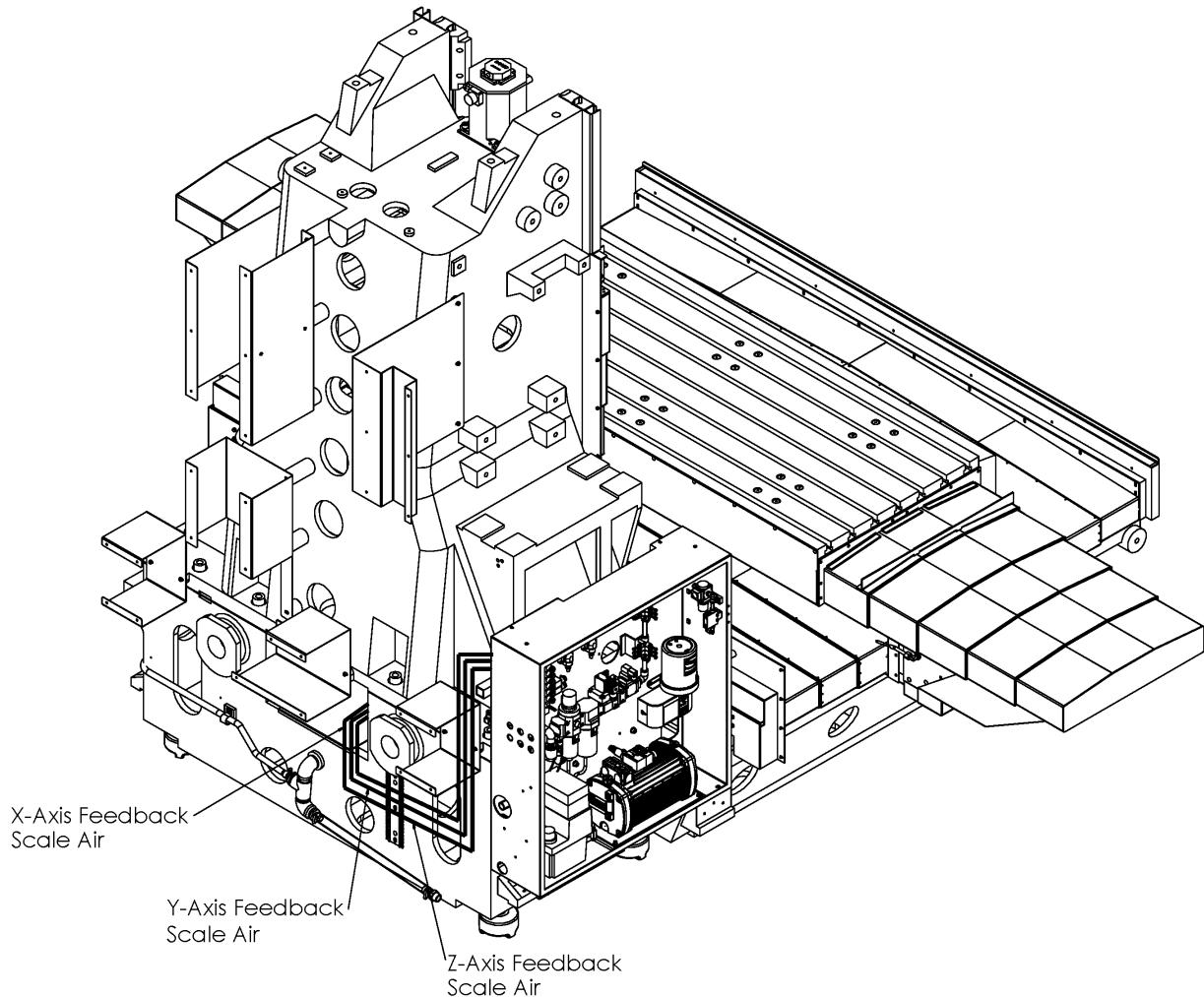


Figure 1.2 Piping Route 1

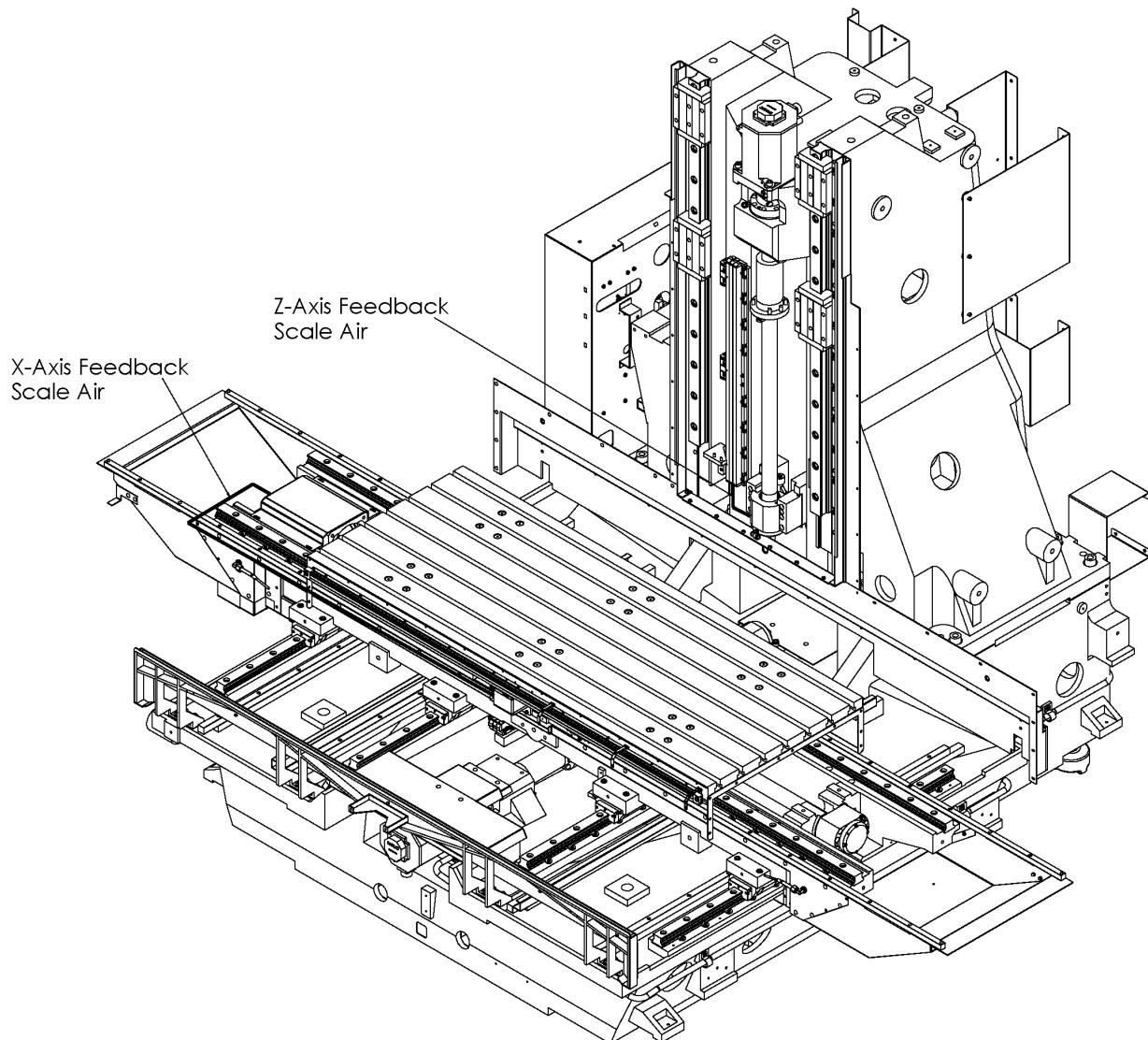


Figure 1.3 Piping Route 2

Chapter 5 Feed Axis

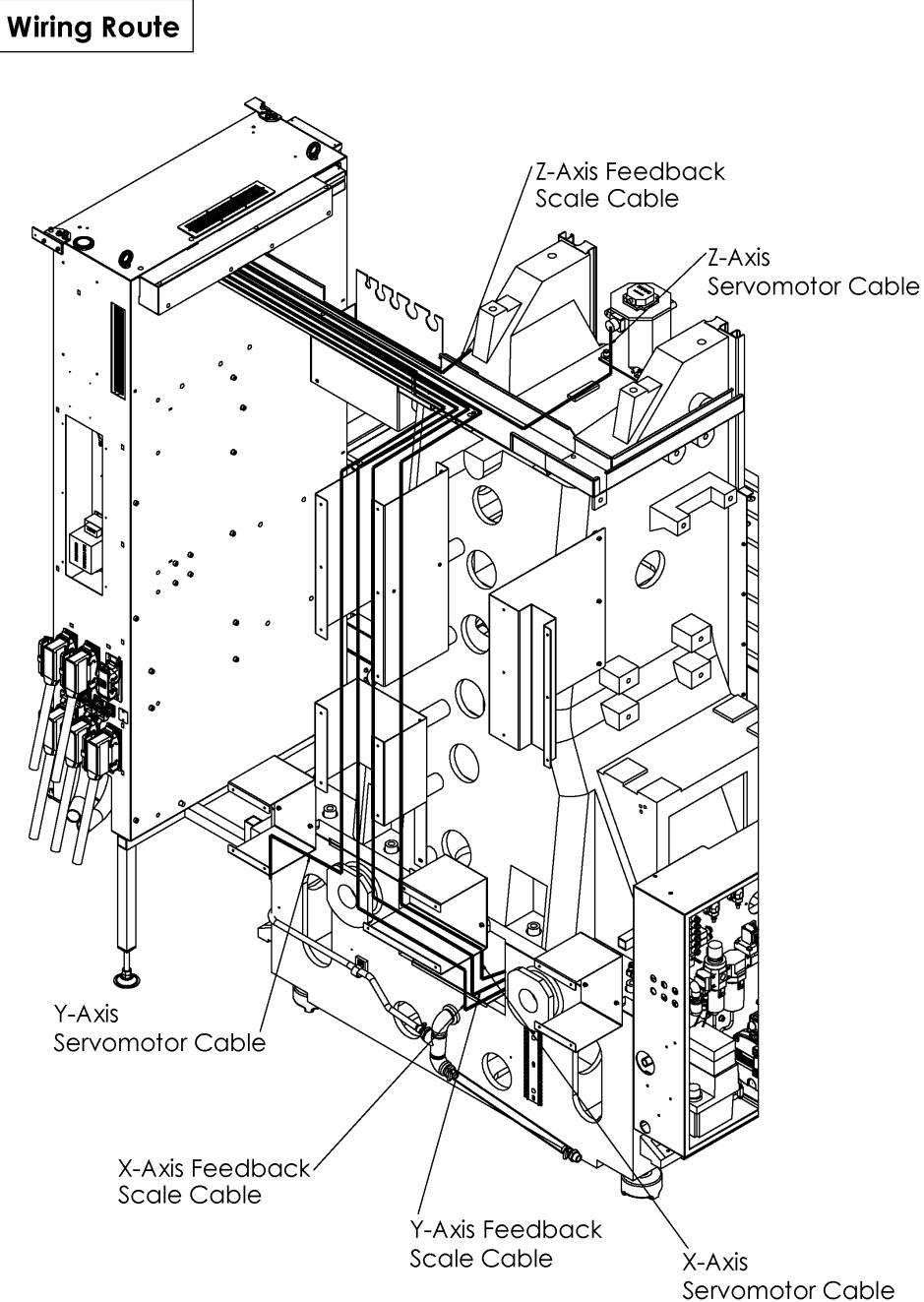


Figure 1.4 Wiring Route 1

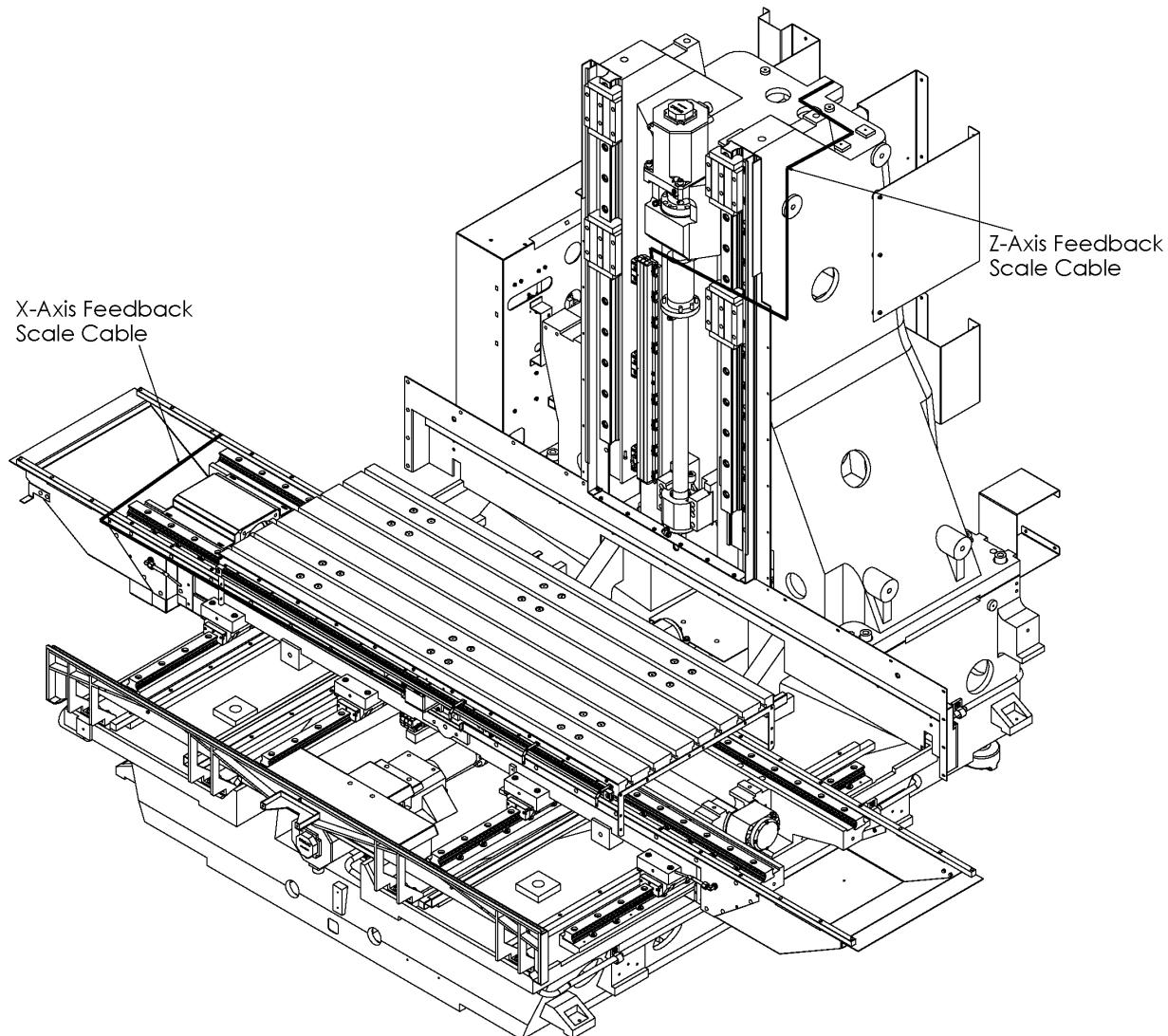


Figure 1.5 Wiring Route 2

Chapter 5 Feed Axis

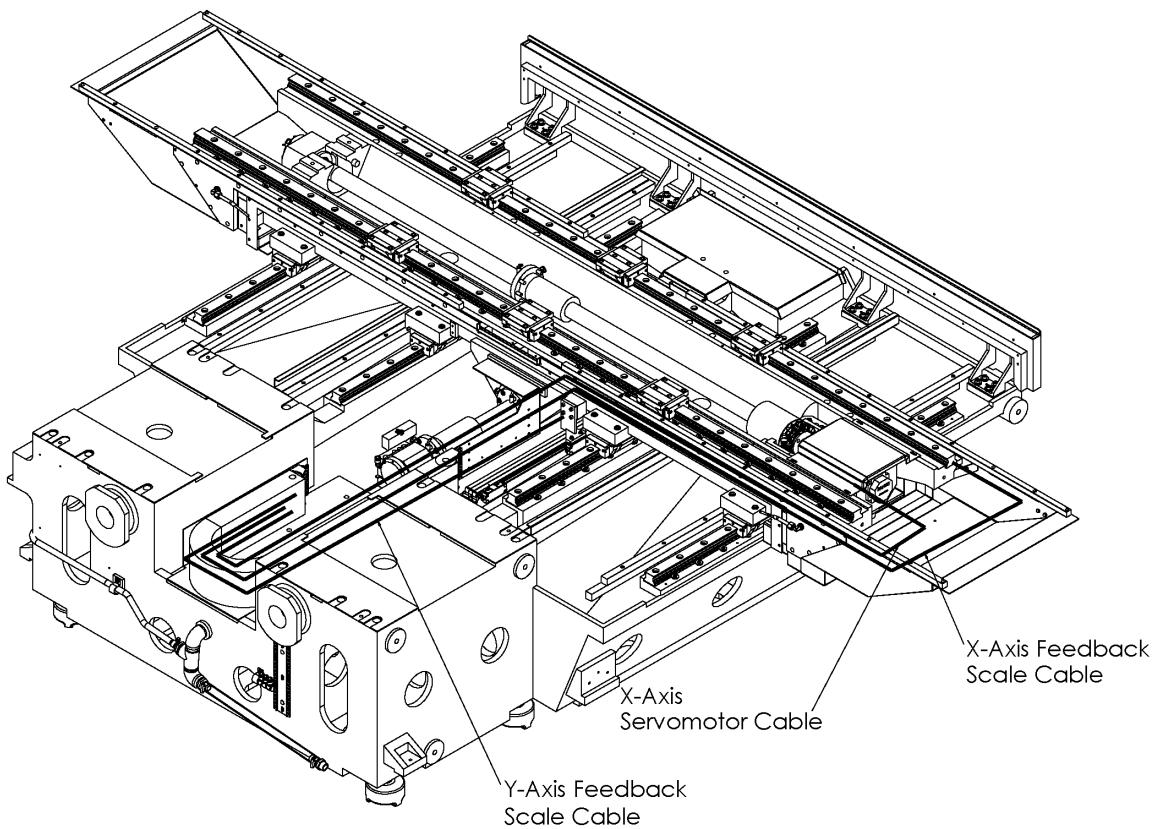
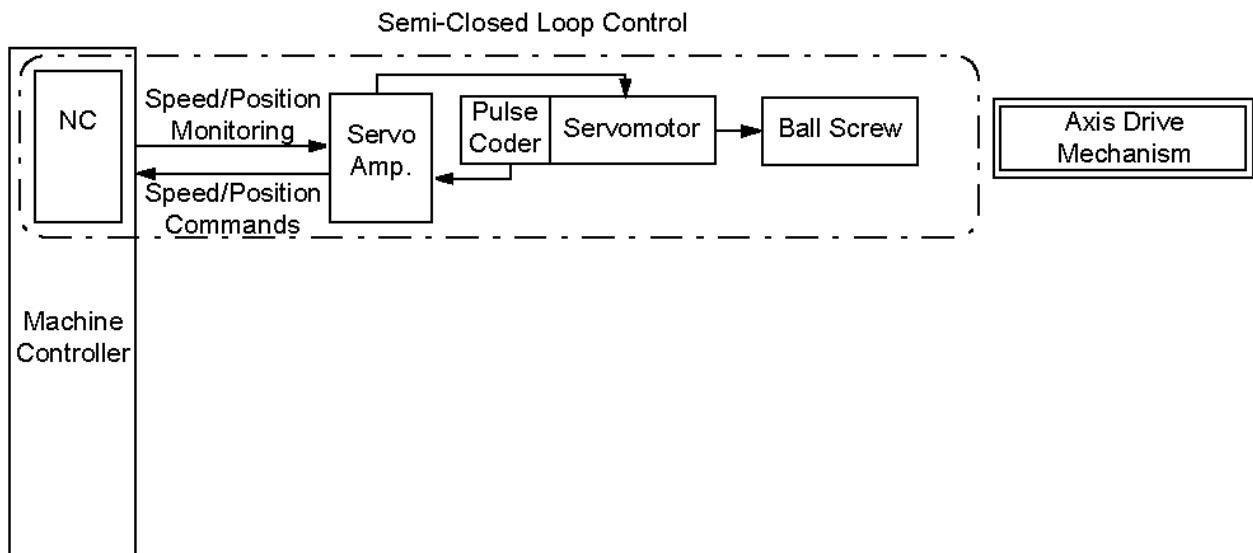


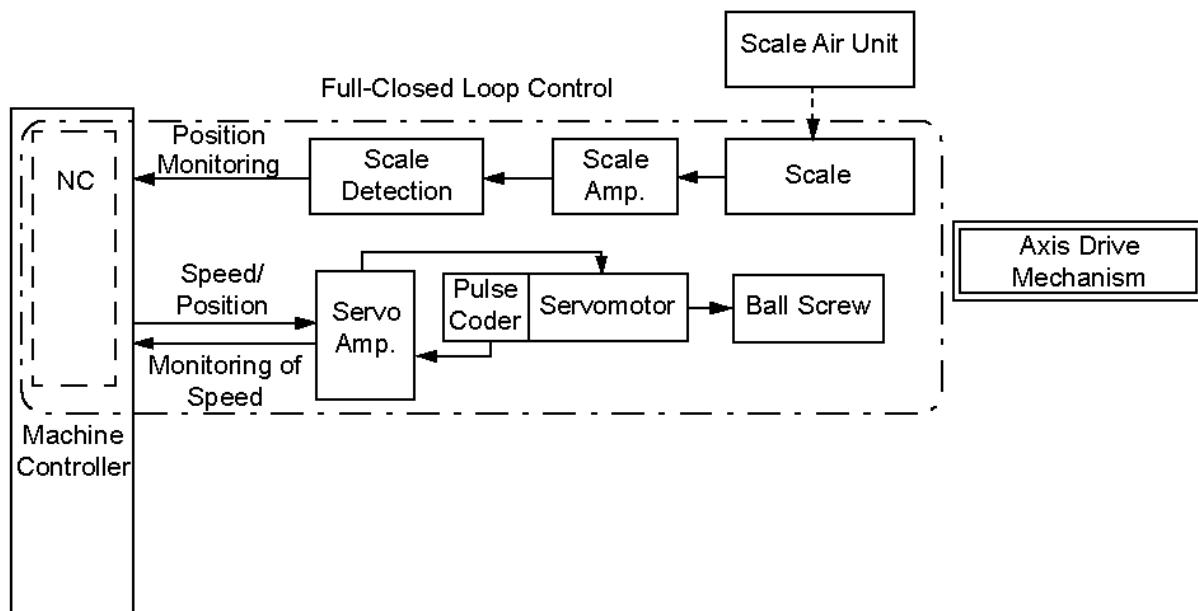
Figure 1.6 Wiring Route 3

2 Feed Axis Mechanism

Standard Specs. (Without Scale Unit)



Option Specs. (With Scale Unit)

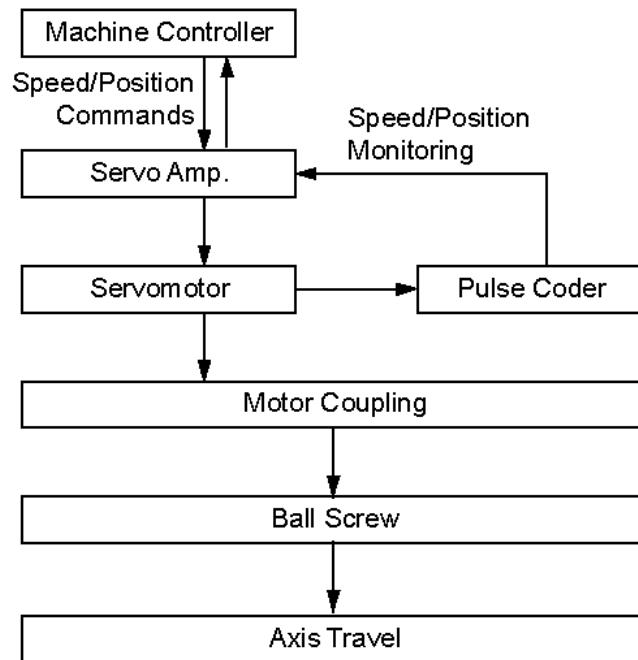


2.1 Feed Axis Drive

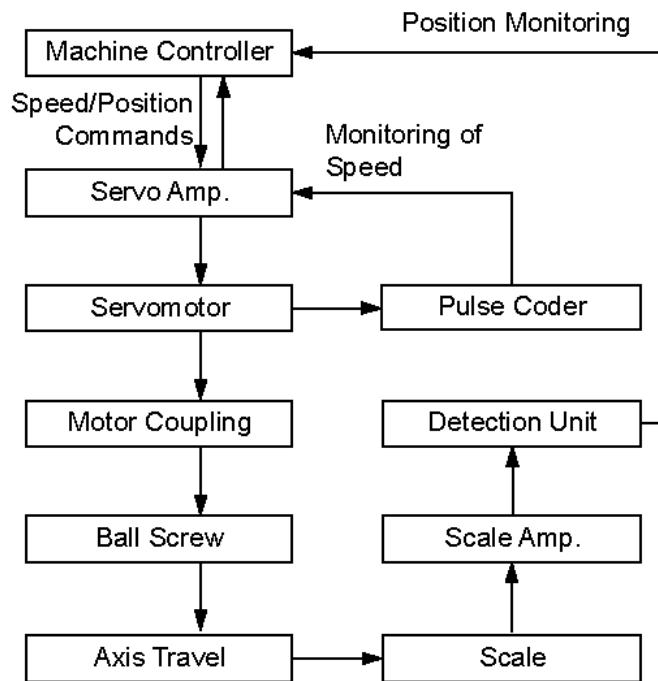
2.1.1 Drive

Each axis is driven by a ball screw and servomotor. The axis movements (speed and positioning) are controlled by the machine controller.

Standard Specs. (Without Scale Unit)



Option Specs. (With Scale Unit)



2.1.2 Axis Configuration

Ball screw is driven by an AC servomotor connected with a motor coupling. The ball screw is rotated by the servomotor and supported by the support bearings (one end fixed and the other end supported). The diagram below shows the axis drive mechanism (configuration).

Servomotor

AC servomotors with built-in absolute type pulse coders drive the feed axes. The Z-axis (gravity axis) servomotor is equipped with a brake. The brake is applied in the following conditions:

- When the power is turned Off (brake can be released by turning the control power On again).
- When the Emergency Stop switch is pressed.
- When the servo amplifier is in Servo Ready Off status.
- When a servo alarm is triggered.

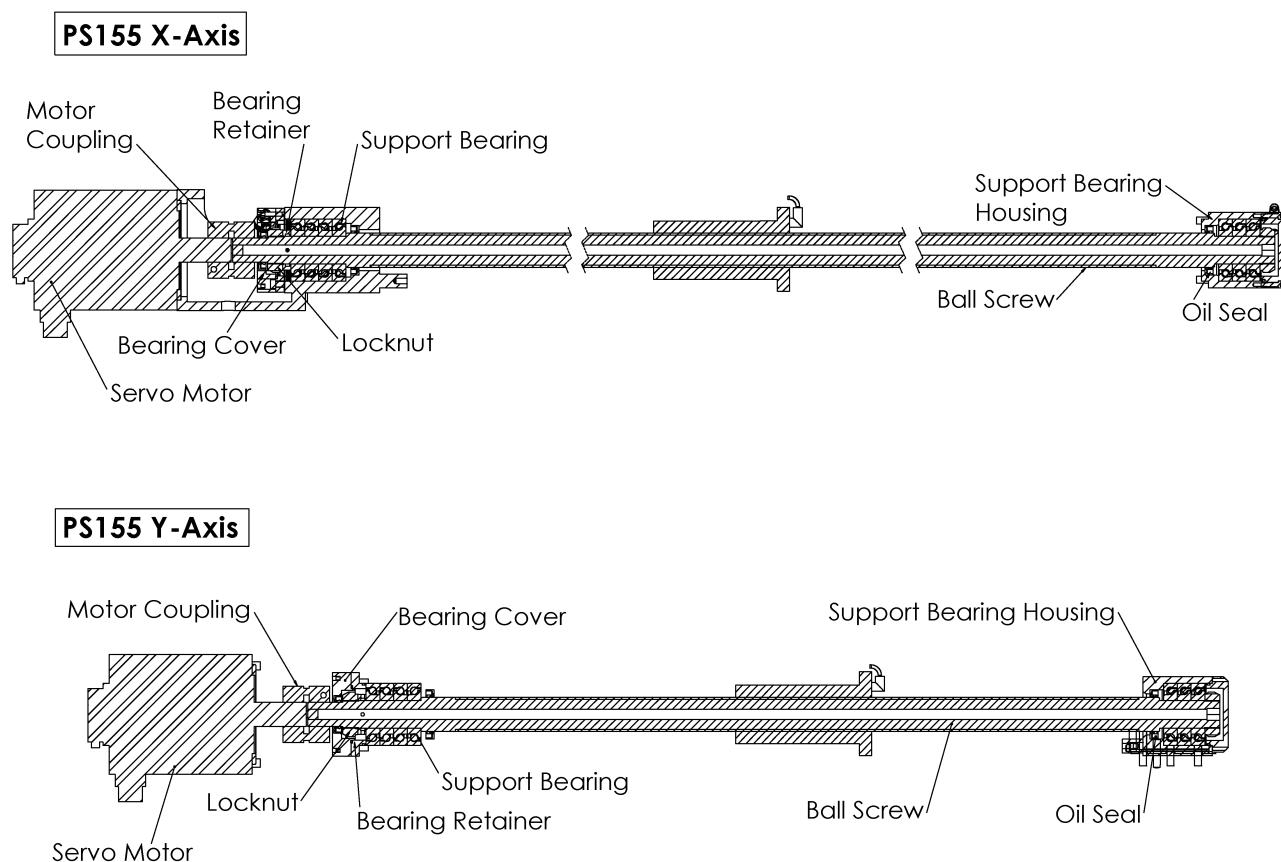


Figure 2.1 Axis Configuration 1

Chapter 5 Feed Axis

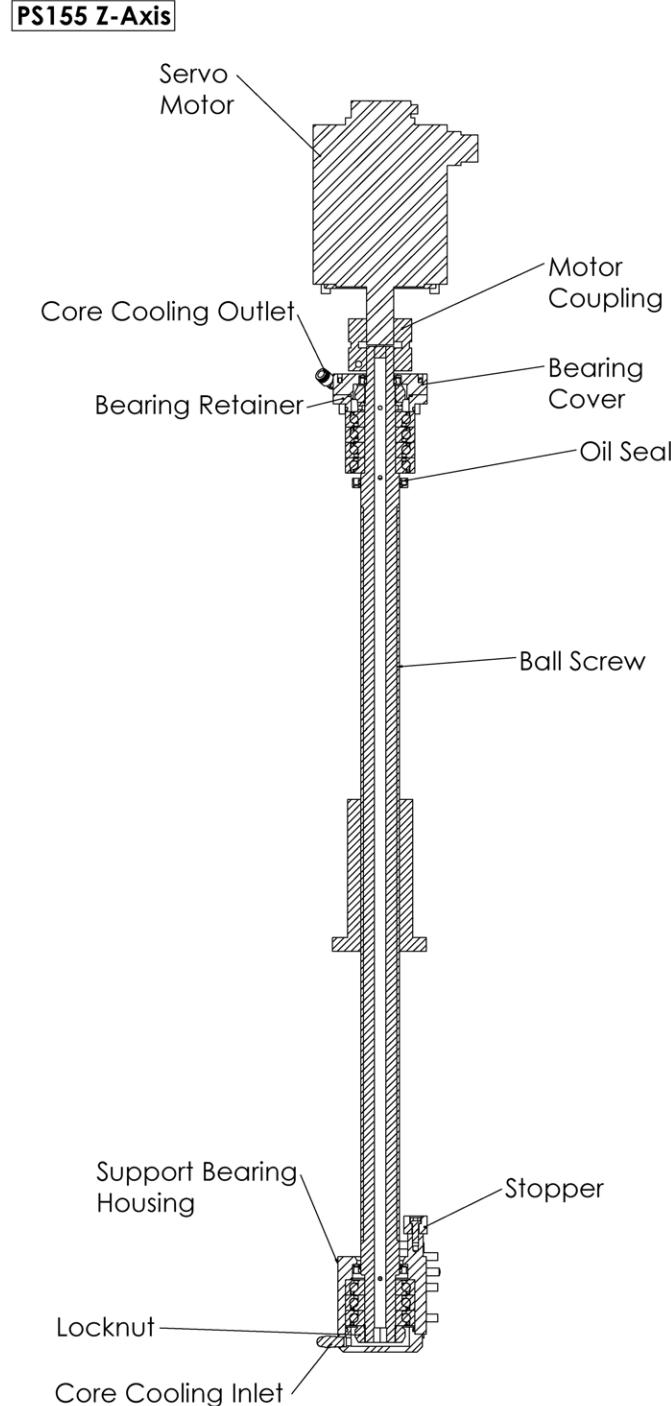


Figure 2.2 Axis Configuration 2

Servomotor Coupling

The motor shaft and the ball screw are connected by a motor coupling. The coupling consists of a coupling flange and flat spring. The coupling flange is deformed when the clamping screws are tightened and the motor shaft and ball screw are connected by means of frictional force.

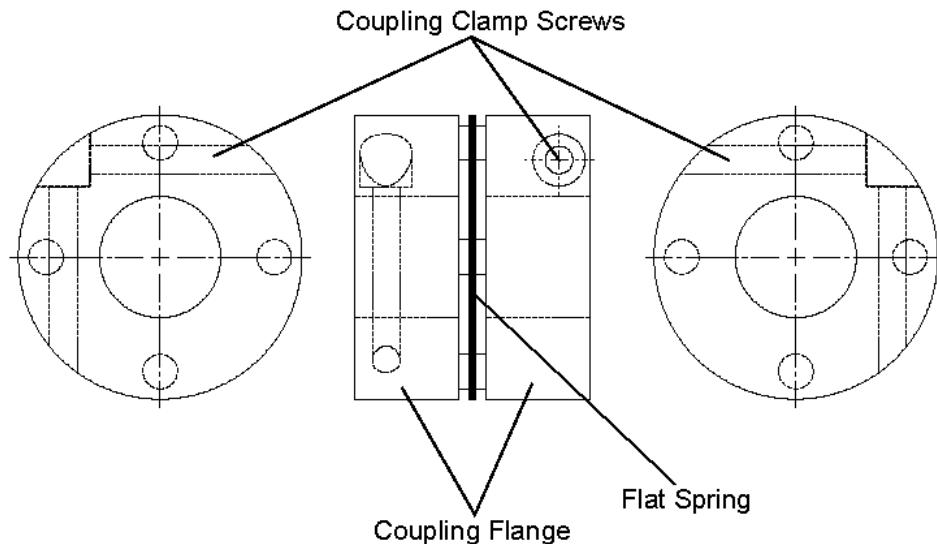


Figure 2.3 Servomotor Configuration

Clamp Bolt Tightening Torque of Miki Pulley Coupling (Option)

Axis	Model	Clamp Bolt Size	Torque (Nm)
X-Axis	SFC-080SA2-35B-35B	M8	30
Y-Axis	SFC-080SA2-35B-35B	M8	30
Z-Axis	SFC-080SA2-35B-35B	M8	30

2.2 Axis Stroke Limits

Axis Reference Positions

Over Travel

The stroke for each axis is limited by an NC software limit (Soft OT1).

- **Soft OT1**

If a command is sent for an axis beyond its stroke limit, the NC unit stops movement of the axis. This condition triggers an alarm but does NOT cause an Emergency Stop.

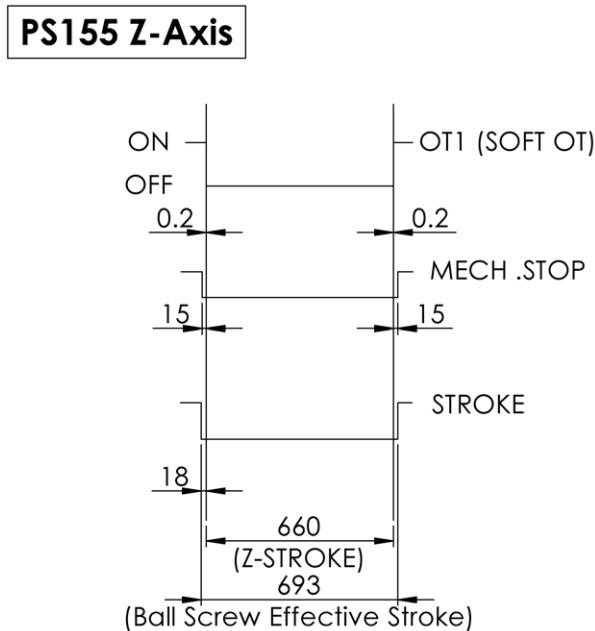


Figure 2.4 Z-Axis Stroke Limits

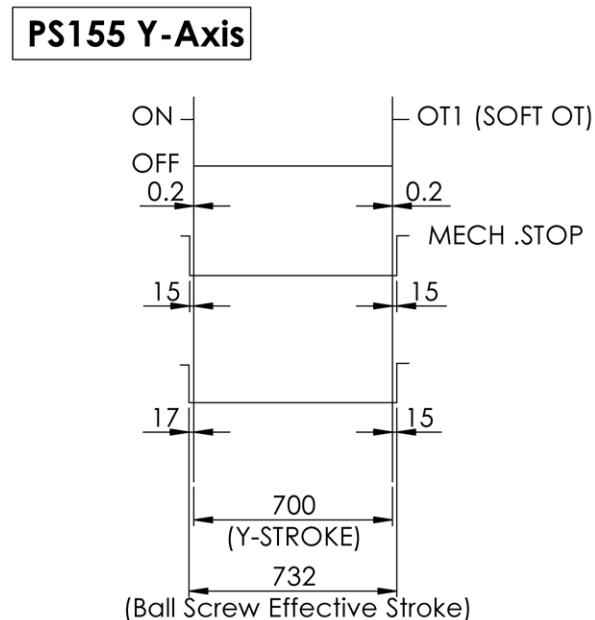


Figure 2.5 Y-Axis Stroke Limits

PS155 X-Axis

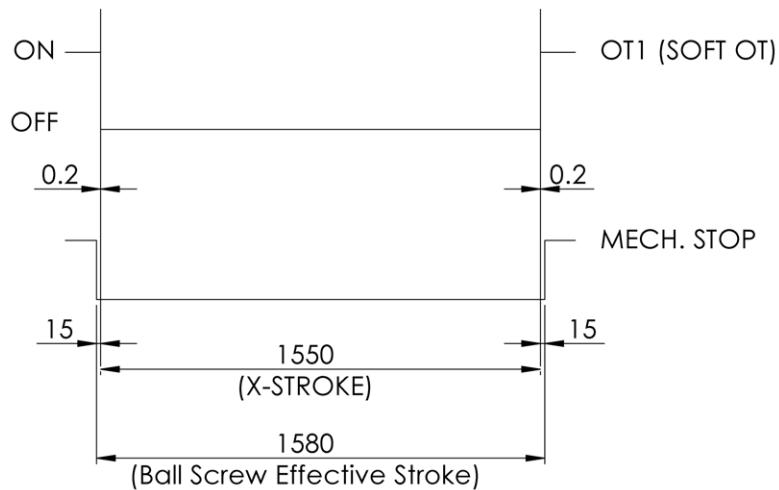


Figure 2.6 X-Axis Stroke Limits

2.3 Reference Position Return

An AC servomotor with an absolute type pulse coder is used as the drive motor. When the motor does not have a scale unit, the position is constantly stored by an absolute pulse coder and when the motor has a scale unit, the position is constantly stored by the absolute scale unit. Therefore, reference position return is not necessary when the main power supply is turned On or after recovering from the Emergency Stop condition. However, reference position return is required in the following cases.

1 After replacing motor signal wire or battery cable or battery for pulse coder.

Perform reference position return for each axis in order to store the reference position in the machine using the following procedure:

- 1) Move the X-axis to the minus side of the center position prior to performing X-axis reference position return.
- 2) Move the axis 16mm (X-axis)/12mm (Y-axis)/12mm (Z-axis) (axis feed amount per motor single revolution) or more in the manual feed (Jog) mode.
- 3) Turn Off the power supply and then turn it back On.
- 4) Press the **[REF]** mode from the Operation Mode selection switch.
- 5) Select the desired axis with the Axis Selection switch.
- 6) Press the **[CYCLE START]** switch to return to the reference position.
- 7) When axis movement stops, confirm the coordinate value is 0.

2 After removing or replacing the motor:

Perform the above procedure Butt Type Reference Position Return to establish the reference positions. (Refer to [Installation Manual Chapter 2, 6.1 Butt Type Reference Position Return](#)).

Contact your Makino service representative for assistance if any clarifications are necessary.

2.4 Axis Ball Screw Core Cooling

The X, Y, Z-axis ball screws are cooled by coolant from spindle cooler to minimize the axis thermal expansion. (Refer to [Chapter 7 Spindle Cooler](#) ¹⁷¹).

2.5 Axis Support and Guide

Each axis is guided and supported by two linear motion guides. One of the linear motion guides is a reference rail and the other is a driven rail. (Refer to [Figure 2.7](#) ¹⁵⁵).

- Linear Motion Guides

Linear motion guides are composed of carriages and rails. Linear motion guides are adjusted along the rail mounting shoulder using the parallel pins and are secured by mounting screws.

- Carriages

The X-saddle, Y-cross slide and Z-spindle ram are mounted to these carriages.

- Rails

For each of the axis two linear guide rails are used.

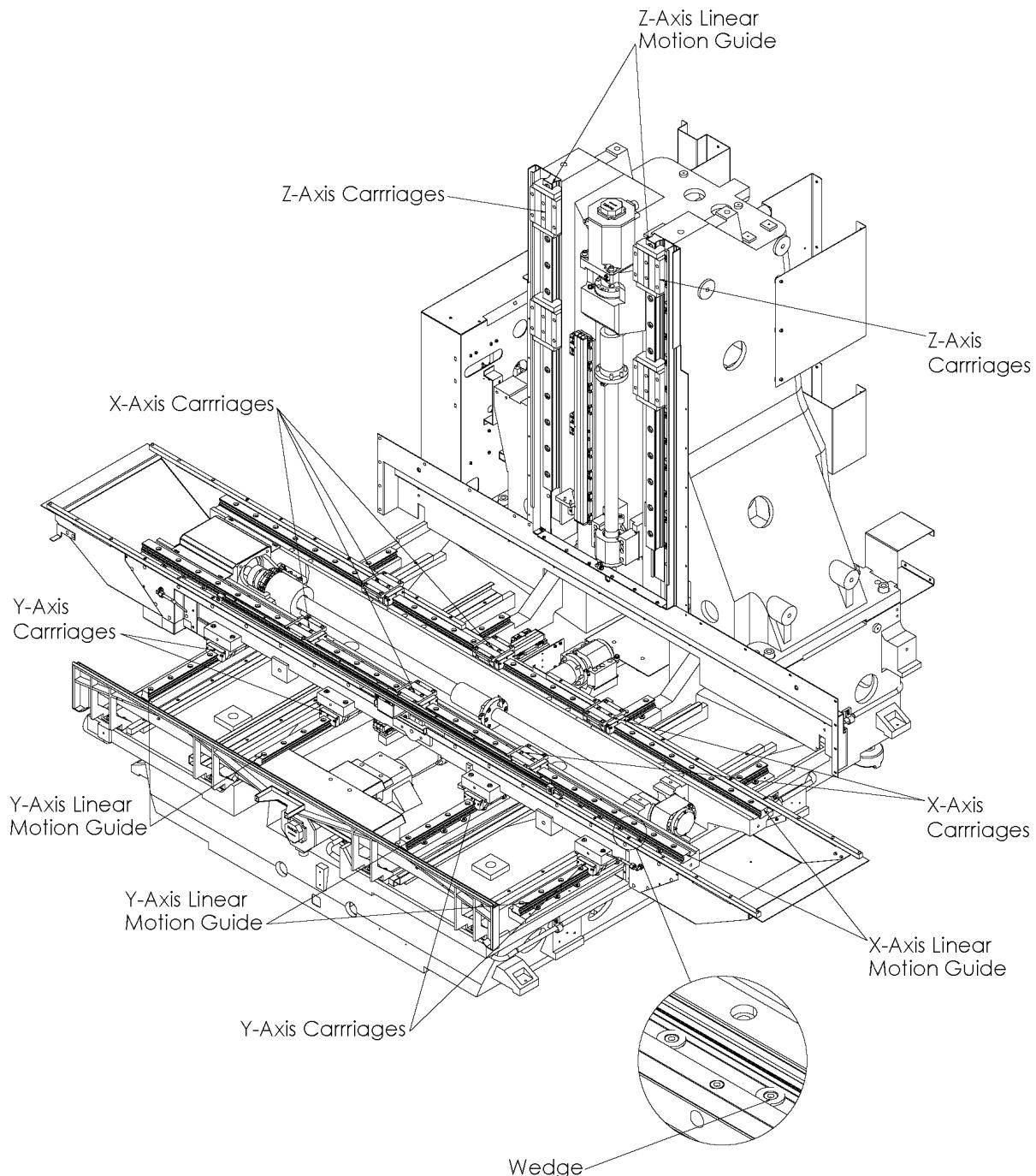


Figure 2.7 Axis Support and Guide

2.6 Axes Backlash

Backlash is a term used to refer to the amount (distance) of motion “lost” by an axis during a change of direction.

Backlash Compensation Function

- Backlash Compensation function allows the mechanical backlash to be corrected electronically.
- The backlash compensation value is set separately for cutting feed and rapid traverse in NC backlash parameter No.1851 & No.1852 respectively.

1 Overview

The ATC arm unit performs a series of tool change operation automatically, such as receiving tools indexed in the tool magazine at the tool change position, attaching the tools to the spindle head and returning the used tools back to the tool magazine. The tool magazine is driven by a servomotor with a reduction gear box.

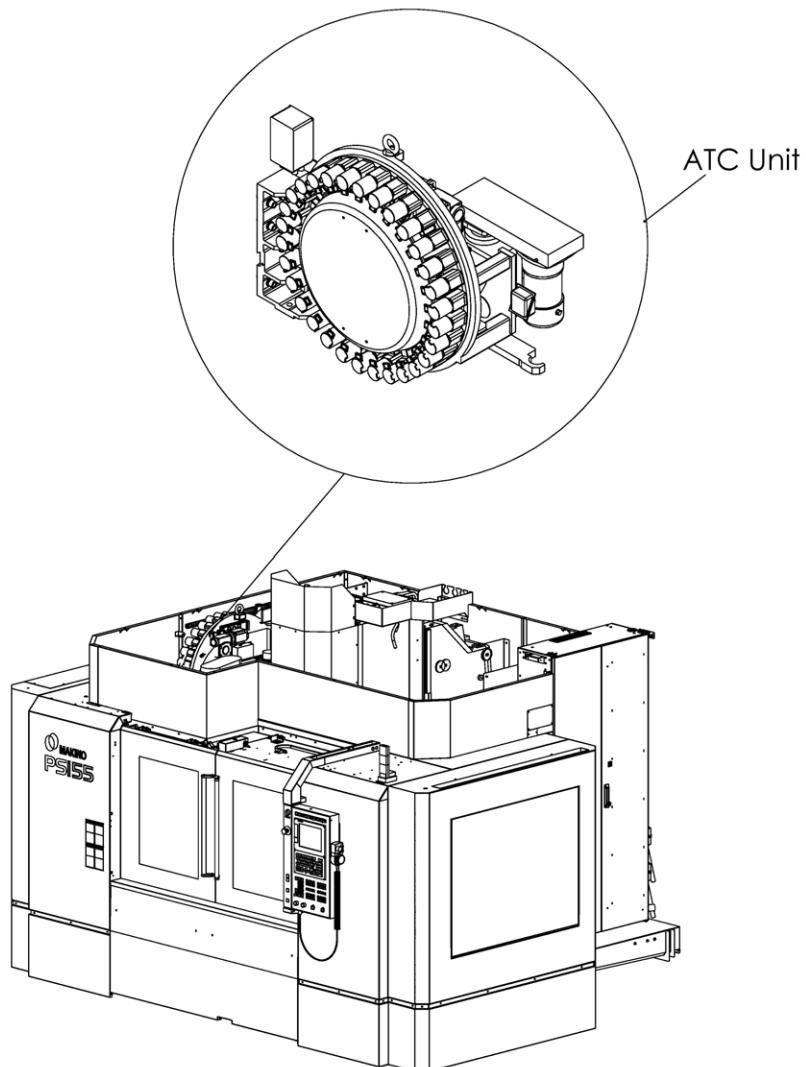


Figure 1.1 General View

1.1 Component Name

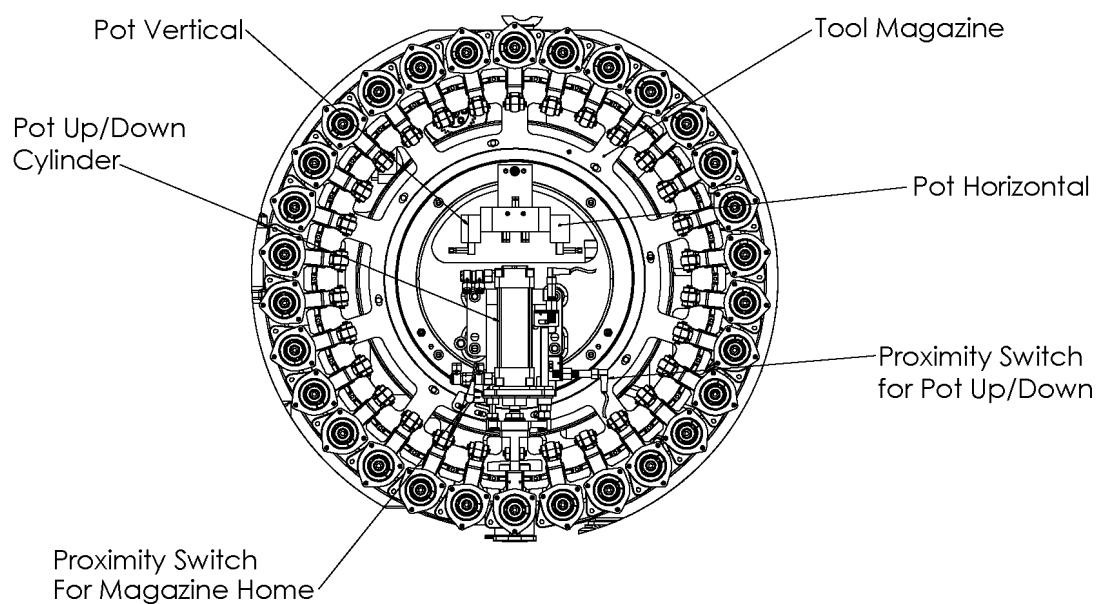
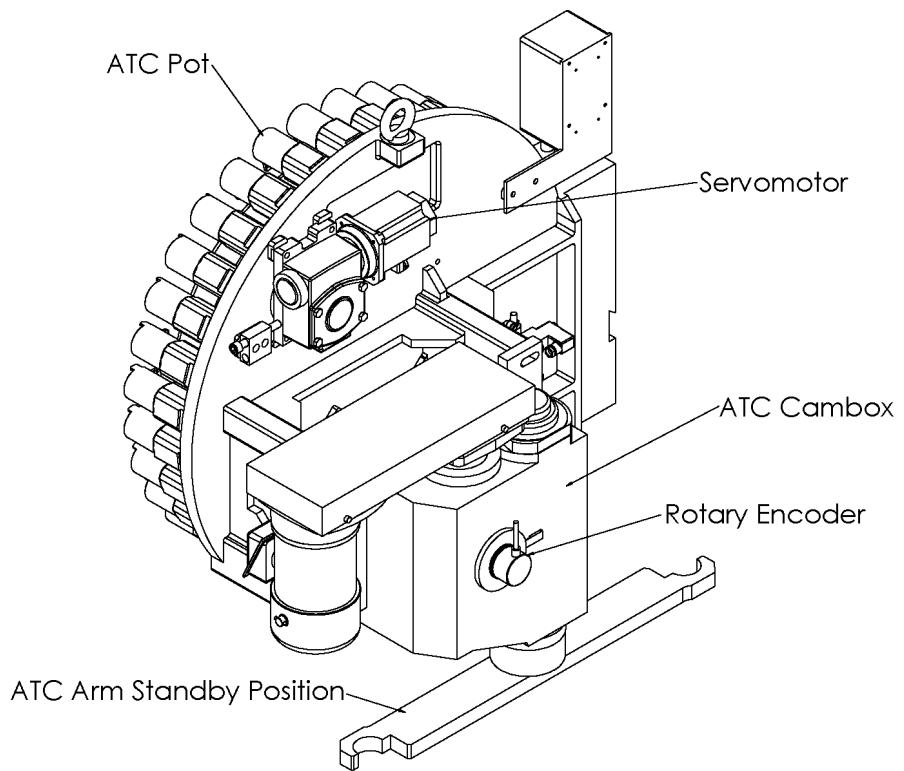


Figure 1.2 ATC Unit

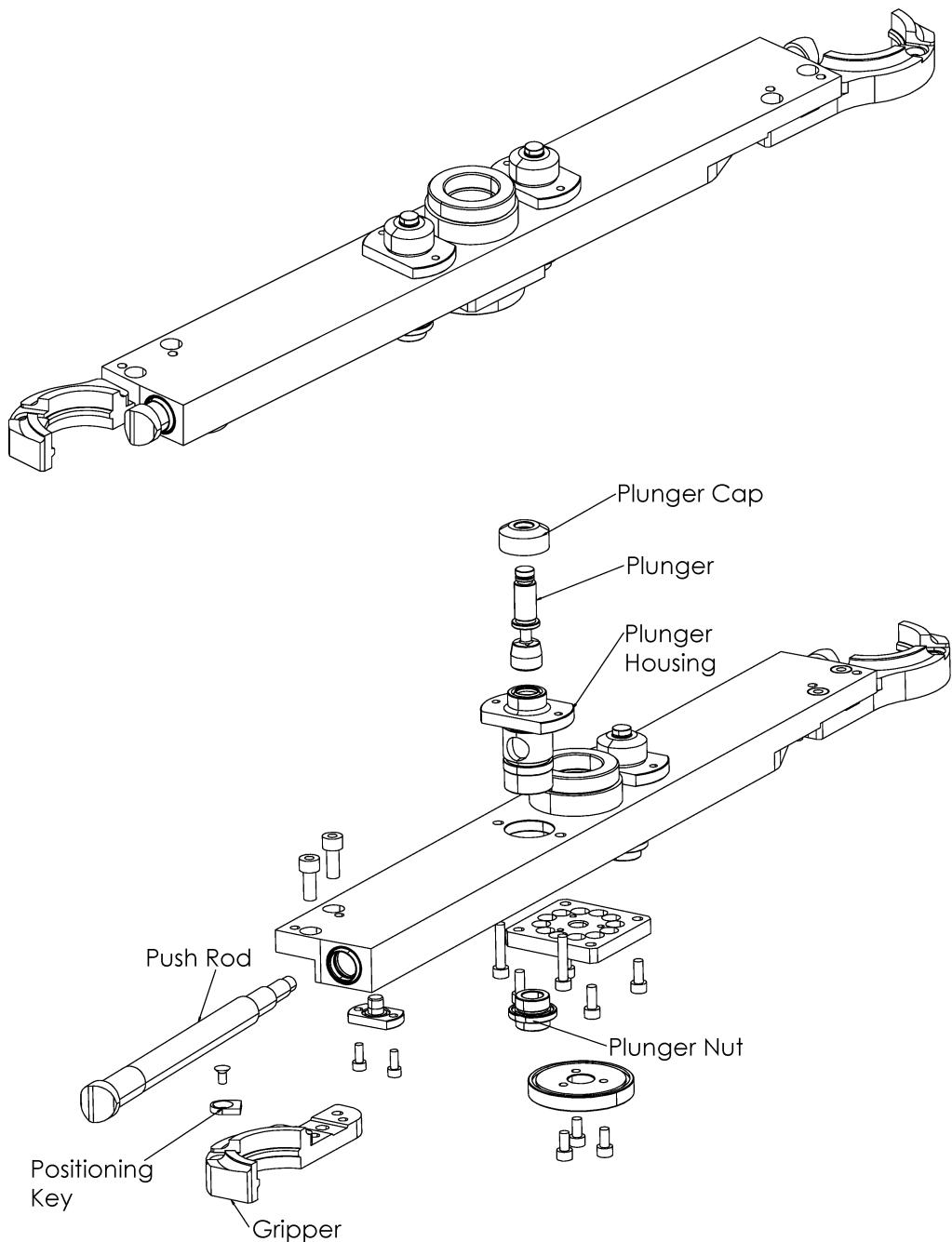


Figure 1.3 ATC Arm

1.2 Wiring

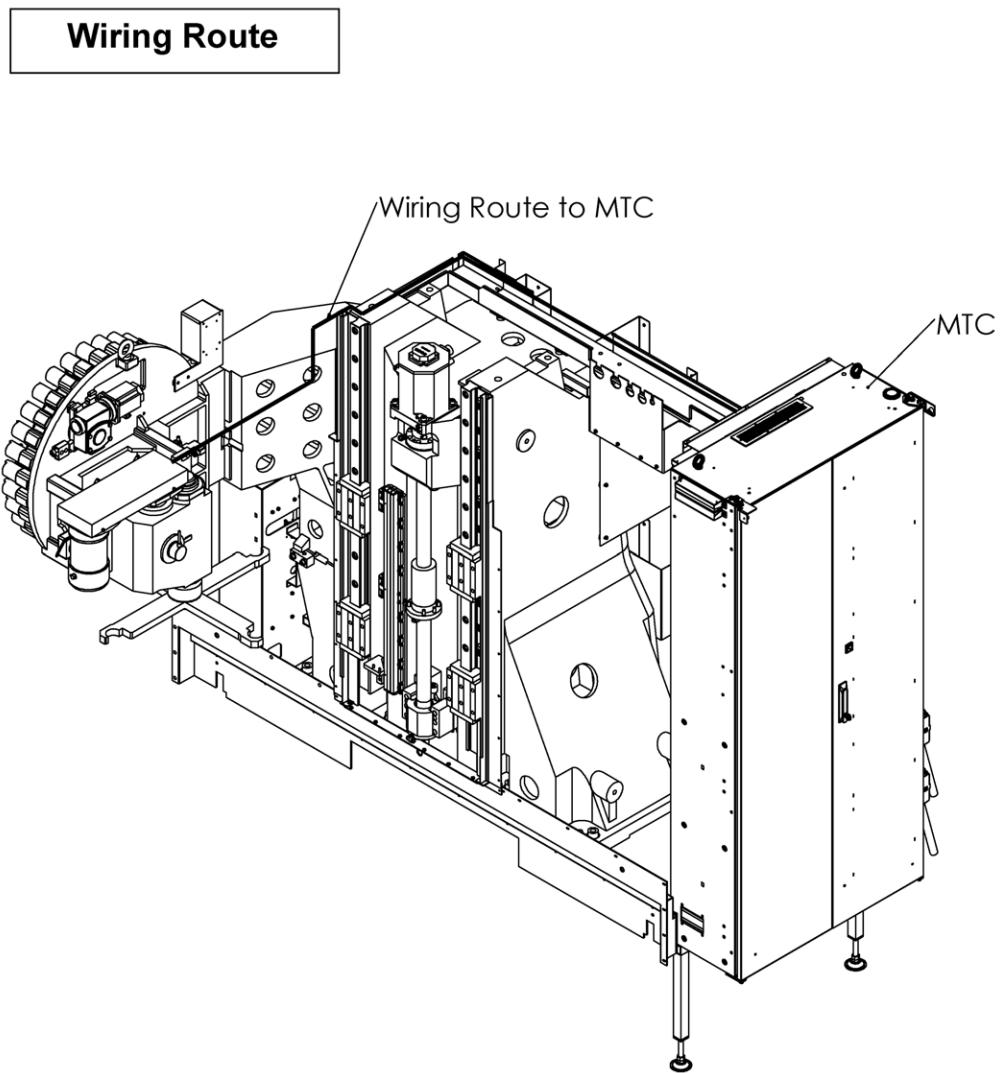
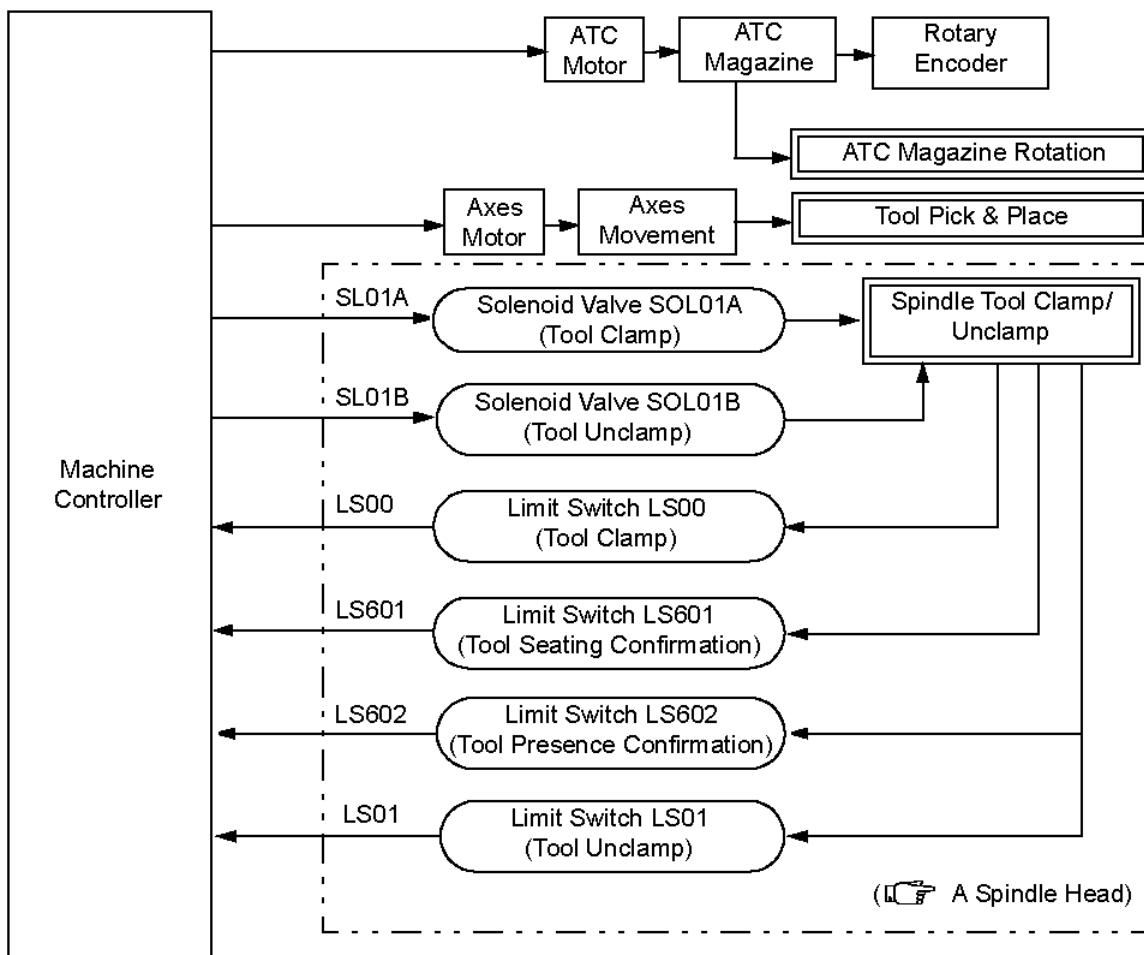


Figure 1.4 Wiring Route

2 ATC Magazine Mechanism

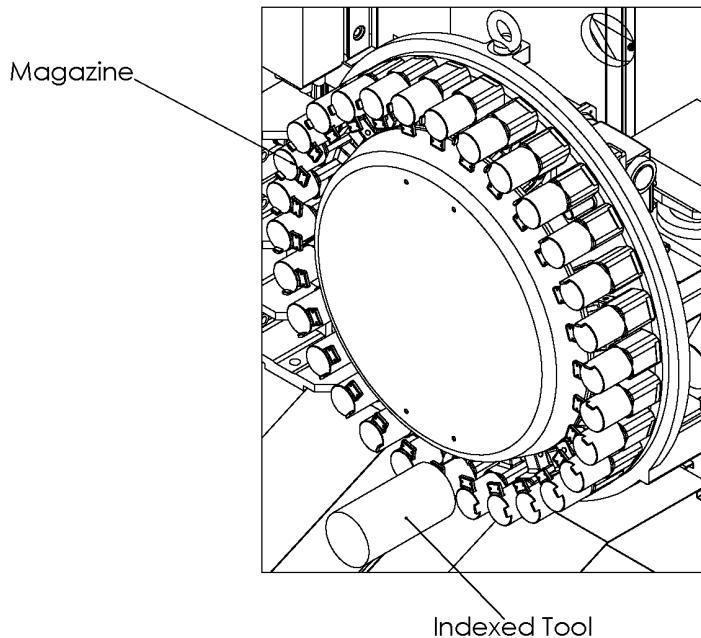


Machine Input / Output Signal Table

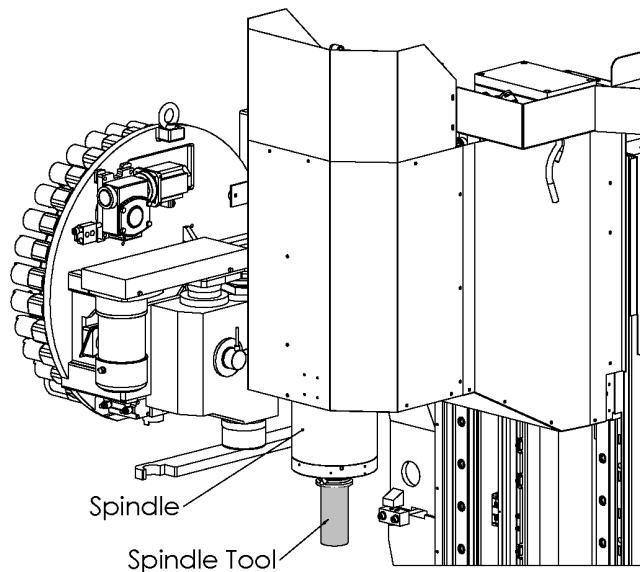
Signal Name	Address	Description
LS00	X0010.0	TOOL CLAMP
LS01	X0010.1	TOOL UNCLAMP
LS601	X0012.2	SPINDLE TOOL SEATING
LS602	X0012.3	SPINDLE TOOL CONFIRM
SL01A	Y0004.0	SPINDLE TOOL CLAMP
SL01B	Y0004.1	SPINDLE TOOL UNCLAMP

2.1 Tool Change Operation

The tool change operation below is a typical example between spindle pot and magazine pot.

