

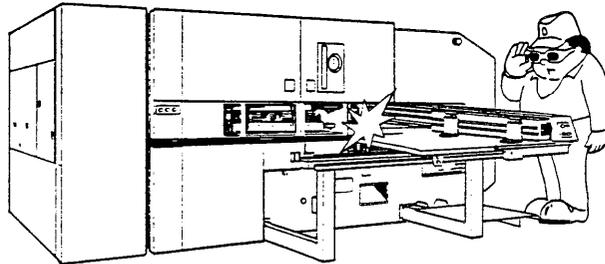
APELIO II 357  
(05PLA/C-1000 II) EUROPE  
**OPERATOR'S MANUAL Part 1**

APE 357 OPE EC-EO1-19%08

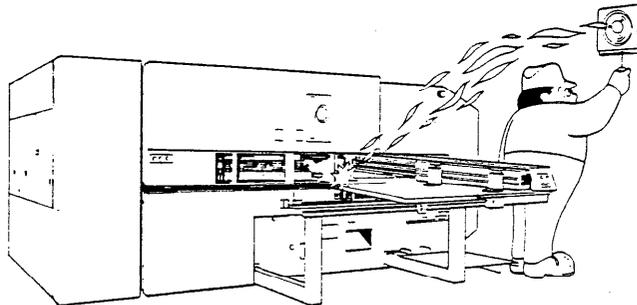
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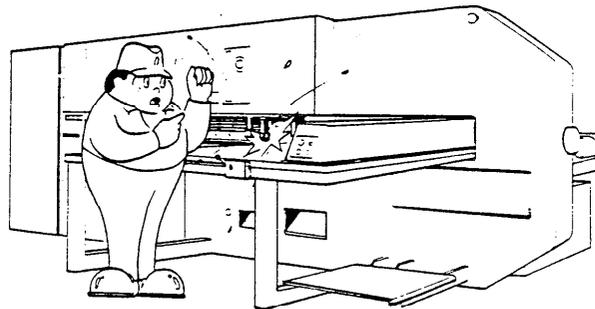
 **SAFETY RULES** 



Wear protective goggles to protect your eyes from the direct or reflected CO<sub>2</sub> laser beam whenever the beam is discharged. The CO<sub>2</sub> laser beam is invisible and extremely hazardous and can cause serious injury to your eyes.



Do not fail to ventilate the area around the machine during laser-cutting operation — some materials produce toxic gases when they are cut.

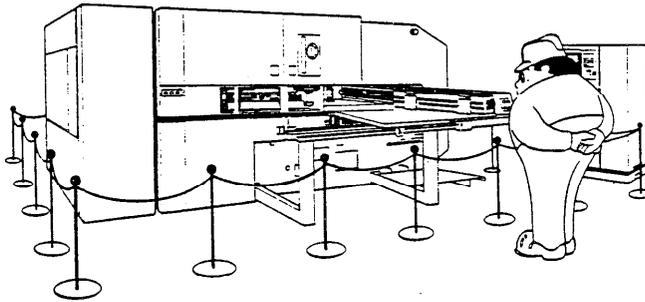


Wear clothing that is nonflammable and exposes less part of your body to protect yourself against spatters of melted material during laser cutting.



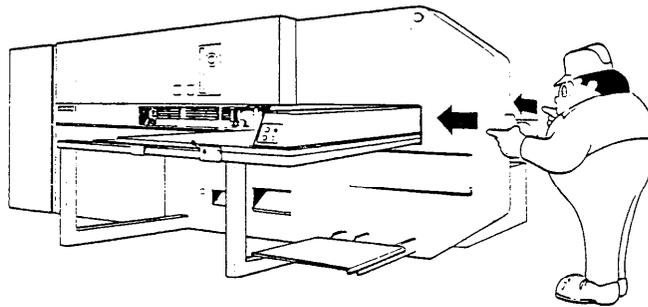


## SAFETY RULES

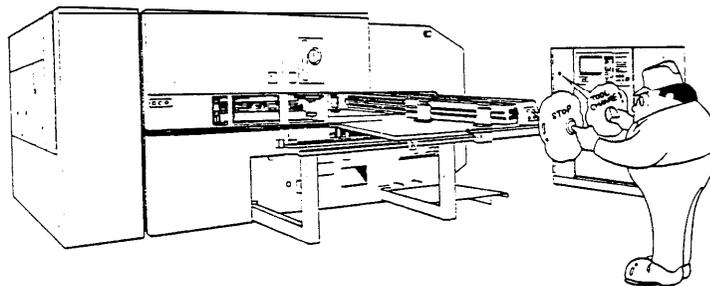


Provide a fence around the machine to keep people out of the area in which the machine table and the worksheet thrust out of the machine.

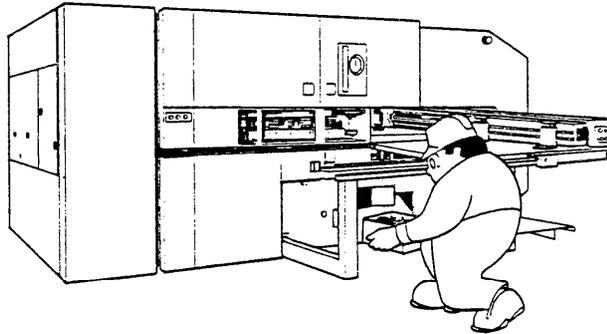
Worksheets of any size will thrust out in the front of the machine during zero-returning of machine axes after an automatic repositioning. An oversized worksheet thrusts out in the front and rear of the machine during operation.



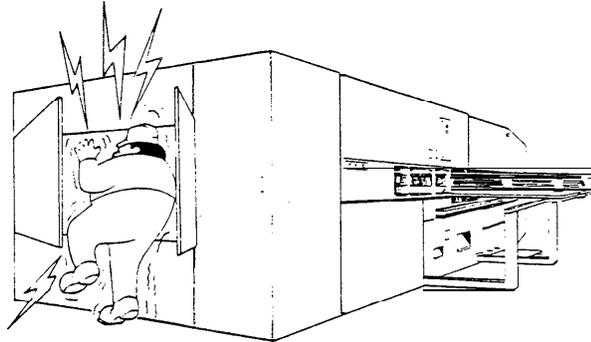
Clear the area around the machine of people and obstacles before zero-returning machine axes, manually moving an axis, starting an automatic operation, or restarting it. Do not fail to do so particularly around the table and behind the machine.



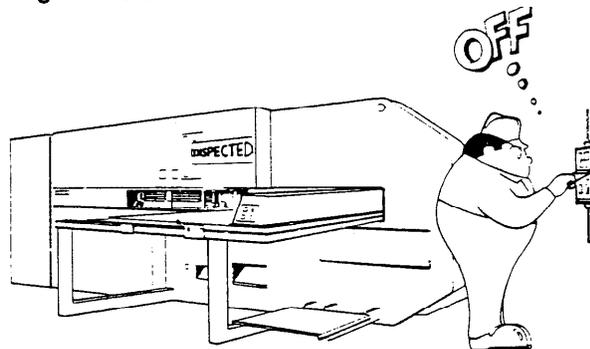
Press a mushroom-head STOP button to stop the machine before changing workclamp positions, removing a workpiece or scrap, etc. For a tool change, be sure to turn the TOOL CHANGE switch to ON.



Remove scrap from the scrap bin as soon as one process is completed in cutting inflammable material — to prevent the scrap from burning. Inflammable material will be set on fire instantly if it is exposed to the CO<sub>2</sub> laser beam.



Never reach into the laser oscillator when it is turned on — it has deadly high voltages inside.

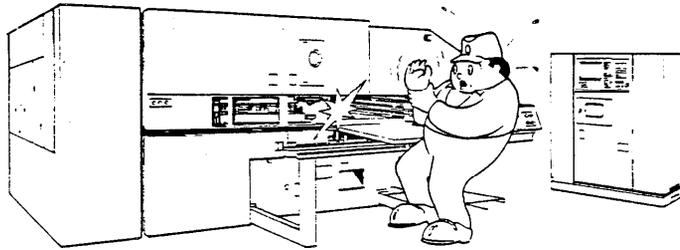


Turn off the shop circuit breaker switch when carrying out a maintenance operation. Then post a sign to inform others that the machine is being served.

If it is absolutely necessary to have the power on, press a mushroom-head STOP button to prevent the machine from being accidentally started during the course of the maintenance operation.

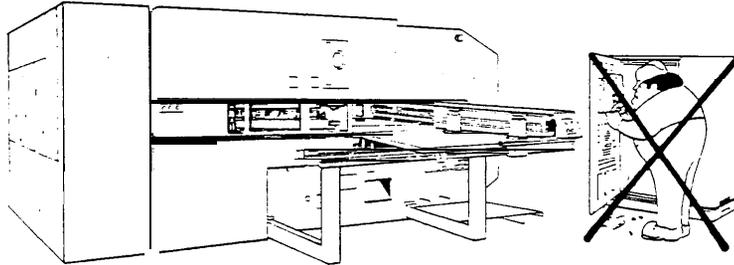


## SAFETY RULES



Never reach under the laser head during operation even when the CO<sub>2</sub> laser beam is not emitted — to prevent serious injury if the beam is emitted by an error.

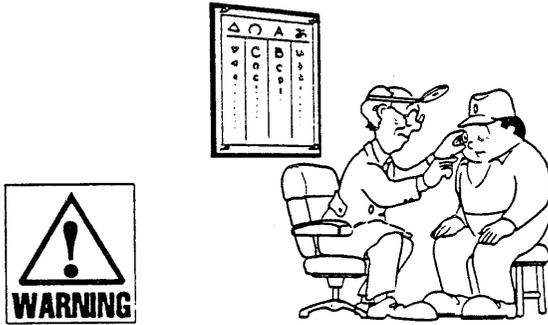
Press a mushroom-head STOP button and turn the LASER SELECTION switch to HeNe if the laser head or bend mirror must be adjusted with the laser oscillator turned on.



Never modify any part of the machine or remove any of its safety devices. Doing so will not only cause disorder or damage to the machine but also disrupt the safety of operation.



Make it a rule to have a single qualified or authorized operator, who has a thorough knowledge of the machine and its operation, control and operate the machine.



Have your eyes thoroughly examined periodically — and immediately in case of any accidental eye exposure to the direct or reflected CO<sub>2</sub> laser beam.

*Refer to the operator's manual for the machine as well as the other manuals provided for the equipment whenever you are not sure of any operation or maintenance procedure. Never operate or maintain the machine by guesswork.*



# SAFETY RULES

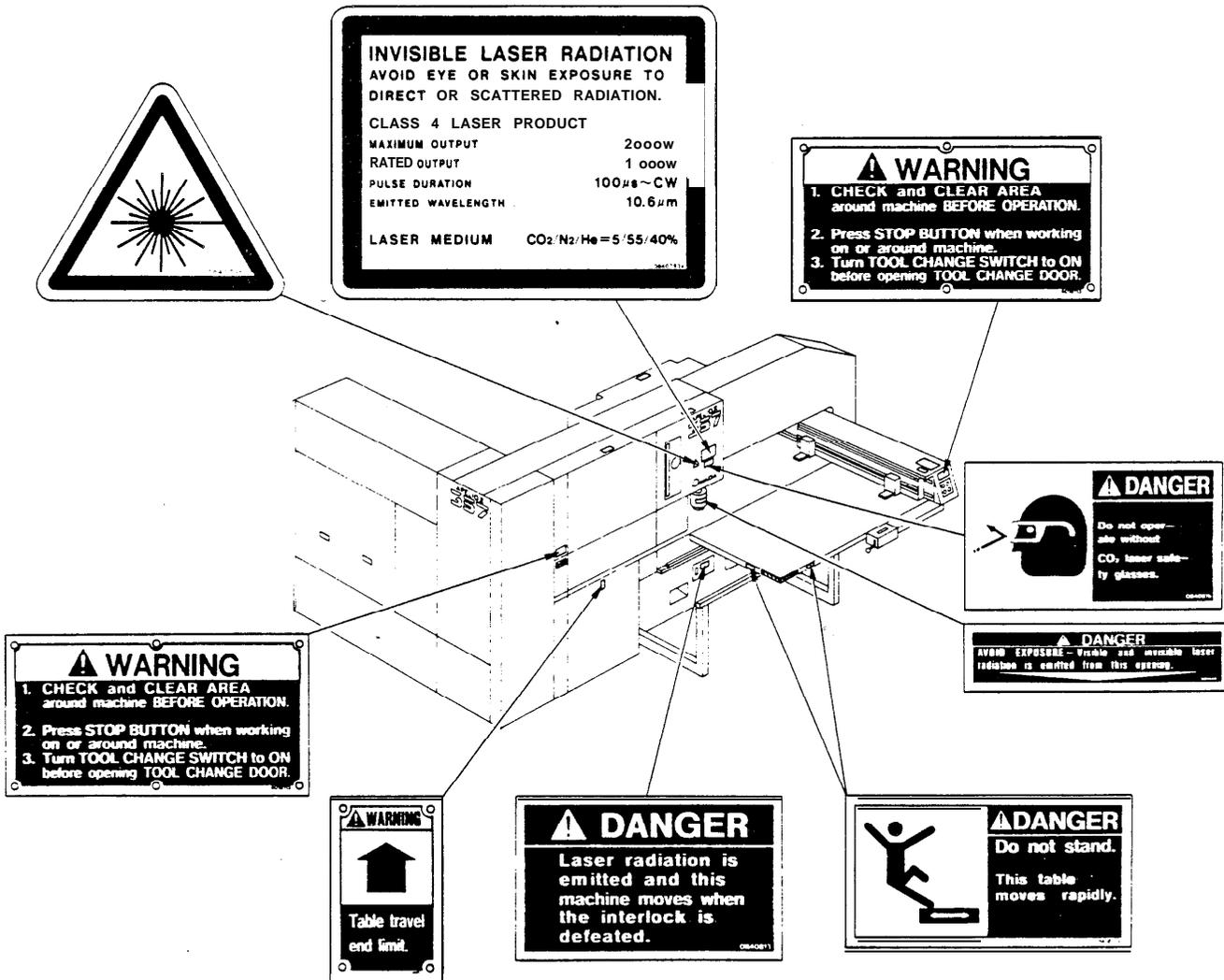
## DANGER and WARNING plates on the machine

Regard their messages and protect yourself as well as your colleagues against hazards whenever you work on the machine. Never remove any plates from the machine and keep them well noticeable.

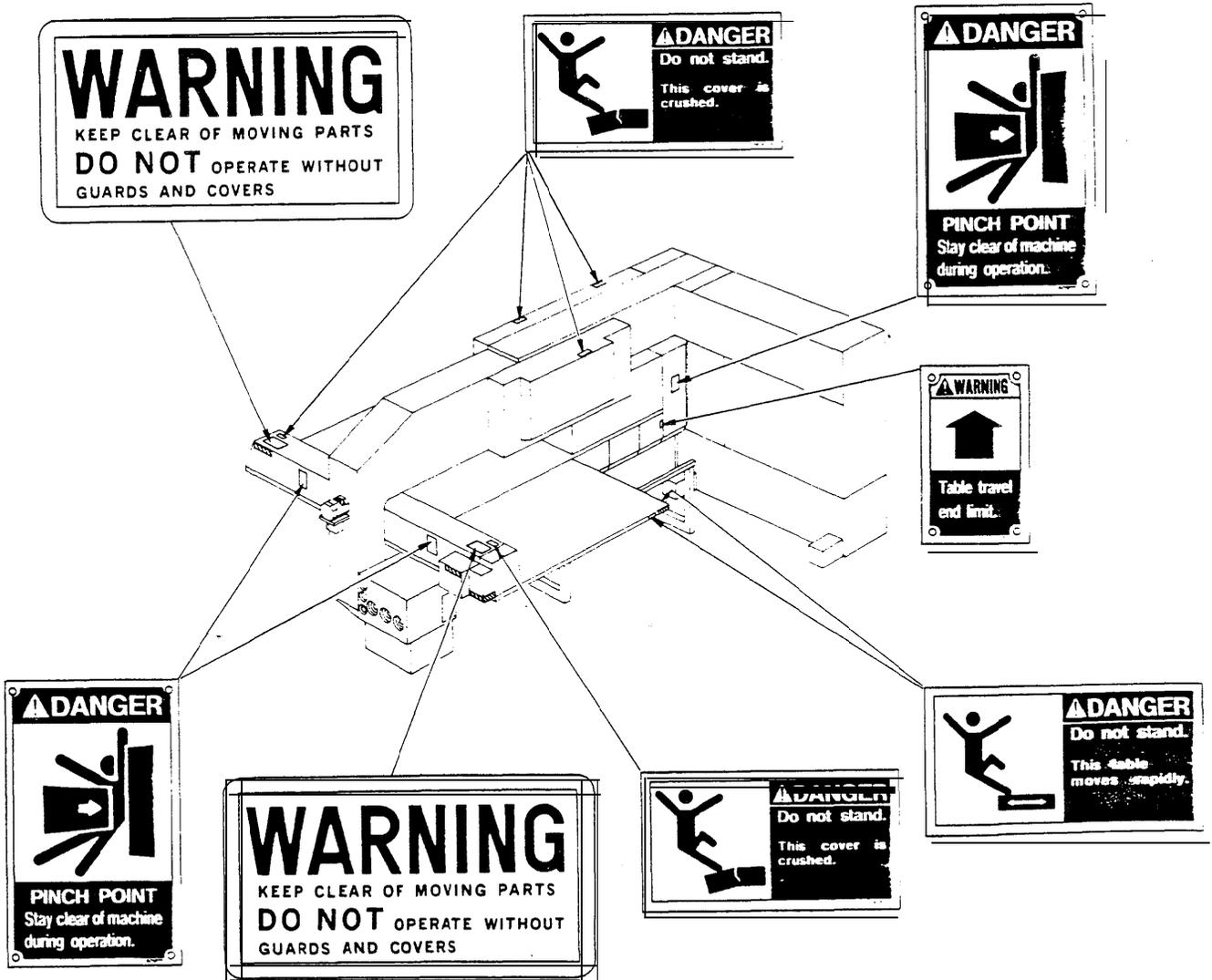
**DANGER** plates warn you of immediate danger of severe personal injury or death.

**WARNING** plates warn you against hazardous practices that could cause severe personal injury or death.

DANGER and WARNING plates and their locations on the machine are shown below:



# SAFETY RULES



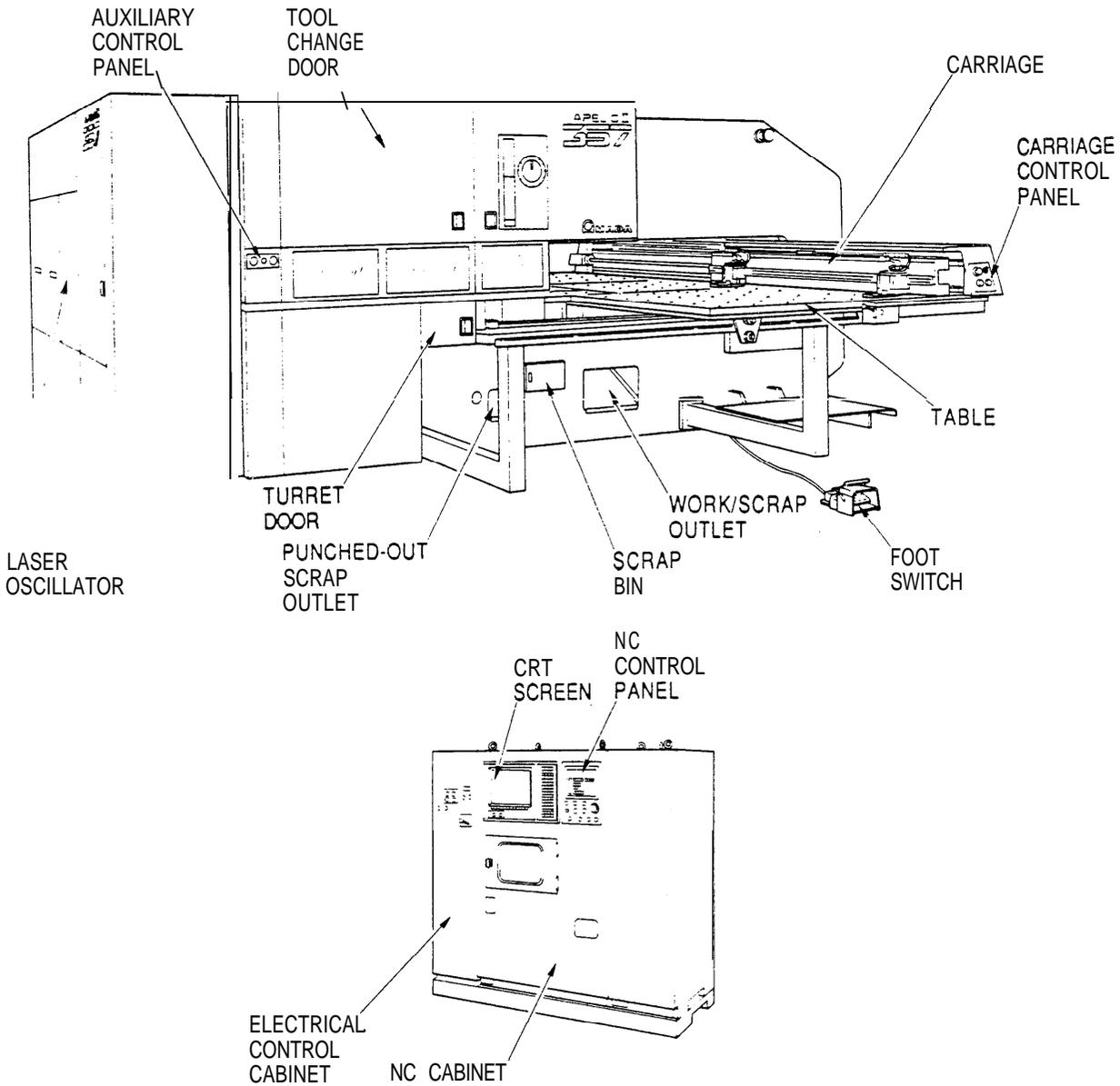
# I

# Description

General view	2
Table & carriage	2
Punching mechanism	4
Laser equipment	5
Safety functions	7



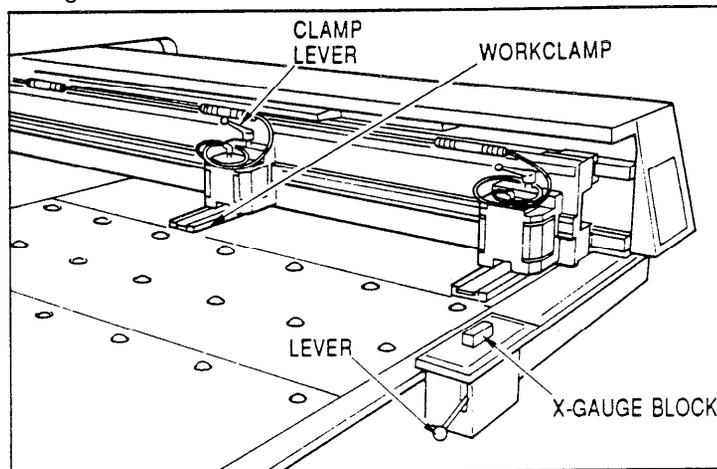
## GENERAL VIEW



## TABLE & CARRIAGE

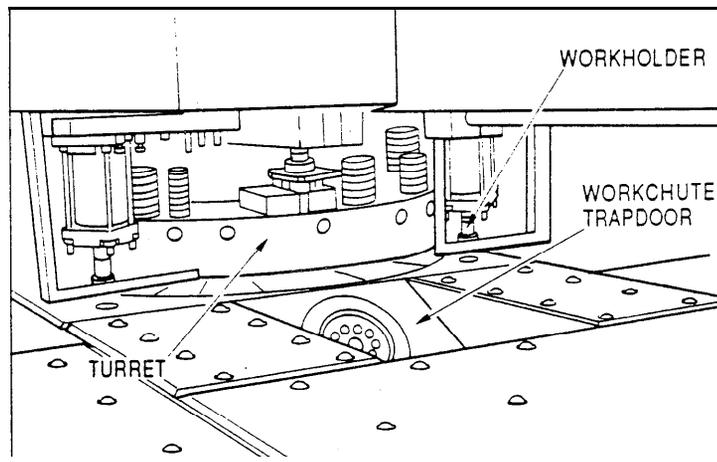
The table is composed of three sections. The two side sections are driven by an AC servomotor and travel along the machine's Y axis in pairs. The middle section is stationary. The table has free-motion ball bearings on the top to permit smooth movement for the worksheet placed on the table.

The carriage, which is driven by an AC servomotor, travels along the machine's X axis over the table. The carriage is equipped with two workclamps, which are opened and closed by using the foot switch.



The workclamps can be shifted in their positions to accommodate clamping of worksheets of various sizes — the lever on the top of each workclamp clamps and unclamps the workclamp.

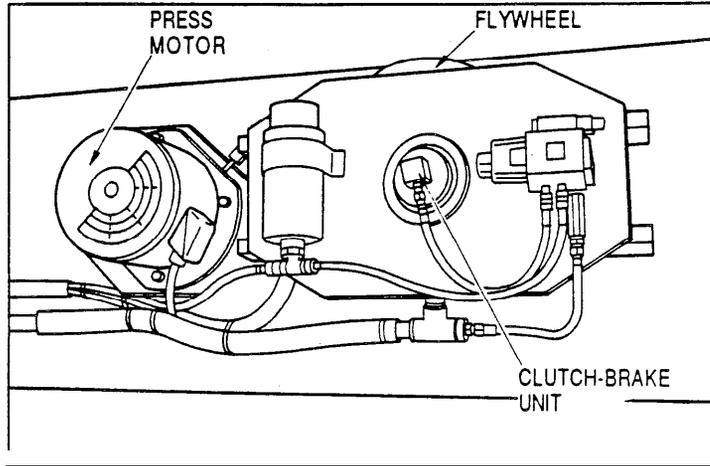
The X-gauge block, which is installed on the edge of the table and raised and lowered by using its lever, is used to position a worksheet at the origin on the table in combination with the workclamps.



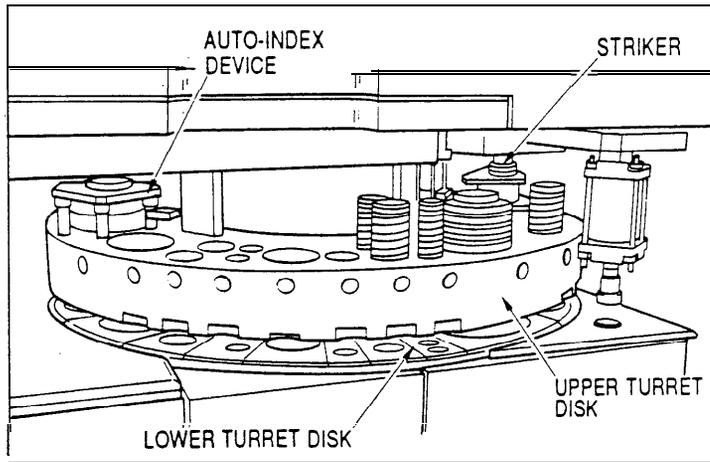
Two workholders, which are installed in front of the turret, are operated to hold the worksheet temporarily when the workclamps release it in order to reposition it on the table in an automatic operation.

Finished workpieces or scrap pieces which are smaller than 350 mm (13.7") square can be dropped to the workchute through the trapdoor in the table and carried out of the machine. Punched-out scrap pieces are carried out of the machine.

## PUNCHING MECHANISM



The press motor operates the flywheel by way of belts. The force generated by the flywheel is transmitted to the crankshaft by way of the hydraulic clutch-brake unit. The crankshaft operates the striker up and down. The striker hits the punch to punch the worksheet.



The tool turret, which is composed of upper (punch) and lower (die) disks, is driven by an AC servomotor. The turret has 58 tool stations — two of which are equipped with the auto-index device which indexes a punch-and-die pair at an angle laterally within the station.

