MITSUBISHI ELECTRIC

WIRE-CUT EDM SYSTEMS

MODEL

MG Series

INSTRUCTION MANUAL

Art.-Nr.: 791353

ORIGINAL OPERATING INSTRUCTIONS

BRN-83587-*-002_260721_ENG-fi

https://www.mitsubishielectric-edm.de/manuals/

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MG Series

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II. AUTOMATIC WIRE FEEDER

III. NC OPERATION DISPLAY SCREEN

IV. PROGRAMMING

V. MAINTENANCE AND ALARM LIST

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BRN-83587-*-002_260721_ENG-fi

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BRN-83587-001-*-002

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1. SAFETY

The machine is built with the latest available technology and is reliable provided the operating manual is observed and the machine- and operation-specific requirements are met.
Nevertheless, the risk of harm to the health of the user or third parties, impairment of the machine, or other property damage may arise during use.

⚠CAUTION

Warning notices and safety instructions
To handle the machine safely, adhere to the safety instructions in this section and the warnings elsewhere in this operating manual.

1.1 Usage conditions

To use the machine properly, observe the following instructions:

- Use the machine only if it is in proper and sound technical condition.
- Use the machine only for its intended purpose, with hazards and safety requirements in mind and in compliance with the operating manual.
- Check the machine for damages or irregularities before working on it. If you notice damage to or malfunctions in the machine that might impair safety, do not use the machine and notify the Service Department of Mitsubishi Electric.

1.2 Intended use

⚠WARNING

Risk of injury or material damage due to non-intended use.
Non-intended use may lead to injuries and/or material damage due to risks from mechanical, electrical, thermal or chemical hazards.
The machine must only be used as intended according to the following requirements.

The EDM systems manufactured by MITSUBISHI are solely intended for machining compliant to the definition of the "Electrical discharge machining of workpieces" and must not be used in any way that deviates from the operating instructions.
Further requirements for intended use of the EDM system include the following:

- Correct use in accordance to the instructions also includes compliance to the operating, maintenance and repair conditions stipulated by the manufacturer. The EDM systems may only be used, maintained and repaired by persons who are acquainted with them and who have been informed of the hazards.
- In addition to the instructions contained in the technical documentation, the generally valid safety and accident-prevention regulations must also be observed.
- The manufacturer is not liable for any damages arising from non-authorised changes made to the EDM system.

⚠CAUTION

Modifications to the system
If changes to the machine are required then these must be carried out by the manufacturer. No responsibility can be accepted by the manufacturer if this instruction is not observed.

1.3 Non-intended use

Examples for non-intended use include:

- Operation in areas or in atmospheres where there is a risk of explosion.
- Operation at altitudes above 1000 metres
- Removal or deactivation of safety equipment.
- Modifications of the PLC systems.
- Any other or additional use that is not in accordance to the instructions

The manufacturer/supplier is not liable for any damages resulting from such use. This risk is borne solely by the user.

1.4 Personnel qualifications

Only personnel who fulfils the following requirements is authorised to handle the machine:

- They are duly qualified and authorised by Mitsubishi Electric.
- They have read this operating manual completely and understood it.
- They are in perfect health and in full command of their mental and physical abilities.
- They are rested and not under the influence of drugs, alcohol, or medications that might reduce reaction or attention.
- They are regularly instructed on difficulties, hazards, special rules of behavior, and fire prevention and occupational health and safety rules.
- They always ensure workstation cleanliness and orderliness.
- To ensure occupational safety, they wear the necessary personal protective equipment.
- They always observe the accident prevention and safety regulations and comply with all legal provisions relevant to personal safety and the safety of others.

All other persons are forbidden to interact with the machine. Roles and responsibilities must be clearly assigned by the operating company in order to prevent ambiguity when it comes to safety relevant tasks.

⚠DANGER

Risk of injury or death due to interference with active implanted cardiac devices
Active implanted cardiac devices might be disturbed by the magnetic fields around the machine, resulting in injury or even death.
Access to the machine must be interdicted to people with active implanted cardiac devices.

1.4.1 Hazards during transport and installation

Transport, installation and relocation must only be taken over by Mitsubishi Electric. However, note the following information and safety considerations for integration of the machine into your work environment.

1.4.2 General considerations

- Make sure that there is enough space around the installation area for maintenance work (refer to the detailed installation/assembly plans).
- The area in which the equipment is assembled should have a hard, non-slip industrial floor.

1.4.3 Installation Conditions

Ensure the space required for maintenance and check according to the configuration diagram. Besides, install the machine at a site meeting the following conditions:

1) Intended use of the EDM system

The erosion systems manufactured by MITSUBISHI are to be used exclusively for machining in accordance with the definition of “electrical discharge machining of workpieces” and not in deviation from the operating instructions.

The MITSUBISHI EDM device must not be operated in potentially explosive atmospheres or areas.

The use of the EDM device must not exceed 1000 meters in altitude.
Any other use or use beyond this is considered improper use. The manufacturer/supplier is not liable for any damage resulting from this. The user alone bears the risk. Intended use also includes compliance with the operating, maintenance and servicing conditions specified by the manufacturer. The erosion systems may only be used, maintained and repaired by persons who are familiar with them and have been informed of the dangers. The relevant accident prevention regulations and other generally recognized safety and occupational health regulations must be observed. Unauthorized modifications to the erosion systems exclude the manufacturer's liability for any resulting damage.

2) Room temperature

- Recommended room temperature: 20±1°C
- Acceptable room temperature: 5°C to 35°C

Temperature changes directly affect the mechanical precision, so it is advised to minimize temperature changes. It is notable that the machining precision may be deteriorated in the environment where the temperature change within 24 hours is greater than 3°C or the temperature change within 1 hour is greater than 1°C. Besides, prevent the air conditioner from directly blowing air towards the main mechanical body and avoid direct sunshine. Meanwhile, do not install the machine near a heating device.

3) Environment

Please install the machine at a site with less dust and free of corrosive gas or fog containing acid and salt. The grinding powder of a grinding machine generates adverse effect on the driving parts such as the mechanical driving part and ball screw, which must be fully noted when an installation site is selected. For example, isolate the machine from the grinding machine or install it in a different workshop.
Besides, do not use the machine in an environment with flammable gas or an explosive environment.

4) Humidity

35% to 75% RH (no condensation)

5) Mechanical heating value

As designing a thermostatic chamber, calculate the heating value of the electric discharge machine based on

the integrated input power (MG series).

6) Vibration of the installation ground

The recommended allowable value for the installation ground

- 10 Hz and less: 0.07 Gal (cm/s^2) and less
- 10 Hz and more: 8 μm/s and less

7) Foundation

As the place is to bear the weight of equipment, it is suggested that the concrete thickness meets following conditions.

400 mm and more

8) Indoor structure

It is recommended to use flame retardant material or fireproof structure for the site for installing the machine. For more information, consult the competent fire department.

9) Ventilation of flammable vapour

Please install a ventilation device that can efficiently remove the flammable vapour or dust. The installation site and dimensioning must be coordinated with Mitsubishi Electric. The ventilation device must be accepted and regularly checked according to local regulations.

10) Temperature during transportation or storage

0°C ~ 55°C

For the powered-on machine, operate it under the condition described in "(1) Room temperature".

11) Electromagnetic interference

Do not use the machine at a site where the primary power supply will bear a surge voltage higher than 1000 V and 1 μm or a site near the large-sized inverter, high output and high frequency oscillator, large-sized contactor or welding machine where a high field or high-intensity magnetic field will be generated.

12) Static electricity

Do not use the machine at a site that will directly bear static electricity higher than 5 kV.

13) Grounding

The grounding of the machine’s electrical system must be assured.

14) Radiation

Do not use the machine at a site where the radiation value greatly exceeds the regular radiation value allowed by the human body.

1.5 Hazards during operation and maintenance

1.5.1 Hazards from dielectric fluid

(1) Air humidity

The air humidity should not be more than 75% and not less than 30%.

(2) Air conditions

The erosion system should not be operated in the following air conditions:

- In rooms with oily, acidic or heavily contaminated air.
- In rooms with dust.
- In rooms with explosive gases.

(3) Operation environment

Please frequently tidy up the four sides of the table for the electric discharge machine and also pay attention to the following items:

- Always store the dielectric so that it is inaccessible to children.
- Keep food and drinks away from the dielectric fluid.
- Pay attention to naked light or high temperature objects such as the heater, welding machine, and grinding machine, and observe the regulations on prohibiting naked light.
- Tidy and clean the room. Do not place any combustible material around the machine.
- Ensure sufficient ventilation.
- In addition to the automatic fire extinguishing device installed on the electric discharge machine, set fire extinguishers nearby the machine.

(4) Special precautions during machining

- Never open the work tank door or the locking lever when the work tank is full.
- Check the work tank regularly for leaks. If leaks occur then contact your MITSUBISHI Service Center.
- Switch off the machine immediately if there is a risk of dielectric flowing into the electrical equipment.
- Prohibit machining as jetting. Do not conduct machining as jetting dielectric fluid on a workpiece.
- To ensure that the dielectric fluid level is higher than the upper surface of the workpiece, please correctly set the fluid level setting box or the working tank door position.
- Pay attention to the workpiece installation method and the position of fixing device to prevent electric discharge near the fluid level.
- Monitor automatic operation. Even for the automatic operation when all the safety devices are equipped, in consideration of safety, appoint at least a number of workers who can adopt correct measures in case of a fire.
- Prevent the dielectric fluid from escaping. This could lead to slipping and the risk of falling. If dielectric fluid should escape, clean it up immediately.

(5) Hazards from pressurised air

Parts of the machine are powered by compressed air. Work on the relevant equipment may only be performed by qualified specialists with special knowledge of and experience in this field of expertise. During malfunctions and work, the following safety rules are to be complied with:

- Switch off the media supply and secure it against being switched back on
- Close off the lines and secure them against being switched back on.
- Allow hot parts to cool sufficiently if necessary.
- Depressurise the system sections and lines that are to be opened.

Check all lines, hoses, and screw connections for leaks and damage after work is complete and regularly thereafter. Replace damaged parts immediately.

Note that cylinders and work elements may move when media is turned on after work is completed; take corresponding precautions.

1.5.2 Precautionary measures for inspection and maintenance

Always carry out inspection and maintenance work in accordance with the instructions in the technical documentation so as not to impair the function and safety of the machine.

Always switch off the machine before carrying out maintenance work and lock the main switch on the input transformer in the “OFF” position.
Lock the main switch on the transformer with a U-lock!

If maintenance work has to be carried out with the main switch switched on, observe the following points:

- The processing voltage must not be applied.
- The machine must not be in automatic mode.
- Avoid any additional risk.
- Mark the machine in a clearly visible place with a sign (e.g. “CAUTION! MAINTENANCE WORK”) so that the machine is not accidentally started up by unauthorized persons while inspection or maintenance work is being carried out.

(1) Notes on inspection and maintenance

Inspection and maintenance work must be carried out regularly and in accordance with the specs in the operating instructions. Ensure that the following points have been read and understood before carrying out any work on the machine.

(2) Training of service personnel

To rule out risks due to a lack of specialist knowledge or incorrect operation of the machine, inspection and maintenance work may only be carried out by appropriately trained personnel. Unauthorized or untrained persons are prohibited from carrying out inspection or maintenance work.

(3) Scope of inspection and maintenance

The scope of the work to be carried out is limited to the items approved in accordance with the operating instructions. Never dismantle or disassemble other components of the machine. In addition to the precision mechanics it contains, there are high-voltage areas both in the machine and in the control cabinet. Unintentional contact with these areas can lead to injury from electric current and damage or destruction of the machine.

(4) Consumables

Only original consumables from the manufacturer should be used to prevent damage and other hazards. If other consumables are used, the manufacturer accepts no responsibility for accidents, malfunctions or faults etc. that may occur.

(5) Waste disposal

The dielectric, the filter elements, the ion exchange resin, the wire electrode, etc. are considered industrial waste. Observe the applicable municipal requirements and regulations for disposal.

(6) Cleaning precautions

When cleaning the machine with dielectric, make sure that no dielectric gets inside the machine.

(7) Cleaning the air filter

Heavy soiling of the air filter can lead to overheating. The air filter must therefore be cleaned regularly. The air filter area on the left-hand side of the machine bed is equipped with a fan. Therefore, always switch off the machine before cleaning the air filter.

(8) Miscellaneous

Even if the main power switch (NFB) is switched off, electrical components may still be charged. Therefore, always contact your MITSUBISHI customer service before replacing fuses, etc.

5.2.9 Environmental hazards

The operating fluids and certain machine components such as filter elements, used electrodes etc. may be environmentally hazardous:

- When operating fluids must be replaced or machine components reach their end of service life: Make sure that they are disposed of properly and in an environmentally friendly manner according to the local regulations.

1.6 Errors and abnormal conditions

1.6.1 Preventive measures in the event of irregularities

If faults occur, switch off the machine immediately.

If there is an unusual smell or smoke after switching off, disconnect the machine from the power supply.

1.6.2 Measures in the event of a fault

Report the current error to MITSUBISHI customer service and follow their instructions.

1.7 Noise emission

The workplace-related emission value of the eroding system is less than 70 db(A).

- Measurement according to: EN ISO 11688-1:2009

1.8 Notes on storage and prolonged shutdown of the machine

- Observe the instructions in section C.2.3 f in this chapter. Avoid storing the machine in rooms with sub-zero temperatures. Residues in the pipes and valves can cause damage.
- Check the condition of the cables etc. before commissioning the machine.

1.9 Converting the machine

Special work is required to convert the machine. Contact MITSUBISHI customer service for such work.

1.10 Precautions for waste disposal

- The dielectric, filter elements, used electrodes, etc. are considered industrial waste. Observe the applicable municipal requirements and regulations for disposal.
- The cooling unit is filled with refrigerant. Observe the applicable municipal requirements and regulations for disposal.
- Observe the applicable municipal requirements and regulations for disposal of all other parts.

1.11 Installed safety devices and instructions for their operation

1.11.1 Emergency stop buttons

The machine is equipped with an emergency stop system which serves to shut down dangerous functions and movements. Observe the following instructions:

- Ensure that the emergency stop button is always freely accessible and can be reached by operating personnel.
- Depending on circumstances, using emergency stop buttons may give rise to undefined switch-off states. Check the machine before switching it back on.
- To switch the machine back on after an emergency stop, follow the procedures communicated in the operator training by Mitsubishi Electric.

The emergency stop buttons are located in the following positions on the machine ("Fig. I.5.1 " on page 21):

- Emergency stop button at the control unit
- Emergency stop button at the manual operation box

1.11.2 Hand-held pendant station

- Do not tear or kink the cable of the hand-held pendant station.
- Handle the hand-held pendant station with care so that it does not get damaged or wet.

1.11.3 Dielectric and rust protection

Observe the manufacturer’s safety instructions when handling the dielectric.
Make sure that the dielectric is never swallowed or gets into the eyes.
Always store the dielectric in such a way that it can never fall into the hands of children.

- Never open the work tank door or the locking lever when the work tank is full.
- Check the working tank regularly for leaks. If leaks occur, contact MITSUBISHI customer service. Switch off the machine immediately if dielectric fluid threatens to leak into the electrical system.

1.11.4 Modifications

For safety reasons, no technical modifications may be made to the machine.
If modifications to the machine are necessary, these must be carried out by the manufacturer. No responsibility can be accepted by the manufacturer in the event of non-compliance.

Do not remove any protective covers in the area of the machine, the eroding unit or the tool changer. The safety switches must also not be bridged or modified.

No program changes (software) may be made to programmable control systems!

- Only use original spare and wear parts - according to the manufacturer's instructions. Otherwise there may be a loss of safety and performance.
- All safety devices must be kept in proper condition and must not be removed.
- Never remove safety notices and always keep them clean. They must be clearly legible at all times.
- Contact MITSUBISHI customer service if the safety instructions are no longer legible.

1.12 Personal protective equipment

To work safely with and on the machine, you may need to wear personal protective equipment. The following table lists the minimum personal protective equipment to be worn for various work on the machine if the operating company provides no additional information.

Personal protective equipment	Required type / protection class	To be worn during
Protective work shoes	Water resistant	All tasks at the machine
Protective work gloves	Water resistant	All tasks at the machine
Safety glasses	Water resistant	All tasks at the machine

1.13 Residual risks

Danger of electric shock

Never touch the wire during processing. There is a risk of electric shock.
Pay particular attention to this when the V-axle is moved forward.
If the operator behaves abnormally during operation, it is possible to reach the electrode.

Dangers due to the dielectric

Avoid any eye contact when handling the dielectric. Wear safety goggles if there is a risk of splashes.

- Keep food and beverages away from the dielectric.
- Consumption of dielectric water is harmful to health.
- Avoid any eye contact when handling the dielectric. Wear safety goggles if there is a risk of splashes. If eyes and/or mucous membranes are contaminated, clean immediately and consult a doctor.
- Improper handling of the dielectric for the application can lead to splashing.
- Avoid leakage of dielectric. This could lead to the risk of slipping and falling.
- If dielectric water escapes, it must be removed immediately.
- Avoid contamination with dielectric by spray mist. This can occur if the flush is used incorrectly.

Use protective gloves (PPE)

For your own protection, wear protective gloves that protect you against injury from workpieces and safety shoes that protect you against injury from falling workpieces.

Risk of crushing

When moving the axles, there is a risk of crushing between the lower working head and the clamping frame.
The referencing speed is 300 mm/min
Incorrect handling or positioning of the hand-held pendant station can result in crushing hazards due to unintentional movement of the axles.
In automatic position mode, there is a risk of crushing when moving the Z-axis in auto mode in the Z-plus direction (reference point) and when moving in the X-direction to the reference point. There is a risk of crushing due to abnormal behavior of the operator when closing the automatic tank door. Here it is possible to reach the danger zone and squeeze yourself in.
There is a risk of crushing during cleaning work on the drainage unit. The drain flaps can lead to crushing. This also applies if the manual control box is operated in one-handed mode.

Risk of incorrect operation due to failure to follow the operating instructions

Observe the operating instructions and the proper handling of the machine.

Risk for implant recipients

The drive system consists of a permanent magnet. Please note the magnetic field.

Rrisk of breakthrough and fallings

Climbing on the machine is prohibited.

1.14 Signs and warnings

Areas where a potential hazard exists under certain circumstances are marked with warnings and information signs.

- Warning signs and information plates must not be removed.
- Damaged or removed warning signs and information plates must be replaced immediately.
- Warning signs and information plates must be checked regularly for completeness and legibility.

These warning signs and information plates are located on the machine or in the immediate working environment of the machine:

Symbol	Meaning
	No access for people with active implanted cardiac devices.
	Electricity warning
	Magnetic field warning
	Warning. Crushing of hands.
	Wear eye protection
	Wear protective gloves
	Wear safety footwear
	See instruction manual

1. CONFIGURATION

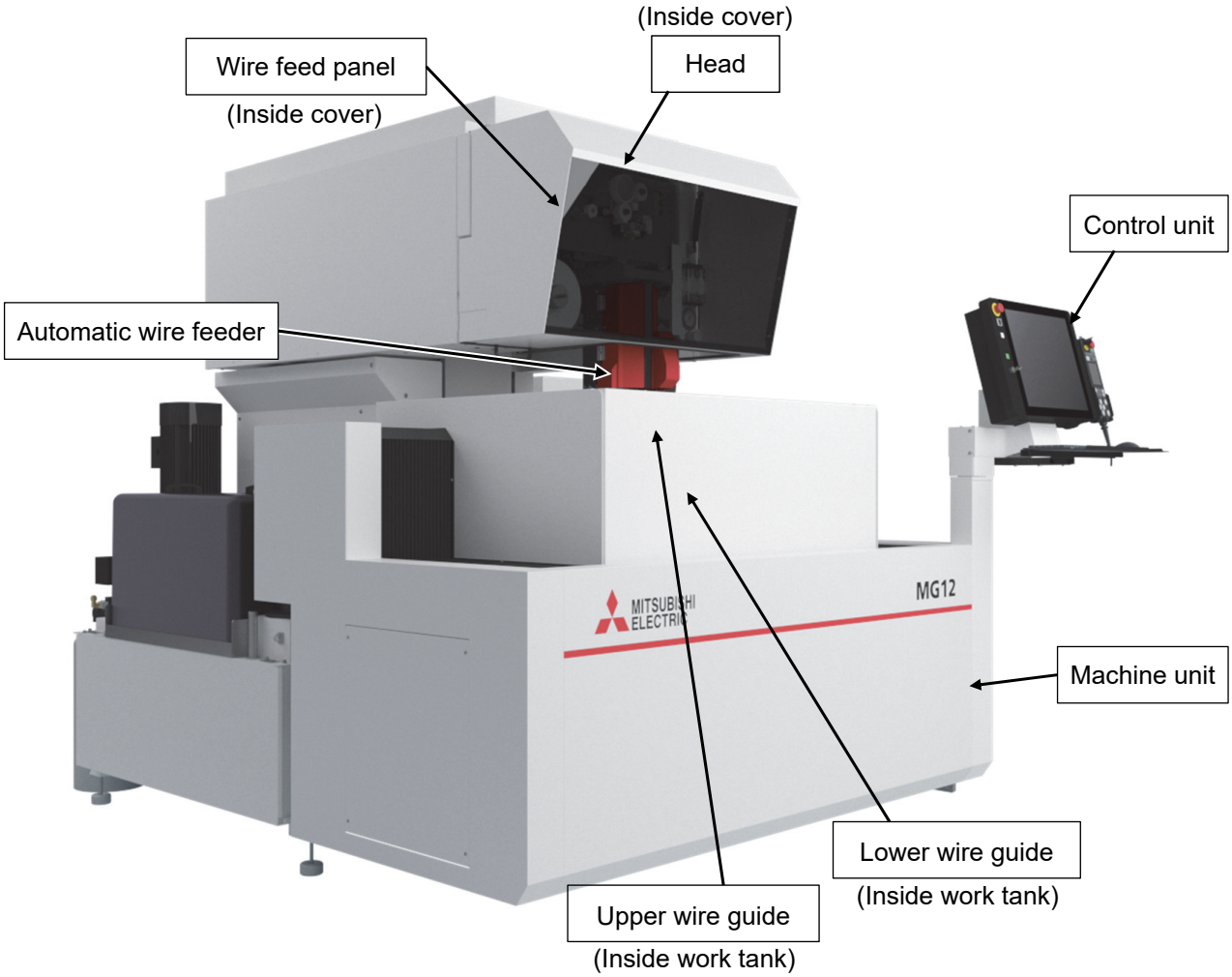


Fig. I.1.1 MG12 series machine appearance (example)

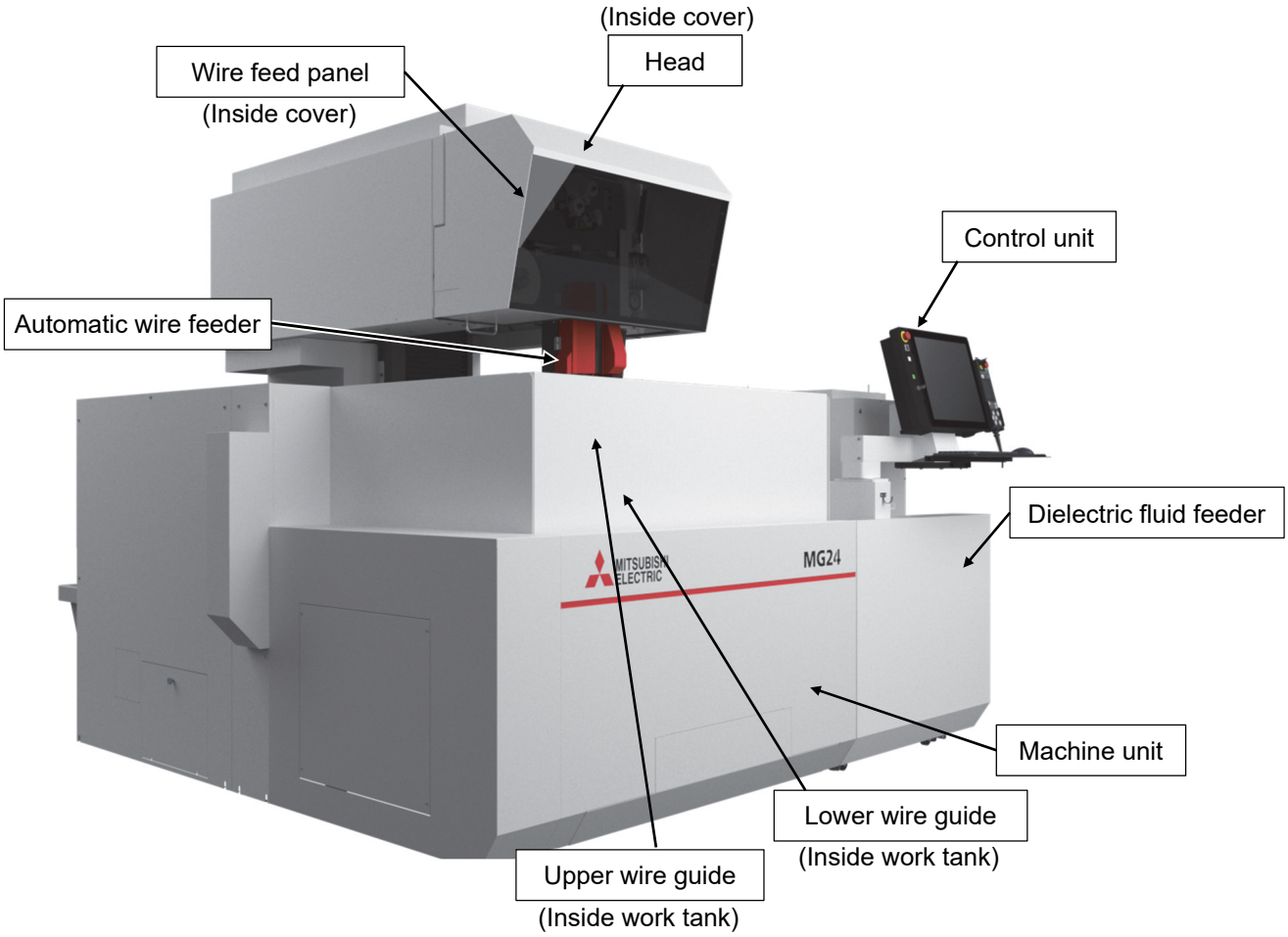


Fig. I.1.2 MG24 series machine appearance (example)

2. SPECIFICATIONS

2.1 Machine Unit

Item		MG12	MG12R
Max. workpiece dimensions (W × D × H)	[mm]	810 × 700 × 215	
Max. workpiece weight	[kg]	500	
Table dimensions	[mm]	640 × 540 (split square shape)	
Movement amount of each axis (X × Y × Z)	[mm]	400 × 300 × 220	
Table rapid traverse rate	[mm/min]	1300	
Wire electrode diameter	[mm]	0.1 to 0.3	
Max. wire electrode feed speed	[m/min]	23	
Wire tension	[N]	0.5 to 25	
External dimensions (W × D × H)	[mm]	1910 × 2760 × 2015	
Weight	[kg]	2700 (including dielectric fluid feeder)	

Item		MG24	MG24R
Max. workpiece dimensions (W × D × H)	[mm]	1050 × 820 × 305	
Max. workpiece weight	[kg]	1500	
Table dimensions	[mm]	840 × 640 (split square shape)	
Movement amount of each axis (X × Y × Z)	[mm]	600 × 400 × 310	
Table rapid traverse rate	[mm/min]	1300	
Wire electrode diameter	[mm]	0.1 to 0.3	
Max. wire electrode feed speed	[m/min]	23	
Wire tension	[N]	0.5 to 25	
External dimensions (W × D × H)	[mm]	2145.5 × 3030 × 2150	
Weight	[kg]	3500	

2.2 Dielectric Fluid Feeder

Item		MG12/MG12R	MG24/MG24R
Dielectric fluid tank volume	[ℓ]	550	860
Filtration flow rate	[ℓ/min]	14 to 46	14 to 46
Filtration accuracy	[μm]	3	3
Filter element		Paper filter (2 pcs)	Paper filter (2 pcs)
Water purifier (ion exchange resin)	[ℓ]	18	18
Dielectric fluid resistivity control range	[μS/cm]	10.5	10.5
External dimensions (W × D × H)	[mm]	Integrated with the machine	939 × 2322.5 × 1363
Weight (when dry)	[kg]	Included in the machine	350

2.3 Automatic Wire Feeder

Item	Specifications	
Model	**MG12/MG12R**	**MG24/MG24R**
Wire diamØeter	Ø0.1 mm to Ø0.3 mm	
Wire	Recommended wire described in "II. AUTOMATIC WIRE FEEDER" > "2. INFORMATION ON WIRE ELECTRODE" > "2.2 Wire Electrode List"	
Wire bobbin	P-3R, P-5R, P-10 DIN100, DIN125, DIN160	
Standard accessories (equipped with the machine)	Upper and lower diamond dies for Ø0.2 mm wire Jet nozzle (Ø1.5)	1 each 1
Others	Using non-recommended or cone-shaped wires, lacking nozzle contact with the workpiece, or unsuitable part geometry can cause poor wire electrode insertion..	

2.4 Taper Machining Unit

< Basic specifications >

Item	Specifications	
	MG12/MG12R	**MG24/MG24R**
U/V axis movement amount [mm]	±60 × ±60	±75 × ±75
Max. taper angle [°]	15 (with 200-mm plate thickness)	15 (with 260-mm plate thickness)

< Restrictions >

MG12

V axis stroke limits depend on the current Y axis stroke position. (Fig. I.2.1.)

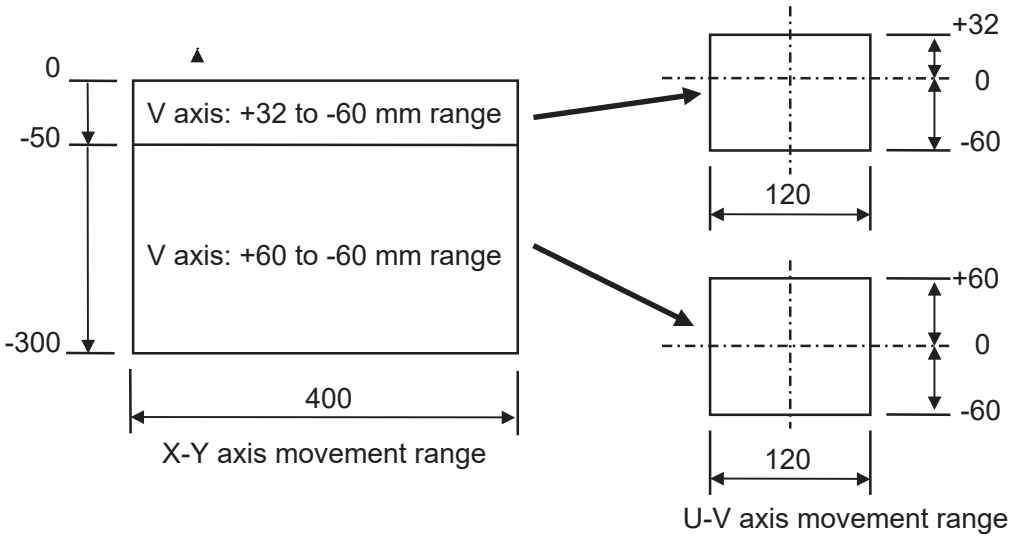


Fig. I.2.1

MG24

V axis stroke limits depend on the Y axis stroke position. (Fig. I.2.2.)

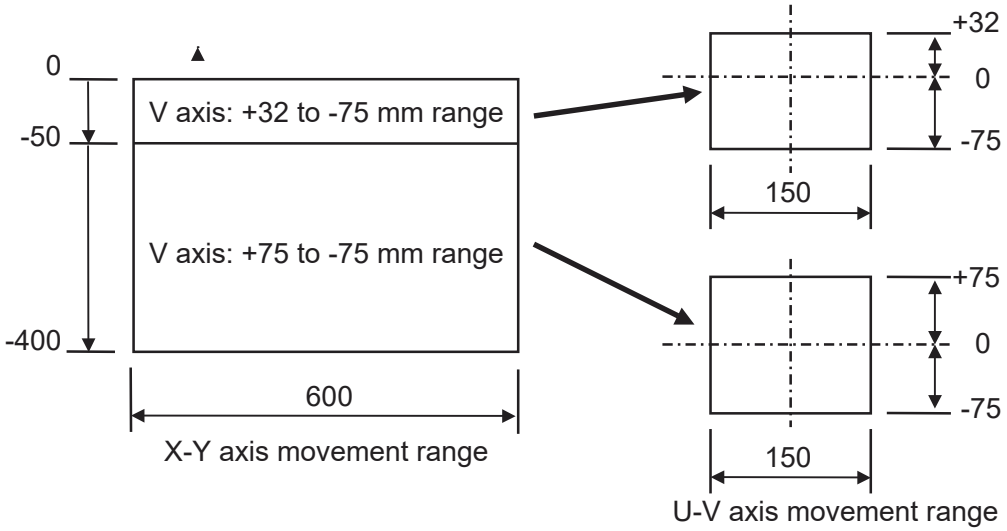


Fig. I.2.2

*** If V axis exceeds ±32 mm and Y axis moves positive, a fail-safe function stops Y axis to prevent the upper wire guide from contacting the working tank.**

*** Software limits control these specs.**

3. DIELECTRIC FLUID FEEDER CONFIGURATION

3.1 Name of Each Part of the Dielectric Fluid Feeder

Stores, filters, and purifies dielectric fluid. A paper filter removes debris; a pump supplies filtered fluid to the machine.

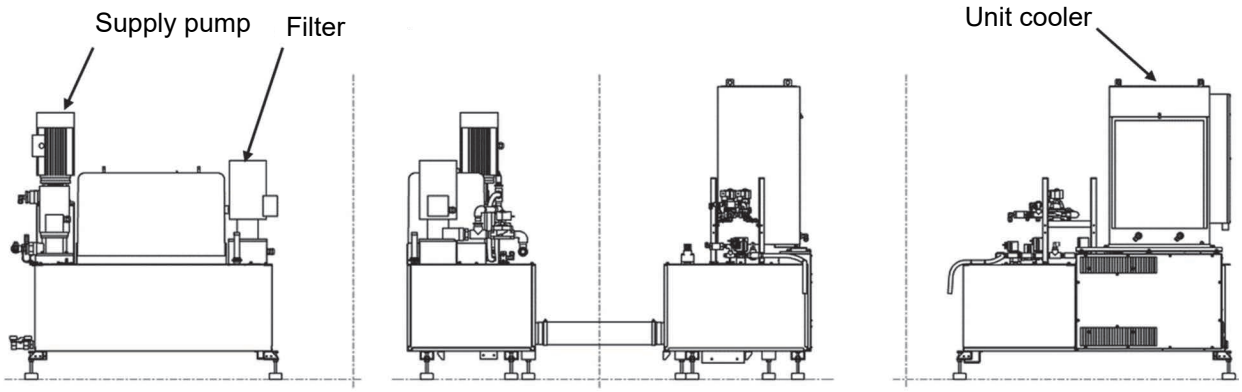


Fig. I.3.1 Outline drawing of MG12/MG12R dielectric fluid feeder

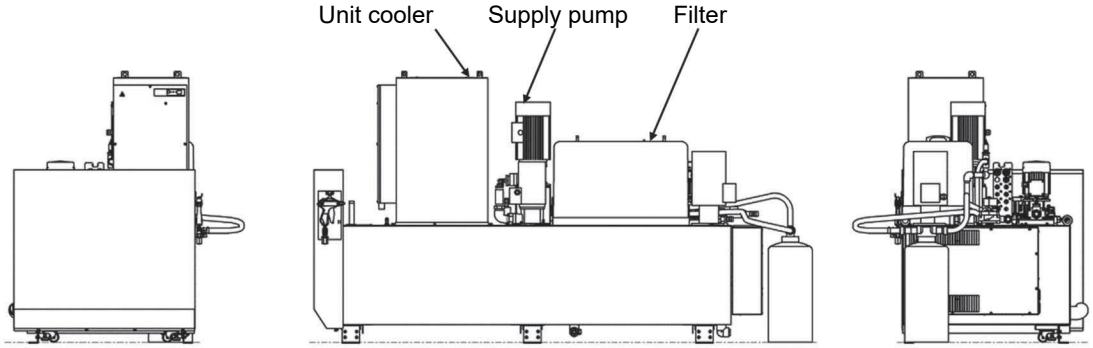


Fig. I.3.2 Outline drawing of MG24/MG24R dielectric fluid feeder

3.2 Dielectric Fluid Feeder Operation

3.2.1 Resistivity adjustment & operation

Set dielectric fluid resistivity to a preset value (control unit maintains it automatically). Select the notch from machining data. Wrong settings can reduce speed and accuracy.

3.2.2 Replacement of water purifier (ion exchange resin)

Water purifier removes iron, lowering conductivity and improving insulation. Machining tungsten carbide shortens resin life. If resistivity stays out of range (display red), replace the resin cartridge. See "V. MAINTENANCE AND ALARM LIST" for procedure.

NOTICE

- **In the READY status, if the resistivity is low, the background color of the current value display may stay lit in "red".**
- **Resin life depends on ion load. Use clean, low-salt and filtered water with low magnesium and calcium, etc.**
- **High room CO2 (e. g. kerosene heaters) shortens resin life. Ensure good ventilation.**

3.2.3 Replenishing dielectric fluid

Dielectric fluid volume decreases over time. Refill every 1-2 days. Check:

(1) Set volume with dielectric fluid filled to the table in the work tank.
Run the filter pump.

(2) Wait 1-2 minutes and confirm the gauge is green.

(3) If below MIN, add water.

(4) If above MAX, drain to range.

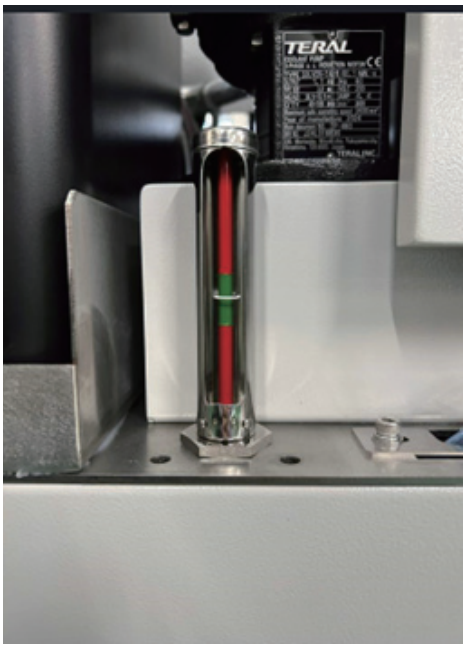


Fig. I.3.3 Level gauge on the side of the dielectric fluid feeder

3.2.4 Replacing the filter element

Replace the filter element at 0.25 MPa. Do not exceed 0.25 MPa or the element may burst and dirty fluid may backflow into the clean tank.

(1) Stop the machine with

and replace the filter as follows.

⚠CAUTION
The machine must be fully stopped when replacing the element.

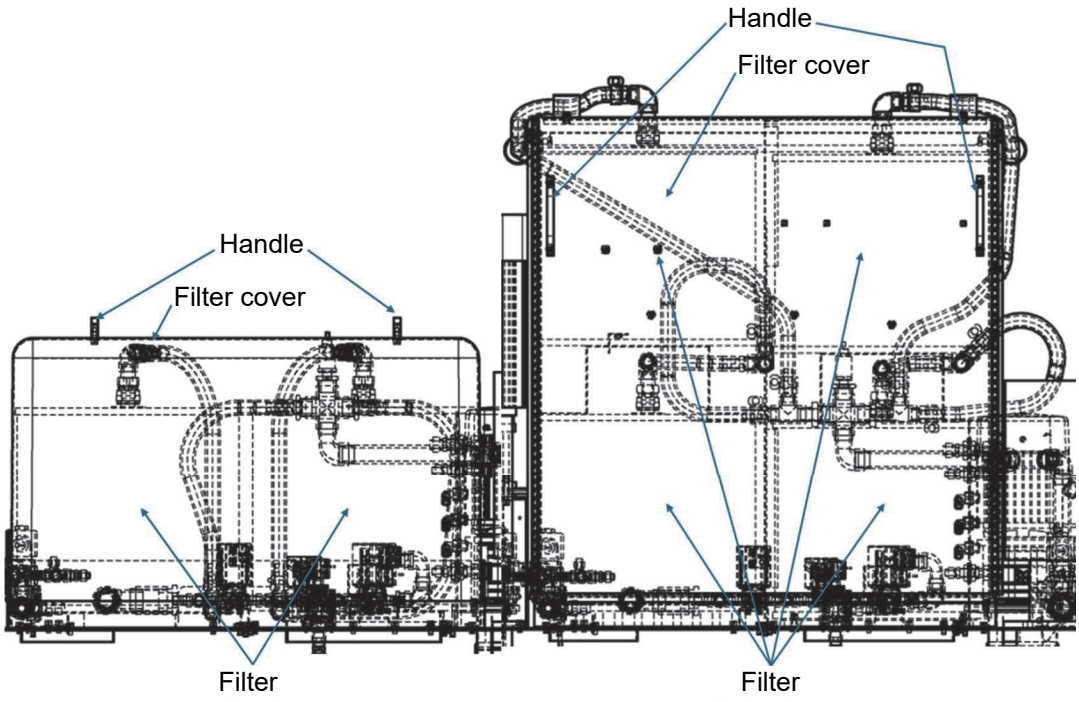


Fig. I.3.4 Installing the filter element (left: standard, right: 4-filter)

(2) To fully utilize filtering capacity:

1) Filter life depends on resistivity, material, conditions, and machining continuity; continuous use shortens life.

2) Aluminum and other non-steel sludge forms scum that clogs the filter and greatly reduces life.

3) Bacterial slime may raise pressure; clean the fluid and tank to continue use.

4) When not machining, use fluid ready OFF. See "III. NC OPERATION DISPLAY SCREEN" for settings.

5) At 0.25 MPa, stop filtering or turn fluid preparation OFF, then wait about 30 minutes to reduce pressure and extend filter life.

3.2.5 Water drainage (Freeze prevention)

In cold climates, or if overnight freezing is likely while the machine is stopped, press the EMERGENCY STOP button to stop all operations. Disconnect the hose from the feed pump discharge port (Fig. I.3.5). Confirm the dielectric fluid has discharged. Then retighten the hose fully.

⚠CAUTION

Always check that the feed pump is stopped before disconnecting the hose.

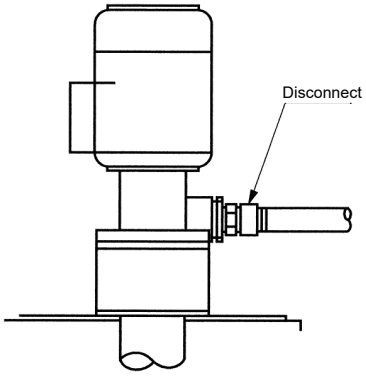


Fig. I.3.5

3.3 Dielectric Fluid Temperature Control Unit

3.3.1 Summary

This inverter fluid temperature control unit automatically stabilizes EDM dielectric temperature. It uses R410A (zero ODP) for efficiency. In constant-temperature rooms, add 1500 W (unit heat) to the room load.

3.3.2 For safe use

Hazards and severity are ranked as follows:

⚠**WARNING**	When fatal or serious injuries may occur due to mistaken handling of the machine.
⚠**CAUTION**	When injuries may occur or when physical damage to buildings or assets may occur due to mistaken handling of the machine.

■Meaning of the "drawing symbols".

Prohibited	Wet hands prohibited	Water prohibited
Observe instructions	Grounding wire connection	Risk of electric shock

3.3.3 During use

⚠WARNING

If any abnormality occurs (abnormal odor, noise, or vibration, etc.), stop the operation immediately and turn the power switch OFF.

Continuing operation in an abnormal state could lead to electric shocks, fires, or trouble.

Turn power OFF

Do not operate power switches with wet hands

Failure to observe this could lead to electric shocks.

Wet hands prohibited

Do not disassemble, install, repair, move, or dispose of this unit.

Improper handling can lead to injuries or water leaks from fires, electric shocks, or dropping of the unit.
Contact your nearest Mitsubishi branch, sales office, or RKE, Co., Ltd., for these matters.

Disassembly, installation, repair, oving and disposal prohibited

Do not insert fingers or rods in intake port or blow-off port

An internal fan is rotating at a high speed. There is a risk of injury.

Prohibited

⚠CAUTION

Do not spray insecticides or flammable sprays.

Failure to observe this could lead to fires or deformation.

Use prohibited

Do not touch the condenser when the filter, etc. is removed.

There is a risk of injury when the filter is removed.

Prohibited

Stop the operation and turn the power switch OFF before cleaning.

A fan is rotating at a high speed during operation. There is a risk of injury.

Turn power OFF

Do not get on an unstable table when installing or removing filters.

There is a risk of injury from dropping or tilting over.

Prohibited

Do not get on or place an object on the unit.

There is a risk of injury from dropping or tilting over.

Use prohibited

Do not disinfect with chemicals.

Failure to observe this could lead to fires or deformation.

Use prohibited

3.3.4 Specifications

Item		Specifications		
Model		HE-SV50-W3		
Control method		Compressor rotation speed control by inverter (ON-OFF when thermal load is below range) Fluid-to-room temperature sync control		
Rated cooling capacity		5.0 kW (25°C, 15 l/min)		
Electrical characteristics	Power supply	50 Hz/200 V	60 Hz/200 V	60 Hz/220 V
	Input value	1.45kW	1.40kW	1.35kW
	Current value	8.0 A	7.7 A	6.8 A
	Power factor	91%	91%	90%
Air volume		18 m^3/min	19 m^3/min	20 m^3/min
Noise value		65dB		
Applicable fluid type		Water		
Fluid flow rate		8 to 30 l/min		
Fluid pressure		Max. 2.94 MPa		
Cooler pressure loss		0.06 MPa (at the fluid flow rate 15 l/min)		
Design pressure Design pressure (high pressure section/low pressure section)		4.2/2.2 MPa		
Refrigerant		R410A 0.65kg		
Input	Main circuit power supply	Single-phase 200 V AC/200 to 220 V AC, 50/60 Hz at 4.5 kVA or more		
	Operation command signal power supply	Single-phase 100 V AC/100 to 110 V AC, 50/60 Hz		
Output	Fault contact	Fault contact (power cutoff, OFF at emergency stop) 250 V AC at 5 A ($\cos\phi = 1$)		
Display		Temperature difference between outlet fluid and room, and error code		
Protection functions		High-pressure switch, fluid overcooling, discharge temperature thermistor, compressor overcurrent, thermistor open/short-circuit		
Working environment		Indoors		
Working ambient temperature		10 to 35°C (To achieve the specified fluid temperature accuracy, use at 15 to 30 °C ambient.)		
Fluid temperature adjustment accuracy		Target temperature ±0.3°C		
Insulation resistance		5 MΩ (500 V DC)		
Withstand voltage		1500 V AC for one minute		
Weight		44kg		
External dimensions		W570 × D390 × H760		

3.3.5 Names and functions of each part

(1) Appearance

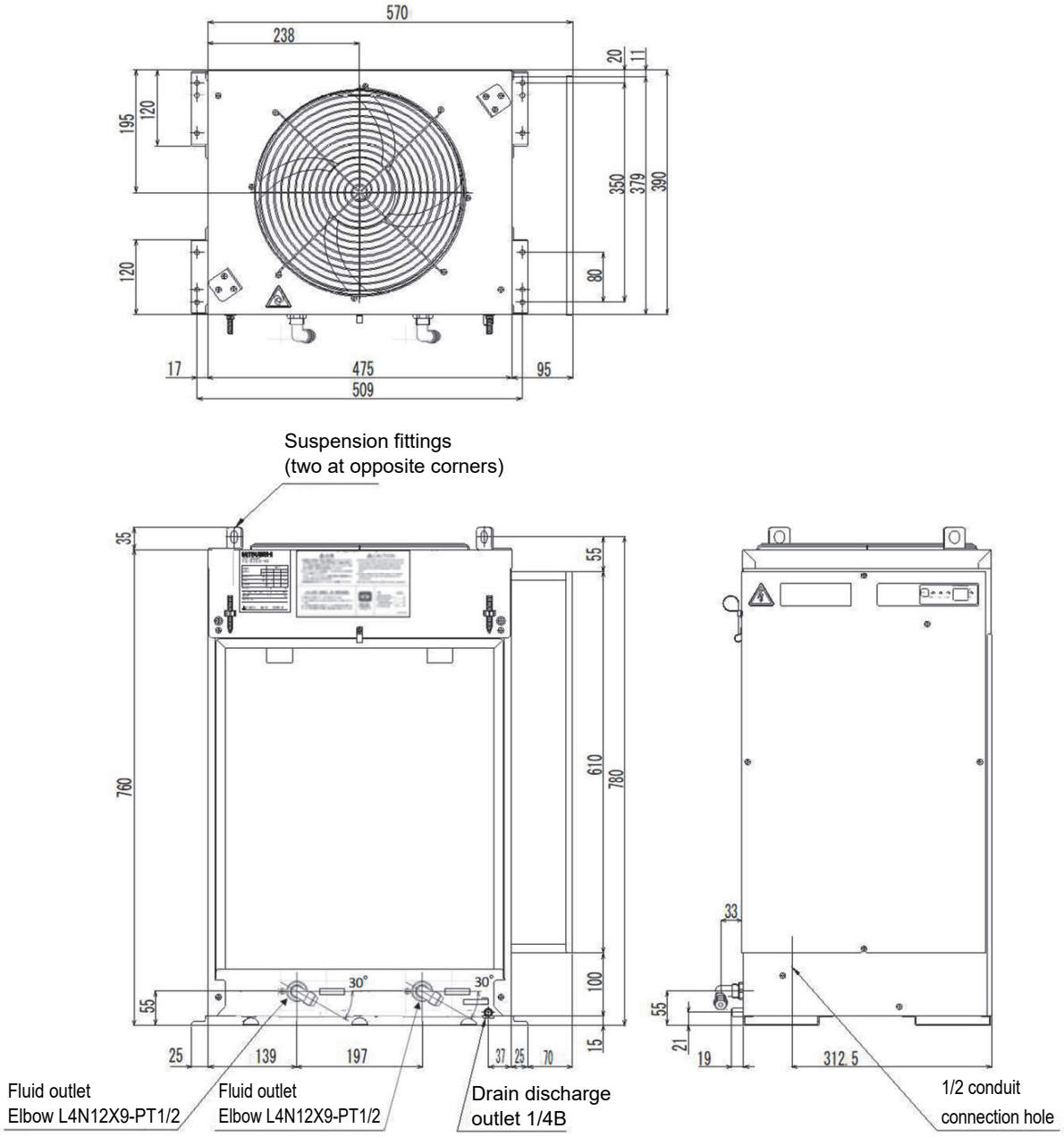


Fig. I.3.6

(2) Display section

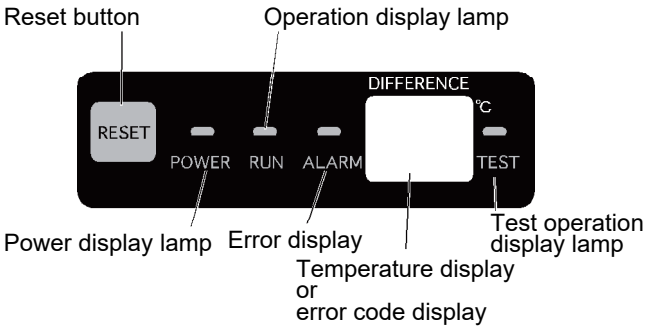


Fig. I.3.7

1) Temperature difference display

Displays the difference between TH2 (water) and TH1 (room).

Positive (plus) data: Displays a stable temperature difference.
Negative (minus) data : Displays the minus sign alternating with the difference.

For error code refer to "Error Codes and Remedies".)

Display lamp	ON	OFF
Power display lamp	Power ON	Power OFF
Operation display lamp	*1	*2
Error display	At error	During normal operation
Test operation (TEST)	During test operation *3	During normal operation

- **The operation display lamp turns ON when an operation command is received from the EDM.**
- **It turns OFF when a stop command is received.**
- **If the test operation lamp is ON or a test is required, contact your nearest Mitsubishi branch, sales office, or RKE Co., Ltd.**

2) Reset button

Resets the unit after an error and returns it to the start-enabled state.

3.3.6 Precaution for installation work

(1) Installing the exhaust duct

When redirecting the unit cooler or venting outdoors, design as follows:

1) Tolerable pressure loss (no auxiliary fan)

50 Hz/200 V: ≤11 Pa
60 Hz/200 V: ≤12 Pa
60 Hz/220 V: ≤14 Pa

NOTICE

Without an auxiliary fan, airflow drops slightly. Clogged filters further reduce cooling and may cause shutdowns

2) Duct specs (examples within limits)

ID 325 mm, length ≤5 m, ≤1 bend
ID 350 mm, length ≤10 m, ≤1 bend

NOTICE

If duct ID ≤325 mm, it is narrower than the blow-off port and pressure loss increases. Add a fan if bends increase

3) Installing the duct

Remove the blow-off port guard on top (4 screws).
Fix the duct using the exposed screw holes.

⚠CAUTION

Always stop the unit cooler before installation. Rotating fan can cause injury..

4) Selecting the additional exhaust fan

Select a fan that exceeds the following airflow at the total duct pressure loss.

50 Hz/200 V: 18–19 m^3/min

60 Hz/200 V: 19–20 m^3/min

60 Hz/220 V: 20–21 m^3/min

View from top of the unit cooler

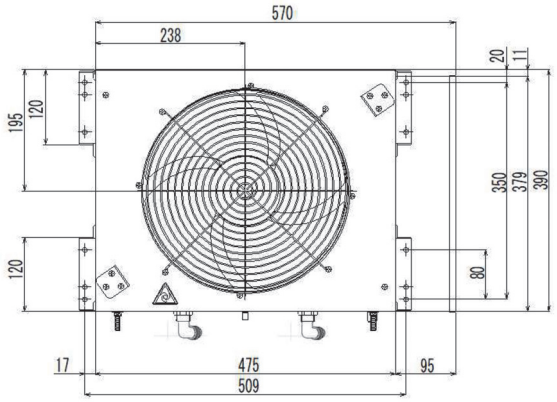


Fig. I.3.8

3.3.7 Precautions for use

(1) Power supply

- Use the following power supply. Large voltage fluctuation, ≥10% distortion, or insufficient capacity may prevent compressor start or cause overcurrent shutdown.

	Voltage/frequency	Tolerable voltage fluctuation	Capacity/voltage
Main circuit power supply	Single-phase 200 V AC/200 to 220 V AC 50/60 Hz	±10%	4.5 kVA or more
Operation command signal power supply	Single-phase 100 V AC/100 to 110 V AC 50/60 Hz	±10%	10mA

(2) Working conditions

- This unit has no heater. Use within the thermal load system.
- Ambient and fluid temperature: 10 to 35 °C. For high-accuracy room sync control, use the following:

Recommended working conditions
- Install in the same room as the EDM.
- Maintain room temperature 15 to 30 °C.
- Set the total fluid rate to within 250 l, and room temperature fluctuation to within -2.5°C/h.

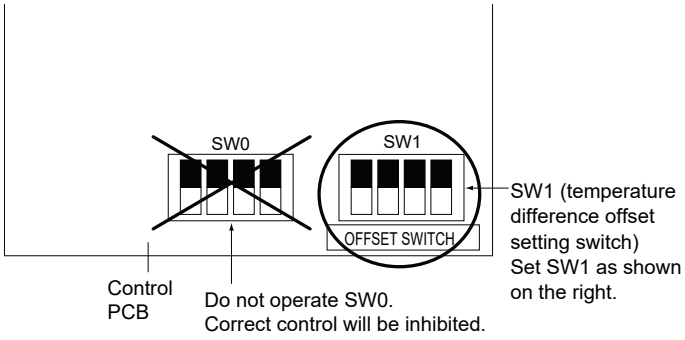
(3) Stopping operation and removing the unit

- Always drain the cooler via water outlet when emptying the system or stopping with fluid drained. Residual fluid can freeze or form sludge and impair function.
- Drain coolant before removing the unit and lift the unit using the suspension fittings with care.

3.3.8 Other functions

(1) Temperature difference offset setting

- The temperature difference offset setting switch is on the controller PCB (lower right) in the electrical part box.



Temperature difference offset setting switch

	SW1 (1 2 3 4, ON = 1, OFF = 0)				Temperature difference °C (Fluid temperature - Room temperature)
	1	2	3	4	
	1	1	1	1	0.00
	0	1	1	1	-0.25
	1	0	1	1	-0.50
	0	0	1	1	-0.75
◎	1	1	0	1	-1.00
	0	1	0	1	-1.25
	1	0	0	1	-1.50
	0	0	0	1	-1.75
	1	1	1	0	-2.00
	0	1	1	0	-2.25
	1	0	1	0	-2.50
	0	0	1	0	-2.75
	1	1	0	0	-3.00
	0	1	0	0	-3.25
	1	0	0	0	-3.50
	0	0	0	0	-3.75

◎ ... Standard setting

Fig. I.3.9

3.3.9 Installing outside a constant temperature room

- This unit emits 1500 W while cooling. Add 1500 W to constant-room HVAC design. If HVAC cannot absorb this load, install the unit cooler in a separate room and extend cables; contact Mitsubishi, a sales office, or RKE Co., Ltd.
- Unit cooler ambient range: 10 to 35 °C; outside this, cooling drops by about 20 %. If installed in a separate room, check ambient temperature.

4. WASTE FLUID TREATMENT

The wire-cut EDM dielectric contains copper and iron.
Waste liquid disposal may be restricted by laws and ordinances.

5. OPERATION PANEL

5.1 Outline of Operation Panel

5.1.1 Outline of operation section

Fig. I.5.1

5.2 Switches

5.2.1 Outline of switches

(1) Power ON switch I

The control unit and EDM power will turn ON.

(2) Power OFF switch O

- Turns off control unit and EDM power.
- Turns off screen shortly after.
- When turning the no-fuse breaker (NF) OFF, wait for the power ON lamp to turn OFF.
- UPS may make a sound even after turn off. This stops in about a minute.

(3) EMERGENCY STOP button

After all of the EDM operations are locked, only the control unit will operate.

5.2.2 Touch panel

The screen operations, including setting area designation and switch operations, can be executed by touching with fingers instead of using keys or a mouse.

5.2.3 Keyboard

The keyboard is mainly used to input numeric values.

5.2.4 Mouse

The mouse is used as an aid during key inputs.

I

5.3 Basics for Data Input

5.3.1 Switching the screens

5.3.2 Inputting data

(1) Inputting data

Data is entered via the keyboard and on-screen numeric keypad (Fig. I.5.2).
The keypad displays when when [Num Keys Dip.] is ON in "Screen operation setting" under "Initial setting" > "Machine parameter". Refer also to "III. NC OPERATION DISPLAY SCREEN" > "3. INITIAL SETTING" > "3.2 Machine parameters" "3.2.9 Screen operation setting" "(1) Screen display".

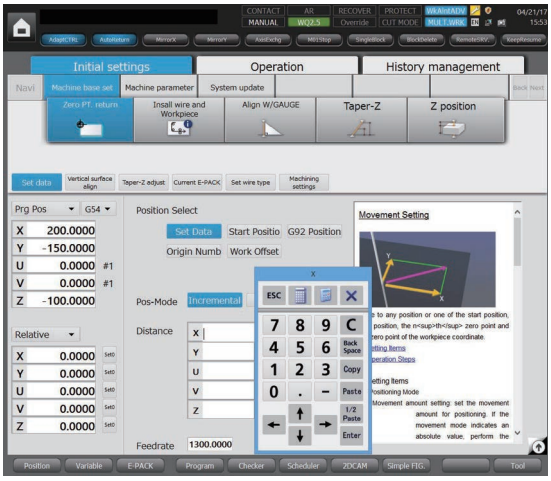


Fig. I.5.2

1) Copy button

Stores (copies) the entire item value. Only one value is stored.

2) Paste button

Pastes the value stored with [Copy] to the entire item and confirms it.

3) 1/2 Paste button

Pastes half of the stored [Copy] value to the entire item and confirms it.

4) Half button

Halves the entire item value and confirms it.

5) ← ↑ ↓ → button

Moves the cursor in the specified direction.

- **Keys on the numeric keypad do not auto-repeat when held.**
- **Pressing [Paste] or [1/2 Paste] overwrites the entire target item and confirms it.**
- **Pressing "→" in a combo box opens the list; it does not move the cursor right.**

(2) Operating the switches and buttons

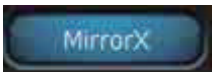
Operate switches and buttons with the touch panel and mouse. ON and OFF states are shown below.

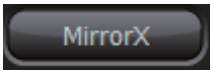
- Switch

ON

OFF

- Operation switch

ON 

OFF 

(3) Input with a right-click menu

Copy, cut, and paste can be performed via the right-click menu in input areas on each screen, the "I/O (Explorer)" screen, the "NC program list" screen, and the "NC program edit" screen.

6. PRODUCT SECURITY

6.1 Security Disclaimer

The EDM CFast can be infected via the network. Symptoms mirror a PC infection (slow screen changes, file deletion), which can stop operation and may require CFast replacement.
Do not install general antivirus on the machine unit. Instead, secure the user's network PCs connected to the machine with antivirus and other measures. An optional, machine-specific virus prevention function is available and recommended.

6.2 Caution on Reselling or Disposing of an EDM

When reselling or disposing of an EDM, delete stored E-Packs, NC programs, and other data. Physically destroy the CFast when disposing.

7. REPORTS/CERTIFICATES

The certificate and, where applicable, other order-specific documents are on the machine.

7.1 EC Declaration of Conformity

The order-related, signed EC Declaration of Conformity in accordance with Machinery Directive 2006/42/EC is attached separately on the machine.

II. AUTOMATIC WIRE FEEDER

BRN-83587-002-*-002

1. PRELIMINARY CHECK
2. INFORMATION ON WIRE ELECTRODE
3. THREADING METHOD OF WIRE ELECTRODE
4. HOW TO USE AUTOMATIC WIRE FEEDER

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1. PRELIMINARY CHECK

1.1 Checking Screen Settings

Set the wire material and wire diameter to be used.

1.1.1 Checking wire electrode settings

(1) Press "Initial settings" on the main menu.

(2) Press "Machine base set" > "Zero PT. return".

(3) Press "Wire Type Settings" and open the Set Wire Type screen.

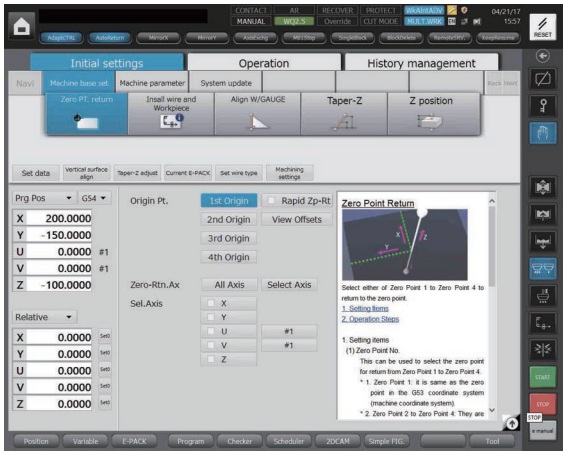


Fig. II.1.1

(4) Set material "Wire Mat" and diameter "Wire Dia" according to the wire actually being used.

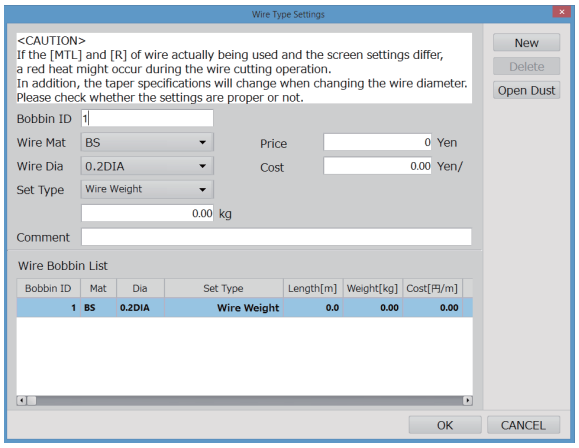


Fig. II.1.2

NOTICE

If the actual wire material and diameter settings differ, automatic insertion or adaptive control may fail. Always check settings when changing wire.

1.1.2 Checking taper Z settings

(1) Press "Initial settings"..

(2) Go to "Machine base set" > "Taper-Z" > "Z3, Z4 setting" and set Z3 to match the Z axis scale. This is an approximate value for automatic wire insertion. For taper machining, use the taper specs and set Z3 more precisely.

Fig. II.1.3

1.2 Checking the Diamond Die

Check that the diamond dies (top and bottom) match the wire diameter. The die is stamped as follows.

Applicable wire diameter	Size stamped on diamond die
Ø0.1	010P
Ø0.15	015P
Ø0.2	020P
Ø0.25	025P
Ø0.3	030P

If the die does not match the wire diameter, replace it. Mismatches can block threading and reduce accuracy.

1.2.1 Checking the upper diamond die

(1) Remove the nozzle retainer (U).

(2) Turn and remove the rectification nozzle (U).

(3) Remove the jet nozzle.

(4) Using the die jig, turn and remove the upper diamond die.

(5) Check the size stamped on the diamond die.
*** When installing the rectification nozzle (U), align the opening with the pin.**

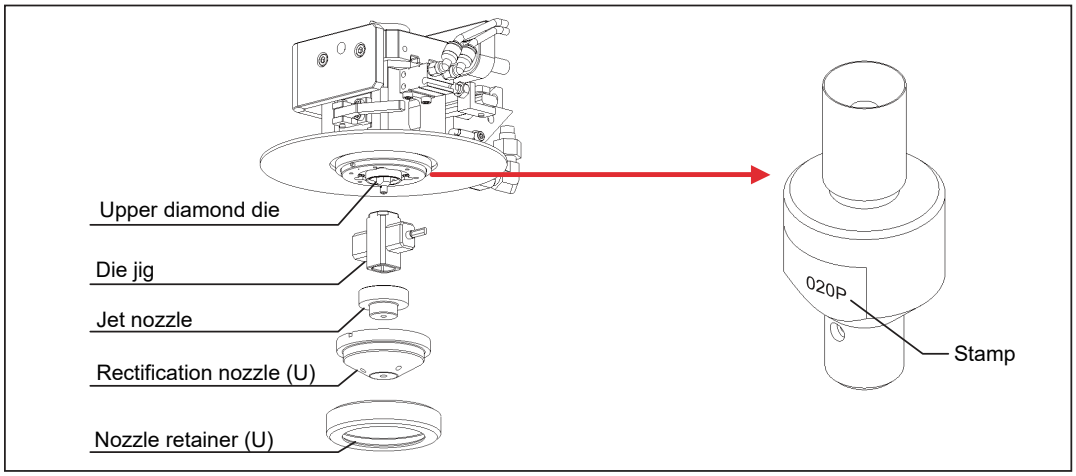


Fig. II.1.4

1.2.2 Checking the lower diamond die

(1) Remove the lower nozzle retainer.

(2) Remove the rectification nozzle (D).

(3) Using the die jig, turn and remove the lower diamond die.

(4) Check the size stamped on the diamond die.

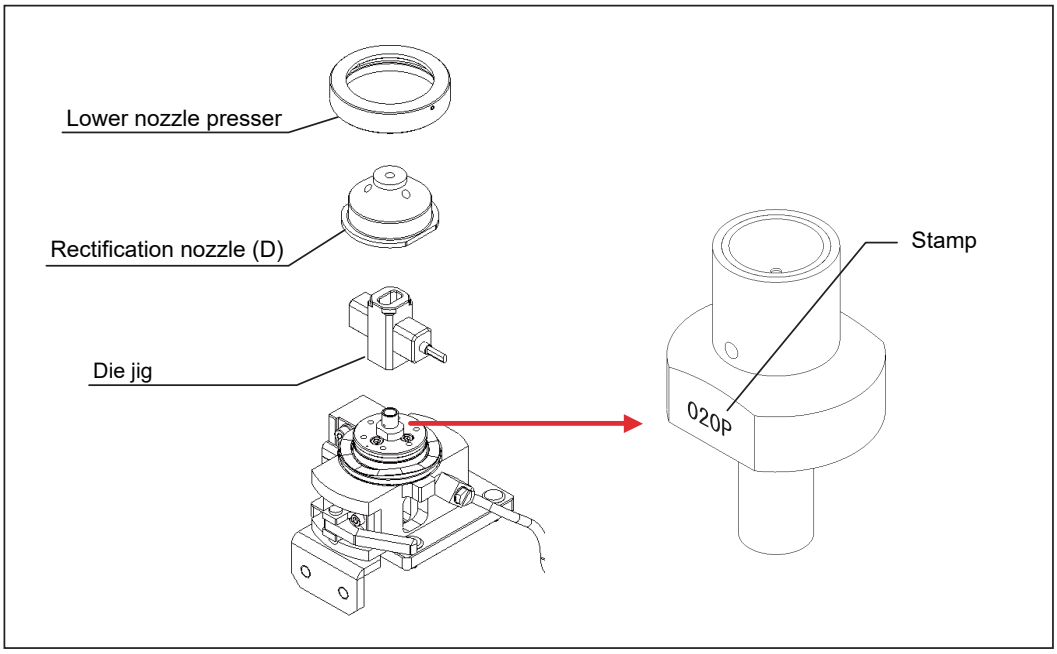


Fig. II.1.5

NOTICE
If the lower nozzle retainer bolt is removed at startup, the rectification nozzle (D) may hit the workpiece and cause damage. **Always tighten the lower nozzle retainer bolt..**

1.3 Checking the Power Feed Terminal

Check wear on the power feed terminals (top and bottom). If a groove exceeds about 1 mm, shift the terminal position. Fast machining or high-speed machining wire accelerates wear.

1.3.1 Compatibility with conventional models

MG series and MV series with D-CUBES are compatible because the power feeder shape is the same.

1.3.2 Checking the power feed terminal

(1) Pull the lever toward you to release the power feeder clamp.

(2) Press one side with a hex wrench and pull the terminal out from the opposite side.

(3) Check the terminal for wear.

(4) If the groove is deep (≈>1 mm), shift the position. For methods, see "V. MAINTENANCE AND ALARM LIST" > "5. MAINTENANCE AND INSPECTION METHOD OF AUTOMATIC WIRE FEEDER" > "5.2 Maintenance and Inspection Methods" > "5.2.4 Power feeder".

(5) Release the lever to clamp the terminal.

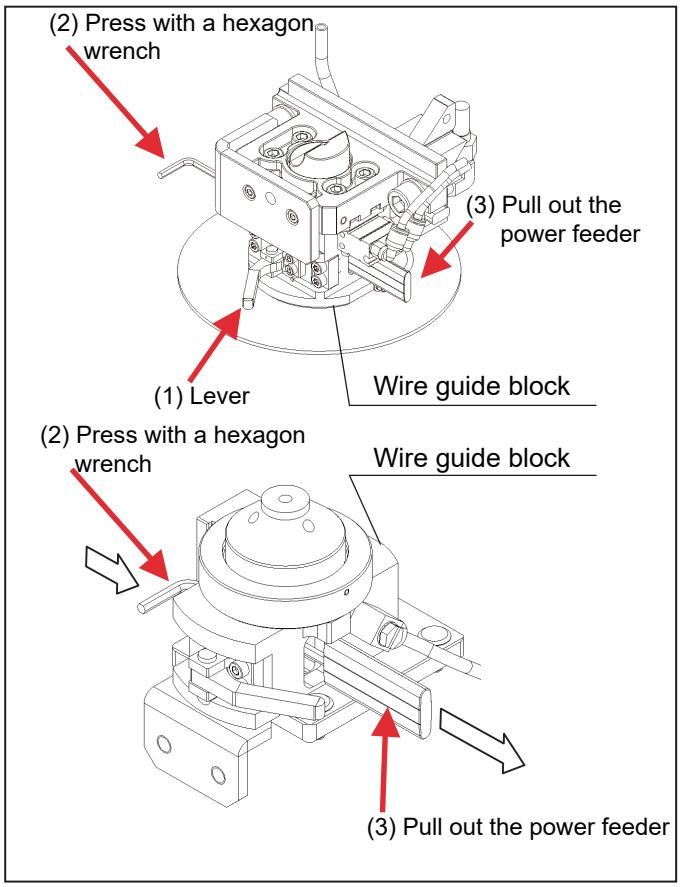


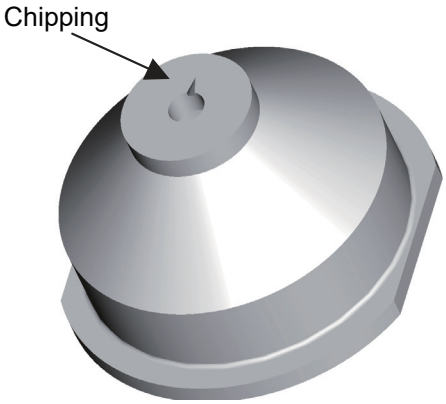
Fig. II.1.6

NOTICE

Machining with the lever engaged can cause unstable power, slow speed, poor accuracy, abnormal discharge, and wire guide block breakage. Release the lever before machining.

1.4 Checking the Dielectric Fluid Nozzle

(1) Two nozzle diameters: Ø4 and Ø7. Inspect top and bottom nozzles for chips or damage. Damaged nozzles destabilize flow, reduce speed, increase wire breaks, and lower accuracy.



Nozzle

Fig. II.1.7

1.5 Checking the Collection Roller Pressing Force

Ensure pressing force matches the wire diameter. The collection rollers are at the back of the machine. Adjust the regulator pressure to the wire diameter.

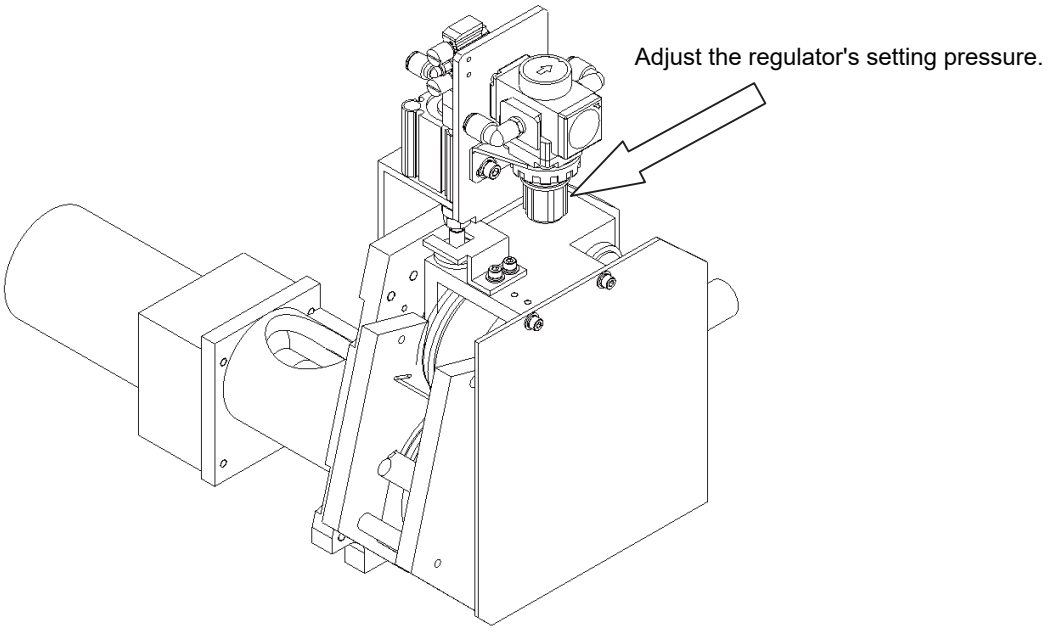


Fig. II.1.8

Wire diameter	Regulator adjustment value (MPa)
Ø0.1	0.16 to 0.18
Ø0.15	0.22 to 0.24
Ø0.2 to 0.3	0.36 to 0.38

1.6 Checking Jet Pressure

(1) Open "Open/Close cock".

(2) Press "Jet" on the operation panel to emit jet water flow.
* To display controls, press the arrow at the upper right (Fig. II.1.9).

(3) Set the pressure meter to about 0.1 MPa by adjusting the jet pressure knob. (Optimal jet pressure is 0.05–0.1 MPa.)

(4) After checking the jet pressure, close the "Open/Close cock".
If the jet does not emit correctly, see "V. MAINTENANCE AND ALARM LIST" > "5. MAINTENANCE AND INSPECTION METHOD OF AUTOMATIC WIRE FEEDER" > "5.2 Maintenance and Inspection Methods" > "5.2.5 Upper wire guide" > "(3) Upper diamond die".

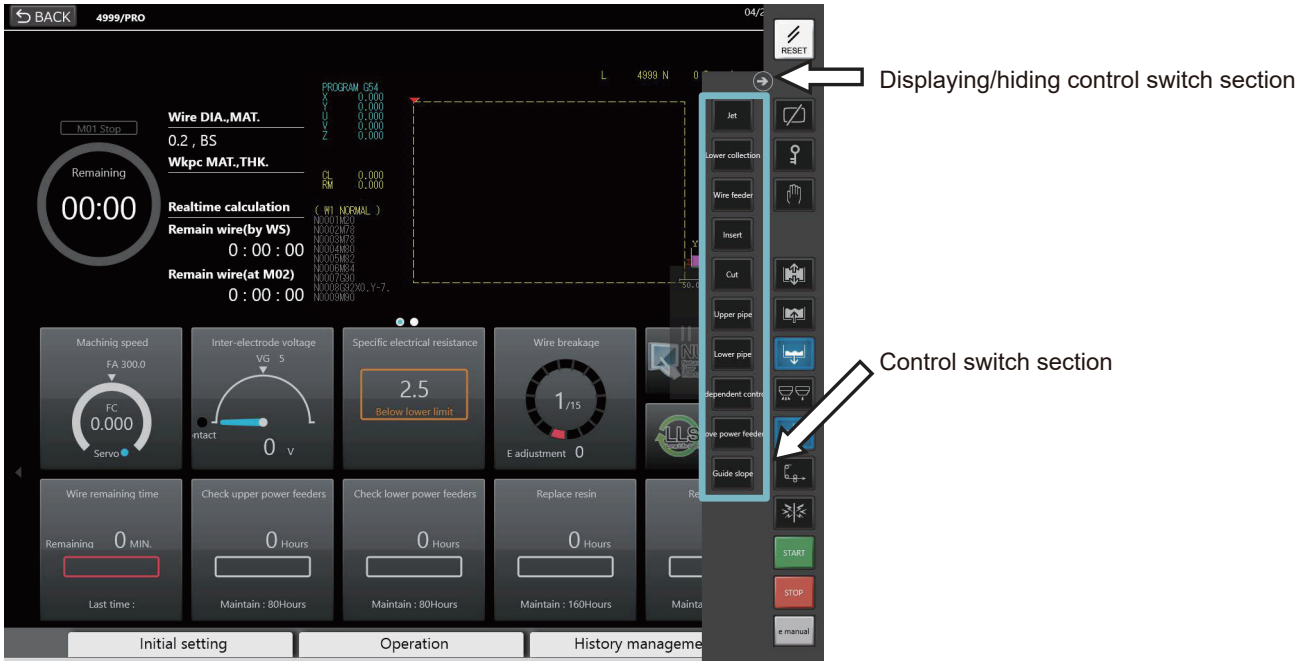


Fig. II.1.9

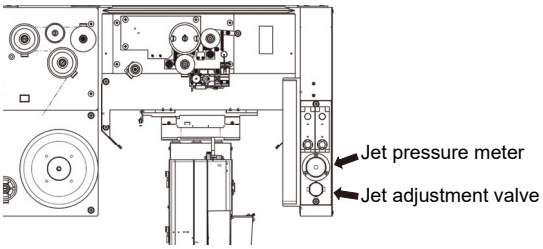


Fig. II.1.10 MG12/MG24

2. INFORMATION ON WIRE ELECTRODE

2.1 Wire Electrode Selection

Depending on wire properties, the automatic wire feeder may insert poorly. Use the following to select a wire.

2.1.1 Wire electrode property standards

Select a wire electrode that meets the standards below.

(1) Wire electrode property standards

1) Surface: non-paraffin
2) Curling rate (L2/L0, horizontal): ≤10% for Ø0.2–0.3; ≤3% for Ø0.1–0.15

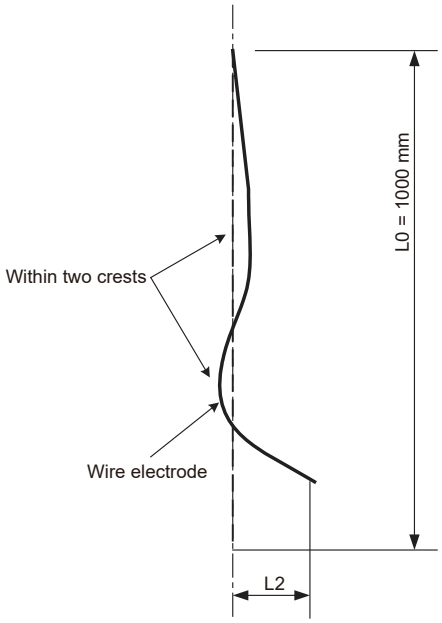


Fig. II.2.1

2.1.2 Restrictions

(1) These are feeder guidelines, not guarantees. Even compliant wire may insert poorly due to storage, batch/material, dust, or rust.

(2) Avoid non-compliant wire. It can cause stops, slower processing, poor precision, insertion failures, or wire breaks.

(3) Maintenance/check intervals assume compliant wire. Shorten intervals for non-compliant wire.

2.2 Wire Electrode List

For wire material symbols used in selection and screen settings, see the table and sections below:

Name	Model	Manufacturer	Automatic wire feeder ○: Available ×: Unavailable	Mounting of wire processing unit (option) ○: Available in mounted state △: Use in unmounted state recommended ×: Unavailable	Symbol used in wire type selection on NC screen
Brass Wire	RBHA-N	Mitsubishi Electric Mechatronics Engineering Corporation	○	○	BS
	OB-PN	Oki Electric Cable Corp.	○	○	
	HBZ-U(N)	Proterial, Ltd.	○	○	
	SBS-HN	Sumiden Fine Conductors Co., Ltd.	○	○	
Wire for high-speed machining	MEGACUT-typeD*2	BERKENHOFF GmbH	×	△	MD
	R wire TYPE-S	Mitsubishi Electric Mechatronics Engineering Corporation	○	×	V
	Topas Plus D *3	BERKENHOFF GmbH	○	×	TD
Wire for large angle taper machining	MEGACUT-typeT *2	BERKENHOFF GmbH	×	△	MT
Wire for precision machining	MEGACUT-typeA *2	BERKENHOFF GmbH	○	△	MA

- **Performance of the above wire electrodes is not guaranteed. See "2.1.1 Wire electrode property standards".**
- **For models with a wire processing unit (option), unmounted is recommended. Wire curl after collection rollers may block the inlet and cause a unit error.**
- **When using the automatic wire feeder, set Jet ON during wire insertion, including breakage-point insertion. See "III. NC OPERATION DISPLAY SCREEN".**

3. THREADING METHOD OF WIRE ELECTRODE

3.1 Threading the Wire Electrode

Two methods: "Manual" and "Auto" (automatic wire feeder).
This section covers "Manual". For "Auto", see "4. HOW TO USE AUTOMATIC WIRE FEEDER".

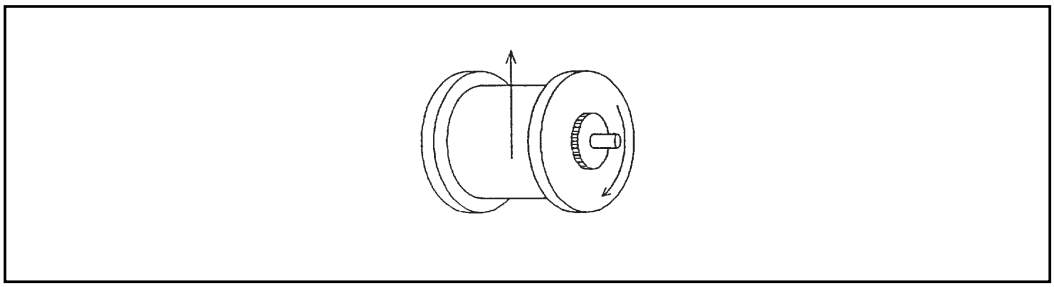
3.2 Selection

Select the wire electrode per "2.1 Wire Electrode Selection".
Check wire screen settings and parts per "1. PRELIMINARY CHECK".

3.3 Initial Wire Bobbin Setting

(1) Turn "PRETENSION" OFF (LED off). See Fig. II.3.2.

(2) Install the wire bobbin on the shaft to rotate clockwise.



(3) Tighten with the bobbin retaining nut.

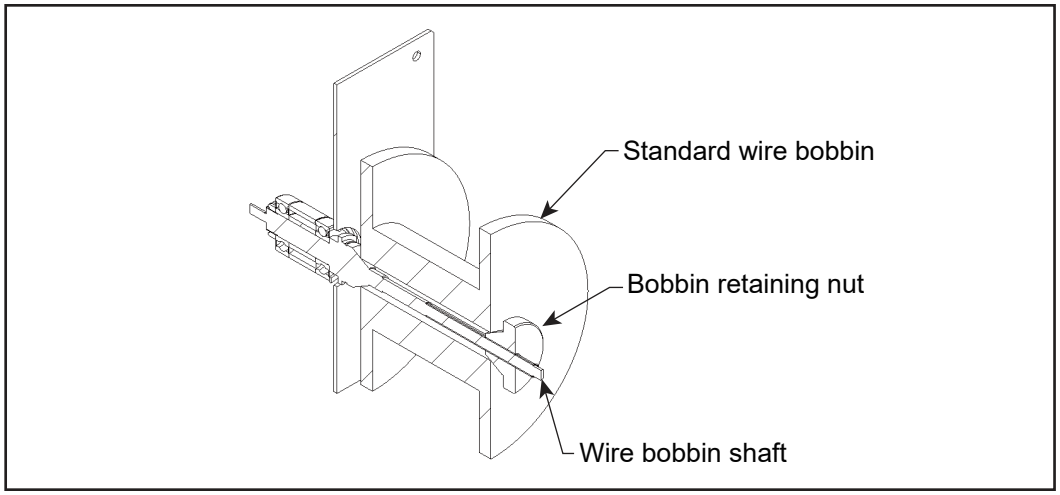


Fig. II.3.1

3.4 Threading from bobbin to automatic wire feeder

(1) Route wire through "Idler pulley" → "Pulley (1)" → "Pulley (2)".

(2) Pass between the "Wire retainer felt".

(3) Route through "Wire detection pulley" → "Pulley (3)".

(4) Hold wire. Push "Pinch roller B" down, pass wire between "Main tension roller" and "Pinch roller B", then return "Pinch roller B" to contact the "Main tension roller".

(5) Move "Pinch roller A" right and fix open.

(6) Thread via "Guide pipe" → "Auxiliary die A"*, then between "Pinch roller A" and "Main tension roller". Tension so the wire contacts the "Main tension roller" circumference.

(7) Pull the "Stopper lever" to clamp "Pinch roller A" to the "Main tension roller".

(8) Turn the "Main tension roller" handle clockwise to extend the wire to the machining table.

(9) Turn "PRETENSION" ON (LED on).

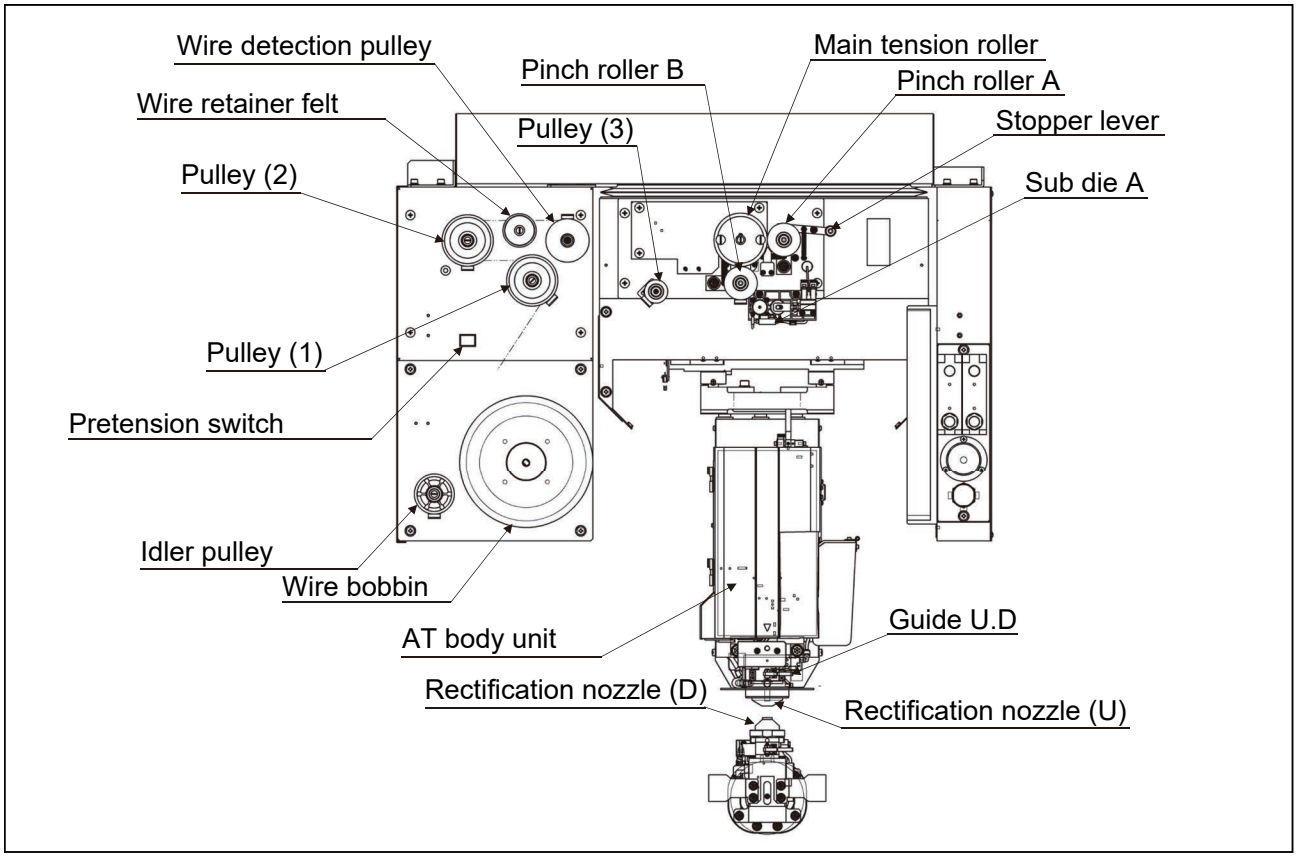


Fig. II.3.2

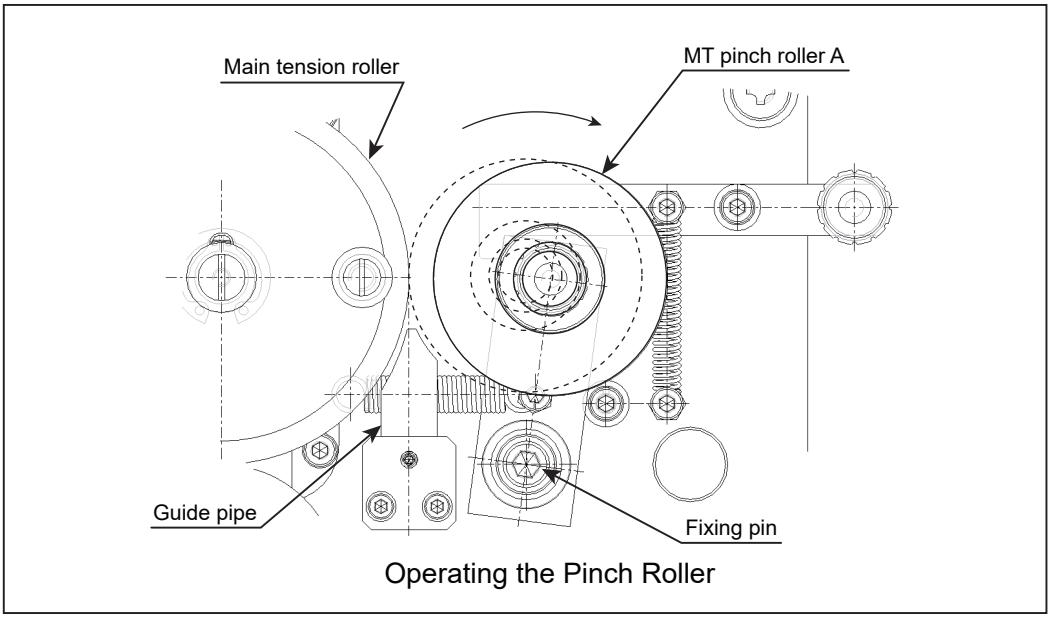

Main tension roller
MT pinch roller A
Guide pipe
Fixing pin
Operating the Pinch Roller

Fig. II.3.3

3.5 Threading wire from automatic wire feeder to collection roller

(1) Open the front cover.

(2) Press "Pipe Down" to lower the "Guide pipe unit".

(3) Thread through "Auxiliary die B" → "Slack detection plate" → "Die guide".

(4) Feed through "Auxiliary die C" → "Guide U, D" → "Guide C" → "Diamond die" to exit "Rectification nozzle (U)".

(5) Pull the wire straight below the "Upper guide" and remove slack.

(6) Press [Lower collection].

(7) Thread the wire electrode through "Rectification nozzle (D)".

(8) Rotate the "Main tension roller" and feed until the wire reaches the "Collection roller" and is taut.

(9) If [Lower collection] ends, press the control switch to shift the wire, then press [pipe▲] to reset the guide pipe and complete threading.
If the wire electrode does not shift, it has not reached the "Collection roller". Repeat from step (6).

(10) Close the front cover.

(11) Close the front cover.

NOTICE

- **Do not curl or bend the wire.**
- **Do not let wire unwind from the bobbin.**
- **Close the front cover before axis moves or machining to prevent interference and damage.**

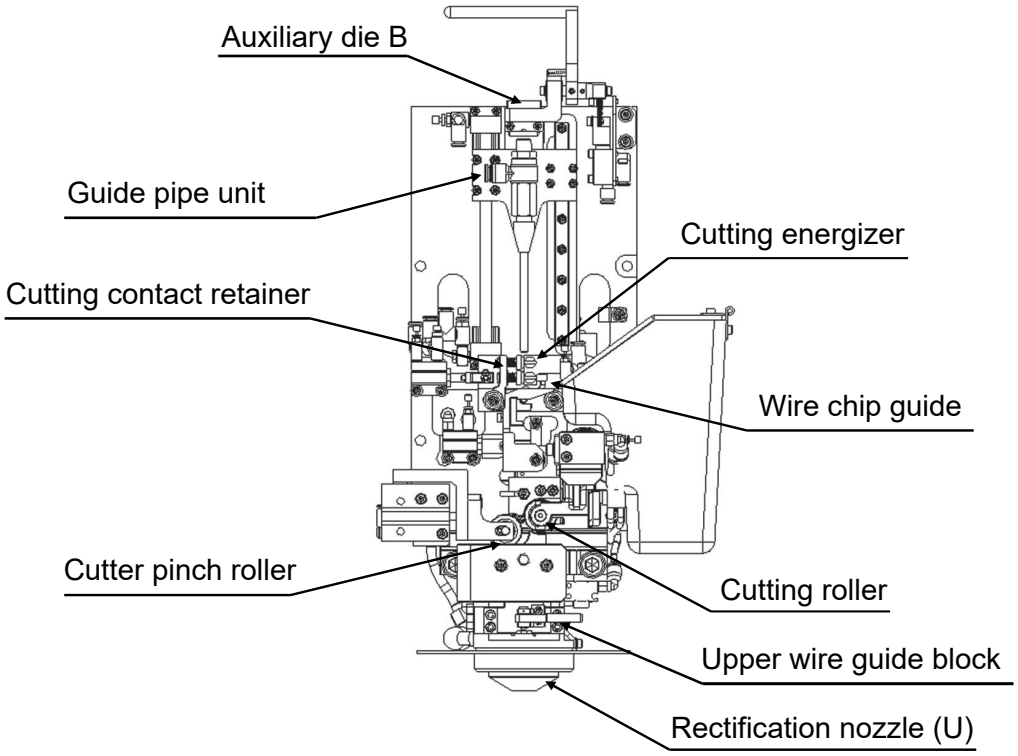


Fig. II.3.4 General drawing of wire travel system (MG12/MG24)

4. HOW TO USE AUTOMATIC WIRE FEEDER

4.1 Initial Setting of Wire Electrode

4.1.1 Checking settings

Check wire screen settings and parts per "1. PRELIMINARY CHECK" for the selected wire.

4.1.2 Initial setting of the wire electrode

See "3.3 Initial Wire Bobbin Setting" and "3.5 Threading wire from automatic wire feeder to collection roller" to step (5). Then pass the wire through the "Upper guide" and proceed.

< Operation procedure >

(1) Tighten the wire on the feeder, leave 10 mm from the upper guide, and cut.

(2) Press "Cut" for automatic cutting.

(3) Remove the wire remaining on the upper guide.

Initial settings are complete.

4.2 Automatically Inserting the Wire

4.2.1 Basic operations

(1) Check wire settings per "1. PRELIMINARY CHECK" for the selected wire.

(2) Configure initial wire settings per "4.1 Initial Setting of Wire Electrode".

(3) Press "Insert" to start auto insertion. Insertion completes when the wire reaches the collection device.

(4) Insertion completes when the wire reaches the collection device.

Lower nozzle position for auto insertion.

- **Use the lower nozzle in the top-held position.**
- **If held at bottom (press down and rotate 90°), auto insertion will not work.**
- **Use bottom only if interference requires it.**

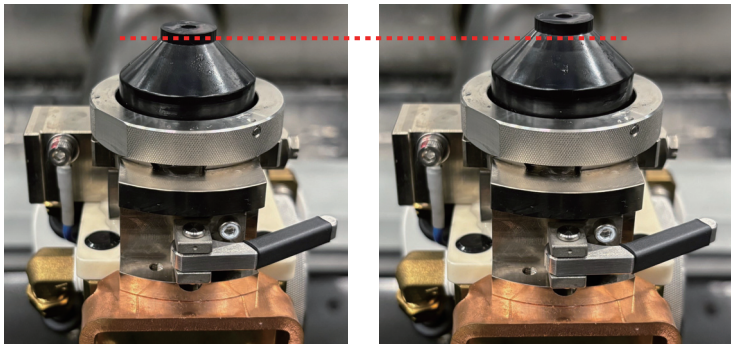


Fig. II.4.1

4.2.2 Small diameter start hole (Ø1.5 to Ø0.5 mm)

(1) Select the jet nozzle to match wire and I/H hole diameters.

(2) The fine hole insertion function can raise success rate depending on sizes.

(3) Submerged connection lowers the rate. (Ø0.15 to Ø0.3 supported)

4.2.3 Wire breakage point

(1) The fine hole insertion function can raise success rate depending on sizes.

(2) Submerged connection lowers the rate. (Ø0.15 to Ø0.3 supported)

- **Not for taper machining. If a taper angle is programmed, turn OFF breakage-point insertion.**
- **If performance drops due to workpiece shape or cone features, set retry to return to the start hole ("Breakage point + M20" or "Breakage point one time + M20").**

4.3 Operation method of automatic wire feeder

4.3.1 Operation panel

Use the control switch to operate the automatic wire threader. See each button's functions, operations, actions, and notes:

Fig. II.4.2

4.3.2 Insert

Function	Automatically inserts the wire.
Operation	1. Press [Insert]. The switch status highlights. 2. Wire feed, jet flow, and lower collection start, and the wire is inserted. 3. When insertion completes, jet flow and lower collection stop. 4. The switch status turns off.
Precautions	• Press [Cut] beforehand. • Turn "PRETENSION" ON. • Enter the correct wire diameter and Z3. Incorrect values can cause insertion failure. • On failure, cutting and insertion repeat up to the set count, default five times. If still unsuccessful, operation stops. • If scrap remains between the lower guide and collection box, turn ON the collector and gather the wire. • The NC code is "M20".

4.3.3 Cut

Function	Cuts the wire to a length suitable for insertion.
Operation	1. Click [Cut]. The switch status highlights. 2. If the wire has reached the collection box, the cut wire goes to the wire collection box. 3. If it has not reached the collection box, the cut wire goes to the waste wire collection box. 4. The switch status turns off.
Precautions	• Turn "PRETENSION" ON. • Enter the correct wire diameter, otherwise cutting may fail. • If cutting fails after the set time, an alarm occurs and operation stops. • If the wire does not reach the collection box and cannot be cut, an alarm occurs and operation stops. • If scrap remains between the lower guide and collection box, turn ON the collector and gather the wire. • NC code is "M21". • If wire scrap exceeds 600 mm, the scrap box may not hold it.

4.3.4 Jet

Function	• Emits jet water flow. • Used to check alignment with the workpiece start hole during auto insertion.
Operation	1. Press [Jet]. The switch status highlights. 2. Jet water flows and lower collection starts. 3. The switch status turns off. Jet and lower collection stop.
Precautions	• Axis movement is possible during operation.

4.3.5 pipe▲

Function	• Raises the lowered guide pipe.
Operation	1. Press [pipe▲]. The switch status highlights. 2. The guide pipe rises.
Precautions	• Does not function when the guide pipe is already raised.

4.3.6 pipe▼

Function	• Lowers the guide pipe and discharges air for a set time. • Used for initial wire setup.
Operation	1. Press [pipe▼]. The switch status highlights. 2. The guide pipe lowers and air discharges for a set time. 3. The wire pressing pinch roller is held open.
Precautions	• After operation, press [pipe▲] to return the guide pipe to the top. • Only air operates while the guide pipe is lowered.

4.3.7 Lower collection

Function	• Starts lower collection. • Used during manual insertion.
Operation	1. Press [Lower collection]. The switch status highlights. 2. Lower collection fluid flows. 3. Press "STOP" to stop the fluid. 4. During manual insertion, it stops automatically when insertion completes.
Precautions	• Does not function when insertion completion is detected.

4.3.8 Move power feeders

Function	• Retracts the power feeder for a set time. • Used to catch the wire or insert manually.
Operation	1. Press [Move power feeders]. The switch status highlights. 2. The power feeder retracts. 3. The switch status turns off. The power feeder returns to its original position..
Precautions	• Usable only with [pipe▲] and [pipe▼]. • The power feeder returns with [RESET] or [STOP].

4.3.9 Guide tilt

Function	• Tilts the wire chip collection guide to remove remaining chips.
Operation	1. Press [Guide tilt]. The switch status highlights. 2. The guide tilts. 3. Press [Guide tilt] again to reset. The switch status turns off.
Precautions	• Usable only with [Wire Chip Suction]. • The guide returns with [RESET] or [STOP].

4.3.10 Wire feeder

Function	• Rotates the wire feed motor to feed wire. • Used for manual insertion.
Operation	1. Press [pipe▼] to lower the guide pipe. 2. Press and hold [Wire feeder] to feed wire. 3. Release [Wire feeder] to stop feeding.
Precautions	

4.3.11 AT manual

Function	• Stops machining with a "Wire cut" alarm at the wire break point.
Operation	1. Press [AT manual]. The switch status highlights.
Precautions	• Turn it ON before starting machining. • Turning it ON during machining triggers an alarm.

III. NC OPERATION DISPLAY SCREEN

BRN-83587-003-*-002

1. SCREEN CONFIGURATION
2. HOME
3. INITIAL SETTING
4. OPERATION
5. HISTORY MANAGEMENT
6. OVERLAP
7. EXPANSION

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1. SCREEN CONFIGURATION

1.1 Menu configuration

1.1.1 Menu configuration overview

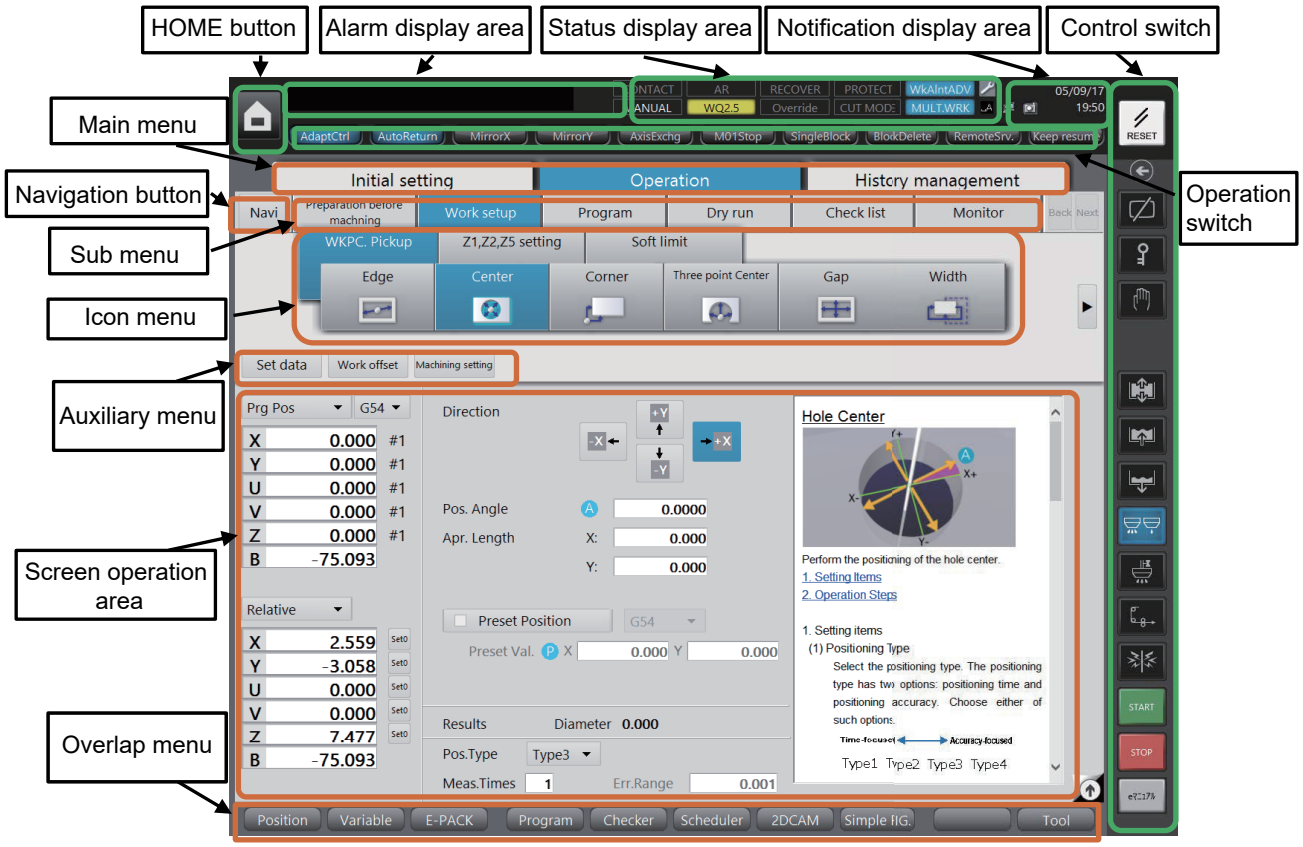


Fig. III.1.1

1.2 Menus and switches

1.2.1 Main menu

There are three main menus.

(1) Initial setting

Initial settings for machine operation.

(2) Operation

Navigation of work from setup to machining in six steps.

(3) History management

Managing of machine history.

1.2.2 Submenu and icon menu

Submenus with icons are provided for each main menu.
The menu display can be customized. See 1.2.10.

1.2.3 Overlap menu

The following screens can be overlapped and displayed on the main screen without bothersome screen switching. (Overlap window)

(1) Position

Displays the coordinate values.

(2) Variable

Displays the variable list.

(3) E-Pack

Displays the currently enabled machining conditions and the machining condition list.

(4) Program

Displays the program list and edits programs.

(5) Checker

Confirms the path of program in the displayed screen.

(6) Scheduler

Registers and continuously operates multiple programs in the displayed screen.

(7) 2DCAM

Displays 2DCAM screen.

(8) Simple FIG.

Easily creates simple shape programs.

(9) Tools

Calls tools.

1.2.4 Screen operation area

Displays graphics etc.

1.2.5 HOME button

Press the button to switch to the HOME screen.

1.2.6 Navigation Buttons

Navigates a series of work from before-machining preparation to machining monitor.
Some icon menus can be hidden.

Icon menus to be hidden when the navigation button is ON
Work setup > WKPC. Pickup > Corner, Three point Center, Gap, Width, Work slope, Work plane

1.2.7 Operation switches

Press each switch to change the relevant action during program operation.
Switch display can be customized. See 1.2.10.

Display	Switch name	Description
	AdaptCtrl	Starts automatic determination of AdaptCtrl speed during EDM.
	AutoReturn	After a stop (including M00 / M01 STOP or wire break), if the table was moved manually, it will auto- return to the previous stop position at the next start.
	MirrorX	Moves X axis by command values in the reverse direction of the commands.
	MirrorY	Moves Y axis by command values in the reverse direction of the commands.
	AxisExchg	This function exchanges the X-axis command value and Y-axis command value.
	M01Stop	When the M01 command is read in, the unit stops reading the next block.
	SingleBlock	Stops after each block.
	BlockDelete	Delete the block with block delete symbol :/ at the beginning of the block.

1.2.8 Control switches

(1) Reset switch

Activation: press and hold 1+ s or press twice.

1) Pressing Reset during operation clears command value / buffer registers, next block and remaining distance data, turns off program error / NC alarm and resets coordinate rotation, scale and axis magnifications.
2) The "Remote Ctrl" switch is turned OFF.

NOTICE

- **Presses under 1 s are ignored, but "Remote Ctrl" still turns OFF.**
- **Repeated RESET clears data each time. To avoid unintended clears, hold RESET >2 s.**

(2) Screen toggle switch

Closes the screen.

(3) Key lock switch

When ON, locks all keys except EMERGENCY STOP, Power OFF, STOP, Key lock, and RESET. The screen turns OFF.

(4) Manual switch

Toggles modes. ON: manual mode. OFF: auto mode.

(5) Working tank door switch

Opens and closes the door.

(6) Rapid fill switch

Adds dielectric fluid to the working tank.

(7) Fluid discharging switch

ON when tank is filled: drains under the table. ON again: fully drains the tank.

(8) Fluid strong/weak switch

Sets dielectric flow to strong (ON) or weak (OFF).

(9) Dielectric fluid switch

Flows dielectric fluid (ON) or stops it (OFF).

(10)Wire switch

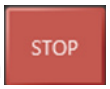
Maintains wire tension during feed. ON: feed. OFF: stop.

(11)Machining switch

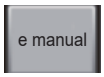
Enables electrical-discharge machining.

(12)START switch

Starts automatic operation.

(13)STOP switch 

1) Stops the NC program during automatic operation. Press START to resume.
2) Disables remote control via PC automation; sets "Remote Ctrl" OFF. Always press STOP when operating at the machine.

(14)e manual switch 

Displays machine manual.

(15)AT switch

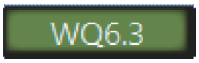
See "II. AUTOMATIC WIRE FEEDER".

1.2.9 Auxiliary menu

Displays common auxiliary menus.

1.2.10 Status display area

Shows status items in colors and values. Display can be customized.

<table>
<tr><td rowspan="5">Resistivity</td><td colspan="3">Displays resistivity [WQ]. Frame color indicates resistivity status.</td></tr>
<tr><td>Display</td><td>Status</td><td>Remarks</td></tr>
<tr><td>  </td><td>Normal</td><td>Text color = Black
Background color = Green</td></tr>
<tr><td> </td><td>Not reached the lower current</td><td>Text color = Black
Background color = Yellow</td></tr>
<tr><td> </td><td>Over the upper current</td><td>Text color = Black
Background color = Red</td></tr>
<tr><td rowspan="3">Assignment of TIME TO START</td><td colspan="3">Displays the TIME TO START assignment state and start time via background and text colors.</td></tr>
<tr><td>Display</td><td>Status</td><td>Description</td></tr>
<tr><td> </td><td>OFF</td><td>Text color = Gray
Background color = Dark gray</td></tr>
<tr><td> </td><td>ON</td><td>Displays TIME TO START in hour and minute.
Text color = Black
Background color = Yellow</td></tr>
<tr><td rowspan="3">M01
Stop</td><td colspan="3">Displays M01 STOP switch status via background and text colors.</td></tr>
<tr><td>Display</td><td>Status</td><td>Remarks</td></tr>
<tr><td> </td><td>The "M01 STOP" switch is OFF</td><td>Text color = Gray
Background color = Dark gray</td></tr>
<tr><td> </td><td>The "M01 STOP" switch is ON</td><td>Text color = White
Background color = Blue</td></tr>
<tr><td rowspan="4">Power saving mode</td><td colspan="3">Displays power save mode status via background and text colors.</td></tr>
<tr><td>Display</td><td>Status</td><td>Remarks</td></tr>
<tr><td> </td><td>Non-contact power save mode setting
OFF</td><td>Text color = Gray
Background color = Dark gray</td></tr>
<tr><td> </td><td>Automatic power off mode</td><td>Text color = Black
Background color = Yellow</td></tr>
<tr><td> </td><td>Wakeup mode</td><td>Text color = Black
Background color = Yellow</td></tr>
<tr><td rowspan="3">Power save mode Reservation</td><td colspan="3">Displays the power save mode reservation activation switch status via background and text colors.</td></tr>
<tr><td>Display</td><td>Status</td><td>Remarks</td></tr>
<tr><td> </td><td>Reservation activation of power save mode
Switch OFF</td><td>Text color = Gray
Background color = Dark gray</td></tr>
<tr><td> </td><td>Reservation activation of power save mode
Switch ON</td><td>Text color = White
Background color = Blue</td></tr>
<tr><td rowspan="3">VAR.TYPE2</td><td colspan="3">Displays VAR.TYPE2 switch status via background and text colors.</td></tr>
<tr><td>Display</td><td>Status</td><td>Remarks</td></tr>
<tr><td> </td><td>When "VAR.TYPE2" is OFF</td><td>Text color = Gray
Background color = Dark gray</td></tr>
<tr><td> </td><td>When "VER.TYPE2" is ON</td><td>Text color = White
Background color = Blue</td></tr>
</table>

<table>
<tr><td rowspan="6">Mirror XY</td><td colspan="3">Displays mirror status via background and text colors.</td></tr>
<tr><td>Display</td><td>Status</td><td>Remarks</td></tr>
<tr><td> </td><td>Both mirror X and Y are OFF</td><td>Text color = Gray
Background color = Dark gray</td></tr>
<tr><td> </td><td>Only mirror X is ON</td><td>Text color = White
Background color = Blue</td></tr>
<tr><td> </td><td>Only mirror Y is ON</td><td>Text color = White
Background color = Blue</td></tr>
<tr><td> </td><td>Both mirror X and Y are ON</td><td>Text color = White
Background color = Blue</td></tr>
<tr><td rowspan="4">Contact</td><td colspan="3">Displays wire-to-workpiece contact status via background and text colors.</td></tr>
<tr><td>Display</td><td>Status</td><td>Remarks</td></tr>
<tr><td> </td><td>Not in contact</td><td>Text color = Gray
Background color = Dark gray</td></tr>
<tr><td> </td><td>In contact</td><td>Text color = White
Background color = Red</td></tr>
<tr><td rowspan="4">Axis exchange</td><td colspan="3">Displays axis exchange status via background and text colors.</td></tr>
<tr><td>Display</td><td>Status</td><td>Remarks</td></tr>
<tr><td> </td><td>OFF</td><td>Text color = Gray
Background color = Dark gray</td></tr>
<tr><td> </td><td>ON</td><td>Text color = White
Background color = Blue</td></tr>
<tr><td rowspan="4">Coordinate rotation</td><td colspan="3">Displays coordinate rotation status via background and text colors.</td></tr>
<tr><td>Display</td><td>Status</td><td>Remarks</td></tr>
<tr><td> </td><td>None</td><td>Text color = Gray
Background color = Dark gray</td></tr>
<tr><td> </td><td>Included</td><td>Text color = White
Background color = Blue</td></tr>
<tr><td rowspan="4">Axis rotation</td><td colspan="3">Displays whether axis rotation is executed via background and text colors.</td></tr>
<tr><td>Display</td><td>Status</td><td>Remarks</td></tr>
<tr><td> </td><td>AR = 0</td><td>Text color = Gray
Background color = Dark gray</td></tr>
<tr><td> </td><td>AR ≠ 0</td><td>Text color = White
Background color = Blue</td></tr>
<tr><td rowspan="4">Figure magnification</td><td colspan="3">Displays figure magnification status via background and text colors.</td></tr>
<tr><td>Display</td><td>Status</td><td>Remarks</td></tr>
<tr><td> </td><td>Excluded</td><td>Text color = Gray
Background color = Dark gray</td></tr>
<tr><td> </td><td>Included</td><td>Text color = White
Background color = Blue</td></tr>
</table>

Axis setting	**Displays axis setting status via background and text colors.**		
	Display	**Status**	**Remarks**
		The mirror image, axis exchange, coordinate rotation, axis rotation, and scale are not set	Text color = Gray Background color = Dark gray
		Either of mirror image, axis exchange, coordinate rotation, axis rotation, or scale is set	Text color = White Background color = Blue
OPTION	**Displays OPTION status via background and text colors.**		
	Display	**Status**	**Remarks**
		When OPTION is not output	Text color = Gray Background color = Dark gray
		Any one of external outputs 1 to 8 is output	Text color = White Background color = Blue
Control unit	**Displays the selected control unit.**		
	Display	**Status**	**Remarks**
		Metric and ×0.1 OFF	Text color = White Background color = Blue
		Metric and ×0.1 ON	Text color = White Background color = Blue
		Inch and ×0.1 OFF	Text color = White Background color = Blue
		Inch and ×0.1 ON	Text color = White Background color = Blue
Tank cycle	**Displays tank cycle switch status via background and text colors.**		
	Display	**Status**	**Remarks**
		The tank cycle switch is off	Text color = Gray Background color = Dark gray
		The tank cycle switch is on	Text color = White Background color = Blue
Memory Recover	**Displays memory power failure recovery switch status via background and text colors.**		
	Display	**Switch**	**Remarks**
		OFF	Text color = Gray Background color = Dark gray
		ON	Text color = White Background color = Blue
OVERRIDE	**Displays OVERRIDE status via background and text colors.**		
	Display	**Status**	**Remarks**
		OVERRIDE = 100%	Text color = Gray Background color = Dark gray
		OVERRIDE ≠ 100%	Text color = White Background color = Blue

PROTECT MODE	**Displays PROTECT MODE status via background and text colors.**		
	Display	**Status**	**Remarks**
		OFF	Text color = Gray Background color = Dark gray
		ON	Text color = White Background color = Blue
Remaining / cutting-off reprocessing mode	**Displays remaining/cut-off reprocessing mode via background and text colors.**		
	Display	**Status**	**Remarks**
		None	Text color = Gray Background color = Dark gray
		Cutting-off	Text color = White Background color = Blue
		Remaining	Text color = White Background color = Blue
Workpiece alignment ADVANCE	**Displays work alignment ADVANCE switch status via background and text colors.**		
	Display	**Status**	**Remarks**
		OFF	Text color = Gray Background color = Dark gray
		ON	Text color = White Background color = Blue
Straightness compensation	**Displays straightness compensation switch status via background and text colors.**		
	Display	**Status**	**Remarks**
		The straightness compensation switch is off	Text color = Gray Background color = Dark gray
		The straightness compensation switch is on	Text color = White Background color = Blue
Up/down arbitrary shape	**Displays up/down arbitrary shape switch status via background and text colors.**		
	Display	**Status**	**Remarks**
		The up/down arbitrary shape switch is off	Text color = Gray Background color = Dark gray
		The up/down arbitrary shape switch is on	Text color = White Background color = Blue
Multiple workpieces	**Displays multiple work switch status via background and text colors.**		
	Display	**Status**	**Remarks**
		OFF	Text color = Gray Background color = Dark gray
		ON	Text color = White Background color = Blue
Touch sensor	**Displays the status of touch sensor switch with the background colors and text colors.**		
	Display	**Status**	**Remarks**
		The touch sensor switch is off	Text color = Gray Background color = Dark gray
		The touch sensor switch is on	Text color = White Background color = Blue

E-OFF	**Displays E-OFF switch status via background and text colors.**		
	Display	**Status**	**Remarks**
		E-OFF switch is off	Text color = Gray Background color = Dark gray
		E-OFF switch is on	Text color = White Background color = Blue
BLK.DELETE	**Displays BLK.DELETE switch status via background and text colors.**		
	Display	**Status**	**Remarks**
		BLK.DELETE switch is off	Text color = Gray Background color = Dark gray
		BLK.DELETE switch is on	Text color = White Background color = Blue
Interference Check	**Displays INTRFR CHK switch status via background and text colors.**		
	Display	**Status**	**Remarks**
		The INTRFR CHK switch is off	Text color = Gray Background color = Dark gray
		The INTRFR CHK switch is on	Text color = White Background color = Blue
Remote control	**Displays DNC remote control status via background and text colors (only when DNC is ON).**		
	Display	**Status**	**Remarks**
		Not in the REMOTE CONTROL	Text color = Gray Background color = Dark gray
		In the REMOTE CONTROL	Text color = Black Background color = Yellow
Soft limit	**Displays soft limit 1–5 enabled/disabled status via background and text colors.**		
	Display	**Status**	**Remarks**
		Soft limit disabled	Text color = Gray Background color = Dark gray
		Soft limit enabled	Text color = White Background color = Blue
CS	**Displays CS (Cost Save) switch status via background and text colors**		
	Display	**Status**	**Remarks**
		OFF	Text color = Gray Background color = Dark gray
		ON	Text color = White Background color = Blue

	Displays the operation mode via corresponding background and text colors.			
	Display	**Modes**	**Operation status**	**Remarks**
Operation		Automatic	Not being started or in the stop status	Text color = White Background color = Dark gray
			M0/M1 Stop	Text color = Black Background color = Yellow
			M2 End	Text color = White Background color = Blue
		Manual	No operation	Text color = White Background color = Black
			Positioning in progress	Text color = Black Background color = Yellow
			Returning to the zero point	Text color = Black Background color = Yellow
			Contact positioning in progress [Change the display according to the positioning mode]	Text color = Black Background color = Yellow
			Determining the taper specification	Text color = Black Background color = Yellow
			Vertical aligning	Text color = Black Background color = Yellow
			Select the positioning mode by JOG	Text color = Black Background color = Yellow
			Manual end	Text color = White Background color = Blue
			Operating in the MDI mode	Text color = Black Background color = Yellow
			Positioning two hole center	Text color = Black Background color = Yellow

The status display area, operation switch, and icon menu can be changed to the dedicated configurations for customer with the customize function.

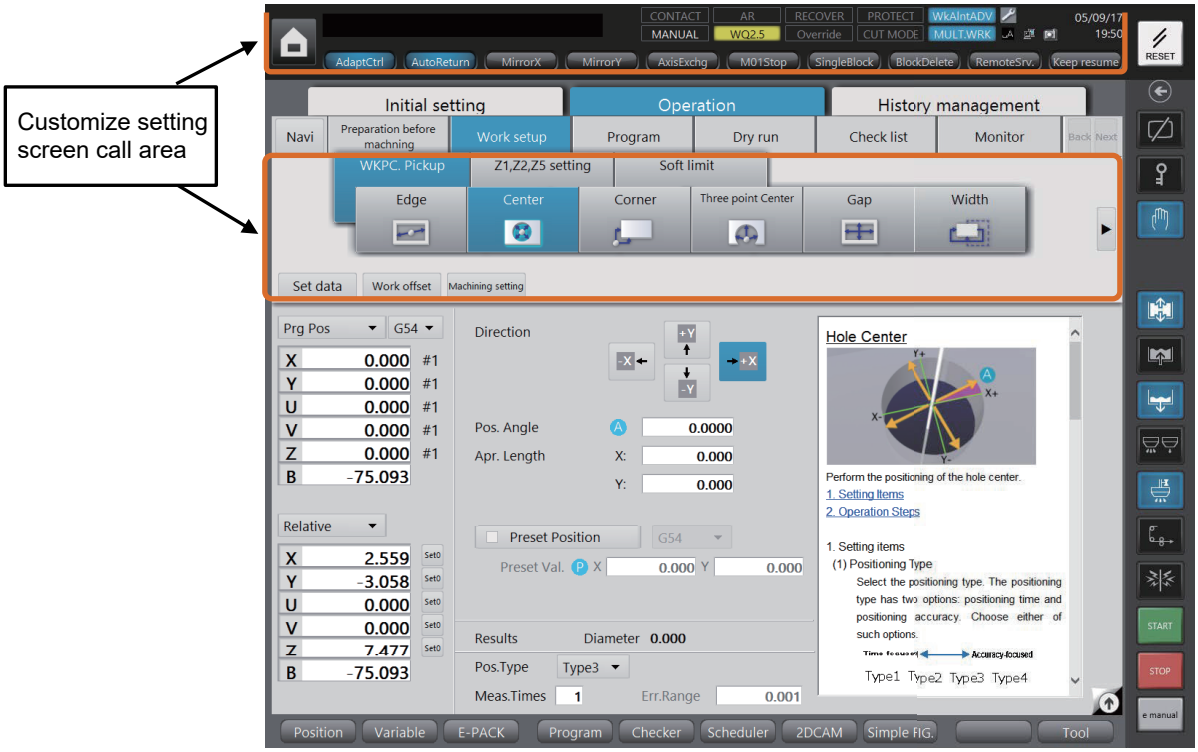
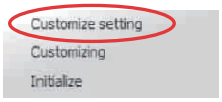


Fig. III.1.2

Right-clicking the call area of the customize setting screen displays <img>.



Select customize setting to display the customize setting screen. Customize according to the following procedures.

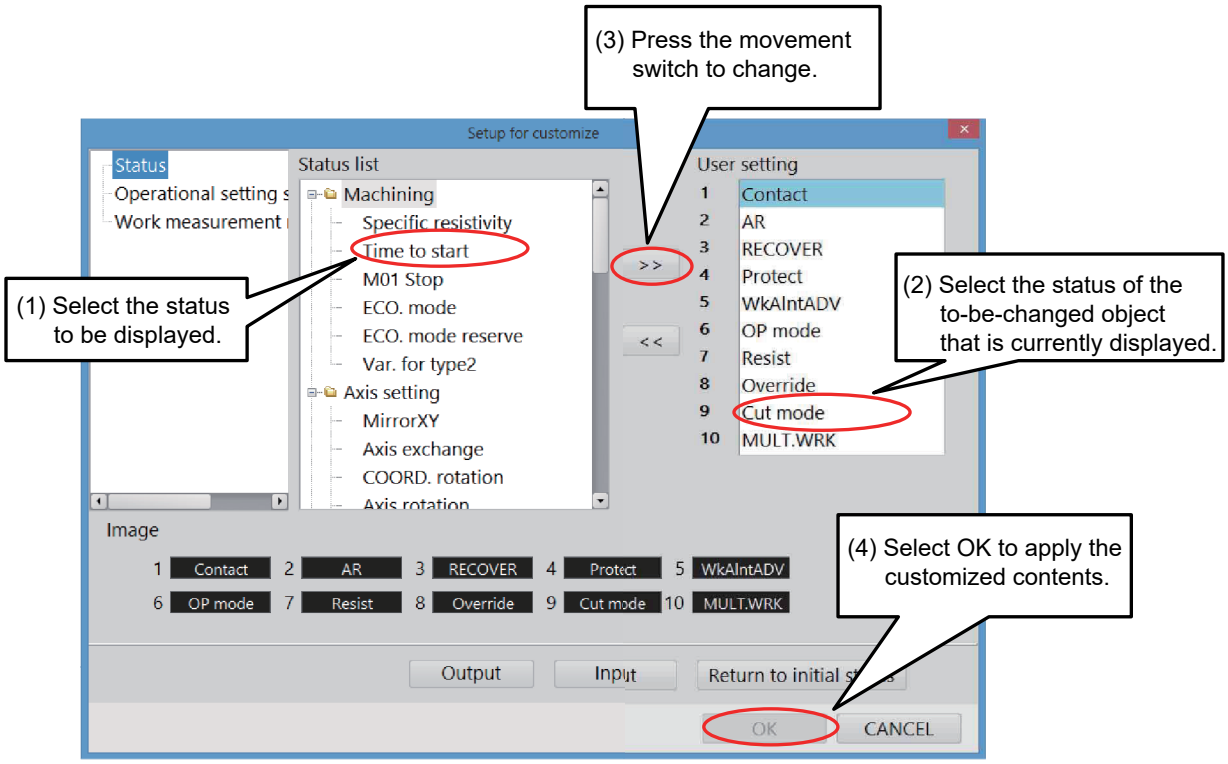


Fig. III.1.3

1.2.11 Message display area

Displays the alarm and warning messages.

Displays message quantity. Select message to display the alarm information.

1.2.12 Notification display area

Item	Description
Clock	Displays YYYY:MM:DD:hh:mm.
Character input mode	: Japanese input (full-width Hiragana) mode : Alphanumeric input mode
Network status	: Connecting : Disconnected
Inspection	: No inspection item : With inspection item

Item	Description
Status of virus infection prevention	: Valid : Invalid : Error
Camera	: Screen shot. Images are saved under: hd(D:)\MYDATA\NETSERVICE\STOCK\REPLAY\CAPTURE

1.3 Launcher function

Enables quick screen transitions via shortcuts to frequently used screens or overlaps. Shortcuts can be registered, deleted, and arranged. Operate with a mouse.

Fig. III.1.4

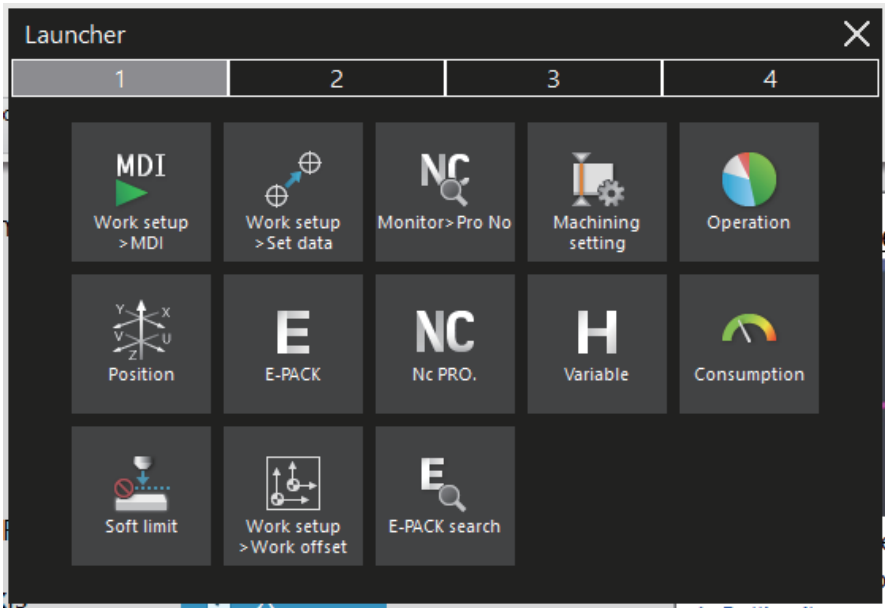


Fig. III.1.5

(1) Operation method

1) Launcher startup

Double-click right mouse on screen or press "F12".

2) Shortcuts selection

Click a shortcut to change screens.

(2) Customize

1) Registering a shortcut

(a) Move the cursor to an empty launcher spot.

(b) Right-click and select "Set "Name" to LNCHR".

NOTE

*1 Registers the last used screen, overlap, or dialog. Do this with the target in focus.

*2 Dialogs and overlaps requiring a transition are registered with the current screen. Selecting the shortcut transitions to the item.

2) Deleting a shortcut

(a) Right-click the shortcut and select "DLT".

*1 If deleted by mistake, register it again.

3) Rearranging shortcuts

Click, drag, and drop within the launcher.

If a shortcut exists at the drop target, they swap. If not, it moves.

4) Changing the tab name

Double-click the tab to edit its name. Use to separate tabs by operation or operator.

2. HOME

2.1 What is HOME?

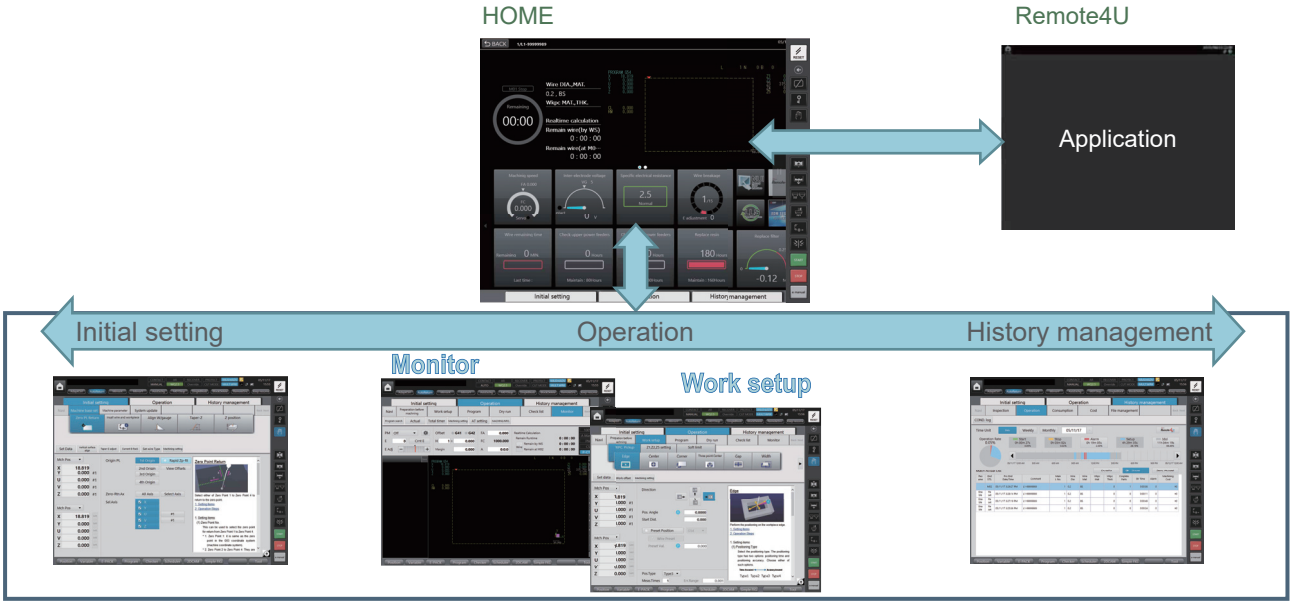


Fig. III.2.1

"HOME" is the center screen with selector functions to view machining progress. It summarizes progress and has no settings. To set functions, touch the item to switch screens.

2.2 HOME Screen Configuration

2.2.1 Overview of HOME screen configuration

Fig. III.2.2

2.2.2 Main menu

There are three main menus.

See "III. NC OPERATION DISPLAY SCREEN" > "1. SCREEN CONFIGURATION".

2.2.3 Tile

Fig. III.2.3

The current EDM status is shown in real time. Tap an item to open its setting screen. Tap "▲" to switch pages. To edit tiles, right-click "HOME" and choose "Customize setting" (Fig. III.2.3).

(1) Adding tiles

Use "(Add)" to place tiles in blank areas. Up to three identical icons. Up to three pages. Drag to reposition. Drag past an edge to move to the next page. Sizes: S and M.

(2) Hiding and rearranging tiles

Right-click for the menu. Tap "[Disp hide]" to hide. Tap "[Return to initial status]" to restore factory settings.

(3) Type of tiles

Multiple types.

*** Size of some items may be limited**

2.2.4 Status display area

Shows M01 switch ON/OFF, predicted remaining machining time, and wire/workpiece info.

2.2.5 Alarm display area

Shows alarms and warnings. Color indicates state of EDM.

Green: Normal

Yellow: Stop in case of stop code (M0, M01)

Red : Alarm

2.2.6 Back button

Returns to the screen shown before "HOME". If "Initial setting" > "Machine base set" > "Align W/gauge" was shown, it returns there.

2.2.7 Program in progress

Shows L No. and comment of the active program.

2.2.8 Graphic display

Shows the machining shape. Touch to open the machining monitor. Touch to go to "Initial setting" > "Zero point return" in navigation mode.

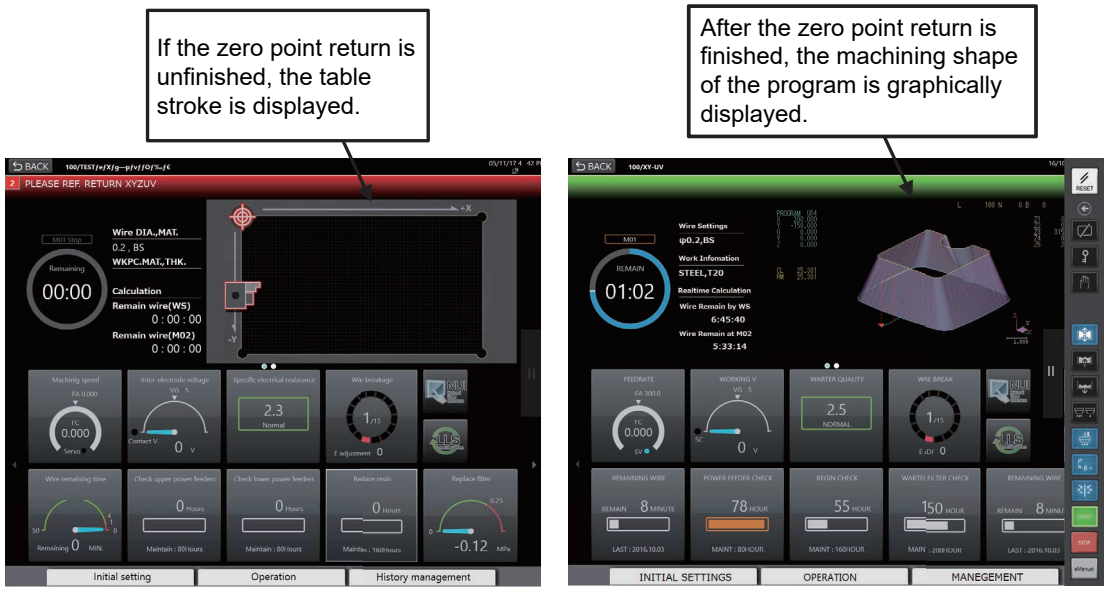


Fig. III.2.4

2.2.9 Call tab of control switch

Tap the tab to display the control switch*

*** See "III. NC OPERATION DISPLAY SCREEN" > "1. SCREEN CONFIGURATION" > "1.2.8 Control switches".**

2.2.10 Shortcut

Tap a shortcut to open its screen.

Shortcuts can be customized like tiles. Shortcut types include the following.

Icon	Name	Category	Function
	Touch sensor	On-machine check	*1 Touch sensor operation screen starts.
	ODS (Opt Drive System)	Precision	*2 Transits to the adaptive control setting screen.
	PFC (Precise finish Circuit)	Productivity	*3 Transits to the 2DCCAM screen.
	LLS (Long Life System)	Energy saving Low cost	*4 Transits to the cost management screen.
	NUI (Natural User Interface)	Operability Workability	Transits to the daily inspection screen.

*1 Touch sensor on-machine check, see "VI. OPTIONS".

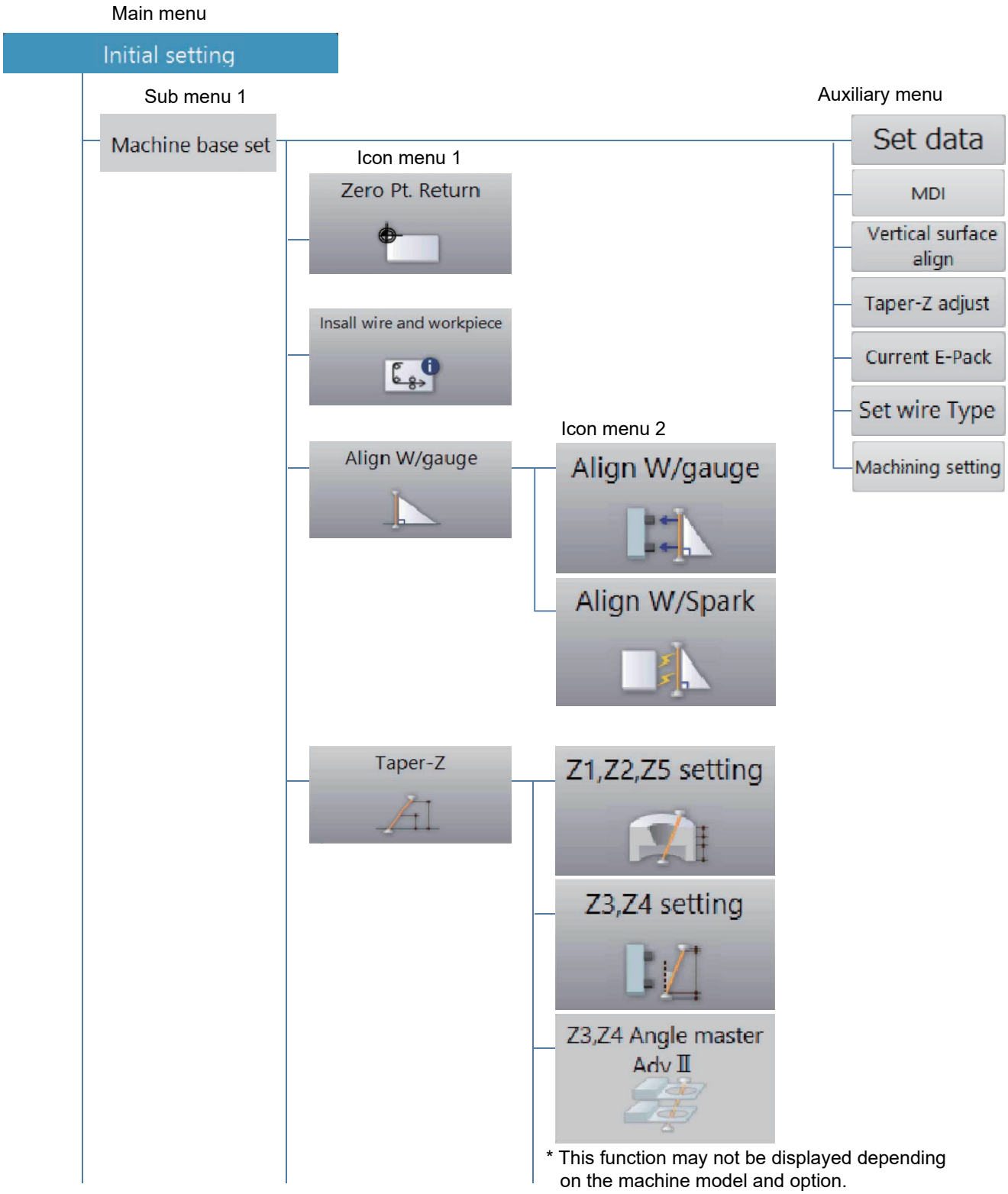
*2 Adaptive control setting, see "III. NC OPERATION DISPLAY SCREEN" > "3.2.11 Machining setting".

*3 2DCAM, see "III. NC OPERATION DISPLAY SCREEN" > "6.7 2DCAM".

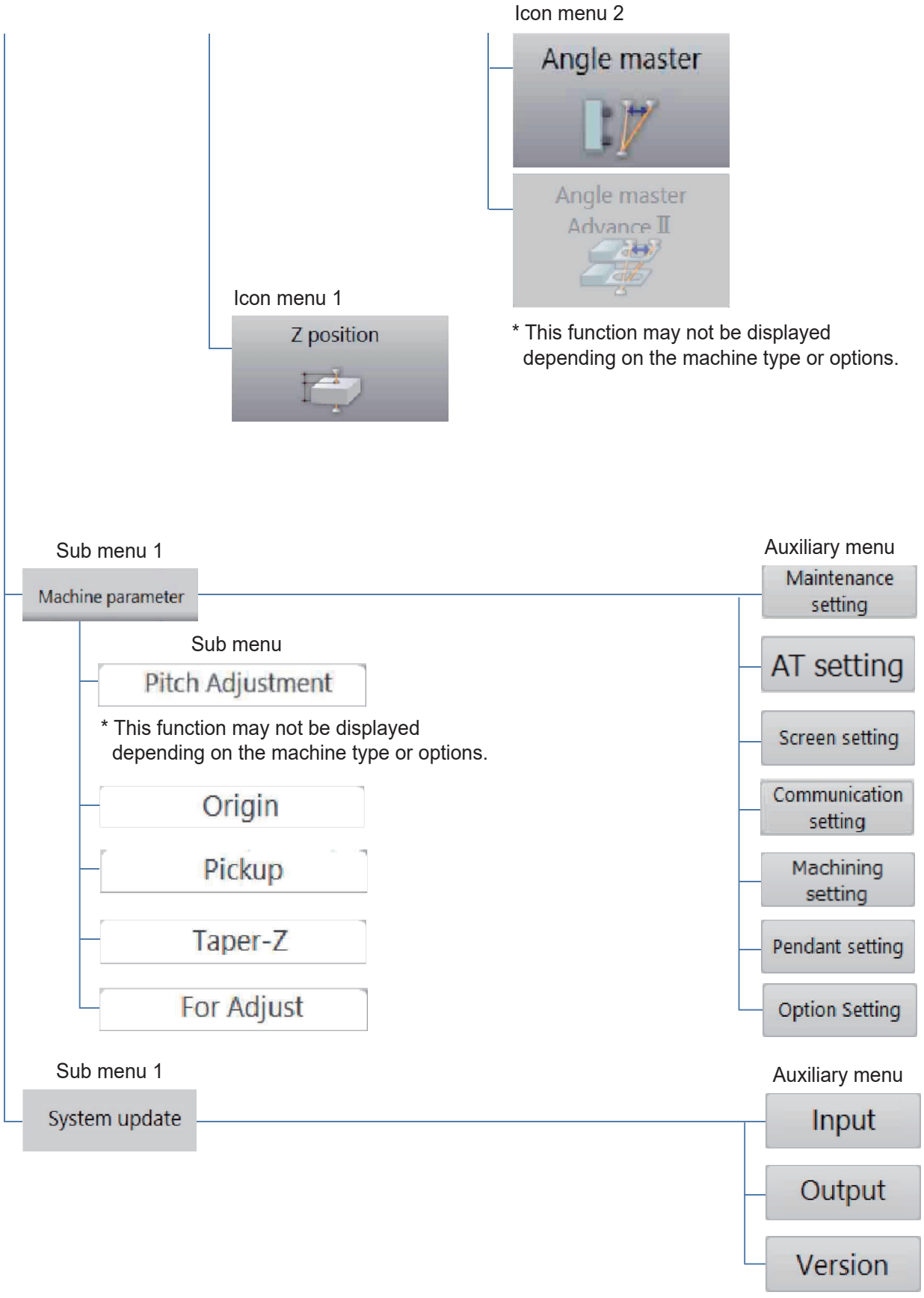
*4 Cost management, see "III. NC OPERATION DISPLAY SCREEN" > "5.4 Cost".

3. INITIAL SETTING

(1) Menu configuration



* This function may not be displayed depending on the machine model and option.


Icon menu 2
Angle master
Angle master Advance II
* This function may not be displayed depending on the machine type or options.
Icon menu 1
Z position
Sub menu 1
Machine parameter
Sub menu
Pitch Adjustment
* This function may not be displayed depending on the machine type or options.
Origin
Pickup
Taper-Z
For Adjust
Auxiliary menu
Maintenance setting
AT setting
Screen setting
Communication setting
Machining setting
Pendant setting
Option Setting
Sub menu 1
System update
Auxiliary menu
Input
Output
Version

3.1 Machine base set

Initial settings cover items completed at startup and lower-frequency items. "Machine base set" provides machining reference settings.

3.1.1 Zero PT. Return

Return to any one of the four zero points:

(1) Description of setting items

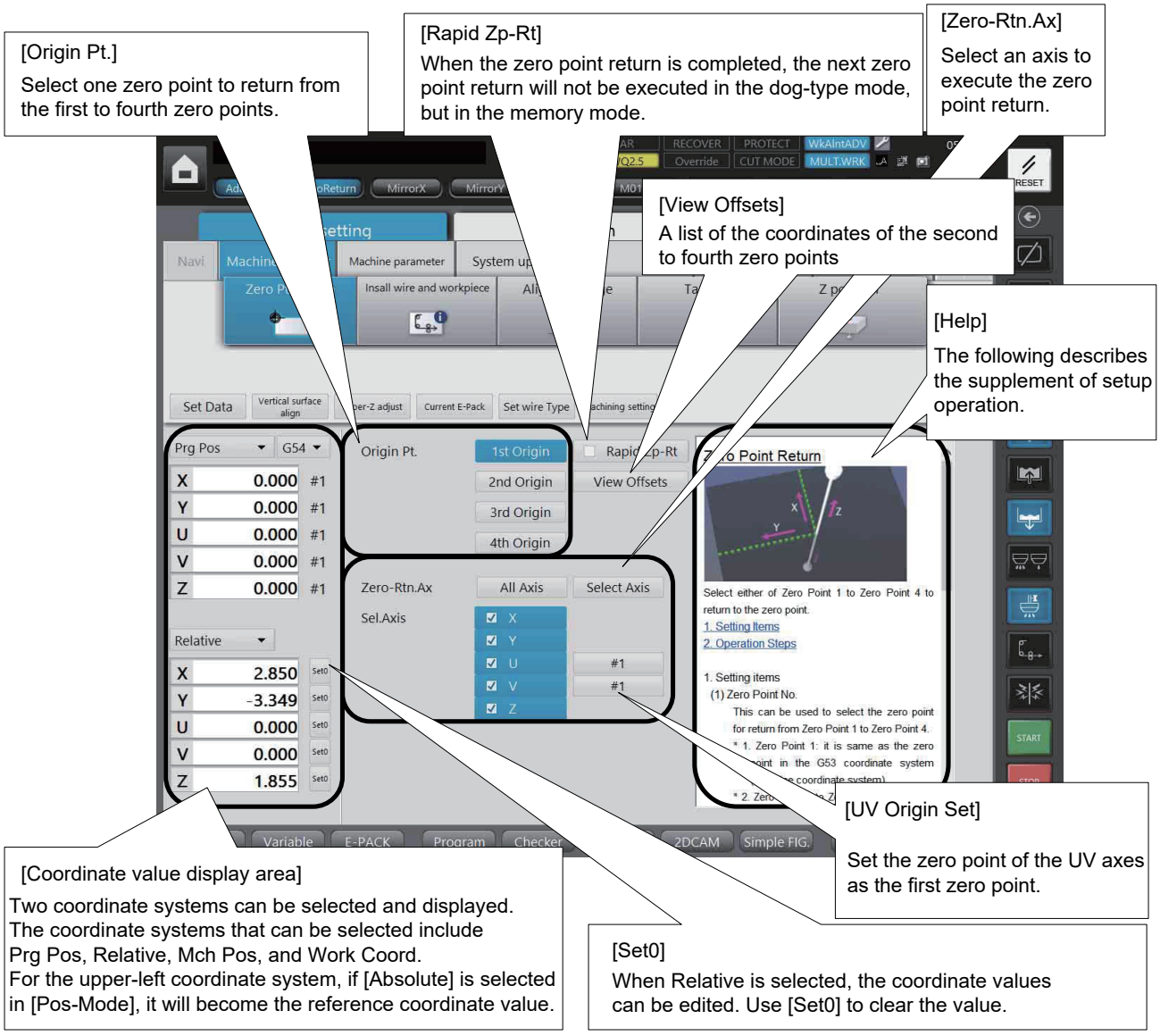


Fig. III.3.1

1) Description of the positions

The following types of coordinates can be selected.

(a) **Prg Pos**..... Displays the coordinate values in the currently selected work coordinate system.

(b) **Relative**..... Displays count starting from any position ever set by the user.

(c) **Mch Pos**..... Displays the coordinate values starting from the machine's zero point.

(d) **Work Coord**..... Displays the coordinate values in the work coordinate system.

2) 1st Origin

Identical with the zero point of G53 coordinate system (machine position). Return to the 1st zero point in the following procedures.

(a) XYZ axis

Identify and return to the zero point with the dog-type.
However, if [Rapid Zp-Rt] switch is set to ON, any zero point return after the second operation will be completed based on the memory.

(b) UV axis

Move to the stored zero point.
Zero point setting of UV axis can be completed in vertical alignment or discharge vertical alignment.

3) 2nd to 4th Origin

Are relative zero points deviating from the 1st zero point. The position relative to the 1st zero point can be set in "View Offsets". All axes move to the stored zero point.

(2) Operation procedure

The operation procedures required for zero point return are shown below.

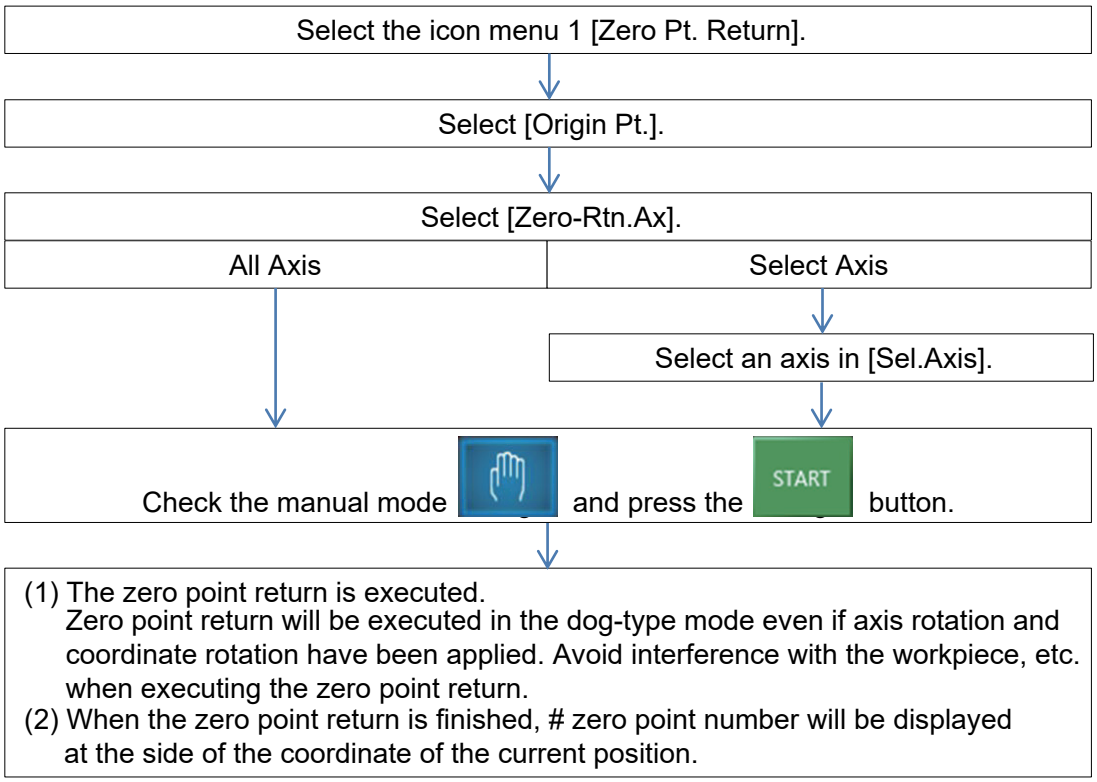


Fig. III.3.2

NOTICE

- **When straightness compensation is ON and Z zero point return is performed in "Unfinished Z Zero Point Return", Z3 parameters are set automatically.**
- **Do not perform a zero point return while program operation is stopped, as the machining position will shift.**

3.1.2 Install Wire and workpiece

Introduce preparation for taper angle machining, as well as installation of wire and workpiece.

(1) Description of setting items

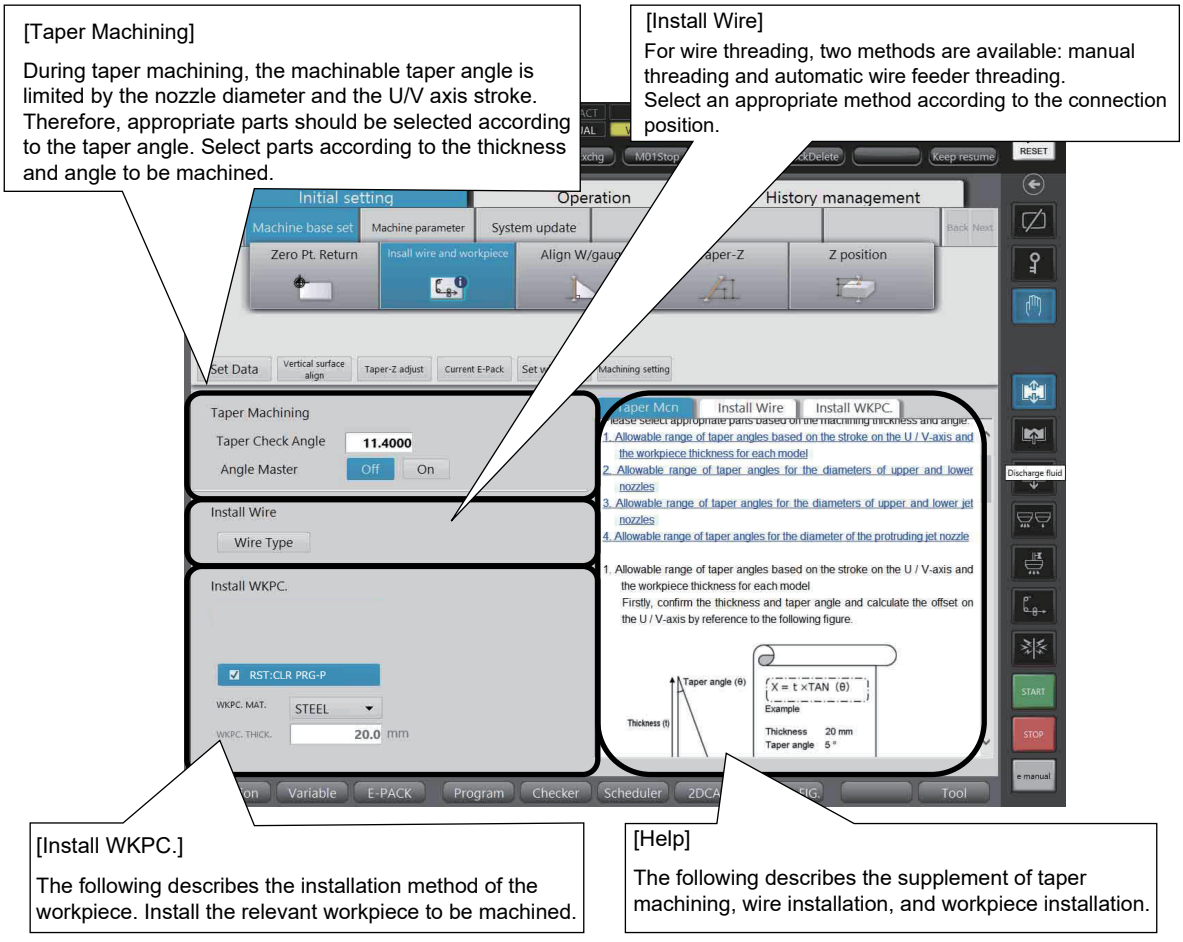


Fig. III.3.3

1) Taper Check Angle

On the "Program" screen, "Program Max Taper A" evaluates the machining program by calculating the maximum achievable taper and recommending a suitable jet nozzle. Set the taper angle threshold here to trigger the message.

2) Angle Master

Turn ON to use angle master compensation for taper machining. Turn OFF to disable.

3) Wire Type

Install the wire and set its type. See "3.1.10 Wire type setting".

4) RST:CLR PRG-P

Relative position on reset:

- ON: Cleared
- OFF: Held

5) WKPC MAT.

Select the workpiece material.

3.1.3 Align W/gauge

(1) Align W/gauge

Performs automatic vertical alignment of the wire fixing seat using the taper unit and wire alignment device.

1) Description of setting items

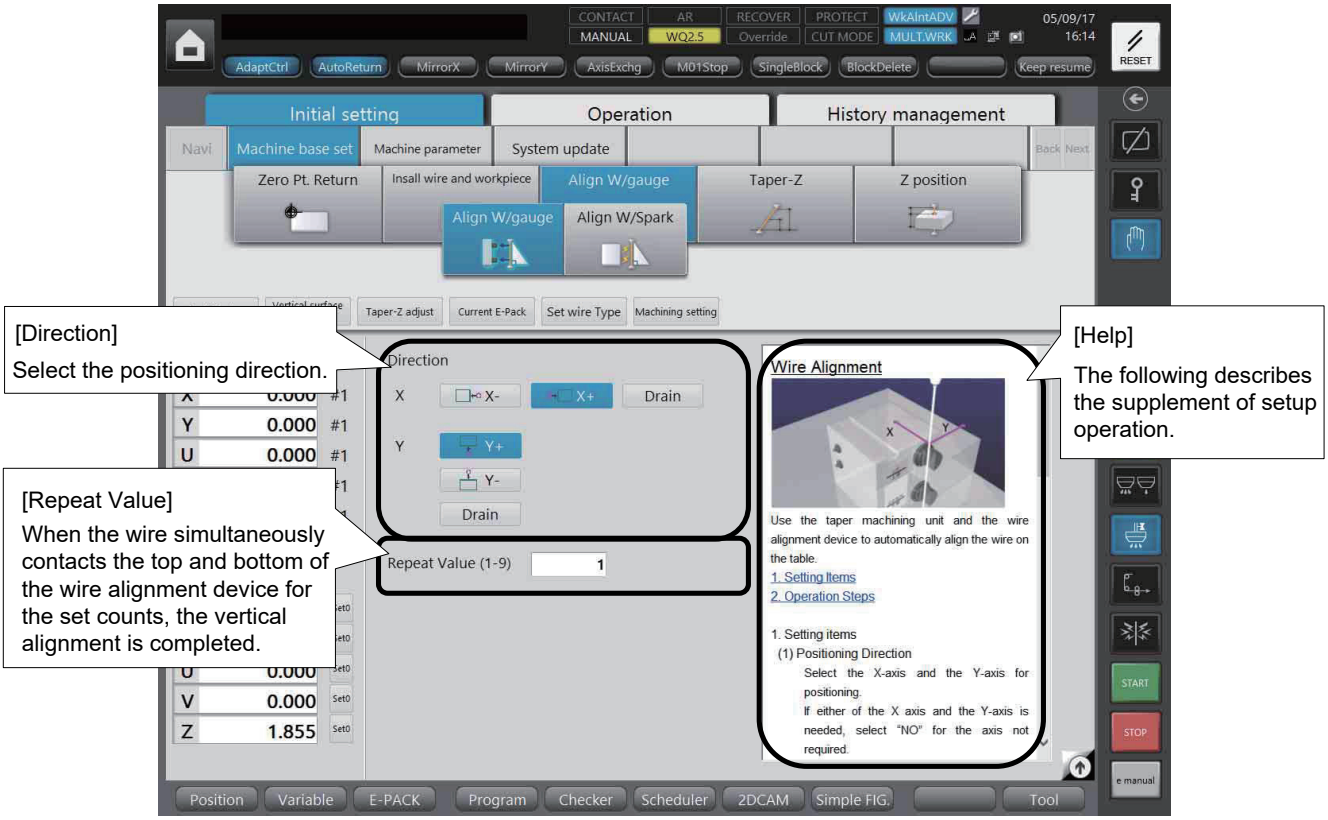


Fig. III.3.4

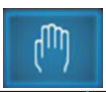
2) Operation procedure

Select the icon menu 2 [Align W/gauge].

↓

Select [Direction] and [Repeat Value].

↓

Check the manual mode  and press the

button.

↓

(1) When 2 axes are designated, the vertical alignment is executed in the order of X → Y. The wire speed is automatically set.
(2) If the wire is already in contact at the start, the alarm "M619 Contacted" occurs.
(3) The UV axes will be automatically set at the zero point once the vertical alignment is completed.

Fig. III.3.5

Before vertical alignment, complete wire type setting. If [Repeat Value] is set to 2 or higher, alignment time increases.

(2) Align W/Spark

Performs weak discharge to confirm wire-workpiece spark, then the user compensates the wire-workpiece angle.

1) Description of setting items

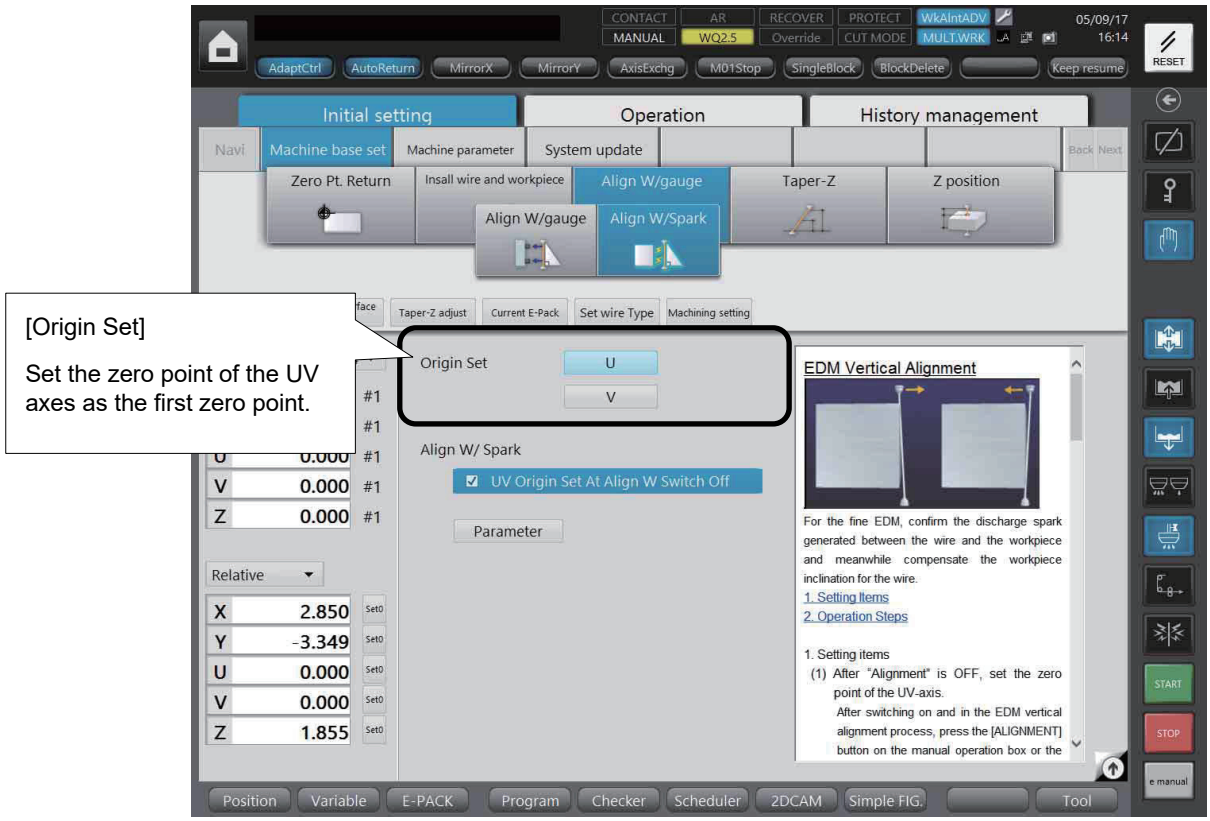


Fig. III.3.6

(a) UV Origin Set At Align W Switch Off

When ON, ending discharge vertical alignment with the [Vertical] button or the reset button on the manual box automatically sets the UV axis zero for the aligned axis.

(b) Parameter setting

Discharge vertical alignment parameters are rarely changed. Caution: Changes significantly affect discharge vertical alignment.

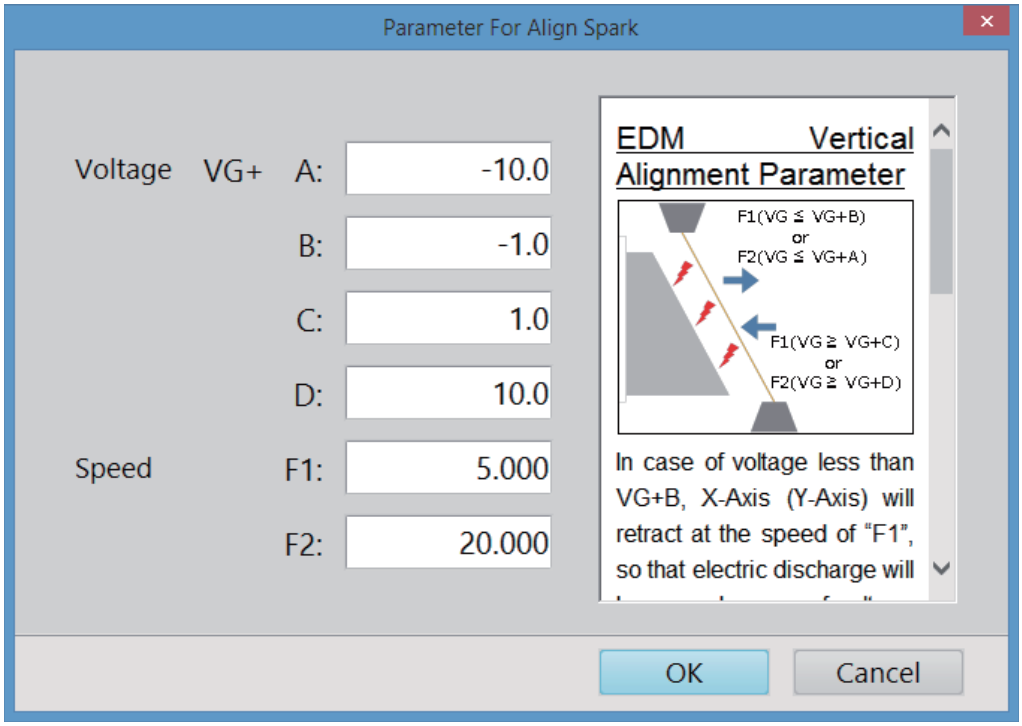


Fig. III.3.7

When voltage < VG+B, retract X or Y at speed F1 to favor discharge.
When voltage < VG+A, retract faster at F2. When voltage > VG+C, advance X or Y at F1.
When voltage > VG+D, advance faster at F2.

(i) Voltage

Set A < B < 0 < C < D.

(ii) Speed

Set F1 = F2.

2) Relationship between discharge vertical alignment and parameters

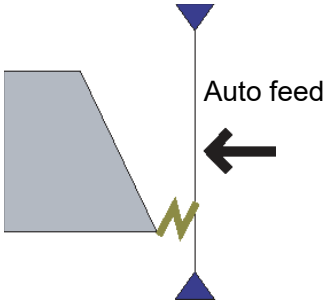
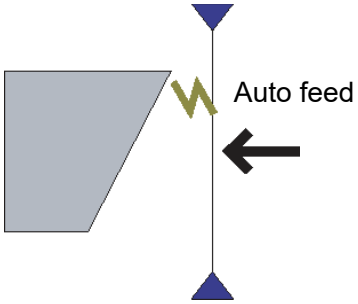
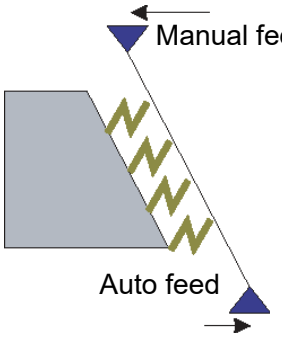
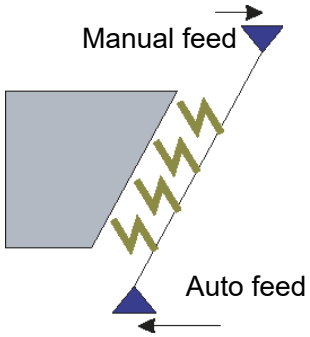
	Lower discharge	Upper discharge
Discharge status after approaching		
Discharge status after vertical adjustment		
Operation description	Manual feeding of the upper (U and V) axes can cause the gap to become narrow, leading to discharge failure. When the voltage falls below VG+(B) V, retract the X (or Y) axis at the speed of F1 to create favorable conditions for discharge. When the voltage falls below VG+(A) V, retract the axis quickly at the speed of F2.	Manual pulling of the upper (U and V) axes can cause the gap to widen, leading to discharge failure. When the voltage exceeds VG+(C) V, advance the X (or Y) axis at the speed of F1 to create favorable conditions for discharge. When the voltage exceeds VG+(D) V, advance the axis quickly at the speed of F2.

Fig. III.3.8

3) Operation procedure

Discharge vertical alignment steps:

- SETUP -

(a) Clean the workpiece and fix it on the table.

(b) Dry the wire, nozzles, and workpiece with an air gun.

(c) Set Z axis height for machining.

(d) Using [+X/U], [-X/U], [+Y/V], [-Y/V], position the wire a few microns from the workpiece.

(e) Check that the supplier E-PACK for vertical alignment is registered. The E-PACK number depends on wire diameter.

E-PACK for various wire diameters

Wire dia	E No	Wire dia	E No	Wire dia	E No
0.01	600	0.04	605	0.2	610
0.02	601	0.05	606	0.25	611
0.025	602	0.07	607	0.3	612
0.03	603	0.1	608	0.36	613
0.035	604	0.15	609		

***1 Set LR to the machining notch.**

***2 Set WS, WT, and PT to final-machining notches per wire diameter.**

***3 Machining conditions may be slightly adjusted for wire and workpiece material.**

- Procedures -

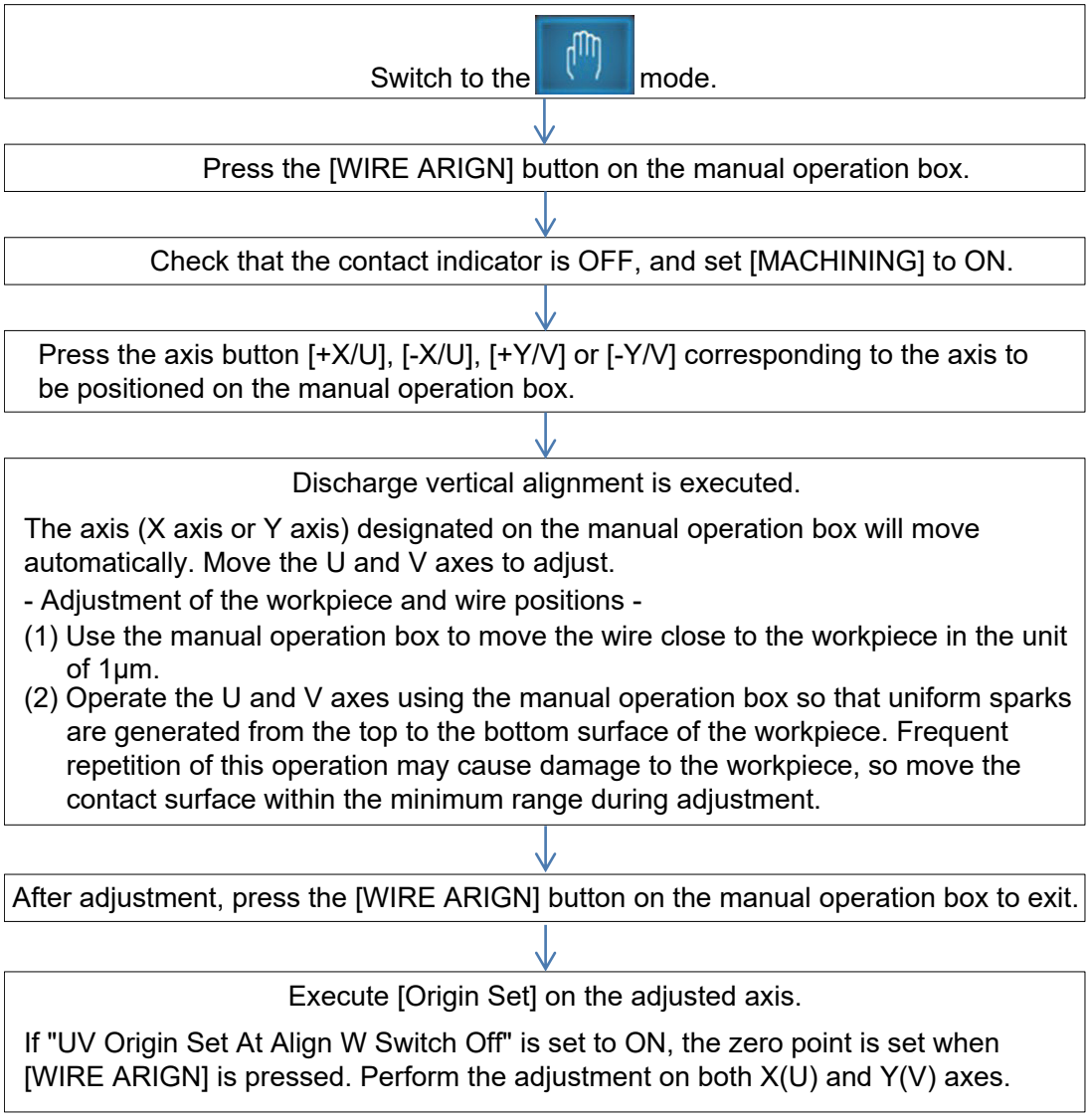


Fig. III.3.9

3.1.4 Determine taper specs

Set or measure taper specs for taper machining. Includes "Z1,Z2,Z5 setting" to set Z1, Z2, Z5 and "Z3,Z4 setting" to measure Z3 (ΔZ3) and Z4.

(1) Z1,Z2,Z5 setting

Sets Z1, Z2, Z5.

1) Description of setting items

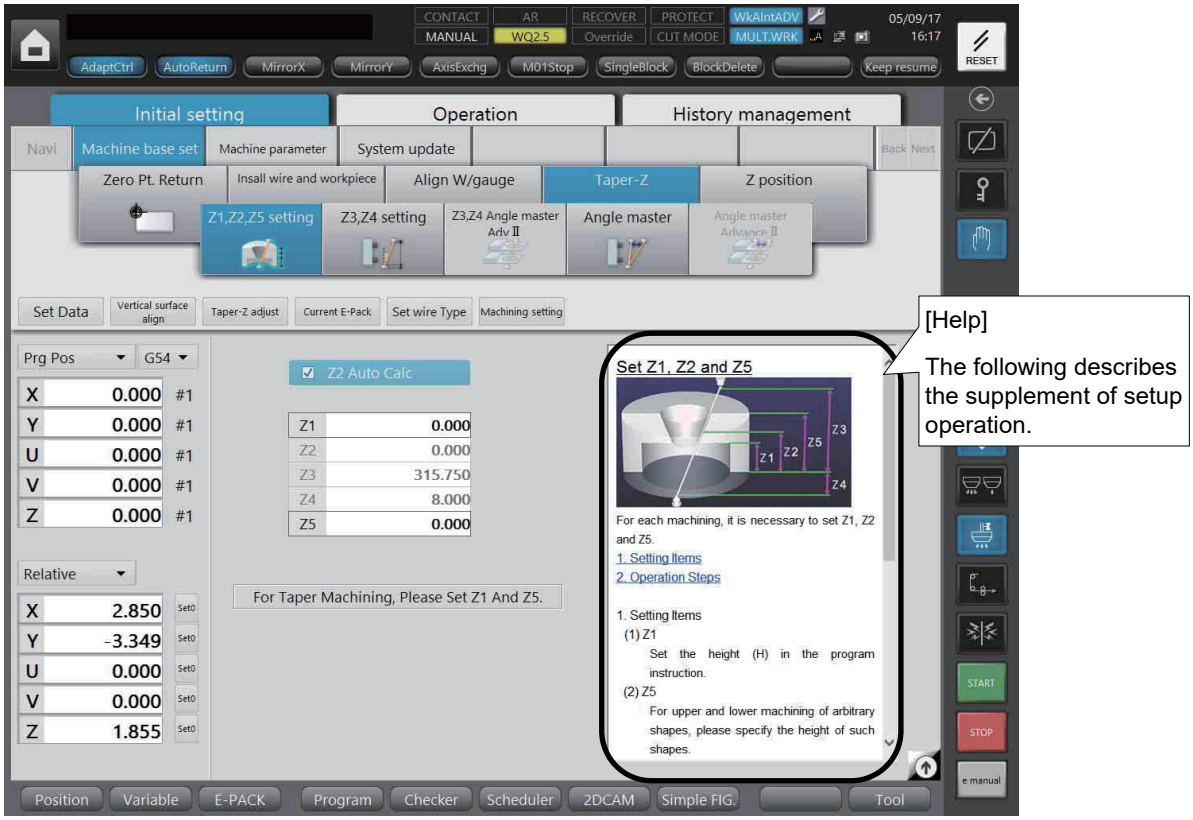


Fig. III.3.10

(a) Z1

Specify height for program according to the distance to the table.
This is also the height of the wire rotation center for taper machining.

(b) Z5

Specify the height for machining workpiece with any shape.
In general taper angle machining, calculate the taper angle between Z1 and Z5.

(c) Z2

For the feeding machining at a constant speed, specify the height achieving the speed by the command.

(d) Z2 Auto Calc

1/2 height between Z1 and Z5 is set automatically as Z2.
In general taper machining, switch it to ON.

(2) Z3, Z4 setting

Measures taper specs ΔZ3 and Z4 required for taper angle machining.

1) Description of setting items

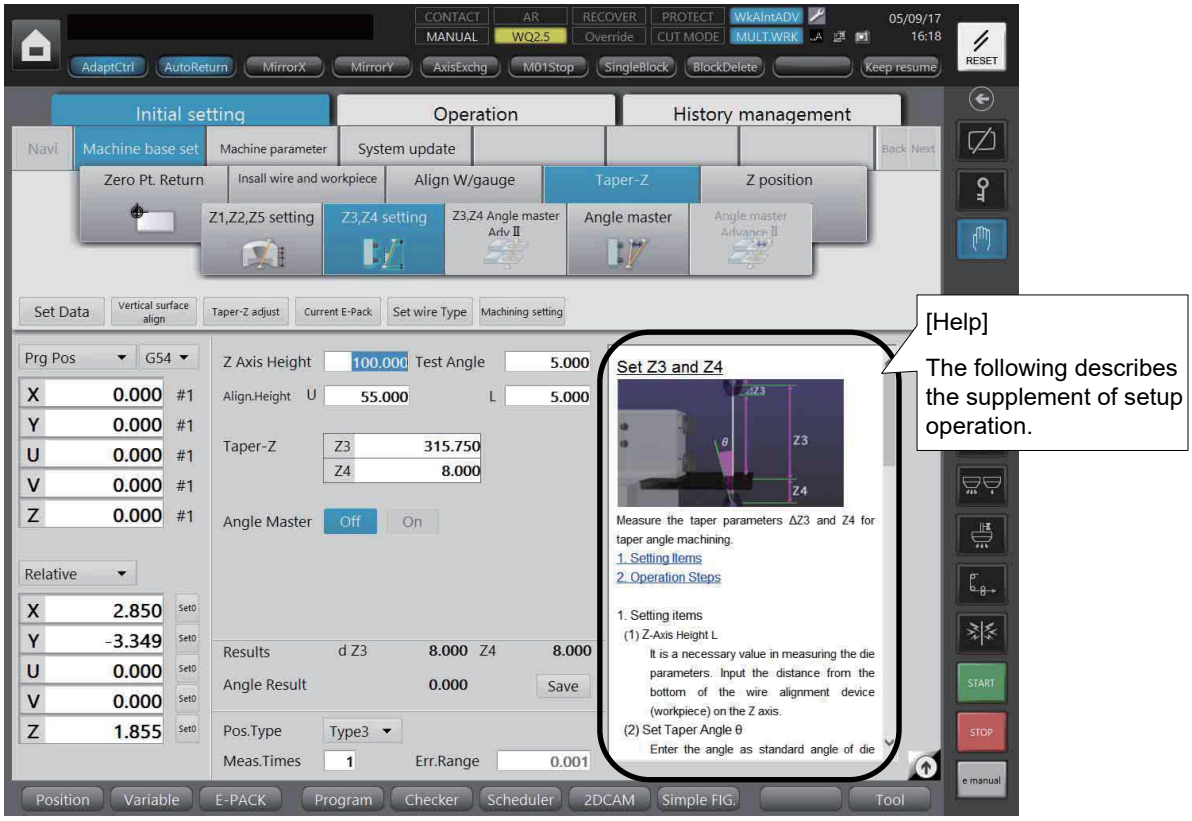


Fig. III.3.11

(a) Z Axis Height

Input the distance to the bottom of wire alignment device (the table) -- Z axis height.

***1 If using a bridging fixture, treat the device's set position as the table surface. Then set [Z Axis Height] as Z height minus the gap between table and device bottom.**

(b) Test Angle

f the taper angle is below 5 degrees, use 5 degrees. If above 5 degrees, set an appropriate value.

(c) Align.Height

Set the distances to the upper and lower measurement points as shown in the figure.

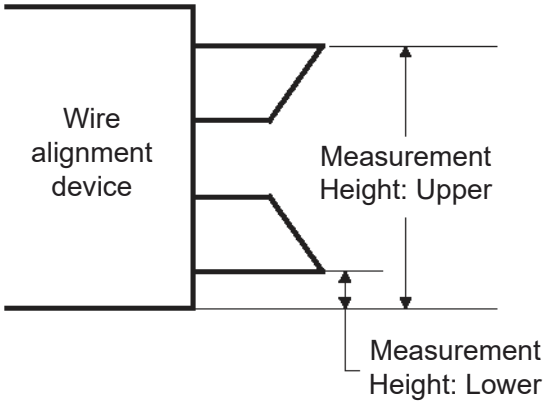


Fig. III.3.12

(d) Taper-Z

Set an approximate value.

(i) Let Z axis return to the zero point.

(ii) Input the value of Z axis stroke +6 (mm) in Z3.

(e) Angle Master

ON measures with angle master compensation. OFF performs no compensation. If no angle master is used for nozzle parameters, select OFF.

(f) Saving measurement results

Press SAVE to store results based on Z3 and Z4. Results are saved by wire diameter in "Machine parameters > Taper specs" and can be read after changing wire diameter.

(g) Pos.Type

Select a positioning type based on time and accuracy.

Time priority ⟷ Accuracy priority

Type1 Type2 Type3 Type4

2) Operation procedure

Setting Z3 and Z4:

Execute the vertical alignment in advance when the wire type is set correctly.
(During Z axis height adjustment, the closer it gets to the vertical meter, the more easily it can prevent the wire vibration.)

↓

Switch to the manual mode and select the icon menu 2 [Z3,Z4 setting].
(In the manual mode, pressing the [TAPER-Z] button on the manual operation box automatically switches the tab to [Z3,Z4 setting]. * 1, 2)

↓

Set the parameters such as [Z Axis Height] and [Test Angle].

↓

Check the manual mode and press the

button.
(When the [TAPER-Z] button on the manual operation box is pressed, press the axis button [-X].) * 3

↓

Measure the taper specifications.
(ΔZ3 and Z4) and measured taper angle θ will be displayed when the taper specification measurement is completed. Use the result to reset the compensated Z3 value.

↓

Press [Save] to save the measured result.

Fig. III.3.13

- **When the "TAPER-Z" button on the manual box is pressed, the "Z3,Z4 setting" screen changes automatically. However, if "Vertical surface align", "Taper-Z Adjust", or "Wire type setting" dialogs are open, the screen cannot change. Press "TAPER-Z" after closing dialogs.**
  Additionally, if "Screen/Mode Sep." in "Screen operation setting" > "Screen Display" is ON, the "Z3,Z4 setting" screen cannot change.
- **After pressing "TAPER-Z", when the message "Please press the -X axis button" appears, press [-X] on the manual box to proceed with taper specification.**

(3) Z3,Z4 Angle Master Adv II

See "VI. OPTIONS".

(4) Angle Master

See "VI. OPTIONS".

(5) Angle master Advance II

See "VI. OPTIONS".

3.1.5 Z axis position

Guides Z axis automatically by inputting workpiece thickness and "Gap" between the upper wire guide and workpiece top after startup.

*** This moves Z vertically. Wrong settings can cause nozzle-workpiece contact.**

(1) Description of setting items

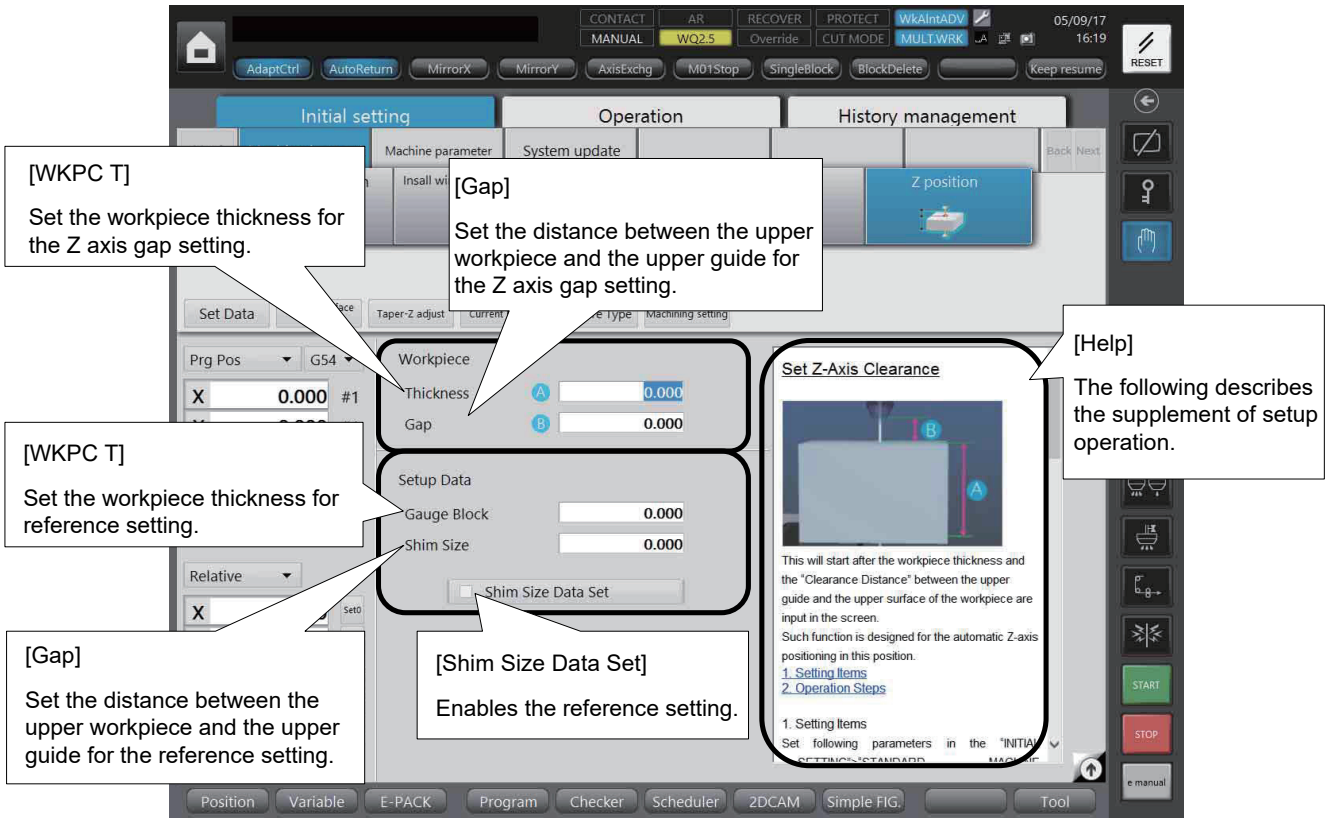


Fig. III.3.14

(2) Operation procedure

Z axis gap setting procedure:

- After a system update
- After power OFF/ON
- After changing [Gauge Block] and [Shim Size] of the standard workpiece

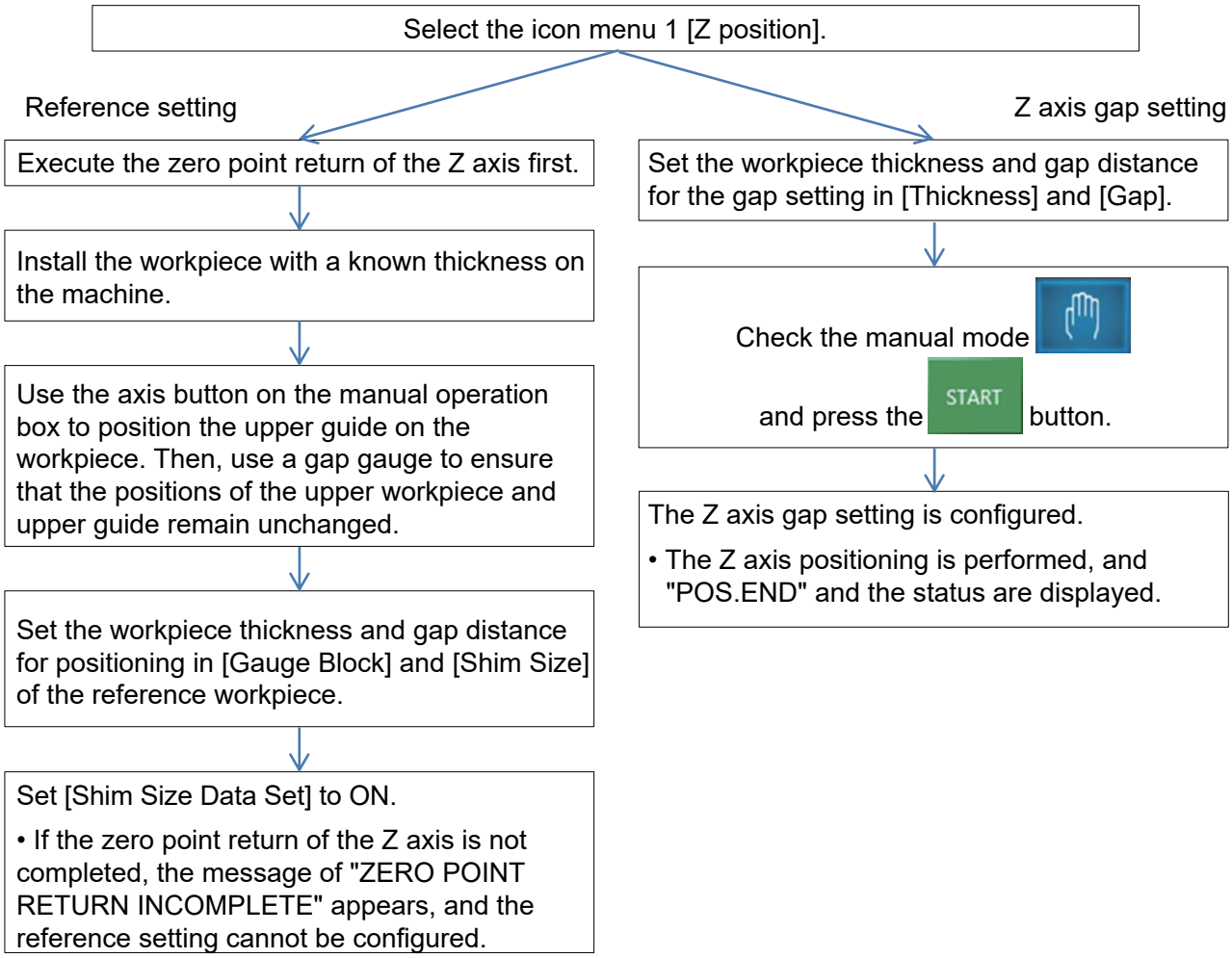
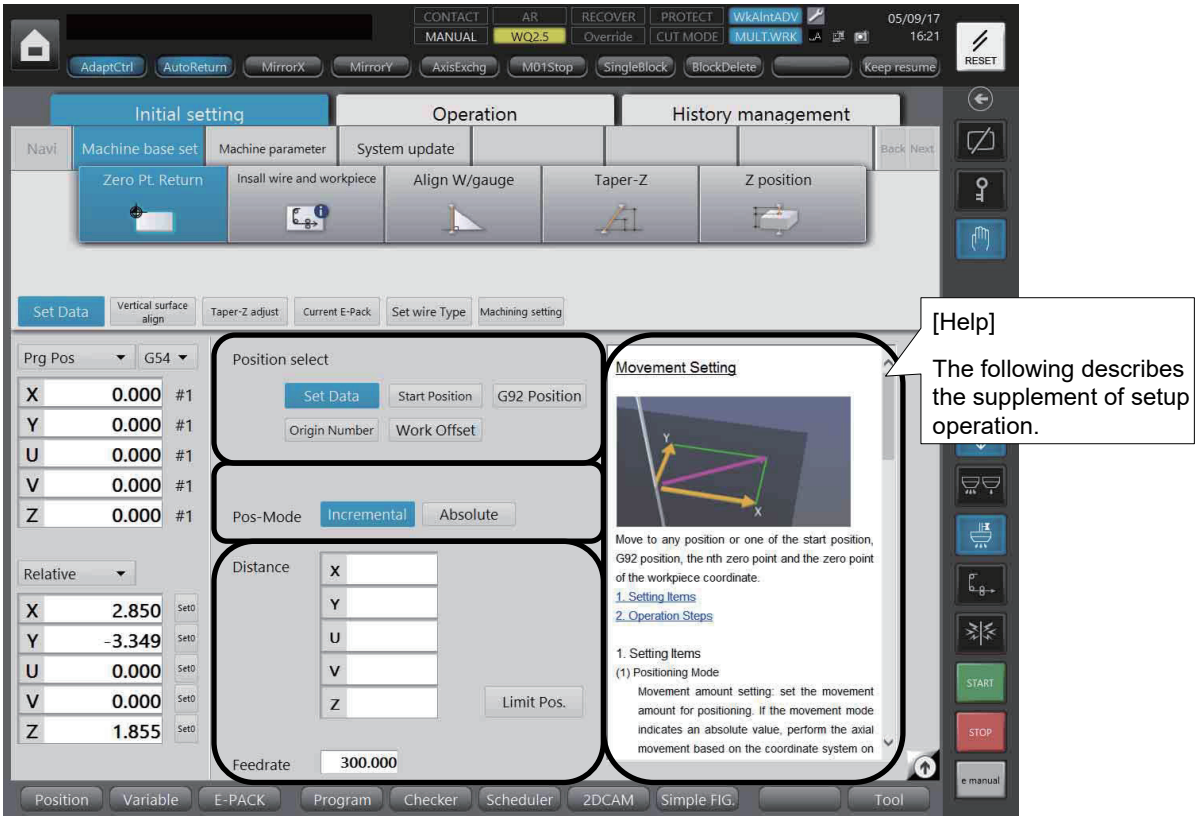


Fig. III.3.15

3.1.6 Set Data

Moves the axis to a specified position.

(1) Description of setting items



[Help]

The following describes the supplement of setup operation.

Fig. III.3.16

1) Position select

The following types of movement can be selected.

(a) Set Data

(b) Start position

(c) G92 Position

(d) Origin Number

(e) Work Offset

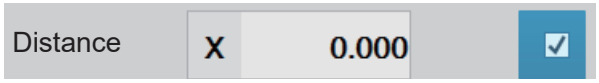
2) Pos-Mode

Designate movement amount by incremental value or absolute value.

3) Distance

When [Movement Setting] positioning mode is selected, you can set any movement amount. Otherwise, the amount is set automatically.

To move an axis, check its box (☑). Uncheck to disable movement.



4) Feedrate

Movement speed is the speed used in positioning modes:

Millimeter mode: mm/min

Inch mode: inch/min

5) Limit Pos.

Sets Z movement to the incremental distance from the current machine coordinate to the Z lower limit of soft limit 5, and switches to incremental mode. Movements for axes other than Z are cleared.

Press [Limit Pos.] to switch to incremental value mode.

(2) Operation procedure

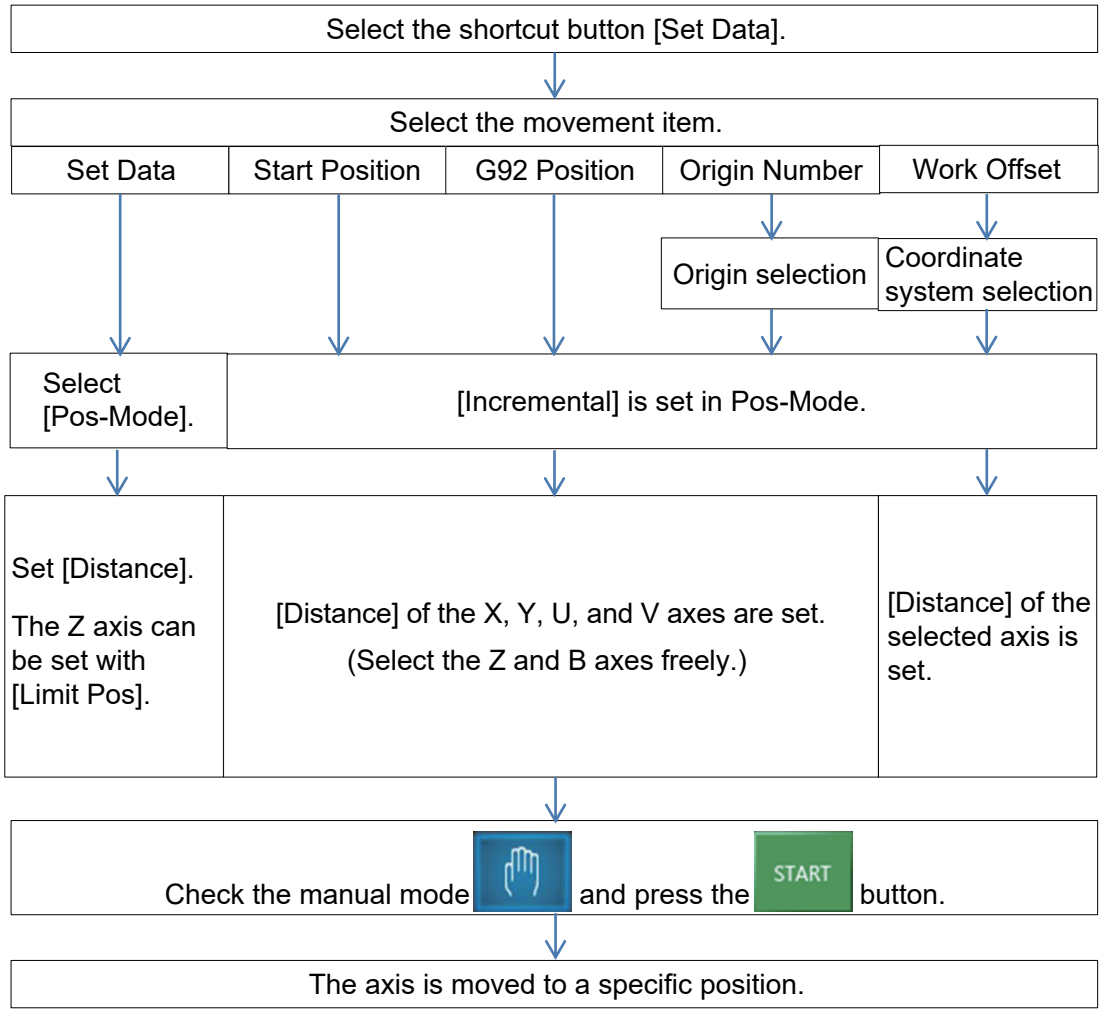


Fig. III.3.17

3.1.7 Vertical surface align

Used as UV compensation for wire inclination. Calculates UV compensation, performs UV axis movement (Vertical surface align), and starts the function to move UV. Compensation ensures wire verticality.

(1) Description of setting items

Fig. III.3.18

1) Z3 (Mcn.Z-Ax Height)

Sets the machining Z height.

It matches Z3 in taper specs.

Press [Copy] to set Z3 from taper specs.

2) Measure Height

Uses and moves a dial gauge, and sets the Z axis movement amount.

3) U Meas.(Bottom Base)

Sets the U axis wire slope measured with a dial gauge after test machining.

4) V1 Meas.(Bottom Base)

Sets the V axis wire slope (rear of table) measured with a dial gauge after test machining.

5) V2 Meas.(Bottom Base)

Sets the V axis wire slope (front of table) measured with a dial gauge after test machining.

6) Z4

Displays Z4 value in taper specs. (Setting is unnecessary.)

(2) Operation procedure

Vertical compensation:

Set the parameters for test machining.

①Select "Operation" > "Program" > "Machining setting" > "Parameter Set" to display the "Rot/Scale" page.

②Set AR, H, and V of [Axis Rotation] to 0.000, S of [Scale S] to 1.000 and SX and SY of [Each S] to 1.000.

③In the same manner, select "Machining setting" > "Parameter Set" > "Auto3" to set the [Work Align ADV.] switch to OFF.

↓

Execute the test machining.

①Execute the concave-shaped test machining.

②After machining, install a dial gauge on the Z axis and measure the difference between the lower reference surface and the upper surface along the X and Y surfaces of the workpiece.

↓

Select the shortcut button [Vertical surface align].

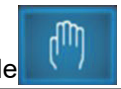
↓

This column is used to set the parameters for calculating vertical compensation.

↓

Press [Calc] and check that the compensation amounts of UV axes are set.

↓

Check the manual mode  and press the

button.

↓

The UV axes move according to the distance set in compensation amounts.

After the movement, a dialog box appears to confirm whether to set the UV zero point. Select "Yes" in the dialog box to set the zero point of the UV axes.

Fig. III.3.19

3.1.8 Taper-Z Adjust

When all parameters must be adjusted in taper angle machining, adjust taper specs to improve taper angle machining accuracy.

(1) Description of setting items

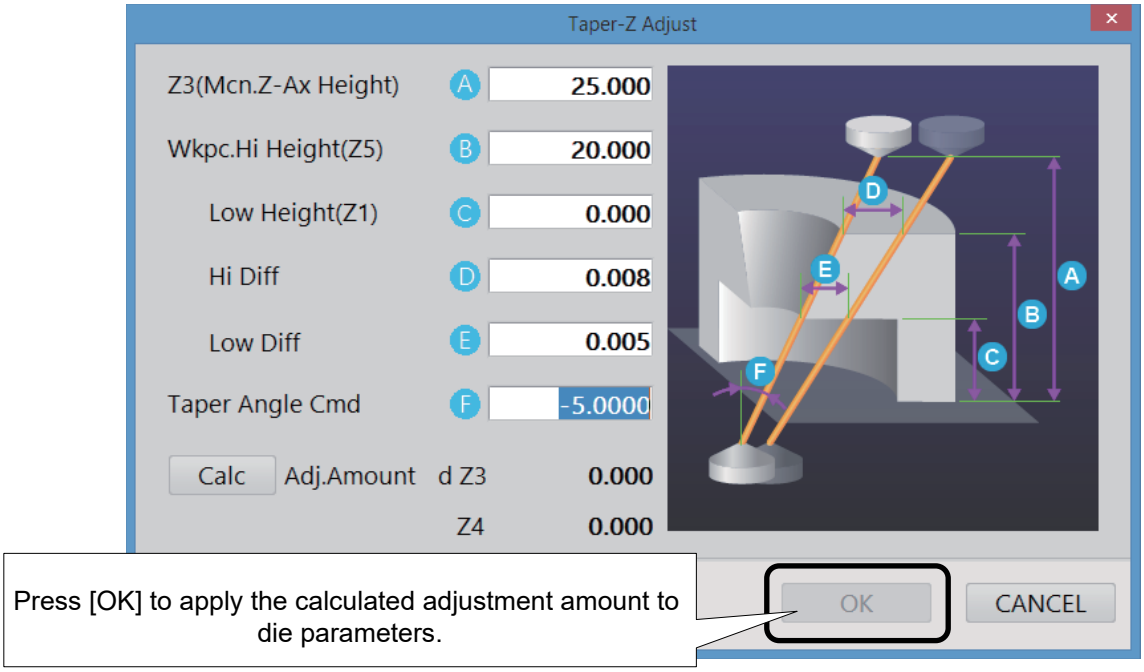


Fig. III.3.20

1) Z3 (Mcn.Z-Ax Height)

Sets the Z axis height for taper angle machining.

If Z3 is set in taper specs when the screen opens, it displays that value.

2) Wkpc.Hi Height (Z5) and Low Height (Z1)

Sets the workpiece upper and lower heights.

If Z1 and Z5 are set in taper specs on screen open, the larger displays as upper height and the smaller as lower height.

3) Hi Diff and Low Diff

Sets the upper and lower machining errors in the results. Relative to the travel direction: rightward compensation is negative, leftward is positive.

4) Taper Angle Cmd

Sets the Taper Angle Cmd for taper angle machining.

5) Calc, Adj.Amount

Press [Calc] to calculate ΔZ3 and Z4 adjustment amounts and display them.

6) Apply the calculated adjustment amount to die parameters

Press [OK] to add the calculated ΔZ3 and Z4 to the die parameters and close the dialog.

(2) Operation examples of taper specification adjustment

1) Machining shape

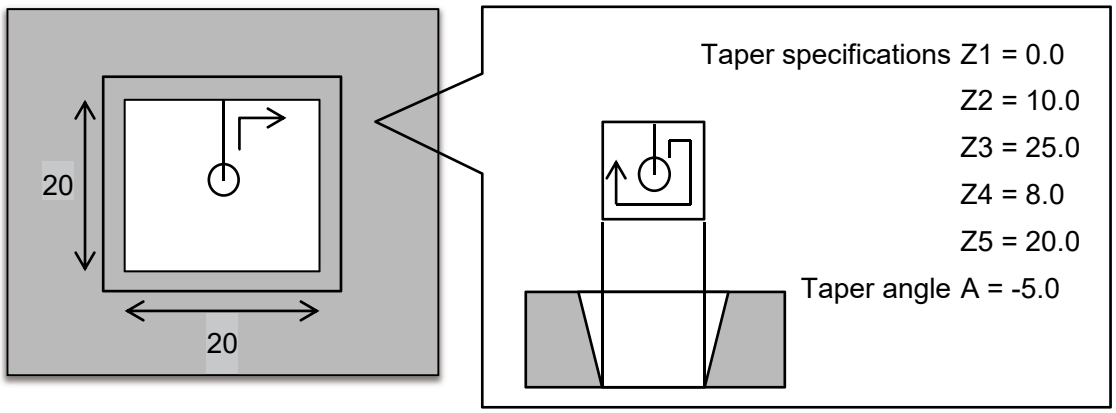


Fig. III.3.21 Machining shape

2) Machining errors of machining results

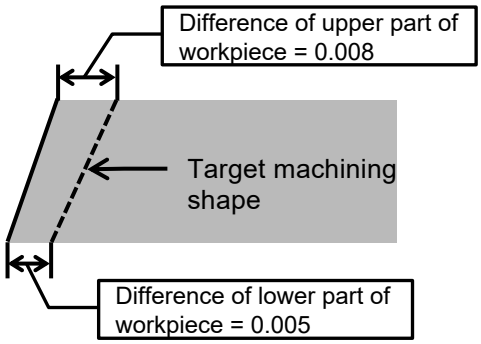


Fig. III.3.22 Machining error

3) Taper specification adjustment

(a) Display "Initial setting" > "Machine base set" > auxiliary menu "Taper-Z adjust".

(b) Set [Hi Diff], [Low Diff] and [Taper Angle Cmd] as follows:

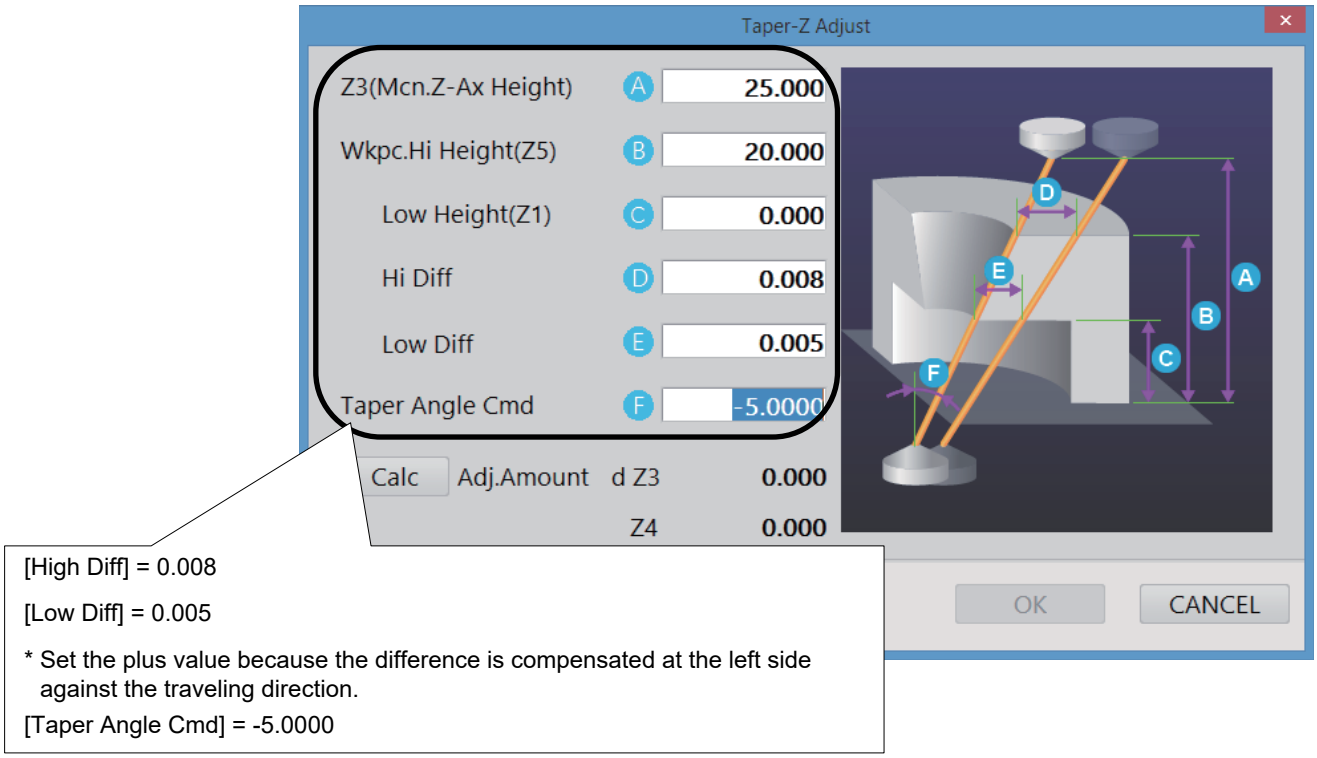


Fig. III.3.23 Input of taper specification adjustment

(c) Press [Calc] to display the calculation results.

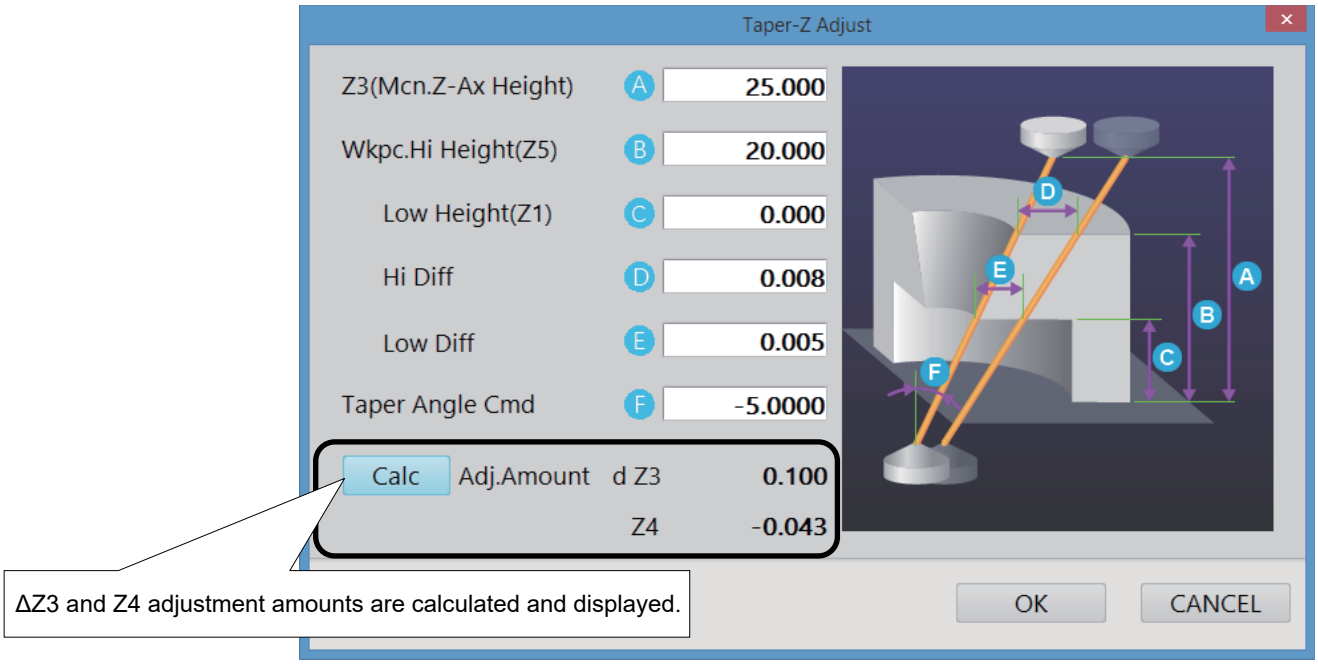


Fig. III.3.24 Taper specification adjustment calculation

(d) Press [OK] to add the ΔZ3 and Z4 adjustment amounts to the die parameters and close the dialog box.

3.1.9 Current E-Pack

Press [Current E-Pack] to display the Current E-Pack window in which current machining settings can be confirmed.

(1) Description of setting items

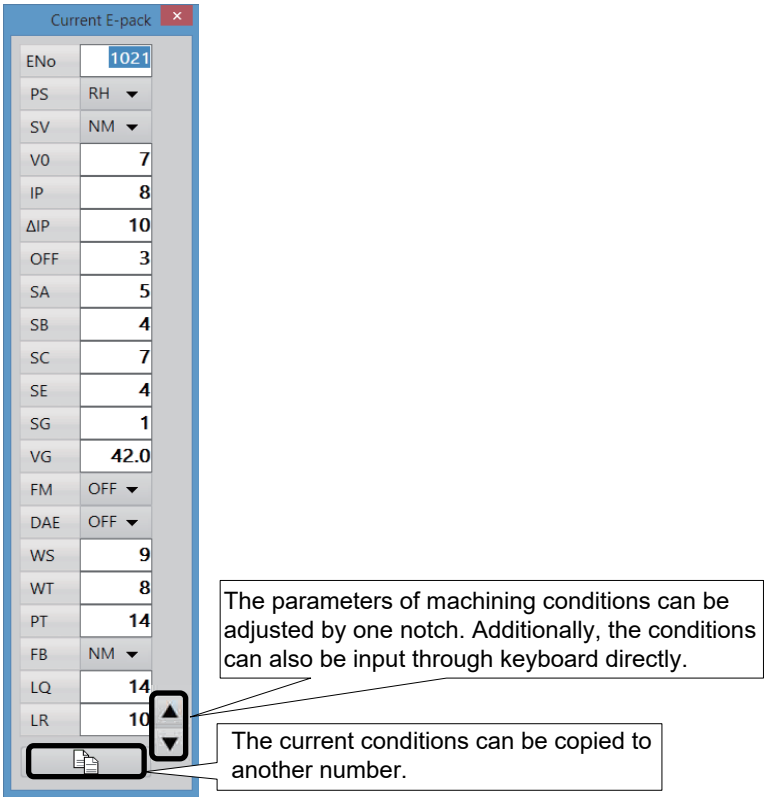


Fig. III.3.25

3.1.10 Wire type setting

By setting actual wire materials and diameters, you can optimize automatic wire feeder operation and adaptive control machining. You can also set cost management parameters.

(1) Description of setting items

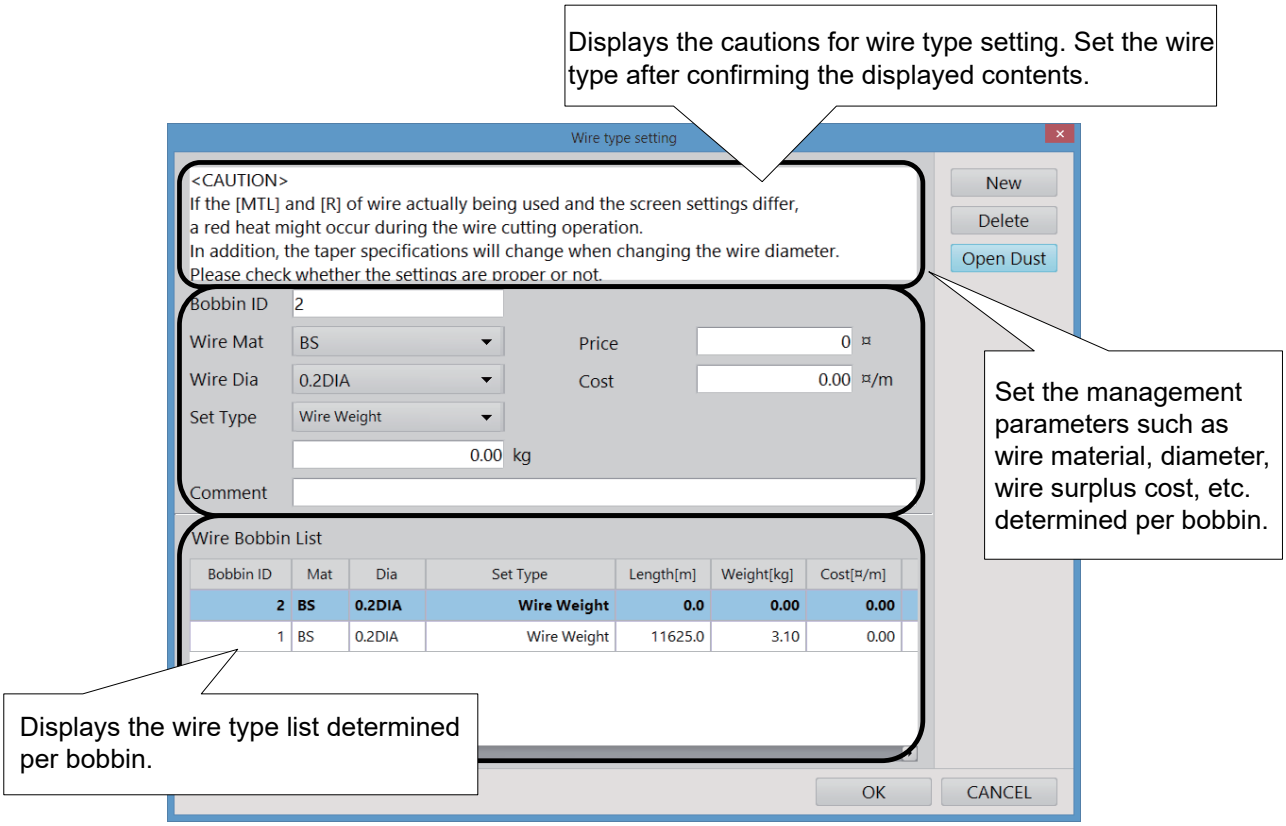


Fig. III.3.26

1) Bobbin ID

The name of each bobbin. Set automatically, and you can change it.

2) Wire Mat

Select the wire material.

3) Wire Dia

Select the wire diameter.

4) Set Type

Manage remaining wire by [Wire Weight], [Wire Length], or automatic detection. If you select the wire product name, it is detected automatically.

5) Price, Cost

Set unit price or cost for cost management.

(a) Price .. Cost per roll

(b) Cost ... Cost per meter (auto calculated when unit price is set)

* Cost set here applies to all machining.

6) Comment

Free text, up to 255 characters.

7) Wire Bobbin List

Displays wire types per bobbin. Select a wire and press [OK]. The optimal automatic wire feeder, adaptive control machining, and cost management start based on the selected wire.

***1 The list records even if the bobbin is removed before use ends. For reuse, select the wire to use remaining length [m] and weight [kg].**

***2 When the wire is used up, press [Delete] to remove the bobbin and clear the record. The bobbin ID moves to the recycle bin. Restore it if deleted by mistake.**

8) New

To set a new wire, select [New].

3.1.11 MDI

Runs an NC program in MDI after creation or editing without assigning an L No. You can also call the last MDI run program or a program assigned by L No.

(1) Description of setting items

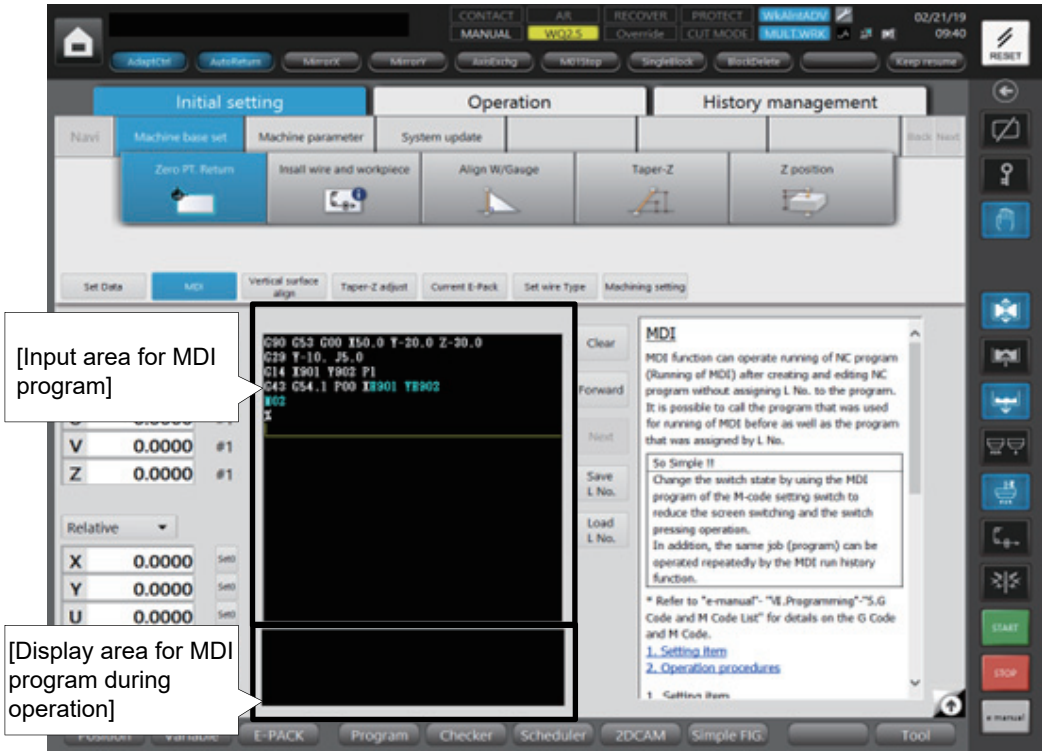


Fig. III.3.27

1) [Input area for MDI program]

Enter the NC program to run in MDI.

2) Clear

Deletes the MDI program being edited.

3) Forward, Next

Reads previously run MDI programs (up to 30).

* History cannot be read if the D drive has no space. Delete unnecessary files.

4) Save L No.

Assigns the MDI program to an L No.

5) Load L No.

Reads an MDI program by L No.

(2) Operation procedure

1) Enter the NC program in the MDI input area.

2) Press "START" to run it. (Cannot execute during automatic operation.)
The running NC program displays in the MDI run area below the screen.

*For G and M code details, see "IV. PROGRAMMING" > "5. G CODE AND M CODE LIST".

When the “Dry Run” switch is ON, the program’s F command is ignored, and the F value from the operation screen is used.

3.2 Machine parameters

Initial settings include startup settings and low-frequency items. Here, [MACHINE PARAMETERS] sets parameters for the machine and control unit.

3.2.1 Pitch Adjustment

(1) Summary

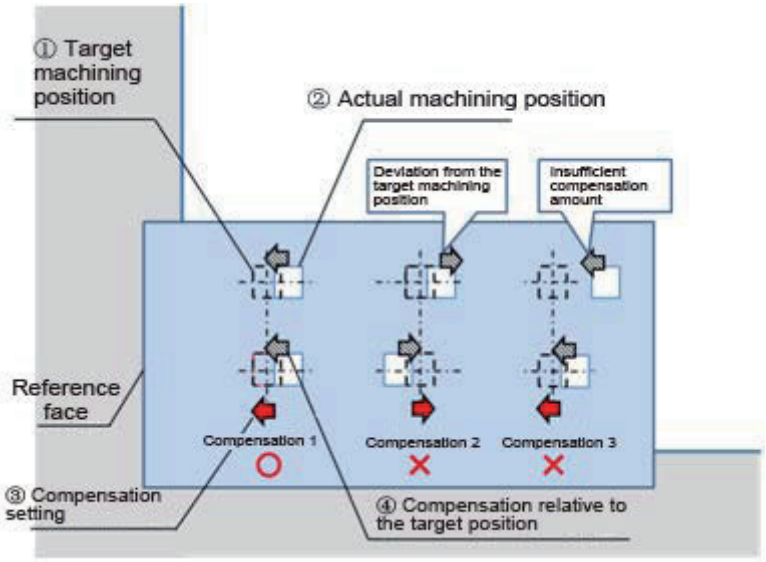
Compensates pitch deviation caused by temperature differences between the machine installation environment and the measuring instrument.

*** This function may not be displayed depending on the machine model and option.**

(2) Restrictions

1) Temperature near the EDM greatly affects precision. Install the EDM in a thermostatic chamber at 20±1°C.
2) Pitch deviation can also result from factors like workpiece material and alignment. For alignment methods, consult the Mitsubishi Service Center.
3) For relatively large machining shapes, this function may not fully take effect.

[Example] X axis pitch adjustment



Compensation 1: Same amount and direction on the same axis during machining: compensation allowed.

Compensation 2: Different directions on the same axis during machining: compensation not allowed.

Compensation 3: Different amounts on the same axis during machining: compensation not allowed.

(3) Description of setting items

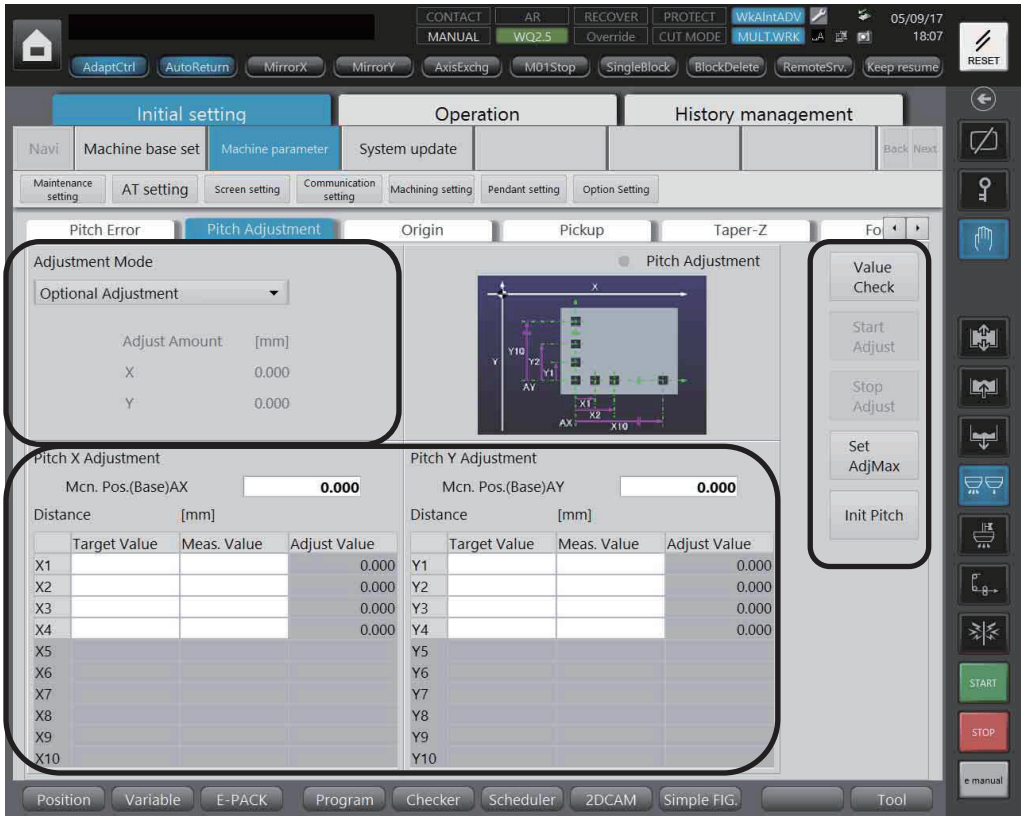


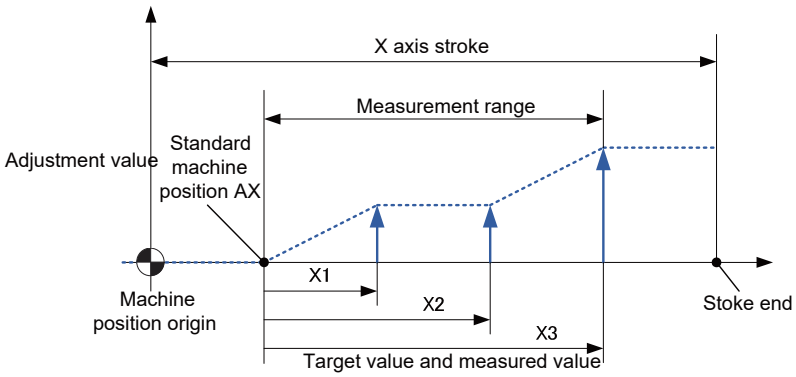
Fig. III.3.28

1) Adjustment Mode

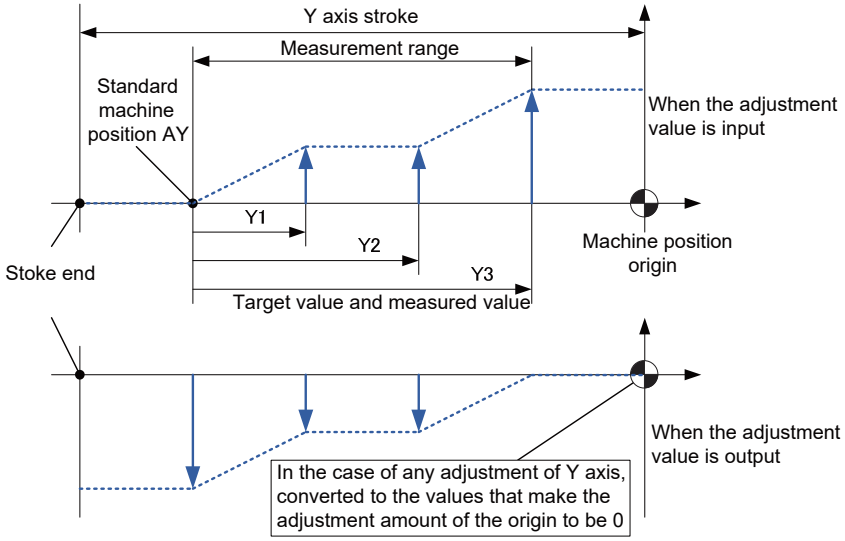
Selects the pitch adjustment mode. Two modes are available and the methods differ.

(a) Optional Adjustment

Use when errors are not proportional to distance. Plot machine coordinate (X) versus adjustment (Y) as the dotted line. For Y axis, set the origin adjustment to 0, then output converted values.



Any adjustment on X axis



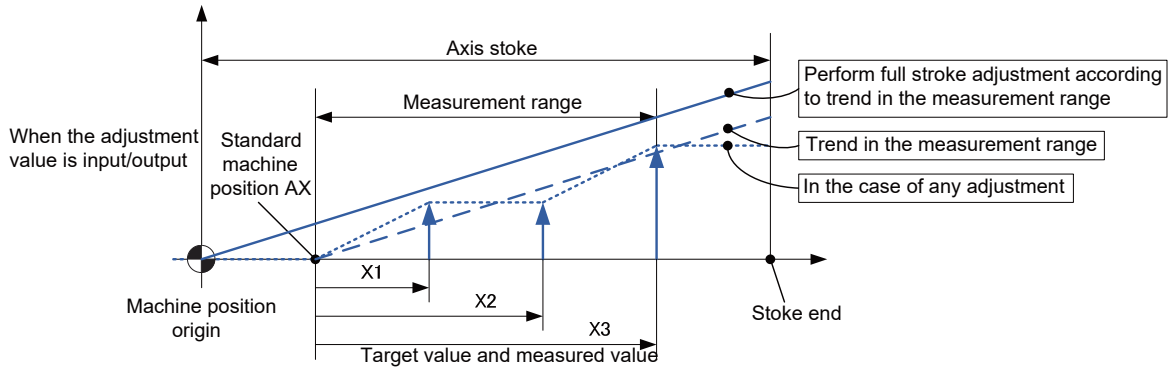
Any adjustment on Y axis

Fig. III.3.29

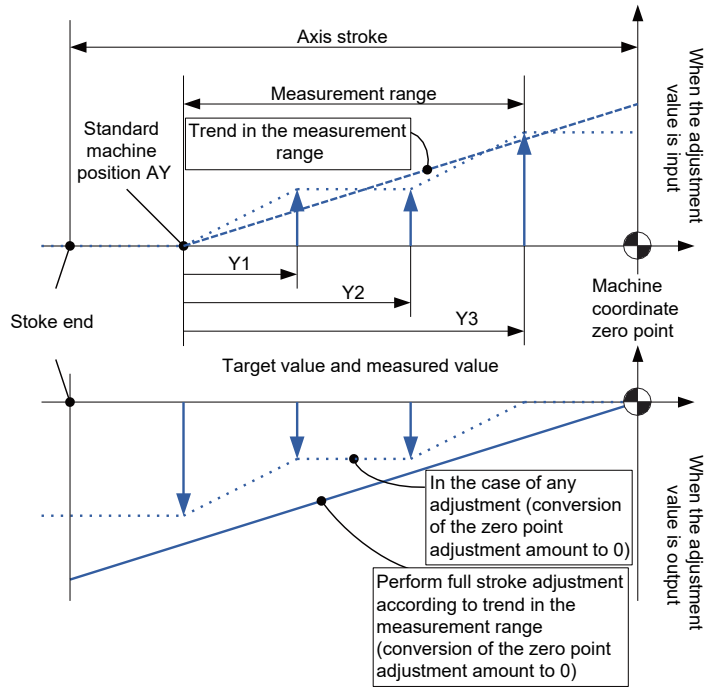
(b) Full Stroke Linear Adjustment and Adjustment Amount

Use when pitch error is proportional to distance, typically from installation temperature differences between the EDM and instruments.

Calculate the coefficient from standard position, target value, and adjustment value over the measurement range. Output the proportional adjustment from the machine origin to stroke end (solid line). For Y axis, output converted values so the origin adjustment is 0.



Full stroke linear adjustment on X axis



Full stroke linear adjustment of Y axis

Fig. III.3.30

- **Whenever the Y axis is adjusted, conversion is applied so the machine origin adjustment is 0, then adjustment starts.**

2) Pitch X Adjustment and Pitch Y Adjustment

Sets pitch adjustment for X axis and Y axis. Input [Mcn. Pos.(Base)AX], [Mcn. Pos.(Base)AY], [Target Value], and [Meas. Value]. Minimum unit follows the control unit command unit. (× 0.1 and inch specs supported)

(a) Mcn.Pos.(Base)AX and Mcn.Pos.(Base)AY

Enter the machine coordinate used as the reference when entering the target value.
For X axis, set the point nearest to the origin side.
For Y axis, set the point nearest to the machine front face.

(b) Distance, Target Value, Meas. Value, and Adjust Value

Target Value: Enter the drawing distance from the reference used as the standard machine position to the adjustment point.
For X axis, enter values in near-to-distant order from Mcn. Pos.(Base)AX in +X.
For Y axis, enter values in near-to-distant order from Mcn. Pos.(Base)AY in +Y.

Meas. Value: Enter the measured distance from the reference to the adjustment point, relative to the target value.

Adjust Value: Enter target and measured values to calculate and display the adjustment. Positive indicates pitch plus direction, negative indicates pitch minus direction.

If both target and measured values are blank, they are ignored in pitch adjustment.

3) Pitch adjustment status

Displays whether pitch adjustment is valid or invalid.
Light on: Pitch adjustment is valid.
Light off: Pitch adjustment is invalid.

(4) Functional menu description

1) Value Check

After completing pitch adjustment settings, check whether the input values are correct.

- If correct: "Checked" is displayed.
- If incorrect: An error message appears. For message details and remedies, see "V. MAINTENANCE AND ALARM LIST".

If settings change after checking, check the input values again.

2) Start Adjust

Enables pitch adjustment after the input value is checked.
When checking is incomplete or not ready, the button is disabled (during automatic operation, positioning moving or positioning measurement, or with active pitch adjustment).
If pitch adjustment is valid, all related settings, input, and operation buttons are locked except [Stop Adjust].

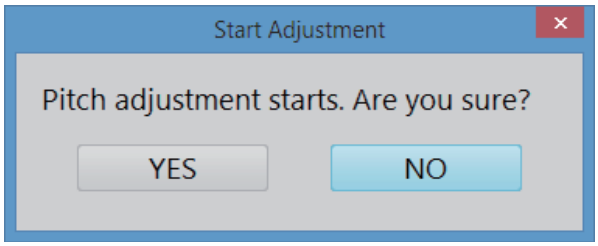


Fig. III.3.31

3) Stop Adjust

Disables pitch adjustment.
The button is disabled in gray when pitch adjustment is inactive or not ready, or during automatic operation, positioning moving, or positioning measurement.

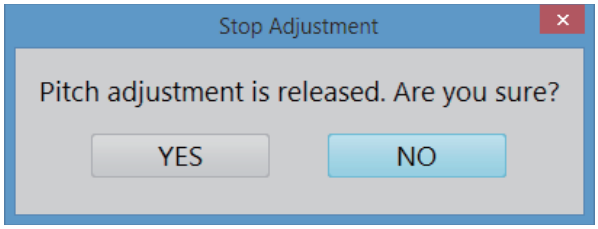


Fig. III.3.32

- **The axis moves when the pitch adjustment amount is output or canceled at start or cancel of adjustment.**
- **To prevent axis movement, start or cancel adjustment at the machine origin.**

4) Set AdjMax

Sets the number of rows for X and Y axis. If the adjustment value is small, restrict the input rows to avoid wrong input in other rows.

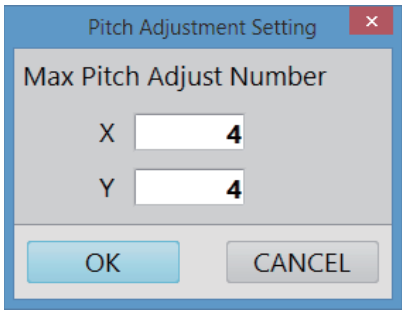


Fig. III.3.33

If the number is reduced after entering target and measured values, inputs beyond the limit are deleted.

5) Init Pitch

Initializes the standard machine coordinate, target value, measured value, and adjustment value for X and Y axis pitch adjustment. Retains the adjustment mode and Set AdjMax. Press the button to open a dialog.

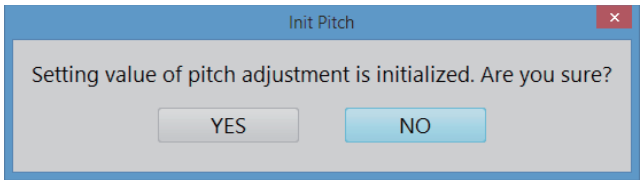


Fig. III.3.34

(5) Operation procedure

Pitch adjustment:

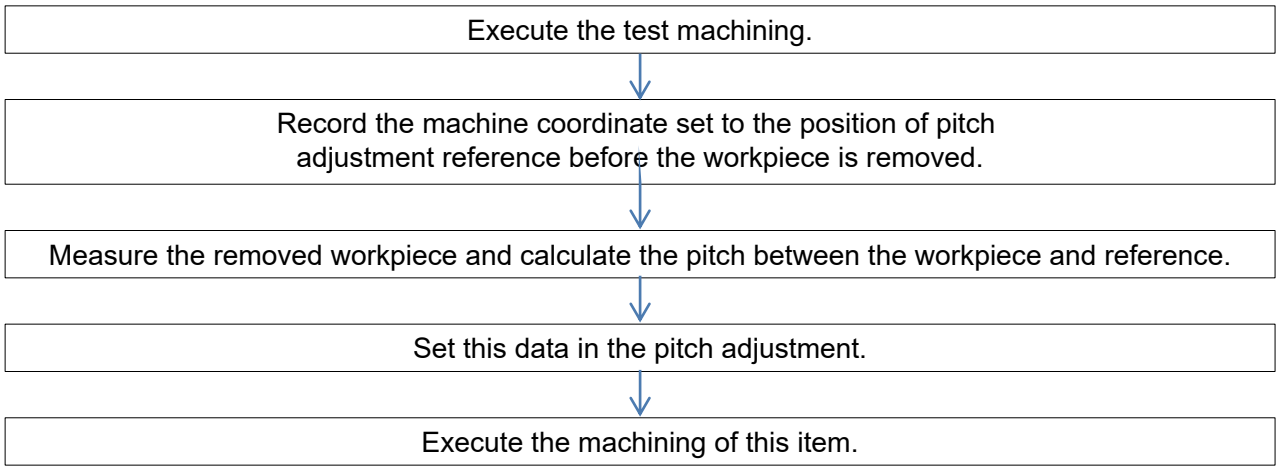
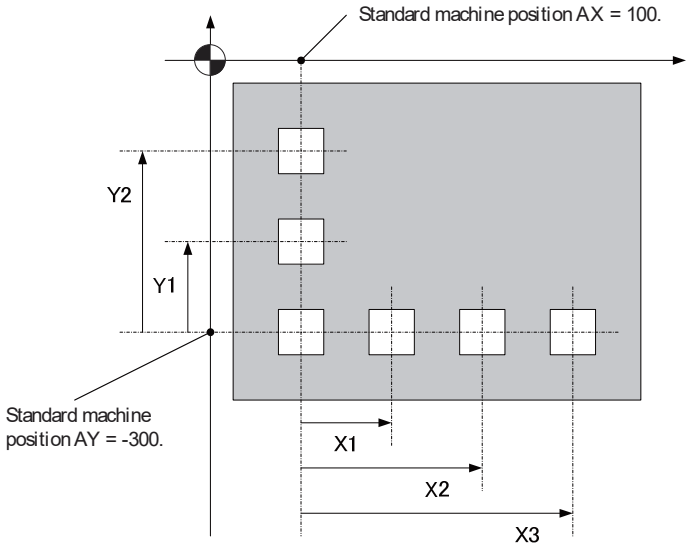


Fig. III.3.35

(6) Pitch adjustment example



	Size	Measured Result
X1	100.	100.0008
X2	200.	200.0022
X3	300.	300.0030
Y1	100.	99.9990
Y2	200.	199.9970

Fig. III.3.36

For X and Y axis pitch adjustment as shown above, enter values as follows.
(When x 0.1 specification is ON)

Mcn. Pos.(Base)AX	100.0000

Mcn. Pos.(Base)AY	100.0000

No.	Target Value	Meas. Value	Adjust Value
X1	100.0000	100.0008	-0.0008
X2	200.0000	200.0022	-0.0022
X3	300.0000	300.0030	-0.0030

No.	Target Value	Meas. Value	Adjust Value
Y1	100.0000	99.9990	0.0010
Y2	200.0000	199.9970	0.0030

When activating pitch adjustment to fine adjust the machined result, keep the standard machine coordinate and target value unchanged. Adjust deviation by increasing or decreasing relative to the current measured value.

1) For optional adjustment

(a) Optional adjustment on X axis

When optional adjustment is performed on the X axis, the output of pitch adjustment amount relative to the machine coordinate is shown below.

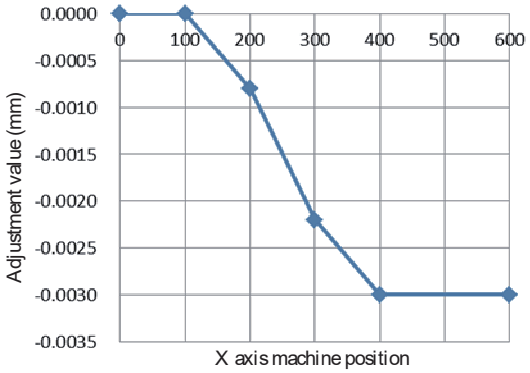
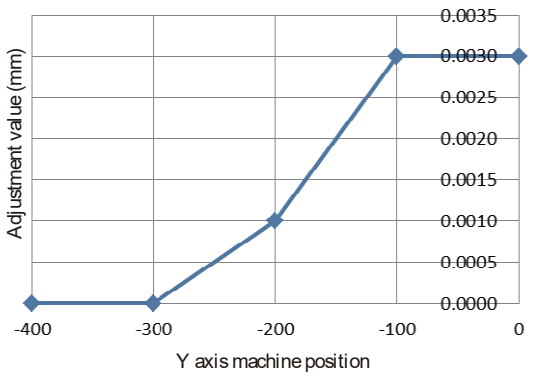


Fig. III.3.37

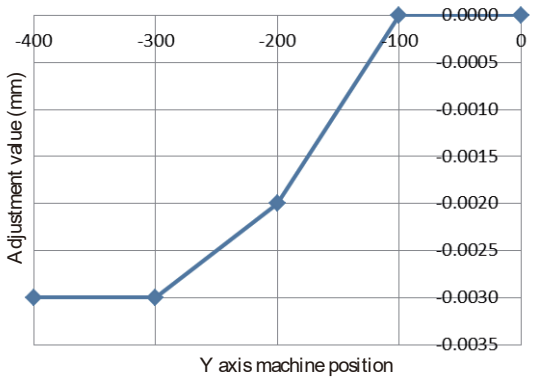
Adjustment Range	Machine Position Range	Content of X Axis Pitch Adjustment
X < Mcn. Pos.(Base)AX	X < 100.0000	Since the adjustment amount in the range is 0, the pitch is not adjusted.
Mcn. Pos.(Base)AX ≤ X < X1	100.0000 ≤ X < 200.0000	The pitch is adjusted by interpolation to ensure that the adjustment amount for the range from Mcn. Pos.(Base)AX to X1 is 0.0000 (mm) to -0.0008 (mm).
X1 ≤ X < X2	200.0000 ≤ X < 300.0000	The pitch is adjusted by interpolation with the amount of -0.0014 (mm) to ensure that the adjustment amount for the range from X1 to X2 is -0.0008 (mm) to -0.0022 (mm).
X2 ≤ X < X3	300.0000 ≤ X < 400.0000	The pitch is adjusted by interpolation with the amount of -0.0008 (mm) to ensure that the adjustment amount for the range from X2 to X3 is -0.0022 (mm) to -0.0030 (mm).
X3 ≤ X	400.0000 ≤ X	Since the adjustment amount in the range does not change, the pitch is not adjusted.

(b) Optional adjustment on Y axis

When any adjustment is performed on the Y axis, the output of pitch adjustment amount relative to the machine coordinate is shown below.



When the target value and measured value are input



When the adjustment value is output (after conversion of the zero point adjustment amount to 0)

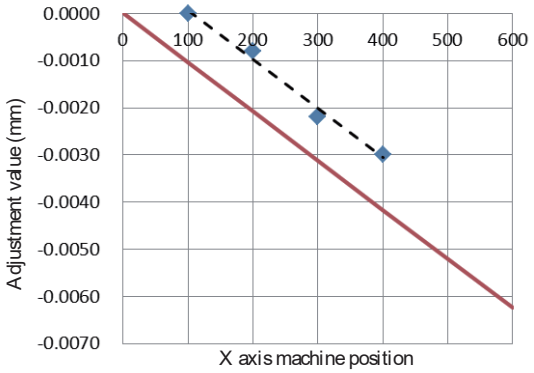
Fig. III.3.38

Adjustment Range	Machine Position Range	Content of Y Axis Pitch Adjustment
Y < Mcn. Pos.(Base)AY	Y < -300.0000	During input, the adjustment for stroke end to Mcn. Pos.(Base)AY is 0, so the change is 0. For output, the adjustment amount after conversion of 0 is -0.0030 (mm), but the change is 0, so the pitch is not adjusted.
Mcn. Pos.(Base)AY ≤ Y < Y1	-300.0000 ≤ Y < -200.0000	During input, the adjustment from Mcn. Pos.(Base)AY to Y1 is 0.0000–0.0010 mm, a +0.0010 mm change. On output, after setting the origin adjustment to 0, it becomes -0.0030–-0.0020 mm, with interpolation at the same +0.0010 mm gradient.
Y1 ≤ Y < Y2	-200.0000 ≤ Y < -100.0000	During input, the adjustment from Y1 to Y2 is 0.0010–0.0030 mm, a +0.0020 mm change. On output, after setting the origin adjustment to 0, it becomes -0.0000—0.0020 mm, with interpolation at the same +0.0020 mm gradient.
Y2 ≤ Y	-100.0000 ≤ Y	During input, the adjustment amount in the range from Y2 to origin is 0.0030 (mm), and the change is 0. For output of compensation amount, the adjustment amount after conversion of the origin adjustment amount 0 is 0 (mm), but the change is 0, so the pitch is not adjusted.

2) For full stroke linear adjustment

(a) Full stroke linear adjustment on X axis

Calculate the adjustment value coefficient (dotted line) from Mcn. Pos.(Base)AX to X3 (X axis 100.0000 to 400.0000). Output the adjustment amount (solid line) in proportion to the machine coordinate. In this example, the adjustment coefficient is −10.4 × 10−6. The product of this coefficient and the EDM X axis stroke displays as the adjustment amount under the adjustment mode.

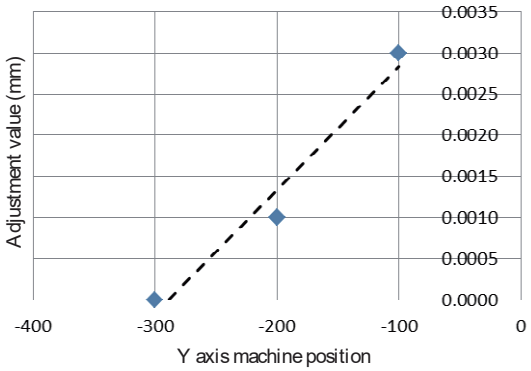


X axis stroke of machine (mm)	400	500	600
Adjustment amount (mm)	-0.0042	-0.0052	-0.0062

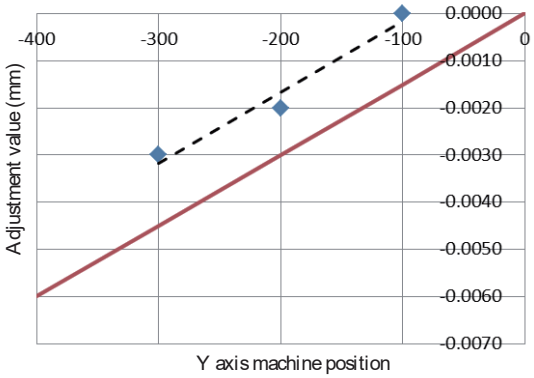
Fig. III.3.39

(b) Full stroke linear adjustment on Y axis

Calculate the adjustment value coefficient (dotted line) from the standard machine coordinate to X2 (Y axis −300.0000 to −100.0000). Output the adjustment amount (solid line) in proportion to the machine coordinate. In this example, the adjustment coefficient is +15.0 × 10−6. The product of this coefficient and the EDM Y axis stroke displays as the adjustment amount under the adjustment mode.



When the target value and measured value are input



When the adjustment value is output (after conversion of the zero point adjustment amount to 0)

YX axis stroke of machine (mm)	300	350	400
Adjustment amount (mm)	0.0045	0.0053	0.0060

Fig. III.3.40

3.2.2 Origin

Displays and sets parameters for adjusting the machine zero point. Adjust only when instructed by the maker.

(1) Description of setting items

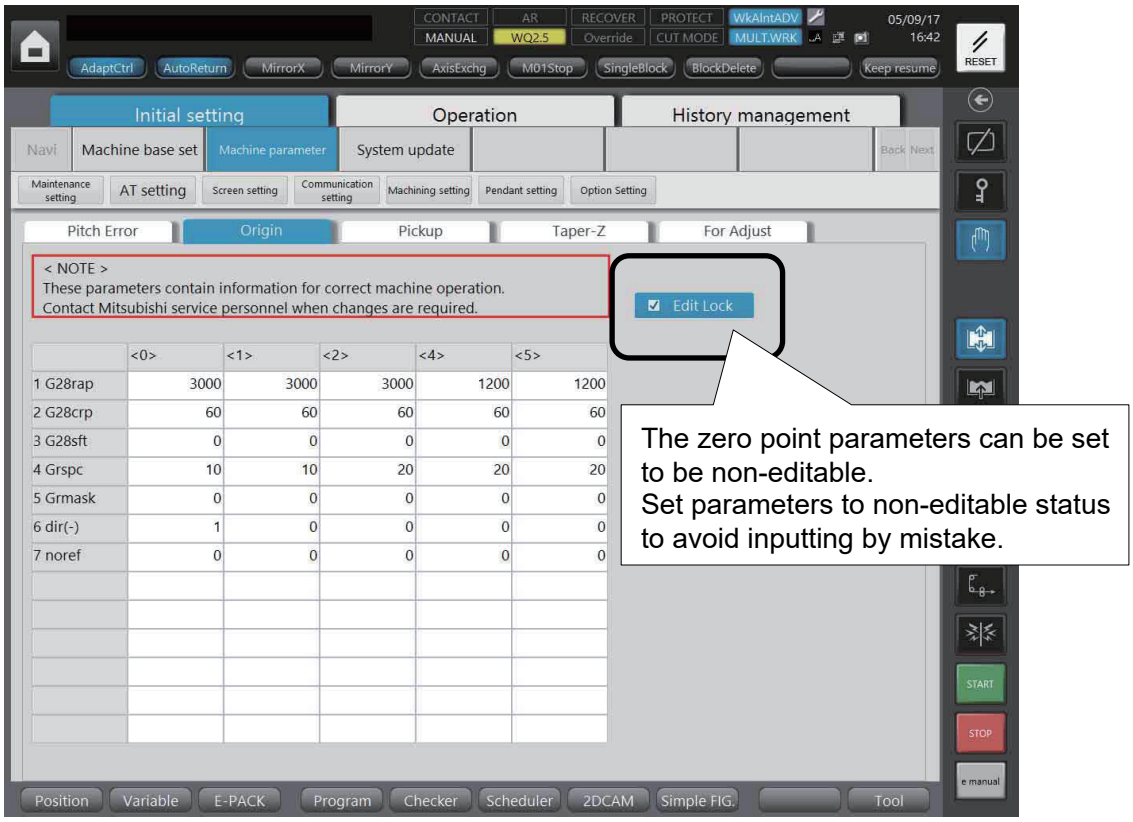


Fig. III.3.41

3.2.3 Pickup

Displays and sets WS, WT, and PT steps for contact positioning.

(1) Description of setting items

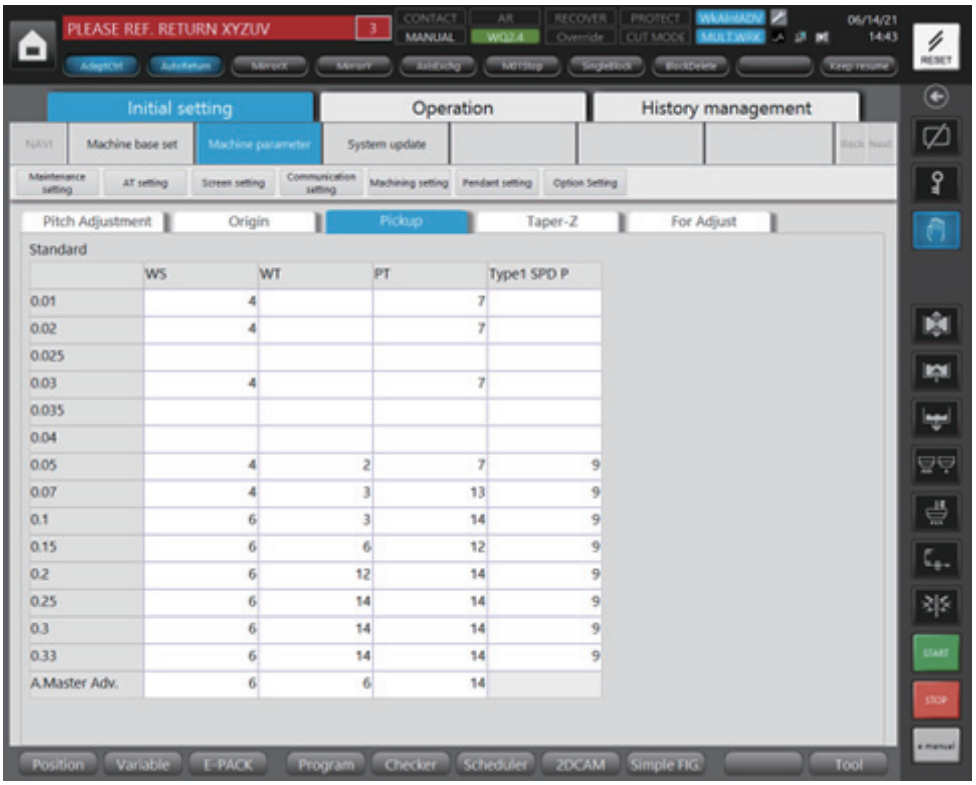


Fig. III.3.42

1) Wire dia

Displays the wire diameter. This value is fixed.

2) WS, WT, PT

Sets each parameter notch for contact positioning. The maker's recommended initial value is displayed. WS, WT, and PT notches for the selected wire diameter are activated during positioning. Changed values cannot be restored to the initial value.

3) Type1 SPD P

Sets the edge detection speed when the “Prcis Positioning” switch is OFF or when Type1 is selected in “Pos.Type”.

Based on P, edge detection runs at the speed shown in the table below.

P command	Speed (mm/min)
1	3
2	6
3	9
4	12
5	15
6	30
7	100
8	300
9	570
Non-specified	60

Current conditions are used if the column is blank.

3.2.4 Taper-Z

Sets ΔZ3 and Z4 for each wire diameter. If you press [Save] on the Taper-Z screen, the ΔZ3 and Z4 values are set on this screen

(1) Description of setting items

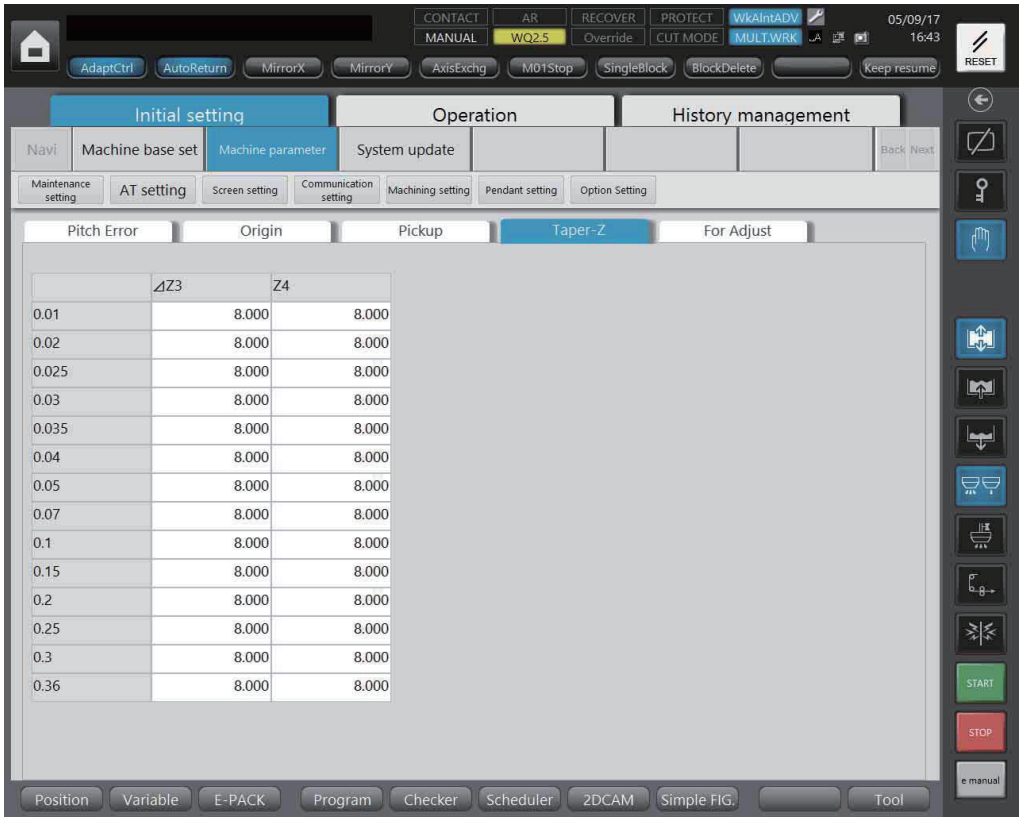


Fig. III.3.43

- **During simple taper machining, save ΔZ3 and Z4 in taper specification parameters. If wire diameters are first use and a new diamond die is installed, measure taper specs and press Save to set them on the Taper-Z screen.**

3.2.5 For Adjust

This screen is used only when required by the service center. Do not use it otherwise.

(1) Description of setting items

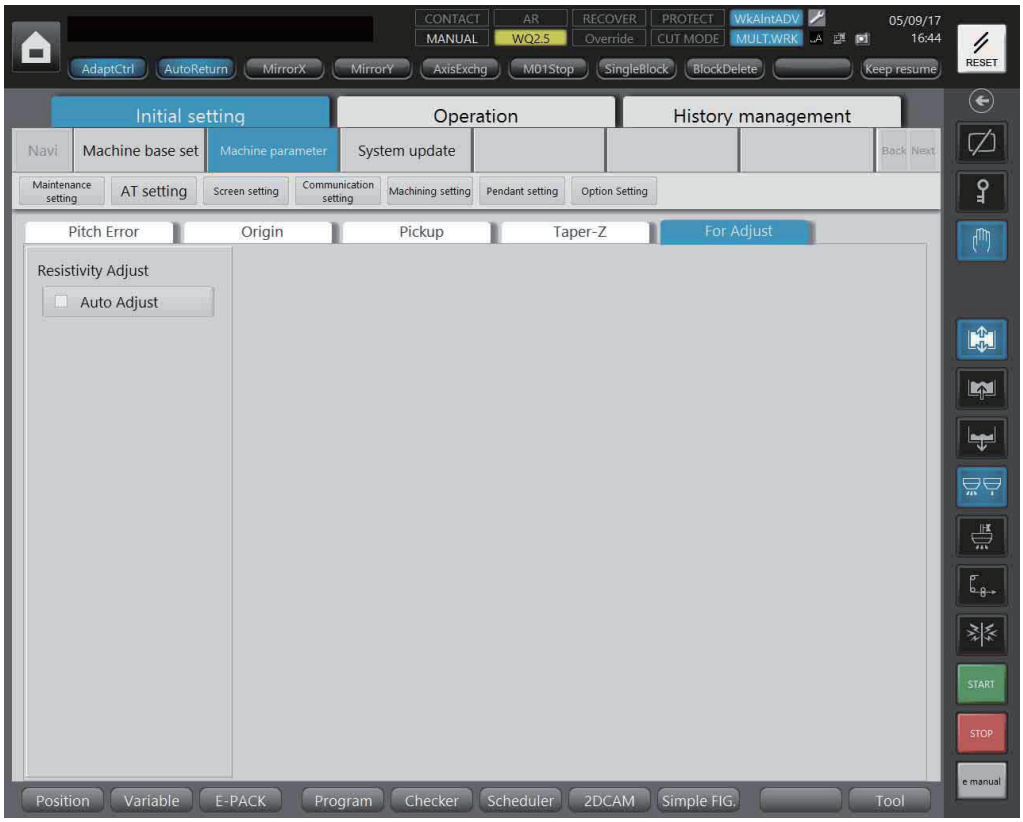


Fig. III.3.44

1) Resistivity Adjust

Press [Auto Adjust] if resistivity needs readjustment. The switch light turns on during adjustment. (otherwise it is off)

3.2.6 Maintenance Setting

(1) Inspection

3.2.7 Maintenance Setting

(1) Inspection

Configure the machine operations and set switch type related to maintenance inspection and consumables replacement.

1) Description of setting items

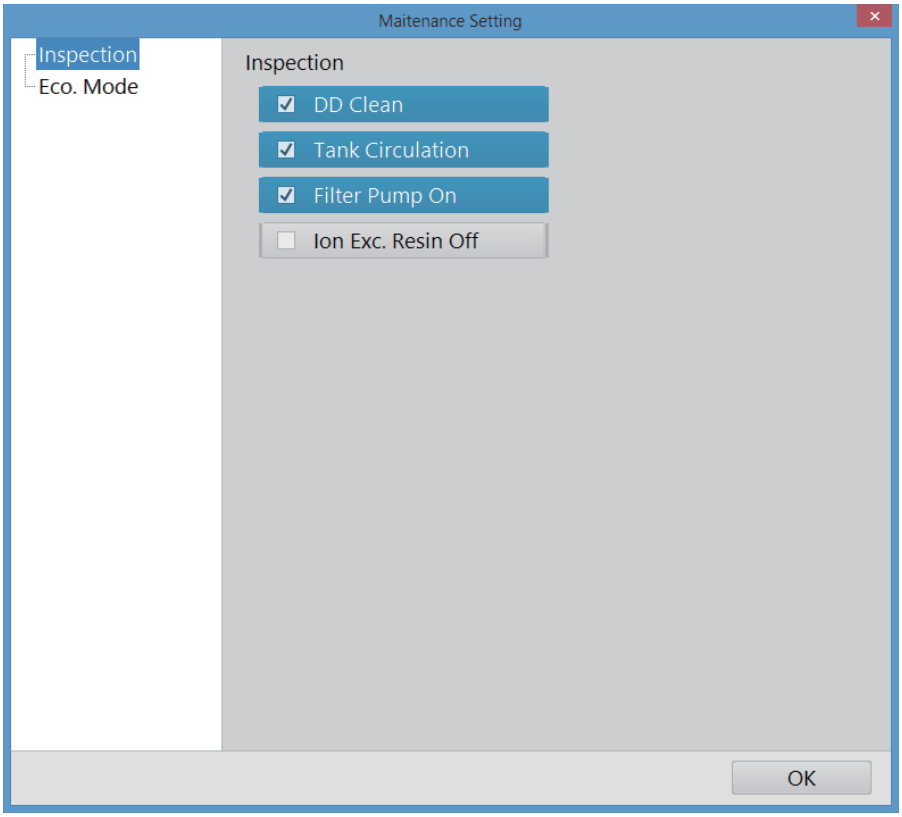


Fig. III.3.45

(a) DD Clean

When ON, cleans the diamond die after machining.

(b) Tank Circulation

When ON, water flows from the lower arm. Usually controlled automatically, but you can switch ON/OFF here.

The axis cannot move when OFF. Move the axis first, then set OFF for cleaning or other work.

(c) Filter Pump On

When ON, the filter pump rotates. Usually linked to preparation ON/OFF. Set OFF when replacing the filter or similar work.

(d) Ion Exc. Resin Off

Set ON when replacing the ion exchange resin.

(i) Switch ON

Stops water flow for the resin and displays “Ion exchange resin OFF”. After replacement, set OFF.

(ii) Switch OFF

Starts water flow for the resin. Usually keep OFF.

(2) Power saving mode

Supplies only minimum power for control units. After exiting the mode, power is restored to all units, and machine temperature is adjusted when dielectric fluid is below the table so operation can start immediately.