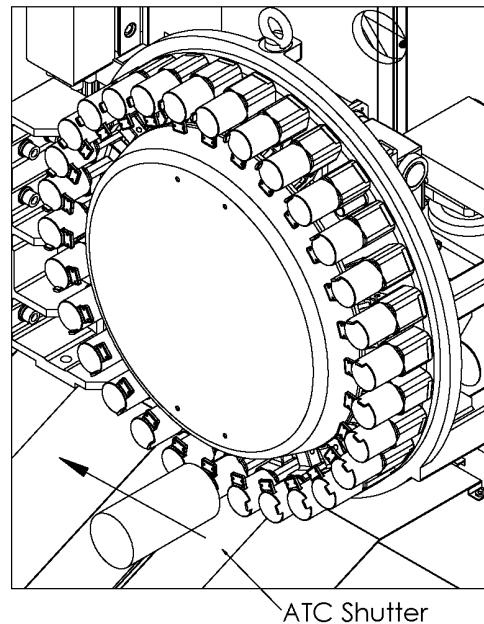


- ① Magazine pocket, containing the desired tool is indexed to the 'tool change position'.

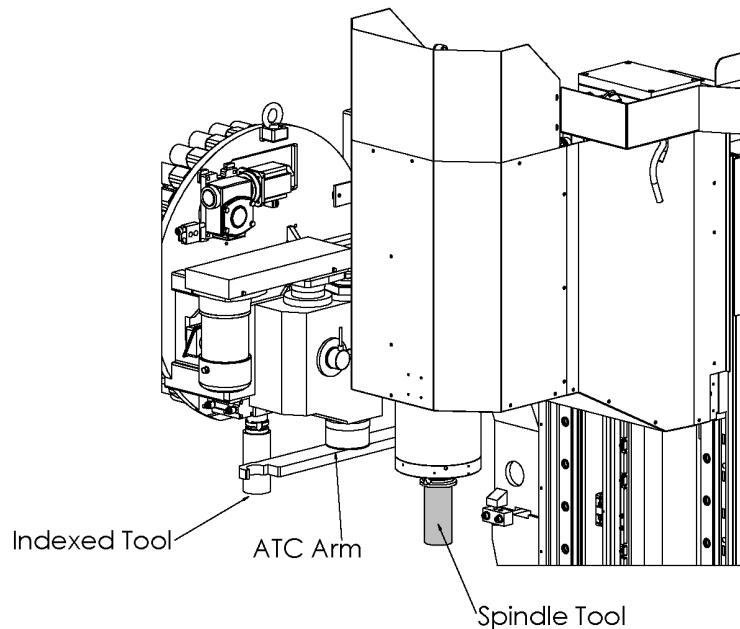


- ② Spindle moved to Z tool change position and oriented.

Figure 2.1 Tool Change Operation 1



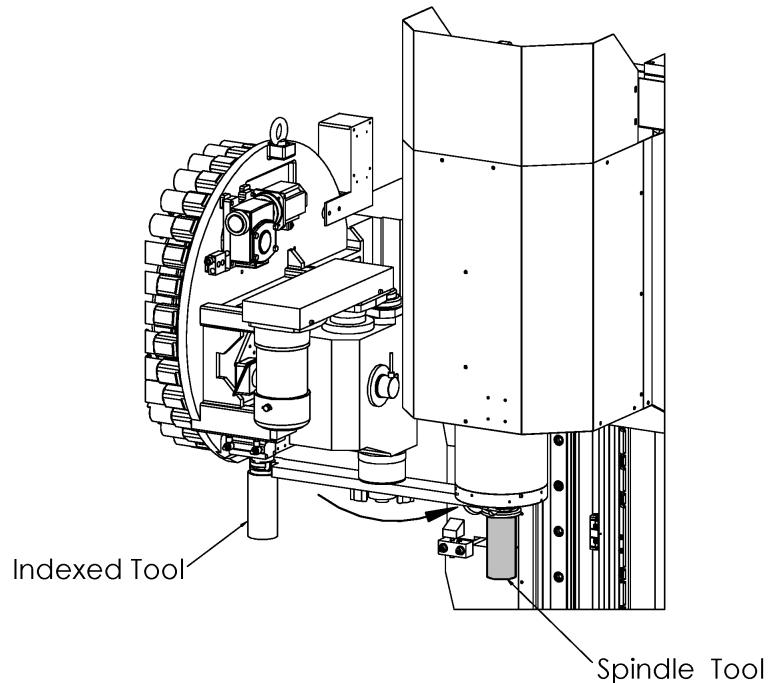
③ ATC shutter opens for tool change.



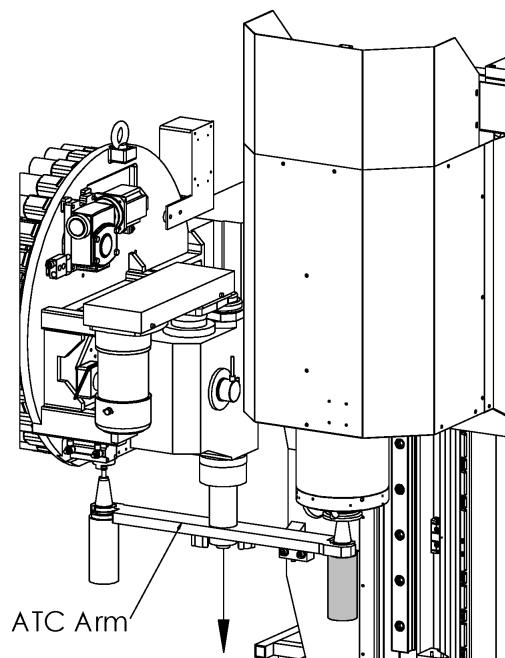
④ ATC pot vertical and ATC arm in standby position

Figure 2.2 Tool Change Operation 2

Chapter 6 Automatic Tool Changer

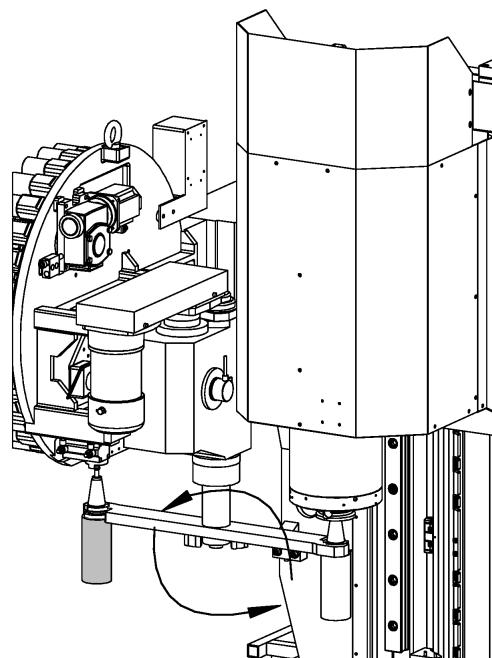


⑤ ATC arm rotates CCW direction and secures both spindle tool and indexed tool.

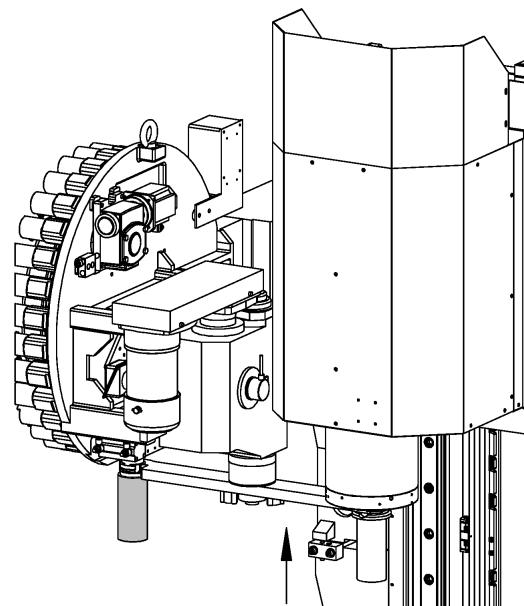


⑥ Spindle tool unclamp and ATC arm moves down.

Figure 2.3 Tool Change Operation 3

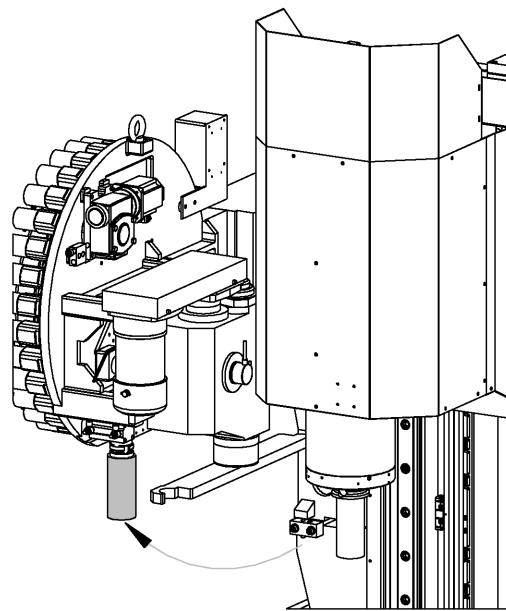


⑦ ATC arm rotates CCW direction by 180°.

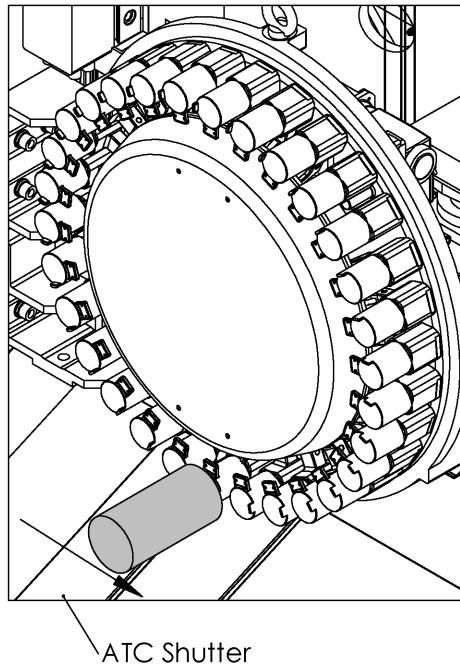


⑧ ATC arm moves up and spindle tool is clamped.

Figure 2.4 Tool Change Operation 4



⑨ ATC arm rotates CW direction and ATC arm in standby position.



⑩ ATC pot horizontal and shutter close.

Figure 2.5 Tool Change Operation 5

2.2 ATC Shutter Mechanism

The ATC shutter is opened and closed by a pneumatic cylinder.

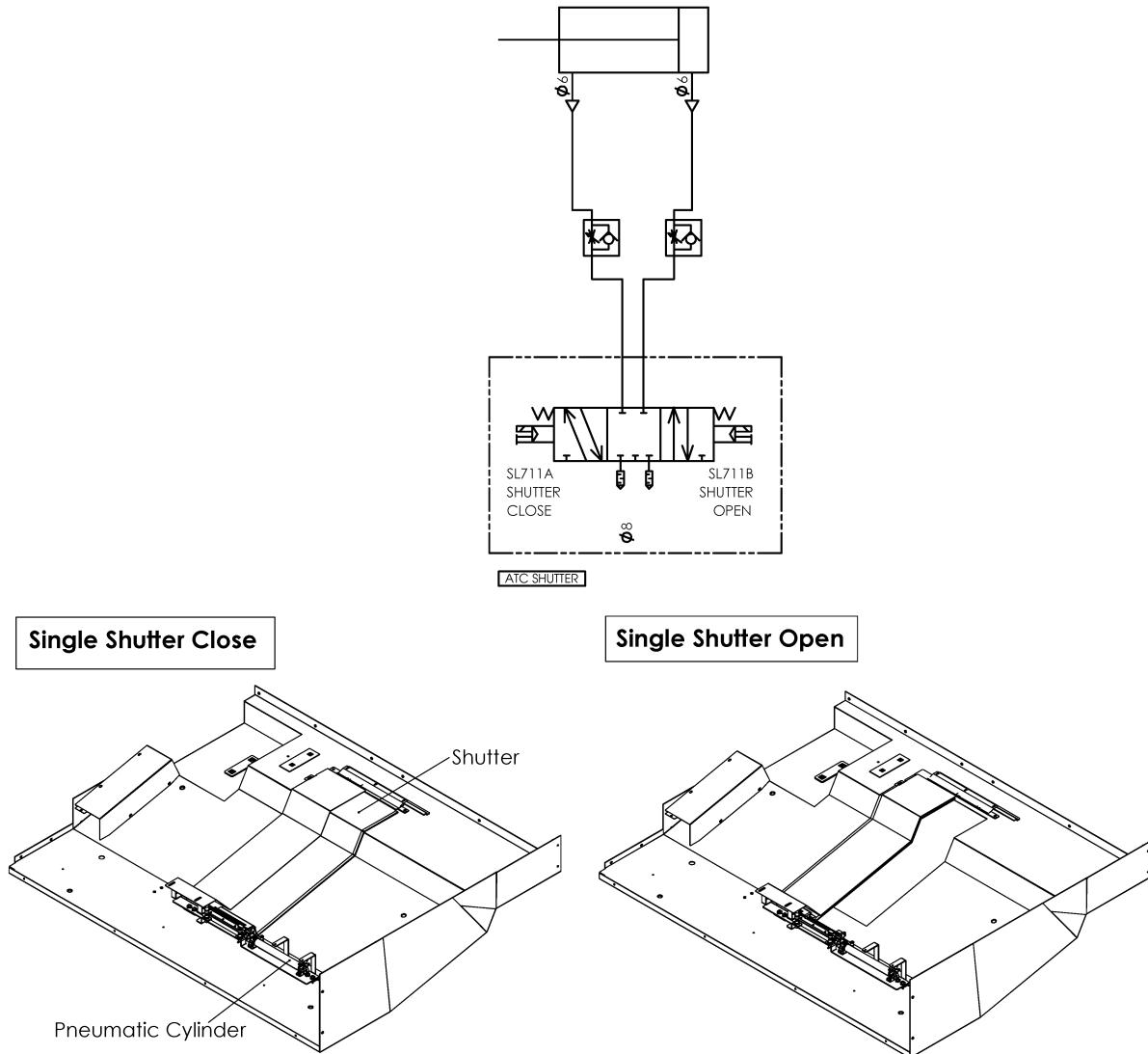


Figure 2.6 ATC Shutter Mechanism (Single Shutter)

Chapter 6 Automatic Tool Changer

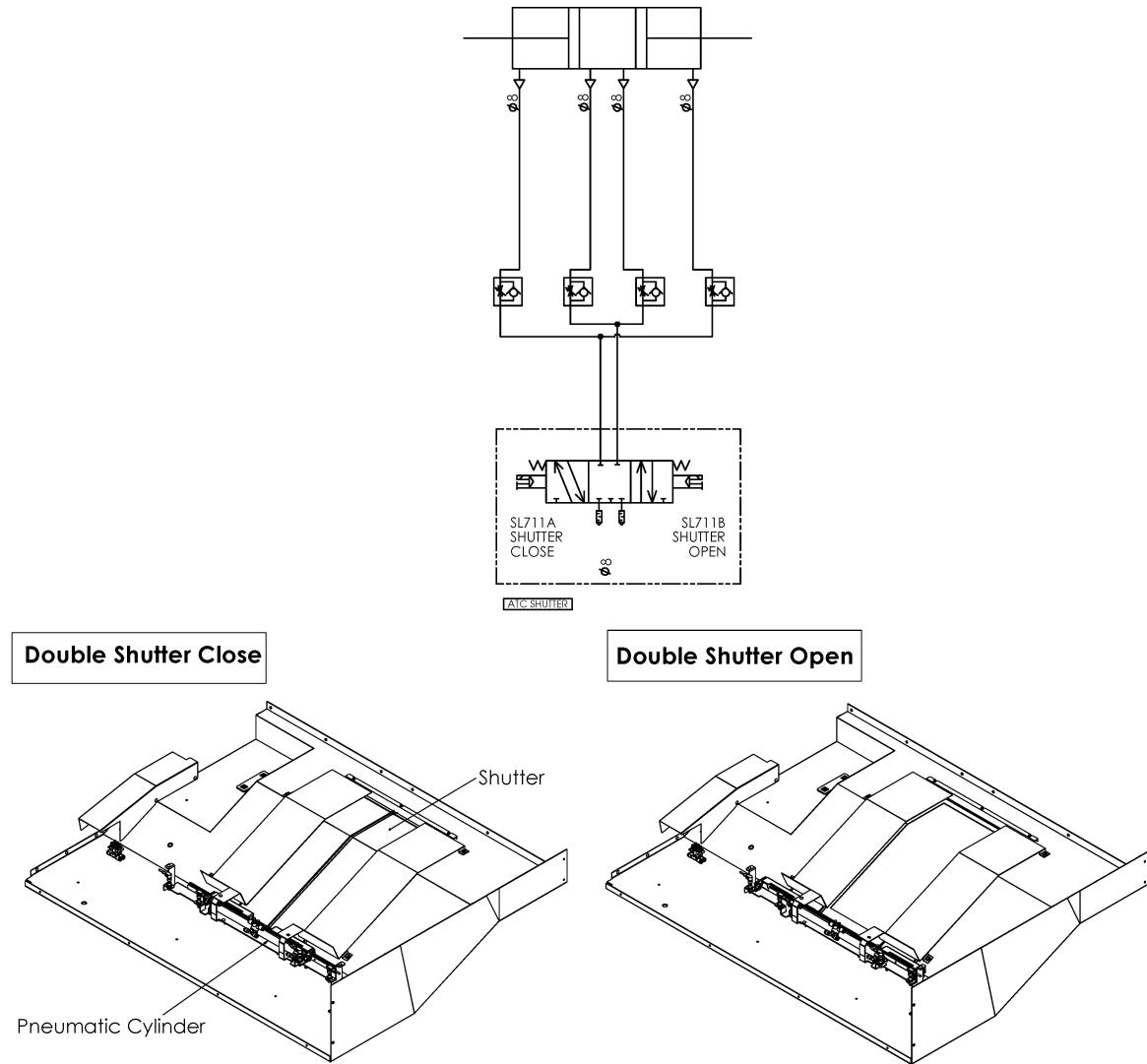


Figure 2.7 ATC Shutter Mechanism (Double Shutter)

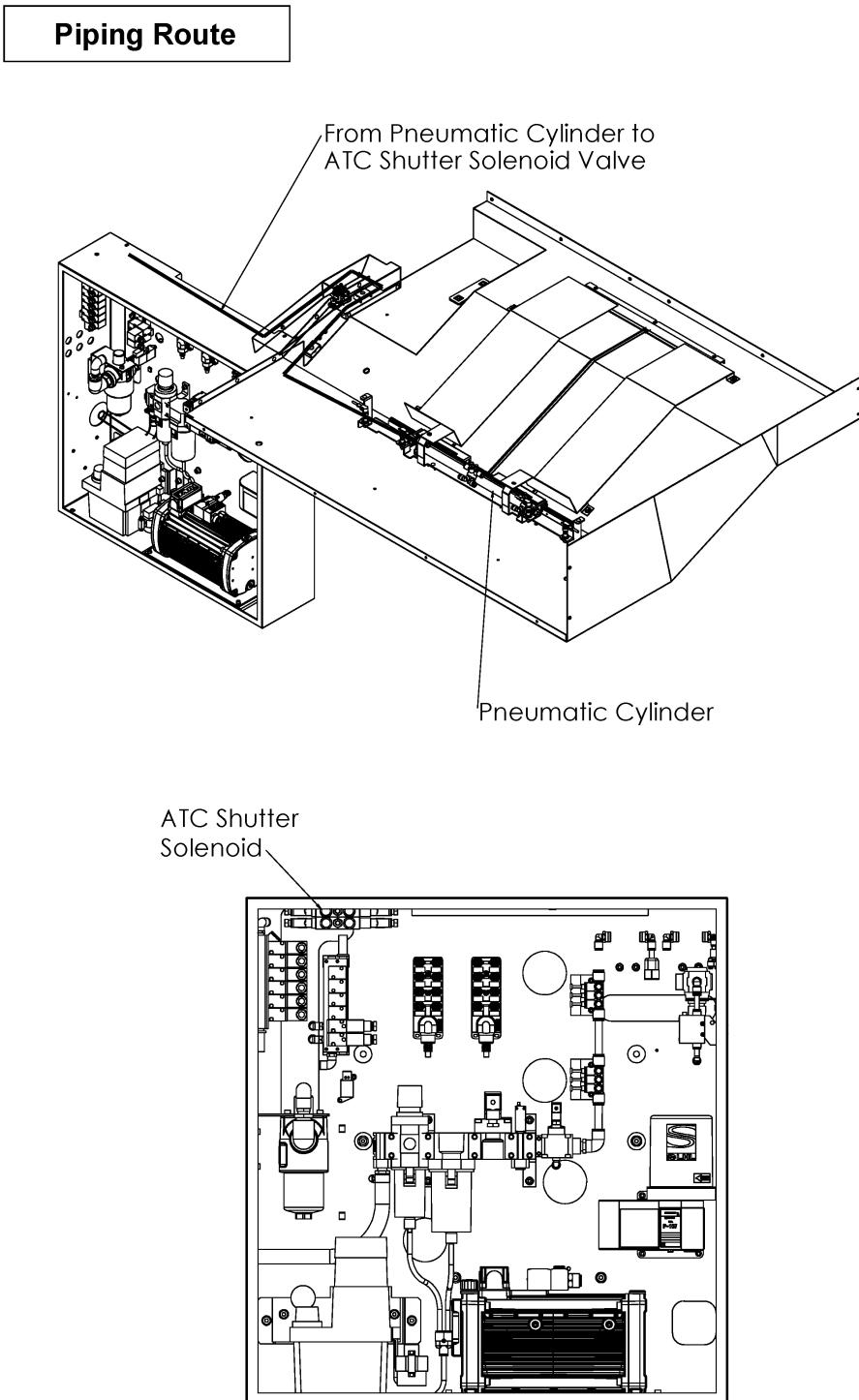


Figure 2.8 Piping Route

2.3 Tool Pot Horizontal/Vertical Pneumatic Cylinder

The pneumatic cylinder tilts the tool horizontally or vertically during tool change command to allow the ATC arm to grip the indexed tool from the tool magazine and change it with the current tool.

It consists a pneumatic cylinder and solenoid valves to move the shaft up or down.

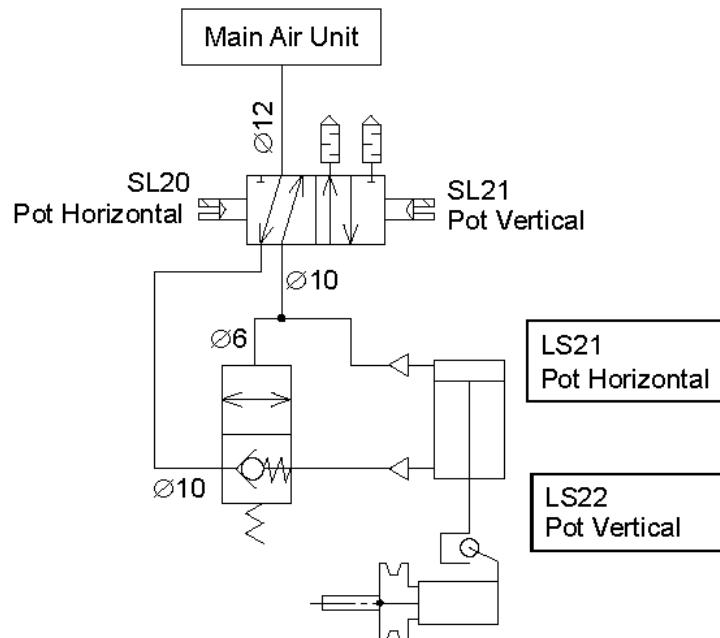


Figure 2.9 Tool Pot Horizontal/Vertical Pneumatic Cylinder

1 Overview

The spindle cooler controls the temperature of the cooling coolant supplied throughout the machine for the following purposes:

- Spindle cooling
- Ball screw core cooling

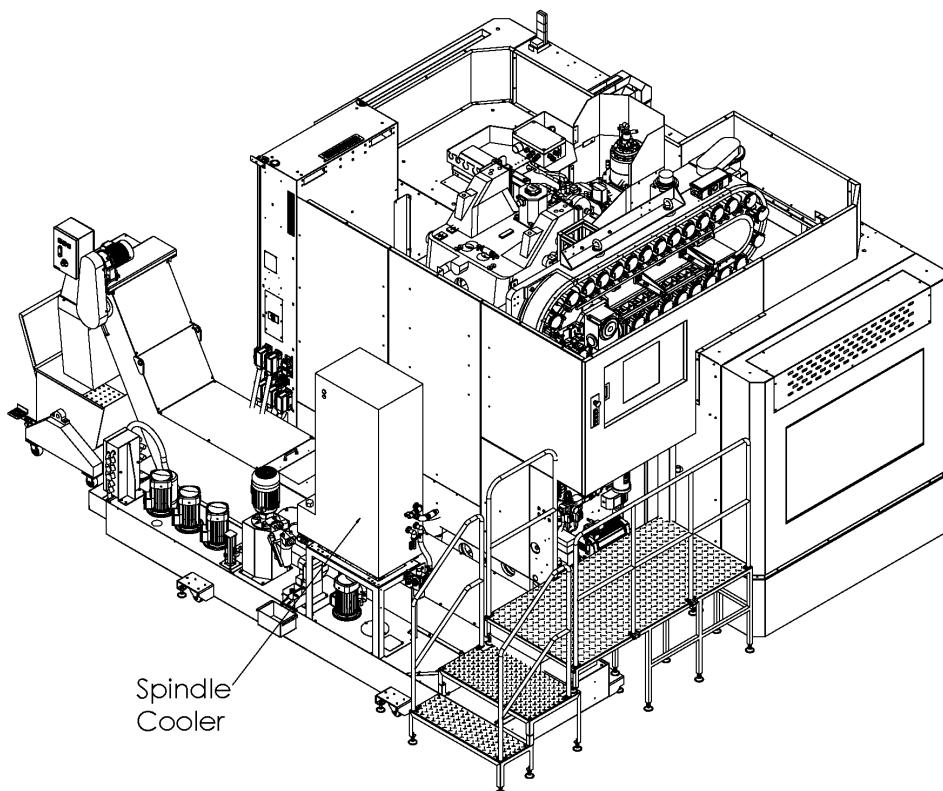
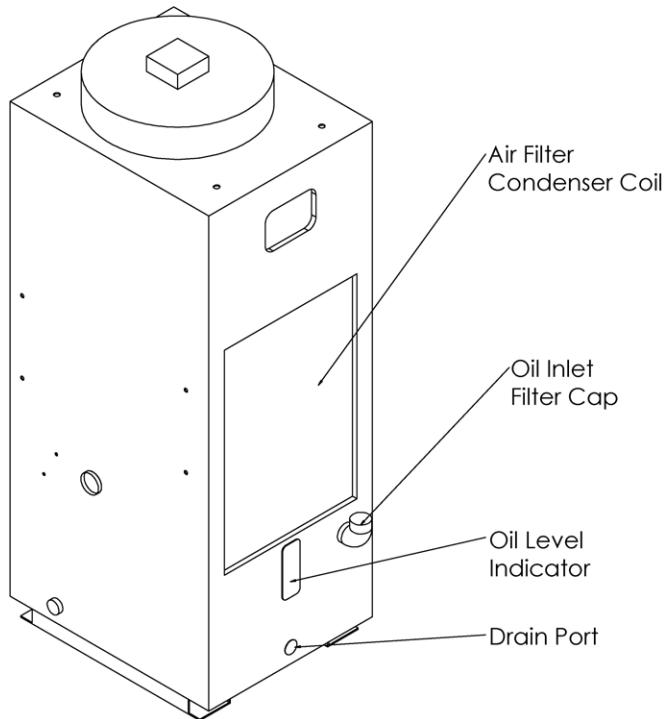


Figure 1.1 General View

1.1 Component Name

14K
Spindle Cooler



10K
Spindle Cooler

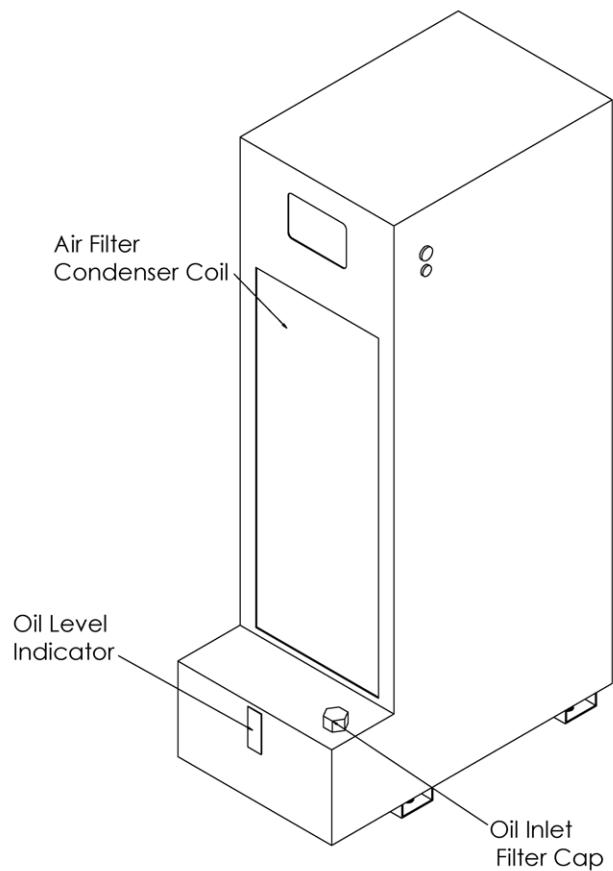


Figure 1.2 Spindle Cooler

1.2 Piping and Wiring

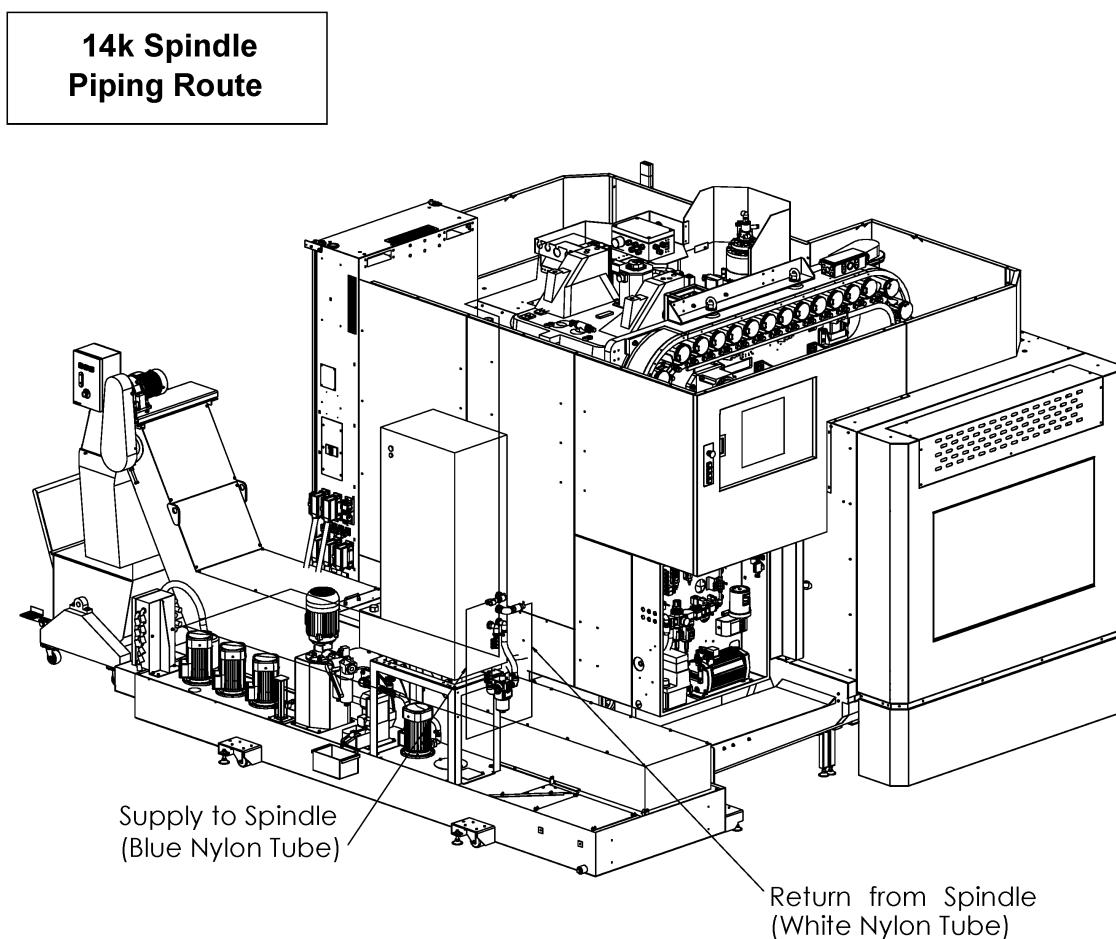


Figure 1.3 14k Spindle Piping Route from Oilmatic to Spindle

**10k Spindle
Piping Route**

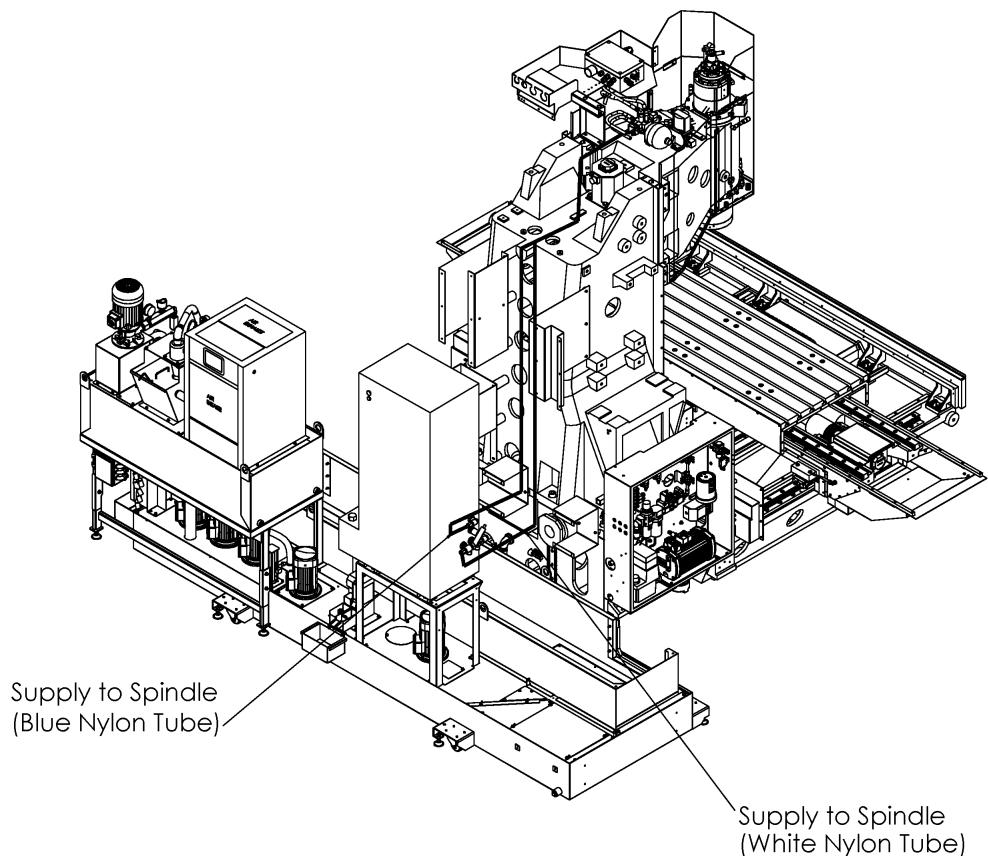


Figure 1.4 10k Spindle Piping Route from Oilmatic to Spindle

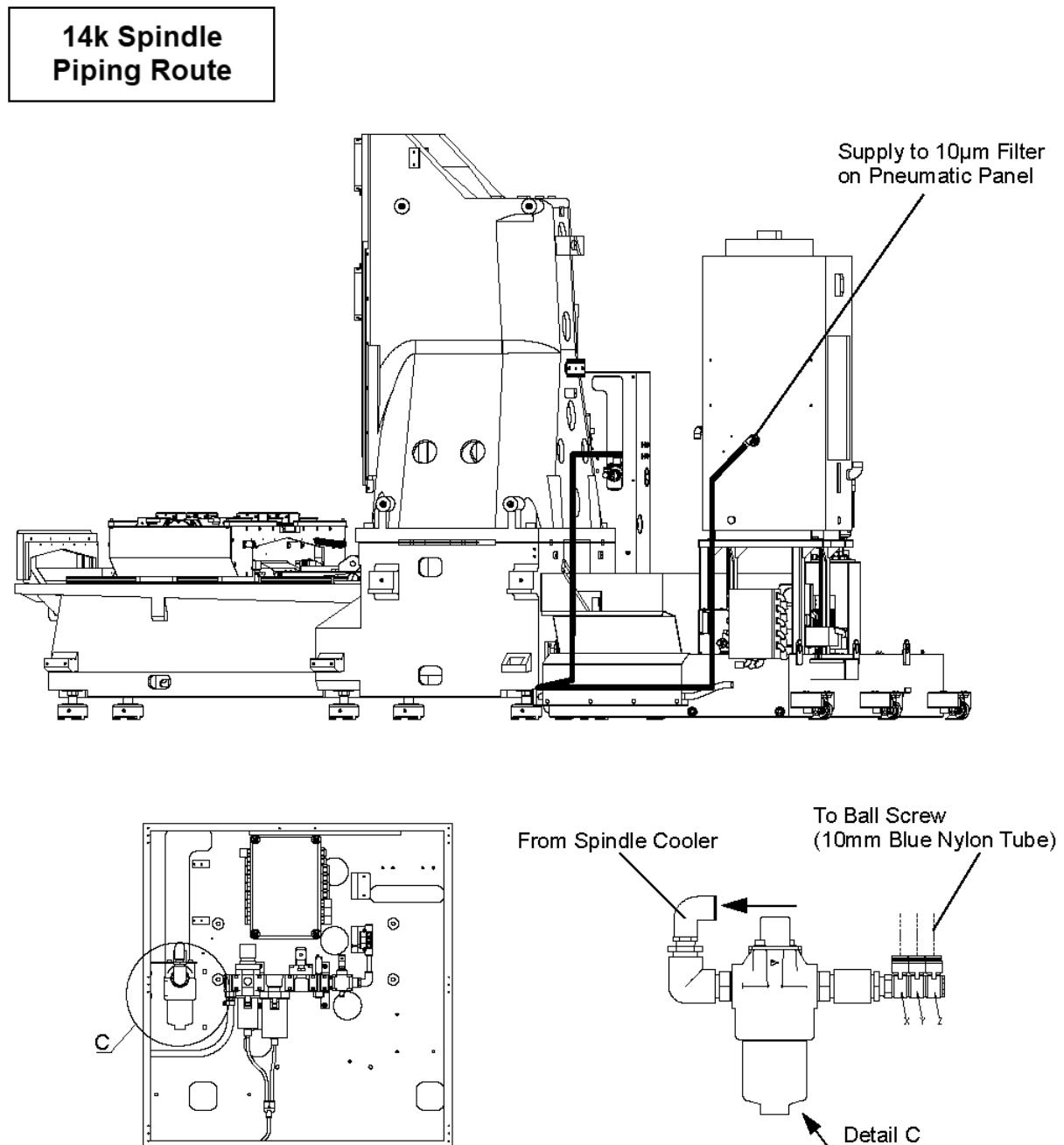


Figure 1.5 14k Spindle Piping Route from Oilmatic to Filter

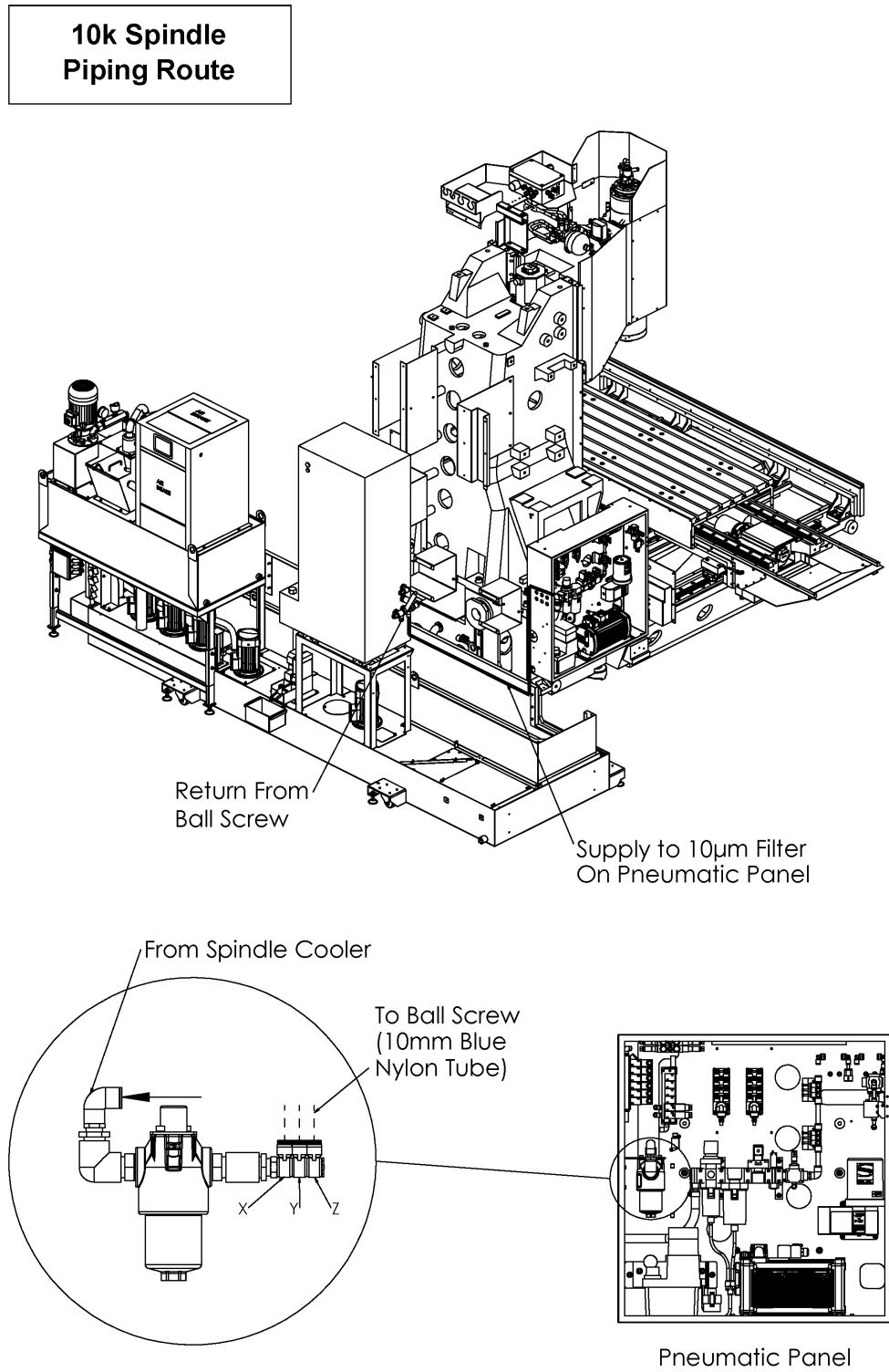


Figure 1.6 10k Spindle Piping Route from Oilmatic to Filter

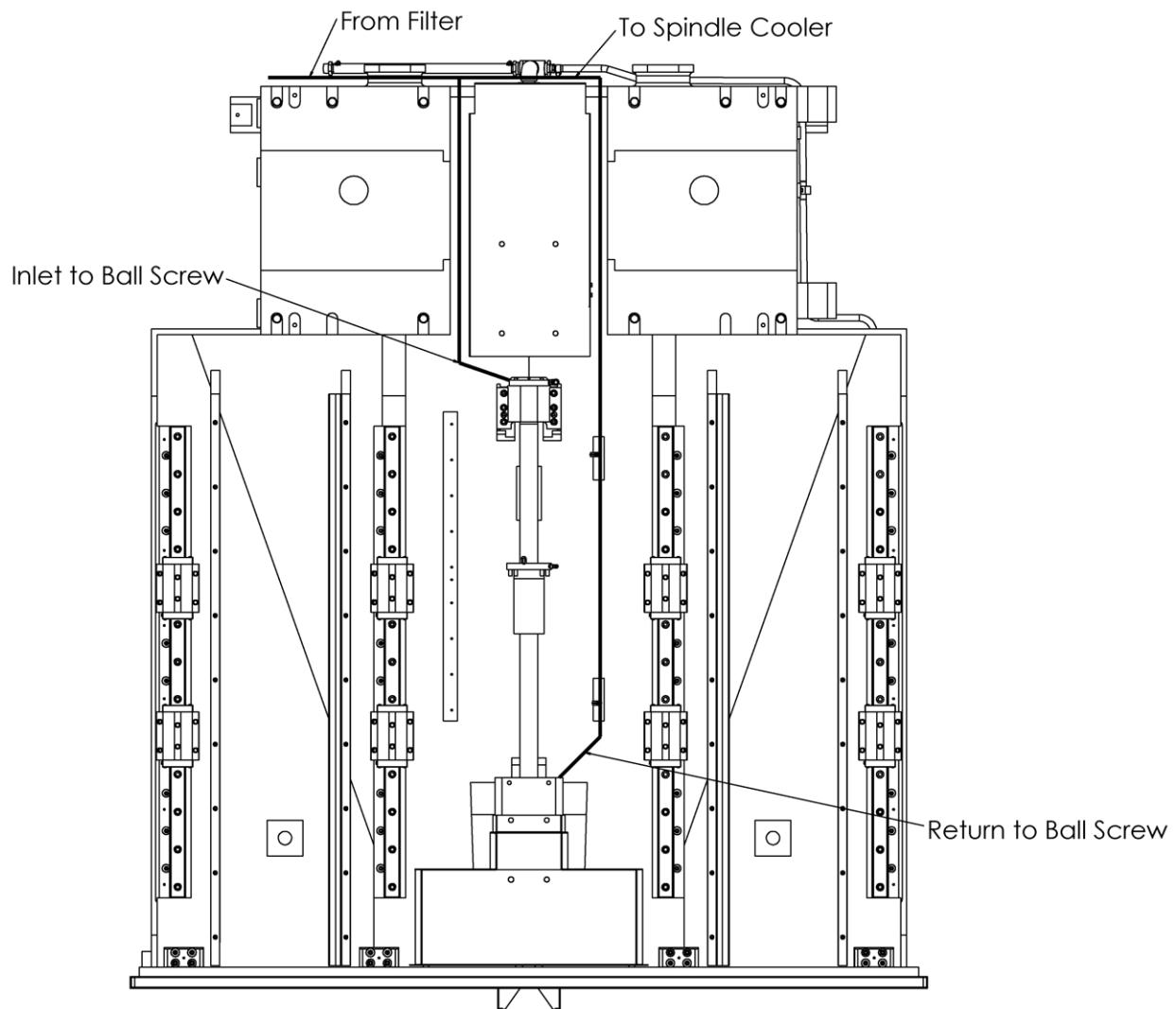


Figure 1.7 Piping Route to Y-Axis Ball Screw Core Cooling

Chapter 7 Spindle Cooler

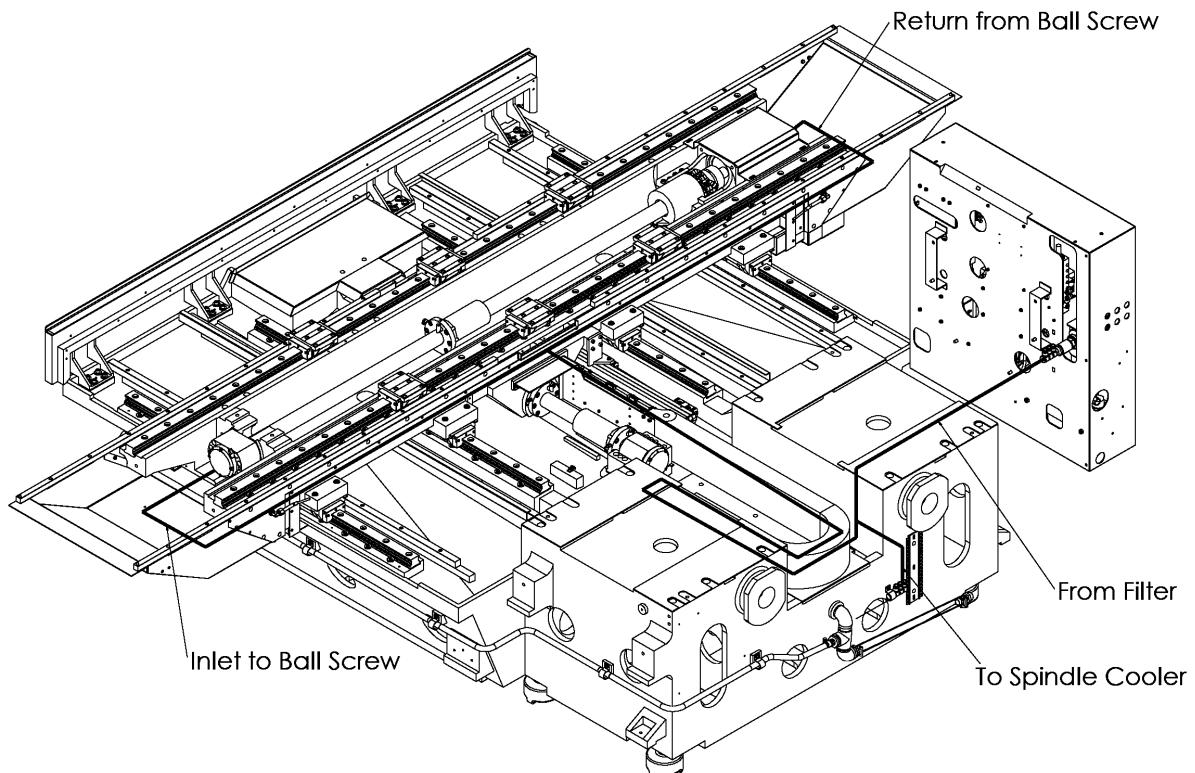


Figure 1.8 Piping Route to X-Axis Ball Screw Core Cooling

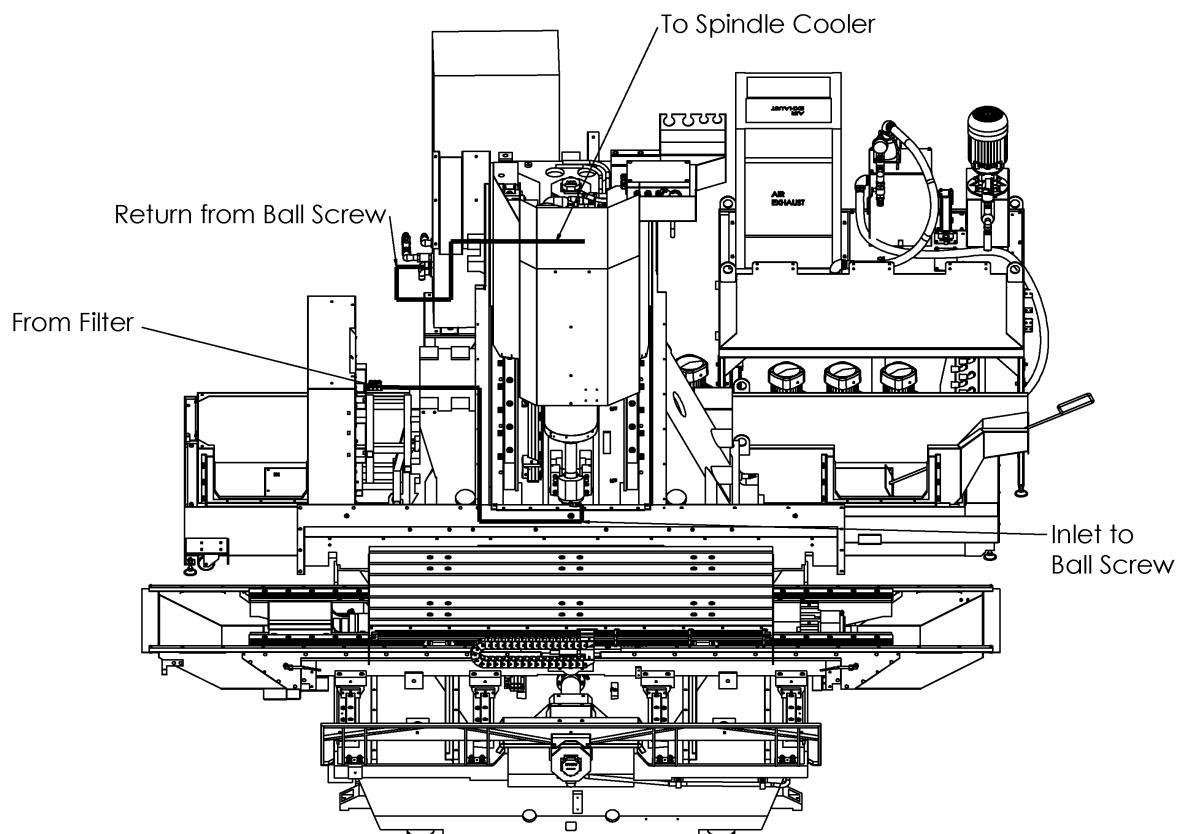


Figure 1.9 Piping Route to Z-Axis Ball Screw Core Cooling

Wiring Route

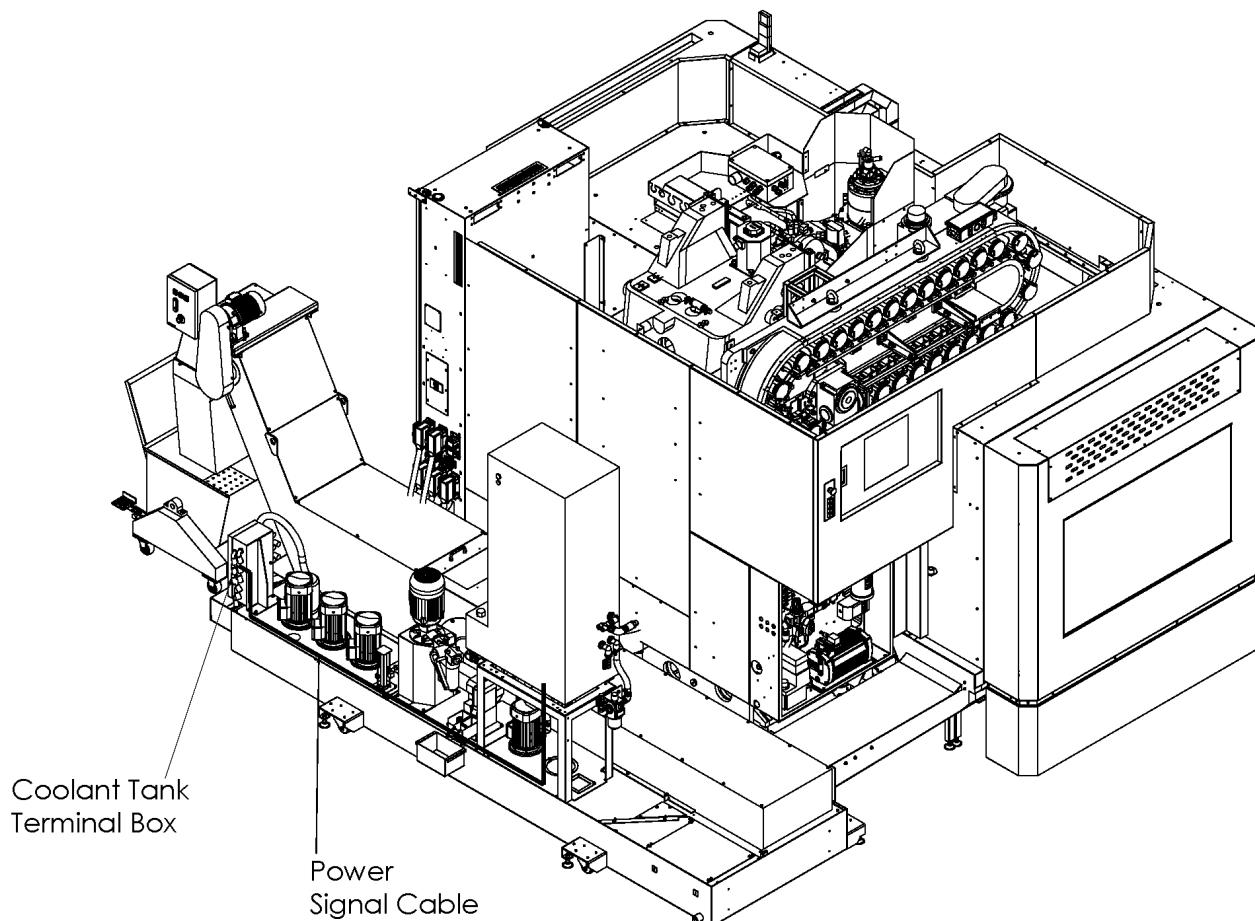


Figure 1.10 Wiring Route

2 Spindle Cooler Unit

Radiator fan cooling concept with water base coolant is used for spindle cooling. The fan draws in cool and exhaust hot air.

