

# OPERATING MANUAL

for

**SUPER TURBO-X48 MkII**  
**SUPER TURBO-X510 MkII**  
**SUPER TURBO-X612 MkII**

(1.5 kW/1.8 kW/2.5 kW/4 kW Laser Specification)

MANUAL No. : H676SA0015E

Serial No. :

NC Equipment : L32B-N

*Before using this machine and equipment, fully understand the contents of this manual to ensure proper operation. Should any questions arise, please ask the nearest Technical/Service Center.*

## IMPORTANT NOTICE

1. Be sure to observe the safety precautions described in this manual and the contents of the safety plates on the machine and equipment. Failure may cause serious personal injury or material damage. Please replace any missing safety plates as soon as possible.
2. No modifications are to be performed that will affect operation safety. If such modifications are required, please contact the nearest Technical/Service Center.
3. For the purpose of explaining the operation of the machine and equipment, some illustrations may not include safety features such as covers, doors, etc. Before operation, make sure all such items are in place.
4. This manual was considered complete and accurate at the time of publication, however, due to our desire to constantly improve the quality and specification of all our products, it is subject to change or modification. If you have any questions, please contact the nearest Technical/Service Center.
5. Always keep this manual near the machinery for immediate use.
6. If a new manual is required, please order from the nearest Technical/Service Center with the manual No. or the machine name, serial No. and manual name.

Issued by *Manual Publication Section, Yamazaki Mazak Corporation, Japan*





## CAUTION

- To maintain the high performance (high-speed and high-accuracy processing) of the laser machine, the level of the machine and its laser optical systems must be kept stable. Accordingly, a foundation must be built to the foundation plan supplied by Mazak, or the machine must be installed on a floor which is approved as meeting our design requirements. If the machine is installed on a floor or foundation which does not meet our design requirements and a problem arises due to improper installation, free services may be denied even within the guaranteed period.
- The laser processing performance values specified in the catalogs and manuals (operating manual and maintenance manual) are for reference purposes only and they are not the values which Mazak guarantees. These values are obtained only under the conditions (material, gas, processing conditions, etc.) in which the machine is installed in a Mazak plant and when the machine is properly maintained according to the instructions specified in the maintenance manual.



# CONTENTS

	Page
1 INTRODUCTION .....	1-1
1-1 List of Manuals to Be Used .....	1-1
1-2 Numbering System for Pages .....	1-1
1-3 Numbering System for Figures and Tables .....	1-1
2 SAFETY PRECAUTIONS .....	2-1
2-1 FDA Compliance with 21 CFR 1040.10 and 1040.11 .....	2-1
2-1-1 Protective housing .....	2-1
2-1-2 Safety interlocks .....	2-1
2-1-3 Master key switch .....	2-1
2-1-4 Remote control connector .....	2-2
2-1-5 Manual reset function .....	2-2
2-1-6 Emission indicator .....	2-2
2-1-7 Beam attenuator .....	2-2
2-1-8 Labeling .....	2-2
2-2 Safety Precautions (Laser) .....	2-11
2-2-1 Rule .....	2-11
2-2-2 Safety of the laser machine .....	2-11
2-2-3 Contact of the laser beam .....	2-12
2-2-4 Danger of fire from spatter or laser beam .....	2-12
2-2-5 Danger of a fire from assist gas .....	2-13
2-2-6 Potential fire and explosion hazards of the dust collector .....	2-13
2-2-7 Cleaning the head and periphery .....	2-14
2-2-8 Oxygen leakage check .....	2-14

2-2-9	Danger of fire due to fast piercing .....	2-14
2-2-10	Toxic fumes .....	2-14
2-2-11	Lethal high voltage shock .....	2-15
2-2-12	Laser and shutter keys .....	2-15
2-2-13	Cautions in handling a condensing or collimate lens.....	2-15
2-2-14	Other gravities .....	2-16
2-2-15	Service .....	2-16
2-2-16	Door interlock for class 1 enclosed cover .....	2-16
2-3	Safety Precautions (Machine).....	2-17
2-3-1	Rule.....	2-17
2-3-2	Basic safety precautions.....	2-18
2-3-3	Clothing and personal safety .....	2-18
2-3-4	Precautions related to operation .....	2-19
2-3-5	Precautions on continuous operation.....	2-19
2-3-6	Precautions related to maintenance .....	2-20
2-3-7	Precautions related to workplace.....	2-20
2-3-8	Safety devices .....	2-20
2-3-9	Safety plates on the machine .....	2-25
2-3-10	Safety plates on the laser resonator and the laser power unit.....	2-34
2-3-11	Others .....	2-37
2-4	Installation Precautions.....	2-37
2-4-1	Wiring .....	2-37
2-4-2	Grounding .....	2-38
2-4-3	Gas and air pipings.....	2-39
2-4-4	Environmental conditions.....	2-41

3	SPECIFICATIONS.....	3-1
3-1	Specifications of the Laser Machine Body.....	3-1
3-2	Specifications of the Laser Oscillator.....	3-2
3-3	CNC Unit Specifications .....	3-3
3-4	Standard Functions and Accessories .....	3-4
3-5	Optional Functions and Accessories.....	3-5
4	EXTERNAL VIEW OF THE MACHINE .....	4-1
5	DESCRIPTION OF PARTS .....	5-1
5-1	Description of Each Machine Part.....	5-1
5-2	Laser Optical System.....	5-1
6	OPERATION SWITCHES.....	6-1
6-1	Switches on the Control Panel.....	6-1
6-2	NC Operation Panel.....	6-2
6-2-1	Functions and names of the switches.....	6-3
6-3	Auxiliary Operation Panel .....	6-9
6-3-1	Names and functions of switches .....	6-9
6-4	Data Input and Output Panel .....	6-12
7	2-PALLET CHANGER (OPTIONAL).....	7-1
7-1	2-Pallet Changer Specifications.....	7-1
7-2	External View of the Machine .....	7-2
7-3	Description of Each Machine Part.....	7-3
7-4	Operation Switches.....	7-4

7-4-1	2-pallet changer operation panel .....	7-4
7-4-2	2-pallet changer foot switch .....	7-7
7-5	M-codes Related to the Pallet Changer .....	7-7
7-6	Conditions for Completing Pallet Changer Setup.....	7-8
<b>8</b>	<b>MACHINE OPERATION AND SCREENS USED FOR OPERATION .....</b>	<b>8-1</b>
8-1	Stopping Operation.....	8-1
8-1-1	Feed hold .....	8-1
8-1-2	Reset.....	8-1
8-1-3	Emergency stop .....	8-2
8-2	Override .....	8-3
8-3	Operation Mode .....	8-5
8-4	Manual Mode.....	8-6
8-4-1	Home position return mode .....	8-6
8-4-2	Rapid feed mode .....	8-7
8-4-3	Jog mode .....	8-8
8-4-4	Handle mode .....	8-9
8-4-5	Clearing the hardware overtravel (OT).....	8-10
8-4-6	Clearing the software overtravel (OT).....	8-11
8-4-7	Laser .....	8-11
8-4-8	Origin set operation .....	8-13
8-5	Automatic Mode.....	8-15
8-5-1	Control menu.....	8-15
8-5-2	Automatic Operation.....	8-16
8-5-3	MDI operation.....	8-17

8-6	Tool Path Check Function .....	8-19
8-7	Basic Screen Operation.....	8-21
8-7-1	Screen configuration.....	8-21
8-7-2	Calling the screen.....	8-22
8-7-3	Basic screen configuration.....	8-22
8-7-4	Changing the display pages .....	8-24
8-7-5	Inputting the data.....	8-24
8-7-6	Setting the clock .....	8-25
8-7-7	Turning off the screen.....	8-25
8-8	COMMAND Screen .....	8-26
8-8-1	Display on the COMMAND screen .....	8-26
8-8-2	Details of displayed items.....	8-26
8-8-3	Screen operation .....	8-27
8-8-4	Menu operation .....	8-28
8-9	POSITION Screen .....	8-30
8-9-1	Screen display.....	8-30
8-9-2	Details of displayed items.....	8-30
8-9-3	Menu display .....	8-30
8-10	PATH CHECK Screen .....	8-31
8-10-1	Screen display.....	8-31
8-10-2	Details of displayed items.....	8-31
8-10-3	Menu operation .....	8-32
8-11	PROGRAM FILE Screen .....	8-34
8-11-1	Screen display.....	8-34
8-11-2	Details of displayed items.....	8-34

8-11-3	Screen operation .....	8-35
8-11-4	Menu operation .....	8-35
8-12	PROGRAM Screen.....	8-38
8-12-1	Creating a new program .....	8-38
8-12-2	Editing the cut mode program.....	8-40
8-12-3	Editing the press mode program.....	8-43
8-13	FD I/O Screen .....	8-47
8-13-1	Screen display .....	8-47
8-13-2	Details of displayed items .....	8-47
8-13-3	Screen operation .....	8-48
8-13-4	Connection to external storage equipment .....	8-51
8-14	TAPE I/O Screen .....	8-57
8-14-1	Screen display .....	8-57
8-14-2	Details of display items .....	8-57
8-14-3	Screen operation .....	8-58
8-15	Cautions on Using the I/O Screens.....	8-62
8-16	WORK OFFSET Screen .....	8-63
8-16-1	Screen display .....	8-63
8-16-2	Details of displayed items .....	8-63
8-16-3	Screen operation .....	8-64
8-17	BEAM OFFSET Screen.....	8-66
8-17-1	Screen display .....	8-66
8-17-2	Details of displayed items .....	8-66
8-17-3	Screen operation .....	8-66
8-18	ALARM Screen .....	8-67

8-18-1	Screen display .....	8-67
8-18-2	Details of display items .....	8-67
8-19	VERSION Screen .....	8-68
8-19-1	Screen display .....	8-68
8-19-2	Details of display items .....	8-68
8-19-3	Screen operation .....	8-68
8-20	I/O MONITOR Screen.....	8-69
8-21	MAINTENANCE Screen .....	8-70
8-21-1	Screen display .....	8-70
8-22	TOOL DATA Screen .....	8-72
8-22-1	Screen display .....	8-72
8-22-2	Details of displayed items .....	8-73
8-22-3	Setting the tool data.....	8-74
8-22-4	Deleting the tool data.....	8-74
8-22-5	Piercing position .....	8-75
8-22-6	Special shape tools .....	8-75
8-23	PROCESS ITEM Screen .....	8-76
8-23-1	Screen display .....	8-76
8-23-2	Details of displayed items .....	8-76
8-23-3	Setting and changing the material name.....	8-77
8-23-4	Setting and changing the workpiece thickness .....	8-77
8-23-5	Copying the material data.....	8-77
8-23-6	Deleting the material data.....	8-77
8-23-7	Deleting the thickness .....	8-78
8-23-8	Editing the conditions .....	8-78

8-23-9	Ending the editing of cutting conditions.....	8-79
8-24	SWITCH Screen .....	8-80
8-24-1	Screen display.....	8-80
8-24-2	Details of displayed items.....	8-80
8-24-3	Changing the ON/OFF status .....	8-81
8-25	SETTING Screen.....	8-82
8-25-1	Screen display.....	8-82
8-25-2	Details of displayed items.....	8-82
8-25-3	Screen operation .....	8-82
8-25-4	Operation parameter and setting range .....	8-83
8-25-5	Details of operation parameters.....	8-83
8-26	USER PARAMETER Screen .....	8-88
8-26-1	Screen display.....	8-88
8-26-2	Details of displayed items.....	8-88
8-27	COMMON VARIABLE Screen .....	8-89
8-27-1	Screen display.....	8-89
8-27-2	Details of displayed items.....	8-89
8-27-3	Screen operation .....	8-89
8-28	LOCAL VARIABLE Screen .....	8-91
8-28-1	Screen display.....	8-91
8-28-2	Details of displayed items.....	8-91
8-28-3	Screen Operation .....	8-92
8-29	SYSTEM VARIABLE Screen .....	8-93
8-29-1	Screen display.....	8-93
8-29-2	Details of displayed items.....	8-93

8-29-3	Screen operation .....	8-93
<b>9</b>	<b>PREPARATION FOR OPERATION.....</b>	<b>9-1</b>
9-1	Items To Be Checked .....	9-1
<b>10</b>	<b>STARTING AND STOPPING LASER OSCILLATOR.....</b>	<b>10-1</b>
10-1	Starting .....	10-1
10-2	Stopping .....	10-2
10-3	Using Gas Cleaning Cancel Switch .....	10-3
<b>11</b>	<b>MANUAL AND AUTOMATIC OPERATIONS .....</b>	<b>11-1</b>
11-1	Profiler Retry Function .....	11-1
11-1-1	Preparation for operation.....	11-2
11-2	NC Retrial Function (Optional).....	11-3
11-2-1	Preparation for operation.....	11-3
<b>12</b>	<b>PROGRAM RESTART FUNCTION .....</b>	<b>12-1</b>
<b>13</b>	<b>OPERATION BREAKS AND COMPLETION .....</b>	<b>13-1</b>
13-1	Breaks in Operation .....	13-1
13-2	Completion of Operation.....	13-2

- NOTE -

# 1 INTRODUCTION

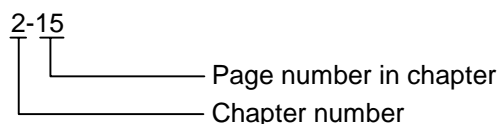
## 1-1 List of Manuals to Be Used

For this machine, the following manuals are provided.

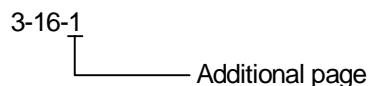
Manual name	Coverage
Operating manual	General information on operation and handling
Maintenance manual	General maintenance information including inspection and adjustment procedures
Parts list	Details of the parts
Electrical wiring diagrams	Electrical connections

## 1-2 Numbering System for Pages

### 1. Normal case

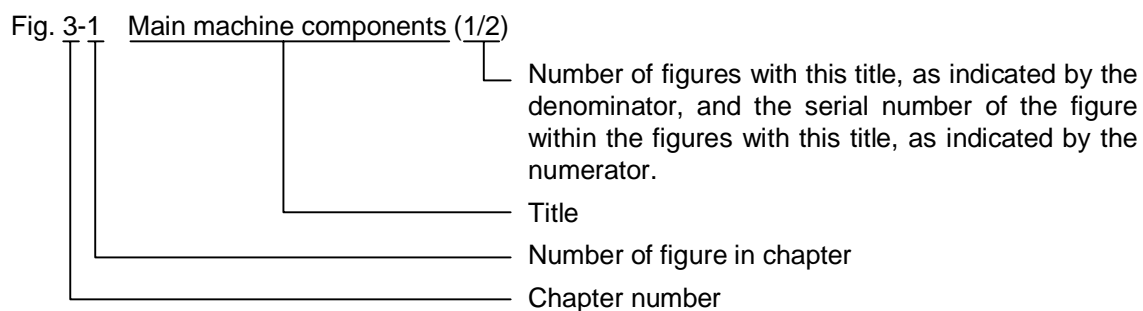


### 2. For additional pages to be inserted

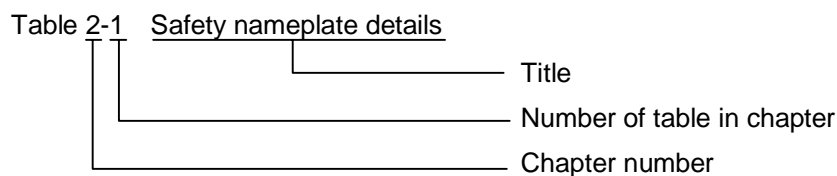


## 1-3 Numbering System for Figures and Tables

### 1. Figure number



### 2. Table number



- NOTE -

## 2 SAFETY PRECAUTIONS

### 2-1 FDA Compliance with 21 CFR 1040.10 and 1040.11

The Mazak laser machine meets the requirements for the “Center for Devices and Radiological Health of Food and Drug Administration for Laser Products”.

FDA: Food and Drug Administration for the U.S.A.

#### 2-1-1 Protective housing

##### 1. Class 4 systems

The laser oscillator and external beam delivery system is enclosed by metallic covers with the exception of the work station.



- DON'T approach the vicinity of the table while machining is in process. Otherwise you may be endangered to exposing yourself to the laser beam.

##### 2. Class 1 systems

The laser oscillator and external beam delivery system is enclosed by metallic covers and the work station is completely enclosed by clear acrylic covers to prevent any access to laser radiation during operation and maintenance.



- In adjusting the focusing torch during manual operation, you may be endangered to expose yourself to the laser beam near the table. In such an operation wear protective goggles. Persons other than a concerned one are prohibited to enter the vicinity of the table. A focus adjusting operator must be qualified by Yamazaki Mazak Corporation.

#### 2-1-2 Safety interlocks

##### 1. Class 4 systems

Oscillators and power supply unit covers have non-defeatable interlock switches. When the cover is removed the high voltage will automatically turn off. The protective housing shielding the beam delivery system is not equipped with interlock switches.

##### 2. Class 1 systems

Oscillator and power supply unit covers have non-defeatable interlock switches. When the cover is removed the high voltage will automatically turn off. The work station door has interlocks, so the door must be closed for the machine to operate. If the door is opened during operation, the laser beam shutter will automatically close and the machine will stop and an alarm will occur.

#### 2-1-3 Master key switch

##### 1. Class 1 systems

A key switch on the control board is the master control switch. The key is removable in the “OFF” position and the laser will not be operational when the key is removed. One person should be responsible for the key.

**2-1-4 Remote control connector**

The remote control connector is provided so that the user can connect to a remote barrier interlock, emergency stop switch or similar device. Generally, the connector is short-circuited. When the connector is opened, the beam shutter will close, the machine will stop and an alarm will occur (please see the maintenance manual for details).

**2-1-5 Manual reset function**

To reset the Remote Control Interlock, push the NC reset key.

**2-1-6 Emission indicator**

The yellow light on top of the NC control is an emission indicator. This light will blink when the high voltage switch is tripped. Then laser discharge inside the oscillator will begin.

**2-1-7 Beam attenuator**

**1. Both Class 4 and Class 1 systems**

An electrically actuated shutter provides a means of preventing access to laser output radiation without turning off the main power. The beam shutter can be controlled by NC commands during automatic operation or can be controlled by the key switch in the manual mode.

**2-1-8 Labeling**

**1. Both Class 4 and Class 1 systems**

The following labels and diagram define the meaning and location of the protective safety labels for your machine. Please study these labels and locate them on the machine in your place of business.

Certification and identification label

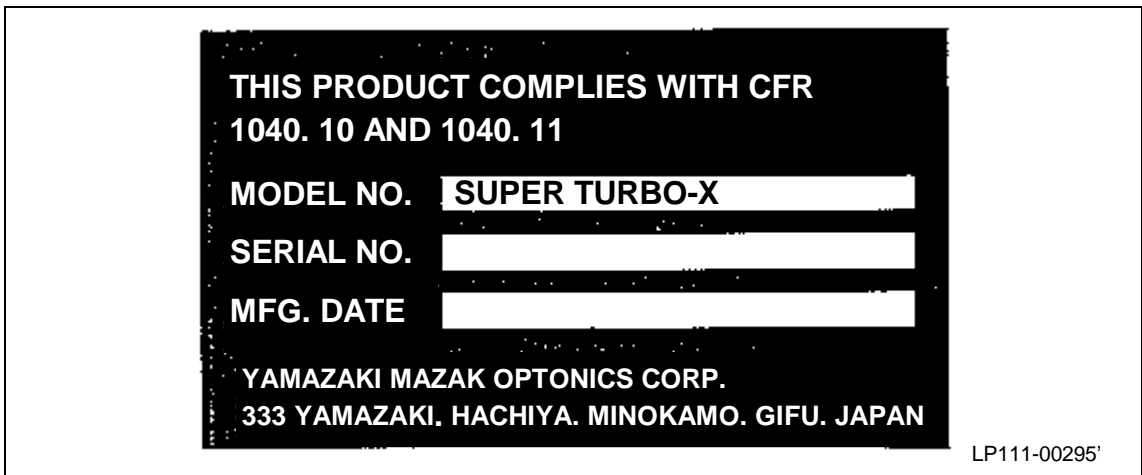


Fig. 2-1 Certification and identification label

Warning, logotype B (Class 4 systems only)



Fig. 2-2 1.5 kW CO<sub>2</sub> laser system



Fig. 2-3 1.8 kW CO<sub>2</sub> laser system



Fig. 2-4 2.5 kW CO<sub>2</sub> laser system



Fig. 2-5 4 kW CO<sub>2</sub> laser system

2. Aperture label located on the Z-axis head

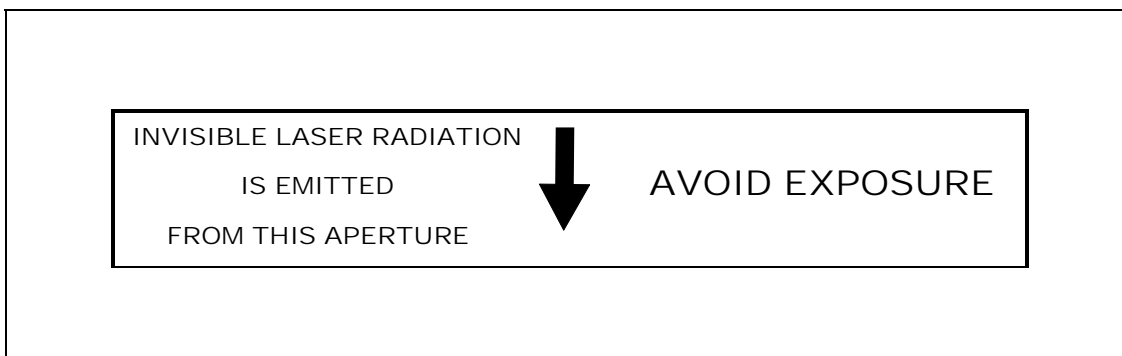


Fig. 2-6 Aperture label

Labels for non-interlocked protective housing  
Located at fixed mirror plates and mirror mount blocks

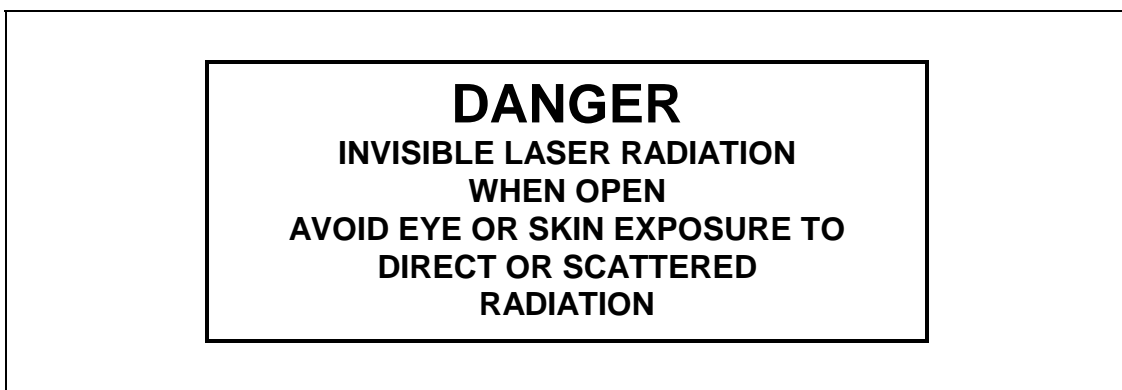
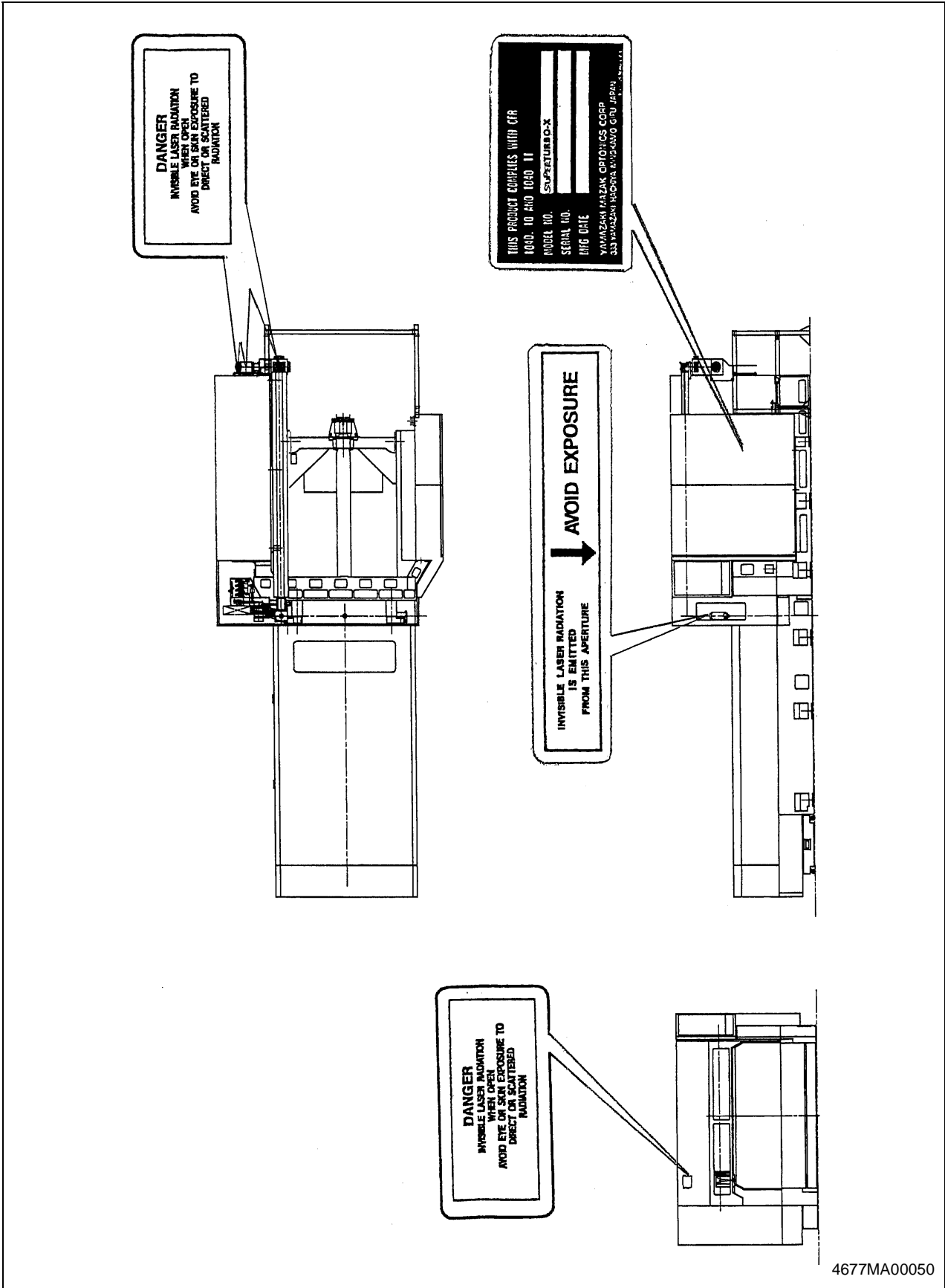
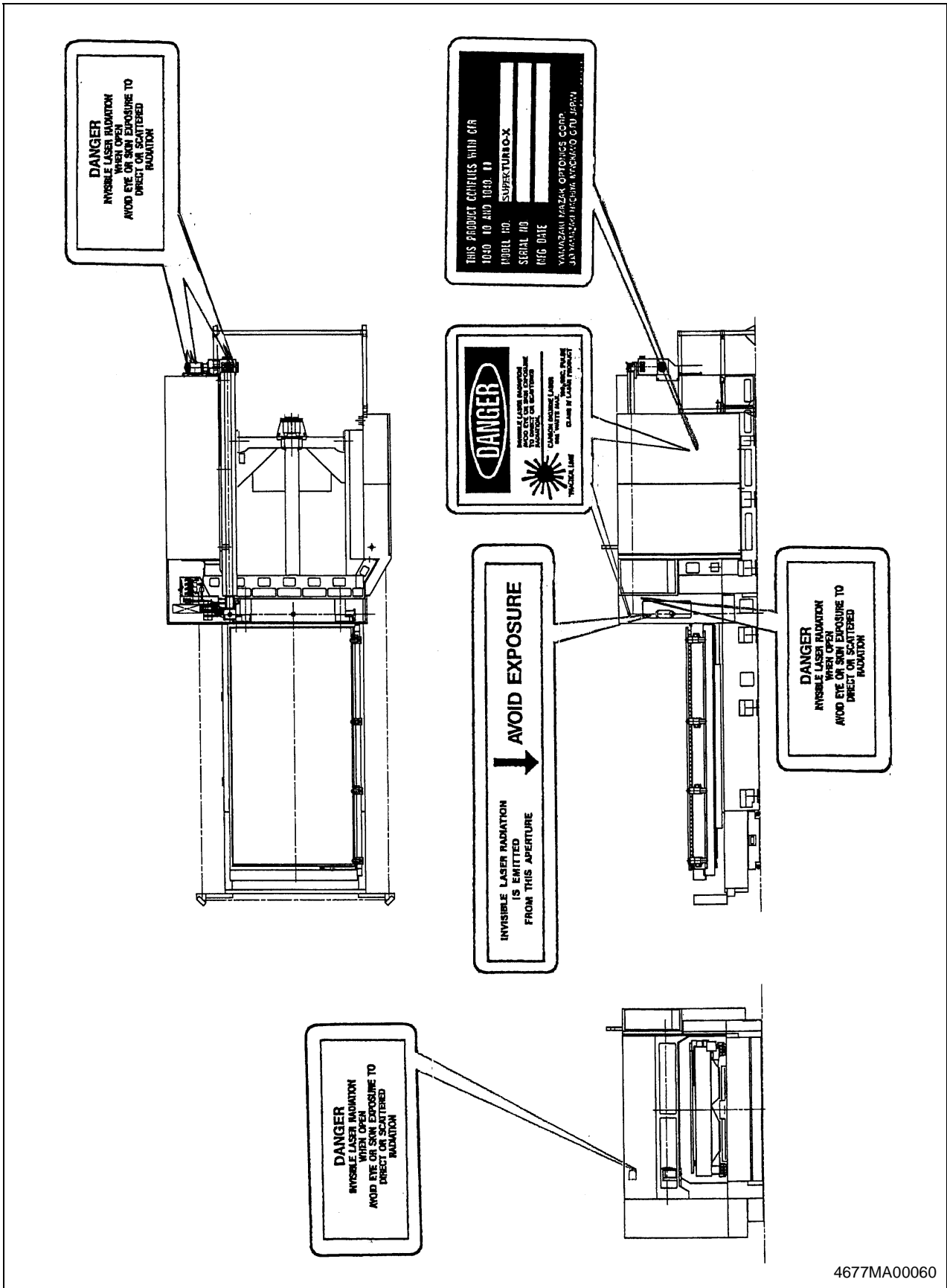


Fig. 2-7 Label for non-interlocked protective housing



4677MA00050

Fig. 2-8 Label locations for Class 1



4677MA00060

Fig. 2-9 Label locations for Class 4

### 3. Warning labels

Where there is a danger of high voltage or of being struck by the laser beam in the resonator, there are labels affixed to positions as indicated in the following illustration.

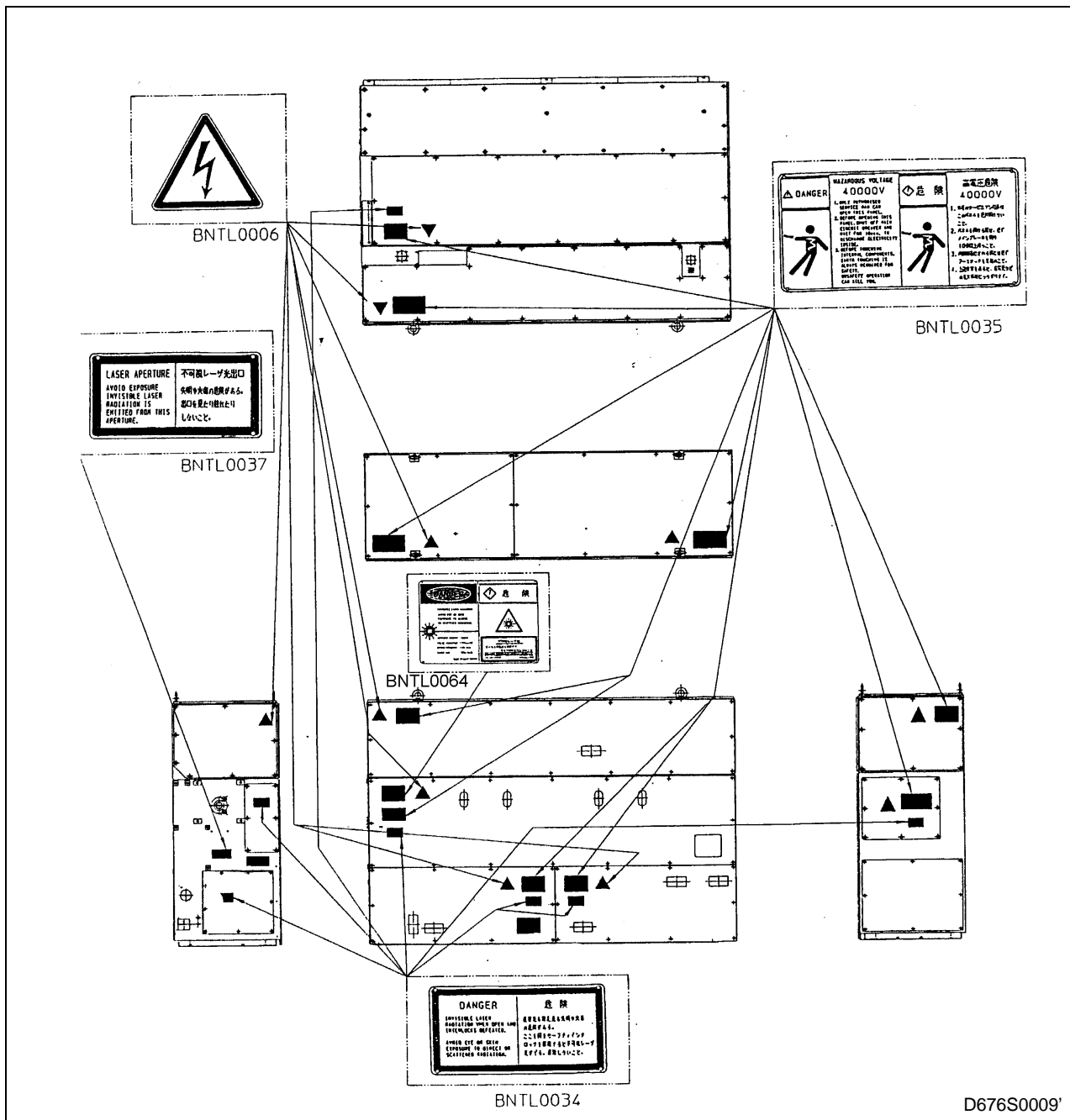


Fig. 2-10 Safety plates on the laser resonator (1.5 kW laser system)

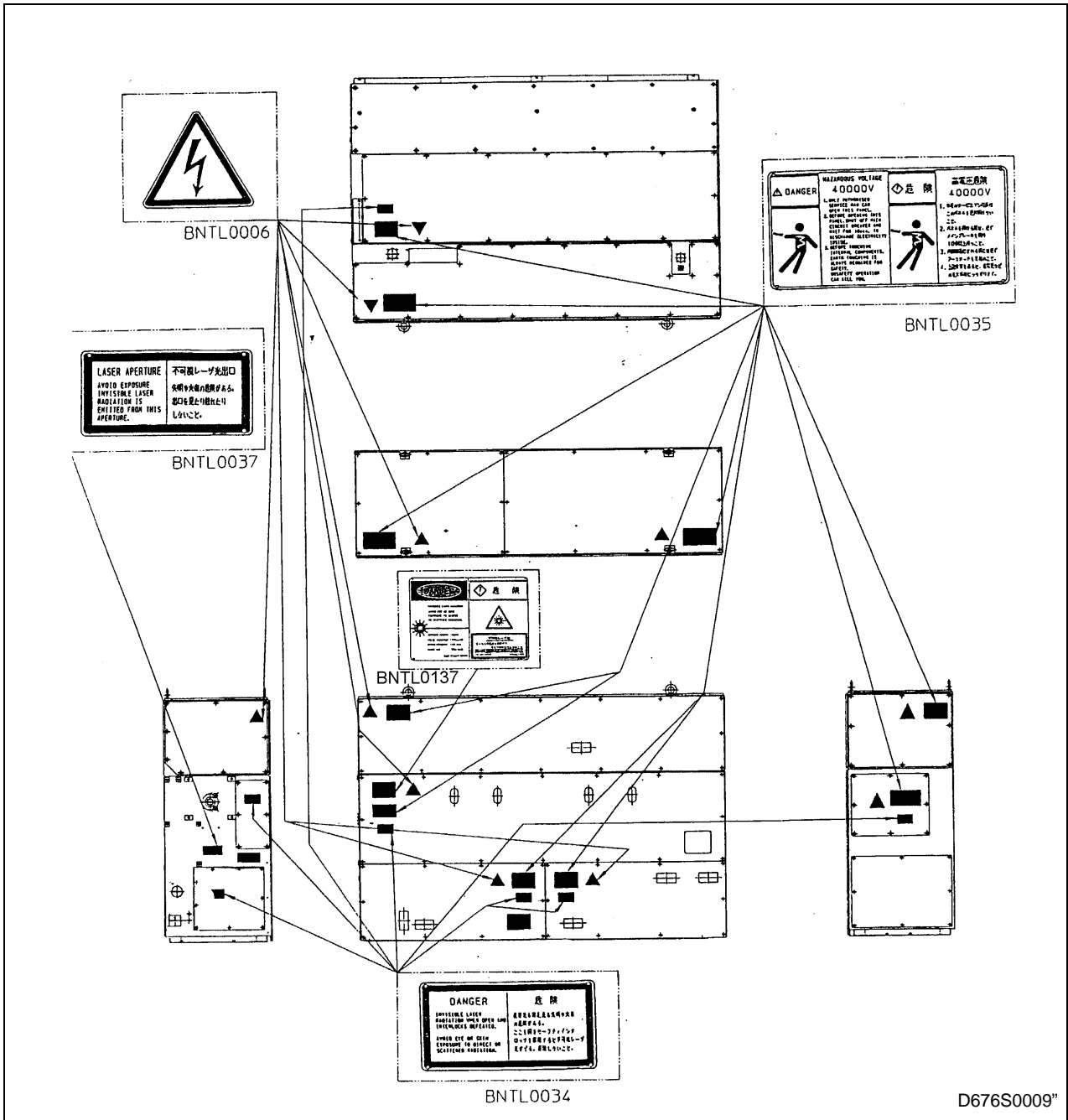


Fig. 2-11 Safety plates on the laser resonator (1.8 kW laser system)

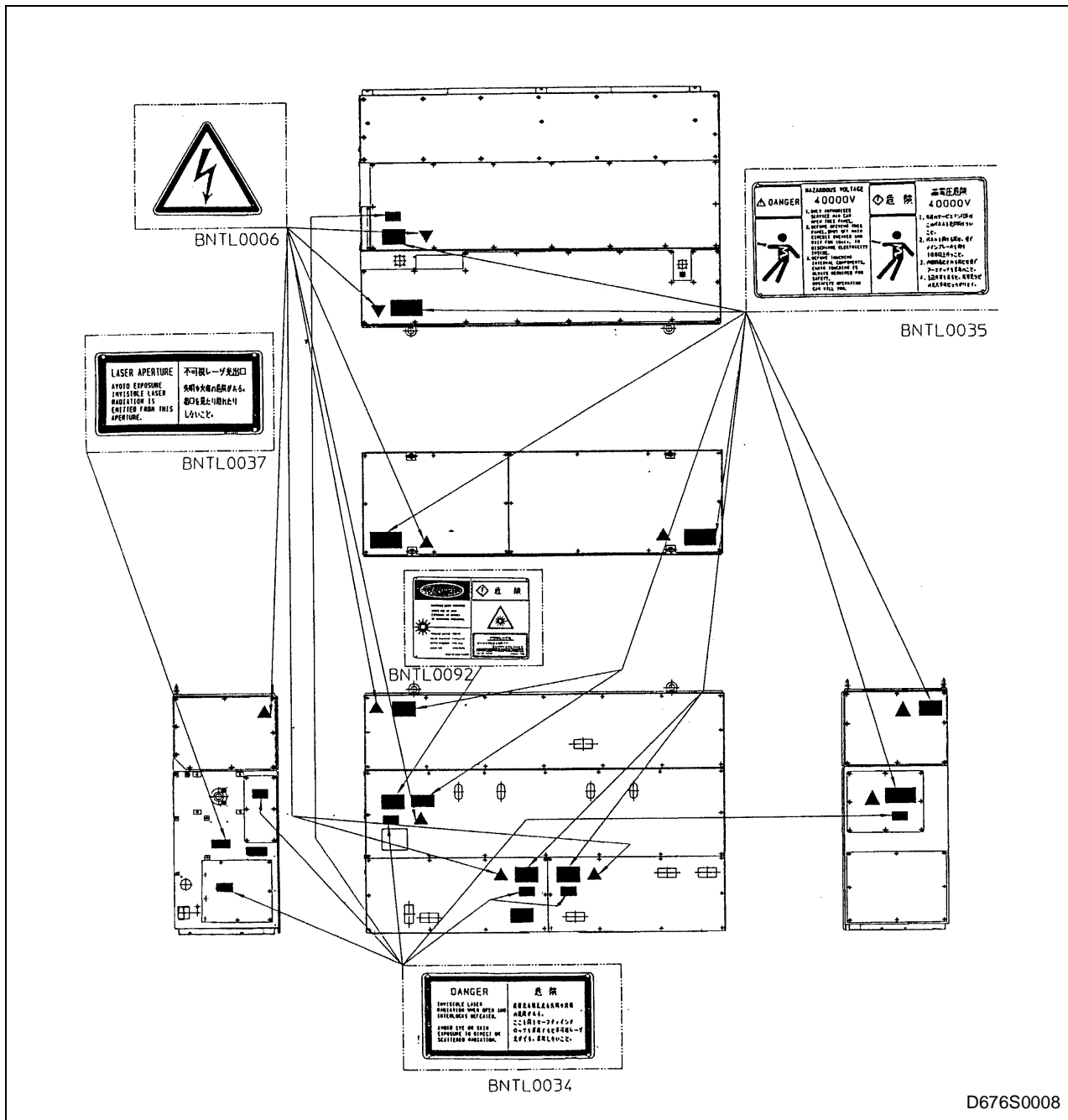


Fig. 2-12 Safety plates on the laser resonator (2.5 kW laser system)

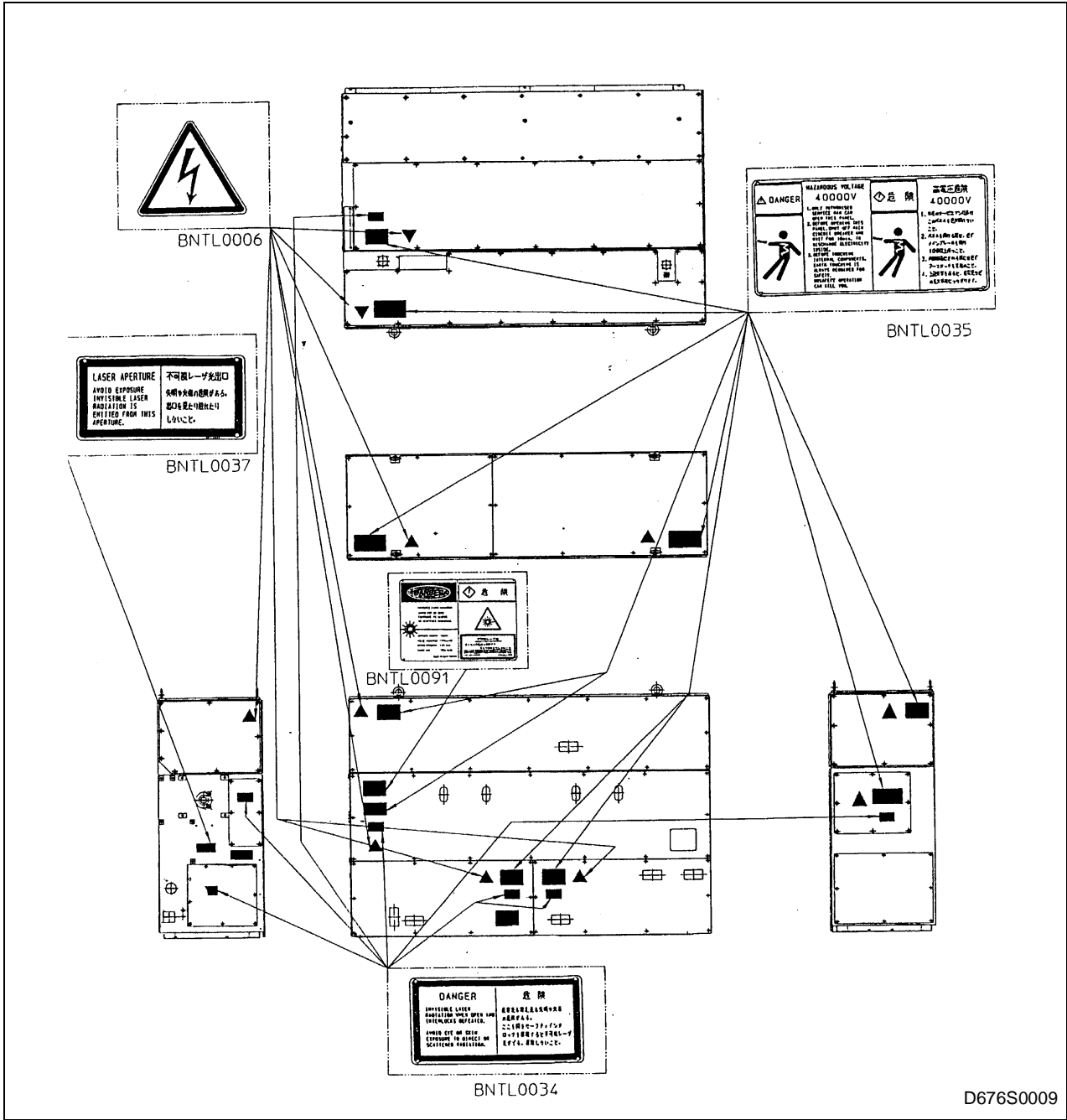


Fig. 2-13 Safety plates on the laser resonator (4 kW laser system)

## 2-2 Safety Precautions (Laser)

This section explains the necessary notes on safe operations of the laser machine. Read through and fully understand the contents before operations. To ensure safer laser machine operations read through the SAFETY PRECAUTIONS prescribed in the PROGRAMMING MANUAL as well.

### 2-2-1 Rule

1. This machine is provided with various safety devices to protect the operator and the machines.  
However, these cannot cover all aspects of safety, therefore the operator must thoroughly read and understand this chapter before operating the machine. The operator should also take into consideration other aspects of safety related to particular environmental conditions and materials.
2. The meanings of our safety precautions to DANGER, WARNING and CAUTION are as follows:



**DANGER**

: Failure to observe these instructions could result in loss of life.



**WARNING**

: Failure to observe these instructions could result in serious harm to a human life or body



**CAUTION**

: Failure to observe these instructions could result in minor injuries or serious machine damages.

### 2-2-2 Safety of the laser machine

Here is explained the safe operation of the machine. The MAZAK laser machine is a safe industrial laser machine tool. There are, however, some basic precautions that you must follow to ensure the safety of your operator.

#### 1. Hazards of laser cutting machines

There are four basic hazards associated with CO<sub>2</sub> Laser cutting machines as follows.

##### A. Contact of laser beam

The contact of the CO<sub>2</sub> beam to eye or skin.

##### B. Fire

Fire danger by either splattering from the worksheet or from direct contact of the CO<sub>2</sub> Laser beam with flammable materials, or due to use of assist gas.

##### C. Toxic fumes

Toxic fumes emitted from exotic materials.

##### D. Lethal high voltage shock

Lethal high voltage shocks from electrical cabinets caused by untrained personnel.

### 2-2-3 Contact of the laser beam

#### 1. Possible hazards

- The laser machine emits a very high powered carbon dioxide laser beam that is not visible to the human eye. It is very important to handle this machine with an extreme care due to the following possible skin and eye hazards.

Contact with the laser beam can cause serious burns.



- NEVER place any part of your body or clothing underneath or in front of the direct path of the laser beam. Contact of your skin or clothing with the laser may result in immediate ignition of either skin or clothing or both.

- The CO<sub>2</sub> laser beam can reflect off the workpiece surface and indirectly contact eyes or skin. This can also produce serious burns to eyes or skin.

#### 2. Recommended safety precautions

- When using the laser machine always wear protective eye ware. Safety glasses made of either plexiglass or plastic with side guards are recommended. Prescription glasses are permissible but also should have side guards to deflect any stray CO<sub>2</sub> radiation from the machine.

Gloves and long sleeve shirts are also recommended to ensure safety when operating the system. Parts that come from the laser machine (especially steel parts) are sometimes very hot after they have been laser processed. Wearing gloves helps to prevent any minor burns that can occur after processing. Long sleeve shirts are recommended as a preventive factor to protect the operators arm from any stray CO<sub>2</sub> radiation.

**NEVER STARE DIRECTLY AT THE LASER BEAM WHILE IT IS CUTTING.**

Even with eye protection it is not recommended that the operator stare directly at the laser torch while the shutter is open.



- NEVER make contact with the CO<sub>2</sub> laser beam!

### 2-2-4 Danger of fire from spatter or laser beam

#### 1. Possible fire hazards

When laser processing with the laser machine there is a possibility of scattering hot fragments to flammable materials near the workpiece area. It is strongly recommended that you are aware of the following hazards.