1) Description of setting items

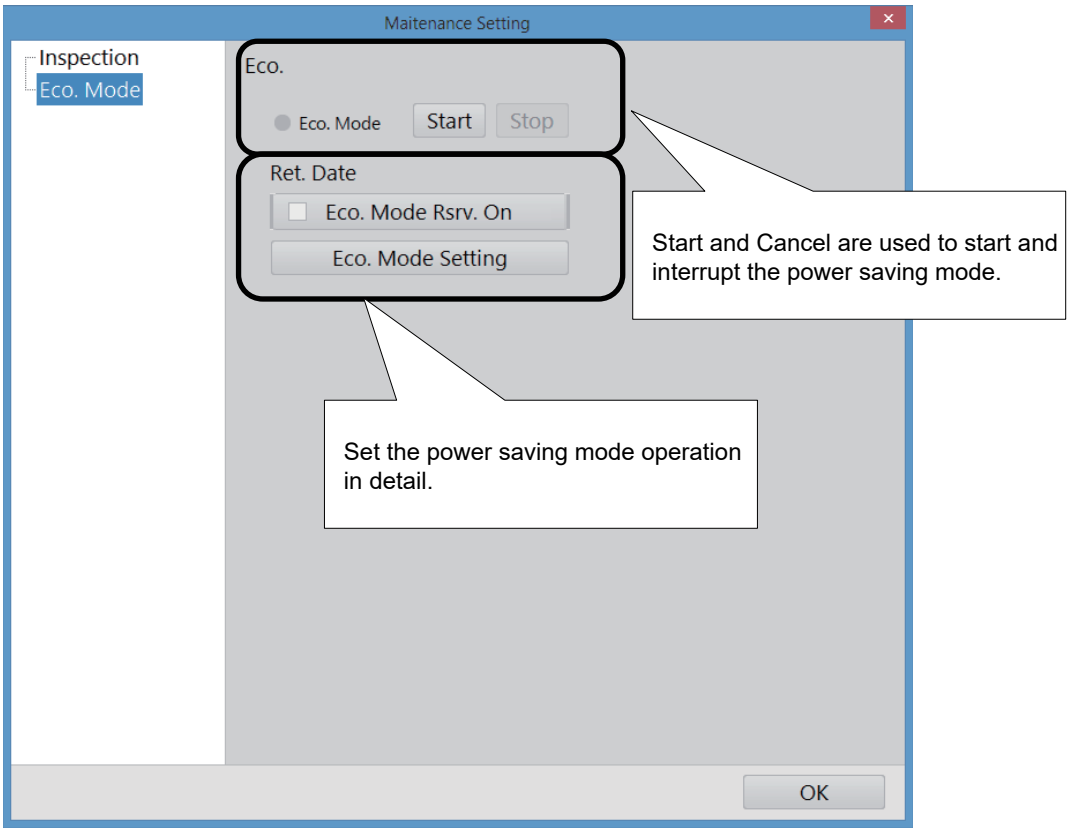


Fig. III.3.46

(a) "Start" and "Stop" are used to start and interrupt the power saving mode

"Start" activates power saving immediately, regardless of "Eco. Mode Rsrv. On". If the mode is "Sleep", return occurs at the effective return time or return date time set in the "ECO. mode setting" dialog box. Press "Stop" to cancel saving mode. If the mode is "Sleep", press "Cancel" to execute the return operation.
When [Eco. Mode] status light is on, power saving is active and only "Stop" is enabled. When it is off, power saving is not set and only "Start" is enabled. When "Start" is pressed, a dialog appears. Press "OK" to start power saving mode.

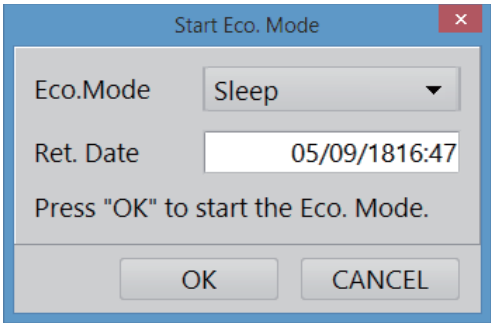


Fig. III.3.47

When "Cancel" is pressed, a dialog box is displayed. To interrupt power saving mode, press "YES".

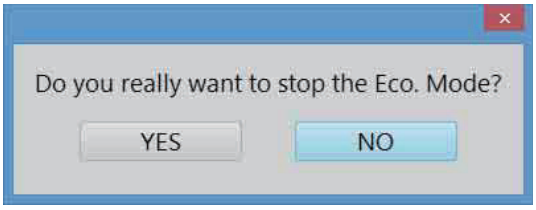


Fig. III.3.48

(b) Operation condition setting

Press "Eco. Mode Setting" to display the following dialog box. If the iQ Care Remote4U agreement has been signed, the screen shown in Fig. III.3.49 appears. Otherwise, Fig. III.3.50 appears.

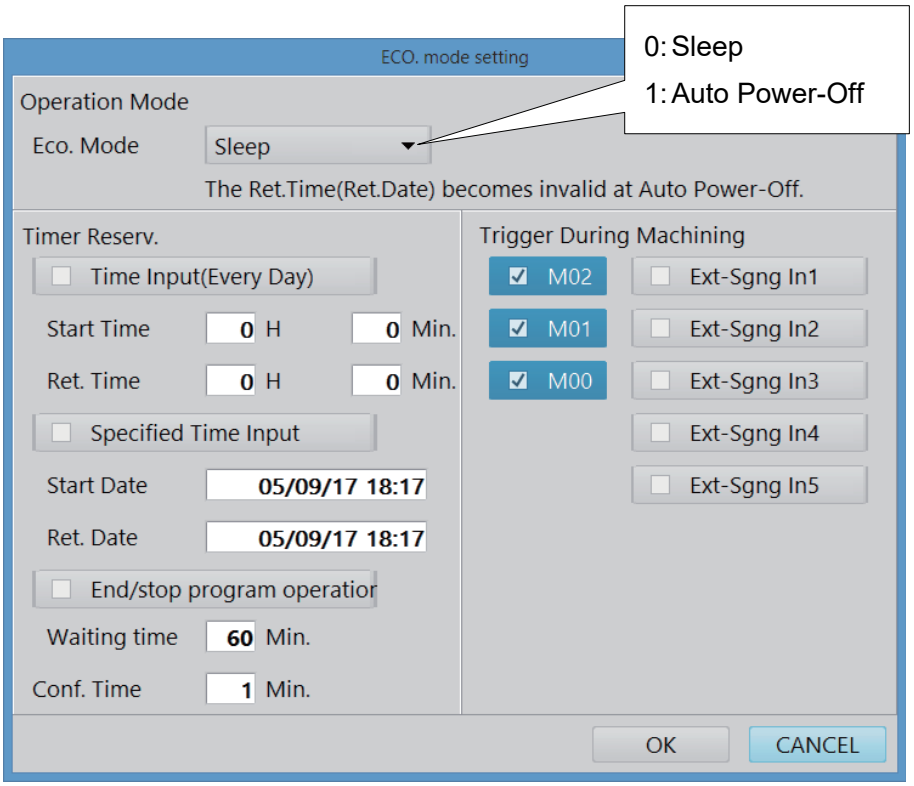


Fig. III.3.49

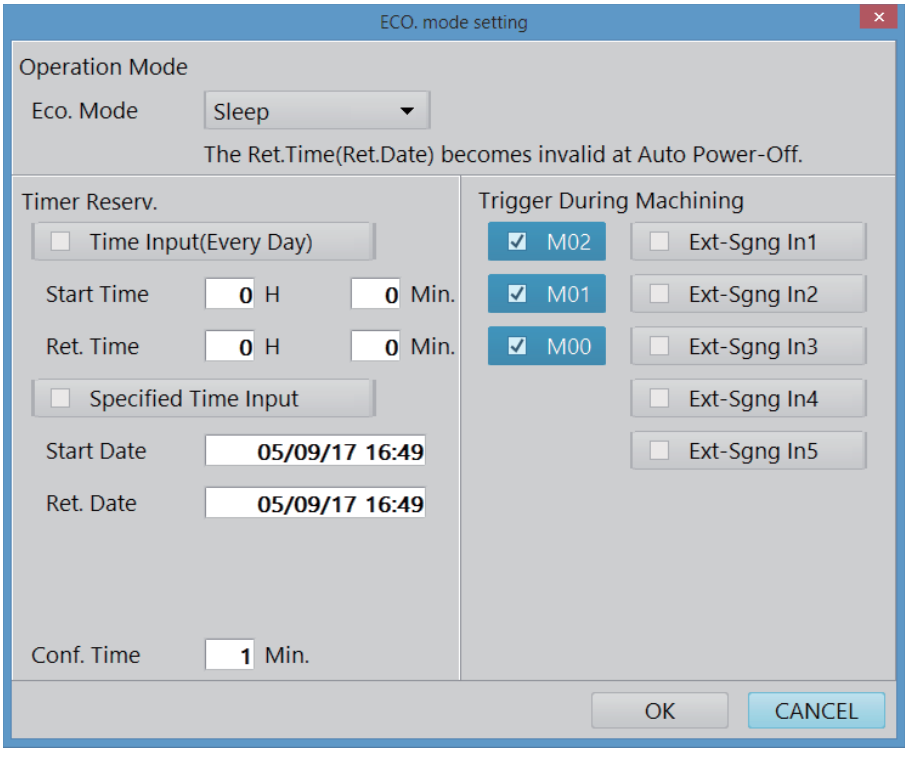


Fig. III.3.50

(i) Operation Mode

Sets [Sleep] or [Auto Power-Off].

[Sleep]: Supplies minimum control power. On return, restores all power, immerses dielectric fluid below the table, and preheats so work can start immediately.

[Auto Power-Off]: Cuts control power after a fixed time post machining completion or external signal.

(ii) Time Input (Every Day)

Reserves daily power saving. Set [Time Input (Every Day)] to ON, set [Start Time] and [Return Time]. For [Auto Power-Off], leave [Return Time] blank.

(iii) Specified Time Input

Reserves one-time power saving. Set [Specified Time Input] to ON, set [Start Date] and [Ret. Date]. For [Auto Power-Off], leave [Return Date] blank. Set return time later than start time.

(iv) Conf. Time

Sets the delay from reservation start to actual start. If the start time occurs during program running, the mode executes after [Conf. Time] and when [Trigger During Machining] is satisfied. During this period, the bar displays "The ECO. mode is started [ECO. MODE STOP] switch is ON, If you really want to stop ECO. Mode." Press [ECO. MODE STOP] to interrupt.

- **If [OK] is pressed with incorrect start/return settings or inconsistent date times, "TIMER RESERV. is incorrect." is shown.**
- **If [Time To Start] equals the reservation time, "The reservation time overlaps with TIME TO START." is shown.**

(v) Trigger During Machining

Specifies conditions to enter power saving while running. Specify machining end ([M00], [M01], [M02]) and external signal.

(vi) End/stop program operation

Executes power saving when [Waiting time] is reached after program end or stop. In [Sleep], return occurs at the daily or dated return time.

*** Shown only when the iQ Care Remote4U agreement is signed.**

(c) Reservation setting of power saving mode

When [Eco. Mode Rsrv. On] is ON, the time reservation set in [Eco. Mode Setting] takes effect. When OFF, no time reservation is executed

NOTICE

If the emergency stop is pressed or a servo alarm occurs, the system cannot return from [Sleep]. When [Sleep] starts, first make sure the machine is ON.

(d) Ret. Date

When [Eco. Mode Rsrv. On] is ON or power saving mode is executing, the reserved return date and time are displayed.

- **Change [Eco. Mode] and [Ret. Date] in [Start Eco. Mode]; [ECO. mode setting] is not updated.**
- **Start [Sleep] only when READY ON; emergency stop or servo alarms prevent return. [Start]/[Stop] do not cancel reservations. [Sleep] closes the screen, reopens it on return, and is canceled by power cycling. The return buzzer means stay clear. Start/return times are recorded. Soaked workpieces may be exposed and rust.**
- **Use this energy-saving function for night stops, ON only at the final machining stage; if always ON, power may cut during preparation.**
- **Auto Power-Off is blocked if a program starts during countdown and resets to OFF after power cycling. If power fails during countdown with recovery ON, recovery runs, then Auto Power-Off triggers after the wait time. If Auto Power-Off cuts power with recovery ON, recovery does not run. Automatic power cuts record only "Power OFF." Some models include this in [Power Saving Mode].**
- **In [Sleep], the screen automatically enters closed/manual closed status. Press operation panel power ON to display it; press the screen closing switch to close it again.**

3.2.8 AT operation setting

(1) AT SETTING

Automatic wire feeder (configure the related setting switch using AT to perform connection).

1) Description of setting items

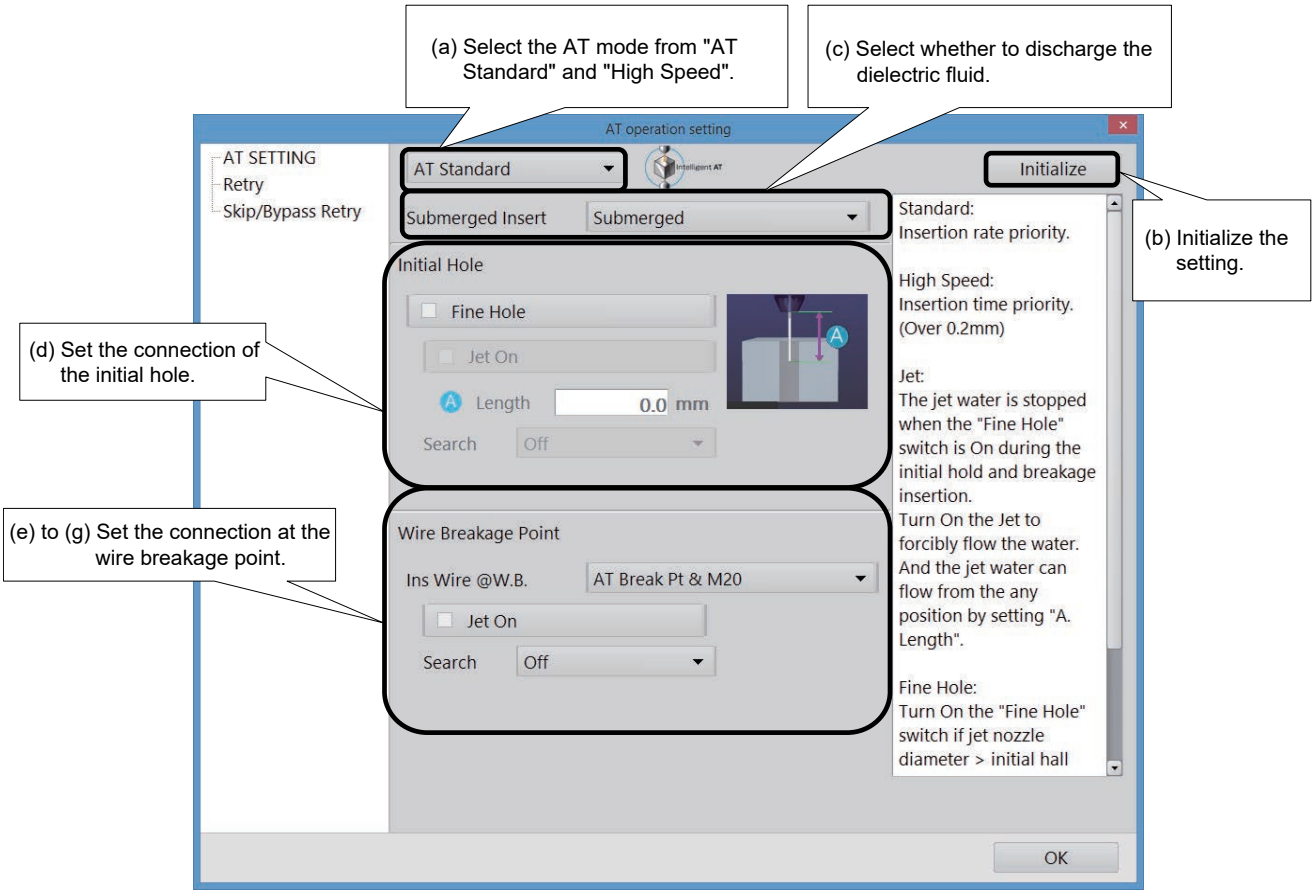


Fig. III.3.51

(a) AT Standard/High Speed

Selects AT mode: [AT Standard] or [High Speed].

[AT Standard]: Prioritizes connection rate.

[High Speed]: Prioritizes connection time (available above Ø0.2).

(b) Initialize

Restores AT settings to delivery status.

(c) Submerged Insert

Sets whether to discharge dielectric fluid during connection.

(d) Initial Hole

(i) Fine Hole switch

Set ON when the jet nozzle diameter is larger than the initial hole diameter. When ON, water is not jetted during connection at the initial hole and wire breaking point.

(ii) Jet On (Initial Hole)

When [Fine Hole] is ON, water is normally not jetted. Set this ON to jet water at the initial hole.

(iii) A Length

Starts water jetting from a set distance.

(iv) Search (Initial Hole)

"Off" : Performs regular connection.

"On" : Moves the wire up and down for small hole connection.

"On(XY Move)" : If up/down cannot be used, moves in XY for hole search, then performs small hole connection.

(e) Ins Wire @W.B.

(i) In the case of "Off"

Moves from the break position to M20, then connects at the initial hole.

(ii) In the case of "AT Wire Brk Point"

Connects only at the break point. Retries until the count in [Insert Limit] is reached. If set to 0, retries 5 times.

(iii) In the case of "AT Break Pt & M20"

Tries at the break point up to the specified times. On error, returns to M20 and tries again. If set to 0, retries 5 times at the break point. On failure, returns to M20 and retries for the specified times.

(iv) In the case of "Once@Brk Pt & M20"

Tries once at the break point. On error, returns to M20 and tries once at the break point only.

- **This function connects at the wire break position. Success rate varies with wire diameter, board thickness, and machining shape.**
- **Break point mode is not cleared by resetting, M02, M30, ready for operation, or power on/off.**

(f) Jetting during connection at the breaking point

Sets whether to jet water during connection. Available only when “Ins Wire @W.B.” is ON.

(g) Search (breaking point)

When ON, performs small hole search during connection at the breaking point. Same operation as “(d)-(iv) Search”.

(2) Retry

Configures settings for the automatic wire feeder (AT) breaking return switch.

1) Description of setting items

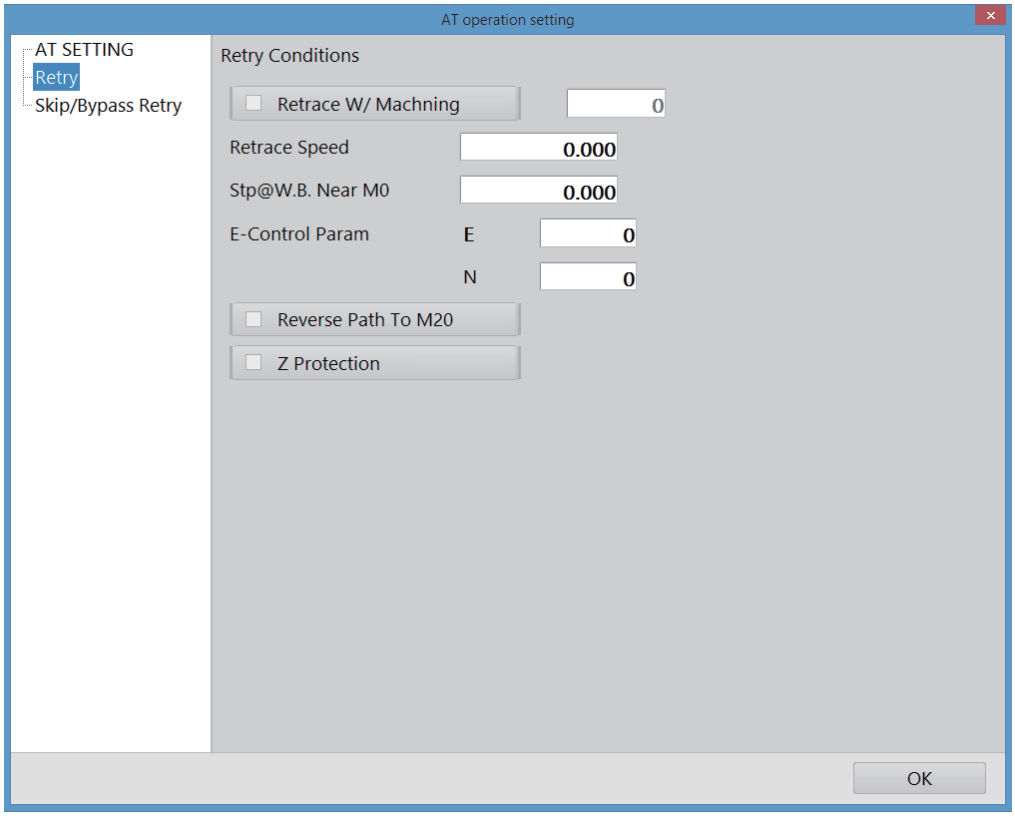


Fig. III.3.52

(a) Retrace W/Machining

Selects whether to turn machining power ON/OFF before returning to the break point.

(i) When the switch is "OFF"

As before, under weak dielectric, return to the break point at 120 mm/min, then turn power ON and resume with original conditions.

(ii) When the switch is "ON"

Execute M84 to turn power ON, use H83 to return with the specified E-Pack conditions, then resume with original conditions. Uses optimal feed when ON.

(iii) E-Pack No.

Sets return conditions when breaking return is ON. Can also be set by H83.

(b) Retrace speed

Sets return speed from initial hole to break point if 120 mm/min is too fast. Can also be set by H90.

(c) Stop due to wire breaking before M0

Stops near M0/M1 without breaking return. Set the distance with "Stp@W.B. Near M0" or H854.
If wire breaks or a 30 s short circuit occurs in this interval, no breaking return occurs. "T210 WIRE BREAKAGE" or "T211 30 SEC CONTACT" is issued and the machine stops. Even with "A.W.F. Skip", skipping to the next shape does not occur.

The no-return interval applies only to the single program segment before M0/M1. If that segment is 0.5 mm, the interval without breaking return is 0.5 mm even if 1 mm is specified.

(d) E-Control Param

Stabilizes machining when breakage occurs.
For usage in each machining state, see the following table.

Machining state	E-Pack input column	Effect
PM machining	-1 to -9	The speed regulating notch is reduced to the specified value each time breaking occurs for the specified times.
Non-PM machining	1	The stabilizing circuit B (SB) of machining conditions is increased by 1 notch each time breaking occurs for the specified times.
Non-PM machining	2 to 5999 or 10000 to 99999	The machining conditions change to E-Pack of the specified number when breaking occurs for the set times.

- **The breaking times are reset by the M20 program segment.**
- **A maximum of 16 notches can be controlled for SB.**
- **The SB of automatic control will not be recovered after machining ends. When automatic pause control is used, be sure to specify E-Pack in the NC program.**
- **If E-Pack is specified after the program segment of M20, the controlled pause time changes to the value specified in E-Pack.**

(e) Reverse Path to M20

When breaking occurs, the machine normally moves linearly to M20 to reconnect. When "Reverse Path to M20" is ON, it returns along the machining trajectory.

(f) Z Protection

Used in segment difference machining to prevent Z axis collision during automatic return. Not effective without the Z axis option. When ON, the Z axis rises to maximum height at automatic return.

Set the Z axis protection function to OFF when automatic return occurs with machining ON.
If Z axis protection is used with machining ON, the dielectric fluid will splash.

(3) Skip/Bypass Retry

Used to switch the enabled/disable status of uncut skip function and set conditions for occurrence of uncut skip. Set according to the machining conditions and initial hole shape.

1) Description of setting items

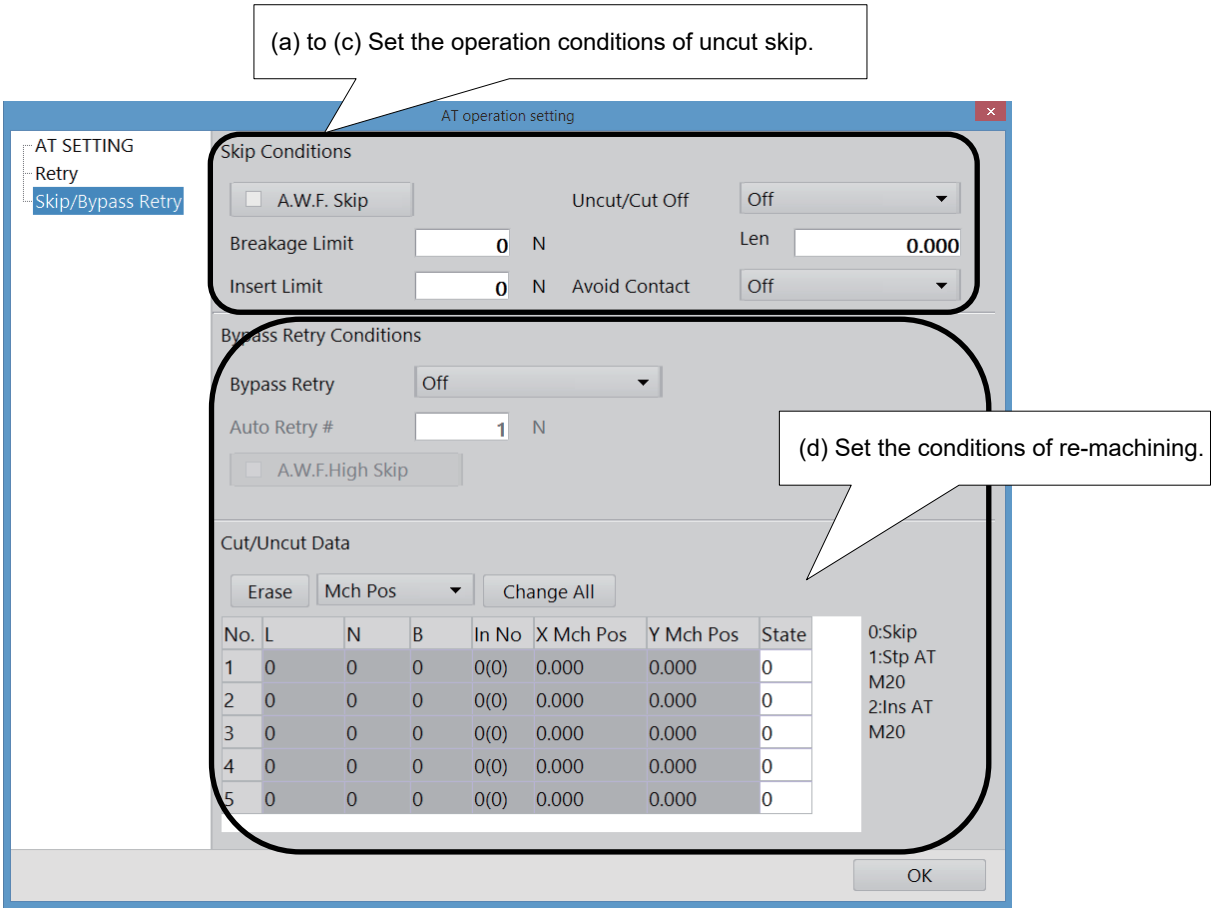


Fig. III.3.53

(a) A.W.F. Skip

When machining with an NC program containing M20, if the specified breakages occur between M20s and the specified connection errors occur during M20, uncut skipping runs at 570 mm/min before the next initial hole. If "A.W.F. Skip" is OFF, skipping does not occur and the machine stops on the field.

(i) Breakage Limit

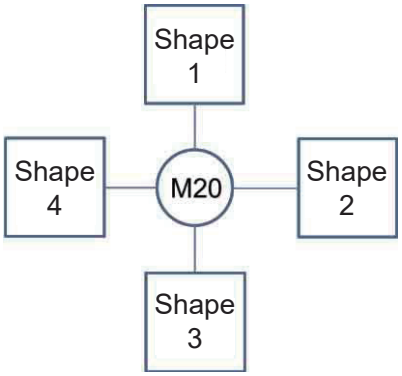
Set the breakage limit before uncut skipping to the next initial hole.

It can be set in the range of 1 to 9999. The default is 15 times.

(ii) Insert Limit

Set the insert limit before uncut skipping to the next initial hole. It can be set in the range of 1 to 9999. The default is 5 times.

- **If the machine stops due to a connection error while returning to the initial hole, breaking return resumes after restart.**
- **If uncut skipping occurs during 1ST cutting, 2ND and later cuts for that hole are also skipped.**
- **If multiple shapes share M20 at the same machine coordinate and skipping occurs on any shape, all subsequent shapes at that coordinate are skipped. For example, if shape 2 skips in the sequence 1, 2, 3, 4, then shapes 3 and 4 are also skipped.**



(b) Uncut/Cut Off

During total circumference machining, creates an NC program with an uncut part to prevent workpiece separation. This does not change the main program. It performs uncutting automatically by the specified amount during machining and machines only the uncut part separately. This cannot be set here during check or machining under automatic 2nd cut mode (item not displayed). Set it on the automatic 2nd cut screen.

(i) Uncut mode

In uncut mode, the move-command segment before M01 is left uncut. M21 runs automatically to skip after the specified uncut and cut distance (H96).

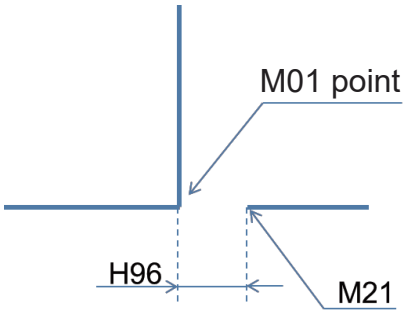


Fig. III.3.54

(ii) Cut off mode

From the endpoint of the move segment before M01, moves forward by the H96 uncut/cut distance at the breaking return speed with machining OFF. Then turns machining power ON at that position and cuts off the uncut part.

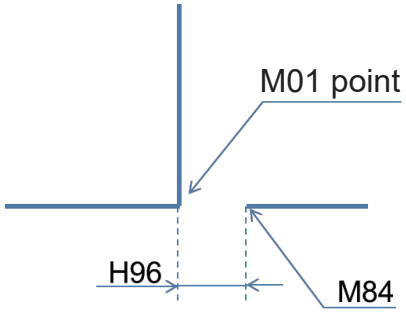


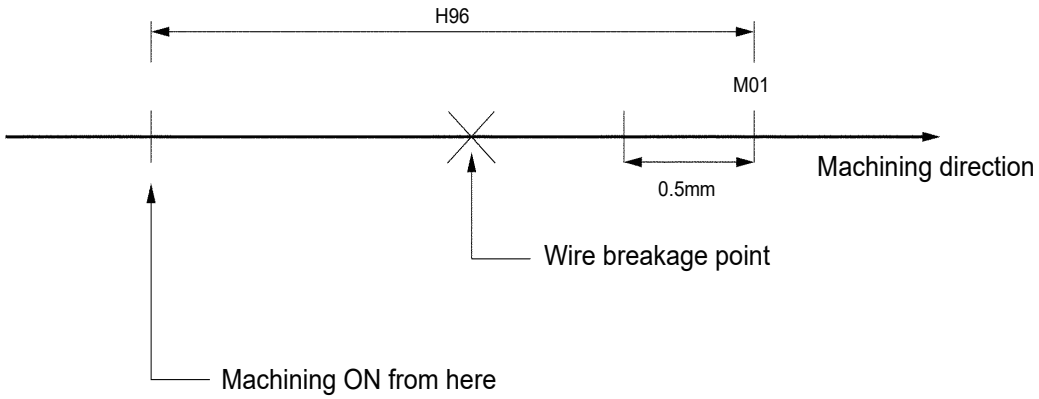
Fig. III.3.55

(iii) Len

Set the cut-off/uncut amount.

Enter the value in H96 when it is specified in the NC program.

- **The same value is used for cut-off and uncut amount. The last set value applies.**
- **The uncut amount may vary slightly with axis speed.**
- **If the remaining distance before "M01" is smaller than the uncut amount (H96), uncut starts. If H96 is too small, uncut may not run and "M01" may be ignored. Set H96 larger than 0.5 mm.**
- **In uncut mode, the axis speed after not cutting is 570 mm/min to skip the uncut section.**
- **In cut off mode, use machining ON control during return if wire may break up to the cut off point.**
- **During breaking return in cut off mode (excluding within 0.5 mm), machining turns ON from the H96 point.**



- **During cut off mode, the machining conditions commanded in the program are ignored.**
  Set machining conditions before starting, or execute the machining condition command in the NC program before switching to cut off mode.

(c) Avoid Contact

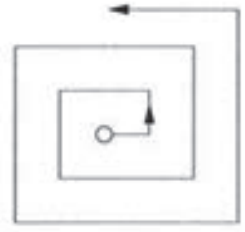
After connection completes, the workpiece may touch the wire and machining cannot start. The Avoid Contact function automatically moves the axis to a position where the wire does not contact the workpiece.

(i) Avoid & Machining (set 1 in the tens place of H246)

Used when machining starts with the position of initial hole as reference.

(ii) Rtn To M20 & Mch (set 2 in the tens place of H246)

Used when machining starts with the position of NC program as reference. It changes to "T211 30 SEC CONTACT" when the position where contact can be avoided cannot be found.



Spiral axis movement is performed to search for the position where the wire does not contact with the workpiece.

Contact avoidance action in the case of "Immediate machining after contact avoidance" and "Machining after returning to the M20 position"

Fig. III.3.56

(iii) UV tilt avoid CONT. (set 3 in the tens place of H246)

Used when the upper hole position and lower hole position of the initial hole are misplaced.

Increase the angle after moving in eight directions.

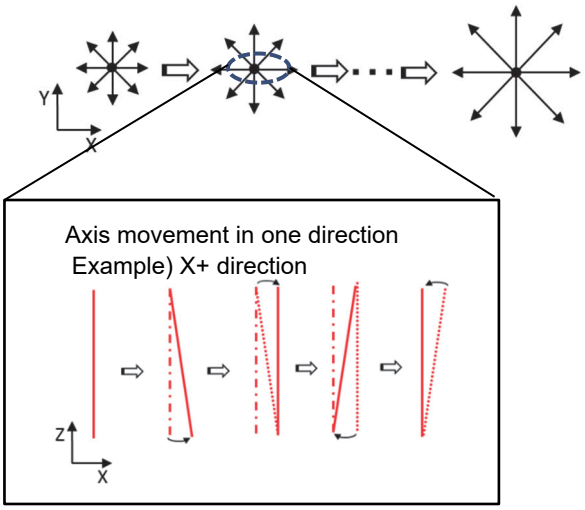


Fig. III.3.57

(iv) Off

When the contact avoidance function is not used, the status changes to "T211 30 SEC CONTACT" due to continuous short circuit.

The stopping function is used to interrupt contact avoidance.

Set , , and to ON, and then restart.

(d) Bypass Retry Conditions

The re-machining setup re-machines only the uncut shape using the saved skipping data on the "Uncut Data" screen after multiple continuous machining.

Use this when uncut skip occurs across multiple continuous machining sessions.

(i) Bypass Retry

The selection in "Bypass Retry" is as follows.

- For manual positioning to the start position: "Bypass Retry"
- For automatic positioning to the start position: "Rtn To Start&Retry"

(ii) Auto Retry #

Enter the number of shapes for continuous re-machining.

(iii) A.W.F.High skip

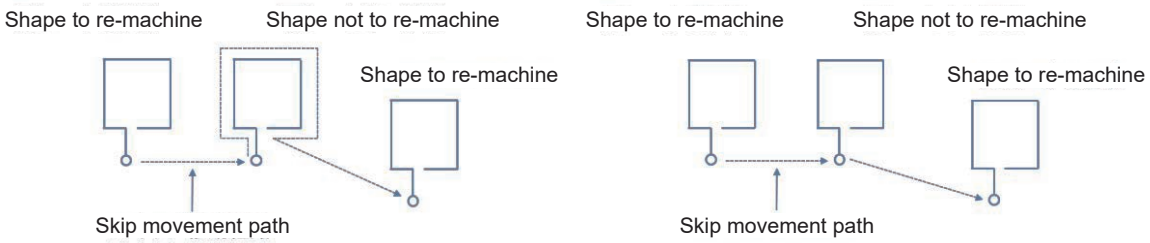
Select the skipping method of the machined shape here.

The "A.W.F.High Skip" switch is set to ON:

The shape not for re-machining will not move along the program shape any more, but will be skipped by linear moving.

The "A.W.F.High Skip" switch is set to OFF:

In the machining OFF state, the shape moves according to the program shape as skipping.



"A.W.F. High Skip" ON "A.W.F. High Skip" OFF

Fig. III.3.58

(iv) Select the machining method of shape for re-machining

Select it by entering the number in "State" in "Cut/Uncut Data". Select the machining method from the following three methods. (When the previous machining ends, all change to the [1:Stp AT M20] state.)

[0:Skip]
Use to skip a shape that cannot be machined in this re-machining.
[1:Stp AT M20]
Use when re-machining needs to be implemented after the causes leading to machining completion failure of all shapes are eliminated. Manual intervention is required since the program segment stops.
[2:Ins AT M20]
Re-machining is implemented after automatic connection of M20.
Use when the causes leading to machining completion failure have been eliminated and automatic continuous operation can be used to perform re-machining.

* To change the "State" of all the shapes, press the [Change All] button to display the dialog box, and select the number to be changed.

(v) Erase Uncut Data

Press [Erase] for the dialog box. Perform the following operations according to the purpose. To interrupt the deletion operation, press the CANCEL key.

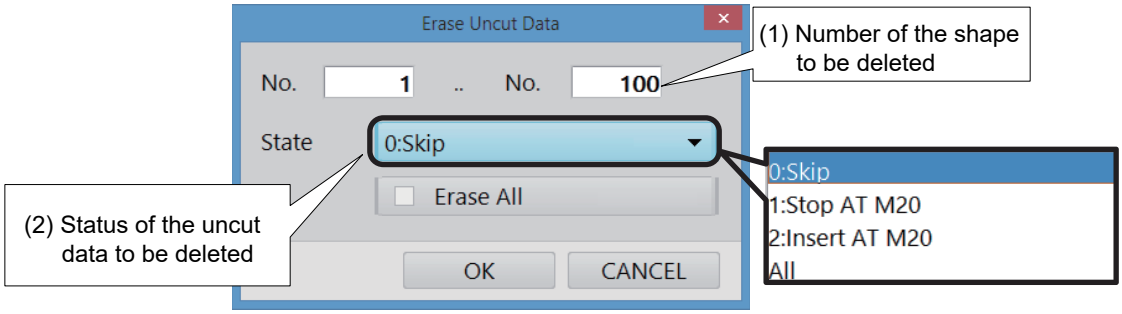


Fig. III.3.59

Enter the number of shape to be deleted in (1). (Fill in any one if only one shape needs to be deleted.)
Select "State" of the uncut data to be deleted in (2).
Press OK key to perform the deletion operation.

*** To delete all shapes, set all deletion switches to ON, and press OK.**

(4) CoreHold

COREHOLD (core disposal function) switches to core-fixing conditions in rough machining, fixes part of the core, and performs total circumference machining to secure it. By machining all cores unmanned and removing them later at once, manned core handling time is greatly reduced.

*** This function may not be displayed depending on machine model and options.**

For more information on CoreHold, see "VI. OPTIONS"

3.2.9 Screen operation setting

The related switches used for screen settings.

(1) Screen display

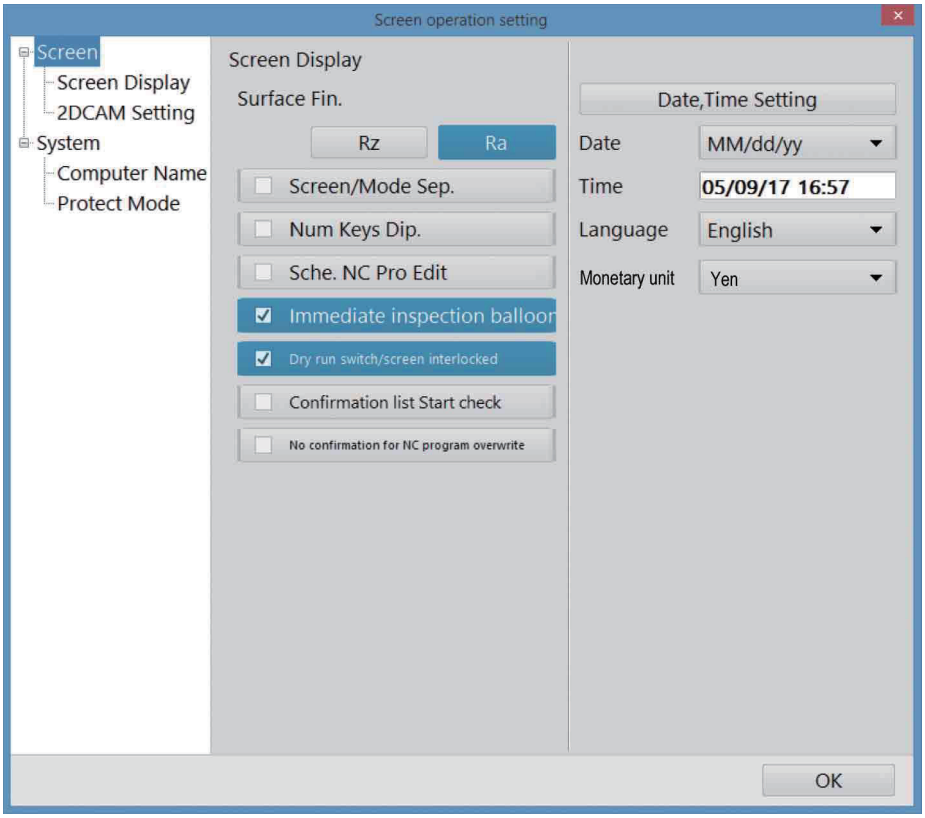


Fig. III.3.60

1) Ra/Rz

The surface roughness display/setting unit is as follows according to the switch status.

- When the [Rz] switch is ON...the unit is Rz.
- When the [Ra] switch is ON...the unit is Ra.

2) Screen/Mode Sep.

When the switch is set to ON, the manual/automatic selection made using the key is separated and cannot be switched.

3) NUM Keys Disp.

Turn ON to display the numeric keyboard.

(a) Display restriction

Turning ON to restrict the screens that display the numeric keyboard to the positioning screen.

(b) Keep display position

Turning ON to fix the numeric keyboard to an arbitrary position.

4) Touch panel setting

Deviation of the touch points can be compensated by carrying out "4-point calibration setting" on the touch panel operation setting screen.
The "×" mark blinks in the lower left part of the screen. Press this button till blinking stops.
After that, a "×" mark will blink in succession in the lower right, upper right, and upper left parts. Similarly, calibrate all the four points in turn.

5) Sche.NC Pro Edit

Turn ON to edit the NC program registered in the scheduling list, but note the following:

- NC program registered to the scheduled task in operation is uneditable.
- For NC program editing performed before scheduled task operation, if the scheduled task operation started before saving, the NC program cannot be saved. The NC program run during planned operation is the program before editing.

6) Date,Time Setting

Set the date, time and time zone.
(The values have been set before delivery, so it does not need to be repeated.)

7) Date and time

Set the date and time display style.

8) Language

Select the display language.
After selecting it, turn the power OFF/ON.

9) Monetary unit

Set the monetary unit, symbol and decimal point.

10) Immediate inspection balloon

When the switch is set to ON and an item requiring inspection occurs, the balloon prompt message requiring inspection is displayed in the upper right corner of Home screen. When the switch is set to OFF, the balloon prompt message is not displayed.

11) Dry run switch/screen interlocked

When the switch is set to ON, if the "Dry run" sub menu is highlighted in blue, the system will skip to the dry running screen forcedly.
For information on sub menus, see "III. NC OPERATION DISPLAY SCREEN" > "1. SCREEN CONFIGURATION".

12) Confirm list Start check

When the switch is set to ON, if the items in "Operation" > "Check list" are not checked completely, machining cannot start.

For the "Check list", see "III. NC OPERATION DISPLAY SCREEN" > "4.5 Check list".

13) No confirmation for NC program overwrite

When the switch is set to ON, the confirmation dialog box "??Overwrite?" will not appear when the existing L No. is overwritten, but the NC program will be overwritten directly.

14) B AX 360deg Disp.

When set to ON: The B axis coordinate (0°to 360°) is displayed in Cartesian coordinate system.

When set to OFF: The B axis coordinate is displayed in polar coordinate system.

Under the status of rotating by one and 2/ 3 circle from the B axis origin as shown in "Fig. III.3.61 ", 270° is displayed when the switch is ON and 630° is displayed when the switch is OFF.

*** This function is optional and may not be displayed.**

15) C AX 360deg Disp.

The content related to the B AX 360deg Disp. switch in 14) is applied to C axis.

*** This function is optional and may not be displayed.**

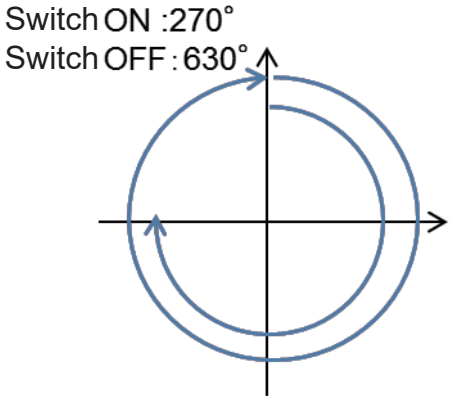


Fig. III.3.61

16) Alarm auto display

Turn ON to enable an alarm when an alarm or a warning occurs after no operations on the manual operation box and the screen have been performed for the time set in "Waiting time".

17) POS. Type disp.*

When the switch is turned ON, positioning types displayed on the positioning screen are from Type1 to Type4.

When the switch is turned OFF, the “Prcis Positioning” switch is displayed.

Setting is enabled by turning POWER OFF and ON.

* Positioning types may not be displayed depending on the machine.

Fig. III.3.62

The alarms and warnings automatically displayed are listed in "V. MAINTENANCE AND ALARM LIST" and "2. LIST OF ALARMS".

- PLC Related Alarms
- Operation Alarms
- Stop Alarms
- Servo Alarms
- MCP Alarms
- Other Servo Alarms
- System Alarms
- System Warning

1. **If the machining viewer switch is ON, the alarm automatic display becomes invalid regardless of "Alarm auto display".**
2. **When the alarm dialog appears automatically with “Screen off” switch ON, "Screen off" switch is turned OFF to prioritize the alarm auto display.**

18) Screen Saver

By turning ON the screen saver, the screen turns OFF automatically after no operations on the manual operation box and the screen have been performed for the time set in "Waiting time".

(2) 2DCAM Setting

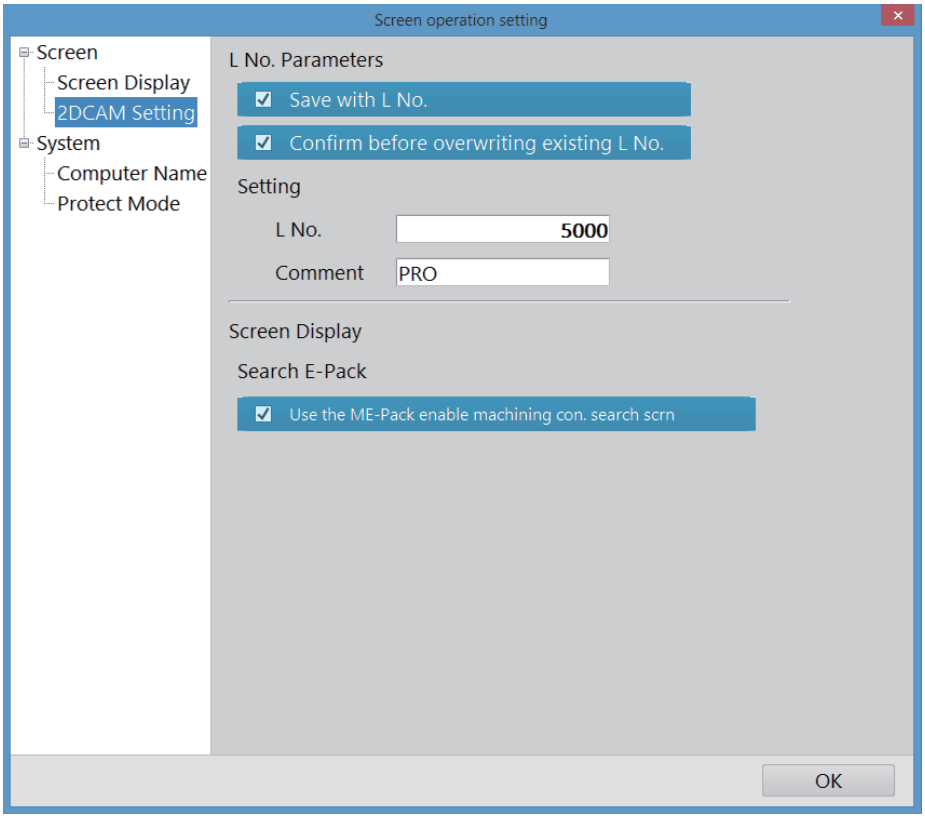


Fig. III.3.63

1) Save L No.

When the NC program generated through 2DCAM is transferred to the detector or monitor, switch the L No. registration and file name registration according to setting of "L No. registration" ON/OFF as shown below.
L No. registration ON: saves the NC program as L No.
L No. registration OFF: not saved as L No., but output to any folder as a file.

2) Confirm before overwriting existing L No.

If the L No. to be saved already exists, a confirmation message for overwriting appears. When multiple L numbers exist, the "Confirmation of overwriting" window displays all the duplicated L numbers. When OFF is set, the number will be overwritten directly without confirmation.

(3) System

1) Computer name

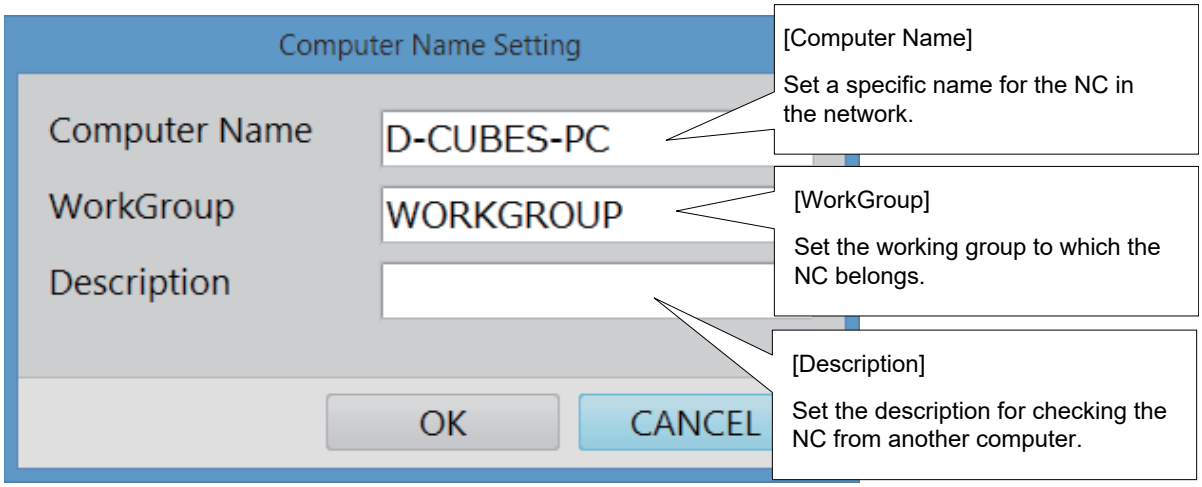


Fig. III.3.64

1. **The set computer name cannot exceed 15 characters.**
2. **The computer name can consist of numbers from 0 to 9, uppercase letters, lowercase letters, and hyphen (-).**
3. **The computer name cannot consist of numbers only, and cannot contain spaces. Additionally, the special characters below cannot be used in the computer name: < > ; : ” * + = ¥ | ? ,**

2) Protect Mode

Prohibits editing of the NC programs, machining conditions (current conditions) and variables, and limits data input from and output to a removable disk. Limitations are specified by pressing the "Setting" button.
Press the "Protect Mode" switch, and authenticate the USB flash memory attached to the machine to enable this function. The switch will change to ON.
Press the "Protect Mode" switch, and authenticate the USB flash memory attached to the machine to disable this function. The switch will change to OFF.
To use this function, the USB flash memory enclosed with the machine is required. Note that commercially-available USB flash memories or USB flash memories enclosed with other machines cannot be used.

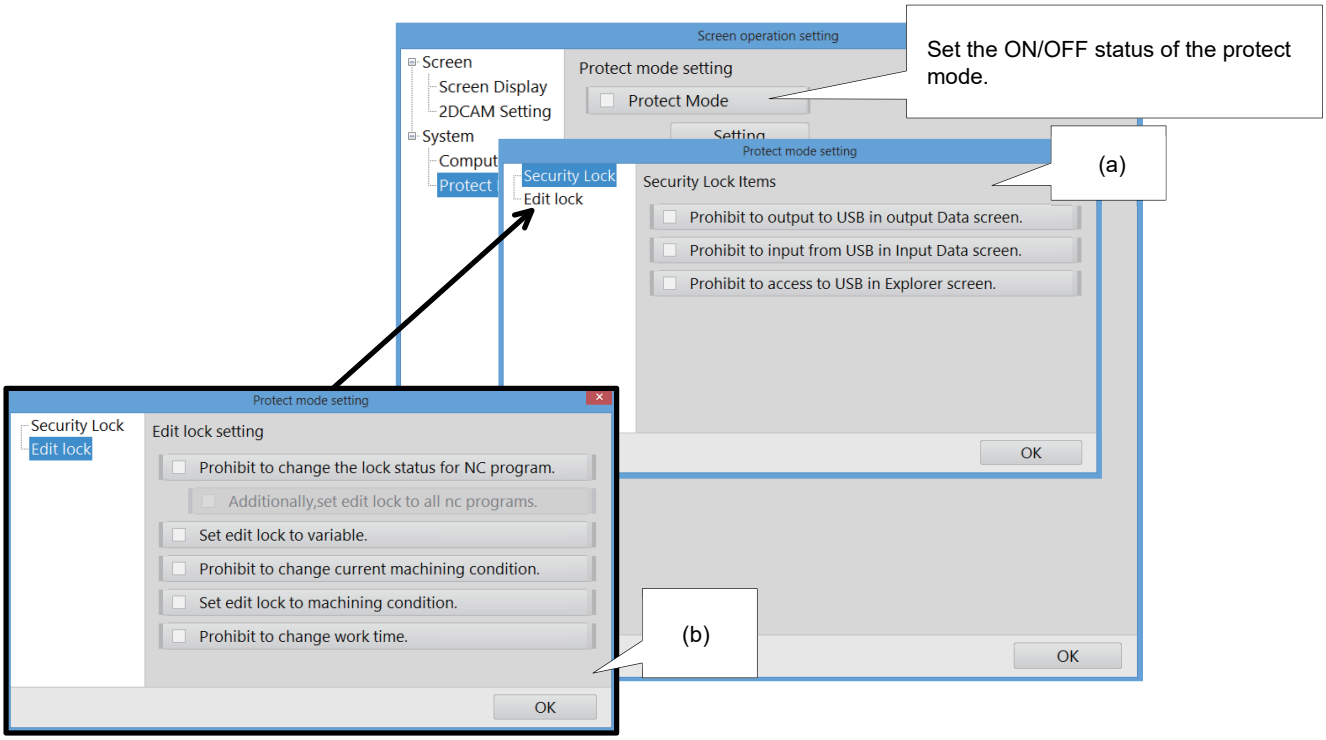


Fig. III.3.65

(a) Security Lock

Set the items that restricting data input and output through a USB flash memory.

(i) Prohibit to output to USB in output Data screen.
Disables output of the NC program to a USB flash memory. When the protection mode function is enabled, pressing START displays the alarm message. "Protect mode is effective. Please inquire to your machine manager".

(ii) Prohibit to input form USB in the file I/O screen.
Disables the input of the NC program from a USB flash memory to the machine through "Initial setting" > "System update" > "Input to display". When the protection mode function is enabled, pressing START displays the alarm message. "Protect mode is effective. Please inquire to your machine manager".

(iii) Prohibit to access to USB in Explorer screen.
"REMOVABLE" is not displayed on the "Explorer" screen.

(b) Edit lock setting

Edit the edit lock status for the NC program, variables, machining conditions, and operation time.

(i) Prohibit to change the lock status for NC program.

The edit lock status of each registered NC program changes to unchangeable. The machining program with edit lock set to ON cannot be overwritten and saved. The created NC program is saved as edit lock OFF.

(ii) Additionally,set edit lock to all nc programs.

This switch can be set only when "Prohibit to change the lock status for NC program." is ON. It changes all the NC programs registered in the machine to edit lock ON. Newly created NC programs are saved with edit lock ON. Disabling the protect mode will automatically turn OFF the edit lock status of machining programs whose edit lock status has been set to ON. To set the edit lock status to ON again, select "Operation" > "Nc PRO.".

For how to set it again, see "III. NC OPERATION DISPLAY SCREEN" > "4.3 Program".

(iii) Set edit lock to variable

Set common variables to the edit lock status and set so that the protect mode cannot be canceled. For setting edit lock to common variables, see "III. NC OPERATION DISPLAY SCREEN" > "1.2.3 Overlap menu".

(iv) Prohibit to change current machining condition

Make the current condition displayed in "Monitor" > "Crnt E" or "Home" > "Servo Volt" not editable through the screen operation.

(v) Set edit lock to machining condition

When this switch is ON and the protect mode is enabled, the edit lock status of the machining conditions (E-Pack) is turned ON, and releasing the edit lock status is prohibited.

(vi) Prohibit to change work time

It changes to the effect that operation time management cannot be reset.

3.2.10 Communication setting

(1) Communication

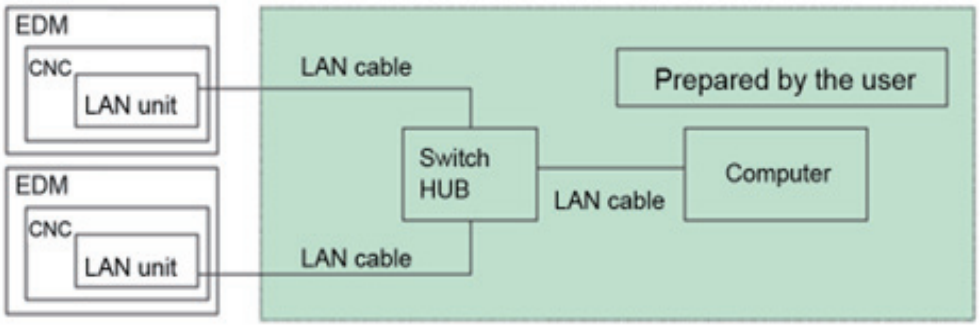
1) Network Setting

It aims to perform network settings for the machine. Perform settings according to the steps below.

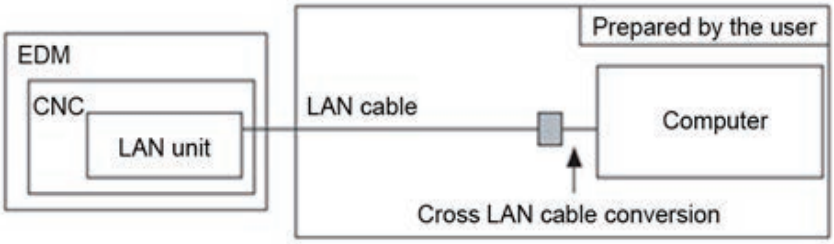
(a) LAN connection of machine

The connection method between the EDM and host is described below.

■When multiple EDMs and computers are connected.



■When one EDM is connected with one computer.



LAN cable specification (make sure to use the cable complying with the following specs)

- Cable of straight full connection type and equipped with a shielded coupler
- Cable compatible with the category-5 cable standard (100BASE-TX compatible)
- STP (4 shielded twisted pairs) cable

HUB specification

- Use a switching HUB (compatible with shielded LAN cable).
- Use a HUB with an AC100V cable (with grounding) power supply.

Do not use a HUB with a DC-IN (AC100V adapter) input power supply,
otherwise it will cause radio interference and lead to malfunction.

* It is recommended to use "FS708XL" produced by Allied Telesis or a compatible model.

(b) Calling the network setting screen

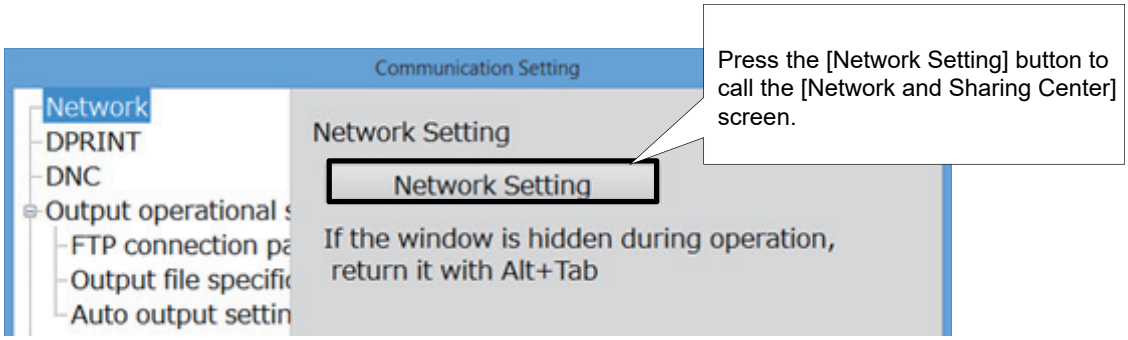


Fig. III.3.66

(c) Network and Sharing Center

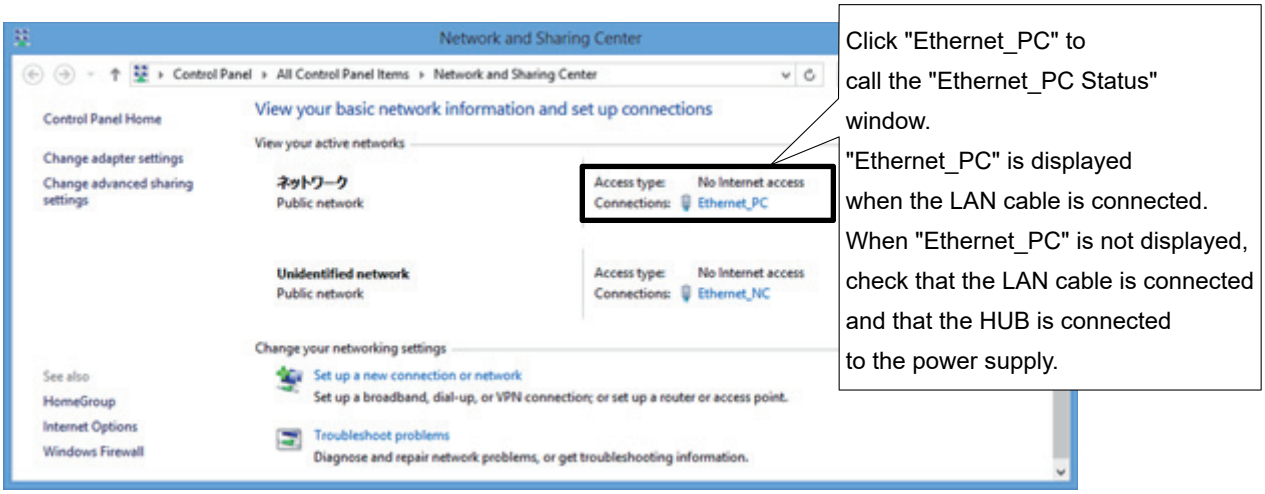


Fig. III.3.67

1. **Click [Ethernet_PC] only; changing other settings may cause malfunction. .**
2. **For network connection:**
   - **Keep the EDM grounded. See “Grounding” in this manual.**
   - **Power the HUB from the factory power socket, not the machining power supply.**
   - **Keep network devices about 5 m from the EDM**
3. **Reduce infection risk by blocking exe execution and USB auto-run. C-FAST may still be infected via network, causing slow screens, file deletion, malfunction, or C-FAST replacement. Do not install general antivirus on the machine; it may slow processing and disrupt operation. Protect connected network PCs instead. The optional machine-specific virus prevention function is recommended.**
4. **When accessing the common drive (C-FAST) from an external PC, enter:**
   Username: D-CUBES
   Password: edm

(d) Ethernet_PC Status > IP Address Setting

Click "Properties" and call the "Ethernet_PC Properties" screen.

Select "Internet Protocol Version 4 (TCP/IPv4)", click "Properties" and set the IP address.

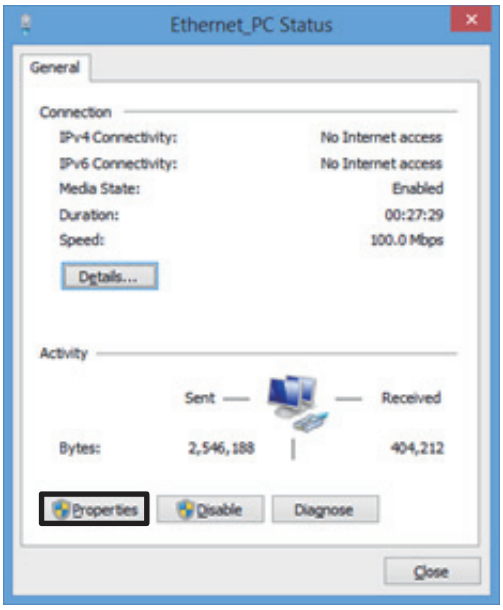


Fig. III.3.68

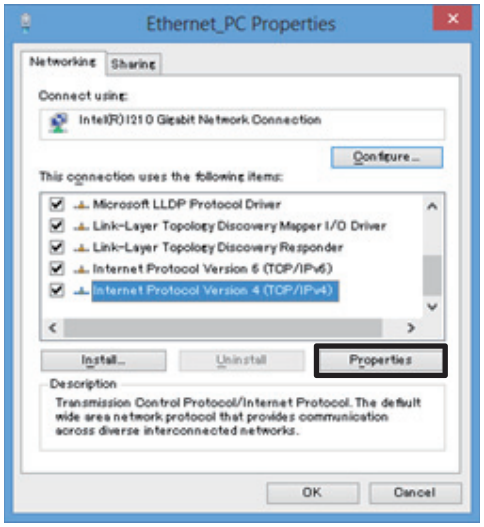


Fig. III.3.69

Do not set "192.168.100.*" to IP address of "Ethernet_PC".**
It is the same way when the IP address is obtained automatically. The machine may not operate properly.

2) DPRINT

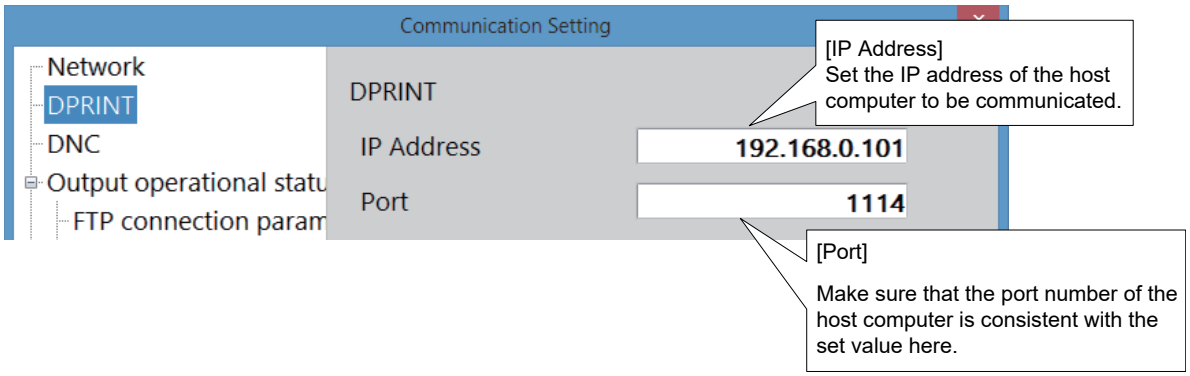


Fig. III.3.70

3) DNC

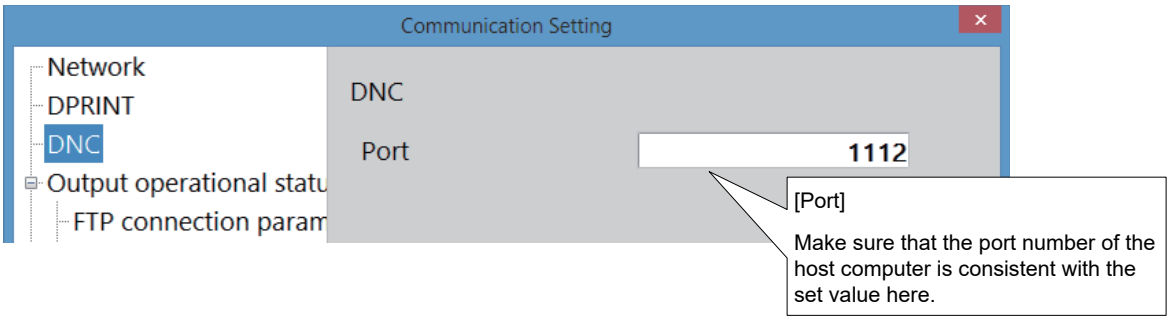


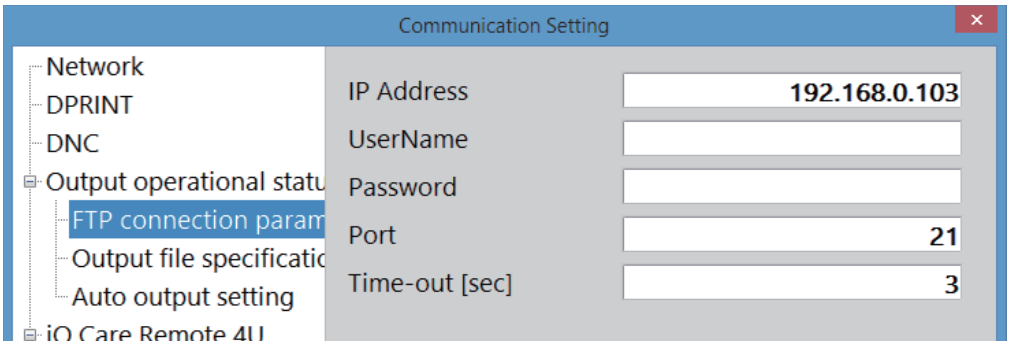
Fig. III.3.71

(2) Output operational status

Perform various settings used to output the machine running status to any folder.

1) FTP connection parameters

Set the necessary parameters for the EDM end when FTP is used.



(a) IP Address

Set the host's IP address.

(b) UserName

Set the user name used to log in to the host.

(c) Password

Set the password used to log in to the host.

(d) Port

The default value is 21. Usually it does not need to be changed.

(e) Time-out [sec]

Set the connection timeout time. Usually it does not need to be changed.

2) Output file specification

Set the output data saving path.

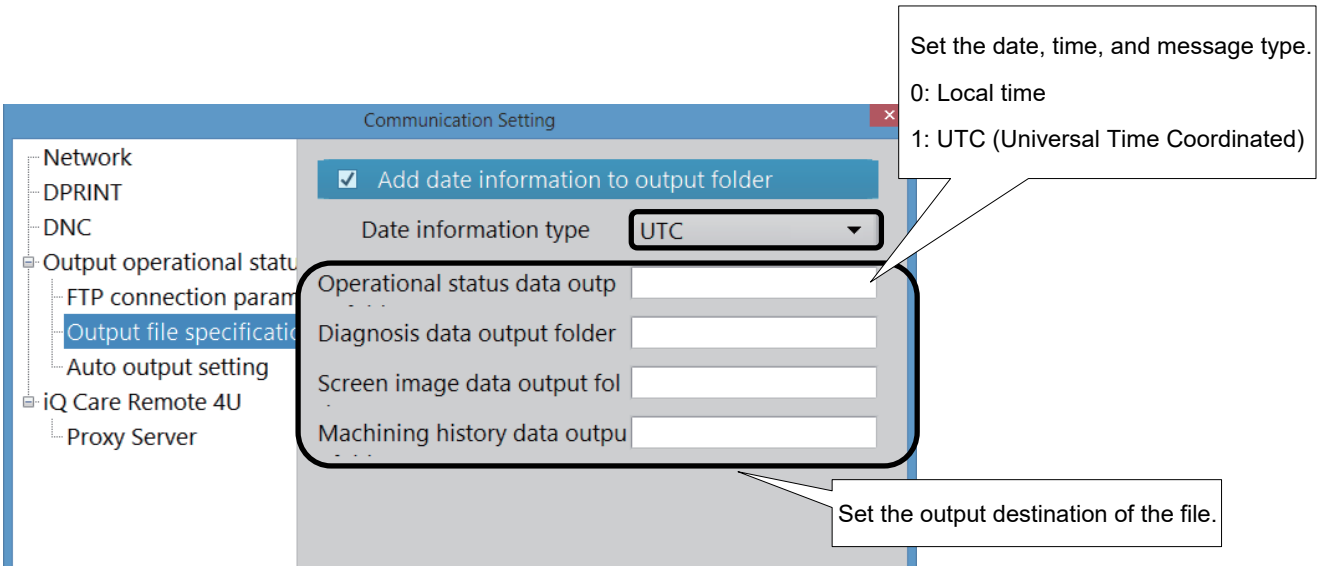


Fig. III.3.72

3) Auto output setting

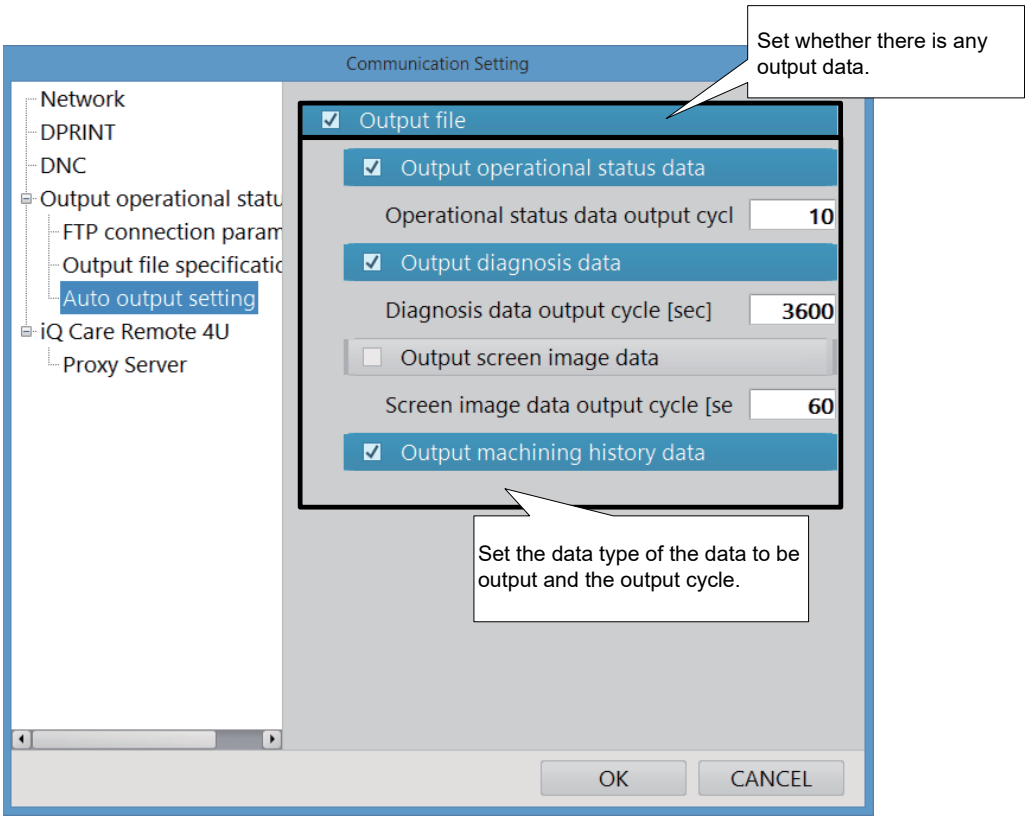


Fig. III.3.73

(3) iQ Care Remote4U

1) Proxy Server

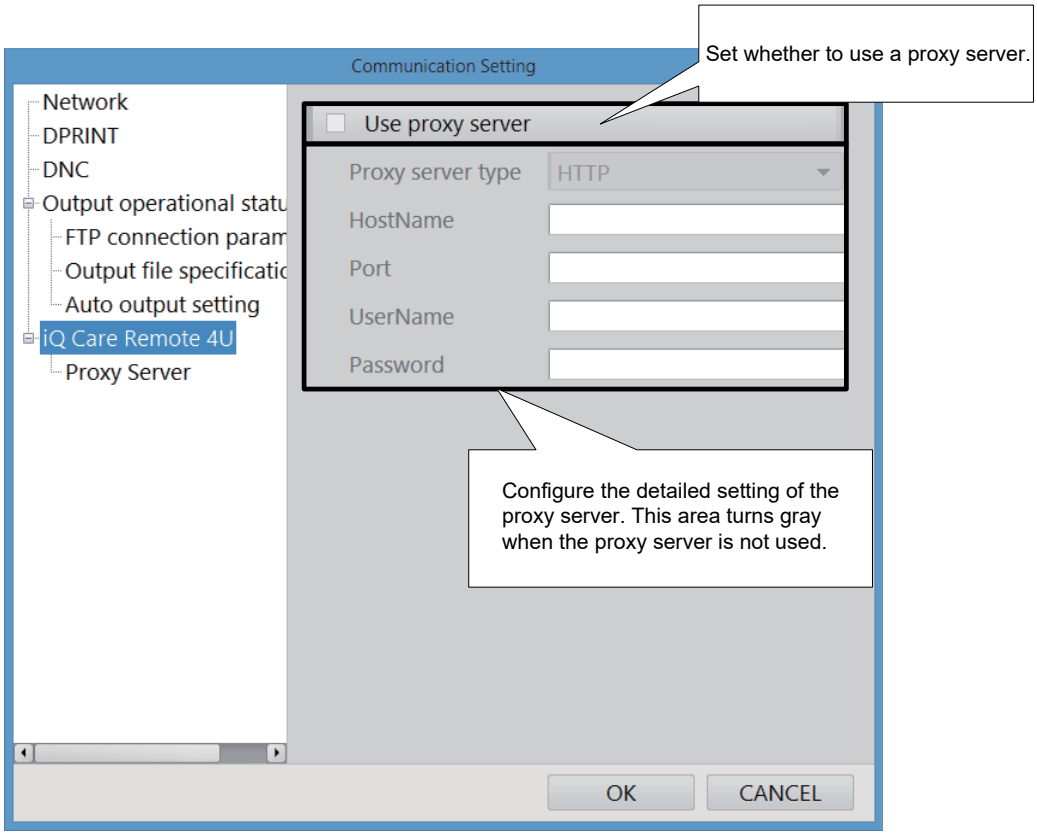


Fig. III.3.74

2) Email notification setting

Perform settings related to mail notification of iQ Care Remote4U.

(a) Basic Information

Perform related settings when the machining status is notified through a mail on iQ Care Remote4U. It is possible to set whether the sent mail is available, recipient (To, Cc), machine name displayed in mail, etc.

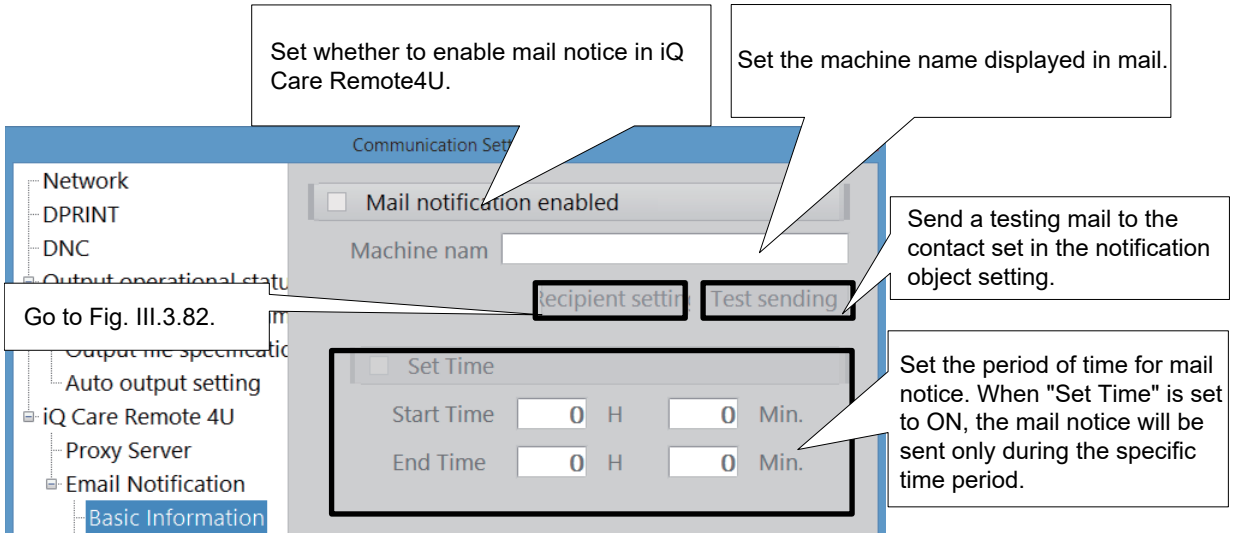


Fig. III.3.75

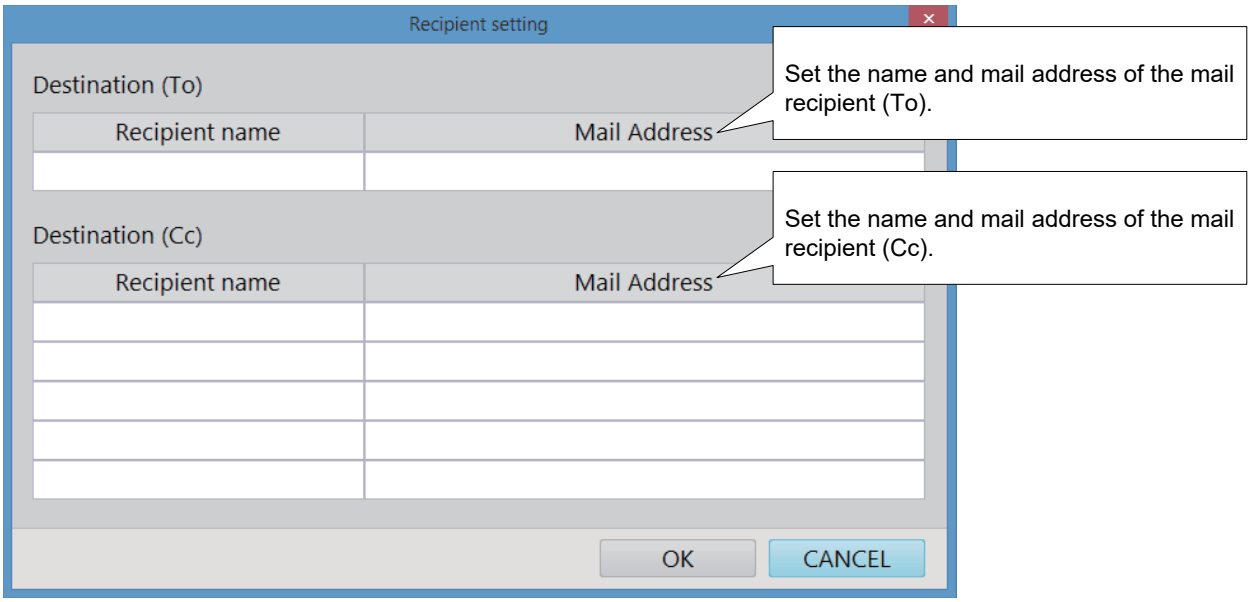


Fig. III.3.76

(b) Notice Condition

Configure the setting for notifying the machining status and other conditions through a mail on iQ Care Remote4U.

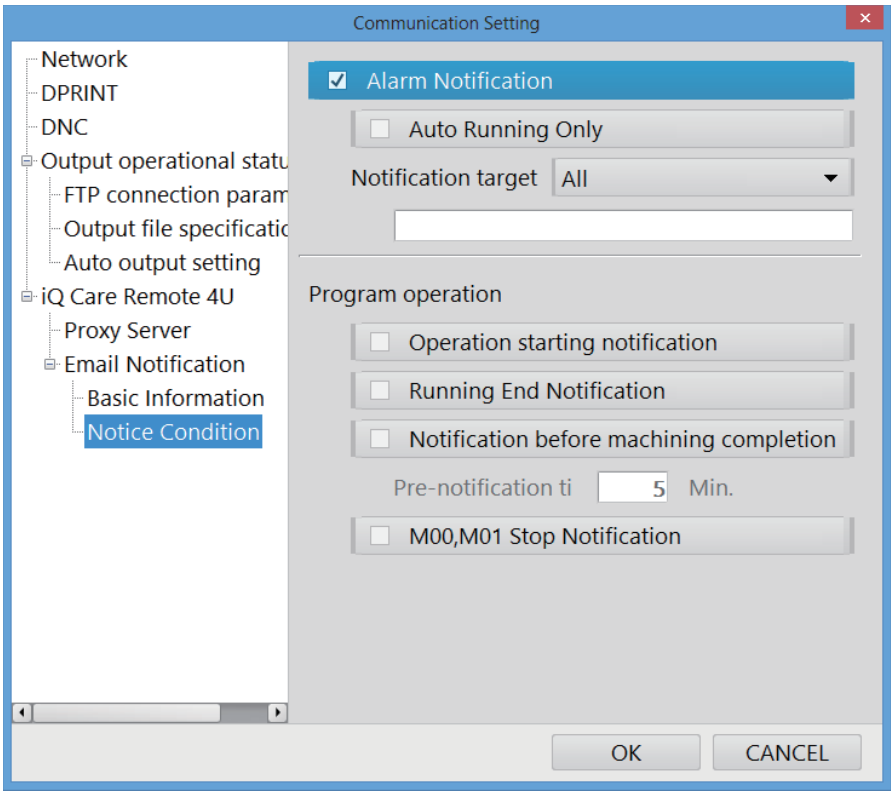


Fig. III.3.77

(i) Alarm Notification

A notification mail is sent at alarm occurrence when the above "Alarm Notification" switch is set to ON.

(ii) Notice timing

Set the time of sending a notification mail when the above "Alarm Notification" switch is set to ON.

(iii) Notification target

Set the alarm used as a notification mail sending object.

When an independent alarm number is set, enter the alarm number directly in the lower window. For the alarm detail, see "V. MAINTENANCE AND ALARM LIST".

Enter the alarm range according to the following format when "1. Specified" or "2. Unspecified" is selected in the notification object alarm and the alarm range is specified.

UOO-UΔΔ

(iv) Program operation

The time of sending a notification mail during program running can be set.

For "Notification before machining completion", enter the advance notification time in the lower window.

3.2.11 Machining setting

(1) P-Ctrl

Confirm the setting content of adaptive control, and manually set the adaptive control function.

1) Standard

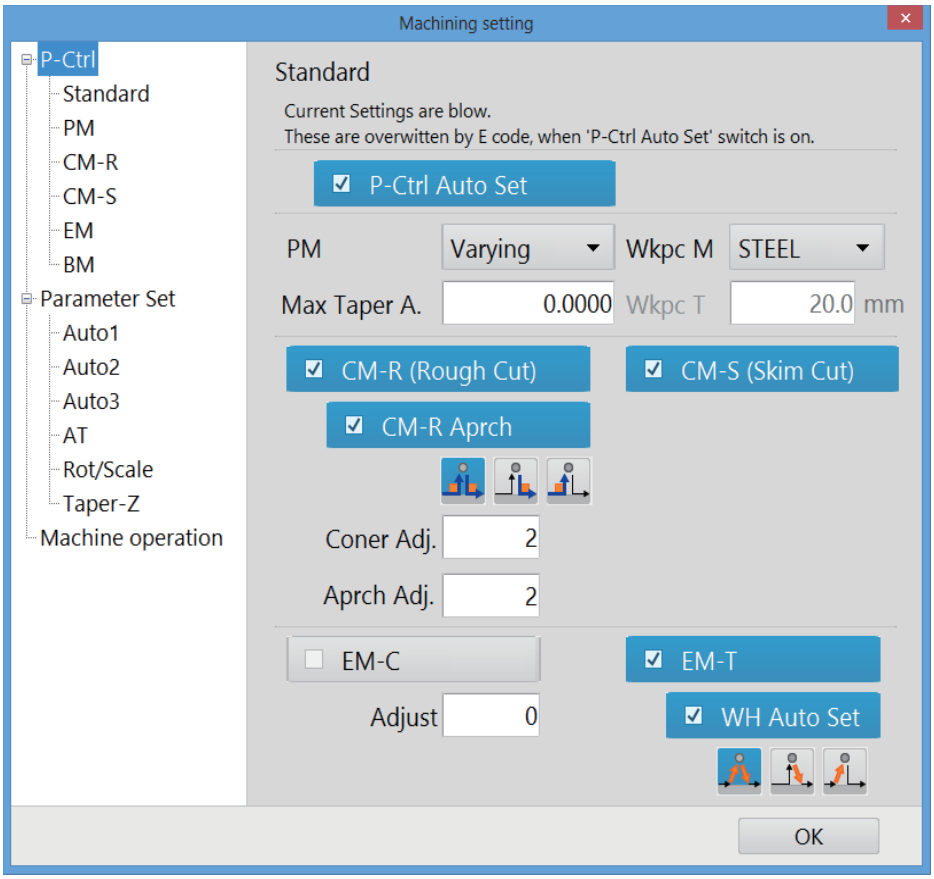


Fig. III.3.78

(a) P-Ctrl Auto Set

When the switch is set to ON, running is based on adaptive control of E-Pack. When adaptive control has been registered in E-Pack beforehand, set the switch to ON before use.

(b) PM

Select the PM control mode.

(c) Wkpc M/Wkpc T

Set the workpiece material and enter the thickness. The minimum unit of thickness is 0.1 mm.

(d) Max Taper A.

Increase of taper angle may lead to unstable machining. To ensure stable machining in this case, enter the maximum taper angle used in machining (not related to movement path and A command).

(e) CM-R (Rough Cut)

Turn ON to improve the corner precision during rapid cutting. The control of approach section can be selected from the three modes: Simultaneous control of inlet/outlet , Inlet only , and Outlet only . When the approach enabling switch is set to OFF, the control of approach section is not enabled.

(f) Corner Adj./Aprch Adj.

The CM-R mode can be selected according to the set content of [PM], [W.Dia/Mat], [Wkpc M], and [Wkpc T]. When it cannot be selected, speed priority setting is fixed. The trajectory will be changed to implement corner droop compensation in speed priority setting, so the machining speed will not be reduced.

(g) CM-S (Skim Cut)

Turnon to improve the corner precision after second cut. The control of approach section can be selected from the three modes: Simultaneous control of inlet/outlet , Inlet only , and Outlet only . When the approach enabling switch is set to OFF, the control of approach section is not enabled.

1. In CM-R/CM-S, the NC program is pre-read to detect corners. If execution differs from the pre-read content, a "Pre-read inconsistency" alarm may occur. This can happen if, after program start, you:
(1) Switch BLK.DELETE when the program contains delete segments.
(2) Change variables that affect execution.
(3) Change offset, taper angle, or Z1–Z5 settings.
(4) Edit the program
2. For CM-R/CM-S control, correctly set wire diameter, wire type, workpiece material, and thickness.

(h) EM-C

The EM-Pack control is enabled when this switch is set to ON.

(i) EM-T

The EM trajectory control is enabled when this switch is set to ON. EM trajectory control can be selected from the three modes: Simultaneous control of inlet/outlet , Inlet only , and Outlet only . When the WH automatic setting switch is set to ON, the automatic calculation of the EM trajectory according to the wire diameter and offset will be set.

2) PM

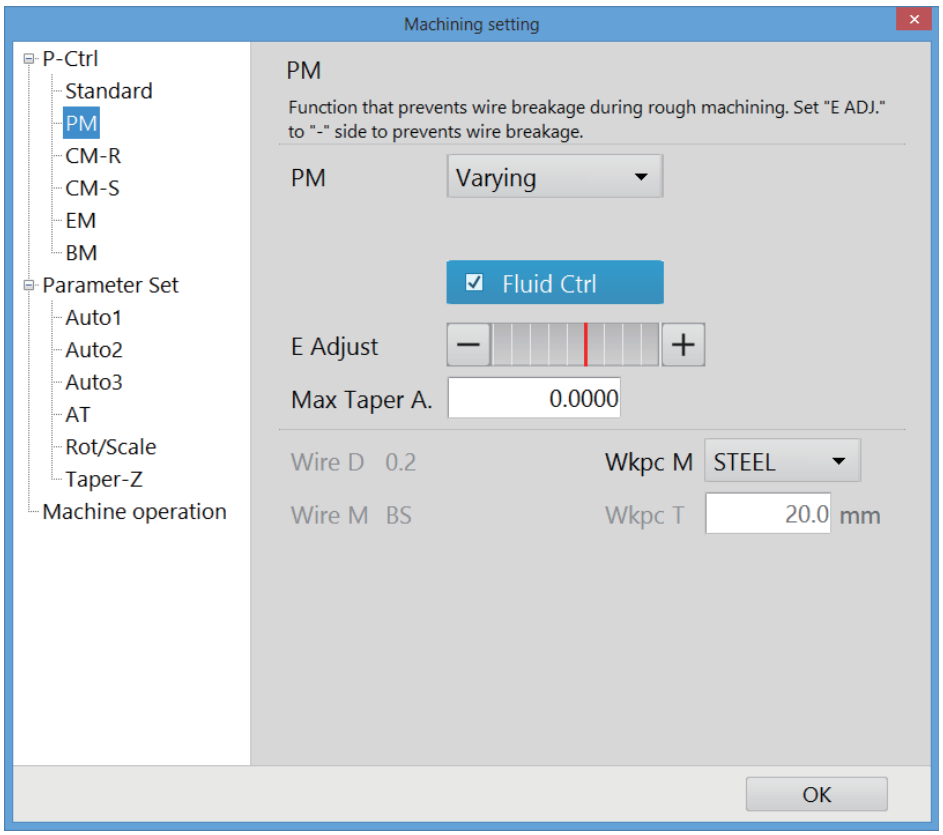


Fig. III.3.79

(a) PM

Select the PM control mode.

(b) Fluid Ctrl

Set the dielectric fluid flow control, when the segment difference machining and other dielectric fluid statuses easily become unstable to automatically control the segment difference position.
Remove the check mark if a strong dielectric fluid pressure is needed in machining of the board thickness above 200 mm.

(c) E Adjust

Set the notch used to adjust the machining speed. It indicates the standard speed when 0 is selected. Notch 0 is restored by executing Reset, M02 and M30.

(d) Max Taper A.

See above.

(e) Wkpc M

Select material of the workpiece to be machined.

(f) Wkpc T

Enter the workpiece thickness. The minimum unit of thickness is 0.1 mm.

3) CM-R

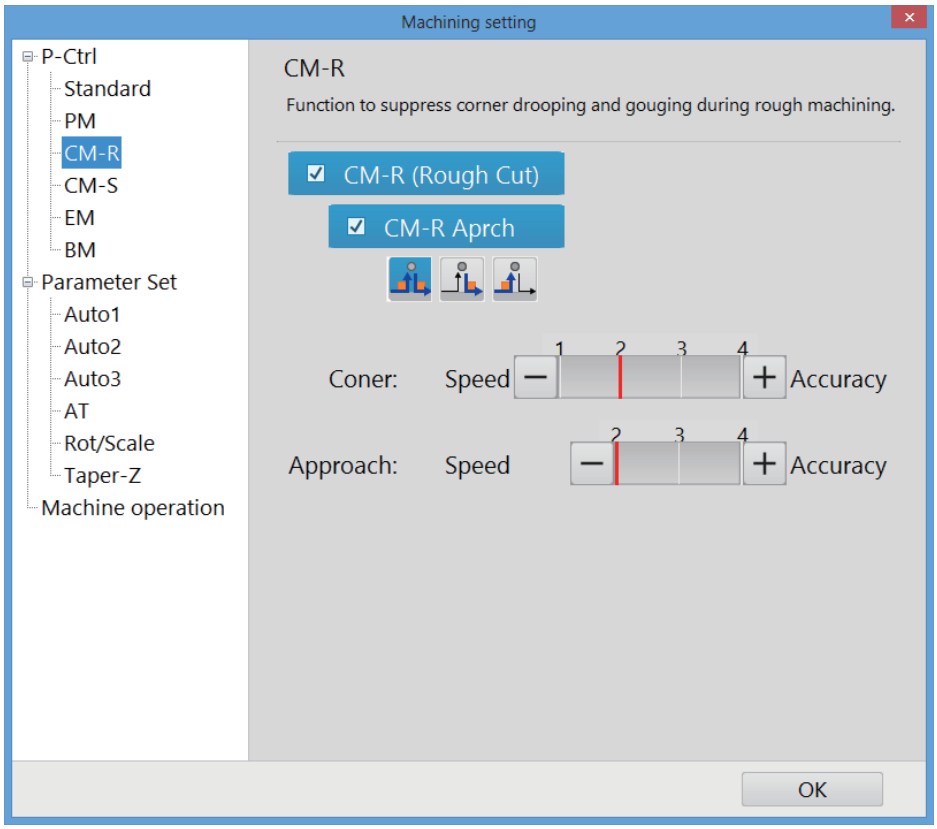


Fig. III.3.80

(a) CM-R (Rough cut)

Turn ON to improve the corner precision during rapid cutting.

(b) CM-R Approach

Additionally, the control of approach section can be selected from the three modes: Simultaneous control of inlet/outlet , Inlet only , and Outlet only . When the approach enabling switch is set to OFF, the control of approach section is not enabled.

(c) Speed-Accuracy

CM-R mode selection depends on [PM], [W.Dia/Mat], [Wkpc M], and [Wkpc T]. If unavailable, speed priority is fixed. In speed priority, the trajectory changes to apply corner droop compensation, so machining speed is not reduced. Precision priority increases corner precision but reduces speed.

4) CM-S

Turn ON to improve the corner precision after second cut.

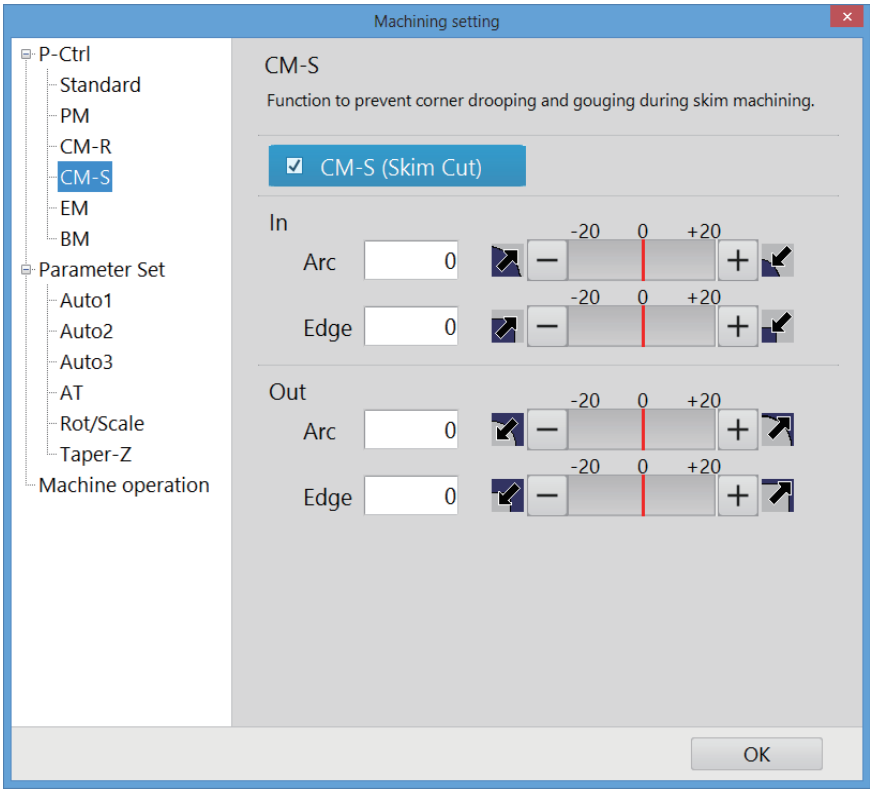


Fig. III.3.81

5) EM

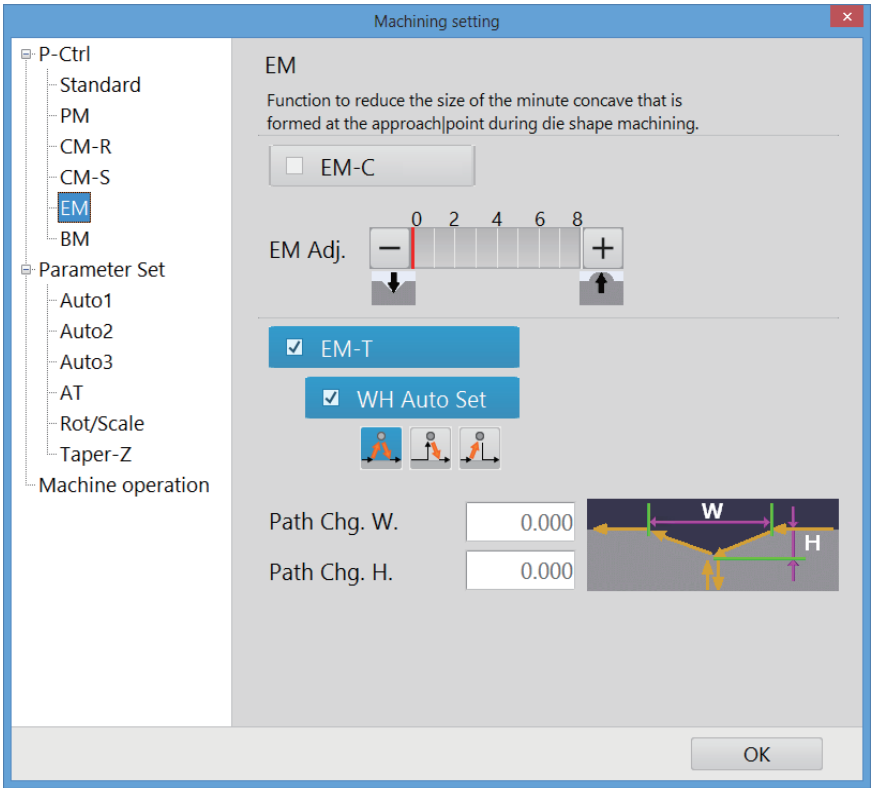


Fig. III.3.82

(a) EM-C

After selecting this option, press "OK" to enable the EM-Pack control function.

(b) EM Adj.

EM-Pack control can be adjusted.

(c) EM-T

After selecting this option, press "OK" to enable the EM trajectory control function.

(d) Path Chg. W. and Path Chg. H.

Set the trajectory change in EM trajectory control.

6) BM

The BM function is enabled when the switch is set to ON.

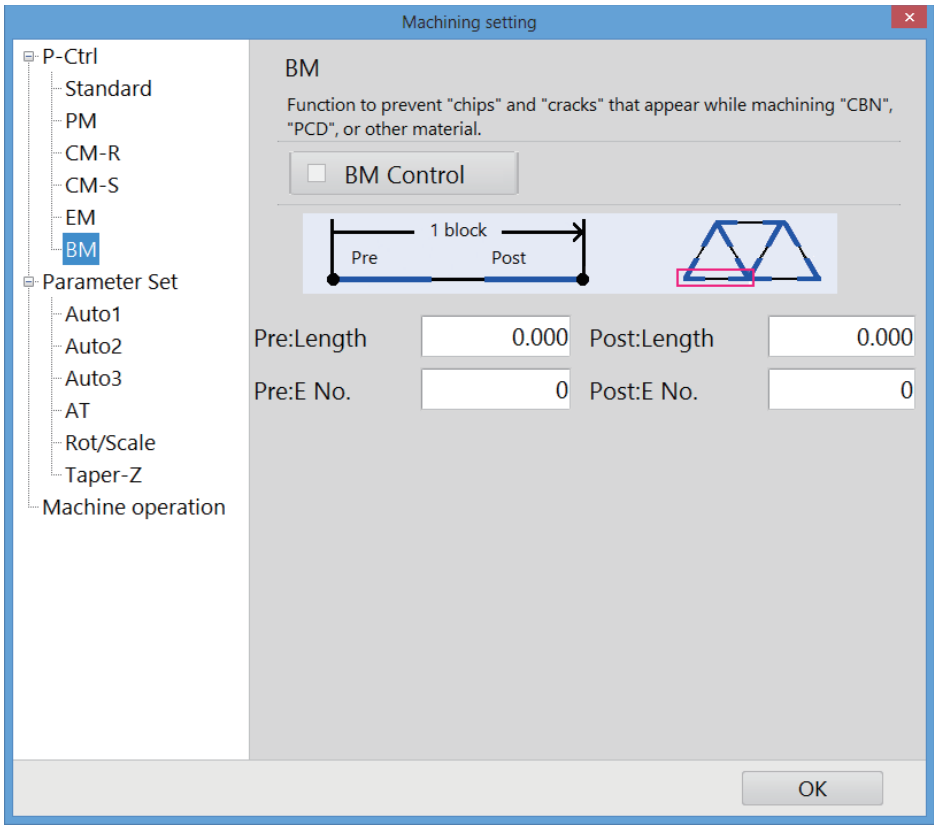


Fig. III.3.83

(2) Auto1

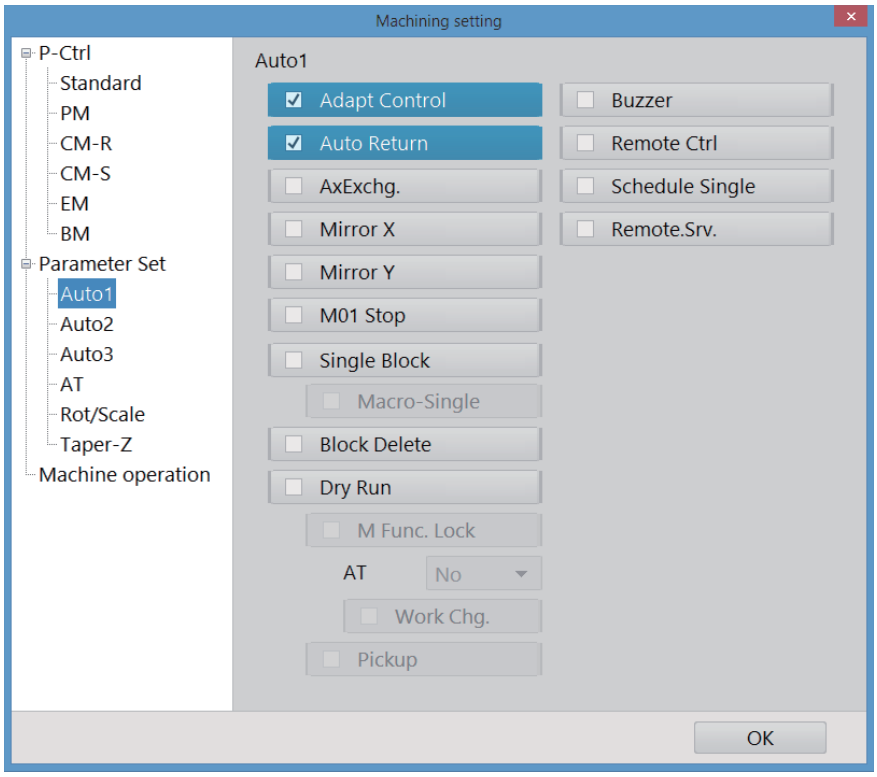


Fig. III.3.84

1) Adapt Control

When ON, selects feed speed automatically based on electrode conditions.

2) Auto Return

When ON, enables automatic return to the original position.

3) AxExchg.

When ON, executes the program with X and Y axes exchanged.

4) MirrorX

Used when X axis mirror is set.

5) MirrorY

Used when Y axis mirror is set.

6) M01 Stop

When ON and an M01 is read, the next block is not read and machining and dielectric fluid stop.

To restart, press the control switches in sequence , , and .

7) Single Block

When ON, stops after each motion block.

8) Macro-Single

When ON, executes non-motion blocks one by one.

9) Block Delete

When ON, ignores blocks starting with “/”.

10) Dry Run

When ON, ignores F in the program and uses the F value from the operation screen.

11) M Func. Lock

When ON, locks M codes except M00, M01, M02, M91.

12) AT

Effective only if M Func. Lock is ON and preset during dry run.

■ In the case of "Test"

- M20 (Wire insert)
  It is replaced with M22 (connection test) during running.
- M21 (Wire cut)
  During running, it is replaced with return operation after the cutting hob, cutting energizer or cutting energizer presser extrudes.

■ When "Stop" is pressed

- Use M20 and M21 to stop.

■ When "No" is pressed

- M20 and M21 are ignored.

13) Work Chg.

When this option is preset during dry running, the M53 and M54 commands in the program will be executed. It will be valid if "M Func. Lock" is set to ON.

*** AWC refers to the automatic workpiece exchange device. (Optional)**

14) Pickup

When this option is preset during dry running, the G29, G30 and G78 commands in the program will be executed. It will be valid if "M Func. Lock" is set to ON.

The switch cannot be operated when the program is running or stopped (except during M0 and M01 stops).

15) Buzzer

When ON, the buzzer sounds for 5 seconds at machining start. After it stops, Start turns on the LED indicator.

16) Remote Ctrl

Shown only when the DNC option is ON. When ON, enables NC remote control from a PC with DNC software (“RESET”, “MANUAL/AUTO”, “FLUID TREATMENT”, “START/STOP”). See "III. NC OPERATION DISPLAY SCREEN" > "7.1 DNC".

17) Schedule Single

When ON, the running scheduler stops automatically at end. Use to correct the next NC program. Press START to resume.

18) Remote Srv.

Shown only when the DNC option is ON. When ON, enables NC remote control from a PC with DNC software. See "7. EXPANSION" > "7.1 DNC".

(3) Auto2

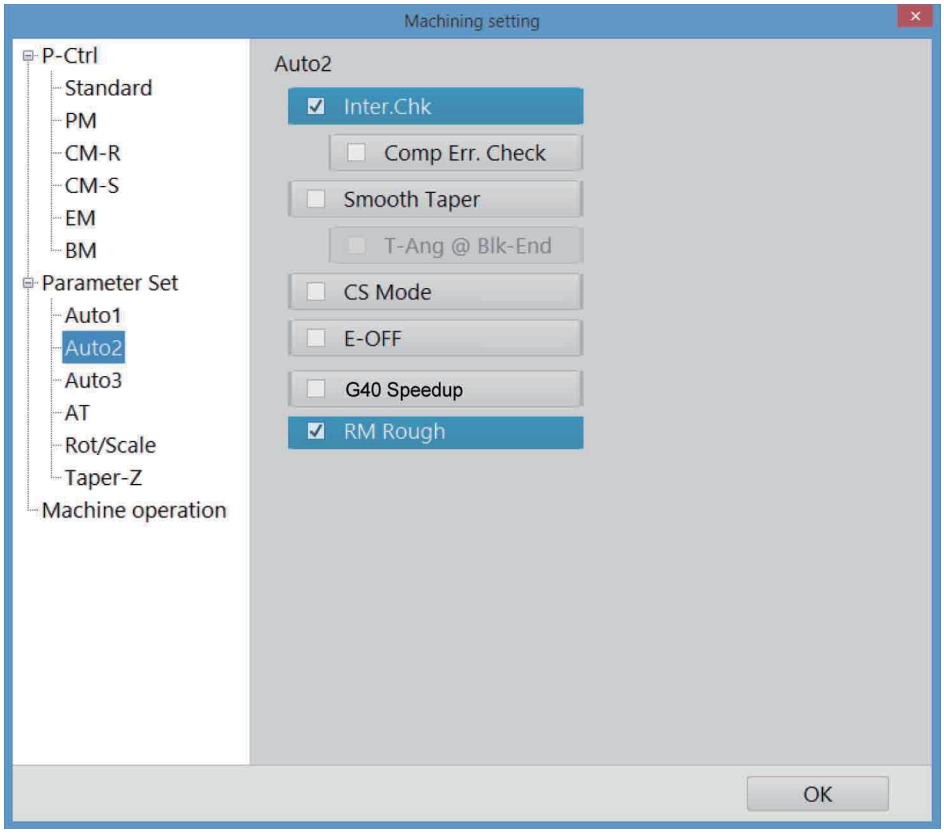


Fig. III.3.85

1) Inter.Chk

Select "Inter.Chk" and press "OK". Then, cut-in occurring in three program segments is prevented in the moving program segment in the offset mode (G41 and G42). When cut-in occurrence is detected actually, different operations shown below will be executed according to different states of the "Comp Err.Check" switch.

- When "Comp Err. Check" is ON (checked)
  It will stop on an alarm.
- When "Comp Err. Check" is set to OFF (not checked)
  After the interference check function is used to replace the trajectory, the NC program is executed continuously to prevent occurrence of cut-in.

2) Smooth Taper

Check "Smooth Taper" and press "OK". The angle changes gradually through control when the taper is changed. On such a basis, the "T-Ang @ Blk-End" switch is used to determine the taper change opportunity as follows.

- When "T-Ang @ Blk-End" is set to ON (checked)
  Moving is conducted to ensure that the command position is reached at the end point of the program segment with a taper change command.
- When "T-Ang @ Blk-End" is set to OFF (not checked)
  Moving is conducted to ensure that the command position is reached at the start point of the program segment with a taper change command.

3) CS Mode

Used to enter CS mode, which reduces the amount of consumed wire to save costs (30% in case of rough machining on the precondition of not reducing the machining accuracy and machining speed). Note the following:

- **Set taper specification.**
- **Can only be used with provided E-Pack. (Running is based on the 1st condition: Workpiece material: Steel; Wire Diameter: BS; Wire Diameter: Ø0.2, Ø0.25, or Ø0.3)**
- **The switch ON/OFF operation cannot be performed during running.**
- **The UV axis will move according to the amount of consumed wire.**
- **The background color for the WS notch part on the current condition screen changes to green. The WS notch cannot be changed.**

4) E-OFF

To set that the machining conditions cannot be switched in the NC program, check "E-OFF", and then press "OK".

- When the "E-OFF" switch is set to ON (checked)
  The machining conditions cannot be switched in the NC program.
- When the "E-OFF" switch is set to OFF (not checked)
  The machining conditions can be switched in the NC program.

5) G40 Speedup

Check "G40 Speedup" and press "OK". The axis feed rate is increased when G40 (Cancel Offset) is read.
*** This function may not be displayed depending on the machine model and option.**

6) RM Rough

Used to implement high speed rough machining when controlling wire breaking.
Use the machine when this switch is set to ON unless otherwise instructed by the maker.

(4) Auto3

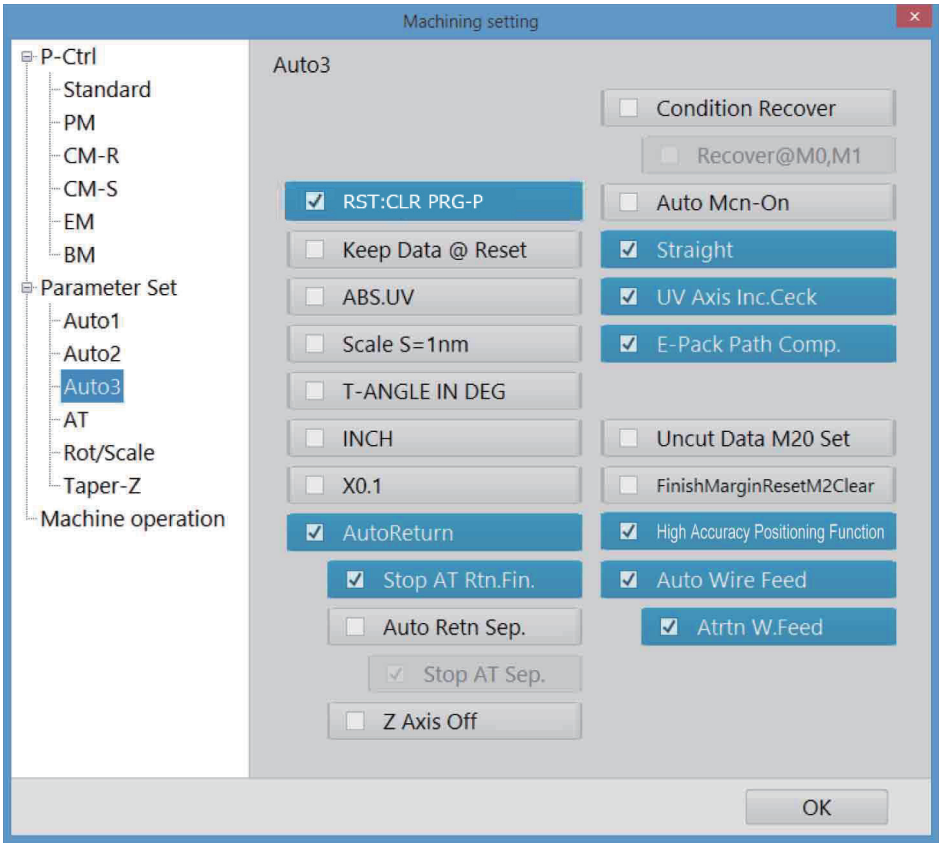


Fig. III.3.86

1) RST:CLR PRG-P

Press the RESET button

twice. Current position coordinates:

- Switch ON: Cleared.
- Switch OFF: Held value.

2) Keep Data @ Reset

- Machining speed: FA
- Taper: A
- Scale: S
- Coord. Rot: K
- Each S: SX, SY

3) ABS.UV

The UV axis moving command is read according to the following switch status:

- ON: Absolute value mode
- OFF: Relative value mode

4) Scale S=1 nm

The scale of program or picture is executed with the unit of 0.000001: S command.

The setting range depends on the following switch status:

- ON: 0.000001 to 99.999999
- OFF: 0.001 to 9999.999

5) T-ANGLE IN DEG

Taper in the program according to the switch status: An integer is taken for A, and the unit read mode in the command is shown as follows:

- Switch ON: The unit is 0.001 degrees.
- Switch OFF: The units are degree, minute and second.

For details, see "IV. PROGRAMMING".

6) INCH

When this switch is turned ON, the inch specs will be applied, and the coordinate value will be displayed as follows.

- "X0.1" switch is set to ON: 5 digits after the decimal point
- "X0.1" switch is set to OFF: 4 digits after the decimal point

When this switch is turned OFF, the metric specs will be applied, and the coordinate value will be displayed as follows.

- "X0.1" switch is set to ON: 4 digits after the decimal point
- "X0.1" switch is set to OFF: 3 digits after the decimal point

7) X0.1

When this switch is set to ON, the control unit can be set to one-tenth.

8) [AutoReturn], [Stop AT Rtn.Fin.], [Auto Retn Sep.], [Stop AT Sep.], [OverFlow Mode Rtn]

- When the [AutoReturn] switch is set to ON, after the machine changes to the stop status (including the stop status of M00 and M01) due to wire breaking during program execution and the platform is moved through manual operation, the machine will return to the automatic running stop position automatically at next startup.
- When the [OverFlow Mode Rtn] switch is set to ON after the machine changes to the stop status (including the stop status of M00 and M01), the working tank door is moved to the overflow position, turning ON the overflow mode.

  * Note: The [OverFlow Mode Rtn] switch may not appear depending on model and option.

If Z axis also moves to the automatically-stop position, and the overflow mode is returned, the operation is as below.

Auto Retn Sep. switch	Stop AT Sep. switch	Stop AT Rtn.Fin. switch	
		ON	OFF
ON	ON	During the first start, all axes except Z axis will return to the stop position. (The alarm of “T234 Z-AXIS NOT RET” will appear, and the axis will stop.) After Z axis returns with the second start, the working tank door* returns to the overflow position. (The alarm of “T230 AUTO RTN FIN” will appear, and the axis will stop.)	During the first start, all axes except Z axis will return to the stop position. (The alarm of “T234 Z-AXIS NOT RET” will appear, and the axis will stop.) After Z axis returns with the second start, the working tank door* returns to the overflow position. Then the axes will continue to execute the NC program without stop.
	OFF	During the first start, all axes except Z axis will return to the stop position. Then after Z axis returns, the working tank door* returns to the overflow position. (The alarm of “T230 AUTO RTN FIN” will appear, and the axis will stop.)	During the first start, all axes except Z axis will return to the stop position. Then after Z axis returns, the working tank door* returns to the overflow position. Then the axes will continue to execute the NC program without stop.

Auto Retn Sep. switch	Stop AT Sep. switch	Stop AT Rtn.Fin. switch	
		ON	OFF
OFF		After all axes return to the stop position during the first start, the working tank door* returns to the overflow position. (The alarm of “T230 AUTO RTN FIN” will appear, and the axis will stop.)	After all axes return to the stop position during the first start, the working tank door* returns to the overflow position. Then the axes will continue to execute the NC program without stop.

Note: When the [OverFlow Mode Rtn] switch is OFF or is not displayed, the working tank door does not move.

Additionally, when Z returns to the stop position during automatic return of division, a wire feeding command is inserted to prevent wire bending. After 5 seconds of wire feed, Z moves to the stop position.
Additionally, regardless of the automatic return of division ON or OFF, Z rises to the approach point during automatic return to avoid workpiece interference. For details, see "List of Expanded AT Functions".

- **The Z axis drops while discharging dielectric liquid. If the level cannot drop sufficiently due to fast descent, Z pauses to wait, then descends slowly according to the drop rate.**
- **To return to the automatic running stop position and continue the NC program in one startup, set "Stop AT Rtn.Fin." to OFF and "Condition Recover" to ON. If "Condition Recover" is OFF with "Stop AT Rtn.Fin." OFF, the machine does not stop at the automatic running stop position, stays machining OFF, and enters the next NC program.**
- **With [OverFlow Mode Rtn], the working tank door moves automatically up or down. Use caution.**

9) Z Axis Off

When this switch is turned ON, the Z axis does not move during automatic return. In addition, [OverFlow Mode Rtn] does not operate.

10) "Condition Recover" and "Recover@M0, M1"

(a) Summary

When ON, , , and are restored to their pre-stop states at restart, then the program continues. You only press

to turn switches that went OFF back ON automatically, and execution continues.When used with "Automatic Return", states are restored after return. The restore behavior depends on the following switch combination.

State restoring operation depending on the switch combination			
"Condition Recover" switch	ON		OFF
"Recover@M0,M1" switch	OFF	ON	
Start after stop using the START button	○	○	×
Start after stop due to an alarm	○	○	×
Start after stop due to a single program segment	○	○	×
Start after M0 and M1 stop	×	○	×

○: State restored ×: State not restored

(b) Operation Description

In the case of stop through the STOP button or due to an alarm, the state is restored after restart. The state restoring operation depends on the switch status when the START button is pressed after the program stops. Therefore, to enable when the program stops, for restoration under the OFF status during restart, set the "Condition Recover" switch to OFF after stop and then restart the machine.

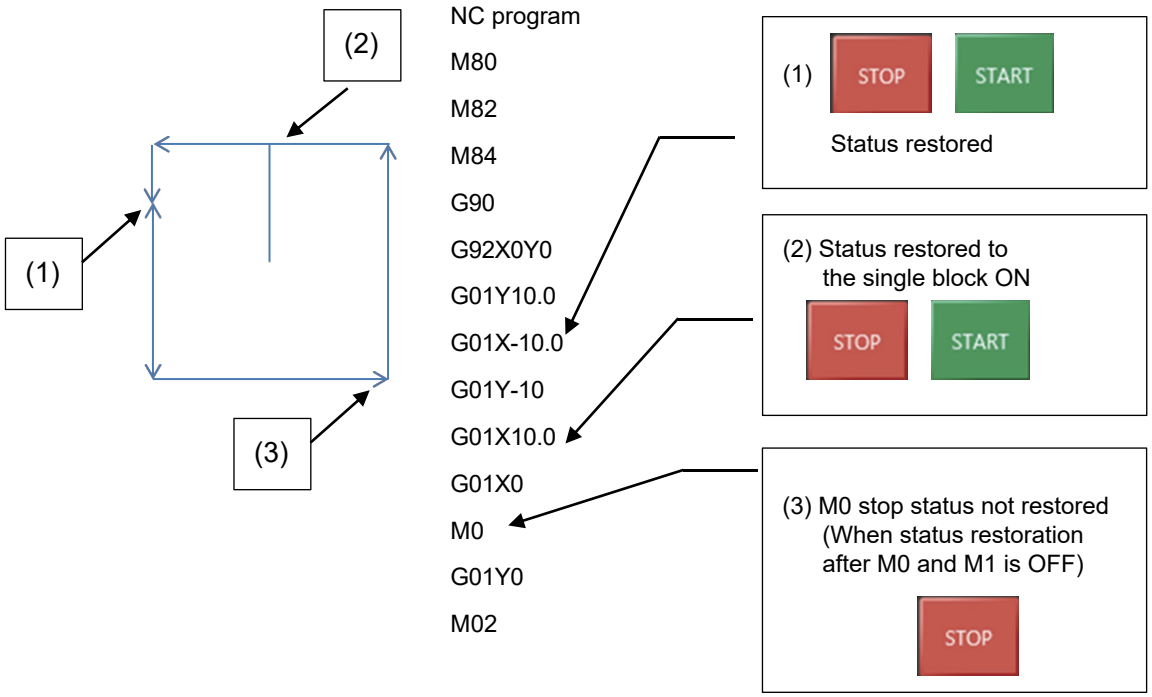
1. When the working tank is full of dielectric fluid, changes to OFF. Therefore, the system judges that is ON and performs the state restoring operation when rapid filling is being executed or has been completed. Additionally, when is set to ON and dielectric fluid is discharged downward from the table, the system judges that rapid filling is OFF and does not restore the state.

2. The restoring operation will not be performed in the following occasions even if the "Condition Recover" switch is turned ON.

- **When the RESET button is pressed**
- **When the M20 and M21 commands exist**
- **When "Dry Run", "M Func. Lock" and "AT: No" are set to ON**

3. When restarting, this function returns the status of , , , and to the status immediately before stopping. Therefore, when the M command or the operation on the operation panel is used during machining to set some items to OFF and stop the machine, the items set to OFF will not be restored after restart.

(c) Example of operation



11) Auto machining ON

Enables automatic execution of rapid fill ON, optimal feed ON, fluid ON, wire feed ON, and machining ON when G01, G02, or G03 runs in the NC program.

When ON, additional functions also run automatically per program commands. See below for details.

(a) G01, G02 and G031 commands

Execute the G01 and other commands after the optimal feed ON and machining ON operations are performed according to the sequence below.

(i) Optimal feed(M90)

(ii) Rapid fill(M78)

(iii) Dielectric fluid(M80)

(iv) Wire feed(M82)

(v) Machining(M84)

(b) G0 command

Move after machining OFF according to the sequence below.

(i) Machining(M85)

(ii) Wire(M83)

(iii) Dielectric fluid(M81)

(c) M06 command

When you do not want optimal feed ON and machining ON to run automatically with G01 and similar commands, or you want to run the program with previously ON optimal feed and machining set to OFF, use M06 even if Auto Mcn-On is ON.

M06 can be specified in a single block or across multiple blocks. See below.

(i) When specifying is expected in one program segment only

Example in G01 command

M06 G01 Xx1 Yy1 Zz1 Uu1 Vv1 Ff1

The G01, G02 and G03 commands stated in the same program segment only implement moving in situation of optimal feed OFF and machining OFF.

(ii) When specifying is expected between multiple program segments

M06P1.....Specifying the start point of interval for moving under the conditions such as optimal

:

:

M06P2.....Specifying the end point of interval for moving under the conditions such as optimal

From M06P1 to M06P2, the G01, G02 and G03 commands implement moving under the condition of optimal feed OFF and machining OFF.

M02, M30 and Reset will become interval end commands even if M06P2 is not specified.

12) Straightness compensation

Used to compensate workpiece straightness in automatic UV axis control.
When [Straight] is ON before startup, straightness compensation is enabled. The compensation amount is defined by information tables CC and T in the machining conditions. You can view and set tables CC and T on the machining condition screen.

- **Be sure to set Z1. Confirm other Z parameters. The machine cannot operate normally without Z parameter data.**
- **Switch ON/OFF cannot be performed during automatic operation.**
- **If information tables CC and T have no values, this switch has no effect even when ON.**
- **Information table CC uses 0.1 μm units; information table T uses mm.**

13) UV Axis Inc.Ceck

When ON beforehand, checks UV axis inclination before automatic start, workpiece measurement, manual box edge positioning, and hole positioning on the SETUP screen. If inclined, an error is reported. Perform UV axis origin return on SETUP → ZERO POINT RETURN, then retry.
During automatic operation, startup does not occur when the workpiece alignment switch is ON.

14) E-Pack Path Compensation

Compensates wire position micro displacement from tension changes between rough and finish machining to improve surface precision. Enabled when ON and compensation is set in information tables PCX, PCY, PCU, and PCV of E-Pack or ME-Pack. Unit is 0.1 μm. Input range is -128 to 127 (-12.8 μm to 12.7 μm).

*** Set by the maker's machining conditions. Turn ON during use unless instructed otherwise by the maker.**

15) Uncut Data M20 Set

When skipping occurs, it can be switched to the M20 operation during re-machining saved in the uncut data.

- Switch OFF (initial state)
  When skipping occurs, the data used for re-machining changes to stop at the M20 position. After manual connection, restart to resume the re-machining.
  Set the data when uncut skipping occurs to "1" to stop in the state column on the "Skip/Bypass Retry" tab under "Initial setting" > "Machine parameters" > "AT operation setting".
- Switch ON
  When skipping occurs, the data used for re-machining changes to M20 automatic connection. Re-machining will resume.
  Use this option when the causes leading to machining completion failure have been eliminated and automatic continuous operation can be used to perform re-machining before re-machining starts.
  Set "2" for automatic connection in the status bar on the "Skip/Bypass Retry" tab.

16) Finish margin M02 Clear

The setting of [State] finish margin amount can be selected to implement initialization through the ON/ OFF operation of the "FinishMarginM2Clear" switch.
OFF (initial state): Held value in the case of M02 and resetting.
ON: Value cleared in the case of M02 and resetting.

17) High Accuracy Positioning Function

The high accuracy positioning function can be enabled to improve the accuracy of the contact positioning function when the switch is set to ON beforehand.
The notches of WS, WT and PT used change to the values specified on the positioning parameter screen regardless of whether the switch is set to ON/OFF.
For details, see "III. NC OPERATION DISPLAY SCREEN" > "3.2.3 Pickup".
*** This function may not be displayed depending on the machine model and option.**

1. **During use, make sure that the "Pos.W Fluid On" switch is also ON.**
2. **Positioning will not be completed immediately even if the CONTACT indicator is turned on during high accuracy positioning.**
3. **Confirm the following items when the positioning accuracy is poor:**
   - **Whether there are sludge and other attachments stick to the workpiece contact surface**
   - **Whether burrs are found on the workpiece contact surface**
   - **Whether the dielectric fluid resistivity is abnormal.**

18) "Auto Wire Feed" and "Atrtn W.Feed"

Set the "Auto Wire Feed" switch to ON, and move the axis manually to the + direction of Y axis or - direction of Z axis. Then, wire feed is set to ON automatically.
When the "Atrtn W.Feed" switch is set to ON, automatic wire feed is also enabled during automatic return.

(5) AT

See "III. NC OPERATION DISPLAY SCREEN" > "3.2.8 AT operation setting" > "(3) Skip/Bypass Retry".

(6) Rot/Scale

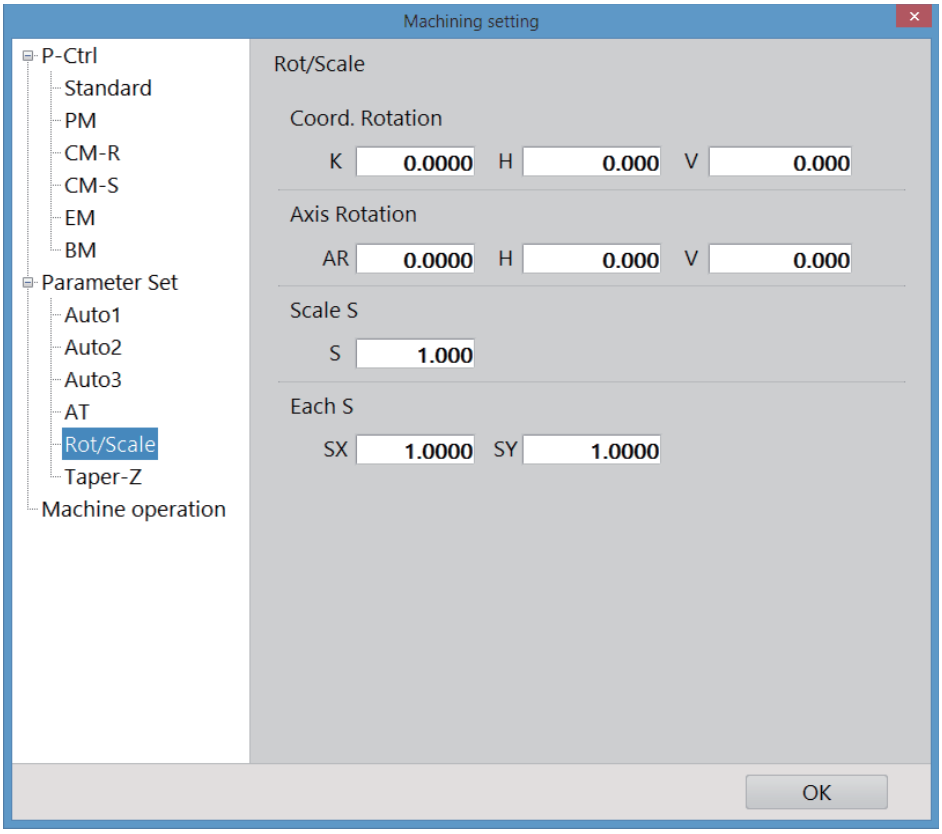


Fig. III.3.87

1) Coord. Rotation (K, H, V)

This function aims to make the graphics rotate by the specified angle as a whole.

The data range is -360.0000 to 360.0000. The counterclockwise direction indicates the positive angle, and the clockwise direction indicates the negative angle. Pressing RESET twice resets "Coord. Rotation" of the data for machining to zero. However, if the "Keep Data@Reset" switch is set to ON, the data will be held even if RESET is pressed.

- Example of using an angle to perform setting
  Set the angle to K.

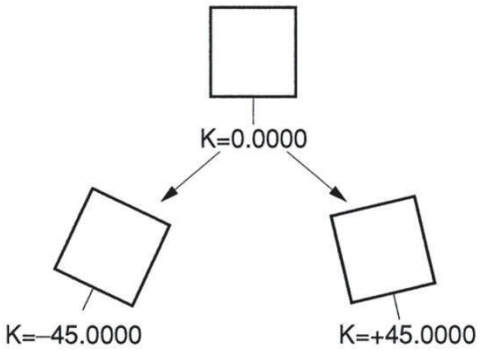


Fig. III.3.88

- Example of using a vector to perform setting
  Set vector H.V as shown in Fig. III.3.89, instead of using an angle.

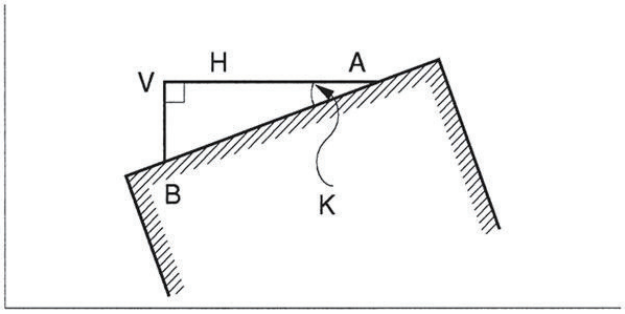


Fig. III.3.89

2) Axis Rotation (AR, H, V)

Aims to compensate workpiece inclination during installation. Enter the axis rotation angle for compensation. After compensation, check parallelism with a dial gauge. Vertical JOG feed or edge positioning can then be performed on the inclined workpiece.

Resetting cannot be performed in RESET, so enter 0 to cancel axis rotation.

The data range is -180.0000 to 180.0000.

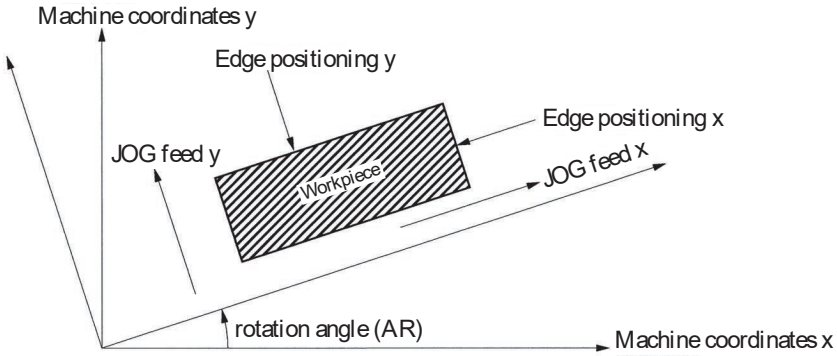


Fig. III.3.90

- **Axis rotation causes up to ±1 μm error without accumulation.**
- **Cancel axis rotation (AR, H, V) when setting the work coordinate origin.**
- **When turning Work alignment ADV ON, cancel axis rotation at the rotation set position**

3) Scale S (S)

This is used to apply a scale on the program when machining. There is no decimal point. When "1" is entered, the following values will be set according to different settings of the switch.

		"Scale S=1nm"	
		OFF	ON
VARIABLE TYPE 2 switch	OFF	0.001 (times)	0.000001 (times)
	ON	1.000 (times)	1.000000 (times)

Pressing RESET twice returns "Scale S" of the data for machining to 1 time. However, if the "Keep Data @ Reset" switch is set to ON, the data will be held even if RESET is pressed.

4) Each S (SX, SY)

Since magnification can be set independently and separately for X axis and Y axis, ellipse machining can be created through circular interpolation. Additionally, this axis magnification parameter can be used to consider the shrink size of plastic die more easily.

Pressing RESET twice returns "Each S" for machining to 1 time. However, if the "Keep Data @ Reset" switch is set to ON, the setting data will be held even if RESET is pressed.

(7) Taper-Z

Set Z1 to Z5 taper specs required for taper machining.

For details, see "III. NC OPERATION DISPLAY SCREEN" > "(1) Z1,Z2,Z5 setting" > "(2) Z3, Z4 setting".

(8) Machine operation

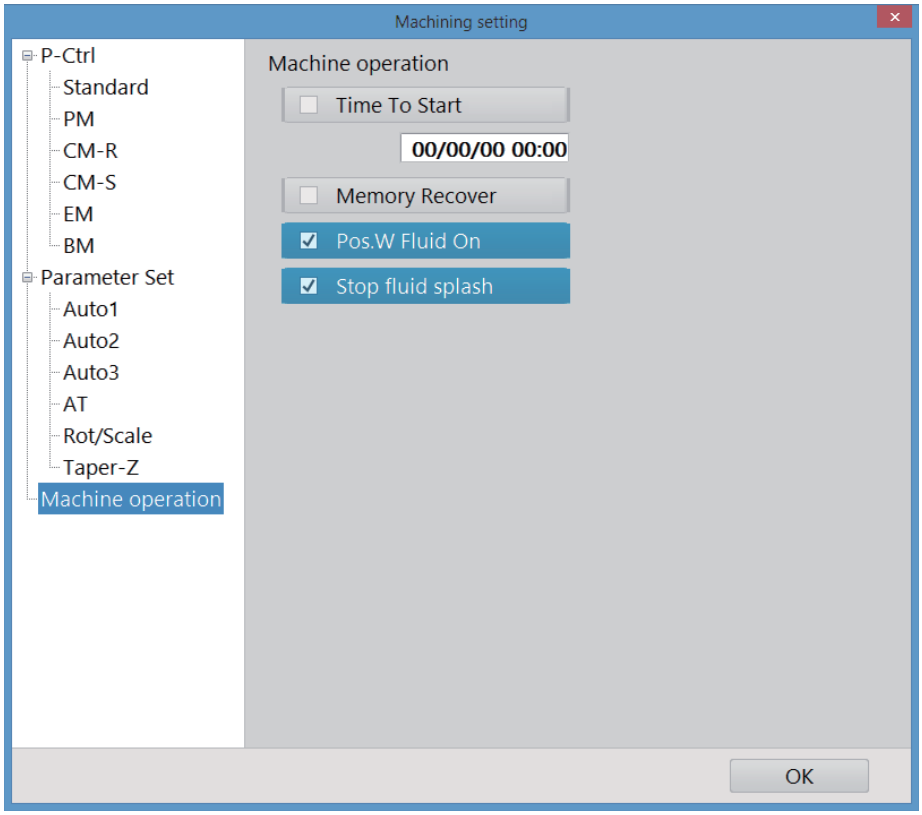


Fig. III.3.91

1) Time To Start

Sets the machining start time. At the set time, the buzzer sounds and the program starts automatically.

Example) To start at 17:30 on May 6, 2017

- Enter "16/5/6 17:30".
- Select "Time To Start", and press OK.

The check mark changes to OFF when the set time comes.

2) Memory Recover

When ON, machining continues automatically from the stop position after power is restored.
To be effective, it must be ON at the time of power failure. Recovery is not possible if a battery alarm is present.

1. This function may not be displayed depending on the machine model and option.
2. READY OFF is required when the switch is switched.
(1) READY OFF.
(2) The switch is switched (ON/OFF).
(3) When READY ON is set, switch switching is enabled.

3) Contact positioning fluid ON

When ON, ejects dielectric fluid in a weak pattern during wire feed ON for the following contact positioning: Corner positioning, 3-point center positioning, groove center positioning, width positioning, edge positioning, hole positioning, and workpiece inclination compensation.

4) Stop fluid splash

When this switch is turned ON, dielectric fluid emission will stop when the liquid level sensor detects the low liquid level.

- **Note that the dielectric fluid interlock above LQ5 is disabled 3 minutes after the level becomes low.**
- **If the level does not reach the sensor due to Z axis height, the level is treated as low. In this case, set "Stop fluid splash" to OFF.**

(9) Setup parameter

*** This function may not be displayed depending on the machine model and option.**
This function must be set only when the optional touch sensor is used to perform automatic measurement.

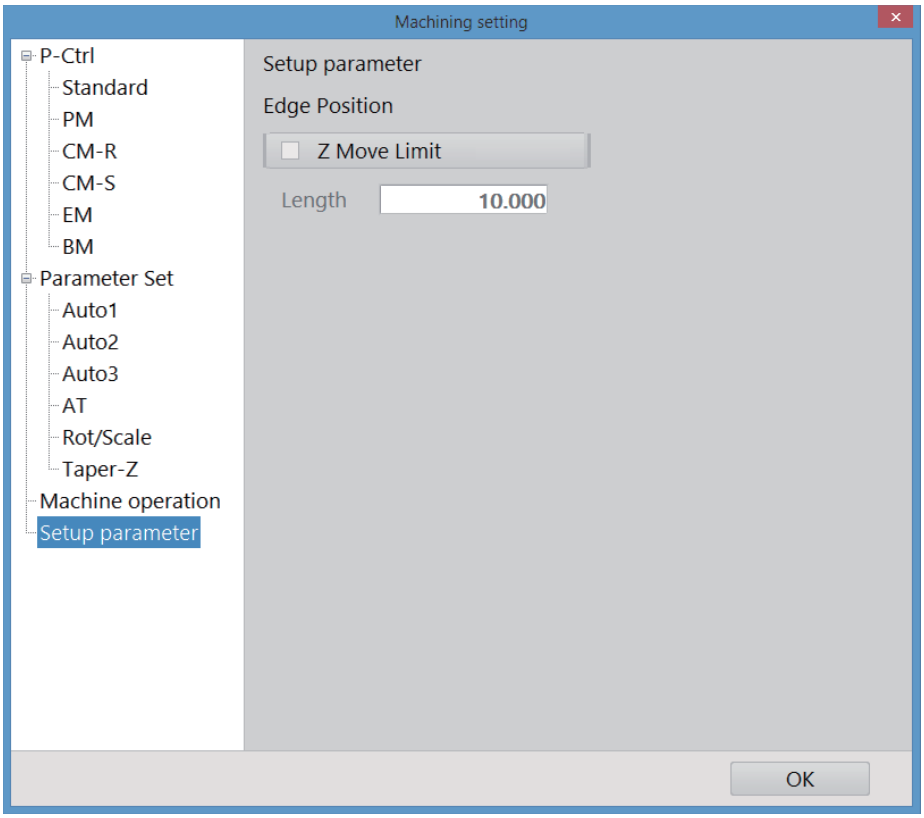


Fig. III.3.92

When the touch sensor is used to perform workpiece measurement in the Z direction, set Z axis moving limit of edge positioning to prevent conflicts with the upper nozzle and workpiece due to free vibration of the touch sensor.

3.2.12 Pendant setting

(1) Pendant parameter setting

Press and hold the manual operation box switch to set time, brightness, automatic OFF of LED lamp etc.

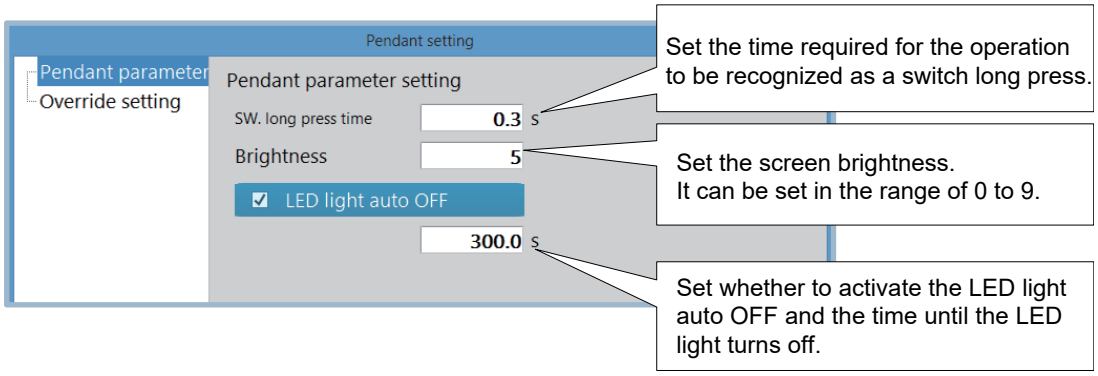


Fig. III.3.93

(2) Override setting

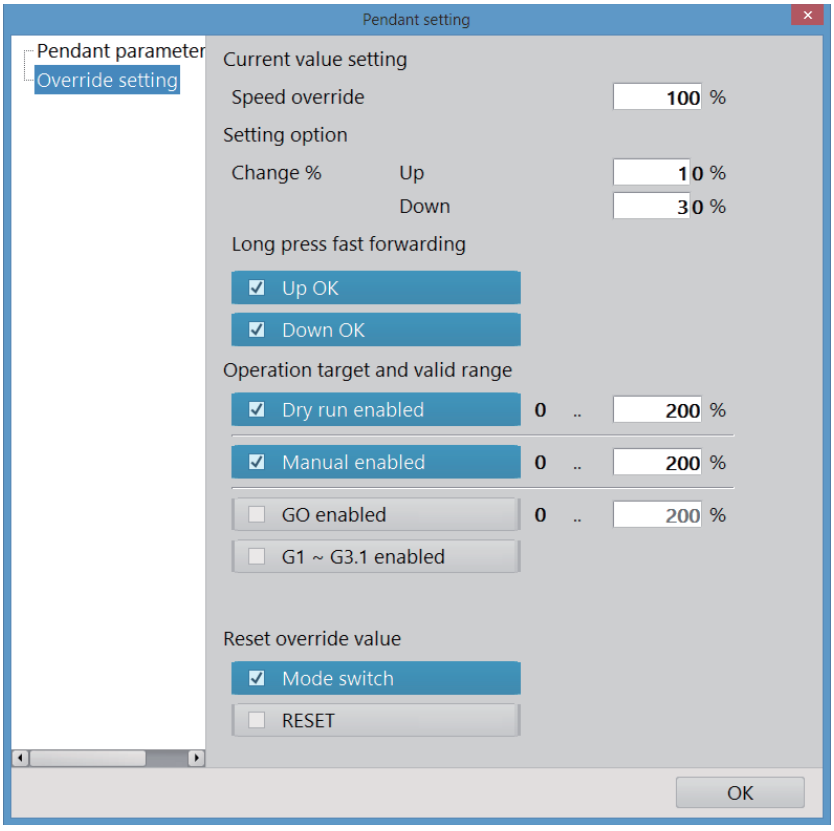


Fig. III.3.94

1) Speed override

The current override value can be set. The setting range is 0 to 200%.

2) Change % (Up and Down)

The control range when the "▲" and "▼" keys on the manual operation box are pressed can be set in the unit of %.

The setting range is 10 to 100%.

3) Long press fast forwarding

Up OK : When set to ON, the axis rises at the rapid feed speed when the "▲" key is long-pressed on the manual operation box.

Down OK: When set to ON, the speed is reduced to 0% when the "▼" key is long-pressed on the manual operation box. This function can be used in the case of transient operation on the occasion where the jet nozzle will be touched soon etc.

4) Operation target and valid range

Set the valid range of override. Even if the override value is set to a value exceeding the valid range, the speed cannot be higher than that of the valid range. The setting range is 100 to 200%.

(a) Dry run enabled

When set to ON, the override function can be used when dry running is executed.

(b) Manual enabled

When set to ON, the override function can be used when the axis is moved under the manual mode.

(c) GO enabled

When the program is executed, the program segment of G0 command can be used to use the override function.

(d) G1 ~ G3.1 enabled

When the program is executed, the program segment of G1 to G3.1 commands can be used to use the override function.

5) Reset override value

(a) Mode switch

When set to ON, the override value is restored to 100% when dry running, automatic and manual are switched.

(b) RESET

The resetting function is used to restore the override value to 100%.

3.2.13 Set Option

The set option can be changed.

The Set Option dialog will be displayed when the "Option Setting" button is pressed.

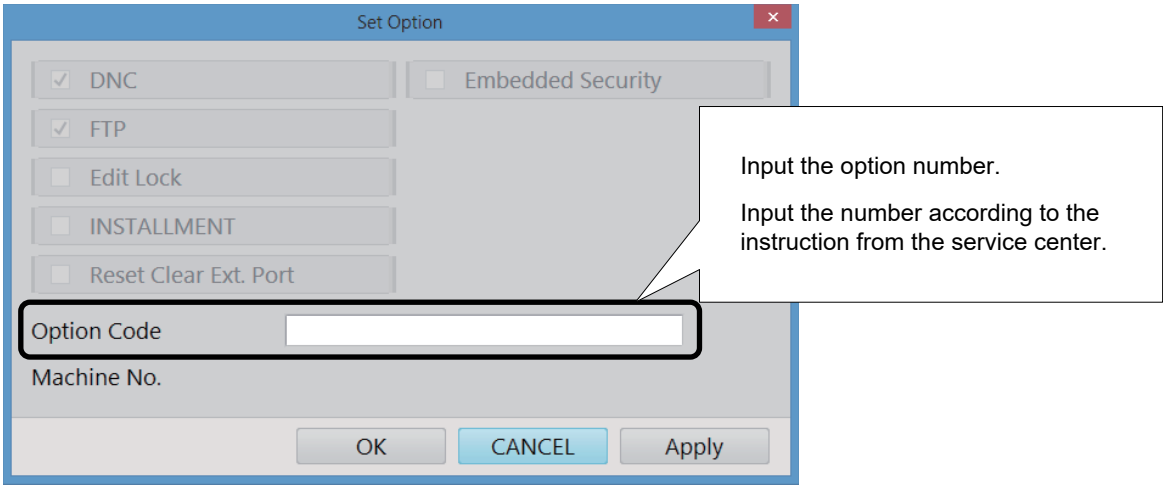


Fig. III.3.95

Enter the option keywords and machine sequence number from the service center. Press OK to turn the option ON or OFF. Then power off briefly and power on again. If setting fails, "E01 SETTING ERROR" appears. Check the keyword and try again.

*** The keyword does not contain the characters I, L or O.**

3.2.14 Spd set with m-box

Used to display and set the axis movement speed with the manual operation box.

(1) Description of setting items

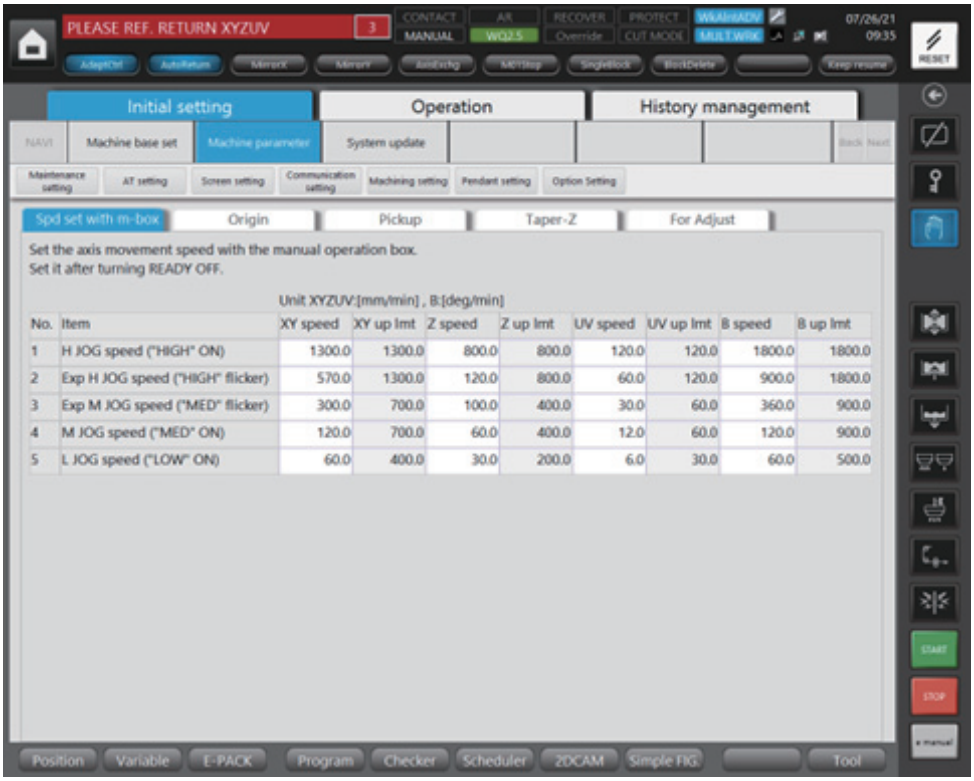


Fig. III.3.96

Set the axis movement speed for each axis movement speed designation key and each axis.

The maker's recommended value is displayed for the initial value. (Fig. III.3.96)

* B axis may not be displayed because it is optional.

When increasing axis movement speed, do not raise it at once. Increase gradually and check actual speed with the manual operation box.

3.3 System Update

3.3.1 System update

Used for system update ("Initial setting" > "System update").

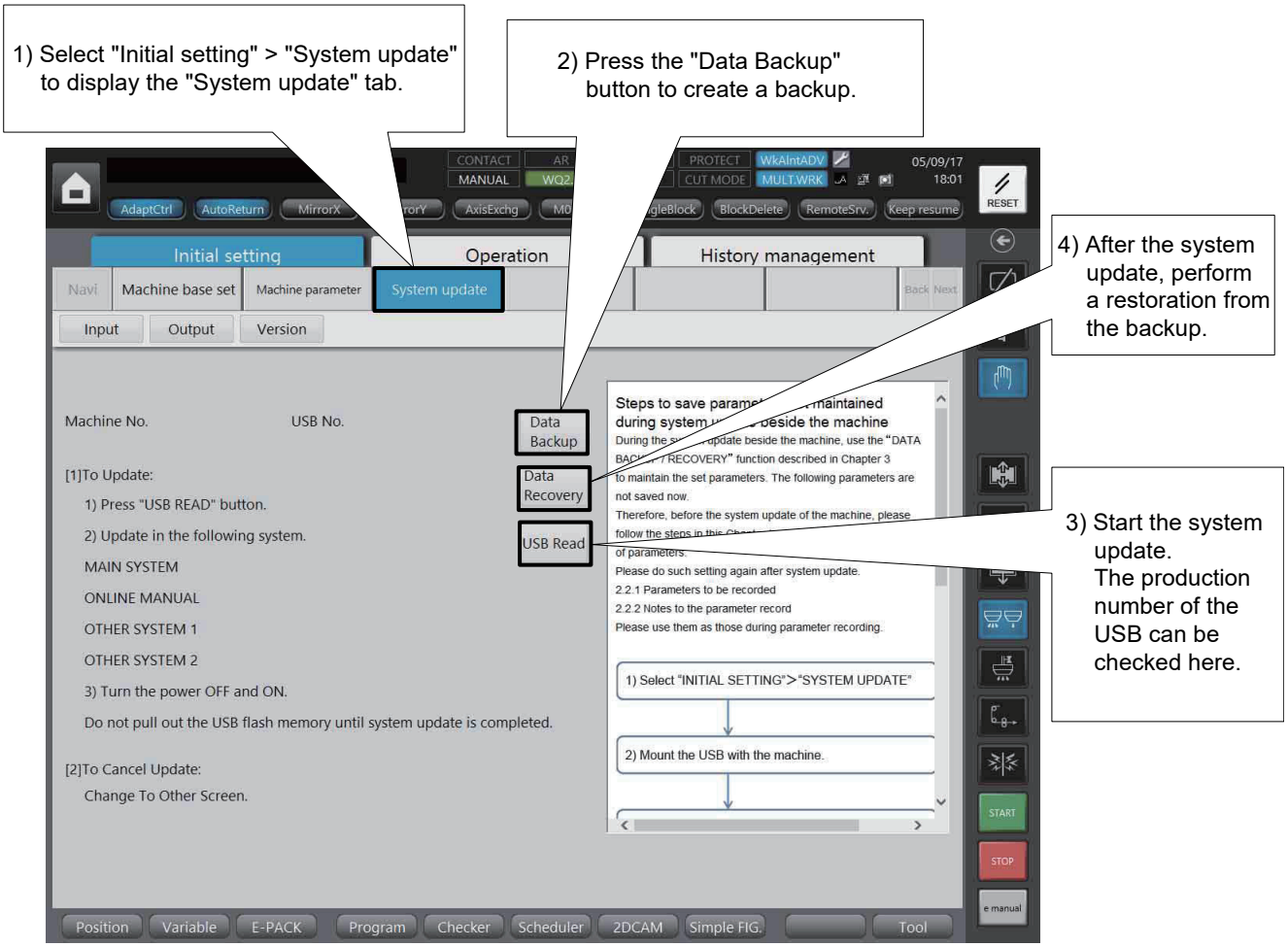


Fig. III.3.97

(1) System update

To update the system program, copy the program from the CD-ROM or similar media to the USB flash memory enclosed with the machine before updating.

The enclosed USB flash memory is required for the update.

(2) Steps for system update

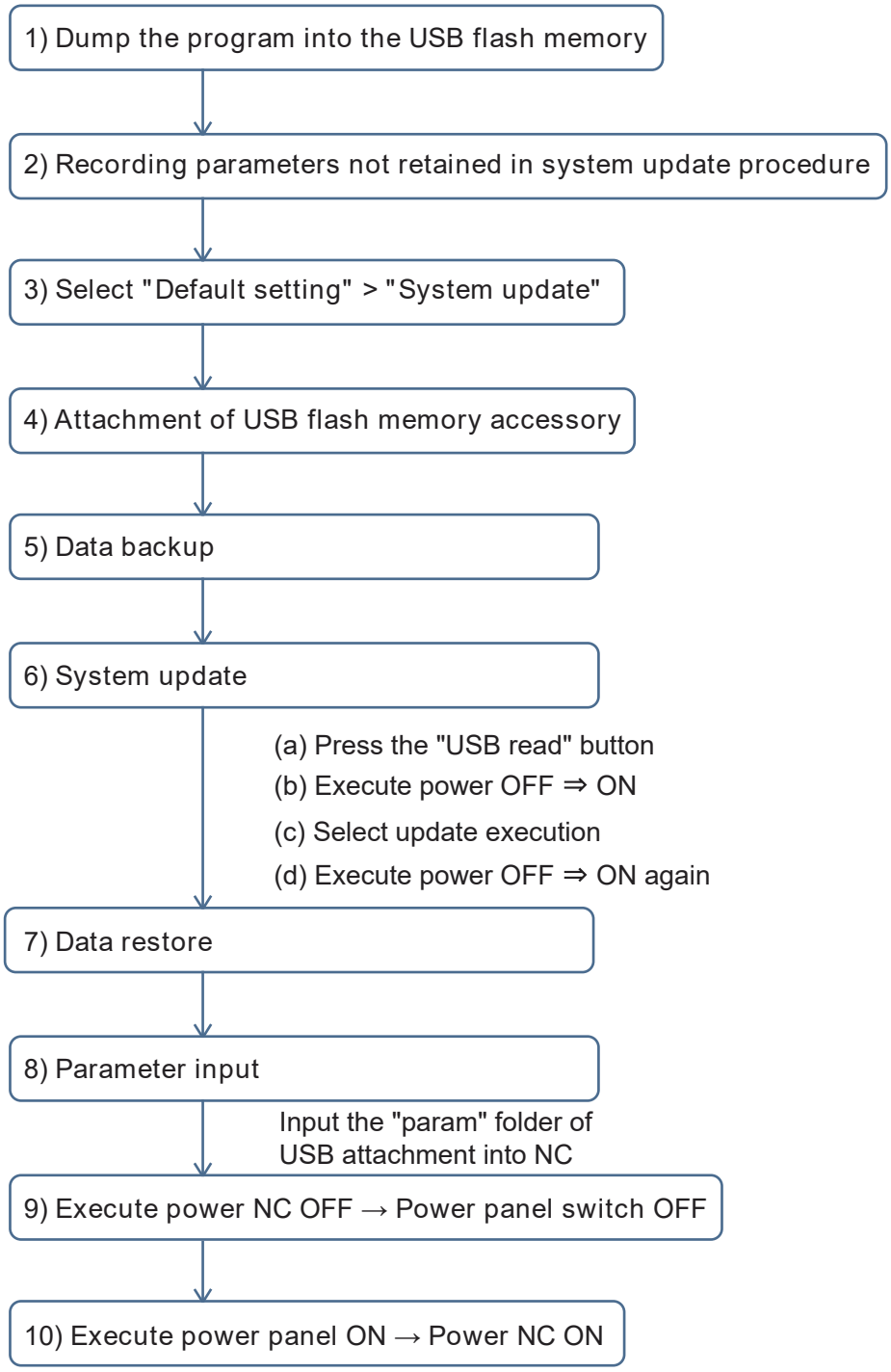


Fig. III.3.98

1) Dump the program into the USB flash memory

Dump the system program in the CD-ROM or the like into the folders in the USB flash memory enclosed with the machine. Save the data to right folders according to data type.

NOTICE

Do not delete files in the param folder in the USB flash memory.

2) Recording procedure of parameter category not kept due to update on the machine side

On the machine side, when the system is updating, you can keep the set parameter category with the function "Data Backup"/"Data Recovery". Follow the steps in this manual and record the settings of the parameter categories before the system update, and then re-set them after the system update has finished.

3) Connect the USB flash memory enclosed with the machine

Confirm that the USB flash memory enclosed with the machine is connected.

NOTICE

- **Do not insert or remove the USB flash memory during the system update or file I/O process.**
- **Only the USB flash memory enclosed with the machine can be used to update the system.**

4) Data backup

Back up the data whose settings will be deleted during the system update. Select "Data Backup" in the System update screen. Save the data immediately after selection.

5) System update

(a) Press the "USB Read" button on the right of "System update" screen.

Check whether the machine serial number and the USB serial number match.
Confirm that the BRD and BRN numbers are correctly displayed at the items to be updated.

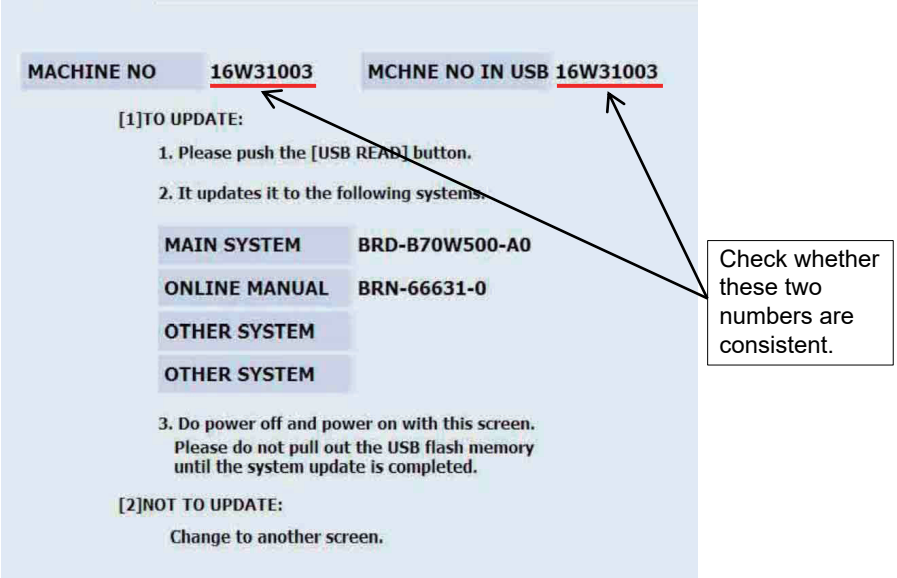


Fig. III.3.99

- **If the machine serial number and the USB serial number do not match, system update cannot be performed.**
- **If there are multiple systems in the USB flash memory, the system with the latest date will be updated.**

(b) Press Stop All button to stop preparation and then turn the power off. When the power indicator ON turns off, turn the power on.

(c) Select Execute Update.

When the power is turned ON, the "SYSTEM UPDATE" screen will appear. Press the "UPDATE" button. (To cancel the update, turn OFF/ON the power.)

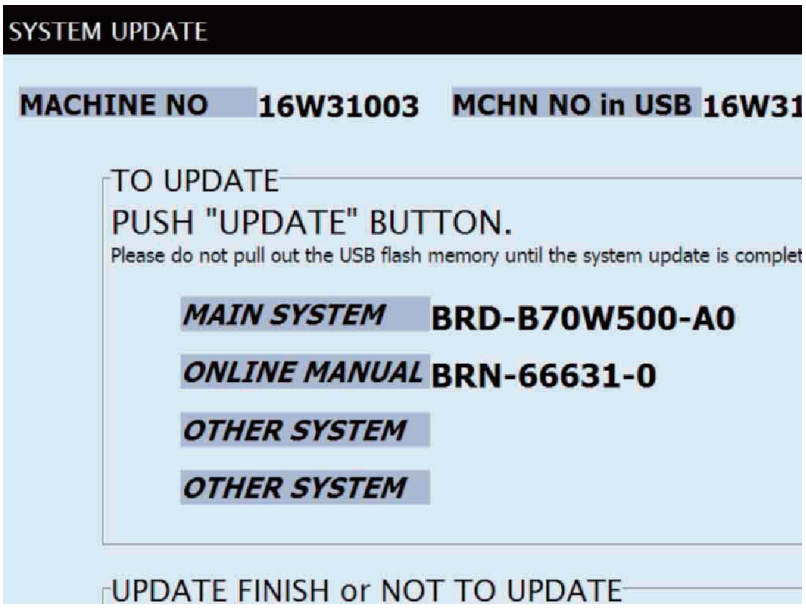


Fig. III.3.100

(d) On completing the update, turn the power off. When the power indicator ON turns off, turn the power on.

6) Data recovery

Select "Data Recovery" in the displayed "System update" screen.
The data to be recovered is the one which has been backed up with “Data Backup”.

If you run "Data Recovery" without a prior "Data Backup", it restores the status from the last backup.

7) Parameter input

Input parameters for movement of the machine by using the USB flash memory enclosed with the machine.
For input steps, see "III. NC OPERATION DISPLAY SCREEN" > "3.3.2 2) Parameter input".

8) Press Stop All button to stop preparation and then turn the power off. When the power indicator ON turns off, set switch (NF) of the power panel to OFF.

9) Set switch of the power panel (NF) to ON, and then turn the power on.

Now, the system update is finished.

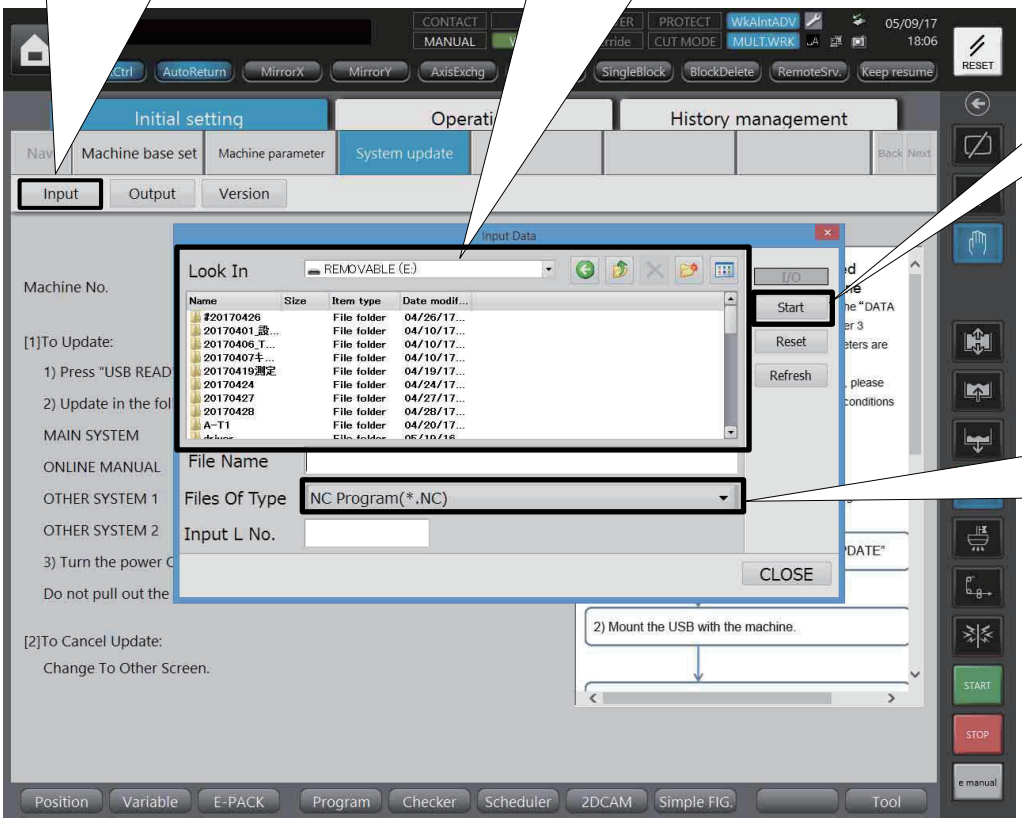
3.3.2 FILE I/O

(1) File input

Select "Initial setting" > "System update" > "Input" to display the "Input" tab.

Search for the file to be input.

It can be operated in a method similar to that of Windows Explorer.



Perform the input.

Select the type of the file to be input.

Fig. III.3.101

1) Machining conditions input

If machining conditions have been downloaded, input machining conditions by "Input".

(a) Select "Input" in "System update" of "Initial setting" menu.

(b) Select "All Files" for data type; double click to select "epack" in the USB flash memory enclosed with the machine, and leave it to display the contents of the "BRD- B13W*-**" folder.**

(c) Press "Start".

2) Parameter input

Input downloaded parameter patches and the parameters preset by the maker.

(a) Select "Input" in "System update" of "Initial setting" menu.

(b) Select "All Files" for data type; double click to select "param" in the USB flash memory enclosed with the machine, and leave it display contents of the "param" folder.

(c) Press "Start".

(d) When multiple "BRD-B31W***-**" folders exist, perform file input in the same steps for all of them.

(2) File output

Files can be output to any position.

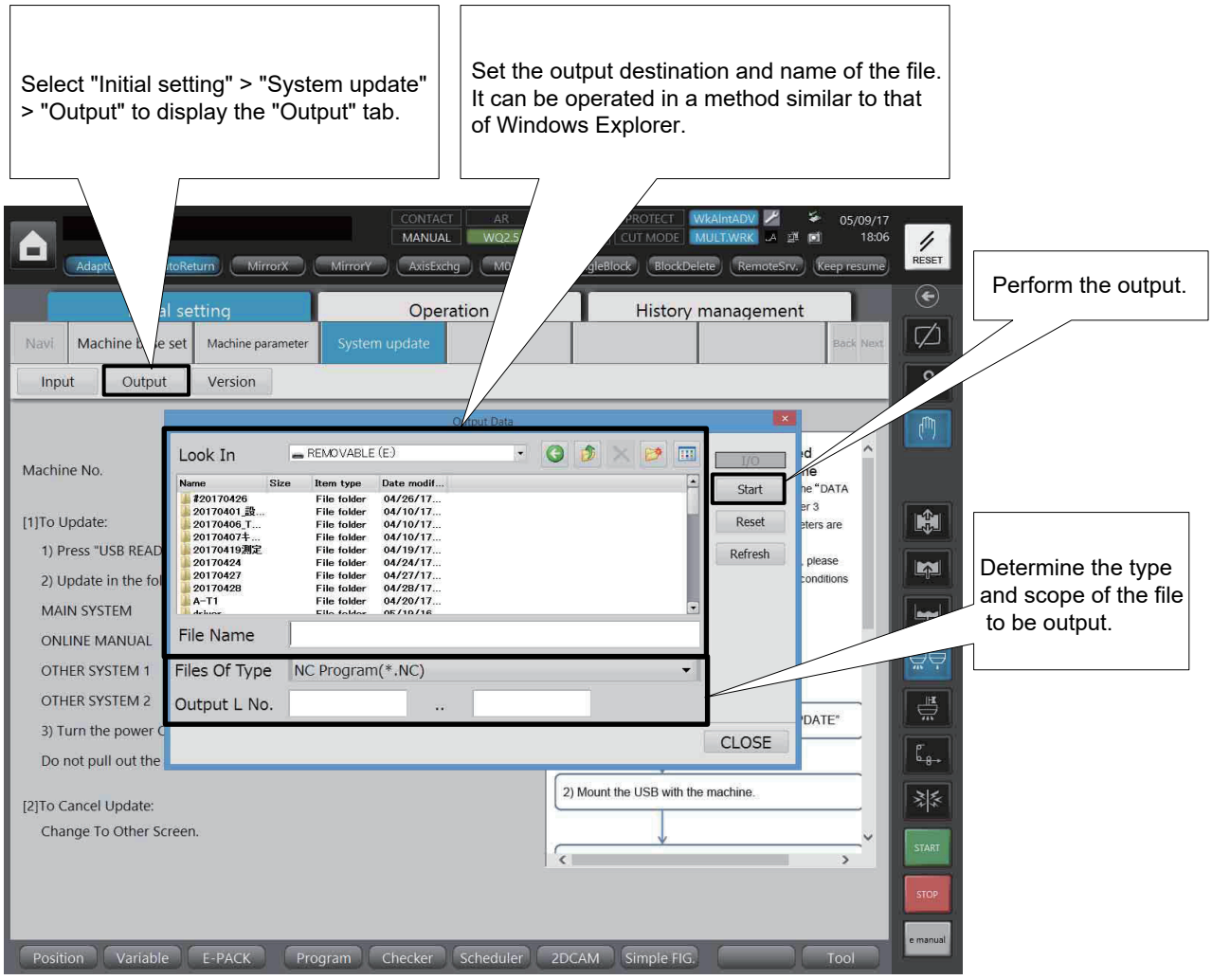


Fig. III.3.102

1) Select "Output" in "System update" of "Initial setting" menu.

2) Select "Look In" and determine the file storage place.

3) Input the name of the file to be output in "File Name".

4) Determine the type of the file to be output in "File Of Type".

5) Determine number of item to be output in "Output No.".
In Fig. III.3.102, item number shall be determined in "Output L No." for outputting NC program.

6) Press "Start" to output the file.

3.3.3 Version

The NC system version, machining conditions version, etc. are displayed on this screen.
Select "Version" in "System update" of "Initial setting" menu.

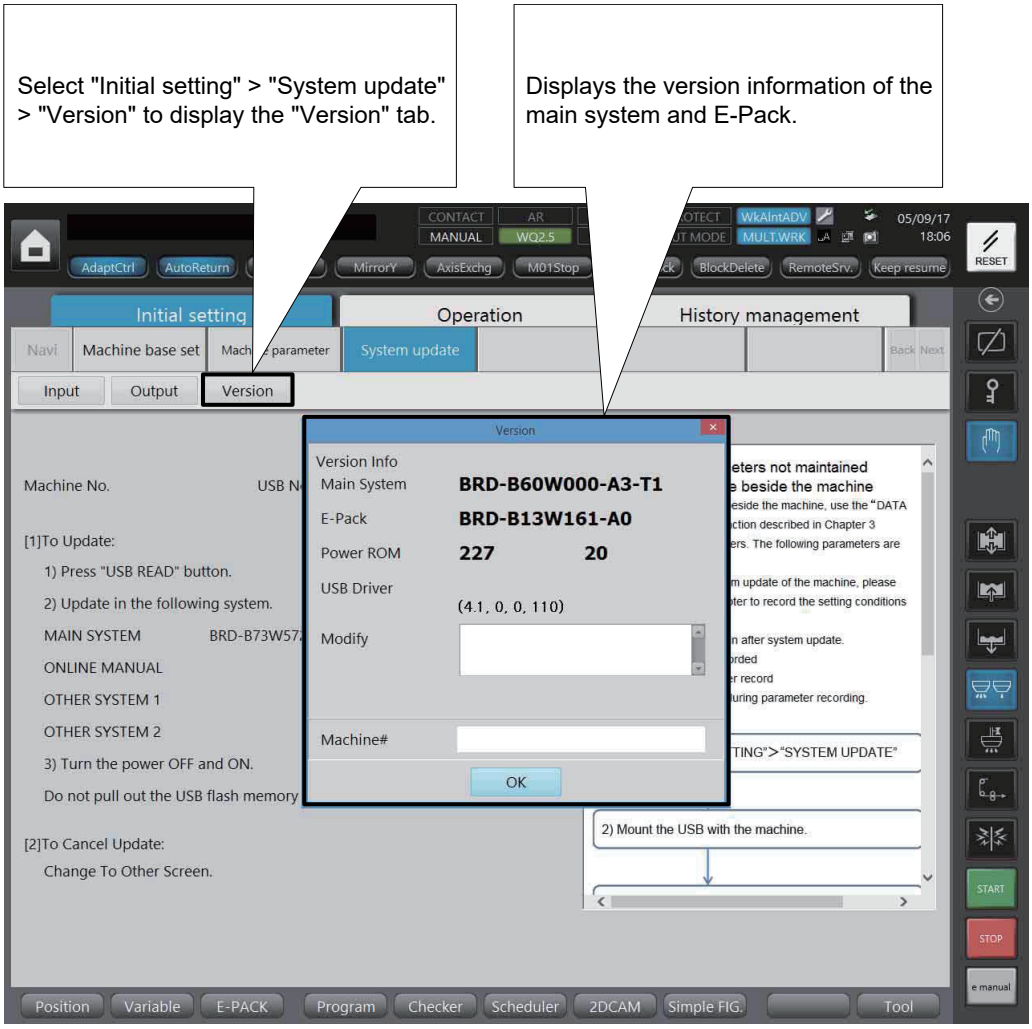
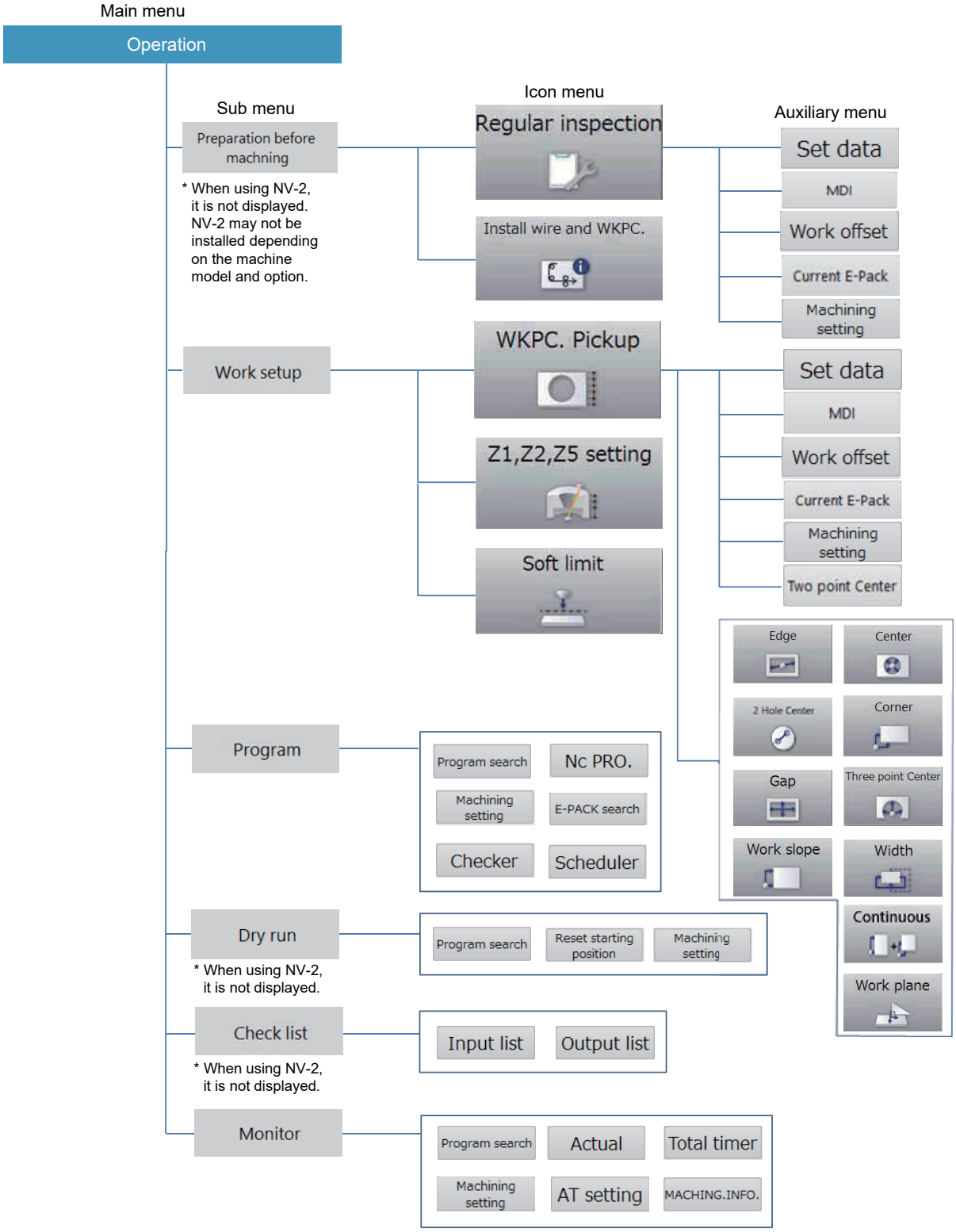


Fig. III.3.103

4. OPERATION

(1) Menu configuration



4.1 Preparation before machining

(1) Summary

Display the screen of preparation for regular inspection.

4.1.1 Regular inspection

See "III. NC OPERATION DISPLAY SCREEN" > "5.1.2 Daily INSP.".

4.1.2 Install wire and WKPC.

See "III. NC OPERATION DISPLAY SCREEN" > "3.1.2 Install Wire and workpiece".

4.1.3 Auxiliary menu

(1) Set data

See "III. NC OPERATION DISPLAY SCREEN" > "3.1.6 Set Data".

(2) Work offset

Sets the current position to any coordinate value in the following coordinate system.

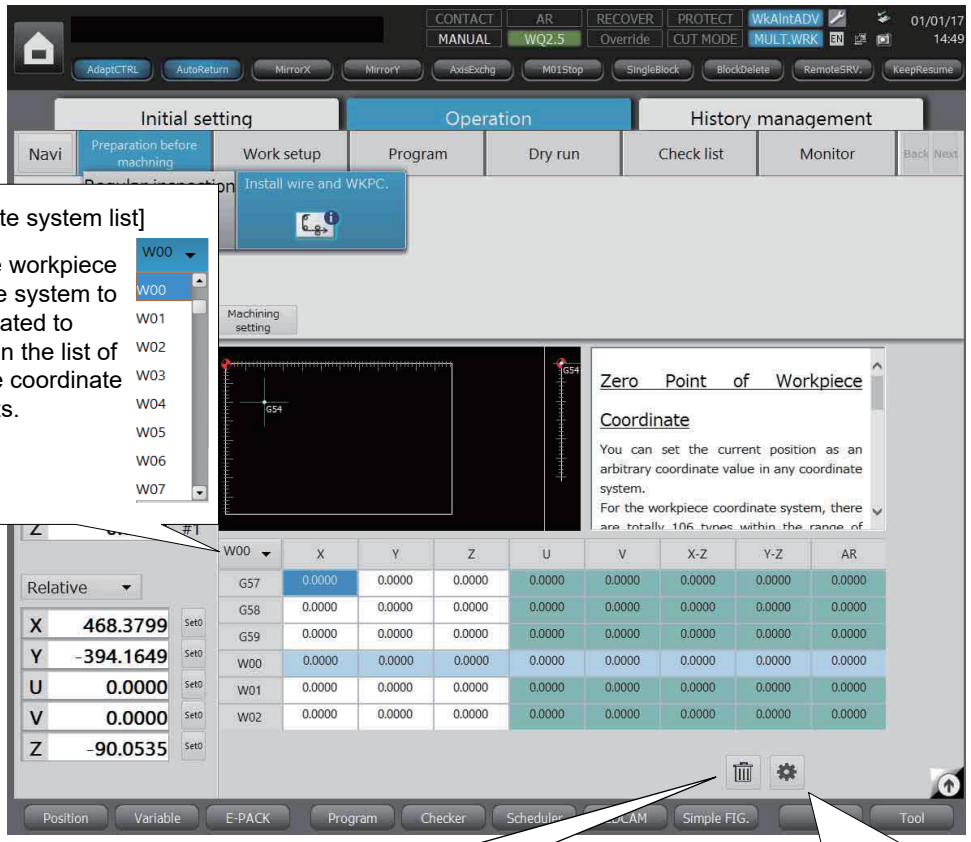
For the usage of multiple coordinate systems, see "IV. PROGRAMMING".

- Workpiece coordinate
  G54 to G59 and W00 to W99, 106 types in total.

When setting the workpiece coordinate home position, make sure that the axis rotation functions (AR, H, V) are canceled.

1) Description of setting items

(a) Workpiece alignment ADVANCE

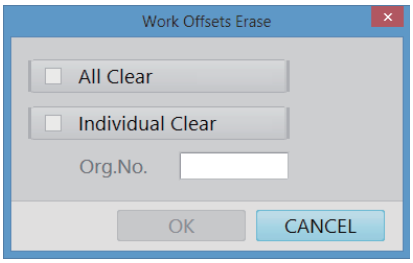


[Coordinate system list]

Select the workpiece coordinate system to be designated to display it in the list of workpiece coordinate zero points.

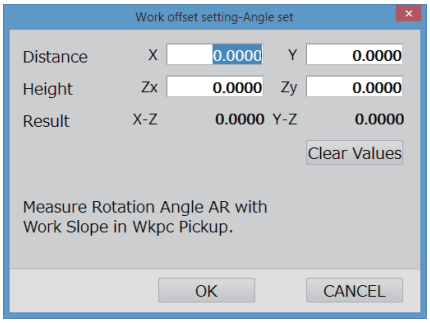
[Work Offsets Erase]

The workpiece coordinate zero point can be cleared.
Select "All Clear" to delete all axes.
Select "Individual Clear" to delete an axis according to the relevant zero point No.

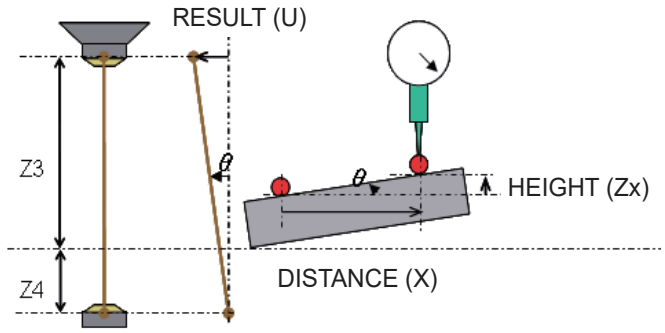


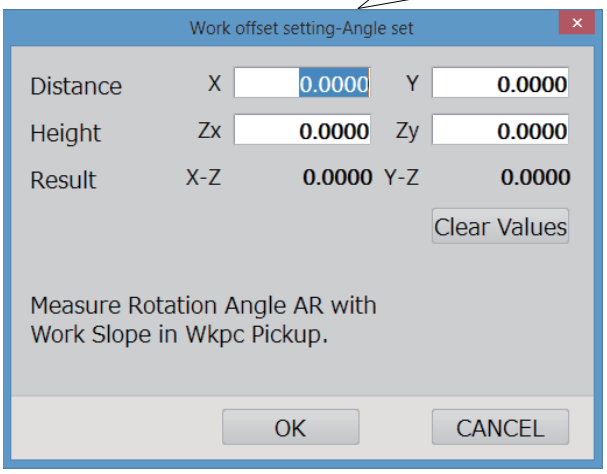
[UV measurement]

Install a dial gauge, make the X axis and Y axis passing above the workpiece, and measure the amount of inclination in the Z direction. The measured results can be converted into the workpiece coordinates of the U axis and V axis and be set as the designated workpiece coordinate zero points. The set U axis and V axis workpiece coordinate values become valid for "Workpiece alignment ADVANCE function" to compensate workpiece inclination in Z direction during NC program operation. For the details of "Workpiece alignment ADVANCE function", refer to "IV. APPLICATION OPERATION" > "9. WORKPIECE ALIGNMENT ADVANCE".

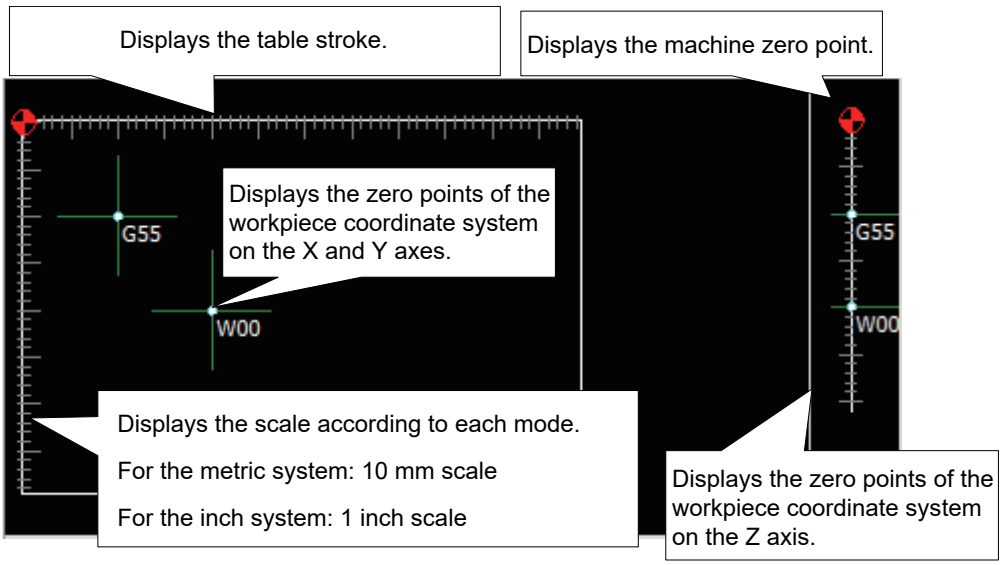


[Distance]
This field indicates the distance that the X or Y axis has moved for measuring the workpiece inclination amount. The value is 0.000 when the dialog box is opened, and it is updated as the X or Y axis moves.
[Height]
After moving the X or Y axis by the measurement distance, input the amount of change in the dial gauge readings (workpiece's inclination amount) into this field. The value is 0.000 when the dialog box is opened.
[Result]
The workpiece's inclination angles for the X-Z and Y-Z planes are calculated based on the values of "Distance" and "Height", and the values are input into this field automatically. The value is 0.000 when the dialog box is opened.





- **The X-Z and Y-Z work angle settings is active only when [Work alignment ADV.] is ON.**
- **For taper angle machining, if "Work alignment ADVANCE" function is used, compensate according to X-Z and Y-Z work angle settings. Keep this in mind when using it.**



The workpiece coordinate system displayed in the zero point screen refers to the coordinate system with the value displayed in the workpiece coordinate zero point list, plus coordinate system setting (G92) and local coordinate (G52).

(3) Machining setting

See "III. NC OPERATION DISPLAY SCREEN" > "3.2.11 Machining setting".

4.2 Work setup

4.2.1 WKPC. Pickup

(1) Summary

Contact the workpiece with the wire (or sensor) for positioning.

1) Universal settings in workpiece measurement

(a) Pos.Type

Select positioning types based on the positioning time and accuracy. Turn on "Prcis Positioning" for high accuracy positioning. When the "POS. Type disp." switch is turned ON ("Initial setting" > "Screen operation setting"), select the positioning type from Type1 to Type4 in Pos.Type.

Time priority ⟷ Accuracy priority

Type1 Type2 Type3 Type4

(b) Meas.Times

Repetitively carry out the edge detection of the workpiece under designated times.

(c) Err.Range

When the number of repetitions is set as over 2, and the coordinate value error exceeds 3 times of the allowable error, the alarm "M627 OUT OF MARGIN" will be displayed.

(d) Pos.W Fluid On

In the auxiliary menu "Machining setting" > "Machine operation", activate "Pos.W Fluid On", the dielectric fluid will automatically be ejected during contact positioning.

(2) Edge

Edge positioning on workpiece.

1) Description of setting items

Fig. III.4.1

(a) Direction

Select positioning direction from +X, -X, +Y and -Y.

(b) Pos. Angle

Input positioning angle.

(c) Start Dist.

Set a distance starting from the start point of edge positioning and within which a 570 mm/min rapid traverse rate to the axis is provided.

(d) Preset Position

Turn ON to preset the coordinates at the point where the positioning was completed. Select Preset Position from the hierarchical menu.

(e) Wire Preset

Turn on ON for complete coordinates presetting at the point with an offset of wire radius to the point where the positioning was completed.

(f) Preset Val.

Set the current position coordinate values for coordinate presetting.

2) Operation procedure

(a) Insert the wire, and thread it.

(b) Move the axis close to the workpiece edge where the wire position is measured.

(c) Select main menus "Operation" > "Work setup" > "WKPC. Pickup" > "Edge". Set the setting items shown in 1), and press "START".

(d) Position in the indicated direction as below.

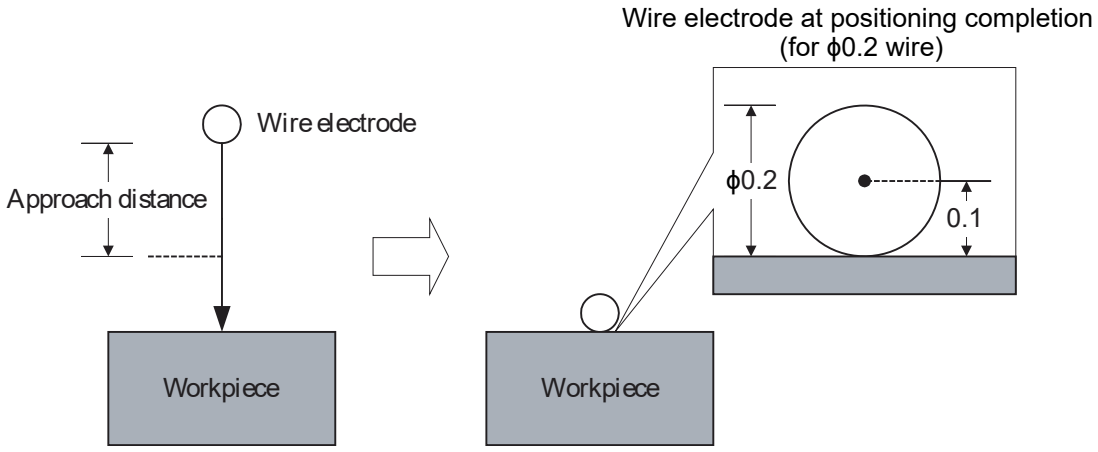


Fig. III.4.2

(3) Center

Positioning is performed at the center of the hole.

1) Description of setting items

Fig. III.4.3

(a) Direction

Select positioning direction from +X, -X, +Y and -Y.

(b) Pos. Angle

Input positioning angle.

(c) Apr. Length

Set a distance starting from the start point of edge positioning and within which a 570 mm/min rapid traverse rate to the axis is provided.

(d) Preset Position

Turn ON to preset the coordinates at the point where the positioning was completed. Select Preset Position from the hierarchical menu.

(e) Preset Val.

Set the current position coordinate values for coordinate presetting.

2) Operation procedure

(a) Insert the wire into the hole of the workpiece to be measured, and thread it.

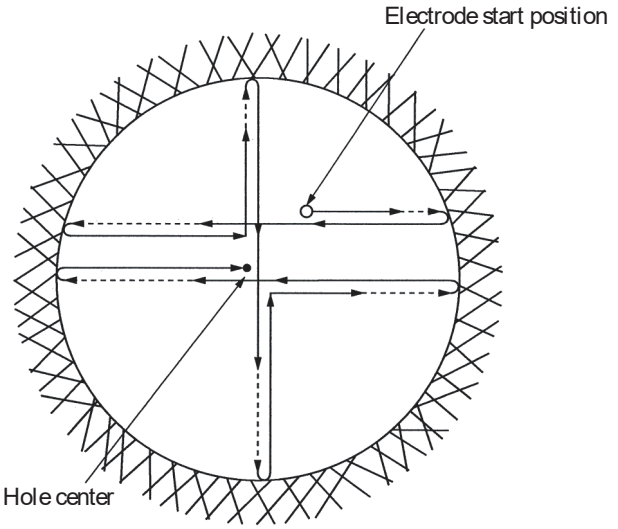
(b) Move the axis and try to place the wire just at the hole center.

(c) Select main menus "Operation" > "Work setup" > "WKPC. Pickup" > "Center".

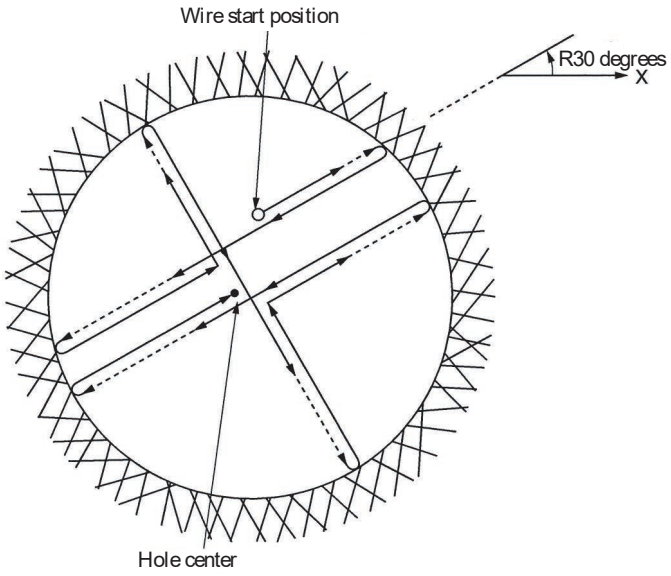
(d) Set the setting items shown in 1), and press "START".

(e) Position in the indicated direction as below.

Select "+X" for the positioning direction.



Select "+X" for the positioning direction, and the positioning angle is set to 30°.



(4) Corner

Use to move from the workpiece corner to the starting hole or the start point for machining. Wire radius will be used in positioning, so confirm the preset wire radius in "Initial setting" > "Machine base set" > "Wire Type" before re-starting positioning.

When "Continuous" is used to measure "Corner", the related items are also set on this screen.

1) Description of setting items

Fig. III.4.4

(a) Direction

Select positioning direction.

(b) Start Dist.

Perform contact inspection between workpiece and wire according to the relative distance to the starting position. Set a value fitting in with the workpiece size.

(c) Mach.St.Pt.

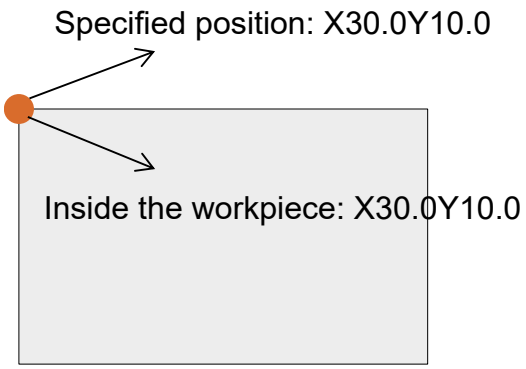
Taking the corner position measured as reference, input the finalized movement position.

(d) Distance

Select designation of START PT in above machining.

When "ST.P.In" is selected, the designation shall be specified according to absolute value.

When "Specified" is selected, the designation will be based on relative value, whether the machining is inside or outside the workpiece.



(e) At@Mch St.Pt.

Select wire status after corner positioning.

When "Insert" is selected, the wire is being inserted.

When "Cut" is selected, the wire is cut.

(f) Preset Position

When the switch is set to ON, preset the coordinates at the point where the positioning was completed.

Select Preset Position from the hierarchical menu.

(g) Preset Val.

Set the current position coordinate values for coordinate presetting.

2) Operation procedure

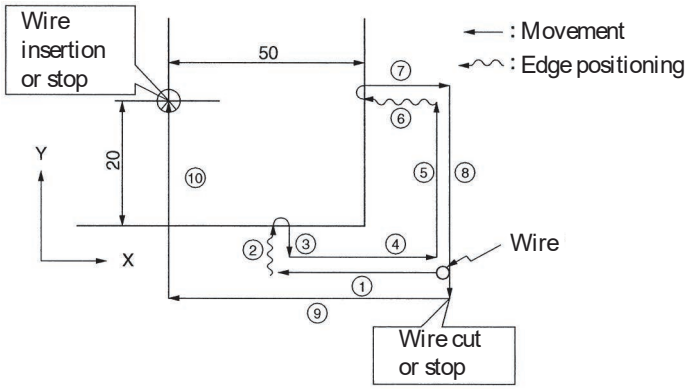
(a) Insert the wire, and thread it.

(b) Move the axis close to the workpiece corner where the wire position is measured.

(c) Select main menus "Operation" > "Work setup" > "WKPC. Pickup" > "Corner".

(d) Set the setting items shown in 1), and press "START".

(e) Position in the indicated direction as below.



(5) Three point Center

Positioning is carried out to the workpiece hole center (for inner side measurement) or the workpiece hole center (for outer side measurement) by finding three points on the workpiece.

1) Description of setting items

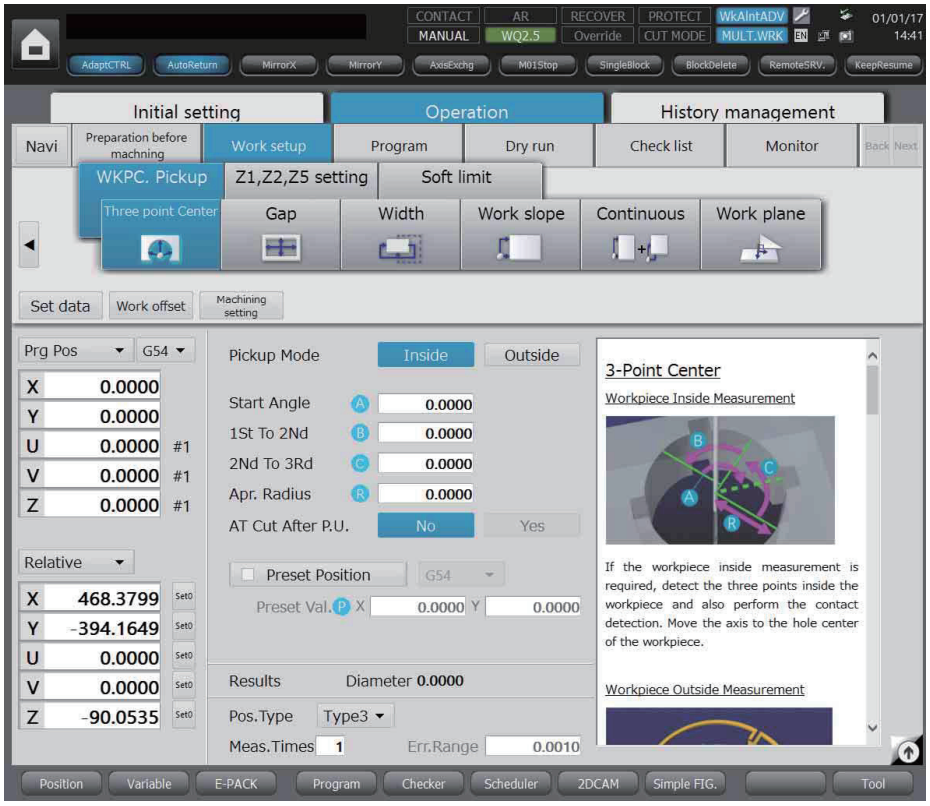


Fig. III.4.5

(a) Pickup Mode

Make a choice between "Inside" and "Outside".

(b) Start Angle

Input the angle of the first point where contact with the workpiece is detected.

(c) 1St To 2Nd

Input the angle difference between the first point and the second point where contact with the workpiece was detected.

(d) 2Nd To 3Rd

Input the angle difference between the second point and the third point where contact with the workpiece was detected.

(e) Apr. Radius

Input approximate radius of workpiece hole or workpiece.

(f) AT Cut After P.U.

Select whether to cut the wire the next time any contact is detected when moving to the start point.
In the 3-point center mode, input is possible when the "Outside" is selected.

(g) Preset Position

When the switch is set to ON, preset the coordinates at the point where the positioning was completed.
Select Preset Position from the hierarchical menu.

(h) Preset Val.

Set the current position coordinate values for coordinate presetting.

2) Operation procedure

Inner side measurement of workpiece

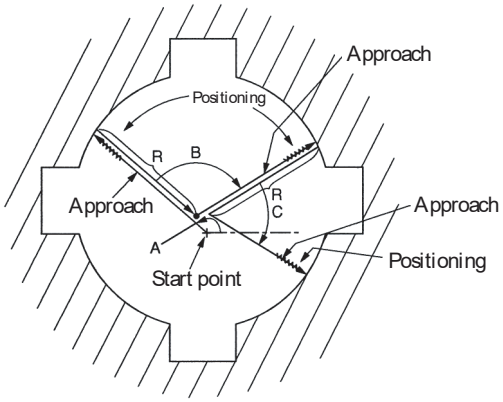
(a) Insert the wire into the hole of the workpiece to be measured, and thread it.

(b) Move the axis and try to place the wire just at the hole center.

(c) Select main menus "Operation" > "Work setup" > "WKPC. Pickup" > "Three point Center".

(d) Set the setting items shown in 1), and press "START".

(e) Position in the indicated direction as below.



Outer side measurement of workpiece

(a) Insert the wire, and thread it.

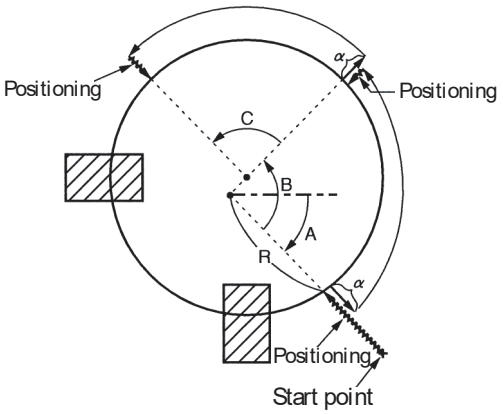
(b) Move the axis close to the edge of the workpiece's first measurement point where the wire position is measured.

(c) Select main menus "Operation" > "Work setup" > "WKPC. Pickup" > "Three point Center".

(d) Set the setting items shown in 1), and press "START".

*** Before positioning, make sure that there will be no incompatibility between the clamp and the nozzle.**

(e) Position in the indicated direction as below. On completion of positioning, the wire is cut off.



- **Use PM mode in OFF status.**
- **In performing 3-point positioning, the AdaptCtrl is turned OFF automatically, and it will be turned ON upon completion.**
- **When the 3-point positioning is paused, the AdaptCtrl is till OFF.**
- **Use mirror image, axis replacement, coordinate rotation and graphic scale in OFF status.**

(6) Gap

This is for moving to the center of the workpiece inner diameter in with boring bore(s).

1) Description of setting items

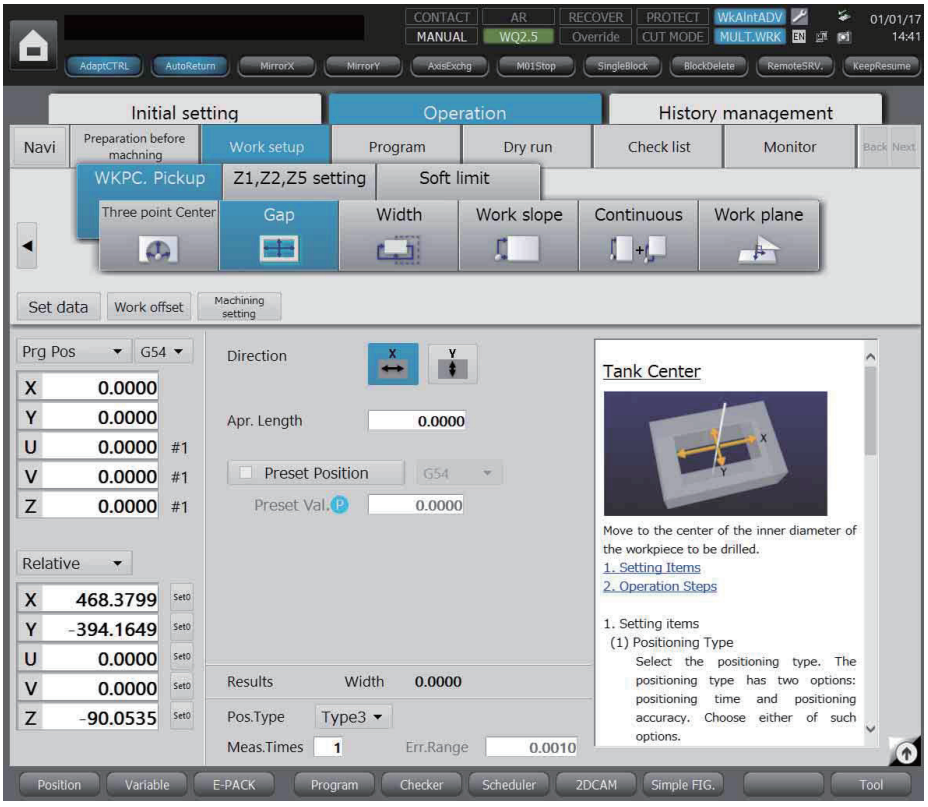


Fig. III.4.6

(a) Direction

Select positioning direction.

(b) Apr. Length

Set a distance within which a 570 mm/min rapid traverse rate for the axis is provided from edge positioning.

(c) Preset Position

Turn ON to preset the coordinates at the point where the positioning was completed. Select Preset Position from the hierarchical menu.

(d) Preset Val.

Set the current position coordinate values on X axis and Y axis for coordinate presetting.

2) Operation procedure

(a) Insert the wire into the hole of the workpiece to be measured, and thread it.

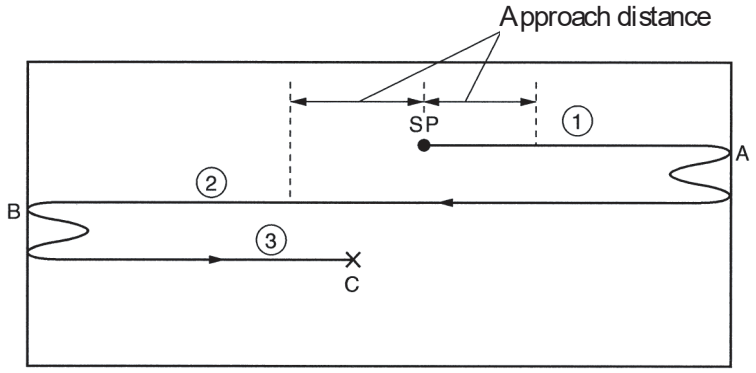
(b) Move the axis and try to place the wire just at the center of the inner diameter.

(c) Select main menus "Operation" > "Work setup" > "WKPC. Pickup" > "Gap".

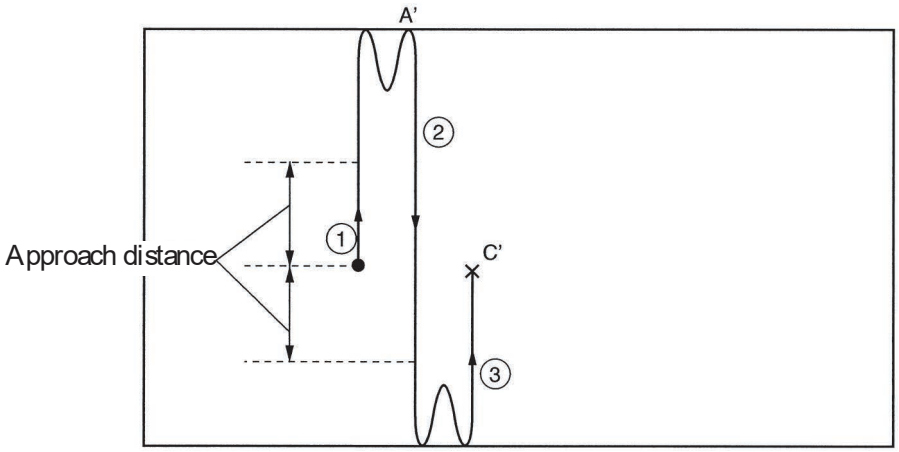
(d) Set the setting items shown in 1), and press "START".

(e) Position in the indicated direction as below.

When X is selected for the positioning direction



When Y is selected for the positioning direction



(7) Width

This is for moving to the center of the workpiece inner diameter in with boring bore(s).

1) Description of setting items

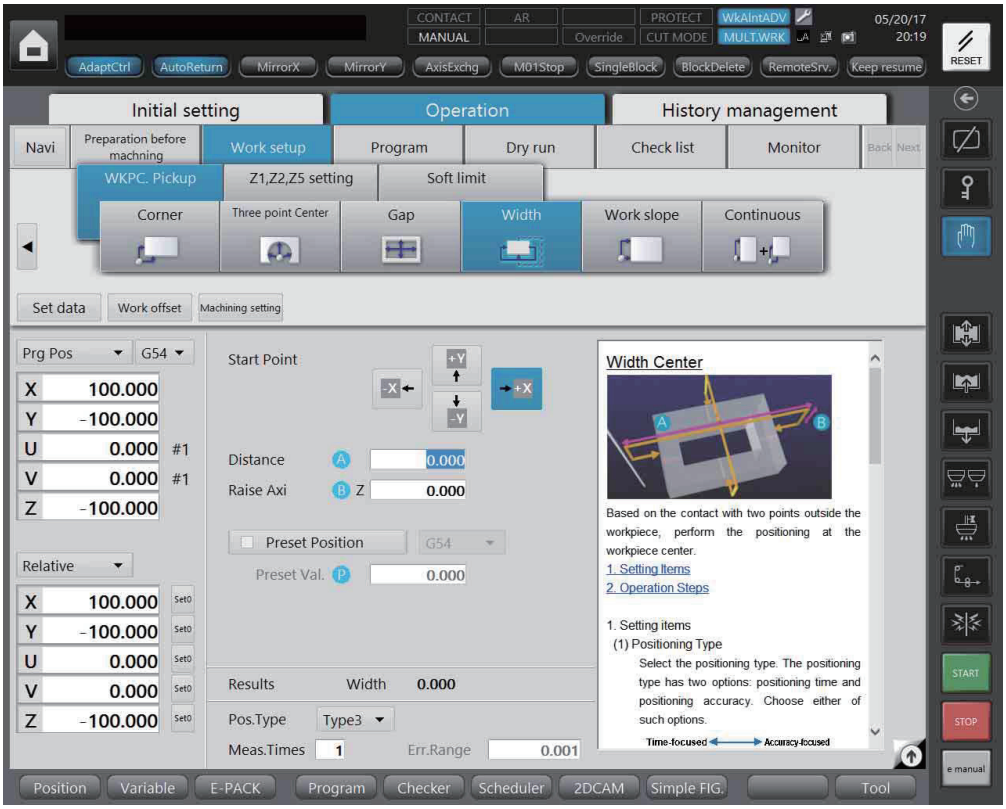


Fig. III.4.7

(a) Start Point

Select positioning direction from +X, -X, +Y and -Y.

(b) Distance

Set the movement amount from one side to the other side once the edge is detected on one side of the workpiece.

(c) Raise Axi

Set the uplift amount of Z axis when it moved from one side to the other side of the workpiece.

(d) Preset Position

Turn ON to preset the coordinates at the point where the positioning was completed. Select Preset Position from the hierarchical menu.

(e) Preset Val.

Set the current position coordinate values on X axis and Y axis for coordinate presetting.

2) Operation procedure

(a) Insert the wire, and thread it.

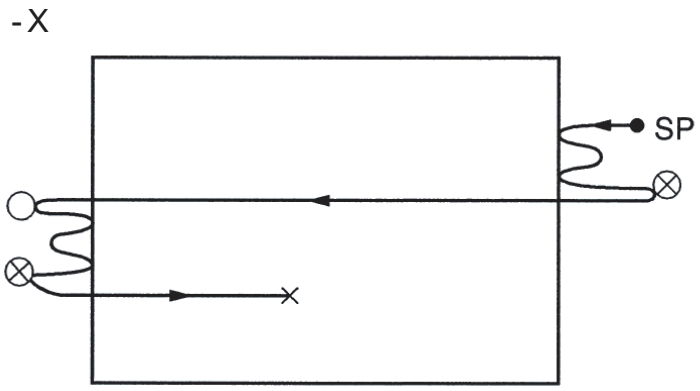
(b) Move the axis close to the workpiece edge where the wire position is measured.

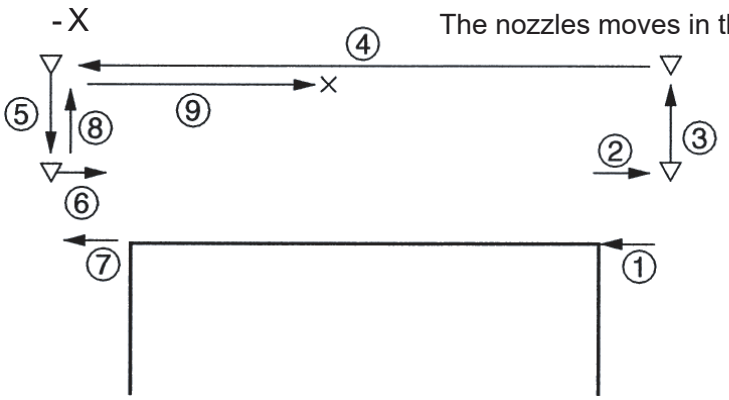
(c) Select main menus "Operation" > "Work setup" > "WKPC. Pickup" > "Width".

(d) Set the setting items shown in 1), and press "START".

(e) Position in the indicated direction as below.

When -X is selected for the positioning direction





The nozzles moves in the order of 1 to 9.

(8) Work slope

Contact with two points of the workpiece, and the workpiece inclination is measured automatically.

1) Description of setting items

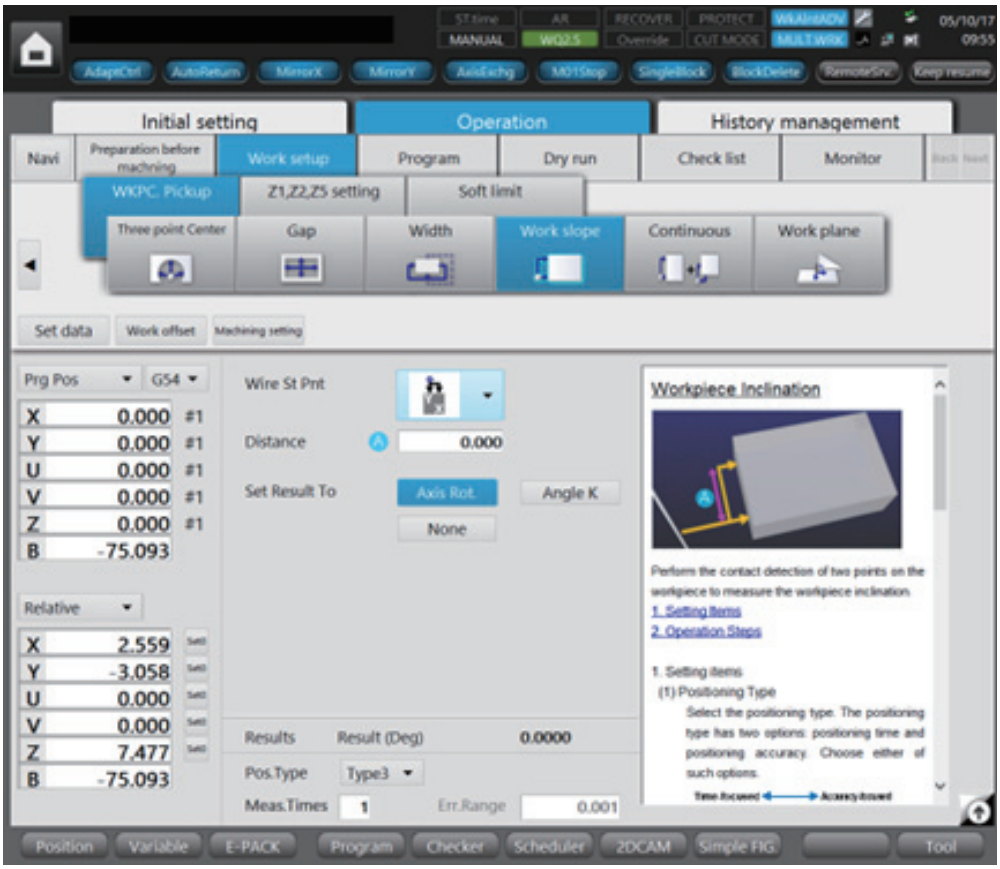


Fig. III.4.8

(a) Wire St Pnt

Select a position where positioning starts.

(b) Distance

Set distance between the two points in contact with the workpiece and measurement was starting from.

(c) Set Result To

Select the transfer destination of measured inclination: [Axis Rot.] or [Angle K].
It is set in the currently selected workpiece coordinate system.
If automatic transfer is not desired, select [None].

2) Operation procedure

(a) Insert the wire, and thread it.

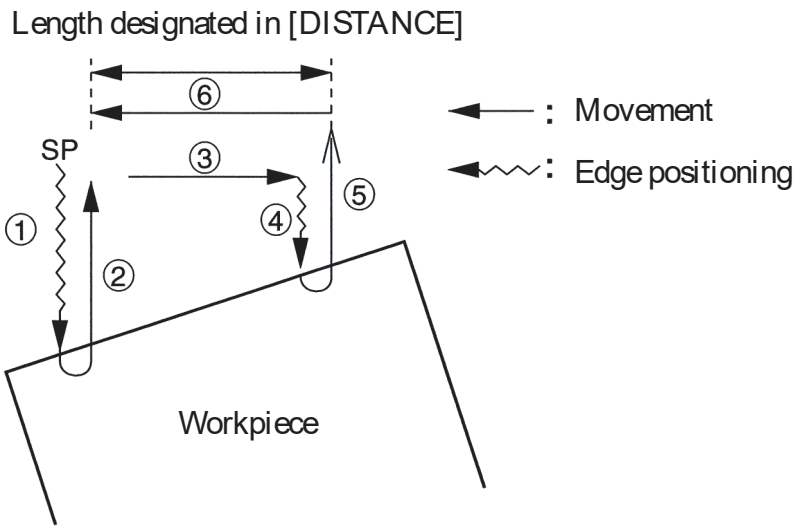
(b) Move to the edge of the workpiece's first measurement point where the wire position is measured.

(c) Select main menus "Operation" > "Work setup" > "WKPC. Pickup" > "Work slope".

(d) Set the setting items shown in 1), and press "START".

(e) Position in the indicated direction as below.

When "1" is selected for the positioning direction; when X is selected for the positioning direction



When "Continuous" is set, "Axis Rot." (Axis rotation) is set regardless of whether the automatic setting object is selected.

(9) Work plane

Use a touch sensor to contact with three points in the workpiece plane. The workpiece inclination is measured automatically.

*** Displayed only when the option of touch sensor is available.**

1) Description of setting items

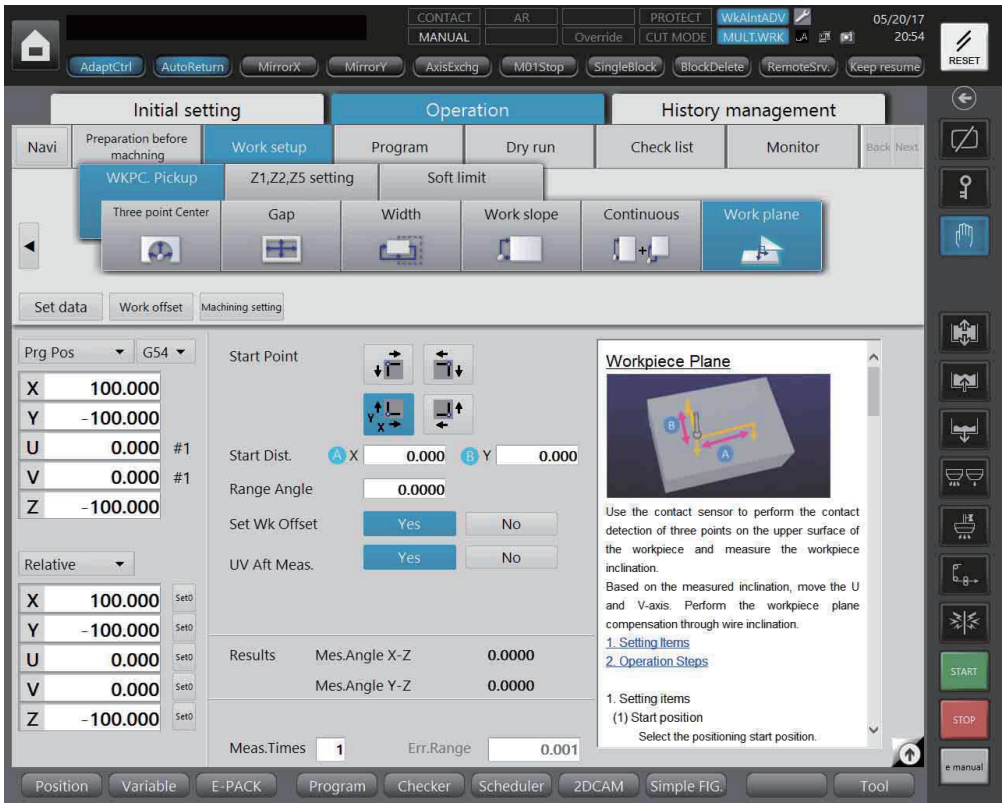


Fig. III.4.9

(a) Start Point

Select a position where positioning starts.

(b) Start Dist.

Input the distances from workpiece contact detection position of point 1 to point 2 and point 3 respectively in the direction of X and Y.

(c) Range Angle

Input the maximum allowable inclination of the measured workpiece.

When 0.0000 is input, inspection of allowable range is not checked.

(d) Set Wk Offset

Select whether to set the workpiece inclination measured to the workpiece coordinate zero point of the workpiece coordinate system selected at the current position.

(e) UV Aft Meas.

Select whether to move the UV axis according to the measured workpiece inclination after the completion of workpiece plane.

2) Operation procedure

(a) Select the touch sensor mode (measuring the probe descending status).

(i) Use M code to select touch sensor mode

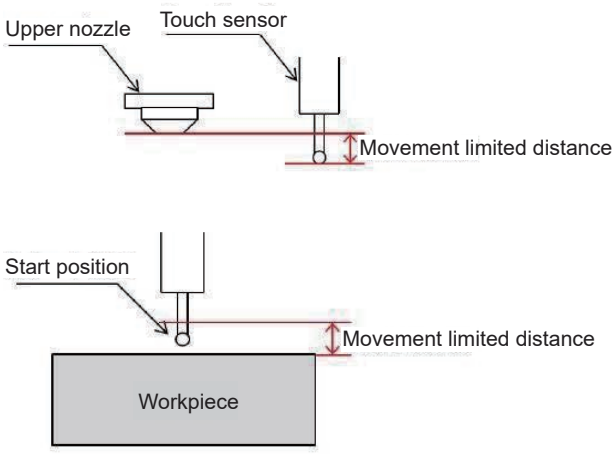
M code	Function	Probe
M62	Touch sensor mode "ON"	Descend
M63	Touch sensor mode "OFF"	Ascend

(ii) Use the action switch to select touch sensor mode

Operation switch	Function	Probe
Touch sensor ▼	Touch sensor mode "ON"	▼
Touch sensor ▲	Touch sensor mode "OFF"	▲

(b) Move the axis and lift the probe end above the workpiece where the first measurement start point is.

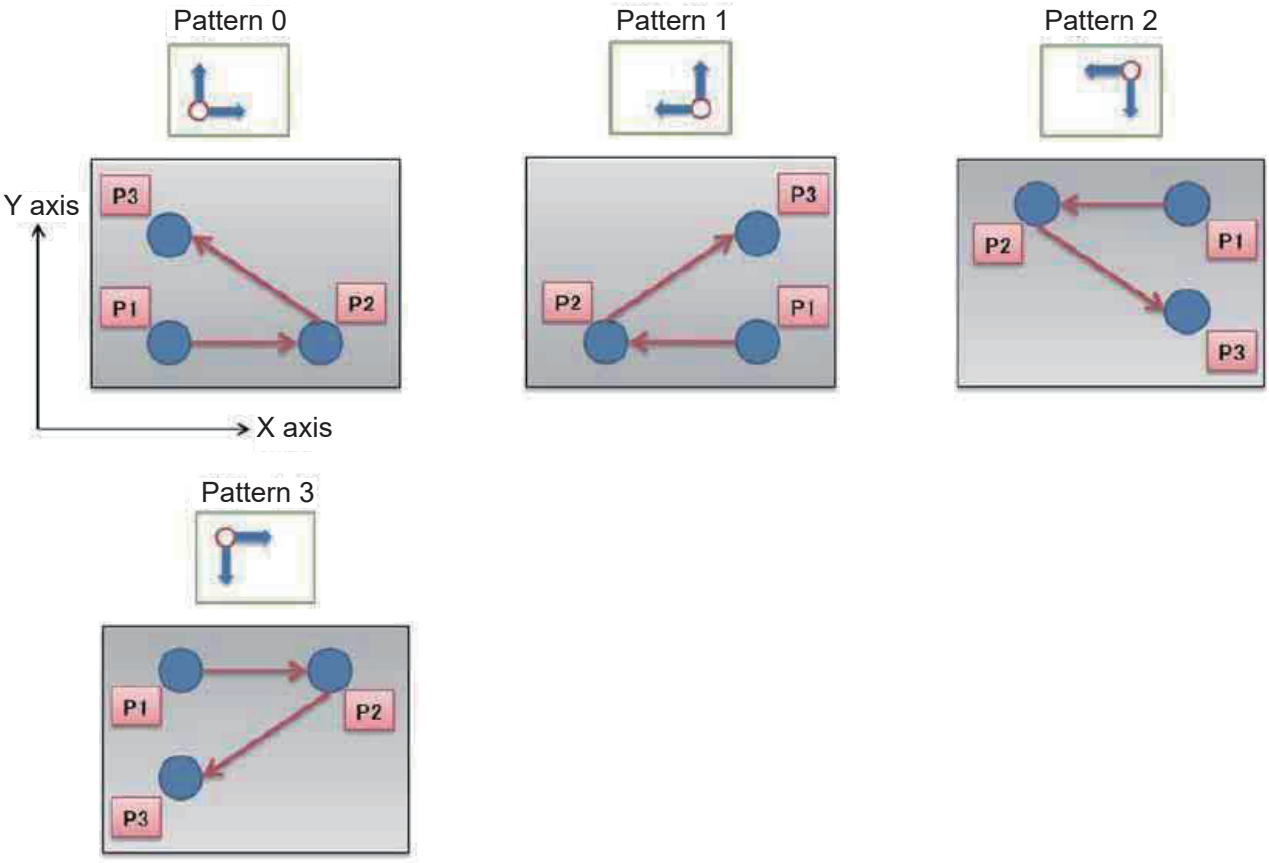
If Z axis movement limit for edge positioning is set, move the probe end from above the workpiece to a height within the limit.



(c) Select main menus "Operation" > "Work setup" > "WKPC. Pickup" > "Work plane".

(d) Set the setting items shown in 1), and press "START".

(e) Position in the indicated direction as below.



Use mirror image, axis replacement, coordinate rotation and graphic scale in OFF status.

(10)Continuous

The workpiece measurement and positioning are performed continuously according to the sequence of "Work slope" and "Corner".

1) Description of setting items

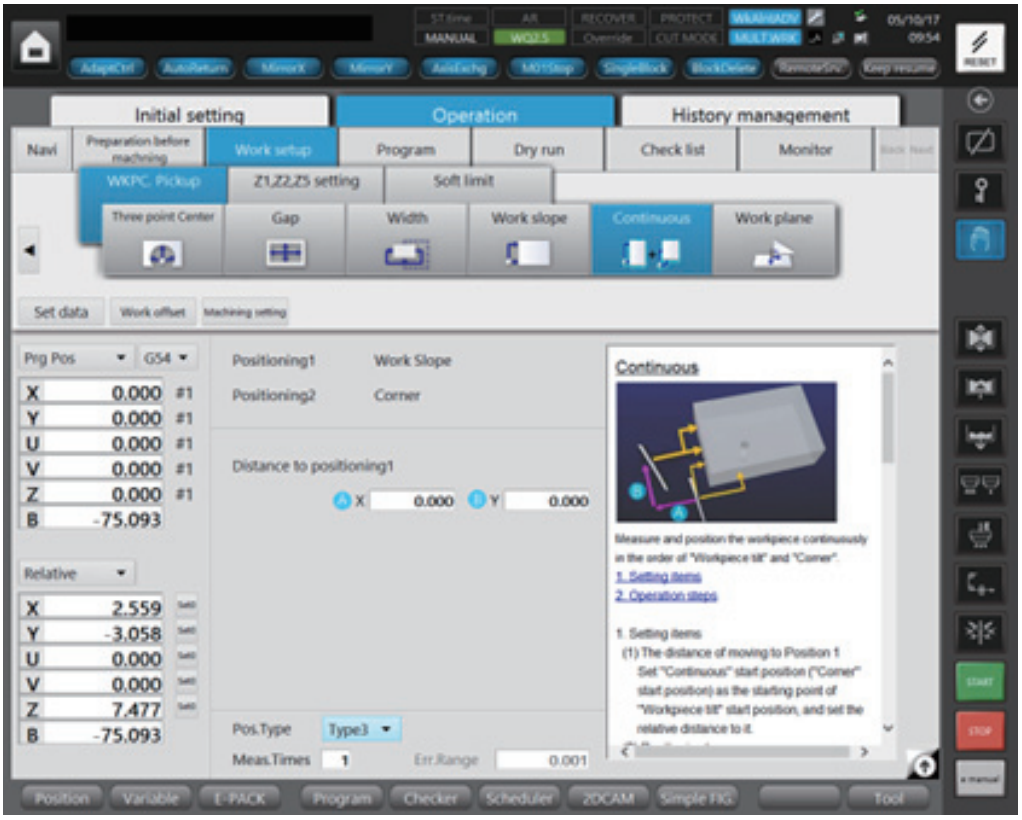


Fig. III.4.10

(a) Distance to positioning1

Set the relative distance from the "Continuous" start position ("Corner" start position) to the start position of "Work slope".

2) Operation procedure

Set the related items according to the sequence of "Work slope (Workpiece inclination)", "Corner" and "Continuous". When the "Start" button is pressed at the starting position of "Corner", the axis will move to the starting position of "Work slope" and start execution from "Work slope".
The detailed operation procedure is provided below.

(a) Insert the wire, and thread it.

(b) Move to the edge of the workpiece's first measurement point where the wire position is to be measured.

(c) Select main menus "Operation" > "Work setup" > "WKPC. Pickup" > "Work slope".

(d) Set the related items on the "Work slope" screen.

(e) Move to the edge of the workpiece's first measurement point where the wire position is to be measured.

(f) Move the axis close to the workpiece corner where the wire position is measured.

(g) Select main menus "Operation" > "Work setup" > "WKPC. Pickup" > "Corner".

(h) Set the related items on the "Corner" screen.

(i) Select "Operation" > "Work setup (Workpiece preparation)" > "WKPC. Pickup" > "Continuous" in the main menu.

(j) Set the related setting items on the "Continuous" screen and press the "START" button.

(k) Execute actions according to the sequence of "Move to the starting position of work slope measurement", "Work slope", "Move to the corner starting position (Continuous starting position)", and "Corner positioning".

- **The result of "Work slope" is set in "Axis Rot." (Axis rotation).**
- **Set "Continuous" after "Axis Rot." (Axis rotation) is canceled.**
- **For "Work slope", set the adjacent surface of "Corner".**

(11)2 Hole Center

Position the center of two holes and measure the angle of inclination and the midpoint between two holes.

1) Description of setting items

Fig. III.4.11

(a) Hole Center Setting

Open the dialog box to set the direction and type etc. of the hole center positioning.

* Setting value for hole center positioning is common to the hole center screen.

(b) AR 0Set

Cancel the axis rotation.

* When the "Work Alignment ADV." switch is ON, the axis rotation in the currently selected workpiece coordinate system is also set to 0.

(c) Distance (relative distance) to Hole 2 X, Y

Set the relative distance from Hole 1 to Hole 2.

* When the axis rotation is set, the axis is moved according to the setting value.
  When canceling the axis rotation, use "AR 0Set".

(d) Raise Axis

Set the movement amount that Z axis is raised to prevent the jig etc. from hitting,
when moving the axis from Hole 1 to Hole 2 and moving the axis from Hole 2 to the positioning end position.

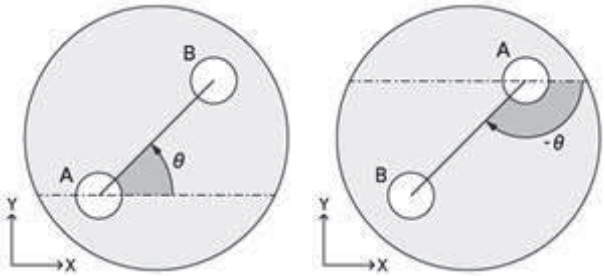
(e) End Position

Select the position when measuring Hole 1 and Hole 2 and finishing the two hole center.
Preset the coordinate at the end position.

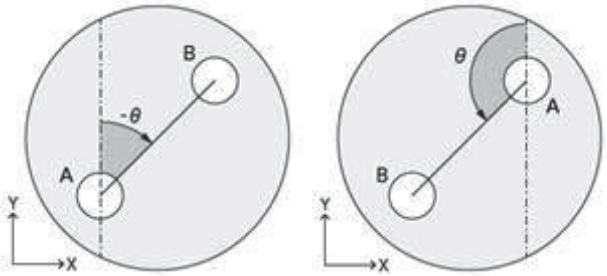
(f) Angle Base Axis

Select the base axis of the Mes. Angle between two holes.

Based on the X axis



Based on the Y axis



(g) Set Wk Coord.

Select the coordinate system to transfer the Mes. Angle and the End Position from the drop-down menu.
It is possible to select whether to transfer the Mes. Angle and the End Position respectively.

(h) Preset Center Pos

Select whether to preset the coordinate system for which the positioning end position is specified.

(i) Preset Val.

Set the coordinates to X axis and Y axis respectively when selecting "Yes" for "Preset Center Pos".

(j) Set Angle To

Select the transfer destination of the measured inclination from "Axis Rot." and "Angle K".
When you do not want to transfer, please select "None".

2) Operation procedure

(a) Move the axis to Hole 1 with axis movement on the manual operation box.

(b) Open "Hole Center Setting" and set the positioning direction, positioning angle, approach length, positioning type, times of repeated positioning and error range of positioning and then press "OK".

(c) Set the approximate relative distance from Hole 1 to Hole 2 to "Distance (relative distance) to Hole 2".

(d) If the jig interferes with the nozzle when moving between each hole, set the height that Z axis is raised to "Raise Axis".

(e) Select the "End Position" for positioning from "Hole 1", "Hole 2" and "Mid Pt.". (Preset the coordinates at the point where the positioning was completed.)

(f) Select the base axis of the Mes. Angle between two holes.

(g) Select "Set Wk Coord." of the measurement results.

(h) When presetting the coordinate, select "Yes" for "Preset Center Pos.".

(i) When using the Mes. Angle of the measurement results, select "Set Angle To".

(j) Press "START".

(k) Positioning is started from Hole 1 to Hole 2 in this order.

* Wire is inserted automatically.

- **When Hole 1 and Hole 2 have different heights, adjust to the higher workpiece height, then start machining.**
- **If the workpiece pickup menu is customized, it may not display after a system update. To show the two hole center, select it in the customization menu.**

4.2.2 Z1,Z2,Z5 setting

See "III. NC OPERATION DISPLAY SCREEN" > "3.1.4 Determine taper specs" > "(1) Z1,Z2,Z5 setting".

4.2.3 Soft limit

Set Z axis limit and soft limit on this screen.

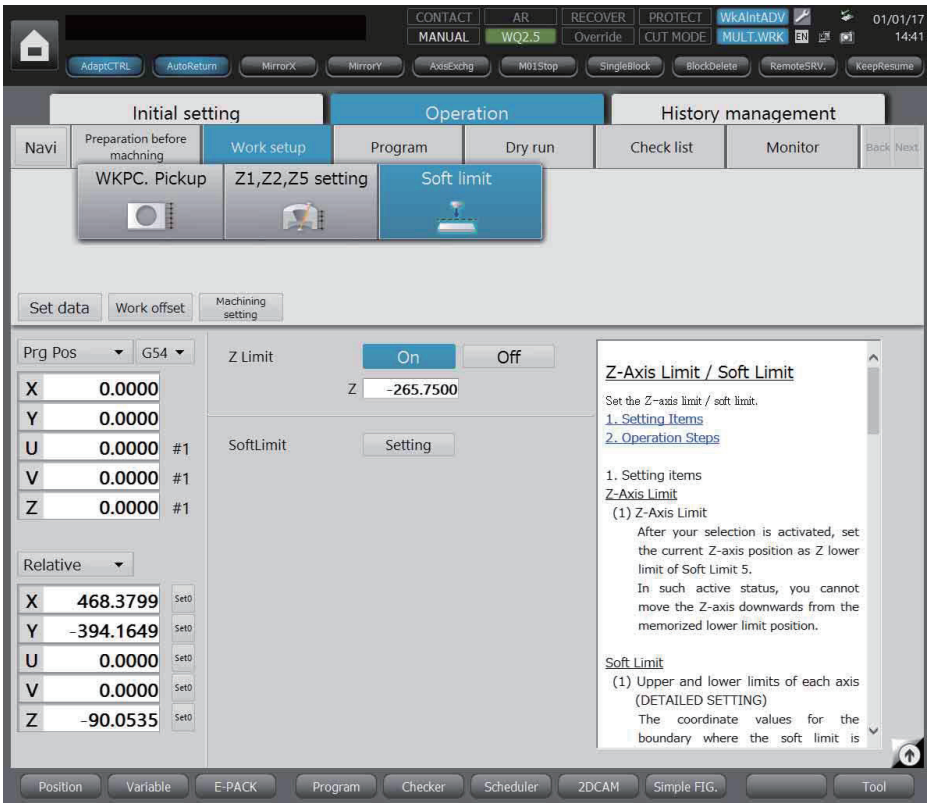


Fig. III.4.12

(1) Z Limit

Z axis soft limit can be set at any position.

1) Description of setting items

(a) Z Limit

By selecting "On", the Z axis position at that time will be set to the lower limit for Z axis of soft limit 5. When it is "On", Z axis cannot be lowered to a position below the lower limit.

2) Operation procedure

(a) Move Z axis to the height where Z axis limit can be activated.

(b) Activate Z axis limit.

[Set from screen]

Select "Operation" > "Work setup" > "Soft limit" on the main menu, set "Z Limit" to ON.

[Set from manual operation box]

Set the "Z limit" of the manual operation box to ON.

(2) SoftLimit

Sets the soft limit for each axis.

With an optional automatic workpiece changer, enter pallet soft limits in "External Signal Data" variables. The soft limit then changes automatically when the pallet changes.

1) Description of setting items

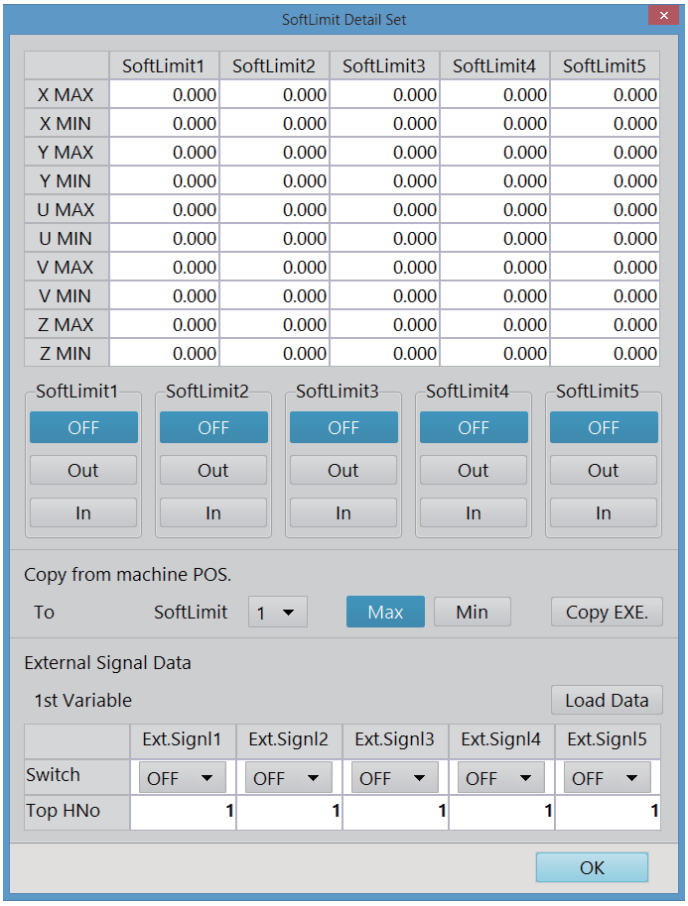


Fig. III.4.13

(a) Upper limit and lower limit of axis (detailed settings)

Define the coordinate value of soft limit boundary. It can be set by any of the following methods.

- Values can be input directly
- Read from machine coordinates
- Read from variables when the external input signal is turned ON

(b) OFF/Out/In (detailed settings)

Select the prohibited range defined by soft limit 1 - 5.

- OFF: no prohibited range is defined.
- Out: define outer side as the prohibited range.
- In: define inner side as the prohibited range.

(c) Copy from machine POS. (detailed settings)

Select the soft limit No. and upper or lower limit to read current machine coordinates.

Press "Copu EXE." to read the machine coordinates into the selected soft limit data.

(d) External Signal Data (detailed settings)

Once any external input signal is received, read the variables to the soft limit data. To use this function, select "ON", and set the variable No. storing the soft limit data.
Press the "Load Data" button to read from the variable to the soft limit data.

2) Operation procedure

[When inputting values directly]

(a) Record the machine coordinates values of the soft limit to be activated.

(b) Select "Operation" > "Work setup" > "Soft limit" on the main menu.

(c) Press "Setting" of soft limit. For any soft limit No., set the machine coordinate values, which form soft limit boundaries, in the "MAX" and "MIN" of all axes.

(d) Select setting items of any soft limit No. from "OFF", "Out" and "In".

[When reading from machine coordinates]

(a) Move the axis to a position where the soft limit is expected to be activated.

(b) Select "Operation" > "Work setup" > "Soft limit" on the main menu.

(c) Press "Setting" of soft limit, select a soft limit No. and "MAX" or "MIN" of "To" under "Copy from machine POS.", and press the "Copy EXE." button.

(d) Select setting items of any soft limit No. from "OFF", "Out" and "In".

[When reading from variables through the input of external input signal]

(a) Select "Operation" > "Work setup" > "Soft limit" on the main menu.

(b) Press "Setting" of soft limit, set the first variable number under "External Signal Data", and press the "Load Data" button.

3) Variable setting method for reading from external input signal

It must be read in sequence from 1 to 5. Enter upper and lower limits for all axes in the sequence X, Y, U, V, Z used as switches and boundaries.

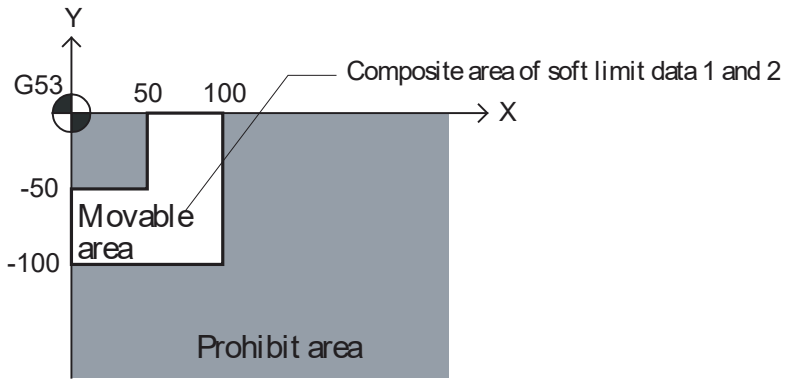
For 5 axis (XYUVZ) models, prepare variables equal to the number of soft limits (5 x 11 = 55). The example below assigns variables for a 5 axis model starting at H501.

	Soft limit No.				
	1	2	3	4	5
Switch 0: Outer side 1: Inner side	H501	H512	H523	H534	H545
Max of X	H502	H513	H524	H535	H546
Max of Y	H503	H514	H525	H536	H547
Max of U	H504	H515	H526	H537	H548
Max of V	H505	H516	H527	H538	H549
Max of Z	H506	H517	H528	H539	H550
Min of X	H507	H518	H529	H540	H551
Min of Y	H508	H519	H530	H541	H552
Min of U	H509	H520	H531	H542	H553
Min of V	H510	H521	H532	H543	H554
Min of Z	H511	H522	H533	H544	H555

4) Example of setting soft limit

When set as follows, the movable range and prohibited range will be as shown in the figure.

	Switch	Boundary	X	Y
SOFT LIMIT 1	OUTER SIDE	MAX	100.000	0.000
		MIN	0.000	-100.000
SOFT LIMIT 2	INNER SIDE	MAX	50.000	0.000
		MIN	0.000	-50.000



4.2.4 Auxiliary menu

(1) Set Data

See "III. NC OPERATION DISPLAY SCREEN" > "3.1.6 Set Data".

(2) MDI

See "III. NC OPERATION DISPLAY SCREEN" > "3.1.11 MDI".

(3) Work offset

See "III. NC OPERATION DISPLAY SCREEN" > "4.1.3 Auxiliary menu".

(4) Current E-pack

See "III. NC OPERATION DISPLAY SCREEN" > "3.1.9 Current E-Pack".

(5) Machining setting

See "III. NC OPERATION DISPLAY SCREEN" > "3.2.11 Machining setting".

(6) Two point Center

Calculate the Mes. angle and the midpoint between 2 points from 2 measurement points.

1) Description of setting items

Fig. III.4.14

(a) Angle Base Axis

Select the base axis for the Mes. angle between the 2 points.

* When the angle base axis is changed, the Mes. angle is automatically calculated.

(b) Clear Mes. Pos

Clear the measurement points that have been input.

(c) Input of Mes. Pos 1 and 2

The current machine coordinate values are input at the measurement points.

* When the "Input" button is pressed, the Mes. angle and center position are automatically calculated.

(d) Set Wk Coordinate

Select the coordinates to transfer the Mes. angle and center position from the drop-down menu.

(e) Set Angle To

Select the transfer destination of the measured inclination from "Axis Rot." and "Angle K".

When you do not want to transfer, please select "None".

(f) Preset Center Pos

Select whether to preset the center position.

Transfer the center position to the workpiece coordinates in "Set Wk Coordinate" to make it a value set as a preset value.

(g) Preset Val.

If "Preset Center Pos" is set to "Yes", the center coordinate is set to the X axis and the Y axis separately.

(h) Transfer

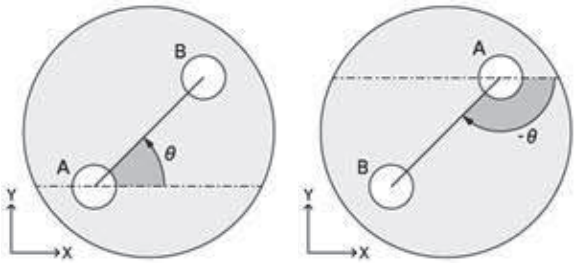
When "Transfer" is pressed, the Mes. angle and center are set for the specified "Set Angle To" and "Work Offset".

When changing the inch/metric unit, the measurement point is not converted. Read the measurement point again.

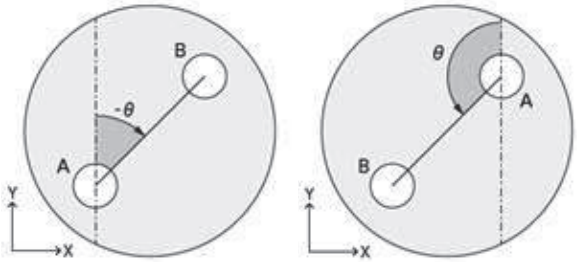
2) Operation procedure

(a) Set the angle base axis.

Based on the X axis



Based on the Y axis



(b) Measure Measurement Point 1 at the hole center with the manual operation box.

(c) Press [Input] for Measurement Point 1.

(d) Same as Measurement Point 1, measure Measurement Point 2.

(e) Press the [Input] button of Measurement Point 2.

(f) Select "Set Wk Coordinate" from the results.

(g) Confirm the Mes. angle of the measurement result, and select "Set Angle To" when using it.

(h) Check the center coordinates and, to preset, select [Yes] for "Preset Center Pos".

(i) Press [Transfer]. The Mes. angle and center are set to the specified "Set Angle To" and "Work Offset".

4.3 Program

In the Program screen, read in the NC program for machining.

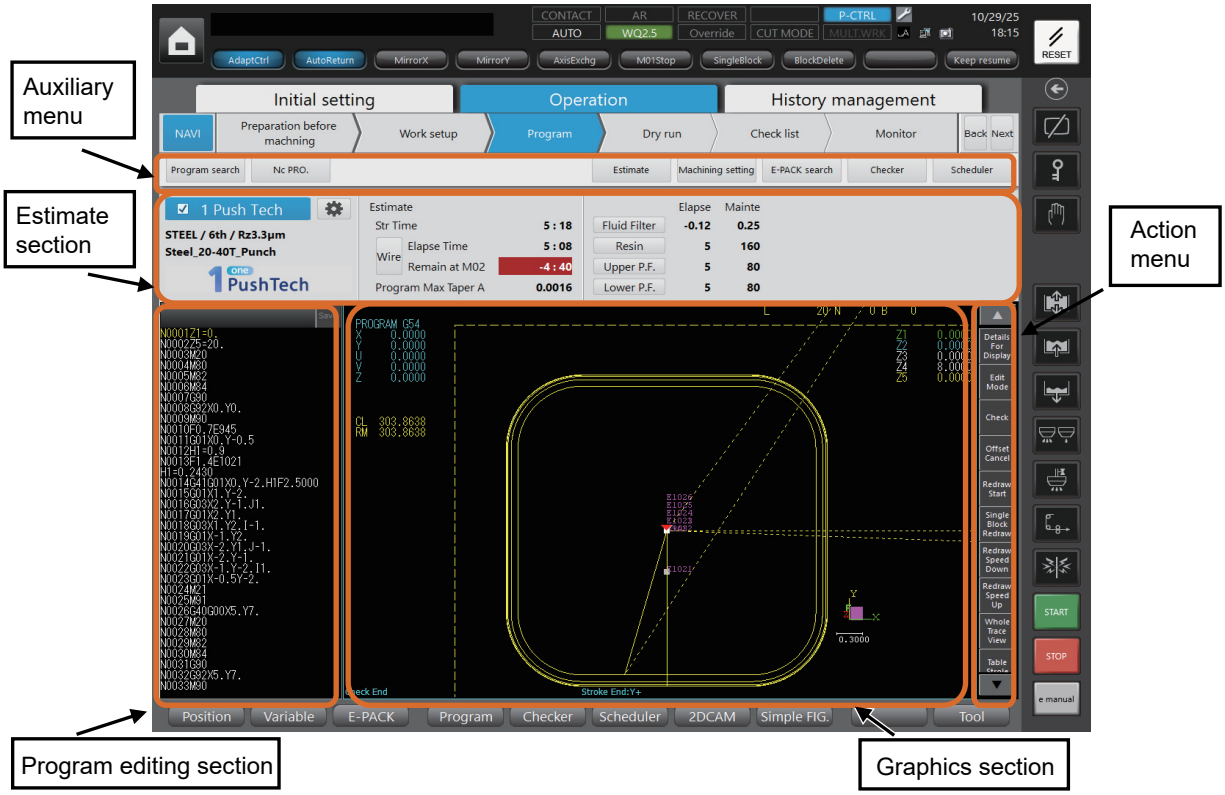


Fig. III.4.15

4.3.1 Auxiliary menu

(1) Program search

Search for the program to execute, and perform the test drawing.
The drawing process can be aborted by pressing the "Esc" key.

This function does not work when the program is running.

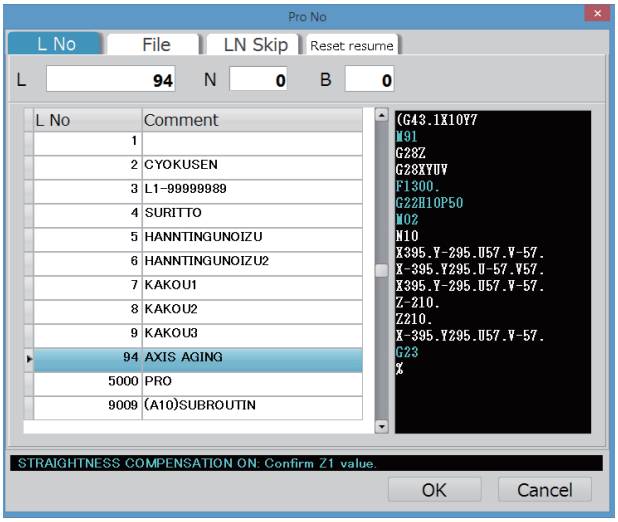


Fig. III.4.16

When the "Straight" switch is set to ON, the message "STRAIGHTNESS COMPENSATION ON: Confirm Z1 value." will be displayed.

1) L No.

(a) [L] [N] [B]

Enter the number of program to be executed [L], sequence number [N] and program segment number [B].

Acceptable characters: eight half-width characters for [L], four half-width characters for [N] and four half-width characters for [B].

(b) [File list display]

Displays a list of NC programs. Name of the selected file can be displayed in the program No. [L].

(c) [File content display]

Displays the contents of the file(s) selected in [File list display]. It cannot be edited.

(d) [OK] button

Button for determining the selected NC program.

(e) [File list display]

Enter the number of program to be executed [L], sequence number [N] and program segment number [B].

2) File

Search through the files in the HD, the flash disk and the network for program to be executed.

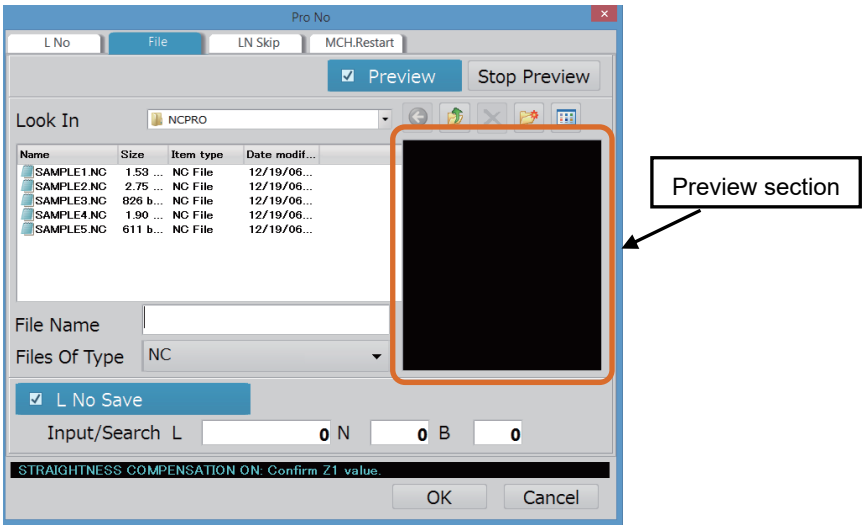


Fig. III.4.17

(a) [Look In]

Select the file location.

(b) [Buttons]

: Moves to the last used folder.

: Moves up to the folder one level above.

: Deletes the selected folders and files.

: Adds a new folder.

: Displays the Display menu. Displays the drop-down list. It can be switched to display by browser.

(c) [Browser]

Displays the content of the folder specified in [Look In].

(d) [File Name]

The file name can be designated with the following two methods.

- Designate file name from the browser
- Directly input file name into [File Name] input field

Observe the following when specifying or entering a file name:

- **For files in Expand Object folder (D: MYDATA SYSTEM) with path, keep file name under 120 bytes.**
- **File name length max 255 bytes, and under 259 bytes including path.**
- **Do not use \ / : * ? " < > |.**
- **File name language must match the machine OS code language. Japanese is SJIS only.**

(e) [Files Of Type]

Select one from "NC program (*.NC, *.TXT)" or "All files (*.*)".

(f) [Preview]

Set the switch to ON. Contents of the selected file are displayed in the preview screen.

(g) [Stop Preview]

Press this button to abort the preview.
When it takes a longer time to display the preview due to the influence of program data capacity and network, you can use this button to abort the preview display.

(h) [L No Save]

Press this switch to register the specified file to the entered L No. Additionally, N and B can be set for file search.

(i) [OK]

Close the dialog box to search for and check the selected file at the same time.
When two or more L No. files are selected, they will be partitioned for storage. When the normal operation is completed, the name of file found is displayed on the graphics screen.

When double-byte character code is included, once any character code is displayed in the position violating correct input format, an input error will be reported.

(j) [Cancel]

Make no settings and close the dialog box.

3) LN Skip

(a) LN Skip action

LN Skip function involves skipping to the [L] [N] [Skip Count] position specified on the LN screen, and automatically positions to the next machining position. It will stop after the movement.

- **Before starting, perform positioning to the initial position of the machining program.**
- **Move to the next machining position in a straight line. Note: avoid any obstacle.**

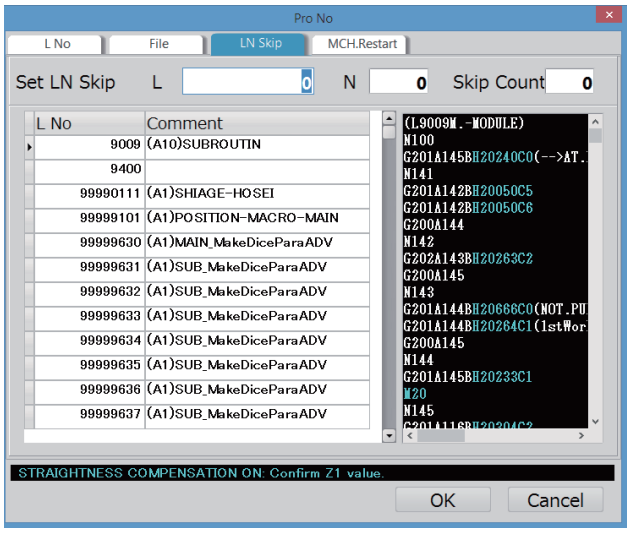


Fig. III.4.18

(i) [L][N][Skip Count]

L: Program number to be executed

N: Sequence number to be executed

(ii) [File list display]

Displays a list of NC programs. Name of selected file can be displayed in the program No. [L].

(iii) [File content display]

Displays the contents of the file(s) selected in [File list display]. It cannot be edited.

(iv) [OK] button

Button for determining the selected NC program.

(v) [Cancel] button

Make no setting and close the dialog box.

(b) LN skip details

Once it is activated, the program will skip to the position with the designated sequence No. and the skip times.

(i) Cut wire before movement.

(ii) Move the skip stop position in a straight line.

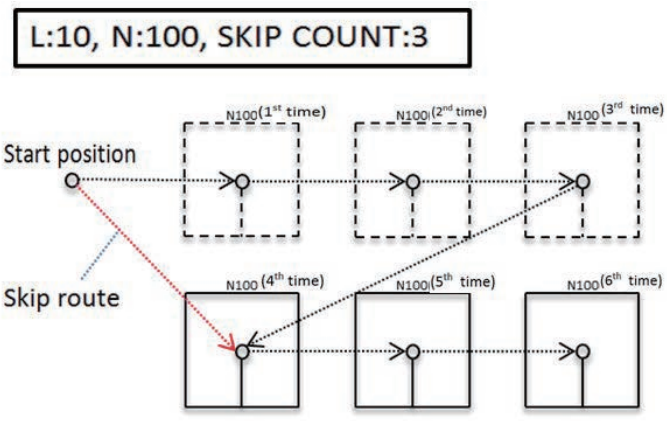
(iii) After completion of movement, "T308 LN SKIP COMPLETE" will be displayed before stop.

(c) LN skip example

(i) Repetitive machining for the same sequence No.

In the LN Skip screen, designate L: 10 N:100 skip times: 3

1st - 3rd N100 machining will not be performed; it will move to the start position of the 4th N100 in a straight line.

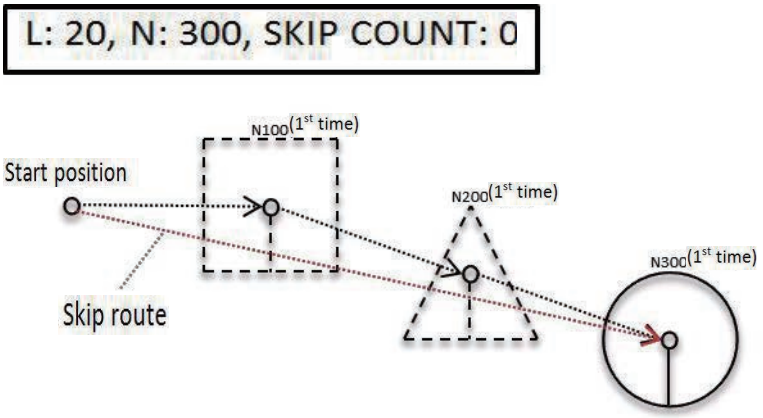



```
L10
...
N100 (KAKOUPROGRAM)
M20 ..... Wire insertion
M80 ..... Dielectric fluid ON
M82 ..... Wire ON
M84 ..... Machining ON
M90F1. ..... Optimum control ON
G42Y-5. ..... Shape machining
G01X-5. ..... Shape machining
G01Y10. ..... Shape machining
G01X10. ..... Shape machining
G01Y-10. ..... Shape machining
G01X-5. ..... Shape machining
G40Y5. .....Shape machining
M21 ..... Wire cut

...
```

(ii) Repetitive machining for different sequence Nos.

In the LN Skip screen, designate L: 20 N:300 skip times: 0

N100 and N200 machining will not be performed; it will move to the start position of N300 in a straight line.



(d) Limits on LN skip

(i) Sequence numbers in subprograms cannot be searched.

(ii) Do not use these G codes in skipped programs: G14, G28, G29, G30, G48, G60, G78.

(iii) Cannot be used with high speed re-machining skip. LN skip mode makes it inactive.

(iv) If power fails or is turned off during LN skip, errors may occur if continued. Reset and run again.

(v) Do not use axis rotation or axis magnification in programs skipped by LN skip.

(vi) M codes inside LN skip are not handled. Specify required M codes after the sequence No.

- **Avoid specifying sequence No. in offset.**
- **The last E command value in the skip remains valid.**

4) MCH.Restart

The machining restart function continues automatic operation from the abort position (reset position*) after a reset due to “Insert machining with higher priority” or an alarm.

*** The reset position is where automatic operation ends due to reset. If a stop command halts automatic operation and you reset after manual axis movement, the stop command position is the reset position.**

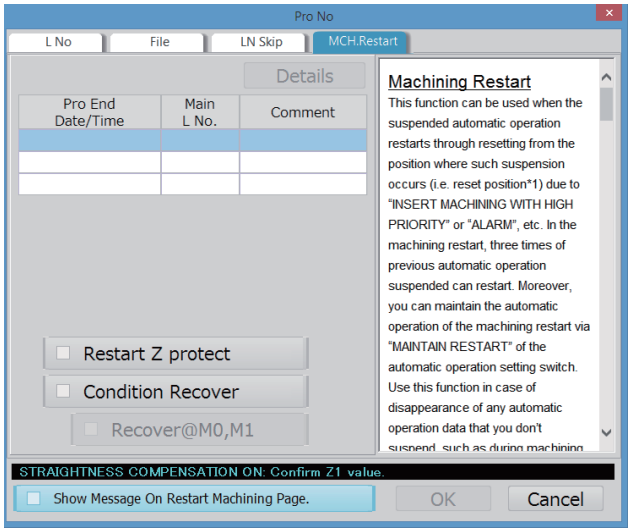


Fig. III.4.19

(2) NC Pro

This screen is for creating or editing an NC program (select the overlapping menu "Program").

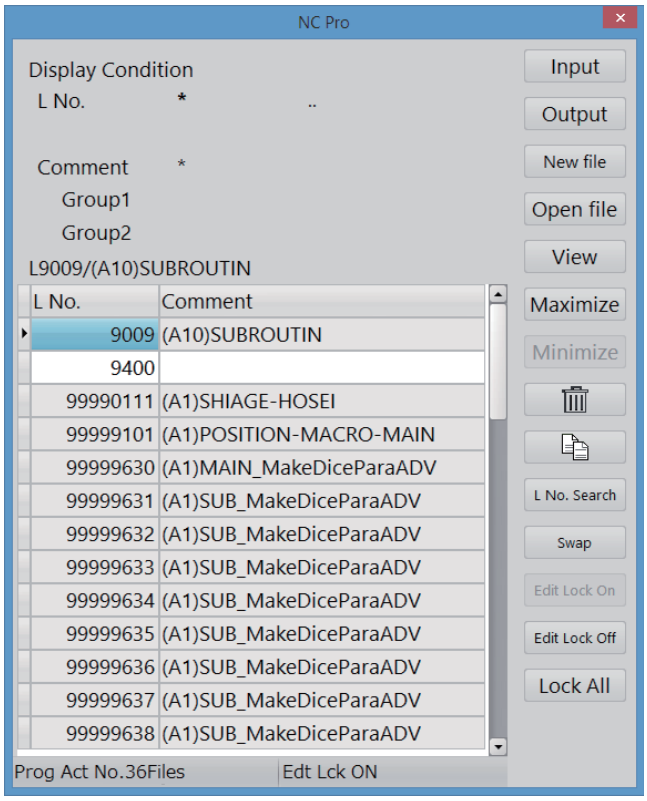


Fig. III.4.20

1) [Input]

Specify the HD and file on the network and enter the NC program. Input the L No. to be registered in the "Input L No.".

Turning ON the "Input All Files" switch inputs all the NC programs in the folder.

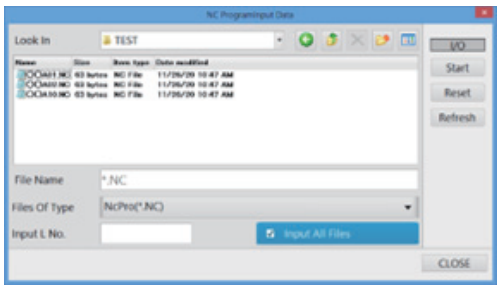


Fig. III.4.21

1. **If an incorrect format is used for the NC program, an input error occurs.**

Examples of input errors

• Without a percent symbol (%)

Example)

L 100/

%

If there is no percent symbol (%) before/after the NC program, an input error occurs.

• English texts used before a slash (/)

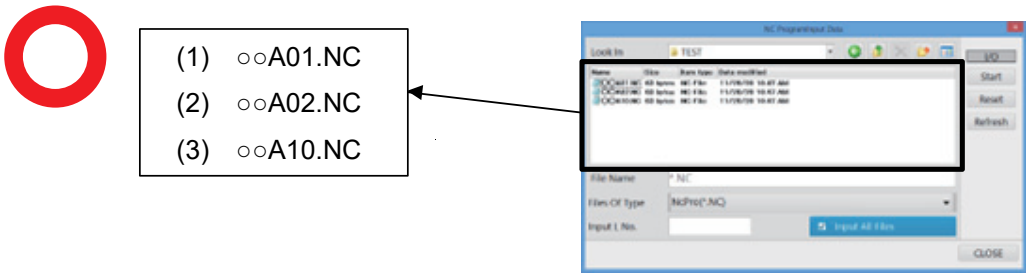
Example) %

L 100/

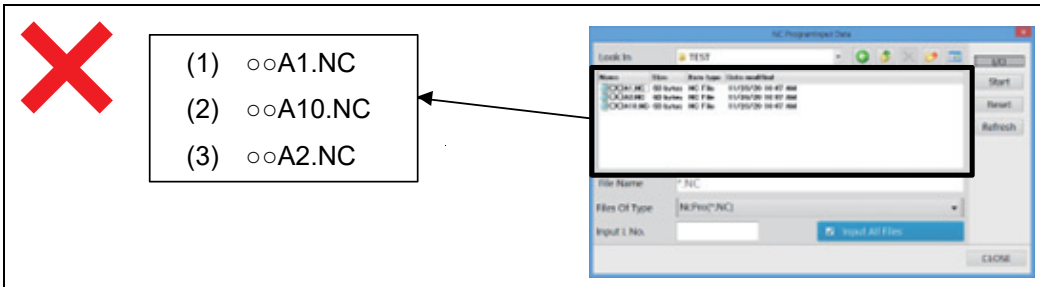
%

If English texts are used before a slash (/), an input error occurs. After a slash (/), English texts can be used because they are regarded as comments.