Pump and fan are continuously On with machine turned On.

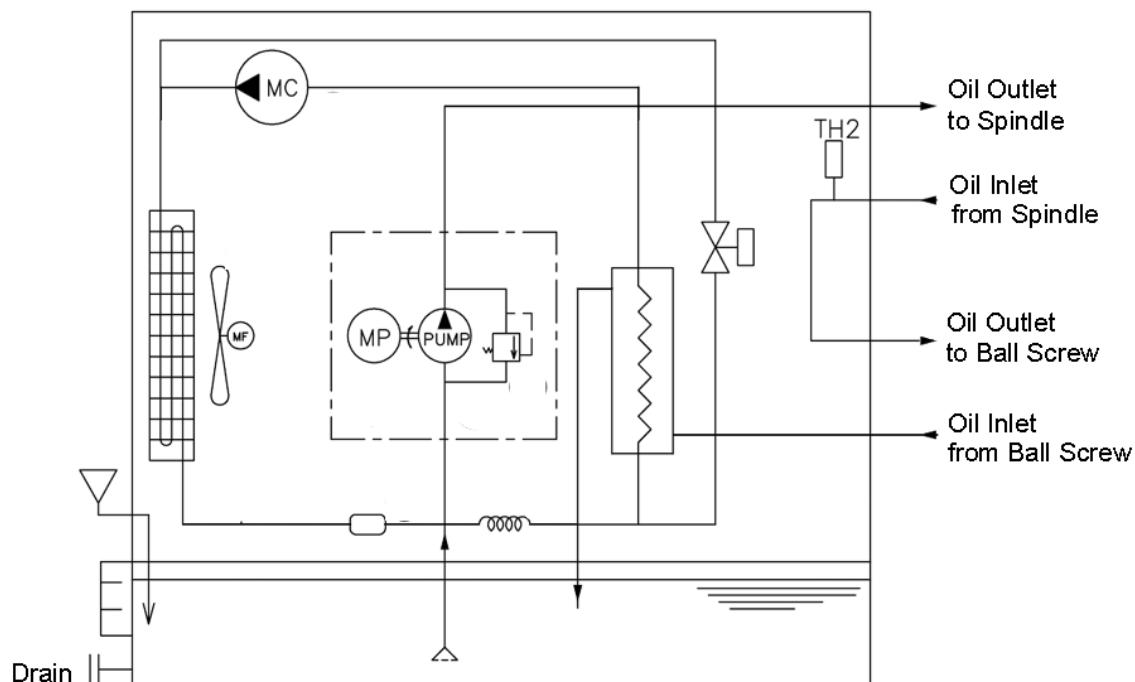


Figure 2.1 Spindle Cooler Circuit

2.1 Axis Ball Screw Core Cooling

The axis ball screw core cooling is supplied with coolant from spindle cooler to remove heat generated.

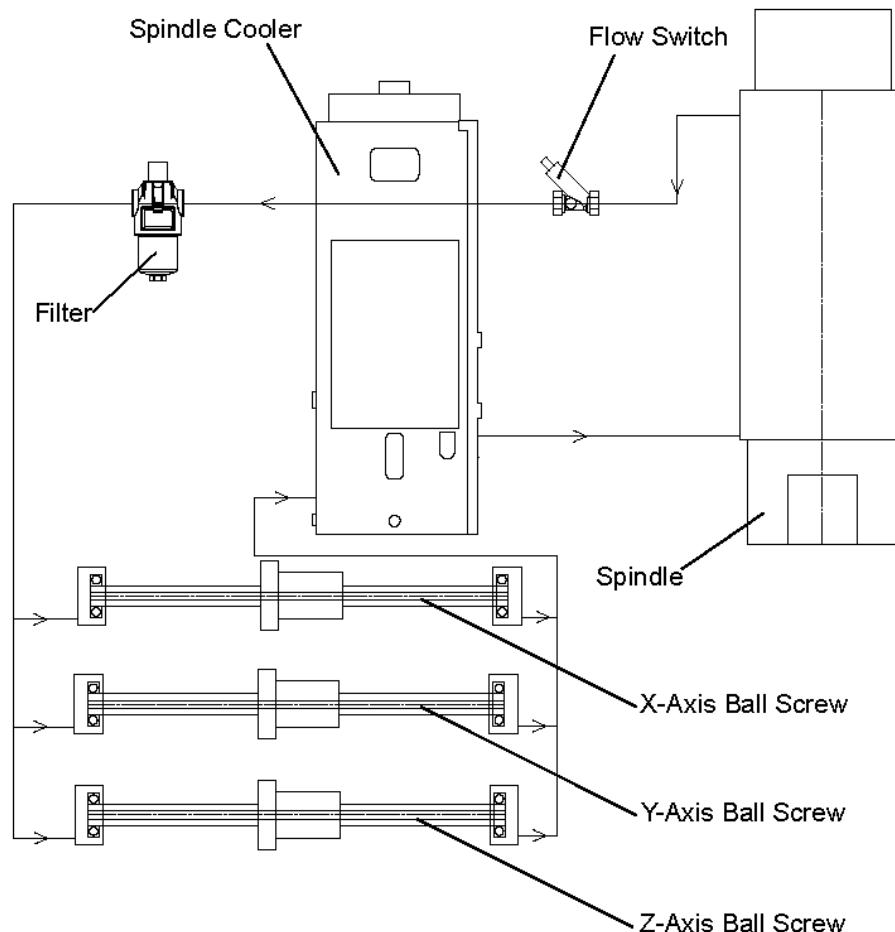
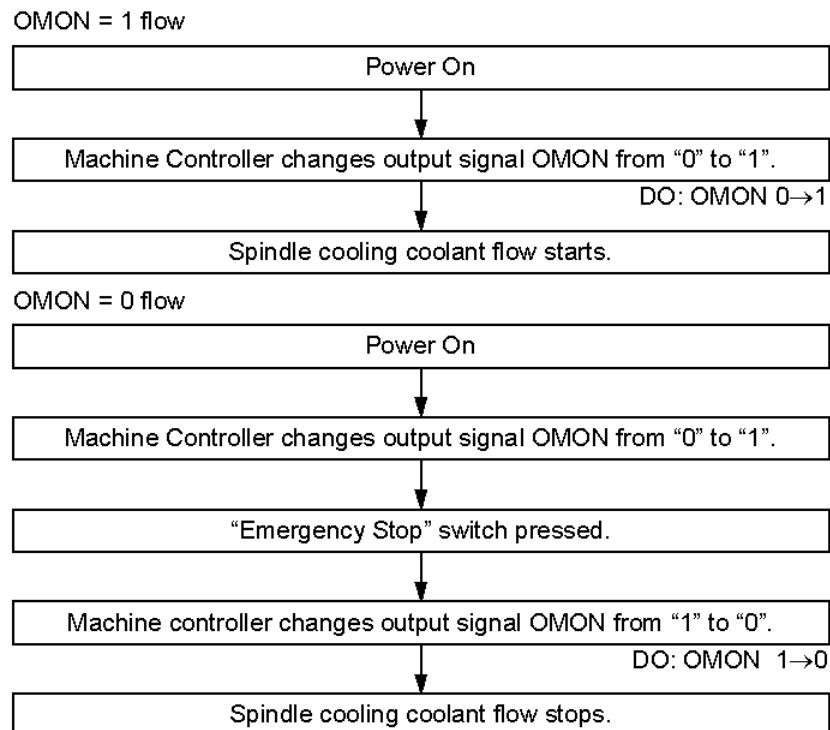


Figure 2.2 Axis Ball Screw Core Cooling

2.2 Signal Sequence

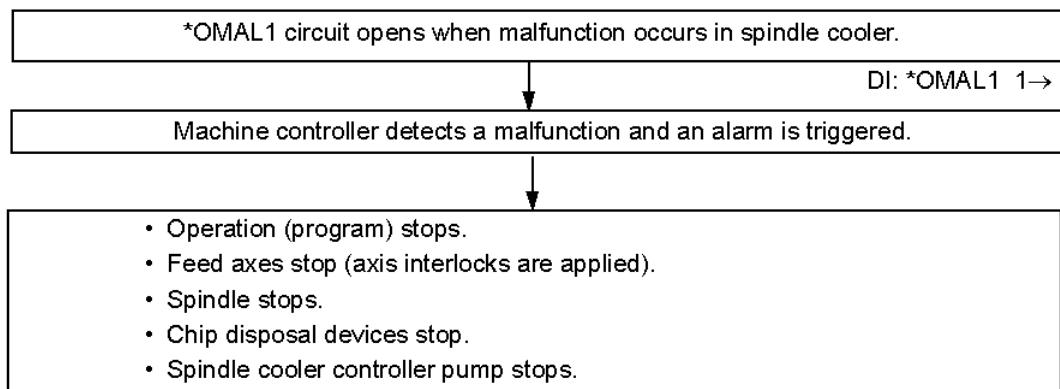
Output Signal

OMON: Start Signal for Spindle Cooler



Input Signal

*OMAL1: Notification of Spindle Cooler Malfunction to Machine Controller



Machine Input/Output Signal Table

Signal Name	Address	Description
OMON	Y0001.5	SPINDLE COOLER ON
*OMAL1	X0004.0	SPINDLE LUBRICANT OIL UNIT ALARM

1 Overview

The automatic grease supply unit supplies grease to the drive unit of machine components as indicated below. By supplying grease, it smoothes the movements of the feed axes.

Grease Points

X/Y/Z-axis of machine unit:

- Linear Motion Guide (LMG)
- Ball Screw

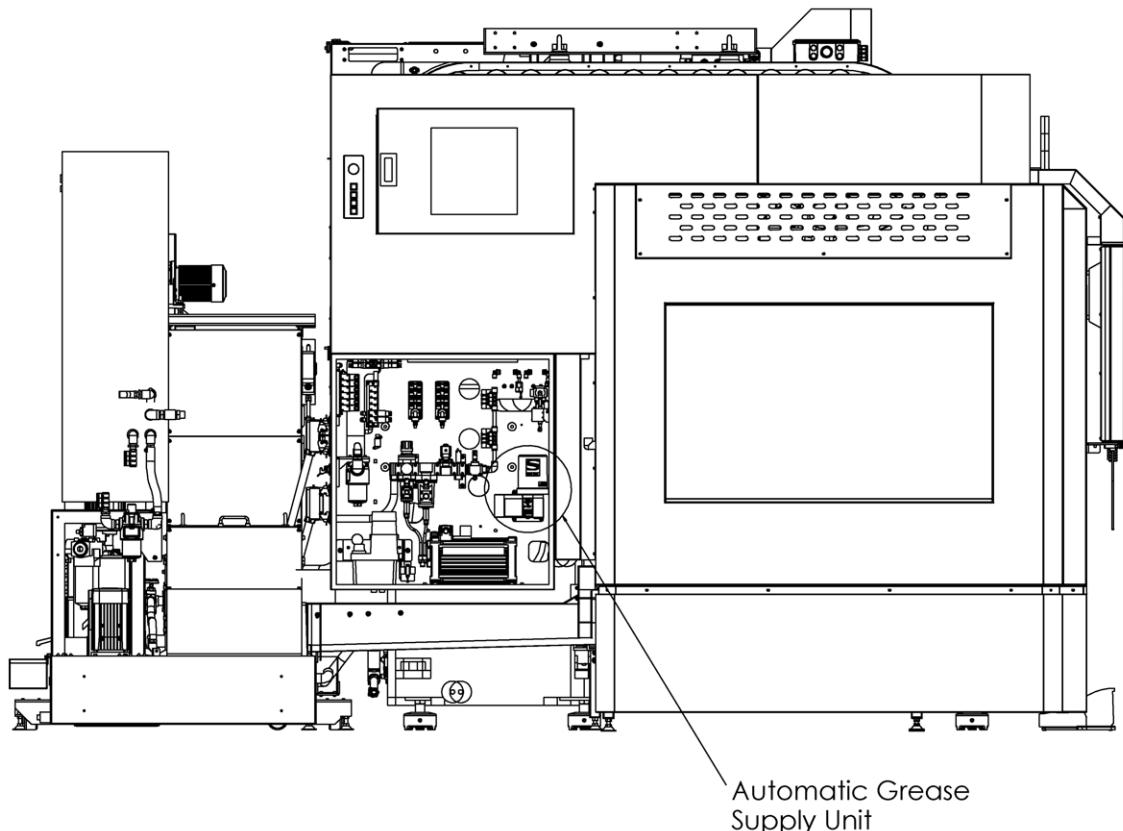


Figure 1.1 General View

1.1 Component Name

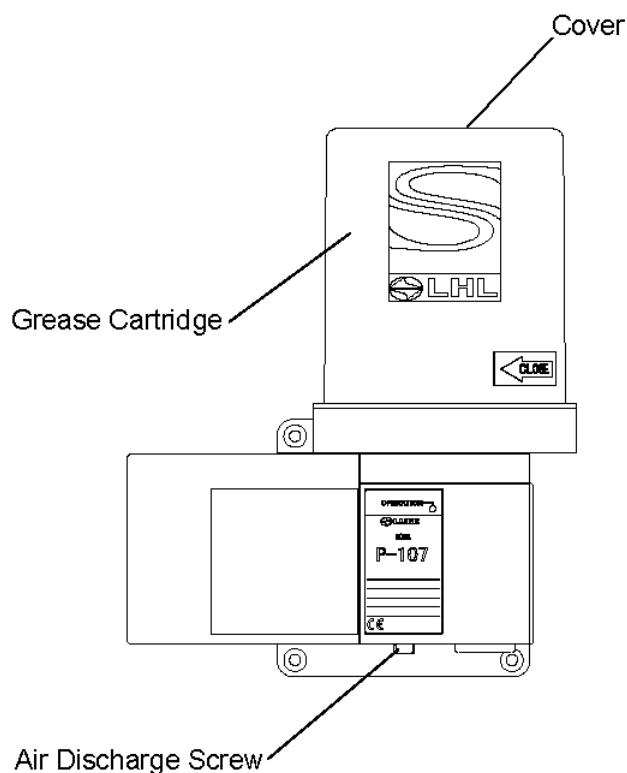


Figure 1.2 Automatic Grease Supply Unit

1.2 Piping and Wiring

Grease Piping

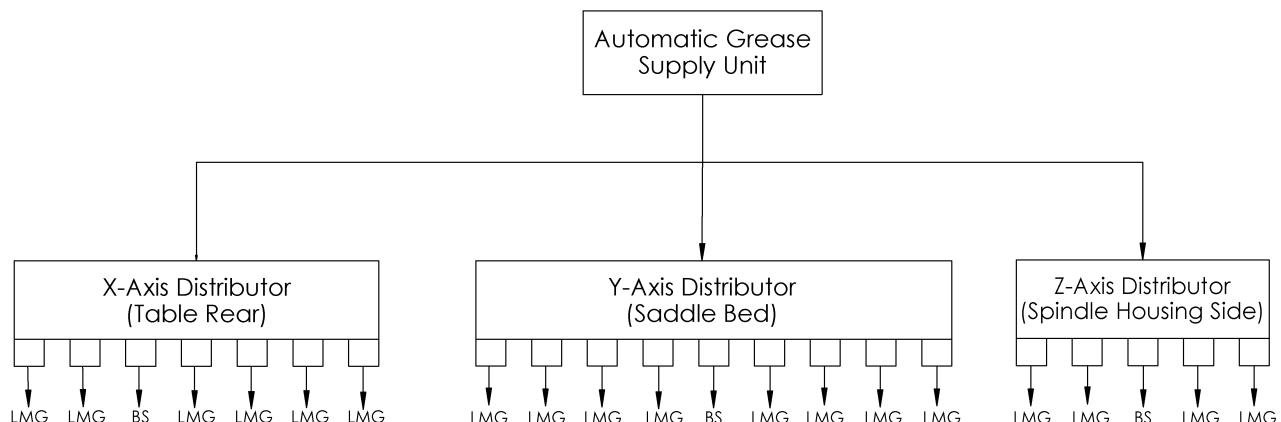


Figure 1.3 Grease Piping

Grease Piping Route

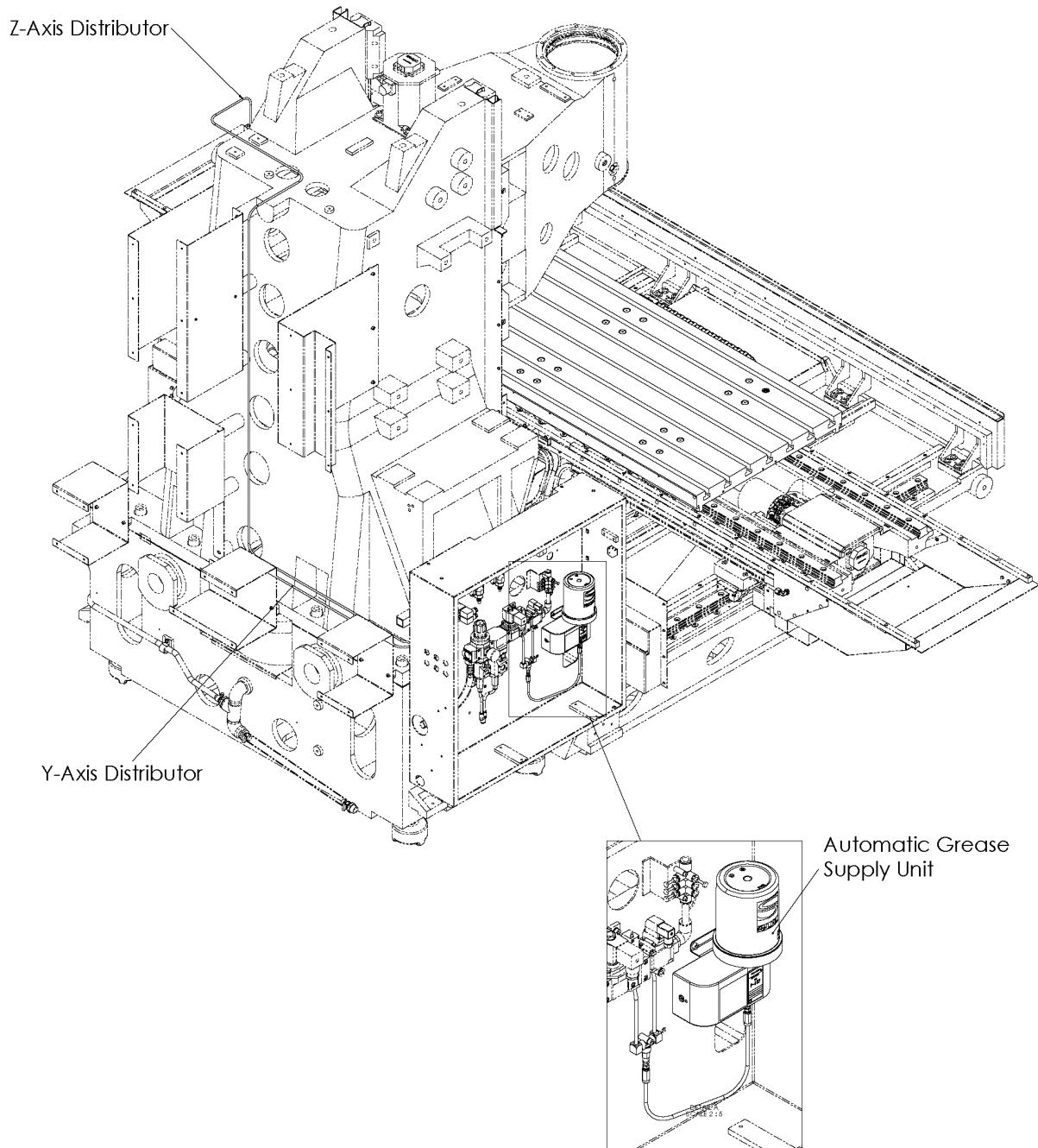


Figure 1.4 Grease Piping Route

Z-Axis Piping Route

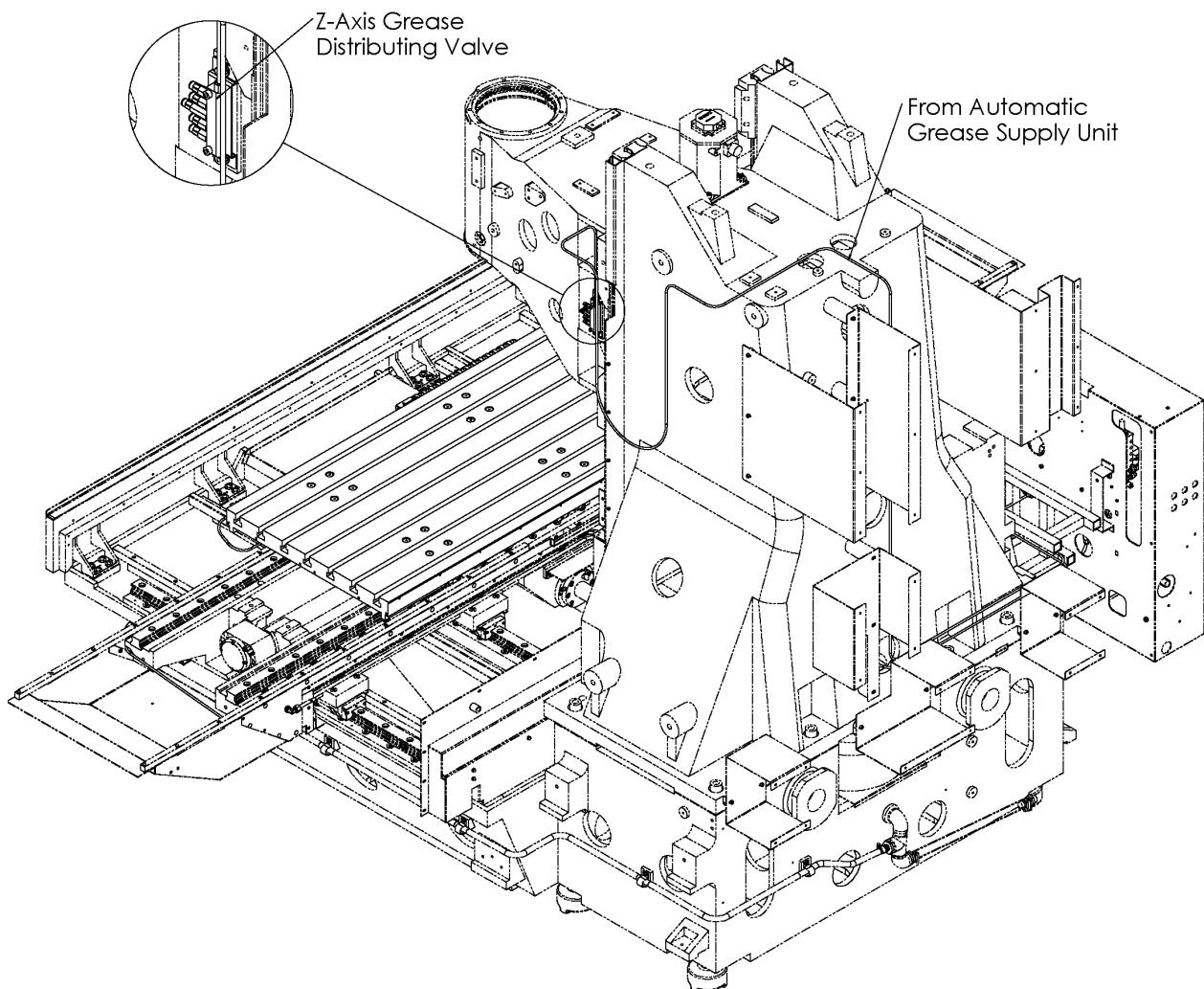


Figure 1.5 Z-Axis Grease Piping Route

Z-Axis Grease Distributing Valve

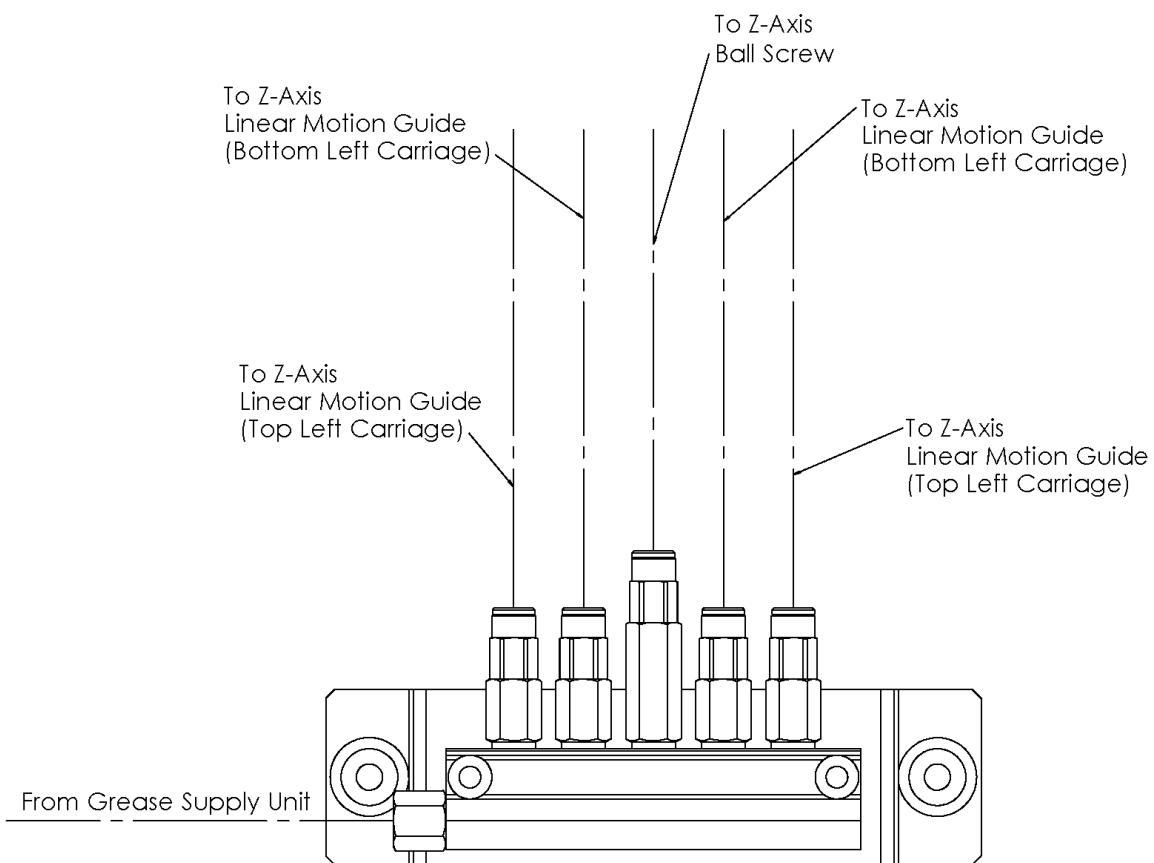


Figure 1.6 Z-Axis Grease Distributing Valve

Chapter 8 Automatic Grease Supply Unit

Y-Axis Grease Piping Route

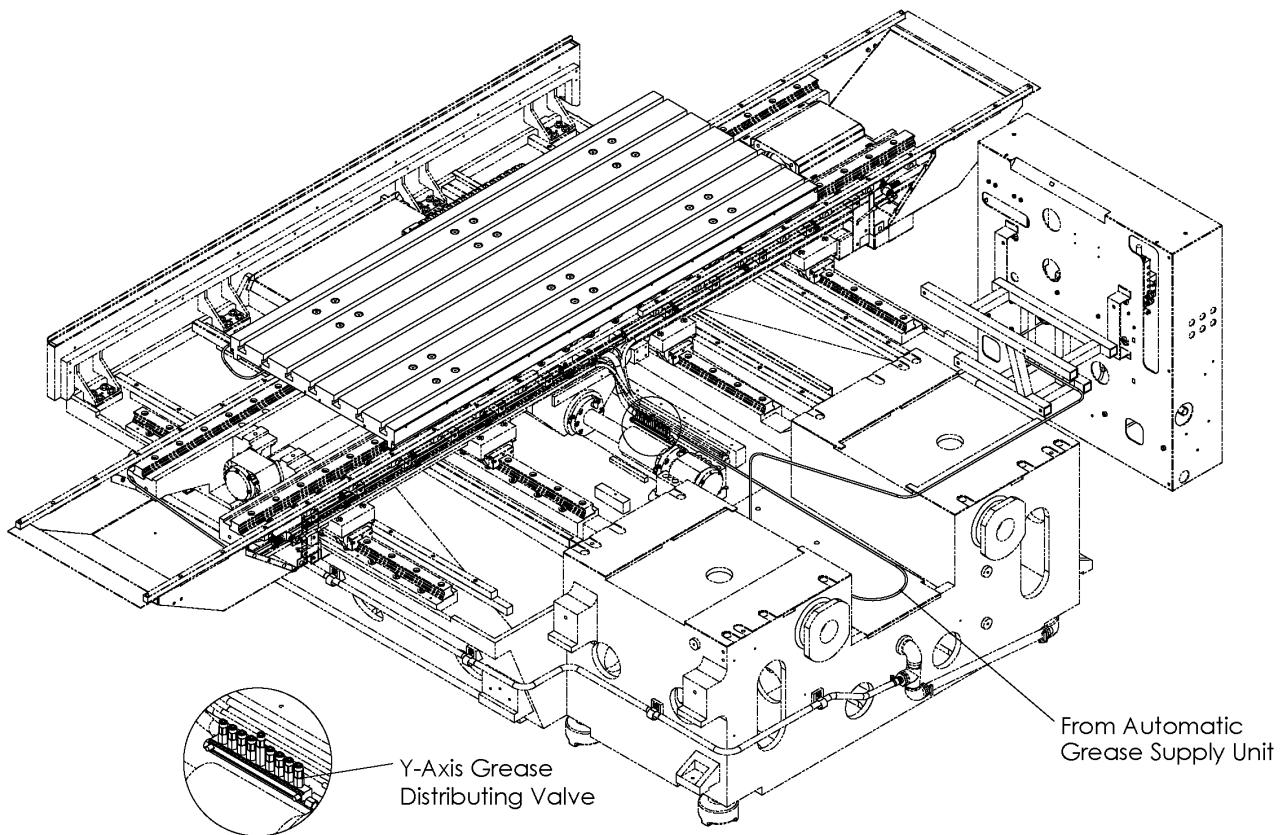


Figure 1.7 Y-Axis Grease Piping Route

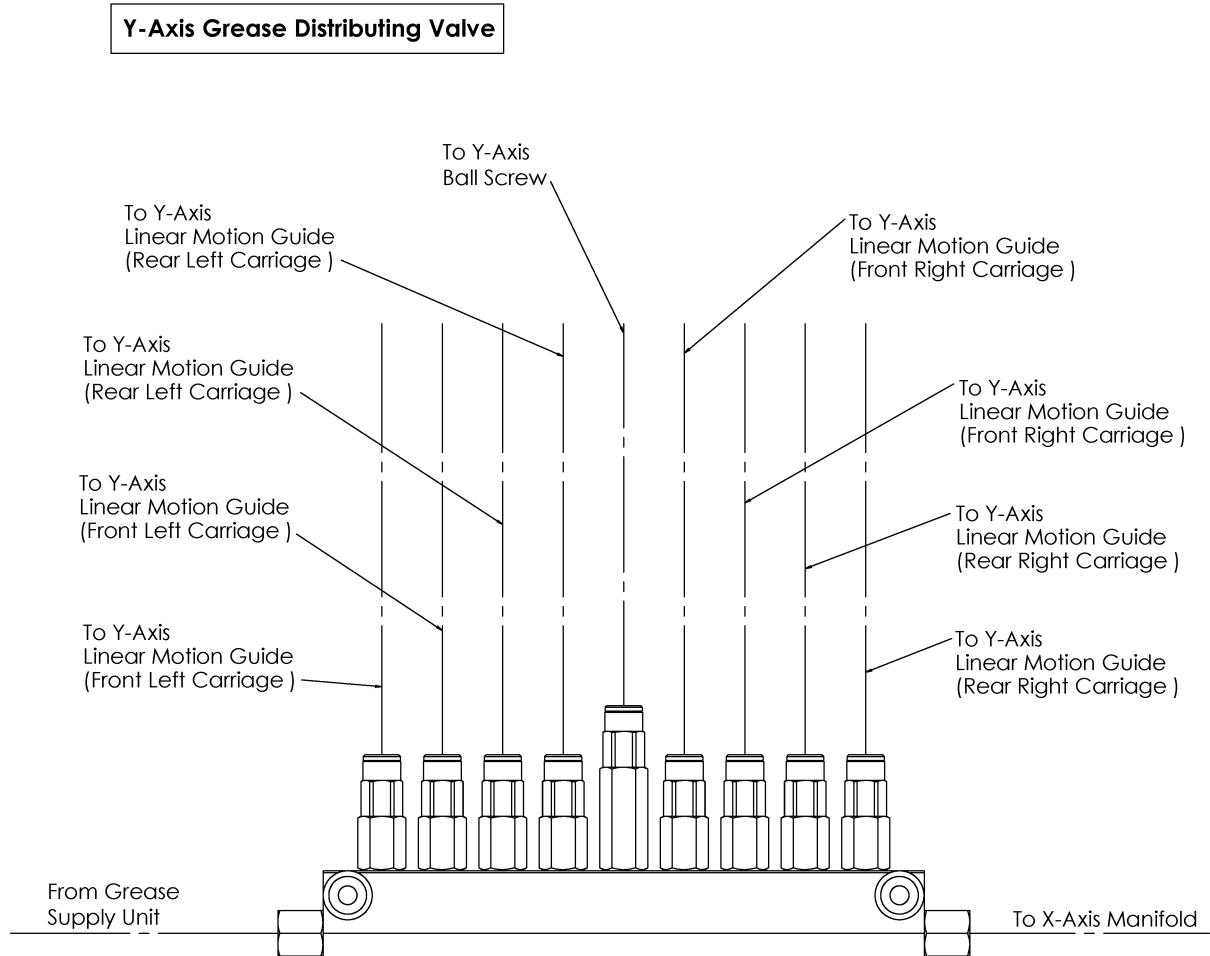


Figure 1.8 Y-Axis Grease Distributing Valve

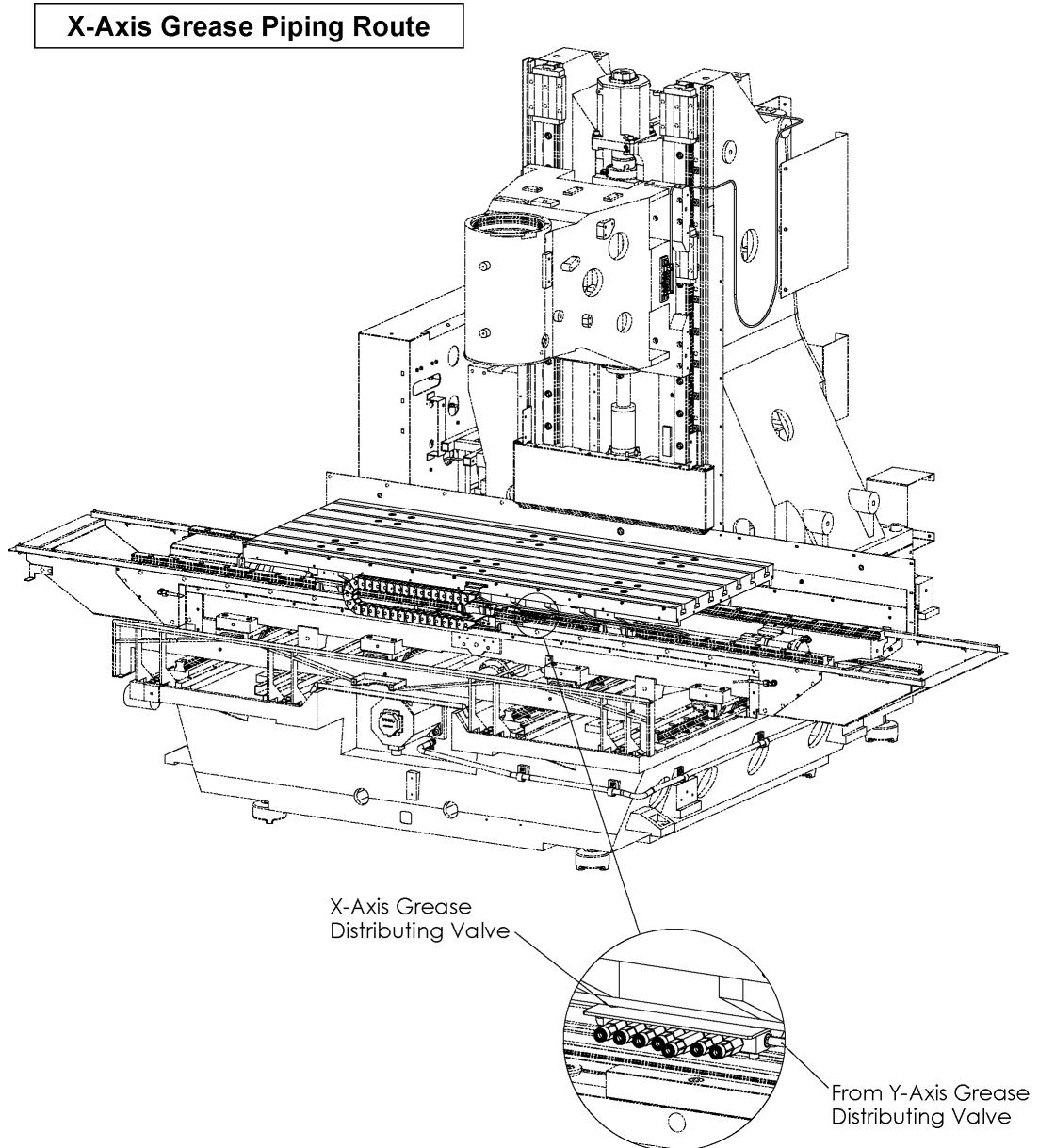


Figure 1.9 X-Axis Grease Piping Route

X-Axis Grease Distributing Valve

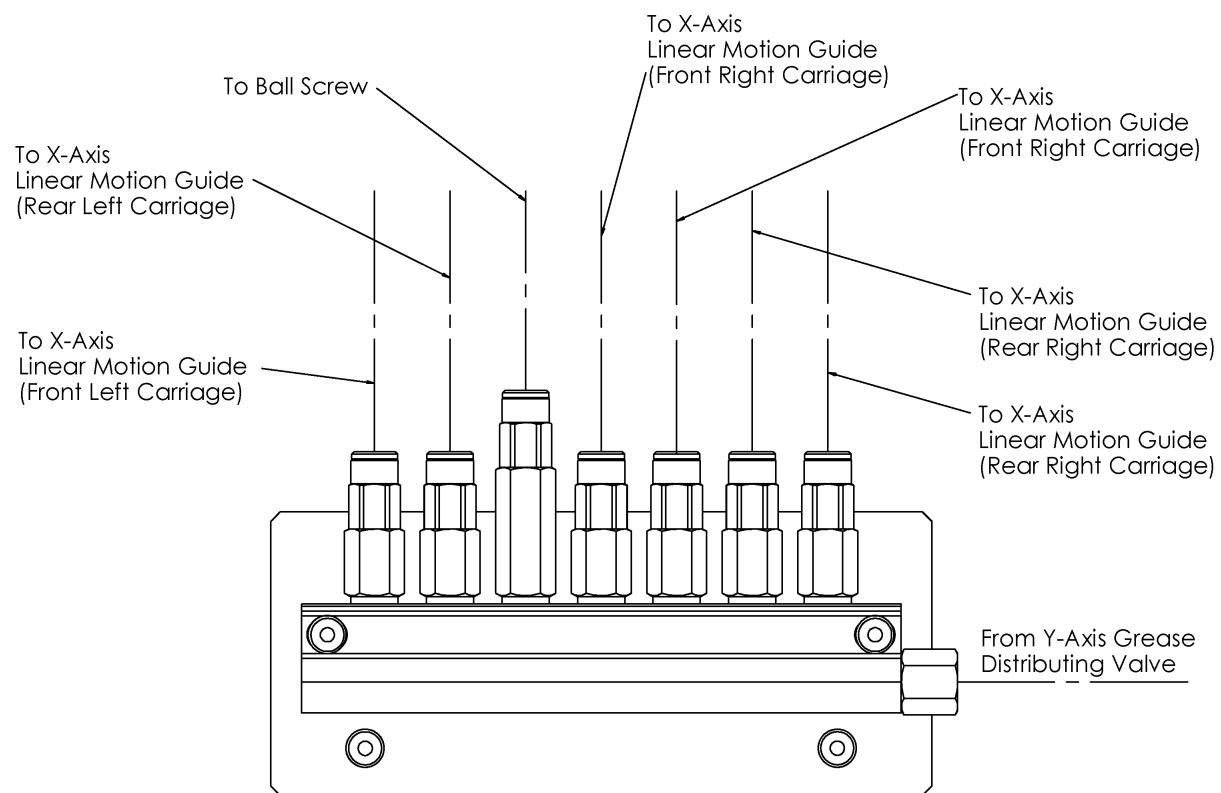


Figure 1.10 X-Axis Grease Distributing Valve

Wiring Route

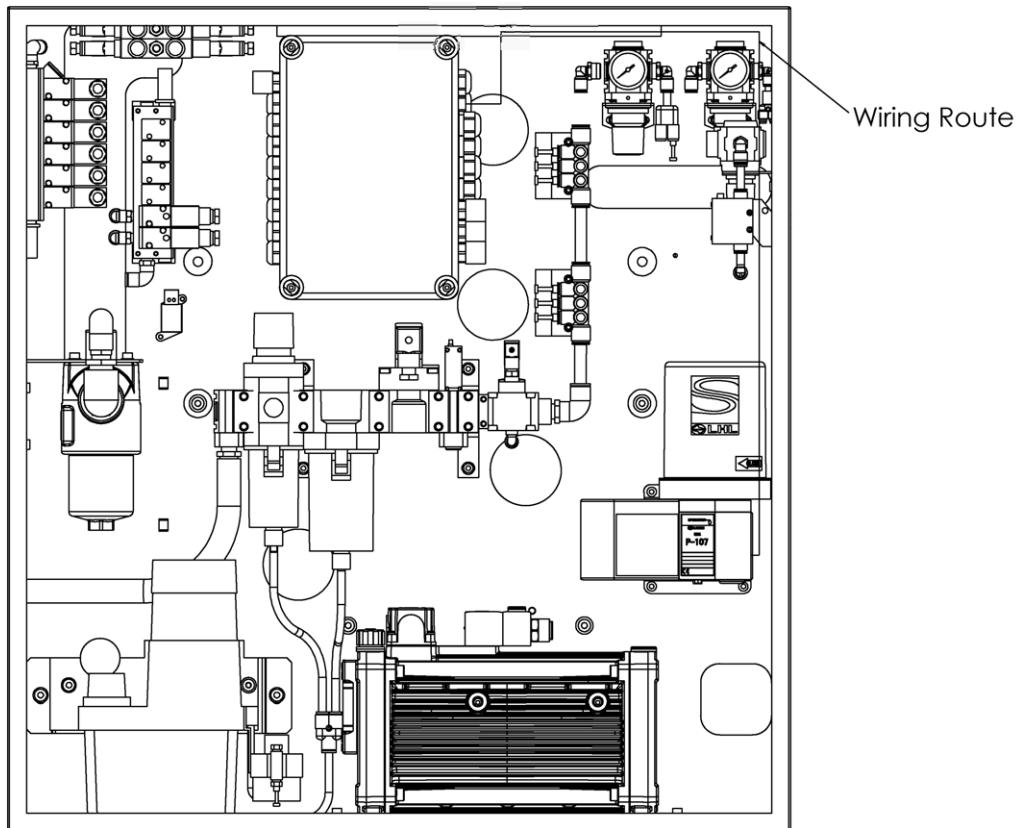
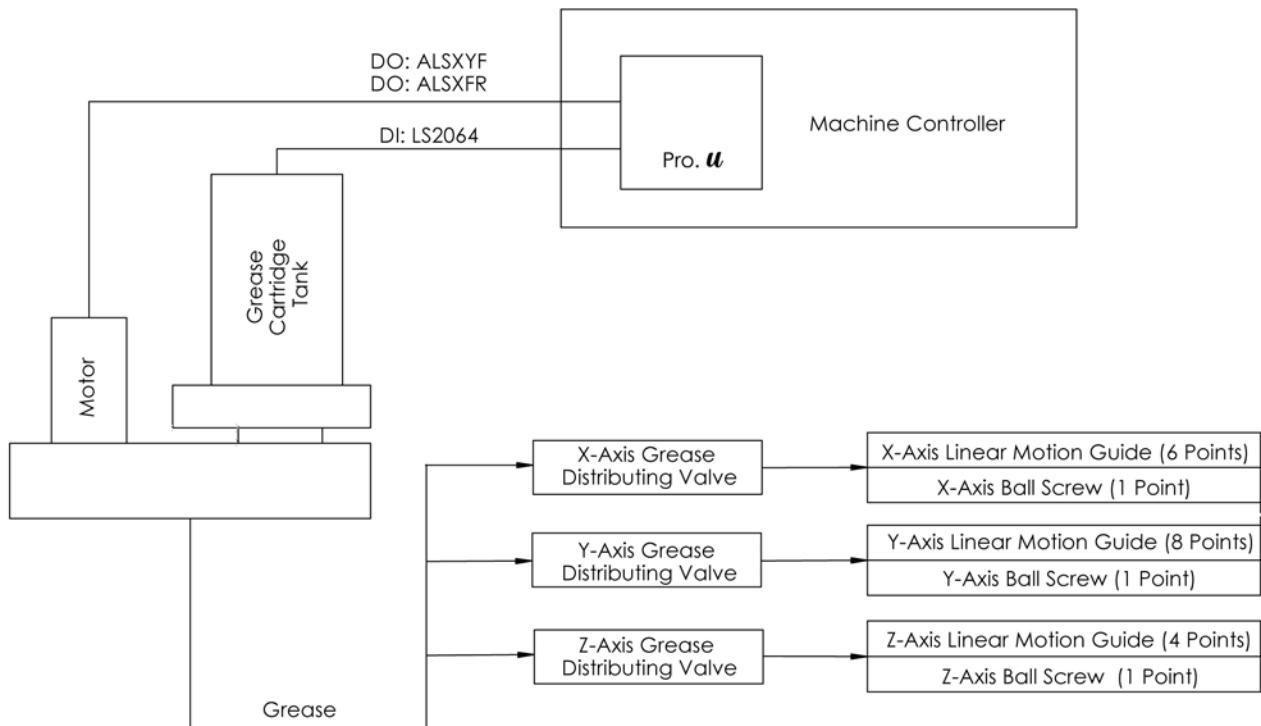


Figure 1.11 Wiring Route

2 Automatic Grease Supply Unit Mechanism



Machine Input / Output Signal Table

Signal Name	Address	Description
LS2089	X0010.4	AUTO GREASE INJECTOR PRESS UP
LS2064	X0010.5	AUTO GREASE SUPPLY UNIT LEVEL SWITCH
ALSXYF	Y0004.5	AUTO GREASE INJECTOR CLOCKWISE

Chapter 8 Automatic Grease Supply Unit

2.1 Automatic Grease Circuit

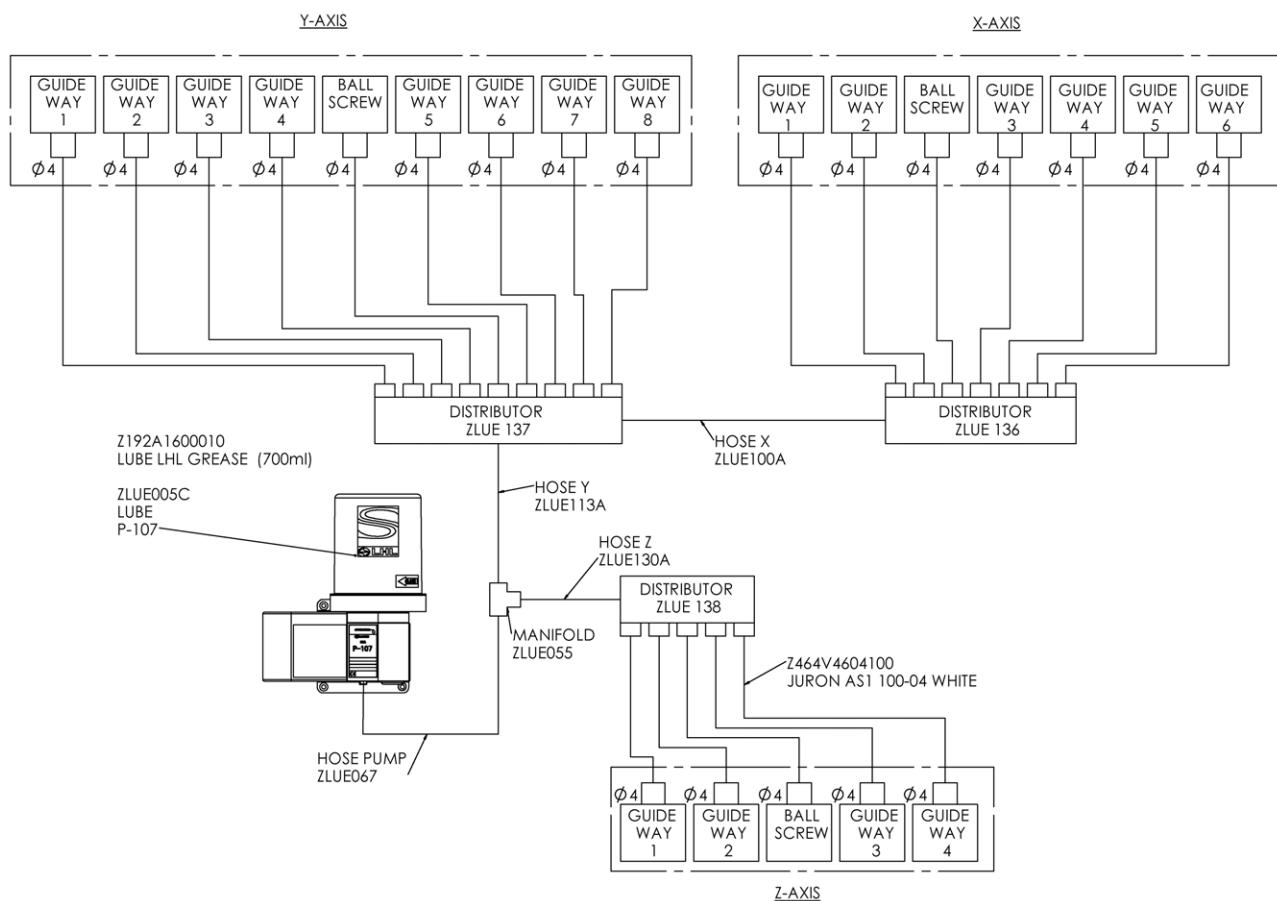


Figure 2.1 Automatic Grease Circuit

Table 2.1 Machine Parameter List

Machine Parameter No.	Description	Standard Setting	Remarks
MC7025	Automatic Grease Supply Unit Pause Time	960	Unit: Minutes
MC7026	Automatic Grease Supply Unit Pause Timing (Initial Filling)	16	Unit: Minutes
MC7006	Automatic Grease Supply Unit Process for Alarm (Cartridge Replacement)	200	Unit: Count
MV7005	Automatic Grease Supply Unit Process for Alarm (Abnormal Pressure)	300	Unit: Seconds

-NOTES-

- With the standard setting, the machine does not stop when Alarm (Warning) is triggered.
- However, it is possible for machine operation to stop when Alarm is triggered by changing the setting.
- Eliminate the cause of the Alarm and reset it to restart the machine.

