

**CNC LASER MACHINE**

**LCG SERIES**

**(FS 31i-LB)**

**(AMNC-F)**

**INSTRUCTION MANUAL**

**X41344C**

AMADA Europe  
BP 41040 – 95912 ROISSY AÉROPORT CDG CEDEX  
Tél : 01 49 90 30 00 – Fax : 01 49 90 31 99

*Original instructions*



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A	18/06/2014	First version for Amada Europe
B	20/10/2014	Update with new declaration
C	10/02/2015	Update : chapter 1 : declaration chapter 2 : new crate chapter 6 : lubrication

It is recommended that the instructions for this machine should be read carefully until you are thoroughly familiar with it.

Scrupulously follow installation, usage and maintenance operations as described in this manual to avoid any risk of accident to the operator.

Keep this documentation close by and refer to it whenever necessary.

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## **IMPORTANT**

**RECEPTION:** Your machine was loaded onto the carrier's truck and the carrier recognises that he received it in perfect condition.

However, if an incident occurs during transport (which is always possible) or if you observe any visible damage (traces of shocks or dents, etc.) on your machine, please make your reserves as follows:

- A – On the delivery form presented to you for acceptance by the carrier.
- B – By notifying them to the carrier and to ourselves (for information) by registered letter within not more than 48 hours.
- C – It is strictly prohibited to use your machine with protective covers removed or modified. Should maintenance operations be required, only qualified staff authorized by AMADA is entitled to do so.

<b>FOR ANY PROBLEMS THAT OCCUR DURING INSTALLATION OF THE MACHINE</b>	
<b>Phone .....</b>	<b>+33 1 49 90 30 00</b>
<b>Fax .....</b>	<b>+33 1 49 90 31 99</b>



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# Hazard Information on Machine

The Hazard Information on Machine communicates machine and other hazard information to the user and prompts the employer to perform risk assessment for occupational accident prevention. The residual risk map and residual risk list contain information required to communicate to the employer the hazards that must be made known to the person or organization to whom the employer transfers the machine.

The Hazard Information on Machine forms part of the manual(s). Do not use the machine after understanding the Hazard Information on Machine alone. Be sure to carefully read and understand the manual(s) as well before using the machine.

In addition to the Hazard Information on Machine, the manual(s) also describes hazard information in detail for specific tasks. Also comply with the hazard information in the manual(s).

The manual(s) classifies the hazardous situations into the following levels:

	<b>DANGER</b>	<b>Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.</b>
	<b>WARNING</b>	<b>Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.</b>
	<b>CAUTION</b>	<b>Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.</b>

(For contents, refer to next page.)

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## **1. Overall management responsibilities**

### **1-1. Complying with safety laws, regulations, and standards concerning laser machines in country or region of use**

The laser machine uses a Class 4 invisible laser for cutting materials and a visible semiconductor laser with a wavelength range of 650 nm for checking cutting positions. If the partitions and other protective covers are all closed and the safeguards are all enabled, the outside of the laser machine corresponds to that of a Class 1 laser product. If these conditions are not satisfied, the laser machine is a Class 4 laser product. Close the partitions and all other protective covers, and enable the safeguards. The visible laser is emitted even if the partitions are opened, but the visible laser belongs to a Class 3R laser product when its radiation is measured by AMADA.

Use the laser machine in compliance with safety laws, regulations, and standards in the country or region of use.

### **1-2. Appointing laser safety officer**

Appoint a laser safety officer from among the employees who have enough knowledge and experience about the operation of the laser machine and the prevention of laser hazards. The laser safety officer must:

- Control keys and other devices for operating the laser machine.
- Inspect and maintain the laser machine, and save its inspection and maintenance records.
- Inspect and maintain the protective gear, and monitor its usage.
- Conduct the occupational health education of operators, and save their records.
- Practice other items necessary for preventing fires and other hazards due to the laser machine.

### **1-3. Posting name of laser safety officer and other information**

Post the following information on the laser machine or in an easy-to-see location near the laser machine:

- Name of the laser safety officer
- Laser hazardousness and harmfulness, and any other laser machine operating precautions

## 1-4. Having keys kept by laser safety officer

Some controls are installed as keyswitches to prevent improper or unauthorized operation. Have the keys of the keyswitches kept by the laser safety officer. (For the positions of the keyswitches, refer to “6. Keyswitch and EMERGENCY STOP button arrangement drawing” in this Part.)



### Keyswitches on NC control box

- LASER keyswitch
- MEMORY PROTECT keyswitch
- SHUTTER keyswitch
- MANUAL CUT keyswitch
- LINE CONTROL keyswitch (only for line operation specification)

## 1-5. Conducting safety and health education of operators

When employing workers to be engaged in laser jobs, assigning workers to laser jobs, or assigning workers to different laser machines, conduct their safety and health education in compliance with safety laws, regulations, and standards in the country or region of use. Concerning the following items in particular, establish safety and health rules in compliance with this manual, and conduct the education and training of operators accordingly:

- Hazardousness and harmfulness of laser machines in compliance with the Hazard Information on Machine.
- Construction of laser machines
- Methods of operating laser machines
- Performance of protective gear and devices, and methods of handling them
- Emergency measures and evacuation

## 1-6. Eye health care

Administer eye health care for workers regularly engaged in laser jobs in compliance with eye health care laws, regulations, and standards in the country or region of use if there are any such ones.

As soon as any workers suspected of exposure to laser radiation are found, bring them to a doctor for examination or treatment.



## 1-7. Inspection and maintenance

Perform maintenance on the laser machine before the start of the day's work.

Before the start of the day's work, instruct the laser safety officer to check the laser beam path, interlock functions, safeguards, and protective gear.

Try to find equipment failures or problems as early as possible. When you find a problem, repair it or take any other necessary measure to prevent an accident.

Do not operate the laser machine with its maintenance doors and those of the NC unit left open.

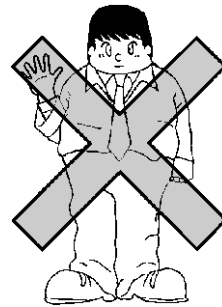
Do not repeatedly turn on and off the power of the laser machine at rapid intervals.

## 1-8. Precautions on clothing to wear during operation

Do not wear loose clothing or jewelry when operating the laser machine. Otherwise you may be caught in or pulled into the laser machine.

As dictated by the work to be performed, wear personal protective gear, such as a safety hat, laser safety goggles, dust safety goggles, safety shoes, ear plugs, gloves, a gas mask, or a dust mask.

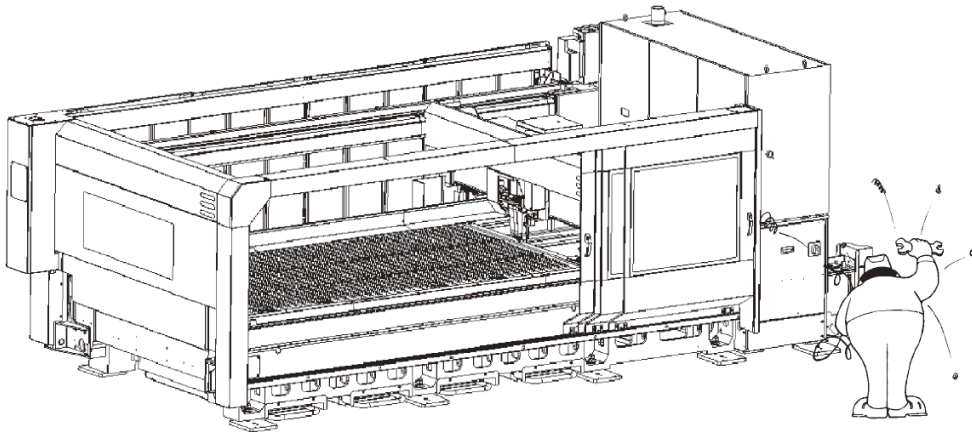
Select such protective gears that comply with specific work safety standards.



## 2. Prohibiting modification of laser machine

### 2-1. Prohibiting modification of laser machine and control circuit

Never modify the laser machine and control circuit. Doing so may cause the laser machine to malfunction.



## **2-2. Prohibition of change to personal computer-based NC unit**

The laser machine is controlled by a personal computer-based NC unit. Any software or hardware changes may cause the laser machine to misoperate and lead to a serious accident.

1. Do not add or change any hardware (e.g., memory, SCSI card, PC card, CF card).
2. Do not remove or insert boards like the CPU board.
3. Do not install or uninstall software.
4. Do not change, add, delete, or move Windows files and folders.
5. Do not operate on the Windows system files (e.g., control panel and registry file).
6. Do not save files other than programs in the NC unit through a USB flash drive or through another computer connected to the AMNC system.
7. To prevent infection with computer viruses, do not use media that contain files and programs of unknown origin.
8. The AMNC-F comes standard with security software. This security software prevents the operation of computer viruses and other malicious software and the execution of software other than that operating in the AMNC-F.

## **2-3. Prohibition of removal of safeguards and of change of their installation position**

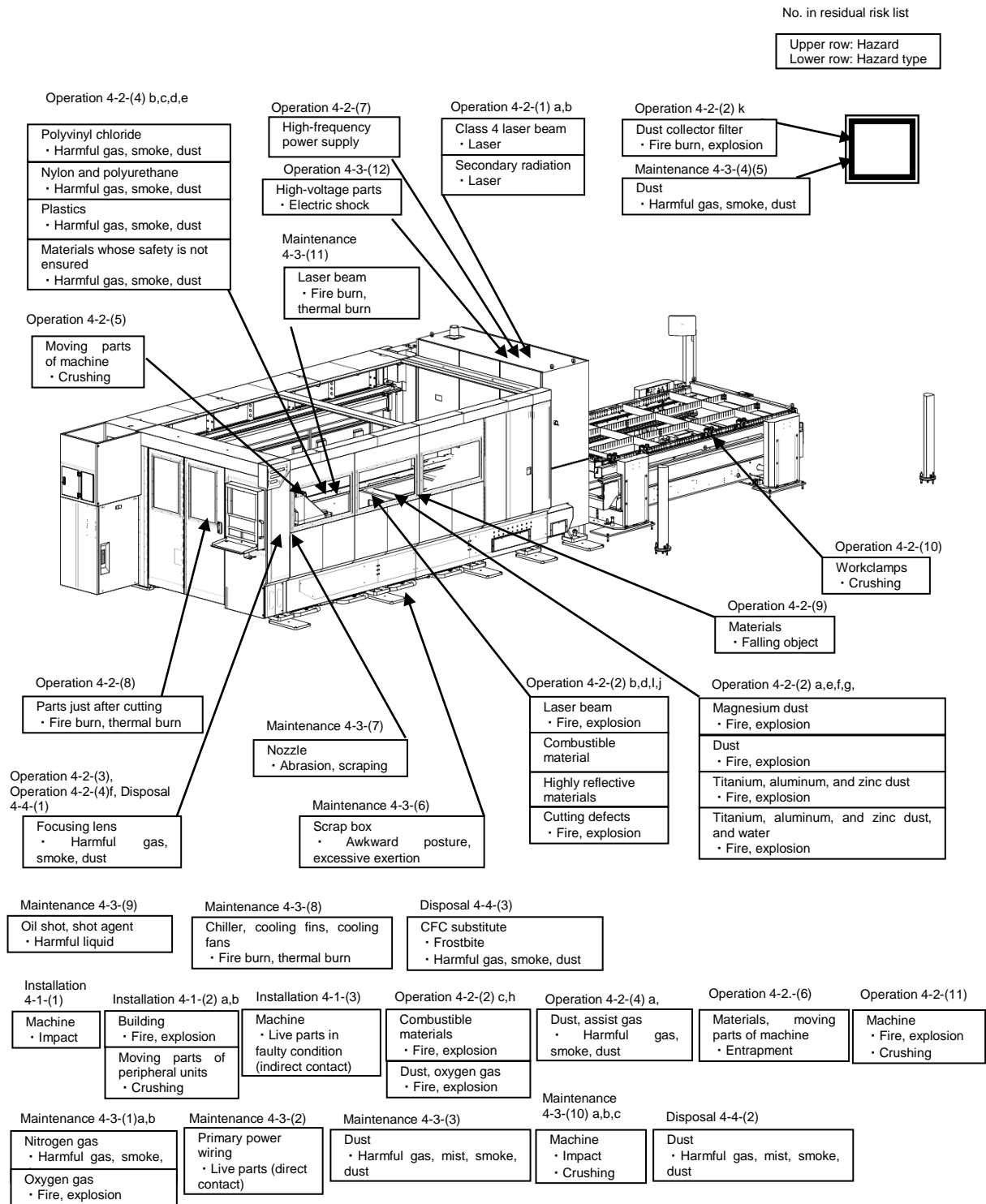
Do not remove the safeguards, entry prevention fences and covers, and do not change their installation position. Do not operate the laser machine with its interlocks removed.

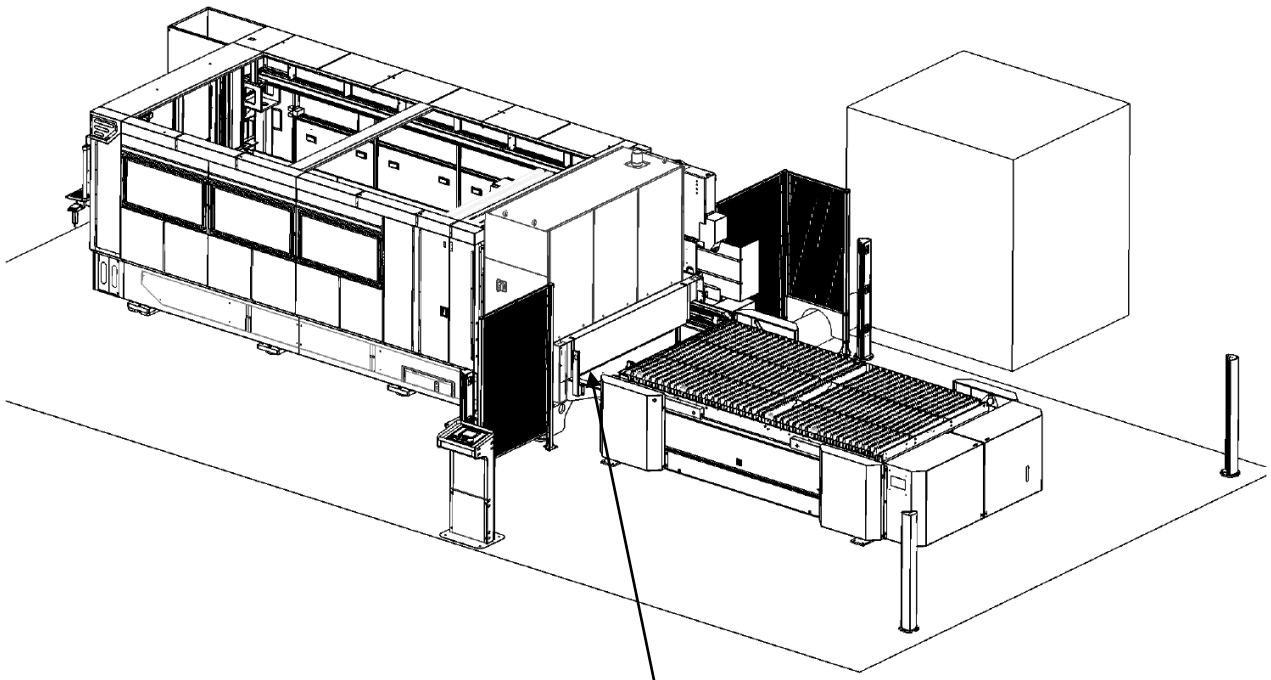
## **3. Residual risk map peculiar to machine Model: LCG series**

For specific locations of residual risks on the machine, refer to “4. Residual risk list peculiar to machine” described later.

### 3-1. Hazard map of machine

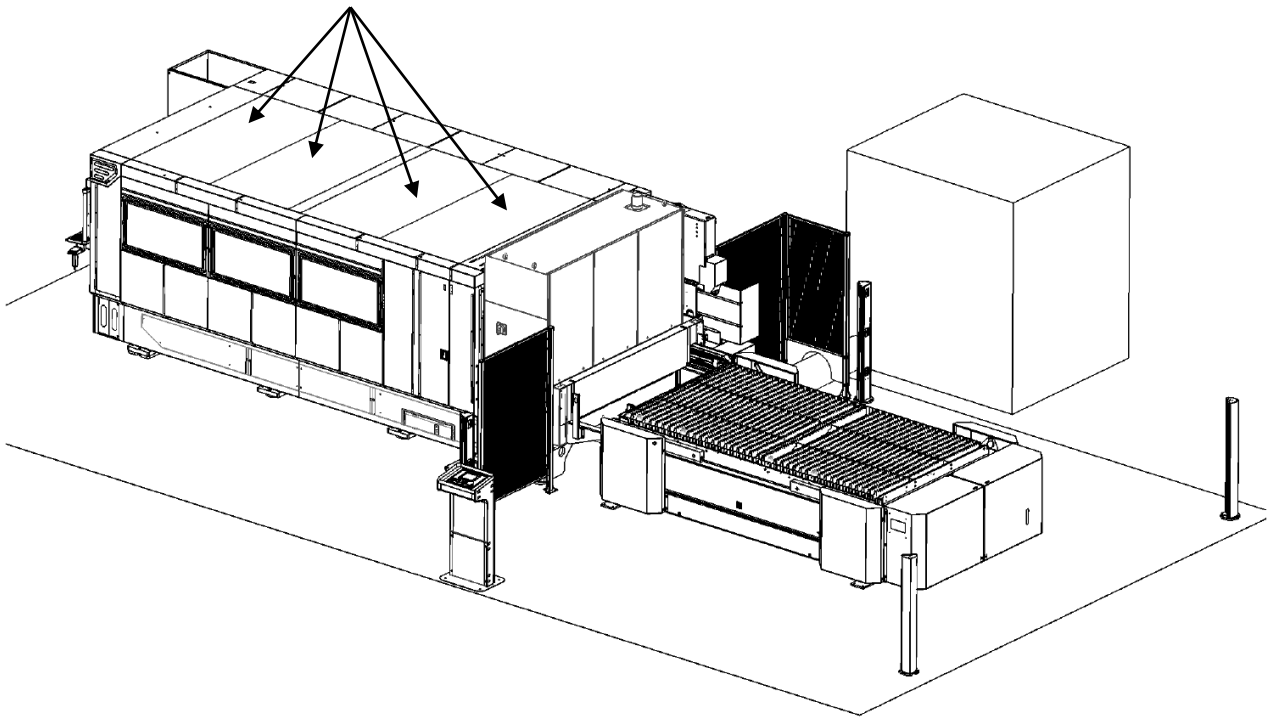
For the peripheral equipment, refer to the Hazard Information on Machine in its manual.





Installation 4-1-(4)  
Optional roof cover

Operation 4-2-(1) a  
Shutter



## 4. Residual risk list peculiar to machine

### Model: LCG series

#### 4-1. Installation

##### (1) Precautions when lifting and moving machine



#### WARNING

- ▶ Hazard ◀ Machine
- ▶ Description ◀ Use appropriate lifting devices and methods to lift and move the machine. Failure to do so may cause the machine to tumble or fall.
- ▶ Measure ◀ Ask Amada or a specialized contractor to lift and move the machine.
- ▶ Reference ◀ Installation Manual

##### (2) Location of machine and protection around machine



#### WARNING

- (a) ▶ Hazard ◀ Building
  - ▶ Description ◀ If a combustible material ignites near or around the laser cutting machine, the fire may spread throughout the shop.
  - ▶ Measure ◀ Install the machine in a fire-resistant building.
- (b) ▶ Hazard ◀ Moving parts of peripheral units
  - ▶ Description ◀ You may collide with a pallet or other moving part around the peripheral unit or may get pinched in a pallet or other moving part.
  - ▶ Measure ◀ Install a safety fence and a light curtain to prevent access to moving parts during operation.
  - ▶ Reference ◀ Installation Manual

##### (3) Precautions when installing electrical wiring



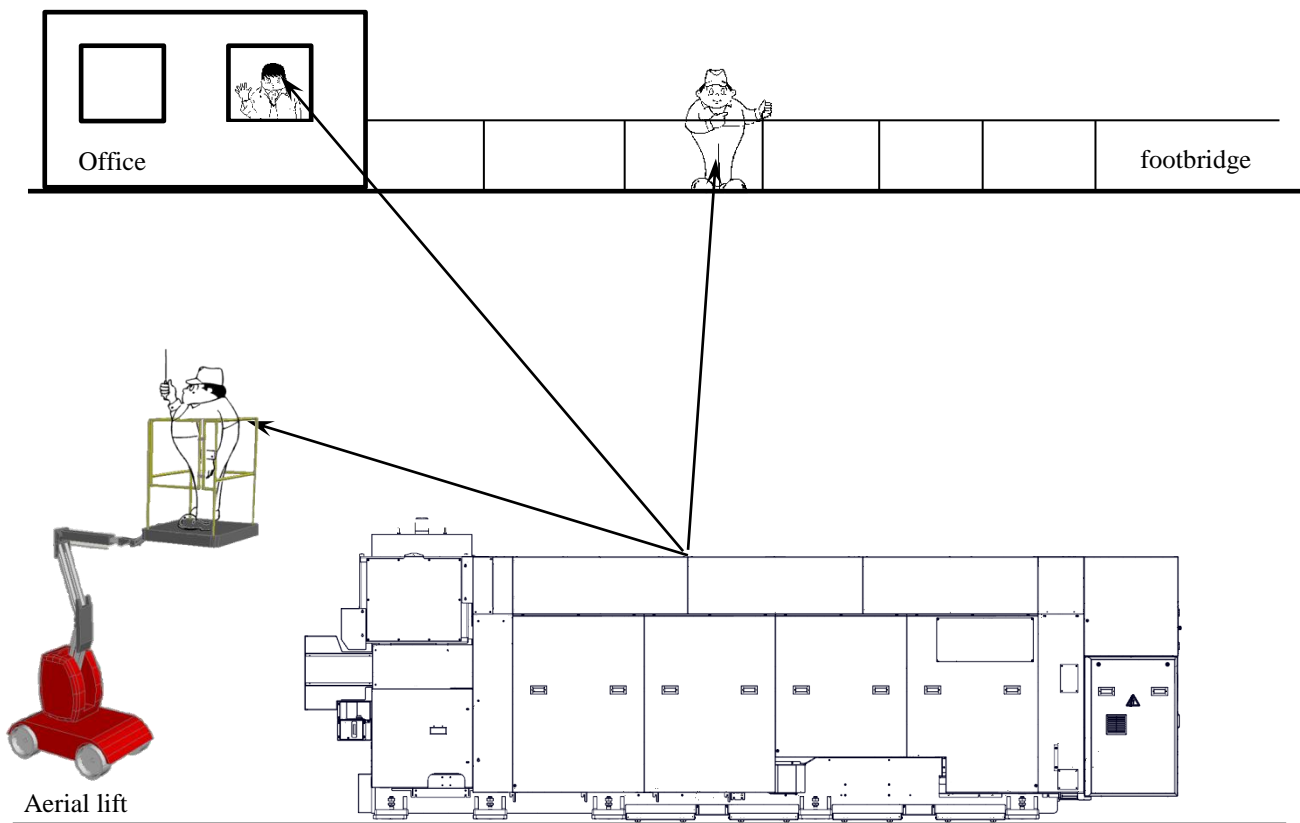
#### WARNING

- ▶ Hazard ◀ Machine
- ▶ Description ◀ If you fail to install primary power wiring and ground wiring as specified, you may get an electric shock from ground-fault current or may get pinched in a malfunctioning machine.
- ▶ Measure ◀ Install primary power wiring and ground wiring as shown on the electrical reference drawing.

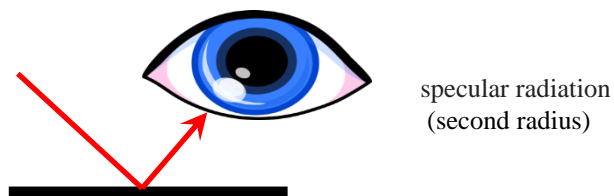
#### (4) Secondary reflected light by the roof

### WARNING

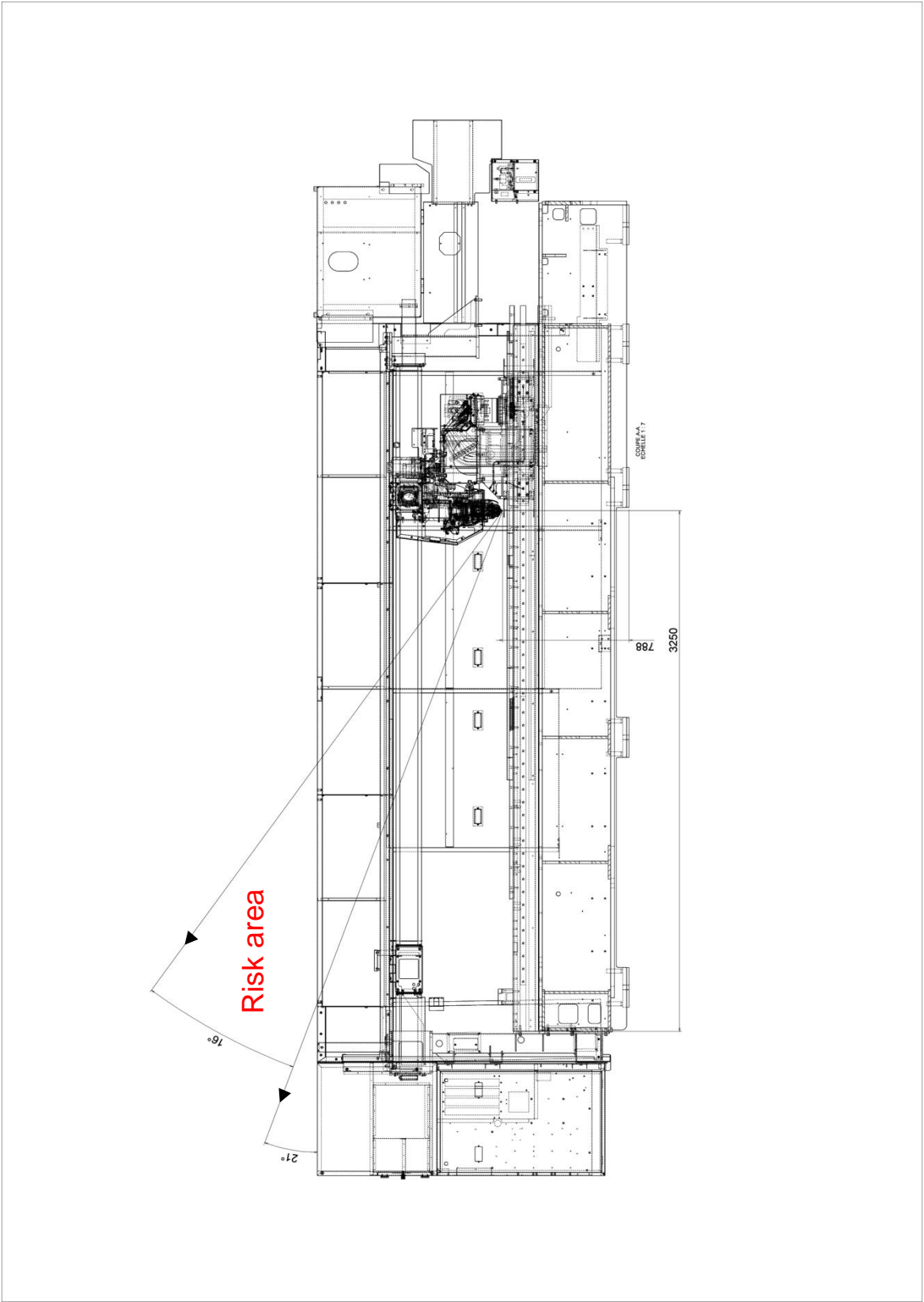
- ▶ Hazard ◀ Laser Beam
- ▶ Description ◀ During laser cutting, visible and ultraviolet light are emitted from the cutting point. This light can go to the top.
- ▶ Measure ◀ In case of a machine installed in a workshop where the offices are located in high position (over the working area) that implies accessed with stairs and footbridge ; due to the fact that some laser beam reflection can reach an employee, therefore it is required to equip the machine with an optional roof cover.  
Owing to possible laser beam reflection it is demanded :
  - Any kind of work to be performed in high position above the laser cutting area working must be prepared with protections such as appropriated curtains
  - Or the laser machine must be stopped during the time of the work.



Risk due to laser radiation toward up







## 4-2. Operation (setup and cutting)

### (1) Checking for safety at start of operation



#### WARNING

- (a) ▶ Hazard ◀ Class 4 laser
- ▶ Description ◀ If the enclosure of a Class 4 laser is broken, the laser beam may leak outside. The Class 4 laser beam is 10600 nm in wavelength and invisible. If the Class 4 laser beam directly enters your eyes or the reflected or scattered radiation from the worksheet surface hits you, you may lose your eyesight or may get burned.
- ▶ Measure ◀ At the start of the day's work, check the enclosure and other protective covers for breakage (holes) or burn marks and the door interlocks for operation. If any abnormality is found, stop the use of the machine and contact Amada.
- Wear the laser safety glasses (attached to the machine). Take care that the glasses cannot shield the laser beam when directly exposed to it.
- When you use the visible laser beam for checking the cutting position, wear the laser safety glasses and take care that the invisible laser beam does not directly enter your eyes.
- (b) ▶ Hazard ◀ Secondary reflected light (visible light and ultraviolet light)
- ▶ Description ◀ During laser cutting, visible light and ultraviolet light are emitted from the cutting point. If you directly look at highly bright visible light or at ultraviolet light, you may get your eyesight reduced.
- ▶ Measure ◀ Every day, check the enclosure and other protective covers for breakage (holes) and the safety devices for condition. If any abnormality is found, stop the use of the machine and contact Amada.
- Wear the laser safety glasses (attached to the machine). Take care that the glasses cannot shield the laser beam when directly exposed to it.
- When you use the visible laser beam for checking the cutting position, wear the laser safety glasses. Take care that the invisible laser beam does not directly enter your eyes.

## (2) Precautions against fire during laser cutting



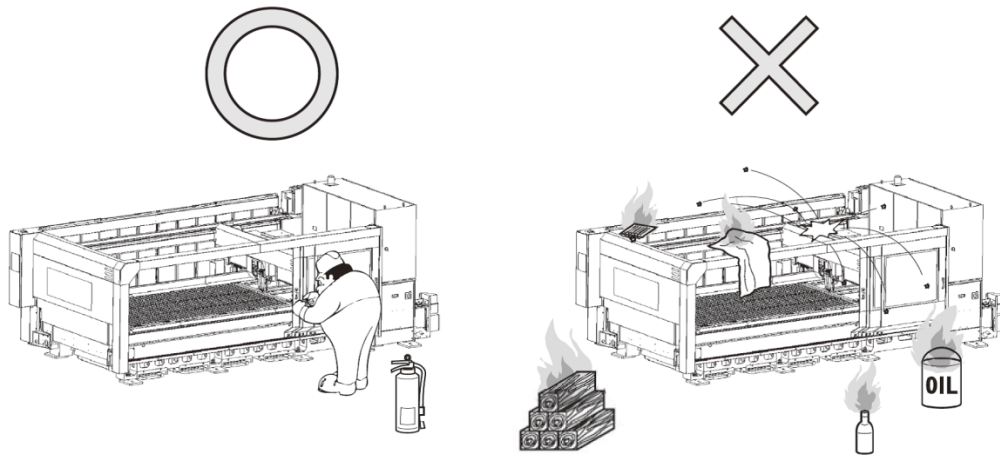
### DANGER

- (a) ▶ Hazard ◀ Magnesium dust
- ▶ Description ◀ Dust generated from cutting magnesium and its alloys has the highest risk of explosion.
- ▶ Measure ◀ Never cut magnesium and its alloys.
- ▶ Reference ◀



### WARNING

- (b) ▶ Hazard ◀ Laser beam
  - ▶ Description ◀ A fire may occur at any time during laser cutting.
  - ▶ Measure ◀ Do not allow laser cutting to be performed unattended. A source of fire may remain after laser cutting. Take care against fire after laser cutting. Install a fire extinguisher near the machine so that, should a fire occur, you can immediately put out the fire with the fire extinguisher. You must use different types of fire extinguishers for different types of fire. There are fire extinguishers for ordinary fires, oil fires, electrical fires, and special fires (metal fires, for example). Provide fire extinguishers suited for types of fires expected to occur in your shop.
- 
- (c) ▶ Hazard ◀ Combustible materials
  - ▶ Description ◀ If a combustible material is struck by the reflected light of the laser or spatter generated during laser cutting, it may ignite and cause a fire.
  - ▶ Measure ◀ Never place combustible materials (typically, oil, grease, acetone, plastics, waste cloth, wood, paper, and dust collector filters) around the machine. Wipe off any oil adhering to the processing pallet.
  - ▶ Reference ◀ 2-1-6. Cleaning table and area around machine, Part 5, Maintenance.
- 
- (d) ▶ Hazard ◀ Combustible materials
  - ▶ Description ◀ Laser cutting of a combustible material may result in a fire.
  - ▶ Measure ◀ Do not laser-cut acrylics, plywood, and other combustible materials. Doing so always carries a risk of fire.



- (e)   ▶ Hazard ◀   Dust
- ▶ Description ◀ Dust generated by laser cutting may present a fire risk as well as a dust explosion risk. A dust explosion occurs the instant three conditions, oxygen, dust concentration above the lower explosion limit, and minimum ignition energy, are all met. If a large amount of dust collects, it is scattered by a dust explosion and the scattered dust may result in a larger secondary explosion.
- ▶ Measure ◀ Clean the scrap box and the dust box of the dust collector every day.
- ▶ Reference ◀ 2-1-8. Cleaning dust box of dust collector, Part 5, Maintenance  
2-1-10. Cleaning scrap box, Part 5, Maintenance
- (f)   ▶ Hazard ◀   Titanium, aluminum, and zinc dusts
- ▶ Description ◀ When mixed with oxidized iron and copper dusts, dusts of titanium, aluminum, zinc, and their alloys collected in the machine, duct, and dust collector cause a thermite reaction, produce high heat, and explode.
- ▶ Measure ◀ Daily cleaning is important in preventing such dusts from collecting in the machine, duct, and dust collector. Dedicate the machine to cutting one type of material. Or before or after laser cutting such a material, completely remove the generated dust so that it does not mix with the dust from laser cutting of the next material. After laser cutting a material, change the dust box of the dust collector so that the collected dust does not mix with the dust produced by laser cutting of the next material.
- ▶ Reference ◀ 2-1-8. Cleaning dust box of dust collector, Part 5, Maintenance  
2-1-10. Cleaning scrap box, Part 5, Maintenance

- (g) ► Hazard ◀ Titanium, aluminum and zinc dusts, and water
- Description ◀ When the dusts of titanium, aluminum, zinc, and their alloys collected in the machine, duct, and dust collector react with water, they produce high heat and hydrogen gas and may cause an explosion.
- Measure ◀ Daily cleaning is important in preventing such dusts from collecting in the machine, duct, and dust collector. Dedicate the machine to cutting one type of material. Or before or after laser cutting such a material, completely remove the generated dust so that it does not mix with the dust from laser cutting of the next material. Never pour water on a metal fire. Be sure to have a fire extinguisher installed for metal fires.
- Reference ◀ 2-1-8. Cleaning dust box of dust collector, Part 5, Maintenance  
2-1-10. Cleaning scrap box, Part 5, Maintenance
- (h) ► Hazard ◀ Dust and oxygen gas
- Description ◀ When dust and oxygen assist gas accumulate to high enough levels, they may cause a fire.
- Measure ◀ Constantly ventilate throughout the shop.
- (i) ► Hazard ◀ Highly reflective materials
- Description ◀ When a highly reflective material is cut, the reflected light may burn combustible materials in and around the machine. Especially, marking presents a higher fire risk.
- Measure ◀ Take care that the warning “BEAM REFLECTING LEVEL 1” does not occur.
- Reference ◀ Warning stop “EX2008 BEAM REFLECTING LEVEL 1”, AMNC-F Alarms
- (j) ► Hazard ◀ Cutting defects
- Description ◀ If you continue to operate the machine with a cutting defect, the reflected light may burn combustible materials in and around the machine.
- Measure ◀ Take full care not to continue to operate the machine with a cutting defect.
- (k) ► Hazard ◀ Filter of dust collector
- Description ◀ If you continue to use a dirty filter in the dust collector, it may eventually ignite and cause a fire.
- Measure ◀ Check the filter and periodically change it. Leave a record of what you have done. Check and change the filter of the dust collector on a scheduled basis.
- Reference ◀ 2-1-8. Cleaning dust box of dust collector, Part 5, Maintenance  
3-2. Checking dust collection filter, Part 5, Maintenance

### (3) Handling broken optical parts

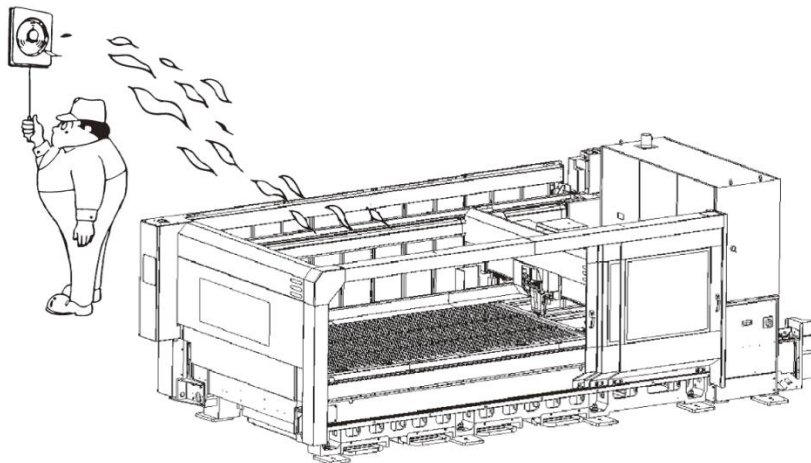
#### WARNING

- ▶ Hazard ◀ Focusing lens
- ▶ Description ◀ The focusing lens contains toxic zinc selenium. If absorbed into the body, zinc selenium may cause a fatal accident. If you inhale the dust of a broken lens, you may run a great risk.
- ▶ Measure ◀ If you have dropped or broken the lens, sweep up the broken pieces and discard them in a waste container while taking care not to get cut by sharp fragments. Use stab-proof gloves, a mask approved by the U.S. Occupational Safety and Health Administration, or a respiratory mask. Wear safety glasses (with protection against dust infiltration from the sides), or goggles. If the dust is scattered, remove it with a damp mop or cloth.

### (4) Precautions against toxic gases and dusts

#### WARNING

- (a) ▶ Hazard ◀ Dust and assist gas
- ▶ Description ◀ If dust and assist gas nitrogen or oxygen accumulate to high enough levels, they may do harm to you.
- ▶ Measure ◀ Constantly ventilate throughout the shop.
- ▶ Reference ◀



- (b) ▶ Hazard ◀ Polyvinyl chloride
- ▶ Description ◀ When laser cut, polyvinyl chloride produces toxic hydrogen chloride gas. Hydrogen chloride gas readily dissolves in water to give hydrochloric acid. This hydrochloric acid badly corrodes equipment.
- ▶ Measure ◀ Never laser cut polyvinyl chloride.

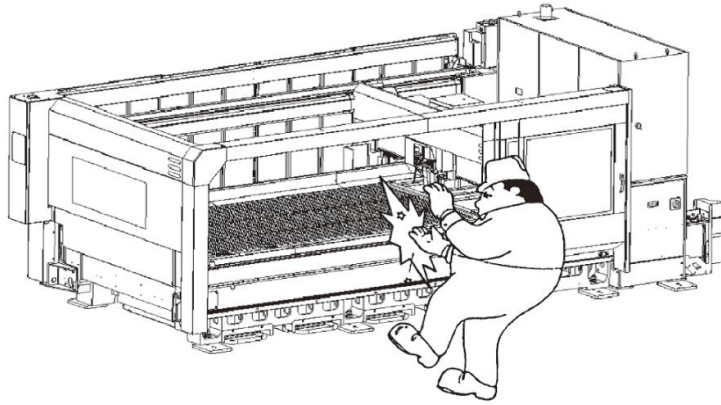
- (c) ▶ Hazard ◀ Nylon and polyurethane
  - ▶ Description ◀ When laser cut, nylon and polyurethane produce toxic hydrogen cyanide gas.
  - ▶ Measure ◀ Never laser cut nylon and polyurethane.
  
- (d) ▶ Hazard ◀ Plastics
  - ▶ Description ◀ When laser cut, plastics may produce carbon monoxide and other toxic gases.
  - ▶ Measure ◀ Do not laser cut plastics.
  
- (e) ▶ Hazard ◀ Materials whose safety is not verified
  - ▶ Description ◀ When laser cut, these materials may produce toxic substances, depending on their type.
  - ▶ Measure ◀ Before you laser cut special materials or materials you have not laser cut before, ask their manufacturers if they may produce toxic gas or dust and if they present a fire or explosion risk when laser cut.
  
- (f) ▶ Hazard ◀ Focusing lens
  - ▶ Description ◀ If you inhale the vapor produced by a burning lens, you may be at risk.
  - ▶ Measure ◀ If the lens has burnt, press the emergency stop button to turn off the laser beam. Escape from the place until the temperature drops low enough. When the vapor is not produced any more, open the windows to change all the air in the room. Take care not to inhale the vapor during this time. Discard the burnt lens in a sealable container while taking care not to touch it directly.

## (5) Precautions when working in moving range of machine



### **WARNING**

- ▶ Hazard ◀ Moving parts of machine
- ▶ Description ◀ You may get pinched in the moving parts of the machine.
- ▶ Measure ◀ Before you work in the moving range of the machine for loading worksheets or unloading parts or scrap, press the STOP button, and turn the SHUTTER keyswitch to OFF.



## (6) Precautions when working with another or more workers

### WARNING

- ▶ Hazard ◀ Materials and moving parts of machine
- ▶ Description ◀ If the operator improperly operates the machine while two or more workers are loading materials or unloading parts together, the workers may get pinched in the materials or moving parts of the machine.
- ▶ Measure ◀ The machine must be operated by a single person familiar with how to operate the machine. When you load materials or unload parts with another or more workers, check each other's safety while checking their working conditions.

## (7) Precautions with electronic medical devices

### CAUTION

- ▶ Hazard ◀ High-frequency power supply (CO<sub>2</sub> laser oscillator)
- ▶ Description ◀ If you wear a pacemaker, defibrillator, or other electronic medical device, your electronic medical device may be adversely affected by the magnetic radiation generated by the machine.
- ▶ Measure ◀ As soon as you feel ill or strange, leave the workplace.

## (8) Precautions when unloading parts

### CAUTION

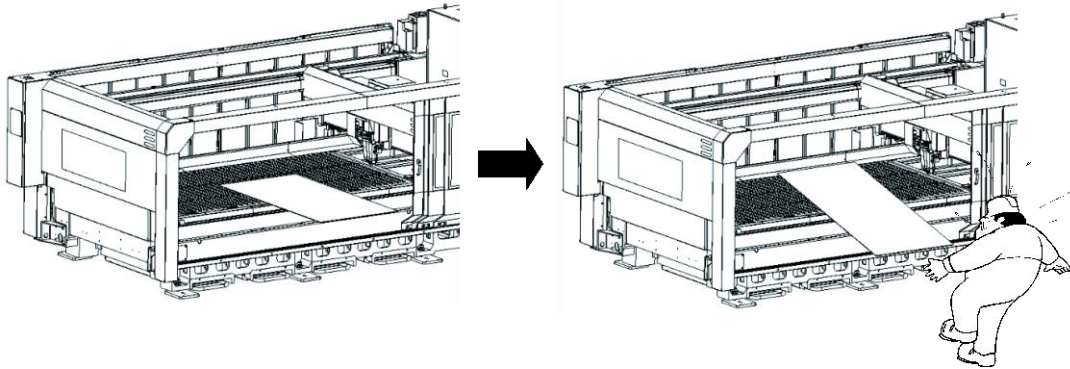
- ▶ Hazard ◀ Parts just after cutting
- ▶ Description ◀ If you touch to remove a part just after cutting, you may get burned by the residual heat of the part.
- ▶ Measure ◀ Wear leather gloves or take any other measure against burn injury.



## (9) Precautions when loading worksheets

### CAUTION

- ▶ Hazard ◀ Worksheets
- ▶ Description ◀ The worksheet may drop from the table and injure your hands or feet.
- ▶ Measure ◀ Load the worksheet on the table so that it does not project from the table.



## (10) Precautions when clamping worksheets

### CAUTION

- ▶ Hazard ◀ Workclamps
- ▶ Description ◀ You may get your fingers pinched in the workclamps.
- ▶ Measure ◀ When you clamp the worksheet, do not reach to the workclamps.

## (11) Procedure when you feel danger at occurrence of trouble

### WARNING

- ▶ Hazard ◀ Machine
- ▶ Description ◀ If you continue to operate the machine after occurrence of trouble, the machine may malfunction and pinch you, or the machine may cause a fire and do unexpected harm to you.
- ▶ Measure ◀ As soon as you feel danger at the occurrence of trouble during the operation of the machine, press the red EMERGENCY STOP button. When pressed, the button is locked and can stop the machine totally. It can also turn off the power to the oscillator and stop the laser oscillation. As soon as you press the button, report the incident to the laser safety officer.
- ▶ Reference ◀ 6. Keyswitch and EMERGENCY STOP button arrangement drawing described later  
3-3. NC control panel, Part 2, Controls

## 4-3. Maintenance

### (1) Precautions when checking and changing gas cylinder

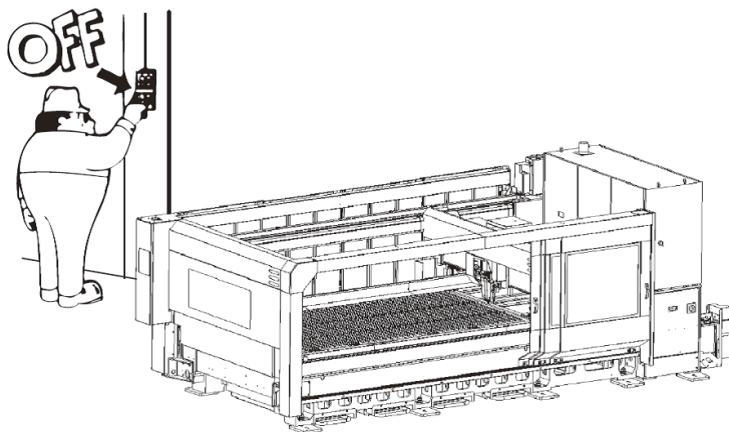
#### WARNING

- (a) ▶ Hazard ◀ Nitrogen gas
  - ▶ Description ◀ If the nitrogen assist gas cylinder is piped improperly, it may leak the nitrogen gas. If the shop is filled with the nitrogen gas, you may be adversely affected by it.
  - ▶ Measure ◀ After changing the nitrogen assist gas cylinder, adjust the nitrogen gas pressure after consulting your gas piping contractor or gas distributor.
  - ▶ Reference ◀ 2-1-5. Checking residual pressure of assist gas, Part 5, Maintenance
  
- (b) ▶ Hazard ◀ Oxygen gas
  - ▶ Description ◀ If the oxygen assist gas cylinder is piped improperly, it may leak the oxygen gas. If the oxygen gas fills the shop, it may do harm to you.
  - ▶ Measure ◀ After you change the oxygen assist gas cylinder, consult your gas piping contractor or gas distributor about how to adjust the oxygen gas pressure.
  - ▶ Reference ◀ 2-1-5. Checking residual pressure of assist gas, Part 5, Maintenance

### (2) Precautions when checking primary power wiring

#### WARNING

- ▶ Hazard ◀ Primary power wiring
- ▶ Description ◀ If you inadvertently touch a live part when checking the shop's primary power wiring, you may get an electric shock.
- ▶ Measure ◀ Before you check the primary power wiring, turn off the power and turn off the shop circuit breaker switch.



### (3) Precautions when cleaning workplace



#### WARNING

- ▶ Hazard ◀ Dust
- ▶ Description ◀ Dust may do harm to you when inhaled and may present a fire risk when accumulated.
- ▶ Measure ◀ Clean the workplace every day. Sweep the floor of the workplace once or more per month. Vacuum or damp-dust the floor to prevent the dust from flying in the air, or wear a dust mask. Never use compressed air in the room to blow off dust from jigs and other objects.

### (4) Precautions when cleaning dust box of dust collector



#### WARNING

- ▶ Hazard ◀ Dust
- ▶ Description ◀ When you clean the dust box of the dust collector, you may inhale the dust. When inhaled, the dust may do harm to you.
- ▶ Measure ◀ When you clean the dust box of the dust collector, wear a dust mask so that you do not inhale the dust. Wear long-sleeved clothing or rubber gloves to prevent your skin from direct contact with the dust. After the cleaning task, use a suction brush to remove the dust from your clothing so that the dust does not fly in the air. Or shake the dust off the clothing in outdoors.
- ▶ Reference ◀ 2-1-8. Cleaning dust box of dust collector, Part 5, Maintenance

### (5) Precautions when checking and changing filter of dust collector



#### WARNING

- ▶ Hazard ◀ Dust
- ▶ Description ◀ When you check or change the filter of the dust collector, you may inhale the dust. When inhaled, the dust may do harm to you.
- ▶ Measure ◀ When you check or change the filter of the dust collector, wear a dust mask so that you do not inhale the dust. Wear long-sleeved clothing or rubber gloves to prevent your skin from direct contact with the dust. After the cleaning task, use a suction brush to remove the dust from your clothing so that the dust does not fly in the air. Or shake the dust off the clothing in outdoors.
- ▶ Reference ◀ 10-1. Changing dust collection filter, Part 5, Maintenance

## (6) Precautions when cleaning scrap box



### WARNING

- ▶ Hazard ◀ Scrap box
- ▶ Description ◀ If you lift the scrap box by force when you clean the scrap box of scrap and dust, you may hurt your back.
- ▶ Measure ◀ Do not lift the scrap box by force. Remove the scrap from the scrap box and dispose of it.
- ▶ Reference ◀ 2-1-10. Cleaning scrap box, Part 5, Maintenance

## (7) Precautions when checking and changing nozzle



### CAUTION

- ▶ Hazard ◀ Nozzle
- ▶ Description ◀ You may get your fingers hurt by a damaged nozzle.
- ▶ Measure ◀ Wear leather gloves or any other protective device to handle such a nozzle.

## (8) Precautions when checking and cleaning air heat exchanger of cooling unit



### CAUTION

- ▶ Hazard ◀ Cooling fins and fans of cooling unit
- ▶ Description ◀ If you touch the cooling fins or fan when you clean the air heat exchanger of the cooling unit, you may get burned.
- ▶ Measure ◀ Before you check or clean the cooling fins and fan, be sure to turn off the main power and wait 10 min or more.

## (9) Precautions when adding shot agent to shot tank



### CAUTION

- ▶ Hazard ◀ Oil shot and shot agent
- ▶ Description ◀ When you add the shot agent to the shot tank, you may get the shot agent in your eyes and may get your eyes reddened or stung by the shot agent.
- ▶ Measure ◀ If the shot agent gets in your eyes, carefully wash the eyes 15 min or more. If you wear contact lenses and can easily remove them, remove them and continue to wash the eyes. If the eye irritation persists, seek medical help at once.
- ▶ Reference ◀ Material Safety Data Sheet, Oil shot No. 9 B-15 SATO SPECIAL OIL CO., LTD.

## (10) Precautions when maintaining and adjusting machine

### WARNING

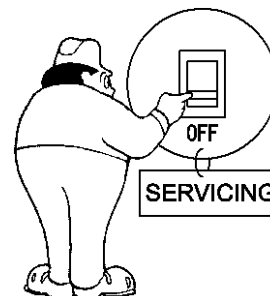
- (a) ▶ Hazard ◀ Machine
- ▶ Description ◀ Another worker may inadvertently turn on the power to machine to start the machine.



- ▶ Measure ◀ When you maintain or adjust the machine with the machine circuit breaker switch set to OFF, lock out the machine circuit breaker switch by padlocking it as shown above, for example.

- (b) ▶ Hazard ◀ Machine
- ▶ Description ◀ Another worker may inadvertently turn on the compressed air to the machine to start the machine.
- ▶ Measure ◀ When you maintain or adjust the machine with the air valve (residual pressure relief valve) set to EXH., lock out the air valve by padlocking it, for example.

- (c) ▶ Hazard ◀ Machine
- ▶ Description ◀ When you are maintaining or adjusting the machine, another worker may inadvertently operate the machine without noticing that you are doing so.



- ▶ Measure ◀ Before you maintain or adjust the machine, tag out the machine circuit breaker switch to inform other workers that you are working on the machine.
- Especially when working in the hazardous area of the machine, turn the machine circuit breaker switch to OFF and padlock it in the OFF state.

## (11) Precautions when cleaning mirrors in machine and adjusting alignment of mirrors

### WARNING

- ▶ Hazard ◀ Laser beam
- ▶ Description ◀ If you improperly work with the mirrors in the machine, you may get burned.
- ▶ Measure ◀ Be sure to ask Amada to do this work.

## (12) Precautions against high voltage



### WARNING

- ▶ Hazard ◀ High-voltage parts (CO<sub>2</sub> gas laser oscillator)
- ▶ Description ◀ A high voltage of 10000 V is used in some parts of the oscillator. If you open the door of the oscillator and touch such a high-voltage part while the power is turned on to the oscillator or just after the power is turned off to the oscillator, you may get killed.  
Capacitors and some other parts in the oscillator may be still charged when the high-voltage power is already turned off to the oscillator.
- ▶ Measure ◀ Never open the housing of the oscillator. If any trouble occurs in the oscillator, contact Amada.

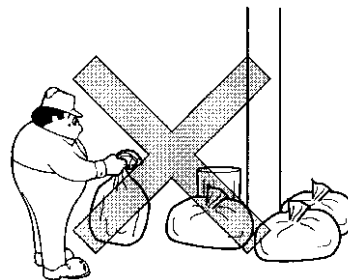
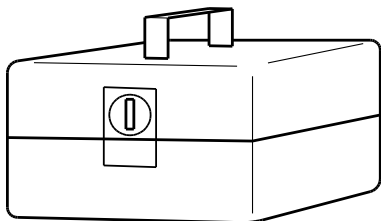
## 4-4. Disposal

### (1) Handling optical parts for disposal



### WARNING

- ▶ Hazard ◀ Focusing lens
- ▶ Description ◀ The lens contains toxic zinc selenide (ZnSe). If the used lens is disposed of improperly, it may cause a fatal accident. Inhalation of the dust from a broken lens may present a particularly serious health risk.
- ▶ Measure ◀ Until you dispose of the used or broken lens, strictly store and manage it out of reach of unauthorized people (particularly infants and children).  
Ask a licensed contractor or Amada to dispose of the lens according to a specified procedure.  
Never dispose of the lens like household waste.



## (2) Precautions when disposing of recovered dust



### WARNING

- ▶ Hazard ◀ Dust
- ▶ Description ◀ When inhaled, the dust may do harm to you.
- ▶ Measure ◀ Seal the recovered dust in a can or bag so that it does not fly in the air. Dispose of it as industrial waste. Do not dispose of it like household waste.

## (3) Precautions when disposing of refrigerant in cooling unit



### WARNING

- ▶ Hazard ◀ CFC substitute
- ▶ Description ◀ If you get your skin in direct contact with the liquefied CFC substitute, you may get frostbite. If the CFC substitute gets in contact with a fire or hot metal, it may produce a toxic gas. If the CFC substitute is released into the atmosphere, it may cause ozone layer destruction and global warming.
- ▶ Measure ◀ When you want to have the CFC substitute drained or added when you dispose of or repair the cooling unit, ask a specialized contractor to do so as specified in the country or region of use.

## 5. Warning labels

Keep the warning labels well noticeable and never remove them.

If any warning label affixed on the machine is damaged or lost, immediately request AMADA for a new one and attach it to the same position.



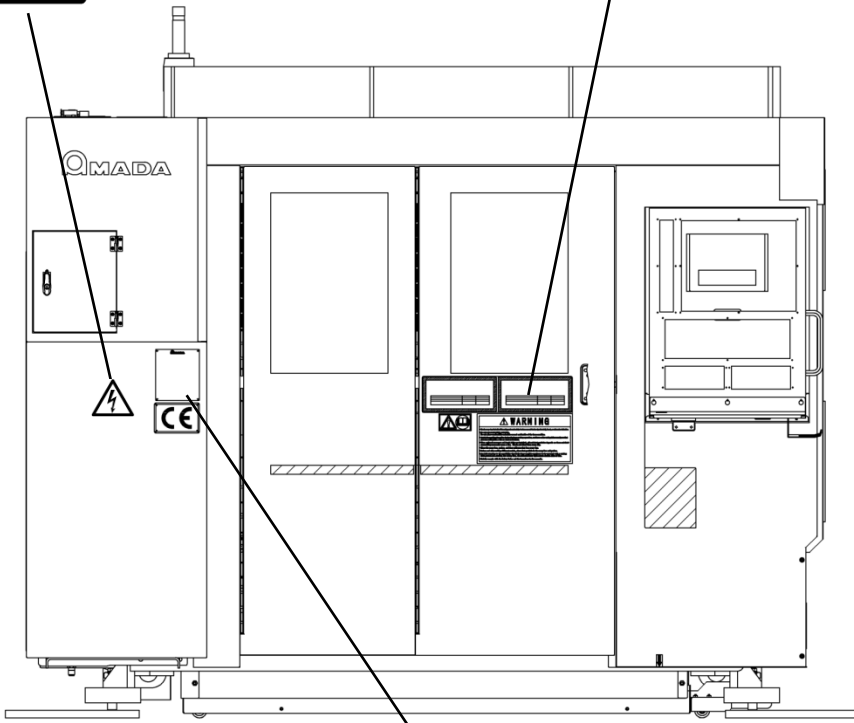


# 5-1. Warning labels arrangement drawing

<b>- INVISIBLE AND VISIBLE LASER RADIATION -</b> <b>- RAYONNEMENT LASER INVISIBLE ET VISIBLE -</b> <b>CLASS 1 LASER PRODUCT / MACHINE LASER CLASSE 1</b>		<b>- SICHTBARE UND UNSICHTBARE LASERTRABLUNG -</b> <b>- RADIAZIONE LASER INVISIBLE E VISIBILE -</b> <b>LASER-MASCHINE KLASSE 1 / MACCHINA LASER CLASSE 1</b>	
<small>IEC 60825-1:2007</small> <small>INVISIBLE</small> <small>VISIBLE</small>		<small>IEC 60825-1:2007</small> <small>UNSICHTBAR / INVISIBLE</small> <small>SICHTBAR / VISIBILE</small>	
PULSE DURATION / DURÉE IMPULSION	100% - CW	100% - CW	100% - CW
EMITTED WAVELENGTH / LONGUEUR D'ONDE ÉMISE	10.6 μm	10.6 μm	10.6 μm
LASER MEDIUM / COMPOSITION GAZ LASER	CO <sub>2</sub> /N <sub>2</sub> /He = 90/10/1%	CO <sub>2</sub> /N <sub>2</sub> /He = 90/10/1%	CO <sub>2</sub> /N <sub>2</sub> /He = 90/10/1%
	HALBLEITER o. HeHe	HALBLEITER o. HeHe	HALBLEITER o. HeHe

**⚠ WARNING**

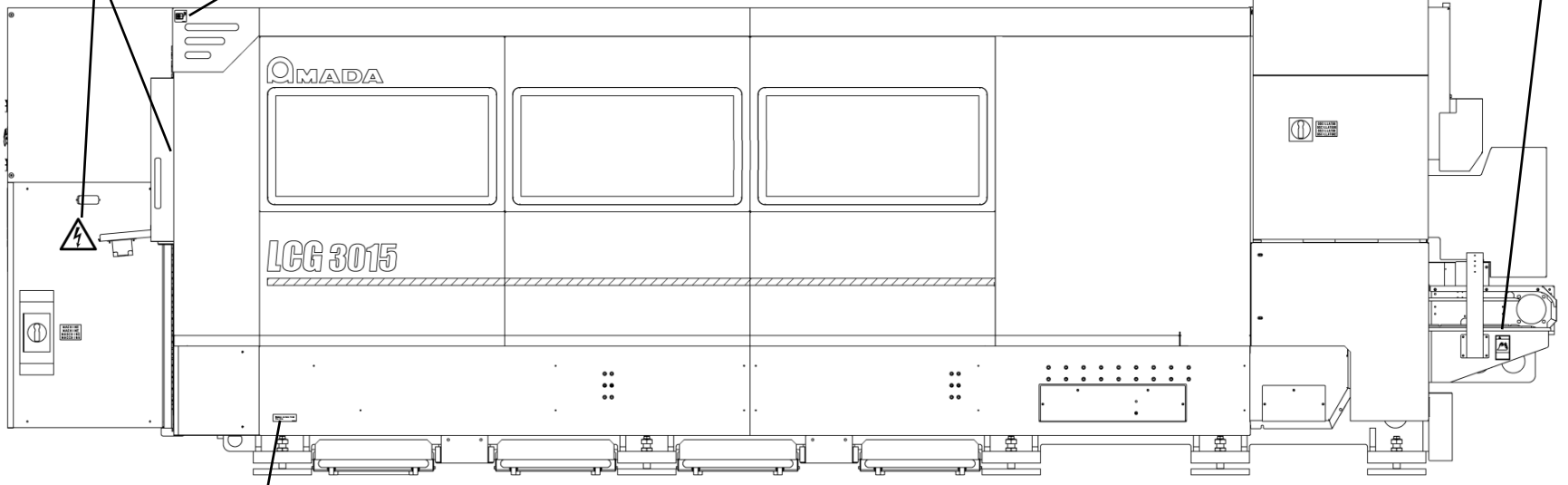
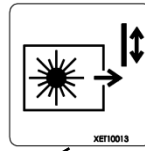
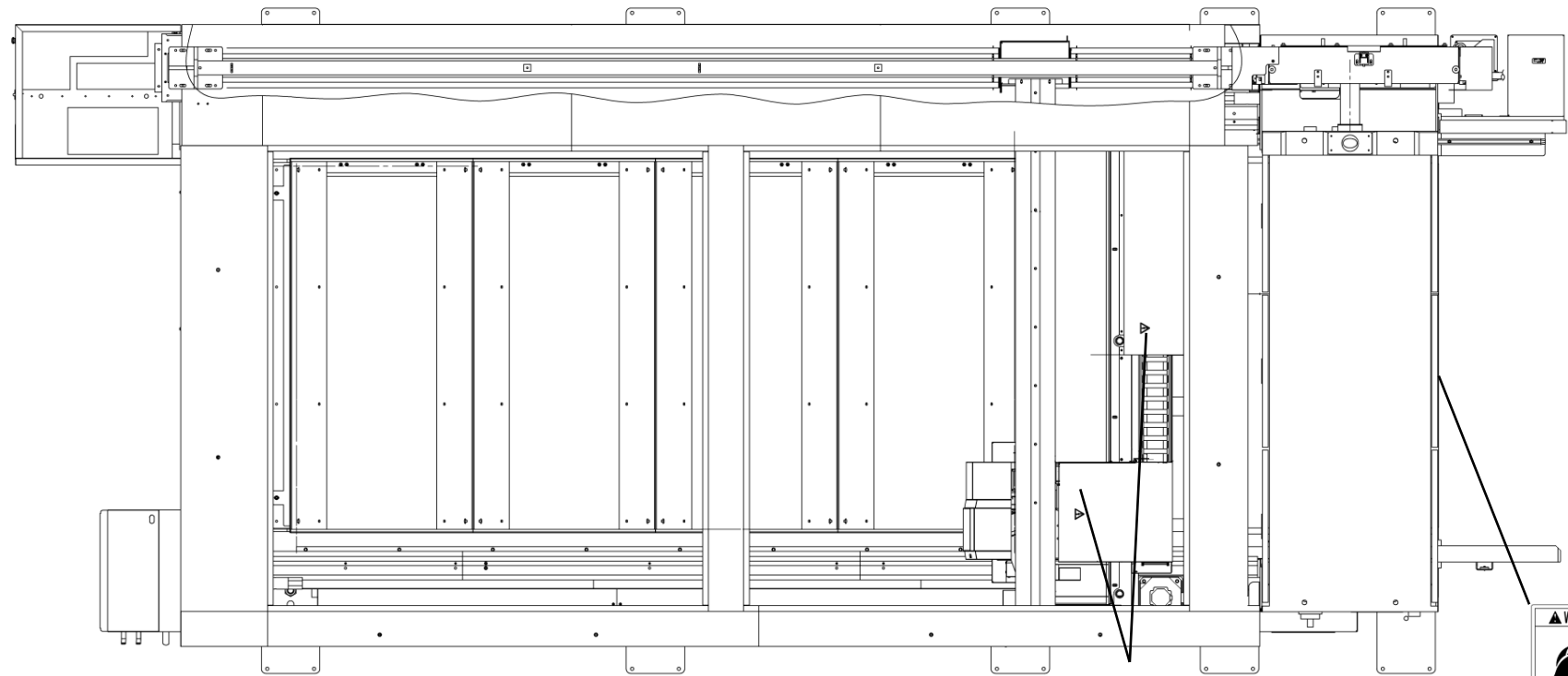
Check every day that all of the safeguards and safety devices are not broken (perforated), burnt, or otherwise defective.  
 Do not cut combustible materials.  
 Do not place combustible materials around and inside of the laser machine.  
 Watch the machine for a fire during the laser cutting operation, and have a fire extinguisher nearby so that you can extinguish a fire as soon as it starts.  
 When optional conveyor and brush table are installed, oil and dust particles deposits on them and their surrounding areas may cause a fire. Check and clean them every day.  
 Clean the scrap box, prebox, and dust collector dust box every day.  
 Before and after cutting different metals, clean dust particle in the scrap box and prebox.  
 Pay full attention to the possibility that if the laser machine continues to be operated with a cutting fault present and marking for a long time, the reflected laser light causes similar risks of fire.  
 Strictly comply with the Safety Rules and the hazardous in the manuals.