2. **[Input] of the NC program overwrites data on the NC program even with [Edit Lock] ON. Check if it is OK to overwrite data on the inputting NC program beforehand.**
3. **Name the files in the folder in ascending order on the NC program as shown below.**



* Putting 0 at the beginning of numbers as above inputs files in a folder in ascending order.



* Without 0 at the beginning of numbers, files are input as above, not in ascending order.

4. **Specifying "Input L number" with "Input All Files" checked inputs serial L numbers. Therefore, be careful when specifying an L number as the sub-program. The program will not be called.**

2) [Output]

Specify the HD and file on the network and output the NC program. Input the L No. to be output in the "Output L No.".

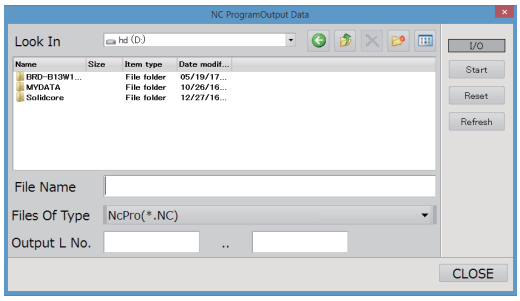


Fig. III.4.22

3) [New file]

An NC program can be created. Up to two screens can be displayed.

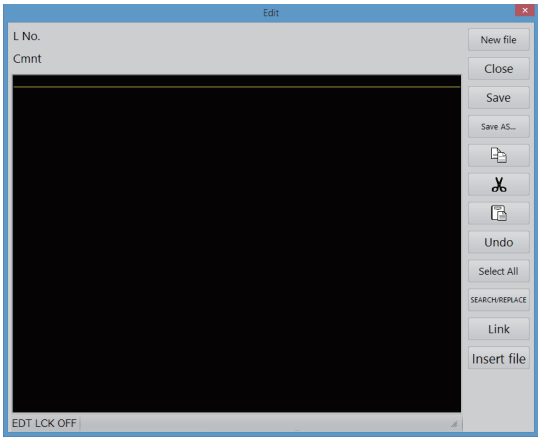


Fig. III.4.23

(a) [New file]

The editing screen is displayed in two screens.

(b) [Close]

Closes the Edit screen. When it is displayed in two screens, the one in the editing mode will be closed. It will be changed to single screen display.

(c) [Save]

For a newly created program, the "Save AS..." screen will be displayed in the same manner as "Save AS..." is pressed. In editing an existing program, the program will be overwritten.

(d) [Save AS…]

Displays the "Save AS..." screen.

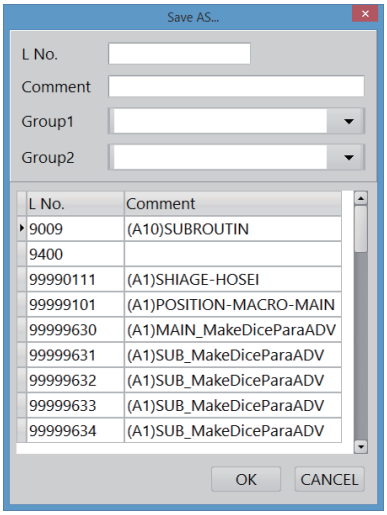


Fig. III.4.24

(e) [Copy]

Copies the selected program code.

- Selecting the range -

Move the cursor (move the │ mark with arrow key) to the start position of the selected range, hold the mouse, and press the arrow key for the times corresponding to the required No. of characters. The highlighted section is the selected range.

(f) [Cut]

Cuts the selected program code.

(g) [Paste]

Pastes the copied or cut program code to the selected position.

(h) [Undo]

The last editing step is undone.

(i) [Select All]

Specifies all the contents displayed as a range. Use this to cut or copy an entire NC program that has been created up to that point.

(j) [SEARCH/REPLACE]

Used to search for and replace a designated character string. Set the search/replace condition, and then press the corresponding button for the desired operation.

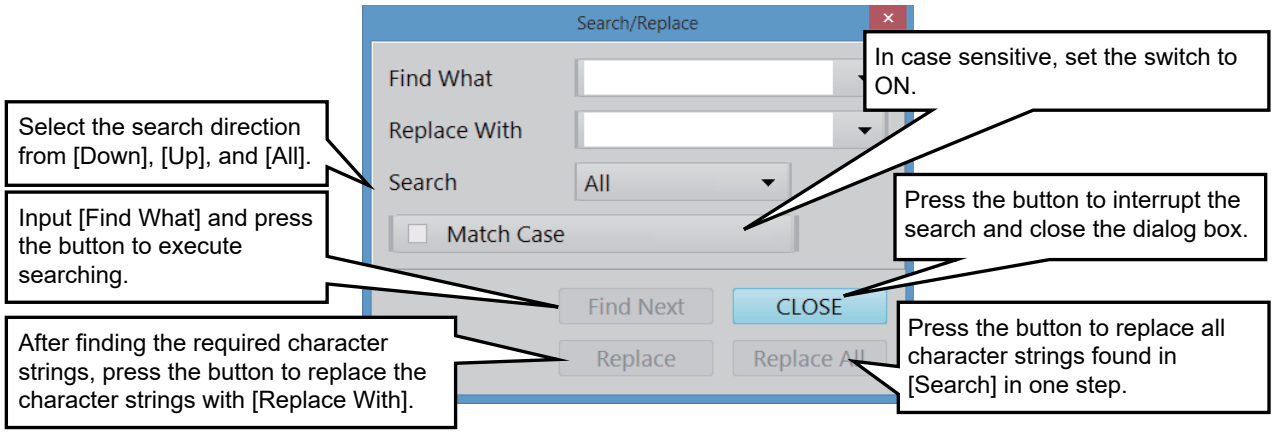


Fig. III.4.25

(k) [Link]

Press the "Link" button in the specified line to call the desired L No., E-Pack No., and ME-Pack No.

(l) [Insert file]

When the program No. calling screen is displayed, select the L No. to be inserted before pressing the "OK" button.

4) [Open file]

Displays the selected L No. in the editing screen. For instructions of the editing screen, see Item 3 above.

5) [View]

L Nos. displayed in the NC program list can be specified as display conditions.

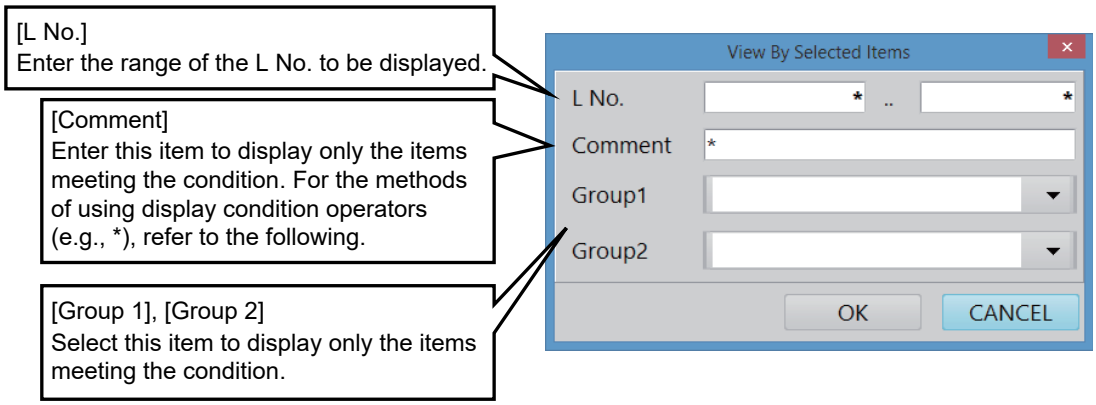


Fig. III.4.26

Display target	Operator	Example
Any one character	?	When "s?t" is set, "sat" and "set" can be displayed.
Any character string	*	When "s*d" is set, "sad" and "started" can be displayed".

6) [Maximize]

Maximizes the NC program screen.

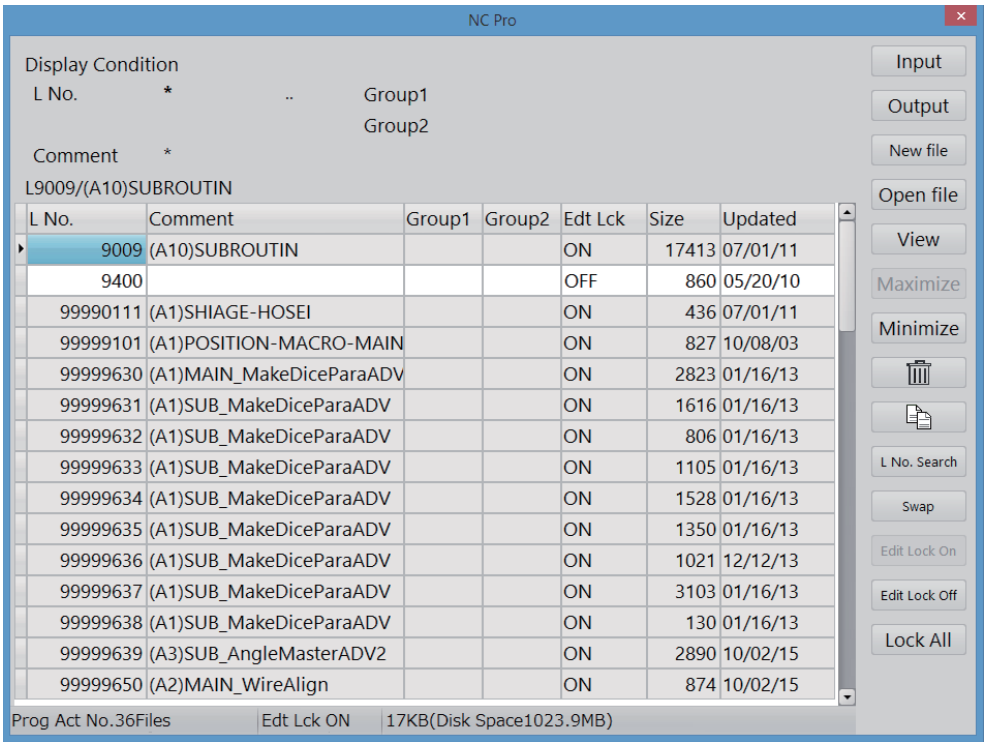


Fig. III.4.27

7) [Minimize]

Returns the maximized NC program screen to its original size.

8) [Delete]

Displays the delete screen. Input the L No. to be deleted. Press the "OK" button to delete the specified L No.

9) [Copy]

Select an L No. on the NC program screen and press "Copy" to open the file copy screen. Enter the target L No. and press "OK". The selected L No. is copied to the specified L No.

10) [L No. Search]

Displays the L No. search screen. Enter the L No. and press Enter to move to that position in the NC program.

11) [Swap]

The character string is replaced on a file-by-file basis on the basis of the definition file.

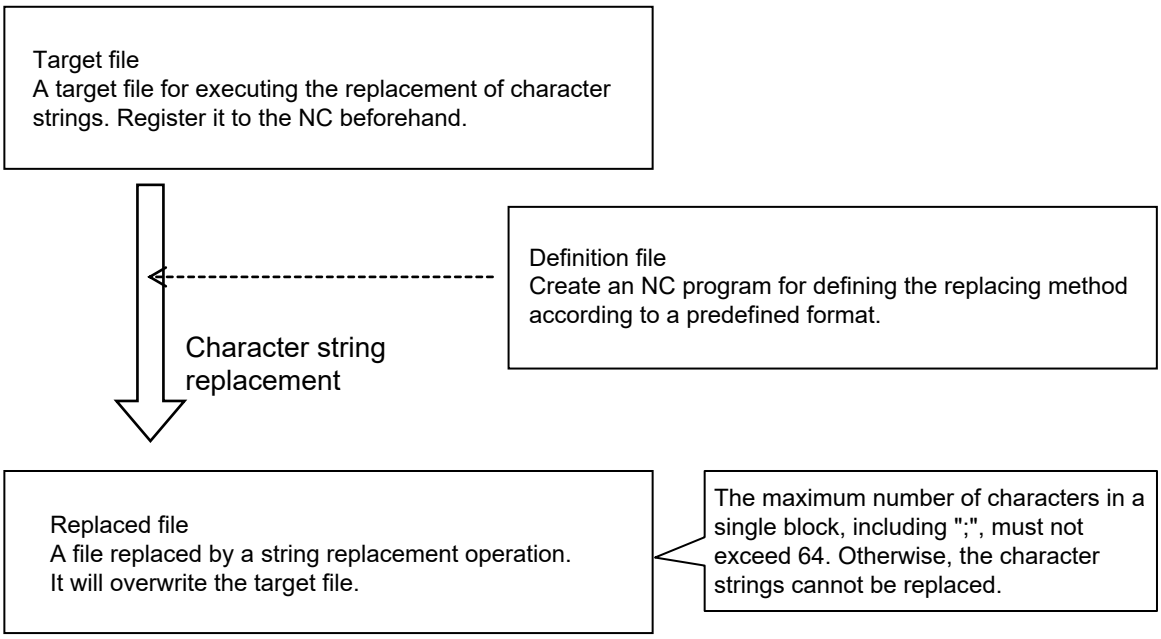


Fig. III.4.28

The operation procedures for character string replacement are shown below.

(a) Create a definition file, and register it to the NC program.

If A is the string before replacement and B is after, create a definition file in this format:

Definition sentence: A(B)

If multiple definitions exist, only the first counts.

To delete A, leave the brackets empty (no space):

A()

(b) Executing character string replacement

Confirm the target file is registered in the NC program. Press "Swap", then specify the target file and the definition file on the character string replacement screen. Create the definition file in "L1" and execute the replacement with "L2" as the target file.

(i) When it is unnecessary to keep L2 before replacement

Input and enter [OK] as shown below to perform character string replacement.

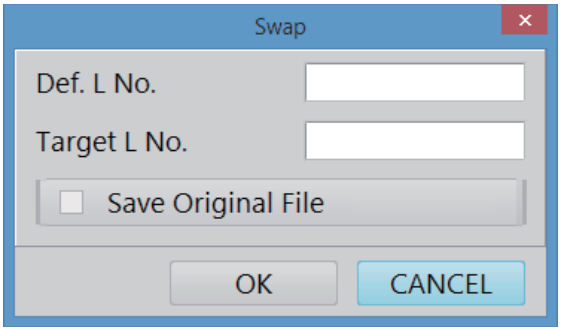


Fig. III.4.29

(ii) When "Save as" is performed to L2 before replacement

Set [Save Original File] to ON. When you press [OK] for string replacement, the pre-replacement L2 is saved as L2.ORG. If L2.ORG exists, choose overwrite or save under a different name. (Extension .ORG)

Character string replacement examples:

Example 1)

Definition file	Target file	Converted file
M20(M80) F50(F100)	M20F50F50M20	M80F100F100M80

Example 2) To delete the characters in the target file

Definition file	Target file	Converted file
M20() F50(F100)	M20F50F50M80	F50F100M80

Example 3) Execution example of repetitive definition.....Only the first definition sentence is valid.

Definition file	Target file	Converted file
M80(M82) M80(M90)	M80M82M84	M82M82M84

Example 4) Execution example of the double replacement.....Converted character cannot be transformed further.

Definition file	Target file	Converted file
M80(M82) M82(M90)	M80M82M84	M82M82M84

Table III.4.1

Message	Details
PROGRAM No. ERROR	The original file and definition file cannot be found.
L NO. DUPLICATION	The converted file already exists.
EXCHANGING CHR	The character string replacement is being executed.
EXCHANGE CHR FIN	The character string replacement has been completed.
DEF. CHR ERR	The definition character in the definition file is illegal, or a block other than the designated format was found in the definition file.
DEF. NO. ERR	The number of definition characters has exceeded the maximum number of characters.
MAX CHR OVER	The converted block has more than 64 characters.

12) [Edit Lock On]

Select an L No. and press the "Edit Lock On" button to disable program editing.

13) [Edit Lock Off]

Select an L No. with "Edit Lock On" and press the "Edit Lock Off" button to enable program editing.

14) [Lock All]

In the "Edit Lock Setting" screen, select the program to set Edit ON or OFF. You can use operators (*, ?) in "L No. to replace" to batch set or release edit lock for multiple files.

Example: To lock programs L00100 to L00199, enter a pattern covering 100 to 199.

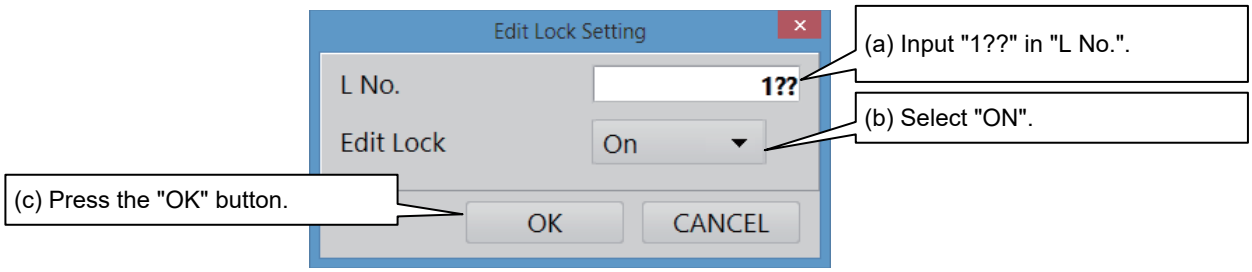


Fig. III.4.30

(3) Machining setting

See "III. NC OPERATION DISPLAY SCREEN" > "3.2.11 Machining setting".

(4) E-Pack search

E-Pack search uses a shape-based program with simple buttons for downward machining to search conditions and create a program. Add the maker's optimal condition No., offset, and set speed to the main program.
<Difference between search results of E-Pack search and ME-Pack search>

Search method	ME-Pack No.	E-Pack No.	Search result
E-Pack search	This section is not used.	500 -	The machining condition No. provided by the manufacturer., offset, and set speed are added to the main program.
ME-Pack search	9000 - 9099	900000 - 909919	Special E-Pack Nos. corresponding to ME-Pack Nos. are added to the main program. If the dedicated E-Pack No. is specified from the NC program, the offset, set speed, and adaptive control registered in ME-Pack will be set automatically.
	9100 - 9199	910000 - 919919	The segment is used to copy and save ME-Pack created in 9000 - 9099. When ME-Pack is copied, E-Pack No. will be copied in the relationship shown in the following table.

There are the following relation between ME-Pack No. and E-Pack No.

ME-Pack No.	E-Pack No.
9000	900000 to 900019
9001	900100 to 900019
…	
9099	909900 to 909919
9100	910000 to 910019
9199	919900 to 919919

There are 20 E-packs for one ME-pack.

*** The command is sent using E-Pack No. from the NC program. ME-Pack No. is used for combined management in the screen, and it cannot be sent from the NC program.**

Example) < Previous command >

H10 = 0.01
E702
G01X5.Y5.G41H10F10.0

< Command with ME-Pack applied >

E900001 … Includes E-command, F-command, and offset settings
G01X5.Y5.G41 … Offset direction command only

1) Explanation of the screen

(a) E-Pack/ME-Pack search

Searches for the optimal machining conditions provided by the manufacturer by entering search items (machining details). How to search:

(i) Condition search

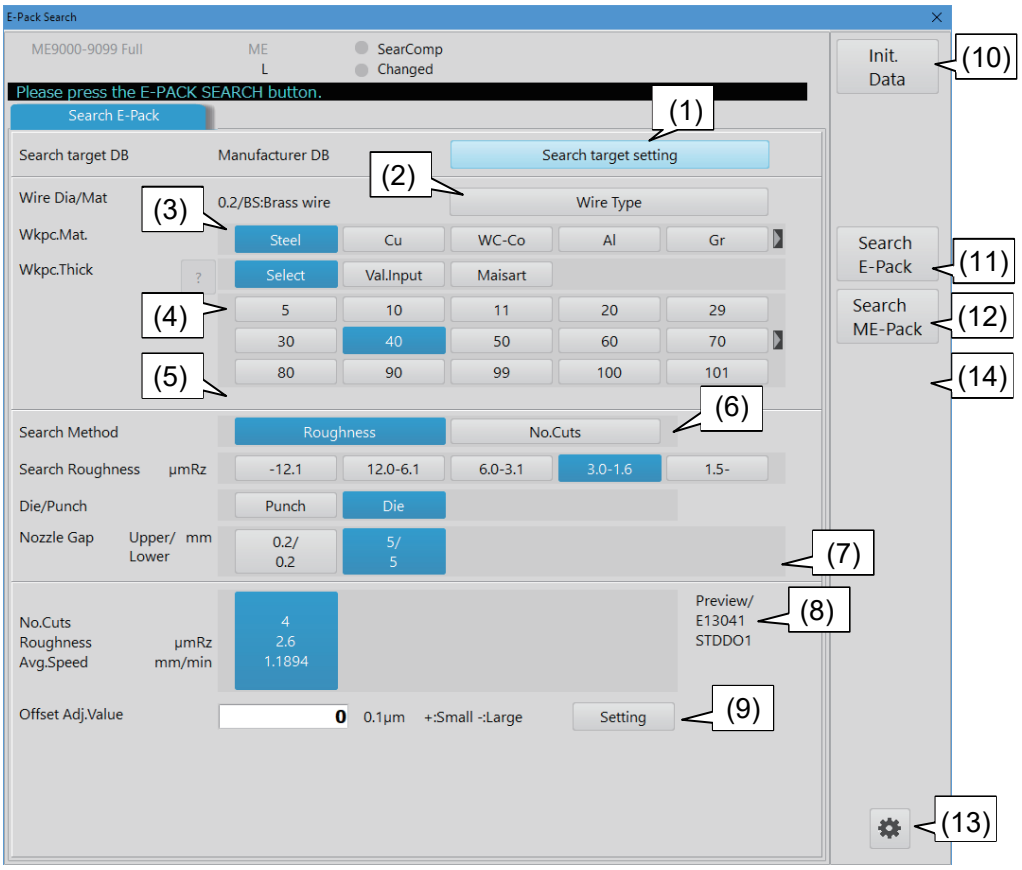


Fig. III.4.31

(1) Search target machining condition

(2) Wire type setting

Select the wire diameter/wire type to search for machining conditions.

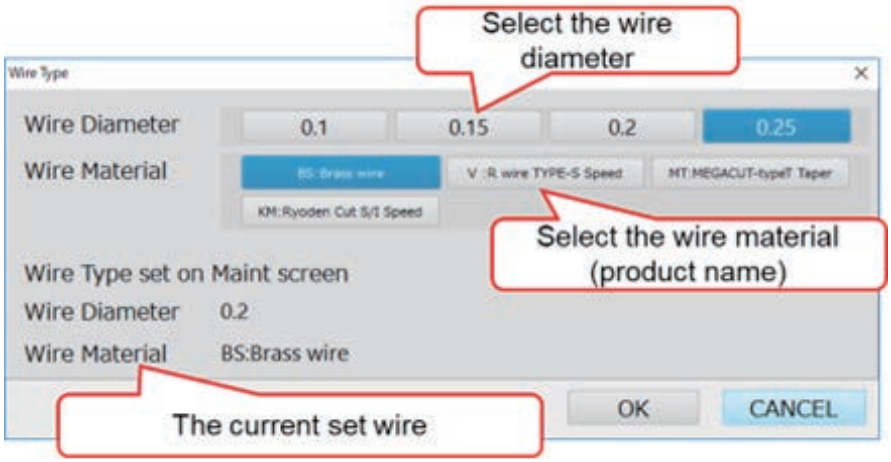


Fig. III.4.32

(3) Workpiece material

(4) Selection of workpiece thickness

(5) Selection of taper angle

(6) Selection of search method

(7) Selection of machining type

(8) Selection of nozzle gap

(9) Selection of machining condition

(10) Offset adjustment

(11) Data initialization

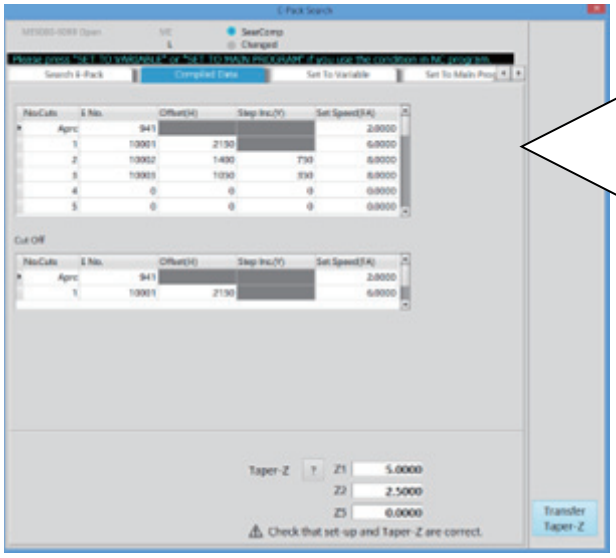
(12) E-Pack search

(13) ME-Pack search

(14) Gear button (Setting)

(15) Header search

(b) When [Search E-Pack] is selected



(1) Check the content of the searched results. Change them on the screen if necessary.

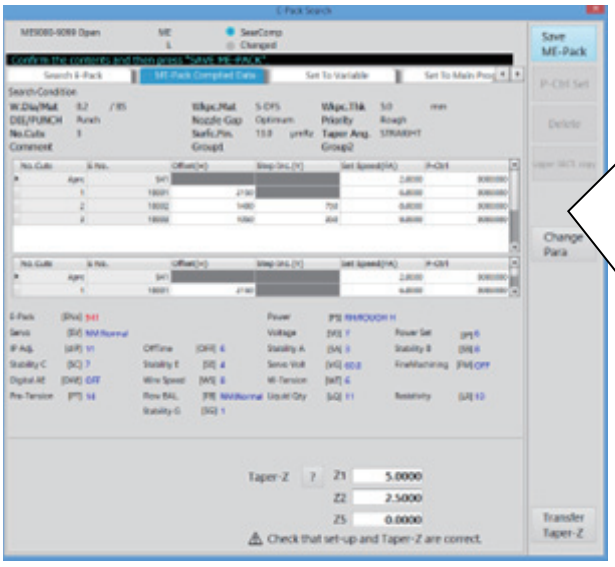
(2) To set the taper specifications to the machining data, select [Transfer Taper-Z].
For details, refer to this section "When setting taper specifications to machining data".

(3) To create a machining program, select [Set to Main Program]. To output the searched results to variables, select [Set to Variable].

* "Cut off" is displayed only when "Punch" is selected for [Die/Punch].

Fig. III.4.33

(c) When [Search ME-Pack] is selected



(1) Check the content of the searched results. Change them on the screen if necessary.

(2) To set the taper specifications to the machining data, select [Transfer Taper-Z].
For details, refer to this section "When setting taper specifications to machining data".

(3) After the completion of the operation, select [Save ME-Pack].

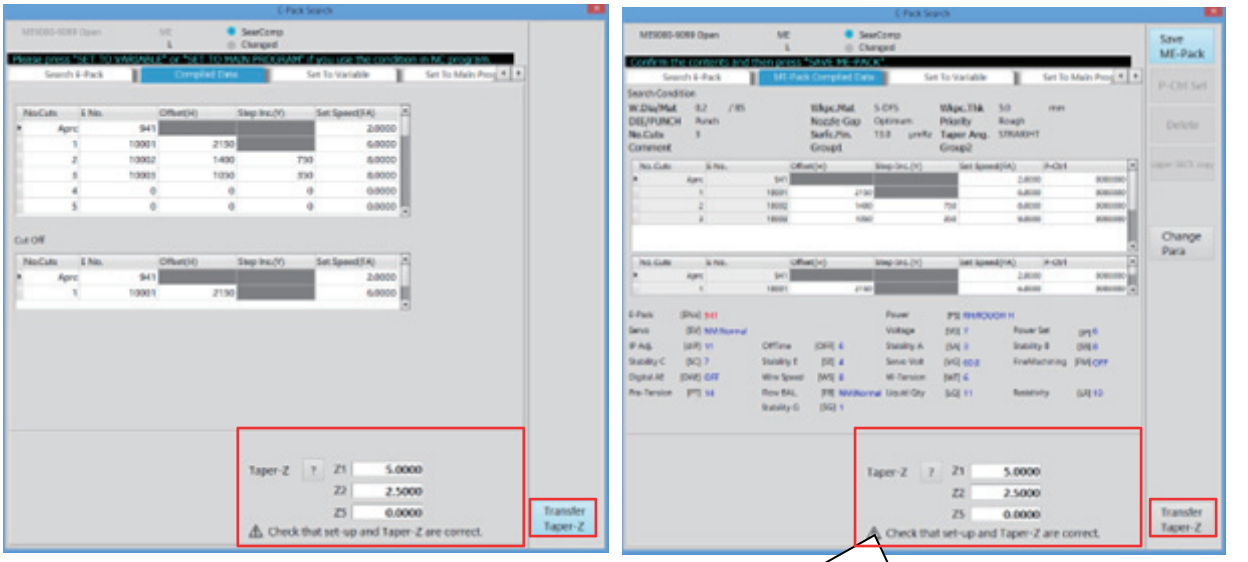
(4) After saving, to create a machining program, select [Set to Main Program]. To output the searched results to variables, select [Set to Variable].

*1 "Cut off" is displayed only when "Punch" is selected for [Die/Punch].

*2 Select [P-Ctrl Set] to display the adaptive control screen.
The ME-Pack can be set without changing the original settings of the machine.

Fig. III.4.34

(d) When setting taper specs to the machining data



(1) The taper specifications (Z1, Z2, Z5) are generated based on the workpiece thickness selected on the condition search screen.
If the nozzle is offset, Z1 is generated taking the offset amount into account.
Make sure that the setup matches the taper specifications.
* The taper specifications can be changed manually.

(2) When [Transfer Taper-Z] is selected, the [Transfer Taper-Z] dialog box appears.
Selecting [YES] sets the taper specification values to the machining data.
* ? button
Used to display how to use the Z specifications.

Fig. III.4.35

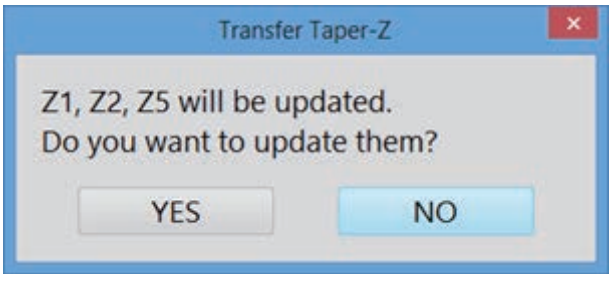


Fig. III.4.36

(5) Checker

Used to confirm the trace shape of other programs in automatic operation.

Different from graphics screen, this function displays the shape checker screen.

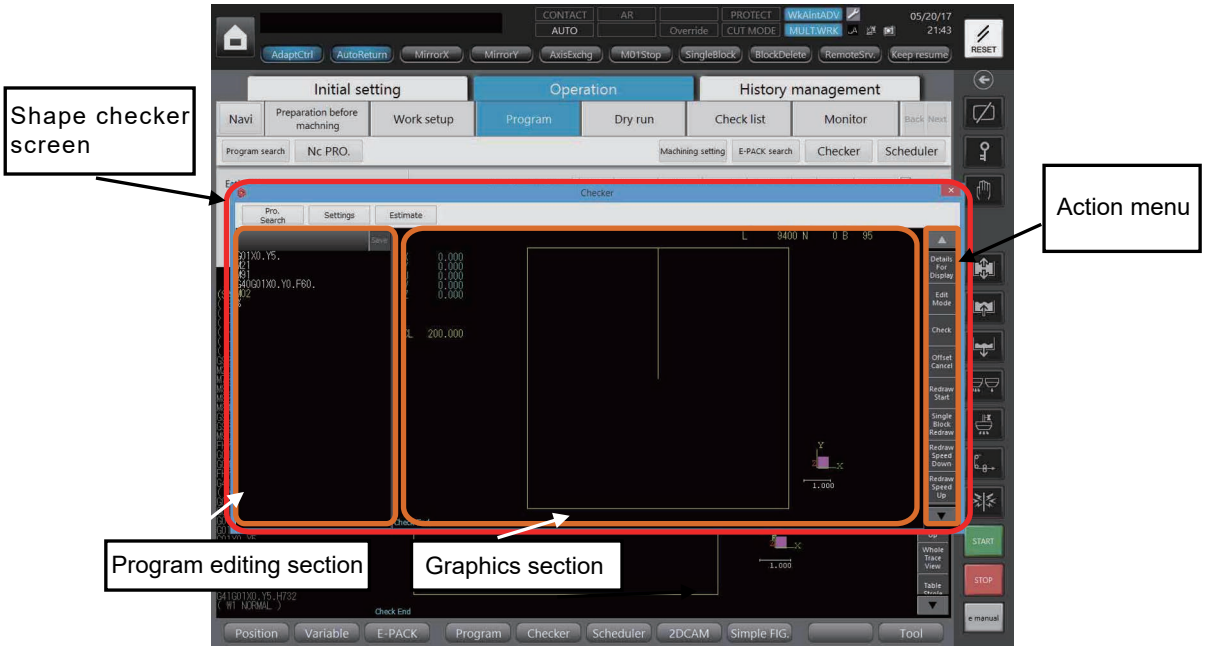


Fig. III.4.37

1) Program No.

(a) [L No]

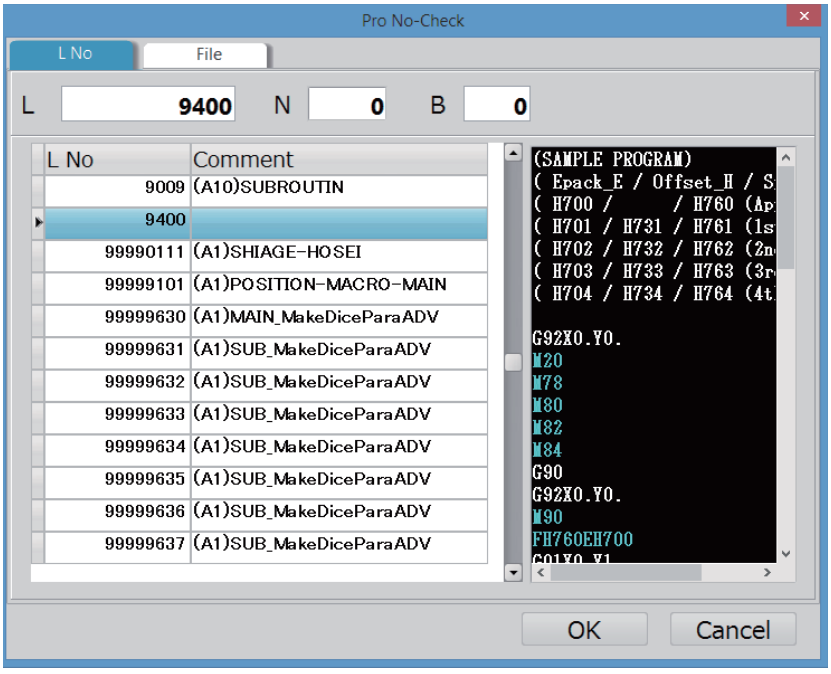


Fig. III.4.38

See "III. NC OPERATION DISPLAY SCREEN" > "4.3.1 Auxiliary menu" > "(1) Program search" > "1) L No.".

(b) [File]

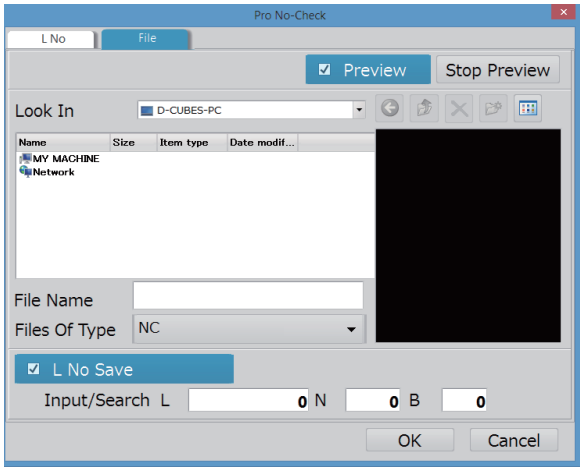


Fig. III.4.39

See "III. NC OPERATION DISPLAY SCREEN" > "4.3.1 Auxiliary menu" > "(1) Program search" > "2) File".

2) Settings

(a) [Parameter Set]

See "III. NC OPERATION DISPLAY SCREEN" > "3.2.11 Machining setting".

(i) [AT]

See "III. NC OPERATION DISPLAY SCREEN" > "3.2.11 Machining setting".

(ii) [Rot/Scale]

See "III. NC OPERATION DISPLAY SCREEN" > "3.2.11 Machining setting".

(iii) [Taper-Z]

See "III. NC OPERATION DISPLAY SCREEN" > "3.2.11 Machining setting".

3) Estimate

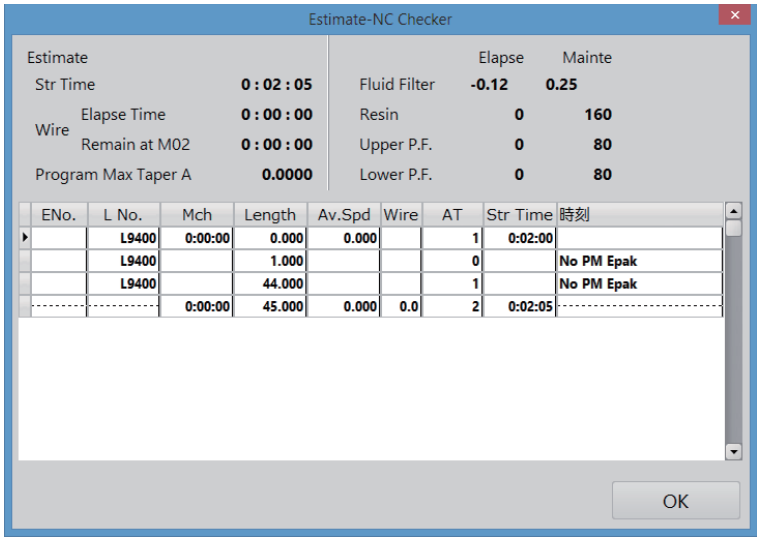


Fig. III.4.40

See "III. NC OPERATION DISPLAY SCREEN" > "4.3.5 Estimate section".

4) Graphics section

See "III. NC OPERATION DISPLAY SCREEN" > "4.3.6 Graphics section".

5) Program editing section

See "III. NC OPERATION DISPLAY SCREEN" > "4.3.7 Program editing section".

6) Action menu

See "III. NC OPERATION DISPLAY SCREEN" > "4.3.8 Action menu".

4.3.2 Scheduler

(1) Summary

Runs multiple NC programs consecutively for continuous machining.

Features:

- For each scheduled task, you can set workpiece coordinate zero, start position, mirroring, and more. This enables machining with one NC program across multiple setups.

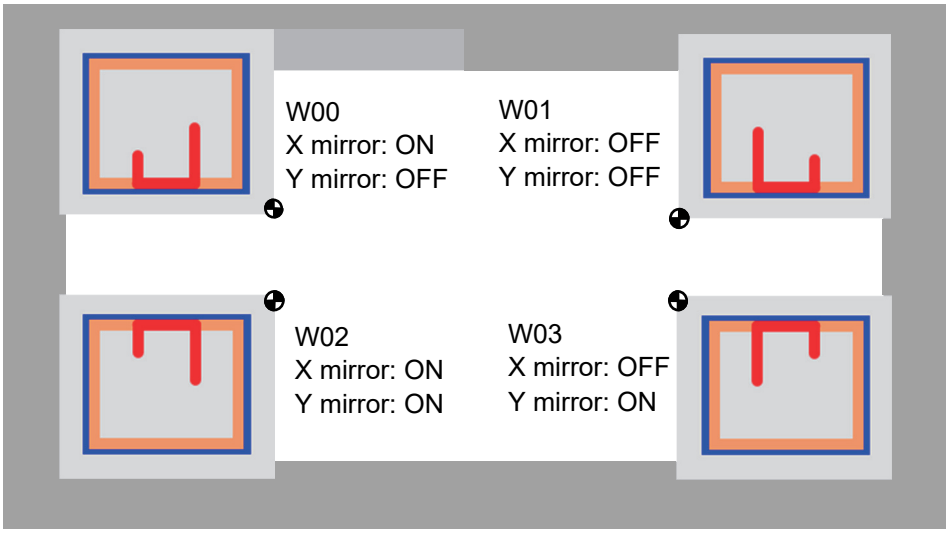


Fig. III.4.41

- By specifying the starting N number and machining order, rough, finish, and trimming programs can be combined into one, simplifying schedule management.

L5000/ PRO
N100
(Rough machining program)
G23

N200
(Cut-off program)
G23

N300
(Finish machining program)
G23

(2) "Schedule edit" tab

Creates and edits scheduled tasks. Sets workpiece coordinate system, start position, mirroring, and other items per shape, plus machining order per process.
Supports up to 20 shapes and up to 20 processes per shape.

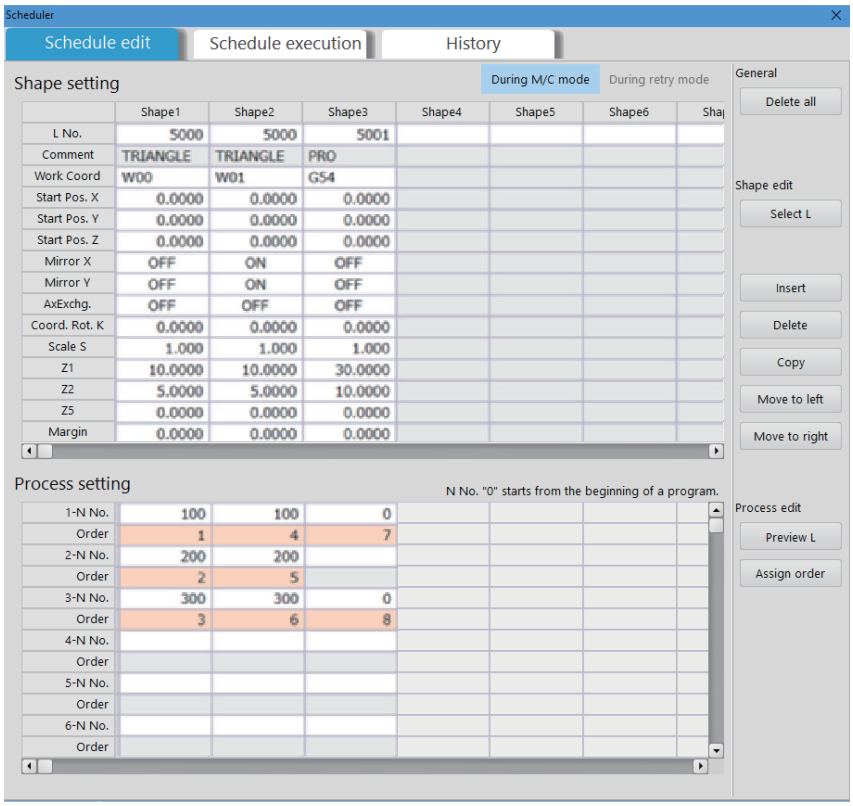


Fig. III.4.42

1) Setting item

(a) Shape setting

Configure settings for each shape (table columns).
During execution, after applying these settings, the customer's NC program (by L number) runs. If that program changes the workpiece coordinate system or other settings, those commands take precedence.

(i) L No.
Enter the L number for the machining NC program.

(ii) Comment
Displays the comment for the L number registered in the NC program list.

(iii) Work Coord
Select the workpiece coordinate system for machining from the list.

(iv) Start Pos. X, Y, Z
Enter the machining start position as a relative value from the workpiece coordinate zero.

(v) Mirror X, Y

(vi) AxExchg.

(vii) Coord. Rot. K

(viii) Scale S

Enter the values for mirroring, axis change, coordinate rotation, and magnification for machining.
These are applied after the movement to the start position.

(ix) Z1, Z2, Z5 (Z specs)
Enter the Z specs for machining.

(x) Margin
Enter the finishing allowance (final offset adjustment value) for machining.
This item is the same as "Margin" displayed on the "Monitor" screen under "Operation".

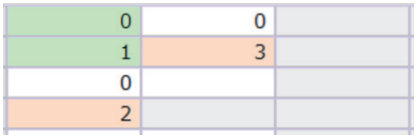
(b) Process setting

Set the processes for the shape. Each pair of lines represents one process. Up to 20 processes can be entered.
For example, processes can be managed as follows:
Process 1 = Rough machining, Process 2 = Trimming, Process 3 = Finish machining. It is also possible to leave Process 2 blank and use only Processes 1 and 3.

(i) N No.
Enter the starting N number (sequence number) in the machining NC program. If "0" is entered, operation starts from the program beginning, so the scheduler can run without N numbers.

(ii) Order
Enter the process run order.
Change it directly or via "Process order" > [Assign order].
Enter values 1 to 400.

(c) Colors in the table



(i) White, orange
Editable cells.

(ii) Gray
Non-editable cells.

(iii) Green
Cells related to shape settings and process settings for the scheduled task in execution. These cells are non-editable.

2) Menu

(a) General

(i) Delete all
Deletes all scheduled tasks (shapes and processes).

(b) Shape edit

(i) Select L
Displays the NC program list dialog. By selecting an L number from the list and pressing [OK], it is set for "L No." for the shape at the cursor position.

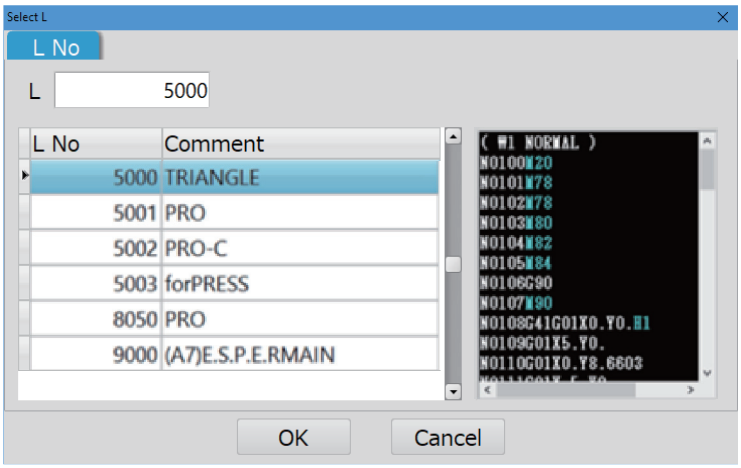


Fig. III.4.43

(ii) Insert

Inserts a shape column with blank cells at the cursor position.

(iii) Delete

Deletes the shape at the cursor position.

(iv) Copy

Copies the shape at the cursor position and inserts it at the cursor position.

(v) Move to left

Swaps the shape at the cursor position with the shape to the left.

(vi) Move to right

Swaps the shape at the cursor position with the shape to the right.

(c) Process edit

(i) Preview L

Displays the NC program with "L No." of the shape at the cursor position.

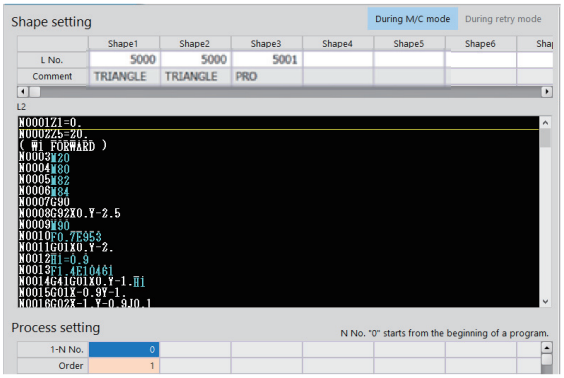


Fig. III.4.44

(ii) Assign order

Displays the "Assign machining order" dialog.

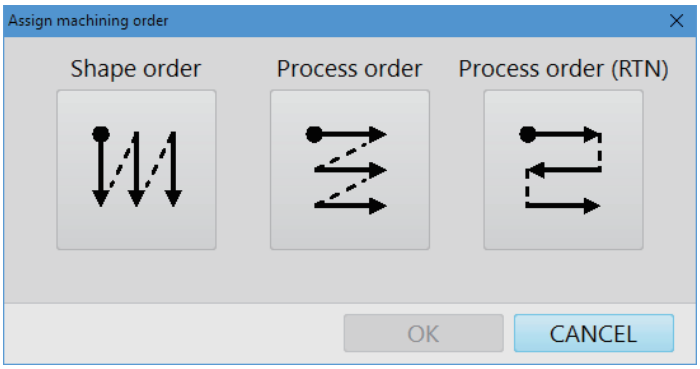
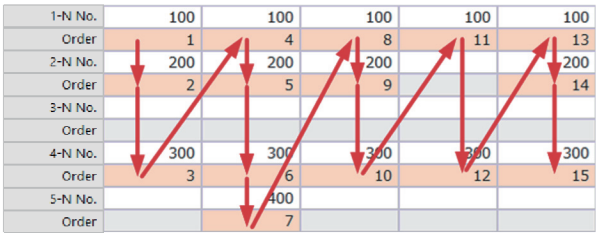


Fig. III.4.45

- **Shape order**

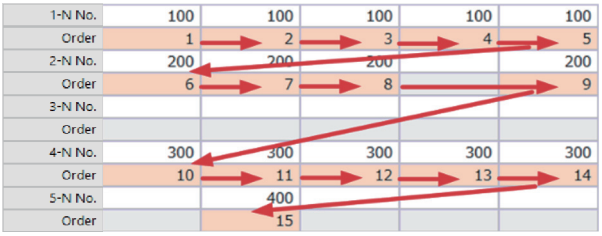
  The machining order is assigned starting from shape 1.



  Use this item when machining for each shape must be completed before proceeding to the next.

- **Process order**

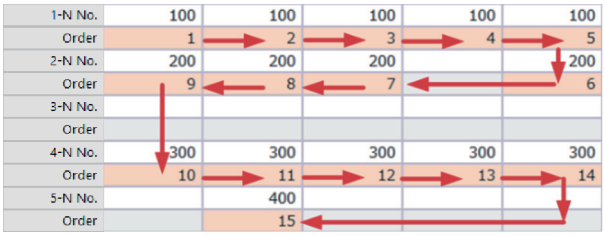
  The machining order is assigned starting from process 1.



  Use this item when rough machining is performed on all shapes first, followed by finish machining.

- **Process order (RTN)**

  The machining order is assigned starting from process 1. However, when the process flow is reversed, the order is assigned in the reverse order (starting from shape 20).



  Use this item when rough machining is performed on all shapes first, followed by finish machining. Compared to "Process order", this reduces the axis movement time when the process flow is reversed.

(3) "Schedule execution" tab

Used to manage and run scheduled tasks.

Each row (each process) is one scheduled task. After reviewing details, press [Set schedule oper. mode] at the bottom right, then press the start button START to begin scheduled task operation.

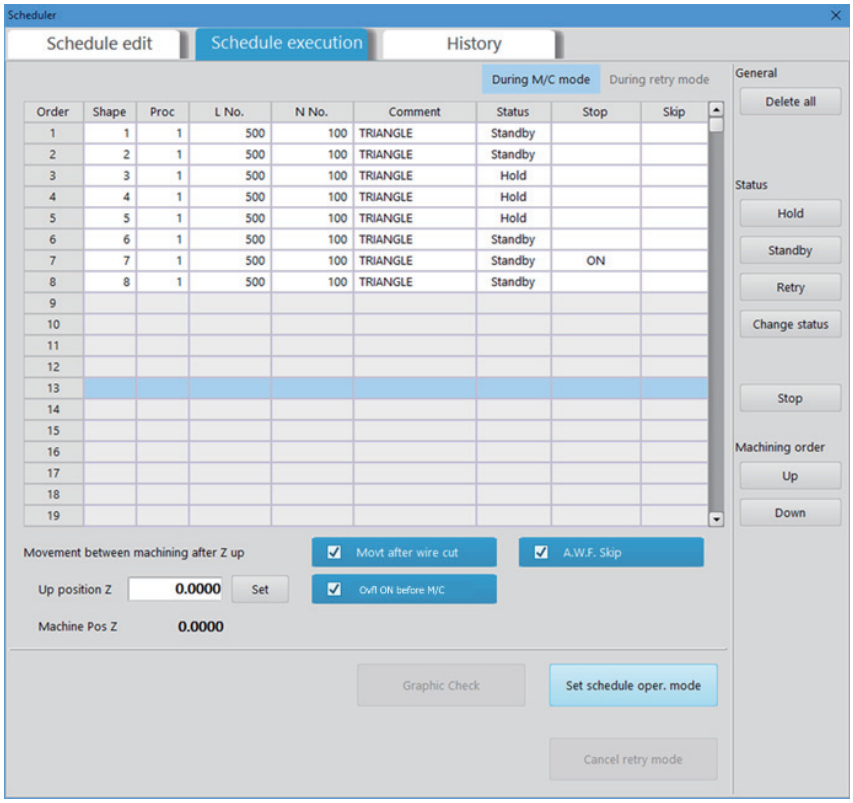


Fig. III.4.46

1) Setting item

(a) Machining order table

Displays registered scheduled tasks in machining order.

You can modify targets, check them, adjust order, and view execution status. Cells cannot be edited directly. Use the menu on the right side of the tab.

(i) Shape

Displays the shape number of the scheduled task.

It corresponds to the "Shape xx" column in the table on the "Schedule edit" tab.

(ii) Proc

Displays the process number of the scheduled task.

It corresponds to the "xx-N No." line in the process setting table on the "Schedule edit" tab.

(iii) L No.

Displays the L number of the NC program for the scheduled task operation.

(iv) N No.

Displays the starting N number of the NC program for the scheduled task operation.

(v) Comment

Displays the comment of the NC program for the scheduled task operation.
Clicking a comment displays the full text in a balloon.

(vi) Status

Displays the operation status of the scheduled task.

- **Standby**
  This is the waiting state for the scheduled task operation.
- **Hold**
  This state is used to prevent the registered scheduled task from being executed.
- **Retry**
  This is the waiting state for the scheduled task operation in the re-machining mode *1.
  Specify the scheduled tasks to be re-machined with "Skip" set to "ON" as "Retry". The status can be changed by selecting [Retry] under "Status" from the menu *2.
  *1.In the re-machining mode, "During retry mode" at the top of the tab is displayed in yellow.

  *2.Only scheduled tasks with "Skip" set to "ON" can be changed to "Retry".
- **Running**
  The scheduled task is currently being executed.
- **Completed**
  The operation of the "Running" scheduled task has been completed.
  When cut-off (wire breaks, uncut skips due to 30-second short-circuit) occurs, "Skip" will be set to "ON".
- **Cancel**
  The operation of the "Running" scheduled task is terminated by pressing the reset key.

(vii) Stop

Displays the enabled/disabled status of the pre-operation stop for the scheduled task.
The setting can be toggled between enabled and disabled by selecting [Stop] under "Status" from the menu.

- **Blank field**
  The scheduled task will start operation without stopping.
- **ON**
  The machine enters a pause state before starting the scheduled task.

  Press the

  button to resume operation.

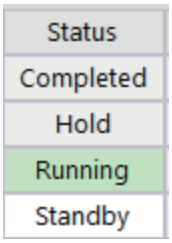
  This function is useful for scheduled tasks that are intended to be started manually after the operator's confirmation.

(viii) Skip

Displays the occurrence status of uncut skips during scheduled task operation.

- **Blank field**
  No uncut skip has occurred.
- **ON**
  An uncut skip occurred during operation.
  After all scheduled task operations are completed, the machine will automatically transition to the re-machining mode. At that time, this schedule can be machined.

(b) Colors in the table



(i) White

Schedules that can be operated with the menu.

(ii) Gray

Schedules that cannot be operated with the menu.
For example, cells for the scheduled tasks prior to the "Currently executing" scheduled task are displayed in gray.

(iii) Green

Indicates the "Currently executing" scheduled task.
Schedules that cannot be operated with the menu.

(c) Scheduled task operation setting

(i) Movement between machining after Z up

Set the Z axis position for retraction before the axis movement between scheduled tasks.
The coordinate system for "Up position Z" is the machine coordinates.

(ii) Move after wire cut

Set whether to cut the wire before the axis movement between scheduled tasks.

- **Switch ON**
  The axis moves after cutting the wire.
- **Switch OFF**
  The axis moves without cutting the wire.
  Use this only if the customer's NC program ends with the wire cut.

(iii) Ovfl ON before M/C

Align the door position to the Z axis height at the start position, then turn on the overflow mode.

- **Switch ON**
  After turning on the overflow mode, the customer's NC program is executed.
- **Switch OFF**
  The customer's NC program is executed without changing the overflow mode.

* This function may not be implemented depending on the machine model and option settings.

(iv) A.W.F. Skip

Enables/disables the uncut skip function.

For details of the uncut skip function, see "III. NC OPERATION DISPLAY SCREEN" > "3.2.8 AT operation setting" > "(3) Skip/Bypass Retry".

2) Menu

(a) General

(i) Delete all

Deletes all scheduled tasks.

(b) Status

(i) Hold

Changes "Status" of the scheduled task at the cursor position to "Hold".

(ii) Standby

Changes "Status" of the scheduled task at the cursor position to "Standby".

(iii) Retry

Changes "Status" of the scheduled task at the cursor position to "Retry".

Only scheduled tasks with "Skip" set to "ON" can be changed.

(iv) Change status

Changes "Status" of the scheduled tasks in a batch.

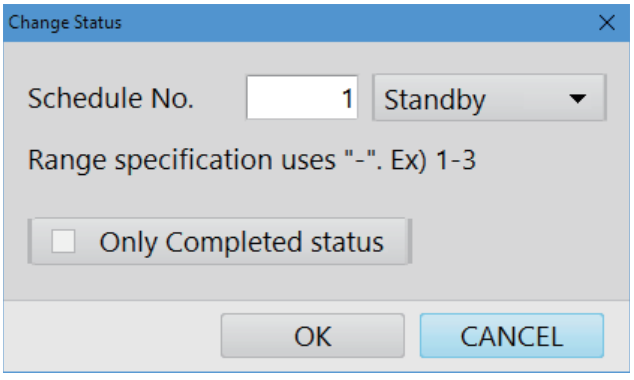


Fig. III.4.47

- **Schedule No.**
  Specify the machining order number to change "Status" (in a format such as "1-5").
  When specifying from the first scheduled task, "1" can be omitted.
  When specifying from an intermediate scheduled task to the last scheduled task, the last machining order number can be omitted.
- **Target state**
  Select the target state. The state can be selected from "Standby", "Hold", and "Retry".
- **Only Completed status**
  Turn on this switch to apply the change only to schedules with "Status" set to "Completed".

(v) Stop

Enables or disables pre-processing stop in the scheduled task at the cursor position.

(c) Machining order

(i) Up

Moves the machining order of the scheduled task at the cursor position up by one.

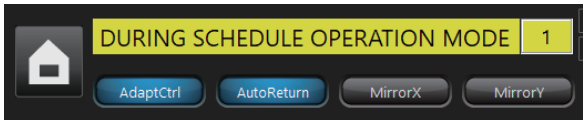
(ii) Down

Moves the machining order of the scheduled task at the cursor position down by one.

3) Scheduled task execution button

(a) Set schedule oper. mode

Pressing the button switches to the scheduled task operation mode, and the warning "DURING SCHEDULE OPERATION MODE" appears. Press the START key in this state to start the scheduled task operation.



Scheduled tasks can be added or edited even after the scheduled task operation mode is set. However, for L numbers and N numbers, whether they are registered in the NC program list is checked; therefore, unregistered numbers cannot be entered.

If switching to the scheduled task operation mode fails, the following balloon message appears.

Table III.4.2

Message	Remedies
There are no corresponding L No. and N No. Check the cell in yellow in the "Schedule edit" tab.	In the "Schedule edit" tab, check the L number and N number in the yellow cells. Prepare the correct NC program or correct the values for the L number and N number.
E21 PROGRAM RUNNING	Perform the operation after the program operation ends.
E30 DURING SCHEDULE OPERATION	No operation is required because the scheduled task is already started.
E31 REMOTE CONTROL ON	Turn off the "Remote Ctrl" switch before the operation.
E43 AUTO POWER-OFF	Turn off the "Auto power off" switch before the operation.
E44 AUTO PUMP-OFF	Turn off the "Auto Pump-Off" switch before the operation.
E45 ECO. MODE	Turn off the "ECO. mode reserve" and "Start Eco. Mode" switches before the operation.

(b) Graphic Check

Pressing this button displays a graphic check for the "Standby" scheduled task.
However, in the re-machining mode, only the scheduled tasks with "Status" set to "Retry" are displayed with the graphic check.

(c) Cancel retry mode

After all scheduled task operations are completed, if there are any scheduled tasks with "Skip" set to "ON", the machine automatically transitions to the re-machining mode and the following display appears.

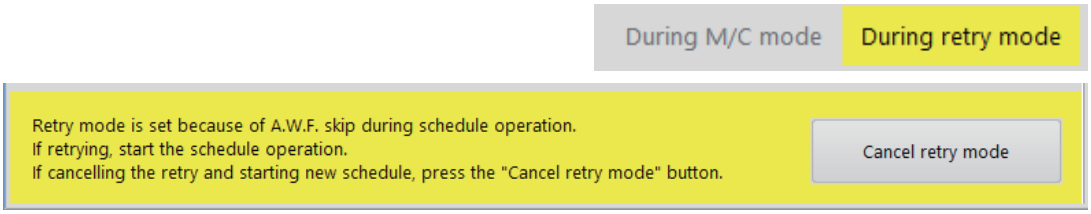


Fig. III.4.48

- **If re-machining is not performed**

  Check the condition of the workpiece, and if re-machining in the re-machining mode is unnecessary, press the [Cancel retry mode] button to exit the re-machining mode.

- **If re-machining is performed**

  After setting the scheduled task operation mode as with normal machining, press the START button to start operation.

  * During re-machining, M20 is automatically inserted, allowing the operation to continue without stopping.

NOTICE

When the re-machining mode is exited, the skip information is cleared, and scheduled tasks marked as skipped this time cannot be machined thereafter.

(4) "History" tab

Used to check the history of scheduled task operations. When completed, tasks are added to the bottom line.

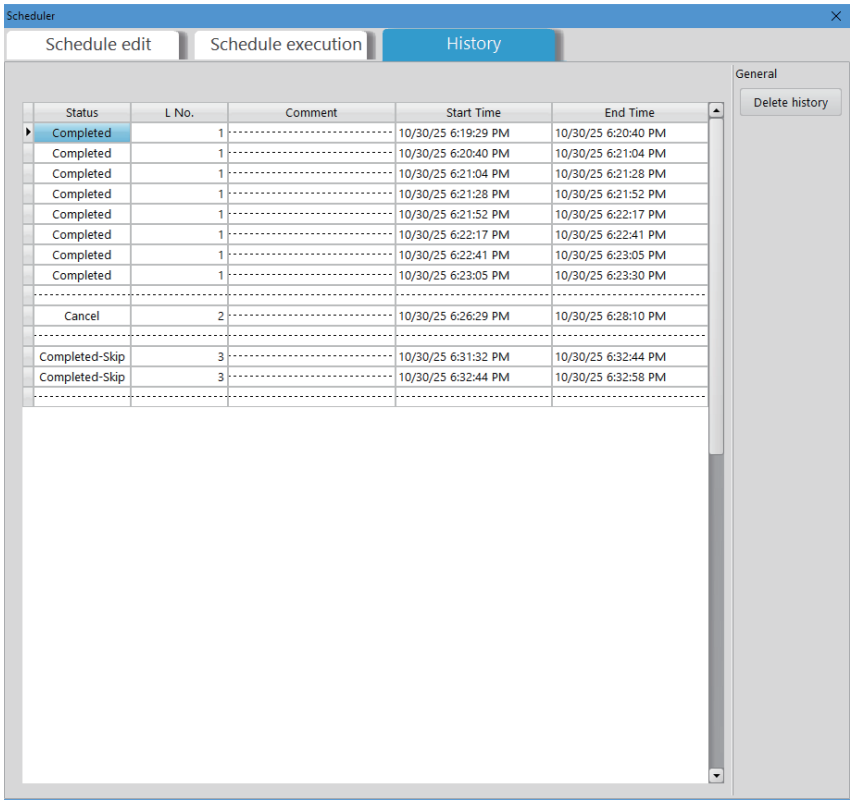


Fig. III.4.49

1) Item

(a) Status

Displays the completion status of the scheduled task operation.

(b) L No.

Displays the L number of the NC program that ran the scheduled task.

(c) Comment

Displays the comment of the NC program that ran the scheduled task.

(d) Start Time

Displays the start time of the scheduled task.

(e) End Time

Displays the finish time of the scheduled task.

2) Menu

(a) General

(i) Delete history

Deletes the history of all scheduled tasks.

(5) Operation method

1) Procedure before scheduled task operation

To perform scheduled task operation, register the scheduled task and execute it according to the following procedure.

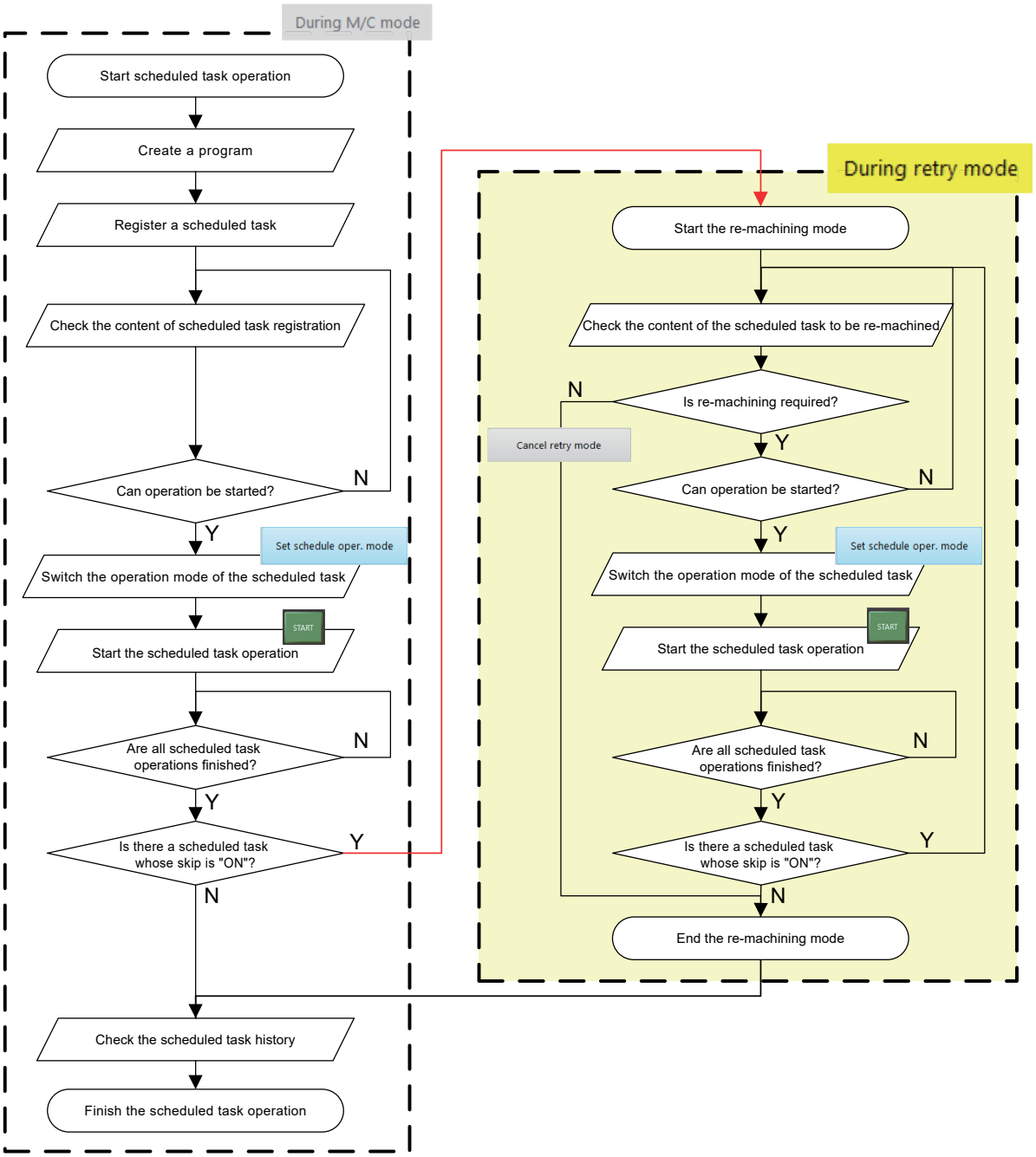


Fig. III.4.50

- **To use this function, open "Machine setting" > "Parameter Set", display "Auto3", and turn ON "Multiple Work" and "Work Align ADV.".**
- **In the scheduled task operation mode, NC programs registered in the schedule cannot be edited.**
  To allow edits, turn ON "Sche. NC Pro Edit" in the auxiliary menu "Screen operation setting" under "Initial setting" > "Machine parameters".
  However, deleting an N number during program editing may cause the "Schedule N number" to become inconsistent with the "N number in the NC program". Pay attention to this.
  If the scheduled operation is continued in this state, the inconsistent scheduled task may fail to start, resulting in a complete stop of the scheduled task operation itself. In such cases, reset the system, correct the NC program, and restart the scheduled task operation itself.
- **During schedule execution, you may add or edit tasks and change order. Moving to the next task while editing may start an uncompleted edit. Near the end of a task, use "Single block" or "Pre-machining stop" to prevent advancing during edits**
- **After schedule operation, settings like workpiece coordinate system and mirror may have changed. Check before running individual programs.**
- **Variable H99 (re-machining mode) turns OFF after schedule operation.**
- **"Resume" works only for machining of a reset task, not the whole schedule. After re-machining resumes, the next task after the reset one (status "Cancel") starts.**
- **If a schedule starts with Dry Run ON, task status shows "Completed". To machine with Dry Run OFF, set the target task to "Standby".**

2) Restrictions on creating an NC program

Table III.4.3

No.	Description
1	When splitting one workpiece program into rough and finish, set the same M20 position. Different precision start positions deform the workpiece and prevent re-machining.
2	Add M20 to the machining program. Without M20, wire reconnection and re-machining are unavailable.
3	Scheduled tasks start with adaptive feed ON. Insert M91 adaptive feed OFF before the move command.
4	If the NC program changes the workpiece coordinate system or mirror, it runs as commanded, since the EDM status is set from the Scheduler screen before execution.

3) EDM operation between scheduled tasks

Axis movement and status settings between scheduled tasks are performed according to the following flow. After completion, the customer's NC program is executed.

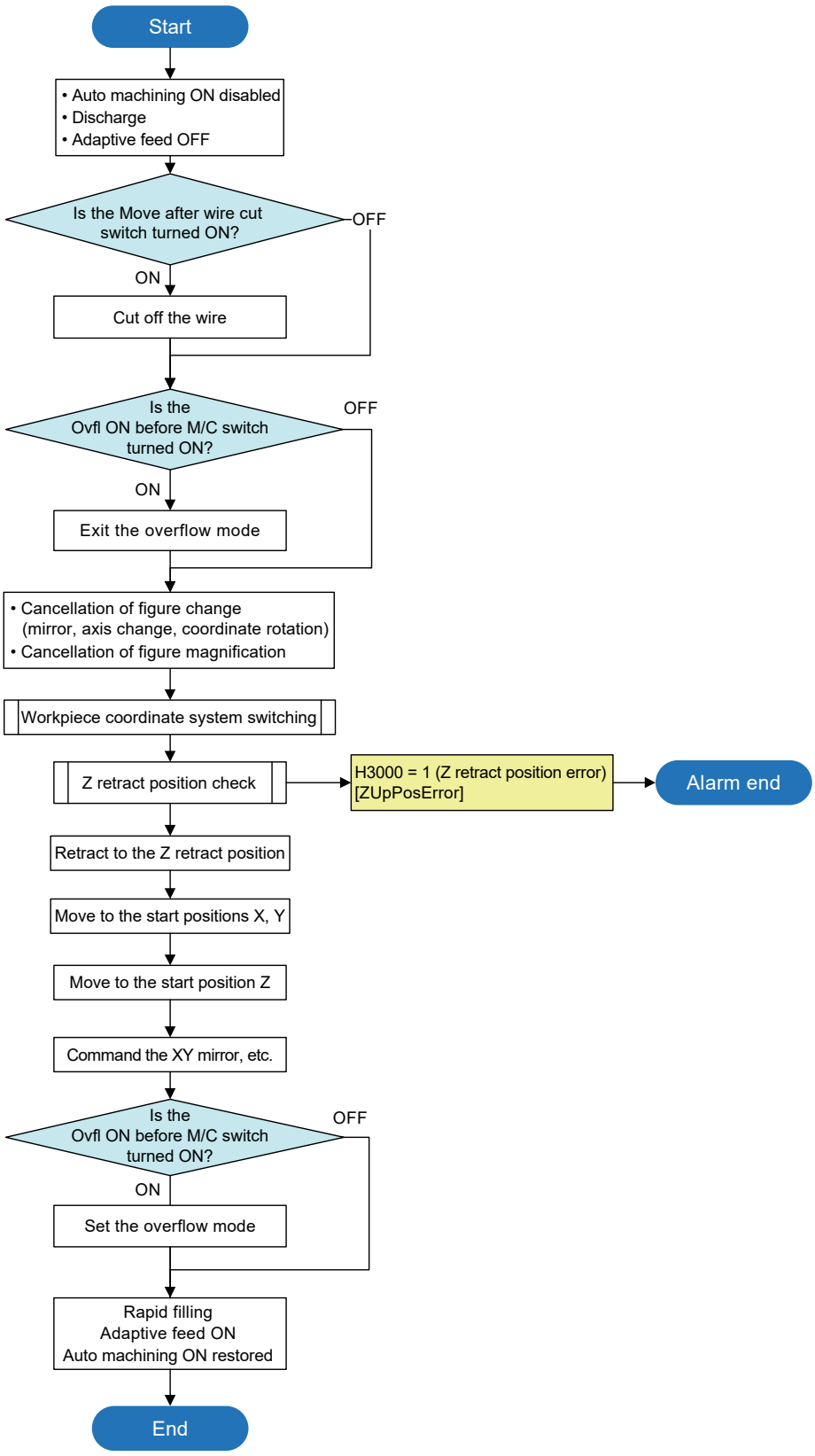


Fig. III.4.51

Z retract position check

If the "next machining start position" is higher than the "Z axis retract position", it will stop with the following alarm. After resetting, check the Z axis retract position and restart the scheduled task operation.

"P277 MACRO ALM MESG 1 ZUpPosError"

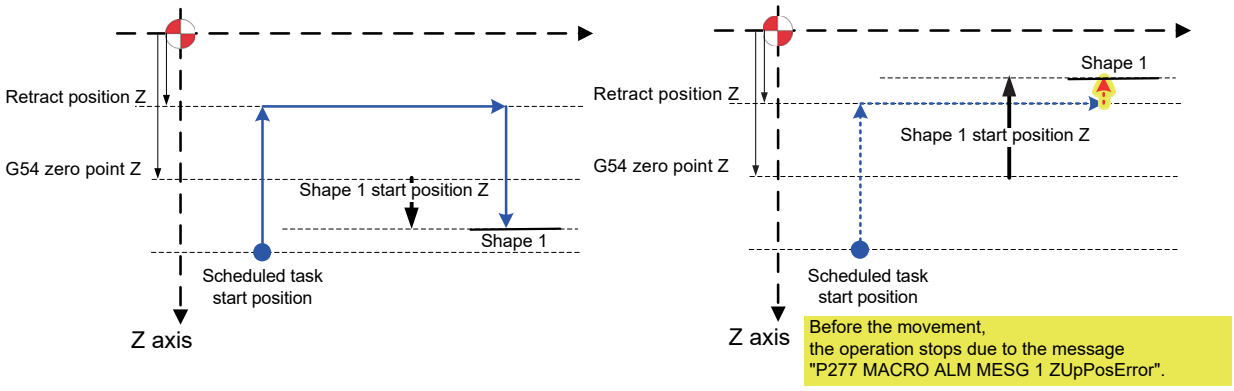


Fig. III.4.52

4) Application example

(a) Machining to be set up at the four corners on the table

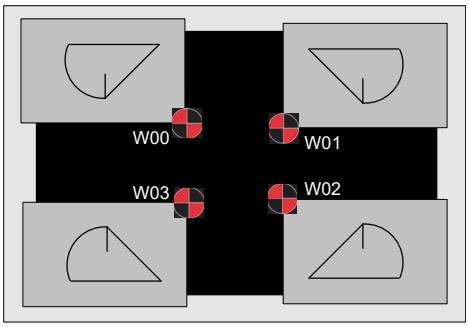


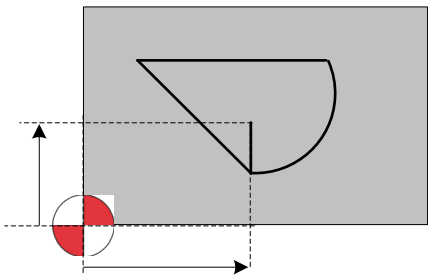
Fig. III.4.53

(i) Create an NC program.

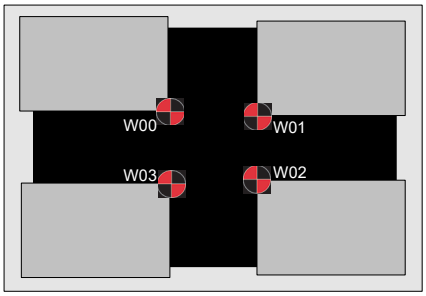
Separate the machining processes for each N number as follows.

```
L5000/DD
N100
(Rough machining program)
G23

N200
(Cut-off program)
G23

N300
(Finish machining program)
G23
```

L5000 N100 program

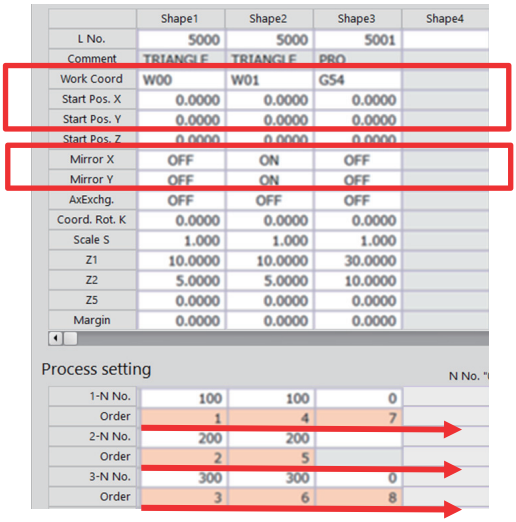


(ii) Position the workpiece at the four corners on the table, perform setup, and preset the workpiece coordinate system.



(iii) Create a scheduled task (shape settings, process settings) in the "Schedule edit" tab.

- Register L5000 for Shape 1 and enter the start positions, Z specs, etc.
- Set Process 1 as rough machining (N100), Process 2 as trimming (N200), and Process 3 as finish machining (N300).
- Select [Copy] from the menu to duplicate the setting for Shape 1 to Shape 2, 3, and 4.
- Change the workpiece coordinate system, start position, and XY mirrors for each of shapes 1 to 4.
- Select "Process order" in the window displayed by selecting [Assign order] from the menu.



	Shape1	Shape2	Shape3	Shape4
L No.	5000	5000	5001	
Comment	TRIANGLE	TRIANGLE	PRO	
Work Coord	W00	W01	G54	
Start Pos. X	0.0000	0.0000	0.0000	
Start Pos. Y	0.0000	0.0000	0.0000	
Start Pos. Z	0.0000	0.0000	0.0000	
Mirror X	OFF	ON	OFF	
Mirror Y	OFF	ON	OFF	
AxExchg.	OFF	OFF	OFF	
Coord. Rot. K	0.0000	0.0000	0.0000	
Scale S	1.000	1.000	1.000	
Z1	10.0000	10.0000	30.0000	
Z2	5.0000	5.0000	10.0000	
Z5	0.0000	0.0000	0.0000	
Margin	0.0000	0.0000	0.0000	

Process setting

1-N No.	100	100	0	
Order	1	4	7	
2-N No.	200	200		
Order	2	5		
3-N No.	300	300	0	
Order	3	6	8	

(iv) Configure the operation settings on the "Schedule execution" tab.

- Check that the status of all registered scheduled tasks are "Standby".
- Enable "Stop" for the first cut-off scheduled task.

Order	Shape	Proc	L No.	N No.	Comment	Status	Stop	Skip
1	1	1	500	100	TRIANGLE	Standby		
2	2	1	500	100	TRIANGLE	Standby		
3	3	1	500	100	TRIANGLE	Hold		
4	4	1	500	100	TRIANGLE	Hold		
5	5	1	500	100	TRIANGLE	Hold		
6	6	1	500	100	TRIANGLE	Standby		
7	7	1	500	100	TRIANGLE	Standby	ON	
8	8	1	500	100	TRIANGLE	Standby		

- Move the Z axis above all workpieces.
- Press the [Set] button for "Up position Z" to specify a position where the workpiece and axis will not collide as the retract position.

(v) Press [Set schedule oper. mode] to transition the machine to the scheduled task operation mode.

(vi) Press [Graphic Check] to check the scheduled task settings and NC program contents.

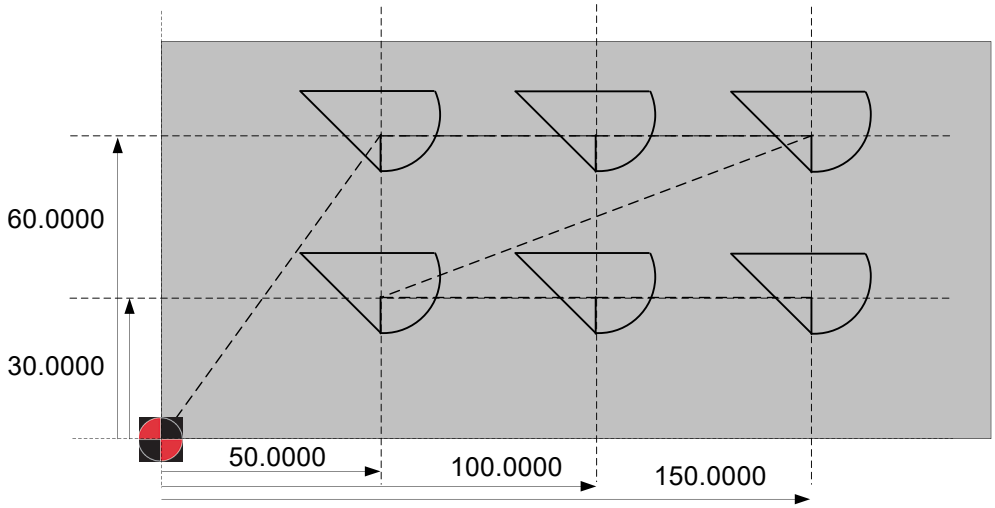
(vii) Press the START **button to start the scheduled task operation.**

(viii) Since the cut-off scheduled task stops before machining, press the START **button again after preparing for cut-off to resume the scheduled task.**

(ix) All scheduled task operations are completed.

(b) Machining with a shifted start position

To perform machining as shown below, create a scheduled task (shape settings and process settings) as follows.



Schedule edit | Schedule execution | History

Shape setting — During M/C mode | During retry mode

	Shape1	Shape2	Shape3	Shape4	Shape5	Shape6
L No.	1	1	1	1	1	1
Comment						
Work Coord	W00	W00	W00	W00	W00	W00
Start Pos. X	50.0000	100.0000	150.0000	50.0000	100.0000	150.0000
Start Pos. Y	60.0000	60.0000	60.0000	30.0000	30.0000	30.0000
Start Pos. Z	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mirror X	OFF	OFF	OFF	OFF	OFF	OFF
Mirror Y	OFF	OFF	OFF	OFF	OFF	OFF
AxExchg.	OFF	OFF	OFF	OFF	OFF	OFF
Coord. Rot. K	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Scale S	1.000	1.000	1.000	1.000	1.000	1.000
Z1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Z2	20.0000	20.0000	20.0000	20.0000	20.0000	20.0000
Z5	48.0000	48.0000	48.0000	48.0000	48.0000	48.0000
Margin	0.0124	0.0124	0.0124	0.0124	0.0124	0.0124

Process setting — N No. "0" starts from the beginning of a program.

1-N No.	100	100	100	100	100	100
Order	1	2	3	4	5	6
2-N No.	200	200	200	200	200	200
Order	12	11	10	9	8	7
3-N No.	300	300	300	300	300	300
Order	13	14	15	16	17	18
4-N No.						
Order						

L1 program

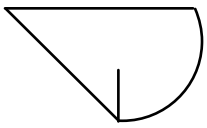


Fig. III.4.54

4.3.3 Alarm List

(1) Stop Alarms

Error No.	Message and details	Remedies	Remarks
T310	**Stop before schedule machining** If the operation stops before machining of a scheduled task with "Stop" enabled	• Press the [Start] button to restart the scheduled task operation. • Press the [Reset] button to end the scheduled task operation.	
P277	**"P277 MACRO ALM MESG 1 ZUpPosError"**	• The next machining start position is higher than the Z-axis retract position. • After resetting, check the Z axis retract position and restart the scheduled task operation.	

4.3.4 1 Push Technology

This function automatically converts programs according to the Maisart conditions selected in the setting dialog to easily use machining conditions using the Maisart control.

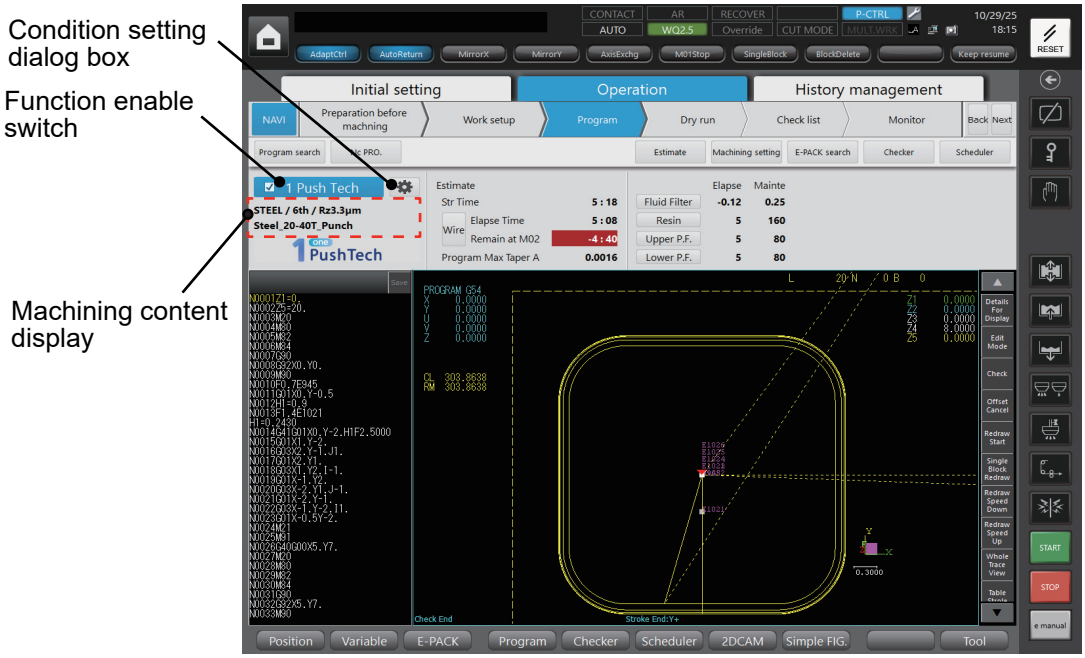


Fig. III.4.55

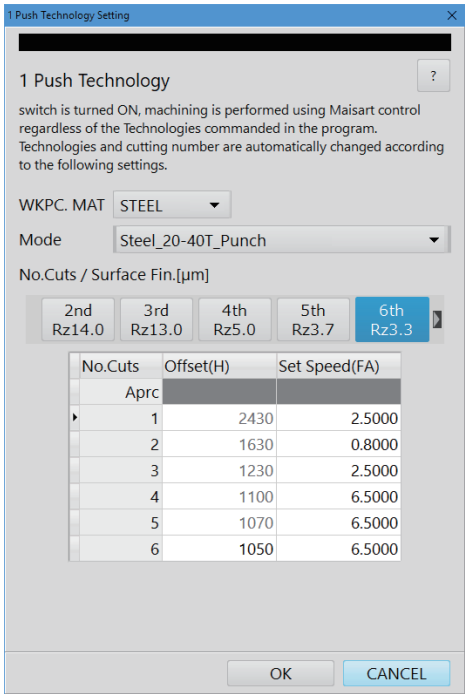


Fig. III.4.56

(1) Machining settings

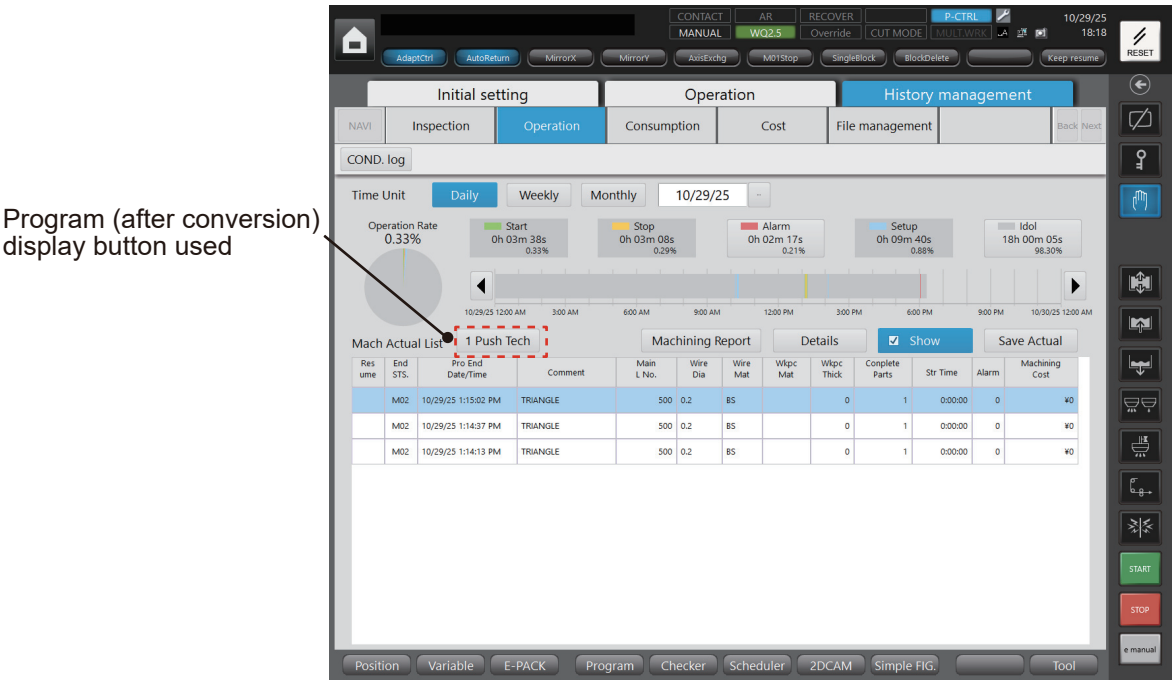
Open the condition setting dialog and select the workpiece material, machining mode, and number of cuts.
It is also possible to select a different number of cuts from the NC program (*).
(*) For programs with one cut or two cuts, the number of cuts cannot be increased.

(2) Program conversion

Turning on the "1 Push Tech" switch converts the program you are searching for.
When you search for a program with the switch ON, the program will be searched in its converted state.

(3) Viewing/save the converted program

By pressing the "1 Push Tech" button on the right of "Mach Actual List" in the screen displayed by selecting "History management" > "Operation", the converted program used in the actual machining will be loaded and displayed on the NC program editing screen.



4.3.5 Estimate section

(1) Str Time

Display the estimated operation time of the read NC program.

(2) Wire

Press the "Wire" button, and "Wire Type" screen will be displayed. Make sure that contents on the wire type setting screen is correct. For the contents of the "Wire Type" screen, see "III. NC OPERATION DISPLAY SCREEN" > "3.1.10 Wire type setting".

1) Elapse Time

Displays the estimated wire operation time of the read NC program.

2) Remain at M02

Displays the estimated wire remaining operation time of the read NC program.

(3) Program Max Taper A

Displays the maximum taper angle of the read NC program.

Display	Details
Calculate maximum taper angle 14.0019	Indicates the calculated maximum taper angle is less than the inspect angle in "Operation" > "Preparation before machining" > "Install wire and WKPC." > "Taper Machining".
Calculate maximum taper angle 14.0019	Indicates the calculated maximum taper angle exceeds the inspect angle in "Operation" > "Preparation before machining" > "Install wire and WKPC." > "Taper Machining". Check the guide, nozzle, etc. again.

(4) Fluid Filter

Displays the current usage time and maintenance time of dielectric fluid filter. Judge according to estimated usage time. Replace it when necessary.

(5) Resin

Displays the current usage time and maintenance time of ion exchange resin.
Judge according to estimated usage time. Replace it when necessary.

(6) Upper P.F.

Displays the current usage time and maintenance time of the upper power feeder.
Judge according to estimated usage time. Replace it when necessary.

(7) Lower P.F.

Displays the current usage time and maintenance time of the lower power feeder.
Judge according to estimated usage time. Replace it when necessary.

4.3.6 Graphics section

(1) Screen Display

1) The trace is displayed in Z1, Z2, and Z5 surfaces by default, and a dotted segment dividing line is placed between the highest surface and the lowest surface of Z.
[Color]
Z1: green Z2: light blue Z5: yellow
[Line type]
To distinguish the machining trace and positioning trace, classify trace lines into the following types:
G1, G2, G3: solid line
G0, G27, G28: dotted line

2) Operation in program inspection is achieved by action menu. At the beginning of the machining, once inspection of the screen drawing completes, outline the actual trace in Z2 surface with white line.

Switch between ON and OFF of [BLK.DELETE] is allowed after machining. As to drawing in inspection, and the change of switch in machining, lines completed in inspection and those completed by tracing may be inconsistent.

3) In displaying machining data, tracing is impossible in "Graphic Check".

(2) Graphic message display

Information displayed in the graphic message area and the action status for message display are shown below.

1) Display of the program reading status in inspection

Display of message	Display timing
Checking	The NC program is being read.
Check End	Reading the NC program has been successfully completed to the end.
Program Error	An alarm cause was found in the NC program.
Check Aborted	Reading the NC program was forcibly aborted by pressing the "Esc" key.
Too Large Program	The NC program exceeds the maximum length that can be checked (approximately 50000 blocks). The drawing will be performed with the data up to that point.
M53 Stop	Reading the NC program has been stopped using the M53 command as a separator for the drawing. The number added to the message indicates the cumulative count of stops.
TOO LARGE SIZE	An error has been detected when the size of the shape becomes too large to be handled properly, such as with the S command in the NC program. Characters added to the message indicate the details.

2) Action status display

Display of message	Display timing
Re-Drawing	The NC program is being read.
Re-Draw End	Reading the NC program has been successfully completed to the end.
Alarm	An alarm cause was found in the NC program.
Single Stop	Reading the NC program was forcibly aborted by pressing the "Esc" key.
M0,M1 Stop	The NC program exceeds the maximum length that can be checked (approximately 50000 blocks). The drawing will be performed with the data up to that point.
Re-Draw Aborted	Reading the NC program has been stopped using the M53 command as a separator for the drawing. The number added to the message indicates the cumulative count of stops.
OffsetCancel	An error has been detected when the size of the shape becomes too large to be handled properly, such as with the S command in the NC program. Characters added to the message indicate the details.

3) Display of the operation-related message

Display of message	Display timing
VF Replay	The machined VF data is being replayed on the VF monitor. The message will disappear when the playback reaches the data from the current E-Pack or when the playback is aborted by pressing the "Esc" key.

4) Other information

Display of message	Display timing
Stroke End	The drawing range exceeds the expected table stroke.
VF data over	VF data is too large and exceeds the memory capacity that can be held.

- **[Too Large Program] may occur before the size reaches 50000 blocks depending on details of the NC program.**
- **For machining in the vicinity of the stroke, use the dry run function to inspect more accurately.**

(3) Screen operation

Touch gesture	Operation details	Movement
Tap	Touch the object once.	Selects the program trace.
Double-tap	Touch the object twice quickly.	Zooms in/out to the specified magnification.
Swipe (flick)	Quickly swipe the object to the desired direction with your finger tip.	Scrolls the screen.
Pinch in	Touch two points of the object, and pinch in the two points together.	Zooms in gradually.
Pinch out	Touch two points of the object, and expand the distance between the two points.	Zooms out gradually.
Rotate	Touch two points of the object, and rotate them to the desired direction.	Rotates the object (clockwise or counterclockwise).
Swipe with two fingers	Place two fingers on the object, and move the finger tips on the surface.	Rotates the object backward.

4.3.7 Program editing section

In program editing section, you can edit the program easily.

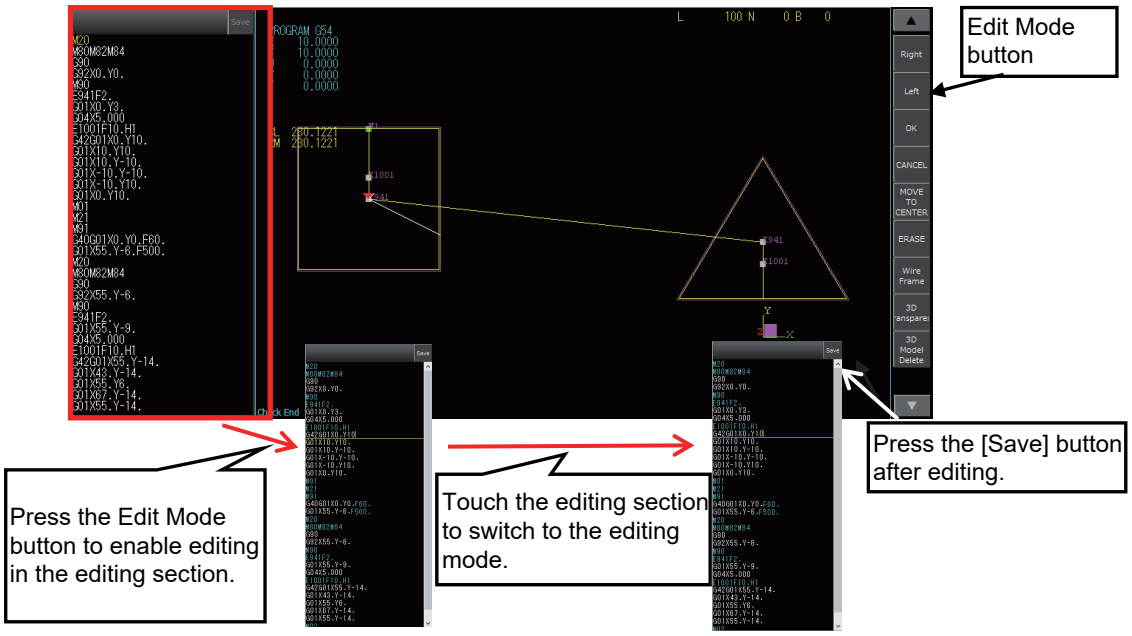


Fig. III.4.57

Press "Edit Mode" button in the action menu, and the program editing screen will be turned into editing mode. Edit the program in editing mode. Press the Save button after editing. The set program will be overwritten. Press the "Recheck" button in the action menu to update the graph.

(1) Graphic connection

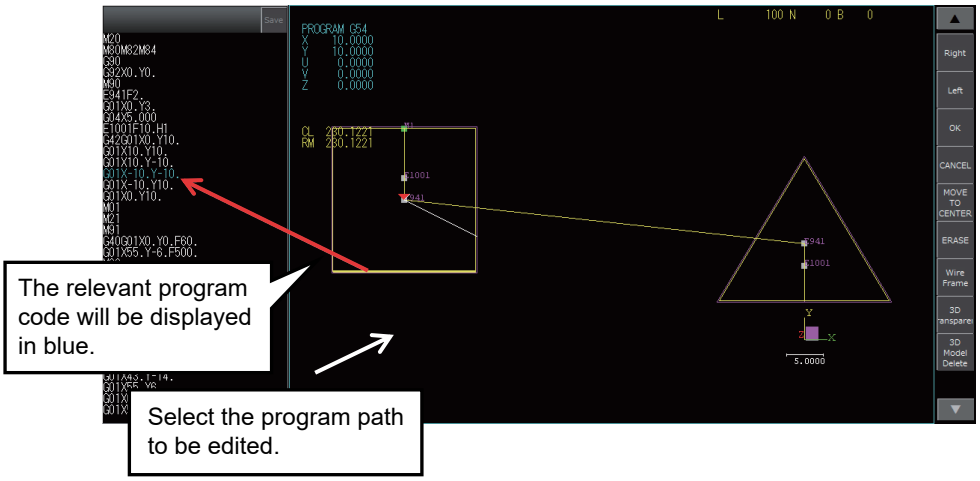


Fig. III.4.58

With the graphic connection function, the relevant program codes in the program editing section can be displayed in blue by selecting the trace on the graphic screen.

4.3.8 Action menu

(1) Details For Display

Press the Details For Display button to open "Details For Display" screen to enable setting of display methods.

1) View Items

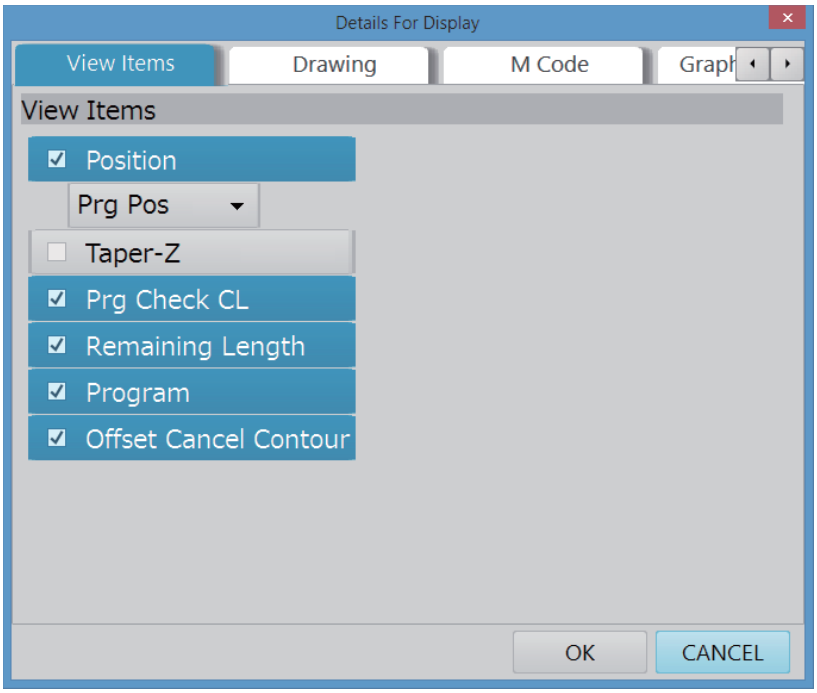


Fig. III.4.59

(a) [Position]

If it is set to ON (checked), the selected coordinate values will be displayed. The "Prg Pos" is displayed by default. When machining monitor is selected, the type of the displayed coordinate can be selected. Use G92 to set it as the command value.

(b) [Taper-Z]

If it is set to ON, the taper specs of Z1 to Z5 will be displayed.

(c) [Prg Check CL]

If it is set to ON (checked), the aggregate of combined axis length on the Z2 surface will be displayed. "CL" will be displayed.

(d) [Remaining Length]

If it is set to ON, the remaining length achieved by subtracting inspected circumference to machined distance will be displayed. "RM" will be displayed.

(e) [Program]

If it is set to ON (checked), the NC program currently running will be displayed. The displayed blocks include the program currently running, and up to 10 blocks can be displayed.

(f) [Offset Cancel Contour]

If it is set to ON (checked), the trace before offset will be displayed on Z1 (cancel offset trace). The displayed color is purple.

Make sure to set the Offset Cancel Contour to ON before inspection.

2) Drawing

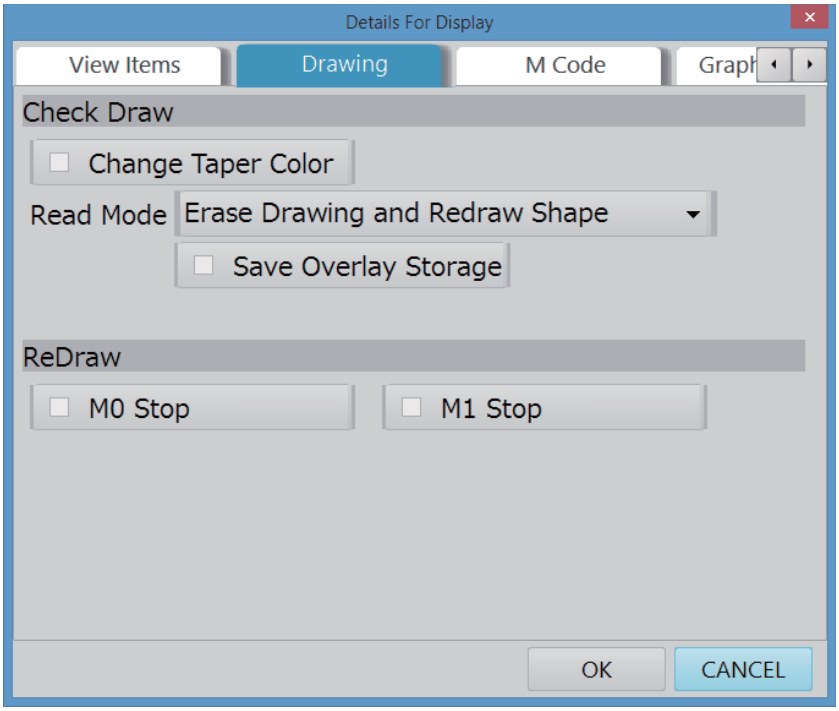


Fig. III.4.60

(a) [Change Taper Color]

If it is set to ON (checked), the drawing color of all surfaces of the tapered block Z1, Z2, and Z5 will be drawn in orange during the drawing inspection. The drawing color of line machining is maintained.

A tapered block refers to a block where the U and V coordinates are specified, and the wire axis is not vertical at the start and end points of the block.

(b) [Read Mode]

If it is set to ON, at the beginning of the inspection, specify in the dialog box how to handle the relevance to the last program drawing. Three modes are available.

- "Erase Drawing and Redraw Shape"
  Unrelated to last drawing. This mode is set by default.
- "Erase Drawing and Redraw Shape"
  The drawing will be done with the same scale as the previous one, but the last drawing will be erased.
- "Keep Drawing and Draw Same Scale"
  The drawing will be overlaid on the last drawing, but the last drawing data will not remain in memory, so the overlapping appearance will only be visible immediately after the drawing inspection is completed. When operations such as zooming in and out are performed, the last drawing will be erased.
  If "Save Overlay Storage" is selected in the displayed item settings, the last drawing data will be saved. So, the last drawing will not be erased, even if operations such as screen switching and zooming in and out are performed.

(c) [Save Overlay Storage]

When the read mode is "Keep Drawing and Draw Same Scale", the last drawing data is maintained, and will not disappear even if the screen is switched.

(d) [M0 Stop]

If it is set to ON (checked), use M0 to disable the "Redraw Start" function. If "Offset Cancel Contour" is selected, drawing is paused once the drawing of the trace to be offset completes. For the moment, message of "OffsetCancel" will be displayed.

(e) [M1 Stop]

If it is set to ON (checked), use M1 to disable the "Redraw Start" function. If "Offset Cancel Contour" is selected, drawing is paused once the drawing of the trace to be offset completes. For the moment, message of "OffsetCancel" will be displayed.

3) M code

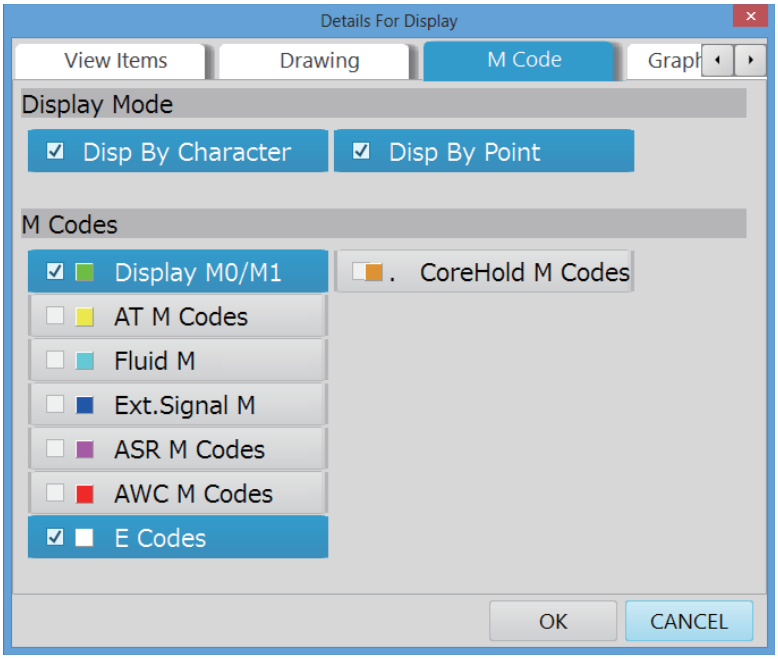


Fig. III.4.61

(a) [Disp By Character]

The M codes and E codes set below will be displayed as text at the commanded position.

(b) [Disp By Point]

The M codes is displayed at the command position as square dots. M codes specified in the same block as the movement block will be displayed at the end point of the block. Positions where M codes that are valid but not included in the following table are commanded will be drawn as gray dots.

Item	Object M code	Display color
[Display M0/M1]	M0, M1	Bright yellow
[AT M Codes]	M20, M21, M22, M23	Yellow
[Fluid M]	M32, M33, M57, M58, M59, M74, M75, M76, M77, M80, M81, M88, M89	Light blue
[Ext.Signal M]	M60 to M69	Blue
[ASR M Codes]	M52	Purple
[AWC M Codes]	M53	Red
[E Codes]	All the E codes specified in the NC program	White

4) Graphic Window

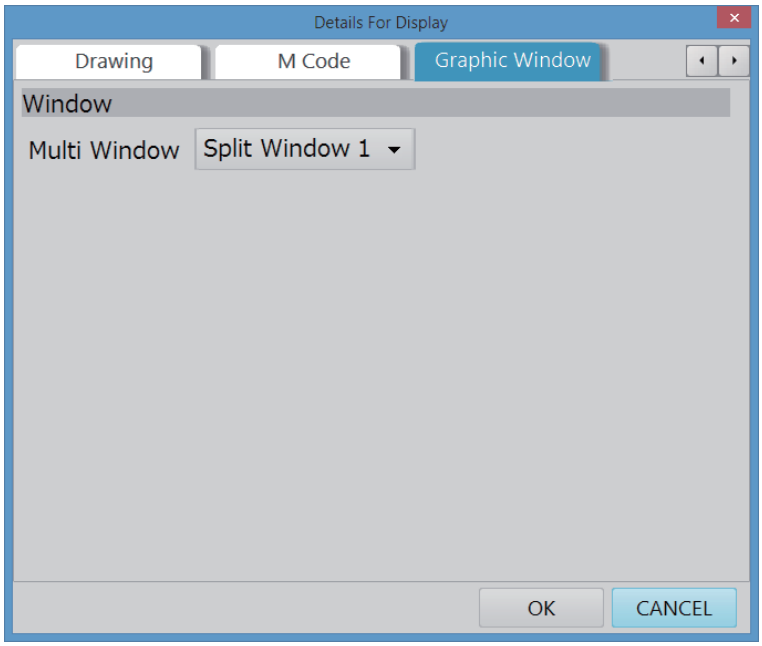


Fig. III.4.62

(a) [Multi Window]

Split the window for display. Select from "Split Window 1", "Split Window 2" or "Split Window 3".

(2) Edit Mode

Program can be edited in the program editing section. See 4.3.4.

(3) Recheck

Starts simulating the specified main program and draws the overall shape trace after completion. Stores required drawing data in memory.
For each Recheck, clears previous data and saves new data.

(4) OffsetCancel

The shape with offset canceled is displayed in purple.

(5) Redraw Start

Redraws the overall shape trace using data in memory. Draws the trace block by block in NC program order.
Press "Esc" to abort. When resumed, drawing restarts from the beginning.

(6) Single Block Redraw

Same as "Redraw Start". However, it stops once the drawing of a program segment completes.

(7) Redraw Speed Down

The redraw speed will be slowed down. There are three adjustment levels, and each time the button is pressed, the speed will be slowed down by one level.

(8) Redraw Speed Up

The redraw speed for the read NC will be increased. There are three adjustment levels, and each time the button is pressed, the speed will be increased by one level.

(9) Whole Trace View

In the perspective of "+Z", displays the full picture of the model and trace in proper scale.

(10)Table Stroke

Adjusts the scale to display, and ensures that the table stroke fits in with the screen. The viewing direction is "+Z". Display of the table stroke and its position relation with the shape are determined by "Set Start Point" in Details For Display.

(11)Prior View-Point

Restores to the last scale and view for display.

(12)VF Mode On/Off

Displays voltage data collected during machining in a graphic form. Collected data is machining speed, denoted as F. In XY, it shows the collection position; in Z, the data value. When a new E-Pack is designated, the previous one is deleted. Only data from machining with the current E-Pack is displayed.

(13)VF Replay

Displays VF data from machining completed with the current E-Pack, and supports past data playback. Each press of "Playback" shows VF data by E-Pack in order from the head command in automatic operation, ending at the current E-Pack. Press "Esc" to end playback. Playback data appears in a lighter color.

(14)Delete Overlay Storage

If "Read Mode" in "Drawing" of "Details For Display" is set to "Keep Drawing and Draw Same Scale", and "Save Overlay Storage" is set to ON (checked), this option can be selected. It deletes the shape trace of the past drawing and the data stored in the memory at the same time.

(15)Refresh and Draw

It can be used to re-draw the trace and re-display the current screen. When the details are hard to view due to drawing complexity and other reasons, use this function.

(16)Erase

Deletes the trace of the last drawing. If it is deleted in single block stop, only later trace is drawn for easier identification.

(17)Fit 3D Model

Returns to the viewpoint angle that was displayed when the model diagram was read.

(18)Rotation Gesture

The rotation is activated.

(19)View Z+

Displays the "+Z" side facing the front.

(20)View Z-

Displays the "-Z" side facing the front.

(21)View X+

Displays the "+X" side facing the front.

(22)View X-

Displays the "-X" side facing the front.

(23)View Y+

Displays the "+Y" side facing the front.

(24)View Y-

Displays the "-Y" side facing the front.

(25)Forward

Display coordinates. Repeat pressing the button to rotate the coordinates forward and move the perspective.

(26)Back

Display coordinates. Repeat pressing the button to rotate the coordinates backward and move the perspective.

(27)Right

Press this read NC button to display coordinates. Repeat pressing the button to rotate the coordinates clockwise with Z axis as the center, and move the perspective.

(28)Left

Press this read NC button to display coordinates. Repeat pressing the button to rotate the coordinates counterclockwise with Z axis as the center, and move the perspective.

(29)OK

Displays the 3D model from the moved perspective. The same operation is allowed by pressing the "Enter" key.

(30)Cancel

Cancels the moved perspective. The same operation is allowed by pressing the "Esc" key.

(31)Move To Center

Re-displays the current position (the position being drawn with ▲) at the center of the screen.

(32)Erase

Deletes the trace of the last drawing.

(33)Wire Frame

Displays the read NC trace line as wire frame.

(34)3D Shade

Displays the 3D model in shaded view.

(35)3D Model Delete

Deletes the 3D model.

4.4 Dry Run

Use the dry run function to check the mechanical action of the NC program to confirm whether there is any interference between the fixture and workpiece.

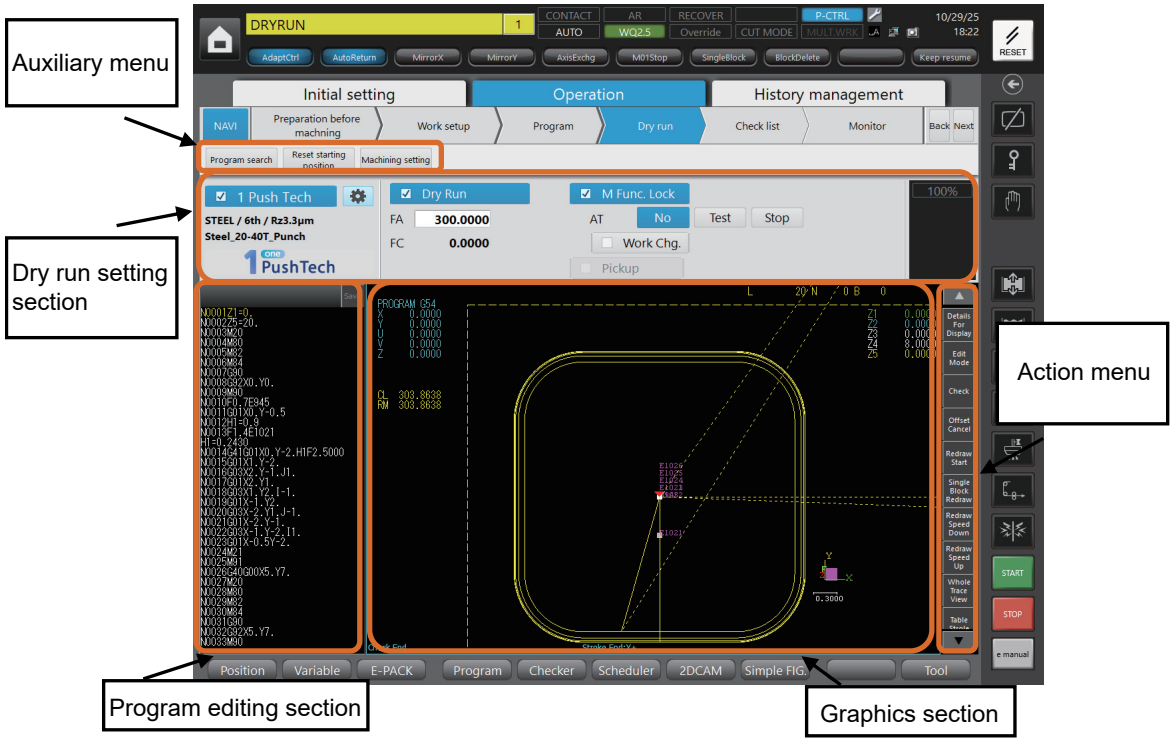


Fig. III.4.63

4.4.1 Auxiliary menu

(1) Program search

See "III. NC OPERATION DISPLAY SCREEN" > "4.3.1 Auxiliary menu" > "(1) Program search".

(2) Reset starting position

After executing dry running, use this function to return to the position where dry running started.

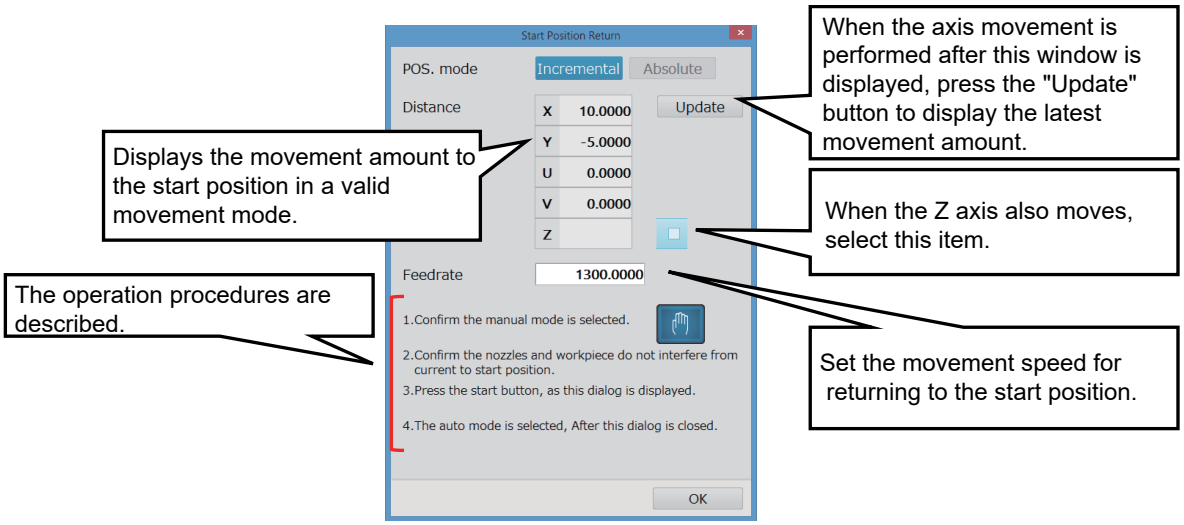


Fig. III.4.64

(3) Machining setting

See "III. NC OPERATION DISPLAY SCREEN" > "3.2.11 Machining setting".

4.4.2 Dry run setting section

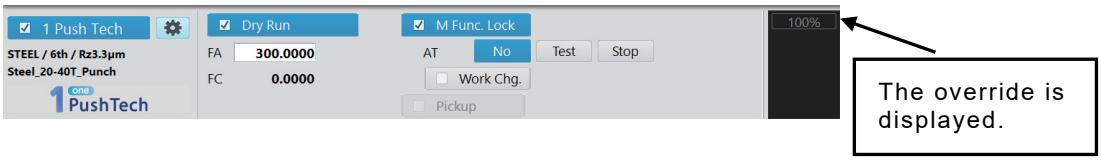


Fig. III.4.65

(1) 1 Push Tech.

See "III. NC OPERATION DISPLAY SCREEN" > "4.3.4 1 Push Technology".

(2) Dry Run

Checks mechanical action of the NC program. Switch [Dry Run] ON to run as in reality.

Movement speed can be replaced by:

- G0, dog-type zero point return, G1, G2, G2.1, G3, G3.1

Maintains the program's initial FA value. If FA was changed on screen, prioritizes the changed value.

Displays dry run speed in FC.

(3) M Func. Lock

When this switch is set to ON and the program is executed, M codes (auxiliary functions), except the following ones, can be locked.

M codes that are not subject to [M Func. Lock]: M00, M01, M02, M90, M91. The following can be set when the auxiliary function lock is ON.

1) AT

When this item is set before execution of dry running, the M20 and M21 commands in the program are replaced according to the setting before further operation as follows.

■ When "Test" is selected

- M20 (connection)
  Operation is performed after it is replaced with M22 (connection test).
- M21 (cut wire)
  Operation is performed after it is replaced with the actions of extending and retracting the cutting roller, cutting energizer, and cutting energizer plate.

■ When "Stop" is selected

- Use M20 and M21 to stop.

■ When "No" is selected

- M20 and M21 are ignored.

2) Work Chg.

When this item is set before execution of dry running, M53 and M54 commands in the program are performed.

When [Work Chg.] is set to ON, M53 and M54 (AWC action) are performed.

When [Work Chg.] is set to OFF, M53 and M54 will not be performed.

AWC refers to the automatic workpiece exchange device. (Optional)

3) Pickup

When this option is preset during dry running, the G29, G30, and G78 commands in the program will be executed.

It will be valid even if "M Func. Lock" is set to ON.

When [Pickup] is set to ON: positioning (G29 [Edge Positioning], G30 [Center Positioning], and G78 [Automatic Vertical Alignment]) is executed.

When [Pickup] is set to OFF: Positioning (G29, G30, or G78) is not executed.

In program operation and stop, the switch operation is disabled. (Except for M0 and M1)

4.4.3 Operation procedure

(1) Set the NC program to perform dry running in the auxiliary menu "Program search".
See 4.3.1 (1).

(2) Perform "Machining setting" in the auxiliary menu.
See "III. NC OPERATION DISPLAY SCREEN" > "3.2.11 Machining setting".

(3) Configure the setting items on the Dry Run Settings screen referring to 4.4.2.

(4) Press the START button upon completing the settings.
* **When approaching the place where interference with workpiece may occur, lower movement speed by overriding.**

4.5 Check list

Check that the normal machining can be performed in advance. The check list items can be changed freely.

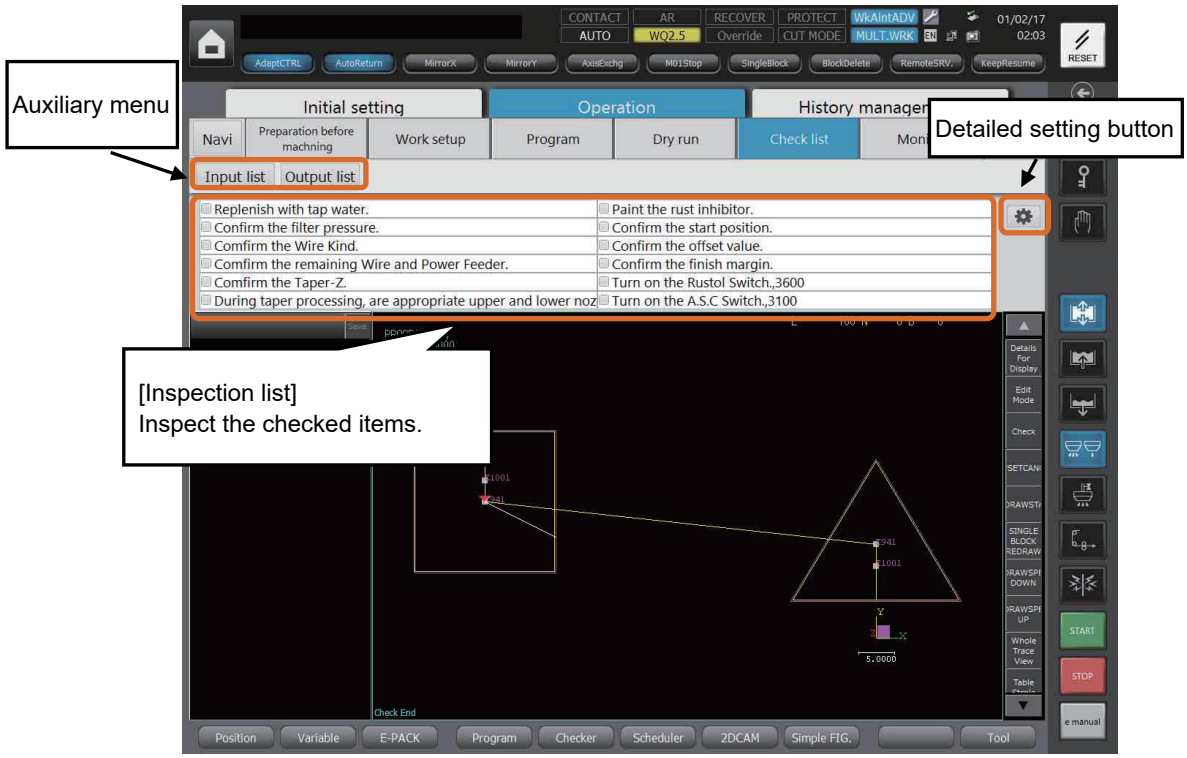


Fig. III.4.66

4.5.1 Auxiliary menu

(1) Input list

Displayed items of the check list can be changed by reading a text file (*.txt) containing a check list.

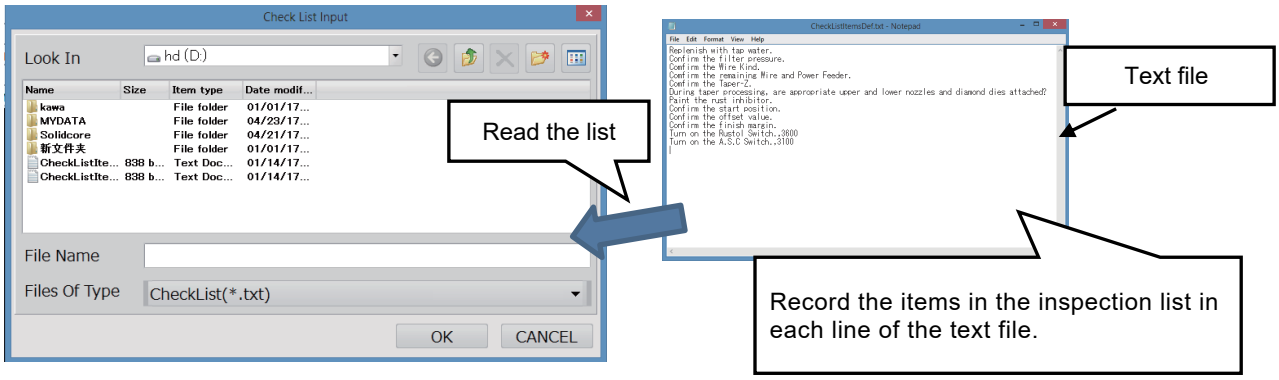


Fig. III.4.67

(2) Output list

Output the currently displayed items in the check list as a text file (*.txt).

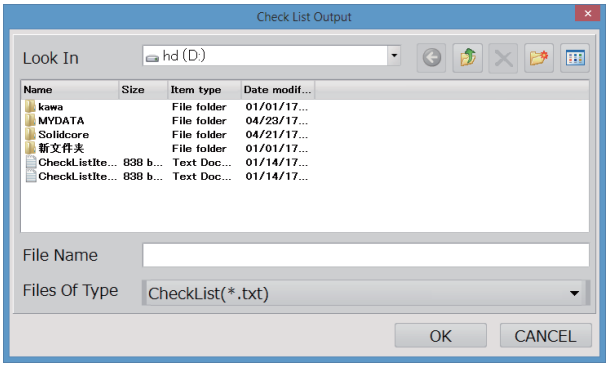


Fig. III.4.68

4.5.2 Detailed setting button

(1) Start on all checked

Turn ON, so the machining program cannot start unless all the items in the check list are checked.

4.6 Monitor

After all preparation before machining is completed, start the machining from the Monitor screen. Once machining starts, the machining status can be monitored.

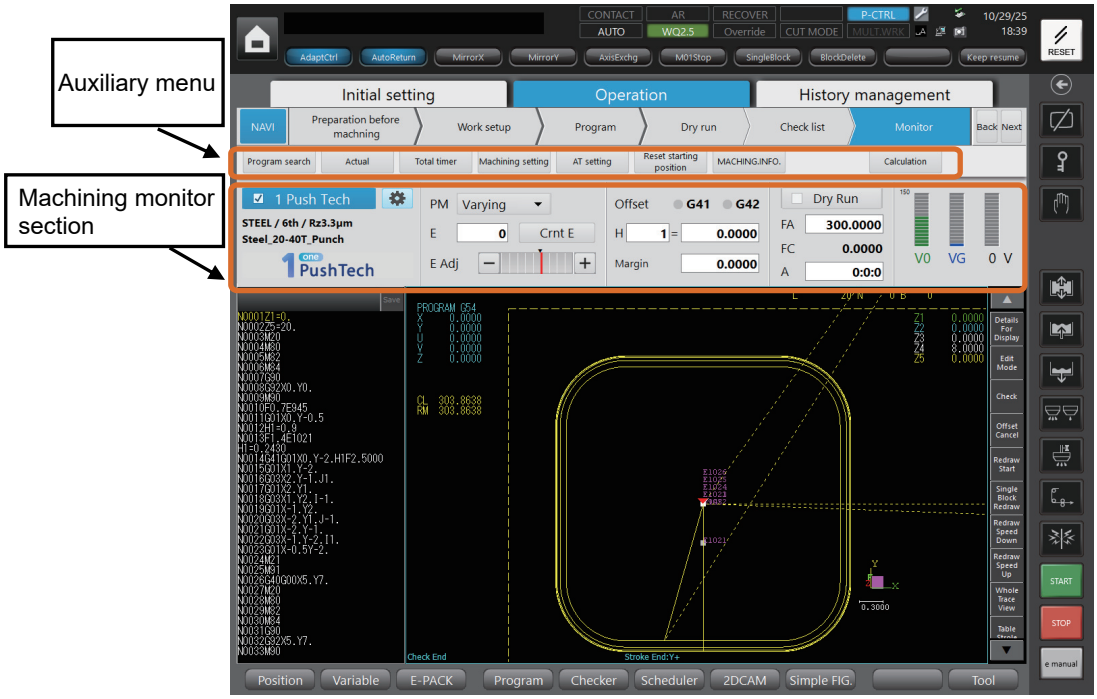


Fig. III.4.69

4.6.1 Auxiliary menu

(1) Program search

See "III. NC OPERATION DISPLAY SCREEN" > "4.3.1 Auxiliary menu" > "(1) Program search".

(2) Actual

Displays the machining time, machining distance, machining speed. etc. under each machining condition in a list.

(3) Total timer

Displays the Total Time Of Machining Cond window.

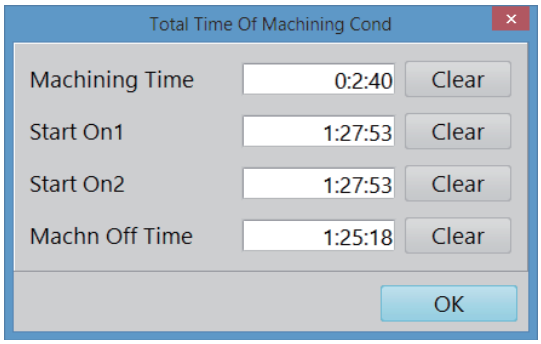


Fig. III.4.70

1) Machining Time

The total machining time is accumulated. Additionally, the accumulated time can be set directly.
Time is input in H/M/S format, which must be separated by [:].
<Example> When setting Machining Time to 1 hour, 23 minutes, and 45 seconds
(1) Move the cursor to the hour/minute/second part of Machining Time.
(2) Input 1:23:45.

2) Start On1/Start On2

The time in Start Time is accumulated. Additionally, the accumulated time can be set directly.
Use Start Time 1 and Start Time 2 according to your requirement.
Time is input in H/M/S format, which must be separated by [:].

3) Machn Off Time

Operation time between start and completion is accumulated. Additionally, the accumulated time can be set directly.
Time is input in H/M/S format, which must be separated by [:].

(4) Machining setting

See "III. NC OPERATION DISPLAY SCREEN" > "3.2.11 Machining setting".

(5) AT setting

See "III. NC OPERATION DISPLAY SCREEN" > "3.2.8 AT operation setting".

(6) MACHING.INFO

Packs all the data and NC programs required for machining as a machining information packet, and saves it in the specified folder. The saved machining information packet can be restored and reused.

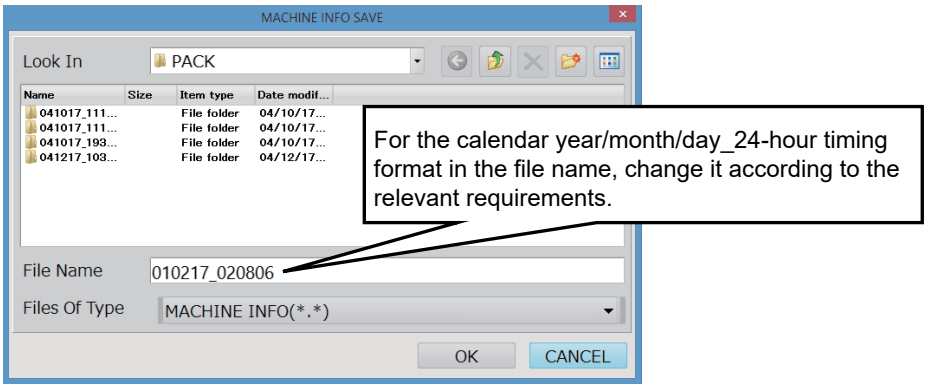


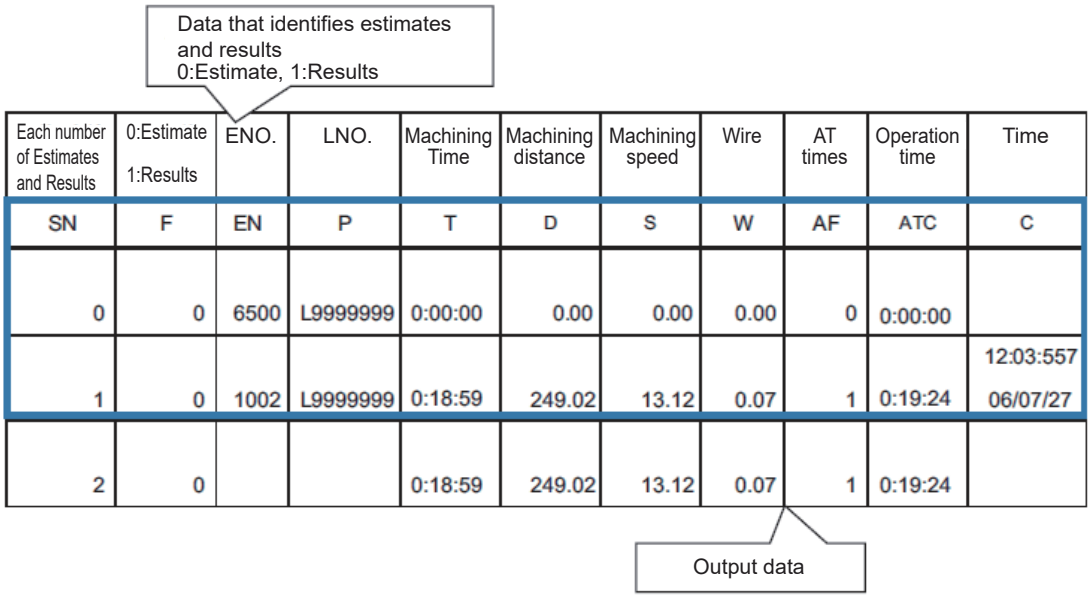
Fig. III.4.71

1) Saved data

- Displayed data on all pages of the monitor parameter setting dialog box
- Displayed data on all pages of the monitor adaptive control dialog box
- All machining conditions (including ME-Pack)
- All monitor variables (including user variables)
- Estimate/actual data in the Actual dialog of Monitor
- AT functions list screen of environment maintenance settings; displayed data on connection/cut-off, wire breaking return, skip/Bypass Retry pages
- All NC programs

2) Application of estimate/actual data

Estimate/actual data can be saved in a machining information packet, and it can be converted into and saved as a CSV file. This file can be imported to an external personal computer.



Each number of Estimates and Results	0:Estimate 1:Results	ENO.	LNO.	Machining Time	Machining distance	Machining speed	Wire	AT times	Operation time	Time
SN	F	EN	P	T	D	S	W	AF	ATC	C
0	0	6500	L9999999	0:00:00	0.00	0.00	0.00	0	0:00:00	
1	0	1002	L9999999	0:18:59	249.02	13.12	0.07	1	0:19:24	12:03:557 06/07/27
2	0			0:18:59	249.02	13.12	0.07	1	0:19:24	

E No. 6500 is the E-Pack for PM. No. 6000 - 6999 machining conditions are used for PM.

(7) Calculation

Estimates the time when the current machining can complete and the wire margin in real time.

1) Remain Runtime

Displays the remaining time of the program in automatic operation.

2) Remain by WS

Displays the remaining time of wire margin and WS gear in the current machining condition.

3) Remain at M02

Displays the remaining time of wire margin when the automatic operation completes. It will be displayed virtually with WS notch 8.

4) "Wire" button

Press the "Wire" button, and "Wire Type" screen will be displayed. If the wire has been changed, change the setting on the wire type setting screen. For the contents of the "Wire Type" screen, see "III. NC OPERATION DISPLAY SCREEN" > "3.1.10 Wire type setting".

4.6.2 Machining monitor section

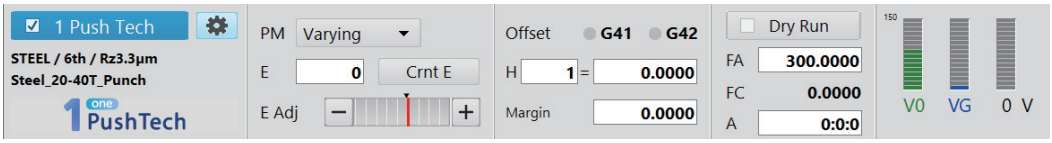


Fig. III.4.72

(1) 1 Push Tech.

See "III. NC OPERATION DISPLAY SCREEN" > "4.3.4 1 Push Technology".

(2) PM

Select the PM control mode. Varying (nozzle release mode), Optimum (nozzle contact mode), and Thin Wkpc (thin plate mode) can be selected.

(3) E

E-Pack No. can be displayed and set.

(4) Crnt E

Displays the current condition screen.

(5) E Adj

Set the notch used to adjust the machining speed. It indicates the standard speed when 0 is selected. Notch 0 is restored by executing Reset, M02, and M30.

(6) Offset

The variable number for storing offset and the offset value can be displayed and set. The initial value of the variable number for storing offset is H1.

(7) Margin

By using finish margin, the machining offset can be changed in an integrated way, without changing the offset set in the program and the monitor screen.

Offset for machining = Offset *1 + Finish margin

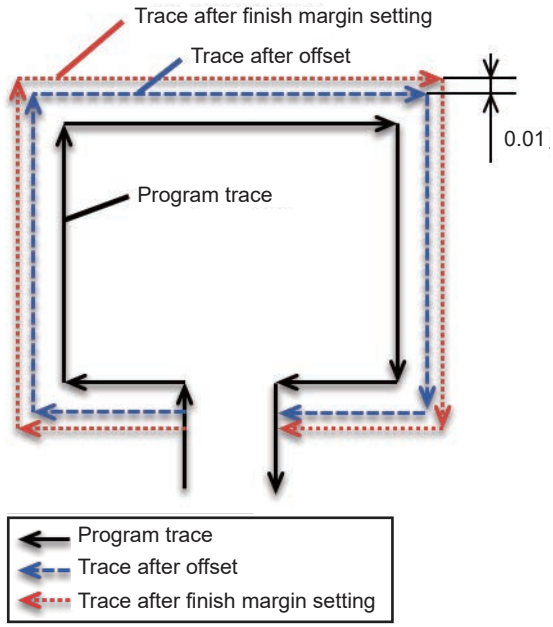
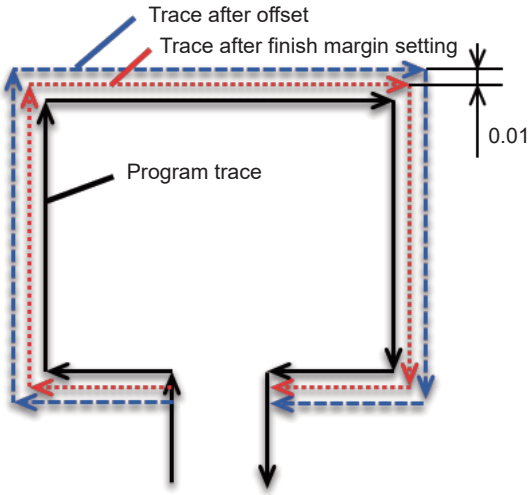
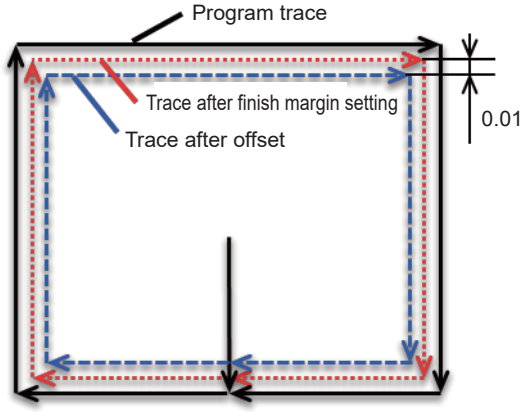
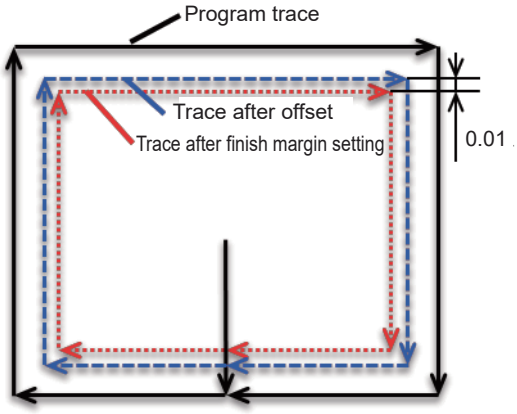
*1 Offset set in the program or the monitor screen

Example) H1=0.150, finish margin = 0.010

Offset for machining = 0.150 + 0.010 = 0.160

- **After the program is finished or reset, the setting value of the finish margin will be maintained. To clear it, select "Machining setting" > "Parameter Set" > "Auto3" from the auxiliary menu, and set the [FinishMarginM2Clear] switch to ON.**
- **Finish margin cannot be set during automatic operation and graphic inspection.**
- **When changing the inch/metric specs, reset the finish margin.**
- **As shown in Table III.4.4 below, the symbol definition varies depending on die and punch.**

Table III.4.4

	Finish margin setting	
	Increase finish machining dimensions	**Decrease finish machining dimensions**
Punch	 Finish margin = 0.01 (set to a positive value) → Offset increases, and finish machining dimensions increase.	 Finish margin = -0.01 (set to a negative value) → Offset decreases, and finish machining dimensions decrease.
Die	 Finish margin = -0.01 (set to a negative value) → Offset decreases, and finishing machining dimensions increase.	 Finish margin = 0.01 (set to a positive value) → Offset increases, and finishing machining dimensions decrease.

(8) FA, FC

FA: Set the machining speed.

FC: Displays the operation speed.

Data range: 0.001 ≤ FA ≤ 9999.999 mm/min.

If the RESET button is pressed twice, [FA] and [FC] of the machining data are cleared. Select "Machining setting" > "Parameter Set" > Auto3 from the auxiliary menu, and set the [Keep Data @ Reset] switch to ON. The data can be maintained even if the RESET button is pressed.

(9) A

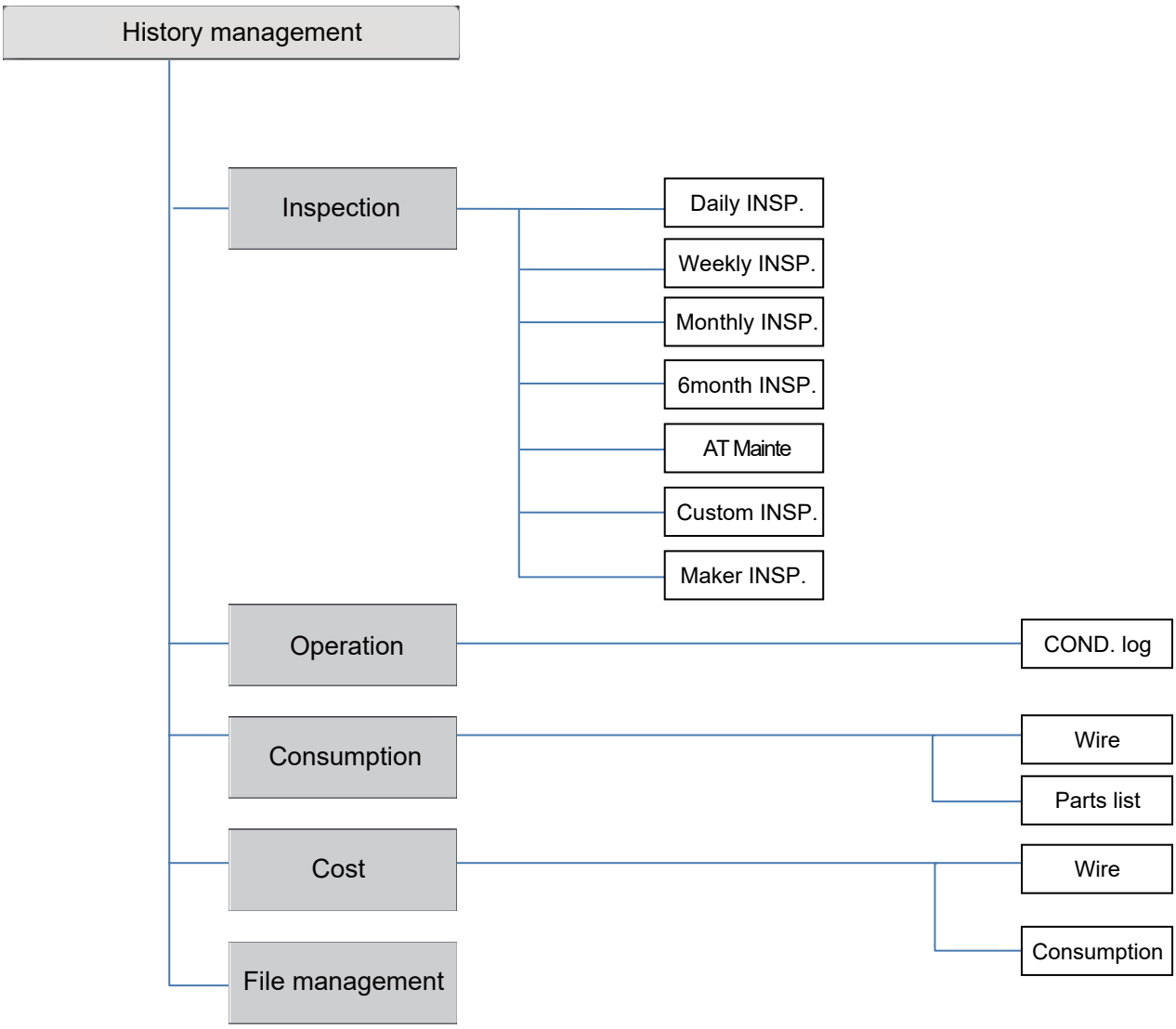
Sets the taper angle for taper machining.

(10)Power voltage

- V0: Displays the V0 notch set by the E-Pack command being output.
- VG: Displays the VG notch set by the E-Pack command being output.
- V: Displays the measured average machining voltage.

5. HISTORY MANAGEMENT

(1) Menu configuration



5.1 Inspection

Display the inspection screen as follows:

- Selecting "Inspection" in the history management menu
- Selecting the balloon of immediate inspection

> - **For details of each item, see "V. MAINTENANCE AND ALARM LIST".**
> - **Inspection time and maintenance quantity are guidelines. Adjust them to the machine use conditions.**

5.1.1 Immediate inspection

(1) Summary

If there are inspection items that need to be conducted immediately or consumables that must be replaced immediately or should be replaced soon, an icon will be displayed in the status area (the top of the screen) to remind the user.

(2) Description of display items

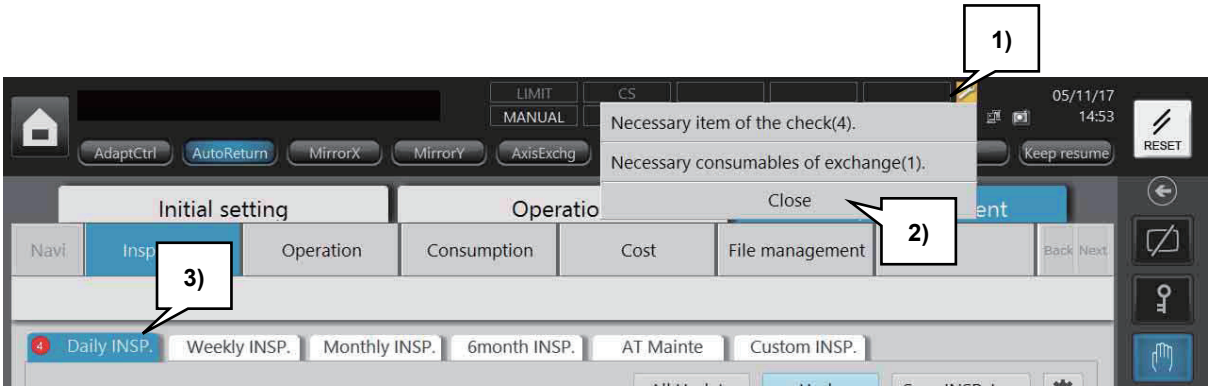


Fig. III.5.1

1) Immediate Inspection Icon

An icon is used to display whether there are inspection items that need to be conducted immediately. Tap the icon to display the number of object items in bubble mode.

2) Displaying Immediate Inspection Bubble

Displays the number of inspection items that need to be conducted immediately or the number of consumables that must be replaced immediately or should be replaced soon. Tap it to display the related screen of each item.

For details, see "III. NC OPERATION DISPLAY SCREEN" > "3.2.9 Screen operation setting".

3) Inspection Tab

Displays the number of immediate inspection objects in each category according to the inspection category.

5.1.2 Daily INSP.

Table III.5.1 Daily inspection items

No.	Inspection Items	Inspection Time Maintenance Quantity	Consumables
1	Wire path	-	-
2	Insulation board	-	-
3	Nozzle	-	-
4	Dielectric fluid	5670h	-
5	Resistivity	-	○
6	Working tank	-	-
7	Machining position	-	-
8	Wire collection section	-	-
9	Lubrication oiling	-	○
10	Filter regulator	-	-
11	Oil filter	-	-
12	Dielectric fluid amount	-	-
13	Dielectric fluid filter	-	○
14	Supply pump	-	-
15	Wire chip collection box	30	-
16	Wire guide	100 times	-
17	Jet nozzle	-	-
18	Wire guide block (front)	-	-

(1) Description of setting items (General)

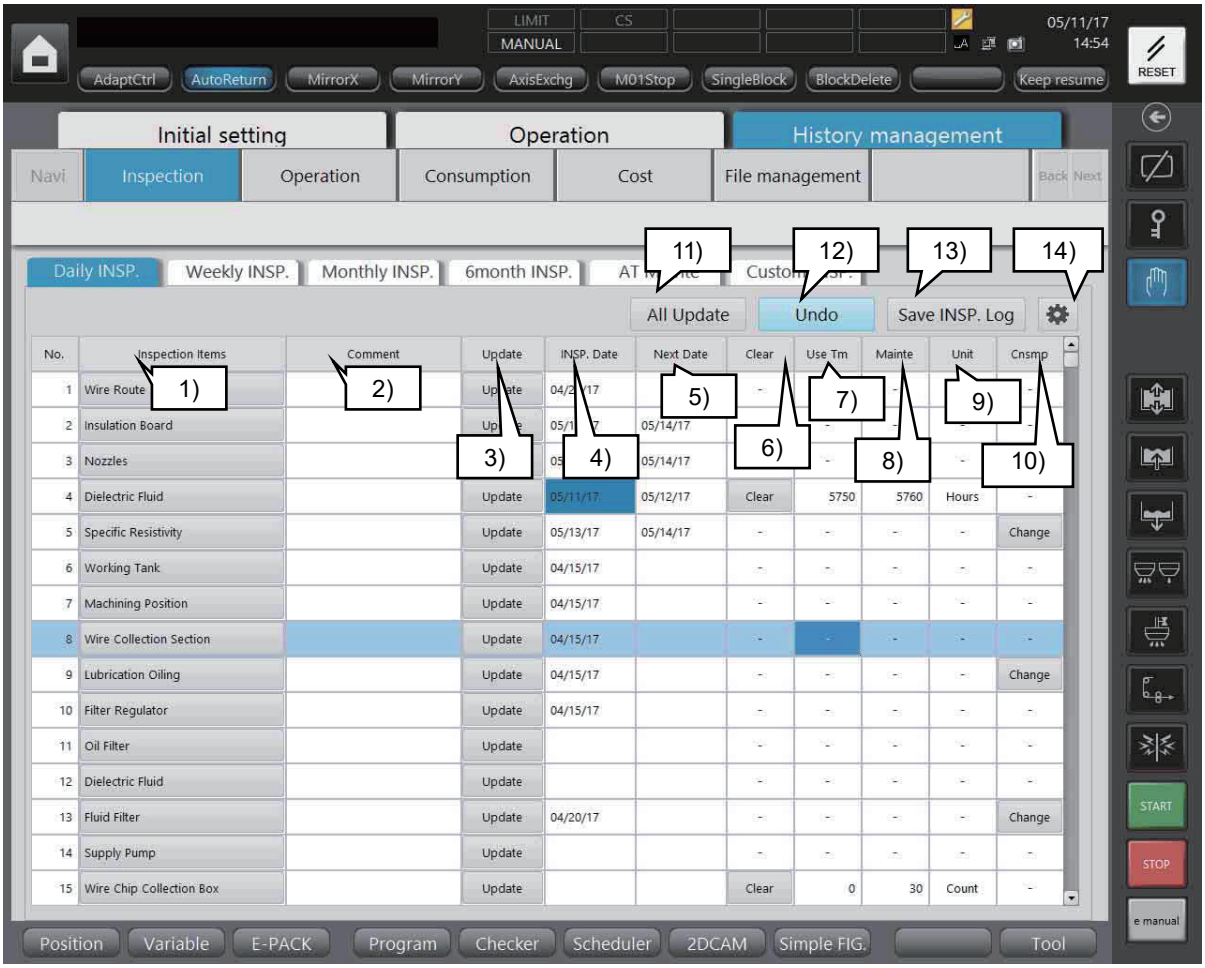


Fig. III.5.2

1) Inspection Items

Describes inspection items for each inspection cycle. Tap an option to display the advanced inspection screen.

(a) Inspection Details Screen (Overlap)

Displays the inspection position of each inspection item and implementation content.

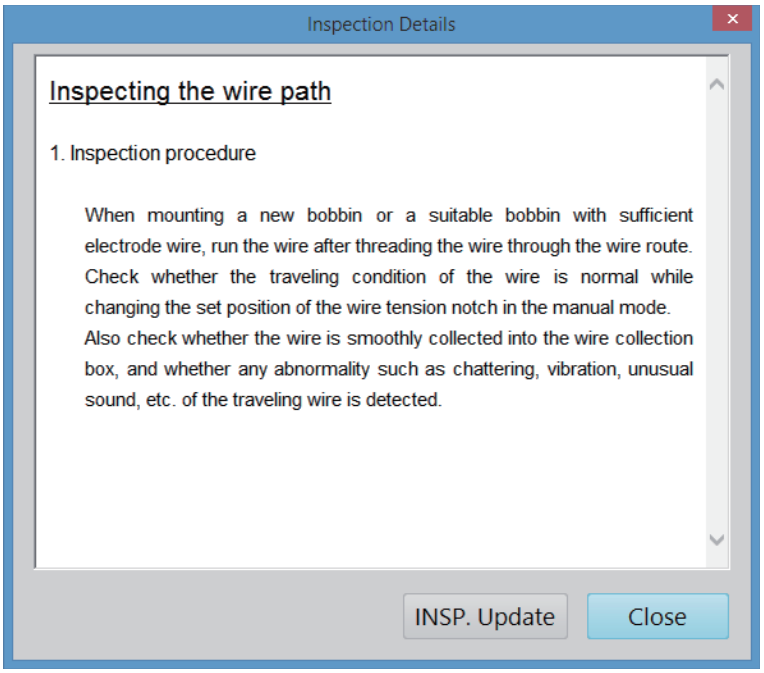


Fig. III.5.3

Tap INSP. Update to update inspection for this item (same as tapping the inspection update button in the inspection table).

2) Comment

Displays the comment at the time of inspection.

3) Inspection button

Updates the inspection implementation date and next inspection date after inspection. Set the next date per the table according to the inspection cycle.

The button usually shows "Update". For immediate inspection items, an alarm bell icon ( ) is shown.

Table III.5.2 Setting content of next inspection date of each inspection cycle

Inspection cycle	Next inspection date
Daily inspection	Set it to the next day.
Weekly inspection	Set it to a date after 7 days.
Monthly Inspection	Set it to the last date of next month.
6-month inspection	Set it to the last date of the month 6 months later.

4) Inspection date

Displays the latest inspection date. Setting this date updates the next inspection date accordingly. If it is today, the background turns blue to indicate completed items.

5) Next inspection date

Displays the next inspection date.

If a past date is set, the content may change to the immediate inspection object after setting.

6) Clear

The clear button is displayed for the item with set usage/maintenance quantity.

7) Use Tm

The usage quantity will be displayed for the item with set usage/maintenance quantity. For the item that cannot be set, "-" (dash) is displayed.
The input range is 0 to 9999.

8) Maintenance

The maintenance quantity will be displayed for the item with set usage/maintenance quantity. For the item that cannot be set, "-" (dash) is displayed.
The input range is 0 to 9999.

The maintenance quantity is the standard usage value for an inspection. When actual usage reaches this quantity, the inspection time is reached. If the maintenance quantity is 0, no inspection notification is issued.

9) Unit

Displays the usage/maintenance quantity unit.

10) Consumables

The "Change" button is displayed for consumables.

For the replacement screen of consumables, see "5.3 Consumption" in this chapter.

11) All Update

Regardless of the immediate inspection status, all items are set to inspection competed status.

12) Undo

Cancels the last change to the inspection table. The scope of Undo is shown in the table below. The item turns gray when Undo cannot be performed.

Table III.5.3 Application scope of "Undo" button

Operation	Cancel the change	Validate the Undo	Undo items
Tap the [All Update] button	× (cannot be canceled)	× (set to invalid)	-
Tap Undo button	×	×	-
Tap the inspection record saving button	- (no change)	- (no effect)	-
Tap the setting button	×	-	-
Tap the [Inspection items] button	-	-	-
Edit comments	○ (can be undone)	○ (set to valid)	Comment
Tap the [Update] button	○	○	Inspection implementation date and next inspection date
Edit the inspection implementation date	○	○	Inspection implementation date and next inspection date
Edit the next inspection date	○	○	Next inspection date
Tap the clear button	○	○	Usage quantity
Edit the usage quantity	○	○	Usage quantity
Edit the maintenance quantity	○	○	Maintenance volume
Tap the [Change] button	×	-	-

13) Save INSP.Log

Outputs CSV files of inspection records for daily, weekly, monthly, 6-month cycles, and AT maintenance (latest 100 each).

If records exceed 100 or management is external, output as needed.

14) Setting

Displays the inspection setting screen.

Set whether to send notice and notice time for each inspection item.

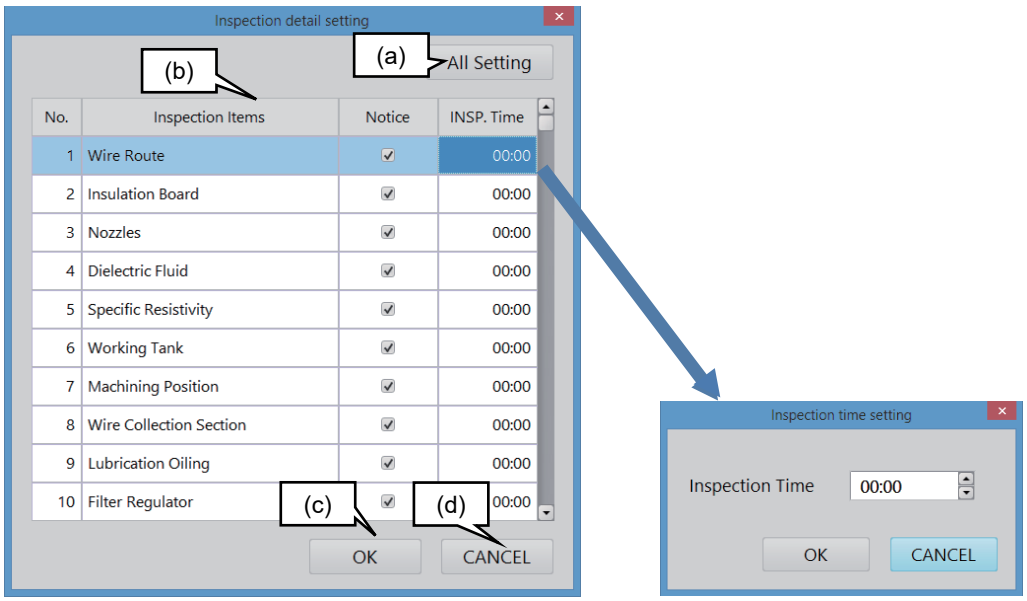


Fig. III.5.4

(a) All Setting

Displays the setting screen. Set the set time to the inspection time of all inspection items as a whole.

(b) Inspection Item List

(i) Inspection Items

Displays the inspection items in a list.

(ii) Notice

Displays whether the inspection time is notified. Tap the item to switch ON/OFF of the selected mark. The selected mark is ON by default.

(iii) Inspection Time

Displays the inspection notice time. Tap the item to display the time setting screen. The time can be set. The default value is 0:00.

(c) OK button

Applies the set content and closes the screen.

(d) CANCEL button

Gives up the set content and closes the screen.

For details of each item, see "V. MAINTENANCE AND ALARM LIST".

5.1.3 Weekly inspection

Table III.5.4 Weekly inspection items

No.	Inspection Items	Inspection Time Maintenance Quantity	Consumables
1	Wire retainer felt	80h	-
2	Upper power feeder	-	○
3	Lower power feeder	-	○
4	Upper diamond die	80h	○
5	Lower diamond die	80h	○
6	Guide block (internal and related parts)	-	-
7	Lower roller block	-	-

5.1.4 Monthly inspection

Table III.5.5 Monthly inspection items

No.	Inspection Items	Inspection Time Maintenance Quantity	Consumables
1	Wire-alignment device (option)	-	-
2	Inspection of lower nozzle clearance	-	-
3	Fluid level sensor	-	-
4	Working tank seal	-	-
5	Oiling of Z and UV axes	240h	-
6	Resistivity sensor	720h	-
7	Annealing roller	200 times	○
8	Annealing pinch roller	-	○
9	Cutting energizer and cutting pressed wire of energizer	200 times	○
10	Wire pressing roller	200h	-
11	Scraper	100 times	-
12	Scroll roller (wire chip collection section)	100 times	-
13	Upper guide U, D	200h	○
14	Upper dielectric fluid nozzle	200h	-
15	Upper guide C	200h	-
16	Lower guide C	200h	-
17	Lower guide U, D	200h	○
18	Auxiliary die	200h	○
19	Warping detection plate	-	-
20	Guide pipe	200h	-
21	Rectification plate	200h	-
22	Wire collection roller	200h	○
23	Collection pinch roller bearing	-	○
24	Power fan	720h	-

5.1.5 6-month inspection

Table III.5.6 6-month inspection items

No.	Inspection Items	Inspection Time Maintenance Quantity	Consumables
1	Float switch	2880h	-
2	Lubrication oiling for pump	-	-
3	Air filter	2880h	-
4	Condenser	-	-
5	Main tension roller	1200h	○
6	MT pinch roller	-	○
7	Lower roller	1200h	○
8	Lower roller bearing	-	○
9	Roller cover	1440h	-
10	MT pinch roller bearing	-	-

5.1.6 AT maintenance

Table III.5.7 AT maintenance inspection items

No.	Inspection Items
1	Guide pipe
2	Upper guide U, D
3	Upper power feeder
4	Upper guide C
5	Upper diamond die
6	Workpiece
7	Lower diamond die

No.	Inspection Items
8	Lower guide C
9	Lower power feeder
10	Lower guide U, D
11	Rectification plate
12	Lower roller
13	Others

(1) Description of setting items (AT maintenance)

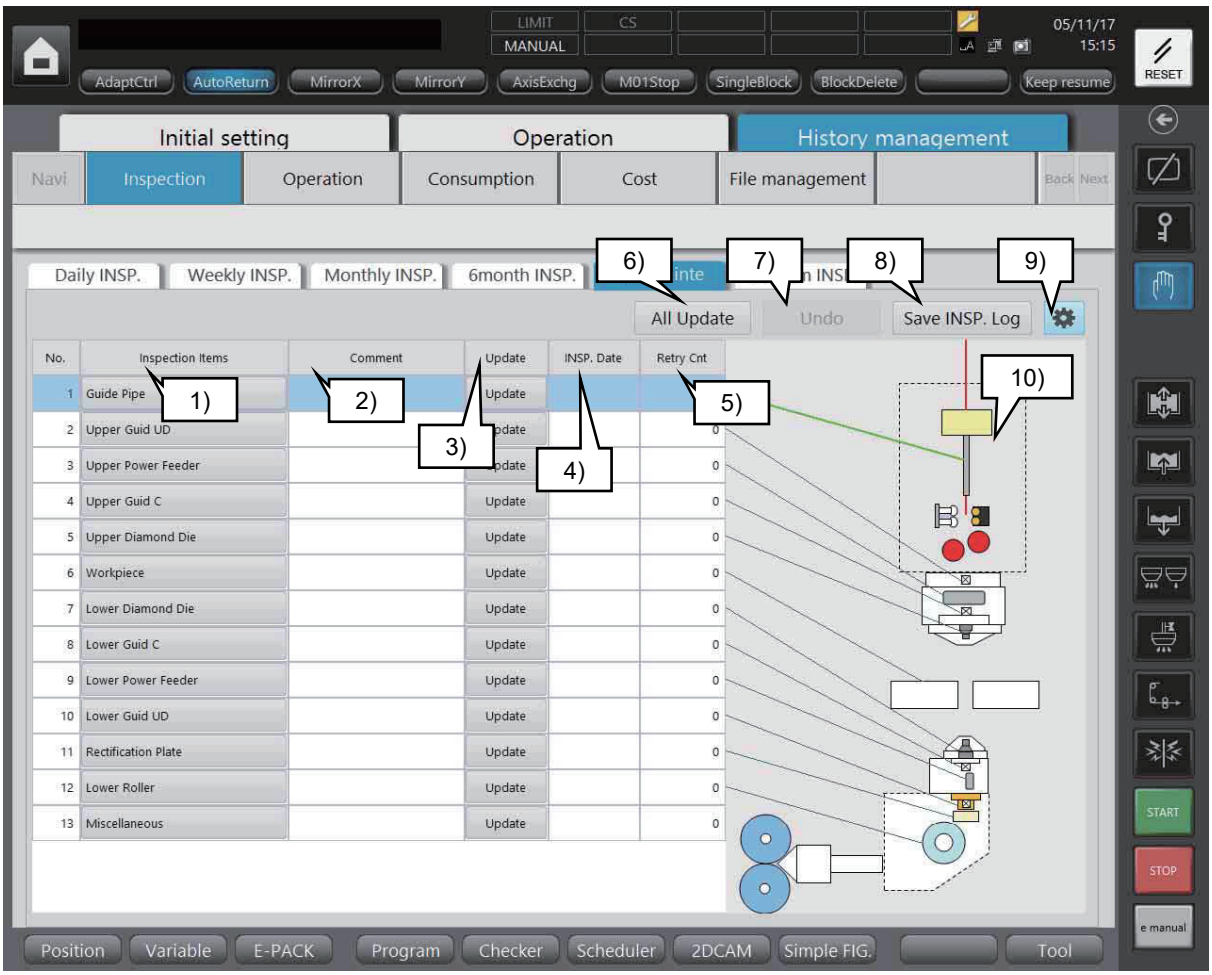


Fig. III.5.5

1) Inspection Items

The inspection items are for AT maintenance.

(a) Advanced Inspection Screen (Overlap)

Displays the inspection position of each inspection item and implementation content.

2) Comment

Displays the comment at the time of inspection.

3) Update button

After inspection is implemented, tap this button to update the inspection implementation date and retry count. Usually "Update" is displayed on the button, however, for the immediate inspection object, the alarm bell mark ( ) is displayed.

4) Inspection date

Displays the latest inspection implementation date.

5) Retry Cnt

Displays the current retry count.

6) All Update button

Regardless of the immediate inspection status, all items are set to inspection competed status.

7) Undo button

Cancels the inspection table content changed through the last operation. The application scope of "Undo" button is shown in the following table. The item changes to gray when the "Undo" operation cannot be performed.

Table III.5.8 Application scope of "Undo" button

Operation	Cancel the change	Validate the Undo	Undo items
Tap the [All Update] button	× (cannot be canceled)	× (set to invalid)	-
Tap the [Undo] button	×	×	-
Tap the [Save INSP. Log] button	- (no change)	- (no effect)	-
Tap the setting button	×	-	-
Tap the [Inspection items] button	-	-	-
Edit comments	(can be canceled)	(set to valid)	Comment
Press the [Update] button	○	○	Inspection date Retry count
Edit the inspection implementation date	○	○	Inspection date

8) Save INSP.Log button

Outputs the AT maintenance inspection records (the latest 100 records) as CSV files.

9) Setting button

Displays the inspection setting screen.

(i) Advanced Inspection Screen (Overlap)

Set whether to send notice (whether the object is regarded as an immediate inspection object) for each inspection item.

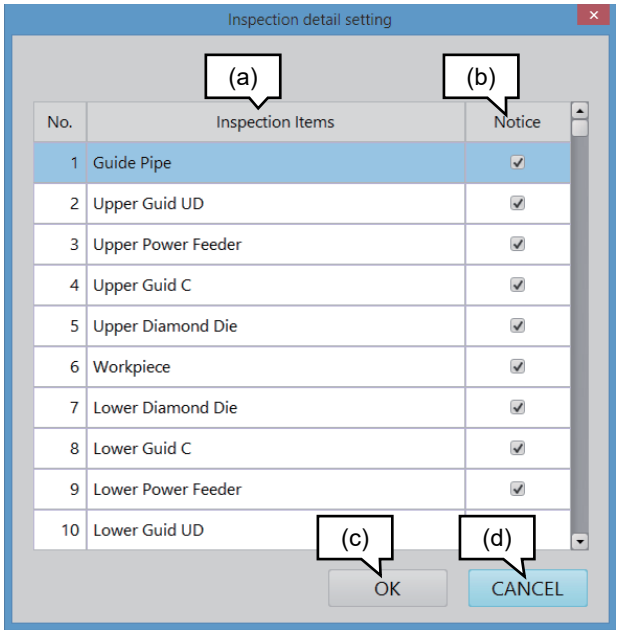


Fig. III.5.6

(a) Inspection Items

Displays the inspection items in a list.

(b) Notice

Displays whether the inspection time is notified. Tap the item to switch ON/OFF of the selected mark. The selected mark is ON by default.

(c) OK button

Applies the set content and closes the screen.

(d) CANCEL button

Gives up the set content and closes the screen.

10) Maintenance position

The AT maintenance position is displayed in graphic mode. When an inspection item is selected, a line is used to connect it to the corresponding inspection position.

5.1.7 Custom inspection

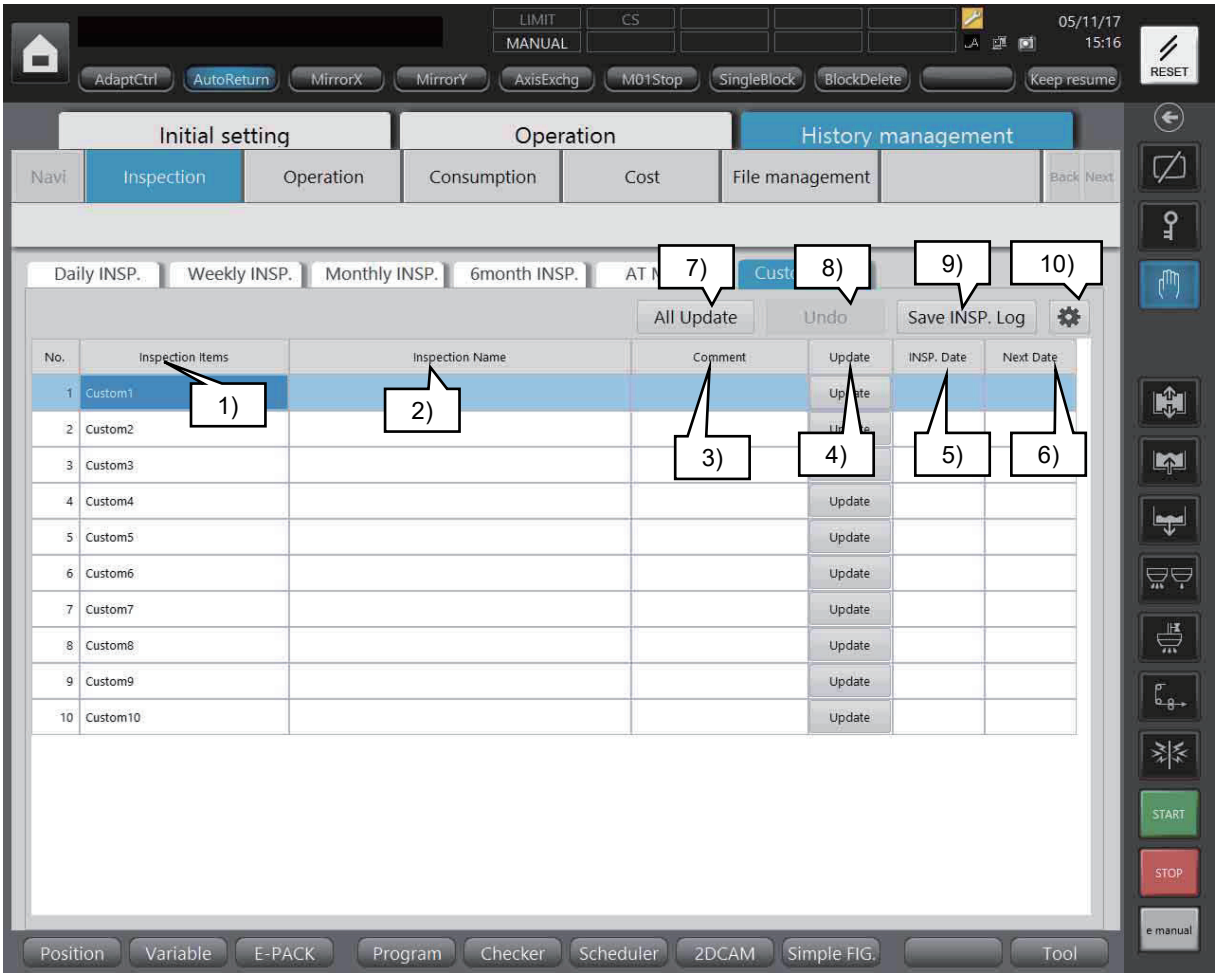


Fig. III.5.7

1) Inspection Items

Refers to the inspection item that can be set freely by the user. Totally 10 custom items (Custom 1 to Custom 10) can be used.

2) Inspection name

Enters/displays the inspection name.

3) Comment

Enters/displays the comment at the time of inspection.

4) Update button

After inspection is implemented, press this button to update the inspection implementation date.
Usually "Update" is displayed on the button, however, for the immediate inspection object, the alarm bell mark ( ) is displayed.

5) Inspection date

Displays the latest inspection implementation date.

6) Next inspection date

Displays the next inspection date. Tap the inspection update button or change the inspection implementation date. Then, the customized inspection will be updated to the next inspection date automatically.

If a past date is set, the content may change to the immediate inspection object after setting.

7) All Update

Regardless of the immediate inspection status, all items are set to inspection competed status.

8) Undo

Cancels the inspection table content changed through the last operation.

9) Save INSP.Log

Outputs the inspection records of daily, weekly, monthly, and 6-month cycles and AT maintenance (the 100 latest records reserved for each) as CSV files.

10) Setting

Displays the inspection setting screen.
Set whether to send notice (whether the object is regarded as an immediate inspection object) and notice time for each inspection item.

5.1.8 Maker INSP.

(1) Summary

Displays maker-set maintenance time (user cannot change).
Shows recommended replacement time on "Maker INSP." This is a guideline; parts may need earlier replacement depending on usage. Contact our service center for replacement.

Table III.5.9 Manufacturer inspection items

No.	Inspection Items	Inspection Time Maintenance Quantity
1	Power supply fan [POWER ON] replacement	1825 days
2	Power supply fan [Machining ON] replacement	1825 days
3	CPU fan replacement	50000 hours
4	LCD replacement	50000 hours
5	CFast replacement	1460 days
6	NC battery replacement	1095 days
7	Fluid level float replacement	1095 days
8	Lubricant strainer replacement	1095 days
9	UPS battery replacement	1095 days
10	Servo amplifier fan replacement	730 days
11	Servo amplifier battery X axis replacement	730 hours*

No.	Inspection Items	Inspection Time Maintenance Quantity
12	Servo amplifier battery Y axis replacement	730 hours*
13	Servo amplifier battery U axis replacement	730 hours*
14	Servo amplifier battery V axis replacement	730 hours*
15	Servo amplifier battery Z axis replacement	730 hours
16	Servo amplifier battery B axis replacement	0 hours
17	Jet nozzle replacement	0 times
18	O-ring replacement	0 times
19	Nest replacement	0 times
20	Pipe end replacement	0 times
21	Power feeder slide cylinder	0 times
22	Power feeder clamp lever	0 hours

*** Setting value for inspection time and maintenance quantity is different depending on each machine model. (Setting value is 0 hour depending on each machine model.)**

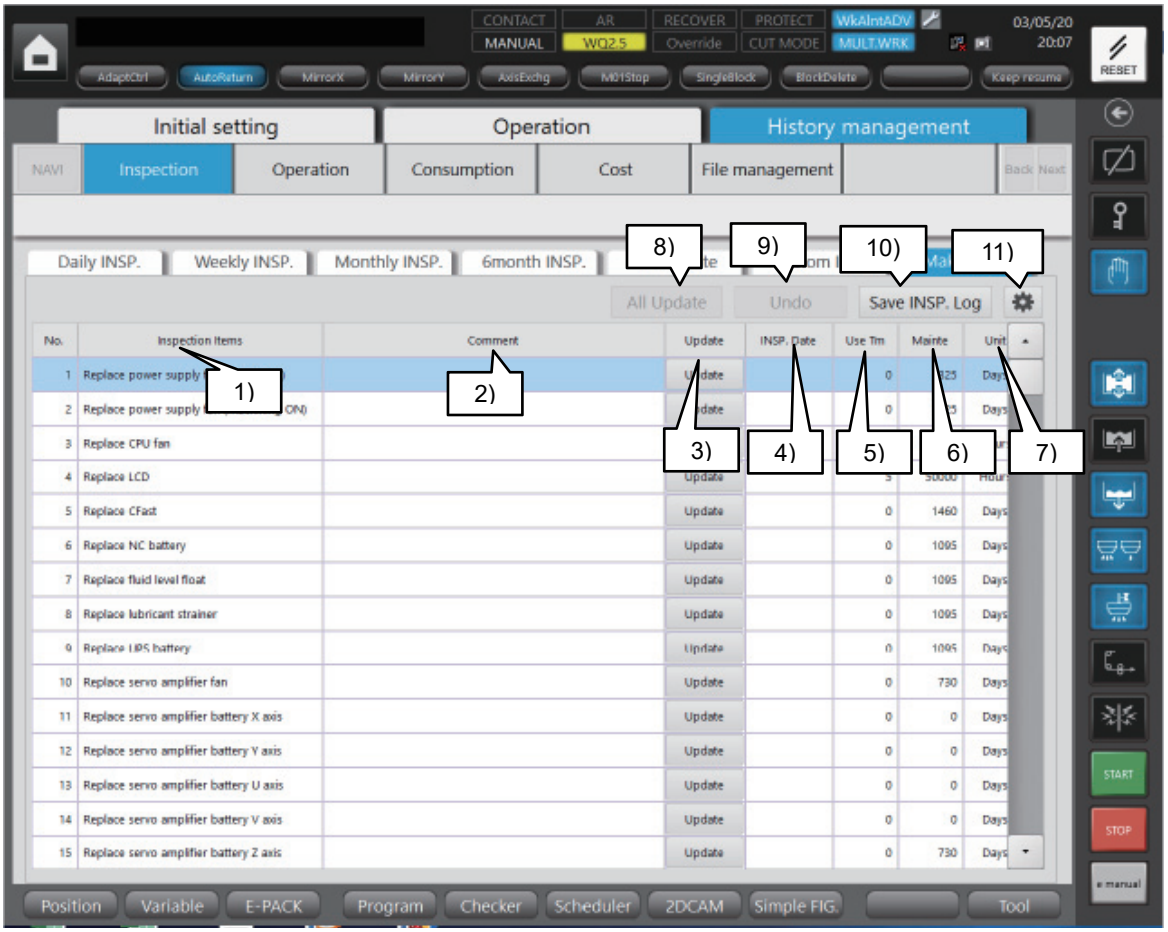


Fig. III.5.8

1) Inspection Items

Describes the inspection items in each inspection cycle.

2) Comment

Displays the comment at the time of inspection.

* It is not possible to input by the user. It is input by our service center.

3) Update button

After inspection is implemented, press this button to update the inspection implementation date.

Usually "Update" is displayed on the button, however, for the immediate inspection object, the alarm bell mark ( ) is displayed.

* It is not possible to input by the user. It is input by our service center.

4) Inspection date

Displays the latest inspection implementation date.

* It is not possible to input by the user. It is input by our service center.

5) Use Tm

The usage quantity will be displayed for the item with set usage/maintenance quantity. For the item that cannot be set, "-" (dash) is displayed.

The input range is 0 to 9999.

* It is not possible to input by the user. It is input by our service center.

6) Maintenance

The maintenance quantity will be displayed for the item with set usage/maintenance quantity.
The input range is 0 to 9999.
* It is not possible to input by the user. It is input by our service center.

The maintenance quantity is the standard value of the implemented inspection. If the usage reaches the maintenance quantity, the inspection time is reached. However, if the maintenance quantity is 0, inspection will not be notified.

7) Unit

Displays the usage/maintenance quantity unit.

8) All Update

Regardless of the immediate inspection status, all items are set to inspection competed status.
* It is not possible to input by the user. It is input by our service center.

9) Undo

Cancels the inspection table content changed through the last operation. The item changes to gray when the Undo operation cannot be performed.
* It is not possible to input by the user. It is input by our service center.

10) Save INSP.Log

Outputs the inspection records of daily, weekly, monthly, 6-month, and manufacturer inspections and AT maintenance (the 100 latest records for each) as CSV files.

11) Setting

Displays the inspection setting screen.
Set whether to send notice (whether the object is regarded as an immediate inspection object) and notice time for each inspection item.

5.1.9 Application of saved inspection record

Saves related data of the executed inspection item when a saved inspection record is run on the inspection screen. The default output file name becomes "InspectionLogData.csv".

Display as text file:

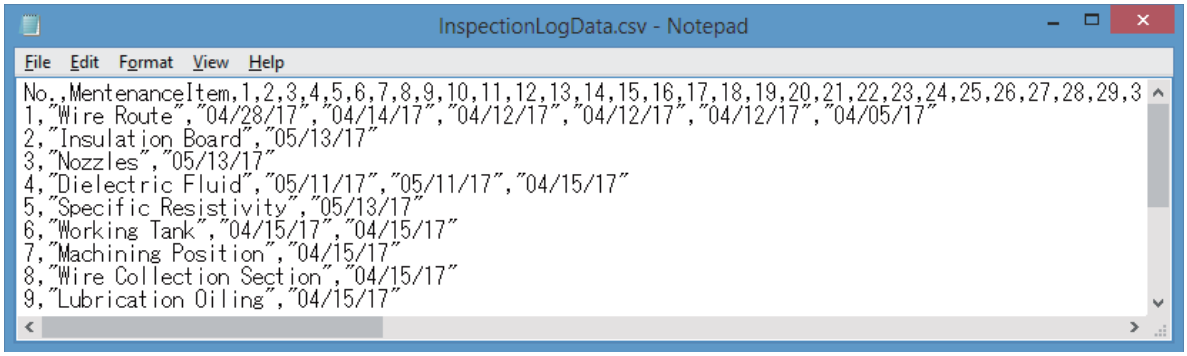


Fig. III.5.9

All the data items are separated by ", (comma)". Manage the inspection records of all items beyond the machine as shown in the table below.

Table III.5.10 Usage examples of inspection history

No.	MentenanceItem	1	2	3	4	5
1	Wire path	12/23/2016	12/21/2016	12/23/2016	12/23/2016	11/14/2016
2	Insulation board	12/23/2016	12/21/2016	11/14/2016	11/14/2016	11/13/2016
3	Nozzle	12/23/2016	11/14/2016	11/14/2016	11/13/2016	11/12/2016
4	Dielectric fluid	11/15/2016	11/14/2016	11/13/2016	11/12/2016	11/11/2016
5	Resistivity	11/15/2016	11/14/2016	11/13/2016	11/12/2016	11/11/2016
6	Working tank	12/23/2016	12/23/2016	11/15/2016	11/14/2016	11/13/2016
7	Machining position	12/23/2016	12/23/2016	11/15/2016	11/14/2016	11/13/2016
8	Wire collection section	11/15/2016	11/14/2016	11/13/2016	11/12/2016	11/11/2016

5.2 Operation

Display the inspection screen as follows:

- Select "Operation" in the history management menu.

5.2.1 Operation

(1) Operation

Used for machining operation status and machining performance management.

The displayed content varies depending on whether there is a contract for iQ Care Remote4U.

(2) Operation details

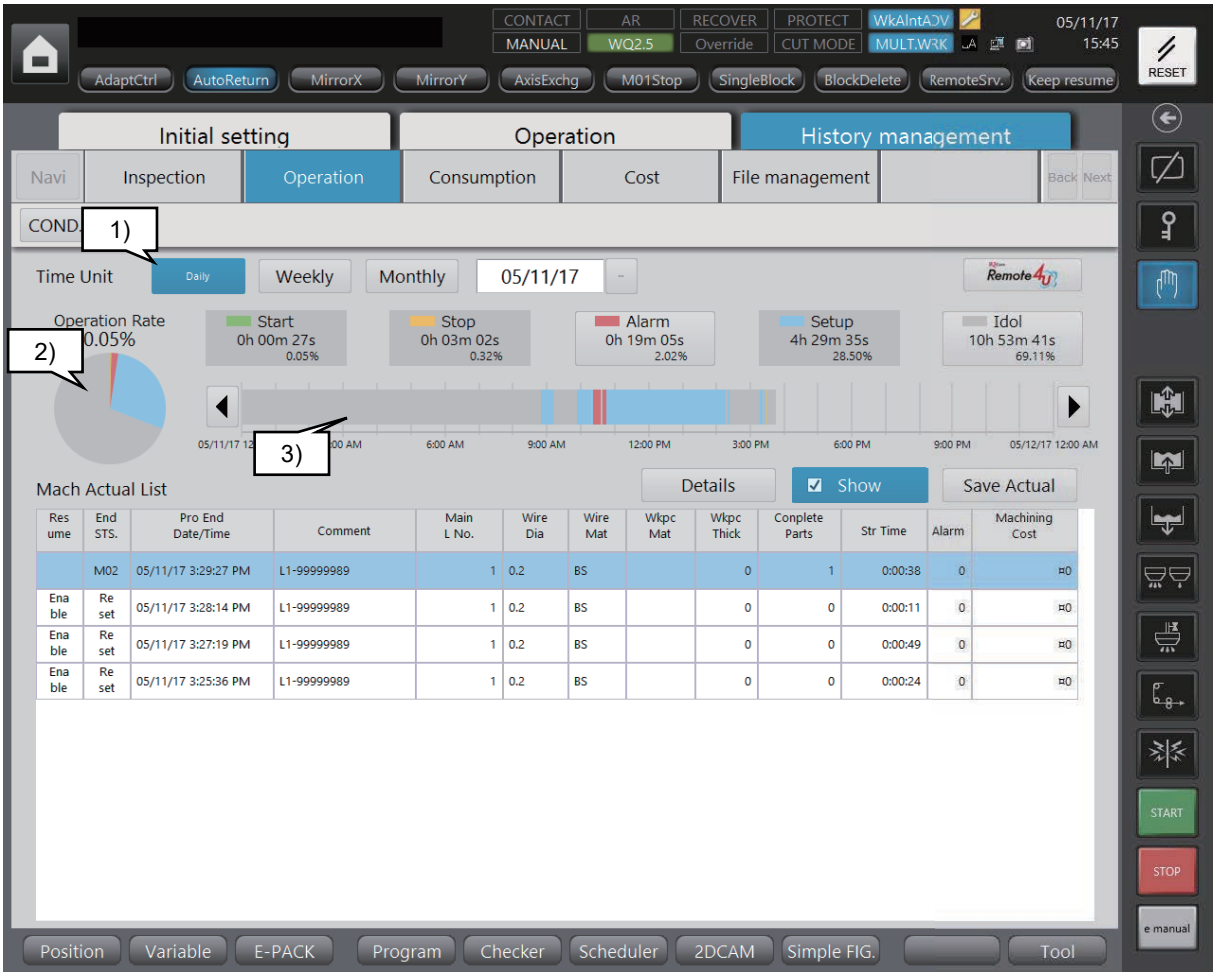


Fig. III.5.10 (With contract for Remote4U)

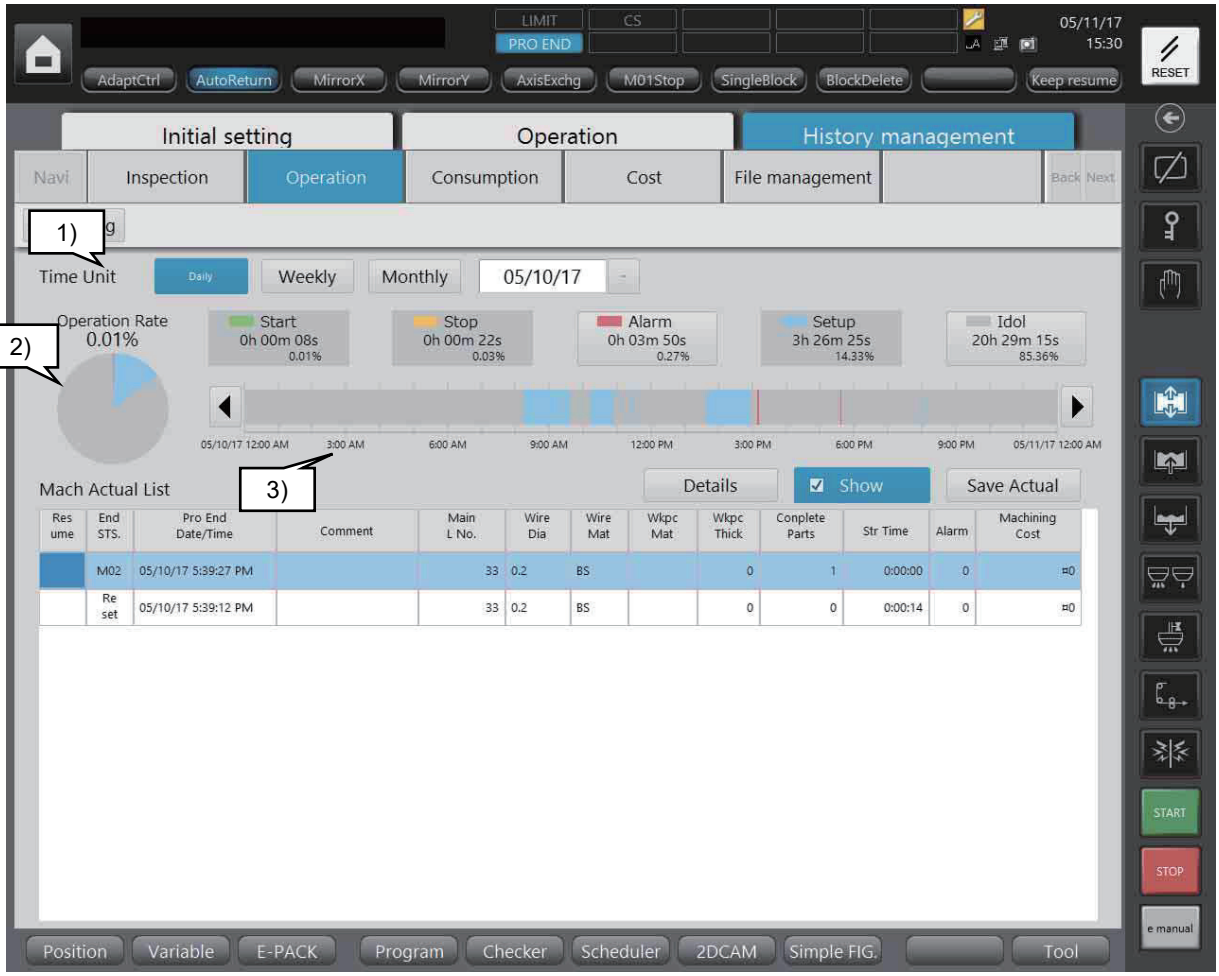


Fig. III.5.11 (No contract for Remote4U)

1) Displaying unit setting

Sets the display unit.

(a) Displaying unit specifying button

Specifies the display unit. The default value is "Daily".

(b) Specifying displayed day

Specifies the last day of displayed date range (default value = date of power-on).

(c) Calendar button

Displays the calendar and sets the specified date to displayed day.

Fig. III.5.12

2) Display utilization rate

Displays the utilization rate in the specified period..

To activate the utilization rate display, a contract for iQ Care Remote4U is required. Additionally, the alarm analysis screen will also be hidden.

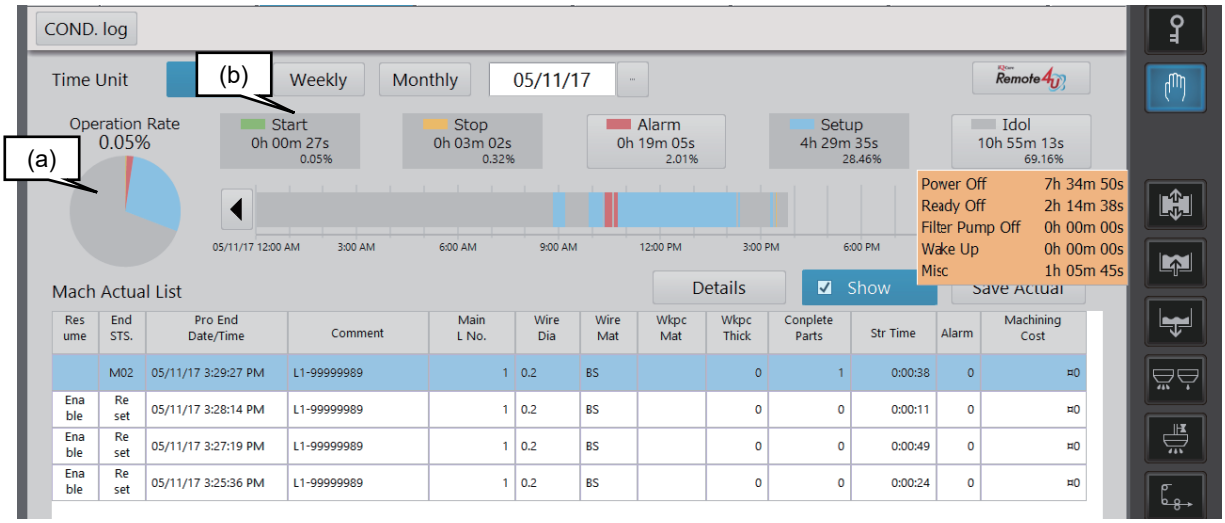


Fig. III.5.13

(a) Utilization rate chart

The rate of each operation category within the specified display period is displayed as a pie chart.

(b) Operation category

(i) Start

Time of running the program and starting the machine (when the start LED is on during automatic operation).

(ii) Stop

Time when the program stops running or pauses (when the start LED is off during automatic operation).

*** Axis moving under the manual mode is not included.**

(iii) Alarm

Time when the alarm is reported (when the alarm LED is on during automatic operation regardless of the manual/automatic mode).

(iv) Setup

Time of performing setup in manual mode.

(v) Idle

Time other than that in the above (i) to (iv), including power-OFF.

(c) Legend

Displays the total time for operation category and the proportion relative to the whole. Tap the alarm part to open the alarm analysis screen.

Tap the idling part to display the idling time details in the bubble mode.

For details on the alarm analysis screen, see "5.2.3 Alarm analysis" in this chapter.

3) Time sequence display

Displays the time sequence operation status in the specified period.

To activate the time sequence display, a contract for iQ Care Remote4U is required.

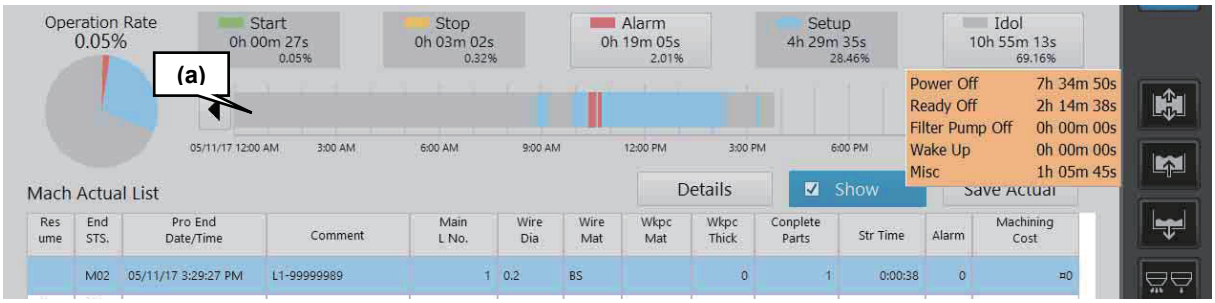


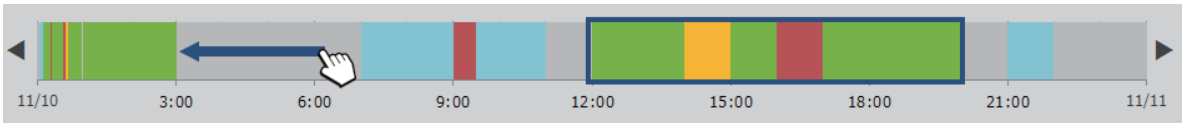
Fig. III.5.14 Time sequence display

(a) Operation method of time sequence display graph

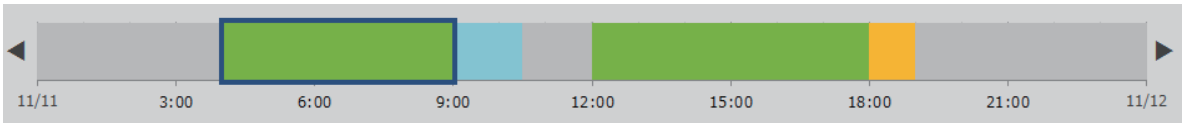
The operation described below can be used to change the graphic display.

(i) Moving display range Swipe

Swipe leftward / use [◀] and rightward / use [▶] to scroll the display range.
The moving amount of one operation is equivalent to the current display range.

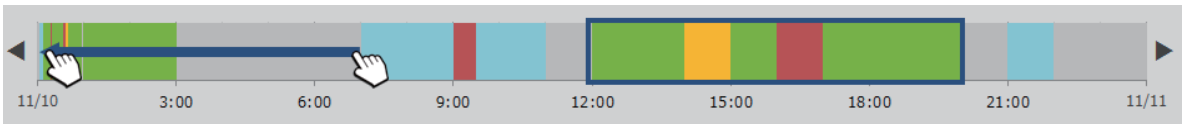


The display range moves forward or backward by one day.

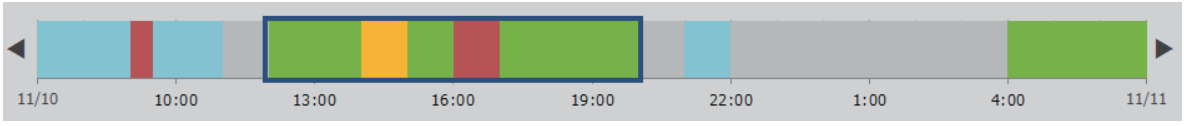


(ii) Moving display range by any amount Panning

Drag the chart left or right to scroll the diplay range forward and backward according to the panned amount (like mouse dragging operation).



The display range moves forward or backward by seven hours.



(iii) Display range zoom in/out by any amount Pinch in/out

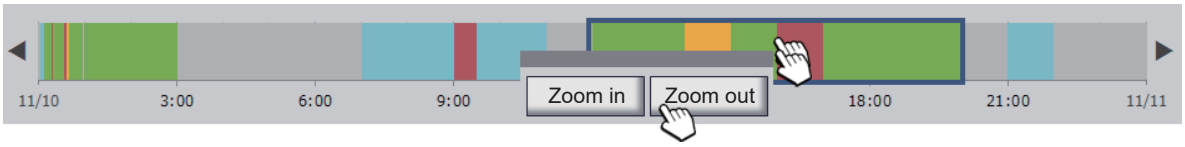
Pinch in/pinch out on the chart to enlarge/reduce.

Zoom-in/out

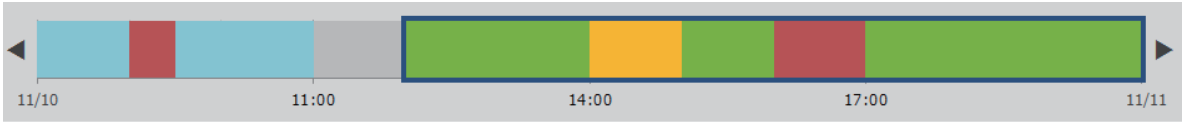
(iv) Display range zoom in/out Double tap

Pinch in/out on the image to enlarge/reduce the time axis scale. Double tap to enlarge 2× centered on the tapped position. The time axis scale button (zoom in/out) appears.

For tap zoom in, enlarges 2× centered on the double-tapped position; for tap zoom out, reduces to 1/2. The scale button disappears when any other position is tapped.

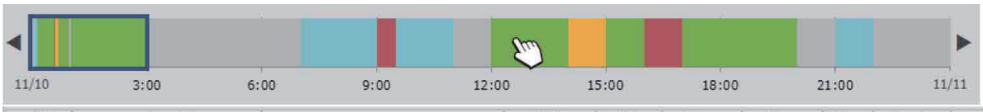


Zoom in to a 12-hour display centered at 4:00 PM.



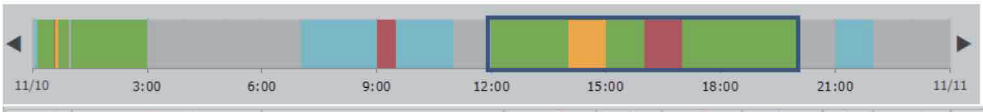
(v) Linkage of the graph with machining performance list

Changes to the time sequence chart range refresh the utilization rate display and machining performance list for that range. Tapping the chart selects the corresponding line in the machining performance list.



End STS.	Pro End Date/Time	Comment	Main L No.	Wire Dia	Wire Mat	Wkpc Mat	Wkpc Thick	Complete Parts	Str Time	Alarm	Machining Cost
Reset	2015/11/10 18:44:44	COMMENT1	100	0.2	BS	STEEL	5	0	0:02:56	0	12,345
Reset	2015/11/10 18:44:45	COMMENT2	101	0.2	BS	STEEL	10	1	0:01:21	1	12,345
Reset	2015/11/10 18:44:46	COMMENT2	101	0.2	BS	STEEL	10	1	0:05:33	0	12,345

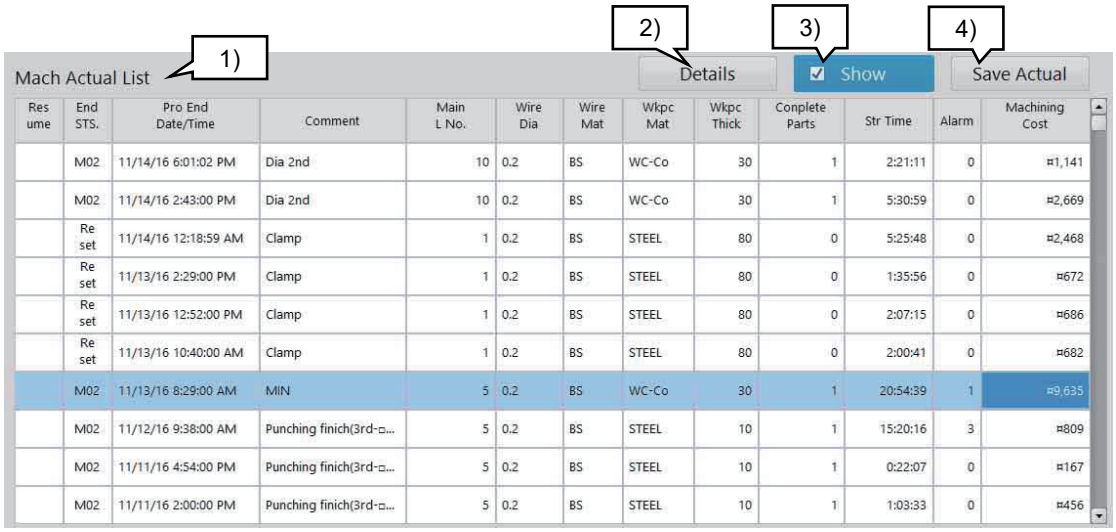
When the following area is touched, the frame line will move with the selected line.



End STS.	Pro End Date/Time	Comment	Main L No.	Wire Dia	Wire Mat	Wkpc Mat	Wkpc Thick	Complete Parts	Str Time	Alarm	Machining Cost
Reset	2015/11/10 18:44:44	COMMENT1	100	0.2	BS	STEEL	5	0	0:02:56	0	12,345
Reset	2015/11/10 18:44:45	COMMENT2	101	0.2	BS	STEEL	10	1	0:01:21	1	12,345
Reset	2015/11/10 18:44:46	COMMENT2	101	0.2	BS	STEEL	10	1	0:05:33	0	12,345

(3) Machining performance list details

Displays the machining performance achieved in the period specified in the displayed unit.



Resume	End STS.	Pro End Date/Time	Comment	Main L No.	Wire Dia	Wire Mat	Wkpc Mat	Wkpc Thick	Conplete Parts	Str Time	Alarm	Machining Cost
	M02	11/14/16 6:01:02 PM	Dia 2nd	10	0.2	BS	WC-Co	30	1	2:21:11	0	¤1,141
	M02	11/14/16 2:43:00 PM	Dia 2nd	10	0.2	BS	WC-Co	30	1	5:30:59	0	¤2,669
	Reset	11/14/16 12:18:59 AM	Clamp	1	0.2	BS	STEEL	80	0	5:25:48	0	¤2,468
	Reset	11/13/16 2:29:00 PM	Clamp	1	0.2	BS	STEEL	80	0	1:35:56	0	¤672
	Reset	11/13/16 12:52:00 PM	Clamp	1	0.2	BS	STEEL	80	0	2:07:15	0	¤686
	Reset	11/13/16 10:40:00 AM	Clamp	1	0.2	BS	STEEL	80	0	2:00:41	0	¤682
	M02	11/13/16 8:29:00 AM	MIN	5	0.2	BS	WC-Co	30	1	20:54:39	1	¤9,635
	M02	11/12/16 9:38:00 AM	Punching finich(3rd-□...	5	0.2	BS	STEEL	10	1	15:20:16	3	¤809
	M02	11/11/16 4:54:00 PM	Punching finich(3rd-□...	5	0.2	BS	STEEL	10	1	0:22:07	0	¤167
	M02	11/11/16 2:00:00 PM	Punching finich(3rd-□...	5	0.2	BS	STEEL	10	1	1:03:33	0	¤456

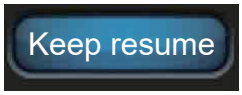
Fig. III.5.15

1) Machining performance list

Displays the machining performance in the specified period in a list.

(a) Resume

"Enable" is displayed for automatic operation for which machining can continue. When "Keep resume" of the "Auto" switch is set to ON, "Enable" is changed to "Keep". When OFF is set, "Keep" is restored to "Enable".



(b) End STS.

"M02" or "Reset" is displayed for the end condition.

(c) Pro End Date/Time

Displays the machining completion date and time.

Format: YY/MM/DD HH:MI:SS

(d) Comment

Displays the program comment.

(e) Main L No.

Displays the main program No.

Lines with "M" displayed indicate the machining using "1Push Technology".

(f) Wire dia

Displays the used wire diameter.

(g) Wire Mat

Displays the used wire material.

(h) Wkpc Mat

Displays the material of machined workpiece.

(i) Wkpc Thick

Displays the thickness of machined workpiece.

(j) Complete Parts

Displays the quantity of parts obtained through machining. The parts are counted through M750 and M751.

(k) Str Time

Displays the required machining time.

Format: HH:MI:SS

(l) Alarm

Displays the count of alarms reported during machining.

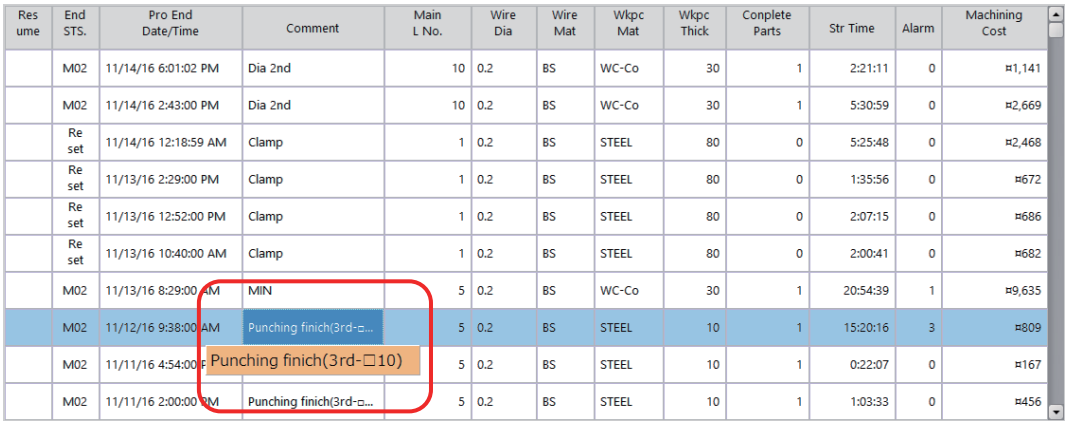
(m) Machining Cost

Displays the required machining cost.

For details, see "5.4 Cost" in this chapter.

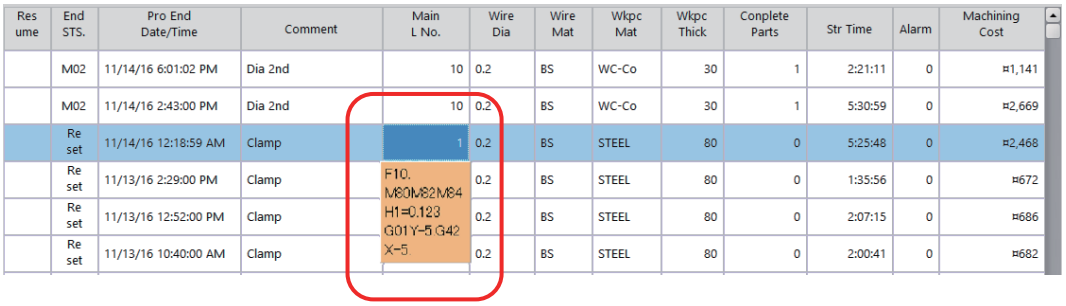
(n) Displaying machining content

When the comment, main L No., alarm, or machining cost is tapped, the corresponding bubble is displayed in the touched position.



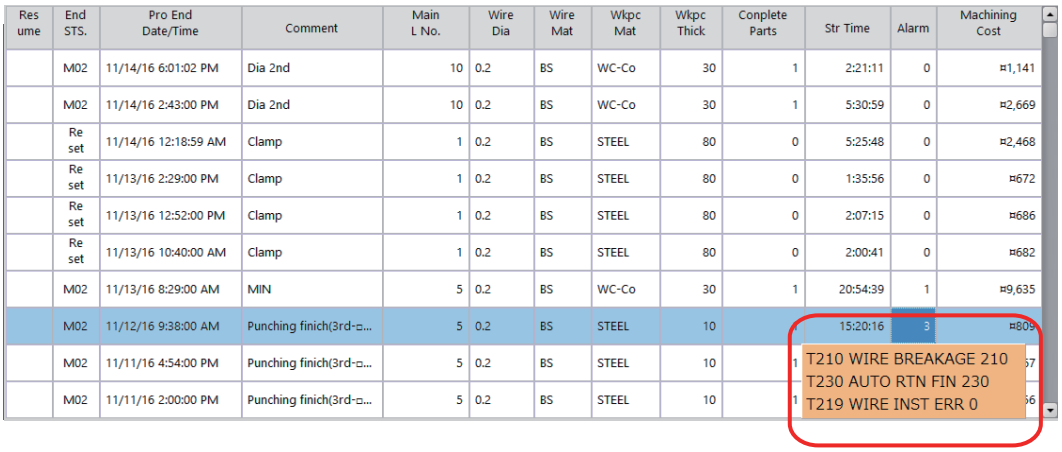
Resume	End STS.	Pro End Date/Time	Comment	Main L No.	Wire Dia	Wire Mat	Wkpc Mat	Wkpc Thick	Conplete Parts	Str Time	Alarm	Machining Cost
	M02	11/14/16 6:01:02 PM	Dia 2nd	10	0.2	BS	WC-Co	30	1	2:21:11	0	¤1,141
	M02	11/14/16 2:43:00 PM	Dia 2nd	10	0.2	BS	WC-Co	30	1	5:30:59	0	¤2,669
	Reset	11/14/16 12:18:59 AM	Clamp	1	0.2	BS	STEEL	80	0	5:25:48	0	¤2,468
	Reset	11/13/16 2:29:00 PM	Clamp	1	0.2	BS	STEEL	80	0	1:35:56	0	¤672
	Reset	11/13/16 12:52:00 PM	Clamp	1	0.2	BS	STEEL	80	0	2:07:15	0	¤686
	Reset	11/13/16 10:40:00 AM	Clamp	1	0.2	BS	STEEL	80	0	2:00:41	0	¤682
	M02	11/13/16 8:29:00 AM	MIN	5	0.2	BS	WC-Co	30	1	20:54:39	1	¤9,635
	M02	11/12/16 9:38:00 AM	Punching finich(3rd-□...	5	0.2	BS	STEEL	10	1	15:20:16	3	¤809
	M02	11/11/16 4:54:00 PM	Punching finich(3rd-□10)	5	0.2	BS	STEEL	10	1	0:22:07	0	¤167
	M02	11/11/16 2:00:00 PM	Punching finich(3rd-□...	5	0.2	BS	STEEL	10	1	1:03:33	0	¤456

When the comment column is touched, the detailed comments will be displayed in a bubble.



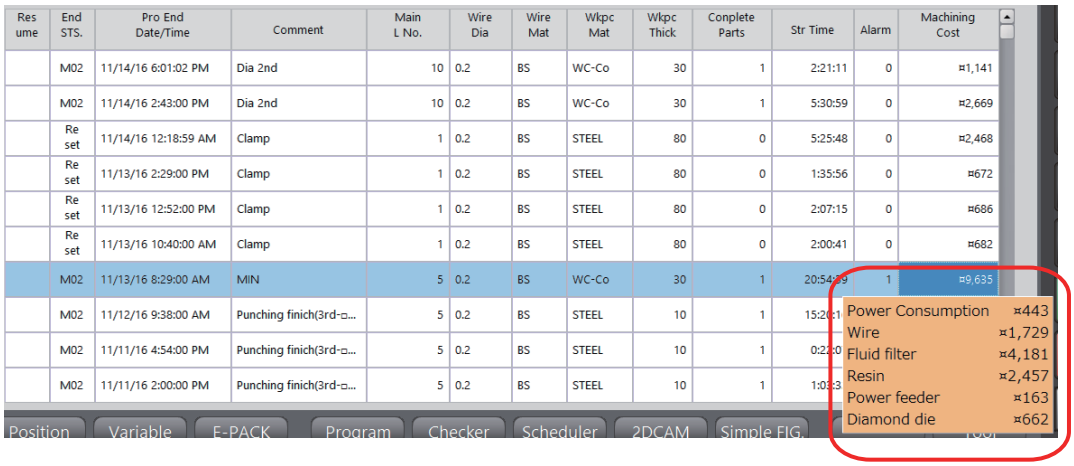
Resume	End STS.	Pro End Date/Time	Comment	Main L No.	Wire Dia	Wire Mat	Wkpc Mat	Wkpc Thick	Conplete Parts	Str Time	Alarm	Machining Cost
	M02	11/14/16 6:01:02 PM	Dia 2nd	10	0.2	BS	WC-Co	30	1	2:21:11	0	¤1,141
	M02	11/14/16 2:43:00 PM	Dia 2nd	10	0.2	BS	WC-Co	30	1	5:30:59	0	¤2,669
	Reset	11/14/16 12:18:59 AM	Clamp	1	0.2	BS	STEEL	80	0	5:25:48	0	¤2,468
	Reset	11/13/16 2:29:00 PM	Clamp	F10. M80M82M84 H1=0.123 G01Y-5.G42 X-5	0.2	BS	STEEL	80	0	1:35:56	0	¤672
	Reset	11/13/16 12:52:00 PM	Clamp		0.2	BS	STEEL	80	0	2:07:15	0	¤686
	Reset	11/13/16 10:40:00 AM	Clamp		0.2	BS	STEEL	80	0	2:00:41	0	¤682

When the main L No. column is touched, the first 5 lines of the main program will be displayed in a bubble.



Res ume	End STS.	Pro End Date/Time	Comment	Main L No.	Wire Dia	Wire Mat	Wkpc Mat	Wkpc Thick	Conplete Parts	Str Time	Alarm	Machining Cost
	M02	11/14/16 6:01:02 PM	Dia 2nd	10	0.2	BS	WC-Co	30	1	2:21:11	0	¤1,141
	M02	11/14/16 2:43:00 PM	Dia 2nd	10	0.2	BS	WC-Co	30	1	5:30:59	0	¤2,669
	Re set	11/14/16 12:18:59 AM	Clamp	1	0.2	BS	STEEL	80	0	5:25:48	0	¤2,468
	Re set	11/13/16 2:29:00 PM	Clamp	1	0.2	BS	STEEL	80	0	1:35:56	0	¤672
	Re set	11/13/16 12:52:00 PM	Clamp	1	0.2	BS	STEEL	80	0	2:07:15	0	¤686
	Re set	11/13/16 10:40:00 AM	Clamp	1	0.2	BS	STEEL	80	0	2:00:41	0	¤682
	M02	11/13/16 8:29:00 AM	MIN	5	0.2	BS	WC-Co	30	1	20:54:39	1	¤9,635
	M02	11/12/16 9:38:00 AM	Punching finich(3rd-□...	5	0.2	BS	STEEL	10		15:20:16	3	¤809
	M02	11/11/16 4:54:00 PM	Punching finich(3rd-□...	5	0.2	BS	STEEL	10				
	M02	11/11/16 2:00:00 PM	Punching finich(3rd-□...	5	0.2	BS	STEEL	10				

When the alarm column is touched, the alarm contents (up to 10) will be displayed in a bubble.



Res ume	End STS.	Pro End Date/Time	Comment	Main L No.	Wire Dia	Wire Mat	Wkpc Mat	Wkpc Thick	Conplete Parts	Str Time	Alarm	Machining Cost
	M02	11/14/16 6:01:02 PM	Dia 2nd	10	0.2	BS	WC-Co	30	1	2:21:11	0	¤1,141
	M02	11/14/16 2:43:00 PM	Dia 2nd	10	0.2	BS	WC-Co	30	1	5:30:59	0	¤2,669
	Re set	11/14/16 12:18:59 AM	Clamp	1	0.2	BS	STEEL	80	0	5:25:48	0	¤2,468
	Re set	11/13/16 2:29:00 PM	Clamp	1	0.2	BS	STEEL	80	0	1:35:56	0	¤672
	Re set	11/13/16 12:52:00 PM	Clamp	1	0.2	BS	STEEL	80	0	2:07:15	0	¤686
	Re set	11/13/16 10:40:00 AM	Clamp	1	0.2	BS	STEEL	80	0	2:00:41	0	¤682
	M02	11/13/16 8:29:00 AM	MIN	5	0.2	BS	WC-Co	30	1	20:54:39	1	¤9,635
	M02	11/12/16 9:38:00 AM	Punching finich(3rd-□...	5	0.2	BS	STEEL	10	1	15:20:16		
	M02	11/11/16 4:54:00 PM	Punching finich(3rd-□...	5	0.2	BS	STEEL	10	1	0:23:0		
	M02	11/11/16 2:00:00 PM	Punching finich(3rd-□...	5	0.2	BS	STEEL	10	1	1:03:3		

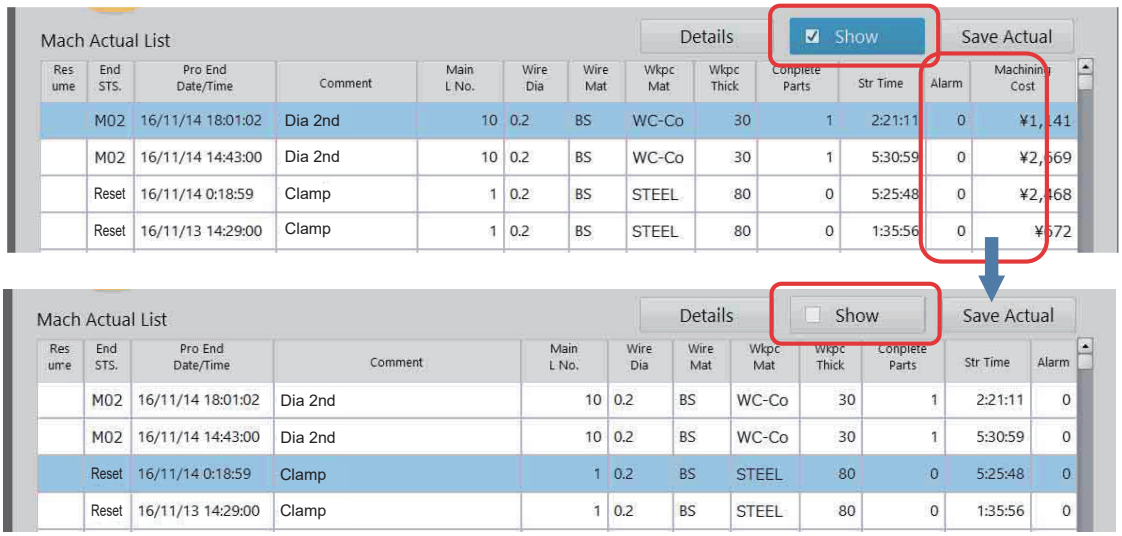
When the machining cost column is touched, the cost composition will be displayed in a bubble.

2) Details button

Displays the machining details , see "5.2.4 Machining details".

3) Machining cost display button

Switches to display/hide the machining cost column.



4) Save Actual button

Outputs machining performance as CSV file.

5) Machining report

Displays and saves customer's machining record as a machining report (output possible PDF file). Reports are saved here:

Save location: D:\MYDATA\DocMgt\Document\MachiningReport

File name: MachiningReport_YYYYMMDD_hhmmss_L"number"_"machining number".pd

A maximum of 2400 reports can be saved. In case of 5% or less space, older reports are deleted.

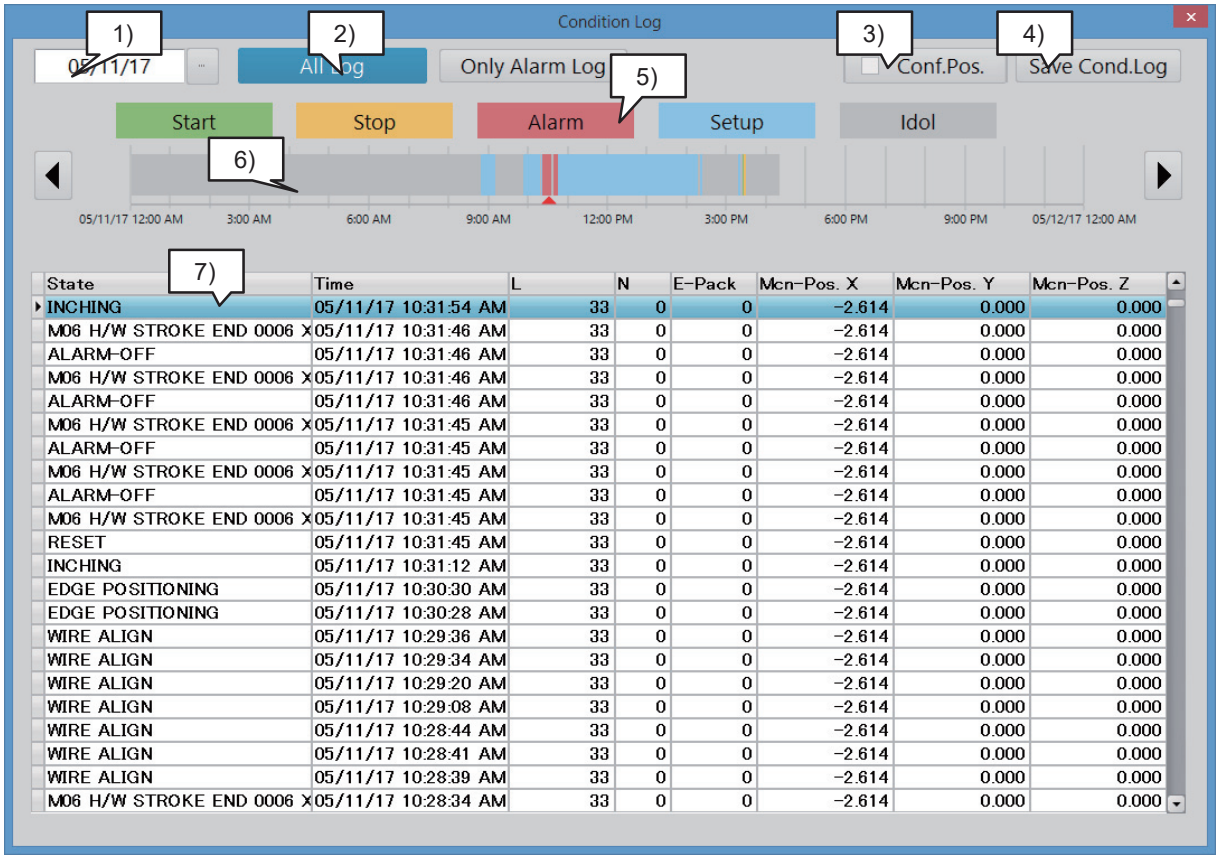
5.2.2 Condition log

(1) Condition log

Used to manage the machine operating status (tap “COND.log”).

Fig. III.5.16

(2) Condition record details



State	Time	L	N	E-Pack	Mcn-Pos. X	Mcn-Pos. Y	Mcn-Pos. Z
INCHING	05/11/17 10:31:54 AM	33	0	0	-2.614	0.000	0.000
M06 H/W STROKE END 0006 X	05/11/17 10:31:46 AM	33	0	0	-2.614	0.000	0.000
ALARM-OFF	05/11/17 10:31:46 AM	33	0	0	-2.614	0.000	0.000
M06 H/W STROKE END 0006 X	05/11/17 10:31:46 AM	33	0	0	-2.614	0.000	0.000
ALARM-OFF	05/11/17 10:31:46 AM	33	0	0	-2.614	0.000	0.000
M06 H/W STROKE END 0006 X	05/11/17 10:31:45 AM	33	0	0	-2.614	0.000	0.000
ALARM-OFF	05/11/17 10:31:45 AM	33	0	0	-2.614	0.000	0.000
M06 H/W STROKE END 0006 X	05/11/17 10:31:45 AM	33	0	0	-2.614	0.000	0.000
ALARM-OFF	05/11/17 10:31:45 AM	33	0	0	-2.614	0.000	0.000
M06 H/W STROKE END 0006 X	05/11/17 10:31:45 AM	33	0	0	-2.614	0.000	0.000
RESET	05/11/17 10:31:45 AM	33	0	0	-2.614	0.000	0.000
INCHING	05/11/17 10:31:12 AM	33	0	0	-2.614	0.000	0.000
EDGE POSITIONING	05/11/17 10:30:30 AM	33	0	0	-2.614	0.000	0.000
EDGE POSITIONING	05/11/17 10:30:28 AM	33	0	0	-2.614	0.000	0.000
WIRE ALIGN	05/11/17 10:29:36 AM	33	0	0	-2.614	0.000	0.000
WIRE ALIGN	05/11/17 10:29:34 AM	33	0	0	-2.614	0.000	0.000
WIRE ALIGN	05/11/17 10:29:20 AM	33	0	0	-2.614	0.000	0.000
WIRE ALIGN	05/11/17 10:29:08 AM	33	0	0	-2.614	0.000	0.000
WIRE ALIGN	05/11/17 10:28:44 AM	33	0	0	-2.614	0.000	0.000
WIRE ALIGN	05/11/17 10:28:41 AM	33	0	0	-2.614	0.000	0.000
WIRE ALIGN	05/11/17 10:28:39 AM	33	0	0	-2.614	0.000	0.000
M06 H/W STROKE END 0006 X	05/11/17 10:28:34 AM	33	0	0	-2.614	0.000	0.000

Fig. III.5.17

To activate the time sequence display, a contract for iQ Care Remote4U is required.

1) Specifying displayed day

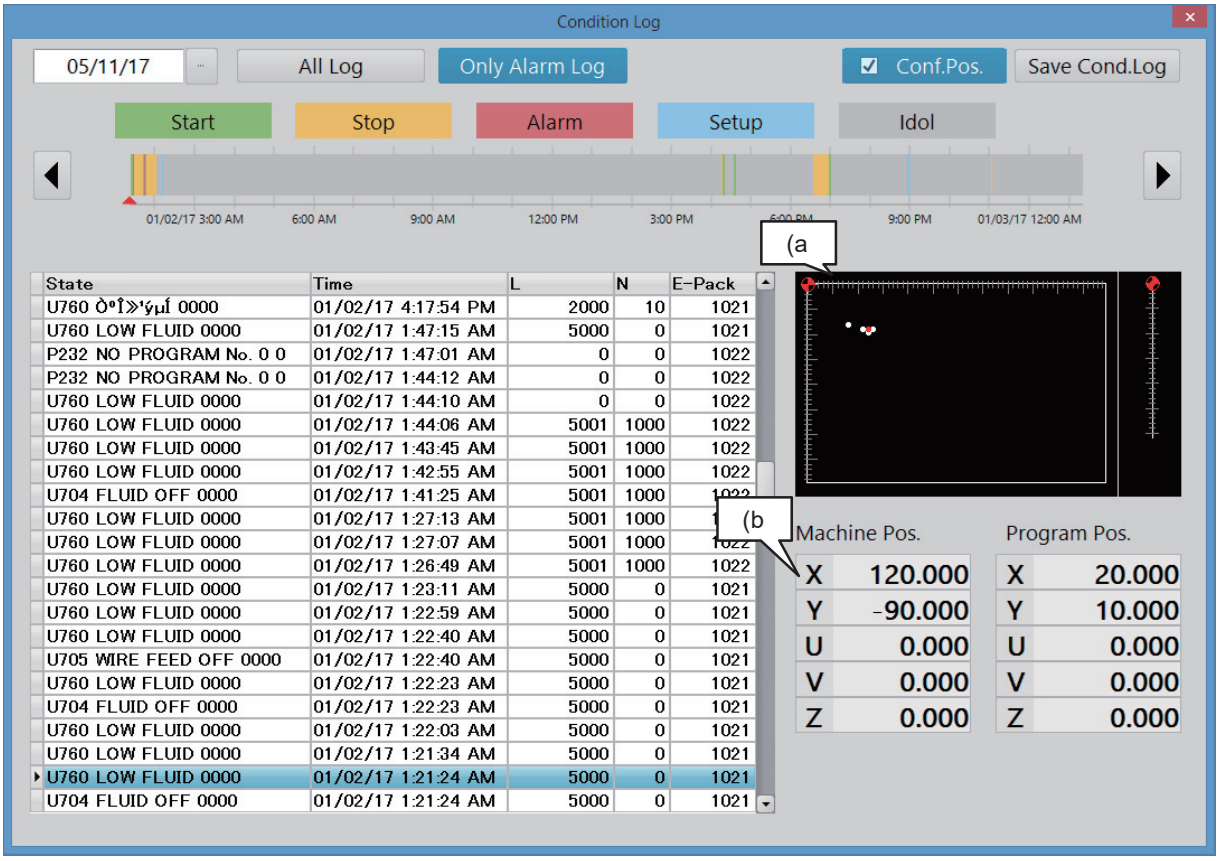
Specifies the displayed day. Format: YY/MM/DD HH:MI:SS (default: date of power-on)

2) Displayed content specifying button

Specifies the content displayed in the list (either “All logs” or “Only Alarm Logs”).

3) Conf.Pos. button

Switches to coordinate confirmation screen.



State	Time	L	N	E-Pack
U760 Ò°Î»'ýµí 0000	01/02/17 4:17:54 PM	2000	10	1021
U760 LOW FLUID 0000	01/02/17 1:47:15 AM	5000	0	1021
P232 NO PROGRAM No. 0 0	01/02/17 1:47:01 AM	0	0	1022
P232 NO PROGRAM No. 0 0	01/02/17 1:44:12 AM	0	0	1022
U760 LOW FLUID 0000	01/02/17 1:44:10 AM	0	0	1022
U760 LOW FLUID 0000	01/02/17 1:44:06 AM	5001	1000	1022
U760 LOW FLUID 0000	01/02/17 1:43:45 AM	5001	1000	1022
U760 LOW FLUID 0000	01/02/17 1:42:55 AM	5001	1000	1022
U704 FLUID OFF 0000	01/02/17 1:41:25 AM	5001	1000	1022
U760 LOW FLUID 0000	01/02/17 1:27:13 AM	5001	1000	1022
U760 LOW FLUID 0000	01/02/17 1:27:07 AM	5001	1000	1022
U760 LOW FLUID 0000	01/02/17 1:26:49 AM	5001	1000	1022
U760 LOW FLUID 0000	01/02/17 1:23:11 AM	5000	0	1021
U760 LOW FLUID 0000	01/02/17 1:22:59 AM	5000	0	1021
U760 LOW FLUID 0000	01/02/17 1:22:40 AM	5000	0	1021
U705 WIRE FEED OFF 0000	01/02/17 1:22:40 AM	5000	0	1021
U760 LOW FLUID 0000	01/02/17 1:22:23 AM	5000	0	1021
U704 FLUID OFF 0000	01/02/17 1:22:23 AM	5000	0	1021
U760 LOW FLUID 0000	01/02/17 1:22:03 AM	5000	0	1021
U760 LOW FLUID 0000	01/02/17 1:21:34 AM	5000	0	1021
U760 LOW FLUID 0000	01/02/17 1:21:24 AM	5000	0	1021
U704 FLUID OFF 0000	01/02/17 1:21:24 AM	5000	0	1021

Fig. III.5.18

(a) Displaying coordinate position

Displays the coordinate position for events in the time sequence graph or list (current line position displayed in red dots, other coordinate position in white dots). The range is as follows:

- Remote4U protocol is signed: Display range of the time sequence graph.
- Remote4U protocol not signed: Display range of the list.

(b) Displaying coordinates

Displays machine coordinates and current position.

4) Save Cond.Log button

Outputs the condition log as a CSV file.

5) Legend

Displays the legend of time sequence graph.

6) Time sequence graph

Displays the time sequence operation status in the specified period.
To change the display range, see "5.2.1 Operation" > "(2) Operation details" > "3) Time sequence display" > "(a) Operation method of time sequence display graph" in this chapter.

7) Condition log list

Displays the condition log. Tapping the title once / twice sorts all items in ascending / descending order.
Default: descending order.

5.2.3 Alarm analysis

(1) Alarm analysis

Used to analyze reported alarms. Alarms are classified and the frequent alarms of each type are displayed. If many alarms are preventable, repeat inspection and maintenance to keep the machine stable.

(2) Alarm analysis details

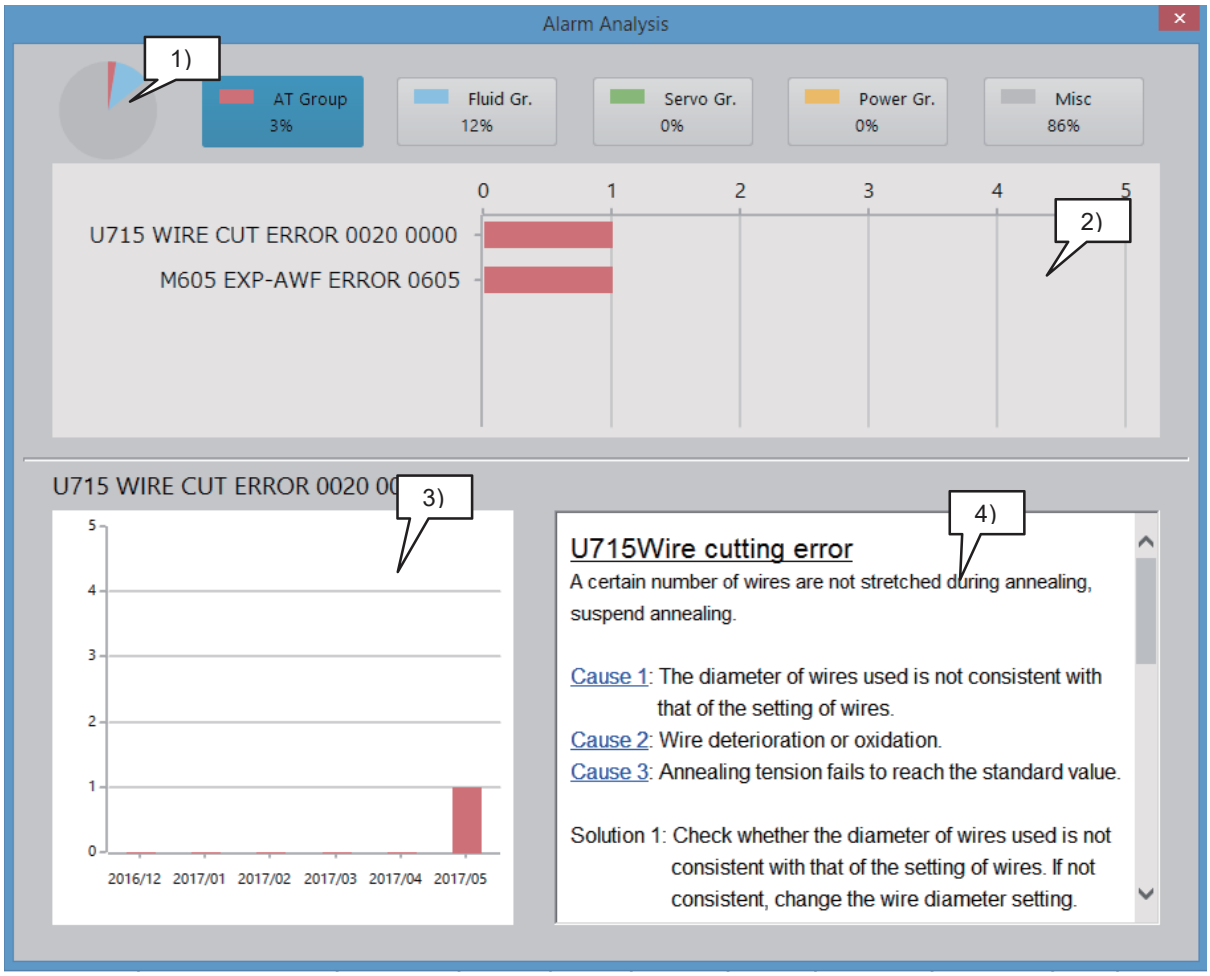


Fig. III.5.19

1) Alarm occurrence status

Displays the occurrence status of each type of alarm in a pie chart. Tapping the legend switches the displayed contents in 2) to 4).

(a) AT Group

Alarms related to AT device are included.

(b) Fluid Gr.

Alarms related to dielectric fluid are included.

(c) Servo Gr.

Alarms related to axis movement are included.

(d) Power Gr.

Alarms related to power supply are included.

(e) Misc

Refers to the alarms not included in (a) to (d) above.

2) Alarm count graph

At most five reported alarms of the selected type are displayed in the graph according to the occurrence count.

3) Occurrence trend graph

The occurrence trend of selected alarm is displayed in the alarm count graph.

4) Analysis content

Displays the analysis content.

5.2.4 Machining details

(1) Machining details

Displays the machining performance details list and performs machining analysis. If wire breaks repeatedly, change machining conditions. If connection errors increase, avoid connecting at the break point and return to the start hole for connection. Improve stability by changing automatic connection settings as above.

(2) Items in machining details

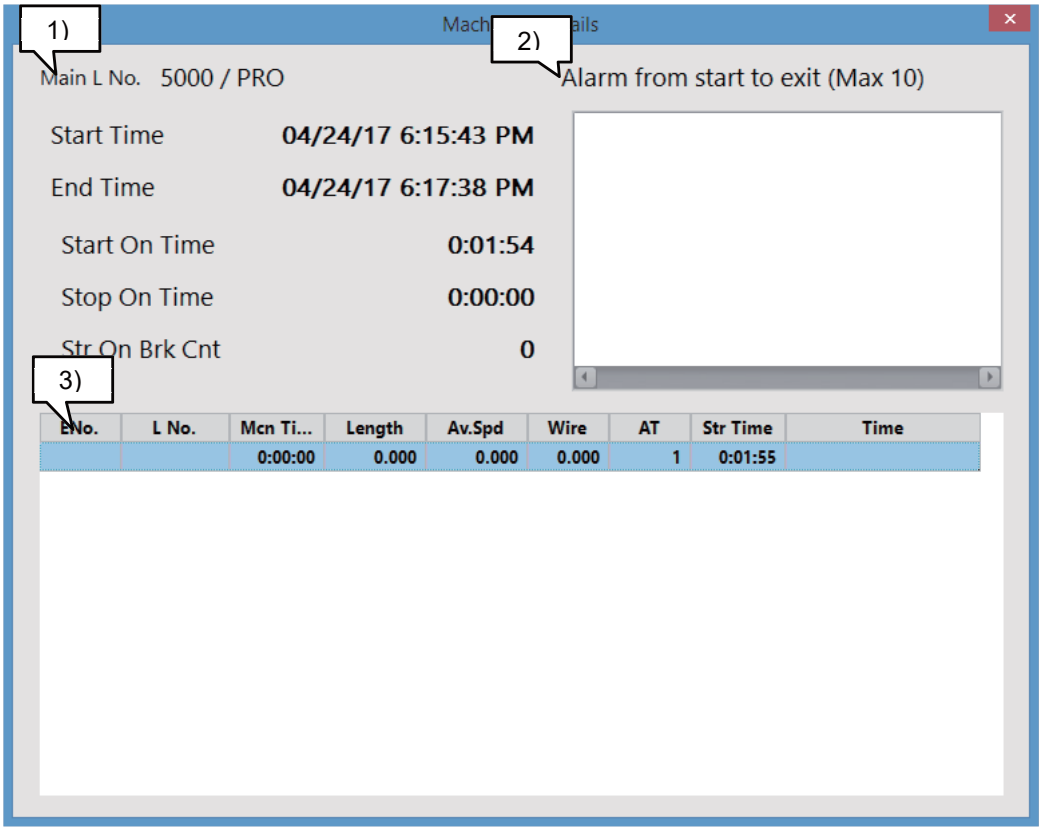


Fig. III.5.20

1) Machining performance

Displays the machining performance summary.

(a) Main L No./Comment

Refers to the main program L No. and comment of automatic operation.

(b) Start Time/End Time

Refers to the start time and end time of automatic operation. Format: YY/MM/DD HH:MI:SS

(c) Start On Time/Stop On Time

Refers to the start time and shutdown time of automatic operation. Format: HH:MI:SS

(d) Str On Brk Cnt

Refers to the wire breaking count in automatic operation.

2) Alarm from start to exit

Refers to the alarms that occur in automatic operation. Up to 10 alarms are shown; older ones are deleted beyond that.

3) Machining performance table

Displays the machining content of each E-Pack.

(a) ENo.

Refers to the E-Pack No.

(b) LNo.

Refers to the L No. of used program. Changes to 0 when the file is running.

(c) Mch

Refers to the time when machining is set to ON. Format: HH:MI:SS

(d) Length

Refers to the axis moving distance (m) when machining is set to ON.

(e) Av. Spd

Refers to the average speed (mm/min) in machining.

(f) Wire

Refers to the used wire amount (kg).

(g) AT

Refers to the count of connections implemented automatically due to the M code command or wire breaking (manual connection not included).

(h) Str Time

Refers to the operation time. Format: HH:MI:SS

(i) Time

Refers to the date and time of switching E-Pack. Format: YY/MM/DD HH:MI:SS

5.2.5 Application of saving condition log

(1) Save Actual

When machining performance saving is executed, the machining performance list data is output as "ProcessResultData.csv" (default). There can also be a text file:

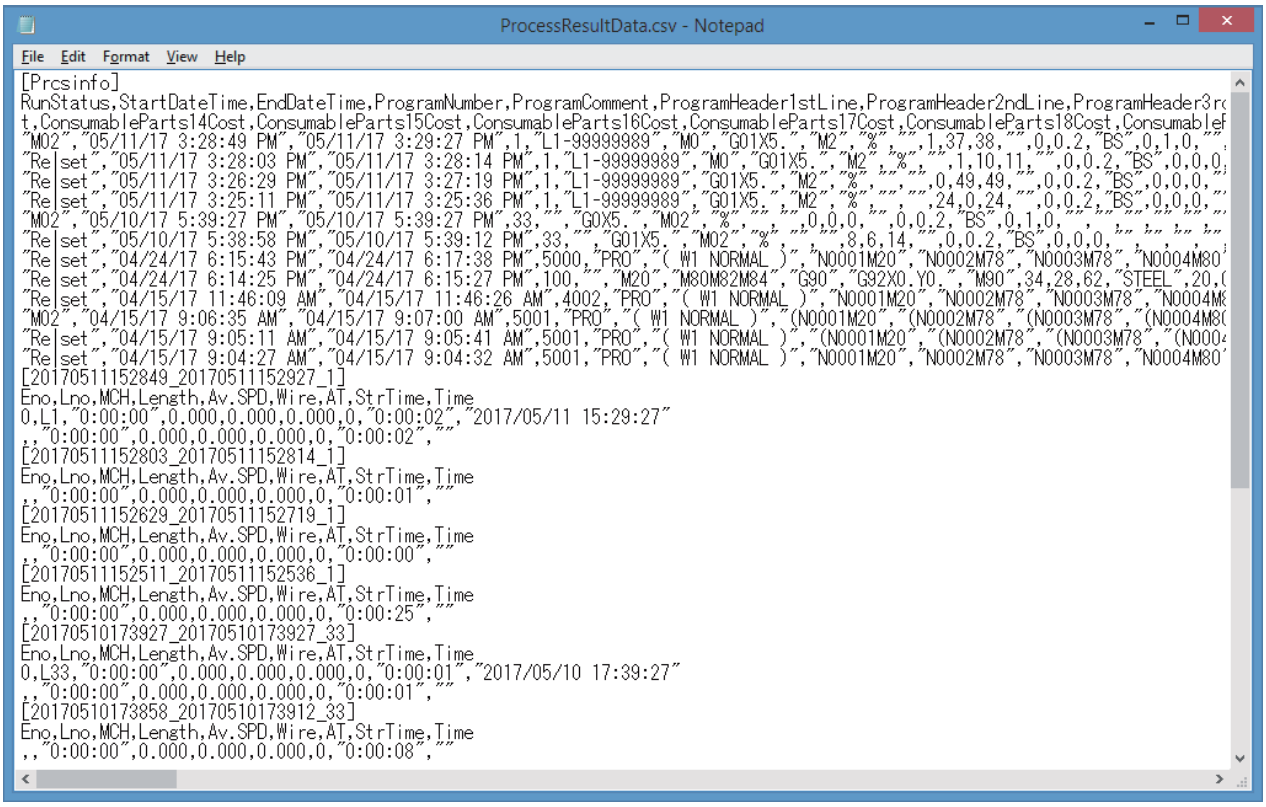


Fig. III.5.21

In the output file, all the data items are separated by ", (comma)". Manage the inspection records of all items beyond the machine as shown in the table below.

Table III.5.11 Usage example of machining performance saving

Data name	Description	Data example	Remarks
RunStatus	End status	M02	
StartDateTime	Operation start date and time	2016/12/15 16:34	
EndDateTime	Operation end date and time	2016/12/15 17:33	
ProgramNumber	Main L No.	40	
ProgramComment	Comment	DEMO	
ProgramHeader1stLine	First 5 lines of the program	(Comment 1	The first line
ProgramHeader2ndLine		(Comment 2	The second line
ProgramHeader3rdLine		(Comment 3	The third line
ProgramHeader4thLine		(Comment 4	The fourth line
ProgramHeader5thLine		(Comment 5	The fifth line
RunTime	Time in startup	0:49:19	
StopTime	Stop time	0:10:11	
TotalTime	Operation time	0:59:30	
WorkpieceMaterial	Workpiece material	STEEL	

Data name	Description	Data example	Remarks
WorkpieceThickness	Workpiece thickness	20	
WireSize	Wire diameter	0.25	
WireType	Wire material	BS	
WireWeightUsed	Used wire weight	68	
TotalPartsCut	Quantity of machined parts	1	
TotalWireBreaks	Total breaking count during operation of the program	1	
WorkCoordinate	Workpiece coordinate (machining count)	G54(2)	
AlarmNumber1	The first alarm during operation	T230	Number
AlarmMessage1		Automatic return completed	Contents
AlarmParameter1		230	Parameter
AlarmNumber2	Second	U824	
AlarmMessage2		WaterRemaining	
AlarmParameter2		0	
AlarmNumber3	Third	T210	
AlarmMessage3		WIRE BREAKAGE	
AlarmParameter3		210	
AlarmNumber4	Fourth	(The blank column is kept if there is no alarm)	
AlarmMessage4			
AlarmParameter4			
AlarmNumber5	Fifth		
AlarmMessage5			
AlarmParameter5			
AlarmNumber6	Sixth		
AlarmMessage6			
AlarmParameter6			
AlarmNumber7	Seventh		
AlarmMessage7			
AlarmParameter7			
AlarmNumber8	Eighth		
AlarmMessage8			
AlarmParameter8			
AlarmNumber9	Ninth		
AlarmMessage9			
AlarmParameter9			
AlarmNumber10	Tenth		
AlarmMessage10			
AlarmParameter10			
PowerCost	Power cost	870	Unit: yen
WireCost	Wire cost	1831	Unit: yen
ConsumableParts1Cost	Filter cost	41	Unit: yen
ConsumableParts2Cost	Ion exchange resin cost	13	Unit: yen
ConsumableParts3Cost	Power feeder cost	8	Unit: yen
ConsumableParts4Cost	Diamond die cost	596	Unit: yen
ConsumableParts5Cost	Main tension roller cost	(The blank column is kept if there is no alarm)	

Data name	Description	Data example	Remarks
ConsumableParts6Cost	MT pinch roller cost		
ConsumableParts7Cost	Auxiliary die cost		
ConsumableParts8Cost	Annealing roller cost		
ConsumableParts9Cost	Guide UD cost		
ConsumableParts10Cost	Annealing pinch roller cost		
ConsumableParts11Cost	Cutting contact cost		
ConsumableParts12Cost	Lubricant cost		
ConsumableParts13Cost	Lower roller cost		
ConsumableParts14Cost	Lower roller bearing cost		
ConsumableParts15Cost	Collection roller cost		
ConsumableParts16Cost	Pinch roller bearing cost		
ConsumableParts17Cost	A.S.C resin cost		
ConsumableParts18Cost	Antirust resin cost		
ConsumableParts19Cost	Wire processing cutter cost		
ConsumableParts20Cost	Anti-verdigris resin cost		

[20161114153951_20161114180102_10][Operation Start Time_Operation End Time_Main Program No.]

Data name	Description	Data example	Remarks
Eno	E-Pack No.	1021	
Lno	Program No.	100	
MCH	Machining time	0:00:00	
Length	Machining distance	0	
Av.SPD	Machining speed (average)	0	
Wire	Wire	0.105	Used wire amount (m)
AT	Number of ATs	0	Connection count
StrTime	Operation time	12:00:00 AM	
Time	E-Pack switch time	12/27/2016 21:46:23	

(2) Save Cond.Log

When condition log saving is executed, the condition log list data will be output as "EventLogData.csv" (default).
Output as text file is possible:

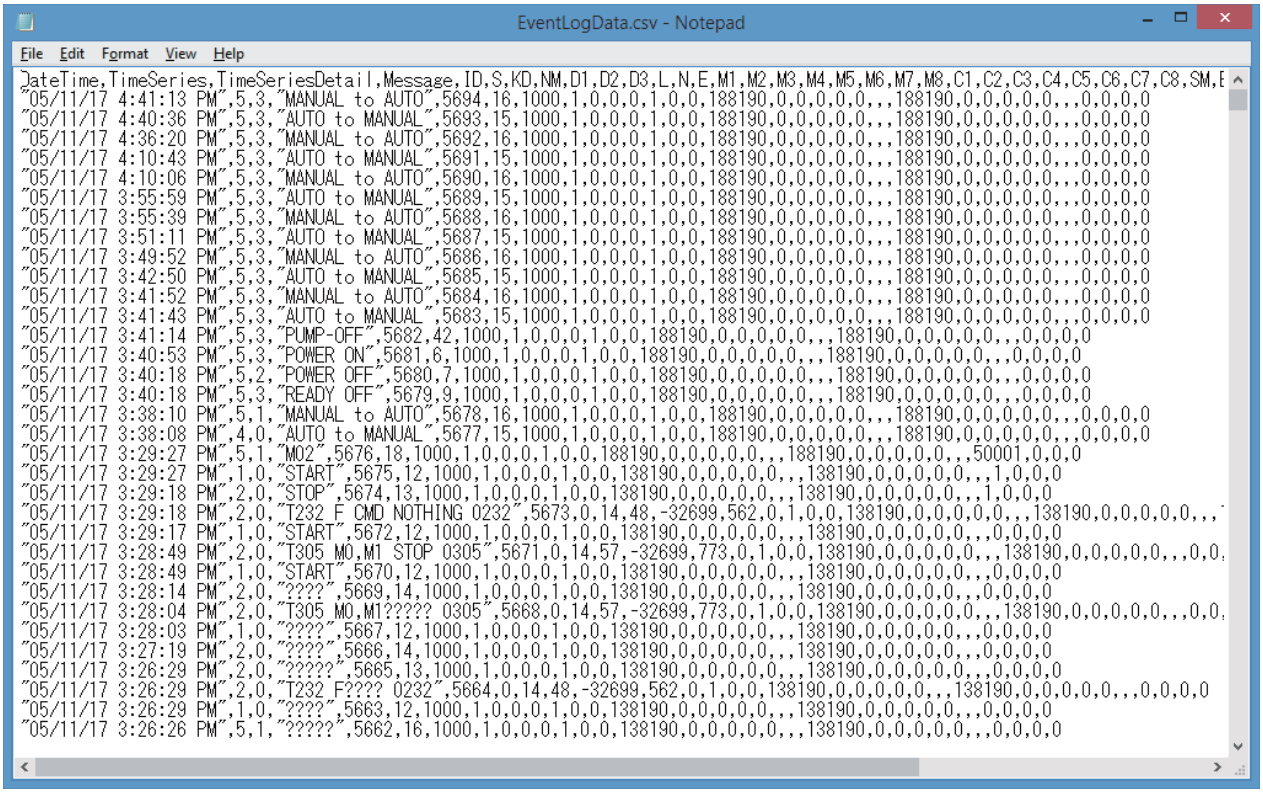


Fig. III.5.22

Each data entry of the output file is separated by "," (comma).
The table below shows the content of each data entry.

Table III.5.12 Saved data of condition log

Data name	Description	Data example	Remarks
DateTime	Event occurrence date and time	2016/12/23 12:02	
TimeSeries		5	Used for maker management
TimeSeriesDetail		1	Used for maker management
Message	Content displayed in condition log	Reset	
ID		3966	Used for maker management
S		14	Used for maker management
KD		1000	Used for maker management
NM		1	Used for maker management
D1		0	Used for maker management
D2		0	Used for maker management
D3		0	Used for maker management
L	L No.	5000	
N	Sequence No.	0	
E	E-Pack No.	941	

Data name	Description	Data example	Remarks
M1	Machine coordinate X axis	1000000	Unit: 0.1 μm
M2	Machine coordinate Y axis	-1970000	
M3	Machine coordinate Z axis	-2000000	
M4	Machine coordinate B axis	0	
M5	Machine coordinate U axis	0	
M6	Machine coordinate V axis	0	
M7			Used for maker management
M8			Used for maker management
C1	Current coordinate X axis	0	Unit: 0.1 μm
C2	Current coordinate Y axis	30000	
C3	Current coordinate Z axis	-2000000	
C4	Current coordinate B axis	0	
C5	Current coordinate U axis	0	
C6	Current coordinate V axis	0	
C7			Used for maker management
C8			Used for maker management
SM		0	Used for maker management
EV		0	Used for maker management
AS		0	Used for maker management
ALARMKIND		0	Used for maker management

5.3 Consumption

Display the consumable screen as follows:

- Selecting "Consumption" in the history management menu
- Selecting the widget of consumables.
  When "Change" of "Cnsmp" is selected on the inspection screen, the replacement dialog of consumables is displayed.

5.3.1 Consumables

(1) Consumable summary

Classifies consumables into main and other on the consumable screen and lists them separately. Displays the replacement method for the selected consumable.

Fig. III.5.23

1) Displaying consumable condition

Displays the consumable condition. Tap to display the replacement screen.

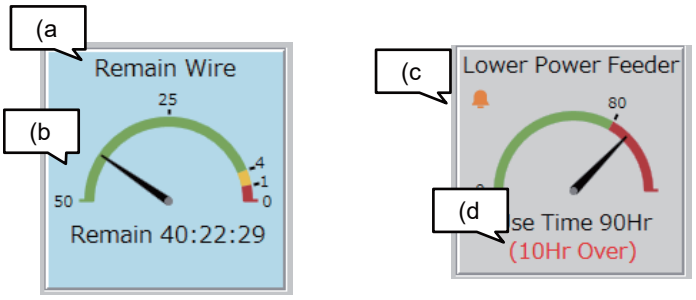


Fig. III.5.24

(a) Consumable name

Displays the consumable name.

(b) Use condition instrument

Displays instrument use condition (increases with use time). Shows Timeout when time exceeds maintenance time. For wire remaining time, instrument margin decreases continuously with wire usage.

(c) Bell mark (🔔)

Displays an alarm bell for consumables with notice set when use time exceeds maintenance time or the preset forecast replacement date.

(d) Use condition

Displays the use time/remaining time, and the exceeded time when time is out.

2) Save Change Info button

Outputs the consumable exchange log as a CSV file.

(2) Replacement screen of the consumables without position change

Shows display items and settings for the replacement screen that appears when tapping the meter of a consumable without position change.

1) Dielectric fluid filter

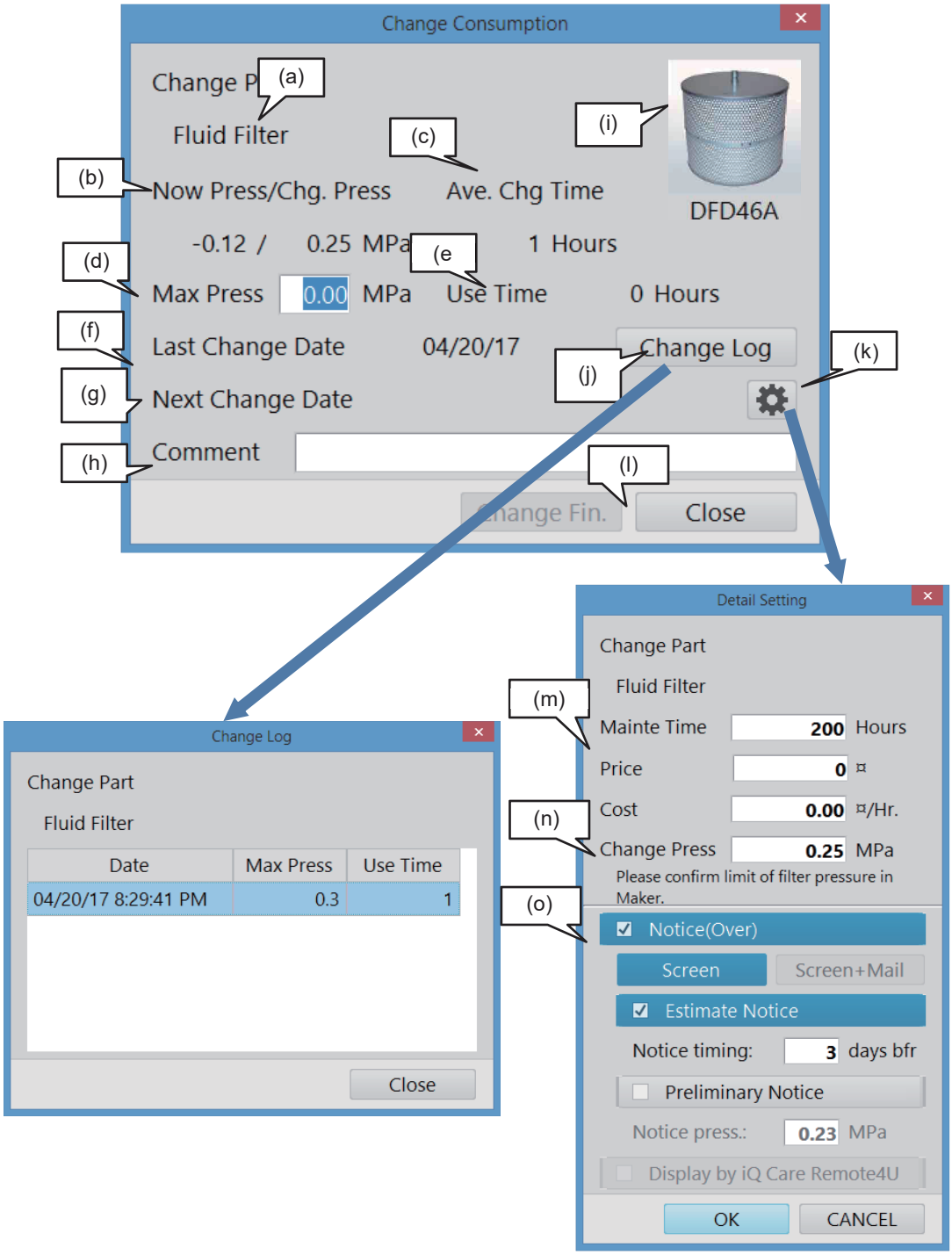


Fig. III.5.25 Filter pressure sensor specification without automatic switching

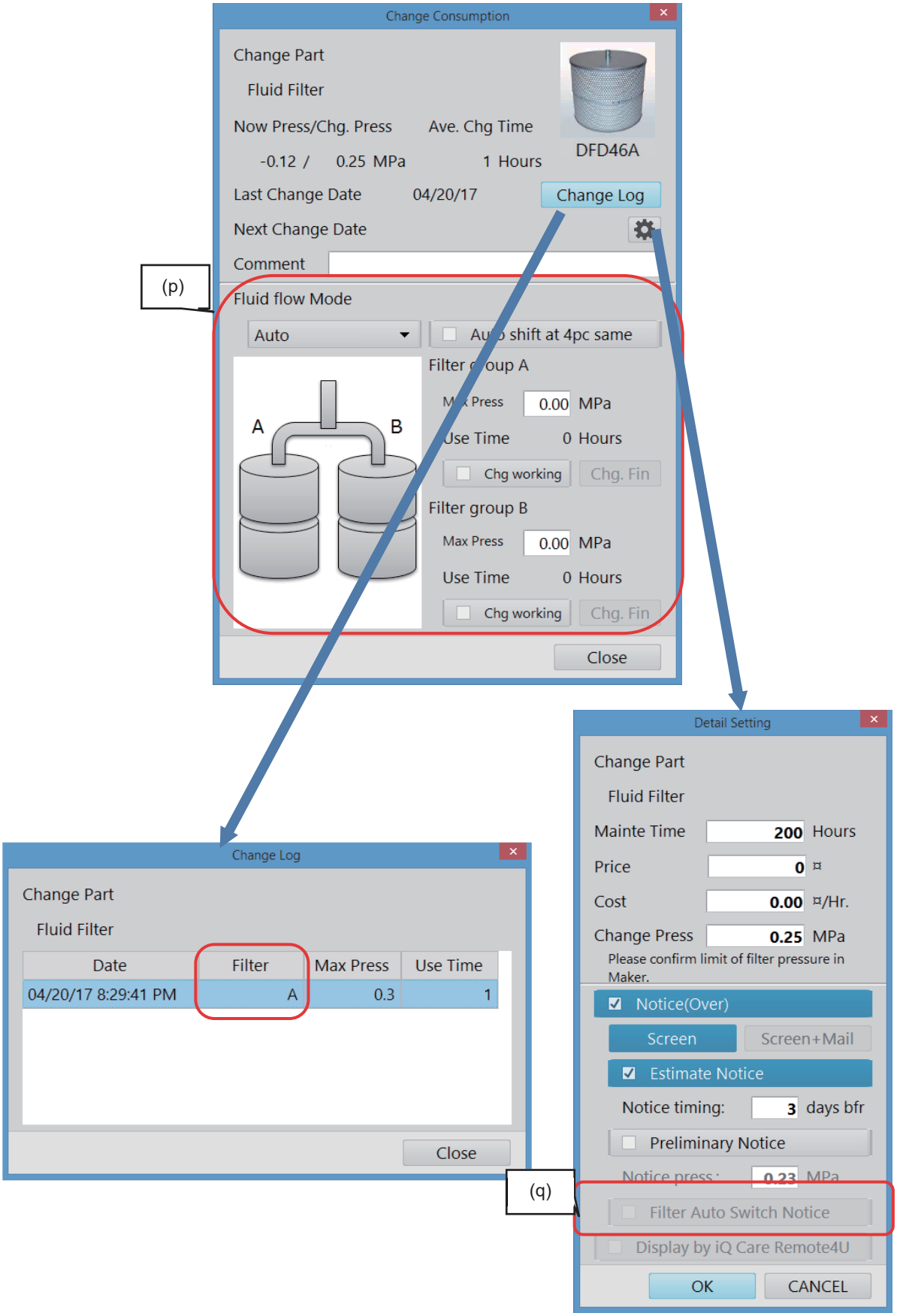


Fig. III.5.26 Filter pressure sensor specification with automatic switching

(a) Change Part name

Displays the replacement position name.

(b) Now Press/Chg. Press

Displays the current dielectric fluid filter pressure and exchange pressure.

(c) Ave. Chg Time

Calculates the average replacement time of consumable according to the replacement record and displays it.

(d) Max Press

Displays the maximum pressure by now after the filter is changed.

(e) Usage time

Displays the current use time.

(f) Last Change Date

Displays the implementation date of last replacement.

(g) Next Change Date

The estimated date of the next replacement is displayed. This item is enabled when (o) Notification setting “Estimate Notice” is set.

(h) Comment

Comment can be entered. Use it as needed.

(i) Picture/Part No.

Displays the consumable picture and part No.

(j) Change Log

Displays the replacement implementation time and the maximum pressure and use time at the time of replacement in a list.

(k) Detailed Setting button

Displays the detailed settings.

(l) Change Fin. button/Close button

Press the "Change Fin." button when the consumable has been replaced.

The following processes are performed.

- Initialization of the use time to 0
- Registration of the actual data as log data

Press the "Close" button to close the screen if replacement is not implemented.

(m) Mainte Time/Price/Cost

When the consumable maintenance time and unit price are set, the cost will be automatically calculated and set.

The cost can also be input directly.

(n) Change Press

Sets the pressure when the dielectric fluid filter is replaced.

(o) Notification setting

(p) Fluid flow Mode

(i) Auto/Only A/Only B/4 at the same time

Select filters to use (Auto switch, all filters or only A or B).

(ii) Auto shift at 4pc same

When "Auto" is selected, it is used to set whether the four filters move automatically at the same time when both filters A and B exceed the replacement pressure.

(iii) Chg working

Water supply to the filter is stopped when this option is selected.

(q) Filter Auto Switch Notice

Set whether to issue a notice when the filter is changed automatically.

- **Requires an iQ Care Remote4U contract to activate e-mail notification.**
- **Requires an iQ Care Remote4U contract to activate the estimation function.**
- **Models without a filter pressure sensor are managed by time.**
  See "5.3 Consumption" > "5.3.1 Consumables" > "(2) Replacement screen of the consumables without position change" > "2) Example of Ion exchange resin".