Hot fragments of the material can scatter and hit objects in the surrounding area.

The CO<sub>2</sub> beam or a reflection of it could come into contact with flammable materials.

#### 2. Recommended safety precautions

Keep flammable materials at least 10 feet away from the work area. Flammable materials are considered to be any solid material (paper, wood, cardboard or plastic) or volatile liquid (such as gasoline, acetone, kerosene, aerosol cans etc.) that can ignite on contact.

When laser processing materials such as plastics and wood, use an inert gas such as nitrogen or helium to prevent uncontrollable ignition of the material.

**WARNING**

- NEVER use oxygen as an assist gas when processing wood, plastic, cardboard, paper or cloth products.
- Fire could arise when wooden, plastic or other flammable materials are machined. In this case it is the responsibility of management to ensure a fire extinguisher is readily available as a safety measure. Additionally, the machine should never perform unmanned operation. An operator must always be present to ensure safety.

A shield between the work area and the operator should be either built or provided by the manufacturer (MAZAK) to inhibit the possible deflection of either CO<sub>2</sub> radiation and/or hot fragments. If the shield is built by the owner of the machine it should be made of sheet metal.

### 2-2-5 Danger of a fire from assist gas

#### 1. Possible hazards

There are times when oxygen gas is used at the assist gas for laser processing. When oxygen gas is used, provide a special gas circuit. If the oxygen gas is connected to any but a special oxygen gas circuit and laser processing is conducted a fire could occur. There should be no oil inside the piping used to connect the oxygen gas cylinder.

#### 2. Recommended safety precautions

When oxygen gas is used as the assist gas during laser processing then connect the oxygen to a special oxygen supply port.

**WARNING**

- Do not use oxygen gas in a high-pressure assist gas circuit.

### 2-2-6 Potential fire and explosion hazards of the dust collector

#### 1. Potential hazards

- The laser machine gives off sparks, soot, coal dust, and/or other dust particles. Emission of these substances can result in dust explosions.
- The chips occurring during no-oxidation cutting (such as aluminum machining with a nitrogen gas) may get burned or ignited by chemical reactions with the moisture that is contained in air.

#### 2. Recommended safety precautions

Institute the following measures so as to avoid the hazards mentioned above:

**WARNING**

- Keep combustibles away from the dust collector.
- During and after no-oxidation cutting, clear dust particles away from the dust collector and the hose connection box as far as possible.
- Check the interior of the dust collector's dust box and remove dust from the dust box at least once every 100 hours of operation. Similarly, check and clean the hose connection box and the dust suction port each day, and the duct at least once a month.
- If the user is to install a special dust collector, design and fabricate it so that sparks or fire does not break out. Also, install a pre-duster and provide metallic piping.

### 2-2-7 Cleaning the head and periphery

Clean all sections dirty with dust particles and/or oils each day so as to prevent fire from occurring. Use a cloth to clean.

### 2-2-8 Oxygen leakage check

If oxygen leakage is discovered, immediately stop the machine. Continued operation of the machine with oxygen leaking can result in fire.

### 2-2-9 Danger of fire due to fast piercing

#### 1. Possible hazards

Machining that uses fast piercing causes very hot spattering in great quantities. Spattering can result in fire.

#### 2. Recommended safety precautions

When using fast piercing to process the worksheet, perform the following items:



**WARNING**

- Use the fast piercing nozzle.
- Use the machining method specified by Yamazaki Mazak.
- Use the side air blowout feature.
- Use a water-soluble anti-spattering agent to coat the worksheet.
- Keep flammable materials away from the laser beam machine.
- Always keep the Z-axial bottom cover and the Y-axial oil pan clean to avoid the likely accumulation of spatters.
- The machine operator himself must absolutely monitor the piercing operation.

### 2-2-10 Toxic fumes

#### 1. Possible hazards

When cutting some materials, there is a potential danger from the fumes emitted as the material is laser processed. It is necessary to evaluate the material before processing and to be very careful in the selection of materials that are to be cut with the laser. Some materials (such as lead, PVC, fiberglass, galvanized steel and some calcium based composites) are very dangerous to cut because of the toxicity of the fumes they emit.

#### 2. Recommended safety precautions



**WARNING**

- Before machining, check with the guidebook of dangerous materials for welding that a worksheet material does not generate toxic gases.

For details of danger from toxic fumes, refer to the guidebook of dangerous materials for welding, etc.

## 2-2-11 Lethal high voltage shock

### 1. Possible hazards

The laser oscillator of the laser machine operates at 40000 V.



- The only person allowed to touch the laser oscillator should be a certified electrical engineer or Mazak service engineer. AT NO TIME SHOULD AN EMPLOYEE OF THE COMPANY THIS MACHINE IS SOLD TO BE RESPONSIBLE FOR ANY ENTRY INTO THE POWER SUPPLY OF THE LASER. Mazak waives any legal responsibility of injury or death due to unauthorized entry into the power supply unit, beam enclosure or oscillator cabinet.

### 2. Recommended safety precautions

The user is prohibited from doing any repairs or adjustments to the electrical parts of the laser oscillator. Please contact a Mazak service engineer for adjustment and repair.

## 2-2-12 Laser and shutter keys

There are two keys on the machine that demand attention in regards to safety: the laser control key and the shutter switch key. These keys should be removed by an authorized person when the machine is not in operation. These keys should be put in a safety place and should not be accessible to any personnel other than the person responsible for them.

**Note:** The shutter switch key is not necessary for operation of the laser machine system. Its main purpose is for maintenance. The user should properly control this key so that it is not handled by persons not officially trained by Mazak.



- If a person not trained handles the shutter switch key, he or she may or will suffer injury such as burns.

## 2-2-13 Cautions in handling a condensing or collimate lens

To avoid danger to human life, take care in handling condensing lenses and collimate lenses (long focus lens) made from ZnSe (Zinc Selenium) or GaAs (Gallium Arsenic).



- DO NOT touch ZnSe or GaAs directly or inhale its fumes; it may endanger human/animal life and cause serious environmental pollution.
  1. Never throw away used lenses and never burn them in a refuse burner. (This combustion gas is very poisonous and if inhaled, may be dangerous to human life.)
  2. Wear gloves when handling lenses, never touch them with bare hands. Besides the lens being toxic, once contaminated by oils from the hand its performance is significantly reduced.
  3. Clean up broken lenses with a vacuum cleaner. Do not directly touch them.
  4. Collect fragments into a plastic bag so as not to raise dust. After cleaning up, wash your hands, nails and face with soap and water, and rinse your eyes.
  5. Do not inhale dust mixed with fragments.
  6. If fragments accidentally get into your eyes, quickly wash them with a large amount of water.

7. In case a child swallows some fragments, have him/her drink a large amount of water and consult a doctor.
8. One person should be responsible for storing lenses so that children or unauthorized people cannot easily access them.
9. Regarding disposal of lenses, engage an authorized disposal agency.
10. If the above caution items are neglected, it may cause serious human accidents or environmental pollution.

### 2-2-14 Other gravities



1. Danger to exposing your eyes and skin to the spatters from a worksheet being machined.
  - DO NOT expose yourself to the spatters from a worksheet being machined especially when it is machined in a test cut or under unstable machining conditions. Otherwise, you may get burnt or be hazardous to abrasion.

2. Wear clothes and goggles to protect yourself from CO<sub>2</sub> laser in laser machine operation. Our laser machine can be optionally equipped with the Class 1 cover for the operator's safety.

Obtaining special eye protection

Special eye protection against the CO<sub>2</sub> laser is available as an optional item. Order it from our Sales or Quality Assurance Section.

3. Compressor fire hazards



- Do not place oxygen containers or oxygen release valves near the air intake port of the compressor. Failure to observe this precaution leads to fire.

### 2-2-15 Service

If you have a problem with your laser machine system, please contact your local Mazak service representative. DO NOT ATTEMPT TO SERVICE THE MACHINE YOURSELF.

### 2-2-16 Door interlock for class 1 enclosed cover

1. All Class 1 laser systems will be equipped with totally enclosed covers with this door interlock for safe operation.
2. When the door is opened the following will occur.
  - Auto operation
    - 1) Feed hold (machine will stop)
    - 2) Beam shutter will close
    - 3) High voltage OFF
    - 4) Alarm display
  - Manual operation
    - 1) Beam shutter close
    - 2) High voltage OFF
    - 3) Alarm display

## 2-3 Safety Precautions (Machine)

### 2-3-1 Rule

1. This machine is provided with various safety devices to protect the operator and the machines. However, these cannot cover all aspects of safety, therefore the operator must thoroughly read and understand this chapter before operating the machine. The operator should also take into consideration other aspects of safety related to particular environmental conditions and materials.
2. The meanings of our safety precautions to DANGER, WARNING and CAUTION are as follows:



**DANGER**

: Failure to observe these instructions could result in loss of life.



**WARNING**

: Failure to observe these instructions could result in serious harm to a human life or body.




**CAUTION**

: Failure to observe these instructions could result in minor injuries or serious machine damages.

3. Always observe the safety instructions inscribed on the safety plates fixed to the machine. Do not remove or damage these plates. If a plate is damaged or becomes illegible, contact Mazak.
4. Do not attempt to operate the machine until you have read all of the manuals (OPERATING, MAINTENANCE, PROGRAMMING MANUALS etc.) supplied with the machine and have understood each of the functions and operating methods.

### 2-3-2 Basic safety precautions



- The laser oscillator uses high 40000 volts. Users are not allowed to adjust or repair it. Negligence may be endangered to death or electric shock.
- There are high voltage terminals on the electrical control panel, transformer, motors, junction boxes and other equipment (with a battery warning mark  attached). Do not touch any of them under any circumstance.



- Never touch or try to touch a moving part like the torch, the table, etc. of the machinery during operation. Or never place a part or whole of your body in the place catching it.
- Never be near an area to be suspected dangerous like the vicinity of the torch to protect you from the hazardous laser beam or spatters.
- Fully understand the operation of the emergency stop pushbutton so that you can operate it at any time.
- Don't turn on the power under the condition of the door or the protective cover removed.
- Don't open the door, the cover, etc. of the laser machine during automatic operation.
- Don't operate the switches or the like with wet hands.



- Take full care not to have your hands or fingers caught by the worksheet clamp, or the worksheet support.
- Shut down the main breaker when the power failed.

### 2-3-3 Clothing and personal safety



- Tie up your long hair back and loose sleeves and avoid wearing a necktie, necklace, etc. to prevent them from being caught by a machine drive.
- Always wear safety protectors like safety shoes.



- Always wear a dust mask if a material which produces dust is machined.
- Always wear gloves to handle a hot or sharp edge worksheet.
- Always operate the machine in good health conditions. Should any abnormality be felt, avoid operating the machine.

### 2-3-4 Precautions related to operation

1. Fully understand the contents of the OPERATING MANUAL before starting operation of the machine.



**WARNING**

- Check that all safety covers, etc. are in position and perfect. If imperfect, change or repair it.
- Make sure that a worksheet has securely been clamped by the worksheet clampers before operation so that it does not move while in operation.
- Don't operate the switches on the operation panel with gloves on. Failures will cause machine misoperation or other troubles.
- Halt machine operation when a violent storm is occurring.



**CAUTION**

- When you leave the machine after operation, turn off the power switch on the CNC operation panel but don't shut down the main breaker of the machine.

2. Precautions when starting an automatic operation

When starting a programmed automatic operation for the first time, a human or mechanical harm or damage is most likely to occur by the spatters flying from improper cutting conditions or by a mechanical interference due to an improper motion path. So carry out an automatic operation, giving the following attentions:



**WARNING**

- Before starting a cut, wear protective goggles for a CO<sub>2</sub> laser in order to protect yourself from a harm caused by spatters or laser beam reflections.



**CAUTION**

- Don't start an automatic operation abruptly but check the machining paths correct on the CNC screen beforehand.
- After checking the paths on the screen, move the machine in a single block mode to check the paths proper on the machine. In such an operation, validate the override function in the feedrate and select a safe speed under the power off condition.

### 2-3-5 Precautions on continuous operation

Continuous operation must always be placed under the supervision of a person. Avoid unattended continuous operation.



**WARNING**

- Even within their standard service lives (specified separately), the lens, mirror, and nozzle on the laser machine may suddenly be damaged due to an unexpected burst and the spatters thereby, resulting in machining defects. Machining defects, in turn, can result in a burst, and laser beam reflections can cause fire.



**CAUTION**

- The conditions of the laser beam cutting have to accord with the thickness, internal stress, etc. of the material to be cut. Machining defects may arise from inappropriate cutting conditions and result in a burst, and laser beam reflections can cause fire.

Operation must always be placed under the supervision of a person in order to immediately take measures against burst and fire caused by machining defects and laser beam reflections, respectively, and to perform necessary adjustments.

### 2-3-6 Precautions related to maintenance

Fully understand the contents of the MAINTENANCE MANUAL before starting maintenance.



**DANGER**

- Users are not permitted to adjust or repair electrical components of the laser oscillator. Ask Mazak service engineer for such work.



**WARNING**

- Shut down and lock the main breaker to prevent someone from misoperating the main breaker or CNC panel switches by mistake.
- Stand a big signboard near a location of maintenance which requires power on so that any unconcerned person may not touch the machine. Be sure that such a maintenance be carried out by two persons or more as each can give a sign and confirm every operation step each other to go to the next step. In addition, if the maintenance needs no pneumatic pressure, stop it before maintenance.
- Residual voltage stays for a while after the power is shut down. So don't start maintenance until the maintaining circuit is checked by a gauge that no voltage is left.

### 2-3-7 Precautions related to workplace



**WARNING**

- Don't put your hand or finger between a belt and a pulley, a chain and a sprocket, etc.
- Start a machine operation after you have mounted back a cover, etc. in place.
- Provide a countermeasure to protect floor feeding cables, etc. from a short circuit caused by cut chips or the like.



**CAUTION**

- After a maintenance, keep everything (environmental and maintenance parts) in order and wipe off water and oil so as to get a safe and normal operation back.

### 2-3-8 Safety devices

The laser machine system has safety devices like doors, covers, interlocks, emergency stop switch, etc. to ensure operator's and machine safety.



**WARNING**

- The machine is provided with various devices for the operator's safety. Never cancel any of the devices. Failure to observe this instruction could result in serious harm to a human life or body.

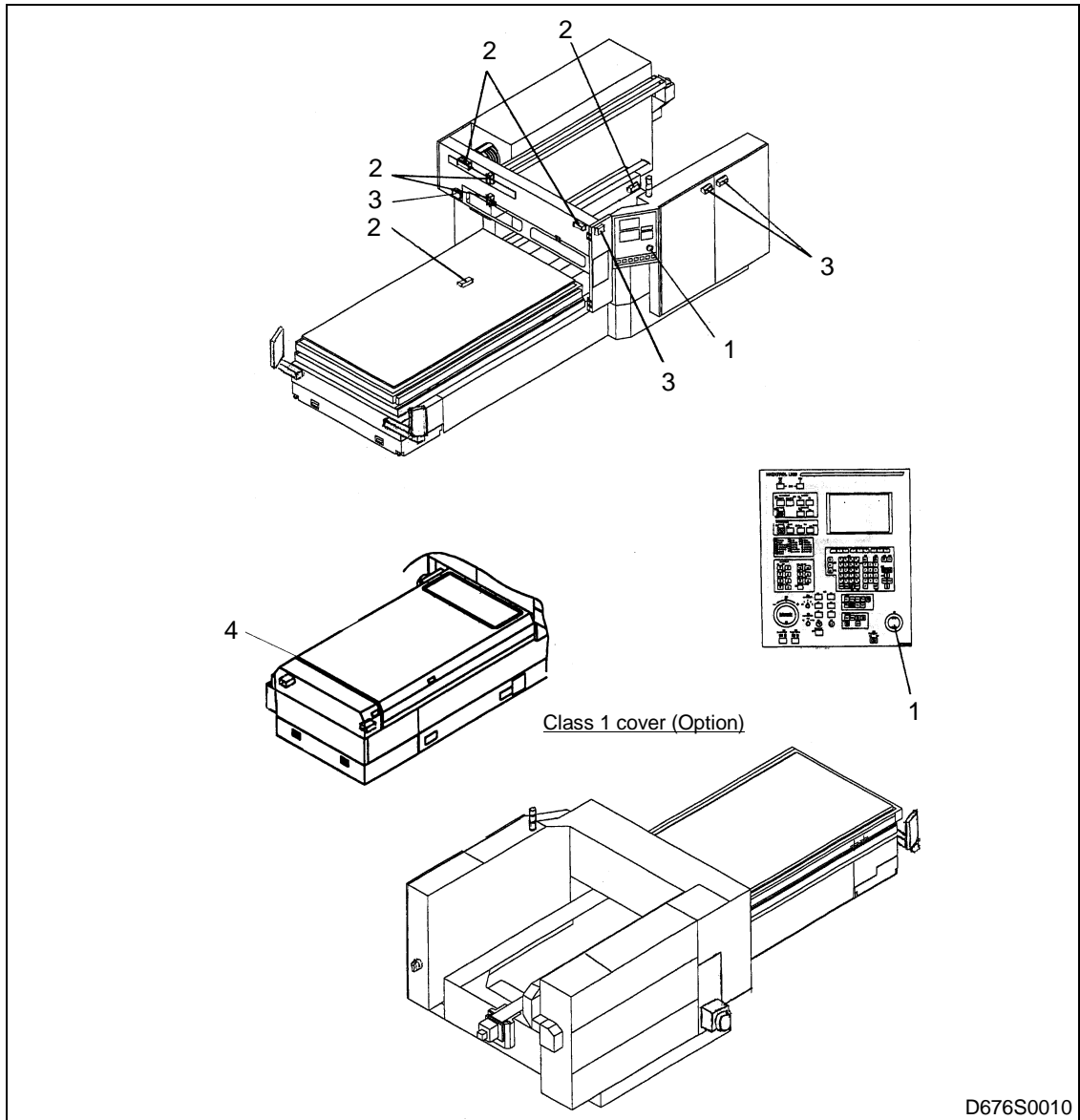


Fig. 2-14 Safety devices of the machine

No.	Part	Description
1	Emergency stop button	Pressing the button on the operation panel stops the machine, closes the beam shutter, and shuts off the laser high-voltage.
2	Over-travel switches (hardware and software)	The switches control the X, Y, and Z axial travels, which are also controlled by software.
3	Safety interlock switches	<ul style="list-style-type: none"> <li>- Installed in the electric cabinet door When the electric cabinet door is opened, the power breaker trips to prevent an unexpected electric shock.</li> <li>- Front door, operator's door When the front door or the operator's door is opened in the automatic operation, the machine will be placed in the feed hold state. In the manual operation, the axis feed rate is limited to F2000.</li> </ul>
4	Touch switch of the optional Class 1 cover	Turing on the touch switch at the end of the Class 1 cover stops the cover motion to prevent a human body from being caught.
5	Light barrier (not provided for a machine having an Class 1 cover)	The Light barrier shields the table periphery of the laser beam machine by activating photoelectric sensors to prevent the machine operator from inadvertently touching or getting caught in the machine during operation. Contact with the sensors brings the machine to a feed-hold stop.

## **1. Light barrier interlock specifications**

When the light barrier detects an obstruction (that is, the interception of the sensor light), the following status will result:

### **A. Message display on the monitor**

When the light barrier detects the obstruction, the message “284 LIGHT BARRIER” will be displayed.

### **B. Ladder hold of the sensor-detected status**

Once the light barrier has detected the obstruction, ladder software holds the sensor-detected status. The sensor-detected status will remain held, even when the light barrier is reset (the intercepted status of the sensor light is cleared).

Press the reset key or the clear key to clear the sensor-detected status.

### **C. Deactivation of automatic operation**

Automatic operation cannot be executed (the cycle start button is inoperative) under the sensor-detected status (when “284 LIGHT BARRIER” is displayed). During automatic operation, when the light barrier operates, an alarm message will be displayed and the machine will come to a feed-hold stop.

Clear the alarm status by pressing the clear key, and then press the cycle start button. Automatic operation can then be continued.

Automatic operation cannot be continued if the alarm status is cleared by pressing the reset key.

### **D. Conditional permission of manual operations**

The axes moving in either the JOG, rapid feed, or homing mode will stop when the light barrier operates. Axial movement at a speed of 2 m/min or less in the JOG, rapid feed, or homing mode can be restarted by pressing the required key while holding down the PERMISSION button. (The required key here, namely, the key to be pressed while holding down the PERMISSION button, refers to the axis direction selection button for the JOG, rapid feed, or homing mode.)

Manual homing operation requires the sensor-detected status (the display of the alarm “284 LIGHT BARRIER”) to be cleared beforehand.

Handle feed is possible (does not stop) since it is independent of the light barrier.

Laser beam emission (shutter operation/discharge) is possible (does not stop) since it is independent of the light barrier.

### **E. Deactivation of the light barrier with the safety fence remaining closed (Only in the case of system specifications)**

For a cell system or a flexible manufacturing system, if the safety fence remains closed, the light barrier of the laser machine will be deactivated. Even if the light barrier detects an obstruction, the detection itself will be ignored.

The light barrier is valid only when the safety fence is open.

#### **F. Self-diagnosis of the light barrier sensors**

If the light-receiving ratio decreases below 50%, the light barrier sensors will detect their own abnormality and generate an error output signal.

This state is caused by trouble with the sensors themselves, misalignment of their optical axes, or the presence of dirt on the light-receiving or light-projecting surface.

When the light barrier sensors generate the error output signal, the message “252 LIGHT BARRIER ALARM” will be displayed and the laser machine will come to an alarm stop. As a result, automatic operation will be impossible.

Manual operations (JOG, homing, and handle feed operations) can be performed without any limitations.

Laser beam emission (shutter operation/discharge) is impossible (no laser beam is emitted).

To clear the alarm status, press the reset key or the clear key after removing the cause of the alarm by replacing, adjusting, or cleaning the sensors.

#### **G. Deactivation of on-alarm power cutoff by the display of an “MOP20 LIGHT BARRIER” message**

On-alarm power cutoff will not be conducted, even when the light barrier operates.

On-alarm power cutoff will be conducted if “252 LIGHT BARRIER ALARM” occurs.

### **2. Light barrier interlock specifications on the 2-pallet changer (optional)**

When the light barrier on the 2-pallet changer side detects an obstruction (that is, the interception of the sensor light), the following status will result:

#### **A. Message display on the monitor**

When the light barrier detects the obstruction, the message “275 PALLET LIGHT BARRIER” will be displayed.

#### **B. Ladder hold of the sensor-detected status**

Once the light barrier has detected the obstruction, ladder software holds the sensor-detected status. The sensor-detected status will remain held, even when the light barrier is reset (the intercepted status of the sensor light is cleared).

Press the reset key or the clear key to clear the sensor-detected status.

#### **C. Deactivation of automatic operation**

Pallet change operation cannot be executed under the sensor-detected status. During automatic operation, when the light barrier operates, an alarm message will be displayed and the machine will come to a feed-hold stop.

Clear the alarm status by pressing the clear key, and then press the cycle start button. Automatic operation can then be continued.

Automatic operation cannot be continued if the alarm status is cleared by pressing the reset key.

#### **D. Conditional permission of manual operations**

When the SETUP switch is set to “1”, the pallet changer can be moved at a speed of 2 m/min or less.

The pallet changer will stop when the light barrier operates.

**E. Self-diagnosis of the light barrier sensors**

If the light-receiving ratio decreases below 50%, the light barrier sensors will detect their own abnormality and generate an error output signal.

This state is caused by trouble with the sensors themselves, misalignment of their optical axes, or the presence of dirt on the light-receiving or light-projecting surface.

When the light barrier sensors generate the error output signal, the message “252 LIGHT BARRIER ALARM” will be displayed and the laser machine will come to an alarm stop. As a result, automatic operation will be impossible.

To clear the alarm status, press the reset key or the clear key after removing the cause of the alarm by replacing, adjusting, or cleaning the sensors.

**F. Deactivation of on-alarm power cutoff**

On-alarm power cutoff will not be conducted, even when the light barrier operates.

On-alarm power cutoff will be conducted if “252 LIGHT BARRIER ALARM” occurs.

2-3-9 Safety plates on the machine

To prevent accidents, safety plates are attached on the laser machine body, peripheral equipment, and other places which are suspected to be dangerous or mis-operated because of the characteristics of the laser machine. Always follow the precautions instructed in the safety plates.

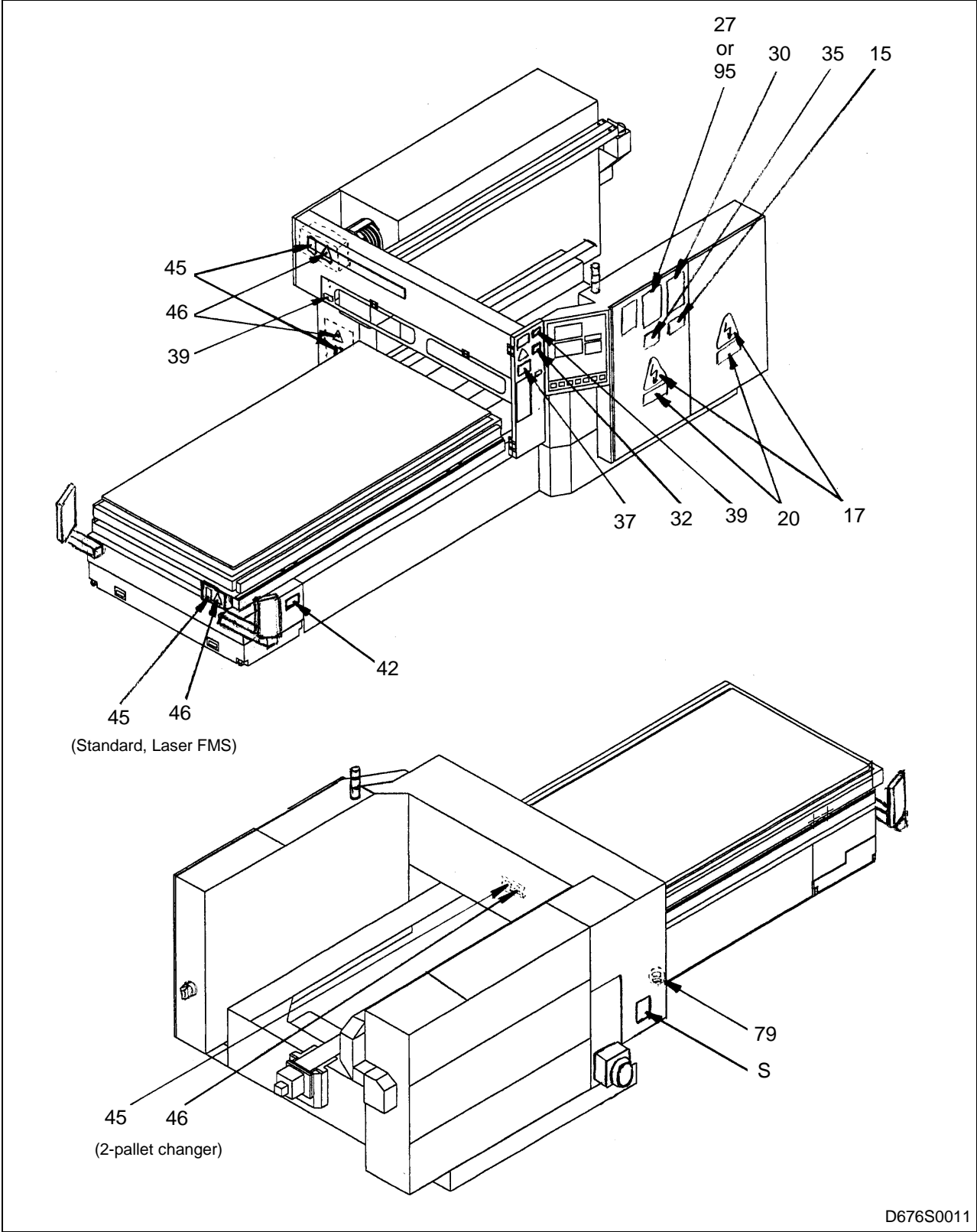


Fig. 2-15 Safety plates on the machine (1/2)

D676S0011

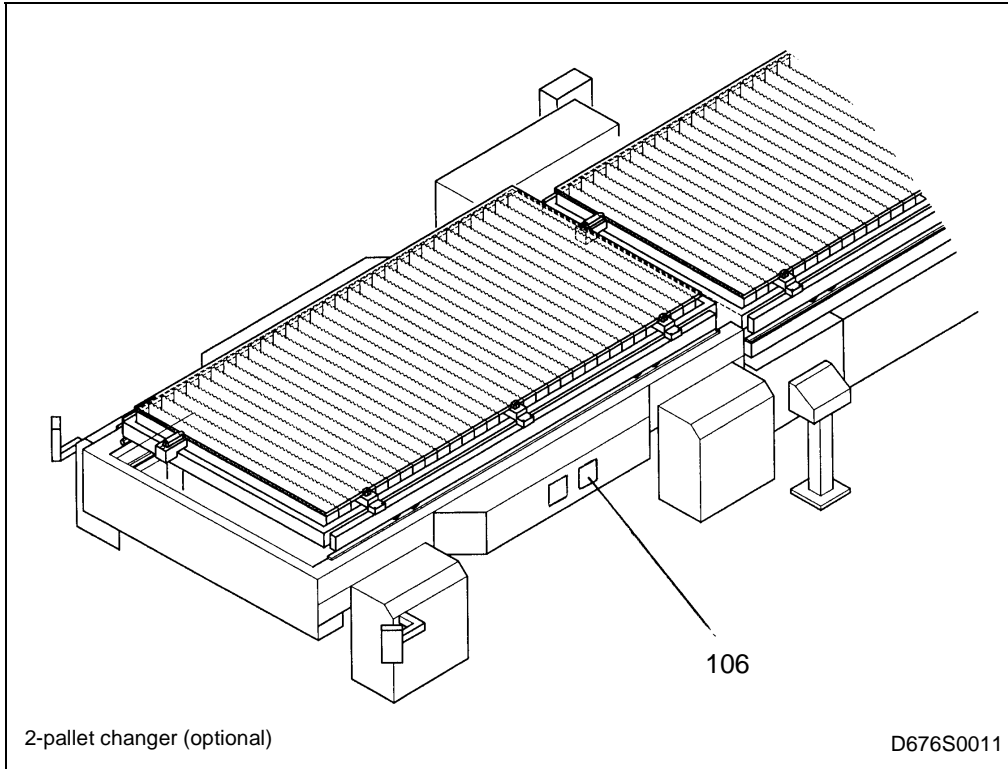


Fig. 2-16 Safety plates on the machine (2/2)

30.

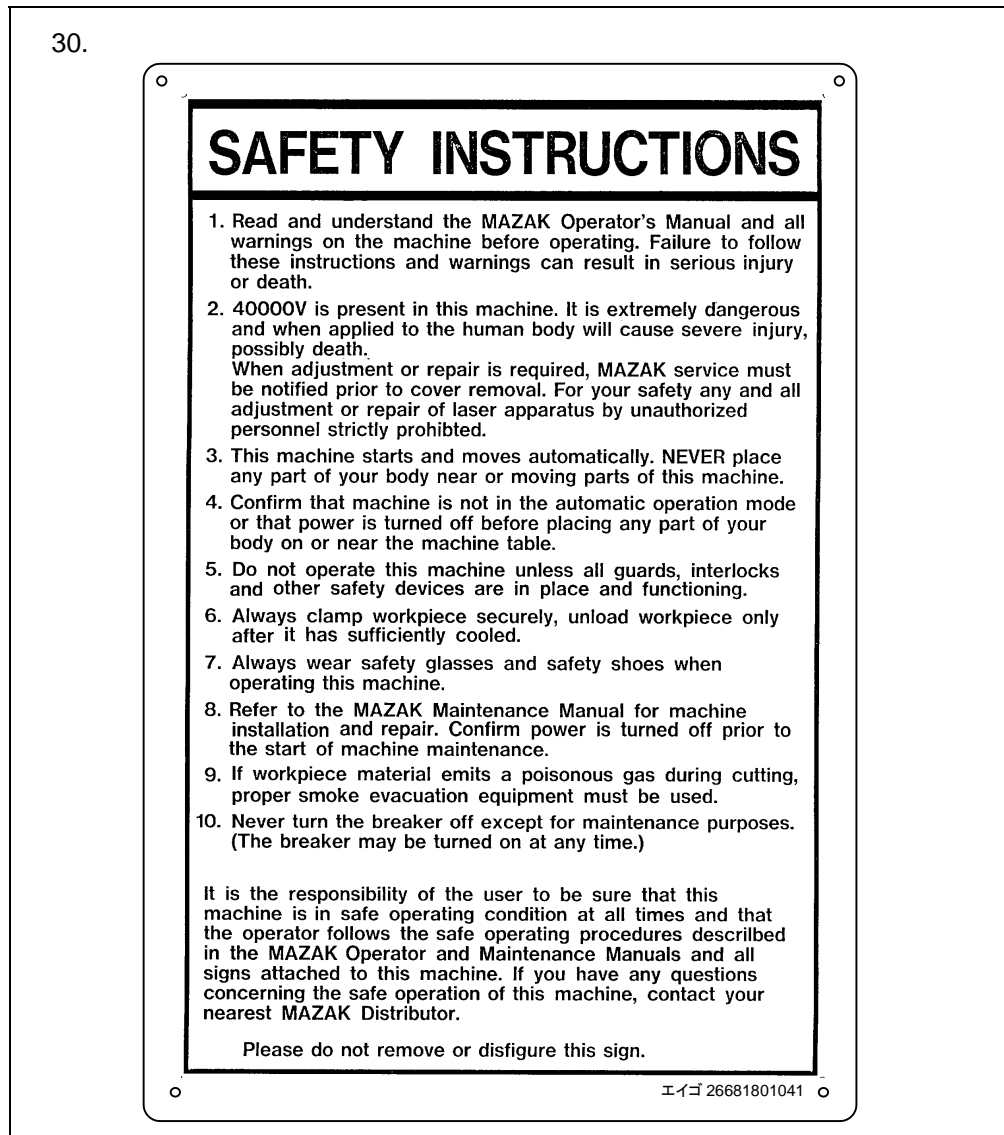
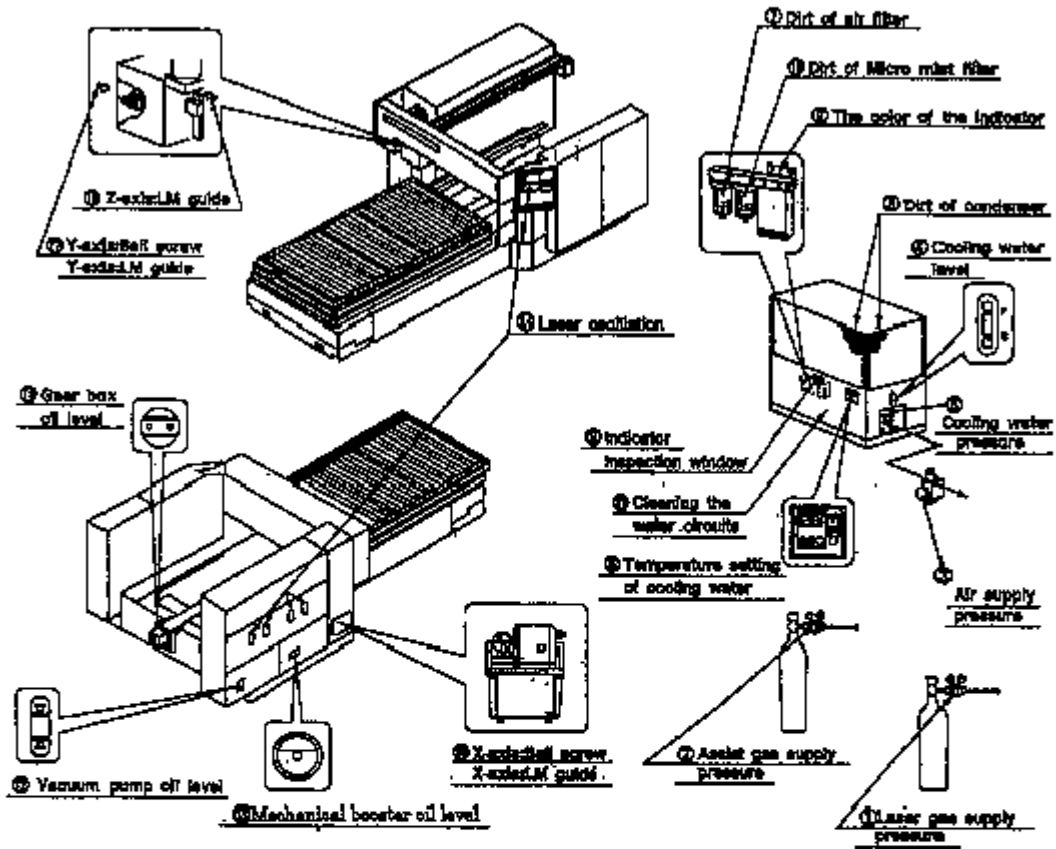


Fig. 2-17 Safety plate

# Daily Maintenance and Inspection Items



For safe operation please check the following items before running the laser machine. The detailed operating contents of following items refer to a conservative explanation.

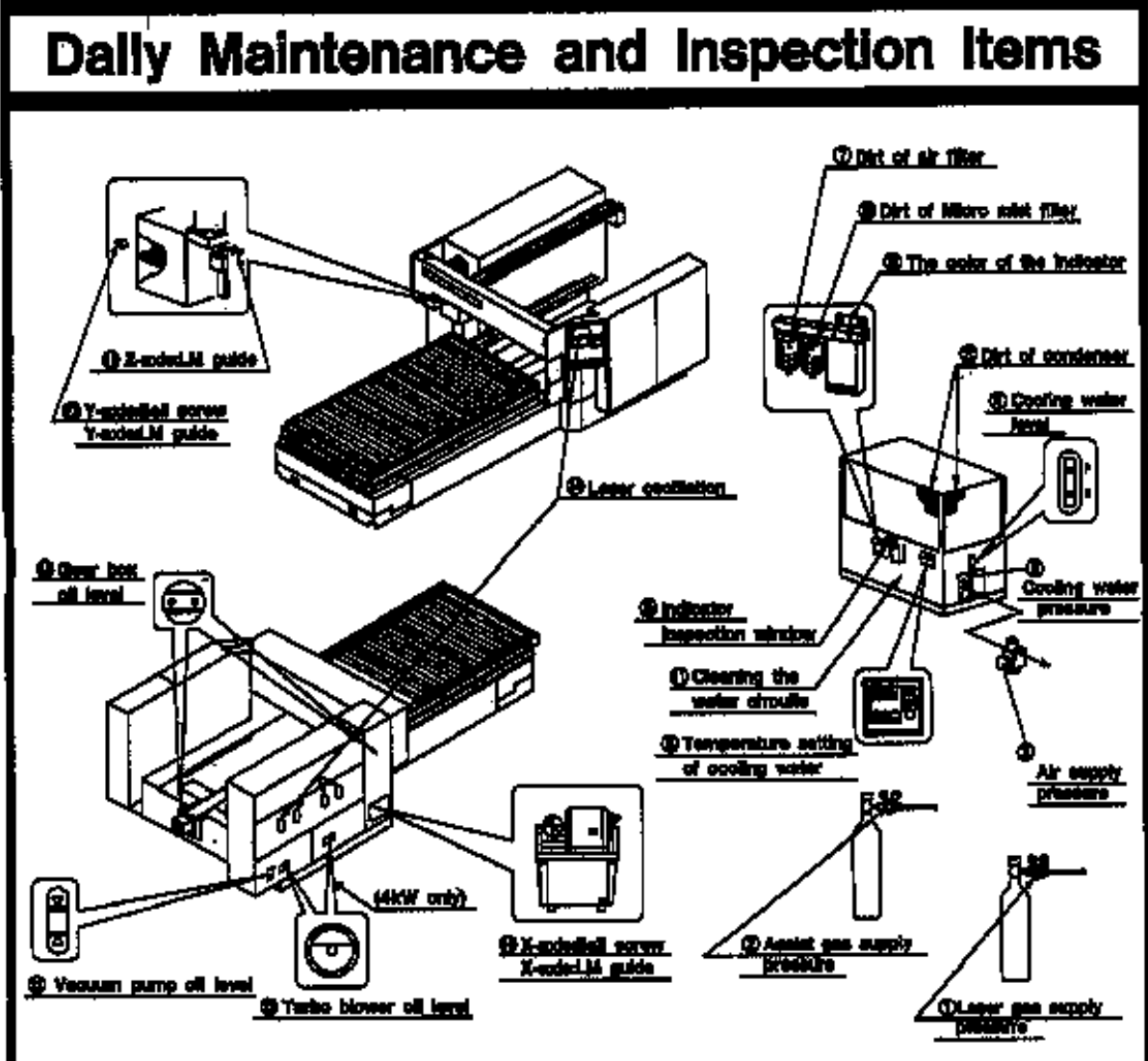
No.	Inspection Item	Conditions	Interval	No.	Inspection Item	Conditions	Interval
1	Laser gas supply pressure	Primary the pressure Min. 0.08MPa (Gauge) Secondary the pressure 0.02MPa (Gauge) (Check during operation)	Daily	14	Mechanical booster oil level	When indicator level (check every 1 year) ULTRACOL, ULTRACOL R-4 (J.S.L.) Power indicator of according to order	Every 2000h of operation or every 1 year
2	Assist gas supply pressure	Primary the pressure Min. 0.08MPa (Gauge) Secondary the pressure 0.02MPa (Gauge) (Check during operation)	Daily	15	Laser excitation		Daily
3	Air supply pressure	Min. 0.7MPa (Gauge) (Check during operation)	Daily	16	Gear box oil level	When indicator level (check every 2000h) SHELL TYPICAL No.2 SHELL OIL No.2 SHELLMOLB 220	Adjustment 2000h
4	Cooling water level	Indicator level	Daily				
5	Cooling water pressure	Min. 0.02MPa (Gauge) When the dry contact for laser operation is available.	Daily				
6	Temperature setting of cooling water	T,SD	Daily				
7	Dirt of air filter	When reaches the stop and fault.	Cleaning every 1000h				
8	Dirt of air condenser	When reaches the stop and fault.	Cleaning every 1000h				
9	Dirt of the indicator	When reaches the stop and fault.	Cleaning every 1000h				
10	Dirt of Micro mist filter	When reaches the stop and fault.	Cleaning every 1000h				
11	Clearing the water circuit	When reaches the stop and fault.	Cleaning every 1000h				
12	Vacuum pump oil level	When indicator level (check every 2000h) SHELL OIL No.2	Adjustment 2000h				

**Oiling Chart-Oil recommendations and oiling intervals.**

No.	Supply location	Approval	Model	Recommended oil	Remarks
14	X-axis/Ball screw	Approx. 100	1	MOBIL	When indicator level (every 2000h)
15	X-axis/M guide	Approx. 100	1	VACUUMBLOC	When indicator level (every 2000h)
16	Y-axis/Ball screw	Approx. 100	1	MOBIL	When indicator level (every 2000h)
17	Y-axis/M guide	Approx. 100	1	MOBIL TPO	When indicator level (every 2000h)
18	Z-axis/M guide	Approx. 100	1	MOBIL TPO	When indicator level (every 2000h)

Fig. 2-18 Daily maintenance and inspection items (1.5 kW, 1.8 kW)

27.



For safe operation please check the following items before starting the laser machine. The detailed operating contents of following items refer to a conservative operation.

No.	Inspection Item	Condition	Interval	No.	Inspection Item	Condition	Interval																													
1	Laser gas supply pressure	Primary Air pressure: Min. 0.4MPa (Gauge) Secondary Air pressure: Min. 0.2MPa (Gauge) Check during operation	Daily	16	Laser beam alignment	When indicator level When indicator level When tube of CO <sub>2</sub> laser When tube of CO <sub>2</sub> laser	Every 1000 hours of operation or every 1 year																													
2	Assist gas supply pressure	Primary Air pressure: Min. 0.4MPa (Gauge) Secondary Air pressure: Min. 0.2MPa (Gauge) Check during operation	Daily	17	Laser gas supply pressure	When indicator level When indicator level	Before every shoot																													
3	Air supply pressure	Min. 0.4MPa (Gauge) Check during operation	Daily	18	Cooling Chart-Oil recommendations and oiling intervals	<table border="1"> <thead> <tr> <th>Supply location</th> <th>Amount</th> <th>Unit</th> <th>Recommended oil</th> <th>Remarks</th> </tr> </thead> <tbody> <tr> <td>X-axis LM guide</td> <td>---</td> <td>---</td> <td>MOSH</td> <td>When indicator level</td> </tr> <tr> <td>Y-axis LM guide</td> <td>---</td> <td>---</td> <td>Turbo oil No.2</td> <td>Every 2 months</td> </tr> <tr> <td>Y-axis LM guide</td> <td>Approx. 100cc</td> <td>---</td> <td>MOSH</td> <td>Oil level</td> </tr> <tr> <td>X-axis LM guide</td> <td>Approx. 50cc</td> <td>---</td> <td>Mobilux 2PO</td> <td>Oil level</td> </tr> <tr> <td>Z-axis LM guide</td> <td>Approx. 10cc</td> <td>---</td> <td>---</td> <td>Oil level</td> </tr> </tbody> </table>	Supply location	Amount	Unit	Recommended oil	Remarks	X-axis LM guide	---	---	MOSH	When indicator level	Y-axis LM guide	---	---	Turbo oil No.2	Every 2 months	Y-axis LM guide	Approx. 100cc	---	MOSH	Oil level	X-axis LM guide	Approx. 50cc	---	Mobilux 2PO	Oil level	Z-axis LM guide	Approx. 10cc	---	---	Oil level
Supply location	Amount	Unit	Recommended oil				Remarks																													
X-axis LM guide	---	---	MOSH	When indicator level																																
Y-axis LM guide	---	---	Turbo oil No.2	Every 2 months																																
Y-axis LM guide	Approx. 100cc	---	MOSH	Oil level																																
X-axis LM guide	Approx. 50cc	---	Mobilux 2PO	Oil level																																
Z-axis LM guide	Approx. 10cc	---	---	Oil level																																
4	Cooling water level	Indicator level Check during operation	Daily	19	Micro mist filter	When indicator level When indicator level	Every 1000 hours of operation or every 1 year																													
5	Cooling water pressure	Min. 0.2MPa (Gauge) Check for any defect for laser operation to occur	Daily	20	Condenser	When indicator level When indicator level	Every 1000 hours of operation or every 1 year																													
6	Temperature setting of cooling water	WFO	Daily																																	
7	Dirt of air filter	Never reveals the strips and check	Monthly																																	
8	Dirt of air filter	Never reveals the strips and check	Monthly																																	
9	Dirt of Micro mist filter	Never reveals the strips and check	Monthly																																	
10	Dirt of Micro mist filter	Never reveals the strips and check	Monthly																																	
11	Clearing the water circuits	Check and adjust of water circulating condition	Every 2 weeks																																	
12	Temperature setting of cooling water	WFO	Daily																																	
13	Oil level	When indicator level When indicator level	Every 1000 hours of operation or every 1 year																																	
14	Indicator inspection window	When indicator level When indicator level	Every 1000 hours of operation or every 1 year																																	
15	Clearing the water circuits	Check and adjust of water circulating condition	Every 2 weeks																																	
16	Laser beam alignment	When indicator level When indicator level	Every 1000 hours of operation or every 1 year																																	
17	Laser gas supply pressure	When indicator level When indicator level	Before every shoot																																	
18	Cooling Chart-Oil recommendations and oiling intervals	When indicator level When indicator level	Before every shoot																																	
19	Micro mist filter	When indicator level When indicator level	Every 1000 hours of operation or every 1 year																																	
20	Condenser	When indicator level When indicator level	Every 1000 hours of operation or every 1 year																																	

Fig. 2-19 Daily maintenance and inspection items (2.5 kW, 4 kW)

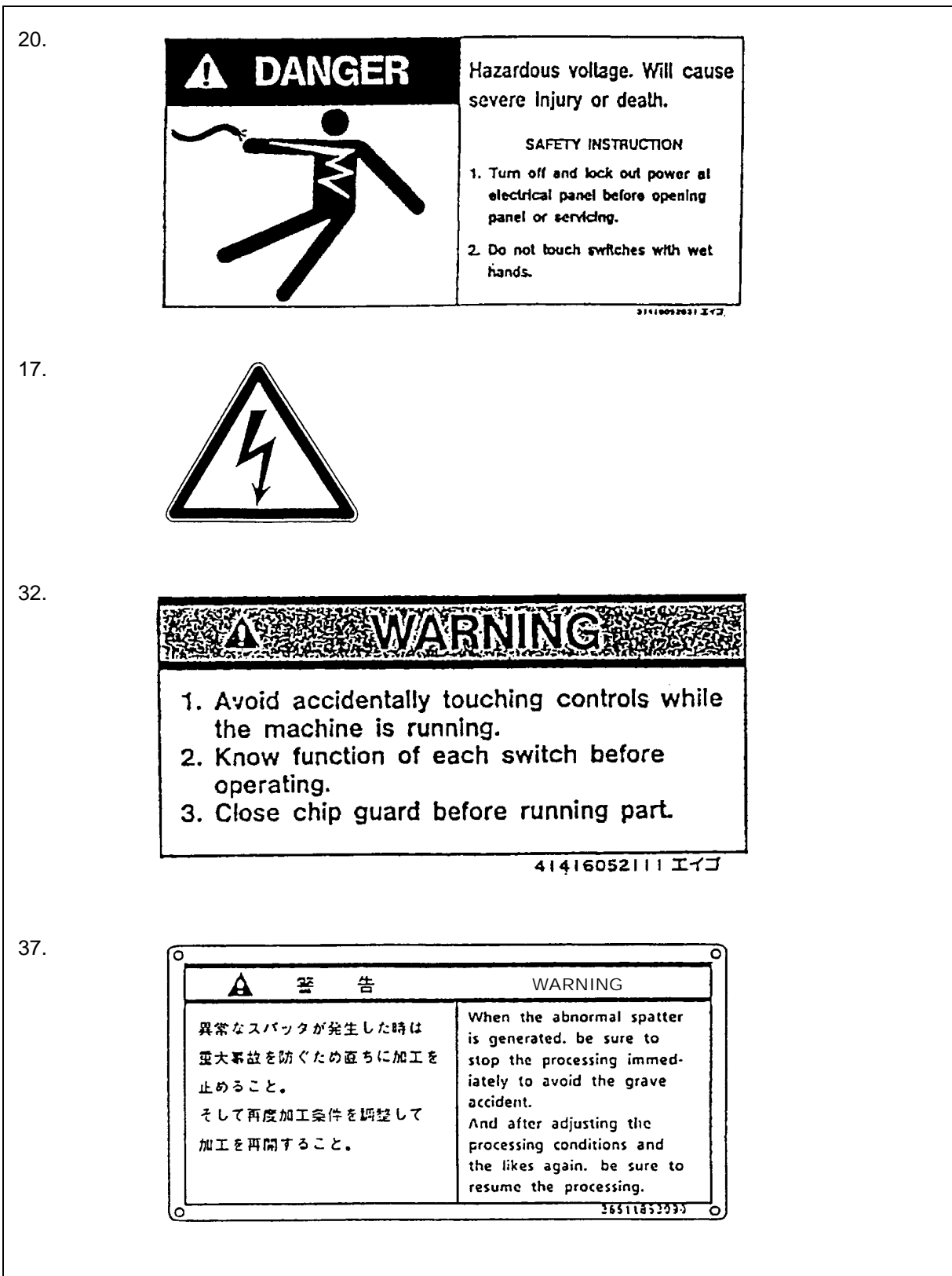
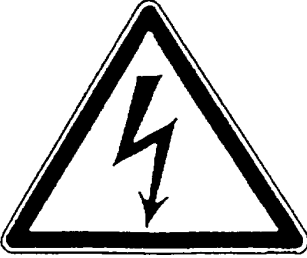



Fig. 2-20 Safety plates

46. 