1 Overview

The spindle hydraulic unit generates (7MPa) with a pump and supplies hydraulic pressure to the spindle for clamping and unclamping of tools.

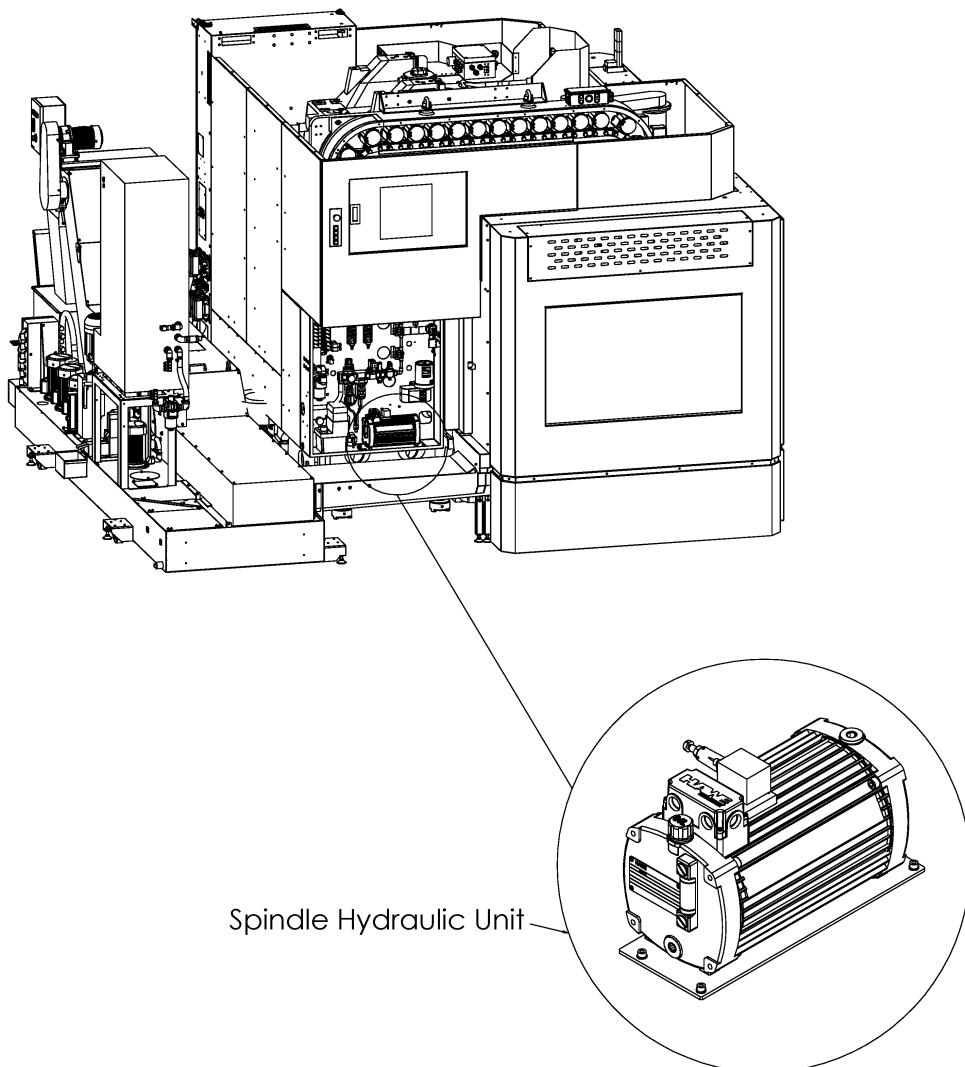


Figure 1.1 General View

1.1 Component Name

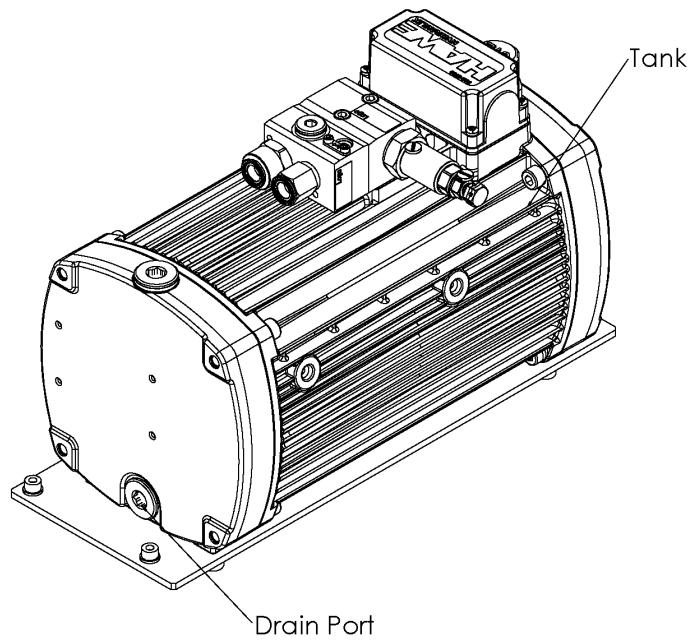
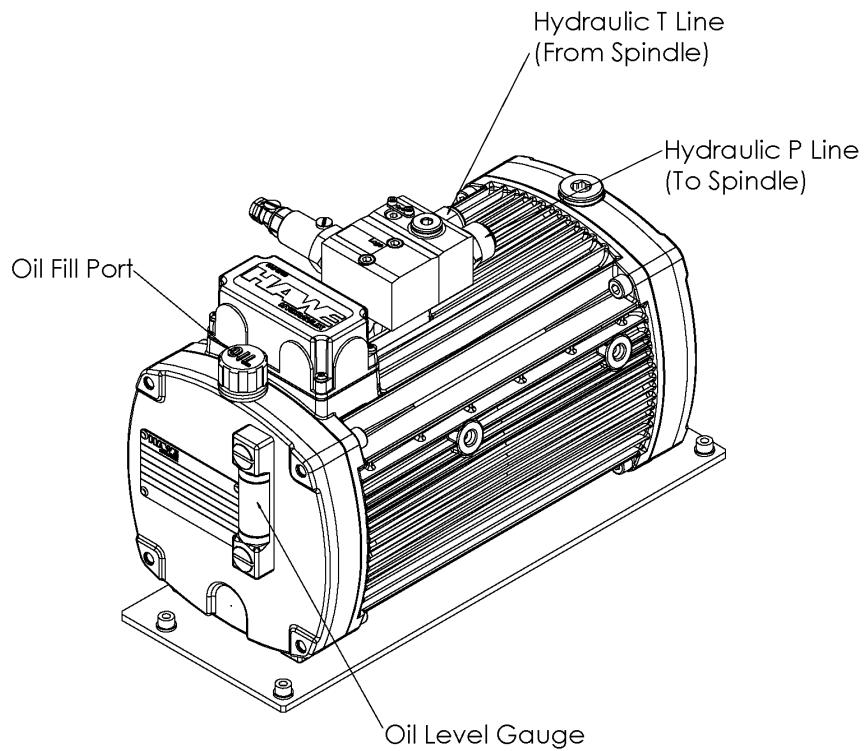


Figure 1.2 Spindle Hydraulic Unit

1.2 Piping and Wiring

Piping Route

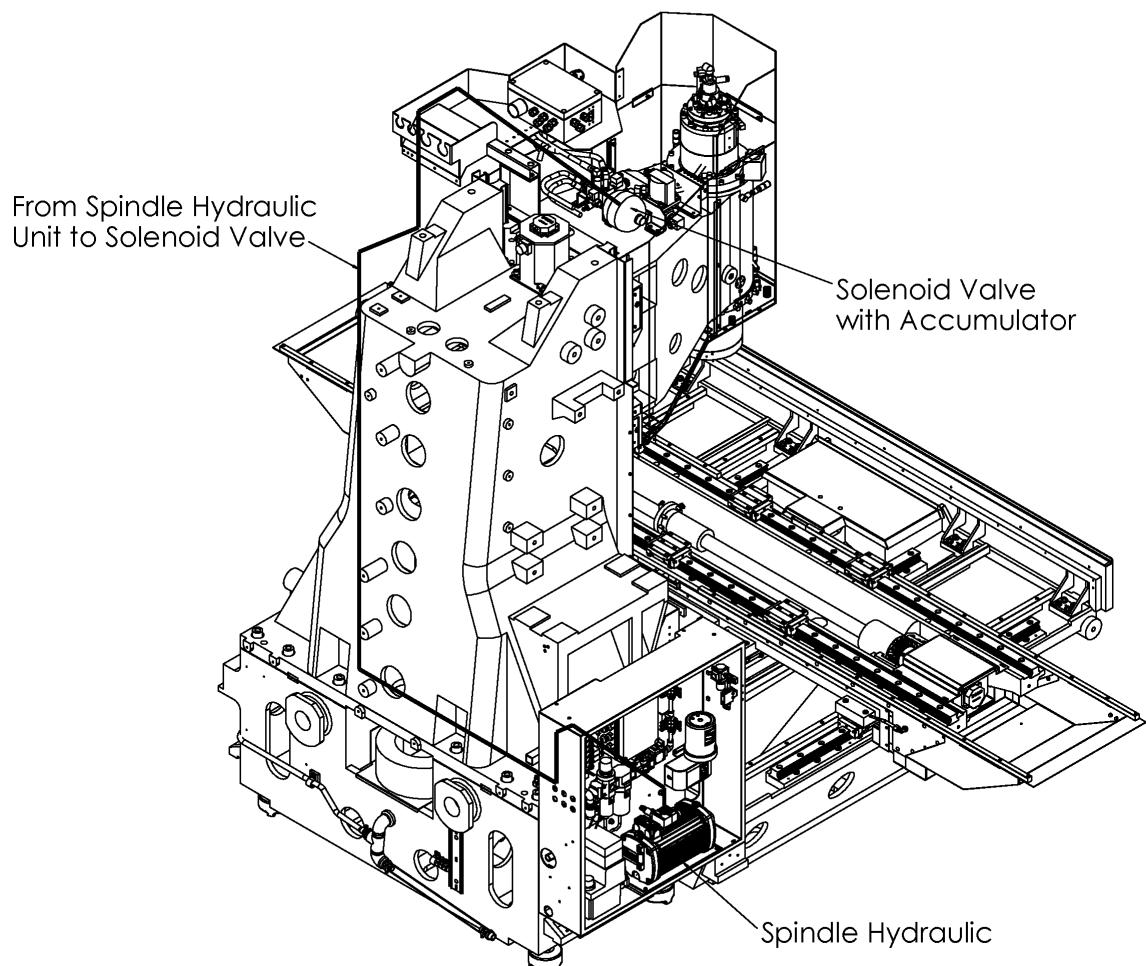
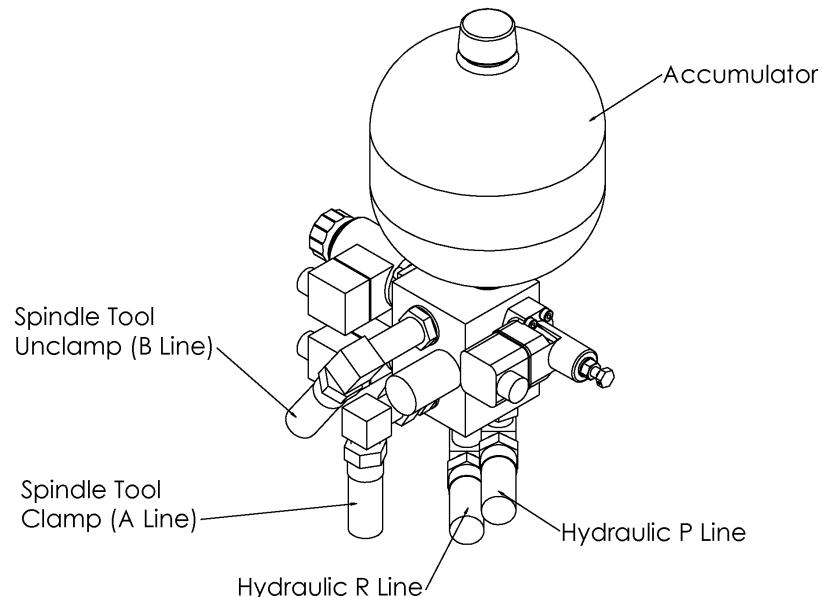


Figure 1.3 Piping Route

Chapter 9 Spindle Hydraulic Unit

Solenoid Valve



Hydraulic Unit

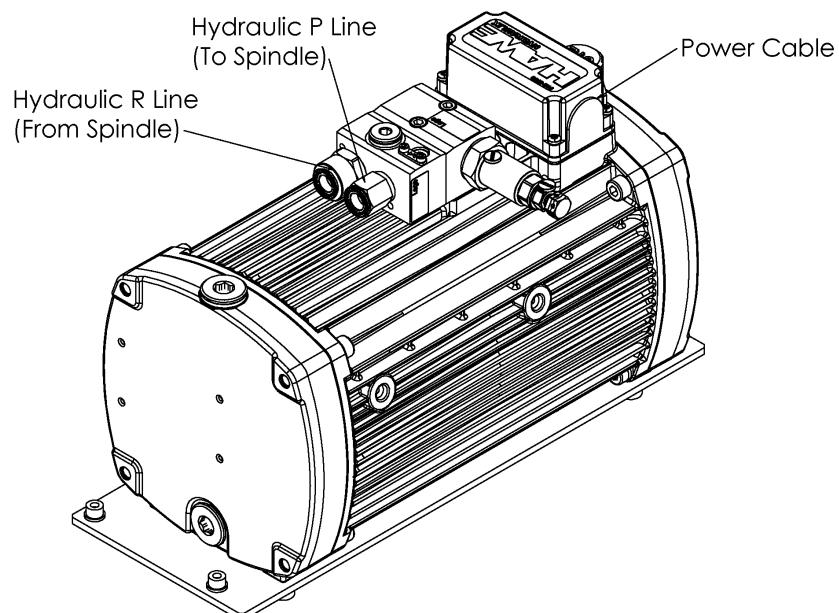


Figure 1.4 Solenoid Valve & Hydraulic Unit

Wiring Route

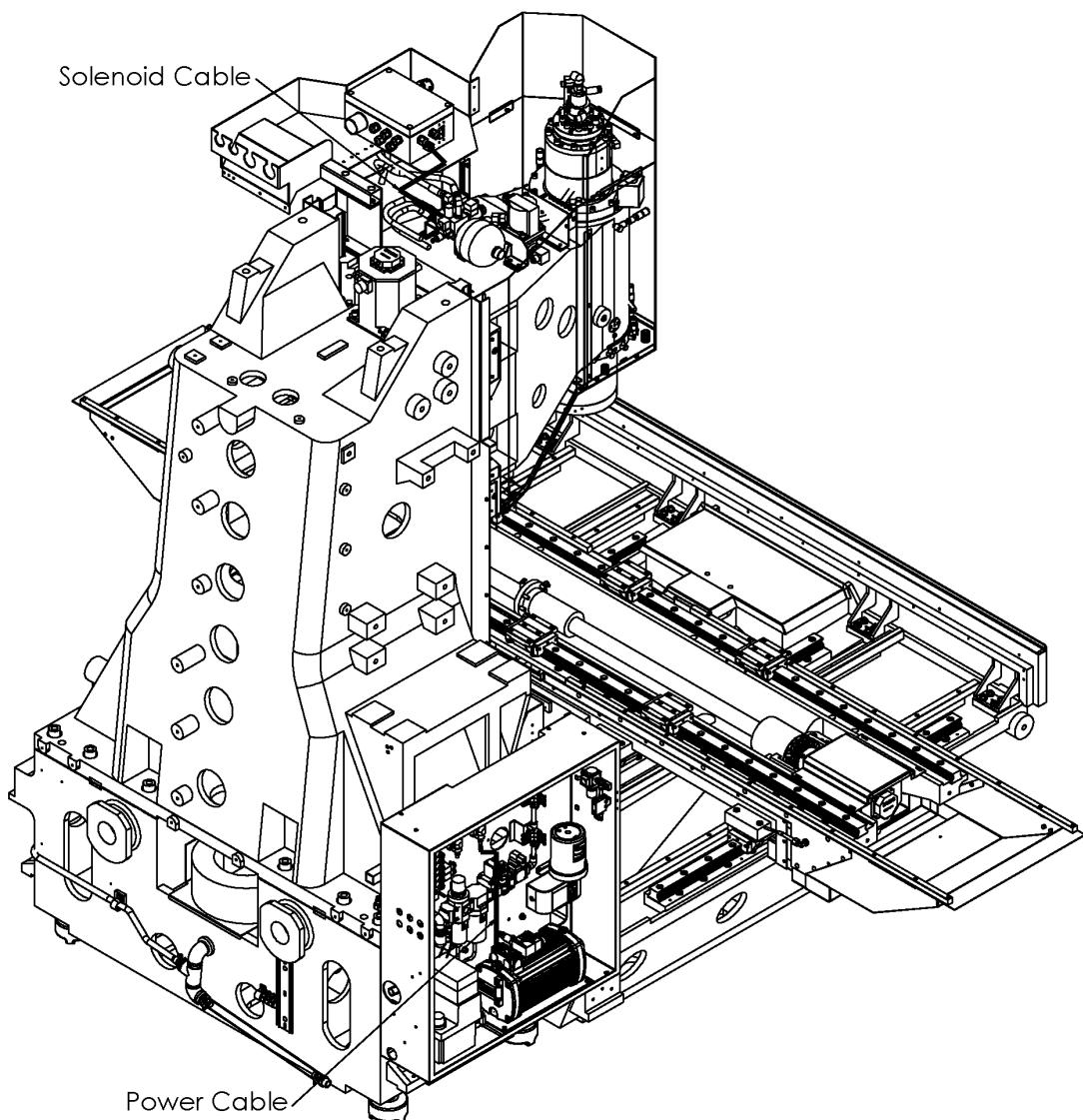
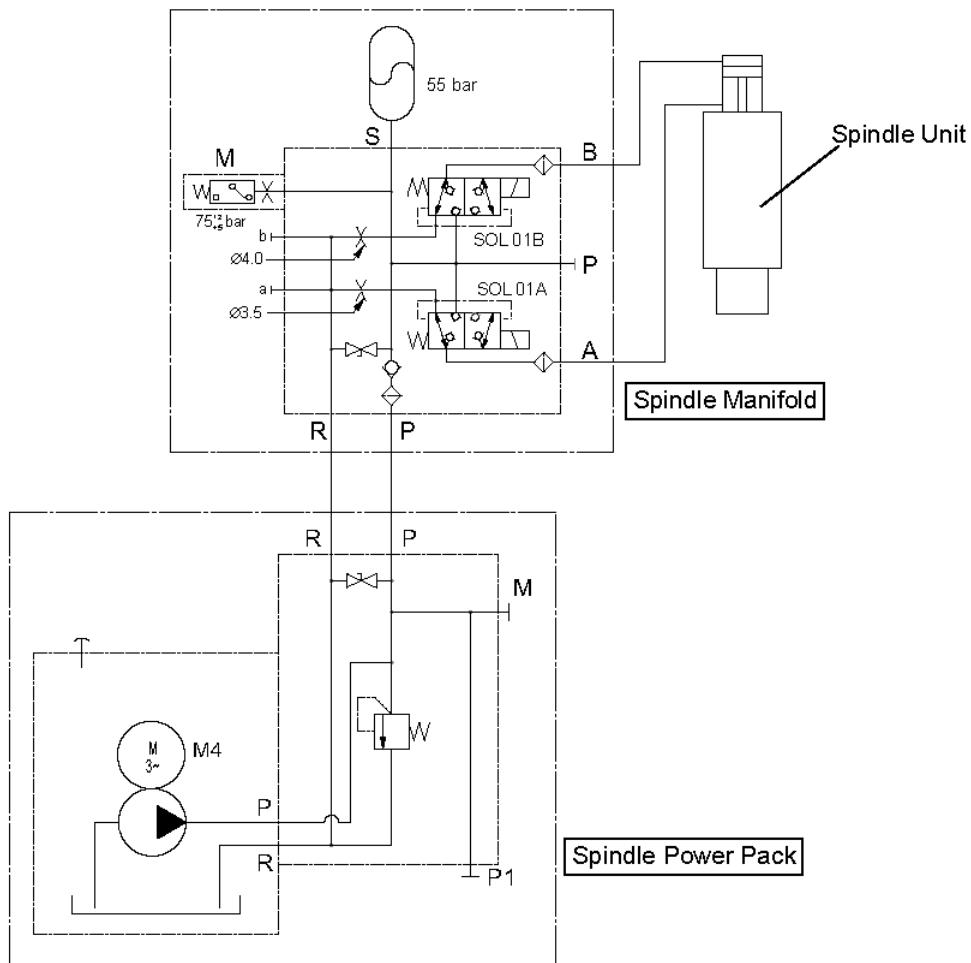


Figure 1.5 Wiring Route

2 Spindle Hydraulic Unit Mechanism



Symbol	Name
M4	Hydraulic Pump Motor
P	Hydraulic P Line
R	Hydraulic R Line

Machine Input/Output Signal Table

Signal Name	Address	Description
MS4	Y0005.4	HYDRAULIC UNIT ON
SL01A	Y0004.0	SPINDLE TOOL CLAMP
SL01B	Y0004.1	SPINDLE TOOL UNCLAMP

1 Overview

The fixture hydraulic unit generates pressure (7MPa) with a pump and supplies hydraulic pressure to control the fixtures on the table.

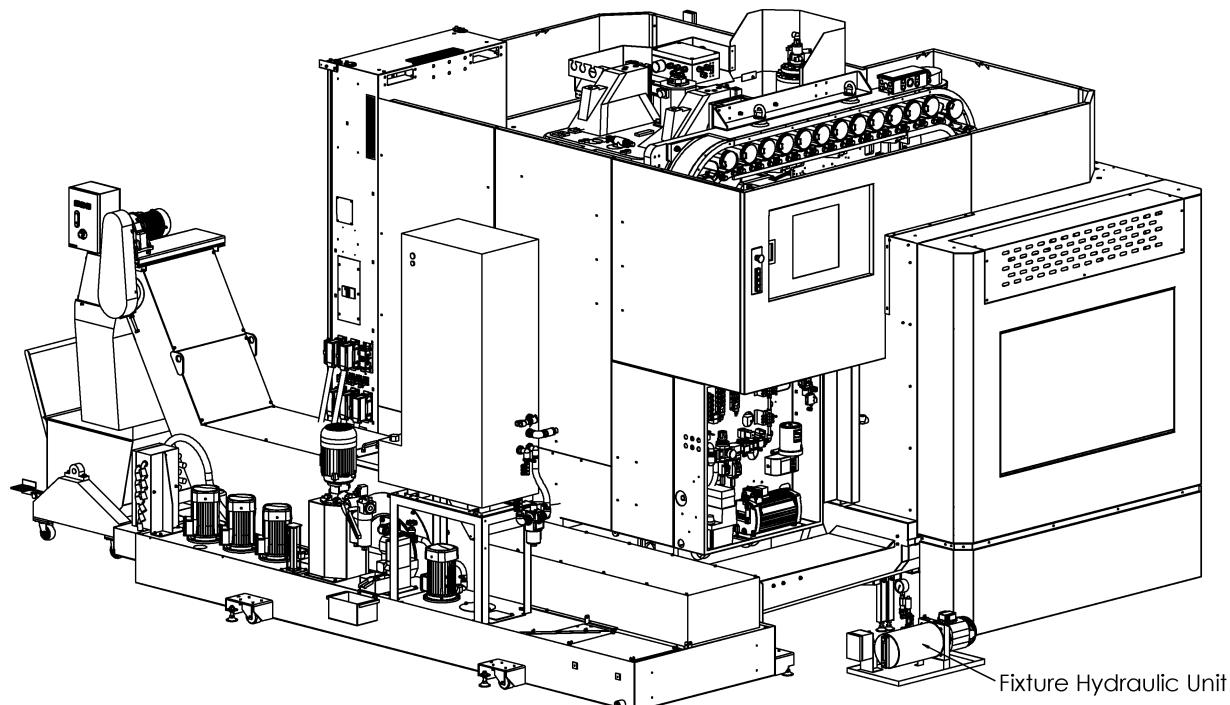


Figure 1.1 General View

1.1 Component Name

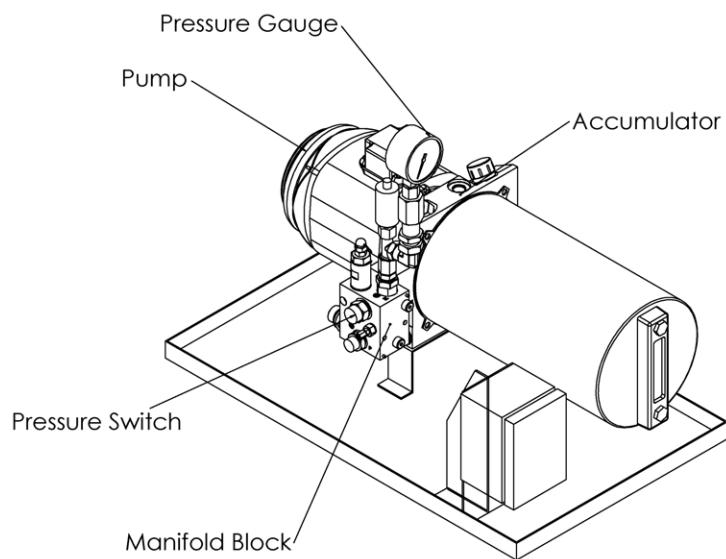


Figure 1.2 Fixture Hydraulic Unit (Option)

1.2 Piping and Wiring

Piping Route (Standard Machine)

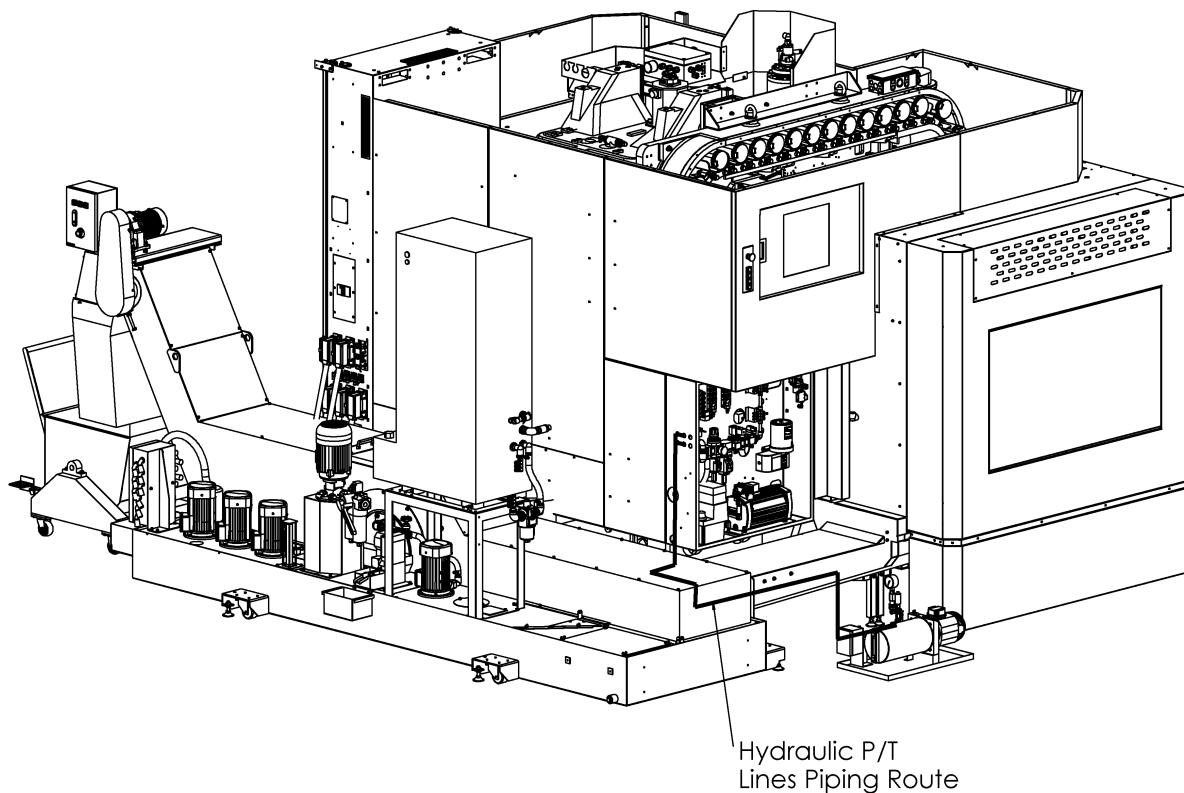


Figure 1.3 Piping Route (Standard Machine)

Wiring Route (Standard Machine)

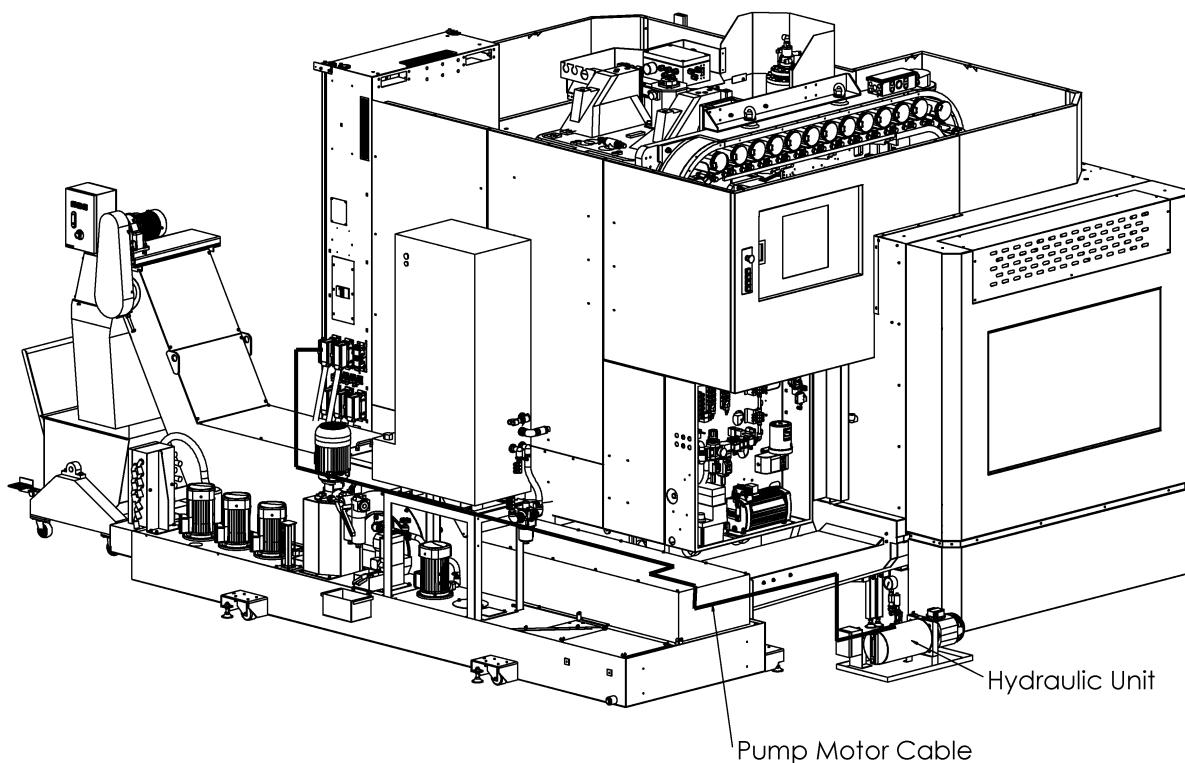


Figure 1.4 Hydraulic Unit Wiring Route

2 Fixture Hydraulic Unit Mechanism

Standard Machine (1A+1B)

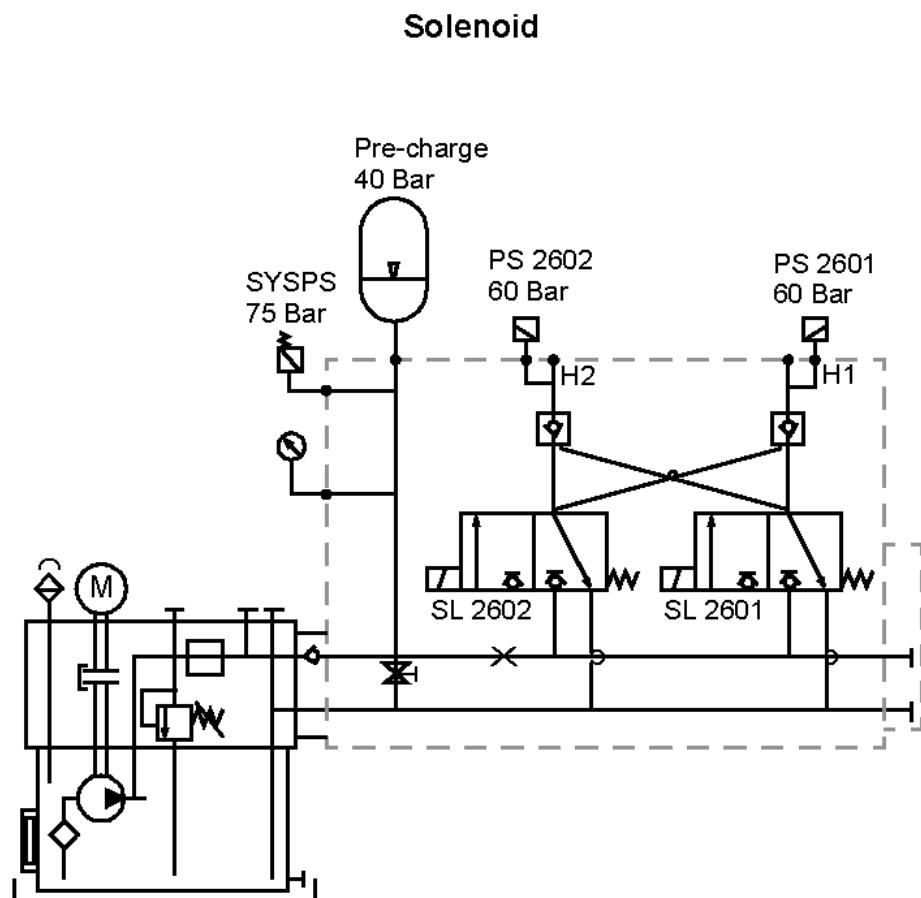


Figure 2.1 Fixture Hydraulic Unit Mechanism

1 Overview

The pneumatic system unit consist of devices (such as filters and regulators) that clean or depressurize the air supplied from the factory equipment and solenoid valves that stop or allow air flow in response to electrical signals.

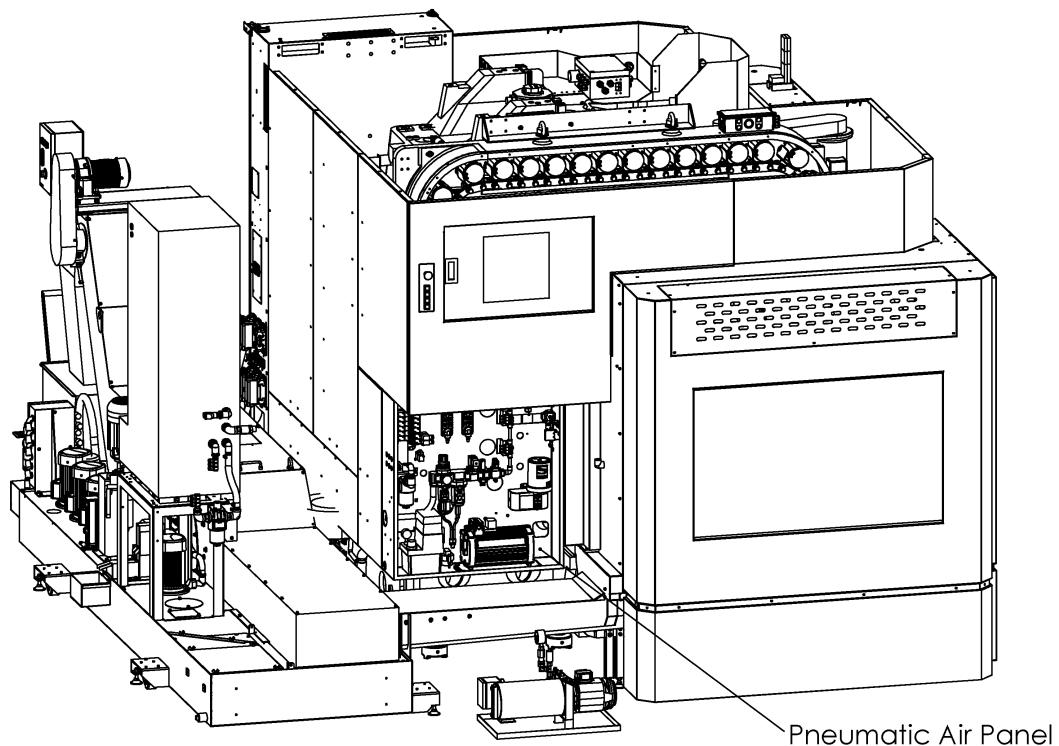


Figure 1.1 General View

1.1 Component Name

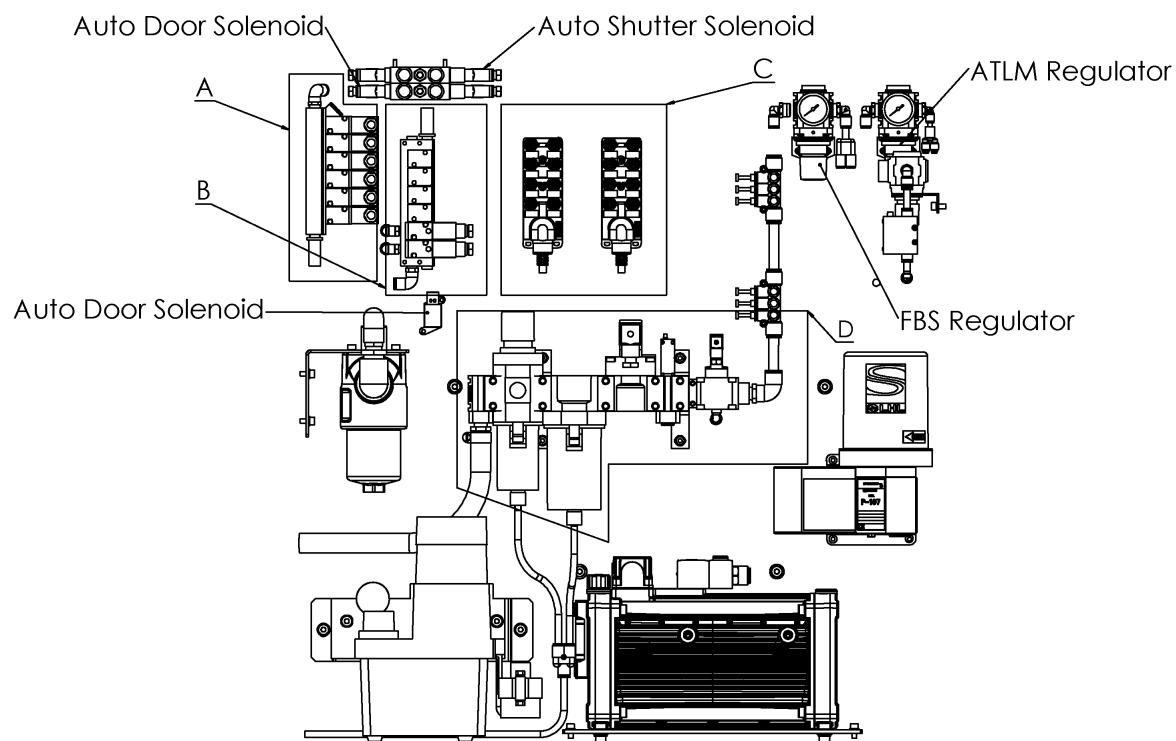
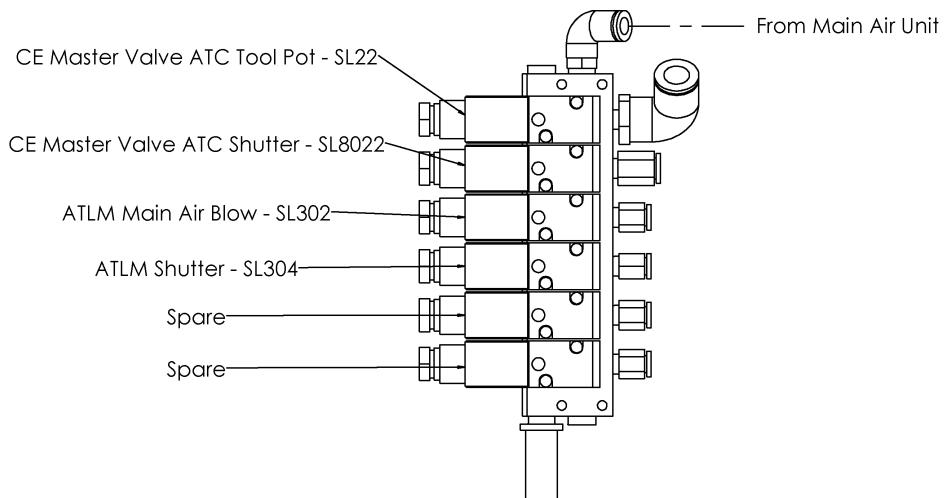


Figure 1.2 Pneumatic System 1

Solenoid Manifold (Option)



Solenoid Manifold (Standard)

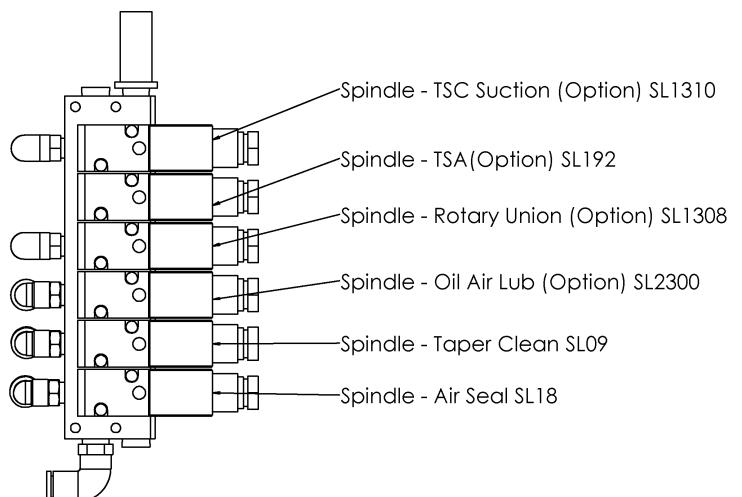
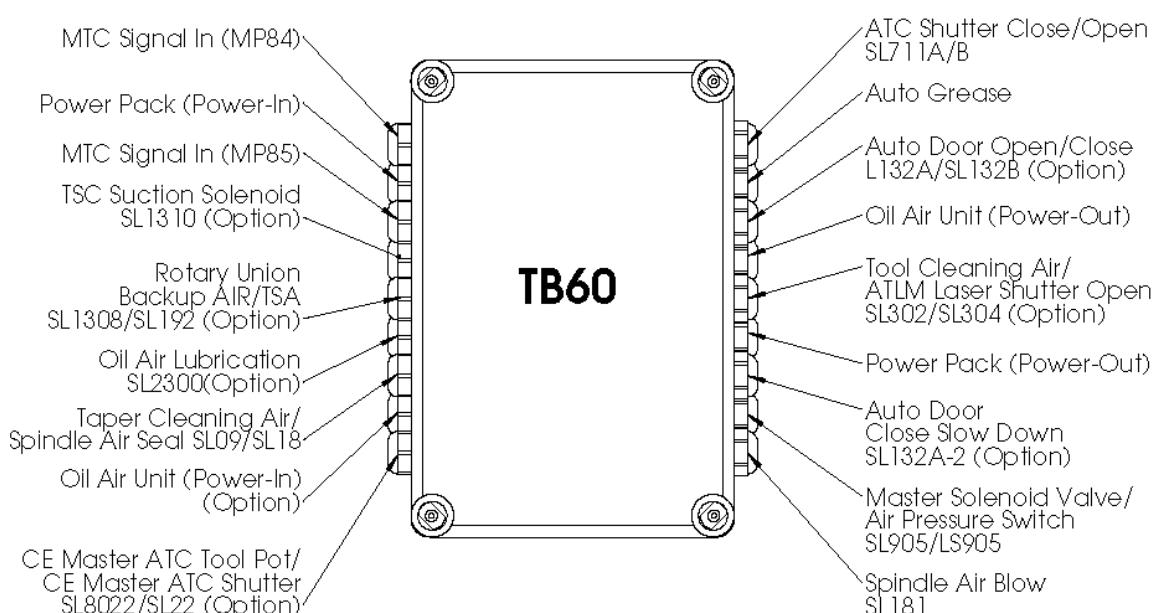
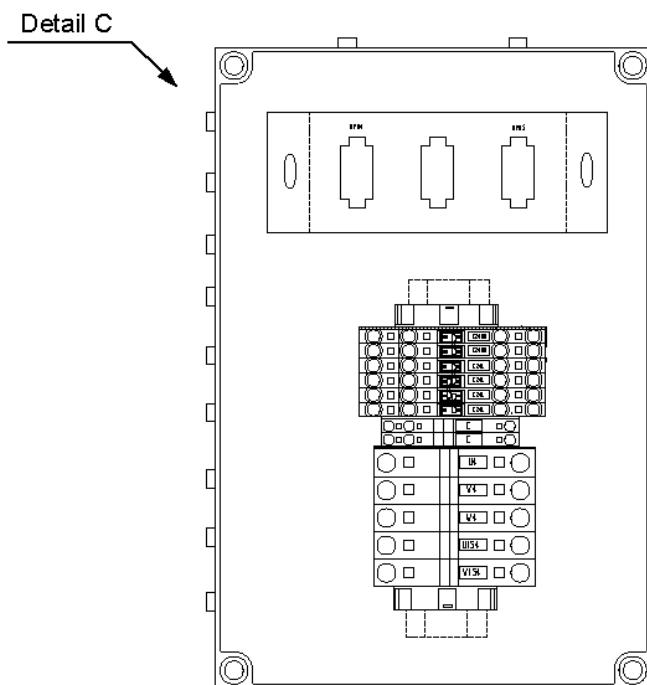


Figure 1.3 Pneumatic System 2

Pneumatic Terminal Box (Option)



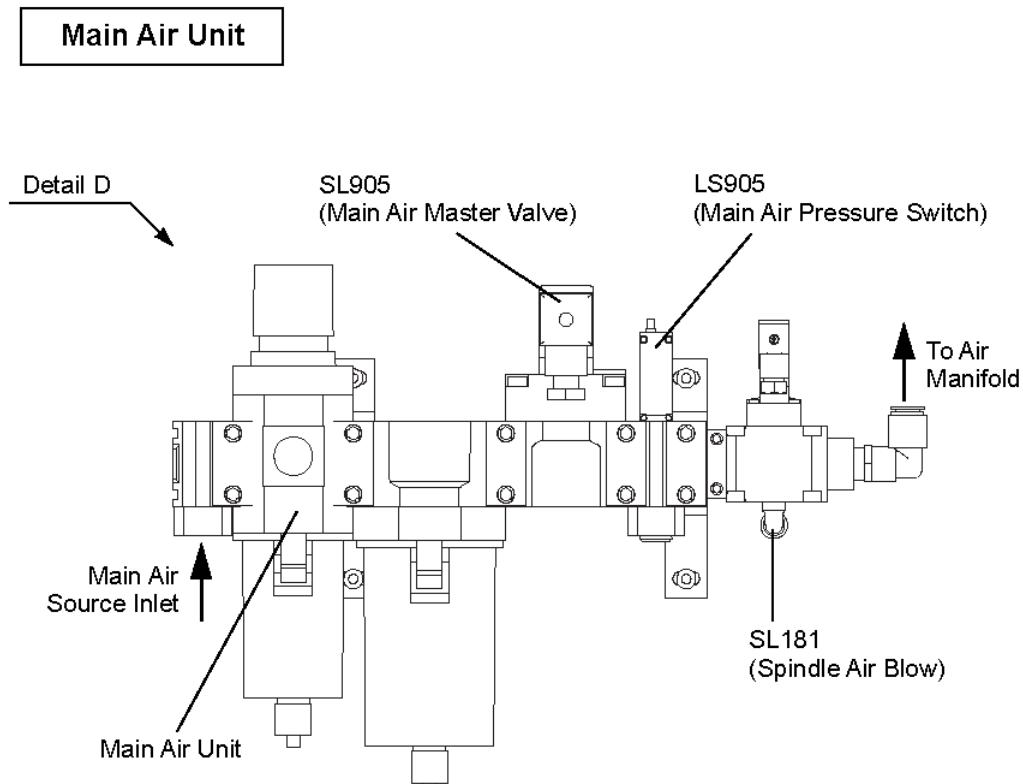
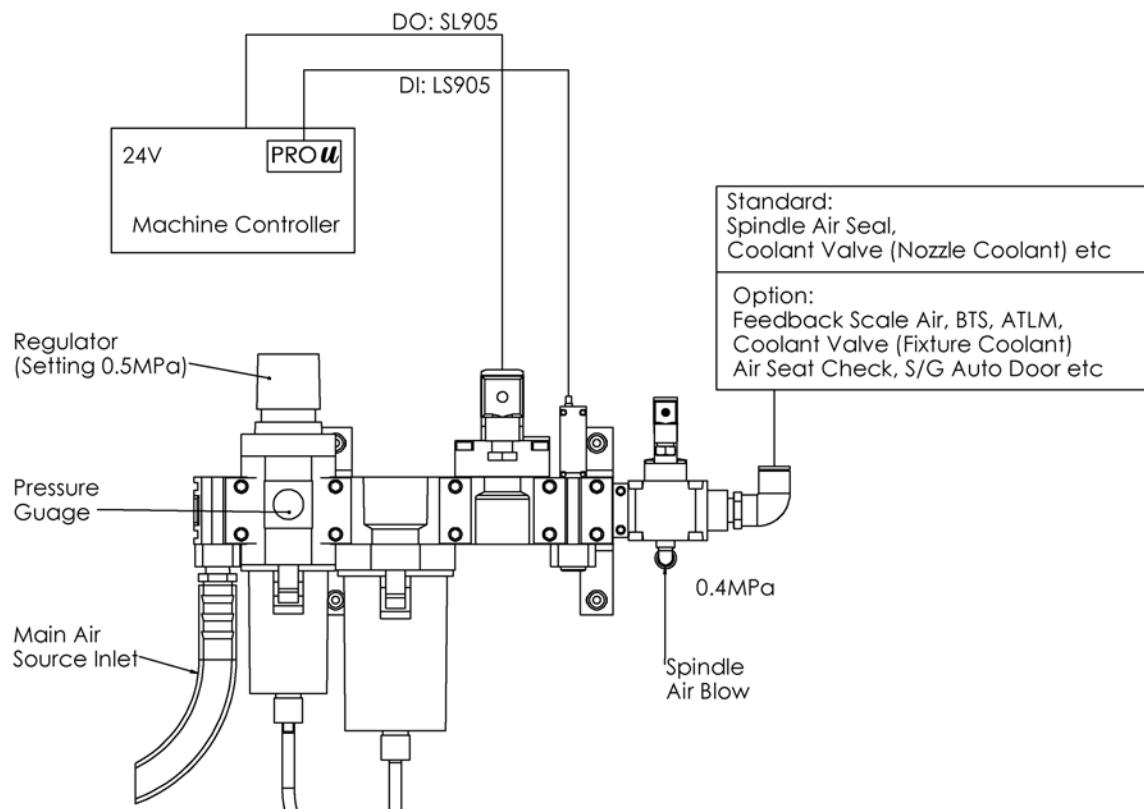


Figure 1.5 Pneumatic System 4

2 Air Unit Mechanism



Machine Input/Output Signal Table

Signal Name	Address	Description
*LS905	X0011.5	AIR PRESSURE SWITCH
SL905	Y0005.5	MASTER SOLENOID VALVE

2.1 Main Air Unit

The main air unit regulates air supply/cut-off to maintain the air pressure at a constant level (0.5MPa).

When the pressure switch LS905 (main air pressure switch) detects that the air pressure drops below 0.5MPa, an alarm is triggered and the machine enters the feed hold condition.

Please note that if the compressed air supplied to the machine does not satisfy the necessary conditions (compressed air free from dust, moisture or oil and the grade is ISO 2.5.2 as stipulated in JIS B 8392-1 [ISO 8573-1]), it may cause a malfunction of the pneumatic system. Contaminated compressed air will severely damage the major components of the machine, such as the spindle and scale units.

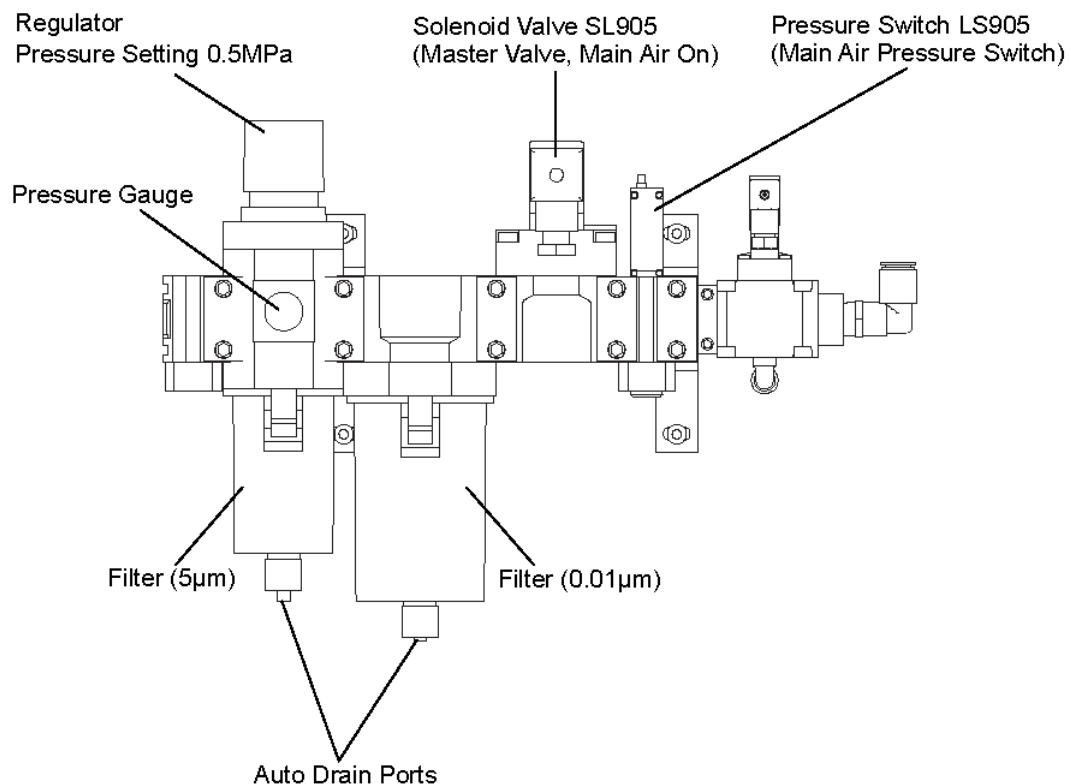


Figure 2.1 Main Air Unit

2.2 Scale Air Unit

The scale air unit raises the air pressure inside the scale devices to prevent the entry of chips and coolant.

Perform the following adjustments and inspections if the scale air unit pressure gauge reading is 0.1MPa or less.