2) Example of Ion exchange resin

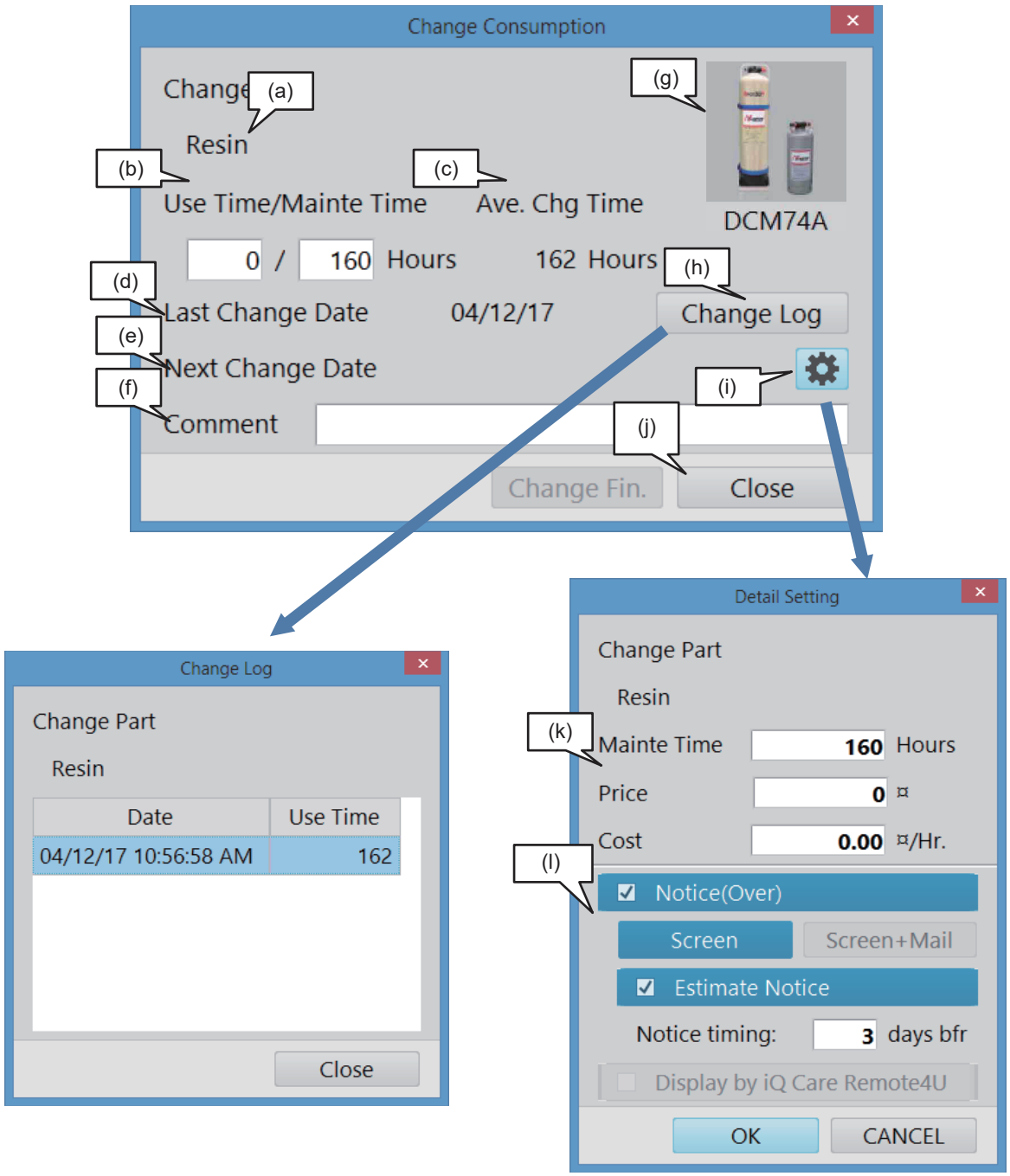


Fig. III.5.27

(a) Change Part name

Displays the replacement position name.

(b) Use time/Mainte time

Displays and sets the current use time and maintenance time.

The input range is 0 to 99999.

(c) Ave. Chg Time

Calculates the average replacement time of consumable according to the replacement record and displays it.

(d) Last Change Date

Displays the implementation date of last replacement.

(e) Next Change Date

The estimated date of the next replacement is displayed. This item is enabled when (l) Notification setting “Estimate Notice” is set.

(f) Comment

Comment can be entered. Use it as needed.

(g) Picture/Part No.

Displays the consumable picture and part No.

(h) Change Log

Displays the replacement implementation time and the use time at the time of replacement in a list.

(i) Detailed Setting button

Displays the detailed settings.

(j) Change Fin. button/Close button

Press the "Change Fin." button when the consumable has been replaced.

Implement processing as follows:

- Initialization of the use time to 0
- Registration of the actual data as log data

Press the "Close" button to close the screen if replacement is not implemented.

(k) Mainte Time/Price/Cost

When the consumable maintenance time and unit price are set, the cost will be automatically calculated and set.

The cost can also be input directly.

(l) Notification setting

3) Other controls and settings

The setup process is the same as for "2) Example of Ion exchange resin" (III-296).

(3) Replacement screen of the consumables with position change

Shows display items and setting items of the replacement screen displayed when the meter of a consumable with position change is tapped.

1) Example of upper power feeder

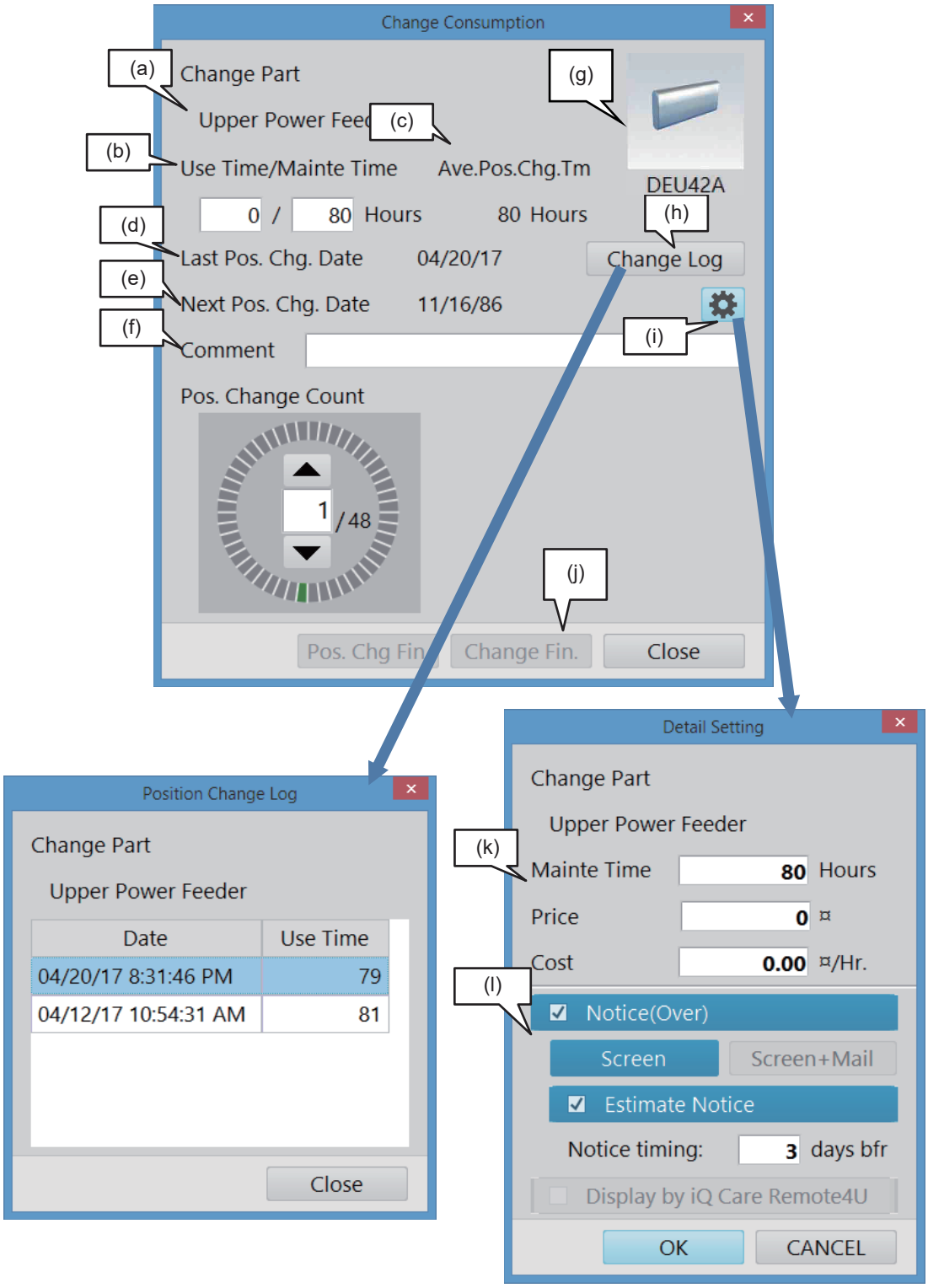


Fig. III.5.28

(a) to (i), (k), (l)

The displayed items and setting items are the same as that of the replacement screen of the consumables without position change.

See "5.3 Consumption" > "5.3.1 Consumables" > "(2) Replacement screen of the consumables without position change" > "2) Example of Ion exchange resin" in this chapter.

(j) Pos. Chg Fin./Change Fin./Close

Press the "Pos. Chg Fin." button when the consumable position has been changed.

Press the "Change Fin." button when the consumable has been replaced.

When the number of the position changes reaches the maximum value, the "Pos. Chg Fin." button cannot be pressed.
Press the "Change Fin." button when the consumable has been replaced.

(m) Pos. Change Count

(i) Pos. Change Count

The value and indicator are used to display the current position change count. The input range is 1 to the maximum value.

(ii) "▲" button/"▲" button

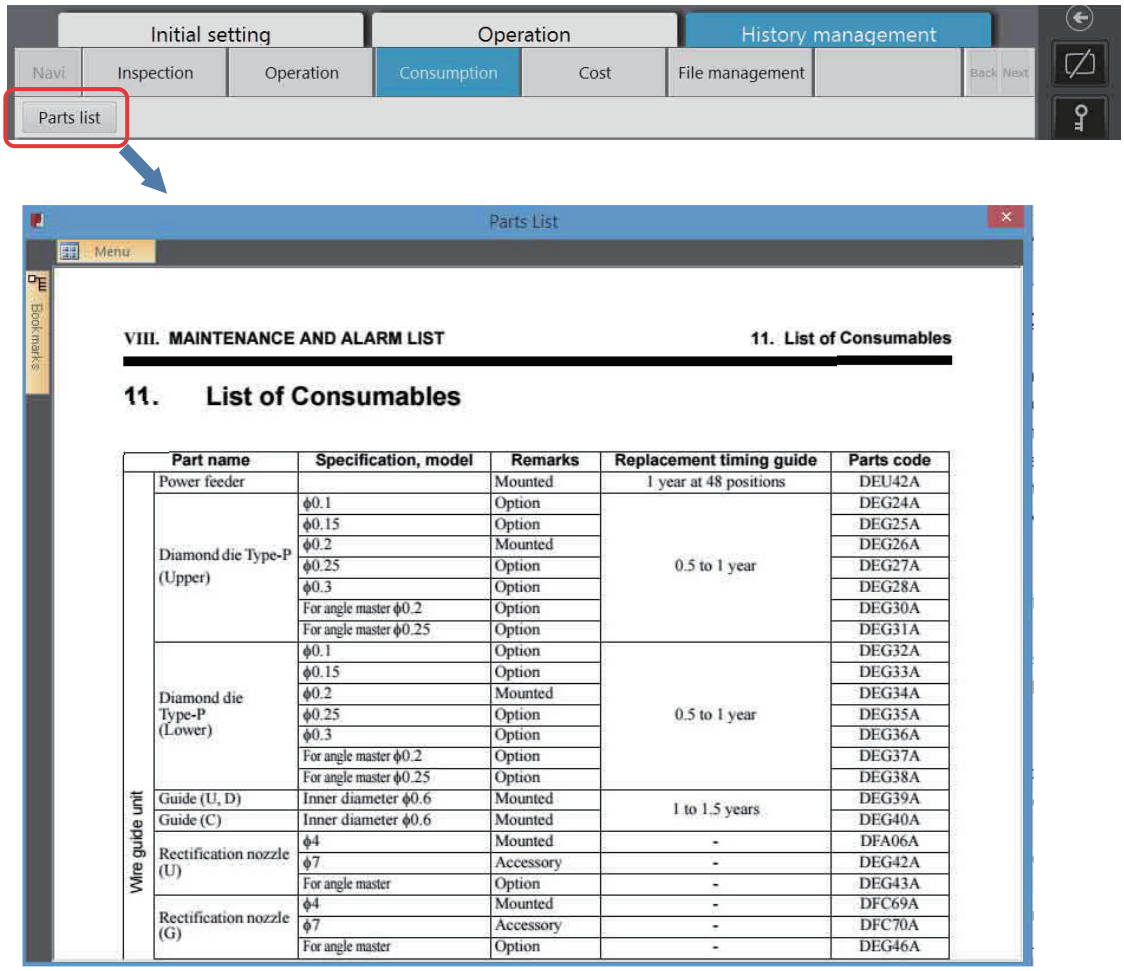
Increase/Decrease the position change count one by one.

2) Other controls and settings

The setup process is the same as for "1) Example of upper power feeder" (III-299).

5.3.2 Parts list

Displays the part list, used for ordering parts.



	Part name	Specification, model	Remarks	Replacement timing guide	Parts code
Wire guide unit	Power feeder		Mounted	1 year at 48 positions	DEU42A
	Diamond die Type-P (Upper)	ϕ0.1	Option	0.5 to 1 year	DEG24A
		ϕ0.15	Option		DEG25A
		ϕ0.2	Mounted		DEG26A
		ϕ0.25	Option		DEG27A
		ϕ0.3	Option		DEG28A
		For angle master ϕ0.2	Option		DEG30A
		For angle master ϕ0.25	Option		DEG31A
	Diamond die Type-P (Lower)	ϕ0.1	Option	0.5 to 1 year	DEG32A
		ϕ0.15	Option		DEG33A
		ϕ0.2	Mounted		DEG34A
		ϕ0.25	Option		DEG35A
		ϕ0.3	Option		DEG36A
		For angle master ϕ0.2	Option		DEG37A
		For angle master ϕ0.25	Option		DEG38A
	Guide (U, D)	Inner diameter ϕ0.6	Mounted	1 to 1.5 years	DEG39A
	Guide (C)	Inner diameter ϕ0.6	Mounted		DEG40A
	Rectification nozzle (U)	ϕ4	Mounted	-	DFA06A
		ϕ7	Accessory	-	DEG42A
		For angle master	Option	-	DEG43A
	Rectification nozzle (G)	ϕ4	Mounted	-	DFC69A
		ϕ7	Accessory	-	DFC70A
		For angle master	Option	-	DEG46A

Fig. III.5.29

5.3.3 Using saved replacement information

When replacement information saving is executed on the consumable screen, the data related to consumable replacement log will be saved as "ReplacementLogData.csv" (default). Output as text is possible:

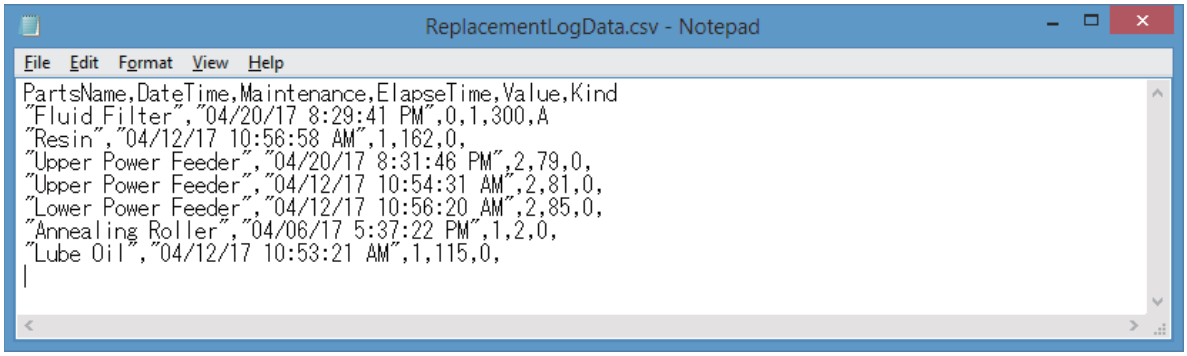


Fig. III.5.30

Each data entry of the output file is separated by "," (comma).
The table below shows the content of each data entry.

Table III.5.13 Saved replacement information data

Data name	Description	Data example	Remarks
PartsName	Consumable name	Dielectric fluid filter	
DateTime	Date and time of last replacement	2016/11/2 13:20	
Maintenance	Type of replacement and position change	1	1: Replacement 2: Position change
ElapseTime	Use time of performing replacement	203	Unit: Hour
Value	Pressure value	253	Unit: kPa Only pressure sensor type
Kind	Type of filter A/B	A	Only pressure sensor type and 4-filter type

5.4 Cost

Display the cost screen used to control the machine operating cost.

- Selecting "Cost" in the history management menu

5.4.1 Cost

(1) Cost summary

Manage the power consumption and cost on the cost screen.

(2) Cost details

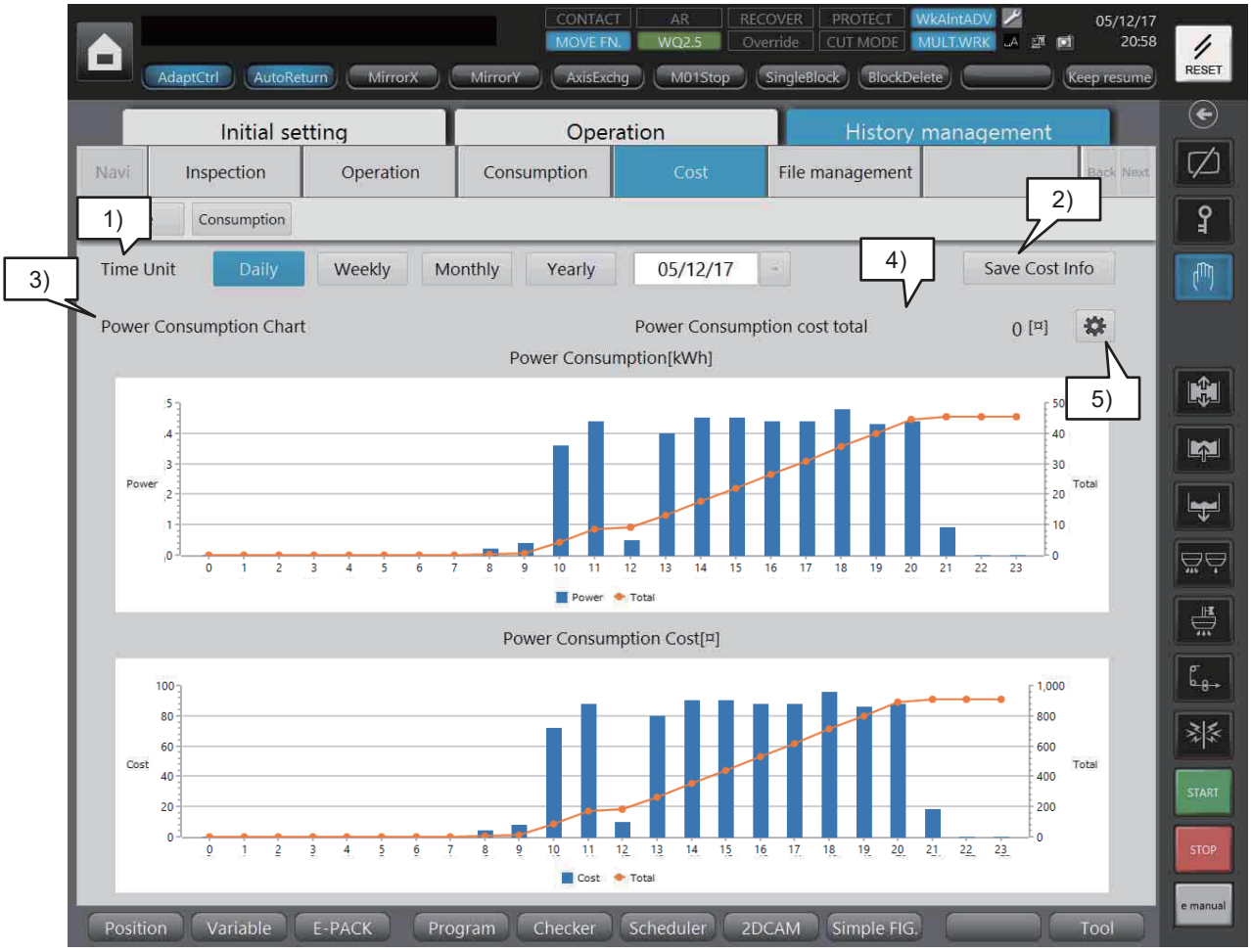


Fig. III.5.31 (When there is a power consumption sensor option)

To display the power consumption and cost, the power consumption sensor option and a contract for iQ Care Remote4U is required.

1) Displaying unit setting

Sets the display period when the machining performance details of power consumption/cost are displayed.

(a) Displaying unit specifying button

Specifies the display unit (default = "Daily").

(b) Displayed day

Specifies the displayed day (default = day of power-on).

(c) Calendar button

Displays the calendar to set any date.

2) Save Cost Info

Outputs the power/wire/consumable use amount and cost to a CSV file.

3) Power Consumption Chart

Displays the use amount and cost in the specified display period.

(a) Daily

Fig. III.5.32 (Daily)

(b) Weekly

Fig. III.5.33 (Weekly)

(c) Monthly

Fig. III.5.34 (Monthly)

(d) Yearly

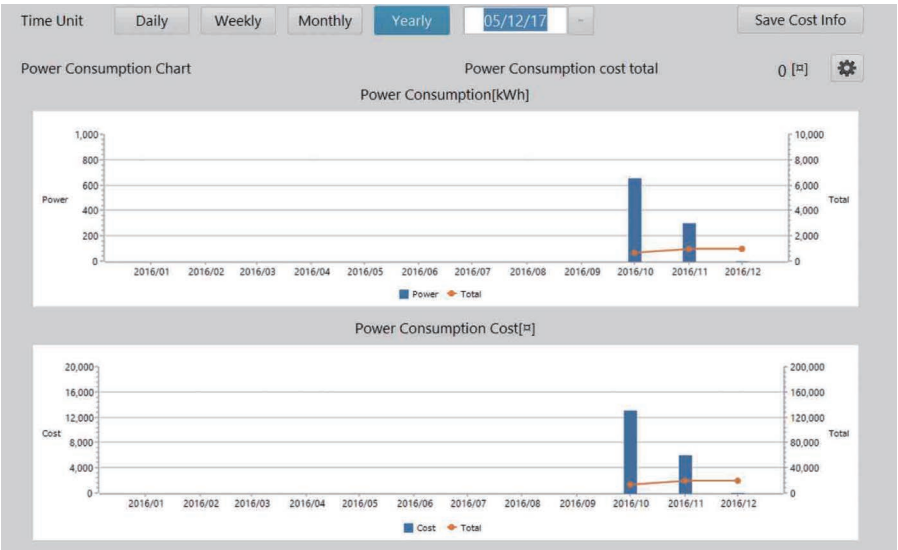


Fig. III.5.35 (Yearly)

4) Power consumption cost total

Displays the total electricity cost of the specified period.

5) Setting button

Display and edit the electricity cost.

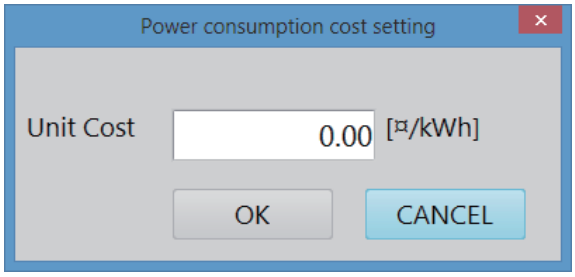


Fig. III.5.36

5.4.2 Wire

(1) Wire cost summary

It is displayed when the "Wire" shortcut is tapped.

The cost setting and details of wire can be checked.

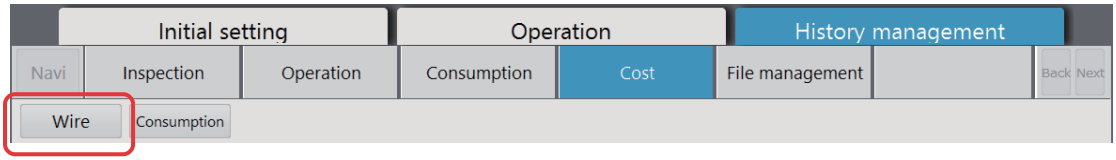


Fig. III.5.37

(2) Wire cost details

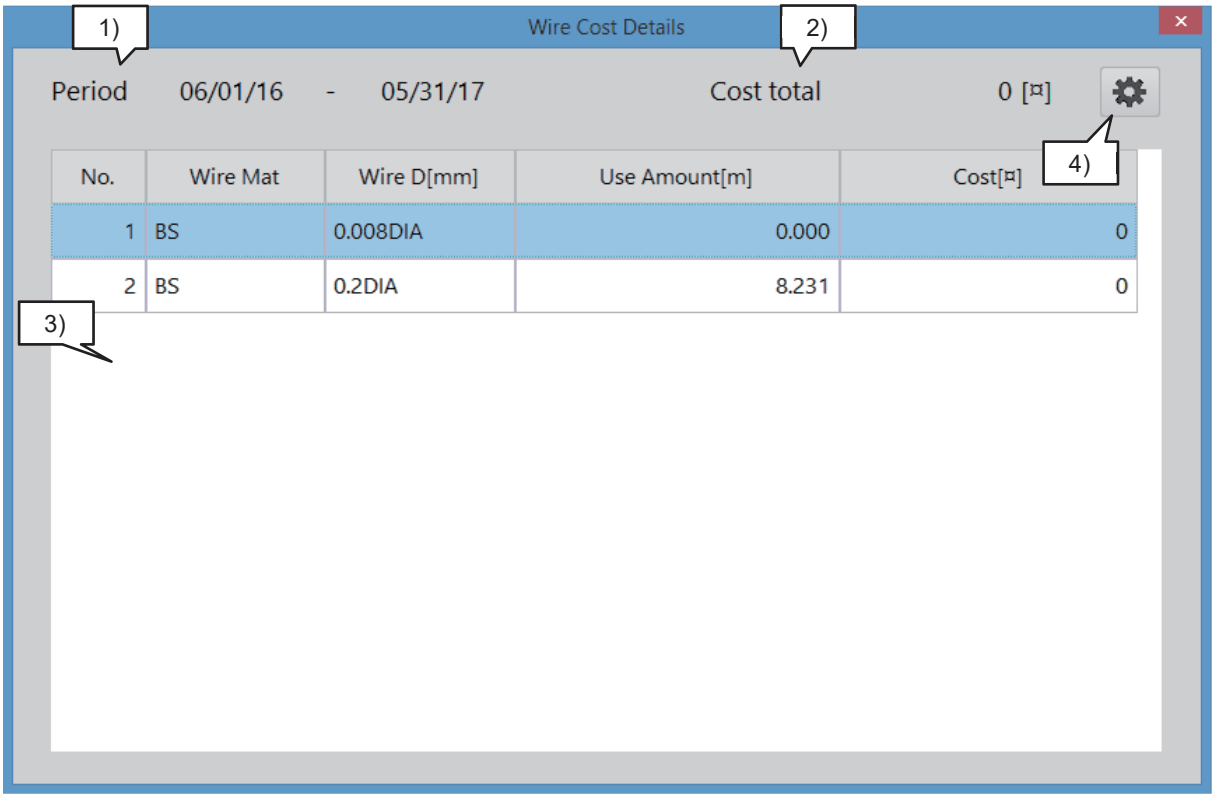


Fig. III.5.38

1) Display period

Displays the display object period of the wire cost. Set the period by the "Time Unit" button and "Displayed day" on the cost screen.

2) Power consumption cost total

Displays the total wire consumable cost in the display period.

3) Consumable cost details table

Lists the wire consumable cost.

The use amount and consumable cost are controlled for each type of wire material and wire diameter.

4) Wire Cost Details button

The unit price of wire is set for each wire material and diameter.

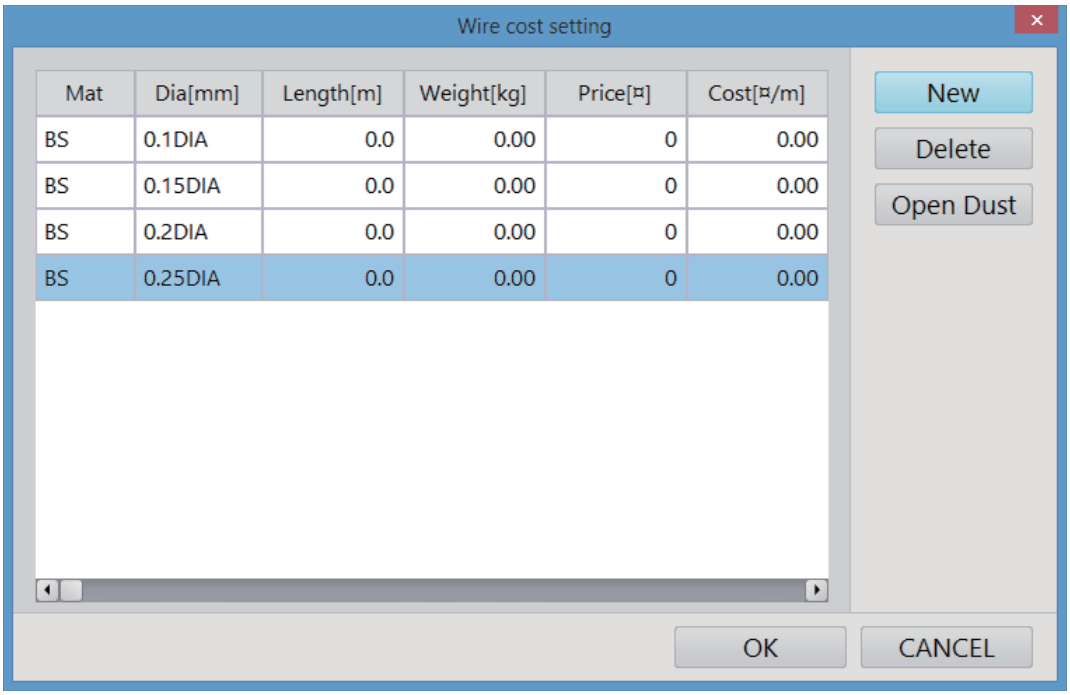


Fig. III.5.39

(a) Wire amount (length)/Wire amount (weight)

Use length or weight to set the amount of one roll of wire.

(b) Price

Set the unit price of one roll of wire.

(c) Cost

Displays the wire cost of each unit amount. The setting is completed automatically according to the wire amount and unit price settings. It can also be entered directly. The input range is 0.00 to 9999999.99.

(d) Comment

Set comments. Use it as needed.

(e) OK button/CANCEL button

When the "OK" button is tapped, the set content will be applied and the screen is closed.
When the "CANCEL" button is tapped, the set content is canceled and the screen is closed.

5.4.3 Consumables

(1) Consumable cost summary

Displays when the "Consumption" shortcut is tapped.

The cost settings and details of consumables other than power and wire can be confirmed.

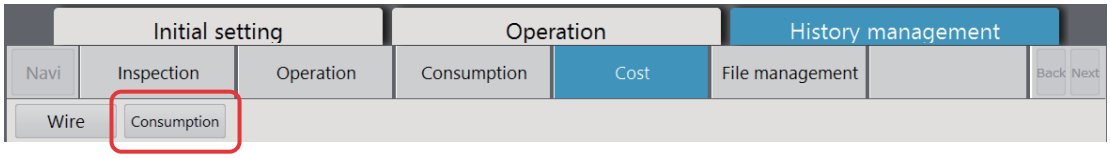


Fig. III.5.40

(2) Consumable cost details

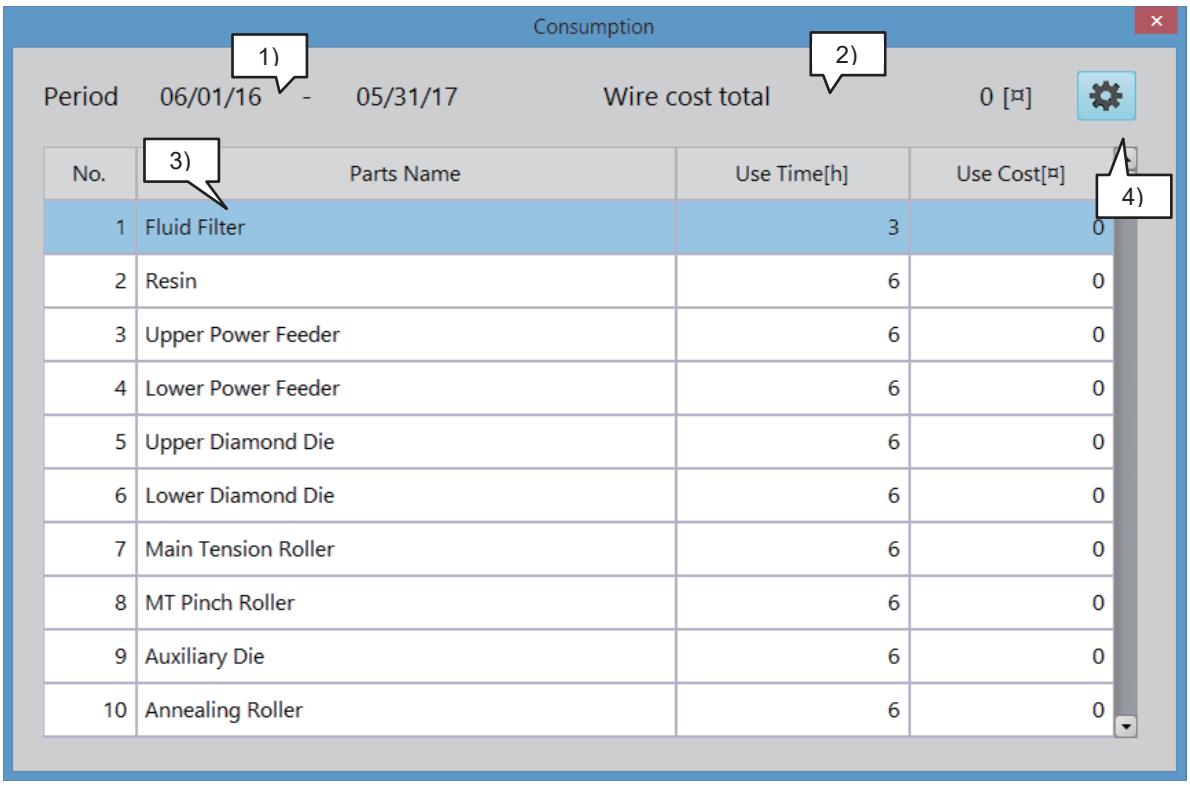


Fig. III.5.41

1) Display period

Displays the display object period of consumable cost. Set the period by the "Time Unit" button and "Displayed day" on the cost screen.

2) Power consumption cost total

Displays the consumable cost total in the display period.

3) Consumable cost details table

Displays the consumable cost list.

The use time and consumable cost are controlled respectively for each type of consumables.

4) Consumable setting button

Displays the consumable cost settings.

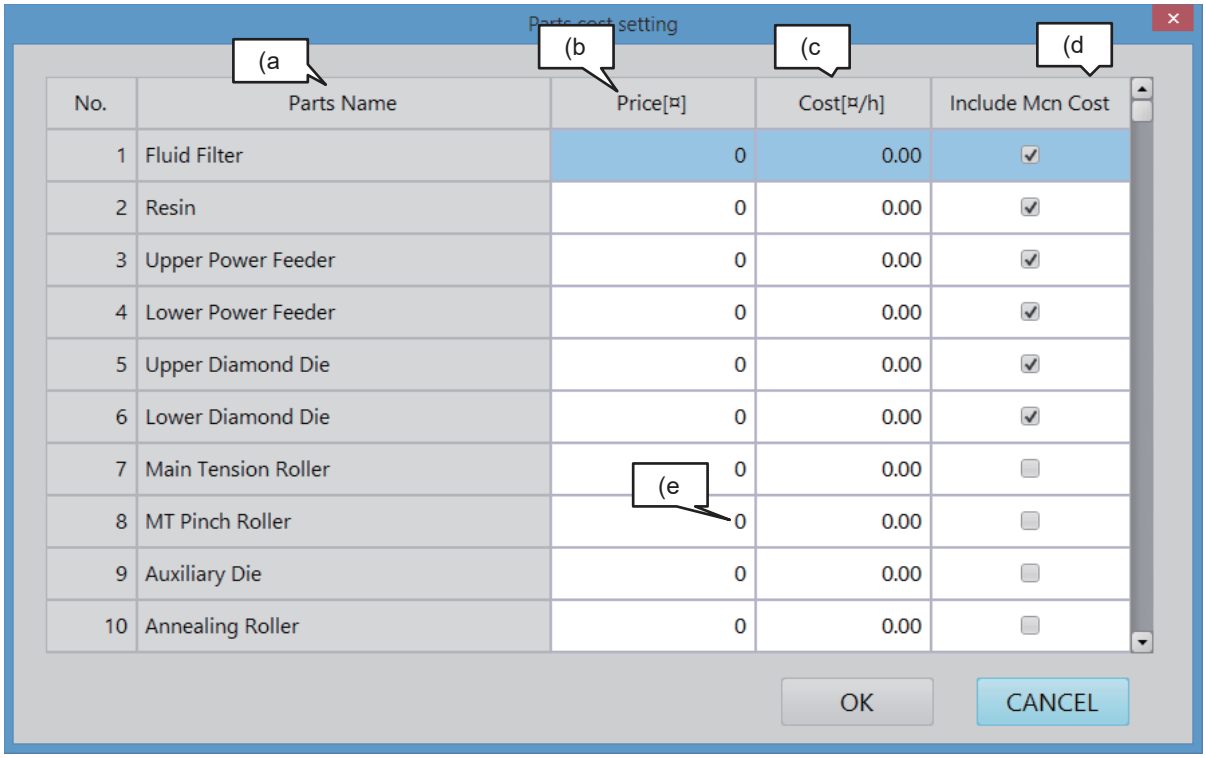


Fig. III.5.42

(a) Parts Name

Displays the name of the consumable.

(b) Price

Set the unit price of consumable.

(c) Cost

Displays the consumable cost in the unit time.

(d) Include Mcn Cost

Set whether to contain the costs of all consumables in the machining cost.

(e) OK button/CANCEL button

When the "OK" button is tapped, the set content will be applied and the screen is closed.

When the "CANCEL" button is tapped, the set content is canceled and the screen is closed.

5.4.4 Using saved cost information

When the cost information saving operation is executed on the cost screen, the data related to cost will be saved as "CostData.csv" (default).
The period of output data is the display period setting. Set it with the daily/weekly/monthly/yearly display unit specifying button and displayed date.
Output as text is possible:

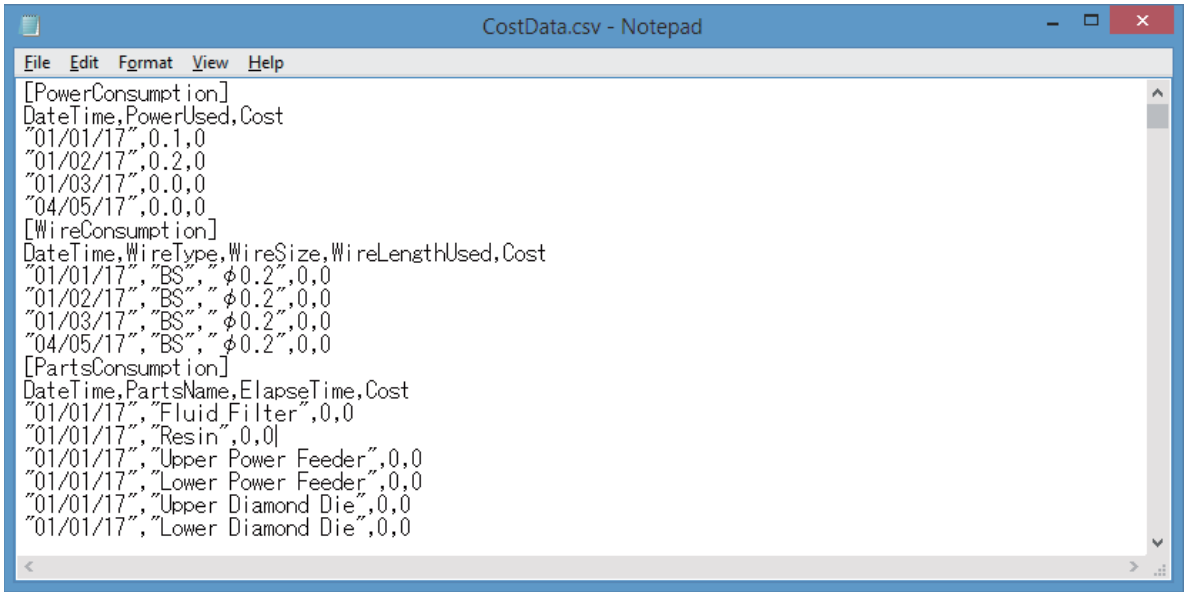


Fig. III.5.43

Each data entry of the output file is separated by "," (comma).
The table below shows the content of each data entry.

Table III.5.14 Saved cost information data

Data name		Description	Data example	Remarks
[PowerConsumable] Power cost	DateTime	Date and time	11/10/2016	
	PowerUsed	Power consumption	47.9	Unit: kW/h
	Cost	Power cost	958	Unit: Yen (*1)
[WireConsumable] Wire cost	DateTime	Date and time	11/10/2016	
	WireType	Wire type	BS	
	WireSize	Wire diameter	ϕ0.2	
	WireLengthUsed	Used wire weight	7773438	Unit: m
	Cost	Wire cost	2254	Unit: Yen (*1)
[PartsConsumable] Consumables cost	DateTime	Date and time	11/10/2016	
	PartsName	Consumable name	Dielectric fluid filter	
	ElapseTime	Usage time	6	Unit: Yen (*2)
	Cost	Cost	1200	Unit: yen

*1 Change it to the currency unit set on the machine.
*2 Change it to time for the model without filter pressure sensor.

5.5 File management

Displays the file management screen (select "File management" in the log management menu) to manage machine parameter files and various documents.

5.5.1 File management

(1) File management summary

The file/folder/shortcut list of specified type is displayed on the file management screen.

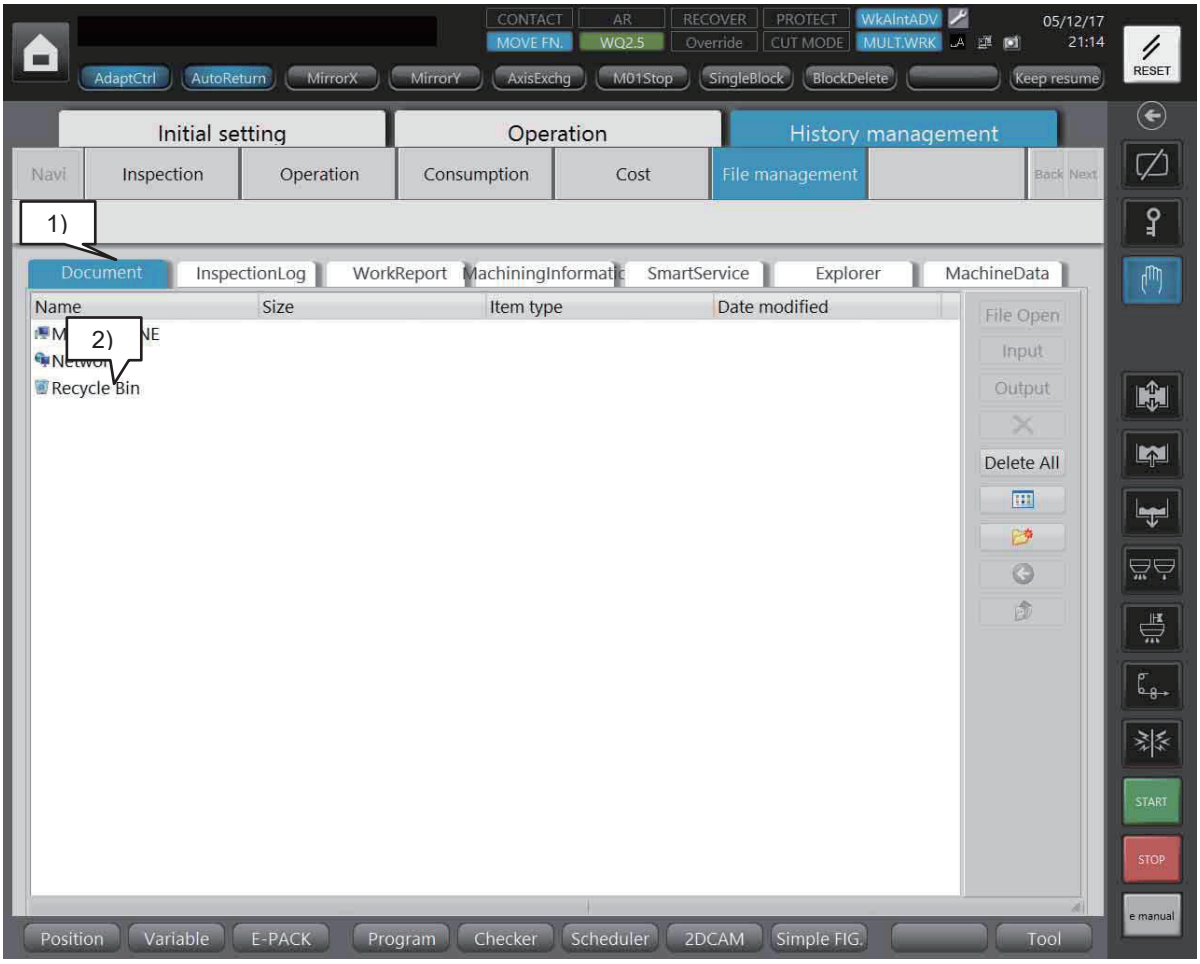


Fig. III.5.44

1) Type

Select the file type.

2) File list

Displays the list of registered files/folders in the selected file type.

5.5.2 Document

(1) Document

Used to manage documents freely (create folders, manage PDF or text files).

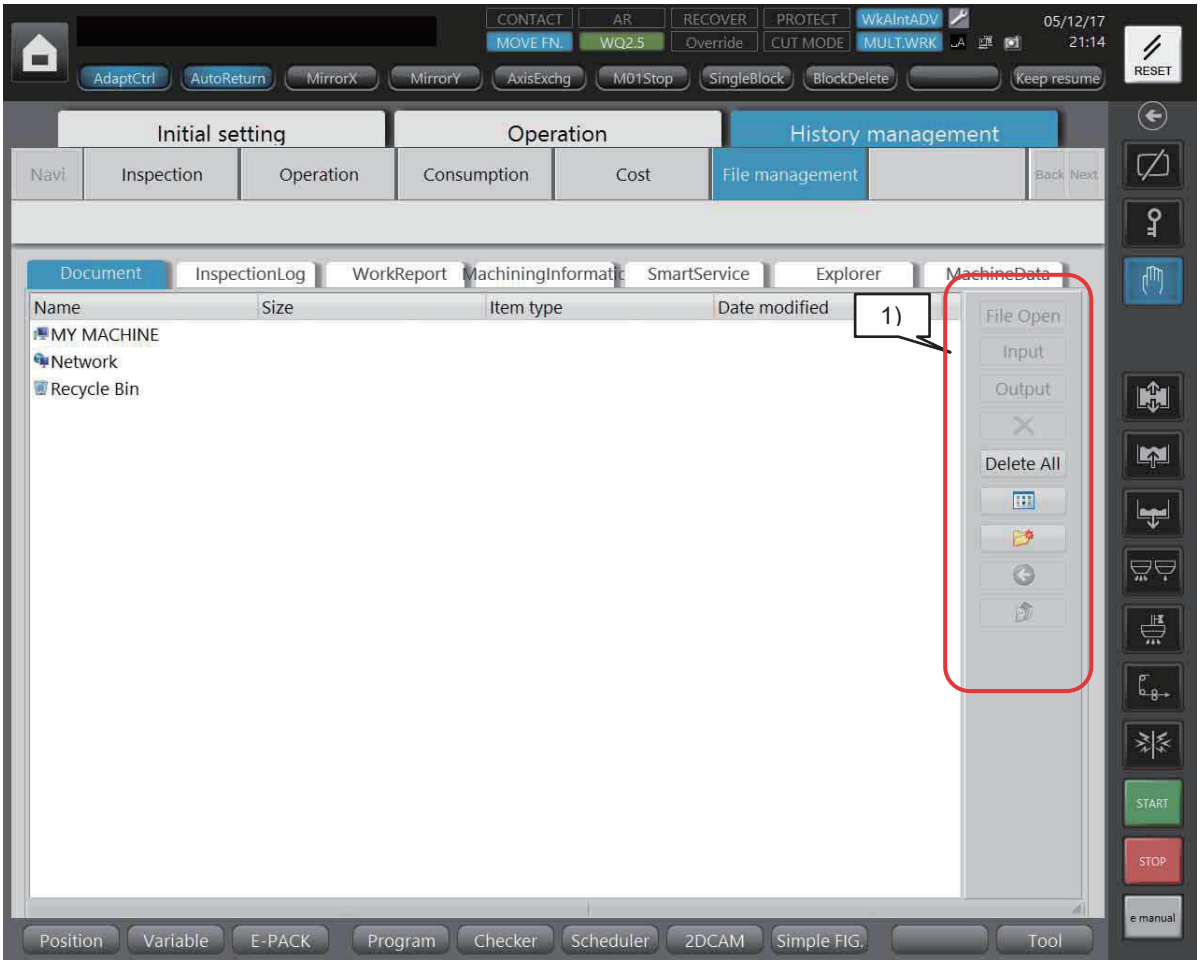


Fig. III.5.45

1) Operation method

(a) File Open

Opens and displays a file selected in the file list.

(b) Input

Displays the file selection (select a file to input it).

(c) Output

Outputs a file selected in the file list.

(d)

Deletes a file selected in the file list.

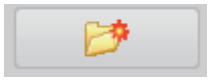
(e) Delete All

Deletes all the files and folders displayed in the file list.

(f)

Select the file list display mode from the big icon/small icon/list/details.

(g)

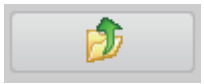


Creates a new folder.

(h)

Restores the file list display to the original status.

(i)



Moves up to the folder one level above.

When a file is deleted by mistake, it can be restored from the trash. Use "5.5.7 Explorer".

5.5.3 InspectionLog.

Used to register and manage the report used when the after-sales service personnel provides after-sales service.
The file format is "PDF(.pdf)."
The operation method is the same as those in "5.5.2 Document" > "1) Operation method".

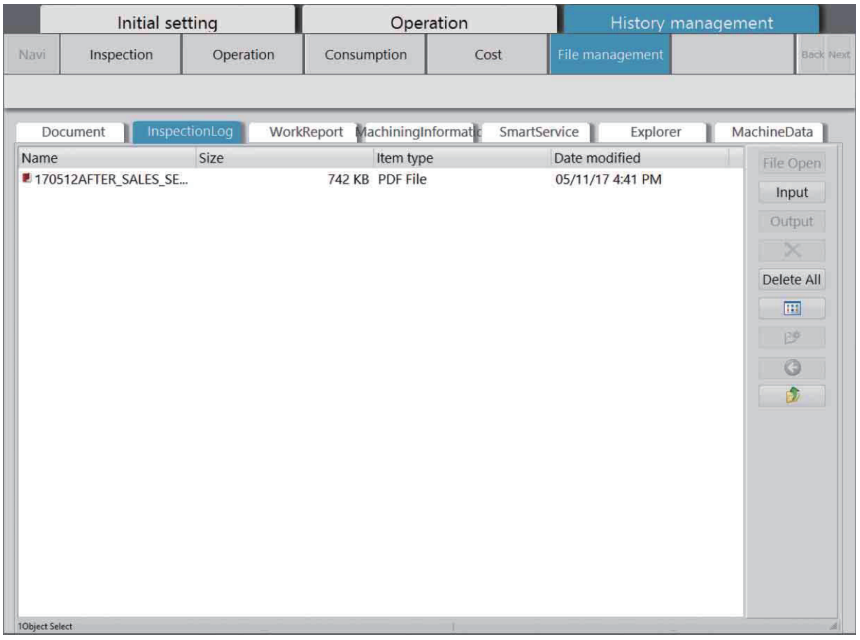


Fig. III.5.46

5.5.4 WorkReport

Used by the after-sales service personnel to register and manage construction reports.
The file format is "PDF(.pdf)".
The operation method is the same as those in "5.5.2 Document" > "1) Operation method".

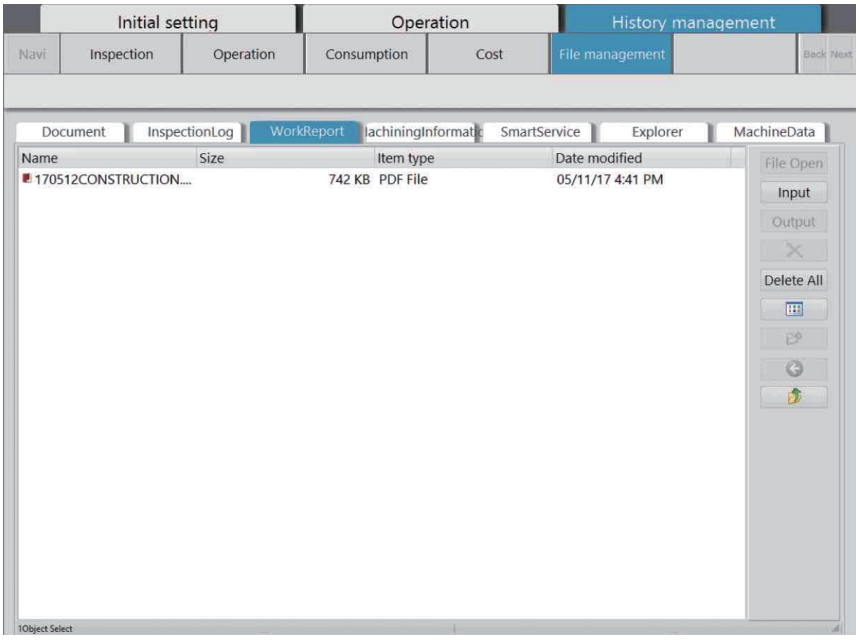


Fig. III.5.47

5.5.5 Machining information data packet

(1) Summary

Displays machining information data packets saved from the monitor screen in a list.

(2) Explanation of the screen

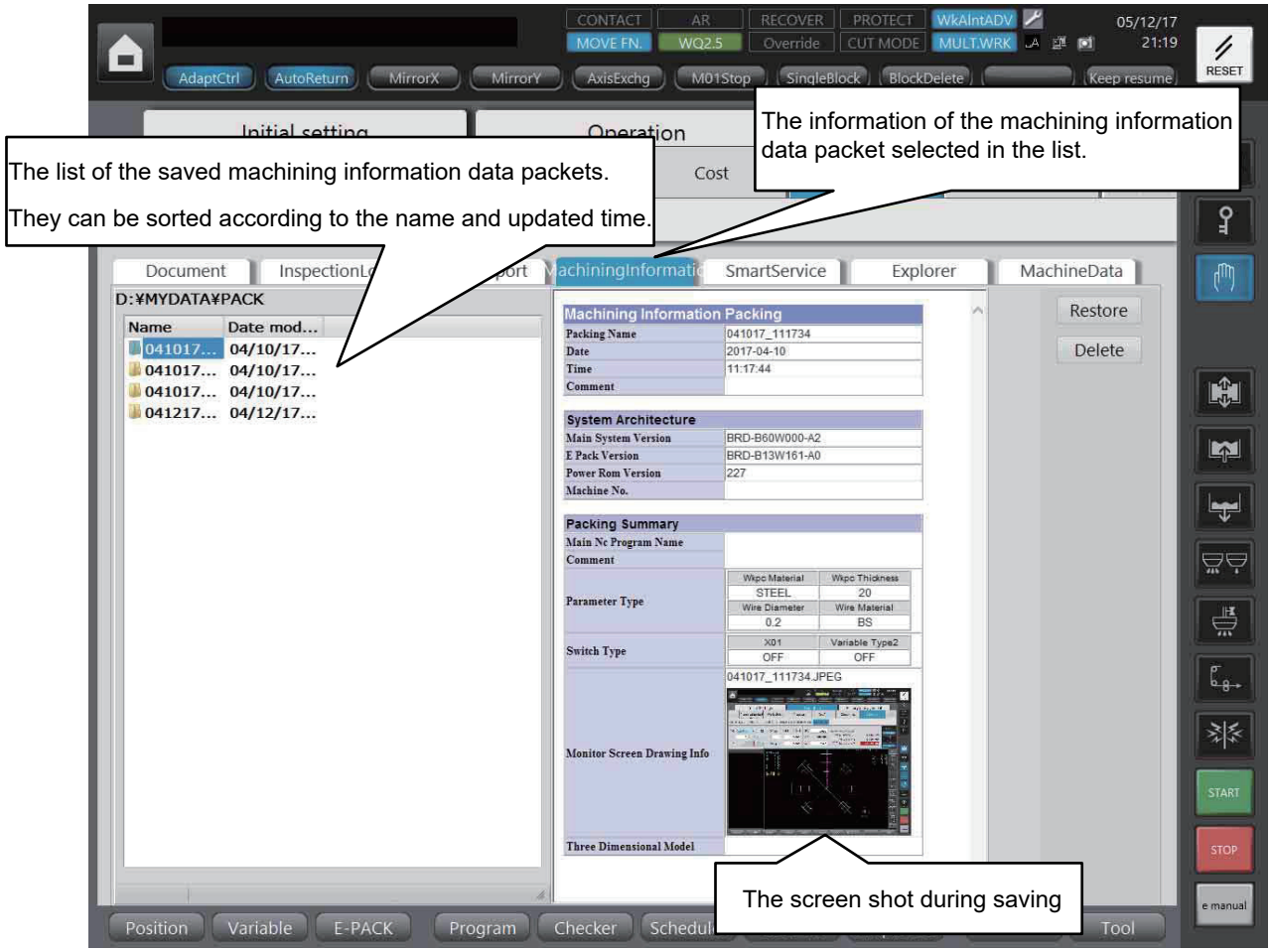


Fig. III.5.48

(3) Operation procedure

1) When the machining information data packet of file is selected, the machining information data packet screen will be displayed. The left part of the screen displays the list of machining information data packets saved in D:\MYDATA\PACK\.

2) Select the machining information data packet to restore from the list, and confirm the information.

3) The following dialog box is displayed when "Restore" is selected.

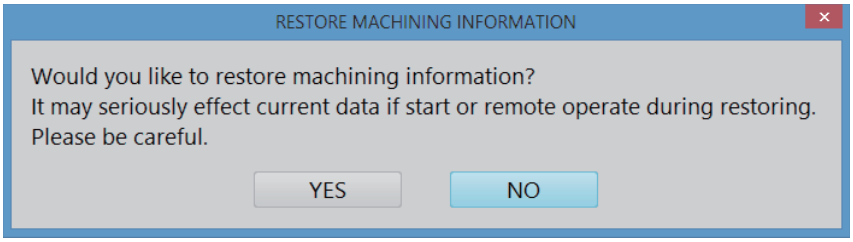


Fig. III.5.49

(a) The following dialog boxes are displayed respectively when edit lock of E-Pack, NC program, and variable overlap are set to ON.

Note that the E-Pack, NC program, and variable with edit lock will be deleted when the restoring operation is performed.

- When edit lock of E-Pack is set to ON

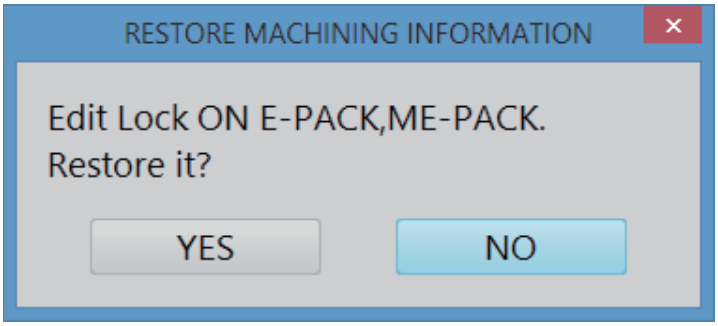


Fig. III.5.50

- When edit lock of NC program is set to ON

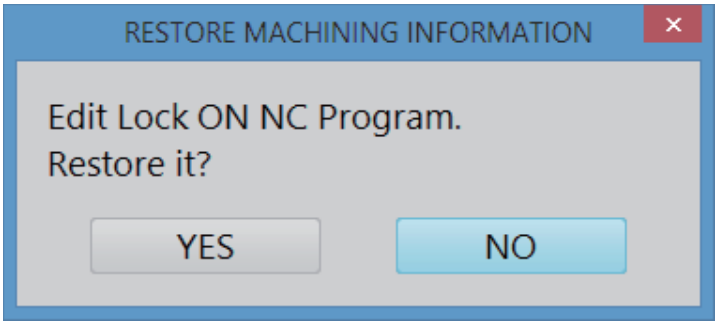


Fig. III.5.51

• When edit lock of variable is set to ON

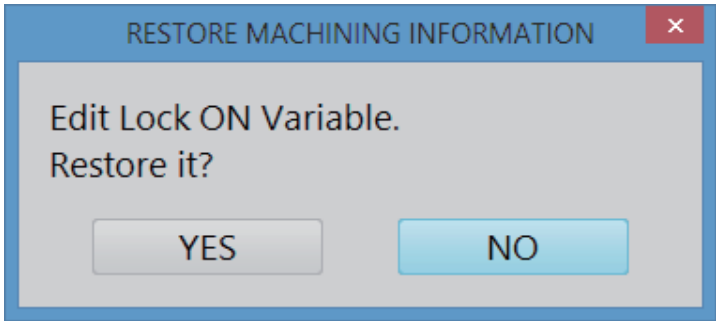


Fig. III.5.52

(b) The following dialog box is displayed when the restore object data is inconsistent with the wire diameter and material data in the system.

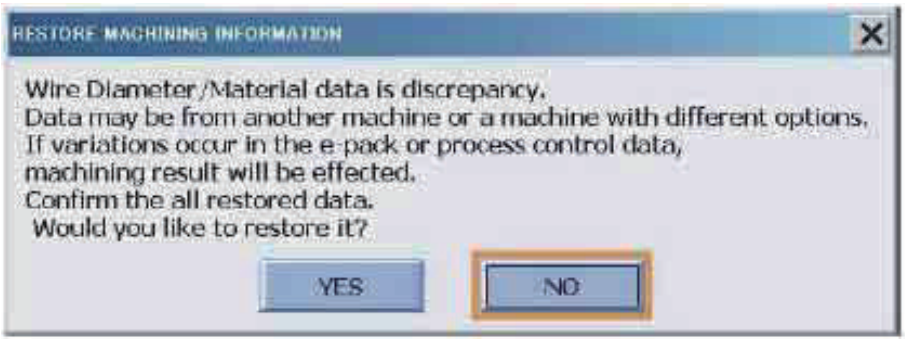


Fig. III.5.53

(c) The following dialog box is displayed for the machines of different system versions and machine numbers.

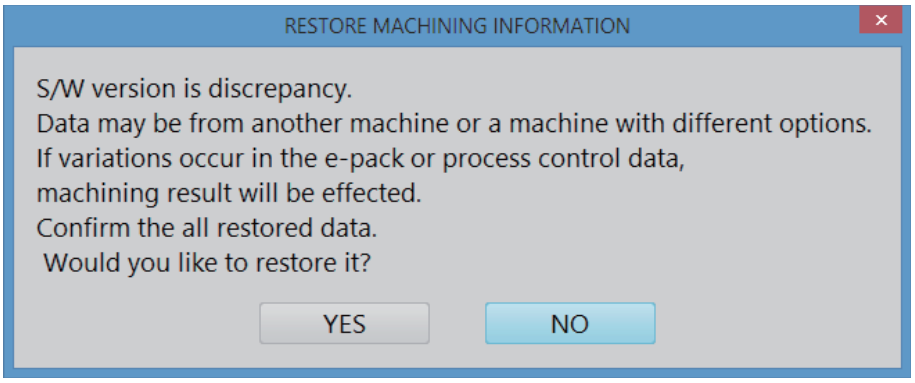


Fig. III.5.54

Note that if restoring operation is performed, the options may be inconsistent and correct operation may fail.

(d) The following dialog box is displayed when [Delete] is selected.

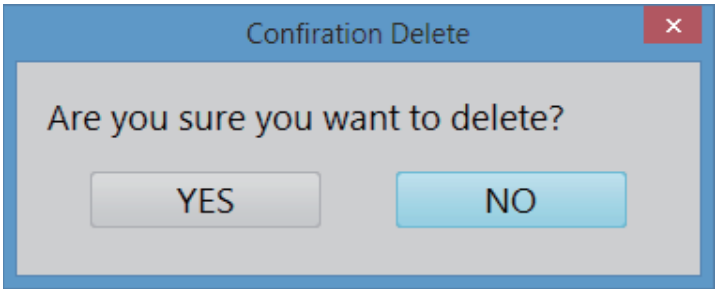


Fig. III.5.55

4) For the sake of safety, the current data is automatically saved as machining information data packets before the restoring operation in "D:\MYDATA\SYSTEM\SAFTY_PACK\".

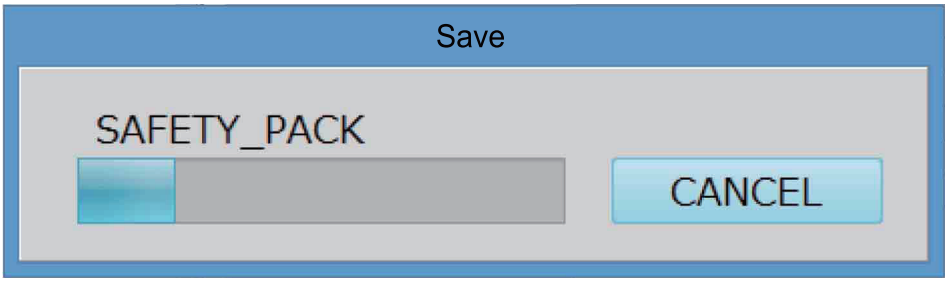


Fig. III.5.56

5) Displays the progress bar and starts restoring. Restoration cannot be stopped halfway.

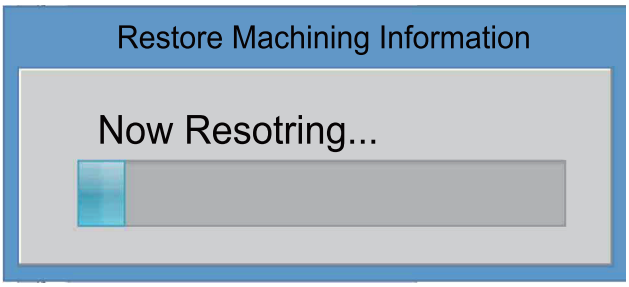


Fig. III.5.57

6) The progress bar is closed when restoration is completed. After completion, the machining setting of machining monitor and other contents can be confirmed.

NOTICE

1. **When restoring a machining information data packet, deletes current machining conditions, variables, NC program, and the restoring screen's current set data, and replaces them with the restored data. Saves the current data automatically as a machining information data packet.**
2. **To restore the automatically saved machining information data packets, use the browser to copy the folder "D:MYDATA\SYSTEM\SAFTY_PACK\" to "D:\MYDATA\PACK\", and perform the restoring operation.**
3. **Machining information data packets cannot be restored in the following cases.**
   - **Any of automatic operation, graphic drawing, IO, or remote operation is in progress**
   - **The model of the restore object is inconsistent with that of the system**
   - **The X0.1 and variable type 2 of the restore object are inconsistent with that of the system**

(4) Data to be restored

1) One set of displayed data set for machining
2) Forecast/actual data
3) One set of machining conditions
4) One set of variables (including user variables)
5) One set of NC programs and one set of monitor variables (including user variables)

NOTICE

- **Restoring may cause option inconsistencies and correct operation may fail. Z3 data for machining is not restored.**
- **PM condition and thresholds are not restored.**
- **Forecast/actual data is always restored to the current data regardless of what was displayed at save time.**
- **File search is not restored; after restoration, open the program number menu in the machining monitor and search the NC program in "D:\MYDATA\PACK\YYYYMMDD_HH:MM:SS of 24-hour system\FILE_SEARCH\ORG" from the file name search dialog; note that performing search updates data to the current forecast/actual data.**
- **The 3D model used in 3D-PM cannot be saved or restored (optional).**

5.5.6 Intelligent service

See "III. NC OPERATION DISPLAY SCREEN" > "7.3 Intelligent service".

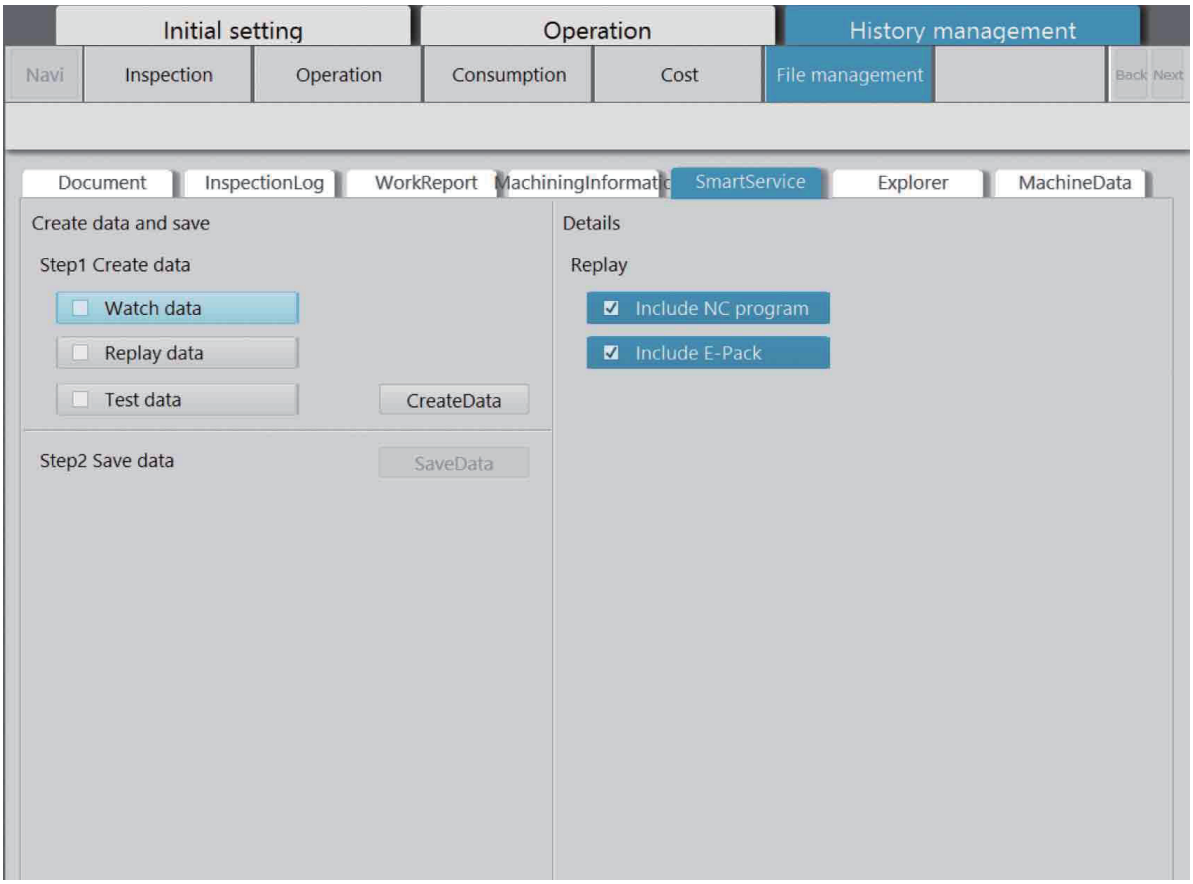


Fig. III.5.58

5.5.7 Explorer

Used to manage files and folders (list, create, delete, or move files and folders). The shared folders in other computers on the network can also be displayed.
To ensure the machine safety, the operations that can be performed are restricted.
For output/input and display of regular files, use the "Document" tab.

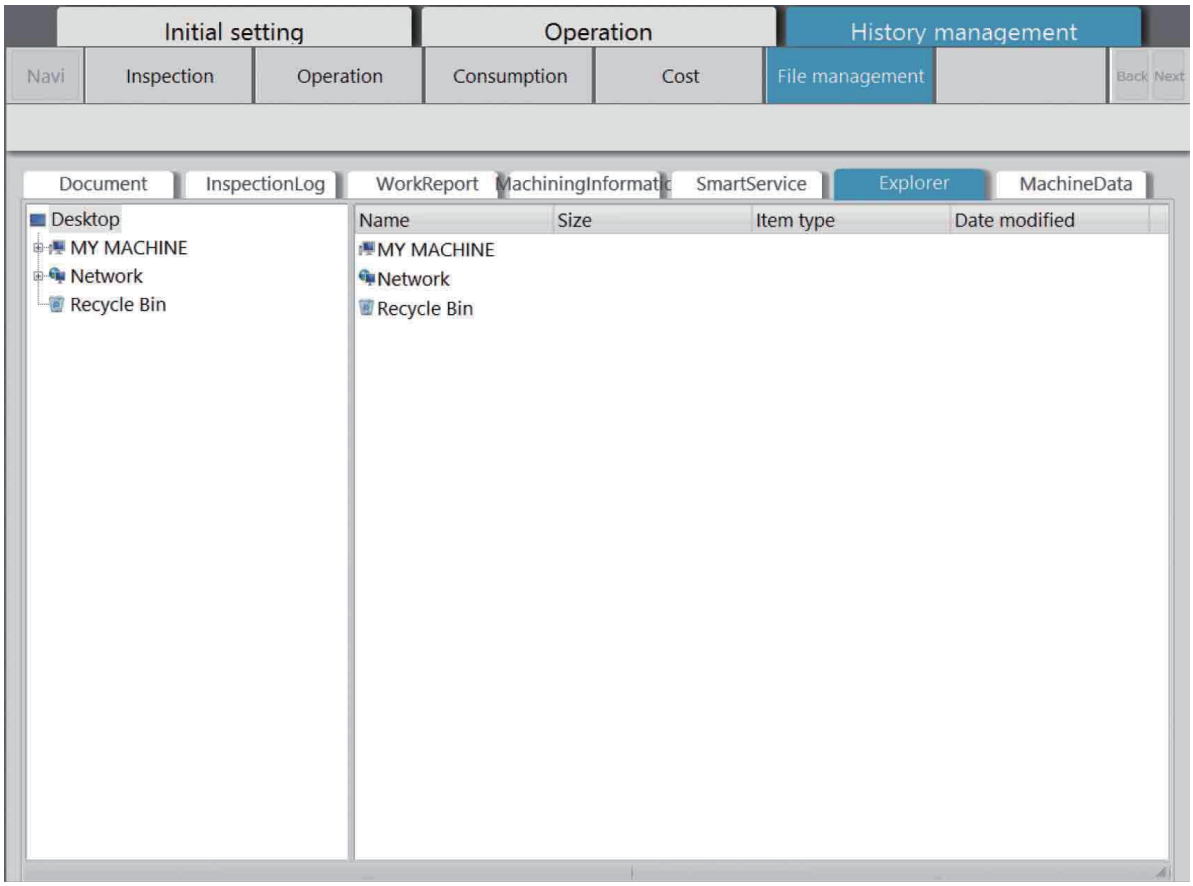
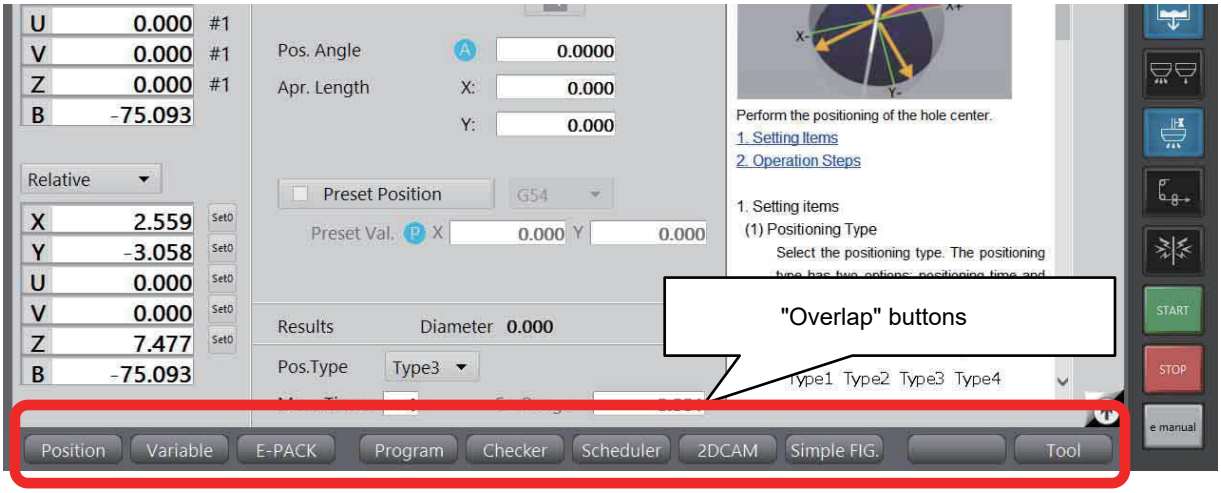


Fig. III.5.59

6. OVERLAP

Select the desired content to be displayed from the overlap buttons at the lower part of the screen. It can be displayed on the "Initial setting", "Operation" and "History management" screens in an overlapped manner.



Item		Description
6.1 Coordinates		Confirm the coordinate value.
6.2 Variable		Confirm the value entered into the Variable field, and enter the variable value used in the NC program.
6.3 E-Pack		Confirm and adjust the E-Pack and ME-Pack.
6.4 NC PRO (NC Program)		Confirm and edit the NC program.
6.5 Checker		Confirm the machining path of the created NC program.
6.6 Scheduler		Run the NC program on a scheduled basis.
6.7 2DCAM		Use the 2DCAM function to create the machining path and select the machining conditions.
6.8 Simple shape		Select the simple shape and set dimensions. 2DCAM can be used to create a machining path easily and simply.
Tools	Machine I/O	Check the machine running status. You may be asked to check it when contacting the after-sales service representatives.
	KnowHow	Skills required for machining can be confirmed.
	MS calculator	Display the calculator.
	Paint Tool	Display the paint tool.

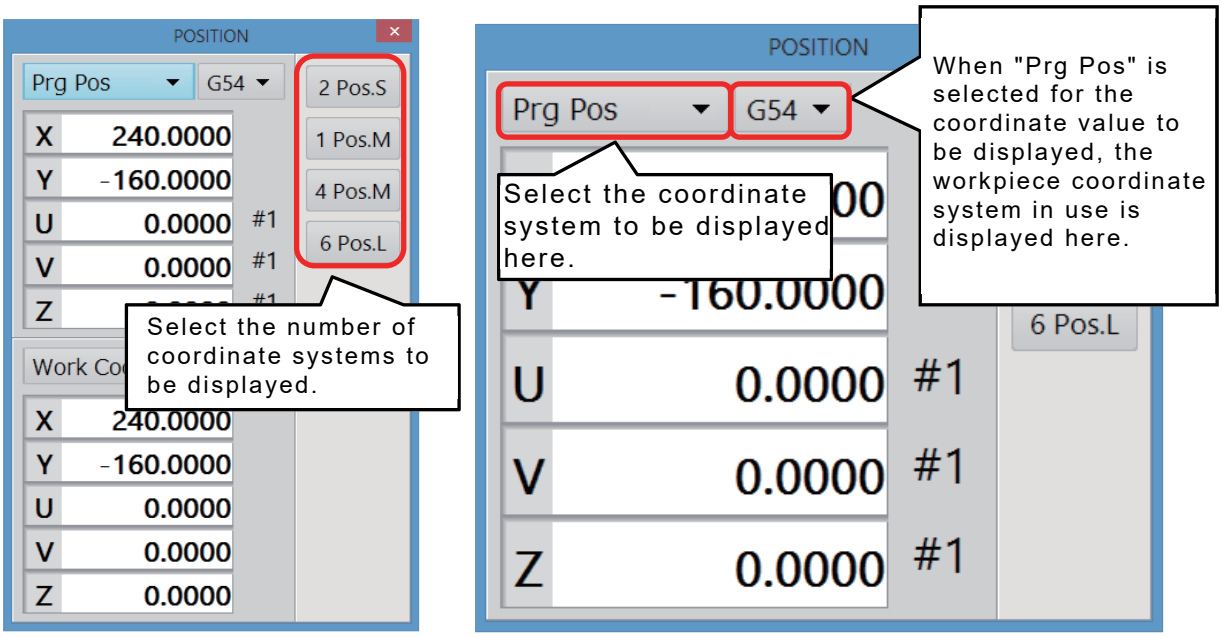
6.1 Coordinates

(1) Summary

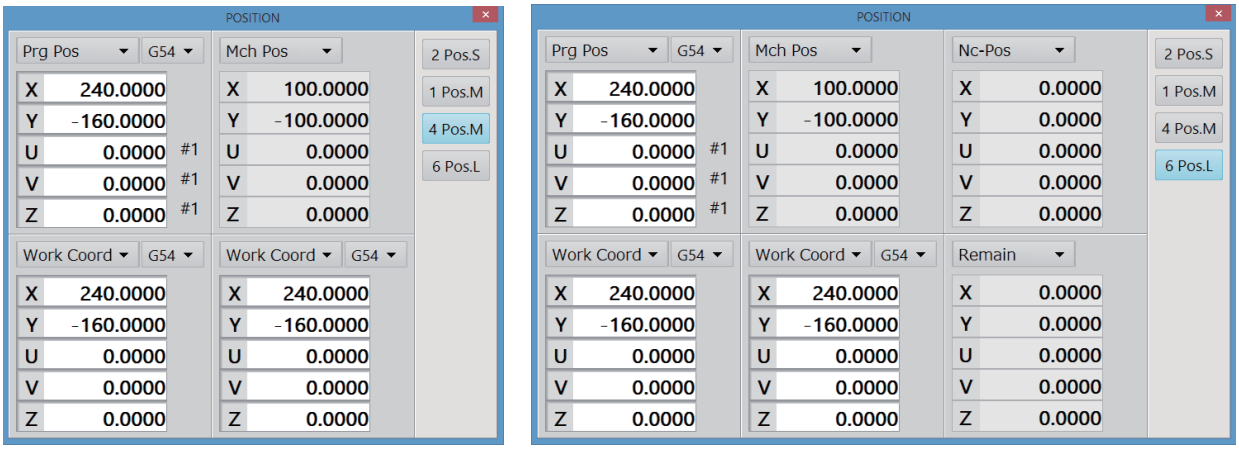
Any coordinate value can be selected and displayed. Switch between displaying/hiding with the overlap button "Position".

(2) Explanation of the screen

The number of coordinates can be selected from the following four display modes using the submenus.



[2 Pos.S] [1 Pos.M]



[4 Pos.M] [6 Pos.L]

Fig. III.6.1 Screen Display

(3) Explanation of each coordinate value

The following types of coordinate values can be selected.

- NC-Pos ..... Displays the axis command value decided by the NC program.
- Prg Pos ..... Displays the workpiece coordinates in the currently selected workpiece coordinate system.
- Relative..... Displays any position count that was ever reset to 0 by the user.
- Remain ..... Displays the remaining distance of one block command value during automatic operation.
- Mch Pos..... Displays the counter from the machine coordinates.
- Work Coord..... Displays the coordinate values in the workpiece coordinate system.
- Each coordinate can be set or reset with the following methods.

Table III.6.1

	Press "RESET" two times	Use G92 to preset	Preset from the screen	During JOG feed with manual operation box
Nc-Pos	Valid	Possible	Impossible	Does not move
Prg Pos	Invalid *1)	Possible	Impossible	Moves
Relative	Invalid	Impossible	Possible	Moves
Mch Pos	Invalid	Impossible	Impossible	Moves
Remain	Valid	Impossible	Impossible	Does not move
Work Coord	Invalid *1)	Possible	Impossible	Moves

*1 It is invalid when the [Rst:Clr Prg-P] switch is turned OFF in "Machining setting" > "Parameter Set" > "Auto3".

6.2 Variable

(1) Summary

Used to display and set the variables. Select one type from the common variables, local variables 0 to 4, and user variables to display. Displaying/hiding of this screen can be switched using the overlap button "Variable".

So simple!!

You can press the "=" button in the data input area to set the result after four arithmetic operations.
"+", "-", "*", and "/" can be used.

Example) "=" ➡ 1.0 + 2.0 ↵ ➡ 3.0

1) VARIABLE FOR TYPE 2

Tap ☐ Variable type 2 to switch ON/OFF of the variable type 2.

Set variable type 2 to ON. Then the check mark appears in the check box, and floating point operation can be performed. Note that, if the variable type 2 switch is set to ON, any NC program created on the premise that this switch is set to OFF cannot be used.

For details of variable operation, see "IV. PROGRAMMING" > "10.7 Operation on Variables".

(2) Common variables

1) Display of the common variables

(a) Selecting the screen size

The variables H1 to H900 can be displayed/set on the "Variable" screen. A size to be displayed can be selected from the following options using the submenus.

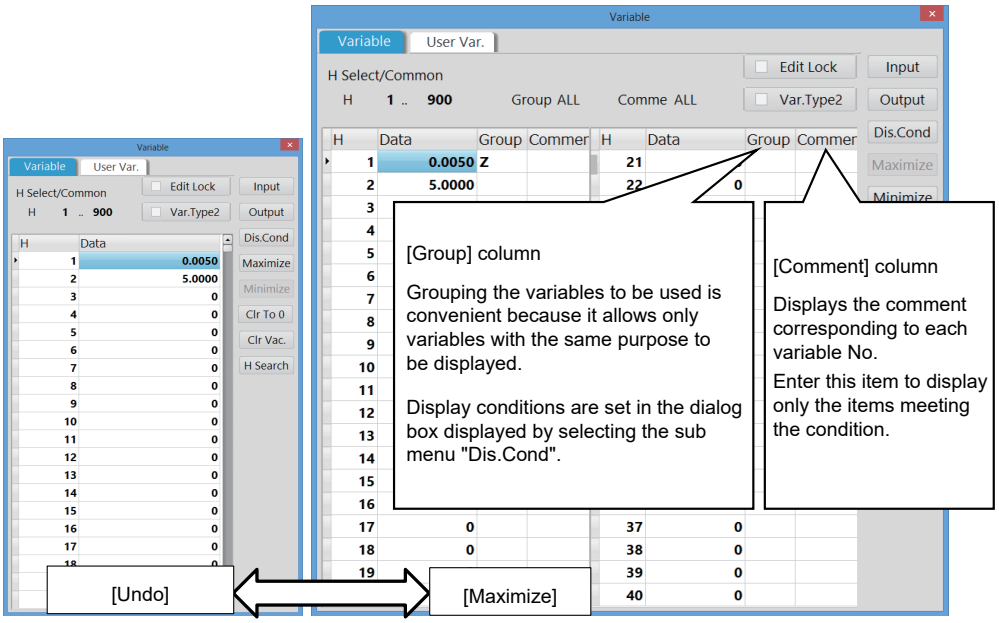


Fig. III.6.2

(b) Start number matching display of the designated variable

The following method can be used to perform start number matching for the designated variable.

(i) Press H Search of the operation menu in the list display to display the following dialog box.

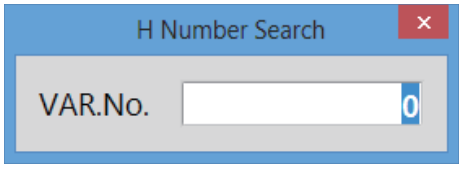


Fig. III.6.3

(ii) Enter the start number of the variables to be displayed in the dialog box, and press Enter .

(iii) The variable with the designated No. will appear.

(c) Selecting the display details

The display details are designated in the dialog box displayed by pressing View .

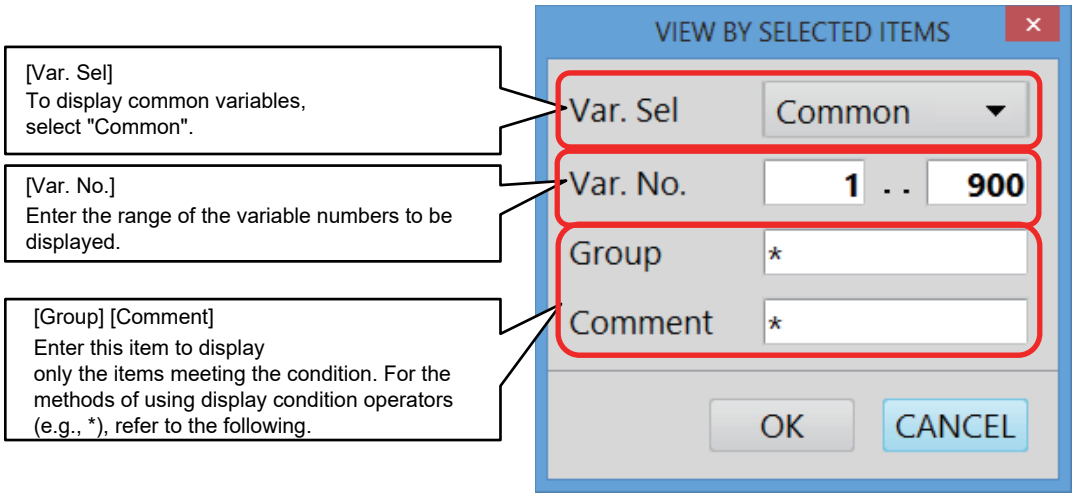


Fig. III.6.4

Table III.6.2 List of display condition operators

Display target	Operator	Example
Any one character	?	When "s?t" is set, "sat" and "set" can be displayed.
Random character string	*	When "s*d" is set, "sad" and "started" can be displayed.

2) Editing the common variables

(a) Deleting variables

The operation menu can be used to delete all the variables.

- Clear to zero: Clr To 0 .
- Clear all variables: Clr Vac. .

(b) Setting/canceling Edit Lock

Variables can be locked so that the variables are not inadvertently edited during screen operations.

To enable edit lock, tap Edit Lock and change it to the Edit Lock ON status. Tap again to set the edit lock status to OFF.

3) List of common variables used in specific functions

The following variables apply to specific functions. Do not use them for other functions. Additionally, variables H850 to H900 are all reserved variables of the maker.

No.	Function
H80	Axis rotation variable command Switch
H81	Axis rotation variable command Axis rotation angle
H82	Taper specification angle
H83	E-Pack No. during resetting due to broken wire
H84	Machining ON control in resetting
H85	Auto pause control
H86	Auto pause parameter
H90	Reset speed
H91	Taper specification ΔZ3
H92	Taper specification ΔZ4
H94	M01 uncut mode
H95	M01 cut off mode
H96	M01 uncut/cut off amount
H97	Skip condition 1 No. of wire breakages
H98	Skip condition 2 No. of insertion errors
H99	Re-machining mode
H195	Z axis scale reading L
H197	Sets the taper angle
H242	AT single action selection (valid only when AT is selected)
H244	ASR discharge position X (valid only when ASR is selected)
H245	ASR discharge position Y (valid only when ASR is selected)
H246	Fine hole insertion (1 digit), contact avoidance (10 digits)
H247	Z protection function (1 digit), inverse trajectory reset (10 digits)
H850	No. of skip times read
H851	No. of wire breaks, short-circuits read
H852	Fine hole search Search distance X
H853	Fine hole search Search distance Y
H854	Stop due to wire breaking before M0
H855	Specifies non-wire-breaking reset interval
H856	Connection at the wire breaking point
H857	Z axis moving distance during connection
H858	Continuous re-machining times
H859	(Reserved variable of the maker)
H860	X direction of proximity compensation
H861	Y direction of proximity compensation
H862 to H900	(Reserved variable of the maker)

(3) Local variables

If there is a designated argument in the user macro H901 to H932 commands or user macro subprogram call and that block is executed, the execution results will be displayed. For the call level of each subprogram of user macro, variables H901 to H932 are provided respectively and displayed only on the variable screen.

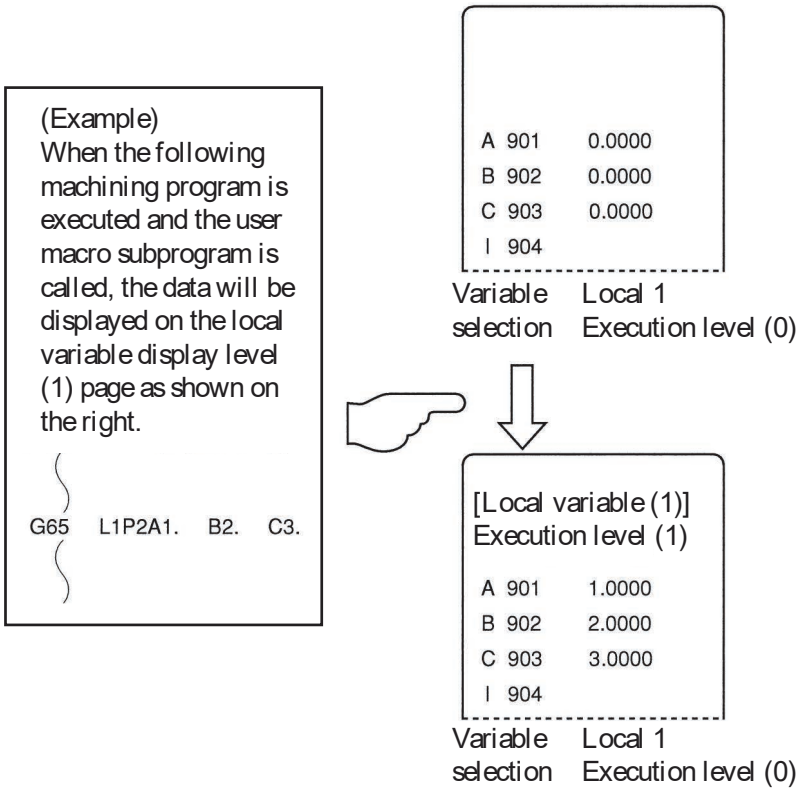


Fig. III.6.5

The relation between the user macro subprogram call execution level and display level is as shown below.

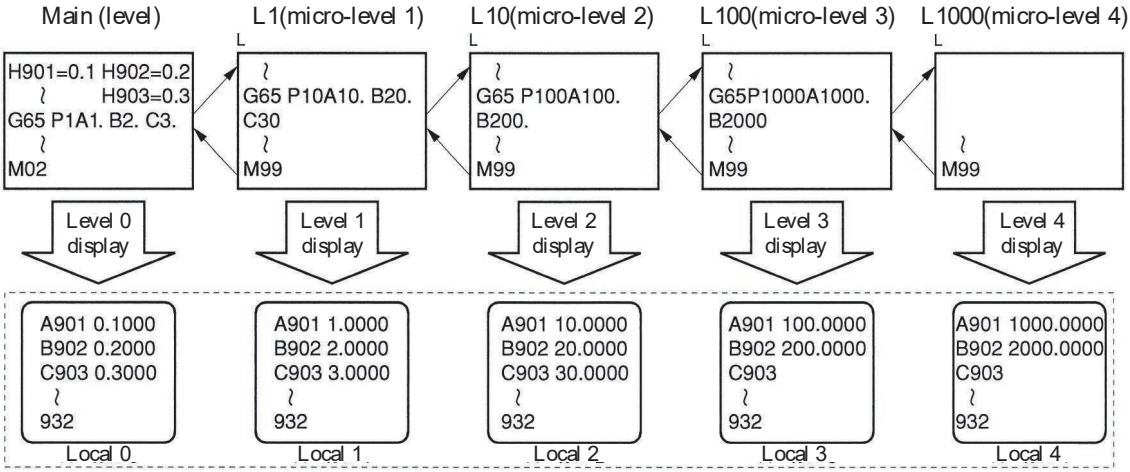


Fig. III.6.6

1) Selecting the screen size

Select the size with Maximize Minimize .

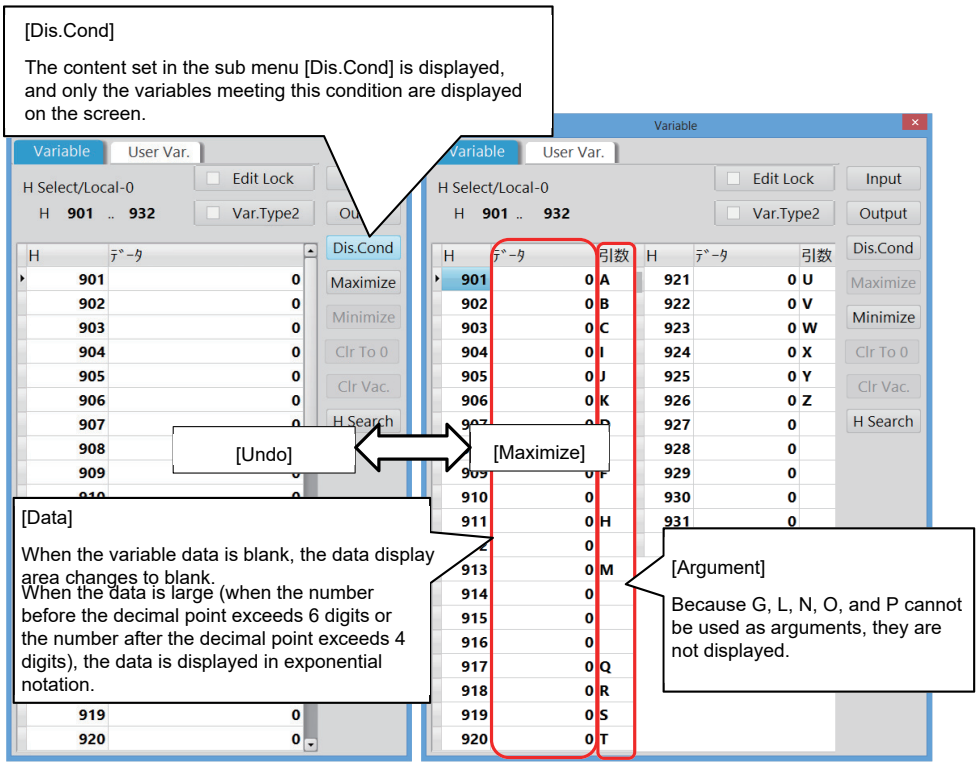


Fig. III.6.7

2) Selecting the display details

Display the display details with View .

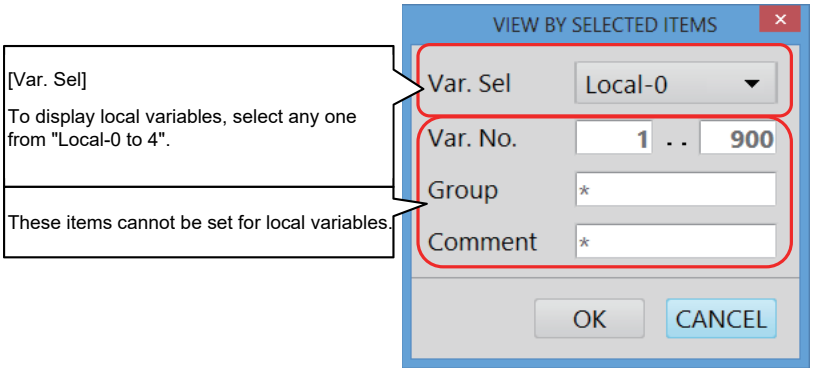


Fig. III.6.8

(4) User variables

The user variable can be displayed using the submenu. An NC program with a variable definition section, to which variable names are assigned to random variable numbers, is called a user program.

For the using method in program, see "IV. PROGRAMMING".

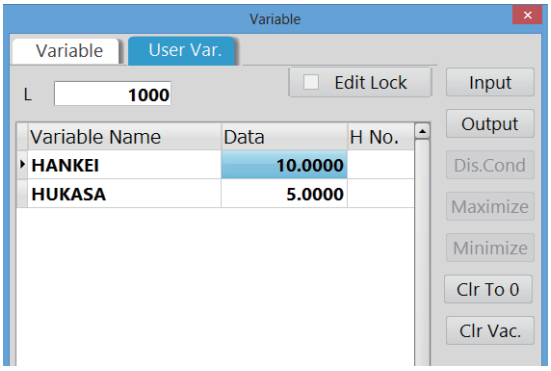


Fig. III.6.9

1) Explanation of each item

<PROGRAM NO.>

The variable definition is read from the user program and displayed by specifying the L number.

<VARIABLE DATA>

Variable data is entered for the variable displayed.

<Example> Read the L1000 variable definition and enter L1000 during variable data/

(* H1 = HANKEI)
(* H2 = FUKASA) G92XYZ
:
:
M02

Select the User Var. tab. Put the cursor on the L number and click it.
Enter the L number "1000".
The L1000 variable definition section will be read out.

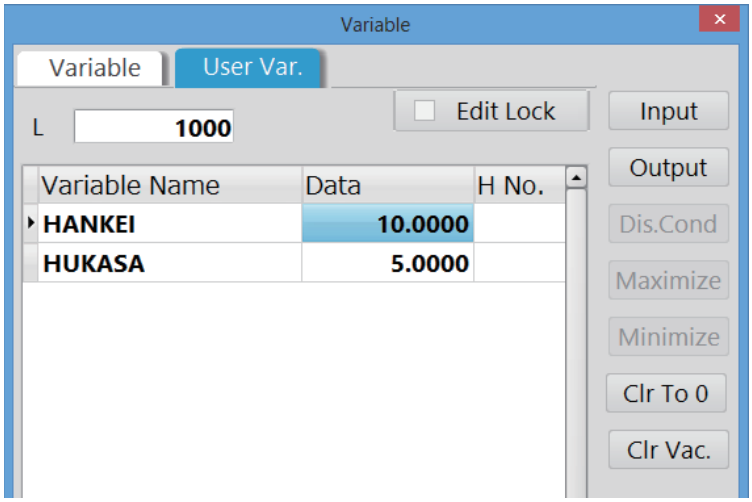


Fig. III.6.10

Put the cursor on the variable data and select it to edit.
Enter the value repeatedly according to the number of variable definitions.

6.3 E-Pack

(1) Summary

The E-Pack and ME-Pack are displayed and set on this screen. For the relations between functions and menus (submenus and operation menus), see the text below. Displaying/hiding of this screen can be switched using the overlap button "E-Pack".
For details, see the explanation of each item.

Machining conditions are decided according to the use purpose of each number. Please use the use area of user.

ME-Pack No.	E-Pack No.	Purpose
	1 - 499	User area
	500 to	Maker area
9000 - 9099	900000 - 909919	Machining condition search generation area (ME-Pack area)
9100 - 9199	910000 - 919919	User saving area (ME-Pack area)

ME-Pack means packing the information in addition of conventional E-Pack. It can be created using the machining condition search function. For details on ME-Pack, see "(3) [ME-Pack Cond] tab".

There are the following relation between ME-Pack No. and E-Pack No.

ME-Pack No.	E-Pack No.
9000	1 to 499
9001	500 to
…	…
9099	909900 to 909919
9100	910000 to 910019
9199	919900 to 919919

There are 20 E-packs for one ME-pack.

* **The command is sent using E-Pack No. from the NC program. ME-Pack No. is used for combined management in the screen, and it cannot be sent from the NC program.**

(2) "E-Pack" tab

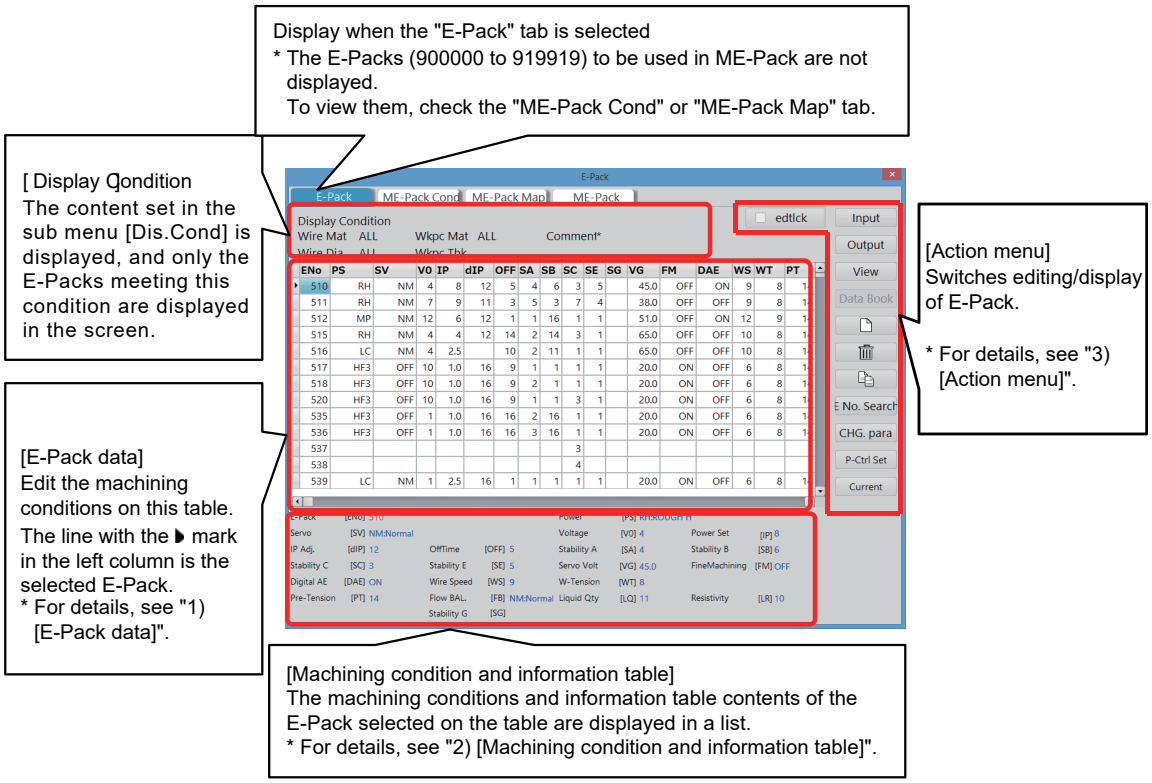


Fig. III.6.11

1) [E-Pack Data]

Displays the currently registered E-Pack data. To edit:

(a) Changing the E-Pack No.

Select the E-Pack No. to change, and enter the desired E-Pack No. An existing E-Pack No. cannot be entered.

(b) Changing a value

Click the information table value to change and enter the value directly.

(c) Changing the selected item

If the setting is a combo box, open the combo box and select the item to be changed.

2) Machining condition and information table

(a) Machining conditions

Please refer to the attached "Machining characteristic condition data book".

(b) Information table (used to indicate the specification of each E-Pack)

- Wire material [WM]
- Wire diameter [WD]
- Workpiece material [M]
- Workpiece thickness [T]: displayed in the unit of mm.
- Machining classification [C]: indicating the machining purpose

1 to 9…Machining conditions for 1stCut
30...Machining conditions for approach
40 to 49...Machining conditions for finish
For 42: 2nd
For 43: 3rd
For 44: 4th
For 45: 5th
For 46: 6th
For 47: 7th
For 48: 8th
For 49: 9th
60 to 69...Machining conditions for cutting edge

* The machining times of monitor screen are displayed based on this value.
For details, see the machining times on the "Operation" > "Monitor" screen of main menu.

- Set speed [F]: set standard speed during machining, displayed in the unit of mm/min.
- Offset [H]: displayed in the unit of 0.1 μm.
- Estimated speed [S]: machining speed used during estimation of the machining time, displayed in the unit of mm/min.
- Surface roughness [R]/Surface roughness [L]: displayed using Rzμ when the estimated surface roughness is R; displayed using Raμ when the estimated surface roughness is L.
- Approach amount [Y]: set in the unit of 0.1 μm.
- [B]: Outer corner control amount when speed priority is set in CM-R.
- [G]: Inner corner control amount when speed priority is set in CM-R; valid when Corner R < Information table [D].
- [I]: coefficient used in CM-S setting
  The first two digits are the coefficient of inner corner, and the last two digits are the coefficient of outer corner.
  The speed at the corner slows down when the value is reduced.
  The speed at the corner increases when the value is increased.
- [VA]: coefficient used in the VG compensation function.
- Straightness compensation [CC]: compensation amount used in the straightness compensation function.
  Set in the unit of 0.1 μm.

• For machining classification [C], it must be set correctly even in the machining condition created by the user.
• The information tables other than this one are set already under the machining conditions provided by the maker, so they do not need to be set usually.

(c) Information table settings

Values can be set in the following information table to create a program with some F commands, H commands, and M conditions omitted.
E-Pack set with the following information table can be used as a command in the program to change the set speed.

Set speed [FF]: set standard speed during machining, set in the unit of 0.1 mm/min. Offset [HH]: Set in the unit of 0.1 μm.

Information table and commands that can be omitted

Information table	Commands that can be omitted	* Precautions
FF	F command	* The F command takes effect when the F command and the E command containing information table FF are executed in the same program segment.
HH	H command	* The H command takes effect when the H command and the E command containing information table HH are executed in the same program segment. * When offset has been specified through the information table, the variable No. changes to H20645.

3) Action menu

(a) Edit Lock : Edit lock

The E-Pack can be locked to prevent inadvertent editing during screen operations. To enable edit lock, tap Edit Lock to select the check box, and change it to the Edit Lock ON status. Tap it again to set the edit lock status to OFF.

(b) Input : Input

Specify the HD and file on the network and enter the E-Pack. Select the E-Pack to be registered and click Start .

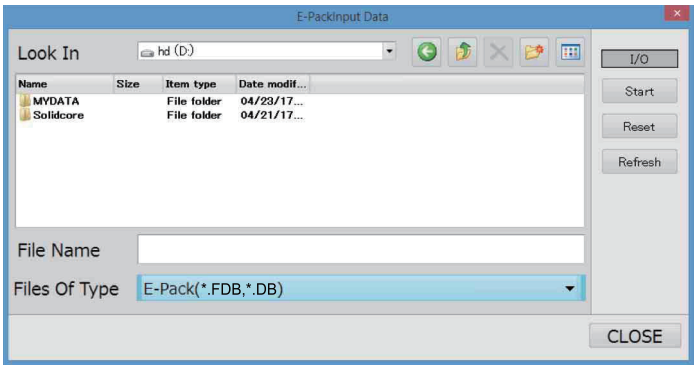


Fig. III.6.12

(c) Output : Output

Output the E-Pack registered to the EDM already. Enter the number range of E-Pack to output in "Output E

No.", and click Start .

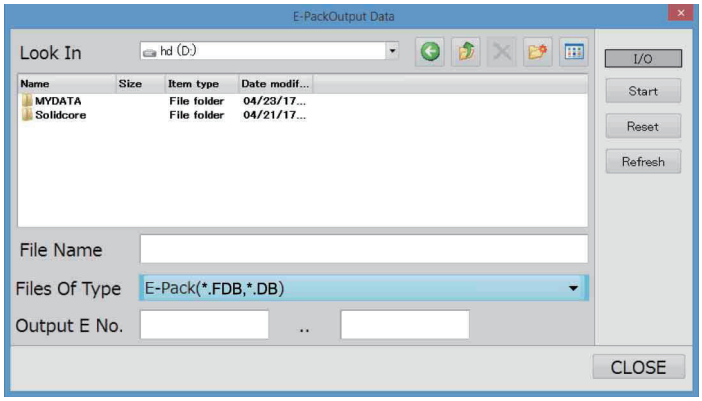


Fig. III.6.13

(d) View : Setting the display condition

The content displayed in machining condition display (full screen) is specified through the dialog box displayed through [View By Selected Items].

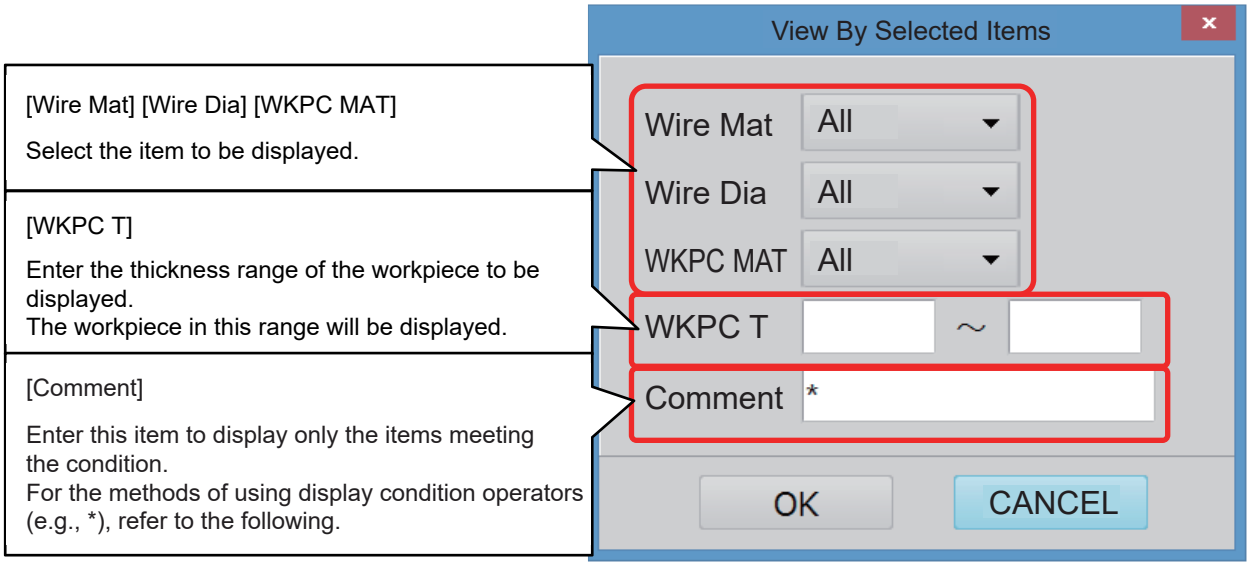


Fig. III.6.14

Table III.6.3 List of display condition operators

Display target	Operator	Example
Any one character	?	When "s?t" is set, "sat" and "set" can be displayed.
Random character string	*	When "s*d" is set, "sad" and "started" can be displayed.

(e) Data Book : Data book

Press the menu Data Book to display the "MACHINING CONDITION DATA BOOK".

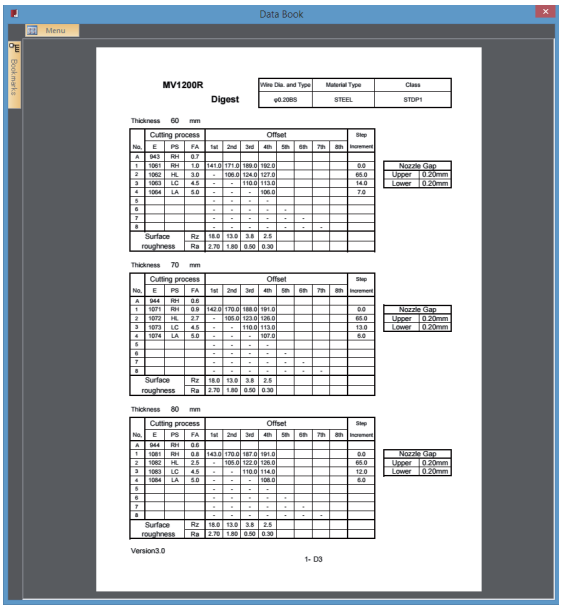


Fig. III.6.15

The "MACHINING CONDITION DATA BOOK" is entered automatically during I/O input of machining condition data provided by the marker.

(f) : New

Create an E-Pack (machining conditions). Create an E-Pack according to the steps below.

(i) Press <img> to insert one blank line above the currently selected line.

(ii) Enter the E-Pack No. and the data of each machining condition in the blank line. After the E- Pack No. is decided, the data is re-sorted according to the E-Pack No. sequence.

No machining condition and information table are set for the new E-Pack. For information table details, see "2) Machining condition and information table".

(g) : Deleting

Select the target E-Pack to delete, and press the menu to delete it.

(h) : Copying

Copy an E-Pack. Copy an E-Pack according to the steps below.

(i) Select the E-Pack to copy.

(ii) Click the menu to display the dialog box used to enter the E No. of copy object.

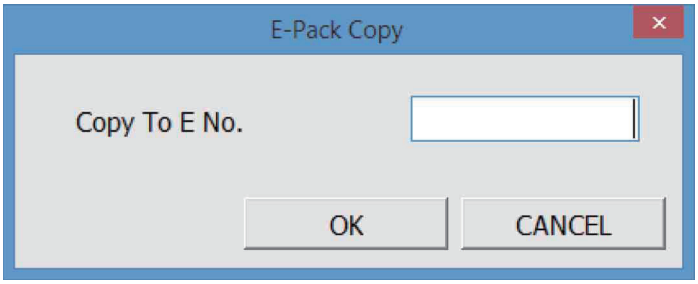


Fig. III.6.16

(iii) Enter the E No. of copy object in the dialog box, and then click [OK].

(i) E No. search : E search

The specified E-Pack can be searched according to the start number. E No. search Click <img> to display the dialog box shown below. Enter the start number of the E-Pack to be displayed in the dialog box, and press "Enter".

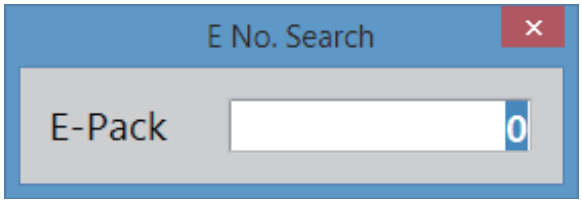


Fig. III.6.17

(j) CHG.para : Switching the E-Pack parameter display

Click CHG.para to switch the displayed machining conditions and information table.

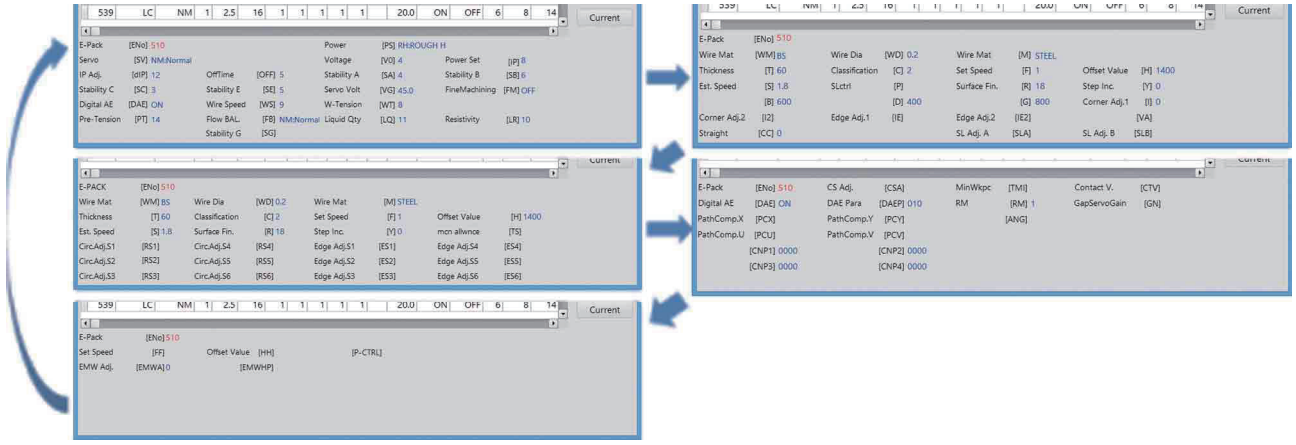


Fig. III.6.18

(k) P-Ctrl Set : P-CTRL (adaptive control) setting

Set the adaptive control of E-Pack. P-Ctrl Set Click <img> to open the following setting screen and set adaptive control.

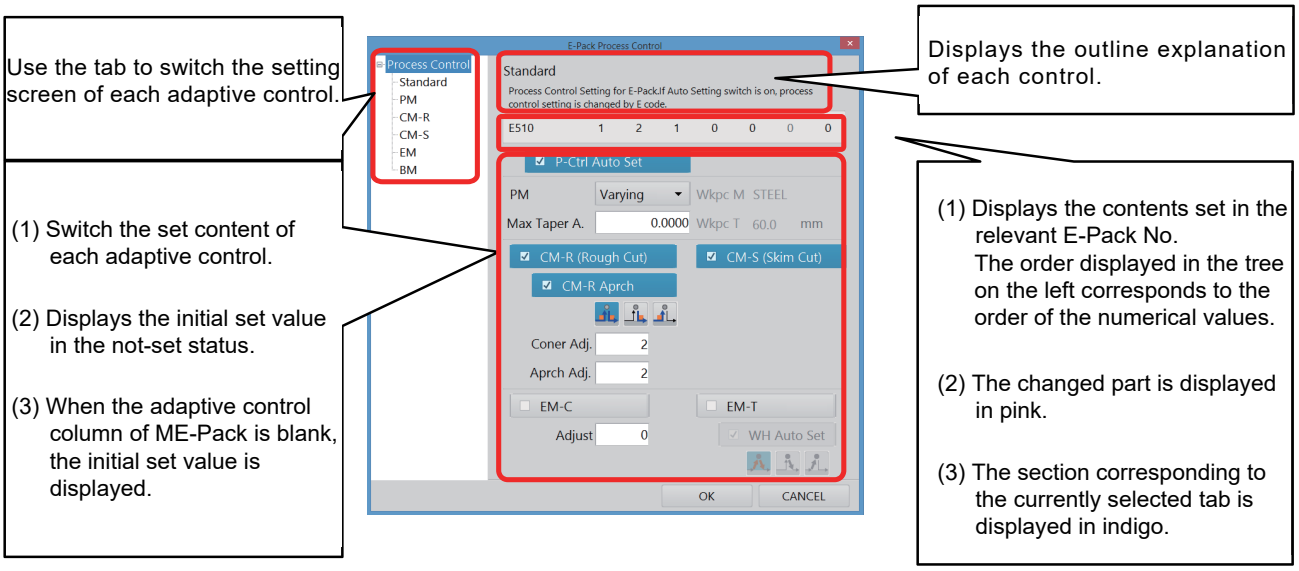


Fig. III.6.19

(l) Current : Displaying the current conditions

Display the current conditions. For details, see "III. NC OPERATION DISPLAY SCREEN" > "3. INITIAL SETTING".

(3) [ME-Pack Cond] tab

ME-Pack means packing the information in addition of conventional E-Pack. It can be created using the machining condition search function. For details on ME-Pack, see "4.3 Program" > "(4) E-Pack search".

In [ME-Pack Cond], the registered ME-Pack list, selected ME-Pack, and E-Pack used in ME-Pack can be viewed through a list.

For details of each screen, see "(4) [ME-Pack Map] tab" and "(5) [ME-Pack] tab".

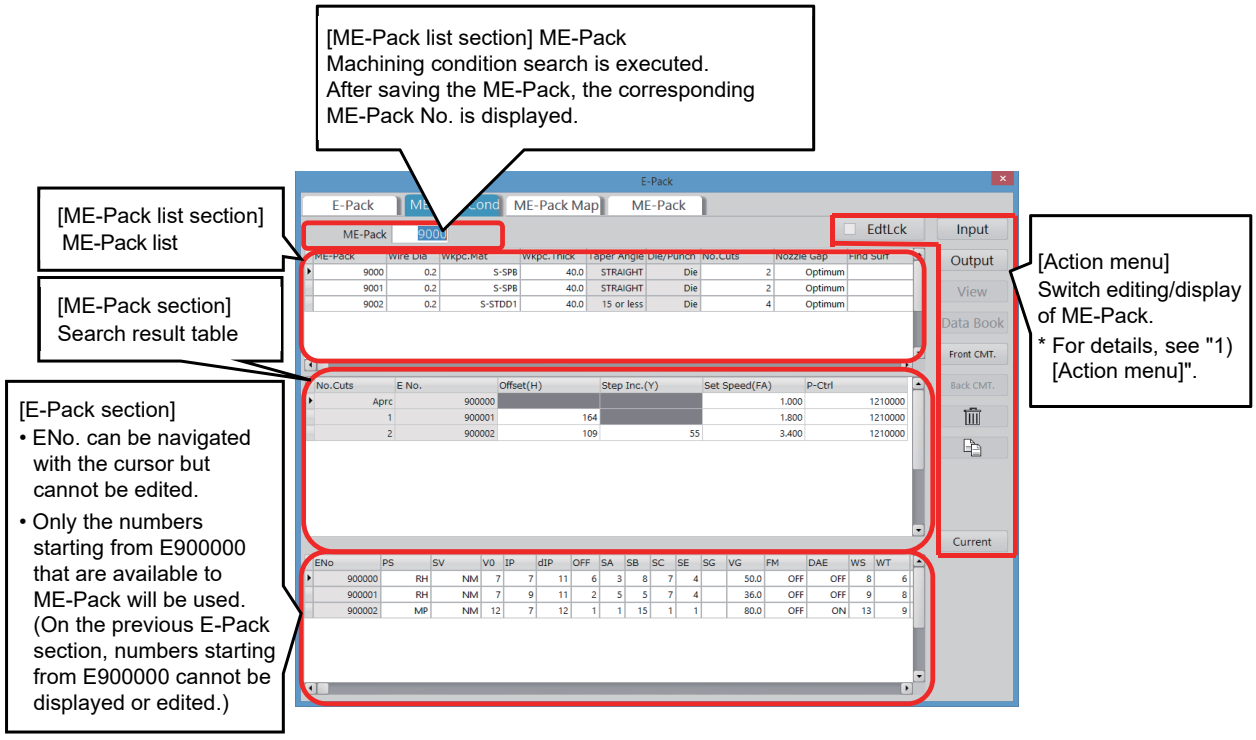


Fig. III.6.20

1) Action menu

(a) Edit Lock : Edit lock

The E-Pack can be locked to prevent inadvertent editing during screen operations. To enable edit lock, tap Edit Lock to select the check box, and change it to the Edit Lock ON status. Tap it again to set the edit lock status to OFF.

(b) Input : Input

Specify the HD and file on the network and enter the ME-Pack. Select the ME-Pack to be registered and click Start .

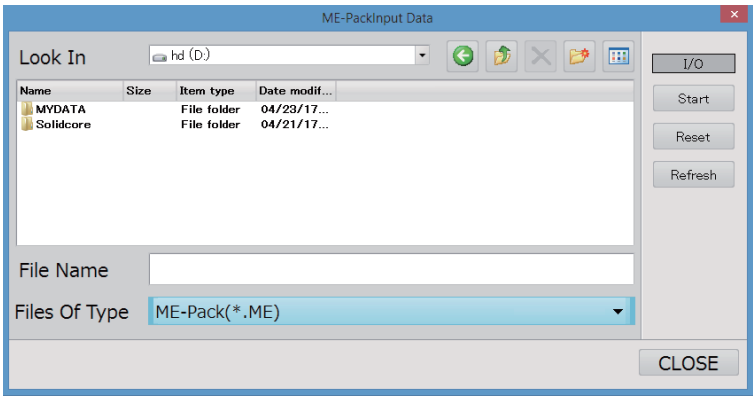


Fig. III.6.21

(c) Output : Output

Output the ME-Pack registered to the EDM already. Enter the number range of ME-Pack to output in "Output ME No.", and click Start .

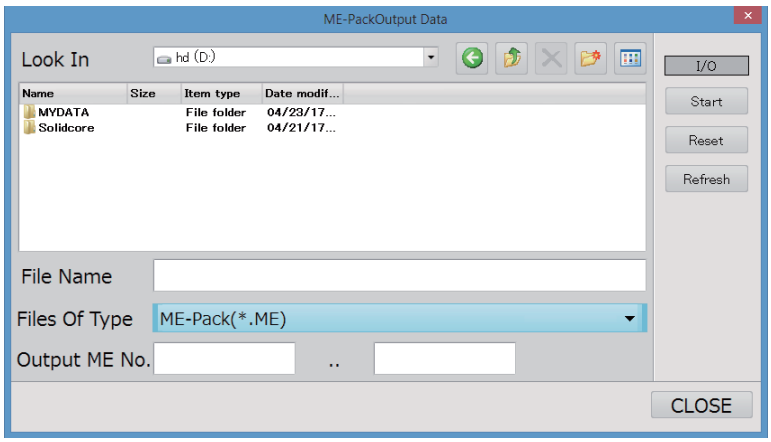


Fig. III.6.22

(d) View : Setting the display condition

The content displayed in machining condition display (full screen) is specified through the dialog box displayed through [View By Selected Items].

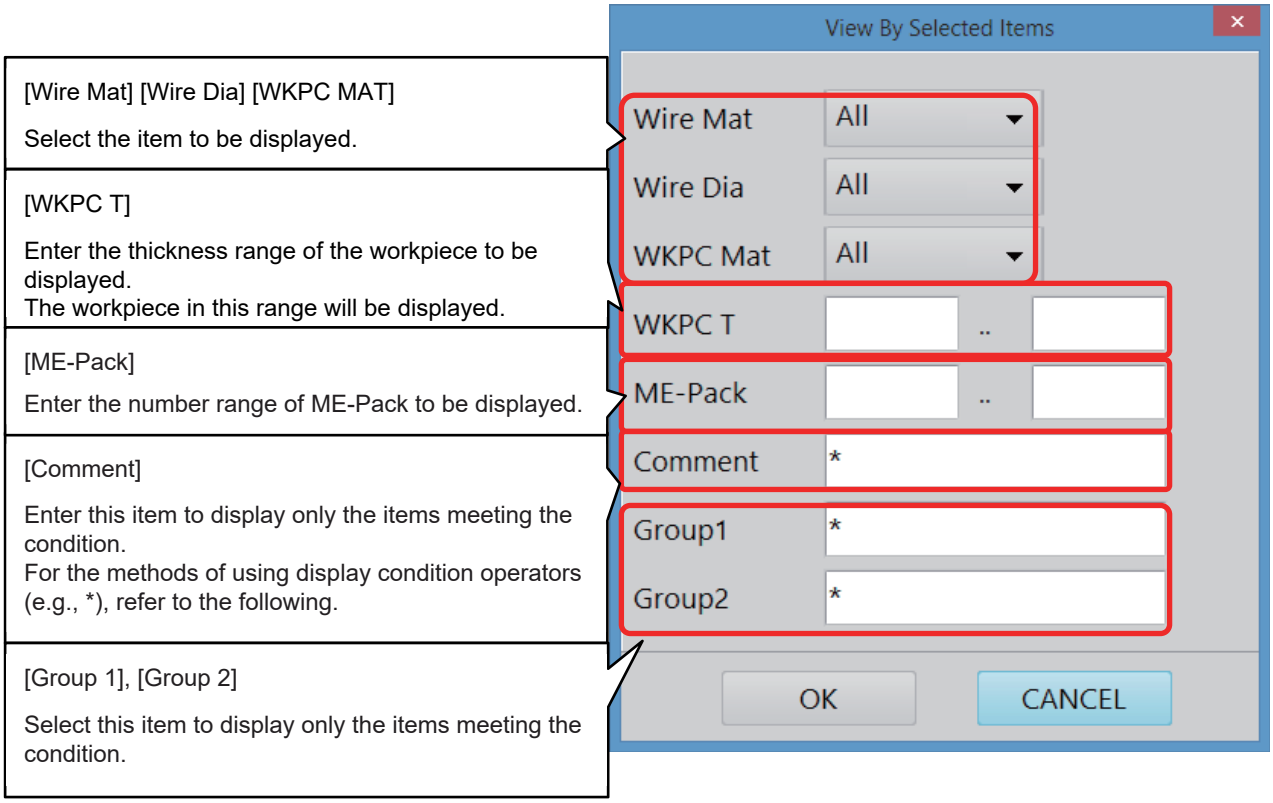


Fig. III.6.23

Table III.6.4 List of display condition operators

Display target	Operator	Example
Any one character	?	When "s?t" is set, "sat" and "set" can be displayed.
Random character string	*	When "s*d" is set, "sad" and "started" can be displayed.

(e) Data Book : Data book

Press the menu Data Book to display the "MACHINING CONDITION DATA BOOK".

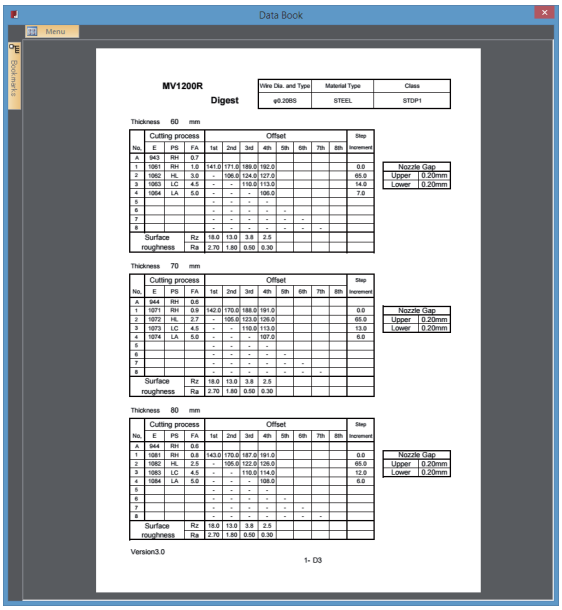


Fig. III.6.24

The "MACHINING CONDITION DATA BOOK" is entered automatically during I/O input of machining condition data provided by the marker.

(f) Front CMT. / Back CMT. : Front comment display

Front CMT. If <img> is selected, the comments are displayed in the front, as shown below.

Back CMT. If <img> is selected, the original display is restored.

	ME-Pack	Comment	Wire Dia	Wkpc.Mat	Wkpc.Thick	Taper Angle	Die/Punch	No.Cuts
▶	9000		0.2	S-STDD1	20.0	STRAIGHT	Die	
	9001		0.2	S-STDD1	20.0	STRAIGHT	Die	
	9002		0.2	STEEL	5T-100T	STRAIGHT	Die	

Fig. III.6.25

(g) 🗑 : Deleting

Select the target E-Pack to delete, and press the menu 🗑 to delete it.

(h) : Copying

Copy an E-Pack. Copy an E-Pack according to the steps below.

(i) Select the E-Pack to copy.

(ii) Click the menu to display the dialog box used to enter the E No. of copy object.

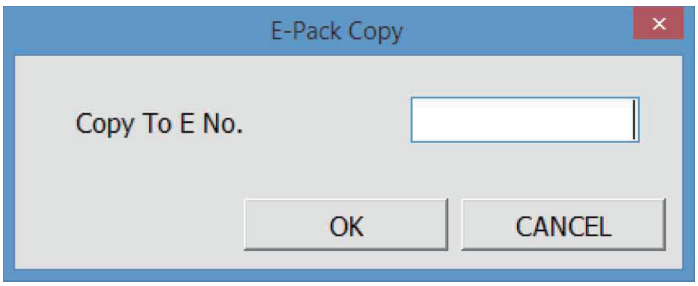


Fig. III.6.26

(iii) Enter the E No. of copy object in the dialog box, and then click [OK].

(i) Current : Displaying the current conditions

Display the current conditions. For details, see "III. NC OPERATION DISPLAY SCREEN" > "3. INITIAL SETTING".

(4) [ME-Pack Map] tab

The registered ME-Pack list can be confirmed.

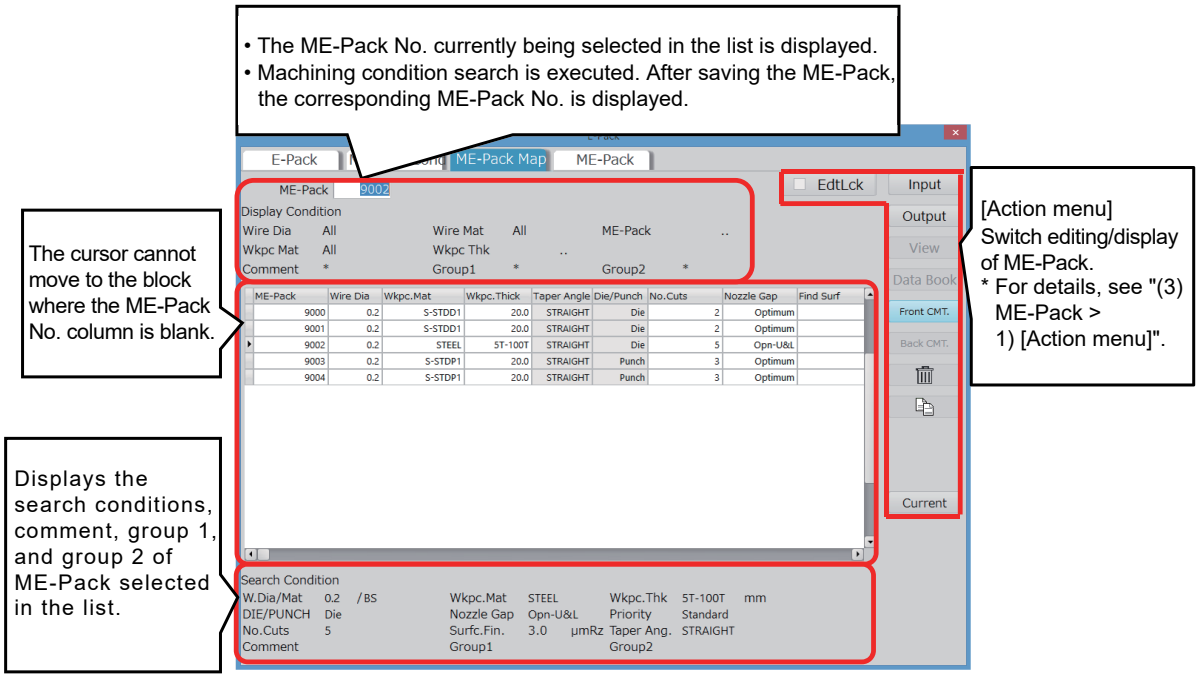


Fig. III.6.27

(5) [ME-Pack] tab

The content of registered ME-Pack can be confirmed/edited.

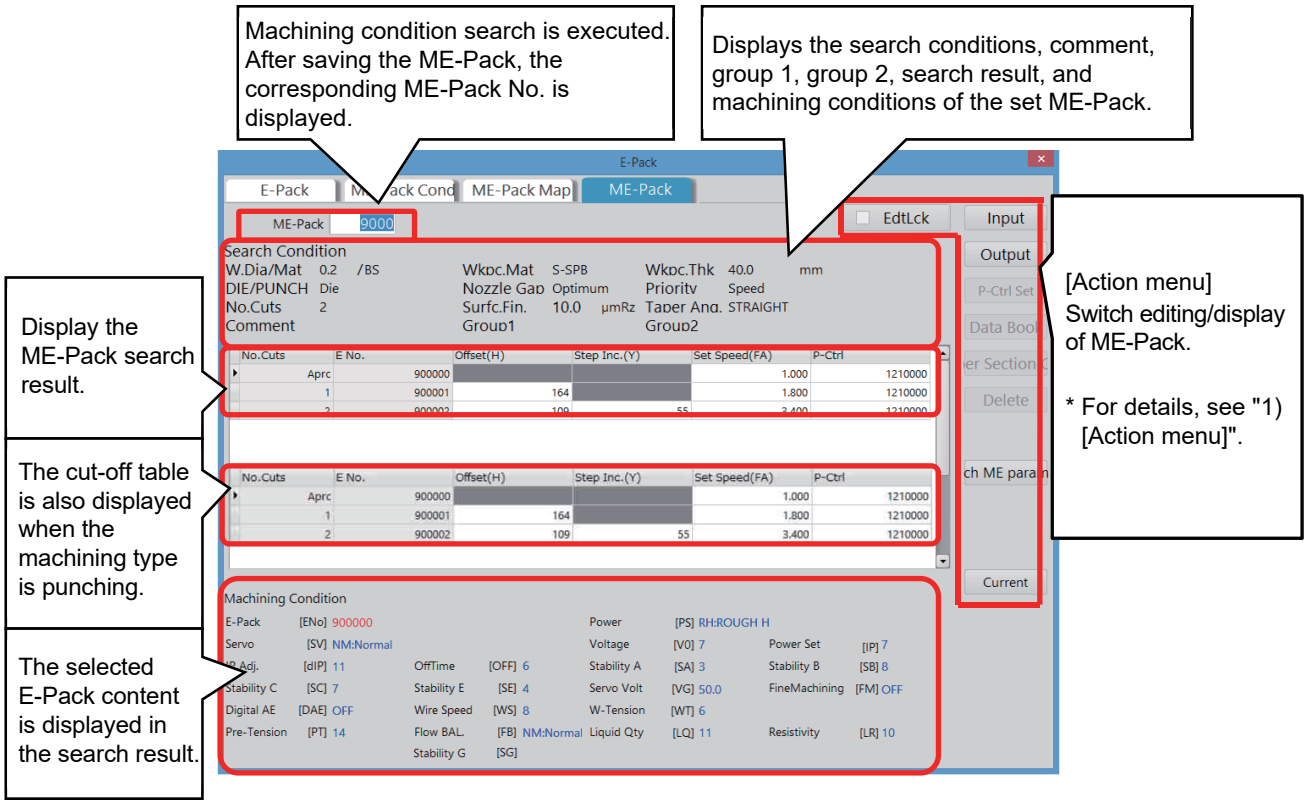


Fig. III.6.28

1) Action menu

(a) Edit Lock : Edit lock

The ME-Pack can be locked to prevent inadvertent editing during screen operations. To enable edit lock, tap Edit Lock to select the check box, and change it to the Edit Lock ON status. Tap it again to set the edit lock status to OFF.

(b) Input : Input

Specify the HD and file on the network and enter the ME-Pack. Select the ME-Pack to be registered and click Start .

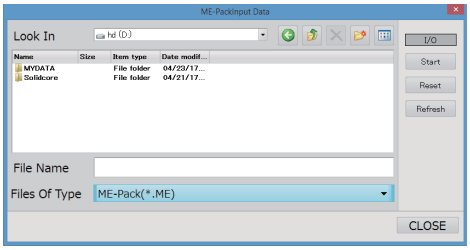


Fig. III.6.29

(c) Output : Output

Output the ME-Pack registered to the EDM already. Enter the number range of ME-Pack to output in "Output ME No.", and click Start .

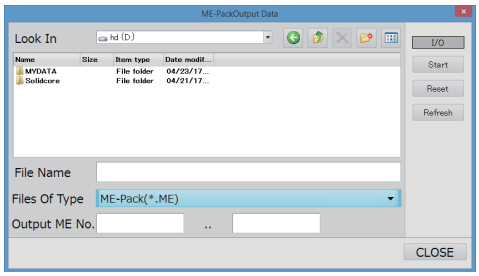


Fig. III.6.30

(d) P-Ctrl Set : P-CTRL (adaptive control) setting

Set the adaptive control of ME-Pack. P-Ctrl Set Click <img> to open the following setting screen and set adaptive control.

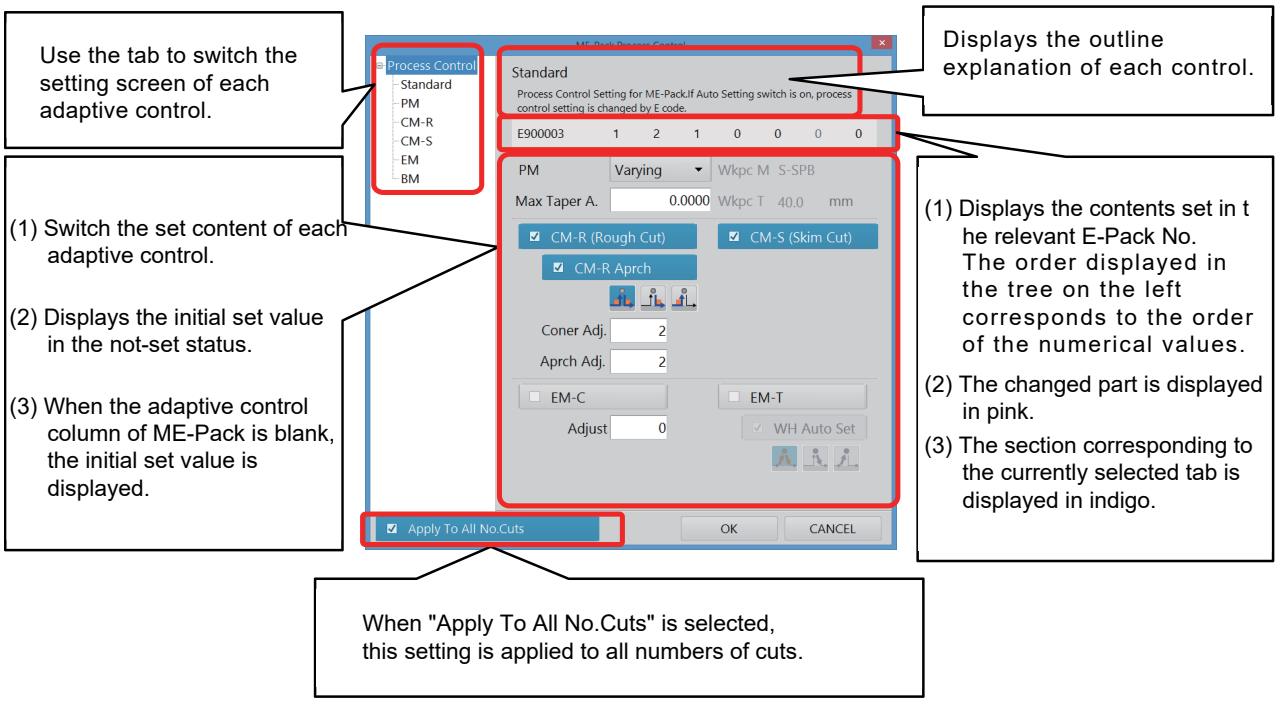


Fig. III.6.31

(e) Data Book : Data book

Press the menu Data Book to display the "MACHINING CONDITION DATA BOOK".

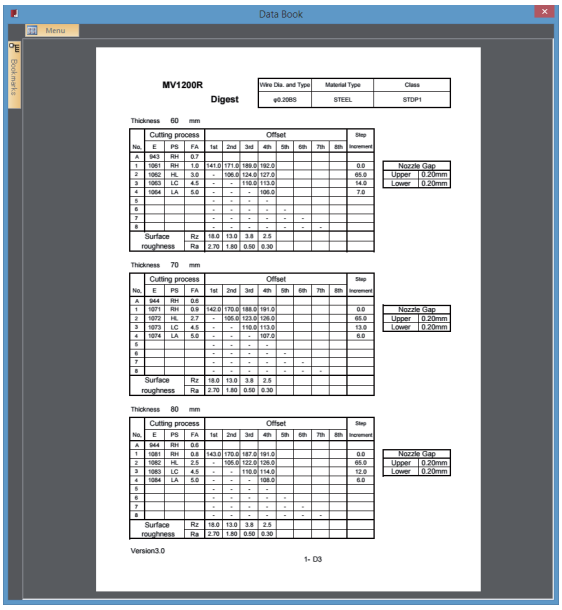


Fig. III.6.32

The "MACHINING CONDITION DATA BOOK" is entered automatically during I/O input of machining condition data provided by the marker.

(f) Upper Section Copy : Copying upper block

Copy the selected [No.Cuts] block, and insert it below the selected block.

*** The blocks other than "Apprc" and "Cut" are valid only when they are selected.**

(g) Delete : Deleting a block

Select the [No. Cuts] to delete, and click Delete to display the dialog box shown below. Click "OK" to delete the selected block.

*** The blocks other than "Apprc", "1", and "Cut" are valid only when they are selected.**

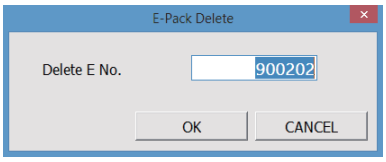


Fig. III.6.33

(h) CHG.para : Switching the ME-Pack parameter display

Click CHG.para to switch the displayed machining conditions and information table.

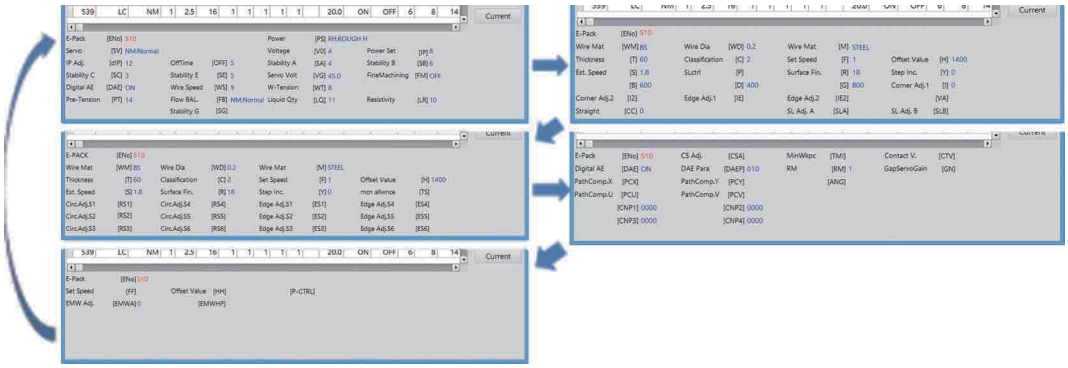


Fig. III.6.34

6.4 NC PRO (NC Program)

Used to implement the related function of NC program.
For details refer to "4.3 Program" > "4.3.1 Auxiliary menu" > "(2) NC Pro".

6.5 Checker

For details refer to "4.3 Program" > "4.3.1 Auxiliary menu" > "(5) Checker".

6.6 Scheduler

For details refer to "4.3 Program" > "4.3.1 Auxiliary menu" > "4.3.2 Scheduler".

6.7 2DCAM

Uses the two-dimensional CAD function or reads DXF, IGES, and CamMagic data to create NC data. Toggle this screen with the overlap button "2DCAM".
For details, refer to the PDF manual in Help.

(1) Function of each section

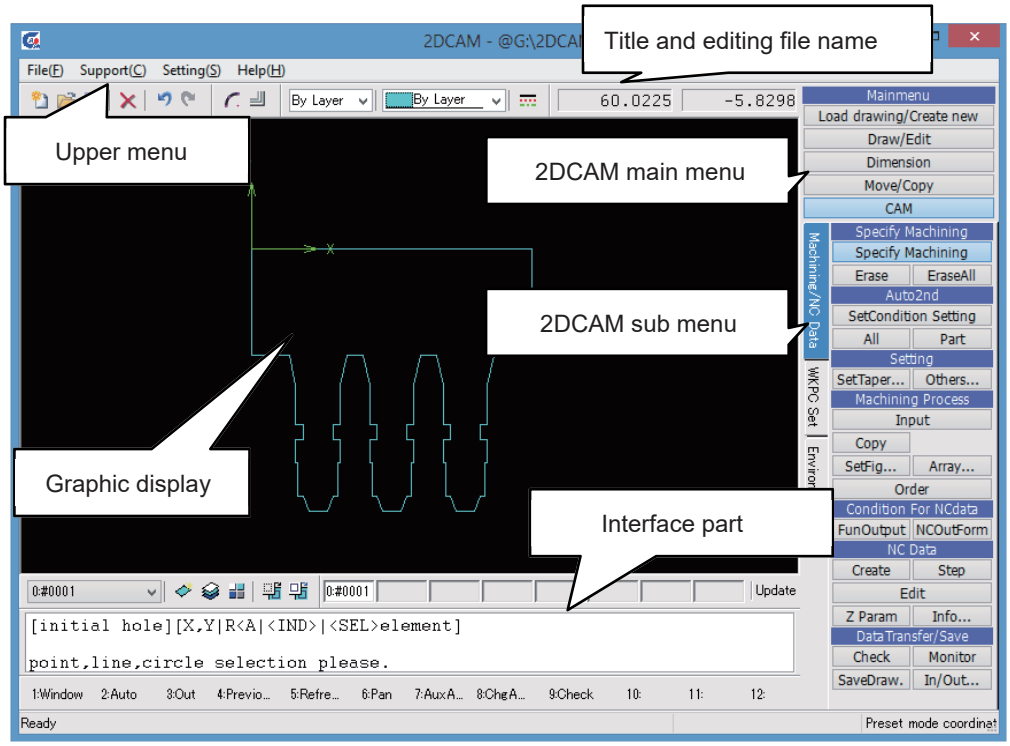


Fig. III.6.35

1) Explanation of the tile and file name editing

The file name being edited is displayed here.

2) Explanation of 2DCAM and upper menu

Including all the hierarchical menus.

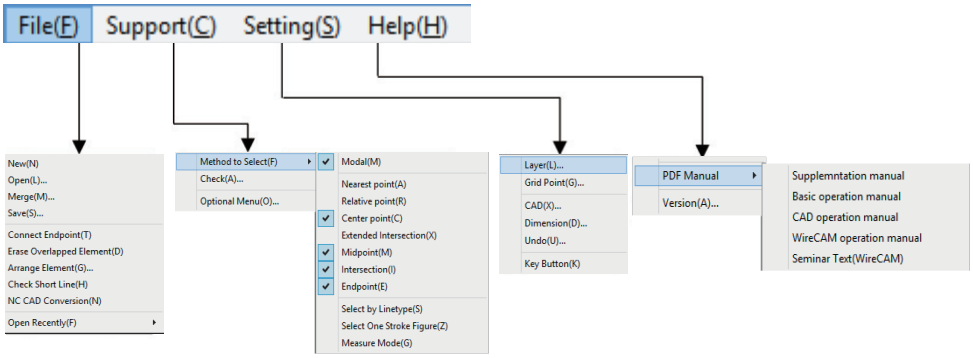


Fig. III.6.36

(a) **File (F)** can be used to save drawings or read IGES and DXF data.

(b) **Support (C)** can be used to set the graphic selection method, check graphics, etc.

(c) **Setting (S)** can be used to set the layer, etc.

(d) **Help (H)** can be used to open the PDF manual through the help operation.
For the detailed operation method of 2DCAM, browse here.

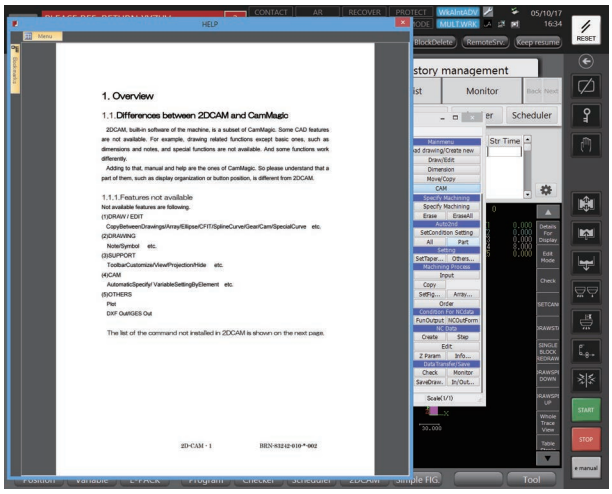


Fig. III.6.37

3) Explanation of 2DCAM and main menu

The drawing reading/creating, drawing editing, size, moving and copying, and CAM buttons are used to perform operations. Press each button to switch the lower 2DCAM and submenu section.

4) Explanation of 2DCAM and submenu

Switch according to the 2DCAM and main menu.

T

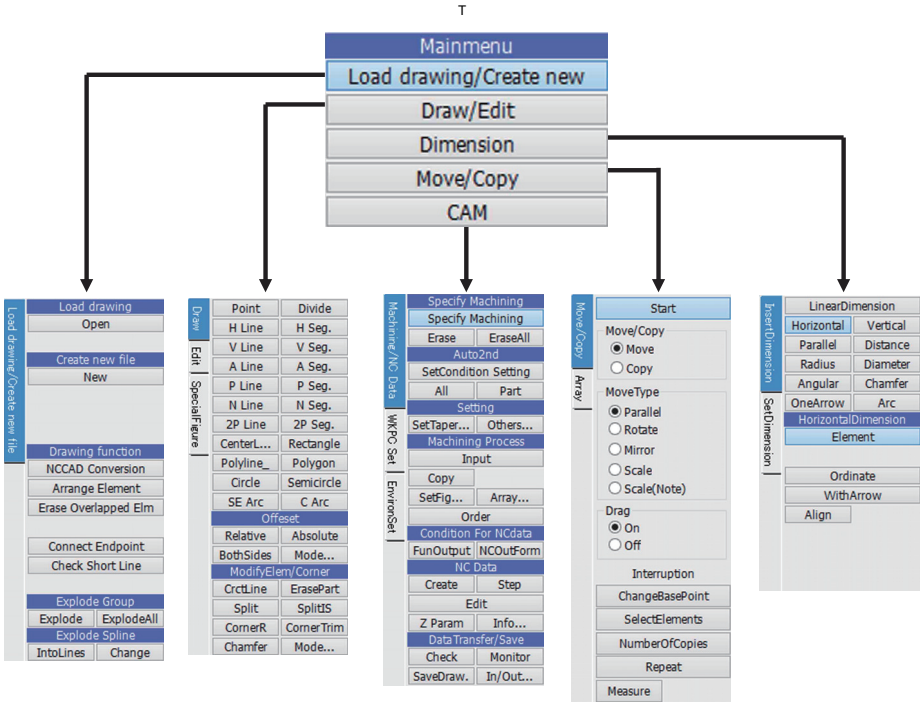


Fig. III.6.38

(a) **Load drawing/Create new** Read the existing drawing and create new drawing.

(b) **Draw/Edit** Draw and edit two-dimensional graphics.

(c) **Dimension** Mark dimensions in graphics.

(d) **Move/Copy** Move and copy the drawn graphics.

(e) **CAM** Define the machining method and generate NC data.

(2) Operation procedure example

The following describes the operation procedure from NC data creation to transferring it to graphic check.

1) Machining definition

(a) Select 2DCAM and the [CAM] button of main menu.
Switch 2DCAM and submenu to the wire machining menu.

(b) Select the [Specify Machining] button of wire machining menu.

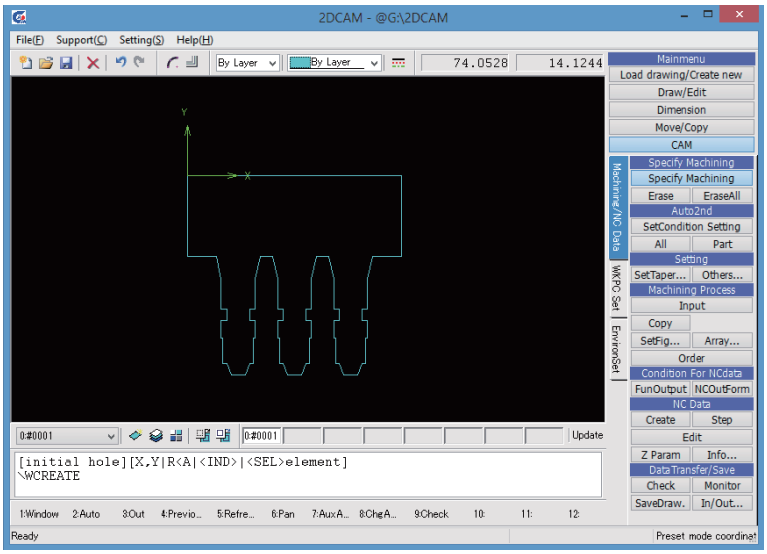


Fig. III.6.39

(c) Designate the initial hole position and use the keyboard to enter coordinates (red square mark).

(d) Designate the approach position. Click to select the graphics (line) (white dot and arrow mark).

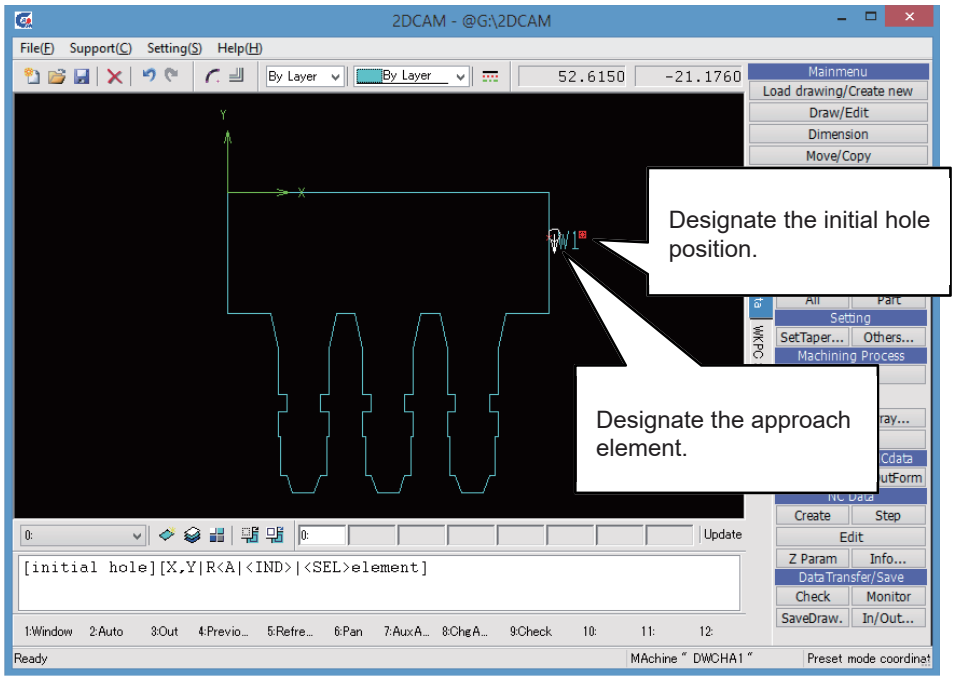


Fig. III.6.40

2) NC data generation

(a) Click the [Create] button to generate NC data (the displayed graphic color will change).

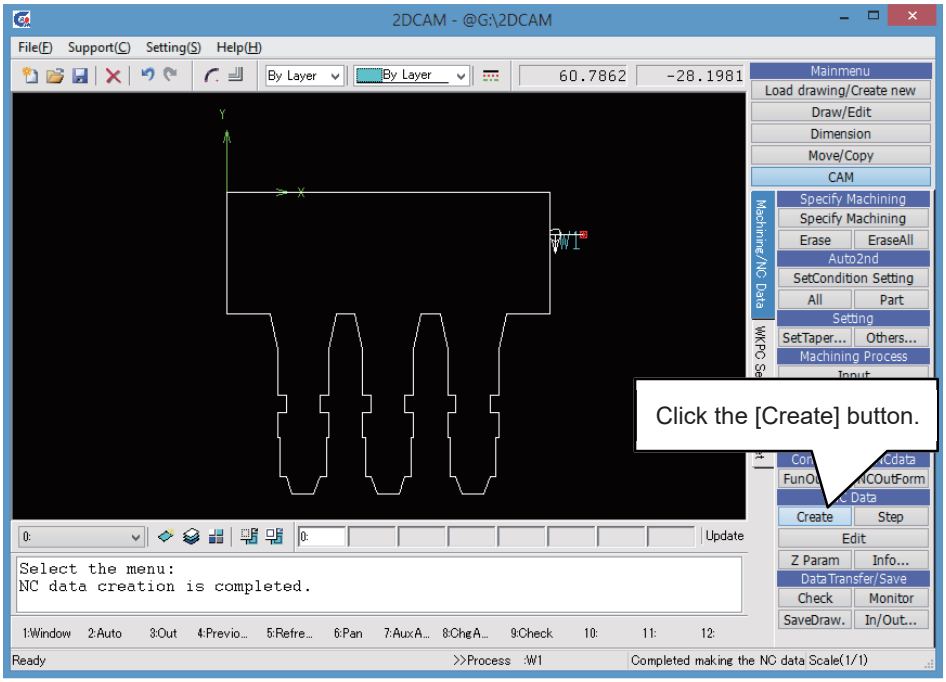


Fig. III.6.41

(b) When necessary, you can click the [Edit] button to confirm the generated NC data.

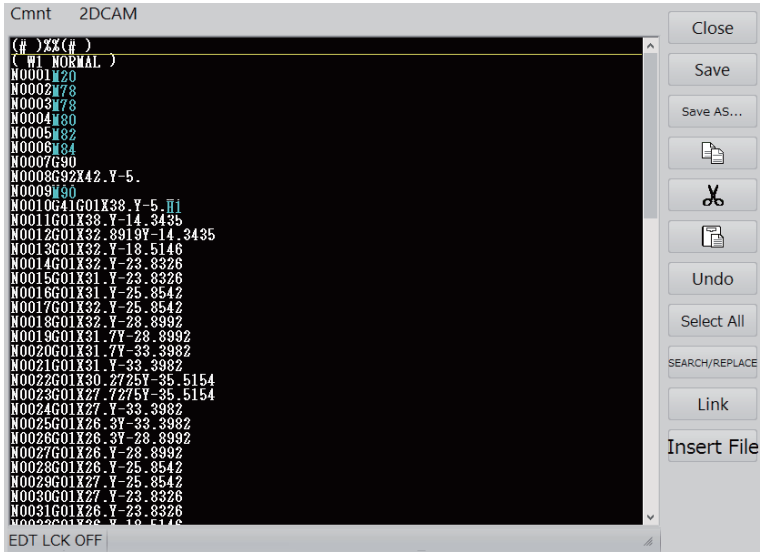


Fig. III.6.42

All kinds of settings must be performed to output the expected condition and M code. For details, refer to the CAM operation part of PDF manual.

3) Transferring to graphic check and monitor

(a) Press the [Check] button. The 3D model and NC data will be transferred to the graphic detector. (To forward them to monitor, click [Monitor]. Complete registration at this time moment.)

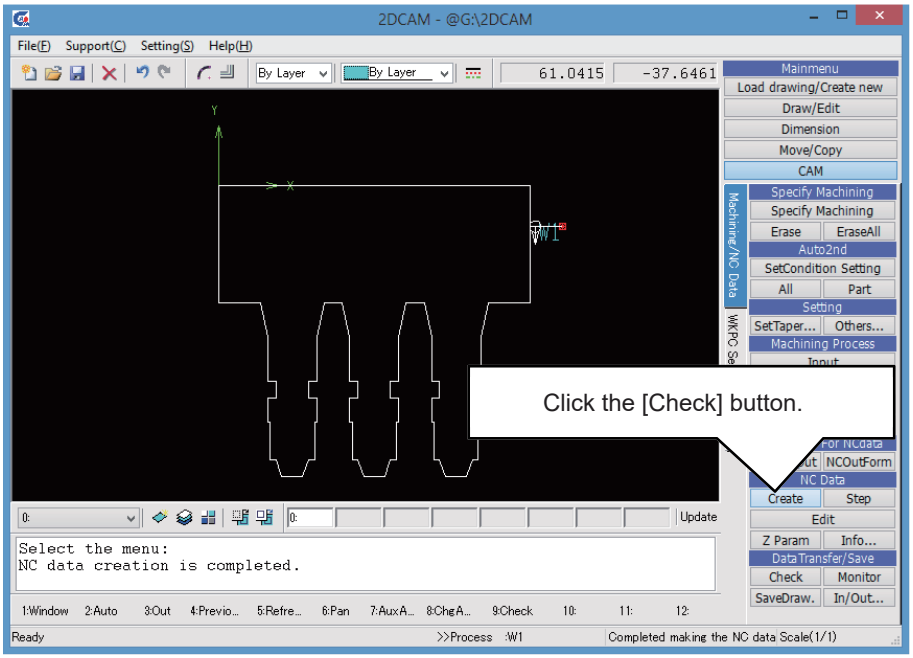


Fig. III.6.43

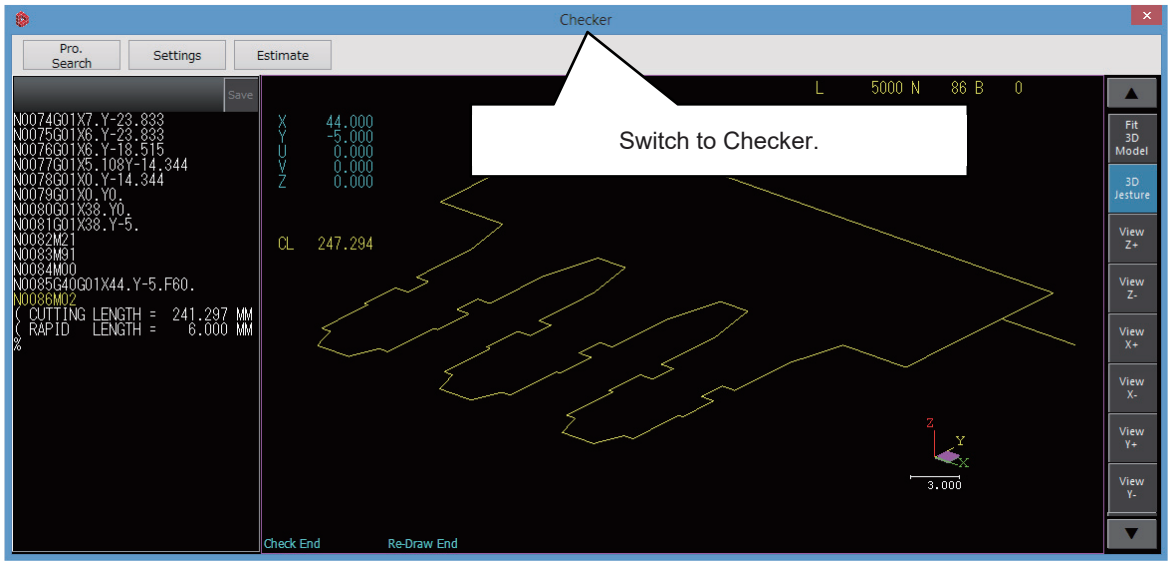


Fig. III.6.44

(b) When the created NC program is saved as an L No., implement it as follows:

(i) "L No. Registration" screen

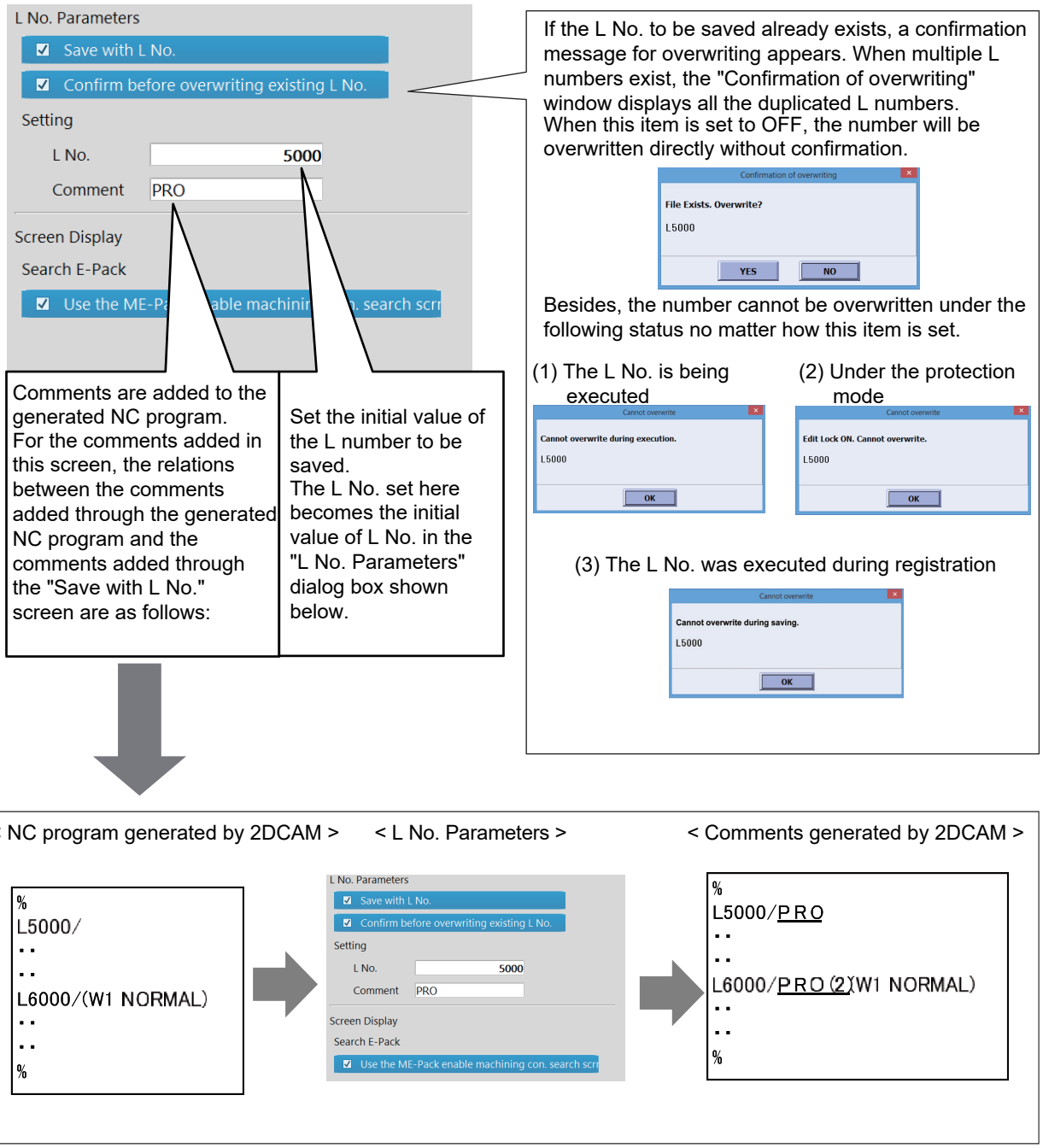


Fig. III.6.45

(ii) **L No. registration operation flow**

When the NC program generated through 2DCAM is transferred to the detector or monitor, switch the L No. registration and file name registration according to setting of "L Registration ON" and "L Registration OFF" as shown below.

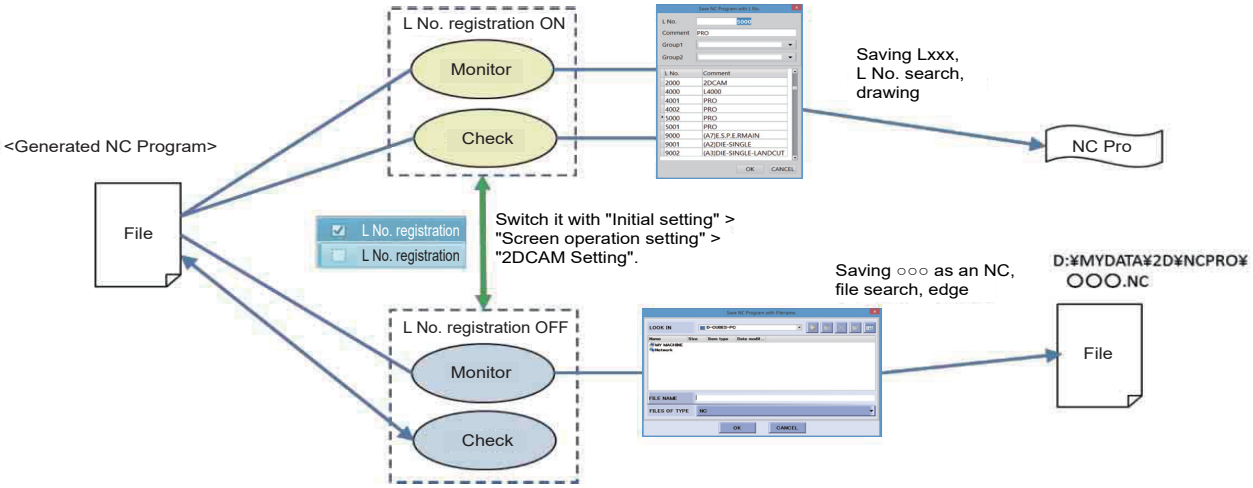


Fig. III.6.46

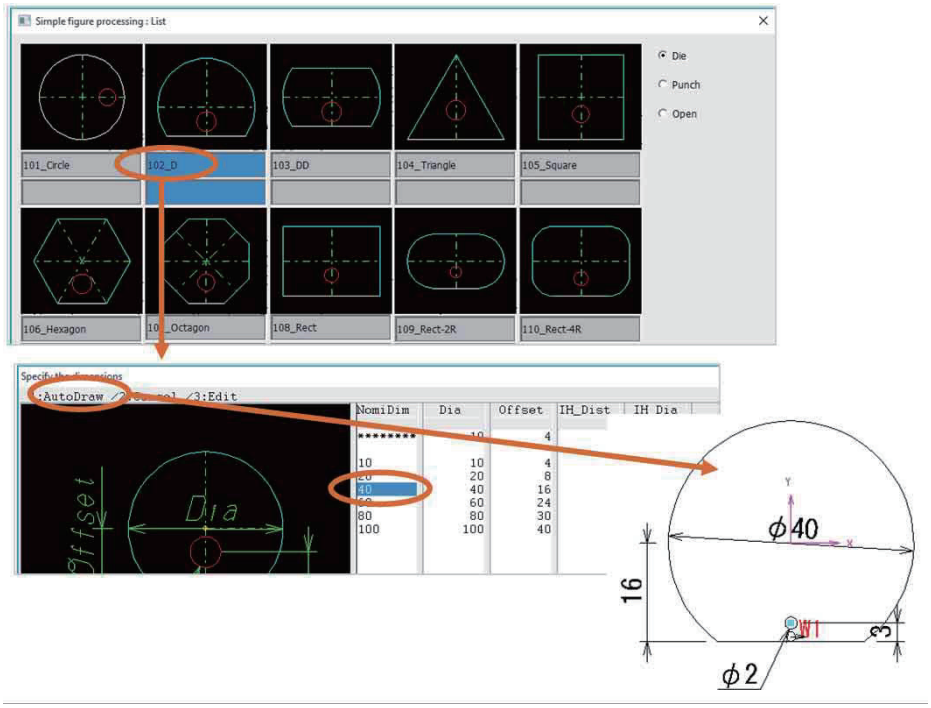
6.8 Simple shape

You can create NC programs just by setting parameters without the need to draw the specific shapes.
Displaying/hiding of this screen can be switched using the overlap button "Simple FIG".

(1) Operation

To create an NC program, operate the options of simple shape machining in order from the top.

1) Shape selection: Select the shape and dimension to automatically draw the shape with machining definition already.



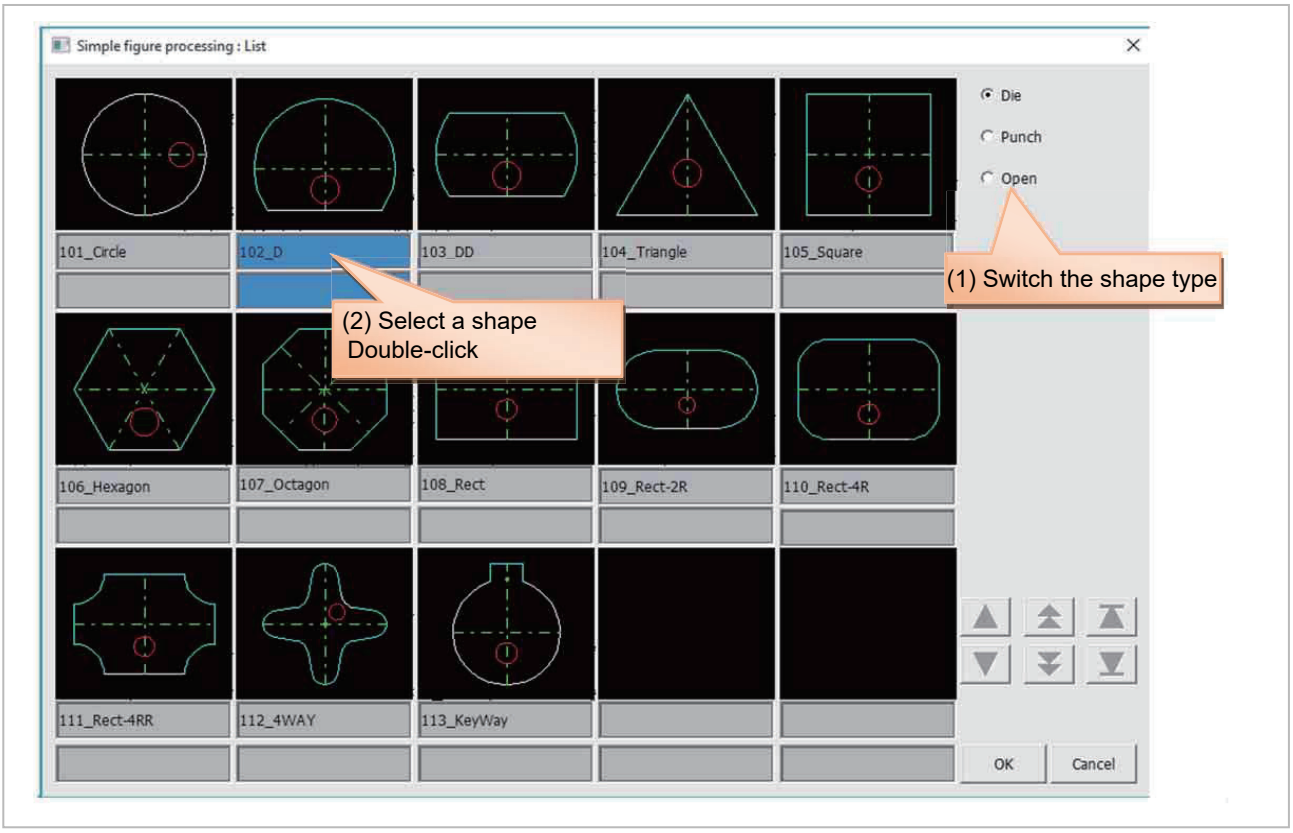
2) Perform machining condition search on the machining condition search screen, and automatically apply the searched machining condition to.

3) Create and start the NC program.

(2) Setting details

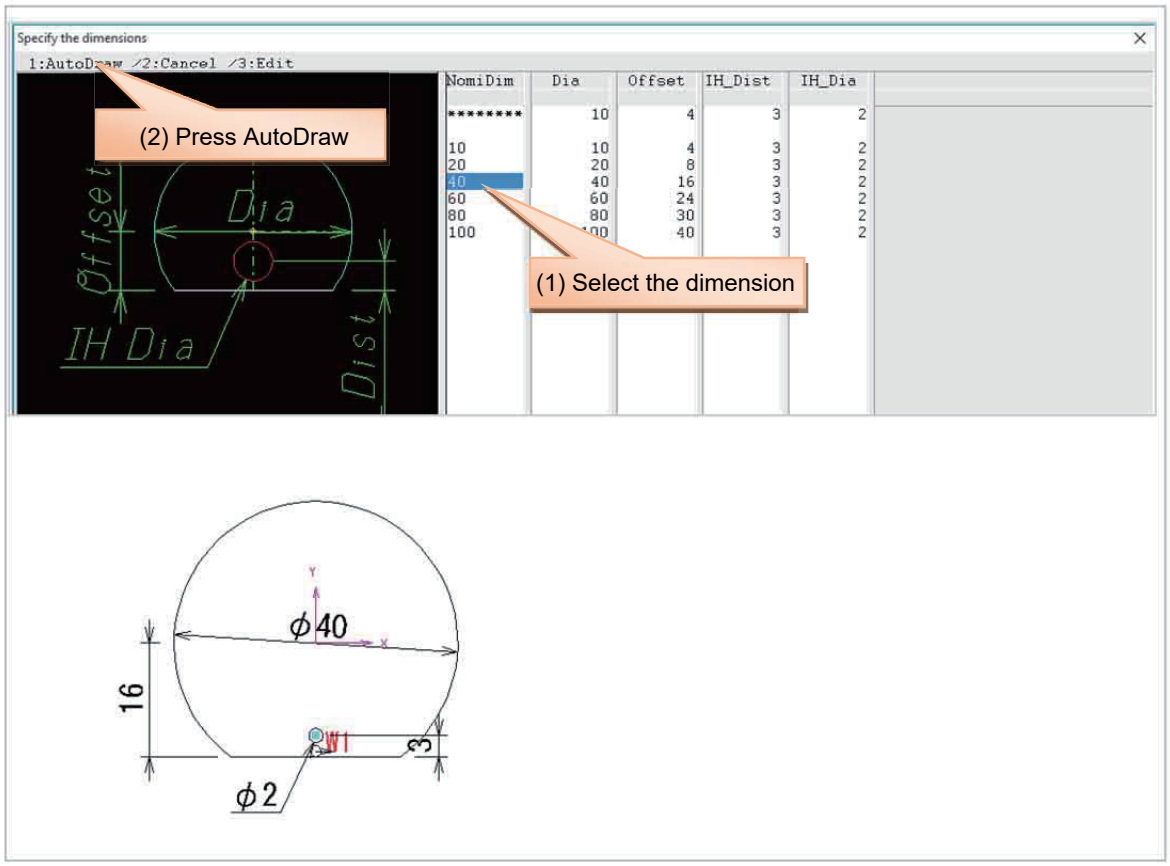
1) Initialization confirmation

When shapes exist on the CAD screen already, the initialization confirmation dialog box is started.
When "YES" is selected, the shape list screen is started **after initialization is completed**.
When "NO" is selected, the shape list screen is started **without initialization**.
When "Operation: Initialization Conf" has been changed from OFF on the [Setting of Simple Figure Proc] screen, the initialization confirmation dialog box will not start even if the CAD shape exits already.



2) "Specify the dimensions" screen

Start the "Specify the dimensions" screen corresponding to the shape selected on the "List" screen. Select dimensions in the dimension list, and use "1: AutoDraw" to draw a shape with the designated dimensions automatically. During automatic drawing, a red circle is used as the IH shape and a white shape is used as the approach shape to execute the wire machining definition automatically.

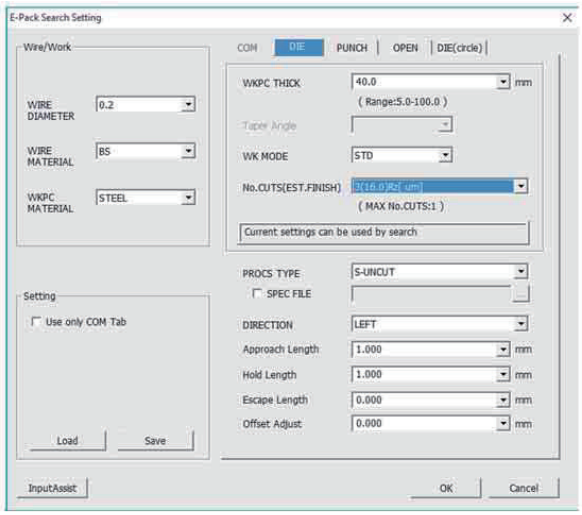


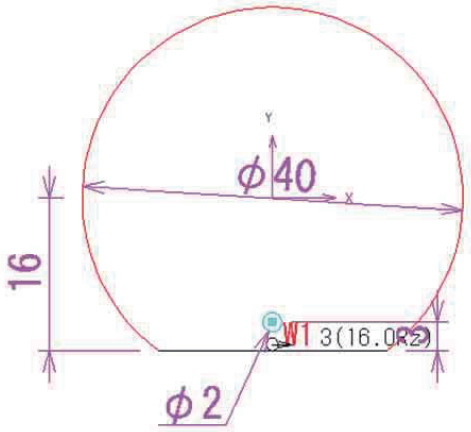
The dimension parameter indicating shape is on the right of the second item in the table, and "Nominal Dimension" of the first item is the name of dimension parameter combination.

The edit dimension list can be entered on this page through the keyboard. Lines can be added or deleted in the dimension table through the "3: Edit" menu. Additionally, the first line is used for operation. Automatic drawing can also be implemented after the dimension value is edited directly each time.

Machining condition search: Condition setting

Start the machining condition search screen. Set the search conditions of machining conditions, and click the "OK" button. The searched machining conditions will be applied to the machining definition automatically.

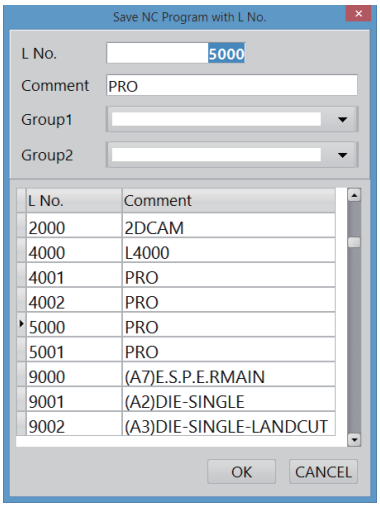





```
Select menu:
W1  (   DIE    ) [S-UNCUT                    ] Number of process 3(16.0Rz)
The retrieval ended normally
```

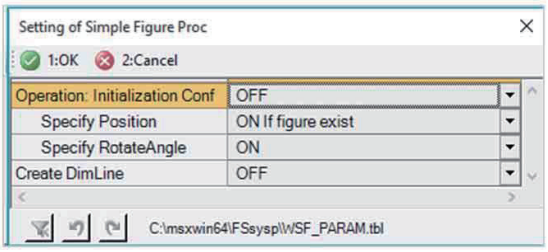
NC data generation: generating

Generate an NC program of simple shape machining. After the NC program is generated successfully, the system goes to the graphic screen of NC program.



Setting simple shape machining

Set "Initialization Conf", "Specify Position", "Specify RotateAngle" and "Create DimLine" for simple shape machining.



No	Item	Movement	
1	Operation: Initialization Conf	* ON	If the shape exists already before simple shape machining, the confirmation dialog box will be displayed, asking whether to initialize the drawing.
		OFF	**The initialization confirmation dialog box will not be started** even if the shape exists already. * "OFF" is recommended when the simple shape is used for machining of multiple shapes in many cases.
2	Specify Position	ON	The operation of using the mouse/keyboard to indicate the drawing position of machining shape is added. * "ON" is recommended for the application scenario where multiple shapes are processed.
		OFF	The machining shape is drawn automatically at the origin position.
		The * symbol in the table indicates the initial value.	If **the CAD shape does not exist on screen**, automatic drawing is performed at the **origin position**. When the CAD shape exists already, the position designation operation is added.
3	Specify RotateAngle	ON	Add the machining shape rotation operation after automatic drawing is completed.
		* OFF	When displayed in the shapelist (rotation angle = 0º), the machining shape is drawn automatically.
4	Create DimLine	* ON	The dimension line is **generated** during automatic drawing.
		OFF	The dimension line is **not generated** during automatic drawing.

The * symbol in the table indicates the initial value.

■ Restrictions

(1) Dimension line format

The dimension line in simple shape machining is generated according to "Number of decimal places = 3", "Clear mode = ON", "Character height = 4.5", and "Diameter size model = Any position of lead type".

(2) Dimension line of small radius

For the diameter dimension with a diameter less than 7 μm and the radius dimension with a radius less than 5 μm, the displayed dimension value is 0. Please redefine the dimension line manually.

7. EXPANSION

7.1 DNC

7.1.1 Summary

The DNC function links the Mitsubishi EDM NC to a host computer for program transfer, status monitoring, and remote operation. This manual covers the general NC protocol; see your host computer's manual for specific limits and examples.

⚠CAUTION

- **Prepare host software compatible with DNC, or use DNC via Mitsubishi Remote-Magic.**
- **Before remote starts, check surroundings, account for blind spots, and warn personnel. If a different operator is on-site, be extra cautious. During machine operation, set [REMOTE] to OFF to block remote control.**
- **Follow these notes and required standards to prevent accidents; installers must ensure operator safety.**

7.1.2 How to connect to the host computer

(1) Connection through LAN (one-to-one connection with the host computer)

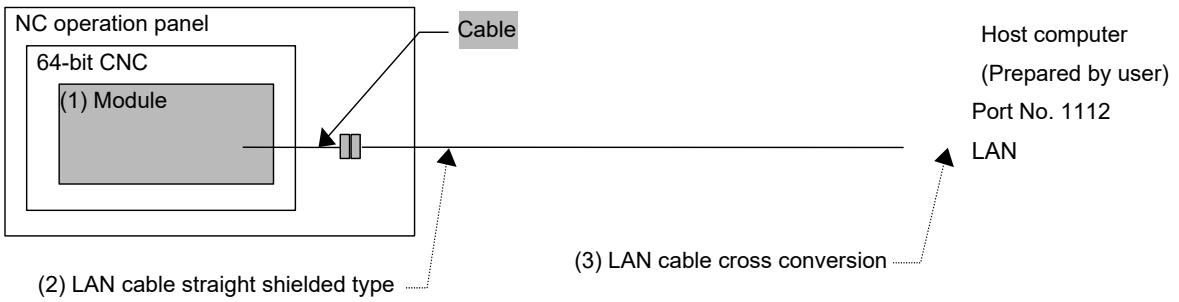


Fig. III.7.1

(2) Connection through LAN (connecting to the host computer through HUB)

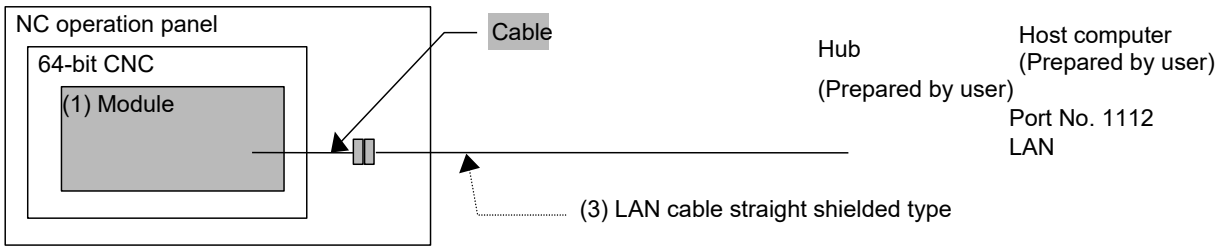


Fig. III.7.2

1. **indicates the parts attached to the DNC function.**
2. **indicates the parts prepared by the user.**
3. **No LAN cable is included. Make sure to use the cable of the following specs.**
   - **Cable of straight full connection type and equipped with a shielded coupler**
   - **Cable compatible with the category-5 cable standard (1000BASE-T compatible)**
   - **STP (4 shielded twisted pairs) cable**
4. **Use a shielded switching hub; do not use hubs with DC-IN adapters (to avoid interference).**
5. **Network conncection:**
   - **EDM is grounded at all times (refer to the "Grounding").**
   - **The HUB is connected to the power supply through the factory power supply socket. Do not connect to the machining power supply.**
   - **Keep network devices ~5 m away from the EDM.**
6. **Virus risk:**
   - **The EDM's HDD can be infected via the network, causing slow screens or file loss; recovery may require HDD replacement.**
   - **Do not install consumer AV on the machine; it can cripple performance. Instead, secure the connected PCs with antivirus and other protections.**

7.1.3 NC control method

(1) Control state conversion

DNC communication between NC (server) and host (client) has distinct stages/states: link off, operation not ready, command wait (reset), command execution (data wait/transmit), and alarm with different control codes, commands, and data formats for each.

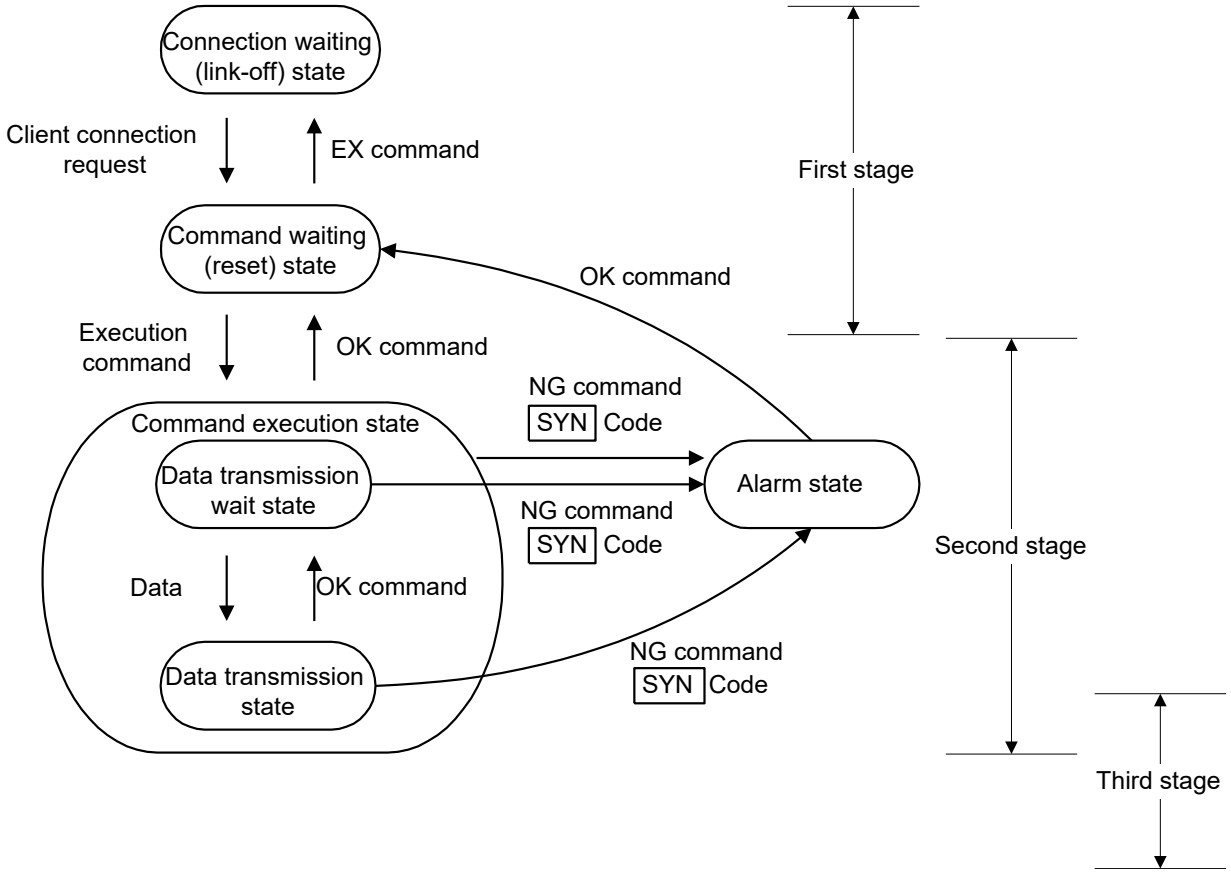


Fig. III.7.3

(2) Control codes

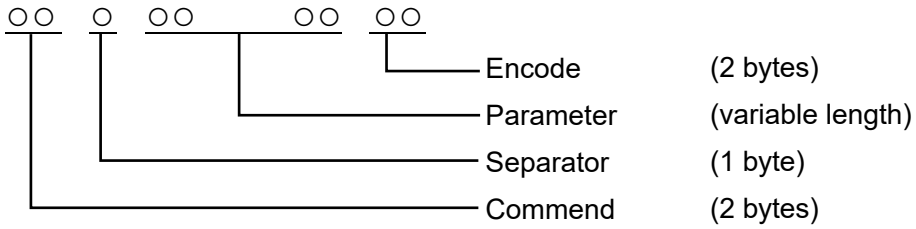
Code	Value	Description
SYN	16H	Host computer → NC Forced interruption of function in execution
CR LF	0DH 0AH	Host computer ←→ NC Command, parameter and data separation Used as a pair
%	25H	Host computer ←→ NC Data start and end codes

* DC1 and DC3 codes are control codes used during RS232C communication and do not need to be used in the LAN environment.

(3) Message

Information is either host > NC or NC > host and must follow the specified format requirements.

1) Format



(a) Command

It describes the message type. This command is also used to specify the command object action and response.

(b) Separator

Some commands have parameters. This indicates the separation between the command and parameter. Here, Δ (space code) is used as a separator.

(c) Parameter

Some commands have parameters. Its content format depends on the command. Details are provided below.

(d) End code

It indicates the end of the message. [CR] and [LF] are used as a pair.

2) Command

A command can be sent from the host computer only, and the NC responds to the command.

(a) Response sent from NC

(i) OK: operation completed

This notifies that the operation requested by the host computer has been completed. The information is also returned when the alarm processing is completed in the NC and the command wait state is entered.

(ii) NG: error occurred

Returned when the host's request can't be completed. The NG command includes a parameter indicating the error. After NC finishes error handling and is ready for new commands, it returns OK.

(b) List of commands sent from the host computer (for details, see the text below)

Category	Function	Command	Compatible with the 32-bit machine
NC program	Download	DL	○
	Upload	UL	○
	Erase	ER	○
	Program search	SR	○
	Specific L No. presence inquiry	LS	○
	Contents	DI	○
Variable	Download	HD	○
	Upload	HU	○
Machining conditions	Download	ED	× (*)
	Upload	EU	× (*)
Status	Get status	ST	○
Remote control	Remote control	RM	○
System	Error removal	[SYN]	○
	Communication disconnection	EX	○

The data format of the 64-bit machine is different from that of 32-bit machine, and they are incompatible.

(4) Data

Data includes NC programs and status exchanged between NC and host. Content is set by host commands. Formats vary, but the common format is as follows:

1) Format

%[CR][LF] ..... Data start

Data complying with the data format [CR][LF] → Separation of each data

| |

%[CR][LF] ..... Data end

2) Start and end of data

Start and end of data are separated by %[CR][LF]. The % code cannot be used in data. NC sending indicates %[CR][LF] of data end; sending OK [CR][LF] indicates end of data sending. Additionally, after receiving %[CR][LF], NC sends OK [CR][LF] to indicate end of data sending.

(5) Control in each stage

1) First stage

Connection establishment and disconnection between the NC and host computer

(a) Connection establishment

The host computer sends a connection request to the client.

The NC judges whether the connection can be established according to whether the Socket connection is open.

(b) Disconnection

The host computer sends the EX command.

2) Second stage

Sending an execution command moves NC from command-wait to execution. If data is required, NC enters data-reception wait. If not, it executes the command immediately.

(a) When carrying out data transmission

(i) When data is transmitted from the host computer to the NC

Host computer		NC
Command Δ (parameter) CR LF	→	
	←	OK CR LF Notifies that the data reception wait state has been entered.
% CR LF ..... % CR LF The host computer transmits the data immediately after receiving the OK command.	→	
	←	OK CR LF Notifies the completion of data reception.

(ii) When data is transmitted from the NC to the host computer

Host computer		NC
Command Δ (parameter) CR LF	→	
	←	OK CR LF Notifies the state of allowing data transmission
	←	% CR LF ..... % CR LF Continues data transmission
	←	OK CR LF Notifies the completion of data reception.

(iii) When data cannot be transmitted

NGΔ×× CR LF

→ Error No.

NC sends this to report an error and end its data processing. After handling the error and returning to command-wait, it sends the following message.

OK CR LF

(b) When data transmission is not carrying out

(i) At normal completion

Host computer		NC
Command Δ (parameter) CR LF	→	
	←	OK CR LF Notifies normal completion

(ii) When an error occurs

Host computer		NC
Command Δ (parameter) CR LF	→	
	←	NGΔ×× CR LF Notifies occurrence of an error
	←	OK CR LF Notifies normal completion

(c) Interrupting a command in execution

(i) Interrupting from the NC side

Host computer		NC
	←	NGΔ×× CR LF Notifies occurrence of an error
	←	OK CR LF Notifies normal completion

(ii) Interrupting from the host computer side

Host computer		NC
SYN Transmits the SYN code	→	
	←	OK CR LF Notifies interrupt processing completion

7.1.4 Function

(1) List of functions and commands

Category	Function	Command *1	Parameter*1*2	Data	Data format	Description	Use when the REMOTE switch is OFF *3
NC program	Download	DL	L Program No.	Host computer → NC	NC program format	Program No. is 1 to 8 digits	Allowed
	Upload	UL	Same as above	Host computer ← NC	Same as above		Allowed
	Erase	ER	Same as above	None			Allowed
	Program search	SR	Same as above	None		Program No. is 1 to 8 digits	Impossible
	Specific L No. presence inquiry	LS	Same as above	None			Allowed
	Contents	DI	None	NC ← Host computer	Contents format		Allowed
Variable	Download	HD	None	NC → Host computer	Variable format		Impossible
	Upload	HU	(None) or (H No. H No.)	NC ← Host computer	Same as above	Variable No. range can also be specified	Allowed
Machining conditions	Download	ED	None	NC → Host computer	Machining condition format		Impossible
	Upload	EU	(None) or (E No. E No.)	NC ← Host computer	Same as above	Machining condition No. range can also be specified	Allowed
Status	Status	ST	None	NC ← Host computer	Status		Allowed
Remote control	Remote control	RM	None	NC → Host computer	Remote control format		Impossible
System	Error removal	SYN	None	None			Allowed
	Communication disconnection	EX	None	None			Allowed

(*1) Commands and parameters are separated using Δ (space code).

(*2) If no parameter is contained, it changes to the format of command CRLF.

(*3) The [REMOTE] switch is located in the status switch on the switch screen and at the lower part of screen.
When operations are being carried out by the operator, the [REMOTE] switch must be turned OFF before operation for safety purposes.

(2) Explanation of each function

1) Download

(a) Command format

DL⊿L××××××××[CR][LF]

Program No. (1 digit to 8 digits)

(b) Function

It is used to specify the program No. from the host computer and transmit the NC program to NC.
If the same program No. exists at the NC side, an error message is returned from the NC to the host computer. Only one program can be transmitted with one command.

(c) Detailed explanation

	Host computer		NC
Normal completion	DL⊿L××××××××[CR][LF] Sends the command and program No.	→	
		←	OK[CR][LF] The "Reception Allowed" message is returned when a different No. exists.
	%[CR][LF] ××××××××/COMMENT[CR][LF] N001G01 ..... %[CR][LF] Transmits NC program	→	
		←	OK[CR][LF] Notifies that the reception has been completed normally and the next command is being awaited for
If the same number exists on the NC side	DL⊿L××××××××[CR][LF]	→	
		←	NG⊿××[CR][LF] An error message is returned if the specified program exists already
		←	OK[CR][LF] Notifies that the error processing has been completed normally and the next command is being awaited for
Forced end by the NC side	%[CR][LF] L××××××××/COMMENT[CR][LF] N001G01 ..... %[CR][LF] Transmitting NC program	→	
		←	NG⊿××[CR][LF] An error message is returned when the NC cannot receive it
		←	OK[CR][LF] Notifies that the error processing has been completed normally and the next command is being awaited for

	Host computer		NC
Forced end by the host computer	%CR LF L××××××××/COMMENT CR LF N001G01 ..... % CR LF Transmitting NC program	→	
	SYN Carries out interruption processing	→	
		←	OK CR LF Notifies that interruption processing has been completed and the next command is being awaited for

(d) Data format (NC program format)

%CR LF
L××××××××/××××××××
Comment
L No. (8 digits) (can be omitted)

NC Program

%CR LF

(i) The L number and comment specification is recognized only immediately after the first %CR LF. The content after it is processed as character strings purely.

(ii) Even if the L No. is designated on the top during downloading, the parameter behind the DL command is still preferred.

(iii) The L No. can also be omitted, and only the comment is specified.
<Example> COMMENT is processed as a comment in the following case:

%CR LF
/COMMENT
G90G92.....

2) Upload

(a) Command format

ULΔL××××××××CR LF
Program No. (1 digit to 8 digits)

(b) Function

Transmits the specified NC program from NC to the host. If the program number doesn't exist on the NC, an error is returned. One command sends one program.

(c) Detailed explanation

	Host computer		NC
Normal completion No designated program	ULΔL×××××××× CR LF Sends the command and program No.	→	
		←	OK CR LF Information that can be transmitted is returned when the designated program exists
		←	% CR LF L×××××××× /COMMENT CR LF N001G01 ..... % CR LF Transmits NC program
		←	OK CR LF Notifies that the reception has been completed normally and the next command is being awaited for
	ULΔL×××××××× CR LF	→	
		←	NGΔ×× CR LF An error message is returned if the designated program is not found
		←	OK CR LF Notifies that the error processing has been completed normally and the next command is being awaited for
Forced end by the NC side		←	% CR LF L×××××××× /COMMENT CR LF N001G01 ..... % CR LF Transmitting NC program
		←	NGΔ×× CR LF An error message is returned if transmission at the NC side fails
		←	OK CR LF Notifies that the error processing has been completed normally and the next command is being awaited for
Forced end by the host computer		←	% CR LF L×××××××× /COMMENT CR LF N001G01 ..... % CR LF Transmitting NC program
	SYN Carries out interruption processing	→	
		←	OK CR LF Notifies that interruption processing has been completed and the next command is being awaited for

3) Erase

(a) Command format

ER△L××××××××[CR][LF]

Program No. (1 digit to 8 digits)

(b) Function

Erases the specified NC program on the NC. If the program number doesn't exist, an error is returned. One command erases one program.

(c) Detailed explanation

	Host computer		NC
Normal completion	ER△L××××××××[CR][LF] Sends the command and program No.	→	
		←	OK[CR][LF] Erased successfully; notifies the next command waiting state
When erasing is not possible	ER△L××××××××[CR][LF]	→	
		←	NG△××[CR][LF] An error message is returned if the designated program cannot be erased
		←	OK[CR][LF] Notifies that the error processing has been completed normally and the next command is being awaited for

4) Search

(a) Command format

SR△L××××××××△N×××××△B××××CR LF

→ Block No. (1 to 4 digits) (can be omitted)

→ Sequence No. (1 to 5 digits) (cannot be omitted)

→ Program No. (1 to 8 digits) (cannot be omitted)

(b) Function

Searches for the specified program for automatic operation. If the program, sequence, or block number doesn't exist, or the program is running, an error is returned.

(c) Detailed explanation

	Host computer		NC
Normal completion	SR△L××××××××CR LF Sends the command and program No.	→	
		←	OKCR LF Search is completed normally and the next command waiting message is returned
When search cannot be completed	SR△L××××××××CR LF	→	
		←	NG△××CR LF An error message is returned if the designated program cannot be searched
		←	OKCR LF Notifies that the error processing has been completed normally and the next command is being awaited for

5) Query whether the specific L No. exists

(a) Command format

LS△L××××××××CR LF

→ Program No. (1 digit to 8 digits)

(b) Function

Checks whether the specified NC program exists on the NC. If not, an error is returned.

(c) Detailed explanation

	Host computer		NC
Existing	LS△L××××××××CR LF Sends the command and program	→	
		←	OK CR LF If the program exits, the next command waiting message is returned
Not existing	LS△L××××××××CR LF	→	
		←	NG△×× CR LF An error message is returned if the designated program is not found
		←	OK CR LF Notifies that the error processing has been completed normally and the next command is being awaited for

6) Contents

(a) Command format

DI[CR][LF]

(b) Function

It is used to send the NC program registration status in the NC to the host computer together with the comment.

(c) Detailed explanation

	Host computer		NC
Normal	DI[CR][LF] Sends the command	→	
		←	OK[CR][LF] The OK message is returned when the command is received
		←	%[CR][LF] 16000Δ×××Δ×××[CR][LF] 90000Δ..... [CR][LF] %[CR][LF] Transmits directory information. (The entire directory information is surrounded by %)
		←	OK[CR][LF] Notifies that directory information transmission has been completed and the next command is being awaited for
Abnormal	DI[CR][LF]	→	
		←	NGΔ××[CR][LF] The directory information getting failure message is returned
		←	OK[CR][LF] Notifies that the error processing has been completed normally and the next command is being awaited for
Forced end by the NC side		←	%[CR][LF] 16000 ..... Directory information being sent
		←	NGΔ××[CR][LF] An error message is returned if transmission at the NC side fails
		←	OK[CR][LF] Notifies that the error processing has been completed normally and the next command is being awaited for

	Host computer		NC
Forced end by the host computer		←	%[CR][LF] 16000..... Directory information being sent
	[SYN] Carries out interruption processing	→	
		←	OK[CR][LF] Notifies that interruption processing has been completed and the next command is being awaited for

(d) Data format (Directory format)

%[CR][LF]

16000Δ[Program No. of current registration]Δ[Remaining byte No.][CR][LF]

Δ[File size]Δ[File size]Δ[COMMENT][CR][LF]

→ The actual number of characters for 32-bit machine

⋮

%[CR]

(i) The first 16000 is fixed. (This number is the maximum program No. that can be registered on the 32-bit machine.)

(ii) Elements are separated using Δ (space code).

7) Variable downloading

(a) Command format

HD CR LF

(b) Function

It is used to send variable data from the host computer to the NC and set the variable value of the NC variable area.

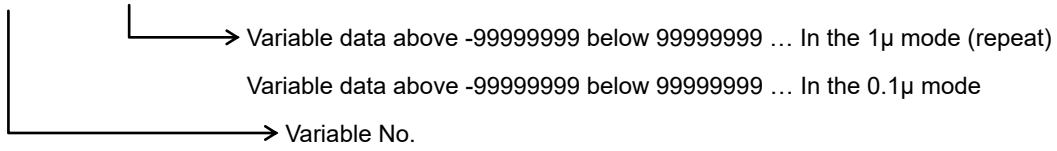
(c) Detailed explanation

	Host computer		NC
Normal transmission	HD CR LF Sends the command	→	
		←	OK CR LF The OK message is returned when downloading preparation is completed
	% CR LF H50 = 123.....% CR LF Transmits variable data	→	
		←	OK CR LF Completes variable value settings normally and notifies the next command waiting state
Forced end by the NC side	% CR LF H50 = 123..... Sending variable data	→	
		←	NGΔ×× CR LF An error message is returned when the NC cannot receive it
		←	OK CR LF Notifies that the error processing has been completed normally and the next command is being awaited for
Forced end by the host computer	% CR LF H50 = 123..... Sending variable data		
		←	OK CR LF Notifies that interruption processing has been completed and the next command is being awaited for

(d) Data format (Variable format)

%[CR][LF]

H×××××= ××××××××[CR][LF]



H×××××= ××××××××[CR][LF]

%[CR][LF]

(i) Including the minus sign and decimal point; the variable data has 9 digits at most in the 1 μ mode.

(ii) The following variable No. can be designated
· H1 to H900
· H20001 to H20900 (however, do not change the contents of the manufacturer's dedicated area)

(iii) Downloadable during automatic operation

8) Variable uploading

(a) Command format

HU△H×××△H××× CR LF

Parameter 2 (variable number at the end of uploading. Can be omitted)

Parameter 1 (variable number at the start of uploading. Can be omitted)

(*) When parameter 2 is omitted, one variable will be uploaded
When both parameters 1 and 2 are omitted, all the variables will be uploaded

(b) Function

The NC uploads the variables of designated range or all the variables to the host computer.

(c) Detailed explanation

	Host computer		NC
Normal transmission - All Variables	HU CR LF Sends the command	→	
		←	OK CR LF Returns the acceptable command message
		←	% CR LF H1 = 1..... H900 = 0 CR LF % CR LF Transmits variable data
		←	OK CR LF Notifies that the transmission has been completed normally and the next command is being awaited for
Normal transmission - Designated range	HU△H100△H200 CR LF Sends the command (in the case of H100 to H200)	→	
		←	OK CR LF ← Returns the message of command that can be sent
		←	% CR LF H100 = 1..... H200 = 0 CR LF % CR LF Transmits variable data
		←	OK CR LF Notifies that the transmission has been completed normally and the next command is being awaited for

	Host computer		NC
Forced end by the NC side		←	%[CR][LF] H50 = 123 ..... Sending variable data
		←	NGΔ××[CR][LF] An error message is returned if transmission at the NC side fails
		←	OK[CR][LF] Notifies that the error processing has been completed normally and the next command is being awaited for
Forced end by the host computer		←	%[CR][LF] H50 = 123 ..... Sending variable data
	[SYN] Carries out interruption processing	→	
		←	OK[CR][LF] Notifies that interruption processing has been completed and the next command is being awaited for

(i) Selectable variable No.
Same as variable download, except H20001–H20900 are maker?reserved and cannot be changed.

(ii) Restrictions
Sending only the variable upload command returns common variables. If the start/end numbers are not selectable, an error occurs. If both are selectable, only those variables are uploaded.

< Example >

HUΔH900ΔH20000[CR][LF] .....NG response

HUΔH900ΔH20001[CR][LF] .....OK response (sending H900 and H20001)

HUΔH3412ΔH3420[CR][LF] .....NG response

9) Machining condition downloading

(a) Command format

ED CR LF

(b) Function

The NC downloads machining condition data from the host computer.

(c) Detailed explanation

	Host computer		NC
Normal transmission	ED CR LF Sends the command	→	
		←	OK CR LF The OK message is returned when downloading preparation is completed
	% CR LF Machining condition data ..... Transmitting machining condition data	→	
		←	OK CR LF Machining conditions are set correctly and the next command waiting message is returned
Forced end by the NC side	% CR LF Machining condition data ..... Transmitting machining condition data	→	
		←	NGΔ×× CR LF An error message is returned when the NC cannot receive it
		←	OK CR LF Notifies that the error processing has been completed normally and the next command is being awaited for
Forced end by the host computer	% CR LF Machining condition data ..... Transmitting machining condition data	→	
	SYN Carries out interruption processing	→	
		←	OK CR LF Notifies that interruption processing has been completed and the next command is being awaited for

(d) Data format (Machining condition format: dedicated to the 64-digit machine)

The output is CSV. The domain name is in the first line, the data arrangement is corresponding to the domain name arrangement, and only the necessary items need to be designated.

*** E500 to E6999 are conditions provided by the maker. Do not change their content.**

10) Machining condition uploading

(a) Command format

EU CR LF

EUΔE××××ΔE×××× CR LF

Parameter 2 (E-Pack No. at the end of uploading. Can be omitted)

Parameter 1 (E-Pack No. at the start of uploading. Can be omitted)

(*) When parameter 2 is omitted, one E-Pack will be uploaded.
When both parameters 1 and 2 are omitted, all E-Packs will be uploaded.

(b) Function

It is used to upload the machining condition data in the designated scope or all the machining condition data from the NC to the host computer. No error will be reported even if there is no data, but the data is blank.

(c) Detailed explanation

	Host computer		NC
Normal transmission - All machining conditions	EU CR LF Sends the command	→	
		←	OK CR LF Returns the machining condition information that can be transmitted
		←	% CR LF Machining condition data CR LF % CR LF Transmits machining condition data
		←	OK CR LF Notifies that the transmission has been completed normally and the next command is being awaited for
Normal transmission - Designated range	EUΔE1ΔE123 CR LF Sends the command (in the case of E1 to E123)	→	
		←	OK CR LF Returns the machining condition information that can be transmitted
		←	% CR LF Machining condition data CR LF % CR LF Transmits machining condition data
		←	OK CR LF Notifies that the transmission has been completed normally and the next command is being awaited for

	Host computer		NC
Normal transmission - No designated condition	EUΔE1ΔE123 CR LF Sends the command (in the case of E1 to E123)	→	
		←	OK CR LF Returns the machining condition information that can be transmitted
		←	% CR LF % CR LF Transmits non-machining condition data (no data between % CR LF)
		←	OK CR LF Notifies that the transmission has been completed normally and the next command is being awaited for
Forced end by the NC side		←	% CR LF Machining condition data ..... Transmitting machining condition data
		←	NGΔ×× CR LF An error message is returned if transmission at the NC side fails
		←	OK CR LF Notifies that the error processing has been completed normally and the next command is being awaited for
Forced end by the host computer		←	% CR LF Machining condition data ..... Transmitting machining condition data
	SYN Carries out interruption processing	→	
		←	OK CR LF Notifies that interruption processing has been completed and the next command is being awaited for

11) Machining condition downloading

(a) Command format

ST CR LF

(b) Function

It is used to send the NC running status to the host computer.

(c) Detailed explanation

Data is reported once each time it is started from the host computer. Therefore, the host computer needs to start regularly when data needs to be reported periodically.

	Host computer		NC
Normal	ST CR LF Sends the command	→	
		←	OK CR LF ← Returns the message of command that can be sent
		←	% CR LF 0Δ CR LF 1Δ Data CR LF Õ 9Δ Data CR LF % Data Transmits NC status (The entire operating status is surrounded by %)
		←	OK CR LF Notifies that the transmission has been completed normally and the next command is being awaited for
Abnormal	ST CR LF	→	
		←	NGΔ×× CR LF If the status cannot be obtained, an error is returned.
		←	OK CR LF Notifies that the error processing has been completed normally and the next command is being awaited for

(d) Data format (Status format)

<table>
<tr><th>Code</th><th>Data</th><th>Function</th></tr>
<tr><td>0</td><td>Indicated by a decimal value</td><td>Status
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>During setup</td><td>During program operation</td><td></td><td></td><td></td><td></td><td></td><td></td><td>Go to...</td><td>Machining</td><td>Program stop</td><td>Program end</td><td>Stop</td><td>Start</td><td>Alarm</td><td>Preparation start</td></tr>
</table>
bit
(Note) The blank areas are ignored.</td></tr>
<tr><td>1</td><td>Indicated by a decimal value</td><td>L No. ☐</td></tr>
<tr><td>2</td><td>Indicated by a decimal value</td><td>N No. ☐</td></tr>
<tr><td>3</td><td>Indicated by a decimal value</td><td>B No. ☐</td></tr>
<tr><td>4</td><td>Indicated by a decimal value</td><td>Alarm No. ☐ Δ ☐ Δ ☐
0 indicates no error.</td></tr>
<tr><td>5</td><td>Indicated by a decimal value</td><td>Stop No. ☐</td></tr>
<tr><td>6</td><td>Indicated by a decimal value</td><td>Remaining machining time ☐ Δ ☐ Δ ☐</td></tr>
<tr><td>7</td><td>Indicated by a decimal value</td><td>Wire remaining time ☐ Δ ☐ Δ ☐</td></tr>
<tr><td>8</td><td>Indicated by a decimal value</td><td>
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Automatic mode</td><td>Manual mode</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0.1μ mode</td></tr>
</table>
bit
1μ mode when 0 is set
(Note) The blank areas are ignored.</td></tr>
<tr><td>9</td><td>Indicated by a decimal value</td><td>
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Wire ON</td><td>Dielectric fluid ON</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
bit
(Note) The blank areas are ignored.</td></tr>
</table>

12) Remote control

(a) Command format

RM[CR][LF]

(b) Function

It is used to transmit the data equivalent to that entered on the NC by the keyboard and implement the remote control of NC.

(c) Detailed explanation

	Host computer		NC
Normal	RM[CR][LF] Sends the command	→	
		←	OK[CR][LF] Returns the acceptable command message
	%[CR][LF] Code△[Data][CR][LF] | Code△[Data][CR] %[CR][LF] Sends remote control content (The entire remote control contents are surrounded by %)	→	
		←	OK[CR][LF] Remote control is completed normally and the next command is being awaited for
Abnormal	RM[CR][LF]	→	
		←	NG△××[CR][LF] The remote control establishment failure message is returned
		←	OK[CR][LF] Notifies that the error processing has been completed normally and the next command is being awaited for
Forced end by the NC side	%[CR][LF] 0△1..... Sending remote control content	→	
		←	NG△××[CR][LF] An error message is returned when the NC cannot receive it
		←	OK[CR][LF] Notifies that the error processing has been completed normally and the next command is being awaited for

	Host computer		NC
Forced end by the host computer	%CR LF 0△1..... Sending remote control content	→	
	SYN Carries out interruption processing	→	
		←	OKCR LF Notifies that interruption processing has been completed and the next command is being awaited for

(d) Data format (remote control format)

Code	Data	Function
0	1	Reset
1	1	Manual mode
	2	Automatic mode
3	1	Dielectric fluid ON
	2	Wire ON
	4	Machining ON
4	1	Stop (manual/automatic)
	2	Start (manual/automatic)
13	1	Dielectric fluid OFF
	2	Wire feed OFF
	4	Machining OFF
		Note) Code: a decimal value (0 to 255) Data: a decimal value (0 to 255) If the conditions are not met and the desired remote control cannot be performed, NG△13CR LF is returned.

⚠CAUTION

- **Check the machine surroundings (people, objects) before starting via remote. Be cautious if the on-site operator differs from the remote operator. Mind camera blind spots and warn sufficiently. During machine operation, set [REMOTE] OFF on the switch screen to prevent remote control.**
- **Remote control works only in automatic mode; in manual mode, error "NG13" is reported.**
- **Set "REMOTE" ON on the EDM before remote control and ensure nearby personnel safety.**
- **When "START" is executed remotely, the buzzer sounds for 5 s regardless of its switch. START executes and the LED turns on after the buzzer stops. If "STOP" or "RESET" is pressed while the buzzer sounds, the remote "START" is suspended, "NG13" is returned, and "REMOTE" turns OFF. If "REMOTE" is set to OFF while the buzzer sounds, the remote "START" is also suspended and "NG13" is returned.**
- **The remote control function remains valid when "KEY LOCK" is ON.**

(3) Error No. list

Error No.	Description	Details	Generated Commands
1	Illegal command format	The NC cannot recognize the command	All
2	Incorrect parameter value	The parameter sent to the NC together with the command is incorrect, or the parameter scope is wrong	All
3	Transmission error	Communication error	All
4	Execution not possible	NC cannot execute the received command (DNC operations are limited by the operating status of NC)	All
5	File access not possible	Machining condition, variable or program is locked and cannot be edited	DL, ER, HD, ED, MD
6	Not used	Reserved 32-digit machine No. (program number overflow)	
7	Program name duplicated	An existing program in NC is designated	DL
8	Stored files	Exceeding the storage capacity of NC	DL
9	No program name	Designated program does not exist in NC	UL, ER, SR, LS, RS
10	Not used	Not used	All
11	Search cannot be started	The NC side cannot receive the search command	SR
12	Link not possible	The "REMOTE" switch of NC is set to OFF	SR, HD, ED, MD, RM
13	Remote control failure	The NC side cannot receive the remote control information	RM
14	Not used	Not used	
15	Illegal address	An illegal address was designated	MR
16	During program operation	When system variable downloading is tried during program operation	HD
17	No keyword field	No keyword field was designated in the field line	ED
18	Field definition error	An illegal field name was designated in the field line	ED
19	Field line error	Other field line errors	ED
20~	MISCELLANEOUS	Errors occurred during processing	All

7.2 FTP

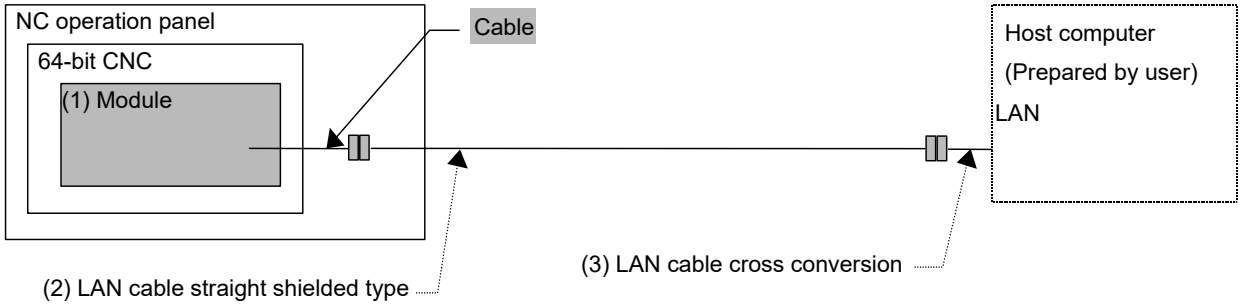
7.2.1 Summary

The FTP function transfers NC programs and other data between the Mitsubishi EDM NC and a host (FTP server) over Ethernet. This manual covers the NC; see your FTP server's manual for its limits and usage.

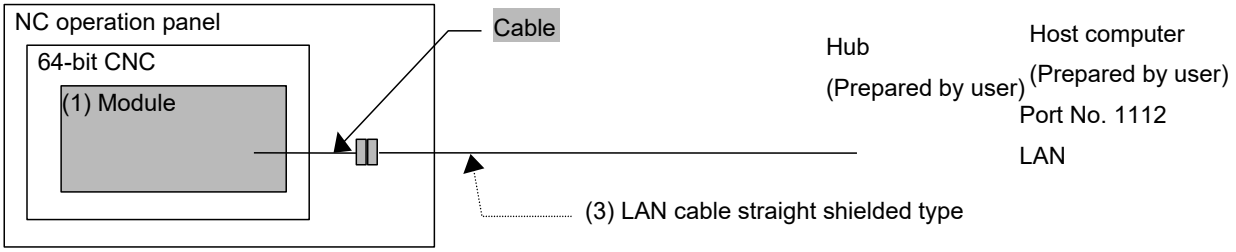
The FTP server software on the host computer must be prepared by the user.

7.2.2 How to connect to the host computer

(1) Connection through LAN (one-to-one connection with the host computer)



(2) Connection through LAN (connecting to the host computer through HUB)



1. ▒▒▒ indicates the parts attached to the DNC function.
2. ⌊ ⌋ indicates the parts prepared by the user.
3. No LAN cable is included. Make sure to use the cable of the following specs.
   - Cable of straight full connection type and equipped with a shielded coupler
   - Cable compatible with the category-5 cable standard (1000BASE-T compatible)
   - STP (4 shielded twisted pairs) cable
4. Use a shielded switching hub; do not use hubs with DC-IN adapters (to avoid interference).
5. Network conncection:
   - EDM is grounded at all times (refer to the "Grounding").
   - The HUB is connected to the power supply through the factory power supply socket. Do not connect to the machining power supply.
   - Keep network devices ~5 m away from the EDM.
6. Virus risk:
   - The EDM’s HDD can be infected via the network, causing slow screens or file loss; recovery may require HDD replacement.
   - Do not install consumer AV on the machine; it can cripple performance. Instead, secure the connected PCs with antivirus and other protections.

7.2.3 How to set the host computer

Press the wizard button to hide some menus. To use FTP on the EDM, start the FTP server on the host. On Windows, you can use Microsoft's IIS FTP server (not installed by default on XP). Other FTP servers are also supported, follow their manuals for installation.

7.2.4 EDM setting method

Set the necessary parameters of EDM.
Select "Initial settings" > "System update" > "FTP".
Click "FTP TYPE" at the bottom right of the dialog that appears, and configure the settings on the following screen.

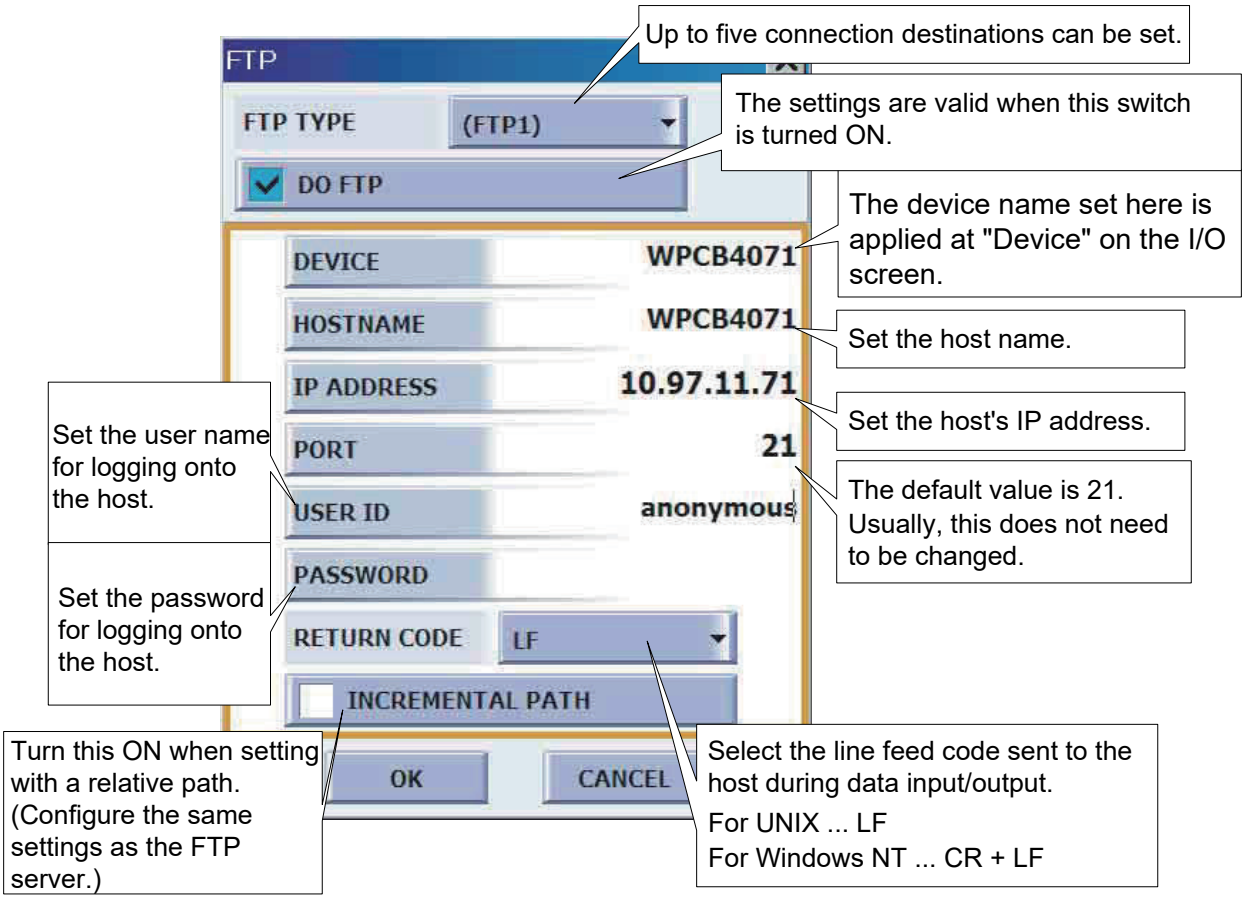


Fig. III.7.4

The host name, IP address, user ID, password, etc., must be decided by the user.

7.2.5 Function

(1) FTP client functions

Connect to the FTP server to transfer files via Data I/O. Supported items include: NC programs, variables, E-Packs, soft limits, work offsets, die parameters, cutting blade parameters, origins, pitch error, lost motion, servo parameters, system constants/timers, parameters, and backlash.

7.3 Intelligent service

The intelligent service button is used to output all kinds of information in the EDM system to HD.
The collected information is helpful to the maintenance service.
To use the intelligent service, select "History management" > "File management" > "SmartService".

7.3.1 Data collection flow

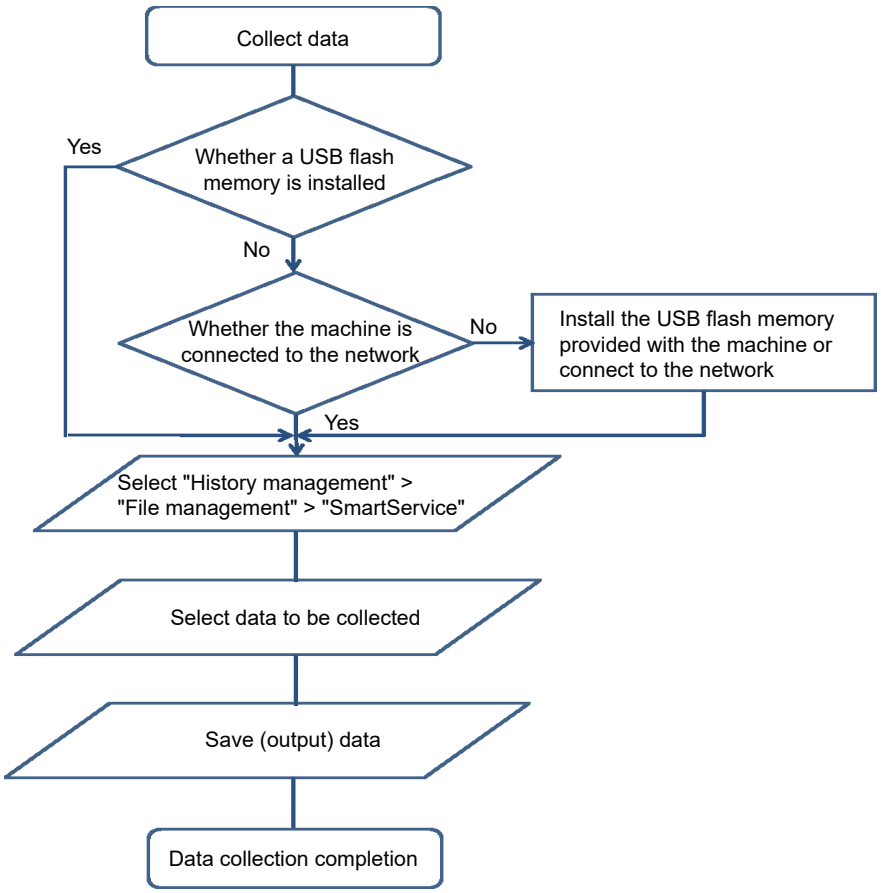


Fig. III.7.5

7.3.2 Data collection procedure

(1) Make sure that the USB flash memory is inserted into the machine or connected through the LAN.

(2) Select "History management" > "File management" > "SmartService".

(3) Select the type of data to be collected, and click the "CreateData" button.

Fig. III.7.6

1) Data type

(a) Watch data

Watch data collects periodic machine and operation counts. If you uncheck it during generation, CreateData is disabled.

(b) Replay data

Collects data needed to report EDM issues to the service center. Use when instructed by Mitsubishi Service. Uncheck “Include NC program” and “Include E-Pack” to exclude NC and machining conditions.

(c) Test data

The after-sales service personnel will collect the running test data when providing door-to-door service. (Data used by the after-sales service personnel)

(d) After data is generated, click the "SaveData" button to save data.

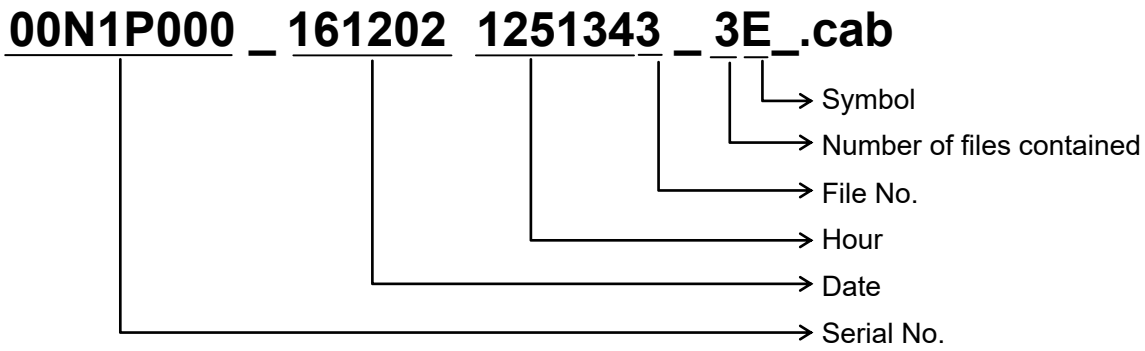
Click SaveData, choose a path, and click “OK” to save a CAB file.

- For USB, select the removable drive under "Look In".
- For LAN, select the network path under “Network” in “Look In”.
- If saved to Drive D, copy it later to USB or a network PC using file browsing

2) About the CAB file

(a) File name

For the generated CAB file, the file name should comply with the following rule.



CAB file name rule

Item	Explanation
Machine No.	Indicates the Machine No.
Date/time	Year, month, date, hour, minute, and second are indicated in two digits respectively. (For all the date formats, the file name is arranged in the sequence of year, month, date, hour, minute and second.)
File No.	When the CAB file is divided into multiple files, it is used to indicate the number of the file according to the dividing sequence. This number is omitted for the first file.
Number of contained files	Indicates whether the CAB file will be divided.
Symbol	Indicates the type (content) of data contained in CAB.

(b) Data content in the CAB file

The last symbol (letter) of the CAB file name indicates the type of data contained in this file.

Content and symbol of CAB file

Symbol	Regular monitoring	Phenomenon reproduction	Test
N	○	-	-
E	○	○	-
A	○	○	○
T	○	-	○

IV. PROGRAMMING

BRN-83587-004-*-002

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1. INTRODUCTION

This chapter covers NC programming including codes and simple examples.

Metric	Normal mode	× 1000	Move 1000 μm
		Move × 1.01 mm	
	× 0.1 mode	× 1000	Move 100 μm
		Move × 1.01 mm	
Inch	Normal mode	× 1000	Move 0.1 inch
		Move × 1.01 inch	
	× 0.1 mode	× 1000	Move 0.01 inch
		Move × 1.01 inch	

"× 0.1" specifying method

(1) Press "EMERGENCY STOP" and turn off [READY].

(2) In the main menu, select "Initial settings" > "Machine parameters" > "Machining settings" > "Auto setting 3", and turn the "× 0.1 " switch ON.

(3) Press "POWER OFF" → "POWER ON" → [READY].

(4) After the above steps are performed, the machine operates in the × 0.1 mode.

(5) To return to the normal mode, perform step 1 to 3 and turn OFF "× 0.1".

2. PROGRAMMING PROCEDURE

The numerical control unit is used to issue numeric control information (NC program) and control the machines that were conventionally operated manually.

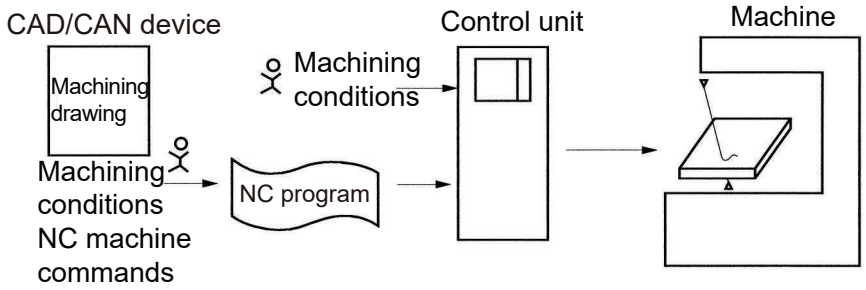


Fig. IV.2.1

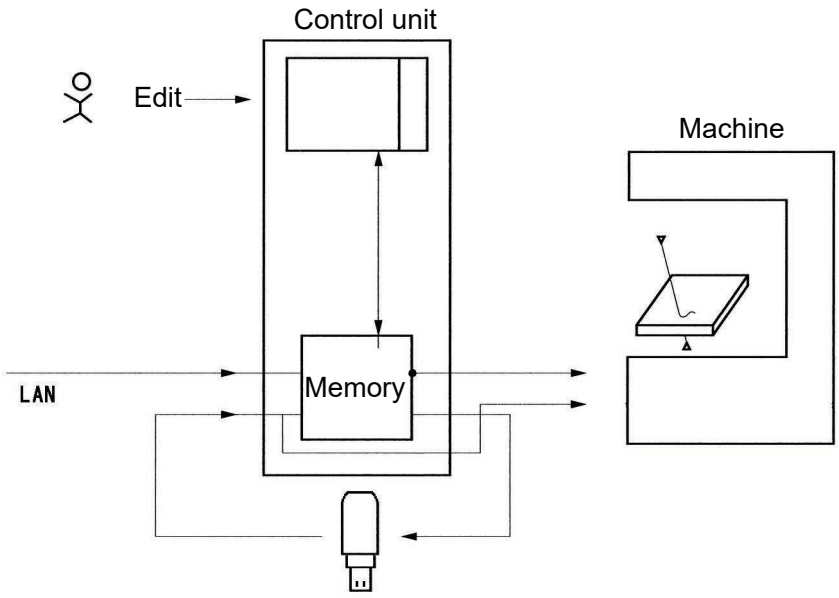


Fig. IV.2.2 Input/output device (USB flash memory)

3. PROGRAM FORMAT

3.1 Program Codes

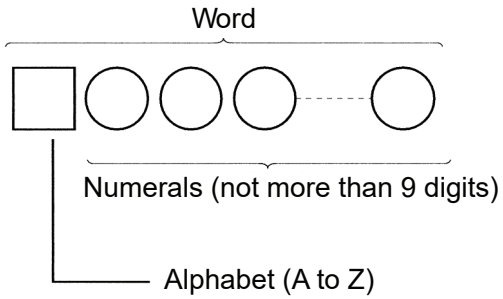
The command consists of alphabets (A to Z), numbers (0 to 9), and symbols (+, -, /, etc.), referred to as characters. Patterns made up of these characters are called codes.

3.2 Program Format

The control uses a predefined program format called the word-address format.

3.2.1 Words and addresses

A word is a meaningful unit the control uses to execute an operation. It consists of one letter followed by up to 9 digits (optionally with a leading + or ?).



For the types and valid numbers of digits of words used for the control unit, see "3.6 Address Command Format List" in this chapter.

3.2.2 Block

A block is a set of words forming one command, ending with EOB (end of block). Max length: 248 characters.

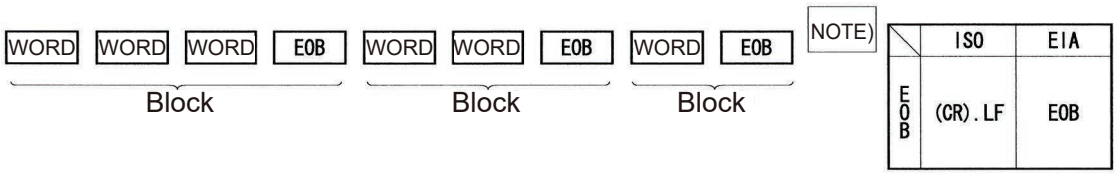


Fig. IV.3.1

3.2.3 Program

A group of blocks forms a program.

1. **The wire offset number is specified by the H address. (H1 to H900)**
2. **All leading zeroes can be omitted. (X000100 → X100)**
3. **Command the program number as a single block at the beginning of each program.**

3.2.4 NC program specs

(Output from the control unit)……USB flash memory and HDD
The NC data output status is shown below:

(1) NUL to NUL%NUL to NUL CR LF ····· Head 1 block
(2) L4444/SAMPLE CR LF ····· Output L No. (header)
(3) ····· NC instruction
(4) M02 CR LF
(5) NUL to NUL%NUL to NUL CR LF ····· End block

3.3 Special Codes

3.3.1 EOB (;) code

The EOB code is used to define the end of the block.

3.3.2 EOR (%) code

Generally, EOR (End Of Record) is a code that indicates the separation of one program.

When there is no program end code (M02 or M30) in the program, the EOR (%) code at the end of the program is treated as M02.

3.3.3 Significant information interval (label-skip function)

When the power is turned ON or reset during automatic operation, saving to the memory, or the search operation, the information up to the first EOB code in the NC program is ignored.

3.3.4 Control out and control in comments (Putting comments)

The control unit ignores all information between control out "(" and control in ")" or "EOB".

3.3.5 Block delete

/ (slash code)

(1) A leading “/” makes a block skippable: with “BLOCK DELETE” “ON”, the block is ignored; with “BLOCK DELETE” “OFF”, it runs.

(2) At a program’s start, L○○○○/×××× is ignored during automatic operation and used as an input L number for data I/O. Elsewhere, it causes an automatic operation error and is treated as a data I/O L number.

3.4 Input Setting Unit

3.4.1 Minimum input setting unit

This is the minimum unit for movement commanded with the machining program. It is expressed in units of mm and inch.

3.4.2 Minimum movement unit and maximum command values

These are the minimum units for the movement command issued to the machine and for the position detection.

Table IV.3.1 (Normal mode)

	Minimum input setting unit	Maximum command value
Metric system	0.001 mm	99999.999 mm
Inch system	0.0001 inch	9999.9999 inch

Table IV.3.2 (× 0.1 mode)

	Minimum input setting unit	Maximum command value
Metric system	0.0001 mm	99999.9999 mm
Inch system	0.00001 inch	9999.99999 inch

1. **The minimum movement unit refers to the movement command unit to the machine and the position detection unit, and does not guarantee the machine movement at that unit.**
2. **When a program is executed with an inch command, an error of ±0.0001 (normal mode) or ±0.00001 (× 0.1 mode) inches could occur on the display. This is an error on the display and is not cumulated.**
3. **The inch/metric unit is changed with the "INCH" switch displayed by selecting "Initial setting" > "Machine parameters" > "Machining setting" > "Auto3".**
   This switch can be set only when ready is OFF. After changing between inch/metric unit, always press

(system shut down) and then press

.

3.5 Decimal Point

3.5.1 Function and purpose

In the machining program input information that defines the tool path, distance, speed, etc., a decimal point command that issues a mm (metric) or inch unit zero point can be input.

3.5.2 Command format

	Normal mode	× 0.1 mode
Metric system	○○○○○.○○○	○○○○○.○○○○
Inch system	○○○○○.○○○○	○○○○.○○○○○

3.5.3 Detailed explanation

(1) The decimal point command is valid for commands.

(2) Addresses where the decimal point command is valid are A, B, F, G, I, J, K, Q, R, S, U, V, X, Y, and Z.

(3) The valid number of digits in the decimal point command is as follows:
Metric system: Integer section 0 to 99999, decimal section 0 to 999 (normal mode)
0 to 9999 (× 0.1 mode)
Inch system: Integer section 0 to 9999, decimal section 0 to 9999 (normal mode)
0 to 99999 (× 0.1 mode)

(4) The decimal point command is valid for variable data definition commands used in the subprogram, etc.

(5) Minimum command units (decimal-point addresses):
- Metric: 0.001 mm (Normal), 0.0001 mm (×0.1)
- Inch: 0.0001 in (Normal), 0.00001 in (×0.1)

3.5.4 Program example

(Example 1) X123.45 (123.45 mm in the metric system)
(Example 2) H50 = 123.45H51 = 5.555
(For metric system)
XH50 YH51 → X123.45Y5.555

{ X123450 Y5555 (normal mode)
X1234500Y55550 (× 0. 1 mode) } Equivalent to

(Example 3) X123.45 (123.45 inch)

{ X1234500 (normal mode)
X12345000 (× 0. 1 mode) } Equivalent to

3.6 Address Command Format List

(Abbreviations are in accordance with JIS B 6313)

Address	Unit	Maximum value	Abbr.	Remarks	Decimal point validity	Data in absolute value
A	0.0001° or 1"	±600000	A + 54	Taper angle specification, user macro	○	
B	0.0001°	±99999999	B + 54	Movement coordinate value, user macro	○	
C				User macro	○	
D			(Note 1)	User macro (=)	○	
E	Integer	Remarks (Note 2)	E4	Electrical machining condition Program errors occur for other than specific values.		○
F	0.001 mm/min 0.0001 inch/min	9999999	F54	Machining speed command value	○	○
G	Integer	Remarks (Note 3)	G31	Preparatory function Program errors occur for other than specific values.	○	○
H	Integer	Remarks (Note 4)	H4	NC program Variable specification, sequence numbers (When a subprogram is called)		○
I	0.001 mm 0.0001 inch	±99999999	I + 54	Circular arc X-axis auxiliary axis	○	
J	0.001 mm 0.0001 inch	±99999999	J + 54	Circular arc Y-axis auxiliary axis	○	
K	0.0001°	±360.0000	K + 54	Coordinate rotation angle	○	
L	Integer	99999999	L8	Program number (L number)		○
M	Integer	Remarks (Note 5)	M2	Auxiliary function Program errors occur for other than specific values.		○
N	Integer	99999	N5	Sequence number		○
P	Integer	30000	P5	Edge detection speed with number of subprogram repetitions, compensation number (G43), G29, or G30, zero point number with G48	○	○
Q	0.001 mm or 0.0001 inch	99999999	Q54	Taper Z5 plane circular arc radius	○	
R	0.001 mm or 0.0001 inch	±99999999	R + 54	R specification circular arc radius, coordinate rotation angle (G05, G29, G30), compensation amount (G43)	○	
S	0.001 times	99999999	S53	Figure magnification	○	○
T	-	-	-	Use prohibited address		
U	0.001 mm 0.0001 inch	±99999999	U + 54	Movement coordinate value	○	
V	0.001 mm 0.0001 inch	±99999999	V + 54	Movement coordinate value	○	
X	0.001 mm 0.0001 inch	±99999999	X + 54	Movement coordinate value	○	

Address	Unit	Maximum value	Abbr.	Remarks	Decimal point validity	Data in absolute value
Y	0.001 mm 0.0001 inch	±99999999	Y + 54	Movement coordinate value	○	
Z	0.001 mm 0.0001 inch	±99999999	Z + 54	Taper parameter, Movement coordinate value	○	

4. PROGRAM NUMBER L

A program number is set with an address followed by a number with a maximum of 8 digits.

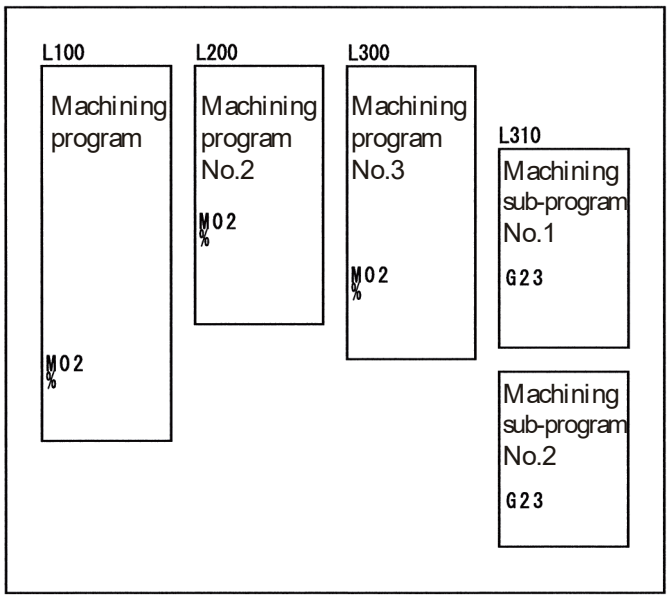


Fig. IV.4.1

L numbers are used to identify different NC programs.

A sequence number is set with address N followed by a number with a maximum of 5 digits. Sequence number N is independent of program number L (Fig. IV.4.2).

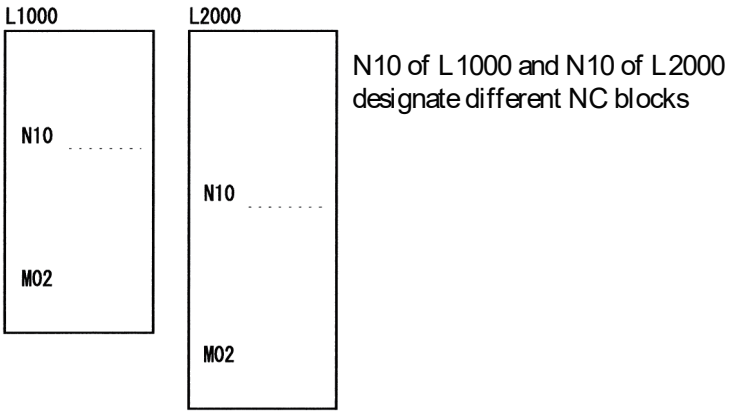


Fig. IV.4.2

The block number returns to zero after reaching 9999.
Thus, when performing control that uses L, N, and block numbers, always command sequence number N within 10000 blocks.

- **Controls using L, N, and block numbers**
  - **Automatic wire breakage return**
  - **Search (when using the block number)**
  - **Automatic power failure recovery**

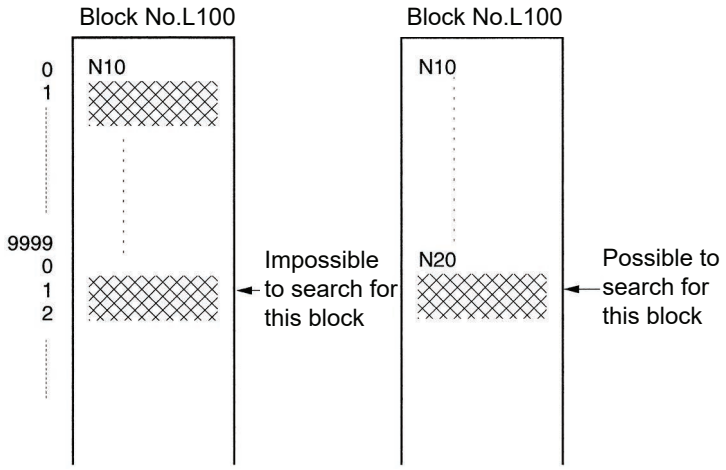


Fig. IV.4.3

5. G CODE AND M CODE LIST

5.1 G Code List

Table IV.5.1

G code	Group	Function	Page
G00	A	Positioning	IV-21
G01	A*	Linear interpolation	IV-23
G02	A	Circular interpolation CW/Helical interpolation CW/R specification circular interpolation CW	IV-25
G02.1	A	Helical circular interpolation (CW)	IV-29
G03	A	Circular interpolation CCW/Helical interpolation CCW/R specification circular interpolation CCW	IV-25
G03.1	A	Helical circular interpolation (CCW)	IV-29
G04	*1	DWELL	IV-35
G05	*1	Coordinate rotation (coordinate rotation center specification)	IV-182
G06	*1	Coordinate rotation cancel	-
G14	*1	Current value reading	IV-88
G22	D	Subprogram call/Figure rotation	IV-93
G23	D	Subprogram return/Figure rotation	IV-93
G27	*1	Zero point verification	IV-33
G28	*1	Memory type automatic zero return	IV-32
G29	*1	Edge positioning	IV-84
G30	*1	Automatic center positioning	IV-85
G40	E*	Wire diameter compensation cancel/Taper angle cancel	IV-36
G41	E	Wire diameter compensation (left)	IV-36
G42	E	Wire diameter compensation (right)	IV-36
G43	*1	Program wire diameter compensation distance setting/Work coordinate system offset setting	IV-42
G43.1	*1	Time data write	IV-89
G44	*1	Program wire diameter compensation distance transfer	-
G44.1	*1	Time data read	IV-89
G46	*3	Micro joint function	IV-101
G48	*1	Memory type automatic zero point (2nd, 3rd, 4th) return	IV-32
G50	*1	Figure magnification cancel (1.0 time)	-
G50.1	*1	G command mirror image cancel	-
G51	*1	Figure magnification setting (scaling center specification)	IV-185
G51.1	*1	G command mirror image setting (mirror image center setting)	IV-103
G52	*2	Local coordinate system setting	IV-162
G53	F	Machine coordinate system selection	IV-154
G54	F*	G54 Workpiece coordinate system selection	IV-154
G54.1	F	W00 to W99 workpiece coordinate system selection	IV-154
G55	F	G55 Workpiece coordinate system selection	IV-154
G56	F	G56 Workpiece coordinate system selection	IV-154
G57	F	G57 Workpiece coordinate system selection	IV-154
G58	F	G58 Workpiece coordinate system selection	IV-154
G59	F	G59 Workpiece coordinate system selection	IV-154
G60	*1	Dog type zero point return	IV-31

G code	Group	Function	Page
G62	*1	G command mirror image	IV-103
G63	*1	Enabling soft limit	IV-92
G64	*1	Disabling soft limit	IV-92
G65	D	Macro simple call	IV-124
G66	D	Macro modal call A	IV-124
G66.1	*1	Macro modal call B	IV-124
G69	*3	Arc end point error image check clear	IV-29
G70	G	Inch command	-
G71	G*	mm command	-
G78	*1	Automatic vertical alignment	IV-86
G87	B	Upper and lower identical R	IV-66
G88	B	Corner R mode	IV-43
G89	B*	Intersection point calculation mode	IV-43
G90	H	Absolute value command	IV-20
G91	H*	Incremental value command	IV-20
G92	*2	Zero point preset	-
G97	*1	X, Y axes exchange	IV-107
G101	J	a = b	IV-124
G102	J	a = b + c	IV-124
G103	J	a = b - c	IV-124
G104	J	a = b * c	IV-124
G105	J	a = b / c	IV-124
G106	J	$a=\sqrt{b^2+c^2}$	IV-124
G107	J	a = b * sinC	IV-124
G108	J	a = b * cosC	IV-124
G109	J	$a = \tan^{-1}b / c$	IV-124
G110	J	$a=\sqrt{b^2-c^2}$	IV-124
G111	J	3-point center calculation	IV-124
G200	J	Unconditional branching	IV-124
G201	J	Zero condition branching	IV-124
G202	J	Negative condition branching	IV-124
G203	J	Bit test	IV-124

Table IV.5.2

	A	B	D	E	F	G	H	I	J	*1	*2	*3
Group A	○											
B	○	×										
D	×	×	×									
E	○	○	×	×								
F	○	○	○	○	×							
G	○	○	○	○	○	×						
H	○	○	○	○	○	○	○					
I	○	○	○	○	○	○	○	×				
J	×	×	×	×	×	×	×	×	×			
*1	×	○	×	×	○	×	×	○	×	×		
*2	×	○	×	×	○	×	○	×	×	×	×	
*3	○	×	×	×	×	×	×	×	×	×	×	×

NOTE) × indicates a program error.

- **At the time of power input or after execution of M02 and M30, the initial state of each group corresponds to the G function marked with * for each group in the table of preparatory functions.**
- **The G codes with no * in the group column are modal. Once these codes are commanded, they are enabled until another G code from the same group is commanded.**
  Each modal group will become * mark modal when reset is executed.
  Note that D group consisting of G22 and G23 becomes G23 after the reset.
- **Those G codes marked by an * are not modal, and remain enabled only in the specified blocks.**
  For G62 and G97, however, the mirror image mode and the axis exchange mode remain enabled.
- **The specifying order of G codes within the same block is not fixed, but when two or more G codes of the same modal group are specified, the last G code read is enabled. For the allowable combinations of G codes, see Table IV.5.2.**
- **When two or more G codes out of G04, G27, G28, G48, G60, G92, and G97 which are not modal are specified in one block, the last G code read is enabled.**
- **If a G code not listed in the table of G codes or not mentioned in the specs is specified, a program error occurs.**

5.2 M Code List

Table IV.5.3

M code	Name	Function	Remarks	Page
M00	Program stop	Stops automatic operation.		IV-167
M01	Optional stop	Same function as M00 only when optional switch is ON		IV-167
M02	Program end	Terminates automatic operation and resets.		IV-167
M06	AUTO MACHINING ON Machining ON/OFF	When the [Auto Mcn-On] switch is turned ON, machining ON/OFF and optimum feed ON/OFF will be switched.		IV-178
M20	Wire insert	Inserts a wire with the automatic wire feeder.	*	IV-168
M21	Wire cut	Cut off a wire by automatic wire feeder.	*	IV-168
M22	Test insert	Sets guide pipe in fixed position by automatic wire feeder.	*	IV-168
M23	Fixed position return	Sets guide pipe in fixed position by automatic wire feeder.	*	IV-168
M30	Program end	Terminates automatic operation and resets.		IV-167
M52	Scrap treatment ON	Carries out automatic scrap treatment.	*	IV-170
M53	Work change ON	Carries out automatic workpiece change.	*	IV-170
M57	Discharge all	Discharge dielectric fluid.		IV-178
M58	Fluid level setting LOW	Keeps the fluid level below the table.	*	IV-169
M59	Fluid level setting HIGH	Keeps the fluid level above the table.	*	IV-169
M60	External signal output 1 ON	Turns ON the control unit external output terminal 1.	*	IV-168
M61	External signal output terminal 1 OFF	Turns OFF the control unit external output terminal 1.	*	IV-168
M62	External signal output 2 ON	Turns ON the control unit external output terminal 2.	*	IV-168
M63	External signal output terminal 2 OFF	Turns OFF the control unit external output terminal 2.	*	IV-168
M64	External signal output 3 ON	Turns ON the control unit external output terminal 3.	*	IV-168
M65	External signal output terminal 3 OFF	Turns OFF the control unit external output terminal 3.	*	IV-168
M66	External signal output 4 ON	Turns ON the control unit external output terminal 4.	*	IV-168
M67	External signal output terminal 4 OFF	Turns OFF the control unit external output terminal 4.	*	IV-168
M68	External signal output 5 ON	Turns ON the control unit external output terminal 5.	*	IV-168
M69	External signal output terminal 5 OFF	Turns OFF the control unit external output terminal 5.	*	IV-168
M74	Dielectric fluid preparation ON	Turns dielectric fluid preparation ON.	*	IV-168
M75	Dielectric fluid preparation OFF	Turns dielectric fluid preparation OFF.	*	IV-168
M76	Dielectric fluid circulation ON	Dielectric fluid circulation ON.		IV-168
M77	Dielectric fluid circulation OFF	Dielectric fluid circulation OFF.		IV-168
M78	Rapid filling up	Fills up fluid rapidly.	*	IV-168
M80	Dielectric fluid ON	Feeds dielectric fluid.		IV-168
M81	Dielectric fluid OFF	Stops dielectric fluid.		IV-168
M82	Wire feed ON	Starts wire feed.		IV-169
M83	Wire feed OFF	Stops wire feed.		IV-169
M84	Machining ON	Turns ON the power supply.		IV-169
M85	Machining OFF	Turns OFF the power supply.		IV-169
M88	Dielectric fluid Low	Decreases fluid flow.		IV-169
M89	Dielectric fluid High	Increases the fluid flow.		IV-169
M90	Adaptive control ON	Starts adaptive control.		IV-169

M code	Name	Function	Remarks	Page
M91	Adaptive control OFF	Stops adaptive control.		IV-169
M93	All stop	Turns OFF [Ready] switch.		IV-169
M101	PM OFF	Turns OFF the PM switch.	*	IV-170
M102	PM nozzle open mode ON	Turns ON the PM switch and selects the nozzle open mode.	*	IV-170
M103	PM nozzle contact mode ON	Turns ON the PM switch and selects the nozzle contact mode.	*	IV-170
M105	PM thin plate mode ON	Turns ON the PM switch and selects the thin plate mode.	*	IV-170
M106	FC OVERRIDE	Specifies the machining speed adjustment notch (-5 to +4) to adjust the machining speed.	*	IV-172
M110	CM-R control change	Used to turn ON/OFF the CM-R switch or select the operation mode.		IV-173
M111	CM-S control ON/OFF	Turns ON/OFF the CM-S switch.		IV-175
M112	EM-trajectory control change	Used to turn ON/OFF the "EM-T" switch and the "WH Auto Set" switch or change the operation mode.		IV-176
M113	EM-condition control change	Used to turn ON/OFF the "EM-C" switch or change the operation mode.		IV-177
M121	TANK DOWN	Sets the working tank door to ON.		IV-178
M122	TANK UP	Sets the working tank door to OFF.		IV-178
M123	OVERFLOW MODE OFF	Turns OFF the overflow mode.		
M124	OVERFLOW MODE ON	Turns ON the overflow mode and moves the working tank door to match the Z axis height.		
M133	G40 SPEED UP ON	Turns ON the [G40 Speedup] switch.		
M134	G40 Speedup OFF	Turns OFF the [G40 Speedup] switch.		

NOTE) Functions marked with a * may not be implemented depending on the model and options.

6. COORDINATE SYSTEM

6.1 Coordinate Terms X, Y, U, V, I, and J

X and Y specify positions/move amounts; I and J specify arc centers or diameter-compensation vectors. Use them with G codes for linear/arc modes.

6.1.1 Axial direction and axial signs

Facing the machine: X represents left/right, Y represents forward/backward. Table moving toward you is Y+, to the left is X+. From above, X+ moves the electrode right; Y+ moves it rearward.

6.1.2 Maximum command value for each input setting unit

The input setting unit is the unit of the movement numerical values specified by input terms. Any value exceeding the maximum command values shown in Table IV.6.1 and Table IV.6.2 cannot be specified. Change the input setting unit between inch and metric on the auxiliary menu "Machining Settings" > "Parameter Set" > "Automatic Setting3".

Table IV.6.1 (Normal mode)

	Input setting unit	Maximum command value
Metric system	0.001 mm	99999.999 mm
Inch system	0.0001 inch	9999.9999 inch

Table IV.6.2 (× 0.1 mode)

	Input setting unit	Maximum command value
Metric system	0.0001 mm	99999.9999 mm
Inch system	0.00001 inch	9999.99999 inch

6.2 Program Coordinate System

Set a fixed workpiece point as program zero. You can place and redefine the program coordinate system anywhere via the program

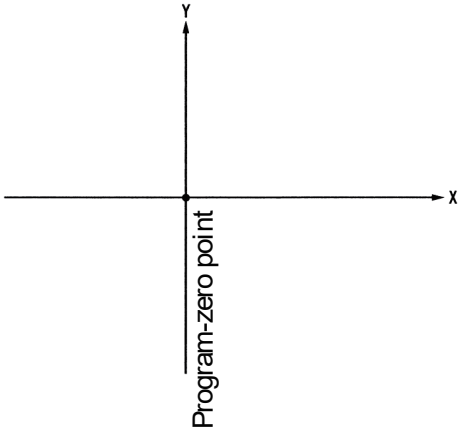


Fig. IV.6.1

Pressing [RESET] sets the current table position (wire position) to the program coordinate system zero point.
If "Rst: Clr Prg-P" is set to "OFF" displayed by selecting "Initial Settings" > "Machine Parameters" > "Machining Settings" > "Auto Setting3", the program coordinates will not change even when [RESET] is pressed.

6.3 Coordinate System Setting (G92)

6.3.1 Function and purpose

The program coordinate values can be preset to the specified values by the G92 command without running the machine.

6.3.2 Command format

G92 Xx1 Yy1 Zz1

6.3.3 Detailed explanation

(1) Figure magnification, mirror image, axis change, and axis rotation are valid.

(2) After the zero point return is completed, reset the coordinate system using the G92 command.

6.3.4 Program example

When a command G92X60.0 Y40.0 is executed, the following program coordinate system is set, and X60.000 Y40.000 is displayed in the program coordinate and program position display.

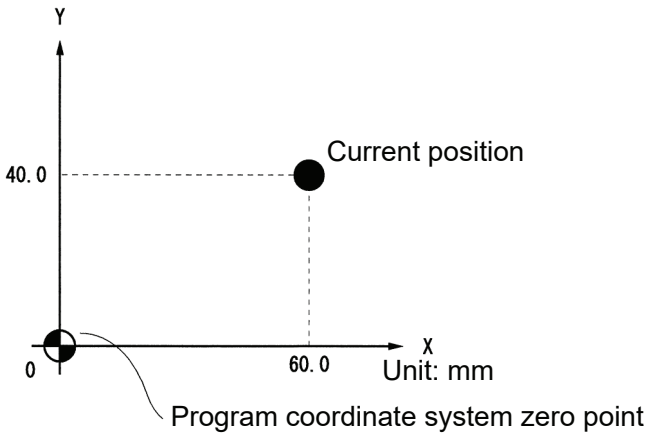


Fig. IV.6.2

6.4 Position Command Method (G90, G91)

6.4.1 Function and purpose

The positioning command system includes both the absolute value command system and incremental value command system. Change between the two systems with G commands.

6.4.2 Command format

G90 executes as absolute value command. U and V are always treated as incremental. G91 sets incremental.

6.4.3 Detailed explanation

(1) Since these commands can be used more than once in a single block, it is possible to use specific addresses as absolute values or incremental values.

(2) The last G90/G91 command issued functions as a modal for the next block.

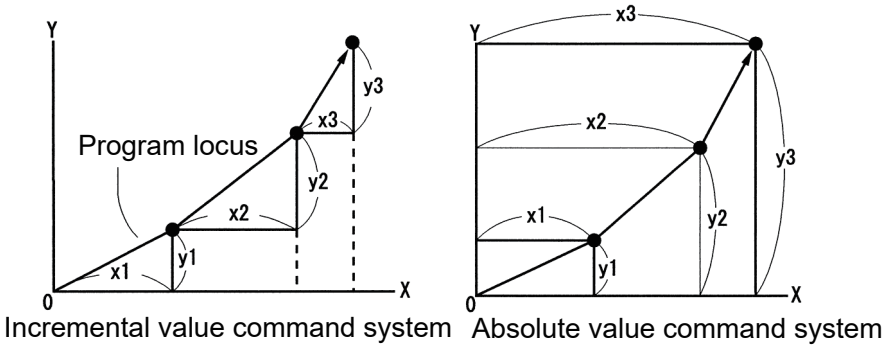


Fig. IV.6.3

NOTICE
The use of incremental value command system can cause an accumulation of errors.

7. MOVEMENT COMMAND

7.1 Positioning and Rapid Traverse (G00)

7.1.1 Function and purpose

This command is used together with coordinate terms for positioning, by taking the shortest route from the current point to the end point specified by the coordinate terms.

7.1.2 Command format

G00 Xx_1 Yy_1 Uu_1 Vv_1

G00 Zz_1

7.1.3 Detailed explanation

When this command has been applied, the G00 mode remains in effect until another G-function command (G01, G02, G03, G02.1 or G03.1) that resets the G00 mode is commanded. This means that when the following command is also G00, only the coordinate terms are required.

7.1.4 Program example

< Example 1 >

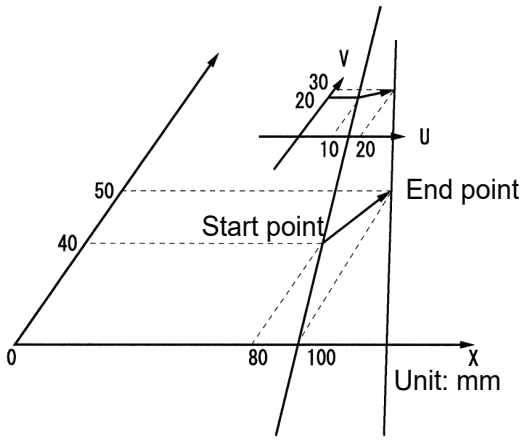


Fig. IV.7.1

NOTICE

- **In G00 positioning, the wire moves along the shortest path. Speed is auto-calculated to finish ASAP without exceeding rapid traverse. Example: with X/Y rapid = 1300 mm/min, G91 G00 X-300.00 Y200.0 moves along the shortest route.**

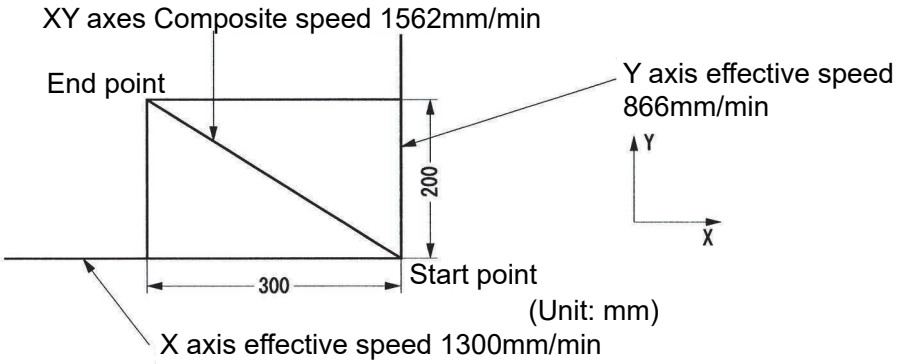


Fig. IV.7.2

- **When G00 is commanded while machining is ON, the axis movement is started after automatically turning OFF the machining.**
- **When the B-axis option is installed, make sure to return the B-axis to the zero point before performing B-axis index.**

7.2 Linear Interpolation (G01)

7.2.1 Function and purpose

This command is issued with coordinate terms and feedrate commands to move (compensate) the wire, at the speed specified by address F, from the current point to the end point specified by the coordinate terms. The feedrate specified by address F always functions as the linear speed in the wire travel direction.