45. 

Hazardous voltage.  
Will cause severe injury or death.  
Turn off and lock out power at electrical panel before opening panel or servicing.

41416051920 エイゴ

S.

注意 CAUTION	
<p><u>排気装置清掃要領</u></p> <p>排気装置の目づまり防止の為、月に最低一度は、下記に示す各部の清掃を行って下さい。</p> <ol style="list-style-type: none"> <li>1. 排気装置</li> <li>2. プレダスタ 清掃口を開け、内部のカーボン堆積物を排出して下さい。</li> <li>3. ダクトホース ダクトバンドをゆるめ、ダクトホースを外し、内部のカーボン堆積物を排出して下さい。</li> <li>4. 吸引込み口</li> </ol>	<p><u>CLEANING EXHAUST UNIT</u></p> <p>Clean up the area mentioned as below at least once a month for the purpose of preventing dust from sticking on the filter.</p> <ol style="list-style-type: none"> <li>1. Exhaust Unit</li> <li>2. Pre-Duster Open cleaning hole cover (door) and take out the accumulated carbon and the like from the inside.</li> <li>3. Duct (Hose) Release the hose band, remove the duct (hose) and take out the accumulated carbon and the like from the inside.</li> <li>4. Suction hood.</li> </ol>

24331732721  
LP111-00303

Fig. 2-21 Safety plates

42.



15.



79.



39.

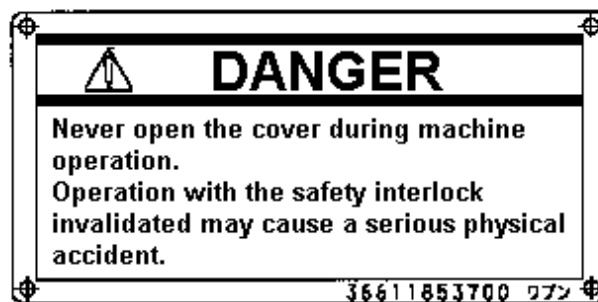
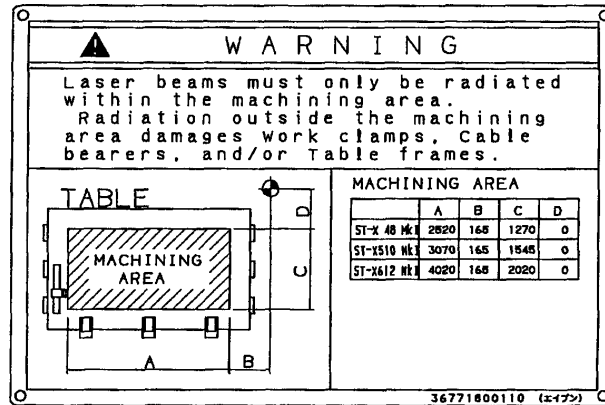
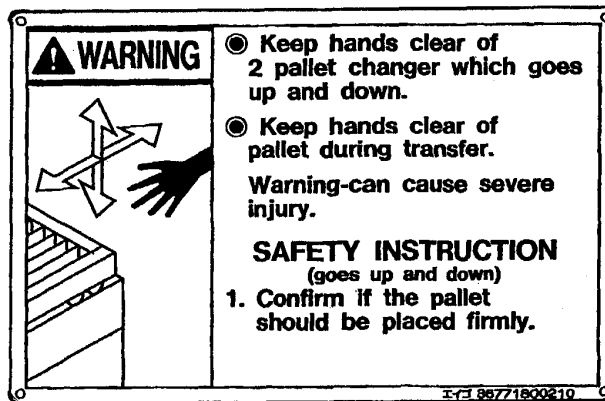


Fig. 2-22 Safety plates

35.



106.



D676S0019

Fig. 2-23 Safety plates

2-3-10 Safety plates on the laser resonator and the laser power unit

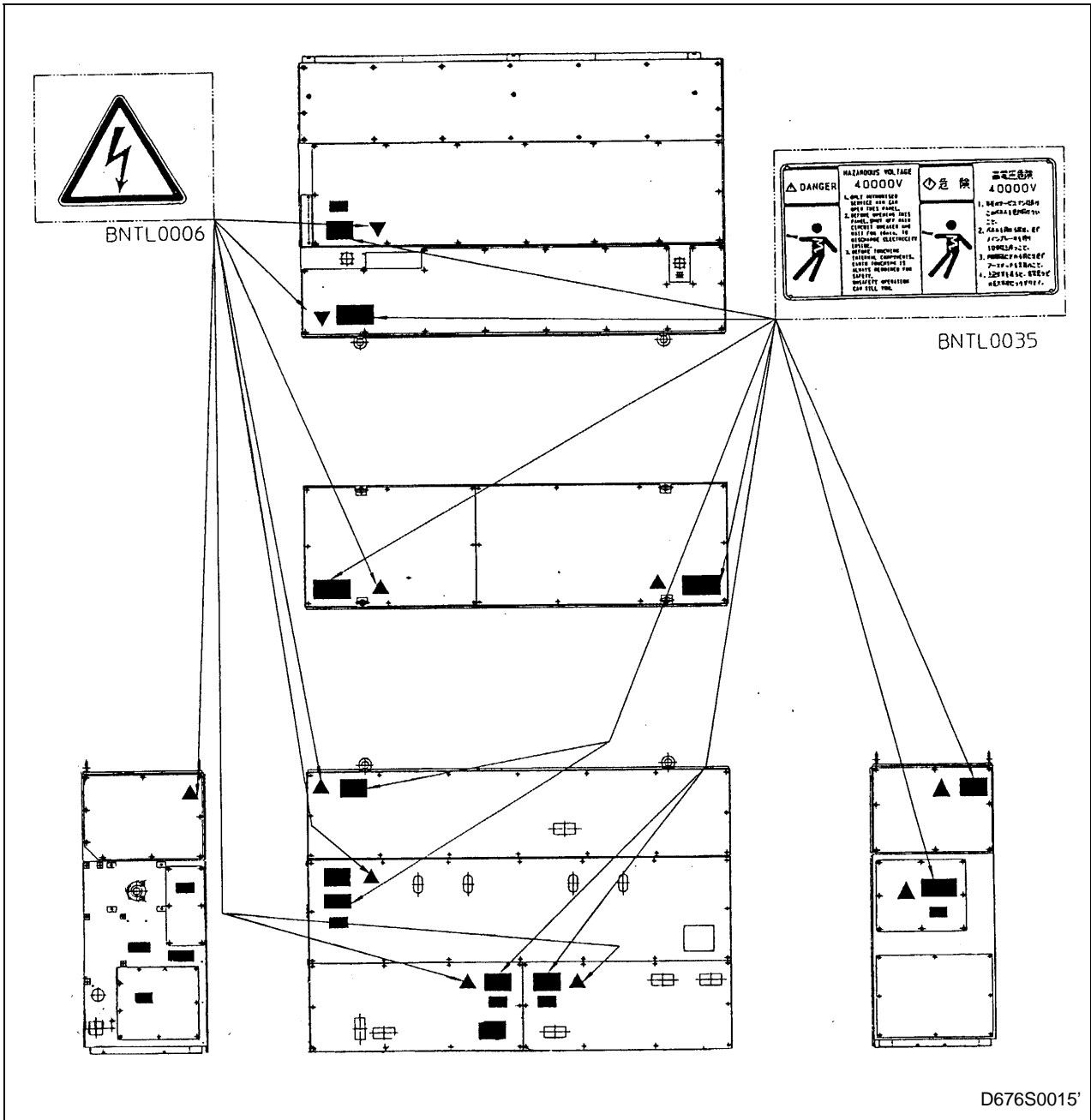


Fig. 2-24 Safety plates (laser resonator and laser power unit) (1.5 kW, 1.8 kW laser system)

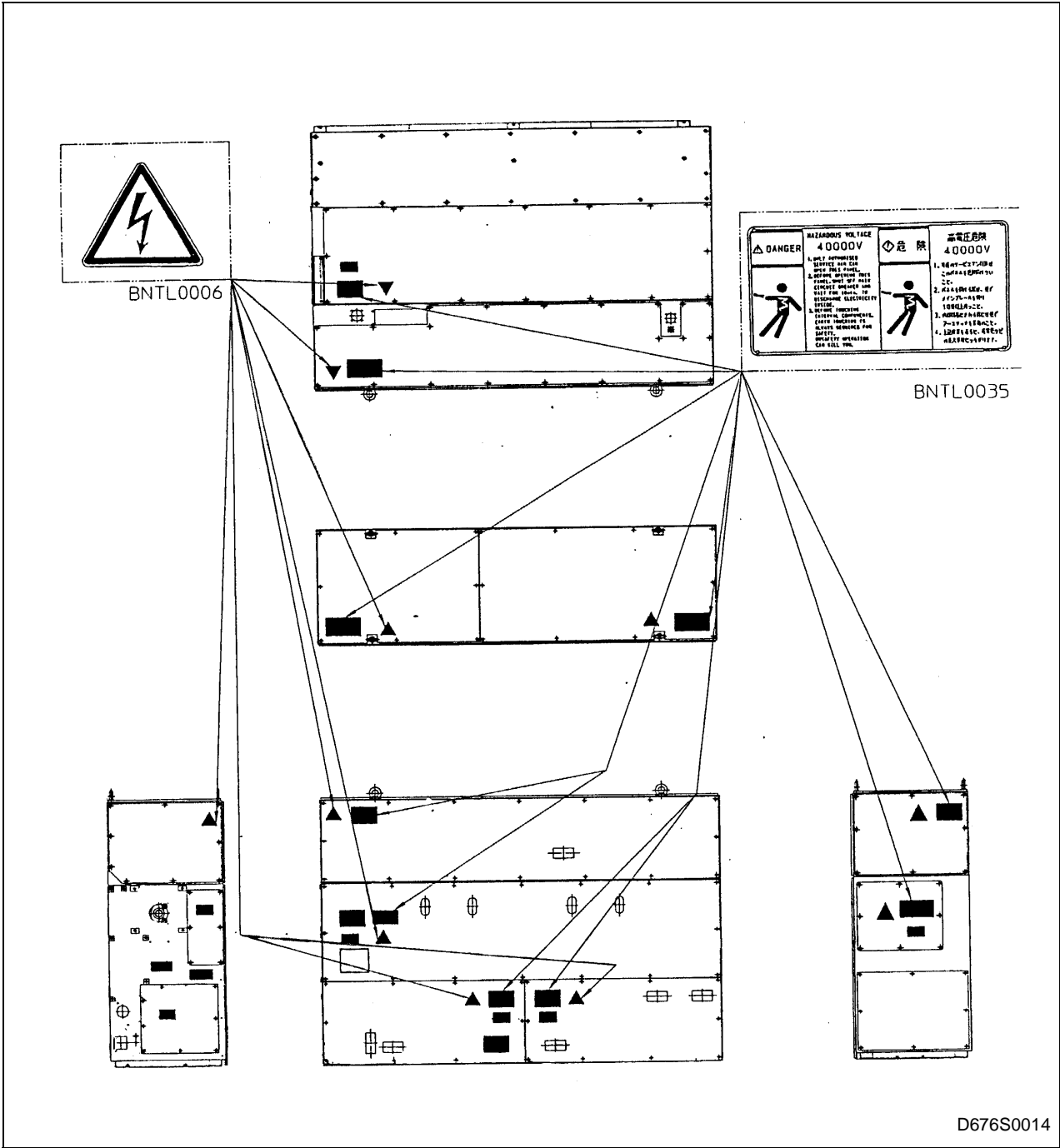


Fig. 2-25 Safety plates (laser resonator and laser power unit) (2.5 kW laser system)

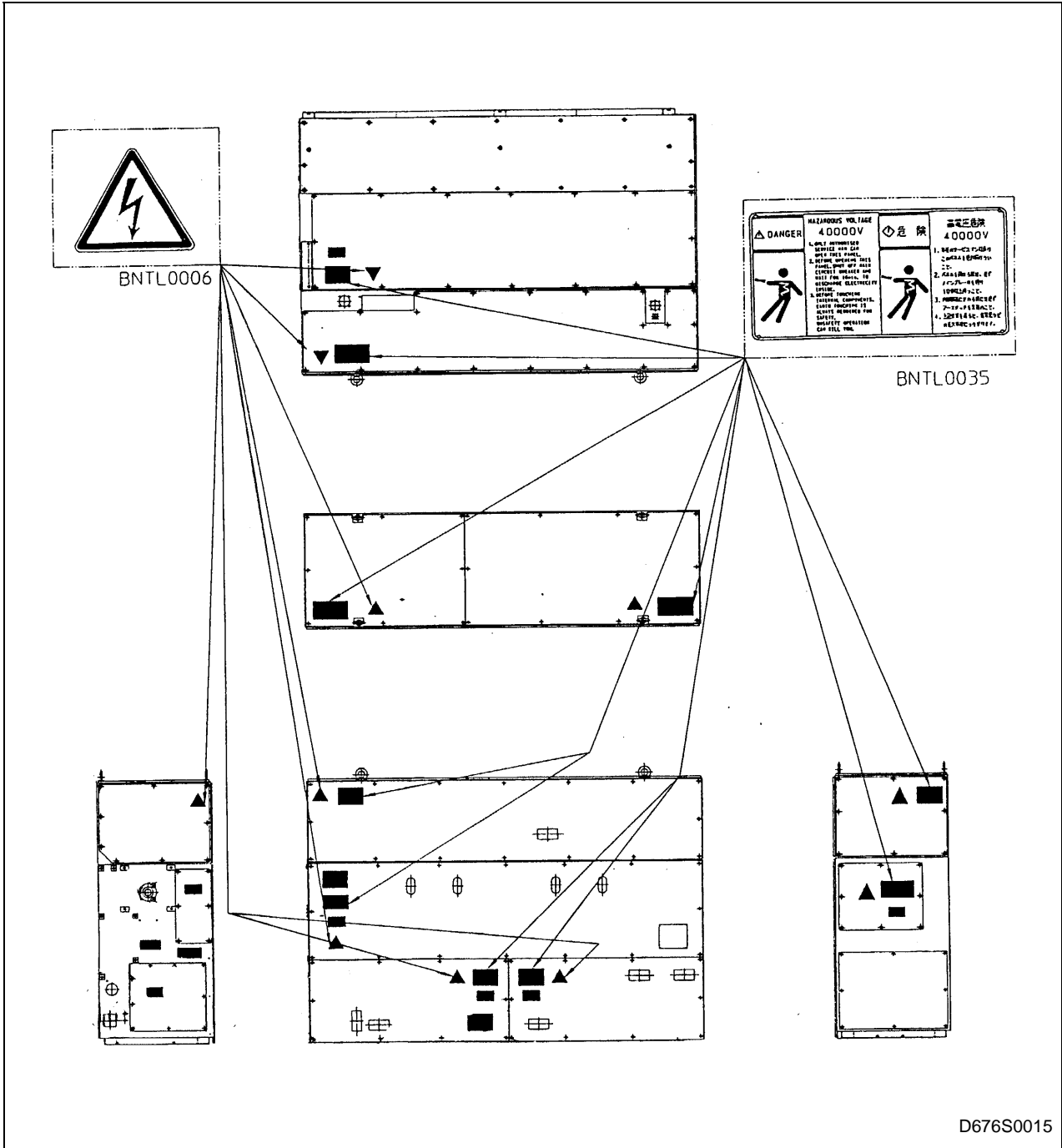


Fig. 2-26 Safety plates (laser resonator and laser power unit) (4 kW laser system)

### 2-3-11 Others

When the knife edge supporter is required to change, be sure to mount it so that the knife edge top level does not come above the level of the carbide insert (clamping jaws) of the worksheet clamp. Otherwise the worksheet is shifted and a machining defect will occur.

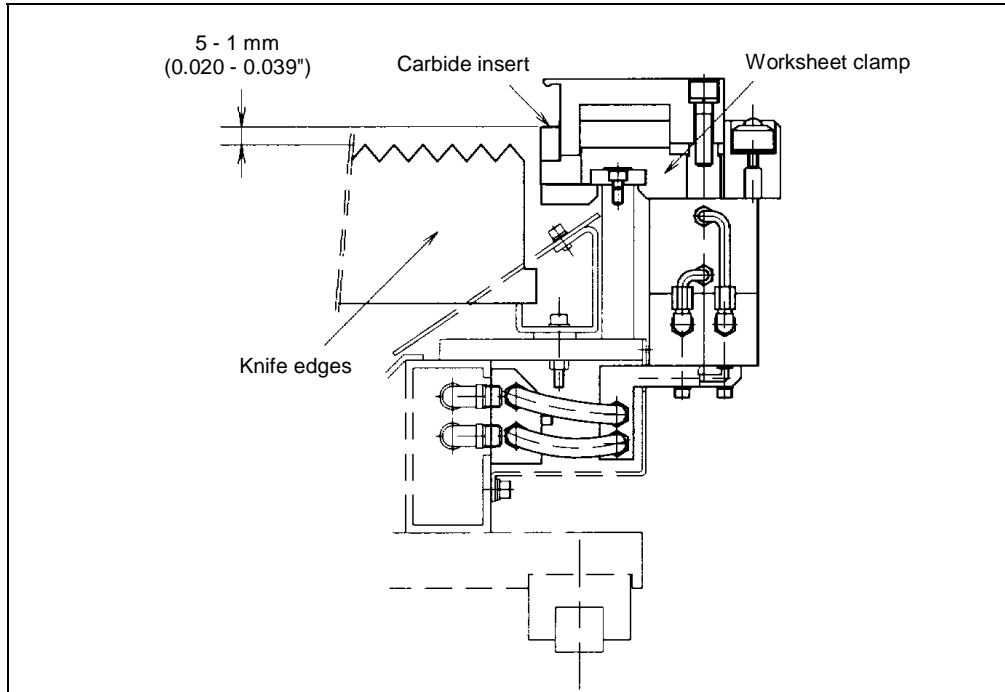


Fig. 2-27 Precautions on replacing the knife edge supporter

## 2-4 Installation Precautions

To ensure safe operation of the laser machine, note the following during installation.

### 2-4-1 Wiring

1. Be sure to use electrical conductors with performance ratings equivalent or superior to those described in the maintenance manual.
2. Do not connect to the power distribution panel any power cables for devices which can cause line noise, such as are welders and induction hardening machines.
3. Arrange for a qualified engineer to connect the power lines.

**2-4-2 Grounding**

The following conforms to first class grounding construction procedures in Section 18 of the Japan Technical Standard of Electrical Installation Manual.

Use a grounding wire with a cross section of more than 22 mm<sup>2</sup> (0.034 in<sup>2</sup>) and a resistance to ground of less than 10 ohms.

Generally, the laser machine should be grounded to a separate grounding rod. If an independent ground cannot be provided for the machine, prepare the ground connection as follows.

1. Connect a single conductor to its own grounding terminal. This will avoid possible serious accidents resulting from ground currents which might otherwise flow in the laser machine if a peripheral device should malfunction.
2. A separate grounding wire should be used, one whose length is as short as possible.
3. Check the resistance to ground by actual measurement. This should measure less than 10 ohms if a single device is connected to its own grounding rod.



- Do not use a building steel frame as a grounding electrode.

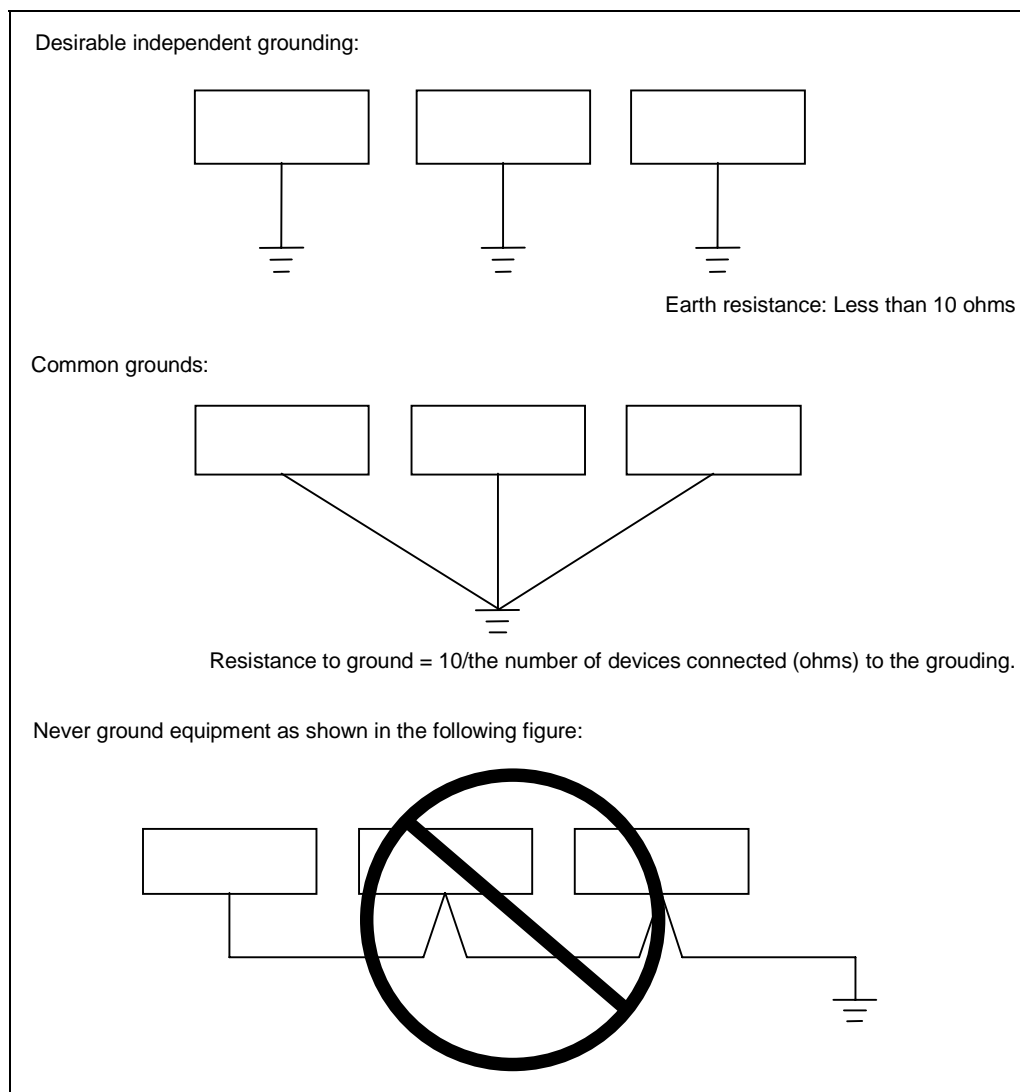


Fig. 2-28

### 2-4-3 Gas and air pipings

The laser machine uses laser gas for the laser oscillator, assist gas (oxygen, nitrogen, or high-pressure air, etc.) for machining, and air for the laser machine drive and dust prevention. Qualities of these gases and air piping for them largely effect machining performance and machine life.

#### 1. Laser gas

1. Use only mixed gas specified.
2. The laser gas especially hates water, so purchase the specified gas from well-controlled supplier of bombs.
3. Use a bomb regulator with a 2-step pressure and less variable supply pressure which qualify the following specifications:  
Primary pressure: 14.72 MPa (2134.5 PSI)  
Secondary pressure: 0 - 0.29 MPa (0 - 42.7 PSI)  
Flow amount: More than 50 NL/min [0.25 MPa (35.6 PSI)]
4. To prevent contamination from the piping materials use teflon tubes for the gas piping from the laser gas cylinder to the oscillator.
5. Gas piping between the laser oscillator and the gas bomb must be free from gas leakage, otherwise the gas mixture rate in the laser oscillator changes and consequently it drops the laser output or damages equipment.

#### 2. Assist gas

##### A. Oxygen or nitrogen

1. Use oxygen or nitrogen containing less than 5 PPM water and of more than 99.9% purity. Otherwise machining fails.
2. Use a bomb regulator which qualifies the following specifications:  
Primary pressure: 14.72 MPa (2134.5 PSI)  
Secondary pressure: 0 - 1.96 MPa (0 - 284.6 PSI)  
Flow amount: More than 320 NL/min [0.78 MPa (113.8 PSI)]  
Insufficient flow amount causes machining failure due to pressure loss.
3. When you use a liquefied gas, be sure to use an evaporator whose capability is more than double of the flow amount. Otherwise it invites pressure drop as well as equipment failures due to invasion of cold gas into the gas control circuit.
4. To prevent gas leakage or impurity invasion from gas piping use metallic pipes.
5. Flush rust and foreign materials off the pipe interior. Otherwise the gas control system fails.
6. Oxygen gas is flammable, so the pipe interior must be free from petroleum, oil, grease, and other flammable materials.

##### B. High-pressure air

1. Dirty air invites lens damage and machining failure. Use a filter and a drier to remove oil and water out of air.
2. Check the drain, oil, and filter of the compressor as specified so that dirty air does not come out.
3. Provide a receiver tank in the high-pressure air circuit to prevent pulsation from occurring.

**3. Air for the laser machine drive and dust prevention**

1. Air for laser machining is used for protecting the laser oscillator and the optical system from dust. Dirty air or wet air damages the oscillator and optical equipment.
2. Air containing dirty air or moisture will damage the laser oscillator or optical components.
3. Never let the laser machining air be mixed with organic compounds or solvents. Otherwise the beam diffuses to cause cutting failures.
4. Provide a drain hole at a concave portion and at a pipe rising portion to drain water from the pipe between the compressor and the chiller import.
5. If air contains water, provide a drain at the chiller import to take water out. Otherwise the filter type drier will be damaged.
6. Air must be supplied at a pressure from 0.5 to 0.8 MPa (71.2 to 113.8 PSI) and a flow rate of 200 NL/min (7 ft<sup>3</sup>/min).

**4. Cooling water specifications**

**A. Water quality**

Use the water which conforms to the following water quality standard:

Standard items	pH	(25°C)	6.0 to 8.0
	Conductivity	μS/cm (25°C)	< 200
	Chloride ion	Cl <sup>-</sup> (ppm)	< 20
	Sodium ion	SO <sub>4</sub> <sup>2-</sup> (ppm)	< 50
	Methyl orange alkalinity	CaCO <sub>3</sub> (ppm)	< 50
	Total hardness	CaCO <sub>3</sub> (ppm)	< 50
Reference items	Iron	Fe (ppm)	< 0.3
	Sulfur ion	S <sup>2-</sup> (ppm)	Does not detect
	Ammonium ion	NH <sub>4</sub> (ppm)	< 0.3
	Ionic silica	SiO <sub>2</sub> (ppm)	< 30

**Note 1:** Normal service water is satisfied with the above standard. However, some districts may bear greater values. In such a case, we recommend you use distilled water.

**Note 2:** Never use industrial water or underground water for this purpose.

**B. Additives**

It is recommended that the following cooling water additives be used to adjust the water quality in areas with particularly poor water quality, to wash out the cooling water system, and to prevent freezing in areas with particularly cold weather. Before using any additive, first consult with the manufacturer of the chiller. In addition, be sure to refer to the additive instructions for information regarding usage precautions and handling methods.

- Water quality adjustment agent      CONTLIME K-6000      (Mitsubishi Gas Chemical)
- Washing agent                              DESLIME                      (Mitsubishi Gas Chemical)
- Anti-freeze                                    Aurora Brine                      (Tokyo Fine Chemical)

**Note:** For the piping in the water recirculation circuit use materials that will not rust or corrode (stainless steel, brass).

### 5. Air for an optional FMS

1. The FMS air is used to suck a worksheet and to move the loader/unloader vertically. Dirty or wet air will clog filters to shorten filter lives.

### 6. Air for a dust collector

1. Dirty air and wet air cause filter clogs and shorten filter life. So air is needed to blow dust off the filters of the dust collector.

### 7. Others

With the compressor

1. It is necessary to confirm the amount of air discharge for selecting a compressor.
2. Use a compressor whose catalogued air discharge capacity is at least 1.2 times the amount of air required for the laser machine.  
When converted for removal of moisture and accommodation of temperature changes, the air discharge capacity of the compressor decreases in the amount of air which can be actually used.
3. If a reciprocating compressor is continuously driven at its power limit, air contains oil and carbides which deteriorate machining accuracy or burns the compressor.
4. Select a reciprocating compressor which can provide 1.4 times or more of necessary power.
5. Do not install a compressor at a paint shop or a place near organic compounds or a dust generating area.

## 2-4-4 Environmental conditions

Generally, the machine will have the following specifications. However, these may change over a period of time or in response to seasonal changes.

Supply voltage:	+10 to -10% rated supply voltage
Source frequency:	Rated frequency $\pm 1$ Hz
Ambient temperature:	0 to 35°C (0 to 95°F)
Humidity:	Max. 85% (Temperature changes should not cause condensation.)
Atmosphere:	Free from excessive dust, acid fumes, corrosive gases and salt.
Exposure to direct sunlight or heat rays which can change the environmental temperature should be avoided.	
Avoid exposing the NC machine to abnormal vibration.	
Maximum acceleration:	0.07 G
Maximum amplitude:	7 $\mu$

If it is difficult to meet these conditions, contact us immediately.

- NOTE -

### 3 SPECIFICATIONS

#### 3-1 Specifications of the Laser Machine Body

Table 3-1 Specifications of the laser machine body

Items	Specifications			Remarks
Machine model	ST-X48 MkII	ST-X510 MkII	ST-X612 MkII	
Type	Hybrid type			X axis: Table shift Y axis: Laser shift
Max. machining size	1250 × 2500 mm (49.21 × 98.43 in.)	1525 × 3050 mm (60.04 × 120.08 in.)	2000 × 4000 mm (78.74 × 157.48 in.)	In case of mild steel ( <b>Note 1</b> ) <b>Thickness:</b> 22 mm (0.87 in.) (2.5 kW) 25 mm (0.98 in.) (4 kW)
Height of work table	900 mm (35.43 in.)			From floor
Maximum weight load capacity	1.5 kW	300 kgf (661 lbs)	440 kgf (970 lbs)	Uniform load
	1.8 kW	400 kgf (882 lbs)	590 kgf (1301 lbs)	
	2.5 kW	550 kgf (1212 lbs)	810 kgf (1786 lbs)	
	4 kW	630 kgf (1389 lbs)	930 kgf (2050 lbs)	
Axis motion stroke	X-axis	2685 mm (105.71 in.)	3235 mm (127.36 in.)	4190 mm (164.96 in.)
	Y-axis	1270 mm (50.00 in.)	1545 mm (60.83 in.)	2020 mm (79.53 in.)
	Z-axis	100 mm (3.98 in.)		
Rapid traverse	X-, Y-axis: 24 m/min (944.88 IPM) Z-axis: 10 m/min (393.73 IPM)		X-, Y-axis: 20 m/min (787.4 IPM) Z-axis: 10 m/min (393.73 IPM)	
Max. machining feedrate	15 m/min (591 IPM)			
Axis drive system	AC servo motor X-, Y-axis: digital servo drive and ball screws Z-axis: digital servo drive and belts			X-axis: Automatic lubrication Y-, Z-axis: Manual grease lubrication
Positioning precision	X-, Y-axis: ±0.01/500 mm (±0.0004/19.69 in.) Z-axis: ±0.01/100 mm (±0.0004/3.94 in.)			<b>(Note 2)</b>
Repeatability	X-, Y-, Z-axis: ± 0.005 mm (±0.0002 in.)			
Cutting head	With lens of focal distance 190 mm (7.50 in.)			Pressure-proof: 1 MPa (142 PSI)
Z-axis profiling	Contact type, Z-axis follow type			
Worksheet clamp and locator	Three worksheet clamps (1.5 kW and 1.8 kW machines) Four worksheet clamps (2.5 kW and 4 kW machines) Five worksheet clamps (Only for ST-X612 Mk II) One locator			
Worksheet lifter	5 mm (0.20 in.) lifted by means of FREEVEYOR rotations			
Worksheet support type	100 mm (3.94 in.) pitch (1.5 kW and 1.8 kW)		Knife edge method	
	50 mm (1.97 in.) pitch (2.5 kW and 4 kW)			
Chip conveyor	Feedrate: 50 Hz: 2.2 m/min (86.6 IPM) 60 Hz: 2.6 m/min (102.4 IPM)			Built in the laser machine
Lighting device	68 W beam lamp is built in for illumination of the cutting portion.			
Oscillation indicator	Yellow signal lamp (laser high voltage ON) Red signal lamp (shutter open)			
Assist-gas switching device	Number of gas types: 3 Set pressure: 0.05 to 0.6 MPa (7.11 to 85.4 PSI) ( <b>Note 3</b> ) Supply pressure: 0.8 MPa (113.86 PSI)			Oxygen, air, the third gas Setting unit: 0.01 MPa (1.45 PSI)
Assist-gas pressure NC control function	Programming can set assist-gas pressure. Maximum pressure is 0.6 MPa (87.02 psi). ( <b>Note 3</b> )			For high-pressure gas line (option), setting is made manually.
Weight	11000 kgf (24250 lbs)	12700 kgf (27998 lbs)	20700 kgf (45635 lbs)	Including chiller unit

- Note 1:** Even for the same materials, maximum cutting thickness, feedrate and surface roughness vary with the unevenness of material factors and surface condition.
- Note 2:** Provided that the fundamental construction recommended by us is carried out and the machine is installed properly.
- Note 3:** When the nozzle diameter is 1.5 mm (0.06 in.) the pressure can be set at up to 0.6 MPa (85.3 PSI), but this is not necessarily so if the nozzle diameter changes.
- Note 4:** The figures indicated in the machine plates shall be applied if ones in the manual may differ.

### 3-2 Specifications of the Laser Oscillator

Table 3-2 Specifications of the laser oscillator

Item	Specifications				Remarks
	1.5 kW laser	1.8 kW laser	2.5 kW laser	4 kW laser	
Laser type	CO <sub>2</sub> gas laser				Far infrared light
Wave length	10.6 μm				Invisible ray
Oscillation mode, configuration	Coaxial type, high-speed axial type integrated oscillator and power unit type				
Continuous rated output	1500 W	1800 W	2500 W	4000 W	CW output
Output range	300 to 1500 W	360 to 1800 W	500 to 2500 W	800 to 4000 W	CW output
Pulse mode	Normal pulse (N/P)				
Pulse frequency and Pulse duty	0 - 1 kHz (N/P), 0 - 100% or 1 - 2 kHz (N/P), 20 - 100%				<b>(Note 1)</b>
Beam mode	Main component - TEM <sub>00</sub>				
Beam diameter	Maximum φ22.5 mm (0.89")				0.3 m (11.81 in.) from exit output mirror
Beam divergence angle	2.0 mrad				Total angular
Output stability	±2.0%				For rated output
Laser gas	Mixed gas of He, N <sub>2</sub> , and CO <sub>2</sub>				
Mixture rate of laser gas	He:N <sub>2</sub> :CO <sub>2</sub> = 74.9% (balanced):23.4 ± 1.0%:1.7 ± 0.2%				
Gas consumption (during continuous operation)	30 L/hr (1.06 ft <sup>3</sup> /hr)		50 L/hr (1.77 ft <sup>3</sup> /hr) (YB-L400A8M1, YB-L400A8M1E) 30 L/hr (1.06 ft <sup>3</sup> /hr) (YB-L400A8M2, YB-L400A8M2E)		<b>(Note 2)</b>
Beam shutter	Built-in mechanical shutter				
Miscellaneous	Circular polarized light unit and power monitor				

- Note 1:** The service range is limited by the combination of the pulse frequency and duty. For actual machining, follow the table of the recommended machining conditions.
- Note 2:** This becomes greater according to the frequency of starting/stopping (turning on/off) the laser machine.

### 3-3 CNC Unit Specifications

Table 3-3 CNC unit specifications

Name	MAZATROL L32B-N
CPU	32 bits
Control method	Semi-closed loop
Number of controlled axes	Simultaneous 3-axis control (X-, Y- and Z-axes), Z-axis profiling control also possible
Programming method	Interactive and EIA/ISO
Command system	Incremental/absolute
Servo specification	Digital servo system
Memory capacity	2000 m (6560.63 ft)
Display unit	9" monochrome EL
Laser processing functions	Interactive programming, Press mode input, Tool registration, Special shape tool registration, Pattern input, Program help display, Intersection calculation, Automatic determination of processing conditions, NC control of processing conditions, external adjustment of processing conditions, NC control of the focal point, Non-stepped NC control of the assist gas pressure, Profiling operation patterns, Laser output adaptive control.
Other functions	Single block, Feed rate override, Manual pulse generator, Automatic zero point return, Dwell, Sequence No. display, Stored pitch error compensation, Operation time display, Decimal point programming, Rapid traverse override, Automatic acceleration/ deceleration for feed, Stored stroke limit, Automatic discrimination of EIA/ISO, Self-diagnosis, Circular Interpolation by radius designation, Work coordinate system setting, Scaling, Optional angle chamfering/corner R, Programmable mirror image, Background editing, Program restart, Automatic corner override, Coordinate rotation.

### **3-4 Standard Functions and Accessories**

#### **1. Laser machine body (one set)**

It includes the following accessories:

- Z-axis profiler (contact type)
- Manual adjustable torch with a 7.5" focus lens
- Worksheet clamps and locator
- Worksheet lifter
- Chip conveyor
- Work light
- Oscillation indicator lamps
- Assist gas switching device
- Assist gas pressure NC control function

#### **2. Laser oscillator (one set)**

#### **3. CNC unit (one set)**

#### **4. Standard accessories (one set)**

- Chiller unit
- Air drier integrated in the chiller unit
- Dust collector system (excluding ST-X612 MkII)
- Lens cleaning set
- Alignment tool
- Adjusting tools
- Floor plates
- Manuals

### 3-5 Optional Functions and Accessories

- Preparation for mounting a dust collector (only for ST-X612 MkII)
- Dust collector system (only for ST-X612 MkII)
- Class 1 cover
- Manual adjustable torch with a 5" lens
- Manual adjustable non-contact torch with a 7.5" lens
- Manual adjustable non-contact torch with a 5" lens
- Automatic adjustable non-contact torch
- Pressure-resistant lens (1.5 MPa)
- High pressure-resistant lens (2 MPa)
- High-pressure air supply system (low noise type)
- 3rd high-pressure gas piping
- 4th high-pressure gas piping (including 3rd high-pressure gas piping)
- Super high-pressure gas piping (3rd, 4th)
- NC retry function
- Additional number of programs: 256, 512
- Resume profiler function
- Automatic power cutoff function
- Micro disk
- 2-pallet changer
- Laser FMS (Refer to the separate specifications.)
- Loader clamps
- Loader sensors
- DNC interface
- CAD/CAM system (Refer to the separate specifications.)
- Nitrogen gas generator

- NOTE -

## 4 EXTERNAL VIEW OF THE MACHINE

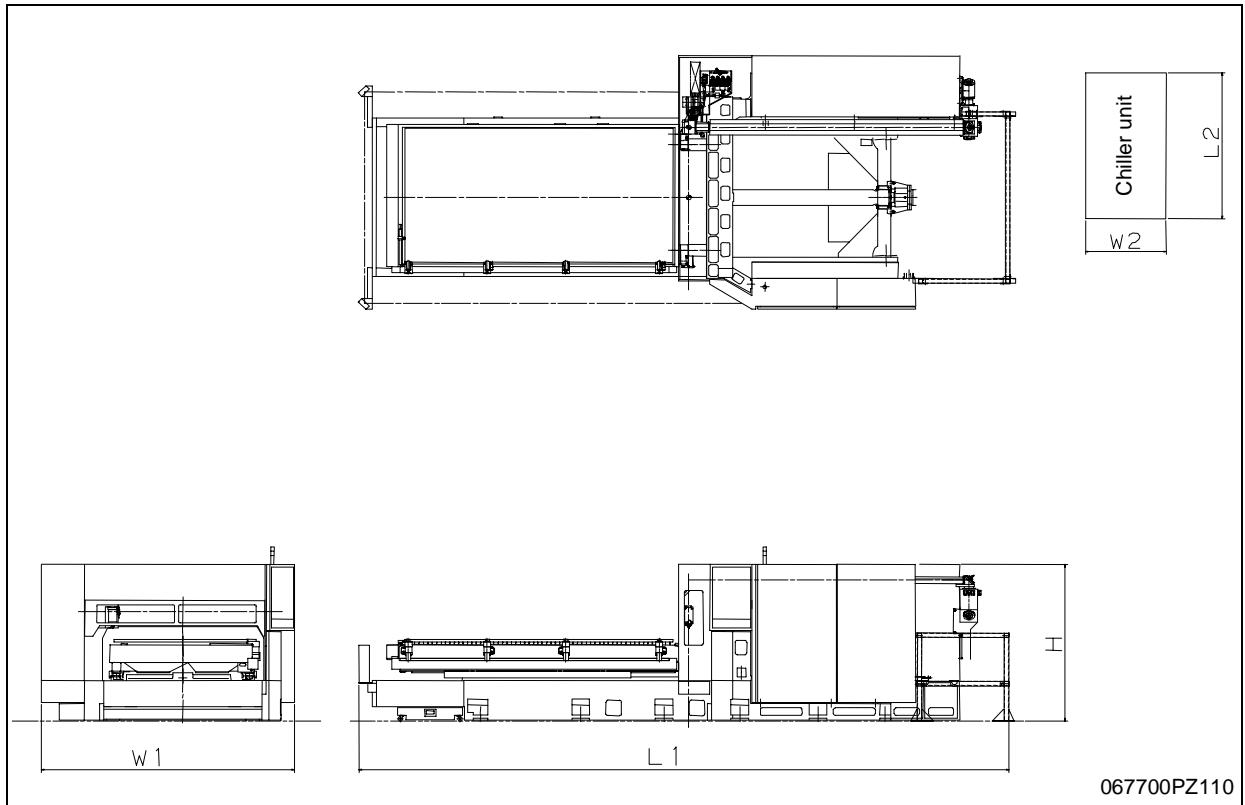


Fig. 4-1 External view of the machine

Symbol	ST-X48 MKII	ST-X510 MKII	ST-X612 MKII
L1	6340 mm (249.61 in.)	7400 mm (291.34 in.)	9365 mm (368.70 in.)
W1	2600 mm (102.36 in.)	2875 mm (113.19 in.)	3350 mm (131.89 in.)
H1	1780 mm (70.08 in.)		
L2	1602 mm (63.07 in.)		
W2	916 mm (36.06 in.)		