**AMADA**  
AMADA CO., LTD

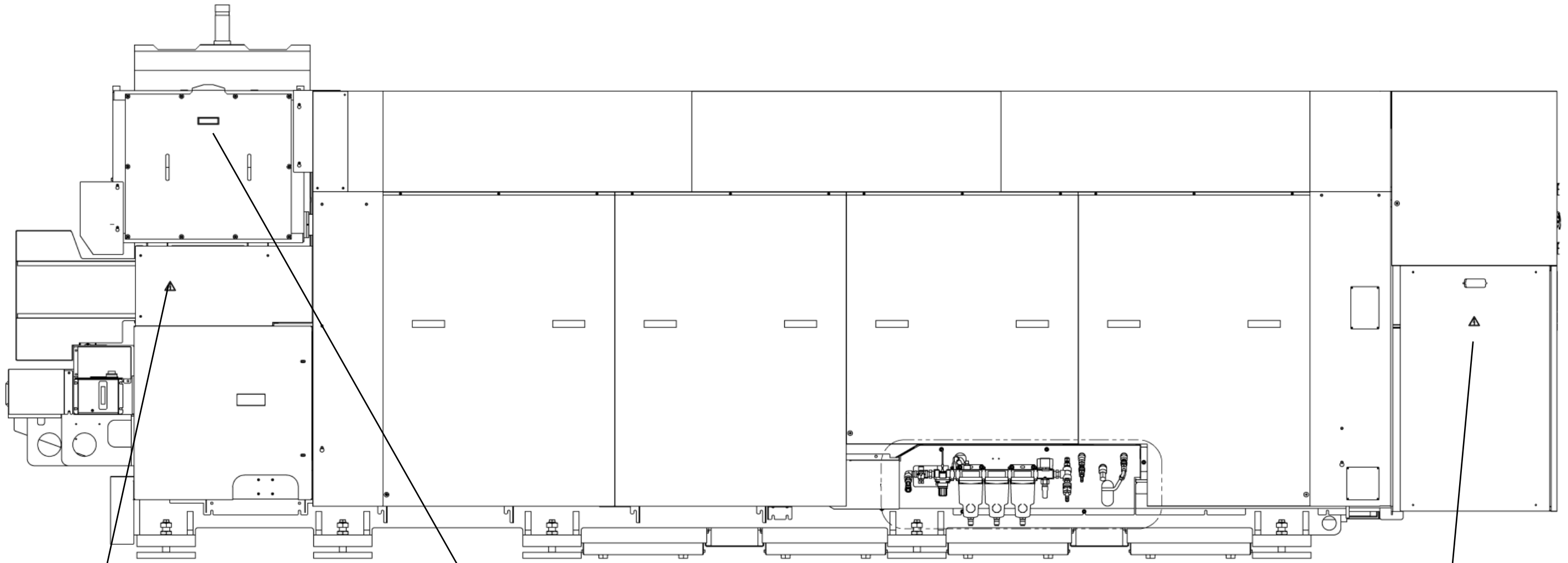
Model Name: \_\_\_\_\_ Country: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_  
 Date of Issue: \_\_\_\_\_  
 Date of Revision: \_\_\_\_\_  
 Drawing No.: \_\_\_\_\_  
 Revision No.: \_\_\_\_\_  
 Date of Issue: \_\_\_\_\_  
 Date of Revision: \_\_\_\_\_

AMADA Europe S.A.  
 88 Avenue de la République  
 F-8200 TREMBLAY EN FRANCE  
 ASSEMBLY IN FRANCE

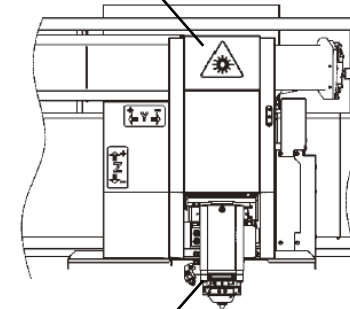
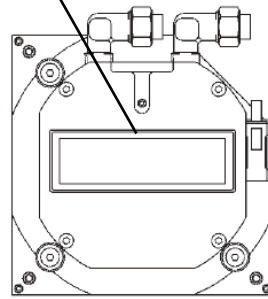


**Remove garbage from the scraps box**

XET10005



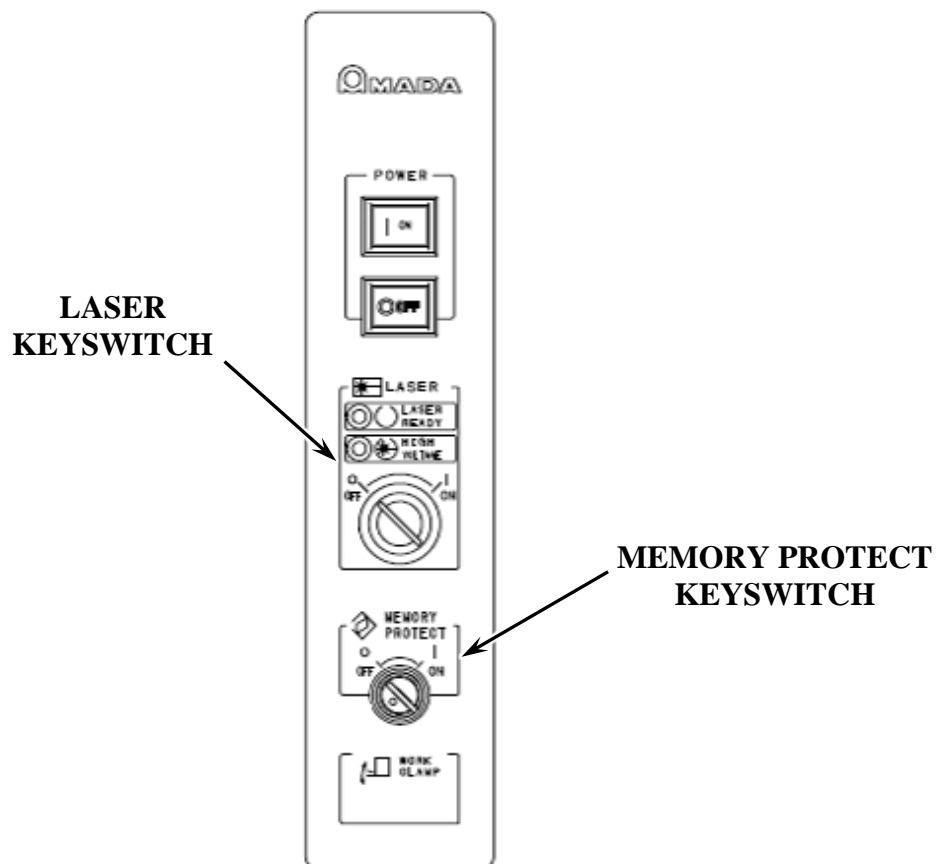
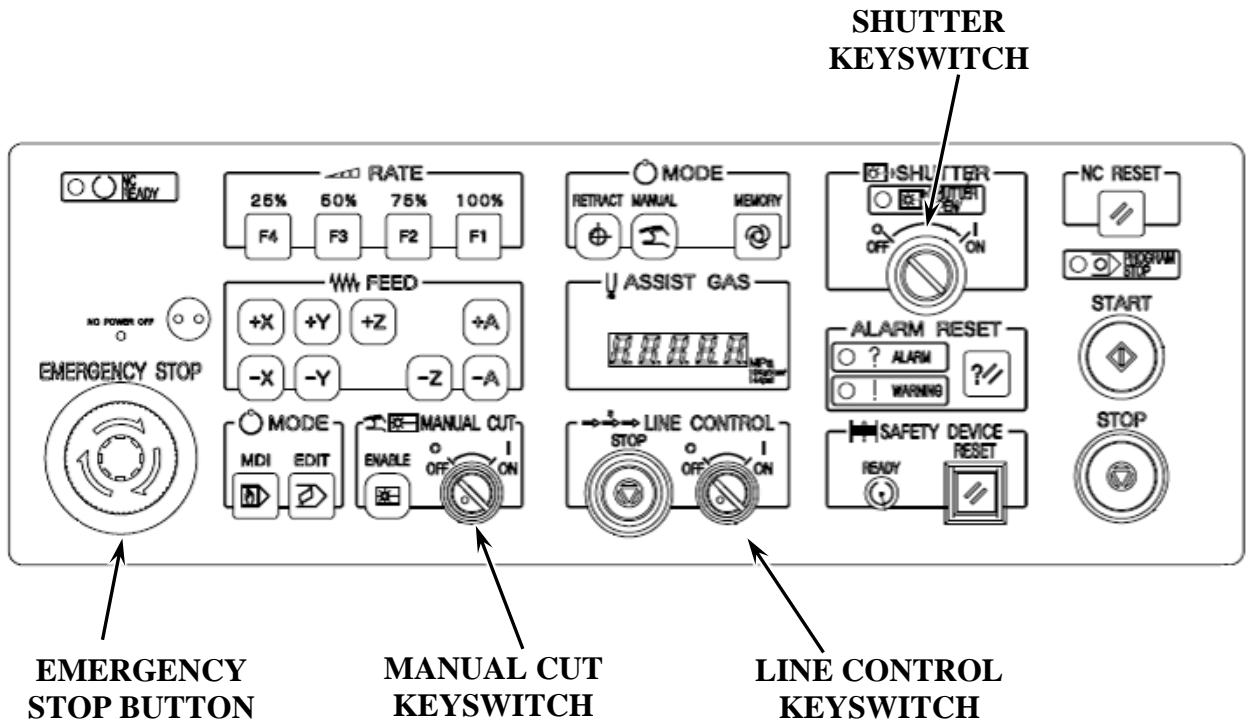
CAUTION - LASER RADIATION WHEN OPEN  
AND INTERLOCKS DEFEATED.  
AVOID EYE OR SKIN EXPOSURE  
TO DIRECT OR SCATTERED  
RADIATION. XET10006



AVOID EXPOSURE - XET10014  
VISIBLE AND/OR INVISIBLE LASER RADIATION  
IS EMITTED FROM THIS APERTURE.

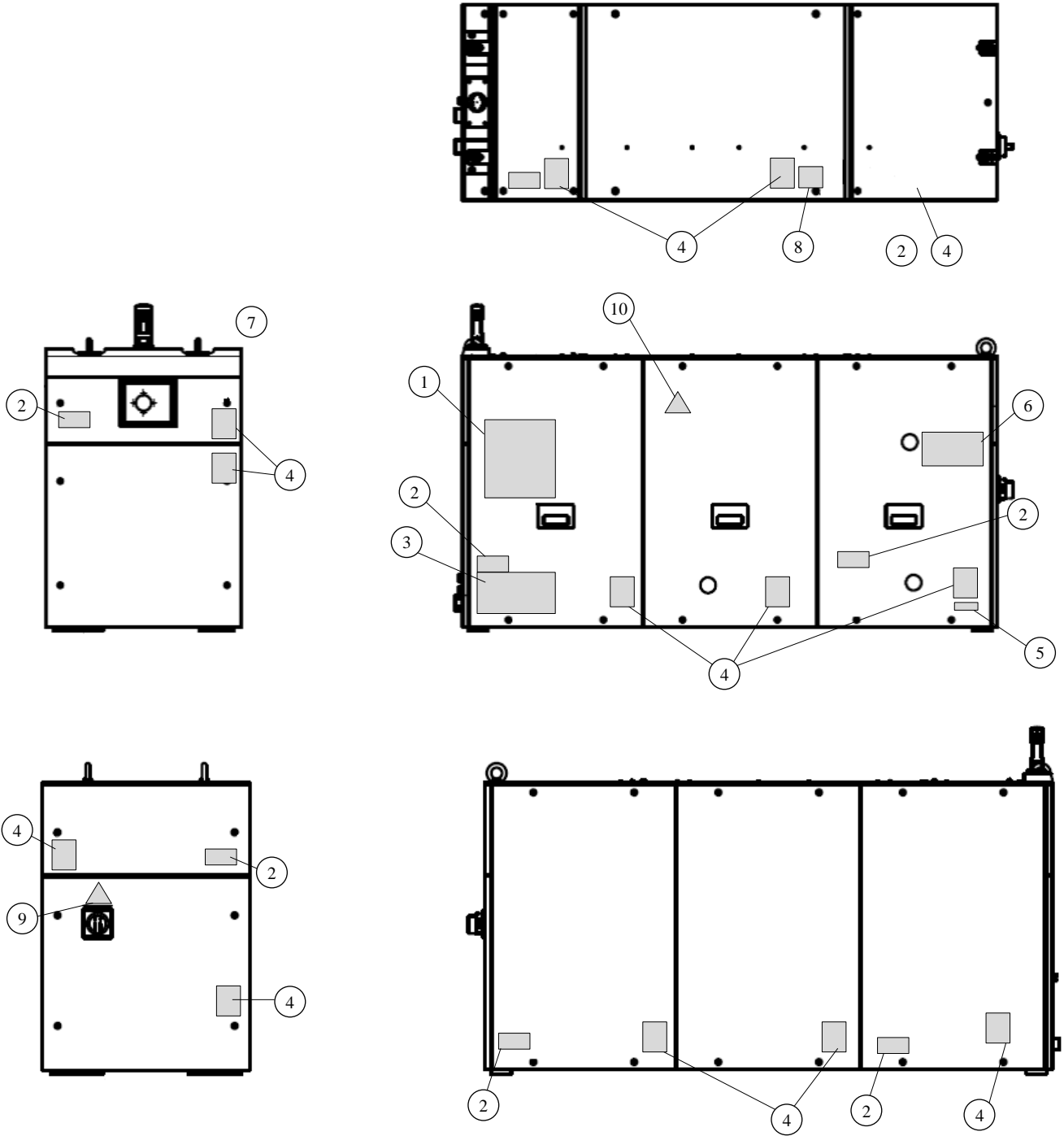


## 6. Keyswitch and EMERGENCY STOP button arrangement drawing

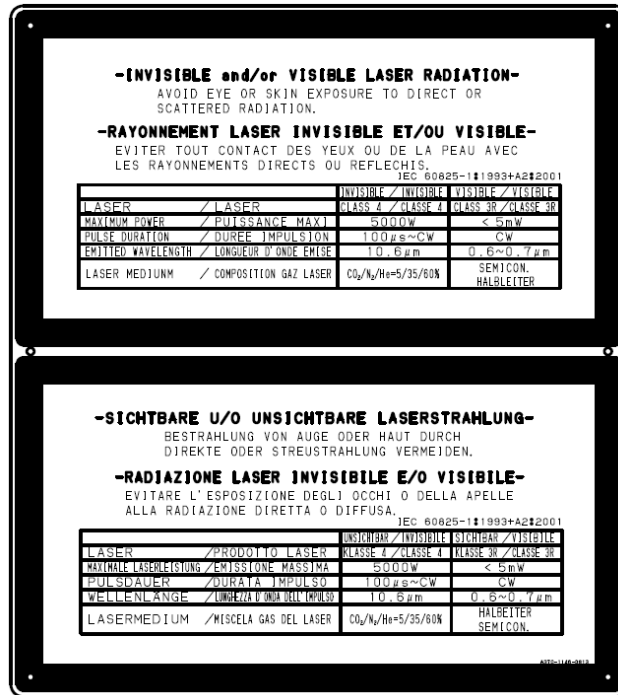


## 7. Warning label fanuc oscillator

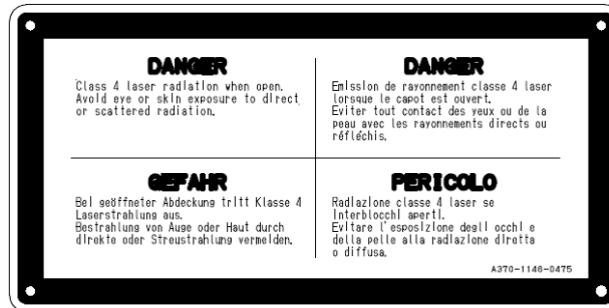
The oscillator uses high voltages and laser beam radiation. Such hazards are indicated with warning labels attached to the positions. In addition, there are some stickers for the explanation. This section describes the warning labels, stickers and their positions.



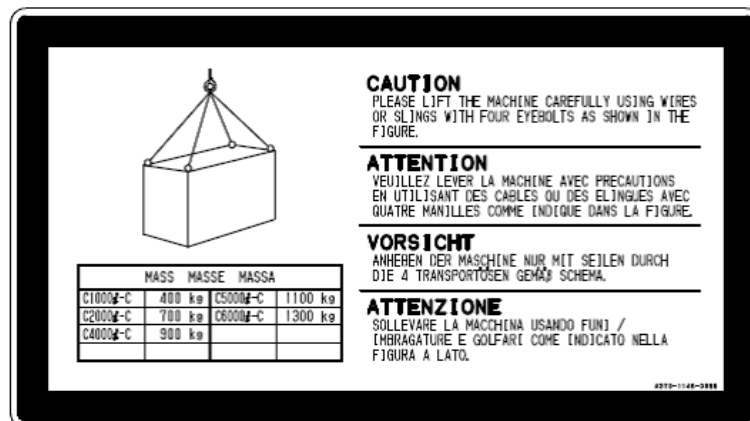
① Class identification label



② Access label



③ Lifting method label



④ Access label

Do not operate  
when the  
cover is open

---

Ne pas utiliser  
la machine  
avec capot ouvert

---

Nicht mit geöffneter  
Abdeckung arbeiten

---

Non utilizzare  
la macchina  
con carter aperto

⑤ Certification label

**—CERTIFICATION LABEL—**

• This laser product complies  
with 21 CFR 1040.10 and 1040.11.

A370-1146-0060

⑥ Label for regulating the atmospheric gasses in the oscillator housing

<p><b>CAUTION</b></p> <p>Do not allow a dangerous gas or a high-pressure gas to enter the laser oscillator housing. Highly concentrated oxygen or flammable gas can cause a fire or an explosion.</p>	<p><b>ATTENTION</b></p> <p>Ne laissez entrer aucun gaz dangereux ou gaz sous haute-pression dans le caisson de l'oscillateur laser. L'oxygène hautement concentré au gaz inflammables peut provoquer un incendie ou une explosion.</p>
<p><b>ACHTUNG</b></p> <p>Keine gefährlichen Gase oder unter Druck stehende Gase in das Laser Oszillatorgehäuse eindringen lassen. Hochkonzentrierter Sauerstoff oder brennbare Gase Können zu Feuerentwicklung oder Explosionen führen.</p>	<p><b>ATTENZIONE</b></p> <p>Evitare che un gas pericoloso o ad alta pressione penetri all'interno dell'oscillatore laser. Un alta concentrazione di ossigeno o di gas infiammabile, può provocare un incendio o un'esplosione.</p>

A370-1146-0464

⑦ Aperture label

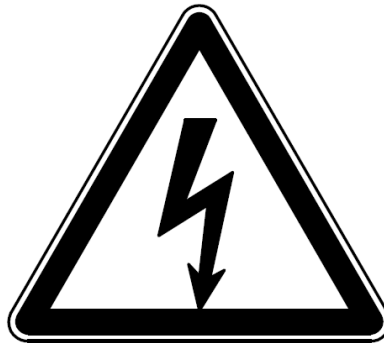
<p><b>AVOID EXPOSURE</b></p> <p>INVISIBLE AND/OR VISIBLE LASER RADIATION IS EMITTED FROM THIS APERTURE.</p>	<p><b>EXPOSITION DANGEREUSE</b></p> <p>UN RAYONNEMENT LASER INVISIBLE ET/OU VISIBLE EST EMIS PAR CETTE OUVERTURE.</p>
<p><b>BESTRHLUNG VERMEIDEN</b></p> <p>AUSTRITT VON SICHTBARER UND/ODER UNSICHTBARER LASERSTRAHLUNG.</p>	<p><b>EVITARE L'ESPOSIZIONE ALLA RADIAZIONE</b></p> <p>LASER VISIBILE E/O INVISIBILI EMESSA DA QUESTA APERTURA.</p>

A370-1146-0144

⑧ Ascent/Descent prohibited label



⑨ Discharge section label



⑩ Laser mark







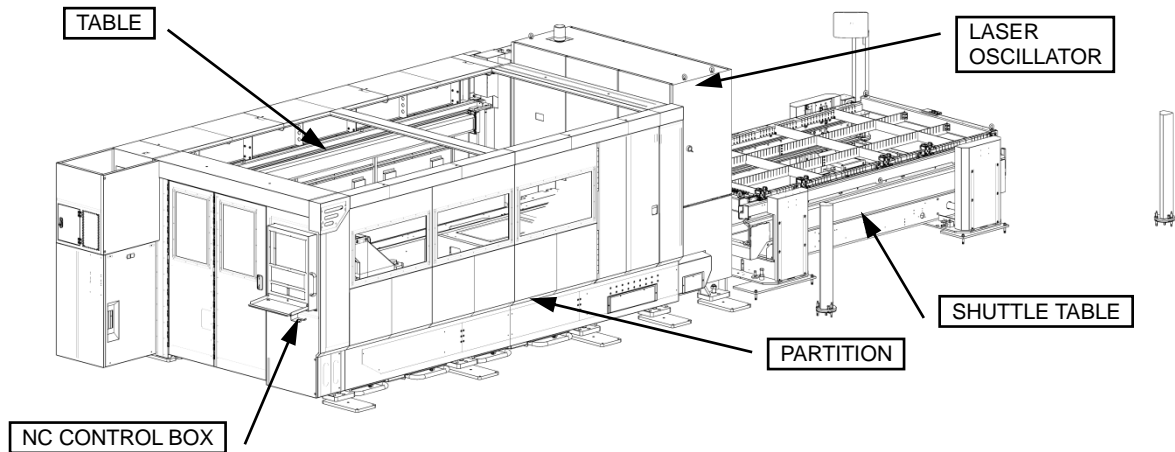
# Part 1

## Description

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# 1. Description

## 1-1. General view



## 1-2. Machine

### 1-2-1. Frame (X-axis)

The table, carriage (X-axis), and laser oscillator are installed on the frame. Racks are installed on both sides of the frame to move the carriage driven along the X-axis.

### 1-2-2. Table

Skids are installed to the table to support a worksheet.

### 1-2-3. Manual X-gauge block

The manual X-gauge block is a pin that serves as origin for clamping a worksheet. The worksheet is manually pushed against the manual X-gauge block to position it.

### 1-2-4. Workclamps

The LCG shuttle table (LST) is equipped with four workclamps.

Depending on the specifications of the machine, there is the manual clamp and the pneumatic clamp (option).

The manual clamp involves using each clamp handle to open and close the workclamps (clamping and unclamping the worksheet).

Operations for opening and closing the workclamps (clamping and unclamping the worksheet) on the machine can be performed by pressing the shuttle clamp open button or the foot switch. The maximum opening width of the workclamps is 40 mm {1.57 in.} for the pneumatic clamp.

### 1-2-5. Partitions

The machine is provided with the partitions. You can open and close the sliding doors of the partitions by hand.

- Front partitions (three fixed panels and one door)
- Rear partitions (fixed panels)
- Side partition (folding door)
- Top partitions (sliding roofs)

## 1-3. Carriage

### 1-3-1. Carriage (X-axis)

The carriage is driven along the X-axis by the AC servo motors installed to the carriage. The carriage has the laser head (Y-, Z-, and B-axes) installed.

### 1-3-2. Laser head (Y-, Z-, and B-axes)

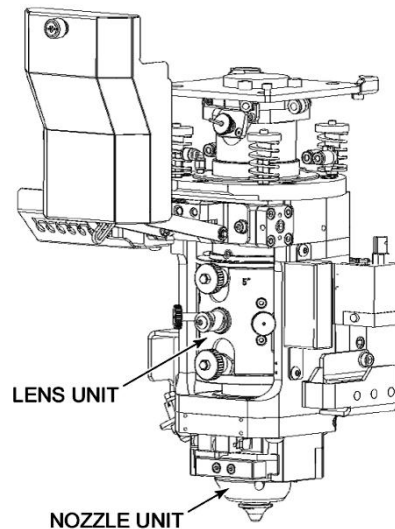
The laser head consists of a laser head collision detector, a lens unit, and a nozzle unit.

The laser beam emitted from the laser oscillator is focused by the lens of the laser head onto the worksheet on the table. The energy of the laser beam thus concentrated is used to cut the worksheet.

The nozzle ejects the focused laser beam and the assist gas that increases the laser cutting efficiency and protects the lens during the cutting operation.

The laser head is moved above the table by the carriage. It is vertically driven along the Z-axis.

The B-axis vertically drives the lens unit to adjust the focal point.



#### 1) Nozzle unit

The nozzle unit consists of a nozzle and a nozzle holder.

##### NOTICE

- Do not use lens with a focal length of 5" or less in the D-type nozzle. The interference of the laser beam in the nozzle may damage the nozzle.

#### [1] Nozzle

The nozzle emits the laser beam and assist gas.

The nozzle is available in S  $\phi$ 0.8E, S  $\phi$ 1.0E, S  $\phi$ 1.2E, S  $\phi$ 1.5, S  $\phi$ 2.0, S  $\phi$ 3.0, D  $\phi$ 1.4E, D  $\phi$ 2.5, D  $\phi$ 4.0, D  $\phi$ 4.0C, D  $\phi$ 7.0C. Use a nozzle that suits your job by referring to the processing condition file.

## **[2] Nozzle holder**

The nozzle is installed in the nozzle holder. The nozzle holder is slidable and simple to install and remove. The nozzle holder doubles as Z-axis tracking sensor. When the laser head strikes the worksheet or a workclamp, the nozzle holder may be damaged. If damaged, it can be changed.

## **2) Lens unit**

The lens is installed in the lens unit. The lens unit is also used to adjust the center of the laser beam at the cutting position of the worksheet.

### **REFERENCE**

- For the adjusting procedure, refer to “2-8. Centering nozzle” in Part 3.

## **[1] Lens**

The lens focuses the laser beam onto the worksheet on the table.

The lens is available with a focal length of 5” or 7.5” (option). Use a lens that suits your job by referring to the processing condition file.

## **[2] Lens holder**

The lens holder is fitted with a centering mechanism.

The lens holder is available with a focal length of 5” or 7.5” (option).

## **3) Laser head collision detector**

This basic part is located where the laser head is installed along the Z-axis. It is equipped with a protection mechanism for preventing damage to the laser head and machine when the laser head (nozzle unit) is subjected to an external force.

## **1-3-3. Bend mirrors**

The laser beam released from the laser oscillator is changed in direction by six bend mirrors before it leaves the laser head.

The angle of each bend mirror can be adjusted with screws, except for the bend mirror 1. From the one above the laser head, the bend mirrors are numbered or called 1, A/O, 2, 3, 4, and 5.

## **1-4. NC unit**

The NC unit controls the drive of the axes, motion of the respective components, and operation of the laser oscillator and cooling unit. These controls are divided into the NC unit and NC control box. The NC unit is installed in the lower left of the rear of the machine. The NC control box is in a fixed position so that the operation surface is facing to the left at the front of the left side of the machine.

## **1-5. Laser oscillator**

The laser oscillator is installed on the machine.

The laser oscillator produces a CO<sub>2</sub> invisible laser beam by using a mixture of carbon dioxide, nitrogen, and helium as laser gas.

The laser beam output conditions are determined according to worksheet material type and thickness, cutting rate and the like and are controlled by the NC unit.

A red visible laser beam (semiconductor laser beam) can also be emitted. It is used to verify the cutting position of the worksheet before actually cutting the worksheet with the CO<sub>2</sub> invisible laser beam.

## **1-6. Cooling unit**

The cooling unit is installed separate from the machine.

The cooling unit circulates cooling water through mirrors of the laser oscillator and machine, so that the laser oscillator can produce a stable CO<sub>2</sub> laser beam and the machine can be operated stable.

Run the cooling water through a deionizer before its use.

For the detailed operation and maintenance of the cooling unit, refer to its operator's manual.

## **1-7. Dust collector (option)**

The dust collector is installed separate from the machine.

A dust collection opening is provided in the frame to remove the generated dust. The dust is collected in the filter of the dust collector.

For the detailed operation and maintenance of the dust collector, refer to its operator's manual.

## **1-8. Shuttle table**

The shuttle table is installed on the left side of the machine.

The table of the machine is of the pallet type. The shuttle table has two pallets and shuttles the pallets to the machine. The shuttle table is adjusted to the same pass line as the table of the machine, so that it can exchange a pallet with the table of the machine.

For the detailed operation and maintenance of the shuttle table, refer to its operator's manual.

## **1-9. AS unit (option)**

The AS unit is installed alongside the machine. It stores two or more pallets in its shelves and automatically exchanges the pallets with the machine.

## **2. Safety functions**

The machine has functions that are designed to safeguard the operator as well as the machine itself as described below.

## 2-1. Operator safety

### **Automatic power shutdown:**

The NC unit and the laser oscillator will be shut down automatically if an overcurrent is supplied. While supplying the high voltage to the laser oscillator, opening a door of the laser oscillator circuit breaker will stop the supply of the high voltage.

### **Interlocks:**

The machine cannot start its automatic operation when the interlocks are actuated or the workclamps are open. The machine will stop as soon as it encounters either of the states mentioned above during its automatic operation.

### **STOP and EMERGENCY STOP buttons:**

The machine cannot start its automatic operation when one of the STOP or EMERGENCY STOP buttons is left in the pressed state. The machine will stop its automatic operation as soon as one of the buttons is pressed.

## 2-2. Machine safety

### **Laser head protection:**

The laser head will collapse at its joint if it hits the worksheet, etc., and the machine will stop.

### **Servosystem protection:**

The machine will stop if a servo motor is overloaded or an irregularity has been caused in the servo system.

### **Overtravel detection:**

The machine will stop if the laser head has overtraveled.

### **Low air pressure detection:**

The machine will stop if the operating air pressure has gone down below the required pressure.

### **Low laser gas pressure detection:**

The machine will stop if the laser gas pressure has gone down below the required pressure.

### **Low assist gas pressure detection:**

The machine will stop if the assist gas pressure has gone down below the required pressure.

### **Reduced cooling water flow detection:**

The machine will stop if the cooling water flow has been reduced below the required flow.

### **Program precheck:**

The program can be checked for syntax errors and overtravels without running the machine — prior to its execution for actual cutting. (This function is enabled or disabled by the PROGRAM CHECK button on the touch screen.)

**Dead zone detection function:**

To prevent the laser head from striking a workclamp, the machine stops operating as soon as during automatic operation the laser head enters the dead zone where it is likely to strike a workclamp. This function is disabled when the DEAD ZONE CANCEL button is illuminated on the touch screen.

The dead zone is as follows:

X-axis = none, Y-axis = 40 mm {1.57 in.}

**Workclamp interference area deceleration function:**

To reduce the speed at which the laser head may strike a workclamp, the laser head is decelerated as it enters the deceleration area during automatic rapid feed or manual feed. This function is disabled when the CLAMP DECELERATION OFF button is illuminated on the touch screen.

**Low purge pressure detection:**

The machine will stop as soon as the purge pressure falls below the specified level.

**Dead zone detection function:**

When the DEAD ZONE CANCEL button on the touch screen is extinguished, the machine will stop its automatic operation as soon as the laser head enters the dead zone where the laser head may strike one of the workclamps.

**Aperture overheat detection:**

The machine will stop as soon as the aperture temperature rises above the specified level.

**Lens damage detection:**

The machine will stop as soon as smoke is detected from the burning lens.

**Dust collection filter damage detection (option):**

The machine and the dust collector will stop as soon as heat is detected from the burning dust collection filter.

The dust collector has a device that supplies nitrogen gas and prevents the fire from spreading. Connect a nitrogen cylinder with the nitrogen inlet of the machine.

### 3. Specifications

#### 3-1. Configuration

The machine is composed of the units shown in the table below.

Unit	Model	Qty
Machine	LCG3015	1
Laser oscillator	AF3500i-C (FANUC)	1
Cooling unit	—	1
NC unit	AMNC-F (FS31i-LB)	1
Dust collector	—	1 (option)
Accessories	—	1 set

#### 3-2. Environment

Item		Operating	Storage/transportation
Ambient temperature		5 to 35°C {41 to 95°F}	-20 to 60°C {-4 to 140°F}
Maximum relative humidity	Normal	75%, non-condensing	
	Short term (within 1 month)	95%, non-condensing	
Allowable vibration level	Acceleration	0.49 m/s <sup>2</sup> {1.61 ft/s <sup>2</sup> }	9.8 m/s <sup>2</sup> {32.15 ft/s <sup>2</sup> }
	Amplitude	5 μm	—
Allowable altitude		1000 m {3281 ft}	12000 m {39370 ft}
Required illumination		500 lux	—



### 3-3. Machine

Item		Specification
Model		LCG3015
Travel method		X- and Y-axes: Optics travel
Control method		Simultaneous control of X-, Y- and Z-axes, plus B-axis
Axis travel	X-axis	3070 mm {120.87 in.}
	Y-axis	1550 mm {61.02 in.}
	Z-axis	100 mm {3.94 in.}
Cutting area	X-axis	3070 mm {120.87 in.}
	Y-axis	1550 mm {61.02 in.}
	Z-axis	100 mm {3.94 in.}
Cutting feed rate	X-axis	0 to 120 m/min {0 to 393.7 fpm}
	Y-axis	0 to 120 m/min {0 to 393.7 fpm}
Max. rapid feed rate	X-axis	120 m/min {393.7 fpm}
	Y-axis	120 m/min {393.7 fpm}
	Z-axis	80 m/min {262.5 fpm}
Max. worksheet mass		920 kg {2029 lb}
Repeatable positioning accuracy		$\pm 0.005$ mm { $\pm 0.0002$ in.}
Least input increment		0.001 mm {0.0001 in.}
Drive feed method		X-axis: Rack and pinion Y-axis: Rack and pinion Z-axis: Ball screw
Assist gas type selector		Automatic selection
Table height		840 mm {33.1 in.}
Mass (only for machine)		8200 kg {17750 lb}
Power supply (only for machine)		AC, three phases, 200 V -15% to +10%, 50/60 Hz 220 V -15% to +10%, 60 Hz
		63 kVA
Short-circuit current rating (SCCR)		Icu : 50 kA

### 3-4. Laser oscillator

#### 3-4-1. Laser for processing

Item		Specification	
Model*		AF3500i-C	
Class		4	
For cutting		Invisible	
Oscillation method		Fast axial flow	
Laser output	Rated output	3500 W	
	Stability	±2.0% (during rated-output closed-loop control)	
	Pulse	Peak output	3500 W
		Frequency range	5 to 10000 Hz
		Duty range	0 to 100%
Output beam	Beam wavelength	10.6 μm	
	Beam mode	Low-order mode	
	Beam diameter	φ22 mm {0.866 in.} at oscillator output	
	Beam dispersion angle	Below 2 mrad	
Polarization		Circular polarization	
Laser gas	Mixture ratio	CO <sub>2</sub> : He : N <sub>2</sub> = 5 : 61 : 34 (Volume ratio, He balance) Allowable of compositional ratio: ±2%	
	Gas flow rate	Approx. 10 L/h {0.35 ft <sup>3</sup> /h}	
Min. cooling water flow rate (Circular type)		160 L/min {42.3 US gal/min}	
Dimensions (W × D × H)		2050 × 750 × 1176 mm {80.7 × 29.5 × 46.3 in.}	
Circular polarizer		Yes (built in laser oscillator)	

\*AF3500i-C is registered trademarks of Amada Co., Ltd. His official model name at FANUC Corporation is C3500i-C. Throughout this manual, please read C3500i-C for AF3500i-C.

### 3-4-2. Laser for positional confirmation

Item	Specification
Model*	AF3500i-C
For aiming	Visible
Class	3R
Rated output	<5 mW
Pulse duration	CW
Emitted wavelength	0.6 to 0.7 $\mu\text{m}$
Laser medium	Semiconductor

\*AF3500i-C is registered trademarks of Amada Co., Ltd. His official model name at FANUC Corporation is C3500i-C. Throughout this manual, please read C3500i-C for AF3500i-C.

### 3-5. NC unit

Item		Specification
Model		AMNC-F (FS31i-LB)
NC control method		Semi-closed loop method
Control functions		X-, Y- and Z-axes simultaneous control
		Laser oscillator control
Program input methods		Keyboard
		USB
		LAN (Ethernet)
Least input increment		0.001 mm {0.0001 in.}
Minimum position detection accuracy		0.001 mm {0.0001 in.}
Program storage capacity		128 MB
		Executable program size depends on NC memory capacity NC memory capacity: 256 m of tape (about 1 MB)
Environment	Ambient temperature	5 to 40°C {41 to 104°F}
	Max. relative humidity	75% without dew condensation
NC modes		RETRACT, MEMORY, MANUAL
Display functions		Pre-edit
		Schedule
		Program
		Result
I/O interfaces		LAN, USB
Display		15-inch color LCD touch screen

### 3-6. Information on sound

INFORMATION ON SOUND IN ACCORDANCE WITH ACT 92767 Section 1.7.4

Appendix 1

Transposing into French law the 89/392 Machine Directive and mentioned in article R233-84 from the Labor Code.

#### AUDIBLE EMISSION

AT WORK STATION:  $LA_{eq} = 72.8$  dBA, when machine is operating

#### SUS304 Stainless Plate

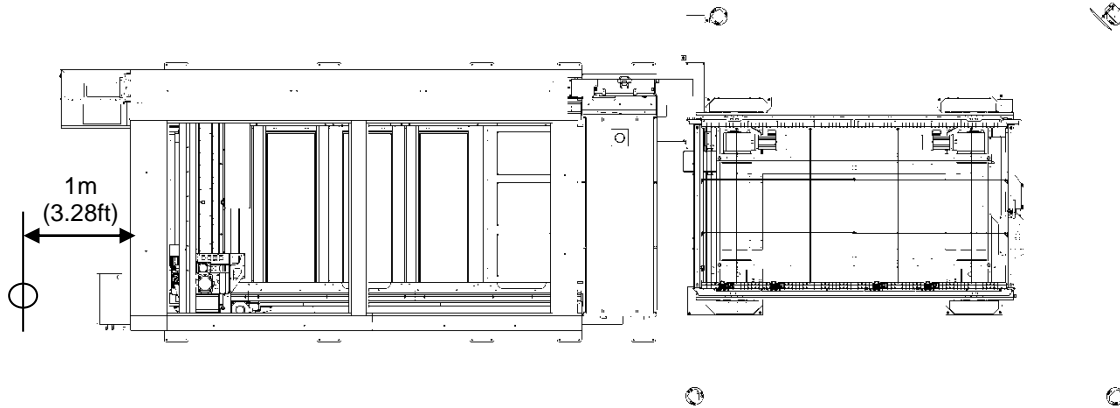
Thickness: 10 mm {0.39 in.}

Size: 1000 x 1000 mm {39.37 x 39.37 in.}

Cutting feed rate: 0.8 m/min {31.5 in./min}

Laser output: 3500 W

Assist gas pressure: 1.5 MPa {217.5 psi}



#### ADVICE FOR DECREASING THE DAILY SOUND EXPOSURE LEVEL

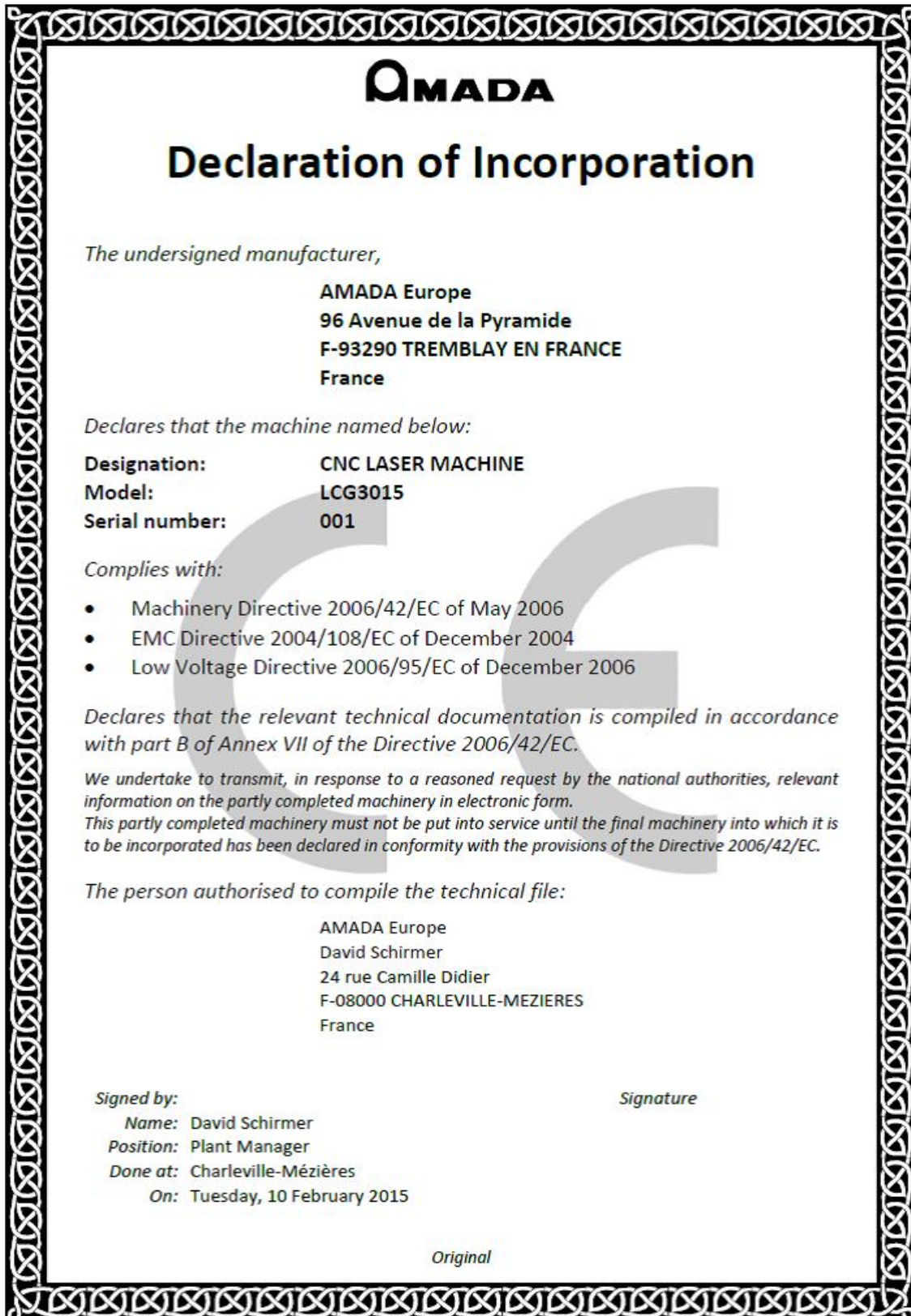
The sound level emitted by a machine depends greatly upon the setting up conditions and the environment of that machine, on the thickness and nature of the materials being worked and of the tooling being used.

Depending on the site layout, it may be necessary to use technical means to reduce noise or to organize work so as to protect neighboring workstations:  
workstation distances, screens, partition doors, acoustic correction of premises' walls, decreased exposure time of operators to noise.

**Wearing individual aural protection is highly recommended in all cases.**

### 3-7. Declaration of incorporation

Each machine comes with an EC declaratrion of incorporation like the example bellow:



**AMADA**

## Declaration of Incorporation

*The undersigned manufacturer,*

**AMADA Europe  
96 Avenue de la Pyramide  
F-93290 TREMBLAY EN FRANCE  
France**

*Declares that the machine named below:*

**Designation: CNC LASER MACHINE  
Model: LCG3015  
Serial number: 001**

*Complies with:*

- Machinery Directive 2006/42/EC of May 2006
- EMC Directive 2004/108/EC of December 2004
- Low Voltage Directive 2006/95/EC of December 2006

*Declares that the relevant technical documentation is compiled in accordance with part B of Annex VII of the Directive 2006/42/EC.*

*We undertake to transmit, in response to a reasoned request by the national authorities, relevant information on the partly completed machinery in electronic form.  
This partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of the Directive 2006/42/EC.*

*The person authorised to compile the technical file:*


**AMADA Europe  
David Schirmer  
24 rue Camille Didier  
F-08000 CHARLEVILLE-MEZIERES  
France**

*Signed by:* *Signature*

**Name:** David Schirmer  
**Position:** Plant Manager  
**Done at:** Charleville-Mézières  
**On:** Tuesday, 10 February 2015

*Original*

Each machine is fitted with a numerical plate fixed permanently on the frame, and a CE, plate in accordance with the current regulation.

 <b>AMADA CO., LTD</b>			
Modèle / Modello Model / Modell	<input type="text"/>	Capacité / Capacità Capacity / Stanzkraft	<input type="text"/>
Numéro de série / Numero di serie Serial number / Seriennummer	<input type="text"/>	Nombre d'outils / No. stationi torreta Nr. of turret stations / Revolverstationen	<input type="text"/>
Date de fabrication / Data di produzione Manufacturing date / Herstellungsdatum	<input type="text"/>	Puissance LASER / LASER potenza LASER power / Laserleistung	<input type="text"/>
Puissance requise / Potenza richiesta Power required / Anschlußleistung	<input type="text"/>	Poids / Peso Weight / Gewicht	<input type="text"/>
Niveau de bruit / Livello sonoro Noise level / Geräuschpegel	<input type="text"/>		<input type="text"/>
<b>AMADA Europe S.A.</b> <b>96 Avenue de la Pyramide</b> <b>F-93290 TREMBLAY EN FRANCE</b> <b>ASSEMBLY IN FRANCE</b>			







# Part 2

## Installation

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8. Assist gas supply.....	2-20
8-1. Piping work drawing for air.....	2-20
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9. Cooling water supply.....	2-27
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11. Hydraulic oil supply.....	2-37
12. Cleaning.....	2-37


# 1. LOCATION AND FOUNDATION

Determine the installation location and the required space for the machine and its auxiliary equipment and provide the required foundation according to the plan supplied by AMADA.

Be sure to reserve ample space around the machine and its auxiliary equipment to allow for worksheet handling and maintenance operations.

The location requires the following conditions:

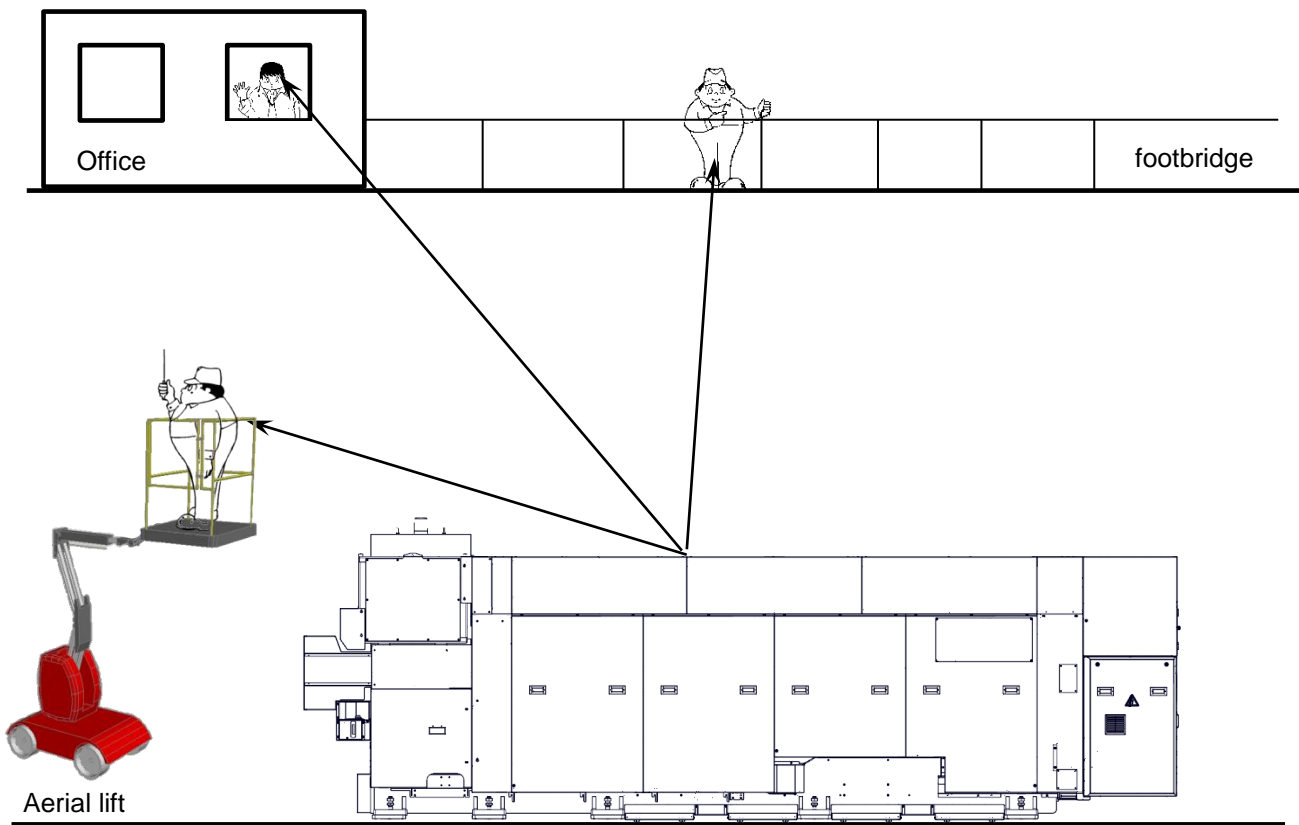
- The foundation must be firm, level concrete floor that resists seismic acceleration of up to 0.49 m/s<sup>2</sup> {0.05G} and amplitude of up to 5 μm.
- The location must be isolated from any nearby equipment that produces dust or vibration; although its immunity level complies with the Electro-magnetic Compatibility Directive (Dir.89/336), the machine should be at least 3 m {10 ft} away from.....
- The ceiling must be at least 3 m {10 ft} high above the floor.
- The location must be outside of any flammable or contaminable environment and be provided with ventilation facilities. The machine and its auxiliary equipment must not be directly exposed to sunlight, or hot or cold air. The ambient temperature must be between 5 to 35°C {41 to 95°F} with a relative humidity of below 75% and without dew condensation.
- Floor anchoring should be considered when preparing arrangements. In this respect, the engineering plans are references.

 <b>CAUTION</b>	<ul style="list-style-type: none"> <li>• Any electrical cable should be protected either through a duct, or a sufficiently thick gullet, or by providing an aerial installation, so as to risk of falling into the working area.</li> </ul>
--	---

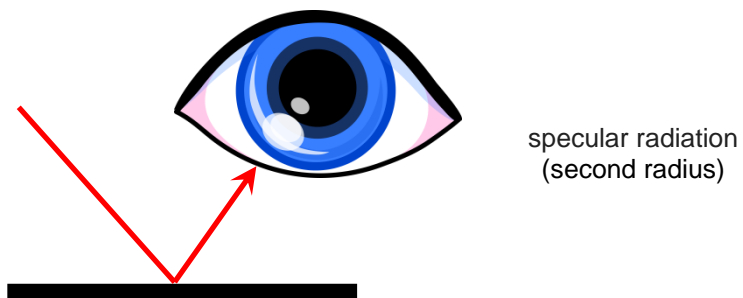
	MASS
LCG3015 (LST specification)	8050 kg {17750 lb}

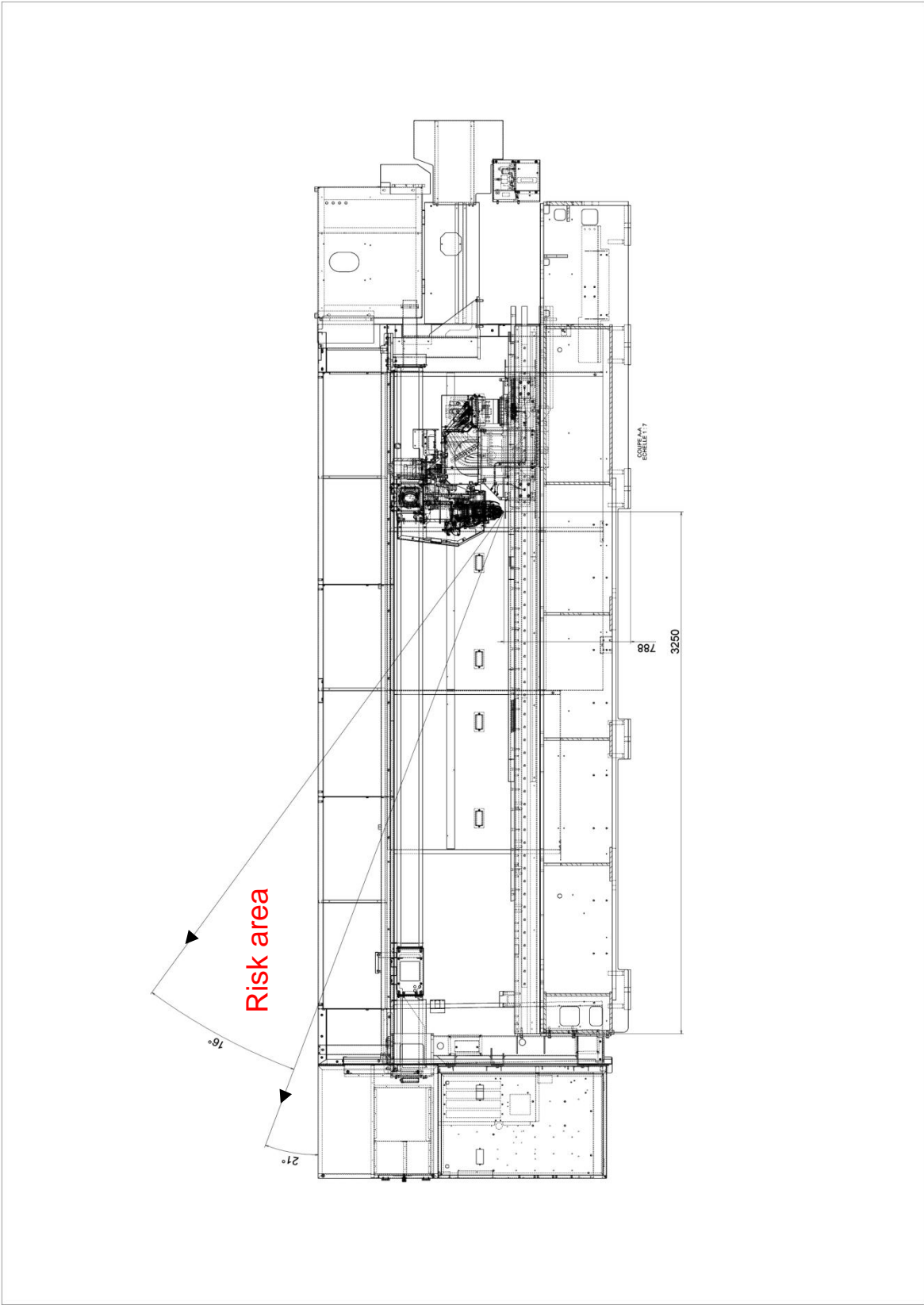
## 1-1. Secondary reflected light by the roof

- ▶ **Description** ◀ During laser cutting, visible and ultraviolet light are emitted from the cutting point. This light can go to the top.
- ▶ **Measure** ◀ In case of a machine installed in a workshop where the offices are located in high position (over the working area) that implies accessed with stairs and footbridge ; due to the fact that some laser beam reflection can reach an employee, therefore it is required to equip the machine with a roof cover.  
 Owing to possible laser beam reflection it is demanded :
  - Any kind of work to be performed in high position above the laser cutting area working must be prepared with protections such as appropriated curtains
  - Or the laser machine must be stopped during the time of the work.