7.2.2 Command format

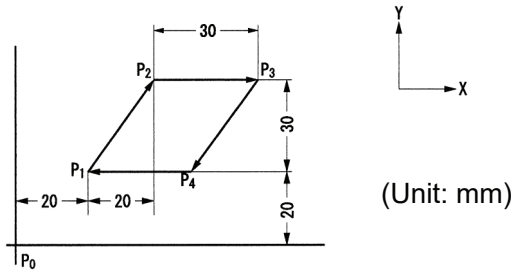
G01 Xx_1 Yy_1 Uu_1 Vv_1 Ff_1

G01 Zz_1 Ff_2

7.2.3 Program example

<Example 1> When machining at 1-mm/min feedrate along path $P_1 \rightarrow P_2 \rightarrow P_3 \rightarrow P_4 \rightarrow P_1$

$P_0 \rightarrow P_1$ represents positioning of the wire.



(Unit: mm)

Fig. IV.7.3

G91	G00	X20.00	Y20.00	……$P_0 \rightarrow P_1$
	G01	X20.00	Y30.00F1.0	……$P_1 \rightarrow P_2$
		X30.00		……$P_2 \rightarrow P_3$
		X-20.00	Y-30.00	……$P_3 \rightarrow P_4$
		X-30.00		……$P_4 \rightarrow P_1$

NOTICE

- **The linear interpolation speed is the linear speed in the wire travel direction as follows.**

  Example: G91G01X - 300.0Y200.0F300.0

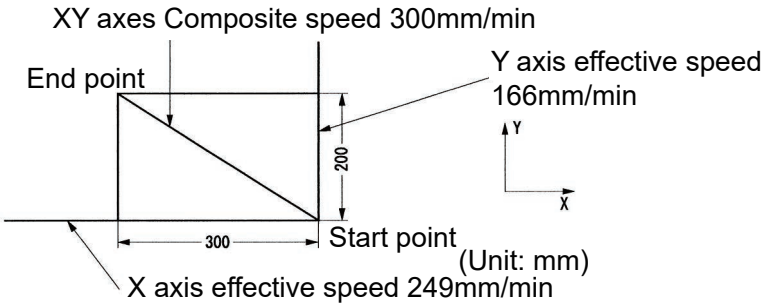


Fig. IV.7.4

- **When adaptive feed M90 is ON, the table will not move unless** **is ON.**
- **When the B-axis option is installed, make sure to return the B-axis to the zero point before performing B-axis index.**

7.3 Circular Interpolation (G02, G03)

7.3.1 I and J command circular interpolation

(1) Function and purpose

These commands are used to move the wire along an arc.
The circular interpolation command cannot be applied to the U axis or V axis command. (A program error will occur.)

(2) Command format

G02(03) X x 1 Y y 1 I i 1 J j 1 F f 1

End point coordinate values

Arc center coordinate values

Feedrate

For a circular command, the arc end point coordinate values are specified by addresses X and Y while the arc center coordinate values are specified by addresses I and J.
For the arc end point coordinate value command, both absolute and incremental values can be used, but for the arc center coordinate value command, only incremental values from the arc start point coordinates can be used.

(3) Detailed explanation

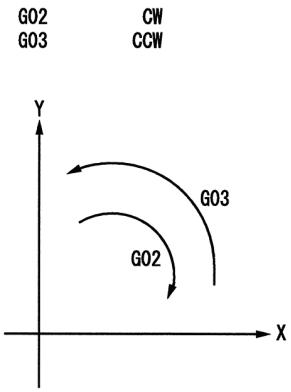


Fig. IV.7.5

The following information is required for carrying out circular interpolation.
a Rotation direction Clockwise (G02) or counterclockwise (G03)
b Arc end point coordinates Specified by addresses X and Y.
c Arc center coordinates Specified by addresses I and J. (incremental value command)
d Feedrate Specified by address F.

(4) Program example

< Example 1 > G02Xx_1Yy_1Ii_1Jj_1Ff_1…Circular movement

< Example 2 > G02I1000F500…Perfect circle command (not possible with X or Y address command)

< Example 3 > G91G02X1000Y-1000I1000F500…3/4 circle command

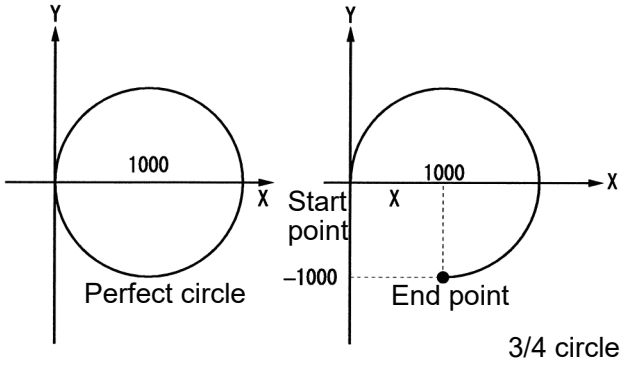


Fig. IV.7.6

For a taper machining for a full circle, create a program using 2 blocks of circular commands.

7.3.2 R specification circular interpolation (G02, G03)

Use the I and J commands whenever possible. An error may occur when R is specified.

(1) Function and purpose

In addition to conventional arc center coordinate command using I and J, the circular command can be issued by specifying the arc radius directly.

(2) Command format

G02(G03) X x_1 Y y_1 R r_1 F f_1

x_1: X axis end point coordinate value

y_1: Y axis end point coordinate value

r_1: Arc radius

f_1: Feedrate

(3) Detailed explanation

The arc center is on a line bisecting the line connecting the start and end points of the arc. The intersection point of the bisector line with the circle of the specified radius centered at the start point is the center coordinate of the specified circular command.

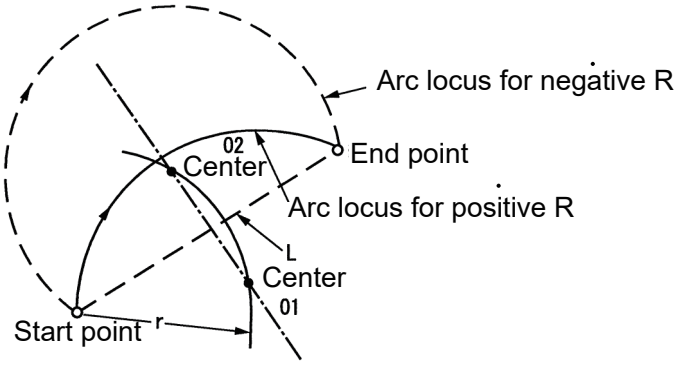


Fig. IV.7.7

The following condition is required for the radius specification circular command:

$$0.001 \leq \frac{L}{2 \times r} \leq 1$$

(4) Program example

< Example 1 >

G02 Xx_1 Yy_1 Rr_1 Ff_1

< Example 2 >

G 0 2 X x ₁ Y y ₁ I i ₁ J j ₁ R r ₁ F f ₁

Ignored

(When R is specified in the same block with I and J , the R specification is given priority.)

< Example 3 >

G 0 2 I i ₁ J j ₁ R r ₁ F f ₁ (The perfect circle cannot be calculated by R designation.)

Ignored

7.3.3 Q specification circular interpolation

(1) Function and purpose

This command is applied to the circular movement on Z5 plane for taper machining.

(2) Command format

G02(03) X x 1 Y y 1 — End point coordinate values

I i 1 J j 1 — Arc center coordinate values

Q q 1 — Radius of arc on Z5 plane

(3) Detailed explanation

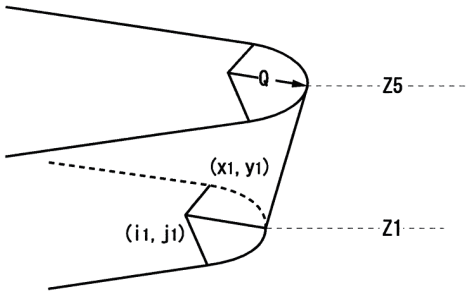


Fig. IV.7.8

1) The Q specification can be commanded only when the blocks before and after the circular command are linear movement commands (G00 or G01) and are tangential to the arc.

2) Only positive values can be used for Q.

7.3.4 Helical circular interpolation (G02.1, G03.1, and G69)

(1) Function and purpose

In normal circular movement, if the arc start radius and arc end radius are not equal, an error occurs. This command prevents this error and makes helical circular movement possible.

(2) Command format

G69 G02 (G03) Xx_1 Yy_1 Ii_1Jj_1

or

G02.1 (G03.1) Xx_1 Yy_1 Ii_1Jj_1

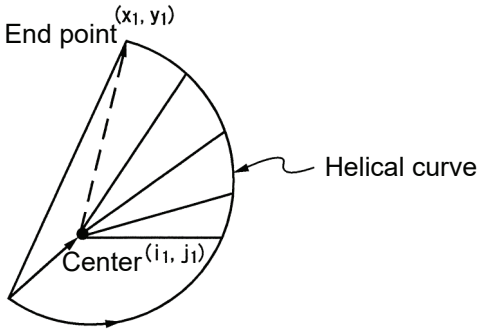


Fig. IV.7.9

(3) Detailed explanation

During circular interpolation, when the end point is not on the circumference and a G02.1 (G03.1) command is used, the radius changes linearly with the moving angle as in the figure below.

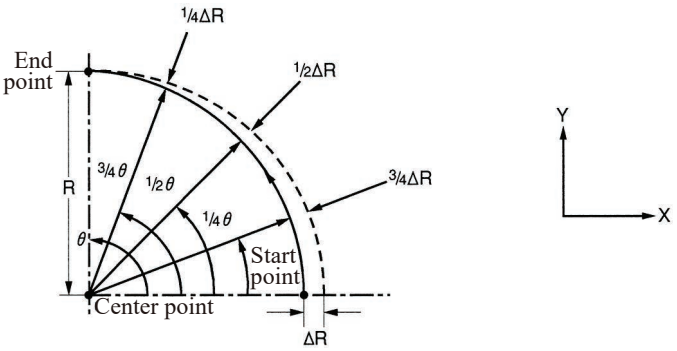


Fig. IV.7.10

1. **When executing G02.1, G03.1, or G69 (end point error check cancel command), programming errors do not occur in the following cases:**
   (1) The end point is not on the circumference of circular interpolation (including helical interpolation).
   (2) The start point radius and end point radius are not identical in the figure rotation. (Only for G69)
   The G02.1 and G03.1 commands are also effective for the next and subsequent blocks.
   The G69 command is only effective for the block in which it was executed.
2. **When normal G02 and G03 commands are executed and differences between the arc start radius and the arc end radius are as follows, an arc end point error occurs.**
   (1) When the arc radius is less than 6 mm, an error occurs at 6 μ or more radial difference.
   (0.6 μ in the 0.1 μ mode.)
   (2) For an arc with 6 mm or more radius, an error occurs at a radial difference of

$$\frac{\text{Radius (start radius)}}{1024}.$$

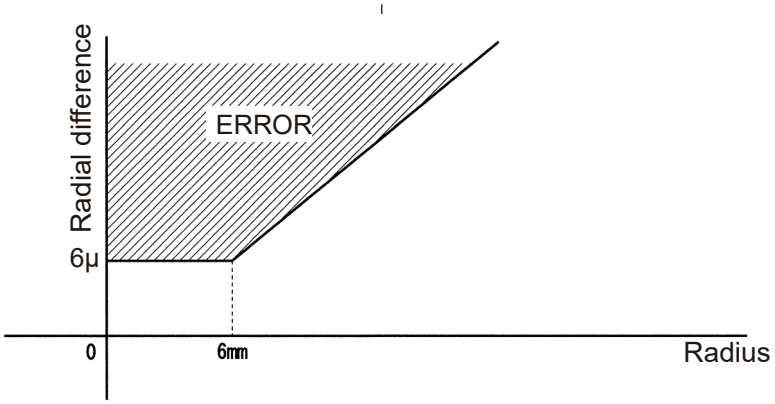


Fig. IV.7.11

7.4 Zero Point Return

Even if zero point return is executed when axis rotation or coordinate rotation is applied, the axis will return to the zero point based on the machine coordinates.
Avoid interference with a workpiece etc.

7.4.1 Machine zero point, 2nd, 3rd, and 4th zero points

(1) The machine zero point is the reference point of the machine coordinate system and is determined by the zero point return command.

(2) The positions of the 2nd, 3rd, and 4th zero points correspond to the coordinate values set as parameters in advance from the zero point of the machine coordinate system.

(3) The machine zero point is at the left-rear side facing the machine. The coordinates of the 2nd, 3rd, and 4th zero points are relative positions from the machine zero point.

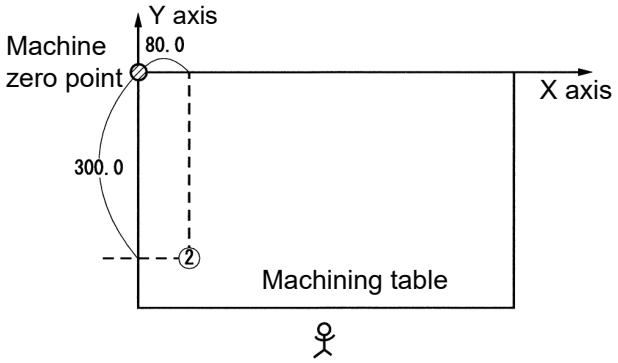


Fig. IV.7.12

(4) If the 2nd zero point is to be position 2) in the above figure, set the X axis to 80.000 and Y axis to -300.000 for "View Offsets" displayed by selecting "Initial settings" > "Machine base set" > "Zero PT. return" from the main menu.

(5) After executing zero point return to the machine zero point (1st zero point), reset the coordinate system with G92.

7.4.2 Dog-type zero point return (G60)

(1) Function

This function returns each commanded axis to the machine zero point at the rapid traverse rate. While G28 uses the memory type for the second and subsequent zero point returns, G60 always uses the dog type.

(2) Command format

G60 Xx_1 Yy_1 Zz_1

(3) Explanation

G60 is the same as G28 except that it always uses the dog type. Therefore, it is ignored when commanded for an axis (U or V) for which an automatic vertical alignment operation has not been performed after preparation.

7.4.3 Zero point return (G28)

(1) Function and purpose

Commanding G28 returns each commanded axis to the machine zero point at the rapid traverse rate.

(2) Command format

G28 Xx_1 Yy_1 Uu_1 Vv_1

G28 Zz_1

(3) Detailed explanation

1) When the READY switch is turned on, axes that have not executed zero point return will perform dog-type zero point return. The second and following zero point returns will be performed at a high speed to the zero point saved at the first zero point return.
2) When the zero point return is completed, the zero point arrival signal (#1) is displayed.
3) The zero point return for U and V axes is always performed by using the memory type.
4) Only the axis address for the commanded axis is valid and the command values will be ignored.

(4) Program example

G28 Xx_1 Yy_1

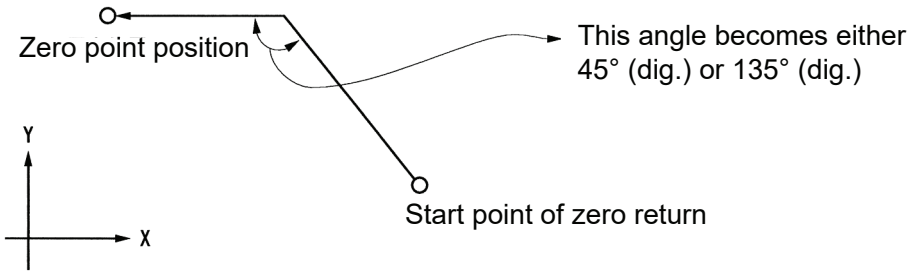


Fig. IV.7.13

7.4.4 Zero point return (2nd, 3rd, and 4th) (G48)

(1) Function and purpose

G48 performs positioning to the 2nd zero point set by parameters in advance.
Zero point return to the 3rd or 4th zero point can be performed by commanding G48P3 or G48P3P4.

(2) Command format

G48 Xx_1 Yy_1 Uu_1 Vv_1

G48 Zz_1

G48P3 (P4) Xx_1 Yy_1 Uu_1 Vv_1

G48P3 (P4) Zz_1

(3) Detailed explanation

1) Before executing G48 zero point return after turning the power ON, the machine zero point must be saved in the control unit with the manual or automatic zero point return command. If G48 zero point return is executed without saving the machine zero point in the control unit, a program error will occur.
2) When the G48 zero point return is completed, the 2nd zero point arrival signal (#2) is displayed.
3) Although the return to the 3rd or 4th zero point is specified with the P3 or P4 command, P0, P1, P2,, P5, and greater are ignored and processed as the 2nd zero point return.
4) Only the axis address for the commanded axis is valid and the command values will be ignored.

(4) Program example

(Example) G48 Xx_1 Yy_1

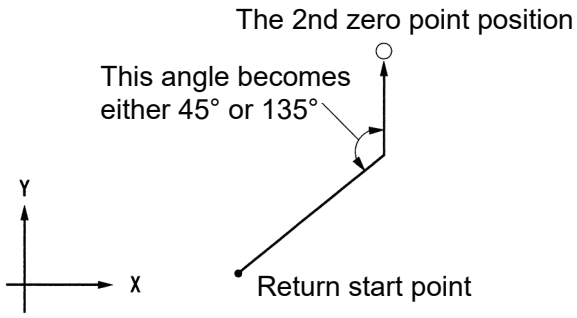


Fig. IV.7.14

7.4.5 Zero point verification (G27)

(1) Function and purpose

This command performs positioning to the commanded point at the rapid traverse rate, and when the point is the 1st zero point, the zero point arrival signal (#1) is displayed. This function is useful in checking whether a program created to return to the machine zero point is properly executed.

(2) Command format

G27 Xx_1 Yy_1 Uu_1 Vv_1

G27 Zz_1

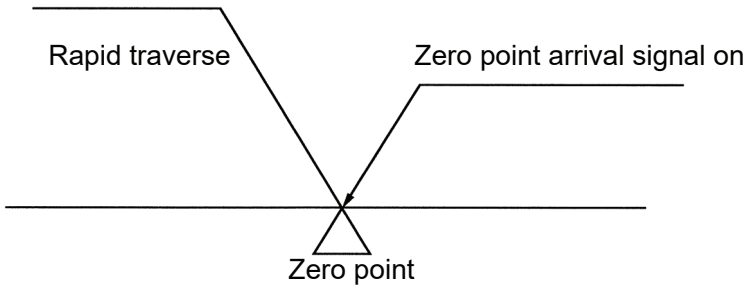
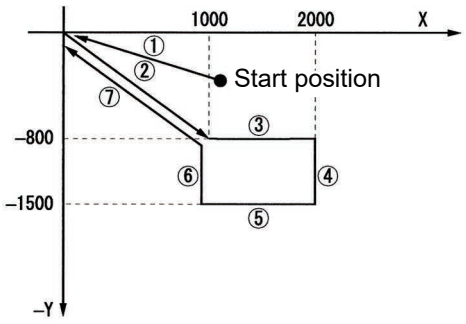


Fig. IV.7.15

(3) Detailed explanation

Prior to executing zero point verification, make sure to perform the dog-type zero point return.
If G27 is commanded without performing the dog-type zero point return, a program error occurs.
Note that under a machine lock condition, the zero point arrival signal is not displayed by only updating coordinate values.
Example




```
G60X1Y1 ----------①
G92X0Y0 ----------①'
```
Machine zero point is regarded as coordinate zero point
```
G91G01X1000Y–800 ----------②
X1000 ----------③
Y–700 ----------④
X–1000 ----------⑤
Y700 ----------⑥
G27X–1000Y800 ----------⑦
```
Zero point verification

If the axis arrives at the zero point without errors at ⑦, the zero point arrival signal (#1) is displayed.

Fig. IV.7.16

7.5 Dwell (G04)

7.5.1 Function and purpose

This command delays execution of the next block by a specified time.

7.5.2 Command format

G04 Xx_1

Addresses Y, U, V, Z, B, P, and F can be used in addition to X. (The unit is 0.001 seconds.)
(The setting unit is the same as X.)

7.5.3 Detailed explanation

Dwell time is as follows:

Table IV.7.1

Input setting unit	Command range
0.001	0.001 to 99999.999 seconds

If the preceding block contains a movement command, the dwell time calculation starts after the completion of the stopping operation.
When the command is issued in the same block as an M or E command, they are executed simultaneously. The dwell function is effective in the interlock state.

7.5.4 Program example

< Example 1 > G04X5000 Dwell time: 5 seconds
< Example 2 > G04F5000 Dwell time: 5 seconds

8. WIRE DIAMETER COMPENSATION FUNCTION

8.1 Wire Diameter Compensation Function (G40, G41, G42)

The wire diameter compensation is a function that compensates the movement command to pass through a path offset from the programmed path by half the wire diameter and the electrical-discharge gap (cutting amount).

8.1.1 Command format

Table IV.8.1

G code	Function
G40	Cancel
G41	Left
G42	Right

8.1.2 Wire diameter compensation number (HΔΔΔ)

(1) Once this command has been issued, the wire diameter compensation number (HΔΔΔ) remains in effect as a modal value until another HΔΔΔ is commanded.

(2) There are 900 wire diameter compensation numbers.
H1 to H900 (which is reset to H1)

(3) Only one wire diameter compensation number (HΔΔΔ) can be used in one block.
(When two or more numbers. are specified, the last one becomes valid.)

(4) The compensation amount range is common to each No. as shown in Table IV.8.2.

Table IV.8.2

Setting unit	Compensation amount range		H No.
	Normal mode	× 0.1 mode	
Metric	-99999.999 to 99999.999 mm	-99999.9999 to 99999.9999 mm	1 - 900
Inch	-9999.9999 to 9999.9999 inch	-9999.99999 to 9999.99999 inch	1 - 900

8.1.3 Start and end of wire diameter compensation

(1) Start of wire diameter compensation

Start the wire diameter compensation with a linear modal (G01). Modals other than G01 are internally converted to G01. G41 and G42 are commands that "perform movement to the position perpendicular to the start point of the next movement command (either linear or arc)".

1) With movement command

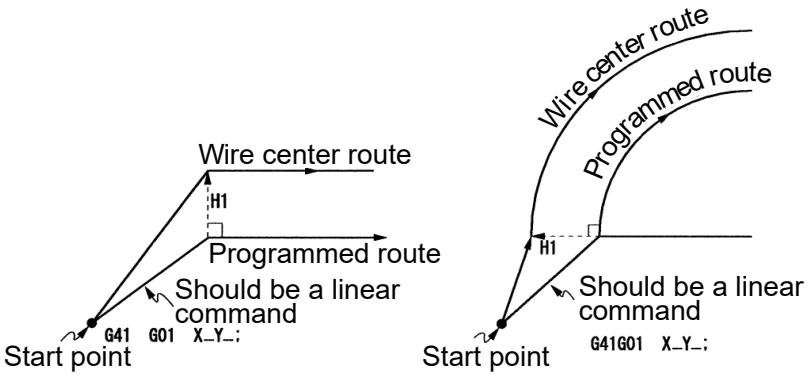


Fig. IV.8.1

2) Without movement command

When G41 (or G42) is commanded outside the movement command block, the wire moves to the wire diameter compensation position before the start of the next movement command, and then it proceeds to the next movement.

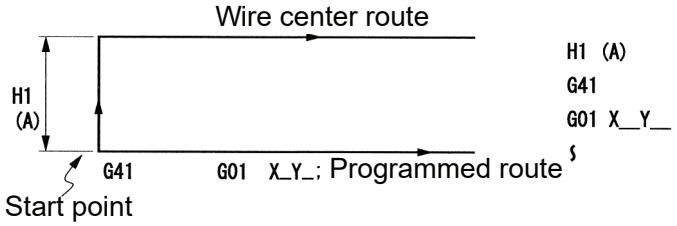


Fig. IV.8.2

3) With IJ command

When G41 (or G42), I, and J are commanded in the same block, the wire center moves to a point perpendicular to the I and J vectors at the end of the command block.

[General shape]

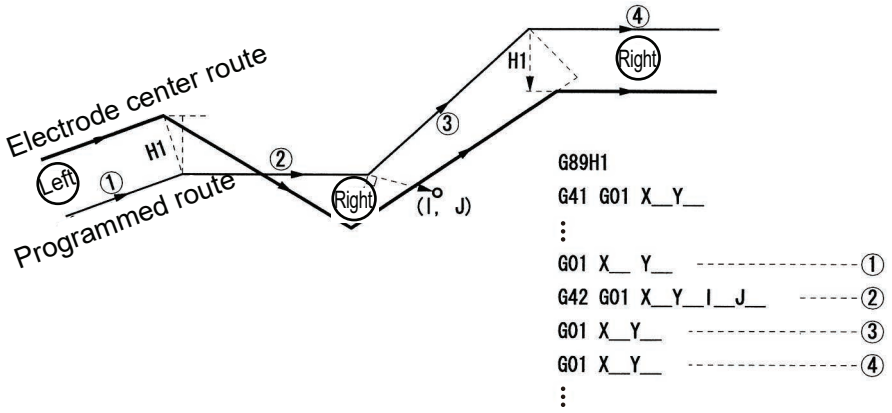


Fig. IV.8.3

(Return on the same line)

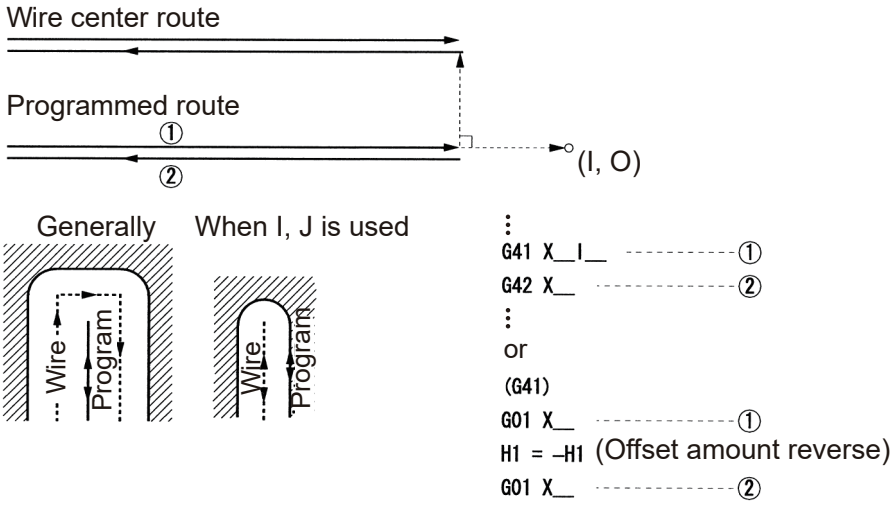


Fig. IV.8.4

1. When G41 (or G42) is commanded again during the wire diameter compensation, the start point is processed with the wire diameter compensation amount and taper angle of the preceding block of G41 (or G42), and the end point follows the principle of the start point of the wire diameter compensation.
(With move command)

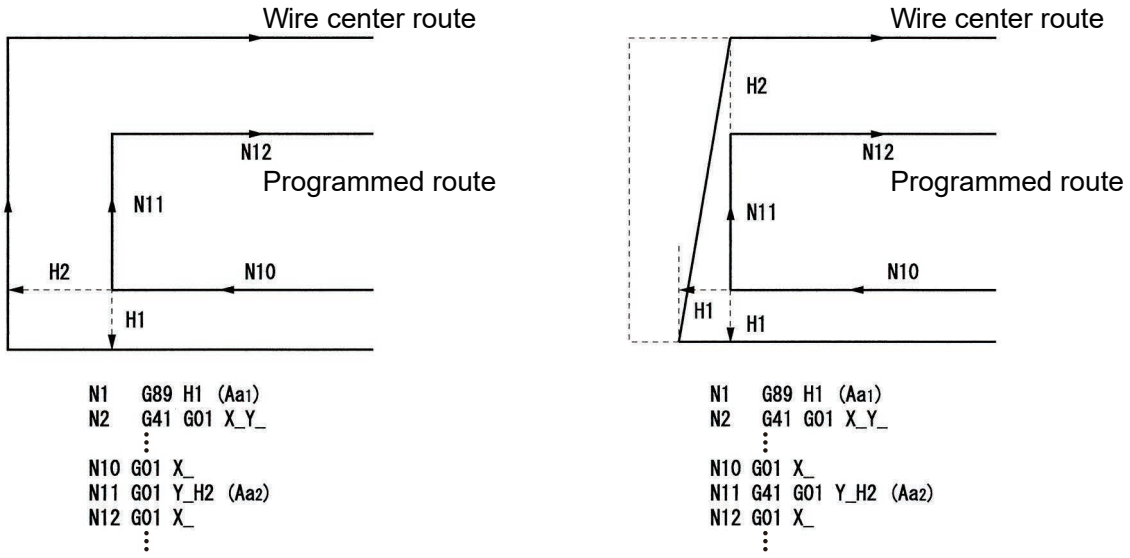


Fig. IV.8.5

(Without move command)

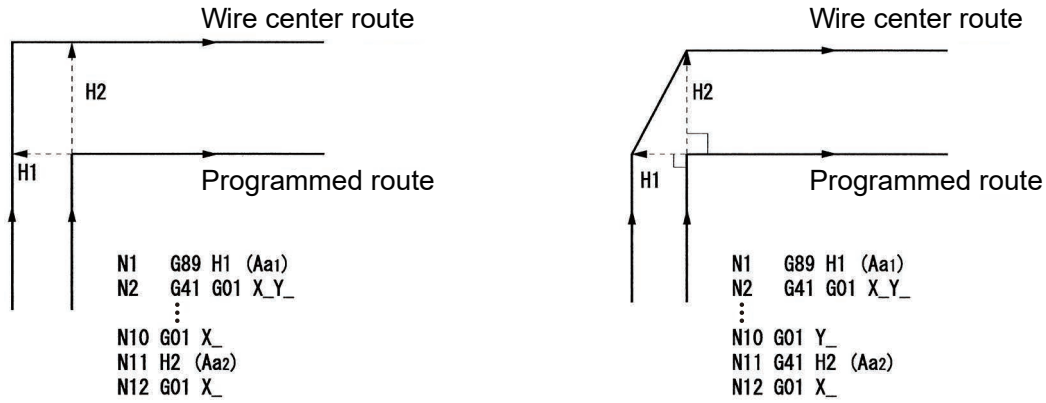


Fig. IV.8.6

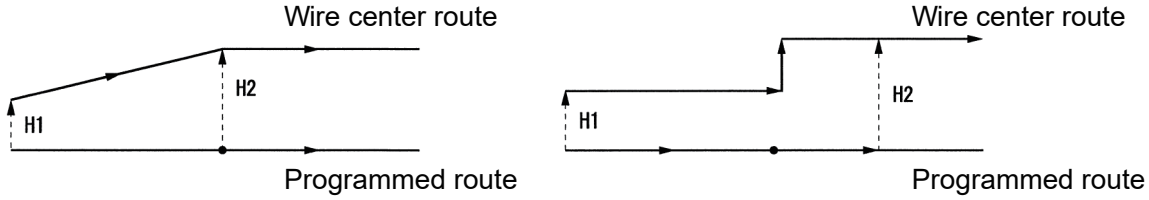


Fig. IV.8.7

2. When the wire diameter compensation amount (HΔΔΔ) and taper angle (AΔΔΔ) are commanded independently while the "T-Ang @ Blk-End" switch is ON, the movement is the same as if G41 (or G42) were commanded in the block.
(This switch is valid only when the "Smooth Taper" switch is ON.)
(Example)

- **When "T-Ang @ Blk-End" switch is ON**

```
G41 A1.0
:
G01 X10.0
A2.0 ← Same as G41 A2.0
G01 X20.0
A3.0 ← Same as G41 A3.0
G01 X30.0
```

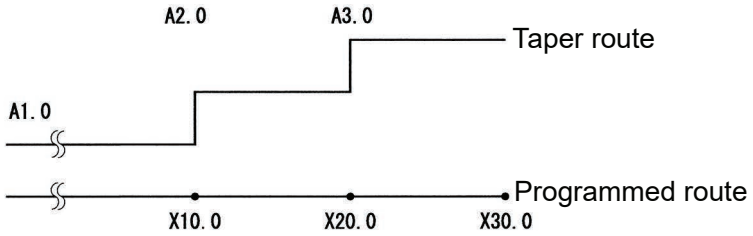


Fig. IV.8.8

- **When "T-Ang @ Blk-End" switch is OFF**

```
    G41 A1.0
     :
N10 G01 X10.0
N20 A2.0
N30 G01 X20.0
N40 A3.0
N50 G01 X30.0
```

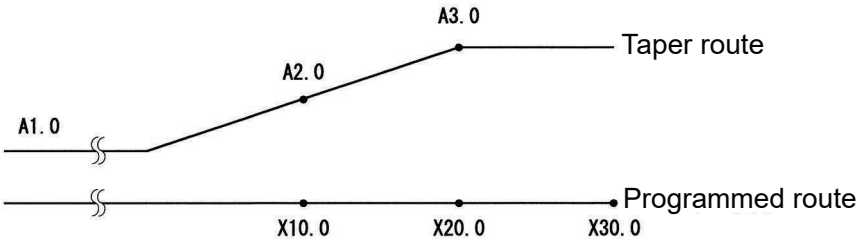


Fig. IV.8.9

(2) Completion of wire diameter compensation

Cancellation of the wire diameter compensation should be done with a linear modal command (G00 or G01). G40 is a command that cancels the wire diameter compensation and taper angle.

[G40 with movement command]

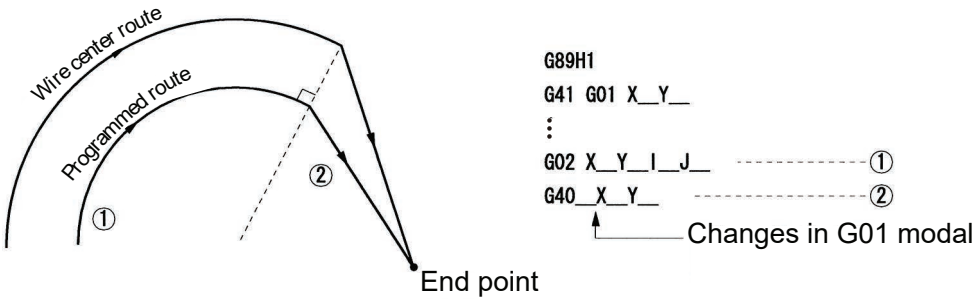


Fig. IV.8.10

[G40 without movement command]

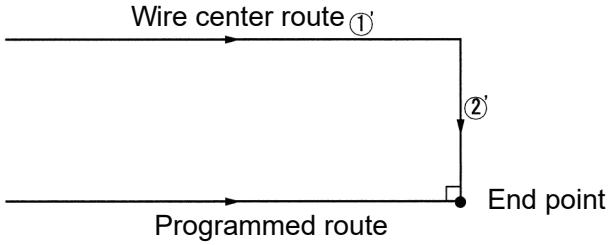


Fig. IV.8.11

```
G89H1
G41 G01 X__Y__
  ⋮
  G01 X__Y__ ----------①'
G40 ----------②'
  ⋮
```

8.2 Program Wire Diameter Compensation Amount Setting and Transfer (G43 (H1=))

8.2.1 Function and purpose

Compensation data can be set with an NC program. A different compensation amount can be used with the same compensation number, and compensation amount can be computed in the same way as with the variable.

8.2.2 Command format

(1) When setting or updating a compensation amount with an NC program
G43 Pp1 Rr1
p1: Compensation number (1 to 900)
r1: Compensation amount (0 to 99999.9999)

8.2.3 Detailed explanation

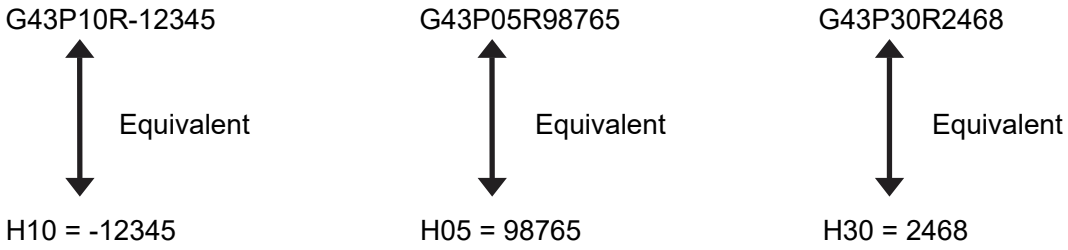
(1) G43 is an unmodal command and valid only in the commanded blocks.

(2) G43 does not perform any movement. However, do not use it with other G commands.

(3) An error occurs when an incorrect compensation number or variable number is specified or when the maximum command value is exceeded.

8.2.4 Program example

(1) When setting the compensation amount with an NC program



8.3 Corner Processing Mode (G88, G89)

The corner processing mode specifies the wire movement at the connection point of two movement command blocks. There are two types of corner processing mode, an intersection point calculation type (G89) and a corner R type (G88).

Corner processing mode

	Intersection point calculation type (G89)	Corner R type (G88)
Line ←→ Line	Intersection point calculation	Corner R
Line ←→ Arc	Intersection point calculation	Corner R
Arc ←→ Arc	Intersection point calculation	Corner R

8.3.1 Intersection point calculation mode (G89)

(1) << Line ←→ Line >>

1) General case

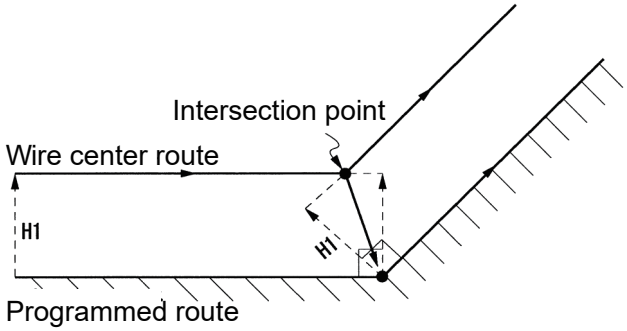
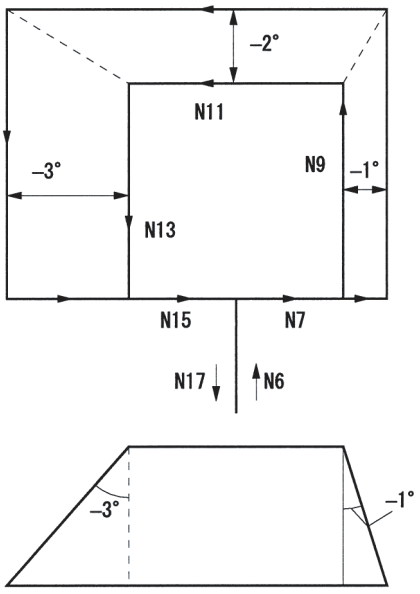


Fig. IV.8.12




```
NC program
N1  M80
N2  M82
N3  M84
N4  G90
N5  G92 X0 Y0
N6  G42 X0 Y5000
N7  G01 X5000 Y5000
N8  A-10000
N9  G01 X5000 Y15000
N10 A-20000
N11 G01 X-5000 Y1500
N12 A-30000
N13 G01 X-5000 Y5000
N14 A0
N15 G01 X0 Y5000
N16 M00
N17 G01 X0 Y0 G40 F1
N18 M02
%
```

Fig. IV.8.13

2) When an intersection point is distant or does not exist

"During straight machining"

When θ is less than 5°, three blocks shown in Fig. IV.8.14 are automatically inserted.

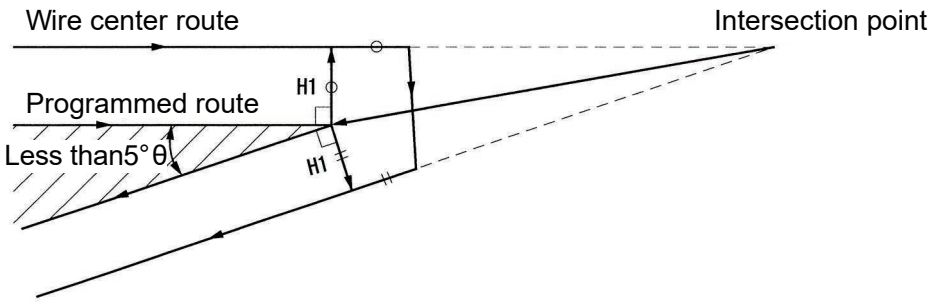


Fig. IV.8.14

"During taper machining"

When θ is less than 5°, three blocks shown in Fig. IV.8.15 are automatically inserted.

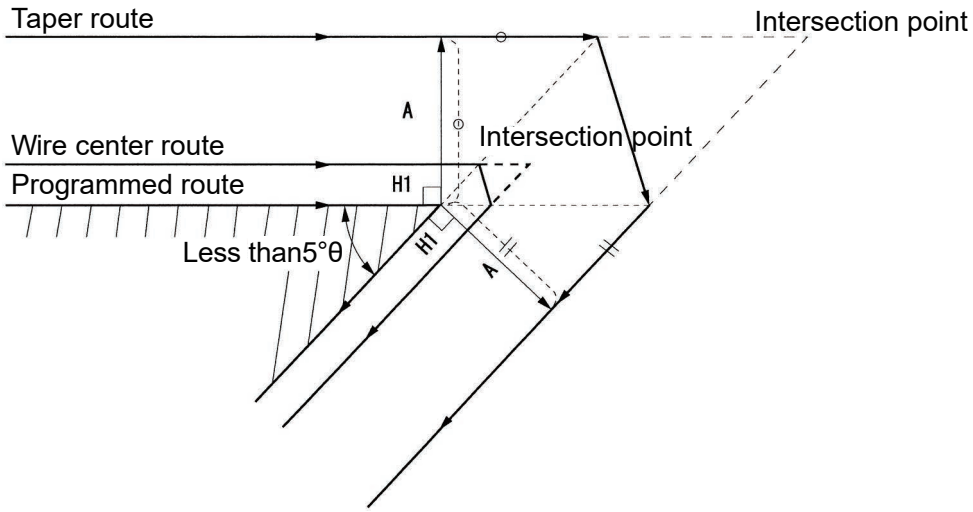


Fig. IV.8.15

When the wire diameter compensation amount or taper angle is changed, the wire moves so the each length of "○" and "//" in Fig. IV.8.14 and Fig. IV.8.15 becomes the same.

3) When not obtaining the intersection point

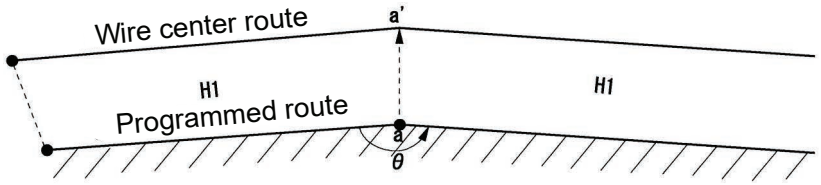


Fig. IV.8.16

When two lines are extremely close to each other (175.0° ≤ θ ≤ 185.0°), the intersection point of the two lines is not obtained. The wire center moves to the wire diameter compensation position (a') perpendicular to the start point (a) of the second line.

When the wire diameter compensation amount (HΔΔΔ) or taper angle (AΔΔΔ) is changed when the two lines are extremely close to each other, the following movement is executed according to the state of the "T-Ang @ Blk-End" switch. (This switch is valid only when the "Smooth Taper" switch is ON.)

1. When the "T-Ang @ Blk-End" switch is OFF

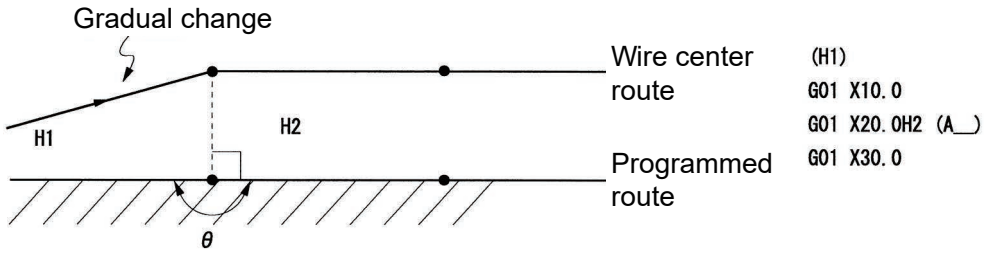


Fig. IV.8.17

The wire diameter compensation amount or taper angle is gradually changed in the previous movement block so that the specified amount is achieved by the start point of the block where the change is commanded.

2. When the "T-Ang @ Blk-End" switch is ON

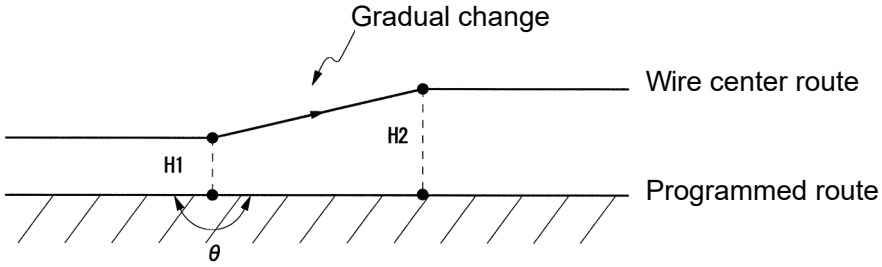


Fig. IV.8.18

The wire diameter compensation amount or taper angle is gradually changed in the commanded block so that the specified amount is achieved by the end point of the block where the change is commanded.

(2) <<Line ←→ Arc >>

1) General case

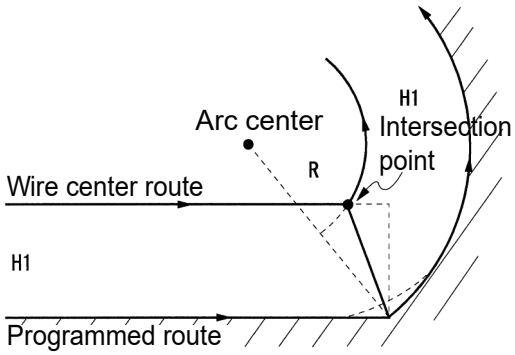
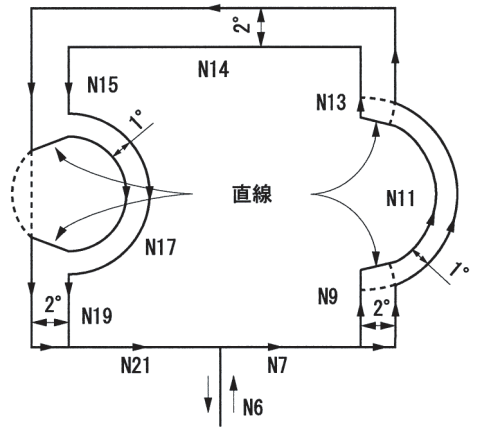


Fig. IV.8.19



NC program
N1 M80
N2 M82
N3 M84
N4 G90
N5 G92 X0 Y0
N6 G42 X0 Y5000
N7 G01 X10000 Y5000
N8 A-20000
N9 G01 X10000 Y10000
N10 A-10000
N11 G03 X10000 Y20000 I0 J5000
N12 A-20000
N13 G01 X10000 Y25000
N14 G01 X-10000 Y25000
N15 G01 X-10000 Y20000
N16 A-10000
N17 G02 X-10000 Y10000 I0 J-5000
N18 A-20000
N19 G01 X-10000 Y5000
N20 A0
N21 G01 X0 Y5000
N22 M00
N23 G01 X0 Y0 G40 F10.
N24 M02
%

Fig. IV.8.20

The following movement will be executed at each intersection point according to the state of the "SMOOTH TAPER" switch.

- **A line is inserted when the "Smooth Taper" switch is OFF.**

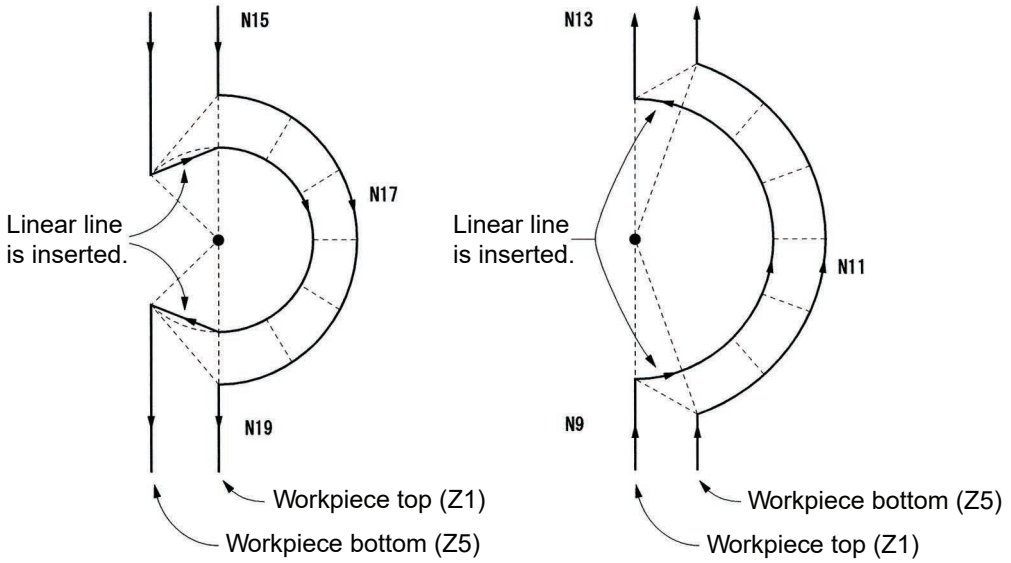


Fig. IV.8.21

- **When the "Smooth Taper" switch is ON, the wire moves so that the workpiece top and bottom reach the intersection point simultaneously. (Aline is not inserted.)**

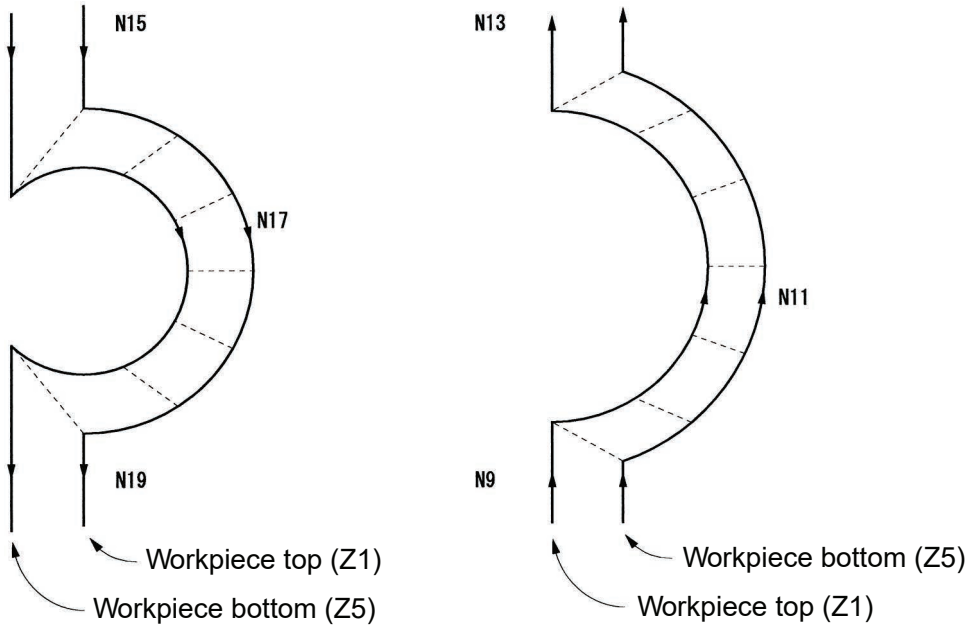


Fig. IV.8.22

2) When an intersection point is distant or does not exist

"During straight machining"

When an intersection point does not exist, three blocks are inserted automatically as shown in Fig. IV.8.23.

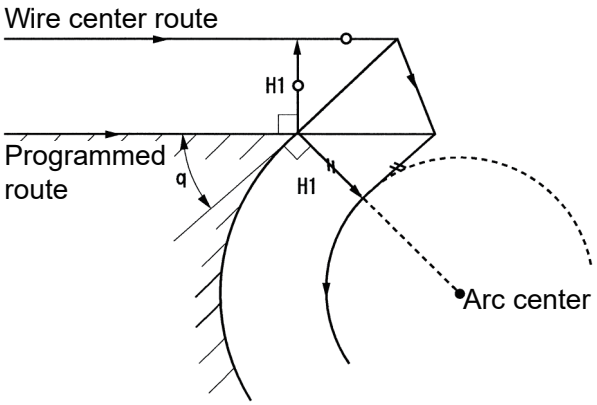


Fig. IV.8.23

"During taper machining"

When an intersection point does not exist in either the wire center route or the taper route, three blocks are inserted automatically as shown in Fig. IV.8.24.

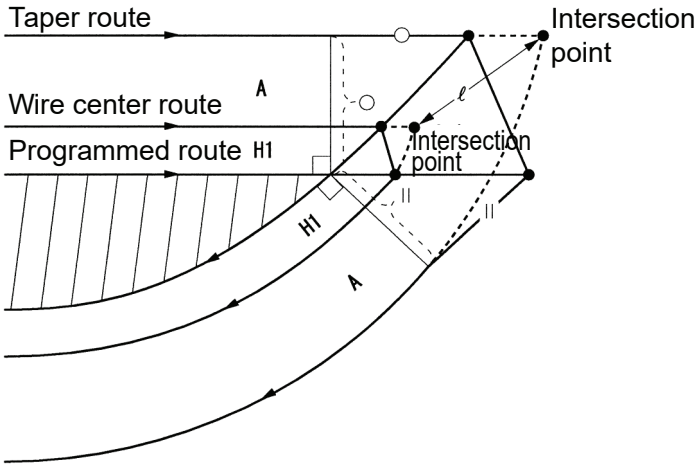


Fig. IV.8.24

When the wire diameter compensation amount or taper angle is changed, the wire moves so that each length of "○" and "//" in Fig. IV.8.23 and Fig. IV.8.24 becomes the same.

3) When not obtaining the intersection point

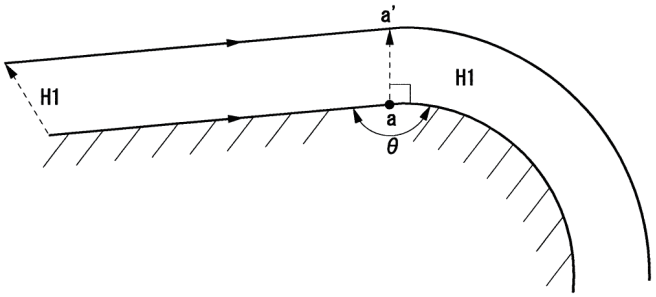


Fig. IV.8.25

When a line and arc come in contact with each other (175.0° ≤ θ ≤ 185.0°), their intersection point is not obtained. The wire center moves to the wire diameter compensation point (a') perpendicular to the start point of the arc (a).

When the wire diameter compensation amount (HΔΔΔ) is changed when the line and arc come in contact, the movement becomes as follows according to the status of the "T-Ang @ Blk-End" switch.
(This switch is valid only when the "Smooth Taper" switch is ON.)

1. When the "T-Ang @ Blk-End" switch is OFF

"When an intersection point exists"

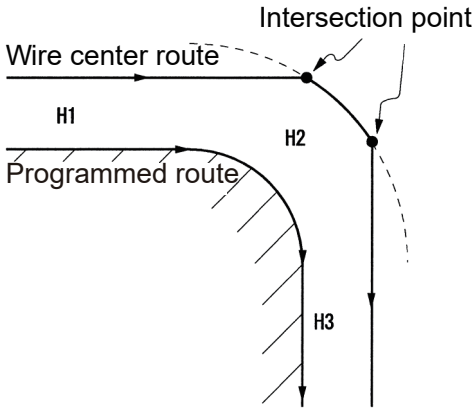


Fig. IV.8.26

Wire moves to the line and arc intersection point.

"When an intersection point does not exist"

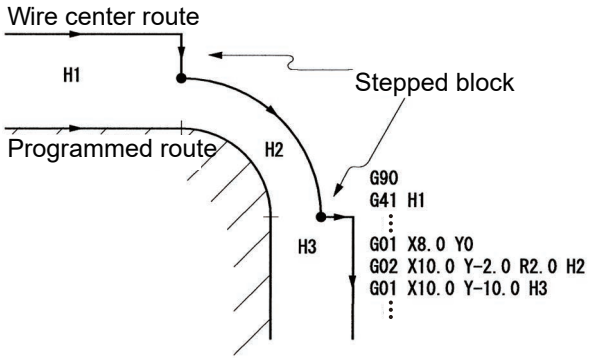


Fig. IV.8.27

A stepped block of the amount of the wire diameter compensation amount difference is inserted.

2. When the "T-Ang @ Blk-End" switch is ON

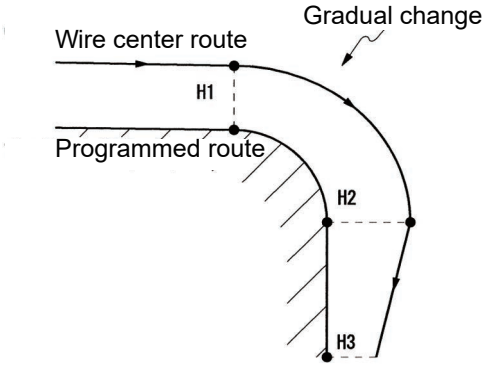


Fig. IV.8.28

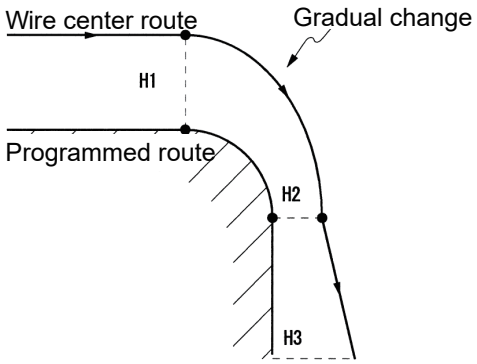


Fig. IV.8.29

The wire diameter compensation amount is gradually changed in the commanded block so that the specified amount is achieved by the end point of the block where the change is commanded.

When the taper angle (AΔΔΔ) is changed when the line and arc come in contact, the movement becomes as follows according to the status of the "Smooth Taper" and "T-Ang @ Blk-End" switches.
(The "T-Ang @ Blk-End" switch is valid only when the "Smooth Taper" switch is ON.)

1. When the "Smooth Taper" switch is OFF

"When an intersection point exists"

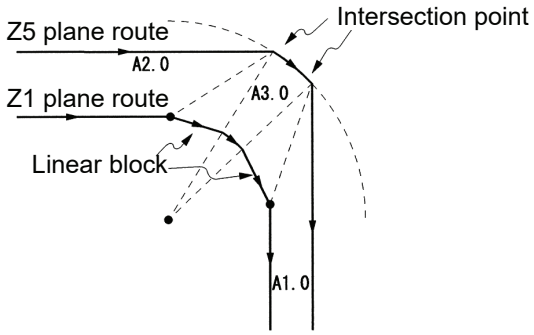


Fig. IV.8.30

The wire moves to the intersection point of the line and arc and then a linear block is generated.

```
G90
G41
⋮
G01 X8. 0 Y0 R2. 0
G02 X10. 0 Y-2. 0 R2. 0 A3. 0
G01 X10. 0 Y-10. 0 A1. 0
⋮
```

"When an intersection point does not exist"

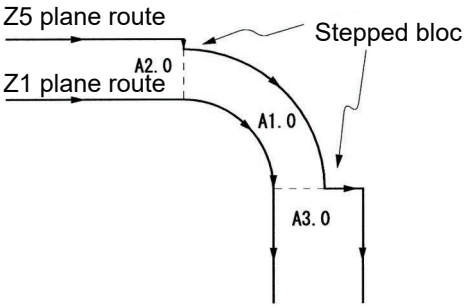


Fig. IV.8.31

A stepped block of the taper angle difference amount is inserted.

```
G90
G41
⋮
G01 X8. 0 Y0 A2. 0
G02 X10. 0 Y-2. 0 R2. 0 A1. 0
G01 X10. 0 Y-10. 0 A1. 0
⋮
```

Continuation:

2. When the "Smooth Taper" switch is ON

(1) When the "T-Ang @ Blk-End" switch is OFF

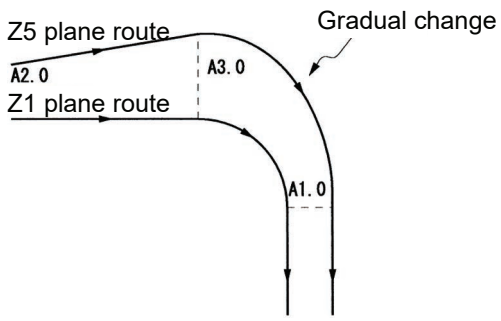


Fig. IV.8.32

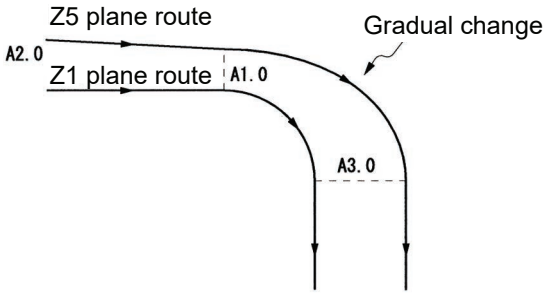


Fig. IV.8.33

The taper angle is gradually changed in the previous movement block so that the specified angle is achieved by the start point of the block where the change is commanded.

(2) When the "T-Ang @ Blk-End" switch is ON

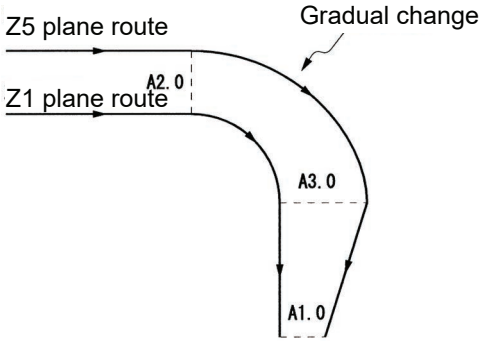


Fig. IV.8.34

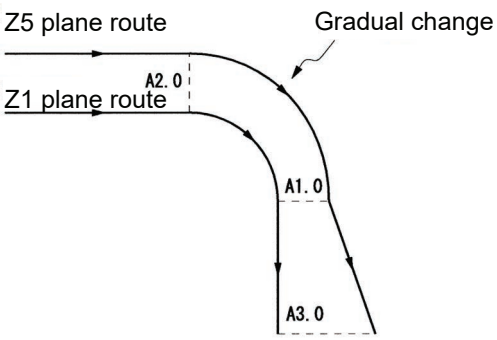


Fig. IV.8.35

The taper angle is gradually changed in the commanded block so that the specified angle is achieved by the end point of the block where the change is commanded.

(3) << Arc ⟷ Arc >>

1) General case

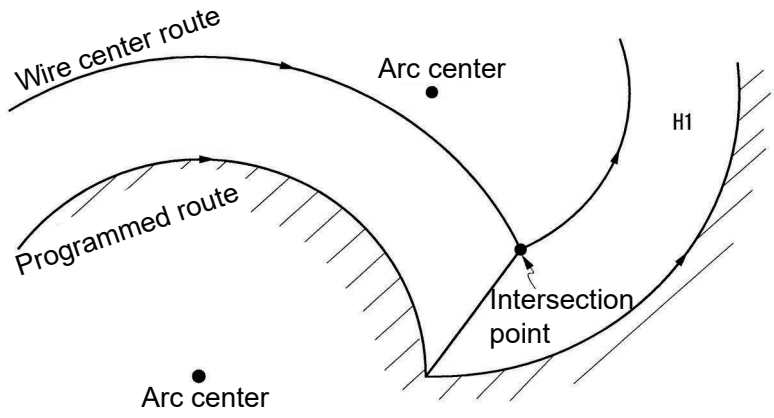
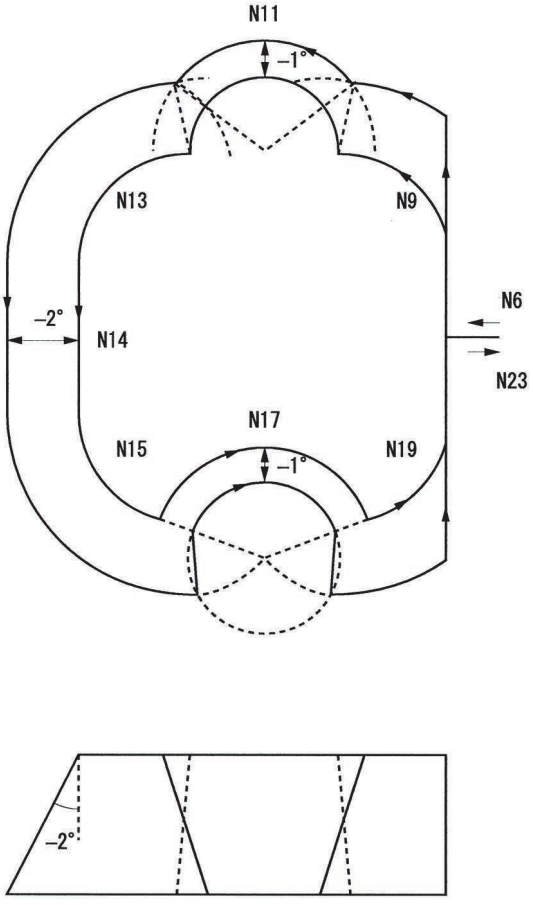


Fig. IV.8.36



NC program
N1 M80
N2 M82
N3 M84
N4 G90
N5 G92 X0 Y0
N6 G42 X-5000 Y0
N7 G01 X-5000 Y5000
N8 A-20000
N9 G03 X-13154 Y12471 I-7500 J0
N10 A-10000
N11 G03 X-21846 Y12471 I-4346 J-2471
N12 A-20000
N13 G03 X-30000 Y5000 I-654 J-7471
N14 G01 X-30000 Y-5000
N15 G03 X-24472 Y-12236 I7500 J0
N16 A-10000
N17 G02 X-10528 Y-12236 I16972 J-2764
N18 A-20000
N19 G03 X-5000 Y-5000 I-1972 J7236
N20 A0
N21 G01 X-5000 Y0
N22 M00
N23 G01 X0 Y0 G40 F10.
N24 M02
%

Fig. IV.8.37

The wire will move as shown below at each intersection point.

1. A line is inserted when the "Smooth Taper" switch is OFF.

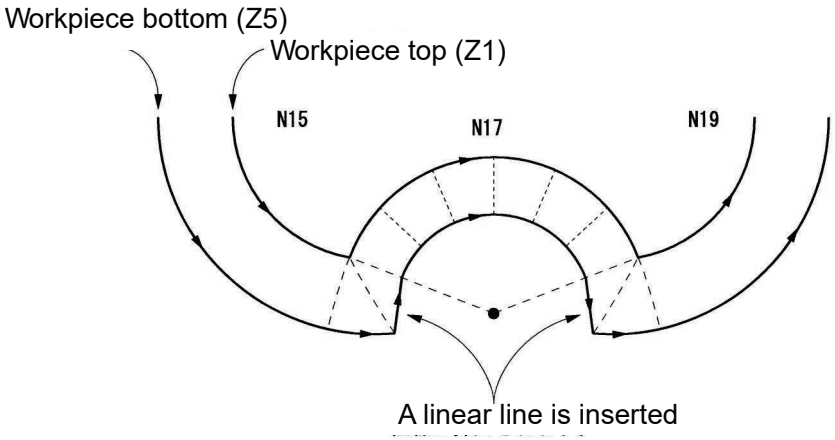


Fig. IV.8.38

2. When the "Smooth Taper" switch is ON, the wire moves so that the workpiece top and bottom reach the intersection point simultaneously. (A line is not inserted.)

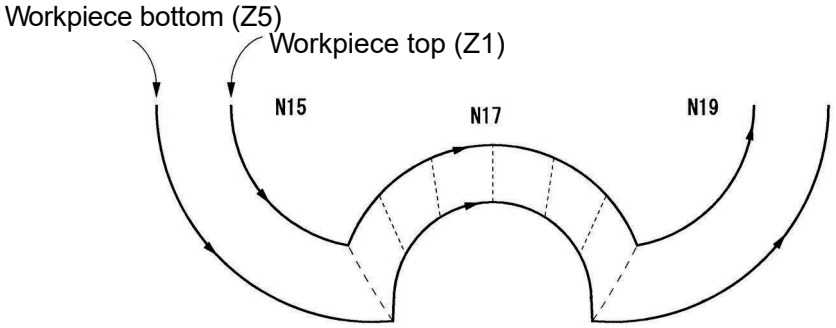


Fig. IV.8.39

2) When an intersection point is distant or does not exist

"During straight machining"

When an intersection point does not exist, three blocks are inserted automatically as shown in Fig. IV.8.40.

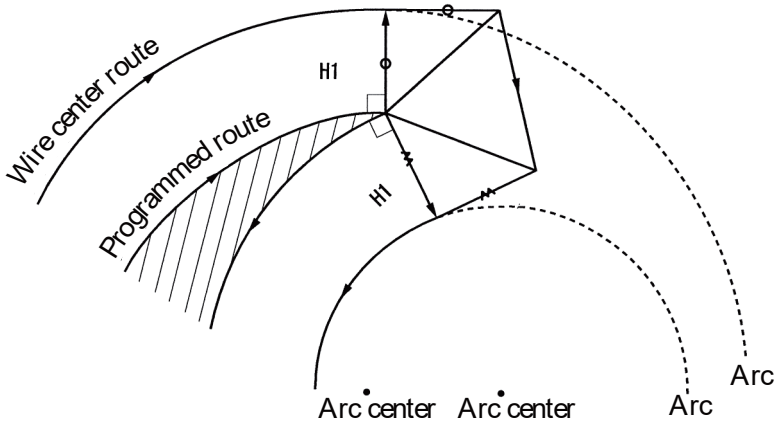


Fig. IV.8.40

"During taper machining"

When an intersection point does not exist in either the wire center route or the taper route, three blocks are inserted automatically as shown in Fig. IV.8.41.

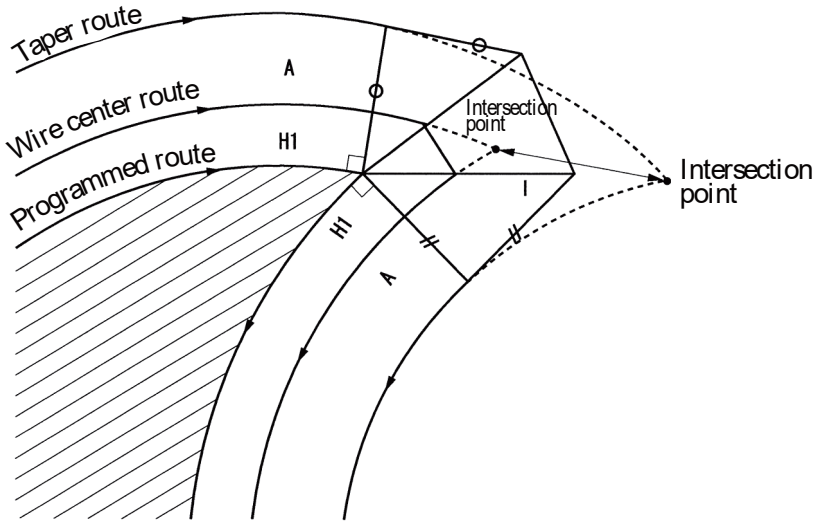


Fig. IV.8.41

When the wire diameter compensation amount or taper angle is changed, the wire moves so that each length of "○" and "//" in Fig. IV.8.40 and Fig. IV.8.41 becomes the same.

3) When not obtaining the intersection point

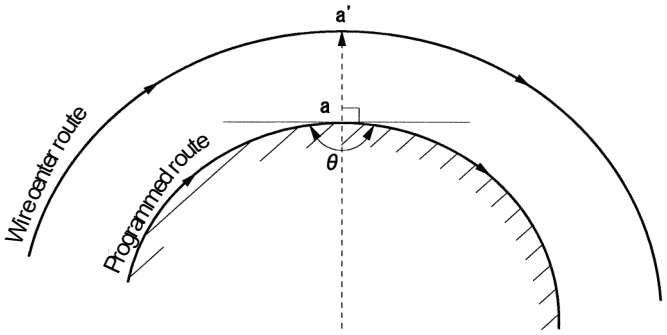


Fig. IV.8.42

When two arcs are extremely close to each other (175.0° ≤ θ ≤ 185.0°), the intersection point of the two arcs is not obtained. The wire center moves to the wire diameter compensation position (a') perpendicular to the start point (a) of the second arc.

When the wire diameter compensation amount (HΔΔΔ) is changed when the arc and arc come in contact, the movement becomes as follows according to the status of the "T-Ang @ Blk-End" switch.
(This switch is valid only when the "Smooth Taper" switch is ON.)

1. When the "T-Ang @ Blk-End" switch is OFF

"When an intersection point exists"

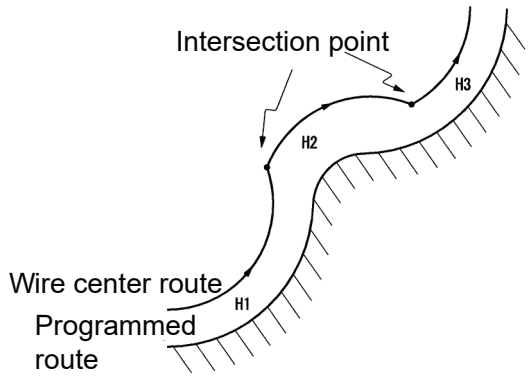


Fig. IV.8.43

The wire moves to the intersection point of the arc and arc.

```
G90
G41 H1
⋮
G03 X5. 0 Y5. 0 R5. 0
G02 X7. 0 Y7. 0 R2. 0 H2
G03 X12. 0 Y12. 0 R5. 0 H3
⋮
```

"When an intersection point does not exist"

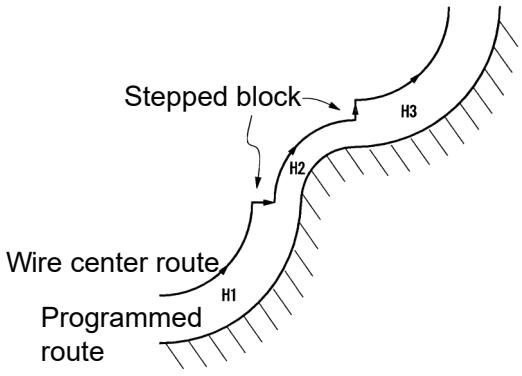


Fig. IV.8.44

A stepped block of the amount of the wire diameter compensation amount difference is inserted.

```
G90
G41 H1
⋮
G03 X5. 0 Y5. 0 R5. 0
G02 X7. 0 Y7. 0 R2. 0 H2
G03 X12. 0 Y12. 0 R5. 0 H3
⋮
```

2. When the "T-Ang @ Blk-End" switch is ON

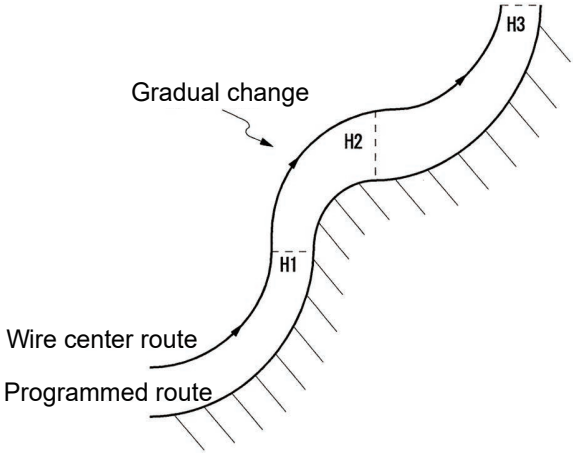


Fig. IV.8.45

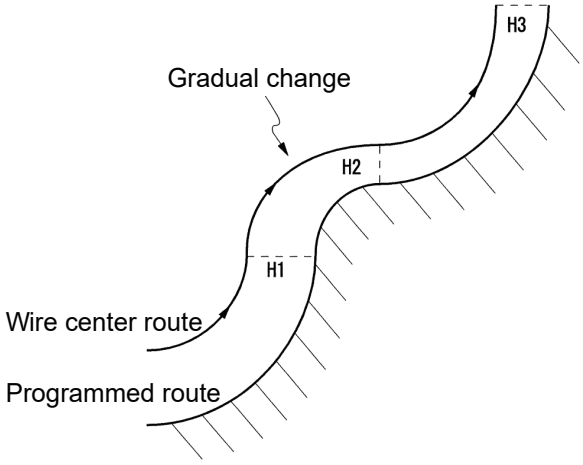


Fig. IV.8.46

The wire diameter compensation amount is gradually changed in the commanded block so that the specified amount is achieved by the end point of the block where the change is commanded.

When the taper angle (AΔΔΔ) is changed when the arc and arc come in contact, the movement becomes as follows according to the status of the "Smooth Taper" and "T-Ang @ Blk-End" switches.
(The "T-Ang @ Blk-End" switch is valid only when the "Smooth Taper" switch is ON.)

1. When the "Smooth Taper" switch is OFF

"When an intersection point exists"

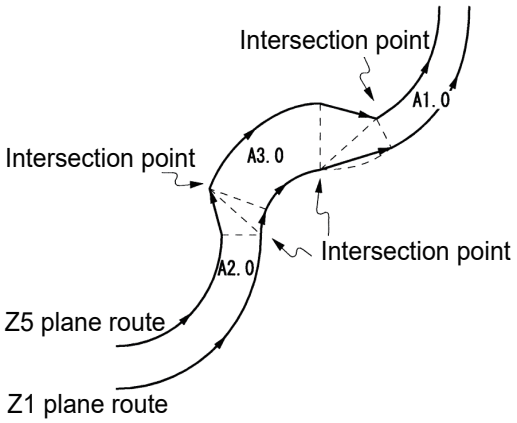


Fig. IV.8.47

The wire moves to the intersection point of the arc and arc. However, linear blocks are generated before and after the intersection point.

```
G90
G41 A2. 0
⋮
G03 X5. 0 Y5. 0 R5. 0
G02 X7. 0 Y7. 0 R2. 0 A3. 0
G03 X12. 0 Y12. 0 R5. 0 A1. 0
⋮
```

"When an intersection point does not exist"

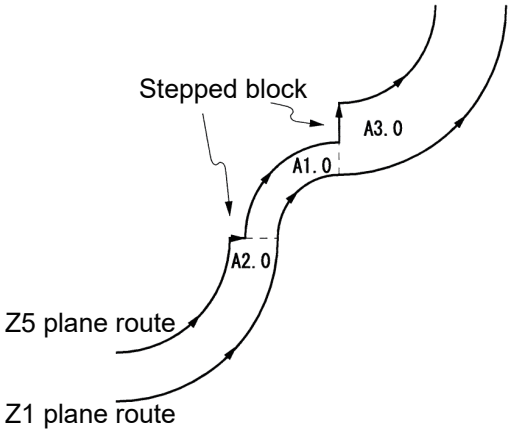


Fig. IV.8.48

A stepped block of the taper angle difference amount is inserted.

```
G90
G41 A2. 0
⋮
G03 X5. 0 Y5. 0 R5. 0
G02 X7. 0 Y7. 0 R7. 0 A1. 0
G03 X12. 0 Y12. 0 R5. 0 A3. 0
⋮
```

Continuation:

2. When the "Smooth Taper" switch is ON

(1) When the "T-Ang @ Blk-End" switch is OFF

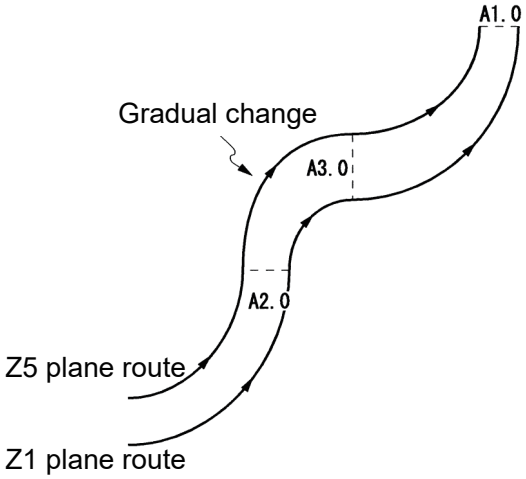


Fig. IV.8.49

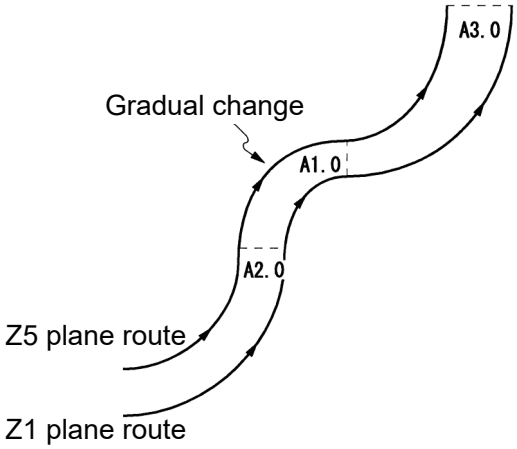


Fig. IV.8.50

The taper angle is gradually changed in the previous movement block so that the specified angle is achieved by the start point of the block where the change is commanded.

(2) When the "T-Ang @ Blk-End" switch is ON

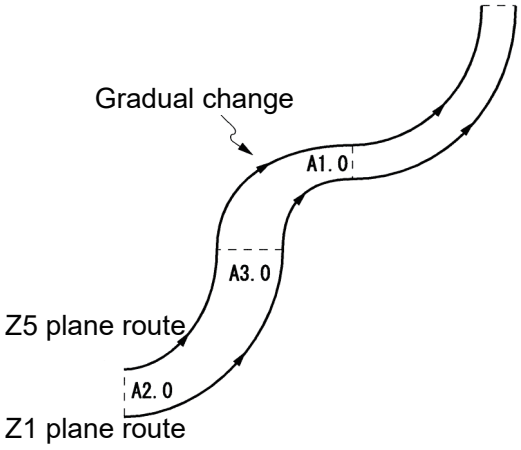


Fig. IV.8.51

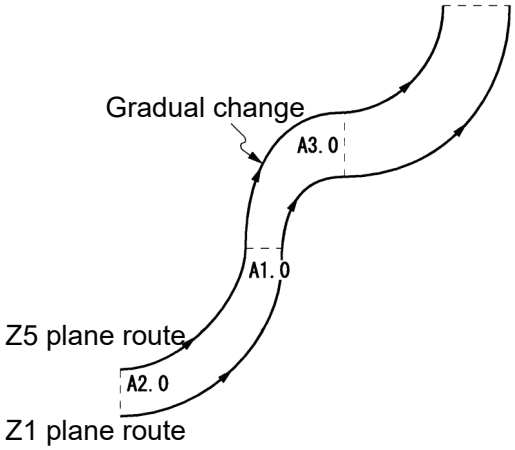


Fig. IV.8.52

The taper angle is gradually changed in the commanded block so that the specified angle is achieved by the end point of the block where the change is commanded.

8.3.2 Corner R mode (G88)

The corner R mode moves the wire to the position perpendicular to the end point of each program path and inserts a corner R block before starting the next movement.

(1) << Line ←→ Line >>

(Mode that changes wire diameter compensation amount during line movement.)

Wire moves outside

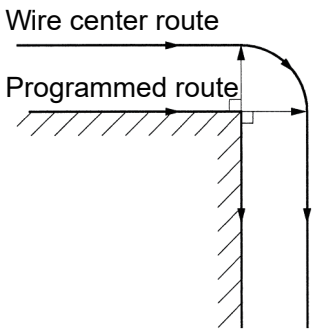


Fig. IV.8.53

Wire moves inside

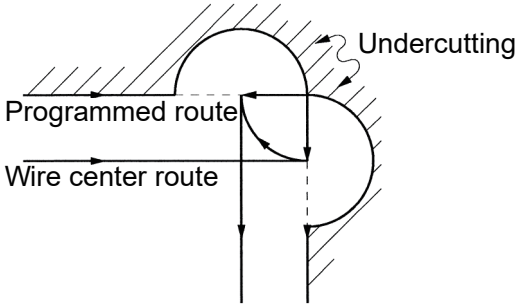


Fig. IV.8.54

When adjusting the wire diameter compensation amount or taper angle in a linear block, the determined wire diameter compensation amount becomes effective from the start point of the linear block.

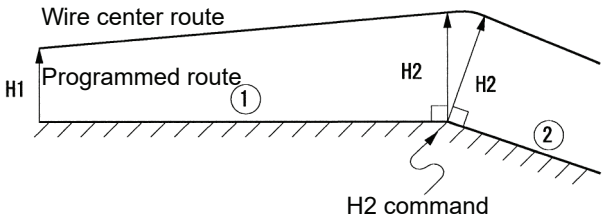


Fig. IV.8.55

NC program
N1 G88
N2 M80
N3 M82
N4 M84
N5 G90
N6 G92 X0 Y0
N7 G42 X0 Y5000
N8 G01 X5000 Y5000
N9 A-10000
N10 G01 X5000 Y15000
N11 A-20000
N12 G01 X-5000 Y15000
N13 A-30000
N14 G01 X-5000 Y5000
N15 A0
N16 G01 X0 Y5000
N17 M00
N18 G01 X0 Y0 G40 F10.
N19 M02
%

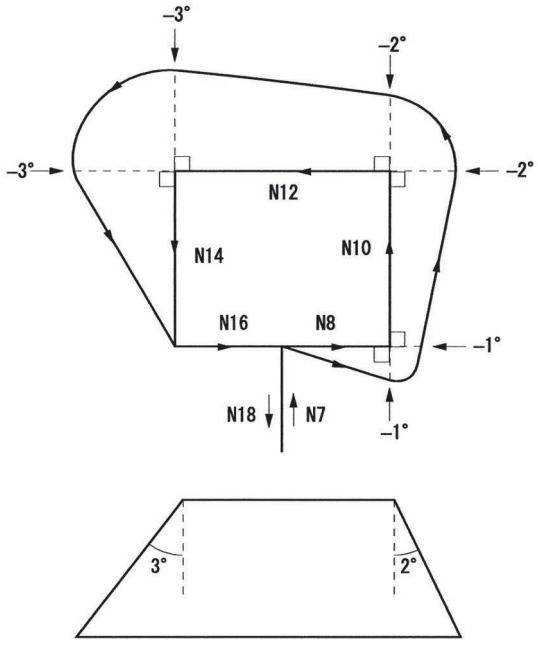


Fig. IV.8.56

Fig. IV.8.57 shows an example of when the taper angles were all set to + (positive) in the above NC program example.
Note that if the taper angle is on the in-corner side, the movement will be as shown in Fig. IV.8.57.

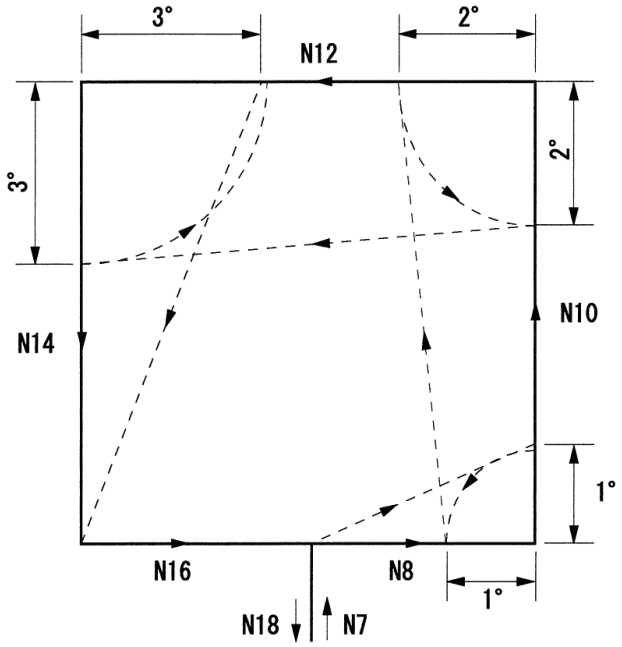


Fig. IV.8.57

(2) <<Line ←→ Arc >>

Wire moves outside

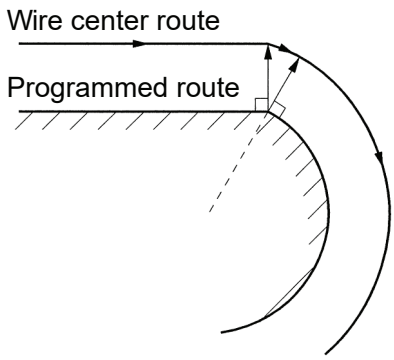


Fig. IV.8.58

Wire moves inside

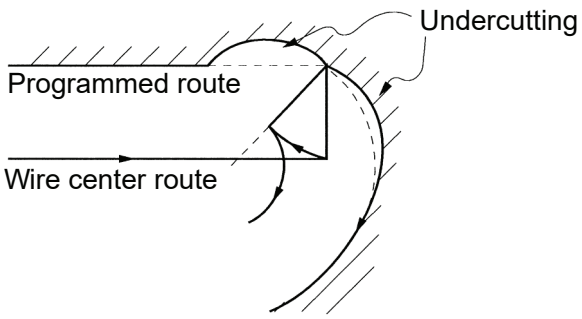


Fig. IV.8.59

When the wire diameter compensation amount (HΔΔ) or taper angle (AΔΔΔ) is input in a circular block, the wire diameter compensation amount is the specified amount to the start point of the circular block.

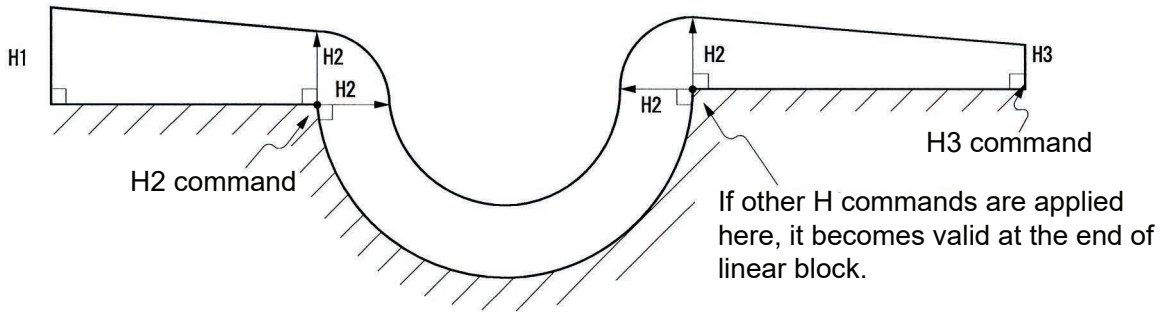
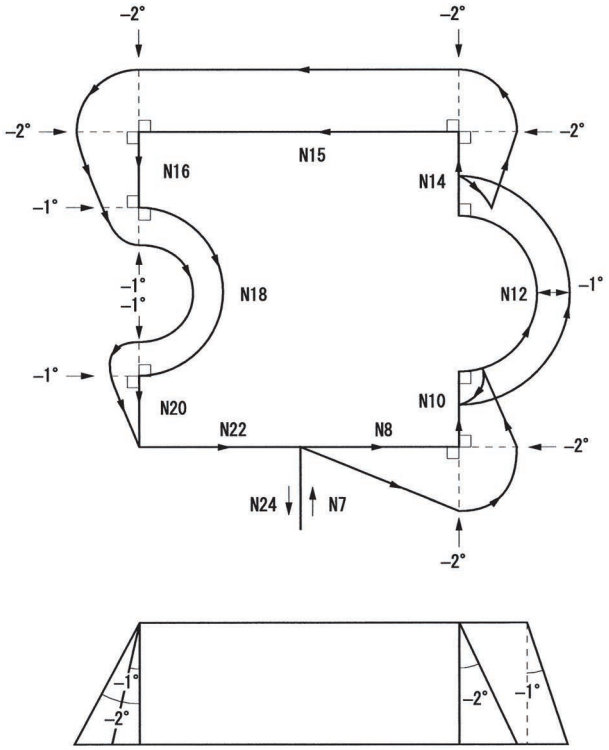


Fig. IV.8.60



NC program
N1 M88
N2 M80
N3 M82
N4 G84
N5 G90
N6 G92 X0 Y0
N7 G42 X0 Y5000
N8 G01 X10000 Y5000
N9 A-20000
N10 G01 X10000 Y10000
N11 A-10000
N12 G03 X10000 Y20000 I0 J5000
N13 A-20000
N14 G01 X10000 Y25000
N15 G01 X-10000 Y25000
N16 G01 X-10000 Y20000
N17 A-10000
N18 G02 X-10000 Y-10000 I0 J-5000
N19 A-20000
N20 G01 X-10000 Y5000
N21 A0
N22 G01 X0 Y5000
N23 M00
N24 G01 X0 Y0 G40 F10.
N25 M02
%

Fig. IV.8.61

(3) << Arc ⟷ Arc >>

Wire moves outside

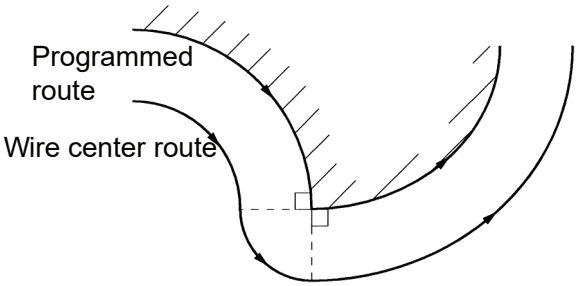


Fig. IV.8.62

Wire moves inside

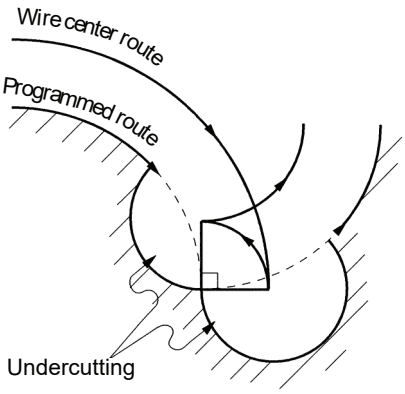
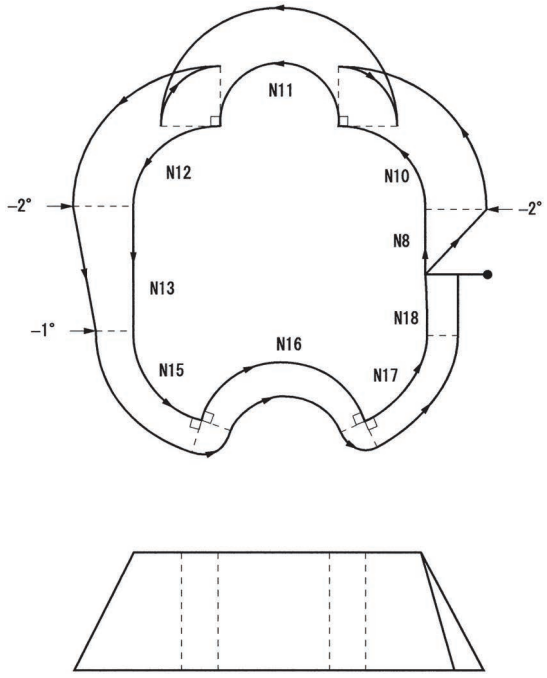


Fig. IV.8.63

The wire diameter compensation amount (HΔΔΔ) and taper angle (AΔΔΔ) cannot be adjusted at the connection point of two circular blocks.



NC program
N1 G88
N2 M80
N3 M82
N4 G84
N5 G90
N6 G92 X0 Y0
N7 G42 X-5000 Y0
N8 G01 X-5000 Y5000
N9 A-20000
N10 G03 X-13154 Y12471 I-7500 J0
N11 G03 X-21846 Y12471 I-4346 J-2471
N12 G03 X-30000 Y5000 I-654 J-7471
N13 G01 X-30000 Y-5000
N14 A-10000
N15 G03 X-24472 Y-12236 I7500 J0
N16 G02 X-10528 Y-12236 I6972 J-2764
N17 G03 X-5000 Y-5000 I-1972 J7236
N18 G01 X-5000 Y0
N19 M00
N20 G01 X0 Y0 G40 F10.
N21 M02
%

Fig. IV.8.64

8.4 Upper and Lower Identical R (G87), Upper and Lower Radius Specification (Q), and Center of Taper Plane (Z5) Specification (QI, QJ)

8.4.1 Function and purpose

This command is used to command the circular movement on the Z5 plane for taper machining without depending on the taper angle.

8.4.2 Command format

(1) When using a circular command on the corner

Upper and lower identical R
G01(G02(G03)) X_Y_(I_J_(R_))
  G02(G03) X_Y_(I_J_(R_))G87(QI_QJ_)
G01(G02(G03)) X_Y_(I_J_(R_))
Upper and lower radius specification
G01(G02(G03)) X_Y_(I_J_(R_))
  G02(G03) X_Y_(I_J_(R_))Q_(QI_QJ_)
G01(G02(G03)) X_Y_(I_J_(R_))

(2) When using , R on the corner

Upper and lower identical R
G01(G02(G03)) X_Y_(I_J_(R_)), R_G87(QI_QJ_)
G01(G02(G03)) X_Y_(I_J_(R_))
Upper and lower radius specification
G01(G02(G03)) X_Y_(I_J_(R_)), R_Q_(QI_QJ_)
G01(G02(G03)) X_Y_(I_J_(R_))

G87 Upper and lower identical R specification
Q Taper plane radius
QI, QJ Taper plane arc center specification (incremental amount from the Z1 plane center)

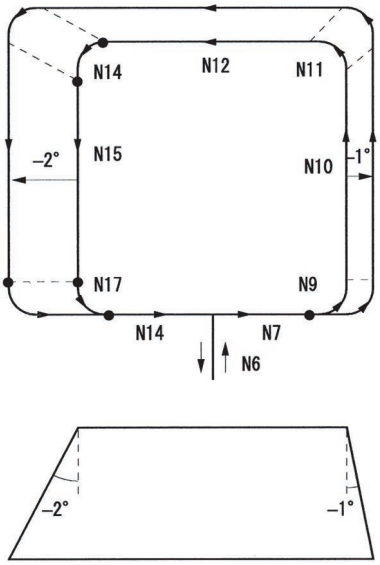
8.4.3 Detailed explanation

(1) When using a circular command on the corner

In the circular block in which G87 or Q is commanded, the arc has either upper and lower identical R or the arc upper and lower radius specification.

1) Program example (upper and lower identical R)

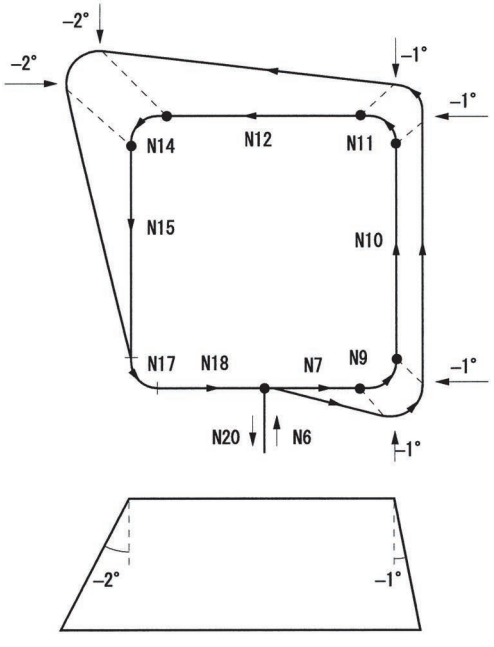
(a) For intersection calculation mode (G89)



NC program
N1 M80
N2 M82
N3 M84
N4 G90
N5 G92 X0 Y0
N6 G42 X0 Y5000
N7 G01 X7500 5000 G87
N8 A-10000
N9 G03 X10000 Y7500 I0 J2500
N10 G01 X10000 Y22500 G87
N11 G03 X7500 Y25000 I-2500 J0
N12 G01 X-7500 Y25000 G87
N13 A-20000
N14 G03 X-10000 Y22500 I0 J-2500
N15 G01 X-10000 Y7500 G87
N16 A0
N17 G03 X-7500 Y5000 I2500 J0
N18 G01 X0 Y5000
N19 M00
N20 G01 X0 Y0 G40 F10.
N21 M02
%

Fig. IV.8.65

(b) For corner R mode (G88)

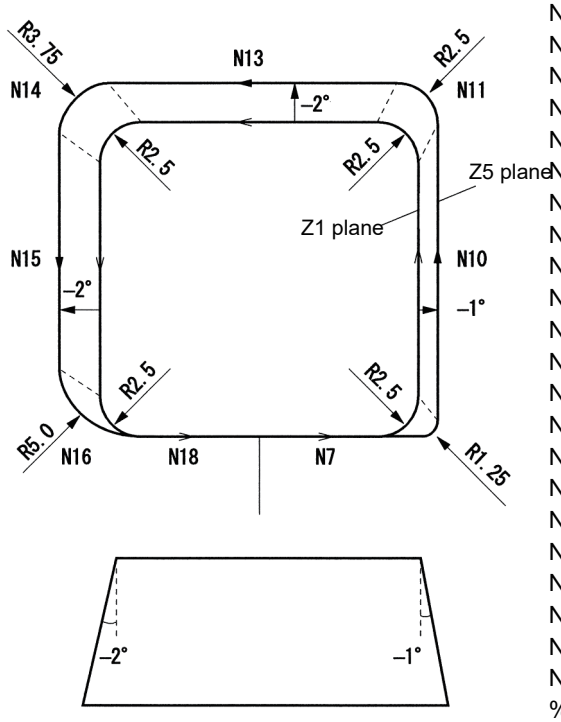


NC program
G88
N1 M80
N2 M82
N3 M84
N4 G90
N5 G92 X0 Y0
N6 G42 X0 Y5000
N7 G01 X7500 Y5000 G87
N8 A-10000
N9 G03 X10000 Y7500 I0 J2500
N10 G01 X10000 Y22500 G87
N11 G03 X7500 Y25000 I-2500 J0
N12 G01 X-7500 Y25000 G87
N13 A-20000
N14 G03 X-10000 Y22500 I0 J-2500
N15 G01 X-10000 Y7500 G87
N16 A0
N17 G03 X-7500 Y5000 I2500 J0
N18 G01 X0 Y5000
N19 M00
N20 G01 X0 Y0 G40 F10.
N21 M02
%

Fig. IV.8.66

2) Program example (Upper and lower radius specification)

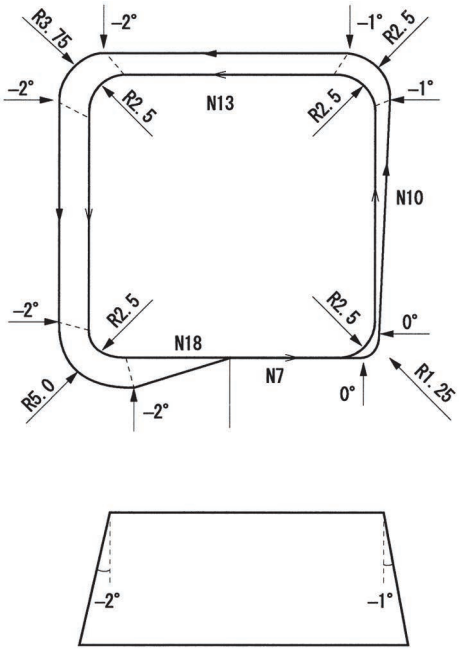
(a) For intersection calculation mode (G89)



NC program
N1 M80
N2 M82
N3 M84
N4 G90
N5 G92 X0 Y0
N6 G42 X0 Y5000
N7 G01 X7500 Y5000
N8 G03 X10000 Y7500 I0 J2500 Q1250
N9 A-10000
N10 G01 X10000 Y22500
N11 G03 X7500 Y25000 I-2500 J0 Q2500
N12 A-20000
N13 G01 X-7500 Y25000
N14 G03 X-10000 Y22500 I0 J-2500 Q3750
N15 G01 X-10000 Y7500
N16 G03 X-7500 Y5000 I2500 J0 Q5000
N17 A0
N18 G01 X0 Y5000
N19 M00
N20 G01 X0 Y0 G40 F10.
N21 M02
%

Fig. IV.8.67

(b) For corner R mode (G88)

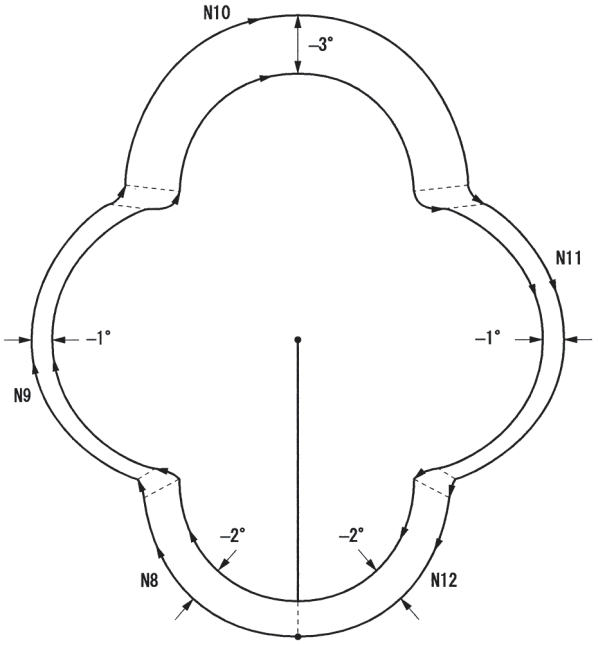


NC program
G88
N1 M80
N2 M82
N3 M84
N4 G90
N5 G92 X0 Y0
N6 G42 X0 Y5000
N7 G01 X7500 Y5000
N8 G03 X10000 Y7500 I0 J2500 Q1250
N9 A-10000
N10 G01 X10000 Y22500
N11 G03 X7500 Y25000 I-2500 J0 Q2500
N12 A-20000
N13 G01 X-7500 Y25000
N14 G03 X-10000 Y22500 I0 J-2500 Q3750
N15 G01 X-10000 Y7500
N16 G03 X-7500 Y5000 I2500 J0 Q5000
N17 A0
N18 G01 X0 Y5000
N19 M00
N20 G01 X-0 Y0 G40 F10.
N21 M02
%

Fig. IV.8.68

(2) When using , R on the corner

When G87 or Q is commanded with , R, the inserted corner arc has either upper and lower identical R or the arc upper and lower radius specification.

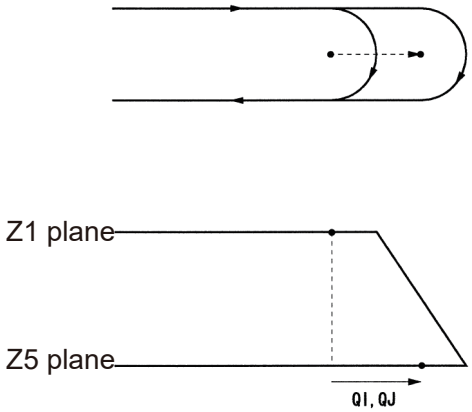



```
N1   N80
N2   M82
N3   M84
N4   G90
N5   G92 X0 Y0
N6   H1 = 0. 2 A0
N7   G42 Y-10. 0
N8   G02 X-5.   Y-5.   R5. 0, R0. 5 G87 A-2.
N9   G02 X-5.   Y5.   R5. 0, R0. 5 G87 A-1.
N10  G02 X5.   Y5.   R5. 0, R0. 5 G87 A-3.
N11  G02 X5.   Y-5.   R5. 0, R0. 5 G87 A-1.
N12  G02 X0 Y-10.   R5. 0 A-2.
N13  G40 X0 Y0
N14  M02
%
```

Fig. IV.8.69

(3) Taper plane arc center specification

The center of the taper plane arc in the upper and lower identical R or upper and lower radius specification arc can be specified with addresses QI and QJ.




```
N1   M80
N2   M82
N3   M84
N4   G90
N5   G92 X0 Y0
N6   A0
N7   G41 X5. 0 Y0
N8   G01 X5. 0 Y1. 0
N9   G01 X10. 0 Y1. 0
N10  G02 X10. 0 Y-1. 0 I0 J-1. 0 G87 A12. 0 QJ0
N11  G01 X5. 0 Y-1. 0
N12  G01 X5. 0 Y0
N13  G40 X0 Y0
N14  M02
%
```

Fig. IV.8.70

1. **When the preceding block of the upper and lower identical R arc is a linear block, G87 can be commanded in this linear block.**

G01	X_Y_G87	⟺	G01	X_Y_
G02	X_Y_R_		G02	X_Y_R_G87

equivalent

2. **The upper and lower identical R command works the same as when the IJ command radius and Q command radius are matched in the upper and lower radius specification.**
3. **When the taper plane arc center (QI, QJ) is not specified, it is automatically calculated.**
4. **It can be specified even when the arc of the upper and lower identical R or upper and lower radius specification is not in contact with the preceding and following blocks.**

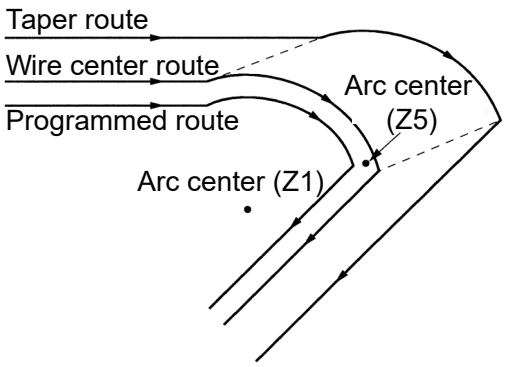


Fig. IV.8.71

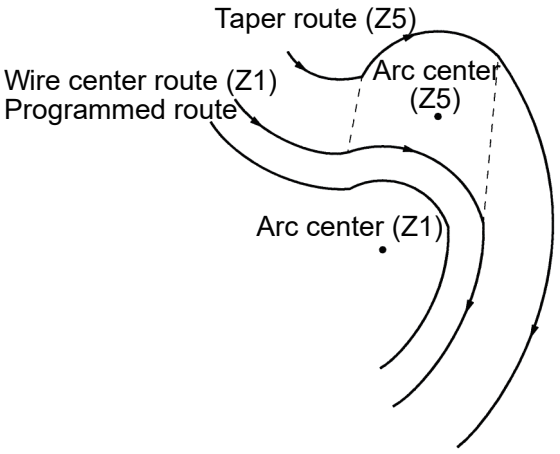


Fig. IV.8.72

5. **In the following case, the arc of the upper and lower identical R or upper and lower radius specification will not be inserted and the shape will be a taper.**
   (1) When the angle θ created by the linear blocks preceding and following the arc is 0°±5° or 180°±5°. (See CAUTION 6 as well.)

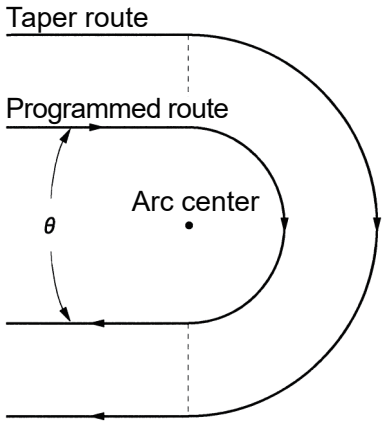


Fig. IV.8.73

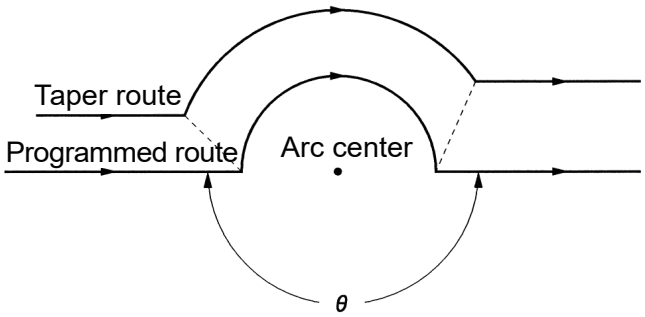


Fig. IV.8.74

6. When the radius is identical at the upper and lower arc and the taper angle of the linear blocks preceding and following the arc do not change, even if the angle is 180°±5° in CAUTION 5 (1), the upper and lower identical R is automatically inserted as shown in Fig. IV.8.75.

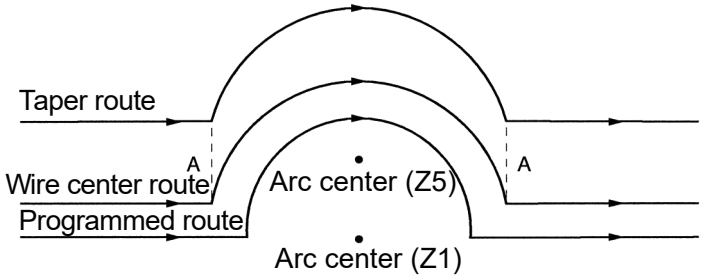


Fig. IV.8.75

7. The "L.S.P. NOTHING" error occurs in the following cases.

(1) When the preceding or following block of an upper and lower identical R or upper and lower radius specification arc is circular, and the center of the taper plane arc cannot be obtained.

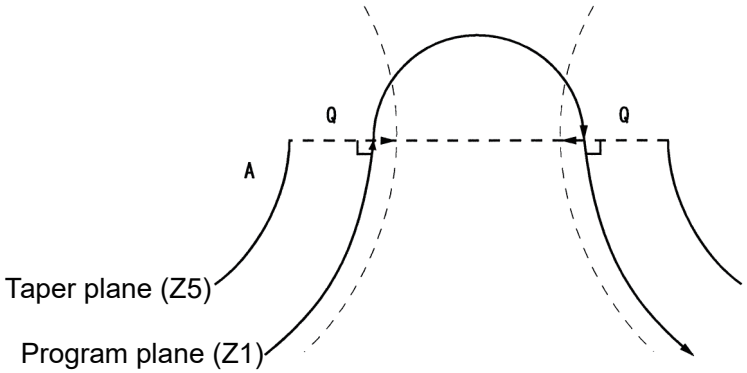


Fig. IV.8.76

(2) When the intersection point cannot be obtained between the arc created by specifying the center of the taper plane arc and its preceding or following block.

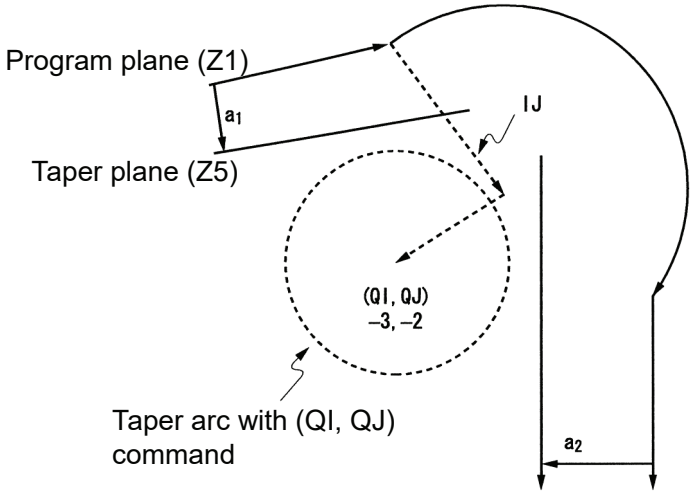


Fig. IV.8.77

8. When a block preceding or following the upper and lower identical R is not a line, the radii of the Z1 plane arc and the Z5 plane arc are the same, but the opening angle of the arcs (arc lengths) do not always match.

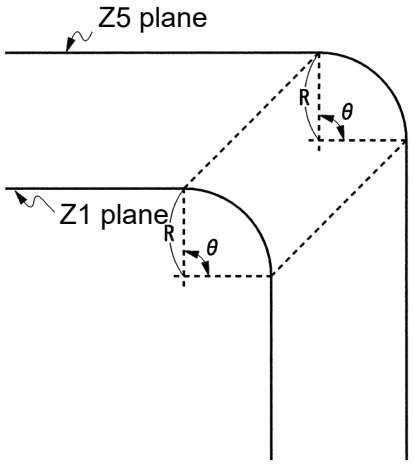


Fig. IV.8.78

When both the blocks preceding and following the upper and lower identical R are arcs, the radii and arc lengths of them are equal.

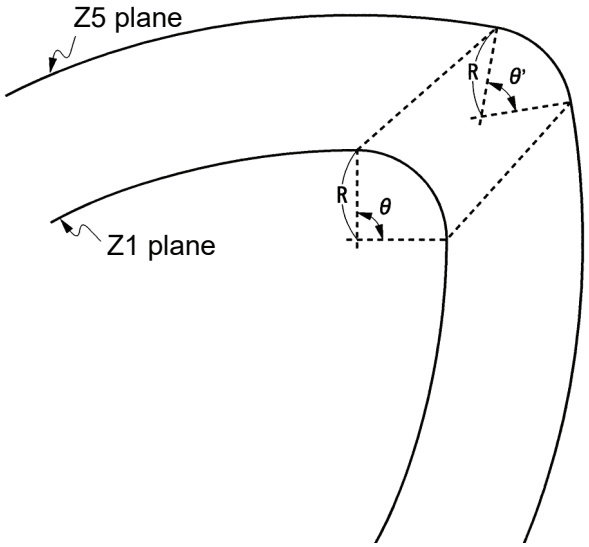


Fig. IV.8.79

When a block preceding or following the upper or lower identical R is an arc, the radii are equal but the arc lengths do not match.

8.5 Cutting Prevention Function by Wire Diameter Compensation (Interference check function)

The wire diameter compensation mode has a function of determining the wire center route automatically to avoid excessive cutting by the wire. As there are cases where excessive cutting is unavoidable even with this function, note the following explanations.
The interference check function is effective only in the intersection point calculation mode (G89).

8.5.1 When the programmed route and wire center route obtained by an intersection point calculation move in opposite directions

(1) Machining a groove smaller than the wire diameter compensation amount

When machining the inside of a groove smaller than the wire diameter compensation amount, the direction of the programmed route and direction of the wire center route obtained by intersection point calculation are reversed, and excessive cutting occurs.
In this case, the wire moves a path that avoids excessive cutting via the position (point E) obtained by an intersection calculation of N100 and N102, as shown in Fig. IV.8.80.

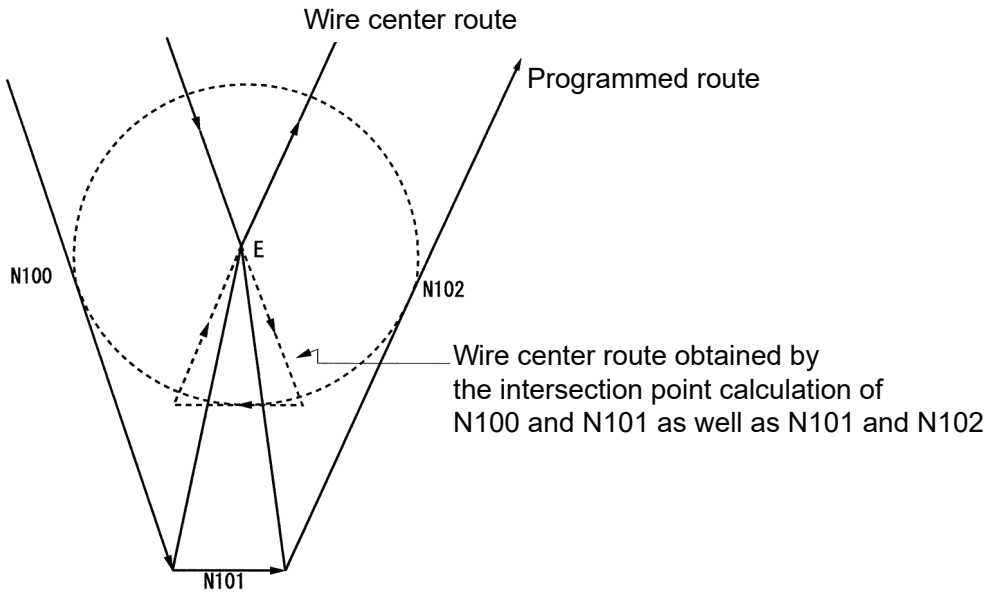


Fig. IV.8.80

The compensation plane movement commanded in the N101 block is ignored (skipped over), and the wire is moved from N100 to N102 via point E.

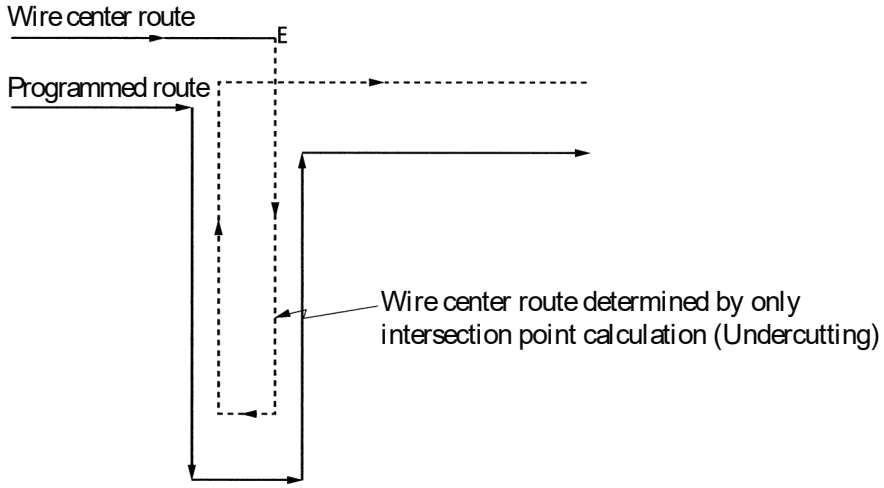


Fig. IV.8.81

As Fig. IV.8.81, when a groove having a smaller size than the wire diameter is to be machined, the movement of the tool stops at point E and a program error occurs.

For the example shown in Fig. IV.8.81, see "8.5.3 Other alarms (errors) in processing interference blocks" in this chapter.

(2) When inserted block cuts too far

For a movement outside of a narrow angle, three linear blocks are inserted at the corner. ("8.3 Corner Processing Mode (G88, G89)") Executing all the three movements may cause excessive cutting.

In this case, the wire center route is determined to prevent excessive cutting by partially omitting the movements of the inserted blocks.

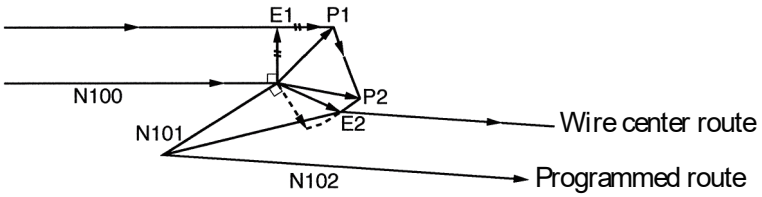


Fig. IV.8.82

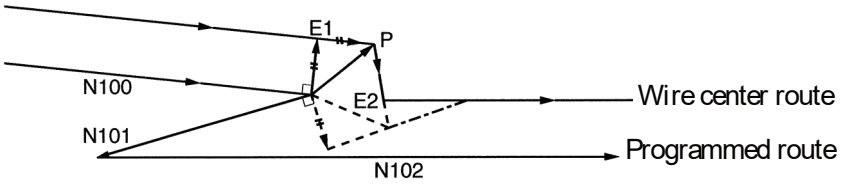


Fig. IV.8.83

8.5.2 Inserted blocks interfere with each other

If the compensation vectors which define the inserted blocks intersect (interfere) with each other, executing the three inserted blocks causes excessive cutting.
In this case the wire center route is determined to prevent excessive cutting by eliminating all or part of the inserted block.

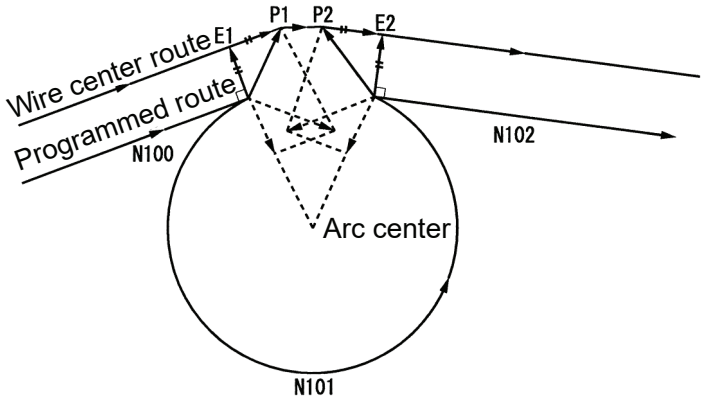


Fig. IV.8.84

In Fig. IV.8.84, N101 and N102 each have one insertion block for $\overline{E_1P_1}$ and $\overline{E_2P_2}$ respectively.
The movements of the axes other than the compensation plane axis of N102 are executed simultaneously with the linear movement (G01) $\overline{P_1E_2}$.
(At this time, the circular movement becomes a linear movement, but the modal value of movement code remains unchanged.)

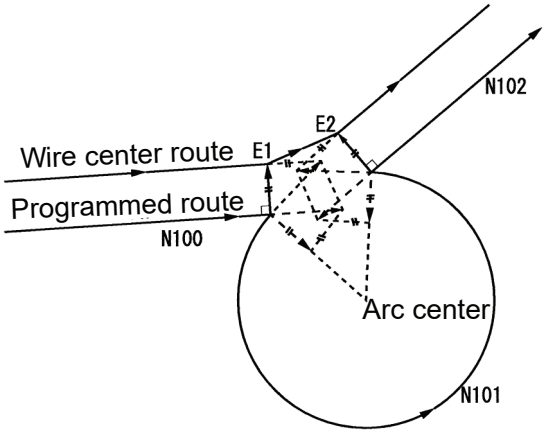


Fig. IV.8.85

In Fig. IV.8.85, the movement of the circular command block N101 is linear movement $\overline{E_1E_2}$ on the compensation plane.
(The modal value of the movement G code remains unchanged.)

8.5.3 Other alarms (errors) in processing interference blocks

(1) When all the compensation vectors defining the inserted blocks are eliminated

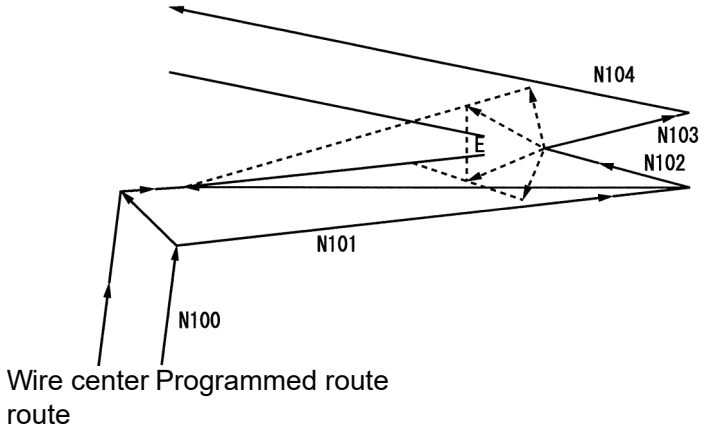


Fig. IV.8.86

When all the compensation vectors defining the inserted blocks are eliminated as shown in Fig. IV.8.86, the excessive cutting occurs. After executing the N101 block, the wire stops at point E with a program error.

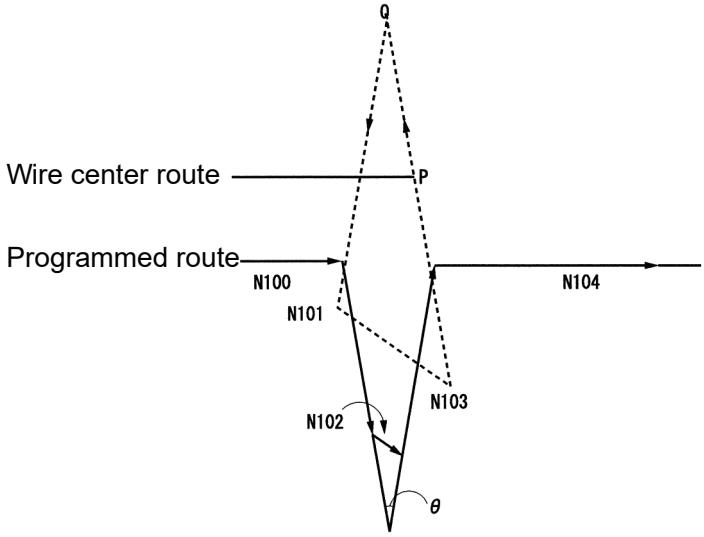


Fig. IV.8.87

When an interference occurs with a very narrow angle as shown in Fig. IV.8.87, calculating the intersection in the preceding and following blocks (N101 and N103) result in the intersection point to be point Q in the figure, causing a dangerous situation. If the interference occurs as shown in Fig. IV.8.87 and θ is smaller than 11.2°, an alarm occurs and the wire movement stops at point P after the N100 cutting ends.

8.5.4 Conditions for enabling the cutting prevention processing (interference check)

(1) Advanced reading of the three blocks with the G0, G1, G2, G3, G2.1 or G3.1 movement is possible
There is no G27, G28, G29, G30, G48, G60, G92, M20, or M53
The three blocks read in advance will be explained as N100, N101, and N102 in the following section. (Fig. IV.8.88.)

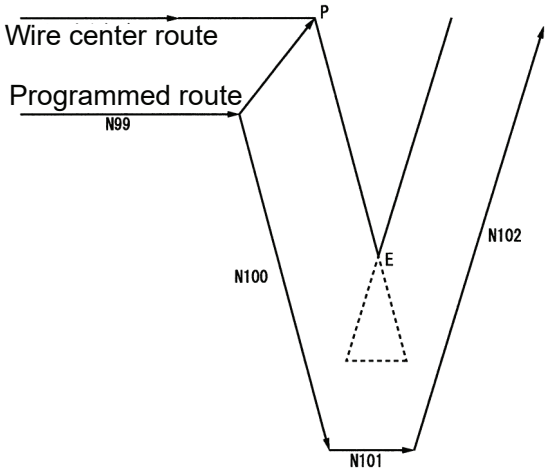


Fig. IV.8.88

(2) The three blocks N100, N101, and N102 must not contain the following blocks.

1) G41, G42, or G40 command (compensation start, compensation end command)
2) G88 command (corner R mode command)
3) G02(G03) I_J_ command (circle command)
4) G87 command (upper and lower identical R command), Q command (upper and lower specification R arc)
5) UV command (upper and lower free shape)

1. Even when the above conditions are satisfied, appropriate processing cannot be performed after the interference in the following state, and a program error occurs.

2. Cases in which interference will occur again when interference check is executed are shown in (1) and (2).

(1) When the N100 block is skipped or reduced to a movement command consisting of only the inserted part as a result of the last interference check
In this case, either excessive cutting has already occurred or excessive cutting is about to occur at the remaining inserted part.
< Example 1 >

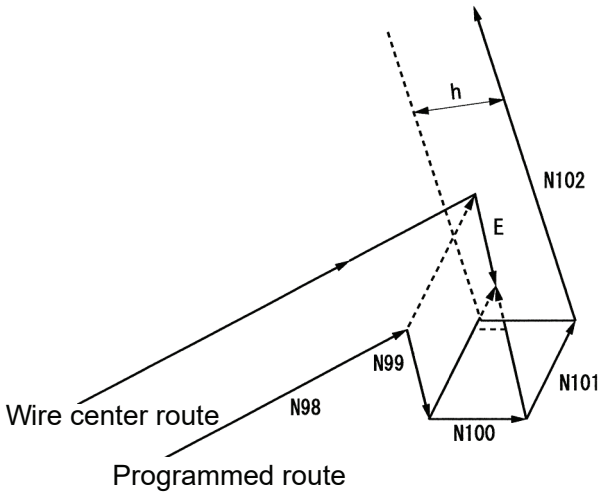


Fig. IV.8.89

When N100 has already been skipped, the wire has moved to point E at machining of N99, which means that excessive cutting has already occurred.
The wire stops at point E and a program error occurs.

< Example 2 >

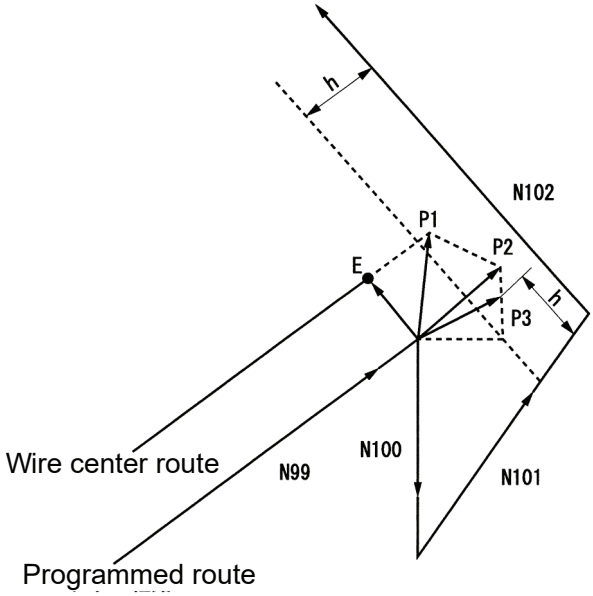


Fig. IV.8.90

In Fig. IV.8.90, the three blocks $\overline{EP_1}$, $\overline{P_1P_2}$, and $\overline{P_2P_3}$ are inserted as a result of the interference check of the three blocks N99, N100, and N101.
When the interference check is performed for N100, N101, and N102, it is judged that there is an interference again. In this case, the wire stops at point E after machining of N99, and a program error occurs.
(In this case, excessive cutting has not occurred yet.)

(2) When the movement G code of N100 is changed internally as a result of the last interference check
(The modal value is not changed.)
< Example >

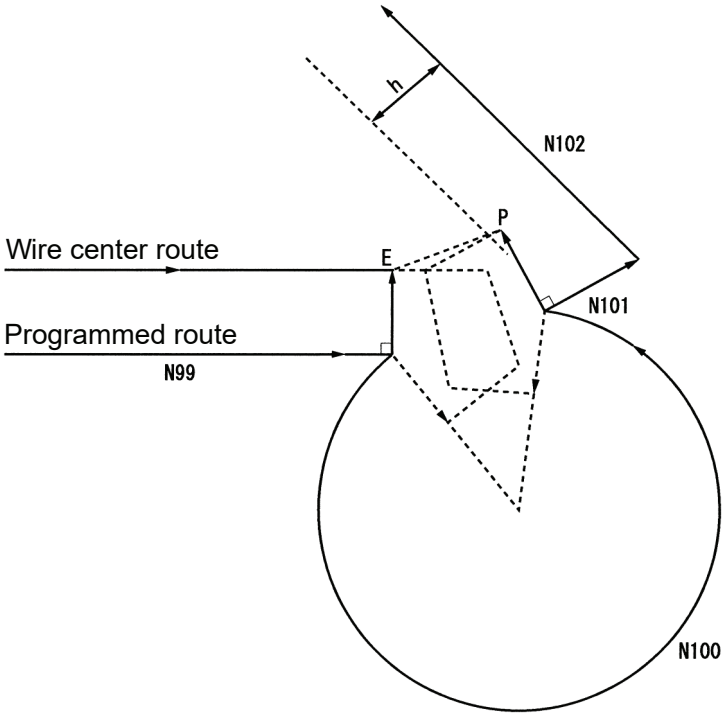


Fig. IV.8.91

In this example, the circular block N100 performs the linear movement $\overline{EP}$ as a result of the interference check of N99, N100, and N101. When the interference check is performed for the three blocks, N100, N101, and N102, it is judged that interference occurs at N101.
In this case, a program error occurs at point E immediately before the execution of N100 and the wire stops.

8.5.5 Limitations of interference checking by three-block advanced reading

There are limitations on preventing excessive cutting by three-block advanced reading. Since excessive cutting may still occur, care should be taken. Note the following two limitations:

(1) Interference processing cannot be performed when four or more blocks interfere.

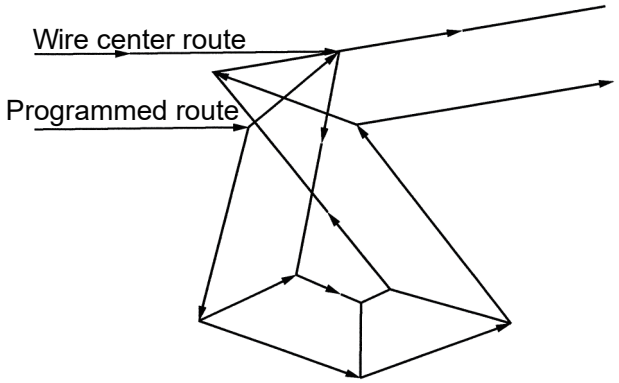


Fig. IV.8.92

In Fig. IV.8.92, the center of the wire moves on the thick line and causes excessive cutting with no interference detected.

(2) When there are inserted blocks at both ends, the wire always passes through the points on the front and rear normal vectors.
(Fig. IV.8.92.)

8.5.6 Example of interference check function

The interference check function is valid when "Inter.Chk" is turned ON in the screen displayed by selecting "Initial settings" > "Machine parameters" > "Machining setting" > "Auto2".
This function is valid only with the intersection point calculation mode (G89).
(Example of command with offset greater than arc radius)

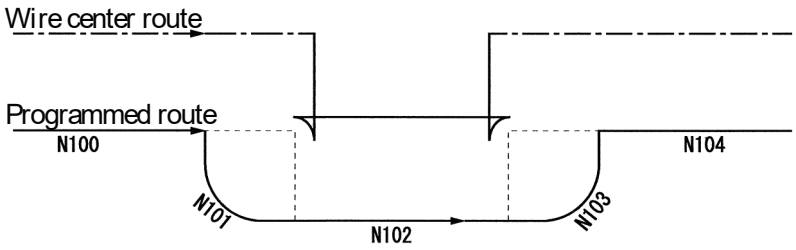


Fig. IV.8.93 The "Inter.Chk" switch OFF

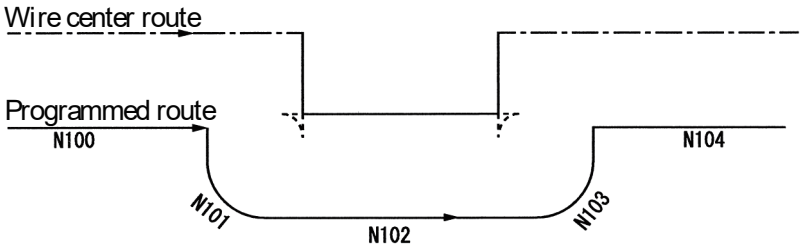


Fig. IV.8.94 The "Inter.Chk" switch ON

8.5.7 "CMP ERROR CHECK" (interference stop) switch

Regarding the interference check function, two operational conditions can be selected by using the "Comp Err. Check" switch on the switch list. This switch is valid only when the "Inter.Chk" switch is ON.

(1) If "Comp Err. Check" has not been selected, a compensation route which is free from excessive cutting is automatically selected by the diameter compensation check function.

(2) If "Comp Err. Check" has been selected, a program error (interference alarm) occurs when the interference is detected.
The following demonstrates the operation of the above two cases using a typical interference example.

```
N100 G91 G41 G01 X30.  Y50.  H1 F1000
N101 X30.
N102 X30.  Y-60.
N103 X10.
N104 X30.  Y60.
N105 X60.  Y-20.      Compensation amount H1 = 20.
  ⋮
```

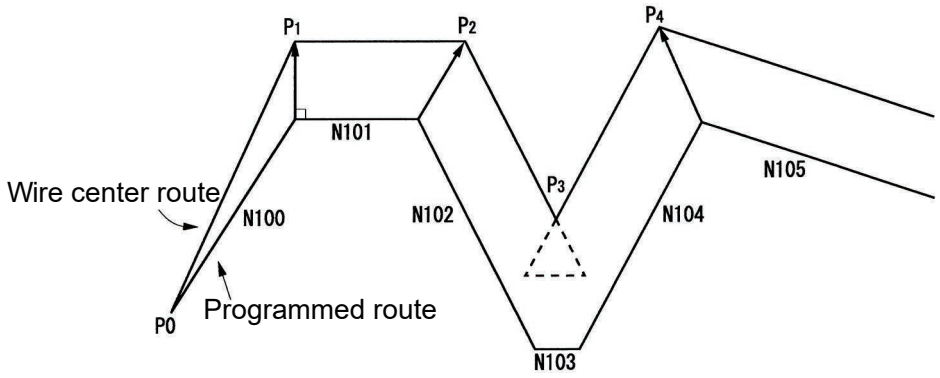


Fig. IV.8.95

- When the "Comp Err. Check" switch is OFF
  The wire moves in the order of $P_0 \rightarrow P_1 \rightarrow P_2 \rightarrow P_3 \rightarrow P_4$… as a result of the interference check.
- When the "Comp Err. Check" switch is ON
  The wire moves in the order of $P_0 \rightarrow P_1 \rightarrow P_2$ as a result of the interference check, and stops with a program error.

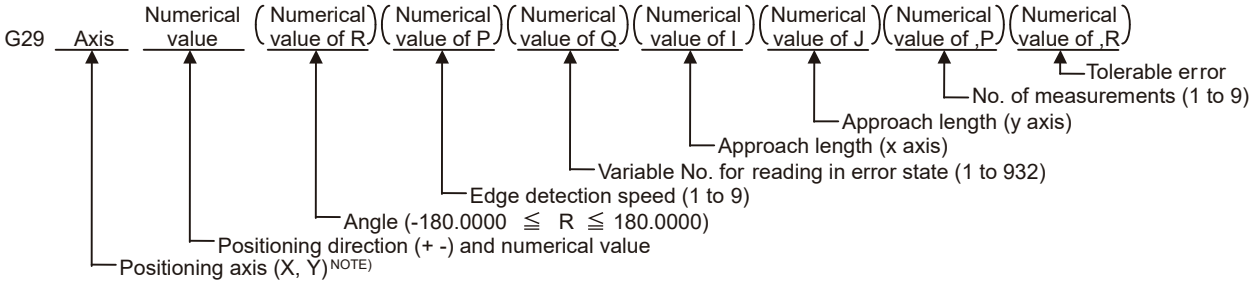
9. MACHINING SUPPORT FUNCTION

9.1 Edge Positioning (G29)

9.1.1 Function and purpose

Wire and workpiece contact positioning is carried out.

9.1.2 Format



Only positive and negative numerical signs are valid.

(1) "P command"

Edge detection will be executed at the following speeds according to the value set in P.

Table IV.9.1 Edge detection speed

P command	Speed (mm/min)
1	3
2	6
3	9
4	12
5	15
6	30
7	100
8	300
9	570
Non-specified	60

(2) "Q command"

This command is used to prevent automatic operation from being stopped even if an error such as "IN CONTACT", "STILL CONTACT", and "WIRE BROKEN" occurs during positioning. When a variable number is specified with the Q command, the program will proceed to the next block even if a positioning error occurs. The following values are output to the specified variable number to show whether positioning was executed normally.

0 .....Positioning normal completion
1 .....Positioning failed as the wire and workpiece are in contacted from the start.
2 .....Positioning has become impossible after positioning was started.
3 .....Data not within the tolerable range was found after positioning was repeated.

(3) "I command", "J command"

Specify the distance to be fed at the rapid traverse rate (570 mm/min) in parts that are not required for edge positioning. Only I is valid when the positioning axis is x, and only J is valid for y.

(4) ", P command" ", R command"

This function is used to automatically determine if the positioning completion position inconsistency is within the normal range after edge positioning is repeated for the specified number of times. (The normal range is three times the specified tolerable error.)

9.1.3 Supplement

(1) The command is applicable to only one axis. When commands are simultaneously applied to two or more axes, priority is given in the order of X and Y.

(2) When edge positioning is complete, the wire will be touching the edge of workpiece.

(3) The following will occur if each address is omitted.

1) If the P specification is omitted, the edge detection speed will be 60 mm/min.

2) If the Q specification is omitted and an error occurs during positioning, an alarm will be triggered and automatic operation will be stopped.

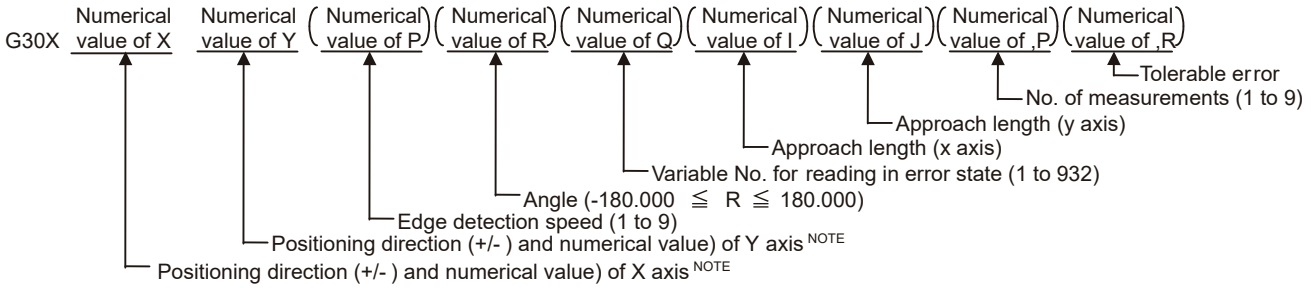
For the WT, WS, and PT notches to be used for positioning, the value set in the "Pickup" screen is used. For details, see "III. NC OPERATION DISPLAY SCREEN".

9.2 Hole Center Positioning (G30)

9.2.1 Function and purpose

The workpiece hole center position is obtained.

9.2.2 Format



- **Only positive and negative numerical signs are valid.**
- **The command is applicable to only one axis. When commands are simultaneously applied to two or more axes, alarm "M625 WIRE BROKEN" occurs.**

(1) "I command", "J command"

Specify the distance to be fed at the rapid traverse rate (570 mm/min) in parts that are not required for the hole center positioning. Only I is valid when the positioning axis is X, and only J is valid for Y.

(2) "Others"

See "9.1 Edge Positioning (G29)" in this chapter.

9.2.3 Supplement

(1) Only the X or Y axis is valid for the axis command. The Z axis and B axis are invalid even if they are commanded.

(2) The following will occur if each address is omitted.

1) If the P specification is omitted, the edge detection speed will be 60 mm/min.

2) If the Q specification is omitted and an error occurs during positioning, an alarm will be triggered and automatic operation will be stopped.

For the WT, WS, and PT notches to be used for positioning, the value set in the "Pickup" screen is used. For details, see "III. NC OPERATION DISPLAY SCREEN".

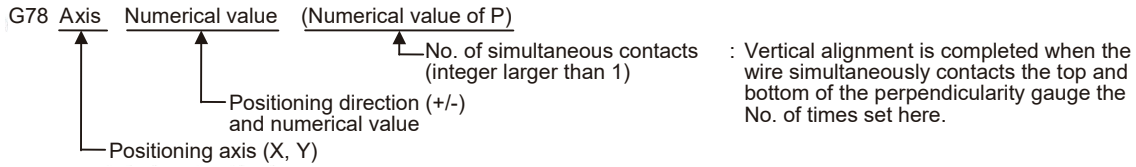
9.3 Automatic Vertical Alignment (G78)

9.3.1 Function and purpose

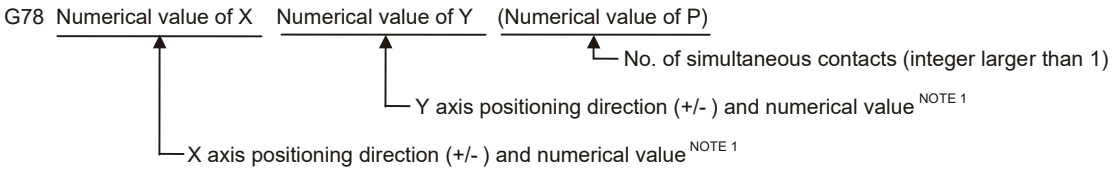
The verticality of the wire to the table is automatically measured with the taper machining unit and wire-alignment device, and the zero points of the UV axes are set.

9.3.2 Format

(1) To carry out vertical alignment and zero point return simultaneously



To vertically align the UV axes with an L-type wire-alignment device



- **When using an L-type wire-alignment device, always move the wire within the range shown in the figure below using the rapid traverse or other method before executing the G78 command.**
  (A position)

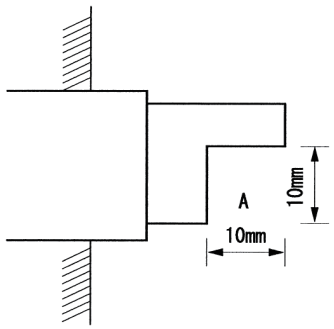


Fig. IV.9.1

(2) To set only the zero point

The UV zero points are set with one of the following commands. G78 sets the UV zero points after automatically vertical alignment. However, setting of only the UV zero points is possible by using one of the following commands.

- G78U0 V0 Q1 When simultaneously setting the UV axes zero points
- G78U0 Q1 When setting the U axis zero point only
- G78 V0 Q1 When setting the V axis zero point only

9.3.3 Supplement

(1) Set the wire tension to the predetermined value (example: PT14 notches and WT8 notches for OB-20P) beforehand. The wire feedrate will be determined automatically.

(2) When the P specification is omitted, the number of simultaneous contacts becomes two.

(3) When vertically aligning the UV axes at once using an L-type wire-alignment device, execute positioning in the order of X axis direction and then Y axis direction.

(4) When the automatic vertical alignment is completed, the UV zero points are automatically set.

9.4 Current Value Reading (G14)

9.4.1 Function and purpose

The current value read function is used to read the current position, etc., into the commanded variable when a current value read command (G14) is issued.

9.4.2 Format

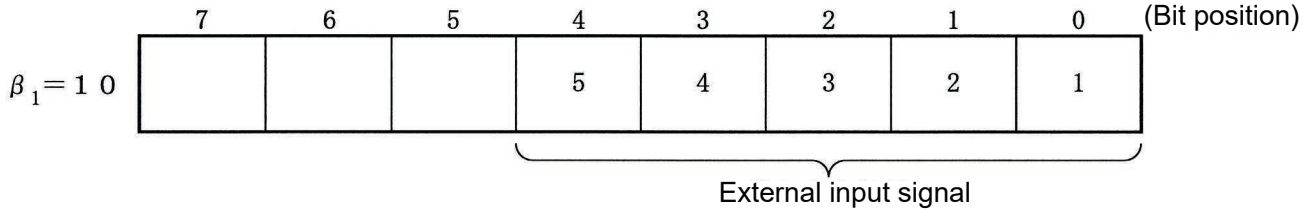
(1) When reading the current position (P0)
G14Xα_1 Yα_2 Uα_3 Vα_4 P0
G14Zα_5 P0
X, Y, U, V, Z .....Axis specification
α_1, α_2, α_3, α_4, α_5 .....Variable number (1 to 932)
When P is omitted, the "current value" is read.

(2) When reading the machine coordinates (P1, P3)
G14Xα_1 Yα_2 Uα_3 Vα_4 P1 or P3
G14Zα_5 P1 or P3
X, Y, U, V, Z .....Axis specification
α_1, α_2, α_3, α_4, α_5 .....Variable number (1 to 932)

(3) When reading the position counter (P4)
G14Xα_1 Yα_2 Uα_3 Vα_4 P4
G14Zα_5 P4
X, Y, U, V, Z .....Axis specification
α_1, α_2, α_3, α_4, α_5 .....Variable number (1 to 932)

(4) When reading the time elapsed after the start (minutes) (P5)
G14Xα_1 Yα_2 Uα_3 Vα_4 P5
G14Zα_5 P5
X, Y, U, V, Z .....Axis specification
α_1, α_2, α_3, α_4, α_5 .....Variable number (1 to 932)

(5) When reading the external input port signal (P7)
(This may not be implemented depending on the model and options.)
G14Xα_1 Yβ_1 P7
α_1.....Variable number (1 to 932)
β_1.....Port number (fixed to 10)



(6) When reading the machining speed (P8)
G14Xα_1 P8
α_1.....Variable number (1 to 932)

(7) When reading the set machining voltage (P9)
G14Xα_1 P9
α_1.....Variable number (1 to 932)
The unit of the read set machining voltage is 0.1 V.

(8) When reading the detected machining voltage (P10)
G14Xα_1 P10
α_1.....Variable number (1 to 932)
The unit of the read detected machining voltage is 0.1 V.

(9) When reading the system status
G14Xα_1 Y20P7
α_1.....Variable number (1 to 932)
With the above command, the system status can be read into the variable specified by address X.

Bit	Details
1	Dry run in progress
2	Inch mode
3	Variable type 2 ON
5	Absolute value command mode
6	× 0.1 mode

G14Xα_1 Y21P7
α_1.....Variable number (1 to 932)
With the above command, the system status can be read into the variable specified by address X.

Bit	Details
3	X mirror image processing
4	Y mirror image processing
5	Axis change processing
6	Figure magnification processing

9.4.3 Detailed explanation

G14 reads the data specified by the value of P into the variables (α_1, α_2, α_3, α_4, and α_5) set for the X, Y, U, V, and Z axes.
The time elapsed after the start (minutes) is read into the variable specified by α_1 for P5 time input. The read variable (data) becomes effective from the next block.
(Application examples)
When reading the current position coordinates of the X, Y, U, and V axes into the variables H50, H51, H52, and H53
G14 X50 Y51 U52 V53 P0
When reading the time elapsed after the start into the variable H55
G14 X55 P5

9.5 Reading and Writing of Time Data (G43.1, G44.1)

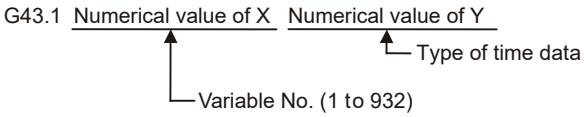
9.5.1 Function and purpose

The time data write function is used to transmit the commanded variable value to the commanded time data, and preset the time data.

On the other hand, the time data read function is used to read various time data into the commanded variable when the time data read command (G44.1) is issued.

9.5.2 Format

(1) To write time data



(2) To read time data

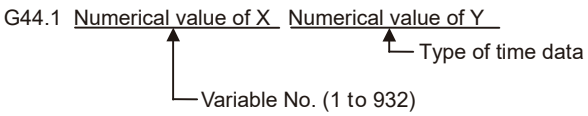


Table IV.9.2 Table of time data type correspondence

Y	Time data		Unit
4	Machining power ON time (machining ON time)		m
7	Starting time 1		m
8	Machining OFF time		m
10	Wire remaining time		m
15	Power feeder rotation	Maintenance time	h
16		Usage time	h
17	Filter replacement	Maintenance time	h
18		Usage time	h
19	Ion exchange resin replacement	Maintenance time	h
20		Usage time	h
21	Specific resistivity sensor cleaning	Maintenance time	h
22		Usage time	h
25	Lubrication oiling	Maintenance time	h
26		Usage time	h

Unit
m: minute
h: hour

- **If the variable number is not within 1 to 932, the operation will stop with the alarm "P241 NO VARI NUMBER".**
- **If the value of Y is not within the range shown in the table of time data type correspondence, the operation will stop with the alarm "P35 CMD-VALUE OVER".**
- **If there is no X or Y command, the operation will stop with the alarm "P33 FORMAT ERROR".**
- **If the maximum time on the display is exceeded during the G43.1 (time data write) command, the operation will stop with the alarm "P35 CMD-VALUE OVER".**

Unit	Maximum time
Hour	9999 hours
Minute	9999 hours 59 minutes (599999 minutes)

- **The value read with the G44.1 (time data read) command becomes effective valid from the next block.**

9.6 Soft Limit (G63, G64)

9.6.1 Function and purpose

This function sets a movement prohibit range for the axis. If the axis tries to enter that movement prohibit range, movement will be stopped.

9.6.2 Command format

(1) Soft limit enabled

G63H Numerical value Numerical value
Valid soft limit value (1 to 5)
0: Outside prohibit 1: Inside prohibit

(2) Soft limit disabled

G64H Numerical value
Invalid soft limitNo. (1 to 5)

> • **Set the soft limit range displayed by selecting "Operation" > "Work setup" > "Soft limit".**

9.6.3 Explanation

< Example 1 > When setting the range of jig 1 to soft limit number 1 and jig 2 to soft limit number 2 as Fig. IV.9.2 and setting both of them to inside prohibit

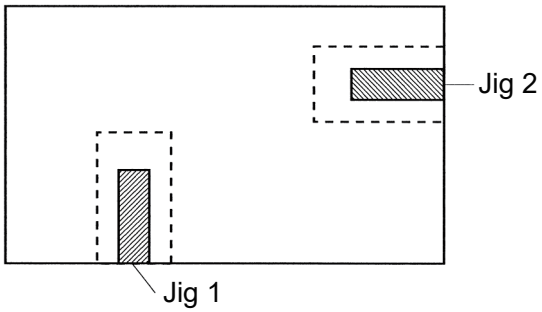


Fig. IV.9.2

G63 H11
G63 H12

10. PROGRAM AUXILIARY FUNCTION

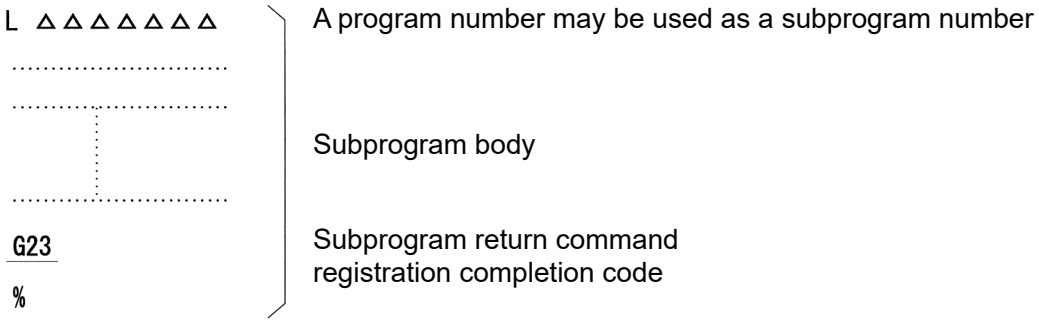
10.1 Subprogram Control (G22, G23)

10.1.1 Function and purpose

The subprogram is an NC program in which the repeatedly used patterns and fixed sequences are saved in the memory beforehand and is used by calling it from the main program (or another subprogram) when necessary.

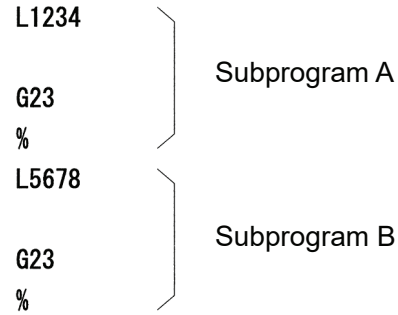
10.1.2 Subprogram

The subprogram has the same format as the machining program for normal memory operation, except that the label No. is inserted as an independent block at the head.



Register the above program.
The numbers of 1 to 99999999 can be used for subprogram numbers. The nesting depth for calling a program from a subprogram can be up to thirty-fold; exceeding this will result in a program error. Exceeding this depth results in a program error "P230 NESTING OVER".

(Registration example)



(1) Outline of subprogram call and return

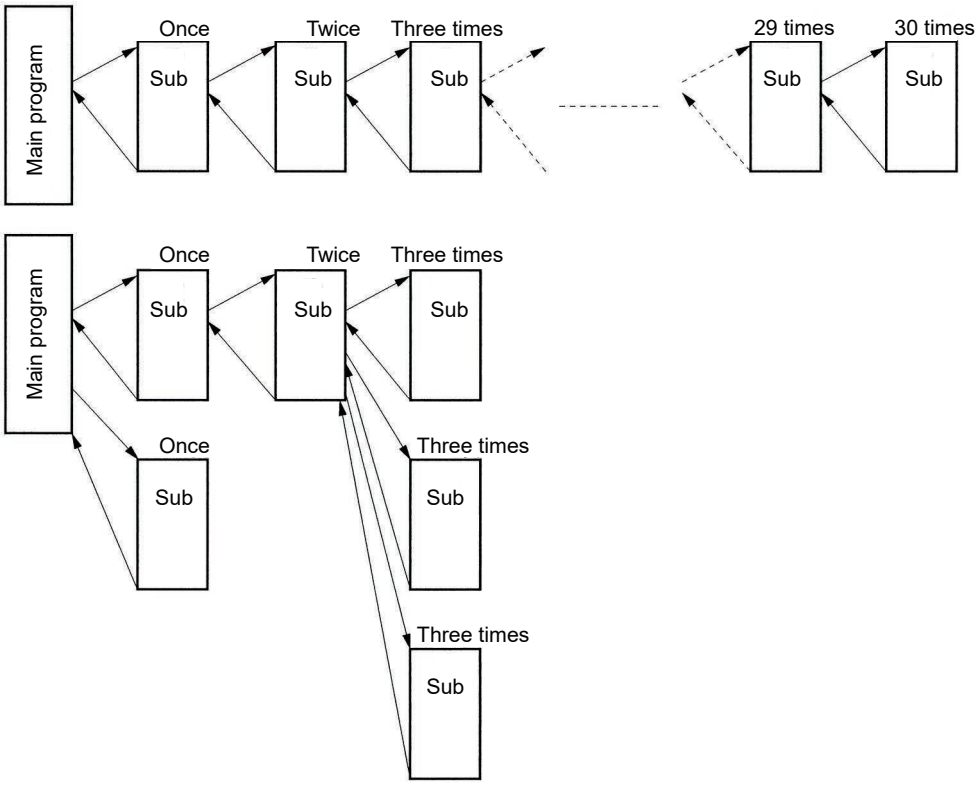


Fig. IV.10.1

1) Calling another subprogram from a subprogram increases the nesting depth by one.
2) Returning to the original subprogram decreases the nesting depth by one.
3) The only difference between the main program and a subprogram is that the main program ends with M02, whereas the subprogram ends with G23.

10.1.3 Execution of subprogram

G22; Subprogram call command

G23; Subprogram return command

Format

G22 L ℓ_1 H h_1 P p_1

	Subprogram number	Sequence number	The number of repetitions

L: Subprogram number to be called by l_1, a numeric value of 8 or less digits.

H: Sequence number within a subprogram to be called by h_1, a numeric value of 5 or less digits.

P: Repetition frequency from 1 to 30000 to be called by p_1, a numeric value of up to 5 digits. When P is omitted or P0, it is treated as P1, and the subprogram is executed just once.
For example, G22L1P1 is equivalent to G22L1.

< Example > When the subprogram is called three times (nesting three times)

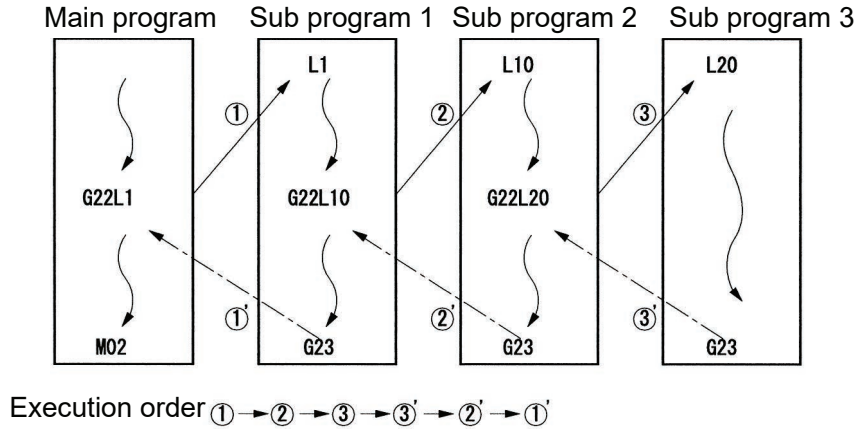
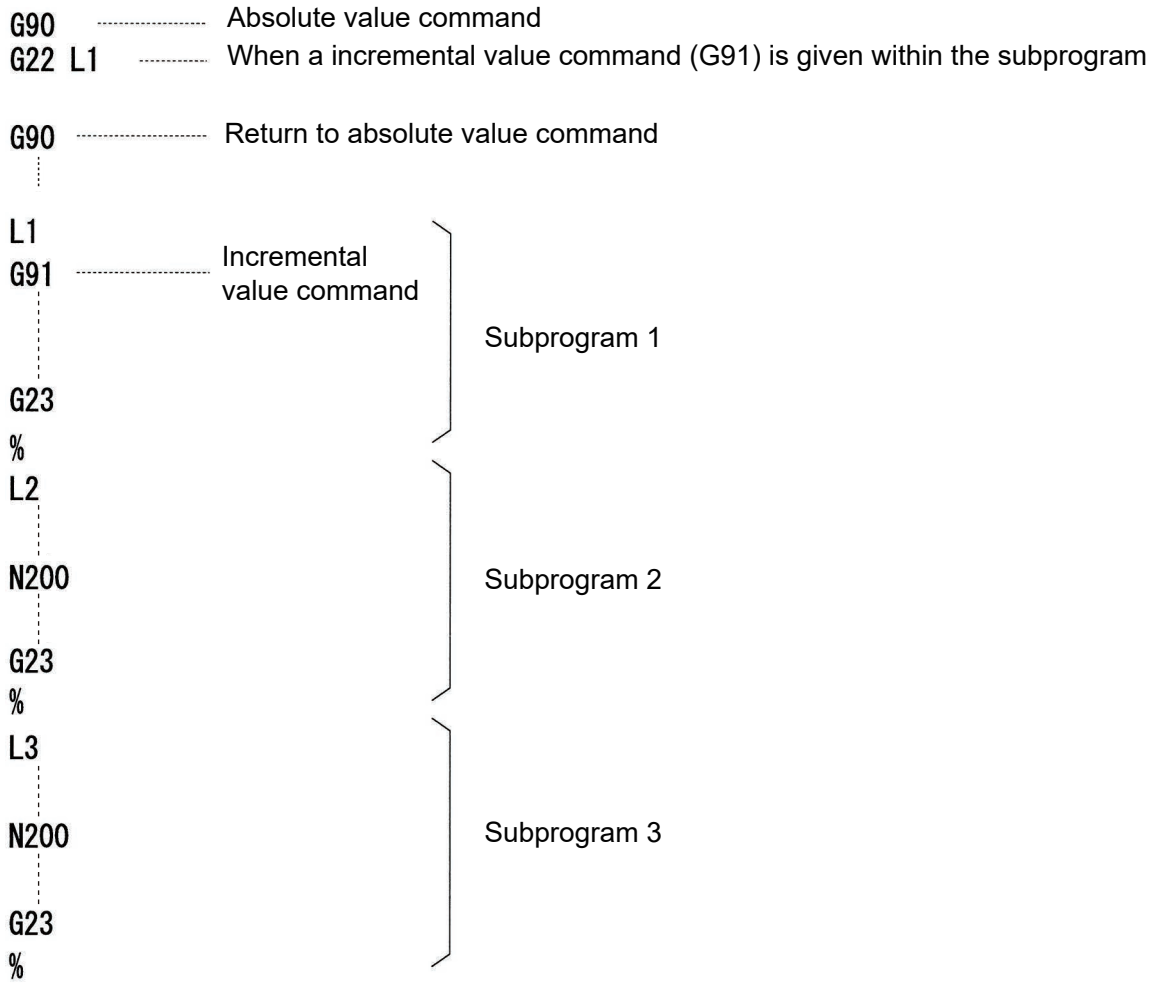


Fig. IV.10.2

When performing nesting, the G22 and G23 commands must always correspond to each other in a one-to-one relationship.

< Example 1 >


G90
Absolute value command
G22 L1
When a incremental value command (G91) is given within the subprogram
G90
Return to absolute value command
L1
G91
Incremental value command
G23
%
Subprogram 1
L2
N200
G23
%
Subprogram 2
L3
N200
G23
%
Subprogram 3

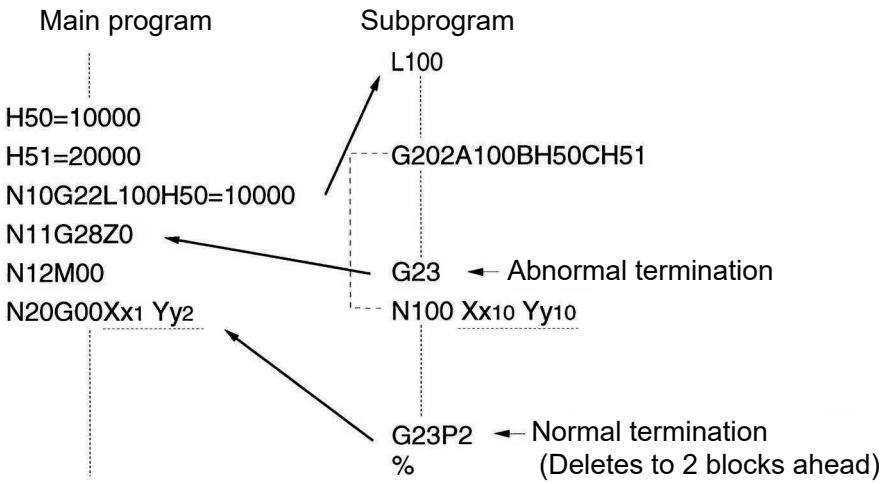
10.1.4 Program skip function (G23)

When returning from a subprogram to the main program by specifying the number of blocks to be skipped in the main program in the same block as the G23 command, the execution order of the main program can be controlled.
The format is as follows.

G23Pp_1

p_1 is the number of blocks to be skipped in the main program (last 4 digits of p_1 are valid).

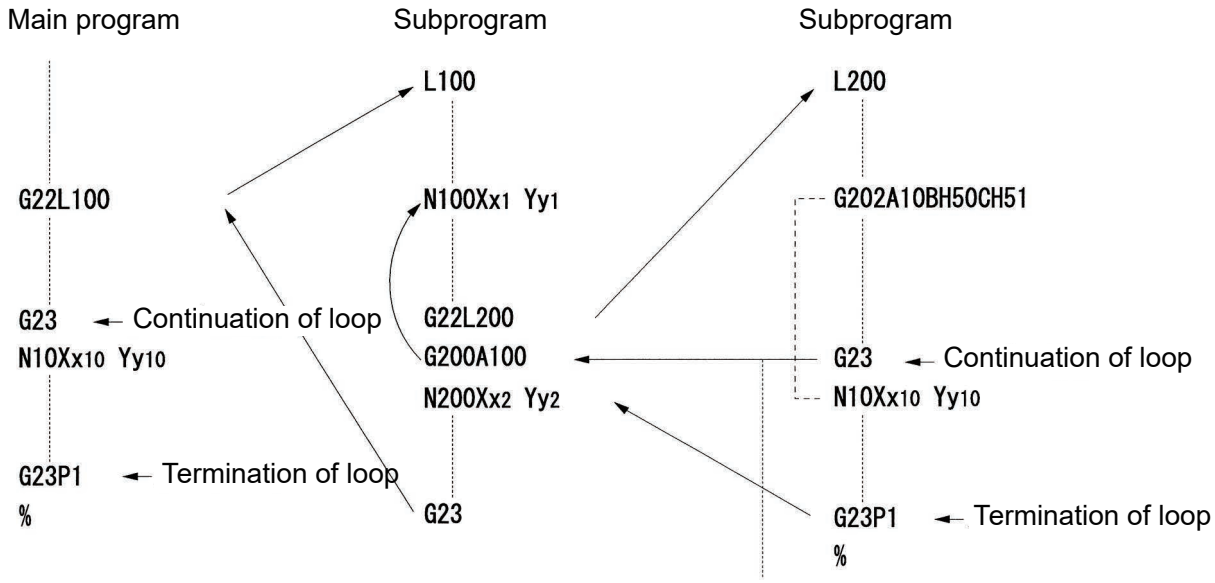
< Example 1 > Normal termination and abnormal termination control



In the above example, for abnormal termination, N11 and N12 are executed, and the program stops. When reactivated, the program starts execution from N20.
For normal termination, two blocks, N11 and N12, are skipped, and N20 is executed without a program stoppage.

- **Skipped blocks are displayed in the buffer as usual but are not executed. Therefore, in single-block mode, the program stops at each block.**
- **A block containing only EOB (;) or a blank line is also counted as one block.**
- **The program skip function is disabled in the main program.**
- **Blocks that are skipped cannot be searched.**
- **The numeric value of P can be a variable, but its sign is ignored.**

< Example 2 > When a loop is applied



The above example shows that there is a loop program within subprogram L100, and that subprogram L200 performs judgment for loop termination.

10.2 Figure rotation (G22, G23)

10.2.1 Function and purpose

A figure specified by a subprogram can be rotated for machining with subprogram control, coordinate words I, J, and P.

10.2.2 Command format

G22L_H_I_J_P_

G22	: Subprogram call G code
L	: Program number of the subprogram to be called
H	: Sequence number of the subprogram to be called
I, J	: Figure rotation center coordinate relative values (relative values from start point)
P	: Repetition frequency of subprogram

10.2.3 Detailed explanation

(1) A subprogram is executed and returned by the subprogram G23 command.

(2) The first execution of a subprogram called via a subprogram call is performed at a rotation angle of 0° and follows the commanded path.

(3) Combination of absolute and relative commands
The rotation subprogram can use both absolute and relative commands.

(4) Subprogram control
Nesting of subprograms is also possible during figure rotation. However, the completion of a figure rotation strictly occurs at the same nesting level as the G23 figure rotation subprogram call.

(5) G22 or G23 movement command in the same block (during figure rotation call)
When there is a movement command in the same block as the G22 command, figure rotation starts after the movement is completed. Therefore, the center of figure rotation is determined by the offset from the coordinates after the movement.
The G23 command, which indicates the end of a figure rotation, must be placed in a separate block. The G23 commands at other levels can include movement commands in the same block.

(6) When using G22 (figure rotation), do not use a subprogram and G92 (home position preset) simultaneously.

10.2.4 Program example

Cutting example of a gear shape: A tooth machining is programmed in a subprogram, and the number of teeth is specified at the time of call.

```
G92X0Y0
G90G00X50000
G22L7P36I-50000
G00X0Y0
M02
```

Main program
Positioning of start point and
figure rotation call of gear machining

```
L7
G03X54999Y251J50000F100
X54812Y4544I-54999J-251
X49810Y4358I-644J-49996
X49240Y8682I-49810J-4358
G23
%
```

Subprogram (L7)
Data on basic gear configuration
(G03 is the modal.)

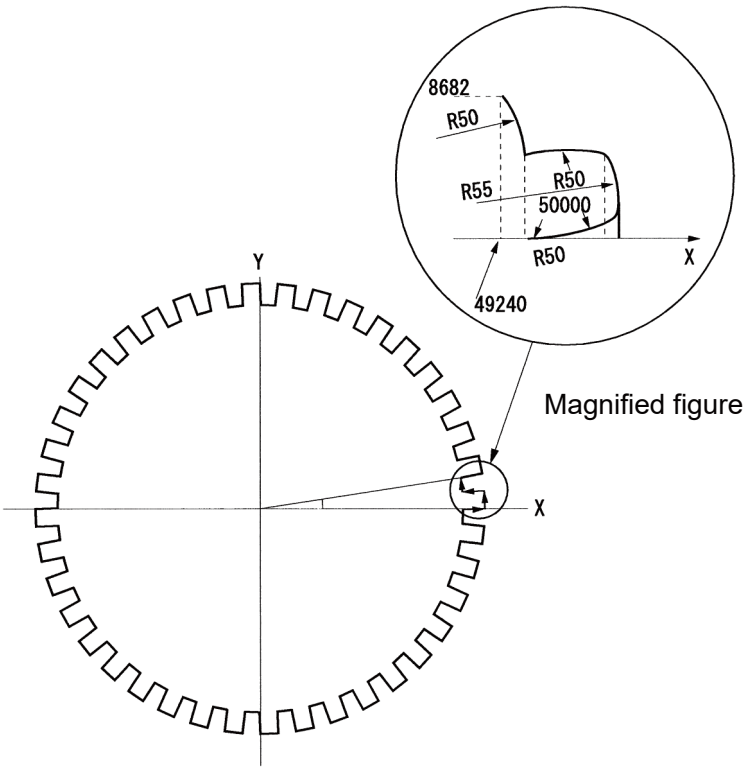


Fig. IV.10.3

10.3 Microjoint Function (G46)

10.3.1 Function and purpose

The movement amount for program commands (G00 to G03) is increased or decreased by the amount specified with H40.

10.3.2 Format

G46 G△ Xα1 Yα2 [Iα3 Jα4]

G△..... G00, G01, G02, G03

α1, α2 . . . . . End point coordinate values

α3, α4 . . . . . Arc center coordinate values

10.3.3 Detailed explanation

G46 is a non-modal command and is effective only when it is commanded in the same block as G00 to G03. Therefore, note that the movement in the next block differs depending on whether an absolute or relative command is used.

Use the setting value of H40 to increase or decrease the position movement amount. The movement amount becomes short when H40 is positive and long when it is negative.

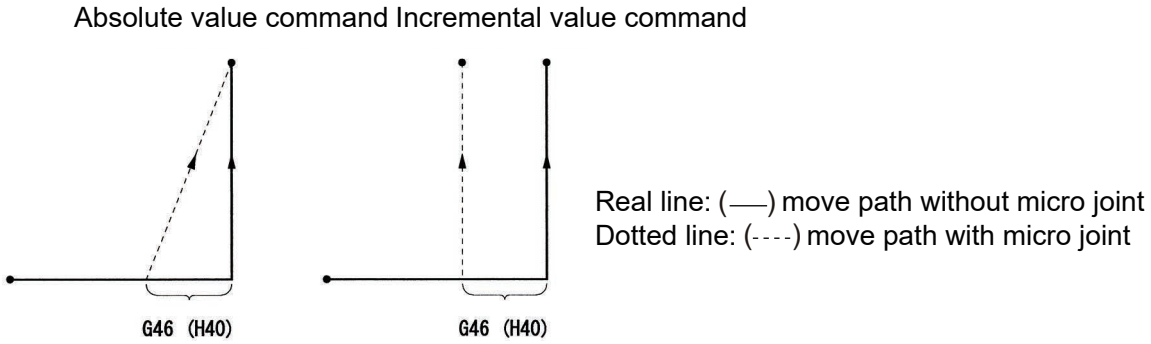


Fig. IV.10.4

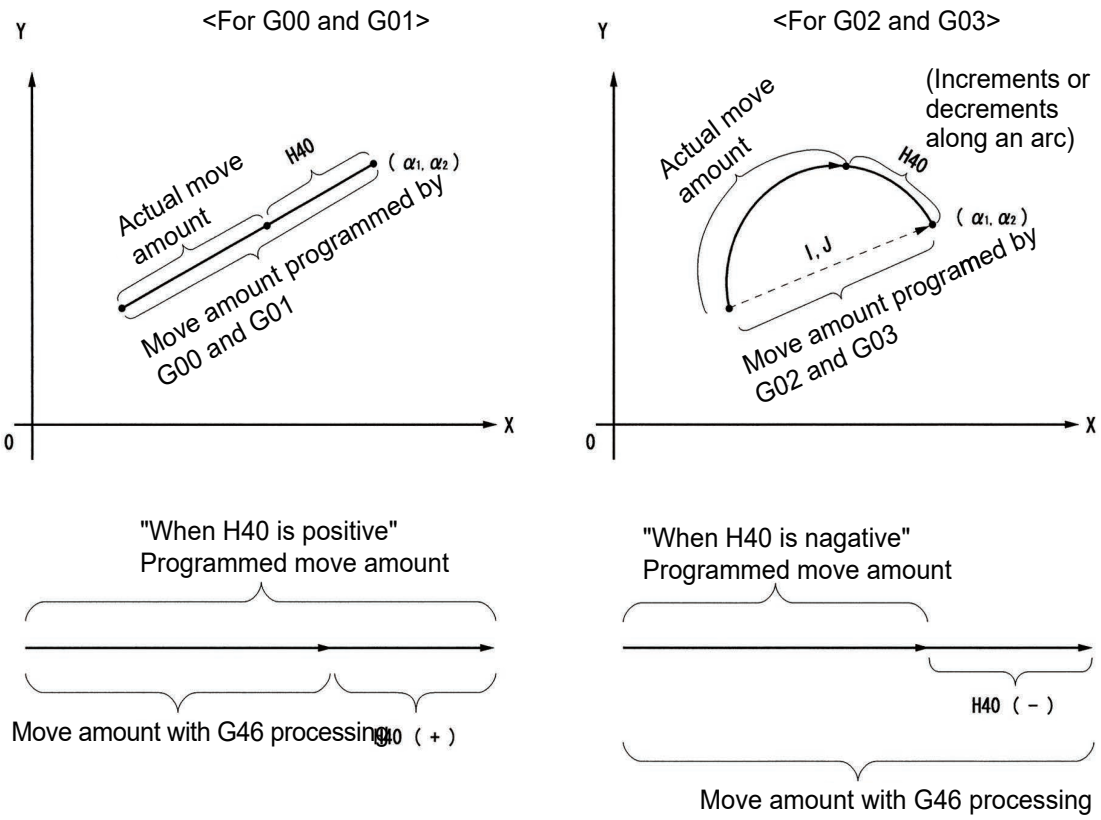


Fig. IV.10.5

Movement is not made from the start point when H40 (positive) is greater than the programmed movement amount (G00 to G03).

10.4 G Command Mirror Image (G62, G51.1)

10.4.1 Function and purpose

This function moves command values of each axis in reverse direction of the commands. This function is processed on the program coordinate system.

10.4.2 Command format

(1)

G62 X0/1 Y0/1 ……

- "0": Mirror image OFF
- "1": Mirror image ON

(2)

G51.1 X_Y_ Mirror image ON (The mirror image center is designated by each axis command value.)
G50.1 X_Y_ Mirror image OFF (Each axis command value is ignored.)

(3)

- G93……X axis mirror image ON, Y axis mirror image OFF
- G94……X axis mirror image OFF, Y axis mirror image ON
- G95……X axis mirror image ON, Y axis mirror image ON
- G96……X axis mirror image OFF, Y axis mirror image OFF

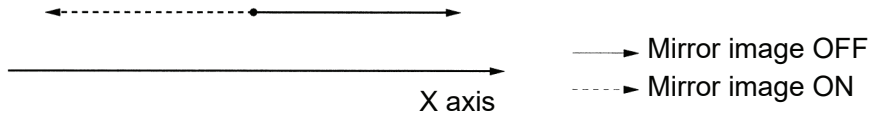
Reference 1

These are for conventional compatibility.

Refrain from using them.

10.4.3 Detailed explanation

(1) In case of X axis mirror



(2) In case of Y axis mirror

< Application example 1 >

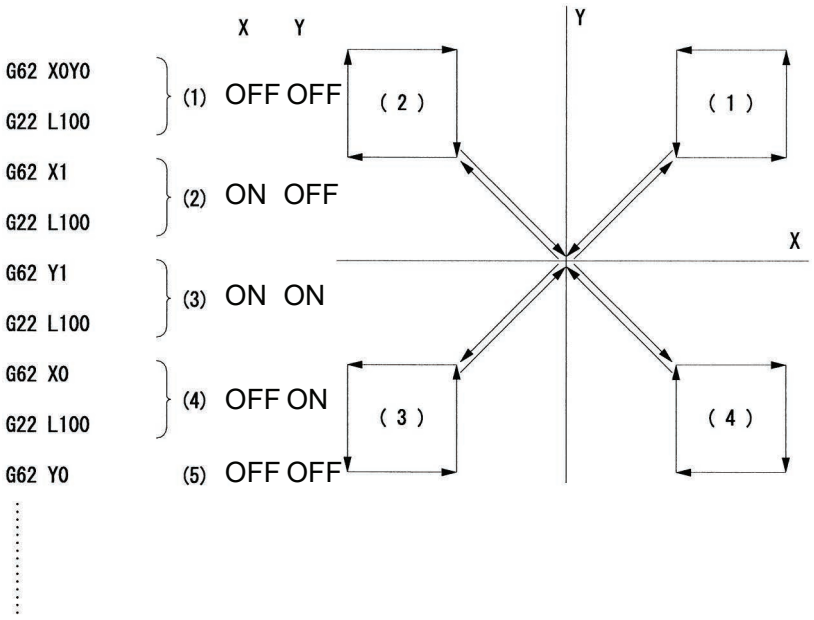
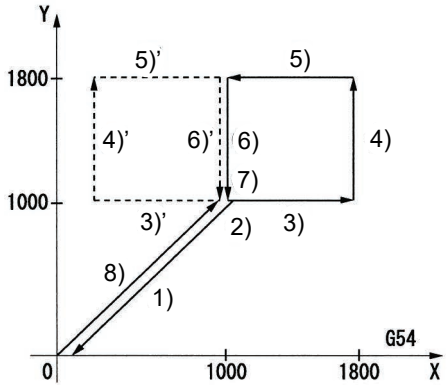


Fig. IV.10.6

< Application example 2 >

When using the mirror image command at a point other than the program zero point.



(Absolute value mode)

```
G90G01X1000Y1000 ..... 1)
G62X1 ..... 2)
    X1800 ..... 3)
    Y1800 ..... 4)
    X1000 ..... 5)
    Y1000 ..... 6)
G62X0 ..... 7)
    X0Y0 ..... 8)
```

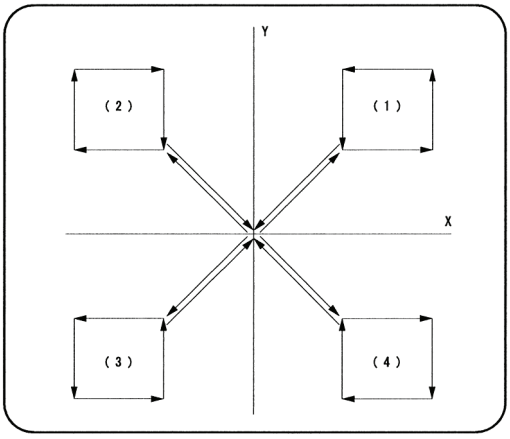
(Incremental value mode)

```
G91G01X1000Y1000 ..... 1)
  G62X1 ..... 2)
        X800 ..... 3)
        Y800 ..... 4)
        X−800 ..... 5)
        Y−800 ..... 6)
  G62X0 ..... 7)
        X-1000Y−1000 ..... 8)
```

Fig. IV.10.7

If a mirror image is designated midway (not at the program home position), the mirror image will be applied to the relative value even if the mode is the absolute value (G90) mode or relative value (G91) mode. Commanding 2) causes the locus to change 3) → 3)' and 5) → 5)'. Commanding 7) causes the mirror image function to be canceled.

< Application example 3 >




```
                                  X     Y
G22      L100                (1) OFF   OFF
G51.1    X0
G22      L100          }     (2) ON    OFF
G51.1    Y0
G22      L100          }     (3) ON    ON
G50.1    X0
G22      L100          }     (4) OFF   ON
G50.1    X0Y0                  OFF   OFF
```

Fig. IV.10.8

10.5 G Command X - Y Axis Exchange (G97)

10.5.1 Function and purpose

This function exchanges the X and Y axis command values.

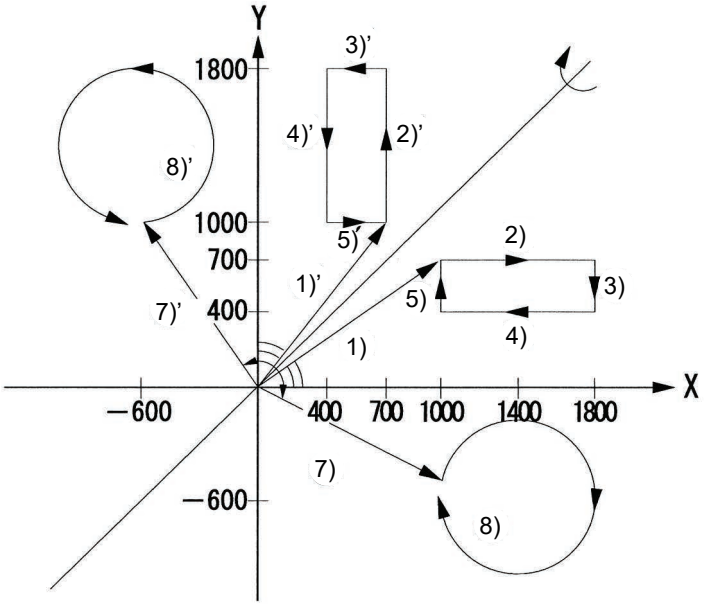
10.5.2 Command format

G97 X0/1 ("1" X-Y axis exchange ON, "0" X-Y axis exchange OFF)

10.5.3 Detailed explanation

The G97 command is non-modal, but the axis exchange ON/OFF state remains in effect until another G97 command is issued.

< Application example 1 >



• Example of rectangular figure

```
G97X1                ..... 0)
G90G01X1000Y700      ..... 1)
      X1800          ..... 2)
      Y400           ..... 3)
      X1000          ..... 4)
      Y700           ..... 5)
G97X0                ..... 6)
```

• Example of circle figure

```
G97X1                ..... 0)
G90G01X1000Y−600     ..... 7)
   G02I400           ..... 8)
G97X0                ..... 9)
```

Fig. IV.10.9

When axis exchange is applied to a rectangular figure, the locus traces are
1) → 1)', 2) → 2)', 3) → 3)', 4) → 4)', and 5) → 5)', and when applied to a circle, as in the above figure, the locus traces are 7) → 7)' and 8) → 8)'.
Note that 6) and 9) are examples of axis exchange ON/OFF commands.

10.6 Adjustment of Wire Diameter Compensation (Offset) Content

10.6.1 Function and purpose

This function sets the offsets (H1 to H900) for wire diameter compensation through the NC program.
Offset amounts can be defined as either constants or variables and can be modified as needed.

10.6.2 Explanation

The method of definition is completely identical to that for variable definition.

10.6.3 Application example

(1) When an offset is defined as a constant
H1 = 5

(2) When the offset number is defined using a variable (assuming H51 = 1),
HH51 = 5.....This is interpreted as H1 = 5.

10.7 Operation on Variables

10.7.1 Summary

Operations on variables can be carried out in either of the following two modes, depending on the specific application.

(1) Conventional compatibility mode
This is a full compatibility mode that allows a machining program to be operated as-is from conventional machines.
All variable operations are carried out as integer operations.

(2) Variable type 2

1) All variable operations are carried out as floating point operations (64-bit), so a wide range of numeric values can be handled.

2) Identical to the decimal point type I of the MELDAS M300 series.

3) Functional operation can be directly described into a machining program by reserved words.

4) Since data is directly specified in the address word (immediate address), a machining program from a conventional machine (that does not use variables or operations) can be used as-is.

5) Machining programs from conventional machines that include variables or operations cannot be used.

When using "Variable type2", set [Var. Type2] to ON on the overlap window "Variable". If [Var. Type2] is set to OFF, the "conventional compatibility mode" will be set.

10.7.2 Structure of the variable operation mode

The following two modes can be freely selected by adjusting parameters.

Address assignment variable operation function	Conventional compatibility mode (H series compatibility)	Immediate address	X2000 X10.0 K45.0 K300000 A1.5 A43000	2000 [µm] 10.0 [mm] 45.0 [°] 30.0 [°] 1.5 [°] 4°30'00" [deg., min., sec.] (T-ANGLE IN DEG switch OFF) 43 (°) (T-ANGLE IN DEG switch ON)	Identical to the conventional compatibility mode only in case of immediate address.
		Variable definition	H50 = 30 H51 = 4.0 H52 = 30 * 2 H53 = 4/8.0 H54 = 3.0 - 4	30 4.000 60 0 2.996	Data without a decimal point is handled with the same unit as for axis data. Data containing a decimal point is interpreted in units of 1 mm, 1 deg., or 1-fold.
		Variable address assignment	XH50 YH51 KH52 SH54 AH50 AH51	30 [µm] 4.0 [mm] 0.0060 [°] 2.996 [times] 0°00' 00" [deg., min., sec.] 4.0 [°]	Address assignment is carried out after judging whether the variable is set with a decimal point.
	Variable type 2 (MELDAS M300 series compatible)	Immediate address	X2000 X200 X10.0 K45.0 K300000 A1.5 A43000	2000 [µm] 200 [µm] 10.0 [mm] 45.0 [°] 30.0 [°] 1.5 [°] 4°30'00"[deg., min., sec.] (T-ANGLE IN DEG switch OFF) 43[°] (T-ANGLE IN DEG switch ON)	Identical to the conventional compatibility mode only in case of immediate address.
		Variable definition	H50 = 30 H51 = 4.0 H52 = 30 * 2 H53 = 4/8.0 H54 = 3.0 - 4	30.0 4.0 60.0 0.5 -1.0	Definition by no-unit floating point type data operation
		Variable address assignment	XH50 YH51 KH52 SH53 AH54 PH52	30.0 [mm] 4.0 [mm] 60.0 [°] 0.5 [times] -1.0 [°] 60 [times]	Data containing a decimal point is interpreted in units of 1 mm, 1 deg., or 1-fold.
		Functional operation	H60 = 100 * SIN [30] H61 = ASIN[0.5] H62 = SQRT[10000] X3 - 2 A45/3.0	50.0 30.0 100.0 1.0 [mm] 15.0 [°]	Operation is carried out regarding the function as a no-unit floating point type data. The assignment of an operation result is the same as the assignment of a variable address.

Same

IV

(1) Outline of each variable operation mode

1) Conventional compatibility mode

(a) A conventional machining program can be used as is, without any modifications.

(b) Operation G-codes (G101 to G111) can be used. Note that an error occurs if a reserved word for a functional operation is entered directly into the machining program.

(c) Integer variable operations are carried out with exactly the same specs as in the previous version.

2) Variable type 2

(a) A conventional machining program in which data is specified directly in the address words can be used as is, without any modifications.

(b) Macro operations, including functional operations, can be fully described.

(c) As variable data and operation data are floating characters, there is no need to worry about omission of digits in operations.
Note that caution is required to the characteristic precision drop during floating point operation. (10.7.5 (5).)

10.7.3 Variable function

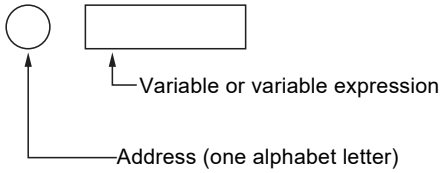
(1) Method of expressing variables

Hn n = 1 to 932

(2) Setting variables

H___ = ___
H___D___

(3) Quotation of variables



(Example) Case where H50 is defined as 1000 and H51 is defined as 2000

XH50	→ X1000
X - H50	→ X - 1000
XH50 + H51	→ X3000

(4) Type of variables

Type	No.	Function
Common variables	1 to 900	Can be used commonly in main, sub, and macro programs. **Note that the following variables are reserved by the manufacturer and can be used only for predetermined purposes.** • H80 to H86 • H90 to H92 • H94 to H99 • H195, H197 • H242 to H247 • H850 to H900
Local variables	901 to 932	Can be used locally in macro programs.
System variables	1000 to	For system use only

All common variables are maintained even after power is turned off.

(5) Type of variable data

Common variables and local variables become either integer types or floating-point types by the variable operation mode.

1) Integer type

Data type in the conventional compatibility mode ("VAL. FOR TYPE 2." switch off)

< Characteristics >

Data with a decimal point is handled as the 1 mm (1 inch) unit.

The lowest digit for data without a decimal point is handled as the minimum command unit.

Example

H50 = 1.234 H50 → 1.234 mm (1.234 inch)

H51 = 1234
- H51 → 1234 μm (0.1234 inch) …… Normal mode
- H51 → 123.4 μm (0.01234 inch) × 0.1 mode

2) Floating point type

Data type in the variable type 2 mode ("VAL. FOR TYPE 2." switch on)

< Characteristics >

Floating point type data with no units

The lowest digit in the data with no decimal point is interpreted as having a decimal point.

At address assignment, the data is interpreted as a 1 mm (1 inch) unit.

Example

H50 = 1.234 H50 → 1.234

H51 = 1234 H51 → 1234.0

XH50 X → 1.234 mm

YH51 Y → 1234.0 mm

(6) Maximum and minimum values of variable

1) Integer type (in conventional compatibility mode)

Normal mode . . . . . .-99999999 to +99999999

× 0.1 mode . . . . . .-999999999 to +999999999

2) Floating point type (in the variable type 2 mode)

The range of the variable's absolute value that can be expressed is as follows.

4.94×10^{-342} to 1.80×10^{308}

(7) Local variables (H901 to H932)

In addition to being defined as an <argument> when accessing a single macro subprogram, this variable can be used locally in both the main program and subprograms, and its value is preserved across macros.

(up to four-fold)

G65L1_1Pp_1 <argument>

1_1 = Program number

p_1 = Repetition frequency

<argument> should be set as Aa_1, Bb_1, Cc_1,…….Zz_1.

The correspondence between the address designated by the <argument> and the local variable number used in the user's macro main program is shown in the charts below.

Access command		Argument address	Local integer number
G65 G66	G66.1		
O	O	A	901
O	O	B	902
O	O	C	903
O	O	D	907
O	O	E	908
O	O	F	909
×	×*	G	910
O	O	H	911
O	O	I	904
O	O	J	905
O	O	K	906
×	×*	L	912
O	O	M	913
×	×*	N	914
×	×	O	915
×	×*	P	916

Access command		Argument address	Local integer number
G65 G66	G66.1		
O	O	Q	917
O	O	R	918
O	O	S	919
O	O	T	920
O	O	U	921
O	O	V	922
O	O	W	923
O	O	X	924
O	O	Y	925
O	O	Z	926
		-	927
		-	928
		-	929
		-	930
		-	931
		-	932

The × marks in the above chart indicate that the argument addresses cannot be used. In the G66.1 mode, however, argument addresses indicated by * can be added and used.

Also, the "-" symbol indicates that there are no corresponding addresses.

Local variables can be independently used in every level of macro call (4-fold). Local variables are also independently available in the main program (macro level 0).

Note that arguments cannot be applied to local variables at macro level 0.

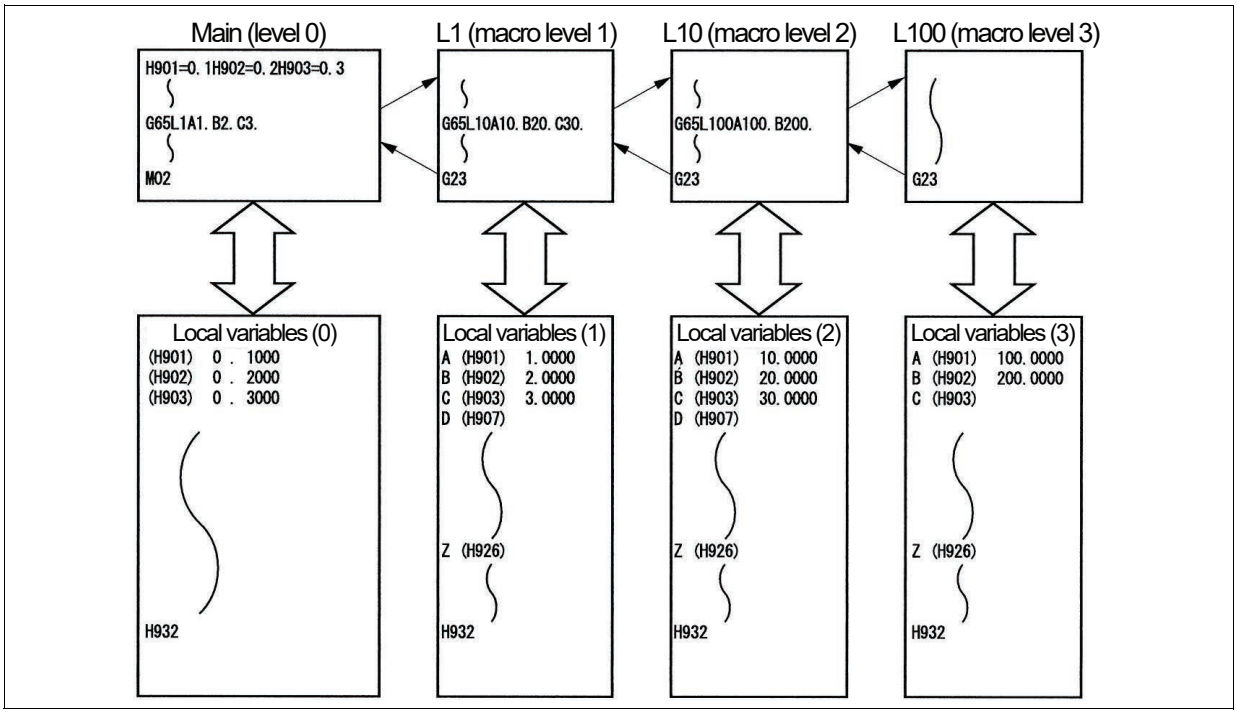


Fig. IV.10.10

(8) Variable macro

1) Workpiece coordinate system offset

Reading of workpiece coordinate system offset data and assignment of values can be done using variable numbers 5221 through 5326.

(Note) The number of axes that can be controlled differs depending on the option specs.

Axis number / Coordinate name	1st axis	2nd axis	3rd axis		6th axis	Remarks
G54	H5221	H5222	H5223		H5226	
G55	H5241	H5242	H5243		H5246	
G56	H5261	H5262	H5263		H5266	
G57	H5281	H5282	H5283		H5286	
G58	H5301	H5302	H5303		H5306	
G59	H5321	H5322	H5323		H5326	

There are no variable numbers assigned to G54.1P00 to G54.1P99.

- NC alarm (H3000)

  The NC can be forced into an alarm state using variable number 3000.

  Command format

```
H3000 = 1
```

• Message display & stop
Using the variable number 3006 stops the operation after the last block has been executed.

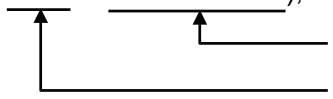
```
H3006 = 1
```

(9) User variables

Random names (variable names) can be set for the common variables and displayed as a list on the USER VARIABLE screen.

Command format

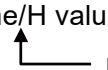
(*H value = variable name);



Max. 20 characters

Variable No. (1 to 900)

(*H value = variable name/H value = variable name);



Indicates a delimiter

- The variable is defined with (*);.
- The variable definition can be described over several blocks.

```
(*H105 = KAIAIWORKNO.);
(*H106 = WOEKSUU/H107 = CORNERNO.);   Variable definition section
(*H110/H111/H112);
N100;
G92 XYZ;
(*H120 = KEIJYOUNO.);                ← Ignored
G90 G01 X10.;
```

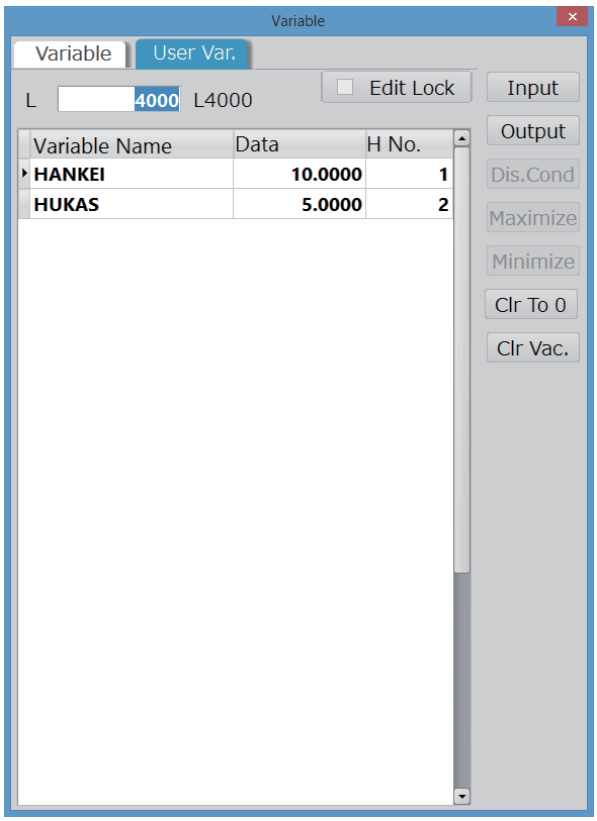


Fig. IV.10.11

- **The variable definition must be set in succession from the head of the program. Settings in the middle of the program will be ignored.**
- **The variable definition is valid only for the settings in the main program. Settings in the subprogram will be ignored.**
- **Up to 20 characters of the variable name will be displayed. If the name exceeds 20 characters, the first 20 characters will be valid.**
- **If the same variable is defined in duplicate, the variable definition set later will be valid.**

10.7.4 Variable operation function of conventional compatibility mode

(1) Arithmetic expression

Arithmetic expressions consist of constants and variables connected by arithmetic operators, which allow addition +, subtraction -, multiplication *, and division /.

- When "*" is entered as "&", it is automatically interpreted as "*".
- As a rule, do not use two operators consecutively. If more than two operators are entered, only the last one becomes effective.
  However, if the last two operators are "++", they are interpreted as "*", and if the last two are "--", they are interpreted as "/".
- When entering data in EIA code, use "D" instead of "=".

(2) Operation precedence

- Multiplication and division take precedence over addition and subtraction.
- In case of equal operation precedence, the operation is carried out from left to right.

(3) Precautions when using arithmetic expressions

- In multiplication and division, integers become multipliers and dividers.

(Example 1) To perform multiplication 1000 × 2.5
enter it as 1000 * 25 / 10.

(Example 2) When the variables are defined with decimal point data, they are calculated as follows.

	Normal mode	× 0.1 mode
Metric system	1000 times	10000 times
Inch system	10000 times	100000 times

(Metric mode) In case H50 = 1. H51 = 2.5
H50 * H51 → 1.0 * 2.5 → 1000 * 2500 → 2500000

- Note that the numerical value of an operation result must be above -999999999 and less than -999999999. If it is not within this range, an error occurs (P35 CMD-VALUE OVER).
- For arithmetic operations, any value below the minimum unit is truncated, so pay attention to the order of operations in such cases.
  (e.g.) 5/2 * 2 becomes 4
  and 5 * 2/2 becomes 5.

(4) Application examples

1) G1X7000 + 1000 - 2000
   Equivalent to G1X6000

2) G1Y- 5000 + 1000 * 3
   Equivalent to G1Y - 2000

3) G1X - H50 + 2000 + H51
   If H50 = 3000 and H51 = 2000, X = 1000.

4) G1YH60 + 3000/H61 - 500
   If H60 = 5000 and H61 = -2, Y = 3000.

5) G1X2000 * 2 * 3
   Equivalent to G1X12000

6) G1Y - 4000/H70 * H71
   If H70 = -2 and H71 = -3, Y = -6000.
   Other examples:

7) G1X H80 + 2000Y − 3000 + H81 * H82

8) A45000 + H83

9) G H84 X1000 + 2000Y1000

10) G22H H85 P5
    Although one H follows immediately after another H, the first H designates a sequence number, while the second H represents a variable.
    Special examples:

11) G1XH H50
    If H50 = 200 and H200 = 1000,
    it becomes G1X1000.

12) In case where D is substituted by "=" and a double definition is applied (unfavorable situation), it becomes as follows.
    H50 = 100
    XHH50D100 It establishes the same meaning as XH100 = 100.
    This is interpreted as X being 0, H100 = 100
    As shown above, it can be used in many ways.

*** The ␣ like in H50, indicates variables.**

10.7.5 Variable type 2

All variables are handled as floating point data.

(1) Variable operation function

Various mathematical operations can be carried out on variables.

Hi = (expression)

The (expression) constitutes combinations of constants, variables, functions, and operators.

Constants may be used as substitutes Hj and Hk listed in the chart below.

1) Definition and substitution of variables	Hi = Hj	Definition and substitution
2) Addition operation	Hi = Hj + Hk Hi = Hj - Hk Hi = Hj ORHk Hi = Hj XORHk	Addition Subtraction Logical OR (per bit in each 32 bits) Exclusive logical OR (per bit in each 32 bits)
3) Multiplication operation	Hi = Hj * Hk Hi = Hj/Hk Hi = Hj MODHk Hi = Hj ANDHk Hi = Hj**Hk	Multiplication Division Remainder Logical AND (per bit in each 32 bits) Power (exponential)
4) Function	Hi = SIN[Hk] Hi = COS [Hk] Hi = TAN[Hk] Hi = ATAN[Hj] Hi = ACOS[Hj] Hi = ASIN[Hj] Hi = SQRT[Hk] Hi = ABS[Hk] Hi = BIN[Hk] Hi = BCD[Hk] Hi = ROUND[Hk] Hi = FIX[Hk] Hi = FUP[Hk] Hi = LN [Hk] Hi = EXP[Hk]	Sine Cosine Sine tanθ uses sinθ/cosθ. Arc sine (either ATAN or ATN) Arc cosine Arc sine Square root (either SQRT or SQR) Absolute value Converted to BINARY from BCD Converted to BCD from BINARY Rounding off (either ROUND or RND) Omitting fractions Rounding up fractions Natural logarithm e (exponent which regards "= 2.718..." as the base)

- Values without fractions are treated as numbers with a decimal point after the last digit.
- AND, OR, and XOR are operated after their fractional digits are rounded off.
- The results of BIN (hexadecimal conversion of decimal numbers) and BCD (decimal conversion of hexadecimal numbers) operations must form a number that can be expressed using only the numerical characters "0" through "9", even if the resulting number is hexadecimal.
- BIN and BCD are used for I/O of external data.
- Power of numbers are applied only to integers of numerical values and when data including fractions is used fractions must be rounded off.

(2) Operation sequence

Operation sequence 1) through 3) comes in the order of function, multiplication operation, and addition operation.

H101 = H111 + H112 * SIN [H113]

1) Function
2) Multiplication operation
3) Addition operation

(3) Setting operation sequence

Sections that are given priority in the operation sequence can be enclosed in brackets. It is possible to enclose a section, including the brackets which enclose the function, within up to five sets of brackets.

H101 = SQRT [[[H111-H112] * SIN [H113] + H114] * H15]

1st set
2nd set
3rd set

(4) Example of operation command

If a value without a decimal point is calculated in "Variable type 2" or used a variable, it will be handled as the value having a decimal point.

1. Designation of main program and arguments	G65 L100 A10 B20. H101 = 100.000 H102 = 200.000	H901 10.000 H902 20.000 H101 100.000 H102 200.000
2. Definition and substitution =	H1 = 1000 H2 = 1000. H3 = H101 H4 = H102 H5 = -10	H1 1000.000 H2 1000.000 H3 100.000 H4 200.000 (from common variables) H5 -10.000 (from common variables)
3. Addition and subtraction + -	H11 = H1 + 1000 . . . . . (1000. + 1000.) H12 = H2 - 50. . . . . (1000. - 50.) H13 = H101 + H1 . . . . . (100. + 1000.) H14 = H5 - 3. . . . . (-10. - 3.)	H11 2000.000 H12 950.000 H13 1100.000 H14 -13.000
4. Logical OR	H3 = 100 . . . . . (100.) H4 = H3OR14 . . . . . (100.OR14.)	H3=01100100(2Binary) 14=00001110(2Binary) H4=01101110=110 → 110.000 (2Binary) (10Binary)
5. Exclusive logical XOR	H3 = 100 . . . . . (100.) H4 = H3XOR14 . . . . . (100.XOR14.)	H3=01100100(2Binary) 14=00001110(2Binary) H4=01101010=106 → 106.0

6. Multiplication and division */	H21 = 100 * 100 . . . . . .(100. * 100.) H22 = 100. * 100 . . . . . .(100. * 100.) H23 = 100 * 100. . . . . .(100. * 100.) H24 = 100. * 100. . . . . .(100. * 100.) H25 = 100/100. . . . . .(100./100.) H26 = 100./100 . . . . . .(100./100.) H27 = 100/100. . . . . .(100./100.) H28 = 100./100.. . . . . .(100./100.) H29 = H5 * H101 . . . . . .(-10. * 100.) H30 = H5/H102 . . . . . .(-10./200.)	H21 10000.000 H22 10000.000 H23 10000.000 H24 10000.000 H25 1.000 H26 1.000 H27 1.000 H28 1.000 H29 -1000.000 H30 -0.050
7. Remainder MOD	H19 = 48 H20 = 9 H31 = H9MODH20	$\frac{H19}{H20} = \frac{48}{9}$ = 5 remainder 3 H31 is 3.000
8. Logical AND	H9 = 100 . . . . . .(100.) H10 = H9AND15 . . . . . .(100.AND15.)	H9=01100100(2Binary) 15=00001111(2Binary) H10=00000100=4 → 4000 (2Binary) (10Binary)
9. Sine SIN	H501 = SIN[60] H502 = SIN[60.] H503 = 1000 * SIN[60] H504 = 1000 * SIN[60.] H505 = 1000. * SIN[60] H506 = 1000. * SIN[60.] (Note) SIN[60] becomes equivalent to SIN[60.].	H501 0.866 H502 0.860 H503 866.025 H504 866.025 H505 866.025 H506 866.025
10. Cosine COS	H541 = COS[45] H542 = COS[45.] H543 = 1000 * COS[45] H544 = 1000 * COS[45.] H545 = 1000. * COS[45] H546 = 1000. * COS[45.] (Note) COS[45] becomes equivalent to COS[45.].	H541 0.707 H542 0.707 H543 707.107 H544 707.107 H545 707.107 H546 707.107
11. Sine TAN	H551 = TAN[60] H552 = TAN[60.] H553 = 1000 * TAN[60] H554 = 1000 * TAN[60.] H555 = 1000. * TAN[60] H556 = 1000. * TAN[60.] (Note) TAN[60] becomes equivalent to TAN[60.].	H551 1.732 H552 1.732 H553 1732.051 H554 1732.051 H555 1732.051 H556 1732.051
12. Arc sine ATN or ATAN	H561 = ATAN[173205/100000] H562 = ATAN[173205/100.] H563 = ATAN[173.205/100000] H564 = ATAN[173.205/100.] H565 = ATAN[1.732]	H561 60.000 H562 89.967 H563 60.000 H564 60.000 H565 59.999
13. Arc sine ASIN	H521 = ASIN[100/141.421] H522 = ASIN[100./141.421] H523 = ASIN[1000./1414.213] H524 = ASIN[10./14.142] H525 = ASIN[0.707]	H521 = 45.000 H522 = 45.000 H523 = 45.000 H524 = 45.001 H525 = 44.991
14. Arc cosine ACOS	H521 = ACOS[100./141.421] H522 = ACOS[100./141.421] H523 = ACOS[1000./1414.213] H524 = ACOS[10./14.142] H525 = ACOS[0.707]	H521 = 45.000 H522 = 45.000 H523 = 45.000 H524 = 44.999 H525 = 45.009

15. Square root SQR or SQRT	H571 = SQRT[1000] H572 = SQRT[1000.] H573 = SQRT[10. * 10. + 20. * 20.] H574 = SQRT[H14 * H14 + H15 * H15] (Note) Carry out operation within parentheses to improve precision.	H571 31.623 H572 31.623 H573 22.361 H574 190.444
16. Absolute value ABS	H576 = -1000 H577 = ABS[H576] H3 = 70.H4 = -50 H580 = ABS[H4 - H3]	H576 -1000.000 H577 1000.000 H580 120.000
17. BIN, BCD	H1 = 100 H11 = BIN[H1] H12 = BCD[H1]	H11 64.000 H12 256.000
18. Rounding off RND or ROUND	H21 = ROUND[14/3] H22 = ROUND[14./3] H23 = ROUND[14/3.] H24 = ROUND[14./3.] H25 = ROUND[-14/3] H26 = ROUND[-14./3] H27 = ROUND[-14/3.] H28 = ROUND[-14./3.]	H21 5.000 H22 5.000 H23 5.000 H24 5.000 H25 -5.000 H26 -5.000 H27 -5.000 H28 -5.000
19. Omitting fractions FIX	H21 = FIX[14/3] H22 = FIX[14./3] H23 = FIX[14/3.] H24 = FIX[14./3.] H25 = FIX[-14/3] H26 = FIX[-14./3] H27 = FIX[-14/3.] H28 = FIX[-14./3.]	H21 4.000 H22 4.000 H23 4.000 H24 4.000 H25 -4.000 H26 -4.000 H27 -4.000 H28 -4.000
20. Rounding up fractions FUP	H21 = FUP[14/3] H22 = FUP[14./3] H23 = FUP[14/3.] H24 = FUP[14./3.] H25 = FUP[-14/3] H26 = FUP[-14.3] H27 = FUP[-14/3.] H28 = FUP[-14./3.]	H21 5.000 H22 5.000 H23 5.000 H24 5.000 H25 -5.000 H26 -5.000 H27 -5.000 H28 -5.000
21. Natural logarithm LN	H101 = LN[5] H102 = LN[0.5] H103 = LN[-5]	H101 1.609 H102 -0.693 Error
22. Exponent EXP	H104 = EXP[2] H105 = EXP[1] H106 = EXP[-2]	H104 7.389 H105 2.718 H106 0.135
23. Power of a number **	H107 = 2**3 H108 = 100**2	H107 8.000 H108 10000.000

(5) Operation accuracy

1) Data type (equivalent to IEEE 64-bit double precision floating point) and rounding error

Sign …… 1 bit
Exponent section …… 11 bits
Mantissa section …… 52 bits

Thus, when a true value is converted into floating point data, generally a rounding error of 2^{-53} will occur. This is because the decimal conversion has an accuracy of approx. 15 digits.

2) Cautions regarding digit dropping

(a) Addition/subtraction

When operating the difference of numeric values that are approximately equal, caution must be taken to digit dropping.

(Example) H10 = 123456789.012345
H11 = 123456789.01234

When the following calculation is carried out, the actual value will be as follows.

H10 - H11 = 0.000005

Actual value:

0.00000500679

Thus, the absolute error will be 0.00000000679,
and the relative error will be 0.00136.

The error will be an extremely large value compared to the above rounding error.

(b) Precautions related to branching conditional expressions in control command

The branching conditional expressions (EQ, NE, GT, LT, GE, LE) of the control command described later are theoretically the same as addition/subtraction, so caution must be taken to the rounding error and digit dropping.

(Example) The following will not be judged correctly.

H12 = 0.1
H12 = H12 + 0.1
H12 = H12 + 0.1
IF[H12 EQ 0.3]

This is because 0.1 itself cannot be expressed strictly as a binary.

Thus, the description must be made as shown below allowing for the error.

IF[ABS[H12 - 0.3]LT0.00000001]

(6) Example of carrying out operation command < equilateral hexadecimal form >

Turn on "VAL. FOR TYPE 2." on the SWITCH screen and then execute the following program.

```
L2000
H50 = 0
H52 = 16
```

Changing the number of angles here will achieve other equilateral forms.

```
H51 = 0
G92X0Y0F100. 0
G90G01X100. 0
WHILE[H50LEH52]DO1
G01X100. 0 * COS[H51]Y100. 0 * SIN[H51]
H50 = H50 + 1
H51 = H50*360.0/H52
END1
G01X0
M02
```

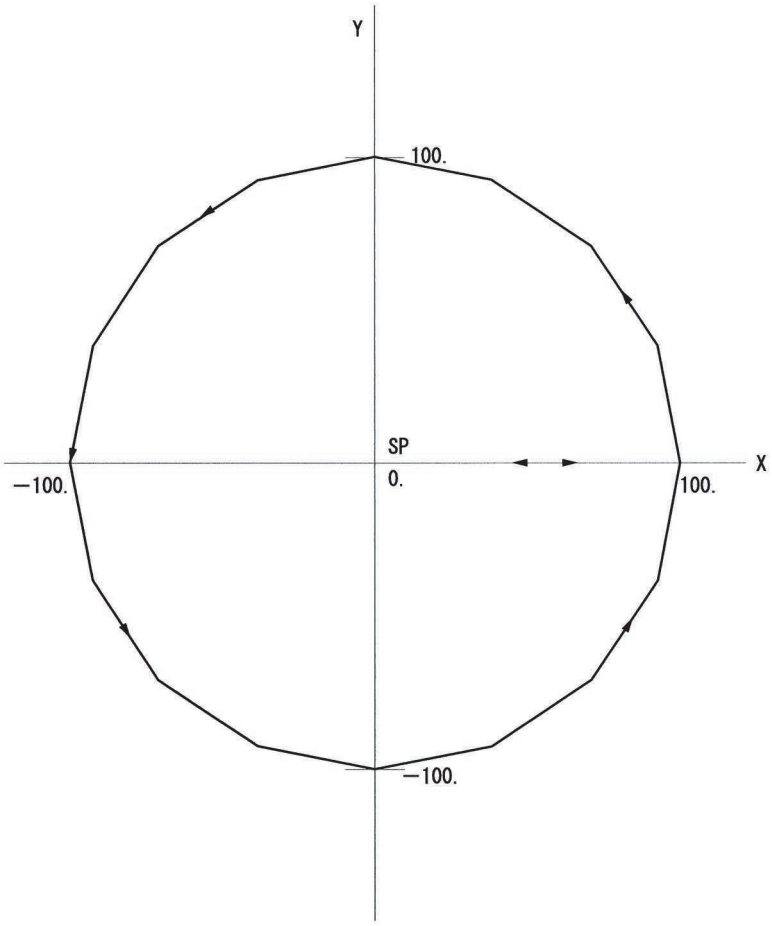


Fig. IV.10.12

10.8 User Macro Functions (G101 to G111, G200 to G202, G203, G65, G66, G66.1)

10.8.1 Function and purpose

In machining programs, certain commands may need to be used repeatedly, and re-writing identical commands each time they are needed is very inconvenient. To allow use of the user macro functions, Mitsubishi control unit provides the following functions for customer's selection.

(1) Operation commands (G101 to G110)

(2) 3-point center calculation (G111)

(3) Judgment branch instructions (G200 to G202)

(4) Bit test (G203)

(5) Macro simple call (G65)

(6) Macro modal call A (G66)

(7) Macro modal call B (G66.1)

10.8.2 Operation commands (G101 to G110)

(1) Function and purpose

By using the operation G codes (G101 to G110), a variety of operations can be performed on variables.

(2) Command format

<operation G code> A <argument 1> B <argument 2> (C <argument 3>)

(3) Detailed explanation

1) A, B, and C represent address words that distinguish one argument from another.

2) Argument 1 must be always specified and must be a variable.
If not specified or if other than variables is specified, a program error results.

3) Arguments 2 and 3 may be either variables or constants, and signs may be added to constants. If not required, these arguments may be omitted. When omitted, they are processed as zero.

Operation instruction table

Operation G code	Contents of operation	Argument type						
		Argument 1		Argument 2		Argument 3		
		Aa	Non-specified	Bb	Non-specified	Cc	Non-specified	
								0
G101	a = b	Hi	Error	Hi, k	0	-		0
G102	a = b + c	Hi	Error	Hi, k	0	Hi, k	Error	0
G103	a = b - c	Hi	Error	Hi, k	0	Hi, k	Error	0
G104	A = b * c	Hi	Error	Hi, k	Error	Hi, k	Error	* Round off at the first decimal place
G105	a = b/c	Hi	Error	Hi, k	Error	Hi, k	Error	* Round off at the first decimal place
G106	$x = \sqrt{b^2 + c^2}$	Hi	Error	Hi, k	Error	Hi, k	Error	* Round off at the first decimal place
G107	a = b * sinC	Hi	Error	Hi, k	Error	Hi, k	Error	* Round off at the first decimal place
G108	a = b * cos c	Hi	Error	Hi, k	Error	Hi, k	Error	* Round off at the first decimal place
G109	$a = \tan^{-1} b/c$	Hi	Error	Hi, k	Error	Hi, k	Error	* Round off at the first decimal place
G110	$a = \sqrt{b^2 - c^2}$	Hi	Error	Hi, k	Error	Hi, k	Error	* Round off at the first decimal place

4) Allowance value { Variable Hi (i = 1 to 932); Variable k }

5) Operation instructions must occupy an independent block.

6) Addresses A, B, and C may be arranged freely.

7) The unit of angle for sin (G107), cos (G108), and tan-1 (G109) operation is 0.001°.

8) The value of tan-1 (G109) corresponds to the polar angle of the point represented by the Cartesian coordinates (c, b), with the angle a in the range -90° ≤ a ≤ 90°.

9) If C = 0 in division (G105) and tan-1 (G109), a program error (P283: Zero division) will occur.

10) In G110, if $B^2 - C^2 < 0$, a program error P282 will occur.

11) Variable arithmetic expressions may be used, instead of addition, subtraction, multiplication, and division operations (G101, G102, G103, G104, and G105).

12) Multiple variables (double variables, such as HH50, and others) can be used.

13) Addresses A, B, and C become floating point data, all except those in the variable conventional compatibility mode.

Fractions are round off only in the conventional compatibility mode.

(4) Program example

< Example 1 >

G101AH50B - 1000(H50 = -1000)

G102AH51BH51C1(H51 = H51 + 1)

G103AH51B7CH54(H51 = 7 - H50)

G104AH52BH53CH54(H52 = H53 * H54)

G15AH55BH53CH10(H55 = H53/H10)

G106AH54BH50CH53(H54 = $\sqrt{H50^2 + H53^2}$)

G107AH58B1000CH53(H58 = 1000 * sin(H53))

G108AH50BH54C3000(H50 = H54 * cos(30.000))

G109AH55BH56CH57(H55 = $\tan^{-1}$(H56/H57))

G110AH54BH50CH53(H54 = $\sqrt{H50^2 - H53^2}$)

10.8.3 3-point center calculation (G111)

(1) Function and purpose

The center position of a circle passing through three points is obtained from the coordinate values of three points.

(2) Command format

G111 AX1 BY1 CX2 DY2 EX3 XX YY (RR)

X1: Point 1 coordinate X

Y1: Point 1 coordinate Y

X2: Point 2 coordinate X

Y2: Point 2 coordinate Y

X3: Point 3 coordinate X

Y3: Point 3 coordinate Y

X: 3-point center coordinate X storage variable name (H ΔΔΔ)

Y: 3-point center coordinate Y storage variable name (H ΔΔΔ)

R: Radius variable name of a circle passing through three points (H ΔΔΔ)

(3) Detailed explanation

- Here, X, Y, R, A, B, C, D, E and F represent address words that distinguish one argument from another.
- Always designate the address words other than R. (Only R can be omitted.)
  If not designated, the program error "P242 EQL.SYM.MSSG." will occur.
- The address word X, Y, and R arguments must be designated with variables.
  If a value other than a variable is designated, the program error "P282 CAL IMPOSS" will occur.
- If the center of the circle cannot be calculated because the coordinate data of the three points are aligned in one row, etc., the program error "P282 CAL IMPOSS" will occur.
- Command the G111 block as an independent block.
- The addresses X, Y, R, A, B, C, D, E, and F can be arranged in any order.

(4) Program example

To obtain the center coordinates XY (H101, H102) and radius R (H103) of coordinate values (H11, H12), (H21, H22) and (H31, H32) for the three points calculated by using the edge positioning function:

G111 AH11 BH12 CH21 DH22 EH31 FH32 XH101

YH102 RH103

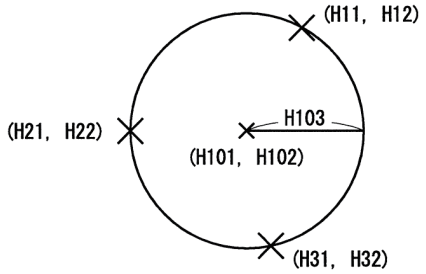


Fig. IV.10.13

10.8.4 Judgment branch instructions (G200 to G203)

(1) Function and purpose

The judgment branch G codes (G200 to G203) allow control of a processing flow with the same program No.

(2) Command format

<judgment branch G code> A <argument 1> (B <argument 2>) (C <argument 3>)

(3) Detailed explanation

A, B, and C represent address words that distinguish one argument from another.
Argument 1 must be always specified. It may be either a variable or a constant, and up to five digits can be specified. If argument 1 is not specified, a program error results.
Arguments 2 and 3 may be either variables or constants, and signs may be added to constants.

Judgment branch instruction table

Judgment branch G code	Name	Argument type						Processing contents
		Argument 1		Argument 2		Argument 3		
		Aa	Non-specified	Bb	Non-specified	Cc	Non-specified	
G200	Unconditional branching	Hi, k	Error					Branch to sequence No. Na block unconditionally.
G201	Zero condition branching	Hi, k	Error	Hi, k	0	Hi, k	0	If b = c, branch to the block of sequence No. Na. If b ≈ c, proceed to next block.
G202	Negative condition branching	Hi, k	Error	Hi, k	0	Hi, k	0	If b < c, branch to the block of sequence No. Na. If b > c, proceed to the next block.
G203	Bit test	k	Error	Hi, k	Error	Hi, k	Error	Proceeds to sequence No. Na if c bit of variable number b is not raised.

Variable Hi (i = 1 to 932)
Allowance value
Variable k

(4) Program example

G200A100 (branch to N100)
G201A200BH50CH51 (If H50 = H51, branch to N200)
G202AH50BH51C50000 (If H51 < 50000, branch to the N number of H50 contents)

- **Sequence numbers must be within the same subprogram of the same program number. If a sequence number is not in the same program as specified, a program error occurs at branch point.**
- **A judgment branch instruction must be commanded in an independent block.**
- **Addresses A, B, and C may be arranged freely.**

1) Supplementary explanation

Subprogram skip function

When returning from a subprogram to the main program by specifying the number of blocks to be skipped in the main program in the same block as the G23 command, the execution order of the main program can be controlled.

The format is:

G23Pp_1

p_1 is the number of blocks to be skipped in the main program (last 4 digits of p_1 are valid).

(Example 1) Normal termination and abnormal termination control

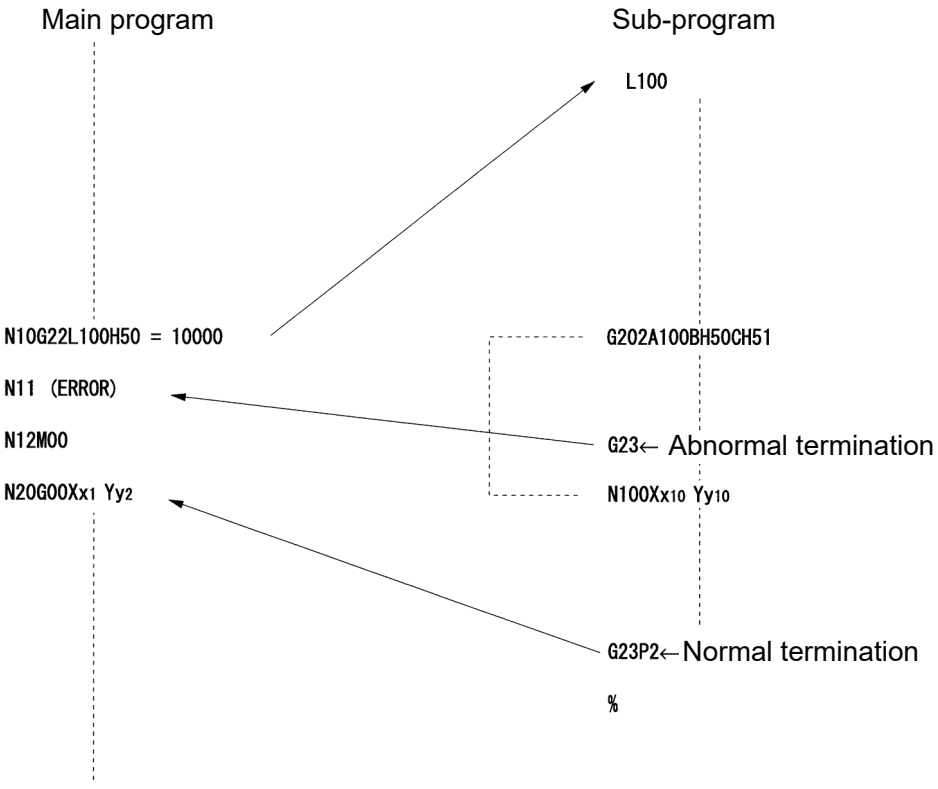


Fig. IV.10.14

In the example, for abnormal termination, N11 and N12 are executed and the program stops.

When reactivated, the program starts execution from N20.

For normal termination, two blocks, N11 and N12, are skipped, and N20 is executed without a program stoppage.

(Example 2) When a loop is applied

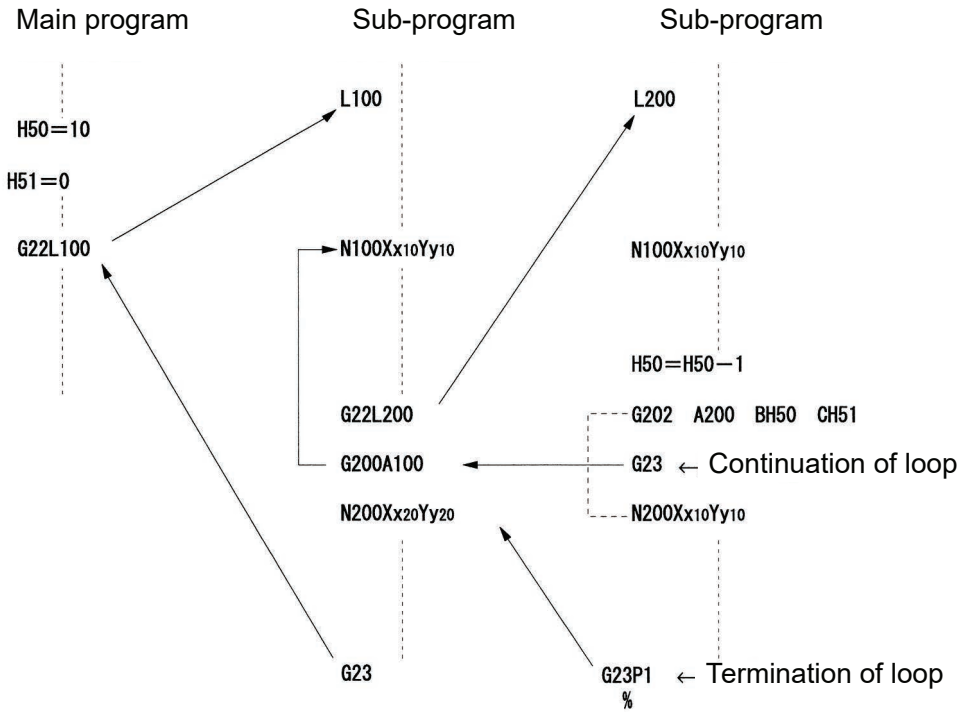


Fig. IV.10.15

The above example shows that there is a loop program within subprogram L100, and that subprogram L200 performs judgment for loop termination.

- **A block containing only EOB (;) or a blank line is also counted as one block.**
- **The program skip function is disabled in the main program.**
- **Blocks that are skipped cannot be searched.**
- **The numeric value of P can be a variable, but its sign will be ignored.**

10.8.5 Bit test (G203)

(1) Function and purpose

Use the G code for bit test (G203) to test if the bit stands in position designated by the variable.

(2) Command format

G203 A < Jump destination sequence number > B < Variable > C < Test bit position >

(3) Detailed explanation

If the bit (specified by C) of the variable specified by B (H1 to 900) is ON, the process proceeds to the next block as is. If the bit is not ON, the process branches to the sequence number specified by A.

- Program example

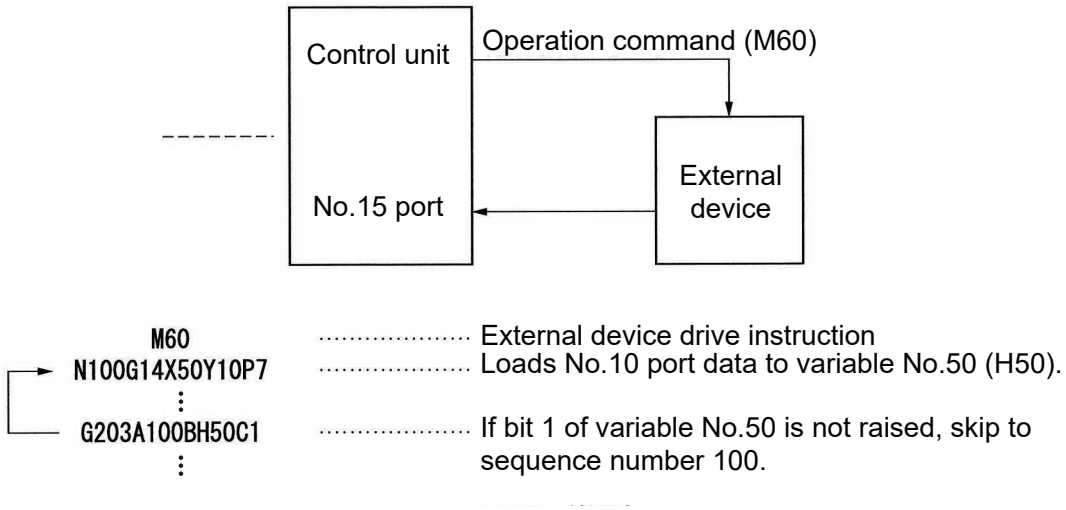


Fig. IV.10.16

In the example above, the operation complete signal from an external device is input to bit 1 of port No. 15. While the operation is not yet complete, sequence N100 is repeatedly executed, and once the operation is completed, the program below is executed.

10.8.6 Macro simple call (G65)

(1) Function and purpose

The G65 command calls a specified user macro subprogram a set number of times within the G65 block.

(2) Command format

$G65L_1Pp_1$ <argument>

l_1: Program number

p_1: Repetition frequency (max. 300000)

(3) Detailed explanation

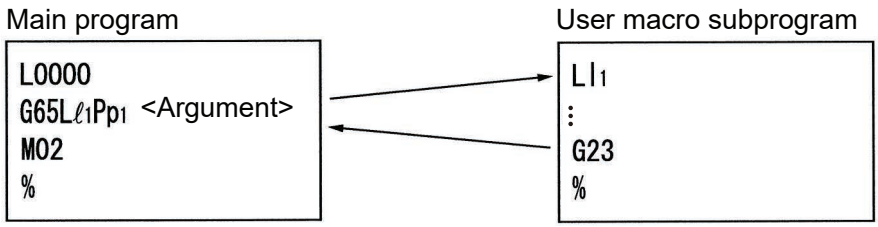


Fig. IV.10.17

A designated program is called the designated number of times.

The end of the subprogram is reached at G23.

The maximum multiple macro program call nesting is four-fold.

When it becomes necessary to transfer an <argument> to a user macro subprogram as a local variable, designate the actual value at the end of the address. (A variable can also be used.)

When doing so, symbols and decimal points can be used in the argument, regardless of the address.

1) Argument designation I

Format: A_B_C_ ..... X_Y_Z_

Detailed explanation

(a) Arguments can be specified using all addresses except G, L, N, and O, P.

(b) Except for I, J, K, the addresses do not need to be specified in alphabetical order.

(c) I, J, K must be specified in alphabetical order.
I_J_K_ is possible.
J_I_K_ is impossible.

(d) Addresses which need not be designated can be omitted.

(e) The correspondence between the addresses that can be used for argument I and the variable numbers within the user macro body is shown in the following table.

Address/variable number correspondence chart		Access commands and usable addresses	
Argument designating address	**Variables within macro**	**G65, G66**	**G66.1**
A	901	○	○
B	902	○	○
C	903	○	○
D	907	○	○
E	908	○	○
F	909	○	○
G	910	×	×*
H	911	○	○
I	904	○	○
J	905	○	○
K	906	○	○
L	912	×	×*
M	913	○	○
N	914	×	×*
O	915	×	×
P	916	×	×*
Q	917	○	○
R	918	○	○
S	919	○	○
T	920	○	○
U	921	○	○
V	922	○	○
W	923	○	○
X	924	○	○
Y	925	○	○
Z	926	○	○

○: usable, ×: unusable, *: usable when in G66.1 modal

2) Argument designation II

Format: A_B_C_I_J_K_I_J_K_.....

Detailed explanation

(a) In addition to addresses A, B, and C, up to 10 sets of arguments consisting of I, J, and K can be specified. Note that K10 (H933) in the 10th set will be ignored.

(b) When the same addresses are duplicated, carry out designation in the appropriate order.

(c) Addresses which need not be designated can be omitted.

(d) The correspondence between addresses which can be used in argument designation II and variable numbers in the main body of the user macro is as in the following chart.

Argument designation II addresses	Variables within macro	Argument designation II addresses	Variables within macro
A	901	J5	917
B	902	K5	918
C	903	I6	919
I1	904	J6	920
J1	905	K6	921
K1	906	I7	922
I2	907	J7	923
J2	908	K7	924
K2	909	I8	925
I3	910	J8	926
J3	911	K8	927
K3	912	I9	928
I4	913	J9	929
J4	914	K9	930
K4	915	I10	931
I5	916	J10	932

Suffixes 1 to 10 for I, J, and K indicate the order of the commanded sets, and are not needed for the actual command.

3) Composite use of argument designation I & II

When both types I and II are used for argument specification and the addresses correspond to the same variable, the one specified later becomes valid.

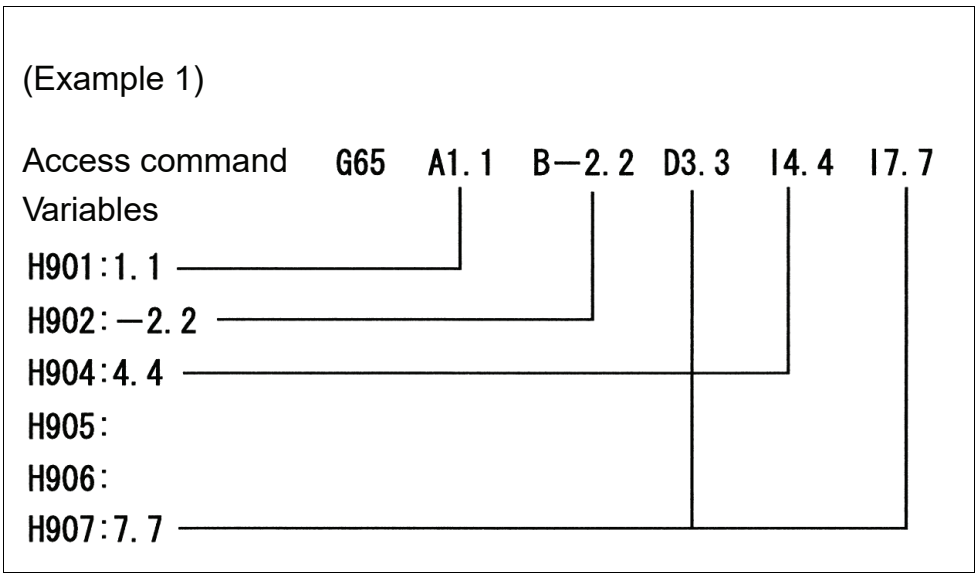


Fig. IV.10.18

In the above, when two arguments, D3.3 and I7.7, are commanded for #7 variable, the I7.7 becomes effective.

Differences between G22 and G65 commands

(a) Arguments can be designated by G65 but not by G22.

(b) Sequence numbers can be specified with G22, but not with G65, G66, or G66.1.

(c) With a G22 call, the level of local variables does not change, whereas with G65 it changes according to the nesting depth. (When executing a G22 command, local variables prior to and following the execution of the command carry the same significance, but when executing a G65 command they turn out to carry a different significance.)

(d) The call nesting depth for G22, combined with G65, G66, and G66.1, is 30 levels, whereas G65, combined with G66 and G66.1, is limited to a maximum of 4 levels

(Example) Explanation of 3)

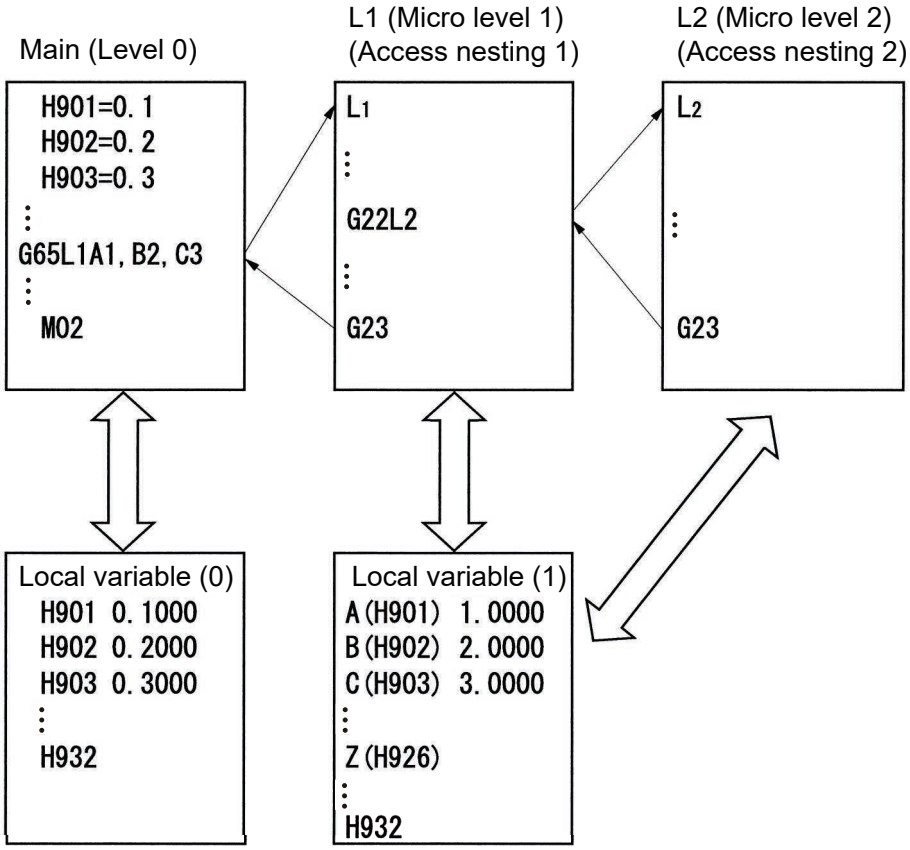


Fig. IV.10.19

10.8.7 Macro modal call A (G66)

(1) Function and purpose

If a block containing a motion command between G66 and G67 is specified, the designated user macro subprogram will be executed after that motion command is executed.

(2) Command format

G66Ll_1Pp_1 <argument>

l_1: Program number

p_1: Repetition frequency

(3) Detailed explanation

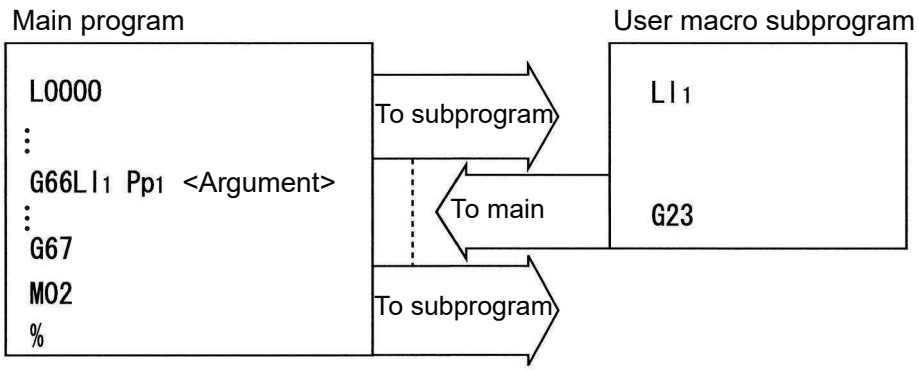


Fig. IV.10.20

1) After executing any motion command between G66 and G67, the designated user macro subprogram is executed. The number of executions is the number of P_1 (repetition frequency) each time called.

2) <argument> is treated the same as simple access.

3) When a G66 command is entered, the specified user macro subprogram is called after executing the motion command of each block that contains a motion command, until a G67 (cancel) command is entered.

4) G66 and G67 commands must appear as a pair within the same program.

5) When a G67 command is input without the G66 command, a program error occurs.

6) Multiplicity of macro access commands
Macro subprograms can be called up to 4-fold through simple access and modal access commands. Arguments at time of macro access command execution are effective only within the level of the accessed macro. Macro
Since the maximum call depth is four, each macro call can use its arguments as local variables within the program.

- **When a G65, G66, G66.1, G-code macro call, or auxiliary command macro call is executed, an interpretation is made that the nesting is 1-fold, and the local variable level is increased to the next greater level.**
- **In modal call A, a designated user macro subprogram is called each time a motion command is executed. However, when multiple G66 commands are issued, a user macro subprogram is also called every time an axis motion is executed for motion commands inside the macro itself.**
  The user macro subprograms are called in order, starting from the one most recently specified.

(Example 1)

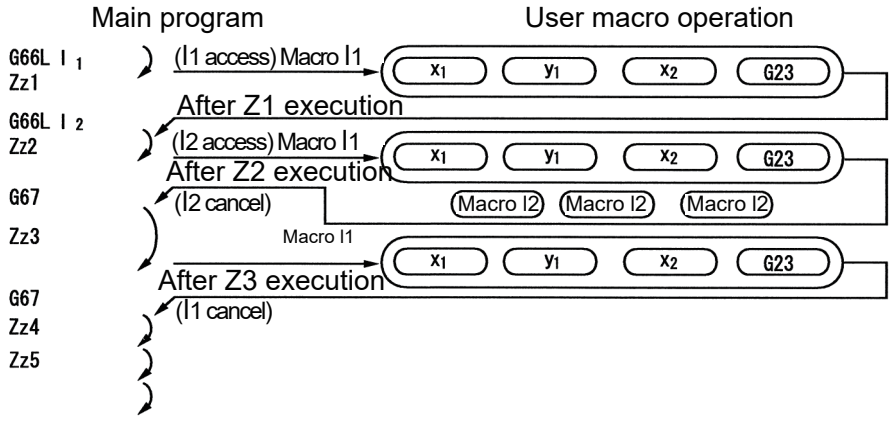


Fig. IV.10.21

10.8.8 Macro modal call B (G66.1)

(1) Function and purpose

For each command block issued between G66.1 and G67, the designated user macro subprogram is called unconditionally.

(2) Command format

G66.1L_1Pp_1 <argument>

l_1: Program

p_1: Repetition frequency

(3) Detailed explanation

For each block issued between G66.1 and G67, the designated user macro subprogram is called unconditionally. The number of executions is the number of P_1 (repetition frequency) each time called. In the G66.1 mode, all codes in each command block, except L, M, and G codes, are treated as arguments and are not executed. However, for G codes, only the last specified one becomes the argument, and for N codes, the one specified after any code other than L or N becomes the argument.

In the G66.1 mode, every significant block is treated as if a G65L_ command has been issued at the beginning of the block.

(Example 1)

For example, in the G66.1L1000 mode, N100G01G90X100.Y200.F400R1000 is equivalent to N100G65L1000G01G90X100.Y200.F400R1000.

Even in a G66.1 command block in the G66.1 mode, the macro call is executed, and the correspondence between argument addresses and variable numbers is the same as for a G65 (simple call).
The command values of G, L, P, and N, which can be used as new variables in the G66.1 mode, are subject to the same restrictions as normal NC command command values.
L, sequence number N, and modal G codes are updated as modal information.

10.9 Control Command

10.9.1 Function and purpose

The program flow can be controlled using IF - GOTO -, IF - THEN -, and WHILE - DO - statements. This does not, however, apply in the variable conventional compatibility mode.

10.9.2 Detailed explanation

(1) Branching (IF - GOTO -)

The format is IF [conditional expression] GOTOn (n represents the sequence number in the program). If the condition is true, the program branches to n; if false, the next block is executed. The IF [conditional expression] part can be omitted, in which case the branch to n is unconditional.
[Conditional expressions] constitute the following.

iEQj	= When i and j are equivalent
iNEj	≈ When i and j are not equivalent
iGTj	> When i exceeds j
iLTj	< When i is less than j
iGEj	≥ When i is greater than j
iLEj	≤ When i is less than j

When making a comparison to see whether data is equal (=), there will be cases when floating point data cannot be compared in the same manner as an integer. When possible, make a judgment by whether the difference is smaller than a certain value.

< Example > When H1 is to be executed in increments from 0.2 to 0.02 and the machining program is to be changed when 0.1 is reached

```
H1 = 0.200
      to
H1 = H1-0. 02

IF[ABS[H1-0. 1]LT0. 001]GOTO10
G22L1000
G23

N10
G22L2000
G23
```

↓

When the difference of H1 and 0.1 is less than 0.001, it is determined as equal.

The n in GOTOn must always exist within the same program; if it does not, an alarm occurs. Expressions or variables can be used in place of i, j, or n.
In the block corresponding to the sequence number n that is executed after GOTOn, the sequence number Nn must appear at the beginning of the block; if it does not, an alarm occurs.
However, if the beginning of a block is "/" followed by Nn, branching to the sequence number is possible.

When searching for the target sequence number, the search proceeds from the block following the IF statement to the program end (the % code); if not found, the search continues from the beginning of the program to the block preceding the IF statement. Therefore, searching for a branch in the reverse direction of program flow takes more execution time than searching in the forward direction.
The loop will be infinite if there is no sequence number.

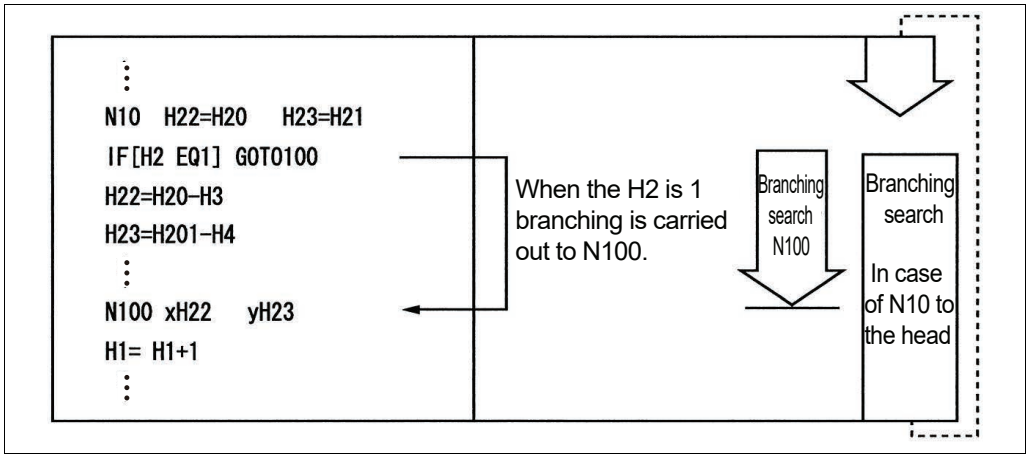


Fig. IV.10.22

(2) Branching (IF - THEN -)

The format IF [condition expression] THEN [variable expression] executes the variable expression following THEN when the condition is true.

The conditional expression is the same as that used with IF - GOTO - .

If the conditional expression is omitted, the variable operation expression will be executed unconditionally.

The following variable operation expressions can be used.

Hi = Hj	Hi = SIN[Hk]
Hi = Hj + Hk	Hi = COS [Hk]
Hi = Hj - Hk	Hi = TAN[Hk]
Hi = HjORHk	Hi = ATAN[Hk]
Hi = HjXORHk	Hi = ACOS[Hk]
Hi = Hj * Hk	Hi = ASIN[Hk]
Hi = Hj/Hk	Hi = SQRT[Hk]
Hi = HjMODHk	Hi = ABS[Hk]
Hi = HjANDHk	Hi = BIN[Hk]
Hi = Hj**Hk	Hi = BCD[Hk]
	Hi = ROUND[Hk]
	Hi = FIX[Hk]
	Hi = FUP[Hk]
	Hi = LN [Hk]
	Hi = EXP[Hk]

Hi is a variable, and Hj and Hk are a variable or constant.

(3) Repetition

Format: WHILE [condition expression] DOm (m = 1, 2, 3...127)
⋮
ENDm

While the conditional expression is true, the blocks from the next block up to the ENDm block are repeatedly executed; when the conditional expression is false, execution proceeds to the block following ENDm. Note that DOm can come before WHILE.

Use WHILE [conditional expression] DOm and ENDm as a pair, if WHILE [conditional expression] is omitted, DOm - ENDm is repeated indefinitely. The identification number of the repetition is 1 to 127.

(DO1, DO2, DO3, ... DO127) Note that the multiplicity can be up to 27-fold.

< Example >

```
 ⋮
F100.
H50 = 10.
WHILE[H50 GT 0]DO1
G01 X1
H50 = H50 - 1
END1
G01 Y1.
 ⋮
```

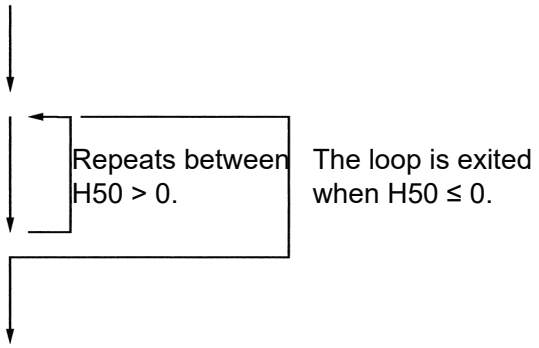
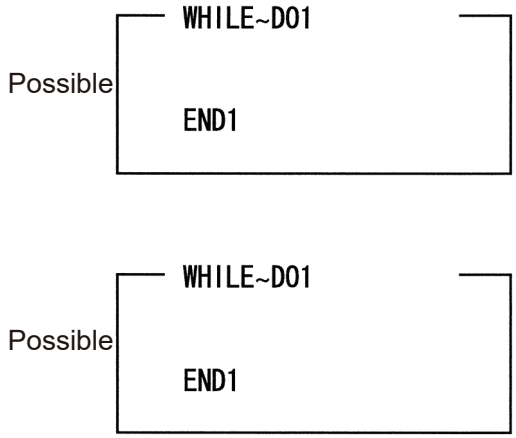
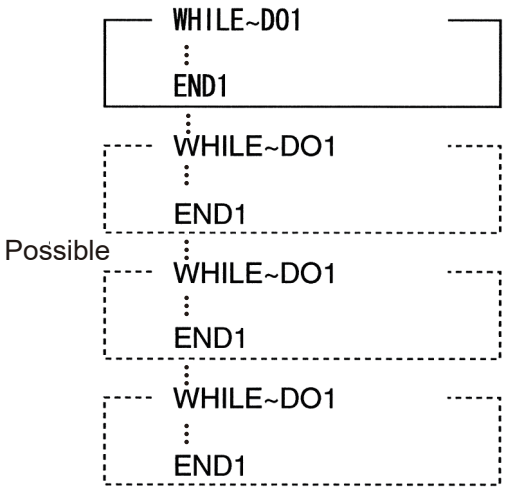


Fig. IV.10.23

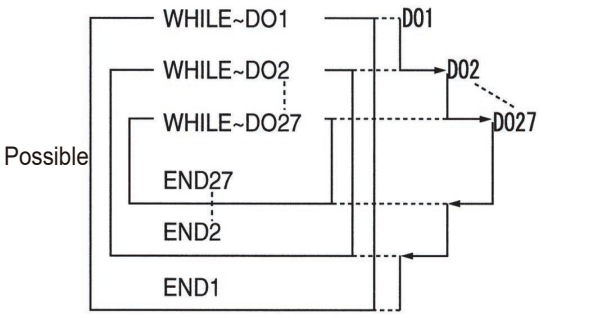
1) The same identification number can be used repeatedly.



2) The identification number for WHILE to DOm can be assigned freely.

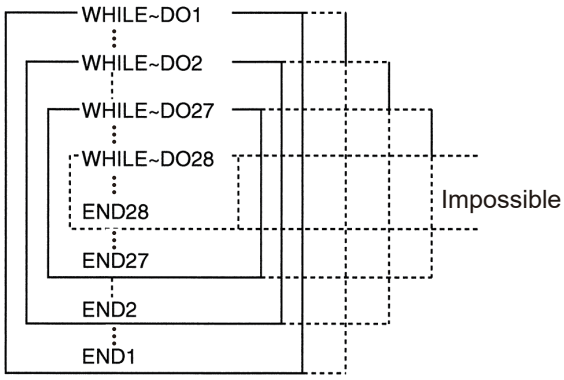


3) The multiplicity for WHILE to DOm is up to 27-fold, and m is 1 to 127 and free for nesting depth.

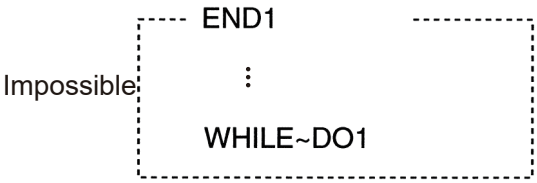


CAUTION
In case of nesting, an m once used cannot be reused.

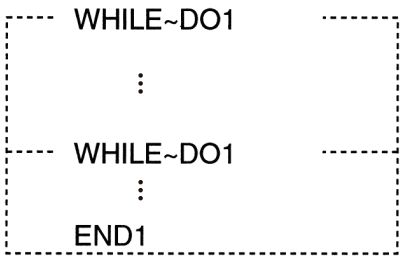
4) The multiplicity for WHILE to DOm cannot exceed 27-fold.



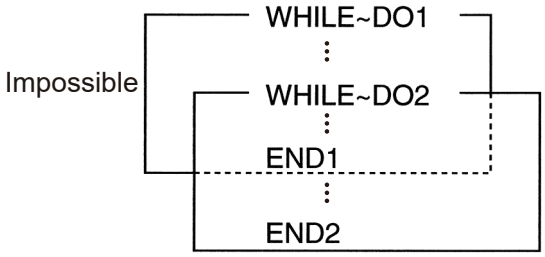
5) WHILE to DOm must be designated first and then ENDm.



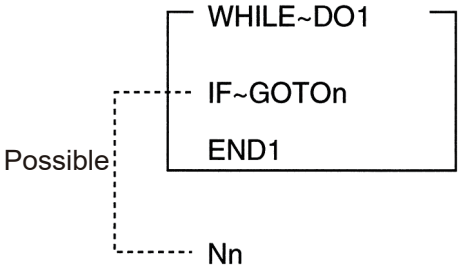
6) WHILE to DOm and ENDm must correspond in a 1/1 ratio within the same program.



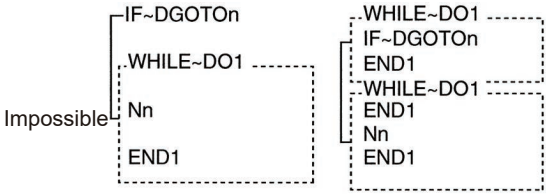
7) Two WHILE–DOm loops cannot be nested or interleaved.



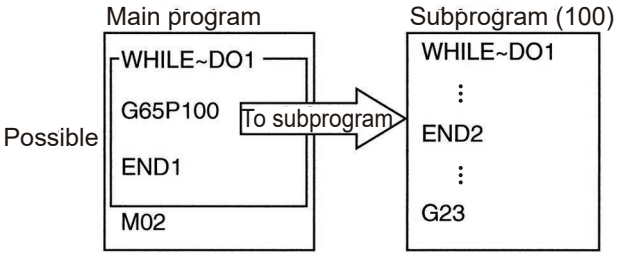
8) Branching out of the boundaries of WHILE to DOm is possible.



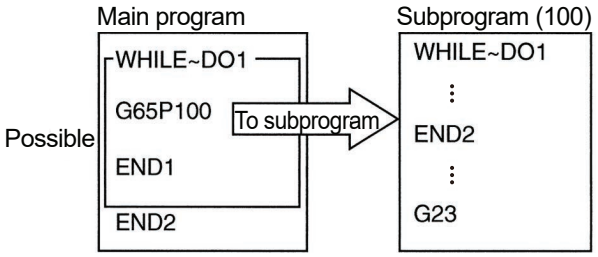
9) Branching into WHILE to DOm is impossible.



10) Subprogram calls using G22, G65, G66, etc., can be made within WHILE - DOm.



11) Within WHILE - DOm, macros can be called using G65 or G66, and new sequence numbers can be specified starting from 1 Nesting can be done up to 27-fold, including the main and subprograms.



12) If WHILE and END are not paired within a subprogram (including macro subprograms), a program error occurs with G23.

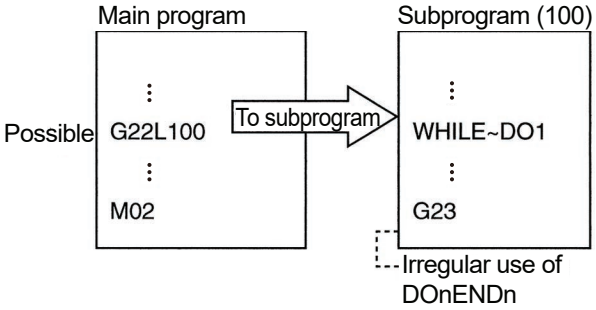


Fig. IV.10.24

When branching from the WHILE to DOm range, the WHILE multiplicity will drop to the branch destination multiplicity, so a conflict does not occur in the WHILE multiplicity.

10.10 Corner Chamfering

10.10.1 Function and purpose

In a command block that forms a corner, adding C_ at the end of the preceding block automatically performs chamfering at any desired angle.

10.10.2 Command format

N100G01X_Y_,C_

N200G01X_Y_ } Chamfering is carried out by setting at the intersection point of N100 and N200.

Distance between the virtual corner and the start point and end point of the chamfering

Arc command also same
G02(G03)X_Y_I_J_,C_
or
G02(G03)X_Y_R_,C_

10.10.3 Detailed explanation

Chamfering is carried out by connecting positions reduced by the lengths specified with C_ before and after the virtual corner, assuming no chamfering is applied.
In case an arc exists, tangent lines are applied at the corner and the chamfering angles are determined accordingly.

- The starting point of the block following completion of a corner chamfering block constitutes the intersecting point of the virtual corner.
- The tool offset is calculated for the configuration following the completion of a corner chamfering operation.
- When a scaling command is executed, scaling is also carried out on the corner chamfering amount.

10.10.4 Program example

- G91G01X100.,C10.
- X100.Y100.

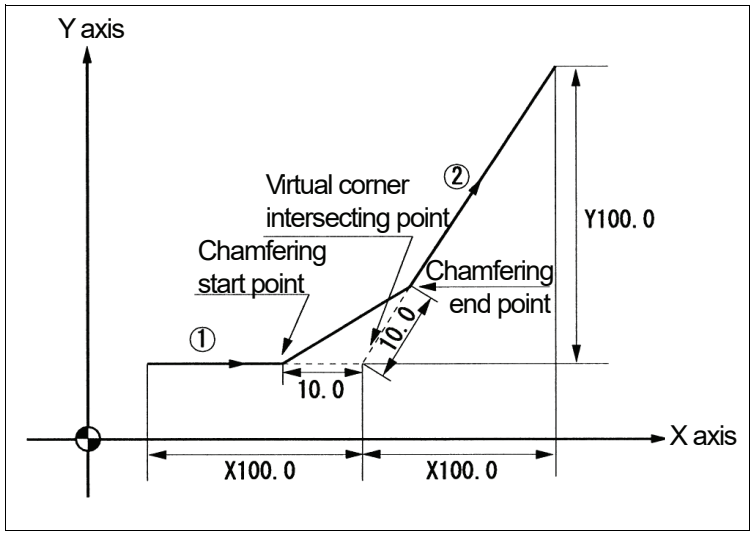


Fig. IV.10.25

- G90G03X60.Y50.I0J40.,C20.
- G01X100.Y20.

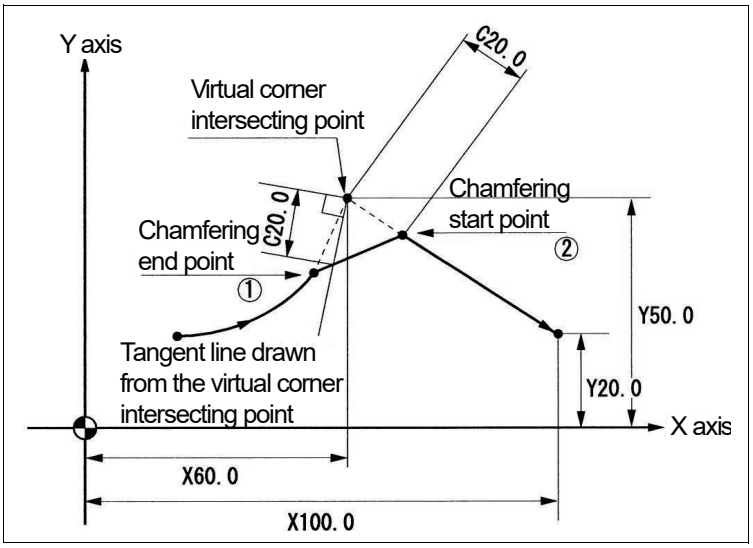


Fig. IV.10.26

(1) Restrictions

1) When both corner chamfering (,C_) and corner R (,R_) commands are used in one particular block, the latter command takes precedence.

2) When a block that follows a block in which a corner chamfering command was executed and it does not contain either a linear line or an arc command, a program error occurs.

3) When a position command is less than the chamfered amount in a block, in which a corner chamfering command was executed, a program error occurs.

4) When a position command is less than the chamfered amount in the next block, in which a corner chamfering command was executed, a program error occurs.

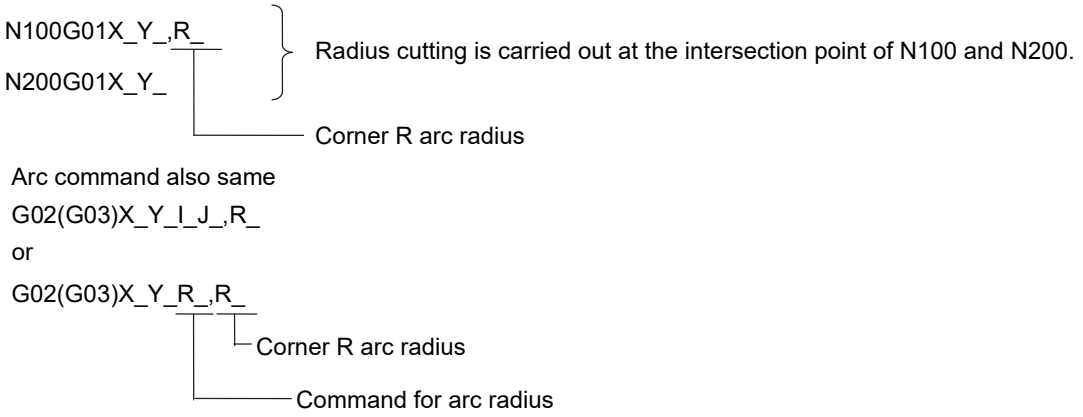
5) When a UV command is used in the block where chamfering is specified or in the following block, a program error occurs.

10.11 Corner R

10.11.1 Function and purpose

In a command block that forms a corner, adding R_ at the end of the preceding block automatically performs corner rounding.

10.11.2 Command format



10.11.3 Detailed explanation

(1) Assuming no corner rounding, the virtual corner is rounded with an arc of the radius specified by R_.

(2) The start point of the block following a corner R is the virtual corner intersection.

(3) When the comma is missing in ", R_", the command is interpreted as an R command.

(4) The tool offset is calculated based on the shape after the corner R is applied.

(5) When scaling is commanded, it also applies to the corner R value.

(6) When both ,C_ and ,R_ commands are used in one block, the latter command becomes effective.

(7) If the block following a command with a corner R is not a straight line or arc command, a program error occurs.

(8) If the movement distance of a block commanded with a corner R is less than the R value, a program error occurs.

(9) If the movement distance of the block following a block commanded with a corner R is less than the R value, a program error also occurs.

(10) If there is a UV command in either the block commanded with a corner R or the following block, a program error occurs.

10.11.4 Program example

- G91G01X100., R10.
- X100.Y100.

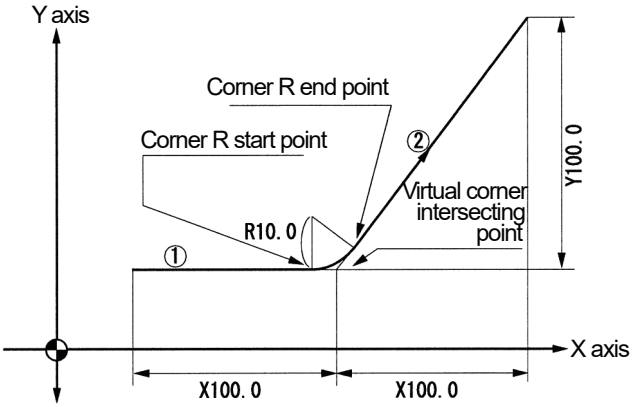


Fig. IV.10.27

- G90G03X100.Y100.I-10.J60., R 20.
- G01X180.Y80.

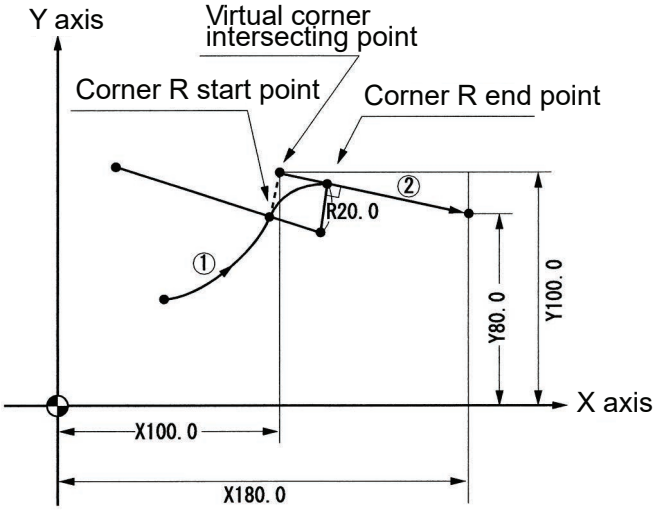


Fig. IV.10.28

10.12 Linear Angle Command

10.12.1 Function and purpose

If a single axis is commanded on either a linear angle or end point coordinates, the end point coordinates are computed out automatically.