4

EXTERNAL VIEW OF THE MACHINE

---

- NOTE -

## 5 DESCRIPTION OF PARTS

### 5-1 Description of Each Machine Part

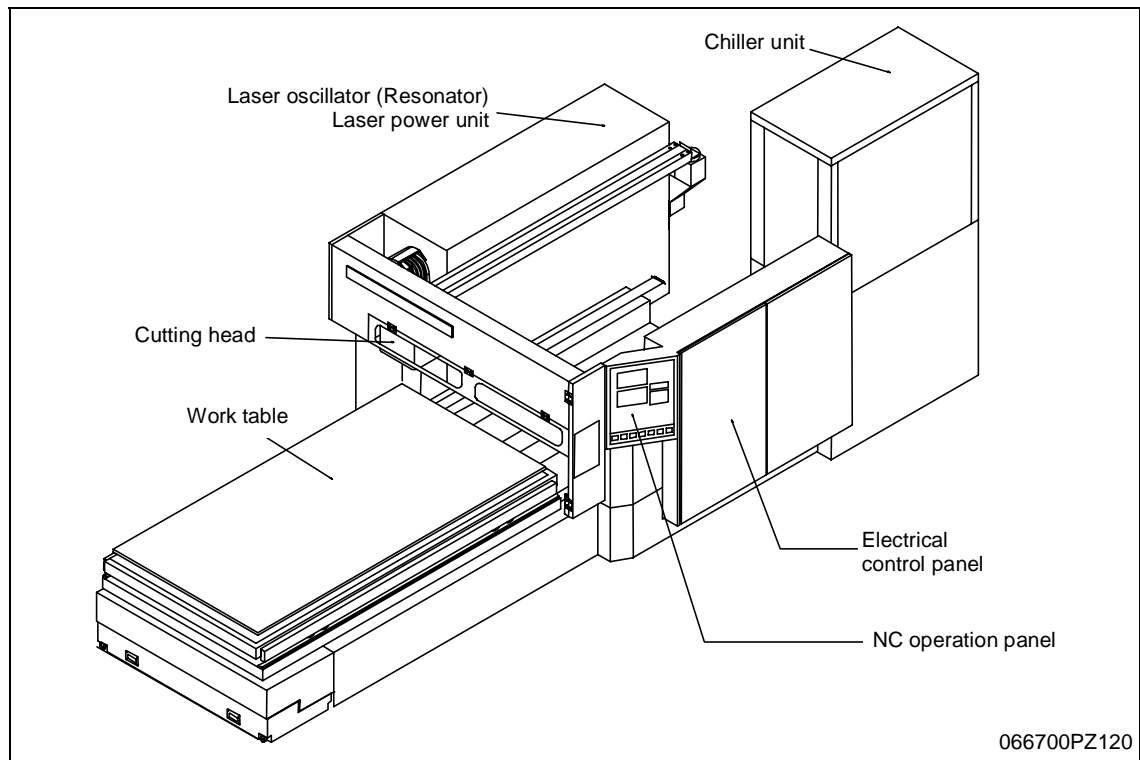


Fig. 5-1 Standard, Laser FMS specifications

### 5-2 Laser Optical System

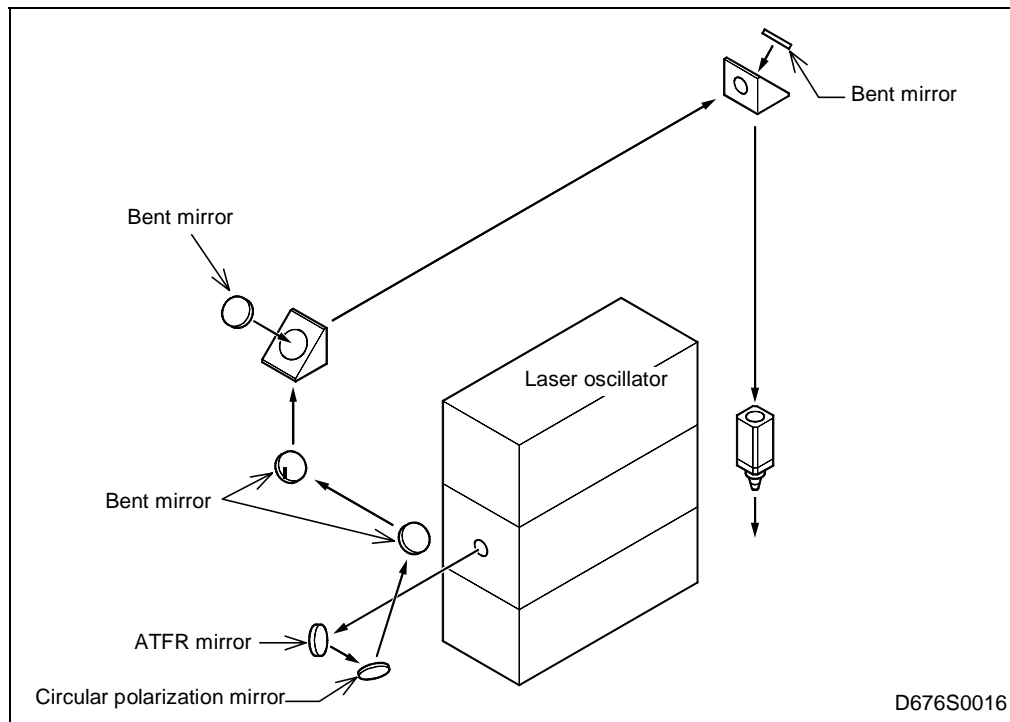


Fig. 5-2 Laser optical system (2.5 kW/4 kW)

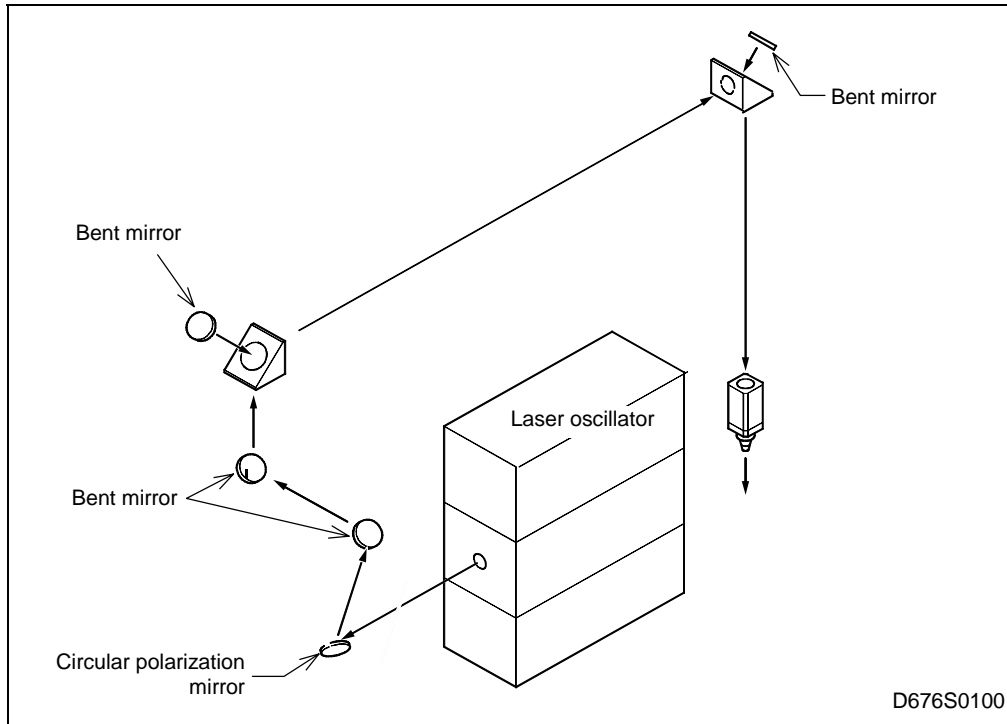
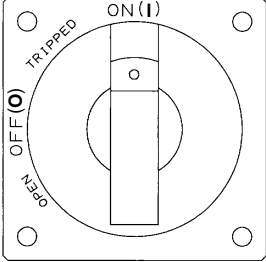
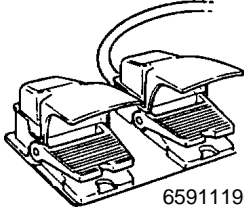



Fig. 5-3 Laser optical system (1.5 kW/1.8 kW)

## 6 OPERATION SWITCHES

### 6-1 Switches on the Control Panel

No.	Name	Function
1	Main power switch (Main circuit breaker handle) 	<p>This is the operating switch for the main circuit breaker connected to the primary side of the factory power supply. There is no power supply to the machine when this switch is set to OFF (O). When operating the machine, this switch must be turned on first.</p> <p>Set it to OPEN in order to open the control panel door. If a short circuit or some other connection problem occurs in the machine, or if the control panel door is opened with the power supply, the switch trips from the ON (I) position to the TRIPPED position. To turn it on again, remove the cause of the trip and check that the machine is safe. Then turn the switch to OFF (O), then back to ON (I). The switch cannot be switched directly from TRIPPED to ON (I).</p> <p>Take full care when the main power switch is on, as the main circuits are alive.</p>
2	Foot switch (STD, Laser FMS spec.) 	<ul style="list-style-type: none"> <li>- When the worksheet clamp is open (locator is up) and the right foot switch is pressed, the worksheet clamp closes (locator goes down).</li> <li>- When the worksheet clamp is closed (locator is down) and the right foot switch is pressed, the worksheet clamp opens (locator goes up).</li> <li>- When the worksheet lifter is up and the left foot switch is pressed, the worksheet lifter goes down.</li> <li>- When the worksheet lifter is down and the left foot switch is pressed, the worksheet lifter goes up.</li> </ul>
3	Foot switch (2-pallet changer spec.) 	<ul style="list-style-type: none"> <li>- When the worksheet clamp is open and the foot switch is pressed, the worksheet clamp closes.</li> <li>- When the worksheet clamp is closed and the foot switch is pressed, the worksheet clamp opens.</li> </ul>

6-2 NC Operation Panel

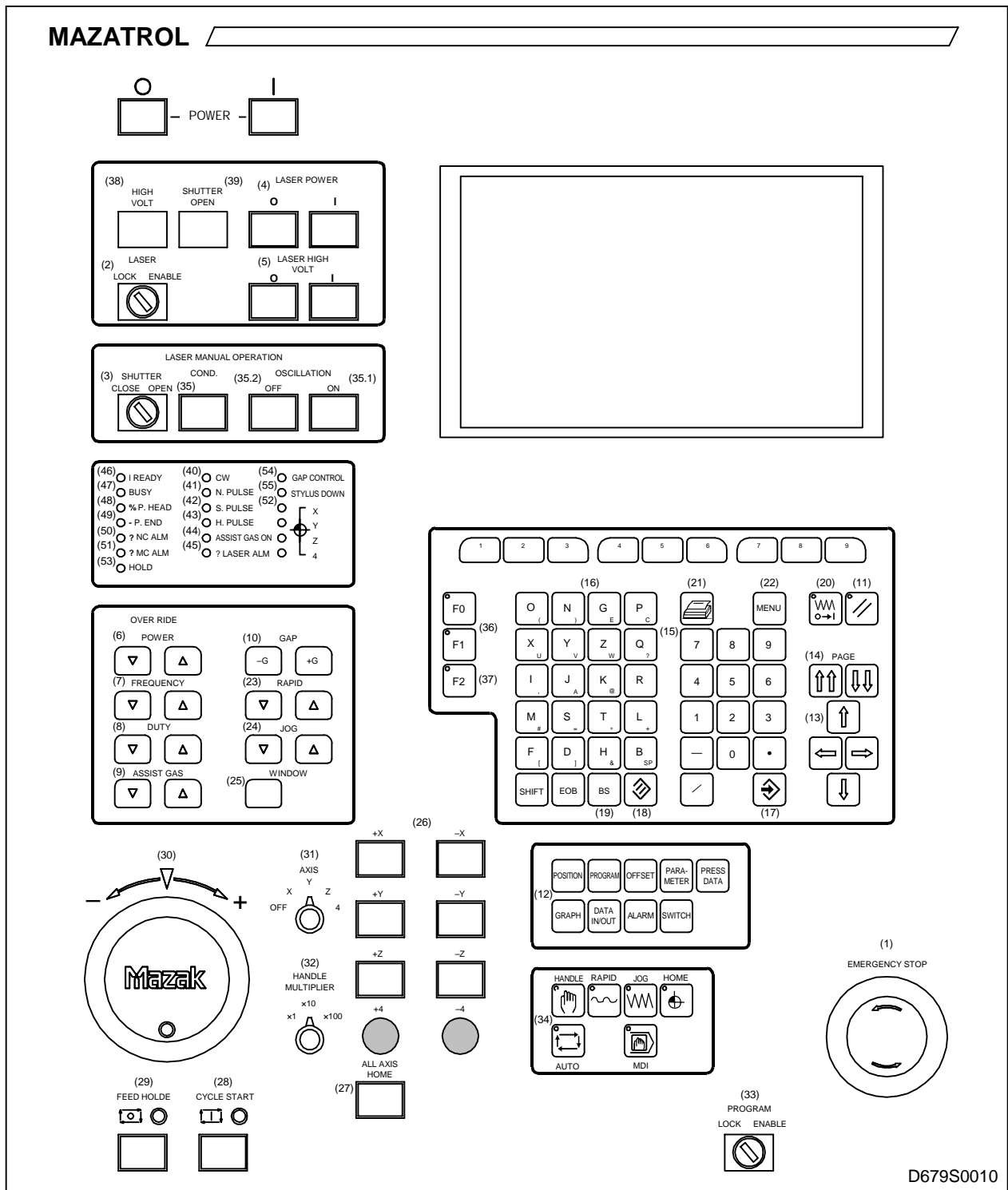


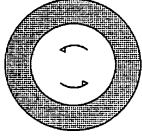


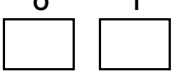

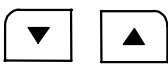


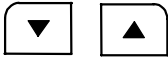





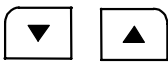


Fig. 6-1 NC operation panel

**Note:** Figures in the parentheses of the above Figure correspond to the No. in Table 6-1.



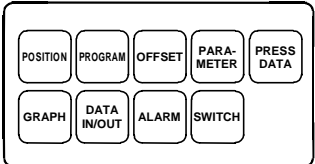
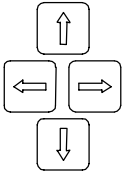


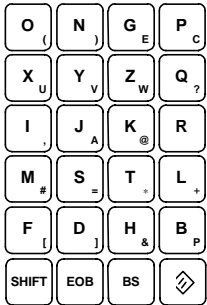


## 6-2-1 Functions and names of the switches





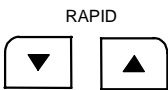


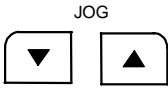


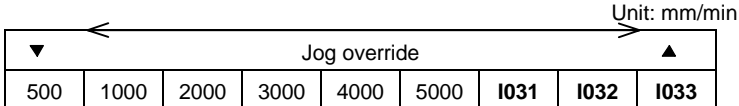

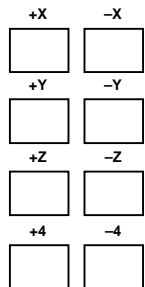
The functions and names of the switches on the NC operation panel are outlined below.

Table 6-1 Functions and names of the switches on the NC operation panel





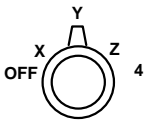
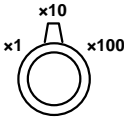

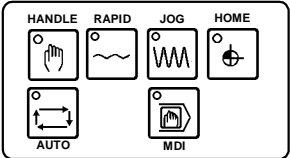

No.	Name	Function
1	Emergency stop button EMERGENCY STOP 	The button for stopping the machine in case of emergency. All axes stop instantly and the NC enters the emergency stop status. High voltage is cut off from the laser oscillator, and operation ceases. The button locks on being pressed. Turn it in the direction of the arrow to reset the lock. Remove the cause of the emergency stop before pressing the reset key and the OT release key simultaneously to resume operation. Before starting automatic operation, manually return all axes to zero.
2	Laser operation switch LASER LOCK ENABLE 	This is the master control switch for the laser oscillator. While the switch is set in the ENABLE position, the laser oscillator is placed in the operation-enabled state and power to the chiller unit is turned on. When the switch is set in the LOCK position, power on the chiller unit is turned off and pushing the LASER POWER I (ON) button has no effect. While the machine is not being operated, the person responsible should remove the key and keep it in a place where unauthorized people cannot access it.
3	Shutter switch SHUTTER CLOSE OPEN 	This is a key-lock type switch to open or close the mechanical shutter of the laser oscillator. It is effective in the manual mode. Note that laser beams are emitted when the shutter is opened.
4	Laser power buttons LASER POWER O I 	When the I (ON) button is pressed, the laser oscillator tube is emptied and laser gas is charged automatically. The indicating lamp blinks during gas charging, and stays lit when the predetermined conditions are met. When the O (OFF) button is pressed, the I button indicating lamp blinks. After completion of power off preparations in the oscillator, the O button indicating lamp lights. After that, press the POWER O button (NC power) and set the main circuit breaker operation handle to the OFF position.
5	High voltage buttons LASER HIGH VOLT O I 	When high voltage is applied to the laser oscillator and the pre-discharge state is established, laser beam can be emitted. Check the button-indicating lamps to examine the machine status.
6	Laser output override keys POWER 	The commanded laser output level can be overridden within the range of 0 to 150% in 2% increments. Overriding exceeding the rated output is not possible. Each time the  key is pressed, the override value is increased by 2% and each time the  key is pressed, the override value is decreased by 2%.
7	Frequency override keys FREQUENCY 	These keys allow an override in the range of 0 to 150% to be applied to the frequency command for laser pulse oscillation, in 2% increments. Each time the  key is pressed, the override value is increased by 2% and each time the  key is pressed, the override value is decreased by 2%.
8	Duty override keys DUTY 	These keys allow an override in the range of 0 to 150% to be applied to the duty command for laser pulse oscillation, in 2% increments. Each time the  key is pressed, the override value is increased by 2% and each time the  key is pressed, the override value is decreased by 2%.
9	Assist gas override keys ASSIST GAS 	The value of the assist gas pressure command can be increased or decreased in 2% increments. Each time the  key is pressed, the override value is increased by 2% and each time the  key is pressed, the override value is decreased by 2%.



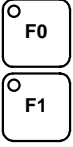











# 6 OPERATION SWITCHES

No.	Name	Function
10	Gap control keys GAP 	The profiler is controlled so that the nozzle is offset in the direction corresponding to the pressed key (0.1 mm (0.004 in.) in each pressing).
11	Reset key 	The reset key is used to release machine-related alarms, laser oscillator-related alarms, NC-related alarms and operation errors. The alarm state is released by pressing the reset key after removing the cause of the alarm. This key is also used for resetting machine operation.
12	Display selection keys 	These keys are used to select the screen to be displayed on the LCD or CRT.
13	Cursor keys 	These keys are used to call the cursor to the screen, or to move the cursor on the screen.
14	Page keys PAGE 	On the screen where multiple pages are contained, these keys are used to display the next or previous page.
15	Numeric keys 	These keys are used to input numeric data. To input a value smaller than "1", it is possible to omit "0" left to the decimal point.
16	Alphabetic keys 	These keys are used to input address, data, and program blocks.
17	Input key 	The input key is used to input the keyed-in data.
18	Clear key 	The clear key is used to clear the keyed-in data. Use this key if wrong data has been keyed in.

No.	Name	Function																								
19	Back-space key 	The BS key is used to delete the keyed-in character, left to the cursor.																								
20	OT release key 	The key is used to return the axis, stopped due to having moved to the stroke end, into the allowable axis motion range. This key is also used to release the emergency stop status.																								
21	Hard copy key 	The copy key is used to print the hard copy of the screen display.																								
22	Control menu key 	The MENU key is used to display the control menu. When the key is pressed, the display of menu changes to the control menu. Pressing the key once again switches the menu display back to the previously displayed menu.																								
23	Rapid traverse override keys 	An override of 0 to 100% in increments of 10% can be applied to the rapid traverse rate. Each time the  key is pressed, the override value is increased by 10% and each time the  key is pressed, the override value is decreased by 10%.																								
24	Jog override keys 	<p>Programmed axis feedrate can be overridden within a range of 0 to 150% in increments of 10%. Each time the  key is pressed, the override value is increased by 10% and each time the  key is pressed, the override value is decreased by 10%.</p> <p>In the manual mode the axis feedrate is changed in the following order.</p> <div style="text-align: center;">  <p>Unit: mm/min</p> </div> <p><b>I031, I032, I033:</b> Set by user parameters.</p>																								
25	Override window key 	<p>This key is used to display the override data window at any display page. When the key is pressed while the override data window is displayed on the screen, the window is cleared.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Override</th> <th>Manual</th> <th>Automatic</th> </tr> </thead> <tbody> <tr> <td>RAPID</td> <td>%</td> <td>%</td> </tr> <tr> <td>JOG</td> <td>mm/min</td> <td>%</td> </tr> <tr> <td>OUTPUT</td> <td>%</td> <td>%</td> </tr> <tr> <td>FREQUENCY</td> <td>%</td> <td>%</td> </tr> <tr> <td>DUTY</td> <td>%</td> <td>%</td> </tr> <tr> <td>ASSIST GAS</td> <td>%</td> <td>%</td> </tr> <tr> <td>GAP</td> <td>mm</td> <td>%</td> </tr> </tbody> </table>	Override	Manual	Automatic	RAPID	%	%	JOG	mm/min	%	OUTPUT	%	%	FREQUENCY	%	%	DUTY	%	%	ASSIST GAS	%	%	GAP	mm	%
Override	Manual	Automatic																								
RAPID	%	%																								
JOG	mm/min	%																								
OUTPUT	%	%																								
FREQUENCY	%	%																								
DUTY	%	%																								
ASSIST GAS	%	%																								
GAP	mm	%																								
26	Axis movement buttons 	<p>These buttons are used to manually move an axis.</p> <p>By pressing the desired button, the selected axis moves in the direction corresponding to the pressed button.</p>																								

# 6 OPERATION SWITCHES

No.	Name	Function
27	All axes home buttons ALL AXIS HOME 	When this button is pressed after selecting the manual home position return mode, the Z-, X- and Y-axes return to their home positions sequentially in this order.
28	Cycle start button CYCLE START 	In the automatic mode, pressing the CYCLE START button begins execution of a program. While a program is being executed, the indicating lamp lights.
29	Feed hold button FEED HOLD 	The FEED HOLD button is used to temporarily halt program execution. The lamp, when lit, indicates that the feed hold function is active.
30	Pulse generator handle 	If the handle mode is selected, axis movement may be carried out using the manual pulse generator. The axis is selected with the AXIS selector switch. The amount of feed per pulse is selected with the HANDLE MULTIPLIER switch. When the pulse handle is turned clockwise, the axis moves in the positive direction and when the pulse handle is turned counterclockwise, the axis moves in the negative direction.
31	Axis selector switch AXIS 	The selector switch is used to select the axis to be moved in the handle mode.
32	HANDLE MULTIPLIER selector switch HANDLE MULTIPLIER 	The selector switch is used to select axis movement distance per pulse in the handle mode. x1 ..... 1 μm x10 ..... 10 μm x100 ..... 100 μm
33	Program protect switch PROGRAM LOCK ENABLE 	The key-lock type switch is used to protect the program or other data stored in memory from careless editing. When the switch is set in the LOCK position, access to the memory is disabled.
34	Mode selection keys 	These keys are used to select the NC mode. The home position return mode (HOME) is selected when power is turned on.
35	Oscillation condition button COND. 	When this button is pressed, the laser oscillation condition screen is displayed. This operation is possible in any display screen.

No.	Name	Function
35.1	Oscillation ON button OSCILLATION ON 	The button is used to turn on the laser oscillator.
35.2	Oscillation OFF button OSCILLATION OFF 	The button is used to turn off the laser oscillator.
36	Spare keys 	Not used.
37	Power save key 	The key is used to turn off the display temporarily to elongate screen life as well as for energy saving. The screen is turned off when it is pressed. The screen is displayed when any key including this key is pressed.
38	High voltage indicating lamp HIGH VOLT 	The indicating lamp lights when high voltage is applied to the laser oscillator in response to the pressing of the LASER HIGH VOLT I (ON) button.
39	Shutter open indicating lamp SHUTTER OPEN 	The indicating lamp flickers when the mechanical shutter of the laser oscillator is opened either by the SHUTTER switch or an M-code. Note that laser beams are being emitted from the laser oscillator while the indicating lamp is flickering.
40	CW indicating lamp 	The CW indicating lamp lights while the laser oscillator is in the continuous oscillation mode.
41	Normal pulse indicating lamp 	The N. PULSE indicating lamp lights while the laser oscillator is in the normal pulse mode.
42	Super pulse indicating lamp 	The S. PULSE indicating lamp lights while the laser oscillator is in the super pulse mode. The super pulse mode is not available for all models.
43	High-speed pulse indicating lamp 	The H. PULSE indicating lamp lights while the laser oscillator is in the high-speed pulse mode. The high-speed pulse mode is not available for all models.
44	Assist gas indicating lamp 	This indicating lamp lights when the assist gas command is given and the assist gas is supplied.
45	Laser alarm indicating lamp 	LASER ALM indicating lamp lights when an alarm occurs with the laser oscillator system.
46	Ready indicating lamp 	The READY indicating lamp lights when the power is supplied to the NC unit and the servo system is ready for operation. This does not indicate the laser oscillator status.
47	Busy indicating lamp 	The BUSY indicating lamp lights when the NC unit is executing operations. (During restart search, for example)

# 6 OPERATION SWITCHES

No.	Name	Function
48	Program head indicating lamp ○ % P. HEAD	The P.HEAD indicating lamp lights when the program is rewound and the pointer is at the start of the program.
49	Program end indicating lamp ○ - P. END	The P.END indicating lamp lights when program execution has been completed.
50	NC alarm indicating lamp ○ ? NC ALM	The NC ALM indicating lamp lights when an alarm occurs with the NC unit or servo system. (Turning off the main power switch is required to release some of the alarms.)
51	Machine alarm indicating lamp ○ ? MC ALM	The MC ALM indicating lamp lights when an alarm occurs with the mechanical system.
52	Home position indicating lamps ○ X ○ Y ○ Z ○ 4	These indicating lamps light when the corresponding axis has been returned to the home position of the individual axes in the manual home position return operation (for each axis, or all axes): They also light after the completion of the home position return operation in the automatic mode by executing the G28 command.
53	Hold indicating lamp ○ HOLD	This indicating lamp lights when the axes are interlocked and immovable. It blinks when the M function is locked.
54	Gap control indicating lamp ○ GAP CONTROL	The gap control function is valid when M32 or M33 command is executed. The indicating lamp lights while the Z-axis control is the gap control mode. The indicating lamp is turned off when the reset key is pressed or when the M31 command is executed.
55	Stylus DOWN indicating lamp ○ STYLUS DOWN	The STYLUS DOWN indicating lamp lights when the stylus of the profile unit has moved down.

## 6-3 Auxiliary Operation Panel

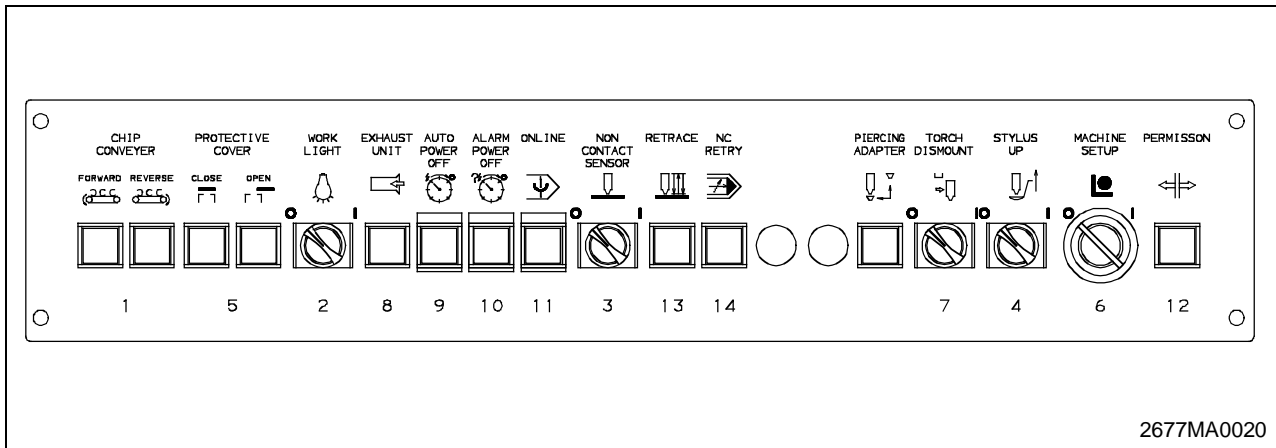


Fig. 6-2 Auxiliary operation panel











### 6-3-1 Names and functions of switches

Table 6-2 Names and functions of switches

No.	Name	Function
1	<p>CHIP CONVEYOR FORWARD/REVERSE buttons</p> <p>CHIP CONVEYER</p> <p>FORWARD REVERSE </p>	<p>These buttons are used to move the chip conveyor.</p> <p>When the FORWARD button is pressed, the chip conveyor moves in the forward (chip transport) direction. If this button is pressed a second time the chip conveyor will stop. The LED in the FORWARD button is lit while the chip conveyor is moving in the forward direction.</p> <p>When the REVERSE button is pressed, the conveyor moves in the reverse direction. Conveyor motion stops when the button is released. The LED in the REVERSE button is lit while the chip conveyor is moving in the reverse direction.</p>
2	<p>WORK LIGHT switch</p> <p>WORK LIGHT</p>	<p>This selector switch is used to switch on the work light. The light comes on when the switch is set to "I" and goes off when it is set to "O".</p>
3	<p>NON CONTACT SENSOR switch (optional)</p> <p>NON CONTACT SENSOR</p>	<p>This selector switch is used to set the non-contact profiling unit valid.</p> <p>The non-contact profiling unit is selected when this switch is set to "I". Setting it to "O" selects the contact type profiling unit.</p> <div style="display: flex; align-items: center;"> <ul style="list-style-type: none"> <li>• Set this switch meeting the type of profiling unit actually installed in your machine.</li> <li>• If the setting does not match the actual type of profiling unit, it will cause damage to the machine.</li> </ul> </div>

# 6 OPERATION SWITCHES

No.	Name	Function
4	<p>STYLUS UP switch</p>	<p>This switch can select whether to allow the stylus of the profiling unit to ascend or to leave it in its lowest position.</p> <p>This switch is placed in the "O" (invalid) position during normal operation. Immediately after the power is turned on the stylus remains in the lower position wherever the switch is placed. When the machine is zero-returned, the stylus ascends. In the COPY OFF mode (M31), the stylus ascends with the switch placed in "I" (valid); it remains in the lower position with the switch in "O" (invalid).</p>
5	<p>CLASS 1 COVER OPEN/CLOSE buttons (optional)</p>	<p>These buttons are used to operate the Class 1 cover.</p> <p>When the OPEN button is pressed, the cover opens; the LED in this button is lit while the cover is open. When the CLOSE button is pressed, the cover closes; the LED in this button is lit while the cover is closed.</p>
6	<p>MACHINE SET UP key switch</p>	<p>This key switch makes possible automatic operation (cycle start) with the Class 1 cover in the open position. Normally, to prevent accidents, set the switch to "O" position. When this switch is positioned to "I", automatic operation can be executed with the cover opened.</p>
7	<p>TORCH DISMOUNT switch (optional)</p>	<p>Operate to mount the auto focus torch (optional) in the machine or to dismount the torch from the machine.</p> <p>During automatic operation, leave the TORCH DISMOUNT switch set to the invalid (O) position.</p> <p>For further details of operations, see the section of the maintenance manual that lays down the torch mounting procedure.</p> <div style="display: flex; align-items: center;"> <p><b>CAUTION</b></p> <ul style="list-style-type: none"> <li>• Before dismantling the auto focus torch from the machine, be sure to execute WNo. 9996 (LENS DOWN PROGRAM). Failure to execute this program may result in the torch not being removable from the machine; if force is used to remove the torch, it will be damaged.</li> </ul> </div>
8	<p>Dust collector button (optional)</p>	<p>This button is used to operate the dust collector unit.</p> <p>When this button is pressed, the power supply to the dust collector unit is switched on. When it is pressed again, the power supply is switched off. The LED in this button is lit while the power supply to the dust collector unit is ON.</p>
9	<p>AUTO POWER OFF button (optional)</p>	<p>This button is used to set whether the automatic power off function is effective or ineffective.</p> <p>When this button is pressed the automatic power off function becomes effective. When it is pressed again, the function is made ineffective. The LED in this button is lit while the automatic power off function is effective.</p>

No.	Name	Function
10	ALARM POWER OFF button (optional) ALARM POWER OFF  	This button is used to set whether the alarm power off function is effective or ineffective. When this button is pressed, the alarm power off function becomes effective. When it is pressed again, the function is made ineffective. The LED in this button is lit while the alarm power off function is effective.
11	ONLINE button (optional) ONLINE  	This button is used to set whether the on-line function (for operation by direct numerical control from the host computer) is effective or ineffective. When this button is pressed, the on-line function becomes effective. When it is pressed again, the function is made ineffective. The LED in this button is lit while the on-line function is effective.
12	PERMISSION button (optional) PERMISSION  	In the case of machine with Class 1 cover, and if this button is equipped, perform simultaneous push button operation.
13	RESUME PROFILER button (optional) RETRACE  	This button is used to retry profiling in case a profiling alarm occurs. When the button is pressed, the LED in the button flickers and pressing the button again turns off the LED. The LED is turned off when the NC power is switched off. When the NC power is switched on, this button is in the off state. Profiling retry is valid while the LED is flickering and it stays lit during a retrial. For details of profiling retry, refer to 10-1 "Profilers Retry Function (Optional)".
14	NC RETRY button (optional) NC RETRY  	This function allows the profiler to move to the next cutting start position and restart processing if it fails to return home by a profiling retrial. For details of CN retry, refer to 11-2 "NC Retrial Function (Optional)".

**6-4 Data Input and Output Panel**

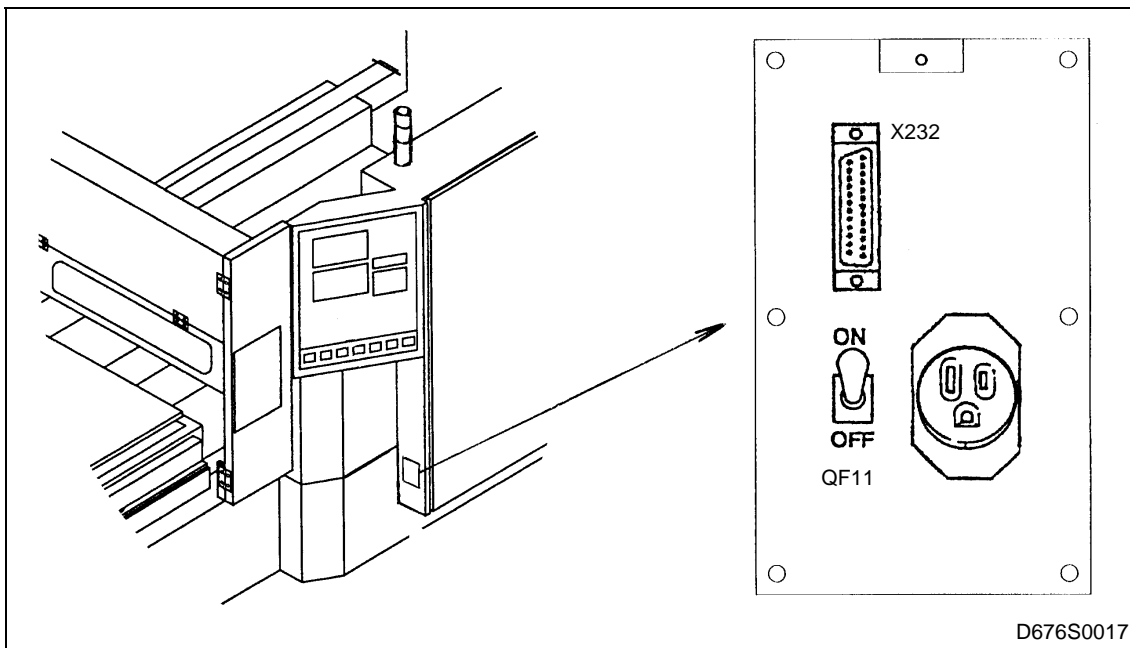






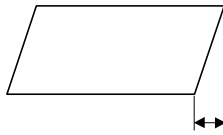
Fig. 6-3 Data input/output panel

Table 6-3 Names and functions of switches

No.	Name	Function
1	X232 	This RS232C interface is used to transfer programs to and from the Mazak micro disk. Connect the plug Identified as "NC" of the RS232C cable supplied with the Mazak micro disk to this X232 connector.
2	QF11 breaker 	This is the breaker for 100 V AC outlet. The 100 V AC outlet capacity is max. 2 A and if an equipment exceeding this limit is connected to this outlet, the breaker is tripped when current over 2 A flows.
3	AC OUTLET 	The AC100 V outlet provided specially for connecting the Mazak micro disk. Do not use this outlet for connecting other devices.

## 7 2-PALLET CHANGER (OPTIONAL)

### 7-1 2-Pallet Changer Specifications

Items	Specifications			Remarks	
Machine model	ST-X48 MkII	ST-X510 MkII	ST-X612 MkII		
Max. machining size of the laser machine	1250 × 2500 mm (49.21 × 98.43 in.)	1525 × 3050 mm (60.03 × 120.08 in.)	2000 × 4000 mm (78.74 × 157.48 in.)		
Max. load weight	1.5 kW	300 kgf (660 lbs)	440 kgf (968 lbs)	Evenly placed load per pallet	
	1.8 kW	400 kgf (880 lbs)	590 kgf (1298 lbs)		
	2.5 kW	550 kgf (1210 lbs)	810 kgf (1782 kgf)		1380 kgf (3036 lbs)
	4 kW	630 kgf (1386 lbs)	930 kgf (2046 lbs)		1600 kgf (3520 kgf)
Material thickness	1.5 kW	0.8 - 12 mm (0.03 - 0.47 in.)		For mild steel	
	1.8 kW	0.8 - 16 mm (0.03 - 0.63 in.)			
	2.5 kW	0.8 - 22 mm (0.03 - 0.87 in.)			
	4 kW	0.8 - 25 mm (0.03 - 0.98 in.)			
Max. Material dimension	Width	1255 mm (49.41 in.)	1529 mm (60.26 in.)	2005 mm (78.94 in.)	
	Length	2515 mm (99.02 in.)	3063 mm (120.59 in.)	4015 mm (158.07 in.)	
Camber	Max. 3 mm (0.12 in.) 				
Angle	Max. 6 mm (0.24 in.) 				
Flatness level	2 mm (0.079 in.) (maximum) on surface plate. Must fall within the range that affects neither installation on our standard pallet nor laser machining.				
Number of pallets	2				
Worksheet support method	Knife edges (50 mm (1.97 in.) pitch)			Worksheet lifter part: 100 mm (3.94 in.) pitch	
Number of worksheet clamps	4			Per pallet	
Worksheet lifter	Lifts up worksheet by means of FREEVEYOR by 5 mm (0.20 in.)				
Pallet lifting mechanism	Digital servo drive, chain				
Pallet transfer mechanism	Digital servo drive, chain				

**7-2 External View of the Machine**

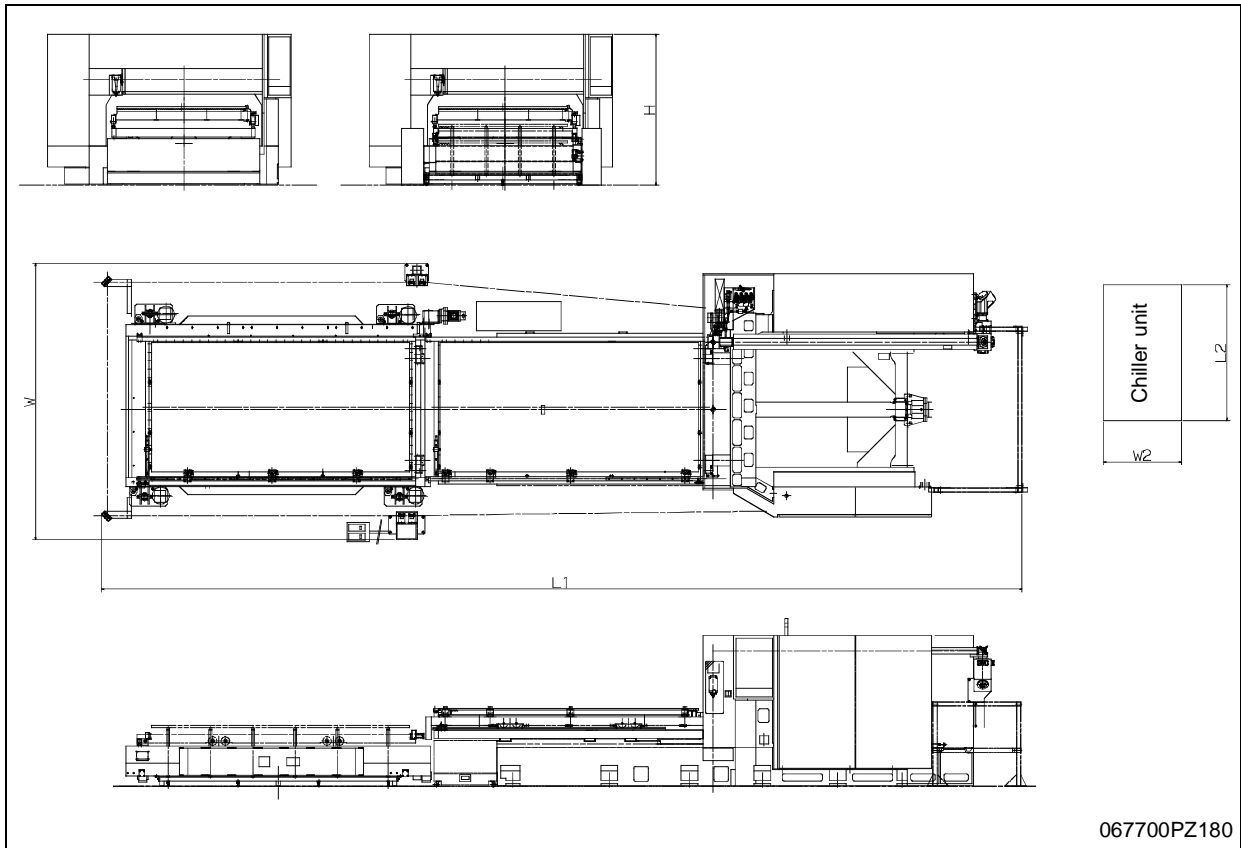


Fig. 7-1 External view of the machine

Table 7-1 Dimensions of each part

Symbol	Unit	ST-X48 Mk II	ST-X510 Mk II
L1	mm (in.)	9727 (382.95)	10877 (428.23)
W	mm (in.)	2986 (117.56)	3261 (128.39)
H	mm (in.)	1780 (70.08)	
L2	mm (in.)	1602 (63.07)	
W2	mm (in.)	916 (36.06)	

### 7-3 Description of Each Machine Part

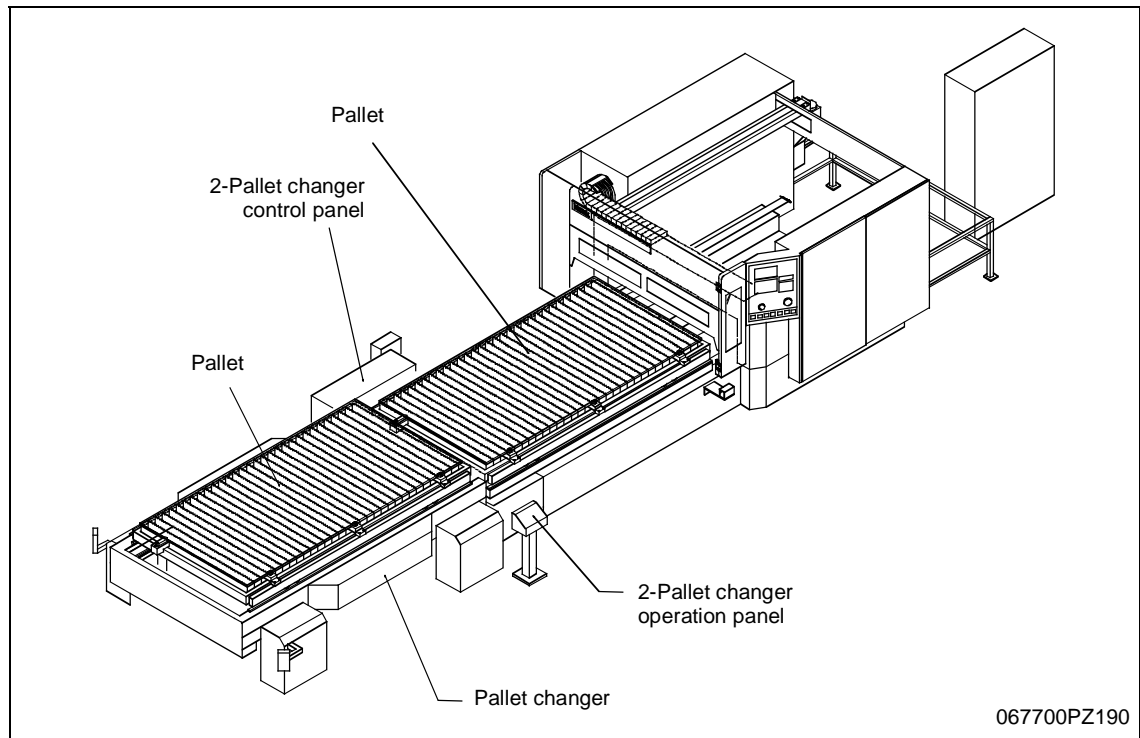


Fig. 7-2 2-pallet changer specification

## 7-4 Operation Switches

### 7-4-1 2-pallet changer operation panel

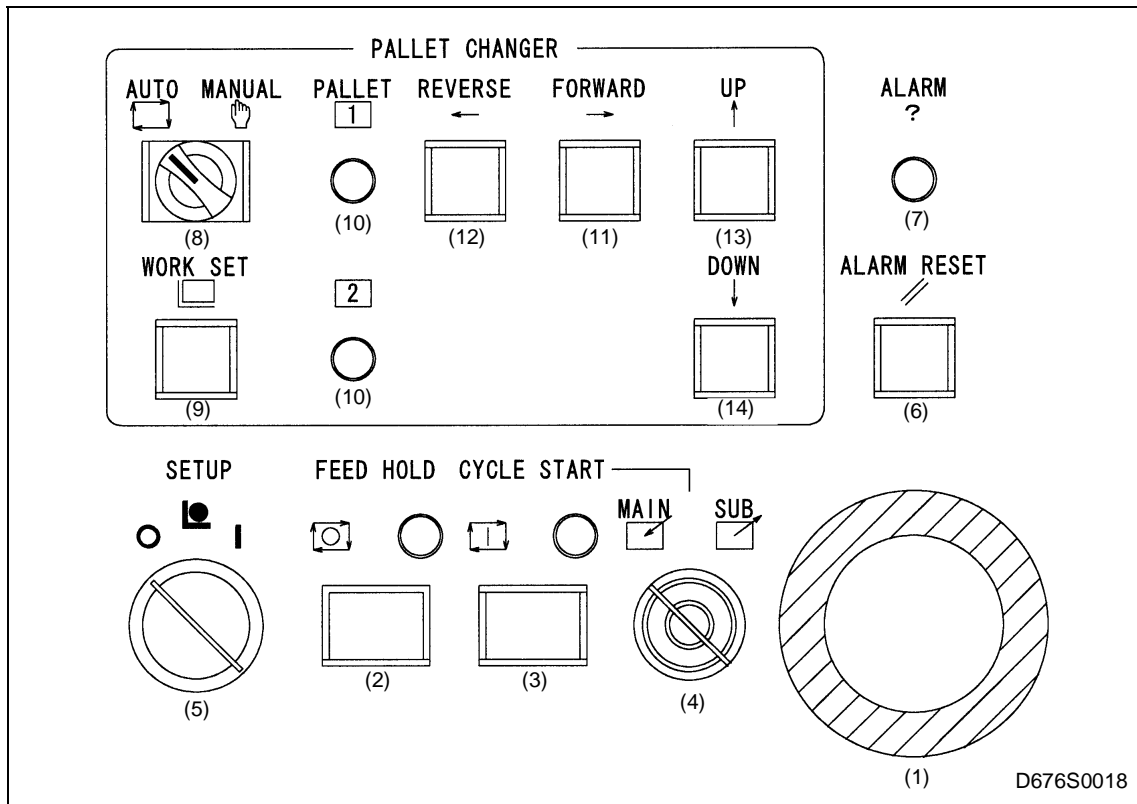
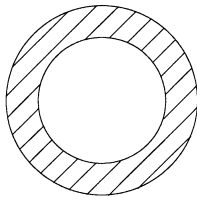
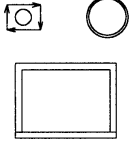


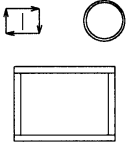
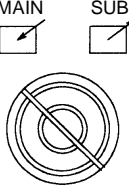
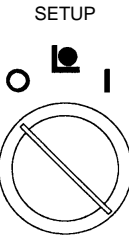
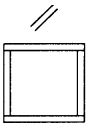


Fig. 7-3 2-pallet changer operation panel

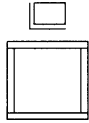

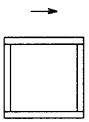


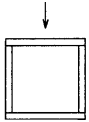
**Note:** Figures in the parentheses of the above Figure correspond to the No. in Table 7-2.

#### 1. Functions and names of the switches

Table 7-2 Functions and names of the switches

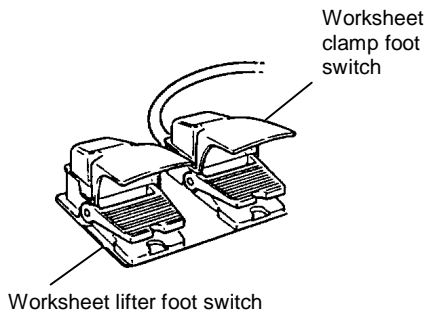
No.	Name	Function
1	Emergency stop button 	This button brings the machine to an emergency stop. The button has the same function as that of the EMERGENCY STOP button located on the operation panel of the laser machine. To release the emergency stop status, rotate the emergency stop button clockwise. After the emergency stop status has been released, press both the OT release key and reset key of the laser machine. In other words, the releasing method is the same as that of a laser machine emergency stop status.
2	FEED HOLD button FEED HOLD 	This button stops automatic operation temporarily. The button has the same function as that of the FEED HOLD button located on the operation panel of the laser machine. When the feed FEED HOLD is pressed, the button LED will light.

No.	Name	Function
3	CYCLE START button CYCLE START 	This button starts automatic operation.  The button has the same function as that of the CYCLE START button located on the operation panel of the laser machine.  When the CYCLE START button is pressed, the button LED will light.
4	CYCLE START MAIN/SUB switch MAIN SUB 	This switch makes the CYCLE START buttons valid or invalid.  <b>MAIN:</b> Makes the CYCLE START button on the operation panel of the laser machine valid. Makes the CYCLE START button on the operation panel of the pallet changer invalid.  <b>SUB:</b> Makes the CYCLE START button on the operation panel of the pallet changer valid. Makes the CYCLE START button on the operation panel of the laser machine invalid.
5	SETUP switch SETUP 	Set this switch to the "I" (ON) position to mount worksheets and to perform other operations inside the light barrier of the pallet changer.  When the switch is set to "I" (ON), even after the light barrier sensor has worked to result in an alarm, vertical pallet moving operations and/or other manual operations required for worksheet mounting can be performed.  When the switch is set to "I" (ON), it is not possible to perform pallet change operations (pallet traveling included).  To change pallets, the SETUP switch must be set to the "O" (OFF) position and the light barrier alarm reset.
6	ALARM RESET button ALARM RESET 	This button releases the occurring alarm. The button has the same function as that of the cancellation key located on the operation panel of the laser machine.  Unlike the reset key on the operation panel of the laser machine, the ALARM RESET button only releases the alarms that can be reset just by pressing the button, and does not reset the NC unit.
7	ALARM LED ALARM ? 	This LED lights to indicate that an alarm has occurred.
8	AUTO/MANUAL (automatic/manual) mode switch AUTO MANUAL 	This switch specifies the operation mode for the pallet changer.  <b>MANUAL:</b> Allows manual operation of the pallet changer.  In manual operation mode, the pallet can be actuated by operating the operation panel switches.  Manual operation is independent operation of each machine component.  While each button is held down, the corresponding unit operates, and when the button is released, the unit will stop operating.  <b>AUTO:</b> Allows automatic operation of the pallet changer.  Pallets can be changed by issuing the M70 code.

No.	Name	Function
9	WORK SET button WORK SET 	<p>Press this button in automatic operation mode.</p> <p>The button LED lights to indicate that following completion of worksheet mounting on the pallet by the operator, the pallet changer has been set up for operation.</p> <p>The operator presses the button after the pallet changer has become ready for operation.</p> <p>A press of the button in automatic operation mode activates the button LED to indicate that the setup for a pallet change has been completed. If the button is not pressed prior to the start of a pallet change, pallets will not be changed since the setup for the pallet change will be judged not to be completed.</p>
10	PALLET 1 or PALLET 2 LED PALLET 	<p>These LEDs light to indicate that a pallet is present at the pallet changer side.</p> <p>PALLET 1: Lights to indicate that the upper pallet is present at the pallet changer side.</p> <p>PALLET 2: Lights to indicate that the lower pallet is present at the pallet changer side.</p>
11	FORWARD button FORWARD 	<p>Press this button in manual operation mode.</p> <p>A press of the button moves the pallet in the direction of the laser machine.</p> <p>The button LED lights when the pallet traveling chain is set to the stand-by position (fixed position) of the laser machine.</p>
12	REVERSE button REVERSE 	<p>Press this button in manual operation mode.</p> <p>A press of the button moves the pallet in the direction of the pallet changer.</p> <p>The button LED lights when the pallet traveling chain is set to the stand-by position (fixed position) of the pallet changer.</p>
13	UP button UP 	<p>Press this button in manual operation mode.</p> <p>A press of the button moves the pallet upward.</p> <p>The button LED lights when the pallet arrives at the end of the upward stroke of the pallet changer.</p>
14	DOWN button DOWN 	<p>Press this button in manual operation mode.</p> <p>A press of the button moves the pallet downward.</p> <p>The button LED lights when the pallet arrives at the end of the downward stroke of the pallet changer.</p>

**Note:** When the pallet vertical movement position is set to the traveling position of the upper pallet, both the UP and DOWN LEDs are activated; the pallet cannot be moved vertically using the UP or DOWN button.