Risk due to laser radiation toward up





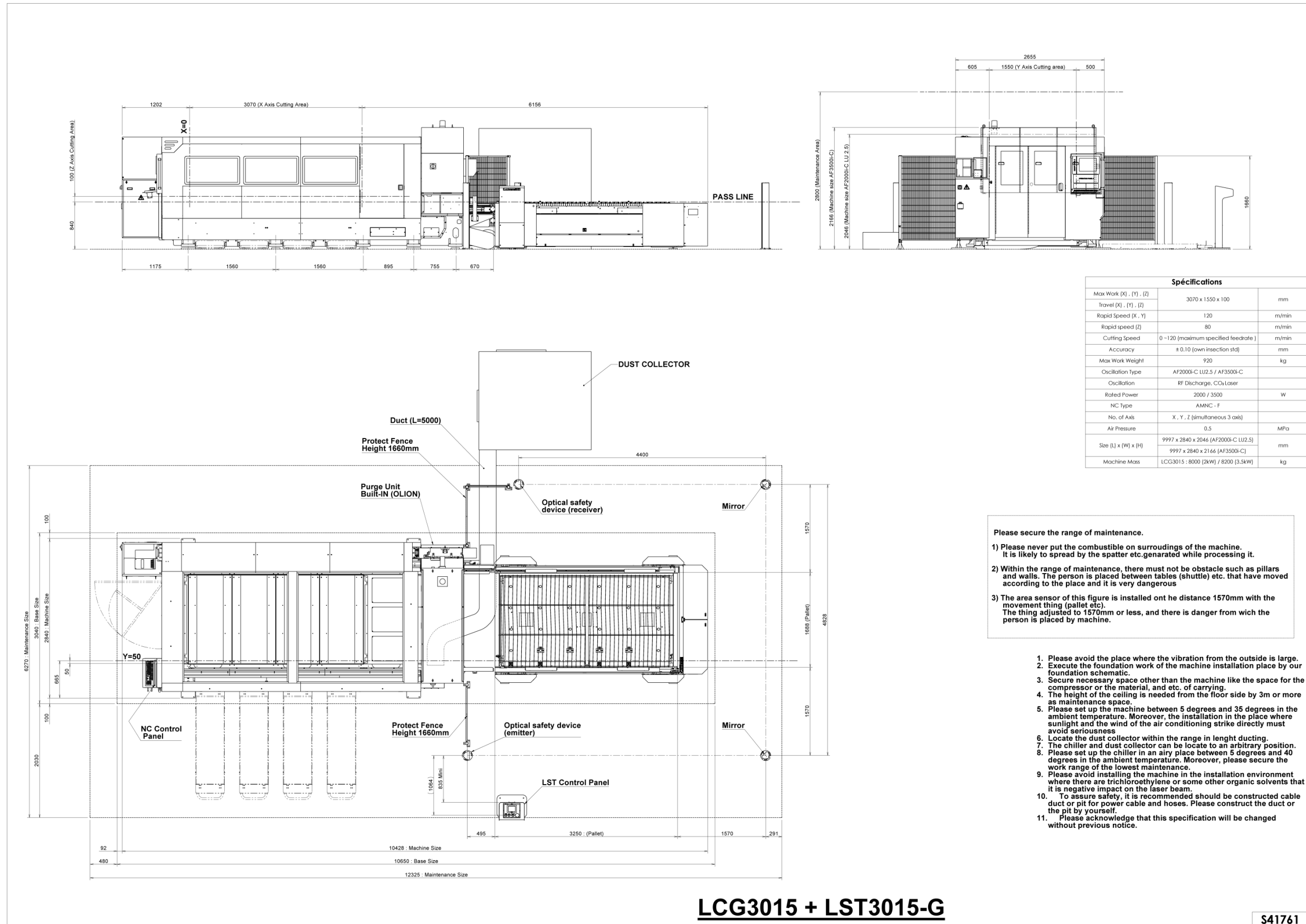
## **1-2. Floor plan drawing**

To secure safety, below conditions should be followed.

- 1 Never place flammable materials around the machine. Sparks may fly and ignite any flammable materials nearby.
- 2 The floor of working area of the machine is recommended to be painted to show it as a "Hazardous area" and make it inside of that area.
- 3 Do not install the machine where there are any obstacles such as columns or a wall in the maintenance area to prevent any persons being caught between the table and obstacles.



1-2-1. LCG3015 + LST



Spécifications		
Max Work [X] - [Y] - [Z]	3070 x 1550 x 100	mm
Travel [X] - [Y] - [Z]		
Rapid Speed [X - Y]	120	m/min
Rapid speed [Z]	80	m/min
Cutting Speed	0-120 (maximum specified feedrate)	m/min
Accuracy	± 0.10 (own insection std)	mm
Max Work Weight	920	kg
Oscillation Type	AF2000i-C LU2.5 / AF3500i-C	
Oscillation	RF Discharge, CO <sub>2</sub> Laser	
Rated Power	2000 / 3500	W
NC Type	AMNC - F	
No. of Axis	X, Y, Z (simultaneous 3 axis)	
Air Pressure	0.5	MPa
Size [L] x [W] x [H]	9997 x 2840 x 2046 (AF2000i-C LU2.5) 9997 x 2840 x 2166 (AF3500i-C)	mm
Machine Mass	LCG3015 : 8000 (2kW) / 8200 (3.5kW)	kg

Please secure the range of maintenance.

- 1) Please never put the combustible on surroundings of the machine. It is likely to spread by the spatter etc. generated while processing it.
- 2) Within the range of maintenance, there must not be obstacle such as pillars and walls. The person is placed between tables (shuttle) etc. that have moved according to the place and it is very dangerous
- 3) The area sensor of this figure is installed on the distance 1570mm with the movement thing (pallet etc). The thing adjusted to 1570mm or less, and there is danger from which the person is placed by machine.

1. Please avoid the place where the vibration from the outside is large.
2. Execute the foundation work of the machine installation place by our foundation schematic.
3. Secure necessary space other than the machine like the space for the compressor or the material, and etc. of carrying.
4. The height of the ceiling is needed from the floor side by 3m or more as maintenance space.
5. Please set up the machine between 5 degrees and 35 degrees in the ambient temperature. Moreover, the installation in the place where sunlight and the wind of the air conditioning strike directly must avoid seriousness
6. Locate the dust collector within the range in length ducting.
7. The chiller and dust collector can be locate to an arbitrary position.
8. Please set up the chiller in an airy place between 5 degrees and 40 degrees in the ambient temperature. Moreover, please secure the work range of the lowest maintenance.
9. Please avoid installing the machine in the installation environment where there are trichloroethylene or some other organic solvents that it is negative impact on the laser beam.
10. To assure safety, it is recommended should be constructed cable duct or pit for power cable and hoses. Please construct the duct or the pit by yourself.
11. Please acknowledge that this specification will be changed without previous notice.

**LCG3015 + LST3015-G**

S41761



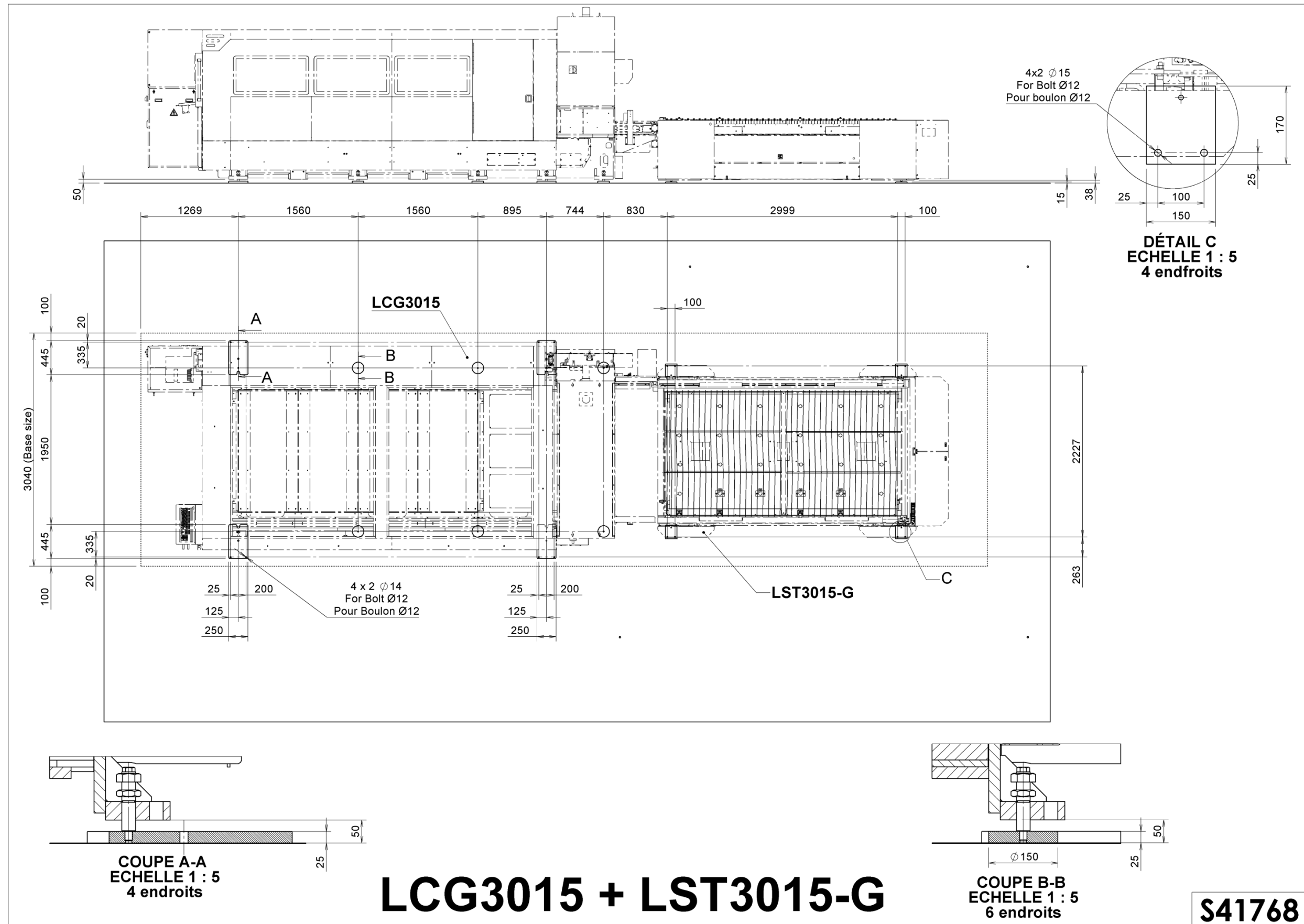


## 1-3. Foundation drawing

- Refer to the page 1 for the machine mass.  
Allowable ground bearing capacity for installing the machine is 55 kPa {7.98 psi}
- Refer to this drawing also when carrying out auxiliary work (such as operator floor construction, waterproofing, and vibration isolation).
- Do not install the machine where it may be exposed to large vibration from the outside of the factory. The maximum allowable vibration acceleration and amplitude for the machine are  $0.49 \text{ m/s}^2$  {0.05 G} and  $0.5 \text{ }\mu\text{m}$ , respectively. Exercise particular care when the machine must be installed near other machine that produces vibration, such as the numerically controlled turret punch press (NCT) or shearing machine, or in the factory alongside the road used by heavy trucks. If the machine must be installed in such environment, use vibration isolators (such as AMADA MAV) for the vibration-producing machine, and cut a trench, at least 25 mm wide and as deep as shown on the drawing in the foundation around the machine.
- Install the machine where there are no columns and obstacles in the maintenance space.
- Install the machine where it is not exposed to direct sunlight and air from air-conditioning equipment.
- Ceiling height of 3 m {10 ft} or more from the floor is required as maintenance space.
- Base plates, washers, anchor bolts, jack bolts, nuts, and bolts necessary for installing the machine are supplied with the machine.
- Foundation drawings are subject to change without prior notice.



1-3-1. LCG3015 + LST




**LCG3015 + LST3015-G**

**S41768**

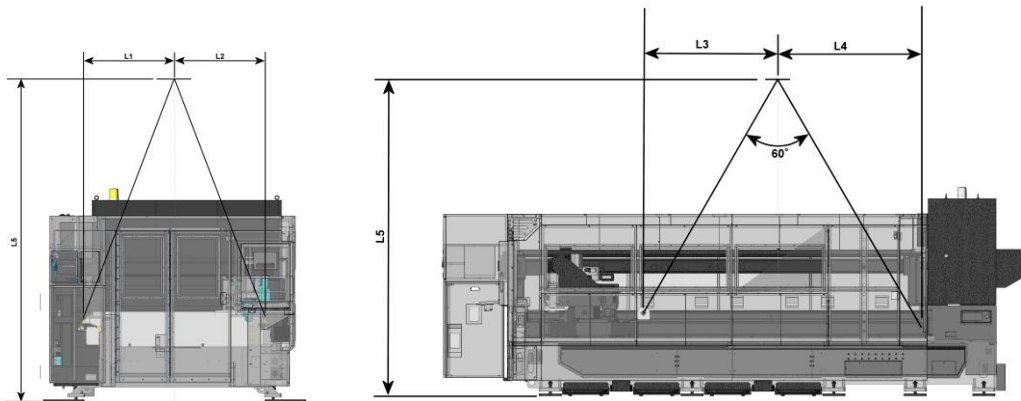


## 2. LIFTING

 <b>WARNING</b>	<ul style="list-style-type: none"> <li>● Have qualified contractors perform all lifting work.</li> <li>● Use a crane and wire ropes that have ample capacity to lift each piece of equipment.</li> <li>● Keep the opening angle of the spread wire ropes at less than 60 degrees.</li> </ul>
--	--

### Machine

Lift the machine by using the lifting tackle as shown in the figure below. Balance the machine carefully when lifting it and lower it slowly to protect it against impacts. The mass of the machine and distance "L1" to "L5" between the lifting hooks are as follows:



**LST specification (EU) (EX)**

MODEL	LCG3015 (LST)
Mass	8200 kg {18080 lb}
L1	980 mm {38.6 in.}
L2	980 mm {38.6 in.}
L3	1479 mm {58.2 in.}
L4	1571 mm {61.9 in.}
L5	3470 mm {136.6 in.}

### Dust collector, cooling unit, and transformer

For lifting the above equipment, refer to the separate manuals.

# 3. TRANSPORTATION

## Introduction :

You will find here below the minimum recommendations regarding the fixation (on vehicle) and the transport which do not disclaim the Amada sales companies responsibility in a matter of fixation the case on vehicle (fixing, locking, etc... for securing the transport) and the transport. They are entirely responsible for these operations and they have to increase the means of fixing, securing and protecting for the transport, if they estimate it necessary.

The placement of the case on vehicle is carried out, with the means of handling of the factory, by Amada Europe staff according to the instructions of the transporter for a balanced distribution so as to ensure the stability of the vehicle and the safety of transport.

- ⇒ The truck must be suited to the loading and in good condition (see tables on next pages),
- ⇒ The driver must have a waterproof tarpaulin which must be in good condition and right size (see tables on next pages), without holes and dry. We remind you that the polyethylene tarpaulins which protect the machines are **dustcover only and are not waterproof.**
- ⇒ **The driver must have at minimum 6 suitable straps, in good condition, per box or case.**
- ⇒ The driver must have a transport letter/CMR, and a transport order note of the sender or similar document specifying the destination, the type and the serial number of the machine. The driver must have also a copy of the safety protocol of the factory related to the loading and unloading operations of the road haulage – protocol completed and signed by Amada Europe and the road haulage company (according to the French law : Decree dated 26<sup>th</sup> April 1996).



Here below a tables indicating the trailer type and tarpaulin sizes according to the different machines types.

These machines are built with high technologies and must be handled with care.

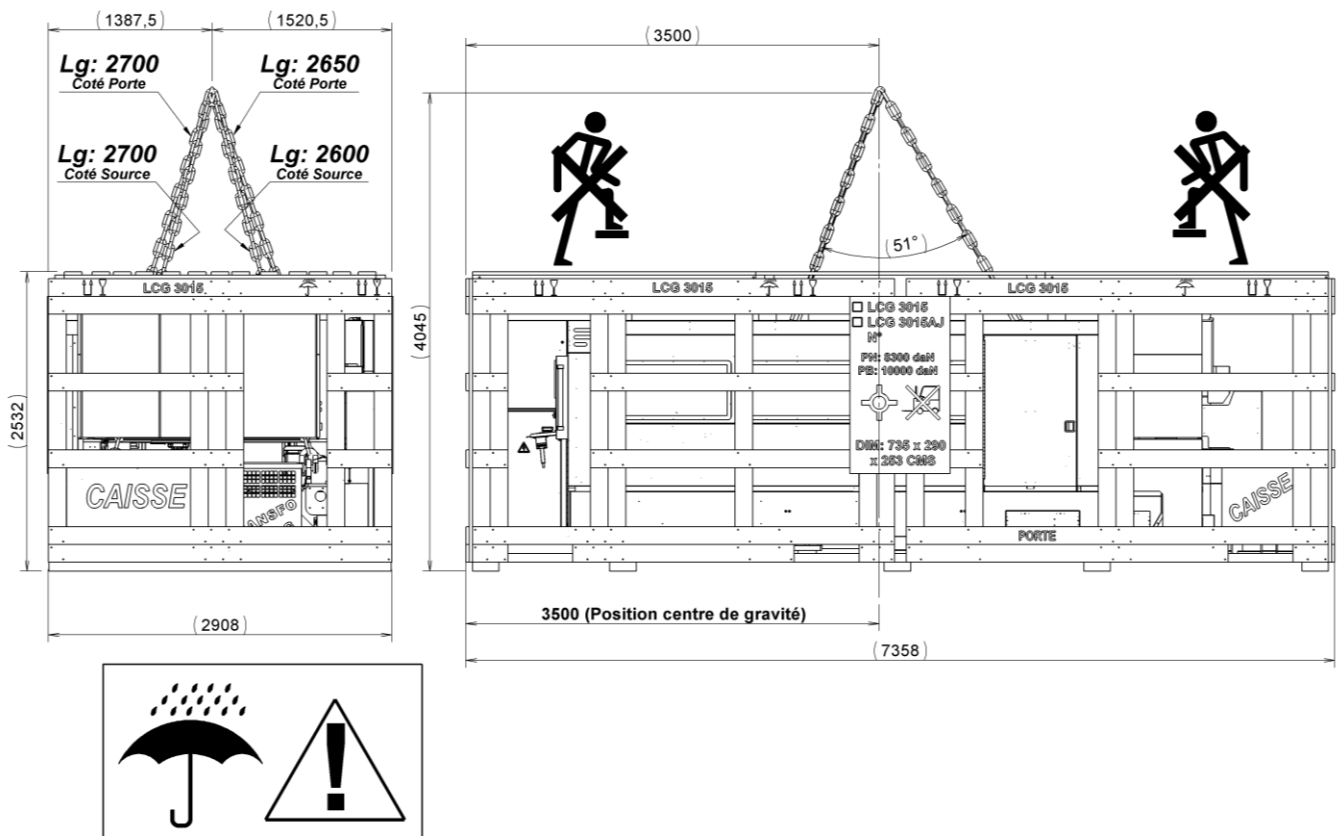
For information, the semi-trailer size (inner size) is L = 13.7 / l = 2.48 / h = 3m

## LCG

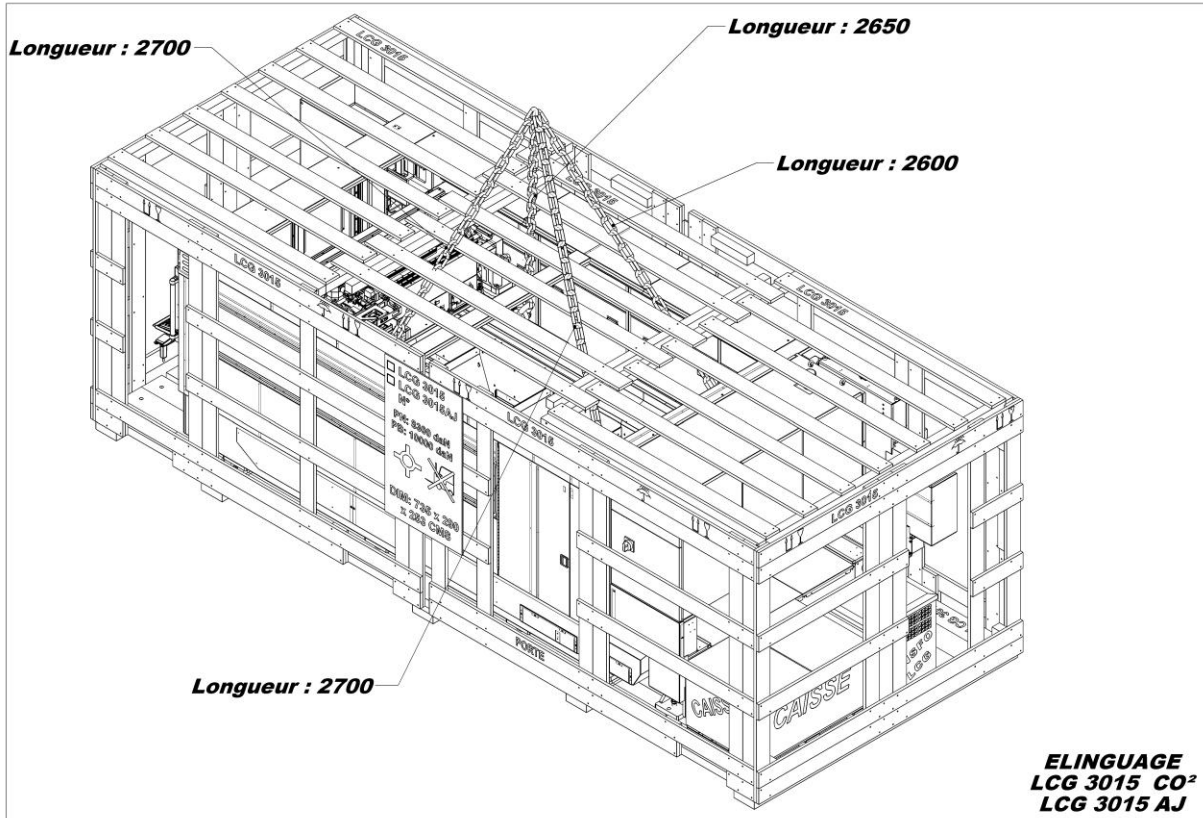
Crate dimension :

Machine Type / Accessories	BOX / CAISSE							Trailer type
	AESA Code	Length (mm)	Width (mm)	Height (mm)	Weight (Ton)	Tarpaulin		
						Length	Width	
<b>LCG 3015</b>	L57019	7358	2908	2532	10	15 m	11m	Flat bed trailer / Tank transporters
<b>Transformer 63kVA (For 3,5kW oscillator)</b>	L66840	900	590	750	0,350	X	X	Included in the machine crate

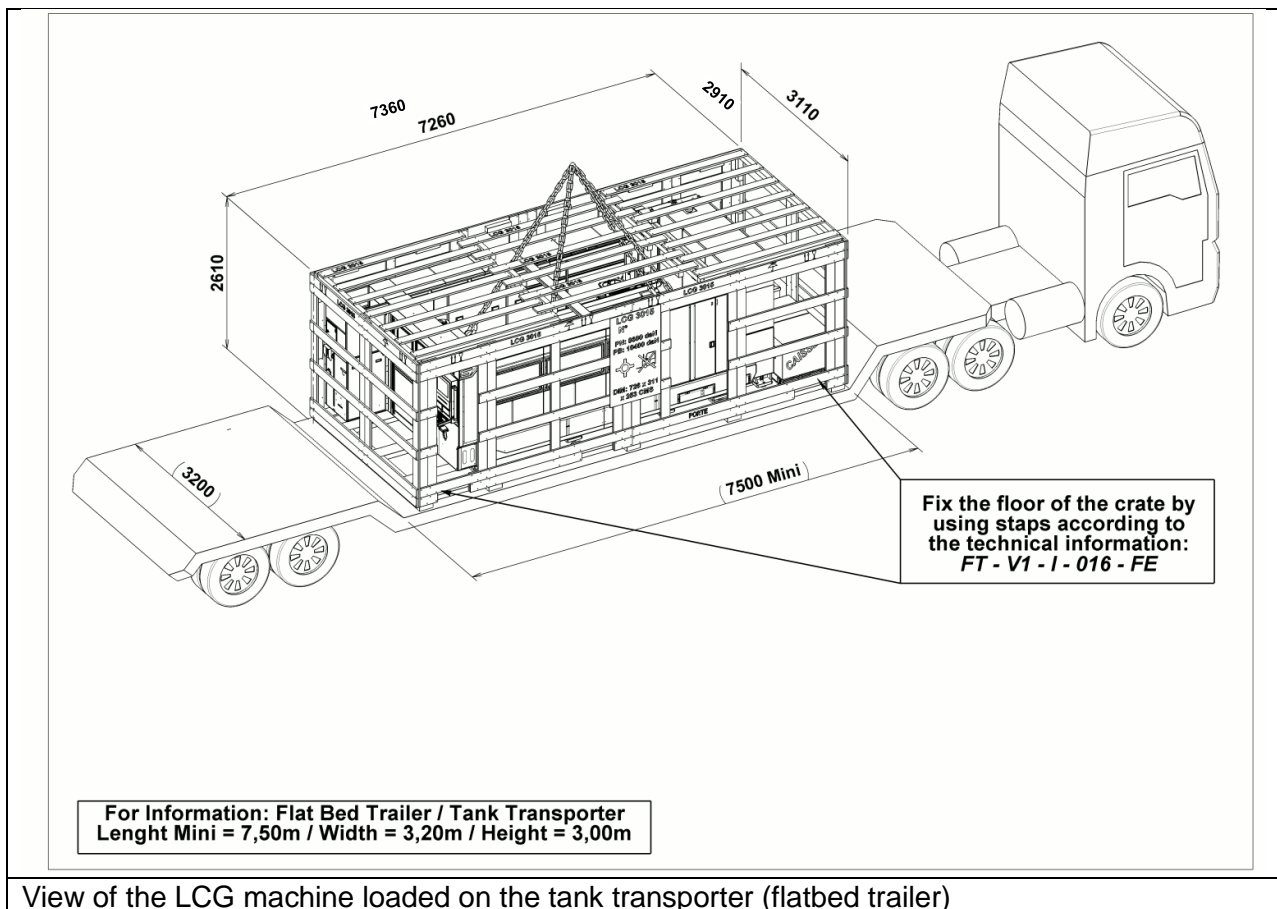
Crate handling :



Chains dimensions :

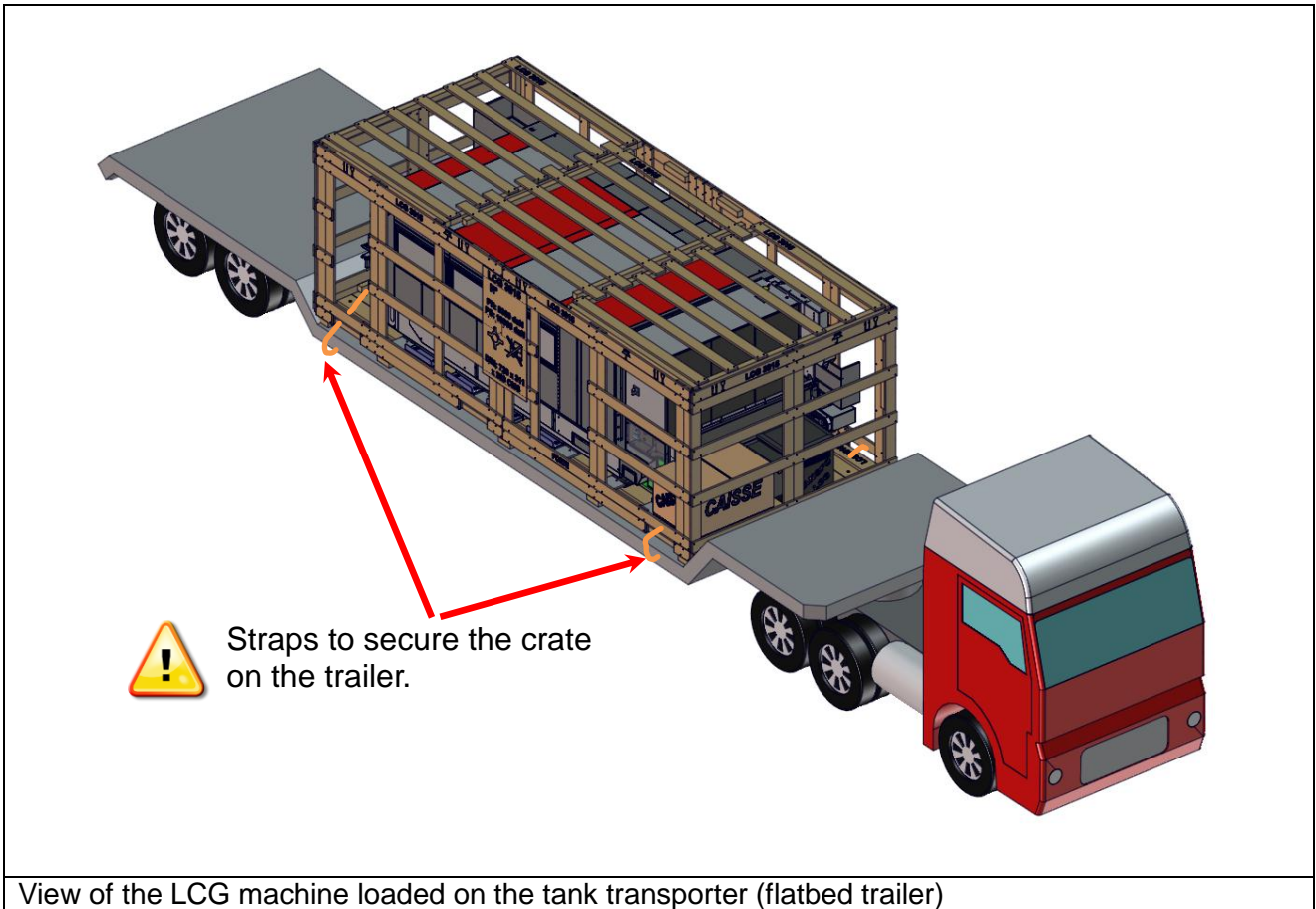


Layout of LCG loading process :





General view of the loaded machine :

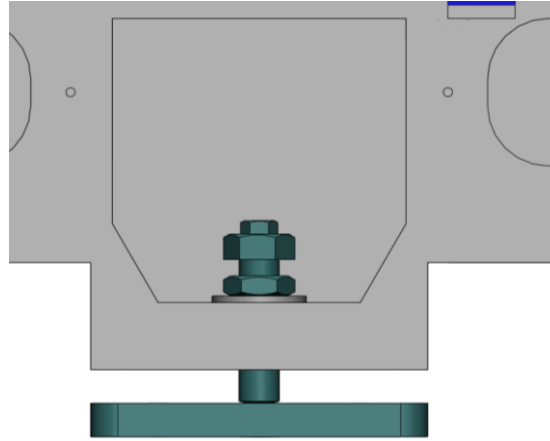


Note : For the general information for transportation cares for the rest of the current CHV product, please refer to the FT-V1-I-016-FE

## 4. LEVELING

Place spirit levels on the top shaved surface in the X- and Y-axis directions. Tighten the jack bolt to level the laser machine. The laser machine must be level to within  $\pm 0.8$  mm/m in both the X- and Y-axis directions.

When the leveling of the laser machine is finished, securely tighten the locknut to fix the jack bolt. When the concrete is completely dried, securely tighten the locknut to fix the machine.



DETAILS OF ANCHOR BOLT SECTION

## 5. REMOVING CLAMPS

The various kinds of clamps should be used only during the transportation. Especially the clamps used for resonator of laser oscillator should be loosened during the storage. Storing the resonator as fixed with clamps for a long time will cause its distortion. The clamps of laser machine is provided for X axis and NC control box. The clamps of laser oscillator are provided for cavity, shutter but not for turbo blower.

## 6. AIR SUPPLY

Perform air piping work as shown on the PIPING WORK DRAWING FOR AIR.

Using stainless steel pipe or pressure hose, connect an air compressor with functions recommended by AMADA and an air dryer compatible with the capacity of the air compressor to the machine. If the air compressor has its own air dryer, there is no need to install a standalone air dryer.

### 6-1. STANDARD SPECIFICATIONS OF LCG SERIES

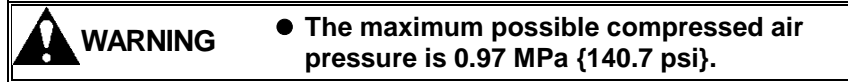
Standard specifications: when one of purge air unit, Clean Cut function, and Air Cut +Eco Cut function is to be used

#### Air compressor

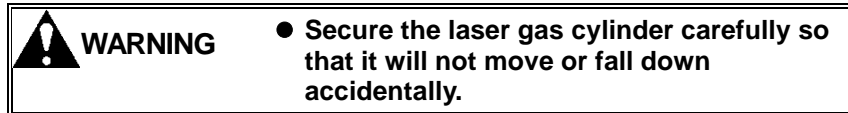
- 15 kW {20 HP} or equivalent
- Fitted with air dryer or connected with standalone air dryer
- Start of air dryer 2 to 3 minutes before start of air compressor
- Operation of air compressor with air intake closed
- Guaranteed air flow: 1550 NL/min
- Supply air pressure: 0.93 MPa {134.9 psi} or more
- Air flow required by machine: 1550 NL/min

## NOTE

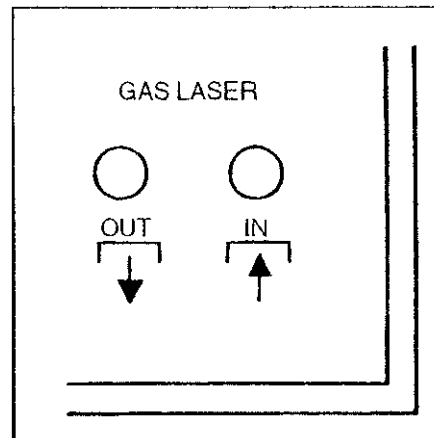
- Install the air compressor and air dryer as close as possible to the machine.
- Be sure to install the air dryer.
- Be sure to use hose bands at hose connections to prevent hose removal.
- Be sure that the air compressor outlet temperature remains in the range of 5 to 35°C {41 to 95 °F}. If this temperature is higher or lower than specified, the performance of the purge air unit may deteriorate to reduce the quality of parts produced.
- Entry of oil, moisture, chips, and other impurities into the air piping of the machine may cause machine damage or malfunction. Before connecting to the air piping of the machine, be sure to flush or clean it with nitrogen or filtered air.
- Hose drain from the filter in the air line and from the filter in the machine to a ditch.
- The air piping work drawing is subject to change without notice.



## 7. LASER GAS SUPPLY



Connect the primary connector of the regulator directly to the laser gas cylinder. Then connect the regulator's secondary connector with the GAS IN connector on the laser oscillator by using the accessory hose and remove the cap from the GAS OUT connector.




### GAS REQUIREMENT

Mixture ratio: 5% CO<sub>2</sub>, 34% N<sub>2</sub>, 61% He  
( Volume allowances of each gas : ±2% )  
Purity: Over 99.99%  
Water content: Below 5 ppm  
Hydrocarbon content: Below 1 ppm

### REGULATOR (with stop valve) REQUIREMENT

Maximum flow rate: 2 L/min {123 in<sup>3</sup>/min}  
Gas consumption: 0.17 L/min {10.3 in<sup>3</sup>/min}  
Gas pressure: 0.15 to 0.2 MPa {21.8 to 29.0 psi}  
Primary gauge: Readable up to 25 MPa {3600 psi}  
Secondary gauge: Readable up to 0.6 MPa {87.0 psi}  
Primary connector: Compatible with cylinder connector  
Secondary connector: 6 mm O.D.

## 8. ASSIST GAS SUPPLY

 <b>WARNING</b>	<ul style="list-style-type: none"> <li>● The pressure used should be less than 0.97 MPa {140.7 psi}.</li> <li>● Have the assist gas cylinder supplier connect the cylinder and the evaporator.</li> <li>● Secure the assist gas cylinder carefully so that it will not move or fall down accidentally.</li> </ul>
--	---

Perform gas piping as shown on the PIPING WORK DRAWING FOR GAS. Connect the assist gas cylinder with an evaporator that has a capacity of 40 m<sup>3</sup>/h {1420 ft<sup>3</sup>/h} and is equipped with a pressure gauge. Then connect the evaporator with an assist gas intake (see below) on the back of the machine. (Refer to "Air Supply" above when using air as assist gas.)

### ASSIST GASES AND INTAKES USED

Liquefied O <sub>2</sub> :	OXYGEN intake
Liquefied N <sub>2</sub> :	CLEAN CUT intake
Air:	AIR intake

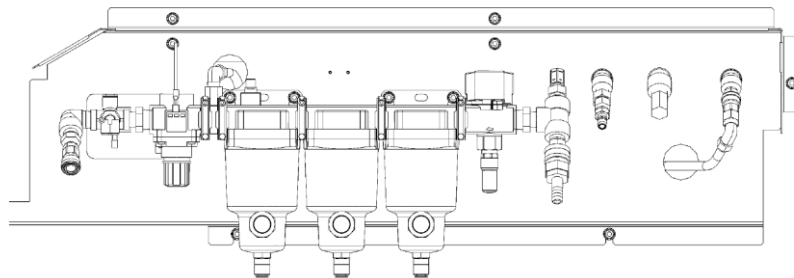
### CONNECTING PIPES AND HOSES

#### Cylinder – Evaporator:

Copper pipe with thickness of over 1 mm {0.039 in.} or hose with pressure resistivity of over 1.5 MPa {215 psi}, both of compatible size.

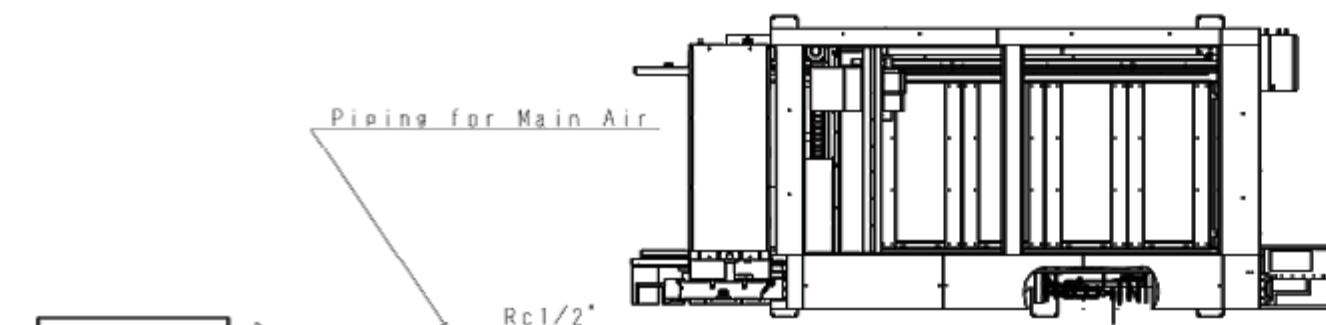
#### Evaporator – Machine:

Copper pipe with thickness of over 1 mm {0.039 in.} and 15 mm I.D. or hose with 1/2" I.D. and pressure resistivity of over 1.5 MPa {215 psi}.

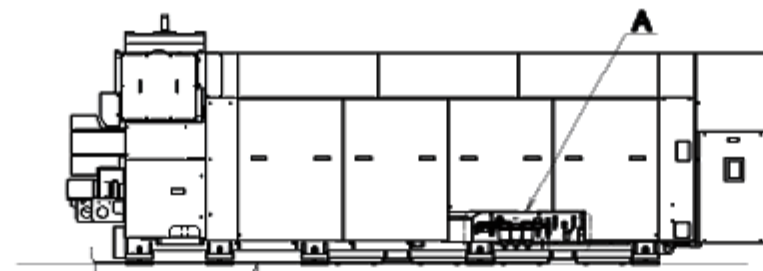


### 8-1. Piping work drawing for air

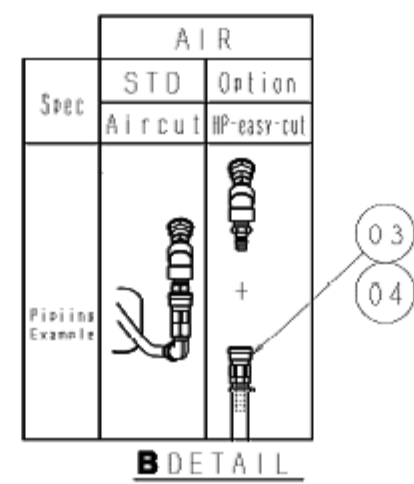
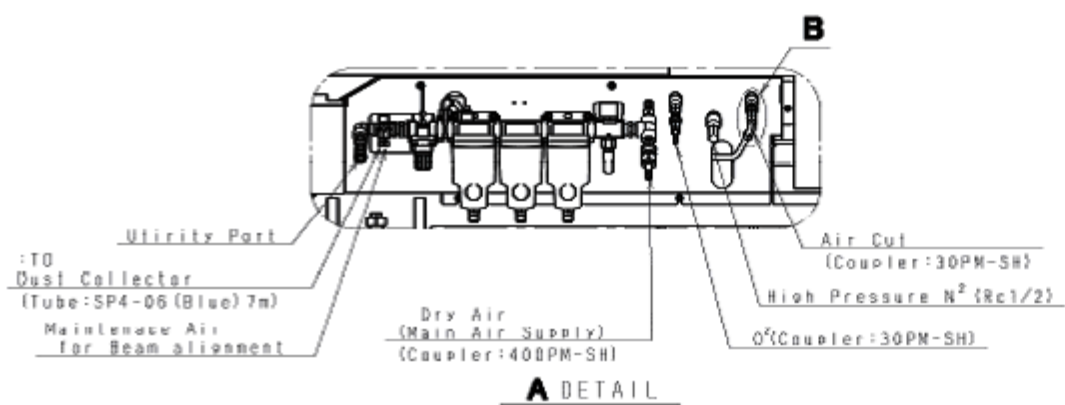
PIPING PARTS LIST (to be prepared by customer)				
Piping	Part No.	Part	Size	Qty
STD (Air Cut Function)	1	Compressed air or compressor	Refer to page 17	1
	2	Air dryer	Capable of treating compressed air described above	1
		Hose	ID: 1/2" Normal operating pressure: 1 MPa {145 psi}	AS required at site
Option (HP-easy-cutting)	3	Coupler	30SH (Nitto)	1
	4	Hose band		2



01 02



Please lay pipes so that the spatter when it processes it should not hang.



Customer Preparation goods

Specification	PART NO	Equipment or fitting	Supply air pressure	Air flow rate	Type or Size	Qty
STD (Air Cut Function)	01	Air compressor with Air Drier:150W(200W) Air drier first to start Guaranteed air flow rate of 1550L/min minimum	0.93MPa	Required flow rate:1550L/min minimum		1
	02					
Option (HP-easy-cutting) NOTE6	03	Coupler			30SH (Nitto)	1
	04	Hose band				2

(NOTE)

1. Entry of oil, moisture, chips, and other impurities into the air line of the machine may cause machine damage or malfunction. Before connecting a hose to the air line of the machine, flush or clean it with nitrogen or filtered air.
2. Be sure to install the air dryer.
3. Use hose bands at hose connections to prevent hose removal.
4. Make sure that the air compressor outlet temperature remains in the range of 5 to 35°C (41 to 95°F). If this temperature is higher or lower than specified, the performance of the purge unit may deteriorate to reduce the quality of parts produced.
5. The maximum supply air pressure is 1MPa(142psi). Never exceed this value with the air regulator.
6. Refer by the HP-easy-cut installation manual when use the HP-easy-cut.
7. This drawing is subject to change without prior notice for purpose of improvement.

name	LCG3015	Piping work drawing for Air	machine	LCG Series	13.09.20
Scale	1:40	No.	DA921601016-		



## 8-2. Piping work drawing for gas

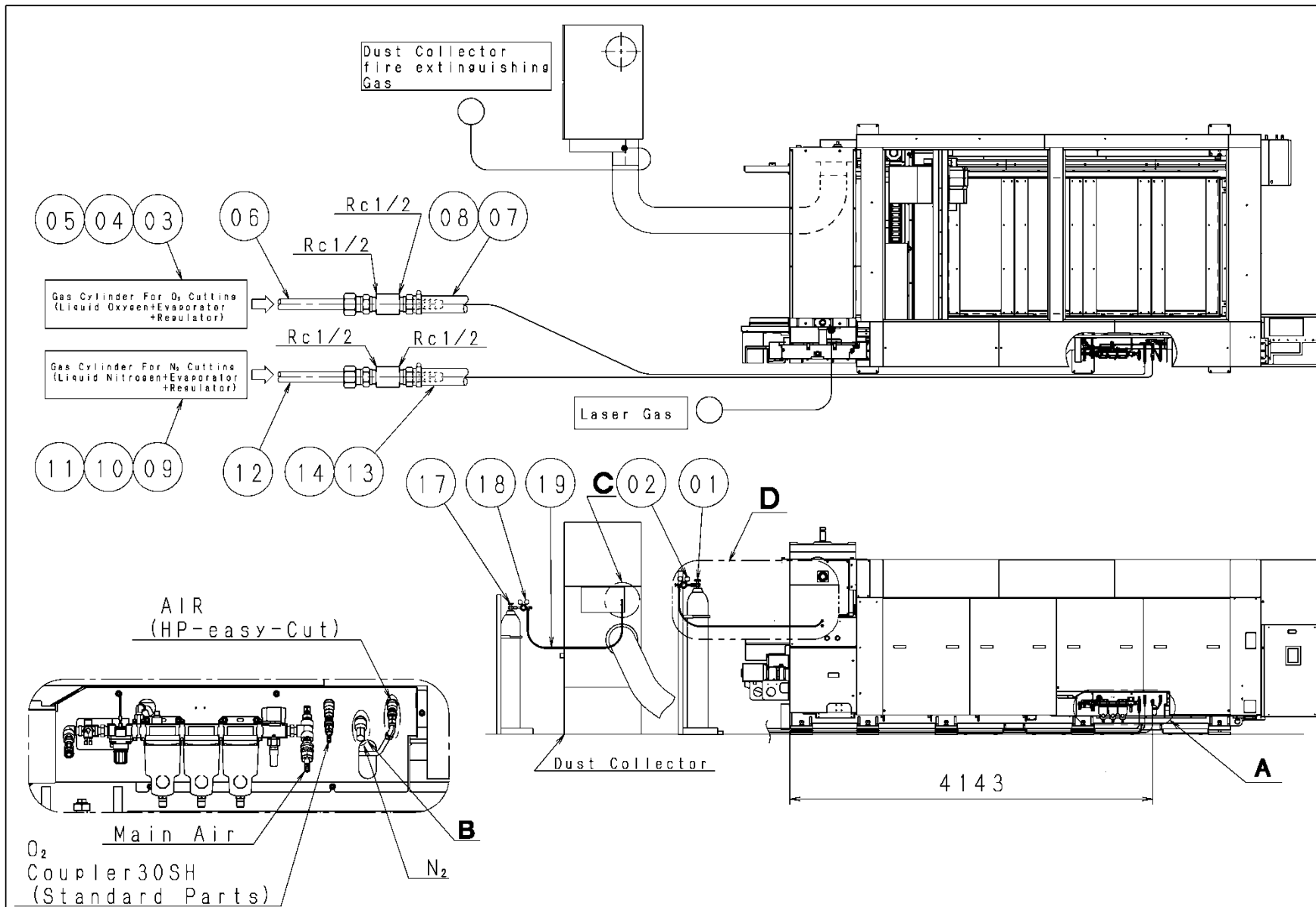
PIPING PARTS LIST (to be prepared by customer)				
Piping	Part No.	Part	Size	Qty
Laser oscillator gas See NOTE 4	1	Mixed gas for laser oscillator See NOTE 2	Gas composition: CO <sub>2</sub> : N <sub>2</sub> : He = 5 : 34 : 61 vol. % Volume allowances of each gas : ±2% Gas purity: Over 99.99%	1
	2	Gas Regulator	JET-S106 (Nissan Tanaka) or equivalent Primary pressure: 25 MPa {3626 psi} Secondary pressure: 0.6 MPa {87.0 psi} (with needle valve) Setting pressure: 0.15 to 0.2 MPa {21.8 to 29.0 psi}	1
		Piping tube (Standard part)	66-P-Y 3/8" (Imperial)	7 m
		Connector (Standard parts)	B-600-1-6RT (SWAGELOK)	1
			SS-6M0-6-6 (SWAGELOK)	1
			Nylon ferrule NY-600-SET (SWAGELOK)	1
			Dia. 6 mm straight hose coupler (Tanabekogyo)	1
Cutting gas	3	Liquid oxygen	132 m <sup>3</sup> (FIF) Gas purity: Over 99.99%	1
	4	Evaporator See NOTE 1	Capacity: 40 m <sup>3</sup> /h or more (Evaporator is not required if compressed oxygen is used)	1
	5	Gas Regulator	Minimum flow rate: 40 m <sup>3</sup> /h Max. operating pressure: 0.99 MPa {143.6 psi} (secondary side)	1
	6	Copper pipe	ID: 15mm Wall thickness: 1mm (0.04 in)	1
	7	High-pressure hose	ID: 1/2" Normal operating pressure: 1.5 MPa {217.6 psi}	AS required at site
	8	Hose band		2

PIPING PARTS LIST (to be prepared by customer)				
Piping	Part No.	Part	Size	Qty
Non-oxidation cutting gas See NOTE 5	9	Liquid nitrogen	107 m <sup>3</sup> (FIF) Gas purity: Over 99.99%	1
	10	Evaporator See NOTE 1	Capacity: 40 m <sup>3</sup> /h or more (Evaporator is not required if compressed)	1
	11	Regulator	Minimum flow rate: 40 m <sup>3</sup> /h Max. operating pressure: 0.99 MPa {143.6 psi} (secondary side)	1
	12	Copper pipe	ID: 15mm Wall thickness: 1mm (0.04 in)	1
	13	High-pressure gas hose	ID: 1/2" Normal operating pressure: 1.5 MPa {217.6 psi}	AS required at site
	14	Hose band		2
	15	Coupler	400PM (Nitto)	1
	16	Coupler	400SH (Nitto)	1
HP-easy-cutting assist gas piping	17	Coupler	30SH (Nitto)	1
	18	Hose Band		2
Dust collector	19	Nitrogen gas	7m <sup>3</sup> Cylinder	1
	20	Gas regulator	SG II (Koike Sanso) or equivalent Setting pressure (secondary pressure): 0.5 MPa {72.5 psi}	1
	21	Gas hose	ID: 1/4" Operating pressure: 1.0 MPa {145.0 psi}	1

NOTE

- 1) No evaporators are required if compressed oxygen and nitrogen are used in place of liquid oxygen or nitrogen, respectively.
- 2) It is recommended to have a spare cylinder each of laser oscillator gas and assist gas.
- 3) Be sure to install an air dryer No.2.
- 4) Piping hose for oscillator gas is supplied tube of 7 m as a standard accessory. Consult AMADA if longer hose is required.  
\* Never use a copper piping.  
\* Do not use any hose other than the dedicated hose.
- 5) Non Oxidation cutting needs pressure 0.85 MPa {123 psi} and gas flow 600 L/min at a cutting head. Please consider a loss in the piping (about 0.1 or 0.2 MPa {14.5 or 29.0 psi}).
- 6) Be sure to use hose bands to all rubber tube so as to avoid it to be deteriorated by shock, cut or crushed.
- 7) Please secure gas cylinders not to be fallen down.
- 8) This piping instructions are subject to change without prior notice.

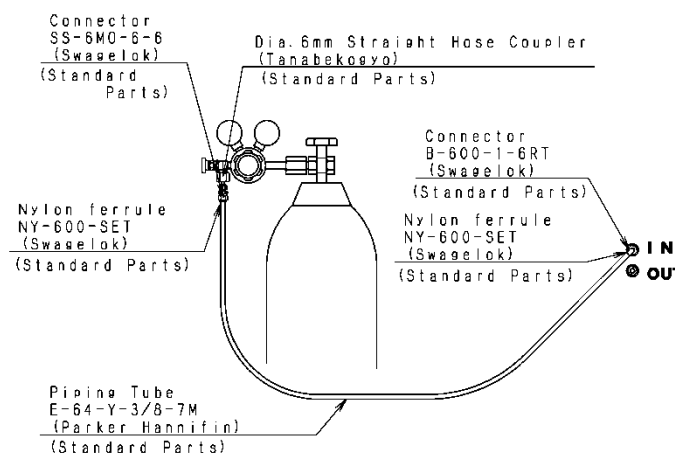
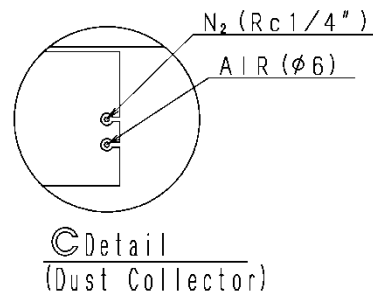




**A** Detail (Assist-Gas)

	Nitrogen High Pressure	Nitrogen Low Pressure
Primary pressure	Min. 0.6MPa Max. 2.5MPa	Min. 0.6MPa Max. 1.0MPa
Coupler	Disapprove	Approve
Pipings Example		

**B** Detail



Customer Preparation goods				
Pipine name	PAR NO	Part name	Size	Qty
Laser gas pipine	01	Mixed gas for laser oscillator (7m(247ft) gas cylinder)	Gas composition: CO <sub>2</sub> :He:N <sub>2</sub> = 5:61:34 vol% Volume allowances of each gas:±2% JET-S106(Nissan Tanakator equivalent)	1 set
	02	Gas regulator	Primary pressure gauge: Readable up to 25 MPa (3625.0 psi) Secondary pressure gauge: Readable up to 0.6 MPa (87.0psi) (with needle valve) Setting pressure: 0.15-0.2 MPa (21.6-29.0psi) Flow rate: 12L/h (732ins/h)	1 set
Normal cutting assist gas pipine	03	Liquid oxygen	Gas purity: Over 99.99%	1 set
	04	Evaporator	Capacity: 40m <sup>3</sup> /h (1413 ft <sup>3</sup> /h) minimum	1 set
	05	Gas regulator	Minimum flow rate: 40m <sup>3</sup> /h (1413 ft <sup>3</sup> /h) Maximum secondary pressure: 0.99 MPa (143.6 psi)	1 set
	06	Copper pipe	ID: 15mm Wall thickness: 1mm(0.04 in)	1 set
Non-oxidation cutting assist gas pipine (NOTES)	07	High-pressure hose	ID: 1/2" Operating pressure: 1.5 MPa (217.6 psi)	As required at site
	08	Hose Band		2
	09	Liquid nitrogen	Gas purity: Over 99.99%	1 set
	10	Evaporator	Capacity: 40m <sup>3</sup> /h (1413 ft <sup>3</sup> /h) minimum	1 set
	11	Gas regulator	Minimum flow rate: 40m <sup>3</sup> /h (1413 ft <sup>3</sup> /h) Maximum secondary pressure: 0.99 MPa (143.6 psi)	1 set
	12	Copper pipe	ID: 15mm Wall thickness: 1mm(0.04)	1 set
	13	High-pressure hose	ID: 1/2" Operating pressure: 1.5 MPa (217.6 psi)	As required at site
Dust collector fire extinguishing gas pipine	14	Hose Band		2
	15	Coupler	400PN(Nitto)	1 set
	16	Coupler	400SH(Nitto)	1 set
	17	Nitrogen gas	7m(247 ft) cylinder	
	18	Gas regulator	SG-I-1G(koike sensofor equivalent) Setting pressure (secondary pressure): 0.5 MPa (72.5 psi)	1 set
	19	Gas hose	ID: 1/4" Operating pressure: 1 MPa (145.0 psi)	1 set

**NOTE**

- Entry of oil, moisture, chips, and other impurities into the gas lines of the machine may cause machine damage or malfunction. Before connecting the hoses and pipes to the gas lines of the machine, flush or clean them with nitrogen, or filtered air.
- No evaporators are required if compressor oxygen are used in place of liquid oxygen and nitrogen, respectively.
- It is recommended to have a spare cylinder each of laser gas and assist gas.
- A 7m (23ft) long hose is provided for laser gas piping. Do not use any hose other than the dedicated hose. Consult AMADA if a longer hose is required.
- Even if the assist gas flow rate is 800L/min (28.2ft<sup>3</sup>/min), the required pressure must be obtained at the laser head. Limit the pressure loss in the gas piping to 0.1MPa (14.5psi).
- Use hose bands at hose connections to prevent hose removal.
- Secure the gas cylinders not to fall down.
- Assist gas needs a primary pressure of 0.6MPa (87.0psi) minimum.
- Don't use coupler at nitrogen high pressure. (Refer by nitrogen high pressure installation drawing)
- This drawing is subject to change without prior notice for purpose of improvement.

名称	LCG Series	Pipine work drawing for gas	機種名	作成日
			LCGseries	13.09.19
			尺 寸	1:40
			図番	DA/9/2/6/01/0/4-

DA9260104-



## 9. COOLING WATER SUPPLY

Determine the installation location and the required space for the chiller (cooling unit) and provide the required cooling water supply according to the PIPING WORK DRAWING FOR WATER or another plan supplied by AMADA.

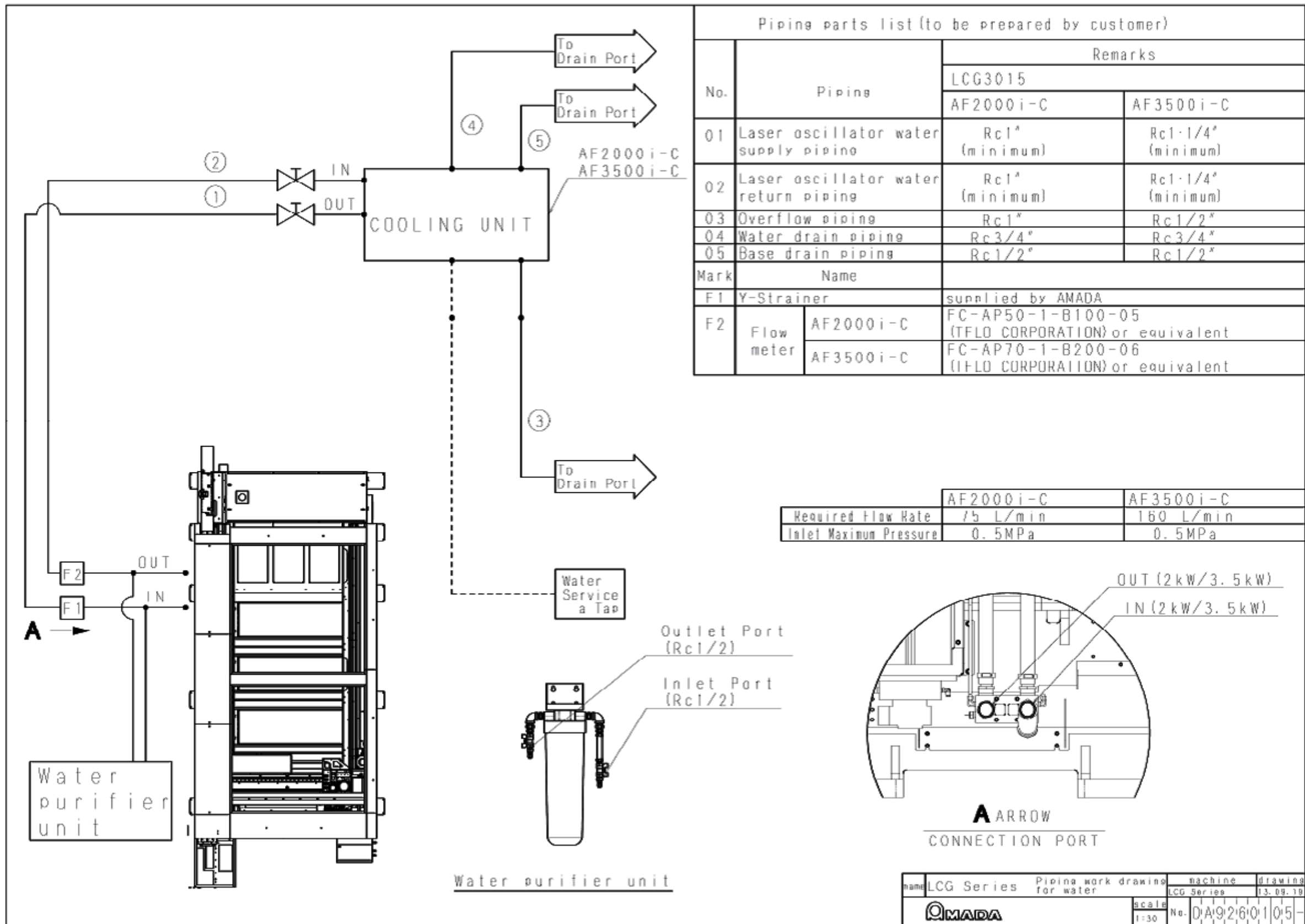
### 9-1. Piping work drawing for water

PIPING PARTS LIST (to be prepared by customer) Source AF3500i-C				
Piping	Part No.	Part	Size	Qty
A: Laser oscillator water supply piping Laser oscillator water return piping	1	Nipple	1-1/4"(SUS)	1
	2	Hose nipple	1-1/4"	4 (minimum quantity)
	3	Hose band	1-1/4"	4 (minimum quantity)
	4	Water hose	1-1/4" Normal operating pressure: 0.5 MPa {72.5 psi}	As required at site
	5	Socket	1-1/4"	4
	6	Piping	1-1/4" (treated against corrosion and freezing)	As required at site
	7	Elbow	1-1/4"	As required at site
	8	Water flow meter	FC-AP70-1-B200-06 (TFLO Corporation) or equivalent	1
B: Chiller water supply piping Chiller drain piping	9	Hose nipple	1/2"	2
	10	Hose Band	1/2"	2
	11	Hose	1/2"	As required at site
	12	Hose nipple	3/4"	1
	13	Hose band	3/4"	1
	14	Hose	3/4"	As required at site

#### NOTE

- 1) Use stainless pipe or vinyl-lined pipe or high-pressure hose for piping. And use fittings made of stainless steel or brass for protection against corrosion.
- 2) Use rubber hose and union as shown in the drawing. It is necessary for maintaining the machine.
- 3) Provide the bypass shown in the drawing. The bypass is used for cleaning and designed to prevent the wasteful use of the water purifier.
- 4) Where the cooling unit is likely to freeze, be sure to use antifreeze during the freezing period as described in the manual of the cooling unit.
- 5) The water purifier may burst when the supply water pressure exceeds 0.35 MPa {50.8 psi}. Be sure to use a water supply regulator.
- 6) Piping details in cooling unit side may be changed depending on types of cooling unit.
- 7) This piping instructions are subject to change without prior notice.