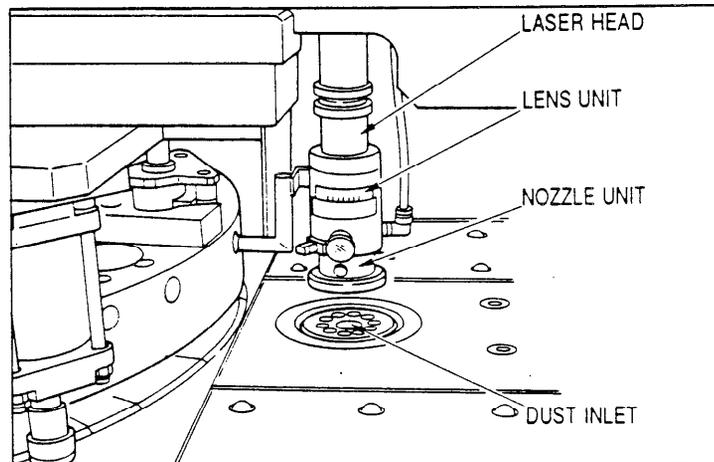
When a tool station is specified, the turret rotates to position the station under the striker and an index pin is inserted into each turret disk to lock the turret.

## LASER EQUIPMENT

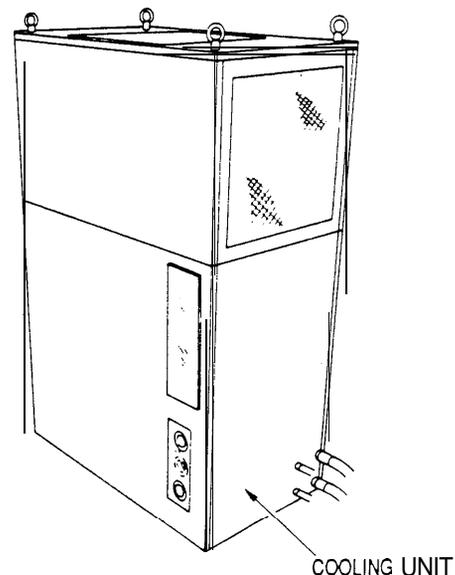
The laser equipment is composed of a laser oscillator, laser head, cooling unit, and dust collector unit.

The laser oscillator generates a CO<sub>2</sub> laser beam inside discharge tubes by using carbon dioxide, nitrogen, and helium gases as agents. The direction of the laser beam emitted from the oscillator is changed by two bend mirrors and discharged from the laser head. (The output conditions of the laser beam must be adjusted according to the material and thickness of the worksheet.)

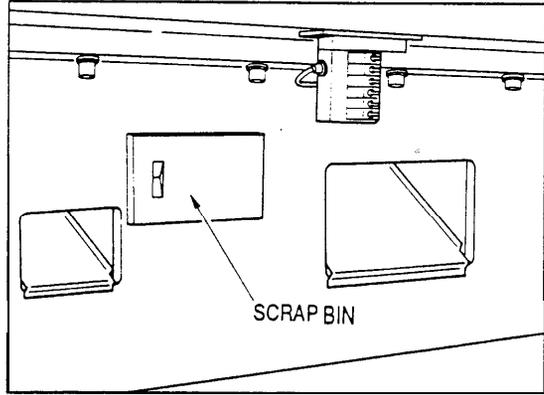
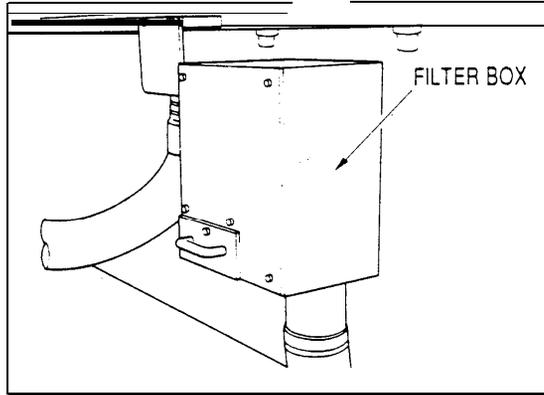
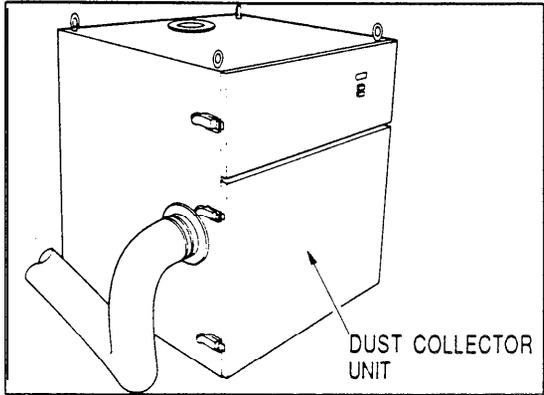
The laser head is composed of a lens unit and a nozzle unit and moved up and down by an AC servomotor. The lens focuses the laser beam on the worksheet and the nozzle discharges an assist gas to increase efficiency and protect the lens during cutting. A red helium-neon (He-Ne) laser beam can also be emitted from the head to pinpoint the position where the CO<sub>2</sub> laser beam will be applied on the worksheet for confirmation before actual cutting.



The cooling unit circulates water inside the piping installed inside and around the laser oscillator and the machine. The laser oscillator must be cooled to maintain its stable condition in order to generate a uniform CO<sub>2</sub> laser beam. The cooling water must be supplied through a water purifier and changed regularly. (The cooling unit that has been delivered may differ in type from what is shown in this manual. Refer to the separate manual provided with the unit for its operation.)



The dust collector unit is installed separately from the machine. The dust inlet is incorporated in the workchute trapdoor in the machine table to suck in dust and tiny scrap from under the laser head during cutting. The dust is collected on the filters in the filter box in the lower back of the machine and the dust collector unit. The scrap is collected in the scrap bin in the lower front of the machine.



## SAFETY FUNCTIONS

The following functions are provided for the safekeeping of the machine:

### **Protection of the punching mechanism**

The shear plate in the striker will break if the punching mechanism is exposed to an overload during punching. The machine will stop in an emergency stop condition if the crankshaft is not at the top dead center when punching.

### **Protection of the laser head**

The laser head will collapse at its joint if it hits the worksheet, etc., and the machine will stop in an emergency stop condition. (This function is enabled/disabled by the LASER HEAD OVERLOAD switch.)

### **Protection of the servosystem**

The machine will stop instantly if a servomotor is overloaded or an irregularity has been caused in the servosystem.

### **Detection of stripping failure**

The machine will stop temporarily if a punch is stuck in the worksheet or it does not complete punching in a given time.

### **Detection of a workclamp override**

The machine will stop temporarily if a workclamp enters the area under the upper turret disk, where the workclamp is likely to be punched. (This function is enabled/disabled by the OVERRIDE switch.)

### **Detection of a workclamp collision**

The machine will stop temporarily if a workclamp is likely to collide with a workholder when the worksheet has been repositioned during an automatic operation. (This function is enabled/disabled by the OVERRIDE switch.)

### **Detection of an overtravel**

The machine will stop instantly if the carriage, table, or laser head has overtraveled.

### **Detection of low operating air pressure**

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

### **Detection of low laser gas pressure**

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

**Detection of low assist gas pressure**

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

**Detection of irregularity in the clutch-brake hydraulic oil**

The machine will stop instantly if the pressure of the clutch-brake hydraulic oil has gone down below the required pressure or its temperature has gone up excessively.

**Detection of low cooling water level**

The machine will stop instantly if the level of the cooling water has been reduced below the required level.

**Program precheck**

The program can be checked for syntax errors and overtravels without running the machine — prior to its execution for actual cutting or punching. (This function is enabled/disabled by the TEST key.)

# III

## Controls

- NC control panel 2
- Carriage control panel 10
- Turret control panel 11
- Auxiliary control panel 13
- Electrical control cabinet 14
- Others 17
- Displays 20
  - ACTUAL POSITION display 21
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  - PROGRAM and PROGRAM DIRECTORY displays 23
  - ALARM/MESSAGE, DIAGNOSIS (I/O) and PARAMETER displays 25
  - MDI displays 27
  - LASER displays 28



- 414 Alarm condition has been caused in X-axis digital servosystem.
- 415 Velocity of over 511875 detection units per second has been instructed to X axis. (This alarm is caused due to error in CMR parameter setting.)
- 416 Irregularity (wire breakage, etc.) has been caused in X-axis pulse-coder's position detection system.
- 417 Error has been found in parameter setting for X-axis digital servosystem.
- 420 Y-axis positional deviation is larger than set data when stopped.
- 421 Y-axis positional deviation is larger than set data during travel.
- 423 Y-axis positional deviation has exceeded  $\pm 32767$  or DA converter's velocity setting is outside required range of +8191 to -8492. (This alarm is caused normally due to parameter setting error.)
- 424 Alarm condition has been caused in Y-axis digital servosystem.
- 425 Velocity of over 511875 detection units per second has been instructed to Y axis. (This alarm is caused due to error in CMR parameter setting.)
- 426 Irregularity (wire breakage, etc.) has been caused in Y-axis pulse-coder's position detection system.
- 427 Error has been found in parameter setting for Y-axis digital servosystem.
- 430 T-axis positional deviation is larger than set data when stopped.
- 431 T-axis positional deviation is larger than set data during travel.
- 433 T-axis positional deviation has exceeded  $\pm 32767$  or DA converter's velocity setting is outside required range of +8191 to -8192. (This alarm is caused normally due to parameter setting error.)
- 434 Alarm condition has been caused in T-axis digital servosystem.
- 435 Velocity of over 511875 detection units per second has been instructed to T axis. (This alarm is caused due to error in CMR parameter setting.)

- 436 Irregularity (wire breakage, etc.) has been caused in T-axis pulse-coder's position detection system.
- 437 Error has been found in parameter setting for T-axis digital servosystem.
- 440 C-axis positional deviation is larger than set data when stopped.
- 441 C-axis positional deviation is larger than set data during travel.
- 443 C-axis positional deviation has exceeded  $\pm 32767$  or DA converter's velocity setting is outside required range of  $+8191$  to  $-8192$ . (This alarm is caused normally due to parameter setting error.)
- 444 Alarm condition has been caused in C-axis digital servosystem.
- 445 Velocity of over 511875 detection units per second has been instructed to C axis. (This alarm is caused due to error in CMR parameter setting.)
- 446 Irregularity (wire breakage, etc.) has been caused in C-axis pulse-coder's position detection system.
- 447 Error has been found in parameter setting for C-axis digital servosystem.
- 450 Z-axis positional deviation is larger than set data when stopped.
- 451 Z-axis positional deviation is larger than set data during travel.
- 453 Z-axis positional deviation has exceeded  $\pm 32767$  or DA converter's velocity setting is outside required range of  $+8191$  to  $-8192$ . (This alarm is caused normally due to parameter setting error.)
- 454 Alarm condition has been caused in Z-axis digital servosystem.
- 455 Velocity of over 511875 detection units per second has been instructed to Z axis. (This alarm is caused due to error in CMR parameter setting.)
- 456 Irregularity (wire breakage, etc.) has been caused in Z-axis pulse-coder's position detection system.
- 457 Error has been found in parameter setting for Z-axis digital servosystem.

**PMC ALARMS**

Contact AMADA if any of these alarms has been caused.

- 600 Illegal command has caused interruption.
- 601 Parity error has been caused in RAM.
- 602 Error has been caused in serial data transmission.
- 603 Watchdog error has been caused.
- 604 Parity error has been caused in ROM.
- 605 Ladder diagram exceeds storage capacity.

**LASER ALARMS**

- 660 Allowance for Z-axis tracking sensor is excessive. (Reset NC.)
- 664 AD converter "1" has irregularity. (Contact AMADA.)
- 662 AD converter "2" has irregularity. (Contact AMADA.)
- 663 RF power source has irregularity. (Contact AMADA.)
- 665 Shutter has irregularity. (Contact AMADA.)
- 666 Some discharge tubes are not functioning. (Contact AMADA.)
- 667 Temperature in laser oscillator has greatly increased. (Take measures to lower ambient temperature.)
- 668 Discharged CO<sub>2</sub> laser beam had been reflected back into resonator. (Decrease laser output.)
- 669 Laser interface printed circuit board has irregularity in power supply. (Contact AMADA.)
- 670 Cooling unit is not ready for operation. (Check and prepare unit.)
- 671 Assist gas supply is not ready for operation. (Check remaining pressure in bomb.)

- 672 Cooling water level is low. (Check cooling unit.)
- 673 Laser gas pressure is low. (Check remaining pressure in bomb.)
- 674 Air blower is overheated. (Contact AMADA.)
- 675 Cooling water temperature is too low and dew is formed on piping in RF power source. (Change setting to higher temperature.)
- 676 CO<sub>2</sub> laser output or discharge voltage has been reduced. (Contact AMADA.)
- 677 Laser beam absorber is overheated. (Contact AMADA.)
- 678 Laser gas pressure in discharge tube is not normal. (Contact AMADA.)
- 679 EMERGENCY STOP button has been pressed and is locked. (Remove cause of stop and unlock button,)
- 680 Laser gas is leaking from discharge tube or gas piping. (Contact AMADA.)
- 681 Required pressure has not been obtained inside discharge tubes in given time. (Contact AMADA.)
- 682 Negative pressure sensor has irregularity. (Contact AMADA.)
- 683 Discharge tube is faulty assist gas is not being discharged, or shutter is not opened. (Contact AMADA.)

## **OVERHEAT ALARMS**

Contact AMADA if any of these alarms has been caused.

- 700 Master printed circuit board is overheated.
- 702 X- or Y-axis AC servomotor is overheated.
- 703 Z-axis AC servomotor is overheated.

**LEFT SECTION**

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**CRT & Soft keys**

The 10 soft keys (except the two at both ends) on the lower CRT frame are assigned functions which vary from one operation to another. Their available functions will be shown on the CRT screen above the keys for every active display. See page II-20 for the descriptions of the displays and soft-key functions.

**POWER OFF (O) button**

Located below the CRT, this button turns off the power for the NC.

**POWER ON (I) button**

Located also below the CRT, this button turns on the power for the NC.

**MIDDLE PANEL: Top key-cluster**

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**RESET key**

Resets the NC when pressed after removing the cause of an alarm.

**CAUTION**

Do not press this key during an automatic operation. The machine will be stopped, canceling the program block that is being executed and resetting the NC. The stopped operation cannot be resumed.

**MMC/CNC key**

Selects the use of the MMC or CNC System. (This manual describes procedures based on the use of the CNC System. For the MMC System operation, refer to the separate manual.)

**SHIFT key**

To key-in the character shown on the lower right top of a numeric key, press this key and then press the numeric key.

**MIDDLE PANEL Second key-cluster from top**

---

**Address keys**

These keys are used to key-in address characters when the CNC System is effective.

**EOB key**

Enters an end-of-block code (;).

MIDDLE PANEL: Third **key-cluster** from top

Numeric keys

These keys are used to key-in numeric data.

ALTER key

Alters a word with another word in a program in the EDIT mode.

INS/CTRL key

Inserts a word or words, or a block of data, in a program in the EDIT mode.

DELET key

Deletes a program word, a program block or blocks, or an entire program in the EDIT mode.

INPUT key

Inputs the keyed-in data into the NC

MIDDLE PANEL: **Bottom** key-cluster

PAGE keys

The ↑/POS key changes the display on the CRT screen to the previous page and the ↓/SET key changes it to the next page if there are any additional pages.

CURSOR keys

The ↑/PRGRM key shifts the cursor backward and upward and the ↓/ALARM key shifts it forward and downward. The ←/MDI and →/LASER keys are not used to shift the cursor.

CAN key

Cancels one keyed-in character in the EDIT mode or one whole word in the AUTO or MDI mode each time this key is pressed.

SELECT key

Selects a display to be shown on the CRT screen when pressed together with one of the PAGE and CURSOR keys. Display names are shown below the arrows on these keys. (See page 11-20, "Displays.")

RIGHT PANEL: Top cluster of indicator lights

NC READY light

Lights when the NC and the machine as well are ready for operation. Unlights if an emergency stop condition has been caused or the EMERGENCY STOP button on this control panel has been pressed.

**LASER READY light**

Lights when the LASER POWER switch on this control panel is turned to ON, the HIGH VOLTAGE light (see below) is on, and M100 (laser mode setup) is commanded in the AUTO mode, or the laser head is lower than its origin in the MANUAL mode. When lighted, laser cutting is permitted but punching cannot be performed.

Blinks when the LASER POWER switch is turned to ON. When blinking, punching is permitted but laser cutting cannot be performed.

Unlights when the LASER POWER switch is turned to OFF. When unlighted, punching is permitted but laser cutting cannot be performed.

**TOP DEAD CENTER light**

Lights when the crankshaft is at the top dead center.

**AXES REFERENCE light**

Lights when all the machine axes are at their origins

**PROGRAM STOP light**

Lights when the machine is stopped by the MOO (program stop) command. Also lights when the machine is stopped by the MO1 (optional stop) command if the OPT STOP key on this control panel is lighted. Unlights when a START button is pressed, resuming the operation.

**OVERRIDE light**

Lights when a workclamp has entered its override zone and punching is stopped.

**HIGH VOLTAGE light**

Lights when the laser oscillator is supplied with high-voltage power and ready for operation.

**OIL FILTER light**

Lights if the line filter in the clutch-brake hydraulic unit is loaded, requiring a filter or oil change.

**STOP SWITCH light.**

Lights when the STOP button on the carriage control panel or the auxiliary control panel has been pressed and the machine is stopped.

**X-GAUGE BLOCK light**

Lights when the X-gauge block is raised and the machine is stopped.

**WORK CLAMP light**

Lights when the workclamps are opened and the machine is stopped.

**INTERLOCK light**

Lights when an interlock alarm has been caused.

**RIGHT PANEL:** Middle cluster of keys

---

## Mode selection keys

These keys are used to select an NC operation mode as described below — the mode is selected when the key is pressed and its light is on.

**NOTE**

The NC **mode** can be changed or selected only when the MODE CHANGE switch on the electrical control cabinet is turned to ON.

- REF ZERO key  
Selects the REF ZERO mode to return a machine axis or axes to their origins.
- AUTO key  
Selects the AUTO mode to perform the following:
  - Execute a registered program.
  - Execute a program by reading it from tape.
  - Search for the number for a registered program or a sequence number in the program.
  - Search for a sequence number in the program intape.
  - Read a program from tape and register it in the NC memory.
- MDI key  
Selects the MDI mode to perform the following:
  - Program and execute block by block.
  - Enter or modify the NC setup data or the output conditions for CO<sub>2</sub> laser beam or assist gas.
  - Check, enter, or modify the number of punching hits for each turret station.
  - Use the PUNCHING button on this control panel for an inch-punching or single-cycle punching operation.
- MANUAL key  
Selects the MANUAL mode to perform the following:
  - Feed the carriage, table, turret, or laser head manually.
  - Change tools.
  - Use the PUNCHING button on this control panel for an inch-punching operation.
  - Use the LASER OUT button on the turret control panel to discharge CO<sub>2</sub> laser beam for the maintenance purpose.
- EDIT key  
Selects the EDIT mode to perform the following:
  - Edit or delete a registered program.
  - Create a new program.
  - Read a program from tape and register it in the NC memory.
  - Transmit a registered program for tape-punching.
  - Search for the number for a registered program.

**SINGLE key**

Stops the machine every time one block of the program is completed in an AUTO mode operation when this key is pressed and its light is on. G68 and G69 nibbling commands will be completed before stopping the machine. With other pattern punching commands, the machine stops after every punch operation.

In any case, the machine can be restarted to execute the next block by pressing a START button.

**TEST key**

Permits to check the contents of a program without operating the machine when this key is pressed and its light is on in the AUTO mode.

**OPT STOP key**

Stops the machine whenever an optional stop command (M01) is read during the execution of a program in the AUTO mode when this key is pressed and its light is on. The machine can be restarted by pressing a START button.

**BLOCK SKIP key**

Ignores and skips every program block to which a slash (/) is attached during the execution of a program in the AUTO mode when this key is pressed and its light is on.

**MULTI-PART MODE keys**

These keys are used to select a punching-and-cutting mode for a multiple-part program as described below — the mode is selected when the key is pressed and its light is on.

IMPORTANT None of these key lights should be on when executing a program other than the multiple-part program.

- **FIRST key**  
Selects the mode in which only one part is punched and cut for trial.
- **OTHERS key**  
Selects the mode in which the remaining parts are punched and cut after the trial of one part.
- **ALL key**  
Selects the mode in which all parts are punched and cut.

**AXES JOGS AND REFERENCES keys**

These keys are used to move a machine axis in the MANUAL or REF ZERO mode as described below. They must be operated together with the AXES JOG ON button on the electrical control cabinet to jog an axis.

- **+X key**  
In MANUAL mode: Shifts the carriage (X) in the plus direction (toward the origin).  
In REF ZERO mode: Returns the carriage as well as the laser head (Z) to their origins. The light on the key will light upon completion of the return.

- **-X key**  
 In MANUAL mode: Shifts the carriage in the minus direction (away from the origin).  
 In REF ZERO mode: Effects no movement.
- **+Y key**  
 In MANUAL mode: Shifts the table (Y) in the plus direction (toward the origin).  
 In REF ZERO mode: Returns the table to its origin. The light on the key will light upon completion of the return.
- **-Y key**  
 In MANUAL mode: Shifts the table in the minus direction (away from the origin).  
 In REF ZERO mode: Effects no movement.
- **TURRET key**  
 In MANUAL mode: Effects no movement.  
 In REF ZERO mode: Returns the turret (T) as well as the auto-index device (C) to their origins. The light on the key will light upon completion of the return.

**FEEDRATE keys**

These keys are used to select rapid feedrates for the carriage (X) and table (Y) and rotating speeds for the turret (T) and auto-index device (C) — the rates and speeds are selected when the key is pressed and its light is on. The rates and speeds assigned to keys F1, F2, F3, and F4 are as follows:

AXIS	MODE	Unit for X & Y axes: m/min (ipm)			
		F1	F2	F3	F4
X & Y	AUTO/MDI	50.0 (1968)	37.5 (1476)	25.0 (984)	12.5 (492)
X & Y	MANUAL	5.2 (204)	5.2 (204)	5.2 (204)	5.2 (204)
T	AUTO/MDI	30.0 r p m	30.0 rpm	15.0 rpm	15.0 rpm
C	AUTO/MDI	60.0 rpm	60.0 rpm	30.0 rpm	30.0 rpm

The turret (T) rotates at 3 rpm in the MANUAL mode.

**RIGHT PANEL:** Bottom cluster of buttons and switches

---

**START button**

Starts the machine in the AUTO or MDI mode — the button will light when pressed. This button has the same function as the START buttons on the carriage control panel and on the auxiliary control panel.

**STOP button**

Interrupts the operation of the machine in any mode. The stopped operation may be restarted by pressing a START button. This button has the same function as the STOP buttons on the carriage control panel and on the auxiliary control panel.

**OT RELEASE button**

Retracts the carriage (X) or the table (Y) when it has over-traveled. Used in combination with the AXES JOG ON button on the electrical control cabinet and a jog key on this control panel (+X, -X, +Y, or -Y) in the MANUAL mode.

**EDIT PROTECT** keyswitch

Protects the programs and other data stored in the NC memory from being erroneously altered or erased when turned to ON. Turn the switch to OFF when editing, deleting or registering a program, or entering or changing the NC setup data, the output conditions for CO<sub>2</sub> laser beam or assist gas, or the number of punching hits for each turret station.

**PUNCHING** button

Starts punching according to the setting on the PRESS SELECTION switch (see below) in the MDI or MANUAL mode.

**PRESS SELECTION** keyswitch

Selects the manner of punching as described below:

Switch position	<u>"INCHING"</u>	<u>"OFF"</u>	<u>"CYCLE"</u>
MANUAL mode	Inch-punching	No punching	No punching
MDI mode	Inch-punching	No punching	Single cycle
AUTO mode	No punching	No punching	Continuous

Inch-punching and single-cycle punching are started by pressing the PUNCHING button in the MANUAL or MDI mode. Continuous punching in the AUTO mode is performed according to the program.

**EMERGENCY STOP** button

Stops and discontinues the operation of the machine in any mode. 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.

**FEEDRATE (%)** switch

Changes the cutting feedrates for the carriage and table within a range of zero to 200% of those specified in a laser cutting program. Set the switch at 100% for laser cutting operations under normal conditions.

**DUTY (%)** switch

Changes the pulse duty within a range of 50 to 150% of that specified in a laser cutting program. Set the switch at 100% for laser cutting operations under normal conditions.

**LASER SELECTION** keyswitch

Selects the use of CO<sub>2</sub> laser beam for cutting or He-Ne laser beam for position confirmation or maintenance operation.

**LASER POWER** keyswitch

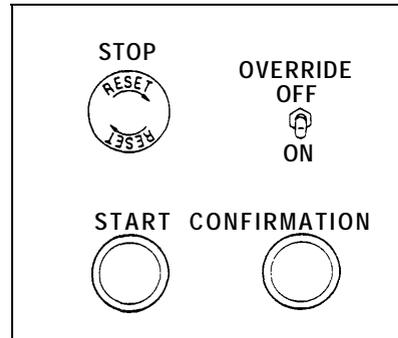
Starts the operation of the laser oscillator when turned to ON — when the NC READY light and the TOP DEAD CENTER light on this control panel are on.



Disable laser generation whenever it is not immediately required and when the machine is not in use. Turn the LASER POWER keyswitch to OFF and remove the key from the switch.

## CARRIAGE CONTROL PANEL

The carriage control panel is located at the end of the carriage and has the following control buttons, etc.:



### STOP button

Interrupts the operation of the machine in any mode — the button will be locked when pressed. The stopped operation may be restarted by turning this button clockwise to unlock it and pressing a START button. This button has the same function as the STOP buttons on the NC control panel and on the auxiliary control panel.

### START button

Starts the machine in the AUTO or MDI mode. This button has the same function as the START buttons on the NC control panel and on the auxiliary control panel.

### OVERRIDE switch (for repositioning confirmation)

Enables the detection functions for the interruption of punches with workclamps and that of workholders with workclamps when flipped to ON. The functions will be enabled regardless of the switch setting, however, during an operation controlled by tape in the AUTO mode.

**CAUTION** Keep this switch in the ON position when performing an operation controlled by a new program.

### OVERRIDE CONFIRMATION button

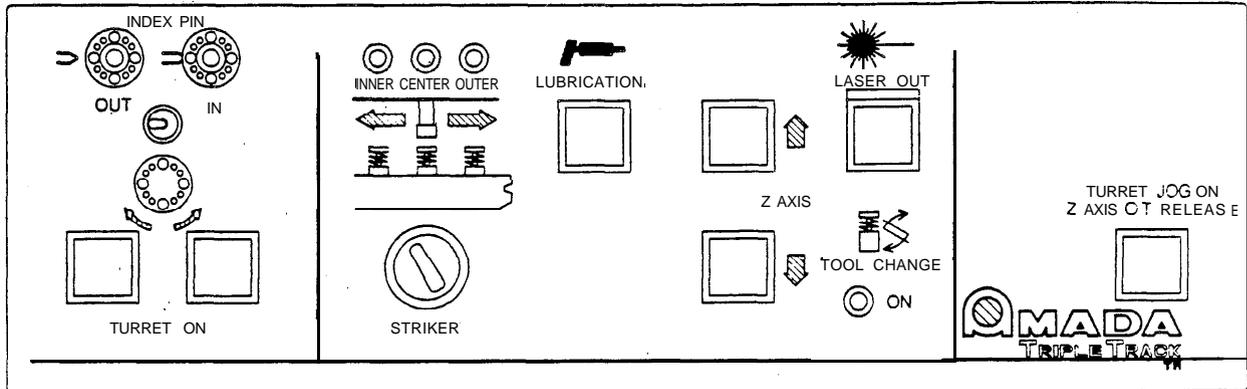
Restarts the machine operation which has been suspended because a workclamp has entered its override zone — when it is confirmed that the workclamp will not be punched and then this button is pressed. The button has the same function as the OVERRIDE CONFIRMATION button on the auxiliary control panel and the CONFIRMATION button on the electrical control cabinet.

### X-GAUGE BLOCK switch (optional)

This switch is added on the carriage control panel when the machine is equipped with the optional air-operated X-gauge block. The switch is enabled only when the machine is stopped by a program stop command (MOO) or optional stop command (M01) during an automatic operation.

## TURRET CONTROL PANEL

The turret control panel is located behind the left tool change door above the turret and has the following control buttons, etc.:



### INDEX PIN OUT and IN lights

These lights indicate whether the turret index pins are inserted in the upper and lower turret disks (IN) or out of the turret disks (OUT).

### INDEX PIN switch

This switch is enabled only in the MANUAL mode to withdraw (left switch position) or insert (right switch position) the turret index pins.

#### IMPORTANT

Keep this switch turned in the left position in modes other than the MANUAL mode.

### TURRET ON buttons

These buttons are used to rotate the turret and enabled only in the MANUAL mode and when the laser head is at its origin. Each button must be pressed together with the TURRET JOG ON/Z AXIS O.T. RELEASE button (see below). Use the left button to rotate the turret clockwise and the right button to rotate it counterclockwise.