10.12.2 Command format

Assume that the axis is at the current point A (x0y0).

G01, Aa1Xx_1 (Yy1) Specifies the angle and the X or Y coordinate of point B.

G01, A-a2Xx_2 (Yy2) Specifies the angle and the X or Y coordinate of point C.

The same applies even if A-a2 is specified as A_{a3}.

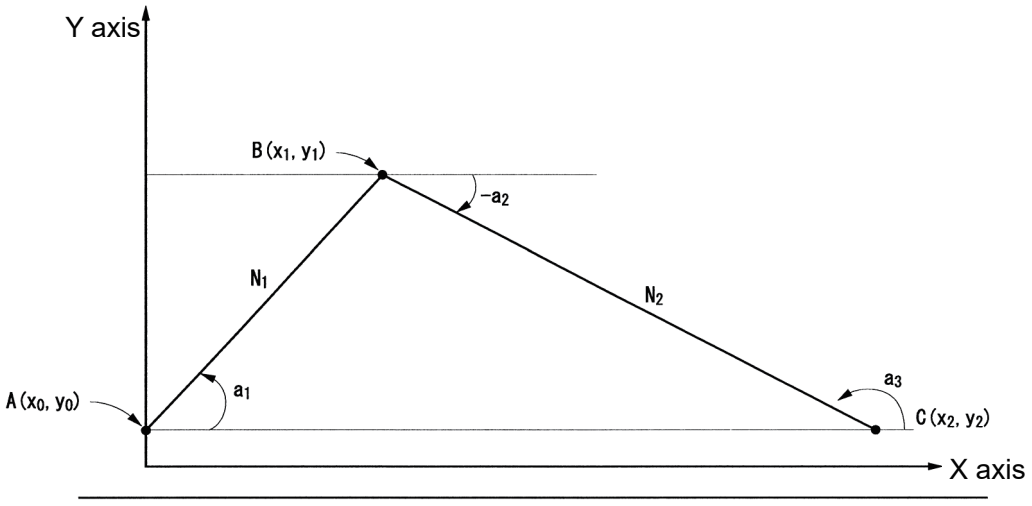


Fig. IV.10.29

10.12.3 Detailed explanation

(1) Angles are measured from the + direction of the 1st axis (horizontal axis) of the selected plane, with counterclockwise (CCW) being positive and clockwise (CW) being negative.

(2) For the end point, either one of the selected plane axes is designated.

(3) Disregard the angle when the angle and coordinates for both axes are already designated.

(4) When only the angle is designated, an interpretation is made that a geometric command is in effect.

(5) For the 2nd block, the angle at either the start or end point may be used.

10.13 Geometric command

10.13.1 Function and purpose

When it is difficult to determine the intersection of two consecutive linear interpolation commands, specifying the slope of the first line N_1 and the slope and absolute endpoint coordinates of the second line N_2 allows the NC to automatically calculate the endpoint of the first line and control the motion command accordingly.

10.13.2 Command format

G01, Aa1Ff_1	Specifies the angle and feed rate.
XxeYye, Aa2Ff_2	Specifies the absolute coordinates (xe, ye) of the next block's end point, along with the angle and feed rate. The same applies even if the angle is specified as Aa2'.

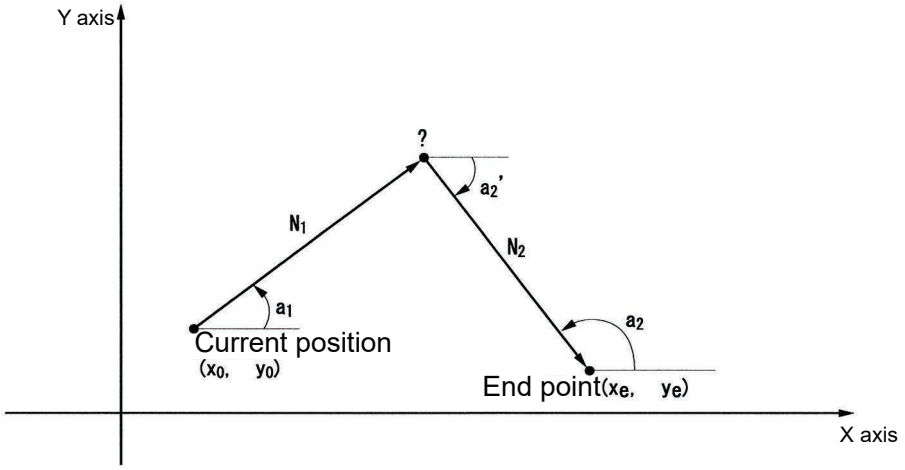


Fig. IV.10.30

10.13.3 Detailed explanation

(1) Geometric commands not in the XY plane will result in a program error.

(2) The tilt represents the angle with respect to the +X axis, with counterclockwise (CCW) being positive and clockwise (CW) being negative.

(3) The range of tilt a is -360.0000 ≤ a ≤ +360.0000.

(4) The tilt of the second block can be commanded at either the start or end side. Whether the specified tilt is at the start or end side is automatically determined within the NC.

(5) Specify the end coordinates of the second block in absolute coordinates. A program error occurs when an incremental value is indicated.

(6) The speed can be designated for each and every block.

(7) A program error occurs when the intersecting angle of two linear lines is less than 5°.

(8) A single block stop can be made at the end point of the 1st block.

(9) A program error occurs if either the 1st or 2nd block is not a straight line.

10.14 EM - trajectory control

10.14.1 Function and purpose

Normally, a protrusion remains at the cut-off section of the material at the end of the 1st cut. (Dotted line in Fig. IV.10.31) Performing a second cut on the entire shape will remove this protrusion, but then, as shown at point P in the figure, there will be a groove where the wire passes twice in a single operation.

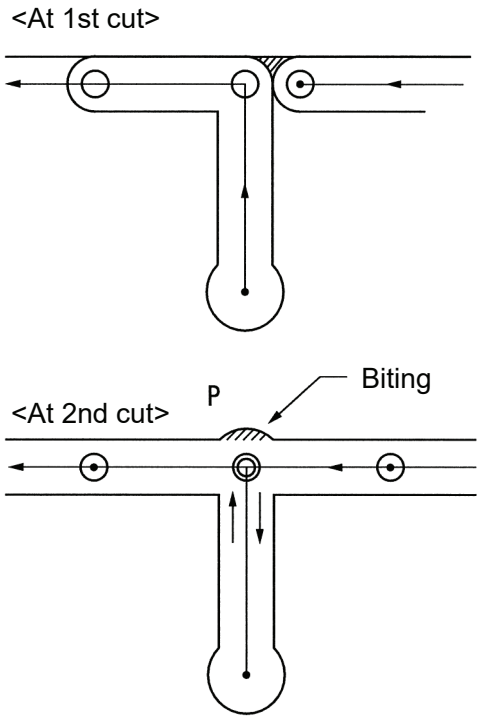


Fig. IV.10.31

This function automatically changes the machining path at the offset start and end sections to prevent this type of biting during the 2nd cut.

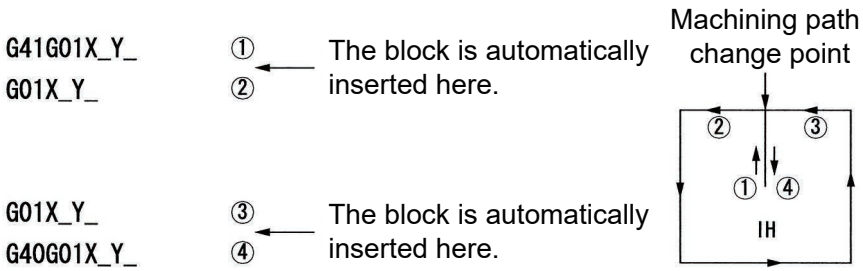


Fig. IV.10.32

10.14.2 Command format

(1) When the path change amount is automatically set

Select the auxiliary menu "Machining settings" > "P-Ctrl", and set the [EM-T] switch and [WH Auto Set] switch to ON in the [EM] sheet.

(2) When the path change amount is manually set

Select the auxiliary menu "Machining setting" > "P-Ctrl", and set the [EM-T] switch to ON and [WH Auto Set] switch to OFF in the [EM] sheet.

1) When a linear block is inserted

H860 …… Path change amount Width
H861 …… Path change amount Length
H862 …… Circular arc radius (= 0)

2) When an arc block (half circle) is inserted

H860 …… Path change amount Width (= 0)
H861 …… Path change amount Length (= 0)
H862 …… Circular arc radius

- **If any one of H860, H861, or H862 is set to zero, this function will not work even if "EM-T" is ON.**
  When inserting a linear block.....If either H860 or H861 is zero
  When inserting a circular block.....If H862 is zero
- **If the path change amount or the inserted circular arc diameter (H862 × 2) exceeds the movement amount of the original block, a program error "P1074 APP COMPEN" will occur.**

10.14.3 Detailed explanation

(1) When the path change amount is automatically set

H860 and H861 of < Machining path of approach error compensation > in Fig. IV.10.33 are automatically set.
Automatic settings of H860 and H861:
H860 ... Offset - Wire radius + H863
H861 ... Approach distance

(2) When the path change amount is manually set

1) When a linear block is inserted

The approach error compensation section becomes the positions of the offset start and offset end commands in the program. However, the offset start (end) commands (1, 4) must be in the same block as the movement command. The movement blocks (2, 3) can use G02 (G03).

< Original machining path > < Original machining path >

[Linear]

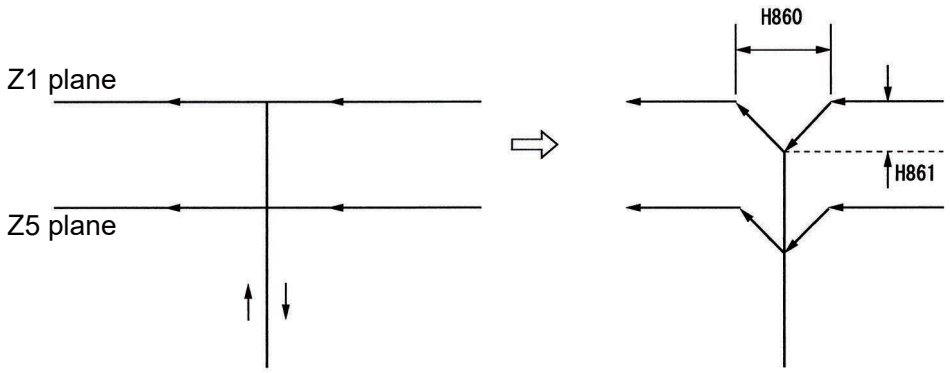


Fig. IV.10.33

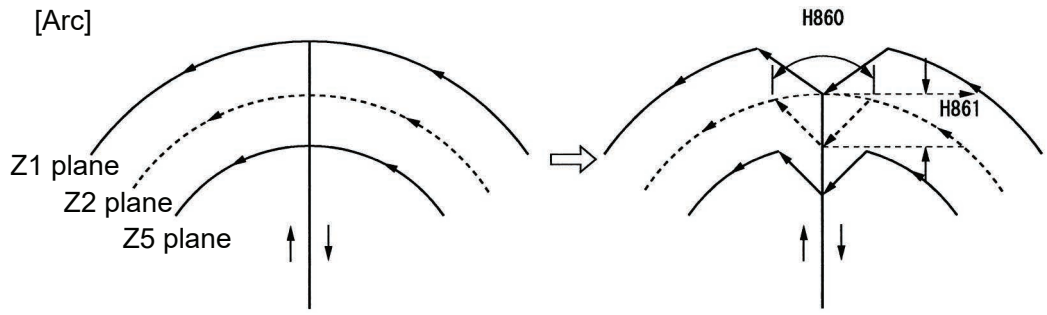


Fig. IV.10.34

The machining path when approach error compensation is executed can be confirmed with program check. In this case, select "Program" > "Graphic Check" > "P-Ctrl", set [EM-T] to "ON", and then check the program. When setting the variables from the screen, select "PROGRAM CHECK DATA" with "Automatic 2nd cut", open the overlap window "VARIABLE", and then set the variables for program checking.

M01 execution position during approach error compensation function execution

```
G01X_Y_          1)
M01
G40G01X_Y_       2)
```

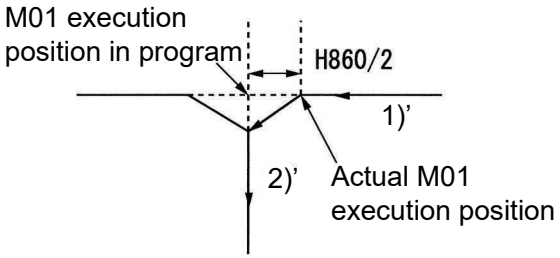


Fig. IV.10.35

When executing the reference point adjustment function, the "Block with next M01" 1) is converted to 1)'. In this case, the execution position of M01 will be at the end point of 1)'.

2) When an arc block (half circle) is inserted

As with inserting a linear block, the approach error compensation section becomes the positions of the offset start and offset end commands in the program. For the insertion method, a semicircle with diameter H862 is inserted from a position just before the inserted circular arc diameter (H862 × 2) along the Z1 surface path of the offset start (end) commands (1), 4))." The offset direction is determined by the offset start (or end) command (G41, G42) and the sign of the offset amount. In taper machining, the inserted arc has the same radius at both the top and bottom. However, program the offset start (end) commands (1, 4) so that they are perpendicular to the movement blocks 2 and 3.

[Linear]

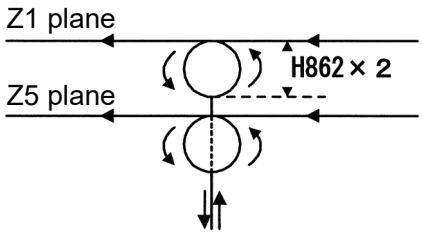


Fig. IV.10.36

[Arc]

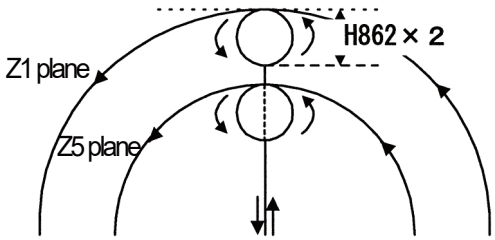


Fig. IV.10.37

- **When approaching an arc-shaped feature, interference with the feature may occur if the radius of the inserted arc is larger than that of the feature's arc.**

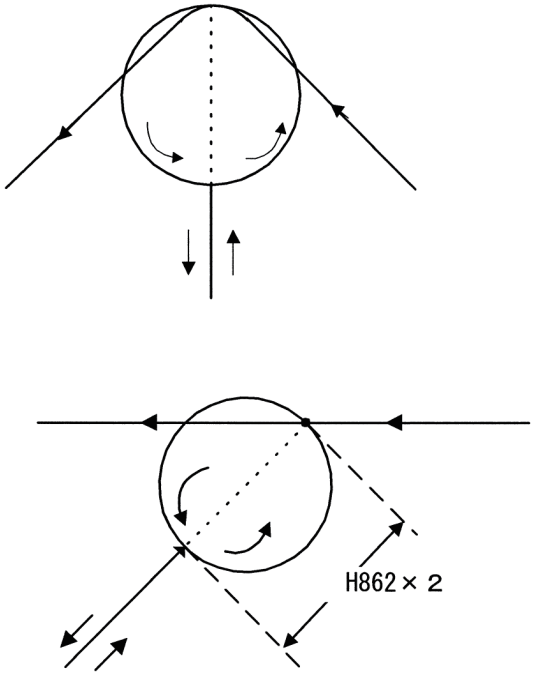


Fig. IV.10.38

- **When approaching a feature at an angle, interference may also occur. Therefore, use this function only when approaching at a right angle.**

11. MULTIPLE COORDINATE SYSTEM FUNCTION (G53 to G59, G54.1P00 to P99, G43)

11.1 Machine Coordinate System and Workpiece Coordinate

The machine coordinate system is a machine-specific coordinate system , and it is set as the reference position of the machine-specific position (dog type zero point return position = machine zero point).

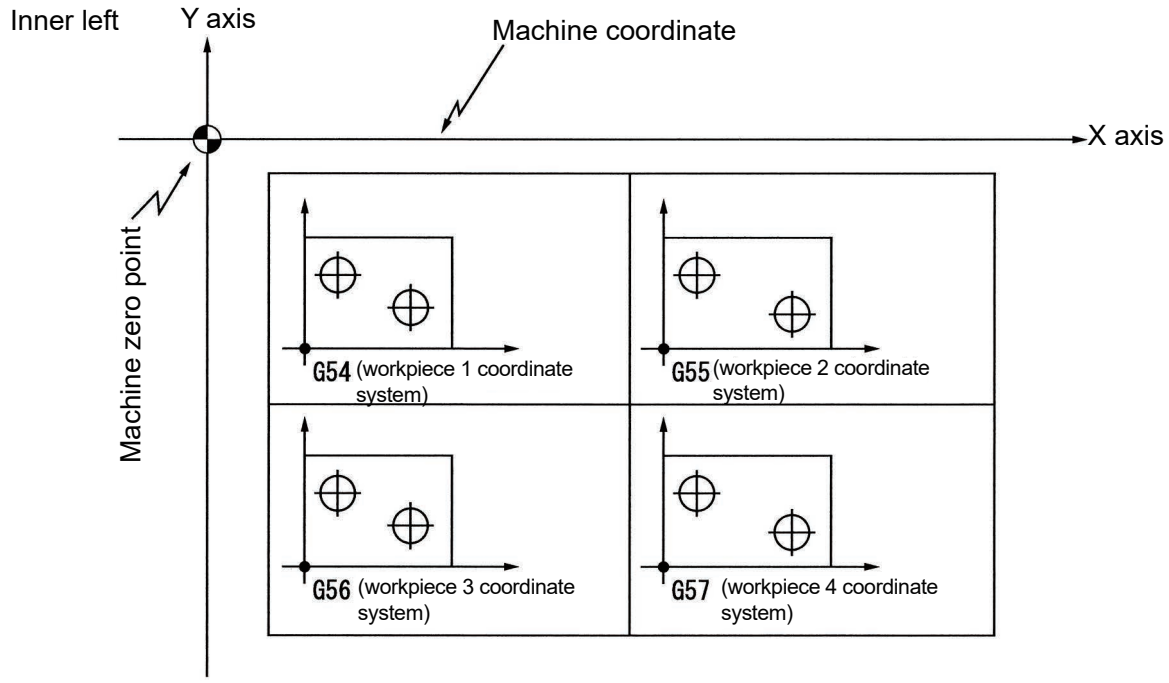


Fig. IV.11.1 Front of the machining table

The six coordinate systems G54 to G59 and 100 coordinate systems G54.1P00 to G54.1P99 (106 in total) can be used as the workpiece coordinate systems. The setting method G54.1P×× in the NC program corresponds to W×× display.

The workpiece coordinate system can also be used with the following two methods.

- Setting the zero point based on the machine zero point (multiple workpiece coordinates)

and

- Setting the zero point with the machine zero point and G92 vector (workpiece coordinate)

To use the multiple workpiece coordinates, turn ON the "Mult.Wrk" switch displayed by selecting "Initial setting > Machine parameters" > "Machining setting" > "Auto3" from the main menu.

11.1.1 Multiple workpiece coordinates

(1) Summary

The zero point of the workpiece coordinate system is the offset amount of each workpiece from the machine zero point.

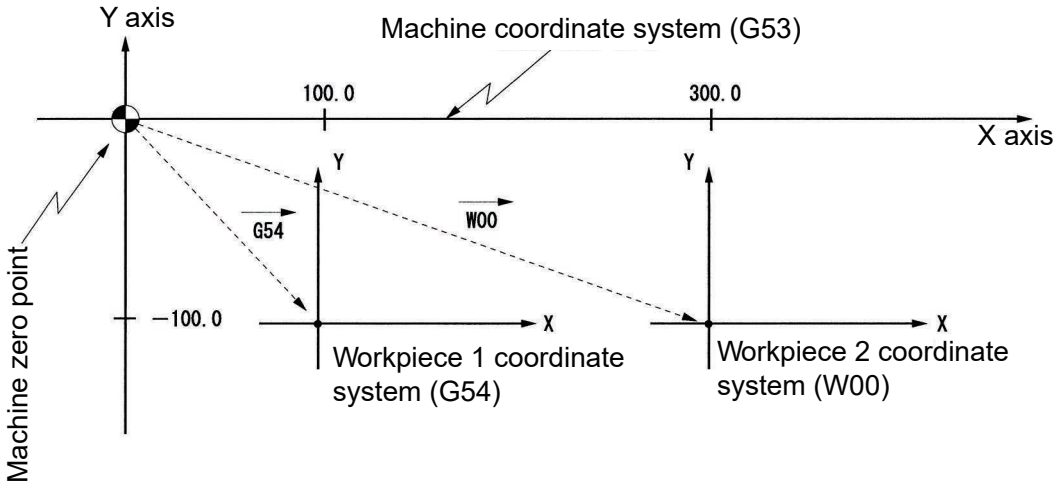


Fig. IV.11.2

11.1.2 Workpiece coordinates

(1) Summary

The zero point of the workpiece coordinate system is the position obtained by adding the G92 vector to offset amount of each workpiece from the machine zero point.

This G92 vector is set when the [Rst:Clr Prg-P] switch is turned ON displayed by selecting "Initial setting" > "Machine parameters" > "Machining setting" > "Auto3" from the main menu, and the current value is cleared to zero with the RESET key or M02 command. This G92 vector is also set in the same manner when the current value is preset to a freely selected using G92. The position commanded with G92 becomes the zero point of the workpiece coordinate, and the difference with the workpiece offset becomes the G92 vector.

For example, when the workpiece offset is set to (100.0, -100.0) and the machine is moved to (150.0, -200.0), the G92 vector will be set to (50.0, -100.0) when the RESET key is pressed (the current position is preset to 0). (Fig. IV.11.3.)

To clear the G92 vector, click the "G92Clear" switch displayed by selecting "Operation" > "Work setup" > "Work offset".

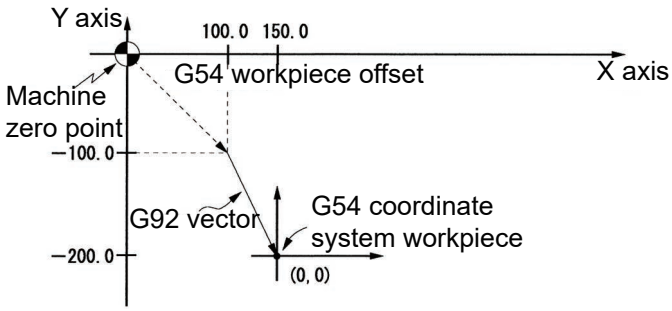


Fig. IV.11.3

11.2 Setting Multiple Coordinate System by NC Program

11.2.1 Function

(1) The G53 command allows movement in the machine coordinate system where the machine zero point is the reference point.
The G53 command is effective only in the commanded block.

(2) Using the G54 to G59 or G54.1 command, workpiece coordinate system can be switched in the program.

(3) Using the G43 command, workpiece offset of various workpiece coordinate systems can be set in the program.

11.2.2 Command format

(1) Selection of machine coordinate system (G53)
G53 G00 X0 Y0Movement to the machine coordinate zero point

(2) Selection of workpiece coordinate

1) Selection of workpiece coordinate system (G54 to G59)
G90 G54 G00 X0 Y0. . . . . Movement to the zero point of the workpiece coordinate system
G54 to G59

2) Selection of workpiece coordinate system (G54.1) (W00 to W99)
G90 G54.1 P00 G00 X0 Y0 . . . . . Movement to the zero point of the workpiece coordinate system
P00 to P99

(3) Setting of workpiece offset using the NC program (G43)

1) Workpiece offset for G54 to G59 coordinate system
G43 G54 X . . . . . Y. . . . . .
G54 to G59

2) Workpiece offset for W00 to W99 coordinate system
G43 G54.1 P00 X . . . . . Y. . . . . .
P00 to P99

- The X and Y values are the distances from the machine zero point to each coordinate system zero point.

11.2.3 Setting method

The workpiece offset for each workpiece coordinate system can be set displayed by selecting "Operation" > "Work setup" > "Work offset" from the main menu. It also can be set using the NC program commands.

(1) When setting from the screen
G54 workpiece coordinate system X = 100.0 Y = -100.0
W00 workpiece coordinate system X = 300.0 Y = -100.0

(2) When setting using program commands
G43 G54 X100. Y-100.
G43 G54.1 P00 X300. Y-100.

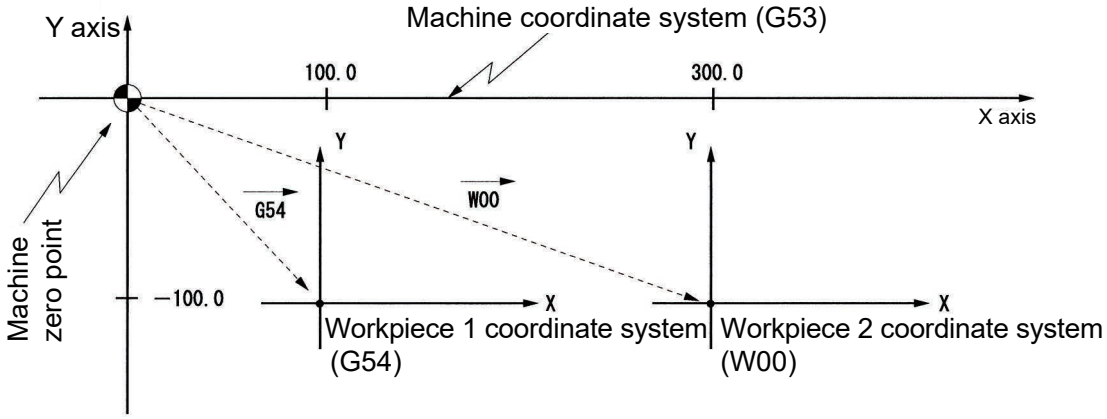


Fig. IV.11.4

- **When setting workpiece coordinates, cancel the axis rotation function.**
- **When setting them with program commands, cancel the figure change functions (magnification, wire diameter compensation, mirror image, axis change, coordinate rotation, and figure rotation).**

11.2.4 Program example

(1) Example 1:

After positioning two workpieces, the start hole position of each workpiece is used as the zero point of each workpiece coordinate system, and punching and die machining are performed for each workpiece.
This example assumes that the shape machining program using automatic program output is being used.

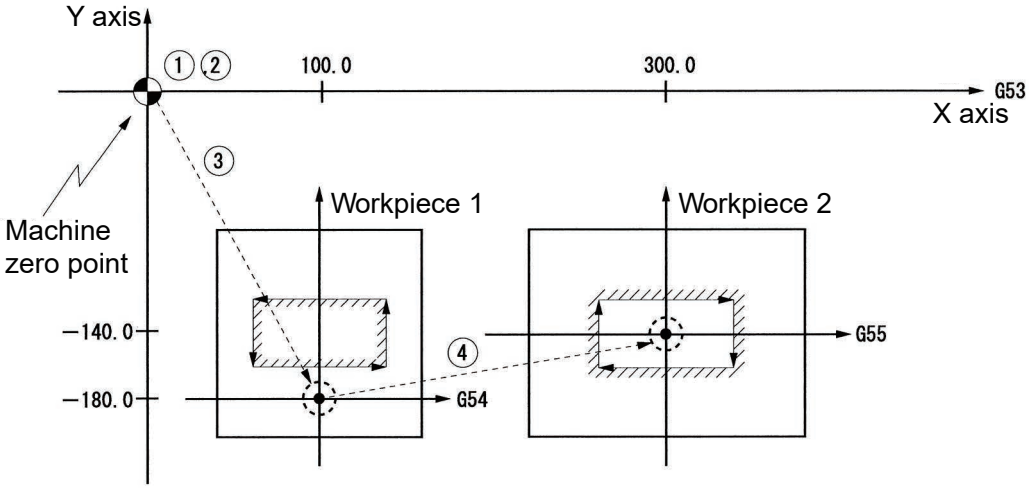


Fig. IV.11.5

1) Workpiece offset data setting

Workpiece 1	X = 100.0	Y = -180.0	.....	G54
2	X = 300.0	Y = -140.0	.....	G55

2) Machining program

(a) G28X0Y0 …Automatic zero point return (Execute only once after turning the power on.)

(b) G90 G54 G00X0Y0 …Movement to the start hole of workpiece 1 (G54 coordinate zero point)

```
M00
M80 M82 M84
G92 X0 Y0
G90 G42 X0 Y20. 0 F100
G01 X40. 0 Y20. 0
X40. 0 Y60. 0
X-40. 0 Y60. 0
X-40. 0 Y20. 0
X0 Y20. 0
G40 X0 Y0
M00
```

Shape machining program for workpiece 1 by automatic program

(c) G90 G55 G00X0Y0 …Movement to the start hole of workpiece 2 (G55 coordinate zero point)

M00
M80
M82
M84
G92 X0 Y0
G90 G42 X0 Y20. 0 F100
G01 X40. 0 Y20. 0
X40. 0 Y20. 0
X-40. 0 Y20. 0
X-40. 0 Y20. 0
X0 Y20. 0
G40 X0 Y0

} Shape machining program for workpiece 2 by automatic program

A movement between workpiece coordinate systems must be performed in G90 (absolute value command mode).

(2) Example 2:

Continuous machining of die opening with different positions for each workpiece using one shape machining program as a subprogram Each workpiece is properly positioned and machine coordinate positions for each workpiece are known. The following shows how machine coordinate values for the reference points are set in a program as workpiece offset for each workpiece coordinate system.

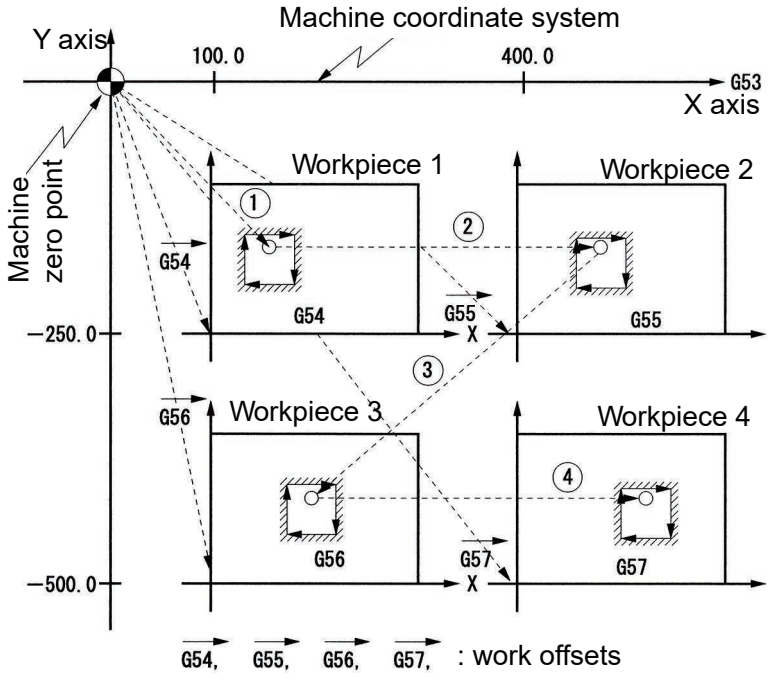
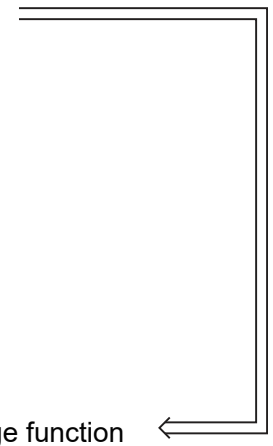


Fig. IV.11.6

1) Machining program (subprogram)

```
L100
G91                 ..... Relative value command
(S1. 5K45. 0)       ..... Figure change function
G41 Y10. 0 F100
G01 X25. 0
Y-50. 0
X-50. 0             } Shape machining
Y50. 0
X25. 0
G40 Y-10. 0
(S1. 0K0)           ..... Cancellation of figure change function
M00
G23
```



2) Positioning program (main)

```
G43 G54 X100. 0 Y-250. 0
G43 G55 X400. 0 Y-250. 0
G43 G56 X100. 0 Y-500. 0    } Setting workpiece offset
G43 G57 X400. 0 Y-500. 0
G28 X0 Y0           ..... Automatic zero point return
(a) G90 G54  G00 X50. 0  Y90. 0
    M00
    G22 L100                } Machining with G54 coordinate system
    G90 G55  G00 X75. 0  Y90. 0
    M00
    G22 L100                } Machining with G55 coordinate system
    G90 G56  G00 X100. 0 Y90. 0
    M00
    G22 L100                } Machining with G56 coordinate system
    G90 G57  G00 X124. 0 Y90. 0
    M00
    G22 L100                } Machining with G57 coordinate system
    M02
```

- **Switching coordinate systems with G54–G59 or G54.1 does not cancel wire diameter compensation or taper angle commands; cancel them first.**
- **Use absolute mode (G90) for movement between workpiece coordinate systems. Before moving, cancel figure change functions (magnification, wire diameter compensation, mirror image, axis change, coordinate/figure rotation) and axis rotation. With W01–W99, movement to the same coordinate system is also treated as inter-system movement.**
- **G54 is selected at reset. G54–G59 and G54.1 are modal; G53 and G43 are unmodal. Use G53 only when wire diameter compensation is OFF (G40); movement may be incorrect during G41/G42.**

11.3 Local coordinate system setting (G52)

11.3.1 Summary

G52 shifts a workpiece coordinate system to create a local coordinate system. The local system is offset by the commanded G52 value and can be set separately for each workpiece coordinate system.
(G54L to G59L)

11.3.2 Command format

G52 Xx_1 Yy_1

Offset amount from workpiece coordinate zero point to local coordinate zero point

11.3.3 Detailed explanation

The local coordinate system is used for machining several workpieces continuously using a workpiece coordinate system when a specific workpiece is to be machined with offset position.
Commanding G52 in the G54 workpiece coordinate system to set G52X50Y-100 changes the G54 coordinates by the amount commanded in G52 thereafter, but the G55 to G59 workpiece coordinate systems will not be affected. (Fig. IV.11.7)

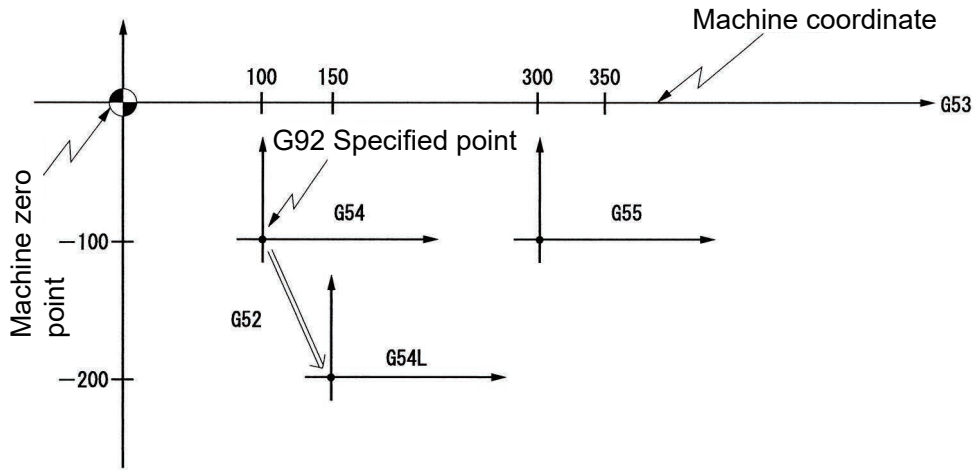
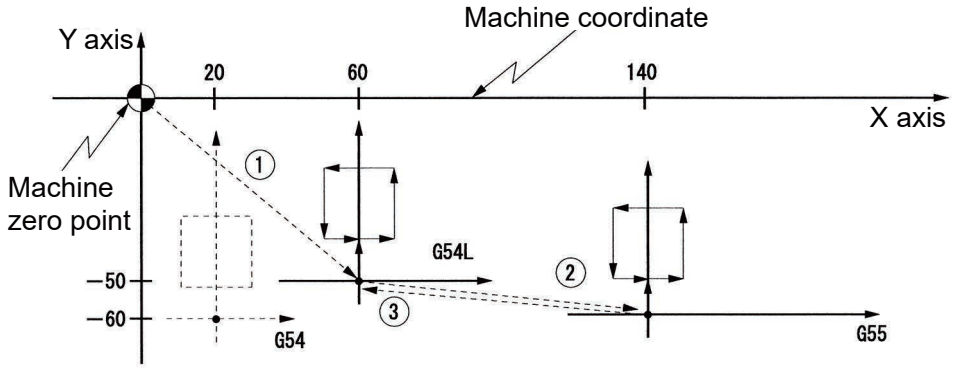


Fig. IV.11.7

G54 . . . . . Old workpiece 1 coordinate system
G54L . . . . . New workpiece 1 coordinate system
G55 . . . . . Workpiece 2 coordinate system

11.3.4 Program example




```
G43 G54 X20 Y-60          } Setting of each workpiece offset
G43 G55 X140 Y-60         } (This can be input from the screen.)
```

Fig. IV.11.8

```
G28   X0   Y0          …  Automatic zero point return (Execute once after turning
                          the power on.)
G90   G54              …  G54Workpiece coordinate system selection
G52   X40   Y10        …  G54LLocal coordinate system selection
1)G00   X0   Y0        …  G54LMove to local coordinate zero point
  M00
  G22L100              …  G54LShape machining with local coordinate system

  G90   G55            …  G55Workpiece coordinate system selection
2)G00   X0   Y0        …  G55Move to workpiece coordinate zero point
  M00
  G22L100              …  G55Shape machining with workpiece coordinate system
3)G90   G54   G00   X0   Y0   …  G54LMove to local coordinate zero point
  M02
  L100
  G91 G42 F100
  G01 X10
  Y20
  X-20                 } Shape machining program
  Y-20                 } (subprogram)
  X10
  G40Y-10
  M00
  G23
```

- **A movement between coordinate system must be done in the absolute value command mode (G90).**
- **To cancel the local coordinate system of G54L, command G90G54G52X0Y0.**
- **G52 is an unmodal command.**
- **For other general cautions, refer to the program examples for the multiple coordinate system setting function.**
- **The local coordinate system function can be canceled with M02, M30, or [RESET].**

12. FEEDRATE FUNCTION (F CODE)

12.1 Rapid Traverse Rate (G00)

The rapid traverse rate is predetermined and does not need to be programmed.

X, Y axes.....1300 mm/min
U, V axes.....120 mm/min
Z axis.....300 mm/min

12.2 Machining Feedrate

Specify the feedrate using address F followed by a number within 8 digits (normal mode) or 9 digits (× 0.1 mode). The unit of feedrate is 1 μm/min (metric mode) or 0.0001 inch/min (inch mode).
The feedrate specifies the speed at which the electrode (or table) moves and is effective when G01, G02, and G03 movement commands are executed.
The feedrate always indicates the speed in the same direction as the movement of the electrode (the tangential speed).
It also indicates the speed at the Z2 height during taper machining.

12.3 Command Unit and Command Speed Range

Normal mode

	Command unit	Command range
Metric system	0.001 mm/min	1 to 99999999
Inch system	0.0001 inch/min	1 to 99999999

× 0.1 mode

	Command unit	Command range
Metric system	0.0001 mm/min	1 to 999999999
Inch system	0.00001 inch/min	1 to 99999999

If a command greater than the above digit is applied, a program error occurs.

12.4 F Command Related Items

(1) By using the manual speed interruption function, the F value can be changed with the operation board at any timing during machining.

(2) When the adaptive feed control is ON, the F code is ignored.

(3) When the "DRYRUN" switch is ON, the F command from the NC program is ignored, and the F value input from the operation screen is enabled.

(4) In blocks where the G04 dwell is commanded, the F command is processed as a dwell waiting time command. It will not be processed as the feederate command.

(5) When the "Keep Data @ Reset" switch is OFF, the machining feedrate FA is cleared to 0 by the M02 or M30 command or by pressing [RESET].

13. MISCELLANEOUS FUNCTION M

The functions shown in 13.1 can be executed with M commands in the NC program.

13.1 Miscellaneous Function Explanation

13.1.1 Program stop (M00)

When this miscellaneous function is read, the reading of the next block is stopped, and the machining and dielectric fluid are stopped.

To restart, press the switches in the order of , , , and [START].

13.1.2 Optional stop (M01)

When the optional stop (M01Stop) switch is ON and the M01 command is read, it functions the same as the previously described M00 command. When the optional stop switch is OFF, the M01 command is ignored and skipped.

< Example >

⋮

N10 G00 X1000
N11 M01
N12 G01 X2000 Z3000 F600

⋮

Optional switch
If ON, stops at N11.
If OFF, ignores N11 and continues to execute N12.

13.1.3 Program end (M02 or M30)

This command is usually used in the final block where machining is completed. The control unit will be reset when it is issued.
Note that the operation starts in the G01 mode if the first movement command after restarting is specified with only a coordinate term.
For the movement command specified first, it is recommended to always specify a G function.

When the [RESET] key is pressed, the independent output of M00, M01, M02, and M30 is reset.

13.1.4 External signal output (M60 to M69) (This may not be implemented depending on the model and options.)

M60 to M69 control output of external signals (1 to 5).
For connection of the external signal I/O ports, refer to the related documentation separately.

13.1.5 Dielectric fluid preparation ON/OFF (M74, M75) (This may not be implemented depending on the model and options.)

These commands control the ON/OFF status of fluid preparation.

13.1.6 Dielectric fluid circulation ON/OFF (M76, M77)

These commands control the ON/OFF status of fluid circulation.

13.1.7 Rapid filling up (M78) (This may not be implemented depending on the model and options.)

When M78 is commanded, the working tank is filled up with dielectric fluid. Filling stops automatically when the specified amount is reached.
Make sure to close the front door of the working tank before issuing the M78 command.

13.1.8 Dielectric fluid ON/OFF (M80, M81)

These commands are used to control the dielectric fluid pump.
The M80 command (dielectric fluid ON) is normally issued at the beginning of a machining NC program, and the M81 command (dielectric fluid OFF) is normally issued before the program end.

13.1.9 Automatic wire feeder control (M20, M21, M22, M23) (This may not be implemented depending on the model and options.)

M20 to M23 control the operation of the automatic wire feeder (wire insert, wire cut, test insert, and fixed position return).

13.1.10 Wire feed control (M82, M83)

These commands control the wire feed start (M82) and wire feed stop (M83).

13.1.11 Machining power ON/OFF (M84, M85)

These commands are used to turn ON/OFF the machining power.

13.1.12 Dielectric fluid Low/High (M88, M89)

These commands are used to increase (M89) or decrease (M88) the dielectric fluid flow using the NC commands. When the dielectric fluid flow control function is provided, the LQ4 notch is set with M88 and the LQ16 notch is set with M89.

< Example >

M89 . . . . . Dielectric fluid High

13.1.13 Adaptive feed ON/OFF (M90, M91)

These commands are used to turn ON/OFF the adaptive feed control.

13.1.14 All stop (M93)

Turns "OFF" the preparation of the control unit.

13.1.15 Fluid level setting (M58, M59) (This may not be implemented depending on the model and options.)

These commands control the opening and closing of the door and set the fluid level.

M58 Holds the dielectric fluid level below the table.

M59 Holds the dielectric fluid level at the set level above the table.

13.1.16 Automatic scrap process (M52) (This may not be implemented depending on the model and options.)

M52 Removes the cut-off workpiece using a robot.

13.1.17 Automatic workpiece change (M53) (This may not be implemented depending on the model and options.)

M53 Picks up the workpiece for machining from the stocker and sets it on the table.

•For random access-type AWC unit (3R)

M53 P value

Pallet number

13.1.18 PM mode selection (M101, M102, M103, M105)

(1) Creating an NC program for using this function

NC codes used

M101	PM circuit OFF
M102	PM Nozzle open mode
M103	PM Nozzle seated mode
M105	Thin plate mode

- **Use E-Packs 1 to 499 when creating a new program.**
- **If there is no P command, it is processed as P0.**
- **If a value other than 0 or 1 is commanded for the P command, "P35 CMD-VALUE OVER" occurs.**

(2) Creating an NC program - Punch shape multiple setup -

With the PM control ON/OFF command in the program, 2nd cut using the PM control for the 1st cut is possible.

1) Program example

(a) Machining order

Slot shape (1st, 2nd)

↓

Square shape (1st, 2nd)

↓

(Slot shape) … Start point

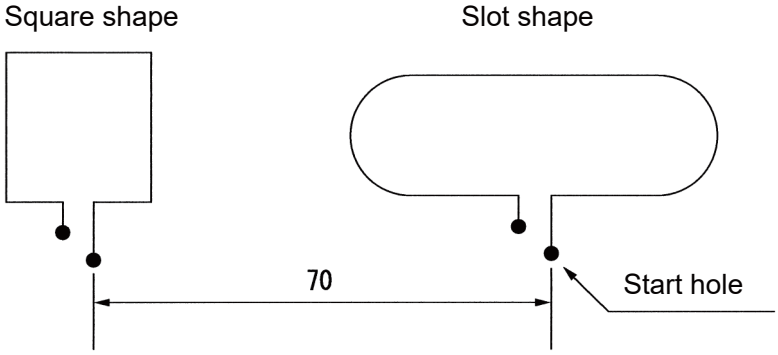


Fig. IV.13.1

(b) Machining shape subprogram

Slot shape .....L5000 (forward direction), L5001 (reverse direction)
Square shape L6000 (forward direction), L6001 (reverse direction)

(c) Example of creating the main program

Example 1 - When turning the PM control ON and OFF with E-Pack machining class (C) setting -

```
L4000/(MAINPROGRAM)
(NAGAANAKEIJOU)
M20
E10 ..... 1st cut E-Pack (machining class (C): 1)
H1 ..... 1st cut offset value
F2.0 ..... 1st cut machining speed FA
G22L5000 ..... Slot shape subprogram (forward direction)
E20 ..... 2nd cut E-Pack (machining class (C): 42)
H2 ..... 2nd cut offset value
F5.0 ..... 2nd cut machining speed FA
G22L5001 ..... Slot shape subprogram (reverse direction)
M21
G91
G00 X-70000 ..... Move to the start hole
(KAKUKEIJOU)
M20
E10 ..... 1st cut E-Pack (machining class (C): 1)
H1 ..... 1st cut offset value
F2.0 ..... 1st cut machining speed FA
G22L6000 ..... Square shape subprogram (forward direction)
E20 ..... 2nd cut E-Pack (machining class (C): 42)
H2 ..... 2nd cut offset value
F5.0 ..... 2nd cut machining speed FA
G22L6001 ..... Square shape subprogram (reverse direction)
M21
G91
G00 X70000 ..... Move to the start hole
M02
```

- **When using machining conditions other than those provided by Mitsubishi Electric, always create them in E1 to 499, and input the machining class in machining class (C).**
- **Start the program after turning the PM control switch ON.**

(3) Machining using automatic 2nd cut (graphic screen only)

Refer to the section on automatic 2nd cut. Since the PM circuit operates automatically in the 1st cut, special programming to turn the PM control ON or OFF is not required.

13.1.19 Machining speed adjustment (M106)

(1) Function and purpose

This command adjusts the machining speed with the specified machining speed adjustment notch (-5 to +4).

(2) Format

M106 Q value

Machining speed adjustment notch (-5 ≤ Q ≤ +4)

(3) Program example

< Example 1 > M106 Q3 .....The machining speed adjustment notch is set to +3.

- **The machining speed adjustment notch is changed by the M106 command, but the machining speed is adjusted only during machining with the 1st machining condition (machining class (C): 1) or during machining with PM.**
- **When Q < -5 is commanded, the machining speed is adjusted to -5, and when Q > 4 is commanded, the machining speed is adjusted to +4.**
  Note that "P35 CMD-VALUE OVER" occurs
  if a value exceeding the range of -99999999 ≤ Q ≤ 99999999 is commanded when the 1 µm specs is used, or if a value exceeding -999999999 ≤ Q ≤ 999999999 is commanded when the 0.1 µm specs is used.

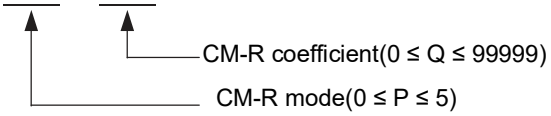
13.1.20 CM-R (M110)

(1) Function and purpose

(This may not be implemented depending on the model and machine.)
This command is used to turn ON/OFF the "CM-R" switch or select the mode.

(2) Format

M110 P value Q value



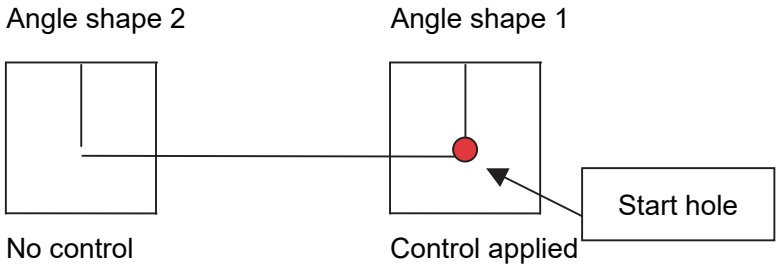
"P command"
P0…"CM-R" switch OFF (The mode does not change, and only the switch is turned OFF.)
P1…"CM-R" switch ON (The mode does not change, and only the switch is turned ON.)
P2…"CM-R" switch ON + priority on speed (path control mode)
P3…"CM-R" switch ON + priority on accuracy (condition control"weak" mode)
P4…"CM-R" switch ON + priority on accuracy (condition control"medium" mode)
P5…"CM-R" switch ON + priority on accuracy (condition control"strong" mode)
"Q command"
This is the compensation coefficient when a priority is given to accuracy with CM-R. If Q0 is commanded, or if the Q command is omitted, compensation is not performed. This is not used normally. The CM-R coefficient compensation can be canceled by turning the CM-R switch OFF, commanding M02 or M30, or pressing [RESET].

(3) Program example

< Example 1 > Changing CM-R control for each shape
<Main program>

```
L4000/(MAINPROGRAM)
(KAKUKEIJOU-1)
M20
M110P2 ..... CM-R ON, set to prioritize the speed
H1 ..... 1st cut offset value
F2.0 ..... 1st cut machining speed FA
G22L5000 ..... Square shape subprogram
M21
G91
G00 X-70000 ..... Move to the start hole
(KAKUKEIJOU-2)
M20
M110P0 ..... CM-R OFF
H1 ..... 1st cut offset value
F2.0 ..... 1st cut machining speed FA
G22L5000 ..... Square shape subprogram
M21
G91
G00 X70000 ..... Move to the start hole
M02
```

< Machining shape program >
Square shapeL5000
< Machining order >



- **For P2 to P5, the "CM-R" switch is turned ON and the commanded CM-R mode is changed. Note that even if the mode is selected, the CM-R control (path or condition) is not performed unless the other conditions are met.**
- **Start the program after correctly setting the workpiece thickness input value.**
- **P0 and P1 only turn the "CM-R" switch ON and OFF. The CM-R mode does not change from the selected state.**
- **If the P command is not commanded or if the commanded value is not within the specified range, a program error occurs.**
  "P1099 CM MODE SELECTION ERROR"
- **If the CM-R option is not provided, P3 to P5 are processed as P2.**
- **When Q < 0 is commanded, the CM-R coefficient is set to 0, and when Q > 99999 is commanded, the CM-R coefficient is set to 99999.**
  Note that "P35 CMD-VALUE OVER" occurs
  if a value exceeding the range of -99999999 ≤ Q ≤ 99999999 is commanded when the 1 μm specs is used, or if a value exceeding -999999999 ≤ Q ≤ 999999999 is commanded when the 0.1 μm specs is used.

13.1.21 CM-S (M111)

(1) Function and purpose

This command is used to turn ON/OFF the "CM-S" switch.

(2) Format

M111 P value

"CM-S" switch (0 ≤ P ≤ 1)

P0…"CM-S" switch OFF

P1…"CM-S" switch ON

(3) Program example

< Example 1 > Changing CM-S control for each shape

<Main program>

```
L4000/(MAINPROGRAM)
(1st-Cut)
……
(2nd-Cut)
(KAKUKEIJOU-1)
M20
M111P1 ..... CM-S ON
H2 ..... 2nd cut offset value
F5.0 ..... 2nd cut machining speed FA
E1032 ..... 2nd cut E-Pack
G22L5000 ..... Square shape subprogram
M21
G91
G00 X-70000 ..... Move to the start hole
(KAKUKEIJOU-2)
M20
M111P0 ..... CM-S OFF
H2 ..... 2nd cut offset value
F5.0 ..... 2nd cut machining speed FA
E1032 ..... 2nd cut E-Pack
G22L5000 ..... Square shape subprogram
M21
G91
G00 X70000 ..... Move to the start hole
M02
```

< Machining shape program >

Square shapeL5000

If the P command is not commanded or if the commanded value is not within the specified range, a program error occurs.
"P1099 CM MODE SELECTION ERROR"

13.1.22 EM-T (M112)

(1) Function and purpose

(This may not be implemented depending on the model and options.)
This command is used to turn ON/OFF the "EM-T" switch and "WH Auto Set" switch.

(2) Format

M112 P value (A value) (B value)
P0…The "EM-T" switch OFF, the "WH Auto Set" switch OFF
P1…The "EM-T" switch ON, the "WH Auto Set" switch OFF
P2…The "EM-T" switch ON, the "WH Auto Set" switch ON
A …Path change amount X (H860)
B …Path change amount Y (H861)

(3) Program example

< Example 1 > Changing the "EM-T" and "WH AUTO SET" for each shape

```
(1st-Cut)
(2nd-Cut)
M20
M112P2 ..... EM-T ON, WH Auto Set ON
H2 ..... 2nd cut offset value
F5.0 ..... 2nd cut machining speed FA
E1032 ..... 2nd cut E-Pack
G22L5000 ..... Square shape subprogram
M21
G91
G00 X-70000 ..... Move to the start hole
M20
M112P1A1.0B0.5 ..... EM-T ON, WH Auto Set OFF
H2 ..... 2nd cut offset value
F5.0 ..... 2nd cut machining speed FA
E1032 ..... 2nd cut E-Pack
G22L5000 ..... Square shape subprogram
M21
G91
G00 X-70000 ..... Move to the start hole
M20
M112P0 ..... EM-T OFF, WH Auto Set OFF
H2 ..... 2nd cut offset value
F5.0 ..... 2nd cut machining speed FA
E1032 ..... 2nd cut E-Pack
G22L5000 ..... Square shape subprogram
M21
G91
G00 X70000 ..... Move to the start hole
M02
```

< Machining shape program >
Square shape. L5000

- **If the P command is not commanded or if the commanded value is not within the specified range, a program error occurs.**
  "P1100 EM SELECT ERR"
- **M112P_; only turns ON/OFF the switch. When there is an A command or a B command, the path change amount is set.**
- **The value commanded with A or B is set for H860 or H861. The EM-path control function operates in the same way as when set with H860 and H861.**
  For details of EM-path control function, see "10.14 EM - trajectory control".
- **Normally, up to four M code commands can be issued. However, the M codes set with arguments must be commanded independently.**
- **The "EM-T" switch status is held even after reset. The setting will not be changed unless changed from the screen or commanded form the program.**

13.1.23 EM-C (M113)

(1) Function and purpose

(This may not be implemented depending on the model and machine.)
This command is used to turn ON/OFF the "EM-C" switch.

(2) Format

M113 P value (Q value)
P0…"EM-C" switch OFF
P1…"EM-C" switch ON
Q …-4 to +4 EM adjustment value (EM adjustment bar) (optional)

(3) Program example

< Example 1 > M113P1Turns ON the "EM-C" switch.

- **If the P command is not commanded or if the commanded value is not within the specified range, a program error occurs.**
  "P1100 EM SELECT ERR"
- **Normally, up to four M code commands can be issued. However, the M codes set with arguments must be commanded independently.**
- **If the Q command value exceeds ± 4, the maximum value will be limited to +4, and the minimum value will be limited to -4.**
- **M113P_; only turns ON/OFF the switch. When there is a Q command, the EM adjustment value is also set.**
- **If this code is commanded simultaneously with a G code, a program error occurs.**
  "P40 G,M UNMATCH"
- **The "EM-C" switch status is held even after reset. The setting will not be changed unless changed from the screen or commanded form the program.**

13.1.24 AUTO MACHINING ON MACHINING ON/OFF (M06)

When the [Auto Mcn-On] switch is turned ON, machining ON/OFF and optimum feed ON/OFF will be switched.
< Example >

G1X_Y_M06.....Machining and adaptive feed are not automatically turned ON in this block.
G1X_Y_.....Machining and adaptive feed are automatically turned ON in this block.
Note: Individually commanded M06 is effective only in the block where it is commanded.

M06P1.....Machining and adaptive feed are not automatically turned ON from this block onward.
G1X_Y_.....Machining and adaptive feed are not turned ON.
M06P0.....Machining and adaptive feed are automatically turned ON from this block onward.
G1X_Y_.....Machining and adaptive feed are turned ON.

13.1.25 DRAIN (M57)

This command is used to discharge the dielectric fluid.

13.1.26 TANK DOWN (M121)

This command is used to lower the working tank door.

⚠CAUTION

When this M code is executed during the automatic operation, pay sufficient attention to safety because the working tank door automatically lowers.

13.1.27 TANK UP (M122)

This command is used to raise the working tank door.

⚠CAUTION

When this M code is executed during the automatic operation, pay sufficient attention to safety because the working tank door automatically rises.

13.1.28 G40 SPEED UP ON (M133)

The [G40 Speedup] switch is turned ON.

13.1.29 G40 SPEED UP OFF (M134)

The [G40 Speedup] switch is turned OFF.

13.1.30 OVERFLOW MODE ON/OFF

(1) Function and purpose

(This may not be implemented depending on the model and options.)

These commands are used to control OVERFLOW MODE ON/OFF.

M123 Turns off the overflow mode.

M124 Turns on the overflow mode and moves the working tank door to match the Z axis height.

⚠CAUTION

- **When M124 is executed during the automatic operation, pay sufficient attention to safety because the working tank door automatically rises (or lowers).**
- **When the working tank door has not been moved to the lower limit since when the power supply was turned ON, the working tank door moves to match the Z-axis height after it moves to the lower limit once.**
- **Be cautious of splashing dielectric fluid when performing machining in the overflow mode.**

(2) Program example

< Example 1> When raising the door to the upper limit during the rough machining to prevent the fluid from splashing and performing the 2nd machining and onward in the overflow mode

(1st-CUT)
M122 ..... Working tank UP
M78 ..... Rapid filling
…… ..... Shape machining
(2nd-CUT)
M124 ..... Overflow mode ON
M78 ..... Rapid filling
…… ..... Shape machining

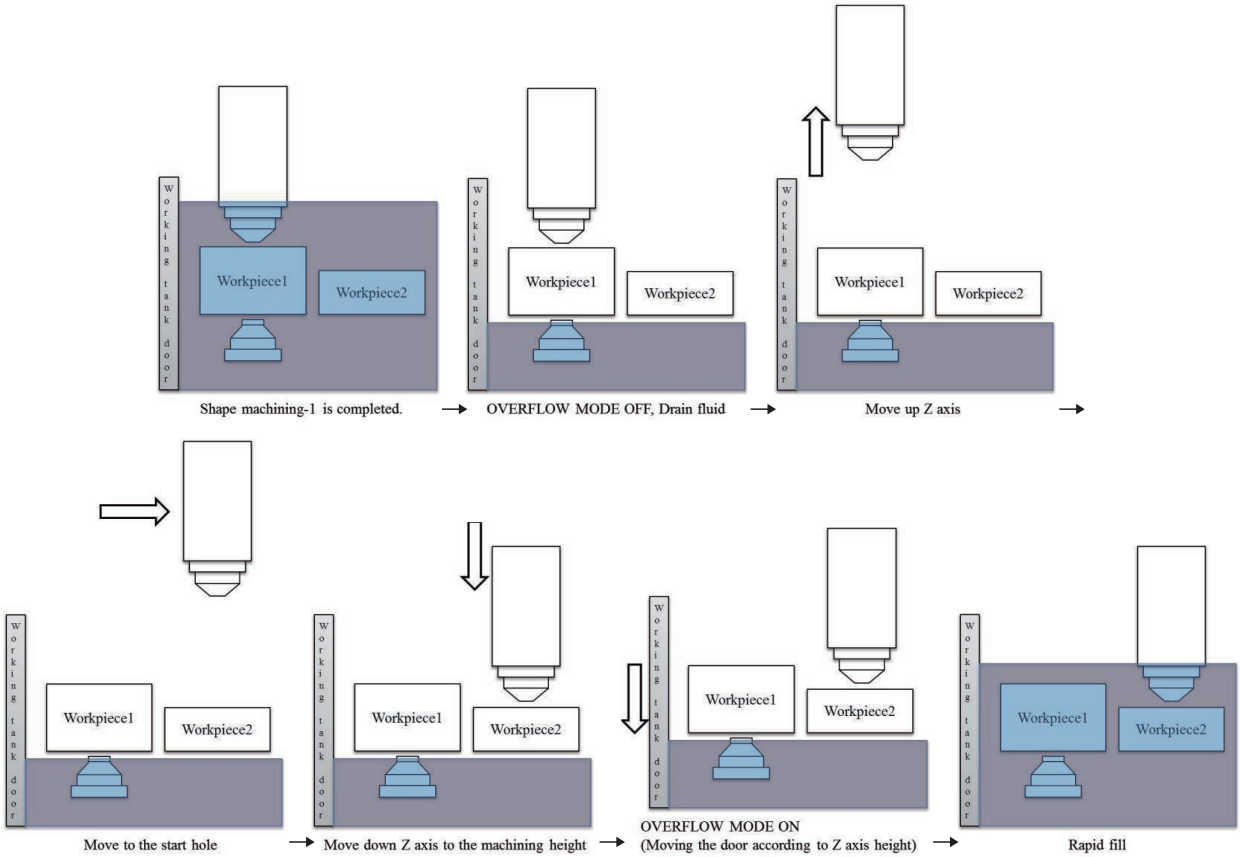


Fig. IV.13.2 Steps for moving axes between workpieces

14. MACHINING CONDITIONS SWITCHING E

This function switches machining conditions using an E code command from the control unit. Conditions are managed in packages containing parameters. If multiple E commands are in one block, the last one applies. There are 499 user packs, 6500 manufacturer packs, and 4000 ME-Pack packages with additional offset, feedrate, and process control settings.

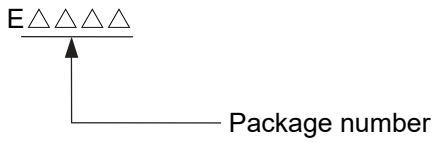
14.1 Command Format

E△△△△

14.2 Package Change

(1) Machining condition package

E0001 to E0499 Packages for users
E0500 to E6999 Packages for manufacturers



(2) Machining condition packages used in ME-Pack

ME-pack No.	E-pack No.
9000	900000 to 900019
9001	900100 to 900119
・ ・ ・ ・	
9099	909900 to 909919
9100	910000 to 910019
9199	919900 to 919919

There are 20 E-packs for one ME-pack.

*** For details on ME-Pack, see "III. NC OPERATION DISPLAY SCREEN".**

15. COORDINATES ROTATION FUNCTION; K (G05)

15.1 Function and purpose

This function is used to obtain a figure by rotating coordinates in a plane.

15.2 Command Format

15.2.1 Command format 1

(1) Program coordinate rotation ON

(Command the rotation angle. The specified position becomes the center of rotation.)

K_

(2) Program coordinate rotation CANCEL

K0

(3) Command range

-3600000 ≤ K ≤ 3600000 (counterclockwise direction +)

or

-3600000 ≤ K ≤ 3600000 (minimum command unit 0.0001°)

15.2.2 Command format 2

(1) Program coordinate rotation ON

G05XαYβRγ α, β : Rotation center coordinates

γ : Rotation angle (counterclockwise direction +)
(minimum command unit 0.0001°)

(2) Program coordinate rotation CANCEL

G06

When the "Keep Data @ Reset" switch is OFF, the coordinate rotation function is cleared by the M02 or M30 command or by pressing [RESET].

15.2.3 Program example

```
K450000 ..... 1)  +45° rotation
G90G01 X800 ..... 2)
X1400 ..... 3)
Y400 ..... 4)
X800 ..... 5)
Y0 ..... 6)
X0 ..... 7)
```

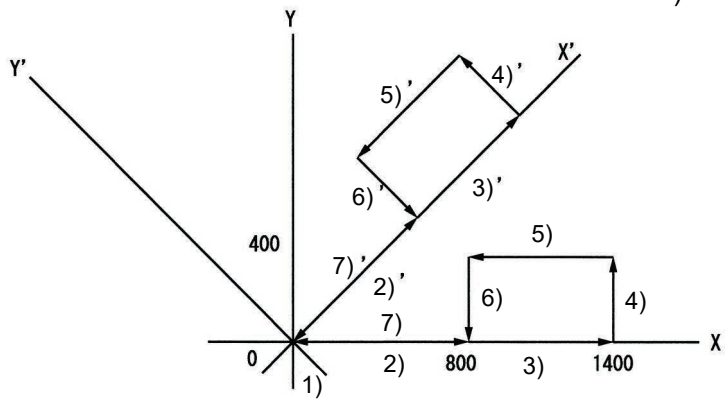


Fig. IV.15.1

When the command 1) is not given, the path traces 2) → 3) → 4) → 5) → 6) → 7).
When the command 1) is given, the path traces 2)' → 3)' → 4)' → 5)' → 6)' → 7)'.

15.2.4 Supplementary explanation

(1) When the rotation center coordinate value is not specified, such as in cases where it is omitted in the G05 command or when only the rotational angle is specified, the current position where the G05 command was executed becomes the rotation center.

(2) The rotation center coordinate values (X, Y) are always commands in the absolute value command mode. The rotational angle (R) are commanded in either the absolute value command mode or the incremental value command mode based on the G90 and G91 commands.

(3) The coordinate rotation commands during coordinate rotation are processed as changes to the center coordinates and rotation angle.

(4) The program coordinate rotation is a function in the workpiece coordinate system. Once it is commanded, all coordinate systems will rotate until the function is canceled.

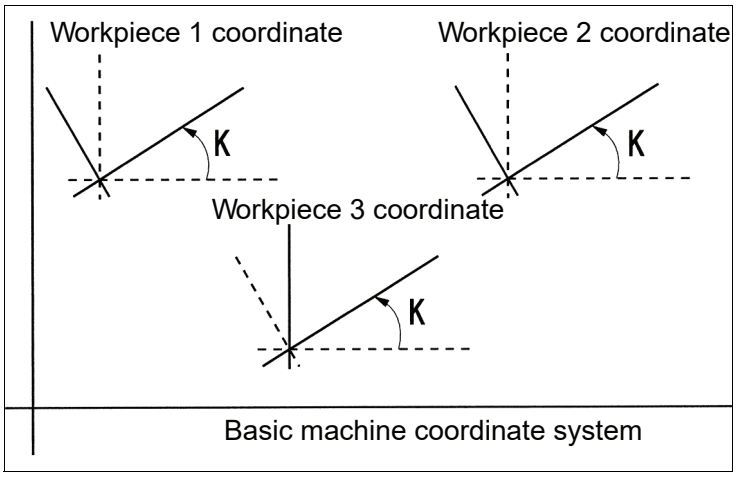


Fig. IV.15.2

(In the above figure, K corresponds to R in the G05 command.)

16. FIGURE MAGNIFICATION SETTING FUNCTION; S (G51)

16.1 Function and purpose

This function carries out magnification (contraction) of numeric values of movement commands.

16.2 Command Format

(1) Scaling ON

S__ (When only the magnification is specified, the center of scaling becomes the current position where the S command was executed.)

or

G51X_Y_P_ (Magnification is commanded by P when designating either the center of scaling or magnification)

(2) Scaling CANCEL

G50 or S1.0 (1.0-time magnification)

16.3 Detailed Explanation

16.3.1 Scaling magnification

(1) S command

1) When the "Scale S=1nm" switch is OFF

Minimum command unit.....0.001 times

Range of S command.....1 ≤ S ≤ 99999999 or 0.001 ≤ S ≤ 99999.999

- "S0" and "S" commands are calculated as S1.0 (1.0 times).
- Values after the fourth decimal place of the S command are ignored (rounded down).
- A program error occurs when the S command value exceeds the upper limit value.

2) When the "Scale S=1nm" switch is ON

Minimum command unit.....0.000001 times

Range of S command.....1 ≤ S ≤ 99999999 or 0.000001 ≤ S ≤ 99.999999

- "S0" and "S" commands are calculated as S1.0 (1.0 times).
- Values after the seventh decimal place of the S command are ignored (rounded down). The maximum No. of digits is eight digits including the above and after the decimal point. Thus, the digits after the eighth digit will be ignored (rounded down).
- A program error occurs when the S command value exceeds the upper limit value.

(2) G51P_ command

Minimum command unit.....0.000001 times
Range of P command.....1 ≤ P ≤ 99999999
or 0.000001 ≤ P ≤ 99.999999

- "P0" and "P" commands are calculated as P1.0 (1.0 times).
- Values after the seventh decimal place of the P command are ignored (rounded down).
- A program error occurs when the P command value exceeds the upper limit value.

(3) Scaling magnification

The scaling magnification can also be set from the screen.

16.3.2 Scaling center

(1) Command G51 to specify the scaling center.

(2) Specify the scaling center according to the absolute/increment modes (G90/G91) at each axis address.

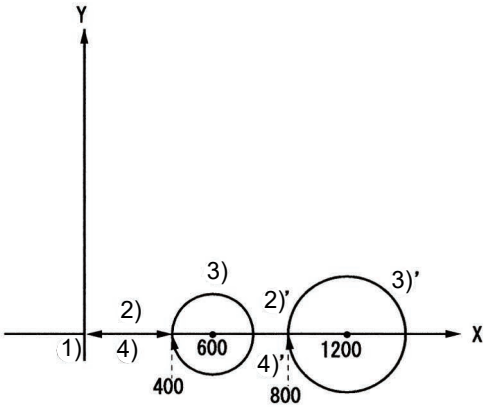
(3) The axis specified by the G51 command becomes the scaling effective axis. Additional scaling effective axes specified by the G51 command are added on to the scaling effective axes set before. The scaling CANCEL command cancels any standing scaling effective axis. The X, Y, U, and V axes are subject to becoming scaling effective axes by the S command.

(4) A program error "SCALE ARC" occurs when attempting to execute a circular arc command when only one of the two circular-arc-constituting axes is a scaling effective axis.

When the "Keep Data @ Reset" switch is OFF, the figure magnification setting function is cleared by the M02 or M30 command or by pressing [RESET]. The scaling magnification will be set to 1.0 times.

16.4 Program Example

< Example 1 >




```
S2000 ····· 1)
G91G01 X400 ····· 2)
G02 I 200 ····· 3)
G01 X0 ····· 4)
```

Fig. IV.16.1

When command 1) is not given, the path traces 2) → 3) → 4). When command 1) is given, the path traces 2)' → 3)' → 4)'.

17. TAPER ANGLE COMMAND FUNCTION; A

17.1 Function and Purpose

This function specifies the taper angle from the program when taper machining is done.

17.2 Format

(1) When the "T-ANGLE IN DEG" switch is OFF

- Command without decimal point

A□□□□□□ Degree, minute, and second unit command

Degrees, minutes, seconds

- Command with decimal point

A□□□ .□□□□ Degree unit command (with decimal point and 4 digits after decimal point)

Up to 4 digits

< Example 1 >

A 123456.....12 degrees 34 minutes 56 seconds

A 23456.....2 degrees 34 minutes 56 seconds

A 8.765.....8.765° (8 degrees 76 minutes 50 seconds)

(2) When the "T-ANGLE IN DEG" switch is ON

- Command without decimal point

A □□□□□ Degree unit command (without decimal point and 0.001degree unit)

- Command with decimal point

A□□ .□□□ Degree unit command (with decimal point and 3 digits after decimal point)

Up to 3 digits

< Example 2 >

A 12345.....12.345°

A 2345.....2.345°

A 8.765.....8.765°

- **The range of angles that can be specified by "A" is -60º0'00" ≤ A ≤ -60º0'00".**
- **A is valid from the block in which the command is given.**
- **The specified taper angle A is set to zero by the reset button, program end (M02), or offset cancel (G40).**
- **The angle symbol is defined as + for the right inclination toward the traveling direction, and - for the left inclination.**

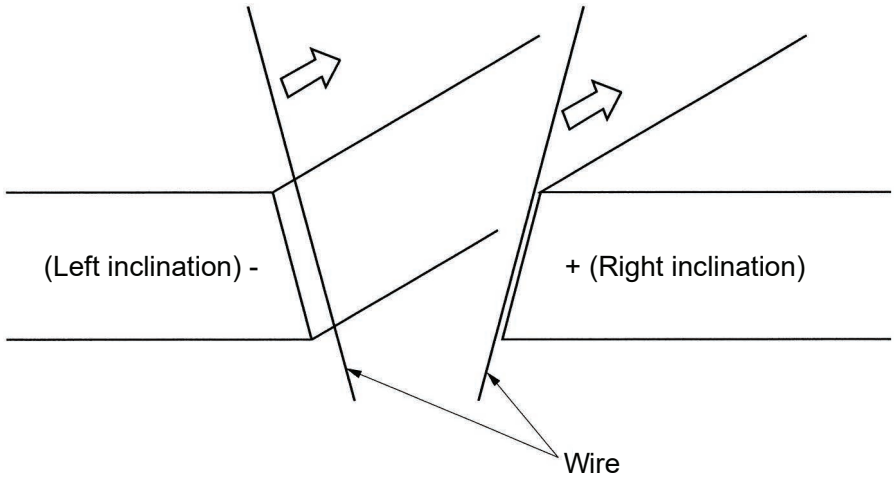


Fig. IV.17.1

- **Since the angle command is valid after the offset command (G41, G42), taper machining is not possible with the specified taper angle if there is no G41 or G42 command.**
- **An angle command less than -60° or more than +60° will cause a program error when read from the program.**

18. AXIS ROTATION SETTING FUNCTION

18.1 Function and Purpose

The axis rotation command can be issued from the program by issuing the axis rotation angle with a variable. For details on the axis rotation angle, see "III. NC OPERATION DISPLAY SCREEN".

18.2 Detailed Explanation

To command the axis rotation angle with variables, set the following variables.
These variables can be set from the Variable screen or with the NC program.

H80 Functions as the switch that determines whether the axis rotation command is enabled with variables.
When H80=1, reads the H81 value into axis rotation "AR" of "Initial settings" > "Machine parameters" > "Machining setting" > "Rot/Scale".

H81 Inputs the axis rotation angle. The setting range is
-180.0000° to 180.0000°.

18.3 Example of Use

- When setting the axis rotation angle to 45°

H80 = 1 … Axis rotation command switch ON
H81 = 45 … Rotation angle 45°

- When resetting the axis rotation angle that is set to 45° to zero

H80 = 1 …… Axis rotation command switch ON
H81 = 0 …… Rotation angle 0°

Or, after confirming H80=0, input zero in the axis rotation "AR" of "Initial settings" > "Machine parameters" > "Machining setting" > "Rot/Scale".

19. EXECUTION SEQUENCE FOR SIMULTANEOUS COMMANDS OF GRAPHIC SCALE AND COORDINATE ROTATE

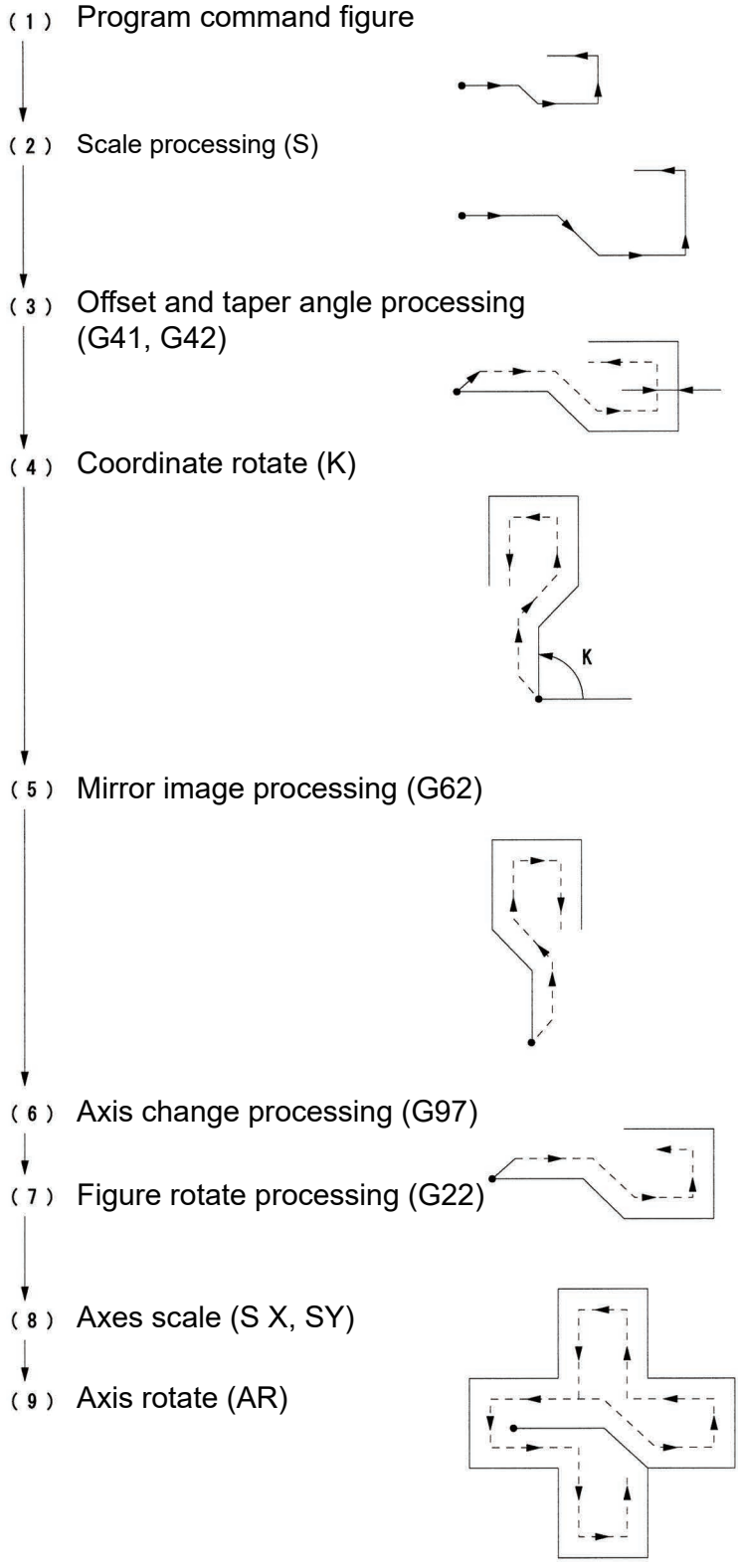


Fig. IV.19.1

20. UPPER AND LOWER FREE SHAPE PROGRAMMING

Upper and lower free shape is specified by UV axes command (U and V command at Z5 plane) in linear interpolation mode (G00 or G01) in addition to XY axes specification.

20.1 Move Path for Intersection Point Calculation Mode (G89)

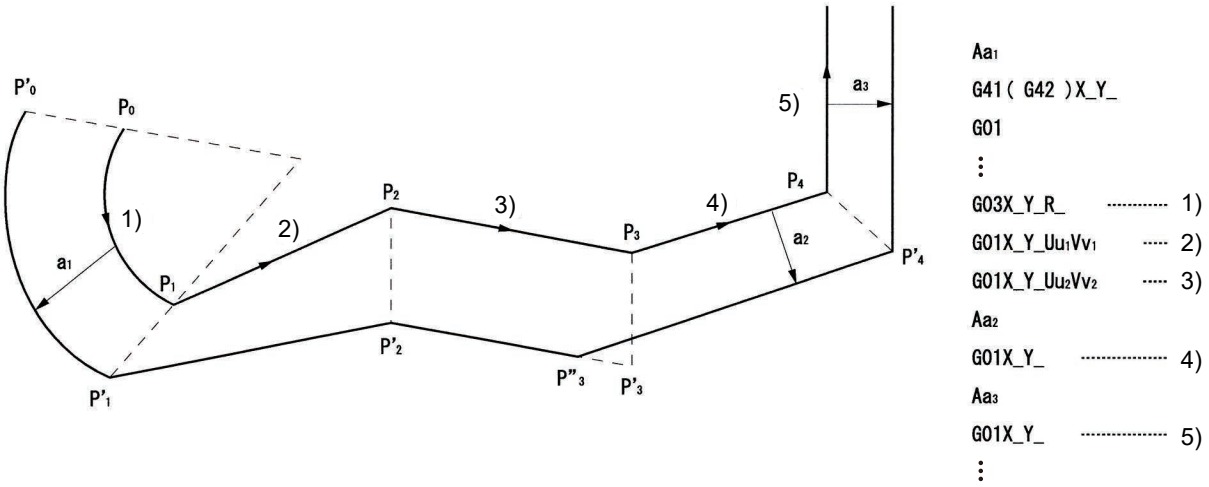


Fig. IV.20.1

(1) Taper offset movement for block 2) containing UV a command starts from the end point P'_1 of the previous block 1). P'_1 is the intersection created by the path where a_1 taper offset is added to 1) and the path where a_1 taper offset is added to 2).

(2) The UV move command is a linear command, so XY must also be linear commands. The UV move command will be as follows regardless of the absolute or incremental value of the XY move command.

- When the "Abs.U/V" switch is OFF
  The UV axes are moved by the incremental value.

$$\overrightarrow{P_2P_2'} = (u_1v_1)\overrightarrow{P_3P_3'} - \overrightarrow{P_2P_2'} = (u_2,v_2)$$

- When the "Abs.U/V" switch is ON
  The UV axes are moved by the absolute value.

$$\overrightarrow{P_2P_2'} = (u_1v_1)\overrightarrow{P_3P_3'} = (u_2,v_2)$$

(3) Moving from linear move command (linear interpolation mode only) containing UV move command to normal taper angle mode 4), 4) must be linear move. In other words 4) must be either in the G00 or G01 mode.

(4) End point P''_3 of the move command block for 3) is the intersection of UV move path of 3) and path where a_2 taper offset is added to 4).

(5) End point P'_4 of the move command block for 4) is the intersection of path where a_2 taper offset is added to 4) and path where a_3 taper offset added to 5).

(6) When the NC program on the right side of Fig. IV.20.1 is executed, the path on the Z5 plane with taper offset becomes
$P'_0 \rightarrow P'_1 \rightarrow P'_2 \rightarrow P''_3 \rightarrow P'_4$.

(7) The path with taper offset shown in Fig. IV.20.1 does not include the tool offset amount. The UV move path to which the tool offset has been added is the path with taper offset that has been deviated the amount of the tool offset.

20.2 Move Path for Corner R Mode (G88)

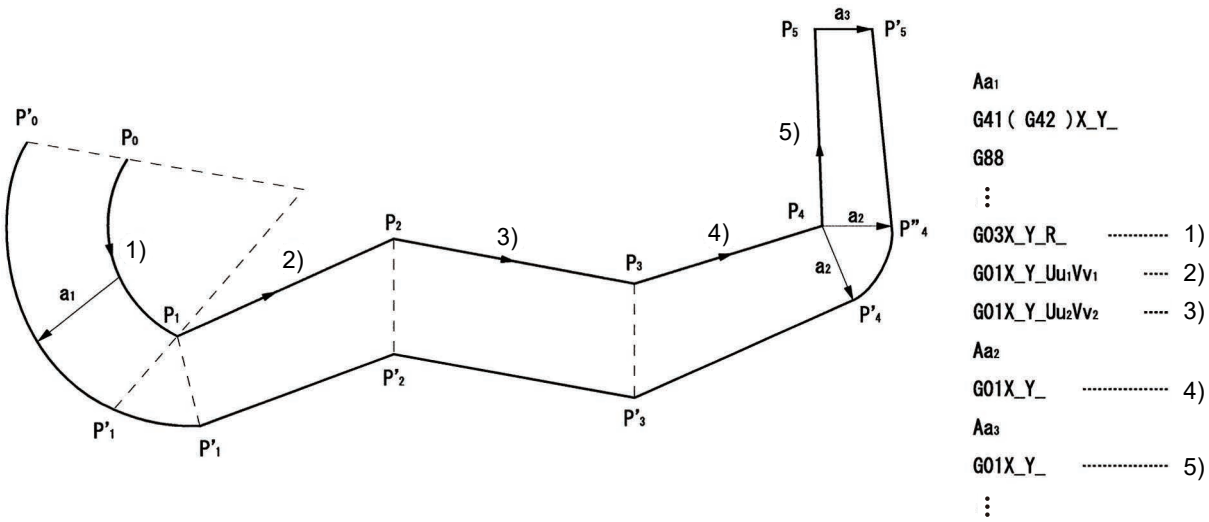


Fig. IV.20.2

(1) Taper offset move for block 2) containing a UV command starts from the previous block 1) end point P"1.

(2) The UV move command is a linear command, so XY must also be linear commands. The UV move command will be as follows regardless of the absolute or incremental value of the XY move command.

- When the "Abs.U/V" switch is OFF
  The UV axes are moved by the incremental value.

$$\overrightarrow{P_2P_2'} = (u_1,v_1)\overrightarrow{P_3P'_3} - \overrightarrow{P_2P_2'} = (u_2,v_2)$$

- When the "Abs.U/V" switch is ON
  The UV axes are moved by the absolute value.

$$\overrightarrow{P_2P_2'} = (u_1,v_1)\overrightarrow{P_3P'_3} = (u_2,v_2)$$

(3) Moving from linear move command (linear interpolation mode only) containing UV move command to normal taper angle mode 4), 4) must be linear move. In other words 4) must be either in the G00 or G01 mode.

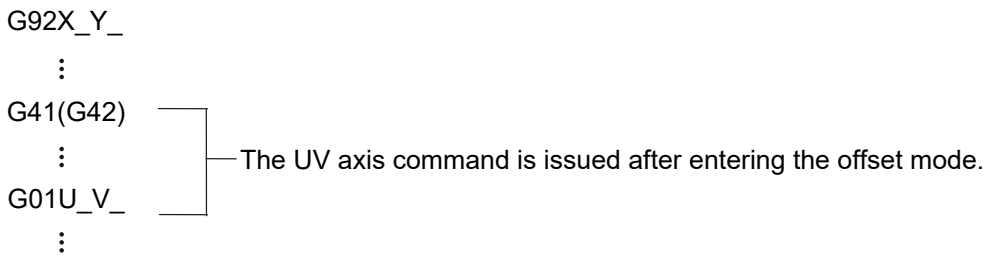
(4) When the NC program on the right side of Fig. IV.20.2 is executed, the path on the Z5 plane with taper offset becomes
$P'_0 \rightarrow P'_1 \rightarrow P''_1 \rightarrow P'_2 \rightarrow P'_3 \rightarrow P'_4 \rightarrow P''_4 \rightarrow P'_5$.

(5) The path with taper offset shown in Fig. IV.20.2 does not include the tool offset amount. The UV move path to which the tool offset has been added is the path with taper offset that has been deviated the amount of the tool offset.

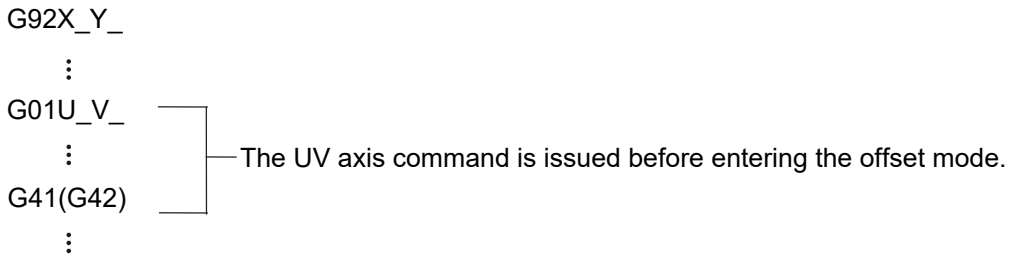
20.3 Precautions for the Upper Lower Free Shape Program

Specify the upper/lower free shape during the offset mode. If the UV axis command is issued while not in the offset mode, the UV axis will move regardless of the Z specs, and correct machining will be impossible when the offset mode is entered.

<Example of good program command>



<Example of poor program command>



20.4 Upper and Lower Free Shape: Z5 Plane XY Command Method

With this command method, the program for the Z5 plane is created with XY axes command in the same manner as the Z1 plane, and is executed in the linear interpolation mode (G00 or G01) or circular interpolation mode (G02, G03, G2.1, G3.1).
By handling the arc sections as arc commands, adaptive control is applied on the corner arc.

(1) Command format

1) Linear interpolation (G00, G01)

G01 X_Y_:G01 X_Y_

Z1 plane command　Z5 plane command

G01 ..... Movement G code (G00, G01)
X__ Y__ ..... Specify the coordinate values for Z1 or Z5 plane.
: (colon) ..... Delimiter for Z1 plane command and Z5 plane command.

2) Circular interpolation (G02, G03, G2.1, G3.1)

G02 X_Y_I_J_(R_):G02 X_Y_I_J_(R_)

Z1 plane command　Z5 plane command

G02 ..... Movement G code (G02, G03, G2.1, G3.1)
X__ Y__ ..... Specify the coordinate values for Z1 or Z5 plane. (Same as linear interpolation)
I__ J__ ..... Center coordinates for Z1 or Z5 plane This is the relative value from each plane's start point to the center.
R__ ..... Specify the arc radius of the Z1 or Z5 plane. (Priority over IJ)
: (colon) ..... Delimiter for Z1 plane command and Z5 plane command.

- **Command the movement G code for both the Z1 plane and Z5 plane.**
  In a program that contains both straight lines and arcs, a program error will occur if only one is commanded.
  The combinations of the Z1 plane and Z5 plane are shown below.

Executable combinations	G00:G00 G01:G01 G02:G02 G03:G03 G2.1:G2.1 G3.1:G3.1
Erroneous combinations	G00:G01 (G02, G03, G2.1, G3.1) G00 (G01):G02 (G03, G2.1, G3.1) G02:G03 G02:G2.1 G03:G3.1

- **A program error may occur if commanded for both the Z1 plane and Z5 plane.**
  Example 1) G41G01X15.Y0.H1:G41G01X10.Y0
  Example 2) G89G01X15.Y0.H1:G89G01X10.Y0
  For other G codes, see "5.1 G Code List" in this instruction manual.
- **If this command is issued in a function other than the wire diameter compensation function (G41, G42), a program error occurs.**

Executable state	Error state
G41 G01:G01 ・・・・・ G40	G01:G01 G41 G01:G01 ・・・・・ G40

(2) Detailed explanation

An upper and lower free shape is commanded with the Z5 plane XY command method.
This command can be issued between the wire diameter compensation function (G41, G42) block to the cancel command (G40).
The program zero point for the coordinate system on the Z5 plane is the same as the Z1 plane.
The Z5 plane position command method can be specified with G90/G91 in the same manner as the program plane (Z1 plane). To issue the upper and lower free shape command during the wire diameter compensation function (G41, G42), refer to the explanation on G89 and G88.

(3) Program example

1) Oblique cone shape

For G90 command	For G91 command
N0001M20	N0001M20
N0002M80	N0002M80
N0003M82	N0003M82
N0004M84	N0004M84
N0005G90	N0005G91
N0006G92X0.Y0.	N0006G92X0.Y0.
N0007G41G01X15.Y0.H1:G01X10.Y0.	N0007G41G01X15.Y0.H1:G01X10.Y0.
N0008G02X35.Y0.I10.J0:G02X50.Y0.I20.J0	N0008G02X20.Y0.I10.J0:G02X40.Y0.I20.J0
N0009G02X15.Y0.I-10.J0:G02X10.Y0.I-20.J0	N0009G02X-20.Y0.I-10.J0:G02X-40.Y0.I-20.J0
N0010M21	N0010M21
N0011M00	N0011M00
N0012G40G01X0.Y0.:G01X0.Y0.	N0012G40G01X-15.Y0.:G01X-10.Y0.
N0013M02	N0013M02
%	%

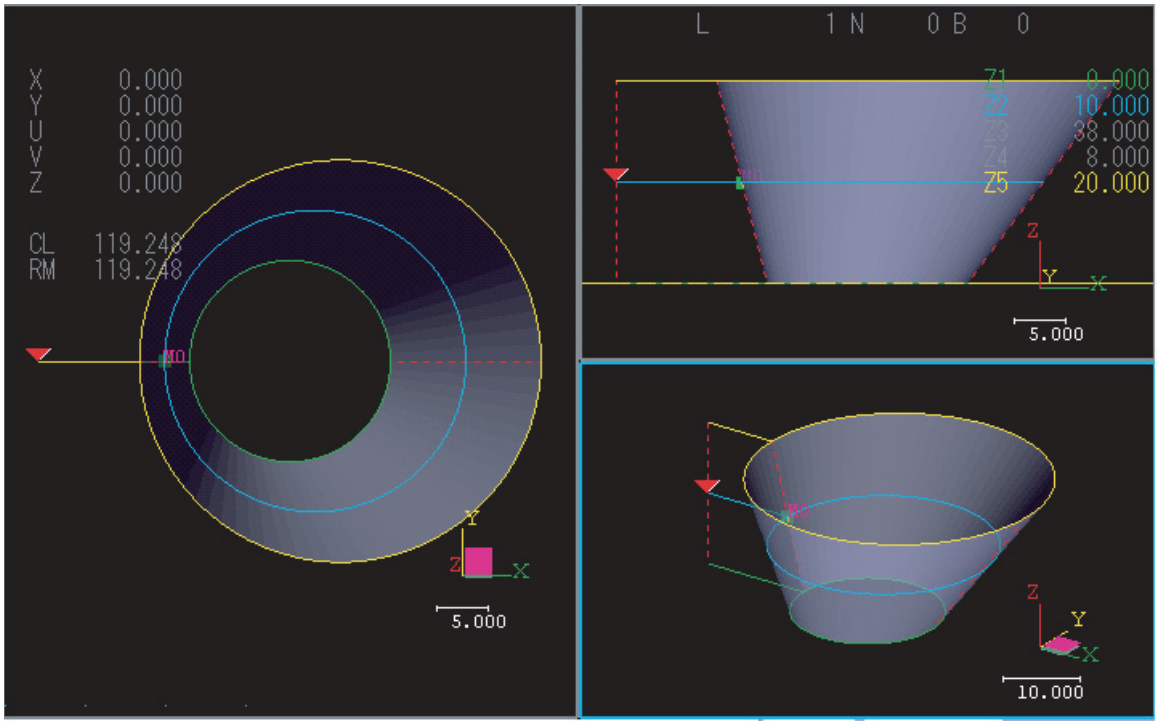


Fig. IV.20.3

2) Continuous arcs

For G90 command
N0001M20
N0002M80
N0003M82
N0004M84
N0005G90
N0006G92X0.Y0.
N0007G41G01X-10.Y0.H1:G01X-10.Y0.
N0008G01X-10.Y-10. :G01X-10.Y-10
N0009G01X10. Y-10. :G01X15.Y-10.
N0010G01X10. Y-4. 899:G01X15. Y-4 899
N0011G02X10. 8Y-3. 919I1. :G02X15. 8Y-3. 919I1
N0012G03X10. 8Y3. 919I-0. 8J3. 919:G03X15. 8Y3. 919I-0. 8J3.919
N0013G02X10. Y4. 899I0. 2J0. 98:G02X15. Y4. 899I0. 2J0. 98
N0014G01X10. Y10. :G01X15. Y10
N0015G01X-10. Y10. :G01X-10. Y10.
N0016G01X-10. Y0. :G01X-10. Y0.
N0017M21
N0018M00
N0019G40G01X0. Y0. :G01X0. Y0.
N0020M02
%

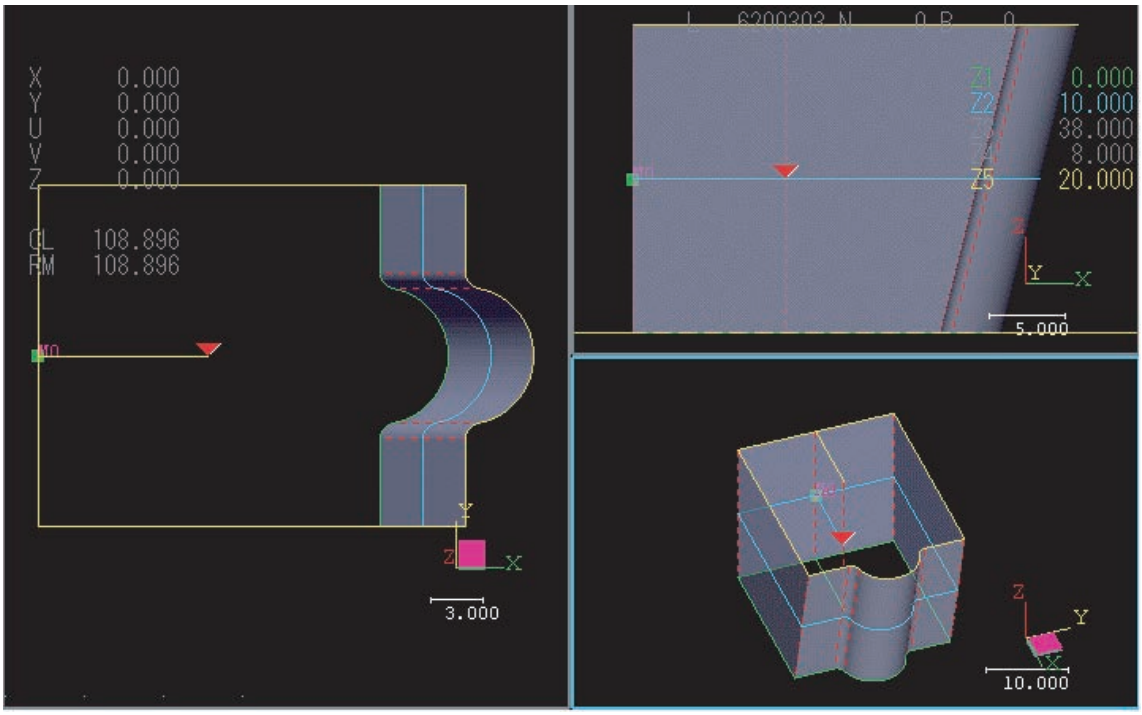


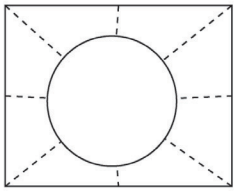
Fig. IV.20.4

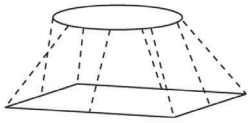
< Common to Z5 plane UV command/Z5 plane XY command >

1. **The interference check function is not valid in the upper and lower free shape program.**
   Carry out a graphic check and confirm that there are no cross cuts before starting machining.
2. **Corner R (".R") and corner chamfer (".C") in the upper and lower free shape program cause a program error.**
3. **The EDM operates in the intersection calculation mode (G89) during the upper and lower free shape command.**
   For details of the operation by the corner processing mode (G89/G88) at the start and end of the upper and lower free shape command, refer to the descriptions for G89 and G88.

< Only for Z5 plane XY command >

1. **The following types of commands will result in a program error.**
   - **Upper and lower free shape command in a mode other than offset mode (Z5 plane XY command)**
   - **Different movement commands for Z1 plane and Z5 plane .**
     Command with linear interpolation (fine segmentation). (The data is output as fine segments by the 2DCAM.)





```
G01 X_ Y_ :G02(G03) X_ Y_ I_ J_ (Error)
          ↓
G01 X_ Y_ :G01 X_ Y_
G01 X_ Y_ :G01 X_ Y_
G01 X_ Y_ :G01 X_ Y_
```

   - **Linear angle command, geometric (".A")**
   - **Micro joint (G46)**

2. **The Z5 plane movement command is not affected by the "Abs.U/V" switch.**
   Movement is performed with the G90/G91 in the program.
3. **Always create machining for one circle with two arc command blocks.**
4. **This Z5 plane XY command shape can be output with the 2DCAM (main system BRD-B70W500-A1 or later). For details of switching the output format, refer to instruction manual "2D CAM" (Chapter 1 2DCAM Supplement 4 Machine Setting).**

V. MAINTENANCE AND ALARM LIST

BRN-83587-005-*-002

1. PRECAUTIONS
2. LIST OF ALARMS
3. MAINTENANCE AND INSPECTION ITEMS
4. MAINTENANCE AND INSPECTION METHOD
5. MAINTENANCE AND INSPECTION METHOD OF AUTOMATIC WIRE FEEDER
6. MAINTENANCE AND INSPECTION OF DIELEC-TRIC FLUID RESERVOIR
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1. PRECAUTIONS

⚠ Caution

1.1 Precautions for Maintenance and Inspection

Perform maintenance and inspection according to the Instruction Manual so as to maintain the safety and functions of the machine.

- Turn off power.
- Lock main power switch.
- If power needs to be ON: Confirm that machining voltage is not applied, automatic operation is off and not other risk are present.
- Put up “Inspection in progress” sign.

(1) Maintenance and inspection methods

Perform maintenance and inspection periodically of the required positions according to the Instruction Manual. Make sure that the following items are well understood before starting the maintenance and inspection.

(2) Limits to maintenance and inspection workers

Only specialist workers who understand the correct maintenance and inspection methods may perform the maintenance and inspection.

(3) Scope of maintenance and inspection

The scope of maintenance and inspection is limited to that described in the Instruction Manual or designated by the Mitsubishi Electric Service Engineer. There are high voltage sections and precision mechanisms in the cover and cabinet, and inadvertent handling of these may lead to electric shocks, faults or deterioration in performance.

(4) Consumable parts

Use genuine Mitsubishi parts for the replacement of consumable parts, etc. Mitsubishi will not bear responsibility for trouble, faults and accidents, etc., caused by use of non-genuine parts.

(5) Treatment of waste

The dielectric fluid, dielectric fluid filter, ion exchange resin and wire electrodes, etc., are industrial waste. Follow the laws and ordinances of the respective country and region when disposing of these matters.
(For industrial wastes, see "I. SAFETY AND OUTLINE OF MACHINE".)

(6) Precautions for cleaning

Make sure that dielectric fluid does not enter the internal parts of the system when cleaning using dielectric fluid. When using a cleaning solution, make sure it matches the purpose. Make sure that organic solvent does not get on the resin parts. The resin parts could crack, etc., if organic solvent gets on them.
When using the lubrication, be sure that lubrication including ester or ether does not get on the resin parts. The resin parts could get crack, etc.

(7) Others

Even when the NF (no-fuse breaker) is turned OFF, there may be parts that are still charged. Thus, when replacing the fuse, etc., contact the Mitsubishi Electric Service Engineer first.

1.2 Measures for Faults and Abnormalities

(1) Prohibition of use during Faults and Abnormalities

Stop operation immediately if a fault is detected. Turn power OFF if needed; always shut off if there is smoke or abnormal odor. Do not continue use, this may cause fatal damage, overheating or fire.

(2) Measures for faults

Immediately notify the Mitsubishi Electric Service Engineer of the fault or abnormality details, and follow the given instructions.

1.3 Prohibition of Modifications

- The user must never modify this system.
- Parts other than the consumable parts and other replacement parts indicated in the Instruction Manual must not be removed from the system.

2. LIST OF ALARMS

2.1 Operation Alarms

Error No.	Message and details	Remedies	Remarks
G1000	**Checking** The NC program is being read for checking.		
G1001	**Check End** The NC program has been read completely.		
G1002	**Check Aborted** The check has been canceled with key operations during reading.	• Read the program again if necessary.	
G1003	**Program Error** The reading ended because of an NC program error.	• Correct the NC program and read it again.	
G1004	**Too Large Program** The NC program exceeds the maximum length that can be checked (approximately 50000 blocks).	• Shorten the NC program and read it again.	
G1005	**Alarm** The redrawing stopped because of an NC program error.	• The alarm message will appear, so take the same remedies as for machining.	
G1006	**Re-Drawing** The path is being redrawn following the execution order.		
G1007	**Re-Draw End** The redrawing ended at the program end or with an alarm.		
G1008	**M0, M1 Stop** The redrawing stopped at M0 or M1.		
G1009	**Single Stop** The redrawing stopped with a single block stop.		
G1010	**Re-Draw Aborted** The redrawing was canceled with the ESC key.	• The path can be redrawn from the head by pressing the key.	
G1011	**Stroke End** The stroke range was exceeded during the check.		
G1012	**Viewport Changing** The viewpoint can be changed with the arrow keys.	• This status can exit by pressing the ESC key.	

Error No.	Message and details	Remedies	Remarks
G1013	**TOO LARGE SIZE** (InvalidOpe)	• The figure scale is too large to allow proper checking. Review the scale.	
G1014	**TOO LARGE SIZE** (ZeroDiv)	• The figure scale is too large to allow proper checking. Review the scale.	
G1015	**TOO LARGE SIZE** (Overflow)	• The figure scale is too large to allow proper checking. Review the scale.	
G1016	**TOO LARGE SIZE** (Underflow)	• The figure scale is too large to allow proper checking. Review the scale.	
G1017	**TOO LARGE SIZE** (Exception)	• The figure scale is too large to allow proper checking. Review the scale.	
G1018	**No PM Epak** The machining conditions were searched without using the PM E-pack.	• Input the machining condition FLD data I/O and then search for the machining conditions.	
G1019	**No[S]Data** The estimated speed [S] of the machining condition information display has not been registered.	• Register the estimated speed [S] of the machining condition information display.	
G1020	**No F cmnd** The estimated time cannot be calculated due to the absence of the F command.	• Input an F command.	
G1021	**No E-pack** The commanded E-pack was not found so the estimated time cannot be calculated.	• Register the commanded E-pack.	
G1022	**E command** When "PM SKIM CUT" is used with the automatic 2nd cut, and an E command (machining condition command) is found in the shape program, this will appear on the Machining Estimate screen after the check is carried out on the "CHECK/ESTIMATE" page.	• When using "PM SKIM CUT" with the automatic 2nd cut, an E command does not need to be issued in the shape program. Delete the E command from the shape program.	

2.2 PLC Related Alarms

Error No.	Message and details	Remedies	Remarks
U700	**WRONG PWR SUP** A faulty power supply was detected.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	
U702	**LR OUT OF CNTL** A specific resistance error was detected.	• Report the situation to the Mitsubishi service center. • When you want to perform machining in any case, you can start machining by setting [CLEAN WATER SENSOR] to any value other than 0, but it may result in poor machining. Therefore, it should be performed at the customer's own responsibility.	
U704	**FLUID OFF** The machining was started without supplying the dielectric fluid.	• Always fill the dielectric fluid before starting machining.	
U705	**WIRE FEED OFF** The machining was started without inserting the wire.	• Insert the wire and fill the dielectric fluid before starting machining.	
U706	**AT NOT HOME** The AWF was not at the home position at the program startup.	• Set the AT at the home position before starting the operation.	
U707	**NO MANUAL MODE** Executing a manual mode command was attempted when the system was not in the manual mode.	• Enter the manual mode and carry out the operation again.	
U708	**NO WIRE** A wire absence was detected when M21 was executed.	• Replace the wire bobbin and then start the operation. Also, check if the limit position is normal.	
U709	**MACHING INTERLOCK** Positioning was attempted when machining was ON.	• Turn OFF the machining before performing positioning.	
U711	**AUX TB CONTACT** Contact with the auxiliary table was detected.	• Remove the obstacle which caused contact trouble from the work tank.	This may not be provided depending on the model.
U712	**COVER OPEN** Machining was attempted with the safety cover open.	• Close the safety cover before starting machining.	

Error No.	Message and details	Remedies	Remarks
U715	**WIRE CUT ERROR** The wire cannot be cut within the specified time. (AT)	• See "V. MAINTENANCE AND ALARM LIST" > "5.3 Troubleshooting", and take corrective actions. • Check the wire diameter and material. If these are correct and the alarm recurs, contact the Mitsubishi service center.	
U716	**AT ABNORMAL** There is an error in the AT operation.	• See "V. MAINTENANCE AND ALARM LIST" in the Instruction Manual and check the unit.	
U718	**WRONG CUT ARM** The wire retainer does not return to the original position even when the set time elapses.	• Report the situation to the Mitsubishi service center.	
U719	**NOT IN POS.** The AT cutter arm is not at the home position.	• Return the cutter arm to the home position.	
U722	**WIRE INST ERR** The wire could not be inserted.	• Clean the dies. Take necessary measures by referring to the troubleshooting procedure stated in the Maintenance and Inspection section (of the automatic wire feeder) in the Instruction Manual.	
U723	**UV NOT ORIGIN** The UV axis is not at the zero point.	• Return the UV axis to the zero point. (The UV zero point has not been set yet, or the U and V axes moved.)	
U726	**AT AIR DOWN** An air pressure drop was detected.	• Check the air pressure.	
U728	**WATER COLL. ERR** Abnormal operation of the water collection box was detected.	• Check for matters obstructing the opening/closing operation around the collection cover, and remove it if found. • Check that the air pressure is 400kPa or more.	
U730	**T/C IN FLUID** The work tank water level has reached the taper unit.	• Check the upper limit of the dielectric fluid, and adjust it so that the taper unit is not submerged.	
U736	**ASR NOT HOME** The ASR deviated from the home position during the axis movement after the operation started.	• Set the ASR at the home position before restarting the operation.	
U737	**ASR MANU MODE** The ASR was put into manual mode when M52 was commanded.	• Set the ASR to automatic mode.	
U738	**ASR ABNORMAL** The scrap could not be removed when the handle contacted it.	• Remove the scrap manually and then restart the operation.	

Error No.	Message and details	Remedies	Remarks
U740	**TCH SNSR NOT H** The touch sensor deviated from the home position during the axis movement after the operation started.	• Set the touch sensor to the home position in the manual mode, and then restart the operation.	
U741	**TCH SNSR MODE** Machining was started in touch sensor mode.	• Cancel the touch sensor mode.	
U742	**WRONG TCH SNSR** The touch sensor did not move even after the specified time elapsed.	• Check the air source and then contact the Mitsubishi service center.	
U743	**TCH SNSR CONT.** The axis contacted the probe when moving in the touch sensor mode.	• Move the probe in the reverse direction by using the corresponding JOG.	
U746	**AWC NOT HOME** The AWC was not at the home position at the program startup.	• Set the AWC at the home position before starting the operation.	
U747	**AWC MANU MODE** The AWC was not in automatic mode when the AWC operation was commanded.	• Set the AWC to automatic mode.	
U748	**AWC ABNORMAL** The AWC control unit detected an error.	• See the AWC Instruction Manual and cancel the AWC control unit error.	
U750	**ZP-RTN NOT FIN** The overflow was operated before the Z axis zero point return was completed.	• Before operating the overflow, complete the Z axis zero point return.	
U756	**APC NOT HOME** The APC was not at the home position at the program startup.	• Set the APC at the home position before starting the operation.	
U757	**APC MANU MODE** The APC was not in automatic mode when the APC was commanded.	• Set the APC to automatic mode.	
U758	**APC ABNORMAL** An APC operation error was detected, or the APC was stopped during operation.	• See the APC Instruction Manual and cancel the control unit error.	
U760	**LOW FLUID** The fluid level is low.	• Check the dielectric fluid amount in the work tank. If the fluid is insufficient, refill the tank. • For non-submerged machining, turn OFF the [Fluid off at low level] switch.	
U766	**LOW AIR PRESS** The air pressure dropped continuously during the specified time.	• Check the air pressure. • Check the compressor's power supply.	Set READY OFF.

Error No.	Message and details	Remedies	Remarks
U779	**WORK TANK DOOR OPEN** FLUID or RAPID FILL was turned ON in the work tank door lower limit mode.	• Before turning ON FLUID or RAPID FILL, turn OFF the work tank door lower limit mode.	
U794	**CLEAN SIDE LOW** The fluid level in the clean fluid tank has dropped.	• Check the dielectric fluid level in the dielectric fluid feeder and replenish if necessary. • The filtration flow rate is insufficient. Check the filter pressure gauge and check the filter hose for bending and pump intake port for clogging. Also, check that the filter drain valve is securely tightened.	
U795	**DIRTY SIDE LOW** The fluid level in the waste fluid tank has dropped.	• Check the dielectric fluid level in the dielectric fluid feeder and replenish if necessary.	
U796	**OVER RUN** The axis moved beyond the hardware stroke end.	• The unit switch that detects the stroke end may be broken, so contact the Mitsubishi service center.	
U814	**WIRE PROCESSING DEV.** The wire gets entangled in the wire processing unit. Or, the motor is locked.	• Remove the tangled wire. • Check whether the cutter unit is worn and replace it if it is worn. • Check that the wire processing unit connector [WCM] is connected.	
U822	**DOOR POS.ERR** The clamp switch was pressed before the work tank door was raised to the upper limit.	• Lower the work tank door to the lower limit, and then press the clamp switch again.	
U823	**DOOR CLAMP ERR** The door was not clamped within the specified time. The clamp was released suddenly for some reason.	• Check whether the door clamp limit switch is broken. • In this case, lower the work tank door to the lower end, and then press the clamp switch again.	
U824	**WaterRemaining** Unclamping of the door was attempted while there was dielectric fluid in the work tank.	• There may be dielectric fluid above the table. Discharge the fluid and then unclamp the door.	
U825	**DoorUnclampERR** The door was not unclamped within the specified time.	• Check whether the door clamp limit switch is broken.	
U827	**SET PARAMETER** READY ON was attempted before the pitch error compensation amount and backlash compensation amount were input.	• Input the pitch error compensation amount and backlash compensation amount, turn the power OFF and ON, and then turn READY ON.	
U828	**REMOTE I/O NOT JOIN** A fault occurred during the remote I/O. • The cable is dislocated. • Remote I/O trouble	• Contact the Mitsubishi service center.	

Error No.	Message and details	Remedies	Remarks
U830	**CUT WIRE REMAINING** Scraps of cut wire could not be collected into the wire collection box and are remaining in the cut wire duct.	• Remove the wires from the cut wire duct. • See "8. TROUBLESHOOTING", and take corrective actions.	
U831	**OIL PUMP ERR** The NF turned OFF because the lubrication pump was overloaded.	• Report the situation to the Mitsubishi service center. (Turn the lubrication pump's NF ON.)	
U832	**Dielectric fluid reservoir controller abnormal** A tank control error was detected.	• Report the situation to the Mitsubishi service center.	
U833	**Feed pump halt** An overcurrent (error) was detected in the supply pump motor.	• Report the situation to the Mitsubishi service center. (Reset the thermal relay for the supply pump motor in the tank control box.)	
U834	**Filter pump halt** An overcurrent (error) was detected in the filter pump motor.	• Report the situation to the Mitsubishi service center. (Reset the thermal relay for the filter pump motor in the tank control box.)	
U835	**Fill pump halt** An overcurrent (error) was detected in the filling pump motor.	• Report the situation to the Mitsubishi service center. (Reset the thermal relay for the filling pump motor in the tank control box.)	
U836	**Ionizer pump halt** An overcurrent (error) was detected in the ionizer pump motor.	• Report the situation to the Mitsubishi service center. (Reset the thermal relay for the ionizer pump motor in the tank control box.)	
U837	**Z axis coolant pump halt** An overcurrent (error) was detected in the Z axis cooling pump motor.	• Report the situation to the Mitsubishi service center. (Reset the thermal relay for the Z axis cooling pump motor in the tank control box.)	This may not be provided depending on the model.
U838	**Circulate pump halt** An overcurrent (error) was detected in the circulation pump motor.	• Report the situation to the Mitsubishi service center. (Reset the thermal relay for the circulation pump motor in the tank control box.)	This may not be provided depending on the model.
U839	**Fan cooler halt** An overcurrent (error) was detected in the fan cooler motor.	• Report the situation to the Mitsubishi service center. (Reset the thermal relay for the fan cooler motor in the tank control box.)	This may not be provided depending on the model and option setting.
U840	**Unit cooler abnormal** An error was detected in the unit cooler.	• Report the situation to the Mitsubishi service center. (Reset the unit cooler at the top of the dielectric fluid tank.)	This may not be provided depending on the model.
U841	**Solenoid abnormal 1** An overcurrent (error) was detected in the solenoid valve (block 1) for the tank control.	• Report the situation to the Mitsubishi service center. (Replace the fuse (F1) in the tank control.)	
U842	**Solenoid abnormal 2** An overcurrent (error) was detected in the solenoid valve (block 2) for the tank control.	• Report the situation to the Mitsubishi service center. (Replace the fuse (F2) in the tank control.)	

Error No.	Message and details	Remedies	Remarks
U843	**Solenoid abnormal 3** An overcurrent (error) was detected in the solenoid valve (block 3) for the tank control.	• Report the situation to the Mitsubishi service center. (Replace the fuse (F3) in the tank control.)	
U844	**Sub unit abnormal** An error was detected in the SUB unit in the power supply panel.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	
U849	**DC unit abnormal 1** An erroneous rise in the temperature of the electronic parts in the DC unit was detected.	• Report the situation to the Mitsubishi service center.	
U850	**DC unit abnormal 2** An erroneous rise in the temperature of the electronic parts in the DC unit was detected.	• Report the situation to the Mitsubishi service center.	
U851	**AVR abnormal** An error was detected in the AVR in the power supply panel.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	
U852	**Generator coolant fan halt** An overcurrent (error) was detected in the cooling fan in the power supply panel.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	
U853	**Generator overheat** An erroneous rise of the temperature in the power supply panel was detected.	• Report the situation to the Mitsubishi service center.	
U854	**OUT OF WIRE D** **(WIRE PROCESSING DEV.)** A wire diameter ϕ0.15 or less was selected while the wire processing unit is installed.	• Remove the wire processing unit when using the wire with a diameter of ϕ0.15 or less. (The wire processing unit is only compatible with wire diameters of ϕ0.2 or more.) • Specify the wire diameter to be used when using a wire electrode with a diameter of ϕ0.2 or more.	
U855	**WIRE PROCESSING DEV. MOTOR STP** The cutter motor switch is OFF. Or, the cutter motor breaker is OFF.	• Turn ON the cutter motor switch. • Turn ON the cutter motor breaker.	
U861	**MAIN unit F3 abnormal** An overcurrent (error) was detected in the main unit in the power supply panel.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	
U862	**MAIN unit DC abnormal** The control power for the main unit in the power supply panel is detected.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	
U863	**MAIN unit1 overheat** An erroneous rise in the temperature of the electronic parts in the main unit 1 is detected.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	

Error No.	Message and details	Remedies	Remarks
U864	**MAIN unit2 overheat** An erroneous rise in the temperature of the electronic parts in the main unit 2 is detected.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	
U865	**AVR input abnormal** An error was detected in the AVR input voltage in the power supply panel.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	
U866	**AVR[power supply A] abnormal** An error was detected in the power supply A of the AVR in the power supply panel.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	
U867	**AVR[power supply B] abnormal** An error was detected in the power supply B of the AVR in the power supply panel.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	
U868	**AVR[power supply C] abnormal** An error was detected in the power supply C of the AVR in the power supply panel.	• Report the situation to the Mitsubishi service center. • Do not turn machining ON. The other sections could be damaged.	
U869	**PAM Protector off** The PAM circuit breaker is turned off, or an overcurrent (error) was detected in the PAM circuit.	• Turn the breaker ON. • Call the service center if the breaker cannot be turned on.	
U870	**Clean Fluid TMP.Low** The clean fluid temperature cannot be managed due to shortage of clean fluid.	• When machining many holes in a short period of time (the machining cycle is ten minutes or less), a warning or alarm may occur. The machining liquid temperature is strictly controlled in the twin U/C specification machine to maintain the machining accuracy. Please confirm that there is sufficient clean fluid in the dielectric reservoir before machining under the above conditions. When a warning or alarm occurs, fill the area under the worktable with fluid and let it stand for more than one hour. Then extend the repetitive machining cycle (use the Dwell function).	
U876	**Door Overrun** A work tank door overrun was detected at the upper or lower limit.	• Contact the service center. • Restore the work tank door position. • Adjust the positions for the limit switches.	
U877	**Door Motor Abnormal** An error of the work tank door motor has been detected.	• Contact the service center. • Check the work tank door. • Check the motor.	
U878	**Door Abnormal** The work tank door raising/lowering operation was not completed.	• Contact the service center. • Check the work tank door. • Check the limit switches. • Check the motor. • Check the motor cables.	

Error No.	Message and details	Remedies	Remarks
U879	**Door Float ERROR** The float switch that stopped the lowering work tank door was not released.	• Clean the float. • If the problem is not solved, contact the service center. • Check the float switch that stops lowering the work tank door.	
U880	**Door Position Adjust ERROR** An error occurred at the position counter. • When the work tank door is being raised/lowered, the encoder signals cannot be detected correctly. • When the work tank door was stopped, the door position deviated.	• Lower the work tank door to the lowest limit.	
U881	**Door Not Lowest Position** The Lowest Pos. switch was operated when the work tank door was not at the lower limit.	• Before moving the work tank door to the lower end, lower it to the lower limit using the Lower Limit switch.	
U882	**CAN'T MOVE AXES** The feed pump stops because the tank circulation switch is turned OFF, or for similar reasons.	• Turn ON the tank circulation switch to operate the feed pump and carry out the axis movement.	
U883	**CAN'T MOVE DOOR FOR FRONT COVER OPEN** Attempting to raise or lower the work tank door is made while the front cover is open.	• Close the front cover.	
U885	**Can't start the machine temperature adjustment, Because READY OFF.** When the wakeup mode is recovered and changed into Ready OFF.	• Since the machine cannot remain in the wakeup mode continuously, set it to Ready ON and then start the fluid adjustment.	
U898	**TCH SNSR DISABLE, FLUID REMAINING.** Attempting to turn ON the touch sensor mode when the fluid was above the table.	• Drain the fluid and then set the touch sensor mode ON again.	
U899	**Pressure limitation of the sensor** When the pressure of the dielectric fluid filter rises to the pressurization limit of the sensor.	• Replace the dielectric fluid filter.	
U900	**Overflow mode disabled** The overflow mode is turned ON above the height where machining can be performed.	• Set the Z axis stroke below the height where machining can be performed.	
U901	**Door: zero point return incomplete** Zero point return for the work tank door is not completed.	• Execute zero point return for the work tank door. If this does not solve the problem, report the situation to the Mitsubishi service center.	
U902	**Press door upper limit switch.** Zero point return for the work tank door is not completed.	• Press the upper limit of the work tank door up/down switch and conduct a zero point return for the work tank door. If this does not solve the problem, report the situation to the Mitsubishi service center.	

Error No.	Message and details	Remedies	Remarks
U903	**Press door lower limit switch.** Zero point return for the work tank door is not completed.	• Press the lower limit of the work tank door up/down switch and conduct a zero point return for the work tank door. If this does not solve the problem, report the situation to the Mitsubishi service center.	
U1038	**Magnetic pole shift amount incorrect** The servo parameter is not entered.	• Because ON cannot be prepared, you need to enter all the parameter files saved under the "param" folder in the USB flash memory.	

2.3 Operation Alarms

Error No.	Message and details	Remedies	Remarks
M01	**DOG OVERRUN** Zero point return could not be completed properly because an error was found.	• Contact the Mitsubishi service center.	
M02	**Z-AX NO CRSS** Zero point return could not be completed properly because an error was found.	• Contact the Mitsubishi service center.	
M04	**INTERLOCK AXIS** Some axes were interlocked because the interlock function became valid (input signal OFF state).	• The interlock function is valid, so release it and then start operation. • Check the sequence of the machines. • Check whether the interlock signal wire is broken.	
M06	**H/W STROKE END** Some axes were interlocked because the stroke end function became valid (input signal ON state).	• Move the machine by manual operation because the stroke end limit switch is working (to cause a stroke end). • Check whether the stroke end signal wire is broken. • Check that the limit switch is working normally and is not damaged.	
M07	**S/W STROKE END** The function of the stroke limit 1 to 5 was activated.	• Move the axis by manual operation because the machine is in the stroke end state. • Check the parameter details if it is not at the axis end. • To release the settings of the soft limit, see ""III. NC OPERATION DISPLAY SCREEN"".	
M09	**WRONG O-PNT NO.** Executing the 2nd to 4th zero point return was attempted for an axis that has not completed zero point return.	• Execute dog type zero point return.	
M163	**AXIS-S OVER** The speed when axis magnification was applied exceeded the axis parameter speed.	• Set the axis magnification again.	
M605	**EXP-AT ERROR** The extended AT mode selection is incorrect.	• Turn OFF either the cut-off mode or uncut mode because both have been selected. • The uncut amount is not set, so set it. • Turn the manual wire breakage recovery ON when the AT unit is not installed.	
M618	**STILL CONTACT** The contact cannot be canceled even when returned 10μm from the contact detection position during positioning.	• Check the workpiece surface for rust, dirt, or burrs, etc. • Check whether the hole is too small.	
M619	**IN CONTACT** The wire is already in contact with the workpiece before the start of positioning.	• Clear the contact state and then restart the positioning operation.	

Error No.	Message and details	Remedies	Remarks
M624	**AT NOT HOME** The operation was attempted to start when the AT was not at the home position.	• Start the operation after returning the AT to the home position.	
M625	**WIRE BROKEN** A wire breakage was detected at the time of positioning.	• Turn ON the pretension switch. • Check whether the limit switch is in position or not. • Check whether the wire is broken or not.	
M626	**Collision detection error** The nozzle contacted the workpiece.	• Move the nozzle in the direction where it does not contact the workpiece using JOG. If two or more axes contact simultaneously and axis movement cannot be performed, turn the power OFF and then ON again. • Check whether the movement command in the NC program is incorrect. • Check whether there is a conductive matter between the upper nozzle and workpiece. • Execute zero point return on all axes again.	
M627	**OUT OF MARGIN** The positioning error after several repetitions exceeds the allowable range.	• Clean the surface of the workpiece and retry the positioning.	
M628	**pisy timeout** When using the corner expert function, pre-reading of the corner position did not end within a set time.	• When using a program with many small blocks, it will take time to pre-read the corner position. Thus, the corner expert function cannot be used. Turn the corner expert switch OFF.	
M629	**Angle Over Err** An angle exceeding the tolerable angle was set.	• Set the angle within the correct range.	
M630	**EDGE NOT SAVE** The edge position was not saved when a 1/2 point movement was made.	• Move 1/2 point after edge positioning.	
M641	**MEASURING NOW** The positioning mode was selected with the manual operation box while the dimension measurement switch was ON.	• Turn OFF the dimension measurement switch or wait for dimension measurement to end before selecting the positioning mode.	
M657	**DIFF.EXCESS FOR ABS SYSTEM** The difference in the absolute position before and after the power failure exceeds 4 mm.	• When the system is reset, zero point return will be incomplete. Execute zero point return again.	
M666	**ZP-RTN NOT FIN** Automatic operation was started before zero point return was completed.	• Execute zero point return before starting automatic operation.	
M667	**Door: zero point return incomplete** Zero point return for the work tank door is not completed.	• Execute zero point return for the work tank door. If this does not solve the problem, report the situation to the Mitsubishi service center.	

Error No.	Message and details	Remedies	Remarks
M676	**Resistivity Auto Adjustment ERROR** You failed to adjust the resistivity automatically using the [Resistivity Auto Adjustment ERROR] switch in the adjustment screen.	• Report the situation to the Mitsubishi service center.	
M678	**NO TCH SNSR MODE** Workpiece plane (flatness) measurement was executed when the touch sensor mode was OFF.	• Restart the workpiece plane (flatness) measurement after turning the touch sensor mode ON.	
M679	**WORK PLANE MEASUREMENT OUT OF MARGIN** Workpiece inclination angle which was measured in workpiece plane measurement was beyond the allowance.	• Reset the workpiece setting again and execute workpiece plane measurement again.	
M680	**POS. NO CONTACT** The contact of the touch sensor and workpiece is not detected even though Z axis moves over the specified length.	• Check the positioning direction and the distance and execute the positioning again.	
M682	**DURING SCHEDULE OPERATION MODE** • The following manual positioning attempts were performed in the schedule operation mode. "Three point Center", "Work plane", "Taper-Z (Angle Master ADVANCE II jig)", "Angle master"	• Press the "RESET" button and cancel the scheduled task operation to perform manual positioning.	

2.4 Stop Alarms

T01	**CAN'T CYCLE ST**	The automatic operation start is impossible because the NC is not in the ready state.

Error No.	Message and details	Remedies	Remarks
T101	**AX IN MOTION** The automatic operation start is impossible because an axis is moving.	• Start the operation once again after all axis movement stop.	
T102	**READY OFF** The automatic operation start is impossible because the NC is not in the [Ready] state.	• Check the cause of the error and take necessary measures according to the alarm contents.	
T103	**RESET ON** The automatic operation start is impossible due to reset signal input.	• Resetting. Wait and then start automatic operation. • Check whether the [Reset] switch is working normally.	
T104	**STP SGNL ON** The [Stop] switch on the machine operation panel is on (valid.)	• The [Stop] switch has been pressed. • Check whether the feed hold signal wire is broken.	
T105	**H/W STROKE END** The automatic operation start is impossible because some axes have reached the stroke end.	• In case the stroke end is detected at the axis end, move the axis by manual operation. • Check whether the stroke end signal wire is broken. • Check whether the stroke end limit switch is damaged or not.	
T106	**S/W STROKE END** The automatic operation start is impossible because some axes have reached the S/W stroke limit.	• Move the concerned axis by manual operation. • Check the parameter details if it is not at the axis end.	
T114	**SEARCHED E-CONDITION NOT FOUND**	• Search for the machining conditions on the Automatic 2nd cut screen before starting.	
T115	**Over filter pressure** Because the dielectric fluid filter pressure exceeds the exchange pressure, automatic startup fails.	• Replace the dielectric fluid filter.	
T116	**START NO CHECK** There are not-checked items in the confirmation list.	• Confirm the confirmation list content and check all the items before starting again.	

T02, T06, T07, T08	**AUTO OPERATION STOP**	The automatic operation under execution stopped due to some conditions.

Error No.	Message and details	Remedies	Remarks
T201	**H/W STROKE END** An axis reached the stroke end.	• Move the axis from the stroke end limit switch position by manual operation. • Change the workpiece mounting position and the machining program.	
T202	**S/W STROKE END** A soft limit was detected.	• Move the concerned axis by manual operation. • Change the workpiece mounting position and the machining program.	
T203	**RSET SGNL ON** The reset signal was input.	• Execute the automatic operation from the machining program start point since the position of program execution has returned to the program head.	
T204	**STP SGNL ON** The [Stop] switch has been turned ON.	• Press the [Start] switch to restart the automatic operation.	
T205	**OP MODE SHFT** The operation mode was changed to the manual mode during automatic operation.	• Change the operation mode to automatic and then restart the operation.	
T209	**AT MANU. MODE** The AT has been put into manual mode by M20 or M21.	• Change the mode from manual to automatic and restart the operation. • Insert and cut the wire by hand, then restart the operation.	
T210	**WIRE BREAKAGE** The wire broke during the machining.	• Set the wire again and restart the machining. • Turn ON the pretension switch.	
T211	**30 SEC CONTACT** A short-circuit state continued for 30 seconds during the machining.	• Clear the short-circuit and restart the machining. • Check for cut workpiece dropping, wire setting error, scrap overflowing from the wire collection box, etc. • Shift the position of the power feeder or position a new surface, then restart the operation.	
T212	**NEXT BLK MISS** The next block cannot be read.	• Check whether the tape has slipped off.	
T213	**WORKING OFF** The machining button was pressed during machining.	• Set the dielectric fluid, wire, machining to ON, and then restart the operation.	
T215	**SEQ. ERROR** An error occurred in the AT, ASR, etc.	• Select the main menu "History management", and confirm the sequence error with the sub menu "Operation" > "COND. log". Follow the remedy methods given for that error.	
T217	**NC ALARM** An error occurred in the AT, ASR, etc.	• Remove the cause of the error and restart the operation.	
T219	**WIRE INST ERR** A wire insertion error occurred during the execution of M20.	• Readjust the dies, etc., and restart the operation. • Take necessary measures by referring to the troubleshooting procedure stated in Maintenance and Inspection of the automatic wire feeder.	

Error No.	Message and details	Remedies	Remarks
T220	**IN CONTACT** The wire is already in contact with the workpiece before the start of automatic positioning.	• Clear the contact state and restart the automatic positioning.	
T221	**STILL CONTACT** The contact state is not cleared even if the wire electrode is moved back by 10μm from the point where contact was detected during the positioning.	• Check the workpiece surface for rust, dirt, or burrs, etc. • Check whether the hole is too small.	
T222	**WIRE BROKEN** A wire breakage was detected during the positioning.	• Fix the wire breakage and restart the positioning.	
T224	**MODE IN USE** The positioning was attempted while some other mode was ON.	• Clear the other mode.	
T227	**ASR NOT HOME** The ASR deviated from the home position during the axis movement.	• Set the ASR at the home position before restarting the operation.	
T228	**TCH SNSR NOT H** The touch sensor deviated from the home position during the start operation.	• Return the touch sensor to the home position and restart the operation.	
T229	**TCH SNSR CONT.** The operation stopped due to contact trouble of the probe while the touch sensor was ON.	• Clear the contact state by using the concerned JOG key and restart the operation.	
T230	**AUTO RTN FIN** The auto return was finished.	• Continue the next operation.	
T231	**AT MAN MODE** The mode changed from automatic to manual during AT mode operation.	• Never change the mode from automatic to manual when the AT is in operation.	
T232	**F CMD NOTHING** No speed command was input.	• Input the speed command through the screen or by the NC program.	
T233	**AXIS-S OVER** The speed when axis magnification was applied exceeded the axis parameter speed.	• Set the axis magnification again.	
T234	**Z-AXIS NOT RET** Automatic return of the X, Y, U, V and B axes was completed, but automatic return of the Z axis is not completed.	• To perform automatic return of the Z axis, keep the "Auto return" and "Auto Retn Sep." switches and then restart the operation. • To continue the program from that position without automatic return of the Z axis, turn OFF the "Auto return" or "Auto Retn Sep." switch. Then restart the operation.	

Error No.	Message and details	Remedies	Remarks
T235	**WIRE BREAKAGE LOWER AREA** When wire breakage occurs in the section between the lower wire guide and the collection roller.	• Clean the wire left in that section. • If sticking is found when cleaning, see ""5. MAINTENANCE AND INSPECTION METHOD OF AUTOMATIC WIRE FEEDER"" for inspection and cleaning, and remove the wire.	
T236	**RETRY STOP** Movement to the M20 position of the figure to be remachined has been completed in the remachining mode.	• Insert the wire manually, and then press the [Start] button.	
T237	**A.W.F. SKIP** An uncut skip occurred.	• Wire insertion is difficult due to an improper start hole, or the wire broke during machining. Complete the machining of all other figures, correct the trouble, and then perform remachining.	
T245	**OPERATION ERROR** An operation error (M-) occurred, and the machine stopped.	• Select the main menu "Maint", and confirm the operation error with the sub menu "Operation" > "COND. log". Follow the remedy methods given for that error.	
T246	**PROGRAM ERROR** A program error (P-) occurred, and the machine stopped.	• Select the main menu "Maint", and confirm the program error with the sub menu "Operation" > "COND. log". Follow the remedy methods given for that error.	
T249	**G48 W/O O-RTN** A G48 command was issued to an axis that has not completed zero point return.	• Execute dog type zero point return.	
T252	**READY FOR RE-** Movement to the start position has been completed in the remachining mode.	• Press the [Start] button to perform remachining.	
T253	**READY FOR APC** Movement to the M53 position has been completed in the remachining mode.	• Press the [Start] button to perform remachining.	
T254	**NO M20** There is no M20 command in the program so dimension measurement cannot be executed.	• Use a program that has an M20 command for each measurement figure when executing dimension measurement (automatic, semiautomatic modes). • Perform dimension measurement without using a program (use manual measurement).	
T255	**MEASRNG DONE** There were 26 or more M20 commands in the program, but dimension measurement was completed only up to the 25th M20 command.	• Dimension measurement using the program can be executed only up to the 25th M20 command. • Measure the remaining figures with the dimension measurement without using the program (manual measurement mode).	
T259	**START MEASURE** • The measurement of one figure was completed with manual measurement. • Movement to the M20 position has been completed with semiautomatic measurement.	• Move to the measurement start point with the manual operation box, and then press the "Start] button.	

Error No.	Message and details	Remedies	Remarks
T262	**RESTART READY** Movement to the last executed M20 position or program start position has been completed.	• Confirm the position, and then press the [Start] button to restart the program.	
T270	**RETURN ERROR** Wire breakage return cannot be executed with reverse path return.	• Wire breakage return cannot be executed with reverse path return. Turn OFF the Reverse path switch on the AT function list screen and then restart the operation. Normal wire breakage return will be executed.	
T271	**NO PM E-PACK** The E-Pack dedicated to PM is not registered when machining with PM.	• Register the E-Pack dedicated to PM.	
T272	**pisy discord** A deviation was detected between the preread corner position and the actual corner position when using the corner expert function.	• See the explanation on the [CM-R/CM-S] switch in 3. INITIAL SETTING > 3.2 Machine parameters > 3.2.11 Machining setting > (1) P-Ctrl in "III. NC OPERATION DISPLAY SCREEN", and check whether an operation that is subject to function limits was carried out. When the alarm on the left occurs and restart is executed, the following program will be executed up to the next M20 without using the corner expert.	
T273	**NO WIRE** A wire absence was detected when M21 was executed.	• Replace the wire bobbin and then start the operation. Check for deviation of the limit.	
T274	**LOW AIR PRESS** The air pressure dropped continuously during the specified time.	• Check the air pressure. • Check the compressor's power supply.	
T275	**INTERLOCK AXIS** Some axes were interlocked because the interlock function became valid (input signal OFF state).	• The interlock function is valid, so release it and then start operation. • Check the sequence of the machines. • Check whether the interlock signal wire is broken.	
T283	**RESUME STOP** Movement to the M20 position of the shape that restarts automatic operation has been completed in the machining restart mode.	• Confirm whether it is consistent with the M20 position of the shape that restarts automatic operation, and then press the [Start] button.	
T284	**RESUME READY** Movement to the machining restart position has been completed in the machining restart mode.	• Press the [Start] button to continue automatic operation.	
T285	**AVOID CONTACT ERROR** Contact release cannot be performed during contact avoidance, or wire feed is turned OFF.	• If contact release is not possible, the inclination of the start hole may be excessive. Check the condition of the start hole. • If the wire feed is turned OFF during contact avoidance, set the dielectric fluid, wire feed, and machining to ON, and then restart the system. Start execution from contact avoidance.	

Error No.	Message and details	Remedies	Remarks
T307	**SCHE. SINGLE STOP** The scheduled task operation was stopped by turning ON the "Schedule single" switch.	• Press the [Start] button to restart the scheduled task operation. • Press the "Reset" button to end the scheduled task operation.	
T308	**LN SKIP COMPLETE** The axis movement to the position of the designated L and N No. in the LN SKIP mode has been completed.	• Press the [Start] switch to restart the automatic operation.	
T309	**UNCUT STOP** The scheduled task operation was stopped with uncut when "Uncut Stp" is set to "On" on the schedule list.	• Press the [Start] button to restart the scheduled task operation. • Press the "Reset" button to end the scheduled task operation.	
T605	**EXP-AT ERROR** The extended AT mode selection is incorrect.	• Turn OFF either the cut-off mode or uncut mode because both have been selected. • The uncut amount is not set, so set it. • Turn the manual wire breakage recovery ON when the AT unit is not installed.	
T626	**Collision detection error** The nozzle contacted the workpiece when the nozzle contact function was selected and machining was OFF.	• Move the nozzle in the direction where it does not contact the workpiece using JOG. If two or more axes contact simultaneously and axis movement cannot be performed, turn the power OFF and then ON again. • Check whether the movement command in the NC program is incorrect. • Check whether there is a conductive matter between the upper nozzle and workpiece. • Execute zero point return on all axes again.	
T628	**pisy timeout** When using the corner expert function, pre-reading of the corner position did not end within a set time.	• When using a program with many small blocks, it will take time to pre-read the corner position. Thus, the corner expert function cannot be used. Turn the corner expert switch OFF.	
T702	**LR OUT OF CNTL** A specific resistance error was detected.	• Report the situation to the Mitsubishi service center.	
T704	**FLUID OFF** The machining was started without supplying the dielectric fluid.	• Always fill the dielectric fluid before starting machining.	
T705	**WIRE FEED OFF** The machining was started without inserting the wire.	• Insert the wire and fill the dielectric fluid before starting machining.	
T706	**AT NOT HOME** The AT was not at the home position at the program startup.	• Set the AT at the home position before starting the operation.	
T707	**NO MANUAL MODE** Executing a manual mode command was attempted when the system was not in the manual mode.	• Enter the manual mode and carry out the operation again.	

Error No.	Message and details	Remedies	Remarks
T709	**MACHING INTERLOCK** Positioning was attempted when machining was ON.	• Turn OFF the machining before performing positioning.	
T711	**AUX TB CONTACT** Contact with the auxiliary table was detected.	• Remove the obstacle which caused contact trouble from the work tank.	
T712	**COVER OPEN** Machining was attempted with the safety cover open.	• Close the safety cover before starting machining.	
T715	**WIRE CUT ERROR** The wire cannot be cut within the specified time. (AF)	• Check the wire diameter and material. If these are correct and the alarm recurs, contact the Mitsubishi service center.	
T716	**AT ABNORMAL** There is an error in the AT operation.	• See "V. MAINTENANCE AND ALARM LIST" in the Instruction Manual and check the unit.	
T718	**WRONG CUT ARM** The wire retainer does not return to the original position even when the set time elapses.	• Report the situation to the Mitsubishi service center.	
T719	**NOT IN POS.** The AWF cutter arm is not at the home position.	• Return the cutter arm to the home position.	
T723	**UV NOT ORIGIN** The UV axis is not at the zero point.	• Return the UV axis to the zero point. (The UV zero point has not been set yet, or the U and V axes moved.)	
T728	**WATER COLL. ERR** Abnormal operation of the water collection box was detected.	• Check for matters obstructing the opening/closing operation around the collection cover, and remove it if found. • Check that the air pressure is 400kPa or more.	
T730	**T/C IN FLUID** The work tank water level has reached the taper unit.	• Check the upper limit of the dielectric fluid, and adjust it so that the taper unit is not submerged.	
T737	**ASR MANU MODE** The ASR was put into manual mode when M52 was commanded.	• Set the ASR to automatic mode.	
T738	**ASR ABNORMAL** The scrap could not be removed when the handle contacted it.	• Remove the scrap manually and then restart the operation.	
T741	**TCH SNSR MODE** Machining was started in touch sensor mode.	• Cancel the touch sensor mode.	

Error No.	Message and details	Remedies	Remarks
T742	**WRONG TCH SNSR** The touch sensor did not move even after the specified time elapsed.	• Check the air source and then contact the Mitsubishi service center.	
T743	**TCH SNSR CONT.** The axis contacted the probe when moving in the touch sensor mode.	• Move the probe in the reverse direction by using the corresponding JOG.	
T746	**AWC NOT HOME** The AWC was not at the home position at the program startup.	• Set the AWC at the home position before starting the operation.	
T747	**AWC MANU MODE** The AWC was not in automatic mode when the AWC operation was commanded.	• Set the AWC to automatic mode.	
T748	**AWC ABNORMAL** The AWC control unit detected an error.	• See the AWC Instruction Manual and cancel the AWC control unit error.	
T750	**ZP-RTN NOT FIN** The X, Y, and Z axes have not been returned to the zero point before AWC operation was commanded.	• Return the X, Y, and Z axes to the zero point before starting AWC operation.	
T756	**APC NOT HOME** The APC was not at the home position at the program startup.	• Set the APC at the home position before starting the operation.	
T757	**APC MANU MODE** The APC was not in automatic mode when the APC was commanded.	• Set the APC to automatic mode.	
T758	**APC ABNORMAL** An APC operation error was detected, or the APC was stopped during operation.	• See the APC Instruction Manual and cancel the control unit error.	
T760	**LOW FLUID** The fluid level is low.	• Check the dielectric fluid amount in the work tank. If the fluid is insufficient, refill the tank. • For non-submerged machining, turn OFF the [Fluid off at low level] switch.	
T794	**CLEAN SIDE LOW** The fluid level in the clean fluid tank has dropped.	• Check the dielectric fluid level in the dielectric fluid feeder and replenish if necessary. • The filtration flow rate is insufficient. Check the filter pressure gauge and check the filter hose for bending and pump intake port for clogging. Also, check that the filter drain valve is securely tightened. • Clean the float.	
T795	**DIRTY SIDE LOW** The fluid level in the waste fluid tank has dropped.	• Check the dielectric fluid level in the dielectric fluid feeder and replenish if necessary. • Clean the float.	

Error No.	Message and details	Remedies	Remarks
T814	**WIRE PROCESSING DEV.** The wire gets entangled in the wire processing unit. Or, the motor is locked.	• Remove the tangled wire. • Check whether the cutter unit is worn and replace it if it is worn. • Check that the wire processing unit connector [WCM] is connected. • Clean the float.	
T822	**DOOR POS.ERR** The clamp switch was pressed before the work tank door was raised to the upper limit.	• Lower the work tank door to the lower limit, and then press the clamp switch again.	
T823	**DOOR CLAMP ERR** The door was not clamped within the specified time. The clamp was released suddenly for some reason.	• Check whether the door clamp limit switch is broken. • In this case, lower the work tank door to the lower end, and then press the clamp switch again.	
T824	**WaterRemaining** Unclamping of the door was attempted while there was dielectric fluid in the work tank.	• There may be dielectric fluid above the table. Discharge the fluid and then unclamp the door.	
T825	**DoorUnclampERR** The door was not unclamped within the specified time.	• Check whether the door clamp limit switch is broken. • When using FX20, lower the work tank door to the lower end, and then press the clamp switch again.	
T828	**REMOTE I/O NOT JOIN** A fault occurred during the remote I/O. • The cable is dislocated. • Remote I/O trouble	• Contact the Mitsubishi service center.	
T830	**CUT WIRE REMAINING** Scraps of cut wire could not be collected into the wire collection box and are remaining in the cut wire duct.	• Remove the wires from the cut wire duct.	
T832	**Dielectric fluid reservoir controller abnormal** A tank control error was detected.	• Report the situation to the Mitsubishi service center.	
T833	**Feed pump halt** An overcurrent (error) was detected in the supply pump motor.	• Report the situation to the Mitsubishi service center.	
T834	**Filter pump halt** An overcurrent (error) was detected in the filter pump motor.	• Report the situation to the Mitsubishi service center.	
T835	**Fill pump halt** An overcurrent (error) was detected in the filling pump motor.	• Report the situation to the Mitsubishi service center.	
T836	**Ionizer pump halt** An overcurrent (error) was detected in the ionizer pump motor.	• Report the situation to the Mitsubishi service center.	

Error No.	Message and details	Remedies	Remarks
T837	**Z axis coolant pump halt** An overcurrent (error) was detected in the Z axis cooling pump motor.	• Report the situation to the Mitsubishi service center.	This may not be provided depending on the model.
T838	**Circulate pump halt** An overcurrent (error) was detected in the circulation pump motor.	• Report the situation to the Mitsubishi service center.	This may not be provided depending on the model.
T839	**Fan cooler halt** An overcurrent (error) was detected in the fan cooler motor.	• Report the situation to the Mitsubishi service center.	This may not be provided depending on the model and option setting.
T840	**Unit cooler abnormal** An error was detected in the unit cooler.	• Report the situation to the Mitsubishi service center.	This may not be provided depending on the model.
T841	**Solenoid abnormal 1** An overcurrent (error) was detected in the solenoid valve (block 1) for the tank control.	• Report the situation to the Mitsubishi service center.	
T842	**Solenoid abnormal 2** An overcurrent (error) was detected in the solenoid valve (block 2) for the tank control.	• Report the situation to the Mitsubishi service center.	
T843	**Solenoid abnormal 3** An overcurrent (error) was detected in the solenoid valve (block 3) for the tank control.	• Report the situation to the Mitsubishi service center.	
T854	**OUT OF WIRE D** (WIRE PROCESSING DEV.) A wire diameter ϕ0.15 or less was selected while the wire processing unit is installed.	• Remove the wire processing unit when using the wire with a diameter of ϕ0.15 or less. (The wire processing unit is only compatible with wire diameters of ϕ0.2 or more.) • Specify the wire diameter to be used when using a wire electrode with a diameter of ϕ0.2 or more.	
T855	**WIRE PROCESSING DEV. MOTOR STP** The cutter motor switch is OFF. Or, the cutter motor breaker is OFF.	• Clean the cutter. • If the alarm sounds again, notify the state to the Mitsubishi service center. • Turn ON the cutter motor switch. • Turn ON the cutter motor breaker.	
T858	**Unit cooler pump halt** An overcurrent (error) was detected in the unit cooler pump motor.	• Report the situation to the Mitsubishi service center.	
T859	**FrontCover[U] Close WorkingTankDoor Cannot Close** Attempting to raise the work tank door was made under the condition that the front cover [upper] was closed.	• Open the front cover [upper].	
T860	**Open the wire chip collection box** The door of the wire chip collection box is open.	• Close the door of the wire chip collection box.	

Error No.	Message and details	Remedies	Remarks
T869	**PAM Protector off** The PAM circuit breaker is turned off, or an overcurrent (error) was detected in the PAM circuit.	• Turn the breaker ON. • Call the service center if the breaker cannot be turned on.	
T870	**Clean Fluid TMP.Low** The clean fluid temperature cannot be managed due to shortage of clean fluid.	• When machining many holes in a short period of time (the machining cycle is ten minutes or less), a warning or alarm may occur. • The machining liquid temperature is strictly controlled in the twin U/C specification machine to maintain the machining accuracy. • Please confirm that there is sufficient clean fluid in the dielectric reservoir before machining under the above conditions. • When a warning or alarm occurs, fill the area under the worktable with fluid and let it stand for more than one hour. Then extend the repetitive machining cycle (use the dwell function).	
T882	**CAN'T MOVE AXES** The feed pump stops because the tank circulation switch is turned OFF, or for similar reasons.	• Turn ON the tank circulation switch to operate the feed pump and carry out the axis movement.	
T883	**CAN'T MOVE DOOR FOR FRONT COVER OPEN** Attempting to raise or lower the work tank door is made while the front cover is open.	• Close the front cover.	
T899	**Pressure limitation of the sensor** The pressure of the dielectric fluid filter rose to the pressurization limit of the sensor.	• Replace the dielectric fluid filter.	
T900	**Overflow mode disabled** The overflow mode is turned ON above the height where machining can be performed.	• Set the Z axis stroke below the height where machining can be performed.	
T901	**Door: zero point return incomplete** Zero point return for the work tank door is not completed.	• Execute zero point return for the work tank door. If this does not solve the problem, report the situation to the Mitsubishi service center.	

T03	**BLK STOP**	The program stopped after executing one block in the program during the automatic operation.

Error No.	Message and details	Remedies	Remarks
T301	**SNGL BLK STOP** The single block switch is ON.	• If necessary, turn the single block switch OFF.	
T302	**MACRO BLK STOP** The macro variable H3006 is used in the program, and the block before it was executed.	• It is possible to restart.	
T305	**M0, M1 STOP** M0 or M1 was executed.	• It is possible to restart.	

T04	**CHECKUP STOP**	A verification stop occurred during the automatic operation.

Error No.	Message and details	Remedies	Remarks
T401	**CHECKUP STOP** A verification stop occurred.	• It is possible to restart the automatic operation by turning ON the start switch.	

2.5 Servo Alarms

Warning details for servo system errors including the drive amplifier, motor, encoder, etc.

S01	**SERVO ALARM: PR** (The address of the axis where an error has occurred is displayed.)	After removing the cause of the alarm, the alarm can be reset by carrying out the reset method shown below.

- **Alarm display on servo amplifier**

The QA series servo amplifier is installed on the left side of the bed when viewed from the front of the machine.
Refer to it when a S01 Servo alarm PR occurs.
Reset method: PR.....After removing the alarm cause,
turn the power OFF and ON.
AR .....After removing the alarm cause,
turn the power OFF and no-fuse breaker OFF, and then start up again.

*●: Item carried out by user ■: Item carried out by manufacturer

Error No.	Message	Description	Investigation method	Remedy	Remarks
10	**Undervoltage**	The PN bus wire voltage is 200 V or less.	● Check the input voltage. 1) Is a single-phase 200 V or 100 V input? 2) Is there an open phase? ■ Check the contactor operation and conductivity. ■ Check the output from the amplifier. 1) Is the connector (CN3) disconnected? 2) Is the cable broken? ■ Check the contactor drive relay operation and conductivity faulty. ■ Check the power capacity.	● Input 3-phase 200 V. ● Contact the Mitsubishi service center. ■ Replace the contactor. ■ Connect correctly. ■ Replace the cable. ■ Replace the relay. ■ Review the power supply.	PR
11	**Axis selection error**	The axis setting rotary switch was not set correctly in the 2-axis integrated drive unit.	■ Check the rotary switch setting.	● Contact the Mitsubishi service center. ■ Set correctly (set to the number obtained by subtracting one from the axis number).	AR
12	**Memory error**	The memory IC (SRAM or FLROM) check sum was illegal.	■ Always repeated. ■ Check for abnormalities in the ambient environment of the unit.	● Contact the Mitsubishi service center. ■ Replace the drive unit. ■ Take measures according to the cause. Ex. High temperature: Check the cooling fan. Grounding not enforced: Add grounding measures.	AR

Error No.	Message	Description	Investigation method	Remedy	Remarks
13	**Software processing error**	Software operation sequence error or operation timing error	● Check the grounding state and ambient temperature. ■ Check the repeatability.	● Contact the Mitsubishi service center. ■ Replace the amplifier. ● Improve the ambient environment.	PR
16	**Pole position detection error**	The differential input of the U, V, or W phase of the magnetic pole position detection signal from the OHE type detector was "H" or "L".	■ Set the servo parameter (SV25) correctly. ■ The detector connectors (unit side and detector side) are disconnected. ■ The detector cable connection is faulty.	● Contact the Mitsubishi service center. ■ Set correctly. ■ Connect correctly. ■ Replace the detector cable.	PR
17	**A/D converter error**	The A/D converter conversion value is incorrect.	● Check the grounding state and ambient temperature. ■ Check the repeatability.	● Contact the Mitsubishi service center. ■ Replace the amplifier. ● Improve the ambient environment.	PR
18	**Detector, initial communication error**	Initial communication with the detector was not possible.	■ Check the connection of the detector connector. Check the cable connection. ■ Replace with the cable for another axis and check the repeatability. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause).	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the detector cable. ■ Replace the parts on the side that caused the alarm.	PR
1A	**Serial detector communication error (SUB)**	The initial communication with the serial pulse encoder installed on the ball screw end was not possible.	■ Check the connection of the detector connector. Check the cable connection. ■ Replace with the cable for another axis and check the repeatability. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause).	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the detector cable. ■ Replace the parts on the side that caused the alarm.	PR
1B	**CPU error (SUB)**	An error was detected in the data stored in EEROM of the serial pulse encoder installed on the ball screw end (alarm output by the detector).	■ Check the connection of the detector connector. Check the cable connection. ■ Replace with the cable for another axis and check the repeatability. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause).	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the detector cable. ■ Replace the parts on the side that caused the alarm.	PR

Error No.	Message	Description	Investigation method	Remedy	Remarks
1C	**LED error (SUB)**	Deterioration of the LEDs in the serial pulse encoder installed on the ball screw end was detected (alarm output by the detector).	■ Check the connection of the detector connector. Check the cable connection. ■ Replace with the cable for another axis and check the repeatability. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause).	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the detector cable. ■ Replace the parts on the side that caused the alarm.	PR
1D	**Data error (SUB)**	An error was detected in the position data per rotation in the serial pulse encoder installed on the ball screw end (alarm output by the detector).	■ Check the connection of the detector connector. Check the cable connection. ■ Replace with the cable for another axis and check the repeatability. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause).	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the detector cable. ■ Replace the parts on the side that caused the alarm.	PR
1E	**Serial detector thermal error (SUB)**	The thermal protector built in the detector operated in the serial pulse encoder installed on the ball screw end (alarm output by the detector).	■ Check the connection of the detector connector. Check the cable connection. ■ Replace with the cable for another axis and check the repeatability. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause).	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the detector cable. ■ Replace the parts on the side that caused the alarm.	PR
1F	**Communication error (SUB)**	Communication with the detector in the serial pulse encoder installed on the ball screw end was cut off.	■ Check the connection of the detector connector. Check the cable connection. ■ Replace with the cable for another axis and check the repeatability. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause).	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the detector cable. ■ Replace the parts on the side that caused the alarm.	PR

Error No.	Message	Description	Investigation method	Remedy	Remarks
20	**No signal detected 1**	The differential input of the A, B, or Z phase signal from the motor end installation detector was "H" or "L" (software detection in the B series).	■ Set the servo parameter (SV25) correctly. ■ The detector connectors (unit side and detector side) are disconnected. ■ The detector cable connection is faulty. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause).	● Contact the Mitsubishi service center. ■ Set correctly. ■ Connect correctly. ■ Replace the detector cable. ■ Replace the parts on the side that caused the alarm.	PR
21	**No signal detected 2**	The differential input of the A, B, or Z phase signal from the machine end installation detector was "H" or "L" (software detection in the B series).	■ Check for abnormalities in the ambient environment of the unit. (ex. ambient temperature, noise, grounding)	● Contact the Mitsubishi service center. ■ Take measures according to the cause. Ex. High temperature: Add the cooling fan. Grounding not enforced: Add grounding measures.	PR
22	**LSI error**	LSI operation error	■ Check the repeatability. ■ Check the grounding state and ambient temperature.	● Contact the Mitsubishi service center. ■ Replace the amplifier. ■ Improve the ambient environment.	AR
24	**Ground fault**	A motor cable ground fault was detected. (Detected only at the [Ready] ON instant.)	■ Check the motor cable and connection. ■ Check the conductivity between cables.	● Contact the Mitsubishi service center. ■ Replace the cable and correct the connection. ■ Replace the motor.	PR
25	**Absolute position data lost**	The absolute position in the detector was lost.	■ Check the battery voltage with a tester (occurs at 3 V or less). ■ Open the panel on the top of the amplifier and check the battery connection. ■ Check the conductivity with a tester.	● Contact the Mitsubishi service center. ■ Replace the battery. ■ Connect correctly. ■ Replace the cable.	AR
26	**Not used axis error**	A power module error occurred on the non-controlled axis of the 2-axis integrated drive unit when the axis setting rotary switch was set to "F".	■ Check for abnormalities in the ambient environment of the unit. (ex. ambient temperature, noise, grounding)	● Contact the Mitsubishi service center. ■ Replace the drive unit or take measures according to the cause. Ex. High temperature: Check the cooling fan. Grounding not enforced: Add grounding measures.	PR

Error No.	Message	Description	Investigation method	Remedy	Remarks
27	**Absolute position detection scale CPU error**	An error was detected in the CPU of the absolute position linear scale (alarm output by the detector).	■ The detector connectors (unit side and detector side) are disconnected. ■ The detector cable connection is faulty. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause). ■ Check for abnormalities in the ambient environment of the unit.	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the detector cable. ■ Replace the parts on the side that caused the alarm. ■ Replace the detector (liner scale) or take measures according to the cause. Ex. High temperature: Check the cooling fan. Grounding not enforced: Add grounding measures.	PR
28	**Absolute position overspeed**	The scale moved at more than 45 mm/sec during initialization with the absolute position linear scale (alarm output by the linear scale).	■ The absolute position linear scale specs are not provided. ■ The machine is operating when the alarm occurs. ■ Open the panel on the top of the amplifier and check the battery connection. ■ Check the conductivity with a tester. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause). ■ Check for abnormalities in the ambient environment of the unit.	● Contact the Mitsubishi service center. ■ Set the SV025 : MTYP parameter correctly. ■ Check the motor mechanical brakes and machine system. Perform ■ Investigation item 3. ■ Connect correctly. ■ Replace the cable. ■ Replace the parts on the side that caused the alarm. ■ Replace the detector (liner scale) or take measures according to the cause. Ex. High temperature: Check the cooling fan. Grounding not enforced: Add grounding measures.	PR

Error No.	Message	Description	Investigation method	Remedy	Remarks
29	**Absolute position detection circuit error**	A hardware error occurred in the absolute position detection circuit of the absolute position linear scale (alarm output by the linear scale).	■ The absolute position linear scale specs are not provided. ■ The machine is operating when the alarm occurs. ■ Open the panel on the top of the amplifier and check the battery connection. ■ Check the conductivity with a tester. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause). ■ Check for abnormalities in the ambient environment of the unit.	● Contact the Mitsubishi service center. ■ Set the SV025 : MTYP parameter correctly. ■ Check the motor mechanical brakes and machine system. Perform ■ Investigation item 3. ■ Connect correctly. ■ Replace the cable. ■ Replace the parts on the side that caused the alarm. ■ Replace the detector (liner scale) or take measures according to the cause. Ex. High temperature: Check the cooling fan. Grounding not enforced: Add grounding measures.	PR
2A	**Relative position detection circuit error**	A hardware error occurred in the relative position detection circuit of the absolute position linear scale (alarm output by the linear scale).	● Check the ambient environment. ■ Check the repeatability.	● Contact the Mitsubishi service center. ● Review the ambient environment. ■ Replace the detector.	PR
2B	**Detector, CPU error**	Detector internal circuit error	● Check the ambient environment. ■ Check the repeatability.	● Contact the Mitsubishi service center. ● Review the ambient environment. ■ Replace the detector.	PR
2C	**Detector, LED error**	The LED in the detector has deteriorated.	● Check the ambient environment. ■ Check the repeatability.	● Contact the Mitsubishi service center. ● Review the ambient environment. ■ Replace the detector.	PR
2D	**Detector, data error**	Detector position data error.	● Check the ambient environment. ■ Check the repeatability.	● Contact the Mitsubishi service center. ● Review the ambient environment. ■ Replace the detector.	PR

Error No.	Message	Description	Investigation method	Remedy	Remarks
2F	**Detector, communication error**	Communication with the detector was cut off or there was an error in the received data.	■ Alarm 18 may occur when the power is turned ON. ■ Check the connector connection. ■ Alarm 18 may occur when the power is turned ON. ■ Exchange the detector and amplifier connection with that for another axis and check the repeatability. (Pinpoint the cause) ■ Is the cable shielded? ■ Is the cable wired with the same route as the motor power line?	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the detector cable. ■ Replace the parts on the side that caused the alarm. ■ Review the cable wiring and shield.	PR
30	**Over-regeneration**	Overheating of the regenerative resistor was detected.	■ Check the regeneration capacity. ■ Check the parameter (SV036). ■ Occurs [Ready] at OFF. ■ Check the power voltage with a tester.	● Contact the Mitsubishi service center. ■ Change the regenerative resistor. ■ Set correctly. ■ Review the power supply.	PR
31	**Overspeed**	The motor speed exceeded the tolerable value.	■ Check the machine specs. ■ Check SV001 (PC1), SV002 (PC2), SV018 (PIT), and SV025 (MTYP). ■ Is the speed loop gain too low? ■ Is the current limit value too low? ■ Does the alarm occur when the power is turned ON? ■ Change with another axis and check the repeatability.	● Contact the Mitsubishi service center. ■ Set correctly. ■ Adjust the gain. ■ Adjust the limit value. ■ Replace the detector.	PR
32	**Power module overcurrent**	The power module overcurrent protection function activated.	■ This should happen simultaneously with [Ready] ON. ■ Check the motor cable and connection. ■ Check the conductivity between cables.	● Contact the Mitsubishi service center. ■ Replace the cable. ■ Correct the connection. ■ Replace the motor.	PR

Error No.	Message	Description	Investigation method	Remedy	Remarks
33	**Overvoltage**	The PN bus wire voltage exceeded 400 V.	■ An alarm occurs when the power is turned ON. ● Check the power voltage with a tester. ■ Check the resistance value of the regenerative resistor. ■ Check the connector at the bottom of the amplifier. ■ Check the parameter (SV036). ■ Although an option resistor is used, the setting is configured to 1000.	● Contact the Mitsubishi service center. ■ Review the power supply. ■ Replace the regenerative resistor. ■ Connect correctly. ■ Set correctly.	PR
34	**NC communication, CRC error**	There was an error in the communication data from the NC.	■ Check the conductivity with a tester. ■ Are the communication pair cables connected in reverse? ■ Check the grounding state. ■ Change the connection with that for another amplifier and find the cause.	● Contact the Mitsubishi service center. ■ Replace the cable. ■ Ground correctly. ■ Replace the amplifier. ■ Replace the NC unit.	PR
35	**NC communication, data error**	The movement command data sent from the NC was excessive.	■ Is this a sub-micron system? ■ Is the axis a rotary axis?	● Contact the Mitsubishi service center.	PR
36	**NC communication, transmission error**	The communication from the NC was cut off.	■ Check the connectors (CN1A, CN1B) (including other axes). ■ Check the conductivity with a tester.	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the cable.	PR
38	**NC communication, protocol error 1**	There was an error in the communication data from the NC.	■ Are the communication pair cables connected in reverse? ■ Check the grounding state. ■ Change the connection with that for another amplifier and find the cause.	● Contact the Mitsubishi service center. ■ Replace the cable. ■ Ground correctly. ■ Replace the amplifier. ■ Replace the NC unit.	PR
39	**NC communication, protocol error 2**	There was an error in the communication data from the NC.	■ Check the conductivity with a tester. ■ Are the communication pair cables connected in reverse? ■ Check the grounding state. ■ Change the connection with that for another amplifier and find the cause.	● Contact the Mitsubishi service center. ■ Replace the cable. ■ Ground correctly. ■ Replace the amplifier. ■ Replace the NC unit.	PR

Error No.	Message	Description	Investigation method	Remedy	Remarks
3A	**Overcurrent**	The motor drive current is excessive.	■ Is VGN1 higher than the standard value in respect to the load inertia? ■ Is vibration occurring? ■ Check the current loop gain. ■ Is the current FB exceeding the current command during acceleration/deceleration? ■ The U, V, W phase connections are incorrect. ■ The line is connected to the motor of another axis. ■ The detector cable is connected to another axis. ■ Check the repeatability.	● Contact the Mitsubishi service center. ■ Lower VGN1. ■ Set the standard value. ■ Lower FC. ■ Connect correctly. ■ Connect correctly. ■ Replace the amplifier. ■ Replace the detector.	PR
3B	**Power module overheat**	Overheating of the IPM used for the servo drive's main circuit was detected.	■ The heat radiating environment is abnormal. ■ Investigate the installation environment. Is the grounding correct? Is there any noise generating equipment in the surrounding area?	● Contact the Mitsubishi service center. ■ Replace the fan or consider ventilating or cooling measures for the panel. ■ Ground correctly. Take noise measures for the device.	PR
3C	**Regenerative circuit error**	An error was detected in the regenerative transistor or resistor.	■ Check the connector at the bottom of the amplifier. ■ Check the resistance value of the regenerative resistor. ■ Is the regenerative resistor burned?	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the regenerative resistor. ■ Replace the amplifier.	AR
42	**Feedback error 1**	1) A skip of the detector feedback signal pulse occurred in the OHE type or OHA type detector used in the semi-closed loop system and ball screw end closed loop system. 2) A skip of the detector feedback signal pulse occurred in the low-speed serial type absolute position linear scale.	■ Open the panel on the top of the amplifier and check the battery connection. ■ Check the conductivity with a tester. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause).	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the cable. ■ Replace the parts on the side that caused the alarm.	PR

Error No.	Message	Description	Investigation method	Remedy	Remarks
43	**Feedback error 2**	A deviation occurred in the feedback amount from the motor end detector and machine end detector in the closed loop system.	■ Check the repeatability. ■ Check the ambient environment.	● Contact the Mitsubishi service center. ■ Replace the detector. ■ Check the ambient environment.	PR
60	**Instantaneous stop**	The 24V DC voltage connected to the CN22 connector has dropped.	■ 24V DC is not applied to the CN22 connector. ■ The LED of the CR unit is unlit. ■ The wiring and power voltage are abnormal. ■ Wiring contact defect, etc.	● Contact the Mitsubishi service center. ■ Increase the power voltage. ■ Replace the unit. ■ Check the problems in the grounding wiring and noise, etc. ■ Replace the power supply and wiring. ■ Replace the wiring or increase the power supply capacity.	AR
61	**Power module overcurrent**	An overcurrent was detected in the power module in the power supply.	■ Occurs each time the servo turns ON after turning 200 V AC ON. ■ The total of all motors' loads exceeds the power supply rated capacity. ■ The rated power supply capacity is not secured. ■ Measure the voltage between R-S, S-T, T-R with a tester. ■ Investigate the installation environment. Is the grounding correct? Is there any noise generating equipment in the surrounding area?	● Contact the Mitsubishi service center. ■ Replace the unit. ■ Lower the motor load and operation frequency. ■ Increase the power supply capacity. ■ Improve the power phase balance. ■ Ground correctly. Take noise measures for the device.	PR
63	**Auxiliary regeneration error**	The auxiliary regeneration transistor in the power supply is continuously ON.	■ Dirt on the regenerative resistance unit at the back of the unit ■ Check the conductivity between the terminal block (P, N, R, S, T) and the resistor surface.	● Contact the Mitsubishi service center. ■ Take measures so that cutting oil or dust does not get on the fins at the back of the unit. ■ Replace the unit.	PR
65	**Rush relay error**	The rush resistance short circuit relay in the power supply does not turn ON.	■ Investigate the repeatability, and check that the problem occurs consistently. ■ Investigate the installation environment. Is the grounding correct? Is there any noise generating equipment in the surrounding area?	● Contact the Mitsubishi service center. ■ Replace the unit. ■ Ground correctly. Take noise measures for the device.	PR

Error No.	Message	Description	Investigation method	Remedy	Remarks
67	**Open phase**	One phase of input 3ø 200 V AC is not connected.	■ The voltage of each input phase is incorrect.	● Contact the Mitsubishi service center. ■ Restore the power supply to normal.	PR
68	**Watch dog**	The power supply software process did not end within the designated time.	■ Investigate the repeatability, and check that the problem occurs consistently.	● Contact the Mitsubishi service center. ■ Replace the unit.	AR
69	**Ground fault**	Motor ground fault.	■ The insulation between the UVW terminals of all motors and the grounding is 100kΩ or less. ■ Is the motor or cable covered with oil?	● Contact the Mitsubishi service center. ■ Motor defect or cable ground fault Replace the motor and cable. ■ Take measures so that oil does not come in contact. Clean the motor's cannon connector and inside the terminal box.	PR
6A	**Contactor fusing**	The externally connected contactor is ON even during [Ready] OFF.	■ An error did not occur on the driver side (power module error, etc.).	● Contact the Mitsubishi service center. Replace contactor.	PR
6B	**Rush relay melt**	The rush resistance short circuit relay in the power supply is ON.	■ Investigate the installation environment. ■ An error occurred on the drive side. (A power module error did not occur.)	● Contact the Mitsubishi service center. ■ Install correctly. ■ Replace the unit.	PR
6C	**Main circuit error**	Charging to the main circuit is not normal.	■ The CHARGE lamp remains lit when an alarm occurs.	● Contact the Mitsubishi service center. ■ Replace the unit.	PR
6D	**Parameter error**	The capacity of the power supply unit (CR) and the regenerative resistor type (RTYP) set in parameter PTYP are not configured as a compatible combination.	■ Check the parameters of the drive unit connected to the power supply unit. Servo: SV036 (PTYP)	● Contact the Mitsubishi service center. ■ Set the correct value.	PR
6E	**Memory error**	Error in the memory circuit in the power supply	● Investigate the installation environment. Is the grounding correct? ● Is there any noise generating equipment in the surrounding area? ■ Investigate the repeatability, and check that the problem occurs consistently.	● Contact the Mitsubishi service center. ■ Replace the unit. ■ Ground correctly.	AR

Error No.	Message	Description	Investigation method	Remedy	Remarks
6F	**A/D converter error/power supply error**	This indicates an error in the A/D converter inside the power supply, or that the driver has detected some kind of abnormal condition in the power supply.	■ 7-segment LED display of the power supply is F. ■ The rotary switch setting is not 0.1. ■ There is a wiring error in the driver communication cable. ■ After replacing the communication cable with the driver, an alarm occurred.	● Contact the Mitsubishi service center. ■ Perform the same remedies as for the A/D converter error (alarm 6E: memory error). ■ Replace the unit. ■ Set the rotary switch correctly. ■ Replace the cable. ■ Replace the unit.	AR
71	**Instantaneous stop/external emergency stop**	The externally installed contactor is OFF. An instantaneous stop exceeding 25 ms occurred.	■ The externally installed contactor is turned OFF by the EMERGENCY STOP button, etc. ■ The RST wiring is not correct.	● Contact the Mitsubishi service center. ■ The power supply operates normally. Review the machine sequence. ■ An error has occurred in the wiring.	PR
73	**Over-regeneration**	The regenerative resistor's load exceeded the tolerable value.	■ Confirm that the external regenerative resistance type set in the parameter (PTYP) of the drive unit connected to the power supply unit is correct.	● Contact the Mitsubishi service center. Configure the correct setting and confirm again.	PR
74	**Regenerative resistance overheat**	The external regenerative resistance thermal relay has functioned.	■ The unit is hot. ■ The connection of pins 1 and 2 on the connector CN22(B) is about to come loose.	● Contact the Mitsubishi service center. ■ Take heat measures for the regenerative resistor. 1) Install it in a well-ventilated place. 2) Cool with a fan, etc. ■ Replace with correct wiring.	PR
75	**Overvoltage**	The voltage between PN exceeded 410 V.	● Investigate the installation environment. Is the grounding correct? ● Is there any noise generating equipment in the surrounding area? ■ The rated power supply capacity is insufficient.	● Contact the Mitsubishi service center. ■ Increase the power supply capacity. ■ Ground correctly. Take noise measures for the device.	PR
76	**External emergency stop setting error**	The rotary switch setting and parameter (PTYP) setting do not match.	■ Confirm the rotary switch setting and the parameter (PTYP) of the drive unit connected to the power supply unit.	● Contact the Mitsubishi service center. ■ Set the rotary switch to 0 or 1. Or, set the parameter (PTYP) correctly.	AR

Error No.	Message	Description	Investigation method	Remedy	Remarks
77	**Power module overheat**	Overheating of the power module (IPM) in the power supply was detected.	● Investigate the installation environment. Is the grounding correct? Is there any noise generating equipment in the surrounding area? ■ The heat radiating environment is insufficient.	● Contact the Mitsubishi service center. ■ Replace the fan. ■ Ground correctly. Take noise measures for the device.	AR
7F	**Power reboot alarm**	The control mode (standard amplifier mode or high-gain amplifier mode) recognized by the EEPROM and the mode set in the parameters differ.		■ Turn the power ON again.	PR
82	**Power supply no signal**	A wire breakage or incorrect connection of the cable connected with the power supply was detected.	■ The communication cable is disconnected. ■ Check the cable breakage. ■ Replace the detector and amplifier with that for another axis and check the repeatability (identify the cause).	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the communication cable. ■ Replace the parts on the side that caused the alarm.	PR
88	**Watch dog**	The servo amplifier software process was not executed within the designated time.	■ Check the repeatability. ■ Check the grounding state.	● Contact the Mitsubishi service center. ■ Replace the amplifier. ■ Ground correctly.	AR

S02 **INIT PARAM ERR**	The parameter transferred from the NC to the AMP at the NC power input time is abnormal.

Error No.	Message	Description	Investigation method	Remedy	Remarks
37	**INIT PARAM ERR**	The servo parameter setting is incorrect.	■ Check the setting range of the parameter having the error No. ■ SV025: A non-entered motor type was selected. SV027: Imc 1 and 2 were set. SV036: A non-entered resistor type was selected. ■ Check the parameters SV001, SV002, and SV018. ■ Check the parameter SV017. ■ Check the parameters SV057 and SV058. ■ Check the parameter SV027.bit15.	● Contact the Mitsubishi service center.	PR

S03 **SERVO ALARM: NR**	This alarm is displayed when an abnormal state of the servo system is detected. It is possible to clear this alarm by the "RESET" key input after removal of the cause of the alarm.

Error No.	Message	Description	Investigation method	Remedy	Remarks
46	**Motor overheat**	Overheating of the motor was detected.	■ Check the ambient temperature. ■ Ensure that the amplifier power is not turned off for a forced reset while the overload alarm (50) is active. ■ Is the load too large?	● Contact the Mitsubishi service center. ● Improve the ambient environment. ■ Review the operation pattern.	
4F	**Instantaneous stop**	The power was cut off for 50msec or more.	■ Check that connectors and wiring are securely connected. ● Is the weather OK? (Has lightning occurred?) ● When using overseas, there are cases when the power supply is poor.	● Contact the Mitsubishi service center. ■ Connect correctly. ● Improve the power supply.	
50	**Overload 1**	An excessive load was applied for longer than the set time.	■ Review the motor capacity selection. ■ Check the brake operation. 1) Check the brake relay. 2) Check the connector connection. ■ Is the ball screw bent? ■ Is there interference with the positioning pin? ■ Are SV021 and SV022 standard values?	● Contact the Mitsubishi service center. ■ Change the motor or amplifier capacity. ■ Repair the faulty section. ■ Replace the faulty section in the machine. ■ Do not use positioning pins. ■ Set the standard value.	

Error No.	Message	Description	Investigation method	Remedy	Remarks
51	**Overload 2**	An excessive load was applied for longer than the set time.	● Visually check whether there was a collision with the machine. ■ Is there interference with the positioning pin? ■ Check the motor power lines (U, V, W). 1) Is the U, V, W phase order correct? 2) The power line is not connected. 3) Is the cable connected to the motor for another axis? ■ Change with another axis and check the repeatability. ■ Check the connection.	● Contact the Mitsubishi service center. ● Check the cause of the collision. ■ Do not use positioning pins. ■ Connect correctly. ■ Replace the detector. ■ Connect correctly.	
52	**Excessive error 1**	The actual motor position and model position difference was excessive at servo ON.	■ Is the motor speed fluctuating? ■ Is the acceleration/deceleration time constant too short? ■ The current limit value is too low to output a sufficient torque. ■ Is the motor brakes cannot be released? ■ Check the SV023 (SV053) setting value. ■ Check the motor power lines (U, V, W). 1) Is the U, V, W phase order correct? 2) Is the cable connected to the motor for another axis? ■ Change with another axis and check the repeatability. ■ Check the connection.	● Contact the Mitsubishi service center. ■ Adjust the gain. ■ Adjust the parameters. ■ Repair the brake circuit. ■ Adjust the parameters. ■ Connect correctly. ■ Replace the detector. ■ Connect correctly.	
53	**Excessive error 2**	The actual motor position and model position difference was excessive at servo OFF.	■ Check the SV026 setting value. ■ Check the NC parameter.	● Contact the Mitsubishi service center. ■ Set correctly.	
54	**Excessive error 3**	The motor current did not flow when the actual motor position and model position difference was excessive at servo ON.	■ Check the connection of the motor power line (U, V, W phase).	● Contact the Mitsubishi service center. ■ Set correctly.	
58	**Collision detection 0**	A collision detection type 1 error was detected during the G0 modal (rapid traverse).	■ Check the parameters.	● Contact the Mitsubishi service center. ■ Set correctly.	

Error No.	Message	Description	Investigation method	Remedy	Remarks
59	**Collision detection 1**	A collision detection type 1 error was detected during the G1 modal (cutting feed.)	■ Check the parameters.	● Contact the Mitsubishi service center. ■ Set correctly.	
5A	**Collision detection 2**	A collision detection type 2 error was detected.	■ The alarm occurs even if the detection level is raised.	● Contact the Mitsubishi service center. ■ Replace the unit.	
5F	**Contactor fusing**	The contact point of the external contactor was fused.	■ Check the contactor conductivity. ■ Check that SV017 (SPEC). bit 3 is set to 1. (The setting is made only for the axis that is actually controlling the contactor.) ■ Check the relay and control cables.	● Contact the Mitsubishi service center. ■ Replace the contactor. ■ Set the parameters. ■ Repair the faulty section.	

S51	(The address of the axis to have caused a warning is displayed.)	The parameter warning is displayed.

Error No.	Message	Description	Investigation method	Remedy	Remarks
E4	**Parameter error warning**	A parameter exceeding the setting range was set. The illegal parameter is ignored, and the value used before the illegal parameter was set is held.	■ Check the parameter setting conditions.	● Contact the Mitsubishi service center. ■ Set correctly.	

S52	(The address of the axis to have caused a warning is displayed.)	The servo warning is displayed.

Error No.	Message	Description	Investigation method	Remedy	Remarks
90	**Low speed serial initial communication error**	The initial communication with the low-speed serial type absolute position linear scale was not possible.	■ Check the parameters.	● Contact the Mitsubishi service center. ■ Set correctly.	PR
91	**Detector communication error**	The absolute position serial data was not correctly sent from the OHA type detector and low-speed serial type absolute position linear scale.	■ Open the panel on the top of the amplifier and check the battery connection. ■ Check the conductivity with a tester. ■ Check the state of the axis when the NC power was turned ON.	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the cable. ■ Repair the faulty section.	-
92	**Detector serial format error**	There was an error in the format of the serial data from the OHA type detector and low-speed serial type absolute position linear scale.	■ Open the panel on the top of the amplifier and check the battery connection. ■ Check the conductivity with a tester. ■ Check the state of the axis when the NC power was turned ON.	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the cable. ■ Repair the faulty section.	-
93	**Initial absolute position fluctuation**	The position data fluctuated when creating the initial absolute position.	■ Open the panel on the top of the amplifier and check the battery connection. ■ Check the conductivity with a tester. ■ Check the state of the axis when the NC power was turned ON.	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the cable. ■ Repair the faulty section.	PR
96	**MP scale feedback error**	In the MP scale absolute position detection system, an excessive deviation was detected between the motor end installation detector and MP scale feedback amount.	■ Open the panel on the top of the amplifier and check the battery connection. ■ Check the conductivity with a tester. ■ Check the state of the axis when the NC power was turned ON.	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the cable. ■ Repair the faulty section.	-

Error No.	Message	Description	Investigation method	Remedy	Remarks
97	**MP scale offset error**	In the MP scale absolute position detection system, an error was detected in the offset data read when the NC power was turned ON.	■ Open the panel on the top of the amplifier and check the battery connection. ■ Check the conductivity with a tester. ■ Check the state of the axis when the NC power was turned ON.	● Contact the Mitsubishi service center. ■ Connect correctly. ■ Replace the cable. ■ Repair the faulty section.	PR
9E	**Detector multi-rotation counter error**	There was an error in the data of the multi-rotation counter in the detector.	■ Check the repeatability.	● Contact the Mitsubishi service center. ■ Replace the detector.	-
9F	**Battery voltage drop**	The battery voltage dropped.	■ The battery life is approx. 5 years. (This will change according to the usage state.) ■ Open the panel at the top of the amplifier and check. ■ Check the conductivity with a tester.	● Contact the Mitsubishi service center. ■ Replace the battery. ■ Connect correctly. ■ Replace the cable.	-
E0	**Over-regeneration warning**	The regeneration level reached 80% or more.	■ Check the regeneration capacity. ■ Check the parameter (SV036). ■ Occurs at [Ready] OFF. Check the power voltage with a tester.	● Contact the Mitsubishi service center. ■ Change the regenerative resistor. ■ Set correctly. ■ Review the power supply.	-
E1	**Overload warning**	The load level reached 80% or more.	■ Check the regeneration capacity. ■ Check the parameter (SV036). ■ Occurs at [Ready] OFF. Check the power voltage with a tester.	● Contact the Mitsubishi service center. ■ Change the regenerative resistor. ■ Set correctly. ■ Review the power supply.	-
E3	**Absolute position counter warning**	A deviation was detected in the absolute position data and relative position data.	■ Check whether a battery error occurred recently.	● Contact the Mitsubishi service center. ■ Replace the detector.	-
E9	**Instantaneous stop warning**	The power was cut off for 25msec or more but 50msec or less.	■ S03 SERVO ALARM/Refer to Error No. 4F.	● Contact the Mitsubishi service center. ■ Connect correctly.	-
EA	**External emergency stop input**	The external emergency stop signal was input.		■ Turn OFF the external emergency stop button.	-
EB	**Over-regeneration**	80% of the over-regeneration alarm level was reached.	Confirm that the external regenerative resistance type set in the parameter (PTYP) of the drive unit connected to the power supply unit is correct.	● Contact the Mitsubishi service center. ■ Configure the correct setting and confirm again.	-

2.6 MCP Alarms

An abnormal state was detected in the drive amplifier or other interface section.
(The message shown in bold characters is displayed.) * ●: Item carried out by User ■: Item carried out by Manufacturer

Y01	**MEMORY ALARM**	An abnormal state was detected in the memory. Check the RAM and ROM.

Error No.	Message and details	Remedies
0001	**Local RAM error**	● Contact the Mitsubishi service center. ■ Replace the HR113 card.
0002	**2-port RAM error**	● Contact the Mitsubishi service center. ■ Replace the HR122 card.
0004	**ROM error**	● Contact the Mitsubishi service center. ■ Replace the HR113 card.

Y02	**SYSTEM ALARM**	The data transfer between the MCP and the amplifier is abnormal after the NC power input.

Error No.	Message and details	Remedies
0001	**CRC error**	● Contact the Mitsubishi service center. ■ Check the mounting condition of the amplifier. Confirm the insertion of the connector. Check the amplifier power supply.
0002	**Reception timing error**	● Contact the Mitsubishi service center.
0004	**Received frame count error**	● Contact the Mitsubishi service center.
0008	**Data ID error**	● Contact the Mitsubishi service center.
0010	**Control axis count error**	● Contact the Mitsubishi service center.

Y03	**AMP UNEQUIPPED**	● Contact the Mitsubishi service center. ■ Check the mounting condition of the amplifier. ■ Confirm the cable connection. ■ Check whether the connection cable is broken. ■ Confirm the insertion of the connector. ■ Check whether the power has been input to the amplifier. ■ Check whether the axis No. switch of the amplifier is correct.
Y04	**MCP RAM PARITY**	● Contact the Mitsubishi service center.

Y05	**INIT PARAM ERR**	The parameter necessary at the NC power input time is abnormal.

Error No.	Message and details	Remedies
0001	**INPUT UNIT SETTING ABNORMAL** The internal setting is incorrect.	● Report the situation to the Mitsubishi service center.
0002	**SET VALUE OF RNG (MOVE UNIT) OR PC2 (GEAR RATIO 2) ILLEGAL**	● Report the situation to the Mitsubishi service center. ■ Check the parameter settings. Check the machine parameters "PC2" and "RNG" displayed on the servo parameter screen.

Error No.	Message and details	Remedies
0003	**RNG (MOVE UNIT) OR PC2 (GEAR RATIO 2) NOT SET YET**	● Report the situation to the Mitsubishi service center. ■ Check the parameter settings. Check the machine parameters "PC2" and "RNG" displayed on the servo parameter screen.
0004	**PIT (BALL SCREW PITCH) OR PC1 (GEAR RATIO 1) NOT SET YET**	● Report the situation to the Mitsubishi service center. ■ Check the parameter settings. Check the machine parameters "PC1" and "PIT" displayed on the servo parameter screen.

Y51	**Parameter error**	An alarm occurred when the control axis was valid due to an abnormal parameter.

Error No.	Message and details	Remedies
0001	**LINEAR ACCELERATION AND DECELERATION RAPID FEED TIME CONSTANT ABNORMAL** The time constant has not been set, or the set value of the time constant is not within the specified range.	● Contact the Mitsubishi service center. ■ Confirm the machine parameter "G0tL" displayed on the axis specification parameter screen.
0002	**LINEAR ACCELERATION AND DECELERATION MACHINING FEED TIME CONSTANT ABNORMAL** The time constant has not been set, or the set value of the time constant is not within the specified range.	● Contact the Mitsubishi service center. ■ Confirm the machine parameter "G1tL" displayed on the axis specification parameter screen.
0003	**PRIMARY DELAY RAPID FEED TIME CONSTANT ABNORMAL** The time constant has not been set, or the set value of the time constant is not within the specified range.	● Contact the Mitsubishi service center. ■ Confirm the machine parameter "G0t1" displayed on the axis specification parameter screen.
0004	**PRIMARY DELAY MACHINING FEED TIME CONSTANT ABNORMAL** The time constant has not been set, or the set value of the time constant is not within the specified range.	● Contact the Mitsubishi service center. ■ Confirm the machine parameter "G1t1" displayed on the axis specification parameter screen.

2.7 Other Servo Alarms

Error No.	Message and details	Remedies
S402	**Z-AXIS CONTACT** The Z axis is in contact with the workpiece, worktable, etc.	● Move the Z axis in the contact clearing direction.

2.8 Program Alarms

(The message shown in bold characters is displayed.)
A program alarm occurs during automatic operation and appears as a program error mainly when the machining program contains a programming mistake or when the created program does not comply with the NC specs.

Error No.	Message and details	Remedies	Remarks
P10	**EXCS AXIS NO.** The number of axis addresses commanded in the same block is larger than the specified number.	• Divide the commands in the block with the error into two groups.	
P32	**ADDRESS ERROR** An address other than specified was set.	• Check the program address and correct it. • Confirm the specs.	
P33	**FORMAT ERROR** The command format in the program is illegal.	• Check the program again.	
P34	**G-CODE ERROR** A G code other than specified was commanded.	• Check the G code address in the program and correct it.	
P35	**CMD-VALUE OVER** The command value of each address went beyond the setting range.	• Check the program again.	
P36	**PROGRAM END ERR** "EOR" was read when the tape and memory were ON.	• M02 and M30 are not set at the program end. • "M99" or "G23" is not set at the subprogram end.	
P37	**L OR N IS 0** Zero was set as the program No. and sequence No.	• Set a number within the range of 1 to 99999999 as the program No. • Set a number within the range of 1 to 99999 as the sequence No.	
P39	**G-CODE UNMATCH** A combination of G codes, whose simultaneous designation is prohibited, exists in the same block.	• Never write illegal G code whose combination is prohibited in the same block.	
P51	**OFFSET MODE** The inch command and millimeter command were set in the G41 and G42 modal.	• Correct the program so that the inch/millimeter changeover is not executed during the diameter correction.	
P60	**OVER CMP. LENG.** The commanded moving distance is too large.	• Check whether the commanded axis address is beyond the designated range.	

Error No.	Message and details	Remedies	Remarks
P70	**ARC ERROR** The set arc start point, arc end point, and arc center point are incorrect.	• Check the numerical values of the addresses for the program start point, end point, and arc center point. • Check the sign (plus or minus) of the set address value.	
P71	**ARC CENTER** The center of the arc cannot be determined for the R specification circular arc.	• Check the numeric value of each address in the program.	
P151	**G2,3 CMP ERR** A correction command (G40, G41, or G42) was input while the arc mode (G02 or G03) was ON.	• Set the linear machining command (G01) or the rapid feed command (G00) in the compensation command block or the cancel block. (To put the modal into "linear interpolation")	
P152	**L.S.P.NOTHING** The intersecting point of one block skip, in the interference block being processed during execution of the tool diameter correction (G41 or G42), cannot be decided.	• Check the program again.	
P153	**LF ERROR** An interference error occurred during the tool diameter correction (G41 or G42).	• Check the program again.	
P170	**NO CORR.NO.** The correction No. (H○○) was not designated at the input time of the offset command (G41, G42, or G43), or the number of the set correction Nos. exceeded the specified quantity.	• Add the offset number command to the offset command block. • Confirm the number of combinations of the correction Nos., and correct the command so that the number of correction Nos. does not exceed the allowable number of combinations.	
P222	**G36 ANGLE ERR** The angle space set by G36 was 0.	• Check the program again.	
P230	**NESTING OVER** The number of sequential calls of one subprogram from another exceeded 30.	• Confirm the allowable number of subprogram calls and correct the program so that the number of subprogram calls does not exceed 30.	
P231	**NO N-NUMBER** No sequence number was found at the time of access to a sub-program or return from a subprogram, or the sequence No. designated by the GOTO command has not been set.	• Set the sequence No. in a suitable block.	
P232	**NO PROGRAM NO.** The program No. of the accessed subprogram has not been set.	• Register the subprogram or correct the subprogram No. called by the main program.	
P241	**NO VARI NUMBER** The commanded variable No. is larger than the specified variable No.	• Correct the program variable No. within the specified range.	

Error No.	Message and details	Remedies	Remarks
P242	**EQL.SYM.MSSG.** The " = " was not designated at the time of variable definition.	• Set the " = " for the variable definition in the program.	
P244	**VAR.DEFF.OVER** The number of defined variables in one block exceeded 10.	• Decrease the number of variable definition commands in one block to 10 or less.	
P251	**MULT.F.ROT** Another figure rotation command was input during execution of one figure rotation command.	• Confirm the program.	
P253	**R-DIFF. OVER** The set finishing radius deviated by 6μ or more and by R/1024 mm or more from the reference radius while figure rotation was in progress.	• Correct the program so that the radius error is within the specified value.	
P272	**NC/MACRO ILL.** The NC statement and macro statement coexist in the same block.	• Check the program again, and set the NC statement in a block different from that of the macro statement.	
P273	**MACRO OVERCALL** The multiple macro calls exceeded the allowable degree.	• Check the program again and correct the program so that the number of macro calls does not exceed the specified number.	
P275	**MACRO ARG. EX.** The number of argument combinations in the macro call argument type II is too large.	• Check the program so that the No. of sets match.	
P276	**CALL CANCEL** The G67 command was input when the G66 command modal was not ON.	• Check the program again. • Set the G66 command before the G67 command input because the G67 command is a cancel command.	
P277	**MACRO ALM MESG** An alarm command was issued to H3000 by the user.	• This alarm is created by the user, so use the appropriate measures.	
P280	**EXC. [,]** The number of [ ] pairs in one block exceeded 5.	• Check the program again. Correct the program so that the number of "[" and "]" pairs does not exceed 5.	
P281	**[,] ILLEGAL** The number of "[" and "]" set in one block differs.	• Check the program again and correct the program so that the respective "[" and "]" are paired.	
P282	**CALC. IMPOSS.** The arithmetic expression is incorrect.	• Check the program again, and correct the arithmetic expression.	
P283	**DIVIDE BY ZERO** The denominator of the division is zero.	• Check the program again, and correct the arithmetic expression so that the denominator of the division does not become zero.	
P290	**IF SNT.ERROR** IF [<conditional expression>] GOTO□ statement is incorrect.	• Check the program again.	

Error No.	Message and details	Remedies	Remarks
P291	**WHILE SNT.ERR** WHILE [<conditional expression>] DO□-END□ statement is incorrect.	• Check the program again.	
P292	**SETVN SNT.ERR** The variable name setting and SETVN□ statement are incorrect.	• Check the program again. • Reduce the number of characters in the variable name used in the SETVN statement to 7 or less.	
P293	**DO-END EXCESS** The number (multiplexing degree) of □ for DO and END□ in the WHILE [<conditional expression>] DO□ to END□ statement exceeded 27.	• Check the program again and correct the program so that the number of the multiplexing degree in the DO to END statements does not exceed 27.	
P294	**DO-END MMC.** The DO-END is not expressed as a pair.	• Check the program again and correct the program so that the respective DO-END is paired.	
P295	**WHILE/GOTO TPE** The WHILE or GOTO statement was detected in the tape during the tape operation.	• Select the memory operation since a program including the WHILE or GOTO statement cannot be executed in the tape operation.	
P296	**NO ARR (MACRO)** The address indispensable to the user macro has not been set.	• Check the program again.	
P297	**ADR-A ERR** The address A is not set by a variable in the user macro.	• Check the program again.	
P298	**NO MEMORY(MAC)** G200 to G203 commands for the user macro were used in the tape operation, MFD operation, or BTR operation.	• Check the program again.	
P300	**VAR.NAME ERROR** The variable name has not been correctly designated.	• Correct the program to the correct variable name. Check the variable name of the program, and if wrong, change it to the correct name.	
P301	**VAR NAME DUPLI** Overlapping variable names were detected.	• Correct the program so that the variable names never overlap.	
P312	**G109 B,C 0** The address B and address C set by G109 in the user macro are zero.	• Check the address B and address C in the G109 block again.	
P314	**CHR. NUM. OVER** The number of characters in one block exceeded 248.	• Reduce the number of characters in one block to 248 or less.	
P315	**1ST CHR. ERR.** A numeric character or symbol was set in the first character position of the block.	• Correct the program.	

Error No.	Message and details	Remedies	Remarks
P316	**G54-59(ARC)** The workpiece coordinate system was changed at the arc modal time.	• Correct the program so that the workpiece coordinate system never changes when the arc modal is ON.	
P317	**G54-59(F.ROT)** The workpiece coordinate system was changed while the figure rotation was in progress.	• Correct the program so that the workpiece coordinate system never changes while the figure rotation is in progress.	
P318	**RETURN F.ROT** A return command (G27 to G30, G47, G48, or G60) was input during execution of the graphic rotation.	• Correct the program so that zero return command (G27 to G30, G47, G48, or G60) is not input while the graphic rotation is in progress.	
P319	**G92(F.ROT)** The G92 command was input during execution of the figure rotation.	• Do not input the G92 command while the sub-program is in progress.	
P320	**G53(F.ROT)** The G53 command was input during execution of the figure rotation.	• Do not input the G53 command while the sub-program is in progress.	
P351	**SCALE ARC** The scale factor of either the horizontal axis or vertical axis of the arc was turned on.	• Either apply the scale factor to both the horizontal and vertical axes of the arc, or apply no scale factor to either axis.	
P370	**G14 P ERR.** The P No. is beyond the specified range.	• Keep the value of P within the range of $0 \leq P \leq 10$.	
P371	**PORT# ERR.** The external port No. is beyond the specified range.	• Check the program again.	
P382	**CORNER NO MOVE** The move command has not been set in the block next to the corner R/C.	• Set the G01 command in the block next to the corner R/C command.	
P383	**CORNER SHORT** The moving distance is shorter than the value specified by the corner R/C command.	• Make the corner R/C smaller than the moving distance because the moving distance is shorter than the corner R/C.	
P384	**CORNER SHORT** The moving distance in the next block set by the corner R/C command is smaller than the corner R/C.	• Make the corner R/C smaller than the moving distance because the moving distance in the next block is shorter than the corner R/C.	
P385	**G0 IN CONR** The corner R/C was commanded when the G00 modal was ON.	• Check the program again.	
P392	**LES AGL(GEOMT)** The angle difference between one geometric straight line and another is within 1.	• Correct the geometric angle.	

Error No.	Message and details	Remedies	Remarks
P393	**INC ERR(GEOMT)** The geometric second block has been set by the increment value.	• Set the geometric second block by the absolute value.	
P394	**NO G01(GEOMT)** No straight line command has been set in the geometric second block.	• Execute the G01 command.	
P395	**NO ADRS(GEOMT)** The geometric format is incorrect.	• Check the program again.	
P396	**PL CHG.(GEOMT)** The plane change was commanded during the geometric command execution.	• Change the plane before execution of the geometric command.	
P400	**RETURN ERR** The number of blocks between M20 and next M20 exceeded 1000 during the graphic check.	• The number of blocks between M20s must be less than 1000 when using the reverse path return function.	
P430	**AXIS NOT RET.** A movement command other than zero point return is issued to an axis whose zero point return has not been executed.	• Execute zero point return by manual operation.	
P434	**COLLATION ERR** Some axes did not return to the zero point when the zero verification command (G27) was executed.	• Check the program again.	
P435	**G27/M ERROR** The M single command has been concurrently set in the G27 command block.	• Set the M single command in a block different from that of the G27 command because the M single command cannot be set in the G27 command block.	
P436	**G47/M ERROR** The M single command has been concurrently set in the G47 command block.	• Set the M single command in a block different from that of the G27 command because the M single command cannot be set in the G27 command block.	
P460	**CONNECTION ERROR** Data could not be output to the external device when the DPRINT function was being used.	• Check if the LAN cable and connectors are correctly connected.	
P461	**FILE I/O ERROR** The files of the machining program cannot be read.	• Connect the USB flash memory and try again.	
P462	**COMPUTER LINK** A communication error occurred during the BTR operation.	• Reset the operation.	
P463	**BTR I/O ERR.** The data cannot be read during the BTR operation.	• Check the cables. • Check the communication parameters of the transmission equipment.	

Error No.	Message and details	Remedies	Remarks
P500	**NO MOVE CMD.** No movement program extending over three blocks was found within 30 advanced reading blocks during the offset mode.	• Correct the program so that three or more move blocks exist within the 30 advanced reading blocks.	
P501	**PRE-READ ERR.** The advanced reading buffer for move blocks became FULL during the offset mode.	• Check the program again.	
P502	**PRE-READ ERR.** The advanced reading buffer for non-move blocks became FULL during the offset mode.	• Decrease the number of non-move blocks among the move blocks.	
P503	**INTERFERENCE** The interference check function encountered an uncertain factor, or the prevention of excessive cut became activated.	• Check the program again. • Turn ON the interference check function and execute the machining again.	
P504	**INTERFERENCE** Interference was detected in the "interference error check" mode.	• Check the program again.	
P505	**INTERFERENCE** Interference that cannot be resolved occurs.	• Check the program again.	
P506	**RQ G87 UV ERR.** The designation of G87 or RQ caused the UV to stick in the preceding or subsequent straight line block.	• Check the program again.	
P507	**READ BUFF OVER** The read buffer for the MFD, TAPE, or BTR operation program was exceeded.	• Reset.	
P550	**MFD USING** The MFD is busy with execution of some other functions.	• Wait until the MFD operation by another function is completed.	
P551	**MFD error** The USB flash memory is not connected (or there is an error).	• Confirm that the USB memory is connected. • Confirm that the USB memory is correct. • The USB memory may be faulty.	
P990	**PREPRO ABNORML** The software operation is abnormal.	• Contact the Mitsubishi service center.	
P1070	**E-PACK ERR** The E-pack has not been stored, or an E No. not designated in the specification was commanded.	• Store the E-Pack. • Use the E No. designated in the specification.	
P1072	**POS. ERR** The commanded valid axis is not set by the G29 or G30 command.	• Confirm the specs.	

Error No.	Message and details	Remedies	Remarks
P1074	**APP COMPEN** The approach compensation length exceeds the movement amount of one block.	• Change the approach compensation length.	
P1080	**RQ G87 ERR1** The pattern of straight line-arc-straight line block has not been set in the G87 and RQ.	• When setting G87 and RQ, specify the pattern of straight line-arc-straight line block.	
P1081	**IJ ERROR** IJ has been designated in the preceding straight line block by G87 and RQ, or IJ has been designated in the UV setting block.	• Do not specify IJ in the G87 and RQ straight line blocks. • Do not specify IJ in the UV setting block.	
P1082	**RQ G87 ERR2** The tool offset in the arc set for the G80 mode by G87 RQ command is different from the tool offset in the subsequent straight line block.	• Set the same tool offset in both the arc and the subsequent straight line block.	
P1083	**UV CIR. ERR.** The mode of the UV setting block is not the straight line mode.	• Set the straight line mode in the UV setting block.	
P1084	**G88 CIR.ERR.** The tool offset and taper offset of the arc in the G88 mode are different from those of another (helical insertion).	• Set the tool offset and taper offset in the arc to the same values as of those in another.	
P1086	**OFSET M0SEARC** The M0 search function was used in the offset mode.	• Use the M0 search function in the offset cancel state.	
P1091	**CP,BL POP ERR** The number of G22 (sub-program call) commands differs from that of G23 (sub-return) commands.	• Make the number of G22 commands equal to that of G23 commands.	
P1094	**Z-OPT. ERR.** The Z axis option has not been installed.	• Do not command the Z axis move through the NC program.	
P1095	**IH-OPT ERR.** The initial hole option has not been installed.	• Do not use any command concerned with the initial hole option device.	
P1096	**M70 UV EXIST** The UV command was input in the initial hole mode.	• Keep the UV command invalid in the initial hole mode.	
P1097	**M82 IN IH-MOD** The "wire feed ON" command was input in the initial hole mode.	• Keep the "wire feed ON" command (M82) invalid in the initial hole mode.	
P1098	**NON H/W OPT** The M code was commanded to a function not supported by the H/W option.	• Check the specs of the H/W option.	

Error No.	Message and details	Remedies	Remarks
P1099	**CM SELECT ERR.** The P command range for the M110 or M111 command is incorrect.	• Review the P command in the program.	
P2020	**N NO. NOT FOUND** There is no designated sequence No.	• Set the correct data again.	
P2051	**No E Header notch label** The alarm occurs and the machine stops if there is no label line or the label lines are less than the number of data by checking if there is the notch label or not when operating NC program.	• Add the label line.	
P2052	**E Header notch label error** The alarm occurs and the machine stops if there is a label that cannot be identified by checking if there is a notch label or not when operating NC program.	• Review the label line.	
P2053	**E Header notch data error** The alarm occurs and the machine stops if there is no corresponding data by checking if there is the notch label or not when operating NC program.	• Review the label line.	

2.9 System Alarms

Error No.	Message and details	Remedies	Remarks
Z01	**WATCH DOG 1** This error occurs in case a process to be finished by the NC system (software) does not end within the set time.	• Report the situation to the Mitsubishi service center.	
Z02	**SYSTEM ERROR** The NC system (software) was destroyed.	• Report the situation to the Mitsubishi service center.	
Z03	**MEMORY PARITY** This error occurs in case some instruction or data was found destroyed during the operation by the NC system (software).	• Replace the card containing the destroyed instructions or data with a new card.	
Z04	**MEMORY PROTECT** Writing of data into a writting-protected memory was attempted.	• Report the situation to the Mitsubishi service center.	
Z05	**DIVIDE BY ZERO** Illegal data requiring a division by zero exists in the parameter machining data or others.	• Check the parameter machining data.	
Z06	**CAN'T LOAD MFD** The floppy storing the system S/W cannot be read due to destruction or the IOP floppy disk unit is out of order.	• Replace the floppy or floppy disk unit (including the card).	
Z07	**CRC ERROR** The data on the system S/W was destroyed.	• Load the backup copy of the floppy again. • Contact the Mitsubishi service center.	
Z08	**FILE AREA ERR** The system is abnormal.	• Report the situation to the Mitsubishi service center.	
Z09	**REMOTE I/O ERR** This error occurs if any of the following troubles is detected in the system that uses a remote I/O unit.	• The cable is dislocated. • Data sending error • Data input error • Remote I/O trouble • Power failure of the remote I/O unit • Replace the cable. • Replace the remote I/O unit. • Power ON the remote I/O unit.	
Z10	**BACKUP BATTERY ABNORMAL** The battery for saving data in the NC is spent, and the data cannot be backed up.	• Report the situation to the Mitsubishi service center. The battery may need to be replaced.	

Error No.	Message and details	Remedies	Remarks
Z11	**CPU TEMPERATURE ABNORMAL** When the control unit's CPU temperature has risen, and the operation reliability has dropped.	• 0001 When a CPU temperature error was detected • 0008 When a control unit fan error was detected • The control unit may be malfunctioning or faulty. Turn the power OFF. • Report the situation to the Mitsubishi service center.	
Z10	**TCC ERROR****** A fault occurs in the control baseplate.	• Report the situation to the Mitsubishi service center. • In this case, contact us according to the **** displayed in the screen.	

2.10 System Warnings

Error No.	Message and details	Remedies	Remarks
Z50	**UNEXPECTED-INT** An illegal interrupt occurred due to an external factor such as noise.	• Report the situation to the Mitsubishi service center.	
Z51	**FROM ERROR** The FROM operation is abnormal.	• Report the situation to the Mitsubishi service center.	
Z52	**BACKUP BATTERY LOW** A drop in the voltage of the battery used to save the NC internal data was detected.	• Report the situation to the Mitsubishi service center. The battery may need to be replaced. If this occurs during machining, replace the battery after completing that machining.	
Z53	**UPS AC FAIL**		During a power failure, it can be determined whether the power was turned OFF due to the power failure or due to the power OFF switch being turned OFF.
Z54	**UPS BATTERY LOW** The battery mounted in the UPS used for holding the NC power during a power failure is spent.	• Charge the battery. (Leave the NC power ON for a short while.) If this does not solve the problem, report the situation to the Mitsubishi service center. The battery may need to be replaced. • If this occurs during machining, replace the battery after completing that machining.	
Z57	**TCC WARNING****** The control baseplate is in the alarm status.	• Report the situation to the Mitsubishi service center. In this case, contact us according to the **** displayed in the screen.	

2.11 Message

Message and details	Remedies	Remarks
LUBRICATION LO The XY axis guide lubricant level is low.	• See the section on Lubrication in the Maintenance and Inspection Section, and supply lubricant. This message will disappear when enough lubricant is supplied.	
OIL PUMP ERR An error was detected in the XY axis guide lubricating unit.	• Stop using the machine immediately as the drive system may be affected. Contact the service center to report the situation.	
LR ERR The dielectric fluid specific resistance value has dropped.	• Check the filter and ion exchange resin. Circulate the fluid so that the specific resistance value increases. This message will disappear when the level reaches an optimum value. • If the work is stopped during machining, you can press the restart button to continue, but the unqualified products may be produced. It is the customer to decide whether to continue to machine.	
SKIPPED A shape skipped by the machining skip function was found.	• Data for the uncut section is listed in "Skip/Bypass Retry" displayed by selecting the main menu "Operation" > the sub menu "Monitor" > "AT setting". This message will disappear when remachining is completed, or when the data is deleted.	
MAINTAIN THE AT DEVICE There are any parts that require maintenance in the AT.	• Select the main menu "History management" > the sub menu "Inspection", and check the "AT Mainte" tab to carry out maintenance. This message will disappear when the [Clear] button is pressed after maintenance.	
ENABLE SW OFF The ENABLE SW on the manual operation box was not pressed during manual mode.	• When the EDM has special specs with an ENABLE SW on the manual operation box, this will appear if the ENABLE SW is not pressed during manual mode. This message will disappear if the ENABLE SW is pressed during axis movement.	
PLEASE REF. RETURN Zero point return is required immediately after the system is loaded or after a servo-related alarm has occurred.	• Execute zero point return immediately. Before starting, remove any items which could obstruct the axis movement in the zero point return direction. Do not move near the stroke end with jog. This message will disappear when zero point return has been completed.	
Turn power off and on **(For absolute position reset)** The motor position detector must be reset.	• Turn the power OFF and ON immediately.	
CAUTION REMOTE CONTROL The [Remote Control] switch is ON, and the EDM can be operated with remote operations from an external source.	• Remote operations from an external source are valid with the DNC when the [Remote Control] switch is ON. Do not approach the machine while this switch is ON, as it can be hazardous. Before working with the machine, always turn the [Remote Control] switch OFF. This message will disappear when the switch is OFF.	
PT SWITCH OFF The PT switch is OFF.	• This message will disappear when the PT switch is turned ON. Make sure not to start machining with the PT switch turned OFF.	

Message and details	Remedies	Remarks
MT Adjusting The main tension aging function is running.	• This message appears when the main tension aging function is running by pressing the [AUTO ADJUST] switch displayed on the main menu "Maint" > "Tool" > "For adjust" screen. This message will disappear at the end of the operation. The main tension roller will rotate at a high speed while the function is running, so always close the wire cover before pressing the switch.	
BM unavailable The BM control is disabled because the adaptive control switch is ON.	• This message appears if the [BM Control] switch is turned ON while the adaptive control (PM, CM, EM, OM) switch is ON and disappears when the [BM] switch is turned OFF. To use the BM control function, turn the adaptive control system switch to OFF.	
DRYRUN The [Dry Run] switch is ON.	• This message will disappear when the [Dry Run] switch is turned OFF. • Make sure not to start machining with the [Dry Run] switch turned OFF.	
SET VG PARAMETER The power control parameter is not set.	• Input "VGSET.ini" in the "param" folder of the USB flash memory.	
SET ZG PARAMETER The machine control parameters are not set.	• Input "ZC.ini" in the "param" folder of the USB flash memory.	
E COMMAND IGNORE MODE The E-OFF switch is tuned ON.	• The E-Pack command is ignored when the E-OFF switch is on.	
CAN'T MOVE AXES The feed pump stops because the tank circulation switch is turned OFF, or for similar reasons.	• Turn ON the tank circulation switch to operate the feed pump and carry out the axis movement.	
Cannot access to Exclusive USB. (1) When the [USB READ] button was pressed on the system update screen without connecting the USB flash memory supplied with the machine (2) When the I/O operation was attempted on the "FILE I/O" screen of the maintenance menu without connecting the USB flash memory supplied with the machine (3) When attempting to recognize the USB flash memory supplied with the machine was made, but the USB driver update file cannot be found	(1) Press the [USB READ] button after connecting the USB flash memory supplied with the machine. (2) Perform I/O operation after connecting the USB flash memory supplied with the machine. (3) Contact the Mitsubishi service center to obtain the USB driver update file. After obtaining it, update the USB driver according to "" The USB flash memory is lost or faulty."" in ""8. TROUBLESHOOTING"".	
FAILED TO UPDATE USB DRIVER The EDM system tried to recognize the new USB flash memory supplied with the machine and found the USB driver update file but failed to update the driver.	• Contact the Mitsubishi service center to obtain the USB driver update file. After obtaining it, update the USB driver according to "" The USB flash memory is lost or faulty."" in ""8. TROUBLESHOOTING"".	
Ion exchange resin is OFF for replacement. The "Ion EXC. resin off" switch in the environment setting screen is set to ON.	• A prompt message is displayed when the "Ion EXC. resin off" switch is set to ON. • After the ion exchange resin has been replaced, always set the "Ion EXC. resin off" switch back to OFF.	

Message and details	Remedies	Remarks
LR ERR The dielectric fluid specific resistance value has dropped.	• Check the filter and ion exchange resin. Circulate the fluid so that the specific resistance value increases. This message will disappear when the level reaches an optimum value. • If the machine stops during machining, it may result in poor machining although the machine can be restarted to proceed with machining. Therefore, the customer needs to decide whether to proceed independently.	
Please confirm the MAINT MONITOR. When the inspection date of an item, set to notify you when maintenance is due, has arrived.	• Check the operation inspection monitor and perform the required maintenance.	
ME-PACK No. is incorrect. The ME-pack No. beyond the valid range is specified.	• Use numbers 8000 to 8199.	
ME-PACK area is full. The ME-pack No. to be registered has been used.	• Re-register it after deleting the unnecessary ME-pack.	
RM SWITCH OFF	• High-speed rough machining control cannot be carried out. Turn on the "RM Rough" switch in the Environment Setting1 screen, unless otherwise specified by the manufacturer.	
The ZUV axes cannot move while cutting the wire. Cutting is in process.	• Wait until the cutting process is completed and try again.	
Output file name is incorrect. "FILE NAME" (output file name) is incorrect when outputting FILE I/O.	• The following unusable letters are included. Designate "FILE NAME" (output file name) again. < Unusable letters > \/:*?"<>|,.;	
LN SKIP MODE ON The LN skip mode is operating.	• This message is displayed when the program is searched with the LN skip. It will not be canceled until L No. or file search is performed.	
DURING SCHEDULE OPERATION MODE The schedule operation mode is set by turning ON the "Set schedule oper. mode" switch.	• The schedule operation mode can be canceled by resetting.	
It has been registered in a schedule list. The program entered in the schedule entry is attempted to be edited.	• Delete the schedule from the schedule entry. • Turn on the "Schedule NC pro edit" switch on the Switch screen and then edit the program.	
Replace the filter element of group A. The pressure of filter group A exceeds the exchange pressure.	• Replace the filter group A.	
Replace the filter element of group B. The pressure of filter group B exceeds the exchange pressure.	• Replace the filter group B.	
Replace the filter element of group A and B. The pressure of filter group A and B exceeds the exchange pressure.	• Replace the filter group A and B.	
Replace the filter.	• Replace the dielectric fluid filter.	

Message and details	Remedies	Remarks
Can't Teaching. Not Manual Mode Teaching from the manual operation box was attempted in a non-manual mode.	• Switch to the manual mode before teaching.	
Can't Teaching. Multiple Work SW off Teaching from the manual operation box was attempted when the multiple workpieces switch was not ON.	• Set the multiple workpieces switch to ON before teaching.	
Can't Set Zero. Positioning Zero setting from the manual operation box was attempted when positioning was implemented.	• Cancel the positioning mode before zero setting.	
Can't Change Work Coord. Positioning The workpiece coordinate needs to be changed from the manual operation box when positioning is implemented.	• Cancel the positioning mode before performing operation again.	
AUTO PROCESS CONTROL When the E command is received, the system switches to the adaptive control setting of each E-Pack automatically.	• The "adaptive control automatic setting mode" can be canceled when the "Process Control Auto Set" switch is set to OFF.	
RESUME MODE Automatic operation is resumed from the machining restart position after the machining restart program is selected. If automatic operation is resumed from the machining restart position, the mode will be canceled.	• Alternatively, the machining continuing mode can be canceled by resetting.	
Press the axis key -X. The "Taper-Z" button on the manual operation box was pressed.	• Press the axis key -X button. Start determining the taper specs.	
Pressure sensor Abnormal • The pressure sensor of the filter pressure cannot be input normally.	• Contact the Mitsubishi service center. Check the cable breakage. Check the pressure sensor.	
Over replacement Pressure • The current pressure is already above the initial exchange pressure when the exchange pressure is set to a value higher than the initial value (0.25 MPa).	• Prepare for replacing the dielectric fluid filter.	
FAN FOR COOLING THE UFS CIRCUIT STOPPED A fault occurs in the cooling fan.	• Contact the Mitsubishi service center.	
AXIS COOLING CIRCUIT FAILURE A fault occurs in the cooling circuit in the shaft linear.	• Contact the Mitsubishi service center.	

3. MAINTENANCE AND INSPECTION ITEMS

Class	Section	Reference No.	Item
Daily and preparatory inspections	4. MAINTENANCE AND INSPECTION METHOD	4.1.1	Wire path
		4.1.2	Insulation board
		4.1.3	Nozzles
		4.1.4	Dielectric fluid
		4.1.5	Resistivity
		4.1.6	Working tank
		4.1.7	Machining position
		4.1.8	Wire collection section
		4.1.9	Oiling
		4.1.10	Filter regulator, oil filter
		4.1.11	Air filter
	6. MAINTENANCE AND INSPECTION OF DIELECTRIC FLUID RESERVOIR	6.1.1	Dielectric fluid amount
		6.1.2	Dielectric fluid filter
		6.1.3	Supply pump
	5. MAINTENANCE AND INSPECTION METHOD OF AUTOMATIC WIRE FEEDER	5.2.3 (1)	Wire chip collection box
		5.2.3 (2)	Wire guide
		5.2.5 (2)	Jet nozzle
		5.2.5 (5) 5.2.6 (4)	Wire guide block (front)
Weekly inspection	5. MAINTENANCE AND INSPECTION METHOD OF AUTOMATIC WIRE FEEDER	5.2.1 (1)	Wire retainer felt
		5.2.4 (1)	Upper power feeder
		5.2.4 (2)	Lower power feeder
		5.2.5 (3)	Upper diamond die
		5.2.6 (1)	Lower diamond die
		5.2.5 (5) 5.2.6 (4)	Wire guide blocks (inside, related parts)
		5.2.7 (3)	Lower roller block
		5.2.8	AT cleaning mode

Class	Section	Reference No.	Item
Monthly inspection	4. MAINTENANCE AND INSPECTION METHOD	4.2.1	Wire-alignment device (option)
		4.2.2	Inspection of lower nozzle clearance
		4.2.3	Fluid level sensor
		4.2.4	Working tank seal
		4.2.5	Oiling of Z and UV axes
	6. MAINTENANCE AND INSPECTION OF DIELECTRIC FLUID RESERVOIR	6.1.4	Resistivity sensor
	5. MAINTENANCE AND INSPECTION METHOD OF AUTOMATIC WIRE FEEDER	5.2.1 (3)	Toughening roller
		5.2.2 (4)	Cutting energizer and cutting pressed wire of energizer
		5.2.2 (5)	Wire pressing roller
		5.2.5 (1)	Guide U, D (upper guide U, D)
		5.2.5 (4) 5.2.6 (2)	Guide C
		5.2.6 (3)	Guide U, D (lower guide U, D)
		5.2.1 (4)	Auxiliary die A*
		5.2.2 (1)	Auxiliary die B
		5.2.2 (2)	Warping detection plate
		5.2.2 (3)	Guide pipe
		5.2.2 (6)	Retriever
		5.2.9 (1)	Wire collection roller
6-month inspection	4. MAINTENANCE AND INSPECTION METHOD	4.3.1	Float switch in the work tank
		4.1.11	Air filter
	6. MAINTENANCE AND INSPECTION OF DIELECTRIC FLUID RESERVOIR	6.1.7	Float switch
	7. MAINTENANCE AND INSPECTION OF THE DIELECTRIC TEMPERATURE	7.1	Air filter
	5. MAINTENANCE AND INSPECTION METHOD OF AUTOMATIC WIRE FEEDER	5.2.1 (2)	Main tension roller
		5.2.7 (1)	Lower roller
		5.2.7 (2)	Nest
Others	6. MAINTENANCE AND INSPECTION OF DIELECTRIC FLUID RESERVOIR	6.1.5	Water purifier (ion exchange resin)
		6.1.6	Dirty fluid tank (dielectric fluid reservoir)

4. MAINTENANCE AND INSPECTION METHOD

4.1 Daily Inspection and Pre-Operation Inspection

4.1.1 Checking wire route

Mount a new bobbin or a suitable bobbin with sufficient electrode wire, and after threading the wire through the wire route, run the wire. Check whether the traveling condition of the wire is normal while changing the set position of the wire tension notch in the manual mode.
In addition, check whether the wire is smoothly collected into the wire collection box, and whether any abnormality of the traveling wire is detected.

4.1.2 Inspection of insulation board

(1) Inspection of lower ceramic plate

Check whether the lower ceramic plate are cracked, and wipe off dirt.

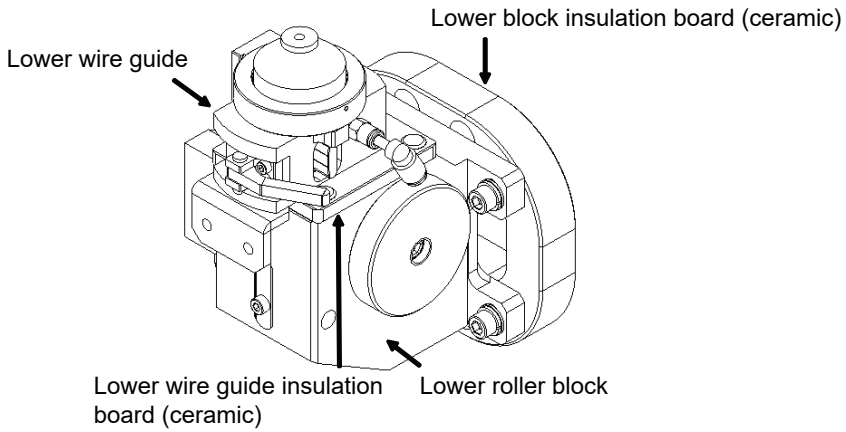


Fig. V.4.1

Chips easily accumulate in the lower guide block and the lower roller block. If chips accumulate on the ceramic insulation boards set there, electric currents may leak and the machining performance may deteriorate. Remove chips from the insulation board surface once every 3 or 4 days using a brush.
Also clean the rear side of the wire guide lower section and the lower block.

4.1.3 Inspection of nozzles

Check whether the upper nozzle and lower nozzle are cracked.
Especially check that the end of the nozzle is not cracked or deformed.

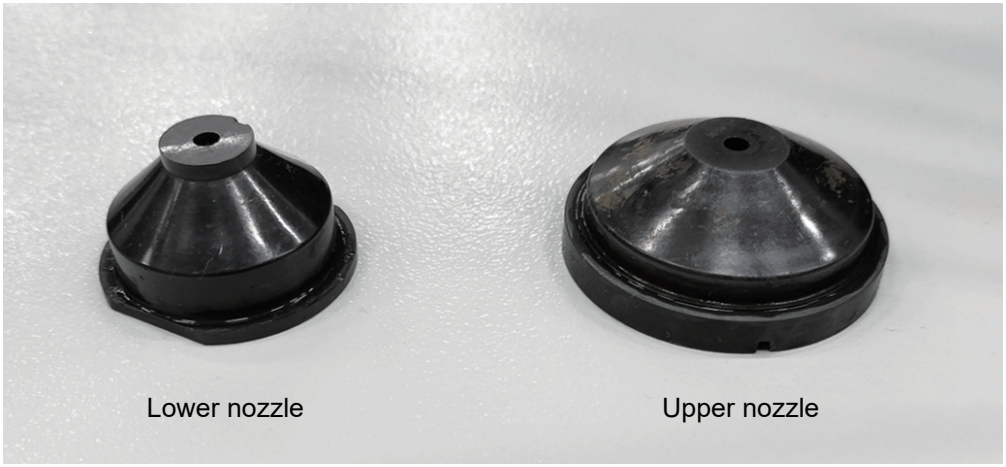


Fig. V.4.2

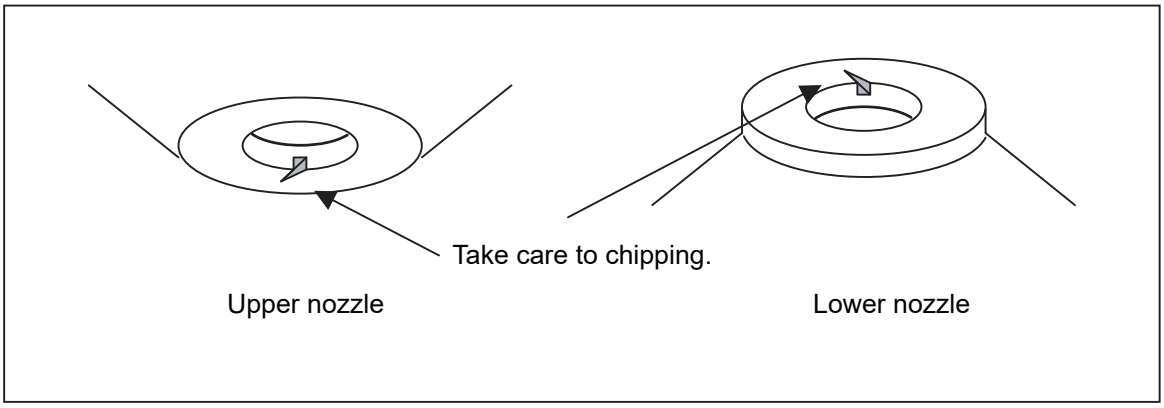


Fig. V.4.3

⚠CAUTION

Risk of serious personal injury from damages, which may cause low machining speed, poor machining precision, and wire breaks when the dielectric fluid feed is unstable.

4.1.4 Checking dielectric fluid

Dielectric fluid is discharged from the upper and lower nozzles. The flow rate can be adjusted with the dielectric fluid ON/OFF or machining condition LQ notch changeover.

*** Fill the dielectric fluid up to the upper nozzle or lower the LQ notch setting to prevent the fluid from splattering during the check.**

(1) Dielectric fluid ON/OFF

Press the dielectric fluid ON/OFF changeover button, and confirm that the dielectric fluid is discharged from the upper and lower nozzles.

(2) LQ notch changeover

The flow rate will increase as flow rate notch (LQ) setting is increased.

A guide to the dielectric fluid flow is shown in the following table.

Table V.4.1 Guide to flow rate corresponding to notch setting when upper and lower nozzles are opened

Flow rate notch (LQ)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Flow rate guide (ℓ/min)	0.0	0.5 ±0.3	1 ±0.5	1.5 ±0.5	2.0 ±0.5	2.5 ±0.5	3.2 ±1	4.0 ±1	5.0 ±1	6.0 ±1	7.5 ±1	9.5 ±1	10 or more	10 or more	10 or more	10 or more

The above flow rates apply when the working tank is filled with dielectric fluid, the FB notch is set to NM, no obstacles are placed before the dielectric fluid outlet of the upper and lower nozzles, and the upper/lower nozzles are separated.

If the flow rate differs greatly from the above table, remove the control panel cover on the tank, and check the ALARM lamp on the inverter. If the ALARM lamp is lit, the inverter could be faulty. If the inverter is not faulty, the flow sensor may be faulty or clogged.

In this case, replace the part. Contact the Mitsubishi Electric Service Department for replacement parts.

4.1.5 Checking resistivity of the dielectric fluid

(1) Indication of resistivity error

Check that displayed conductivity matches the set value:

- Green: OK
- Yellow: Low, add running water.
- Red: High, “LR ERR” shown, ion-exchange pump feeds dielectric through the resin.

If resistivity does not rise after several dozen minutes of flow, replace the ion-exchange resin.

(2) Start interlock

If machining is started while the above "LR ERR" message is displayed, the "U702: LR OUT OF CNTL" alarm will occur, and starting will be inhibited. Replace the ion exchange resin in the water purifier. (For the ion exchange resin replacement method, see "6.1.5 Replacement of water purifier (ion exchange resin)" in "6.1 Maintenance and Inspection Items of Dielectric Fluid Reservoir".)

*** Water purifier (ion exchange resin)**

- removes ion from water to purify it
- purifies up to several hundred liters of ordinary city water
- saturates faster with materials like tungsten carbide.
- When saturated, conductivity cannot reach the set value and display turns red. In this case, replace the water purifier.

4.1.6 Cleaning of working tank

Cleaning is required when there is sludge or scrap in the working tank. Using the gun nozzle for the water is handy. Confirm the operation of the automatic fluid level setting float switch with the following steps.

(1) Press with the working tank door closed, and check that the dielectric fluid rises to the upper wire guide and stops.

(2) Set the height of Z axis to 100 mm with the working tank door closed and press again. The operation is normal when the fluid level rises.

If the operation is abnormal, clean the fluid level sensor on the back of the automatic wire feeder, and then confirm the operation again. ("4.1.4 Checking dielectric fluid" in this chapter.)

4.1.7 Checking machining position

Remove the cut wire scraps, and check whether abnormalities on the table surface, scratches of the feeders, cracking trouble of the nozzles, etc. are detected or not. Also check the dies, and remove foreign matters from the lower arm section (in order to prevent biting trouble).

*** Mount the workpiece as shown in the figure. When moving the table, do not bump the upper part of the upper wire guide against the clamp metal.**

*** Never touch the wire and the upper wire guide section during the machining. Remember to wear insulating shoes or other suitable protection during machining work.**

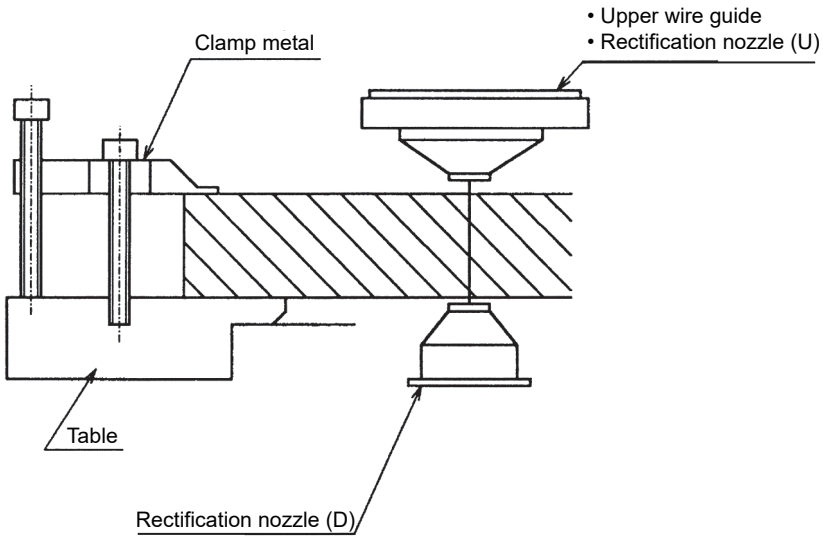


Fig. V.4.4

NOTICE

The clearance between the workpiece and upper nozzle and lower nozzle is extremely small. If the workpiece parallelism is poor or the flatness of the upper and lower surfaces of the workpiece is poor due to protrusions, etc., consider a different workpiece setting method, such as distancing the nozzle. By this, prevent the nozzle and workpiece from interfering.

4.1.8 Inspection of wire collection section

(1) Check whether there are used wires hanging in the collection unit.

(2) Is the wire curl appropriate?

(3) Does the wire slip at the max. wire tension notch setting being used?

(4) Are the roller surfaces dirty?

(5) If there is a 0.05 mm or more dent on the roller surface, reverse or replace the roller.
When reversing, install the gears on the opposite surface of the rollers.
(Use a fingernail to confirm that there are no snags, or check visually.)

(6) Check the lower collection flow rate.

Before starting work, confirm that the wire collection roller operation and lower collection flow rate are correct.

1) Check method of lower collection flow rate

Check whether the collecting box is off the ground.

(a) Press the [WIRE COLLECT] on the manual operation box.

(b) The lower collection fluid will flow.

(c) Check that the lower collection flow rate is appropriate. (Fig. V.4.5.)

(d) Press

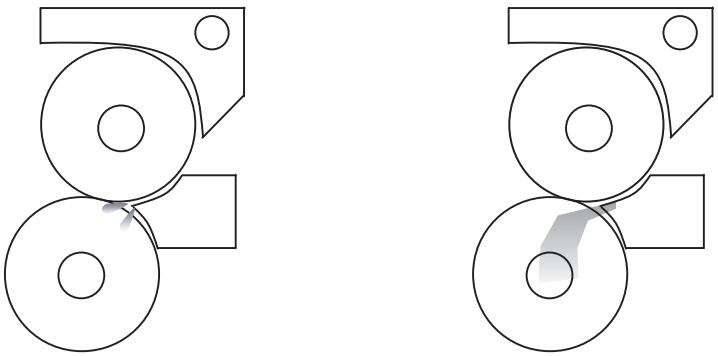
on the operation panel.

The lower collection fluid will stop.

2) Measures for abnormalities

(a) When the lower collection flow rate is found to be low as shown in Fig. V.4.5, the following measure is required.

(b) Check that the lower roller section aspirator is not clogged with foreign matter.



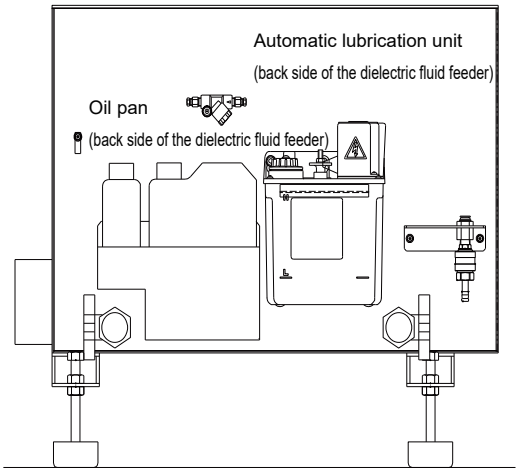
Abnormal (low flow rate) Normal

Fig. V.4.5 Checking the lower collection flow rate

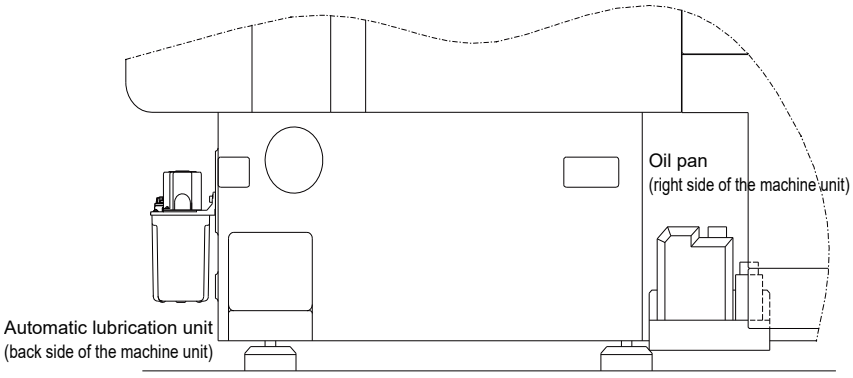
4.1.9 Oiling

Automatic lubrication (standard):

- automatically lubricates each guide of the XY axes at 2-hour intervals.
- waste oil drains to the oil tray (MG12: behind dielectric fluid feeder; MG24: left machine side), ensure the tray is correctly positioned and do not let overflow.
- Check oil level (float /visual) and refill before "LUBRICATION LO" alarm occurs.
- Use the slide face lubricant G68 (industrial lubricant ISO viscosity grade ISO VG 68).



MG12 automatic lubrication unit and oil pan (back side of the machine unit)



MG24 automatic lubrication unit and oil pan (back side of the machine unit)

Fig. V.4.6 Automatic lubrication unit and oil pan

4.1.10 Inspection of the filter regulator and oil filter

Filter regulator and oil filer are on the back:

- The filter regulator removes dust, moisture, etc.
- Oil filter removes oil; clogging impairs operation.
- Periodically turn the drain knob to discharge oil.

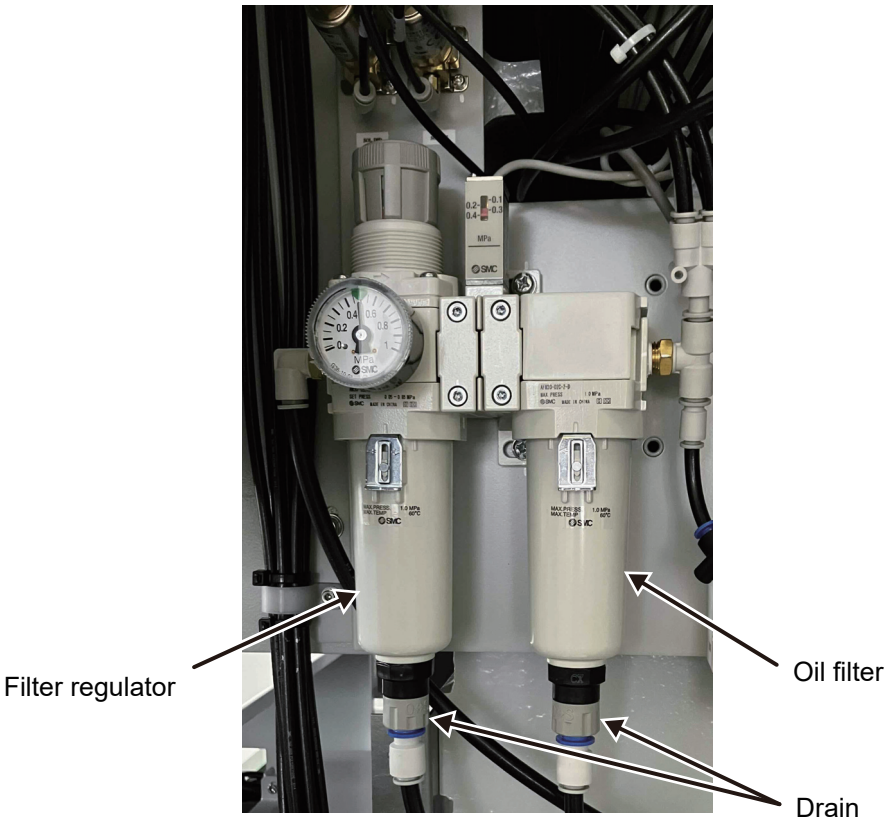


Fig. V.4.7 Filter regulator

Drain the filter regulator, and at the same time drain the air source of the compressor, etc.

4.1.11 Cleaning of the air filter

⚠CAUTION

For safety purpose, always turn the main power OFF before maintenance or inspection.

Unit	Item	Descriptions	Inspection cycle
Power supply section	Air filter	Remove adhered dust with air. When it is extremely dirty, please replace in time.	Weekly

(1) If the filter in the power supply section or dielectric fluid reservoir control box is clogged, the unit could fail and alarm could occur.
Check and clean the air filter once a week.

4.2 Monthly Inspection

4.2.1 Inspection of wire-alignment device (option)

(1) Check whether the surface that contacts the wire is scratched. Avoid a scratch section when using.

(2) If the surface that contacts the wire is scratched and can no longer be used, regrind the surface.
The perpendicularity must be 0.005/50 mm or less
Alignment is possible by using the workpiece if the wire-alignment device cannot be used. See "III. NC OPERATION DISPLAY SCREEN".
*** Note that the wire can be regrind at your nearest Mitsubishi Electric Service Center. Please contact us.**

4.2.2 Inspection of lower nozzle clearance

- Mount the magnet support with dial gauge on the AT front plate and zero the gauge
- Move UV axes, measure bottom nozzle height and ensure the nozzle top is below the table.
- If clearance between table's upper surface and lower nozzle is 0.2 mm or above, contact the Mitsubishi Electric Service Department or Mitsubishi Electric Mechatronics Engineering Corporation.

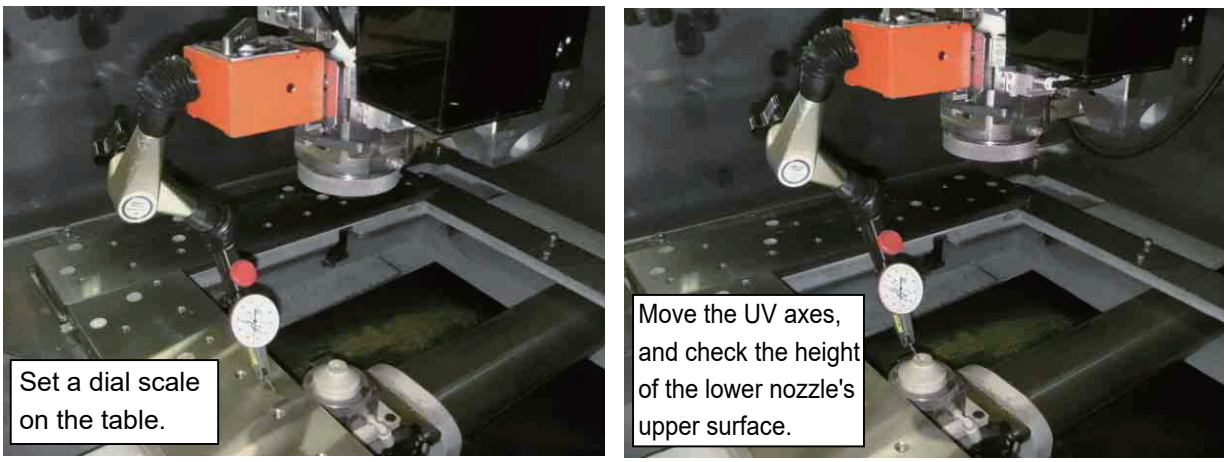


Fig. V.4.8

4.2.3 Cleaning of fluid level sensor

(1) Remove the AT bottom cover at the rear of the upper wire guide.

(2) Clean the sensor near the upper nozzle using a brush or waste cloth, etc. (Fig. V.4.9.)

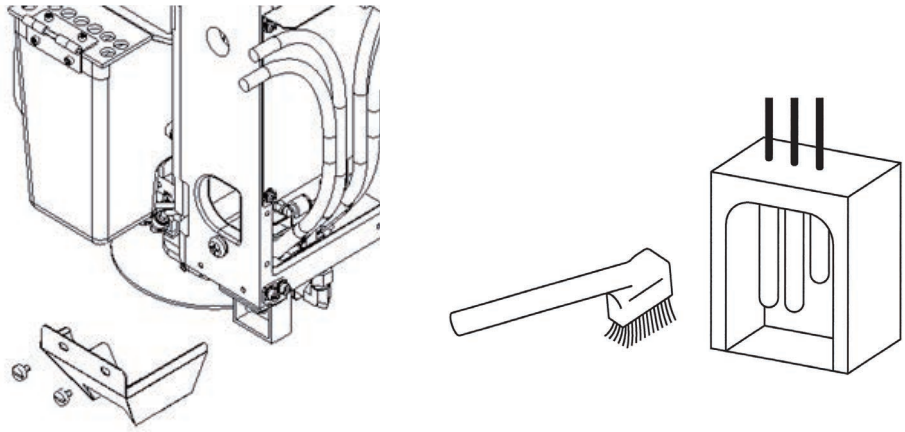


Fig. V.4.9 Fluid level sensor

Clean the sensor to remove any dirt from the surface of the three electrodes.
If use is continued with a dirty sensor, it may not be possible to control the fluid level correctly, and the machining may be disabled with a "taper submerged alarm", etc.

4.2.4 Cleaning of working tank seal

(1) Discharge the dielectric fluid from the working tank.

(2) Move the X axis to the right end.

(3) Wipe off any sludge adhered on the seal plate shown in the shaded section in the figure below with a waste cloth, etc.

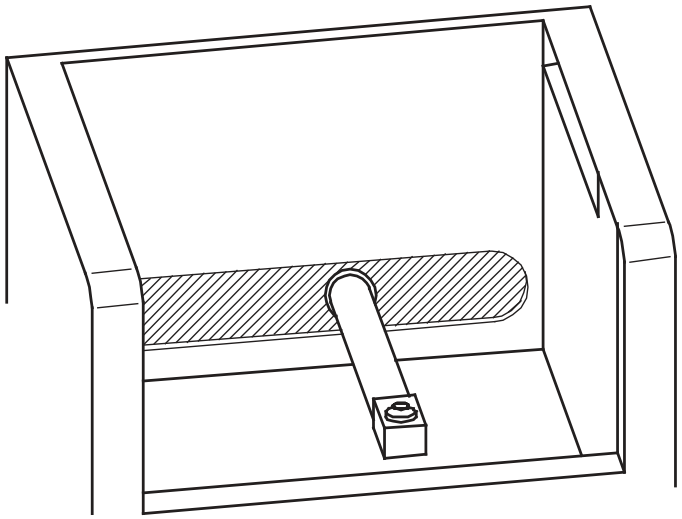


Fig. V.4.10

(4) Move the X axis to the left end.

(5) In the same manner as step (3), wipe off any sludge adhered on the seal plate.

(6) Wash the seal plate with water using gun nozzle.

1) Adjust the fluid rate with a lever.

2) Move the X axis and completely wash the exposed seal plate with water.

⚠CAUTION

- **To avoid danger, never move the axes when using the gun nozzle to clean.**
- **If dielectric fluid setup is turned OFF immediately after machining the copper material, the dielectric fluid pipe may be rusted inside, thus leading to clogging. Do not turn OFF the dielectric fluid setup until the fluid in the working tank circulates and penetrates thoroughly.**

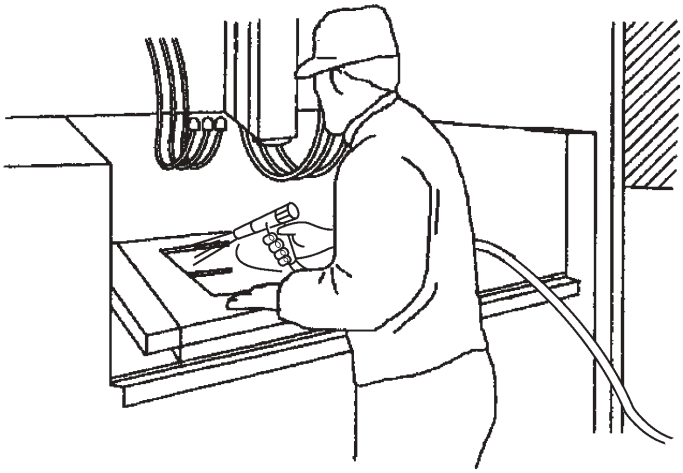


Fig. V.4.11

4.2.5 Oiling of Z and UV axes

Replenish the Z and UV axes once every month.
Oil with the following procedure.

(1) Z axis

1) Ball screw, guide

(a) Move the Z axis to the position where the Z-axis base grease fitting is visible.

(b) Inject grease with the grease gun. (Five positions)
*** For the grease types, see Table V.4.2.**

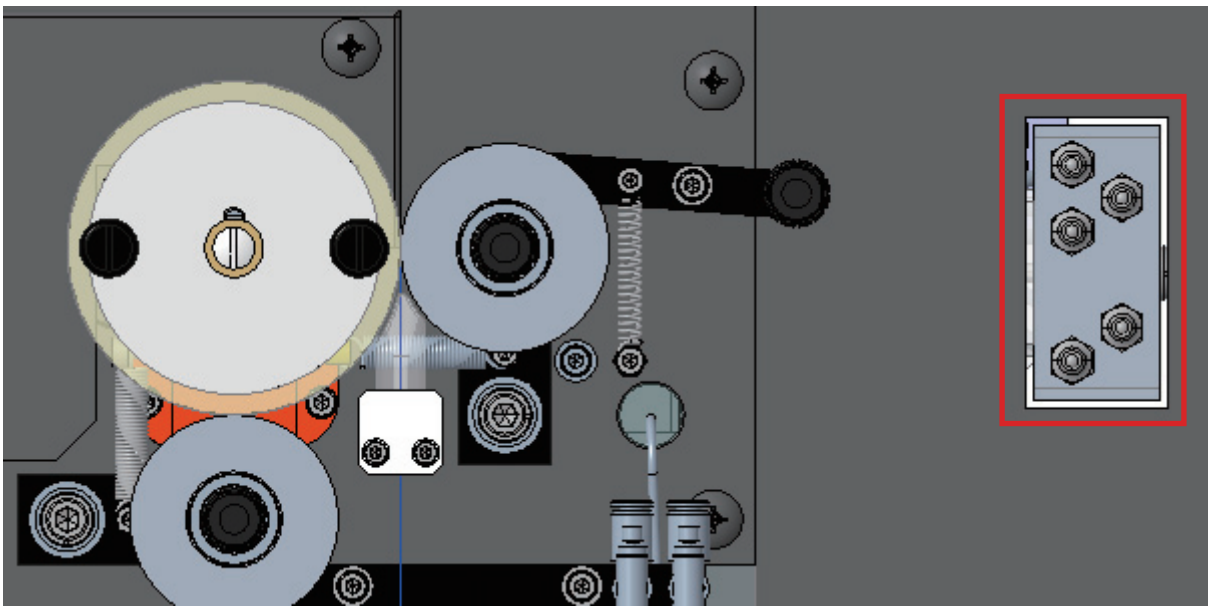


Fig. V.4.12

Table V.4.2

Recommended grease	Albania Grease No. 2 (Shell Oil) or equivalent product
No. of pumping times	Once/grease fitting

(2) Ball screw and guide of UV axes

1) Raise the Z axis for workability.

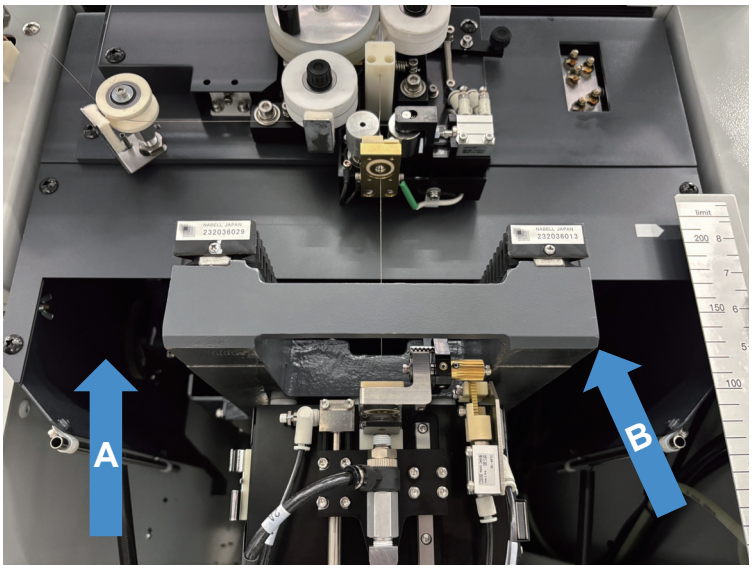
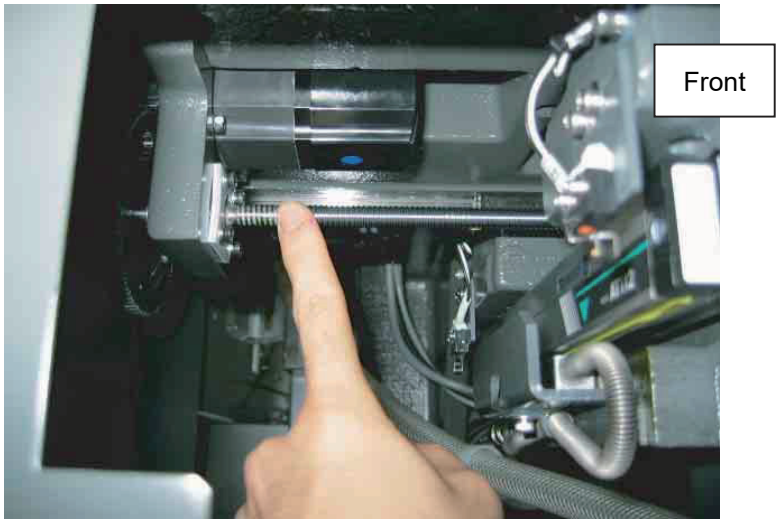
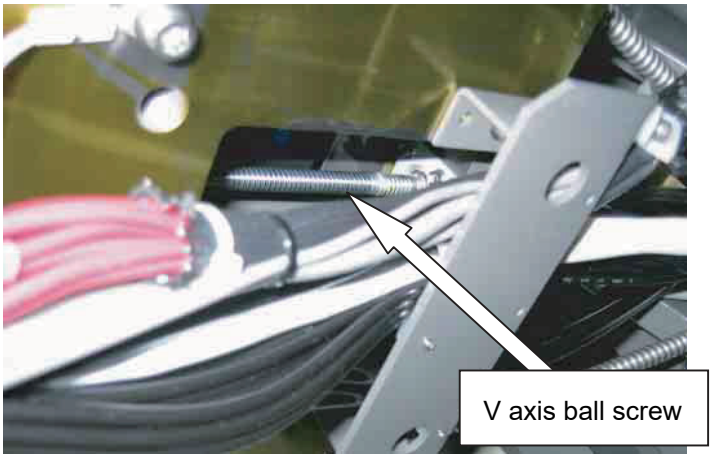


Fig. V.4.13

2) Move the +U axis to the stroke end, wipe off all the old grease, and then apply new grease onto the entire exposed ball screw with a finger. (Fig. V.4.14 1) (For the UV axes ball screw specification)
Move the -V axis to the stroke end, wipe off all the old grease, and then apply new grease onto the entire exposed ball screw with a finger. (Fig. V.4.14 2) (For the UV axes ball screw specification)



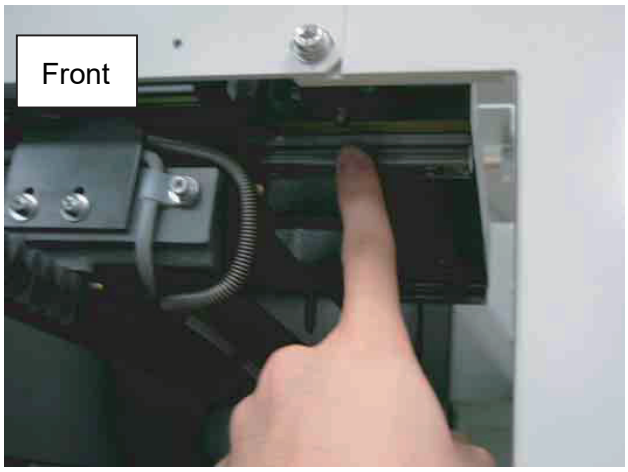
1) Detailed view of arrow A (front of the U axis ball screw)



2) Detailed view of arrow B (lower part of the V axis ball screw)

Fig. V.4.14

3) Move the +U axis, -U axis, +V axis and -V axis to the stroke end, wipe off all the old grease, and then apply new grease onto the exposed guide section (front and back sides) with a finger.



1) Detailed view of D (front of the U axis guide)

2) Viewed from the left side of detailed view of E
(left side of the V axis guide)

Fig. V.4.15

4) Return the T/C cover (bottom) and feeder wire suspension pipe to the original positions.
After mounting the T/C cover (bottom), always attach the feeder wire suspension spring to the feeder wire suspension pipe.

4.3 6-Month Inspections

4.3.1 Cleaning of float switch in the tank

(1) Cleaning of the float switch for preventing the AT unit from submersion

A float switch pevents the AT unit from submersion.

If the area around the AT unit is contaminated with sludge or other contaminants, the float switch may not operate correctly. Clean it approximately every 6 months.

1) Cleaning method

Disassemble the AT back cover, remove the float switch, and then lightly remove the dirt around the float switch using a brush, etc.

If strong impact is applied, the electrical contact in the shaft could be damaged.

The float (black) has an orientation. When installing the float, make sure that the "OPEN" indication comes to the top.

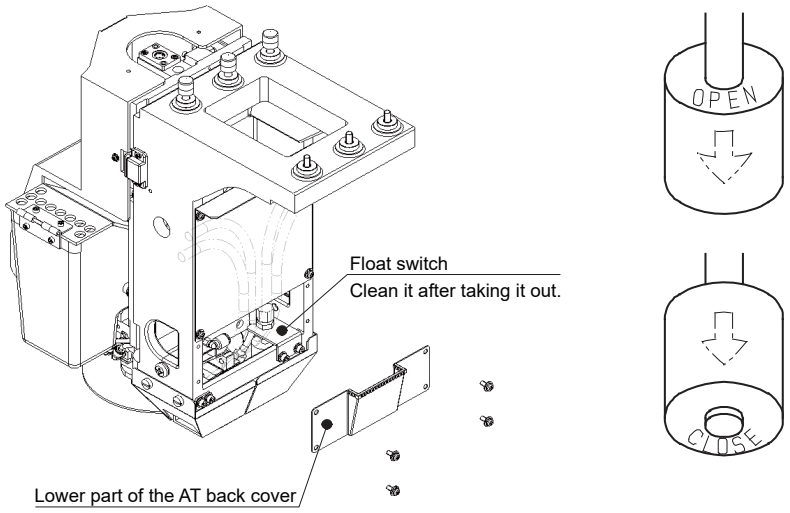


Fig. V.4.16

(2) Cleaning of float switch in the tank

A float switch used for stopping rapid filling has been set in the working tank.

Clean it in the same manner as the float switch for preventing the AT unit from submersion.

4.4 Others

4.4.1 Display screen

The life of the LCD backlight is approximately 50000 hours.
When the backlight is consumed, the brightness of the screen will start to drop. Replace the backlight in this case.

4.4.2 Uninterruptible Power Supply (UPS)

The life of the contained battery varies according to the ambient temperature (approx. 3 at 25 °C ambient temperature). Replace battery when the "UPS BATTERY LOW" alarm appears.

4.4.3 Replacing the backup battery

The lithium battery in the control unit lasts approximately 6 years, but should be replaced every 5 years. Also replace battery when the "BACKUP BATTERY LOW" alarm appears.

4.4.4 C-Fast (flash memory card)

The recommended replacement interval is about 5 years; this is a guideline, not a warranty or free service. With heavy or continuous use, the C?Fast may need earlier replacement. Data on a failed C?Fast is not guaranteed, so regularly back up NC programs, E?Packs, and variables to a USB flash drive.

4.4.5 Replacing the servo amplifier backup battery

This axis uses an absolute position detection system with a lithium battery in the servo amplifier (life time approx. 12000 hours). Replace the battery when "S52 Servo Warning 9F" appears. After approx. 100 hours the servo alarm "S01 Servo alarm 25" will appear, READY ON will fail and the absolute position detection data will be lost. Replace the battery as soon as the warning occurs. Do not turn OFF the breaker on the power supply panel as the absolute position could be lost.

*** Contact the Mitsubishi Electric Service Department for replacement of the above parts.**

5. MAINTENANCE AND INSPECTION METHOD OF AUTOMATIC WIRE FEEDER

5.1 Maintenance and Inspection Items

The maintenance and inspections to be performed periodically to ensure that the automatic wire feeder and entire system operate smoothly are shown in Table V.5.1. The names of each part are shown in Fig. V.5.1 and Fig. V.5.2. Refer to the pages indicated with the Reference No. for details on each item.

5.1.1 Maintenance and inspection table

Table V.5.1 Maintenance and inspection items of the automatic wire feeder

Class	Inspection section name	Reference No.
Daily and preparatory inspections	Wire chip collection box	5.2.3 (1)
	Wire guide	5.2.3 (2)
	Jet nozzle	5.2.5 (2)
	Wire guide block (front)	5.2.5 (5) 5.2.6 (4)
Weekly inspection	Wire retainer felt	5.2.1 (1)
	Upper power feeder	5.2.4 (1)
	Lower power feeder	5.2.4 (2)
	Upper diamond die	5.2.5 (3)
	Lower diamond die	5.2.6 (1)
	Wire guide blocks (inside, related parts)	5.2.5 (5) 5.2.6 (4)
	Lower roller block	5.2.7 (3)
	AT cleaning mode	5.2.8
Monthly inspection	Annealing roller	5.2.1 (3)
	Cutting energizer and cutting pressed wire of energizer	5.2.2 (4)
	Wire pressing roller	5.2.2 (5)
	Guide U, D	5.2.5 (1)
	Guide C	5.2.5 (4) 5.2.6 (2)
	Guide U, D	5.2.6 (3)
	Sub die A	5.2.1 (4)
	Auxiliary die B	5.2.2 (1)
	Warping detection plate	5.2.2 (2)
	Guide pipe	5.2.2 (3)
	Retriever	5.2.2 (6)
	Wire collection	5.2.9 (1)
6-month inspection	Main tension roller	5.2.1 (2)
	Lower roller	5.2.7 (1)
	Nest	5.2.7 (2)

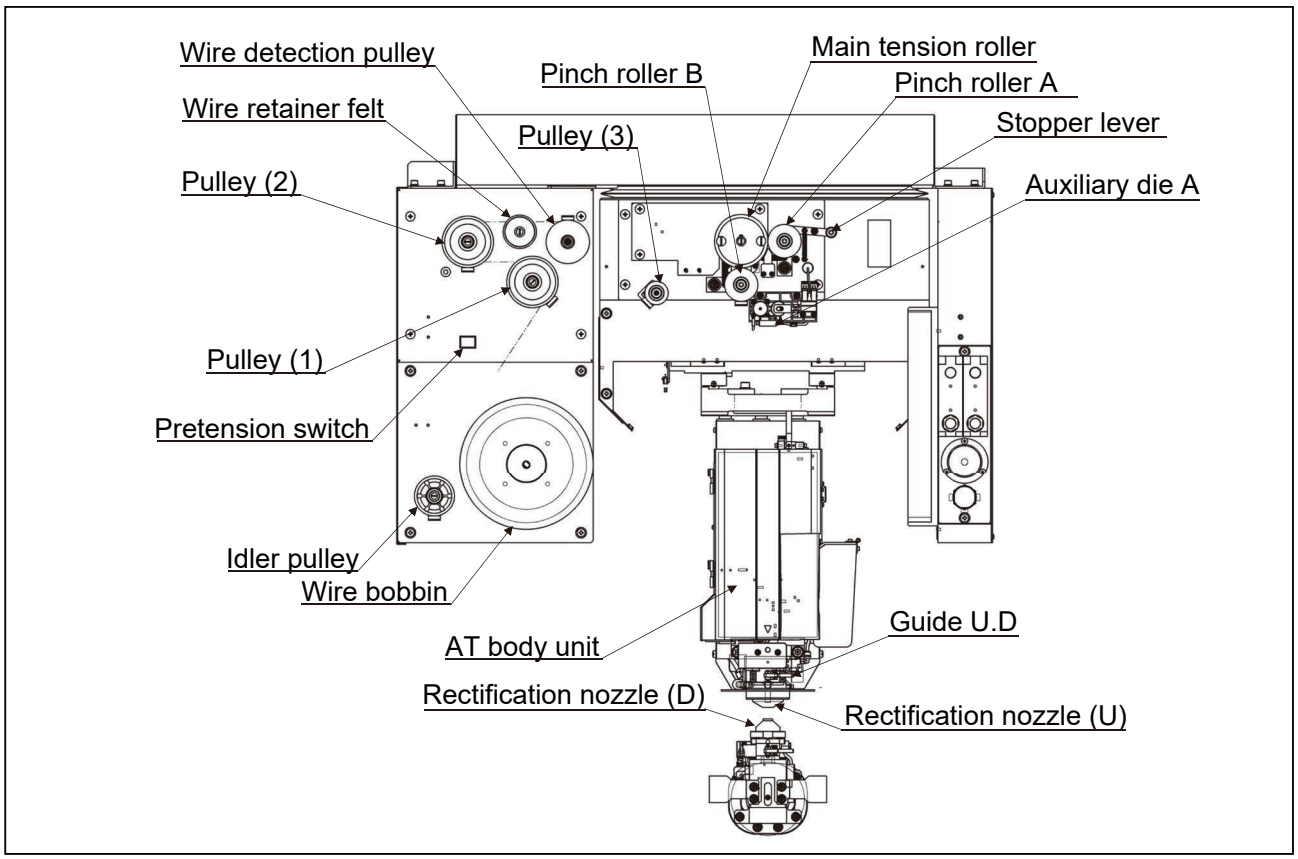


Fig. V.5.1 General drawing of wire travel system

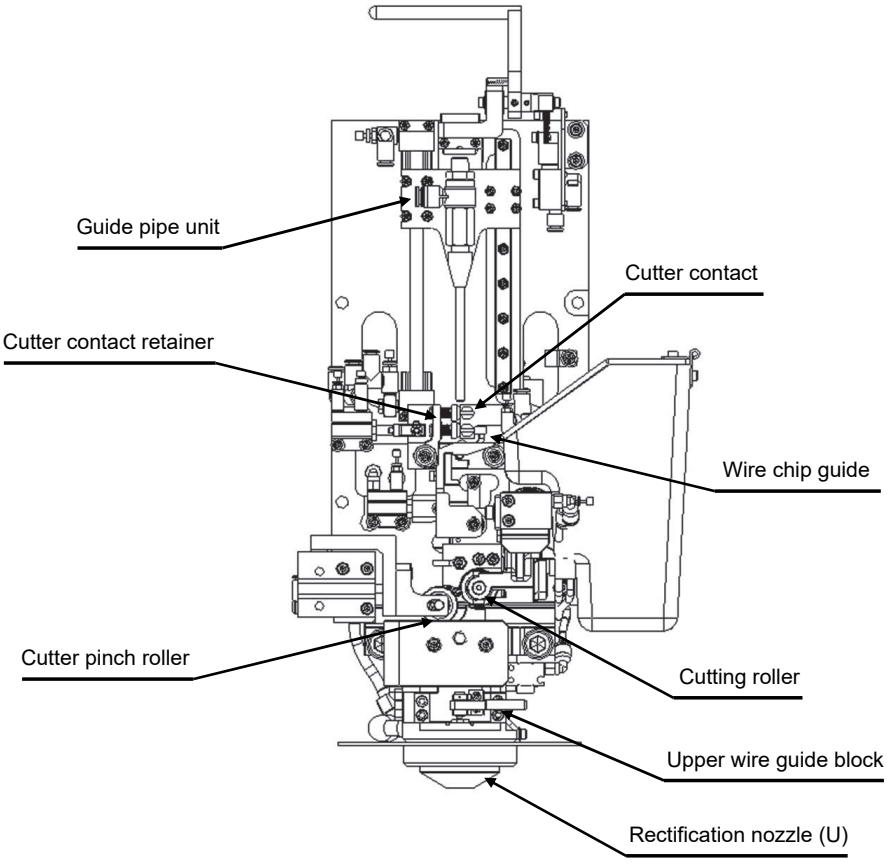


Fig. V.5.2 AT body unit

5.1.2 AT maintenance guide screen

The maintenance positions and service notes of the automatic wire feeder can be checked in the AT maintenance guide screen. For the operation method, see "III. NC OPERATION DISPLAY SCREEN".

5.2 Maintenance and Inspection Methods

5.2.1 Wire feed section

(1) Wire retainer felt

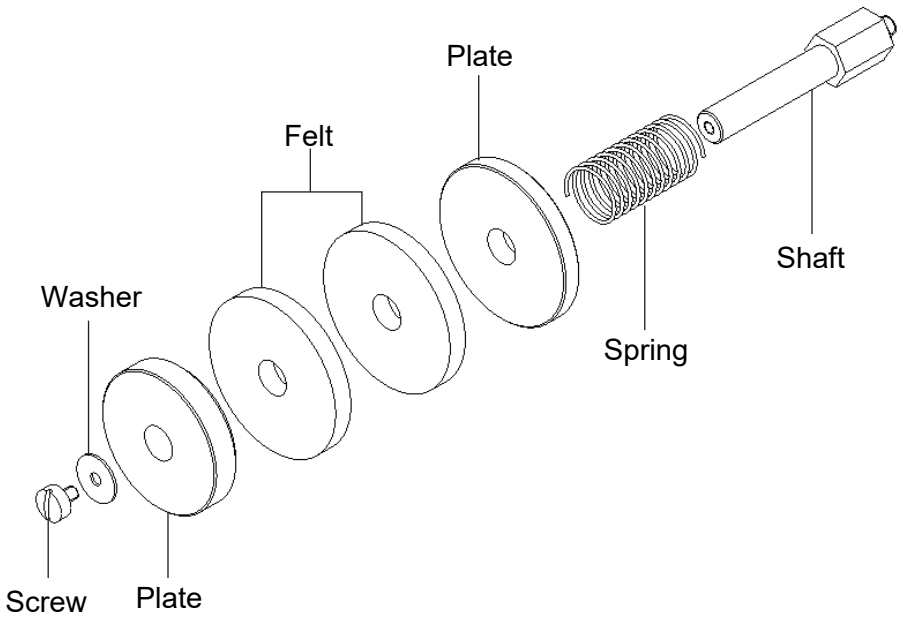


Fig. V.5.3

The wire retainer felt can be used to remove the dirt adhering to the surface of wire electrode. Please rotate the felt when replacing the wire electrode and the wire electrode must go through the felts.

1) Inspection method

Visually check the felt. If the white side is stained black, flip it. If both sides are stained black, replace the felt.

2) Replacing method

(a) Remove the screws.

(b) Pull the plate and felt out of the shaft.

(c) Exchange the front and rear sides of felt or replace the felt with a new one.

(d) Place the felt into the plate and insert them into the shaft, and then tighten the screw.

(2) Main tension roller

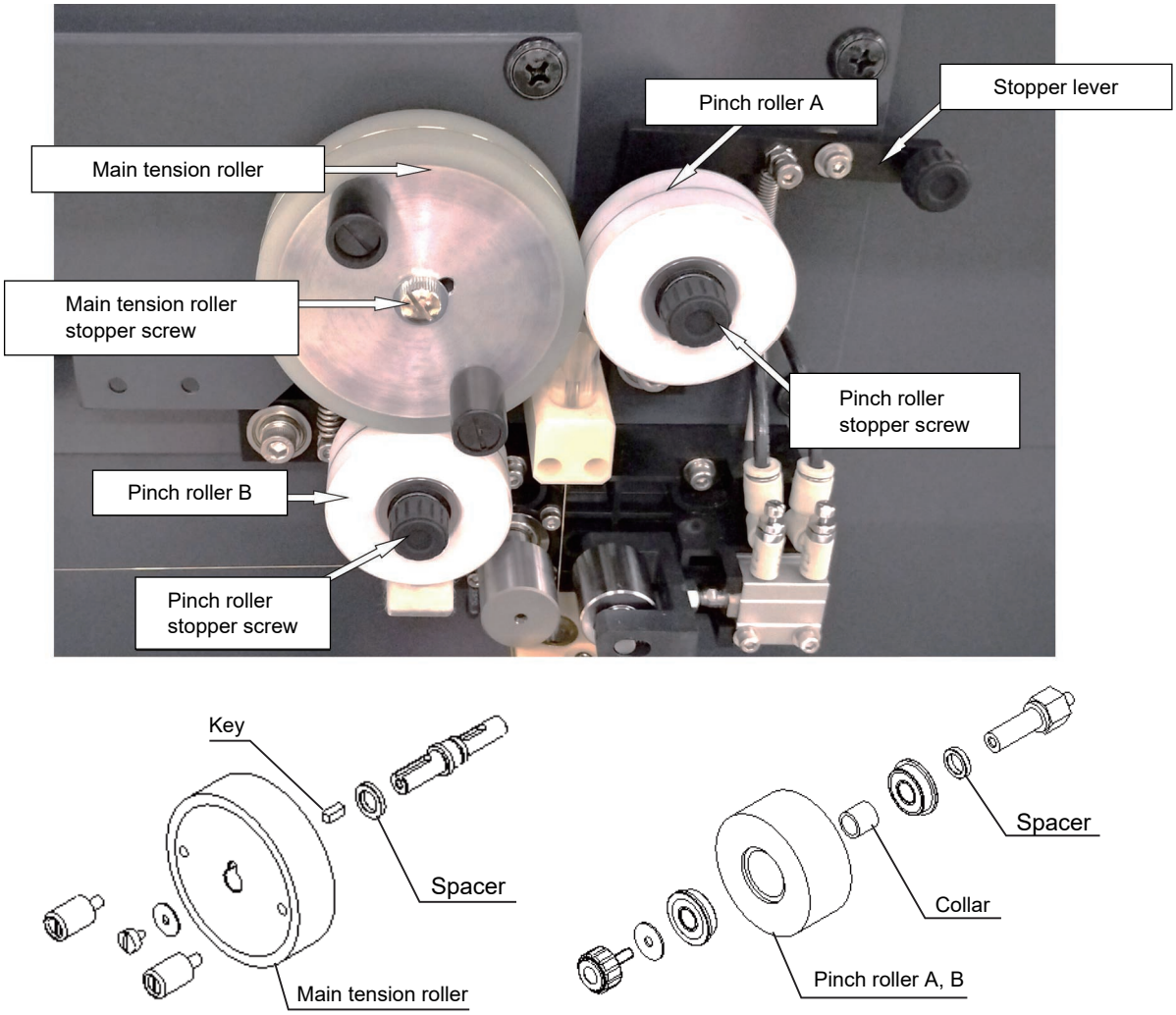


Fig. V.5.4

The main tension roller and pinch roller A/B are used to run the wire electrode and apply tension to it.