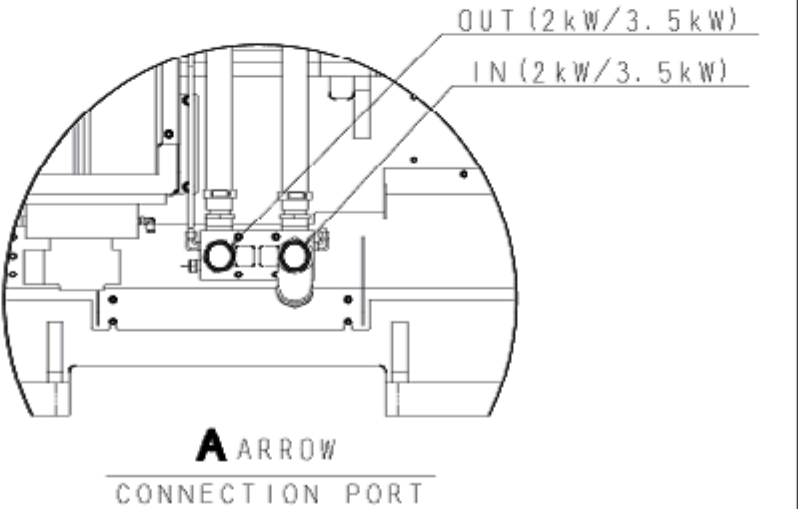




Piping parts list (to be prepared by customer)

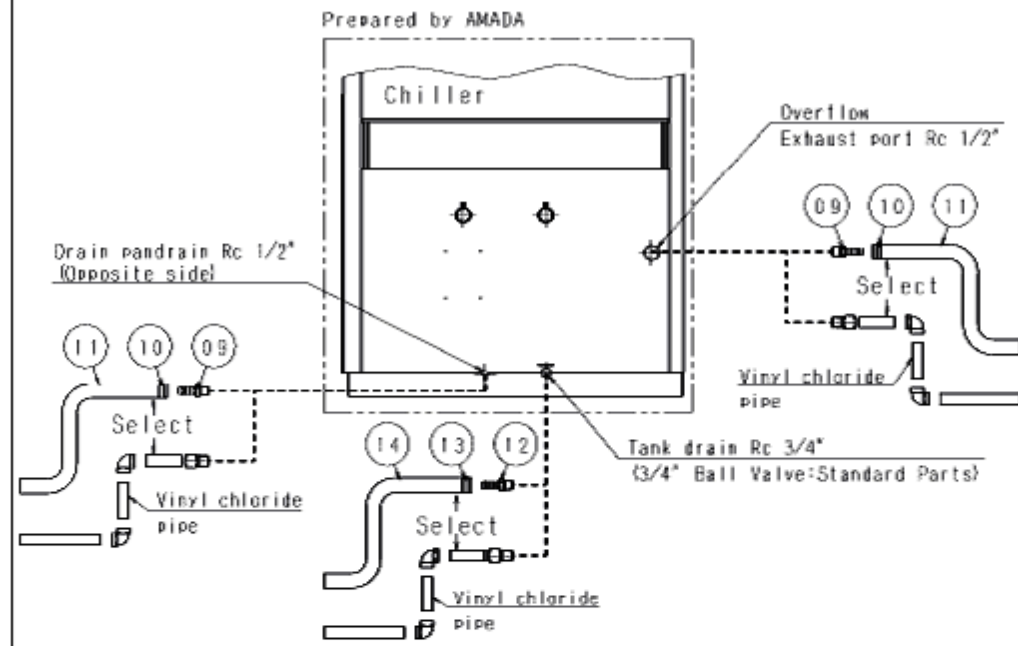
No.	Piping	Remarks	
		LCG3015	
		AF2000 i-C	AF3500 i-C
01	Laser oscillator water supply piping	Rc1" (minimum)	Rc1-1/4" (minimum)
02	Laser oscillator water return piping	Rc1" (minimum)	Rc1-1/4" (minimum)
03	Overflow piping	Rc1"	Rc1/2"
04	Water drain piping	Rc3/4"	Rc3/4"
05	Base drain piping	Rc1/2"	Rc1/2"
Mark	Name		
F1	Y-Strainer	supplied by AMADA	
F2	Flow meter	AF2000 i-C	FC-AP50-1-B100-05 (TFLD CORPORATION) or equivalent
		AF3500 i-C	FC-AP70-1-B200-06 (TFLD CORPORATION) or equivalent

	AF2000 i-C	AF3500 i-C
Required flow Rate	75 L/min	150 L/min
Inlet Maximum Pressure	0.5MPa	0.5MPa



name	LCG Series	Piping work drawing for water	machine	LCG Series	drawing	13.09.10
	AMADA		scale	1:30	No.	0A9260105-

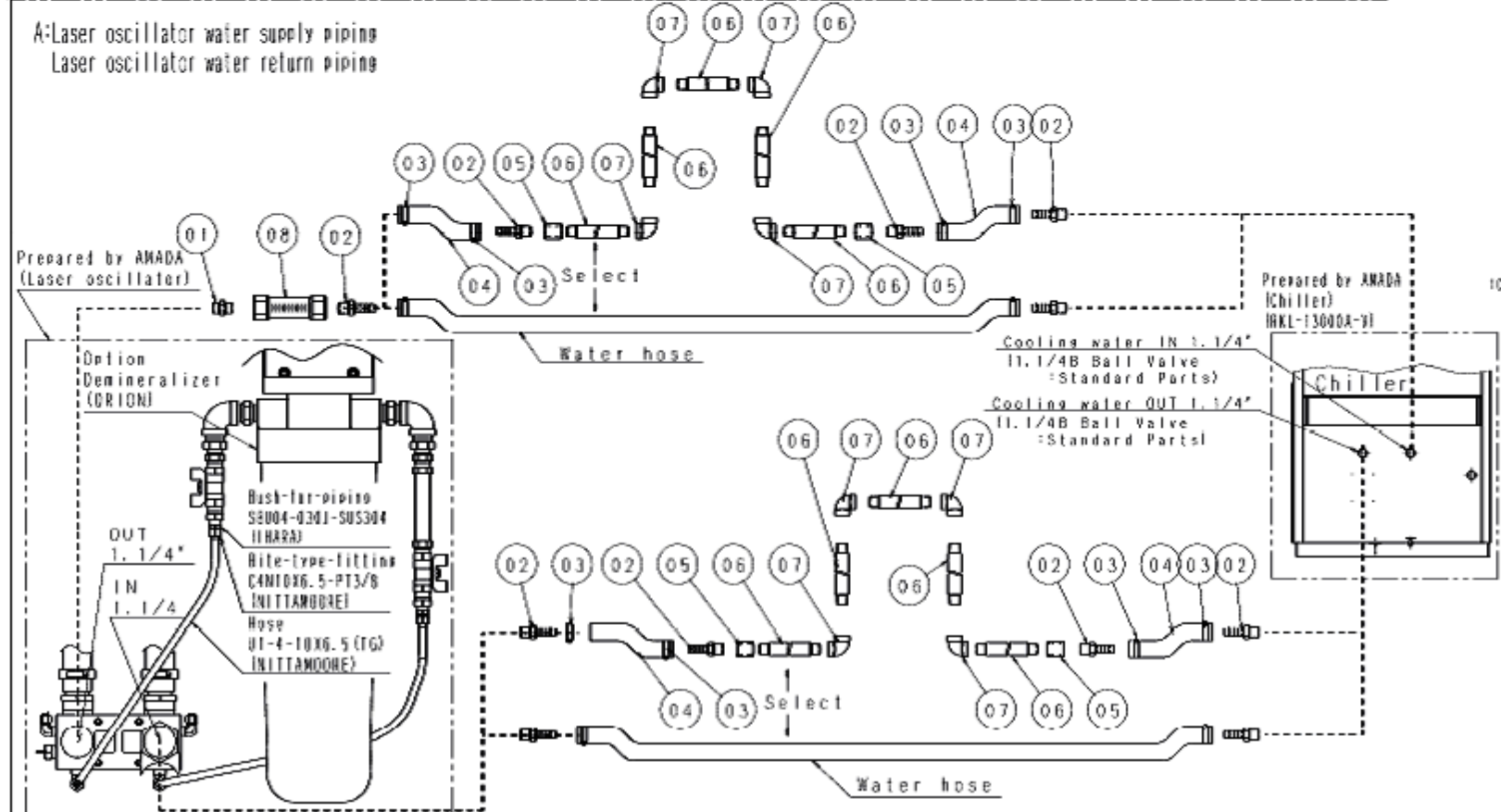
B:Chiller water supply piping  
Chiller drain piping



Piping parts list (to be prepared by customer)				
Piping	Part No.	Parts	Size	Qty
A: Laser oscillator water supply piping	01	Nipple	1. 1/4" (SUS)	1
	02	Hose nipple	1. 1/4"	1
	03	Hose band	1. 1/4"	1
	04	Water hose	1. 1/4" Normal operating pressure 0.5MPa (5kgf/cm <sup>2</sup> )	The work amount
	05	Socket	1. 1/4"	4
	06	Pipino	1. 1/4" (treated against corrosion and freezing)	The work amount
	07	Elbow	1. 1/4"	The work amount
	08	Flow meter	FC-AP70-1-B200-06 (TFLO CORPORATION) or equivalent	1
B: Chiller water supply piping	09	Hose nipple	1/2"	2
	10	Hose band	1/2"	2
Chiller drain piping	11	Hose	1/2"	The work amount
	12	Hose nipple	3/4"	1
	13	Hose band	3/4"	1
	14	Hose	3/4"	The work amount


- Note:
- Use stainless pipe or high-pressure hose for piping. And use fittings made of stainless steel or brass for protection against corrosion.
  - Use rubber hose and union as shown in Figs. It is necessary for maintaining the machine.
  - Provide the bypass shown in Figs. The bypass is used for cleaning and designed to prevent the wasteful use of the water purifier.
  - When the chiller is likely to freeze, be sure to use antifreeze during the freezing period as described in the manual of the chiller.
  - The water purifier may burst when the supply water pressure exceeds 0.34MPa (3.5kgf/cm<sup>2</sup>). Be sure to use a water supply regulator.
  - TFLO CORPORATION  
The sales department of the main office: TEL 042-582-6111  
Osaka office: TEL 06-6885-1811
  - Specifications are subject to change without prior information.
  - In case of stainless steel piping, total length of piping (one way) should be within 10 meters to get required water flow rate. If it is over 10 meters, to increase piping diameter from 1-1/4" to 1-1/2" otherwise the machine may not work correctly due to lack of water flow rate.
  - In case of water tube, total length of tube (one way) should be within 15 meters to get required water flow rate. If it is over 15 meters, it is necessary to increase piping diameter from 1-1/4" to 1-1/2" otherwise the machine may not work correctly due to lack of water flow rate.
  - Specifications are subject to change without prior information.

A:Laser oscillator water supply piping  
Laser oscillator water return piping



Model	LCG Series (AF35001-C)	Machine	105 Series	Drawing	03.09.11
Part No.	DA92601	Rev.	1	07	

# 10. ELECTRIC POWER SUPPLY

 <b>WARNING</b>	<ul style="list-style-type: none"> <li>● Have a qualified electrician carry out all electrical work in order to prevent injuries or accidents.</li> </ul>
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**NOTICE**

- The machine requires a 3-phase, 200 VAC±10%, and 63 kVA power supply.
- Use a shop circuit breaker of at least 160 A.
- For the recommended primary power cable specifications and connection method, see the table below.

Conductor material	Copper (use copper conductors only)
Rated conductor temperature	75°C
Conductor diameter	35 mm <sup>2</sup>
	Cable: max length 20m
Terminal arrangement	L1, L2, and L3

- Supply the machine from a power source different from that for welding, drilling, sanding, or grinding machines to protect it from electrical noise and voltage drop.
- Install the crimp terminals so that their poles become parallel as shown below.



<b>TENSION / TENSIONE</b> <b>VOLTAGE / SPANNUNG</b>	<b>3 X 400V</b> <b>50 / 60 Hz</b>
<b>PUISSANCE / POTENZA RICHIESTA</b> <b>POWER REQUIRED / ANSCHLUSSLEITUNG</b>	<b>63 KVA</b>
<b>POUVOIR DE COUPURE / CAPACITA DI ROTURA</b> <b>BREAKING CAPACITY / SCHALTLEISTUNG</b>	<b>I<sub>cc</sub> = 50 KA</b>

- 1 The machine transformer requires a 3-phase, 400 VAC±10%,50/60 Hz, and 63 kVA power supply.
- 2 The customer must protect a differential circuit breaker, 100mA, 125 A curve D to protect the main line

## **Earth**

All class 1 equipment must have an earth connection. This necessity also applies to operation and floor drainage for any interference.

- The section of the earth conductor must, of course, be sufficient. For added safety, earth distribution should use a STAR configuration from the supply panel terminal block. In the same way as the electrical installation, the standard of the "earth" must be checked regularly by an approved organization.

## **Interference linked with network and environment**

---

### **NOTICE**

---

- Whatever process is used, never solder or weld any components onto the machine as this could cause damage to mechanical, electrical and electronic devices.

Some electronic components may, consequently, be exposed to abnormal or excessive voltages and currents liable to cause their destruction.

It may be necessary to consider the interposing of certain additional elements without a galvanic link to the networks (voltage stabilizer, inverter, converter group, transformer, insulation transformer, etc.)

If the need arises, the standard of the electrical power supply must be examined by an approved organization and the results of the examination after analysis will determine the type of equipment needed.

The following interference may be considered as disturbing to all electronic systems.

### **Electrostatic discharge**

Electrostatic discharge is particularly critical where the ambient relative humidity levels are low: it is for instance not unusual for a person or a group of people on the move to generate discharges amounting to several thousands of volts when touching a door handle or a cabinet frame. It may be necessary to install an anti-static environment. The machine has complied with the tests required by the European standard EN 6100.4.2 related to the immunity to electrostatic discharges.

### **Transients on the network supply**

Transients are spurious pulses propagating along network conductors and which may affect system operation. They may have internal origins: welding unit for instance, or may be generated by any other machine generating noise in the sector; they can also be external: stormy weather, nearby factory, etc. The machine has complied with the tests required by the European standard EN 6100.4.4 related to the immunity to fast transients.



**Stormy weather**

The accumulated charges during storms may cause transients to arise on electrical lines or interconnecting cables. Do not use long overhead lines.

**Magnetic fields**

A variable magnetic field will cause phenomena of induction in circuit loops and generate a considerable amount of unwanted voltage. Cathode ray tubes which are sensitive to magnetic fields and indicate the sensitivity by a change in the chromatics of the image or its geometry, are provided with a protective shield.

**Electro-magnetic medium or high frequency radiations**

This type of interference may cause many problems in different systems (operational amplifiers, computer memory, etc.). In general, the scope of the interference observed depends upon the duration and intensity of such radiation.

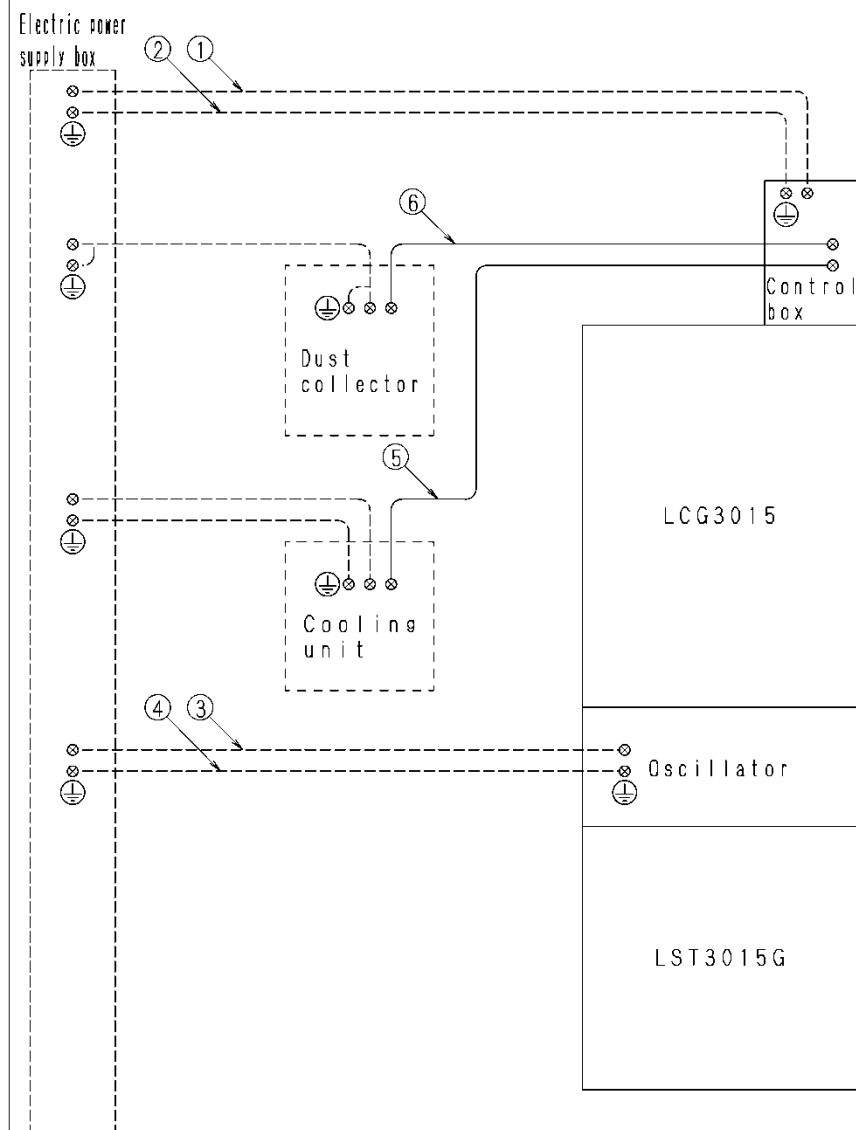
Although the machine has complied with the tests required by the European standards EN 50140 and 50141, it is recommended to install the punching machine in an environment free of the above mentioned interferences.



# 10-1. Electric parts arrangement drawing

Table of electric cable part (customer preparation)

Specification						Earthing	Cable side terminal specification		
No.	Name	Number of the cores	Section (mm <sup>2</sup> )	Qty.	Entrance diameter of the cable (Note. 5)		Laser machine	Equipment side	Electric power supply box side
Note. 3)	① NC primary power supply	3 cores (1 core)	2.2 (1.4)	1 (3)	—	1000 OR LESS	M5	—	Customer preparation
	② NC earthing	3 cores (1 core)	1.6 (1.4)	1	—				
Note. 4)	③ Oscillator primary power supply	1 core	1.00	3	φ14-25 (3 points)	100 OR LESS	—	M8	Customer preparation
	④ Oscillator earthing		0.50	1	φ14-25 (1 point)				
Note. 6)	⑤ Cooling unit control cable	10 cores	0.3	1	—	—	Connector 1-1318118-6 (AMP)	M3.5	—
Note. 7)	⑥ Dust collector control cable	7 cores	0.5	1	—	—	Connector 1-1318119-4 (AMP)	M3.5	—



Wiring reference

Note. 0) If the customer's power supply is not AC200V 50/60Hz or AC220V 60Hz transformer which is protected by fuse or breaker in primary line and is adapted secondary line should have neutral regime. (For example type TN) (EN60204-1 ch. 6.3.3 and ch. 8) The transformer check and select the specification of (A) and (B).

Note. 1) Breakers should use the thing dealing with high frequency.

Note. 2) Breakers (A) (B) of NC and the oscillator uses the one suitable for specification of (A) and (B). The specification of (A) and (B) in the case of AC200V 50Hz.

Note. 3) NC should keep the following specification.  
 · In case primary power supply is less than 25[m].  
 The section of cable is 25 [mm<sup>2</sup>] or more.  
 The ambient air temperature of a cable is 50 degrees or less.  
 · In case primary power supply is more than 25[m].  
 Consult with qualified electrical engineering specialists about selection of cable.

Note. 4) Refer to the attached handling description for wiring work for cooling unit and dust collector.

Note. 5) Cable uses the one suitable for each specification. Do not make a gap at the entrance of cable.

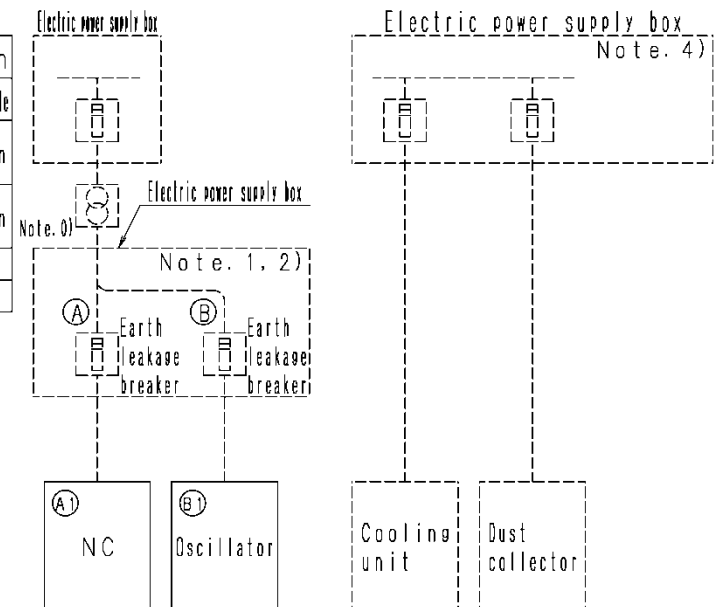
Note. 6) Cooling unit control cable of ⑤ is attached. 15m or more and when required, please arrange of customer.

Note. 7) Dust collector control cable of ⑥ is attached. 15m or more and when required, please arrange of customer.

Note. 8) Please consult with qualified electrical engineering specialists about selection of power incoming unit.

Note. 9) The line and sign in diagram is as follows.  
 — (Solid line) is attachment goods.  
 ··· (Dotted line) is customer preparation.  
 ⊗ (Sign) shows the connecting location of the cable.  
 Machine size, placement are different from the fact to show wiring.

Note. 10) Specification are subject to change without prior notice.



(A) NC specification

	LCG3015
Circuit breaker [A]	50
Rated current [A]	180
Time of rated current [ms]	200
Power capacity [kVA]	4
Power factor [%]	74
Leakage current [mA]	30

(B) Oscillator specification

	AF3500 i-C
Earth leakage breaker [A]	225
Rated current [A]	190
Power capacity [kVA]	55
Leakage current [mA]	100

LCG3015 (EU) + AF3500 i-C

Name	ELECTRIC REFERENCE	Machine	LCG3015EU	Drawing	13.09.13
	AMADA Confidential	Scale	No.	DA1921610118-	

DA7508910-



## 11. HYDRAULIC OIL SUPPLY

The gas blower and the vacuum pump in the laser oscillator require hydraulic oil. Refer to Operator's Manual for specified hydraulic oils and filling procedure.

## 12. CLEANING

Remove the rust preventive grease from the machine surface by using a cleaning oil and then apply lubricant to the surface.

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### NOTICE

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- Do not use solvent to remove grease. If used, it will damage the coating of the machine surface.



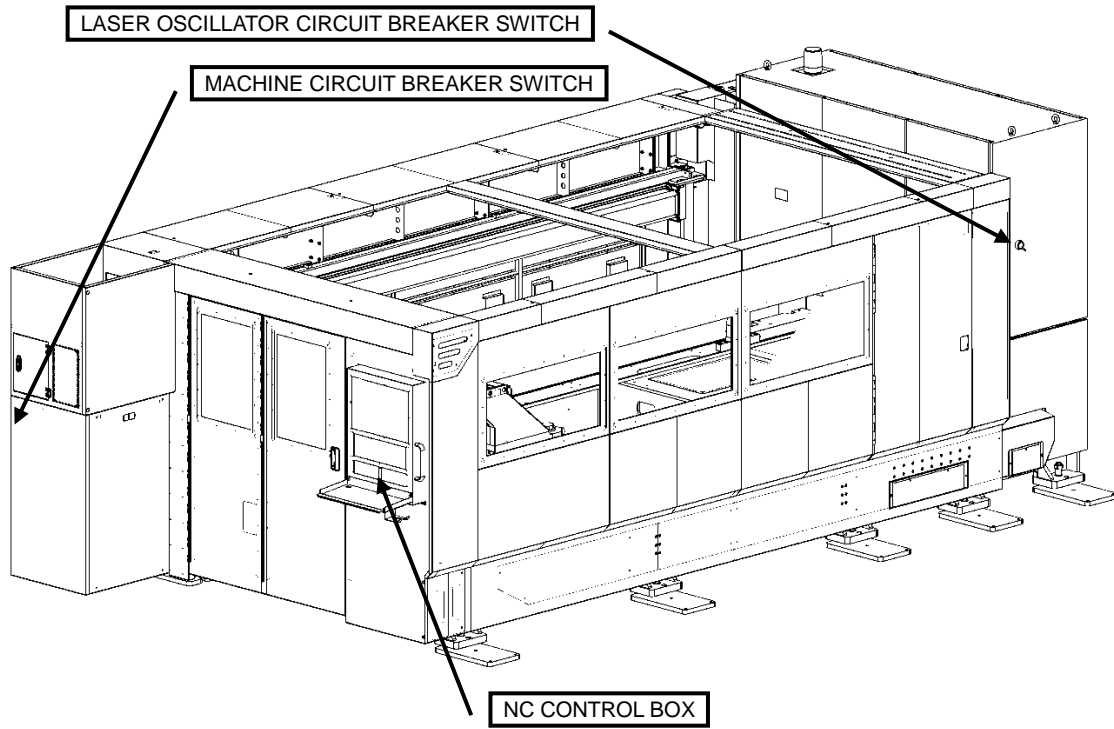
# Part 3

## Controls

1. Arrangement and names of controls .....	3-2
2. Circuit breaker switches.....	3-3
3. NC control box.....	3-4
3-1. Touch screen.....	3-4
3-2. ON/OFF panel.....	3-5
3-3. NC control panel .....	3-7
3-4. USB ports.....	3-12
3-5. Handwheel control box interface .....	3-13
3-6. Handwheel control box.....	3-13
4. Rear control cabinet.....	3-14

# 1. Arrangement and names of controls

LCG3015





## 2. Circuit breaker switches

### Machine circuit breaker switch

NOTICE

#### Machine circuit breaker switch

Used to turn on and off the power of the machine and the NC unit. The flow of overcurrent automatically turns off the power of the machine and the NC unit.

The lever can be padlocked when the switch is turned to OFF.



### Laser oscillator circuit breaker switch

NOTICE

- Do not turn the laser oscillator circuit breaker switch to OFF when the LASER READY light on the NC control box is illuminated.

Turn the laser oscillator circuit breaker switch to ON to make the laser oscillator ready for turning on its power.

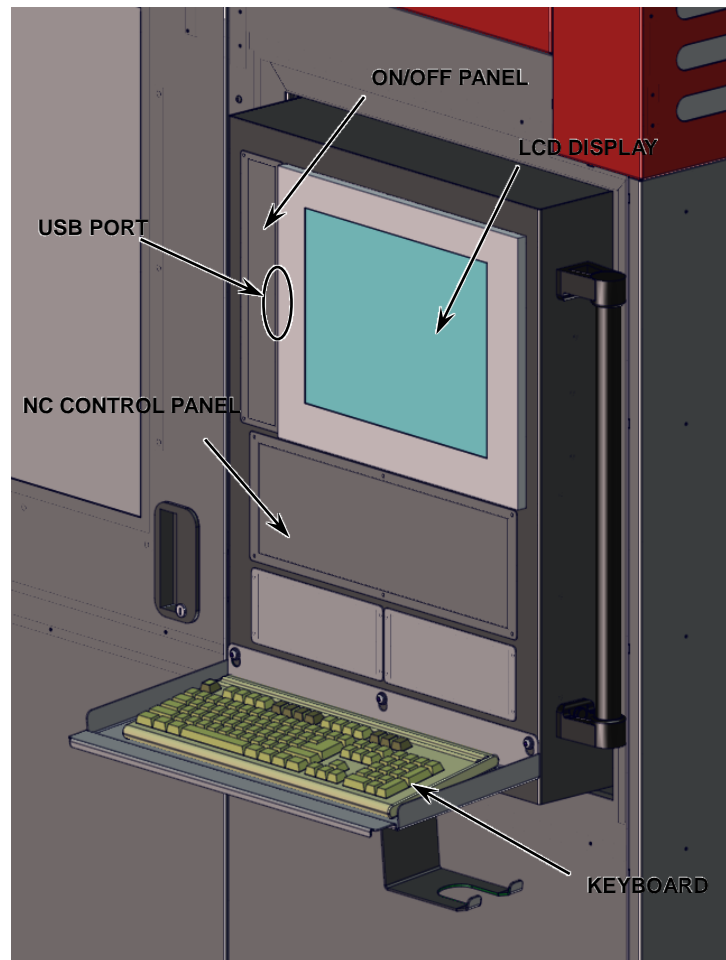
To turn off the power of the laser oscillator, press the POWER OFF button. After power-off processing, the laser oscillator is powered off. The laser oscillator circuit breaker switch automatically changes to TRIP.

When manually turning off the power of the laser oscillator, press the POWER OFF button. When the message "It is now safe to turn off your computer" appears on the touch screen, turn the laser oscillator circuit breaker switch to OFF.

When a failure like a short occurs or an overcurrent flows during the operation of the machine, the laser oscillator circuit breaker switch automatically changes to TRIP to turn off the power of the laser oscillator. In the breaker tripped state, stop the use of the machine, and contact AMADA.

### 3. NC control box

The NC control box consists of a touch screen, an NC control panel, an ON/OFF panel and a USB ports among other things.



#### 3-1. Touch screen

This is a 15-inch color LCD touch screen. Press one of the buttons displayed on the screen to select the corresponding function. These functions allow you to set the machine operating controls and to display and edit the programs. You can also check the status of the machine.

##### REFERENCE

- For the details of the applications, refer to Part I, Displays, in the reference manual of the AMNC-F.

## 3-2. ON/OFF panel

### [1] POWER buttons

#### • POWER ON button

Pressed to illuminate the button light and turn on the power of the NC unit. The NC READY light on the NC control panel illuminates to indicate that the NC unit is ready. To turn on the power of the NC unit, turn the machine circuit breaker switch to ON and press the POWER ON button.

Illuminated: The power of the NC unit is turned on.

Extinguished: The power of the NC unit is turned off.

#### • POWER OFF button

#### NOTICE

- Do not turn off the power of the NC unit while a program is being executed or the access LED of the USB flash drive is flashing.

Press the POWER OFF button to illuminate itself. At the same time, a buzzer continues to sound for 10 seconds. The button then flashes, and the NC unit, machine and laser oscillator power off.

The machine circuit breaker switch and laser oscillator circuit breaker switch automatically change to TRIP.

Within the 10-second time during which the buzzer sounds as soon as the POWER OFF button is pressed, the power-off processing procedure can be cleared by pressing the button again.

Flashing: The power-off processing procedure is being executed.

Extinguished: The power-off processing procedure is not being executed.

### [2] LASER keyswitch and lights

#### • LASER keyswitch

Starts and stops the laser oscillator.

ON: Starts supplying the laser gas to the laser oscillator and then the high voltage to the laser oscillator.

OFF: Stops supplying the high voltage to the laser oscillator, removes the laser gas, and stops the laser oscillator 5 seconds later. When the machine is not in use, turn the keyswitch to OFF, remove the key from the keyswitch, and hand the key to the laser equipment manager for his safekeeping.



NOTE
------

- When the machine enters an emergency stop state while the laser oscillator is starting up, the HIGH VOLTAGE light extinguishes, and the supply of the high voltage to the laser oscillator stops. Clear the emergency stop state, reset the alarm, and turn the LASER keyswitch to OFF and turn it back to ON within 5 seconds. The HIGH VOLTAGE light flashes.

When the preparation is completed for supplying the high voltage to the laser oscillator, the HIGH VOLTAGE light illuminates, and the laser oscillator restarts.

- **LASER READY light**

Extinguished: The LASER keyswitch is set to OFF.

Flashing: The LASER keyswitch is set to ON and the laser oscillator is starting up, or that the LASER keyswitch is turned to OFF and the HIGH VOLTAGE light is extinguished.

Illuminated: The LASER keyswitch is set to ON and the laser oscillator is ready for operation.

- **HIGH VOLTAGE light**

Extinguished: High voltage is not supplied to the laser oscillator.

Flashing: High voltage is being readied for supply to the laser oscillator.

Illuminated: High voltage is supplied to the laser oscillator.

### **[3] MEMORY PROTECT keyswitch**

Protects the program or schedule data in the NC memory from being erased or changed by mistake.

ON: Enables the memory protect function. To protect the program or schedule data from being inadvertently erased or changed, turn the keyswitch to ON, remove the key from the keyswitch, and hand the key to the laser equipment manager for his safekeeping.

OFF: Disables the memory protect function. When editing, registering or calling a program and presetting or editing a schedule, turn the keyswitch to OFF.

NOTE
------

- The processing condition files cannot be protected.

### **[4] Workclamp switch (Optional)**

Opens and closes the workclamps.

The workclamps open or close each time this button is pressed.

Press and hold this button until the clamps are completely closed when closing.

The button has a light that indicates as follows:

Extinguished: The clamp is open completely or it is in the act of opening. When the button is pressed in this state, the clamp starts to close.

Flashing: The clamp is closing with one of the following two actions available.

(1) Close clamp completely

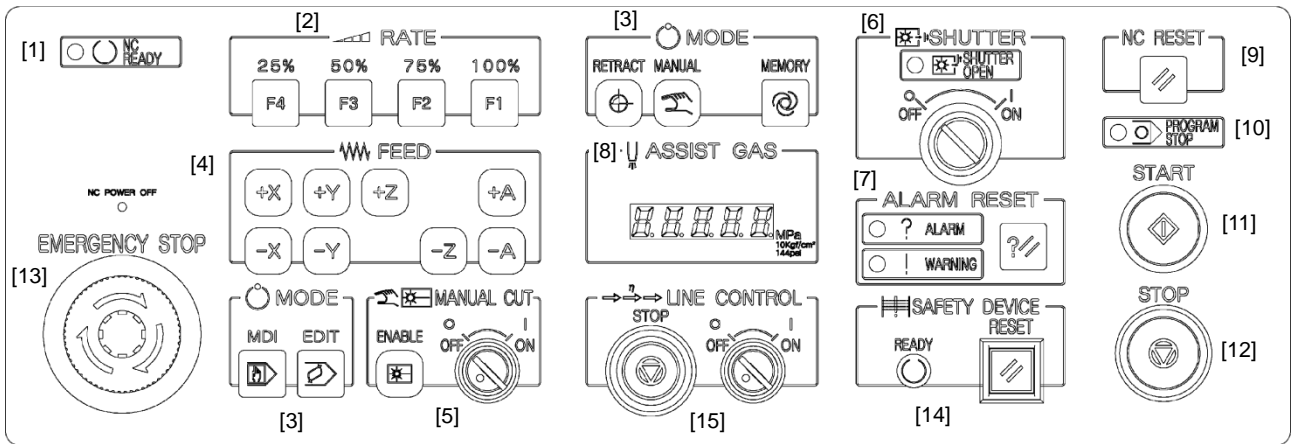
Press the button continuously until the button light illuminates.

(2) Return the clamp to open

Stop pressing the button.

Illuminated: The clamp is closed completely. When the button is pressed in this state, the clamp starts to open.

### 3-3. NC control panel



#### NOTE

- The arrangement and number of controls may vary with the selection of options.

#### [1] NC READY light

Illuminated: The machine circuit breaker switch is turned to ON and the POWER ON button is pressed to make the NC unit ready for operation.

Extinguished: The power of the machine is turned off. The NC unit is not ready and the machine cannot be operated.

#### [2] RATE buttons

Reduce the manual feed rate when moving an axis by one of the FEED buttons and the rapid feed rate specified with G00 in the program. When one of the RATE buttons is pressed, it illuminates.

##### • F4 button

Reduces the feed rate to 25%.

##### • F3 button

Reduces the feed rate to 50%.

##### • F2 button

Reduces the feed rate to 75%.

##### • F1 button

Does not reduce the feed rate. (100%)

RATE button		F4	F3	F2	F1
Manual feed rate	X- and Y-axes	5 m/min {16.4 ft/min}	10 m/min {32.8 ft/min}	15 m/min {49.2 ft/min}	20 m/min {65.6 ft/min}
	Z-axis	3 m/min {9.84 ft/min}	6 m/min {19.68 ft/min}	9 m/min {29.52 ft/min}	12 m/min {39.36 ft/min}
Rapid feed rate (G00 command)	X- and Y-axes	20 m/min {65.6 ft/min}	40 m/min {131.2 ft/min}	60 m/min {196.8 ft/min}	80 m/min {262.4 ft/min}
	Z-axis	15 m/min {49.2 ft/min}	30 m/min {98.4 ft/min}	45 m/min {147.6 ft/min}	60 m/min {196.8 ft/min}
	B-axis	0.025 m/min {0.082 ft/min}	0.05 m/min {0.164 ft/min}	0.075 m/min {0.246 ft/min}	0.1 m/min {0.382 ft/min}

### [3] MODE buttons

Select the NC mode of the machine. When a MODE button is pressed, it illuminates. The RETRACT mode is selected by default when the power of the machine is turned on.

You can select one of the RETRACT, MEMORY, and MANUAL buttons.

Do not select the MDI or EDIT button as they are provided for maintenance purposes.

- **RETRACT button**

Pressed to manually zero-return the X-, Y-, and Z-axes.

- **MANUAL button**

Pressed to manually move the X-, Y-, and Z-axes.

- **MEMORY button**

Pressed basically to run an AMNC-F application.

- **MDI button**

Do not press this button as it is provided for maintenance purposes.

- **EDIT button**

Do not press this button as it is provided for maintenance purposes.

#### [4] FEED buttons

When the MANUAL mode is selected, pressing and holding one of these buttons moves the associated axis in the direction marked on the button.

When the RETRACT mode is selected, pressing one of the +X, +Y and +Z buttons zero-returns the associated axis. The button flashes to indicate that the associated axis is zero-returning and illuminates to indicate that the associated axis has completed its zero-return.

Zero-return the Z-axis, followed by the X- and Y-axes in that order.

#### Description of operation

FEED button	RETRACT mode	MANUAL mode
+X	The X-axis zero-returns.	The X-axis moves in the plus direction (or toward the origin).
-X	The X-axis does not move.	The X-axis moves in the minus direction.
+Y	The Y-axis zero-returns.	The Y-axis moves in the plus direction (or toward the origin).
-Y	The Y-axis does not move.	The Y-axis moves in the minus direction.
+Z	The Z-axis zero-returns.	The Z-axis moves in the plus direction (or toward the origin).
-Z	The Z-axis does not move.	The Z-axis moves in the minus direction.

#### [5] MANUAL CUT keyswitch and button

##### • MANUAL CUT keyswitch

ON: Enables the jog cut function.

OFF: Disables the jog cut function.

##### • MANUAL CUT ENABLE button

Used to perform jog cutting.

Set the processing conditions, turn the MANUAL CUT keyswitch to ON, press and hold the MANUAL CUT ENABLE button, and press one of the FEED buttons to determine the cutting direction. Jog cutting is performed as long as the two buttons are pressed and held.

## **[6] SHUTTER keyswitch and light**

### **• SHUTTER keyswitch**

ON: Enables the shutter of the laser oscillator to be opened.

OFF: Disables the shutter of the laser oscillator to be opened and emits the semiconductor laser beam from the laser head. When the machine is not in use, turn the keyswitch to OFF, remove the key from the keyswitch, and hand the key to the laser equipment manager for his safekeeping.

### **• SHUTTER OPEN light**

Illuminated: The laser shutter is open.

Extinguished: The laser shutter is closed.

## **[7] ALARM RESET button and lights**

### **• ALARM RESET button**

Clears an alarm when pressed. Remove the cause of the alarm beforehand when the machine is in the alarm condition and the ALARM light on the NC control panel illuminates.

This button can be used only for clearing the alarm, unlike the NC RESET button on the NC control panel.

### **• ALARM light**

Illuminated or flashing: A machine alarm has occurred.

Extinguished: There is no alarm.

### **• WARNING light**

Flashing: A machine warning has occurred.

Extinguished: There is no warning.

## **[8] ASSIST GAS pressure indicator**

Indicates the pressure of the assist gas.

NOTE
------

- This indicator does not show the pressure of the laser gas.

## **[9] NC RESET button**

Used to clear a machine alarm. When a machine alarm occurs, the ALARM light illuminates. Remove the cause of the alarm, and press the NC RESET button to clear the machine alarm with the program returned to the beginning (NC unit reset). The ALARM light is also extinguished.

When this button is pressed without the cause of the alarm being removed, the machine alarm will be cleared with the program returned to the beginning. The ALARM light remains flashing.

## **[10] PROGRAM STOP light**

Illuminated: The machine is stopped by a program stop (M00) command.

Extinguished: The machine is not stopped by a program stop (M00) command.



### [11] START button

Pressed to start the automatic operation of the machine when the MEMORY mode is selected.

Illuminated: The machine is automatically operating.

Extinguished: The machine is not automatically operating.

### [12] STOP button

Pressed to illuminate and stop the automatic operation of the machine. Unless the button is pressed again, the stop state cannot be cleared.

Illuminated: The STOP button is pressed or the machine is stopped by an alarm, for example.

Extinguished: The machine is not stopped.

### [13] EMERGENCY STOP button

 <b>DANGER</b> <ul style="list-style-type: none"><li>● <b>Before unlocking the EMERGENCY STOP button, be sure to remove the cause of the emergency stop and check for safety around the machine.</b></li></ul>
---

Pressed to stop and discontinue the operation of the machine in any mode.

The NC unit enters an emergency stop condition and stops its automatic operation. The laser oscillator has its high-voltage power turned off to stop its oscillation.

The stopped operation cannot be resumed and must be started again from the beginning.

The button will be locked when pressed and can be unlocked by turning it clockwise. After clearing the emergency stop, be sure to zero-return the machine.

NOTE
------

- Zero-return the Z-axis, followed by the X- and Y-axes in that order.
- There are two EMERGENCY STOP buttons: one on the NC control box and the other on the rear control box.

### [14] SAFETY DEVICE button and light

#### ● SAFETY DEVICE RESET button

The machine stops when the safety device operates.

Remove the cause of the operation of the safety device, and press the button to clear the stop state and ready the safety device.

#### ● SAFETY DEVICE READY light

Indicates the condition of the processing machine.

Illuminated: That the safety device is ready and the machine can be operated.

Extinguished: The safety device has operated to stop the machine.

## [15] LINE CONTROL button and keyswitch (option)

### • LINE STOP button with light

Pressed to illuminate itself and stop the schedule operation of the machine. The stop state cannot be cleared unless the button is pressed again.

The button also illuminates when the line is stopped.

### • LINE CONTROL keyswitch

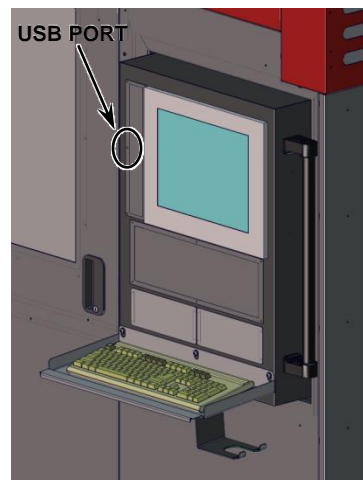
ON: Enables the schedule operation of the machine. The machine cuts worksheets according to the schedule made on the SCHEDULE display.

OFF: Causes the machine to cut only a single worksheet according to the schedule.

## 3-4. USB ports

Open the cover before use.

Insert the USB flash drive into the USB port to input and output data and programs between the USB flash drive and NC unit.



### NOTICE

- The AMNC-F is installed with security software. Take extra care against viruses and other malicious software. Do not connect media of unknown origin into the USB port.

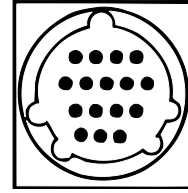
### NOTE

- The processing programs saved in the USB flash drive may not be able to be listed on the screen in the SDD format and transfer identifier format, depending on their total capacity or number. In such a case, delete some processing programs saved in the USB flash drive.
- The processing programs may not be able to be saved in the root directory of a USB flash drive formatted in the FAT16 file system because the number of files that can be saved is predetermined, irrespective of its free capacity.
- It is recommended to remove the USB media from the USB port when the NC unit is powered off. If you want to remove the USB media while the NC unit is powered on, check that the access LED of the USB media is not flashing, and then remove the USB media.
- Do not connect any device other than the USB media and keyboard into the USB port. Some USB media may not operate in the AMNC-F.

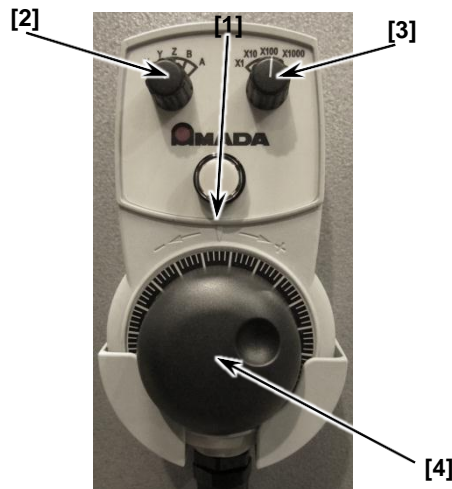
### 3-5. Handwheel control box interface

Located on the flexible cable connecting bracket in the rear of the NC control box.

Connects the handwheel control box.



### 3-6. Handwheel control box



#### [1] Handwheel mode button

Pressed to illuminate the handwheel mode button, enable the operation of the machine with the handwheel control box, and extinguish the lights of the RETRACT, MEMORY and MANUAL buttons.

Pressed again to extinguish the handwheel mode button and disable the operation of the machine with the handwheel control box.

#### [2] Axis selection switch

Turned to the position below to enable the selected axis.

Turned to X to select the X-axis.

Turned to Y to select the Y-axis.

Turned to Z to select the Z-axis.

Turned to B to select the B-axis.

Turned to A to select the A-axis.

Selects the axis to be moved by the handwheel.

#### [3] Magnification selection switch

Selects the feed magnification for the handwheel.

**x1:** Feeds in 0.001 mm {0.0001 in.} per graduation.

**x10:** Feeds in 0.01 mm {0.001 in.} per graduation.

**x100:** Feeds in 0.1 mm {0.01 in.} per graduation.

**x1000:** Feeds in 1 mm {0.1 in.} per graduation.

#### [4] Handwheel

Moves the axis that was selected with the axis selection switch at the feed rate that was selected with the magnification selection switch. Turning clockwise moves the axis in the plus direction while turning counterclockwise moves it in the minus direction.

### 4. Rear control cabinet

APC battery box and handle side



#### [1] Breaker handle

This can be used to turn on the power of the machine.

Refer to “2. Circuit breaker switches” section in this Part.



#### [2] APC battery box (four size D alkaline batteries)

Used for storing the coordinate positions of axes.



# Part 4

# Operation

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## **WARNING**

- **Before working in the hazardous area around the machine (for setting the worksheet or removing the part or scrap, for example), be sure to press the STOP button and turn the SHUTTER keyswitch to OFF.**

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# 1. Preparation procedures

## 1-1. Checking before start of day's work



### WARNING

- **Be sure to check the machine before the start of the day's work. As soon as you find equipment failure or trouble, repair it or take any other necessary measure to prevent an accident.**

### REFERENCE

- For the items and other details of before starting the day's work, refer to "2-1. Maintenance before start of day's work" in Part 5.

Before starting the day's work, perform the following items.

- Check (Clean) the lens.
- Check the nozzle.
- Check the nozzle unit of the Z-axis tracking sensor.
- Check the residual pressure of the laser gas.
- Check the residual pressure of the assist gas.
- Clean the table and the area around the machine.
- Clean the dust box of the dust collector.
- Check the oil level of the exhaust pump (vane pump).
- Check the oil level of turboblower.
- Check the safety device.
- Clean and check the scrap box (remove flammables)

## 1-2. Starting up machine

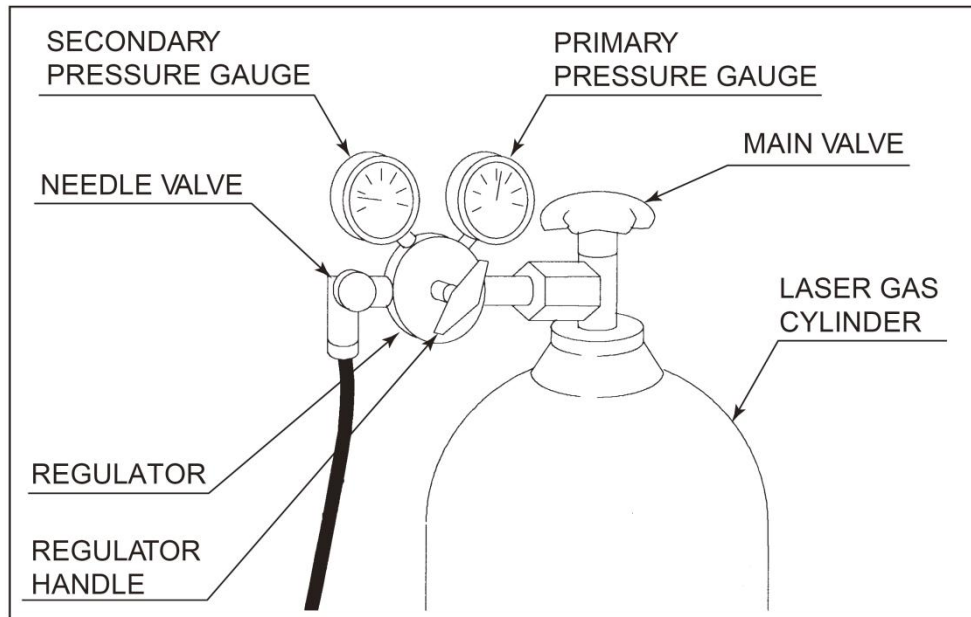
Start up the machine as described below.

1. Turn on the power of the air compressor.
2. Turn to ON the shop ground-fault circuit breakers connected to the machine, laser oscillator, and purge unit.

### NOTICE

- Use ground-fault circuit breakers for high-frequency application.
  - Check that the shop ground-fault circuit breakers connected to the cooling unit and the dust collector are set to ON.
3. Turn the main valve of the laser gas cylinder counterclockwise to open.

4. Turn the needle valve of the laser gas regulator counterclockwise to open. Check that the primary and secondary pressure gauges read as below.
  - Primary pressure: 1 MPa {143 psi} or more.
  - Secondary pressure:  $0.175 \pm 0.025$  MPa (0.15 to 0.20 MPa)  
or  $25.4 \pm 3.6$  psi (21.8 to 29.0 psi).



5. Turn the main valve of the assist gas cylinder counterclockwise to open.
6. Check that compressed air of 0.5 MPa {72 psi} or more is supplied to the machine. Read the air pressure gauge of the machine.

**REFERENCE**

- For the pressure adjustment of compressed air, refer to “5-5. Adjusting air unit” in Part 5.
7. Check that the LASER and SHUTTER keyswitches on the NC control box are set to OFF.
  8. Turn the laser oscillator circuit breaker switch to ON.
  9. Turn the machine circuit breaker switch to ON.
  10. Press the POWER ON button on the NC control box.

When the NC unit becomes ready, the NC READY light on the NC control panel illuminates.

**NOTE**

- When an alarm is caused, remove the cause of the alarm, and press the SAFETY DEVICE RESET button or NC RESET button on the NC control panel.



## 1-3. Zero-returning

Zero-return the machine as described below.

1. Check that the RETRACT button on the NC control panel is illuminated.
2. With the FEED buttons on the NC control panel, zero-return the X-, Y-, and Z-axes in the following order.

The FEED button for each axis flashes to indicate that the axis is zero-returning and changes to steady to indicate that the axis has completely zero-returned.

- (1) Press the +Z button to zero-return the Z-axis.
- (2) Press the +X and +Y buttons sequentially to zero-return the X- and Y-axes.

## 1-4. Checking safety devices

### 1-4-1. Checking interlocks for operation

The area sensor (light curtain) or the sliding doors of the partitions are equipped with interlocks. Check the interlocks for operation as described below.

When other interlocks are used, refer to their manuals. Check all of them for operation.

If the interlocks do not operate, stop the use of the machine, and contact AMADA.

1. Check that the SAFETY DEVICE READY light is illuminated.
2. Operate each interlock, and check that the SAFETY DEVICE READY light extinguishes and that the ALARM light illuminates.

#### **Partitions:**

Open each swing door to operate its interlock, and check that the SAFETY DEVICE READY light extinguishes and that the ALARM light illuminates.

3. When you have completed the operational check of each interlock, return it to the original condition, and press the SAFETY DEVICE RESET button. Check that the SAFETY DEVICE READY light illuminates and that the ALARM light extinguishes.

### 1-4-2. Checking EMERGENCY STOP buttons for operation

Check all of the EMERGENCY STOP buttons for operation.

If the EMERGENCY STOP buttons do not operate, stop the use of the machine, and contact AMADA.

1. Press each EMERGENCY STOP button. Check that it is locked, that the ALARM light illuminates, and that EMG appears on the screen.
2. When you have completed the operational check of each EMERGENCY STOP button, unlock it. Check that the ALARM light extinguishes and that EMG disappears from the screen.

NOTE
------

- As soon as an EMERGENCY STOP button is pressed, the laser oscillator is turned off. To continue the operation of the machine, start up the laser oscillator.

## 1-5. Starting up laser oscillator

Turn the LASER keyswitch on the NC control box to ON.

Laser gas supply and high-voltage supply start. Upon completion of the startup, the laser oscillator becomes ready for operation.

### NOTE

- While the laser oscillator is starting up, the LASER READY light and HIGH VOLTAGE light on the NC control box are flashing. Both lights illuminate steady to indicate that the laser oscillator has completely started up.

### Warming up laser oscillator

When it is a cold season, warm up the laser oscillator as described below.

1. Press and illuminate the MEMORY button on the NC control panel.
2. Press the UTILITY button at the top of the screen to open the UTILITY display.
3. Press the Internal electric discharge button on the UTILITY display to open the Internal electric discharge display.

On the Internal electric discharge display, set the conditions for the laser oscillator to deliver 80% of the rated output, and set the Time field to 900 sec.

4. Turn the SHUTTER keyswitch on the NC control panel to OFF.
5. Press the START button on the NC control panel to start the laser oscillator discharging.

### NOTE

- In a cold season, restart the laser oscillator after the warm-up operation to update the correction value of the laser oscillator and stabilize the laser beam.

## 2. Preparing for automatic operation

Here are described the preparation procedures for automatically operating the machine after starting up the machine and laser oscillator.

### 2-1. Calling program or programs

#### 2-1-1. Single-program operation

To perform the single-program operation of the machine, call the necessary program to the PROGRAM display as described below.

### REFERENCE

- For the detailed procedure for calling a program, refer to “5-2. Calling program from PROGRAM display” in Part I, Displays, in the reference manual of the AMNC-F.
1. Press and illuminate the MEMORY button on the NC control panel.
  2. Press the PROGRAM button at the top of the screen to open the PROGRAM display. Check that the operating mode change PROGRAM button is selected and illuminated on the PROGRAM display.

3. Press the OPEN button on the PROGRAM display to show the Open display.
4. Press one of the media selection button containing the program you want to call from the Open display.

Programs are listed on the Open display.

5. Select the necessary program from the list.
6. Press the OK button on the Open display.

The selected program is shown on the PROGRAM display.

## 2-1-2. Schedule operation

To perform the schedule operation of the machine, call the necessary program or programs to the SCHEDULE display as described below.

### REFERENCE

- For the detailed procedure for calling a program, refer to “4-2. Calling program from SCHEDULE display” in Part I, Displays, in the reference manual of the AMNC-F.

1. Press and illuminate the MEMORY button on the NC control panel.
2. Press the SCHEDULE button at the top of the screen to open the SCHEDULE display. Check that the operating mode change SCHEDULE button is selected and illuminated on the SCHEDULE display.
3. Press the OPEN button on the SCHEDULE display to show the Open display.
4. Press one of the media selection button containing the program or programs you want to call from the Open display.

Programs are listed on the Open display.

5. Select the necessary program or programs on the Open display.
6. Press the OK button on the Open display.

The selected program or programs are called to the SCHEDULE display.

7. Enter the number of worksheets to be processed, and press the OK button.

When you have called multiple programs, check the name of each program, and enter the number of worksheets to be processed for each program.

8. The called program or programs are registered on the SCHEDULE display.

### NOTE

- To read an ASIS schedule file, press the media selection SCHEDULE button on the Open display.

## 2-2. Setting up

When there is a setup to be made with the program shown on the PROGRAM display, the display for the setup automatically appears. When there is no setup to be made, such a display does not automatically appear.

### NOTE

- To automatically show the display for the setup, check the necessary setup boxes on the Application settings window of the maintenance display.

### REFERENCE

- For the detailed procedure of setting up, refer to “11. Setting up” in Part II, Program Management, in the reference manual of the AMNC-F.
1. Press the setup icon for the job after the current job to open the Setup Main window. Press the LASER or MATERIAL/CLAMP button.
  2. Set up those items shown in red at the material change setup.  
When the material change setup is completed, press the SETUP COMPLETE button.
  3. Set up those items shown in red at the workclamp position setup.  
When the workclamp setup is completed, press the SETUP COMPLETE button.
  4. When all setups are completed, press the BACK button.
  5. If the LASER and MATERIAL/CLAMP buttons on the Setup Main window are colored gray, it means that the setup procedure is completed. Press the OK button.

## 2-3. Checking processing condition file

The processing condition file specified by M102 is automatically called when the machine is operated by using the program.

### REFERENCE

- For checking the processing condition files, refer to “8. Processing condition displays” in Part I, Displays, in the reference manual of the AMNC-F.
1. Press the COND. button at the top of the screen to open the processing condition display.
  2. Press the LIST button on the processing condition display to open the LIST display. Select the processing condition file of the worksheet material you want to cut.
  3. Press the CALL button on the LIST display.

The display changes to the CUT display and shows the selected processing condition file.

## 2-4. Setting worksheet



### CAUTION

- When fixing the worksheet with the workclamps, take care not to have the fingers pinched in the workclamps.
- When handling the worksheet, wear leather gloves or thick cotton gloves. If you do not wear such gloves, you may get injured at the edges, corners, or burrs of the worksheet.

Set the worksheet on either pallet of the shuttle table, and load the pallet onto the machine table.

To fix the worksheet with the pneumatic clamps, press and hold the SHUTTLE CLAMP OPEN button for 3 sec or more.

### REFERENCE

- For the pallet change procedure, refer to “7-6. Shuttle Exchange” in Part I, Displays, in the reference manual of the AMNC-F.

## 2-5. Changing nozzle



### WARNING

- When changing the nozzle, press the STOP button, turn the SHUTTER keyswitch to OFF, remove the key from the keyswitch, and hand it to the laser equipment manager for safekeeping.
- Unless the nozzle unit is securely inserted until it stops, the nozzle may jump out when the assist gas is discharged.

### NOTICE

- Use a dedicated nozzle or collared-type nozzle. When a conventional type or non-collared type is used, spatter may deposit on the sensor cone of the nozzle mount to cause damage or misoperation of the nozzle. Spatter may also plug the cooling air outlet holes of an ECO nozzle and may make the nozzle unable to function as intended.
- Store the removed nozzle in a dedicated nozzle case or cabinet. If the nozzle is contaminated or damaged, it may cause a processing failure.

Before changing the nozzle, prepare a nozzle that suits the processing method to be employed. A genuine nozzle is marked with its type and Amada logo. Then check that the nozzle is cleaned.

When performing maintenance on the nozzle unit or changing the nozzle for a new processing method, remove and install the nozzle unit.

The entire laser head is designed to tilt and absorb the energy of impact and protect the laser head when the nozzle unit strikes the part as the part rises during the processing operation or strikes other obstacle.

## 2-5-1. Removing nozzle

1. With the FEED buttons on the NC control panel, move the laser head to a position where the nozzle can be easily changed.

The laser head can also be moved by setting the Exchange Position X, Y, and Z on the Nozzle/Head Exchange Position display.

### REFERENCE

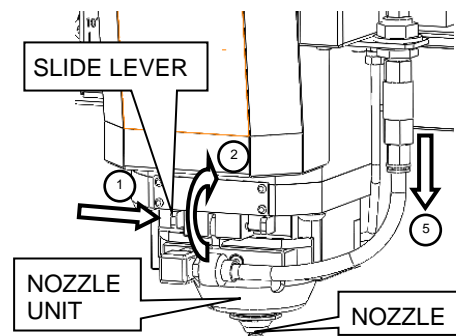
- For the detail of the Nozzle/Head Exchange Position display, refer to “7-4. Nozzle/Head Exchange Position” in Part I, Displays, in the reference manual of the AMNC-F.