#### NOTE

The turret will rotate as long as the buttons are held pressed and will stop at the nearest turret station when the buttons are released.

### STRIKER INNER, CENTER and OUTER lights

These lights indicate the current position of the striker. The INNER position is on the side toward the center of the turret.

### STRIKER switch

This switch is enabled only in the MANUAL mode to shift the position of the striker to INNER (left switch position), CENTER (top switch position), or OUTER (right switch position).

#### IMPORTANT

Keep this switch turned in the top position in modes other than the MANUAL mode.

**LUBRICATION button**

Operates the automatic lubrication system to apply grease to the punching mechanism.

**Z AXIS buttons**

These buttons are enabled only in the MANUAL mode to raise and lower the laser head — each button must be pressed together with the TURRET JOG ON/Z AXIS O.T. RELEASE button (see below). Use the upper button to raise the head and the lower button to lower it.

**LASER OUT button**

Discharges CO<sub>2</sub> laser beam from the laser head when the conditions described below are provided — this button must be pressed together with the TURRET JOG ON/Z AXIS O.T. RELEASE button (see below). The required conditions are as follows:

- The required output conditions for CO<sub>2</sub> laser beam are set on the LASER SETTING (SET DATA) display.
- The required output conditions for assist gas are set on the LASER SETTING (ASSIST GAS) display.
- The laser head is brought down lower than its origin.
- The MANUAL mode key on the NC control panel is pressed and its light is on.
- The LASER POWER switch on the NC control panel is turned to ON.
- The LASER SELECTION switch on the NC control panel is turned to CO<sub>2</sub>.
- The HIGH VOLTAGE light on the NC control panel is lighted.
- The LASER READY light on the NC control panel is lighted.



Check to ensure that there is nobody around the machine before pressing the buttons.

**TOOL CHANGE ON light**

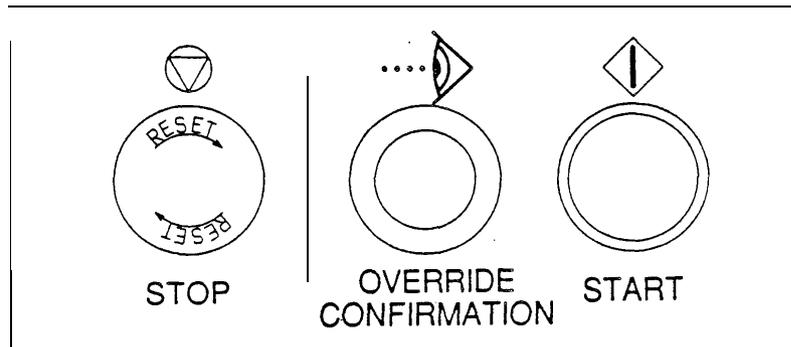
Lights when the TOOL CHANGE switch on the electrical control cabinet is turned to ON for tool change.

**TURRET JOG ON/Z AXIS O.T. RELEASE button**

This button must be pressed together with a TURRET ON button, Z AXIS button, or the LASER OUT button when any of these buttons is used in the MANUAL mode.

## AUXILIARY CONTROL PANEL

The auxiliary control panel is located on the left side of the left tool change door and has the following buttons



### STOP button

Interrupts the operation of the machine in any mode — the button will be locked when pressed. The stopped operation may be restarted by turning this button clockwise to unlock it and pressing a START button. This button has the same function as the STOP buttons on the NC control panel and on the carriage control panel.

### OVERRIDE CONFIRMATION button

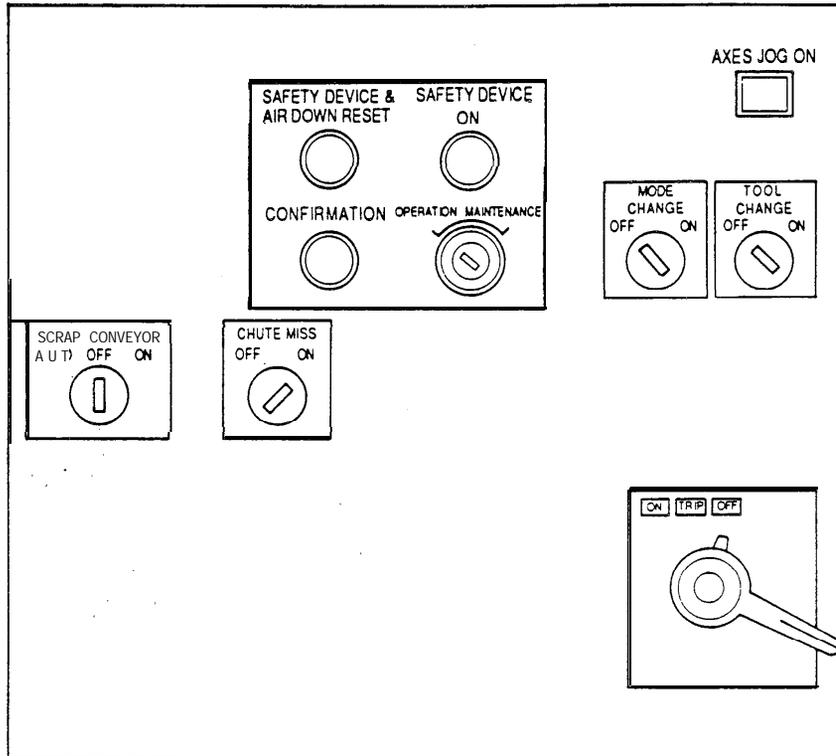
Restarts the machine operation which has been suspended because a workclamp has entered its override zone — when it is confirmed that the workclamp will not be punched and then this button is pressed. The button has the same function as the OVERRIDE CONFIRMATION button on the carriage control panel and the CONFIRMATION button on the electrical control cabinet.

### START button

Starts the machine in the AUTO or MDI mode. This button has the same function as the START buttons on the NC control panel and on the carriage control panel.

# ELECTRICAL CONTROL CABINET

The electrical control cabinet is installed on the left side of the NC cabinet. On the cabinet's front door, which is flush with the NC control panel, are the following switches:



### SAFETY DEVICE ON light

Lights when the SAFETY DEVICE switch (see below) is turned to OPERATION. Unlights if a safety mat is stepped on, an optical safety device is activated, or the operating air pressure has been reduced — relights when the SAFETY DEVICE & AIR DOWN RESET button (see below) is pressed after removing the cause. . Optional.

### SAFETY DEVICE keyswitch

Enables the optional safety devices mentioned above, when this switch is turned to OPERATION. Keep the switch turned to OPERATION normally regardless of the use of the safety devices. Turn it to MAINTENANCE only when performing a maintenance operation.

**SAFETY DEVICE & AIR DOWN RESET button**

Resets the condition when one of the optional safety devices (see above) has been actuated or the operating air pressure has been reduced — after the cause has been removed. The SAFETY DEVICE ON light (see above) will relight when the condition is reset by pressing this button.

**CONFIRMATION button**

Restarts the machine operation which has been suspended because a workclamp has entered its override zone — when it is confirmed that the workclamp will not be punched and then this button is pressed. The button has the same function as the OVERRIDE CONFIRMATION buttons on the carriage control panel and the auxiliary control panel.

**AXES JOG ON button**

Used in combination with the +X, -X, +Y, -Y, or TURRET jog key on the NC control panel in the REF ZERO or MANUAL mode.

**MODE CHANGE keyswitch**

Enables the mode selection keys on the NC control panel when turned to ON. Keep this switch turned to OFF when the changing of modes is not required.

**TOOL CHANGE keyswitch**

Stops the press motor and locks the carriage, table, and laser head when turned to ON, permitting to operate the TURRET ON buttons on the turret control panel in the MANUAL mode to rotate the turret for the changing of tools. Keep this switch turned to OFF at other times.

**SCRAP CONVEYOR switch**

Enables the optional scrap conveyor. Turn this switch to AUTO to automatically start the conveyor during an automatic operation. Turn the switch to OFF to disable the conveyor. Turn it to ON to independently operate the conveyor during a maintenance operation.

**CHUTE MISS switch**

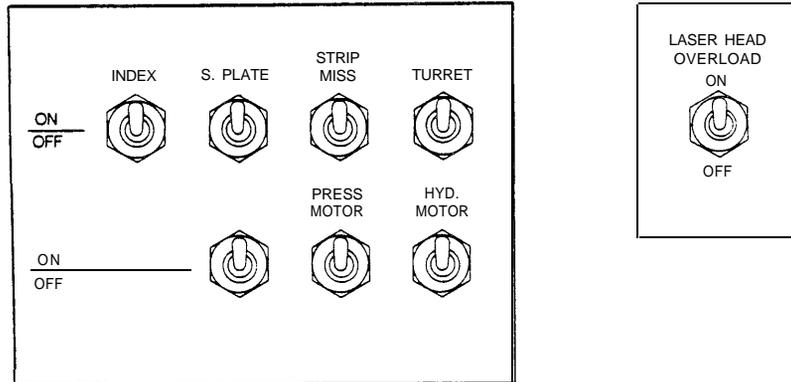
Enables the function to detect a failure of the workchute in dropping work or scrap. Keep this switch turned to ON normally.

**Circuit breaker switch**

Turns on the power for the NC and the machine when turned to ON. The switch will be turned to TRIP automatically if an overcurrent is supplied — turn the switch back to ON after removing the cause.

*See next page for the description of the switches on a panel inside the electrical control cabinet.*

Switch panel inside the electrical control cabinet:



**INDEX switch**

Enables the auto-index device when flipped to ON. Keep this switch flipped to ON normally.

**S. PLATE switch**

Raises the optional support plate when flipped to ON.

**STRIP MISS switch**

Enables the function to detect a stripping failure when flipped to ON. Keep this switch flipped to ON normally.

**TURRET switch**

Enables the rotation of the turret when flipped to ON. Keep this switch flipped to ON normally.

**PRESS MOTOR switch**

Starts the press motor as soon as the NC READY light on the NC control panel is lighted when flipped to ON. Keep this switch flipped to ON normally.

**HYD. MOTOR switch**

Starts the hydraulic pump motor as soon as the NC READY light on the NC control panel is lighted when flipped to ON. Keep this switch flipped to ON normally.

**LASER HEAD OVERLOAD switch**

Enables the function to detect the collapse of the laser head when this switch is flipped to ON. Keep the switch flipped to ON normally.

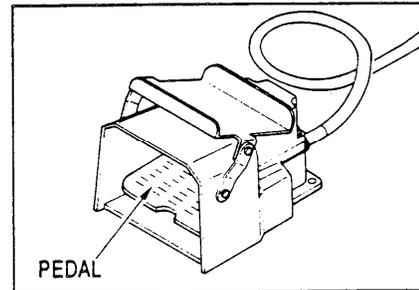
NOTE Although laser cutting will be disabled when the laser head is collapsed, punching may be performed with this switch flipped to OFF.

## OTHERS

The machine is equipped with the following additional switches, etc.:

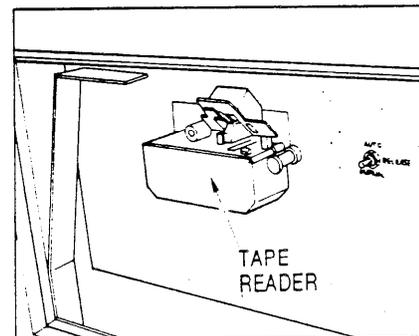
### FOOT SWITCH

The workclamps are opened or closed when the pedal is pressed. During an automatic operation, the foot switch can be operated only when the machine is stopped by a program stop command (MOO) or an optional stop command (M01).



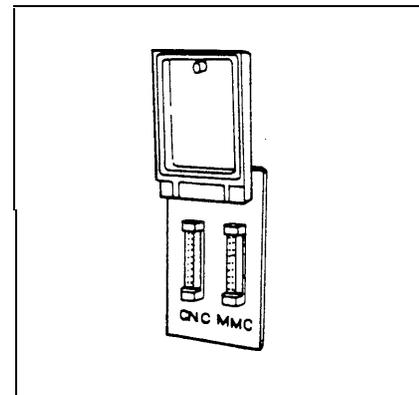
### TAPE READER SWITCH

This switch is located on the front of the NC cabinet and controls the tape reader operation. Turn it to RELEASE to load or remove a program tape. Turn it to AUTO to read the tape or to MANUAL to feed it.



### I/O INTERFACES

These interfaces are located on the front of the NC cabinet. The left interface (CNC) is used to connect the tape reader/puncher to input or output NC program data. The right interface (MMC) is used to input or output source program data.

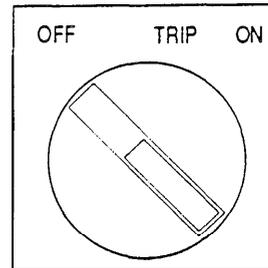


Both interfaces have RS232C type 25-pin connectors and signals are assigned to the pins as follows:

1	2	3	4	5	6	7	8	9	10	11	12	13
FG	SD	RD	RS	CS	DR	SG	CD					
14	15	16	17	18	19	20	21	22	23	24	25	
						ER						+24N

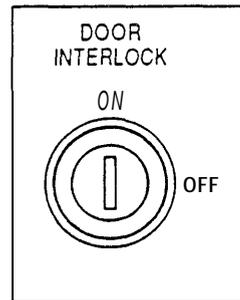
**LASER OSCILLATOR CIRCUIT BREAKER SWITCH**

This switch turns on the power for the laser oscillator when turned to ON. The switch will be turned to TRIP automatically if an overcurrent is supplied — turn the switch back to ON after removing the cause.

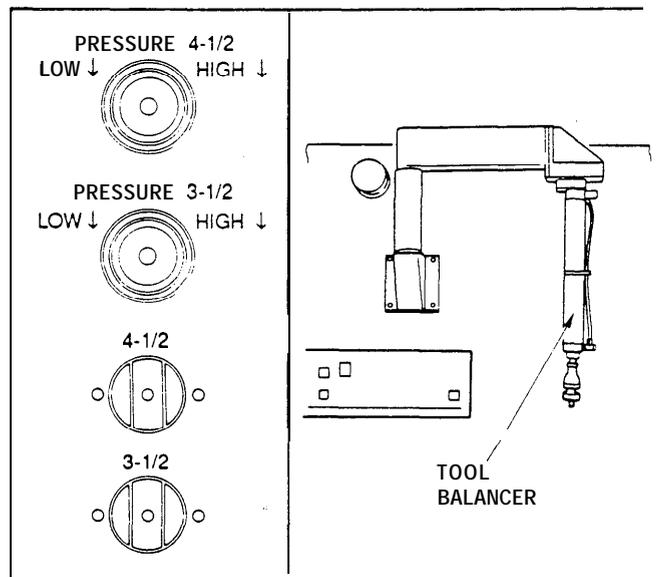


**DOOR INTERLOCK KEYSWITCH**

This switch is located on the back of the NC cabinet. When the switch is turned to ON, the NC and the laser oscillator will be turned off automatically if the NC cabinet's backdoor, electrical control cabinet's backdoor, or laser oscillator's side door is opened. Keep the switch turned to ON normally. (\* The right door with the oscillator's circuit breaker switch on the front)



**TOOL BALANCER SWITCHES**



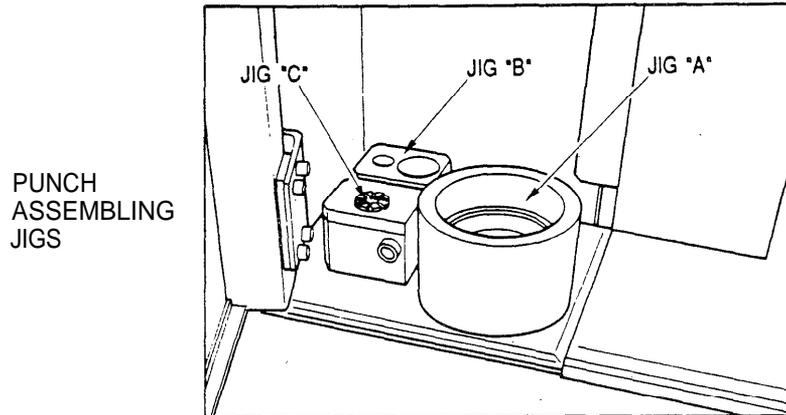
These switches are located behind the left tool change door and used to control the tool balancer when mounting a large-diameter punch on the turret or dismounting it:

**PRESSURE 4-1/2 and 3-1/2 knobs**

The 4-1/2 knob controls the tool balancer's power to handle the punch with a diameter of 4-1/2" and the 3-1/2 knob to handle a 3-1/2" punch. Pull out the knob ring and turn the knob clockwise to increase the power or counterclockwise to decrease it. The adjustment is not required normally, however.

#### 4-1/2 and 3-1/2 switches

These switches operate the tool balancer. Press and turn these two switches together clockwise (OFF) to attach the punch to or detach it from the tool balancer. To lift and hold the punch, turn the switch which corresponds to the punch diameter counterclockwise (ON). To stow the tool balancer into the machine, turn either one of the switches to its ON position.



These jigs are located behind the left tool change door and used to assemble/disassemble punches or adjust their height as described below:

#### Jig "A"

Used when assembling or disassembling a C-type (2"), D-type (3-1/2"), or E--type (4-1/2") punch.

#### Jig "B"

Used when assembling or disassembling or adjusting the height of a shaped A-type (1/2") or B-type (1-1/4") punch.

#### Jig "C"

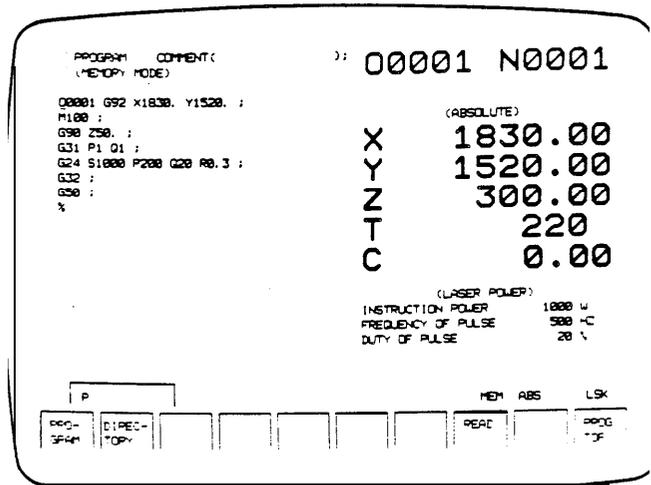
Used when assembling or disassembling or adjusting the height of a round A-type (1/2") or B-type (1-1/4") punch.

## DISPLAYS

A number of displays can be selectively shown on the CRT screen by using PAGE and CURSOR keys together with the SELECT key. See below for the description of these displays.

On any display the current status of the NC is shown in its lower right section just above the soft key labels as seen in the following example:

The words used to indicate the status and their definitions are described below:



NOT READY	The control system or the servosystem is not ready for operation.
LSK	The label skip function is on.
BUF	A block of commands has been read but has not been executed.
ABS	The absolute coordinate system is selected — in the MDI mode operation.
INC	The relative coordinate system is selected — in the MDI mode operation.
ALM	An alarm has been caused — the word blinks.
SRCH	A sequence number search is being performed — the word blinks.
READ	The program tape is being read — the word blinks.
MCRM	Macro data are being read — the word blinks.
ZRN	The REF ZERO mode is effective.
MEM	The AUTO mode is effective to perform an automatic operation by using a registered program.
TAPE	The AUTO mode is effective to perform an automatic operation by using a program tape.
MDI	The MDI mode is effective.
JOG	The MANUAL mode is effective.
EDIT	The EDIT mode is effective.



**LASER POWER - INSTRUCTION POWER**  
 Currently instructed output power of CO<sub>2</sub> laser beam in watts.

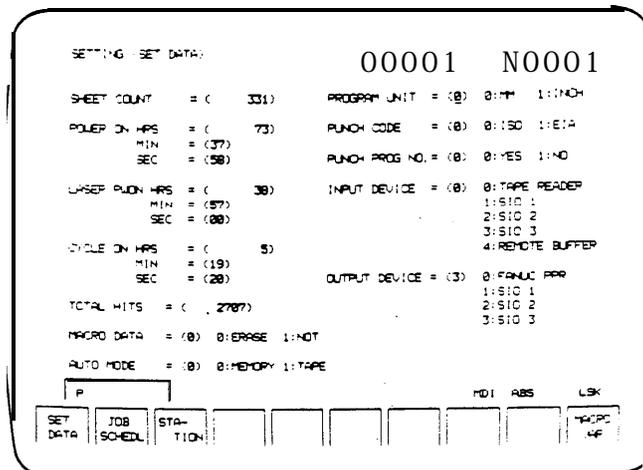
**LASER POWER - FREQUENCY OF PULSE**  
 Currently instructed pulse frequency of CO<sub>2</sub> laser beam in hertz.

**LASER POWER - DUTY OF PULSE**  
 Currently instructed pulse duty of CO<sub>2</sub> laser beam in percent-age.

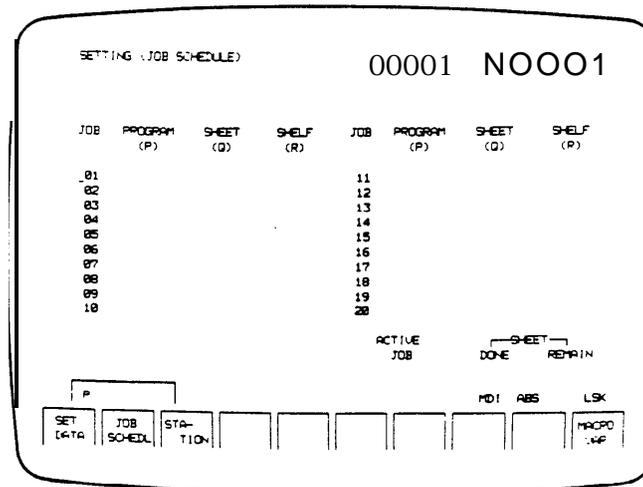
**SETTING displays**

Press the ↓/SET key together with the SELECT key to show a SETTING display — there are “SET DATA”, “JOB SCHEDULE” and “STATION PUNCH NO.” SETTING displays. They can be selected and shown by using the SET DATA, JOB SCHEDL, and STATION soft keys in the MDI mode. (The MACRO VAR soft key is not activated although it is defined on these displays.)

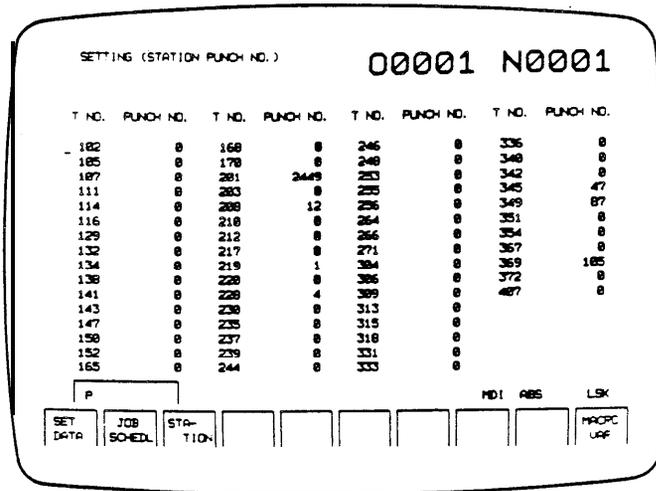
SETTING (SET DATA) display: Used to enter data to set up the NC for an operation.



SETTING (JOB SCHEDULE) display: Used when the optional scheduled operation function is equipped.



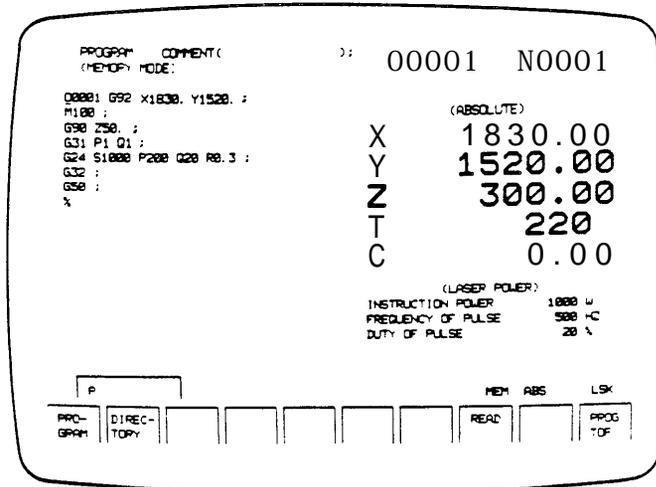
**SETTING (STATION BUNCH NO.)**  
display: Used to check or set the number of punching hits for individual turret stations.



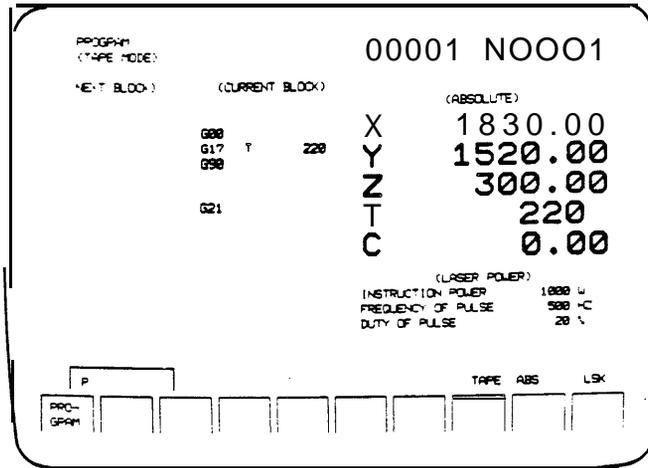
**PROGRAM and PROGRAM DIRECTORY displays**

Press the ↑/PRGRM key together with the SELECT key to show a PROGRAM display or PROGRAM DIRECTORY display — what is shown on these displays vary in different operation modes as shown below. Use the PROGRAM and DIRECTORY soft keys to change from one to the other display.

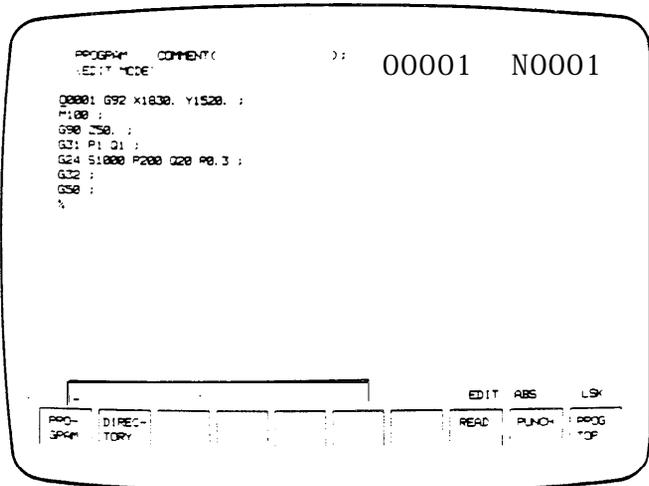
PROGRAM display in AUTO mode “memory” operation: Shows the contents of the program, which is to be executed or being executed in an automatic operation, the current machine axial positions, and the laser output data. The display is also used to search for a program registered in the NC memory or read a new program.



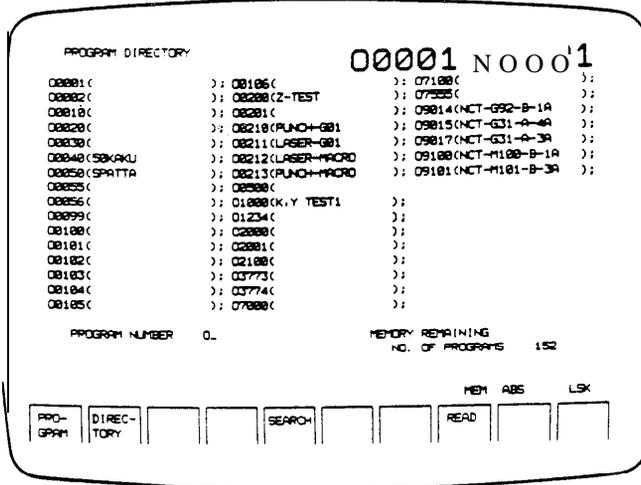
PROGRAM display in AUTO mode "tape" operation: Shows the current and next blocks instead of the contents of the program being executed in the automatic operation. The current machine axial positions and the laser output data are also shown.