1) Inspection method

Visually check the surfaces main tension roller or pinch roller A/B for dirt or deep wear grooves from the wire. Also check for instant stops while the electrode is running.

(a) If the roller surface is dirty, please wipe it with the alcohol.

(b) When there is a groove (approx. 0.2 mm or more depth) on the roller surface, change the wire travel position or replace it with a new one.

(c) If the roller stops transiently, the wire electrode may slip. In this case, change the wire travel position or replace it with a new one.

2) Cleaning method

(a) If the roller surface is dirty, please wipe it with the alcohol.

(b) When there is a groove (approx. 0.2 mm or more depth) on the roller surface, change the wire travel position or replace it with a new one.

(c) If the roller stops transiently, the wire electrode may slip. In this case, please change the wire travel position or replace it with a new roller.

Removing the main tension roller

1) Turn the pinch roller A right until it clicks.
2) Remove the fixing screw of the main tension roller.
3) Remove the main tension roller while manually lowering the pinch roller B.

Removing the pinch rollers A/B

1) Turn the pinch roller A right until it clicks.
2) Remove the fixing screw of the pinch roller.
3) Pull out the pinch roller A.
4) Manually lower the pinch roller B to pull it out.

3) Replacing method

The wire travel position of the main tension roller and pinch rollers A and B can be changed with the following two methods. By using these two methods in combination, the same roller can be used four times.

(a) Reversing the roller front and back

(b) Shifting the collar position

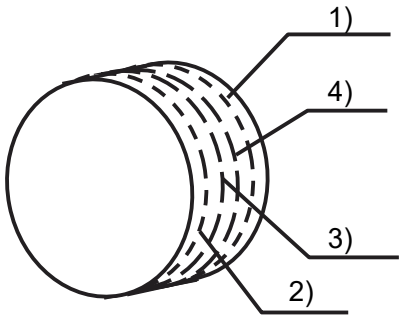


Fig. V.5.5

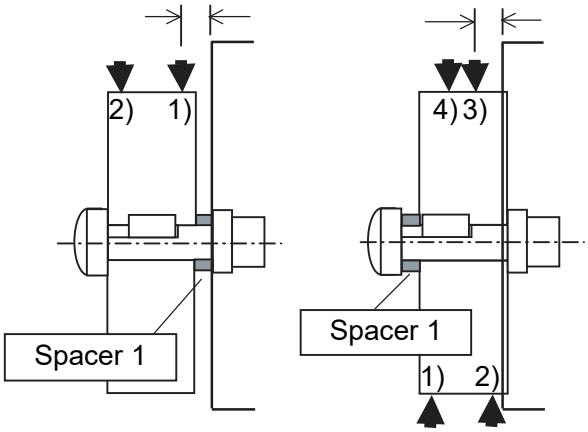


Fig. V.5.6

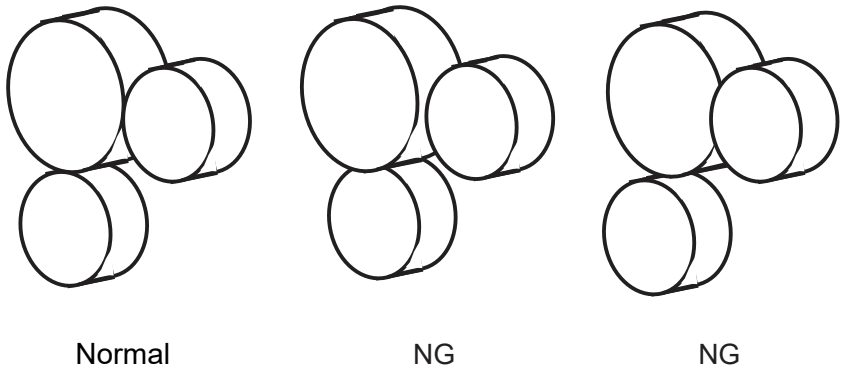


Fig. V.5.7

⚠CAUTION

- **When cleaning the adhering foreign matter off the surface of the main tension roller, use alcohol instead of water.**
- **Do not use the machine while there is a level difference between the pinch roller A and B. The wire might slip off the rollers, which causes machine to stop.**
- **If the main tension roller rotates too fast, the wire may warp. As a result, parts of the wire electrode or the automatic wire feeder may snag on the workpiece.**
- **Do not lose the collars and spacers of the pinch rollers A and B.**
- **Do not lose the key and spacer of the main tension roller axis.**

(3) Annealing roller

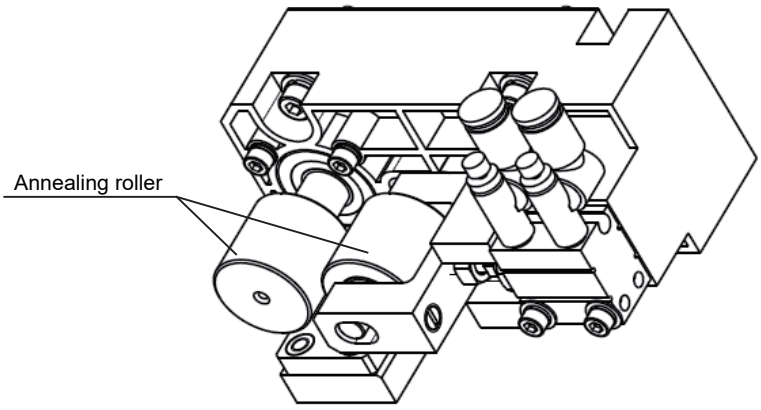


Fig. V.5.8

The annealing roller is composed of a fixed roller and a movable roller, and clamps with the wire electrode to energize for wire electrode straightening.

1) Inspection method

A dirty annealing roller reduces wire straightness and the auto connection rate. Visually inspect its surface for dirt.

2) Cleaning method

(a) Wipe the dirt on the surface of the annealing roller with a cotton swab moistened with a weak acidic detergent*.

(b) Wipe the surface of the annealing roller with a wet cotton swab and then dry it with an air blower.
*** Recommendation: Japan Mecha Chemical, KC-12A 2% to 3% water-diluted solution**

(4) Auxiliary die A*

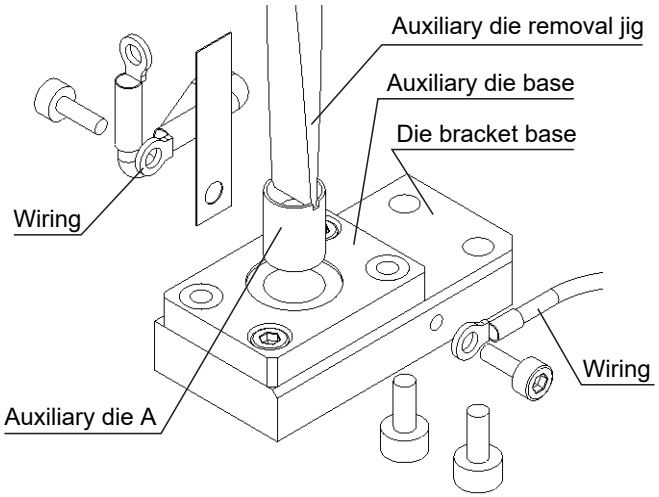


Fig. V.5.9

The auxiliary die A retains the wire electrode during taper Z machining.

1) Inspection method

The wire electrode gets through the auxiliary die A. Check whether it is blocked by foreign matter adhering to the wire electrode. Clean the wire electrode if it cannot pass through the auxiliary die A.

2) Cleaning method

(a) Remove the wirings (two places).

(b) Remove the die bracket base.

(c) Remove the auxiliary die A using the supplied auxiliary die removal jig.

(d) Clean the auxiliary die A with an ultrasonic cleaning device.

(e) Install the auxiliary die A onto the auxiliary die base.

(f) Install the die bracket base while pressing it onto the annealing base with force.

(g) Install the wirings (two places).

- **As the wire electrode cannot be straightened, the wire harness must be installed.**
- **If the die bracket base is installed improperly, the straightening of the wire electrode may be affected. Please press the annealing base while installing.**

5.2.2 Automatic wire feeder

(1) Auxiliary die B

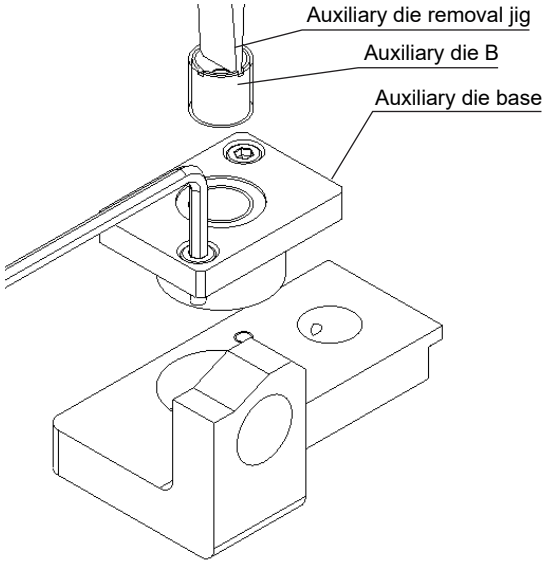


Fig. V.5.10

The auxiliary die B retains the wire electrode during taper Z machining.

1) Inspection method

The inspection method is the same as for auxiliary die A. See "(4) Auxiliary die A*" in "5.2.1 Wire feed section".

2) Cleaning method

(a) Remove the auxiliary die base.

(b) Remove the auxiliary die B using the supplied auxiliary die removal jig.

(c) Clean the auxiliary die B with the ultrasonic cleaning device.

(d) Install the auxiliary die B onto the auxiliary die base.

(e) Install the auxiliary die base.

NOTICE

If the auxiliary die base is installed improperly, the tension of the wire electrode may be affected. Please press the housing of the shaft roller while installing.

(2) Warping detection plate

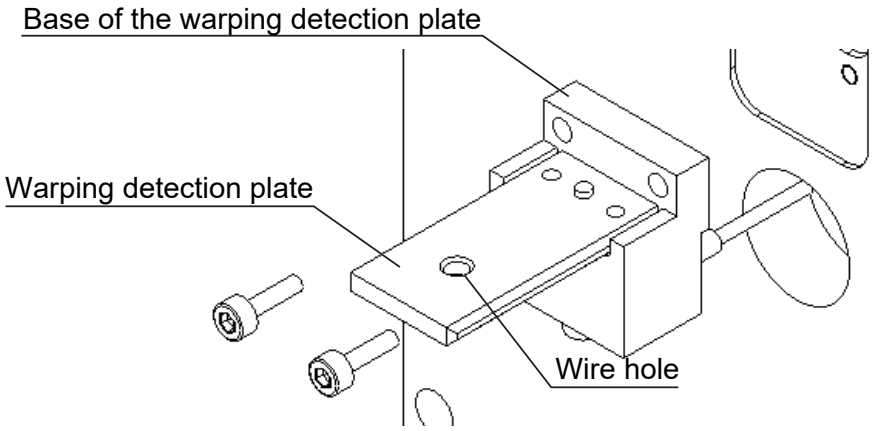


Fig. V.5.11

The warping detection plate can detect the warping of wire electrode during auto wire inserting.

1) Inspection method

During automatic wire insection, ensure the feed stops when the wire touches the warp detection plate and insertion continues. If contact occurs but feeding does not stop, clean the detection plate.

2) Cleaning method

(a) Remove the mounting base of the warping detection plate.

(b) Wipe the inside of the wire hole on the warp detection plate with a cotton swab moistened with acidic detergent*.

(c) Install the warping detection plate after pressing its mounting base from the left and bottom.
*** Recommendation: Japan Mecha Chemical, KC-12A 2% to 3% water-diluted solution**

NOTICE

- **Exposure to any organic solutions may cause cracking of the base of the warping detection plate. Therefore, do not spray any acidic detergent directly onto the base plate.**
- **If the warping detection plate is installed improperly, the wrong detection on warping will be caused. Please install it while pressing its left or top.**

(3) Guide pipe

The guide pipe lowers when inserting the wire, and feeds the wire to the upper guide block with air transfer force without applying excessive force on the wire.

1) Inspection method

(a) Check whether the LM guide or cylinder surface is dirty.

(b) While the wire is threaded, check that it is aligned to the center of the guide pipe.

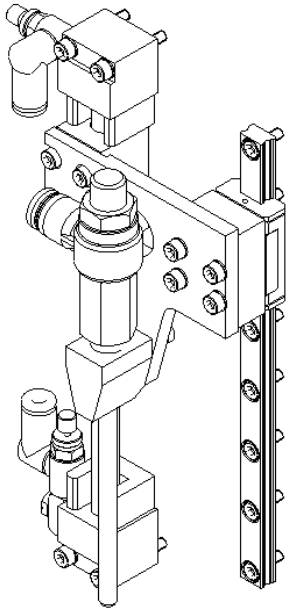


Fig. V.5.12

2) Cleaning method

If the linear guide movement is poor due to contamination, etc., wipe off the rail surface of the linear guide and the air cylinder with a dry cloth, and then grease*1 the guide section.

***1 Shell, Albania grease or equivalence**

NOTICE
• **If the adhering dirt cannot be removed, wash it with an ultrasonic cleaning device carefully.** • **Do not bump the edges of the guide pipe.**

(4) Cutting energizer and cutting energizer presser

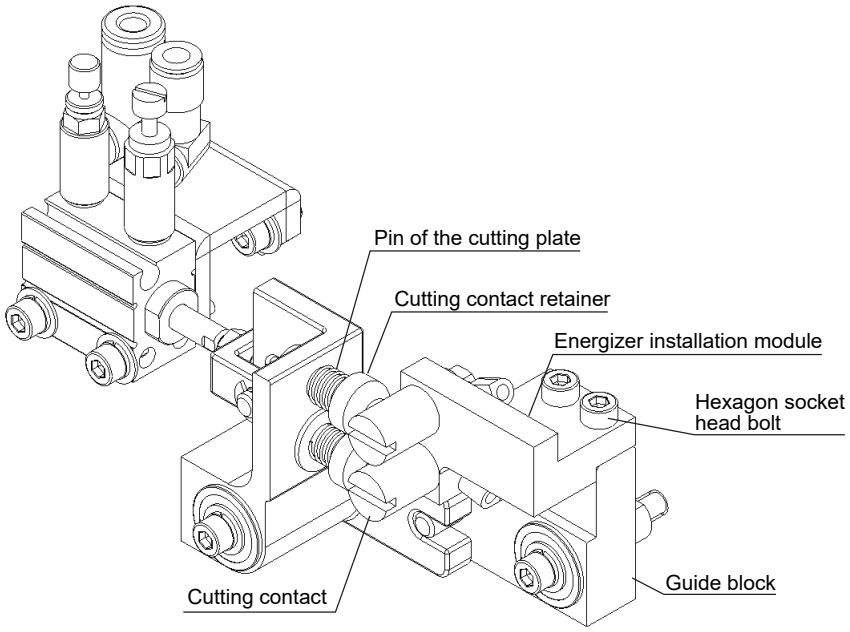


Fig. V.5.13

The cutting energizer applies voltage to heat and cut the wire between upper and lower energizers. Water or dirt on the surface can prevent proper energizing and cause a “Cutting Error.” The opposing presser ensures contact; if it doesn’t retract during cutting, the wire may not cut.

1) Inspection method

(a) Check whether there is any water or dirt on the surface.

(b) Move the cutting energizer and presser by hand to confirm that they move without catching and that the installation state is not loose.

2) Cleaning method

(a) Wipe the energizer surface with a dry cloth or cotton swab moistened with alcohol.

(b) When the contamination cannot be removed, or if the surface is worn, shift the position of the energizer.

(i) Loosen the two hexagon socket bolts, and remove the energizer installation block from the guide block.

(ii) Insert a slotted screwdriver into the slit on the front side of the energizer, and loosen the nut on the backside with the wrench (6), until the contact face of the energizer changes.

(iii) Tighten the nut to fix the position, and restore it to the guide block.

(iv) Fix the energizer installation block while pressing it to the guide block contact face. After installation, check that the end of the wire is not bent while cut.

(c) Wipe off the surface of the cutting energizer presser with a dry cloth or a cotton swab soaked with alcohol.

(d) When the cutting energizer presser does not act smoothly, apply grease* onto the pin of the cutting plate.
*** Shell, Albania grease or equivalence**

NOTICE
Apply Loctite, etc., in the screw section when assembling to prevent loosening.

(5) Wire pressing roller

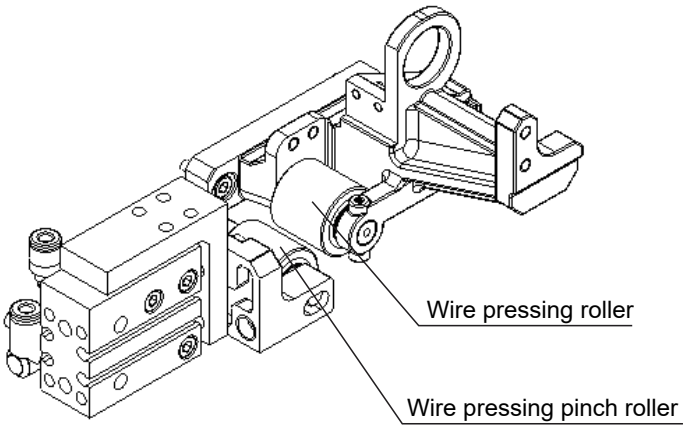


Fig. V.5.14

The wire pressing unit has a fixed roller and a cylinder?mounted pinch roller. It closes only during wire shifting and cutting.

1) Inspection method

If the wire pressing roller (ceramic) gets dirty, the wire is more likely to drop off. Check whether the roller surface is dirty due to foreign matter adhering to wire.

2) Cleaning method

(a) Wipe the roller surface with a cotton swab moistened with alcohol.

(b) When the surface of the roller is extremely dirty, clean it with a cotton swab moistened with acidic detergent*.
*** Recommendation: Japan Mecha Chemical, KC-12A 2% to 3% water-diluted solution**

NOTICE

- **After washing with the weak acidic detergent, flush the weak acid completely with clean water.**
- **When the cylinder of the wire pressing pinch roller does not act smoothly, apply grease onto the LM guide.**

(6) Retriever

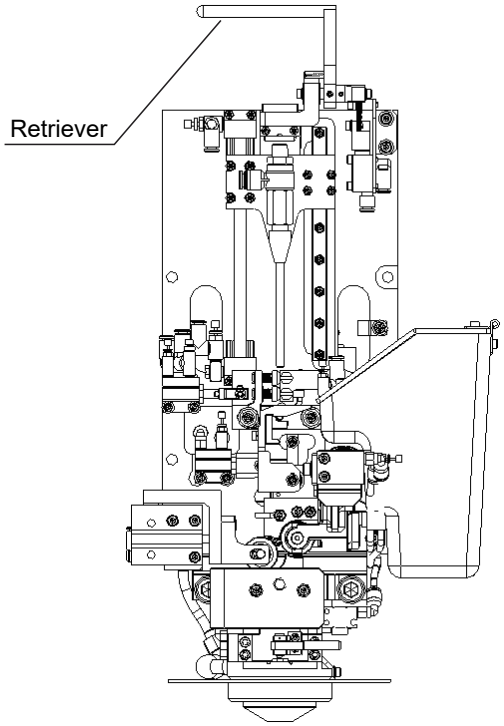


Fig. V.5.15

1) Inspection method

If the retriever is dirty, the automatic connection rate could drop. Check whether the retriever is dirty due to any foreign matter adhering to wire.

2) Cleaning method

(a) Wipe the retriever with a cotton swab moistened with alcohol.

(b) When the surface of the roller is extremely dirty, clean it with a cotton swab moistened with acidic detergent*.
*** Recommendation: Japan Mecha Chemical, KC-12A 2% to 3% water-diluted solution**

5.2.3 Wire chip collection section

(1) Wire chip collection box

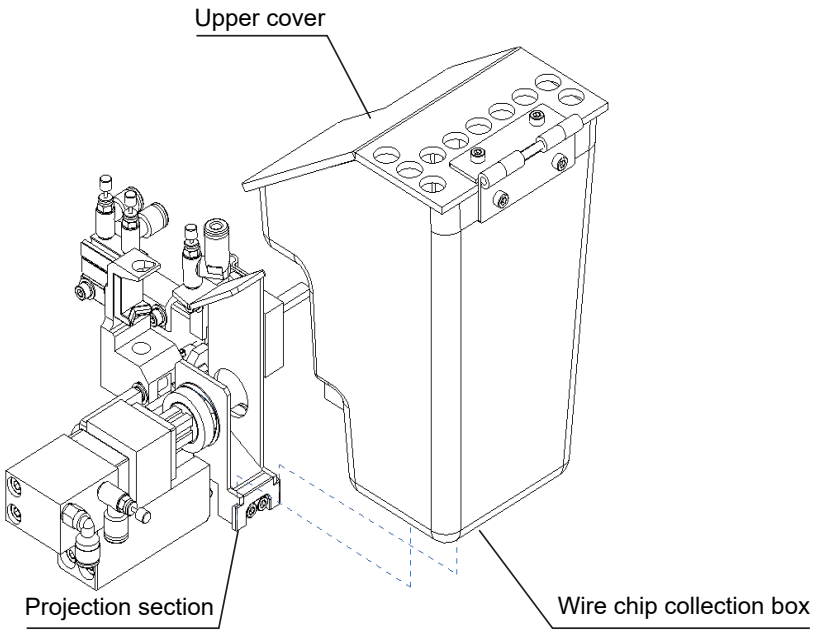


Fig. V.5.16

The wire chip electrode with cut-off wire electrode is stored in the wire chip collection box temporarily.

1) Inspection method

Visually check the wire chip collection box. If the AT maintenance guide shows chips at the set limit, remove them.

2) Cleaning method

(a) Open the AT cover.

(b) Remove the wire chip collection box from the automatic wire feeder, and open the upper cover to remove wire electrodes.

(c) Reinstall the wire chip collection box to the original position so that it hooks onto the projection section.

NOTICE

- **The wire chip collection box may be cracked in case of dropping. Please install it with care.**
- **As the wire chip electrodes may fly into the working tank or out of the host of the machine, you must install a wire chip collection box when performing wire cutting.**
- **If you continue to machine when the wire chip remains in the working tank, short circuit may be caused.**

(2) Wire guide

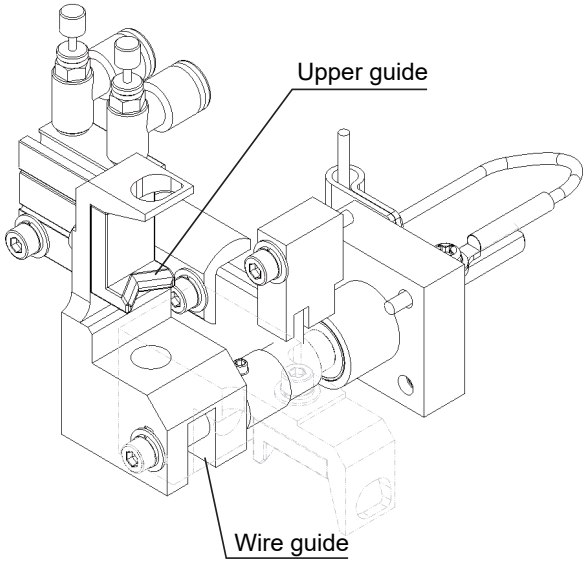


Fig. V.5.17

The wire guide guides the cut wire chip electrodes into the collection unit.

1) Inspection method

Check for wire chips in the wire guide. If present, clean them to prevent insertion, cutting, and machining issues.

2) Cleaning method

(a) Open the AT cover.

(b) Press the [Guide tilt] control switch to make the wire guide inclined, so as to clean the wire chip left.

(c) Press the [Guide tilt] control switch to reset the wire guide.

(d) When the surface of the upper guide (ceramic) is extremely dirty, wipe it with a cotton swab moistened with alcohol.

⚠CAUTION
Do not get your hands trapped.

5.2.4 Power feeder

The power feeder supplies power to the wire electrode and wears over long machining. If wire breaks frequently between electrodes, remove and inspect the power feeder.

(1) Upper power feeder

1) Inspection method

(a) Removing the upper power feeder

(i) Pull the lever toward you, and release the clamp of the power feeder.

(ii) Use a hexagon wrench to push one side of the power feeder, and pull it out from the other side.

(iii) When the groove where the power feeder wears (used section) is deep (guideline: approx. 0.5 mm to 1.0 mm), shift the position by referring to "(b) Method for positioning the upper power feeder at any desired position" and use a new unworn surface. Please use the supplied power feeder positioning jig to fix the position of the power feeder.

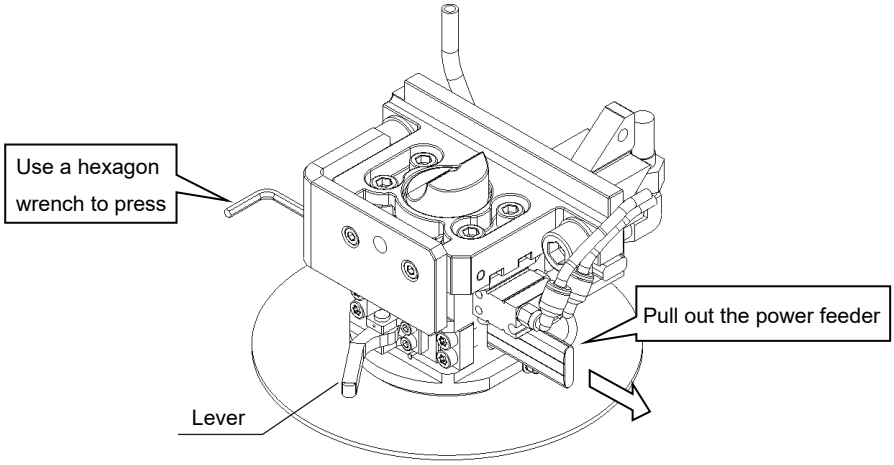


Fig. V.5.18

(b) Method for positioning the upper power feeder at any desired position

Use the power feeder positioning jig to specify any position of the upper power feeder as the wire travel path.

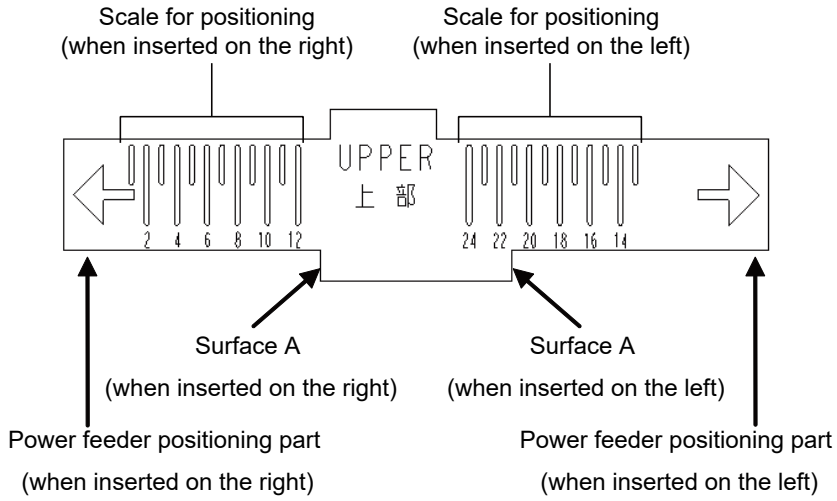


Fig. V.5.19 Power feeder positioning jig (upper setting surface)

(i) Put the power feeder on the positioning part with the upper setting surface of the positioning jig facing upward, and put its end against the surface A of the positioning jig. In this state, read the positioning jig scale (number) of the set power feeder position.

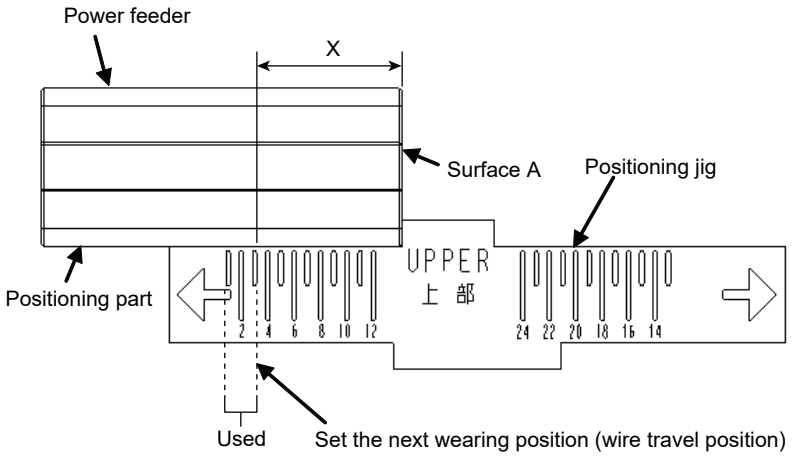


Fig. V.5.20 Positioning the power feeder (any setting)

(Example: When the scales 1 and 2 have been used and the next setting is scale 3)

(ii) Rotate the power feeder vertically, and then insert it into the feeder port of the upper wire guide block.

(iii) Insert the positioning jig (upper setting surface up) into the upper wire guide block with its edge against the power feeder. Push the feeder until mark (i) aligns with the guide block's right face; the clamp scale then aligns to the wire path (X dimension unchanged).

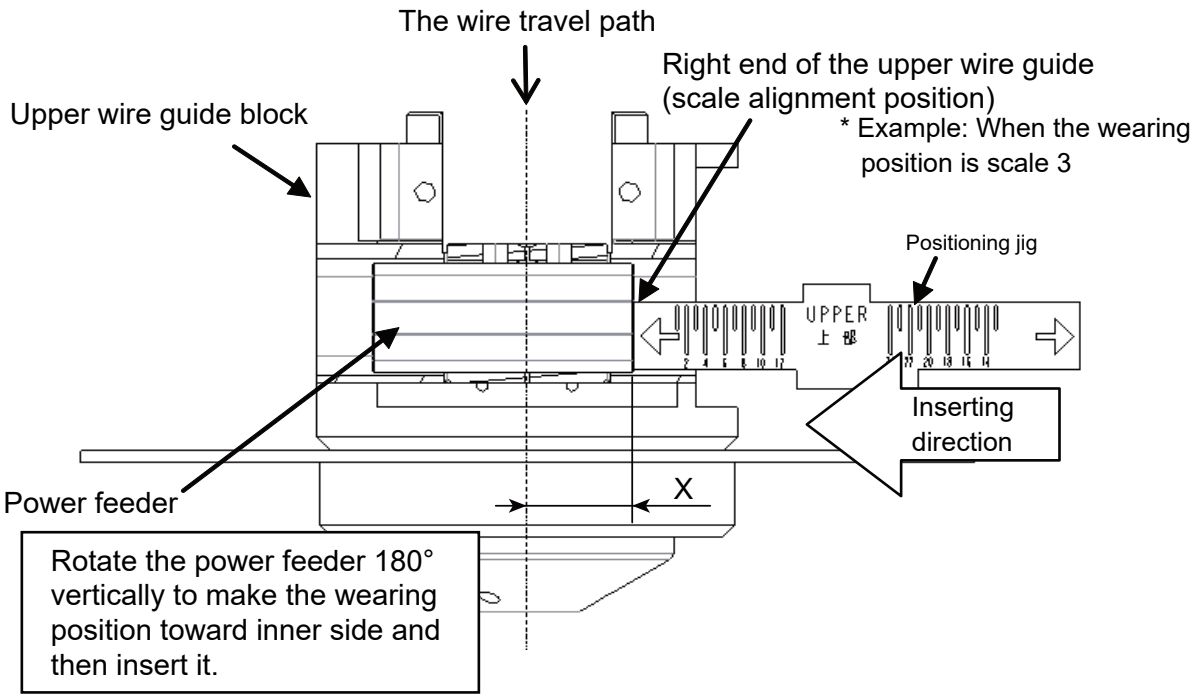


Fig. V.5.21 Inserting the power feeder (when inserted from the right side)

*** Check whether there is any foreign object on the setting surface of the power feeder, and remove it if any.**

*** Use the scales 1 to 12 of the positioning jig when inserting the power feeder from the right side, and use scales 13 to 24 when inserting it from the left side.**

(c) Installation of upper power feeder
After changing the wear position, release the lever and confirm the power feeder is secure. If you don't, power may be insufficient, reducing speed and accuracy, causing abnormal discharge, and impairing machining and AT INSERT functions.

2) Cleaning method

(a) Cleaning of power feeder

(i) Remove the power feeder from the machine, and immerse it into the acidic detergent, or clean it with an ultrasonic cleaning device or nylon brush.

(ii) After washing, flush it with running water, and then dry with an air blower.

NOTICE

- **The power feeder can be used in the 1.5-mm pitch, and each side can be used 24 times. After using 24 times each on both sides, replace the power feeder.**
- **Wear of the power feeder varies depending on the wire electrode diameters and machining status (mainly rough machining). If the machining speed drops or if the wire breaks frequently, the power feeder may have reached its life.**
- **When the power feeder positioning jig is dirty, wipe it with neutral detergent. Do not use volatile liquid.**
- **The power feeder is a very important part affecting the machining performance, so be sure to use the designated one. Use of other power feeders, due to difference in size and material, might reduce the machining performance or might discharge between the guide block and the power feeder, resulting breakage in the guide block.**

(2) Lower power feeder

1) Inspection method

(a) Removing the lower power feeder

(i) Pull the lever toward you, and release the clamp of the power feeder.

(ii) Use a hexagon wrench to push one side of the power feeder, and pull it out from the other side.

(iii) When the groove where the power feeder wears (used section) is deep (guideline: approx. 0.5 mm to 1.0 mm), shift the position by referring to "(b) Method for positioning the lower power feeder at any desired position" and use a new unworn surface. Please use the supplied power feeder positioning jig to fix the position of the power feeder.

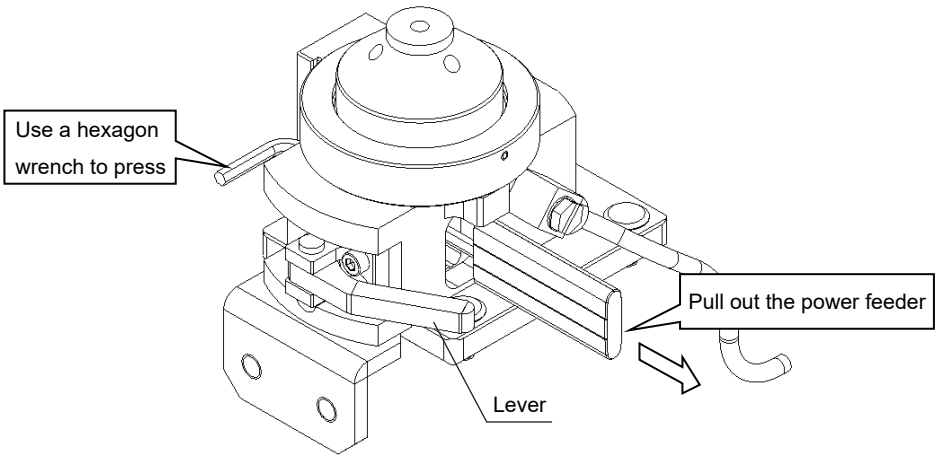


Fig. V.5.22

(b) Method for positioning the lower power feeder at any desired position

Use the power feeder positioning jig to specify any position of the lower power feeder as the wire travel path.

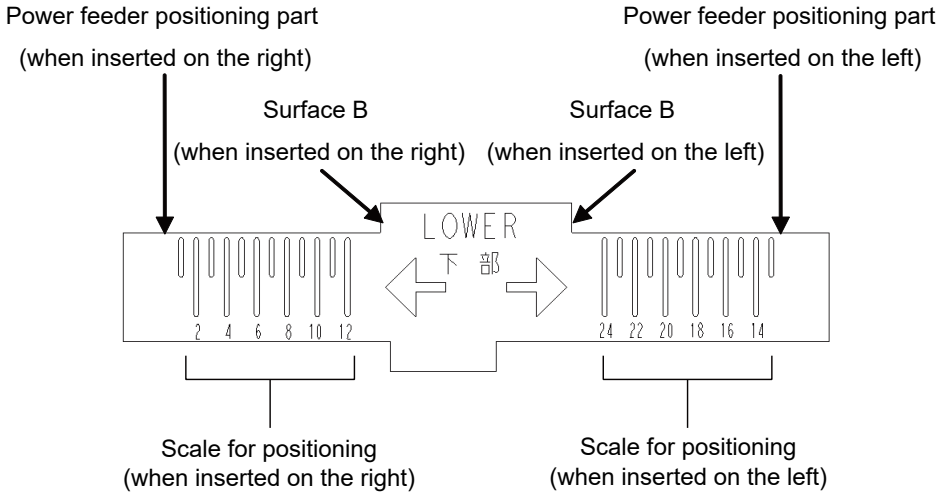


Fig. V.5.23 Power feeder positioning jig (lower setting surface)

(i) Put the pulled power feeder on the positioning part with the lower setting surface of the positioning jig facing upward, and put its end against the surface B of the positioning jig. In this state, read the positioning jig scale (number) of the set power feeder position.

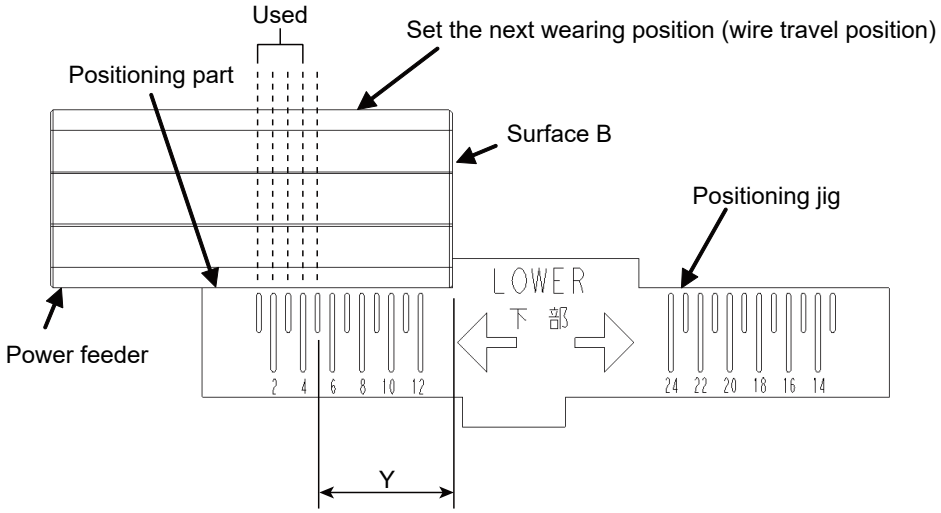


Fig. V.5.24 Positioning the power feeder (any setting)

(Example: When the scales 1 to 4 have been used and the next setting is scale 5)

(ii) Rotate the power feeder vertically, and insert it into the power feeder opening under the lower wire guide block.

(iii) Insert the positioning jig (lower setting surface up) into the lower wire guide block with its edge against the power feeder. Push the feeder until mark (i) aligns with the guide block's right face; the clamp scale aligns to the wire path (Y dimension unchanged).

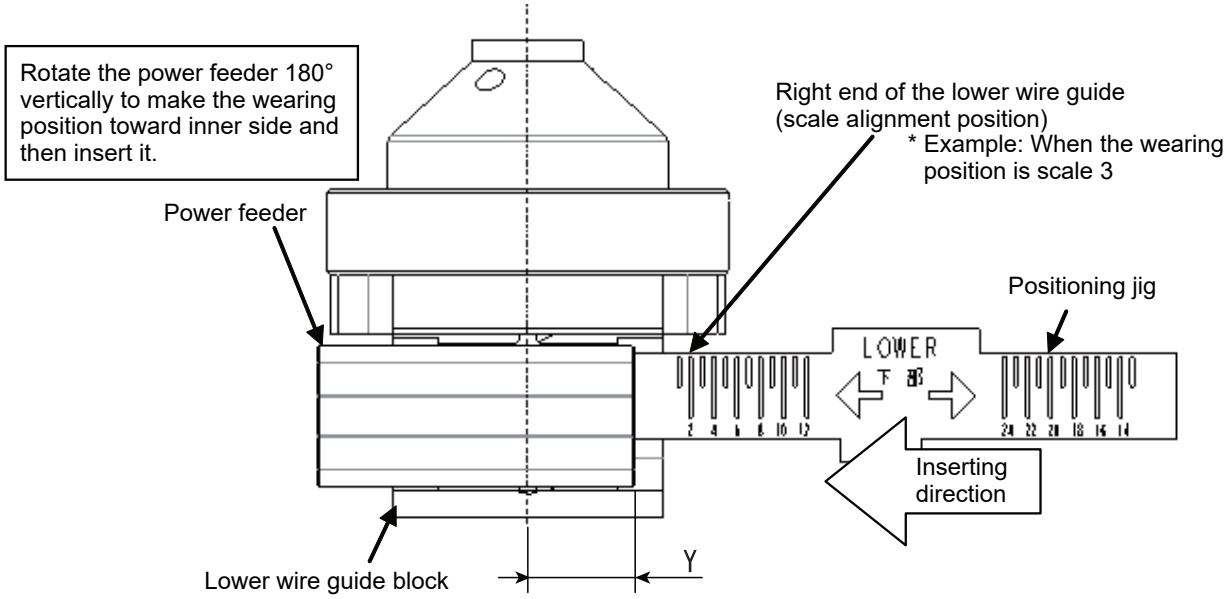


Fig. V.5.25 Inserting the power feeder (when inserted from the right side)

*** Check whether there is any foreign object on the setting surface of the power feeder, and remove it if any.**

*** Use the scales 1 to 12 of the positioning jig when inserting the power feeder from the right side, and use scales 13 to 24 when inserting it from the left side.**

(c) Installation of the lower power feeder

After changing the wear position, release the lever and confirm the power feeder is secure. Otherwise, insufficient power may cause abnormal discharge, reduced speed/accuracy, and AT INSERT malfunctions.

2) Cleaning method

(a) Cleaning of power feeder

(i) Remove the power feeder from the machine, and immerse it into the acidic detergent, or clean it with an ultrasonic cleaning device or nylon brush.

(ii) After washing, flush it with running water, and then dry with an air blower.

NOTICE

- **The power feeder can be used in the 1.5-mm pitch, and each side can be used 24 times. After using 24 times each on both sides, replace the power feeder.**
- **Wear of the power feeder varies depending on the wire electrode diameters and machining status (mainly rough machining). If the machining speed drops or if the wire breaks frequently, the power feeder may have reached its life.**
- **When the power feeder positioning jig is dirty, wipe it with neutral detergent. Do not use volatile liquid.**
- **The power feeder is a very important part affecting the machining performance, so be sure to use the designated one. Use of other power feeders, due to difference in size and material, might reduce the machining performance or might discharge between the guide block and the power feeder, resulting breakage in the guide block.**

5.2.5 Upper wire guide

(1) Maintenance of guide U, D

Guide U/D sits atop the upper guide block, shearing and pressing the wire against the power feeder between the upper guide and guide C. Wire chips increase with long or high?speed machining.

1) Inspection method

Remove the guide U,D. Check whether copper chips, etc. have built up in guide U, D, by checking visually or by passing a wire.

2) Cleaning method

(a) Remove the magnet support mounting plate.

(b) Remove the screw fixing the upper guide U, D holder and pull it toward you.

(c) Loosen the screw fixing the guide U, D, and extrude the guide U, D out with the supplied die removal jig.

(d) Soak the guide U, D in the solution *, and use the ultrasonic cleaning machine or nylon brush to clean them.

(e) After cleaning, wash sufficiently with running water, and then blow with air.

*** Recommendation: Japan Mecha Chemical, KC-12A 2% to 3% water-diluted solution**

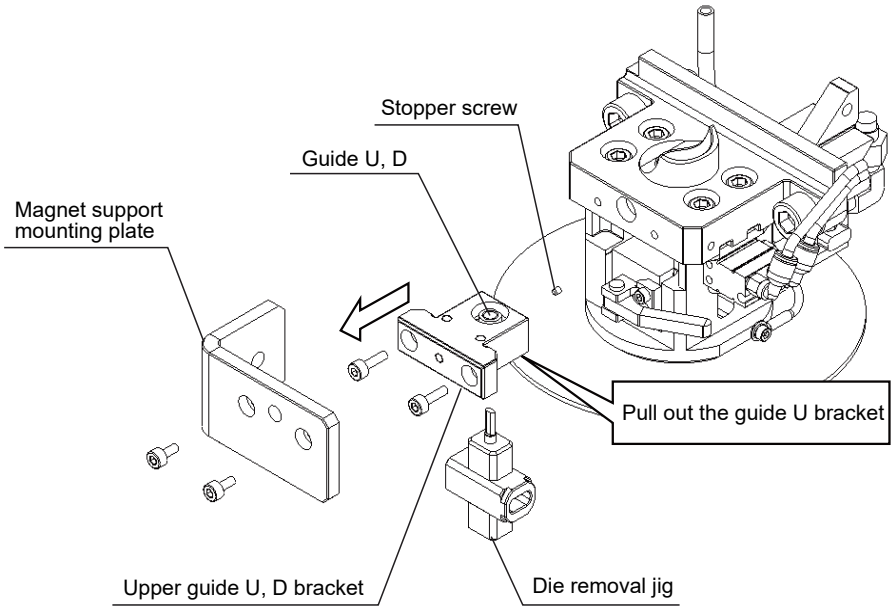


Fig. V.5.26 Removing the guide U, D

(2) Jet nozzle

1) Inspection method

(a) Open "Open/Close cock".

(b) Press the control switch "Jet" to check whether the jet water flow is normal.

(c) Check that the pressure of the jet water flow is 0.05 to 0.2 MPa.
The optimum jet fluid pressure varies with the start hole diameter or wire diameter, but normally set it to 0.1MPa.

(d) After confirming the jet water flow, close the "Open/Close cock".
When the jet water flow is faulty as shown in Fig. V.5.27, the following measures must be taken.

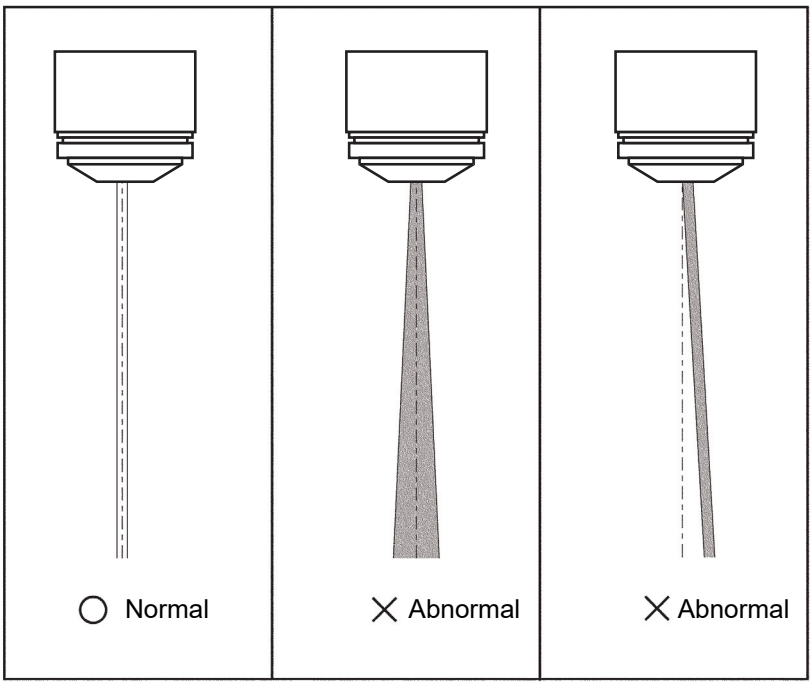


Fig. V.5.27

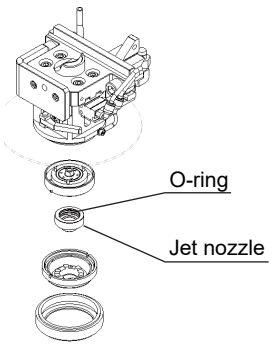


Fig. V.5.28

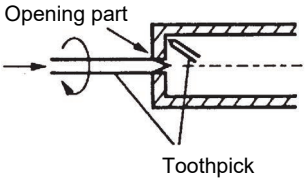


Fig. V.5.29

2) Cleaning method

(a) Remove the nozzle retainer (U), rectification nozzle (U) and jet nozzle.

(b) Clean the six rectification holes of rectification drum (U) (inside) with a nylon brush, etc.

(c) If the jet nozzle is heavily dirtied, clean it. If foreign matter has entered or adhered into the jet nozzle or opening, remove it with a cotton swab or wooden toothpick.

(d) Apply a small amount of grease onto the O-ring of the jet nozzle. If the O-ring is damaged, replace the O-ring.

⚠CAUTION

- **Always check the jet fluid pressure before using the machine.**
- **Align the cutout of the rectification nozzle (U) and pin of the rectification drum (U) to avoid damaging the rectification nozzle (U).**

3) Precautions for handling the jet nozzle

(a) Jet nozzle
The ceramic nozzle is high?precision and can chip from impacts or concentrated force. Handle with care.

(b) Precautions for handling

(i) Storing the nozzle
Wrap the nozzle in cushioning material, and make sure that it does not contact other parts or other nozzles.
(Avoid storing the nozzle in a tool box or with other parts.)

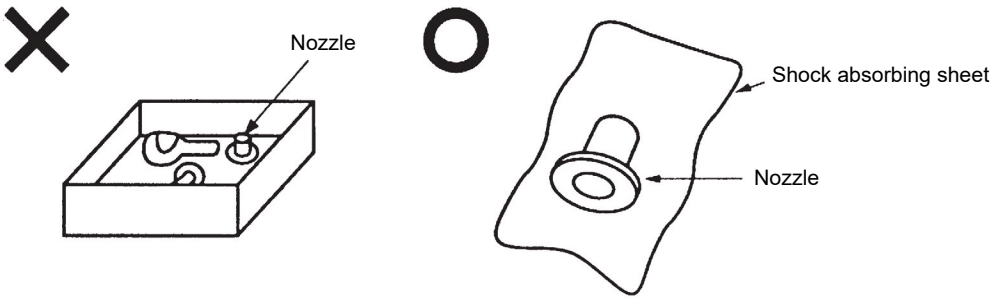


Fig. V.5.30

(ii) Do not apply impact on the nozzle.
Do not throw or drop the nozzle.

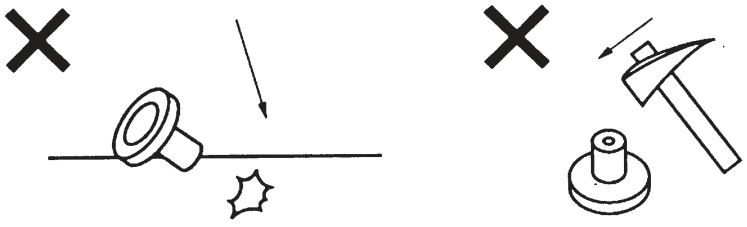


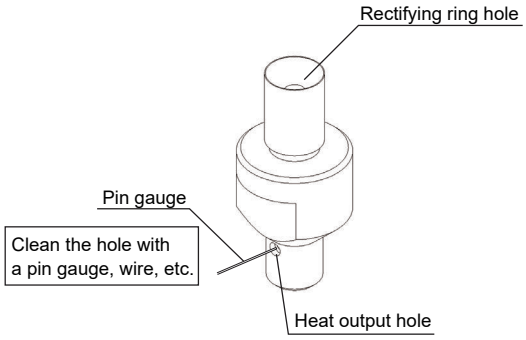
Fig. V.5.31

Avoid handling the nozzle with tools, and use hands when possible.

Fig. V.5.32

(iii) Precautions for dielectric fluid
If foreign matter (cutting chips, etc.) enters the dielectric fluid, the nozzle will wear easily. Accurately service the dielectric fluid filter (refer to "V. MAINTENANCE AND ALARM LIST"), and make sure that foreign matter does not enter the clean fluid tank of the dielectric fluid reservoir.

(3) Upper diamond die



[Cleaning the side hole of the upper diamond die]

Fig. V.5.33

1) Inspection method

If the diamond die's interior is dirty or the heat outlet is blocked (oil/residue), auto?connection drops and wire breaks increase. If upper die retries rise on the AT Maintenance screen, clean the diamond die.

2) Cleaning method

(a) Remove the upper diamond die guide. For the removal method, see "1.2.1 Checking the upper diamond die".

(b) Soak the upper diamond die in the solution*, and use the ultrasonic cleaning machine or nylon brush to clean them.

(c) After cleaning, wash sufficiently with running water, and then blow with air.

(d) Please clean the heat output hole of the upper diamond die with a plug gauge or wire.

* **Recommendation: Japan Mecha Chemical, KC-12A 2% to 3% water-diluted solution**

- **The side hole at the tip is for the cooling water. If this hole is clogged with sludge, etc., the wire could break. During maintenance, always confirm that this hole is not clogged.**
- **Always use the die replacement jig when tightening the diamond die.**
- **If the diamond die has been soaked into the acid solution for a long time, the diamond section may drop.**

(4) Guide C

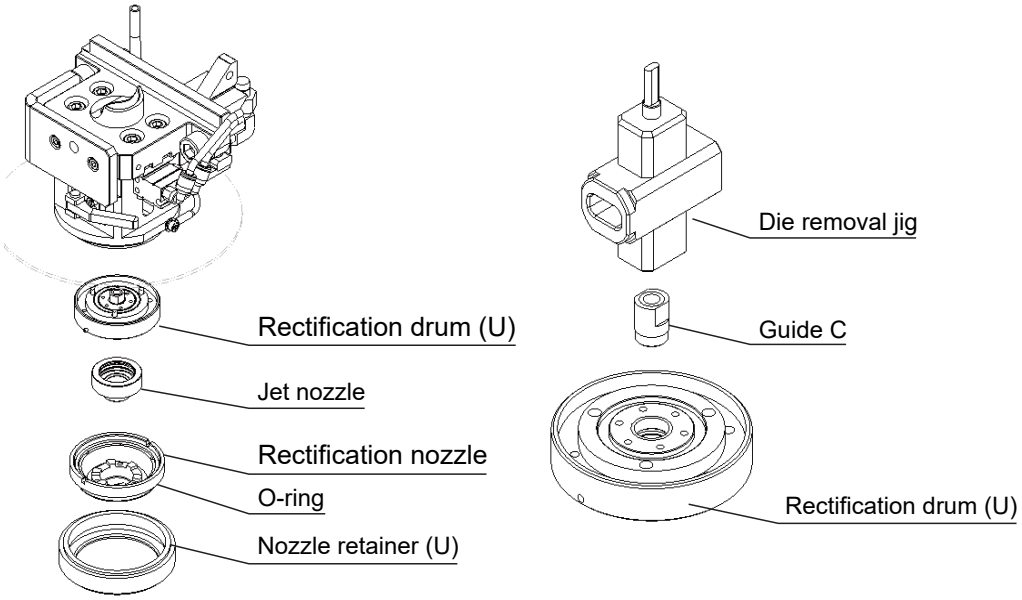


Fig. V.5.34

Upper guide C, mounted on the U rectification drum, presses the wire against the power feeder between the upper guide and guide UD. Long or high?speed machining generates wire chips.

1) Inspection method

Check whether the guide C is clogged by brass powder by visual inspection or wire threading. In case of clogging, clean the guide C.

2) Cleaning method

(a) Remove the nozzle pressing pad (U), rectifying nozzle (U) and jet nozzle.

(b) Disassemble the rectification drum (U). (Three positions are fixed with M3 eyebolts.)

(c) Disassemble the guide C from the rectification drum (U) using the die removal jig.

(d) Soak the guide C in the solution*, and use the ultrasonic cleaning machine or nylon brush to clean them.

(e) After cleaning, wash it sufficiently with running water, and then blow with air.

(f) Reinstall the guide C, and then reassemble the rectification drum (U) and other parts.

(g) Fit the O ring to the rectification nozzle (U), and then install it using the nozzle retainer (U).
*** Recommendation: Japan Mecha Chemical, KC-12A 2% to 3% water-diluted solution**

NOTICE

Align the cutout of the rectification nozzle (U) and pin of the rectification drum (U) to avoid damaging the rectification nozzle (U).

(5) Upper wire guide block

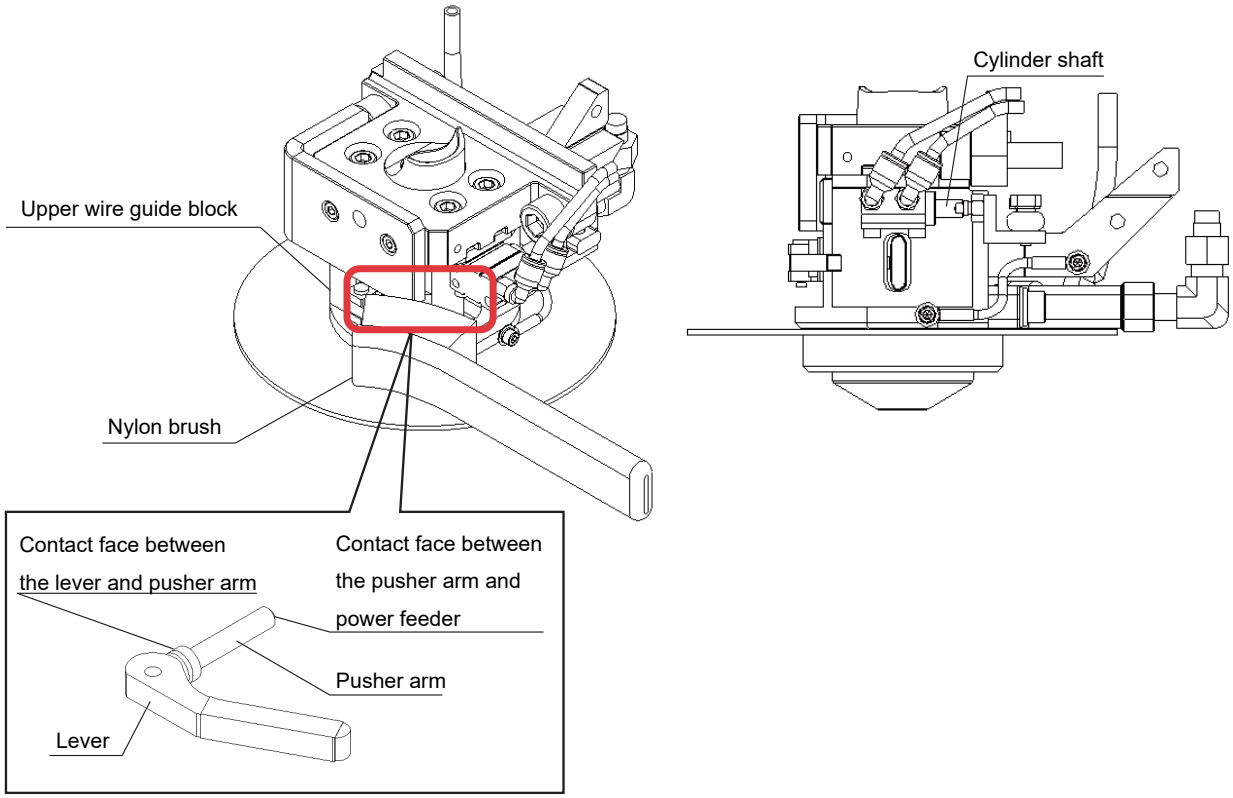


Fig. V.5.35

1) Inspection method

Machining chips darken the dielectric, fouling the upper wire guide block. Excess buildup degrades performance and accuracy—clean it after machining.

2) Cleaning method

(a) Spray an appropriate amount of cleaner onto the guide, scrub with a nylon brush, and use a brass brush for stubborn stains.
Remove the power feeder first, then blow dielectric or air into its insertion hole to clear wire and feeder chips.
Always clean after changing the feeder position.

(b) Wipe the dirt off the air cylinder shaft.

(c) Install the power feeder on the upper wire guide block properly.

(d) Be sure to close the hand lever and make sure the power feeder is fixed.
When the lever is not flexible enough to operate, clean the following parts:
1) Contact face between the lever and pusher arm (check if there is any machining sludge)

2) Contact face between the pusher lever and power feeder (check if there is any machining sludge)

NOTICE

- **Severe adhesion of dirt to the upper wire guide block may cause corrosion (rust) on the surface and inside of the block. In addition, insufficient power supply may cause abnormal discharge between the power feeder and the upper wire guide block and further affect machining performance, machining accuracy, and the AT INSERT functions.**
- **If the fluid filter is used under the status of being pierced, or a non-specified filter is used, dirt will adhere to the upper wire guide block at an early stage due to cycle of polluted fluid. To maintain normal operation of the machine, always use the specified fluid filter (refer to "V. MAINTENANCE AND ALARM LIST") and replace it when torn.**
  Pay attention so that AT unit does not get wet with the fluid when cleaning the upper wire guide block.
- **Do not use the commercial cleaning spray for the wire cut.**
  Otherwise, the resin parts used in the AT unit may be damaged.
- **If the air cylinder is still not smooth after the air cylinder shaft is cleaned, contact the service center.**
- **If you find any abnormal condition while cleaning, contact the service center to solve the problems by consultation.**

5.2.6 Lower wire guide

(1) Lower diamond die

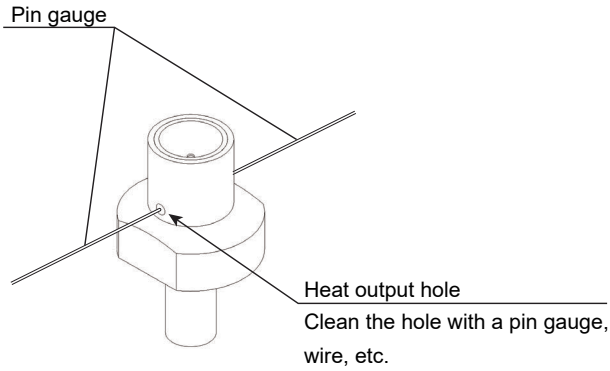


Fig. V.5.36

1) Inspection method

If the lower diamond die is dirty or its heat outlet is blocked (sludge/dirt), auto-connection drops and wire breaks increase. If lower die retries rise on the AT Maintenance screen, clean the diamond die.

2) Cleaning method

(a) Remove the lower diamond die. For the removal method, see "1.2.2 Checking the lower diamond die". Please use the removal jig special for die for removal.

(b) Soak the lower diamond die in the solution*, and use the ultrasonic cleaning machine or nylon brush to clean them.

(c) After cleaning, wash it sufficiently with running water, and then blow with air.

(d) Clean the Cooling hole on the tip of the lower diamond die with the pin gauge or wire.

*** Recommendation: Japan Mecha Chemical, KC-12A 2% to 3% water-diluted solution**

NOTICE

- **The side hole at the tip is for the cooling water. If this hole is clogged with sludge, etc., the wire could break. During maintenance, always confirm that this hole is not clogged.**
- **Always use the die replacement jig when tightening the diamond die.**
- **If the diamond die has been soaked into the acid solution for a long time, the diamond section may drop.**

(2) Guide C

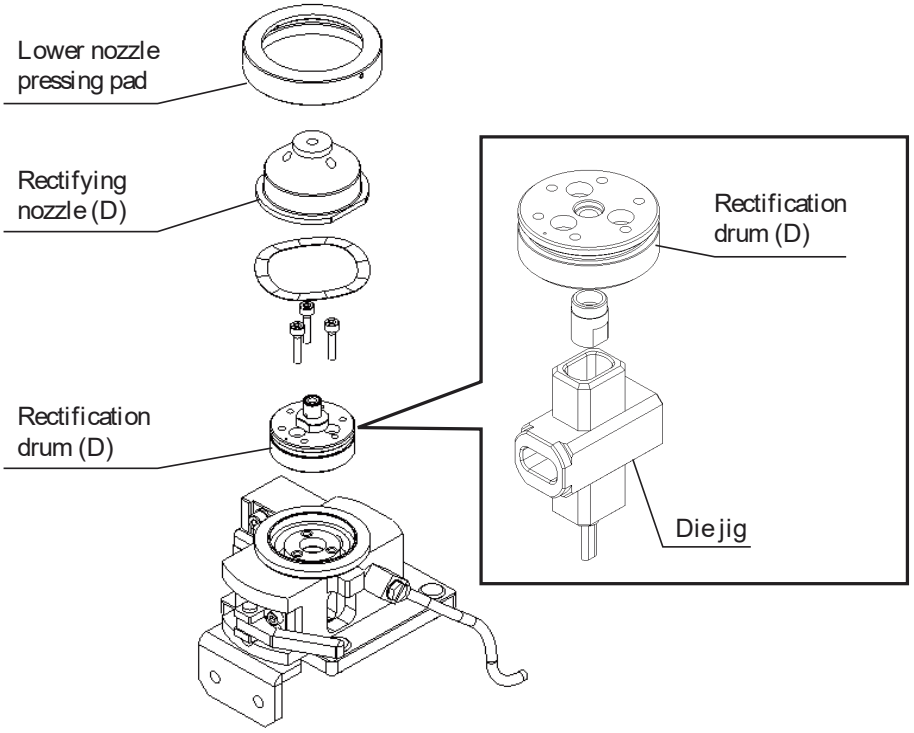


Fig. V.5.37

Lower guide C, mounted on the D rectification drum, presses the wire against the power feeder between the lower guide and guide UD. Long or high?speed machining generates wire chips.

1) Inspection method

Check whether the guide C is clogged by brass powder by visual inspection or wire threading. In case of clogging, clean the guide C.

2) Cleaning method

(a) Remove the lower nozzle retainer and the rectification nozzle (D).

(b) Remove the rectification drum (D). (Three positions are fixed with M3 eyebolts.)

(c) Disassemble the guide C from the rectification drum (D) using the die removal jig.

(d) Soak the guide C in the solution*, and use the ultrasonic cleaning machine or nylon brush to clean them.

(e) After cleaning, wash it sufficiently with running water, and then blow with air.

(f) Reinstall the guide C, and then reassemble the rectification drum (D) and other parts.

* **Recommendation: Japan Mecha Chemical, KC-12A 2% to 3% water-diluted solution**

(3) Guide U, D

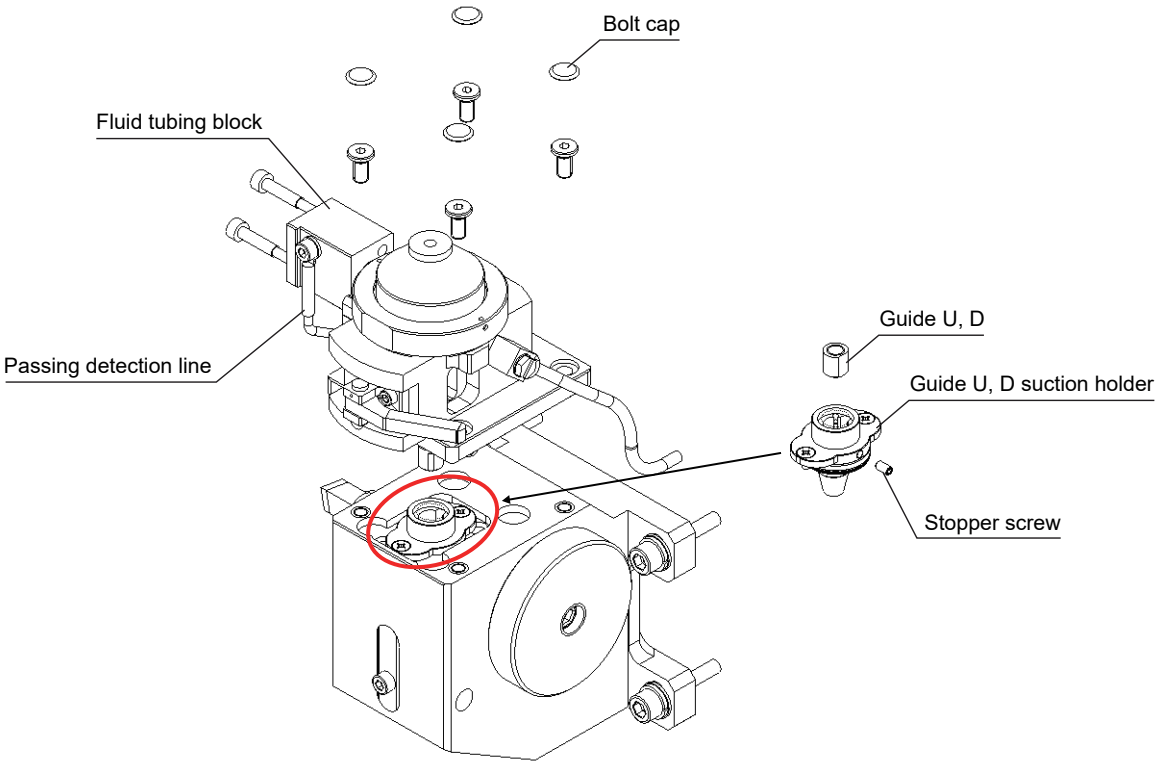


Fig. V.5.38

Lower guide U/D is beneath the lower guide block. It shears and presses the wire against the power feed between the lower guide and lower guide C. Wire chips increase with long or high?speed machining.

1) Inspection method

History management > Inspection > AT maintenance:
If lower guide U/D retries increase or “WIRE BREAKAGE LOWER AREA” occurs, hand-feed wire through the lower diamond die to check for clogs/catching. If found, clean it per the procedure.

2) Cleaning method

(a) Remove the fluid tubing block.

(b) Remove the bolt cover and lower wire guide block. (Please take care not to lose the bolt cover.)

(c) Remove the lower guide U, D holder.

(d) Loosen the screw fixing the guide U, D, and extrude the guide U, D out with the supplied die removal jig.

(e) Soak the guide U, D in the solution*, and use the ultrasonic cleaning machine or nylon brush to clean them.

(f) After cleaning, wash it sufficiently with running water, and then blow with air.

*** Recommendation: Japan Mecha Chemical, KC-12A 2% to 3% water-diluted solution**

NOTICE

- **When fixing guide U, D to the lower wire guide block, securely press and fix as this section determines the power feed terminal shearing amount.**
- **Before reassembly, always check the installation of the passing detection line.**

(4) Lower wire guide block

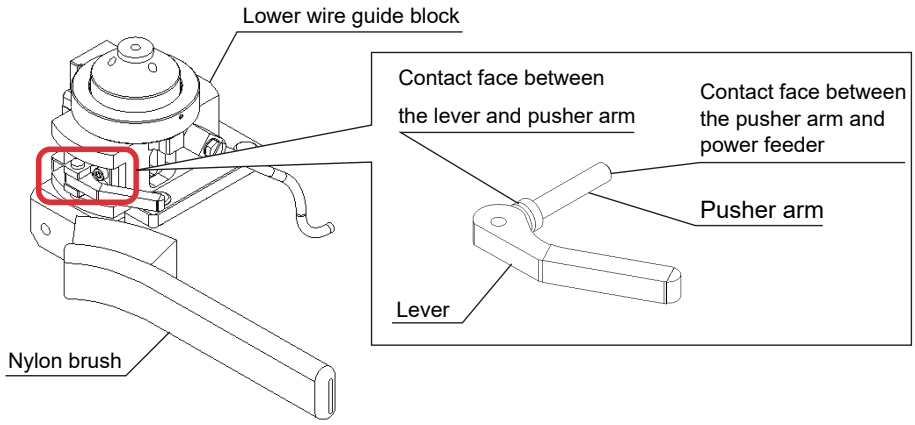


Fig. V.5.39

1) Inspection method

Machining chips darken the dielectric, fouling the lower wire guide block. Buildup reduces performance and precision. Clean it after each job.

2) Cleaning method

(a) Spray an appropriate amount of cleaner onto the lower wire guide block, scrub with a nylon brush, and use a brass brush for stubborn stains.

(b) Remove the power feeder, then blow dielectric or air into its insertion hole to clear wire and feeder chips. Wipe the air?cylinder shaft clean. Always clean after changing the feeder position.

(c) Install the power feeder on the lower wire guide block properly.

(d) Be sure to close the hand lever and make sure the power feeder is fixed.
When the lever is not flexible enough to operate, clean the following parts:
1) Contact face between the lever and pusher arm (check if there is any machining sludge)
2) Contact face between the pusher lever and power feeder (check if there is any machining sludge)

NOTICE

- **Severe adhesion of dirt to the lower wire guide block may cause corrosion (rust) on the surface and inside of the block. In addition, insufficient power supply may cause abnormal discharge between the power feeder and the lower wire guide block and further affect machining performance, machining accuracy, and the automatic connection functions.**
- **If the fluid filter is used under the status of being pierced, or a non-specified filter is used, dirt will adhere to the lower wire guide block at an early stage due to cycle of polluted fluid. To maintain normal operation of the machine, always use the specified fluid filter (refer to "V. MAINTENANCE AND ALARM LIST") and replace it when torn.**
- **Pay attention so that AT unit does not get wet with the fluid when cleaning the lower wire guide block.**
- **If you find any abnormal condition while cleaning, contact the Mitsubishi Electric Service Center to solve the problems by consultation.**

5.2.7 Lower roller

NOTICE

- **When fixing lower wire guide block, machining sludge or dirt sticking on the surface of WG lower insulation board (ceramic) may cause the ceramic to break. Therefore, clean the ceramic surface first before installation.**
- **Do not forget to attach the bolt caps. Otherwise, the machining performance may be decreased.**
- **If cables are removed during inspection and cleaning, reinstall them by referring to "(4) Lower feeder" in "5.2.7 Lower roller" of this chapter.**

Caution

Precautions for lower wire guide installation

1. Installing the lower wire guide

Before installing the lower wire guide, clean the back of the lower ceramic insulation plate and the front of the lower roller block. Sludge or dirt on the mounting surfaces can damage the insulation plate.

(a)Clean the mounting surface (back) of the lower insulation plate and the mounting surface (front) of the lower roller block.

If sludge or dirt attaches to the mounting surface, use a nylon brush to remove it. If the sludge is stubborn, dip a cloth in neutral detergent and use it to wipe the contaminated part.

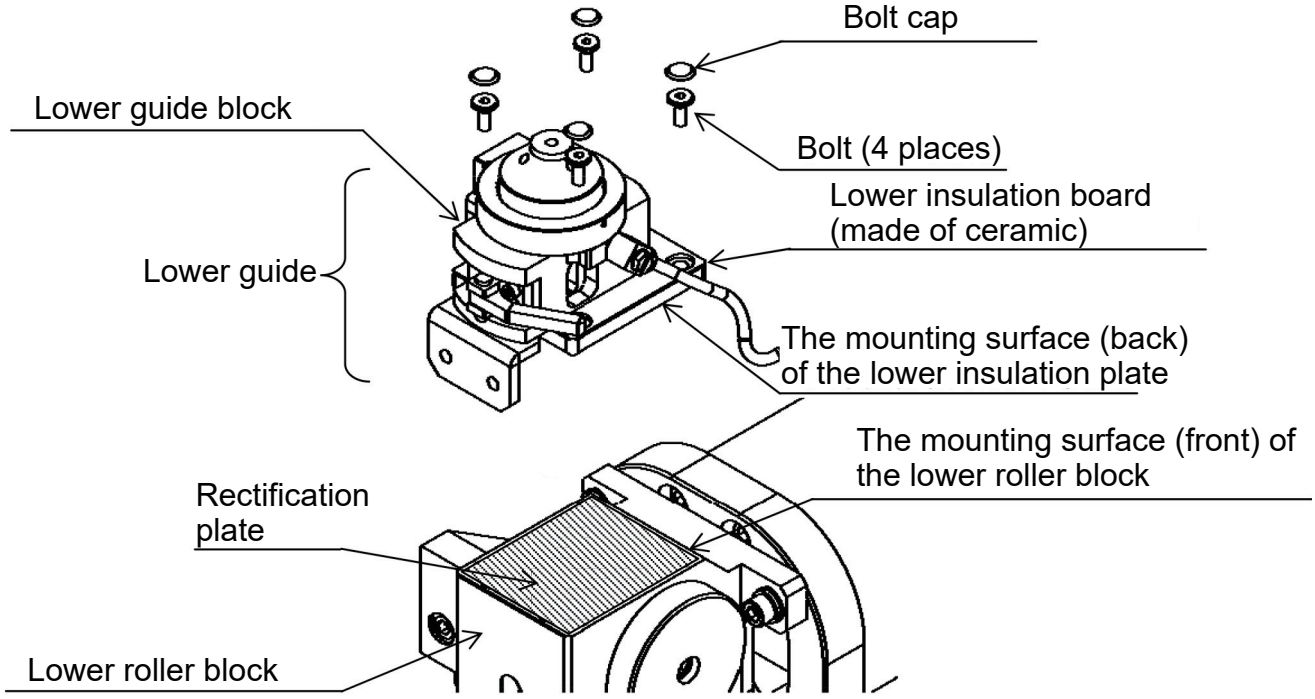


Figure 1 Lower guide schematic diagram

(b) Check the mounting surface (front) of the lower roller block for scratches caused by burrs or depression.

If any scratches caused by burrs or depressions are found, use a gravel to remove them.

(c) Check that the lower insulation plate and the lower roller block fit tightly and seamlessly.

If a gap appears between the lower insulation plate and lower roller block after installing the lower wire guide, the lower guide UD holder or rectification plate is likely misinstalled. Reinstall per the maintenance guide.

(d) Tighten the bolts (4) evenly, and attach the bolt caps.

If the bolts are too loose, the dielectric fluid may be ejected or the threading rate may drop during lower recovery. Therefore, be sure to tighten the bolts so that dielectric fluid will not be ejected during lower recovery. Do not forget to attach the bolt caps.

2. Assembling the lower guide

It is not necessary to remove the lower insulation plate from the lower guide block. If it is removed, follow the steps below to reinstall it. Be sure to clean the mounting surface (back) of the lower guide block and the mounting surface (front) of the lower insulation plate before installation. If foreign matters like sludge or dirt attach to the mounting surface, the lower insulation plate may be damaged.

(a) Clean the mounting surface (back) of the lower guide block and the mounting surface (front) of the lower insulation plate.

If sludge or dirt attaches to the mounting surface, use a nylon brush to remove it. If the sludge is stubborn, dip a cloth in neutral detergent and use it to wipe the contaminated part.

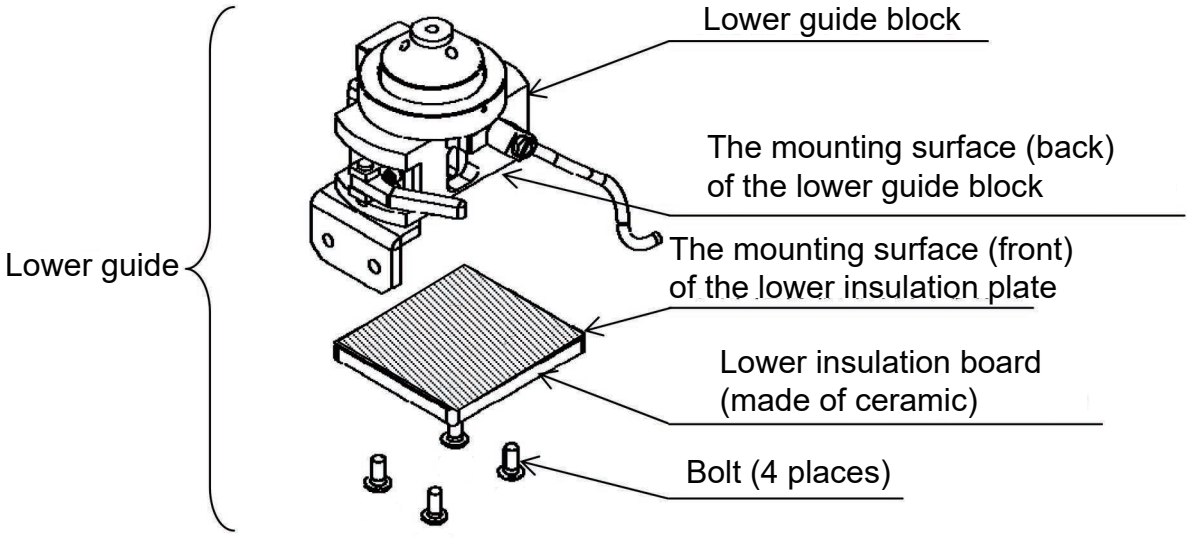


Figure 2 Lower guide schematic diagram

(b) Check that the mounting surface (back) of the lower guide block is free of scratches caused by burrs or depression.

If any scratches caused by burrs or depressions are found, use a gravel to remove them.

(c) Tighten the bolts (4) evenly, and attach the bolt caps.

If the bolts are too loose, the dielectric fluid may be ejected or the threading rate may drop during lower recovery. Therefore, be sure to tighten the bolts so that dielectric fluid will not be ejected during lower recovery. Do not forget to attach the bolt caps.

(1) Lower roller

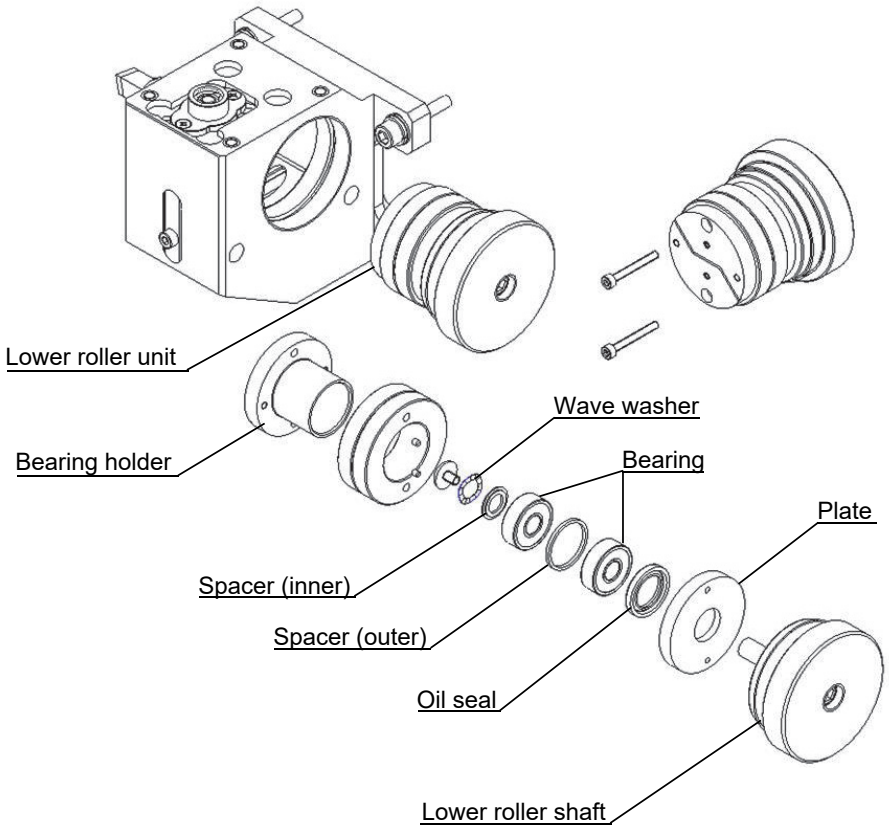


Fig. V.5.40

The "lower roller" is located below the lower wire guide block. It functions to smoothly feed the machined wire from the lower arm through the back of the machine and collect it in the collection pipe.

1) Inspection method

If the lower roller's oil seal is worn, sludge/dirt can foul the bearing, causing rough rotation, higher wire tension, and wire breaks. If the removed roller doesn't spin smoothly, clean or replace parts. If it spins smoothly, wipe the roller's slot with a cotton swab.

2) Cleaning method

(a) Prepare a wave washer and an oil seal ring in advance.

(b) Rotate the shaft (knob of knurled screw) in the clockwise direction (left-handed screw), and remove the lower roller.

(c) Install the M3 screws used for fixing roller in hole A, tighten the M3 screws alternately, and then remove the lower roller shaft from the bearing holder.

(d) After removing the bearing from the lower roller shaft, clean the dirt on the surface of the lower roller and machining sludge and dirt inside the bearing holder.

(e) Replace the bearing, oil seal ring and wave washer, and assemble them to the original state. When installing the bearing holder onto the bearing shaft, tighten the M3 screws alternately.

NOTICE

- **Pay attention to the direction of the oil seal. If you install it in the opposite direction, machining sludge and dirt may enter the bearing holder, which may shorten the lifetime of the bearing.**
- **Do not reuse the removed oil seal and wave washer.**
- **Do not soak the lower roller unit into the acidic liquid.**
- **If cables are removed during inspection and cleaning, reinstall them by referring to "(4) Lower feeder" in "5.2.7 Lower roller" of this chapter.**

(2) Nest

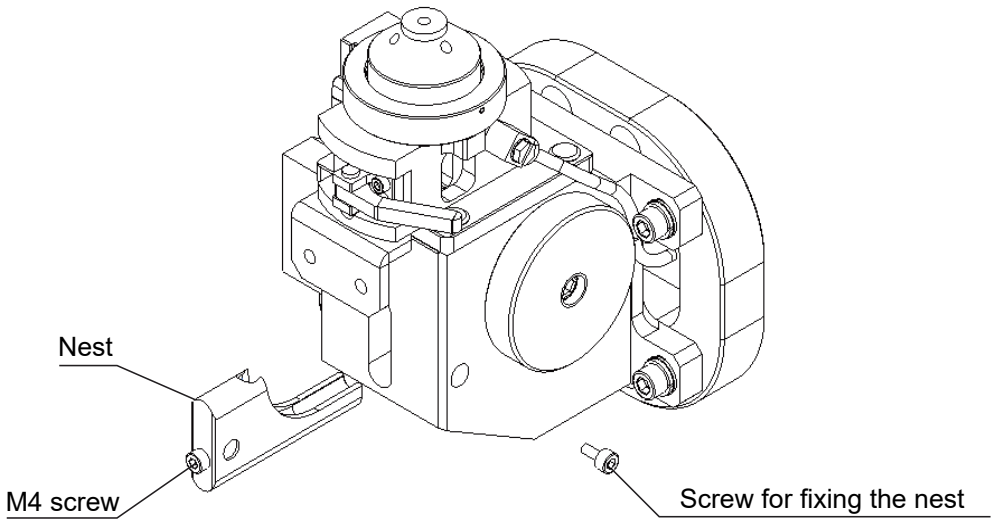


Fig. V.5.41

The nest is used to transfer both wire and cutting fluid to the collection part when the wire is being inserted.

1) Inspection method

If the number of retries around the nest increases during wire inserting, it may be caused by the machining sludge or damage on the R chamfer angle part of the lower roller nest. If the above problem occurs, follow the following flow to clean the nest.

2) Cleaning method

(a) Loosen the screw fixing the nest under the right side of the lower roller block.

(b) Pull out the nest by pinching the head of the M4 screw on the front side. If it is hard to pull out, use pliers to hold the M4 screw.

(c) Clean the R chamfer angle part of the nest. When the R chamfer angle part is damaged, polish it with a fine emery paper (around 1000 grit).

(d) After installing the nest, tighten the screw fixing the nest under the right side of the lower roller block.

- **If the nest is hard to remove, machining sludge may be adhering around the nest. Before installing the nest, clean the surface of the nest or around the nest insertion hole first.**
- **If cables are removed during inspection and cleaning, reinstall them by referring to "(4) Lower feeder" in "5.2.7 Lower roller" of this chapter.**

(3) Lower roller block

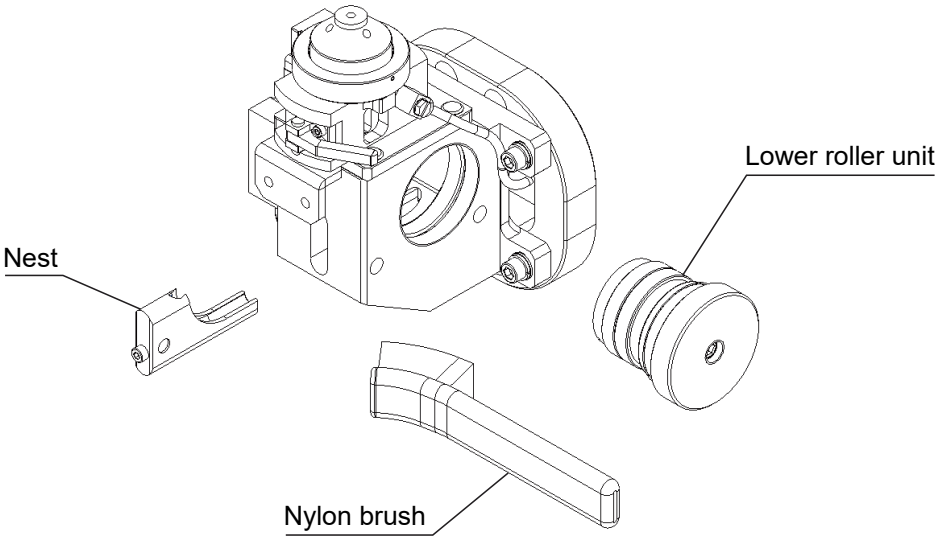


Fig. V.5.42

1) Inspection method

Machine operation produces chips, causing the dielectric fluid inside the working tank to turn black. Since the lower roller block is soaked in this fluid for a long time, dirt is gradually adhered to it. Excess dirt adhering to lower roller block may decrease machining performance, so be sure to clean after each time of machining.

2) Cleaning method

(a) Remove the nest of the lower roller and lower roller block.

(b) Clean the machining sludge off the surface and inside of the lower roller block.

(4) Lower feeder

The lower feeder means one set of cables connected to the lower roller block with bolts as shown in the below pictures.

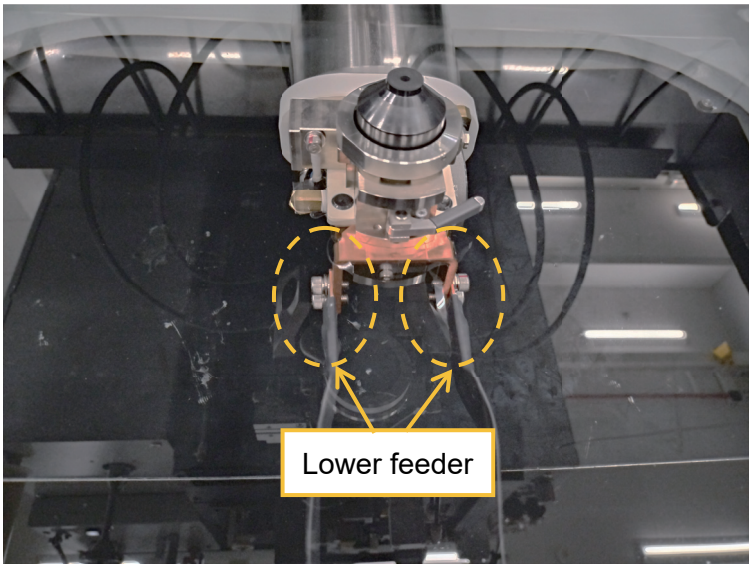


Fig. V.5.43 Lower feeder

5.2.8 AT cleaning mode

1) Inspection method

If the diamond die is dirty or its heat outlet is blocked (sludge/dirt), auto?connection drops and wire breaks increase. Use AT cleaning mode to clean the die without removal.

2) Cleaning method

(a) Change the rectification nozzles (U) and (D) to the cleaning nozzles (U) and (D), respectively.

(b) Press the [AT Washer] button to execute the cleaning.

(c) Put the rectification nozzles (U) and (D) back.

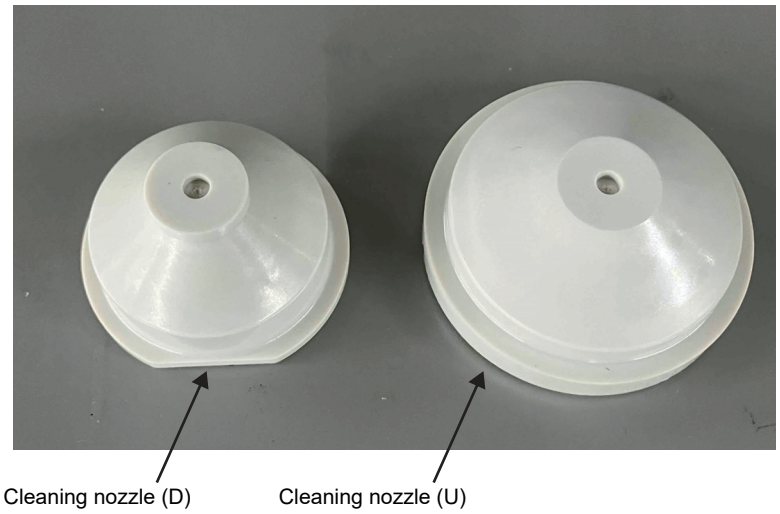


Fig. V.5.44 Cleaning nozzle

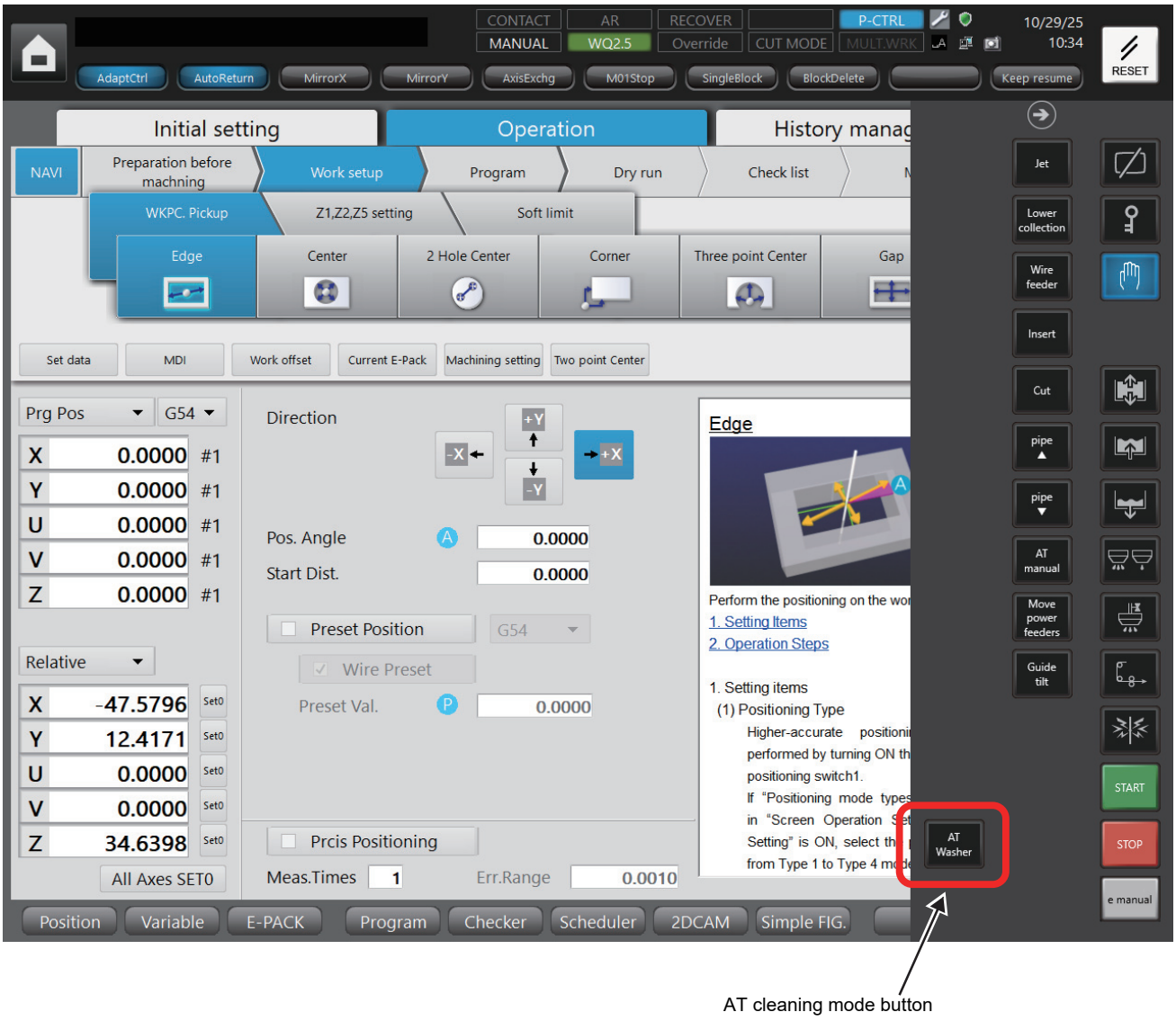


Fig. V.5.45 AT cleaning mode selection screen

5.2.9 Wire collection section

(1) Wire collection device

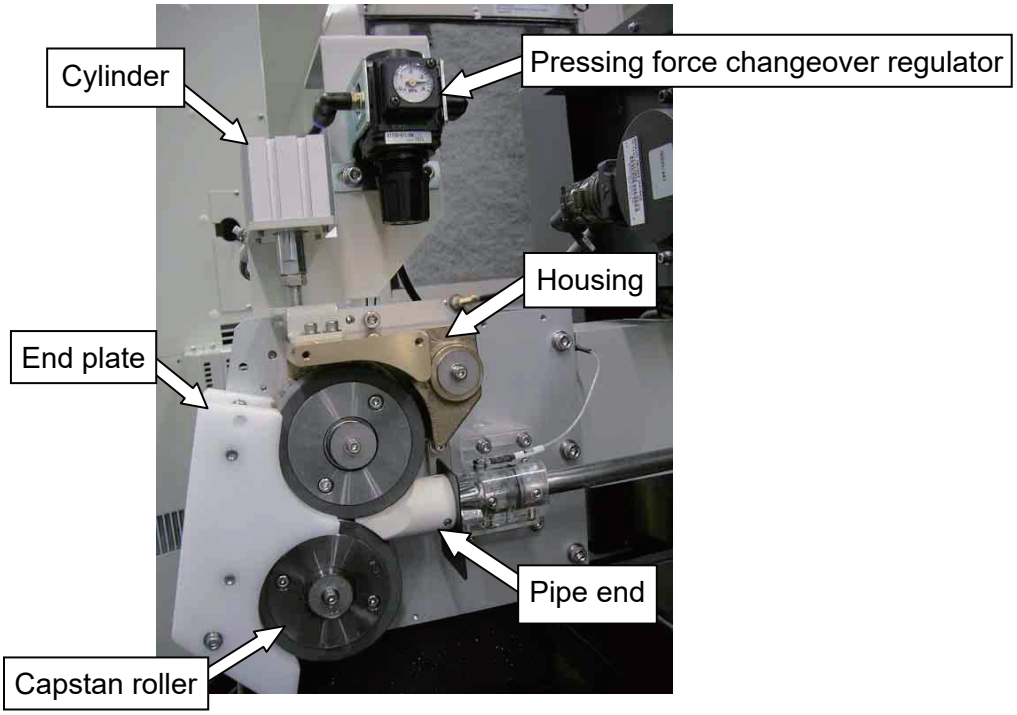


Fig. V.5.46

The wire collection unit has a fixed roller and a pinch roller. During feed, they grip and rotate to apply tension between the main tension rollers and wind the wire.

1) Inspection method

If machining continues while the collection roller is worn, the wire may get entangled or a "Wire breakage area" alert may occur.

(a) Remove the splash proof cover (two M4 screws).

(b) Check if the surface of the collection roller gets dirty or worn.

(c) Check if the wire gets entangled on the collection roller and inner gear.

Sludge could enter the roller shaft and make it hard to remove the rollers. When inspecting the roller surface, periodically remove the roller and clean the roller shaft.

2) Cleaning method

(a) Wipe the roller surface with a dry cloth.

(b) When the roller gets worn, please turn the roller from side to side, change the collar, or replace new parts.

3) Replace method of the roller

(a) Remove the splash-proof cover of the wire collection section and the end plate, and turn the pressure switching regulator of the roller pressure plate to the 0 MPa position.

(b) Move the pipe-end block to the main unit side within the slot range.
Remove the two M4 screws from the capstan roller.
(Make sure that the collar in the shaft does not get lost.)

(c) Remove the two M4 screws from the pinch roller, and pull out the pinch roller from the shaft while lifting the housing.
(Make sure the collar in the pinch roller does not get lost.)

(d) The wire travel position of the collection roller can be changed with the following two methods. By using these two methods in combination, the same roller can be used for four times* 1

(i) Reversing the roller front and back
Reverse the pinch roller and capstan rollers so that the front side comes to the back.

(ii) Shifting the collar position
Before setting the rollers, attach the collar previously removed onto the end of the pinch roller and capstan roller shafts.
Attach the rollers in the same direction as the previous direction.

(e) If the four positions on the roller surface have already been used, replace it with a new one.* 2

(f) Following the removal procedure in reverse, fix the pinch roller and capstan roller respectively.
(Pay attention to the resin spacer between the gear and roller when inserting the screw.)* 3

(g) Secure the pipe-end block against the positioning plate.

(h) Install the drip-proof cover.

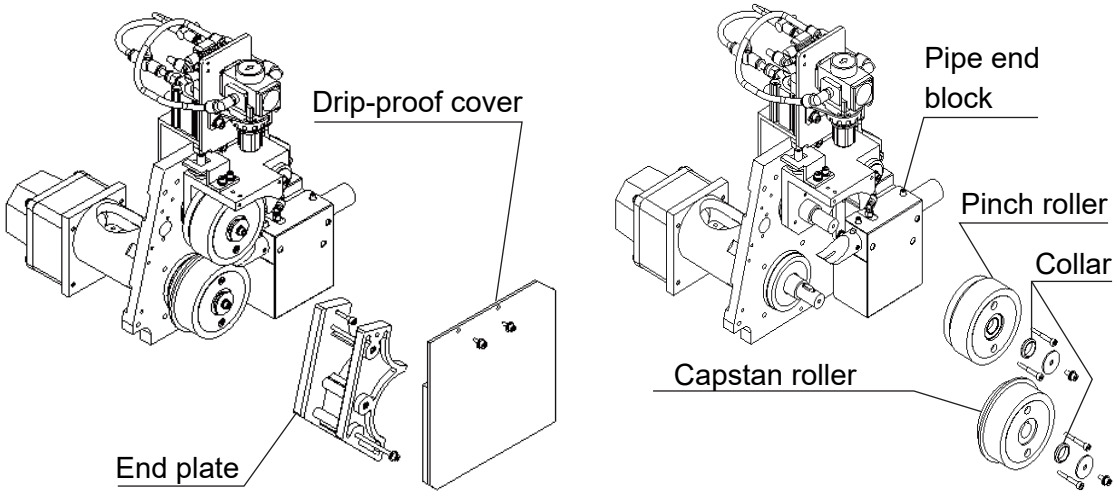
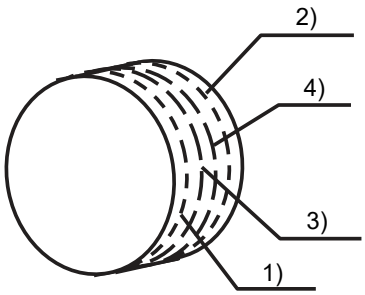
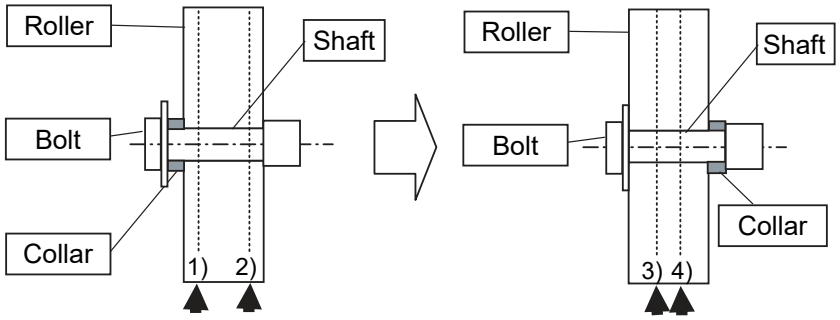


Fig. V.5.47

Collection roller wire travel position



Procedures for using four times

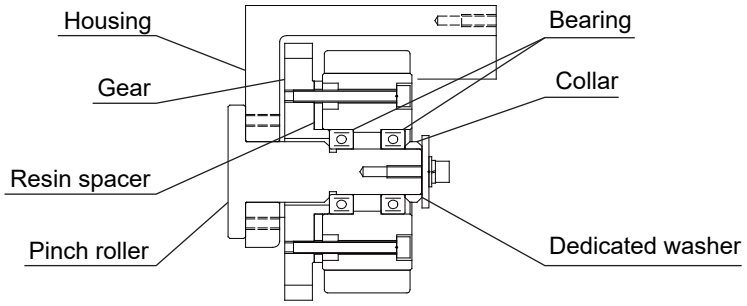


1) Use normally. (The collar is outside the roller.)
2) Reverse the roller's front and back before use.
3) Attach the collar to the inside of the roller before use.
4) Reverse the roller's front and back before use.

Fig. V.5.48

*1 The wire travel position of both pinch roller and capstan roller can be shifted in positions 1) to 4).
*2 Change the position or replace the upper and lower pinch rollers and capstan rollers at the same time. The wire could become more curled and cause entangling if only one side of the rollers is replaced.
*3 The rear side vertical sectional view of the housing and pinch roller and the dissembled parts are shown below.

Rear side vertical sectional view of housing and pinch roller section



Disassembled housing and pinch roller section

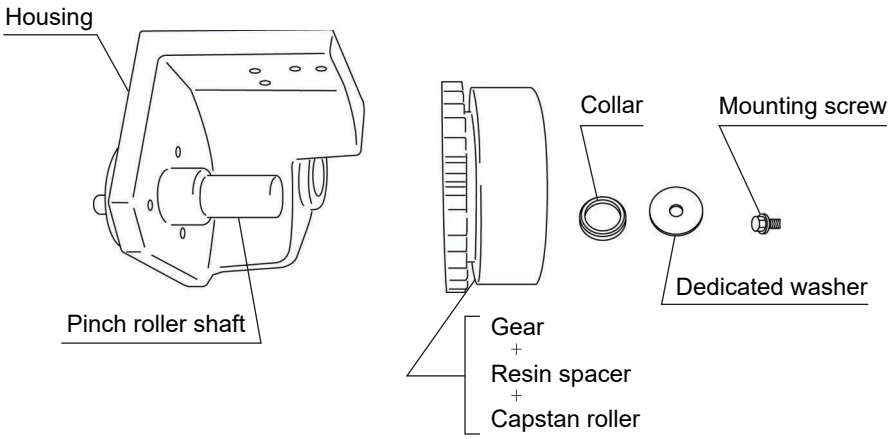


Fig. V.5.49

4) Removing the housing

The housing must be removed when servicing the collection unit. Use the following procedures to remove the housing.

(a) Remove the splash-proof cover (acrylic cover) from the wire collection section.

(b) Turn the roller pressing force changeover regulator to the 0 MPa position.

(c) Remove the three M4 socket bolts, and then remove the hook and stopper plate.

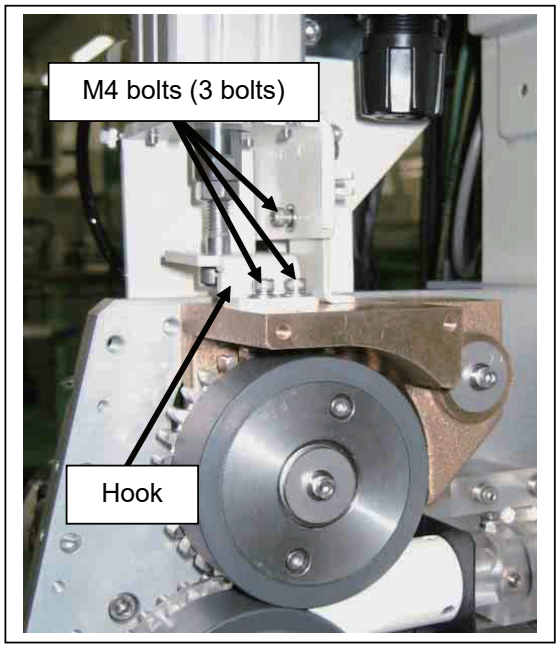


Fig. V.5.50

(d) Remove the M4 socket bolt fixing the housing, and then lift the housing upward to remove it.

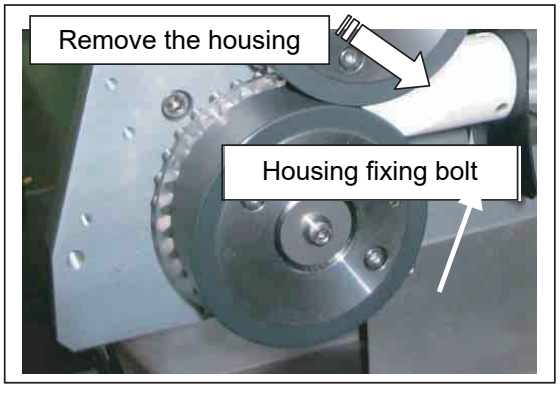


Fig. V.5.51

(e) This completes the removal work.

(f) To mount the housing again, follow the removal procedures in reverse and fix it with the M4 bolt.

(g) When attaching the stopper plate, always press the stopper plate against the upper side and fix it with the M4 bolts. Lift the housing up to the stopper and fix the hook plate with the M4 screw.
*** If the movable distance of the capstan roller is insufficient, an insertion fault could occur.**

(h) Install the splash-proof cover (acrylic cover).

5.3 Troubleshooting

If the device or system fails, all auto/manual runs stop. For listed AT (auto wire threader) issues, use the provided recovery steps. For other or unresolved problems, contact our service center.

5.3.1 Insertion

(1) When it is unable to insert

Cause 1	When the wire electrode cannot pass through any guide section, and the reset times exceed the set times
Remedies	1) Clean the diamond die. 2) Clean the guide U, guide D, and guide C. 3) Clean the jet nozzle. 4) Clean the cutting contact and cutting contact retainer. 5) Clean the wire pressure roller. 6) Clean the guide C.
Cause 2	Wire electrodes cannot be transferred.
Remedies	1) Check that the wire electrode path is correct. 2) Check whether the wire has come off the pulley in the wire electrode path.

5.3.2 Cutting

(1) Cannot be cut off

Cause 1	Cutting current cannot flow sufficiently.
Remedies	1) Clean the cutting contact and cutting contact retainer. 2) Check the operation of the cutting contact retainer. If it does not operate smoothly, please apply grease onto the pin of the cutting plate.
Cause 2	No cutting tension is applied.
Remedies	1) Clean the main tension roller and pinch roller A/B. 2) Clean the wire pressure roller.

5.3.3 Wire chip collection

(1) When wire chip electrodes cannot be wound up

Cause 1	Wire chip electrodes remain in the collection unit.
Remedies	1) Remove wire electrodes from the wire chip collection box. 2) Remove wire chips in the collection unit. 3) Replace the scraper.

5.3.4 Wire collection device

(1) When wire electrodes are twined

Cause 1	The value set for the pressure of wire pressing is incorrect.
Remedies	1) Set the pressure of wire pressing.

6. MAINTENANCE AND INSPECTION OF DIELECTRIC FLUID RESERVOIR

6.1 Maintenance and Inspection Items of Dielectric Fluid Reservoir

	Item	Maintenance and inspection	Reference
Before operation inspection	Dielectric fluid amount	Check that there is sufficient dielectric fluid	6.1.1
	Dielectric fluid filter	Check that the filter pressure is 0.25MPa or less	6.1.2
	Supply pump	Check for abnormal sounds and leaks	6.1.3
Monthly inspection	Resistivity sensor	Clean the specific resistivity sensor	6.1.4
6-month inspection	Float switch	Clean of the float switch	6.1.7
Others	Water purifier	Replace the ion exchange resin	6.1.5
	Tank	Clean the waste fluid tank	6.1.6

6.1.1 Checking dielectric fluid amount

If the fluid level in the dielectric fluid reservoir is low, the working tank may not be filled with enough fluid to reach the workpiece height.

Checking the dielectric fluid reservoir fluid level

(1) Turn ON with the working tank open, and accumulate the fluid under the table of the working tank.

(2) When rapid fill stops, wait at least 1 to 2 minutes for the fluid level to stabilize.

(3) View the level gauge on the tank. It is normal when the fluid level is within the green range.

(4) When the fluid level is below the green range, the fluid is insufficient and must be filled.

Fig. V.6.1

Note that if too much fluid is filled in, the fluid could leak out of the tank when the power is OFF.

6.1.2 Inspection of dielectric fluid filter

(1) Check the filter pressure under the condition without fluid overflow, and replace the filter with 0.25MPa as a guide. However, only the original Mitsubishi fluid filter can be used.
Check the pressure value of the dielectric fluid filter from "History management" > "Consumption".

(2) Disassemble the filter cover and check whether the filter has been damaged or broken by visual inspection.
(For the filter replacement method, see "I. SAFETY AND OUTLINE OF MACHINE".)

- **The guideline for the filter pressure is for when machining ferrous material. The filter life could drop remarkably when machining aluminum or depending on usage frequency.**
- **The filter lifetime may vary greatly with machining (wire diameter, work piece material, and number of cuts).**
- **The filter pressure changes with the amount of dielectric fluid (LQ notch of machining condition).**
  Do not discharge the fluid when confirming the pressure of the filter.
- **Replace the two filters at the same time.**
  Crack may be caused when the filter with clogged hole is used with a normal filter.

6.1.3 Inspection of the supply pump

(1) Check that there is no metallic sound, or abnormal vibration.

(2) Check that there is no fluid leaking from the pump flange section.

Observe the following matters to prevent the supply pump from running dry during installation and during initial operation after the machine has been stopped for a long time.

- **Dielectric fluid amount setting LQ = 14 notch or more**
- **Air bleeding**

6.1.4 Cleaning of resistivity sensor

Sludge can build up on the specific resistivity sensor's electrode, skewing readings. Monthly, power off, remove the sensor, scrub the electrode with a nylon brush, or clean with a mild acid and rinse well.

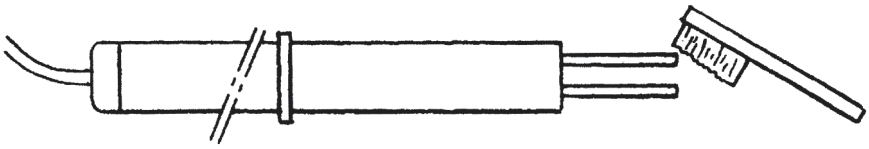


Fig. V.6.2 Specific resistivity sensor

6.1.5 Replacement of water purifier (ion exchange resin)

The water purifier removes ions to raise resistivity and improve insulation. The 10?L resin purifies several hundred liters, but life varies with the set resistivity and shortens with materials like tungsten carbide. When saturated, purification drops, resistivity won't reach the set range, and the current value display stays red.

- **In the state, when the resistivity is low, the background color for the resistivity value displayed will change to red and the light will stay lighting.**
- **The life of the ion exchange resin will differ according to the amount of ion in the dielectric fluid, so always use clean filtered water with low levels of salt, magnesium, and calcium, etc.**
- **If the concentration of carbon dioxide increases in the room due to the use of a kerosene heater, etc., the life of the ion exchange resin may be shortened. Always ventilate the room well.**
- **Drain the water when replacing the ion exchange resin or if freezing is anticipated.**

(1) For RPT-18: Standard specification

1) Replacement procedures

(a) Operate the screen and turn ON the "Ion Exc.Resin Off" switch.
(Main menu "Maint" > submenu "SWITCHES" > hierarchical menu "SWITCH SCREEN")

(b) Remove the coupler on the IN side from the used bottle.

(c) To drain the water, blow air into the IN side of the used bottle by using the air gun etc.

(d) Remove the coupler on the OUT side from the used bottle.

(e) Attach the protective cap onto the used bottle to avoid water leakage.

(f) Prepare a new bottle, and install the couplers on the IN side and OUT side.

(g) Turn OFF the "Ion Exc.Resin Off" switch which is turned ON in (a).

Fig. V.6.3

2) Precautions for handling the RPT-18

(a) Precautions for maintaining the performance of the ion exchange resin

- Do not open the bottle containing ion exchange resin unless you are to use the resin immediately.
- Do not dry the ion exchange resin or expose it to air before use. If water is supplied when it is dry, the bottle may burst due to the rapid resin expansion. Do not carry out such operation. What's worse, the lifetime of the ion exchange resin may be shortened.
- Do not expose the bottle to sunlight or heat. Store it in normal temperature below 40°C and avoid freezing.

(b) Precautions for handling the bottle

- Always place the bottle vertically. If it is placed horizontally, leakage may occur.
- Do not remove the bolt for fixing the cover of the bottle.
- Be sure to tighten the cover of the hose connector after using and draining the fluid from the bottle. Otherwise, leakage may occur during transportation.
- Please note that leakage may occur when the hose is connected by inserting it into the hose connection section.
- Do not confuse the IN side connection and the OUT side connection.

The RPT-18 is a system using the dedicated cartridge type.
Use genuine Mitsubishi parts for replacement. Use of parts other than the genuine parts may lead to machining failure. For any question, please contact MITSUBISHI ELECTRIC MECHATRONICS ENGINEERING CORPORATION Service Center.

(2) For H-10 type (cream-colored container)

1) Draining the water

A "Siphon" is used with the following procedure to drain the water.

(a) Remove the end of the outlet hose, and guide it to the waste water tank. Make sure that the end of the hose is lower than the cartridge.

(b) Turn ON the water so that the hose is filled.

(c) Stop the water, and remove the inlet hose from the cap immediately.

(d) The "Siphon" drains the water from the outlet hose. It takes approximately 3 to 5 minutes for the water to be drained.

(e) If the water does not drain properly, repeat the above procedure.

2) Replacement procedures

(a) Stop the unit.

(b) Remove the fixing band.

(c) Disconnect the hoses from the cartridge outlet/inlet. (Fig. V.6.6 Ⓐ → Ⓑ → Ⓒ)

(d) Remove the cartridge from the top of the tank.

(e) Turn the cartridge cap counterclockwise and remove.

(f) Pull out the collector pipe in the H-10 type cartridge. (Fig. V.6.4.)

(g) Turn the cartridge upside down, and wash off the resin with water.

(h) Fill the ion exchange resin (MB-4). (Fig. V.6.5.)

(i) After filling, gradually fill the cartridge with water until it is almost full.

(j) Insert the collector pipe in the middle of the cap, and then screw the cap onto the cartridge.

(k) Install the cartridge on the set position onto the tank.

(l) Connect the hose to the cartridge outlet/inlet. (Fig. V.6.6 Ⓒ → Ⓑ → Ⓐ)

(m) Install the fixing band.

NOTICE

While replacing the ion exchange resin, do not apply any force on the cartridge (especially the bottom). Otherwise, the cartridge may be damaged.

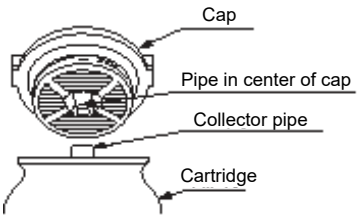


Fig. V.6.4

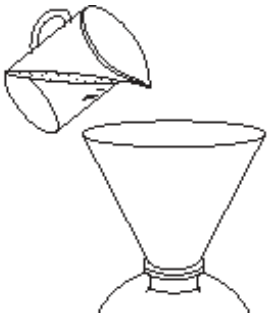


Fig. V.6.5

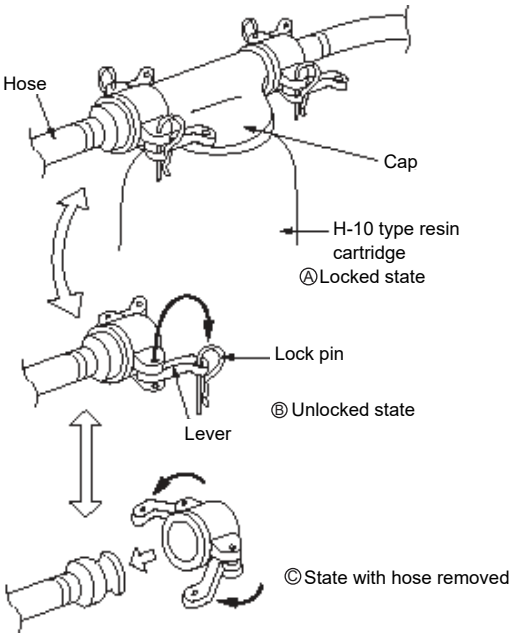


Fig. V.6.6

3) Precautions for handling the H-10 type

(a) The cartridge in this water purifier is made of plastic, and must be used at room temperature. Do not place it near sources of heat, as the body could deform.

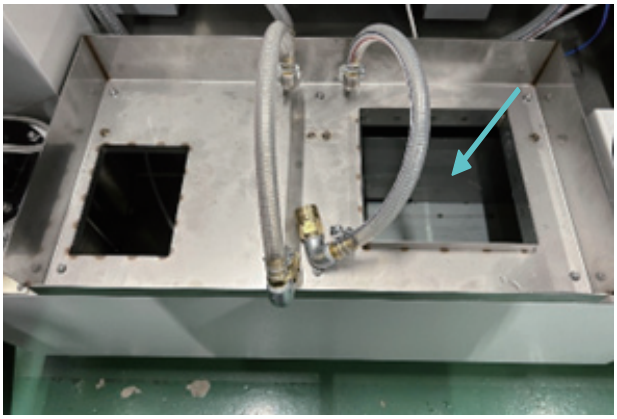
(b) The container could be damaged if directly contacted against concrete walls, etc.

(c) If the cartridge is dirty, wipe it off with a neutral detergent. Do not use volatile fluids such as thinner.

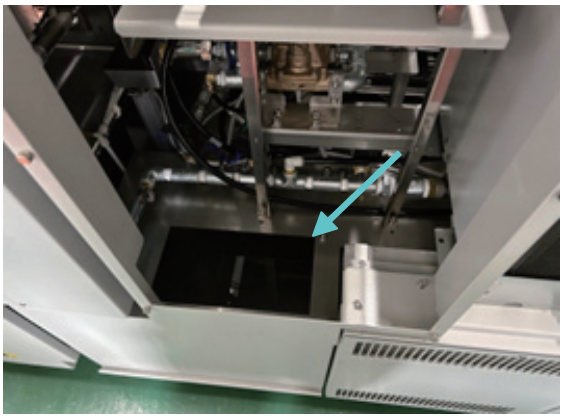
(d) Do not dry or freeze the ion exchange resin. Otherwise, the resin will break easily.

6.1.6 Cleaning of the dirty fluid tank (dielectric fluid reservoir)

Clean the contaminated fluid tank inside the tank from the opening part of the dielectric fluid reservoir with the supplied gun nozzle or long handle brush etc.

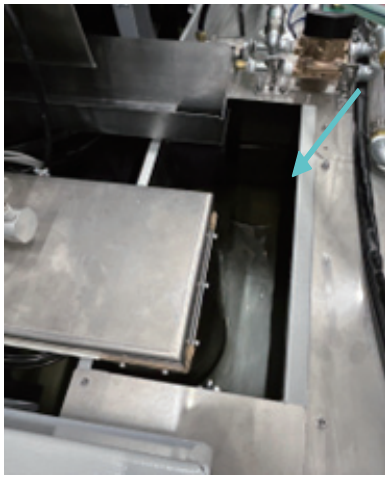


MG12 dielectric fluid feeder opening part (left)
(front view of the dielectric fluid feeder)

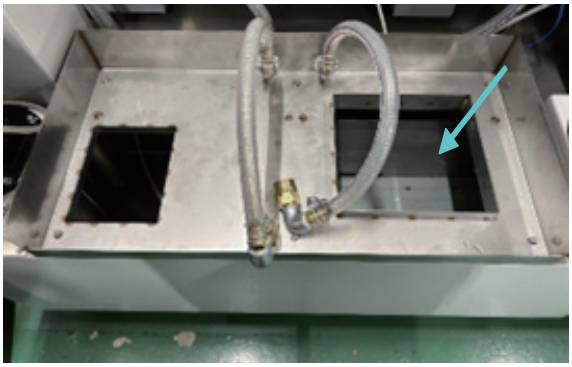


MG12 dielectric fluid feeder opening part (right)
(side view of the dielectric fluid feeder)

Fig. V.6.7



MG24 dielectric fluid feeder opening part (front)



MG24 dielectric fluid feeder opening part (back)

Fig. V.6.8

NOTICE
When obvious verdigris appears in the dielectric fluid reservoir, change the dielectric fluid. **If verdigris has spread all over, clogging in the dielectric fluid piping may be caused.**

6.1.7 Cleaning of the float switch

(1) Cleaning the float switch in the dielectric fluid reservoir

Two float switches in the dielectric reservoir prevent pump dry?run. Clean them about every six months to remove sludge.

1) Cleaning method

Remove the screw and pull the float?switch stay from the tank top. Beware sharp corners. Do not disassemble the switch; gently brush sludge off the shaft. Avoid impacts that could damage contacts. Reinstall the float with “OPEN” facing up.

Move the float lightly by hand. Cleaning is completed if the float does not snag, etc.
Insert the stay into the dielectric fluid tank, and install the stay fixing screw.

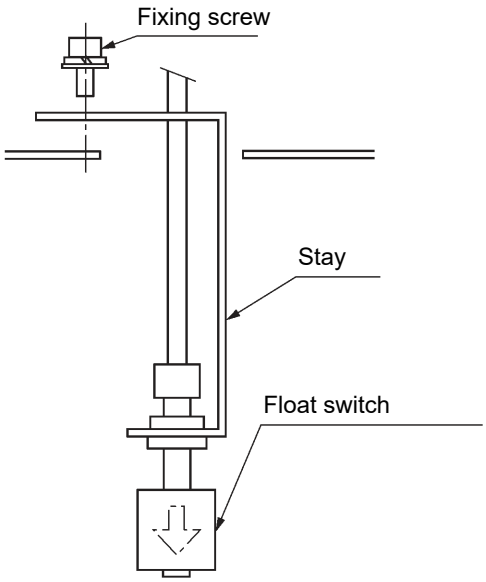


Fig. V.6.9

7. MAINTENANCE AND INSPECTION OF THE DIELECTRIC TEMPERATURE

⚠WARNING

For safety purposes, always turn the main power OFF before starting maintenance or inspection.

Item	Descriptions	Inspection cycle
General	Must be no abnormal vibration or noise. Ambient temperature (during operation) 10 to 35°C Power voltage Single-phase 200/200 to 220 V AC ±10% 50/60 Hz	Daily
Air filter	Remove any adhered dust with compressed air or a brush. (Clean the filter once a week.)	Daily
Cooler	Check that there are no fluid leaks and abnormal vibrations or noises in the piping. When draining the fluid from the machine system, or when stopping operation with the fluid drained, always drain the fluid accumulated in the cooler from the cooler water outlet. If fluid is left accumulated in the cooler, sludge and other deposits could adhere on the inner side of the cooler. This can inhibit proper functions.	Daily

7.1 Cleaning of the air filter

(1) If the air filter installed on the front of the condenser is clogged, cooling will be disabled, the unit could fail and alarms could occur. Check and clean the air filter once a week.

(2) Replace the air filter once every three to six months.
Note that the air filter replacement cycle will differ greatly according to the installation environment.

(3) Always mount the air filter when operating the machine.

1) Remove the filter by pulling it forward and out.

Fig. V.7.1

⚠CAUTION

Do not touch the condenser when removing the filter. Otherwise, injuries may be caused.

2) Clean off any dirt from the filter with a vacuum cleaner or by washing with water.
   - If the filter is heavily contaminated, clean it in lukewarm water in which a neutral detergent has been dissolved.
   - Do not wash the filter with hot water (approximately 50°C or more). The filter could deform.

3) After rinsing the filter with water, dry it thoroughly in the shade.
   - Do not dry the filter in direct sunlight or with a direct flame.

4) Install the filter at the original position. (Follow the removal procedures in reverse.)

7.2 Error Codes and Remedies

7.2.1 Error codes

When a protection function activates, the unit will stop operation, and an error code shown in the following table will appear at the display.

7.2.2 Work procedures when error codes are displayed

(1) When any one of E1 to E8 is displayed

1) Press the RESET switch on the display section. (Cancel the error).
2) Once the recovery conditions are established, operation will start in approximately 30 seconds after the code is displayed.
3) If E1 to E8 appears again after operation resumes, perform the "Remedy" given in the table.
4) If the error recurs after carrying out the "Remedy", contact your nearest Mitsubishi branch, sales office, or Mitsubishi Electric Mechatronics Engineering Corporation.

(2) When C3, C6, C7, or C8 is displayed

1) Watch the state for a short time. (If the error is reset, the operation will automatically resume.)
2) If the error code does not disappear or appears frequently, perform the "Remedy" given in the table.
3) If the error recurs after carrying out the "Remedy", contact your nearest Mitsubishi branch, sales office, or Mitsubishi Electric Mechatronics Engineering Corporation.

*** If an error code does not appear but the unit does not start or stop, contact your nearest Mitsubishi branch, sales office, or Mitsubishi Electric Mechatronics Engineering Corporation.**

*** The electric circuit, refrigeration circuit, and cooling fluid circuit must be repaired by person with expertise using dedicated tools and protective equipment, etc.**

Error codes	Descriptions (meaning of error display)	Remedy	Recovery conditions	Recovery method
E1	Discharge pressure error Discharge pressure (63H) ≥ 4.1 ± 0.1 MPa Condenser temperature (TH11) ≥ 70°C	• If there is any object obstructing the intake/exhaust, remove it. • When using in an installation environment with high intake temperature, set to an appropriate temperature. (Use of this unit within an ambient temperature of 15 to 30°C is recommended.) • If the air filter is dirty or contaminated with foreign matter, clean or replace the filter. • If the condenser fin is dirty or contaminated with foreign matter, clean with compressed air or a brush.	Discharge pressure (63H) ≤ 3.1 ± 0.15 MPa Condenser temperature (TH11) < 70°C	Reset switch
	Discharge temperature error Discharge temperature (TH) ≥ 116°C		Discharge temperature (TH) < 116°C	
E2	Inverter error	Contact your nearest Mitsubishi branch, sales office or MITSUBISHI ELECTRIC MECHATRONICS ENGINEERING CORPORATION.	30 seconds after code is displayed.	Reset switch
E3	Thermistor error • Thermistor open/short-circuit Discharge temperature thermistor (TH) Fluid temperature thermistor (TH2) Freeze prevention thermistor (TH4) Condenser temperature thermistor (TH11) Overcooling thermistor (TH12) Refrigerant inlet temperature thermistor (TH21) • Pressure switch (63H) open	Contact your nearest Mitsubishi branch, sales office or MITSUBISHI ELECTRIC MECHATRONICS ENGINEERING CORPORATION.	Release open or short-circuit set (Repair broken wire or connection disconnection)	Reset switch
E4	Thermistor error PCB temperature Fin temperature thermistor (TH13)	• This unit intakes air from under the electric parts box. Remove any obstacles that may be in the area. • When using in an installation environment with high intake temperature, set to an appropriate temperature. (Use of this unit within an ambient temperature of 15 to 30°C is recommended.)	Drop of PCB temperature or fin temperature Release open or short-circuit set (Repair broken wire or connection disconnection)	Reset switch
E5	Heating degree error Heating degree (TH - TH11) > 80°C	Contact your nearest Mitsubishi branch, sales office or MITSUBISHI ELECTRIC MECHATRONICS ENGINEERING CORPORATION.	Heating degree (TH - TH11) ≤ 80°C	Reset switch

Error codes	Descriptions (meaning of error display)	Remedy	Recovery conditions	Recovery method
E6	Cooling performance insufficient Temperature difference (TH2 - TH1) ≥ 9°C for three consecutive hours	• If there is any object obstructing the intake/exhaust, remove it. • When using in an installation environment with high intake temperature, set to an appropriate temperature. (Use of this unit within an ambient temperature of 15 to 30°C is recommended.) • If the air filter is dirty or contaminated with foreign matter, clean or replace the filter. • If the condenser fin is dirty or contaminated with foreign matter, clean with compressed air or a brush. • If the heat load to be cooled by this unit is large, set the heating amount to the correct value.	30 seconds after code is displayed.	Reset switch
E7	Evaporator freezing prevention Refrigerant inlet temperature (TH21) ≤ -10°C for 30 consecutive seconds	• If the intake temperature is low, set to the correct temperature. (Use of this unit within an ambient temperature of 15 to 30°C is recommended.) • Check the flow rate in the dielectric fluid circuit, and secure the optimum flow rate. • If the water circuit in this unit could be clogged, suspend operation for approx. one hour, and then resume operation.	30 seconds after code is displayed.	Reset switch
E8	Microcomputer read error	Contact your nearest Mitsubishi branch, sales office or MITSUBISHI ELECTRIC MECHATRONICS ENGINEERING CORPORATION.	30 seconds after code is displayed.	Reset switch
C3	Fluid freezing prevention Fluid temperature (TH2) < 4°C or freezing prevention temperature (TH4) < 4°C for one consecutive minute	• If the intake temperature is low, set to the correct temperature. (Use of this unit within an ambient temperature of 15 to 30°C is recommended.)	Fluid temperature (TH2) ≥ 7°C, and freezing prevention temperature (TH4) < 7°C for one consecutive minute	Automatic
C6	Heating degree error Heating degree (TH-TH11) < 0°C for 20 consecutive minutes	Contact your nearest Mitsubishi branch, sales office or MITSUBISHI ELECTRIC MECHATRONICS ENGINEERING CORPORATION.	30 seconds after code is displayed.	Automatic
C7	Communication error	Contact your nearest Mitsubishi branch, sales office or MITSUBISHI ELECTRIC MECHATRONICS ENGINEERING CORPORATION.	Reset internal communication error	Automatic
C8	Inverter error	Contact your nearest Mitsubishi branch, sales office or MITSUBISHI ELECTRIC MECHATRONICS ENGINEERING CORPORATION.	30 seconds after code is displayed.	Automatic

8. TROUBLESHOOTING

*** Some photos may differ from the actual machine.**

Error No.	U708 T273
Messages and descriptions	NO WIRE A wire absence was detected when M21 was executed.
Confirmation items & remedies	• Please check whether the wire on the wire bobbin has been used up. If there is no wire left, replace it and then restart the machine.
Countermeasures (Details)	

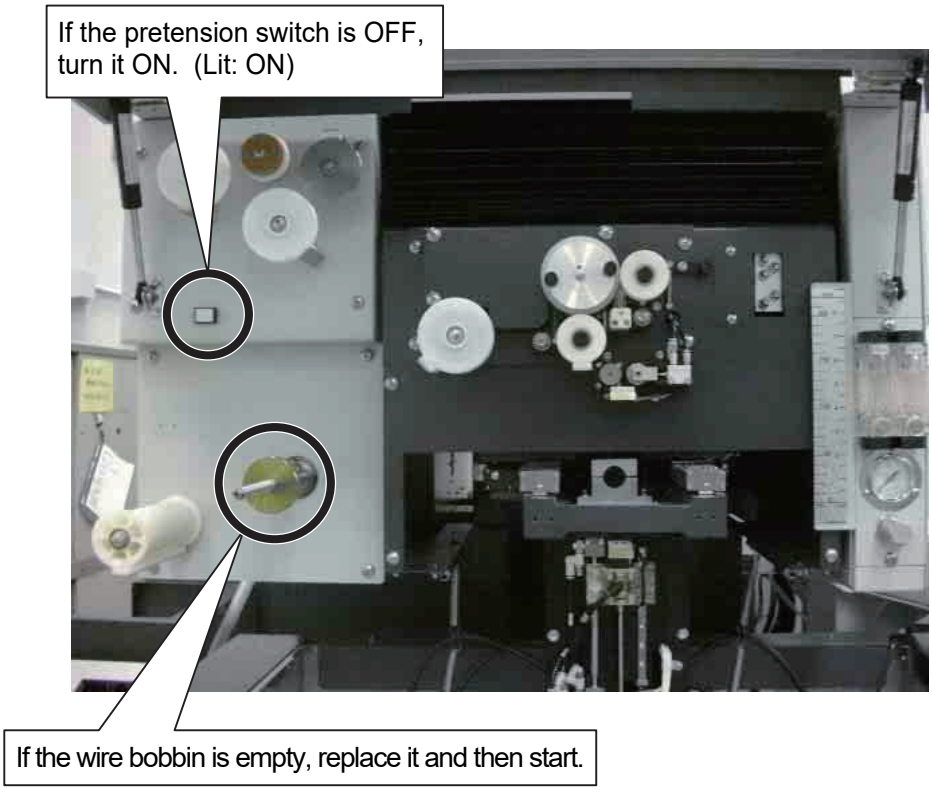
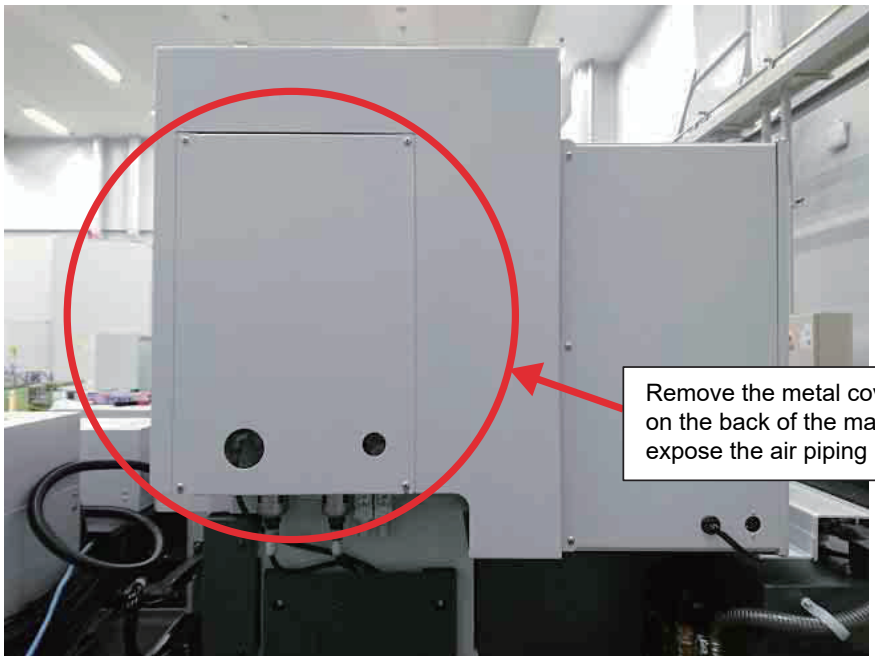


Fig. V.8.1

Error No.	1) U726 2) U766 3) T274
Messages and descriptions	1) A.W.F.AIR DOWN An air pressure drop was detected. 2) 3) LOW AIR PRESS The air pressure dropped continuously during the specified time.
Confirmation items & remedies	1) Check the air pressure. 2) 3) Check the air pressure. Check the compressor's power supply.
Countermeasures (Details)	



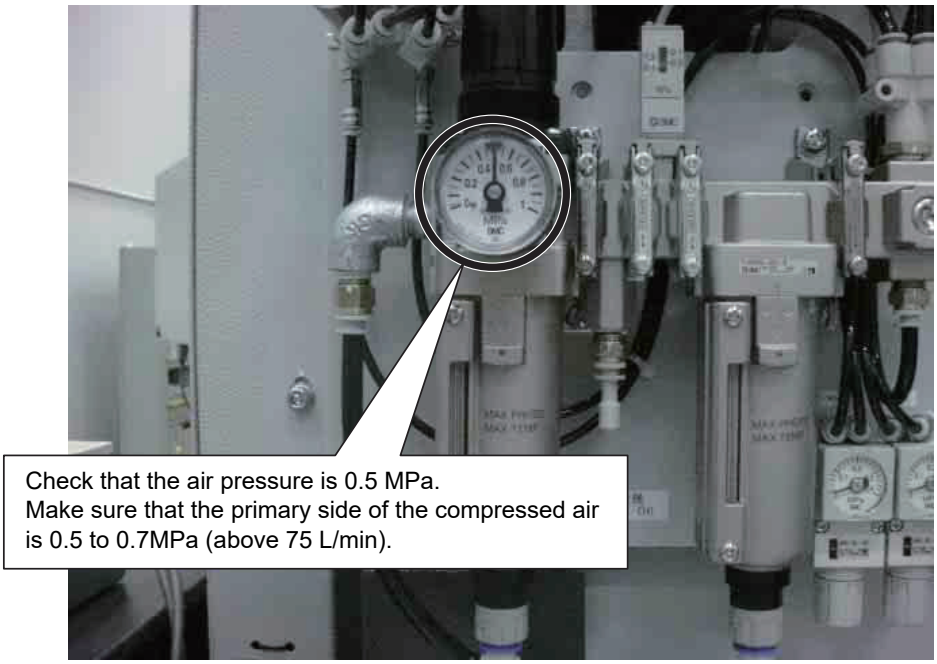
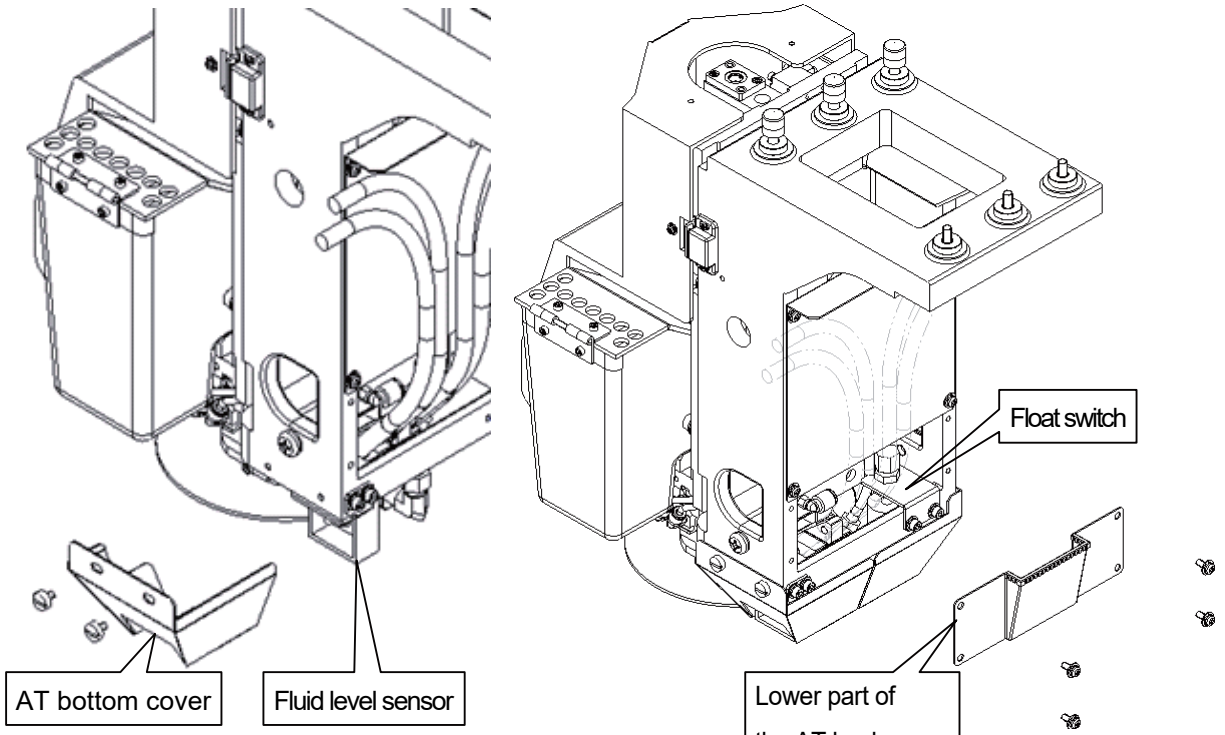


Fig. V.8.2

Error No.	U730 T730
Messages and descriptions	T/C IN FLUID The fluid level in the working tank has reached the upper guide.
Confirmation items & remedies	• Please clean the fluid sensor and float switch near the upper nozzle. Try to keep the dielectric fluid calm and not choppy.
Countermeasures (Details)	



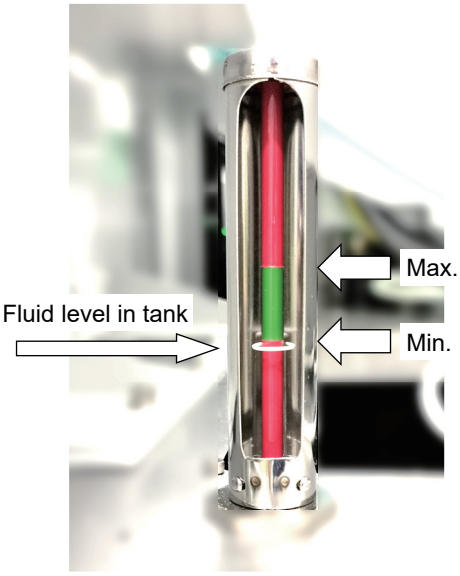
Remove the AT back or AT bottom cover, and clean the fluid level sensor and float switch.

Fig. V.8.3

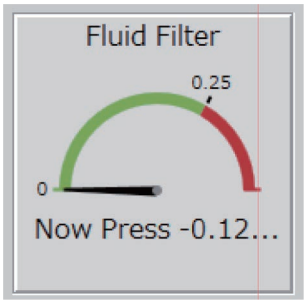
Error No.	U794 T794
Messages and descriptions	CLEAN SIDE LOW The fluid level in the clean fluid tank has dropped.
Confirmation items & remedies	1) Check the dielectric fluid level and replenish the fluid if it is insufficient. 2) Check the pressure gage of the filter and replace the filter when the pressure is 0.25 MPa or more. 3) Check whether the filter hose is bent. * The target filter life is 0.25 MPa, but the actual life varies with the wire diameter, work piece material, and number of cuts.

Countermeasures (Details)

Check the following items if the CLEAN SIDE LOW alarm occurs.



1) Check the dielectric fluid level and replenish if insufficient.



2) Check that the filter pressure is 0.25 MPa.
The filter pressure can be checked on the Consumption window displayed by selecting History management > Consumption.

3) Check whether the filter hose is bent.

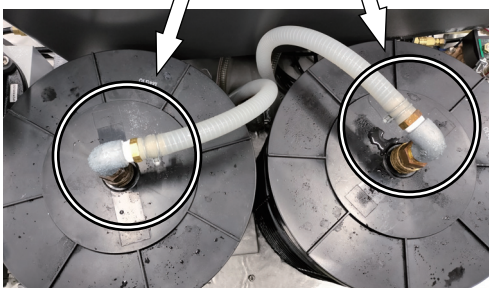
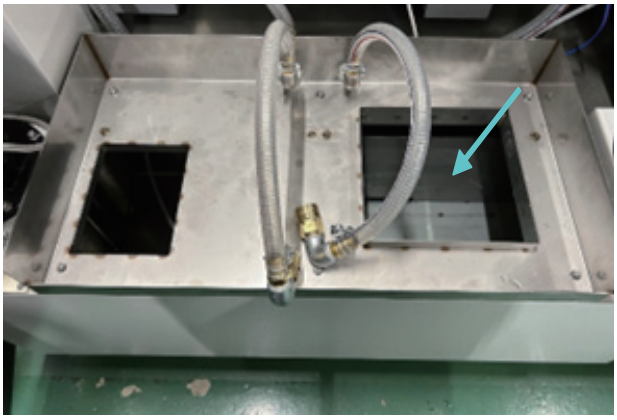
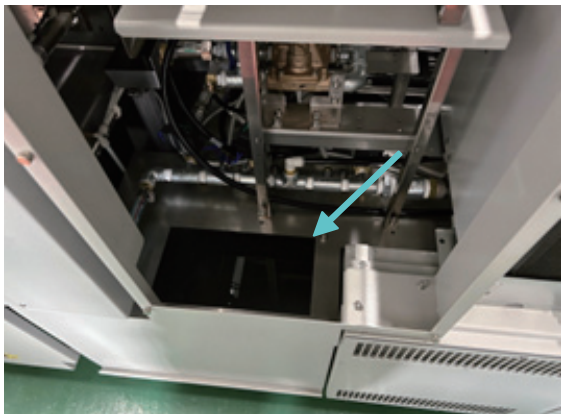


Fig. V.8.4

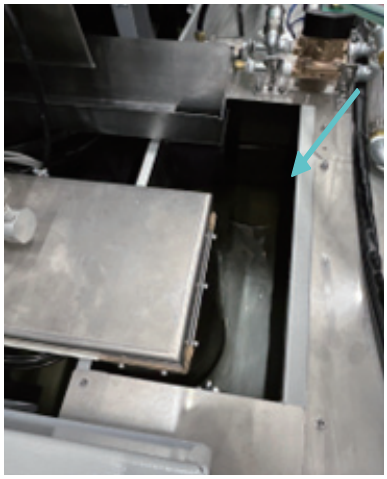
Error No.	U795 T795
Messages and descriptions	DIRTY SIDE LOW The fluid level in the waste fluid tank has dropped.
Confirmation items & remedies	• Check the dielectric fluid level in the dielectric fluid feeder, and replenish if necessary.
Countermeasures (Details)	



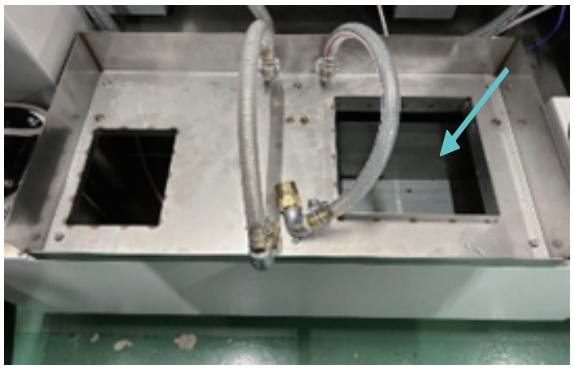
MG12 dielectric fluid feeder opening part (left)
(front view of the dielectric fluid feeder)



MG12 dielectric fluid feeder opening part (right)
(side view of the dielectric fluid feeder)



MG24 dielectric fluid feeder opening part (front)



MG24 dielectric fluid feeder opening part (back)

Fig. V.8.5

Error No.	U814 T814
Messages and descriptions	WIRE PROCESSING DEV. This occurs if the wire has become entangled in the wire processing unit or if the motor has locked.
Confirmation items & remedies	• Remove the tangled wire. • Check whether the cutter unit is worn, and replace if worn. • Check that the wire processing unit connector [WCM] is connected.
Countermeasures (Details)	

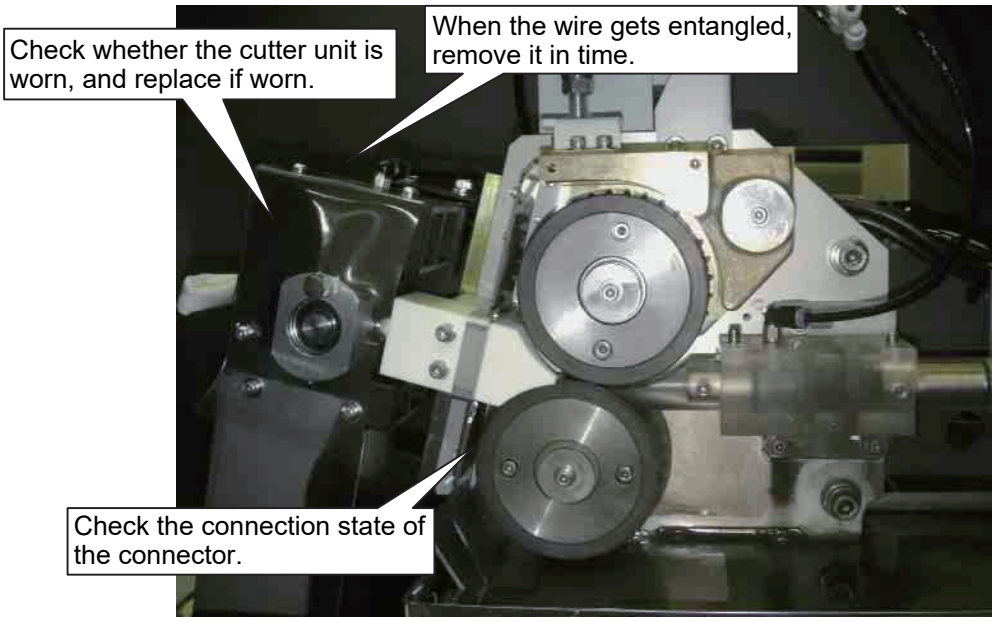


Fig. V.8.6

Error No.	U830 T830
Messages and descriptions	CUT WIRE REMAINING Scraps of cut wire could not be collected into the wire collection box, and are remaining in the cut wire duct.
Confirmation items & remedies	• Please clear the remaining wire. • See "5. MAINTENANCE AND INSPECTION METHOD OF AUTOMATIC WIRE FEEDER".
Countermeasures (Details)	

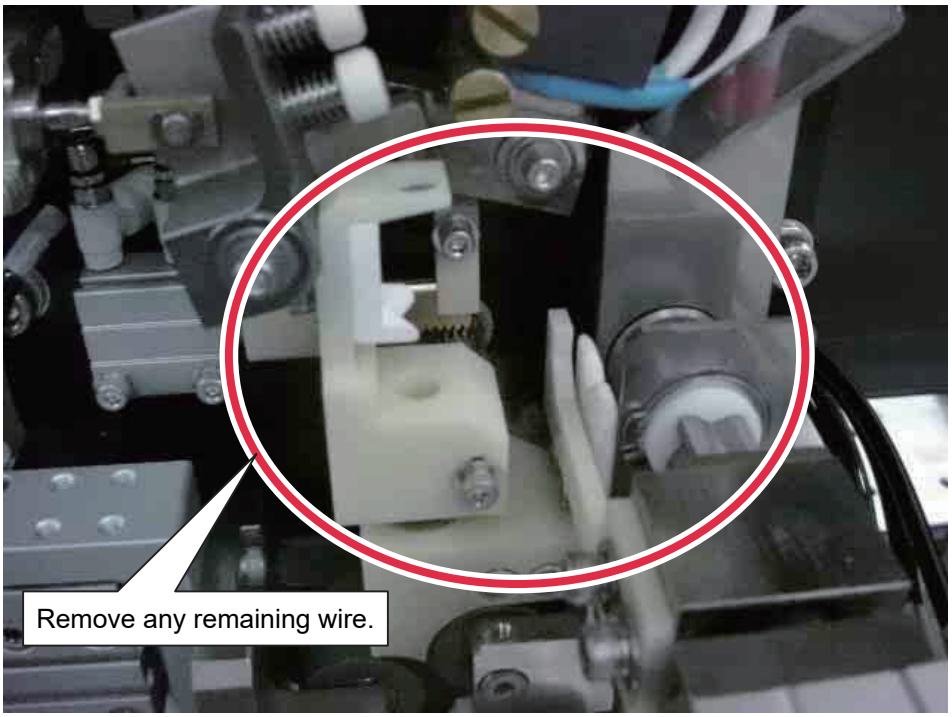


Fig. V.8.7

Error No.	U840 T840
Messages and descriptions	Unit cooler abnormal An error was detected in the unit cooler.
Confirmation items & remedies	• Check the display on the unit cooler on the dielectric fluid tank. • If the alarm appears even after pressing the Reset button, notify the state to the Service Center.

Countermeasures (Details)

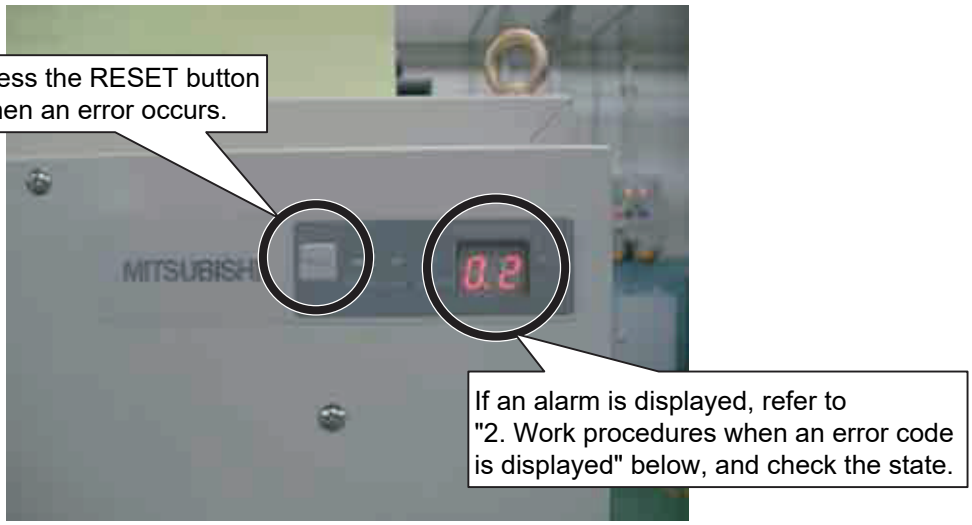


Fig. V.8.8

1. Cleaning of the air filter

Cooling faults can occur if the air filter is clogged and result in device faults or alarms. Check and clean the air filter once a week. The air filter should be replaced once every three to six months. (Note that the replacement timing differs greatly according to the installation environment.)

2. Work procedures when an error code is displayed

1) When any one of E1 to E6 is displayed

(a)Press the RESET switch on the display section. (Reset the error.)

(b)Once the recovery conditions are established, operation will start in approximately 30 seconds after the code is displayed.

(c)If E1 to E6 appears again after operation resumes, see "7.2 Error Codes and Remedies" and perform "Remedy".

2) When C3, C6, or C7 is displayed

(a) Observe the state for a while. (Operation will automatically restart when the error is reset.)

(b) If the error code does not disappear or appears frequently, see "7.2 Error Codes and Remedies" and perform "Remedy".

(c) If the error occurs again after performing "Remedy", contact your nearest Service Center.

* If there may be a unit error, such as if the operation does not start or stops without displaying an error code, contact your nearest Service Center.

Error No.	U854 T854
Messages and descriptions	OUT OF WIRE D(WIRE PROCESSING DEV.) A wire diameter ϕ0.15 or less was selected while the wire processing unit was mounted.
Confirmation items & remedies	• The wire processing unit is only compatible with wire diameters of ϕ0.2 or more. Remove the wire processing unit when using the wire with a diameter of ϕ0.15 or less. • Specify the wire diameter to be used when using a wire with a diameter of ϕ0.2 or more. • For removing the wire processing unit, see "VI. OPTIONS". • If the same alarm occurs even after removing the wire processing unit, there may be a problem. Contact the Service Center to inform them of the situation.

Countermeasures (Details)

The wire processing unit is only compatible with wire diameters of ϕ0.2 or more. Remove the wire processing unit when using the wire with a diameter of ϕ0.15 or less.

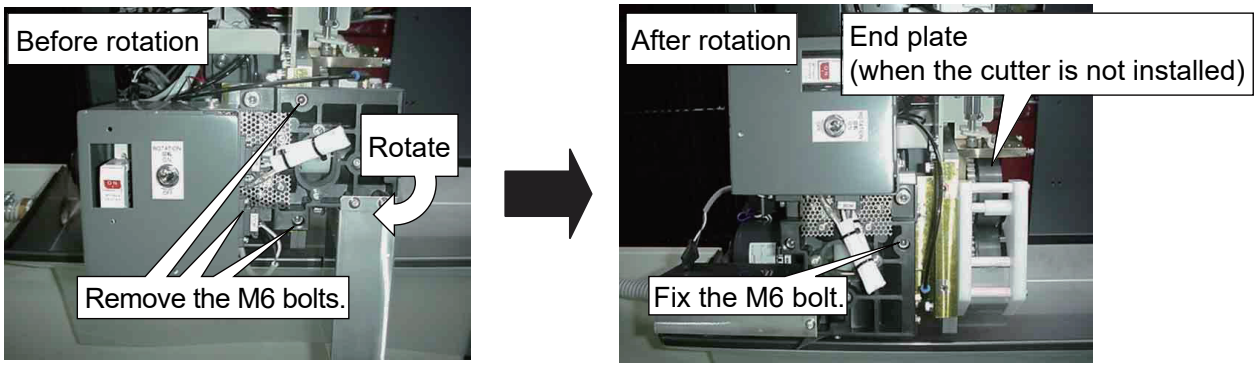


Fig. V.8.9

For removing the wire processing unit, see "VI. OPTIONS".

Error No.	U855 T855
Messages and descriptions	WIRE PROCESSING DEV. MOTOR STP This occurs if the cutter motor switch is OFF or if the cutter motor breaker is OFF.
Confirmation items & remedies	• Turn the cutter motor switch ON. • Turn the cutter motor breaker ON.
Countermeasures (Details)	

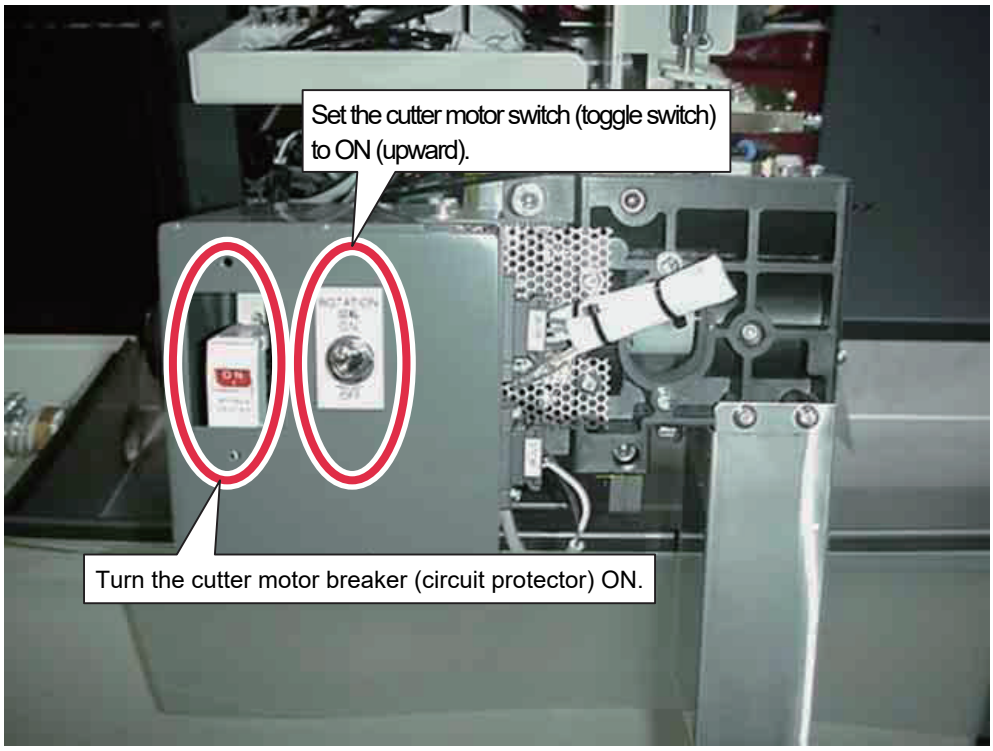


Fig. V.8.10

Descriptions	The USB flash memory is lost or faulty.
Remedies	**Contact the Mitsubishi Service Center to obtain a new USB flash memory dedicated to the machine, and then install the driver by following the steps below.** **Without the USB flash memory dedicated to the machine, the system upgrade and the I/O operation on the file I/O screen are impossible.**

Countermeasures (Details)

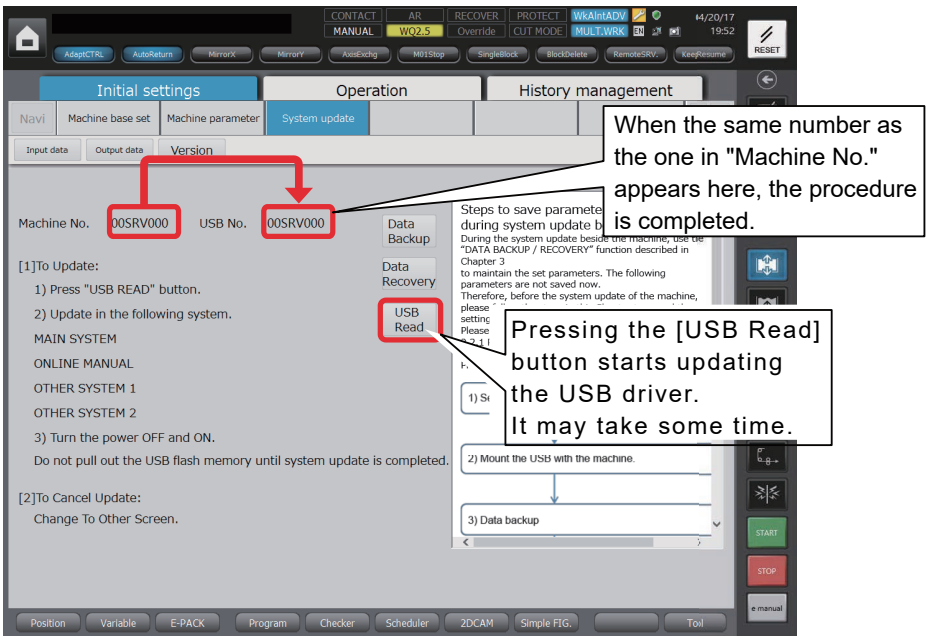
After obtaining the new USB flash memory from the Mitsubishi Service Center, it is necessary to install the USB driver that matches the new USB flash memory and make the USB driver recognized by the EDM system, by following the steps (1) to (4) below.

1)When a USB driver update file for the new USB flash memory has been provided from the Mitsubishi Service Center, connect the new USB flash memory to the personal computer, and then copy the update file to the directory under the "driver" folder in the new USB flash memory. If no update file has been provided, this procedure 1) is not required.

2) Connect the new USB flash memory to the EDM.

3) Display the "System update" screen by selecting the "Initial settings" > "System update", and then press the [USB Read] button.

4) When the same number as in the "MACHINE NO" appears in the "MACHINE NO IN USB", this procedure is completed. Turning the power OFF and ON is not required. Just switch over to any other screen.



⚠CAUTION

1. The file stored in the "driver" folder in the USB flash memory dedicated to the machine is essential for the USB flash memory to be recognized as that dedicated to the machine by the EDM system. Do not delete it.
2. After pressing the [USB Read] button, do not disconnect or reconnect the USB flash memory until a number appears in "USB No.".
3. Connecting more than one USB flash memory dedicated to the machine at the same time will prevent the EDM from recognizing the USB flash memory correctly. Do not connect USB flash memories dedicated to other machines.
4. Even if the lost USB flash memory dedicated to the machine is found later, do not use it because using it may cause troubles in system operation.
5. If the new USB flash memory is the same type as the old one, a number appears in "USB No." immediately after pressing the [USB Read] button. This operation is normal and there is no problem.

VI. OPTIONS

BRN-83587-006-*-002

1. ANGLE MASTER/ANGLE MASTER ADV II
2. 20 kg/25 kg WIRE WINDING UNIT
3. WIRE PROCESSING UNIT
4. VIRUS INFECTION PREVENTION FUNCTION
5. COREHOLD (CORE HANDLING FUNCTION)
6. iQ Care Remote4U
7. NV-2
8. TOUCH SENSOR ON-MACHINE CHECK FUNCTION

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1. ANGLE MASTER/ANGLE MASTER ADV II

1.1 Specifications (Angle Master)

1.1.1 Summary

These specs are related to the function which enables a 45° taper angle.

1.1.2 Specifications

(1) Applicable wire electrodes

Mitsubishi-designated wire electrode

Only the following Mitsubishi wire electrodes may be used.

Wire electrode	Electrode material	Wire bobbin	Manufacturer/dealer
ØØ0.2 to 0.25	Megacut Type-T wire	P-5R	Berkenhoff GmbH/Oberon Co., Ltd.
	BS wire	P-5R	See "V. MAINTENANCE AND ALARM LIST".

(2) Machinable taper angle

45°

*1 The taper angle differs according to the wire electrode being used.

Electrode material	Machinable taper angle
Megacut Type-T wire	0 to 45°
BS wire	0 to 20°

When a BS wire is used, even if the machining taper angle is smaller than 20°, stripe or wire breakage may occur on the machined surface due to reasons such as the machining shape and machining state.

Even when the machining taper angle is smaller than 20°, the Megacut Type-T wire is recommended.

*2 See "(6) Restrictions"1).

(3) Machinable workpiece thickness

Ø 40 mm

*The workpiece thickness differs according to the taper cut stroke.

Taper cut stroke (mm)	Workpiece thickness (mm)
±75, ±60	Ø40
±32	Ø15
±21	Ø3

(4) Maximum workpiece thickness for automatic wire supply

No jet: Ø60 mm * See "(6) Restrictions".

With jet: Ø100 mm * See "(6) Restrictions"2).

*** The maximum workpiece thickness is limited according to the above taper cut stroke.**

(5) Accessories

Upper nozzle	…1 piece
Lower nozzle	…1 piece (* See "(6) Restrictions"3))
Large angle diamond die (U)	…1 piece
Large angle diamond die (D)	…1 piece
Macro programs FLD	…1 piece

(6) Restrictions

1) If the long stroke taper specification is not used, prepare a Ø10 mm workpiece. (See "1.3 How to Use (Angle Master)" section in this chapter.) When using the long stroke taper specs, initialization can be carried out with the wire-alignment device.

2) The Ø3.4 jet nozzle (optional) can be used with an angle of 20 degrees or less.
However, the upper nozzle specified for Ø3.4 jet nozzle is required. Check and purchase one.

3) The diameter of the enclosed lower nozzle is larger than the standard diameter, so the XY axis stroke may be limited.

   (a) The stroke end on both sides is limited by 5 mm each with each axis.

   (b) The user must set the stroke limit with the soft limit.

NOTICE

Remove the lower nozzle during machine zero point return operations.
The lower nozzle and platform will interfere with each other because the lower nozzle diameter is greater than the standard size.

1.2 Configuration (Angle Master)

1.2.1 Hardware

A special diamond die is used to adapt to the large taper angle. This special die can be interchanged with the standard diamond die. Use a dielectric fluid nozzle with large bore to prevent interference with the wire caused by the larger angle.

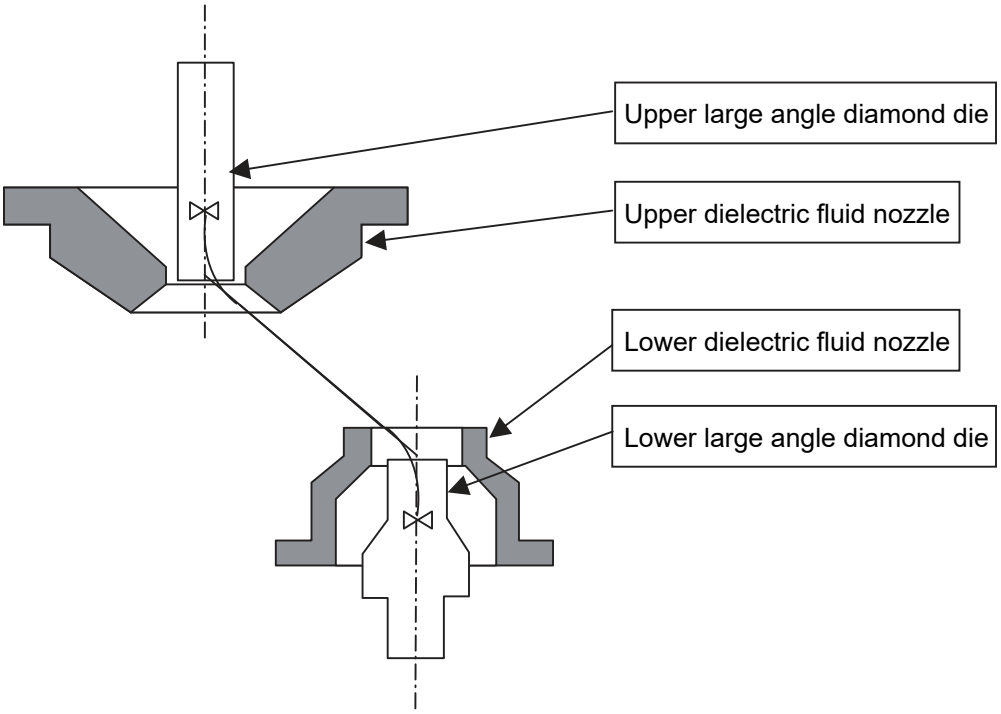


Fig. VI.1.1

1.2.2 Angle master compensation control

This software supports the type of hardware configuration shown above.
Since a diamond die with large rounding at the holding section is used, the wire support point (specification value) will change according to the size of the angle. This will make it difficult to create an accurate angle. This will make it difficult to create an accurate angle. With the angle master compensation control, the compensation amount (die parameters) for each angle are prepared before machining and the angle is compensated so that a correct angle can be achieved.

***1 "Large angle" refers to an angle 15° or more.**

***2 The angle master compensation control software is available in the standard mounting.**

1.3 How to Use (Angle Master)

1.3.1 Preparing for angle master machining

(1) See "II. AUTOMATIC WIRE FEEDER" of this manual, and exchange the upper/lower diamond die and upper/lower large angle dielectric fluid nozzle.
* As explained in "(6) Restrictions" of the "1.1 Specifications (Angle Master)" section, when the special dielectric fluid nozzle is mounted, interference will occur with the table at the stroke end. Thus, set the soft limit beforehand.

(2) The jet nozzle cannot be used for taper machining exceeding 20°.

(3) Attach the waterproof cover.
* The dielectric fluid could splatter during large angle machining if the waterproof cover is not attached. (Purchase the waterproof cover if necessary.)

(4) Replace the wire electrode. Use the BS wire or Megacut Use Type-T wire (refer to "1.1 Specifications (Angle Master)" in this chapter for information on wire electrodes to use).

(5) When connecting the wire, insert the wire manually, or carry out automatic connection with the following conditions.
(Conditions)
- Select the wire electrode to be used from the main menu "Initial settings" > "Machine base set" > "Install wire and workpiece" > "Wire Type" screen, or from the "Operation" > "Preparation before machining" > "Install wire and WKPC." > "Install wire and workpiece" > "Wire Type" screen.
- In "Initial settings" > "Machine parameters" > "AT setting" screen, set the switch of [Jet On] to "OFF" in the initial settings.
- Set the Z height to 20 mm or less.

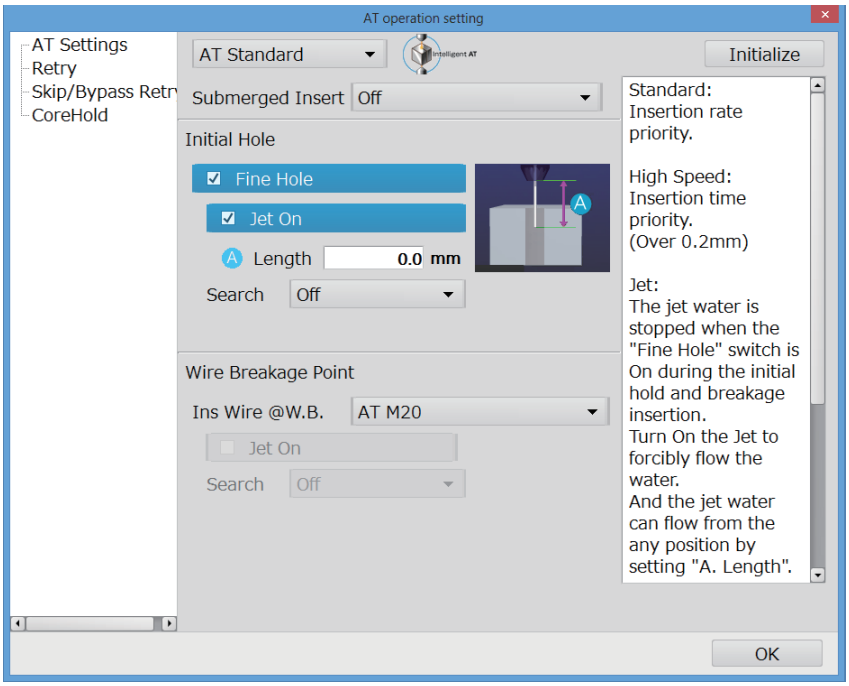


Fig. VI.1.2

*** The Megacut Type-T wire cannot be connected automatically.**

(6) Prepare the following type of workpiece to measure the die parameters.
Workpiece conditions: Workpiece thickness 10t, upper/lower surface polished, no chamfering
(The perpendicularity will affect the measurement value for initialization.)
*** A workpiece is not required when using a wire-alignment device to measure the die parameters with a long stroke taper specification machine.**

(7) Carry out initialization following the section "Measuring the die parameters".
*** When carrying out initialization with a workpiece, if wire cutting chips accumulate between the workpiece and wire contact section, the die parameter values will fluctuate. Make sure that the cutting chips are not generated by flowing dielectric fluid or by submerging during the measurement. Note that the wire-alignment device is not waterproof, so it cannot be submerged.**

1.3.2 Explanation of ANGLE MASTER screen

Open the ANGLE MASTER screen by selecting "Initial settings" > "Machine base set" > "Taper-Z" > "Angle master".

Fig. VI.1.3

(1) Explanation of screen

1) DIE PARAMETER

The die parameters are parameters used for angle master compensation.

2) ANGLE MASTER COMP. switch

Turn this switch to activate the angle master compensation. The compensation will not be activated if this switch is OFF or if the die parameters are not input (all values are set to 0).

*** Always turn this switch OFF if the mounted die is not the one measured when inputting the current die parameters. The compensation will not function correctly and the machining shape could be adversely affected if the parameters are different.**

3) Only A Standard Angle

Set this switch to remeasure the specification values of the standard angle such as when successively machining with the same die and only the standard angles that differ according to the shape need to be changed, or when a die used previously (for which the diamond parameters have been measured or I/O input already) is mounted again.

***1 When carrying out initialization for using the large angle die, turn the Only a standard value switch ON and measure with the LARGE ANGLE screen instead of using the normal specification setting.**

***2 MIN ANGLE, MAX ANGLE, and INTERVAL do not need to be input when this switch is ON.**

4) Z Axis Height:

This value is required for measuring the die parameters. Input the distance from the table to the bottom of the upper nozzle in the same manner as the normal initialization.

5) Std. Angle: (1.0° to 45.0° (up to 40°: when using wire-alignment device))

Input the angle used for the die parameter reference. The other angles are the relative values set in the parameters for the standard angle.

Input the value of the angle which needs to be as accurate as possible. If there is no such angle, input the maximum angle.

***1 Set an integer such as 5.0°, and do not input a number with a digit after the decimal point such as 5.5°.**

***2 Set a value between 1.0° to 40.0° when using a wire-alignment device to measure the die parameters.**

6) Min angle: (1° to 44°)

This is the minimum angle for measuring the die parameters.

Set the minimum angle to be machined.

*** Always set an angle smaller than the maximum angle.**

7) Max Angle: (2° to 45°)

This is the maximum angle for measuring the die parameters.

Set the maximum angle to be machined.

*** Always set an angle larger than the minimum angle.**

8) Interval: (1° to 45°)

Set the interval of the angles to be measured.

When set as MAX ANGLE 45°, MIN ANGLE 1°, INTERVAL 10°, the die parameters are measured while changing the angle in the order of 45°, 35°, 25°, 15°, 5°, and 1°.

9) Meas.Heigh U

Input the distance from the position where the wire contacts to the table when the wire is inclined in the U-direction to measure the die parameters.

*** The values input for Meas.Heigh U and Meas.Heigh L are used to calculate the die parameters. Input these values as accurately as possible.**

10) Meas.Heigh L

Input the distance from the position where the wire contacts to the table when the wire is inclined in the U+ direction to measure the die parameters.

11) Estimated time

The estimated time required for measuring the die parameters is displayed.

12) Measured Result

The results of measuring the specs (ΔZ3 and Z4) at the standard angle are displayed.

13) Adjust

A dialog box for adjusting the parameters opens when this button is clicked

1.4 Specifications (Angle Master ADV II)

1.4.1 Summary

These specs are related to the angle master ADVANCE II function. The angle master ADVANCE II function can be used to prevent the angle error caused by the wire taper angle and the taper angle direction, and improve the taper angle machining precision.
With Angle Master ADVANCE II, you can improve taper machining accuracy even when machining with multiple taper angles.

1.4.2 Angle Master ADVANCE II specifications

(1) Applicable wire electrodes

Only the following Mitsubishi wire electrodes may be used.

Wire electrode	Electrode material	Wire bobbin	Manufacturer/dealer
Ø0.2 to 0.25	Megacut Type-T wire	P-5R	Berkenhoff GmbH/ Oberon Co., Ltd.
	BS wire	P-5R	See "V. MAINTENANCE AND ALARM LIST" in the instruction manual.

(2) Maximum taper angle

The maximum taper angle varies depending on the optional parts installed.

Specifications	Maximum taper angle
Standard specification	15°
Angle master DD up/down kit (±30°)	30°
Angle master DD up/down kit (±45°)	45°

*** Please purchase the Angle master DD up/down kit separately.**

The taper angle that can be processed differs according to the wire electrode being used.

Electrode material	Machinable taper angle
Megacut Type-T wire	0 to 45°
BS wire	0 to 20°

*** When a BS wire is used, even if the machining taper angle is smaller than 20°, stripe or wire breakage may occur on the machined surface due to reasons such as the machining shape and machining state.**
Even when the machining taper angle is smaller than 20°, the Megacut Type-T wire is recommended.

(3) Machinable workpiece thickness (at 45° taper angle)

T/C device stroke (U × V)	Thickness
±60 × ±60 mm ±75 × ±75 mm	10 mm 30 mm 40 mm

(4) Automatic wire threading possible thickness

Specifications		Automatic wire threading possible thickness	
Optional part	Jet nozzle	With jet	No jet
Standard specification	Ø1.5 (standard accessory)	100 mm	60 mm
Angle master DD up/down kit (±30°)	Ø7.0 (Accessory of the angle master DD up/down kit (±30°))	100 mm	60 mm
Angle master DD up/down kit (±45°)	-	-	60 mm

(5) Accessories

Angle Master ADVANCE II dedicated measuring jig…1 set

Name	Q'ty
Dedicated measuring jig	2
Detector block (H = 5.0)	1
Detector block (H = 12.5)	1
Detector block (H = 20.0)	1
Detector block (H = 80.0)	1
M8 × 30 bolt	1
M8 × 40 bolt	1
M8 × 60 bolt	1
M8 × 110 bolt	1

(6) Restrictions

1) The lower nozzle included with the Angle master DD up/down kit (±45°) has a larger diameter than the standard nozzle, which causes XY axis stroke restrictions.

   (a) The stroke end on both sides is limited by 5 mm each with each axis.

   (b) The user must set the stroke limit with the soft limit.

   (c) Remove the lower nozzle during machine zero point return operations.

1.5 Configuration (Angle Master ADV II)

1.5.1 Hardware

For the taper angle less than 15°, measurement of the taper specs can be performed with the standard diamond die. For 15° or more taper angle, a special diamond die is used. This special die can be interchanged with the standard diamond die. Use a dielectric fluid nozzle with large bore to prevent interference with the wire caused by the larger angle.

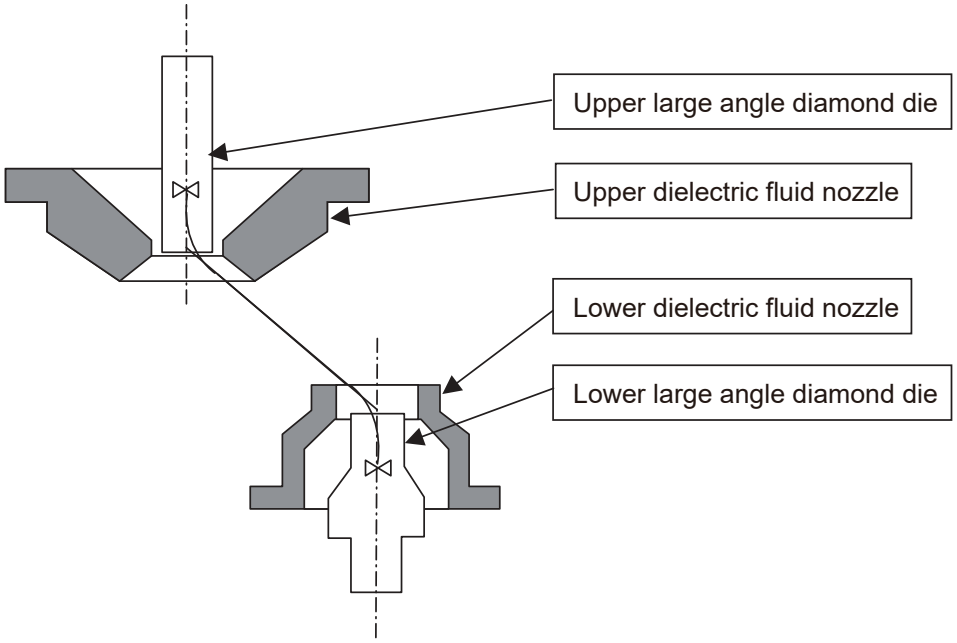


Fig. VI.1.4 Hardware

1.5.2 Specification measurement using the Angle Master ADVANCE II jig

This software supports the type of hardware configuration shown above.
In high accuracy taper specification determination and the Angle Master ADVANCE II function (multiple angle specification determination), the compensation amount (die parameters) for each angle at the four directions of U axis positive/negative direction and V axis positive/negative direction are respectively generated before machining, and each direction of the taper angle is compensated so that a correct angle can be achieved.

- **For detailed instructions, contact our customer service.**

1.5.3 Taper-Z adjustment

The adjustment amount for ΔZ3/Z4 of the taper specs is calculated from the results of taper machining (Z axis height during machining, workpiece top/bottom height, command taper angle, workpiece top/bottom error), and the die parameters created during high accuracy taper specs and Angle Master ADVANCE II compensation control are adjusted.

For detailed instructions, contact our customer service.

1.6 How to Use (Angle Master ADV II)

1.6.1 Angle Master ADVANCE II dedicated measuring jig Preparation before measurement

(1) Turning each switch ON/OFF

High accuracy taper specification determination and Angle Master ADVANCE II compensation control utilize the high accuracy positioning function.

From the "Machining setting" auxiliary menu in "Operation", display the "Parameter Set" > "Auto3" screen and turn on the [X0.1] switch (Fig. VI.1.5). Also, make sure that the [ABS.UV] switch is OFF. If it is ON, turn it OFF. Turn off the "AxiEchg.", "Mirror X", and "Mirror Y" operation switches.

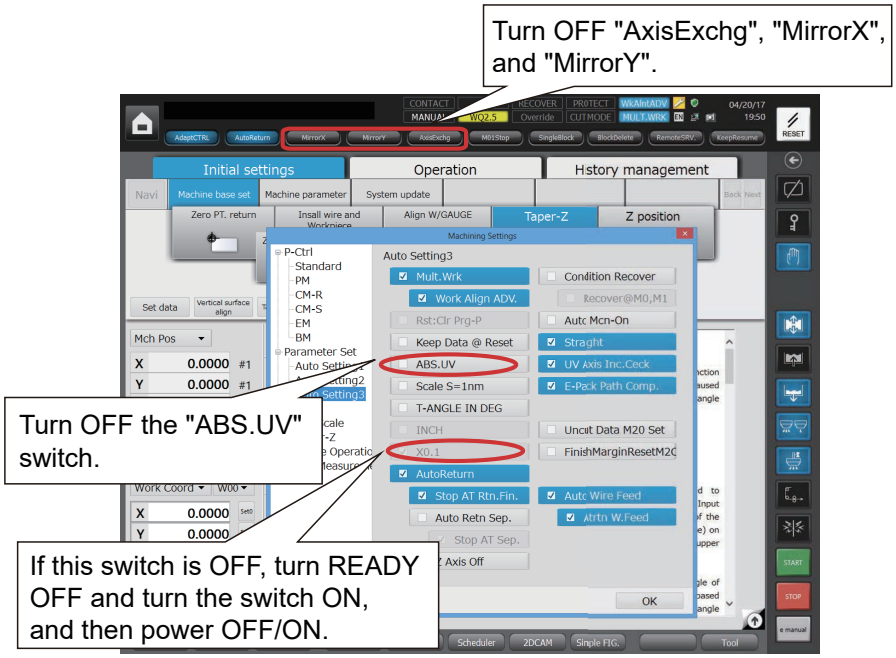


Fig. VI.1.5 Environmental setting screen

(2) Setting positioning parameters

Check the values of the positioning parameters. Configure the settings on the "Initial settings" > "Machine parameters" > "Pickup" screen (Fig. VI.1.6). Change the WT notch in "A.Master Adv.".

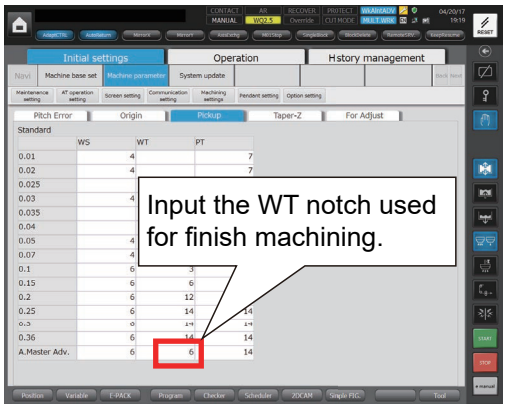
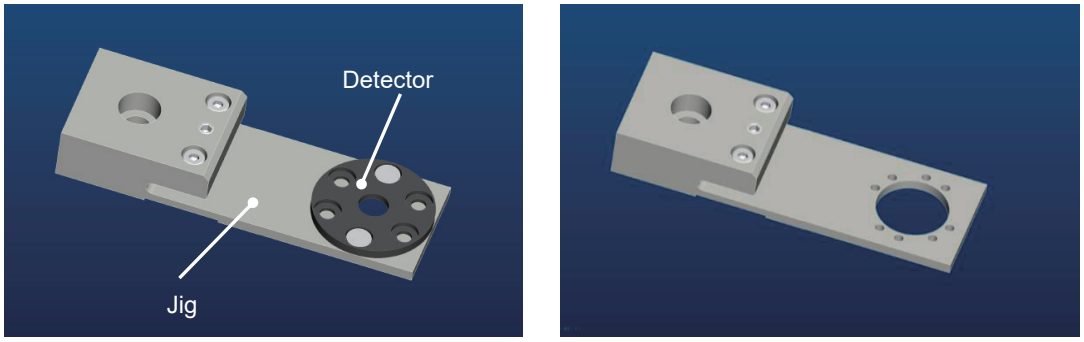


Fig. VI.1.6 Positioning parameter setting (MP, MV series)

1.7 Maintenance (Angle Master ADV II)

To correctly measure all the parameters (compensation amount), regularly maintain and check the dedicated measuring jig for Angle Master ADVANCE II.
To level the measurement position, always check the contact position between the clamp and the table and the detector touched by the wire during measurement.



(a) With detector (b) Without detector

Fig. VI.1.7 Angle Master ADVANCE II measuring jig

1) Rotating the detector

The detector is fixed on the clamp body using screws and can be removed. First rotate the detector before use.

2) Replacing the detector

If there is still a scratch near the wire contact position after the detector is rotated, or if it is hard to find the plane due to distortion of the detector, replace the detector. For purchase of a detector, consult the service center.

3) Polishing the jig and detector

When the surface of the jig and the detector on the back has defects or burrs, polish it. In such a case, note to ensure flatness of the polished surface.
Check whether there are any scratches after measurement. Use detergent for cleaning, and spray rust preventive before storage.

2. 20 kg/25 kg WIRE WINDING UNIT

2.1 Introduction

This chapter describes the use of the 20 kg/25 kg wire winding unit that enables a stable feed of wire electrode for a long time with little tension fluctuation.

2.2 Specifications

(1) Wire electrode diameter

- Brass wire Ø0.2, Ø0.25, Ø0.3

(2) Applicable workpiece

- 20 kg wire bobbin or 25 kg wire bobbin

  *** When using 10 kg, 5 kg, or 3 kg wire bobbin, install them to the wire bobbin installation shaft on the machine unit. Supply is not possible when installed on this unit.**

(3) Set tension

- Approximately 200 g

(4) Rated voltage

- 100 V AC 50/60 Hz (Supplied from control unit)

  Use the wire electrode listed in "II. AUTOMATIC WIRE FEEDER" for the 20 kg/25 kg wire electrode mounted on this unit.

2.3 Configuration

The 20 kg/25 kg wire winding unit is installed on the left of the machine. The configuration is as shown below:

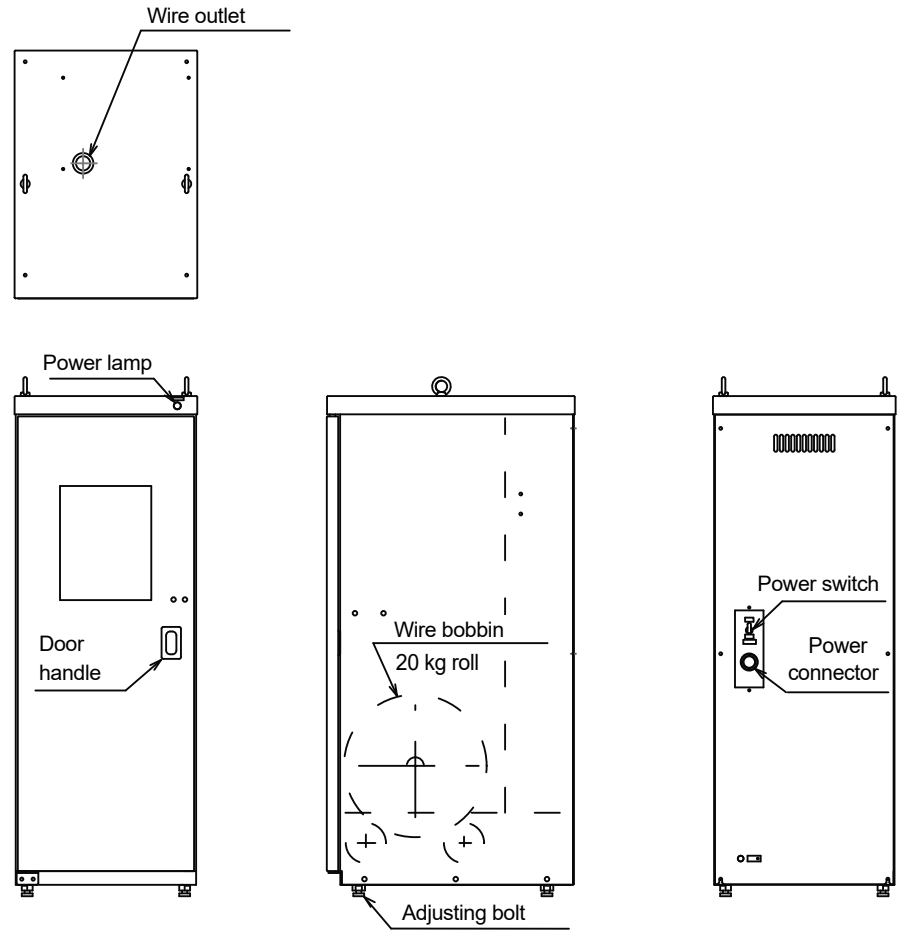


Fig. VI.2.1 20 kg/25 kg wire winding unit (Exterior)

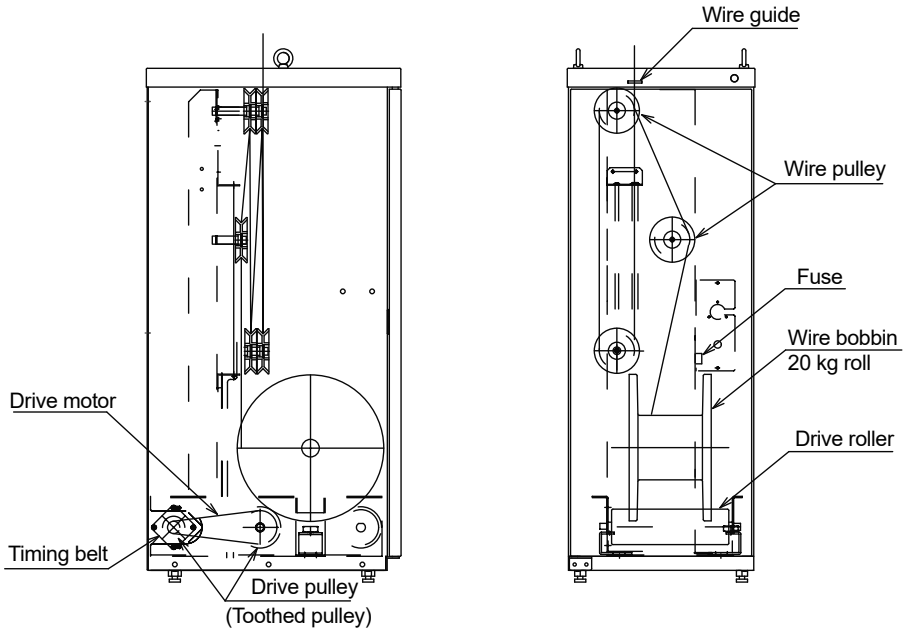


Fig. VI.2.2 20 kg/25 kg wire winding unit (Interior structure)

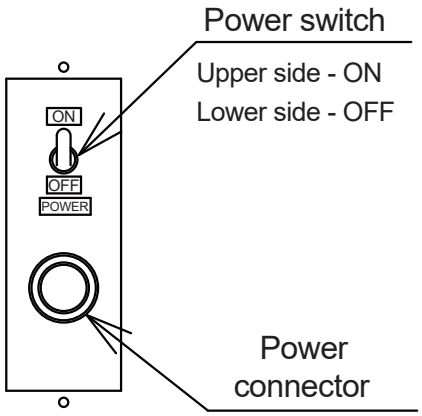


Fig. VI.2.3 Operation panel (Unit rear)

2.4 Handling Procedure

2.4.1 Switch operation

(1) Switching to the 20 kg/25 kg winding bobbin

1) Press EMERGENCY STOP on the control unit and turn OFF "READY".
2) Turn ON the unit.
3) Turn ON "READY" on the control unit, and then press "RESET" twice.
4) Turn ON the 20 kg/25 kg wire switch on the 20 kg /25 kg wire winding unit.

(2) Switching from the 20 kg/25 kg winding bobbin back to the standard bobbin

1) Press EMERGENCY STOP on the control unit and turn OFF "READY".
2) Turn ON the unit.
3) Turn ON "READY" on the control unit, and then press "RESET" twice.
4) Turn OFF the 20 kg/25 kg wire switch on the 20 kg /25 kg wire winding unit.

2.4.2 Installing the 20 kg/25 kg winding bobbin

Open the door and insert the wire bobbin between the two rollers in the direction shown in Fig. VI.2.4.

*** The wire bobbin is heavy so take care when handling it. Also, take care not to damage the wire bobbin.**

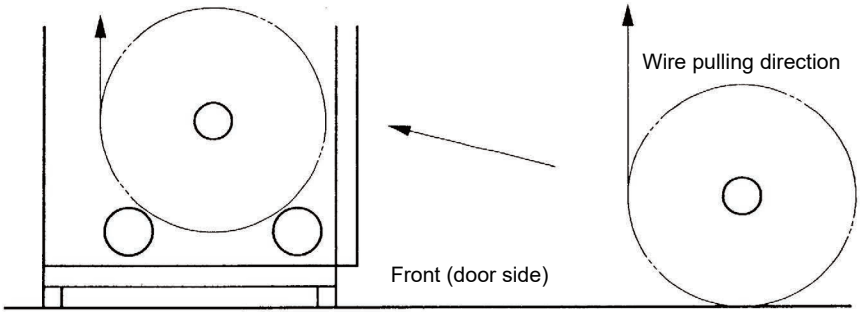


Fig. VI.2.4 Installing the winding bobbin

2.4.3 How to thread the wire electrode

(1) Pull out the wire electrode by 1.5 to 2 m from the wire bobbin installed on the unit.

(2) Hook this wire on the pulley in the following sequence. (Fig. VI.2.5.)
Arrangement of pulleys in sequential order
(1)→(2)→(3)→(2)→(3)
<Back><Front>

When pulley (4) is lifted approximately 100 mm, the unit is ready to feed wire. The wire electrode can be pulled out smoothly. (With power ON.)

(3) Pass the wire electrode through to the wire guide.

(4) Thread the wire electrode as shown in Fig. VI.2.6 to Fig. VI.2.8.

NOTICE

- **After threading the wire electrode, always travel the wire electrode before machining and check that it does not contact the 20 kg/25 kg winding unit or the machine unit.**
  Use the manual operation box or indicator ON state to check for contact
  Only start machining after confirming that there is no contact.
  If the wire electrode slips off during machining and contacts the 20 kg/25 kg wire winding unit or machine unit, a fire could occur.
- **When using the standard bobbin (10 kg, 5 kg, or 3 kg), turn OFF the switch on this unit and turn ON the pretension switch on the machine unit.**
- **Do not touch the wire electrode during machining, as a machining voltage is applied to it.**
- **The speed of the drive rollers is automatically adjusted by the position (height) of the pulley (4) , so do not lift the pulley higher than required. The wire bobbin will rotate at a high speed that is dangerous, and will be overloaded. (There will be no problem if the pulley (4) is lifted up by the wire pull-out on the machine unit side.)**

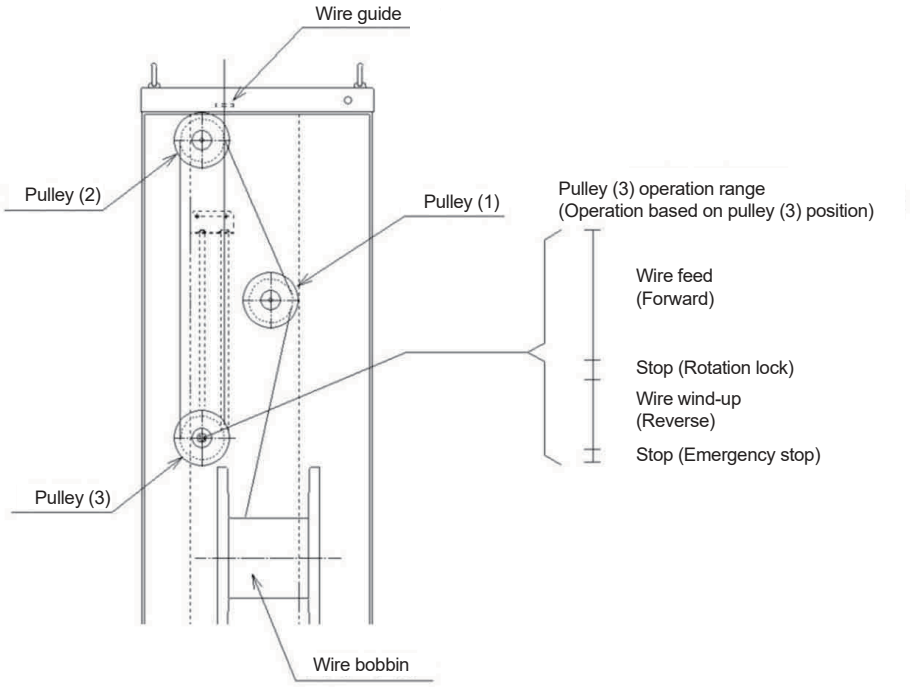


Fig. VI.2.5 Wire path (Inside 20 kg/25 kg wire winding unit)

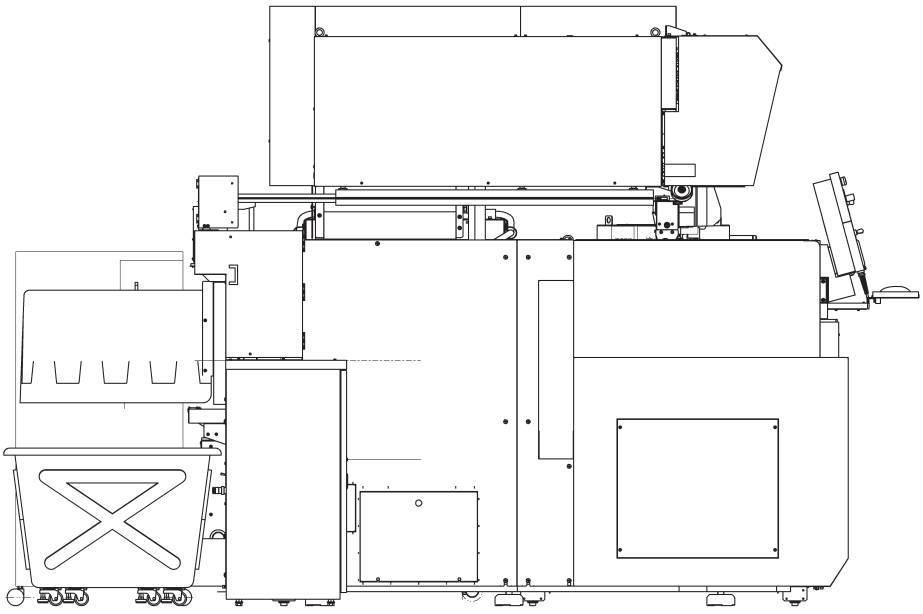


Fig. VI.2.6 Wire path (left side of machine) (MG24 series)

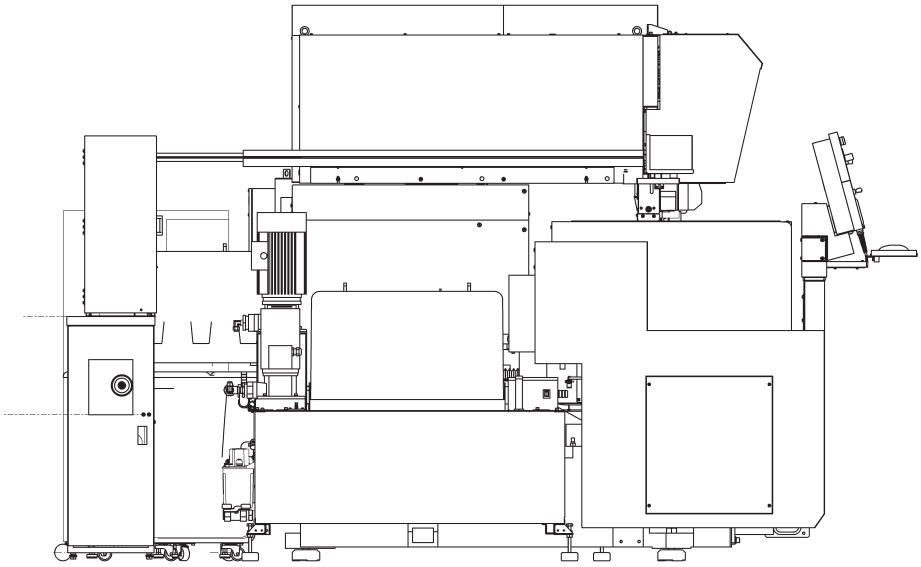


Fig. VI.2.7 Wire path (left side of the machine) (MG12 series)

1) Pulley section on the upper part of 20 kg/25 kg wire winding unit (MG24 series)

- The cover opens and closes as shown in Fig. VI.2.8.
- Tense the wire electrode in the direction of the arrow shown in the drawing.

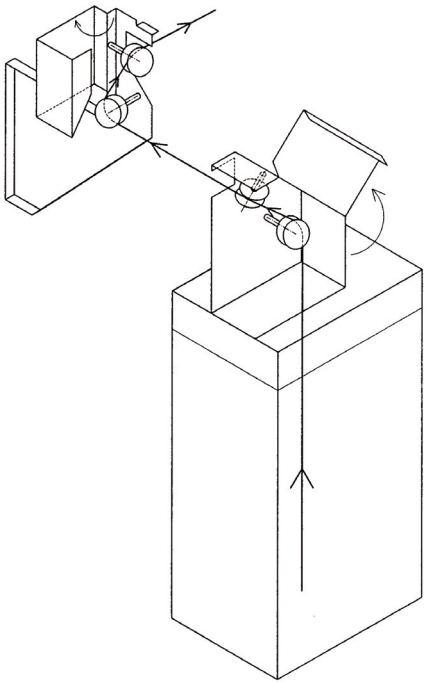


Fig. VI.2.8 Pulley section on the upper part of 20 kg/25 kg wire winding unit (MG24 series)

2) Pulley section on the upper part of 20 kg/25 kg wire winding unit (MG12 series)

- The cover opens and closes as shown in Fig. VI.2.9.
- Tense the wire electrode in the direction of the arrow shown in the drawing.

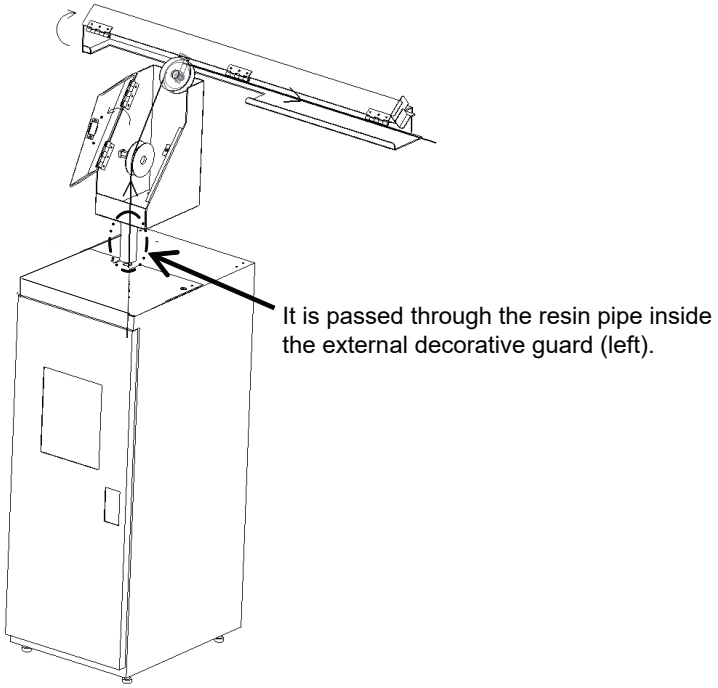


Fig. VI.2.9 Pulley section on the upper part of 20 kg/25 kg wire winding unit (MG12 series)

3) Lower wire feed panel

- Open the cover downward.
- Tense the wire electrode in the direction of the arrow shown in the drawing.

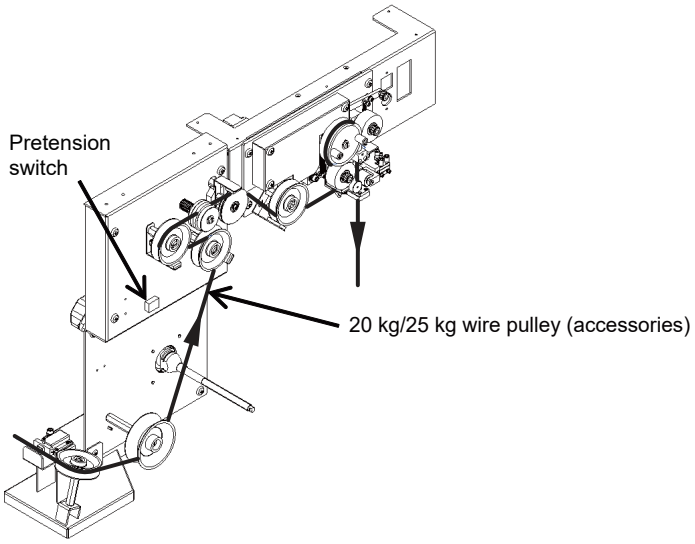


Fig. VI.2.10 Lower wire feed panel

2.4.4 Setting of pre-tension value

Turn "ON" the pretension switch in Fig. VI.2.10.

2.5 Troubleshooting

Mode	Cause	Measure
Power supply lamp does not light when the switch is turned ON.	Connector (located on the back side of the unit) is disconnected.	Connect the connector.
	Fuse is blown.	Replace the fuse (located at the operation panel of unit) with a new fuse. (5A)
The device does not operate when the power supply lamp is lit.	Wire is cut. Wire is off the pulley.	Stretch the wire electrode tightly.

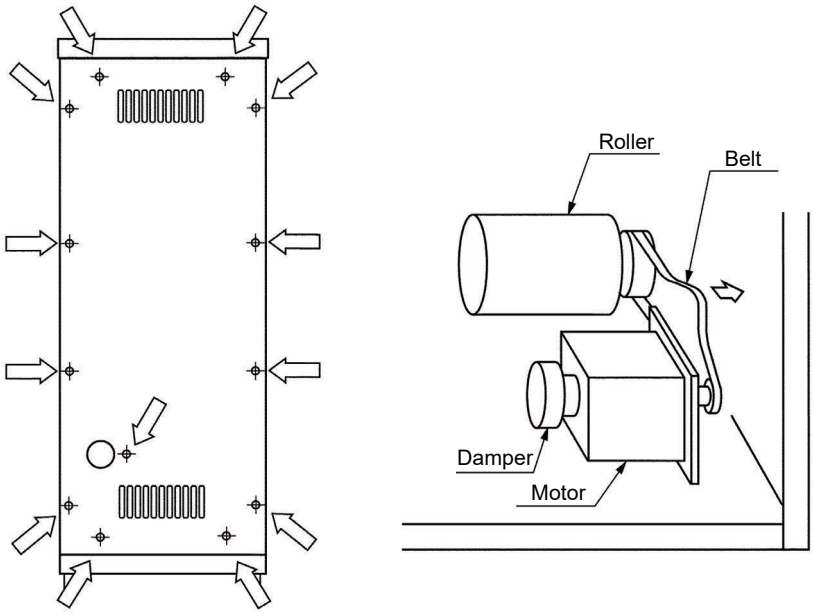
2.6 Replacement of Timing Belt

Replace the timing belt for drive with the following procedure when required.

2.6.1 Removal

(1) Turn OFF the power switch and disconnect the power supply connector, and then remove the rear lid.
- The positions of the screws fixing the rear lid are shown with arrows in Fig. VI.2.11 (13 positions).

(2) Press the belt outward, rotate the motor by hand, and remove the belt from the gears on the motor side.
- The motor and belt used to drive the roller are at the lower right corner under the rear lid. (Fig. VI.2.11.)



[Removing the rear lid] [Removing the belt]

Fig. VI.2.11

2.6.2 Installation

(1) Securely catch the new belt on the roller side gears, and rotate the motor by hand while pressing the belt so as to catch it on the motor side gears.

(2) Reinstall the lid and connector.

⚠CAUTION

- **The motor can be easily rotated by hand when the damper (yellow suspension gear on the opposite side of motor gears) is rotated.**
- **Be careful not to get your hands caught when replacing the belt.**

3. WIRE PROCESSING UNIT

3.1 Introduction

This chapter explains how to use the wire processing unit. Mitsubishi Electric hasbuilt in safety measures, but some risks remain. Read and understand this manual before operation of the wire-cut EDM.

3.2 Specifications

3.2.1 State of wire collection section

(1) State with wire processing unit mounted

The wire processing unit (wire cutter unit) cuts the wire electrode spent during machining, and collects the small pieces. Normally, the machine is used with this unit mounted.

(2) State with wire processing unit dismounted

With this method, the spent wire is collected into the collection box in the original state. This method is temporarily used when the cutter blade for the wire processing unit has reached its life, or when using Ø0.1 or Ø0.15 wire.

3.2.2 Wire electrode applicable with wire processing unit

- Applicable wire electrode diameter is Ø0.2 to Ø0.36 mm (refer to "II. AUTOMATIC WIRE FEEDER").
- The Ø0.1 and Ø0.15 wire electrodes cannot be used when the wire processing unit is installed. When using the Ø0.1 and Ø0.15 wire electrodes, always ensure that the wire processing unit is not installed.,

⚠CAUTION

Always dismount the wire processing unit before using the Ø0.2 wire electrode for high speed machining of "R wire TYPE-S" of MITSUBISHI ELECTRIC MECHATRONICS ENGINEERING CORPORATION.

3.2.3 State of cutting chips

The wire electrode is cut into small chips approximately 5 mm or smaller.

3.2.4 Items changed for wire processing unit setting (Removed → Installed)

No.	Item
1	Install the cutter motor unit
2	Change wire collection section's aspirator

3.2.5 Standard accessories

Cutter unit ..... One set
Cutter motor unit (motor, coupling, and wiring)..... One set
Aspirator (for wire processing unit installation), duct (for uninstallation)..... One each

3.2.6 Special instructions

(1) Guideline to collectable weight

When the wire processing unit is installed…20 kg
(Note that if too many cutting chips are accumulated, it will be difficult to dispose of them, so periodically dispose of the accumulated chips.)
When the wire processing unit is installed…5 kg
(The waste wire volume will increase as the wire is curled.)

(2) Guideline to life (These are not guaranteed values.)

Fixed blade1000 hours (per point) × 3 points
Rotary blade2000 hours (per point) × 2 points
Note that these values are for using a Ø0.2 brass wire.

(3) Precautions for using high-speed machining wire

Uninstall the wiring processing unit before using high-speed or angle-master wire. Post-roller curl may prevent the wire electrode from entering the unit inlet, causing processing unit errors.

(4) Precautions for power OFF

1) Stop the wire feed before turning off the power.
2) Before turning ON, ensure the wire does not protrude between the aspirator and collection roller.

3.3 Explanation of wire processing unit

3.3.1 Aspirator

This part guides the wire from the collection roller to the cutter unit. Compressed air is blown from inside.

3.3.2 Cutter unit

This unit cuts wire chips. It is driven by the cutter motor.

3.3.3 Cutter motor unit

This is an integrated cutter motor and cutter unit. When collecting the wire without cutting it, installation position of this unit is shifted and fixed.

3.3.4 End plate

When collecting the wire without cutting it, the above cutter unit is removed and installed behind the collection rollers, and the spent wire is guided into the wire collection box.

3.3.5 Wire collection cover

This cover encloses the entire wire processing unit.

3.3.6 Collection roller pressing force changeover regulator

The collection roller pressing force is changed for each wire diameter.
For the pressing force, refer to the nameplate.

3.3.7 Drip-proof cover

This cover prevents the water flow, which contacts the collection roller during AT insertion, from spattering. Fix the upper two points with M4 socket bolts.

3.3.8 Toggle switch

This prevents the cutter unit from rotating when replacing the cutter unit and during maintenance.

3.3.9 Circuit protector

If the cutter's rotary blade has reached its life, etc., causing it to lock when it cannot cut the wire, the motor rotation will stop and the temperature will rise. When the temperature exceeds as the set level, this protector will shut off the power to the motor for safety purposes.

3.3.10 Wire collection box

The waste wire is collected into this box.

3.3.11 Chain

This chain discharges the static electricity from waste wire chips. With the processing unit installed, the machine (W side) conducts to the chips via electrostatic rubber. When the wire processing unit is not mounted, the conduction circuit is cut off by disconnecting the cables and connectors of the cutter motor, etc. Thus, the machine body and waste wire are insulated. When the wire processing unit is not installed, always remove the connector by following the procedure described in "3.4 Removing and Installing Wire Processing Method".

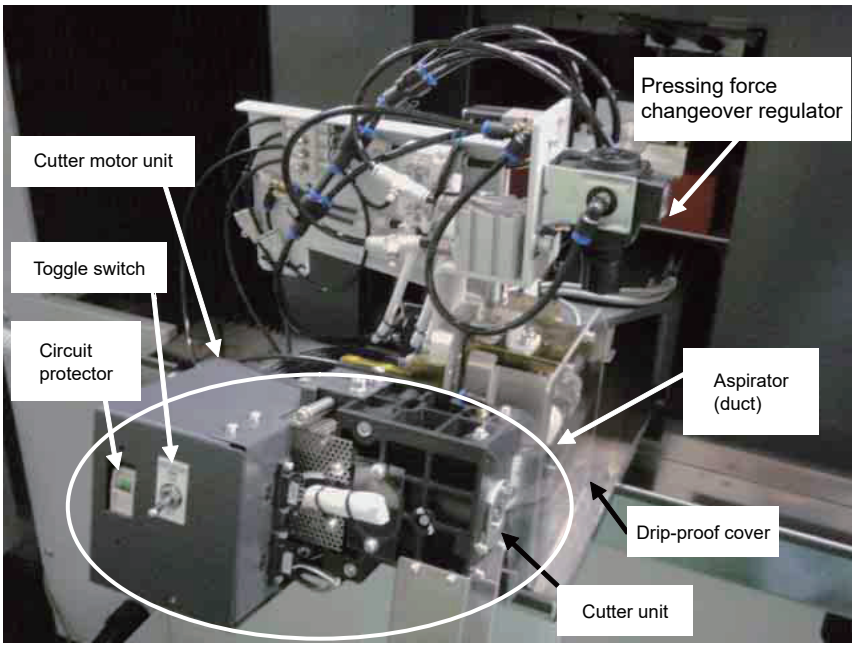


Fig. VI.3.1

3.4 Removing and Installing Wire Processing Method

3.4.1 Removing the unit

(1) Toggle switch OFF

⚠CAUTION

Before starting the operation, turn the toggle switch OFF and stop the cutter motor. There is a risk of injury if the toggle switch is left ON.

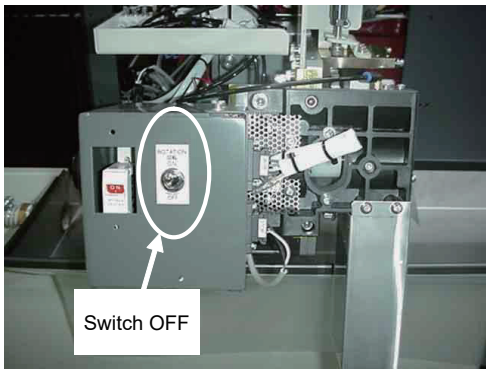


Fig. VI.3.2

(2) Machine READY OFF

⚠CAUTION

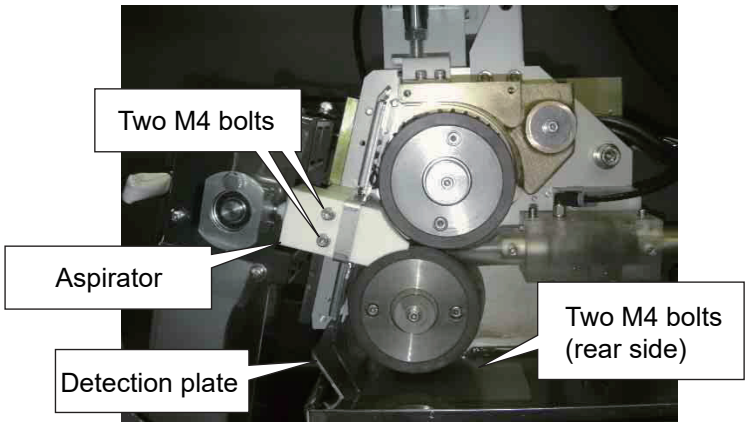
Turn OFF [READY] on the machine. There is a risk of electric shock when disconnecting the connector if this switch is left ON.

(3) Removing the detector plate

Remove the two M4 socket bolts under the roller and remove the detector plate. Attach the removed M4 bolts to the original positions.

(4) Removing the aspirator

Remove the two M4 socket bolts and remove the aspirator (with the detector plate).



(5) Disconnecting the connector

From the back of the machine, reach through the left-rear wire collection cover window and unplug the lowest of the three connectors on the mounting plate.

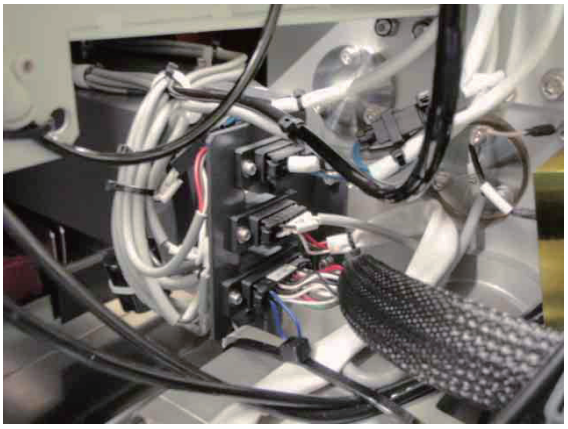


Fig. VI.3.3

(6) Removing the cutter motor unit

Remove the three M6 socket bolts, leaving the upper left bolt as a support point. Pull the cutter motor unit forward avoiding interference, and then turn the entire cutter motor unit 90 degrees clockwise using the support bolt as a center point.

⚠CAUTION
Take care not to directly touch the motor while rotating it as it will be very hot.

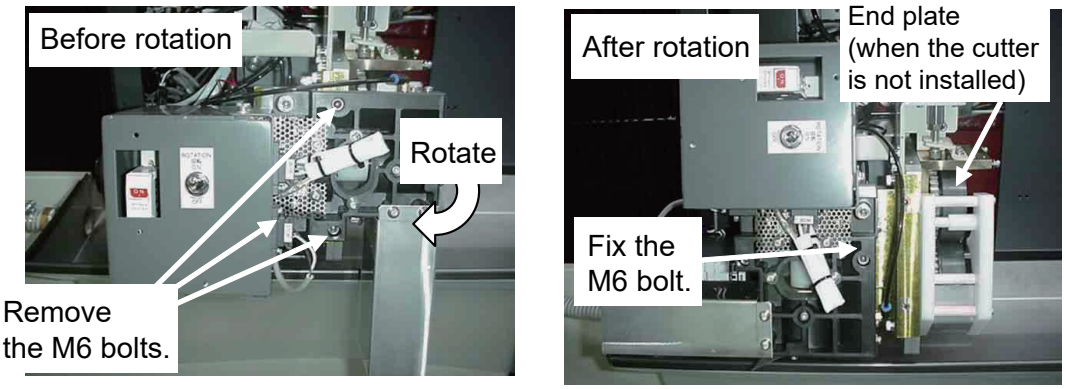


Fig. VI.3.4

(7) Fixing the cutter motor unit

Fix the motor with an M6 socket bolt at only one position below the support bolt.

(8) Installing the duct

Fix the two points with the supplied M4 socket bolts.

3.4.2 Mounting the unit

(1) Machine READY OFF

⚠CAUTION

Turn OFF [READY] before starting the operation. Otherwise, there is a risk of electric shock when connecting the connector.

(2) Removing the end plate

Remove the two bolts on the end plate mounted for guiding the waste wire into the collection box, and then remove it.

(3) Installing and fixing the cutter motor unit

Remove the M6 socket bolt below the support bolt. Pull the cutter motor unit forward avoiding interference, and then turn the entire cutter motor unit counterclockwise using the support bolt as a center point. Position the resin case of the cutter motor unit against the casting's positioning surfaces (right and lower sides), and position the unit. Fix the cutter motor unit with three M6 socket bolts except the support screw.

(4) Connecting the connector

Connect the connector at the left back of the collection unit to the original position. (Make sure that the connector is securely fitted in.) If the machine is operated without the connector installed, an error will occur.

(5) Installing the detector plate

Install the detector plate with the M4 socket bolt. Press the detector plate against the rotary unit's body plate and fix.

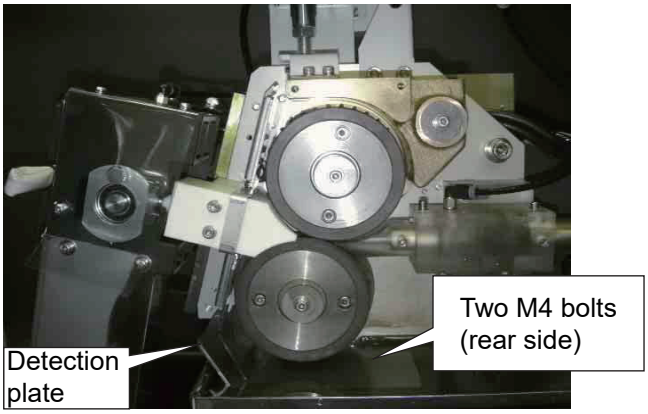


Fig. VI.3.5

(6) Installing the aspirator

Tighten the two M4 socket bolts to install the aspirator (with the detector plate). Press the aspirator against the resin case of the cutter motor unit, and fix.

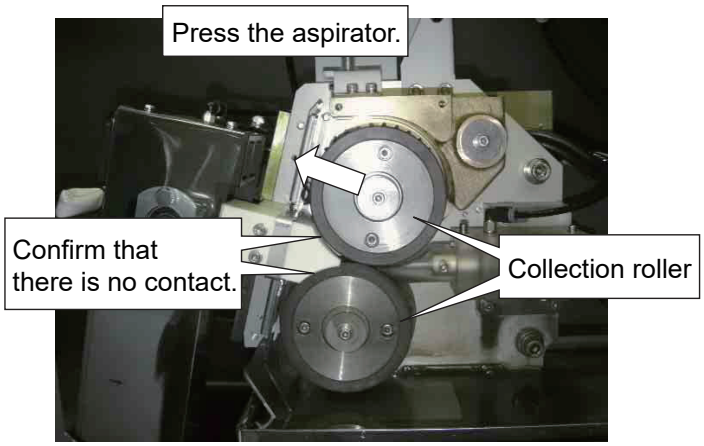


Fig. VI.3.6

After installation, check the following two points.

1) Confirm that the collection roller and aspirator are not contacting (there is a gap of approx. 1 mm).
   If these are contacting, the wire could break because of abnormal collection roller wear.

2) Confirm that the detector plate installed in step (5) and the metal plate installed on the aspirator are not contacting.
   If the detector plate is contacting the metal plate, wire protrusion could be incorrectly detected and wire will not run.

(7) READY ON

Turn ON [READY] on the machine.

(8) Toggle switch ON

Turn ON the toggle switch.

3.5 Maintenance

3.5.1 Inspection method

(1) When the wire processing unit is installed

1) When inserting the wire, check that the wire end does not protrude between the aspirator and collection roller.
2) Confirm that there are no bumps on the collection roller surface.
(Lightly touch the surface with a fingernail, and check that there are no snags, or visually confirm.)
3) Check the lower collection flow rate.
4) Confirm that the cutter's rotary blade rotates. Confirm that the blade rotates when the toggle switch is "ON" and the wire is being fed.
5) Confirm that there are no wire chips in the aspirator.
6) Confirm that the collection roller pressing force is set appropriately for the wire diameter.
7) Confirm that the system is not stopped by the alarm "WIRE PROCESSING UNIT", and that the wire is not protruding between the aspirator and collection roller.
8) Confirm that the detector plate installed under the roller is not contacting the metal plate installed on the aspirator.
9) Confirm that the cutter's rotary blade and fixed blade have not reached their lives. (Check that the shape of the wire chips is not abnormal.)
10) Confirm that the chain mounted on the machine body is placed in the wire collection box.

(2) When wire processing unit is dismounted

Perform the above 1) to 3) and 6) in "(1) When the wire processing unit is installed".

3.5.2 Measures for abnormalities

(1) If the wire is protruding, the collection roller pressing force may not be appropriate. Check the position of the collection roller pressing force changeover regulator.

(2) If there are bumps on the collection roller, reverse or replace the roller.

(3) Check whether the detection sensor at the lower roller section is clogged by foreign matter, etc.

(4) If the cutter's rotary blade is not rotating, the circuit protector may be activated or the toggle switch may be turned OFF. Turn the circuit protector or toggle switch "ON".

(5) If there are any wire chips, turn OFF the toggle switch, and remove the aspirator and wire chips.

(6) Set the collection roller pressing force suitable for the wire diameter.

(7) Turn the toggle switch "OFF" to stop the cutter's rotary blade, then remove the wire chips.
If wire chips are dogleg, the rotary or fixed blade is near end-of-life. Shift the position or replace.Lifespan guidelines follow.

(8) If there are any other problems, the machining or automatic wire threader operation could be affected, so contact the service canter.

(9) If the chain is not in the wire collection box, place it in the box.
Estimated wire cutter life

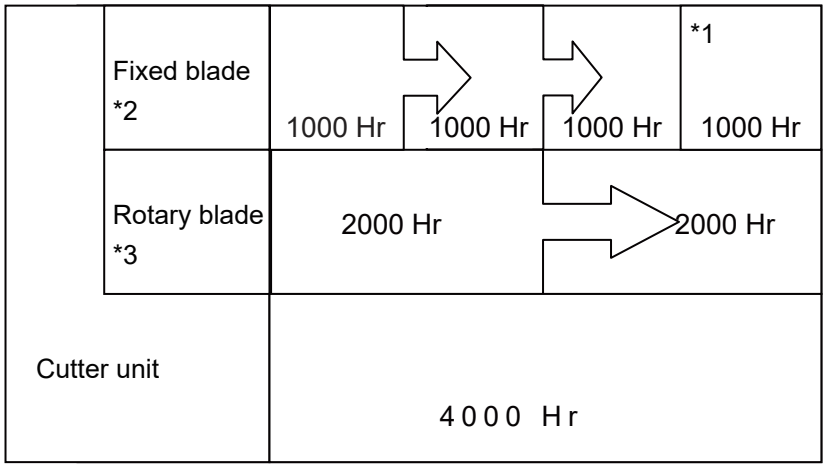


Fig. VI.3.7

⚠CAUTION

- **With regard to only fixed blade, additional one needs to be purchased.**
- **Fixed blade: 1000 h per locations, 3000 h in total (three usable locations)**
- **Rotary blade: 2000 h per location, 4000 h in total (two usable locations)**
- **Always turn the toggle switch OFF before replacing the wire cutter unit to prevent accidents.**

3.5.3 Replacing the wire cutter unit

(1) Removing the unit

1) Turn OFF the toggle switch. There is a risk of injury, so always turn this switch OFF before starting the following work.
2) Loosen the M4 socket bolt on the back of the cutter unit case.
3) Hold the knob and pull out the cutter unit.

(2) Installing the unit

1) Insert the cutter unit into the cutter unit case, aligning the cutter unit's pin with the groove of the cutter unit case.
2) Insert the rotary shaft of the cutter unit aligning the two chamfered faces of the shaft with the matching surface of the hole.
3) Fix the cutter unit by tightening the M4 socket bolt on the back.

3.5.4 Inspecting the wire collection box

(1) Checking for dielectric fluid accumulation in wire collection box

The collection box stores wasted wire, but some dielectric and collection water will slightly leak and accumulate. Check periodically and drain.

*** Always wear leather gloves when contacting the stainless steel plate at the bottom of the collection box, such as when draining dielectric fluid pooled at the bottom. The stainless steel plate is chamfered but may have sharp edges.**

(2) Checking the collection amount

Before starting machining, check that there is sufficient space for collecting the wire. If a large amount of waste wire has accumulated, dispose of it.

(3) Checking the chain

Confirm that the chain is placed in the collection box.
This chain is used to discharge the static electricity that builds up in the wire chips cut by the wire processing unit.

NOTICE
If the chain is not in the box, always place the chain in the box before touching the chips.

(4) Checking the collection box position

Center the processing unit's duct over the collection boy by adjusting left/right. If off-center, waste wire may miss the box near the X-axis stroke end.

3.5.5 Maintenance information

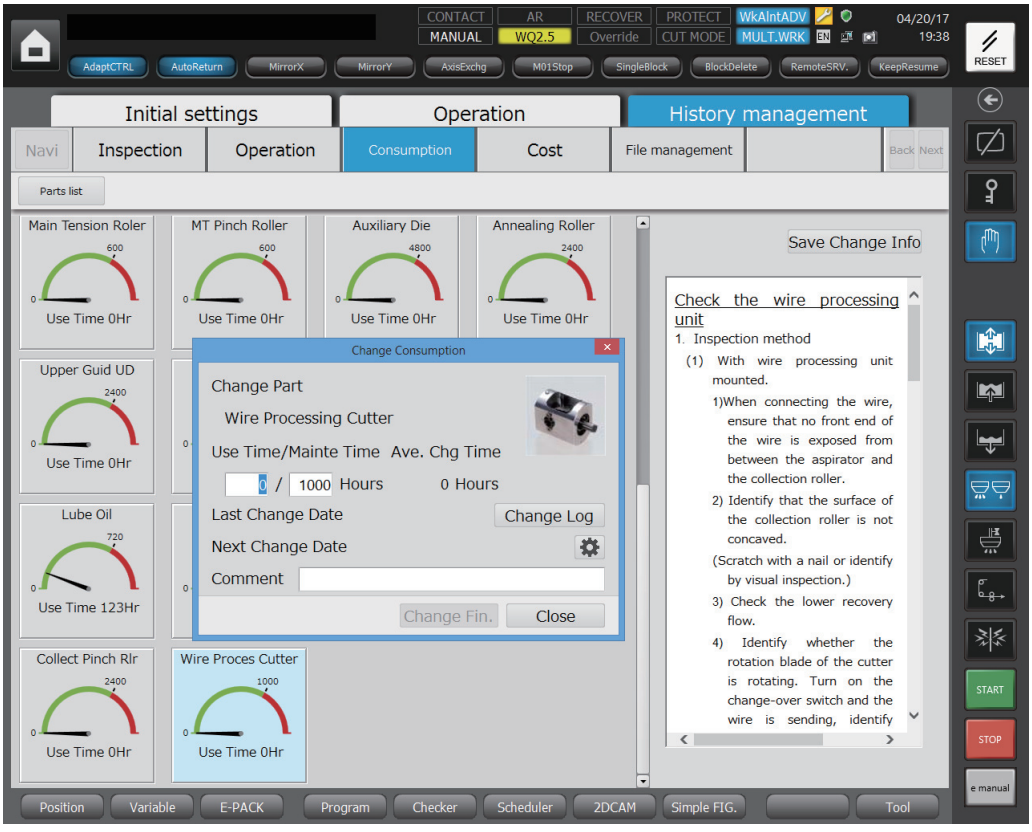


Fig. VI.3.8

Preset the cutter blade life in [Maintenance Time]. The elapse time will be counted as the time passes, so if the maintenance or elapse time needs to be cleared to zero after maintenance is completed, press [Clear].
* For how to use the operation inspection monitor, see "III. NC OPERATION DISPLAY SCREEN".

3.6 Alarm List

3.6.1 PLC related alarms

Error No.	Messages and descriptions	Remedies	Remarks
U814	**WIRE PROCESSING UNIT** When the wire electrode get entangled in the wire processing unit. Or, when the motor is locked.	• Remove the tangled wire. • Check whether the cutter unit is worn, and replace if worn. • Check that the wire processing unit connector [WCM] is connected.	
U854	**OUTSIDE WIRE DIAMETER RANGE (WIRE PROCESSING UNIT)** A wire diameter Ø0.15 or less was selected while the wire processing unit is installed.	• Remove the wire processing unit when using the wire electrode with a diameter of Ø0.15 or less. (The wire processing unit is only compatible with wire diameters of ØØ0.2 or more.) • Specify the wire diameter to be used when using a wire electrode with a diameter of Ø0.2 or more.	
U855	**WIRE PROCESSING UNIT MOTOR STOP** The cutter motor switch is OFF. Or, when the cutter motor breaker is OFF.	• Turn ON the cutter motor switch. • Turn ON the cutter motor breaker.	

3.6.2 Stop Codes

Error No.	Messages and descriptions	Remedies	Remarks
T855	**WIRE PROCESSING UNIT MOTOR STOP** When the cutter motor switch is OFF. Or, when the cutter motor breaker is OFF.	• Turn ON the cutter motor switch. • Turn ON the cutter motor breaker.	

3.7 List of Consumable Parts

	Name	Part code	Mounted quantity
1	Cutter unit	DES91A	1
2	Fixed blade	DAY61A	1

4. VIRUS INFECTION PREVENTION FUNCTION

4.1 Introduction

The EDM uses Trellix®'s "Trellix Embedded Control®" to prevent viruses via whitelisting, blocking any unapproved apps or malware* not allowed on the whitelist. Benefits include stronger protection, reduced attack surface, and controlled execution.

[Main advantages]

- Without the need of updating pattern files of computer viruses, the security is also effective against the unknown viruses.
- Uses minimal resources and thus the impact on processing speed is minimized.

[Restrictions]

- Cannot restore an already infected system (cannot remove the virus).
- Enabling this function after EDM installation requires replacing the hard disk.
- Unauthorized apps/malware may be copied to the EDM's shared drive, but they are not executed, thus leaving the control unit unaffected.

*** "Malware" is a general term for malicious software and program codes that have been created with intent to cause unauthorized and harmful computer behaviors.**

4.2 Explanation of screen

The operation status of the virus infection prevention function is indicated with icons in the notification display area in the upper right corner of the screen.

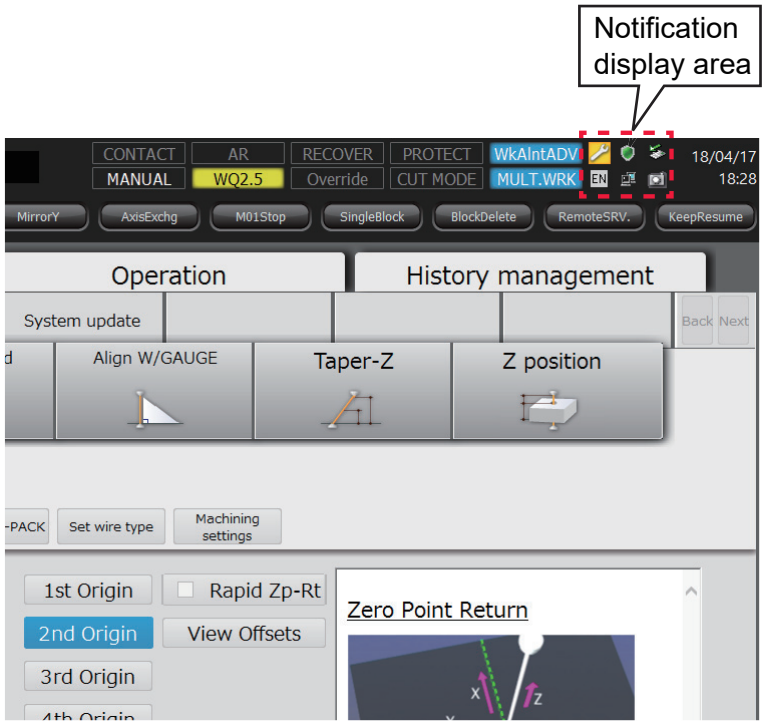


Fig. VI.4.1 Notification display area

Table VI.4.1 Descriptions of icons for the virus infection prevention function

Icon	Status	Description
	Enabled	• The virus infection prevention function is enabled and normally running.
	Disabled	• The virus infection prevention function is disabled. • Contact the Service Center.
	Error	
[No icon]	**Option OFF**	• The virus infection prevention function is disabled. • If no icon is displayed although you have purchased this option, contact the Service Center.

- **If the on-screen icon is in the disabled or error state, contact the service center.**
- **Executing the security check may slow down the on-screen processing.**
- **If replacing the NC unit is required for maintenance or service, it is necessary to enable this function again after the replacement.**

5. COREHOLD (CORE HANDLING FUNCTION)

5.1 Summary

Corehold (core disposal function) means switching to the machining condition for core fixing in rough machining, making a part of core fixed, and performing total circumference machining for the core at the same time to fix the core.

⚠CAUTION

The fixing state changes according to the conditions such as workpiece, dielectric fluid and machining shape, and the core retention force will also change along with the fixing distance and fixing position, so a cut test must be carried out.
If fixing is improper (the core is not fixed, the fixing distance is too short, balance of the fixing position is poor, etc.), the core may fall off after total circumference machining ends.

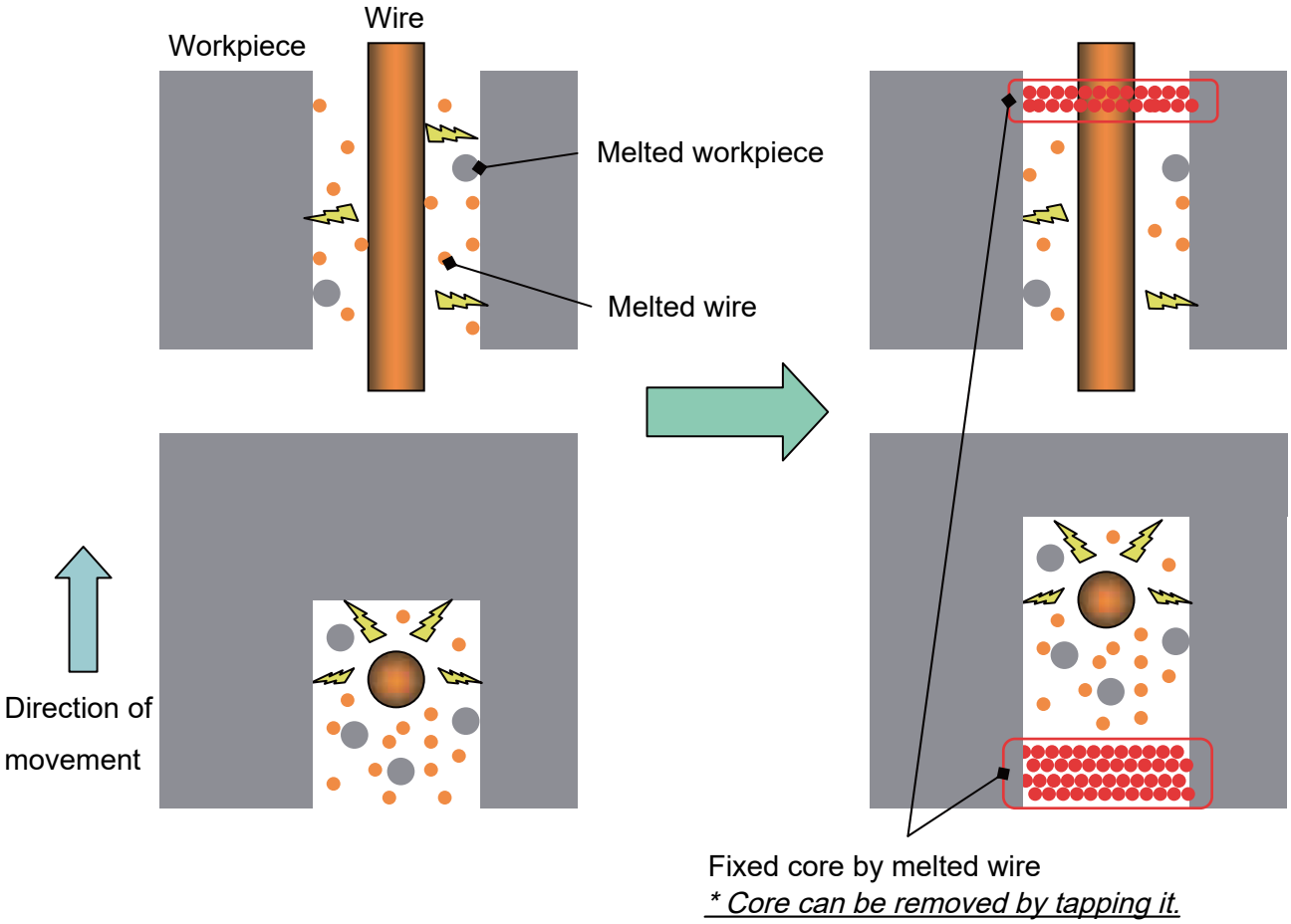


Fig. VI.5.1 Description of corehold

5.2 Specifications

5.2.1 Specification range

1) Wire material and diameter : BS • Ø0.2, Ø0.25

2) Workpiece material and plate thickness : Steel • 5 mm to 50 mm (Ø0.2), 10 mm to 50 mm (Ø0.25)
Tungsten carbide • 5 mm to 30 mm (Ø0.2), 10 mm to 30 mm (Ø0.25)
Steel corresponds to SKD011 (HRC60) and tungsten carbide corresponds to VF40 (HRA89 to 91).

3) Amount of nozzle gap: Indicated in the attached machining condition table.

4) Fixing machining position specifying method: M code, dedicated screen, 2DCAM

5) Restrictions

(1)Always perform a test cut due to the following possibilities.
- The core drops during machining due to the core weight, machining shape, fixing position/ distance setting, and fixing state.
- The core can hardly be taken out after machining due to the fixing position/distance setting, machining shape, and fixing state.
- The fixing state changes due to the machining condition, dielectric fluid quality, workpiece material, etc.
- Relative to the regular rough machining condition, the gap of fixing condition is different. Therefore, there may be un-machined sections in the interval of fixing condition even if finish machining is performed. The method for reducing un-machined section is described in 5.3.4.

(2)Use of the dedicated screen is limited to fixing machining of simple shapes. Use the 2DCAM or M code for the fixing machining of complicated shapes.

(3)Short circuit return is not performed in fixing machining. When a 30-second short circuit takes place, skipping is implemented if skipping is set to be enabled; an error occurs and the operation is stopped if skipping is set to be disabled.

(4)In fixing machining, return is not implemented during insertion at the breaking point. Additionally, when the wire is broken again within 500 m after fixing machining ends, the machine returns to the fixing end position to perform insertion, instead of returning to 500 m.

(5)The machine does not return to the M20 position when the wire is broken. Skipping is implemented if skipping is set to be enabled; an error is reported before stop if skipping is set to be disabled.

5.2.2 Miscellaneous function M for corehold (M131 and M132)

Corehold Modal specification of fixing machining (M131 and M132)

(1) Function and purpose

Commands M131 to M132 are used to perform machining for fixing.
Specify the E-Pack No. of machining conditions and machining feed speed and machining interval in arguments.

(2) Format

M131 P value Q value R value I value
: Designation of start of machining interval for fixing and machining condition for fixing
* If there is not any command, "P32 ADDRESS ERROR" occurs.
However, the I command can be omitted only when R is 0.
M132
: End of machining section for fixing

[P command]
It refers to the E-Pack No. of machining conditions used for fixing.
* "CMD-VALUE OVER" occurs when the value is 30000 or more. When the specified machining condition is missing, "E-PACK ERR." occurs.
[Q command]
It refers to the machining feed speed F (mm/metric system) in machining for fixing.
0.001 ≤ Q ≤ 9999.999 (regular mode/metric system)
Specify the value in the range of 0.0001 ≤ Q ≤ 9999.9999 (×0.1 mode/metric system).
[R command]
It refers to the number of fixing points per block.
Specify the value in the range of -2 ≤ R ≤ 99. The value -2, -1, and 0 are special commands.
-2: Fixing from the start point of the block
-1: Fixing until the end point of the block
0: Fixing the entire block
(It is used to divide the block for fixing with CAM.)
1 to 99: It refers to the number of fixing points per block.
The fixing points are arranged at equal interval in the block.
* "CMD-VALUE OVER" occurs when the value is other than the above.
* When the command contains a decimal point, enter 0 after the decimal point in the same way as -2.0 or 1.0.
Variable type 2: The part after the decimal point is rounded up when it is set to ON.
Variable type 2: The part after the decimal point is discarded when it is set to OFF.
< Example >
1: Fixing before the middle point of the block.
2: Dividing the block into three equal parts and fixing the two points dividing the block.

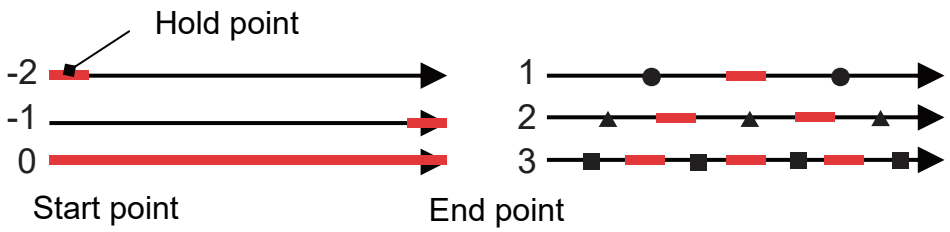


Fig. VI.5.2 R command value and fixing points

[I command]

It refers to the distance of machining based on the machining conditions for fixing (mm, metric system).

0.001 ≤ I ≤ 99999.999 (regular mode/metric system)

Specify the value in the range of 0.0001 ≤ I ≤ 99999.9999 (×0.1 mode/metric system).

* Specify 0.5 mm or more of distance so that the function can operate properly.

When the R command value is 0, the I command can be omitted.
If the I command is specified, its value will be ignored.

(3) Program example

< Example 1 > When specifying fixing for all blocks

```
…
M131 P401 Q3.0 R1 I2.0
G42G01Y-5.0
G01X-5.0
…
```

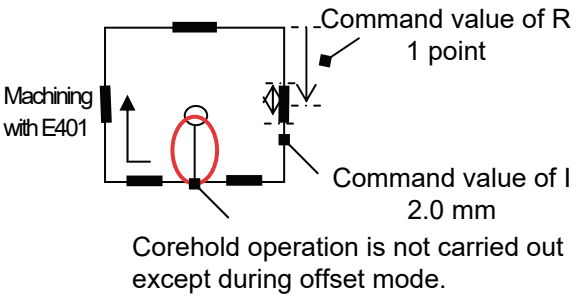


Fig. VI.5.3 Program example 1

< Example 2 > When specifying fixing for each block

```
…
E1001
…
M131 P401 Q3.0 R1 I2.0
G01X10.0
M132
…
```

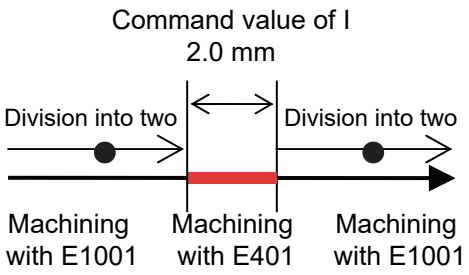
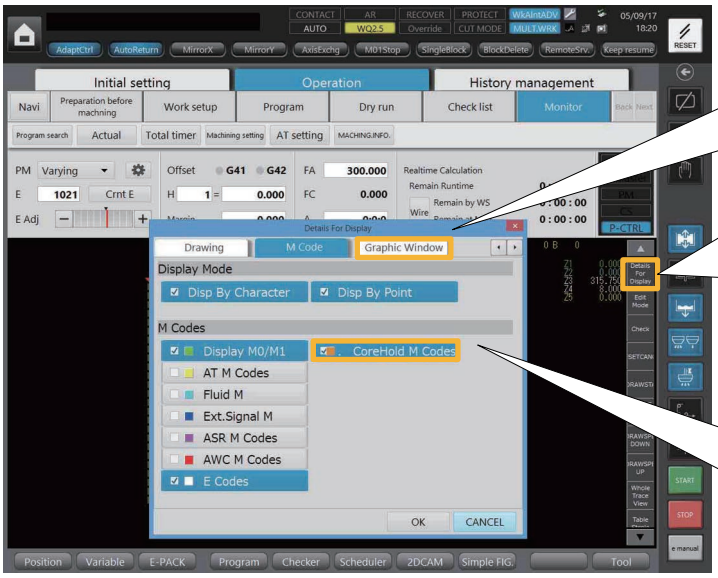


Fig. VI.5.4 Program example 2

(4) Graphic display

The M131 and M132 command positions are displayed in graphics. Set "CoreHold M Codes" in "Details For Display"

> "CoreHold M Codes" of the "Monitor".



Select "M Code" in the displayed dialog box.

Select "Details For Display" in the machining monitor

.

Select "CoreHold M Codes".

VI

⚠CAUTION

1. **The functions cannot be used with the following functions. Use them with switch OFF and without setting information table.**
   - **PM**
   - **E-OFF [Setting to prevent changing of the machining conditions during NC program]**
   - **Information table**
     Setting speed [FF], offset amount [HH], PM mode [PM], and machining speed adjustment [FCO]
2. **Machining used for fixing is performed in the 1st machining only. Set "2" in the information table C of E-Pack of machining conditions for 1st machining.**
   *** In < Example 2 >, set 2 in the information table C of E1001.**
3. **When the CM-R trajectory control, R command, C command, and other blocks are inserted in the M131 fixing machining interval, fixing machining is also performed for the inserted blocks.**
4. **Short circuit return is not performed in fixing machining.**
   When a 30-second short circuit takes place, skipping is implemented if skipping is set to be enabled; an error occurs and the operation is stopped if skipping is set to be disabled.
5. **In fixing machining, return is not implemented during insertion at the breaking point. Additionally, when the wire is broken again within 500 m after fixing machining ends, the machine returns to the fixing end position to perform insertion, instead of returning to 500 m.**
6. **When the condition for switching to fixing occurs once after M20, the machine does not return to the M20 position when the wire is broken before the next M20. Skipping is implemented if skipping is set to be enabled; an error is reported before stop if skipping is set to be disabled.**
7. **When the machining condition has been changed in fixing machining, it is restored to the machining condition before fixing starts when fixing machining ends.**
8. **When the IP and other current conditions have been changed in fixing machining, changes of current conditions will not be kept when fixing machining ends so that the machining conditions before fixing starts can be restored.**
9. **Machining for fixing is not displayed in estimation.**
10. **Corehold is not operated when performing re-machining. Be careful not to cut off the core.**

5.2.3 Corehold screen

The corehold screen can be displayed with the auxiliary menu "AT operation setting" of "Initial settings".

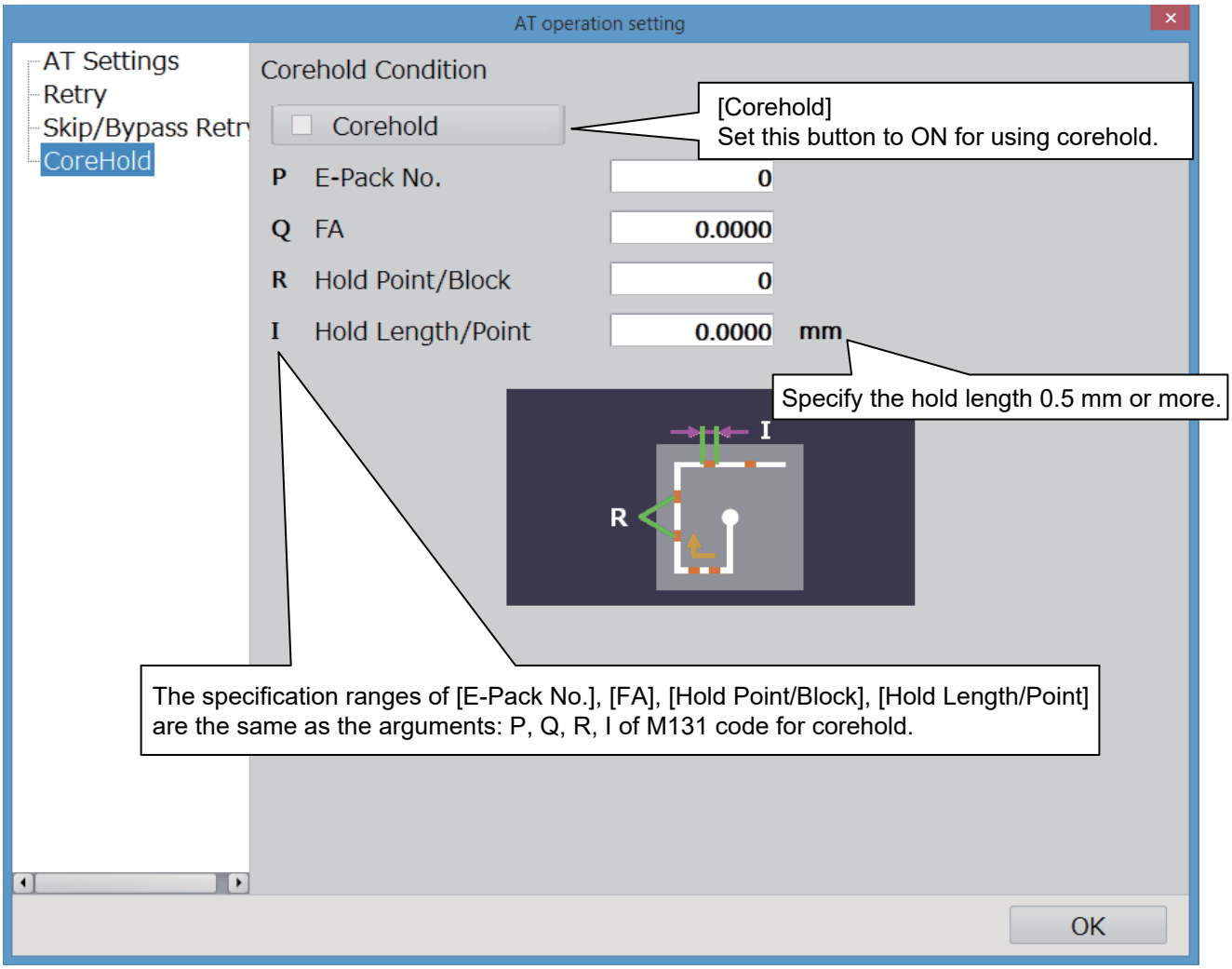


Fig. VI.5.5 Corehold screen

When the [Corehold] switch is ON, all the axis movement blocks during the offset mode of the rough machining become the target of fixing.

Use the auxiliary function M for corehold or 2DCAM if it is necessary to change target/non-target for fixing for each axis movement block.

5.2.4 2DCAM

See the 2DCAM instruction manual.

5.3 Method of use

There are the following methods for using the corehold function.

- Adding M code commands directly through program edit
- Specifying from the setting
- Creating a program including the M code command for corehold with 2DCAM

The details of each method are described below.

5.3.1 Creating program including corehold demand

< Program example >

L401/

M132…Corehold is turned OFF.

M20

M78

M78

M80M82M84

G90

G92X0.Y9.

H1 = 0.000

M90

F0.9E14051…The condition for rough machining is commanded.

G41G01X0.Y5.H1

G01X4.8Y5.

G02X5.Y4.8J-0.2

G01X5.Y1.

M131P406Q0.5R0…Corehold is commanded.

(E-Pack number 406, machining speed 0.5, fix the entire block)

G01X5.Y-1….A block that performs fixation

M132…Corehold is turned OFF.

G01X5.Y-4.8

G02X4.8Y-5.I-0.2

…

5.3.2 Designating corehold on screen

This section describes method of using corehold for simple shape machining on corehold screen.

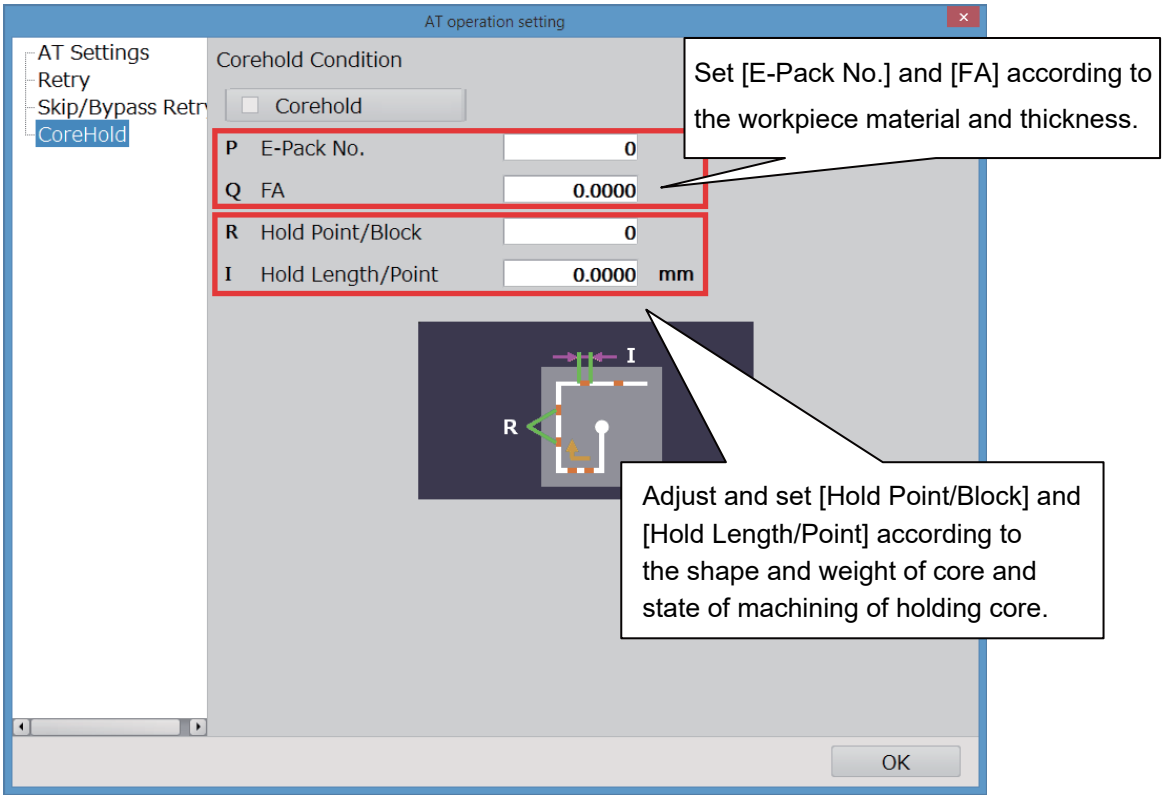


Fig. VI.5.6 Setting example of the corehold screen

< Example 1 > Square

As shown in the right figure, when the program consisting of the seven axis moving blocks 1) → 2) → … → 7) is used to perform fixing machining for the middle point in each axis moving block,

R: The number of fixing points per block is "1".

I: The fixing length per point is "2 mm".

1) and 7) are blocks used for starting and canceling offset, so fixing machining will not be implemented for these two blocks, but will be implemented for the other blocks.

Adjust the number of fixing points per block and the fixing length per point based on the change of core weight due to the length of one side and board thickness.

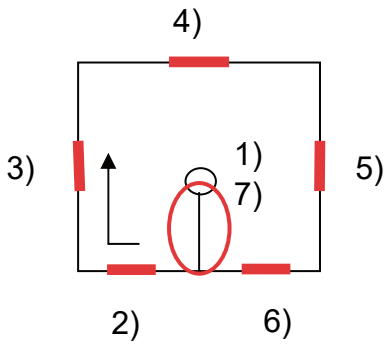


Fig. VI.5.7 Example of square

< Example 2 > Circle

With the same setting as example 1, fixing can be performed in the program consisting of five axis moving blocks 1) → 2) → … → 5) as shown in the right figure.

Since 1) is the block for starting offset and 5) is for canceling offset, fixing machining is not performed to them.

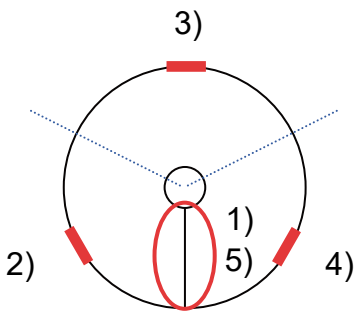


Fig. VI.5.8 Example of circle

5.3.3 2DCAM

See the 2DCAM instruction manual.

5.3.4 Finish machining when using corehold

Machining gap under rough machining condition is normally different from the one under machining condition for fixing. Therefore, there may be un-machined sections in the zone of fixing condition even after finish machining.

• Recommended machining conditions
Steel: Accuracy priority conditions (ACU) Nozzle separated condition (STDO)
Tungsten carbide: Standard condition (STD)

5.4 Prevention function for core from coming off

(1) Function and purpose

If fixing distance is inadequate or fixing point is improper, the core may come off after finish circumference machining, risking tilt, wire breaks and short-circuits.

⚠CAUTION

This function cannot completely prevent core from coming off.

(2) Specifications

After commanding M20, if fixing has been performed at least once, M01 is in the next block, and wire breakage or 30-second short circuit has occurred at the point where the remaining distance is less than that specified with H854, the machining will stop with "T210 WIRE BREAKAGE" or "T211 30 SEC CONTACT" without performing wire reconnection or skipping.

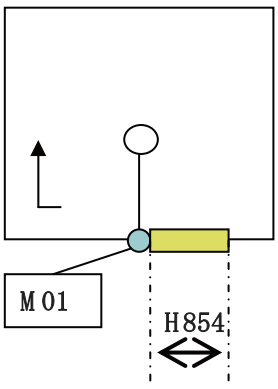


Fig. VI.5.9 Prevention function for core from coming off

(3) Method of use

Create a program including M01 after the last block of circumference machining.
Specify the distance at which this function becomes active with H854.
Turn OFF the [M01 STOP] switch.

5.5 Machining condition for fixing

For the machining condition for fixing, refer to the machining condition data sheet.

6. iQ Care Remote4U

6.1 Dashboard Function

6.1.1 Summary

Used to confirm the EDM operational status through a PC, smart mobile phone or tablet PC (on the Internet Explorer Ver. 10 or later).

6.1.2 Method of use

Use the function by following the steps below:

***1 The following screens are from PC. Display on smart mobile phone and table PC may differ.**

1) Enter
https://wwwf11.mitsubishielectric.co.jp/fa/iq_care/remote4u/edm/login/

2) Enter the customer's login name (USER ID) and password..

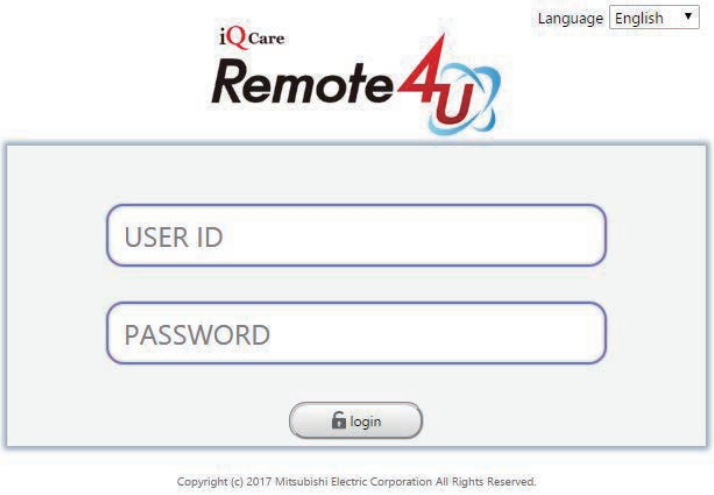


Fig. VI.6.1

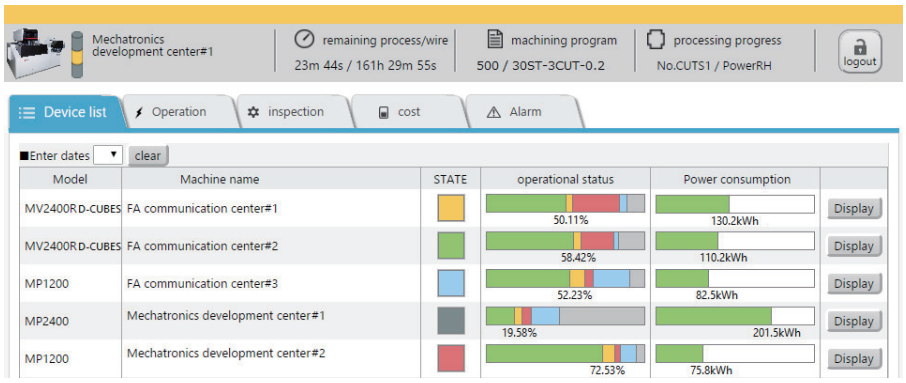


Fig. VI.6.2

3) Click the "Display" button (right button) of the machine whose operating status needs to be confirmed.

4) Select the tab to be confirmed (the upper tab). Confirm its content.

6.1.3 Screen configuration

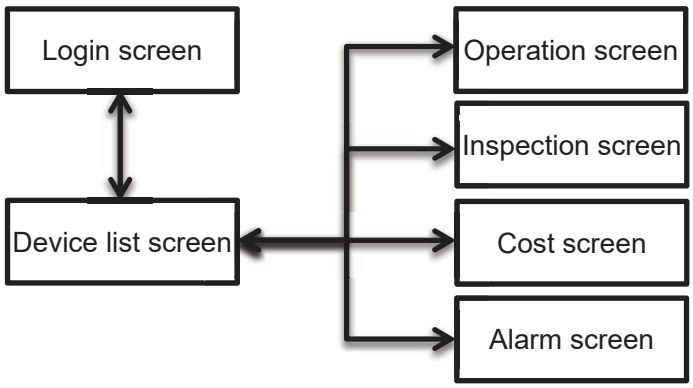


Fig. VI.6.3

6.1.4 Screen details

(1) Login screen

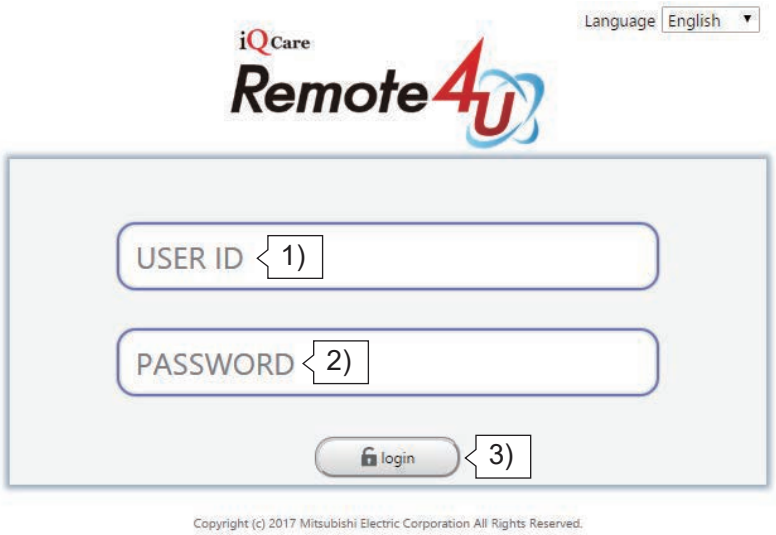


Fig. VI.6.4

1) USER ID

2) PASSWORD

3) login

(2) Device list screen

List of machines that can be viewed by the customer. The device to be confirmed can be selected on this list.