2. Press and illuminate the STOP button on the NC control panel.
3. Check that the SHUTTER keyswitch on the NC control panel is set to OFF. If not, turn it to OFF.

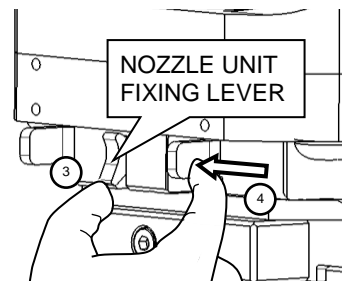
4. Open the front doors.

The power to all axes is disconnected for safety.

5. Move the slide lever to the right. ①  
And raise the nozzle unit fixing lever. ②



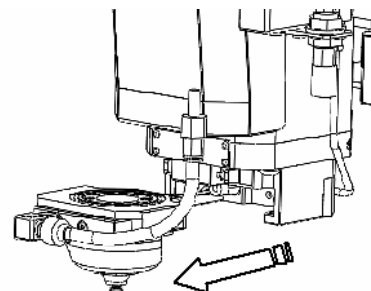
6. Hold the nozzle unit fixing lever up. ③  
And move the slide lever to the left so as not to lower the nozzle unit fixing lever. ④



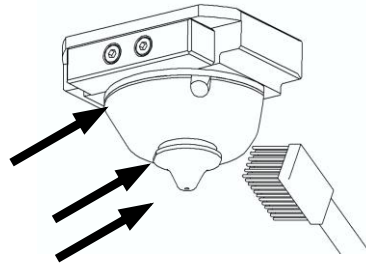
7. Disconnect the air blow tube for the sensor cone from the one-touch coupler. ⑤

8. Pull out the nozzle unit.

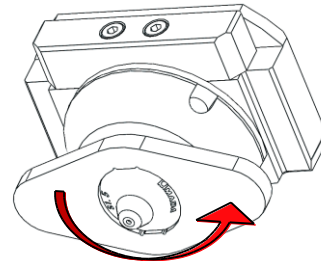
The cable of the Z-axis tracking sensor and the connector of nozzle cooling air are disconnected automatically.



- Clean the nozzle unit with a toothbrush or cotton swab if it is dirty with dust or foreign matter (in particular, the arrow-marked portions shown right).



- When changing the nozzle, use the nozzle jig on the notches of the nozzle, and turn the nozzle to remove it.



## 2-5-2. Installing nozzle

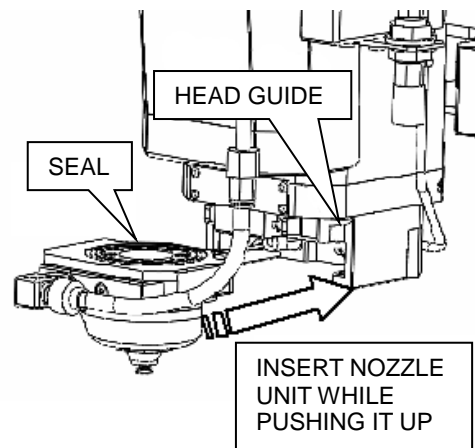
- Install a nozzle to suit the processing method to be employed or a maintained nozzle.

The nozzle unit may break if it is tightened excessively with the nozzle jig.

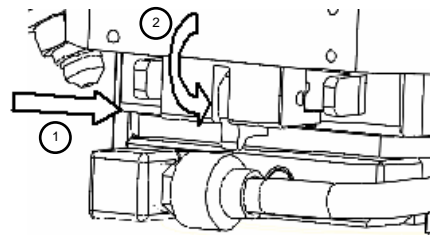
- Insert the nozzle unit in parallel with the seal guide while pushing it up so as to smash the seal against the laser head guide.

The cable of the Z-axis tracking sensor and the connector of nozzle cooling air are connected automatically.

Swing the nozzle unit to the right and left, and insert or remove it once and insert it again if it is not fully inserted.



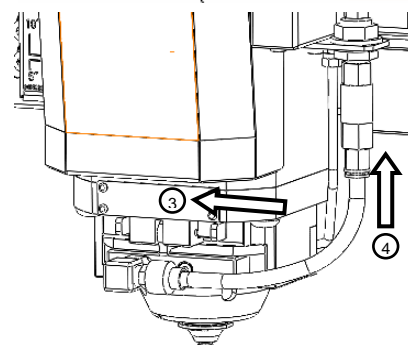
- Move the slide lever to the right. ①  
And lower the nozzle unit fixing lever. ②



- Move the slide lever to the left to fix the nozzle unit. ③

- Connect the one-touch coupler to the air blow tube for the sensor cone. ④

- Close the front doors.



7. Check for safety in the surrounding area, and press the SAFETY DEVICE RESET button on the NC control panel.

The SAFETY DEVICE READY light on the NC control panel illuminates.

8. Press and extinguish the STOP button on the NC control panel.
9. When the nozzle unit and nozzle are installed again, center the nozzle and calibrate the Z-axis tracking sensor.

## 2-6. Changing lens



### WARNING

- When changing the lens, press the STOP button, turn the SHUTTER keyswitch to OFF, remove the key from the keyswitch, and hand it to the laser equipment manager for safekeeping.

### NOTICE

- Protect the removed lens with a dedicated lens cap, and store it in a dedicated lens case. If the lens is contaminated or damaged, it may cause a processing failure.

If the seal is contaminated or damaged, it may cause an assist gas leak and processing failure.

- The lens contains zinc selenide (ZnSe). At the end of the day's work, store the lens in its case and then the case in a lockable cabinet.

Before changing the lens, prepare a lens that suits the processing method to be employed. A genuine lens is marked with its type and Amada logo. Then check that the lens is cleaned.

When performing maintenance on the lens or changing the lens for a new processing method, do as described below.

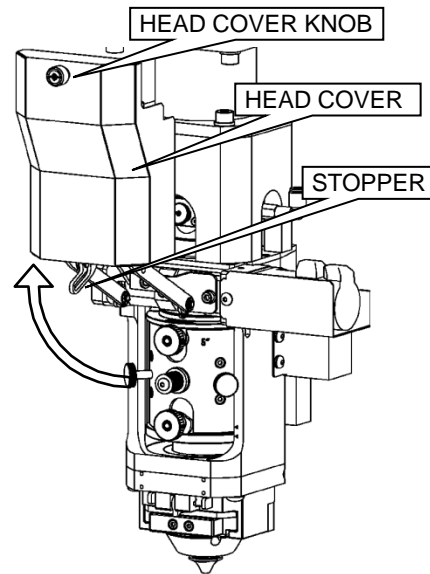




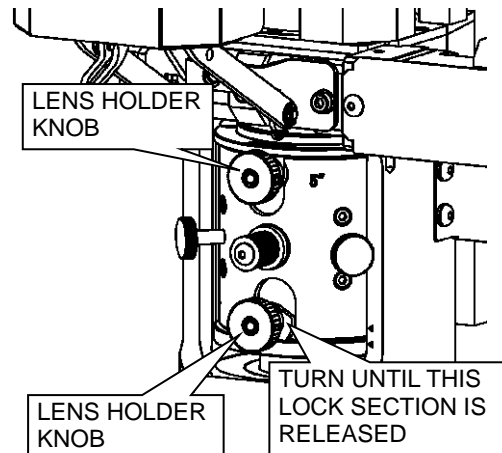
## 2-6-1. Removing lens

1. With the FEED buttons on the NC control panel, move the laser head to a position where the lens can be easily changed.
2. Press and illuminate the STOP button on the NC control panel.
3. Check that the SHUTTER keyswitch on the NC control panel is set to OFF. If not, turn it to OFF.
4. Open the front doors.

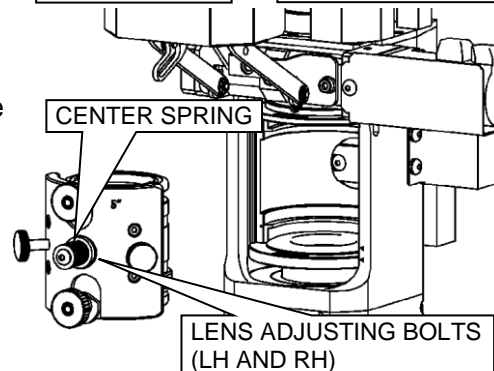
The power to all axes is disconnected for safety.



5. Lift and open the laser head cover. (The laser head cover is fixed open by the stopper.)
6. Loosen the lens holder knobs above and below the lens holder to release the lock.

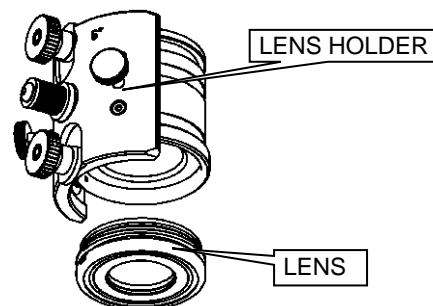


7. Hold and pull out the lens holder to remove it. (Do not remove the left and right golden lens adjusting bolts and the center spring.)



8. Remove the lens from the lens holder.

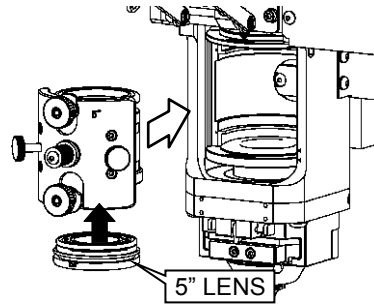
With the 7.5" lens holder, lift its upper part, and slightly turn the lens for easy removal. Handle the lens with care so as not to drop it.



9. Press and extinguish the STOP button on the NC control panel.

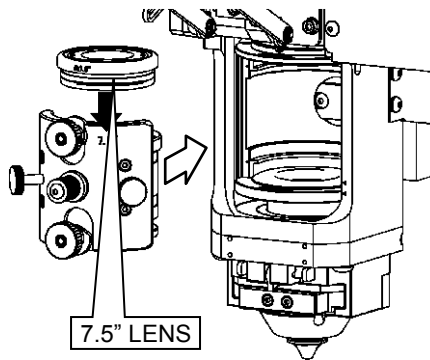
## 2-6-2. Installing lens

1. Install a lens to suit the processing method to be employed or a maintained lens in the lens holder.
2. The 5" lens and 7.5" lens (option) must be installed in their dedicated lens holders, respectively. Install the lens in the lens holder so that its marked position matches that of the lens holder. Centering the nozzle becomes reliable



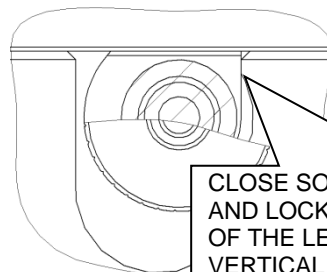
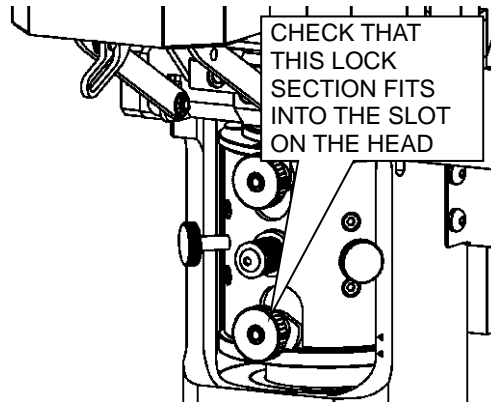
3. Install the 5" lens in the 5" lens holder from below. The 5" holder has no upper parts.

Install the 7.5" lens in the 7.5" lens holder from above. Slightly turn it until it snugly fits in the lens holder. Have the upper part of the lens holder lowered beforehand.

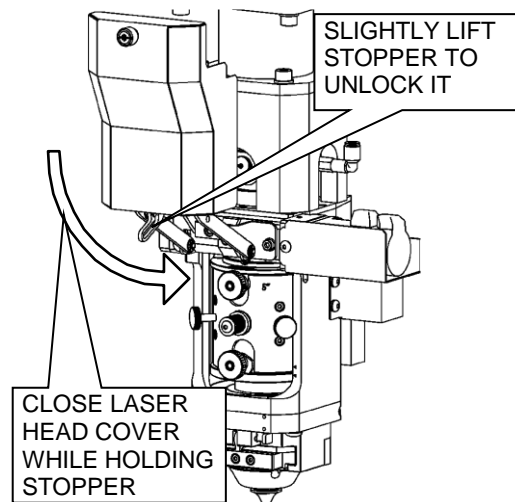


The lens holder has a stopper. The stopper prevents the lens from being fully inserted and the laser head cover from being closed when the lens is improperly installed. Pay attention to the installation direction.

4. Turn the lens holder knobs above and below the lens holder counterclockwise to lock. The lens may be loose if the lock is not tight enough. Make sure that the lock section of the lens holder knob is in the position indicated in the figure at right.



- Unlock the stopper, and close the laser head cover. (To center the nozzle, leave the laser head cover open. Close it after centering the nozzle.)
- Close the front doors.



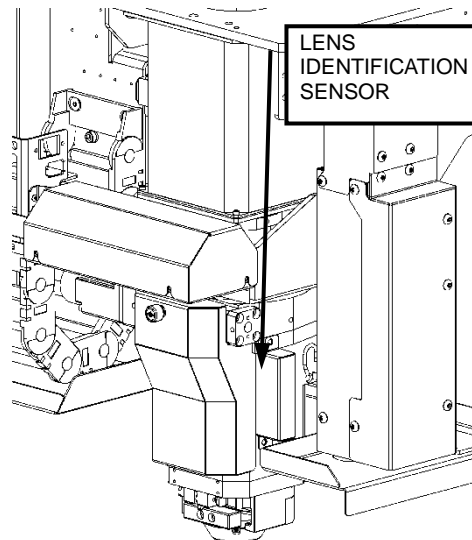
- Check for safety in the surrounding area, and press the SAFETY DEVICE RESET button on the NC control panel.

The SAFETY DEVICE READY light on the NC control panel illuminates.

- Press and extinguish the STOP button on the NC control panel.

**NOTE**

- The laser head has a lens identification sensor. An alarm occurs when the program operation is started with the lens different from that in the processing condition file installed.



## 2-7. Checking assist gas

Check that the assist gas is normally discharged as described below.

- Press and illuminate the MEMORY button on the NC control panel.
- Press the UTILITY button at the top of the screen to open the UTILITY display.
- Press the CHECK ASSIST GAS button on the UTILITY display to open the Check Assist Gas display.

**REFERENCE**

- For the detail of the Check Assist Gas display, refer to “7-8. Check Assist Gas” in Part I, Displays, in the reference manual of the AMNC-F.
- On the Check Assist Gas display, set the Gas Kind, Gas Pressure, and Time fields to suit the processing method to be employed.

To use oxygen, nitrogen, and air as assist gas, set the Gas Kind field to 1, 4, and 5, respectively.

5. Press the START button on the NC control panel.

The assist gas is discharged. Check the pressure with the ASSIST GAS pressure indicator on the NC control panel.

## 2-8. Centering nozzle

**⚠ WARNING**

- **Never look into the laser head even when the SHUTTER keyswitch is turned OFF. Otherwise you may lose your eyesight.**
- **Press the STOP button and set the SHUTTER keyswitch to OFF when attaching or peeling off the adhesive tape for adjusting and checking the centering position of the nozzle. Otherwise you may get your hand burned or caught in the machine.**

### NOTICE

- Center the nozzle at a position with no worksheet or skid just below the laser head. If the laser head is centered just above the worksheet or skid, the reflected light may burn the adhesive tape.

Centering refers to the adjustment of the lens to align the center of the laser beam with the center of the nozzle.

Be sure to perform this centering task at the start of the day's work, after the maintenance or replacement of the nozzle or lens, or after the adjustment or alignment of the laser beam.

The centering task is also required when spatter is unevenly produced on the worksheet surface from the cutting position during a linear or circular cut, or when cut parts or scrap are of uneven cut edge quality.

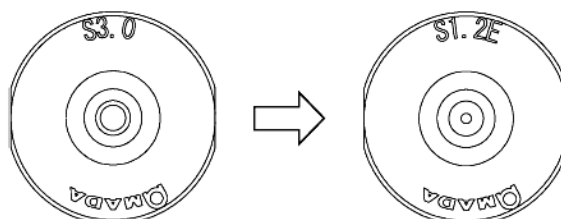
Center the nozzle as described below.

1. Center the lens with the nozzle to be used for the processing operation.

When changing the nozzle, refer to "2-5. Changing nozzle" in this Part.

### NOTE

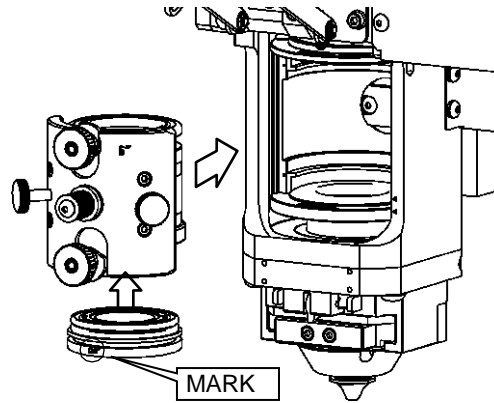
- If the lens is centered with a large-diameter nozzle, a subsequent change to a smaller-diameter nozzle shifts the center of the lens and adversely affects the processing operation. Visually check the trace of the nozzle tip and the position of the hole pierced by the laser beam, using the accessory loupe.



2. Install the lens with its mark facing the front. To install the lens, refer to “2-6. Changing lens” in this Part.

NOTE

- If the lens is changed in its mounting position, it may be changed in its focal point as well.



3. With the FEED buttons on the NC control panel, move the laser head to a position where the nozzle can be easily centered.
4. Press and illuminate the MEMORY button on the NC control panel.
5. Press the UTILITY button at the top of the screen to open the UTILITY display.
6. Press the Adjust the Nozzle Unit Centering button on the UTILITY display to open the Adjust the Nozzle Unit Centering display.

NOTE

- Select the installed lens from the LENS pull-down menu on the Adjust the Nozzle Unit Centering display.

7. Press and illuminate the STOP button on the NC control panel.
8. Check that the SHUTTER keyswitch on the NC control panel is set to OFF. If not, turn it to OFF.
9. Open the front doors.

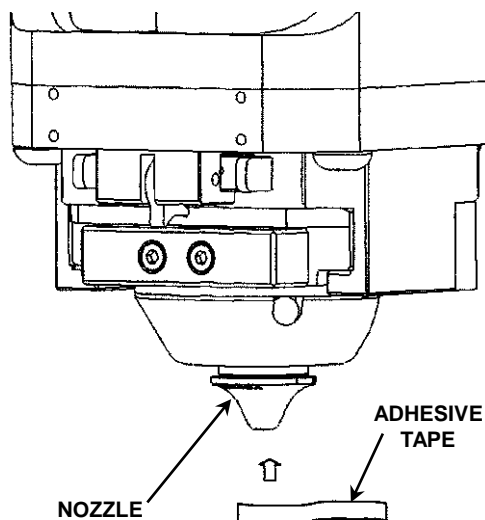
The power to all axes is disconnected for safety.

10. Attach adhesive tape to the nozzle tip.

NOTE

- Putting ink on the nozzle tip with a black marker or stamp pad facilitates the nozzle center adjustment. Wipe it off after completion of the work.

Use glossy adhesive tape. The center cannot be checked if matte type (i.e., inconspicuous) adhesive tape is used.



11. Close the front doors.
12. Check for safety in the surrounding area, and press the SAFETY DEVICE RESET button on the NC control panel.

The SAFETY DEVICE READY light on the NC control panel illuminates.

13. Press and extinguish the STOP button on the NC control panel.

14. Turn the SHUTTER keyswitch on the NC control panel to ON.
15. Press the ADJUSTMENT button on the Adjust the Nozzle Unit Centering display.
16. Press the START button on the NC control panel.

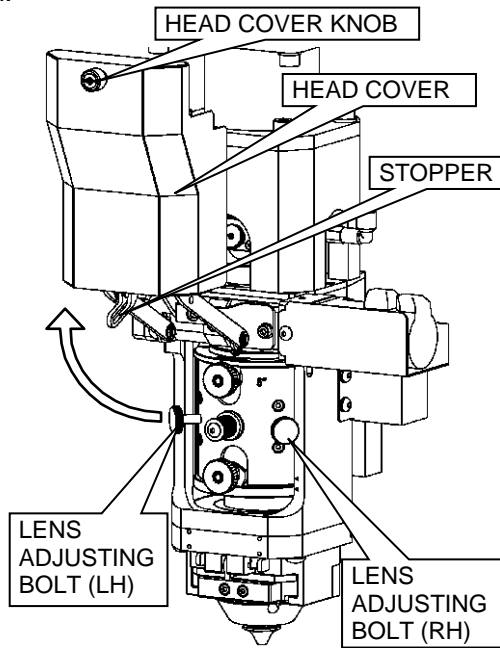
The laser head moves down and emits a laser beam.

17. Press and illuminate the STOP button on the NC control panel, and turn the SHUTTER keyswitch on the NC control panel to OFF.
18. Open the front doors.

Remove the adhesive tape from the nozzle tip. Check with a magnifier to see if the center of the laser-pierced hole is aligned with the center of the ink-marked nozzle tip circle. Adjust the lens position if the hole is misaligned.

19. Lift and open the laser head cover. (The laser head cover is fixed open by the stopper.)

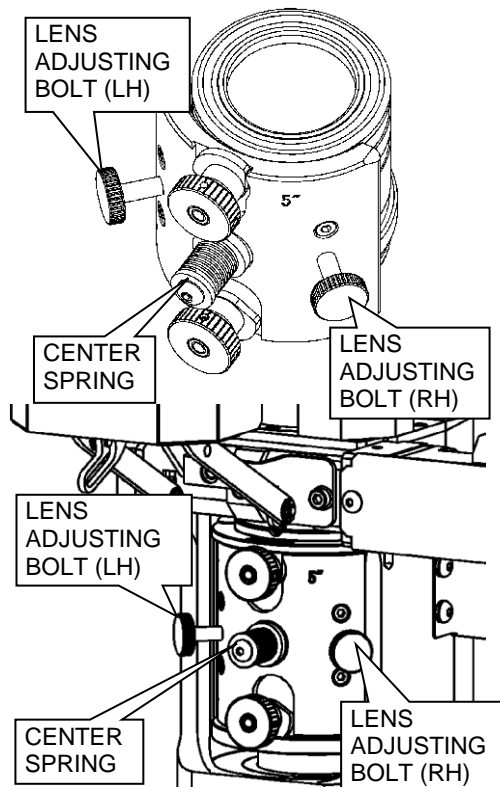
The second and subsequent center adjustments may be made with the laser head cover open.



20. Adjust the lens position with the right and left lens adjusting bolts.

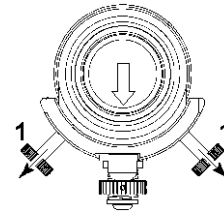
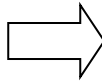
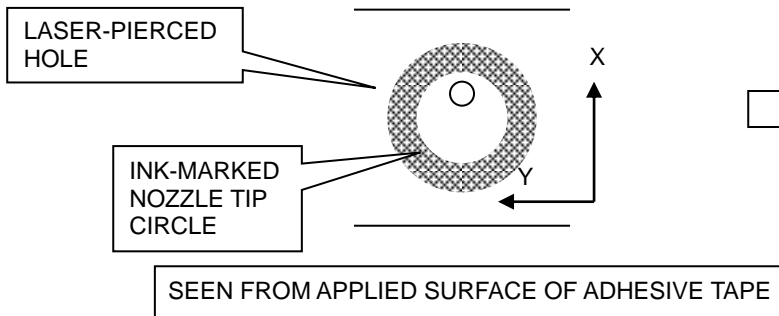
**NOTE**

- The lens holder is fixed to the laser head. Adjust the position of the lens holder body by using the two pushing bolts (right and left lens adjusting bolts). The pulling bolt (center bolt) is constantly pulled forward by a center spring.



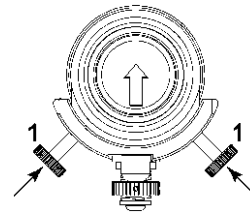
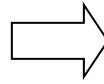
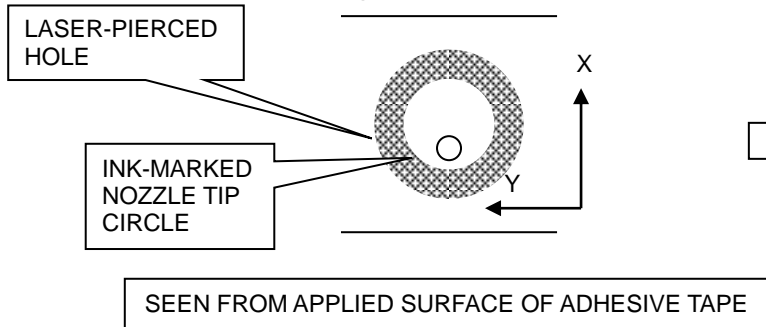
21. Center the nozzle as shown below.

- If the laser-pierced hole shifts toward the  $-X$  side of the ink-marked nozzle tip circle



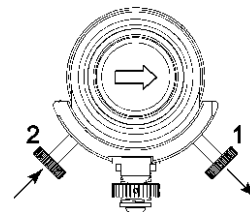
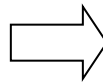
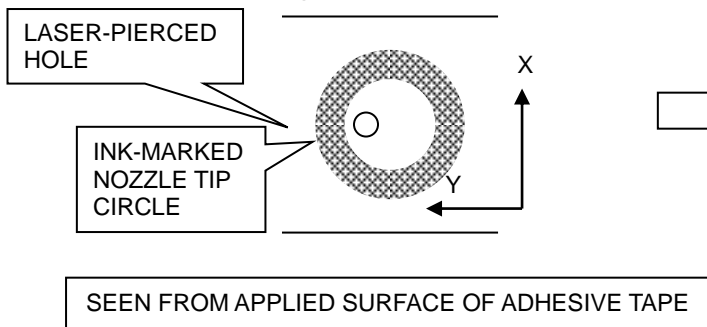
1. Loosen (turn counterclockwise) the right and left lens adjusting bolts evenly.

- If the laser-pierced hole shifts toward the  $+X$  side of the ink-marked nozzle tip circle



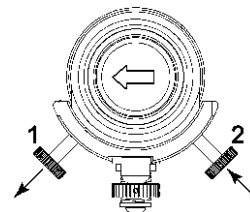
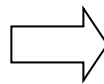
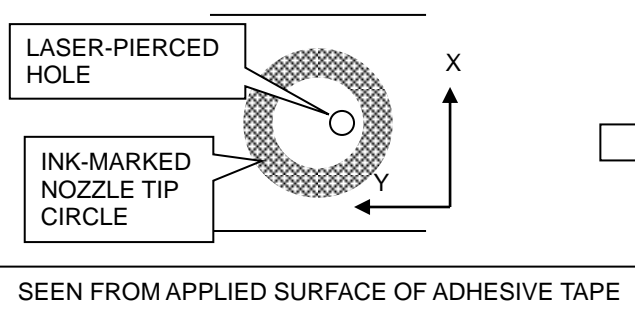
1. Tighten (turn clockwise) the right and left lens adjusting bolts evenly.

- If the laser-pierced hole shifts toward the  $-Y$  side of the ink-marked nozzle tip circle



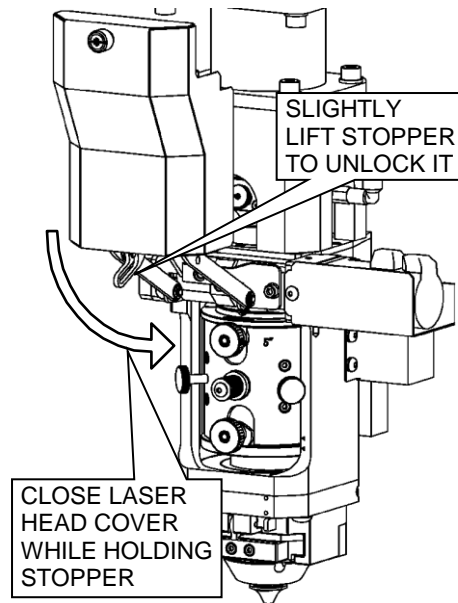
1. Loosen (turn counterclockwise) the right lens adjusting bolt.
2. Tighten (turn clockwise) the left lens adjusting bolt.

- If the laser-pierced hole shifts toward the  $+Y$  side of the ink-marked nozzle tip circle



1. Loosen (turn counterclockwise) the left lens adjusting bolt.
2. Tighten (turn clockwise) the right lens adjusting bolt.

22. Repeat steps 7 to 21 until the laser–pierced hole in the adhesive tape is adjusted to the center of the ink-marked nozzle tip circle.
23. After completing the center adjusting procedure, press the CLOSE button on the screen.
24. Unlock the stopper, and close the laser head cover.
25. Close the front doors.
26. Check for safety in the surrounding area, and press the SAFETY DEVICE RESET button on the NC control panel.  
  
The SAFETY DEVICE READY light on the NC control panel illuminates.
27. Press and extinguish the STOP button on the NC control panel.



## 2-9. Calibrating Z-axis tracking sensor

### NOTE

- When equipped with the optional nozzle changer, the Z-axis tracking sensor is calibrated during the nozzle change. The calibration of the Z-axis tracking sensor is performed on the calibration plate in the nozzle changer.

Calibrate the Z-axis tracking sensor as described below.

1. Press and illuminate the RETRACT button on the NC control panel.
2. Press the +Z button on the NC control panel to zero-return the Z-axis.
3. Press and illuminate the MANUAL button on the NC control panel.
4. Place the worksheet on the table, and fix it with the workclamps.
5. With the FEED buttons on the NC control panel, move the laser head to a position suitable for calibrating the Z-axis tracking sensor.
6. Press and illuminate the MEMORY button on the NC control panel.
7. Press the UTILITY button at the top of the screen to open the UTILITY display.
8. Press the Adjust HS Sensor button on the UTILITY display to open the Adjust HS Sensor display.

### REFERENCE

- For the detail of the display, refer to “7-7. Adjust HS Sensor” in Part I, Displays, in the reference manual of the AMNC-F.



9. Press the ADJUSTMENT button on the Adjust HS Sensor display, and press the START button on the NC control panel to start the calibration.
10. The writing of the data takes 10 seconds after the movement of the laser head is completed.
11. The START button on the NC control panel extinguishes to indicate that the calibration is completed. When the TRACE OFF button on the panel B of the screen is illuminated, it automatically extinguishes.

## 2-10. Cleaning nozzle

Processing may cause dust, spatter, and other foreign matter to deposit on the surface of the nozzle. These foreign matter deposits on the nozzle surface may cause the Z-axis tracking sensor to operate improperly, resulting in a processing problem. The nozzle cleaner is used to clean the nozzle to prevent the occurrence of such a processing problem.

If the NC RESET button or STOP button is pressed before the completion of the utility procedure and extinguishment of the START button, the data are cleared, and the nozzle is not properly cleaned.

NOTE
------

- When equipped with the optional nozzle changer, the nozzle is cleaned during its change. The nozzle cleaning is performed in the nozzle changer.

Clean the nozzle as described below.

1. Press and illuminate the MEMORY button on the NC control panel.
2. Press the UTILITY button at the top of the screen to open the UTILITY display.
3. Press the Clean the Nozzle Unit button on the UTILITY display to open the Clean the Nozzle Unit display.

REFERENCE
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- For the detail of the display, refer to “7-16. Clean the Nozzle Unit” in Part I, Displays, in the reference manual of the AMNC-F.

4. Press the START button on the NC control panel.

The laser head moves to the nozzle cleaning position, and the cleaner cleans and calibrates the nozzle.

5. The START button on the NC control panel extinguishes to indicate that the cleaning is completed and that the laser head returns to the original position.

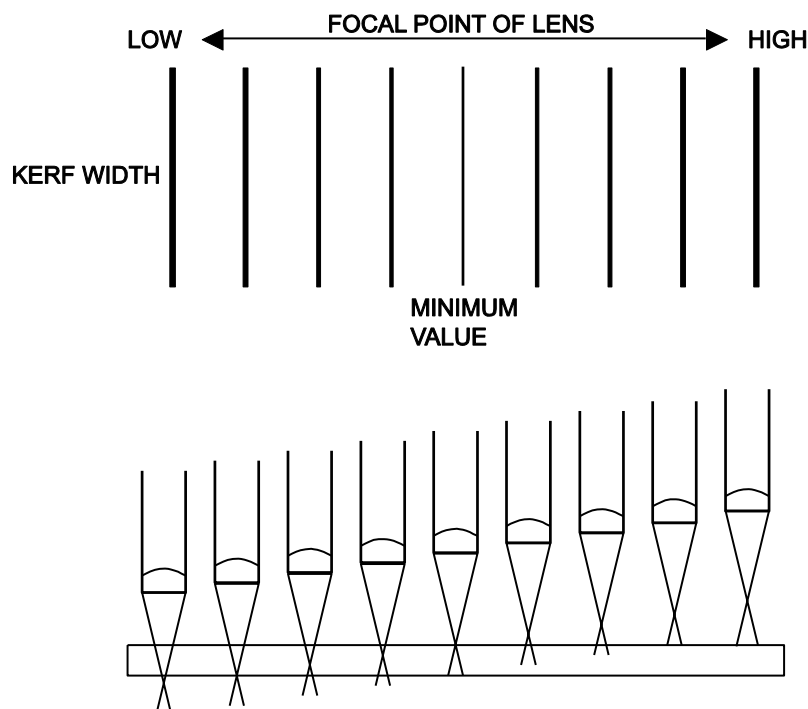
## 2-11. Adjusting focal point reference position

The optimum focal point for processing varies with the worksheet material type, thickness, and processing method. If the focal point of the lens does not meet the processing conditions, the worksheet cannot be properly cut. The focal point reference position must be adjusted so that the kerf width becomes smallest.

The kerf width is the smallest where the focal point of the lens meets the worksheet surface. This position is called the focal point reference position. After a lens change, be sure to adjust the focal point reference position of the new lens.

A 1.0-mm {0.039-in.} thick sheet of stainless steel is suited for adjusting the focal point reference position of the lens.

Use the condition No. E9 under the material name "FOR-ADJUST-FOCUS", and use nitrogen as assist gas



Set the focal point reference position as described below.

1. Place the worksheet on the table, and fix it with the workclamps.
2. Change the NC mode to MEMORY, and press the Adjust Focus button on the UTILITY display to open the Adjust Focus display.

### NOTE

- If the Focus field in the selected processing condition file does not show zero, set it to zero.

### REFERENCE

- For the operating procedure of the Adjust Focus display, refer to "7-10. Adjust Focus" in Part I, Displays, in the reference manual of the AMNC-F.
3. From the lens No. pulldown menu, select the number of the installed lens.

4. Set the Condition No., Start Focus Position, End Focus Position, and Focus Change Amount fields.

NOTE

- Press the START button on the NC control panel to execute the focal point adjusting program. The laser head cuts a 60 mm {2.36 in.} long slits while moving in the –Y axis direction from the slit cutting start point. It then moves 60 mm {2.36 in.} in the +Y axis direction and 8 mm {0.31 in.} in the +X axis direction, and cuts the next slit. Lastly, it cuts 60 mm {2.36 in.} slits along the X-axis at the pitch of 8 mm {0.31 in.}.
5. Turn the SHUTTER keyswitch on the NC control panel to ON.
  6. Press the START button on the NC control panel.

The laser head cuts 60-mm {2.36-in.} long slits at the pitch of 8 mm {0.31 in.} set in the Focus Change Amount field from the point set in the Start Focus Position to the point set in the End Focus Position field.

7. After the end of the focal point adjusting program and the stop of the machine, find a slit of the smallest kerf width from among the slits cut in the worksheet.

The height of the focal point where the slit of the smallest kerf width was cut should be set in the focal point reference position field of the adjusted lens on the Adjust Focus display.

NOTE

- When the lens is not changed but when the worksheet material type, thickness or processing method is changed, good cut edges may not be obtained. In such a case, adjust the focal point reference position of the lens to suit the worksheet material type, thickness, and processing method.

### **Changing material name**

1. With the Adjust Focus display shown on the screen, press the COND. button at the top of the screen to open the processing condition display.
2. Open the LIST display on the processing condition display.
3. Select the processing condition file you want to call, and press the CALL button on the LIST display.
4. Check that the selected processing condition file is called, open the Adjust Focus display, and press the REGISTER MTRL button on the display.
5. The REGISTER MTRL display opens.  
If the material name is correct, press the YES button.
6. The material name is registered in the Material Name field of the Adjust Focus display.

## 2-12. Selecting operating method

Select and set each item to suit the operating method.

### REFERENCE

- For the details of the buttons on the display, refer to “2-1. Processing status display area 1” in Part I, Displays, in the reference manual of the AMNC-F.

### 2-12-1. Block skip function

Select whether or not to enable the block skip function with the BLOCK SKIP button on the panel A of the screen.

When the BLOCK SKIP button is pressed and illuminated to enable the block skip function, the machine ignores a block that starts with a slash (/) and reads the next block that does not start with a slash.

### 2-12-2. Optional stop function

Select whether or not to enable the optional stop function with the OPTIONAL STOP button on the panel A of the screen.

If the OPTIONAL STOP button is pressed and illuminated to enable the optional stop function, the machine pauses when it reads M01 (optional stop command). Press the START button on the NC control panel to resume the operation of the machine.

### 2-12-3. Single block function

Select whether or not to enable the single block function with the SINGLE BLOCK button on the panel A of the screen.

When the START button on the NC control panel is pressed after pressing and illuminating the SINGLE BLOCK button to enable the single block function, the machine executes a single block of the program and stops, except when M760 is specified to open the laser shutter or a user macro program is being executed.

### 2-12-4. Program check function

Select whether or not to enable the program check function with the PROGRAM CHECK button on the panel A of the screen.

When the START button on the NC control panel is pressed after pressing and illuminating the PROGRAM CHECK button to enable the program check function, the machine dry runs or checks the program. During the dry run, the coordinates on the screen change, but the axes do not move and the M-codes are not executed. After the dry run, it is necessary to zero-return the machine manually.

### 2-12-5. Rapid feed rate

With the RATE (F4 to F1) buttons on the NC control panel, select the X-, Y-, and Z-axis rapid feed rates that suit the processing operation to be performed. Set as low a feed rate as possible when:

- The part to be processed has high accuracy to meet.
- The worksheet is badly bowed.

## 2-12-6. Automatic power-off function

Select whether or not to enable the automatic power-off function with the AUTO POWER OFF button on the panel A of the screen.

When the automatic power-off function is enabled, the machine automatically turns off after the end of its operation or the suspension of its operation following the occurrence of an alarm.

## 2-12-7. Z-axis tracking sensor

Select whether or not to enable the Z-axis tracking sensor with the TRACE OFF button on the panel B of the screen.

Press and illuminate the TRACE OFF button to disable the Z-axis tracking sensor if you do not use the Z-axis tracking sensor when processing a worksheet to which the Z-axis tracking sensor does not respond.


## 2-12-8. Override function


If necessary, finely adjust the processing conditions in the selected processing condition file by applying an override factor to them.

### REFERENCE

- For details of the override function, refer to “4. Override function” in Part 4.

## 3. Starting automatic operation

 <b>WARNING</b> <ul style="list-style-type: none"><li>● <b>Before starting the machine, check that there are no workers and obstacles around the machine. Pay particular attention to the rear of the machine.</b></li><li>● <b>Never enter the travel areas of the machine and worksheet during operation.</b></li></ul>
--

 <b>CAUTION</b> <ul style="list-style-type: none"><li>● <b>Before pressing the START button, fully check for safety around the machine.</b></li></ul>
--

When the preparations for automatic operation are completed, the machine can be automatically operated as described below.

### 3-1. Executing program

1. With the operating mode change buttons on the screen, select the operating mode of the machine.

To perform the single-program operation of the machine, open the PROGRAM display, and press the operating mode change PROGRAM button.

To perform the schedule operation of the machine, open the SCHEDULE display, and press the operating mode change SCHEDULE button. Then the LINE CONTROL keyswitch on the NC control panel to ON.

#### NOTE

- When the LINE CONTROL keyswitch on the NC control panel is set to OFF, only the first of the worksheets programmed in the schedule is processed.
- When the LINE CONTROL keyswitch on the NC control panel is set to ON, all of the worksheets programmed in the schedule are processed.

#### REFERENCE

- For the detailed procedure of the operation mode, refer to “2-3. Data edit area” in Part I, Displays, in the reference manual of the AMNC-F.
2. Check that the SHUTTER keyswitch on the NC control panel is set to OFF. (In this condition, the visible laser beam for checking the processing position can be turned on to improve the ease of positioning the worksheet.)
  3. With the FEED buttons on the NC control panel, move the laser head to the processing start point.

When the program is designed to start at the origin, zero-return the each axis.

4. Check that the cursor is placed at the beginning of the program on the PROGRAM display. Press the NC RESET button on the NC control panel to move the cursor to the beginning of the program.
5. Press and illuminate the MEMORY button on the NC control panel.
6. Turn the SHUTTER keyswitch on the NC control panel to ON.
7. Check for safety around the machine, and press the START button on the NC control panel. The START button illuminates, and the machine starts to operate according to the program.

### 3-2. Executing multiple-part cutting program

#### REFERENCE

- For the details of the multiple-part cutting program, refer to “2-1. Processing status display area 1” in Part I, Displays, in the reference manual of the AMNC-F.
1. Call a multiple-part cutting program.
  2. Press and illuminate one of the FIRST PART, REMAINING PART, and ALL PARTS buttons on the panel A of the screen.
  3. Press the START button on the NC control panel.

#### NOTE

- Before starting to execute the multiple-part cutting program, be sure to press and illuminate one of the FIRST PART, REMAINING PART, and ALL PARTS buttons on the panel A of the screen. If all of the buttons are extinguished, an alarm will occur in the middle of the multiple-part cutting operation.

Before starting to execute a non-multiple-part cutting program, extinguish all of the buttons. If either button is illuminated, the program will not be properly executed.

- When multiple parts are drawn by the drawing function, they are shown according to the multiple-part cutting function selected.

### **3-3. Stopping automatic operation**

The machine stops automatically when an emergency stop condition or alarm occurs during its automatic operation. The machine can also be stopped by entering a stop command beforehand in the program or by pressing the STOP button on the NC control panel or an EMERGENCY STOP button.

#### **3-3-1. Stop by program command**

##### **Program stop (M00) and optional stop (M01)**

When the block containing an M00 or M01 command is executed, the automatic operation of the machine pauses and the PROGRAM STOP light on the NC control panel comes on. At this time, the START button on the NC control panel remains illuminated.

Since the modal information up to then is all saved, pressing the START button resumes the automatic operation of the machine.

The OPTIONAL STOP button on the panel A of the screen allows you to select whether or not to enable the optional stop function.

##### **REFERENCE**

- For the detail of the Optional STOP button, refer to “2-1. Processing status display area 1” in Part I, Displays, in the reference manual of the AMNC-F.

##### **Program end (M02 and M30)**

M02 and M30 indicate the end of the main program. The execution of M02 or M30 stops the automatic operation of the machine and resets the NC unit.

The execution of M30 also returns the cursor to the beginning of the program.

##### **Zero-return and end (G50)**

G50 indicates the end of the main program. The execution of G50 stops the automatic operation of the machine after zero-return, resets the NC unit, and returns the cursor to the beginning of the program.

#### **3-3-2. Stop by switch operation**

##### **Emergency stop buttons**

As soon as an EMERGENCY STOP button is pressed during the automatic operation of the machine, the NC unit is placed in an emergency stop condition, and the machine is stopped and powered off. The high-voltage power to the laser oscillator is also shut off to stop the laser oscillation.

Remove the cause of the emergency stop, and turn the pressed EMERGENCY STOP button clockwise to unlock it. Then zero-return the machine, and resume the laser oscillation.

NOTE
------

- If the emergency stop is invoked when the laser oscillator is started up, the HIGH VOLTAGE light on the NC control box is extinguished, and the high-voltage power to the laser oscillator is turned off. Remove the cause of the emergency stop, clear the alarm, and turn the LASER keyswitch on the NC control box to OFF and then back to ON within 5 seconds. The HIGH VOLTAGE light flashes. When supply of the high-voltage power to the laser oscillator is completed, the HIGH VOLTAGE light goes steady, and the laser oscillator restarts.
- When the machine has its power turned off or is stopped in an emergency, the laser head is lowered to a certain position, but there is no risk of breakage.

### **NC RESET button**

When the NC RESET button on the NC control panel is pressed during the automatic operation of the machine, the cutting operation is stopped, and the modal data of the NC unit is all cleared.

NOTE
------

- When the NC RESET button is pressed during the automatic operation, the modal data of the NC unit is cleared to disallow the current cutting operation to be continued. When you have made the reset, return the program to the beginning, move the laser head to a new processing start point in the MANUAL mode, and perform another automatic operation.

### **STOP button**

When the STOP button on the NC control panel is pressed and illuminated during its automatic operation, the machine pauses, and the STOP button illuminates.

To resume the automatic operation, press and extinguish the STOP button, and press the START button. When the STOP button is pressed and illuminated in the middle of a cut (the cut being made with the laser shutter open), the rest of the cut may not be completed properly.

## **3-3-3. Alarm stop**

When the machine develops trouble or is improperly operated, it is automatically stopped by a machine alarm or NC alarm.

Remove the cause of the alarm, and press the ALARM RESET button or NC RESET button on the NC control panel.

## **3-3-4. Safety device stop**

When an interlock of the machine actuates, the machine enters the safety stop condition and its automatic operation is stopped.

Clear the cause of the safety stop, and press the SAFETY DEVICE RESET button on the NC control panel to make the interlocks ready.



### 3-4. Removing parts



#### **WARNING**

- **Before removing the parts and scrap, press the STOP button, turn the SHUTTER keyswitch to OFF, remove the key from the SHUTTER keyswitch, and hand the key to the laser safety officer for safekeeping.**
- **The parts and scrap (especially of heavy-gauge material) may be hot enough to burn your hands. When unloading them, wear leather gloves or thick cotton gloves.**

Unload the part-laden pallet from the machine table onto the shuttle table.

#### REFERENCE

- For the pallet change procedure, refer to “7-6. Shuttle Exchange” in Part I, Displays, in the reference manual of the AMNC-F.

## 4. Ending procedure

#### NOTICE

- Do not turn the machine circuit breaker switch and laser oscillator circuit breaker switch to OFF before turning off the power of the laser oscillator and machine. Otherwise the NC unit may fail.
- Usually, leave at ON the shop ground-fault circuit breakers connected to the cooling unit and the dust collector.

### 4-1. Normal ending procedure

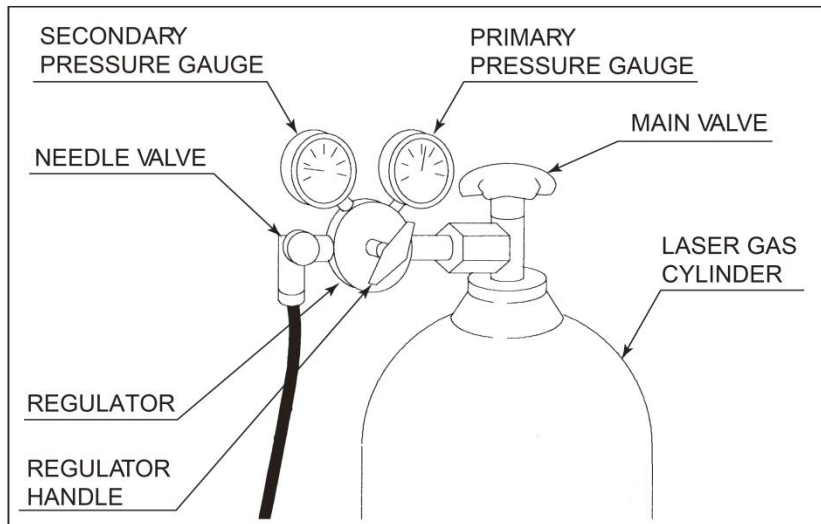
#### NOTE

- When the AUTO POWER OFF button on the panel A of the screen is pressed and illuminated, the NC unit and laser oscillator are automatically powered off after the end of the program operation. The machine and laser oscillator circuit breaker switches also automatically change to TRIP.

1. Turn the SHUTTER keyswitch on the NC control panel to OFF.
2. Turn the LASER keyswitch on the NC control box to OFF.

After a few minutes, the power of the laser oscillator automatically turns off.

3. After checking that the LASER READY light on the NC control box has extinguished, turn the needle valve of the laser gas cylinder clockwise to close.
4. Turn the main valve of the laser gas cylinder clockwise to close.



5. Turn the main valve of the assist gas cylinder clockwise to close.
6. With the FEED buttons on the NC control panel, move the laser head to a position where the nozzle can be easily changed.

The laser head can be also moved to such a position by opening the Nozzle/head Exchange Position display from the UTILITY display and setting the nozzle unit or laser head change positions on the Nozzle/head Exchange Position display.

#### REFERENCE

- For the details of the UTILITY display, Nozzle/head Exchange Position display, and operating procedure, refer to “7. UTILITY display” in Part I, Displays, in the reference manual of the AMNC-F.

7. Open the front doors.  
The power to all axes is disconnected for safety.
8. Remove the lens holder from the laser head.
9. Remove the lens from the lens holder. Check the lens, and clean it if it is dirty. Store the lens in its case and then the case in a lockable cabinet.
10. Remove the nozzle unit from the laser head. Check the nozzle, and clean or change it as required.
11. Install the nozzle unit in the laser head.
12. Close the front doors.
13. Check for safety in the surrounding area, and press the SAFETY DEVICE RESET button on the NC control panel.  
The SAFETY DEVICE READY light on the NC control panel illuminates.
14. Press and illuminate the RETRACT button on the NC control panel.
15. With the FEED buttons on the NC control panel, zero-return the X-, Y-, and Z-axes in the following order.

The FEED button for each axis flashes to indicate that the axis is zero-returning and changes to steady to indicate that the axis has completely zero-returned.

- (1) Press the +Z button to zero-return the Z-axis.
- (2) Press the +X and +Y buttons sequentially to zero-return the X- and Y-axes.

16. Press the POWER OFF button on the NC control box.

For 10 seconds, the POWER OFF button illuminates and a buzzer sounds. After 10 seconds, the POWER OFF button flashes and power-off processing is performed. The NC unit and machine are powered off. (When the laser oscillator is actuated, it is also powered off.) Then the machine and laser oscillator circuit breaker switches automatically change to TRIP.

NOTE
------

- The power-off processing can be canceled by pressing again the POWER OFF button within the above-mentioned 10 seconds.

17. Turn off the power of the air compressor.
18. Remove scrap from the table, and clean the table and surrounding area.
19. Clean the dust collection filter.
20. Lock the front doors.
21. Turn to OFF the shop ground-fault circuit breakers connected to the machine, laser oscillator, and purge unit.

NOTE
------

- Usually, leave at ON the shop ground-fault circuit breakers connected to the cooling unit and the dust collector.



# Part 5

## Functions

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## 1. Cutting precautions

- The cutting conditions and piercing conditions must be finely adjusted, depending on the condition of the mirrors or lens. Lower the cutting feed rate or raise the pulse duty for gouging during cutting. Extend the piercing time or raise the pulse duty when the hole is not pierced through the worksheet.
- The maximum cutting feed rate for cutting a round hole is 150 times the diameter of the hole. The roundness of the hole deteriorates when the hole is cut at a higher feed rate.
- When cutting a hole by using a pre-registered processing condition file, use a cutting condition of decreasing number with decreasing hole diameter.
- The minimum diameter of the hole to be cut is the same as the thickness of the worksheet to be used.
- Worksheets may not be properly cut, depending on their material or surface condition (whether or not rust, oil, or scale is deposited).
- When a worksheet with its top surface protected with a vinyl sheet is cut, the protective sheet may be removed by the discharge of the assist gas and interfere with the cutting of the worksheet.
- When an aluminum worksheet is cut with its vinyl sheet-protected surface facing down, the adhesion of dross on the bottom of the cut can be reduced.
- When a worksheet protected with a vinyl sheet (especially polyvinyl chloride sheet) is cut, the gas generated during the cutting operation corrodes the machine. Apply a rust inhibitor to the machine.
- When the pulse duty is increased to increase the output power, piercing can be performed in a short time. When the worksheet is of heavy gauge, however, sudden heating makes its piercing unstable. When piercing a heavy-gauge worksheet, increase the pulse frequency and duty in steps for fast and stable piercing. Refer to “5. Step piercing” in this Part.
- Some laser marks may be difficult to read, depending on the surface quality of the worksheet, for example. In such a case, correct the marking conditions by adjusting the pulse duty.
- Aluminum worksheets cannot be laser marked.
- When plastics, wood, or precoated steel are processed, resultant vapors may contaminate the lens or spatter may occur. Check the lens carefully, and clean it if necessary.

## 2. Processing condition files

Processing condition files where normal cutting conditions, piercing conditions, and edge and-approach cutting conditions are preset and registered beforehand in the NC unit.

One processing condition file can set 10 normal cutting conditions (9 for cutting and 1 for marking), 5 piercing conditions, and 10 edge-and-approach cutting conditions. (See the note below.) A maximum of 1000 processing condition files can be registered, including those already registered.

### REFERENCE

- For registering a new processing condition file and setting normal cutting, piercing or edge-and-approach cutting conditions, refer to “8. Processing condition displays” in Part I, Displays, in the reference manual of the AMNC-F.

NOTE
------

- When a pre-registered processing condition file has less than 9 normal cutting conditions, the condition with the highest cutting feed rate is set for the numbers for the other conditions. When setting new conditions, change unnecessary conditions, or register a new processing condition file and set necessary conditions in the file.

## 2-1. Listing processing condition files

The processing condition files pre-registered in the NC unit can be checked on the LIST display. The LIST display lists the processing condition files in alphanumeric order. The number and contents of the pre-registered processing condition files vary with the laser oscillator model.

## 2-2. Names of processing condition files

The pre-registered processing condition files are named according to the JIS material name, thickness (in millimeters), and processing method of the worksheet for which the cutting conditions are set.

When the material name ends in a number, it is connected by a hyphen to the thickness.

SPC:	Cold-rolled steel SPCC
C-SPC:	Clean Cut of cold-rolled steel SPCC
E-SPC:	EZ Cut (optional) of cold-rolled steel SPCC
SPH:	Hot-rolled steel SPHC
SS400:	Structural steel SS400
F-SS400:	FFC (Fine Finish Cut) (optional) of structural steel SS400
A-SUS:	Air Cut of stainless steel SUS304-2B
C-SUS:	Clean Cut of stainless steel SUS304-2B
E-SUS:	EZ Cut (optional) of stainless steel SUS304-2B
SC-SUS:	Silky Cut (optional) of stainless steel SUS304-2B
A1050:	Pure aluminum A1050
C-A1050:	Clean Cut of pure aluminum A1050
A5052:	Aluminum alloy A5052
C-A5052:	Clean Cut of aluminum alloy A5052
SECC:	Electrogalvanized steel SECC
C-SECC:	Clean Cut of electrogalvanized steel SECC
E-SECC:	EZ Cut (optional) of electrogalvanized steel SECC

The letter after the material name ends represents the following content.

S:	7.5" lens is used
E:	ECO Cut
H:	Over 1.0 MPa high-pressure assist gas
HS:	High-speed cutting



NOTE

- The processing conditions are set for the following worksheet material types:
  - Mild steel: 3.2 mm and less: SPCC
  - 4.5 to 6.0 mm: SPHC
  - 9.0 mm and above: SS400
  - SUS: SUS304-2B
  - SECC: Electrogalvanized steel with zinc coating amount of 10 g/m<sup>2</sup> per side
  - Aluminum: JIS A1050 aluminum alloy
  - JIS A5052 aluminum alloy

### 2-3. Programming

Cutting program commands are used to specify a processing condition file required for laser cutting and one cutting condition set in the file, as shown in the example given below.

**Example:**

M102(C-SUS1.0); (1)

G90 G92 X1270 Y1270;

G00 X20 Y20;

M100;

E01; (2)

G01 Y10;

:

:

- (1) The processing condition file C-SUS1.0 is selected by “M102 (C-SUS1.0).”

REFERENCE

- For details of the LIST display, refer to “8-8-2. LIST display” in Part I, Displays, in the reference manual of the AMNC-F.

- (2) No. 1 cutting condition is selected by “E01.”

REFERENCE

- For details of the CUT display, refer to “8-2. CUT display” in Part I, Displays, in the reference manual of the AMNC-F.

Since 201 is set for “Edge data,” No.201 edge cutting condition is selected.

REFERENCE

- For details of the EDGE display, refer to “8-4. EDGE display” in Part I, Displays, in the reference manual of the AMNC-F.

Since 101 is set for “Pirc No.,” No.101 piercing condition is selected.

REFERENCE

- For details of the PIERCE display, refer to “8-3. PIERCE display” in Part I, Displays, in the reference manual of the AMNC-F.

### 3. Cautions when looking at processing conditions

- The processing conditions are bound in a separate volume.
- The processing conditions present the data entered in the processing condition files at the time of delivery.
- The processing conditions are reference values and outside the scope of warranty.
- The focal point is the distance moved from the reference position set so that the kerf width of slits cut by setting the nozzle gap at 1.5 mm {0.06 in.} becomes the smallest.
- The nozzle gap is a clearance between the worksheet surface and the nozzle tip.
- The processing conditions describe the lens type, nozzle type, and assist gas setting pressure. Before starting the cutting operation, check that the machine is ready.

#### (1) Lens

Focal length of the lens. The lens may have a focal length of 5" or 7.5" (optional). Check that the lens registered in the applicable processing condition file is installed.

#### (2) Nozzle

Nozzle hole diameter. The nozzle may be a  $\phi$ 0.8 nozzle,  $\phi$ 1.2 nozzle,  $\phi$ 1.5 nozzle,  $\phi$ 2 nozzle,  $\phi$ 3 nozzle, or  $\phi$ 2.5 W-nozzle, among other things. Check that the nozzle registered in the applicable processing condition file is installed.

#### (3) Assist gas pressure setting

The assist gas pressure need not be set because it is controlled by the NC assist gas control.

### 4. Override function

If necessary, finely adjust the processing conditions in the processing condition file as described below.

1. Press the COND. button to open one of the Processing displays.
2. Press the OVERRIDE button to open the Override display.

#### REFERENCE

- For the details of the OVERRIDE display, refer to "8-1-2. Common area 2" in Part I, Displays, in the reference manual of the AMNC-F.
3. Of the Feed Rate, Power, Freq., Duty, and Gas Press. fields, select to which field to apply the override.

- Adjust the override factor with the UP and DOWN buttons.

Feed Rate: 0 to 254%

Power: 0 to 200%

Freq.: 0 to 200%

Duty: 0 to 150%

Gas Press.: 0 to 200%

NOTE

- If required, press the “10” button. When the “10” button indicates “1”, the override factor can be adjusted in increments of 1%.
- Press the CANCEL button to cancel the override factor applied to the selected processing condition and return the override factor to 100%.

- After completing the setting, press the BACK button.

## 5. Step piercing

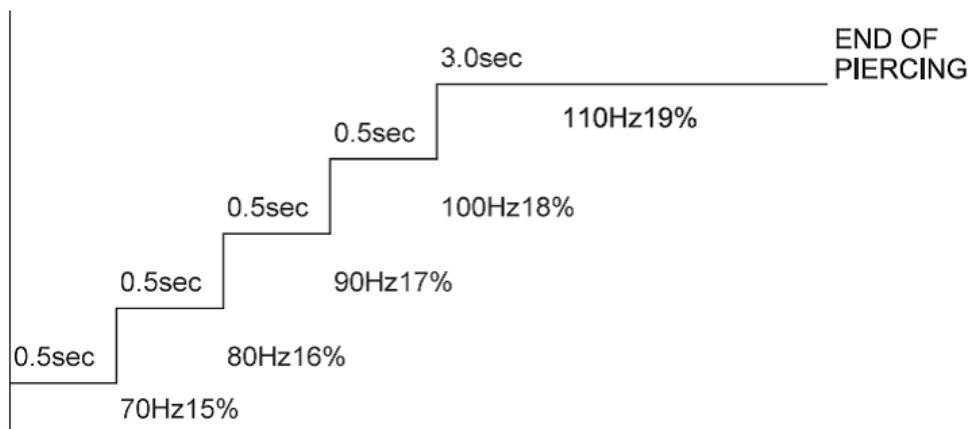
Step piercing is a function of piercing a heavy-gauge worksheet at high speed and stability by increasing the pulse frequency and duty in steps.

The pulse frequency and duty are incremented from their initial values by preset amounts for the number of steps per each step time.