- Scale Air Pressure Adjustment
- Main Air Unit Check

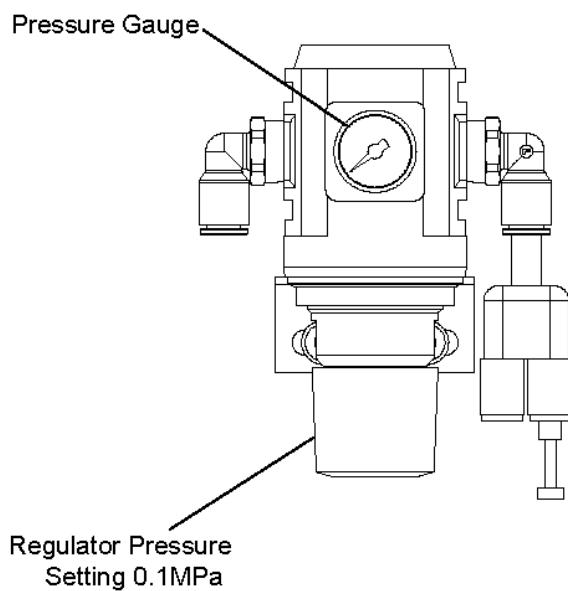
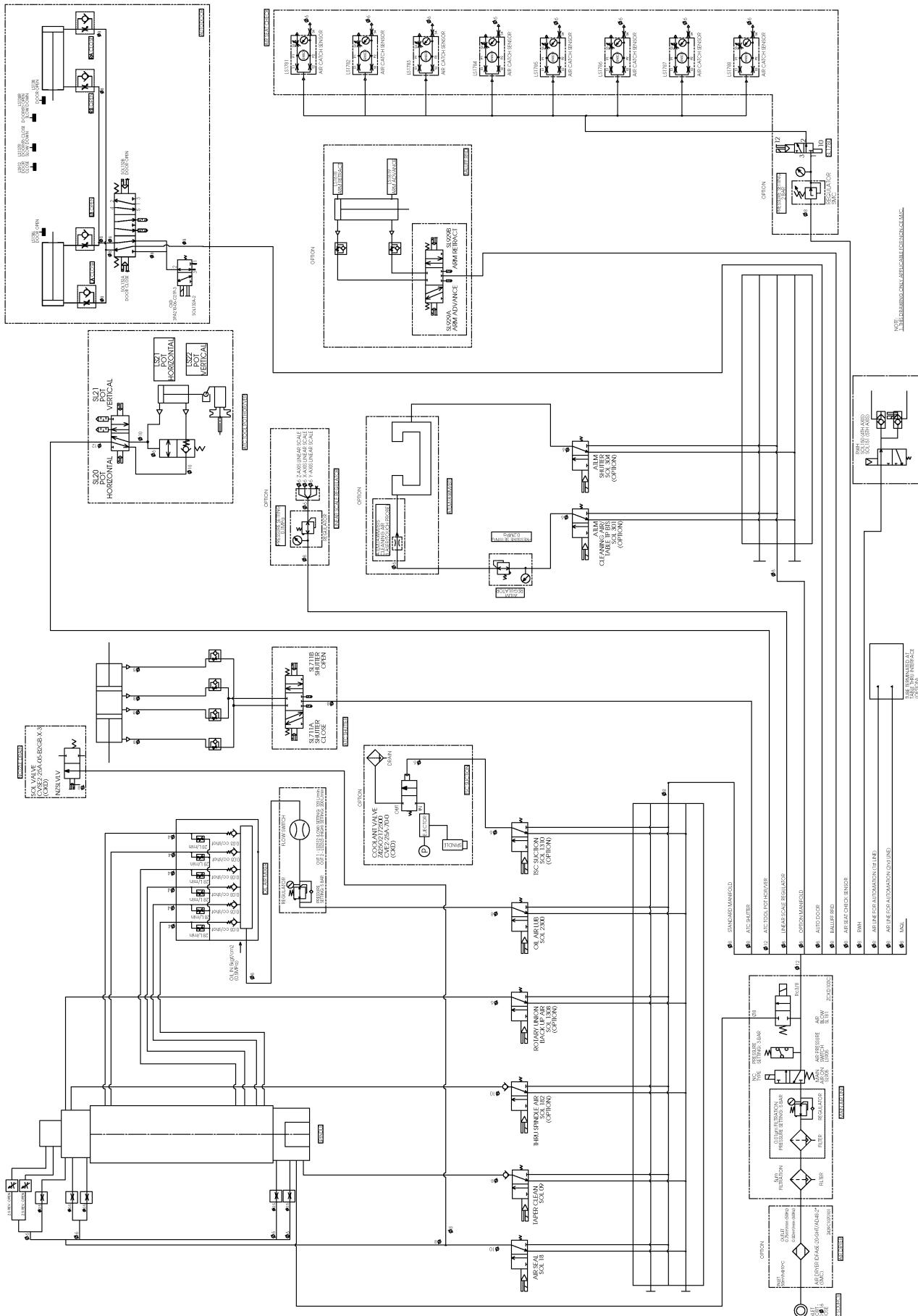
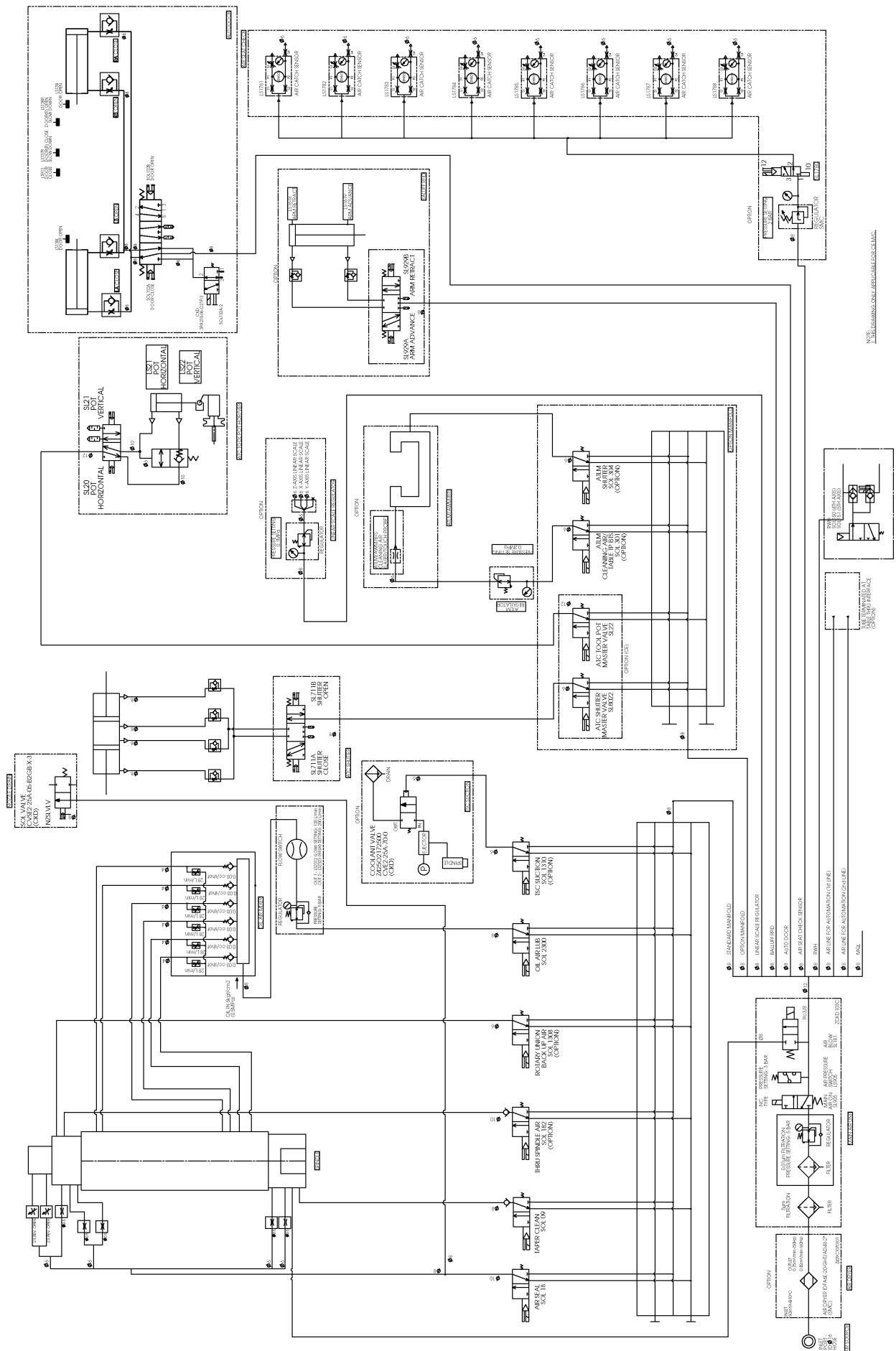


Figure 2.2 Scale Air Unit

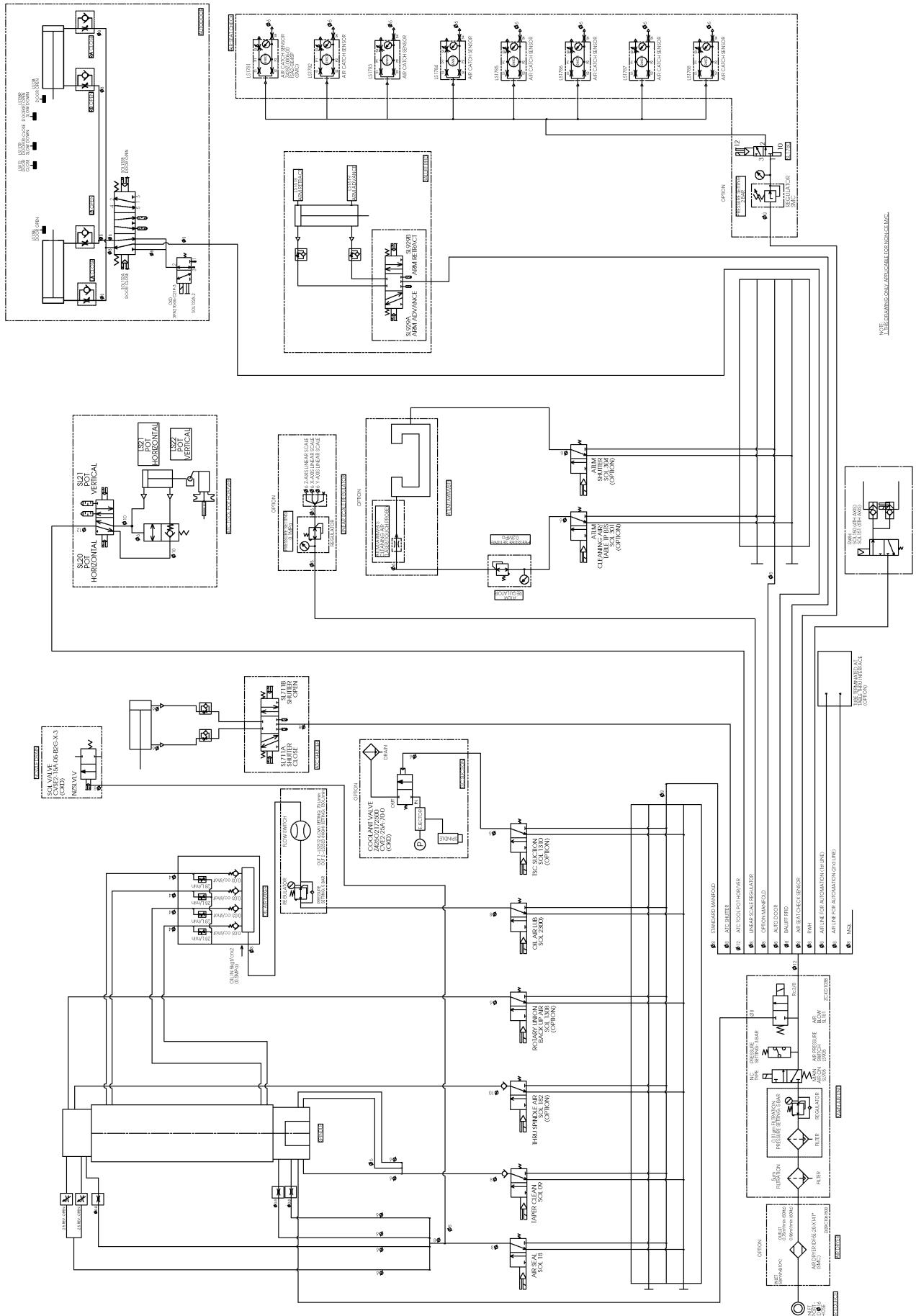
2.3 Pneumatic Circuit Diagram – 10K Machine and Options



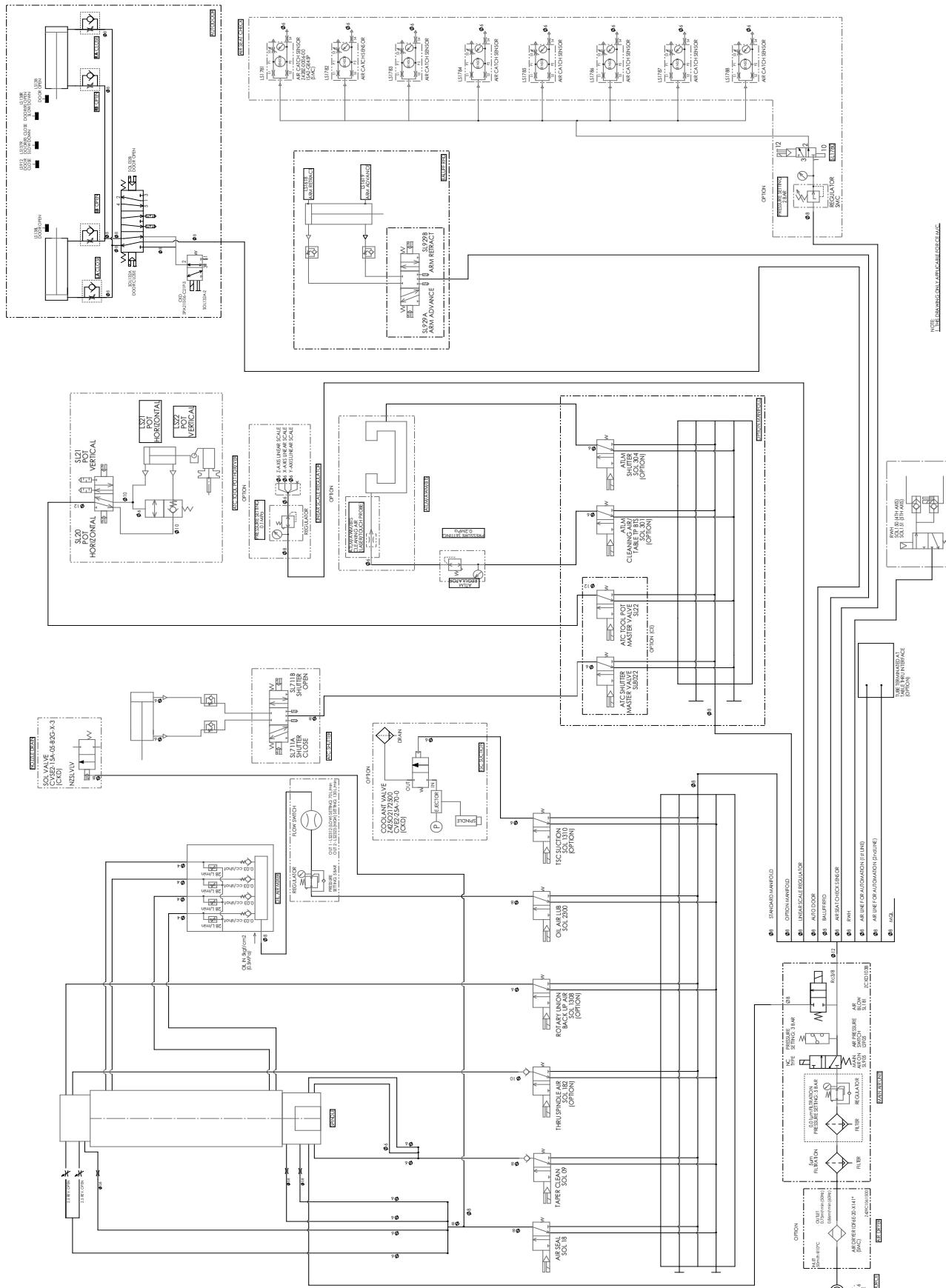
2.4 Pneumatic Circuit Diagram – 10K CE Machine and Options



2.5 Pneumatic Circuit Diagram – 14K Machine and Options



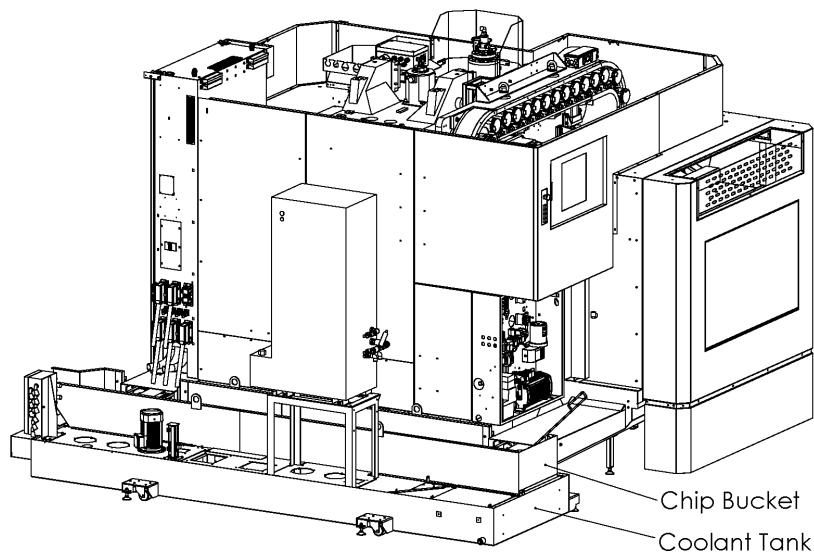
2.6 Pneumatic Circuit Diagram – 14K CE Machine and Options



1 Overview

The chip disposal unit consist of chip bucket or an optional lift-up chip conveyor. The device separates chips and cutting fluid, returning the cutting fluid to the tank and discharging the chips from the machine manually or automatically.

Chip Bucket (Standard)



Lift-up Chip Conveyor (LUCC- Option)

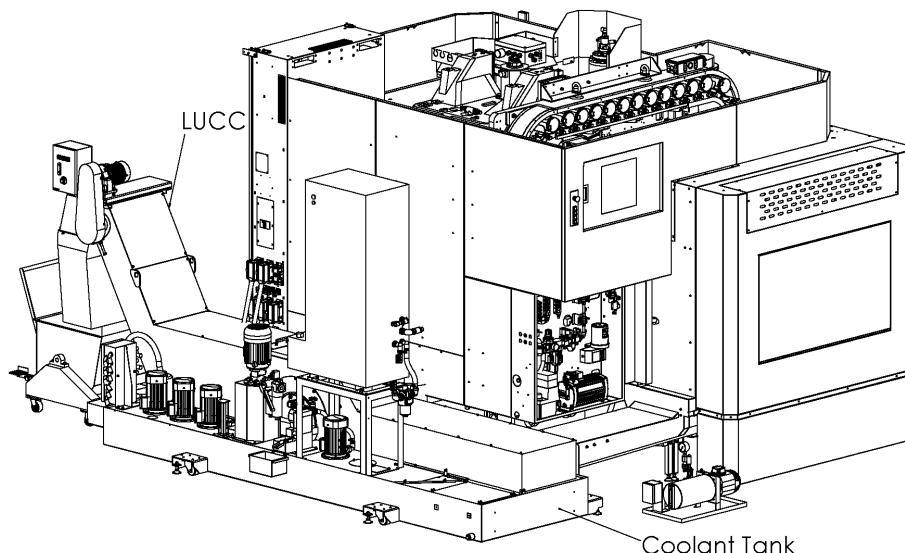
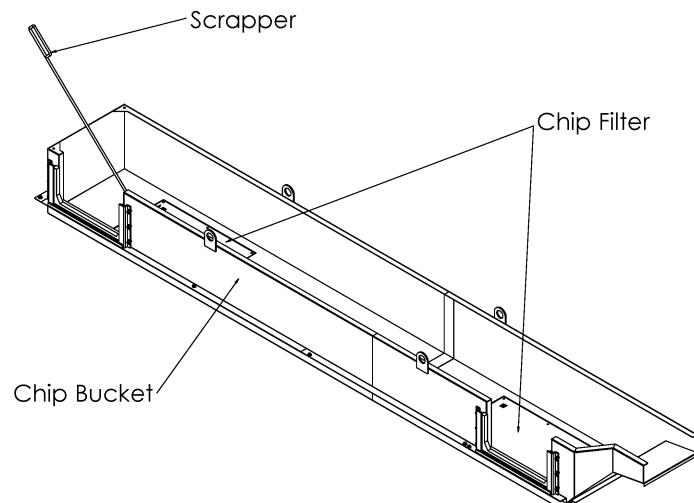


Figure 1.1 General View

1.1 Component Name

Chip Bucket (Standard)



Lift-Up Chip Conveyor (LUCC - Option)

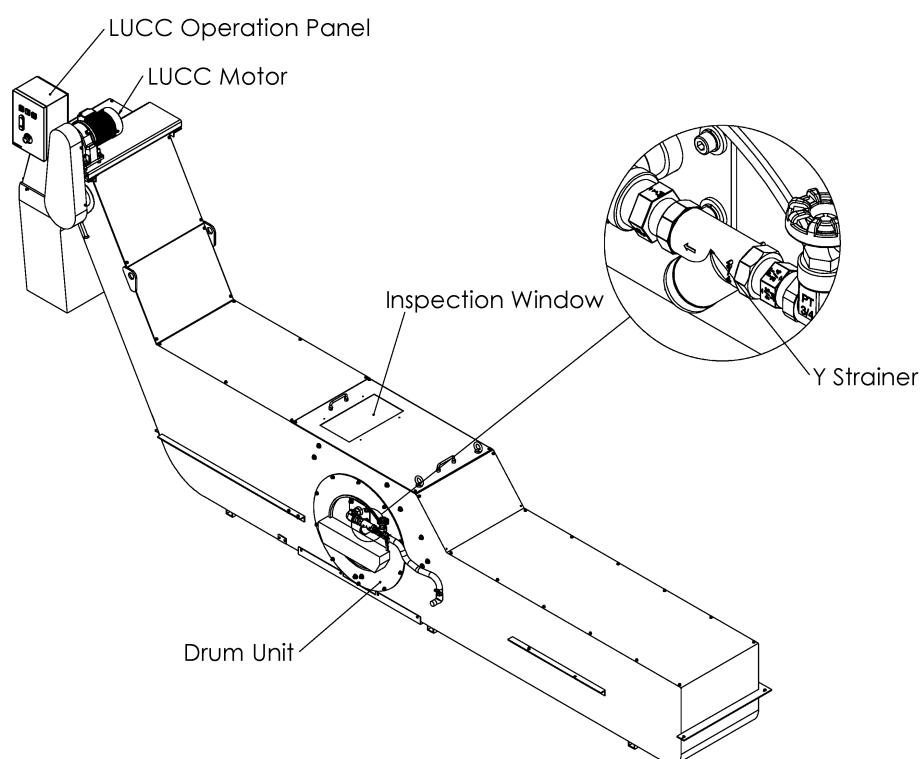


Figure 1.2 Spindle Hydraulic Unit

1.2 Wiring

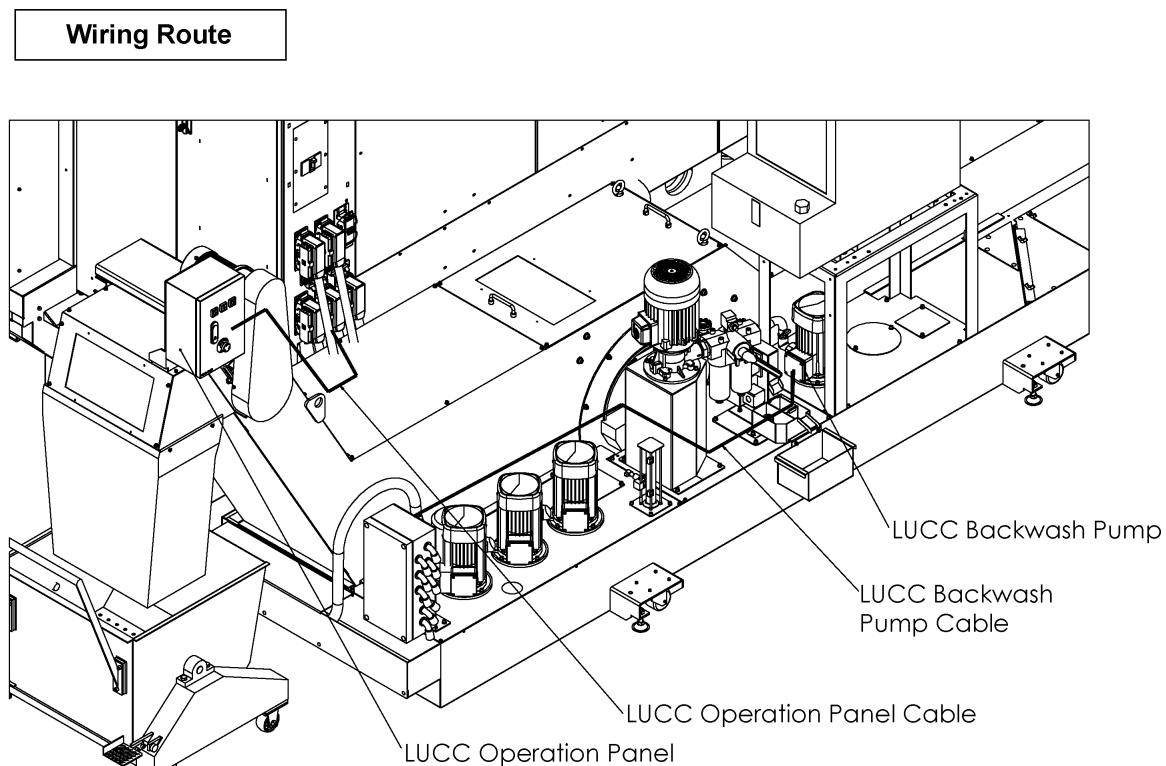
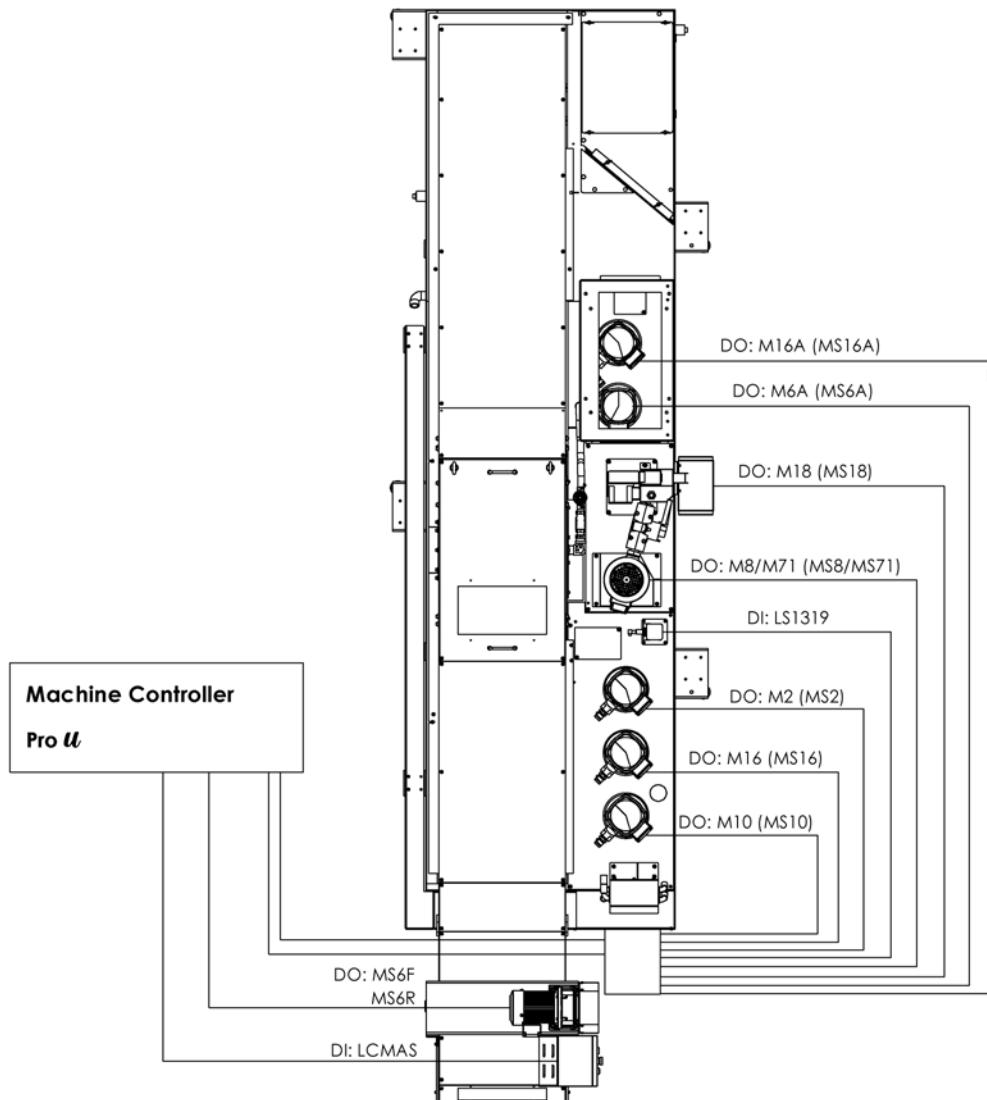


Figure 1.3 Wiring Route

2 Chip Disposal and Conveyor Mechanism



Machine Input/Output Signal

Signal Name	Address	Description
MS8	Y0009.4	THROUGH SPINDLE COOLANT
MS2	Y0004.2	NOZZLE COOLANT
MS6A	Y0011.5	DRUM FILTER CLEANING PUMP
MS16	Y0004.3	FLUSH COOLANT
MS16A	Y0061.7	FIXTURE COOLANT
MS18	Y0007.5	OIL SKIMMER
MS10	Y0009.5	SHOWER COOLANT
MS71	Y0011.6	SECONDARY FILTER TANK PUMP ON
MS6F	Y0009.2	LUCC FORWARD
MS6R	Y0009.3	LUCC REVERSE
LS1319	X0005.1	COOLANT TANK EMPTY DETECT
LCMAS	X0017.3	LUCC MANUAL INTERRUPT SWITCH

2.1 Flush Coolant

Chips generated during machining are flushed by the cutting fluid. Mixture of cutting fluid and chips is transferred by flush coolant to the rear side of the machine going to the chip bucket or LUCC. This is where the cutting fluid and chips are separated and cutting fluid is reused on the same cycle.

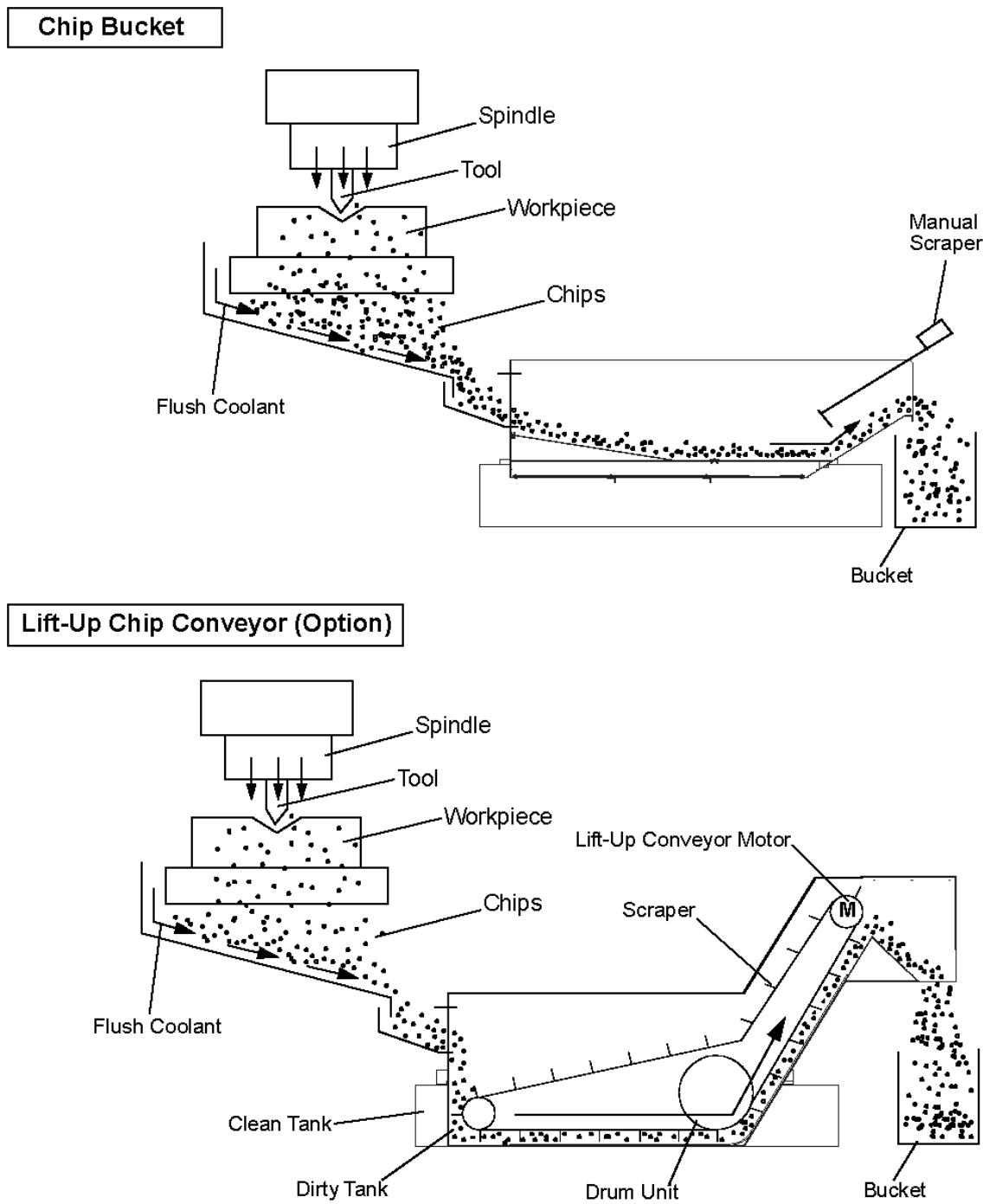


Figure 2.1 Flush Coolant

2.2 Lift-Up Chip Conveyor (Option)

The lift-up chip conveyor separates the chips and discharged the cutting fluid from the machine and returns the cutting fluid to the dirty tank.

The cutting fluid in the dirty tank is then filtered through the drum unit filter and transferred to the primary (semi-clean) tank.

For details of cutting fluid (Refer to [Chapter 13 Cutting Fluid Supply Unit and Tank](#)^[227])

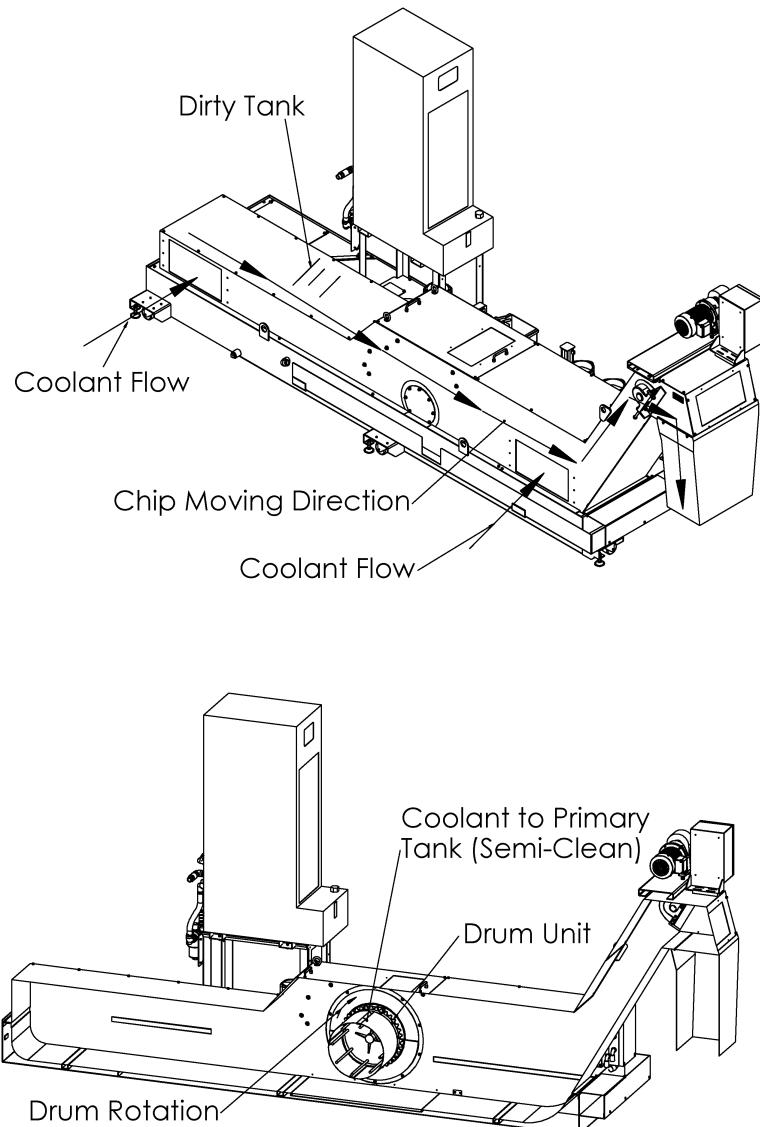


Figure 2.2 Lift-Up Chip Conveyor (Option)

2.3 Drum Unit

The drum unit filters the cutting fluid and transfer it into the dirty tank. Filters are mounted around the drum unit. Chips caught in the filters are removed by the flush coolant (backwash) from the filter cleaning nozzles located in the drum unit.

For details of backwash coolant of the drum unit (Refer to [2.3 Backwash Coolant](#) [236]).

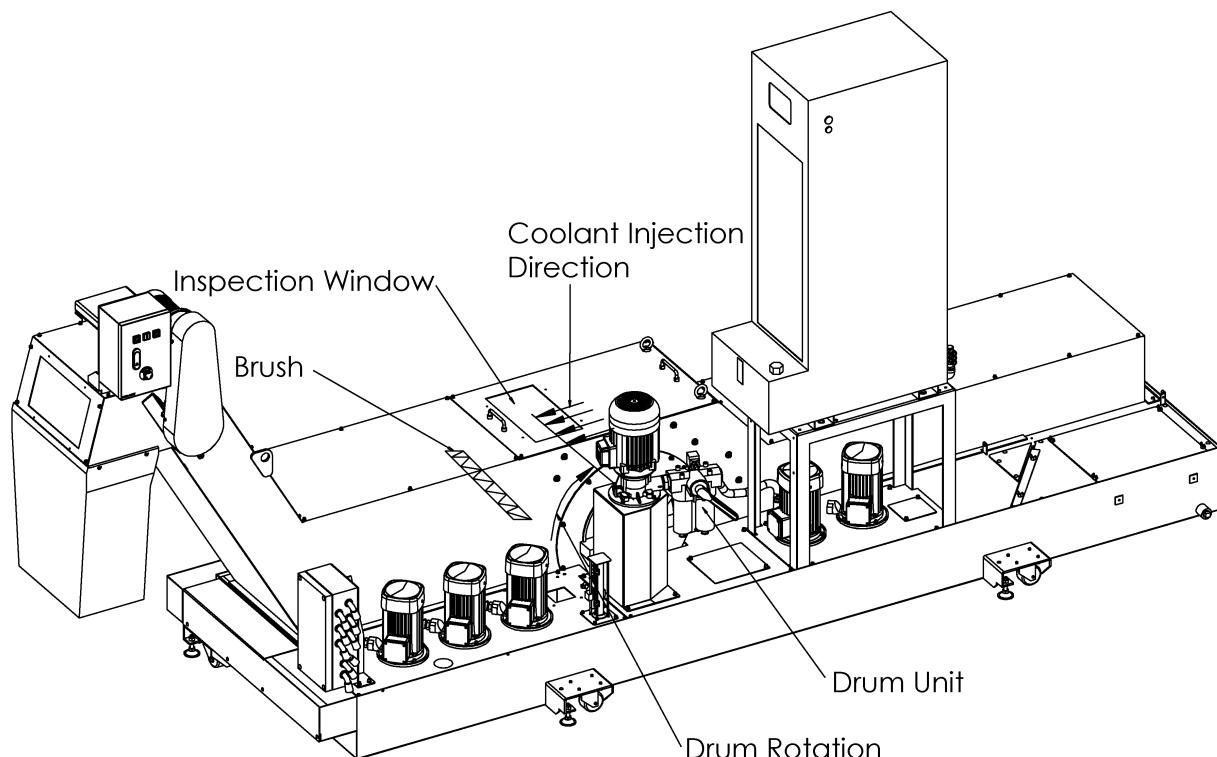
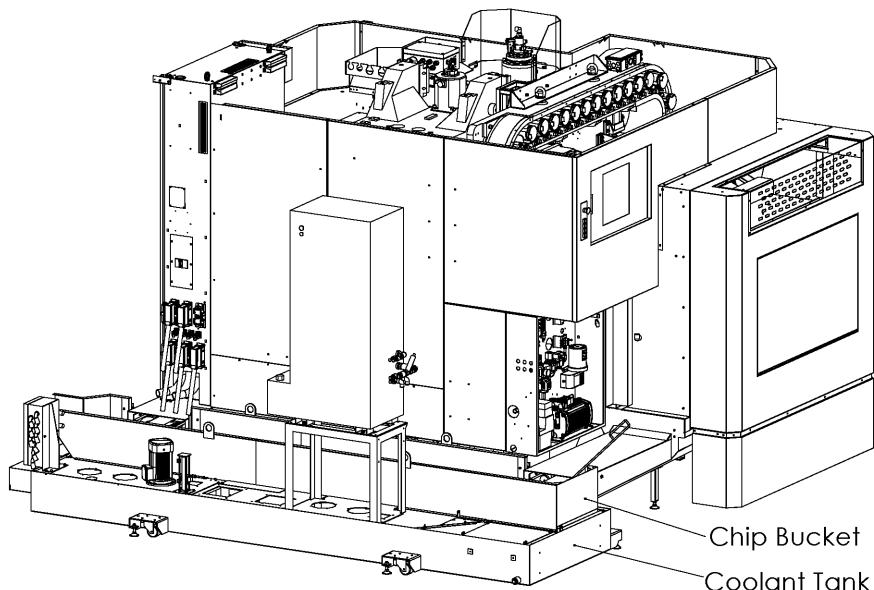


Figure 2.3 Drum Unit

1 Overview

The cutting fluid supply unit and tank are required for the machining process. The cutting fluid collected from the machine is filtered in the drum unit and chips are disposed off by the optional lift-up chip conveyor.

Chip Bucket (Standard)



Lift-Up Chip Conveyor (LUCC - Option)

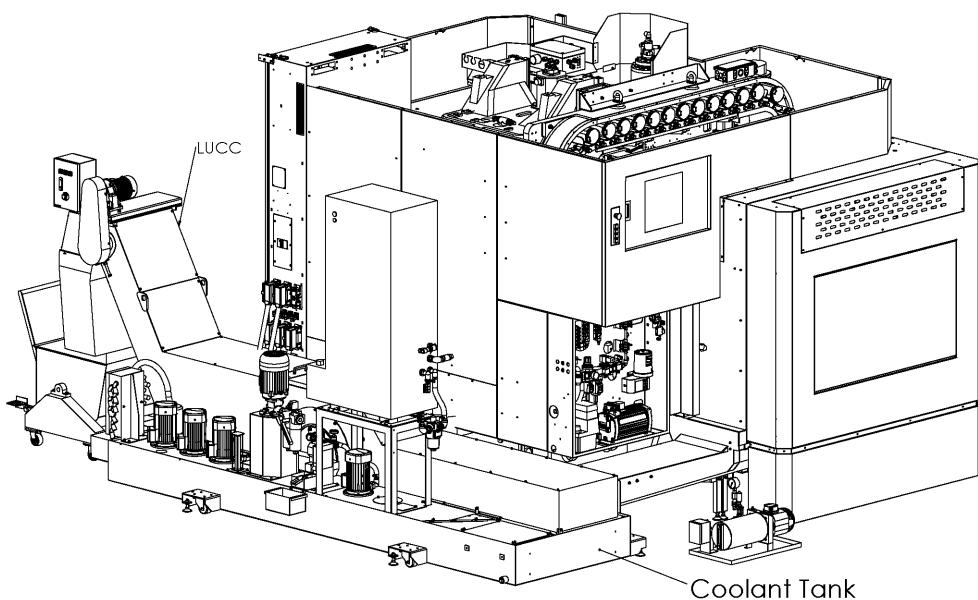


Figure 1.1 General View

1.1 Component Name

Coolant Tank (Standard)

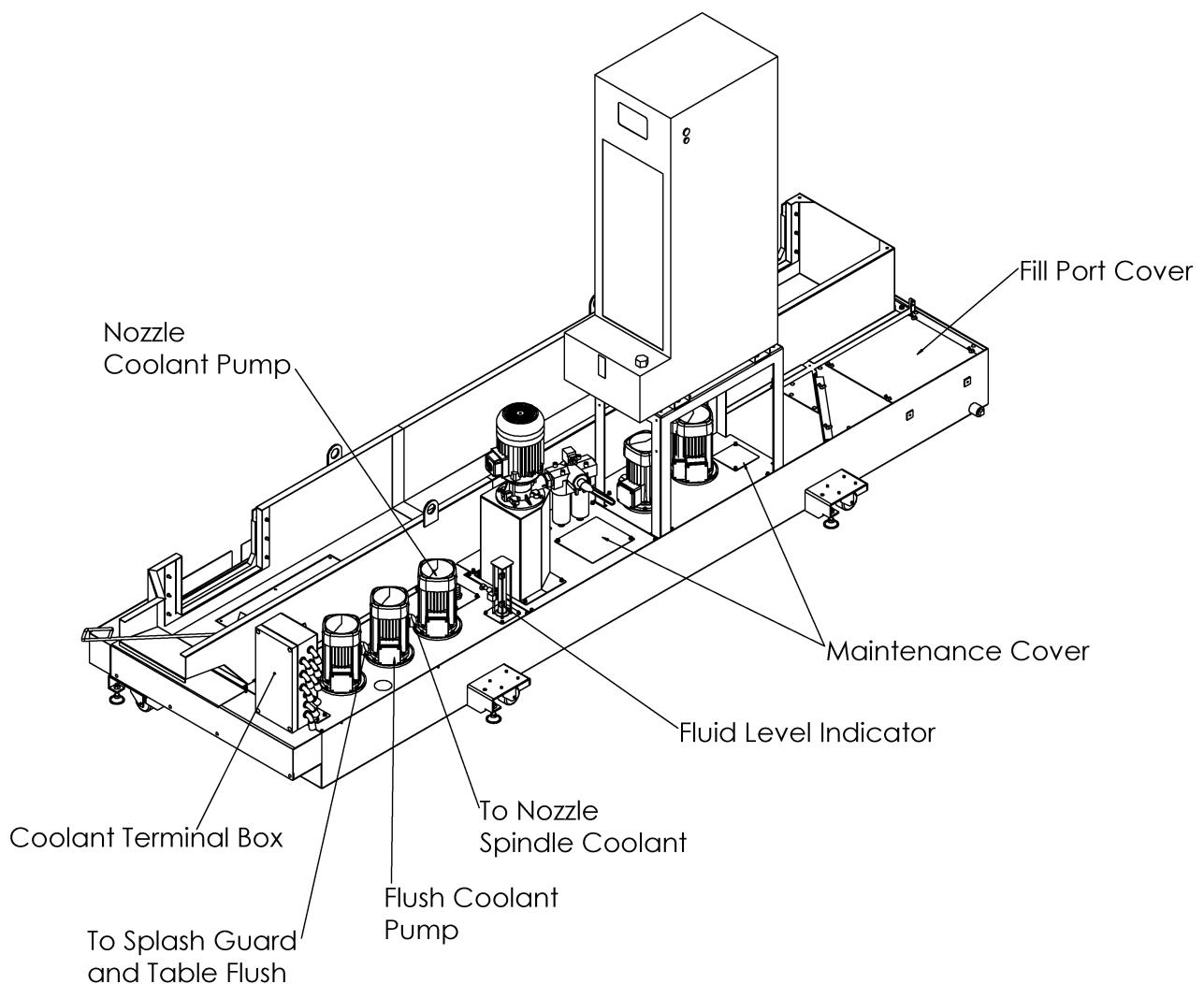


Figure 1.2 Coolant Tank (Standard)

Coolant Tank with Options

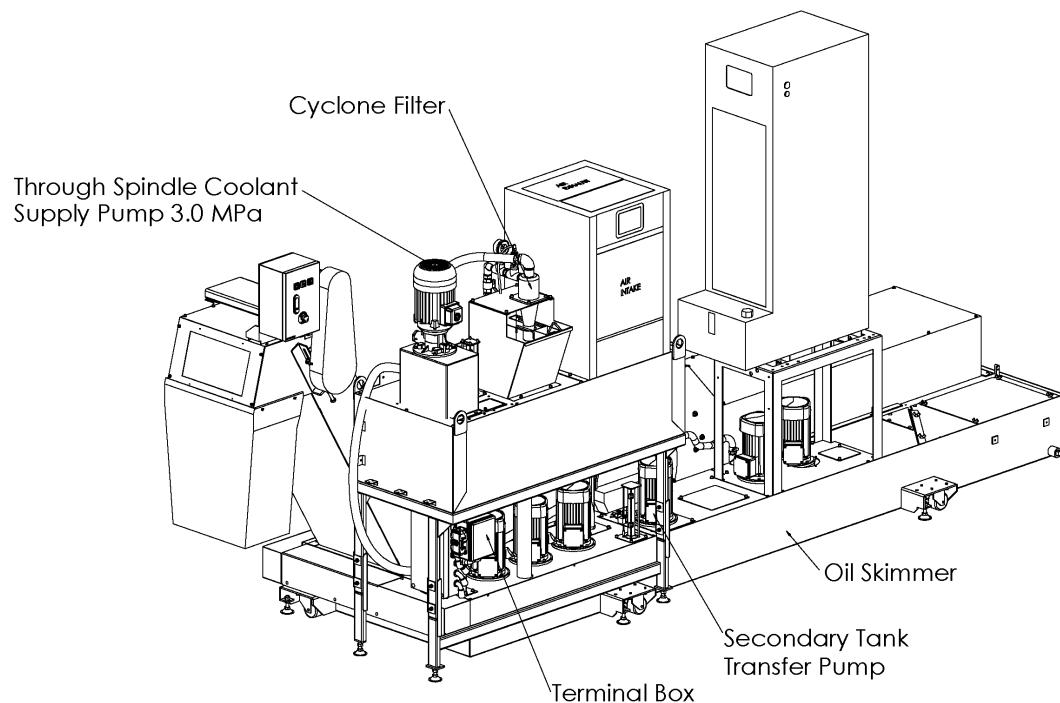
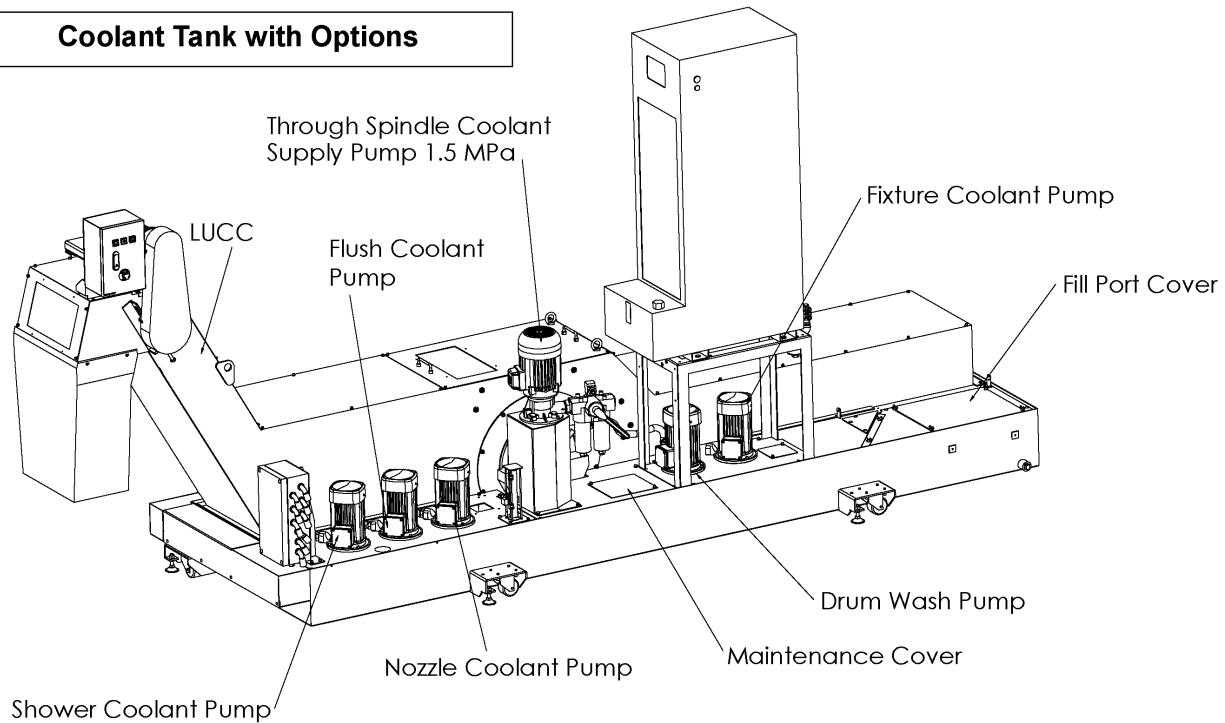


Figure 1.3 Coolant Tank with Options

Centralized Coolant for Standard Machine

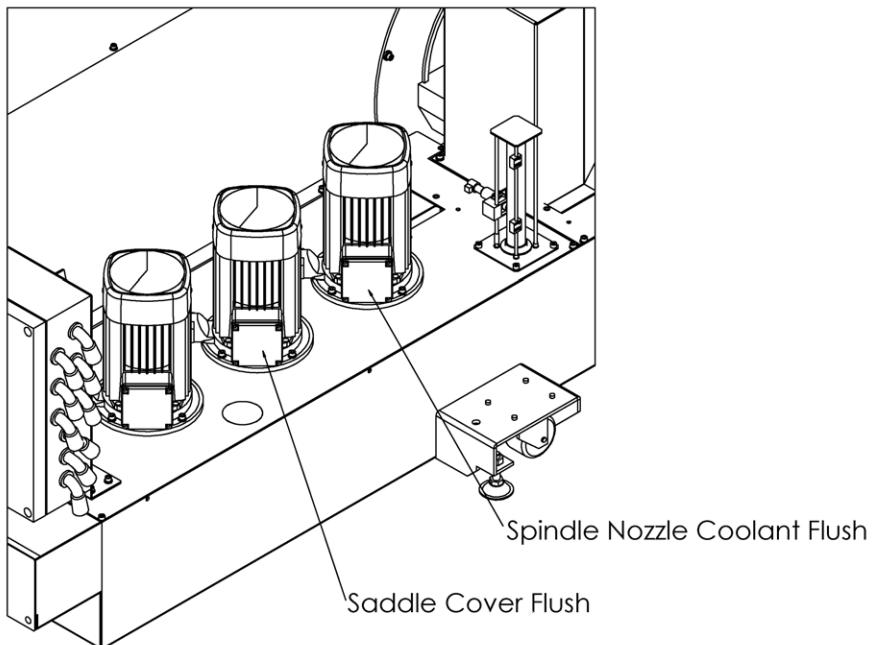


Figure 1.4 Centralized Coolant for Standard Machine

1.2 Piping and Wiring

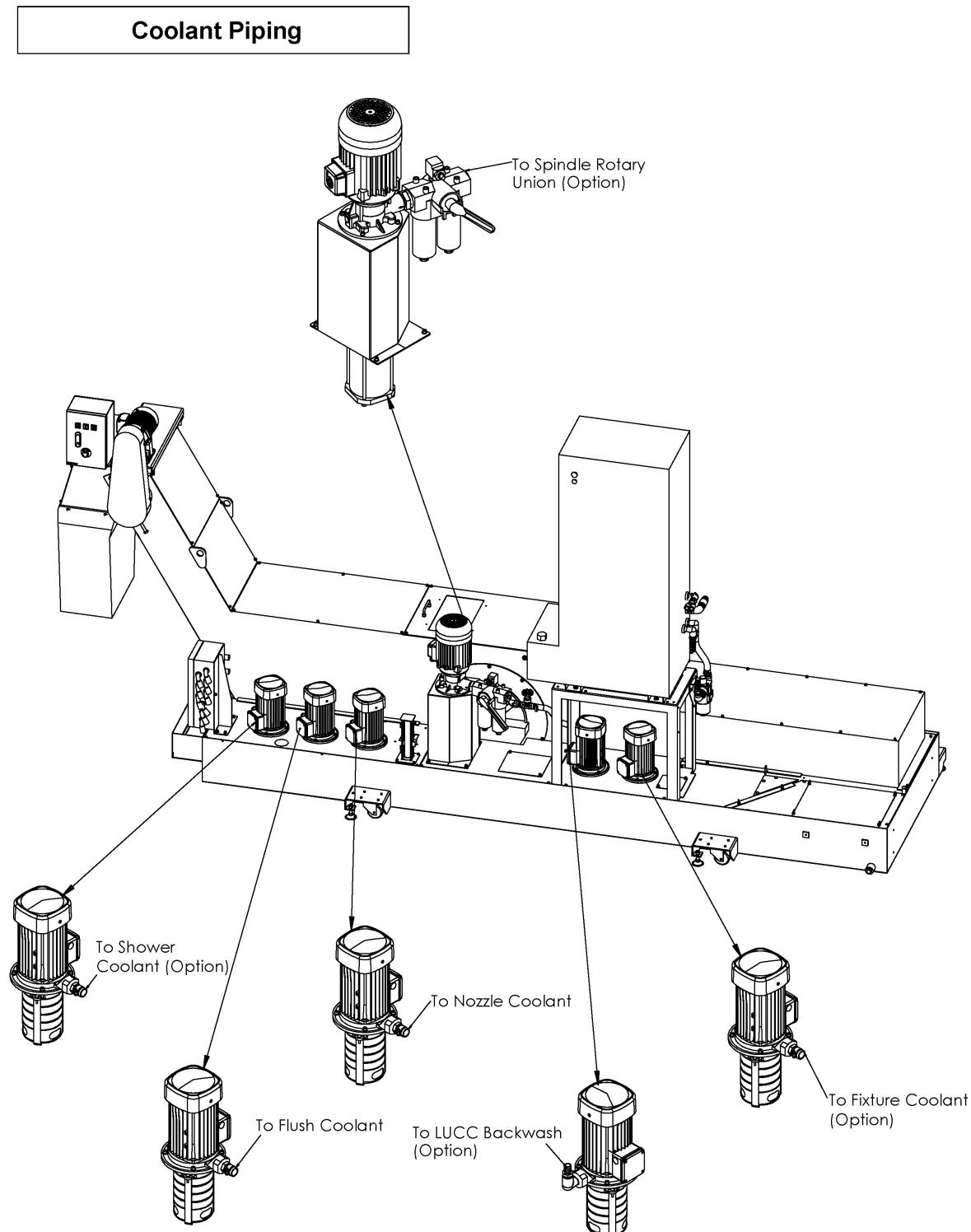


Figure 1.5 Coolant Piping

MTC Wiring (Rear Side)

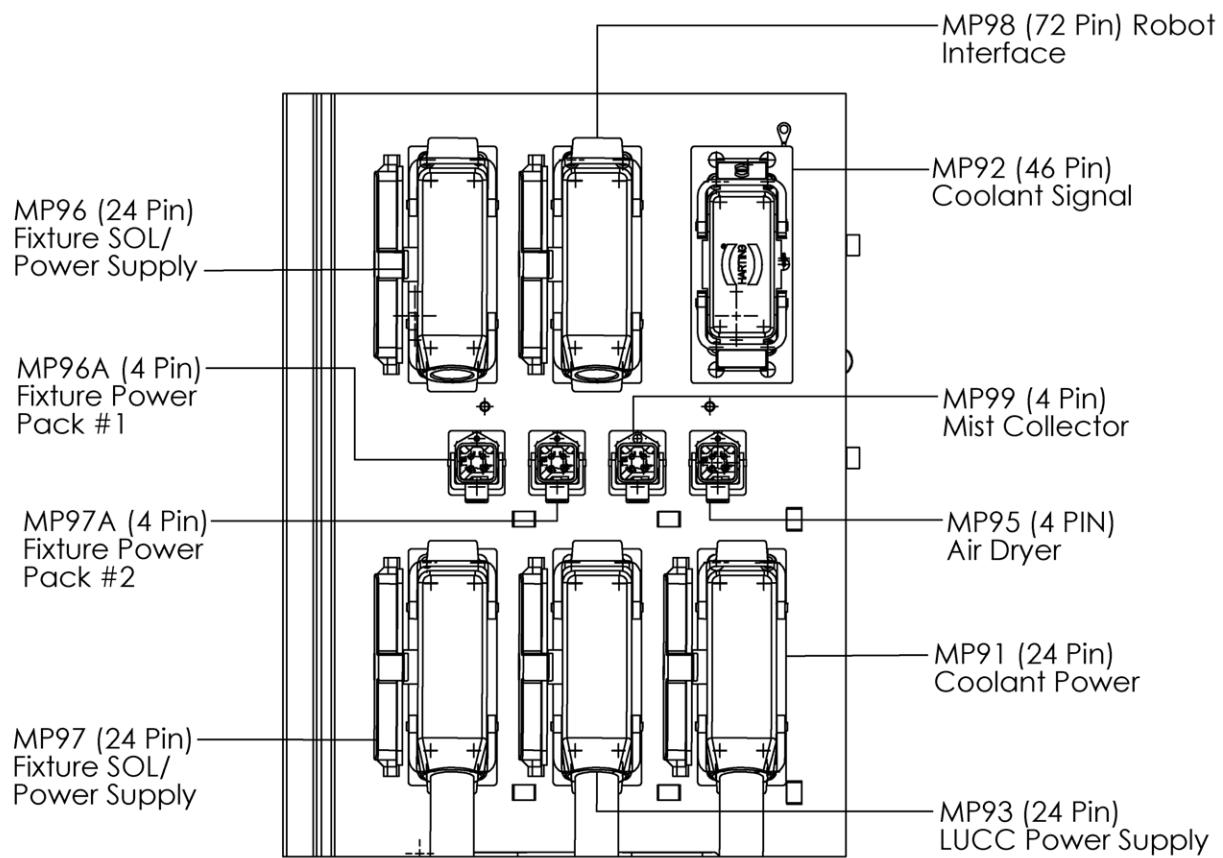


Figure 1.6 MTC Wiring (Rear Side)

2 Cutting Fluid Supply Unit and Tank Mechanism

Standard Machine with Options

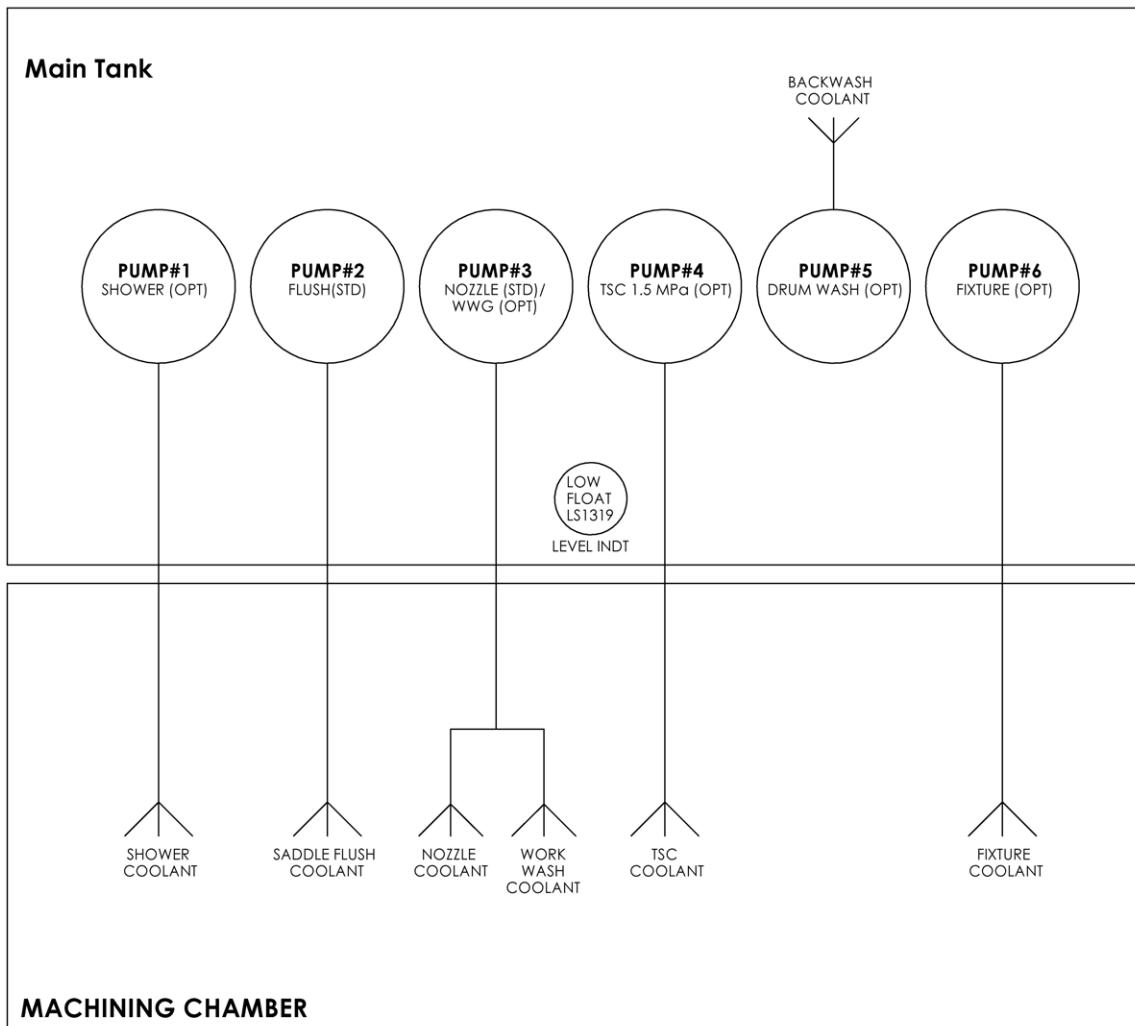


Figure 2.1 Cutting Fluids Supply Unit and Tank Mechanism

2.1 Saddle Flush Coolant (Standard Machine)

The saddle flush coolant function discharges cutting fluid from the right and left of flushing nozzle to transfer chips from the telescopic cover to the coolant tank.