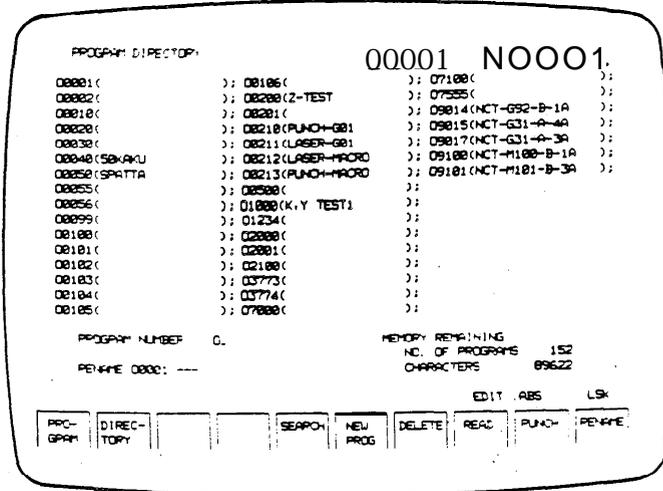
PROGRAM display in EDIT mode: Used to search for, edit, or delete a program, which is registered in the NC memory, output the program to a tape puncher, or write or read a new program.



PROGRAM DIRECTORY display in AUTO mode "memory" operation: Shows a list of the programs registered in the NC memory as well as the remaining memory size. The display is also used to search for a program or read a new program.



PROGRAM DIRECTORY display in EDIT mode: Shows a list of the programs registered in the NC memory and the remaining memory size. The display is also used to search for or delete a program, output a program to a tape puncher, or to write or read a new program.



The PROGRAM and PROGRAM DIRECTORY displays have one or more of the following soft keys:

PROGRAM	Shows a PROGRAM display.
DIRECTORY	Shows a PROGRAM DIRECTORY display.
SEARCH	Searches for a specified registered program.
NEW PROG	Enables to write a new program.
D E L E T E	Deletes a specified registered program.
READ	Reads a program from tape to register it in the NC memory.
PUNCH	Outputs a specified registered program to a tape puncher.
PROG TOP	Returns the cursor to the top of the displayed program.
RENAME	Changes the program number for a specified registered program.

### ALARM/MESSAGE, DIAGNOSIS (I/O) and PARAMETER displays

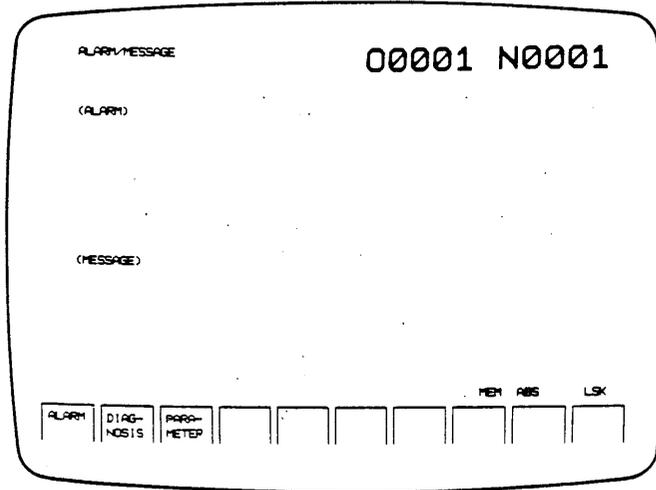
Press the ↓/ALARM key together with the SELECT key to show the ALARM/MESSAGE display, DIAGNOSIS (I/O) display, or PARAMETER display. Use the ALARM, DIAGNOSIS, and PARAMETER soft keys to change from one display to another.

The ALARM/MESSAGE display will be shown automatically when an alarm has been caused.

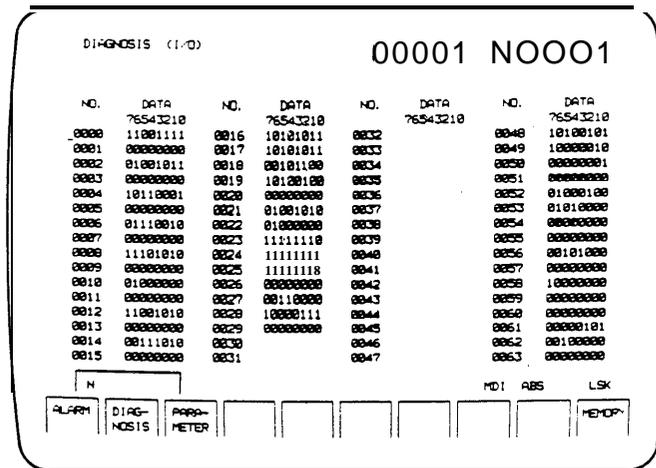
#### CAUTION

Do not change any settings on the DIAGNOSIS (I/O) display or the PARAMETER display. These displays are used by AMADA engineers only for specific purposes.

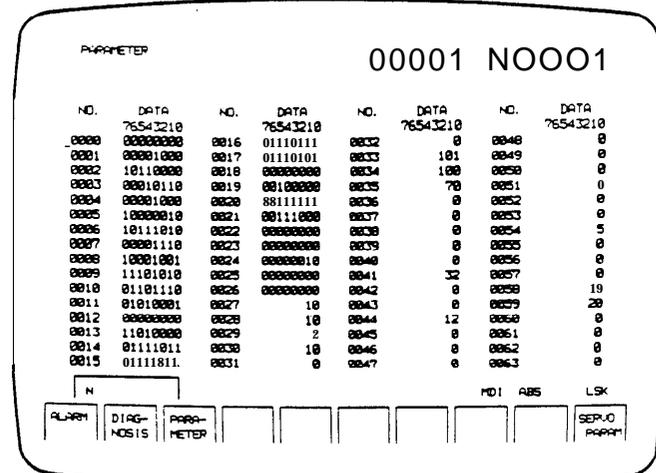
ALARM/MESSAGE display



DIAGNOSIS (I/O) display



PARAMETER display



### MDI displays

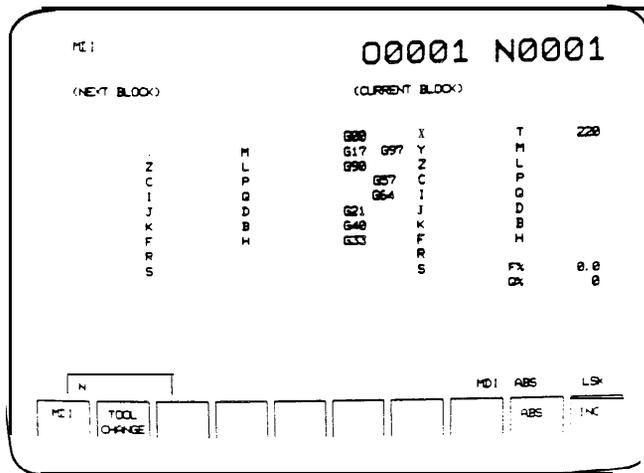
Press the ←/MDI key together with the SELECT key to show the MDI display or MDI (TOOL CHANGE) display. Use the MDI and TOOL CHANGE soft keys to change from one to the other display

The following two MDI displays have two additional soft keys, which are:

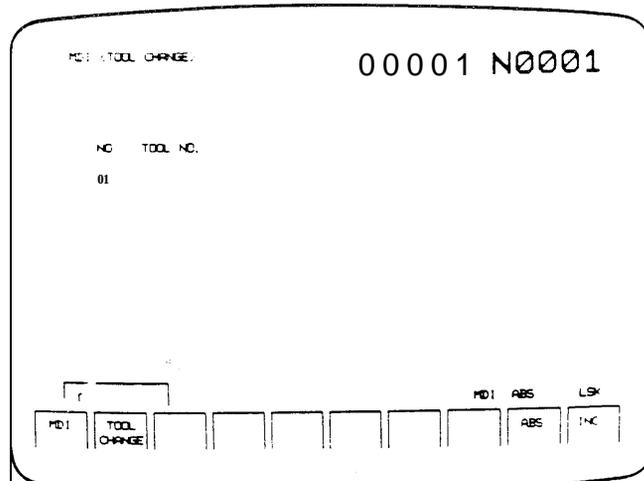
ABS: Enables the absolute coordinate system for data entry.

INC: Enables the relative coordinate system for data entry.

MDI display: Used to enter data block-by-block and execute them in an MDI mode operation.



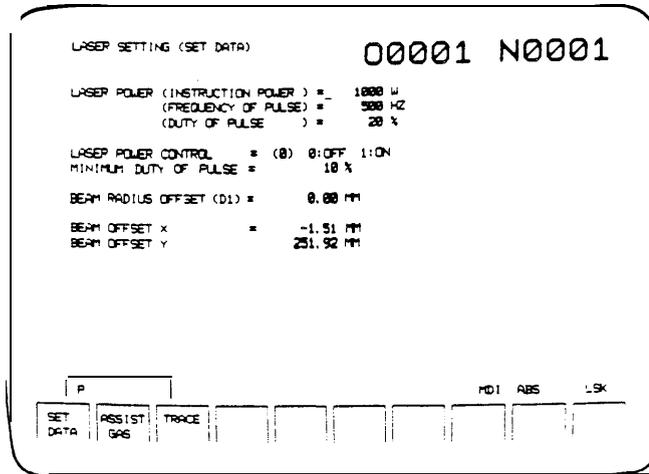
MDI (TOOL CHANGE) display: Used to specify a turret station to be moved to the tool change position in the MDI mode.



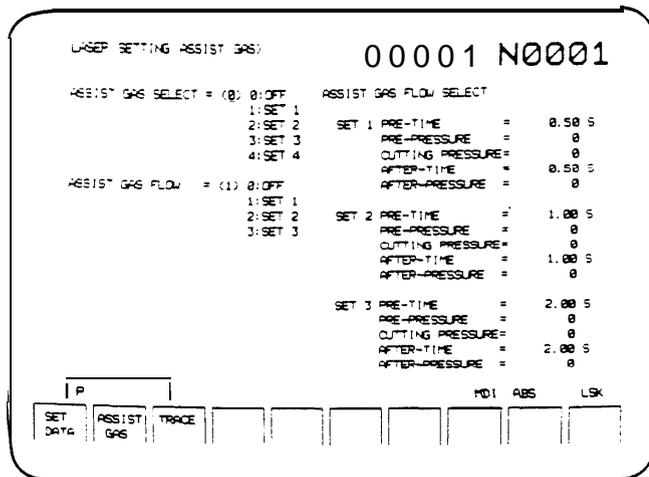
### LASER displays

Press the +/LASER key together with the SELECT key to show the LASER SETTING (SET DATA) display or LASER SETTING (ASSIST GAS) display. Use the SET DATA and ASSIST GAS soft keys to change from one to the other display. Another LASER display named LASER SETTING (TRACE) may be shown by using the TRACE soft key on these displays.

LASER SETTING (SET DATA) display: Used to set the required output conditions for CO<sub>2</sub> laser beam in the MDI mode when discharging the beam manually.



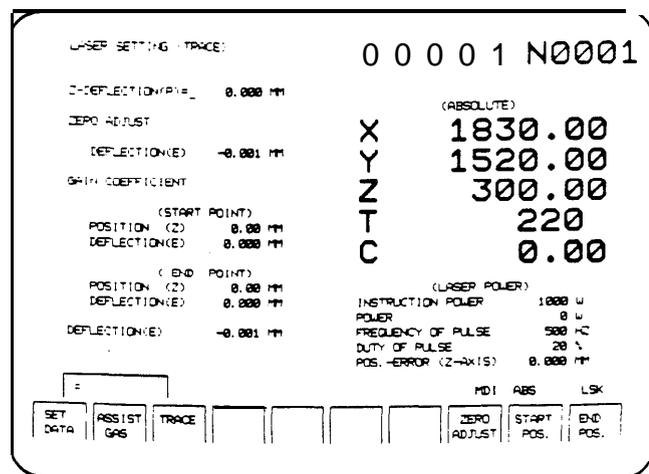
LASER SETTING (ASSIST GAS) display: Used to set the required assist gas application conditions in the MDI mode.



LASER SETTING (TRACE) display

**CAUTION**

Do not change any settings on the LASER SETTING (TRACE) display. This display is used by AMADA engineers only for specific purposes.



# III

## Operation

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- Checking a registered program 20
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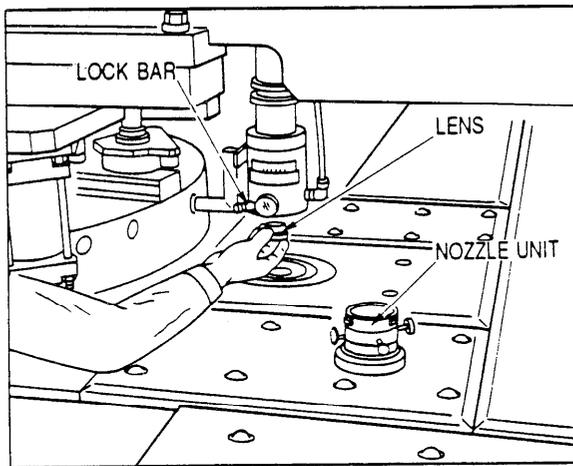


## PREPARATION PROCEDURE

The preparation procedure for a punching and laser cutting operation and that for a punching operation are described in this section.

Be sure to inspect the machine before starting the day's work (refer to Part V, Maintenance) and then prepare the machine for the operation.

### Punching & laser cutting operation



1 Mount the lens on the laser head as follows:

- (1) Open the right tool change door.
- (2) Pull out the nozzle unit lock bar on the laser head and detach the unit by turning it counterclockwise (viewed from the bottom).
- (3) Mount the lens by turning it clockwise.

---

**CAUTION**

---

Do not touch the lens surfaces when handling the lens.

(4) Replace the nozzle unit by turning it clockwise and then push in the lock bar.

(5) Close the tool change door.

- 2 Turn on the shop circuit breaker switch.
- 3 Turn on the machine circuit breaker switch on the electrical control cabinet.
- 4 Turn on the cooling unit (refer to the separate manual provided with the unit).
- 5 Turn on the laser oscillator circuit breaker switch.
- 6 Press the POWER ON (I) button.
- 7 Turn the SAFETY DEVICE switch to OPERATION, lighting the SAFETY DEVICE ON light.
- 8 Turn on the dust collector.
- 9 Confirm that the NC READY light and the TOP DEAD CENTER light are on.
- 10 Open the main and stop valves of the laser gas bomb. Confirm that the secondary pressure gauge for the bomb regulator indicates 1.5 kgf/cm<sup>2</sup> (21.4 psi) — adjust the pressure by using the regulator. if necessary.

- II Open the main valve of the assist gas bomb to be used.
- 12 Adjust the assist gas pressure according to the work material and thickness — refer to References “Laser cutting conditions.” (The pressure can be adjusted by using the regulator on the piping and checked on the regulator’s pressure gauge.)
- 13 Turn the LASER POWER switch to ON. The laser oscillator will then be turned on — the LASER READY light will blink and the HIGH VOLTAGE light will come on in 5 to 7 minutes
- 14 Confirm that the REF ZERO mode key’s light is on. If not, turn the MODE CHANGE switch to ON, press the REF ZERO mode key, and then return the MODE CHANGE switch to OFF.
- 15 Press and hold the AXES JOG ON button with the left hand and then within one second press the jog keys in the order of the +X, +Y, and TURRET with the right hand to zero-return all the machine axes (X, Y, Z, T, C).

**DANGER**

Be sure that the area around the machine is cleared of people and perform this step of operation alone.

Upon completion of the zero-return, the lights on the +X, +Y, and TURRET jog keys will be lighted and the AXES REFERENCE light will come on.

- 16 Set up the NC — see page III-4 for the procedure described under “Setting up the NC.”
- 17 Set the output conditions for the assist gas to be used — see page III-7 for the procedure described under “Assist gas output conditions.” (The procedure is not required normally.)
- 48 Center the nozzle unit — refer to Part V, Maintenance, for the procedure.
- 19 Adjust the position of the laser head — refer to Part V, Maintenance, for the procedure.

## Punching operation

- 1 Turn on the shop circuit breaker switch.
- 2 Turn on the machine circuit breaker switch on the electrical control cabinet.
- 3 Press the POWER ON (I) button.
- 4 Turn the SAFETY DEVICE switch to OPERATION, lighting the SAFETY DEVICE ON light.

*(Continued on next page.)*

- 5 Confirm that the NC READY light and the TOP DEAD CENTER light are on
- 6 Confirm that the REF ZERO mode key's light is on. If not, turn the MODE CHANGE switch to ON, press the REF ZERO mode key, and then return the MODE CHANGE switch to OFF.
- 7 Press and hold the AXES JOG ON button with the left hand and then within one second press the jog keys in the order of the +X, +Y, and TURRET with the right hand to zero-return all the machine axes (X, Y, Z, T, C).



**DANGER**

Be sure that the area around the machine is cleared of people and perform this step of operation alone.

Upon completion of the zero-return, the lights on the +X, +Y, and TURRET jog keys will be lighted and the AXES REFERENCE light will come on.

- 8 Set up the NC — see below for the procedure described under "Setting up the NC."

## Setting up the NC

The procedure for setting up the NC for a punching and laser cutting operation or a punching operation is as follows (enter data for the required items as described in this section):

- 1 Turn the MODE CHANGE switch to ON, press the MDI mode key, lighting its light, and then return the MODE CHANGE switch to OFF.
- 2 Turn the EDIT PROTECT switch to OFF.
- 3 Press the SELECT key and the ↓/SET key together, showing the SETTING (SET DATA) display on the CRT screen. (See below for the description of the items shown on the display.)
- 4 Shift the cursor to the item for which data must be entered or changed by using the CURSOR keys.
- 5 Enter data as required — key-in "P" and data and then press the INPUT key.

**NOTE**

An entry error can be erased by pressing the CAN key if the INPUT key has not yet been pressed. If the INPUT key has been pressed, overwrite the data by entering the correct data.

- 6 Repeat the procedure for every item that requires data or a change.
- 7 Return the EDIT PROTECT switch to ON.

The following items are shown on the SETTING (SET DATA) display — the display has two pages:

SETTING (SET DATA)		00001 N0001	
SHEET COUNT = ( 331 )	PROGRAM UNIT = (0) 0:MM 1:INCH		
POWER ON HRS = ( 73 )	PUNCH CODE = (0) 0:ISD 1:EIA		
MIN = (37)	PUNCH PRG NO. = (0) 0:YES 1:NO		
SEC = (00)			
LASER PUNCH HRS = ( 30 )	INPUT DEVICE = (0) 0:TAPE READER		
MIN = (07)	1:SIO 1		
SEC = (00)	2:SIO 2		
	3:SIO 3		
	4:REMOTE BUFFER		
CYCLE ON HRS = ( 5 )	OUTPUT DEVICE = (3) 0:FANUC APP		
MIN = (19)	1:SIO 1		
SEC = (00)	2:SIO 2		
	3:SIO 3		
TOTAL HITS = ( 2707 )			
MACRO DATA = (0) 0:ERASE 1:NOT			
AUTO MODE = (0) 0:MEMORY 1:TAPE			
<input type="checkbox"/> P		MDI	ABS LSK

An accumulated number of worksheets is shown, which have been processed in operations other than in the MDI mode or when the "MULTI-PART MODE" FIRST key is lighted. To reset the count, enter zero.

#### POWER ON HRS, MIN, SEC

An accumulated period of time is shown in hours, minutes, and seconds, in which the NC has been turned on. To reset the count, enter zero to each unit of time.

#### LASER PWON HRS, MIN, SEC

An accumulated period of time is shown in hours, minutes, and seconds, in which the laser oscillator has been turned on. To reset the count, enter zero to each unit of time.

#### CYCLE ON HRS, MIN, SEC

An accumulated period of time is shown in hours, minutes, and seconds, in which the machine has been operated. To reset the count, enter zero to each unit of time.

#### TOTAL HITS

An accumulated number of punching hits is shown, which have been made by all turret stations in AUTO mode operations. To reset the count, enter zero.

#### MACRO DATA

Enter "0" normally.

#### AUTO MODE

Enter "0" to perform AUTO mode memory operation or enter "1" to perform AUTO mode tape operation.

**PROGRAM UNIT**

Either "0 (millimeter)" or "1 (inch)" is the default setting and it cannot be changed.

**PUNCH CODE**

Enter "0" to use the ISO code or "1" to use the EIA code for the output of registered programs to the tape puncher.

**PUNCH PROG NO.**

Enter "0" to output the program number to the tape puncher or "1" to omit the number for the output of registered programs to the tape puncher.

**INPUT DEVICE**

Specify an input device (tape reader) used for the registration of programs in the NC memory.

- 0: Tape reader equipped on the machine.
- 1: External device with a baud rate of 1200.
- 2: External device with a baud rate of 2400.
- 3: External device with a baud rate of 4800.
- 4: Remote buffer.

**OUTPUT DEVICE**

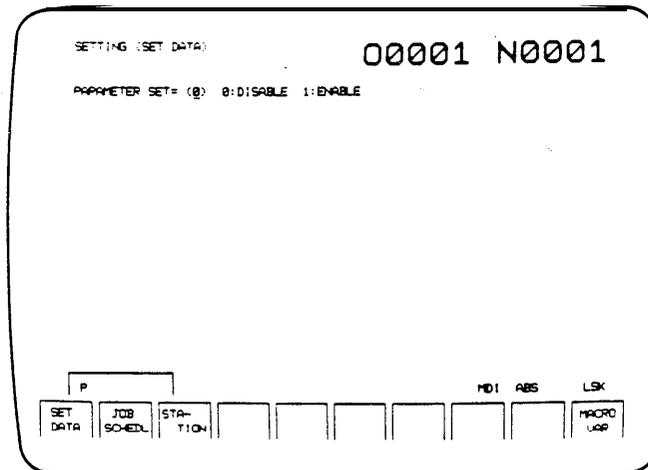
Specify an output device (tape puncher) used for the output of registered programs.

- 0: FANUC PPR tape puncher.
- 1: External device with a baud rate of 1200.
- 2: External device with a baud rate of 2400.
- 3: External device with a baud rate of 4800.

**PARAMETER SET** (this item is shown on the second page)

Keep the setting at "0".

NOTE An alarm will be caused if the setting is changed.



## Assist gas output conditions

The procedure for setting the output conditions for the assist gas to be used in the punching and laser cutting operation is as follows (enter data for the required items as described in this section):

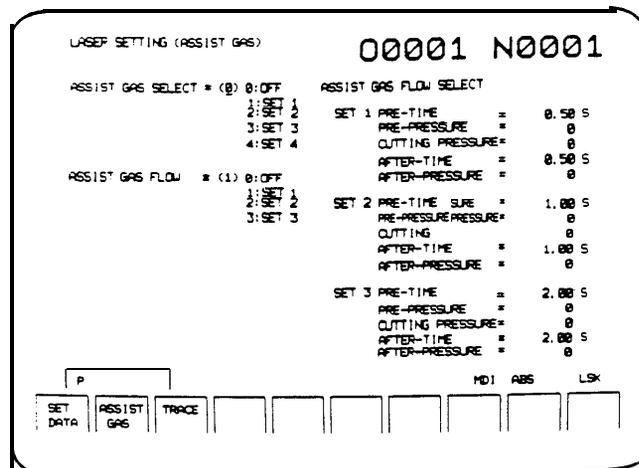
- 1 Turn the MODE CHANGE switch to ON, press the MDI mode key, lighting its light, and then return the MODE CHANGE switch to OFF.
- 2 Turn the EDIT PROTECT switch to OFF.
- 3 Press the SELECT key and the +/-LASER key together, showing the LASER SETTING (SET DATA) display on the CRT screen
- 4 Press the ASSIST GAS soft key, changing the display to the LASER SETTING (ASSIST GAS) display. (See below for the description of the items shown on the display.)
- 5 Shift the cursor to the item for which data must be entered or changed by using the CURSOR keys.
- 6 Enter data as required — key-in "P" and data and then press the INPUT key.

### NOTE

An entry error can be erased by pressing the CAN key if the INPUT key has not yet been pressed. If the INPUT key has been pressed, overwrite the data by entering the correct data.

- 7 Repeat the procedure for every item that requires data or a change.
- 8 Return the EDIT PROTECT switch to ON

An entry or change of data is required only for the items explained below, which are shown in the right column of the LASER SETTING (ASSIST GAS) display.



ASSIST GAS FLOW SELECT

SET 1: Used to set conditions when specifying "1" for ASSIST GAS FLOW in the left column or when assigning "1" to the "J" or "Q" data in the G31 command (assist gas selection) in the program.

PRE-TIME:

A lapse of time between the discharge of assist gas and the discharge of CO<sub>2</sub> laser beam within a range of 0.00 to 9.99 sec. The default setting is 0.50 sec.

AFTER-TIME:

A period of time in which assist gas is discharged after the stopping of CO<sub>2</sub> laser beam within a range of 0.00 to 9.99 sec. The default setting is 0.50 sec.

SET 2: Used to set conditions when specifying "2" for ASSIST GAS FLOW in the left column or when assigning "2" to the "J" or "Q" data in the G31 command (assist gas selection) in the program.

PRE-TIME:

A lapse of time between the discharge of assist gas and the discharge of CO<sub>2</sub> laser beam within a range of 0.00 to 9.99 sec. The default setting is 1 .00 sec.

AFTER-TIME:

A period of time in which assist gas is discharged after the stopping of CO<sub>2</sub> laser beam within a range of 0.00 to 9.99 sec. The default setting is 1.00 sec.

SET 3: Used to set conditions when specifying "3" for ASSIST GAS FLOW in the left column or when assigning "3" to the "J" or "Q" data in the G31 command (assist gas selection) in the program.

PRE-TIME:

A lapse of time between the discharge of assist gas and the discharge of CO<sub>2</sub> laser beam within a range of 0.00 to 9.99 sec. The default setting is 2.00 sec.

AFTER-TIME:

A period of time in which assist gas is discharged after the stopping of CO<sub>2</sub> laser beam within a range of 0.00 to 9.99 sec. The default setting is 2.00 sec.

## STARTING PROCEDURE

This section explains the procedure to start the machine after it has been prepared for an operation as described in the preceding section,

### AUTO mode "memory" operation

The procedure for starting an automatic operation which is controlled by a program registered in the NC memory is as follows:

REMINDER

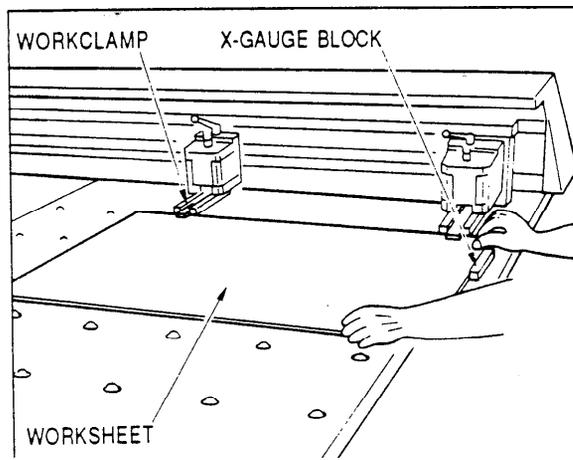
Mount tools in the turret as required before starting the procedure. (Refer to the supplementary section on tooling.)

- 1 Confirm that the AXES REFERENCE light and the SAFETY DEVICE ON light are on.
- 2 Turn the MODE CHANGE switch to ON, press the AUTO mode key, lighting its light, and then return the MODE CHANGE switch to OFF.
- 3 Confirm that the word "MEM" is shown in the lower right section of the CRT screen.
- 4 Press the SELECT key and the ↑/PRGRM key together, showing the PROGRAM display.
- 5 Show the program to be used on the display. (Refer to Part IV, Program Management, for the procedure.)
- 6 Move the cursor to the start of the displayed program under the address character "O" for the program number if it is not. The move may be achieved by pressing the PROG TOP soft key or the ↑/PRGRM key.

NOTE

If the cursor is not at the start of the program, the program will be executed from where the cursor is.

- 7 Set the worksheet on the machine table in the following manner:
  - (1) Adjust the positions of the workclamps according to the worksheet size. and the program.



- (2) Press the foot switch pedal to open the workclamps, lighting the WORK CLAMP light.
- (3) Place the worksheet on the machine table.
- (4) Raise the X-gauge block, lighting the X-GAUGE BLOCK light.
- (5) Position the worksheet accurately by pushing it against the workclamps and the X-gauge block.