## 7-4-2 2-pallet changer foot switch

No.	Name	Function
1	 <p>Worksheet clamp foot switch</p> <p>Worksheet lifter foot switch</p> <p>65911190</p>	<ul style="list-style-type: none"> <li>- Worksheet clamp foot switch</li> </ul> <p>This switch opens or closes the worksheet clamps of the pallet located on the pallet changer.</p> <p>When the upper pallet is present, the worksheet clamps of the upper pallet are opened or closed.</p> <p>When the lower pallet is present, the worksheet clamps of the lower pallet are opened or closed.</p> <p>When both pallets are present, neither is opened or closed.</p> <p>Use the switch as required when mounting/dismounting worksheets.</p> <ul style="list-style-type: none"> <li>- Worksheet lifter foot switch</li> </ul> <p>This switch moves the pallet on the pallet changer upward or downward and activates the worksheet lifter.</p> <p>The switch is valid when the pallet is positioned at the end of the downward stroke of the pallet changer.</p> <p>The switch is invalid when both pallets exist.</p> <p>Use the switch as required when mounting/dismounting worksheets.</p>

## 7-5 M-codes Related to the Pallet Changer

M70 Pallet change command.  
It changes pallets between the pallet changer and the laser machine.

### Example of M70 usage

```
O9999 ;
M21 ;           Laser shutter close
G91G28Z0 ;     Z-axis return to home position
G91G28X0Y0 ;   X-axis/Y-axis return to home position
M70 ;          Pallet change
M99 ;          Subprogram return

O0001 ;
M98P9999 ;
:
Machining program
:
M98P9999 ;
M30 ;
```

## **7-6 Conditions for Completing Pallet Changer Setup**

To change pallets, both pallets must have been ready for the change.

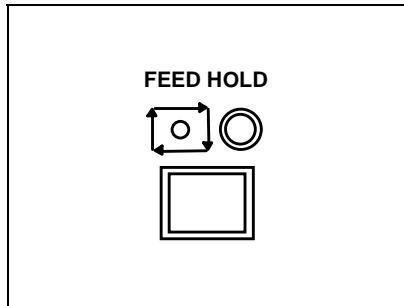
When the following conditions are satisfied, pallet change setup will be completed to allow the pallets to be changed:

1. An emergency stop status or an alarm must not be occurring.
2. All axes of the laser machine must have been returned to the respective home positions and there must be no laser beam emissions (laser shutter closed).
3. For the M70 command, automatic operation mode must have been selected and the WORK SET button must be on (button LED on).
4. The SETUP switch must be off and the light barrier sensor must be off.
5. Both worksheet clamps on the pallet must have been closed.
6. Both the laser machine and the pallet changer must have a clamped pallet (PALLET 1 or PALLET 2 LED on).
7. The vertical position of the pallet changer must have been set to the end of its downward or upward stroke (DOWN or UP button LED on).
8. The traveling chain of the pallet changer must have been set to the stand-by position of the laser machine (FORWARD button LED on).

## 8 MACHINE OPERATION AND SCREENS USED FOR OPERATION

### 8-1 Stopping Operation

#### 8-1-1 Feed hold

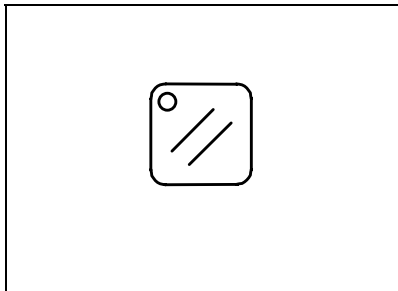


The FEED HOLD button is valid only in automatic operation. When this switch is pressed:

- the axes decelerate and stop,
- the shutter closes,
- discharge is turned off,
- profiling is turned off, and
- gas stops.

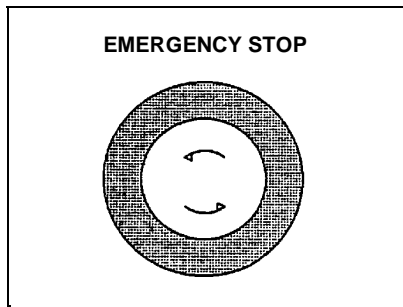
When the machine is placed in the feed hold state, the indicating lamp above the switch lights. If the CYCLE START button is pressed while the machine is stopped in the feed hold mode, the automatic operation restarts continuously from the position where the automatic operation has been suspended.

#### 8-1-2 Reset



The reset key is valid both in the manual and the automatic modes. After the pressing of the reset key, the machine is placed in the same state as after the pressing of the FEED HOLD button. In this case, however, pressing the CYCLE START button after suspending the operation will restart the operation from the start of the program.

### 8-1-3 Emergency stop



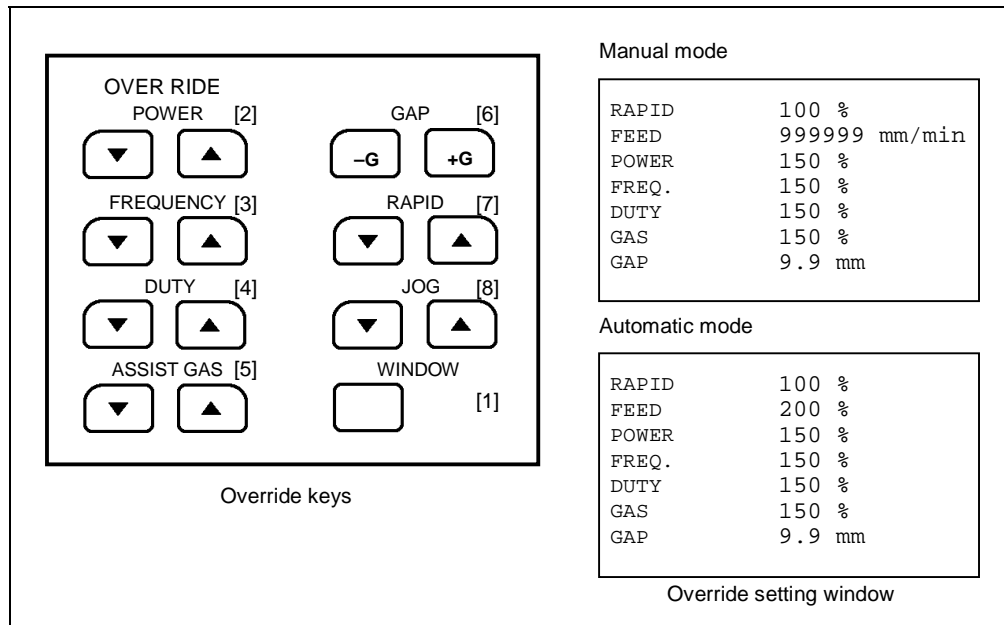
The EMERGENCY STOP button is valid both in the manual and the automatic modes. When the EMERGENCY STOP button is pressed, the axes stop immediately and high voltage to the laser oscillator is shut off. To release the locking state of the EMERGENCY STOP button, turn the button in the direction indicated by the arrow symbols on the button.

Since the servomotor is still in the servo off state even after the EMERGENCY STOP button is reset, press the reset key and the OT release key at the same time to turn on the servo system.

High voltage to the laser oscillator is also turned off. For the procedure used for turning on high voltage for the laser oscillator, refer to Chapter 10, "STARTING AND STOPPING LASER OSCILLATOR". After the emergency stop state is released, the machine requires home position return operation. Execute the home position return, referring to the procedure explained in Subsection 8-4-1, "Home position return mode".

## 8-2 Override

The function to change the axis feedrate, laser output conditions, etc. during manual or automatic operation without changing the program is called the override function. For the override function, the following keys are provided.



### 1. WINDOW key

When the WINDOW key is pressed, the override setting window shown above is displayed on the screen. To clear the window, press the key once again. If the override value is changed, the override window is displayed automatically.

In the override window, only the data display for FEED differs between the manual and automatic mode.

### 2. POWER keys

Using the POWER keys, preset laser power can be changed in the range of 0 to 150% in units of 2%. Laser power is set by "G82 P\_\_" in the program for automatic operation or on the laser condition screen for manual operation.

### 3. FREQUENCY keys

Using the FREQUENCY keys, preset frequency can be changed in the range of 0 to 150% in units of 2%. Frequency is set by "G82 Q\_\_" in the program for automatic operation and on the laser condition screen for manual operation.

### 4. DUTY keys

Using the DUTY keys, preset duty can be changed in the range of 0 to 150% in units of 2%. Duty is set by "G82 R\_\_" in the program for automatic operation and on the laser condition screen for manual operation.

For example, if duty override is set at 50% while 50% duty is set, actual operation is executed in 25% duty. If the result of "specified duty × duty override" is 100% or larger, it is assumed continuous output.

**5. ASSIST GAS keys**

Using the ASSIST GAS keys, preset assist gas pressure can be changed in the range of 0 to 150% in units of 2%. Assist gas pressure is set by "G88 P\_\_" in the program for automatic operation and on the laser condition screen for manual operation.

**6. GAP keys**

The gap between the worksheet and the nozzle is controlled to be constant by the profiler. The gap is changed in the range of  $\pm 3$  mm ( $\pm 0.12$  in.) during operation by pressing the GAP keys in units of 0.1 mm (0.004 in.). Remember that the allowable adjustable gap range is restricted by the profiler specifications.

**7. RAPID keys**

The RAPID keys are used to override the axis feedrate executed in the rapid feed mode (G00). Override is possible in units of 10% within the range of 0 to 100%.

For example, if the override is set to 50% while the rapid feedrate is 24 m/min (944.9 IPM), the machine operates at 12 m/min (472.4 IPM).

**8. JOG keys**

The JOG keys are used to override the axis feedrate executed in the jog feed mode (G01, G02, or G03). The feedrate specified by the F-code in the program or the feedrate set in the laser conditions can be changed in units of 10% within the range of 0 to 150%.

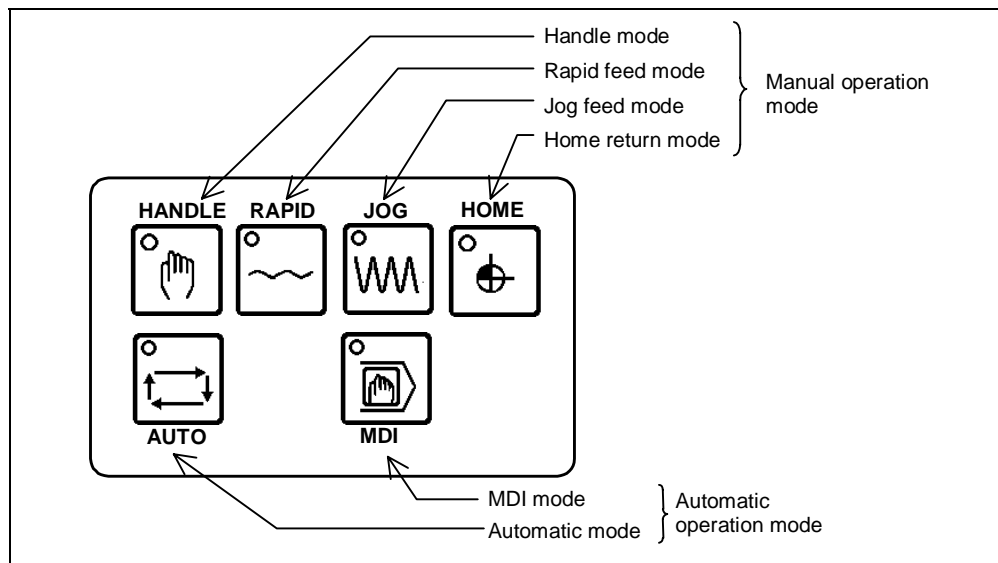
### 8-3 Operation Mode

The operation mode is largely classified into the manual mode and the automatic mode.

In the manual mode, the machine is directly operated by an operator using the switches and the buttons on the operation panel.

In the automatic mode, the machine is automatically operated by a machining program or preset data.

The six keys provided at the lower area on the operation panel are used to select the operation mode. The required operation mode can be selected simply by pressing the corresponding key. The indication lamp at the upper left corner in each key lights to indicate the mode presently selected.



#### 1. Manual operation mode

**Home return mode:** This selects the home return mode to return the axes to their home positions manually.

**Rapid feed mode:** This selects the rapid feed mode to move the axes at a rapid traverse rate.

**Jog feed mode:** This selects the jog feed mode to move the axes at a jog feedrate.

**Handle mode:** This selects the handle mode to move the axes using the pulse generator handle.

#### 2. Automatic operation mode

**Automatic mode:** This selects the automatic mode to execute an automatic operation using memory-stored program.

**MDI mode:** This selects the MDI mode to execute a machine operation by manual data input.

## 8-4 Manual Mode

In the manual mode, the machine is directly operated by an operator using the switches and the buttons on the operation panel.

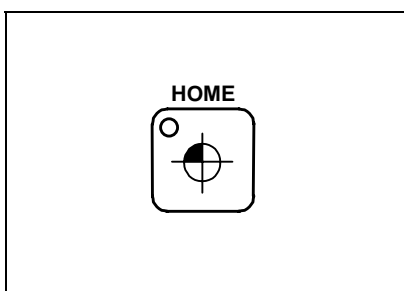
(The origin setting on the COMMAND/POSITION screen is possible only in the manual mode.)

### 8-4-1 Home position return mode

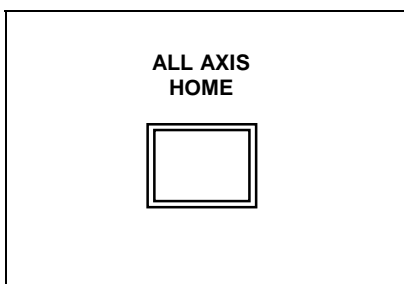
After turning on the power, it is necessary to execute the home position return operation. Unless the axes are returned to the home position, automatic operation is not possible. Select this mode also to execute home position return manually.

#### Operating procedure

- (1) Press the HOME mode selection key. The indicating lamp at the upper left corner in the key lights.



- (2) Press the ALL AXIS HOME button.



- (3) The Z-axis automatically begins home position return. After the Z-axis has reached the home position, the X- and Y-axes begin home position return simultaneously.

**Note 1:** Once the all axis home position return operation is started, the operation does not stop even when the button is released. To stop the all axis home position return operation halfway, either press the reset key or the EMERGENCY STOP button.

**Note 2:** During the home position return operation, the axes are moved at the home position return feedrate. If override is set, the setting is valid for the home position return operation.

- (4) After the completion of home position return, the axes stop and the home position indicating lamps light.

●	X-axis machine zero point	○: Lamp OFF ●: Lamp ON
●	Y-axis machine zero point	
●	Z-axis machine zero point	

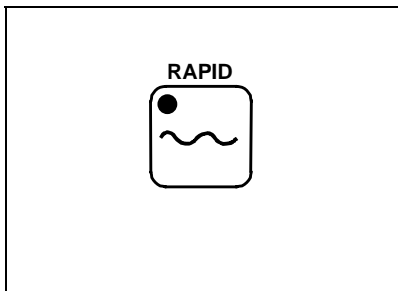
**Note:** In the home position return operation executed just after turning on power or releasing the emergency stop state, lower axis feedrate is used. In the second and later home position return operations, faster axis feedrate is used.

### 8-4-2 Rapid feed mode

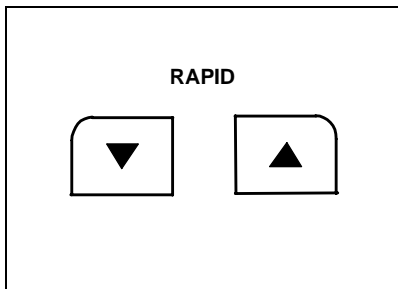
Select the rapid feed mode when an operator wants to move the axes to the position convenient for attempted operation or to move the axes quickly.

#### Operating procedure

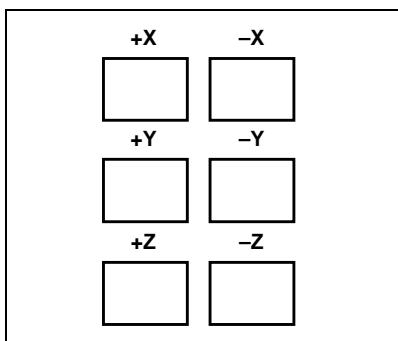
- (1) Press the RAPID mode selection key. The indicating lamp at the upper left corner in the key lights.



- (2) Adjust the feedrate using the OVERRIDE - RAPID keys.



- (3) Press the axis feed button corresponding to the required axis and axis feed direction.
  - The axis keeps moving while the button is held pressed, and the axis stops when the button is released.



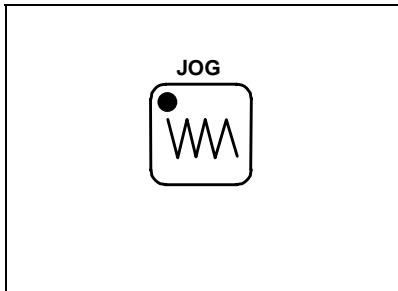
**Note:** The rapid feedrate can be adjusted using the OVERRIDE - RAPID keys even during axis feed.

### 8-4-3 Jog mode

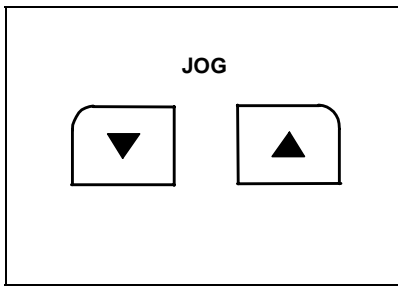
Select the jog feed mode when machining a simple shape manually or to move the axes slowly. The available jog feedrates are indicated below.

#### Operating procedure

- (1) Press the JOG mode selection key. The indicating lamp at the upper left corner in the key lights.



- (2) Adjust actual jog feedrate to be used by pressing the OVERRIDE - JOG keys.



[Override setting range]

▼ OVERRIDE JOG ▲									
500	1000	2000	3000	4000	5000	I031	I032	I033	mm/min
197	394	787	1181	1575	1969	I031	I032	I033	inch/min

For **I031**, **I032** and **I033**, jog feedrates are set by user parameters.

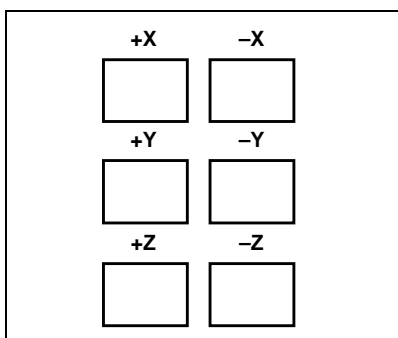
Standard setting: **I031** 6000 (mm/min)

**I032** 7000 (mm/min)

**I033** 8000 (mm/min)

- (3) Press the axis feed button to move the desired axis to the desired position.

- The axis keeps moving while the button is held pressed, and the axis stops when the button is released.



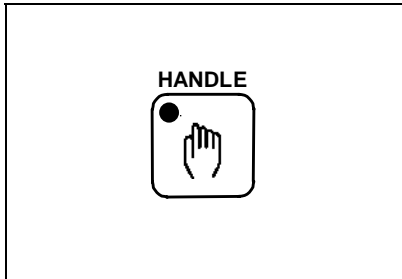
**Note:** The jog feedrate can be adjusted using the OVERRIDE - JOG keys even during axis feed.

#### 8-4-4 Handle mode

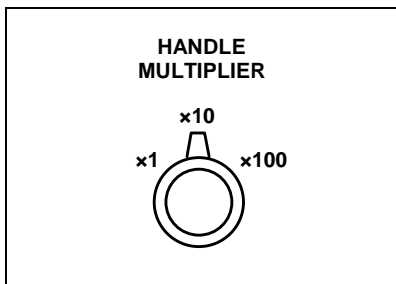
Select the handle mode when executing positioning accurately or to move the axes slowly.

##### Operating procedure

- (1) Press the HANDLE mode selection key. The indicating lamp at the upper left corner in the key lights.

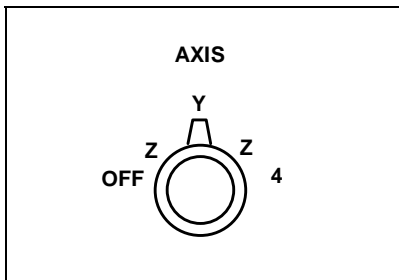


- (2) Select axis movement distance per pulse using the HANDLE MULTIPLIER switch.



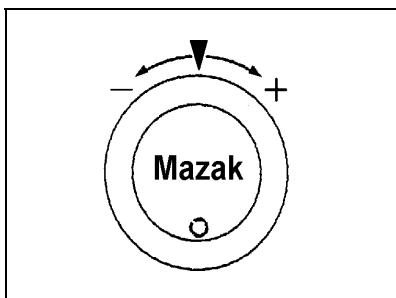
x1	→	0.001 mm (0.0001 inch)
x10	→	0.01 mm (0.001 inch)
x100	→	0.1 mm (0.01 inch)

- (3) Select the axis to move using the AXIS selector switch.



- (4) Turn the pulse handle to move the selected axis to the target position.

- When the pulse handle is turned clockwise, the axis moves in the positive direction and when the pulse handle is turned counterclockwise, the axis moves in the negative direction.



### 8-4-5 Clearing the hardware overtravel (OT)

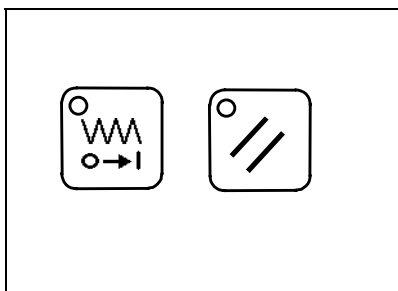
When the machine has an OT (overtravel) limit switch at the stroke end of individual axes, one of the following overtravel alarms occurs if any axis reaches the stroke end to trip the OT limit switch.

102	<b>+X OVERTRAVEL</b>
103	<b>-X OVERTRAVEL</b>
104	<b>+Y OVERTRAVEL</b>
105	<b>-Y OVERTRAVEL</b>
106	<b>+Z OVERTRAVEL</b>
107	<b>-Z OVERTRAVEL</b>
108	<b>+4 OVERTRAVEL</b>
109	<b>-4 OVERTRAVEL</b>

The operation to return the axis which has reached the stroke end is called "clearing the hardware OT state". Only in the case the alarm message is displayed due to hardware overtravel (one of the messages shown above), it is necessary to clear the overtravel alarm state using the following procedure.

#### Operating procedure

- (1) Press the reset key and the OT release key at the same time.



- Keep the keys held pressed until the READY indicating lamp lights.
    - I READY
  - After making sure that the READY indicating lamp has lit, release the reset key. Keep in mind that the OT release key must be held pressed.
- (2) Select the handle mode and select the axis movement distance per pulse. For the procedure, refer to Subsection 8-4-4, "Handle mode".
 

**Note:** Although the operation is possible in other modes, it is recommended to use the handle mode to ensure safe operation.
  - (3) Move the axis in the direction opposite to the direction in which the OT alarm has occurred.
  - (4) After the limit switch is released, release the OT release key.
  - (5) Press the reset key to clear the alarm message.

### 8-4-6 Clearing the software overtravel (OT)

The axis movable range is set by the parameter for individual axes. If an axis is moved beyond the set range, a software OT alarm occurs: the corresponding alarm message is displayed and the axis stops.

110	+X SOFT OT
111	-X SOFT OT
112	+Y SOFT OT
113	-Y SOFT OT
114	+Z SOFT OT
115	-Z SOFT OT
116	+4 SOFT OT
117	-4 SOFT OT

The operation to return the axis which has reached the software OT is called “clearing the software OT state”.

#### Operating procedure

- (1) Press the reset key to clear the alarm message.
- (2) Select the handle mode and select the axis movement distance per pulse. For the procedure, refer to Subsection 8-4-4, “Handle mode”.

**Note:** Although the operation is possible in other modes, it is recommended to use the handle mode to ensure safe operation.

- (3) Move the axis in the direction opposite to the direction in which the OT alarm has occurred.

**Note:** The software OT function is not valid for the axes which have not been returned to the home position after turning on power.

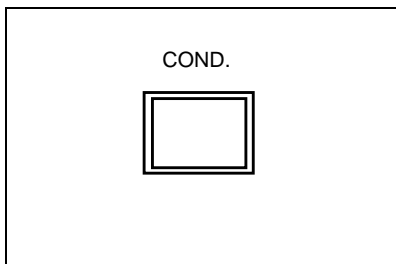
### 8-4-7 Laser

The procedure for setting the laser conditions and starting laser oscillation manually is explained below. When the power is turned on, the laser oscillator is not ready. Start the laser oscillator by referring to Chapter 9, “PREPARATIONS FOR OPERATION” and Chapter 10, “STARTING AND STOPPING LASER OSCILLATOR”.

#### Operating procedure

- (1) Set the laser conditions.

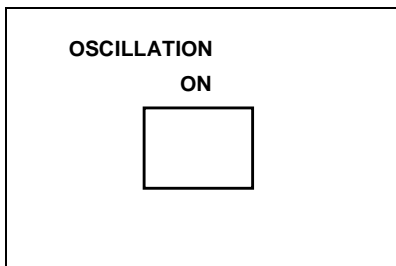
- Press the LASER MANUAL OPERATION - COND. button, and the following screen is displayed.



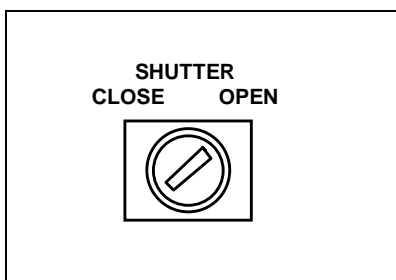
*** LASER COND. ***			WNo.9999	23:59:59									
	LASER CONDITION	COMMAND	POSITION										
PEAK POWER	9999 W	9999 W	X -99999.999										
			Y -99999.999										
PULSE	NORMAL PULSE	NORMAL PULSE	Z -99999.999										
			4 -99999.999										
FREQUENCY	9999 Hz	9999 Hz	MACHINE										
			X -99999.999										
PULSE DUTY	100 %	100 %	Y -99999.999										
			Z -99999.999										
AST GAS	OxG	OxG	4 -99999.999										
PRESS.	9.9 kg	9.9 kg	FEEDRATE										
AVERAGE	9999 W		999999 mm/min										
<table border="1"> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>													

- Move the cursor to the data item for which the data should be set using the cursor keys and key in the data. For PULSE and AST GAS, selection should be made from the menu.

(2) Press the OSCILLATION ON button, and laser oscillation starts.



(3) If the SHUTTER switch is turned to the OPEN position, laser is output from the torch.

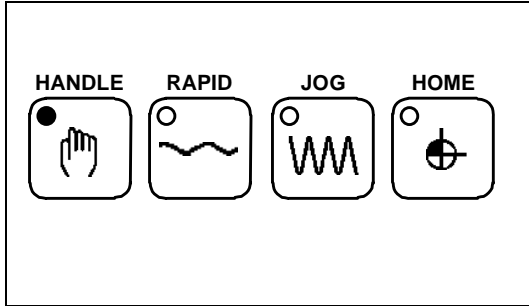


### 8-4-8 Origin set operation

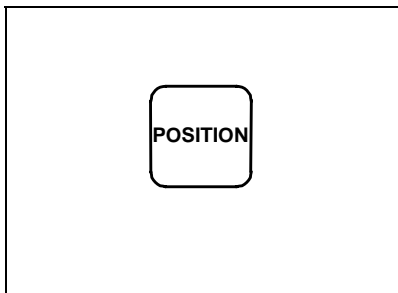
The origin set function is used for establishing the coordinate system by setting the coordinate value for the present position. The coordinate system established here is also valid for automatic operation.

#### Operating procedure

- (1) Select a manual mode (HANDLE, RAPID, JOG or HOME).



- (2) Press the POSITION screen selection key, and the following COMMAND screen is displayed.



*** COMMAND ***			WNo. 9999	COMMAND → POSITION	23:59:59
			(SUB )		LASER CONDITION
POSITION	DISTANCE TO GO	NEXT COMMAND			
X -99999.999	X -99999.999	G 999.9	PEAK POWER	9999 W	
Y -99999.999	Y -99999.999	M 999 999 999 999	PULSE	NORMAL PULSE	
Z -99999.999	Z -99999.999	B 999 999 999 999	FREQUENCY	9999 Hz	
4 -99999.999	4 -99999.999		DUTY	100 %	
MACHINE	REMAIN	WPC(WK.DIE.COOR.)	AST GAS	OXG	
X -99999.999	X -99999.999	X -99999.999	PRESS.	9.9 kg	
Y -99999.999	Y -99999.999	Y -99999.999	AVERAGE	9999 W	
Z -99999.999	Z -99999.999	Z -99999.999			
4 -99999.999	4 -99999.999	4 -99999.999	0 20 40 60 80 100%		
FEED 999999 mm/min	COUNT	POWER ON 99999:59'59"			
NNo. 9999	AUTO OPE	99999:59'59"			
BNo. 9999	AUTO CUT	99999:59'59"			
	TOTAL CUT	99999:59'59"			
SEQ.No.	MODAL	PROGRAM			ORIGIN
SET	INFORM	MONITOR			WNo.

- (3) Select **ORIGIN** from the menu displayed in the screen. The menu display is highlighted and the following window is displayed on the screen.

POSITION	
X	-9999 $\square$ .999
Y	-99999.999
Z	-99999.999
4	-99999.999

- (4) Move the cursor to the axis for which the coordinate value of the present position should be set using the cursor keys.
- When the coordinate values are keyed in, the coordinate system is established so that the present position will take the keyed in coordinate values.
- (5) After completing the operation, press the **ORIGIN** menu key. The menu display returns to normal display and the window is cleared from the screen.

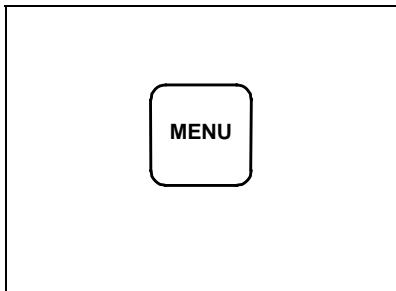
**Note:** The coordinate system set in the origin set operation is cleared when manual home position return is executed.

## 8-5 Automatic Mode

In the automatic mode, the machine is automatically controlled by the program or preset data.

### 8-5-1 Control menu

The control menu is used for setting the conditions for automatic operation. When the MENU key is pressed, the control menu is displayed independent of the presently displayed screen mode. Pressing the menu key corresponding to the required function causes the menu display to be highlighted, indicating that the function has been selected. To make the selected function invalid, press the menu key again. The menu display returns to the normal display, indicating that the selection of the function has been canceled.



Example of control menu display (single block function is valid)

<b>SINGLE</b>	BLOCK	OPTIONAL	MACRO	MACRO	MACRO	M CODE		BEAM OFF
BLOCK	DELETE	STOP	TEST	REMAIN	GLOBAL	LOCK		

#### 1. SINGLE BLOCK

When the single block function is valid, one block of the program is executed at a time. That is, upon completion of one block of the programmed commands, the automatic operation is suspended. To execute the next block, press the CYCLE START button.

#### 2. BLOCK DELETE

When the block delete function is valid, the blocks preceded by the slash code (/) are skipped.

#### 3. OPTIONAL STOP

When the optional stop function is valid, execution of the automatic operation is suspended when the M01 command is executed. The automatic operation may be restarted by pressing the CYCLE START button.

#### 4. MACRO TEST/MACRO REMAIN/MACRO GLOBAL

These functions are used for executing the press mode program. For details, refer to the Programming Manual.

#### 5. M CODE LOCK

When the M-code lock function is valid, all M-codes with an exception of M02, M30, M98 and M99 are ignored.

## 6. BEAM OFF

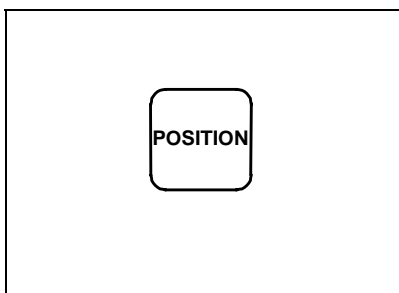
When the beam off function is selected, the program is executed without emitting laser outside. During the execution of the program, the shutter is kept closed. This function is used for dry run mode operation.

### 8-5-2 Automatic Operation

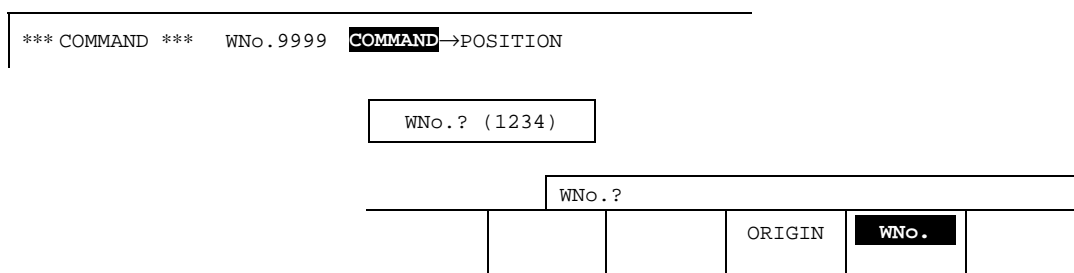
Select the automatic mode to operate the machine by calling the program stored in the memory.

#### Operating procedure

- (1) In the manual mode, move the axes to the position where automatic operation should be started. Refer to Section 8-4, "Manual Mode".
- (2) Press the POSITION screen selection key to display the COMMAND or POSITION screen.



- (3) Press the **WNo.** menu key. The following window is displayed on the screen. Set WNo. used for automatic operation.

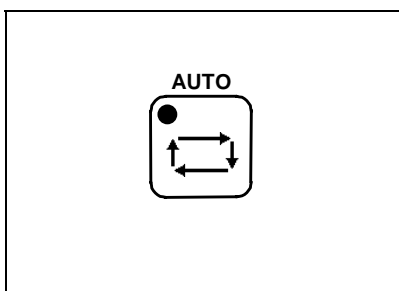


- If the WNo. has been set, this step is not necessary.
- The WNo. displayed at the top line in the screen indicates the WNo. used for automatic operation.

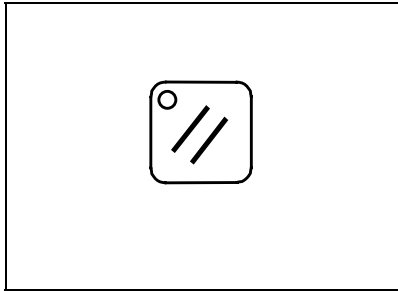
- (4) In response to the setting of the WNo., the set number is displayed at the top line.



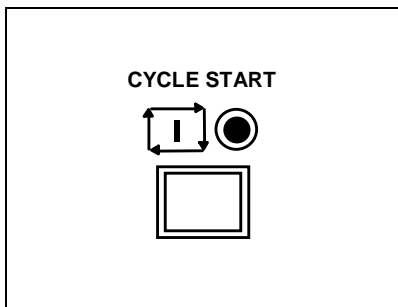
- (5) Press the AUTO mode selection key. The indicating lamp at the upper left corner in the key lights.



- (6) Select the conditions for executing the automatic operation.
  - Select the functions from the control menu. Refer to Subsection 8-5-1, "Control menu".
  - Set the override values. Refer to Section 8-2, "Override".
- (7) Press the reset key.



- (8) Press the CYCLE START button.



- The CYCLE START indicating lamp lights and the execution of the program starts.
- After the completion of the program execution, the machine stops automatically and the CYCLE START indicating lamp is turned off.



- When machining a worksheet which requires frequent positioning or frequent acceleration/deceleration, or when executing the program in which rapid axis feed is set repeatedly, the servomotor and the amplifier will be overloaded to cause an alarm, disabling machine operation. If such a problem occurs, allow the machine to cool by suspending machine operation for a while. After that restart the operation by changing the axis feedrates to a lower value.

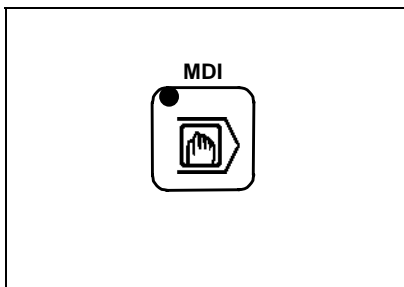
### 8-5-3 MDI operation

In the MDI mode, the machine is controlled by the program which is directly keyed in by the operator.

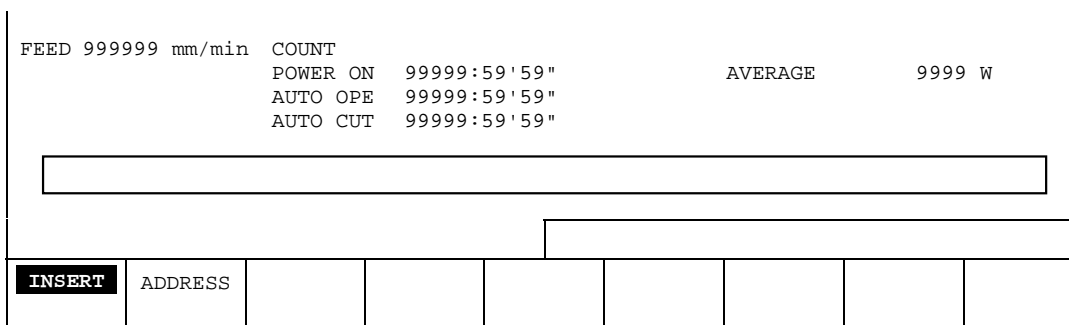
#### Operating procedure

- (1) In the manual mode, move the axes to the position where automatic operation should be started. Refer to Section 8-4, "Manual Mode".

- (2) Press the MDI mode selection key. The indicating lamp at the upper left corner in the key lights.

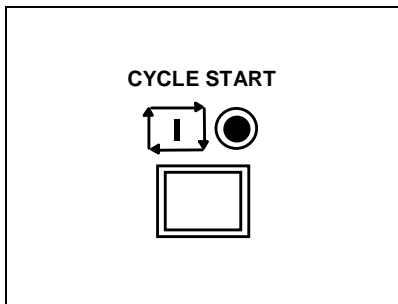


- The window is displayed in the screen; the NC waits for the entry of a program.



Example of MDI window display on the COMMAND screen

- (3) Input a program.  
 - The input program is displayed in the window.
- (4) Select the conditions for executing the MDI mode operation.  
 - The same procedure as selecting the conditions for automatic operation.
- (5) Press the CYCLE START button.



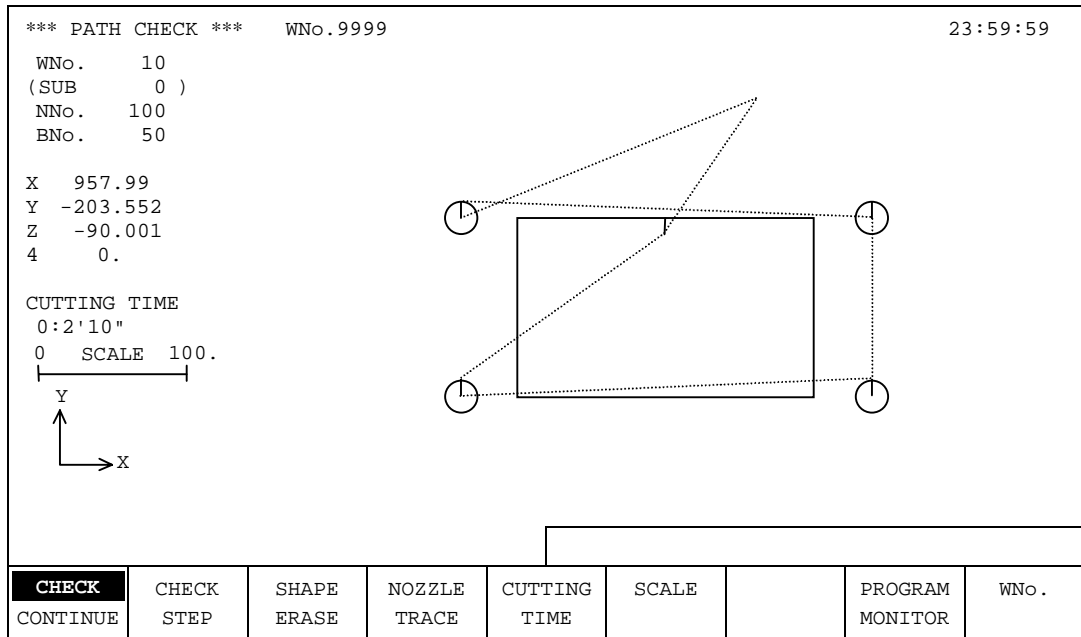
- The CYCLE START indicating lamp lights and the program set inside the window is executed.
- After the completion of the program execution, the machine stops automatically and the CYCLE START indicating lamp is turned off. The program set in the window is cleared and the NC is ready for inputting the next program.

### 8-6 Tool Path Check Function

The tool path check function is used for checking how the program is executed on the screen without actually executing the program.

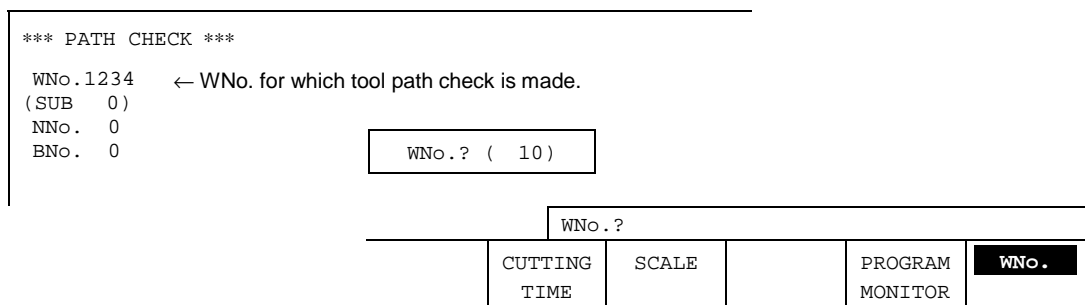
Operating procedure

- (1) Press the GRAPH screen selection key, and the following PATH CHECK screen is displayed.



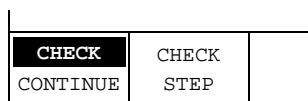
Example of tool path check

- (2) Press the **WNo.** menu key. The following window is displayed on the screen. Set the WNo. for which tool path check is made.



- If the WNo. has been set, this step is not necessary.

- (3) If the **CHECK CONTINUE** menu key is pressed, the menu item is highlighted and the tool paths are displayed on the screen while executing the program continuously. If the **CHECK STEP** menu key is pressed, the program is executed block by block.



- (4) When program execution is completed while the **CHECK CONTINUE** menu item is highlighted, the menu display returns to normal display. In the check step mode, highlighted display returns to the normal display each time execution of a block is completed.

**Note 1:** Rapid feed paths executed in the G00 mode are displayed in broken lines ( - - - - ) , and jog feed paths executed in the G01, G02, or G03 mode are displayed in solid lines ( — ).

**Note 2:** The path check function is valid for both cut mode programs and press mode programs.

**Note 3:** During execution of an automatic operation, the program not used for automatic operation can be checked. However, path check speed will be slower since data processing priority is given to actual cutting operation.

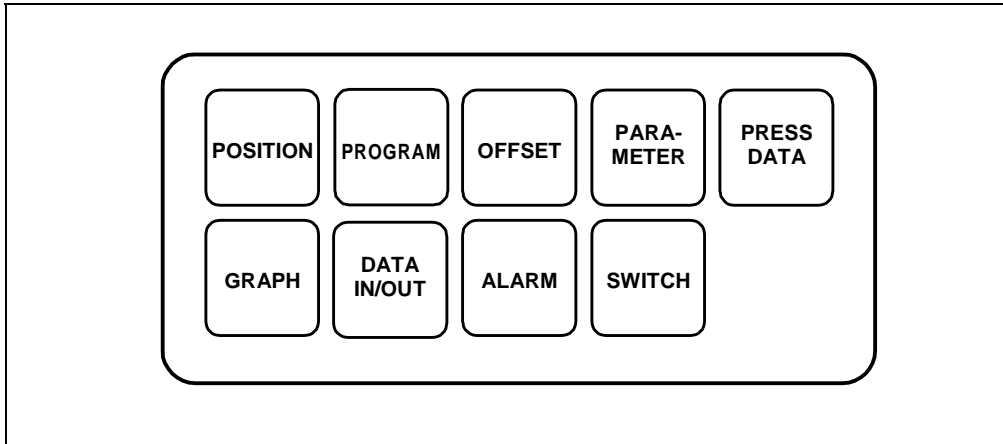
**Note 4:** The CUTTING TIME is calculated from the axis motion distance and feedrate, it may be different from the actual cutting time. The processing time of the M-codes is set by a parameter. The parameter set time is added to the calculated CUTTING TIME each time an M-code is executed.

M-code parameter: User parameter **I033** (0.01 sec)

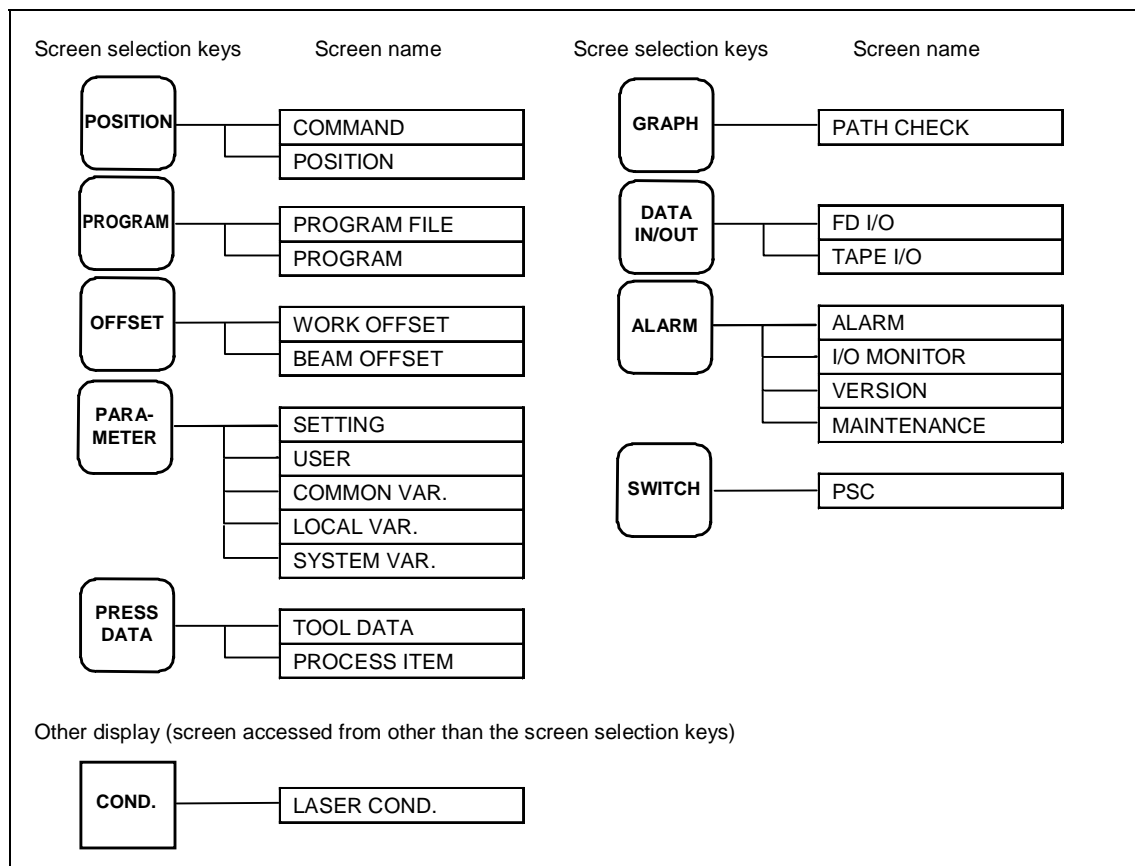
## 8-7 Basic Screen Operation

### 8-7-1 Screen configuration

The following keys are used to change the display.



Screens are given in groups and the screen selection keys on the operation panel are used to select the group. The following diagram shows the screen names in each of the groups.



### 8-7-2 Calling the screen

When a screen selection key is pressed, any screen of the selected group is displayed. To switch the screen in the same group, press the same screen selection key.

**Example:** To display the POSITION screen while the present screen is not COMMAND or POSITION screen

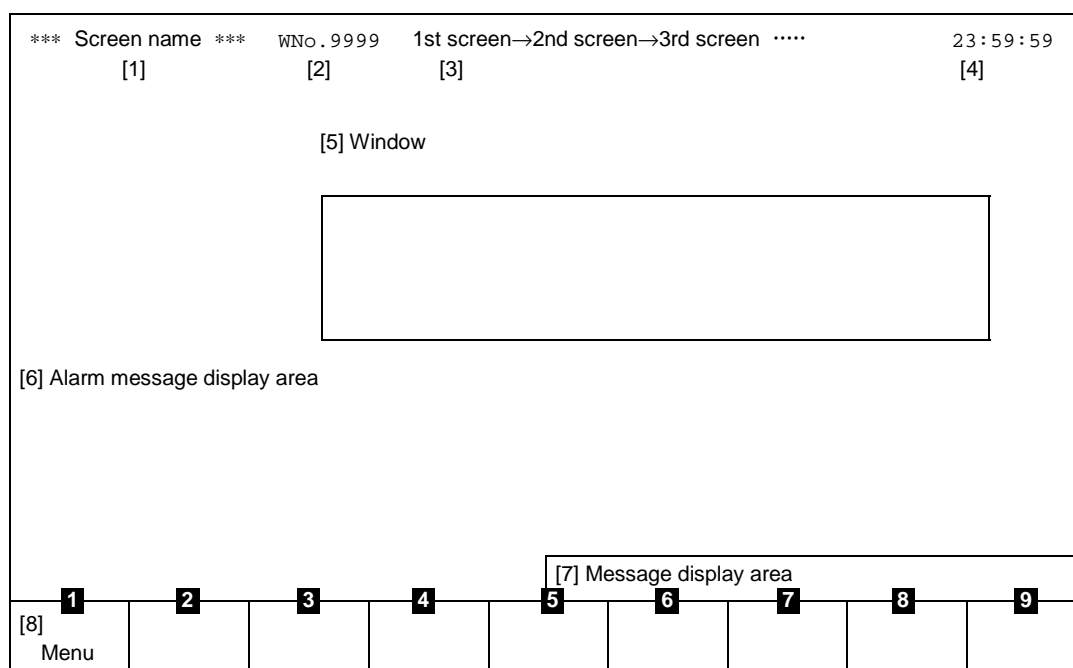
1. Press the POSITION screen selection key. The COMMAND screen is displayed.
2. Press the POSITION screen selection key again. The screen is switched to the POSITION screen.