**Example 1:** Preset number of steps is completed within piercing time

Pierce No.	Output S	Initial value		Incremental value		Step		Pierce time	Gas pressure	Gas type	Change time	Gap
		Frequency	Duty	Frequency	Duty	Time	Number					
101	3600	70	15	10	1	0.5	4	5	0.05	1	0	0

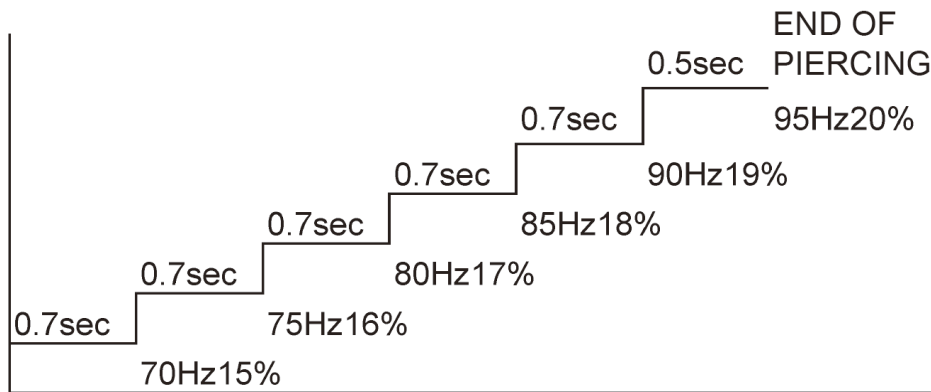
When the preset number of steps is completed within the preset piercing time, the remaining piercing operation is performed at the final pulse frequency and duty.



**Example 2:** Preset number of steps is not completed within piercing time

Pierce No.	Output S	Initial value		Incremental value		Step		Pierce time	Gas pressure	Gas type	Change time	Gap
		Frequency	Duty	Frequency	Duty	Time	Number					
101	3600	70	15	5	1	0.7	10	4	0.05	1	0	0

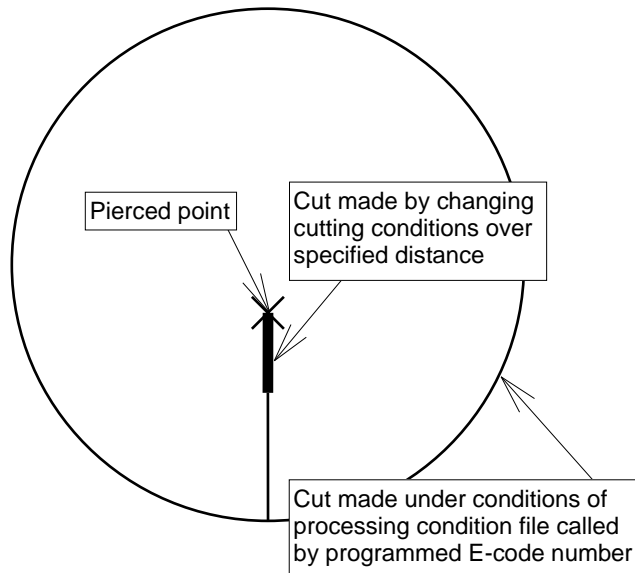
If the preset number of steps is not completed within the preset piercing time, additional steps are performed until the end of the preset time.



**6. Approach and edge cutting functions**

**6-1. Approach and edge cutting functions**

The approach and edge cutting functions judge whether or not the portion to be cut is an approach or edge cut portion from the setup data of the NC, and control the laser beam so that the approach or edge cut can be made under optimum conditions.



APPROACH CUTTING

**6-1-1. Use and purpose of approach cutting function**

The approach cutting function controls the laser beam so that a successful approach cut can be made after the completion of piercing. This function is effective in preventing a problem when cutting a heavy-gauge structural steel (SS) sheet or cutting any type of worksheet by the Aluminum Cut, Clean Cut, Air Cut, or EZ Cut method.

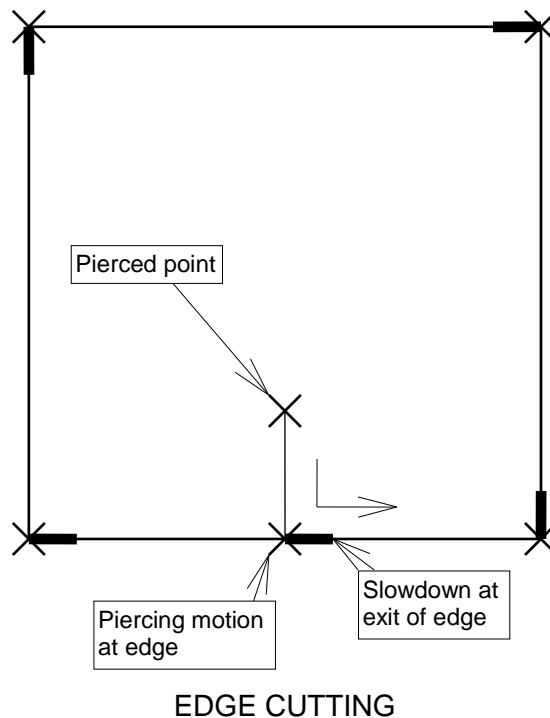
### 6-1-2. Performance of approach cutting function

When approach cutting is performed, as the figure above, normal cutting conditions are changed to approach cutting conditions over the specified distance from the pierced point according to the approach cutting conditions in the processing condition file. For more stable cutting, set a lower approach cutting feed rate.

### 6-1-3. Use and purpose of edge cutting function

The edge cutting function prevents cutting problems like edge meltdown. This function is effective in cutting mild steel and other materials whose edge is likely to melt down.

The edge cutting function need not be used when the edge is to be cut by a method that prevents the edge from melting down, such as Clean Cut, Air Cut, or EZ Cut (but can be used without any problem).



### 6-1-4. Performance of edge cutting function

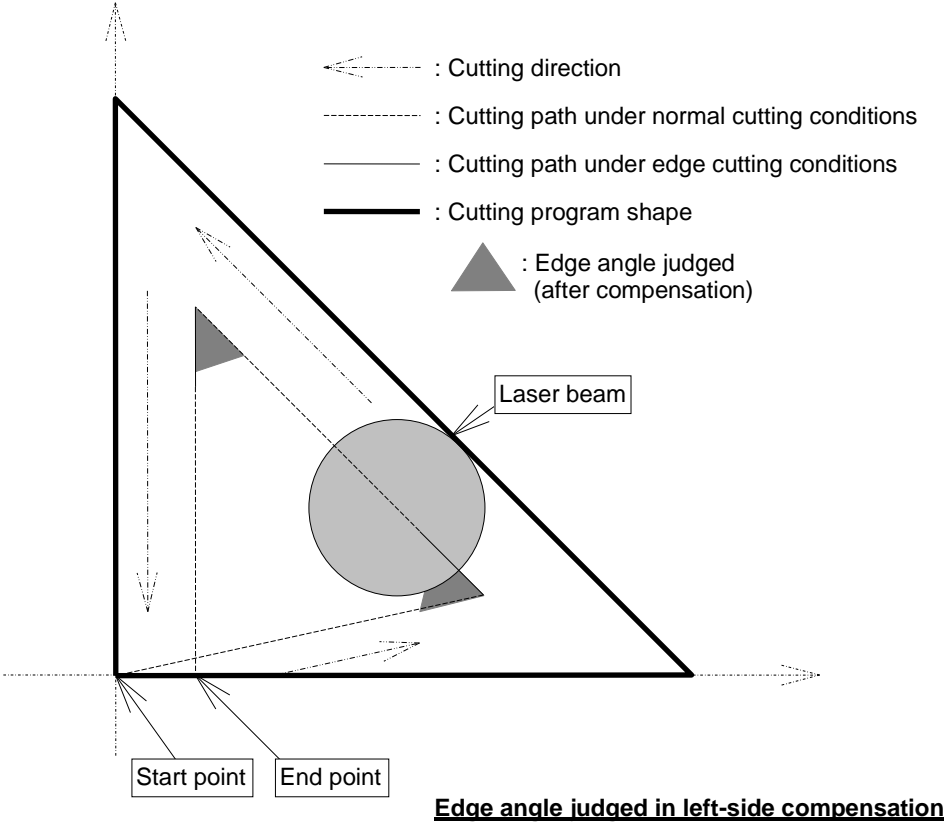
When edge cutting is performed, the laser beam makes a piercing motion at the edge according to the edge cutting conditions in the processing condition file, and the normal cutting conditions are changed to the edge cutting conditions over the specified distance.

The maximum angle for edge control is set at "Angle" column among the edge cutting conditions on the EDGE display. When the edge angle calculated in the NC is smaller than the preset value of "Angle" column, edge cutting control is automatically performed.

The edge angle automatically judged by the NC is not the edge angle commanded in the program, but is the edge angle commanded in the program and compensated for the cutting path. The NC calculates the edge angle by a different method, depending on whether the cutting path is compensated for at the left or right side of the laser beam in the cutting direction.

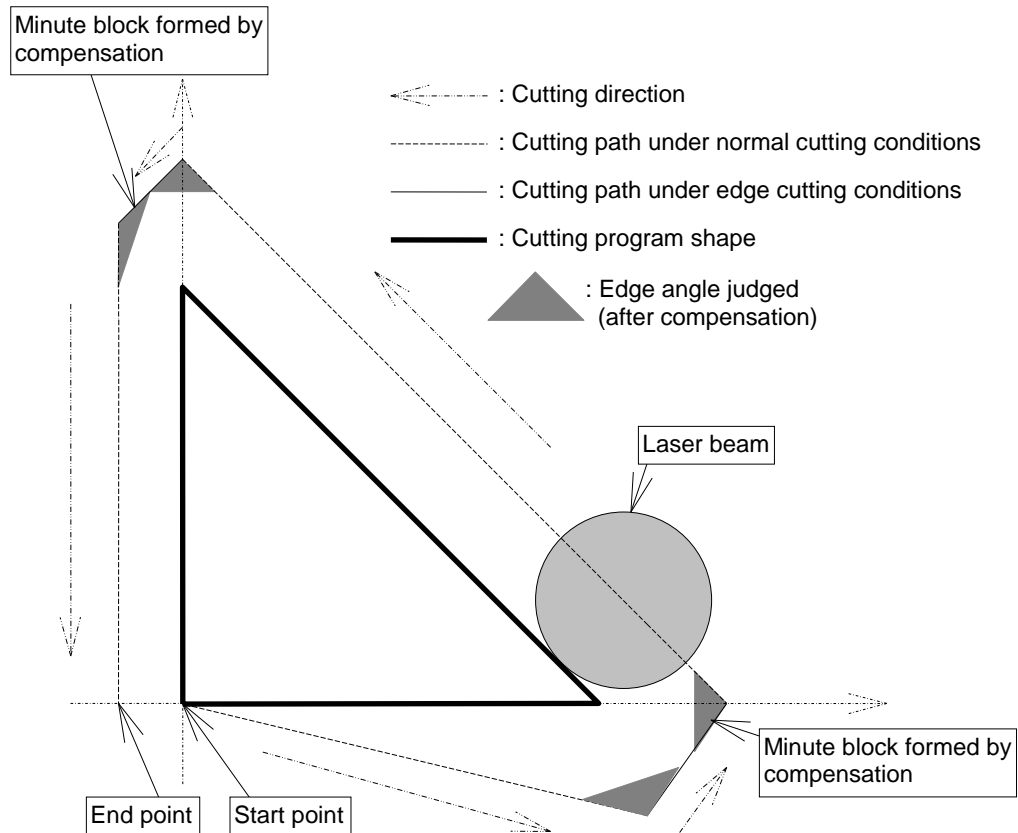
**Left-side compensation**

When the cutting path is compensated for at the left side of the laser beam in the cutting direction, the edge angle becomes as shown below. The edge angle commanded in the program becomes the same as that calculated in the NC.



## Right-side compensation

When the cutting path is compensated for at the right side of the laser beam in the cutting direction, the edge angle commanded in the program becomes different from that calculated in the NC. When right-side compensation is commanded, the NC forms minute blocks at the edge as shown below.



### Edge angle judged in right-side compensation

Edge cut processing becomes effective for the data obtained after the cutting path compensation. When a minute block is formed at the edge, the NC assumes the angle of the minute block as the edge angle and judges the motion of the laser beam accordingly. The minute block is formed during calculation in the NC and cannot be confirmed in the program. The edge angle in the minute block formed varies with the shape of the cut to be made and is difficult to calculate.

A large standard value of  $150^\circ$  is set at “Angle” column among the edge cutting conditions, so that edge cutting can be performed in the right-side compensation even when minute blocks are formed. Fully consider this point when changing the preset value.

Edge cutting is not performed when “Angle” column is  $0^\circ$ .

Edge cutting is performed for all edges and tangents when “Angle” column is  $180^\circ$ .

Edge cutting is performed for all edges but tangents when “Angle” column is  $179^\circ$ .

“Angle” column need not be set in the approach cutting conditions. Any value set at “Angle” column is ignored during approach cutting.

## 6-1-5. Operating approach and edge cutting functions

When numbers 201 to 205 are entered at “Appr. data” and “Edge data” on the CUTTING CONDITION display for the processing condition file called by the program, the NC can make approach and edge cuts under automatic control. The necessary approach or edge cutting conditions must be preset at the corresponding numbers.

If any number where approach or edge cutting conditions are not preset is specified, an alarm occurs during approach or edge cutting or the cutting is performed under the approach or edge cutting conditions selected last.

## 6-1-6. Constraint on creation of edge cutting program

The edge cutting function is controlled by the NC unit and imposes the following constraint in the program:

The edge cutting function does not operate if G00 is commanded for the edge.

When assigning the laser cutting path during the creation of a program with the automatic programming unit, do as described below.

Turn off the output of G00.

When the program is created under this condition, G00; is not output in the program.

## 7. Clean Cut

The Clean Cut is a process for laser cutting stainless steel and other materials without oxidation.

### NOTE

- For the procedure, refer to “2-3. Checking processing condition file” in Part 3.

## 8. Aluminum Cut

The Aluminum Cut is a process whereby materials likely to reflect the beam of the CO<sub>2</sub> laser, such as aluminum and brass, are laser cut by protecting the laser oscillator from the reflected light. Detection of the CO<sub>2</sub> laser beam returning back after being reflected off the material surface interrupts the cutting operation and displays an alarm.

## 9. Hyper EZ Cut II (option)

The Hyper EZ Cut II is a higher version of the EZ Cut, or is an air cutting process that supplies the assist gas at a pressure higher than the EZ Cut and ensures a more stable assist gas concentration than the EZ Cut.

## 10. Z-axis tracking sensor

The Z-axis tracking sensor is automatically calibrated. The HS edge detection function can also be used.

### REFERENCE

- For the procedure for operating the Z-axis tracking sensor, refer to “2-12-7. Z-axis tracking sensor” in Part 3.
- For the details of the HS edge detection function, refer to “2-18. HS edge detection (G121, G122)” in Part III, NC codes, in the reference manual of the AMNC-F.



## 11. NC assist gas control

NC assist gas control refers the function of automatically selecting the assist gas type and setting the assist gas pressure.

The NC assist gas control sets the assist gas pressure in a processing condition file. The assist gas type and pressure can be checked on the Check Assist Gas display, one of the UTILITY displays.

### REFERENCE

- For details of the gas type and setting gas pressure, refer to “8-2. CUT display” in Part I, Displays, in the reference manual of the AMNC-F.

### NOTE

- During the program operation of the machine, the assist gas is not discharged unless the following conditions are met:
  - a) The laser oscillator is started up, and the SHUTTER keyswitch is set to ON.
  - b) The laser shutter is open, or the Z-axis is positioned below the gas discharge height.

Item	Specification
Pressure display range	0.000 to 1.999 MPa {0 to 290 psi}
Least input increment	0.01 MPa {1.5 psi}
NC specified pressure range	0.02 to 2.00 MPa {2.9 to 290.1 psi}
Controlled gas pressure range	0.00 to 2.00 MPa {0 to 290.1 psi}
Accuracy	±3% full scale (0 to 50°C {32 to 122°F}; reference temperature of 25°C {77°F})
Operating temperature and relative humidity	0 to 50°C {32 to 122°F} and 80% RH maximum

### NOTE

- The override function allows a minimum assist gas pressure of 0.02 MPa {2.8 psi} to be specified, but if the minimum assist gas pressure of 0.02 MPa {2.8 psi} is specified, it cannot be guaranteed that the assist gas will be discharged at the specified pressure.

## 12. Nozzle cleaner

The nozzle cleaner brushes off dust, spatter, and other foreign matter from the surface of the nozzle.

### REFERENCE

- For a detailed operating procedure, refer to “2-10. Cleaning nozzle” in Part 4

## 13. NC focus control

NC focus control refers to the function of automatically moving up and down the focal point of the lens.

The focus control axis is the B-axis. The NC focus control function sets the focal point in a processing condition file.

### REFERENCE

- For the detail of the NC focus control, refer to “8-2. CUT display” in Part I, Displays, in the reference manual of the AMNC-F.

### NOTE

- The B-axis need not be zero-returned.

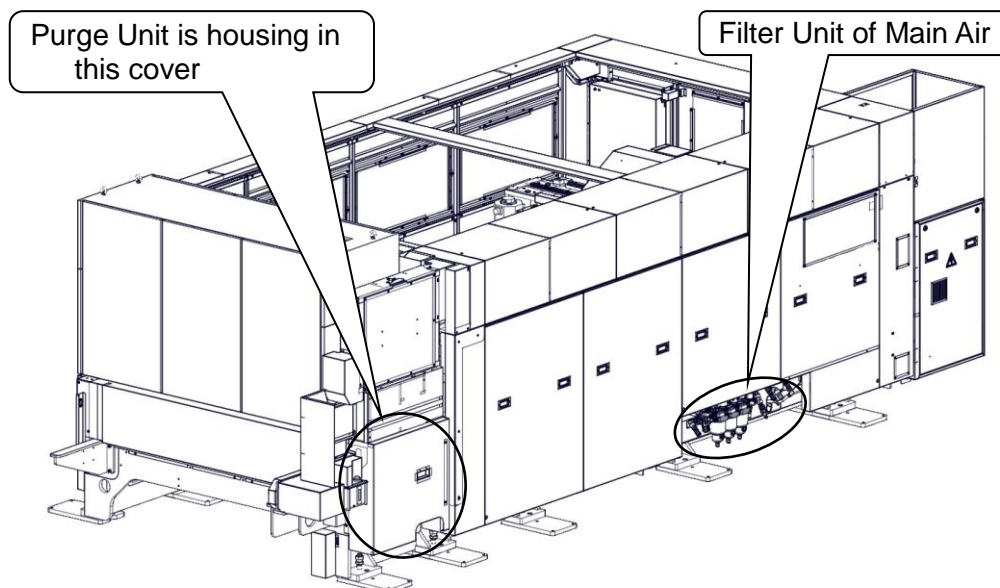
Item	Specification
Focus control	B-axis
B-axis travel distance	21.000 mm {0.8268 in.}
B-axis rapid feed rate	100 mm/min {3.9 in./min}
Least input increment	0.001 mm {0.0001 in.}
B-axis command range	0 to 21.000 mm {0 to 0.8268 in.}

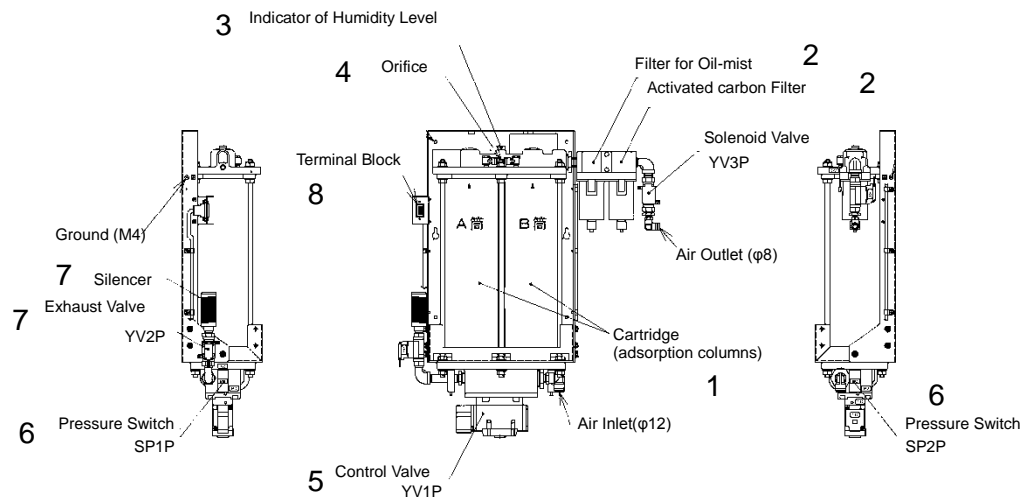
## 14. Purge unit

### 14-1. Usage

The purge unit supplies clean air into the laser beam path to prevent the diffusion of the laser beam, for example.

### 14-2. Arrangement of units





No.	Part name	Function
1	Cartridge (adsorption columns)	Water is removed here by supplied compressed air. There are two cartridges (adsorption columns). Two cartridges repeat adsorption and restoration in turn.
2	Activated carbon Filter and Filter for Oil-mist	This filter removes impurities of air coming out of an adsorption columns.
3	Indicator of Humidity Level	This detection paper detects an upswing in dew-point temperature of the Outlet Air. By viewing, the change of the color is confirmed.
4	Orifice	Volume of communication air of two adsorption columns is held down in this way.
5	Control Valve (YV1P)	Two adsorption columns are changed and run by this valve.
6	Pressure Switch (SP1P, SP2P)	The pressure drops of supply air is detected by this switch.
7	Exhaust Valve Silencer	These are Exhaust Valve for restoration air and Silencer for reducing exhaust sound.
8	Terminal Block	This terminal is for the solenoid valve, and pressure switch.

### 14-3. Specifications

Specification	Pneumatic circuit	Fluid		Compressed Air
		Inlet Pressure (Gauge Pressure)	MPa	0.46
			psi	66.7
		Inlet Air Capacity	m <sup>3</sup> /min	0.325
			ft <sup>3</sup> /min	11.48
		Inlet Air Temperature / Humidity	°C/%	5 to 60 / 90 (less or equal)
			°F/%	41 to 140 / 90 (less or equal)
		Inlet concentration of oil mist	mg/m <sup>3</sup>	0.1
			lb/ft <sup>3</sup>	0.62x10 <sup>-9</sup>
		Inlet concentration of carbon dioxide		Equivalent to the standard atmosphere
	Volume of product gas	m <sup>3</sup> /min	0.210	
		ft <sup>3</sup> /min	7.42	
	Volume of restoration gas	m <sup>3</sup> /min	0.115	
		ft <sup>3</sup> /min	4.06	
	Performance	Dew point temperature of product gas	°C	Atmosphere - 58 (less or equal)
			°F	Atmosphere – 136.4 (less or equal)
		Concentration of carbon dioxide of product gas	ppm	50 (less or equal)
		Concentration of oil mist of product gas	mg/m <sup>3</sup>	0.01
lb/ft <sup>3</sup>	0.62x10 <sup>-10</sup>			
Temperature of environment	°C	2 to 40		
	°F	35.6 to 104		
Electrical Property	Power supply	V	DC 24	
	Input	W	3.0	
	Current	mA	125	

## 14-4. Operation

### 14-4-1. Starting operation

1. Check the main air filter unit, make sure of the drain discharge once a week or less.

NOTICE
--------

- Make sure of the drain discharge one time a week or less.  
If the drain discharge is twice or more a week, the air supply could be due to contamination.  
Refer to “14-5. Troubleshooting” in this Part.

2. Turn on the POWER on NC control panel. And the purge unit produces the gas.

NOTICE
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- Be sure to use dry air for main air supply by dryer.
- Be sure to keep humidity of air supply below 90%.
- After starting purge unit, Changing the air in optical axis is one minute. Display a message “EX0126 (OR EX2059) PURGE READY DRIVING”, during changing the air in optical axis.
- Laser can't output during changing the air in optical axis.

### 14-4-2. Finishing operation

Turn off the POWER on NC control panel. Then turn off the power of film purge unit, shut off the valve, and stop supplying the gas.

## 14-5. Troubleshooting

Situation	Cause	Confirm and remedy
The drain discharge few times a week.	The air supply could be due to contamination.	Stop the air compressor. Contact the supplier to inspect and fix it. Inspect each filter and activated carbon cylinder. Replace it, if necessary.
Processing conditions not stabilized	Air supply pressure fluctuates.	Review the main air supply facilities, and to keep the pressure 0.5MPa.
	The supplied air is contaminated with organic gas.	Please do not work degreasing or painting with organic solvents around the air compressor. Organic gases are passed through the Film Purge Unit. It creeps into optical axis, and then it has a negative impact to the laser beam.
	Deterioration of filter element or active carbon	Inspect the damp or odor of the filter that is placed after activated carbon cylinder. If the filter was stink or damp, replace all filter elements including activated carbon cylinder. Or replace the film separator, also too.

NOTICE

- If did not recognize that the bad conditions are continued, The unit might be in trouble or break. And the compressor might be same too.

## 14-6. Alarms

Alarm displays	Conditions and causes	Responses
EX0126 EX2059 PURGE READY DRIVING	<p>- Conditions -</p> <p>This is displayed when the NC power is turning on and clean air is being supplied to the laser beam path.</p> <p>- Cause -</p> <p>(1) This occurs whenever the NC power is turned on (NC power switch turned to "ON").</p>	<p>(1) This is resolved automatically when the laser beam path has been supplied with clean air.</p> <p>The purging operation cannot be completed properly if any of the following alarms occur:</p> <p>EX0001 MAIN AIR PRESSURE DOWN</p> <p>EX0204 ADSORPTION PRESSURE SWITCH ERROR</p> <p>EX0205 PLEASE EXCHANGE OIL MIST FILTER + ACTIVATED CARBON FILTER</p> <p>EX0206 PLEASE EXCHANGE ADSORBENT</p>
EX2063 EX2125 PLEASE ARRANGE THE MAINTENANC E KIT(6000H) Alternatively EX2064 EX2126 PLEASE ARRANGE THE MAINTENANC E KIT(12000H)	<p>- Conditions -</p> <p>* PLEASE ARRANGE THE MAINTENANCE KIT(6000H).</p> <p>This is displayed when the changeover period for the oil mist filter and activated charcoal filter is within 500H.</p> <p>* PLEASE ARRANGE THE MAINTENANCE KIT(12000H).</p> <p>This is displayed when the changeover period for the adsorbent is within 500H.</p> <p>-----</p> <p>- Cause -</p> <p>(1) The changeover period for consumables is within 500H.</p>	<p>(1) This message is treated as a warning, which means that laser work is possible, but as the changeover period for consumables is approaching, you should contact AMADA.</p> <p>* Note: If the consumables are not changed after this message is displayed and you continue to use the machine, one of the following occurs within 500 hours; "EX0205 or EX2123: PLEASE EXCHANGE OIL MIST FILTER + ACTIVATED CARBON FILTER", or "EX0206 or EX2124: PLEASE EXCHANGE ADSORBENT"</p>

Alarm displays	Conditions and causes	Responses
EX0204 EX2122 ADSORPTION PRESSURE SWITCH ERROR	<p>- Conditions -</p> <p>When the control valve is ON and one minute passes and either the adsorbent pipe A pressure switch is open or the adsorbent pipe B pressure switch is closed, or on the other hand the control valve is OFF and one minute passes and the adsorbent pipe A pressure switch is closed or the adsorbent pipe B pressure switch is open, this is displayed.</p> <p>-----</p> <p>- Cause -</p> <p>(1) Control valve failure            (2) Exhaust valve failure            (3) Pressure switch failure            (4) Silencer blocked</p>	<p>If you press the ALARM RESET button to clear the alarm but it reoccurs, contact AMADA to have the following parts replaced.</p> <p>(1) Replace the control valve.            (2) Replace the exhaust valve.            (3) Replace the pressure switch.            (4) Replace the silencer.</p>
EX0205 EX2123 PLEASE EXCHANGE OIL MIST FILTER + ACTIVATED CARBON FILTER Alternatively EX0206 EX2124 PLEASE EXCHANGE ADSORBENT	<p>- Conditions -</p> <p>* PLEASE EXCHANGE OIL MIST FILTER + ACTIVATED CARBON FILTER.</p> <p>This is displayed when the changeover period for the purge maintenance kit has passed 6000H.</p> <p>* PLEASE EXCHANGE ADSORBENT.</p> <p>-----</p> <p>- Cause -</p> <p>(1) The changeover period for consumables has passed.</p>	<p>(1) There are parts that need to be changed so contact AMADA.</p> <p>(2) Replace the consumables. After this, go to the maintenance window, select the part that was changed, and press the complete button.</p> <p>*Note: If the filter elements of the filters and the adsorbent are not changed regularly, the machine may malfunction or fail.</p> <p>It will also be impossible to do laser work as the air in the laser beam path is not purged when this alarms occurs.</p>



## 14-7. Daily maintenance

### 14-7-1. Checking compressor for main air

Check the air compressor as described in its manual.

### 14-7-2. Checking purge unit

Maintenance list

1. Drain exhaust situation of main air filter.

Check that the amount of drain is not increased rapidly.

2. Leak or damage of main air piping (including the customer's factory piping)

Check that the main air regulator does not indicate 0MPa before starting the compressor.

## 14-8. Periodic maintenance

### 14-8-1. Checking compressor for main air

Check the air compressor as described in its manual.

### 14-8-2. Checking purge unit

Check film purge unit periodically.

In case of exchanging maintenance parts, select its name from "inspection setting" on operation display, and press complete button

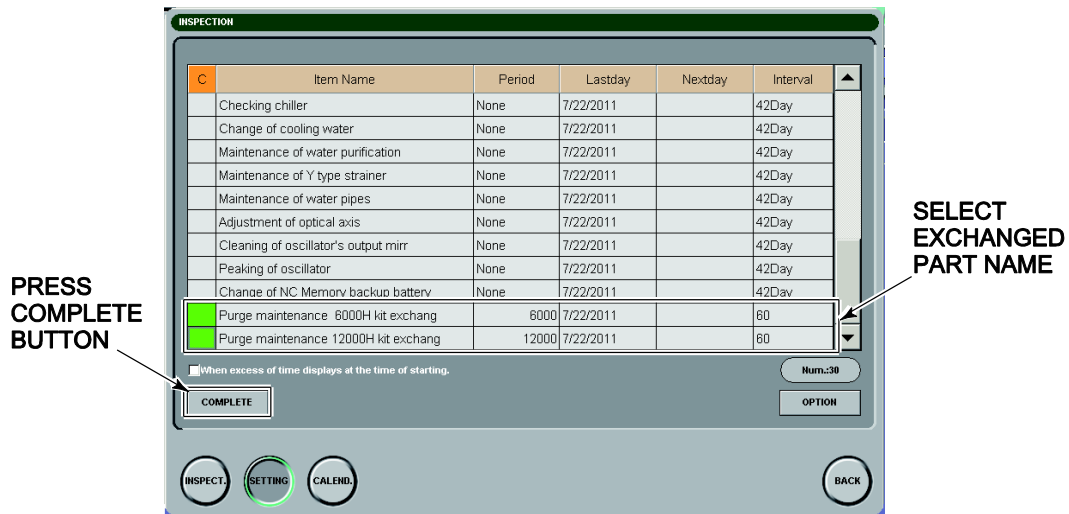
Items to be checked and serviced	Content and timing of checks and services
<ul style="list-style-type: none"><li>● Consumable kit for oil mist filter</li><li>● Consumable kit for activated charcoal filter</li><li>● Silencer</li></ul>	Change every year or 6000 hours. Order changes when the purge maintenance kit 6000H request (NC) warning occurs. Contact AMADA when making the changes.
<ul style="list-style-type: none"><li>● Adsorbent (insert cartridge)</li><li>● Humidity indicator (test paper)</li><li>● Check valve (check valve assembly)</li></ul>	Change every two years or 12000 hours. Order changes when the purge maintenance kit 12000H request (NC) warning occurs. Contact AMADA when making the changes.
<ul style="list-style-type: none"><li>● Bowl O ring</li><li>● Bowl assembly</li><li>● Bowl guard assembly</li></ul>	Check once every six months. Replace if air is leaking or there is damage. Contact AMADA when making the changes.
<ul style="list-style-type: none"><li>● Others</li></ul>	

#### NOTICE

- Unless maintenance parts are exchanged periodically, breakdown or damage can appear in the film purge unit.

### 14-8-3. Inspection setting

When maintenance parts are exchanged, press MAINTENANCE, MAINTENANCE1, INSPECTION, and SETTING buttons. On the inspection display, select the exchanged part name, and press complete button.



### 14-8-4. Consumable parts list (main air filters are listed on other tables)

Name	Model	Maker
Consumable Part Set ( each 6,000 hr)	-	ORION
Consumable Part Set ( each 12,000 hr)	-	ORION
Consumable Part Kit ( for Oil-mist Filter)	M3000-KIT	ORION
Consumable Part Kit ( for Activated Carbon Filter)	M3000-KIT-X	ORION

## 15. OVS IV (option)

The OVS IV system takes images of the worksheet with a CCD camera, captures the images, and makes necessary measurements and calculations on the images to compensate for the deviation of the cut origin and to calculate the circularity and pitch of laser-cut holes, for example.

### REFERENCE

- For the detail of the OVS IV, refer to its operator's manual.

## 16. Oil shot (option)

### 16-1. Usage

“Oil shot” is a method whereby oil (shot agent No. 9) is sprayed on a piercing point before piercing. “Side blow” is a method whereby air is side sprayed on the piercing point during or after piercing. The Oil shot is used together with the Side blow.

The shot agent No. 9 is a solvent developed to facilitate the removal of spatter generated when a mild steel sheet is pierced by the ECO Cut.

### 16-2. Detail description

When a mild steel sheet is pierced by the ECO Cut, the pierced hole is larger than a hole pierced by a conventional process. A large amount of spatter is formed on the sheet surface to hinder the subsequent cutting operation. During or after piercing, the sheet can be side sprayed with air not to form spatter.

When a thick mild steel sheet is pierced, spatter is formed on the sheet surface in such a large amount that it cannot be properly removed by the Side blow alone. Before piercing, the sheet can be sprayed with the shot agent No. 9 to facilitate the removal of spatter.

The shot agent No. 9 is a nonhazardous material, but must be disposed of in the same way as hydraulic oil.

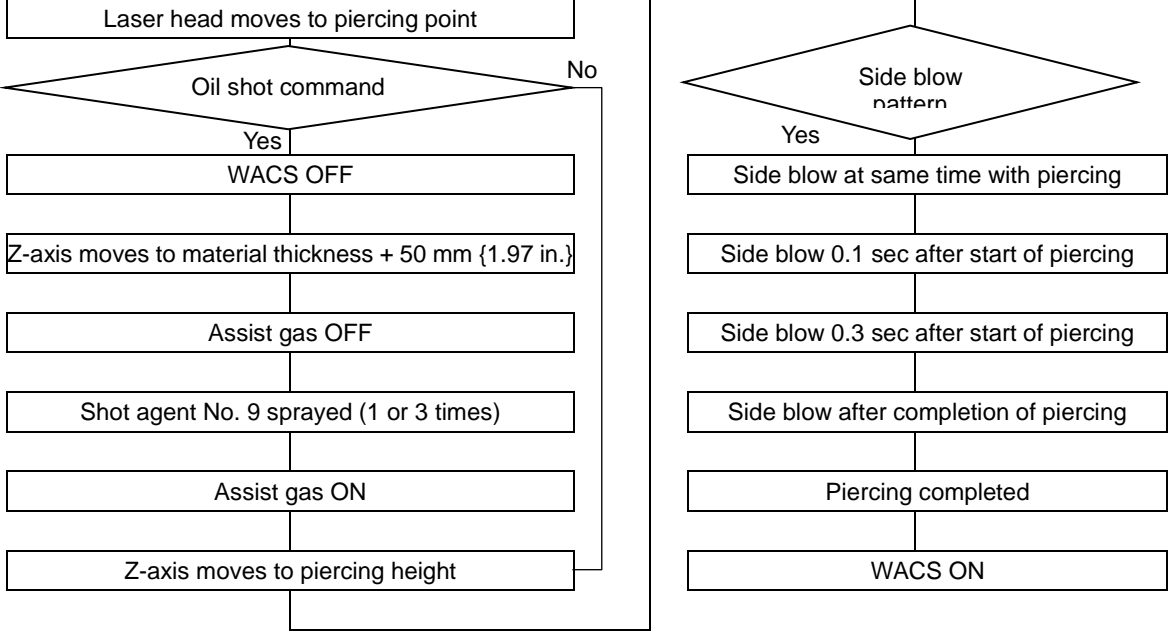
### 16-3. Method of use

To enable the Oil shot, set some number other than “OFF” in the Blow column on the PIERCE display of a processing condition file. See the table below for the set values and operation patterns.

Blow column	Oil shot	Side blow	Application* (Mild steel sheet)
OFF (0)	None	None	Up to 6 mm {0.24 in.} thick
1		No timer	Medium-gauge, 9 to 12 mm {0.35 to 0.47 in.} thick
2	Once	No timer	Medium-gauge, 9 to 12 mm {0.35 to 0.47 in.} thick
3		Timer 1 (after 0.1 sec)	Heavy-gauge, 12 to 19 mm {0.47 to 0.75 in.} thick
4		Timer 2 (after 0.3 sec)	
5	Three times	No timer	
6		Timer 1 (after 0.1 sec)	
7		Timer 2 (after 0.3 sec)	
8	Three times	After piercing	
9	None	None	
10	None	None	

\*The above applications are those assumed during test operation.

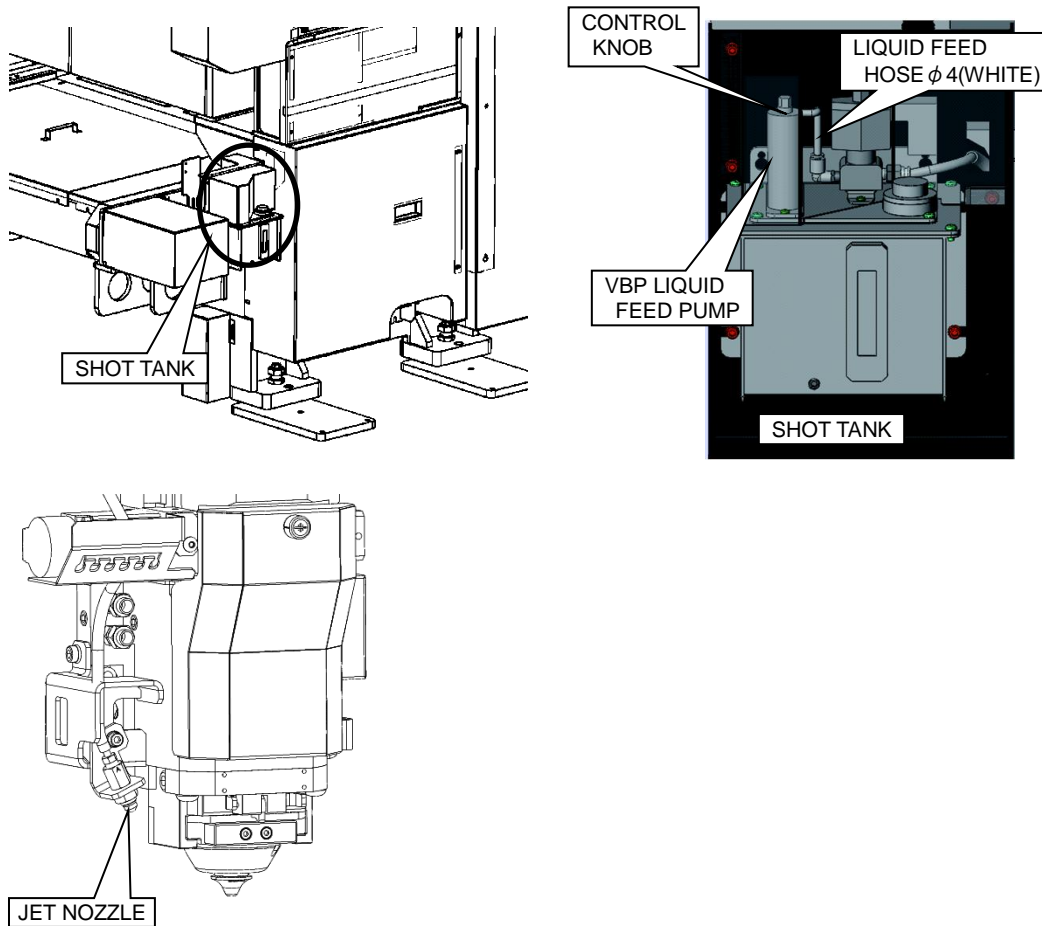
**Flowchart for piercing using Oil shot (for reference)**



## 16-4. Composition

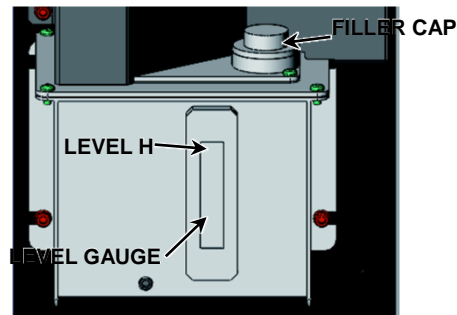
The Oil shot unit is composed of a 1.8 L {60 fl.oz.} capacity shot tank fitted with a VBP liquid feed pump to deliver the shot agent No. 9 at a constant rate and of a jet nozzle to spray the shot agent No. 9. The shot tank is installed at the rear of the machine, and the jet nozzle is installed in the laser head.

The shot agent No. 9 is supplied in a 5 L {169 fl.oz.} container as consumable. The amount of the shot agent No. 9 sprayed per shot is 0.07 mL {0.0024 fl.oz.} when the control knob is fully opened. (The control knob is set fully open at the time of factory shipment.)



## 16-5. Filling shot tank with shot agent

Remove the yellow filler cap from the shot tank, fill the shot tank with the shot agent to the level H (about 1.8 L {60 fl.oz.}), and replace the filler cap. Do not carry out this filling operation during laser cutting.



## 16-6. Bleeding air

### Bleeding air

When the Oil shot unit is operated with a low level in the shot tank, air enters the VBP liquid feed pump and reduces the force with which the shot agent is sprayed from the jet nozzle. After filling the shot tank with the shot agent, run the following program 5 to 6 min until the shot agent is forcibly sprayed from the jet nozzle. Then bleed the entrained air from the VBP liquid feed pump.

Air bleeding can also be performed by opening the Oil Shot display from the UTILITY display.

M154; M-code for spraying shot agent

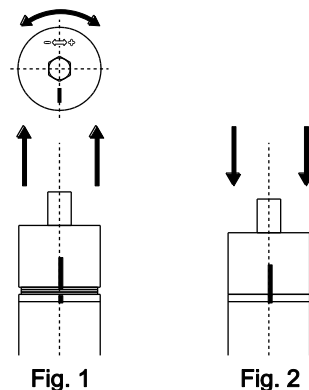
M97; M-code for repetition

The shot tank has a shot agent level detection function that produces the warning "EX2071 OIL SHOT OIL LOWER LIMIT" when the shot agent level drops close to the low limit. When this warning is displayed, add the shot agent to the shot tank.

### Adjusting spray amount of shot agent

Adjust the spray amount of the shot agent as described below.

1. Pull up the control knob to unlock it as shown in Fig. 1.
2. As shown in Fig. 1, turn the control knob in the negative direction or counterclockwise until it cannot turn any more. (At this time, the spray amount of the shot agent is set to zero.)
3. As shown in Fig. 1, turn the control knob in the positive direction or clockwise to adjust the spray amount of the shot agent. (One turn is equivalent to 0.005 mL {0.00017 fl.oz.} of the shot agent.)
4. Push down the control knob to lock it as shown in Fig. 2.



### Number of turns of control knob versus spray amount of shot agent per shot

Turns of knob	0	1	2	4	6	8	10	12	14
Spray amount (mL)	0	0.005	0.01	0.02	0.03	0.04	0.05	0.06	0.07
Spray amount ( $\times 10^{-4}$ fl.oz.)	0	1.7	3.4	6.8	10.1	13.5	16.9	20.3	23.7

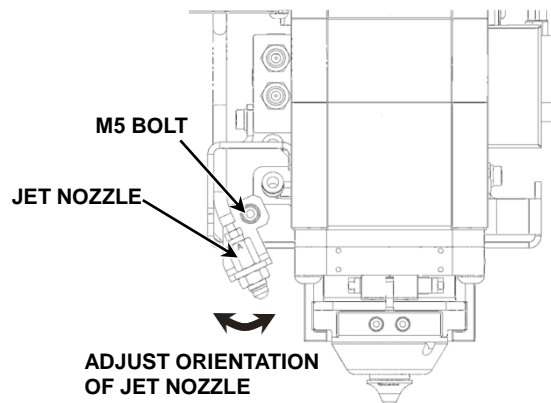
#### NOTICE

- After adjusting the spray amount of the shot agent, lock the control knob. Unless the control knob is locked, the spray amount of the shot agent may vary during piercing.
- Do not turn the control knob 14 turns or more.

## 16-7. Adjusting orientation of jet nozzle

When the jet nozzle has hit the worksheet or other object and shifted in orientation, adjust its orientation as described below.

1. Move the Z-axis to the material thickness plus 50 mm {1.97 in.}.
2. Run the above-mentioned program (M154 and M97) to spray the shot agent one or three times, and stop the machine.
3. Loosen the bolt shown at lower left, and adjust the orientation of the jet nozzle so that the shot agent can be sprayed on a piercing point as indicated by the red visible laser beam (semiconductor laser beam).
4. Tighten the bolt to fix the jet nozzle.
5. Spray the shot agent again, and check that the shot agent is directed to the piercing point.



## 16-8. Shot agent pre-spraying function

When the Oil shot unit is not used for a certain period of time, the pressure in the piping drops to such a degree that the first several shots of the shot agent may not be forcible enough to reach piercing points.

The shot agent is pre-sprayed, or the first several shots are made to stabilize the subsequent regular shots when the Oil shot unit is left unused for a certain period of time.

## Pre-spraying conditions

- Immediately after starting machine:

At the beginning of the day's work, the shot agent is pre-sprayed immediately after starting the machine. When the machine is restarted in the same day, the shot agent is not pre-sprayed.

- During continuous operation:

The shot agent is pre-sprayed 50 hours after the last regular shot is made during continuous operation.

## Number of first shots

The first shots are added to the scheduled number of regular shots.

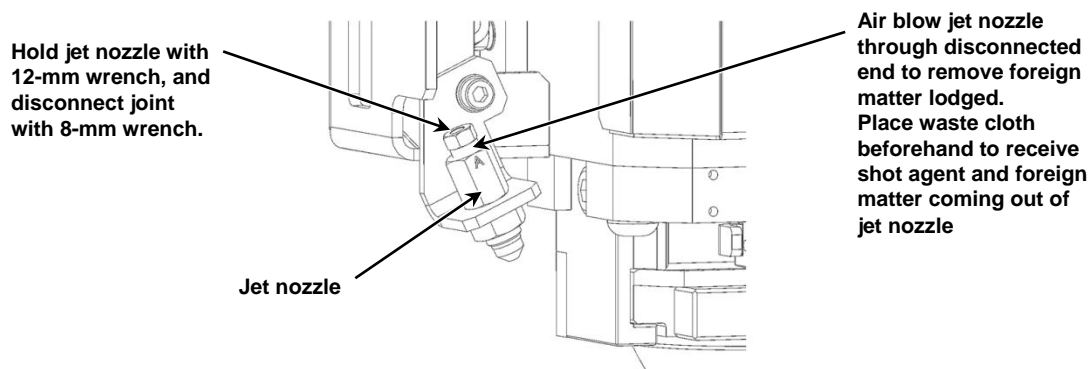
Number of first shots to be added: 3 as initial value

## 16-9. Troubleshooting

**Symptom 1: While the machine is operated without using the Oil shot unit, the shot agent drips from the jet nozzle.**

**Cause:** Foreign matter is lodged in the check valve of the jet nozzle to render the check valve ineffective.

**Remedy 1:** Air blow the jet nozzle to remove the foreign matter from the check valve as described below.

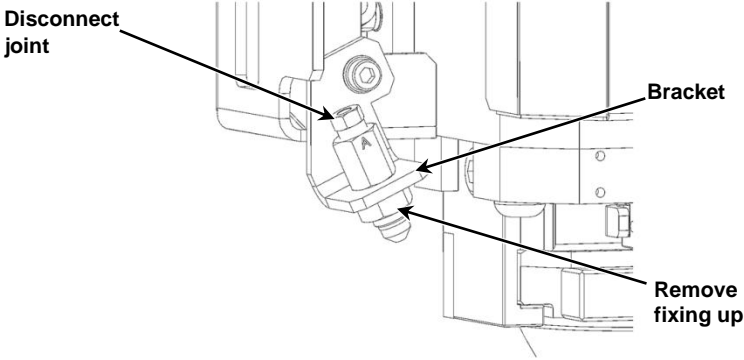


1. Air blow the jet nozzle through the disconnected end to remove the foreign matter lodged. Place waste cloth beforehand to receive the shot agent and foreign matter coming out of the jet nozzle.
2. Reconnect the joint to the jet nozzle.
3. Bleed air as described in “16-6. Bleeding air”, and check the shots for their force and point.
4. If the shot agent is sprayed on an unintended point, adjust the orientation of the jet nozzle as described in “16-7. Adjusting orientation of jet nozzle”.



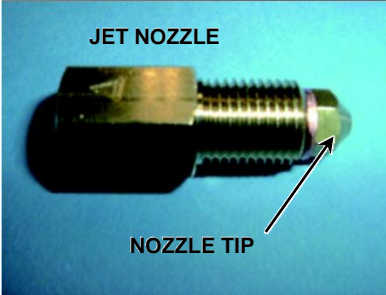
**Remedy 2:** If the air blow fails to remedy the situation, clean the check valve in the jet nozzle as described below.

- 1. Remove the jet nozzle.
  - (1) Remove the fixing nut with a 14-mm wrench.
  - (2) Disconnect the joint with an 8-mm wrench.
  - (3) Remove the jet nozzle from the bracket.

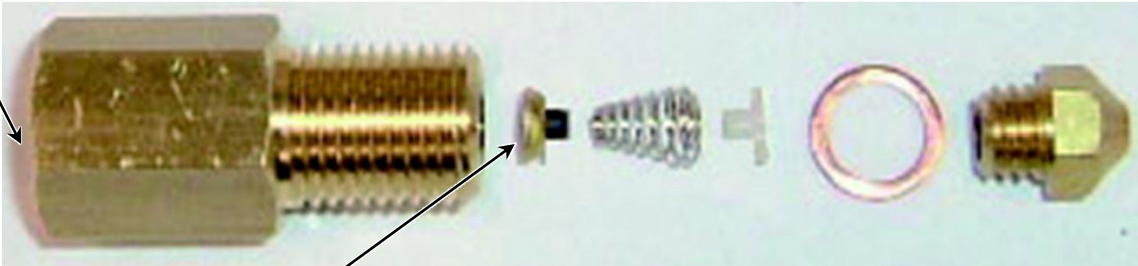


- 2. Disassemble the jet nozzle, and clean the check valve.

- (1) When the nozzle tip is removed, the jet nozzle can be disassembled as shown below.
- (2) Insert a thin rod from the opposite side to remove the check valve.
- (3) Clean the black surface of the check valve.
- (4) Reassemble the jet nozzle in the reverse order of disassembly.



INSERT THIN FROM THIS SIDE TO REMOVE CHECK VALVE



BLACK SURFACE OF CHECK VALVE

DISASSEMBLED VIEW OF JET NOZZLE

- 3. Install the jet nozzle to the bracket.
- 4. Reconnect the joint with the 8-mm wrench.
- 5. Install the fixing nut with the 14-mm wrench.
- 6. Bleed air as described in “16-6. Bleeding air”, and check the shots for their force and point.
- 7. If the shot agent is sprayed on an unintended point, adjust the orientation of the jet nozzle as described in “16-7. Adjusting orientation of jet nozzle”.

**Symptom 2: The shot agent is not sprayed forcible enough to reach the piercing point.**

**Cause:** Air is introduced into the VBP liquid feed pump.

**Remedy 1:** Bleed air as described in “16-6. Bleeding air”.

**Remedy 2:** If the symptom is not improved still, air blow the jet nozzle or clean the check valve as described for symptom 1.

**Symptom 3: The shot agent is sprayed, but spatter is not removed during piercing.**

**Cause:** The shot agent is not sprayed on the piercing point.

**Remedy:** As described in “16-7. Adjusting orientation of jet nozzle”, adjust the orientation of the jet nozzle, and check that the shot agent is sprayed on the piercing point.

## 16-10. Consumables

- Shot agent No. 9 (5 L {169 fl.oz.} container)
- Jet nozzle

## 17. Active cut

### 17-1. Description

Active Cut is an application system developed to make the most of the capability of Amada’s laser cutting machines.

With laser cutting, one of the thermal cutting processes, a laser beam is produced by an oscillator and focused by a lens to a small spot of high enough energy density to cut metals.

To achieve a more stable laser cutting capability, it is important to form an optimally focused spot on the surface of the worksheet to cut (or optimally control the focal point of the lens) and to control the spot diameter to suit specific worksheet material types, thicknesses and processing methods.

At present, the movement of the laser head changes the optical path length (distance from the oscillator to the laser head), which in turn changes the properties of the propagating laser beam. The difference in the cutting position changes the laser beam entering the lens and slightly varies the focal point and spot diameter.

The Active Cut system is equipped with an optical unit (active mirror unit or A/O unit) that has the function of changing the properties of the laser beam in the optical path between the oscillator and lens.

The A/O unit curvature is appropriately changed to suit the movement of the laser head. This makes it possible to compensate for the change in the incident beam diameter of the lens with the optical path length and to reduce the effect of the status change of the laser beam on cutting.

The curvature change is optimized according to the worksheet material type, thickness and processing method (control pattern) to improve the capability of the machine in the following aspects:

- Cutting feed rate of light-gauge to medium-gauge mild steel sheets
- Cutting stability of heavy-gauge mild steel sheets
- Clean Cut stability of stainless steel sheets
- Clean Cut capability of stainless steel sheets  
(high-pressure assist gas required, depending on sheet thickness)
- Cutting stability of aluminum sheets

These improvements provide for more stable laser cutting.

## 17-2. Operation

The Active Cut system is constantly at work and needs no particular operation and setup. The Active Cut specification machines are set at the time of factory shipment to minimize the property variation of the laser beam with the cutting position.

The Active Cut setting parameters are linked with the processing condition files in the NC unit. Selecting the material name automatically determines the control pattern suited for a particular processing job. No special operation and setting are required.

### REFERENCE

- For the details of the display, refer to “8. Processing condition displays” in Part I, Displays, in the reference manual of the AMNC-F.

## 18. Eco cut

### 18-1. Description

Mild steel is generally laser cut by using oxygen as assist gas.

ECO Cut is a laser cutting process developed to reduce the running cost as compared with conventional cutting by using oxygen as assist gas and proves effective in:

- Improving the cutting feed rate.
- Shortening the part processing time.
- Reducing the assist gas consumption.
- Preventing the melting and loss of minute portions.

### 18-2. Operational cautions

- Before use, clean the nozzle. Before using the ECO nozzle, clean its inside with an air gun or the like, and check that it is free from spatter and other foreign matter. The installation and use of the ECO nozzle with such deposits in the laser head may cause misoperation of the tracking function and damage to the laser head.
- Before use, check the ECO nozzle for tip breakage and hole deformation. The tip breakage and hole deformation adversely affect the cut quality.
- The hole of the ECO nozzle is of smaller diameter than that of the standard nozzle. Perform the centering nozzle. If the ECO nozzle is misaligned with the laser beam, the ECO Cut cannot function as intended, and the ECO nozzle may also be damaged.
- Use the ECO nozzle while ejecting head cooling air. Use of the ECO nozzle without cooling air ejection may make the lens hotter by the heat of reflection from the material and may cause the misoperation of the tracking function and damage to the lens or laser head.
- The ECO Cut differs from conventional laser cutting in that the Z-axis makes only one tracking motion before piercing to shorten the cutting time. The Z-axis rapidly to the piercing height at the next cutting point.

When the piercing position at the next cutting point is 300 mm {11.8 in.} or more apart, the Z-axis makes another tracking motion before piercing. When A16 and A17 are used for piercing, the laser head rises only to the piercing position after cutting the path. Do not use A16 and A17 for cutting a bowed worksheet or 3D part. Otherwise the laser head or ECO nozzle may break. When the laser head strikes against the worksheet, the ECO nozzle may be damaged by the laser beam. In such a case, remove the laser head, and check the nozzle and the sensor cone for damage.

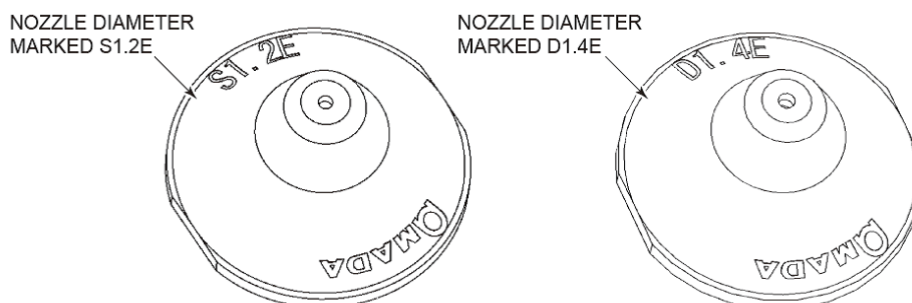
- The ECO nozzle is a dedicated nozzle for ECO Cut.
- When the cutting operation is interrupted by pressing the NC RESET button or STOP button by reason of a cutting failure, for example, raise the Z-axis 35 mm {1.4 in.} or more to ensure a sufficient nozzle gap, turn the SHUTTER keyswitch to OFF, and clean the ECO nozzle of spatter and other foreign matter deposits. Then resume the cutting operation.
- After an ECO CUT operation, give full consideration to the maintenance of the machine. Clean the machine (especially the drive unit) of dust and other foreign matter deposits.

### 18-3. Specifications

Usable lens	Lens diameter D	D = 1.5"
	Focal length Lf	Lf = 5", 7.5" (option)
Nozzle type	ECO nozzle	φ1.2, φ1.4 (*1)
Cooling air	Air supply pressure	0.3 MPa {43 psi}
Worksheets	Material	Mild steel (SPCC, SPHC, SS400)
	Thickness	AF3500i-C: 1.0 to 12.0 mm {0.039 to 0.472 in.}
Commanded nozzle gap	0.7 to 1.5 mm {0.028 to 0.059 in.}	


\*1 Carefully align the center of the laser beam with that of the ECO nozzle. Misalignment not only detracts from the ECO Cut function, but also damages the ECO nozzle.

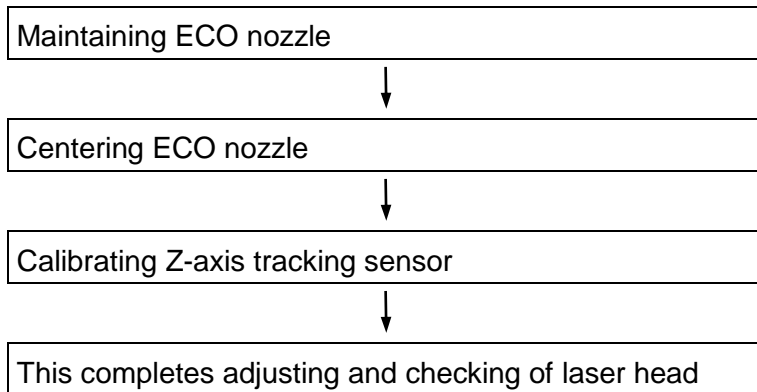
### 18-4. ECO nozzle



## 18-5. Adjustment

Before using the ECO nozzle, adjust and check each part as described below.

 <b>DANGER</b> <ul style="list-style-type: none"><li>● During the adjustment, a minute laser beam may be emitted from the ECO nozzle. Never place your hands or any other body part below the ECO nozzle. Otherwise you may get burned.</li></ul>
--



### 18-5-1. Maintaining ECO nozzle

Maintain the ECO nozzle as described below.

1. Remove the nozzle unit.
2. Remove the ECO nozzle with a 24-mm wrench, blow it with an air gun, and wipe off spatter and other foreign matter from it with waste cloth. The removal and installation steps are as same as the standard nozzle.
3. Install the ECO nozzle in the nozzle unit with the 24-mm wrench.
4. Install the nozzle unit.

### 18-5-2. Centering ECO nozzle

Center the ECO nozzle in the same way as that of the standard nozzle.

#### REFERENCE

- For the procedure for centering the nozzle, refer to “2-8. Centering nozzle” in Part 3.

#### NOTE

- The ECO cut uses a nozzle of small diameter. Carefully center the ECO nozzle. Unless it is accurately centered, it cannot display its full performance.

Before centering the nozzle, make the following settings on the processing condition display:

Material Name field: from POWER

Material Type field: Standard

Focus field: +1.5

- If the hole pierced by the laser beam is large, the nozzle cannot be accurately centered. Issue an appropriate power command to center the nozzle.

### 18-5-3. Calibrating Z-axis tracking sensor

Calibration refers to the calibration of the nozzle gap and sensor output signal.

This calibration is required when:

- a) The nozzle is changed.
- b) The sensor cone is changed.
- c) The command value is different from the actual nozzle gap by more than a control accuracy of  $\pm 0.2$  mm { $\pm 0.008$  in.}.
- d) When the Z-axis tracks the worksheet surface at the cutting start (piercing) point, the laser head bumps into the worksheet or lowers at an extremely reduced speed.