*(Continued on next page.)*

- (6) Press the foot switch pedal to close the workclamps, clamping the worksheet and unlighting the WORK CLAMP light.
- (7) Lower the X-gauge block, unlighting the X-GAUGE BLOCK light.
- 8 Open the left tool change door and confirm the following on the turret control panel:
  - The STRIKER “CENTER” light is on.
  - The INDEX PIN “OUT” light is on.
  - The TOOL CHANGE ON light is out.Then close the door.
- 9 Confirm that the following red and amber lights on the NC control panel are not on:
  - OIL FILTER light
  - STOP SWITCH light
  - X-GAUGE BLOCK light
  - WORK CLAMP light
  - INTERLOCK light
- 70 Set the required conditions by using the following switches on the NC control panel:
  - OPT STOP key
  - BLOCK SKIP key
  - SINGLE key
  - FEEDRATE key
  - MULTI-PART MODE key
  - PRESS SELECTION switch
  - LASER SELECTION switch
  - FEEDRATE(%) switch (normally set at 100%)
  - DUTY (%) switch (normally set at 100%)
- 11 Flip the OVERRIDE switch to ON, or flip it to OFF if the program is ensured of not punching the workclamps.
  - |         |
|---------|
| CAUTION |
|---------|

 Flip the OVERRIDE switch to ON unless you are absolutely sure or if the program is new and has never been executed before,
- 72 Clear the area around the machine of people and obstacles.
- 73 If the optional safety mats or optical safety device is equipped, press the SAFETY DEVICE & AIR DOWN RESET button, lighting the SAFETY DEVICE ON light.
- 14 Press a START button to start the operation.



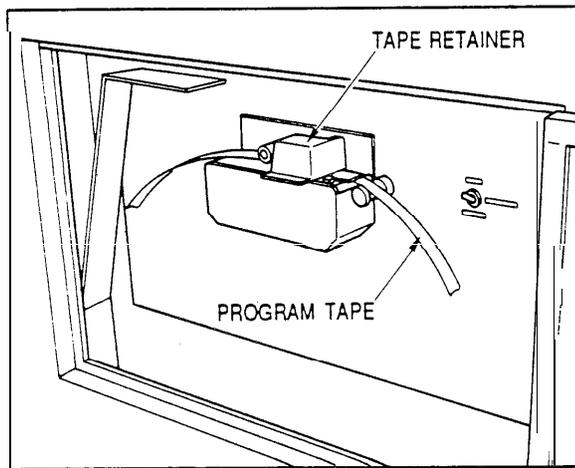
Do not press the START button until the area around the machine is completely cleared of people and obstacles.

## AUTO mode "tape" operation

Start an automatic operation which is controlled by a program in tape in the following procedure:

REMINDER Mount tools in the turret as required before starting the procedure. (Refer to the supplementary section on tooling.)

- 1 Confirm that the AXES REFERENCE light and the SAFETY DEVICE ON light are on.
- 2 Turn the MODE CHANGE switch to ON, press the AUTO mode key, lighting its light, and then return the MODE CHANGE switch to OFF.



- 3 Confirm that the word "TAPE" is shown in the lower right section of the CRT screen.
- 4 Turn the tape reader switch to RELEASE, set the program tape in the reader, and then turn the switch to AUTO.

- 5 Set the worksheet on the machine table in the following manner:
  - (1) Adjust the positions of the workclamps according to the worksheet size and the program.
  - (2) Press the foot switch pedal to open the workclamps, lighting the WORK CLAMP light.
  - (3) Place the worksheet on the machine table.
  - (4) Raise the X-gauge block, lighting the X-GAUGE BLOCK light.
  - (5) Position the worksheet accurately by pushing it against the workclamps and the X-gauge block.
  - (6) Press the foot switch pedal to close the workclamps, clamping the worksheet and unlighting the WORK CLAMP light.
  - (7) Lower the X-gauge block, unlighting the X-GAUGE BLOCK light.
- 6 Open the left tool change door and confirm the following on the turret control panel:
  - The STRIKER "CENTER" light is on.
  - The INDEX PIN "OUT" light is on.
  - The TOOL CHANGE ON light is out.
 Then close the door.

*(Continued on next page.)*

- 7 Confirm that the following red and amber lights on the NC control panel are not on:
  - OIL FILTER light
  - STOP SWITCH light
  - X-GAUGE BLOCK light
  - WORK CLAMP light
  - INTERLOCK light
- 8 Set the required conditions by using the following switches on the NC control panel:
  - OPT STOP key
  - BLOCK SKIP key
  - SINGLE key
  - FEEDRATE key
  - MULTI-PART MODE key
  - PRESS SELECTION switch
  - LASER SELECTION switch
  - FEEDRATE (%) switch (normally set at 100%)
  - DUTY (%) switch (normally set at 100%)
- 9 Clear the area around the machine of people and obstacles.
- 10 If the optional safety mats or optical safety device is equipped, press the SAFETY DEVICE & AIR DOWN RESET button, lighting the SAFEN DEVICE ON light.
- 11 Press a START button to start the operation.



Do not press the START button until the area around the machine is completely cleared of people and obstacles.

## MDI mode operation

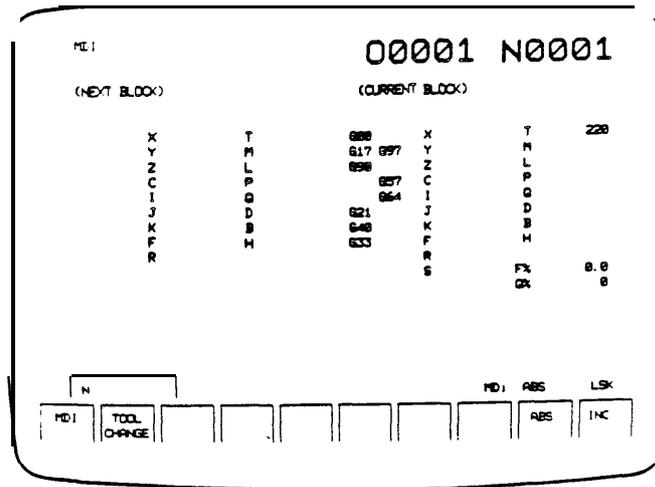
The procedure for starting an operation of block-by-block execution in the MDI mode is as follows (refer to the programming manual for the entirety of data):

- 1 Confirm that the SAFETY DEVICE ON light is on.
- 2 Turn the MODE CHANGE switch to ON, press the MDI mode key, lighting its light, and then return the MODE CHANGE switch to OFF.

**NOTE**

The AXES REFERENCE light does not have to be on when starting an operation in the MDI mode.

- 3 Press the SELECT key and the ←/MDI key together, showing the MDI display on the CRT screen.



- 4 Press the ABS soft key to select the absolute coordinate system, showing the word "ABS" in the lower right section of the display.
- 5 Key-in data for one block by using address and numeric keys and then press the INPUT key.

NOTE

An entry error can be erased by pressing the CAN key if the INPUT key has not yet been pressed. If the INPUT key has been pressed, overwrite the data by entering the correct data.

Key-in the remaining data for the same block, if any, in the same manner.

NOTE

To erase all the data entered in one block, press the RESET key. To erase one of the data, key-in the address character of that data, press the CAN key, and then press the INPUT key.

- 6 Open the left tool change door and confirm the following on the turret control panel:
  - The STRIKER "CENTER" light is on.
  - The INDEX PIN "OUT" light is on.
  - The TOOL CHANGE ON light is out.
 Then close the door.
- 7 Confirm that the following red and amber lights on the NC control panel are not on:
  - OIL FILTER light
  - STOP SWITCH light
  - X-GAUGE BLOCK light
  - WORK CLAMP light
  - INTERLOCK light
- 8 Set the required conditions by using the following switches on the NC control panel.
  - FEEDRATE key
  - PRESS SELECTION switch

*(Continued on next page.)*

- 9 Clear the area around the machine of people and obstacles.
- 10 If the optional safety mats or optical safety device is equipped, press the SAFETY DEVICE & AIR DOWN RESET button, lighting the SAFETY DEVICE ON light.
- 11 Press a START button to start the operation.



**DANGER**

Do not press the START button until the area around the machine is completely cleared of people and obstacles.

To perform punching, press the PUNCHING button when positioning is completed.

In the MDI mode operation, only positioning will be made after the START button is pressed even when the PRESS SELECTION switch is set at INCHING or CYCLE.

To execute a pattern punching command other than G68 and G69 nibbling commands, select the single-block function (press the SINGLE key to light its key), then repeat the steps of pressing the START button and the PUNCHING button for every hole in the pattern to complete it. Otherwise only a series of positioning will be performed without punching.

## STOPPING PROCEDURE

The procedures for stopping the punching and laser cutting operation and the punching operation are as follows:

### Punching and laser cutting operation

- 1 Turn the LASER POWER switch to OFF, unlighting the HIGH VOLTAGE light and the LASER READY light.
- 2 Shut off the main and stop valves of the laser gas bomb.
- 3 Shut off the main valve of the assist gas bomb used.
- 4 Confirm that the AXES REFERENCE light is on. If not, turn all the machine axes to their origins (see page III-22, "Zero-return" for the procedure).
- 5 Turn off the dust collector.
- 6 Press the POWER OFF (0) button.
- 7 Turn off the laser oscillator circuit breaker switch.
- 8 Turn off the cooling unit.
 

<b>CAUTION</b>	if the cooling unit is installed in a location where the temperature is below 0°C(32°F), keep the power on to prevent the cooling water from freezing.
----------------	--
- 9 Turn off the machine circuit breaker switch.
- 10 Turn off the shop circuit breaker switch.
- 11 Dismount the lens from the laser head in the following manner:
  - (1) Open the right tool change door.
  - (2) Pull out the nozzle unit lock bar on the laser head and detach the unit by turning it counterclockwise (viewed from the bottom).
  - (3) Remove the lens by turning it counterclockwise.
 

<b>CAUTION</b>	Do not touch the lens surfaces when handling the lens.
----------------	--
  - (4) Replace the nozzle unit by turning it clockwise and then push in the lock bar.
  - (5) Close the tool change door.

### Punching operation

- 1 Confirm that the AXES REFERENCE light is on. If not, return all the machine axes to their origins (see page III-22, "Zero-return" for the procedure).
- 2 Press the POWER OFF (0) button.
- 3 Turn off the machine circuit breaker switch.
- 4 Turn off the shop circuit breaker switch.

## INTERRUPTION & RESTARTING

The machine operation will be stopped due to one of the actions or causes listed below. The stopped operation may be resumed from where it was interrupted or must be restarted from the beginning depending on the action taken or the cause of the stop. (See page 111-22, "Zero-return," for the procedure to zero-return all the machine axes.)

- A STOP button has been pressed.
 

STOP button on the carriage control or auxiliary control panel: The operation is stopped temporarily, lighting the STOP SWITCH light. It may be resumed by unlocking the pressed STOP button and then pressing a START button.

STOP button on the NC control panel: The operation is stopped temporarily. It may be resumed by pressing a START button.

  - ✱ If the operation was stopped during the laser cutting process, however, it cannot be resumed unless the workchute trapdoor was being opened or closed or the laser head was being raised at the time. The operation must be restarted again from the beginning after resetting the NC and returning all the machine axes.
  
- The X-gauge block has been raised.
 

The operation is stopped temporarily, lighting the X-GAUGE BLOCK light. It may be resumed by lowering the X-gauge block and then pressing a START button.

  - ✱ If the operation was stopped during the laser cutting process, however, it cannot be resumed unless the workchute trapdoor was being opened or closed or the laser head was being raised at the time. The operation must be restarted again from the beginning after resetting the NC and returning all the machine axes.
  
- A program stop (MOO) has been commanded.
 

The operation is stopped temporarily, lighting the PROGRAM STOP light. It may be resumed by pressing a START button.
  
- An optional stop (M01) has been commanded -when the "optional stop" function is effective with the OPT STOP key's light on.
 

The operation is stopped temporarily, lighting the PROGRAM STOP light. It may be resumed by pressing a START button.
  
- The execution of one program block has been completed -when the "single block" function is effective with the SINGLE key's light on.
 

The operation is stopped temporarily. It may be resumed by pressing a START button.
  
- Irregularity has been caused in the automatic lubrication system.
 

The operation is stopped temporarily, showing machine status indication No. 2029 on the CRT screen. Press the LUBRICATION button and confirm that the number has been cleared. The operation may be resumed by pressing a START button.

- A tool change door, a turret door, or the scrap bin door has been opened.  
The operation is stopped temporarily, showing machine status indication No. 2032 on the CRT screen. Close the door and confirm that the number has been cleared. The operation may be resumed by pressing a START button.

- **\*** If the operation was stopped during the laser cutting process, however, it cannot be resumed unless the workchute trapdoor was being opened or closed or the laser head was being raised at the time. The operation must be restarted again from the beginning after resetting the NC and returning all the machine axes.

- The “workchute failure” detection function has been activated.  
The operation is stopped temporarily, showing machine status indication No. 2055 on the CRT screen. Remove the workpiece or scrap which is caught by the workchute trapdoor. The operation may be resumed by pressing a START button.

**DANGER**

Never let anybody touch a START button while correcting the condition.

- One of the workclamps has entered the override zone.  
The operation is stopped temporarily, lighting the OVERRIDE light. If it is confirmed that the workclamp will not be punched, press an OVERRIDE CONFIRMATION button or the CONFIRMATION button to resume the operation.  
If it is likely that the workclamp will be punched, reset the  return all the machine axes to their origins, change the workclamp positions or modify the program, and restart the operation again from the beginning.
- The “stripping failure” detection function has been activated.  
The operation is stopped temporarily, showing machine status indication No. 2030 on the CRT screen. Check to see if a stripping failure has actually been caused or it has been self-amended, the worksheet is firmly clamped, and the punch is fully raised. If none of these poses a problem to restart the operation, it may be resumed by pressing a START button. If any of them poses a problem, however, reset the NC and restart the operation again from the beginning.

**WARNING**

Inspect the conditions of the turret, punches and dies, as well as the quality of the work material, to prevent stripping failures.

- The “repositioning confirmation” function has been activated.  
The operation is stopped temporarily, showing machine status indication No. 2033 on the CRT screen. Check to see if the workclamps will not interfere with a workholder when they reclamp the worksheet. If no interference is confirmed, the operation may be resumed by pressing a START button. If interference is likely to be caused, reset the NC, return all the machine axes to their origins, modify the program, and restart the operation again from the beginning.

- The crankshaft is not stopped at the top dead center in the AUTO mode operation.

The operation is stopped in the emergency stop condition, with the TOP DEAD CENTER light out and showing machine status indication No. 2016 on the CRT screen. Take the following steps when this condition has been caused:

- (1) Press the POWER OFF (●) button and then the POWER ON (I) button.
- (2) Turn the MODE CHANGE switch to ON, change to the MANUAL mode, and then return the switch to OFF.
- (3) Open the left tool change door, turn the INDEX PIN switch to the right, lighting the INDEX PIN IN light, and then close the door.
- (4) Turn the PRESS SELECTION switch to INCHING.
- (5) Press the PUNCHING button intermittently until the TOP DEAD CENTER light comes on.
- (6) Return all the machine axes to their origins, and restart the operation again from the beginning.

- The EMERGENCY STOP button has been pressed.

The operation is stopped in the emergency stop condition. Remove the cause of the stop, unlock the button, reset the NC, return all the machine axes to their origins, and restart the operation again from the beginning.

- An alarm has been caused.

The operation is stopped, showing the word "ALM" blinking in the lower right section of the CRT screen, with the NC READY light out or on.

- (A) If the NC READY light is out and the cause of the alarm is an overtravel of the carriage or table, take the following steps:



**DANGER**

Clear the area around the machine of people and carry out the following steps without other's assistance.

- (1) Turn the MODE CHANGE switch to ON, change to the MANUAL mode, and then return the switch to OFF.
- (2) Press and hold the OT RELEASE button with the right hand (you will have to use the same hand to press a jog key located above the button while holding it pressed), lighting the NC READY light. Then with the left hand press and hold the AXES JOG ON button. And within one second press the required jog key with the right hand (still holding the OT RELEASE button) to retract the overtraveled axis while still holding the AXES JOG ON button with the left hand.
- (3) Release the key and the buttons. (The NC READY light should remain lighted at this time.)
- (4) Press the RESET key, clearing the "ALM" display.
- (5) Return all the machine axes to their origins, modify the program, and restart the operation again from the beginning.

- (B) If the NC READY light is out and the cause of the alarm is an overtravel of the laser head, take the following steps



Clear the area around the machine of people and carry out the following steps without other's assistance.

- (1) Turn the MODE CHANGE switch to ON, change to the MANUAL mode, and then return the switch to OFF.
  - (2) Open the left tool change door.
  - (3) Press and hold the TURRET JOG ON/Z AXIS O.T. RELEASE button, lighting the NC READY light. Then press the Z AXIS button to retract the laser head while still holding the above button.
  - (4) Release the buttons. (The NC READY light should remain lighted at this time.)
  - (5) Close the tool change door.
  - (6) Press the RESET key, clearing the "ALM" display.
  - (7) Return all the machine axes to their origins, modify the program, and restart the operation again from the beginning,
- (C) If the NC READY light is out and the cause of the alarm is other than an overtravel of the carriage, table, or laser head, contact AMADA.
- (D) If the NC READY light is on, remove the cause of the alarm, reset the NC, return all the machine axes to their origins, and restart the operation again from the beginning.

- The operating air pressure has been reduced, an optional safety mat has been stepped on, or the optional optical safety device has been activated.

The operation is stopped, unlighting the SAFETY DEVICE ON light. (The operating air pressure reduction will be identified by machine status indication No. 2026 shown on the CRT screen.)

If the cause is the reduced air pressure, correct the cause, press the SAFETY DEVICE & AIR DOWN RESET button, lighting the SAFETY DEVICE ON light, reset the NC, return all the machine axes to their origins, and restart the operation again from the beginning.

If the cause is the safety mat or the optical safety device, remove the cause, press the SAFETY DEVICE & AIR DOWN RESET button, lighting the SAFETY DEVICE ON light, and then press a START button to resume the operation.

- If the operation was stopped during the laser cutting process, however, it cannot be resumed unless the workchute trapdoor was being opened or closed or the laser head was being raised at the time. The operation must be restarted again from the beginning after resetting the NC and returning all the machine axes.

## PROGRAM CHECKING

The contents of a program, which is either registered in the NC memory or in tape, can be checked for syntax errors or data which will cause an overtravel when the program is executed. The check is performed without actually operating the machine and will be interrupted if an error is found, identifying the error by an alarm number on the CRT screen.

### Checking a registered program

The procedure for checking the program registered in the NC memory is as follows:

Confirm that the AXES REFERENCE light and the SAFETY DEVICE ON light are on.

- 2 Turn the MODE CHANGE switch to ON, press the AUTO mode key, lighting its light, and then return the MODE CHANGE switch to OFF.
- 3 Confirm that the word "MEM" is shown in the lower right section of the CRT screen.
- 4 Press the SELECT key and the ↑/PRGRM key together, showing the PROGRAM display.
- 5 Show the program to be checked on the display — refer to Part IV, Program Management, for the procedure.
- 6 Move the cursor to the start of the displayed program under the address character "O" for the program number if it is not. The move may be achieved by pressing the PROG TOP soft key or the ↑/PRGRM key.
- 7 Press the TEST key, lighting its light.
- 8 Press the SINGLE key, lighting its light, if necessary.
- 9 Press a START button to start checking.
- 10 If an error has been found and the check is interrupted, press the RESET key and correct the error — refer to Part IV, Program Management, for the procedure.  
(If no errors are found, the check will be made to the end of the program.)  
To check the remaining part of the program, the check must be ended after the error has been corrected and the program must be run again for another check from the beginning.
- 11 Press the TEST key, unlighting its light, upon completion of the check or after correcting the error.
- 72 Return all the machine axes to their origins — see page 111-22, "Zero-return." Then end the session or take necessary steps to run another check.

## Checking a program in tape

The procedure for checking the program in tape is as follows:

- 1 Confirm that the AXES REFERENCE light and the SAFETY DEVICE ON light are on.
- 2 Turn the MODE CHANGE switch to ON, press the AUTO mode key, lighting its light, and then return the MODE CHANGE switch to OFF.
- 3 Confirm that the word "TAPE" is shown in the lower right section of the CRT screen.
- 4 Press the SELECT key and the ↑/PRGRM key together, showing the PROGRAM display.
- 5 Turn the tape reader switch to RELEASE, set the tape in the tape reader, and then turn the switch to AUTO.
- 6 Press the TEST key, lighting its light.
- 7 Press the SINGLE key, lighting its light, if necessary.
- 8 Press a START button to start checking.
- 9 If an error has been found and the check is interrupted, press the RESET key and remake the tape. (If no errors are found, the check will be made to the end of the program.)
- 10 Press the TEST key, unlighting its light, upon completion of the check or after pressing the RESET key.
- 11 Return all the machine axes to their origins — see page III-22, "Zero-return." Then end the session or take necessary steps to run another check.

## MANUAL OPERATIONS

The procedures for returning all the machine axes to their origins and for using CO<sub>2</sub> laser beam manually are described in this section.

### Zero-return



**DANGER**

Clear the area around the machine of people and carry out the following steps all by yourself.

Return all the machine axes to their origins in the manner described below — before starting an operation after a program check, or restarting it from the beginning after an alarm.

- 1 Confirm that the SAFETY DEVICE ON light is on.
- 2 Turn the MODE CHANGE switch to ON and press the MANUAL mode key, lighting its light.
- 3 Press and hold the AXES JOG ON button with the left hand. Then within one second press the -X jog key with the right hand to shift the carriage about 200 mm (8") away from its origin — while holding the above button.
- 4 Press and hold the AXES JOG ON button with the left hand. Then within one second press the -Y jog key with the right hand to shift the table about 200 mm (8") away from its origin — while holding the above button.
- 5 Press the REF ZERO mode key, lighting its light, and then return the MODE CHANGE switch to OFF.
- 6 Press and hold the AXES JOG ON button with the left hand. Then within one second press the +X, +Y, and TURRET jog keys successively with the right hand while holding the above button — this will start zero-returning.

**NOTE**

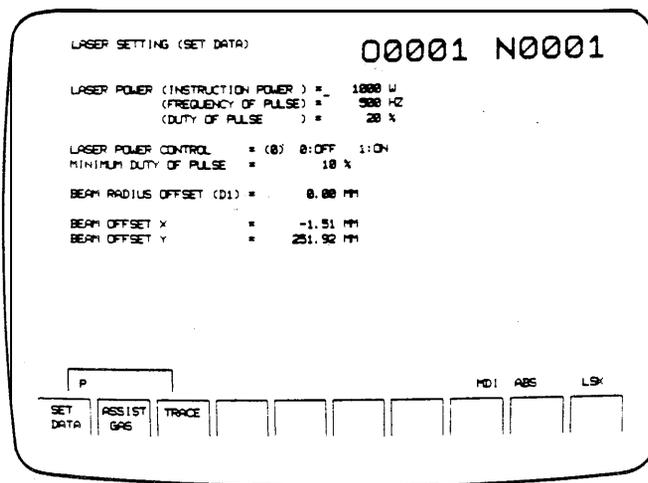
It is not necessary to press the TURRET jog key if these steps are being taken after a program check.

When the axes have been returned to their origins, the lights on the +X, +Y, and TURRET jog keys will be lighted and the AXES REFERENCE light will come on.

## Laser beam application

Discharge CO<sub>2</sub> laser beam from the laser head manually in the following manner:

- 1 Turn the SAFETY DEVICE switch to MAINTENANCE, unlighting the SAFETY DEVICE ON light.
- 2 Turn the MODE CHANGE switch to ON and press the MDI mode key, lighting its light.
- 3 Turn the EDIT PROTECT switch to OFF.
- 4 Press the SELECT key and the +/LASER key together, showing the LASER SETTING (SET DATA) display on the CRT screen.



- 5 Shift the cursor and enter data to the three items described below. Key-in "P" and data and then press the INPUT key for each item.

### NOTE

An entry error can be erased by pressing the CAN key if the INPUT key has not yet been pressed. If the INPUT key has been pressed, overwrite the data by entering the correct data.

#### INSTRUCTION POWER

Specify an output power for the beam within a range of zero to 1000 W.

#### FREQUENCY OF PULSE

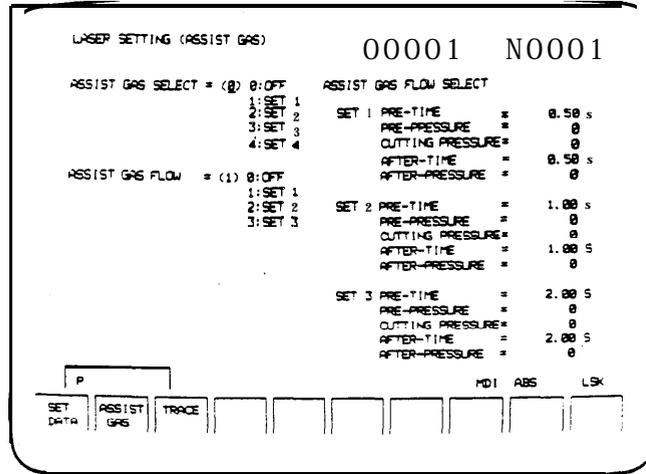
Specify a pulse frequency for the beam within a range of 5 to 2000 Hz.

#### DUTY OF PULSE

Specify a pulse duty for the beam within a range of zero to 100%.

*(Continued on next page.)*

- 6 Press the ASSIST GAS soft key, changing the display to the LASER SETTING (ASSIST GAS) display.



- 7 Shift the cursor and enter data to the two items described below. Key-in "P" and data and then press the INPUT key for each item.

**NOTE** An entry error can be erased by pressing the CAN key if the INPUT key has not yet been pressed. If the INPUT key has been pressed, overwrite the data by entering the correct data.

**ASSIST GAS SELECT**

Specify the assist gas to be used (1: Low pressure oxygen, 2: High pressure oxygen, 3: Air, 4: Gas supplied through "SPARE" intake).

**ASSIST GAS FLOW**

Specify the condition set in the right column (1, 2, or 3).

- 8 Return the EDIT PROTECT switch to ON.
- 9 Turn the LASER POWER switch to ON, blinking the LASER READY light and lighting the HIGH VOLTAGE light.
- 10 Press the MANUAL mode key, lighting its light, and then return the MODE CHANGE switch to OFF.
- 11 Open the left tool change door.
- 12 Press the TURRET JOG ON/Z AXIS O.T. RELEASE button and the lower Z AXIS button together to lower the laser head away from its origin, lighting the LASER READY light.
- 13 Turn the LASER SELECTION switch to CO<sub>2</sub>.
- 14 Press the TURRET JOG ON/Z AXIS O.T. RELEASE button and the LASER OUT button together to discharge the beam from the laser head.



**DANGER**

Clear the area around the machine of people and carry out this step without anyone's assistance.

# IV

## Program Management

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## PROGRAM REGISTRATION

Programs can be registered in the NC memory in the following procedures:

### Registering a program from tape

A program can be read from tape and registered in the NC memory by using the PROGRAM or PROGRAM DIRECTORY display.

On PROGRAM display

- 1 Turn the MODE CHANGE switch to ON, change to the EDIT mode or the AUTO (memory) mode, and then return the MODE CHANGE switch to OFF. (The AUTO mode will be identified by the word "MEM" on the screen.)
- 2 Turn the EDIT PROTECT switch to OFF.
- 3 Press the SELECT key and the ↑/PRGRM key together, showing the PROGRAM display.
- 4 Key-in address "O" and a 4-digit number (0001 to 7999) for the program to be registered if it has no program number or the number must be changed.
- 5 Turn the tape reader switch to RELEASE, set the program tape in the reader, and then turn the switch to AUTO.
- 6 Press the READ soft key to start reading the tape. The number for the registered program as well as the first page of the program will be shown on the display when the program has been read and registered in the memory.

NOTE	Tape reading may be stopped by pressing a STOP button — its contents which have been read before stopping will be registered in the memory.
------	---

- 7 Return the EDIT PROTECT switch to ON.

On PROGRAM DIRECTORY display

- 1 Turn the MODE CHANGE switch to ON, change to the EDIT mode or the AUTO (memory) mode, and then return the MODE CHANGE switch to OFF. (The AUTO mode will be identified by the word "MEM" on the screen.)
- 2 Turn the EDIT PROTECT switch to OFF.
- 3 Press the SELECT key and the ↑/PRGRM key together, showing the PROGRAM display. Then press the DIRECTORY soft key to change to the PROGRAM DIRECTORY display.
- 4 Key-in a 4-digit number (0001 to 7999) for the program to be registered if it has no program number or the number must be changed.

- 5 Turn the tape reader switch to RELEASE, set the program tape in the reader, and then turn the switch to AUTO.
- 6 Press the READ soft key to start reading the tape. The number for the registered program will be shown in the upper right section of the display when the program has been read and registered in the memory.