At the top line in the screen, the presently selected screen name and the list of name of the accessible screens in the same selected group are displayed. The presently selected screen name is given in highlighted display.

```
*** COMMAND ***   WNo. 9999  COMMAND→POSITION
```

### 8-7-3 Basic screen configuration

The NC unit provides a variety of screens. The screen configuration common to all the screens is explained below.



**1. Screen name**

The name of the screen presently selected is displayed.

**2. WNo. display**

The WNo. (work number) to be used for automatic operation is displayed.

**3. Screen names (in the same group)**

The list of the screen names accessible in the presently selected group is displayed. The present screen name is given in highlighted characters.

#### 4. Clock

The present time (h : m : s) is displayed.

#### 5. Window

Without changing the present display, required information can be displayed in the screen in response to such as menu selection. Contents, size and position of the window vary according to the window type.

#### 6. Alarm message display

If an alarm state is detected with the CNC or the machine, the corresponding alarm number and the alarm message are displayed in this area. There are two types of alarms: the alarm which stops machine operation and the one which allows the machine to continue operating.

**Example:** 613 **IMPROPER G-CODE** The alarm which causes the machine to stop.  
401 ILLEGAL NUMBER INPUT The alarm which allows the machine to continue operating.

As shown in the examples above, the alarm which stops machine operation is given in highlighted display while the alarm which allows the machine to continue operating is given in normal display.

##### Resetting the alarm

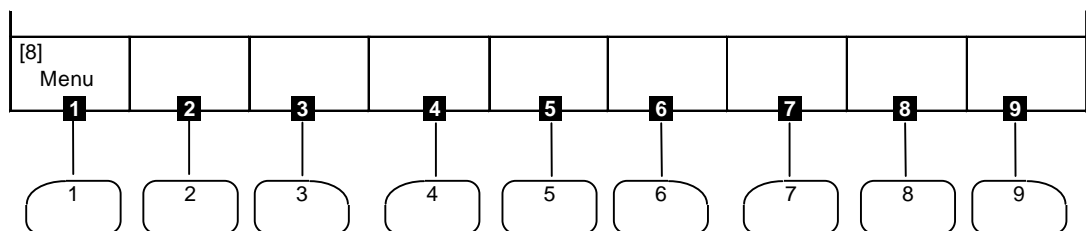
If an alarm message is displayed, take proper corrective action by referring to Chapter 13, "ALARM LIST" in the Maintenance Manual.

#### 7. Message display

The operation guide message is displayed in this area.

#### 8. Menu

The CNC unit provides a variety of menus which are accessible from the relevant screen. This menu display area shows the set of menu functions which are selectable from the presently displayed screen. Actual selection of the menu function is made by pressing the corresponding menu key: one menu key is allocated for each menu item.

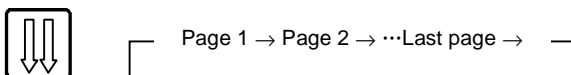


### 8-7-4 Changing the display pages

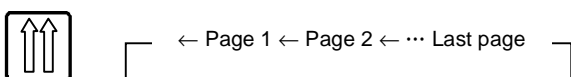
Some of the screen display consists of more than one page. The page keys are used to change the display page. The present page is displayed on the screen in such as "PAGE 3/6". The page number is usually displayed at the lower right area of the screen.

#### Page changing sequence

Ascending order



Descending order

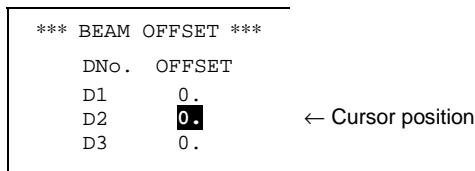


### 8-7-5 Inputting the data

The general operation procedure used for inputting the data on the screen or in the window is explained below, along with the procedure used for clearing or changing the input data. The operation used only for specific data or specific situation, such procedure is given for the related screen.

#### 1. To set the data on the BEAM OFFSET screen

- (1) Move the cursor to the data column of the item for which the data should be set. The guide message for the necessary operation is displayed in the message display area.



- (2) Key in the required value using numeric keys. The data being keyed in is highlighted.  
D2 **1.325** "1.325" has been keyed in.
- (3) After keying in the value, press the input key. The display returns to the normal display and the keyed in data is input.



D2 1.325

#### 2. To clear the value having been keyed in

The value having been keyed in is cleared by pressing the clear key before pressing the input key.

- (1) D2 **1.325** "1.325" has been keyed in.

- (2)  Press the clear key.

- (3) D2 0. The state is returned to the previous state before keying in the value.

### 3. To delete the character keyed in last

The character keyed in last can be deleted by pressing the BS key before pressing the input key.

(1) D2 **1.325** "1.325" has been keyed in.

(2)  Press the BS key.

(3) D2 **1.32** "5" is deleted.

**Note:** Pressing the BS key continuously will delete the other character at the end of the keyed in value.

### 8-7-6 Setting the clock

To set the clock, follow the procedure below after displaying the VERSION screen.

(1) Press the **TIME SET** menu key.

The cursor moves to the time display area.

Message: Enter present time (H.M.S)

(2) Key in the time and press the input key

The time input format is indicated below.

**Example:** 12.34.56 This is displayed as "12:34'56".

Setting range: 0.00.00 to 23.59.59

**Note:** It is possible to skip "0" for inputting the time data.

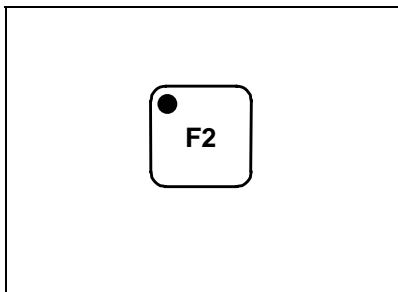
1 → 1 : 00' 00"

12.3 → 12 : 03' 00"

### 8-7-7 Turning off the screen

Although the long-life EL display is used, its brightness will be lowered if the display is kept on for a long time. It is possible to turn off the screen while the power to the machine is on. If the operation at the screen is not necessary while executing automatic operation, or if the machine is not operating although power is on, use this function to turn off the screen so that the screen life will be elongated.

(1) Press the F2 key (power save key). The indicating lamp at the upper left corner in the key lights and the screen is turned off.



(2) To display the screen in this state, press any key or switch on the operation panel.

## 8-8 COMMAND Screen

On the COMMAND screen, the set WNo., coordinate values, machine operating status, etc. are displayed.

### 8-8-1 Display on the COMMAND screen

[1]	[2]	[3]	[4]
*** COMMAND ***		WNo. 9999	COMMAND → POSITION
(SUB )			23:59:59
			LASER CONDITION
POSITION [5]	DISTANCE TO GO [7]	NEXT COMMAND [9]	[12]
X -99999.999	X -99999.999	G 999.9	PEAK POWER 9999 W
Y -99999.999	Y -99999.999	M 999 999 999 999	PULSE
Z -99999.999	Z -99999.999	B 999 999 999 999	FREQUENCY 9999 Hz
4 -99999.999	4 -99999.999		PULSE DUTY 100 %
MACHINE [6]	REMAIN [8]	WPC(WK.DIE.COOR.) [10]	AST GAS
X -99999.999	X -99999.999	X -99999.999	PRESS. 9.9 kg
Y -99999.999	Y -99999.999	Y -99999.999	[14] AVERAGE 9999 W
Z -99999.999	Z -99999.999	Z -99999.999	0 20 40 60 80 100%
4 -99999.999	4 -99999.999	4 -99999.999	
[13] FEED 999999 mm/min	COUNT	POWER ON 99999:59'59"	
NNo. 9999	AUTO OPE	99999:59'59"	
BNo. 9999.	AUTO CUT	99999:59'59"	
[15] TOTAL CUT		99999:59'59"	
[11]			
SEQ.No.	MODAL	PROGRAM	ORIGIN
SET	INFORM	MONITOR	WNo.

### 8-8-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	COMMAND			The name of the screen presently displayed
[2]	WNo. SUB	0 to 9999 0 to 9999		Possible	The WNo. used for automatic operation The subprogram number presently executed
[3]	List of screen names	COMMAND POSITION			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	X, Y, Z	± 99999.999	mm	Note 1	Present position of the nozzle in the work coordinate system
	4	± 99999.999	degree or mm	Note 1	Same as above (for additional axis specification)
[6]	X, Y, Z	± 99999.999	mm	Note 1	Present position of the nozzle in the machine coordinate system
	4	± 99999.999	degree or mm	Note 1	Same as above (for additional axis specification)
[7]	X, Y, Z	± 99999.999	mm	Note 1	Distance from the end point of the present block to that of the next block
	4	± 99999.999	degree or mm	Note 1	Same as above (for additional axis specification)
[8]	X, Y, Z	± 99999.999	mm	Note 1	Remaining distance to the end point in the presently executed block
	4	± 99999.999	degree or mm	Note 1	Same as above (for additional axis specification)

No.	Data name	Display range	Unit	Setting	Description
[9]	G, M, B	0 to 999, blank	Code No.		Codes specified in the next block
[10]	X, Y, Z	± 99999.999	mm	Note 1	Workpiece zero point in the machine coordinate system
	4	± 99999.999	degree or mm	Note 1	Same as above (for additional axis specification)
[11]	POWER ON	0:00'00" to 99999:59'59"	H:M:S	(Possible)	Accumulated power on time
	AUTO OPE			Possible	Accumulated time from cycle start to reset
	AUTO CUT			Possible	Time excluding the time in which the machine has been stopped due to feed hold and single block from the AUTO OPE time
	TOTAL CUT			Possible	Accumulated cutting time in AUTO CUT time
[12]	PEAK POWER	0 ~ 9999	W		Specified laser output power
	PULSE	CW NORMAL PULSE			Laser pulse type
	FREQUENCY	0 to 9999	Hz		Laser pulse oscillation frequency
	PULSE DUTY	0 to 100	%		Laser pulse duty ratio
	AST GAS	OXG, AIR, 3RD (4TH) GAS			Assist gas type 4th assist gas is optional
	PRESS.	0 to 9.9	kgf		Assit gas pressure <b>Note:</b> the maximum display values and pulse type vary depending on the laser oscillator.
[13]	FEED	0 to 999999	mm/min	Note 2	Feedrate
[14]	AVERAGE	0 to 9999	W		Actual output of laser oscillator
	Load meter	0 to 100	%		Load of laser output
[15]	NNo.	0 to 9999			Present sequence number
	BNo.	0 to 9999			Present block number

**Note 1:** For the machine of the inch system, the display range and the unit for the linear axes are as indicated below.

Display range	Unit
± 9999.9999	inch

**Note 2:** For the machine of the inch system, the display range and the unit for FEED are as indicated below.

Display range	Unit
0 - 99999	inch/min


### 8-8-3 Screen operation

#### 1. Setting the operating time management information

Input the data for the following: POWER ON, AUTO OPE, AUTO CUT, TOTAL CUT, and OSCILLATION TIME

(1) Press the cursor key to call the cursor at the required data input column.

Message: INPUT THE TIMETABLE

**Note:** To move the cursor to the POWER ON column, first move the cursor to the AUTO OPE column and press the  key while pressing the SHIFT key.

- (2) Key in the time data and press the input key.

The time input format is indicated below.

**Example:** 12.34.56 → This is displayed as 12:34' 56".

Setting range: 0.00.00 to 23.59.59

**Note:** It is possible to skip "0" for inputting the time data.

1 → 1 : 00' 00"

12.3 → 12 : 03' 00"

### 8-8-4 Menu operation

#### 1. Restart

Refer to Chapter 12 "PROGRAM RESTART FUNCTION".

#### 2. Displaying the modal information

Display the present modal information.

- (1) Press the **MODAL INFORM** menu key. The menu item is highlighted and the following window is displayed.

GROUP [1]	GROUP	[2]
1 G999.9	11 G999.9	F9999999
2 G999.9	12 G999.9	M999 [3]
3 G999.9	13 G999.9	
4 G999.9	14 G999.9	B999 [4]
5 G999.9	15 G999.9	
6 G999.9	16 G999.9	D999 [5]
7 G999.9	17 G999.9	P9999
8 G999.9	18 G999.9	Q9999
9 G999.9	19 G999.9	R100
10 G999.9		C9.9

G-code: Preparatory function

F-code: Feedrate

M-code: Miscellaneous function

B-code: Second miscellaneous function

D-code: Cutter diameter compensation number

P-code: Laser output

Q-code: Laser frequency

R-code: Laser duty ratio

C-code: Gas pressure

- (2) Press the menu key again, and the menu display returns to the normal display and the window is cleared.

No.	Data name	Display range	Unit	Setting	Description
[1]	G-code	0 to 999 or no display	Code No.		Modal G-codes (in group)
[2]	F-code	0 to 999999	mm/min		Modal F command
[3]	M-code	0 to 999 or no display	Code No.		Modal M commands
[4]	B-code	0 to 999 or no display	Code No.		Modal B commands
[5]	P (power) Q (frequency) R (duty ratio) C (gas pressure)	0 to 9999 0 to 9999 0 to 100 0 to 9.9			Modal P, Q, R, and C commands

### 3. Displaying the program monitor

The program line presently executed is displayed.

- (1) Press the **PROGRAM MONITOR** menu key. The menu item is highlighted and the following window is displayed.

```
N100 G00X100.Y100.;  
N110 G04X10.;  
N200 G28X10.Y10.Z10.;
```

- The program block presently executed is displayed in highlighted characters at the top line.
  - While not in the automatic operation, the present program is displayed from the first line.
- (2) Press the menu key again, and the menu display returns to the normal display and the window is cleared.

### 4. Setting the origin

Refer to Subsection 8-4-8, "Origin set operation".

## 8-9 POSITION Screen

The present position of the machine is displayed.

### 8-9-1 Screen display

*** COMMAND ***				WNo. 9999	COMMAND	→	POSITION	23:59:59
[1]	[2]	[3]	[4]					
<b>WNo. 9999</b>								
<b>X -99999.999</b>								
<b>Y -99999.999</b>								
<b>Z -99999.999</b>								
<b>4 -99999.999</b>								
SEQ.No. SET	MODAL INFORM	PROGRAM MONITOR					ORIGIN	WNo.

### 8-9-2 Details of displayed items

Refer to Subsection 8-8-2, "Details of displayed items", for the COMMAND screen.

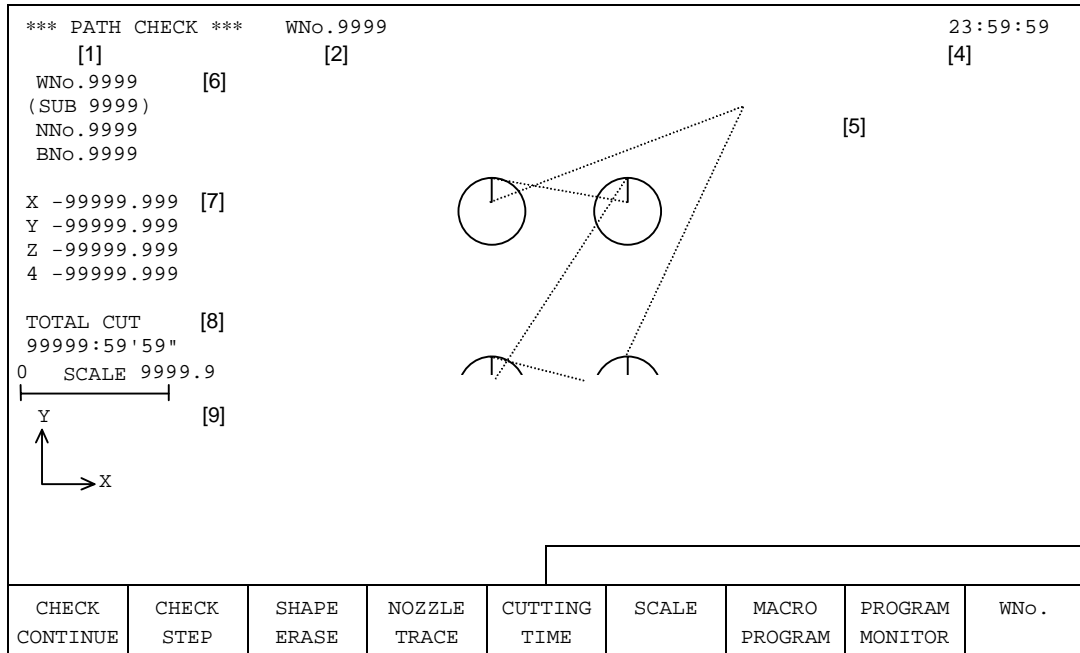
### 8-9-3 Menu display

Refer to Subsection 8-8-1, "Display on the COMMAND screen".

## 8-10 PATH CHECK Screen

The program is simulated and the tool paths are displayed on the screen. During simulation, the approximate cutting time is calculated.

### 8-10-1 Screen display



### 8-10-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	PATH CHECK			The name of the screen presently displayed
[2]	WNo	0 to 9999			The WNo. used for automatic operation Not related with the execution of the tool path check function.
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	Nozzle paths	Graphic			Tool paths of the nozzle
[6]	WNo.	0 to 9999			WNo. for which the tool path check is made
	SUB	0 to 9999			The subprogram number called during the execution of the tool path check function
	NNo.	0 to 9999			Sequence number during the execution of the tool path check function
	BNo.	0 to 9999			Block number during the execution of the tool path check function
[7]	X, Y, Z	± 99999.999	mm	Note 1	Present position of the nozzle in the work coordinate system (tool path)
	4	± 99999.999	degree or mm	Note 1	Same as above (for additional axis specification)
[8]	TOTAL CUT	0:00'00" to 99999:59'59"	H:M:S		Calculated cutting time (Stop time during tool path step is excluded.) (The time required for the execution of miscellaneous functions is calculated based on estimation.)
[9]	SCALE	0 to 9999.9	mm	Note 2	Scale for graphic display

**Note 1:** For the machine of the inch system, the display range and the unit for the linear axes are as indicated below.

Display range	Unit
± 9999.9999	inch

**Note 2:** For the machine of the inch system, the display range and the unit for SCALE are as indicated below.

Display range	Unit
0 to 99999	inch

### 8-10-3 Menu operation

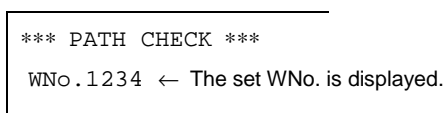
#### 1. Setting the WNo. used for tool path check

- (1) Select **WNo.** from the menu to display the window.



- (2) Key in the WNo. and press the input key.

The window is cleared and the set WNo. is displayed on the screen.



#### 2. Setting the scale

Set the center and scale for graphic display.

- (1) Select **SCALE** from the menu.

- The cursor is displayed at the center of the screen.

Message: DESIGNATE THE CENTER OF DISPLAY.

- (2) Set the center of the display.

- Move the cursor to the center for the graphic display and press the input key.

- The cursor moves to the SCALE data input field.

The graphic having been displayed is cleared from the screen.

Message: SCALE <INPUT>?

- (3) Set the scale.

- Set the length which corresponds to |———| in "mm".

- Key in the SCALE data and press the input key.

The SCALE value presently set is displayed on the screen. If it is not necessary to change the present setting, press the input key without keying the scale value.

#### 3. Drawing the tool path

Refer to Section 8-6, "Tool Path Check Function".

#### 4. Clearing the tool paths

Press the **SHAPE ERASE** menu key to clear the displayed tool paths. The menu key may be pressed while the tool paths are being drawn.

## 5. Drawing the rapid feed paths

The tool paths executed at the rapid feedrate (other than G01, G02, G03 mode) is drawn in broken lines.

- (1) Press the **NOZZLE TRACE** menu key, and the tool paths where the nozzle is moved at a rapid feedrate are drawn in broken lines.
  - The **NOZZLE TRACE** menu item is highlighted.
- (2) When the **NOZZLE TRACE** menu key is pressed while the rapid feed tool path drawing mode is valid, the display of **NOZZLE TRACE** menu is returned to normal display. After this, the rapid feed paths are not displayed.

## 6. Displaying the program monitor

The program presently executed is displayed.

- (1) Press the **PROGRAM MONITOR** menu key. The menu item is highlighted and the following window is displayed.

```
N100 G00X100.Y100. ;
N110 G04X10. ;
N200 G28X10.Y10.Z10. ;
```

- The block presently executed is displayed at the top line in highlighted characters.
- (2) Pressing the menu key again returns the highlighted display to normal display, and the window is cleared.

## 7. Displaying the cutting time

The cutting time is calculated and displayed at the same time the tool paths are drawn.

- (1) Select **CUTTING TIME** from the menu. The menu item is highlighted and the cutting time for the following operation is calculated and displayed.
- (2) While the **CUTTING TIME** menu item is highlighted, press the menu key again, and the display returns to the normal display. The cutting time is not calculated for the following operation.

**Note 1:** The calculated cutting time may not match the actual cutting time precisely.

**Note 2:** When the cutting time calculation is made, the time required for tool path drawing is elongated.

## 8. Setting for multi-setup

The multi-setup function is used to execute the press mode program which includes the multi-setup commands.

- (1) When **MACRO PROGRAM** is selected from the menu, the menu item is highlighted and the macro program function becomes valid.
  - This is the same function as the **MACRO GLOBAL** control menu in the automatic mode.
- (2) Execute the program for checking by pressing the **CHECK CONTINUE** or **CHECK STEP** menu key.

### 8-11 PROGRAM FILE Screen

The PROGRAM FILE screen is used to check the registered programs. On the PROGRAM FILE screen, the following operation is possible.

1. Changing the work number of the registered programs
2. Deleting the program
3. Copying the program

#### 8-11-1 Screen display

*** PROGRAM FILE ***					WNo. 9999	<b>PROGRAM FILE</b> → PROGRAM	23:59:59		
	[1]		[2]	[3]				[4]	
No.	WNo.	BLOCK	RECORD	COMMENT	No.	WNo.	BLOCK	RECORD	COMMENT
1	9999 <b>C</b>	9999	9999	ABCDEFGHIJKL	17				
2	[5]	[6]	[7]	[8]	18				
3					19				
4					20				
5					21				
6					22				
7					23				
8					24				
9					25				
10					26				
11					27				
12					28				
13					29				
14					30				
15					31				
16					32				
		[9]			[10]				[11]
		MEMORY USE	100.0%		BACK GROUND	WNo. =9999			PAGE 1/3
					ALL				
					ERASE				

#### 8-11-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	PROGRAM FILE			The name of the screen presently displayed
[2]	WNo	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	PROGRAM FILE PROGRAM			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	WNo.	1 to 9999			The registered program numbers (WNo.) To distinguish the programs between press programs and cutting programs, <b>P</b> or <b>C</b> is added following the program number. 1111 <b>P</b> Press program 2222 <b>C</b> Cutting program
[6]	BLOCK	1 to 65535			The number of blocks in the program
[7]	RECORD	1 to 65535			The number of records used in the program
[8]	COMMENT	Max. 12 characters			Comment (the first line of the program)
[9]	MEMORY USE	0 to 100%			The used status of the memory
[10]	BACK GROUND WNo.	0 to 9999			WNo. of the program presently processed in the back ground mode (WNo. of the program presently edited)
[11]	PAGE				The page number of the present display

### 8-11-3 Screen operation

On the PROGRAM FILE screen, the list of the programs registered to the memory is displayed in the order of WNo. If the programs cannot be displayed in one page, use the page key to change the display page.

### 8-11-4 Menu operation

On the PROGRAM FILE screen, press a cursor key, and the cursor is displayed and the following menu is displayed.

	PROGRAM No. CHG	PROGRAM COPY	PROGRAM ERASE	ALL ERASE		MODE CHANGE		

Using this menu, the following operation is possible.

#### 1. Changing the program number of the registered programs

- (1) Move the cursor to the program number to be changed.
- (2) Press the **PROGRAM No. CHG** menu key.
- (3) The menu item is highlighted and the following window is displayed.

DEST. WNo. ? (     )
----------------------

- (4) Key in the WNo. and the keyed in number is displayed in the window.
- (5) Press the input key. The cursor located program number is changed to the keyed in program number. The menu display returns to the normal display and the window is cleared.

**Note:** When changing the program number, a number which is not used for registered programs may be used.

#### 2. Copying the program

The registered program can be copied to a program number which is not used for registered programs.

- (1) Move the cursor to the program which is required to be copied.
- (2) Press the **PROGRAM COPY** menu key.
- (3) The menu item is highlighted and the following window is displayed.

COPY DEST. WNo. ? (     )
---------------------------

- (4) Key in the destination WNo. and the keyed in number is displayed in the window.
- (5) Press the input key. The program is copied to the keyed in program number. The menu display returns to the normal display and the window is cleared.

**Note:** When copying the program, a number which is not used for registered programs may be used.

### 3. Deleting the program

The registered program can be deleted.

- (1) Move the cursor to the program which is required to be deleted.
- (2) Press the **PROGRAM ERASE** menu key.
- (3) The menu item is highlighted and the following window is displayed.

```
PUSH <INPUT> KEY
```

- (4) Press the input key. The specified program is deleted. The menu display returns to the normal display and the window is cleared.

**Note:** If the program erase protect function is used, warning will be issued, when an attempt is made to erase the related program.

### 4. Deleting all programs

All the registered programs can be deleted.

- (1) Press the **ALL ERASE** menu key.
- (2) The menu item is highlighted and the following window is displayed.

```
ALL ERASE <-9999INPUT> ( )
```

- (3) After keying in “-9999”, press the input key. All of the registered programs are deleted. The menu display returns to the normal display and the window is cleared.

**Note:** If the program erase protect function is used, related programs will remain not deleted.

### 5. Changing the type

The mode of created programs can be changed from cut to press or from press to cut.

- (1) Move the cursor to the work number for which the mode should be changed.
- (2) Press the **TYPE CHANGE** menu key.
- (3) The menu item is highlighted and the following window is displayed.

```
PRESS:0 CUT:1 ? ( )
```

- (4) Select the required type and key in the corresponding code number. Press the input key, and the program mode is changed. The menu display returns to the normal display and the window is cleared.

**Note:** When changing the program mode from cut mode to press mode, take the following caution into consideration.

If more than one G-code is designated in a single block of the cut mode program, such a block must be divided into several blocks so that one block has only one G-code before changing the type.

**Example:** G90 G92 X0 Y0;    Cut mode program  
               ↓ Divide the block into two blocks  
               G90;                    Cut mode program  
               G92 X0 Y0;  
               [Type change]  
               G90;                    Press mode program  
               G92 X0 Y0;

If the program type is changed while the program has blocks which include more than one G-code, the press mode program may fail to control the machine correctly.

#### 6. Program erase protect function

Assigning the desired number to user parameter **I060** is recommended. When the following operations are performed on the programs ranging from that number to 9999, a warning message will be displayed and those functions deactivated:

- Changing the program
- Erasing the program
- Creating a new program

**Note:** To stop the menu operations indicated above, press the menu key selected presently again.

## 8-12 PROGRAM Screen

On the PROGRAM screen, program creation or program editing is possible. The processing program has two types - cut mode and press mode. Depending on the program type, the method to create the program differs from each other.

### 8-12-1 Creating a new program

To create a new program using a WNo. not registered to the NC, follow the procedure indicated below.

- (1) Press the PROGRAM screen selection key to display the PROGRAM screen.
- (2) Press the **WNo.** menu key. The menu item is highlighted and the following window is displayed.

WNo. ? (      )
-----------------

Message: WNo. ?

- (3) Key in the WNo. and press the input key.  
Note that a WNo. not registered to the NC should be used.
- (4) The menu display returns to the normal display and the window is cleared. The following screen is displayed.


*** PROGRAM ***		WNo.9999	PROGRAM FILE→	<b>PROGRAM</b>	23:59:59
		WNo.1234	Line 0		
MODE TYPE <MENU>					
CUT	PRESS				

- (5) Press the **CUT** or **PRESS** menu key to select the mode.
- (6) Depending on the selected mode, the screen changes.
  - When the cut mode is selected, the program can be created on the same screen. For the operation to follow, refer to 8-12-2, "Editing the cut mode program". If the press mode is selected, the procedure explained below must be followed.

- (7) If the press mode is selected, the following screen is displayed.

*** PROGRAM ***	WNo.9999	PROGRAM FILE→PROGRAM	23:59:59
WNo.1234	MATERIAL: █ ( )	THICKNESS: 99.9 mm	
1.SPCC	9.	17.	25.
2.SPHC	10.	18.	26.
3.SS41	11.	19.	27.
4.SUS304	12.	20.	28.
5.	13.	21.	29.
6.	14.	22.	30.
7.	15.	23.	31.
8.	16.	24.	32.
MATERIAL NUMBER?			
WNo.			


- (8) The materials having been set on the PROCESS ITEM screen are displayed in list. The cursor is displayed at the MATERIAL field to allow the selection of material. Select the material from the list and key in the code number of the selected material.

In the case of a subprogram, entry of MATERIAL and THICKNESS is not required. Press the PAGE key  to select the program edit state. For the following procedure, refer to item "2. Creating and editing a program" in Subsection 8-12-3, "Editing the press mode program".

- (9) After the input of the material code number, the code number and the material name are displayed at the cursor position. Then, the cursor moves to the THICKNESS field. Input the thickness.

*** PROGRAM ***	WNo.9999	PROGRAM FILE→PROGRAM	23:59:59
WNo.1234	MATERIAL: 1(SPCC)	THICKNESS: █ mm	
MATERIAL THICKNESS?			

- (10) In response to the input of the worksheet thickness, the cutting conditions automatically determined from the worksheet material and thickness are displayed.





- (11) After confirming the cutting conditions, proceed to the program edit process by pressing the PAGE  key.

Message: EDITION SCREEN FOLLOWS ON NEXT PAGE

- (12) The program created in the press mode can be edited. For further operating procedure, refer to 8-12-3, "Editing the press mode program".



### 3. Overwriting a program





- (1) Using the cursor keys   , move the cursor to the position where the program should be overwritten.
- (2) Press the **ADDRESS** menu key. The menu item is highlighted and the cursor located line is displayed in the program edit line.
- (3) Using the cursor keys   , move the cursor to the position where the program should be overwritten.
- (4) Key in the data using the alphabetic and numeric keys. The keyed in data overwrites the cursor located data.
- (5) After keying in the data, press the input key. The data displayed and edited in the program edit line is copied to the program display area and the contents of the memory are updated accordingly.

**Note 1:** If the BS key is pressed during the insert or overwrite operation, the character before the cursor is deleted. When the input key is pressed, the program displayed and edited in the program edit line is copied to the program display area and the contents of the memory are updated accordingly.

**Note 2:** If the clear key is pressed during the insert or overwrite operation, the program having been keyed in is cleared.

**Note 3:** If the program erase protect function is used, warning will be issued, when an attempt is made to edit the related program.





### 4. Deleting lines of program

- (1) Using the cursor keys   , move the cursor to the first line to be deleted.
- (2) Press the **DELETE** menu key. The menu item is highlighted and the message "MOVE CURSOR TO THE LAST LINE, AND PRESS ENTER" will be displayed.
- (3) Designate the last line to be deleted using the cursor key  , page key  and **END OF TEXT** menu key. The designated range will be reverse highlighted.





**Note:** The range may be specified only after the start point.

- (4) Press the input key. The lines in the designated range are deleted.



### 5. Copying lines of program

- (1) Using the cursor keys   , move the cursor to the first line to be copied.
- (2) Press the **LINE COPY** menu key. The menu item is highlighted and the message "END POINT <INPUT>?" is displayed.
- (3) Specify the copy range by using the cursor key  , page key  , and the **PROGRAM END** menu key. The specified area is highlighted.






**Note:** The copy range may be specified only after the start point.

- (4) Press the input key. The lines in the highlighted area return to the normal display and the message "DESIGNATE THE COPY LOCATION" is displayed. Move the cursor to the copy destination by using the cursor keys   , page keys   and the **PROGRAM HEAD** and **PROGRAM END** menu keys. Then, press the input key.
- (5) The specified range is copied before the cursor position.

## 6. Copying the program

- (1) Using the cursor keys  , move the cursor to the line where the program should be copied.
- (2) Select the **PROGRAM COPY** menu key. The menu item is highlighted and the message "WNo.?" is displayed.
- (3) After keying the WNo. (displayed on the program edit line), press the input key.
- (4) The specified program is copied before the cursor located line.

## 7. Search

- (1) Press the **DATA SEARCH** menu key. The menu item is highlighted. The character-string input previously is displayed. If different character-string should be searched, press the clear key and key in the required character-string.
- (2) Specify the direction of search by the cursor keys  . And the search is made in the specified direction from the cursor position.  
 or : Search is made in the forward direction.  
: Search is made in the backward direction.
- (3) If the specified character-string is found, the line containing that character-string is displayed at the first line.

## 8. Jump to the head

When the **JUMP** and **PROGRAM HEAD** menu keys are pressed in this order, the cursor jumps to the first line in the program.

## 9. Jump to the end

When the **JUMP** and **PROGRAM END** menu keys are pressed in this order, the cursor jumps to the end line of the program.

## 10. Replace

- (1) Press the **REPLACE** menu key. The menu item is highlighted and the window is displayed.
- (2) Enter the character-string to replace, select a replace mode and press the input key.
- (3) Replace is executed from the line following the cursor. Press the clear key to stop the replace operation during execution.

### 8-12-3 Editing the press mode program

#### 1. Editing procedure

- (1) Press the PROGRAM screen selection key to display the PROGRAM screen.
- (2) Press the WNo. menu key. The menu item is highlighted and the following window is displayed.

WNo.? ( )

Message: WNo.?

- (3) Key in the WNo. and press the input key.  
The following steps are described assuming that the WNo. of the registered press mode program is input.
- (4) The menu display returns to the normal display and the window is cleared.

Line	G/MACRO	X/D/L	Y/F	I	J	K/R	P/#R	Q/#C	C	T	M/W
1	G92	0.	0.								
2	G70	-50.	-40.								
3	G00	-60.5	-45.						45.45	49	
4											M30
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											

WNo.	DELETE	INSERT	SEARCH	G CODE INFORM	TOOL INFORM	M CODE INFORM	DETAILED INFORM	?
------	--------	--------	--------	------------------	----------------	------------------	--------------------	---

**Note:** For creating a new program, the program contents are not displayed.



#### 2. Creating and editing a program

Create the program in units of lines following the instructions displayed in guide message. When editing a program, move the cursor to the data to be edited. When adding a program, move the cursor to the line next to the end line.

**Note 1:** When inputting a program, the block is recognized when the cursor exits the line. At the recognition of the block, the syntax check is made; when there is no syntax error, it is confirmed as the block and the cursor moves to the next line.

If an error is detected, the cursor moves to the address where data is missed. In this case, the block is not confirmed; continue data input.

The block (input line) confirmation is made in the following cases:

- The input key is pressed at the last data input column in a line (the position differs depending on the G-code number, etc.).
- The cursor key  or  is pressed.
- The page key is pressed.

**Note 2:** While the data is being input for a line, the line number is highlighted. The line number returns to the normal display when the data input for the line is completed. Call an other screen only after the data input for the line has been completed. Otherwise, the data having been input may be ignored.

<Example screen - during data input>

Line	G/MACRO	X/D/L	Y/F	I	J	K/R	P/#R	Q/#C	C	T	M/W
<b>1</b>	G26			100.							

<Example screen - end of data input>

Line	G/MACRO	X/D/L	Y/F	I	J	K/R	P/#R	Q/#C	C	T	M/W
1	G26			100.	0.	4					

### 3. Clearing the address data

To cancel the data having been input, other than the G-codes, press the clear key after locating the cursor on the data to be cleared.

### 4. Clearing the changes made in a line

While inputting the data for a line (during highlighting the line number), it is possible to clear the data having been input (changed) in that line. Move the cursor to the G/MACRO column and press the clear key.

### 5. Deleting a line

(1) Press the **DELETE** menu key. The menu item is highlighted and the line delete mode is established.

Message: PUSH <INPUT>

(2) Move the cursor to the line to be deleted. It is possible to use the search function to move the cursor to the line to be deleted.

(3) Press the input key. The line specified by the cursor is deleted; the following lines move up to fill the deleted line.

(4) To cancel the line deletion mode, press the **DELETE** menu key again.

### 6. Inserting a line

(1) Press the **INSERT** menu key. The menu item is highlighted and the line insert mode is established. A blank line is inserted above the cursor located line and the cursor moves to the G/MACRO column in the inserted blank line.

(2) Input data.

(3) After the completion of data for one line, another blank line is inserted.

(4) To cancel the line insert mode, press the **INSERT** menu key again. The current blank line is deleted.



### 7. Search


(1) Press the **SEARCH** menu key. The menu item is highlighted and the following window is displayed.


SEARCH:

Message: INPUT THE CHARACTER OF DATA.

(2) Input the character-string to be searched.

- (3) Specify the direction of search by the cursor keys  . And the search is made in the specified direction from the cursor position.

: Search is made in the forward direction.

: Search is made in the backward direction.

- (4) When the specified character-string is found, the program is displayed on the screen with the line containing it at the top line.



Message: DATA IS COMPLETED.

- (5) If the specified character-string is not found, the following message is displayed.

Message: DATA NOT FOUND

- (6) The specified character-string can be searched continuously by pressing the cursor key

 .

**Note:** The character-string input for the purpose of search is retained in memory until the power is turned off. The specified character-string is displayed whenever the **SEARCH** menu key is pressed. The search is again made by pressing the cursor key  . To cancel the search mode, press the **SEARCH** menu key again.

## 8. G-code list

When the **G CODE INFORM** menu key is pressed, the menu item is highlighted and the G-code list window is displayed. When the **G CODE INFORM** menu key is pressed again, the menu display returns to the normal display and the window closes.

## 9. Tool list

When the **TOOL INFORM** menu key is pressed, the menu item is highlighted and the cursor located line is displayed at the top line. The window opens displaying the similar to the TOOL DATA screen.

When the **TOOL INFORM** menu key is pressed again, the menu display returns to the normal display and the window closes.

For the detailed procedure, refer to Section 8-22, "TOOL DATA Screen".

## 10. M-code list

When the **M CODE INFORM** menu key is pressed, the menu item is highlighted and the cursor located line is displayed at the top line. The window opens displaying the M-code list. Program input is possible even while the window is displayed.

When the **M CODE INFORM** menu key is pressed again, the menu display returns to the normal display and the window closes.

## 11. Detailed information

When the **DETAILED INFORM** menu key is pressed, the menu item is highlighted and the cursor located line is displayed at the top line. The window opens displaying the detailed information on the G-code in the present line.

The detailed information window is not displayed for the G-code for which no detailed information is provided or if the operation is attempted while the cursor is located in the line where no G-code is set. Program input is possible even while the window is displayed.

When the **DETAILED INFORM** menu key is pressed again, the menu display returns to the normal display and the window closes.

**12. Post calculation (menufunction “?”)**

Refer to the Programming Manual.

**13. Inputting the block delete code**

Press the [ / ] key while the cursor is at the G/MACRO column. The “/” code is displayed at the start of that block.

**Example 1:** G00 → /G00

If the [ / ] key is pressed while the line has the block delete code, the block delete code can be canceled.

**Example 2:** /G00 → G00

**14. Inputting the press mode macros**

To input the macro instruction of U, V or W, press the [U], [V] or [W] key while the cursor is at the G/MACRO column. After inputting U, V or W, input the macro number.

**15. Inputting the comment**

To input a comment, press the [ ( ] key while the cursor is at the G/MACRO column. Key in a comment following the “(”.

Message: COMMENT?

After keying in the comment, press the [ ) ] key or the input key.

### 8-13 FD I/O Screen

Using the FD I/O screen, it is possible to transfer the data between the NC and the microdisk.

#### 8-13-1 Screen display

*** FD I/O ***		WNo. 9999	FD I/O → TAPE I/O	23:59:59
[1]	[2]	[3]	[4]	
No.	WNo.	SIZE	COMMENT	MODE ( ) [6]
1	100C	20	AAAAAAAAAAAA	
2	1234C	100	BBBBBBBBBBBB	WNo. ( ) ( ) ( ) ( [7] )
3	2345D	150	CCCCCCCCCCCC	( ) ( ) ( ) ( )
4				( ) ( ) ( ) ( )
5				( ) ( ) ( ) ( )
6				( ) ( ) ( ) ( )
7				
8	[5]		TOOL	( ) [8]
9			OFFSET	( ) [9]
10			PROCESS ITEM	( ) [10]
11			PARAMETER	( ) [11]
12				
13				
14				
15				
16				
PAGE 1/6				[12]
INPUT THE MODE FUNCTION				
LOAD NC←FD	LOAD ALL NC←FD	SAVE NC→FD	SAVE ALL NC→FD	DIR
				WORK No. SELECT
				START

#### 8-13-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	FD I/O			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	FD I/O TAPE I/O			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	Program list				List of the programs stored in the memory
[6]	MODE	LOAD SAVE SAVE ALL LOAD ALL DIRECTORY		Possible	Data transfer mode (selection from the menu)
[7]	WNo.	9999, blank		Possible	Program number of the program to be transferred (direct input or selection)
[8]	TOOL	1 (yes), 0 (no)		Possible	Yes/No of transfer of common tools
[9]	OFFSET	1 (yes), 0 (no)		Possible	Yes/No of transfer of work offset data and beam diameter offset data
[10]	PROCESS ITEM	1 (yes), 0 (no)		Possible	Yes/No of transfer of cutting condition data
[11]	PARAMETER	1 (yes), 0 (no)		Possible	Yes/No of transfer of parameters
[12]	I/O data				Display of data being transferred

### 8-13-3 Screen operation

In the list of the programs given at the left area of the screen, WNo. is displayed in units of pages. Use the page key to change the pages.

#### 1. Reading the data (loading)

To read the programs and data from the microdisk to the NC, follow the procedure indicated below.

- (1) Press the **LOAD NC←FD** menu key. The menu item is highlighted and LOAD is displayed in the MODE column.

MODE ( LOAD )								
WNo. ?								
<b>LOAD</b> NC←FD	LOAD ALL NC←FD	SAVE NC→FD	SAVE ALL NC→FD	DIR			WORK No. SELECT	START

- (2) Input the WNo. of the program to be loaded.  
Key in the WNo. and press the input key.
- (3) Specify "1" (Yes) or "0" (No) for individual data items for data transfer.  
After moving the cursor to the data item, set "1" or "0".  
Message: I/O YES: 1 NO: 0
- (4) Execute loading.  
Press the **START** menu key, and the loading processing starts.
- (5) After the completion of loading, the menu display returns to the normal display.  
Message: LOADING END

#### 2. Writing the data (saving)

To output the programs and data from the NC to the microdisk.

- (1) Press the **SAVE NC→FD** menu key.  
The menu item is highlighted and SAVE is displayed in the MODE column.

MODE ( SAVE )								
WNo. ?								
LOAD NC←FD	LOAD ALL NC←FD	<b>SAVE</b> NC→FD	SAVE ALL NC→FD	DIR			WORK No. SELECT	START



- (2) Input the WNo. of the program to be saved.  
The WNo. may be input in either of the following two methods.
  - Direct input using numeric keys: Key in the WNo. and press the input key.
  - Input by copy from the program list: Copy the WNos. of the programs to be saved from the list of program numbers displayed in the left part of the screen to the right part.

- 1) While the cursor is in the WNo. list area, press the **WORK No. SELECT** menu key. The menu item is highlighted, then the cursor appears in the WNo. list area.

No.	WNo.	SIZE	COMMENT	MODE (SAVE )	WNo. ( ) ( ) ( ) ( )
1	100C	20	AAAAAAAAAAAA		
2	1234C	100	BBBBBBBBBBBB		
3	2345P	150	CCCCCCCCCCCC		
4					

WNo. ?							
LOAD NC←FD	LOAD ALL NC←FD	<b>SAVE</b> NC→FD	SAVE ALL NC→FD	DIR		<b>WORK No.</b> SELECT	START

- 2) Move the cursor by the cursor keys   to the WNo. to be saved.
- 3) Press the input key and the WNo. specified by the cursor is copied to the WNo. columns in the right area.

No.	WNo.	SIZE	COMMENT	MODE (SAVE )	WNo. ( 2345 ) ( ) ( ) ( )
1	100C	20	AAAAAAAAAAAA		
2	1234C	100	BBBBBBBBBBBB		
3	2345P	150	CCCCCCCCCCCC		
4					

- 4) Press the **WORK No. SELECT** menu key and the menu display returns to the normal display and the NC is placed in the WNo. input state.

**Note:** If a WNo. not in the memory is specified, an alarm occurs.

Message: NO DESIGNATED PROGRAM NUMBER

If the same WNo. is specified two times, an alarm occurs.

Alarm message: SAME PROGRAM APPOINT

To clear the specified WNo. press the clear key. The WNo. columns may contain blank area.

- (3) Specify "1" (Yes) or "0" (No) for individual data items for data transfer. After moving the cursor to the data item, set "1" or "0".

Message: I/O YES: 1 NO: 0

- (4) Execute saving.

Press the **START** menu key, and the saving processing starts.

- (5) After the completion of saving, the menu display returns to the normal display.

### 3. Reading all programs (ALL LOAD)

To read all programs from the microdisk to the NC, follow the procedure indicated below.

- (1) Press the **SAVE ALL NC→FD** menu key.

The menu item is highlighted and ALL LOAD is displayed in the MODE column.

MODE (ALL LOAD)							
LOAD NC←FD	<b>LOAD ALL</b> NC←FD	SAVE NC→FD	SAVE ALL NC→FD	DIR		WORK No. SELECT	START

- (2) Execute all load processing.

Press the **START** menu key, and the all load processing starts.

(3) After the completion of all load processing, the menu display returns to the normal display.

**4. Writing all programs (ALL SAVE)**

To read all programs from the microdisk to the NC, follow the procedure indicated below.

(1) Press the **SAVE ALL NC→FD** menu key. The menu is highlighted and ALL SAVE is displayed in the MODE column.

MODE(ALL SAVE)								
LOAD NC←FD	LOAD ALL NC←FD	SAVE NC→FD	<b>SAVE ALL</b> NC→FD	DIR			WORK No. SELECT	START

(2) Execute all save processing.

Press the **START** menu key, and the all save processing starts.

(3) After the completion of all save processing, the menu display returns to the normal display.

**5. Displaying the directory (DIR)**

To display the directory of the programs and data saved in the microdisk, follow the procedure indicated below.

(1) Press the **DIR** menu key.

The menu item is highlighted, and the DIRECTORY screen is displayed. On this screen, cursor not is displayed.

(2) Execute directory display.

Press the **START** menu key, and the directory display processing starts.

(3) After the completion of processing, the menu display returns to the normal display.

### 8-13-4 Connection to external storage equipment

Cable connection diagrams for connecting the L32B (L32B-N) and external storage equipment are shown below.

The external storage equipment that can be used is either a MAZAK microdisk unit, the FACIT N1060, a PC/AT-compatible personal computer, or the NEC PC-9801.

#### 1. General precautions for using external storage equipment

- The D-sub 25-pin female connector on the side of the operating panel does not conform to the RS-232C interface standards since a voltage of +24 VDC is supplied to the 24th pin of this connector. See the section marked “\*1” in the cable connection diagram.

Except the 24th pin, the RS-232C interface standards, however, can be satisfied.

- If the GND level differs between the L32B (L32B-N) and the external storage equipment, voltage signal levels will also differ correspondingly and this may result in trouble with the L32B (L32B-N) or the external storage equipment. Take the following preventive measures against equipment trouble:

<If the external storage equipment operates on 24-VDC power>

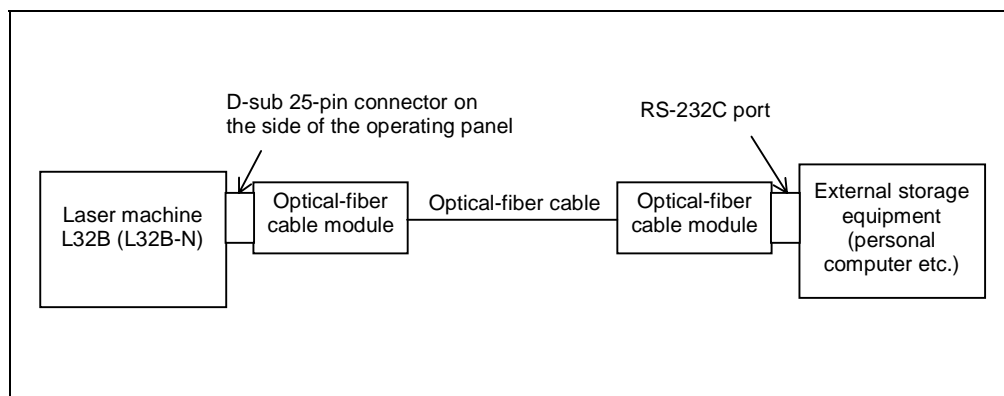
Use the 24th pin of the D-sub 25-pin female connector mentioned above. This pin is for use only with the FACIT N1060 or other external storage equipment operating on 24-VDC power. Be careful not to bring the 24th pin into contact with other pins. Contact results in short-circuiting.