#### REFERENCE

- For the procedure for calibrating the Z-axis tracking sensor, refer to “2-9. Calibrating Z-axis tracking sensor” in Part 3.

### 18-6. Operation

Before cutting with the ECO Cut, adjust each part, and check the items described below.

#### 18-6-1. Explanation of operation of ECO cut

##### 1) A6 (quick piercing) and A7 (woodpecker piercing)

The following command changes the motion of the Z-axis:

- Command from the PIERCE display under the processing condition display.

Set 6 or 7 in the Piece type column.

1. For the first operation, the Z-axis rises after the tracking motion. (Nozzle gap in the pierce condition No.E103) Here, the height and position of the Z-axis are memorized.
2. The Z-axis rises from that position while emitting the laser beam and then lowers to the original position while emitting the laser beam.

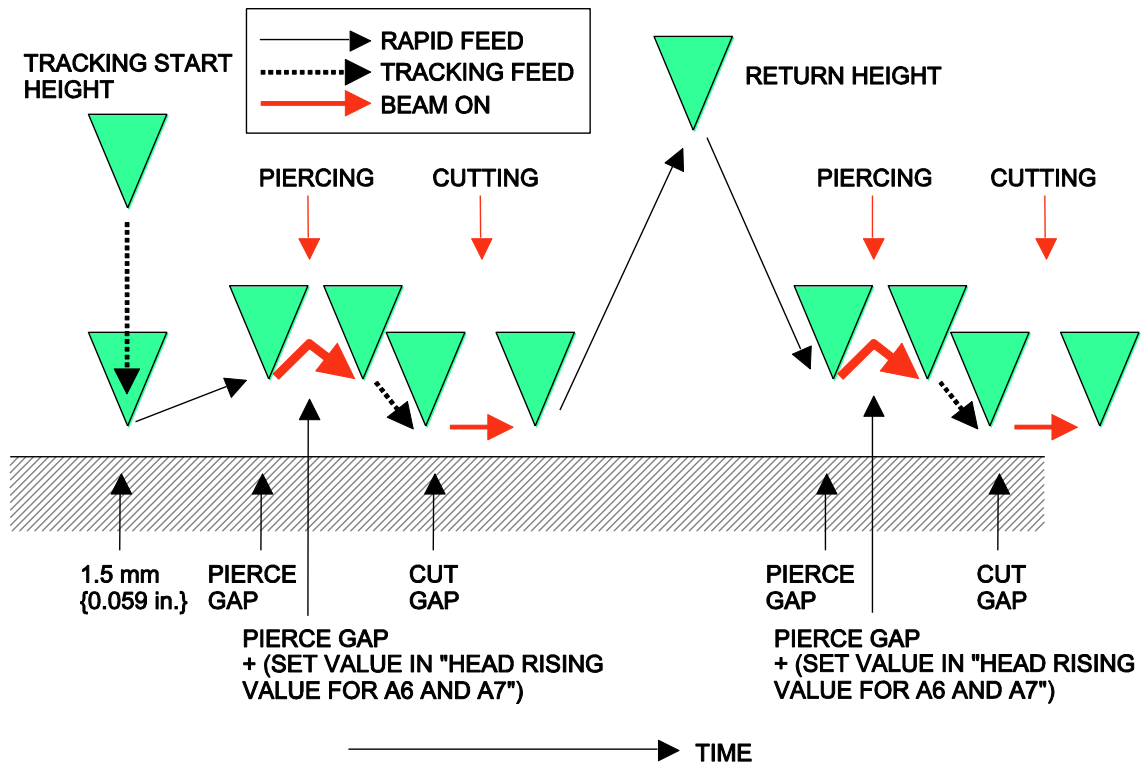
The Z-axis warms up for the time set in the Warming Time field on the macro display for the first operation and then moves while tracking to the position of “nozzle gap” set as one cutting condition.

3. Before the Z-axis zero-returns at M104, its height and position are memorized again.
4. For the second and subsequent operations, the Z-axis rapidly down to the nozzle gap in the pierce condition and moves as described in step 2.

If the Z-axis is apart more than 300 mm {11.8 in.} from the height and position memorized in step 3, it repeats the motion described in step 1.

## NOTE

- When directly command A6, and A7 in the program, the laser power, frequency, duty, and assist gas type and pressure are as set in the pierce condition No.E103.



## 2) A16 (quick modal processing)

The following command changes the motion of the Z-axis:

M103 A16

In a regular-shaped hole macro

G111.....A16

In the absence of the A\_ command thereafter, the Z-axis moves as commanded by A16.

A99 is commanded to cancel quick modal processing.

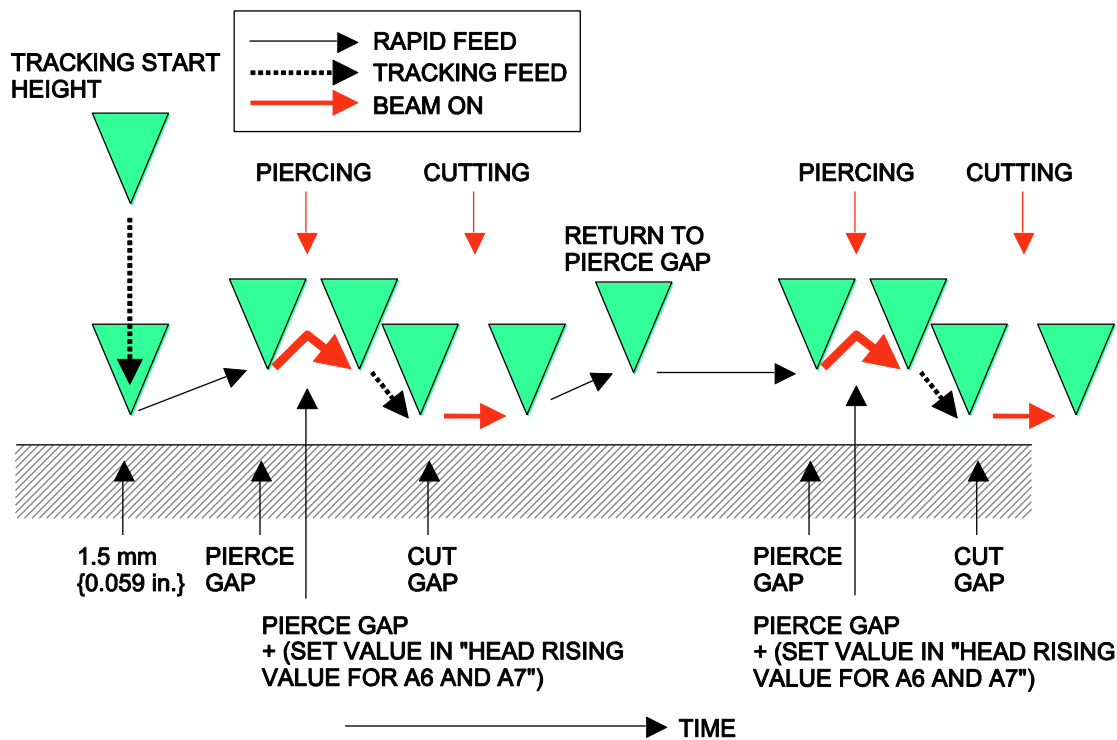
Any other pierce command, like A0 or A3, is canceled.

### Motion

A16 is commanded for high-speed processing of A6.

A16 is the same as A6 in motion and setting. The return height at M104 is the value set in the Nozzle gap in the piercing condition E103. The assist gas is a cutting assist gas.

In the M104 M00, M104 M180, and M104 Z\_ commands, the Z-axis returns to each return height.



### 3) A17 (woodpecker modal processing)

The following command changes the motion of the Z-axis:

M103 A17

In a regular-shaped hole macro

G111.....A17

#### Motion

In the absence of the A\_ command thereafter, the Z-axis moves as commanded by A17.

The return motion and assist gas during modal processing are the same as commanded by A16. Modal processing is canceled by commanding A99. Other pierce commands, such as A0 and A3, are canceled.

A function of fast exhaust discharge, if equipped, operates once for the first operation.

## 18-6-2. Preparing for editing program

Prepare for editing a program as described below.

1. Check that the MEMORY PROTECT keyswitch is set to OFF.
2. Press and illuminate the MEMORY button.
3. Press the PROGRAM button on the screen.
4. Press the OPEN button to open the Open display.
5. Select the call-from media, and display the programs contained in the call-from media. Select the program, and press the OK button.



### 18-6-3. Replacing word

A given word in the displayed program can be replaced with another word or an address.

NOTE
------

- The first instance of the specified word to occur after the current cursor position is replaced. To replace all instances of the specified word, move the cursor to the beginning of the program, and start the procedure.
- The word to be replaced and the word to replace with can be both specified in a maximum length of 73 characters.

Replace all instances of the specified word after the current cursor position as described below.

**Example:**

G00 G41 X25 Y-5

E003

M103 (insert A7 in pierce command M103, and replace with M103 A7)

G01 Y0

G01 X50

G01 Y50



G00 G41 X25 Y-5

E003

M103 A7 (after replacement)

G01 Y0

G01 X50

G01 Y50

1. Press the REPLACE button.
2. Enter the word M103 to be replaced.
3. Enter the word M103 A7 to replace with.

REFERENCE
-----------

- For the replacement of the words, refer to “8-2. Replacing word” in Part II, Program Management, in the reference manual of the AMNC-F.

## 18-6-4. Changing cutting conditions

Open the processing condition display to use as described below.

1. Press the COND. button to open the processing condition display, and press the LIST button.
2. Scroll by fingertip to the line of the material name to use. Press the line by fingertip to select it.
3. Press the OPEN button.

## 18-6-5. Checking data in processing condition file

When using the ECO Cut, check the data in the attached processing condition file.

### NOTICE

- Be sure to enter the laser power, frequency and duty, assist gas kind and pressure, and nozzle gap in E103. When the laser mode is continuous wave (CW), enter a value of 100 or more for the frequency. If the frequency is set to 0, an alarm occurs.
- When the Material Type in the processing condition file is set to “High speed”, high-speed processing is prioritized.
- Set the “Assist gas ejection height” parameter in the processing condition file to a value greater than “Nozzle gap in E103 + (Head Rising Value for A6 and A7)”.

## 18-6-6. Changing data

The data can be always changed as described below.

1. Using the arrow keys on the keyboard or the screen, move the cursor to the data you want to change.
2. Using the numeric keys, enter the value you want to change to.

### NOTE

- If you have entered a wrong value, press the Esc key, and enter the correct value.

## 18-6-7. Saving data

The data can be saved as described below.

1. Press the SAVE button.
2. A message window opens to display that the data has been saved.

NOTE
------

- The changed data is shown on the display. Unless the changed data is saved, the corresponding data in memory does not change. When the material name (processing condition file name) is called again without saving the changed data, the original data is shown.
- If the program has the material command “M102 ( )”, execution of the program without saving the changed data causes piercing to be performed according to the original data.
- Before operating the ECO Cut, perform the assist gas adjustment on the UTILITY display with the type of assist gas set in the processing condition file to use, in order to remove the remaining gas in the laser head.
- Check that the TRACE OFF button on the panel B of the screen is extinguished to indicate that the tracking function is enabled.

## 18-7. Maintenance

### 18-7-1. List

Item		Daily	Weekly	Monthly
Laser head	Checking nozzle	<input type="radio"/>		
	Checking nozzle unit	<input type="radio"/>		
	Checking lens	<input type="radio"/>		
Machine	Cleaning table surroundings	<input type="radio"/>		
	Cleaning workclamps	<input type="radio"/>		
	Cleaning conveyors	<input type="radio"/>		
	Cleaning scrap boxes	<input type="radio"/>		

### 18-7-2. ECO nozzle

Check the ECO nozzle, and change it as necessary. After the change, it is necessary to adjust the new ECO nozzle.

REFERENCE
-----------

- For details of adjustment, refer to “18-5. Adjustment” in this Part.

## ECO nozzle

Check the nozzle tip for breakage and hole deformation. Breakage or hole deformation of the nozzle tip may adversely affect the cut quality.



**Example:** Laser head struck worksheet and had nozzle tip cut off by laser beam.

If the nozzle is badly damaged as shown above, it must be changed. Order its replacement under the following name:

Nozzle name: ECO nozzle marked with diameter

## 18-7-3. Machine

After cutting with the ECO Cut function, carefully maintain the machine. Wipe the machine (especially the nozzle unit) with waste cloth to clear spatter and other foreign matter.

## 19. Executing jog cutting

### REFERENCE

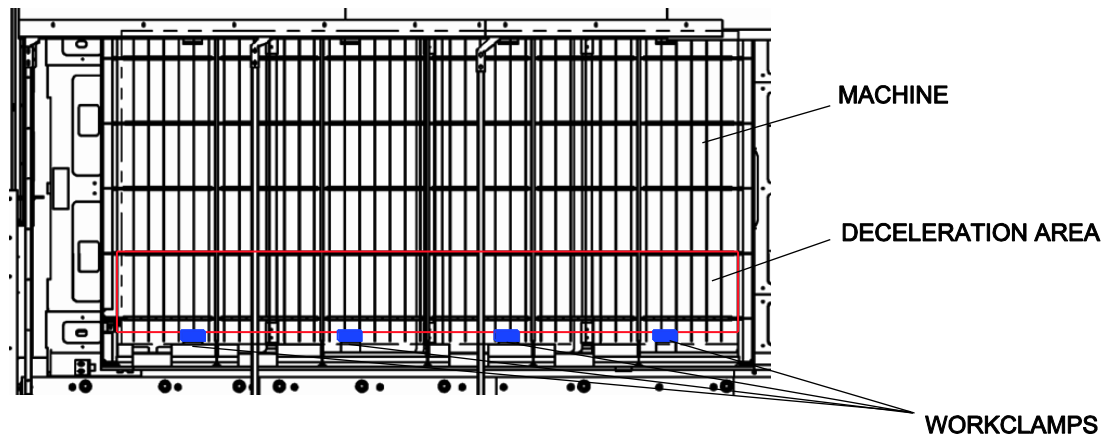
- For the detail of the displays, refer to “7-5. JOG Cutting” in Part I, Displays, in the reference manual of the AMNC-F.
1. With the FEED buttons on the NC control panel, move the laser head to the processing start point.
  2. On the COND. display, select the processing condition file that suits the material to be processed.
  3. Press and illuminate the MEMORY button on the NC control panel.
  4. Press the UTILITY button at the top of the screen to open the UTILITY display.
  5. Press the JOG Cutting button on the UTILITY display to open the JOG Cutting display.
  6. Press and illuminate the HEAD DOWN button on the JOG Cutting display.
  7. Press the START button on the NC control panel to lower the laser head.
  8. Press and illuminate the PIERCE button on the JOG Cutting display.
  9. Turn the SHUTTER keyswitch on the NC control panel to ON, and press the START button on the NC control panel to start the piercing operation.
  10. Press and illuminate the MANUAL button on the NC control panel.
  11. Turn the MANUAL CUT keyswitch on the NC control panel to ON. The warning “EX0024 MANUAL CUT MODE” occurs, but continue the procedure by ignoring the warning.
  12. While pressing and holding the MANUAL CUT ENABLE button on the NC control panel, press and hold one of the FEED buttons for the direction in which you want to process the worksheet. The laser head starts cutting the worksheet in the selected direction.

## 20. Workclamp interference area deceleration function

In the area where the laser head is likely to interfere with the workclamp, the laser head decreases in its automatic rapid feed rate or manual feed rate.

### NOTICE

- To operate the machine with the workclamp interference area deceleration function disabled, take care that the laser head does not interfere with the workclamp.
- The workclamp interference area deceleration function is not designed to protect the machine from damage when the laser head strikes the workclamp.
- Also take care that the laser head does not strike the worksheet or other object in other areas.



**The laser head decreases in its automatic rapid feed rate and manual feed rate in the deceleration area.**

- Deceleration area
  - Rapid feed: Less than  $Y = 370 \text{ mm}$  {14.57 in.} and less than  $Z = 60 \text{ mm}$  {2.36 in.}
  - Manual feed: Less than  $Y = 125 \text{ mm}$  {4.92 in.} and less than  $Z = 60 \text{ mm}$  {2.36 in.}
- Axis speed in deceleration area
  - X axis: 5 m/min {16.4 ft/min}
  - Y axis: 5 m/min {16.4 ft/min}
  - Z axis: 3 m/min {9.8 ft/min}
- The laser head decelerates along the X-, Y-, and Z-axes, but not decelerate in +Y and +Z directions (in which it moves away from the workclamps.)
- During its processing feed, the laser head does not decelerate in the deceleration area. The part processing accuracy is consequently not affected.
- In the MANUAL or handwheel mode, the following message is displayed when the Z-axis position becomes less than 60 mm {2.36 in.}, regardless of the X- and Y-axis positions.  
Operate the machine with care.  
EX2058 HEAD INTERFERENCE WARNING
- The deceleration function operates in the same area as the manual feed when the handwheel control box is used.

**The laser head stops in the dead zone when the DEAD ZONE CANCEL button is extinguished.**

When the DEAD ZONE CANCEL button is extinguished on the touch screen (or when the function of detecting the laser head in the dead zone or the dead zone detection function is enabled), the dead zone detection function prioritizes over the workclamp interference area deceleration function and stops the machine.



When the DEAD ZONE CANCEL button is illuminated on the touch screen (or when the dead zone detection function is disabled), the laser head decelerates in the deceleration area.

**The workclamp interference area deceleration function can be disabled.**

When the CLAMP DECELERATION OFF button is illuminated on the touch screen, the workclamp interference area deceleration function is disabled.



# Part 6

## Maintenance

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### WARNING

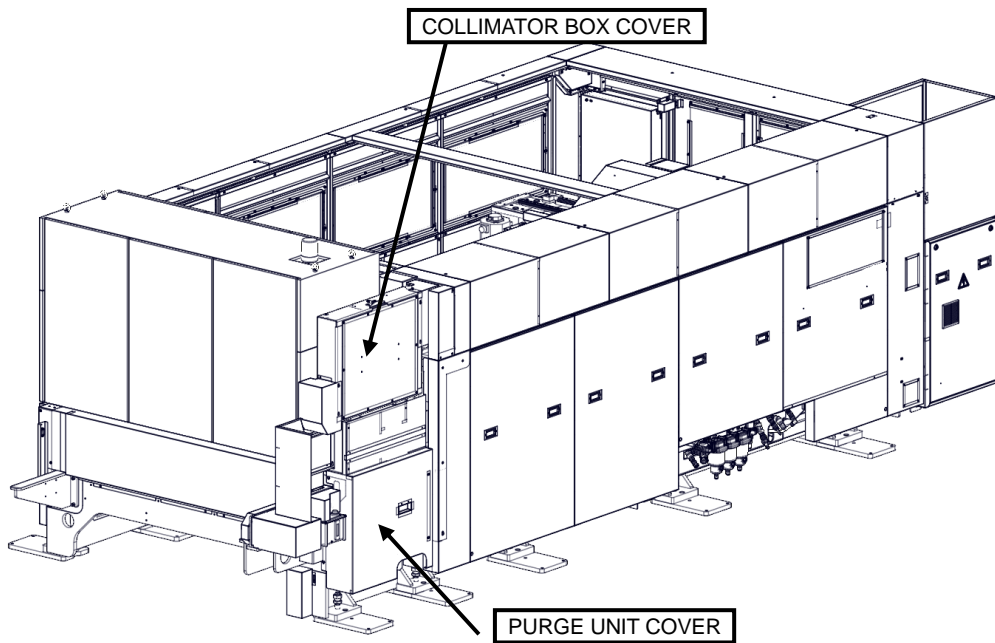
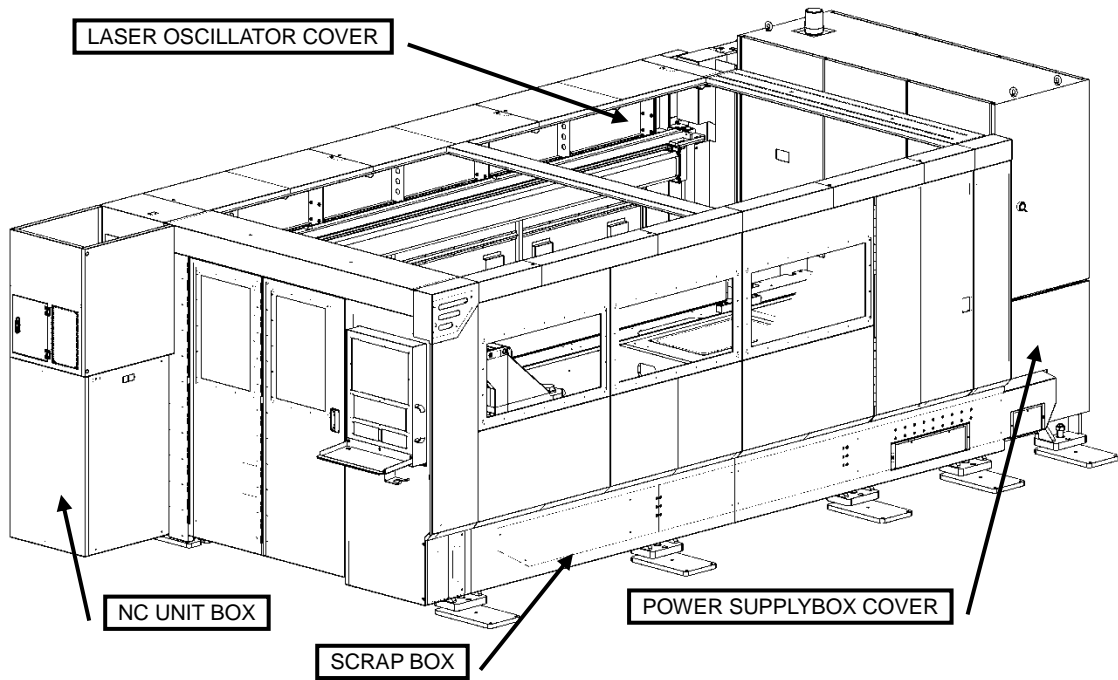
- Before performing maintenance and adjustment on the machine, stop the supply of compressed air and electric power to the machine, and turn off the shop circuit breaker switch.
- To prevent other workers from turning on the power of the machine by mistake, padlock the machine circuit breaker switch in the OFF state.
- Before working in the hazardous area of the machine with its compressed air and electric power turned on, press the STOP button, and turn the SHUTTER keyswitch to OFF.
- When performing maintenance and adjustment on the machine, post a sign to notify other workers that maintenance and adjustment are under way.

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# 1. Arrangement and names of covers

LCG3015



## 2. Daily maintenance

### 2-1. Maintenance before start of day's work


Before starting the machine every day, check and maintain the items described below.

#### 2-1-1. Checking lens (cleaning)

Check every day that the lens is not dirty.

The surface deposition of soot, dust, oil, and spatter damages the lens. High-speed cutting, Clean Cut, Aluminum Cut, and cutting of coated steel sheets are likely to cause spattering.

The low pressure of the assist gas for ECO Cut and cutting of heavy-gauge mild steel emphasizes the adverse effect of lens surface contamination.

 <b>WARNING</b> <ul style="list-style-type: none"><li>● <b>The lens contains components designated as toxic and cannot be discarded carelessly. When you want to dispose of the lens, ask a contractor or AMADA to do so.</b></li></ul>
--

#### NOTICE

- Be sure to use the cleaning paper and cotton swabs contained in the accessory lens cleaning kit. Do not use commercial tissue paper and medical cotton swabs because they are likely to damage the lens and their oil components contaminate the lens.
- Do not use the cleaning paper or cotton swab in the dry state, and do not reuse them. Otherwise the lens may be damaged. If the lens is still dirty or is scratched or cracked, it may break, burn, or cause improper cutting. Change it.

If its surfaces are dirty, clean the lens as described below.

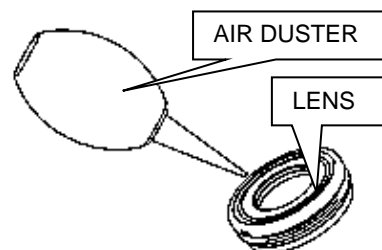
1. Remove the lens from the laser head. At this time, never touch the lens.

#### REFERENCE

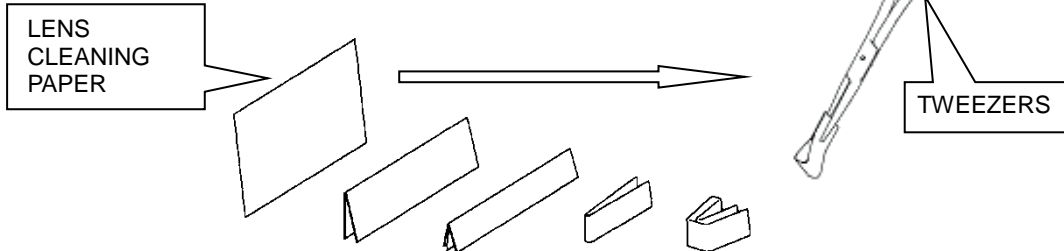
- For the details of the procedure for removing the lens, refer to “2-6. Changing lens” in Part 3.

2. Blow off dust and other foreign matter on the lens with an air duster (blower).

If the lens is still dirty, do as described below.



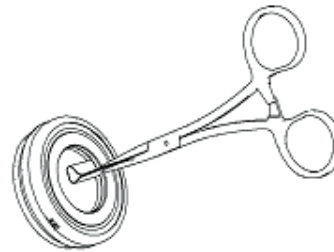
3. Fold the lens cleaning paper to a small size, hold it with a pair of tweezers, and dampen it with acetone or absolute alcohol. Too little acetone or absolute alcohol damages the lens, and too much acetone or absolute alcohol detracts from the wiping effect. Dampen the lens cleaning paper with acetone or absolute alcohol to such a degree that when it is shaken, no drops fly off it.



4. Lightly wipe the lens surface with the wet paper.

Be sure to wipe in only one direction. Since its surface coating is likely to be scratched, handle the lens with due care so that it is not scratched by the tips of the tweezers.

If the lens cannot be cleaned at a time, be sure to change the lens cleaning paper, and repeat steps 3 and 4.



5. If the deposit or stain cannot be removed, dampen a cotton swab with acetone, and clean the lens with the wet cotton swab.

If the lens cannot be cleaned by one operation, be sure to change the cotton swab, and repeat the operation.

6. When the lens is cleaned of any deposit or stain, check it for damage to the surface coating, and blow the lens again with an air duster (blower).

Install the lens in the laser head.

#### REFERENCE

- For the details of the procedure for installing the lens, refer to “2-6. Changing lens” in Part 4.

## 2-1-2. Checking nozzle

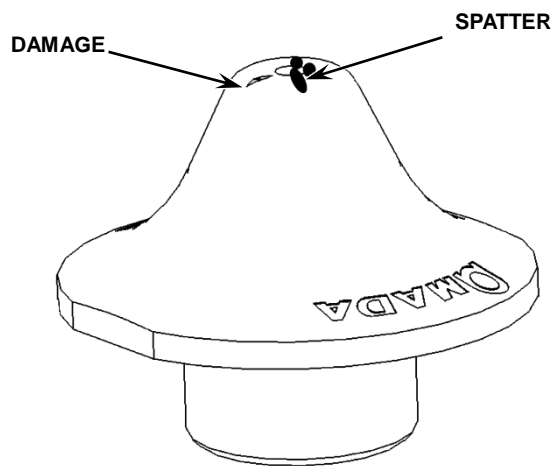
### NOTICE

- Before installing or removing the nozzle, be sure to discharge your static electricity by touching the machine or other metal surface. Otherwise the static electricity may cause the failure or malfunction of the control devices in the machine.

Check the nozzle every day.

During a cutting operation, spatter flies in all directions. If the nozzle opening is clogged with the spatter or the nozzle is damaged by the spatter, a good cut edge may not be obtained. Be sure to pay full attention to this possibility.

When the nozzle is damaged or smeared with a deposit of foreign matter, remove it, and clean or change it.



## 2-1-3. Checking nozzle unit of Z-axis tracking sensor

Check the nozzle unit of Z-axis tracking sensor for damage or deposit every day. If the nozzle unit is damaged or has a deposit of foreign matter, clean or change it.

### NOTICE

- If the machine is used with spatter or dust deposited on the Z-axis tracking sensor, the life of the Z-axis tracking sensor and the detection accuracy of the nozzle gap may be seriously affected.

## 2-1-4. Checking residual pressure of laser gas

Check the residual pressure of the laser gas every day.

Change the laser gas cylinder when the residual pressure is less than 1 MPa {142 psi} on the primary side or when the laser gas is likely to run out during the middle of the cutting operation.

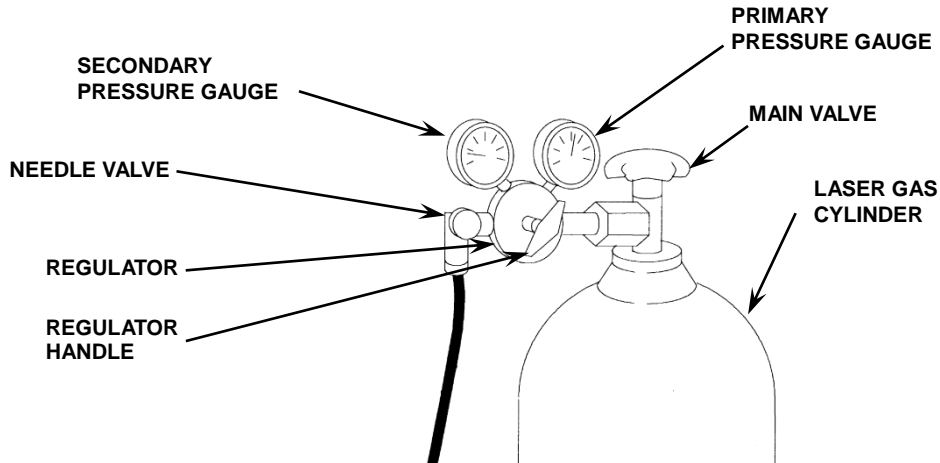
### NOTE

- When its residual pressure drops, the laser gas changes in composition and may make it impossible to perform proper laser cutting. Change the laser gas cylinder as early as possible.



## CAUTION

- When opening the main valve of the laser gas cylinder, be sure to stand at the side of the pressure regulator and to direct the glass surface of the pressure gauge where there are no other persons. If the glass breaks and flies, it may be dangerous.



### Changing laser gas cylinder

1. Close first the needle valve and then the main valve of the laser gas cylinder to stop the supply of the laser gas.
2. Turn the regulator handle fully counterclockwise.
3. Remove the regulator from the laser gas cylinder, and install it to the new laser gas cylinder.

#### NOTE

- Be sure to check the connection to the cylinder with soap water for gas leakage.
4. Stand at the side of the regulator, and direct the glass surface of the pressure gauge where there are no other persons.
  5. Open the main valve of the cylinder.
  6. Check that the primary gas pressure gauge reads 1 MPa {142 psi} or more.
  7. Turn the regulator handle clockwise to set the secondary pressure at  $0.175 \pm 0.025$  MPa (0.15 to 0.20 MPa) or  $25.4 \pm 3.6$  psi (21.8 to 29.0 psi).
  8. Open the needle valve.

This completes the procedure for changing the laser gas cylinder.

## 2-1-5. Checking residual pressure of assist gas

Check the residual pressure of the assist gas every day.

Change the assist gas cylinder when the residual pressure is 0.5 MPa {72 psi} or less, or when the assist gas is likely to run out during the middle of the cutting operation.

### NOTE

- When liquefied gas is used as assist gas, there may remain a large amount in the cylinder despite a low residual pressure reading. Adjust so that the cylinder is always kept at high pressure.

Contact the assist gas supplier about changing the assist gas cylinder or adjusting the pressure of the assist gas cylinder.

## 2-1-6. Cleaning table and area around machine



### WARNING

- **Reflected light and spatter may cause a fire. Never place combustible materials around the machine.**
- **Frequently remove scrap from the scrap boxes. Especially if a combustible material is collected, a fire or explosion may occur.**

Clean the table and the area around the machine every day.

Spatter scatters on the table during the laser cutting operation. Be sure to clean the table.

If the free-motion ball bearings are broken or rusted, they may scratch the worksheet. Clear them of spatter with an air gun, and clean them with lubricating oil.

Spatter may cause a fire during the laser cutting operation. Never place combustible materials around the machine.

Do not place worksheets, parts, scrap, and other materials around the machine. Maintain a safe working space around the machine. Reflected light and spatter may cause a fire. Never place combustible materials around the machine.

Frequently remove scrap from the table and scrap boxes. Especially if a combustible material is collected, a fire or explosion may occur.

Before cleaning the table, close the workclamps so that you do not get your fingers pinched in the workclamps or get your hands injured by the claws of the workclamps.

## 2-1-7. Checking oil level in exhaust pump (vane pump)

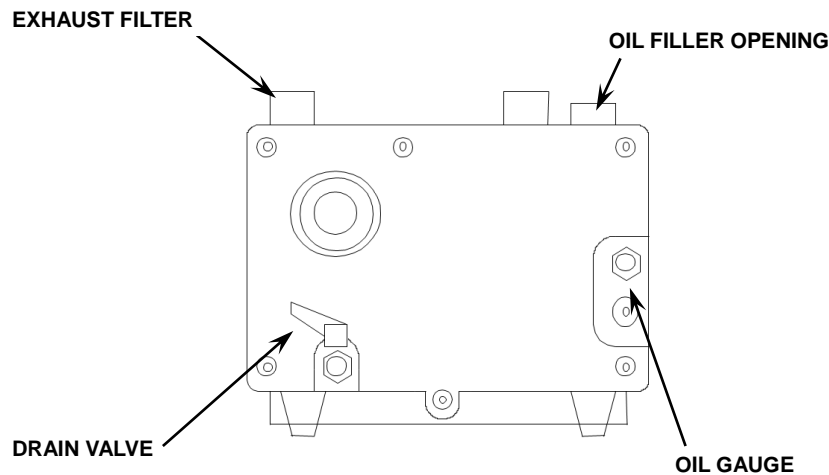
### NOTICE

- If the oil level is abnormally low, there is a possibility of oil back flow, oil leakage, or exhaust filter failure. Contact AMADA.

Check the oil level and condition of the exhaust pump through the oil level check window in the cover of the laser oscillator every day.

The oil level is appropriate when positioned between the MAX and MIN marks of the oil gauge during operation. If the oil level is below the MIN mark, contact AMADA.

The oil is clear when fresh. If it is dark, contact AMADA.



## 2-1-8. Cleaning dust box of dust collector



### WARNING

- Clean the dust box of the dust collector to prevent a fire or explosion.

Clean the dust box of the dust collector every day.

Remove the dust collected in the dust box.

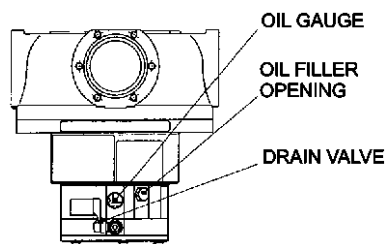
If the machine is operated with the dust box full, the life of the dust collection filter may be prematurely shortened, and a fire or explosion may occur.

## 2-1-9. Checking oil level of turboblower

Check that the oil level falls between the H and L marks of the oil gauge when the laser oscillator is being purged.

### NOTE

- The oil level cannot be correctly checked when the turboblower is operating.



## **2-1-10. Cleaning scrap box**

Clean the scrap box every day.

Remove the dust collected in the scrap box.

In particular, when switching to oxygen cutting of iron after performing cutting of aluminum, clean the scrap box so that there is no aluminum dust left.

## **3. Monthly maintenance**

Perform the following maintenance tasks every month.

### **3-1. Lubricating machine parts**

Lubricate the machine parts as described in “13. Lubrication” in this Part.

### **3-2. Checking dust collection filter**

Check the dust collection filter every month.

Change the dust collection filter when it is clogged or damaged.

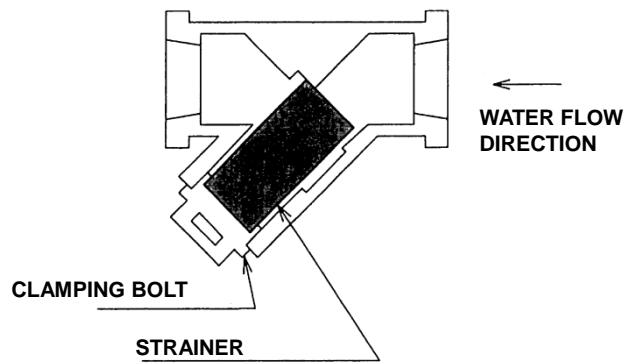
The dust collector is designed to automatically clean its filter. When dust leaks from the exhaust opening during operation or dust deposits on the worksheet during cutting, the dust collection efficiency is reduced. Clean or change the dust collection filter. (For cleaning or changing the dust collection filter, read the manual of the dust collector.)

### **3-3. Cleaning Y-type strainer**

Clean the Y-type strainer in the cooling water line to the laser oscillator every month.

1. Turn the LASER keyswitch to OFF to stop the laser oscillator.
2. Press the POWER OFF button on the NC control box to turn off the NC unit, and turn the machine circuit breaker switch and laser oscillator circuit breaker switch to OFF.
3. Stop the cooling unit.
4. Close the stop valves at the inlet and outlet of the laser oscillator cooling water line to shut off the cooling water path from the cooling unit.
5. Remove the bolt clamping the Y-type strainer in the external cooling water line, and remove the filter (strainer) of the Y-type strainer.
6. Remove the dust and other foreign matter from the strainer with a brush or the like.
7. Wash the strainer in water.
8. Replace the strainer, and tighten the clamping bolt to secure it.
9. Open the stop valves at the inlet and outlet of the laser oscillator cooling water line.





#### NOTE

- Removal of the Y-type strainer may reduce the amount of cooling water available for the cooling unit. In such a case, add cooling water to the tank of the cooling unit.

#### REFERENCE

- For the details of the procedure for adding cooling water, refer to “5-3-4. Adding water to tank of cooling unit” in this Part.

### 3-4. Checking laser oscillator output

Check that the laser oscillator output is not reduced. Make this check with the machine and laser oscillator running.

1. Check that the SHUTTER keyswitch is set to OFF. If not, turn the SHUTTER keyswitch to OFF.
2. Check that the NC mode is MEMORY, and press the Check Power button on the UTILITY display to open the Internal electric discharge display. Set the Power field to the applicable CW oscillator rated output condition:

AF3500i-C: 3500 W

#### REFERENCE

- For the detail of the display, refer to “7-14. Internal electric discharge” in Part I, Displays, in the reference manual of the AMNC-F.
3. Press the START button. The laser oscillator starts discharging.
  4. Change to the laser information display, and wait for about 1 min until the output of the laser oscillator is stabilized.
  5. Check the value of the Actual Power field. If the value is smaller than the CW laser oscillator rated output less 50 W, contact AMADA.
  6. Press the STOP button. The laser oscillator stops discharging.

## 4. Quarterly maintenance

### 4-1. Changing in-line filters

The in-line filters are used to prevent the entry of dust, rust, and other foreign matter through the assist gas lines into the pneumatic equipment of the machine.

Check the in-line filters every three months, and change them and their O-rings when they are clogged.

**NOTE**

- If the in-line filters are clogged, do not reuse them, but change them.

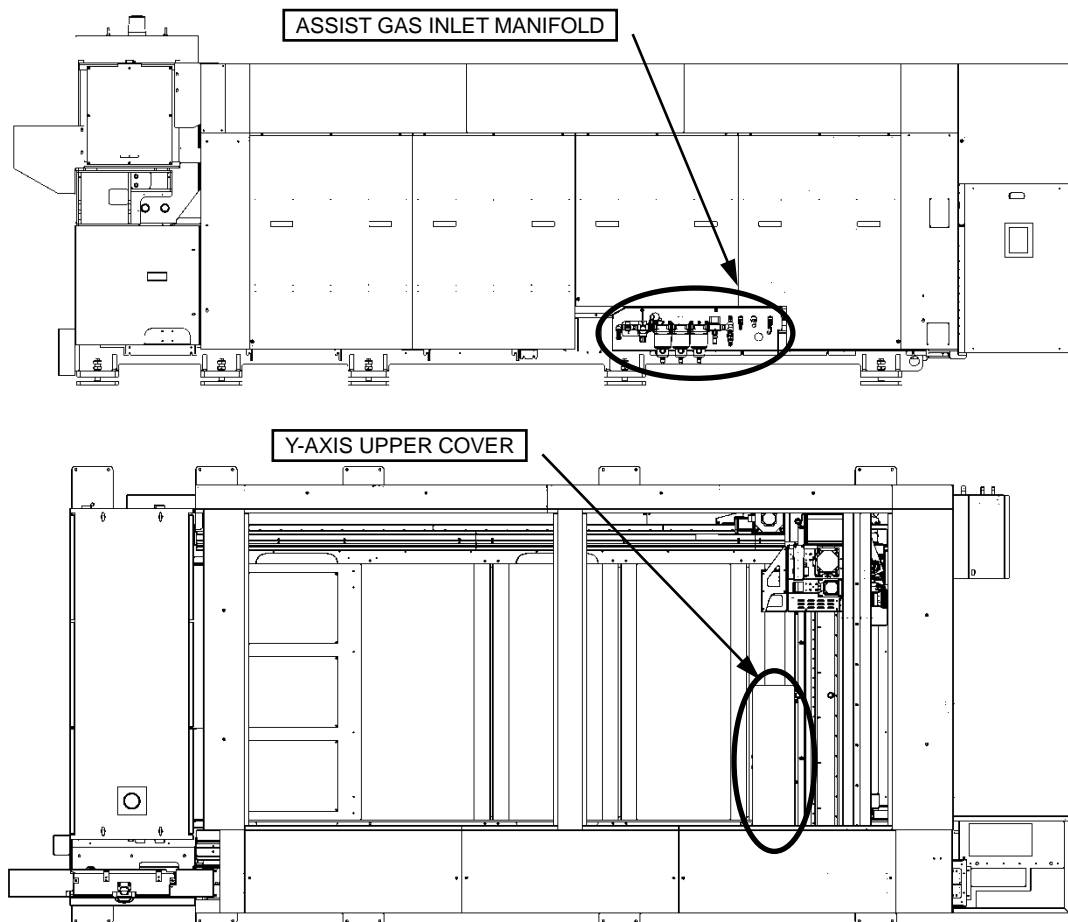
The in-line filter is judged to be clogged when the assist gas used under normal processing conditions drops in pressure by more than 10%.

When the in-line filter is clogged with a large amount of dust or other foreign matter, it makes it difficult for the pressure of the assist gas to rise to the preset level.

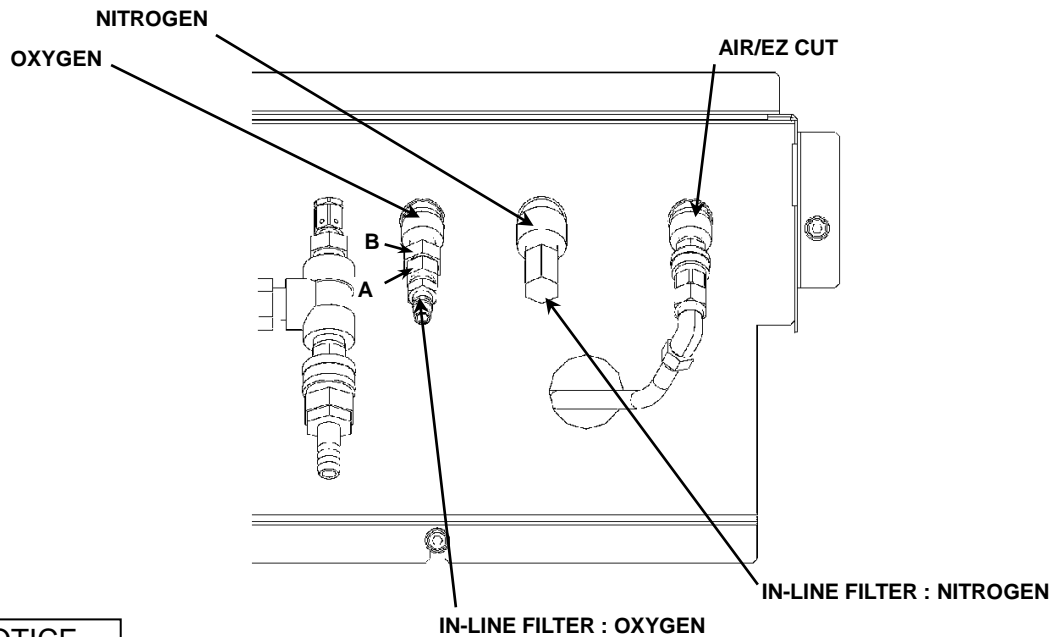
There are two in-line filters in the assist gas inlet manifold.

Another in-line filter is also installed in the upper part of the Y-axis. When this in-line filter is clogged, contact AMADA.

When the machine is equipped with the optional high-pressure assist gas control, another in-line filter is added to the manifold. When this in-line filter is clogged, contact AMADA.



## 4-1-1. Disassembling in-line filters



### NOTICE

- Before disassembling the in-line filters, be sure to turn off the power of the machine and stop the supply of each assist gas.

1. Stop the supply of oxygen and nitrogen as described below.
  - (1) Close the outlet valve of the oxygen cylinder.
  - (2) Close the outlet valve of the nitrogen cylinder.
  - (3) Turn on the assist gas, and remove the residual pressure. (This applies to oxygen and nitrogen.)

For the procedure for checking the assist gas, refer to “7-8. Check Assist Gas” in Part I, Displays, in the reference manual of the AMNC-F.

2. Press the POWER OFF button on the NC control box to turn off the power of the NC unit.
3. Turn the machine circuit breaker switch to OFF.
4. Disassemble the in-line filters of oxygen and nitrogen as described below.
  - (1) Remove the coupler by paying attention to the following:
    - When the coupler is removed, the gas forcefully escapes from the machine for some time. As the gas escapes, its hissing sound is heard.
    - Protect the removed coupler against the entry of dust and other foreign matter.
  - (2) Apply wrenches to the A and B of the in-line filter, and turn the cap nut of the B. The in-line filter parts on the coupler side are removed to reveal the filter and O-ring. Do not turn the A. Otherwise the O-ring may break.
  - (3) Check the filter for clogging. If it is clogged, change it.

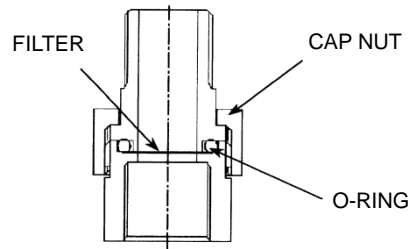
## 4-1-2. Changing in-line filters

### NOTE

- The oxygen filter is different in size from the nitrogen filter.
- Do not lubricate.

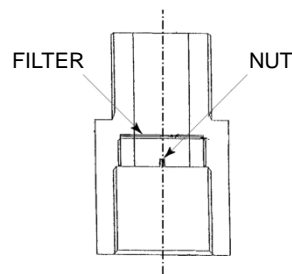
### Oxygen filter

1. Remove the O-ring with the fingernail, and remove the filter inside.
2. Set the new filter, and fix it with the O-ring.



### Nitrogen filter

1. Remove the nut with the flathead screwdriver, and remove the filter inside.
2. Set the new filter, and fix it with the nut.



## 4-1-3. Installing in-line filters

1. Apply wrenches to the A and B, and turn the cap nut in the B with the projecting part of the in-line filter with the cap nut is aligned with the filter.

Hold still the wrench applied to the A, and turn the wrench applied to the cap nut of the B.

Tighten the cap nut of the B until it no longer turns.

2. Connect the oxygen, nitrogen, and air couplers.

## 4-1-4. Checking installation of in-line filters

1. Open the outlet valves of the oxygen and nitrogen cylinders.
2. Check that each assist gas is supplied.
3. Check the oxygen and nitrogen in-line filters for leakage.

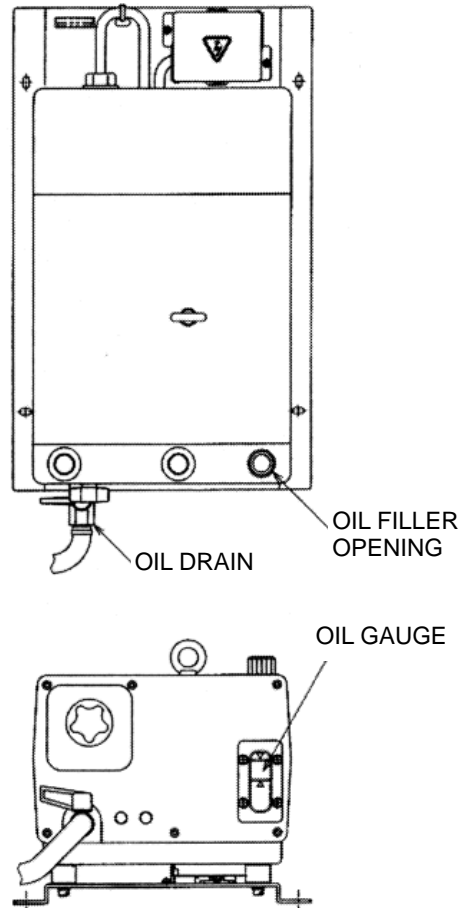
## 4-2. Checking oil level of exhaust pump (vane pump)



### WARNING

- An oil mist is present in the exhaust gas of the turbo blower and captured in the exhaust pump. The oil level of the exhaust pump consequently increases with time. If the oil level is too high, the exhaust pump produces a white smoke or develops an oil leak. The exhaust pump may also decline in exhaust capacity or break.

Check that the oil level is between the L and H lines of the level gauge. Also check that the oil is not black. If the oil level is below the L line or above the H line, contact AMADA.



## 5. Semiannual maintenance (or maintenance every 2000 hours of operation)

### 5-1. Changing oil of exhaust pump (vane pump)

The oil of the exhaust pump must be changed after the first six months or 2000 hours of operation, whichever comes first. Ask AMADA to make the oil change.

### 5-2. Maintaining cooling unit

Maintain the cooling unit every six months.

Before performing maintenance on the cooling unit, turn the LASER keyswitch from ON to OFF, and turn off the power of the cooling unit, machine and laser oscillator. For details, refer to the manual of the cooling unit.

## Air heat exchanger

Clean the air heat exchanger every six months.

When the air heat exchanger is operated for a long period of time, dust and other foreign matter deposit on the fins and filter to reduce the cooling capacity.

## Installation environment

The cooling unit must be properly installed to provide adequate cooling. After delivery and installation, check that the installation environment has not changed worse, that waste heat does not accumulate around the cooling unit, and that the cooling unit is not exposed to direct sunlight.

## 5-3. Changing cooling water and cleaning Y-type strainer

Every six months, change the cooling water of the cooling unit, and clean the Y-type strainer in the cooling water line in the laser oscillator.

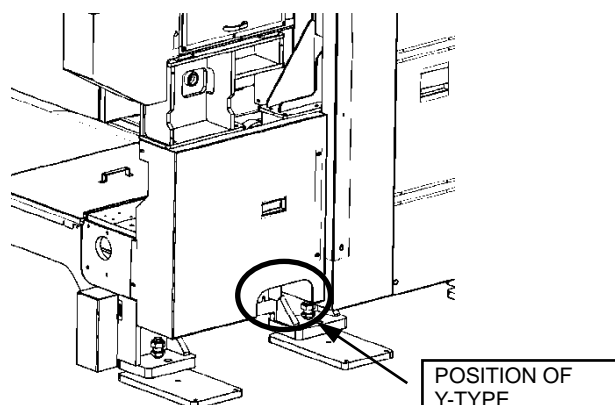
### 5-3-1. Draining water from laser oscillator

Drain the water as described below.

1. Turn the LASER keyswitch to OFF to stop the laser oscillator, and turn the laser oscillator circuit breaker switch to OFF.
2. Stop the cooling unit.
3. Close the stop valves at the inlet and outlet of the cooling unit to shut off the cooling water path from the cooling unit.
4. Remove the bolts securing the Y-type strainer in the external cooling water line, remove the Y-type strainer, and drain the water from the Y-type strainer.
5. Disconnect the hose from the cooling water inlet of the laser oscillator.

#### NOTE

- Place waste cloth or a water bucket below the position where the hose is to be disconnected.
  - When water is spilled, wipe it off dry.
6. When no more water drips down, gradually supply compressed air set at a pressure of 0.5 MPa {72.5 psi} or more to the cooling water inlet. This takes about 10 minutes.



7. Close the valve, and continue to supply the compressed air until the water is completely drained from the laser oscillator.
8. After the water is completely drained from the laser oscillator, open the valve, and connect the water hose from the cooling unit to the cooling water inlet of the laser oscillator.

**NOTE**

- Clean and replace the removed strainer after draining the water from the tank of the cooling unit.

### 5-3-2. Draining water from tank of cooling unit

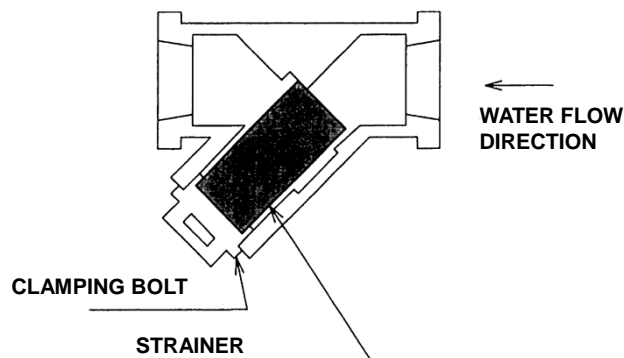
1. Check that the laser oscillator circuit breaker switch is turned to OFF and that the cooling unit is stopped.

**REFERENCE**

- Handling of the cooling unit varies with its model. Refer to the manual of the cooling unit.
2. Stop the supply of water from the water deionizer.
  3. Open the drain valve of the cooling unit.
  4. When all water is drained, clean the inside of the tank with tap water.
  5. Close the drain valve.

### 5-3-3. Cleaning Y-type strainer

1. Remove the dust and other foreign matter deposited on the Y-type strainer with a brush or the like.
2. Wash the Y-type strainer with water.
3. Replace the Y-type strainer, and secure it with the clamping bolts.



### 5-3-4. Adding water to tank of cooling unit

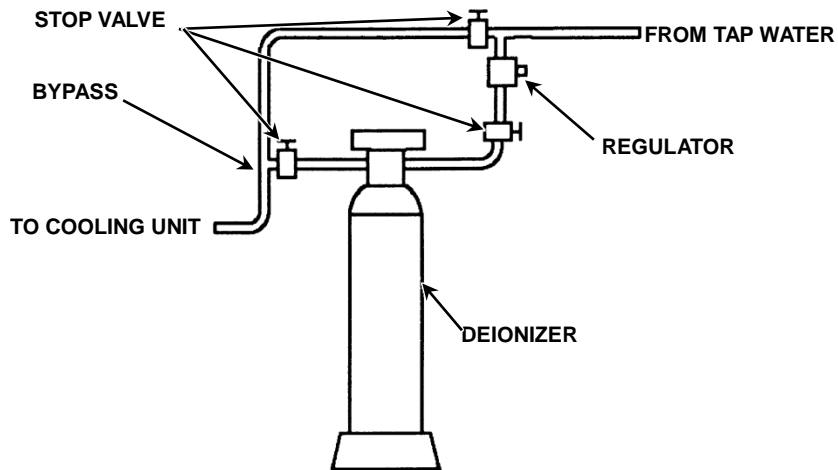
1. Check that the drain valve in the tank of the cooling unit is closed.
2. Check that the Y-type strainer is installed.
3. Check that the pipe joint removed at the rear of the oscillator is replaced.

#### REFERENCE

- Refer to the separate installation manual to fill the cooling unit.  
Use commercial purified water if it is not advisable to use town water for filling it. The following is an example of filling by passing town water through a deionizer.
4. Add water from the water deionizer through the inlet in the tank of the cooling unit. Measure the electrical conductivity of the water with an electrical conductivity meter.

#### NOTICE

- If the pressure of the tap water is higher than pressure resistance of the water deionizer, the water deionizer may break. Use a tap water pressure regulator. (When the water deionizer is the Organo G-10 model, set the regulator at 0.35 MPa {49.8 psi} or less.)



- Feed the tap water through the water deionizer at a flow rate of 3 L/min {0.8 US gal/min} or less. If the flow rate is too high, sufficient ion exchange cannot occur.
  - Start the cooling unit more than 12 hours after the machine is turned on.
- (1) Put four size AA batteries in the holder, and install the holder in the electrical conductivity meter.
  - (2) Push down the change lever of the electrical conductivity meter to F (ADJ), and turn the ADJ. VOL knob to set the pointer at the red line at the right edge.

#### NOTE

- If the pointer does not reach the red line when the ADJ. VOL knob is turned fully clockwise, change the batteries.
- If the pointer does not move when the change lever and ADJ. VOL knob are turned, check the orientation of the batteries and the connection of the power cord.



- (3) Push up the change lever to MEAS, and measure the electrical conductivity of the water.

NOTE

- The scale of the meter indicates that the larger the value, the higher the electrical conductivity and the poorer the water quality.
- When the electrical conductivity of the water exceeds 1  $\mu\text{S}/\text{cm}$ , stop the supply of the water to the tank of the cooling unit, change the resin cylinder of the water deionizer, and resume the supply of the water to the tank of the cooling unit.

(Ask the water deionizer dealer about changing the resin cylinder. Before changing the resin cylinder, drain the water from the water deionizer as described in “16. Draining water from water deionizer” in this Part.)

5. After completing the addition of water to the tank of the cooling unit, check that the electrical conductivity of the water is 15  $\mu\text{S}/\text{cm}$  or less when the water is circulated.

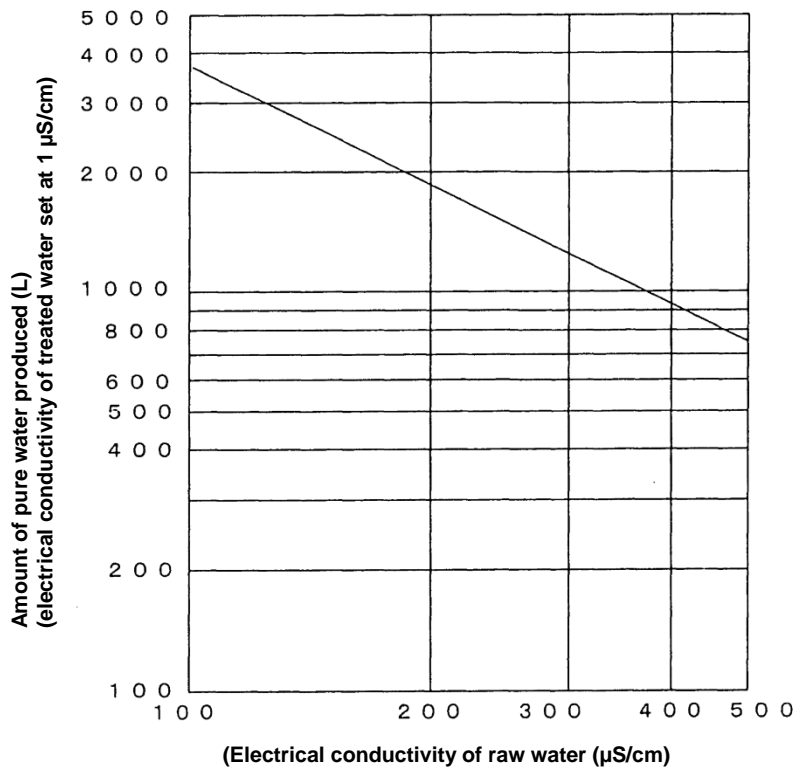
If its electrical conductivity is more than 15  $\mu\text{S}/\text{cm}$ , change the cooling water again.

### Maintaining water deionizer

NOTICE

- The resin cylinder of the water deionizer is made of plastic. Use it at room temperature. If the water deionizer is placed near fire, its body may deform.
- If the water deionizer is placed in direct contact with a concrete wall, for example, its body may be scratched.
- If the resin cylinder is dirty, wipe it off with a neutral detergent. Do not use a volatile liquid like a thinner.
- Do not allow the ion exchange resin to dry or freeze. It may become liable to break.

The ion exchange resin of the water deionizer is saturated and loses its ion exchange capacity when used to produce a given amount of pure water. In such a case, the resin cylinder must be changed (or the ion exchange resin must be regenerated). The amount of pure water that can be made varies with the quality of raw water. The amount of pure water that can be produced may be estimated from the electrical conductivity of raw water as shown in the following graph:



#### 5-4. Checking water line

Check the water line every six months.