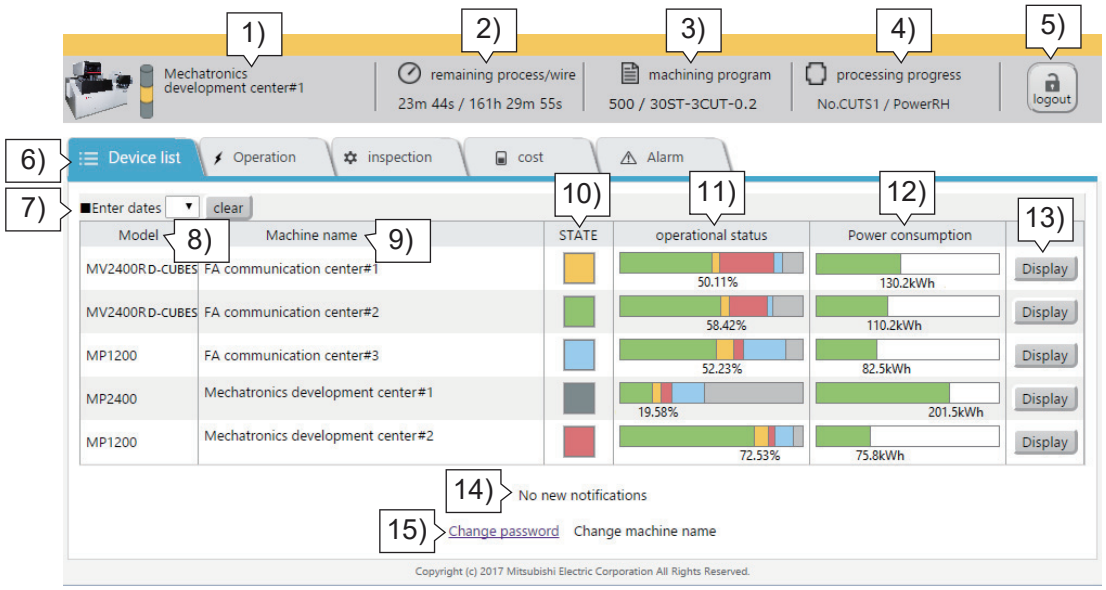


Fig. VI.6.5

1) Machine name

Displays "---" before the "Display" button is pressed (immediately after login). After pressing it, see (3) Operation screen.

2) Remaining time Operation/Wire

Displays "---" before the "Display" button is pressed (immediately after login). After pressing it, see (3) Operation screen.

3) Machining program

Displays "---" before the "Display" button is pressed (immediately after login). After pressing it, see (3) Operation screen.

4) Machining progress

Displays "---" before the "Display" button is pressed (immediately after login). After pressing it, see (3) Operation screen.

5) logout

Log out and go back to the login screen.

6) Tab menu

Before pressing [Display] after login, the screen cannot be switched since no machine is selected. After pressing [Display] you can switch to: "Device list", "Operation", "inspection", "cost", "Alarm".

7) Specifying period

Shows operational status and power consumption for a chosen period (1 to 7 days, including today). If left blank, the past 7 days are displayed.

8) Model

Displays the models of machines that can be viewed by the user who has logged in.

9) Machine name

Displays the machine name.

10) Operation status

Displays the current status.

(a) Green: Operating (b) Yellow: Stopped (c) Red: Alarm (d) Light blue: Setup

(e) Gray: Power OFF, wakeup, fluid preparation OFF, or idling

11) Operational status

Displays the proportion of operational status (operating time, etc.) of each machine. The percentage at the lower layer in the box displays the utilization rate in the specified period.

$$\text{Utilization rate} = \frac{\text{Startup time}}{(\text{Startup time} + \text{Stop time} + \text{Alarm time} + \text{Setup time} + \text{Idling time})}$$

12) Power consumption of machining (optional)

For details, see "III. NC OPERATION DISPLAY SCREEN".

13) Display

Switch to the operation screen of selected machine.

14) Notice

Displays the notice from our company.

15) Change password

The password can be changed (the user ID cannot be changed).

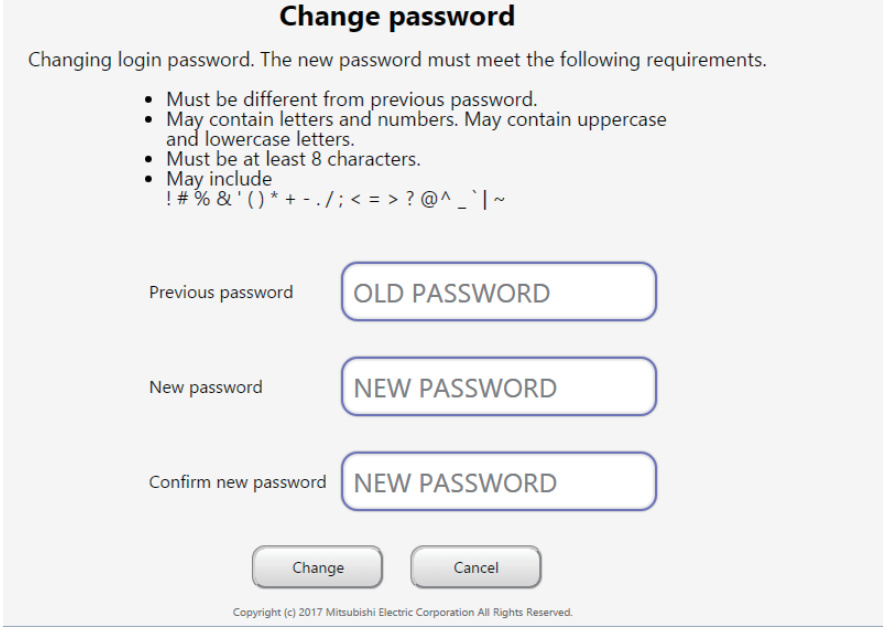


Fig. VI.6.6

(3) Operation screen

Displays the operation information.

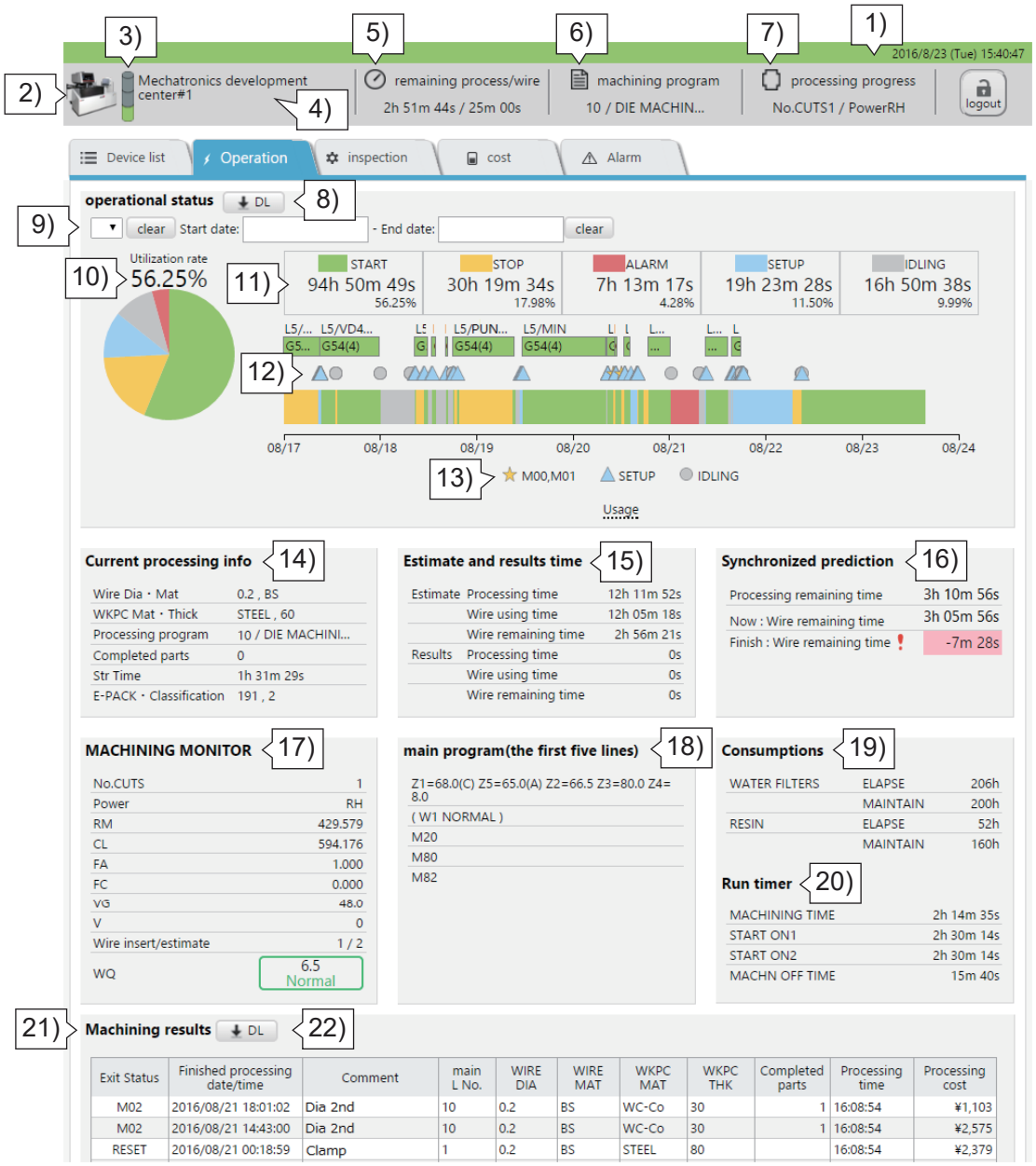

1)
2016/8/23 (Tue) 15:40:47
2)
3)
Mechatronics development center#1
4)
5)
remaining process/wire
2h 51m 44s / 25m 00s
6)
machining program
10 / DIE MACHIN...
7)
processing progress
No.CUTS1 / PowerRH
logout
Device list
Operation
inspection
cost
Alarm
operational status
DL
8)
9)
clear
Start date:
- End date:
clear
10)
Utilization rate
56.25%
11)
START
94h 50m 49s
56.25%
STOP
30h 19m 34s
17.98%
ALARM
7h 13m 17s
4.28%
SETUP
19h 23m 28s
11.50%
IDLING
16h 50m 38s
9.99%
12)
08/17
08/18
08/19
08/20
08/21
08/22
08/23
08/24
13)
M00,M01
SETUP
IDLING
Usage
Current processing info
14)
Wire Dia・Mat 0.2 , BS
WKPC Mat・Thick STEEL , 60
Processing program 10 / DIE MACHINI...
Completed parts 0
Str Time 1h 31m 29s
E-PACK・Classification 191 , 2
Estimate and results time
15)
Estimate Processing time 12h 11m 52s
Wire using time 12h 05m 18s
Wire remaining time 2h 56m 21s
Results Processing time 0s
Wire using time 0s
Wire remaining time 0s
Synchronized prediction
16)
Processing remaining time 3h 10m 56s
Now : Wire remaining time 3h 05m 56s
Finish : Wire remaining time -7m 28s
MACHINING MONITOR
17)
No.CUTS 1
Power RH
RM 429.579
CL 594.176
FA 1.000
FC 0.000
VG 48.0
V 0
Wire insert/estimate 1 / 2
WQ 6.5 Normal
main program(the first five lines)
18)
Z1=68.0(C) Z5=65.0(A) Z2=66.5 Z3=80.0 Z4=8.0
(W1 NORMAL)
M20
M80
M82
Consumptions
19)
WATER FILTERS ELAPSE 206h
MAINTAIN 200h
RESIN ELAPSE 52h
MAINTAIN 160h
Run timer
20)
MACHINING TIME 2h 14m 35s
START ON1 2h 30m 14s
START ON2 2h 30m 14s
MACHN OFF TIME 15m 40s
21)
Machining results
DL
22)
Exit Status | Finished processing date/time | Comment | main L No. | WIRE DIA | WIRE MAT | WKPC MAT | WKPC THK | Completed parts | Processing time | Processing cost
M02 | 2016/08/21 18:01:02 | Dia 2nd | 10 | 0.2 | BS | WC-Co | 30 | 1 | 16:08:54 | ¥1,103
M02 | 2016/08/21 14:43:00 | Dia 2nd | 10 | 0.2 | BS | WC-Co | 30 | 1 | 16:08:54 | ¥2,575
RESET | 2016/08/21 00:18:59 | Clamp | 1 | 0.2 | BS | STEEL | 80 | | 16:08:54 | ¥2,379

Fig. VI.6.7

1) Machine name, date and time of the machine data, and alarm information

The screen displays the date and time of data last sent by the machine.

Operating

Stopped (If there is a stop alarm message, it is displayed at the same time.)

Alarm (The alarm message is displayed at the same time.)

Others

2) Machine picture

The screen displays the picture of the selected model.

3) Operation status

The screen displays the current status.

(a) Green: Operating (b) Yellow: Stopped (c) Red: Alarm

(d) Gray: Power OFF, wakeup, fluid preparation OFF, or idling

4) Machine name

The screen displays the machine name.

5) Remaining time Operation/Wire

Displays the remaining machining time as well as estimated time until the current WS wire runs out.

See 16) Real-time forecast as well.

6) Machining program

The main L number and comment of the operating program are displayed.

7) Machining progress

The number of machining and PS notch content (power supply type) are displayed.

8) DL

(a) Download the operational status in the specified period.

Records operating, stopped, alarm, setup, and idling states with machine and current coordinates. Download as CSV format for use in spreadsheets and status management.

(b) File name: EventLog.csv

The table header is in the first line, and data after the second line is output according to the arrangement sequence in the header.

9) Specifying period

Shows operational status for chosen persiod (1 to 7 days, including today) If left blank the past 7 days are displayed. A custom start and end date to view a specific range can be set.

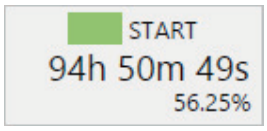
10) Utilization rate

A pie chart is used to display the operational status ratio in the specified period, and display the operating time as utilization rate at the same time.

11) Operational status ratio

The screen displays the cumulative time and ratio of each operational state (operating, stopped, alarm, setup, and idling) in the specified period.

(a) Green: Operating

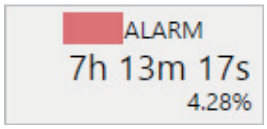


The actual NC program starts with automatic operation and the time when the start lump is being turned ON is recorded. The stopped and alarm states are not included.

(b) Yellow: Stopped

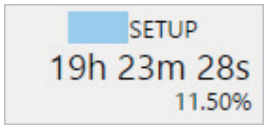
When automatic operation stops, the actual time is recorded.

(c) Red: Alarm



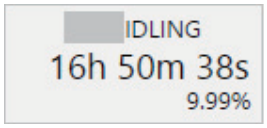
When an alarm occurs during automatic operation and the alarm lump is turned ON, the time when the operation is stopped is recorded.

(d) Light blue: Setup



The time during manual mode is recorded.

(e) Gray: Idling



The time except when the operational status is operating, stop alarm, or setup will be recorded. It includes the states such as power OFF, ready OFF, and the state where the ready is left ON.

12) Time sequence

The operational status in the specified period is displayed as a time sequence diagram.

***1 The time sequence diagram cannot be displayed when the specified period exceeds 7 days.**

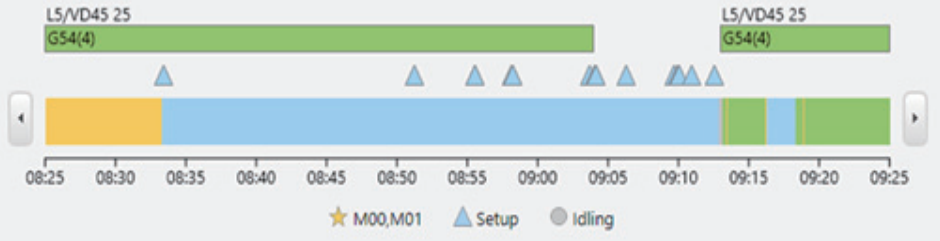


Fig. VI.6.8

13) Event and program

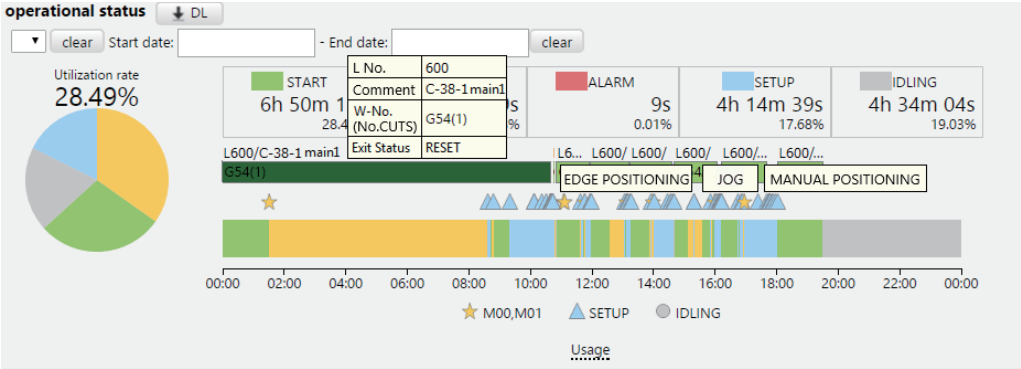


Fig. VI.6.9

The time sequence diagram displays M00, M01, Setup, and Idling. Click the legend part to set the corresponding event to OFF (click the part again to re-display it). During the program operation, the green lines indicate the period.

VI

(a) Event item

Category	Event item	Mark
M00,M01	M00,M01	★
SETUP	EDGE POSITIONING HOLE POSITIONING GAP POSITIONING WIDTH POSITIONING CORNER POSITIONING WORK SLOPE THREE POINT CENTER MANUAL POSITIONING INCHING JOG TAPER-Z	▲
IDLING	POWER ON POWER OFF READY ON READY OFF PUMP-ON PUMP-OFF The ECO. mode is started. The ECO. mode is finished.	●

These events are recorded at the start of operation.

(b) Detailed display

L No.	600
Comment	C-38-1 main1
W-No. (No.CUTS)	G54(1)
Exit Status	RESET

EDGE POSITIONING

Shows event and programm details for analysis and improvement. Move/hover the curser to see a bubble with details.

14) Current processing info

Displays the wire diameter, material, and other parameters.

15) Estimation/result

(a) Operating time and wire use time

Estimation: Calculated when program check is drawn on the machine
Result: Recorded when the machining ends

(b) Wire remaining time (at the time of finishing)

Estimation: Calculates the remaining wire time at machining end during programm check drawing.
Result: Forecasts / records the wire remaining time when machining ends.

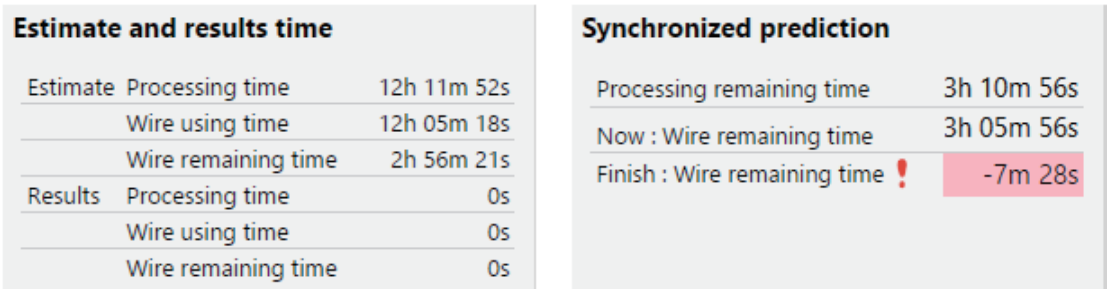


Fig. VI.6.10

16) Real-time forecast

(a) Remaining operation time

Current processing remaining time

(b) Wire remaining time (current WS linkage)

Wire remaining time under the currently used wire feed speed WS

(c) Wire remaining time (at the time of finishing)

Displays real-time forecast of wire remaining time at machining end. Compares with remaining machining times. If insufficient, background turns red and an alarm appears (insufficient time shown as negative).

17) Machining monitor

Displays the remaining perimeter (RM), checked voltage (V), and other current machining conditions.

18) Main program (first five lines)

It displays the first five lines of the NC program. Machining notes can be added for clarity.

19) Consumables

The dielectric fluid filter and ion exchange resin are integrated into the operation screen. When the exchange time comes, the alarm mark is used to send a notice. It can be compared with the machining time estimate and used in corresponding activities such as exchange before machining.

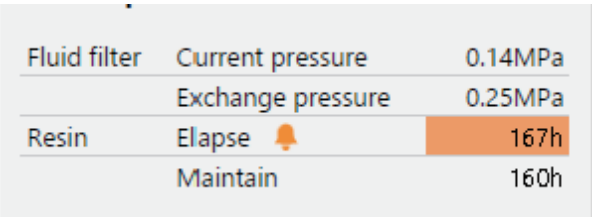


Fig. VI.6.11

20) Total timer

Displays the cumulative time used to manage the machine.

21) Machining results

(a) The results are recorded for each M02 or resetting.

The machining result retention period is approximately 1 year. Utilize the DL function to save the data separately as needed.
(The uninterrupted retention period can also be changed according to the system condition.)

(b) Machining cost

Cost can be controlled at each time of machining, and the recorded data is used to display the cost during similar machining when an order is taken. Hover to see a bubble with machining cost.

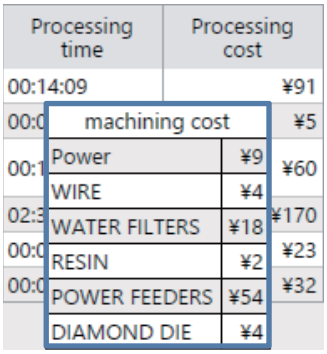


Fig. VI.6.12

The power consumption can be displayed when an ammeter is installed as needed.

(c) Mail notice

The mail notice function can be used to receive mail notices according to the operating status. Four types of mail notices can be set. For details, see "III. NC OPERATION DISPLAY SCREEN".

- **To view the machining cost on the dashboard, cost must be set on the machine. See "III. NC OPERATION DISPLAY SCREEN" and configure the setting.**
- **When cost is set on the machine, the cost is applied to the subsequent machining results.**

22) DL

(a) Download the displayed machining results.

Records machining start/end tmes and alarm info. Download as CSV for use in spreadsheets and status management.

(b) File name: Prcsinfo.csv

(4) Inspection screen

Displays the consumable related content.

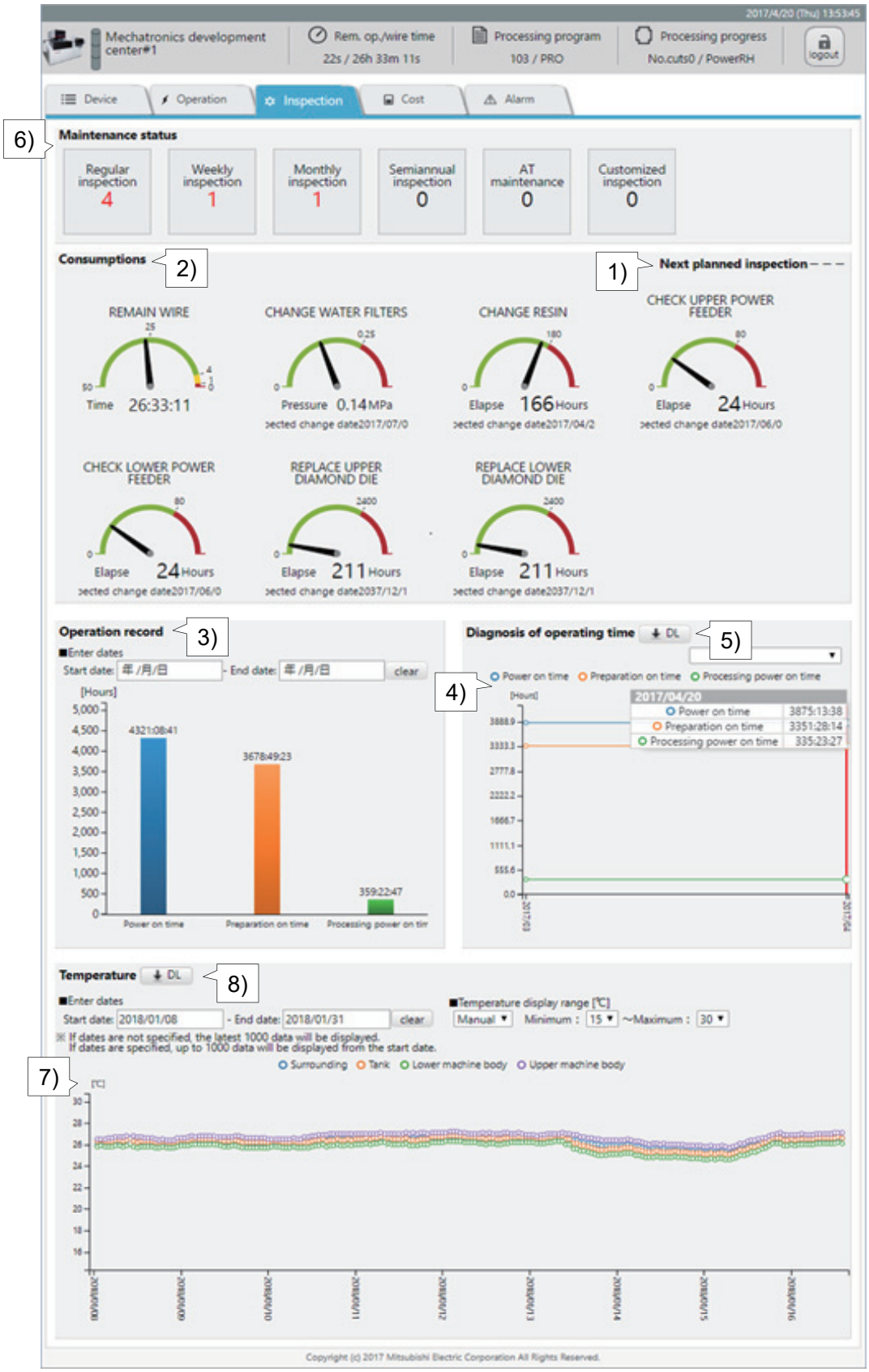


Fig. VI.6.13

1) Next planned inspection

It refers to the planned date of next maintenance and inspection.

2) Consumables

(a) It displays the status of the machine operation and inspection monitor screen.

***1 The user needs to set the maintenance time and use time of the consumables on the machine to apply them on the inspection screen. For the setting method, see "III. NC OPERATION DISPLAY SCREEN".**

***2 Whether to display the consumable meter or not can be switched with the "Display by iQ Care Remote4U" switch in III. NC OPERATION DISPLAY SCREEN > 5. HISTORY MANAGEMENT > 5.3 Consumption > Detail Setting.**

***3 Replacement of wire processing cutter, A.S.C resin, anti-rust resin, and anti-verdigris resin are optional.**

(b) Mail notice

The mail notice function can be used to receive mail notices according to the consumable maintenance status. For details, see "III. NC OPERATION DISPLAY SCREEN".

3) Operation result

The operation result status can be displayed in a bar graph.

(a) Power on time (HH:MM:SS)

(b) Preparation ON time (HH:MM:SS)

(c) Processing power on time (HH:MM:SS)

When the time period is not specified, the total time and cumulative value of total output of each item are displayed.

4) Operation time diagnosis

The broken line graph mode can be used to display the monthly operation time.

(a) Power on time (HH:MM:SS)

(b) Preparation ON time (HH:MM:SS)

(c) Processing power on time (HH:MM:SS)

5) DL

When the [DL] button is pressed, the data is aggregated on a monthly basis and can be downloaded in CSV format.

(a) File name: Diagdata.csv

6) Maintenance status

The number of necessary items on the machine which are inspected regularly is displayed. See "III. NC OPERATION DISPLAY SCREEN".

7) Temperature (option)

The temperature in the specified period is displayed in a line graph of time sequence diagram.
The data of 0°C or lower is not displayed in the graph.

(a) Specifying period

The temperature in the specified period is displayed.

(b) Temperature display range

The temperature within the specified range is displayed.

8) DL (option)

When the [DL] button is pressed, the temperature for the specified period can be downloaded in CSV format.

(a) File name: Temperature.csv

(5) Cost screen

Fig. VI.6.14

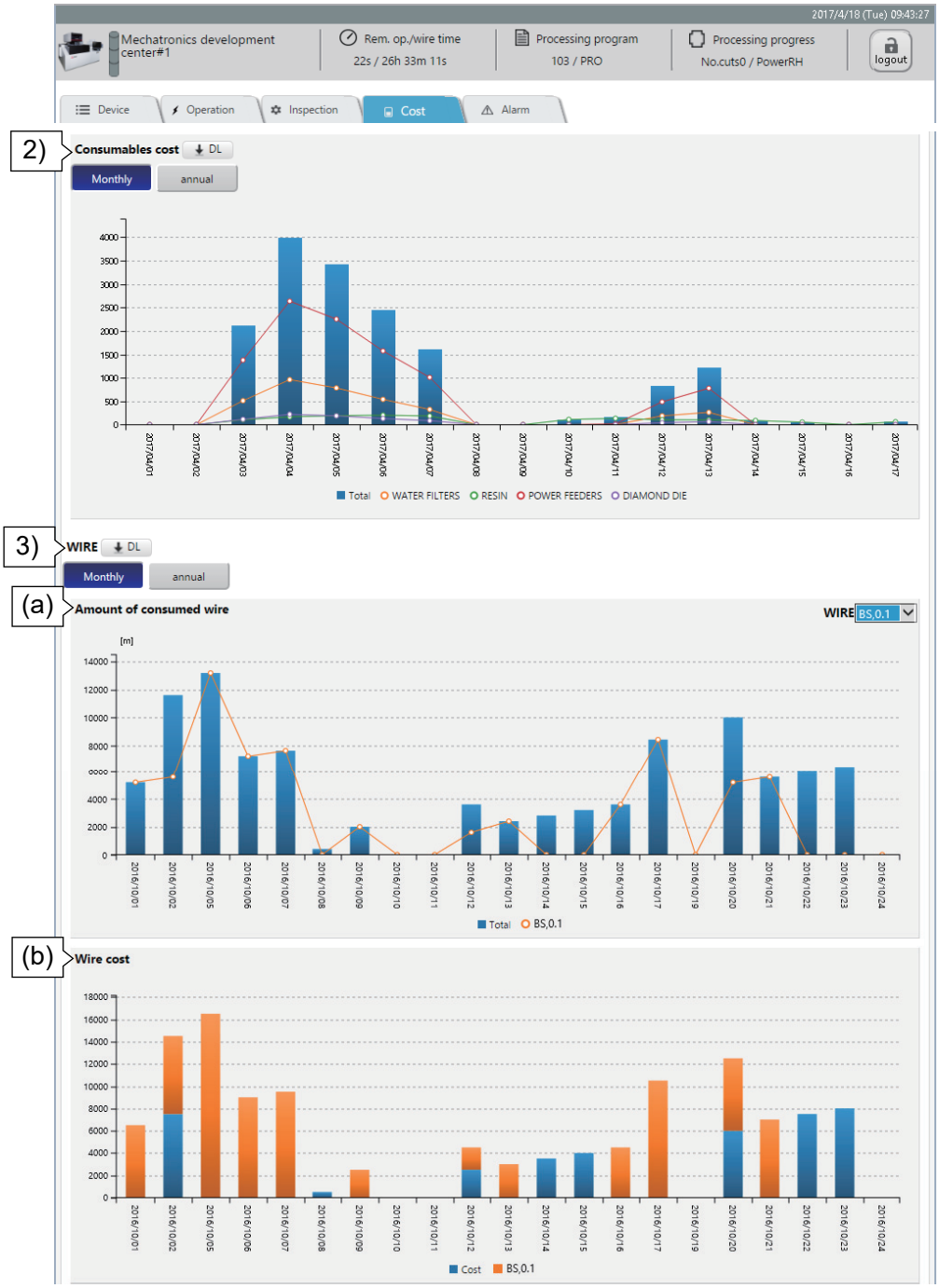

2017/4/18 (Tue) 09:43:27
Mechatronics development center#1
Rem. op./wire time
22s / 26h 33m 11s
Processing program
103 / PRO
Processing progress
No.cuts0 / PowerRH
logout
Device
Operation
Inspection
Cost
Alarm
2)
Consumables cost
DL
Monthly
annual
Total
WATER FILTERS
RESIN
POWER FEEDERS
DIAMOND DIE
3)
WIRE
DL
Monthly
annual
(a)
Amount of consumed wire
WIRE
BS,0.1
[m]
Total
BS,0.1
(b)
Wire cost
Cost
BS,0.1

Fig. VI.6.15

VI

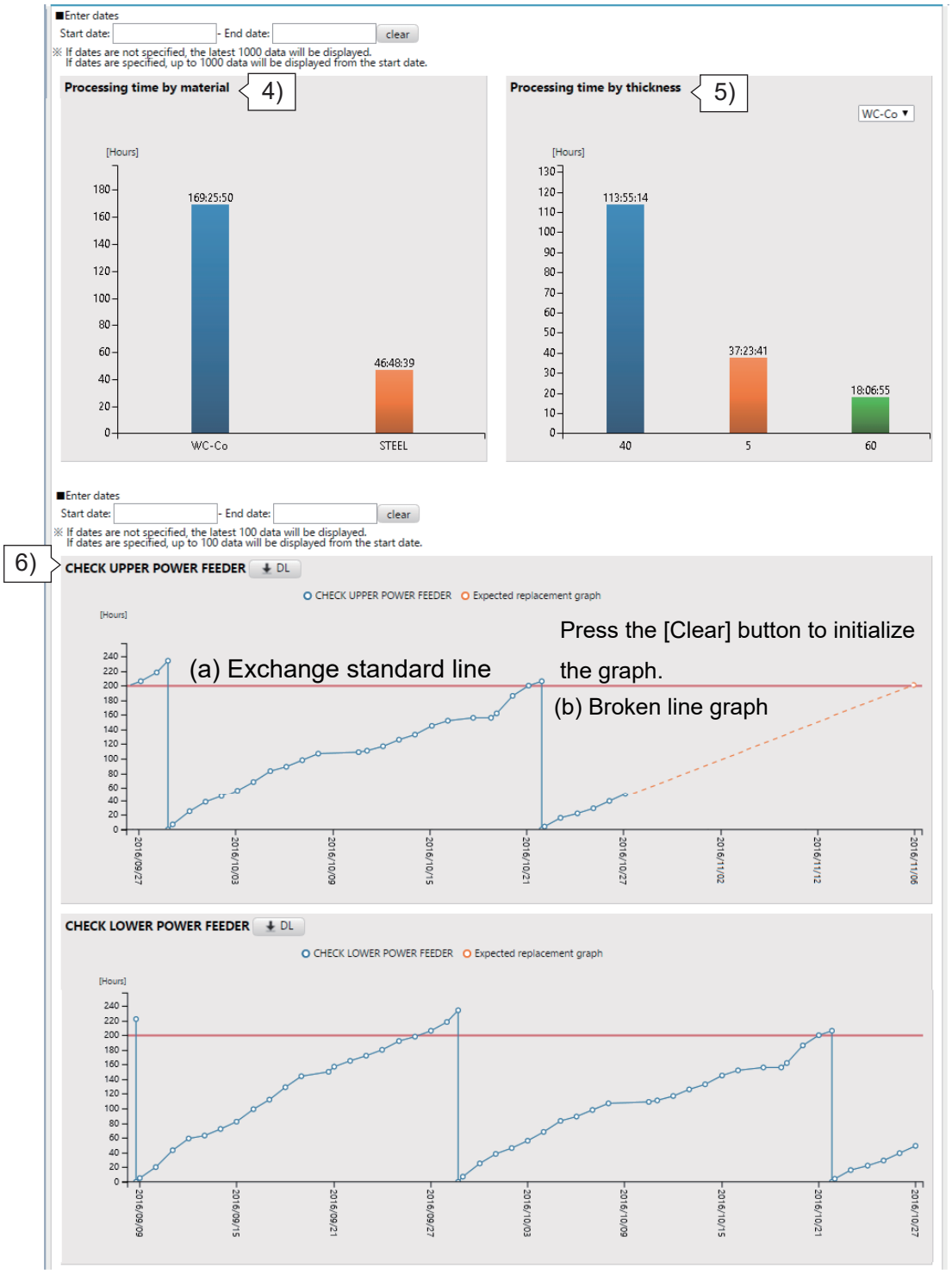


Fig. VI.6.16

1) Power consumption (optional)

(a) Electric energy

Displays power consumption in a bar graph (daily, monthly, yearly).

(b) Power cost

Displays the cost (when set).

2) Consumables cost

The total value of dielectric fluid filter, ion exchange resin, power feeders (upper and lower), and diamond die are displayed in a bar graph. Meanwhile, a broken line graph is used to display the cost of each item.

Table VI.6.1 DL data of consumables

Data name	Description	Data example	Remarks
DateTime	Event occurrence date and time	2016/12/23	
PartsID	Type of consumables	2	**1: Dielectric fluid filter 2: Ion exchange resin 3, 4: Upper and lower power feeders (the cost is the total value) 5, 6: Upper and lower diamond dies (total)**
ElapseTime	Usage time	1	**Unit: Hour**
Cost	Cost	1600	**Unit: yen**

3) Wire

(a) Amount of consumed wire

The amount of consumed wire is displayed in a bar graph (daily, monthly, yearly). Meanwhile, a broken line graph can be used to display the ratio for each type of wire. Only one type of wire can be selected. When necessary, select a wire type from the upper right list in the chart.

(b) Wire cost

The cost can be displayed when cost has been set on the machine.

Table VI.6.2 DL data of amount of consumed wire

Data name	Description	Data example	Remarks
WireType	Wire type	BS	
WireSize	Wire diameter	0.2	
WireLengthUsed	Used wire weight	7773438	**Unit: m**

4) Processing time by material

The screen displays the use time (HH:MM:SS) of each material.

5) Processing time by thickness

The screen displays the use time (HH:MM:SS) of the selected material under different thicknesses.

6) Consumable replacement cycle

The broken line graph of time sequence can be used to implement exchange cycle management for the 6 types of consumables: upper power feeder, lower power feeder, dielectric fluid filter, ion exchange resin, upper diamond die, and lower diamond die.

(a) Exchange standard line

The maintenance time set on the operation and inspection monitor screen of machine is used as "Exchange standard line" in the consumable exchange cycle graph and displayed in red.

(b) Broken line graph

The [clear] button on the operation and inspection monitor screen of the machine can be used to implement initialization and confirm the exchange cycle on the chart.

(c) Expected replacement graph

The consumable exchange cycle is displayed in a broken line graph.

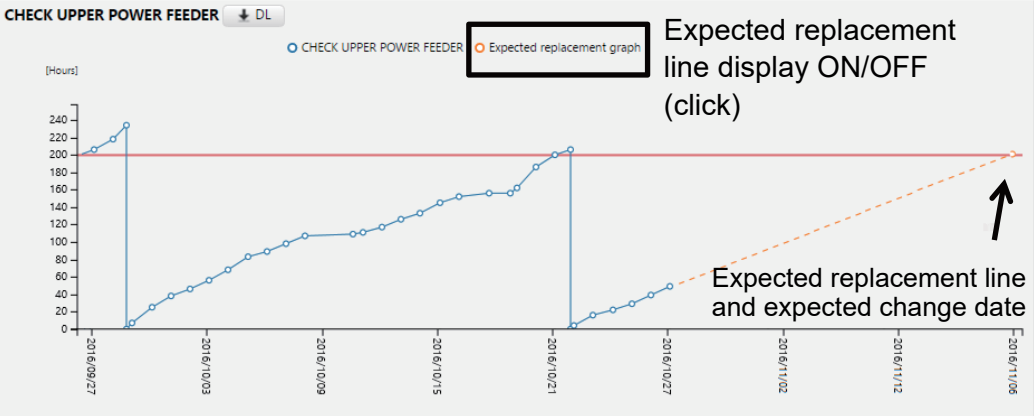


Fig. VI.6.17

Table VI.6.3 DL data of power feeder, ion exchange resin, and diamond die

Data name	Description	Data example	Remarks
DateTime	Event occurrence date and time	2016/11/27 0:00:25	
ElapseTime	Usage time	211	**Unit: Hour**

Table VI.6.4 DL data of dielectric fluid filter

Data name	Description	Data example	Remarks
DateTime	Event occurrence date and time	2016/11/27 0:00:25	
ElapseTime	Usage time	211	**Unit: Hour**
Pressure	Pressure	124	**Unit: kPa**
FilterType	Unit: kPa	1	**1: Filter group A (red)** **2: Filter group B (blue)** **3: Filter groups A and B (yellow)**

(d) Dielectric fluid filter sensor with four filters (option)

For the dielectric fluid filter, the exchange cycle management can be implemented by time or by filter pressure sensor.

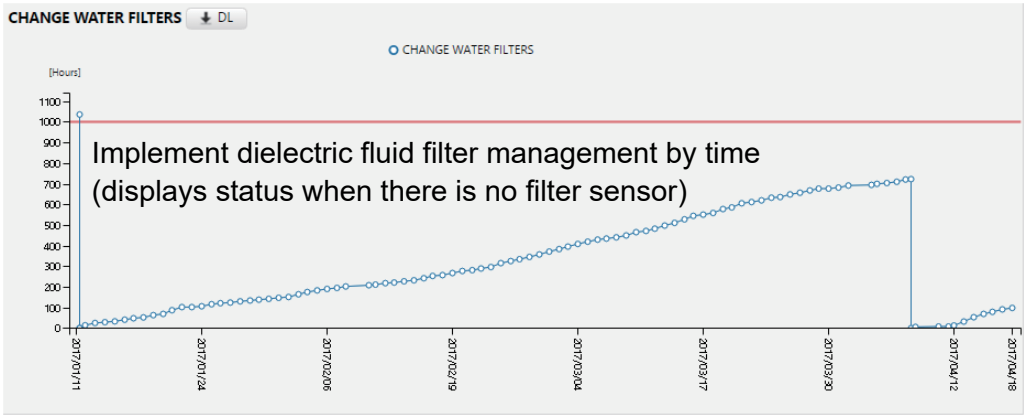


Fig. VI.6.18

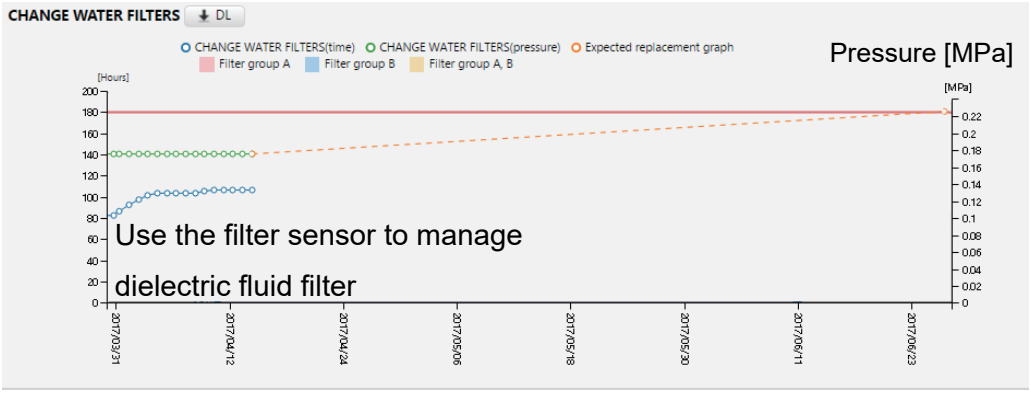


Fig. VI.6.19

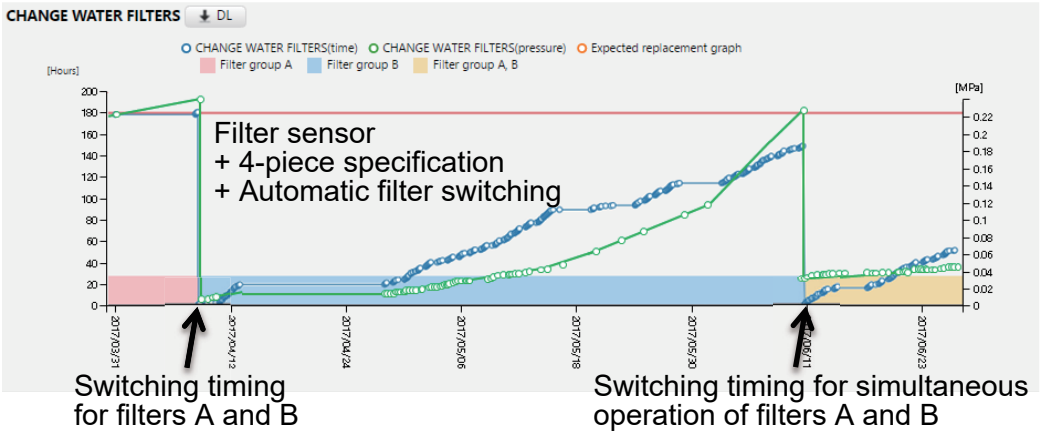


Fig. VI.6.20

***1 For details refer to "III. NC OPERATION DISPLAY SCREEN".**

(6) Alarm screen

It displays the alarm list.

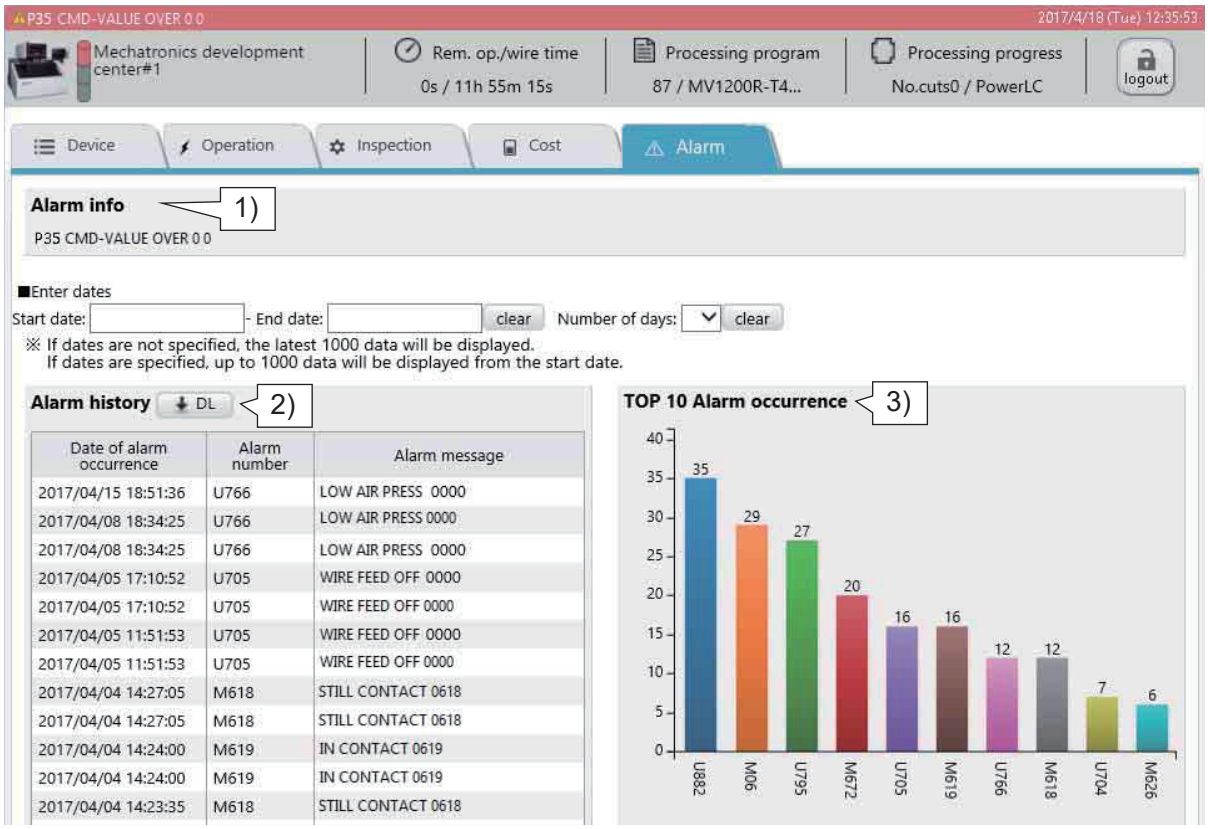


Fig. VI.6.21

1) Alarm info

(a) The screen displays the current alarm message. (a maximum of 9 lines)

(b) Mail notice

The mail notice function can be used to receive mail notices according to the alarm occurrence status. Two types of mail notices can be set. For details, see 3.2.10 Communication setting > (3) iQ Care Remote4U > 2) Email notification setting.

2) Alarm history

The screen displays the alarm history.

3) TOP10 Alarm occurrence

The top 10 alarms that have occurred most frequently can be checked.

Table VI.6.5 DL data of alarm history

Data name	Description	Data example	Remarks
DateTime	Event occurrence date and time	2016/12/23 12:02	
Number	Alarm No.	T230	
Message	Alarm message	Automatic return completed	
Parameter	Alarm parameter	230	

6.2 Remote Diagnosis Function

6.2.1 Summary

Our service center can connect directly to the EDM to check status, review alarms and machining conditions, and provide support.

6.2.2 Method of use

Enable the remote diagnosis function, and apply for remote diagnosis. After that, our employees will implement the remote diagnosis function according to the steps below.

Fig. VI.6.22

Press the "RemoteSRV." operation switch at the upper left part of the machine, and set the switch to ON.
Our employees will inform you that the remote diagnosis function has been activated.

***1 The screen movement may be slow temporarily in the remote diagnosis connection.**

***2 To disable this function, press the "RemoteSRV." button again. Additionally, remote diagnosis is disabled when the power supply of machine is cut off.**

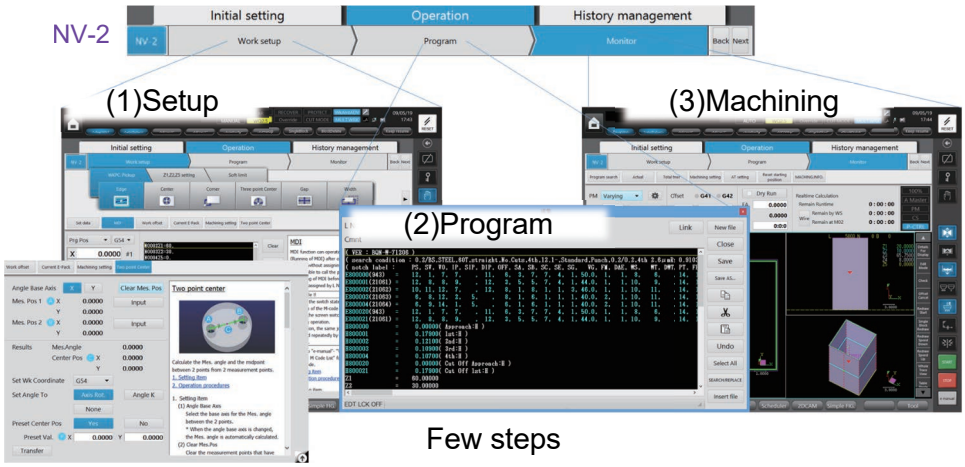
***3 If connection fails, contact Mitsubishi Electric employees.**

1. **During remote diagnosis connection, [Close Screen] and [Keyboard Lock] are disabled to prevent failure of the remote operation. Confirm the status of the remote diagnosis switch.**
2. **During remote diagnosis connection, the following switches are disabled for safety reasons. To use them, disable the remote diagnosis function.**
   - **Press and holding the auxiliary switches**
   - **Switches other than control switches [RESET], [STOP], and [e manual]**

7. NV-2

7.1 Summary

Selecting NV-2 lets you embed a machining condition header (E-header) to unify the shape and machining conditions.



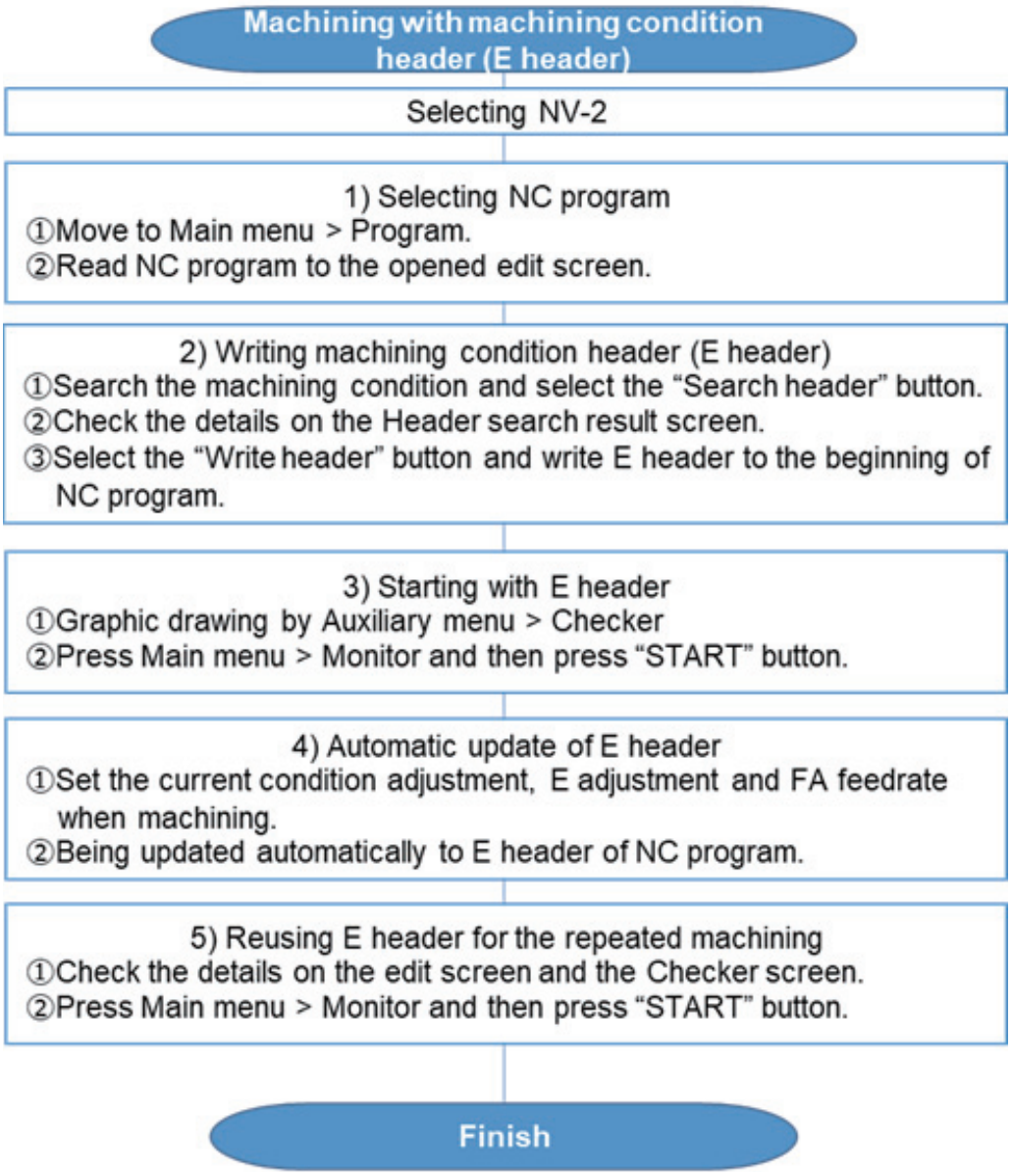
(1) Easy setup
MDI, 2-point center, etc.
You can select familiar manual operations from a wide range of functions:
• Operation using familiar G-codes
• User-friendly interface through on-screen operation

(3) Easy similar/repeat machining
Centralized E-headers and shape programs can be reused, making setup simple and minimizing operational errors.
• Centralized management makes machining control easy
• Condition adjustments during machining are automatically registered

(2)Easy creation of programs
By integrating the E-header into the NC program, shapes and machining conditions are seamlessly linked, greatly enhancing the means of machining adjustment.
• Easy filtering of machining conditions
• Simple unification with shape programs
• Easy call of saved E-headers

(1) Operation flow

The following shows the operation flow using NV-2.



(2) Selection operation

1) Selecting NV-2

Click the navigation menu and select NV-2. This makes it easy to configure and operate the E-header.

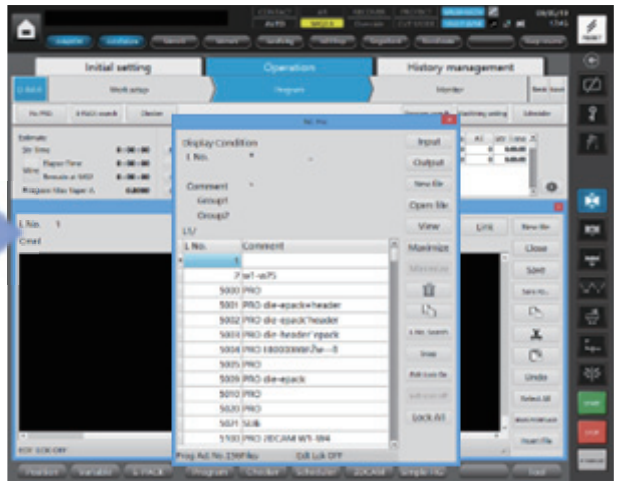
(3) Operation method

1) Selecting an NC program

(a) Follow the navigation steps and click the "Next" button to select Main Menu > Program.

(b) On the editing screen, load the NC program for which you want to write the machining conditions from the Auxiliary Menu > NC Pro.

The edit screen is opened



The NC program is read

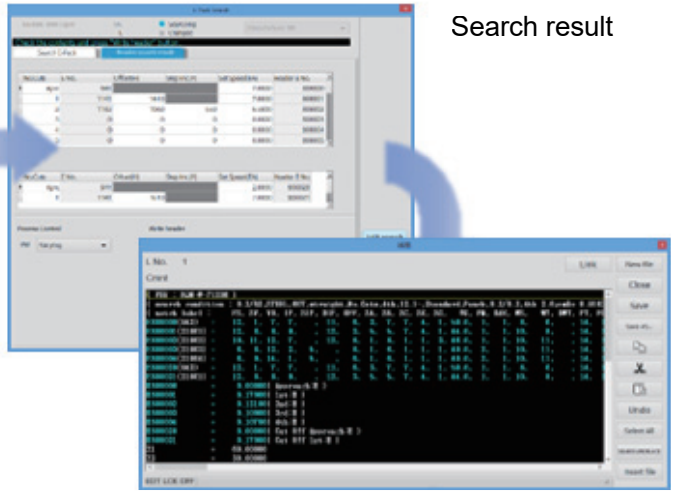
2) Writing an E-header

(a) Set the search conditions on the machining condition search screen and press the "Search Header" button.

(b) The "Header search result" screen displays the manufacturer machining conditions.

(c) Press "Write header" to insert them as an E-header at the beginning of the NC program.

Header search



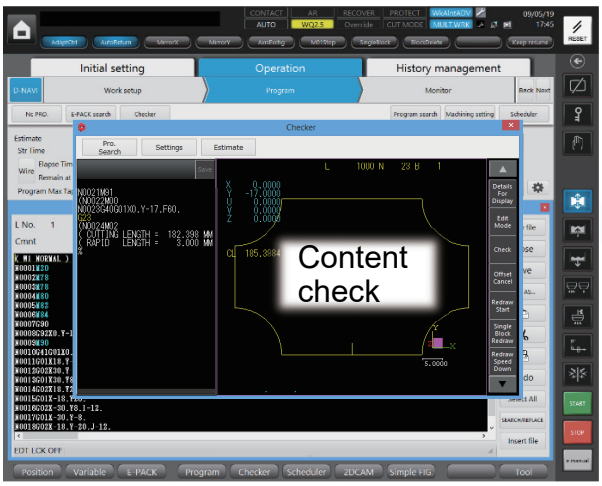
Search result

Header writing

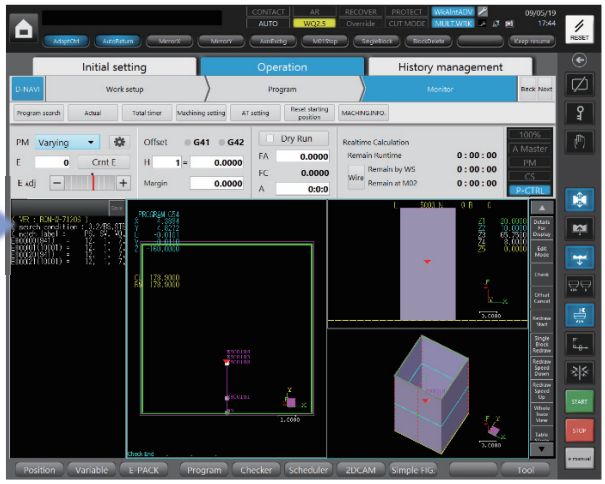
3) Machining start with E-header

(a) After writing the E-header, openauxiliary menu > Shape checker to immediately render the shape of the NC program and review machining details in advance.

(b) Following the navigation steps, click "Next" to open Main Menu > Machining Monitor.



Shape checker

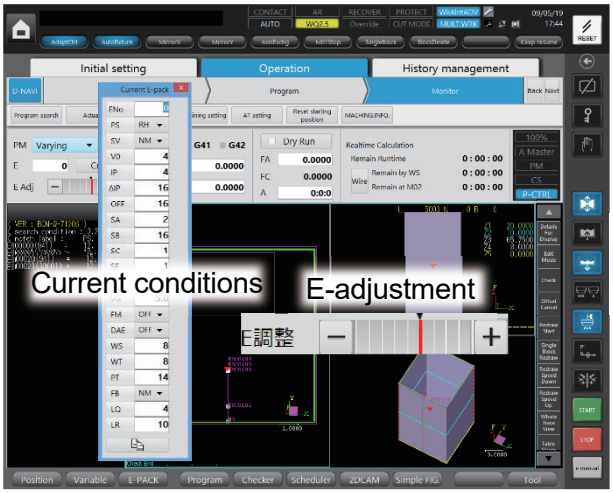


Machining start

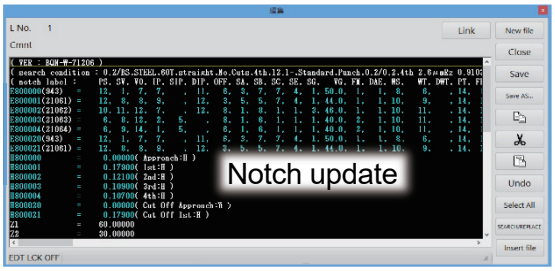
4) Automatic update of E-headers

(a) To avoid wire breakage/short circuit during machining, the current conditions, E adjustment, FA feed rate, and PMON/OFF set by the user are recorded in the machine.

(b) When the NC program is finished, the recorded adjustment results are automatically updated in the E-header in the NC program.



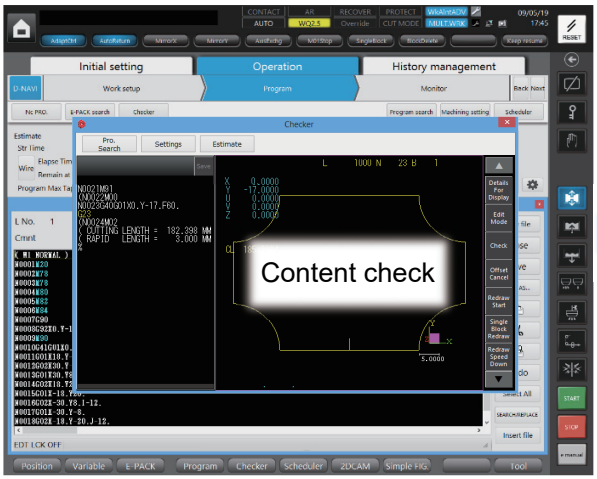
Current conditions during machining,
E-adjustments, FA, PMON/OFF



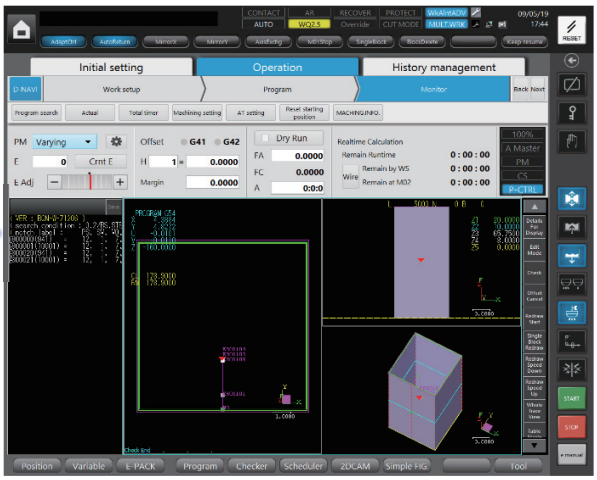
Automatic update to E-header

5) Reuse of E-headers in repeated machining

(a) For similar/repeated machining, simply call up the NC program where the "machining conditions" and "shape" are unified and check the contents using the editing screen and shape checker.



Shape checker



Machining start

7.2 Method of use

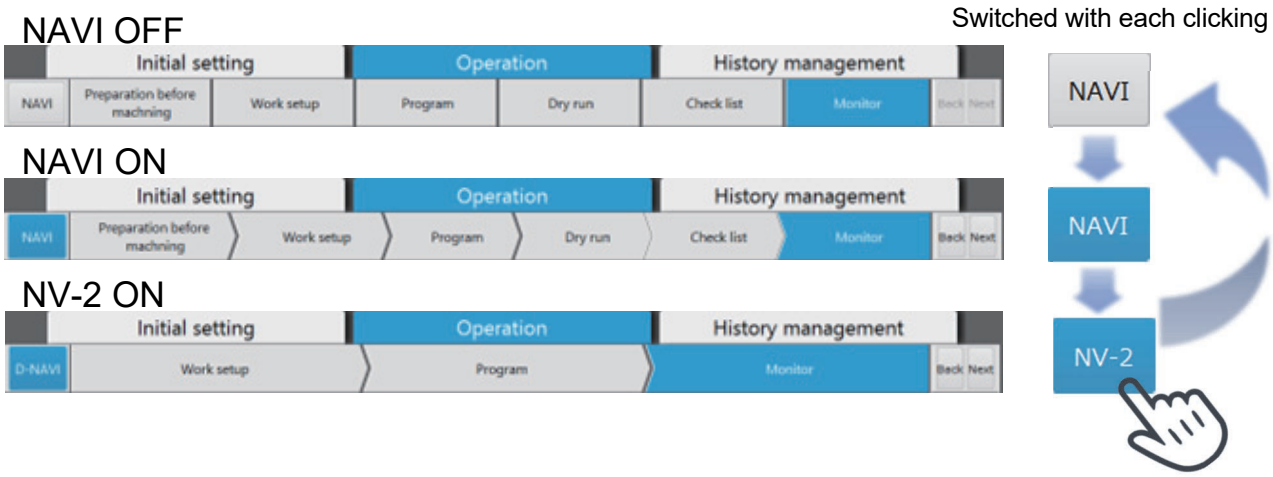
7.2.1 Navigation Button

(1) Navigation ON/OFF

Press the navigation button to navigate a series of work from before-machining preparation to machining monitor.

(2) NV-2 (Navi 2) ON

It smoothly navigates through the process from setup to machining according to the constantly changing machining conditions and configuration, providing the flexibility to freely select according to various situations.



*** When "Operation" is opened with NAVI ON or NV-2, switching between Work setup and Monitor cannot be performed with automatic and manual switching.**

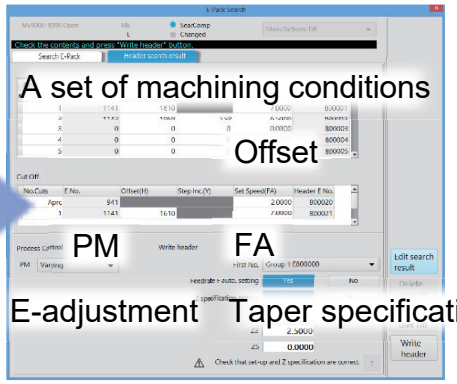
7.2.2 Machining condition search

(1) Header search (machining condition header) overview

At the beginning (header) of the NC program, a set of machining conditions for the number of machining times found in the E-Pack search can be registered as E-header, and can be adjusted as desired on the editing screen. The E-header contains the same information as the conditions for E-Pack search. In addition, offset, FA, taper specs, PM ON/OFF, and E adjustment are registered along with the header, and these can be optimized by individually adjusting them for each shape.

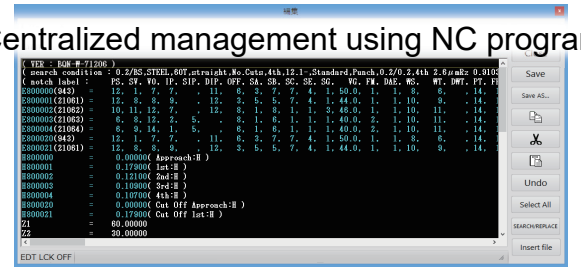
Header search

Search result



At the beginning (header section) of the NC program,register the set of machining conditions, offsets, FA, taper specifications, PM, and E-adjustments.

Centralized management using NC program



Header writing

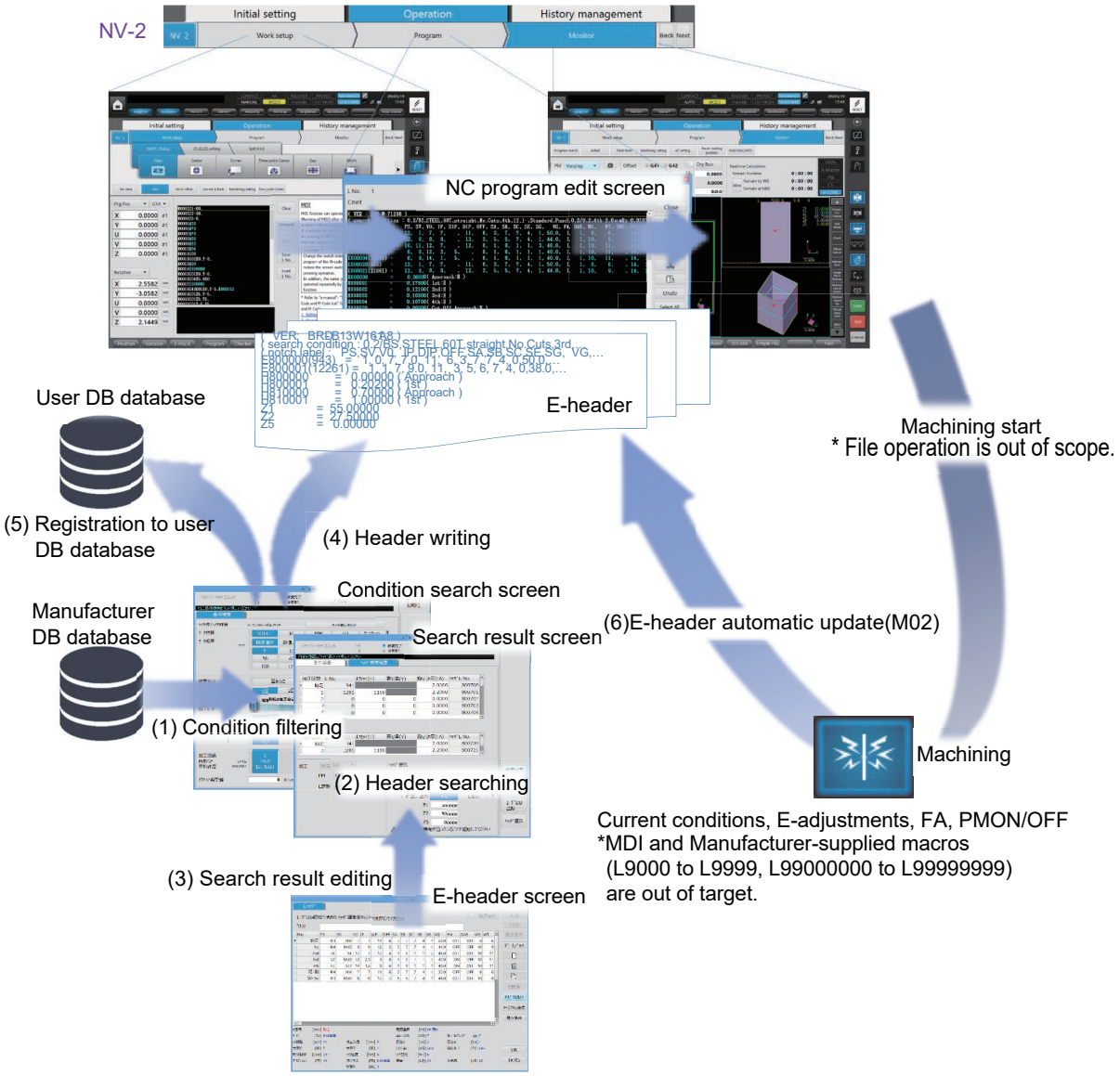
(2) Explanation of E-header search

NO.	Item	Description
(1)	Difference between E-header search and other search functions	As with the ME-Pack, the complete set of machining conditions (machining condition setting notch, information table, and adaptive control) can be changed/edited for each machining. What makes it different from the ME-Pack is that the shape and machining conditions of the NC program are paired and registered as an E-header at the beginning of the NC program. You can also save the header search results in the user database. For details, see "(4) Explanation of the screen".
(2)	E-header automatic update	To avoid wire breakage/short circuit during machining, the current condition adjustment, E adjustment, FA feed rate, and PMON/OFF settings manually made by the operator are recorded on the machine. When the NC program is finished, the recorded content is automatically updated in the E-header in the NC program.
(3)	Reusing E-headers	By optimizing the E-header, it can be managed together with the shape in the NC program. By reusing it, you can easily repeat similar/repeated machining.
(4)	E-header data	The machining condition switching E command allows you to specify a set of machining conditions (machining condition setting notch, information table, and adaptive control) as well as the feed rate F. For details, see "(4) Explanation of the screen".
(5)	E-header adaptive control setting	The adaptive control settings (P-CTRL settings) in the E-header operate according to the adaptive control settings (P-CTRL settings) in the E-header, regardless of whether the ☑adaptive control automatic setting switch is ON or OFF, and switch according to the E command during machining.
(6)	Machining conditions of the search source	You can create an E-header using the machining condition search screen, but just like with E-Pack searches, you can perform conditional searches. The machining conditions used at that time will be the machining conditions provided by the manufacturer. For details, see "(4) Explanation of the screen".
(7)	Use with other machines	It can be used if the model of the machine, options, and machining conditions are the same. If they are different, adjust the parameters accordingly.
(8)	Assignment in 2DCAM	In 2DCAM, you can assign E-headers in the same way as the machining condition search on the machine. 2DCAM allows assignment to multiple shapes. For details, see the 2DCAM instruction manual.

(3) Overall structure

1) E-header search using NV-2

By selecting NV-2 and incorporating the E-header search results into the NC program, you can unify the shape and machining conditions.



(1) Condition filtering

Search is performed in the same way as E-Pack/ME-Pack.

(2) Header searching

Switch to the search results screen by using the [Search header] button dedicated to the E-header.

(3) Search result editing

Check the details of the machining conditions on the E Header screen.

(4) Header writing

Place (write) the E-header at the beginning of the NC program.

(5) User DB registration

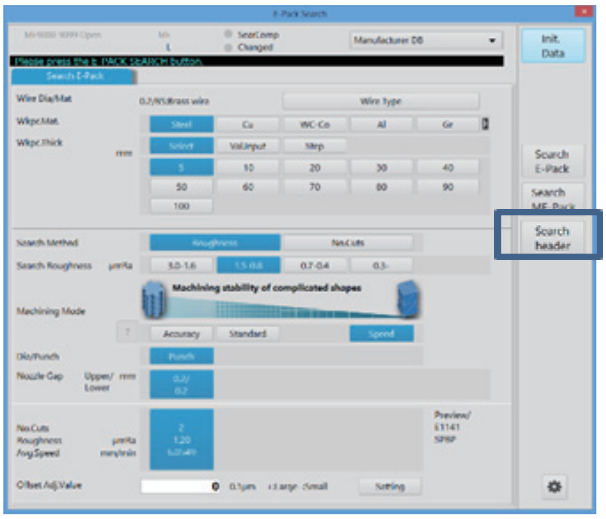
The same content as the E-header written in the NC program is saved in the search target user DB.

(6) Automatic E-header update

Current conditions, E adjustment, FA, and PMON/OFF adjustment results are automatically saved in the E-header.

2) Structure of the E-header placed (written) at the beginning of the NC program

When you press the "Write header" button on the search results screen, an E-header will be generated and written to the NC program. The E-header structure is as follows:



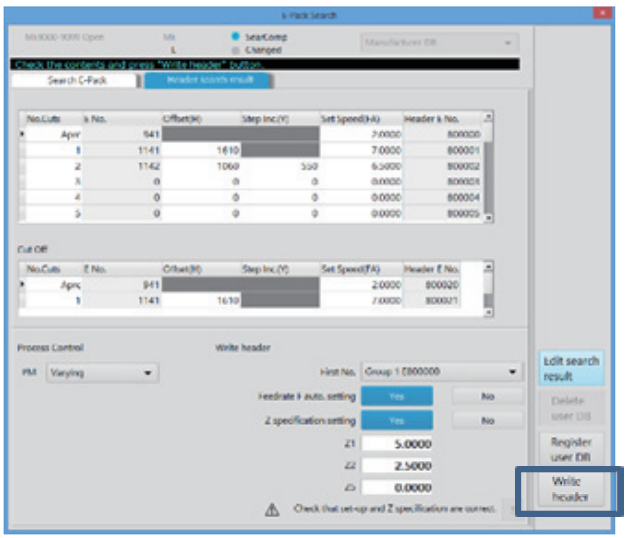


Table VI.7.1 E-header structure

E-header structure	Name
(VER : BRD-B13W161-A8)	(1) Machining condition version
(search condition : 0.2/BS,STEEL,5T,straight,No.Cuts,5th-, ...	(2)Search conditions (3) Automatically updated comments
(notch label: PS, SV, V0, IP, DIP, OFF, SA, SB, SC, SE, SG, VG, ...	(4) Notch label (name)
E800000(943) = 1, 0, 7, 7.0, 11, 6, 3, 7, 7, 4, 0,50.0, ...	(5) E-header (complete set of machining conditions) : Approach
E800001(12261) = 1, 1, 7, 9.0, 11, 3, 5, 6, 7, 4, 0,38.0, ...	: 1st
H800000 = 0.00000(Approach:H)	(6) Offset header : Approach
H800001 = 0.20200(1st:H)	: 1st
H810000 = 0.70000(Approach:FA)	(7) F-header (feed rate F) : Approach
H810001 = 1.00000(1st:FA)	: 1st
Z1 = 55.00000	(8) Z-header (Z specs)
Z2 = 27.50000	
Z5 = 0.00000	
(END)	(9) Exit code

(1) Machining condition version

The version of the machining conditions provided by the manufacturer when the E-header is generated.

(2) Search conditions

The search content / condition search screen when the E-header is generated. Items are arranged from left to right, corresponding to the order from the top to the bottom in the screen.

(3) Automatically updated comments

Current conditions during machining and E adjustment results

- CurrentEpack=x/x ... It becomes "0" if the current conditions have not been changed during machining. It becomes "1" if they have been changed.
- Eadjustment=x/x ... It becomes "0" if E adjustment is not performed during processing. If E adjustment is performed, it becomes the adjustment value from "-5" to "4".

(4) Notch label

The name of each notch in the machining conditions. They are arranged from left to right, just like the E-Pack screen (there are some notches that are not displayed).
For example, the notch label VG in "Table VI.7.1 E-header structure" is paired with "50.0" in the E-header "E800000" and "38.0" in "E800001".

*** The notch label and notch data for the E-header are arranged in pairs, one above the other, and the machine collates the label and data before machining. Make sure that the pairing relationship is not lost.**

(5) E-header

Generated as a condition search result: E800001(12261) = 1,…

- **E-header number** **"E800001"**
- **E No. provided by the search source manufacturer** **"(12261)"**
- **Identifier** **"="**
- **Data** **"1,…"**

(6) Offset header

The offset for the number of cuts generated as a condition search result.

(7) F-header

The feed rate F for the number of cuts generated as a condition search result (incorporation into the E-header is optional).

(8) Z-header

The Z specs to be searched for generated as a condition search result (incorporation into the E-header is optional).

(9) Exit code

The last line of the E-header. Do not delete it when editing an NC program.

NOTICE

- **The E-header structure is automatically generated in the machining condition search screen. Do not change anything other than the notch (numerical value), offset value, speed value, and Z specification value.**
- **Do not delete the line with the exit code "(END)".**

3) E-header number assignment

For E-headers, numbers are randomly assigned during searches.

(1) E-Pack No.

The E-Pack No. of the E-header used in the machining condition switching E command on the NC program is fixed.

(2) Machining condition group

Up to 20 E-headers can be registered in an NC program used for one machining operation.

When searching for a header, Group 1: E800000 is used by default. If you need to change the group, use the start number switching function on the search results screen.

(3) H variable offset

A number is assigned according to the selected machining condition group.

* The H variables used in the E-header cannot be referenced on the variable screen.

(4) H variable speed F

A number is assigned according to the selected machining condition group.

(5) Number of cuts

A number is assigned to each selected machining condition group.

(4) Explanation of the screen

1) Condition search

The conditions required for the search are the same for E-Pack and ME-Pack.

(1) Search header

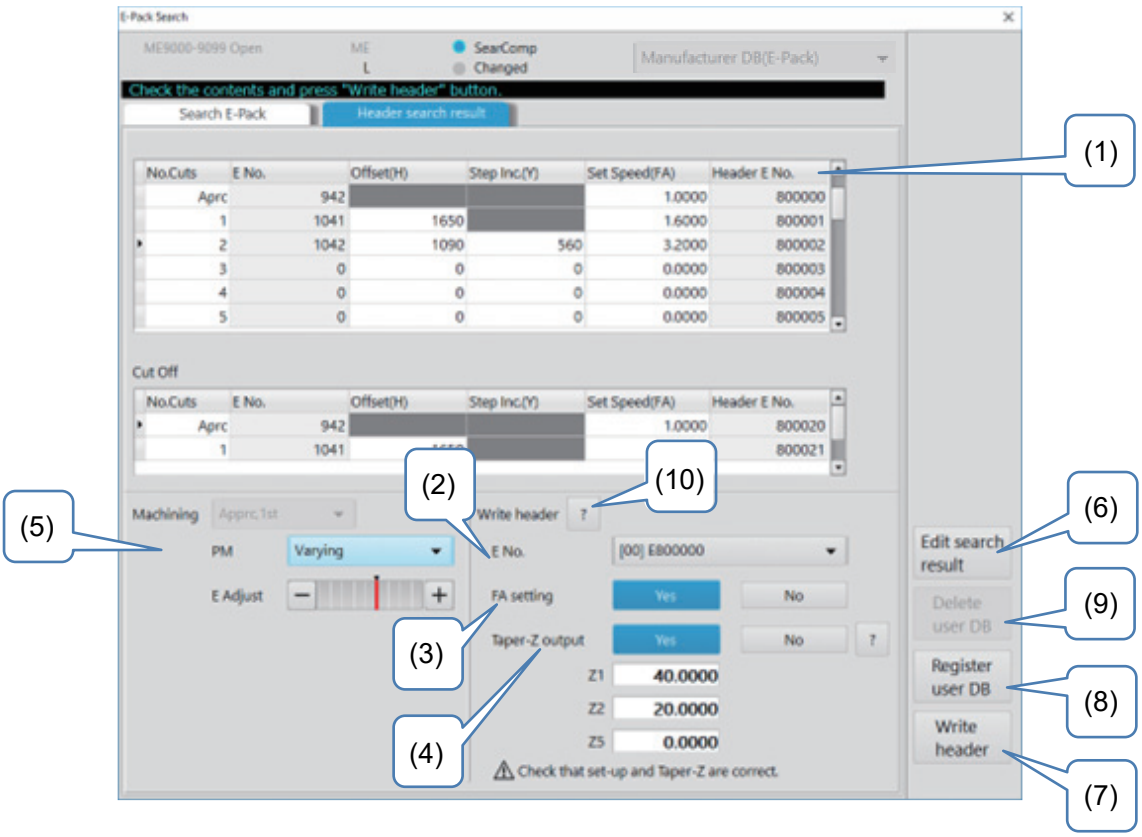
At the beginning (header) of the NC program, a set of machining conditions (machining condition setting notch, information table, and adaptive control) for the number of machining times found in the E-pack search is searched as a machining condition header (hereinafter referred to as E-header).

(2) Search target setting

You can switch between the manufacturer DB (E-Pack), option DB (E-Pack), and user DB (E-header).

2) When [Search header] is selected

The search is performed in the same way as E-Pack/ME-Pack, but there is data exclusive to the E-header.



(1) Header E No.

An E-header is registered at the beginning (header section) of the NC program, and the E-header number for each number of cuts is displayed.

(2) E No.

Specify the header E No. to be assigned as the E-header. The default is E800000, and if you do not change the E No., E-headers will always be assigned starting from E800000 for the number of cuts.

For information on E-header number assignment, see "7.2 Method of use" > "7.2.2 Machining condition search" > "(3) Overall structure" > "3) E-header number assignment".

(3) FA setting

The speed F set in the machining conditions is automatically set according to the E command of the NC program.

(4) Taper-Z output

The Z specs of the NC program is set as the Z-header and used for taper machining. It also prevents a decrease in the accuracy of straightness compensation.

(5) Machining (settings)

Add machining settings to the searched E-header.

In the initial state, the machining conditions of the search source are set. Change them as necessary.

[Apprc, 1st] This is the setting for approach and 1st machining.

- **PM**

  Select the PM control mode.

- E Adjust

  Set the notch used to adjust machining speed. It indicates the standard speed when 0 is selected. Notch 0 is restored by executing Reset, M02 and M30. Set to "+" to increase the machining speed; set to "-" to reduce the speed. If the machining speed is enhanced, the possibility of wire breaking may increase. Change it while checking the stability of the machining (effective for the approach and 1st).

(6) Edit search result

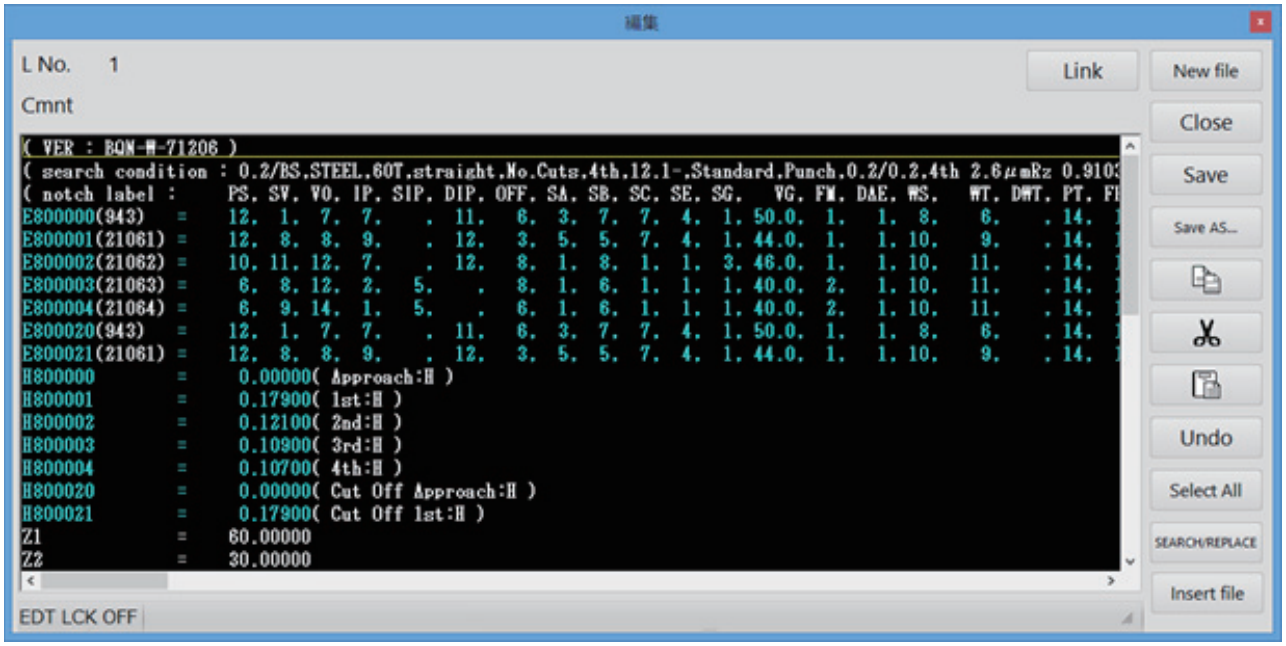
Before writing the machining condition search results to the beginning of the NC program, you can edit them in the same way as the offset (H) and set speed (FA).

Pressing the button will launch the E Header screen. Change them as necessary.

For the E Header screen, see "3) E Header screen (search result editing)".

(7) Write header

Pressing the button writes the E-header to the beginning of the NC program. For the E-header, see "2) Structure of the E-header placed (written) at the beginning of the NC program".



(8) Register user DB

In addition to writing the machining condition search results to the beginning of the NC program, they can also be registered in the user DB.

For registration to the user DB, see"4) User DB registration/deletion".

(9) Delete user DB

Delete the E-header registered in the user DB.

For deletion from the user DB, see"4) User DB registration/deletion".

(10) ? button for header writing

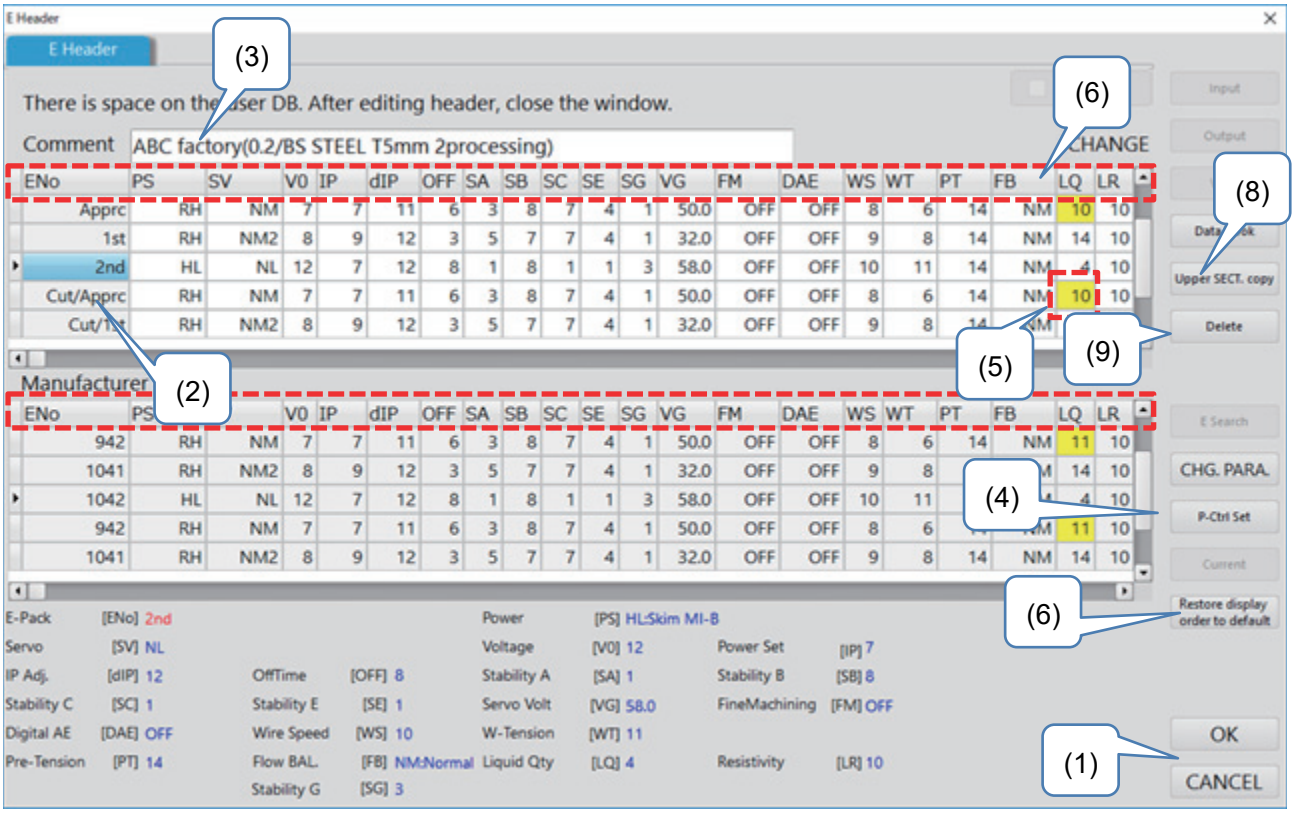
Used to display how to use the entire E-header.

* For help on taper specification output, press the ? button for Taper-Z output.

3) E Header screen (search result editing)

This is the dedicated editing screen for E-headers.

The operation of each function is the same as on the E-Pack screen. For operation, see "III. NC OPERATION DISPLAY SCREEN" > "6. OVERLAP" > "6.3 E-Pack".



(1) [OK], [CANCEL]

Edit the E-header and select it when you want to close the screen.

(2) ENo

No number is assigned to the E-header until it is registered at the beginning (header section) of the NC program. The display will be according to the number of cuts.

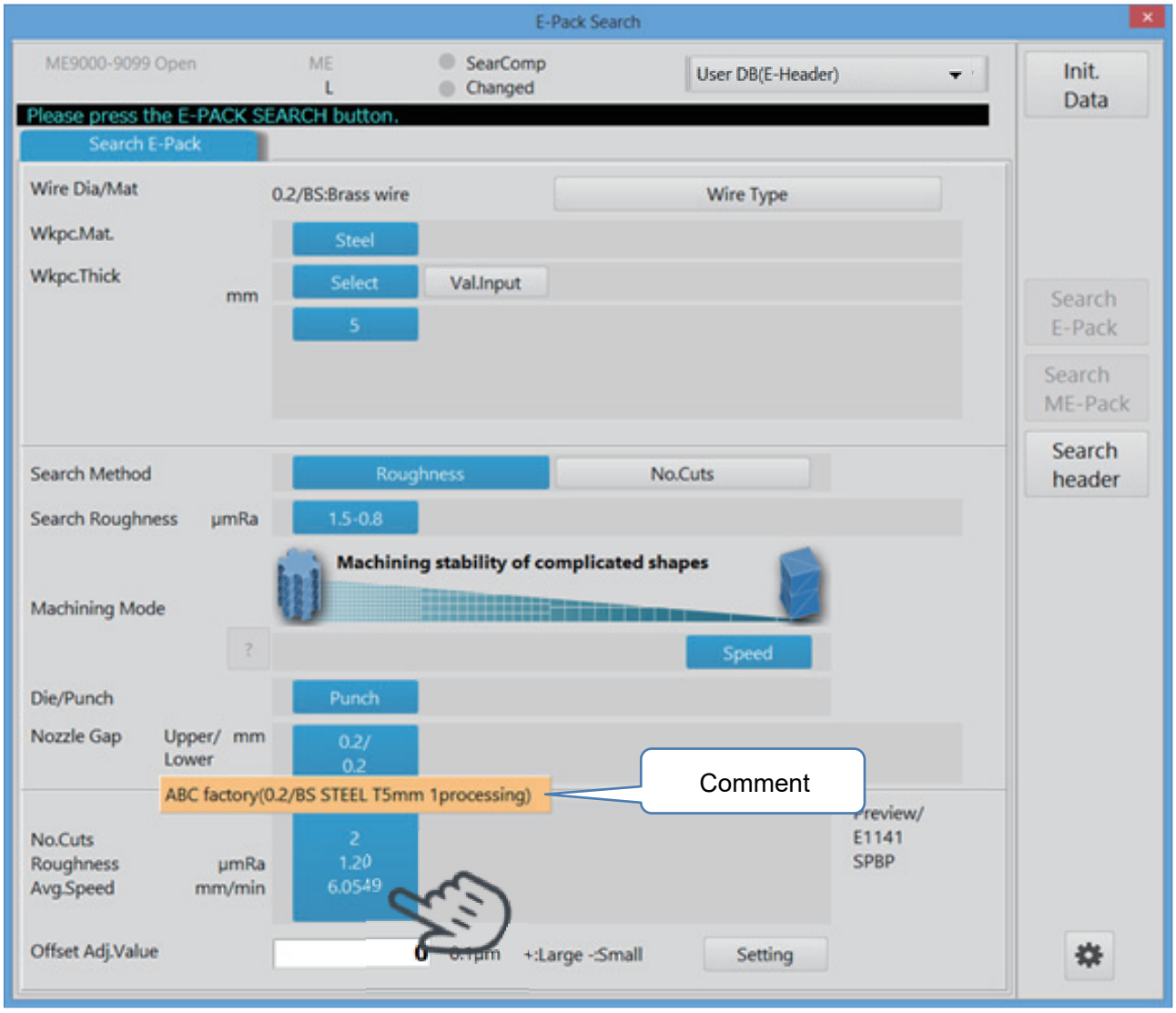
(3) Comment

An E-header is registered at the beginning (header section) of the NC program, and a comment can be added to the E-header.

• E-header on the NC program

• E header in the user DB

E-headers can also be registered in the user DB.

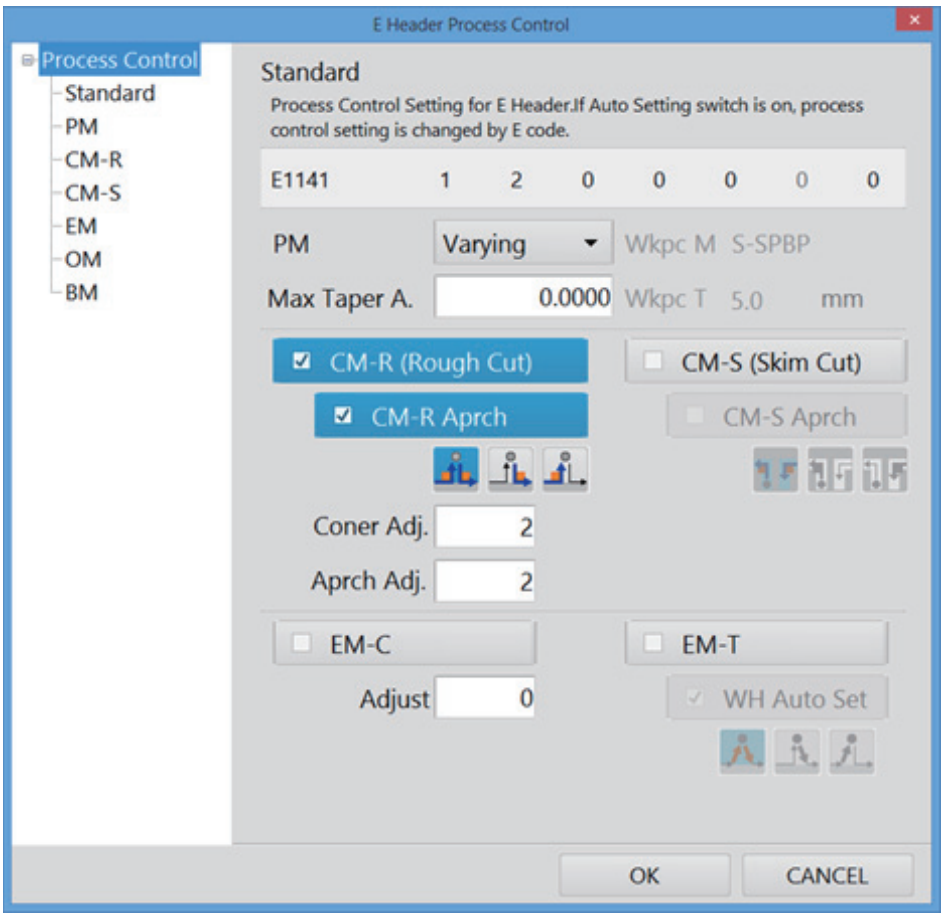

E-Pack Search
ME9000-9099 Open
ME
L
SearComp
Changed
User DB(E-Header)
Init. Data
Please press the E-PACK SEARCH button.
Search E-Pack
Wire Dia/Mat
0.2/BS:Brass wire
Wire Type
Wkpc.Mat.
Steel
Wkpc.Thick
mm
Select
Val.Input
5
Search E-Pack
Search ME-Pack
Search header
Search Method
Roughness
No.Cuts
Search Roughness
µmRa
1.5-0.8
Machining stability of complicated shapes
Machining Mode
Speed
Die/Punch
Punch
Nozzle Gap
Upper/ mm
Lower
0.2/
0.2
ABC factory(0.2/BS STEEL T5mm 1processing)
Comment
Preview/
E1141
SPBP
No.Cuts
Roughness
µmRa
Avg.Speed
mm/min
2
1.20
6.0549
Offset Adj.Value
0
+:Large -:Small
Setting

(4) P-Ctrl Set

This is the P-CTRL (adaptive control) setting in the E-header.

It is set for each number of cuts, operates according to the adaptive control settings (P-CTRL settings) in the E-header regardless of whether the adaptive control automatic setting switch is ON or OFF, and switches according to the E command during machining.

For settings, see "III. NC OPERATION DISPLAY SCREEN" > "3. INITIAL SETTING" > "3.2 Machine parameters" > "3.2.11 Machining setting".



(5) Highlight display (yellow background)

The E Header screen displays the machining condition header in the NC program and the search source manufacturer DB (machining conditions provided by the manufacturer).

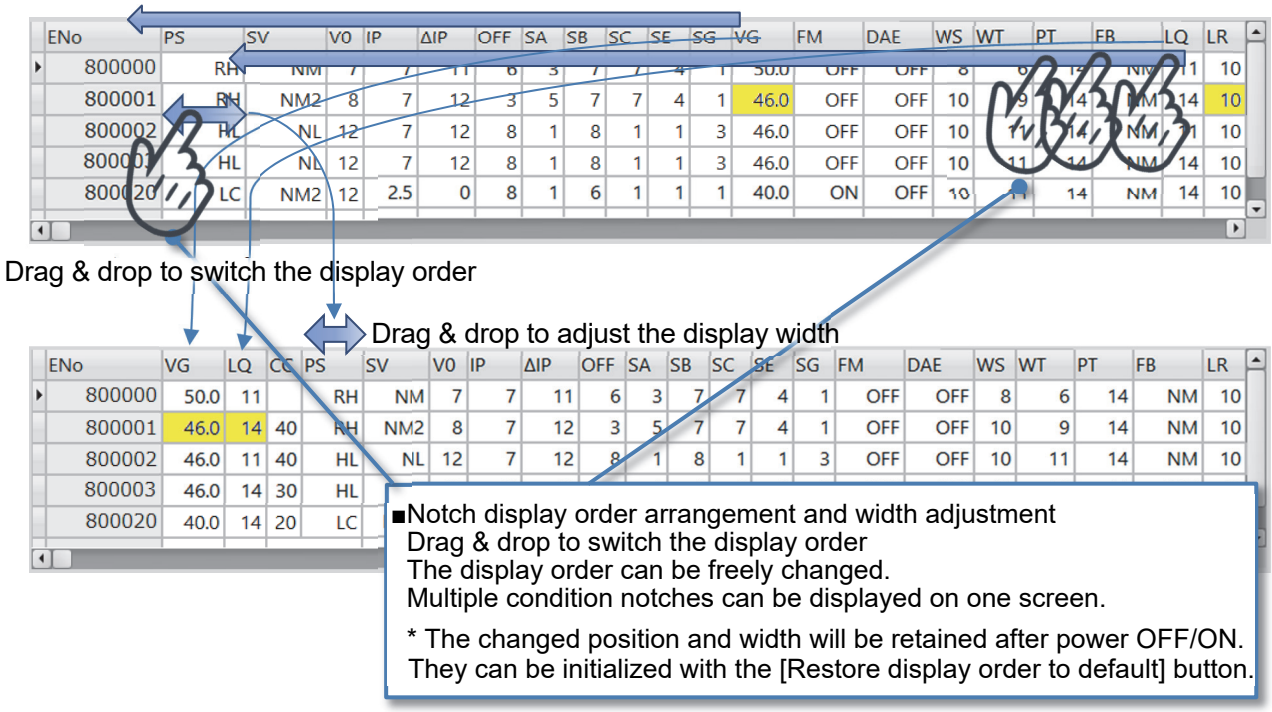
The machining condition header on the NC program is compared with the search source E-Pack provided by the manufacturer, and the differences are highlighted.

However, the information table written in the E-header as the machining condition search results will be highlighted as differences. (H, C, FF, ENS, REM)

(6) Changing the display order and display width [Restore display order to default]

Drag-and-drop action enables to change the display order of each notch on the E Header screen.

Press the [Restore display order to default] button to restore the default.



The display order and display width changed on the E Header screen will also be synchronized on the E-Pack screen.

[Restore display order to default]: Initializes the display order and display width.

(8) Upper SECT. copy

Copies the selected [ENo] row and inserts it below the selected row.

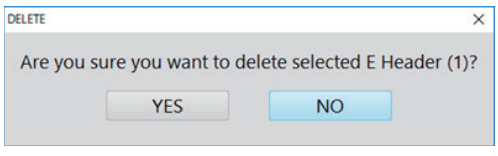
*1 This is valid only when a row other than "Apprc", "Cut/Apprc", or "Cut/1st" is selected.

*2 The number of cuts for approach to 19th is the upper limit, and if no more rows can be added, a balloon massage will appear stating "Cannot copy. ME-PACK is full.".

(9) Delete

Select the [ENo] row you want to delete and press [Delete] to display the following dialog. Click [YES] to delete the selected block.

* This is valid only when a row other than "Apprc", "1st" (top), "Cut/Apprc", or "Cut/1st" is selected.

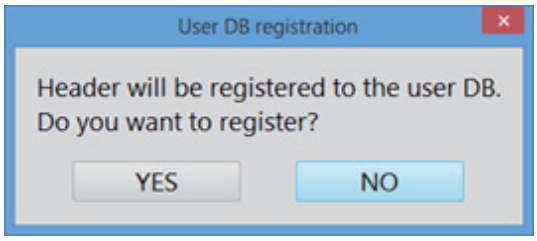


4) User DB registration/deletion

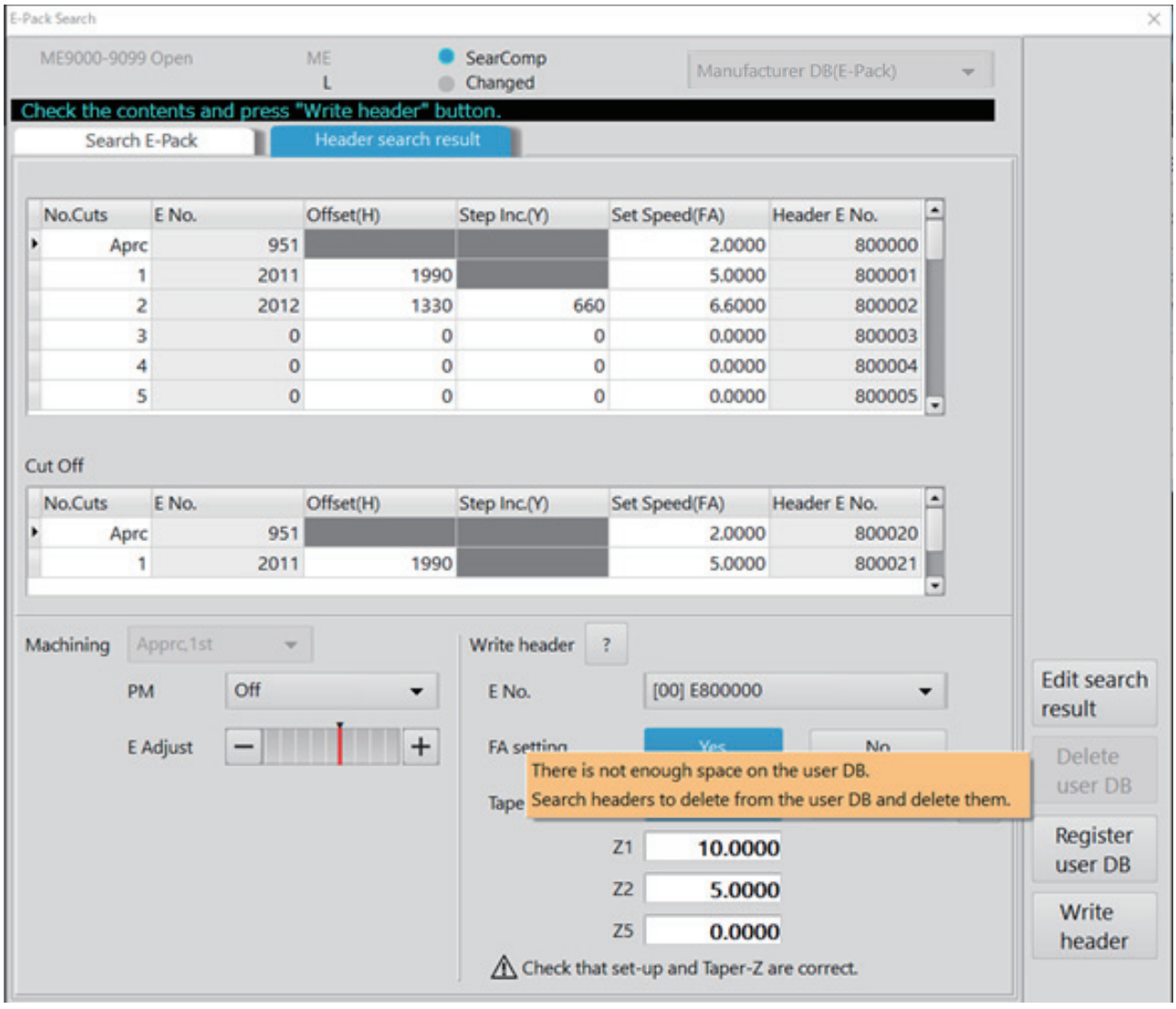
Besides writing the search results as an E-header, you can save them in the user DB. Follow on-screen messages:

(1) Registration

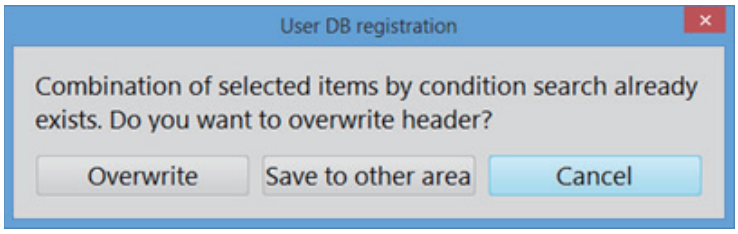
- **The E-header of the search conditions is the one registered in the user DB for the first time, and there is space in the user DB.**



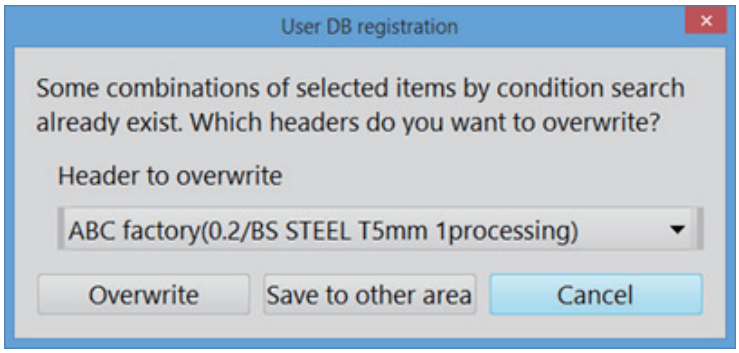
- **The E-header of the search conditions is the one registered in the user DB for the first time, and there is no space in the user DB.**
  (There is not enough space on the user DB. Search headers to delete from the user DB and delete them.)

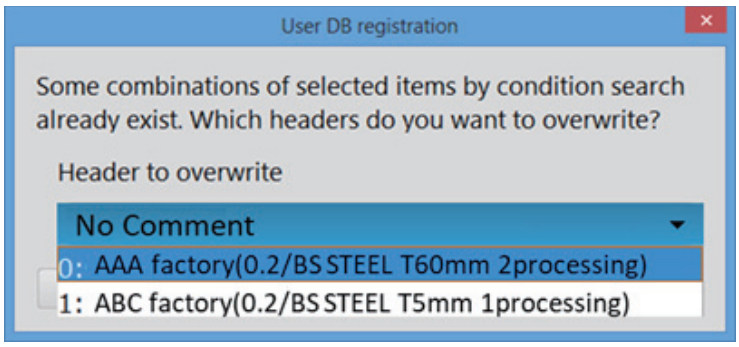


- **The E-header of the search conditions (only one) is the one already registered in the user DB, and there is space in the user DB.**

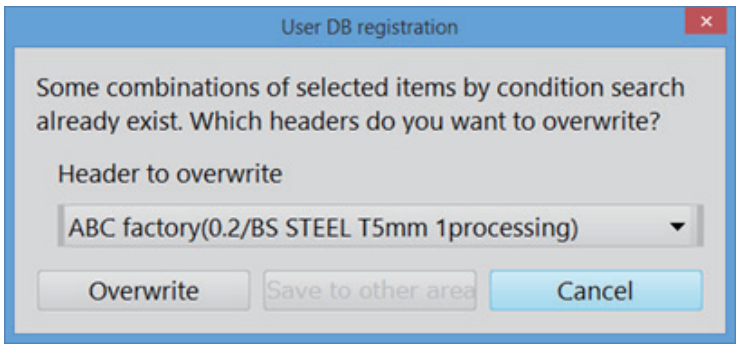


- **The E-headers of the search conditions (multiple) are the ones already registered in the user DB, and there is space in the user DB.**





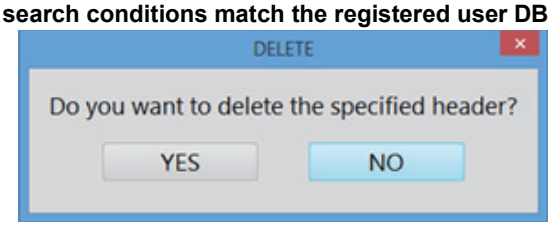
- **The E-headers of the search conditions (multiple) are the ones already registered in the user DB, and there is no space in the user DB.**
  (There is not enough space on the user DB. Search headers to delete from the user DB and delete them.)



(2) Deletion

To delete an E-header from the user DB where it is registered, use the condition search to identify the corresponding E-header and select it as the target for deletion. Search for the target E-header → Press the [Delete user DB] button.

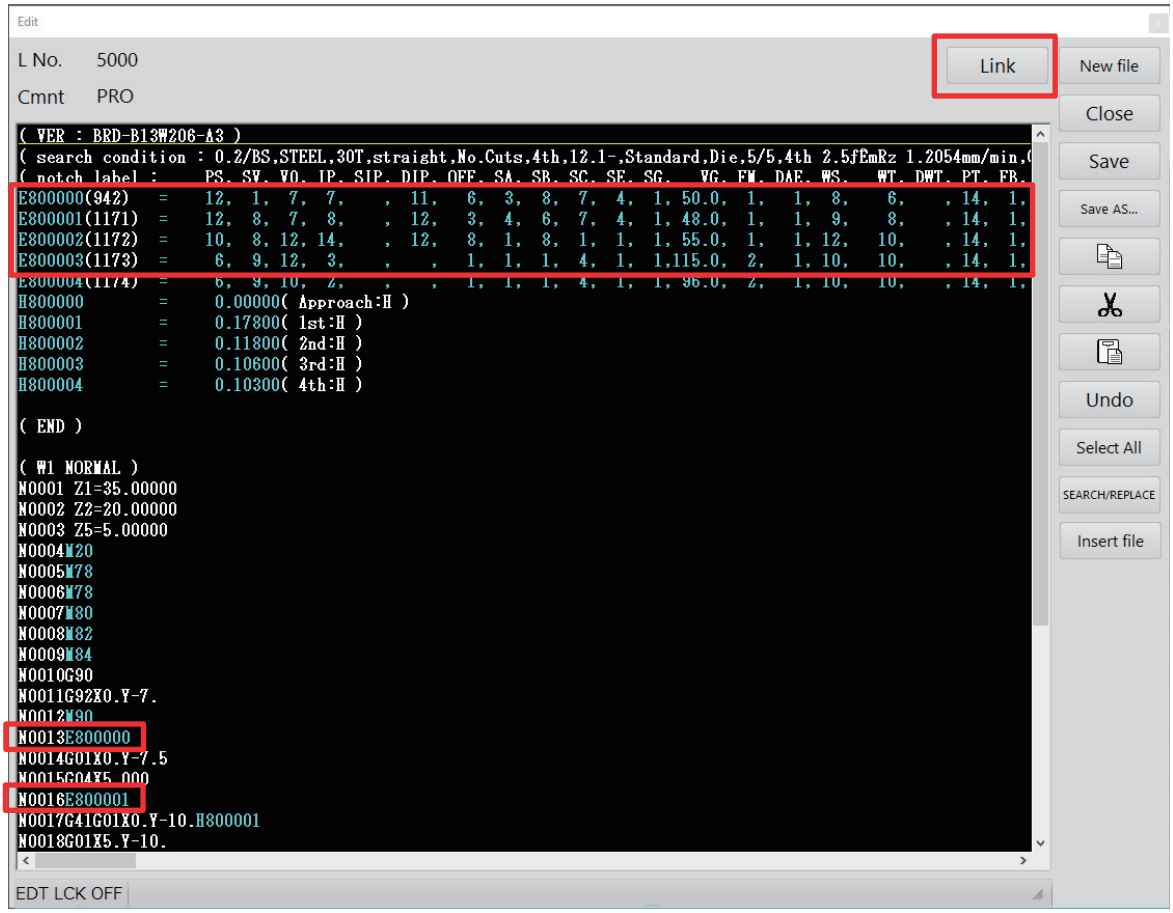
• E-header whose search conditions match the registered user DB



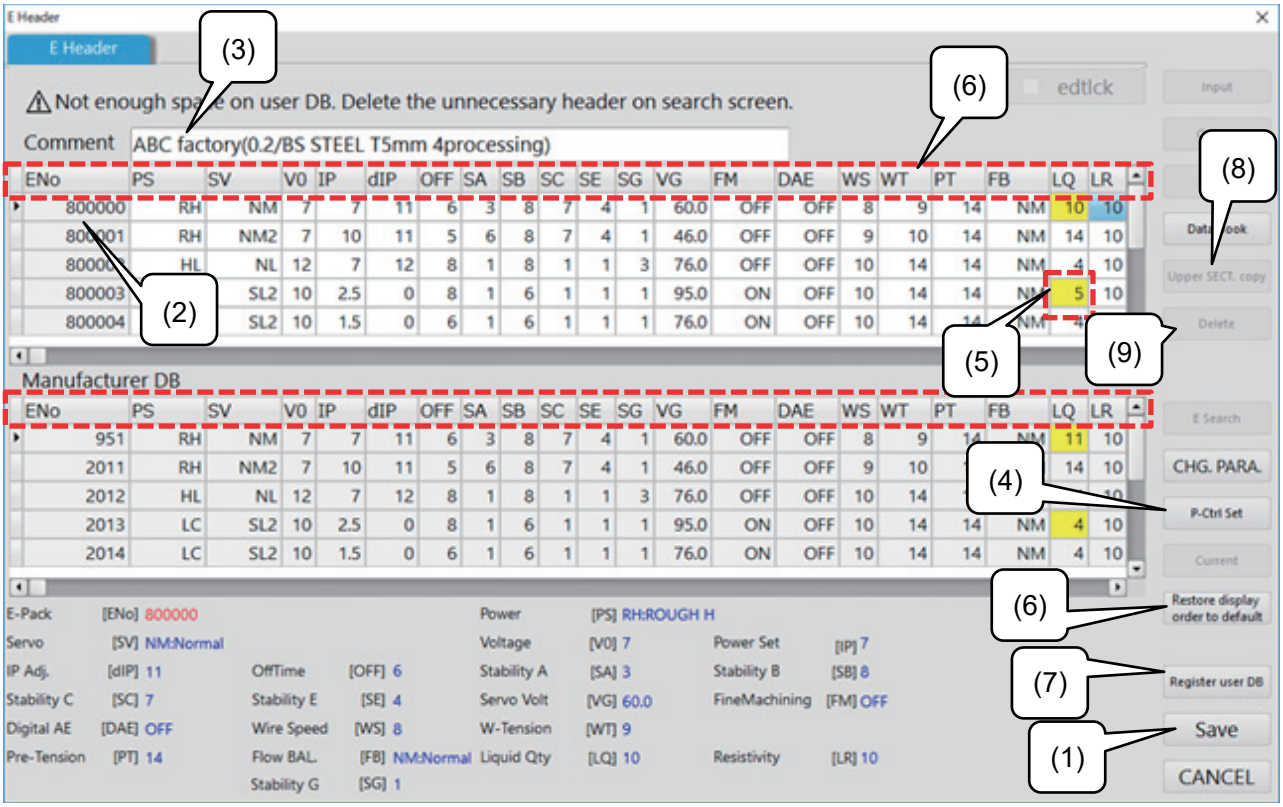
7.2.3 E-header editing

Press "Link" on the E-header definition line or E-Pack no. to open that E-header group.

* If the E-header breaks structure the rules, it will be automatically normalized and loaded.



- **E Header screen (for editing NC Pro E-header)**
  This is the editing screen for the E-header registered at the beginning of the NC program. Editing results can be saved in the NC program or registered in the user DB.
  The operation of each function is the same as on the E-Pack screen. For operation, see "III. NC OPERATION DISPLAY SCREEN" > "6. OVERLAP" > "6.3 E-Pack".



(1) [Save], [CANCEL]
Edit the E-header and select it when you want to close the screen.

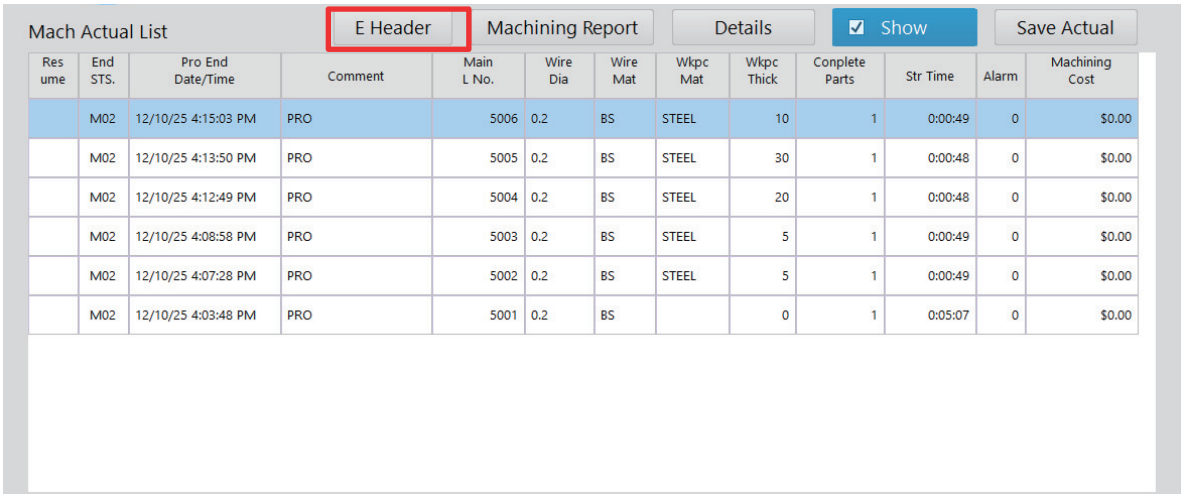
(2) ENo
This is the number of the E-header registered at the beginning (header section) of the NC program.

(7) [Register user DB]
The E-header of the NC program updated as machining results can be registered as user-specific machining conditions. Registered machining conditions can be searched for in the user DB and can be reused.

For items (3) to (6), (8), and (9), see"VI. OPTIONS" > "7. NV-2" > "7.2 Method of use" > "7.2.2 Machining condition search" > "(4) Explanation of the screen" > "3) E Header screen (search result editing)".

7.2.4 Operation result linkage

Press "E Header" (right of "Mach Actual List") under "History management" > "Operation", to load the E-header used in actual machining into the NC editor. The data can be registered in a user DB or saved in an NC program and reused.



Resume	End STS.	Pro End Date/Time	Comment	Main L No.	Wire Dia	Wire Mat	Wkpc Mat	Wkpc Thick	Complete Parts	Str Time	Alarm	Machining Cost
	M02	12/10/25 4:15:03 PM	PRO	5006	0.2	BS	STEEL	10	1	0:00:49	0	$0.00
	M02	12/10/25 4:13:50 PM	PRO	5005	0.2	BS	STEEL	30	1	0:00:48	0	$0.00
	M02	12/10/25 4:12:49 PM	PRO	5004	0.2	BS	STEEL	20	1	0:00:48	0	$0.00
	M02	12/10/25 4:08:58 PM	PRO	5003	0.2	BS	STEEL	5	1	0:00:49	0	$0.00
	M02	12/10/25 4:07:28 PM	PRO	5002	0.2	BS	STEEL	5	1	0:00:49	0	$0.00
	M02	12/10/25 4:03:48 PM	PRO	5001	0.2	BS		0	1	0:05:07	0	$0.00

(1) Structure of the E-header to be saved

1) File order

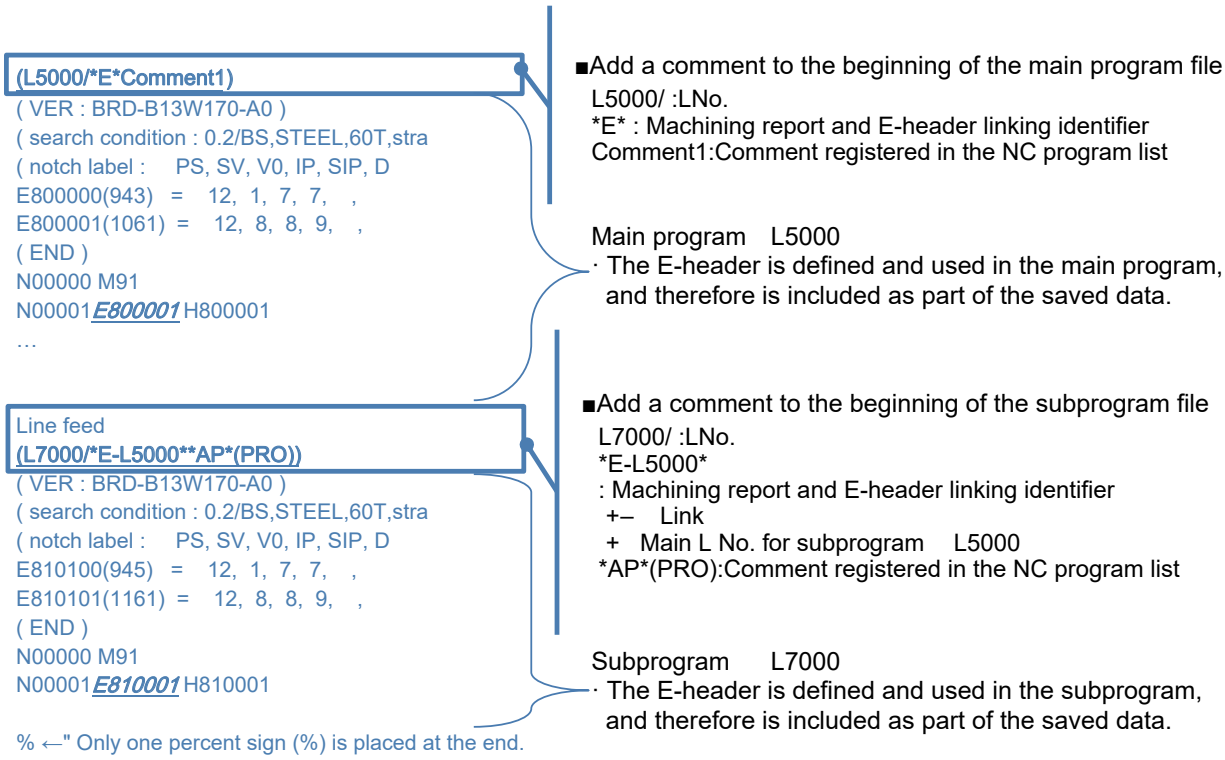
The NC program including the E-header is integrated into one file.

2) File unit separation

When multiple files are integrated, a comment is inserted at the beginning of each program file to separate the programs.

3) File end symbol %

When merging multiple files, the file end symbol % of each file will be deleted and % will be output only at the end of the integrated file.



7.2.5 Programming

(1) Machining conditions switching E

1) Machining condition package used in E-header

(a) E-header structure and number

(notch label: PS, SV, V0, IP, DIP, OFF, SA, SB, SC, SE, SG, VG, ...

E800000(943) = 1, 0, 7, 7.0, 11, 6, 3, 7, 7, 4, 0, 50.0, ...

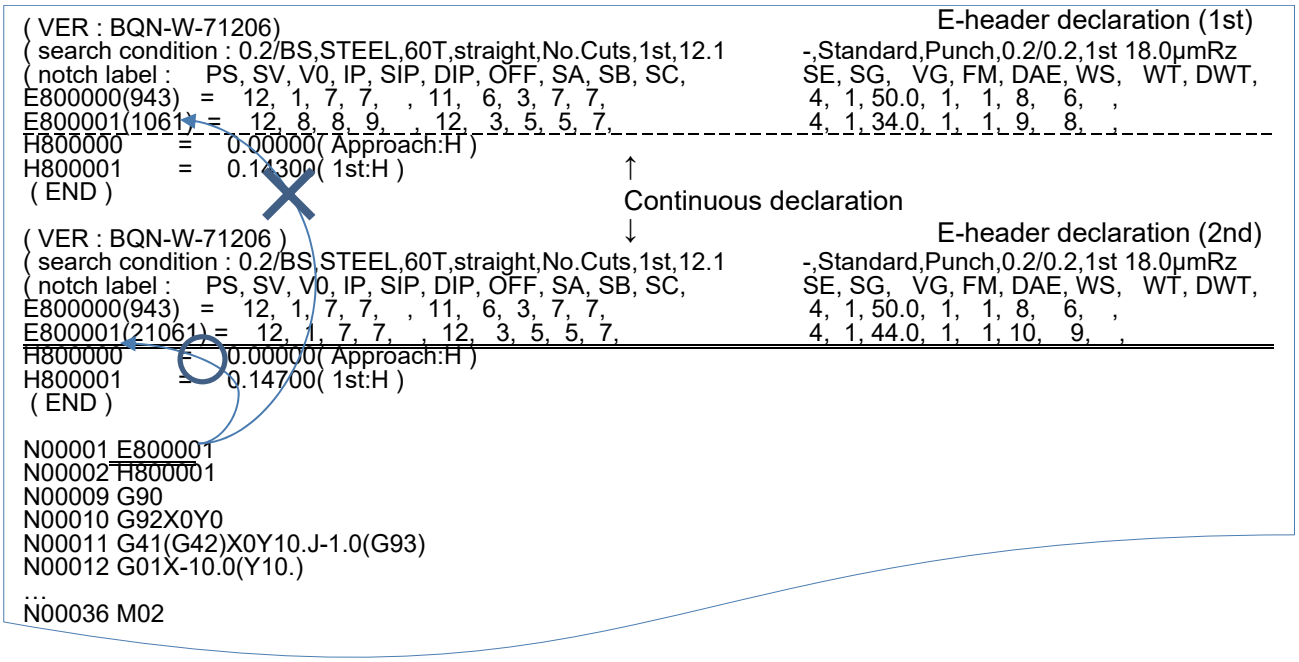
E800001(12261) = 1, 1, 7, 9.0, 11, 3, 5, 6, 7, 4, 0, 38.0, ...

- **E-header number** **"E800000" "E800001"**
  20 groups **E800000 to E800021, ... E801900 to E801921**
- **E No. provided by the search source manufacturer** **"(943)" "(12261)"**
- **Identifier** **"="**
- **Data** **"1, ..."**

(b) Placing E-headers and corresponding shape programs

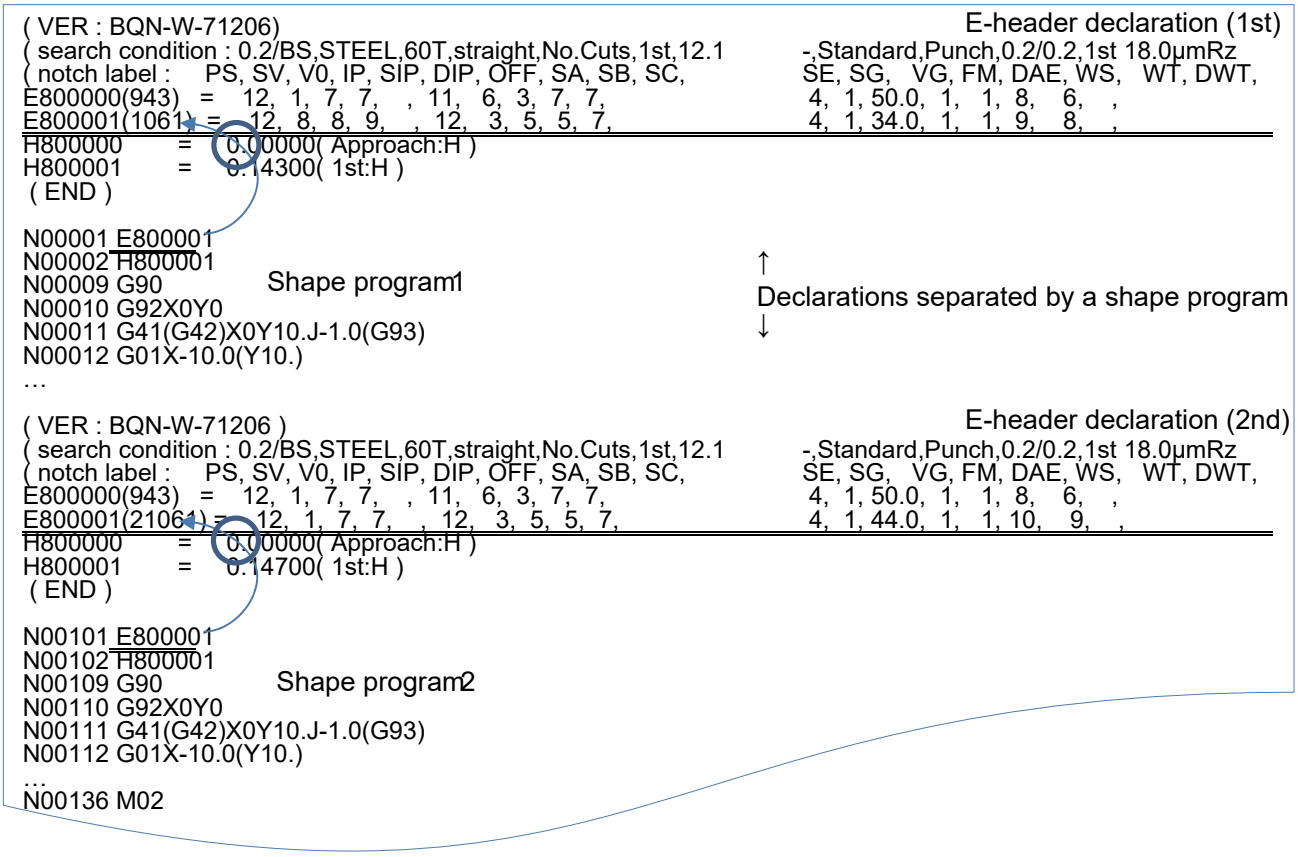
The E-header uses the E-header declaration in the NC program to be executed.

(1) Consecutive E-header declarations



Recommended: Do not declare unnecessary E-headers. Also, if two different types of E-headers are used, use two different groups. Example: Group 1 E800000, Group 2 E800100

(2) E-header declarations with shape program in between



In the above example, the E-header declaration (first one) E800001 (1061) is used for shape program 1.

(c) E-header and feed rate function F

The E-header searched by the header search function can incorporate a feed rate F.

Example 1) When "F command" and "FF in E header" are specified on the same line in the program

F10.0 E800001 ..... If the F and E commands are written on the same line, the F command will be used regardless of the order.

Example 2) When specifying "F command" and "FF in E header" on two separate lines in the program

F10.0
E800001 ..... If they are split into two lines, the FA specified in the latter line will be used.

- **Place the E-header declaration corresponding to the E command in the NC program to be executed (including the NC program that will be executed).**
- **The E-header must be declared before the shape program to be executed.**
- **If two types of machining condition groups are registered in one NC program, do not use the same E-header number.**
- **The NC program for the E-header is not recognized even if it is executed in advance.**
- **If an E-header declaration is placed before a user variable (refer to "III. NC OPERATION DISPLAY SCREEN" > "6. OVERLAP" > "6.2 Variable" > (4)), the user variable will not be recognized.**

7.3 Other precautions

7.3.1 Alarm

(1) Program Alarms

Error Number	Message and details	Remedies	Remarks
P2051	**No E Header notch label** When the NC program is operated, presence of the notch label is checked, and the alarm occurs and the machine stops if there is no label line or the label lines are less than the number of data.	• Add the label line.	
P2052	**E Header notch label error** When the NC program is operated, presence of the notch label is checked, and the alarm occurs and the machine stops if there is the label line that cannot be identified.	• Review the label line.	
P2053	**E Header notch data error** When the NC program is operated, presence of the notch label is checked, and the alarm occurs and the machine stops if there is no corresponding data.	• Review the label line.	

(2) Message

Message and details	Remedies	Remarks
Display the edit screen for NC program to write header. • If the editing screen is not opened when the header is written, there is no writing destination, so you will be prompted to open an NC program.	• Open the editing screen. • Load an NC program onto the editing screen.	
Disk space is full. Delete NC program which is not needed. • When the header is written or automatically updated, there is insufficient space in the saving destination disk.	• Delete unnecessary files on the disk to free up space.	
Lxxx is being used by another program. • The NC program is running when the header is written.	• Write it again after the operation is completed.	
Lxxx is locked now. • When the header is written, the destination NC program is in the edit lock state.	• Disable the edit lock and try again.	
Lxxx have been registered in the schedule. • When the header is written, the destination NC program is registered in the built-in scheduler.	• Remove it from the schedule registration and try again.	

Message and details	Remedies	Remarks
E Header No. and E Header No. used for machining in NC program do not match. (2)|tmp file was saved on the document screen. • The specified line for the write destination is not the E-header (it may have been edited and shifted after machining).	• When M02 is commanded, avoid editing the target NC program. • During automatic updates, if writing is not possible, a tmp file is created. After checking the contents, update the information table of the E-header to apply the changes made during machining. D:\MYDATA\DocMgt\Document\HEADER\	
E Header No. and E Header No. used for machining in NC program do not match. (3)|tmp file was saved on the document screen. • The nn in E80nnxx is not within the range of 00 to 19. (It may have been edited and shifted after machining.)	Same as above	
E Header No. and E Header No. used for machining in NC program do not match. (4)|tmp file was saved on the document screen. • The xx in E80nnxx is other than 00 to 19, 20, or 21. (It may have been edited and shifted after machining.)	Same as above	
There is no manufacturer E No. (xxxx) in E Header of NC program. (5)|Do not change the structure of the header. • Manufacturer E No. "(mmm)" in E80nnxx(mmm) is missing.	• The number provided by the manufacturer that was the search source for the E-header on the NC program has been deleted. Restore the number or add a new one.	
Search condition information of NC program is incorrect. (6)|Do not change the structure of the header. • There is no search condition line.	• The search condition line is missing from the header. Please place it again or register a new one.	
There is no notch label in NC program. (7)|tmp file is saved on the document screen. • There is no notch label line.	• During automatic updates, if writing is not possible, a tmp file is created. After checking the contents, update the information table of the E-header to apply the changes made during machining. D:\MYDATA\DocMgt\Document\HEADER\	
Notch label in NC program does not match. (8)|Check the structure of the header and add an insufficient notch. • The notch label line is missing.	• The notch label may have been removed, or the system may have been updated and some notches have been added. Add a label and notch, or leave it as is if there is no problem.	
Notch data of E Header in NC program is incorrect. (9)|tmp file was saved on the document screen. • Each E notch data is described in a way it cannot be converted into a numerical value (it may have been edited and shifted after machining).	• During automatic updates, if writing is not possible, a tmp file is created. After checking the contents, update the information table of the E-header to apply the changes made during machining. D:\MYDATA\DocMgt\Document\HEADER\	
Search condition information of NC program does not exist. (10)|Do not change the structure of the header. • CurrentEpack or Eadjustment is missing from the search condition line. • The search condition line is not found.	• It may have been deleted by a user. The machine will restore it as much as possible. Do not delete it.	
E Header in NC program and search condition information do not match. (11)|Do not change the structure of the header. • CurrentEpack or Eadjustment may have been edited.	• The NC program may have been edited, causing the CurrentEpack or Eadjustment and E-header to become misaligned.	

Message and details	Remedies	Remarks
E Header No. is not within the range. (20) • The nn in E80nnxx is not within the range of 00 to 19 (it may have been edited and shifted after machining).	• The E-header range has been exceeded. Review the numbers used in the NC program.	
E Header No. is not within the range. (21) • The xx in E80nnxx is other than 00 to 19, 20, or 21 (it may have been edited and shifted after machining).	Same as above	
There is no manufacturer E No. (xxxx) in E Header of NC program. (22)|Do not change the structure of the header. • The notch is missing. (It may have been edited and shifted after machining.)	• The E-Pack to be compared to is not specified at the time of the search on the E-header screen. Restore it to the state it was in at the time of the search, or add it again.	
Notch of E Header in NC program is insufficient. (23)|Do not change the structure of the header. • The notch is missing. (It may have been edited and shifted after machining.)	• If each notch in the E-header is missing, an empty space will be displayed. Restore it to the state it was in at the time of the search, or add it again.	
Notch data of E Header in NC program is incorrect. (24)|Do not change the structure of the header. • The notch cannot be converted.	• If each notch in the E-header cannot be converted, an empty space will be displayed. Restore it to the state it was in at the time of the search, or add it again.	
H and F Headers in NC program are incorrect. (25)|Do not change the structure of the header. • There is no H80nnxx corresponding to the existing E80nnxx • - Numerical values in the F-header, H-header, and Z-header cannot be converted.	• The E-header in the NC program does not have a corresponding H- or F-header. Restore it to the state it was in at the time of the search, or add it again.	
There is no notch label in NC program. (26)|Do not change the structure of the header. • The notch label cannot be called up to the E Header screen because there is no notch label in the header.	• If the notch label in the header of the NC program is missing, it will not work with the E-header. Restore it to the state it was in at the time of the search, or add it again.	
Notch label in NC program does not match. (27)|Check the structure of the header and add an insufficient notch. • The notch label is partially missing. The missing notch is imported into the E Header screen as an empty space.	Same as above	
Header cannot be updated because of editing the file. (1)|tmp file was saved on the document screen. • The destination NC program was being edited when the header was automatically updated.	• When M02 is commanded, avoid editing the target NC program. • During automatic updates, if writing is not possible, a tmp file is created. After checking the contents, update the information table of the E-header to apply the changes made during machining. D:\MYDATA\DocMgt\Document\HEADER\ * tmp file is not saved when linking.	

Message and details	Remedies	Remarks
Header cannot be updated because another program is used. (1)|tmp file was saved on the document screen. • The NC program is in use when the header is automatically updated.	• The NC program is used for graphic drawing, etc. When M02 is commanded, avoid using the target NC program. • During automatic updates, if writing is not possible, a tmp file is created. After checking the contents, update the information table of the E-header to apply the changes made during machining. D:\MYDATA\DocMgt\Document\HEADER\ * tmp file is not saved when linking.	
Header cannot be updated because the disk is full. (1)|tmp file was saved on the document screen. • When the header is automatically updated, there is insufficient space in the saving destination disk.	• Delete unnecessary files on the disk to free up space. * tmp file is not saved when linking.	
Header cannot be updated because the editing is locked. (1)|tmp file was saved on the document screen. • When the header is automatically updated, the destination NC program is in the edit lock state.	• Disable the edit lock. When M02 is commanded, avoid editing the target NC program. • During automatic updates, if writing is not possible, a tmp file is created. After checking the contents, update the information table of the E-header to apply the changes made during machining. D:\MYDATA\DocMgt\Document\HEADER\ * tmp file is not saved when linking.	
Header cannot be updated because the file is only for reading. (1)|tmp file was saved on the document screen. • When the header is automatically updated, the destination NC program is set as read-only.	• Disable the read-only setting. When M02 is commanded, avoid editing the target NC program. • During automatic updates, if writing is not possible, a tmp file is created. After checking the contents, update the information table of the E-header to apply the changes made during machining. D:\MYDATA\DocMgt\Document\HEADER\ * tmp file is not saved when linking.	

8. TOUCH SENSOR ON-MACHINE CHECK FUNCTION

8.1 Outline

This function can execute the positioning of the workpiece machining reference, adjust the wire position as a preparation before machining, measure the approximate dimensions after machining, and check a pitch at the center position.

8.1.1 Contents of on machine check

The following types of positioning and shape checks as shown in Table VI.8.1 are possible.

Table VI.8.1 Contents of reference positioning

Positioning item	Contents
Corner	Executes the positioning of the corner position
Hole center	Executes the positioning of XY width and the midpoint of the round shape
4-point center (Inner)	Executes the positioning of XY width and the midpoint of the inside of the square shape
4-point center (Outer)	Executes the positioning of XY width and the midpoint of the outside of the square shape

Table VI.8.2 Contents of shape checks

Check item	Contents
XY width	Checks XY width and the midpoint position of the square shape
X width	Checks X width and the midpoint position of the square shape
Y width	Checks Y width and the midpoint position of the square shape
Round hole	Checks the diameter and the midpoint position of the round shape
Edge	Checks X and Y positions of the workpiece edges
Corner	Checks X and Y positions of the workpiece corners
3-point center (Inner)	Checks the diameter and the midpoint position of the round shape from 3-point edge position
Distance between pitches	Calculates a distance between pitches of the center position of the shape
Angle between pitches	Calculates an angle between pitches of the center position of the shape

8.1.2 Basic operations of the touch sensor

1) Touch sensor mode selection

Touch sensor mode is required to be set to execute the positioning by the touch sensor. See the instruction manual for the touch sensor.

8.1.3 Precautions when using the touch sensor

NOTICE

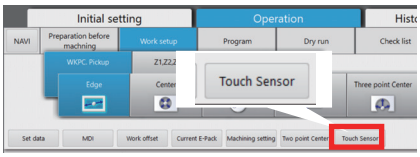
1. **Since the installation part for the touch sensor is the same potential as a wire electrode, do not touch it during machining.**
2. **Be careful of interference with especially a workpiece or a jig etc. while the touch sensor is moved.**
   (Do not make the touch sensor probe hit.)
   If its probe hits a workpiece, the axis stops with the alarm "TCH SNSR CONT. (Touch sensor contact stop)". At this time, move the axis to the reverse direction to cancel the alarm.
3. **Check the following switch settings when executing the positioning and checking the shape by the touch sensor.**
   - **"Multiple Work": ON**
   - **"Workpiece Alignment ADV.": ON**
   - **"INCH": OFF**
   - **"x 0.1": ON**
   - **"High Accuracy Positioning": ON**

   *** When the positioning mode is displayed as Type, use Type2 to Type4.**
4. **Cut the wire before executing the positioning and checking the shape by the touch sensor.**
5. **Since the measurement is executed according to the workpiece tilt, the measurement under the condition which UV is tilted is not possible.**
6. **When starting positioning, UV axes move to the reference tilt.**
   Since UV coordinate values displayed at the start of the positioning move to "0 (zero)" position, be careful when a large value is input in the coordinate values of UV axes.
7. **When moving up/down (mounting/removing) the touch sensor during positioning, perform the step again from the distance compensation between the touch sensor and the wire.**
8. **For others, read the instruction manual for the touch sensor and work in a safe way.**

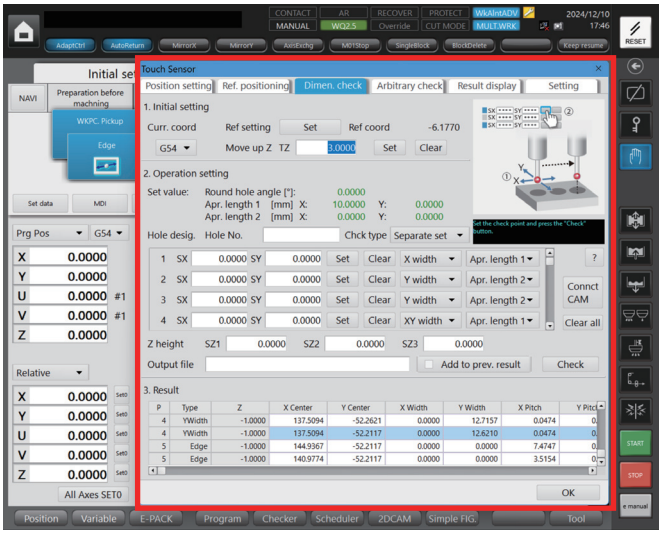
8.2 SYSTEM CONFIGURATION

8.2.1 Touch Sensor On Machine Check Screen

HOME screen



Operation > Work setup



Touch sensor on machine check screen

Fig. VI.8.1 Opening the touch sensor on machine check screen

For displaying the "Touch Probe" icon on the home screen, set it by the customization setting. Right-click on the icon and select "Customizing". After that, select "Touch Sensor" from "Shortcut".

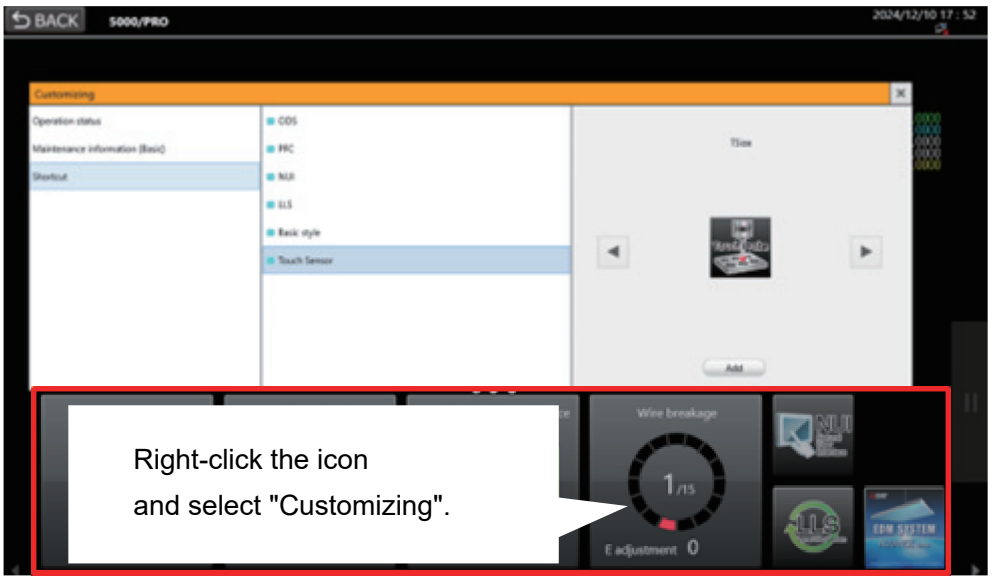


Fig. VI.8.2 HOME screen customization

8.2.2 Screen configuration

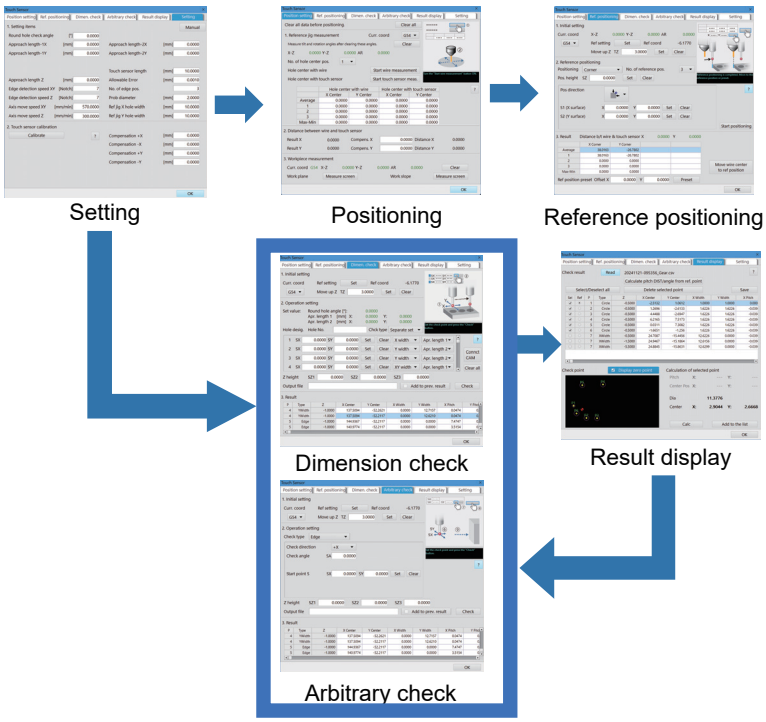


Fig. VI.8.3 Screen configuration

(1) Setting

The necessary setting values when the positioning is executed are checked on the setting screen.
When changing the touch sensor probe, make sure to set its probe diameter and calibrate the touch sensor.

(2) Positioning setting

The distance between the touch sensor and the wire is measured.

(3) Reference positioning

The corner, hole center, 4-point center (Inner), and 4-point center (Outer) positioning are executed. Furthermore, the nozzle is moved to the reference position to which the positioning was executed, and the coordinate system is preset on this screen.

(4) Dimension check

The multiple shapes of the workpiece after machining are checked consecutively.

(5) Arbitrary check

1 shape of the workpiece after machining is checked with various methods.

(6) Result display

The results of the dimension check and the arbitrary check can be checked and be saved on the result display screen.

8.3 Setting/Operation Details

8.3.1 Setting

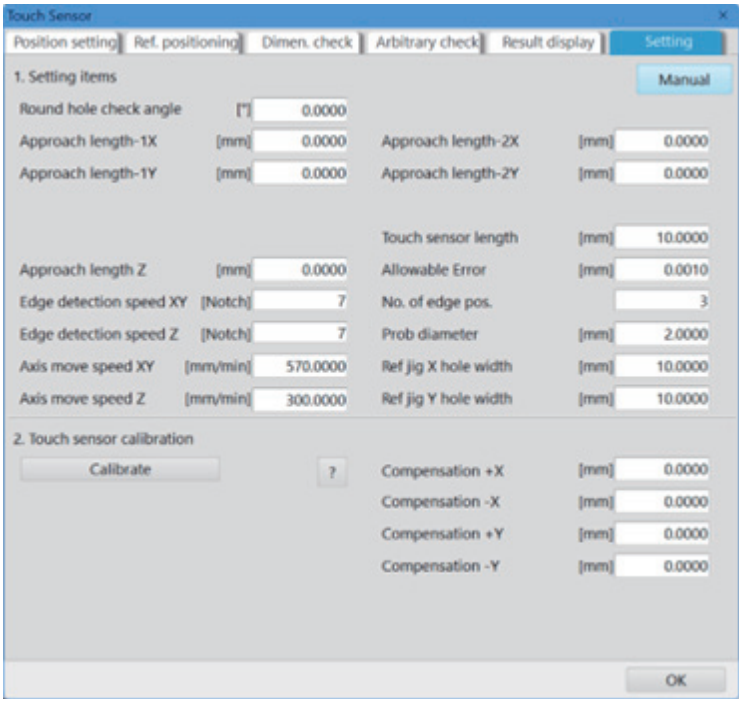


Fig. VI.8.4 Setting screen

(1) Setting item

Set the necessary parameters for executing the touch sensor on machine check.

1) Round hole check angle

This is the parameter used when selecting "Round hole" in "Chck type" (Check type) on the "Dimen. check" (Dimension check) screen.

Angle when the round hole positioning is executed can be changed depending on the setting value. (It is effective when avoiding the approach point during machining etc.)

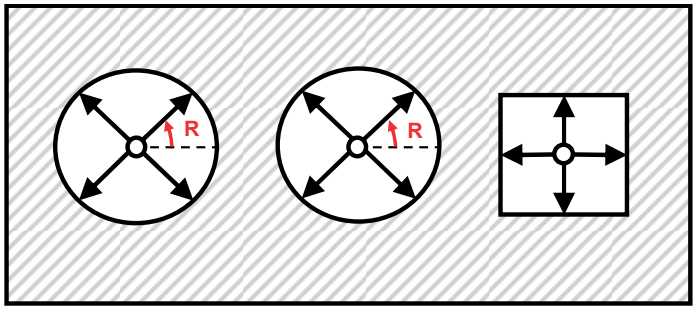


Fig. VI.8.5 Round hole check angle (R is the setting value.)

2) Approach length

Set the approach length according to the dimension check.
Set approach length 1 and 2 with configurable X and Y distances.

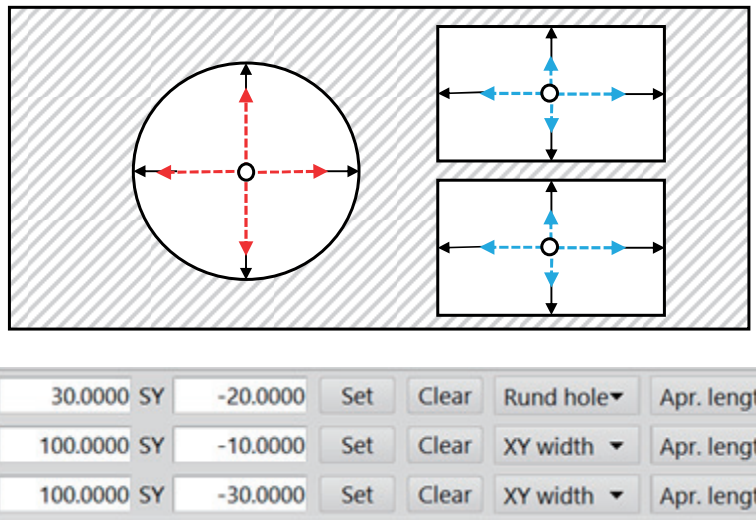


Fig. VI.8.6 Approach length-1 (Left) and approach length-2 (Right) (Dotted line shows the approach.)

3) Edge detection speed

Set the approach length when the dimension check and the arbitrary check are executed by designating a notch. XY directions and Z direction can be respectively set.

Table VI.8.3 Notch designation for edge detection speed

Notch	Axis movement speed [mm/min]
For 1 to 50 A	For 3 to 50 A
For 2 to 50 A	For 6 to 50 A
For 3 to 50 A	: L9
For 4 to 50 A	For 12 to 50 A
For 5 to 50 A	For 15 A
For 6 to 50 A	For 30 to 50 A
For 7 to 50 A	For 100 to 50 A
For 8 to 50 A	For 300 to 50 A
For 9 to 50 A	For 570 to 50 A

4) Axis movement speed

The speed when moving the axis (except the positioning and the approach). XY directions and Z direction can be respectively set.

5) Allowable error

The allowable error when positioning at the dimension check and the arbitrary check..

6) Number of times the edge positioning is executed

The number of times the positioning is executed at one point when the dimension check and the arbitrary check are executed.

7) Probe diameter

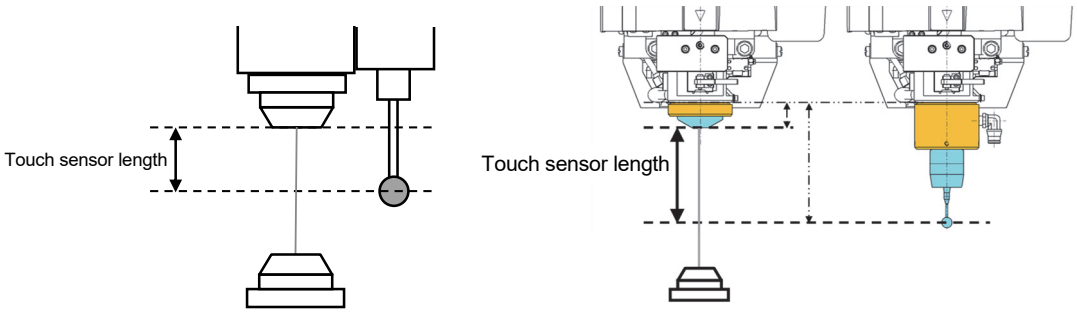
Set the probe diameter to be mounted. When changing the probe, make sure to check its diameter again.

8) Hole width of the reference jig

Input the reference jig dimensions checked using measuring equipment of the user environment to eliminate an error by the measuring environment. The reference jig is the accessory.

9) Touch sensor length

Input the length form "the tip of the upper nozzle" to "the center of the probe".



(a) Chuck type touch sensor,
Renishaw up/down type touch sensor

(b) Nozzle removable touch sensor

Fig. VI.8.7 Touch sensor length

For Positioning setting and Reference positioning, set "Allowable error" and "the number of times the edge positioning is executed" on each screen.

(2) Touch sensor calibration

In the positioning by the touch sensor, the probe is fed to a fixed amount even after it contacts a workpiece, and the contact is detected after the probe bends. For that reason, when changing the touch sensor probe, setting its probe diameters and calibrating are required.

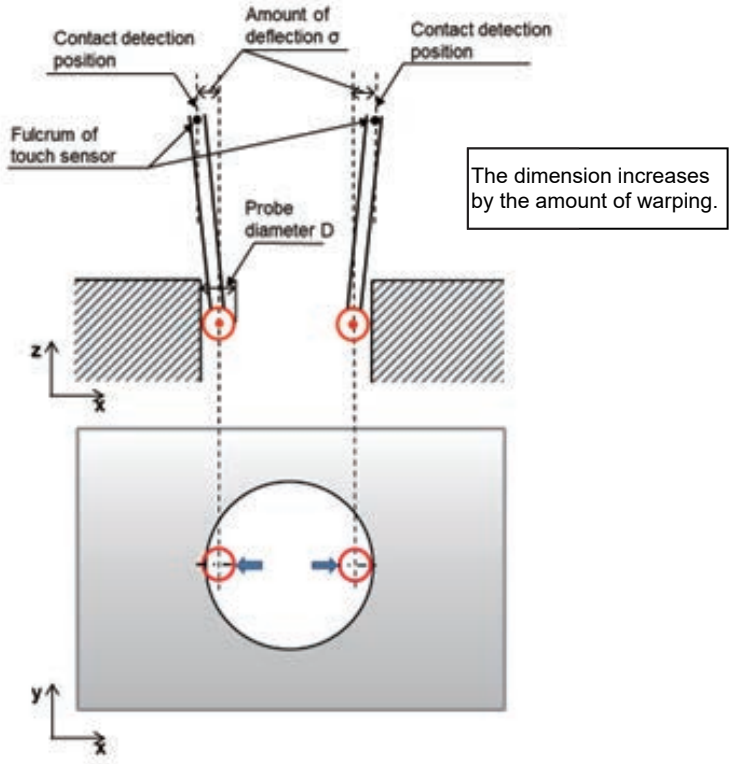


Fig. VI.8.8 Amount of deflection of touch sensor

1) Touch sensor calibration

The touch sensor is calibrated according to the "Reference jig dimensions".

2) Touch sensor compensation amount

The results of the touch sensor calibration are displayed. If uniform errors occur in the results when the dimension check and the arbitrary check are executed, calibrate the touch sensor again or adjust the values.

3) Operation procedure

(a) Setup

(i) Prepare a reference jig as shown in Fig. VI.8.9.
Accurately measure the hole diameter and the height dimension of the reference jig using measuring equipment of the user environment to set on the setting screen. Input the measured hole diameter and height dimension of the reference jig in "Ref jig X hole width" (Reference jig X hole width) and "Ref jig Y hole width" (Reference jig Y hole width) respectively.

(ii) Install the reference jig on the table.

(iii) Set up the reference jig in the available range for positioning with the touch sensor and the wire.

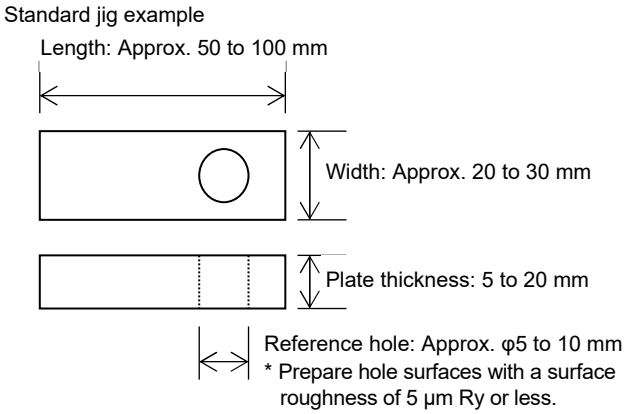


Fig. VI.8.9 Reference jig

(b) Touch sensor calibration

(i) Move the touch sensor probe to the approximate center position of the reference jig hole by feeding manually in the state of installing the touch sensor.

(ii) Press "Calibrate" and then "START".

(iii) The touch sensor calibration is started, and the hole center positioning is executed. After completing, each value is saved in "Compensation +X", "Compensation -X", "Compensation +Y" and "Compensation -Y".

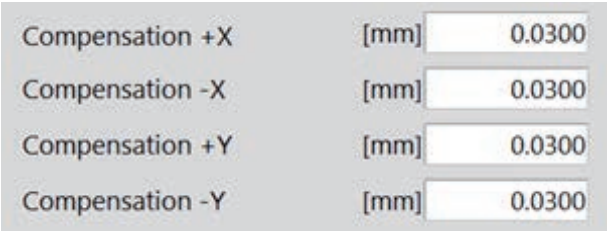


Fig. VI.8.10 Touch sensor compensation amount

8.3.2 Positioning setting

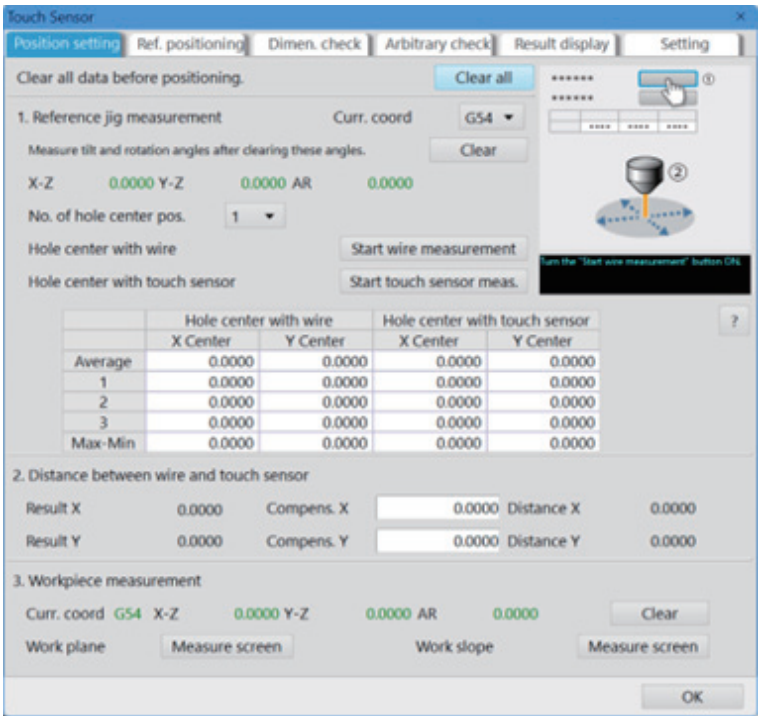


Fig. VI.8.11 Position setting screen

(1) Clearing before positioning

Clear the past measurement results and compensation values before positioning by pressing "Clear all".

(2) Reference jig measurement

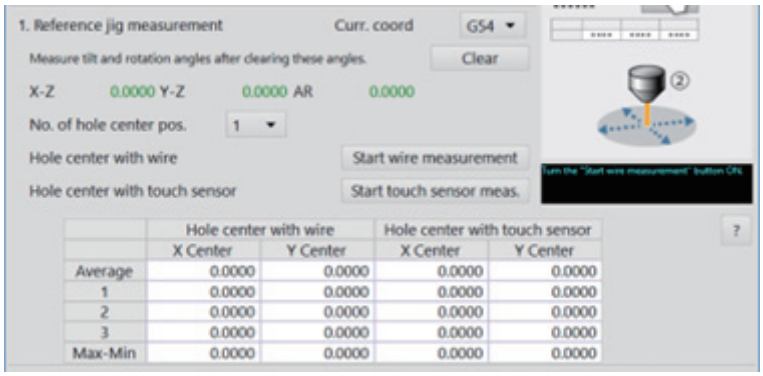


Fig. VI.8.12 Reference jig measurement

1) Clearing the coordinate rotation

The positioning of the distance between the touch sensor and the wire is required to be executed after clearing the rotation compensation of the selected coordinate system.
Press "Clear" to clear the rotation compensation of the coordinate system.

2) Number of times hole center positioning is repeated

Select the number of times that the hole center positioning is repeated by the wire and the touch sensor.

3) Hole center positioning with the wire and hole center positioning with the touch sensor

The hole center positioning with the wire and the hole center positioning with the touch sensor are executed.

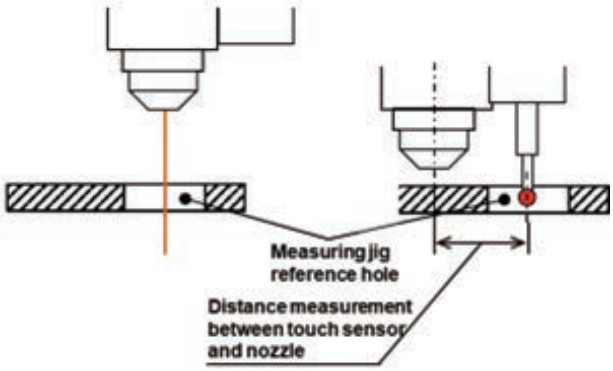


Fig. VI.8.13 Method for measuring

(a) Hole center positioning with the wire

Press "Start wire measurement" and then "START" after threading the wire into the hole of the reference jig.

(b) Hole center positioning with the touch sensor

Press "Start touch sensor meas." and then "START" after moving the probe to the hole of the reference jig to which the hole center positioning with the wire was executed.

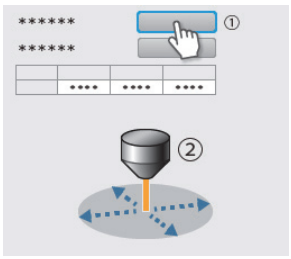
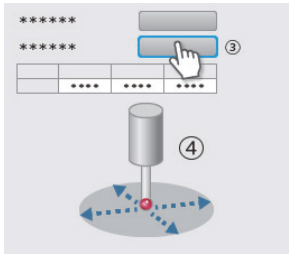
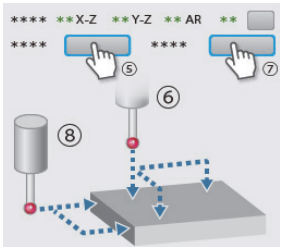
4) Result check

The results of the hole center positioning with the wire and with the touch sensor are displayed.
The results of X and Y coordinates of the center, average values, and maximum errors are displayed.
If variations are large, execute the hole center positioning again.

5) BMP display and message

Each BMP and message are displayed according to the operation. Refer to each BMP and message to set the screen and operate.

Table VI.8.4 Contents of BMP and message display

Status	Message	Remedies	BMP
The hole center positioning with the wire is not executed yet.	Turn "Start wire measurement" ON.	Press "Start wire measurement" after threading the wire into the hole of the reference jig.	
"Start wire measurement" was pressed.	Press "START" to measure with the wire.	Press "START". The hole center positioning with the wire is started.	
The hole center positioning with the wire is being executed.	Measuring hole center with wire	-	
The hole center positioning with the wire was completed, and the hole center positioning with the touch sensor is not executed yet.	Press "START" to check the reference surface.	Press "Start touch sensor meas." after moving the probe to the hole of the reference jig.	
"Start touch sensor meas." was pressed.	Press "STRAT" to measure with the touch sensor.	Press "START". The hole center positioning with the touch sensor is started.	
The hole center positioning with the touch sensor is being executed.	Measuring hole center with touch sensor	-	
Distance measurement between the touch sensor and the wire was completed.	Press "Measure screen" to measure the workpiece.	See "(4) Workpiece measurement" to measure the workpiece plane and tilt.	

6) Help [?]

Displays the instruction manual.

(3) Distance between the touch sensor and the wire

The measured X and Y distances between the touch sensor and the wire are displayed.
When adding the compensation values by inputting manually, input each value in "Compens. X" and "Compens. Y".

(4) Workpiece measurement

The plane compensation and the rotation compensation are executed as needed for the workpiece where reference positioning is performed.

1) Workpiece plane

Flatness compensation (X-Z and Y-Z plane compensations) is executed by measuring the upper surface of the workpiece.

2) Workpiece slope

Parallelism compensation (X-Y rotation compensation) is executed by measuring the side of the workpiece.

8.3.3 Reference positioning

The nozzle (the center of the wire) is moved to the reference position by executing the positioning with the touch sensor to the reference position of the workpiece.

* Execute the workpiece flatness and parallelism compensations before executing the reference positioning and then execute the reference positioning to the compensated workpiece.

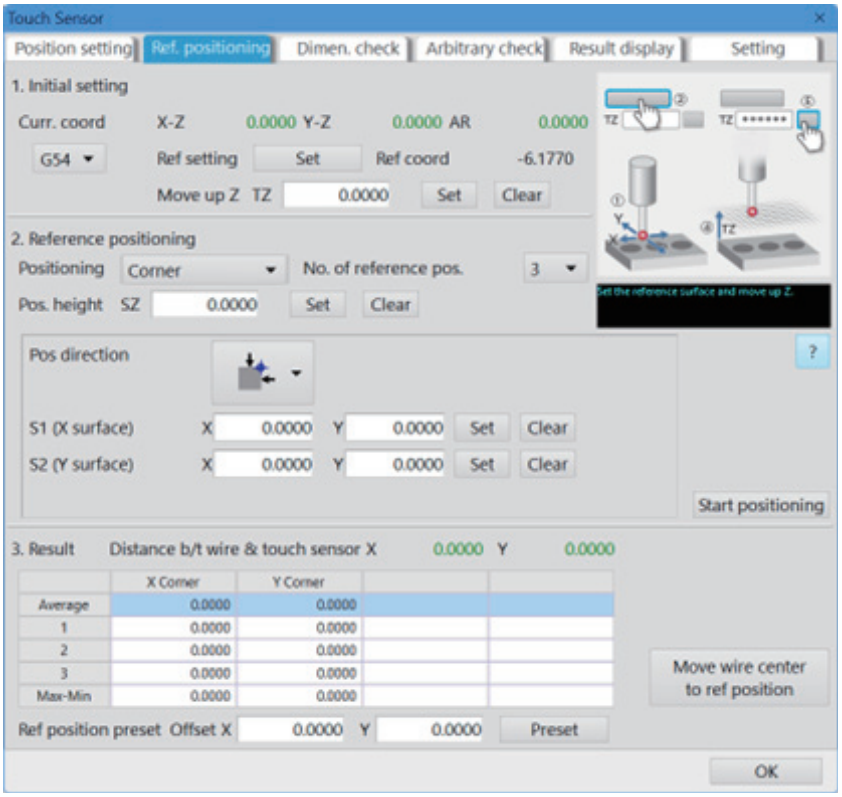


Fig. VI.8.14 Reference positioning

(1) Initial setting

Set the reference surface and the retract surface.

1) Current coordinate system

The selected coordinate system as the current coordinate system is displayed.

2) Start of the setting

"Set" is highlighted in blue after pressing it. The edge positioning to Z direction is executed by pressing "START" in this state.

* Set the probe diameter on the "Setting" screen.

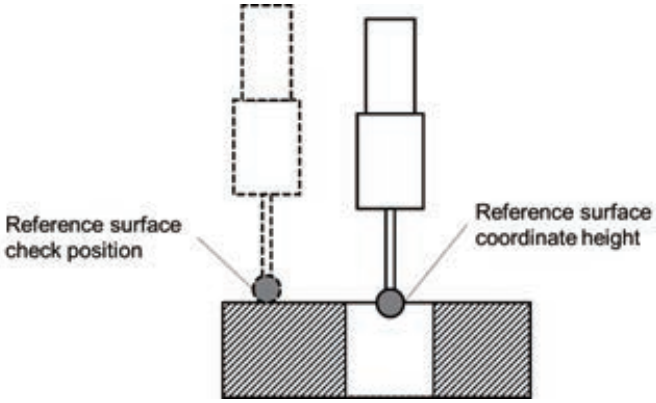


Fig. VI.8.15 Height of reference surface coordinate

3) Retract Z height (Move up Z)

Set the height for moving up the touch sensor when moving the axis. Make sure to set the higher position than the reference surface coordinate.

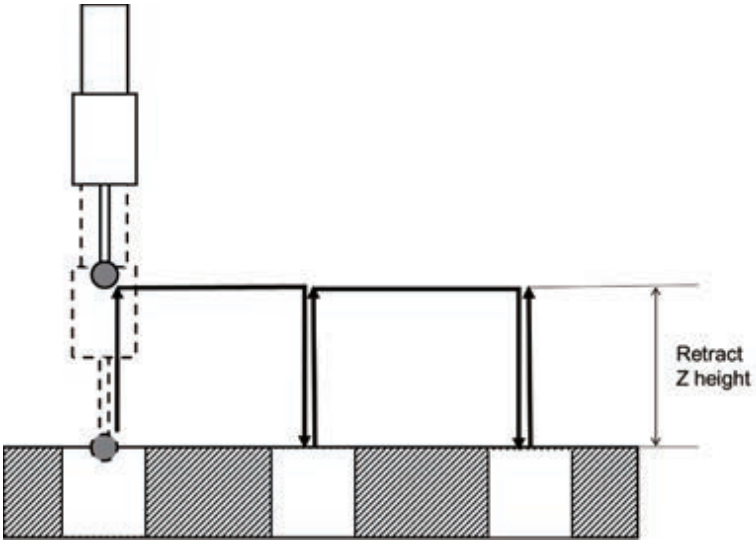


Fig. VI.8.16 Retract Z height (Move up Z)

(a) Set/Clear

Z coordinate of the current coordinate system is set by pressing "Set".

"0" is set by pressing "Clear".

The value can also be directly input in the setting part.

(b) Highlighting retract Z height

If the retract Z height is the reference surface coordinate or less, the probe hits when moving the touch sensor.

For that reason, in the case of Retract Z height ≤ (Reference surface coordinate + Probe diameter/2), the coordinate value in the setting part turns red as a warning.

* Probe diameter is set on the Setting screen.

(2) Reference positioning (Corner)

The positioning to the reference corner is executed.

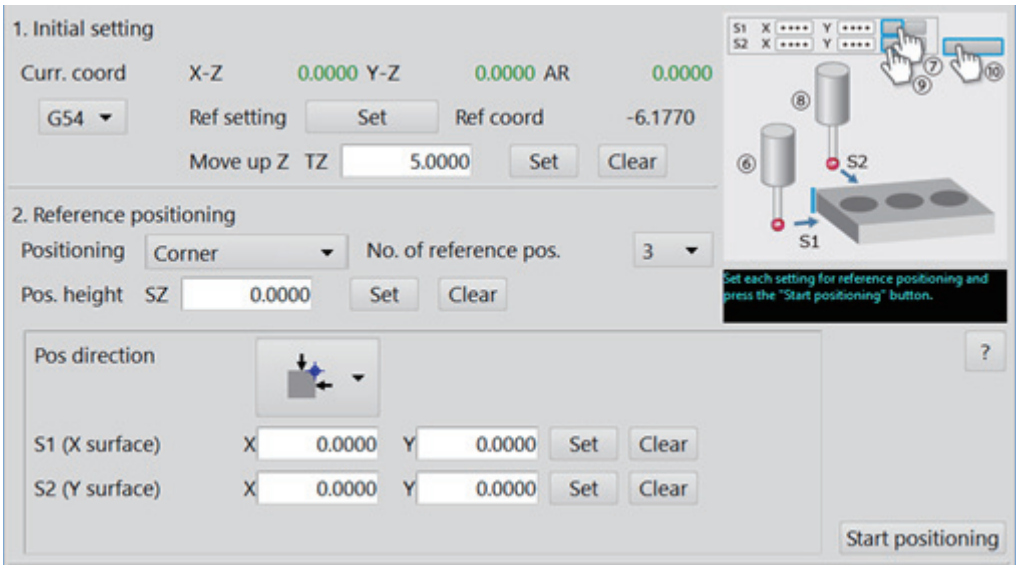


Fig. VI.8.17 Reference positioning (Corner)

1) Selecting types of positioning

Select the type of the reference positioning.
Select "Corner" if executing the positioning to the corner.

2) Number of times the reference positioning is repeated

Select the number of times the reference positioning is repeated.
The number of times can be selected from 1 to 3 times.

3) Positioning height SZ

Input Z height for executing the positioning with the relative value from the reference surface.
Input "-2.0" when measuring the position (lower direction) being 2 mm from the upper surface.
Manual teaching is also possible by moving the probe to the height for executing the positioning and then pressing "Set".

4) Positioning direction

Select the pattern of the corner where the positioning is executed.

5) Teaching the point where the positioning is executed

Input the positioning point S1 of X surface and the positioning point S2 of Y surface.
Manual teaching is also possible by moving the probe to the position for executing the positioning and then pressing "Set".

6) Positioning operation

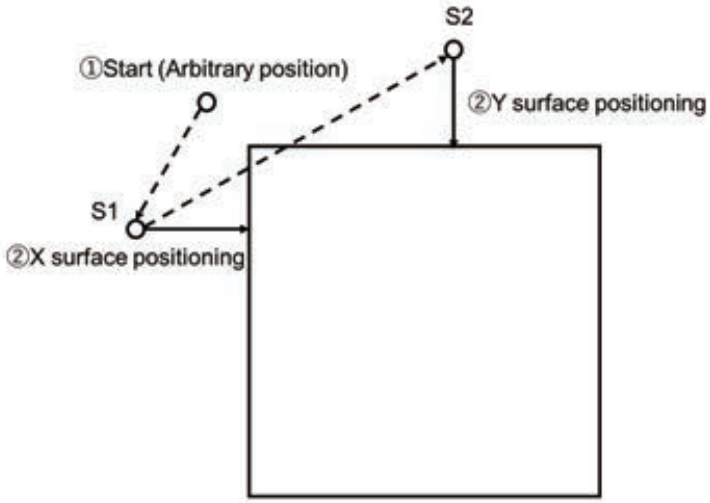


Fig. VI.8.18 Corner positioning operation

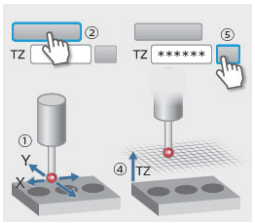
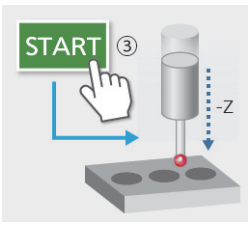
7) Start of the reference positioning

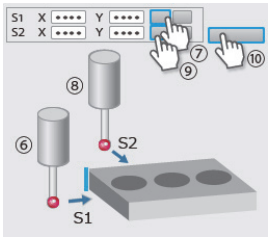
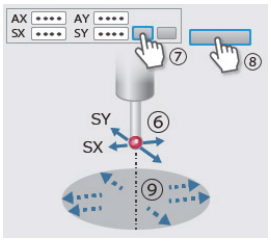
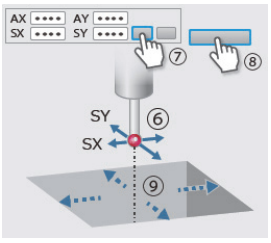
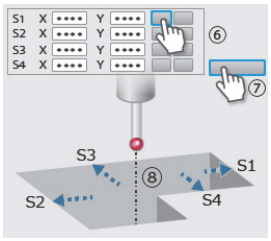
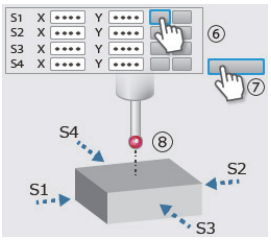
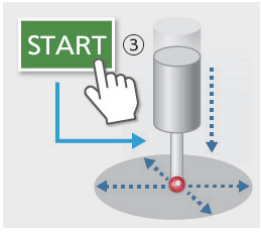
"Start positioning" is highlighted in blue after pressing it. The reference positioning is executed by pressing "START" in this state.

8) BMP display and message

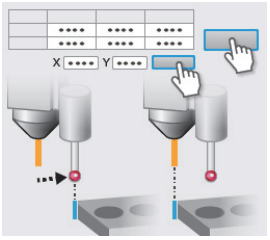
Each BMP and message are displayed according to the operation. Refer to each BMP and message to set the screen and operate.

Table VI.8.5 Contents of BMP and message display

Status	Message	Remedies	BMP
The reference surface and the retract Z height are not set yet.	Set the reference surface and retract height.	See "(1) Initial setting" to set the reference surface and the retract height.	
"Reference surface check" was pressed.	Press "START" to check the reference surface.	Press "START". The reference surface check is started.	
The reference surface check is being executed.	Checking the reference surface.	-	

Status	Message	Remedies	BMP
The reference surface and the retract surface are set.	Set each setting for reference positioning and press "Start positioning".	See "(2) to (5) Reference positioning" to set. After setting, press "Start positioning".	Corner  Hole center  4-point center (Inner) - 1 point designation  4-point center (Inner) - 4-point designation  4-point center (Outer) 
"Check" was pressed.	Press "START" to start the reference positioning.	Press "START". The reference positioning is started.	
The reference positioning is being executed.	Positioning the reference	-	

VI

Status	Message	Remedies	BMP
The reference positioning is completed.	Reference positioning is completed. Move to the reference position or preset.	See "(6) Result" to check the positioning result. Move to the reference position or preset.	
"Move wire center to ref position" was pressed.	Press "START" to move to the reference position.	Press "START". Moving to the reference position is started.	
Moving to the reference position	Moving to the reference position	-	

9) Help [?]

The instruction manual for the positioning setting screen is displayed.

(3) Reference positioning (Hole center)

The positioning to the reference round hole is executed.

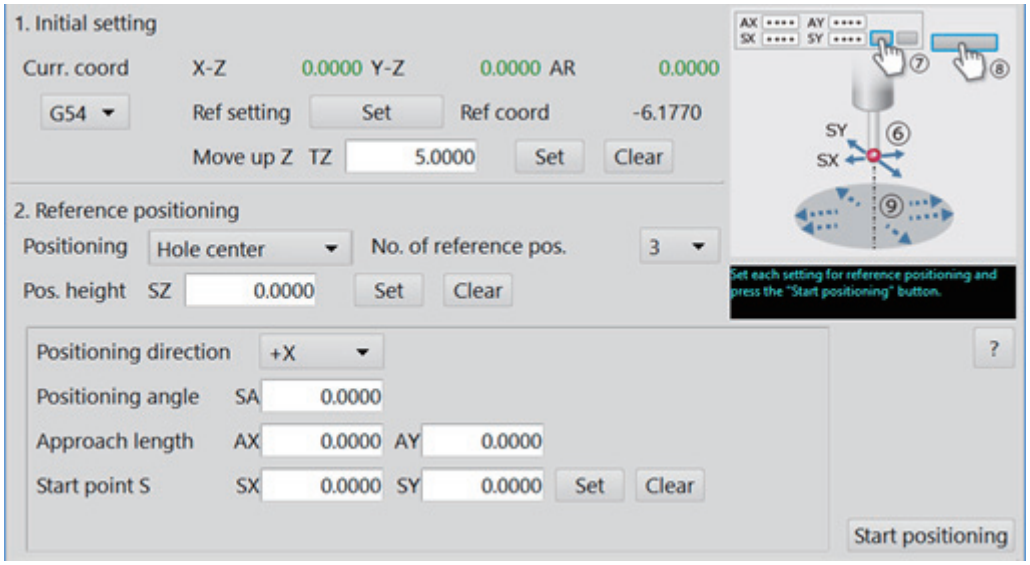


Fig. VI.8.19 Reference positioning (Hole center)

1) Selecting types of positioning

Select the type of the reference positioning.

Select "Hole center" if executing the positioning to the round hole.

2) Number of times the reference positioning is repeated

Select the number of times the reference positioning is repeated.

The number of times can be selected from 1 to 3 times.

3) Positioning height SZ

Input Z height for executing the positioning with the relative value from the reference surface.

Input "-2.0" when measuring the position (lower direction) being 2 mm from the upper surface.

Manual teaching is also possible by moving the probe to the height for executing the positioning and then pressing "Set".

4) Positioning direction

Select the positioning direction of the first point in hole center.

5) Pos. Angle

Set the positioning angle of the hole center positioning.

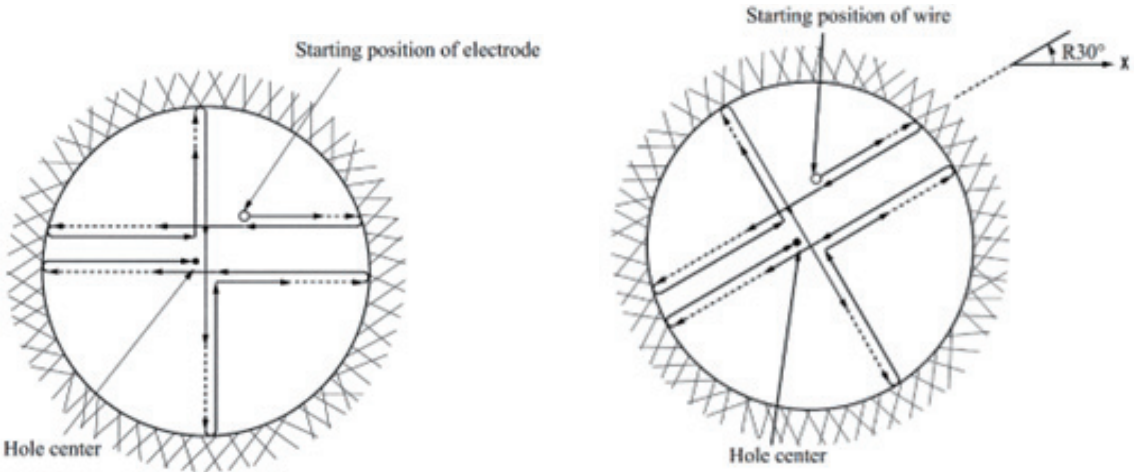
6) Approach length

Set the approach lengths in X direction and Y direction.

7) Teaching the point where the positioning is executed

Input the positioning start point. Set the center of the round hole as the start point as much as possible.
Manual teaching is also possible by moving the probe to the positioning start position and then pressing "Set".

8) Positioning operation



a. Positioning angle 0° b. Positioning angle 30°

Fig. VI.8.20 Operation for checking round hole

After moving to the center position, the point moved to the retract height is the positioning end position.
* If the value is set in "Positioning angle", change it according to the setting value.

9) Start of the reference positioning

"Start positioning" is highlighted in blue after pressing it. The reference positioning is executed by pressing "START" in this state.

10) BMP display and message

See "(2) Reference positioning (Corner)".

11) Help [?]

See "(2) Reference positioning (Corner)".

(4) Reference positioning (4-point center (Inner))

The positioning to the reference square hole is executed.

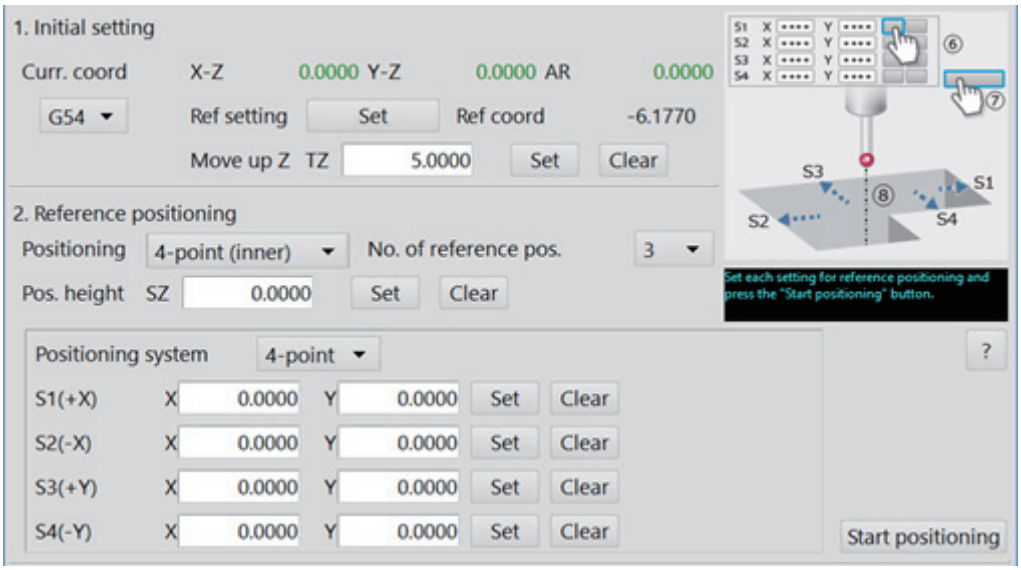


Fig. VI.8.21 Reference positioning (4-point center (Inner) (4-point designation))

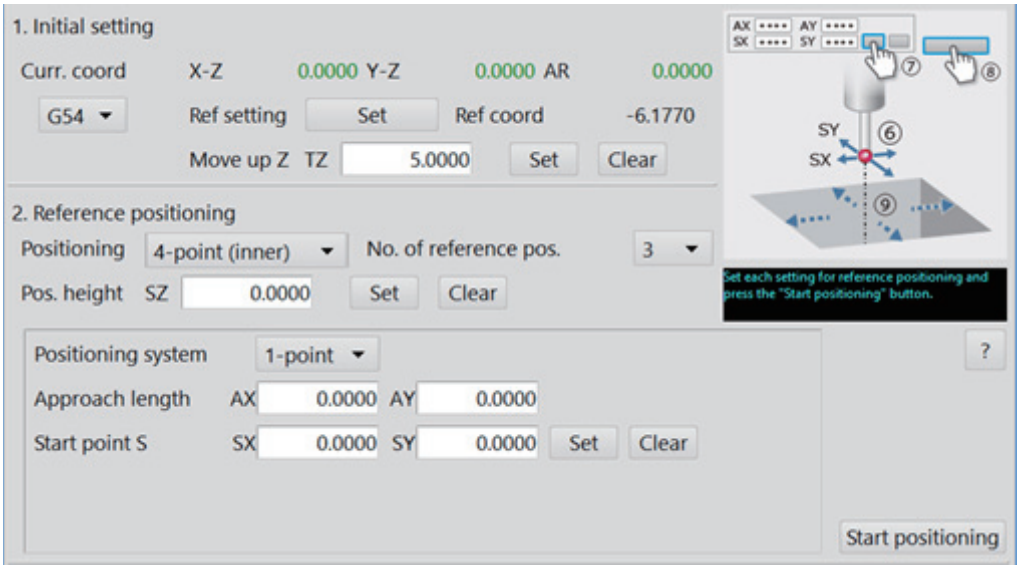


Fig. VI.8.22 Reference positioning (4-point center (Inner) (1 point designation))

1) Selecting types of positioning

Select the type of the reference positioning.

2) Number of times the reference positioning is repeated

Select the number of times the reference positioning is repeated.

3) Positioning height SZ

Input Z height for executing the positioning with the relative value from the reference surface.
Input "-2.0" when measuring the position (lower direction) being 2 mm from the upper surface.

4) Positioning system

Select the positioning method from "4-point" and "1 point".

5) Teaching the point where the positioning is executed (Only for 4-point)

Designate 4 positioning points.

6) Approach length (Only for 1-point)

Set the approach lengths in X direction and Y direction.

7) Start point (Only for 1-point)

Input the positioning start point.

8) Positioning operation

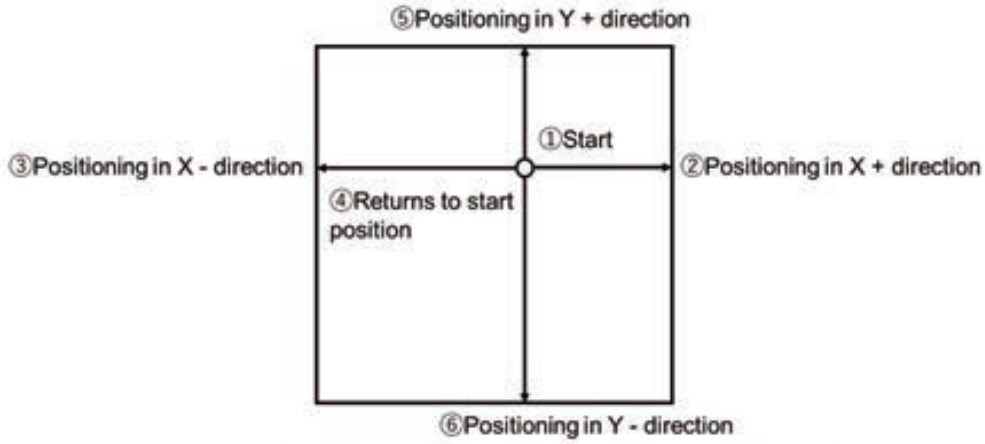


Fig. VI.8.23 4-point center (Inner) (1 point designation) positioning operation

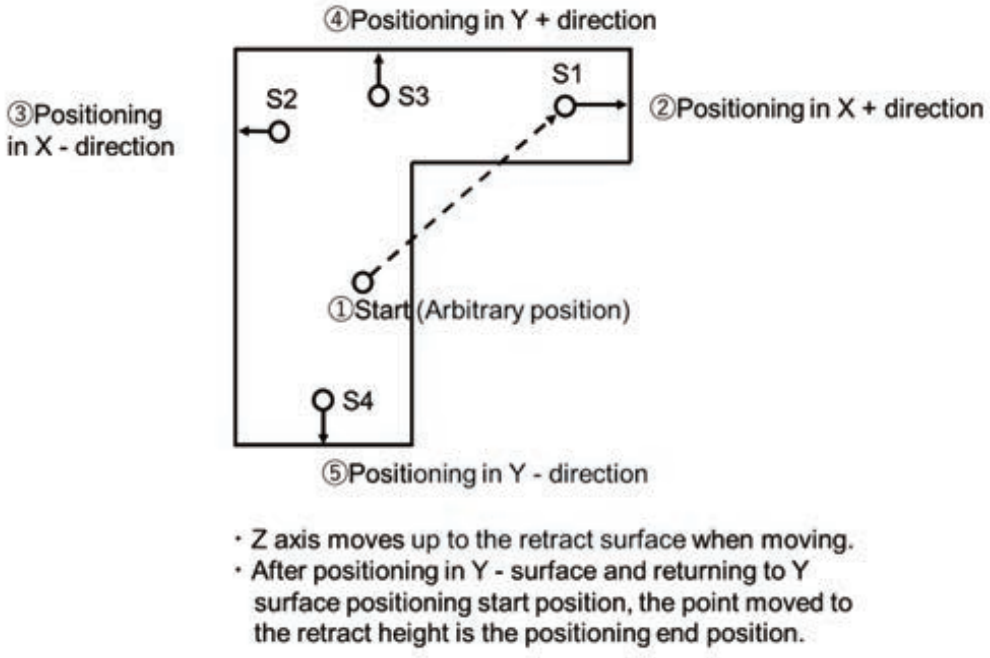


Fig. VI.8.24 4-point center (Inner) (4 point designation) positioning operation

9) Start of the reference positioning

"Start positioning" is highlighted in blue after pressing it. The reference positioning is executed by pressing "START" in this state.

10) BMP display and message

11) Help [?]

See "(2) Reference positioning (Corner)".

(5) Reference positioning (4-point center (Outer))

The positioning for the outer shape of the square workpiece is executed.

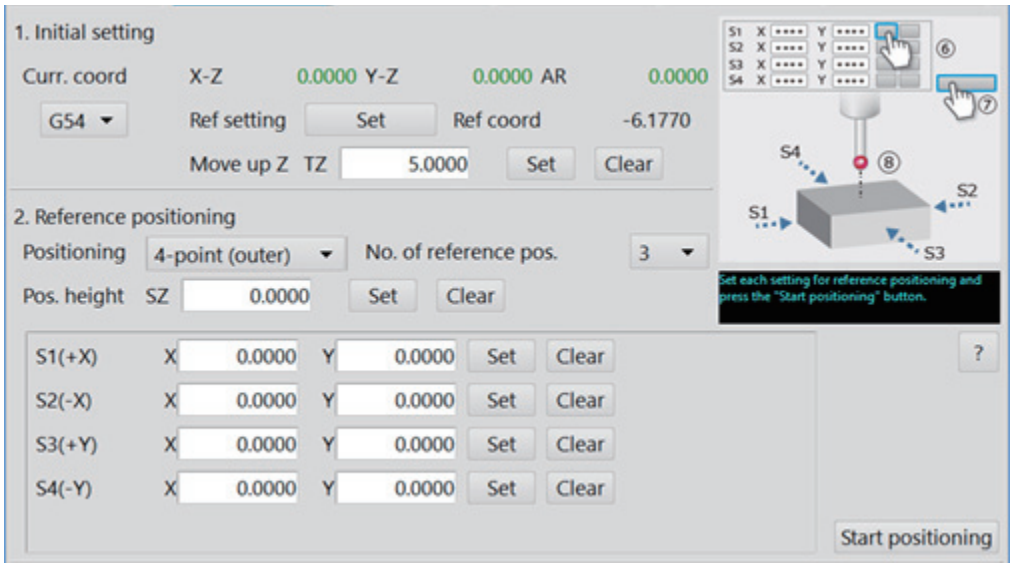


Fig. VI.8.25 Reference positioning (4-point center (Outer))

1) Selecting types of positioning

Select the type of the reference positioning.

2) Number of times the reference positioning is repeated

Select the number of times the reference positioning is repeated.

3) Positioning height SZ

Input Z height for executing the positioning with the relative value from the reference surface.
Input "-2.0" when measuring the position (lower direction) being 2 mm from the upper surface.

4) Teaching the point where the positioning is executed

Designate 4 positioning points.

5) Positioning operation

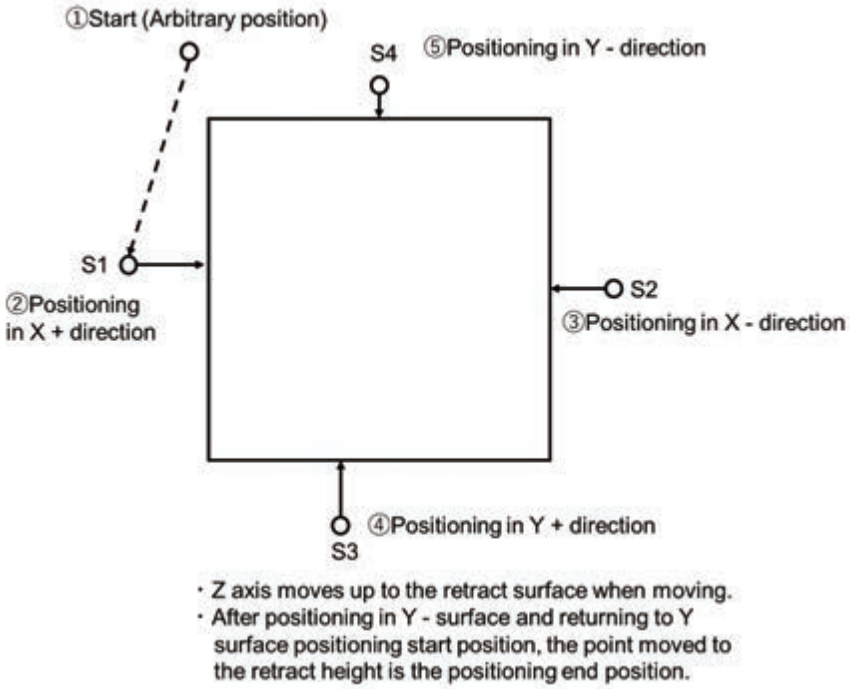


Fig. VI.8.26 4-point center (Outer) positioning operation

6) Start of the reference positioning

"Start positioning" is highlighted in blue after pressing it. The reference positioning is executed by pressing "START" in this state.

7) BMP display and message

8) Help [?]

See "(2) Reference positioning (Corner)".

(6) Result

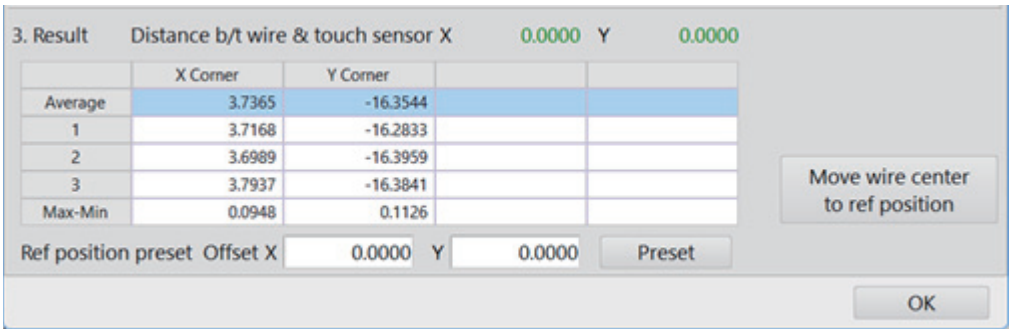


Fig. VI.8.27 Reference positioning results (Example: Corner)

1) Result

X and Y coordinates of the reference position to which the positioning was executed are displayed.

2) Moving the wire center to the reference position

The wire center (nozzle) is moved to the reference position to which the positioning was executed.
The wire center is moved to the reference position by pressing "START" after pressing "Move wire center to ref position".

3) Reference position preset

The coordinate system is preset by pressing "Preset".

4) Clearing the result

The positioning result is cleared by changing the coordinate system.

8.3.4 Dimension check

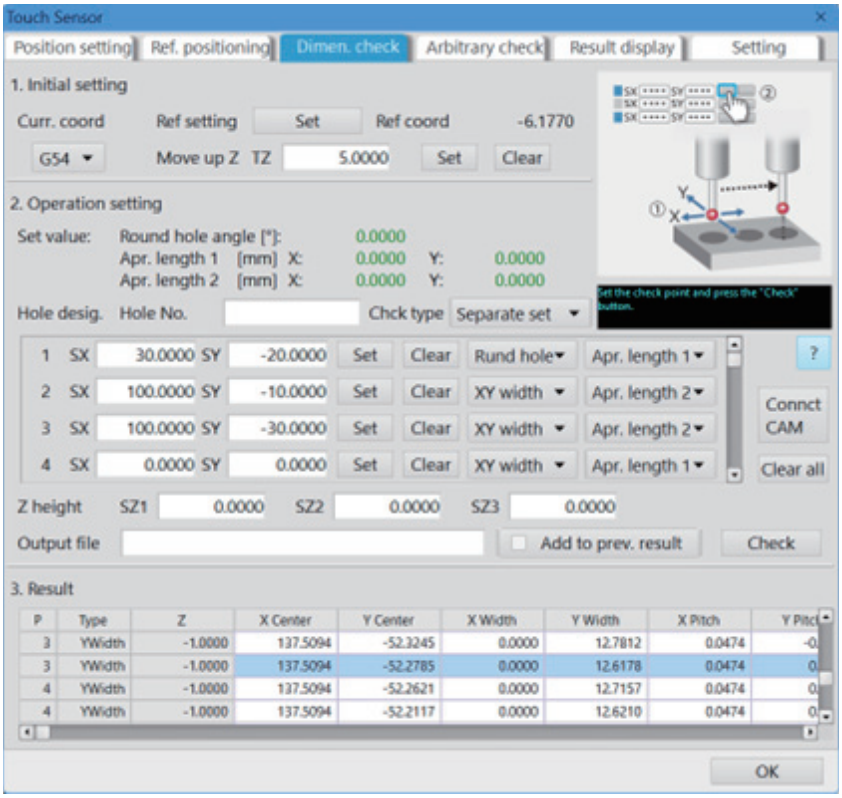


Fig. VI.8.28 Dimension check

(1) Initial setting

Set the reference surface and the retract surface.

1) Current coordinate system

The selected coordinate system as the current coordinate system is displayed.

2) Start of the setting

"Set" is highlighted in blue after pressing it. The edge positioning to Z direction is executed by pressing "START" in this state. After the positioning is completed, Z coordinate value obtained by subtracting the radius of the probe from the edge detection position is displayed in "Ref coord" (Reference surface coordinate).

* Set the probe diameter on the "Setting" screen.

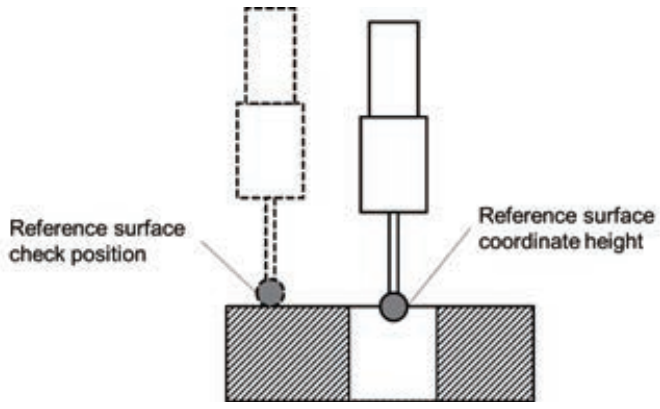


Fig. VI.8.29 Height of reference surface coordinate

3) Retract Z height (Move up Z)

Set the height for moving up the touch sensor when moving the axis.

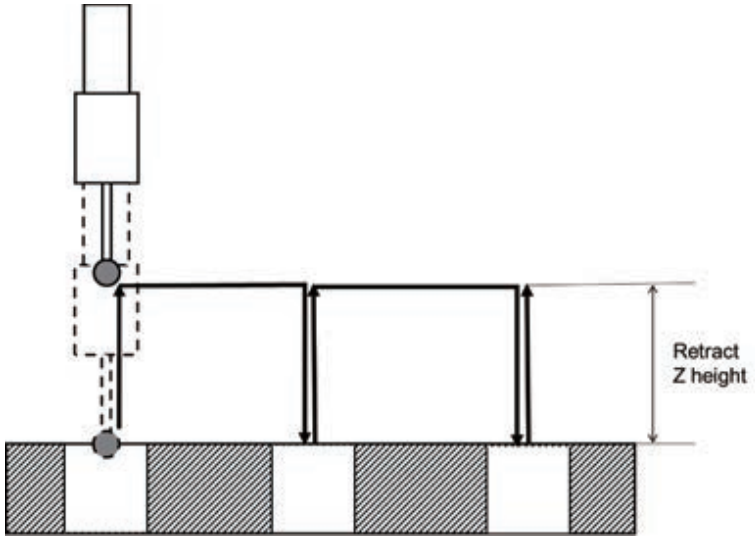


Fig. VI.8.30 Retract Z height (Move up Z)

(a) Set/Clear

Z coordinate of the current coordinate system is set by pressing "Set".

"0" is set by pressing "Clear".

(b) Highlighting retract Z height

If the retract Z height is the reference surface coordinate or less, the probe hits when moving the touch sensor.

For that reason, in the case of Retract Z height ≤ (Reference surface coordinate + Probe diameter/2), the coordinate value in the setting part turns red as a warning.

* Probe diameter is set on the Setting screen.

(2) Operation setting

1) Setting value

"Round hole angle", "Approach length 1X", "Approach length 1Y", "Approach length 2X", and "Approach length 2Y" are displayed on the setting screen.

2) Check hole designation

Input the hole number where the dimension check is executed.

Table VI.8.6 Check hole designation

Setting details	Input limitation
Character string allowing input	"0, 1, 2, 3, 4, 5, 6, 7, 8, 9" "," (comma) "-" (hyphen)
Upper limit of check point	For 30 to 50 A

3) Type of check

Select it from the list of "XY width", "X width", "Y width", "Round hole", and "Separate set".

When setting "XY width", "X width", "Y width", or "Round hole", all the check holes are changed to the set type of check.

When selecting "Separate set", change the arbitrary shape to be checked individually.

4) Check point setting

Fig. VI.8.31 Check point setting

(a) Set/Clear

X coordinate of the current coordinate system is set to SX, and Y coordinate of the current coordinate system is set to SY by pressing "Set". "0" is set by pressing "Clear".

(b) Individual setting of the type of check

Set the type of check to each check point.

(c) Approach length setting

Set the approach length to each check point.

(d) Highlighting the check point

The hole that will be checked from now is highlighted in blue and the hole that has already been checked is highlighted in green. Additionally, the hole where an error occurred when the positioning was executed is highlighted in red.

5) CAM collaboration

Read a CSV file in which the check point created by CAM is set to configure settings.

Start CAM collaboration after setting the workpiece coordinate zero point, X-Z, Y-Z, and AR with the coordinate system of the touch sensor.

6) Clear all

"Hole No." and all the setting items by the check point are cleared.

7) Z height

Input Z height for executing the dimension check with the relative value (negative number) from "Reference surface coordinate (Ref coord)".

Fig. VI.8.32 Z height setting

8) Output file name

Input the file name to be saved as the dimension check result.

9) Add to the previous result

If it is OFF, the dimension check result is saved as a new file.
If it is ON, the dimension check result is saved after adding to the last row of the previous result. It is useful when there is the necessary hole to be additionally checked and the hole is checked again or the hole is continuously checked from the "Arbitrary check".

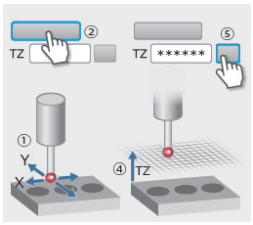
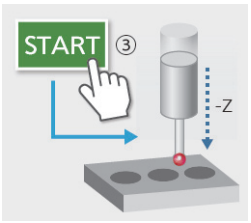
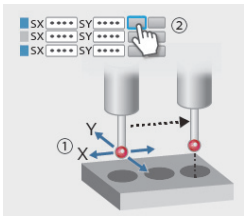
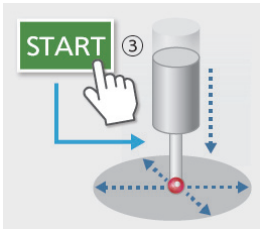
10) Check

"Check" is highlighted in blue after pressing it. The dimension check is executed by pressing "START" in this state.
The result is saved as "Date + "Output file name".csv" in CSV file format to "D:/MYDATA/Inspection/Touchsensor".

11) BMP display and message

Each BMP and message are displayed according to the operation. Refer to each BMP and message to set the screen and operate.

Table VI.8.7 Contents of BMP and message display

Status	Message	Remedies	BMP
The reference surface and the retract Z height are not set yet.	Set the reference surface and retract height.	See "(1) Initial setting" to set the reference surface and the retract height.	
"Reference surface check" was pressed.	Press "START" to check the reference surface.	Press "START". The reference surface check is started.	
The reference surface check is being executed.	Checking the reference surface…	-	
The reference surface and the retract surface are set.	Set the check point and press "Check".	See "(4) Operation procedure" to set the check point. After setting, press "Check".	
"Check" was pressed.	Press "START" and check the dimensions.	Press "START". The reference surface check is started.	
The dimension check is being executed.	Checking the dimensions…**%	-	
The dimension check is completed.	The dimension check is completed.	-	
When the positioning error occurs after the dimension check is completed.	Positioning error: ** errors	See "When the positioning error occurs in "(4) Operation procedure"".	

12) Help [?]

The instruction manual for the dimension check screen is displayed.

(3) Result

1) Check result table

(4) Operation procedure

1) Check the operated coordinate system (the selected current coordinate system).

2) Press "Set" and then "START" to execute the reference surface check. (The positioning to Z direction is started.)

3) Check the coordinate value of the reference surface (the value that the probe diameter is subtracted from the edge end position) displayed.

4) Move the axis to the higher position than the top surface of the workpiece. Pressing “Set” displays Z coordinate value and sets it as the retract Z height.

* When the retract Z height is not set
When the retract Z height is lower than the reference surface, it is highlighted in red. When it is highlighted, check the reference surface height or the retract Z height again.

5) Check the displayed value in the check setting value. Change the parameter on the "Setting" screen as needed.

6) Select the type of check. (X width, Y width, XY width, Round hole)

7) Move the probe to the machining hole by hand. Pressing "Set" reads XY coordinate values of the current coordinate and sets the check start position. Select the type of check individually as needed.

8) Select one of Approach length 1 and 2 to be used. (Set the "Approach length" depending on if it is far from the center position of the shape to be checked or near. Setting the "Approach length" and selecting the shape according to the shape to be checked enable to effectively execute the positioning.)

9) Input the hole number where the dimension check is executed.

10) Input the Z height for executing the dimension check with the value from the upper surface.

11) Input the output file name. Press "Check" and then "START" to execute the dimension check.

12) After the dimension check is completed, check the dimension check result. Additional dimension check is possible according to the check result.

- **When checking many points and then measuring only some of the holes again**
  Inputting the hole number to be checked again, checking the box "Add to prev. result", and then pressing "START" enable to add the check result to the previous result.
- **When the positioning error occurs**
  In this case, check the positioning setting value and the workpiece again. After that, pressing "Check" again and then "START" enable to execute the dimension check to only the point where the positioning

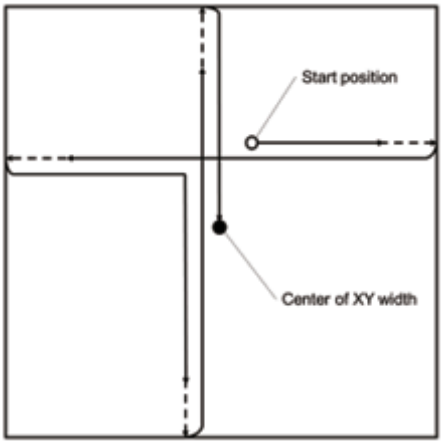
error occurs.

NOTICE

- **Do not change the current coordinate while the dimension check is set. If the coordinate system when checking the reference surface and the current coordinate at the dimension check are different, the height of the reference surface is different so that the workpiece may interfere with the touch sensor. When changing the current coordinate, the message "The coordinate system of the reference surface is different from the current coordinate system. Be careful of the axis motion." is displayed by pressing "Check".**
- **While the dimension check is operated, do not release the "Touch sensor mode" by mounting/removing and raising/lowering the touch sensor. Doing so prevents the dimension check from operating properly.**
- **X mirror, Y mirror, axis change, and coordinate rotation cannot be used with the dimension check together.**
- **While the dimension check is operated, the adaptive feed is OFF and then ON again after it is completed. If resetting while the dimension check is operated, check the adaptive feed switch.**

(5) Operation for the dimension check

1) Operation for checking XY width



(a) The positioning is started with the set position in SX and SY as the start position.

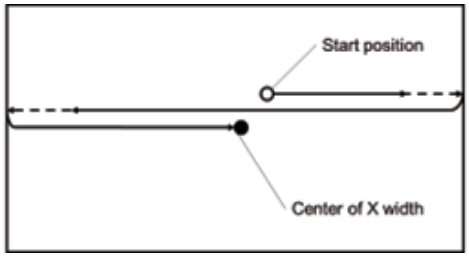
(b) Check X width and then move to the center position of X width.

(c) Check Y width and then move to the center position of Y width.

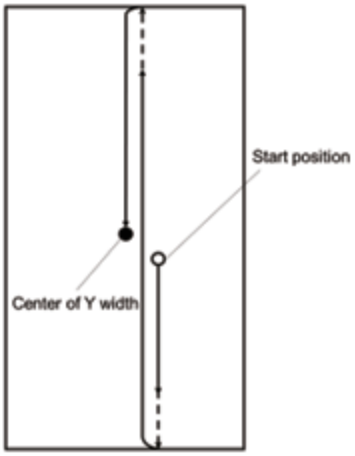
(d) After moving to the center position, move to the retract Z height.

Fig. VI.8.33 Operation for checking XY width

2) Operation for checking X width and Y width



a. X width



b. Y width

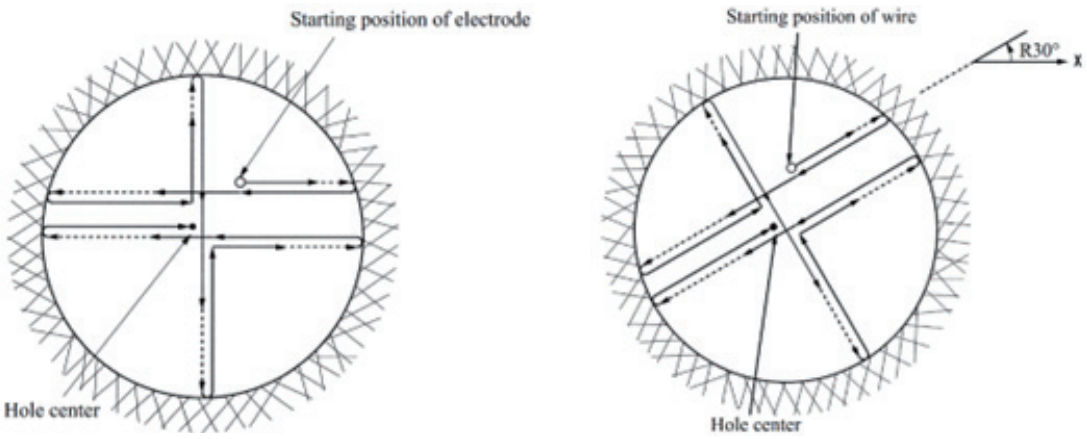
Fig. VI.8.34 Operation for checking X width or Y width

(a) The positioning is started with the set position in SX and SY as the start position.

(b) Check X width or Y width and then move to the center position of the width.

(c) After moving to the center position, move to the retract Z height.

3) Operation for checking round hole



a. Round hole check angle 0°　　b. Round hole check angle 30°

Fig. VI.8.35 Operation for checking round hole

(a) The positioning is started with the set position in SX and SY as the start position.

(b) Check X width and then move to the center position of X width.

(c) Check Y width and then move to the center position of Y width.

(d) Check X width again and then move to the center position of X width.

(e) After moving to the center position, move to the retract Z height.

* If the value is set in "Round hole angle", change it according to the setting value.

8.3.5 Arbitrary check

The workpiece shape after machining is checked.

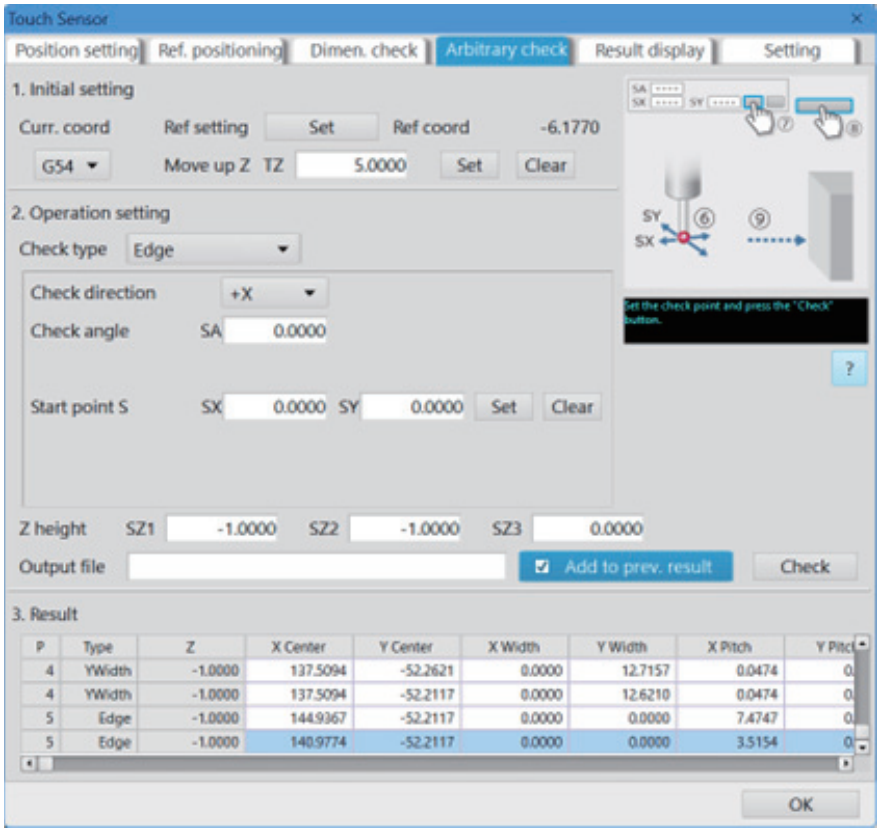


Fig. VI.8.36 Arbitrary check

(1) Initial setting

Set the reference surface and the retract surface.

1) Current coordinate system

The selected coordinate system as the current coordinate system is displayed.

2) Start of the setting

"Set" is highlighted in blue after pressing it. The edge positioning to Z direction is executed by pressing "START" in this state.

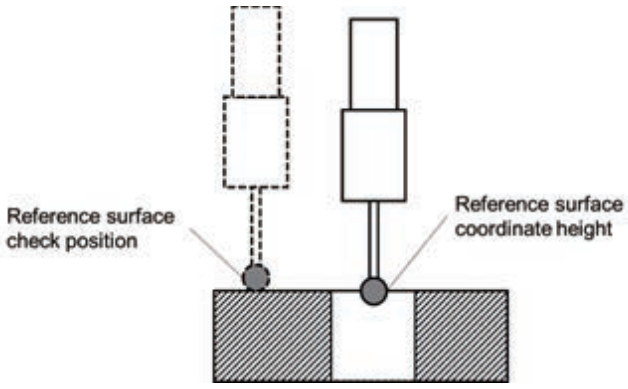


Fig. VI.8.37 Height of reference surface coordinate

3) Retract Z height (Move up Z)

Set the height for moving up the touch sensor when moving the axis.

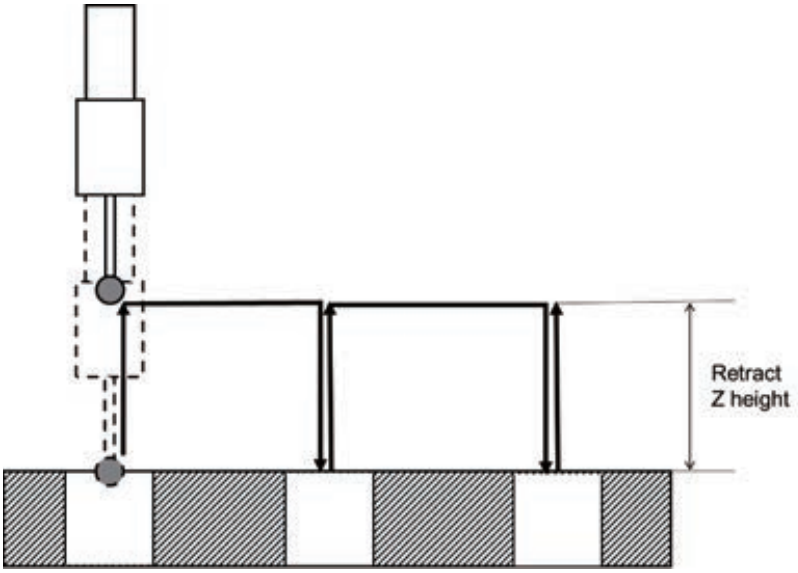


Fig. VI.8.38 Retract Z height (Move up Z)

(a) Set/Clear

Z coordinate of the current coordinate system is set by pressing "Set".

"0" is set by pressing "Clear".

(b) Highlighting retract Z height

If the retract Z height is the reference surface coordinate or less, the probe hits when moving the touch sensor.

For that reason, in the case of Retract Z height ≤ (Reference surface coordinate + Probe diameter/2), the coordinate value in the setting part turns red as a warning.

* Probe diameter is set on the Setting screen.

(2) Operation setting (Edge)

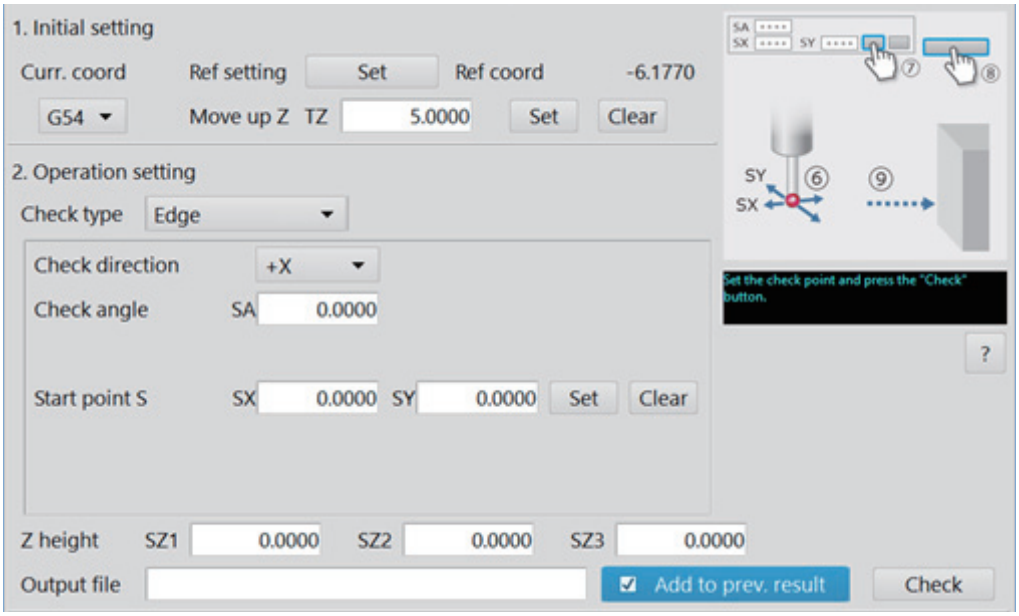


Fig. VI.8.39 Operation setting (Edge)

1) Type of check

Select the type of the arbitrary check.
When executing the edge positioning, select "Edge".

2) Direction in checking

Select the direction to which the edge positioning is executed.

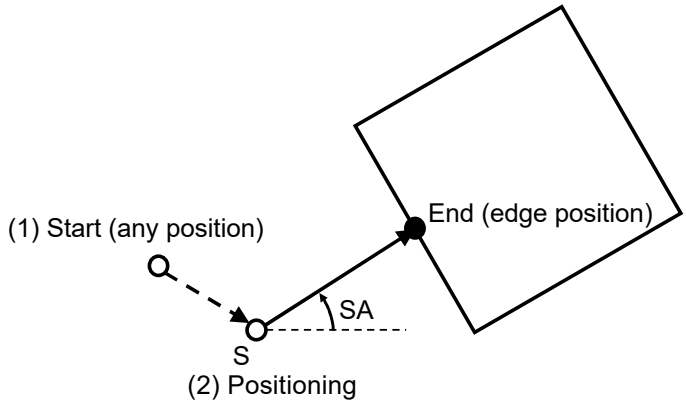
3) Check angle

Input the edge positioning angle.

4) Teaching the point to be checked

Input the start point of the edge positioning.

5) Operation for checking



- During movement, the Z axis rises to the retract Z height.
- At the end, it stops at the edge position.

Fig. VI.8.40 Edge operation

6) Z height

Input Z height for executing the arbitrary check with the relative value (negative number) from "Reference surface coordinate (Ref coord)".
If Z height is not input yet or it is "0", the arbitrary check is not executed.
Inputting the same values in Z height "SZ1", "SZ2", and "SZ3" enables to execute the positioning at the same height up to 3 times.

Fig. VI.8.41 Z height setting

7) Output file name

Input the file name to be saved as the arbitrary check result.

8) Add to the previous result

If it is OFF, the arbitrary check result is saved as a new file.
If it is ON, the dimension check result is saved after adding to the last row of the previous result. It is useful when there is the necessary hole to be additionally checked and the hole is checked again or the hole is continuously checked from the "Dimension check".

9) Check

"Check" is highlighted in blue after pressing it. The arbitrary check is executed by pressing "START" in this state.
The result is saved as "Date + "Output file name".csv" in CSV file format to "D:/MYDATA/Inspection/Touchsensor".

10) BMP display and message

Each BMP and message are displayed according to the operation. Refer to each BMP and message to set the screen and operate.

11) Help [?]

The instruction manual for the arbitrary check screen is displayed.

(3) Operation setting (Round hole)

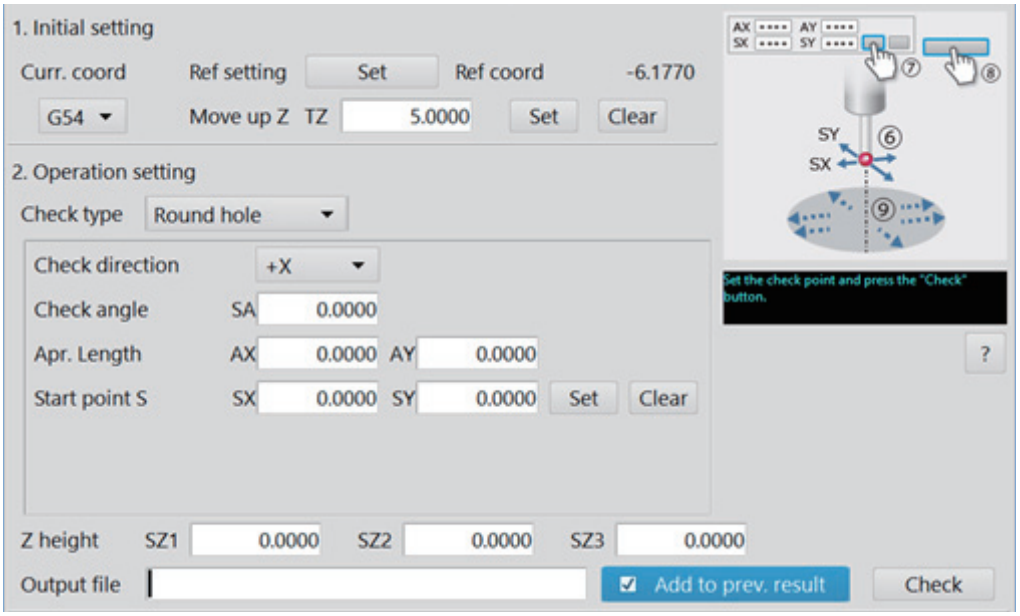


Fig. VI.8.42 Operation setting (Round hole)

1) Type of check

Select the type of the arbitrary check.
When checking the round hole, select "Round hole".

2) Direction in checking

Select the positioning direction of the first point in hole center.

3) Check angle

Input the positioning angle of the hole center positioning.

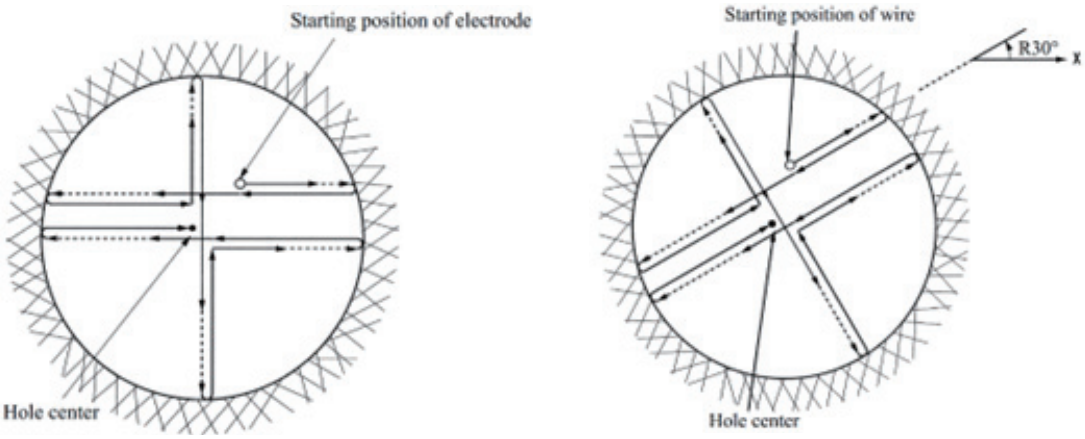
4) Approach length

Input the approach lengths in X direction and Y direction.

5) Teaching the point to be checked

Input the start point of the hole center positioning. Set the center of the round hole as the start point as much as possible.

6) Operation for checking



a. Positioning angle 0° b. Positioning angle 30°

Fig. VI.8.43 Round hole operation

After moving to the center position, the point moved up to the retract Z height is the positioning end position.

* If the value is set in "Check angle", change the positioning angle according to the setting value.

7) Z height

8) Output file name

9) Add to the previous result

10) Check

11) BMP display and message

12) Help [?]

See "(2) Operation setting (Edge)".

(4) Operation setting (XY width (Inner))

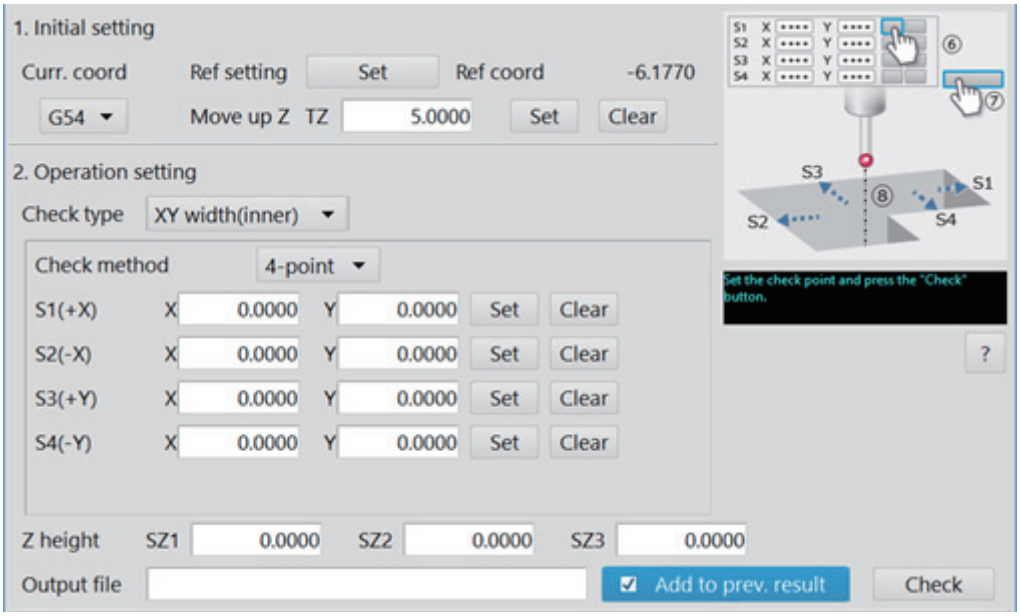


Fig. VI.8.44 Operation setting (XY width (Inner) - 4-point designation)

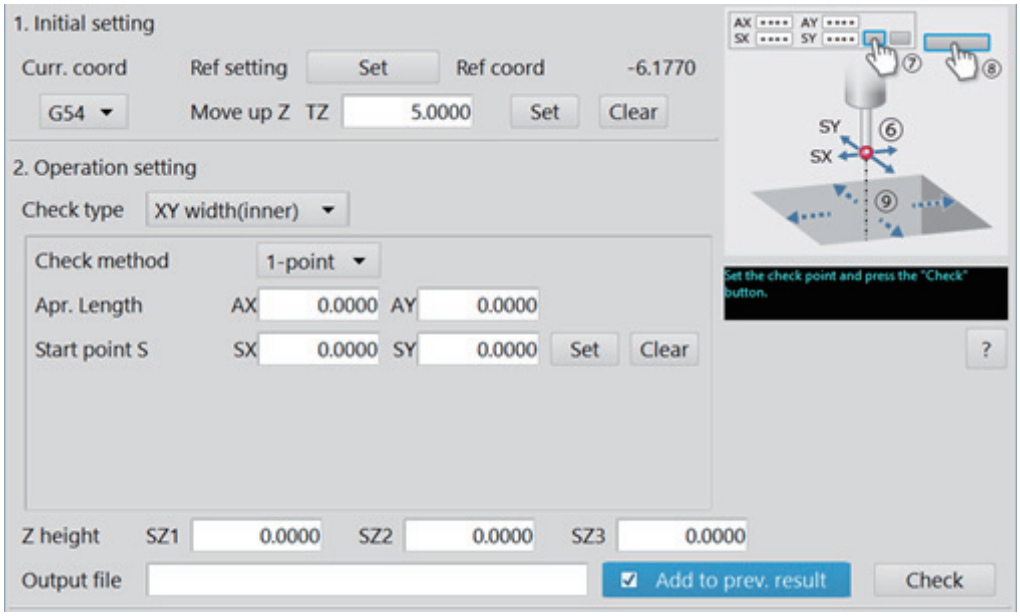


Fig. VI.8.45 Operation setting (XY width (Inner) - 1 point designation)

1) Type of check

Select the type of the arbitrary check.

When checking the inside of the square hole, select "XY width(inner)".

2) Checking method

Select the checking method from "4-point" or "1-point".

The positioning is executed by designating 4 points individually when selecting "4-point".

The 4-point center is executed by designating only the start point when selecting "1-point".

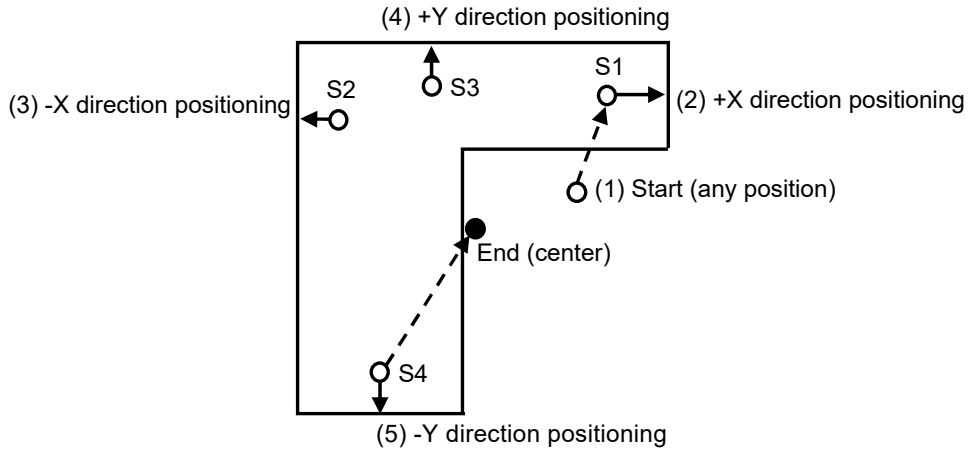
3) Approach length (Only for 1-point)

Input the approach lengths in X direction and Y direction.

4) Teaching the point to be checked

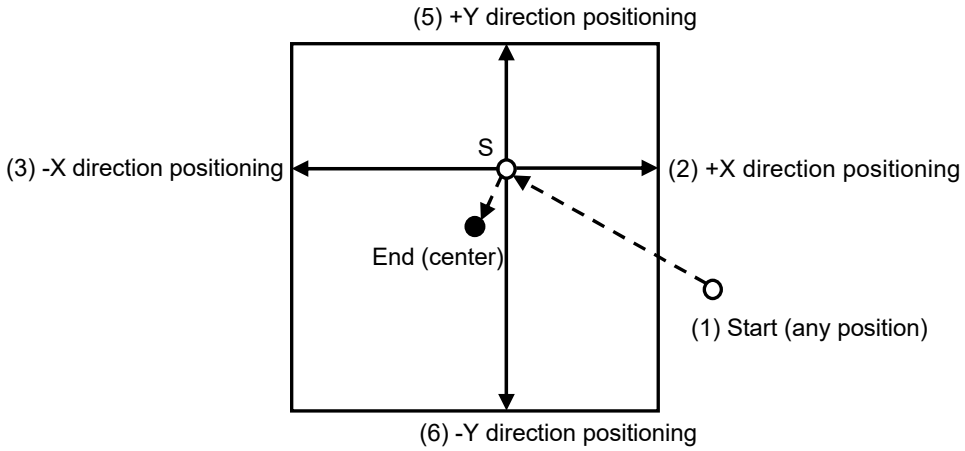
Designate 4 points or 1 point to be checked.

5) Operation for checking



- During movement, the Z axis rises to the retract Z height.
- At the end, it stops at the center position.

Fig. VI.8.46 XY width (Inner) - 4-point designation operation



- During movement, the Z axis rises to the retract Z height.
- At the end, it stops at the center position.

Fig. VI.8.47 XY width (Inner) - 1 point designation operation

6) Z height

7) Output file name

8) Add to the previous result

9) Check

10) BMP display and message

11) Help [?]

See "(2) Operation setting (Edge)".

(5) Operation setting (XY width (Outer))

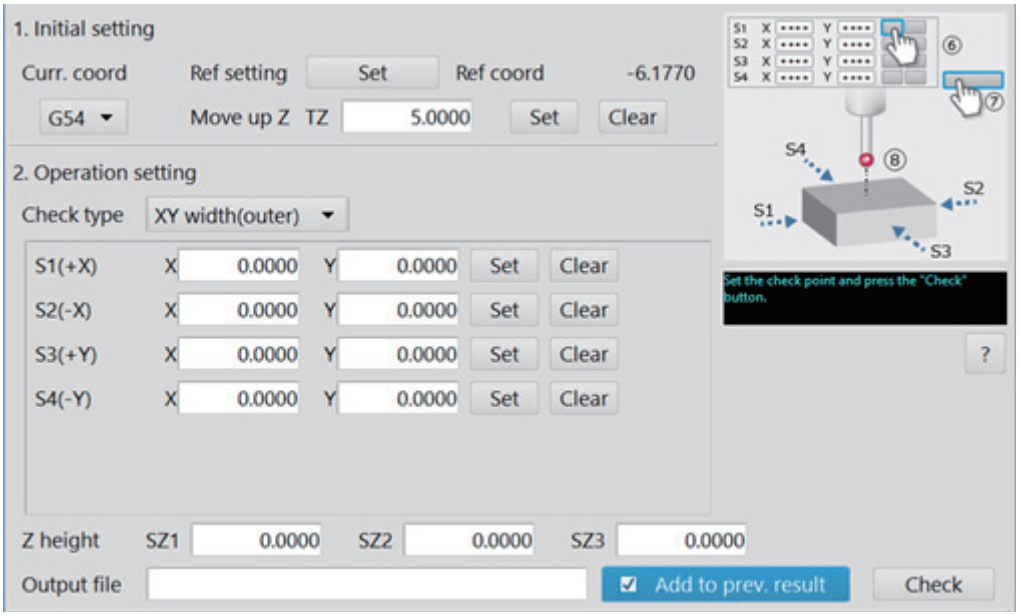


Fig. VI.8.48 Operation setting (XY width (Outer))

1) Type of check

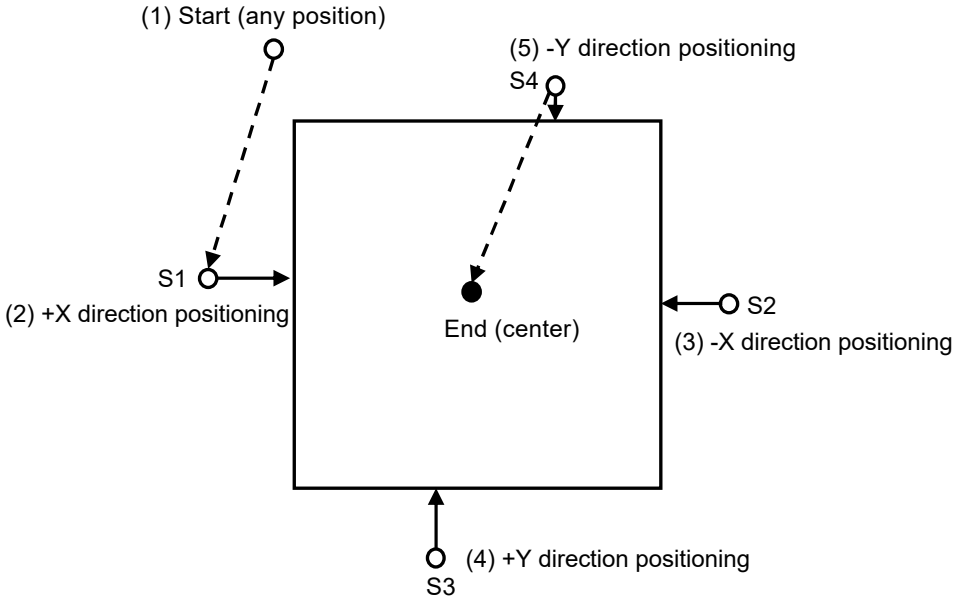
Select the type of the arbitrary check.

When checking the outline of the square workpiece, select "XY width(outer)".

2) Teaching the point to be checked

Designate 4 points to be checked.

3) Operation for checking



• During movement, the Z axis rises to the retract Z height.
• At the end, it stops at the center position.

Fig. VI.8.49 XY width (Outer) operation

4) Z height

5) Output file name

6) Add to the previous result

7) Check

8) BMP display and message

9) Help [?]

See "(2) Operation setting (Edge)".

(6) Operation setting (Width (Inner))

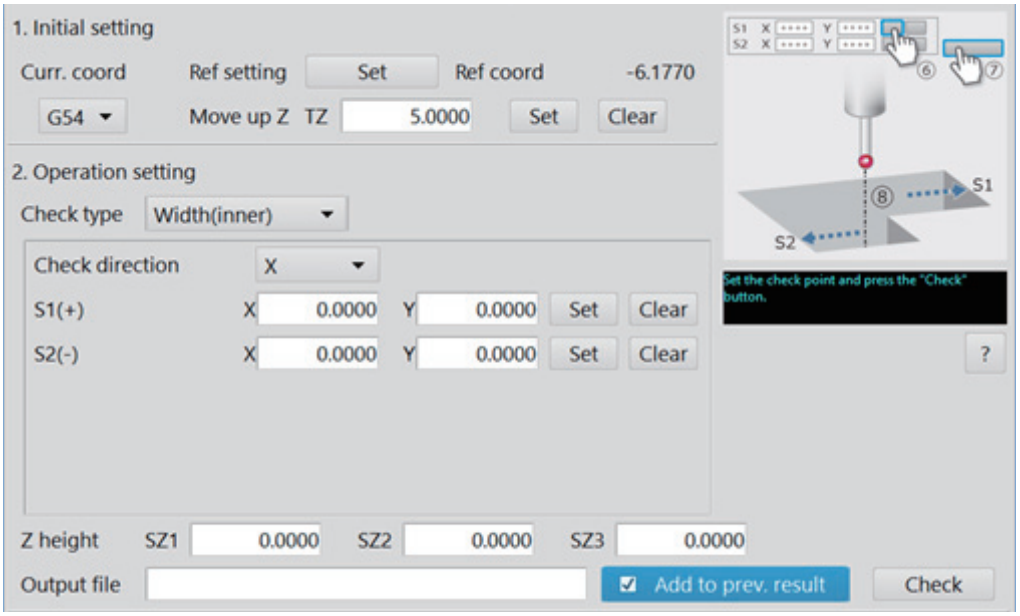


Fig. VI.8.50 Operation setting (Width (Inner))

1) Type of check

Select the type of the arbitrary check.

When checking 2 points of the inside of the square hole, select "Width(inner)".

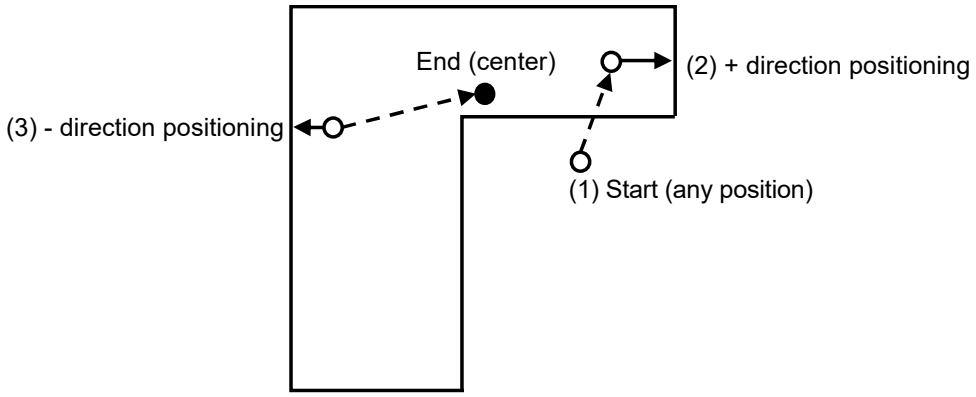
2) Direction in checking

Select the direction (X width or Y width) of the width to be checked.

3) Teaching the point to be checked

Designate 2 points to be checked.

4) Operation for checking



- During movement, the Z axis rises to the retract Z height.
- At the end, it stops at the center position.
  * In the case of X width, the Y position is the midpoint of the two values in the Y coordinate.
    In the case of Y width, the X position is the midpoint of the two values in the X coordinate.

Fig. VI.8.51 Width (Inner) operation (Example of the figure shows X width.)

5) Z height

6) Output file name

7) Add to the previous result

8) Check

9) BMP display and message

10) Help [?]

See "(2) Operation setting (Edge)".

(7) Operation setting (Width (Outer))

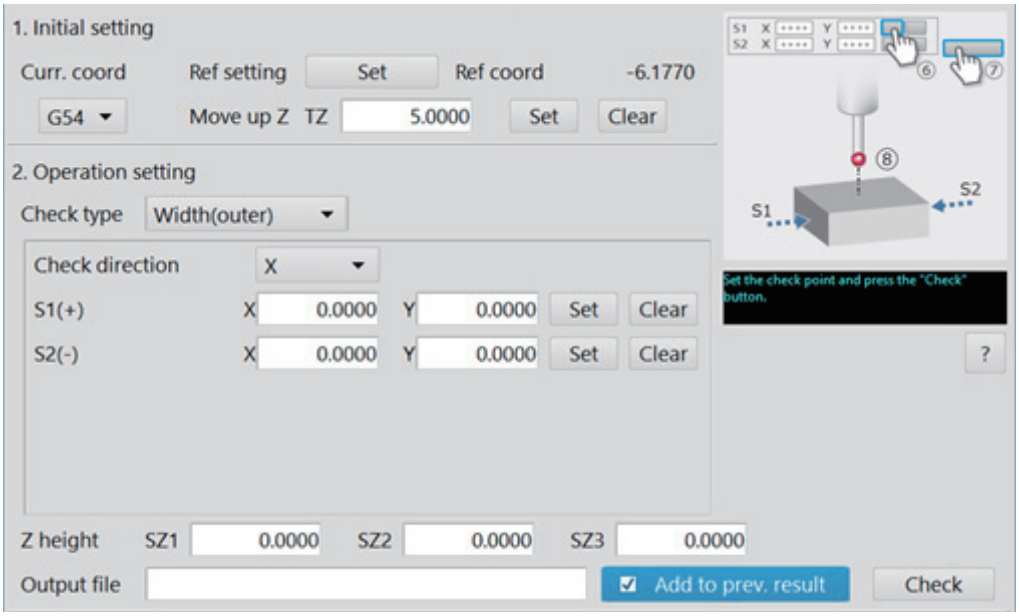


Fig. VI.8.52 Operation setting (Width (Outer))

1) Type of check

Select the type of the arbitrary check.

When checking 2 points of the outline of the square hole, select "Width(outer)".

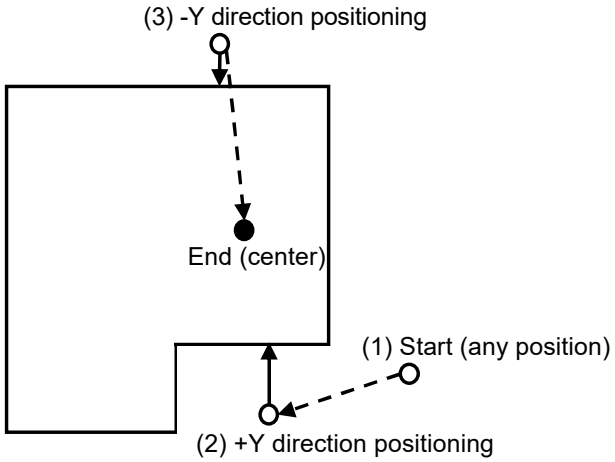
2) Direction in checking

Select the direction (X width or Y width) of the width to be checked.

3) Teaching the point to be checked

Designate 2 points to be checked.

4) Operation for checking



- During movement, the Z axis rises to the retract Z height.
- At the end, it stops at the center position.
  * In the case of X width, the Y position is the midpoint of the two values in the Y coordinate.
    In the case of Y width, the X position is the midpoint of the two values in the X coordinate.

Fig. VI.8.53 Width (Outer) operation (Example of the figure shows Y width.)

5) Z height

6) Output file name

7) Add to the previous result

8) Check

9) BMP display and message

10) Help [?]

See "(2) Operation setting (Edge)".

(8) Operation setting (Corner)

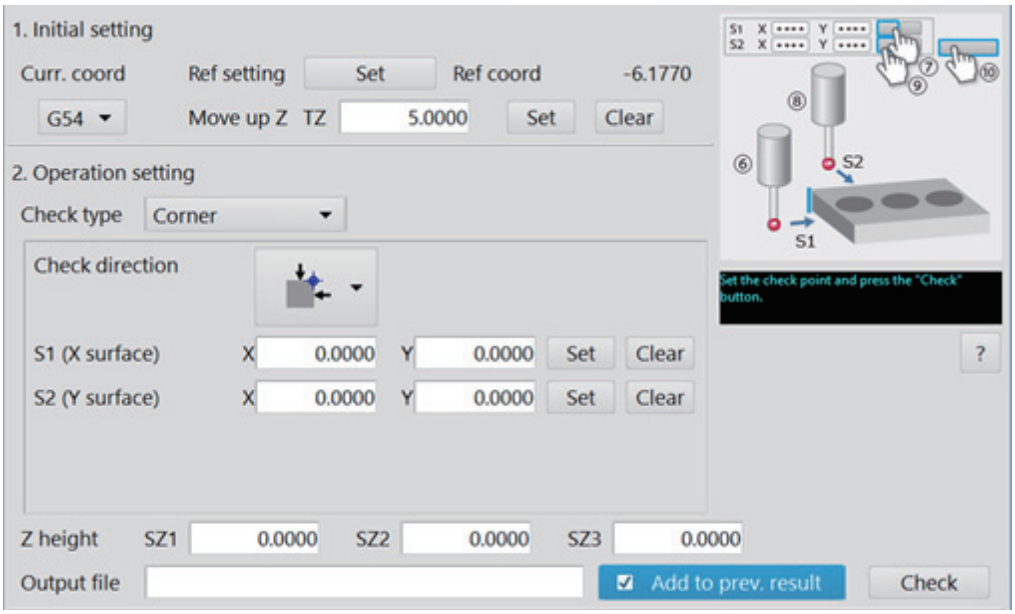


Fig. VI.8.54 Operation setting (Corner)

1) Type of check

Select the type of the arbitrary check.

When checking the corner, select "Corner".

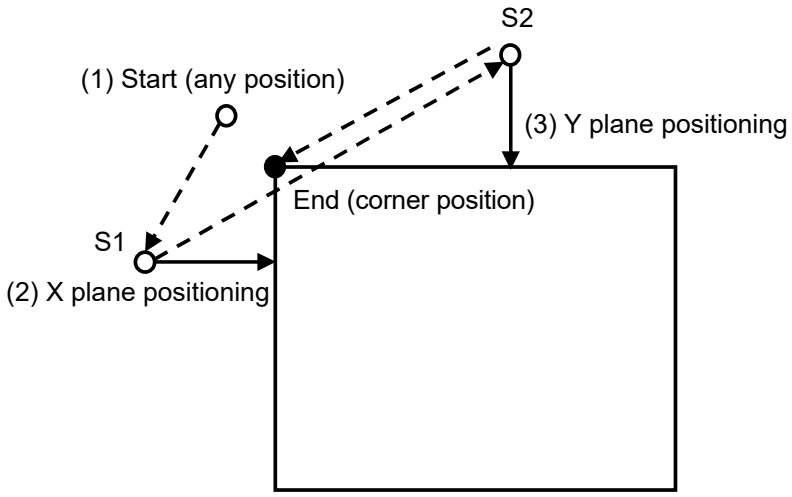
2) Direction in checking

Select the corner pattern to be checked.

3) Teaching the point to be checked

Input the start point S1 of X surface and the start point S2 of Y surface.

4) Operation for checking



- During movement, the Z axis rises to the retract Z height.
- At the end, it stops at the corner position.

Fig. VI.8.55 Corner motion

5) Z height

6) Output file name

7) Add to the previous result

8) Check

9) BMP display and message

10) Help [?]

See "(2) Operation setting (Edge)".

(9) Operation setting (3-point center (Inner))

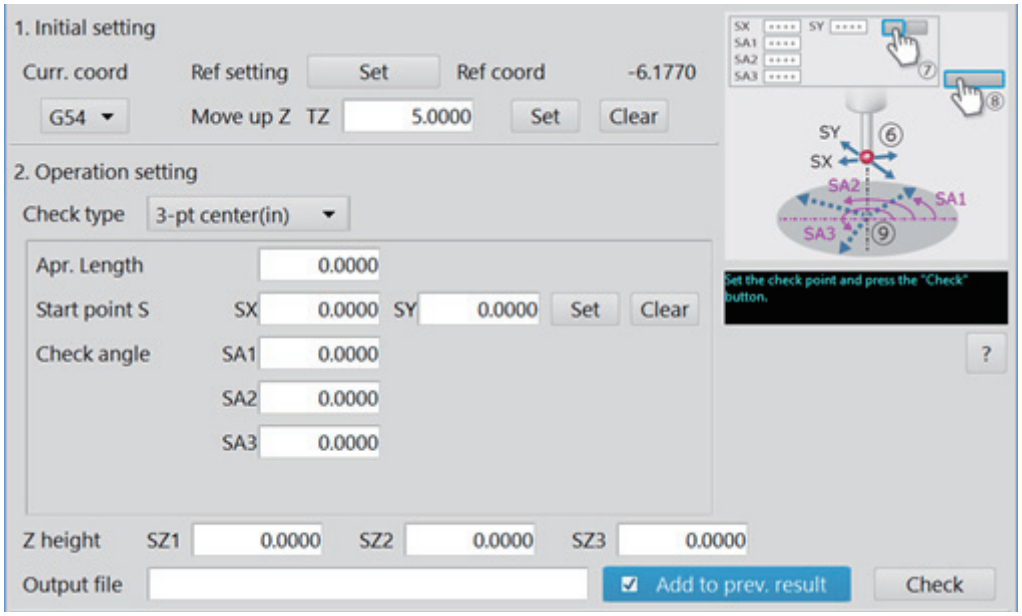


Fig. VI.8.56 Operation setting (3-point center (Inner))

1) Type of check

Select the type of the arbitrary check.
When checking the round hole with 3-point (Inside), select "3-pt center(in)".

2) Approach length

Input the approach length.

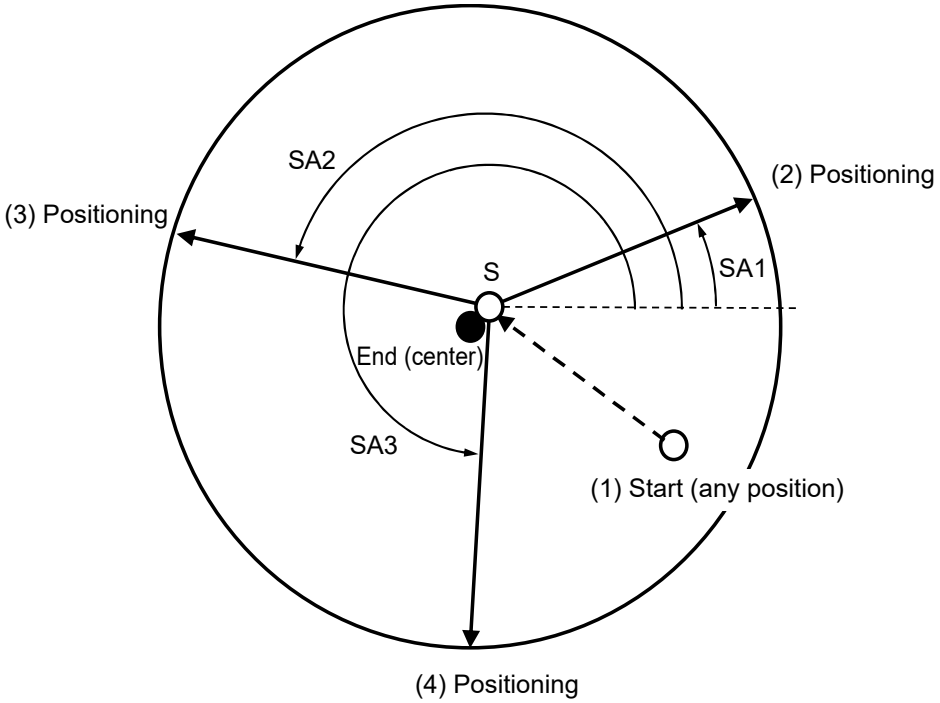
3) Teaching the point to be checked

Input the start point. Set the center of the round hole as the start point as much as possible.

4) Check angle

Input each angle in 3 directions to be checked.
Use "SA1" for the angle of the 1st point, "SA2" for the angle of the 2nd point, and "SA3" for the angle of the 3rd point.

5) Operation for checking



• During movement, the Z axis rises to the retract Z height.
• At the end, it stops at the center position.

Fig. VI.8.57 3-point center (Inner) operation

6) Z height

7) Output file name

8) Add to the previous result

9) Check

10) BMP display and message

11) Help [?]

See "(2) Operation setting (Edge)".

NOTICE

- **Do not change the current coordinate while the arbitrary check is set. If the coordinate system when checking the reference surface and the current coordinate at the arbitrary check are different, the height of the reference surface is different so that the workpiece may interfere with the touch sensor. When changing the current coordinate, the message "The coordinate system of the reference surface is different from the current coordinate system. Be careful of the axis motion." is displayed by pressing "Check".**
- **While the arbitrary check is operated, do not release the "Touch sensor mode" by mounting/removing and raising/lowering the touch sensor. Doing so prevents the arbitrary check from operating properly.**
- **X mirror, Y mirror, axis change, and coordinate rotation cannot be used with the arbitrary check together.**
- **While the arbitrary check is operated, the adaptive feed is OFF and then ON again after it is completed. If resetting while the arbitrary check is operated, check the adaptive feed switch.**

(10)Result

1) Check result table

The results of the arbitrary check and the dimension check are displayed.
The saved file name is displayed after the check is complete.

8.3.6 Result display

(1) Check result

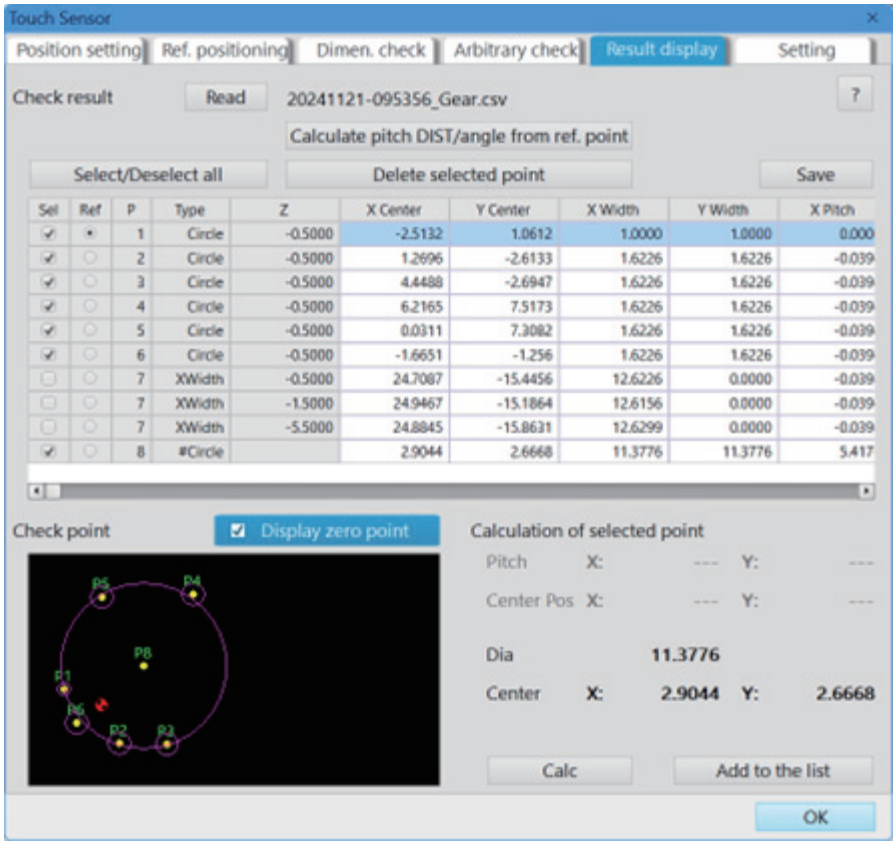


Fig. VI.8.58 Result display screen

1) Read

The dialog box for selecting a file is opened to select a CSV file to be checked.

* If an "Output file name" is not designated at the dimension check and the arbitrary check, a file name will be created depending on a date.

2) Calculate pitch DIST/angle from ref. point

Pitch is calculated with the "X Center" and "Y Center" columns of the selected rows in the "Reference" column as standard. The calculated pitch distances: X, Y are stored to the "X Pitch" column and the "Y Pitch" column. The pitch angle is stored to the "PitchAngle" column.

3) Select/Deselect all

All checks of the "Selection" column are ON or OFF.

4) Delete selected point

The checked row of the "Selection" column is deleted.

5) Save

The dialog box for saving a file is displayed.
When saving, data in which a pitch is recalculated and is sorted is newly saved as a CSV file. Additionally, a graphic display image is saved as a png file with the same name as a CSV file.

6) Check result

The following contents of the check results are displayed.
When selecting the row name in the table, the order is sorted in the order corresponding to initial order > ascending order > descending order > initial order.

7) Check point

The check point is displayed with a graphic so that it can be selected from the whole picture of the checked workpiece (plate).

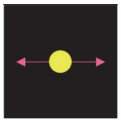
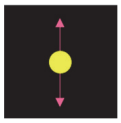
(a) Display zero point

When turning it ON, the zero point mark is displayed on the workpiece coordinate zero point position (0,0).
When turning it OFF, the zero point mark is not displayed.

(b) Graphic display area

The point selected in the "Selection" column of the table is displayed with " " and "P" number.
The positional relation of each position is displayed with a graphic using XY coordinate positions of "X Center" and "Y Center".

Table VI.8.8 AContour display of check point displayed with a graphic

Type of check	"Type" column	Contour display	Example
Round hole 3-point center (Inner) Circle added to the list	#Circle : 3PCircle #Circle	The contour (○) of the hole diameter is displayed. The size is changed by "X Width" and "Y Width" values.	
XY width (Outer) XY width (Inner)	XYWidth	The contour (□) of XY width is displayed. The size is changed by "X Width" and "Y Width" values.	
Width (Outer) Width (Inner)	XWidth YWidth	The arrows (↔) are displayed according to the directions. The length is changed by "X Width" value or "Y Width" value.	 
Corner/Edge Point added to the list	Other than above	None	

8) Calculation of the selected point

(a) Calculation

The selected point is calculated using XY coordinate positions of "X center" and "Y center" of the point selected in the "Selection" column of the table by pressing "Calc".

Table VI.8.9 Calculation contents of selected point

Number of selected points	Result item	Content of calculation
2 points	Pitch	The distance (absolute value) of 2 selected points is calculated and displayed.
	Midpoint	The midpoint of 2 selected points is calculated and displayed.
3 points or more	Diameter	The proximate circle passing the selected points and having the fewest errors is calculated. The diameter of that proximate circle is displayed.
	Center	The center of that proximate circle is displayed.

However, if the selected point is not proper or the used coordinate value is not a number , "---" is displayed in the calculation result.

If the calculation error occurs, "**********" is displayed in the calculation result.

(b) Add to the list

The result calculated in the "Calculation of selected point" is added to the last row in the table by pressing "Add to the list".

It is added with the following contents. Type has "#" at the front so that it can be distinguished.

Table VI.8.10 Calculation contents added to the list

Number of selected points	Row data to be added				
	Type	X Center	Y Center	X Width	Y Width
2 points	#Half	Midpoint X	Midpoint Y		
3 points or more	#Circle	Center X	Center Y	Diameter	

9) Help

The instruction manual for the result display screen is displayed.