The flush coolant is discharged and stopped when the main coolant pump (MS2) operation is started and stopped.

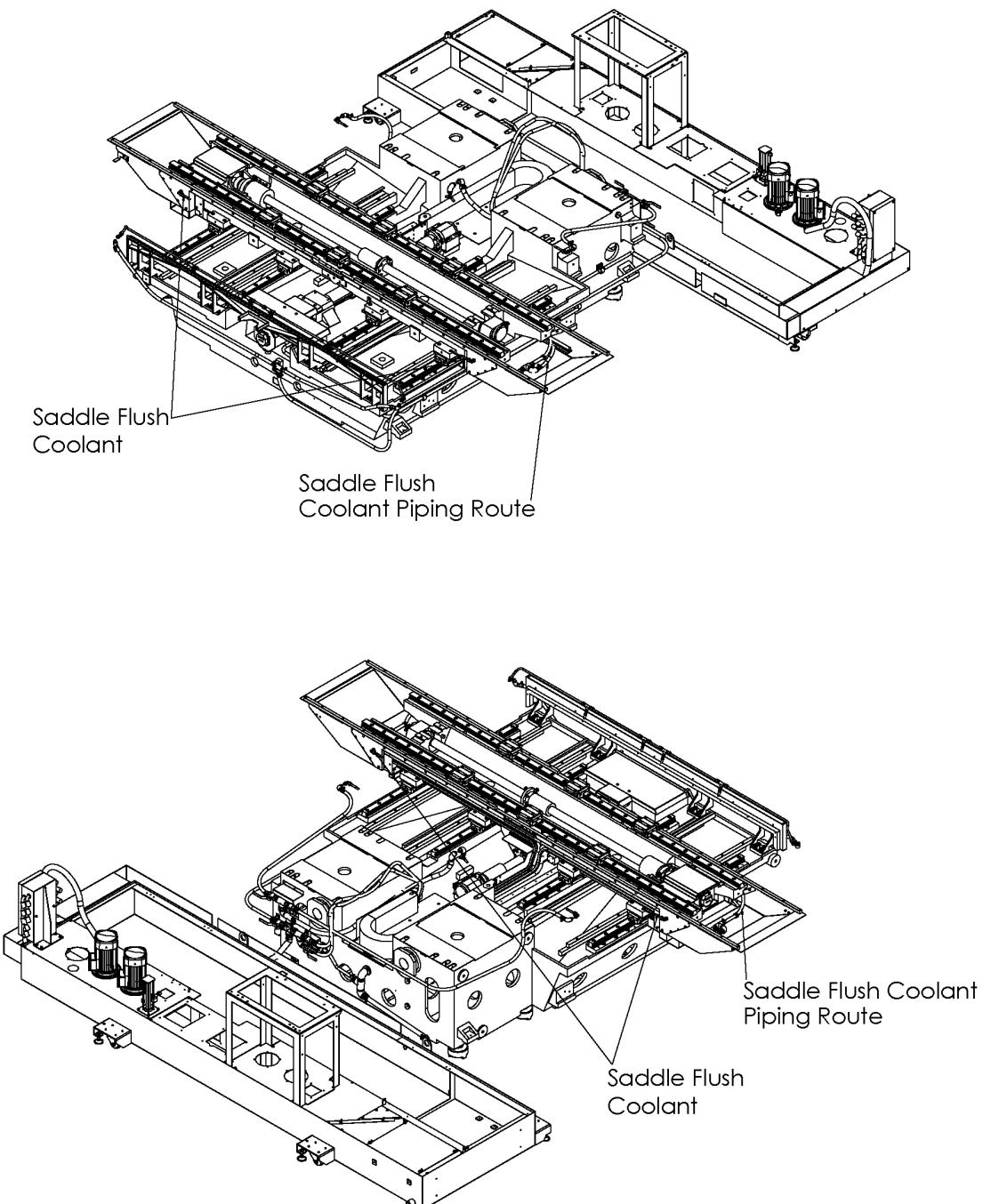


Figure 2.2 Flush Coolant (Standard Machine)

2.2 Nozzle Coolant

The nozzle coolant function discharges cutting fluid from the front nozzle located at the end of the spindle head. Cutting fluid is flushed directly over the tool edges and the surface of the workpiece to effectively clean and cool the tool and workpiece.

The nozzle coolant is discharged and stopped when the main coolant pump (MS2) operation is started and stopped.

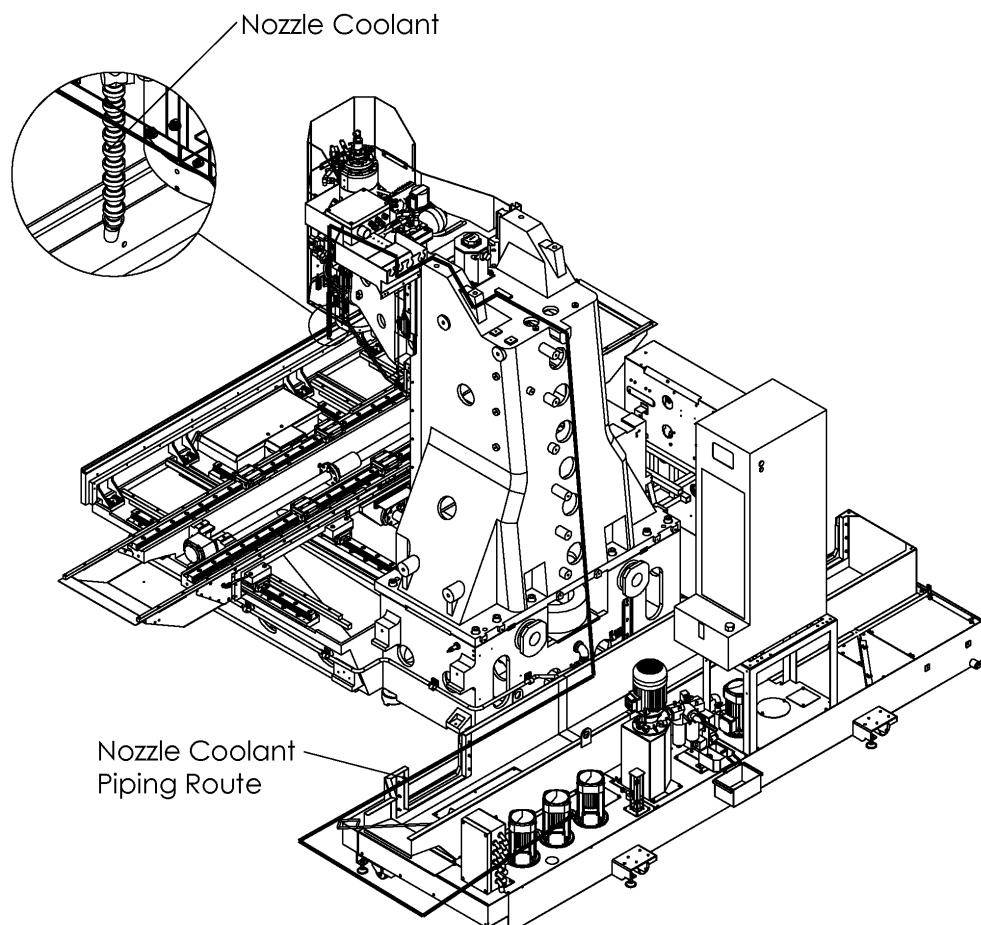


Figure 2.3 Nozzle Coolant

2.3 Backwash Coolant

The backwash coolant functions within the drum unit by removing chips adhering to the drum unit filter in order to prevent clogging in the lift-up chip conveyor.

The backwash coolant is discharged and stopped when the lift-up chip conveyor coolant pump (M71) operation is started and stopped by the operation of the lift-up chip conveyor.

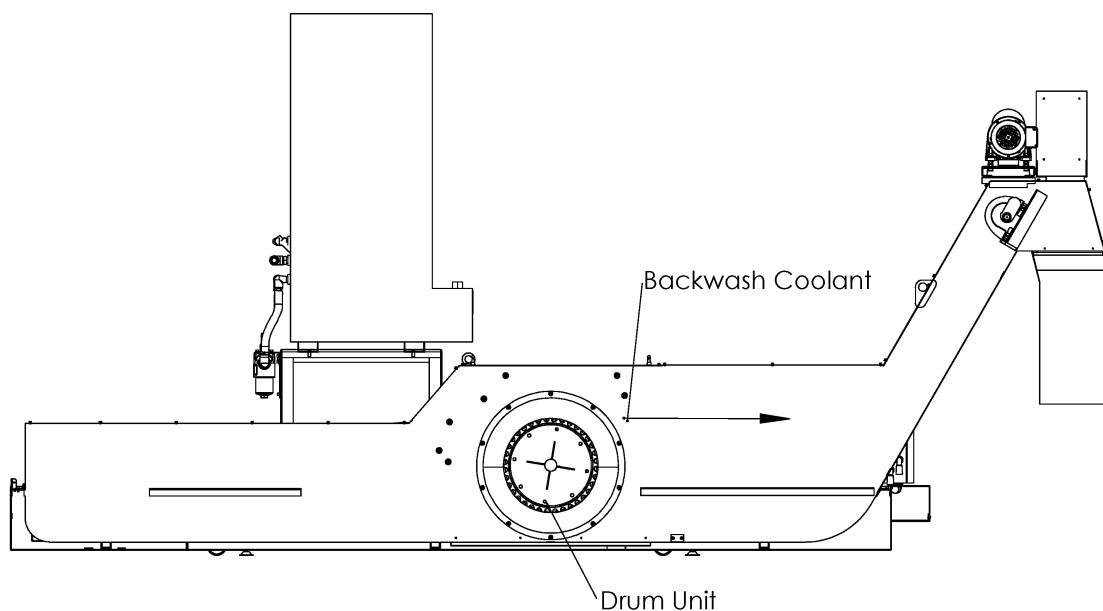
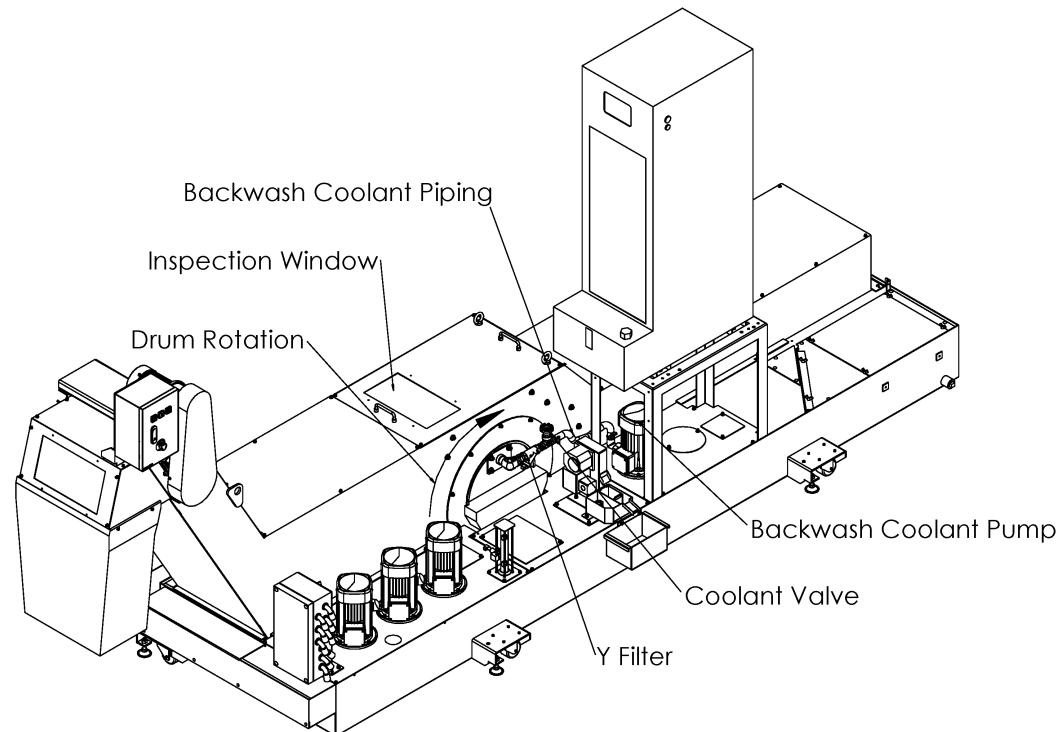


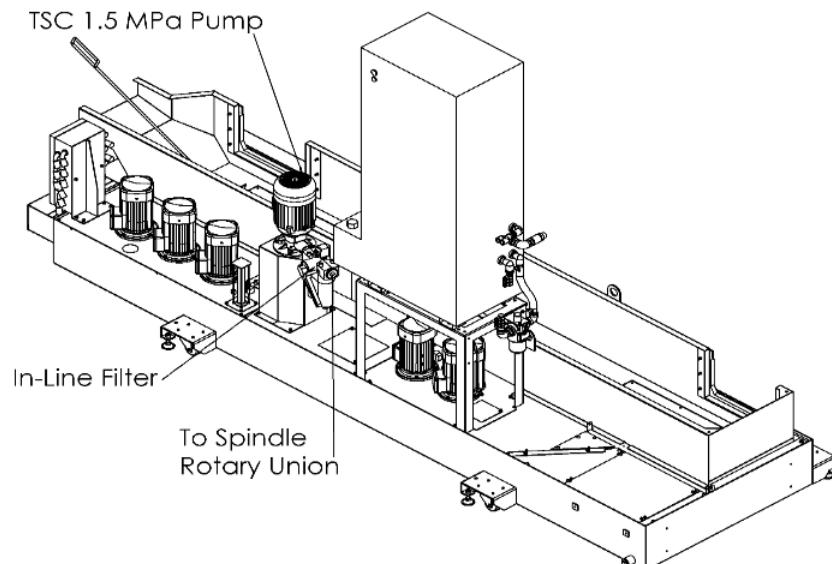
Figure 2.4 Backwash Coolant

2.4 Through Spindle Coolant

The through spindle coolant function discharges high pressure cutting fluid from the tip of the tool using a special through spindle holder and tool. Coolant is discharged from the TSC pump (MS8).

Specification of Through Spindle Coolant

- TSC 1.5MPa (In-line Filter)



- TSC 1.5MPa (Cyclone Filter on 2nd Tank)

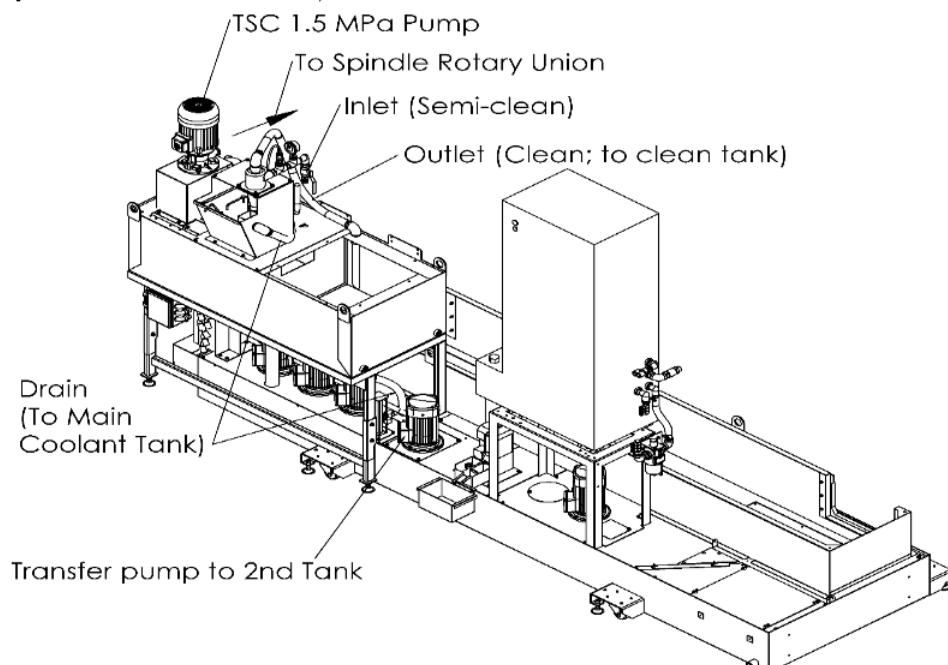


Figure 2.5 Through Spindle Coolant 1.5MPa (TSC)

Chapter 13 Cutting Fluid Supply Unit and Tank

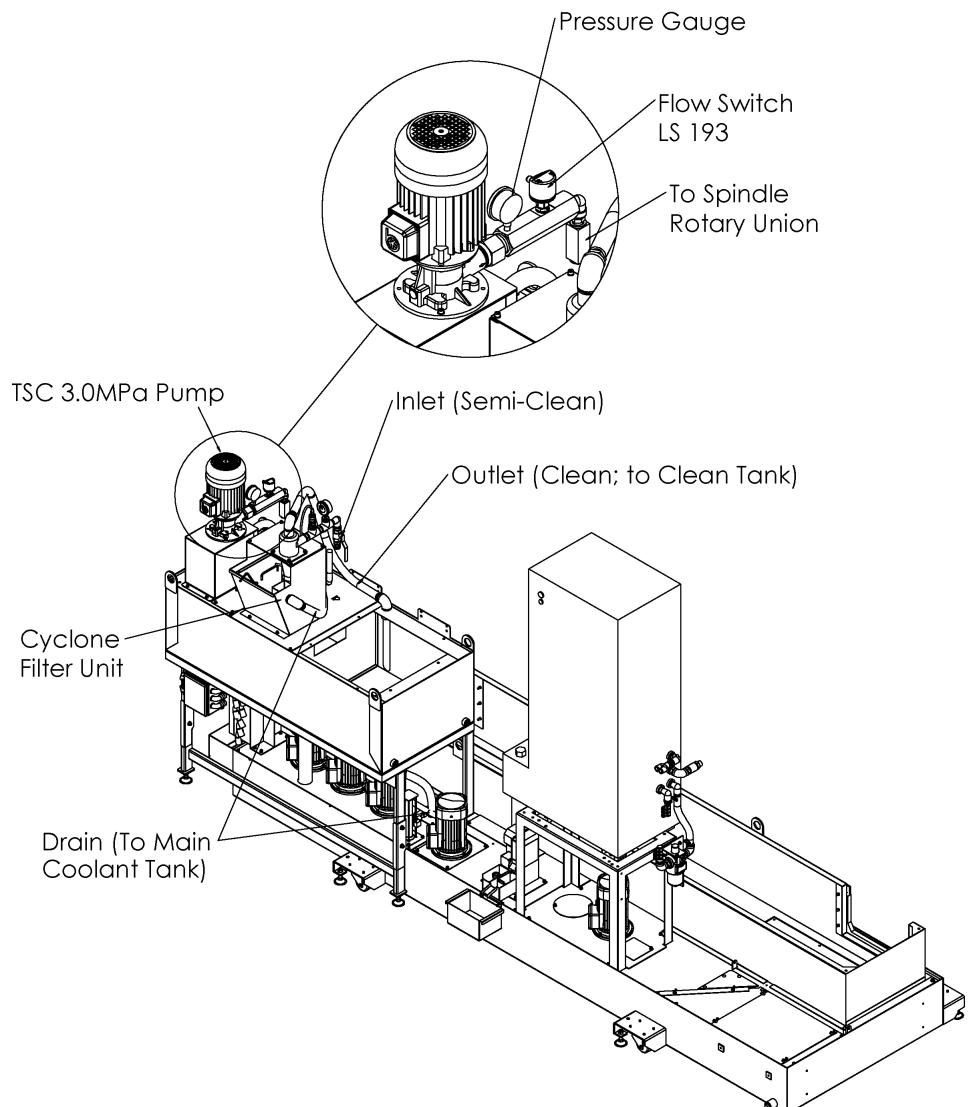


Figure 2.6 Through Spindle Coolant 3.0MPa (TSC)

2.4.1 Cleaning of 2nd Tank 3.0 MPa/7.0 MPa TSC Coolant Y-strainer



- Turn Off the power supply before performing the following procedures.
- When performing any work be sure to place a warning tag on each operation panel, main power switch and other locations to ensure that other personnel do not inadvertently operate the machine (Chapter 1 Safety "["1.6 Lock-out & Tag-out Confirmation"](#)"^[7]).

Required items

Item	Type
Wrench	-
Allen Key	-

Cleaning Procedure (Check and clean the Y-strainer when the TSC coolant pump flow rate drops significantly)

- 1) Turn OFF the power supply.
- 2) Dis-connect the TSC pump outlet pipe.
- 3) Remove cover [3] and cover [4].
- 4) Take out the pump to clean the Y-strainer [5].
- 5) Loosen the plug [1] and remove the strainer [2].
- 6) Clean the strainer [2], put back the strainer and tighten the plug [1].
- 7) Mount the pump to the mounting bracket and connect the outlet pipe to the pump.
- 8) Mount the cover [3] and cover [4].

This completes the Y-strainer cleaning procedure.

Chapter 13 Cutting Fluid Supply Unit and Tank

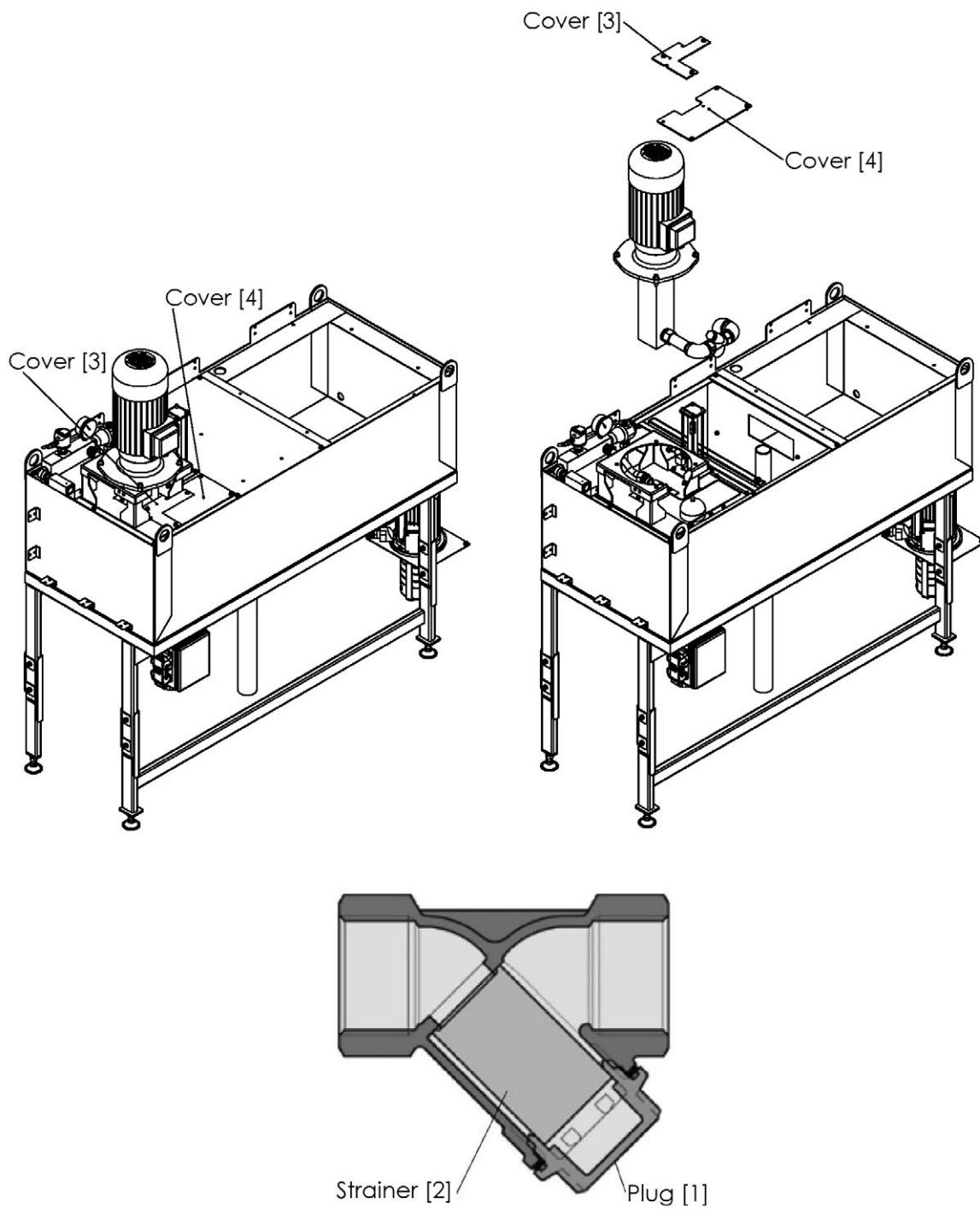


Figure 2.7 Second Tank 3.0MPa/7.0 MPa TSC Y-Strainer

2.5 Cyclone Filter (Option)

A cyclone filter (for TSC) is installed to protect the rotary union and the pump from chips and other contaminants.

The cyclone filter uses centrifugal force to flush out fine chips. These chips are then suspended outside and settled down where it is separated from the coolant.

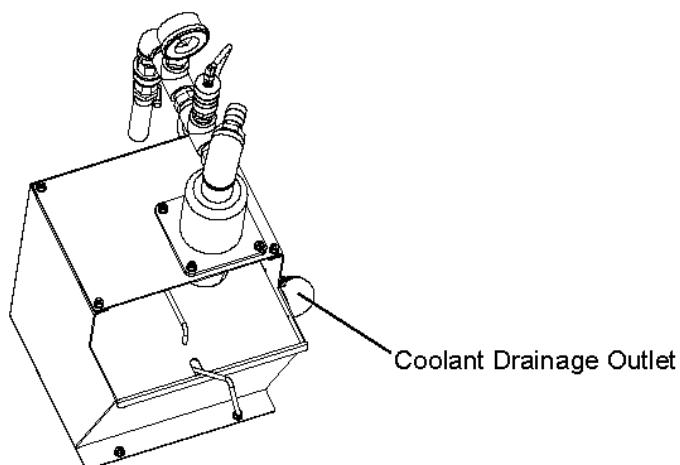
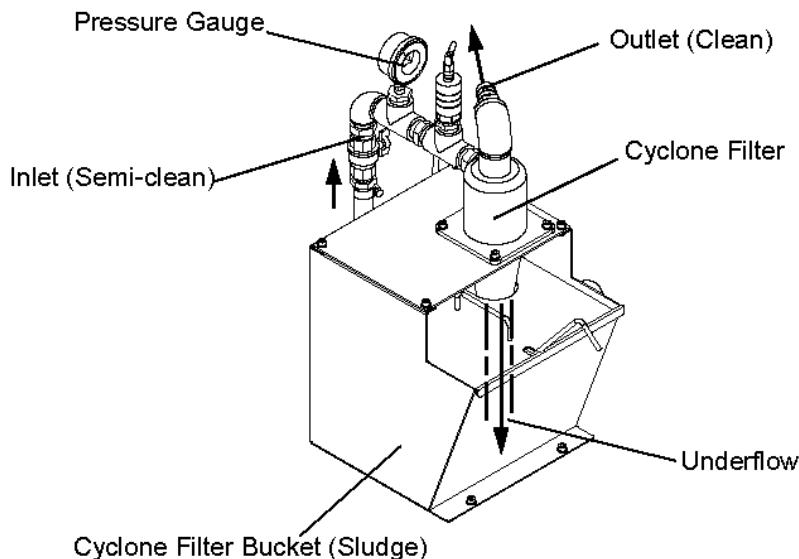


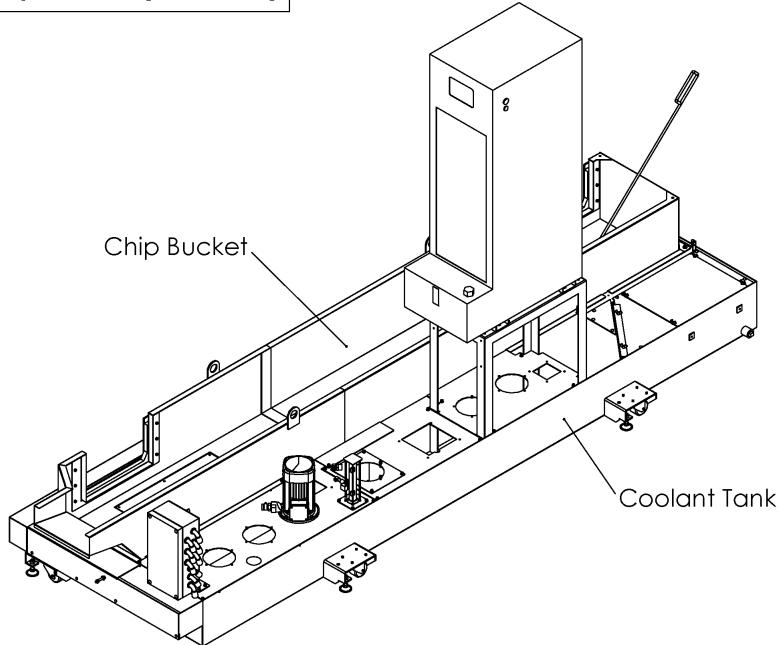
Figure 2.8 Cyclone Filter (Option)

2.6 Coolant Tank

The coolant tank consist of a tank where cutting fluid that has been returned from the machining chamber is stored and where an optional lift-up chip conveyor that discharges chips outside the machine is mounted.

For details on lift-up chip conveyor (Refer to [Chapter 12 Chip Disposal and Conveyor](#) [219]).

Chip Bucket (Standard)



Lift-Up Chip Conveyor (LUCC-Options)

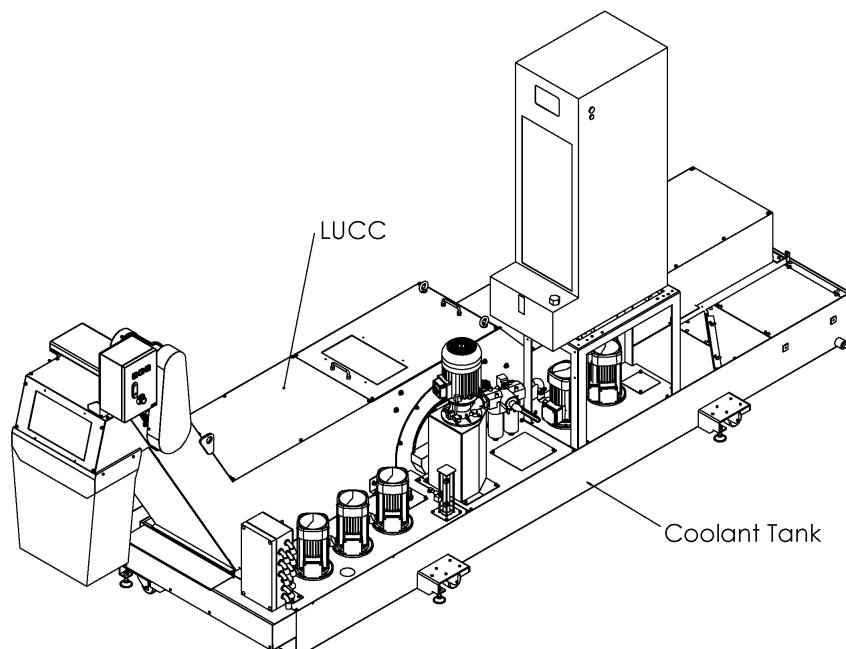


Figure 2.9 Coolant Tank

2.6.1 Proximity Switch LS1319 (Low Level Detection)

The proximity switch LS1319 (low level detection) is mounted on the fluid level gauge. When the cutting fluid level drops below the lower limit level, the proximity switch detects the dog and triggers an alarm in the sequence described below.

Dimensions below applies when the machine is not using the coolant.

Alarm Trigger Sequence

Cutting fluid level decreases, float and dog drop below the lower limit level.



Proximity switch LS1319 detects dog (detecting low cutting fluid level).



Machine controller triggers Alarm No. EX1525

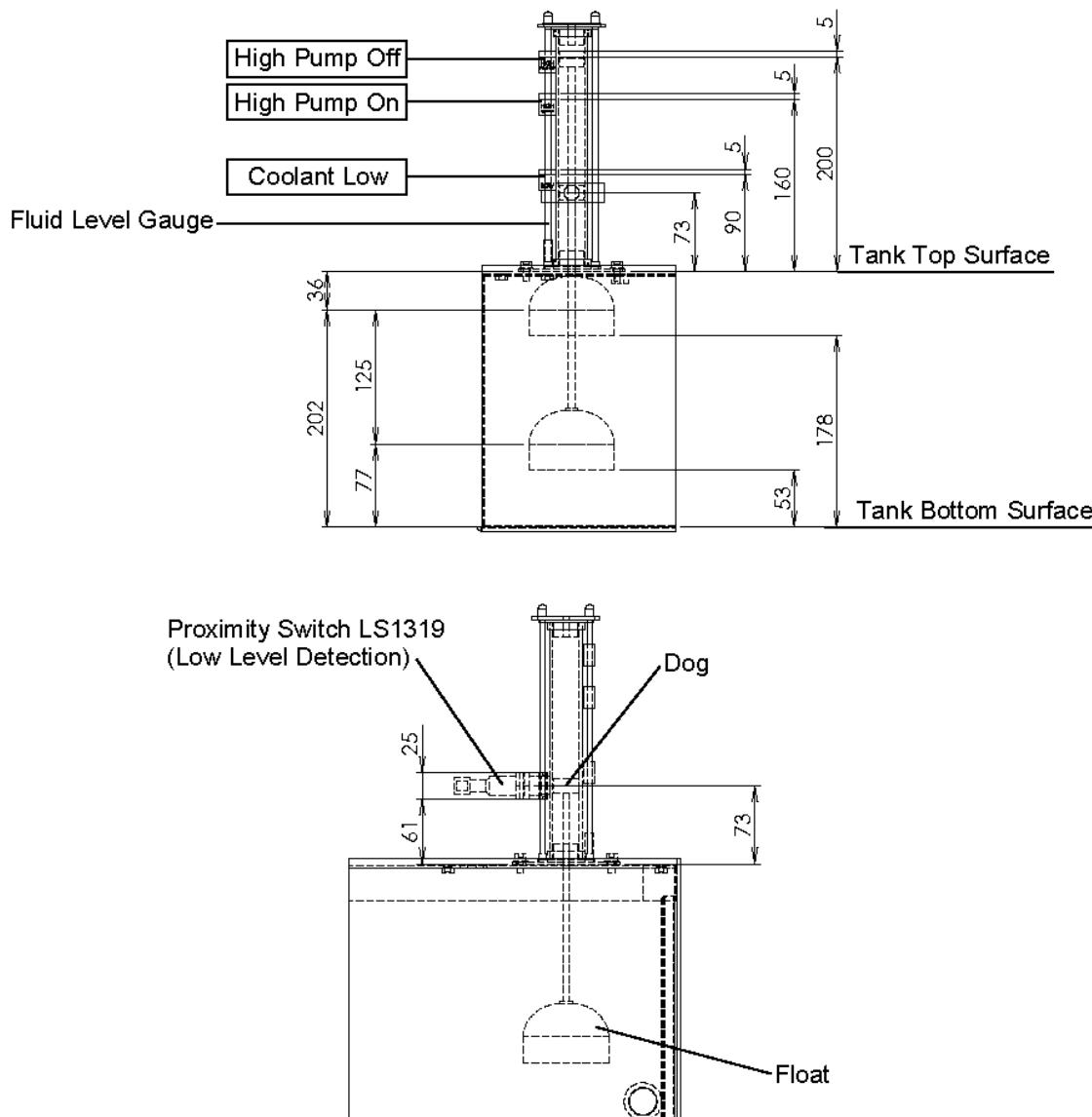


Figure 2.10 Proximity Switch LS1319

2.6.2 Oil Skimmer

Cutting fluid and discharged oil from the bed and the spindle head unit that flow into the oil pan are separated to cutting fluid and floated oil. The belt conveyor skims the cutting fluid and lifts up the floated oil from the tank. The cutting fluid is returned to the coolant tank and the floated oil is transferred to the waste oil tank. The oil in the waste oil tank must be disposed of regularly.

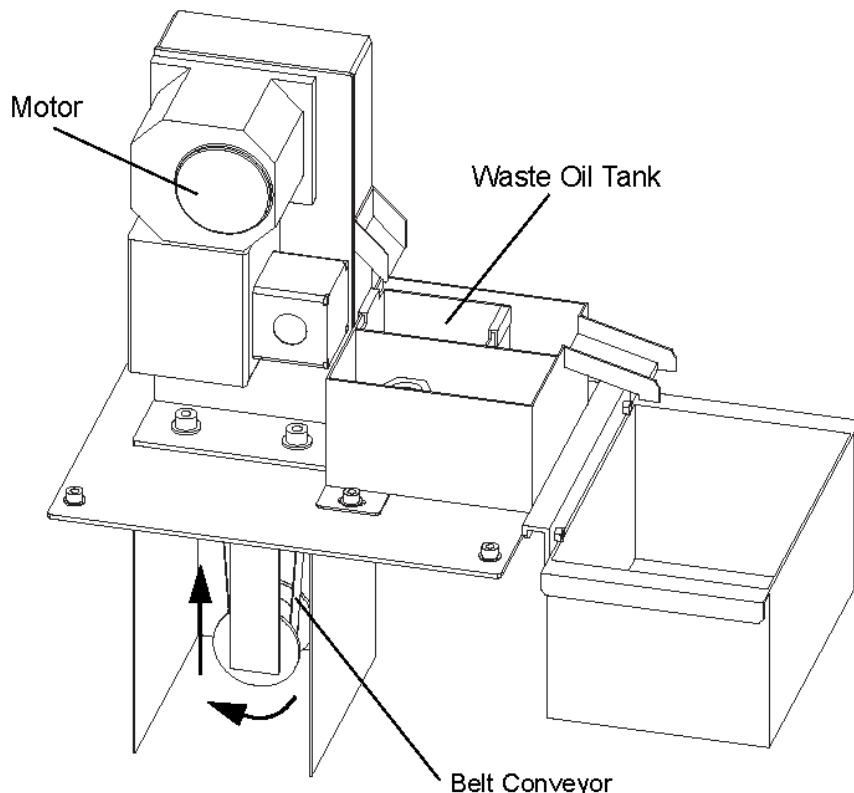


Figure 2.11 Oil Skimmer

2.7 Cutting Fluid Temperature Controller (Option)

The cutting fluid temperature controller controls the temperature of the cutting fluid in the coolant tank to prevent the fluid temperature from rising due to residual heat emitted by chips and heat generated by the coolant pump.

The cutting fluid temperature controller compares the temperatures detected by a temperature sensor (thermistor) mounted on the bed and in the cutting fluid temperature controller and activates a heater or cooler to adjust the temperature of the cutting fluid until it matches that of the bed.

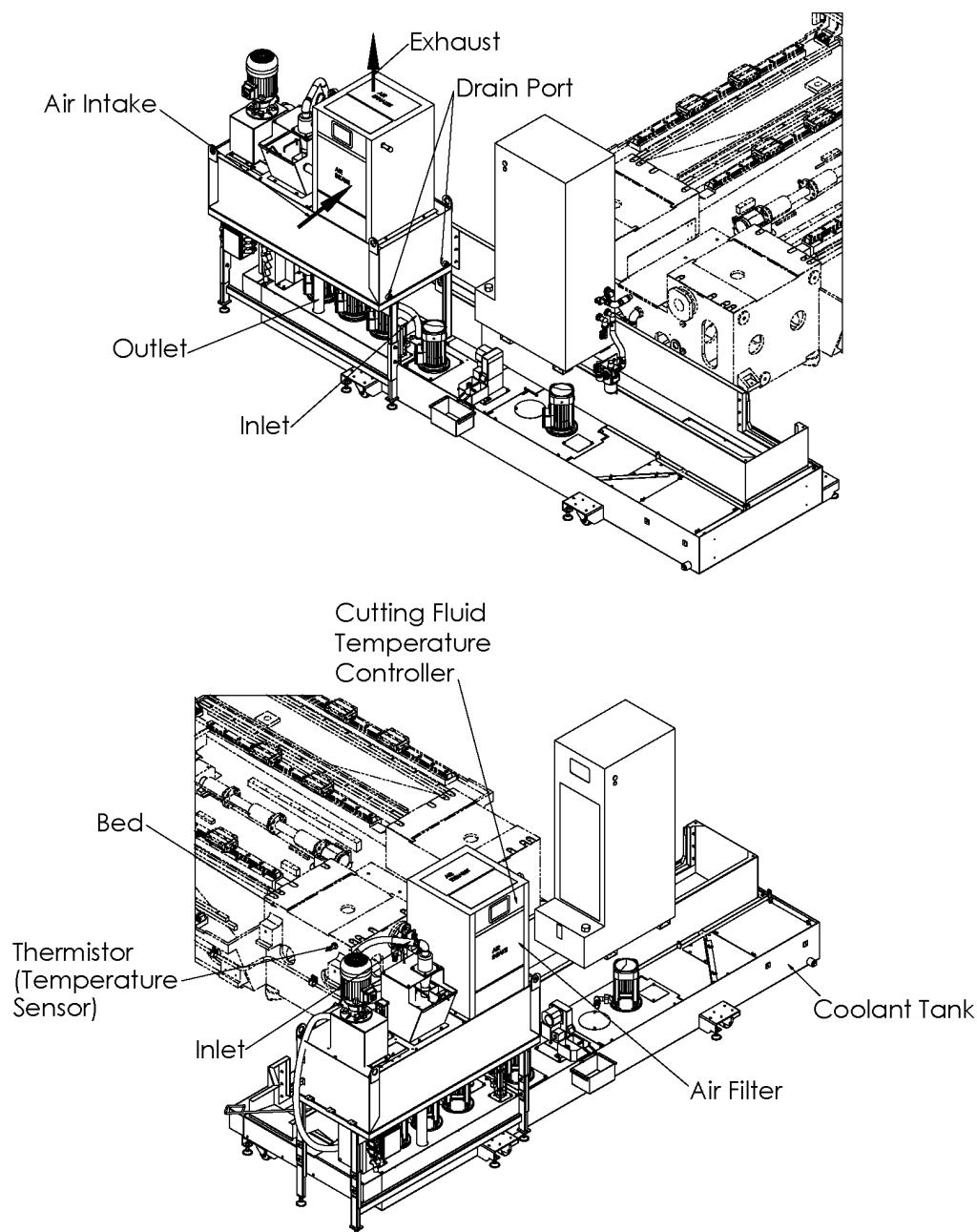


Figure 2.12 Cutting Fluid Temperature Controller (Option)

1 Overview

This chapter describes the following six units:

Unit	Section	Page
Axis Covers	Refer to 2 Axis Telescopic Covers <small>[249]</small>	253
Machine Side Covers	Refer to 3 Machine External Covers <small>[250]</small>	254
Safety Door	Refer to 4 Safety Devices <small>[251]</small>	255
Lighting Device	Refer to 5 Lighting Device <small>[258]</small>	262
Signal Lamp (Warning Lamp)	Refer to 6 Signal Lamp (Warning Lamp) <small>[260]</small>	264

1.1 Component Name

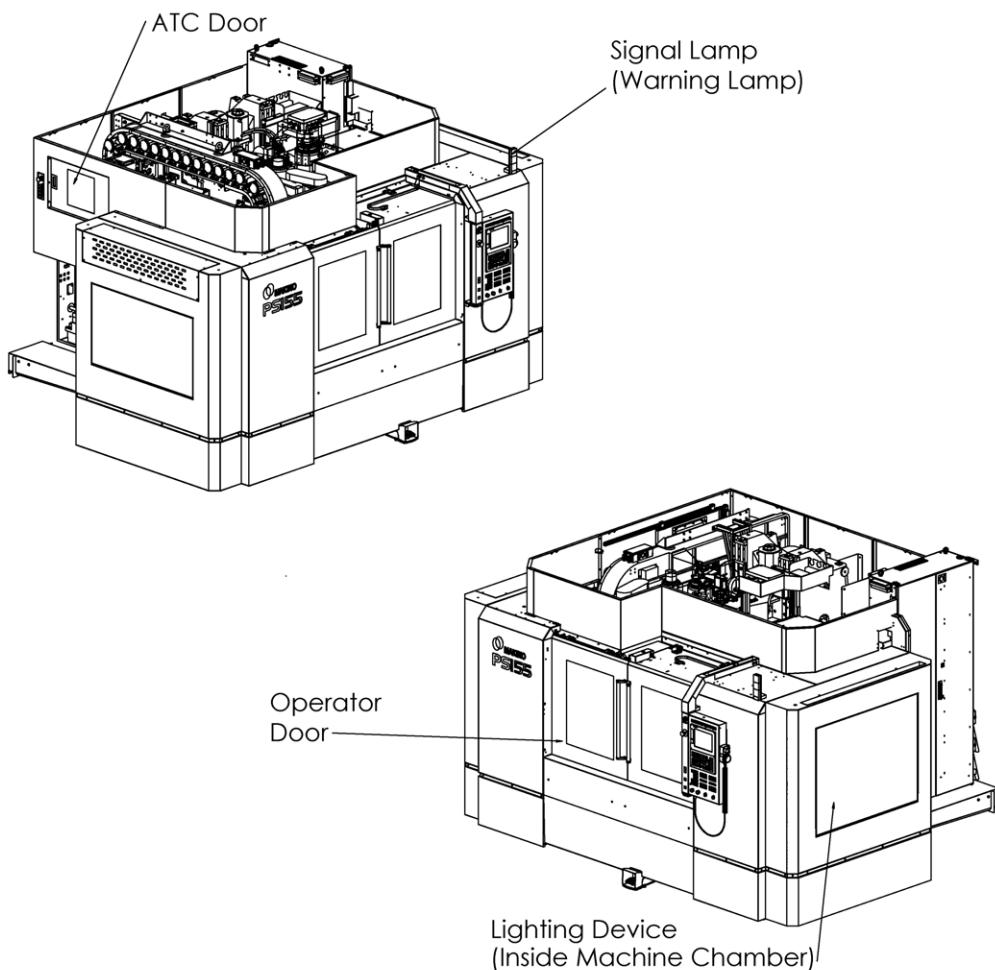


Figure 1.1 General View

1.2 Wiring

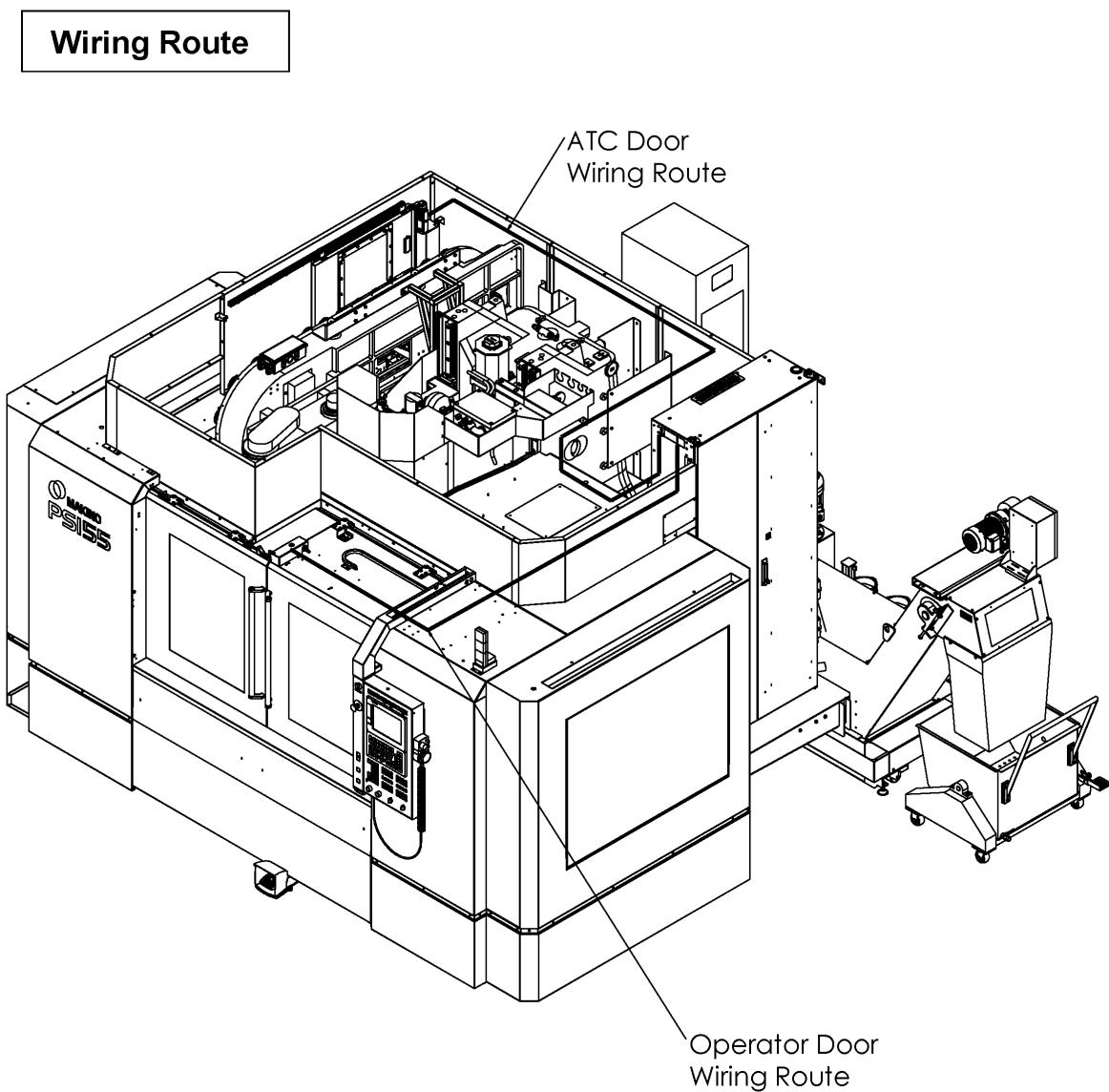


Figure 1.2 Wiring Route

2 Axis Telescopic Covers

The axis telescopic covers prevent chips and coolant from entering the inside of the feed axis.

Axis telescopic covers consist of the following.

- X-axis telescopic cover: There are a total of two identical X-axis telescopic covers required for each machine. Each cover is mounted between the table and the saddle covers on each end of the saddle.
- Y-axis telescopic cover: There are a total of two identical Y-axis telescopic covers required for each machine. Each cover is mounted from the saddle to their respective front and rear telescopic frame with a seal sandwiched in between to prevent leakage.
- Z-axis telescopic cover: Only one Z-axis telescopic cover is required for each machine. One end of the cover is mounted onto the Y-axis telescopic frame (rear) and the other end is mounted onto the spindle casting.