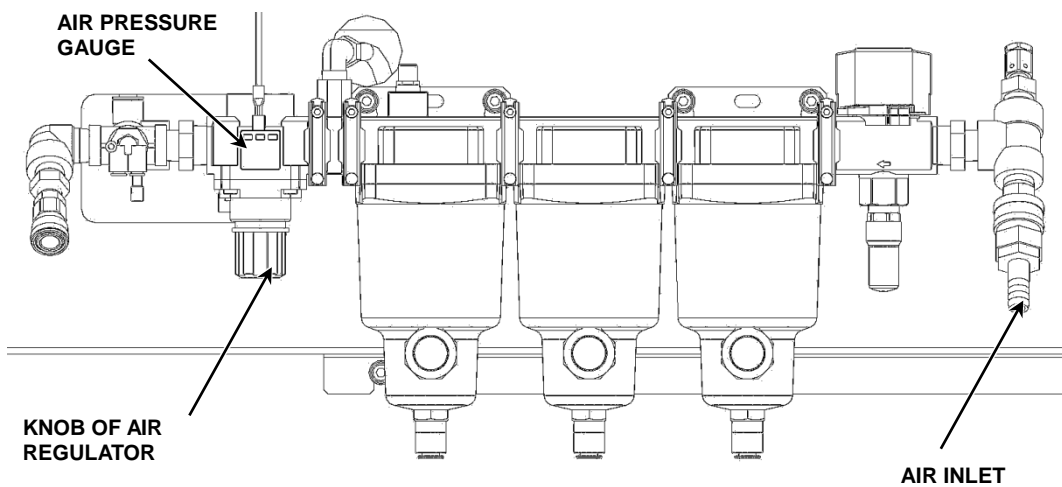
Check the connections and hoses for water leakage. Check the hoses for cracking and aging.

#### 5-5. Adjusting air unit

Adjust the air unit every six months.

Check that the air pressure is 0.5 MPa {72 psi}.

If the air pressure is not 0.5 MPa {72 psi}, turn the air regulator knob to set the air pressure at 0.5 MPa {72 psi}. Turn the knob clockwise to increase the air pressure and counterclockwise to decrease the air pressure.



## 5-6. Checking electrical wiring and gas connectors

Every six months, check the electrical wiring connections and gas connectors for looseness. If they are loosened, securely tighten them.

## 5-7. Cleaning fiber of smoke sensor

Clean the fiber of the smoke sensor every six months.

When the message “CONFIRM THE LENS UNIT” is displayed, check the lens for damage.

### NOTICE

- If the lens is damaged, never touch the damaged portion, but contact AMADA.

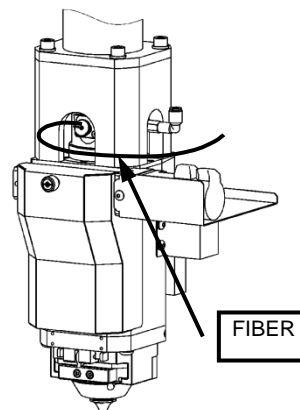
Any time when the message “LENS ALARM” is displayed, clean the fiber of the smoke sensor.

### NOTICE

- If the message “LENS ALARM” does not disappear despite the fiber of the smoke sensor is cleaned, the fiber may be broken. Contact AMADA.

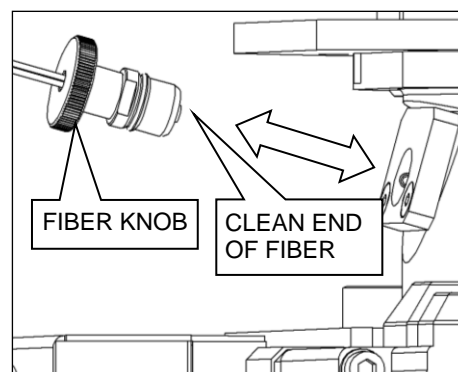
Clean the fiber of the smoke sensor as described below.

1. Move the laser head to an easy-to-work position.
2. Press the STOP button, and turn the SHUTTER keyswitch to OFF.
3. Open the front doors. The power to each axis is disconnected for safety.
4. To prevent the entry of dust and other foreign matter into the beam axis, remove the dust and other foreign matter around the fiber.
5. Pull out straight the fiber knob.



The fiber is flexible enough to be bent to a minimum radius of 4 mm {0.15 in.}, but handle it carefully.

6. Wipe dry the end of the fiber with a clean cloth. Since the fiber is plastic, do not use acetone or alcohol.
7. Insert the fiber knob deep into the laser head.
8. Close the front sliding doors.



9. Check for safety, and press the SAFETY DEVICE RESET button.
10. Clear the STOP button.

## 6. Annual maintenance

### 6-1. Changing memory battery of NC unit

The memory battery of the NC unit must be changed every year. Contact AMADA to change it.

### 6-2. Changing APC batteries

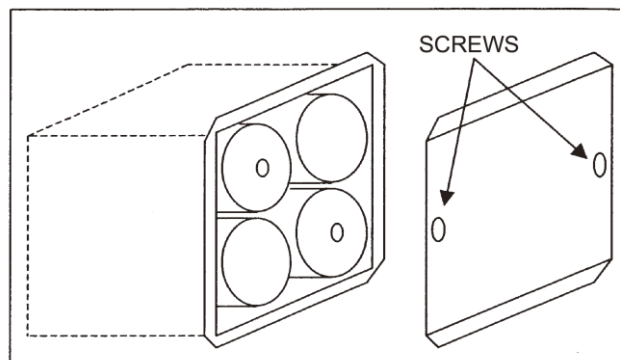
Change the APC batteries every year.

The LCG uses an absolute pulse coder (APC) system for storing the axis coordinate positions when the power of the NC unit is turned off. Batteries are used for this purpose. When the batteries are exhausted, an alarm is displayed. When a low battery alarm (alarm DS0306, DS0307, or DS0308) is displayed, change the batteries.

Batteries: Four size D alkaline batteries

#### NOTICE

- Change the batteries when the power of the NC unit is turned on. If the batteries are removed when the power of the NC unit is turned off, the coordinate positions of axes stored in the memory will be lost.
1. Press the EMERGENCY STOP button on the NC control panel to stop the machine in an emergency.
  2. Remove the cover of the APC battery case on the rear control box.
  3. Remove the batteries, and install new batteries in their place.
  4. Replace the cover of the APC battery case.
  5. Turn the EMERGENCY STOP button clockwise to clear the emergency condition.
  6. Turn off the power of the NC unit, and then turn it back on.



### 6-3. Changing filters for hyper EZ Cut II (option)

The filters for the hyper EZ Cut II (option) have their service life. Periodically check them, and change them if required.

Change the filter elements when the filters are used one year or when an EZ Cut alarm is displayed.

When changing the filter elements, refer to the manual of the hyper EZ Cut II (option).

## **6-4. Changing elements for the beam stabilizer unit**

The elements of the beam stabilizer unit have their service life.

Change the elements after one year or 6000 hours of use, whichever is shortest.

Contact AMADA to change the elements.

## **7. Maintenance every two years**

### **7-1. Changing the adsorbent for the beam stabilizer unit**

The adsorbent of the beam stabilizer unit has its service life.

Change the adsorbent after two years or 12000 hours of use, whichever is shortest.

Contact AMADA to change the adsorbent.

## **8. Maintenance every 3500 hours**

### **8-1. Changing oil of turboblower**

The oil of the turboblower must be changed every 2 years or 3500 hours of operation, whichever comes first. Ask AMADA to make the oil change.

## **9. Maintenance every 4000 hours of operation**

### **9-1. Changing exhaust filter element of exhaust pump (vane pump)**

The exhaust filter element of the exhaust pump must be changed every 1 year or 4000 hours of operation, whichever comes first. To change the exhaust filter element of the exhaust pump, contact AMADA.

## **10. Maintenance every 5000 hours of operation**

### **10-1. Changing dust collection filter**

The dust collection filter must be changed every 2.5 years or 5000 hours of operation, whichever comes first. For the procedure for changing the dust collection filter, refer to the manual of the dust collector. Changing time is exactly depends on its processing method, material, and condition. If the air flow rate cannot be recovered unless cleaning the dust collection filter, change the filter whenever it is under 5000 hours of operation.

## **11. Maintenance every 10000 hours of operation**

### **11-1. Overhauling exhaust pump (vane pump)**

The exhaust pump must be overhauled every 10000 hours of operation. Contact AMADA for its overhaul.

## 12. Maintenance every 20000 hours of operation

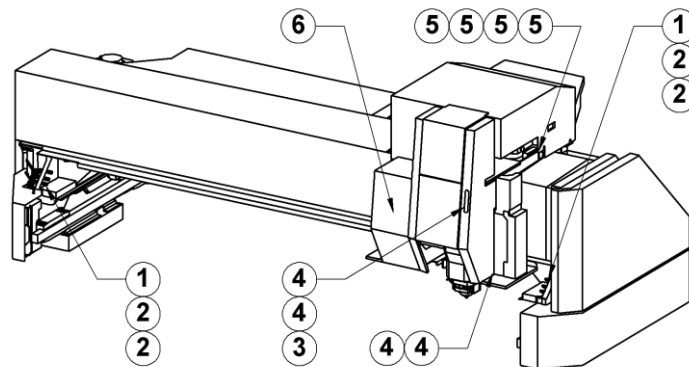
### 12-1. Overhauling turboblower

The turboblower must be overhauled every 20000 hours of operation. Contact AMADA for its overhaul.

(An alarm to prompt the overhaul is displayed after 20000 hours of operation. The turboblower must be overhauled before 24000 hours of operation.)

## 13. Lubrication

Lubrication is very important in maintaining the accuracy of the machine and preventing its failure. Be sure to provide adequate lubrication.



### Recommended lubricants

Maker	A	B
AMADA	AMADA Grease EP2	AMADA GREASE K-2
MOBIL	MOBIL EP2	
SHELL	Gadus S2 V220 2	

### Lubrication list

N°	Lubrication point	Type	Source	Frequency
1	X-Axis Rack Pinion	B	Grease Nipple	Monthly
2	X-Axis Slider	A	Grease Nipple	Monthly
3	Y-axis Rack pinion	B	Grease Nipple	Monthly
4	Y-Axis Slider	A	Grease Nipple	Monthly
5	Z-Axis Slider	A	Grease Nipple	Monthly
6	Z-Axis Ballscrew-nut	A	Grease Nipple	3 Months

## Grease lubrication method

Maintenance is indispensable to maintaining the accuracy of the machine and improving the life of the machine. Particularly if the LM guides and ball screws are improperly grease lubricated, their service life is shortened. Grease lubricate these parts as described below.

NOTICE
--------

- If the waste cloth to be used in the following procedure is smeared with metal dust, the LM guides and ball screws are damaged by the metal dust. Be sure to use clean waste cloth.
1. Inject new grease through the grease nipple with a grease gun or the like. Continue to inject the new grease until the old grease is all removed (or the new grease oozes out).
  2. Wipe off the old grease from the LM guide rails and ball screw shafts with clean waste cloth.
  3. Apply a thin coating of grease to the LM guide rails and ball screw shafts.

## 14. Setting water temperature of cooling unit

When the temperature is high in summer, dew condensation occurs in the cooling water path so that the machine may be stopped by a dew condensation alarm. This alarm can be prevented by raising the water temperature of the cooling unit by 2 to 3°C {35.6 to 37.4°F} above the normal level of 25°C {77.0°F}. Set the water temperature of the cooling unit by referring to the manual of the cooling unit.

## 15. Leaving machine idle for long period of time

When the machine is to be left idle for a long period of time, do as described below.

- To maintain the performance of the solenoid valve of the cooling unit, turn on and off the circuit breaker switch once a month, and check the solenoid valve for operation. If the solenoid valve is normal, it clicks. If the solenoid valve does not properly operate, contact AMADA.
- In winter, do not turn off the power of the cooling unit to prevent the cooling water from freezing.
- In winter, drain the water from the water deionizer to prevent the water from freezing. For the procedure for draining the water from the water deionizer, refer to the manual of the water deionizer or “16. Draining water from water deionizer” in this Part.

## 16. Draining water from water deionizer (when resin cylinder is changed and when freezing is likely)

Drain the water from the water deionizer by utilizing the principle of the siphon as described below.

1. Disconnect the end of the outlet hose, and put it into a drain tank. Position the end of the hose below the resin cylinder.
2. Turn on the water, and fill the hose with water.
3. Turn off the water, and immediately disconnect the inlet hose from the cap.
4. The water is drained from the outlet hose by the action of the siphon. The water draining time is 3 to 5 min.
5. If the water is not properly drained, repeat steps 1 to 4.

NOTE
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- For changing the resin cylinder (or regenerating the resin cylinder), contact your water deionizer dealer.

## 17. Dismantling and scrapping

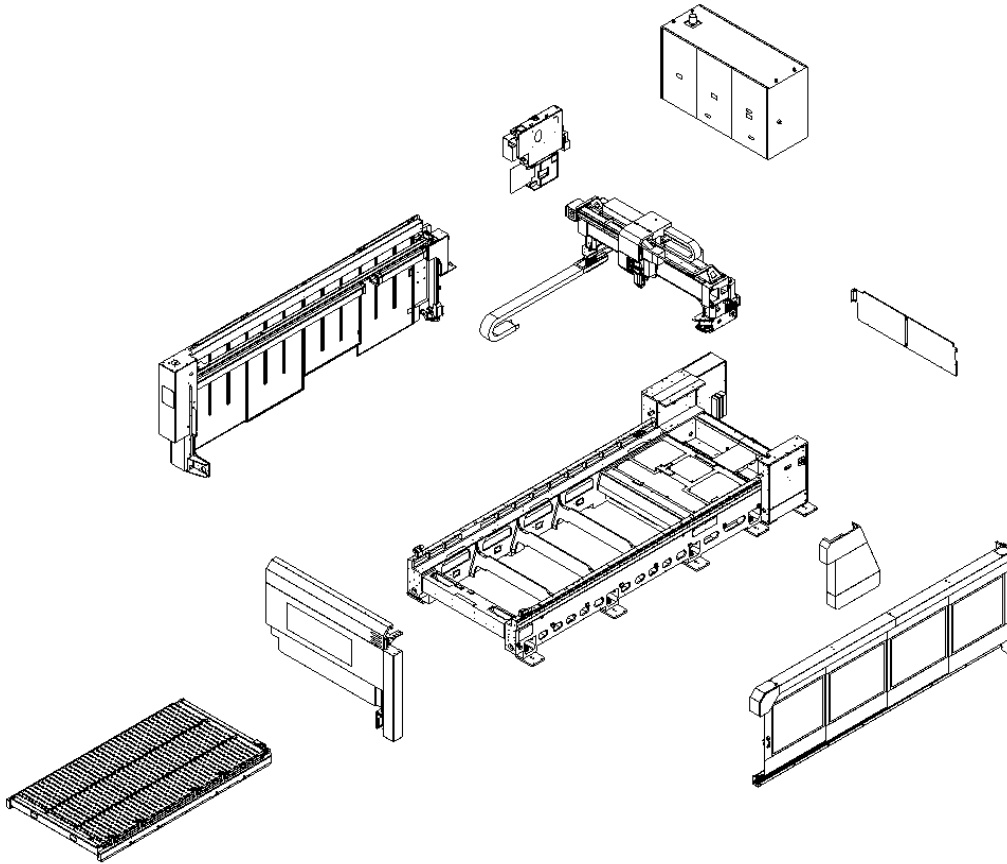




## 17-1. Disposal of machine body

The body of the laser machine must be disposed of by a contractor.

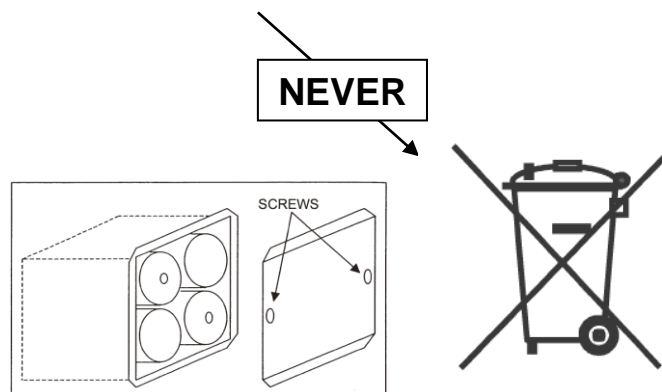
Disassemble parts such as the frame, cover, and table. Sort the materials into iron, aluminum, and stainless steel and dispose of them appropriately.



## 17-2. Disposal of electrical parts

The control panel and other electrical parts must be disposed of appropriately by a contractor.

Before these parts are recycled, remove all batteries and deposit them following the requirements of the manufacturer.





# Appendix

# Material Safety

# Data Sheets

Nichimoly K-2 .....	A-2
Gadus S2 V220 2 .....	A-6
Zinc selenide .....	A-14
Laser gas nitrogen.....	A-19
Laser gas carbon dioxide .....	A-23
Laser gas helium .....	A-27

**PRODUCT NAME: " NICHIMOLY K-2 Grease"****MATERIAL SAFETY DATA SHEET****1. CHEMICAL PRODUCT & COMPANY IDENTIFICATION**

CHEMICAL PRODUCT NAME:	Lubricating Grease
NAME OF MANUFACTURER / SUPPLIER	DAIZO CORPORATION
NAME OF SECTION	PRODUCTION TECHNOLOGY DEPT. NICHIMOLY DIVISION
ADDRESS	639, KAWAHARA, KOUSYU, GOKA-MACHI, SASHIMA-GUN, IBARAGI 306-0304, JAPAN
TELEPHONE NUMBER.	0280-84-1023
FAX NUMBER	0280-84-3208

**2. COMPOSITION / INFORMATION ON INGREDIENTS**

SUBSTANCE / MIXTURE Mixture

## INGREDIENTS AND COMPOSITION

CHEMICAL NAME	Refined Mineral Oils	Urea-compound Thickener	Molybdenum oxysulfide dithio carbamate	Additives
COMPOSITION Mass %	70~80	5~15	<3	10~20
CAS No.	Listed but can not be disclosed.			

**3. HAZARDS IDENTIFICATION**

CLASS NAME OF HAZARDOUS CHEMICALS FOR SDS IN JAPAN

Not Applicable

PHYSICAL AND CHEMICAL HAZARD

—

ADVERSE HUMAN HEATH EFFECTS

Harmful by inhalation and in contact with skin.

ENVIRONMENTAL EFFECTS

No relevant information found

**4. FIRST-AID MEASURES**

EYE CONTACT	Gently rinse the affected eyes with clean water for at least 15 minutes. And refer for medical attention.
SKIN CONTACT	Wash with Soap and Water.
INHALLATION	Not applicable because of semi-solid type.
INGESTION	Rinse mouth with water. Do not induce vomiting-consult physician.

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**5. FIRE-FIGHTING MEASURES****FIRE-FIGHTING**

1. In case of small fire, use dry chemical powder or carbon dioxide.
2. In case of large fire, foam spray is effective to stop flow-in of air.
3. Water may be effective for cooling, but may not effect extinguishment.
4. Keep personnel removed from and upwind fire.
5. Firefighters should wear proper protective equipment.
6. Evacuate personnel to safe area.

**SPECIAL HAZARDS WITH REGARDS TO FIRE-FIGHTING MEASURES:**

Toxic gases(carbon monoxide) will form upon combustion.

**EXTINGUISHING MEDIA:**

Dry chemical powder, foam or carbon dioxide.

---

**6. ACCIDENTAL RELEASE MEASURES**

1. Shut off all sources of ignition.
2. Prepare proper fire-extinguishing measures.
  - For the case of large release:
    - Evacuate non essential personnel
    - Wear proper protective equipment
    - Prevent spreads by sand, etc. and lead spill to safe zone and take up and place in container as much as possible.
    - Prevent spills from entering sewers, watercourses.
  - For the case of small release:
    - Absorb spill with sand, clothes and then place in waste containers and completely removed contamination by clothes.

---

**7. HANDLING & STORAGE****HANDLING:**

1. Keep away from flame, fire, or other heat
2. Avoid contact with personnel
3. Pay caution for ventilation and ignition.
4. Wear proper protective equipment for prevention of skin, or eye contact.
5. Pay caution for ventilation and source of ignition, because evaporation is heavier than air and tends to contaminate.
6. Follow all regulation in your country.

**STORAGE:**

1. Store in cool, dry, well-ventilated location.
2. Keep away from heat.
3. Keep away from reach of child.
4. Keep away from sunlight.
5. Keep at temperature below 40°C
6. Follow all regulation in your country.

**8. EXPOSURE CONTROL / PERSONAL PROTECTION**

CONTROL PARAMETER	Not applicable
ENGINEERING MEASURES	Good general ventilation should be sufficient for most conditions.
PERSONAL PROTECTIVE EQUIPMENT	
RESPIRATORY PROTECTION	For most conditions, no respiratory protection should be needed.
EYE PROTECTION	Wear safety glasses
PROTECTIVE WEAR	Wear long-sleeve working wear.
OTHERS	No precautions other than clean body-covering clothing should be needed.

**9. PHYSICAL & CHEMICAL PROPERTIES**

APPEARANCE	Smooth
PHYSICAL STATE, FORM	Semi-Solid
COLOUR	Yellow
ODOUR	Mineral Oil Odor
DENSITY	0.93g/cm <sup>3</sup>
BOILING POINT(Refined Mineral Oils)	Over 250°C
MELTING POINT	Over 200°C
SOLUBILITY IN WATER	Insoluble
SOLUBILITY IN ORGANIC SOLVENT	Miscible

**10. PHYSICAL HAZARDS (STABILITY & REACTIVITY)**

FLASH POINT(Refined Mineral Oils)	Over 200°C
UPPER AND LOWER EXPLOSION LIMIT	Not applicable
FLAMMABILITY	Flammability
SPONTANEOUS COMBUSTIBILITY	Will not occur
REACTIVITY WITH WATER	Stable
OXIDIZIBILITY	Will not occur
SELF-REACTIVITY	Will not occur
STABILITY & REACTIVITY	This material is stable. Hazardous decomposition and polymerization will not occur.

**11. TOXICOLOGICAL INFORMATION**

CORROSIVE AND IRRITANT PROPERTIES	No relevant information found
ALLERGENIC AND SENSITIZING EFFECTS	No relevant information found
ACUTE TOXICITY	No relevant information found
CHRONIC TOXICITY	No relevant information found
CARCINOGENIC EFFECTS	No relevant information found
MUTAGENIC EFFECTS	No relevant information found
EFFECTS ON THE REPRODUCTIVE SYSTEM	No relevant information found
TERATOGENIC EFFECTS	No relevant information found

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**12. ECOLOGICAL INFORMATION**

BIODEGRADIBILITY  
BIOACCUMULATION  
FISH TOXICITY

This substance is not biodegradable.  
No relevant information found  
No relevant information found

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**13. DISPOSAL CONSIDERATION**

1. Do not dump into sewers , on the ground or into any body of water.  
Disposal shall be in accordance with the concerned rules and regulation.
2. Follow all regulation in your country.

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**14. TRANSPORT INFORMATION**

Follow all regulation in your country.

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**15. REGULATORY INFORMATION**

Follow all regulation in your country.

---

**16. OTHER INFORMATION**

All materials may present unknown hazard and should be used in caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards which exist.

## Material Safety Data Sheet

### 1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

**Material Name** : Shell Gadus S2 V220 2  
**Uses** : Automotive and industrial grease.  
**Product Code** : 001D8451

**Manufacturer/Supplier** : Shell Italia S.P.A.  
Via Alessandro Manzoni 44  
I-20095 Cusano Milanino MI

**Telephone** : (+39) 0261101  
**Fax** : (+39) 0261103411  
**Email Contact for MSDS** : If you have any enquiries about the content of this MSDS please email lubricantSDS@shell.com

**Emergency Telephone Number** : (+39) 02 3800.4461/2 (available 24h a day)

### 2. HAZARDS IDENTIFICATION

**EC Classification** : Not classified as dangerous under EC criteria.

**Health Hazards** : Not expected to be a health hazard when used under normal conditions. Prolonged or repeated skin contact without proper cleaning can clog the pores of the skin resulting in disorders such as oil acne/folliculitis. High-pressure injection under the skin may cause serious damage including local necrosis. Used grease may contain harmful impurities.

**Signs and Symptoms** : Local necrosis is evidenced by delayed onset of pain and tissue damage a few hours following injection. Oil acne/folliculitis signs and symptoms may include formation of black pustules and spots on the skin of exposed areas. Ingestion may result in nausea, vomiting and/or diarrhoea.

**Safety Hazards** : Not classified as flammable but will burn.  
**Environmental Hazards** : Not classified as dangerous for the environment.

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

**Preparation Description** : A lubricating grease containing highly-refined mineral oils and additives.

#### Hazardous Components

Chemical Identity	CAS	EINECS	Symbol(s)	R-phrase(s)	Conc.
Zinc alkyl dithiophosphate	68649-42-3	272-028-3	Xi, N	R38; R41; R51/53	< 2,40 %

**Additional Information** : The highly refined mineral oil contains <3% (w/w) DMSO-extract, according to IP346. Refer to chapter 16 for full text of EC R-phrases.



## Material Safety Data Sheet

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### 4. FIRST AID MEASURES

- |                            |   |
|----------------------------|---|
| <b>General Information</b> | : Not expected to be a health hazard when used under normal conditions.   |
| <b>Inhalation</b>          | : No treatment necessary under normal conditions of use. If symptoms persist, obtain medical advice.  |
| <b>Skin Contact</b>        | : Remove contaminated clothing. Flush exposed area with water and follow by washing with soap if available. If persistent irritation occurs, obtain medical attention. When using high pressure equipment, injection of product under the skin can occur. If high pressure injuries occur, the casualty should be sent immediately to a hospital. Do not wait for symptoms to develop. Obtain medical attention even in the absence of apparent wounds.   |
| <b>Eye Contact</b>         | : Flush eye with copious quantities of water. If persistent irritation occurs, obtain medical attention.  |
| <b>Ingestion</b>           | : In general no treatment is necessary unless large quantities are swallowed, however, get medical advice.  |
| <b>Advice to Physician</b> | : Treat symptomatically. High pressure injection injuries require prompt surgical intervention and possibly steroid therapy, to minimise tissue damage and loss of function. Because entry wounds are small and do not reflect the seriousness of the underlying damage, surgical exploration to determine the extent of involvement may be necessary. Local anaesthetics or hot soaks should be avoided because they can contribute to swelling, vasospasm and ischaemia. Prompt surgical decompression, debridement and evacuation of foreign material should be performed under general anaesthetics, and wide exploration is essential. |

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### 5. FIRE FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

- |  |  |
|--|--|
| <b>Specific Hazards</b>                      | : Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Carbon monoxide. Unidentified organic and inorganic compounds. |
| <b>Suitable Extinguishing Media</b>          | : Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.   |
| <b>Unsuitable Extinguishing Media</b>        | : Do not use water in a jet.   |
| <b>Protective Equipment for Firefighters</b> | : Proper protective equipment including breathing apparatus must be worn when approaching a fire in a confined space.  |

---

### 6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. See Chapter 13 for information on disposal. Observe the relevant local and international regulations.

- |                            |   |
|----------------------------|---|
| <b>Protective measures</b> | : Avoid contact with skin and eyes. Use appropriate containment |
|----------------------------|---|

## Material Safety Data Sheet

- Clean Up Methods** : to avoid environmental contamination. Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers.  
: Shovel into a suitable clearly marked container for disposal or reclamation in accordance with local regulations.

### 7. HANDLING AND STORAGE

- General Precautions** : Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material.
- Handling** : Avoid prolonged or repeated contact with skin. Avoid inhaling vapour and/or mists. When handling product in drums, safety footwear should be worn and proper handling equipment should be used.
- Storage** : Keep container tightly closed and in a cool, well-ventilated place. Use properly labelled and closeable containers. Storage Temperature: 0 - 50°C / 32 - 122°F
- Recommended Materials** : For containers or container linings, use mild steel or high density polyethylene.
- Unsuitable Materials** : PVC.
- Additional Information** : Polyethylene containers should not be exposed to high temperatures because of possible risk of distortion.

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

If the American Conference of Governmental Industrial Hygienists (ACGIH) value is provided on this document, it is provided for information only.

#### Occupational Exposure Limits

Material	Source	Type	ppm	mg/m3	Notation
Oil mist, mineral	ACGIH	TWA [Mist.]		5 mg/m3	
	ACGIH	STEL [Mist.]		10 mg/m3	
	ACGIH	TWA [Inhalable fraction.]		5 mg/m3	

- Additional Information** : Due to the product's semi-solid consistency, generation of mists and dusts is unlikely to occur.
- Exposure Controls** : The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances.  
Appropriate measures include: Adequate ventilation to control airborne concentrations. Where material is heated, sprayed or

**Material Safety Data Sheet**

		mist formed, there is greater potential for airborne concentrations to be generated.
<b>Personal Protective Equipment</b>	:	Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.
<b>Respiratory Protection</b>	:	No respiratory protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid breathing of material. If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Select a filter suitable for combined particulate/organic gases and vapours [boiling point >65 °C (149 °F)] meeting EN14387.
<b>Hand Protection</b>	:	Where hand contact with the product may occur the use of gloves approved to relevant standards (e.g. Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection: PVC, neoprene or nitrile rubber gloves. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended.
<b>Eye Protection</b>	:	Wear safety glasses or full face shield if splashes are likely to occur. Approved to EU Standard EN166.
<b>Protective Clothing</b>	:	Skin protection not ordinarily required beyond standard issue work clothes.
<b>Monitoring Methods</b>	:	Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate.
<b>Environmental Exposure Controls</b>	:	Minimise release to the environment. An environmental assessment must be made to ensure compliance with local environmental legislation.

**9. PHYSICAL AND CHEMICAL PROPERTIES**

<b>Appearance</b>	:	Brown. Semi-solid at ambient temperature.
<b>Odour</b>	:	Slight hydrocarbon.
<b>pH</b>	:	Not applicable.
<b>Initial Boiling Point and Boiling Range</b>	:	Data not available
<b>Dropping point</b>	:	> 180 °C / 356 °F
<b>Flash point</b>	:	> 180 °C / 356 °F (COC)
<b>Lower / upper Flammability or Explosion limits</b>	:	Typical 1 - 10 %(V) (based on mineral oil)
<b>Auto-ignition temperature</b>	:	> 320 °C / 608 °F
<b>Vapour pressure</b>	:	< 0,5 Pa at 20 °C / 68 °F (estimated value(s))

## Material Safety Data Sheet

Density	: Typical 900 kg/m <sup>3</sup> at 15 °C / 59 °F
Water solubility	: Negligible.
n-octanol/water partition coefficient (log Pow)	: > 6 (based on information on similar products)
Kinematic viscosity	: Not applicable.
Vapour density (air=1)	: > 1 (estimated value(s))
Evaporation rate (nBuAc=1)	: Data not available

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### 10. STABILITY AND REACTIVITY

Stability	: Stable.
Conditions to Avoid	: Extremes of temperature and direct sunlight.
Materials to Avoid	: Strong oxidising agents.
Hazardous Decomposition Products	: Hazardous decomposition products are not expected to form during normal storage.

---

### 11. TOXICOLOGICAL INFORMATION

Basis for Assessment	: Information given is based on data on the components and the toxicology of similar products.
Acute Oral Toxicity	: Expected to be of low toxicity: LD50 > 5000 mg/kg , Rat
Acute Dermal Toxicity	: Expected to be of low toxicity: LD50 > 5000 mg/kg , Rabbit
Acute Inhalation Toxicity	: Not considered to be an inhalation hazard under normal conditions of use.
Skin Irritation	: Expected to be slightly irritating. Prolonged or repeated skin contact without proper cleaning can clog the pores of the skin resulting in disorders such as oil acne/folliculitis.
Eye Irritation	: Expected to be slightly irritating.
Respiratory Irritation	: Inhalation of vapours or mists may cause irritation.
Sensitisation	: Not expected to be a skin sensitiser.
Repeated Dose Toxicity	: Not expected to be a hazard.
Mutagenicity	: Not considered a mutagenic hazard.
Carcinogenicity	: Product contains mineral oils of types shown to be non-carcinogenic in animal skin-painting studies. Highly refined mineral oils are not classified as carcinogenic by the International Agency for Research on Cancer (IARC). Other components are not known to be associated with carcinogenic effects.
Reproductive and Developmental Toxicity	: Not expected to be a hazard.
Additional Information	: Used grease may contain harmful impurities that have accumulated during use. The concentration of such harmful impurities will depend on use and they may present risks to health and the environment on disposal. ALL used grease should be handled with caution and skin contact avoided as far as possible. High pressure injection of product into the skin may lead to local necrosis if the product is not surgically removed.

---

### 12. ECOLOGICAL INFORMATION

Ecotoxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the ecotoxicology of similar products.

## Material Safety Data Sheet

- Acute Toxicity** : Poorly soluble mixture. May cause physical fouling of aquatic organisms. Expected to be practically non toxic: LL/EL/IL50 > 100 mg/l (to aquatic organisms) (LL/EL50 expressed as the nominal amount of product required to prepare aqueous test extract). Mineral oil is not expected to cause any chronic effects to aquatic organisms at concentrations less than 1 mg/l.
- Mobility** : Semi-solid under most environmental conditions. Floats on water. If it enters soil, it will adsorb to soil particles and will not be mobile.
- Persistence/degradability** : Expected to be not readily biodegradable. Major constituents are expected to be inherently biodegradable, but the product contains components that may persist in the environment.
- Bioaccumulation** : Contains components with the potential to bioaccumulate.
- Other Adverse Effects** : Product is a mixture of non-volatile components, which are not expected to be released to air in any significant quantities. Not expected to have ozone depletion potential, photochemical ozone creation potential or global warming potential.

---

### 13. DISPOSAL CONSIDERATIONS

- Material Disposal** : Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Do not dispose into the environment, in drains or in water courses.
- Container Disposal** : Dispose in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand.
- Local Legislation** : Disposal should be in accordance with applicable regional, national, and local laws and regulations.  
EU Waste Disposal Code (EWC): 12 01 12 spent waxes and fats. Classification of waste is always the responsibility of the end user.  
Waste from the product is classified as hazardous waste. Its disposal is regulated by D.Lgs. 152/2006 and following amendments.

---

### 14. TRANSPORT INFORMATION

**ADR**  
This material is not classified as dangerous under ADR regulations.

**RID**  
This material is not classified as dangerous under RID regulations.

**ADNR**  
This material is not classified as dangerous under ADNR regulations.

## Material Safety Data Sheet

### IMDG

This material is not classified as dangerous under IMDG regulations.

### IATA (Country variations may apply)

This material is not classified as dangerous under IATA regulations.

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## 15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

EC Classification	: Not classified as dangerous under EC criteria.
EC Symbols	: No Hazard Symbol required
EC Risk Phrases	: Not classified.
EC Safety Phrases	: Not classified.
Chemical Inventory Status	
EINECS	: All components listed or polymer exempt.
TSCA	: All components listed.
Other Information	: Classification, packaging and labelling of dangerous substances (D.Lgs.52/1997 and subsequent amendments). Classification, packaging and labelling of dangerous preparations (D.Lgs.65/2003). Safeguard of health and safety in the workplaces (D.Lgs.81/2008 and subsequent amendments). Waste oils (D.Lgs.95/1992 and subsequent amendments).

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## 16. OTHER INFORMATION

### R-phrases)

	Not classified.
R38	Irritating to skin.
R41	Risk of serious damage to eyes.
R51/53	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

MSDS Version Number	: 1.0
MSDS Effective Date	: 30.11.2010
MSDS Revisions	: A vertical bar ( ) in the left margin indicates an amendment from the previous version.
MSDS Regulation	: Regulation 1907/2006/EC
MSDS Distribution	: The information in this document should be made available to all who may handle the product.
Disclaimer	: This information is based on our current knowledge and is

Shell Gadus S2 V220 2  
Version 1.0

Effective Date 30.11.2010

Regulation 1907/2006/EC

## Material Safety Data Sheet

intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

# MATERIAL SAFETY DATA SHEET



II-VI INCORPORATED, 375 Saxonburg Boulevard, Saxonburg, PA 16056

General Offices: 724-352-4455 Sales: 724-352-1504 FAX: 724-352-4980 Telex: 469864

## SECTION I - PRODUCT IDENTIFICATION

**TRADE NAME:** 10.6  $\mu\text{m}$  AR Coated Zinc Selenide (ZnSe) Optics **CAS No.:** 1315-09-9

**SYNONYMS:** Raytran ZnSe, Kodak Irtran-4

**FORM:** Solid Optical Element

**CHEMICAL FAMILY:** Inorganic chemical belonging to the II-VI group of periodical systems of elements

**MANUFACTURER / SUPPLIER:** II-VI Incorporated  
375 Saxonburg Boulevard  
Saxonburg, PA 16056  
Tel - 724-352-4455; Fax - 724-352-4980

## SECTION II - COMPOSITION / INGREDIENTS

<u>MATERIAL COMPONENTS:</u>	<u>% ATOMIC:</u>	<u>CAS NUMBER</u>
Zinc	50%	7440-66-6
Selenium	50%	7782-49-2

### COATING COMPONENTS:

Zinc Selenide	N/A	1315-09-9
Thorium Fluoride	N/A	13709-59-6

## SECTION IV - HAZARDS IDENTIFICATION

	<u>Material</u>	<u>Limit</u>
<b>THRESHOLD LIMIT VALUE:</b>	Zinc oxide fumes	5 mg/m <sup>3</sup>
	Zinc oxide dust	10 mg/m <sup>3</sup>
	Selenium and compounds	0.2 mg/m <sup>3</sup>

### **OCCUPATIONAL ANNUAL LIMIT ON INTAKE BY INHALATION:**

	<u>Material</u>	<u>Limit</u>
	Thorium fluoride dust with 1 $\mu\text{m}$ particle size (value increases significantly with increasing particle size to a maximum at 20 $\mu\text{m}$ , at which point particles are no longer respirable).	136 mg

Revised: 6/23/02  
Supersedes: 4/22/99



**EFFECTS OF OVEREXPOSURE:** **ZnSe** - Effects are not known, but some zinc and selenium compounds can be formed, such as: **Zinc Oxide** - Chills and fever. **Selenium and Compounds** - Acute exposure might produce sternal pain, cough, nausea, pallor, coated tongue, gastro-intestinal disorders, nervousness and/or conjunctivitis. A garlic odor of the breath or sweat may occur. **Thorium** - Suspected carcinogen due to its radioactivity at NIOSH levels of intake. However, no effects observed for inhalation intakes of less than 270 to 540 mg per year, at which point risks are thought to increase linearly with intake. External exposure from holding a lens continuously for 2,000 hours per year is less than the exposure associated with two (2) dental x-rays, one (1) round-trip transcontinental (US) plane flight, or smoking 1/3 of a cigarette per day for one year. **Inorganic fluorides** - Generally highly irritating and toxic. Inhalation may cause irritation to the respiratory tract and mucous membrane, asthma attacks, excessive salivation, thirst, sweating, vomiting, colic, diarrhea, lung granulomas, fluoerosis, and pulmonary fibrosis.

#### SECTION IV – FIRST-AID MEASURES

**EMERGENCY AND FIRST AID PROCEDURES:** In Dust Form:

**EYES:** Wash with plenty of water - See physician

**SKIN:** Wash with plenty of water - See physician

**INGESTION:** Call physician

**INHALATION:** Remove from exposure, treat symptomatically, call physician

#### SECTION V – FIRE-FIGHTING MEASURES

Not flammable and not explosive.

#### SECTION VI – ACCIDENTAL RELEASE

See exposure controls section.

#### SECTION VII – HANDLING AND STORAGE

**HANDLING AND STORAGE PRECAUTION:** If material is to be machined, ground or polished, processes should be done wet so as to minimize dust which could result in inhalation. Good work practices such as keeping hands clean and not letting slurry splash significantly should be followed so that transferal to mouth by contamination on the hands or clothing followed by ingestion will not occur. Wash hands and face thoroughly after handling material and before eating.

If parts are dropped or otherwise broken, sweep up pieces which may have sharp edges as one would clean up broken glass and safely transfer to disposal container. Large pieces may have salvage value.

ZnSe material should be wrapped in lens tissue or optical tissue and placed in individual plastic boxes to avoid possible breakage.

Revised: 6/27/02  
Supersedes: 4/22/99

### SECTION VIII – EXPOSURE CONTROLS / PERSONAL PROTECTION

RESPIRATORY PROTECTION: NIOSH approved respiratory with fume type cartridge

VENTILATION:  Local Exhaust  
 Mechanical (General)  
 Special (Specify)  
 Other (Specify) See Below

**In case of vaporization:** Leave room and allow dust to settle. Clean all surfaces. If room has ventilation, allow for several air changes. Locate exhaust near location of ZnSe processing or use if failure by melting is likely.

### SECTION IX – PHYSICAL AND CHEMICAL CHARACTERISTICS

BOILING POINT, 760 mm Hg: Sublimes      MELTING POINT: 1525 °C  
SPECIFIC GRAVITY (H<sub>2</sub>O=1): 5.27      VAPOR PRESSURE: N/A  
VAPOR DENSITY (Air=1): N/A      SOLUBILITY IN H<sub>2</sub>O, % by WT: Insoluble  
% VOLATILES BY VOL.: N/A      FLASH POINT (Test Method): Not flammable  
and not explosive  
APPEARANCE & ODOR: Yellow transparent solid. Odorless.

### SECTION X – STABILITY AND REACTIVITY

STABILITY: Stable; not reactive.

CONDITIONS TO AVOID: Extreme heat greater than 500 °C could result in decomposition

MATERIALS TO AVOID: Strong acids, strong bases

HAZARDOUS DECOMPOSITION PRODUCTS: Selenium/Oxides of Selenium, Zinc Oxide

HAZARDOUS POLYMERIZATION:  Will not occur  
 Will occur

### SECTION XI – TOXICOLOGICAL INFORMATION

**ZnSe** - Effects are not known, but some zinc and selenium compounds can be formed, such as:  
**Zinc Oxide** - Chills and fever. **Selenium and Compounds** - Acute exposure might produce sternal pain, cough, nausea, pallor, coated tongue, gastro-intestinal disorders, nervousness and/or conjunctivitis. A garlic odor of the breath or sweat may occur.

Revised: 6/27/02  
Supersedes: 4/22/99

**SECTION XII – ECOLOGICAL INFORMATION**

Not applicable.

**SECTION XIII – DISPOSAL INFORMATION**

Dispose of used laser optics in a licensed industrial waste facility in compliance with all local, state and federal regulations. If you do not have access to a licensed industrial waste facility, the used laser optics may be returned to II-VI Incorporated for proper disposal. Contact II-VI Incorporated before returning any used laser optics.

**SECTION XIV – TRANSPORT INFORMATION**

ZnSe material should be wrapped in lens tissue or optical tissue and placed in individual plastic boxes to avoid possible breakage.

**SECTION XV - REGULATORY INFORMATION**

**CONDITIONS TO AVOID:** Extreme heat greater than 500 °C could result in decomposition

**MATERIALS TO AVOID:** Strong acids, strong bases

**HAZARDOUS DECOMPOSITION PRODUCTS:** Selenium/Oxides of Selenium, Zinc Oxide

**HAZARDOUS POLYMERIZATION:**      Will not occur  
   Will occur

**CONDITIONS TO AVOID:** N/A

**SECTION XVI - REFERENCES**

1. "Dangerous Properties of Industrial Materials," Richard J. Lewis, Sr., 1992, 8th Edition.
2. "TLVs Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1981," American Conference of Industrial Hygienists.
3. Some information was taken from our vendor's Material Safety Data Sheets.
4. 2001 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices," published by American Conference of Governmental Industrial Hygienists.
5. Zinc Selenide as a compound was found to be non-toxic at 5g/1kg in an "Acute Oral Limit Toxicity Study" conducted by Toxikon. The test was initiated on January 7, 1993 by II-VI Inc. and it was performed according to Federal Hazardous Substances Act, 16CFR, Part 1500.3, January 1990.
6. International Commission on Radiological Protection, ICRP Publication 71, "Age-dependent Doses to members of the Public from Intake of Radionuclides: Part 4 Inhalation Dose Coefficients", 1996.
7. International Commission on Radiological Protection, ICRP Publication 26, "Recommendations of the International Commission on Radiological Protection", 1977.

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REVISED: 6/02  
SUPERSEDES: 8/01

Prepared by:  6/28/02  
Herman E. Reedy

Title: Vice President, General Manager of Quality and Engineering

Date:

Revised: 6/27/02  
Supersedes: 4/22/99



# MATERIAL SAFETY DATA SHEET

## PRODUCT INFORMATION

PRODUCT.....LASAL 1  
TRADE NAME.....LASAL 1  
CHEMICAL NAME.....Nitrogen  
SYNONYMS.....None  
FORMULA.....N<sub>2</sub>  
CHEMICAL FAMILY.....Inert Gas  
MANUFACTURER'S NAME.....Canadian Liquid Air Ltd.  
MANUFACTURER'S ADDRESS.....1155 Sherbrooke Street West  
Montreal, Quebec, Canada H3A 1HB  
EMERGENCY PHONE NUMBER.....(514) 878-1667  
MOLECULAR WEIGHT.....28.01  
PRODUCT USE.....LASER; Laser Gas  
NA # or UN #.....UN 1066

## HAZARDOUS INGREDIENTS

CHEMICAL IDENTITY	CONCENTRATION	CAS #	LD (50)	LC (50)
Nitrogen	99+%	7727-37-9	None	None

## PHYSICAL DATA

PHYSICAL STATE.....Gas under pressure  
ODOUR AND APPEARANCE.....Colorless, odorless gas  
ODOUR THRESHOLD.....Odorless  
SPECIFIC GRAVITY.....Not applicable (gas)  
VAPOUR PRESSURE.....21.1°C = Above the critical temperature  
VAPOUR DENSITY (air = 1)......967  
EVAPORATION RATE.....Not applicable (gas)  
BOILING POINT.....-195.803°C  
FREEZING POINT.....-210.002°C  
pH.....Not applicable (gas)  
DENSITY (g/ml).....@ 1 atm 1.1605 kg/m<sup>3</sup>  
COEFFICIENT OF WATER/OIL  
DISTRIBUTION.....@ 20°C Bunsen Coefficient = .01557

## FIRE OR EXPLOSION HAZARD

CONDITIONS OF FLAMMABILITY.....Nonflammable gas

2971-0653-0

1

MATERIAL SAFETY DATA SHEET

MEANS OF EXTINCTION ..... Nonflammable gas  
FLASHPOINT AND METHOD OF  
DETERMINATION ..... Nonflammable gas  
UPPER EXPLOSION LIMIT (% BY VOL)..... Nonflammable gas  
LOWER EXPLOSION LIMIT (% BY VOL)..... Nonflammable gas  
AUTO-IGNITION TEMPERATURE ..... Nonflammable gas  
FLAMMABILITY CLASSIFICATION..... Nonflammable gas  
HAZARDOUS COMBUSTION PRODUCTS ..... Nonflammable gas  
EXPLOSION DATA ..... Nonflammable gas  
SENSITIVITY TO STATIC DISCHARGE..... No

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**REACTIVITY DATA**

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CHEMICAL STABILITY..... Stable  
INCOMPATIBLE MATERIALS ..... None  
CONDITIONS OF REACTIVITY ..... None  
HAZARDOUS DECOMPOSITION PRODUCTS ..... None

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**TOXICOLOGICAL PROPERTIES**

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ROUTES OF ENTRY

SKIN CONTACT..... No

SKIN ABSORPTION ..... No

EYE..... No

INHALATION..... Effects of exposure to high concentrations so as to displace the oxygen in the air necessary for life are headache, dizziness, labored breathing and eventual unconsciousness.

INGESTION ..... No

ACUTE OVER EXPOSURE EFFECTS ..... LASAL 1 is nontoxic but the liberation of a large amount in a confined area could displace the amount of oxygen in air necessary to support life.

CHRONIC OVER EXPOSURE EFFECTS ..... None

## MATERIAL SAFETY DATA SHEET

EXPOSURE LIMITS .....LASAL 1 should be considered a simple asphyxiant.  
Oxygen levels should be maintained at greater than 18 molar percent at normal atmospheric pressure which is equivalent to a partial pressure of 135 mm Hg. (ACGIH 1992–1993).

IRRITANCY OF PRODUCT .....No  
SENSITIZATION TO MATERIAL.....No  
CARCINOGENICITY, REPRODUCTIVE EFFECTS .....None  
TERATOGENICITY, MUTAGENICITY .....No  
TOXICOLOGICALLY SYNERGISTIC PRODUCTS.....None

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### PREVENTIVE MEASURES

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PERSONAL PROTECTIVE EQUIPMENT: Gloves, any material  
Safety goggles or glasses  
Safety shoes

SPECIFIC ENGINEERING CONTROLS: LASAL 1 is noncorrosive and may be used with any common structural material.

LEAK AND SPILL PROCEDURES: Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in container or container valve, contact the closest Canadian Liquid Air location.

WASTE DISPOSAL: Do not attempt to dispose of waste or unused quantities. Return in the shipping container properly labeled, with any valve outlet plugs or caps secured and valve protection cap in place to Canadian Liquid Air for proper disposal. For emergency disposal, contact the closest Canadian Liquid Air location.

HANDLING PROCEDURES AND EQUIPMENT: Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (3,000 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. Do not tamper with (valve) safety device. Close valve after each use and when empty.

## MATERIAL SAFETY DATA SHEET

STORAGE REQUIREMENTS: Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 52°C. Cylinders must be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in – first out" inventory system to prevent full cylinders being stored excessive periods of time.

TDG CLASSIFICATION .....2.2

HP CLASSIFICATION .....A

SPECIAL SHIPPING INFORMATION: Always secure cylinders in an upright position before transporting them. NEVER transport cylinders in trucks of vehicles, enclosed vans, truck cabs or in passenger compartments. Transport cylinders secured in open flatbed or in open pick-up type vehicles.

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### FIRST AID MEASURES

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SPECIFIC FIRST AID PROCEDURES: PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVER EXPOSURE TO LASAL 1. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.

Inhalation: Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given assisted resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.

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### PREPARATION INFORMATION

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PREPARED BY.....Safety and Quality Assurance Department  
PHONE NUMBER OF PREPARER .....(514) 842-5431  
DATE PREPARED.....September 1988  
LAST REVISION DATE .....July 15 1993

FOR INFORMATION OR MSDS, PLEASE CONTACT YOUR LOCAL C.L.A. OFFICE OR DISTRIBUTOR.

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THE INFORMATION, RECOMMENDATIONS AND DATA CONTAINED IN THIS DOCUMENT ARE INTENDED TO BE USED BY PROPERLY TRAINED AND QUALIFIED PERSONNEL ONLY AND AT THEIR SOLE RISKS AND DISCRETION. THE INFORMATION, RECOMMENDATIONS AND DATA HEREIN CONTAINED ARE DERIVED FROM SOURCES WHICH WE BELIEVE TO BE RELIABLE. HOWEVER, CANADIAN LIQUID AIR LTD. MAKES NO REPRESENTATION AND GIVES NO WARRANTY OF ANY KIND WHATSOEVER WITH RESPECT TO THEIR ACCURACY OR COMPLETENESS AND ASSUMES NO LIABILITY FOR DAMAGES OR LOSS ARISING DIRECTLY OR INDIRECTLY FROM THEIR USE, WHETHER PROPER OR IMPROPER.





## MATERIAL SAFETY DATA SHEET

MEANS OF EXTINCTION ..... Nonflammable gas  
FLASHPOINT AND METHOD OF  
DETERMINATION ..... Nonflammable gas  
UPPER EXPLOSION LIMIT (% BY VOL)..... Nonflammable gas  
LOWER EXPLOSION LIMIT (% BY VOL)..... Nonflammable gas  
AUTO-IGNITION TEMPERATURE ..... Nonflammable gas  
FLAMMABILITY CLASSIFICATION..... Nonflammable gas  
HAZARDOUS COMBUSTION PRODUCTS ..... Nonflammable gas  
EXPLOSION DATA ..... Nonflammable gas  
SENSITIVITY TO STATIC DISCHARGE ..... No

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### REACTIVITY DATA

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CHEMICAL STABILITY..... Stable  
INCOMPATIBLE MATERIALS ..... None  
CONDITIONS OF REACTIVITY ..... None  
HAZARDOUS DECOMPOSITION PRODUCTS ..... None

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### TOXICOLOGICAL PROPERTIES

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#### ROUTES OF ENTRY

SKIN CONTACT..... No

SKIN ABSORPTION ..... No

EYE..... No

INHALATION..... Low concentrations (3–5 molar %) cause increased respiration and headache. Eight to 15 molar % concentrations cause headache, nausea and vomiting which may lead to unconsciousness if not moved to open air or given oxygen. Higher concentrations cause rapid circulatory insufficiency leading to coma and death.

INGESTION ..... No

ACUTE OVER EXPOSURE EFFECTS ..... LASAL 2 is the most powerful cerebral vasodilator known. Inhaling large concentrations causes rapid circulatory insufficiency leading to coma and death.

CHRONIC OVER EXPOSURE EFFECTS ..... Chronic, harmful effects are not known from repeated inhalation of low (3–5 molar %) concentrations.

## MATERIAL SAFETY DATA SHEET

EXPOSURE LIMITS .....TWA = 5,000 Molar PPM; STEL = 30,000 Molar PPM (ACGIH 1992–1993)  
IRRITANCY OF PRODUCT .....None  
SENSITIZATION TO MATERIAL.....No  
CARCINOGENICITY, REPRODUCTIVE  
EFFECTS .....None  
TERATOGENICITY, MUTAGENICITY .....None  
TOXICOLOGICALLY SYNERGISTIC  
PRODUCTS.....None

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### PREVENTIVE MEASURES

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PERSONAL PROTECTIVE EQUIPMENT: Safety goggles or glasses, safety shoes

SPECIFIC ENGINEERING CONTROLS: Dry LASAL 2 can be handled with most common structural materials. Moist LASAL 2 is corrosive by its formation of carbonic acid. For these applications, 316 309 and 310 stainless steels may be used as well as Hastelloy<sup>®</sup> A, B & C and Monel<sup>®</sup>. Ferrous nickel alloys are slightly corroded.  
At normal temperatures LASAL 2 is compatible with most plastics and elastomers.

LEAK AND SPILL PROCEDURES: Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with an inert gas prior to attempting repairs. If leak is in container or container valve, contact the closest Canadian Liquid Air location.

WASTE DISPOSAL: Do not attempt to dispose of waste or unused quantities. Return in the shipping container properly labeled, with any valve outlet plugs or caps secured and valve protection cap in place to Canadian Liquid Air for proper disposal. For emergency disposal, contact the closest Canadian Liquid Air location.

HANDLING PROCEDURES AND EQUIPMENT: Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<1500 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. Keep cylinder away from heat and flame. Do not tamper with (valve) safety device. Close valve after use and when empty.

## MATERIAL SAFETY DATA SHEET

STORAGE REQUIREMENTS: Protect cylinders from physical damage. Store in cool, dry, well-ventilated area of non combustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 52°C. Cylinders must be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in – first out" inventory system to prevent full cylinders being stored excessive periods of time.

TDG CLASSIFICATION .....2.2

HP CLASSIFICATION .....A

SPECIAL SHIPPING INFORMATION: Always secure cylinders in an upright position before transporting them. NEVER transporter cylinders in trucks of vehicles, enclosed vans, truck cabs or in passenger compartments. Transport cylinders secured in open flatbed or in open pick-up type vehicles.

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### FIRST AID MEASURES

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SPECIFIC FIRST AID PROCEDURES: PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVER EXPOSURE TO LASAL 2. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.

Inhalation: Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given assisted resuscitation and supplemental oxygen. Assure that vomited material does not obstruct the airway by use of positional drainage. Medical assistance should be sought immediately.

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### PREPARATION INFORMATION

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PREPARED BY.....Safety and Quality Assurance Department  
PHONE NUMBER OF PREPARER .....(514) 842-5431  
DATE PREPARED.....September 1988  
LAST REVISION DATE .....July 15 1993

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# MATERIAL SAFETY DATA SHEET

## PRODUCT INFORMATION

PRODUCT.....LASAL 4  
 TRADE NAME.....LASAL 4  
 CHEMICAL NAME.....Helium  
 SYNONYMS.....Helium, Compressed  
 FORMULA.....He  
 CHEMICAL FAMILY.....Inert Gas  
 MANUFACTURER'S NAME.....Canadian Liquid Air Ltd.  
 MANUFACTURER'S ADDRESS.....1155 Sherbrooke Street West  
 Montreal, Quebec, Canada H3A 1HB  
 EMERGENCY PHONE NUMBER.....(514) 878-1667  
 MOLECULAR WEIGHT.....4.00  
 PRODUCT USE.....LASER; Laser Gas  
 NA # or UN #.....UN 1046

## HAZARDOUS INGREDIENTS

CHEMICAL IDENTITY	CONCENTRATION	CAS #	LD (50)	LC (50)
Helium	99+%	7440-59-7	None	None

## PHYSICAL DATA

PHYSICAL STATE.....Gas under pressure  
 ODOUR AND APPEARANCE.....Colorless, odorless gas  
 ODOUR THRESHOLD.....Odorless  
 SPECIFIC GRAVITY.....Not applicable (gas)  
 VAPOUR PRESSURE.....Not applicable (gas)  
 VAPOUR DENSITY (air = 1)......138  
 EVAPORATION RATE.....Not applicable (gas)  
 BOILING POINT.....-268.96°C  
 FREEZING POINT.....-271.387°C @ 3013 kPa  
 pH.....Not applicable (gas)  
 DENSITY (g/ml).....@ 15.5°C =.167 kg/m<sup>3</sup>  
 COEFFICIENT OF WATER/OIL  
 DISTRIBUTION.....@ 20°C Bunsen Coefficient = .0086

## FIRE OR EXPLOSION HAZARD

CONDITIONS OF FLAMMABILITY.....Nonflammable gas

## MATERIAL SAFETY DATA SHEET

MEANS OF EXTINCTION ..... Nonflammable gas  
FLASHPOINT AND METHOD OF  
DETERMINATION ..... Nonflammable gas  
UPPER EXPLOSION LIMIT (% BY VOL) ..... Nonflammable gas  
LOWER EXPLOSION LIMIT (% BY VOL) ..... Nonflammable gas  
AUTO-IGNITION TEMPERATURE ..... Nonflammable gas  
FLAMMABILITY CLASSIFICATION ..... Nonflammable gas  
HAZARDOUS COMBUSTION PRODUCTS ..... Nonflammable gas  
EXPLOSION DATA ..... Nonflammable gas  
SENSITIVITY TO STATIC DISCHARGE ..... No

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### REACTIVITY DATA

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CHEMICAL STABILITY ..... Stable  
INCOMPATIBLE MATERIALS ..... None  
CONDITIONS OF REACTIVITY ..... None  
HAZARDOUS DECOMPOSITION PRODUCTS ..... None

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### TOXICOLOGICAL PROPERTIES

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ROUTES OF ENTRY  
SKIN CONTACT ..... No

SKIN ABSORPTION ..... No

EYE ..... No

INHALATION ..... Effects of exposure to high concentrations so as to displace the oxygen in the air necessary for life are headache, dizziness, labored breathing and eventual unconsciousness. Breathing mixtures of LASAL 4 with adequate oxygen to support life modifies the voice sound so that it is higher "pitched".

INGESTION ..... No

ACUTE OVER EXPOSURE EFFECTS ..... LASAL 4 is nontoxic but the liberation of a large amount in a confined area could displace the amount of oxygen in air necessary to support life.

CHRONIC OVER EXPOSURE EFFECTS ..... None

## MATERIAL SAFETY DATA SHEET

EXPOSURE LIMITS .....LASAL 4 is defined as a simple asphyxiant. Oxygen levels should be maintained at greater than 18 molar percent at normal atmospheric pressure which is equivalent to a partial pressure of 135 mm Hg. (ACGIH 1992–1993).

IRRITANCY OF PRODUCT .....None

SENSITIZATION TO MATERIAL.....No

CARCINOGENICITY, REPRODUCTIVE EFFECTS .....None

TERATOGENICITY, MUTAGENICITY .....No

TOXICOLOGICALLY SYNERGISTIC PRODUCTS.....None

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### PREVENTIVE MEASURES

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PERSONAL PROTECTIVE EQUIPMENT: Protective gloves  
Safety goggles or glasses  
Safety shoes

SPECIFIC ENGINEERING CONTROLS: LASAL 4 is noncorrosive and may be used with any common structural material.

LEAK AND SPILL PROCEDURES: Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in container or container valve, contact the closest Canadian Liquid Air location.

WASTE DISPOSAL: Do not attempt to dispose of waste or unused quantities. Return in the shipping container properly labeled, with any valve outlet plugs or caps secured and valve protection cap in place to Canadian Liquid Air for proper disposal. For emergency disposal, contact the closest Canadian Liquid Air location.

HANDLING PROCEDURES AND EQUIPMENT: Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<3,000 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. Do not tamper with (valve) safety device. Close valve after each use and when empty.

## MATERIAL SAFETY DATA SHEET

STORAGE REQUIREMENTS: Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 52°C. Cylinders must be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in – first out" inventory system to prevent full cylinders being stored excessive periods of time.

TDG CLASSIFICATION .....2.2

HP CLASSIFICATION .....A

SPECIAL SHIPPING INFORMATION: Always secure cylinders in an upright position before transporting them. NEVER transport cylinders in trucks of vehicles, enclosed vans, truck cabs or in passenger compartments. Transport cylinders secured in open flatbed or in open pick-up type vehicles.

---

### FIRST AID MEASURES

---

SPECIFIC FIRST AID PROCEDURES: PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVER EXPOSURE TO LASAL 4. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.

Inhalation: Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given assisted resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.

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### PREPARATION INFORMATION

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PREPARED BY..... Safety and Quality Assurance Department  
PHONE NUMBER OF PREPARER .....(514) 842-5431  
DATE PREPARED..... September 1988  
LAST REVISION DATE ..... July 15 1993

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**AMADA Europe**  
BP 41040 – 95912 ROISSY AÉROPORT CDG CEDEX  
Tél : 01 49 90 30 00 – Fax : 01 49 90 31 99