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**NOTE**

Tape reading may be stopped by pressing a STOP button — its contents which have been read before stopping will be registered in the memory.

- 7 Press the PROGRAM soft key to show the first page of the registered program on the PROGRAM display, if necessary.
- 8 Return the EDIT PROTECT switch to ON.

### **Registering programs from single tape**

A number of programs contained in single tape may be read and registered in the NC memory in one operation. The procedure is basically the same as that for registering one program except the step described below. However, the tape must have a G50 command at the end of each program in it and an end-of-record code — "ER" (EIA code) or "%" (ISO code) — at the end of the tape.

#### WHEN PROGRAM-NUMBERING IS REQUIRED

Key-in address "O" and a program number (or just a program number if on the PROGRAM DIRECTORY display) for the first program and then press the READ soft key. The tape will stop when the G50 command is read, permitting to do the same for the next program.

#### WHEN PROGRAM-NUMBERING IS NOT REQUIRED

If all the programs are numbered and can be registered as they are, key-in address "O" and "-9999" (or just "-9999" if on the PROGRAM DIRECTORY display) and then press the READ soft key.

### **Adding a program from tape to a registered program**

A program in tape can be added to a program which is already registered in the memory.

- 1 Turn the MODE CHANGE switch to ON, change to the EDIT mode or the AUTO (memory) mode, and then return the MODE CHANGE switch to OFF. (The AUTO mode will be identified by the word 'MEM' on the screen.)
- 2 Turn the EDIT PROTECT switch to OFF.
- 3 Show the registered program, to which the program in tape must be attached, on the PROGRAM display. (To search for it, see page IV-5, "Search.")

*(Continued on next page.)*

- 4 Turn the tape reader switch to RELEASE, set the program tape in the reader, and then turn the switch to AUTO.
- 5 Press the CAN key and then the READ soft key to start reading the tape.

NOTE	Tape reading may be stopped by pressing a STOP button — its contents which have been read before stopping will be registered in the memory.
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- 6 Return the EDIT PROTECT switch to ON.

### Creating and registering a program

A new program can be created on the screen and registered in the memory.

- 1 Turn the MODE CHANGE switch to ON, change to the EDIT mode, and then return the switch to OFF.
- 2 Turn the EDIT PROTECT switch to OFF.
- 3 Press the SELECT key and the ↑/PRGRM key together, showing the PROGRAM display. Then press the DIRECTORY soft key to change to the PROGRAM DIRECTORY display, if necessary.
- 4 If on the PROGRAM display, key-in address "O" and a 4-digit program number (0001 to 7999) and then press the INS/CTRL key, renewing the display.  
If on the PROGRAM DIRECTORY display, key-in a 4-digit program number (0001 to 7999) and then press the NEW PROG soft key, renewing the display.

- 5 Create the new program starting with the entry of the first block.

IMPORTANT	No more than 40 characters can be entered in one line. Do not break a word when the line must be changed.
-----------	---

NOTE	Use the CAN key to erase a keyed-in character or characters from the last entered one.
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Press the EOB key and then the INS/CTRL key to mark the end of each block.

NOTE	After the end-of-block code (;) has been entered, any corrections must be made in an editing session — see page IV-8, "Editing". To resume data entry after such session, place the cursor under the address of the last entered word.
------	--

- 6 Return the EDIT PROTECT switch to ON.

## SEARCH

A search for a program, sequence number, or word can be made in the following procedures:

### Searching for a registered program

A registered program can be searched for in the NC memory by using the PROGRAM or PROGRAM DIRECTORY display.

On PROGRAM display **(A)**

- 1 Turn the MODE CHANGE switch to ON, change to the EDIT mode or the AUTO (memory) mode, and then return the MODE CHANGE switch to OFF. (The AUTO mode will be identified by the word "MEM" on the screen.)
- 2 Press the SELECT key and the ↑/PRGRM key together, showing the PROGRAM display.
- 3 Key-in address "O" and the 4-digit number (0001 to 7999) for the program to be searched for.
- 4 Press the L/ALARM key to start the search. The first page of the program, which is identified by its number shown on the screen, will appear on the display when the program has been found.

On PROGRAM display **(B)**

- 1 Turn the MODE CHANGE switch to ON, change to the EDIT mode, and then return the switch to OFF.
- 2 Press the SELECT key and the ↑/PRGRM key together, showing the PROGRAM display.
- 3 Key-in address "O" and then press the ↓/ALARM key to show the program which is registered following the currently displayed program. (The program will be identified by its number shown on the screen.)

       **N O T E** Registered programs will be shown in the order of their registered numbers if the I/ALARM key is kept pressed, returning to the first program after the last one.

On PROGRAM DIRECTORY display

- 1 Turn the MODE CHANGE switch to ON, change to the EDIT mode or the AUTO (memory) mode, and then return the MODE CHANGE switch to OFF. (The AUTO mode will be identified by the word "MEM" on the screen.)
- 2 Press the SELECT key and the ↑/PRGRM key together, showing the PROGRAM display. Then press the DIRECTORY soft key to change to the PROGRAM DIRECTORY display.

*(Continued on next page.)*

- 3 Key-in the 4-digit number (0001 to 7999) for the program to be searched for.
- 4 Press the SEARCH soft key to start the search. The program number, which has been specified for the search, will appear on the screen when the program has been found.
- 5 Press the PROGRAM soft key to show the first page of the program on the PROGRAM display.

### **Searching for a sequence number in a registered program**

A sequence number can be searched for in a registered program.

- 1 Turn the MODE CHANGE switch to ON, change to the AUTO (memory) mode, and then return the switch to OFF. (The mode will be identified by the word "MEM" on the screen.)
- 2 Show the required program on the PROGRAM display.
- 3 Key-in address "N" and the 4-digit sequence number (0000 to 9999) to be searched for.
- 4 Press the L/ALARM key to start the search. The cursor will be placed under the address "N" of the block which has the specified sequence number, which will be shown on the screen when the number has been found.

NOTE

The block which has the specified sequence number must contain M-, T- and G-code commands and the required coordinate data if the program must be executed from that block.

### **Searching for a sequence number in a program in tape**

A sequence number can be searched for in a program in tape.

- 1 Turn the MODE CHANGE switch to ON, change to the AUTO (tape) mode, and then return the switch to OFF. (The mode will be identified by the word "TAPE" on the screen.)
- 2 Press the SELECT key and the ↑/PRGRM key together, showing the PROGRAM display.
- 3 Turn the tape reader switch to RELEASE, set the program tape in the reader, and then turn the switch to AUTO.
- 4 Key-in address "N" and the 4-digit sequence number (0000 to 9999) to be searched for.
- 5 Press the S-/ALARM key to start the search. The tape will stop when the specified sequence number is found, showing the number on the screen.

NOTE

The block which has the specified sequence number must contain M-, T- and G-code commands and the required coordinate data if the program must be executed from that block.

**Searching for a word in a registered program**

A word can be searched for in a registered program.

- 1 Turn the MODE CHANGE switch to ON, change to the EDIT mode, and then return the switch to OFF.
- 2 Show the required program on the PROGRAM display.
- 3 To search for the word:
  - (a) Key-in the entire word (address and data) and then press the J/ALARM key. When the word has been found, the cursor will be placed under the word's address.
  - (b) Key-in only the address of the word and then press the J/ALARM key. When the word has been found, the cursor will be placed under the words address.
  - (c) Scan the displayed program by using the CURSOR and PAGE keys. To return the cursor to the top of the program, press the PROG TOP soft key or the RESET key.

## EDITING

A registered program can be edited for alteration, deletion, or addition in the following procedures:

To edit a registered program, the following basic steps must be taken:

Show the required program on the PROGRAM display, and locate the point of editing in the program. (See page IV-5, 'Search.')

- 2 Turn the MODE CHANGE switch to ON, change to the EDIT mode, and then return the switch to OFF.
- 3 Turn the EDIT PROTECT switch to OFF.
- 4 Make alteration, deletion, or insertion as described below.
- 5 Return the EDIT PROTECT switch to ON.

### Alteration of a word

Example:       Change T215 to T303.  
                  G28 I20. 9180. K10 T215 ;  
(Altered)       G28 I20. J180. K10 T303 ;

- 1 Place the cursor under the address of the word which must be altered ("T" in word "T215" in example).
- 2 Key-in the address and data for the new word ("T303" in example).
- 3 Then press the ALTER key.

### Deletion of a word

Example:       Delete Y50.  
                  G91 X-50. Y50. T303 ;  
(Deleted)       G91 X-50. T303 ;

- 1 Place the cursor under the address of the word which must be deleted ("Y" in example).
- 2 Then press the DELET key.

**Deletion of a block**

Example: Delete the G91 block.  
 G28 I20. 5180. K10 T105 ;  
~~G91~~ x-50. Y50. ;  
 G50 ;

(Deleted) G28 I20. J180. K10 T105 ;  
~~G~~50 ;

- 1 Place the cursor under the address of the first word in the block which must be deleted ("G" of G91 in example).
- 2 Press the EOB key.
- 3 Then press the DELET key.

**Deletion of blocks**

Example: Delete blocks G91 to N1003.  
 N1002 G91 X50. Y20. T303 ;  
~~G91~~ x-50. Y50. ;  
 N1003 G90 X900. Y900. ;  
 G50 ;

(Deleted) N1002 ~~G91~~ X50. Y20. T303 ;  
~~G~~50 ;

- 1 Place the cursor under the address of the first word in the first block which must be deleted ("G" of G91 in the second line in example)
- 2 Key-in address "N" and the 4-digit sequence number (0000 to 9999) for the last block to be deleted, which must be a block with a sequence number ("N1003" in example). (If there are any more blocks between the first and last blocks, they will also be deleted.)
- 3 Then press the DELET key.

**Insertion of a word or words**

Example: Insert T105 after K20.  
 G28 I20. 5180. ~~K~~20 ;

(Inserted) G28 I20. J180. ~~K~~20 ~~T~~105 ;

- 1 Place the cursor under the address of the word after which a new word or words must be inserted ("K" in example).
- 2 Key-in the address and data for the new word ("T105" in example) or words.

**REMINDER**

No more than 40 characters can be entered in one line. Do not break a word when the line must be changed.

- 3 Then press the INS/CTRL key.

### Insertion of a block

Example: Insert a new block after the G28 block.

G28 I20. 5180. K20 T105 ;  
G50 ;

(Inserted) G28 I20. J180. K20 T105 ;  
G91 X-50. Y50. T303 ;  
G50 ;

- 1 Place the cursor under the end-of-block code (;) for the block after which a new block must be inserted.
- 2 Key-in data for the entire new block.

REMINDER No more than 40 characters can be entered in one line.  
Do not break a word when the line must be changed.

- 3 Then press the INS/CTRL key.

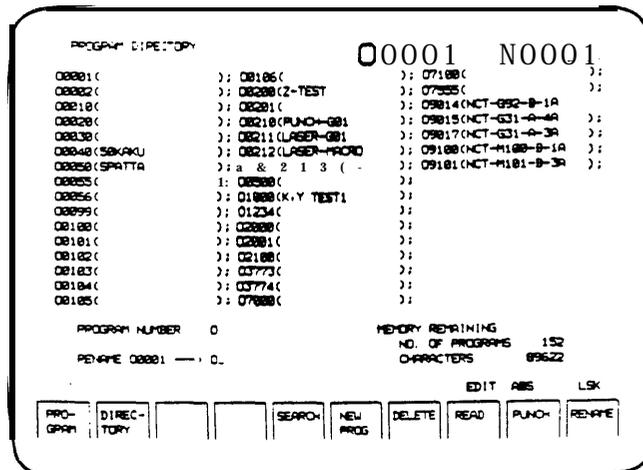
### Deletion of an entire program

To delete a registered program shown on the PROGRAM display entirely, key-in address "O" and the 4-digit program number (0001 to 7999) and then press the DELET key. (Key-in "O" and "-9999" to delete all the registered programs.)

A registered program can also be deleted on the PROGRAM DIRECTORY display by keying-in the program number and then pressing the DELETE soft key. (Key-in "-9999" to delete all the registered programs.)

### Changing a program number

Change to the PROGRAM DIRECTORY display, and place the cursor on the right of "O" shown to the right of the "RENAME" prompt. Key-in the new 4-digit program number (0001 to 7999) and then press the RENAME soft key. (The new program number will appear in the upper right section of the display when the change is made.)



## TAPE PUNCHING

A registered program can be output to a tape puncher for punching in the following manner:

- 1 Connect the puncher to the CNC I/O interface on the NC cabinet and set it up for punching.
- 2 Change the NC setup data related to tape-punching, if necessary, in the MDI mode. (See page III-4, 'Setting up the NC")
- 3 Turn the MODE CHANGE switch to ON, change to the EDIT mode, and then return the switch to OFF.
- 4 Press the SELECT key and the ↑/PRGRM key together, showing the PROGRAM display. Then press the DIRECTORY soft key to change to the PROGRAM DIRECTORY display, if necessary.
- 5 Key-in address "O" and the 4-digit program number (0001 to 7999) for the program which must be output for tape-punching. (On the PROGRAM DIRECTORY display, key-in only the program number)  
Key-in "-9999" instead of the program number when all the registered programs must be punched.
- 6 Press the PUNCH soft key to start punching.

---

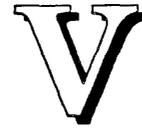
**NOTE**

Punching may be stopped by pressing the RESET key but the interrupted operation cannot be resumed.

---

**REMINDER**

Tape will be fed about 900 mm (3 ft) before and after punching and about 300 mm (1 ft) between programs when all the programs are punched.



# Maintenance

- Daily maintenance 2
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  - Schedule "1" 6
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## DAILY MAINTENANCE

Carry out the maintenance routine described below before starting the day's operation.

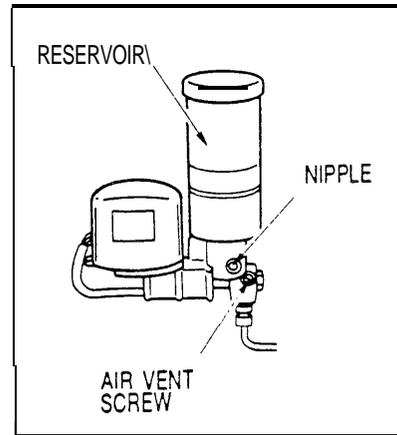
### LUBRICATION

- Inspect the level of grease in the automatic lubricator reservoir and replenish a specified grease through the nipple on the reservoir, if necessary, by using a grease gun.

\* MOBIL Mobilux EP-0 or  
SHELL Alvania EP-R0

#### CAUTION

Keep air out of the reservoir when replenishing.



After the inspection and replenishment, turn on the NC, open the left tool change door, press the LUBRICATION button, and then close the door.

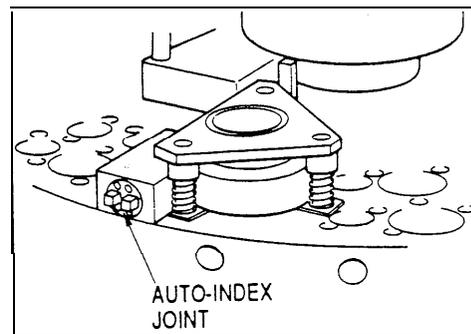
- See page V-9, "Lubrication," and lubricate the machine parts as described.

### CLEANING

Inspect the following parts and clean them if necessary as described below:

- Carriage guide rail.
- Table guide rails.
- Turret index pins & their holes:  
Clean them by using compressed air and then apply a specified oil lightly.

\* MOBIL Mobilux 2 or  
SHELL Alvania 2



- Auto-index joints on the driven side:  
Clean it by using compressed air.
- Lower turret disk top:  
Clean it by using compressed air.
- Laser head nozzle unit & lens:  
See page V-11, "Cleaning," for their cleaning procedures.
- Dust collector scrap bin:  
Open the bin and empty the tray.

- Dust collector filter box:  
Remove the clamp screw from the tray in the box, and then remove and empty the tray.
- Dust collector pipe:  
Remove deposits from the pipe through the dust inlet with the workchute trapdoor closed.
- Workchute trapdoor:  
Remove deposits from its ball bearings and dust inlet.
- Tape reader tape guide & reading head:  
Clean their surfaces by using gauze impregnated with pure ethyl alcohol.

## NOISE

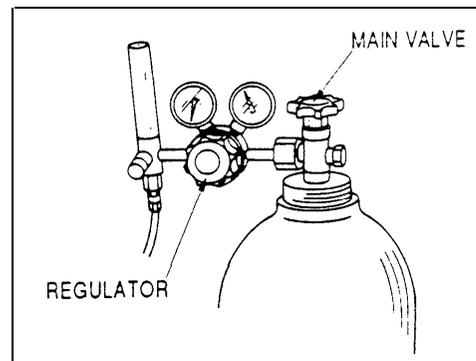
Confirm that the press motor, servomotors, table gears, and turret gears operate without irregular noise.

## TOOLS

- Inspect the punches and dies for wear and damage.
- Check to ensure that the punches and dies are mounted firmly on the turret and are not floating.
- Apply a specified oil to the punch guide surfaces.
  - \* MOBIL DTE Oil Light or SHELL Tellus Oil C32

## LASER GAS SUPPLY

Inspect the amount of laser gas in the bomb. Open the bomb's main valve and read the primary pressure gauge on the regulator attached to the bomb. Change the bomb if the reading is below 10 kgf/cm<sup>2</sup> (142 psi).



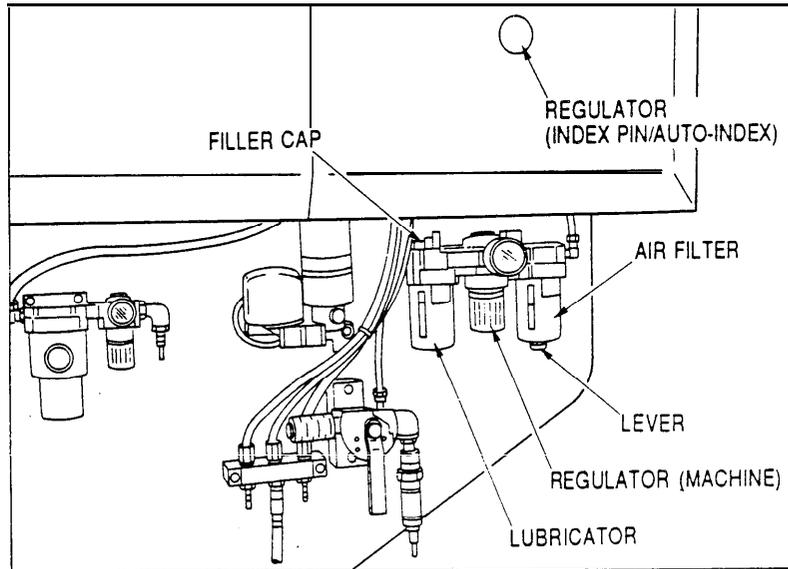
## ASSIST GAS SUPPLY

Inspect the amount of assist gas in the bomb. Open the bomb's main valve and read the pressure gauge for the evaporator. Change the bomb if the reading is below 3 to 5 kgf/cm<sup>2</sup> (43 to 71 psi).



**WARNING** Have the supplier change the assist gas bomb.

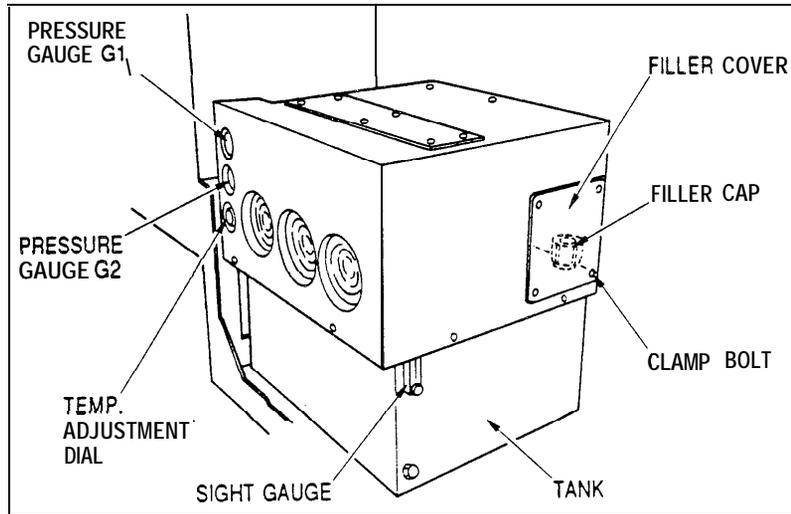
## AIR SYSTEM



- Supply the required compressed air and inspect operating air pressures on the regulators for the following parts. Adjust them to the specified pressures if necessary by using the regulator knobs:  
Machine proper: 5.0 kgf/cm<sup>2</sup>  
Turret index pins and auto-index device: 5.0 kgf/cm<sup>2</sup>
- Check to ensure that the air piping is free of damage or loosened couplings, and leakage
- Drain the accumulated water from the air filter housing by using the lever on the bottom of the housing.
- Inspect the level of oil in the lubricator, which should be between the upper and lower levels shown on the level gauge, and replenish a specified oil\* if necessary.  
\* MOBIL DTE Oil Light or SHELL Tellus Oil C32

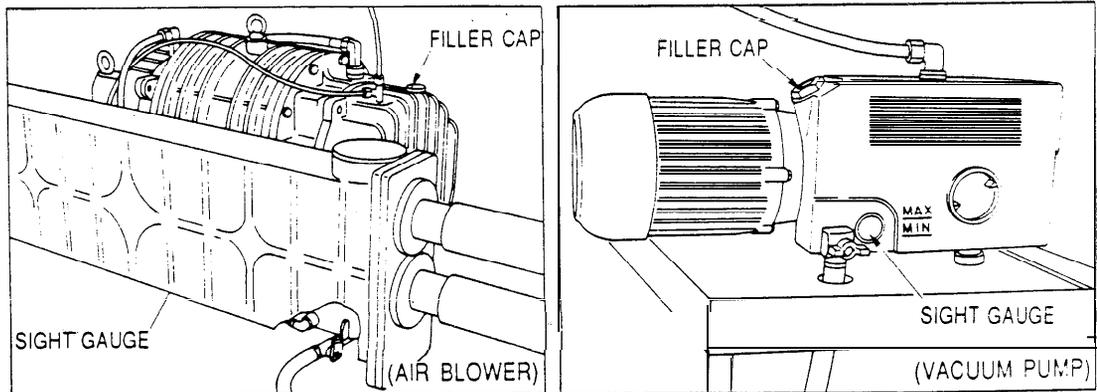
## HYDRAULIC SYSTEM

- Confirm that the temperature adjustment dial on the clutch-brake hydraulic unit is set at 70°C.
- Inspect the level of oil in the tank of the clutch-brake hydraulic unit, which should be between the upper limit and 1/3 levels on the sight gauge, and replenish a specified oil\* if necessary, by removing the filler cover clamp bolts and the cover.  
\* AMADA A-110, MOBIL DTE Oil 25, or SHELL Tellus Oil 46



- Confirm that the two pressure gauges on the clutch-brake hydraulic unit show the following pressures when the hydraulic pump motor is operating:  
 Pressure gauge G1 (operating pressure): 60 kgf/cm<sup>2</sup>  
 Pressure gauge G2 (cooling pressure): Below 1.5 kgf/cm<sup>2</sup>  
 Contact AMADA if these pressures are not obtained.
- Check to ensure that the hydraulic piping is free of damage or loosened couplings, and leakage.

**LASER OSCILLATOR**



Turn off the shop circuit breaker switch and wait for five minutes before opening the side doors of the laser oscillator (on the right side with the oscillator circuit breaker switch in front).

Inspect the levels of oil in the air blower and the vacuum pump (see note), which should be between the upper limit and 1/2 levels on their sight gauges. Replenish the specified oil (AMADA LC-SAH), if necessary.

**NOTE** Check to see the degree of contamination of the oil in the vacuum pump at the same time. If the oil is not clear or has a milklike appearance, contact AMADA.

## PERIODICAL MAINTENANCE

Carry out maintenance operations periodically in addition to the daily maintenance routine. There are two sets of scheduled maintenance operations as described below — Schedule "1" (see below) and Schedule "2" (see next page).

Be sure to carry out both of them as scheduled without fail. If the same item is listed in both schedules, carry out the operation according to the schedule whichever comes earlier.

### Schedule "1"

This set of maintenance operations is scheduled by calendar periods.

#### Once every week

- Lubricate machine parts by referring to "Lubrication" (see page V-9).
- Inspect the ball screws of the carriage, table, and laser head, and clean them by using compressed air and apply a specified oil\* lightly if necessary.  
\* MOBIL Mobilux 2 or SHELL Aivania 2
- Wipe the tape reader light source clean by using a piece of gauze, which may be impregnated with pure ethyl alcohol if necessary.
- Wipe the tape reader tape retainer and passage by using a piece of gauze impregnated with pure ethyl alcohol.
- Inspect the dust collector unit filter and clean it if necessary (refer to the separate dust collector unit manual).
- Check to ensure that the piping and cables are free of damage or loosened connections.

#### Once every month

- Lubricate machine parts by referring to "Lubrication" (see page V-9).
- Clean the filter in the dust collector filter box (see page V-11, "Cleaning").
- Inspect the flywheel drive belts in the back of the machine for tension and damage. See page V-21, "Adjustments," to tighten the tension. If any of the belts is damaged, contact AMADA for replacement.

**Once every 3 months**

- Lubricate machine parts by referring to “Lubrication” (see page V-9).
- Change the oil and the line filter in the clutch-brake hydraulic unit after the initial three months of operation. See page V-15, “Replacements.” (Change them every 12 months or 2000 hours of operation thereafter, whichever comes earlier.)

**Once every 6 months**

- Change the oil in the vacuum pump in the laser oscillator. See page V-15, “Replacements.”
- Inspect the air filter and the mist separator element of the air system and change them if they are contaminated. See page V-15, “Replacements.”

**Once every 12 months**

- Change the oil in the clutch-brake hydraulic unit and its line filter. See page V-15, “Replacements.”
- Change the NC memory backup cells. See page V-15, “Replacements.”
- The exhaust filter of the vacuum pump in the laser oscillator must be changed — contact AMADA.

**Once every 24 months**

- Change the oil in the air blower in the laser oscillator. See page V-15, “Replacements.”

**Schedule "2"**

This set of maintenance operations is scheduled by hours of actual machine operation.

**Every 200 hours**

- Inspect the bend mirrors, which are located above the laser head and between the laser oscillator and the machine proper, and clean the mirrors if necessary. See page V-11, “Cleaning.”
- Clean the air filter located inside the NC cabinet. See page V-11, “Cleaning.”
- Clean the strainers located inside the cooling water piping. See page V-11, “Cleaning.”
- Inspect the amount of oil applied by the air system lubricator and adjust it if necessary. See page V-21, “Adjustments.”

**Every 1000 hours**

- Inspect the machine for loosened bolts and nuts and retighten them if loosened.

**Every 1500 hours**

- Change the oil in the vacuum pump in the laser oscillator. See page V- 15, "Replacements."

**Every 2000 hours**

- Change the oil in the clutch-brake hydraulic unit and its line filter. See page V-15, "Replacements."

**Every 3000 hours**

- The exhaust filter of the vacuum pump in the laser oscillator must be changed — contact AMADA.

**Every 16000 hours**

- Change the oil in the air blower in the laser oscillator. See page V-I 5, "Replacements."