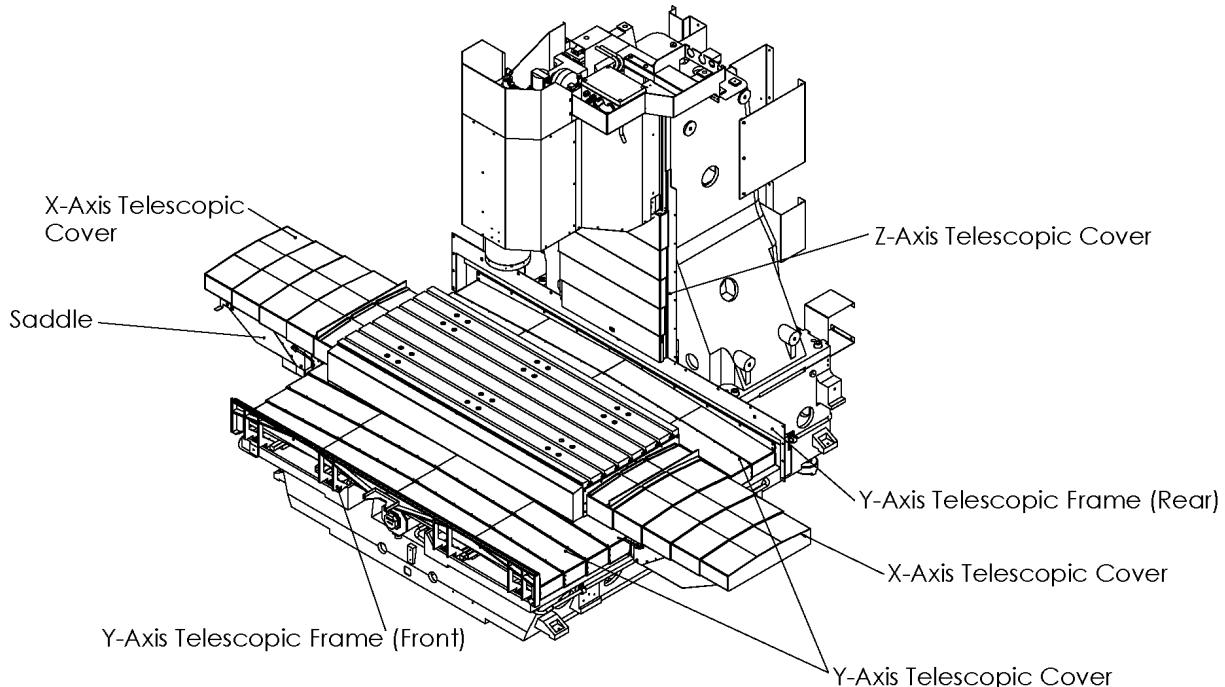


Figure 2.1 X, Y and Z Telescopic Cover

3 Machine External Covers

The machine external covers are located on the splash guard for the following purpose:

Cover	Name	Purpose
A	Splash Guard Side Cover	Access to feed axis.
		Access to fixture/axis rotary table.
B	Spiral Conveyor Maintenance Cover	Access to coolant tray (for spiral conveyor replacement)

-NOTE-

- 1 Turn Off the power supply before removing the covers.
- 2 Exercise extreme caution when entering into the machine.

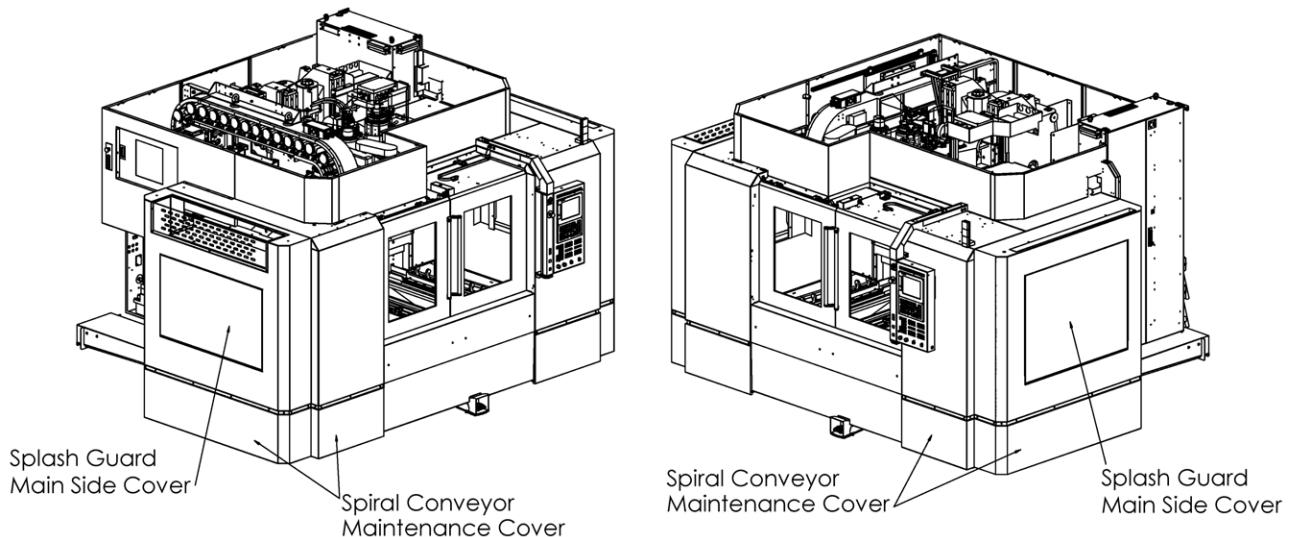


Figure 3.1 Machine External Covers

4 Safety Devices

Safety devices are installed on the operator door and the ATC magazine cover.

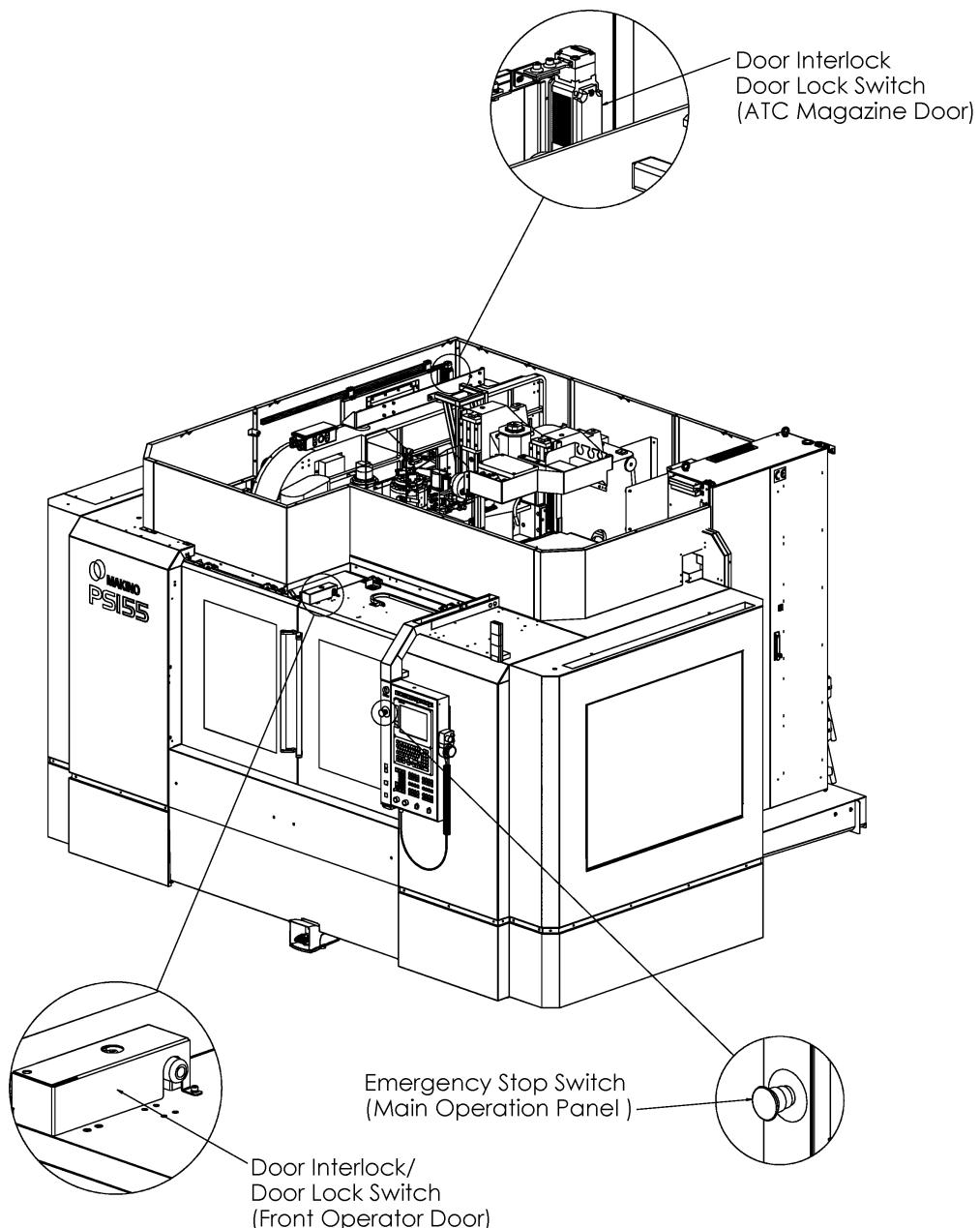


Figure 4.1 Safety Devices 1

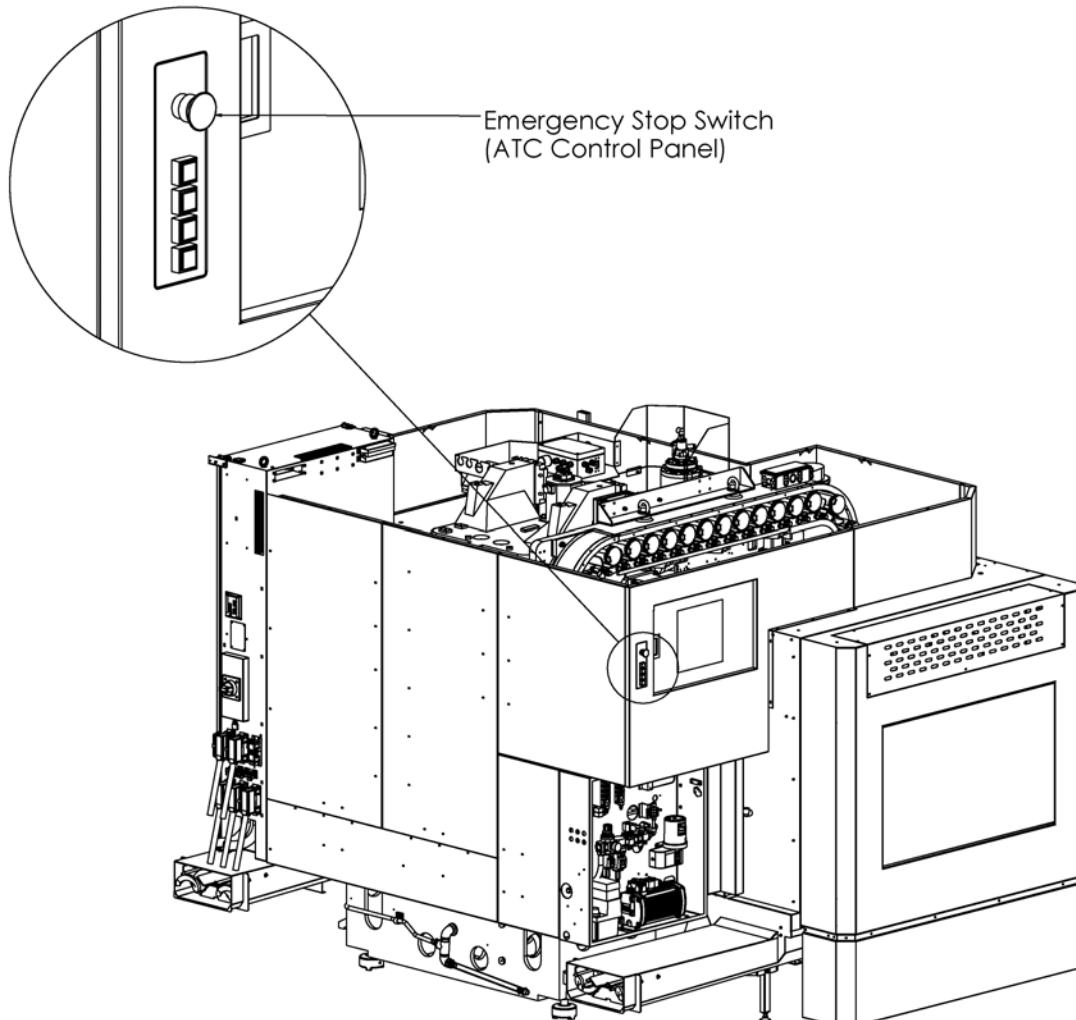
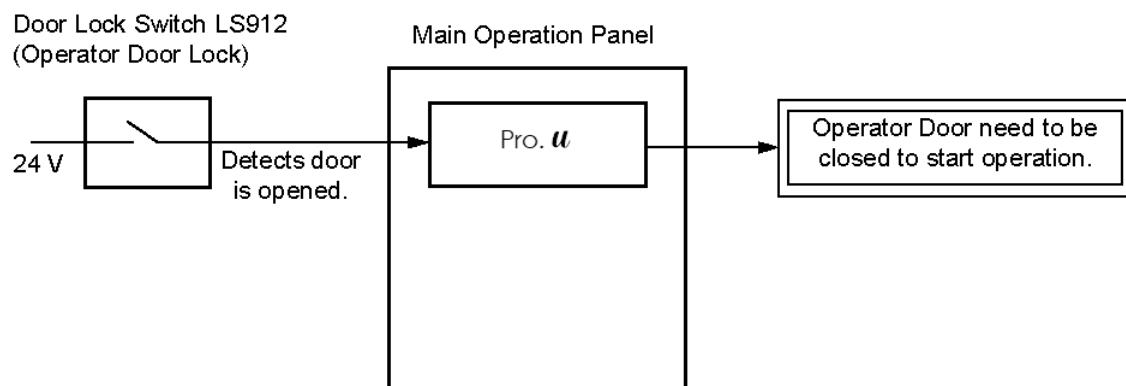


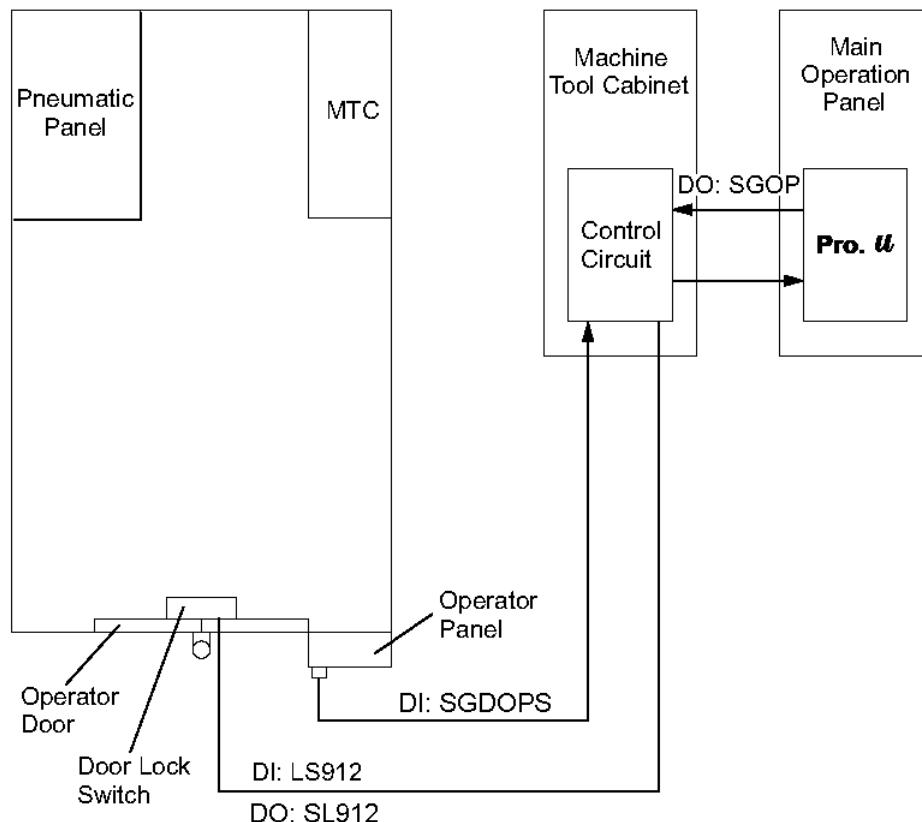
Figure 4.2 Safety Devices 2

Operator Door Lock



4.1 Splash Guard Door Lock Devices

4.1.1 Standard Splash Guard with Manual Operator Door

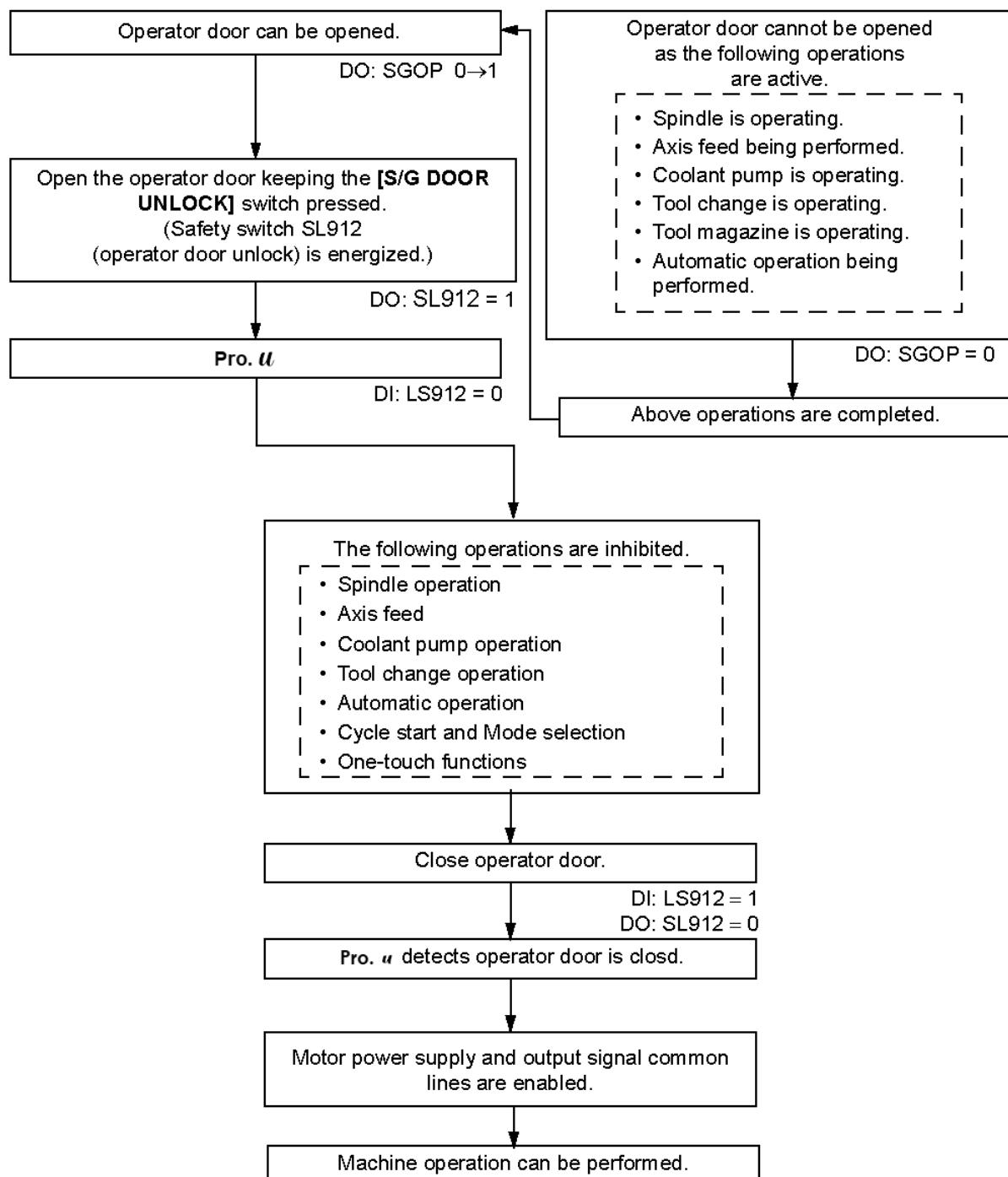


Machine Input/Output Signal Table

Signal Name	Address	Description
SL912	Y0002.4	SPLASH-GUARD DOOR INTERLOCK LIMIT SWITCH
LS912	X0007.4	SPLASH-GUARD DOOR UNLOCK SOLENOID
SW569	X0105.5	SPLASH-GUARD DOOR UNLOCK PB
LP569	Y0105.6	SPLASH-GUARD DOOR OPEN LAMP (OK)

Figure 4.3 Door Lock (Operation Mode) 1

Operating Sequence



-NOTES-

The following operations can be performed when the operator door is open:

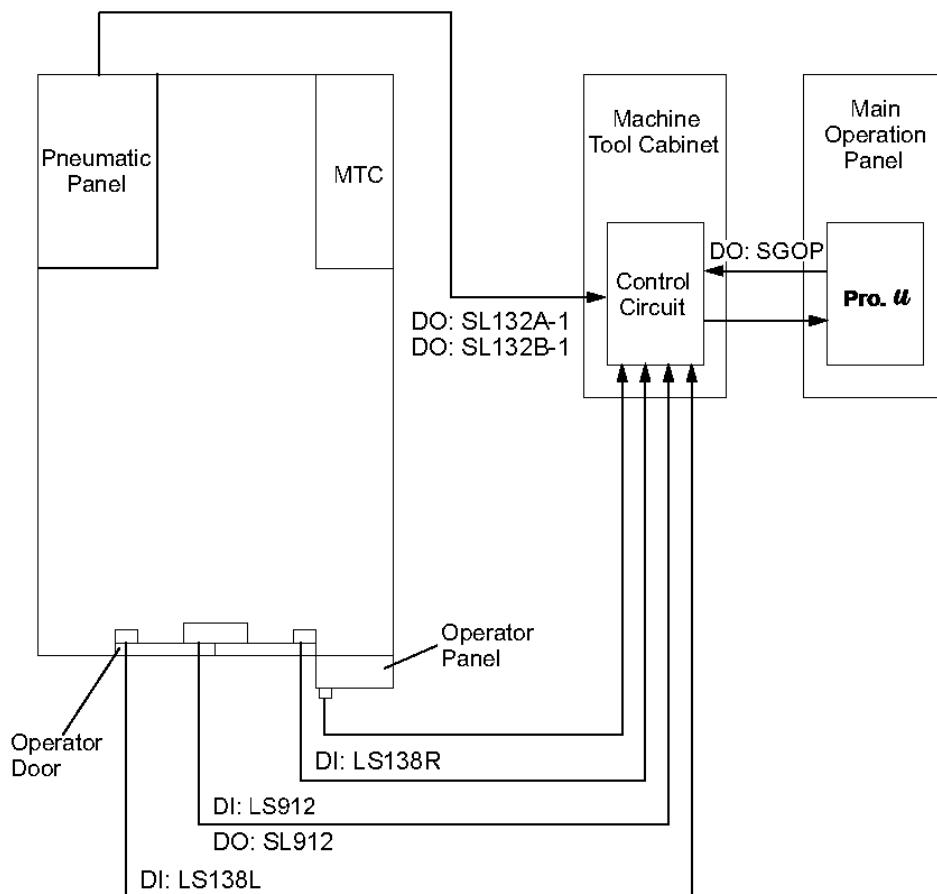
- 1 Axis feed using the manual pulse generator.

Axis feed using the manual pulse generator handle is possible when the Handle mode is selected by pressing the [HANDLE ENABLE] switch.

- 2 Tool Clamp/Unclamp.

Tool clamping/unclamping can be performed when the Handle mode is selected.

4.1.2 Standard Splash Guard with Auto Operator Door

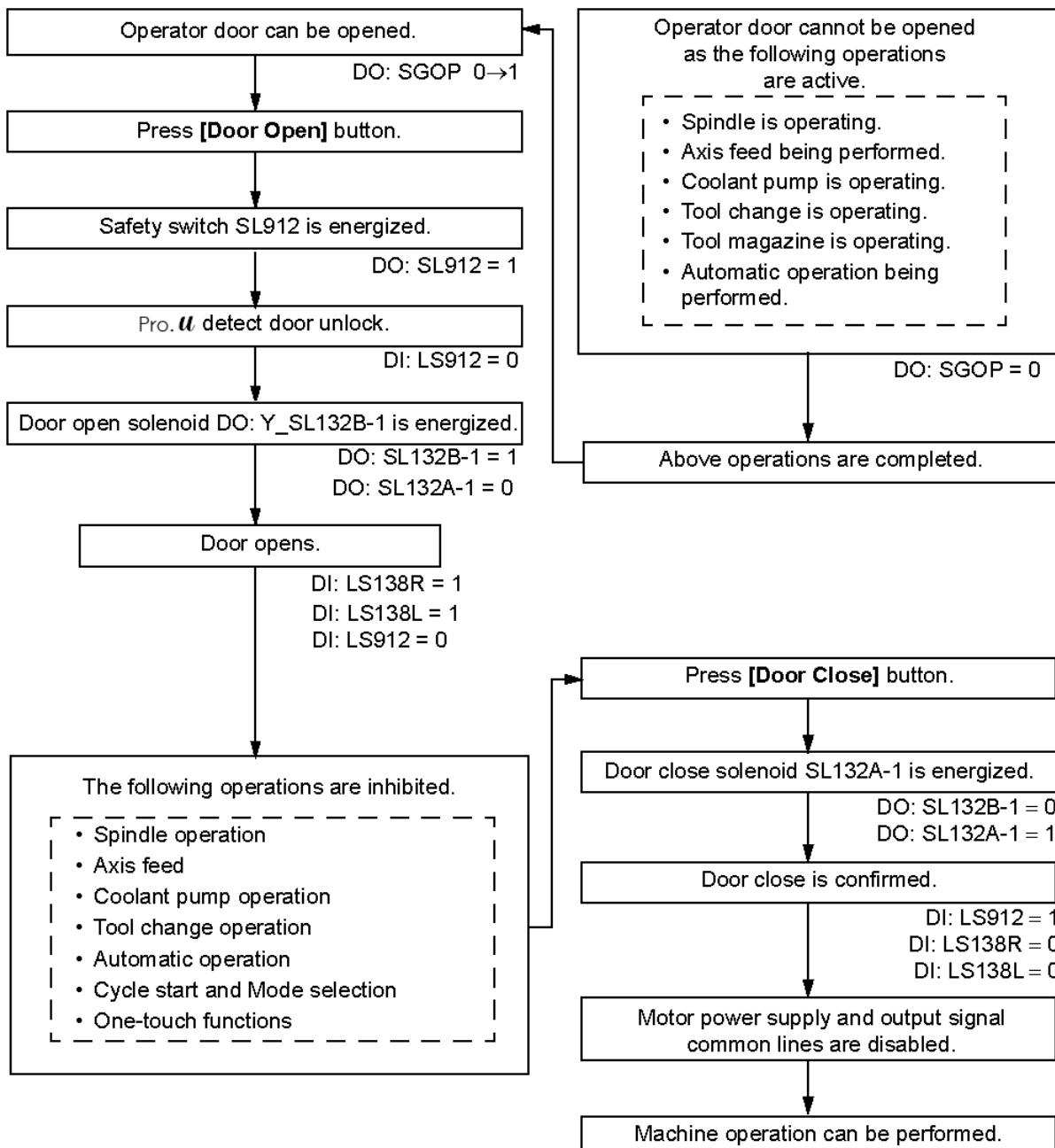


Machine Input/Output Signal Table

Signal Name	Address	Description
LS136	X0010.6	AUTO DOOR OPEN SLOW DOWN
LS138	X0010.7	AUTO DOOR OPEN
LS137	X0014.4	AUTO DOOR CLOSE SLOW DOWN
SL132A-1	Y0004.7	AUTO DOOR CLOSE
SL132B-1	Y0004.6	AUTO DOOR OPEN
SL132A-2	Y0007.4	AUTO DOOR CLOSE SLOW DOWN
SL912	Y0002.4	SPLASH-GUARD DOOR UNLOCK SOLENOID
LS912	X0002.4	SPLASH-GUARD DOOR INTERLOCK LIMIT SWITCH
LP569	Y0105.6	SPLASH-GUARD DOOR OPEN LAMP (OK)

Figure 4.4 Door Lock (Operation Mode) 2

Chapter 14 Splash Guard



-NOTES-

The following operations can be performed when the operator door is open:

1 Axis feed using the manual pulse generator.

Axis feed using the manual pulse generator handle is possible when the Handle mode is selected by pressing the [HANDLE ENABLE] switch.

2 Tool Clamp/Unclamp.

Tool clamping/unclamping can be performed when the Handle mode is selected.

4.2 Manual Override

Use a screwdriver and turn the door lock switch from lock the **[LOCK]** position to the **[UNLOCK]** position with the machine power turned Off to release the door lock and open the door. When the door lock switch is set to **[UNLOCK]**, the door cannot be locked and the machine will not operate even if the the door is closed.

After doing manual override, make sure to confirm the door lock switch is returned to the **[LOCK]** position.

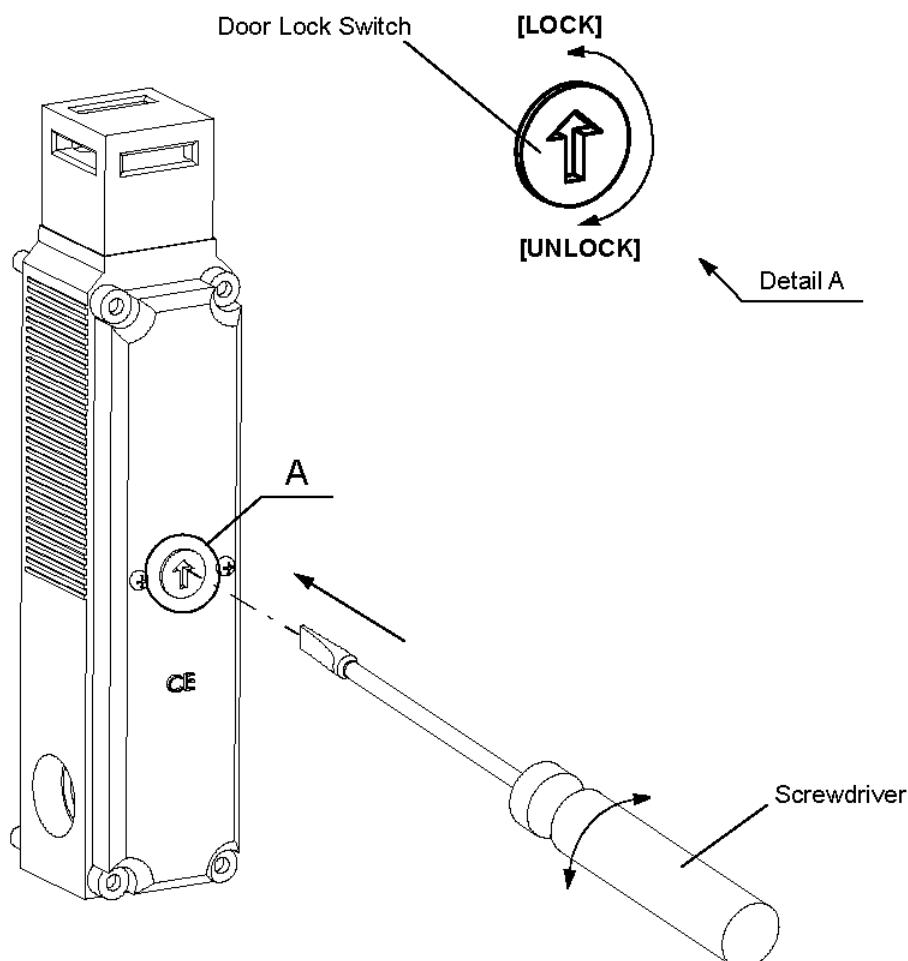


Figure 4.5 Manual Override

5 Lighting Device

5.1 Overview

The lighting device illuminates the machining chamber.

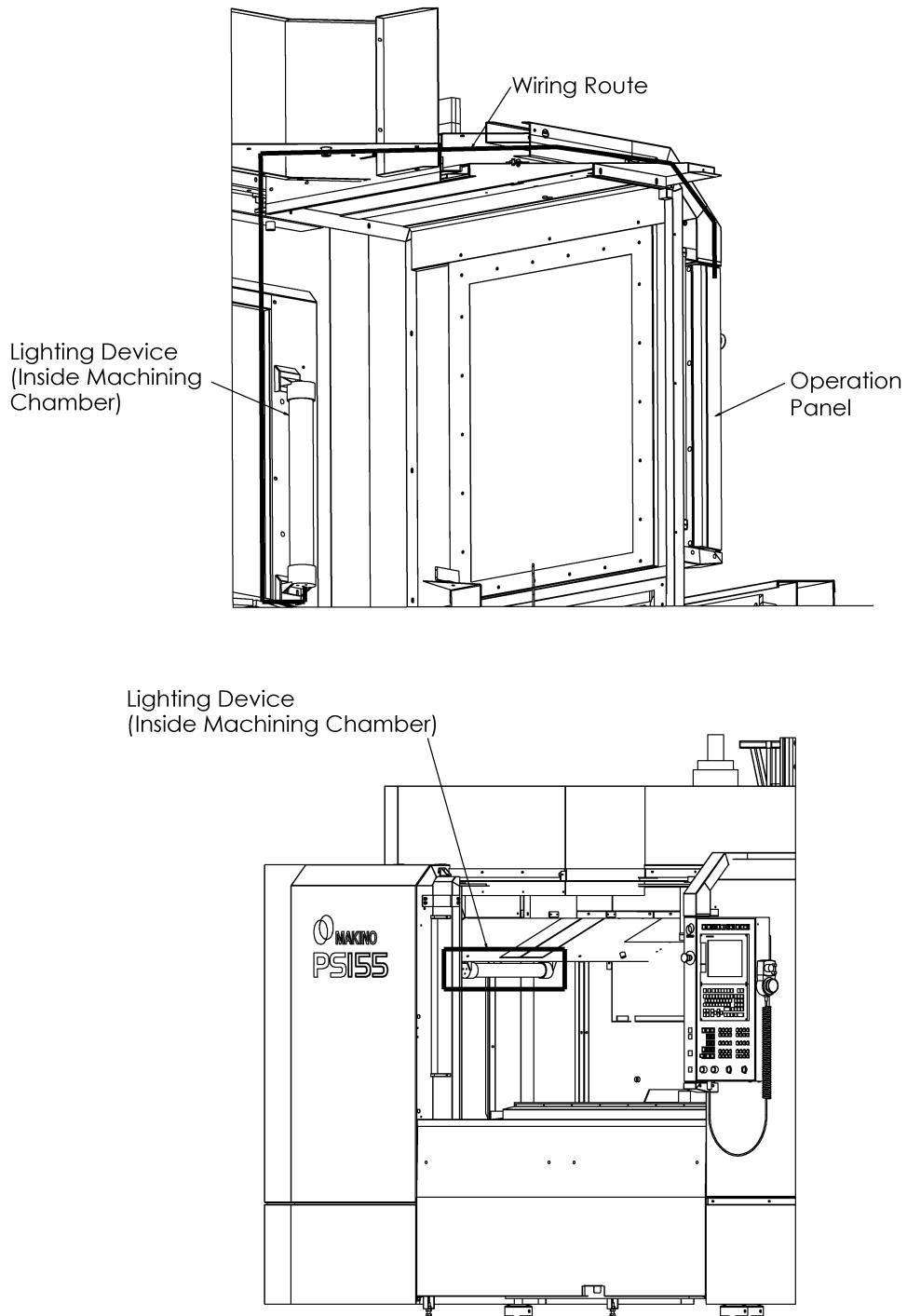


Figure 5.1 Lighting Device 1

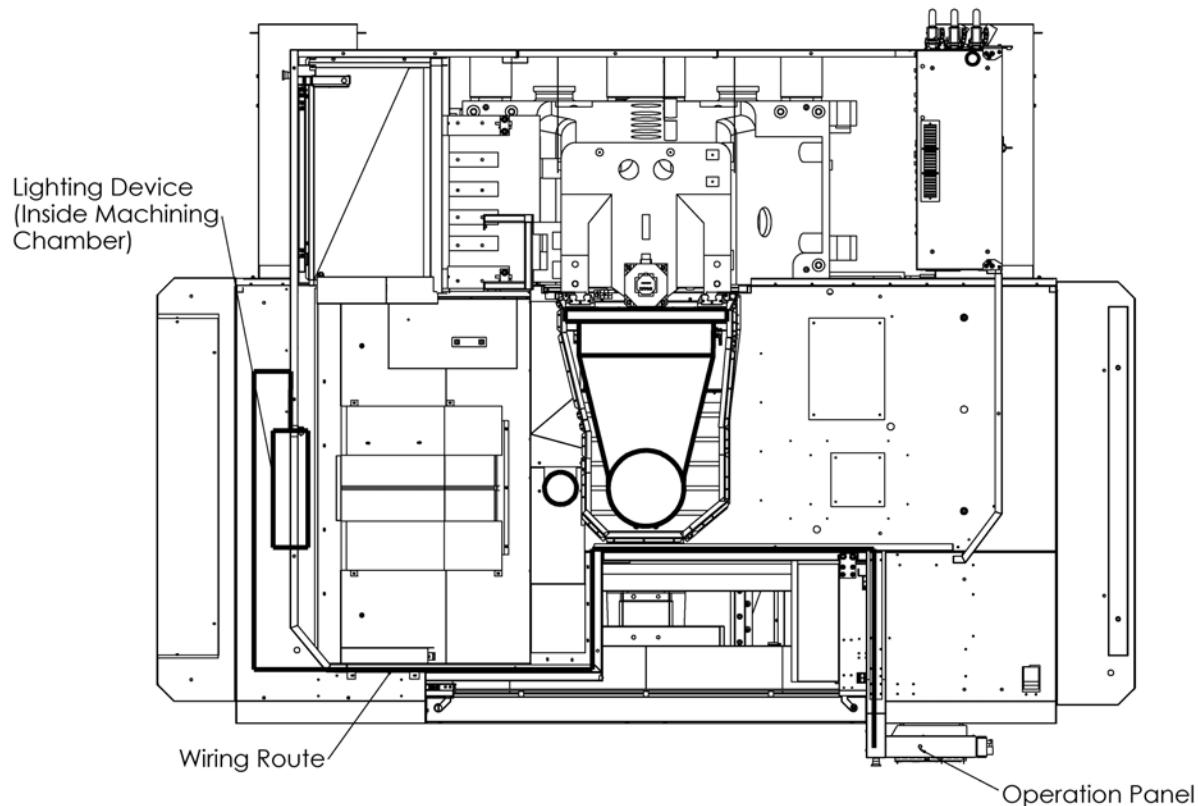
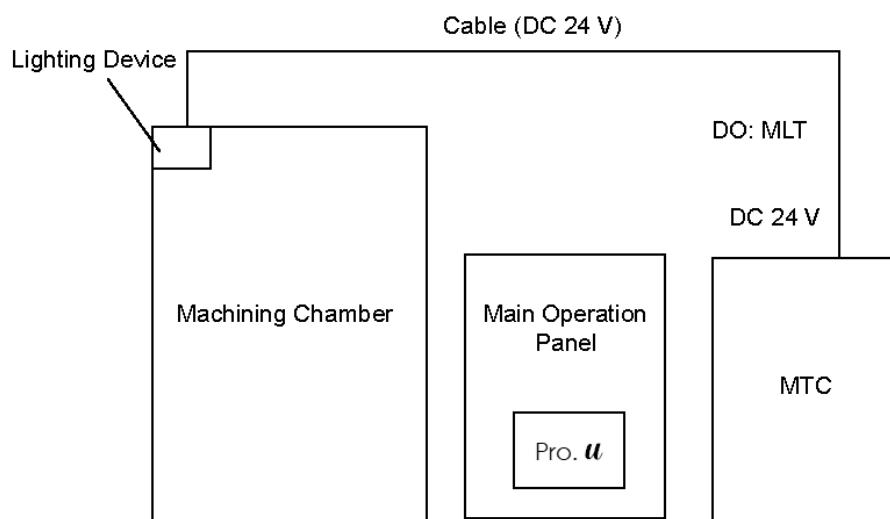


Figure 5.2 Lighting Device 2



Machine Input/Output Signal Table

Signal Name	Address	Description
MLT	Y0105.2	MACHINE LIGHT ON

6 Signal Lamp (Warning Lamp)

6.1 Overview

The signal (warning) lamp notifies the operator of the machine operating status. The signal lamp has three lights: Red, yellow and green. A buzzer is an available option.

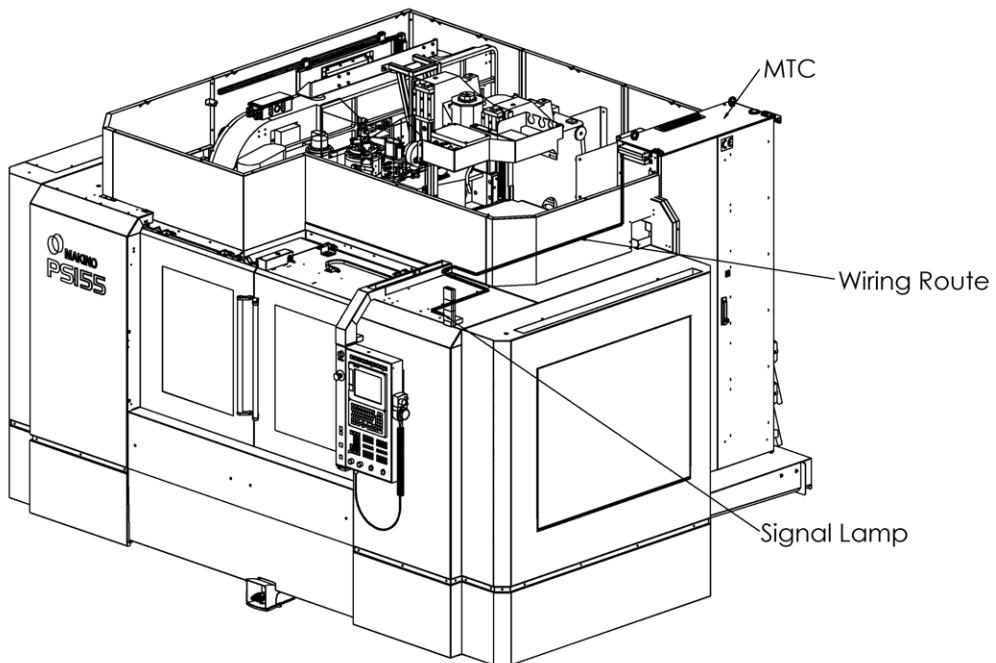
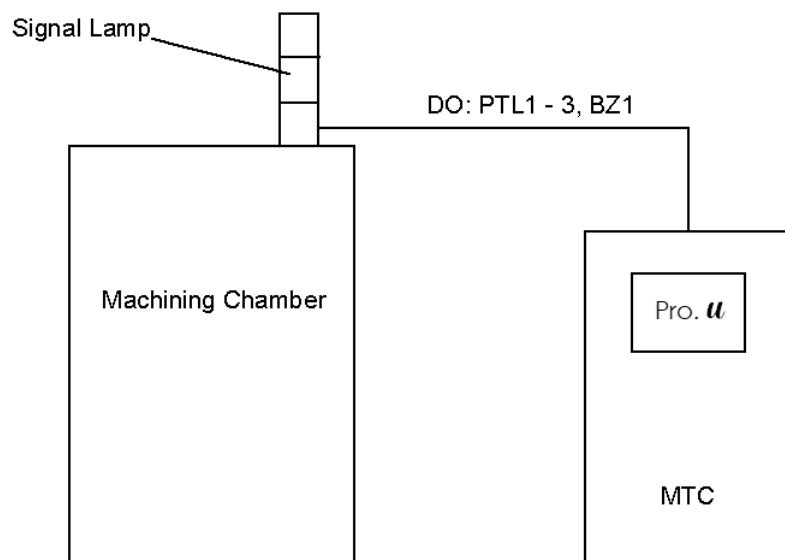


Figure 6.1 Signal Lamp (Warning Lamp)

**Machine Input/Output Signal Table**

Signal Name	Address	Description
PTL1	Y0105.1	PATROL LIGHT 1
PTL2	Y0105.0	PATROL LIGHT 2
PTL3	Y0104.7	PATROL LIGHT 3

1 Overview

The mist collector removes the vaporized cutting fluid generated in the machining chamber. The mist is then filtered and separated into clean air and cutting fluid using centrifugal force.

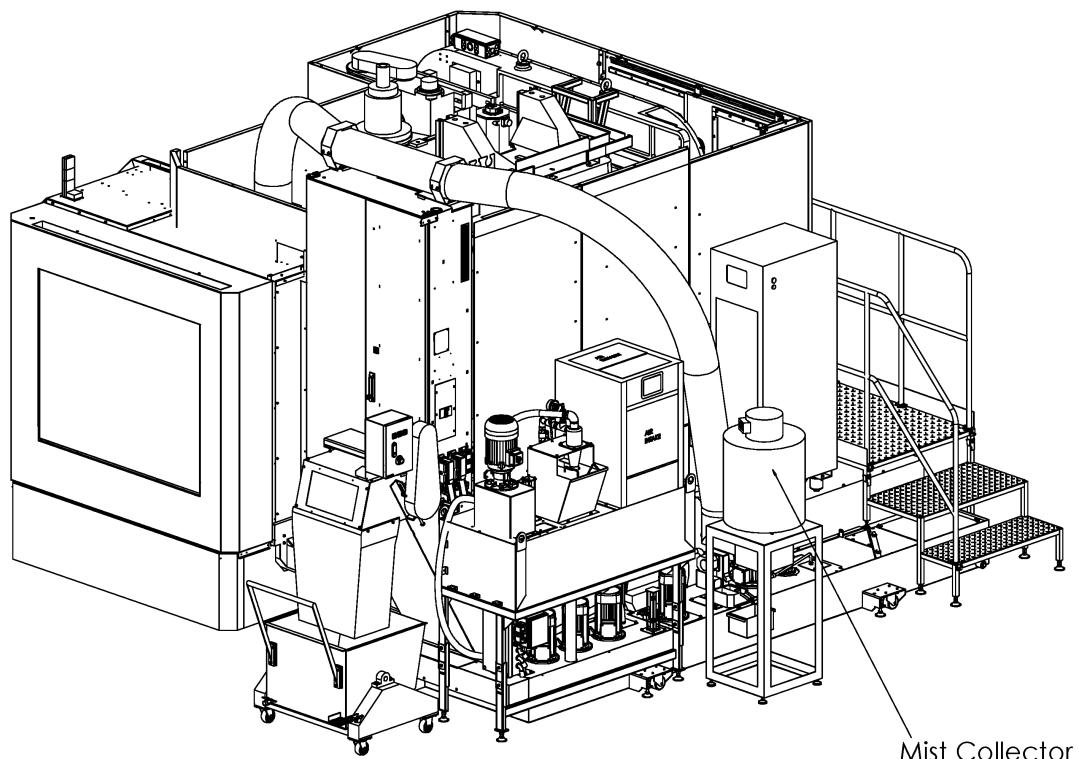


Figure 1.1 General View

1.1 Component Name

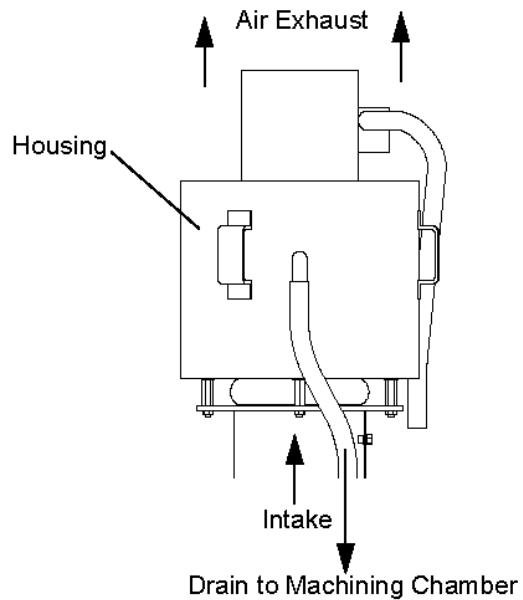


Figure 1.2 Mist Collector

1.2 Piping and Wiring

Drain Piping and Wiring Route

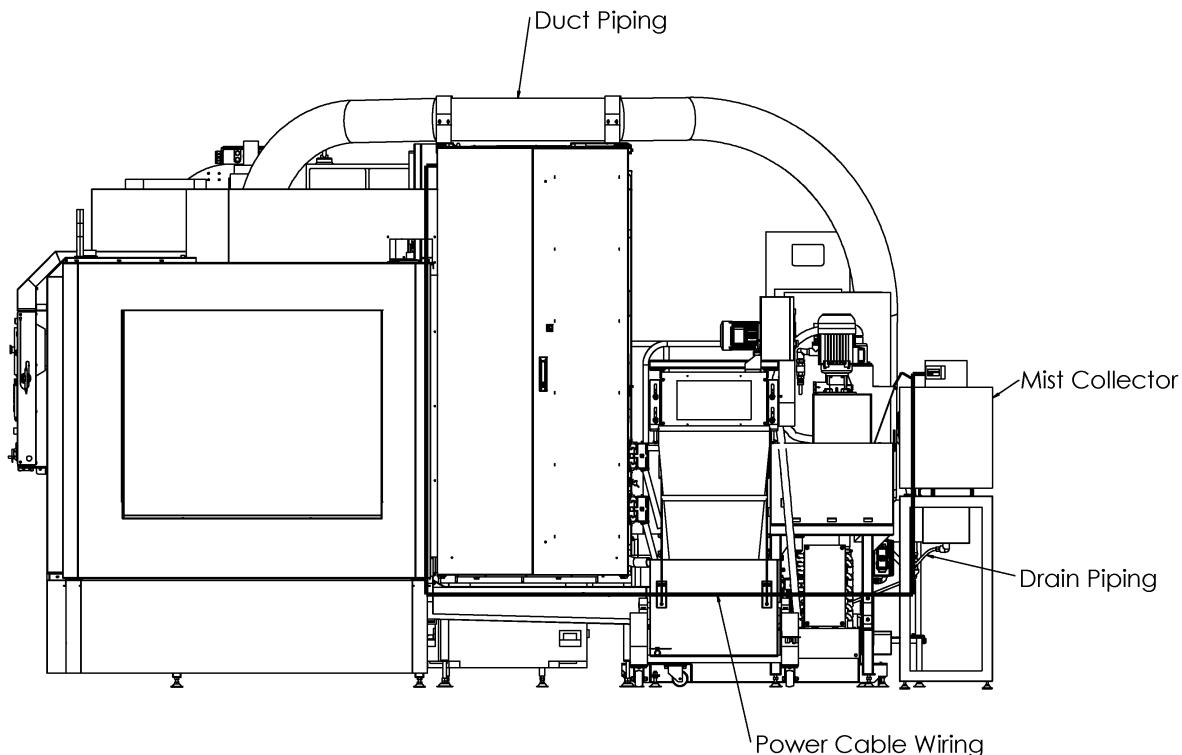
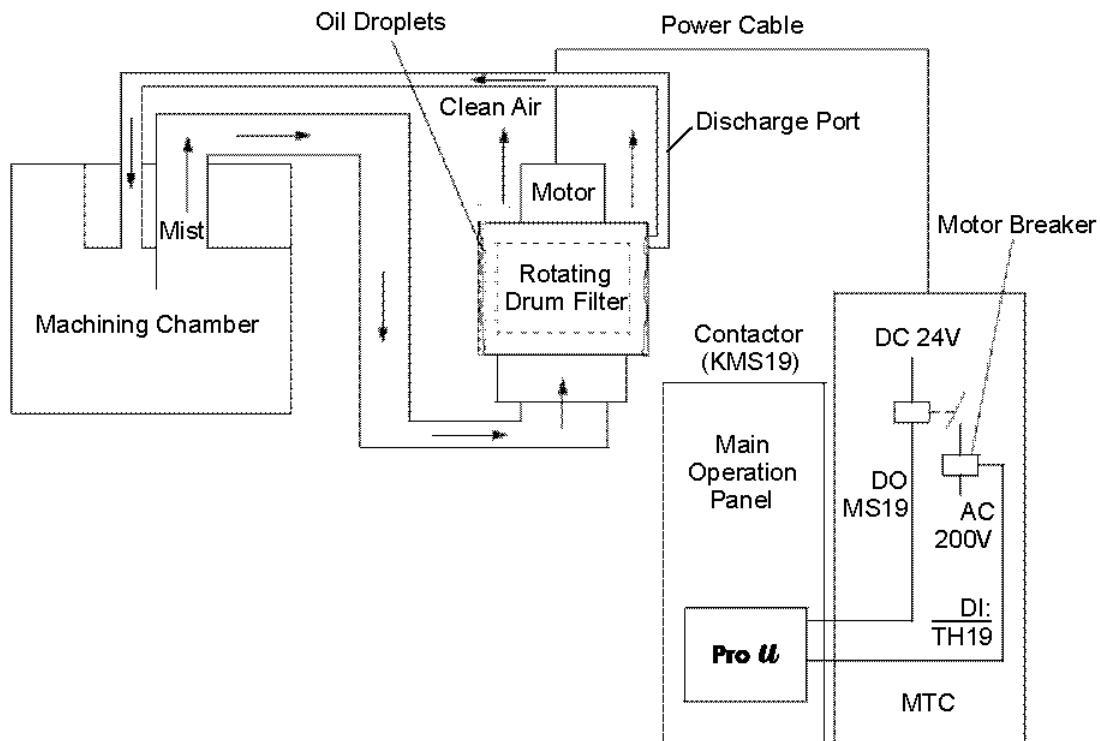


Figure 1.3 Piping and Wiring Route

2 Mist Collector Mechanism

The collected mist passes through the primary filter and is separated by centrifugal force generated by the rotating drum filter. Oil droplets will form on the walls of the housing and exit out through the discharge ports. The clean air is then passed through the drum filter and is discharged from the air discharge outlet. The cutting fluid is returned to the machining chamber.



Machine Input/Output Signal Table

Signal Name	Address	Description
MS19	Y0009.6	MIST COLLECTOR ON
TH19	X0017.6	MIST COLLECTOR THERMAL TRIP

2.1 Mist Collector Start and Stop Operation

The mist collector starts/stops in the following order.

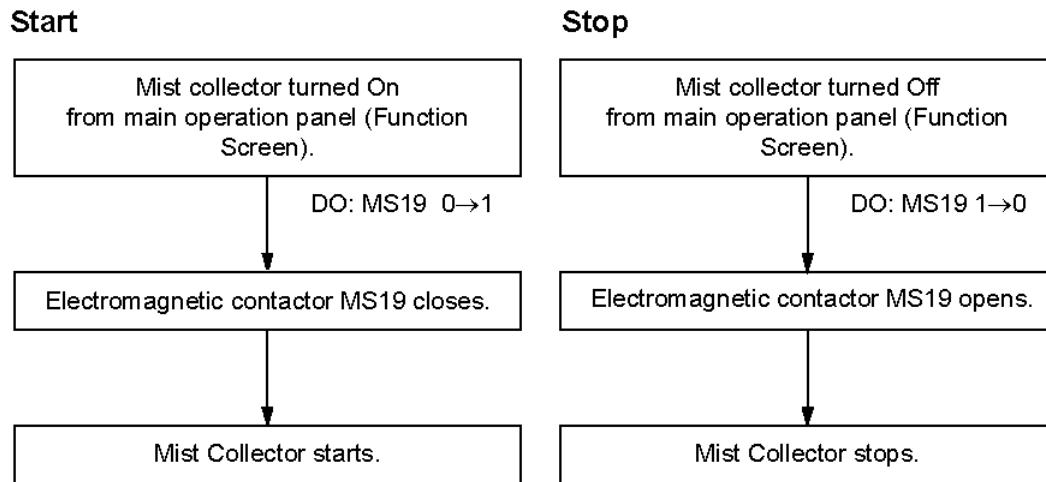


Figure 2.1 Mist Collector Operation Mode

1 Overview

The air dryer is used to remove moisture, hot and humid air from the machine. Thus cooling the hot and humid air from the air dyer inside. (Refer to [2 Air Dryer Mechanism](#))



- The air dryer uses fluorocarbon (HFC) as refrigerant.
- It is strictly forbidden to emit fluorocarbon into the atmosphere. Before you repair the refrigerant circuit, you should collect the refrigerant with proper evacuation system. The collected refrigerant should be properly recycled by qualified agency. Only personnel with proper credential are allowed to handle refrigerant.
- Only properly trained and qualified personnel are allowed to remove the cover panel of the equipment.