<If the external storage equipment operates on 100-VAC power>

Use the 100-VAC service power outlet located on the side of the operating panel. This outlet can be used for external equipment such as a microdisk unit.

<If the external storage equipment operates on other power>

In this case, it is very difficult to match the GND level of the external storage equipment to that of the L32B (L32B-N). Therefore, electrically insulate the L32B (L32B-N) and the external storage equipment (such as a personal computer) by inserting an optical-fiber cable module between both.



- Be sure to power off the external storage equipment before connecting connectors.
- The cable connection diagram for connection to external storage equipment other than a MAZAK microdisk unit is shown for reference only and does not guarantee normal operation. If malfunction occurs, recheck the L32B (L32B-N) and the external storage equipment for inappropriate settings of the baud rate, stop bits, and other communications parameters (see the parameter list) and for wrong cable connections. If normal communications cannot be performed even so, refer to the Specification accompanying the external storage equipment and contact your MAZAK service representative.

**2. Supplementary description of connection between the L32B (L32B-N) and external storage equipment**

**A. For a MAZAK microdisk unit**

A new type and an old type are available. They can be identified by their outline dimensions.

- New type: 62 mm (2.44 in.) by 270 mm (10.63 in.) by 118 mm (4.65 in.), produced in and after December 1989.

Use the cable connected as standard.

- Old type: 82 mm (3.23 in.) by 270 mm (10.63 in.) by 138 mm (5.43 in.), produced in and before November 1989.

To connect this type to the L32B (L32B-N), do not use the unit-accompanying cable as it is. Instead, modify this cable into the MAZAK microdisk unit standard connection cable shown below.

The above modification is necessary because up to control signal pins 15, 16, 17, 18, 19, and 24, which are not required for connecting the L32B (L32B-N) and external storage equipment, are already wired and thus because the use of the +24-VDC 24th pin connected to the L32B (L32B-N) could cause trouble.

**B. For the FACIT N1060 (D-sub 9-pin type)**

The N1060, manufactured by FACIT, is similar to a MAZAK microdisk unit. The N1060 is one of the most common FACIT external storage units.

Since the cable accompanying the N1060 cannot be used to supply power to this unit, the cable shown in the appendix is required. With this cable, the N1060 will create the same GND level as that of the L32B (L32B-N). This cable is for the L32B (L32B-N) only; do not use it for other machines.

**C. For a personal computer**

Commercially available RS-232C cables vary from type to type in terms of connections. The cable connection diagrams shown below apply only to a commercially available cable that is likely to be popular and has been tested at our engineering department to ensure normal operation. If malfunction occurs, recheck the L32B (L32B-N) and the external storage equipment for inappropriate settings of the baud rate, stop bits, and other communications parameters (see the parameter list) and for wrong cable connections.

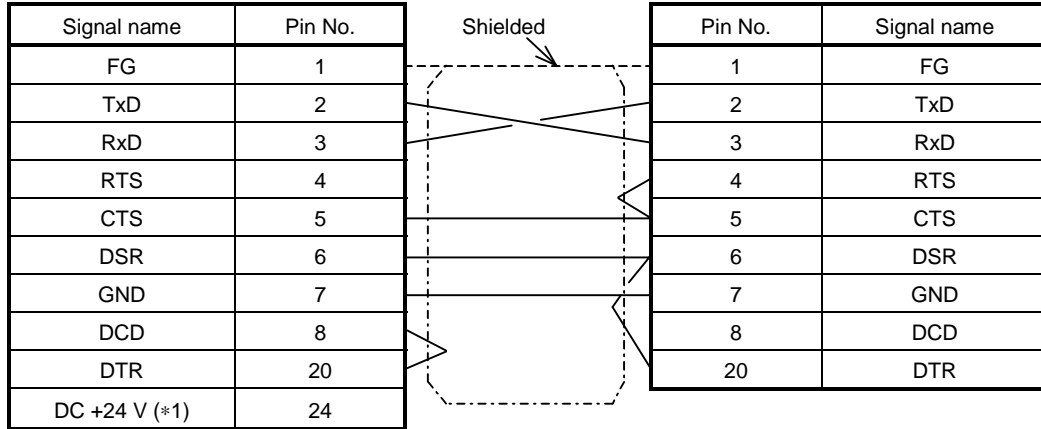
The cable connection diagrams in the above three cases are shown below.

**3. Connection diagram**

**A. For a MAZAK microdisk unit (standard connection)**

L32B/L32B-N  
(D-sub 25-pin male connector)

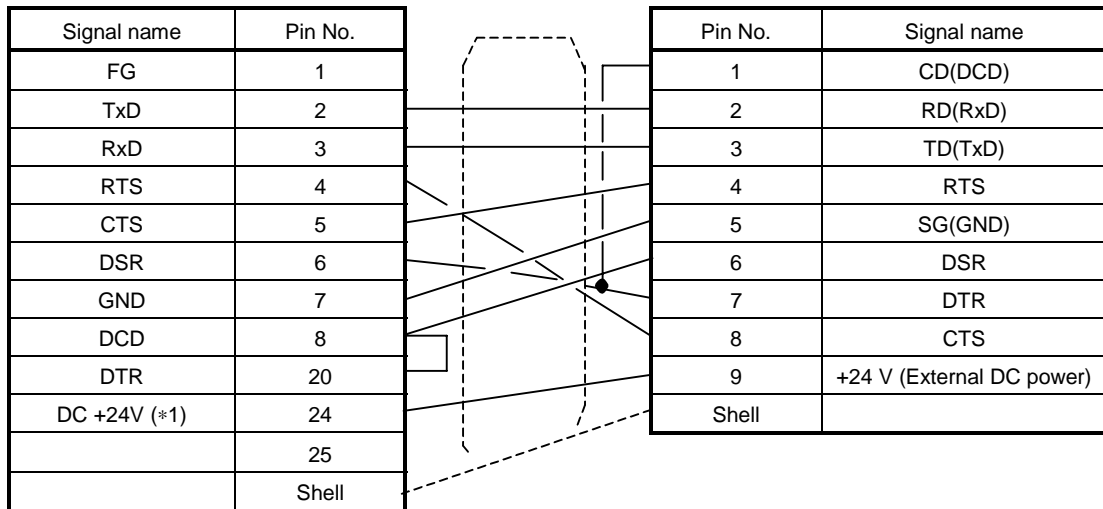
MAZAK microdisk  
(D-sub 25-pin male connector)



**B. For the FACIT N1060 (D-sub 9-pin type)**

L32B/L32B-N  
(D-sub 25-pin male connector)

FACIT  
(D-sub 9-pin female connector)



**C. For a personal computer**

PC/AT-compatible personal computer (D-sub 9-pin type)

Select either of the following connections, whichever suits your needs:

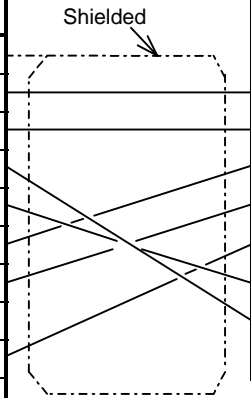
- These are the most common pin connections of a commercially available cable.

L32B/L32B-N  
(D-sub 25-pin male connector)

Signal name	Pin No.
FG	1
TxD	2
RxD	3
RTS	4
CTS	5
DSR	6
GND	7
DCD	8
DTR	20
DC + 24 V (*1)	24

PC/AT-compatible personal computer  
(D-sub 9-pin female connector)

Pin No.	Signal name
1	DCD
2	RxD
3	TxD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	CI



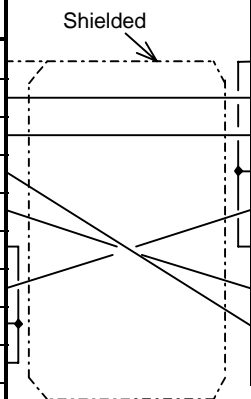
- These are the easiest connections for the user to perform.

L32B/L32B-N  
(D-sub 25-pin male connector)

Signal name	Pin No.
FG	1
TxD	2
RxD	3
RTS	4
CTS	5
DSR	6
GND	7
DCD	8
DTR	20
DC + 24V (*1)	24

PC/AT-compatible personal computer  
(D-sub 9-pin female connector)

Pin No.	Signal name
1	DCD
2	RxD
3	TxD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	CI



**NEC PC-9801 (D-sub 25-pin type)**

Select either of the following connections, whichever suits your needs:

- These are the most common pin connections of a commercially available cable.

L32B/L32B-N

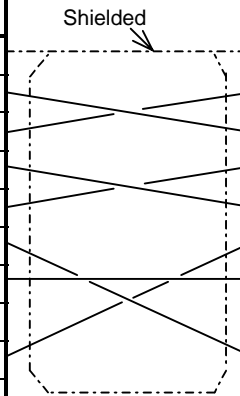
(D-sub 25-pin male connector)

Signal name	Pin No.
FG	1
TxD	2
RxD	3
RTS	4
CTS	5
DSR	6
GND	7
DCD	8
DTR	20
DC + 24 V (*1)	24

PC9801

(D-sub 25-pin male connector)

Pin No.	Signal name
1	FG
2	TxD
3	RxD
4	RTS
5	CTS
6	DSR
7	GND
8	DCD
20	DTR



- These are the easiest connections for the user to perform.

L32B/L32B-N

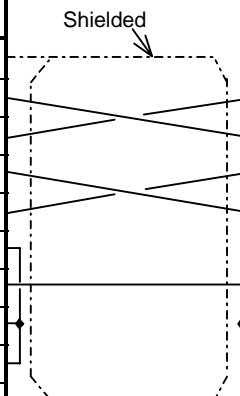
(D-sub 25-pin male connector)

Signal name	Pin No.
FG	1
TxD	2
RxD	3
RTS	4
CTS	5
DSR	6
GND	7
DCD	8
DTR	20
DC + 24V (*1)	24

PC9801

(D-sub 25-pin male connector)

Pin No.	Signal name
1	FG
2	TxD
3	RxD
4	RTS
5	CTS
6	DSR
7	GND
8	DCD
20	DTR



4. Parameters for L32B (L32B-N) communications

Parameters for L32B (L32B-N) communications can all be set on the SETTING screen. These parameters are numbered 28 to 32 in operation parameter display mode. Set the parameters so that they match those of the external storage equipment to be used. The following settings are the standard parameter settings for the L32B (L32B-N):

*** SETTING ***			WNo. 9999 <b>SETTING</b> → USER → COM. → LOC. → SYS.			23:59:59		
No.	PARAMETER	DATA	No.	PARAMETER	DATA			
1	.....		17	.....				
2	.....		18	.....				
3	.....		19	.....				
4	.....		20	.....				
5	.....		21	.....				
6	.....		22	.....				
7	.....		23	.....				
8	.....		24	.....				
9	.....		25	.....				
10	.....		26	.....				
11	.....		27	.....				
12	.....		28	FD I/O OUTPUT 0:ISO 1:EIA	0			
13	.....		29	STOP BIT 1:1 2:1.5 3:2	3			
14	.....		30	PARITY 0:EVEN 1:ODD	0			
15	.....		31	PARITY CHECK 0:VALID 1:INVALID	0			
16	.....		32	BAUD RATE 1:9800 2:4800...	2			
						PAGE1/1		

## 8-14 TAPE I/O Screen

Using TAPE I/O screen, it is possible to transfer the data between the NC and the tape reader/punch.

### 8-14-1 Screen display

*** TAPE I/O ***			WNo.9999	FD I/O→	<b>TAPE I/O</b>	23:59:59	
	[1]	[2]	[3]				[4]
No.	WNo.	SIZE	COMMENT	MODE	(	)	[6]
1	100C	20	AAAAAAAAAAAA		(	)	( [7] )
2	1234C	100	BBBBBBBBBBBB		(	)	( )
3	2345P	150	CCCCCCCCCCCC		(	)	( )
4					(	)	( )
5					(	)	( )
6					(	)	( )
7					(	)	( )
8		[5]		OFFSET	(	)	[9]
9					(	)	( )
10				PROCESS ITEM	(	)	[10]
11					(	)	( )
12				PARAMETER	(	)	[11]
13					(	)	( )
14				TOOL	(	)	[8]
15					(	)	( )
16					(	)	( )
PAGE 1/6						[12]	
READ NC←TAPE	READ ALL PRG	PUNCH NC→TAPE	PUNCH ALL PRG	COMPARE	COMPARE ALL PROG		WORK No. SELECT
							START

### 8-14-2 Details of display items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	TAPE I/O			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	FD I/O TAPE I/O			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	Program list				List of the programs stored in the memory
[6]	MODE	READ PUNCH COMPARE ALL READ ALL PUNCH ALL COMPARE		Possible	Data transfer mode (selection from the menu)
[7]	WNo.	9999, blank		Possible	Program number of the program to be transferred (direct input or selection)
[8]	TOOL	1 (yes), 0 (no)		Possible	Yes/No of transfer of common tools
[9]	OFFSET	1 (yes), 0 (no)		Possible	Yes/No of transfer of work offset data and beam diameter offset data
[10]	PROCESS ITEM	1 (yes), 0 (no)		Possible	Yes/No of transfer of cutting condition data
[11]	PARAMETER	1 (yes), 0 (no)		Possible	Yes/No of transfer of parameters
[12]	I/O data				Display of data being transferred

### 8-14-3 Screen operation

In the list of the programs given at the left area of the screen, WNo. is displayed in units of pages. Use the page key to change the pages.

#### 1. Reading the data

To read the cutting programs and data from the tape reader/punch, follow the procedure indicated below.

- (1) Press the **READ NC←TAPE** menu key. The menu item is highlighted and READ is displayed in the MODE column.

MODE ( READ )								
WNo. ?								
<b>READ</b> NC←TAPE	READ ALL PRG	PUNCH NC→TAPE	PUNCH ALL PRG	COMPARE	COMPARE ALL PROG		WORK No. SELECT	START

- (2) Input the WNo. of the program to be read.  
Key in the WNo. and press the input key.
- (3) Specify "1" (Yes) or "0" (No) for individual data items for data transfer.  
After moving the cursor to the data item, set "1" or "0".  
Message: I/O YES:1 NO:0
- (4) Execute reading.  
Press the **START** menu key, and the reading processing starts.
- (5) After the completion of loading, the menu display returns to the normal display.  
Message: READING END

#### 2. Punching the data

To output the programs and data from the NC to the tape reader/punch, follow the procedure indicated below.

- (1) Press the **PUNCH NC→TAPE** menu key.  
The menu item is highlighted and PUNCH is displayed in the MODE column.

MODE ( PUNCH )								
WNo. ?								
READ NC←TAPE	READ ALL PRG	<b>PUNCH</b> NC→TAPE	PUNCH ALL PRG	COMPARE	COMPARE ALL PROG		WORK No. SELECT	START



- (2) Input the WNo. of the program to be punched.  
Input the WNo. in either of the following two methods.
  - Direct input using numeric keys  
Key in the WNo. and press the input key.
  - Input by copy from the program list  
Copy the WNos. of the programs to be punched from the list of program numbers displayed in the left part of the screen to the right part.

- 1) While the cursor is in the WNo. list area, press the **WORK No. SELECT** menu key. The menu item is highlighted, then the cursor appears in the WNo. list area.

No.	WNo.	SIZE	COMMENT					
1	100C	20	AAAAAAAAAAAA					
2	1234C	100	BBBBBBBBBBBB	MODE	( PUNCH )			
3	2345P	150	CCCCCCCCCCCC					
4					WNo. ( ) ( ) ( ) ( )			

WNo. ?								
READ NC←TAPE	READ ALL PRG	PUNCH NC→TAPE	PUNCH ALL PRG	COMPARE	COMPARE ALL PROG		WORK No. SELECT	START

- 2) Move the cursor by the cursor keys   to the WNo. to be saved.
- 3) Press the input key and the WNo. located by the cursor is copied to the WNo. columns in the right area.

No.	WNo.	SIZE	COMMENT					
1	100C	20	AAAAAAAAAAAA					
2	1234C	100	BBBBBBBBBBBB	MODE	( PUNCH )			
3	2345P	150	CCCCCCCCCCCC					
4					WNo. ( 2345 ) ( ) ( ) ( )			

- 4) Press the **WORK No. SELECT** menu key and the menu display returns to the normal display and the NC is placed in the WNo. input state.

- Note:** If a WNo. not in the memory is specified, an alarm occurs.  
 Message: NO DESIGNATED PROGRAM NUMBER
- If the same WNo. is specified two times, an alarm occurs.  
 Alarm message: SAME PROGRAM APPOINT
- To clear the specified WNo. press the clear key. The WNo. columns may contain blank area.
- (3) Specify "1" (Yes) or "0" (No) for individual data items for data transfer. After moving the cursor to the data item, set "1" or "0".  
 Message: I/O YES: 1 NO: 0
  - (4) Execute punching.  
 Press the **START** menu key, and the punching processing starts.
  - (5) After the completion of punching, the menu display returns to the normal display.

**3. Compare (verify) processing**

In the compare processing, the data stored in the memory is compared with the data in the external storage device by specifying the data in the memory.

- (1) Press the **COMPARE** menu key.

The menu item is highlighted and COMPARE is displayed in the MODE column.

MODE ( COMPARE )								
READ NC←TAPE	READ ALL PRG	PUNCH NC→TAPE	PUNCH ALL PRG	<b>COMPARE</b>	COMPARE ALL PROG		WORK No. SELECT	START

- (2) Input the WNo. of the program to be compared.  
Key in the WNo. directly and press the input key.
- (3) Specify "1" (Yes) or "0" (No) for individual data items for data transfer. After moving the cursor to the data item, set "1" or "0".  
Message: I/O YES: 1 NO: 0
- (4) Execute compare processing.  
Press the **START** menu key.
- (5) After the completion of compare processing, the menu display returns to the normal display.
  - When there is no unmatched data in the compare processing, the following message is displayed: CHECK OF CONTENTS IS CORRECT.
  - When unmatched data is found, the unmatched data is highlighted, the following messages are displayed and the processing ends.  
Alarm message: CONTENTS ARE NOT COINCIDENT  
Message: I/O FUNCTION IS CANCELLED

**4. Reading all programs**

To read all programs from the tape reader/punch, follow the procedure indicated below.

- (1) Press the **READ ALL PRG** menu key.

The menu item is highlighted and READ ALL PRG is displayed in the MODE column.

MODE (READ ALL PRG)								
READ NC←TAPE	<b>READ</b> NC←TAPE	PUNCH NC→TAPE	PUNCH ALL PRG	COMPARE	COMPARE ALL PROG		WORK No. SELECT	START

- (2) Execute reading.  
Press the **START** menu key, and the all program reading processing starts.
- (3) After the completion of processing, the menu display returns to the normal display.

## 5. Punching all programs

To punch all programs to the tape reader/punch, follow the procedure indicated below.

- (1) Press the **PUNCH ALL PRG** menu key. The menu item is highlighted and PUNCH ALL PRG is displayed in the MODE column.

MODE(PUNCH ALL PRG)								
READ NC←TAPE	READ ALL PRG	PUNCH NC→TAPE	<b>PUNCH</b> ALL PRG	COMPARE	COMPARE ALL PRG		WORK No. SELECT	START

- (2) Execute punching.  
Press the **START** menu key, and the all program punch processing starts.
- (3) After the completion of processing, the menu display returns to the normal display.

## 6. Comparing all programs

To compare all programs in the external storage device with the programs in the NC, follow the procedure indicated below.

- (1) Press the **COMPARE ALL PRG** menu key.

The menu item is highlighted and COMPARE ALL PRG is displayed in the MODE column.

MODE(COMPARE ALL PRG)								
READ NC←TAPE	READ ALL PRG	PUNCH NC→TAPE	PUNCH ALL PRG	COMPARE	<b>COMPARE</b> ALL PRG		WORK No. SELECT	START

- (2) Execute compare processing.  
Press the **START** menu key. The menu item is highlighted and the compare processing starts.
- (3) After the completion of compare processing, the menu display returns to the normal display.
  - When there is no unmatched data in the compare processing, the following message is displayed: ALL CHECK OF CONTENTS IS CORRECT.
  - When unmatched data is found, the unmatched data is highlighted, the following messages are displayed and the processing ends.  
Alarm message: CONTENTS ARE NOT COINCIDENT  
Message: I/O FUNCTION IS CANCELLED

## 8-15 Cautions on Using the I/O Screens

1. Switching the I/O screens

It is possible to switch the I/O screen while the processing is being executed. When the previously selected I/O screen is displayed again, the processing state including the processing completion message is displayed.

2. Stopping the I/O processing

It is possible to stop the I/O processing halfway by pressing the **START** menu key.

Message: I/O FUNCTION IS CANCELLED

3. Changing the data being transferred

While the data is transferred, the data cannot be changed.

4. Communication error

If the following occurs during data transfer, an alarm occurs and the communication is stopped.

- Connection error occurs.
- Memory becomes full.

## 8-16 WORK OFFSET Screen

On the WORK OFFSET screen, the work coordinate systems (zero point of the work coordinate system) are set (G54 to G59).

This setting is not related with the execution of the press mode programs.

### 8-16-1 Screen display

*** WORK OFFSET ***		WNo. 9999	WORK OFFSET → BEAM OFFSET	23:59:59
[1]	[2]	[3]	[4]	
G54 [5]	G56	G58	SHIFT [10]	
X -99999.999	X [6]	X -99999.999	X -99999.999	
Y -99999.999	Y [7]	Y -99999.999	Y -99999.999	
Z -99999.999	Z [8]	Z -99999.999	Z -99999.999	
4 -99999.999	4 [9]	4 -99999.999	4 -99999.999	
G55	G57	G59	MACHINE [11]	
X -99999.999	X -99999.999	X -99999.999	X -99999.999	
Y -99999.999	Y -99999.999	Y -99999.999	Y -99999.999	
Z -99999.999	Z -99999.999	Z -99999.999	Z -99999.999	
4 -99999.999	4 -99999.999	4 -99999.999	4 -99999.999	
TEACH	INCR.			

### 8-16-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	WORK OFFSET			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	WORK OFFSET BEAM OFFSET			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	Work coordinate system	G54 to G59	G-code		Name of the work coordinate system
[6]	X coordinate value of the zero point	± 99999.999	mm (Note)	Possible	X coordinate value of the zero point in the machine coordinate system
[7]	Y coordinate value of the zero point	± 99999.999	mm (Note)	Possible	Y coordinate value of the zero point in the machine coordinate system
[8]	Z coordinate value of the zero point	± 99999.999	mm (Note)	Possible	Z coordinate value of the zero point in the machine coordinate system
[9]	4th axis coordinate value of the zero point	± 99999.999	mm (Note)	Possible	4th axis coordinate value of the zero point in the machine coordinate system

No.	Data name	Display range	Unit	Setting	Description
[10]	SHIFT	± 99999.999	mm (Note)	Possible	Shift data for G54 to G59, G92 work zero point, and origin set
[11]	MACHINE	± 99999.999	mm (Note)		Coordinate values of the present position in the machine coordinate system

**Note:** For the machine of the inch system, the display range and the unit for the linear axes are as indicated below.

Display range	Unit
± 9999.9999	inch

### 8-16-3 Screen operation

#### 1. Inputting the coordinate values in the work coordinate system

The coordinate values (work zero point in the machine coordinate system) are set for G54 to G59. The coordinate values can be input in either of the following two methods:

##### A. Direct input

If the coordinate values to be input are known, these values may be input directly using numeric keys.



- (1) Move the cursor to the data input column with the cursor keys    .

Message: INPUT THE COORDINATE OF WORKPIECE POINT

- (2) Key in the coordinate values with the numeric keys and press the input key.

##### B. Using the nozzle position menu

This method is used when setting the work zero point in reference to the present nozzle position.

- (1) Move the cursor to the data input column with the cursor keys    .

Message: INPUT THE COORDINATE OF WORKPIECE POINT

- (2) Press the **TEACH** menu key. The menu is highlighted and the following window opens.

POSITION (  )
--

Message: INPUT EXISTENCE BY WORKPIECE COORDINATE

- (3) After keying in the value, press the input key. The menu display returns to the normal display and the window closes. The coordinate values are updated accordingly.

#### 2. Inputting the coordinate shift data

Set the shift data applied for G54 to G59, G92 and origin set coordinate values.

- (1) Move the cursor to the data input column with the cursor keys    .

Message: INPUT SHIFT AMOUNT OF WORKPIECE POINT

- (2) Key in the shift data using the numeric keys and press the input key.

### 3. Inputting the compensation data for the work offset and shift data

- (1) Move the cursor to the data input column with the cursor keys     .

Message: INPUT THE COORDINATE OF WORKPIECE POINT

- (2) Press the **INCR.** menu key, and the following window opens.

ADDING AMOUNT (       )
-------------------------

Message: INPUT THE ADDING AMOUNT

- (3) Key in the compensation data and press the input key. The menu display returns to the normal display and the window closes. The coordinate values are updated accordingly.

## 8-17 BEAM OFFSET Screen

On the BEAM OFFSET screen, set the beam radius offset data to be called by the G41 and G42 commands.

This setting is not related with the execution of the press mode programs.

### 8-17-1 Screen display

*** BEAM OFFSET ***				WNo. 9999	WORK OFFSET→	<b>BEAM OFFSET</b>	23:59:59
[1]		[2]	[3]	[4]			
DNo.	OFFSET	DNo.	OFFSET	DNo.	OFFSET	DNo.	OFFSET
D1	9.999 [5]	D9	9.999	D17	9.999	D25	9.999
D2	9.999	D10	9.999	D18	9.999	D26	9.999
D3	9.999	D11	9.999	D19	9.999	D27	9.999
D4	9.999	D12	9.999	D20	9.999	D28	9.999
D5	9.999	D13	9.999	D21	9.999	D29	9.999
D6	9.999	D14	9.999	D22	9.999	D30	9.999
D7	9.999	D15	9.999	D23	9.999	D31	9.999
D8	9.999	D16	9.999	D24	9.999	D32	9.999

### 8-17-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	BEAM OFFSET			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	WORK OFFSET BEAM OFFSET			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	OFFSET	9.999	mm (Note)		32 sets (D1 to D32) of beam radius offset

**Note:** For the machine of the inch system, the display range and the unit for OFFSET are as indicated below.

Display range	Unit
0.9999	inch

### 8-17-3 Screen operation

Inputting the beam radius offset data:

- (1) Move the cursor to the beam offset data input column using the cursor keys



- (2) Key in the beam offset data and press the input key.

### 8-18 ALARM Screen

On the ALARM screen, the detailed information of alarms currently occurring is displayed.

#### 8-18-1 Screen display

*** ALARM ***	WNo. 9999	ALARM	→I/O→VERSION→MAINTENANCE	23:59:59
[1]	[2]	[3]		[4]
TOTAL ( 99 ) [5]				
ALARM	MESSAGE	WNo. NNo. BNo.	TIME OF ALARM	ORIGIN OF ALARM
9999	ABCDEFGHIJKLMNQRSTUvwxyz123	(9999,99999,99999)	'99/12/31 23:59	
[6]	[7]	[8] [9] [10]	[11]	[12]
:	:	:	:	:
:	:	:	:	:
:	:	:	:	:
:	:	:	:	:
:	:	:	:	:
:	:	:	:	:
9999	ABCDEFGHIJKLMNQRSTUvwxyz123	(9999,99999,99999)	'99/12/31 23:59	MCHN
9999	ABCDEFGHIJKLMNQRSTUvwxyz123	(9999,99999,99999)	'99/12/31 23:59	SERVO
9999	ABCDEFGHIJKLMNQRSTUvwxyz123	(9999,99999,99999)	'99/12/31 23:59	NC
9999	ABCDEFGHIJKLMNQRSTUvwxyz123	(9999,99999,99999)	'99/12/31 23:59	PC
9999	ABCDEFGHIJKLMNQRSTUvwxyz123	(9999,99999,99999)	'99/12/31 23:59	OPE

#### 8-18-2 Details of display items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	ALARM			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	ALARM, I/O, VERSION, MAINTENANCE			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	TOTAL	0 to 99			The number of alarm occurrences (16 alarm occurrences displayed on the screen)
[6]	ALARM	1 to 9999			Alarm number
[7]	MESSAGE	Max. 29 digits			Alarm message
[8]	WNo.	0 to 9999			Program number involved with the alarm
[9]	NNo.	1 to 99999			Sequence number involved with the alarm
[10]	BNo.	0 to 99999			Block number involved with the alarm
[11]	TIME OF ALARM	'99/12/31 23:59	Y/M/D H:M		Date and time of alarm occurrence
[12]	ORIGIN OF ALARM	OPE, SYSTEM, SERVO, MCHN, I/O, DATA, NC			Origin of alarm

## 8-19 VERSION Screen

The version of the software and the option setting status are displayed on the VERSION screen.

### 8-19-1 Screen display

*** VERSION ***		WNo. 9999	ALARM→I/O→	<b>VERSION</b>	→MAINTENANCE	23:59:59
[1]	[2]	[3]				[4]
----- ROM VERSION -----			----- OPTION -----			
	[5]			[6]		
1	IMC	(797) ( 53) (B02 )		1	EXTENSION MEMORY	: 2000 m
2	IOC	(797) ( 53) (B02 )		2	EXTENSION PROGRAM	: invalid
3	S-MACRO	(797) ( 0) (B00 )		3	PRINTER	: invalid
4		( ) ( ) ( )		4	DNC	: invalid
5		( ) ( ) ( )		5	Inc.FD.	: invalid
6	SV12	(797) (121) (B02 )		6		
7	SV34	(797) (121) (B02 )		7		
8	SQ	(797) (121) (B00 )		8		
9	SEQUENCER	(661) ( ) ( )		9		
10		( ) ( ) ( )		10		

### 8-19-2 Details of display items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	VERSION			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	ALARM, I/O VERSION, MAINTENANCE			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	VERSION				ROM version, ROM name (model) (aux. Information) (version name)
[6]	OPTION				Option setting status

### 8-19-3 Screen operation

The current time can be set. For details refer to Subsection 8-7-6, "Setting the clock".

### 8-20 I/O MONITOR Screen

The I/O MONITOR screen displays the input/output signals.

This screen is provided to be used by Mazak service engineers.

*** I/O MONITOR ***				WNo. 9999	ALARM→	I/O→	VERSION→	MAINTENANCE	23:59:59
ADDRESS		DATA							
REGISTER [X,Y,I,O,A,B,R]									
HEX		DEC	31	BIN		0			
PROGRAM MEMORY [K,T,P,D]									
HEX		DEC	31	BIN		0			
[Empty area for data entry]									

## 8-21 MAINTENANCE Screen

The MAINTENANCE screen is displayed when the power is switched on. It consists of two pages and displays the following maintenance information.

1. Daily inspection items  
The items which must be inspected before starting the machine to maintain correct machine performance. If inspection of these items is ignored, it may lead malfunctioning of the machine. Therefore, these items must be inspected every day before starting day's work.
2. Periodical inspection items  
If periodical inspection becomes necessary, the required inspection items are displayed. If such items are displayed, contact Mazak technical center for periodical inspection. If inspection of these items are ignored, it may lead malfunctioning of the machine. Therefore, these items must be inspected periodically by the Mazak service engineers.

### 8-21-1 Screen display

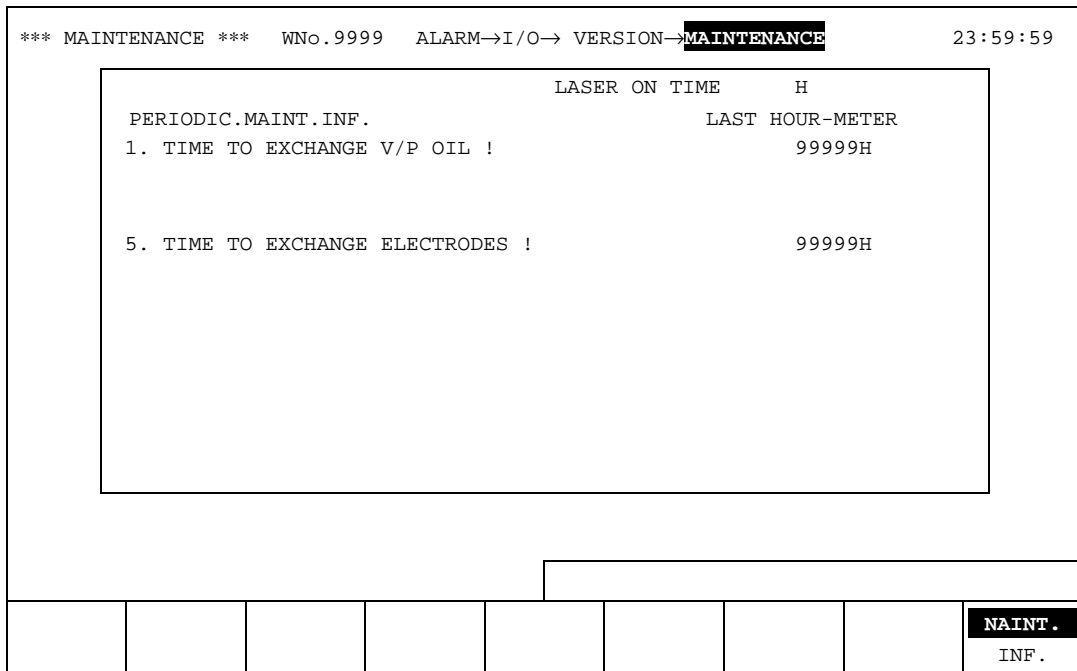
#### 1. Daily inspection items

When periodical inspection is not necessary, the following screen is displayed.

*** MAINTENANCE ***								WNo.9999	ALARM→I/O→	VERSION→	<b>MAINTENANCE</b>	23:59:59
1.	CHECK PRESSURE OF LASER GAS CYLINDER	MIN	10kg/cm <sup>2</sup>									
2.	CHECK PRESSURE OF ASSIST GAS CYLINDER											
3.	CHECK 2ND PRESSURE OF ASSIST GAS	SET TO	8kg/cm <sup>2</sup>									
4.	CHECK 2ND PRESSURE OF H.P.ASSIST GAS	SET TO	10kg/cm <sup>2</sup>									
5.	CHECK WATER LEVEL	WITHIN	MIN/MAX LEVEL									
6.	CHECK WATER QUALITY	EXCHANGE	EVERY 3 MONTHS									
7.	CHECK LUBRICATING OIL	WITHIN	MIN/MAX LEVEL									
8.	CHECK VACUUM PUMP OIL	WITHIN	MIN/MAX LEVEL									
9.	CHECK T/B OIL	WITHIN	MIN/MAX LEVEL									
10.	CHECK CHILLER WATER PRESSURE	WITHIN	3-3.5 kg/cm <sup>2</sup>									
11.	CHECK FOCAL LENS QUALITY	EXCHANGE	WHEN BAD COATING									
12.	CHECK NOZZLE QUALITY	EXCHANGE	WHEN BAD ORIFICE									
13.	CHECK FOCAL POINT											
14.	CHECK NOZZLE-MATERIAL DISTANCE											
												MAINT. INF.

#### 2. Periodical inspection items

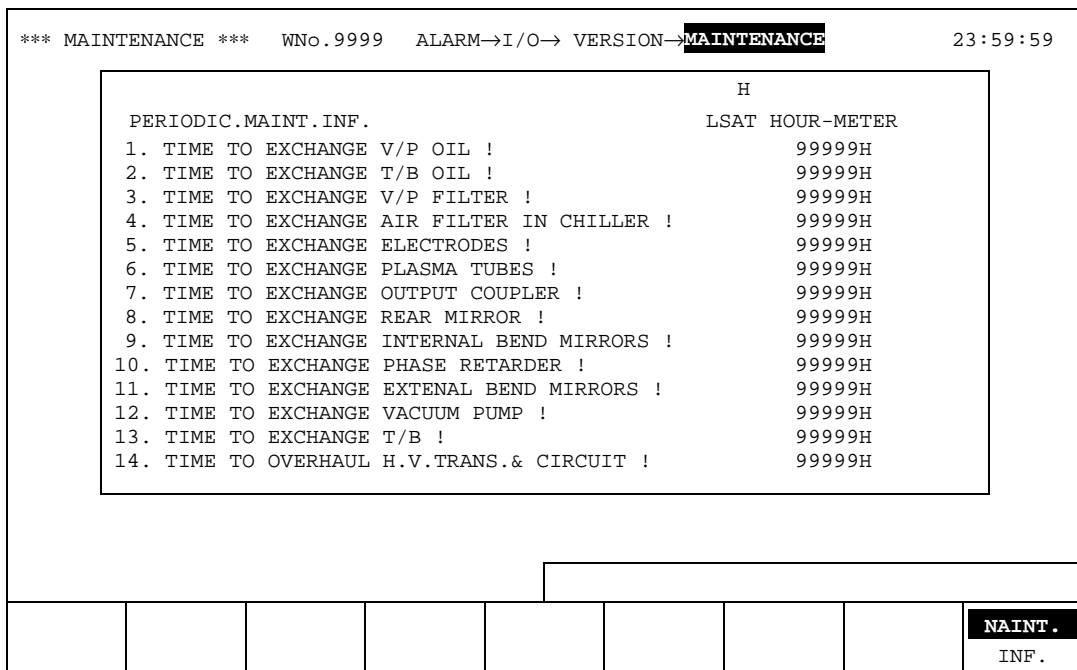
When the periodical inspection is necessary, the following PERIODIC. MAINT. INF. screen is displayed first. On this screen, the items that require periodical inspection are displayed in highlighted characters. Contact Mazak technical center for inspection by Mazak service engineer.



The information actually displayed on your machine may vary from this sample screen according to the machine specifications.

Pressing the **MAINT. INF.** menu key changes the screen to the daily inspection screen.

If the **MAINT. INF.** menu key is pressed once again on the daily inspection screen, the screen returns to the periodical inspection screen. On this screen, all the items subject to periodical inspection are displayed with the items requiring inspection given in highlighted characters. The items not highlighted need not be inspected.



The displayed contents differ according to the particular machine conditions.

## 8-22 TOOL DATA Screen

The tools are classified into common tool and special tool.

T01 to T48: Common tools and can be read from all press mode program screens.

T49 to T96: Special tools and can be registered only at the specific press mode program screen.  
These tools are accessible only from the specific program.

To set the common tools, press the PRESS DATA screen selector key to display the TOOL DATA screen. Then, set the common tools by pressing the **TOOL SET** menu key. On this screen, special tools cannot be set.

To set the special tools, press the **TOOL INFORM** menu key on the press mode program screen to fix the tool numbers of T49 and later. On this screen, setting for T01 to T48 is not possible.

### 8-22-1 Screen display

*** TOOL DATA ***					WNo.9999 <b>TOOL DATA</b> →PROCESS ITEM					23:59:59
[1]	[2]	[3]	[4]							
T	SHAPE	Y/DIA	X/WNo.	SEL	T	SHAPE	Y/DIA	X/WNo.	SEL	SHAPE
[5]	[6]	[7]	[8]	[9]						
1	ROUND	9999.99	-	10	13					
2	RECTGL	9999.99	9999.99	10	14					
3	OBROUND	9999.99	9999.99	10	15					
4	SNGL.D	9999.99	9999.99	10	16					
5	DBL.D	9999.99	9999.99	10	17					
6	SPOT R	-	-	10	18					
7	SPOT L	-	-	10	19					
8	SPECIAL	-	WNo.9999	10	20					
9					21					
10					22					
11					23					
12					24					
										(PAGE 1/4)
		TOOL SET	DELETE							

Fig. 8-1 Common tool setting screen

```

*** PROGRAM ***   WNo.9999   PROGRAM FILE->PROGRAM   23:59:59
WNo.9999   MATERIAL: 1 (SPCC)   THICKNESS:1.0 mm
Line  G/MACRO  X/DL  Y/F  I  J  K/R  P/#R  Q/#C  C  T  M/W
  1   G00      10.  -20.
T   SHAPE  Y/DIA  X/WNo.  SEL  T  SHAPE  Y/DIA  X/WNo.  SEL  SHAPE
1   ROUND   9999.99  -      10   13
2   RECTGL  9999.99  9999.99  10   14
3   OBROUND 9999.99  9999.99  10   15
4   SNGL.D  9999.99  9999.99  10   16
5   DBL.D   9999.99  9999.99  10   17
6   SPOT R   -        -        10   18
7   SPOT L   -        -        10   19
8   SPECIAL -        WNo.9999  10   20
9
10
11
12

```

(PAGE 1/4)

		TOOL SET	DELETE				
--	--	----------	--------	--	--	--	--

Fig. 8-2 Special tool setting screen

Fig. 8-1 and Fig. 8-2 above indicate the common tool setting screen and the special tool setting screen, respectively. The items displayed on these screens are common to both screens.

**8-22-2 Details of displayed items**

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	TOOL DATA			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	PROCESS ITEM TOOL DATA			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	T	1 to 96			T 1 to T48: Tool No. of common tools T49 to T96: Tool No. of special tools
[6]	SHAPE	ROUND, RECTGL, OBROUND, SNGL. D, DBL. D, SPOT R, SPOT L, SPECIAL		Possible	Tool shape (selection form the menu)
[7]	Y/DIA	0 to 9999.99	mm (Note)	Possible	Y dimension, or diameter
[8]	X/WNo.	0 to 9999.99 0 to 9999	mm (Note)	Possible	X dimension, or WNo. for special tools
[9]	SEL	10 to 1		Possible	Cutting condition number

**Note:** For the machine of inch system, the display range and the unit for dimension Y/X and diameter are as indicated below.

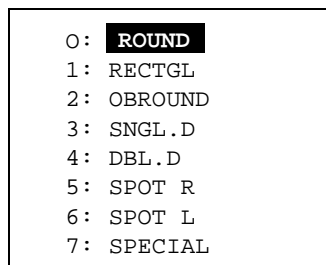
Display range	Unit
0 to 999.999	inch

### 8-22-3 Setting the tool data

- (1) Move the cursor to the data setting column by pressing the cursor keys.
- (2) Press the **TOOL SET** menu key to begin tool setting.

The tool shape selection window opens.

Message: TOOL SHAPE <0-7>



- (3) Select the tool shape by the code number or by moving the cursor to the required shape and by pressing the input key.
- (4) The selected shape is displayed in graphics.
- (5) Set the shape defining data according to the given guide messages.

### 8-22-4 Deleting the tool data

- (1) Move the cursor to the tool data to be deleted.
- (2) Press the **DELETE** menu key.

The menu item is highlighted.

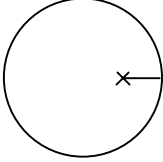
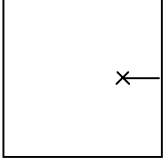
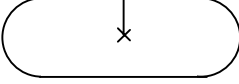
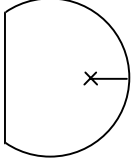
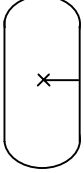


The tool data where the cursor is presently located is highlighted.

Message: PRESS INPUT TO DELETE DATA

- (3) Press the input key.
- (4) The cursor located tool data is deleted.
- (5) The highlighted menu display returns to the normal display.

**Note:** The delete processing can be stopped halfway by pressing the **DELETE** menu key again.

**8-22-5 Piercing position**

ROUND	RECTGL	OBROUND	SNGL. D
			
DBL. D		SPOT R	SPOT L
			

Piercing position

The position marked with “x” symbol is taken as the piercing position. The distance is set by “thickness x parameter-set value”. If the shape is smaller than “thickness x parameter-set value x 2”, it is the distance up to the center of the shape.

To start the cutting of arbitrary shape, the spot R or spot L tool should be used for piercing and the piercing position taken at the G00 specified position.

**8-22-6 Special shape tools**

Refer to the Programming Manual.

### 8-23 PROCESS ITEM Screen

The PROCESS ITEM screen is used for displaying or setting the cutting conditions used for press mode program. The conditions for piercing and cutting are set for each combination of “material - thickness”.

The following screen is displayed when the PRESS DATA screen selector key is pressed. If other screen is displayed, press the same key again.

#### 8-23-1 Screen display

*** PROCESS ITEM ***		WNo.9999	TOOL DATA→	<b>PROCESS ITEM</b>					23:59:59		
[1]	1	[2]	2	[3]	3	4	5	6	7	[4]	8
	SPCC	SPHC	[5] SS41		SUS304	SUS420	AL1	AL2		ABCDEFGH	
1	0.8	1.0	0.8		1.0	0.8	1.0	0.8		1.0	
2	1.2	2.0	1.2		2.0	1.2	2.0	1.2		2.0	
3	1.6	3.0	1.6		3.0	1.6	3.0	1.6		3.0	
4	2.3	4.0									
5	3.2	[6]									
6	4.5	6.0									
7	6.0	7.0									
8	9.0	8.0									
9	12.0	9.0									
10	15.0	10.0									
11	99.9	11.0									
12	99.9	12.0									
(PAGE 1/4)											
EDIT									COPY	DELETE	

#### 8-23-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	PROCESS ITEM			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	PROCESS ITEM TOOL DATA			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	Material	Max. 8 characters (alphanumerics, symbols, space)		Possible	Worksheet material
[6]	Thickness	0.1 to 99.9	mm (Note)	Possible	Worksheet thickness

**Note:** For the machine of the inch system, the display range and the unit for the thickness are as indicated below.

Display range	Unit
0.01 to 9.99	inch

### 8-23-3 Setting and changing the material name

- (1) Move the cursor to the material column using the cursor keys.  
Message: MATERIAL NAME
- (2) Key in the material name and press the input key.  
Setting range: 8 characters (alphanumerics, symbols, space)

### 8-23-4 Setting and changing the workpiece thickness

- (1) Move the cursor to the thickness column using the cursor keys.  
Message: MATERIAL THICKNESS?
- (2) Key in the material thickness and press the input key.
- (3) The data is sorted in the order of thickness (ascending order).

**Note:** The total number of material thickness data which can be set is 60.  
If the 61st thickness is going to be set, an alarm occurs.

Alarm message: CUTTING CND. STORAGE AREA FULL

### 8-23-5 Copying the material data

It is possible to copy all the data set for a material name.

- (1) Move the cursor to the material column, to be copied, by using the cursor keys.
- (2) Press the **COPY** menu key. The menu item is highlighted and the window opens.

COPY LOCATION? (     )

- (3) Key in the copy destination material number and press the input key.
- (4) The menu display returns to the normal display and the window closes.
- (5) The data set for the specified material is all copied.

### 8-23-6 Deleting the material data

It is possible to delete all the data set for a material name.

- (1) Move the cursor to the material column, to be deleted, by using the cursor keys.
- (2) Press the **DELETE** menu key. The menu item is highlighted and the following message is displayed.

Message: PUSH <INPUT> KEY

- (3) Press the input key.
- (4) The menu display returns to the normal display and the data set for the specified material is deleted.

**Note:** To stop the delete processing, press the **DELETE** menu key again.

### 8-23-7 Deleting the thickness

It is possible to delete thickness and the related data (cutting conditions).

- (1) Move the cursor to the thickness column, to be deleted, by using the cursor keys.
- (2) Press the **DELETE** menu key. The menu item is highlighted and the following message is displayed.

Message: PUSH <INPUT> KEY

- (3) Press the input key.
- (4) The menu display returns to the normal display and the thickness and related data is deleted.

**Note:** To stop the delete processing, press the **DELETE** menu key again.

### 8-23-8 Editing the conditions

- (1) Move the cursor to the thickness column, where the cutting conditions are set, by using the cursor keys and press the **EDIT** menu key.
- (2) The following screen is displayed.

*** PROCESS ITEM ***										WNo.9999	TOOL DATA→	<b>PROCESS ITEM</b>	23:59:59
[1]		[2]	[3]						[4]				
	PIERCING	POWER	FREQ.	DUTY	PULSE	GAS	PRESS.	DWELL	GAP				
	CONDITION	(W)	(Hz)	(%)			(kg)	(SEC)	(mm)				
MATERIAL [5]	1	9999	9999	100	NRM.	OXG	9.9	99.9	9.9				
ABCDEFGH	2	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[16]				
	3	9999	9999	100	NRM.	OXG	9.9	99.9	9.9				
	4	9999	9999	100	NRM.	OXG	9.9	99.9	9.9				
	5	9999	9999	100	NRM.	OXG	9.9	99.9	9.9				
THICKNESS (mm) [6]	FEED	POWER	FREQ.	DUTY	PULSE	GAS	PRESS.	OFFSET	GAP				
99.9	(mm/min)	(W)	(Hz)	(%)			(kg)	(mm)	(mm)				
	10	999999	9999	9999	100	NRM.	OXG	9.9	9.999	9.9			
	9	[7]	9999	9999	100	SP.	AIR	9.9	[15]	9.9			
	8	999999	9999	9999	100	NRM.	3RD	9.9	9.999	9.9			
	7	999999	9999	9999	100	NRM.	OXG	9.9	9.999	9.9			
CUTTING	6	999999	9999	9999	100	SP.	AIR	9.9	9.999	9.9			
CONDITION	5	999999	9999	9999	100	NRM.	3RD	9.9	9.999	9.9			
	4	999999	9999	9999	100	SP.	OXG	9.9	9.999	9.9			
	3	999999	9999	9999	100	NRM.	OXG	9.9	9.999	9.9			
	2	999999	9999	9999	100	NRM.	AIR	9.9	9.999	9.9			
	1	999999	9999	9999	100	SP.	3RD	9.9	9.999	9.9			
END									DELETE				

#### Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	PROCESS ITEM			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	PROCESS ITEM TOOL DATA			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	MATERIAL	Max. 8 characters (alphanumerics, symbols, space)			Worksheet material

No.	Data name	Display range	Unit	Setting	Description
[6]	THICKNESS	0.1 to 99.9	mm (Note)		Worksheet thickness
[7]	FEED	0 to 999999	mm/min	Possible	Feedrate adopted for cutting
[8]	POWER	0 to 9999	W	Possible	Specified laser output power
[9]	FREQ.	0 to 9999	Hz	Possible	Laser pulse oscillation frequency
[10]	DUTY	0 to 100	%	Possible	Laser pulse duty ratio
[11]	PULSE	NRM. SP.		Possible	Pulse type (selection from the menu)
[12]	GAS	OXG, AIR, 3RD		Possible	Assist gas type (selection from the menu)
[13]	PRESS.	0 to 25.0	kgf	Possible	Assist gas pressure (direct command)
[14]	DWELL	0 to 99.9	sec	Possible	Piercing time (only for piercing)
[15]	OFFSET	0 to 9.999	mm (Note)	Possible	Beam offset data (radius)
[16]	GAP	0 to 9.9	mm	Possible	Gap offset data

**Note:** For the machine of the inch system, the display range and the unit for THICKNESS and OFFSET are as indicated below.