## LUBRICATION

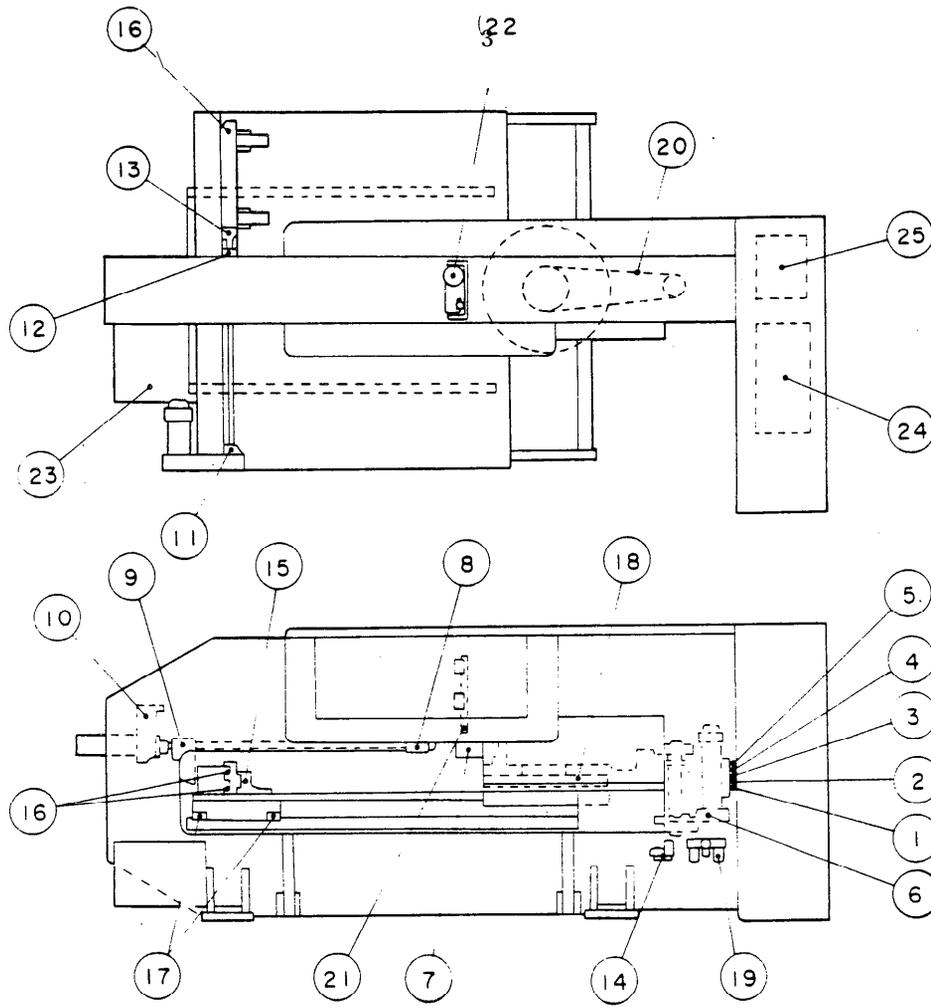
Lubricate machine parts or change oils as specified in this section. Carry out lubrication and oil changes in the daily and periodical maintenance operations as scheduled in the list shown below — *the numbers in the list identify the locations in the drawings shown on the next page:*

### SPECIFIED OILS

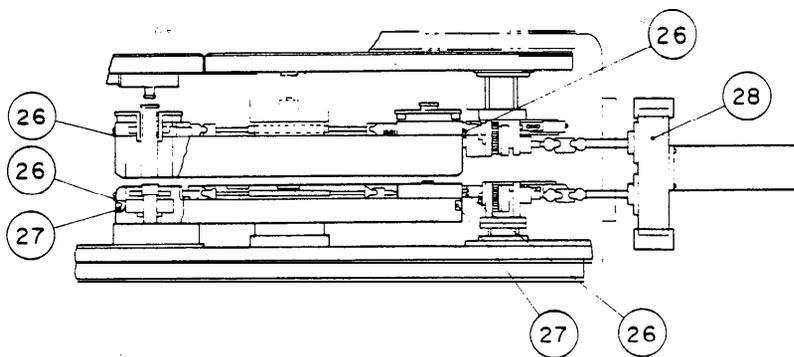
- A: MOBIL DTE Oil Light, SHELL Tellus Oil C32
- B: MOBIL Mobilux 2, SHELL Alvania 2
- c: MOBIL Mobilux EP-0, SHELL Alvania EP-RO
- D: AMADA A-I 10, MOBIL DTE Oil 25, SHELL Tellus Oil 46
- E: AMADA LC-SAH

NO.	PART	OIL	FREQUENCY
	Turret drive gears	B (grease nipple)	Once/month
2	Lower tensioner bearings	B (grease nipple)	Once/month
3	Lower turret disk bearings	B (grease nipple)	Once/month
4	Upper turret disk bearings	B (grease nipple)	Once/month
5	Upper tensioner bearings	B (grease nipple)	Once/month
6	Turret gearbox	A (oil bath)	Once/3 months*
7	Striker	B (grease nipple)	Once/month
8	Table bearings	C (grease nipple)	Once/month
9	Table ball nut	B (grease nipple)	Once/month
10	Table gearbox	A (oil bath)	Once/3 months*
11	Carriage bearings	C (grease nipple)	Once/month
12	Carriage ball nut	B (grease nipple)	Once/month
13	Carriage bearings	C (grease nipple)	Once/month
14	Automatic lubricator	C (reservoir)	Replenish as required.
15	Workclamps	A (oiler)	Daily
16	Carriage guides	C (grease nipple)	Once/week
17	Table guides	C (grease nipple)	Once/week
18	Punch guide surfaces	A (oiler)	Daily
19	Air system lubricator	A (reservoir)	Replenish as required.
20	Turret drive chains	A (oiler)	Once/3 months
21	Laser head guide rail	B (overspread lightly)	Once/month
22	Laser head ball screw	B (overspread lightly)	Once/month
23	Clutch-brake hydraulic unit	D (oil bath)	Change after initial 3 mos and every 12 mos or 2000 hours thereafter.
24	Laser oscillator air blower	E (oil bath)	Change every 24 mos or 16000 hours.
25	Laser oscillator vacuum pump	E (oil bath)	Change every 6 mos or 1500 hours.
26	Auto-index wormgear bearings	C (grease nipple)	Once/month
27	Auto-index wormwheel bearings	C (grease nipple)	Once/month
28	Auto-index gearbox	A (oil bath)	Once/3 months'

\* Replenish to keep the oil level between the upper and lower levels on the gearbox oil level gauge.



AUTO-INDEX DEVICE



## CLEANING

This section describes the cleaning procedures for the following parts:

Lens	Bend' mirrors
Nozzle	NC cabinet air filter
Dust collector filter	Cooling water strainers

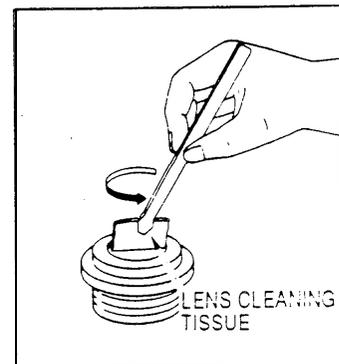
### Lens

Clean the lens, if it is not clean, in the following manner:

**CAUTION**

Do not touch the lens surfaces and handle the lens carefully to keep it intact.

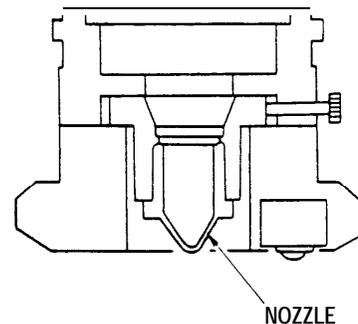
- 1 Blow the dust off the lens surfaces by using clean and dry compressed air.
- 2 If the lens has not been made clean enough, then use a photographic lens cleaning tissue. Fold the tissue into a small piece and damp it with pure ethyl alcohol or acetone. Hold it by pincers and wipe the lens surface lightly in circular motion in one direction. Repeat the step, if necessary, by changing the tissue.
- 3 If the lens still has dirty spots, then use a cotton swab (100% cotton). Damp it with acetone, remove the spots, and then repeat the above step.



### Nozzle

Inspect and clean the nozzle, if it is not clean, in the following manner:

- 1 Return the laser head to its origin.
- 2 Turn off the shop circuit breaker switch.
- 3 Open the right tool change door.

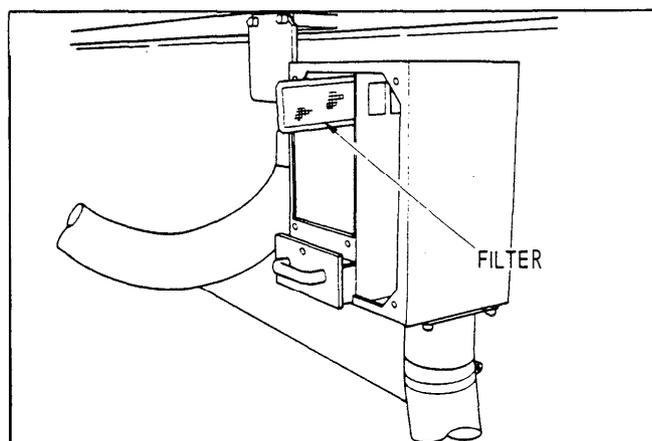


*(Continued on next page.)*

- 4 Pull out the nozzle unit lock bar, turn the unit counterclockwise (viewed from the bottom), and remove the unit.
- 5 Inspect the condition of the nozzle, which is incorporated in the nozzle unit, on the outside and inside.
- 6 Clean the nozzle if necessary. If the nozzle is damaged, remove the nozzle by placing the accessory jig on the nozzle and turning it counterclockwise, and mount the new nozzle by using the jig and turning the nozzle clockwise.
- 7 Replace the nozzle unit by turning it clockwise, push in the lock bar, and then close the tool change door.

## Dust collector filter

Clean the filter in the dust collector filter box in the following manner:



- 1 Turn off the shop circuit breaker switch.
- 2 Remove the clamp screws on the box cover and then the cover.
- 3 Remove the filter by sliding it sideways.
- 4 Remove the dust from the filter by tapping it lightly.
- 5 Replace the filter. Then replace and clamp the cover.

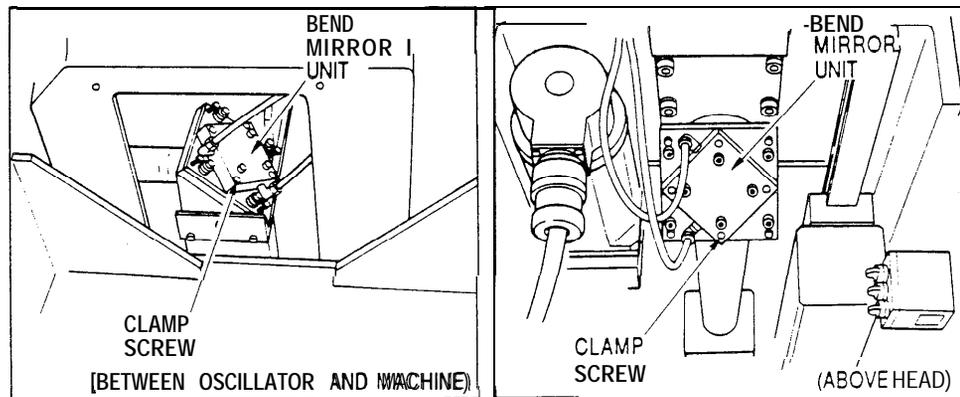
## Bend mirrors

inspect and clean the two bend mirrors, if necessary, in the following manner:

**CAUTION**

Do not touch the mirror surfaces and handle the mirrors carefully to keep them intact.

- 1 Turn off the shop circuit breaker switch.
- 2 Open the door for the mirror located between the laser oscillator and the machine proper. Then remove the beam axis frame covers by removing their clamp bolts.
- 3 Remove the clamp screws from the mirror unit and then the unit.

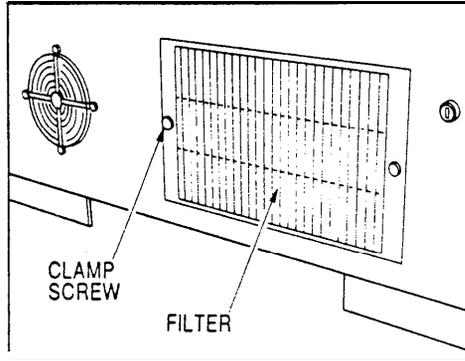


- 4 Blow the dust off the mirror surface by using clean and dry compressed air.
- 5 Fold a photographic lens cleaning tissue into a small piece, or use a cotton ball, and damp it with pure ethyl alcohol or acetone. Hold it by pincers and wipe the mirror surface lightly in circular motion in one direction.
- 6 Dry the wiped surface by blowing it with clean and dry compressed air.
- 7 Replace and clamp the unit.
- 8 For the mirror located between the machine proper and the laser oscillator, replace and clamp the frame covers and close the door.

## NC cabinet air filter

Clean the NC cabinet air filter, which is in the lower section of the rear panel of the cabinet, in the following manner:

- 1 Turn off the shop circuit breaker switch.
- 2 Remove the filter clamp screws and then the filter.
- 3 Blow the dust off the inside of the filter by using compressed air.



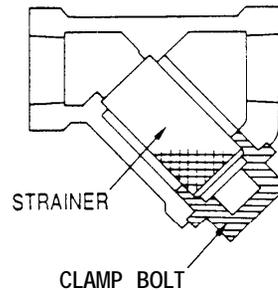
- 4 If necessary, wash the filter gently in water by using a neutral detergent, rinse it, and then let it dry in the shade — do not wring the filter during the process.
- 5 Replace and clamp the filter,

## Cooling water strainers

Clean the two strainers — one in the feed pipe on the laser oscillator side and the other in the return pipe on the cooling unit side — in the following manner:

NOTE Clean the tank of the cooling unit also at this time.

- 1 Turn off the shop circuit breaker switch.
- 2 Drain the water from the cooling unit and clean the tank. Refer to the separate manual for the unit for details.
- 3 Remove the strainer clamp bolt and then the strainer out of the pipe.
- 4 Clean the strainer of deposited sludge, etc. by using a brush.
- 5 Replace and clamp the strainer.
- 6 Refill the tank with the water obtained through a purifier.



CAUTION Be sure to use the purified water.

## REPLACEMENTS

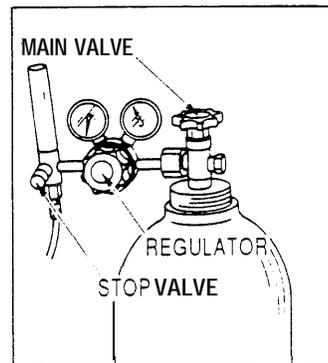
This section describes the replacement procedures for the following parts:

Laser gas bomb	Air system air filter
Clutch-brake oil & line filter	Mist separator element
Air blower oil	NC memory backup cells
Vacuum pump oil	

### Laser gas bomb

Change the laser gas bomb in the following manner:

- 1 Turn off the shop circuit breaker switch.
- 2 Close the main valve of the currently used bomb and then close the stop valve.
- 3 Turn the regulator knob to make the secondary pressure gauge indicate 0 kgf/cm<sup>2</sup> (0 psi).
- 4 Detach the regulator from the bomb and attach it to the new bomb.



#### NOTE

#### GAS REQUIREMENTS

Composition: 5% CO<sub>2</sub>, 55% N<sub>2</sub>, 40% He

Composition accuracy: Less than ±5%

Purity: Over 99.99%

- 5 Keep away from the faces of the pressure gauges and open the main valve.



Keep people away from the pressure gauges. The face glass may be shattered and fly off if the regulator is damaged.

- 6 Confirm that the primary pressure gauge is showing a sufficient pressure.
- 7 Apply soap-suds to the connection of the bomb and the regulator and confirm that there is no leakage from the connection.
- 8 Turn the regulator knob to make the secondary pressure gauge indicate 1.5 kgf/cm<sup>2</sup> (21.4 psi).
- 9 Close the main valve.

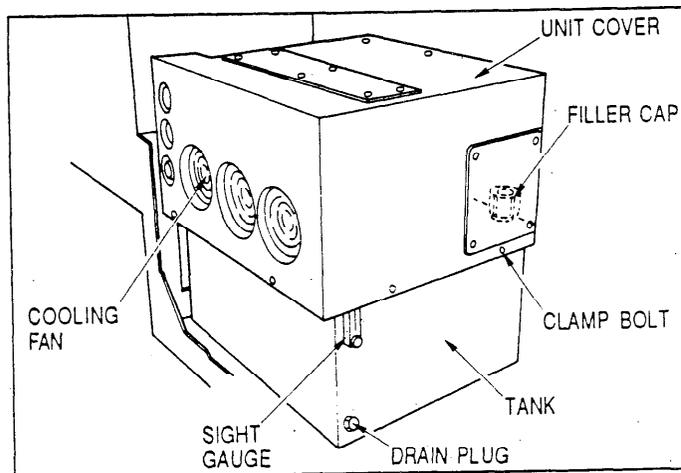
## Clutch-brake oil & line filter

Change the hydraulic oil and the line filter in the clutch-brake hydraulic unit in the following manner:

**NOTE**

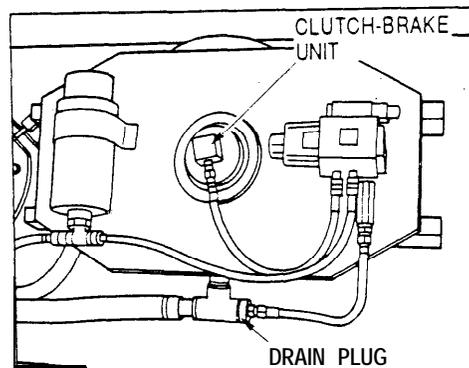
If only the line filter is changed, check the oil level after the change and replenish to the required level if necessary.

- 1 Turn off the shop circuit breaker switch.
- 2 Wait until the hydraulic pump motor and the cooling fans are completely stopped.



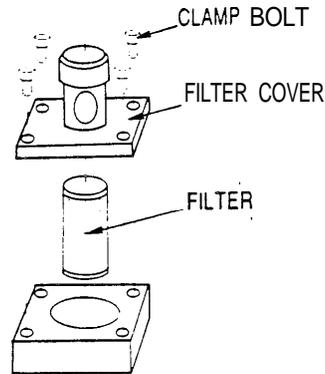
- 3 Remove the hydraulic unit cover clamp bolts and the cover, and then the filler cap.

- 4 Open the punching mechanism cover on the back of the machine, place a pan under the drain plug of the machine's clutch-brake unit, remove the plug to drain the oil, and then replace the plug and close the cover.



- 5 Place a pan under the drain plug of the hydraulic unit tank, remove the plug to drain the oil, and then replace the plug.

- 6 Remove the line filter cover clamp bolts and then the cover.
- 7 Remove the filter and set the new filter in the housing.
- 8 Replace and clamp the filter cover.
- 9 Fill a specified oil\* from the filler up to a level between the top and 2/3 levels on the sight gauge. The tank has a capacity of 60 liters (15.9 US gallons).

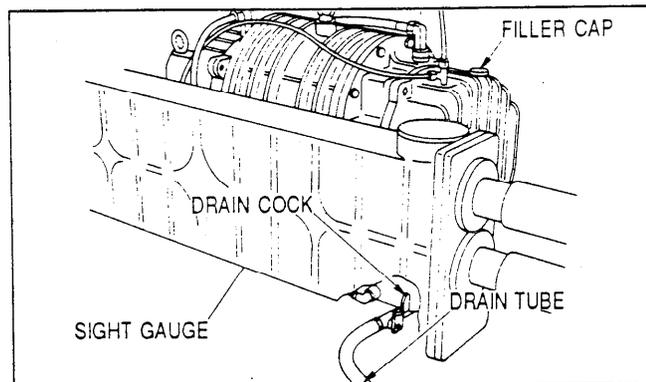


\* AMADA A-110, MOBIL DTE Oil 25,  
SHELL Tellus Oil 46

- 10 Replace the filler cap and the hydraulic unit cover and clamp the cover.

## Air blower oil

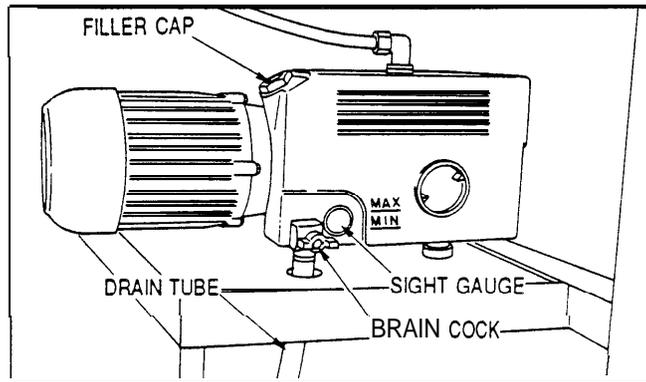
Change the oil in the laser oscillator air blower in the following manner:



- 1 Turn off the shop circuit breaker switch.
- 2 Wait at least for 5 minutes after the air blower has stopped.
- 3 Open the side doors of the laser oscillator — the doors are on the right side viewed with the oscillator circuit breaker switch in front.
- 4 Remove the filler cap, place a pan and the drain tube in the pan, open the drain cock to drain the oil, and then close the cock.
- 5 Fill the specified oil (AMADA LC-SAH) from the filler up to a level between the top and mid levels on the sight gauge. The tank has a capacity of 1.0 liter (0.26 US gallon).
- 6 Replace the filler cap and close the doors.

## Vacuum pump oil

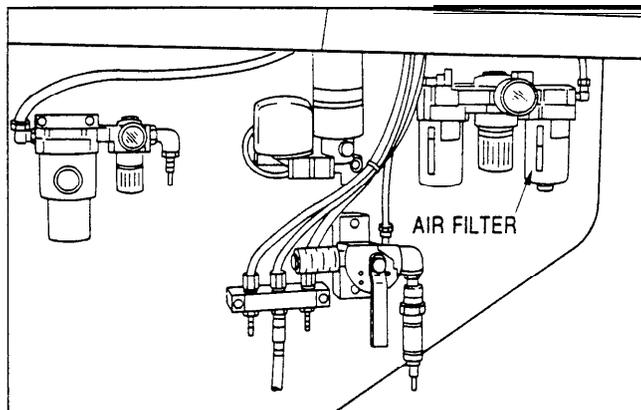
Change the oil in the laser oscillator vacuum pump in the following manner:



- 1 Turn off the shop circuit breaker switch.
- 2 Wait at least for 5 minutes after the vacuum pump has stopped.
- 3 Open the side doors of the laser oscillator — the doors are on the right side viewed with the oscillator circuit breaker switch in front.
- 4 Remove the filler cap, place a pan and the drain tube in the pan, open the drain cock to drain the oil, and then close the cock.
- 5 Fill the specified oil (AMADA LC-SAH) from the filler up to a level between the top and mid levels on the sight gauge. The tank has a capacity of 0.5 liter (0.13 US gallon).
- 6 Replace the filler cap and close the doors.

## Air system air filter

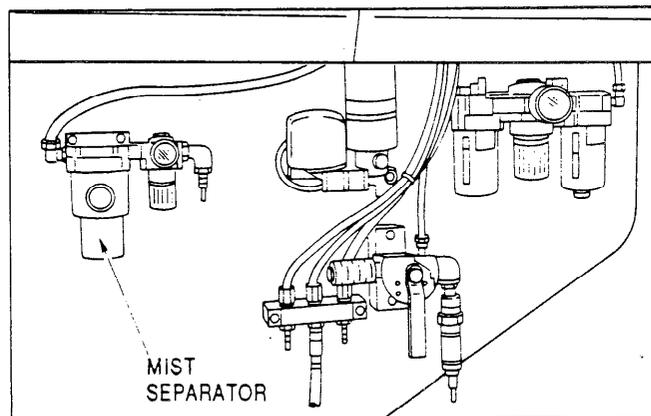
Inspect the air filter in the air system and change it, if necessary, in the following manner:



- 1 Turn off the shop circuit breaker switch.
- 2 Stop the air supply to the machine.
- 3 Push down the knob in the front of the air filter cover and turn the cover counterclockwise to remove it.
- 4 Remove the filter clamp screw and then the filter.
- 5 Inspect the filter and change it if necessary.
- 6 Set and clamp the filter.
- 7 Replace the cover and turn clockwise until the knob in the front of the cover comes up.

## Mist separator element

Inspect the mist separator element in the air system and change it, if necessary, in the following manner:



- 1 Turn off the shop circuit breaker switch.
- 2 Stop the air supply to the machine.
- 3 Push down the knob in the front of the mist separator cover and turn the cover counterclockwise to remove it.
- 4 Remove the element clamp screw and then the element.
- 5 Inspect the element and change it if necessary.
- 6 Set and clamp the element
- 7 Replace the cover and turn clockwise until the knob in the front of the cover comes up.

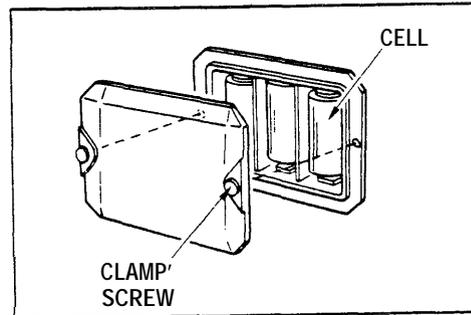
## NC memory backup cells

Change the NC memory backup cells in the following manner once every 12 months or whenever an alarm for a low cell voltage has been caused:

**CAUTION**

Be sure to turn on the NC before changing the cells. Otherwise the data in the memory will be erased when the cells are removed.

- 1 Turn on the NC.
- 2 Turn the SAFETY DEVICE switch to MAINTENANCE, unlighting the SAFETY DEVICE ON light.
- 3 Remove the cell holder cover clamp screws and then the cover.



- 4 Remove the consumed cells and set the new cells with their poles properly matched to the markings inside the holder.

**IMPORTANT**

Be sure to use three new, full-capacity AM-1(1.5V) alkaline cells at the same time. Do not mix any old ones.

- 5 Replace and clamp the cover.
- 6 Turn the SAFETY DEVICE switch to OPERATION, lighting the SAFETY DEVICE ON light.
- 7 Reset the NC.

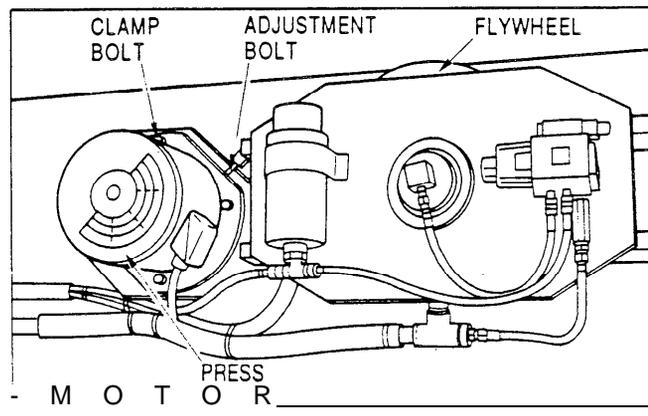
## ADJUSTMENTS

This section describes the following adjustment procedures:

Flywheel drive belt tension	Laser head position
Air system lubricator oil application	Lens focal point
Nozzle unit centering	Laser beam axis

### Flywheel drive belt tension

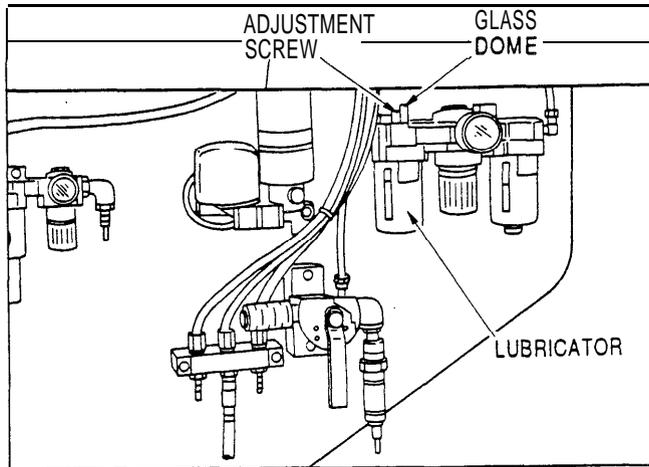
Inspect the condition and tension of the flywheel drive belts, which are in the back of the machine. If any of the belts is damaged, contact AMADA. Adjust the tension, if necessary, in the following manner:



- 1 Turn off the shop circuit breaker switch.
- 2 Open the punching mechanism cover on the back of the machine.
- 3 Inspect the condition of the belts. If any of them is damaged, contact AMADA.
- 4 Inspect the tension. The belts should flex about 9 mm (0.35") when pressed in the middle of the span between the flywheel and the press motor with a force of 1.9 to 2.0 kgf (4.2 to 4.4 lb).
- 5 To adjust the tension, loosen the press motor clamp bolts, loosen the adjustment bolt clamp nut, and turn the adjustment bolt.
- 6 After the adjustment, tighten the adjustment bolt clamp nut and then the press motor clamp bolts.
- 7 Close the cover.

## Air system lubricator oil application

Inspect and adjust, if necessary, the amount of oil applied to the air system by the lubricator in the following manner:



Turn the SAFETY DEVICE switch to MAINTENANCE, unlighting the SAFETY DEVICE ON light.