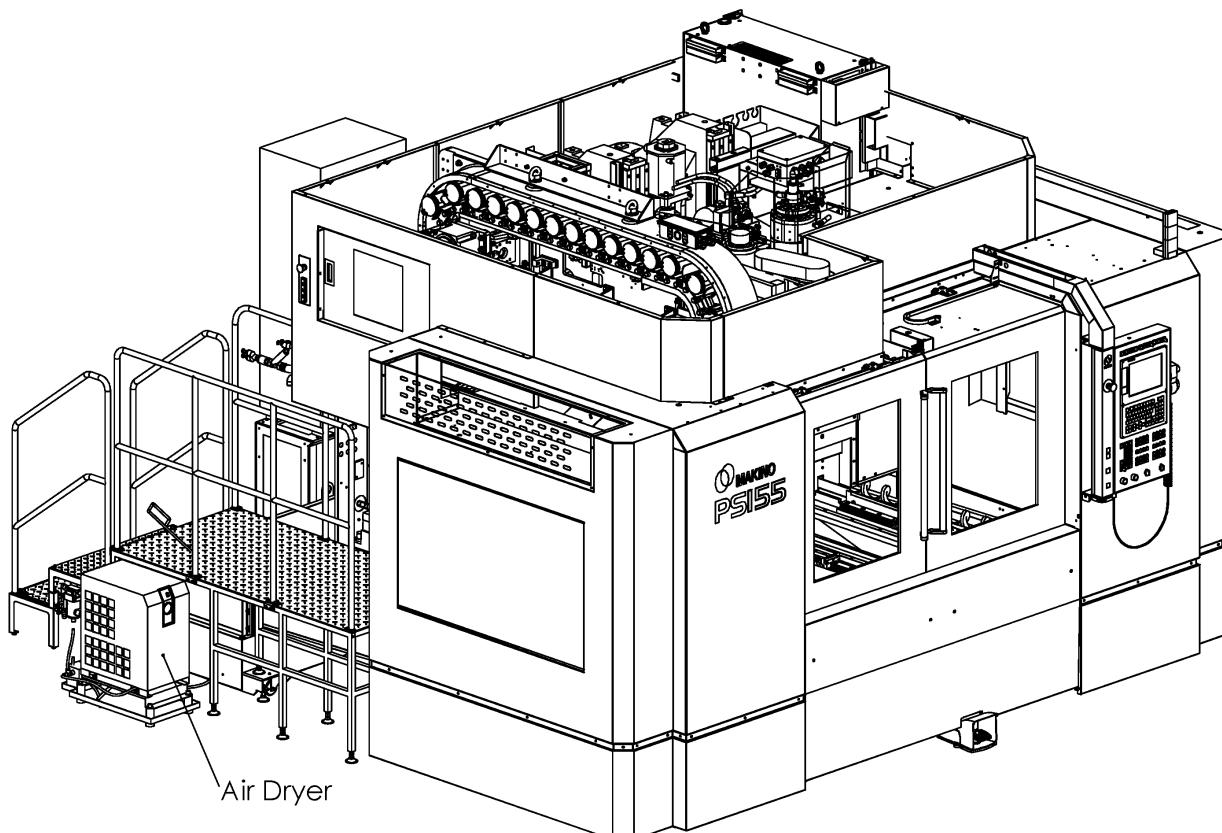


Figure 1.1 General View

1.1 Component Name

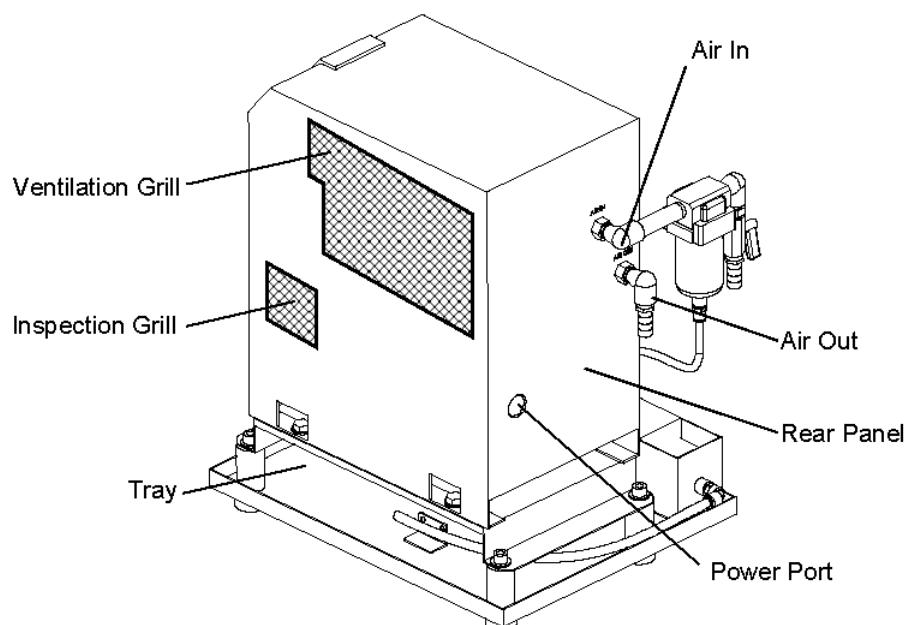
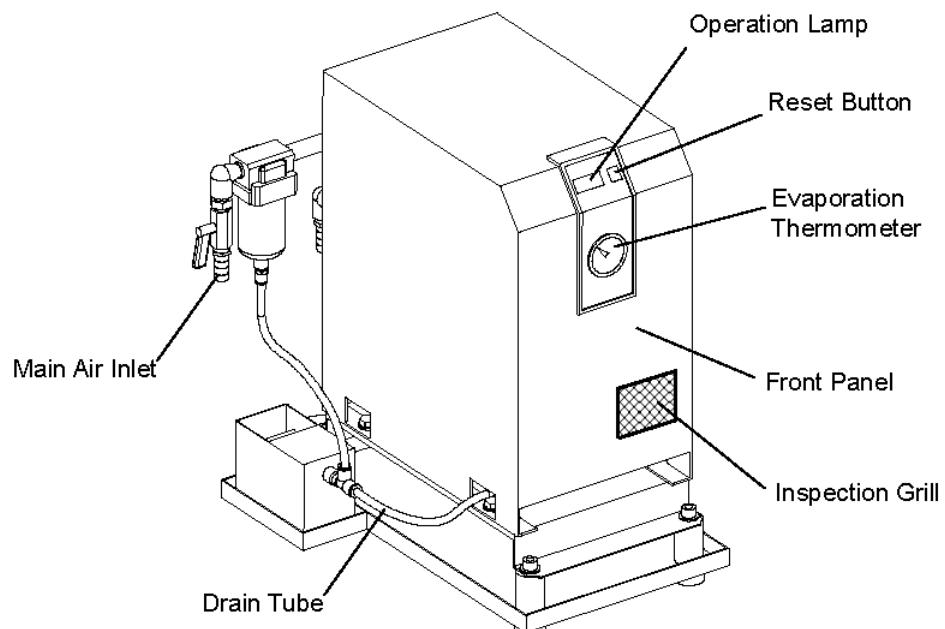


Figure 1.2 Air Dryer

1.2 Piping and Wiring

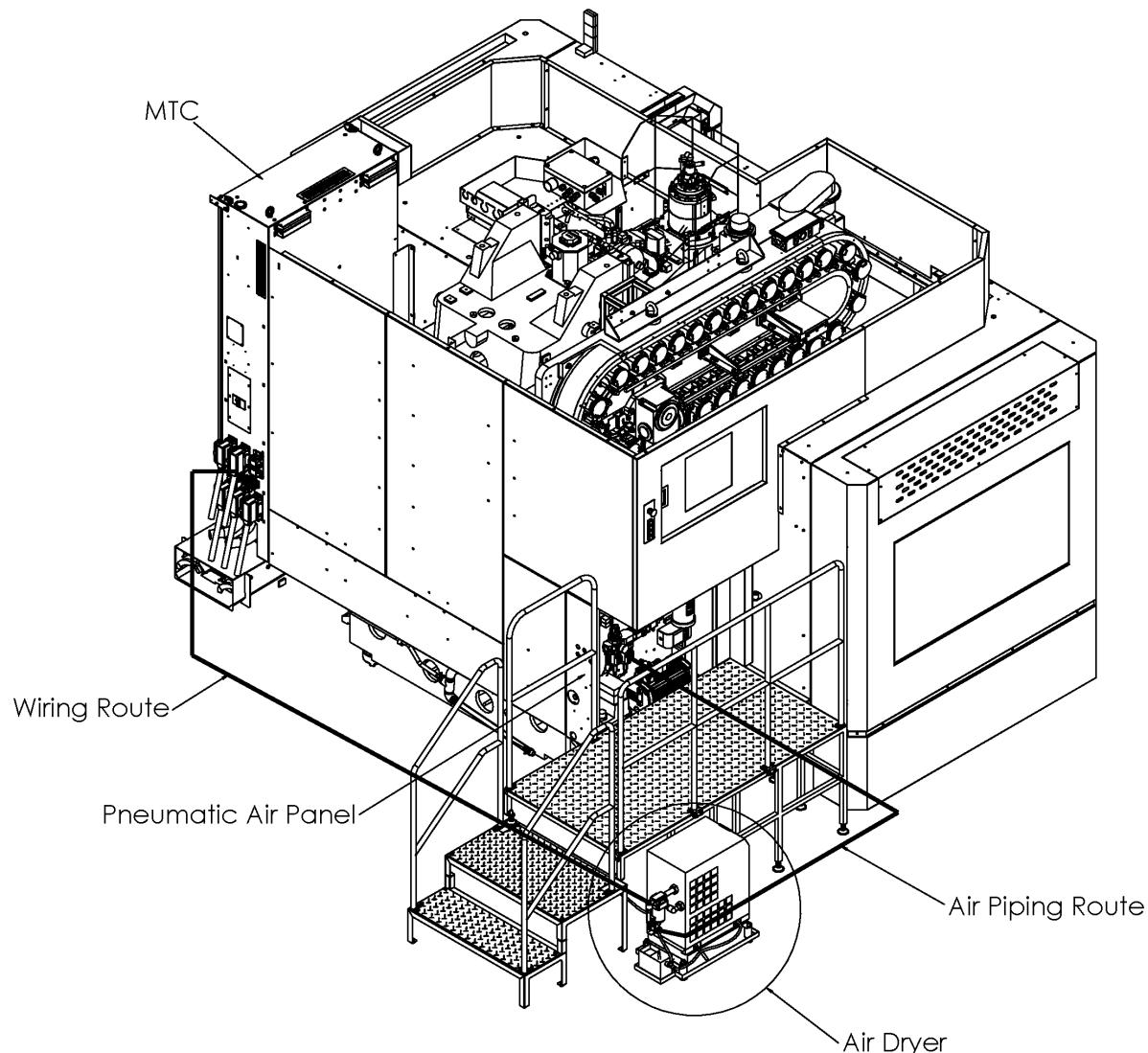


Figure 1.3 Piping and Wiring Route

2 Air Dryer Mechanism

2.1 Compressed Air and Refrigerant Circuit

Compressed Air Circuit

Hot and humid air that enters the air dryer unit is cooled. The condensate is then separated from it by the drain separator and is discharged automatically. The dry air is reheated until it reaches the ambient temperature.

Refrigerant Circuit

The HFC is compressed and cooled to become liquid. It goes through the capillary tube to throttle and passes the heat exchanger to draw heat from the air. It turns to gas state again, to the compressor and the cycle goes again.

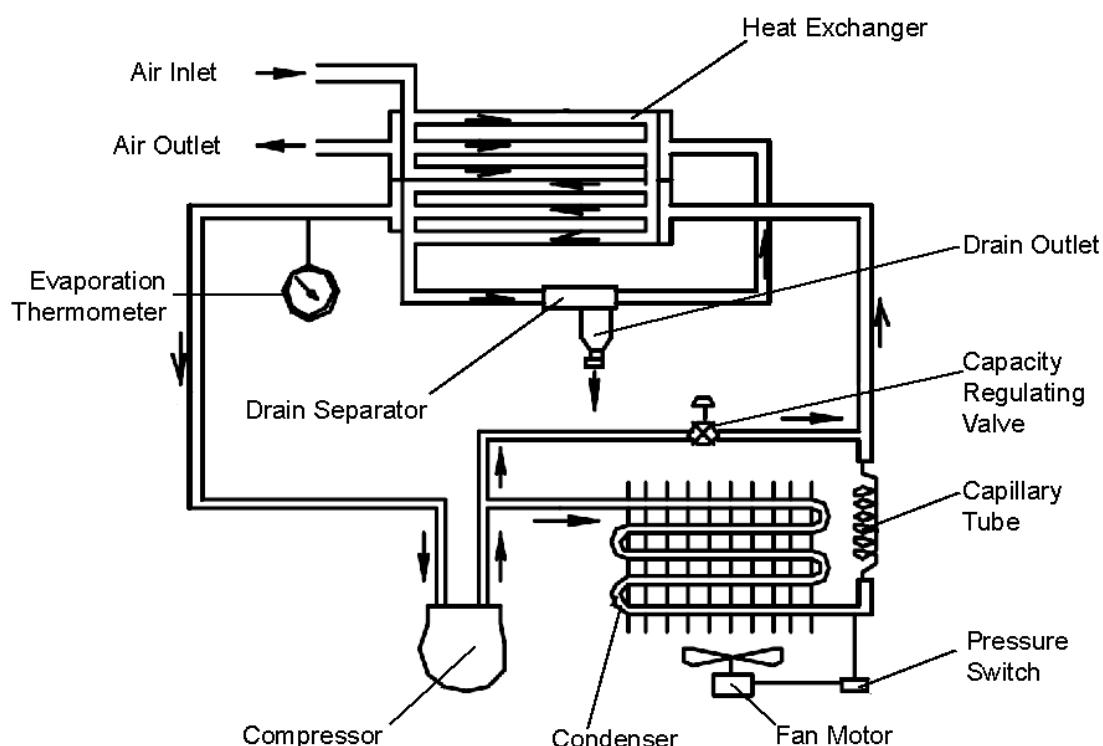


Figure 2.1 Compressed Air and Refrigerant Circuit

2.2 Electrical Circuit

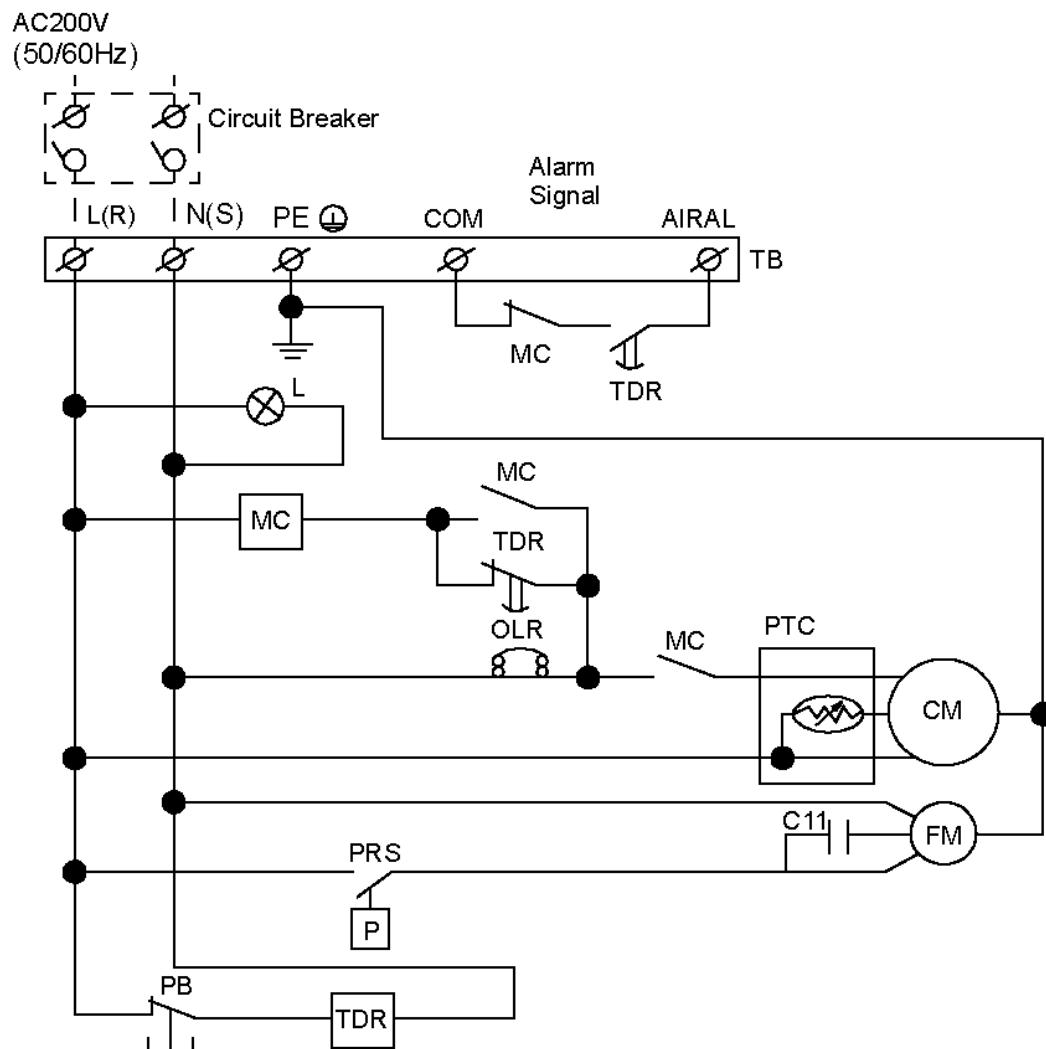


Figure 2.2 Electrical Circuit

Chapter 16 Air Dryer (Option)

Table 2.1 Electrical Circuit Definitions

Symbol	Device Name
CM	Compressor Motor
FM	Fan Motor for Condenser
OLR	Over Load Relay
PRS	Pressure Switch
L	Power Lamp
PTC	PTC Starter (Start Relay)
TB	Terminal Block
C11	Capacitor for Running Compressor Motor
MC	Magnetic Contactor
TDR	Time Delay Relay
PB	Reset Switch (For Alarm Signal Reset)

1 Input Signal List

Signal Address	Signal Name	Description	Classification
X0004.0	*OMAL1	SP LUB OIL UNIT ALM	SPINDLE
X0004.1	*LS170	SP LUB OIL FLOW SW	SPINDLE
X0004.2	HWER	HANDLE ENABLE	SPINDLE
X0004.3	LSROK	LASER OK	MEASUREMENT
X0004.4	STA	STATIC	MEASUREMENT
X0004.5	MSALA	MEAS SYSTEM RECEPTION ALM	MEASUREMENT
X0004.6	MSALB	MEAS SYSTEM BATTERY ERROR	MEASUREMENT
X0004.7	SKIP	SKIP SIGNAL	MEASUREMENT
X0005.0	AIRAL	AIR DRYER ALM	SPINDLE
X0005.1	*LS1319	CLNT TANK EMPTY DETECT	SPINDLE
X0005.2	*OMAL2	COOLANT CHILLER UNIT ALARM	SPINDLE
X0005.3	*LS1343	COOLANT CHILLER FLOW SWITCH	SPINDLE
X0005.4	*LS173	SP LUB OIL FIL PRESS LS	SPINDLE
X0005.5	TH154	OIL AIR UNIT TH ALM	SPINDLE
X0005.6	*LS2307	OIL AIR UNIT LOW LVL	SPINDLE
X0005.7	LS2308	OIL AIR UNIT AIR PRESS DETECT	SPINDLE
X0006.0	GRAY0	ATC ARM BIT 0	ATC
X0006.1	GRAY1	ATC ARM BIT 1	ATC
X0006.2	GRAY2	ATC ARM BIT 2	ATC
X0006.3	GRAY3	ATC ARM BIT 3	ATC
X0006.4	GRAY4	ATC ARM BIT 4	ATC
X0006.5	GRAY5	ATC ARM BIT 5	ATC
X0006.6	GRAY6	ATC ARM BIT 6	ATC
X0006.7	GRAY7	ATC ARM BIT 7	ATC
X0007.0	GRAY8	ATC ARM BIT 8	ATC
X0007.1	LS2466	AREA SENSOR	SAFETY GUARD
X0007.2	RCH1	SP LOW SPEED	SPINDLE
X0007.3	RCH2	SP HIGH SPEED	SPINDLE
X0007.4	LS912	OPERATOR DOOR INTERLOCK LS	SAFETY GUARD
X0007.5	LS942	ATC MAGAZINE DOOR CLOSE LS	SAFETY GUARD
X0008.0	SMC	MCC CONDITION	MTC

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
X0008.1	CBTP	CP TRIPPED	MTC
X0008.2	FPTP	FUSE BLOWN	PROTECTION
X0008.3	*EMI	EMERGENCY STOP SW	SAFETY
X0008.4	*ESP	EMERGENCY STOP SIGNAL	SAFETY
X0008.5	OT2X	OVER TRAVEL X	AXIS
X0008.6	OT2Y	OVER TRAVEL Y	AXIS
X0008.7	OT2Z	OVER TRAVEL Z	AXIS
X0009.0	---	SPARE	---
X0009.1	---	SPARE	---
X0009.2	SDCL	SIDE DOOR CLOSE TORQUE	DOOR
X0009.3	*DECM	MAG AXS REF RTN DECEL	AXIS
X0009.4	FTSW2	FOOT PEDAL FOR TOOL UNCLAMP CONFIRMATION B	SPINDLE
X0009.5	SPARE	SPARE	SPARE
X0009.6	DPAL	DIFFERENTIAL PRESSURE ALARM	SPINDLE
X0009.7	24VOK	POWER SUPPLY OK	SAFETY
X0010.0	LS00	TOOL CL	SPINDLE
X0010.1	LS01	TOOL UNCL	SPINDLE
X0010.2	TH2	NOZZLE CLNT MTR TH ALM	COOLANT
X0010.3	TH16	FLUSH CLNT TH ALM	COOLANT
X0010.4	LS2089	AUTO GREASE INJECTOR PRESS UP	AUTO GREASE
X0010.5	LS2064	AUTO GREASE SPLY UNIT LVL SW	AUTO GREASE
X0010.6	LS136	AUTO DOOR OPEN SLOWDOWN	SPLASH GUARD
X0010.7	LS138R	AUTO DOOR OPEN	SPLASH GUARD
X0011.0	TH7	SPIRAL CHIP CONV MTR TH ALM	CHIP CONVEYOR
X0011.1	TH7A	SPIRAL CHIP CONV MTR TH ALM A	CHIP CONVEYOR
X0011.2	LS747	ATC SHUTTER CLOSE	SPLASH GUARD
X0011.3	LS748	ATC SHUTTER OPEN	SPLASH GUARD
X0011.4	TH4	HYD UNIT TH ALM	MAIN HYD PP
X0011.5	*LS905	AIR PRESS SW	PNEUMATIC SYSTEM
X0011.6	MS11C	WORK WASH GUN PUMP ON	WORK WASH GUN
X0011.7	TH89	MTC AIR CON THERMAL ALARM	MTC AIR CON
X0012.0	LS969	SP HYD UNIT PRESS SW (LOW)	SPINDLE
X0012.1	LS968	SP HYD UNIT PRESS SW (HIGH)	SPINDLE

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
X0012.2	LS601	SP TOOL SEATING	SPINDLE
X0012.3	LS602	SP TOOL CONFIRM	SPINDLE
X0012.4	LS2312	OIL AIR UNIT FLOW LOWER CHECK	OIL AIR UNIT
X0012.6	*LS184	SEC TANK EMPTY DETECT	COOLANT
X0012.7	LS3320	TSC PRESSURE SWITCH	COOLANT
X0013.0	LS21	POT HORIZONTAL	ATC
X0013.1	LS22	POT VERTICAL	ATC
X0013.2	LS2769 / LS674	TLS TOOL LOCK REED SWITCH	ATC
X0013.3	LS2770	TLS TOOL UNLOCK REED SWITCH	ATC
X0013.4	LS25	TOOL MAGAZINE HOME SENSOR	ATC
X0013.5	LS1122	AUTO DOOR BLOCKED	SPLASH GUARD
X0014.1	ABRK	ATC ARM MOTOR BRAKE	ATC
X0014.2	TMATC	ATC ARM MTR OVERHEAT	ATC
X0014.3	THARM	O/L ATC ARM MTR (TH78)/INVERTER ALARM	ATC
X0014.5	TH18	OIL SKIMMER MTR TH ALM	SPINDLE
X0014.6	LS181	NOZZLE CLNT FLOW SW	COOLANT
X0015.0	LS191	SEC FIL TANK UPPER FLOAT	COOLANT
X0015.1	LS192	SEC FIL TANK LOWER FLOAT	COOLANT
X0015.2	LS1325	CL TANK UPPER FLOAT FOR CL SUPPLY	COOLANT
X0015.3	LS1337	CL TANK LOWER FLOAT FOR CL SUPPLY	COOLANT
X0015.5	LS176	SPINDLE COOLER OIL LEVEL LOW	SPINDLE
X0015.6	LS1641	TOOL UNCLAMP POWER PACK TEMP SENSOR	ATC
X0015.7	LS1639	TOOL UNCLAMP POWER PACK LW LVL SENSOR	ATC
X0016.0	LS151	A-AXIS CLAMP SWITCH	4TH AXIS RWH
X0016.1	LS152	A-AXIS UNCLAMP SWITCH	4TH AXIS RWH
X0016.2	LS154	C-AXIS CLAMP SWITCH	5TH AXIS RWH
X0016.3	LS155	C-AXIS UNCLAMP SWITCH	5TH AXIS RWH
X0016.4	*LS1340	TS UNION ABNORMAL DETECT	TSC
X0016.5	LS1311	TSC LEAKAGE DETECT	TSC
X0016.6	LS193	THROUGH SP CL FLOW SWITCH	TSC
X0016.7	LS1338	THROUGH SP CL PRESSURE CHECK	TSC
X0017.0	LCFWD	LUCC FORWARD SW	CHIP CONVEYOR
X0017.1	LCREV	LUCC REVERSE SW	CHIP CONVEYOR

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
X0017.2	TH6	LUCC MTR TH ALM	CHIP CONVEYOR
X0017.3	LCMAS	LUCC MANUAL INTERRUPT SW	CHIP CONVEYOR
X0017.4	TH8	TS CLNT PUMP MTR TH ALM	COOLANT
X0017.5	TH10	OVERHEAD SHOWER CLNT TH ALM	COOLANT
X0017.6	TH19	MIST COLLECTOR MTR TH ALM	COOLANT
X0017.7	OMAL3	ROT AXS CHILLER UNIT ALM	COOLANT
X0018.0	LS2604-2	2nd HYD OIL TEMP SENSOR	4TH AXIS
X0018.1	LS2603-2	2nd HYD OIL LVL FLOAT SW	4TH AXIS
X0018.2	-L4	4TH AXS MINUS SIDE STROKE END	4TH AXIS
X0018.3	-L5	5TH AXS MINUS SIDE STROKE END	5TH AXIS
X0018.4	5NG	5TH AXS NEGLECT	5TH AXIS
X0018.5	ROTB / +L5	5TH AXS OVERTRAVEL	5TH AXIS
X0018.6	4NG	4TH AXS NEGLECT	4TH AXIS
X0020.2	LS131L	LEFT SIDE DOOR OPEN	SPLASH GUARD
X0020.3	LS130L	LEFT SIDE DOOR CLOSE	SPLASH GUARD
X0020.4	LS1306	LUCC SLIP DETECT	SECONDARY FILTER TANK
X0020.5	TH6A	THERMAL	DRAWING PUMP (CL CHILLER)
X0020.6	TH71	SEC FIL TANK PUMP TH ALM	ROTARY AXIS
X0020.7	TH260-2	2nd HYD PP MTR OVERLOAD	HYDRAULIC
X0021.0	*DEC4	4TH AXS REF RTN DECEL	4TH AXIS
X0021.1	*DEC5	5TH AXS REF RTN DECEL	5TH AXIS
X0021.2	SYSPS	2nd HYD PP SYSTEM PRESS (HIGH)	HYDRAULIC
X0021.4	TSCCG1	100% CLG-ALM/TSC FIL 1 CLG	COOLANT
X0021.5	TSCCG2	75% CLG-WRN/TSC FIL 2 CLG	COOLANT
X0021.6	LS1339	TSC SUCTION FILTER CLOG DETECT (BEFORE PUMP)	COOLANT
X0022.6	L151-2 / LS679	ADDITIONAL 3RD AXS CL / SHIFTER FIRST SECTION RET	3RD AXIS
X0022.7	L152-2 / LS680	ADDITIONAL 3RD AXS UNCL / SHIFTER FIRST SECTION ADV	3RD AXIS
X0023.0	L154-2 / LS751	ADDITIONAL 4TH AXS CL / SHIFTER SECOND SECTION RET	4TH AXIS
X0023.1	L155-2 / LS750	ADDITIONAL 4TH AXS UNCL / SHIFTER SECOND SECTION ADV	4TH AXIS
X0023.4	TH40	DRAWING PUMP THERMAL ALARM	HYDRAULIC
X0024.0	SYSPS-2	2ND HYD PP SYSTEM PRESS (HIGH)	HYDRAULIC
X0024.1	SYSPS2-2	2ND HYD PP SYSTEM PRESS (LOW)	HYDRAULIC
X0024.2	LS2604-2	2ND HYD OIL TEMP SENSOR	HYDRAULIC
X0024.3	LS2603-2	2ND HYD OIL LVL FLOAT SW	HYDRAULIC

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
X0025.4	USDI1	USER DI 1	USER I/O
X0025.5	USDI2	USER DI 2	USER I/O
X0025.6	USDI3	USER DI 3	USER I/O
X0025.7	USDI4	USER DI 4	USER I/O
X0026.0	USDI5	USER DI 5	USER I/O
X0026.1	USDI6	USER DI 6	USER I/O
X0026.2	USDI7	USER DI 7	USER I/O
X0026.3	USDI8	USER DI 8	USER I/O
X0028.0	RBRDY READY ERNOERR	ROBOT HEALTHY,CHANGE FINISH,AWC READY	ROBOT INTERFACE
X0028.3	SYSTR ERROR	AUTO START INSTRUCTION CHANGING ALARM	ROBOT INTERFACE
X0028.6	WULDFN NEUTRAL ERMCARE ERMCINT	WORK UNLOAD FINISH WORK MASTER IN-POSITION MACHINE AREA MACHINE INTERLOCK	ROBOT INTERFACE
X0028.7	NOWPST ERSTATUS ERMCOM	AUTO START WITHOUT WORK	ROBOT INTERFACE
X0035.0	CUSDI9	CUSTOM DESIGN INPUT 9	CUSTOM
X0035.1	CUSDI10	CUSTOM DESIGN INPUT 10	CUSTOM
X0035.3	CUSDI12	CUSTOM DESIGN INPUT 12	CUSTOM
X0060.0	HY1CL	HYD CL PB	Fixture
X0060.1	HY1UC	HYD UNCL PB	Fixture
X0060.2	EJCL	EJECT CLMP PB	Fixture
X0060.3	EJUC	EJECT UNCLMP PB	Fixture
X0060.4	PS2601	HYD PRESS SW 1	Fixture
X0060.5	PS2602	HYD PRESS SW 2	Fixture
X0060.6	PS2603	HYD PRESS SW 3	Fixture
X0060.7	PS2604	HYD PRESS SW 4	Fixture
X0061.0	PS2605	HYD PRESS SW 5	Fixture
X0061.1	PS2606	HYD PRESS SW 6	Fixture
X0061.2	PS2607	HYD PRESS SW 7	Fixture
X0061.3	PS2608	HYD PRESS SW 8	Fixture
X0061.4	TH260	HYD MOTOR OVERLOAD	Fixture
X0061.5	AUT	AUT MD SELECTION SW	Fixture
X0061.6	AIRSV	AS CHECK SW	Fixture
X0061.7	TH106 / *OMAL3	TABLE CL PUMP TH ALM / HYDRAULIC CHILLER	Fixture
X0062.0	LS1785	AS SENSOR 5	Fixture
X0062.1	LS1786	AS SENSOR 6	Fixture

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
X0062.2	LS1787	AS SENSOR 7	FIXTURE
X0062.3	LS1788	AS SENSOR 8	FIXTURE
X0062.4	LS1881	POSITION SENSOR 1	FIXTURE
X0062.5	LS1882	POSITION SENSOR 2	FIXTURE
X0062.6	LS1883	POSITION SENSOR 3	FIXTURE
X0062.7	LS1884	POSITION SENSOR 4	FIXTURE
X0063.0	PS2701	HYD PRESS SW 101	FIXTURE
X0063.1	PS2702	HYD PRESS SW 102	FIXTURE
X0063.2	PS2703	HYD PRESS SW 103	FIXTURE
X0063.3	PS2704	HYD PRESS SW 104	FIXTURE
X0063.4	PS2705	HYD PRESS SW 105	FIXTURE
X0063.5	PS2706	HYD PRESS SW 106	FIXTURE
X0063.6	PS2707	HYD PRESS SW 107	FIXTURE
X0063.7	PS2708	HYD PRESS SW 108	FIXTURE
X0064.0	LS1789	AS SESNROR 9	FIXTURE
X0064.1	LS1790	AS SESNROR 10	FIXTURE
X0064.2	LS1791	AS SESNROR 11	FIXTURE
X0064.3	LS1792	AS SESNROR 12	FIXTURE
X0064.4	LS1781	AS SENSOR 1	FIXTURE
X0064.5	LS1782	AS SENSOR 2	FIXTURE
X0064.6	LS1783	AS SENSOR 3	FIXTURE
X0064.7	LS1784	AS SENSOR 4	FIXTURE
X0065.0	SYSPS	HYD PP SYSTEM PRESS (HIGH)	FIXTURE
X0065.1	SYSPS2	HYD PP SYSTEM PRESS (LOW)	FIXTURE
X0065.2	LS2604	HYD OIL TEMP SENSOR	FIXTURE
X0065.3	LS2603	HYD OIL LVL FLOAT SW	FIXTURE
X0065.4	THPBR	TWO HAND PB R	FIXTURE
X0065.5	THPBL	TWO HAND PB L	FIXTURE
X0065.6	STRSW	STRIKER SW / AUTO START	FIXTURE
X0100.0	EDTS	EDIT MODE	OPERATOR PANEL
X0100.1	MEMS	MEMORY MODE	OPERATOR PANEL
X0100.2	DS	MDI MODE	OPERATOR PANEL
X0100.3	TS	EXTERNAL INPUT	OPERATOR PANEL

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
X0100.4	HS	HANDLE MODE	OPERATOR PANEL
X0100.5	JS	JOG FEED MODE	OPERATOR PANEL
X0100.6	RTS	RAPID TRAVERSE MODE	OPERATOR PANEL
X0100.7	ZRNS	ZERO RETURN MODE	OPERATOR PANEL
X0101.0	FPS1	SINGLE BLOCK	OPERATOR PANEL
X0101.1	FPS2	BLOCK SKIP	OPERATOR PANEL
X0101.2	FPS3	OPTIONAL STOP	OPERATOR PANEL
X0101.3	FPS4	DRY RUN	OPERATOR PANEL
X0101.4	FPS5	COOLANT ON/OFF	OPERATOR PANEL
X0101.5	FPS6	NOZZLE COOLANT	OPERATOR PANEL
X0101.6	FPS7	AIR BLOW	OPERATOR PANEL
X0101.7	FPS8	TS CL	OPERATOR PANEL
X0102.0	FPS9	SPINDLE SPEED (-)	OPERATOR PANEL
X0102.1	FPS10	SPINDLE SPEED (+)	OPERATOR PANEL
X0102.2	FPS11	SPINDLE ORIENTATION	OPERATOR PANEL
X0102.3	ALRSTS	ALARM RESET	OPERATOR PANEL
X0102.4	OTFS1	AUTO ZERO	OPERATOR PANEL
X0102.5	OTFS2	TOOL CHANGE	OPERATOR PANEL
X0102.6	OTFS3	SETUP POSITION	OPERATOR PANEL
X0102.7	OTFS4	CUSTOM	OPERATOR PANEL
X0103.0	OTFST	ROUTINE FUNCTION START	OPERATOR PANEL
X0103.1	OTfsp	ROUTINE FUNCTION STOP	OPERATOR PANEL
X0103.2	XAXS	AXIS SELECT X	OPERATOR PANEL
X0103.3	YAXS	AXIS SELECT Y	OPERATOR PANEL
X0103.4	ZAXS	AXIS SELECT Z	OPERATOR PANEL
X0103.5	4AXS	AXIS SELECT 4TH	OPERATOR PANEL
X0103.6	5AXS	AXIS SELECT 5TH	OPERATOR PANEL
X0103.7	6AXS	AXIS SELECT CS	OPERATOR PANEL
X0104.0	JOG (+)	JOG + SWITCH	OPERATOR PANEL
X0104.1	JOG (-)	JOG - SWITCH	OPERATOR PANEL
X0104.2	SPS	FEED HOLD SWITCH	OPERATOR PANEL
X0104.3	STS	CYCLE START SWITCH	OPERATOR PANEL
X0104.4	MOPMMUL	MAIN OPER PNL MODE UNLOCK SW	OPERATOR PANEL

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
X0104.5	EMGNC	OP.PANEL EMERGENCY SWITCH FEEDBACK	OPERATOR PANEL
X0104.6	KEY1	MEMORY PROTECT KEY SWITCH	OPERATOR PANEL
X0104.7	OTRS	OT RELEASE SWITCH	OPERATOR PANEL
X0105.0	SPSP	SPINDLE STOP	OPERATOR PANEL
X0105.1	SPST	SPINDLE START	OPERATOR PANEL
X0105.2	POFFS	POWER OFF	OPERATOR PANEL
X0105.4	FPS12	SCREW CONVEYOR ON/OFF PUSHBUTTON	OPERATOR PANEL
X0105.5	SW569	OPERATOR DOOR UNLOCK PUSHBUTTON	OPERATOR PANEL
X0105.6	STUCS	TOOL UNCLAMP SWITCH	OPERATOR PANEL
X0116.0	JFV1I	CUTTING/JOG FEED OVERRIDE SWITCH (1)	OPERATOR PANEL
X0116.1	JFV2I	CUTTING/JOG FEED OVERRIDE SWITCH (2)	OPERATOR PANEL
X0116.2	JFV4I	CUTTING/JOG FEED OVERRIDE SWITCH (4)	OPERATOR PANEL
X0116.3	JFV8I	CUTTING/JOG FEED OVERRIDE SWITCH (8)	OPERATOR PANEL
X0116.4	JFV16I	CUTTING/JOG FEED OVERRIDE SWITCH (16)	OPERATOR PANEL
X0116.5	JFVM	CUTTING/JOG FEED OVERRIDE (INHIBIT)	OPERATOR PANEL
X0116.6	ROV1	RAPID OVERRIDE SWITCH (1)	OPERATOR PANEL
X0116.7	ROV2	RAPID OVERRIDE SWITCH (2)	OPERATOR PANEL
X0117.0	ROV3	RAPID OVERRIDE SWITCH (3)	OPERATOR PANEL
X0117.1	ROV4	RAPID OVERRIDE SWITCH (4)	OPERATOR PANEL
X0117.2	HOV1	HANDLE OVERRIDE SWITCH (1)	OPERATOR PANEL
X0117.3	HOV2	HANDLE OVERRIDE SWITCH (2)	OPERATOR PANEL
X0117.4	HOV3	HANDLE OVERRIDE SWITCH (3)	OPERATOR PANEL
X0117.5	HOV4	HANDLE OVERRIDE SWITCH (4)	OPERATOR PANEL
X0117.6	HOV5	HANDLE OVERRIDE SWITCH (5)	OPERATOR PANEL
X0118.0	MP1	HANDLE MULTIPLY *10	OPERATOR PANEL
X0118.1	MP2	HANDLE MULTIPLY *100	OPERATOR PANEL
X0118.2	HX	HANDLE SELECT (X)	OPERATOR PANEL
X0118.3	HY	HANDLE SELECT (Y)	OPERATOR PANEL
X0118.4	HZ	HANDLE SELECT (Z)	OPERATOR PANEL
X0118.5	H4	HANDLE SELECT (4TH)	OPERATOR PANEL
X0118.6	H5	HANDLE SELECT (5TH)	OPERATOR PANEL
X0118.7	H6	HANDLE SELECT (6TH)	OPERATOR PANEL
X0119.0	*EMATA	EMERGENCY ATC OK	SAFETY

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
X0119.1	*EMRBT	EMERGENCY ROBOT OK	SAFETY
X0119.2	*EMEXT	EMERGENCY EXTERNAL OK	SAFETY
X0119.3	*EMLUC	EMERGENCY STOP LUCC	SAFETY
X0119.4	*EMFXT	EMERGENCY FIXTURE	SAFETY
X0119.5	OT-A	A AXIS OVER TRAVEL	SAFETY
X0119.6	OT-B	B AXIS OVER TRAVEL	SAFETY
X0119.7	BTSOT	BTS OVERTRAVEL	SAFETY
X0120.2	PRDYS	APC READY PUSHBUTTON	
X0120.3	PCMAS	APC MANUAL PUSHBUTTON	
X0120.4	*PCPS	APC FEEDHOLD PUSHBUTTON	
X0121.0	ADOPN	AUTO DOOR OPEN PB	
X0121.1	ADCLS	AUTO DOOR CLOSE PB	

2 Output Signal List

Signal Address	Signal Name	Description	Classification
Y0000.0	SA	SERVO READY	AXIS
Y0000.1	OTR	OVERTRAVEL RELEASE	AXIS
Y0000.2	MCF	MCC ON	SAFETY
Y0000.3	EMSG	EMG + SG DOOR	SAFETY
Y0000.4	EMATC	EMG + ATC DOOR	SAFETY
Y0000.6	EMG	EMERGENCY	SAFETY
Y0000.7	POUT	AUTO POWER OFF	PROTECTION
Y0001.0	SL181	AIR BLOW	SPINDLE
Y0001.1	SL09	TAPER CLEANING AIR 1	SPINDLE
Y0001.2	SL192	THROUGH SPINDLE AIR	SPINDLE
Y0001.3	SL18	SPINDLE AIR SEAL	SPINDLE
Y0001.4	SL2300/SL171 (20K)	SPINDLE LUBRICATION AIR (OIL AIR UNIT)	SPINDLE
Y0001.5	OMON	SPINDLE CHILLER ON	SPINDLE
Y0001.6	CLOMON	COOLANT CHILLER ON	COOLANT
Y0001.7	RCHP	SPINDLE STATOR CONN	SPINDLE
Y0002.0	SP01	MANUAL AIR GUN	SPLASHGUARD
Y0002.1	BLCOM	SUCTION UNIT ENABLE	SPINDLE
Y0002.2	EMSG_2	APC MAINTENANCE DOOR (SPARE3)	SPLASHGUARD
Y0002.3	MS154	OIL AIR UNIT PUMP ON	SPINDLE
Y0002.4	SL912	FRONT DOOR UNLOCK SOLENOID	SAFETY
Y0002.5	SL913	ATC DOOR UNLOCK SOLENOID	SAFETY
Y0003.0	ENBL1	ENABLE1	MEASUREMENT
Y0003.1	ENBL2	ENABLE2	MEASUREMENT
Y0003.2	ENBL0/LSRC_L	LASER CLEARANCE (ENABLE 0)	MEASUREMENT
Y0003.3	SL304	LASER SHUTTER OPEN	MEASUREMENT
Y0003.4	SL303	PURGE AIR	MEASUREMENT
Y0003.5	SL302	TOOL CLEANING AIR	MEASUREMENT
Y0003.6	OPPON	MEASURING PROBE POWER ON	MEASUREMENT
Y0003.7	PRBSEL	PROBE SELECT	MEASUREMENT

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
Y0004.0	SL01A	SP TOOL CL SOLENOID	SPINDLE
Y0004.1	SL01B	SP TOOL UNCL SOLENOID	SPINDLE
Y0004.2	MS2	NOZZLE COOLANT	COOLANT
Y0004.3	MS16	FLUSH CL	COOLANT
Y0004.4	SL1337/SLSUC1	NOZZLE COOLANT ON/SUCTION SOL1	COOLANT
Y0004.5	ALSXYF	AUTO GREASE INJECTOR CW	AUTO GREASE
Y0004.6	SL132B-1	AUTO FRONT DOOR OPEN	SPLASH GUARD
Y0004.7	SL132A-1	AUTO FRONT DOOR CLOSE	SPLASH GUARD
Y0005.0	MS7F	SPIRAL CONVEYOR FWD	CHIP CONVEYOR
Y0005.1	MS7R	SPIRAL CONVEYOR REV	CHIP CONVEYOR
Y0005.2	SL711A	ATC SHUTTER CLOSE	SPLASH GUARD
Y0005.3	SL711B	ATC SHUTTER OPEN	SPLASH GUARD
Y0005.4	MS4	HYD UNIT ON	HYDRAULIC
Y0005.5	SL905	MASTER SOLENOID VALVE	HYDRAULIC
Y0005.6	SL750/SLSUC2	WORK WASH GUN/SUCTION SOL2	COOLANT
Y0005.7	SLATCF/SLSUC3	ATC FLUSH/SUCTION SOL3	ATC
Y0006.0	SL21	POT VERTICAL	ATC
Y0006.1	SL20	POT HORIZONTAL	ATC
Y0006.2	SL1081A/SL776	TLS TOOL LOCK	ATC
Y0006.3	SL1081B	TLS TOOL UNLOCK	ATC
Y0006.4	HOUR1	SPINDLE RUN HOUR METER	SPINDLE
Y0006.5	HOUR2	MACHINE CYCLE RUN HOUR METER	SPINDLE
Y0006.6	PIVRH/SL612	INVERTER SPEED 1 (HIGH SPEED)/PRELOAD1 (CX14)	SPINDLE
Y0006.7	PIVRH/SL613	INVERTER SPEED 2 (MID SPEED)/PRELOAD2 (CX14)	SPINDLE
Y0007.0	PIVRL	INVERTER SPEED 3 (LOW SPEED)	ATC
Y0007.1	MS78B	ATC MOTOR BRAKE	ATC
Y0007.2	MS78F/SL2301	ATC MOTOR FORWARD/SL2301(CX14)	ATC
Y0007.3	MS78R/SL615	ATC MOTOR REVERSE/SPINDLE EXHAUST(CX14)	ATC
Y0007.4	SL132A-2	AUTO DOOR CLOSE SLOW DOWN	SPLASHGUARD
Y0007.5	MS18	OIL SKIMMER	SPINDLE
Y0007.6	NZSLVLV	NOZZLE SOL VALVE	COOLANT
Y0007.7	SL16	TAPER CLEANING AIR 2	COOLANT
Y0008.0	SL150	A-AXIS UNCLMAP	4TH AXIS

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
Y0008.1	BRK4/SL150B	4TH AXIS BRAKE/CLAMP	4TH AXIS
Y0008.2	SL151	C-AXIS UNCLAMP	5TH AXIS
Y0008.3	BRK5/SL151B	5TH AXIS BRAKE/CLAMP	5TH AXIS
Y0008.4	SL1308	TS UNION BACKUP AIR	COOLANT
Y0008.5	SL1309	TS UNION DRAIN	COOLANT
Y0008.6	SL1306	TSC SUPPLY & DRAIN	COOLANT
Y0008.7	SL1310	TS SUCTION SOLENOID	COOLANT
Y0009.0	LCALMIL	LUCC ALARM LAMP	CHIP CONVEYOR
Y0009.1	LCMAL	LUCC MANUAL INTERRUPT LAMP	CHIP CONVEYOR
Y0009.2	MS6F	R LUCC FORWARD	CHIP CONVEYOR
Y0009.3	MS6R	R LUCC REVERSE	CHIP CONVEYOR
Y0009.4	MS8	THROUGH SP CL	COOLANT
Y0009.5	MS10	OVERHEAD SHOWER CL	COOLANT
Y0009.6	MS19	MIST COLLECTOR	COOLANT
Y0009.7	OMON3	FEED AXIS CHILLER	COOLANT
Y0011.2	SL130B-L	LEFT SIDE DOOR OPEN	SPLASHGUARD
Y0011.3	SL130A-L	LEFT SIDE DOOR CLOSE	SPLASHGUARD
Y0011.5	MS6A	DRUM FILTER CLEANING PUMP	COOLANT
Y0011.6	MS71	SEC FILTER TANK PUMP ON	COOLANT
Y0011.7	M260-2	2ND HYD POWER PACK	SPINDLE
Y0012.6	SL150-2	ADDITIONAL 3RD AXS UNCL	3RD AXIS
Y0013.0	SL151-2	ADDITIONAL 4TH AXS UNCL	4TH AXIS
Y0014.4	USDO1	USER DO1	USER I/O
Y0014.5	USDO2	USER DO2	USER I/O
Y0014.6	USDO3	USER DO3	USER I/O
Y0014.7	USDO4	USER DO4	USER I/O
Y0015.0	USDO5	USER DO5	USER I/O
Y0015.1	USDO6	USER DO6	USER I/O
Y0015.2	USDO7	USER DO7	USER I/O
Y0015.3	USDO8	USER DO8	USER I/O
Y0016.0	MCRDY LOAD ERDBIT8	MACHINE READY CHANGING COMMAND DATA BIT 256	ROBOT INTERFACE
Y0016.1	*MCALM A8 ERDBITP	MACHINE ALARM MAGAZINE NUMBER BIT8 DATA BIT PARITY	ROBOT INTERFACE
Y0016.2	*MCWRN CHUCK ERDBIT9	MACHINE WARNING CHUCK NUMBER CHUCK ADDRESS BIT 1	ROBOT INTERFACE

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
Y0016.3	ACSOK TCP1 ERDBIT10	INTERVENTION PREMISSION CHUCK1 INPOSITION CHUCK ADDRESS BIT2	ROBOT INTERFACE
Y0016.4	WSRDY COP1 ERSTART	START RESERVATION CONDITION CHUCK1 CL/UC OK START	ROBOT INTERFACE
Y0016.5	MCRUN TCP2 ERULCHK ERCHRBT	MACHINE RUNNING CHUCK2 INPOSITION CHUCK UNLOCK PERMISSION CHUCK AWC SIDE	ROBOT INTERFACE
Y0016.6	WLDRQ COP2 ERMACC ERMINT	EROWA WORK LOAD REQUEST CHUCK2 CL/UC OK MACHINE ACCESS MOTION INTERLOCK	ROBOT INTERFACE
Y0016.7	WULDRQ	WORK UNLOAD REQUEST	ROBOT INTERFACE
Y0017.0	WSCOK A0 ERDBIT0	WORK SEATING OK MAGAZINE NUMBER BIT0 DATA BIT 1	ROBOT INTERFACE
Y0017.1	WSCNG A1 ERDBIT1	WORK SEATING NG MAGAZINE NUMBER BIT1 DATA BIT 2	ROBOT INTERFACE
Y0017.2	FCLFN A2 ERDBIT2	FIXTURE CLAMP FINISH MAGAZINE NUMBER BIT2 DATA BIT 4	ROBOT INTERFACE
Y0017.3	FUCFN A3 ERDBIT3	FIXTURE UNCLAMP FINISH MAGAZINE NUMBER BIT3 DATA BIT 8	ROBOT INTERFACE
Y0017.4	PCP01 A4 ERDBIT4	STOCKER PALLET NO 1 MAGAZINE NUMBER BIT4 DATA BIT 16	ROBOT INTERFACE
Y0017.5	PCP02 A5 ERDBIT5	STOCKER PALLET NO 2 MAGAZINE NUMBER BITS5 DATA BIT 32	ROBOT INTERFACE
Y0017.6	WCN01 A6 ERDBIT6	WORK CONDITION NO 1 MAGAZINE NUMBER BIT6 DATA BIT 64	ROBOT INTERFACE
Y0017.7	WCN02 A7 ERDBIT7	WORK CONDITION NO 2 MAGAZINE NUMBER BIT7 DATA BIT 128	ROBOT INTERFACE
Y0018.0	ERDBIT7	EROWA DATA BIT7	ROBOT INTERFACE
Y0018.1	ERDBIT8	EROWA DATA BIT8	ROBOT INTERFACE
Y0018.2	ERDBIT9	EROWA DATA BIT9	ROBOT INTERFACE
Y0018.3	ERDBIT10	EROWA DATA BIT10	ROBOT INTERFACE
Y0021.4	CUSDO13	CUSTOM DESIGN OUTPUT 13	OPERATOR PANEL
Y0021.5	CUSDO14	CUSTOM DESIGN OUTPUT 14	OPERATOR PANEL
Y0060.0	LHY1CL	STOCKER SIDE FX CLMP LMP	Fixture
Y0060.1	LHY1UC	STOCKER SIDE FX UNC LMP	Fixture
Y0060.2	LEJCL	STOCKER SIDE EJECT CLMP LMP	Fixture

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Signal Address	Signal Name	Description	Classification
Y0060.3	LEJUC	STOCKER SIDE EJACT CLMP UNLMP	Fixture
Y0060.4	SL2601	HYD SOLENOID 1	Fixture
Y0060.5	SL2602	HYD SOLENOID 2	Fixture
Y0060.6	SL2603	HYD SOLENOID 3	Fixture
Y0060.7	SL2604	HYD SOLENOID 4	Fixture
Y0061.0	SL2605	HYD SOLENOID 5	Fixture
Y0061.1	SL2606	HYD SOLENOID 6	Fixture
Y0061.2	SL2607	HYD SOLENOID 7	Fixture
Y0061.3	SL2608	HYD SOLENOID 8	Fixture

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
Y0061.4	MS260	HYD MOTOR ON	FIXTURE
Y0061.5	MNLLMP	FIX MANUAL LAMP	FIXTURE
Y0061.6	LAIRS	AS CHECK VALID LAMP	FIXTURE
Y0061.7	MS106	TABLE COOLANT	FIXTURE
Y0062.0	SL2701	HYD SOLENOID 101	FIXTURE
Y0062.1	SL2702	HYD SOLENOID 102	FIXTURE
Y0062.2	SL2703	HYD SOLENOID 103	FIXTURE
Y0062.3	SL2704	HYD SOLENOID 104	FIXTURE
Y0062.4	SL2705	HYD SOLENOID 105	FIXTURE
Y0062.5	SL2706	HYD SOLENOID 106	FIXTURE
Y0062.6	SL2707	HYD SOLENOID 107	FIXTURE
Y0062.7	SL2708	HYD SOLENOID 108	FIXTURE
Y0063.0	SL1801	FIX. CLEAN SOLENOID 1	FIXTURE
Y0063.1	SL1802	FIX. CLEAN SOLENOID 2	FIXTURE
Y0063.2	SL1803	FIX. CLEAN SOLENOID 3	FIXTURE
Y0063.3	SL1804	FIX. CLEAN SOLENOID 4	FIXTURE
Y0063.4	SL1781	AS CHECK SOLENOID 1	FIXTURE
Y0063.5	SL1782	AS CHECK SOLENOID 2	FIXTURE
Y0063.6	SL1783	AS CHECK SOLENOID 3	FIXTURE
Y0063.7	SL1784	AS CHECK SOLENOID 4	FIXTURE
Y0100.0	EDTL	EDIT MODE SWITCH LAMP	OPERATOR PANEL
Y0100.1	MEML	MEMORY MODE SWITCH LAMP	OPERATOR PANEL
Y0100.2	DL	MDI MODE SWITCH LAMP	OPERATOR PANEL
Y0100.3	TL	TAPE MODE SWITCH LAMP	OPERATOR PANEL
Y0100.4	HL	HANDLE MODE SWITCH LAMP	OPERATOR PANEL
Y0100.5	JL	JOG MODE SWITCH LAMP	OPERATOR PANEL
Y0100.6	RTL	RAPID MODE SWITCH LAMP	OPERATOR PANEL
Y0100.7	ZRNL	REF MODE SWITCH LAMP	OPERATOR PANEL
Y0101.0	FPL1	SINGLE BLOCK	OPERATOR PANEL
Y0101.1	FPL2	BLOCK SKIP	OPERATOR PANEL
Y0101.2	FPL3	OPTIONAL STOP	OPERATOR PANEL
Y0101.3	FPL4	DRY RUN	OPERATOR PANEL
Y0101.4	FPL5	COOLANT ON/OFF	OPERATOR PANEL

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
Y0101.5	FPL6	NOZZLE COOLANT	OPERATOR PANEL
Y0101.6	FPL7	AIR BLOW	OPERATOR PANEL
Y0101.7	FPL8	TS COOLANT	OPERATOR PANEL
Y0102.0	FPL9	SPINDLE SPEED (-)	OPERATOR PANEL
Y0102.1	FPL10	SPINDLE SPEED (+)	OPERATOR PANEL
Y0102.2	FPL11	SPINDLE ORIENTATIONSPINDLE ORIENTATION	OPERATOR PANEL
Y0102.3	ALRSTL	ALARM RESET PANEL	OPERATOR PANEL
Y0102.4	XAXL	X AXIS SELECT LAMP	OPERATOR PANEL
Y0102.5	YAXL	Y AXIS SELECT LAMP	OPERATOR PANEL
Y0102.6	ZAXL	Z AXIS SELECT LAMP	OPERATOR PANEL
Y0102.7	4AXL	4TH AXIS SELEEECT LAMP	OPERATOR PANEL
Y0103.0	5AXL	5TH AXIS SELECT LAMP	OPERATOR PANEL
Y0103.1	6AXL	CS AXIS SELECT LAMP	OPERATOR PANEL
Y0103.2	OTF1L	AUTO ZERO	OPERATOR PANEL
Y0103.3	OTF2L	TOOL CHANGE	OPERATOR PANEL
Y0103.4	OTF3L	SETUP POSITION	OPERATOR PANEL
Y0103.5	OTF4L	CUSTOM	OPERATOR PANEL
Y0103.6	OTFSTL	ROUTINE FUNCTION START	OPERATOR PANEL
Y0103.7	OTFSPL	ROUTINE FUNCTION STOP	OPERATOR PANEL
Y0104.0	SPLO	FEED HOLD	OPERATOR PANEL
Y0104.1	STLO	CYCLE START	OPERATOR PANEL
Y0104.2	SPONL	SPINDLE ON LAMP	OPERATOR PANEL
Y0104.3	POFFL	POWER OFF	OPERATOR PANEL
Y0104.4	STUCL	SPINDLE TOOL UNCLAMP SWITCH LAMP	OPERATOR PANEL
Y0104.5	FPL12	SCREW CONVEYOR ON/OFF LAMP	OPERATOR PANEL
Y0104.6	SPRL1/SUGNLP	SPARE 1/SUCTION GUN LAMP	OPERATOR PANEL
Y0104.7	PTL3	SIGNAL LIGHT 3	OPERATOR PANEL
Y0105.0	PTL2	SIGNAL LIGHT 2	OPERATOR PANEL
Y0105.1	PTL1	SIGNAL LIGHT 1	OPERATOR PANEL
Y0105.2	MLT	MACHINE LIGHT IN SPLASH GUARD	OPERATOR PANEL
Y0105.3	LECO	ECO LAMP	OPERATOR PANEL
Y0105.4	TAPRTL	TAP RETRACT LAMP	OPERATOR PANEL
Y0105.5	LMLGT1	PB LAMP STOCKER SIDE MACHINE LIGHT	OPERATOR PANEL
Y0105.6	LP569	OPERATOR DOOR UNLOCK LAMP	OPERATOR PANEL

Chapter 17 Signal Tables

Signal Address	Signal Name	Description	Classification
Y0105.7	PTL4	SIGNAL LIGHT 4	OPERATOR PANEL
Y0106.3	PMCOK	PMC STATUS CHECK	OPERATOR PANEL
Y0107.1	LSETUP	LAMP SETUP FINISH	OPERATOR PANEL
Y0107.3	PRDYL	APC READY LAMP	OPERATOR PANEL
Y0107.4	PCMAL	APC MANUAL LAMP	OPERATOR PANEL
Y0107.5	PCSPL	APC FEEDHOLD LAMP	OPERATOR PANEL
Y0107.6	LP970	STOCKER DOOR UNLOCK LAMP	OPERATOR PANEL
Y0107.7	MLGT1	STOCKER SIDE MACHINE LAMP	OPERATOR PANEL

Revision Record

Manual Title	PS155 MAINTENANCE MANUAL Professional <i>u</i>
Manual No.	V360I-M1E-XC

No.	Manual No. (Month/Year Issued)	Contents	Remarks
1	V360I-M1E-XA (07/2024)	Newly issued	
2	V360I-M1E-XB (09/2024)	Controller name change from Professional S to Professional <i>u</i> .	
3	V360I-M1E-XC (10/2024)	Controller name change from Professional <i>u</i> to Professional <i>U</i> .	