Data name	Display range	Unit
THICKNESS	0.01 to 9.99	inch
OFFSET	0 to 0.9999	inch

(3) Move the cursor to the piercing condition column, and set the data according to the guide messages.

- For PULSE and GAS, select the item from the menu.

**Note 1:** The piercing conditions can be set for up to five steps. This is for stepped-piercing, and piercing is executed in order from step 1. Therefore, if piercing conditions are set only for one line, stepped-piercing is not executed.

**Note 2:** Set the data for all items of the piercing conditions. If any item is omitted, an alarm occurs when the program is executed.

(4) Move the cursor to the cutting condition setting column and set the data according to the guide messages.

- For PULSE and GAS, select the item from the menu.

**Note 1:** The cutting conditions can be set for up to 10 types. The data set number corresponds to the setting for SEL in the tool data.

**Note 2:** Set the data for all items of the cutting conditions. If any item is omitted, an alarm occurs when the program is executed.

### 8-23-9 Ending the editing of cutting conditions

(1) Press the **END** menu key.

- The screen is switched to the list of material and thickness.

## 8-24 SWITCH Screen

The SWITCH screen is used for changing and displaying the ON/OFF status of the switches.

The screen is provided to support the switches on the operation panel and the contents displayed on the screen differ depending on the machine models and specifications.

### 8-24-1 Screen display

*** SWITCH ***		WNo. 9999	PSC	23:59:59		
[1]	[2]	[3]	[4]			
No.	TITLE	SWITCH	No.	TITLE	SWITCH	
1		ON	17		OFF	
2		OFF	18		ON	
3	[5]	[6]	19			
4			20			
5			21			
6			22			
7			23			
8			24			
9			25			
10			26			
11			27			
12			28			
13			29			
14			30			
15			31			
16			32			
ON/OFF						

### 8-24-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	SWITCH			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	PSC			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	TITLE	Max. 28 characters			Title of switches ON: Highlighted
[6]	SWITCH	ON/OFF			For setting the ON/OFF status of the switch

### 8-24-3 Changing the ON/OFF status

- (1) Move the cursor to the ON/OFF column, where the ON/OFF status should be changed, by using the cursor keys.

Message: PRESS ON/OFF MENU KEY TO CHANGE SWITCH STATUS

- (2) Press the **ON/OFF** menu key.
  - OFF switch: The switch status changes to the ON status, and the title is highlighted.
  - ON switch: The switch status changes to the OFF status, and the title display returns to the normal display.

If the objective (actuator, etc.) of control is set in the OFF status, the title display returns to the normal display.

**Note:** Depending on the nature of the switch function, the ON/OFF status of the control objective may not be changed immediately.

## 8-25 SETTING Screen

On the SETTING screen, the operation parameters are set or changed. The operation parameters are those used or referenced to in daily operation.

### 8-25-1 Screen display

*** SETTING ***			WNo. 9999	SETTING	→USER→COM.→LOC.→SYS.	23:59:59
[1]	[2]	[3]				[4]
No.	PARAMETER	DATA	No.	PARAMETER	DATA	
1			17			
2			18			
3	[5]	[6]	19			
4			20			
5			21			
6			22			
7			23			
8			24			
9			25			
10			26			
11			27			
12			28			
13			29			
14			30			
15			31			
16			32			
						PAGE1 / 1

### 8-25-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	SETTING			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	SETTING, USER, COM., LOC., SYS.			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	PARAMETER	Max. 24 characters			Parameter name
[6]	DATA	Depending on the parameters		Possible	Parameter data

### 8-25-3 Screen operation

Move the cursor to the parameter data to be set or changed. Key in the data and press the input key.

### 8-25-4 Operation parameter and setting range

No.	Parameter	Initial setting	Unit
1	APPROACH 0: XY-Z 1: XYZ	0	0/1
2	Z AXIS APPROACH POS. [ $\mu\text{m}$ ]	30000 11811	0.001 mm 0.0001 inch
3	AUTO GAP CONTROL MODE	1	0/1
4	Z AXIS UP/DOWN SELECT	1	0/1
5	Z AXIS LIFT LENGTH [ $\mu\text{m}$ ]	30000 11811	0.001 mm 0.0001 inch
6	(NOT USED)	0	
7	G50 RETURN POINT	0	0/1
8	PIERCING POINT *THICKNESS [ $\times 0.1$ ]	30	$\times 0.1$
9	STABLE TIME OF GAS PRESSURE	0	0.1 sec
10	(NOT USED)	0	
11	(NOT USED)	0	
12	ASSIST GAS HIGH PRES. [0.1 kgf/m <sup>2</sup> ]	40	0.1 kg
13	ASSIST GAS LOW PRES. [0.1 kgf/m <sup>2</sup> ]	20	0.1 kg
14	DECREASE DISTANCE OF PROFILER	0 0	0.001 mm 0.000 inch
15	PIERCE EXPANSION DWELL [0.1 SEC]	0	0.1 sec
16	(NOT USED)	0	
17	(NOT USED)	0	
18	ADAPT. CONTROL LENGTH [ $\mu\text{m}$ ]	10000 3937	0.001 mm 0.0001 inch
19	AUTOMATIC CORNER FEEDRATE	1200 472	1 mm/min 1 inch/min
20	(NOT USED)	0	
21	CLEARANCE AMOUNT OF CIRCLE SHAPE	15 6	0.001 mm 0.0001 inch
22	OFFSET TYPE OF TOOLS DIA. 0: A 1: B	0	0/1
23	TAPE I/O OUTPUT 0: ISO 1: EIA	0	
24	STOP BIT 1: 1 2: 1.5 3: 2	3	
25	PARITY 0: ENEN 1: ODD	0	
26	PARITY CHECK 0: INVALID 1: VALID	0	
27	BAUD RATE 1: 9600 2: 4800....7	2	
28	FD I/O OUTPUT 0: ISO 1: EIA	0	
29	STOP BIT 1: 1 2: 1.5 3: 2	3	
30	PARITY 0: ENEN 1: ODD	0	
31	PARITY CHECK 0: INVALID 1: VALID	0	
32	BAUD RATE 1: 9600 2: 4800....7	2	

### 8-25-5 Details of operation parameters

#### 1. APPROACH 0: XY-Z 1: XYZ

The parameter which is valid for executing the program created in the press mode. The parameter selects the approach mode by the X-, Y-, and Z-axes to the piercing point.

- 0: XY  $\rightarrow$  Z (After simultaneous motion of the X- and Y-axes, the Z-axis moves.)
- 1: XYZ (The X-, Y-, and Z-axes move simultaneously.)

**2. Z AXIS APPROACH POS.**

The parameter which is valid for executing the program created in the press mode. The parameter sets the Z-axis position (distance between the nozzle and worksheet) in positioning at the piercing position. Profiling starts from this position.

Setting range: 0 to 999999 (0.001 mm)  
(0.0001 inch)

**3. AUTO GAP CONTROL MODE**

The parameter which is valid for executing the program created in the press mode. The parameter sets whether or not profiling is executed during cutting.

0: Profiling only during approach  
1: Profiling during approach and cutting

**4. Z AXIS UP/DOWN SELECT**

The parameter which is valid for executing the program created in the press mode. The parameter sets whether or not the Z-axis should move up/down after the completion of cutting.

0: Z-axis does not move up after the completion of cutting.  
1: Z-axis moves up after the completion of cutting.

**5. Z AXIS LIFT LENGTH**

The parameter which is valid for executing the program created in the press mode. The parameter sets the Z-axis move up distance after the completion of cutting.

The parameter is valid when "1" is set for Z AXIS UP/DOWN SELECT.

Setting range: 0 to 999999 (0.001 mm)  
(0.0001 inch)

**6. (NOT USED)**

**7. G50 RETURN POINT**

The parameter which is valid for executing the program created in the press mode. The parameter sets the return operation to be called by the G50 command.

0: Return to the machine zero point  
1: Return to the cycle start ON position

**8. PIERCING POINT \*THICKNESS [\*0.1]**

The parameter which is valid for executing the program created in the press mode. The piercing position is determined according to the setting for this parameter. The position determined by "Thickness x parameter setting" is taken as the piercing position. If "0" is set, the tool offset function is invalid. If the start-up is made for arc, the offset is impossible or if it is made for line, the shape cannot be machined correctly.

Setting range: 0 to 99 (0.1 time units)

**9. STABLE TIME OF GAS PRESSURE**

The parameter which is valid for executing the program created in the press mode. The parameter determines the dwell period if gas pressure command is specified for piercing.

Setting range: 0 to 99 (0.1 sec units)

**10. (NOT USED)****11. (NOT USED)****12. ASSIST GAS HIGH PRES.****13. ASSIST GAS LOW PRES.**

These parameters set the assist gas pressure when M50, M51, M52, M53, M54, or M55 command is specified in the program. When the assist gas pressure is specified by the M56, M57, M58, or G88 command, these parameters are ignored.

For the machine equipped with the 3rd assist gas option, and if the 3rd assist gas high pressure is selected, the AST GAS HIGH PRES. setting is ignored.

Setting range: 0 to 250 (0.1 kgf units)

**14. DECREASE DISTANCE OF PROFILER**

If the gap control ON command is executed while the Z-axis (machine position) is above the position set for this parameter, the Z-axis positioning is executed to the parameter-set position at a rapid feedrate. The stylus is moved down after the completion of positioning.

Setting range:  $\pm 99999999$  (0.001 mm)  
(0.0001 inch)

**15. PIERCE EXPANSION DWELL**

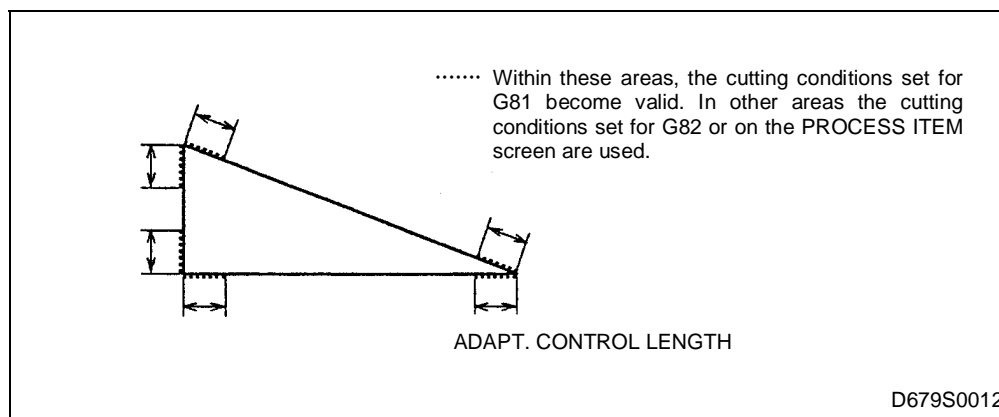
The parameter which is valid for executing the program created in the press mode. After the completion of piercing, dwell is executed for the period set for this parameter while the laser is kept output with the cutting conditions changed to the normal cutting conditions.

Setting range: 0 to 25.0 (0.1 sec units)

**16. (NOT USED)****17. (NOT USED)****18. ADAPT. CONTROL LENGTH**

The parameter is valid when "G81 P\_Q\_R\_F\_" is specified for the program created in the press mode or cut mode. The parameter sets the distance for changing the cutting conditions between the blocks in the G01, G02 or G03 mode.

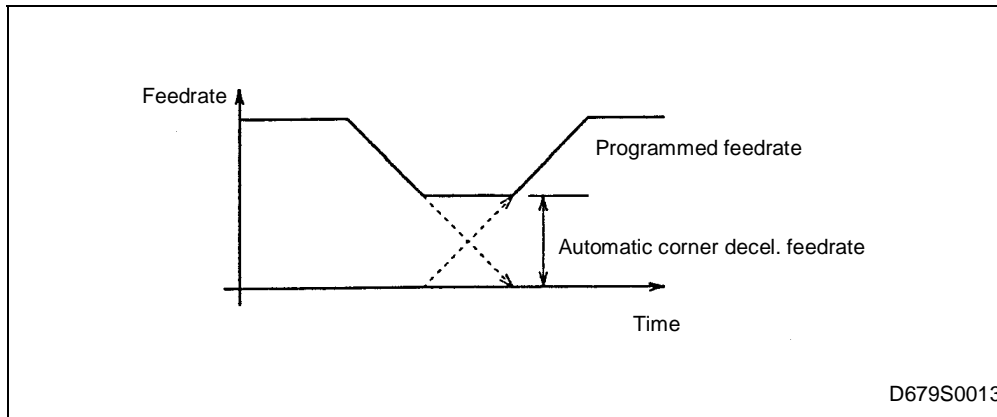
Setting range: 0 to 99999999 (0.001 mm)  
(0.0001 inch)



**19. AUTOMATIC CORNER FEEDRATE**

The parameter is valid if the G62 command is specified when executing the program created in the cut mode. At the end of the G01, G02, or G03 block, feedrate is decelerated to the parameter-set feedrate.

Setting range: 0 to 99999999 (1 mm/min)  
(1 inch/min)



**20. (NOT USED)**

**21. CLEARANCE AMOUNT OF CIRCLE SHAPE**

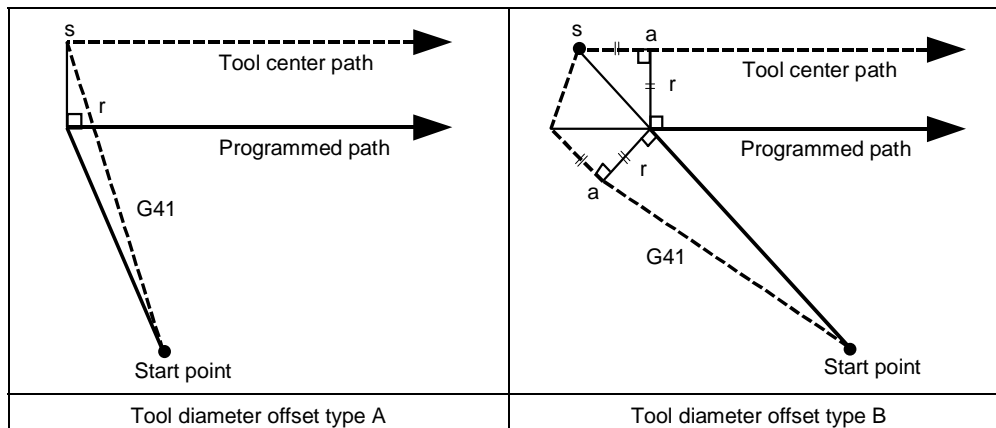
When an arc is cut at a high speed, the actual path is generated inside the programmed path causing a smaller arc to be cut. The allowable error for this reduction is set for this parameter and feedrate is automatically reduced so that the error will not exceed the parameter-set value. If "0" is set, this parameter is invalid.

Setting range: 0 to 9999 (0.001 mm)  
(0.0001 inch)

**22. OFFSET TYPE OF TOOLS DIA.**

When the tool diameter offset is specified, there are two modes for turning around the corner. The parameter sets the mode for this operation.

- 0: Tool diameter offset type A
- 1: Tool diameter offset type B



**23. TAPE I/O OUTPUT**

0: ISO 1: EIA

**24. STOP BIT**

1: 1 2: 1.5 3: 2

**25. PARITY**

0: EVEN 1: ODD

**26. PARITY CHECK**

0: INVALID 1: VALID

**27. BAUDRATE**

1: 9600 2: 4800 3: 2400 4: 1200 6: 600 7: 300 bps

Parameters 23 to 27 set the data communication condition when a tape reader/punch is used. Set the conditions meeting the setting made for the tape reader/punch.

**28. FD I/O OUTPUT**

0: ISO 1: EIA

**29. STOP BIT**

1: 1 2: 1.5 3: 2

**30. PARITY**

0: EVEN 1: ODD

**31. PARITY CHECK**

0: INVALID 1: VALID

**32. BAUDRATE**

1: 9600 2: 4800 3: 2400 4: 1200 6: 600 7: 300 bps

Parameters 28 to 32 set the data communication condition when an external I/O device (microdisk, CAD/CAM, etc.) is used. Set the conditions meeting the setting made for the external I/O device.

## 8-26 USER PARAMETER Screen

The USER parameter screen is used for displaying and changing the user parameters.

### 8-26-1 Screen display

*** USER ***	WNo. 9999	SETTING→ <b>USER</b> →COM.→LOC.→SYS.	23:59:59
[1]	[2]	[3]	[4]
I000 999999	I016	I032	I064
I001	I017	I033	I065
I002 [5]	I018	I034	I066
I003	I019	I035	I067
I004	I020	I036	I068
I005	I021	I037	I069
I006	I022	I038	I070
I007	I023	I039	I071
I008	I024	I040	I072
I009	I025	I041	I073
I010	I026	I042	I074
I011	I027	I043	I075
I012	I028	I044	I076
I013	I029	I045	I077
I014	I030	I046	I078
I015	I031	I047	I079 999999
PAGE 1/2			

### 8-26-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	USER			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	SETTING, USER, COM., LOC., SYS.			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	Parameter	999999		Possible	Parameter data

The parameters which are displayed on the screen are:

- I000 to I079** Parameters for cut mode
- K000 to K047** Not used
- L000 to L031** Parameters for press mode

## 8-27 COMMON VARIABLE Screen

COMMON VARIABLE screen is used for displaying and changing the common variables used in user macro.

### 8-27-1 Screen display

*** COMMON VAR. ***		WNo. 9999	SETTING→USER→ <b>COM.</b> →LOC.→SYS.				23:59:59
[1]		[2]	[3]				[4]
No.	DATA	No.	DATA	No.	DATA	No.	DATA
#100	-99999.9999	#110	-99999.9999	#120	-99999.9999	#130	-99999.9999
#101	-9.9999e 47	#111	-9.9999e 47	#121	-9.9999e 47	#131	-9.9999e 47
#102	-9.9999e-39	#112	-9.9999e-39	#122	-9.9999e-39	#132	-9.9999e-39
#103		#113		#123		#133	
#104		#114		#124		#134	
#105		#115		#125		#135	
#106		#116		#126		#136	
#107	[5]	#117		#127		#137	
#108		#118		#128		#138	
#109		#119		#129		#139	

PAGE 1/6

AUTO OPE	TOOL PATH								
	CHECK								

### 8-27-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	COMMON VAR.			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	SETTING, USER, COM., LOC., SYS.			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	Common variable	999999		Possible	Common variable data

### 8-27-3 Screen operation

#### 1. Inputting the common variable in exponent

For common variables, exponent input is possible in addition to the ordinary decimal value input.

**Example:**

Input	Display
-123.45E-20	→ -1.234e-18
↑	
Press [E] key.	

**2. Selection of display objective**

The common variables are classified into the following two types:

- Common variables used for automatic operation (foreground)
- Common variables used for tool path check (background)

Selection is made by using a proper menu key.

<b>AUTO OPE</b>	TOOL PATH CHECK							
-----------------	--------------------	--	--	--	--	--	--	--

**3. Clear**

It is possible to set null for the common variables.

- (1) Move the cursor to the data column for the common variable for which the present setting should be cleared to null.
- (2) Press the clear key.

The cursor located data is cleared to null, and the cursor moves to the next data column.

## 8-28 LOCAL VARIABLE Screen

The LOCAL VARIABLE screen is used for displaying the local variables used in user macro.

### 8-28-1 Screen display

*** LOCAL VAR. ***		WNo. 9999	SETTING→USER→COM.→	LOC.	→SYS.	23:59:59		
[1]		[2]	[3]			[4]		
No.	DATA	No.	DATA	No.	DATA	No.	DATA	
# 1	-99999.9999	#11	-99999.9999	#21	-99999.9999	#31	-99999.9999	
# 2	-9.9999e 47	#12	-9.9999e 47	#22	-9.9999e 47	#32	-9.9999e 47	
# 3	-9.9999e-39	#13	-9.9999e-39	#23	-9.9999e-39	#33	-9.9999e-39	
# 4		#14		#24		#34		
# 5		#15		#25		#35		
	[5]							
# 6		#16		#26		#36		
# 7		#17		#27		#37		
# 8		#18		#28		#38	-99999.9999	
# 9		#19		#29		#39		
#10		#20		#30		#40		
								[6]
								NEST 1/5
AUTO OPE	TOOL PATH							
	CHECK							

### 8-28-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	LOCAL VAR.			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	SETTING, USER, COM., LOC., SYS.			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	Local variable				Local variable data
[6]	Nest	1 to 5			Nesting level

**8-28-3 Screen Operation**

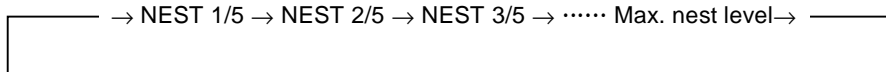
**1. Referencing the local variable**

Select the required nesting level by using the page keys.

The present nesting level is displayed at the lower right area on the screen. (Displaying in the reversed order is also possible.)

**Example:** NEST (3)

The nesting level changes according to the pressing of the page key in the forward or backward sequence.



**Note:** The local variables can only be displayed and input is not possible.  
Local variables are displayed in the same format as the common variables.

**2. Selection of display objective**

The local variables are classified into the following two types:

- Local variables used for automatic operation (foreground)
- Local variables used for tool path check (background)

Selection is made by using a proper menu key.

AUTO OPE	TOOL PATH							
	CHECK							

## 8-29 SYSTEM VARIABLE Screen

The SYSTEM VARIABLE screen is used for displaying and changing the system variables used in user macro.

### 8-29-1 Screen display

*** SYSTEM VAR. ***								WNo.9999	SETTING → USER → COM. → LOC. →	SYS.	23:59:59
[1]		[2]		[3]		[4]					
No.	DATA	No.	DATA	No.	DATA	No.	DATA				
#10000	-99999.9999	#10010	-99999.9999	#10020	-99999.9999	#10030	-99999.9999				
#10001	-9.9999e 47	#10011	-9.9999e 47	#10021	-9.9999e 47	#10031	-9.9999e 47				
#10002	-9.9999e-39	#10012	-9.9999e-39	#10022	-9.9999e-39	#10032	-9.9999e-39				
#10003		#10013		#10023		#10033					
#10004		#10014		#10024		#10034					
	[5]										
#10005		#10015		#10025		#10035					
#10006		#10016		#10026		#10036					
#10007		#10017		#10027		#10037					
#10008		#10018		#10028		#10038					
#10009		#10019		#10029		#10039					
								PAGE 1/5			
AUTO OPE	TOOL PATH										
	CHECK										

### 8-29-2 Details of displayed items

No.	Data name	Display range	Unit	Setting	Description
[1]	Screen name	SYSTEM VAR.			The name of the screen presently displayed
[2]	WNo.	0 to 9999			The WNo. used for automatic operation
[3]	List of screen names	SETTING, USER, COM., LOC., SYS.			The list of the screen names which are accessible from the present screen, by pressing the screen selection key, and the presently displayed screen
[4]	Clock	00:00:00 to 23:59:59	H:M:S		Present time
[5]	System variables			Possible	System variable data

### 8-29-3 Screen operation

The same procedure as used on the COMMON VARIABLE screen.

- NOTE -

## 9 PREPARATION FOR OPERATION

### 9-1 Items To Be Checked

#### 1. Laser gas supply

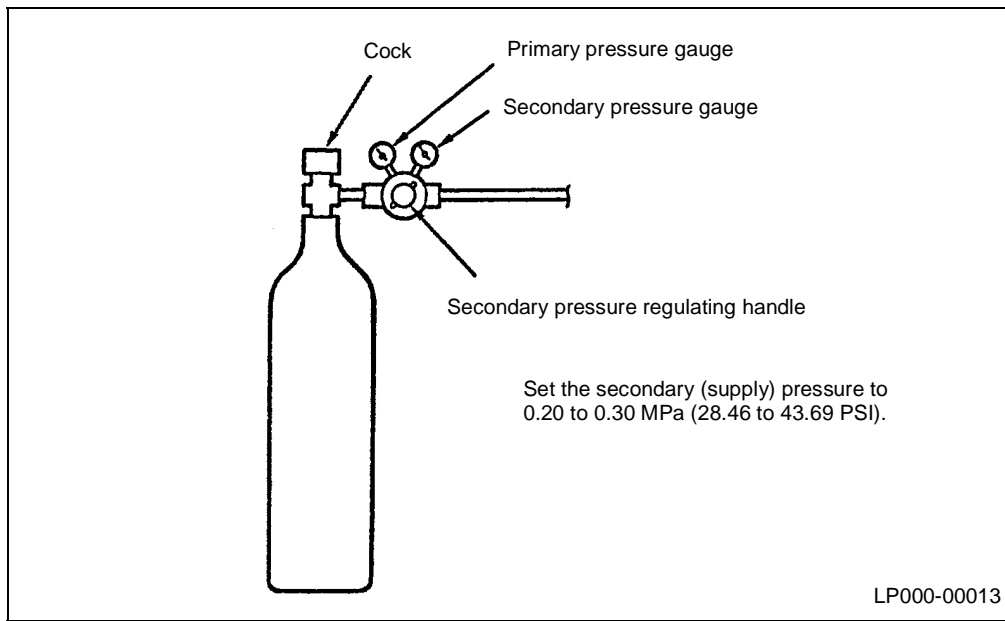
When the mixed gas is supplied, open the cock on the mixed gas cylinder. When only one gas is supplied, open the cocks on all gas cylinders: He, N<sub>2</sub> and CO<sub>2</sub>.

Check the pressure on the primary side of the regulator that sufficient gas remains in the cylinders and that the secondary side pressures are at their specified values.

Gas specification: Industrial grade

Purity .....99.5% or better

Moisture .....5 ppm or lower



#### 2. Assist gas supply

Supply oxygen when it is to be used as the assist gas. As for the laser gas, check the pressure on the primary side of the gas regulator that sufficient gas remains in the cylinder and that the pressure on the secondary side is set to 0.78 MPa (113.8 PSI).

#### 3. Cooling water supply

Supply the cooling water as described in the laser oscillator specification. For chiller specified by Mazak, turning ON the laser power supply automatically commences the cooling water supply.

Setting: Pressure .....0.34 - 0.44 MPa (49.81 - 64.04 PSI)

Temperature .....17.5°C (63.5°F)

Clean the chiller when the cooling water pressure exceeds 0.44 MPa (64.04 PSI) during the daily inspection.

#### 4. Air supply

The air supply is required to have a pressure of at least 0.5 MPa (71.2 PSI) and a flow rate of 300 L/min (10.50 ft<sup>3</sup>/min) at the outlet of the chiller.

The maximum pressure at the inlet of the chiller is 0.83 MPa (119.53 PSI).

Turn on the air supply after turning the main power switch on. When the main power switch is turned on, the air valve is opened to allow supply of dehumidified air.

**Note:** If the supply air pressure decreases below 0.49 MPa (71.15 PSI), the following trouble will occur:

1. The gripping force of the worksheet clamps will decrease, which will move the material during table sliding and cause a defect in shape.
2. The gripping force of the pallet fixtures on the pallet changer (optional) will decrease and this will cause a defect in shape.
3. Defects in machining will result from the likely occurrence of a lens positioning error in the auto focus torch (optional).

Provide your factory utilities equipment with sufficient air supply capabilities and be sure that even when the compressed air of the factory is used for other machines or at other jobsites, the supply air pressure to the laser machine will not decrease below 0.49 MPa (71.15 PSI).

#### 5. Turning power ON

Turn on the main power switch (main circuit breaker handle) on the side of the electrical control cabinet.

Press the POWER ON button on the NC operation panel.

## 10 STARTING AND STOPPING LASER OSCILLATOR

### 10-1 Starting

#### 1. When the laser oscillator is started everyday.

- (1) Press the SWITCH screen selection key and make sure that the GAS CLEANING CANCEL button is turned OFF.
- (2) Insert a key into the LASER key switch on the NC operation panel and place it in the ENABLE position. This turns on the power supply to the laser oscillator.
- (3) Press the LASER POWER I button on the NC operation panel.  
The laser oscillator tube is automatic emptied and filled with gas. The Lamp of the I button flickers while the gas is being charged. After the completion of gas charging, the lamp stays lit, indicating that the LASER HIGH VOLT I button can be pressed.
- (4) After making sure that the LASER POWER I button lamp is lit, press the LASER HIGH VOLT I button. High voltage is applied to the laser oscillator and the pre-discharge status is established. After a while, the LASER HIGH VOLT I button lamp begins to blink, and then turns on. At the same time, HIGH VOLT indicating lamp lights. In this state, laser beam can be emitted by the operation of the SHUTTER key switch or the NC command. This completes preparatory steps for the operation.
- (5) If laser beam emission is interrupted by pressing the EMERGENCY STOP button during machine operation, turn the LASER key switch to LOCK position and then repeat steps (1) to (4).

#### 2. When the laser oscillator has not been used for more than two days

When the laser oscillator is started after more than two days, it is necessary to carry out gas charge 5 times or more to remove impurities (gas) inside the laser oscillator.

Follow the procedure below to start the laser oscillator.

- (1) Press the SWITCH screen selection key and make sure that the GAS CLEANING CANCEL button is turned OFF.
- (2) Insert a key into the LASER key switch on the NC operation panel and place it in the ENABLE position. This turns on the power supply to the laser oscillator.
- (3) Press the LASER POWER I button on the NC operation panel.  
The laser oscillator tube is automatically emptied and filled with gas.  
The I button lamp flickers while the gas is being charged. After the completion of gas charging, the lamp stays lit, indicating that the LASER HIGH VOLT I button can be pressed.
- (4) Press the LASER POWER O button on the NC operation panel.  
Mixed gas fills the laser oscillator. Make sure that the LASER POWER O button lamp is lit.
- (5) To carry out gas charge for 5 times of more, repeat the steps (2) to (4) 4 times or more.
- (6) After the fifth operation of steps (2) and (3), make sure that the LASER POWER I button lamp is lit and press the LASER HIGH VOLT I button again.  
High voltage is applied to the laser oscillator and pre-discharge status is established. After the while, the LASER HIGH VOLT I button lamp stops blinking and stays lit. At the same time, HIGH VOLT indicating lamp lights. In this state, laser beam can be emitted by the operation of the SHUTTER key switch or the NC command. This completes preparatory steps for the operation.

- (7) If laser beam emission is interrupted by pressing the EMERGENCY STOP button during machine operation, turn the LASER key once to LOCK position and then repeat steps (1) through (4) of item 1 above.

## 10-2 Stopping

- (1) Press the LASER HIGH VOLT **O** button. The laser oscillator stops and high voltage is shut off.
- (2) Press the LASER POWER **O** button. The LASER POWER **I** button lamp flickers and the laser oscillator tube is filled with mixed gas. After the completion of gas charging, LASER POWER **I** button lamp is turned off and LASER POWER **O** button lamp lights. Never place the LASER key switch to the LOCK position, press the LASER POWER **O** button or turn off the main power supply until the LASER POWER **O** button lamp is turned on.
- (3) Place the LASER key switch in the LOOK position and remove the key. One person should be responsible for keeping track of the key.

### 10-3 Using Gas Cleaning Cancel Switch

At the start up of the laser oscillator, gas cleaning is carried out to stabilize gas mixture ratio in the piping run for the gas bomb and that inside the laser oscillator.

#### 1. Example

##### A. To start up immediately after turning off laser operation:

Gas mixture ratio in the laser gas piping run remains stable. In this case, therefore, cancel the gas cleaning operation.

##### B. To stop the machine for 30 minutes for lunch break:

If the machine should be stopped for 30 minutes there is no remarkable difference in gas consumption volume between keeping the machine running and carrying out gas cleaning after stopping it once. Therefore, in such situation, it is recommended to keep the machine running with the high voltage turned off. Press the LASER HIGH VOLT I button again does not start gas cleaning.

##### C. To stop the machine for 1 hour:

Turn off the operation, cancel gas cleaning then start up the operation. This can save gas consumption compared to the case explained in 2 above.

##### D. To stop the machine at 5:00 PM and to start it at 8:00 AM in the next morning (stopping the machine for approximately 15 hours):

In this case, it is necessary to carry out gas cleaning.

##### E. After stopping the operation for two days or more:

Repeat gas charge operation 5 times or more (required time: 20 minutes / 5 times). After that start the operation and carry out gas cleaning.

**Note:** During gas cleaning operation, the LED indicating the pressure in the laser tube flickers. This LED is usually lit.

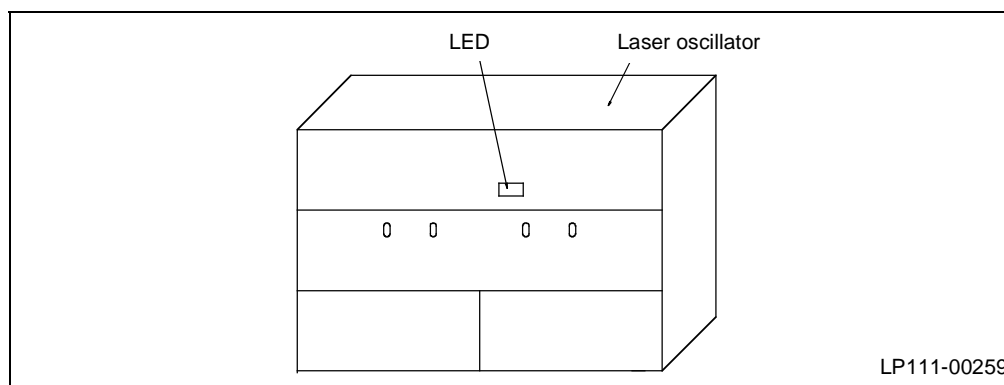


Fig. 10-1 LED indicating the pressure in the laser

## 2. Precautions

In the following cases, start operation after repeating gas charge 5 times or more and then carry out gas cleaning since gas mixture ratio might be changed due to mixing of air.

1. After changing mixture gas bomb.
2. If leak is found in the piping run between the mixture gas bomb and the resonator laser gas inlet port.
3. After changing the piping run for the mixture gas bomb.
4. If there is a possibility that air was mixed into the mixed gas introduction and sealing passages

## 11 MANUAL AND AUTOMATIC OPERATIONS

Refer to the separate programming manual.

The following points must be kept in mind when creating a program.

1. During work with a high positioning frequency, work with a high frequency of repetition acceleration and deceleration, and continuous processing using a program set at a fast processing speed and overload could be applied to the servo motor and amplifier causing an alarm to occur and make continuation of operation impossible. When this happens, stop operation for a while to allow the machine to cool down and then restart operation after lowering the processing speed setting.
2. Create the program so that there is no interference between the worksheet clamp, locator, and cutting head.
3. When sheet metal is cut by laser, the part that has been cut free will sometimes tilt over so that a portion of it is projecting above the surface of the worksheet.

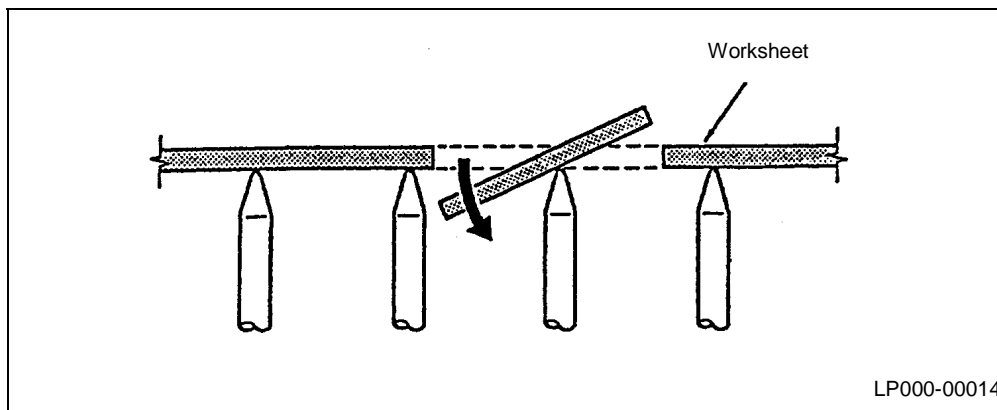


Fig. 11-1 Interference between the head and a fallen piece

To avoid interference between the cutting head and parts like this, a program must be made so that the cutting head does not travel over portions of the worksheet which have already been cut.

4. In the event that there is interference and the profiler stylus shaft is damaged, replace it with a spare part.

### 11-1 Profiler Retry Function

The alarm that occurs the most during laser processing is the profiler alarm. (Message: 241 AUTO GAP CONTROL ALARM)

The profiler alarm occurs when a piece of cut worksheet falls and lands slanted causing one end to stick up and into this end and the stylus runs over it and becomes lifted as shown in the illustration below.

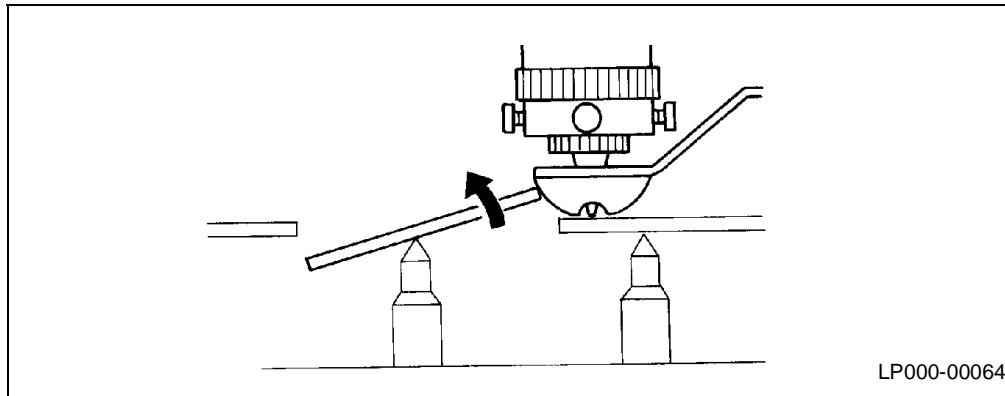


Fig. 11-2 Stylus interference

When the profiler alarm occurs, a feed hold stop is executed and processing is stopped. If a person responsible for laser processing is nearby, this person will check the stoppage situation, and if he presses cycle start, the process will restart where it left off. But sometimes the worker is away from the machine during processing because it is break time, etc. If the profiler retry is made valid at this time, there is less of a possibility that profiler alarm will occur.

### 11-1-1 Preparation for operation

Set the Z-axis rising amount and speed in the user parameter.

**I029:** Z-axis rising amount (Unit:  $\mu\text{m}$ )

**I030:** Z-axis rising speed (Unit: mm/min)

Set the parameters according to your machining condition.

**Note:** Regardless of the inch/mm mode, enter parameters in the above unit.

- Operation

- (1) Profiler alarm occurs.  
↓
- (2) Stylus up  
(Rises even if stylus up is made invalid using the selector switch.)  
↓
- (3) If the stylus itself catches on the worksheet the stylus alarm will be generated. Use RESET to reset the stylus.  
↓
- (4) If an alarm is not generated, move the stylus to the Z-axis zero point.  
↓
- (5) Lower the stylus and conduct positioning using the profiler.  
↓
- (6) Continue processing.  
↓
- (7) If the alarm will continue to be generated even when this procedure is repeated 3 times, during the 4th time the alarm status will be maintained. At this time use RESET to reset it.

**Note:** While in a retrial operation, all switches other than the emergency stop button become inoperative.

## 11-2 NC Retrial Function (Optional)

This function allows the stylus to pass without machining the portion which cannot be overcome by three retrials in the resume or retrial operation and start processing from the next piercing point. So it leaves some portions unmachined but can go on operation without stopping at a profiling error position which occurs due to a worksheet lift.

### 11-2-1 Preparation for operation

Set the Z-axis rising amount and speed in the user parameter.

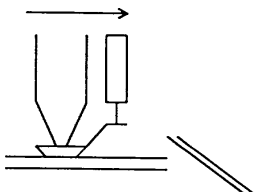
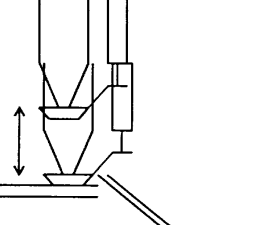
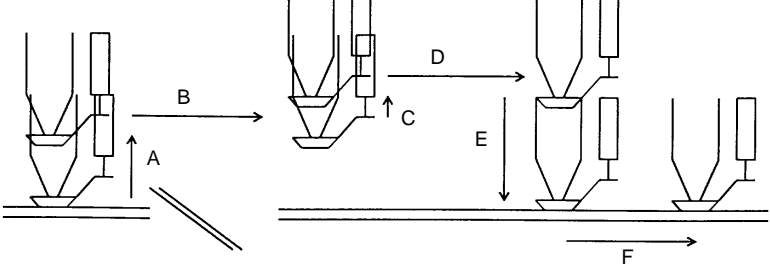


**I029:** Z-axis rising amount (Unit:  $\mu\text{m}$ )

**I030:** Z-axis rising speed (Unit: mm/min)

Set the parameters according to your machining condition.

**Note:** Regardless of the inch/mm mode, enter parameters in the above unit.

#### Example of the stylus motion

1		<p>A worksheet inclines and blocks the stylus motion as shown here.</p>
2		<p>First, the profiler retry function works and the stylus moves up and down three times.</p>
3		<p>After that, the NC retrial function starts working and</p> <p>The Z axis mechanism moves up,</p> <p>The laser is not output but the torch runs without machining the portion.</p> <p>The processing finish subprogram is carried out,</p> <p>The stylus moves to the next processing position in the rapid traverse,</p> <p>Normal piercing starts (The profiling unit and the laser unit go on) and the stylus starts processing to the next part.</p> <p>Processing the next part starts.</p>
4	<p>NC retrial (Optional)</p> <p>NC RETRY</p>  	<p>In order to validate the retrial function, press this button.</p> <p>When the LED blinks, the function becomes valid.</p> <p>While the NC retrial function is working, the LED is lighting.</p> <p>However, if the profiling resume (retrial) function itself is invalid, the NC retrial function does not work.</p>

- NOTE -

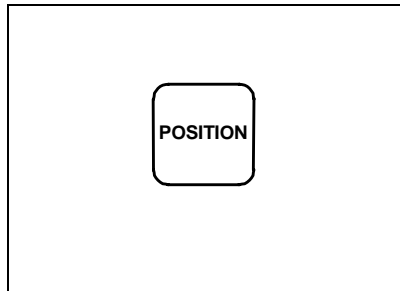
## 12 PROGRAM RESTART FUNCTION

It is possible to restart the program from the specified position.

Note that the restart function is not valid for the press mode program.

### Operating procedure

- (1) Select the manual mode and move the axes to the automatic operation start position. Refer to Section 8-4, "Manual Mode".
- (2) Press the POSITION screen selection key to display the COMMAND or POSITION screen.



- (3) Press the **WNo.** menu key. The window opens in which the WNo. of the program to be restarted should be keyed in. After keying in the WNo., press the INPUT key.
  - When program restart is made for a subprogram, set the WNo. of the main program where the subprogram is called.

*** COMMAND ***    WNo. 9999 <b>COMMAND</b> →POSITION					
<div style="border: 1px solid black; display: inline-block; padding: 2px;">WNo. ? (1234)</div>					
<div style="border: 1px solid black; display: inline-block; padding: 2px;">WNo. ?</div>					
			ORIGIN	<b>WNo.</b>	

- If the WNo. of the program which should be restarted is already set, this operation is not necessary.
  - The WNo. displayed at the top line in the screen is the WNo. used for automatic operation.
- (4) When the WNo. is set, it is displayed in the WNo. field at the top line in the screen.

*** COMMAND ***    WNo. 1234 <b>COMMAND</b> →POSITION					
---	--	--	--	--	--

(5) Press the **SEQ No. SET** menu key.

- The menu item is highlighted.
- The window shown below opens.

	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">SWNo.</td> <td style="width: 10%;">( 0 )</td> <td>.....WNo. of the subprogram to be restarted</td> </tr> <tr> <td>NNo.</td> <td>( 0 )</td> <td>.....Restart sequence number</td> </tr> <tr> <td>BNo.</td> <td>( 0 )</td> <td>.....Restart block number (Note 1)</td> </tr> <tr> <td>L</td> <td>( 0 )</td> <td>.....Sub program count (Note 2)</td> </tr> <tr> <td colspan="3" style="text-align: center;">START</td> </tr> </table>	SWNo.	( 0 )	.....WNo. of the subprogram to be restarted	NNo.	( 0 )	.....Restart sequence number	BNo.	( 0 )	.....Restart block number (Note 1)	L	( 0 )	.....Sub program count (Note 2)	START			
SWNo.	( 0 )	.....WNo. of the subprogram to be restarted															
NNo.	( 0 )	.....Restart sequence number															
BNo.	( 0 )	.....Restart block number (Note 1)															
L	( 0 )	.....Sub program count (Note 2)															
START																	
<b>SEQ.No.</b>																	
SET																	

(6) Key in the data for the items displayed in the window.

**Note 1:** Block number

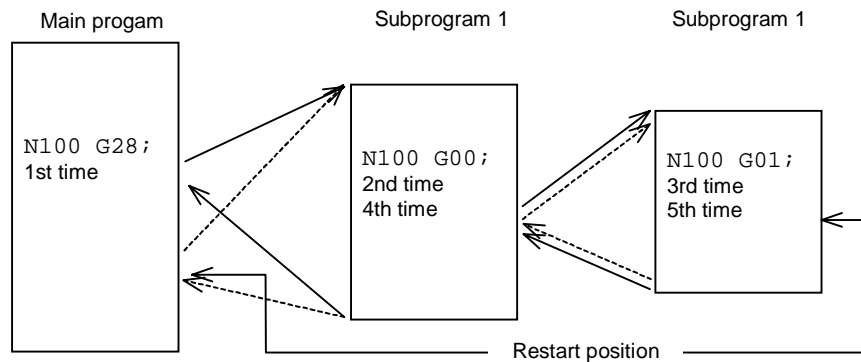
The block number is reset to "0" at each appearance of a program number or a sequence number. When a block not preceded by a program number or a sequence number is read, the block number is increased by one. See the example below.

Program	Block No.
O1000;	0
N10 T28;	0
N11 G00;	0
G01;	1
G02;	2
N12 G01;	0
N13 G00;	0

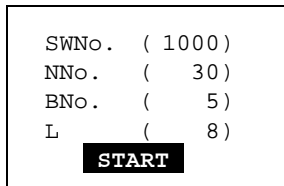
**Note 2:** Subprogram count

Set the numbers of the N number at the request location, in terms of its position in the sequence of N numbers counting from the head of the main program. If restarting from the main program, input "1". If restarting from a subprogram, determine the number of the N number for the subprogram, in terms of its position in the sequence of N numbers counting from the main program's N number, and set this number.

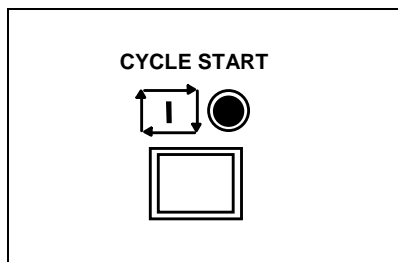
**Example:** If the subprogram count is "5"



- (7) Move the cursor at START and press the INPUT key. The search starts for the set data.



- (8) After the completion of search, the menu display returns to the normal display and the window closes. In the search processing, the modal G-code information, coordinate values, laser condition, profiling mode, etc. are all stored to the NC, and at the start of cutting, necessary G-codes and M-codes are output. Therefore, the restart can be made automatically without requiring an operator to set the M-codes, etc.
- (9) Press the CYCLE START button. The program is executed from the searched position.



- NOTE -

## 13 OPERATION BREAKS AND COMPLETION

### 13-1 Breaks in Operation

When taking a break from operation, it is recommended that the machine be left in the laser ready status. Enter laser ready status by pressing the LASER HIGH VOLT **O** button on the NC operation panel.

The laser standby status is a laser gas circulating status and operation mode can be reverted to immediately by pressing the LASER HIGH VOLT **I** button.

If the LASER POWER **O** button is pressed, laser gas circulation ceases. In this case, operation is recommenced by pressing the LASER POWER **I** button. Evacuation and charging with laser gas is then necessary, and takes approximately 5 to 6 minutes.

For the procedure to be followed when starting up the laser resonator after machine stop, refer to 10-3 "Using Gas Cleaning Cancel Switch".

### 13-2 Completion of Operation

- (1) Stop the laser oscillator.
- (2) Press the LASER HIGH VOLT **○** button on the NC operation panel.
- (3) Press the LASER POWER **○** button on the NC operation panel.
- (4) Turn the LASER key switch to LOCK on the NC operation panel. (This is allowed only after the confirmation of the LASER POWER **○** button lamp lighting.)
- (5) Cut the NC Power.  
Press the POWER **○** button on the NC operation panel.
- (6) Keep the main breaker in the electrical control panel ON.  
To carry out maintenance, turn the main breaker lever to the OFF position.
- (7) Cut off the laser and assist gas supplies.
- (8) Cut off the air supply.
- (9) Cut off the cooling water supply.  
The chiller stops when the LASER key switch is turned to the LOCK position.