- 2 Turn the MODE CHANGE switch to ON, change to the MANUAL mode, and then return the switch to OFF.
- 3 Turn the TOOL CHANGE switch to ON, lighting the TOOL CHANGE ON light.
- 4 Open the left tool change door.
- 5 Turn the INDEX PIN switch to the right and then return it to the left repeatedly for five times — during this switch operation, confirm that one drop of oil drips down inside the glass dome on the top of the lubricator.  
If not, turn the screw located next to the glass dome to adjust the amount of oil dripping. And repeat the step until one drop of oil drips down during the switch operation.
- 6 Close the tool change door.
- 7 Turn the TOOL CHANGE switch to OFF, unlighting the TOOL CHANGE ON light.
- 8 Turn the SAFETY DEVICE switch to OPERATION, lighting the SAFETY DEVICE ON light.

## Nozzle unit centering

Center the nozzle unit as described below when preparing the machine for a punching-laser cutting operation as well as after the laser beam axis has been adjusted.

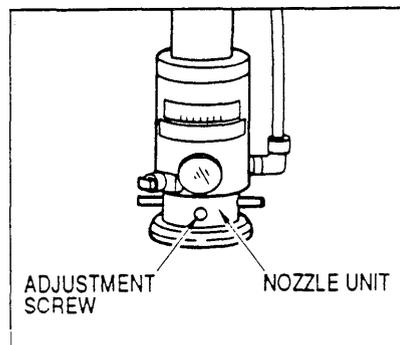
- 1 The following program is required for the purpose:
 

```
G92 X1830. Y1520. ;      (Unit: mm)
M100 ;
G00 X1830. Y1270.;
G90 G00 Z__ ;
G31 P1 Q1;
G24 S300 Q100 R0.1 ;
G31 PO QO ;
G00 Z50. ;
Moo ;
M101 ;
G-50 ;
```
- 2 Confirm that the AXES REFERENCE and SAFETY DEVICE ON lights are lighted.
- 3 Turn the MODE CHANGE switch to ON, change to the AUTO mode, and then return the switch to OFF.
- 4 Set a stainless steel sheet with a size of about 250 mm square and thickness of 0.5 to 1.0 mm on the machine table under the laser head.
- 5 Turn the LASER SELECTION switch to CO<sub>2</sub>.
- 6 If the optional safety mats or optical safety device is equipped, press the SAFETY DEVICE & AIR DOWN RESET button, lighting the SAFETY DEVICE ON light.
- 7 Press a START button to execute the program.



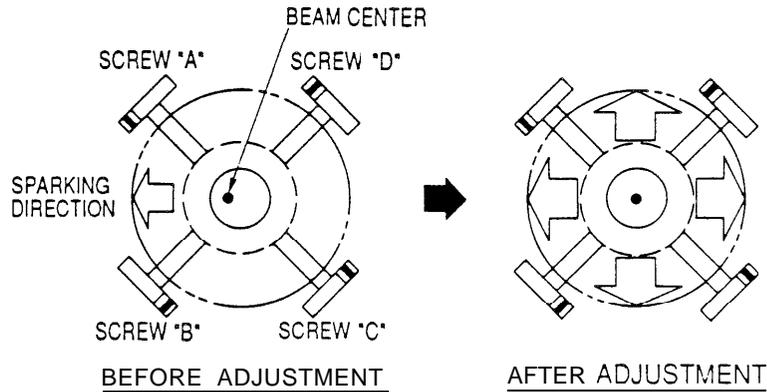
Check to ensure that the area around the machine is cleared of people before pressing the START button.

- 8 When the machine is stopped by the MOO command, press the STOP button on the carriage or auxiliary control panel, and then turn the LASER SELECTION switch to HeNe.
- 9 Inspect the directions in which sparks flew on the worksheet. Sparks fly uniformly in all directions when the nozzle unit is correctly centered.
- 10 To correct the position of the nozzle unit, open the right tool change door and adjust the position by using the four adjustment screws on the unit (see figures). Close the tool change door after the adjustment.



*(Continued on next page.)*

In this example, adjustment screws "A" and "B" are turned counterclockwise and "C" and "D" clockwise to align the nozzle unit center with the beam center.



- 11 Shift the worksheet on the machine table to change the location of cutting for the next trial.
- 12 Unlock the pressed STOP button, and press the SAFETY DEVICE & AIR DOWN RESET button to light the SAFETY DEVICE ON light if necessary. Then press a START button, returning the laser head to its origin.
- 13 Turn the LASER SELECTION switch to CO<sub>2</sub>.
- 14 Repeat Steps 7 to 13 until the nozzle unit is centered and sparks fly uniformly in all directions.
- 15 Turn the LASER SELECTION switch to HeNe.
- 16 Remove the worksheet.
- 17 Press the SAFETY DEVICE & AIR DOWN RESET button to light the SAFETY DEVICE ON light if necessary.

## Laser head position

Adjust the position of the laser head as described below when preparing the machine for a punching-laser cutting operation as well as after the laser beam axis and the lens focal point have been adjusted.

- 1 The following program is required for the purpose:
 

```
G92 X1830. Y1520.;      (Unit: mm)
G93 x20. Y110. ;
X25. Y25. T306 ;
M100 ;
G30 P1 R1. ;
G00 G42 X25. Y56. D1;
G00 Z__ ;
G31 P1 Q1;
G 24 S__ P__ Q__ R__ LO ;
G31 P2 Q1;
G01 X25. Y50.S__ F__ P__ Q__ ;
G00 ;
G01 X0. ;
G00 ;
G01 Y0.;
G00 ;
G01 X50.;
G00 ;
G01 Y50. ;
G00 ;
Go1 x25. ;
G31 PO QO;
G00 2200. ;
G00 G40 ;
M80 ;
G04 Xl. ;
M81 ;
M101 ;
G-50 ;
```
- 2 Mount 20 mm-square tools on turret station No. 306.
- 3 Confirm that the AXES REFERENCE and SAFETY DEVICE ON lights are lighted.
- 4 Turn the MODE CHANGE switch to ON and change to the AUTO mode.
- 5 Set a worksheet on the machine table.
- 6 Turn the LASER SELECTION switch to CO<sub>2</sub>.
- 7 If the optional safety mats or optical safety device is equipped, press the SAFETY DEVICE & AIR DOWN RESET button, lighting the SAFETY DEVICE ON light.

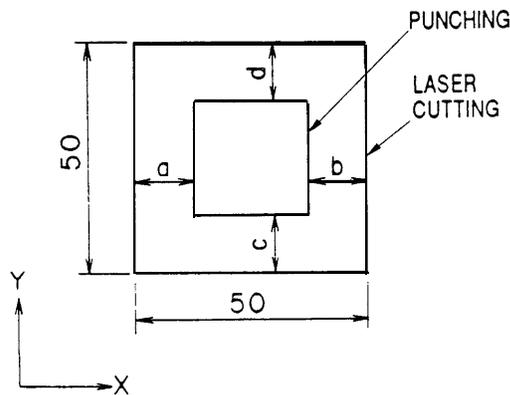
*(Continued on next page.)*

- 8 Press a START button to execute the program.



Check to ensure that the area around the machine is cleared of people before pressing the START button.

- 9 Upon completion of the program, press the STOP button on the carriage or auxiliary control panel, and then turn the LASER SELECTION switch to HeNe.
- 10 Remove the worksheet and measure dimensions "a", "b", "c", and "d" (see figure) in millimeters by using a caliper or micrometer to an accuracy of 5/100 mm or less. The measured dimensions will be needed for calculation in Step 13.



- 11 Change to the MDI mode.
- 12 Press the SELECT key and the +/-LASER key together to show the LASER SETTING (SET DATA) display.
- 13 Read beam offset data "X" and "Y" shown on the display and calculate the required offset data in the following formulas (the dimensions measured in Step 10 are also needed):

$$\text{Laser head offset on X axis [mm]: } AX = (\text{Beam offset X}) + \left[ \frac{a - b}{2} \right]$$

$$\text{Laser head offset on Y axis [mm]: } AY = (\text{Beam offset Y}) + \left[ \frac{c - d}{2} \right]$$

Example of calculation:

Beam offset X: 0.32 mm	Beam offset Y: 251.64 mm
Dimension "a": 15.65 mm	Dimension "b": 14.35 mm
Dimension "c": 13.93 mm	Dimension "d": 16.07 mm

$$\Delta X = 0.32 + \left[ \frac{15.65 - 14.35}{2} \right] = 0.32 + 0.65 = 0.97 \text{ mm}$$

$$AY = 251.64 + \left[ \frac{13.93 - 16.07}{2} \right] = 251.64 + (-1.07) \\ = 251.64 - 1.07 = 250.57 \text{ mm}$$

- 14 Turn the EDIT PROTECT switch to OFF.
- 15 Shift the cursor to BEAM OFFSET X, key-in "P" and the AX data calculated in Step 13", and then press the INPUT key. Then shift the cursor to BEAM OFFSET Y, key-in "P" and the AY data calculated in Step 13", and then press the INPUT key.
  - Enter the data down to two decimal places—round up the fractions of 5 and over at the third decimal place as a unit to the second decimal place (e.g 0.9352 →0.94).
- 16 Return the EDIT PROTECT switch to ON.
- 17 Change to the AUTO mode and return the MODE CHANGE switch to OFF.
- 18 Set a new worksheet on the machine table.
- 19 Unlock the pressed STOP button and then turn the LASER SELECTION switch to CO<sub>2</sub>.
- 20 Press the SAFETY DEVICE & AIR DOWN RESET button to light the SAFETY DEVICE ON light if necessary.
- 21 Press a START button to execute the program again.

**DANGER**

Check to ensure that the area around the machine is cleared of people before pressing the START button.

- 22 Upon completion of the program, turn the LASER SELECTION switch to HeNe.
- 23 Remove the worksheet and measure dimensions "a", "b", "c", and "d" as in Step 10. And confirm that dimensions "a" and "b" are identical and so are dimensions "c" and "d".
- 24 Press the SAFETY DEVICE & AIR DOWN RESET button to light the SAFETY DEVICE ON light if necessary.

## Lens focal point

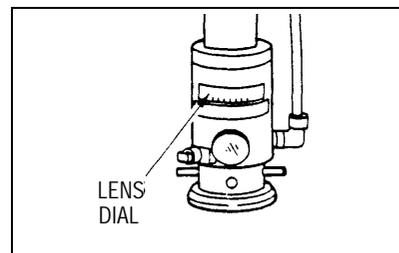
Adjust the lens focal point as described below when the lens has been changed.

- 1 The following program is required for the purpose:

```

G92 X1830. Y1520.;      (Unit: mm)
G93 X20. Y110.;
M100 ;
G30 P1 R0.1 ;
G00 G42 X.20. Y10.D1 ;
G00 Z1.6 ;
G31 P1 Q1 ;
G24 S1000 P200 Q20 R1.5 ;
G31 P2 Q1 ;
G01 Y60. S1000 F1200 P500 Q30 ;
G31 P0 Q0 ;
G00 Z50. ;
G00 X20. Y80. ;
G00 Z1.6 ;
G31 P1 Q1 ;
G24 S1000 P200 Q20 R1.5 ;
G31 P2 Q1 ;
G01 Y70. S1000 F1200 P500 Q30 ;
G00 ;
G01 x10. ;
G00 ;
G01 Y0.;
G-00 ;
G01 x30. ;
G00 ;
G01 Y70.;
G00 ;
G01 x20. ;
G31 P0 Q0 ;
G00 Z200. ;
G00 G40 ;
M80 ;
M81 ;
M101      ;
G-50 ;
    
```

- 2 Prepare the machine for a punching-laser cutting operation in the normal manner — except to turn the lens dial fully clockwise after the lens is mounted on the laser head.

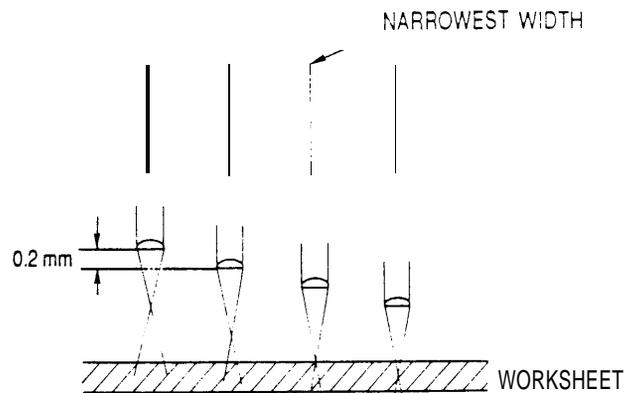


- 3 Confirm that the AXES REFERENCE and SAFETY DEVICE ON lights are lighted.
- 4 Turn the MODE CHANGE switch to ON, change to the AUTO mode, and then return the switch to OFF.
- 5 Set a piece of mild steel sheet with a thickness of 1.6 mm (0.06") on the machine table.
- 6 Turn the LASER SELECTION switch to CO<sub>2</sub>.
- 7 If the optional safety mats or optical safety device is equipped, press the SAFETY DEVICE & AIR DOWN RESET button, lighting the SAFETY DEVICE ON light.
- 8 Press a START button to execute the program.

**DANGER**

Check to ensure that the area around the machine is cleared of people before pressing the START button.

- 9 Upon completion of the program, press the STOP button on the carriage or auxiliary control panel, and then turn the LASER SELECTION switch. to HeNe.
- 10 Open the right tool change door, turn the lens dial four graduations (0.2 mm) counterclockwise, and then close the door.
- 11 Unlock the pressed STOP button.
- 12 Repeat Steps 5 to 11 by changing the lens focal point. Repeat the steps a few times by changing the lens focal point each time.
- 13 Press the STOP button on the carriage or auxiliary control panel and open the right tool change door.
- 74 Set the lens dial at the position where the narrowest cut width was obtained and then return the dial 10 graduations (0.5 mm) clockwise. Then close the tool change door.



(Continued on next page.)

- 15 Set a new piece of mild steel sheet with a thickness of 1.6 mm (0.06") on the machine table.
- 16 Unlock the pressed STOP button and then turn the LASER SELECTION switch to CO<sub>2</sub>.
- 17 Press the SAFETY DEVICE & AIR DOWN RESET button to light the SAFETY DEVICE ON light if necessary.
- 18 Press a START button to execute the program



**DANGER**

Check to ensure that the area around the machine is cleared of people before pressing the START button

- 79 Upon completion of the program, press the STOP button on the carriage or auxiliary control panel, and then turn the LASER SELECTION switch to HeNe.
- 20 Open the right tool change door, turn the lens dial two graduations (0.1 mm) counterclockwise, and then close the door.
- 21 Repeat Steps 15 to 20 by changing the lens focal point. Repeat the steps a few times by changing the lens focal point each time.
- 22 Open the right tool change door.
- 23 Set the lens dial at the position where the narrowest cut width was obtained and then turn the dial 10 graduations (0.5 mm) counterclockwise. Then close the tool change door.
- 24 Unlock the pressed STOP button.
- 25 Adjust the laser head position (see page .V-25).

## Laser beam axis

The laser beam axis may be adjusted as described below if laser cutting is not properly performed although all other laser conditions are correctly provided.



### WARNING

The procedure for adjusting the laser beam axis is extremely dangerous and must be carried out under supervision of an **AMADA** engineer.



### DANGER

Beware of the beam — it is invisible. Wear protective goggles, keep away from the beam path as far as possible, and never look at the spot where the beam is applied.

- 1 Prepare the machine for a punching-laser cutting operation under the following conditions:
  - Keep the nozzle unit mounted.
  - Keep the lens dismounted.
  - Use air as assist gas.

The nozzle unit must be centered and the laser head position must be adjusted after this adjustment has been made.

- 2 Make preparations necessary for discharging CO<sub>2</sub> laser beam manually by using the LASER OUT button (refer to Part III, Operation). The required conditions, which must be set on LASER SETTING displays, are as follows.

On the LASER SETTING (SET DATA) display:

LASER POWER	(INSTRUCTION POWER)	= 300 W
	(FREQUENCY OF PULSE)	= 100 Hz
	(DUTY OF PULSE)	= 100 %

On the LASER SETTING (ASSIST GAS) display:

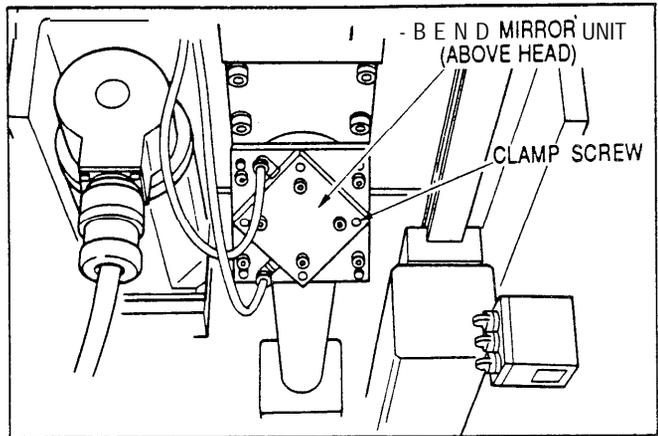
ASSIST GAS SELECT	= (3)
ASSIST GAS FLOW	= (1)

- 3 Position the laser head at 100 mm (4").
- 4 Press the STOP button on the carriage or auxiliary control panel and then turn the LASER SELECTION switch to HeNe.
- 5 Open the tool change doors.
- 6 Pull out the nozzle unit lock bar and turn the unit counter-clockwise (viewed from the bottom) to remove it.
- 7 Remove the clamp screws from the bend mirror unit, which is located above the laser head, and remove the unit (see figure below).

### CAUTION

Do not touch the surface of the mirror when removing the unit.

*(Continued on next page.)*



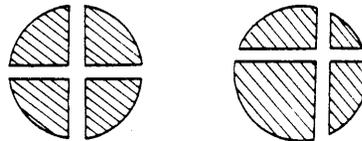
- 8 Set up the accessory mirror target in the position where the bend mirror unit has been removed. Then place a piece of acryl plate with a thickness of about 10 mm (0.4") behind the target — in relation to the direction of the beam path.
- 9 Unlock the pressed STOP button and then turn the LASER SELECTION switch to CO<sub>2</sub>.
- 10 Press the LASER OUT button together with the TURRET JOG ON/Z AXIS O.T. RELEASE button and hold them for one second to apply the beam to the acryl plate.



**DANGER**

Check to ensure that the area around the machine is cleared of people before pressing the two buttons — they should be operated by a single operator.

- 11 Press the STOP button on the carriage or auxiliary control panel and then turn the LASER SELECTION switch to HeNe.
- 12 Compare and determine the discrepancy between the center of the cross burnt in the acryl plate and the center of the mirror target.



- 13 If necessary, adjust the attitude of the bend mirror located between the laser oscillator and the machine proper. For the procedure, see page V-33, "Bend mirror attitude adjustment."
- 14 Remove the mirror target. Then replace and clamp the bend mirror unit on the laser head.
- 15 Screw in the accessory lens target into the lens mount.
- 16 Set another piece of acryl plate with a thickness of about 10 mm (0.4") under the laser head.

- 17 Unlock the pressed STOP button and then turn the LASER SELECTION switch to CO<sub>2</sub>.
- 18 Press the LASER OUT button together with the TURRET JOG ON/Z AXIS O.T. RELEASE button and hold them for one second to apply the beam to the acryl plate.



Check to ensure that the area around the machine is cleared of people before pressing the two buttons -they should be operated by a single operator.

- 19 Press the STOP button on the carriage or auxiliary control panel and then turn the LASER SELECTION switch to HeNe.
- 20 Compare and determine the discrepancy between the center of the cross burnt in the acryl plate and the center of the lens target.
- 27 If necessary, adjust the attitude of the bend mirror located above the laser head. For the procedure, see "Bend mirror attitude adjustment" below.
- 22 Remove the lens target and mount the lens.
- 23 Replace the nozzle unit by turning it clockwise (viewed from the bottom) and push in the lock bar.
- 24 Close the tool change doors
- 25 Turn the SAFETY DEVICE switch to OPERATION, lighting the SAFETY DEVICE ON light.
- 26 Return all the machine axes to their origins
- 27 Center the nozzle unit (see page V-23).
- 28 Adjust the position of the laser head (see page V-25).

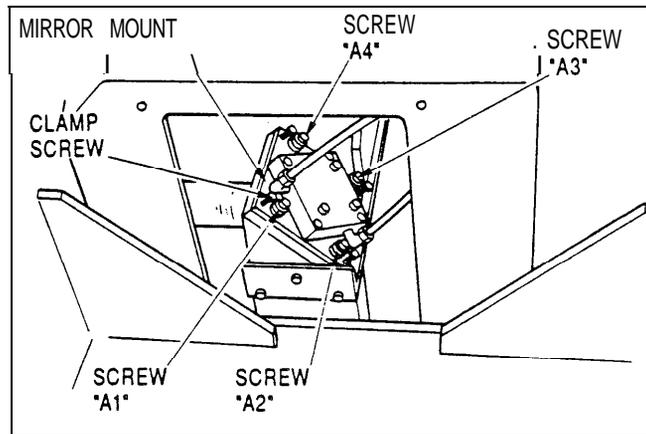
## **BEND MIRROR ATTITUDE ADJUSTMENT**

As part of the laser beam axis adjustment (page V-31, Steps 13 and 21), adjust the attitude of the bend mirror located between the laser oscillator and the machine proper and that of the mirror above the laser head as described below.

### **Mirror between the laser oscillator & the machine proper**

- 1 Open the door on the section between the laser oscillator and the machine proper, remove the clamp bolts from the beam axis frame covers, and then remove the covers.
- 2 Loosen the four clamp screws on the mount of the mirror unit and then loosen adjustment screw "A1" completely, which is also on the mount (see figure below).

*(Continued on next page.)*



- 3 Turn adjustment screws "A2", "A3" and "A4" to adjust the position of the mount in order to bring the center of the cross in the acryl plate and the center of the mirror target into agreement.
- 4 Place a new piece of acryl plate behind the mirror target — in relation to the direction of the beam path.
- 5 Unlock the pressed STOP button and then turn the LASER SELECTION switch to CO<sub>2</sub>.
- 6 Press the LASER OUT button together with the TURRET JOG ON/Z AXIS O.T. RELEASE button and hold them for one second to apply the beam to the acryl plate.



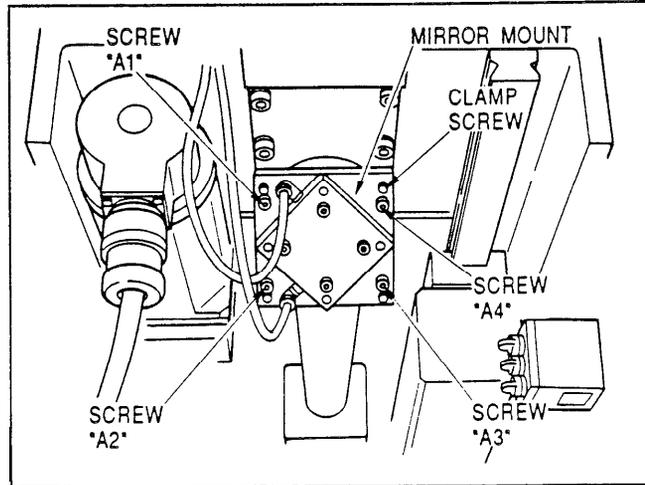
**DANGER**

Check to ensure that the area around the machine is cleared of people before pressing the two buttons -they should be operated by a single operator.

- 7 Press the STOP button on the carriage or auxiliary control panel and then turn the LASER SELECTION switch to HeNe.
- 8 Compare and determine the discrepancy between the center of the cross burnt in the acryl plate and the center of the mirror target.
- 9 Repeat Steps 3 to 8 until the centers are brought into agreement.
- 10 Upon completion of the adjustment, tighten the mount clamp screws, replace and clamp the frame covers, and then close the door.

## Mirror above the laser head

- 1 Loosen the four clamp screws on the mount of the mirror unit and then loosen adjustment screw "A1" completely, which is also on the mount,



- 2 Turn adjustment screws "A2", "A3" and "A4" to adjust the position of the mount in order to bring the center of the cross in the acryl plate and the center of the lens target into agreement
- 3 Place a new piece of acryl plate under the laser head.
- 4 Unlock the pressed STOP button and then turn the LASER SELECTION switch to CO<sub>2</sub>.
- 5 Press the LASER OUT button together with the TURRET JOG ON/Z AXIS O.T. RELEASE button and hold them for one second to apply the beam to the acryl plate.



### **DANGER**

Check to ensure that the area around the machine is cleared of people before pressing the two buttons -they should be operated by a single operator.

- 6 Press the STOP button on the carriage or auxiliary control panel and then turn the LASER SELECTION switch to HeNe.
- 7 Compare and determine the discrepancy between the center of the cross burnt in the acryl plate and the center of the lens target.
- 6 Repeat Steps 2 to 7 until the centers are brought into agreement.
- 9 Upon completion of the adjustment, tighten the mount clamp screws.

# References

Laser cutting conditions	2
Machine status indication	6
Alarms	9
Installation of equipment	26
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## LASER CUTTING CONDITIONS

The laser-cutting conditions for mild steel, stainless steel, and zinc plated steel worksheets are shown in this section.

These conditions are based on the requirements commonly used to obtain optimum results. The results may be adversely affected, however, by differences in material qualities, environmental temperatures, etc. In order to achieve the best results, determine the laser output, cutting rate, or assist gas pressure according to the given material and environmental conditions.

### LASER OUTPUT

The laser output is the most important factor when the cutting rate is set and cannot be changed. If the output is too high, dross will be caused. If it is too low, the worksheet will not be cut.

### CUTTING RATE

The cutting rate is the most important factor when the laser output is set and cannot be changed. If the rate is too fast, the worksheet will not be cut. If it is too slow, dross will be caused. (The cutting rate should be determined according to the contour and the required cutting accuracy normally.)

### ASSIST GAS PRESSURE

If the pressure is too high, the cut edges will be rough although dross will not be caused. If it is too low, dross will be caused. (The higher the pressure is set, the more the gas will be consumed.)

If optimum results cannot be obtained by changing these cutting conditions, check to ensure that the following conditions are properly provided:

- The lens focal point has properly been adjusted.
- The nozzle is clean and free of damage or excessive wear.
- The nozzle unit has properly been centered.
- The worksheet is flat and least warped.
- The correct worksheet thickness is entered in the Z data for the G00 command which is used to lower the laser head prior to cutting.

**MILD STEEL**

(The laser duty is shown for reference only and should be set appropriately.)

Worksheet thickness	Cutting rate	Laser output	Laser frequency	Laser duty	Asst. gas (O <sub>2</sub> ) pressure	Dwell time
mm (inch)	mm/min (ipm)	watt	HZ	%	kgf/cm <sup>2</sup> (psi)	sec
0.5 (0.02)	Piercing	1000	200	20	1.0 (14.3)	0.5
0.5 (0.02)	300 (11.8)	1000	100	8	3.0 (42.7)	
0.5 (0.02)	1500 (59.1)	1000	1000	20	3.0 (42.7)	—
0.5 (0.02)	3000 (118)	1000	1500	25	3.0 (42.7)	—
0.5 (0.02)	5000 (197)	1000	2000	35	3.0 (42.7)	
1.0 (0.04)	Piercing	1000	200	20	1.0 (14.3)	1.0
1.0 (0.04)	300 (11.8)	1000	100	10	3.0 (42.7)	
1.0 (0.04)	1200 (47.2)	1000	500	25	3.0 (42.7)	—
1.0 (0.04)	2500 (98.4)	1000	1000	30	3.0 (42.7)	—
1.0 (0.04)	4000 (157)	1000	2000	35	3.0 (42.7)	—
1.2 (0.05)	Piercing	1000	200	20	1.0 (14.3)	1.0
1.2 (0.05)	300 (11.8)	1000	100	10	3.0 (42.7)	
1.2 (0.05)	1200 (47.2)	1000	500	25	3.0 (42.7)	—
1.2 (0.05)	2500 (98.4)	1000	1500	30	3.0 (42.7)	—
1.2 (0.05)	4000 (157)	1000	2000	35	3.0 (42.7)	
1.6 (0.06)	Piercing	1000	200	20	1.0 (14.3)	1.5
1.6 (0.06)	300 (11.8)	1000	300	15	3.0 (42.7)	
1.6 (0.06)	1200 (47.2)	1000	500	30	3.0 (42.7)	
1.6 (0.06)	2500 (98.4)	1000	2000	35	3.0 (42.7)	
1.6 (0.06)	4000 (157)	1000	2000	45	3.0 (42.7)	
2.3 (0.09)	Piercing	1000	200	20	1.0 (14.3)	2.0
2.3 (0.09)	300 (11.8)	1000	100	20	3.0 (42.7)	
2.3 (0.09)	1200 (47.2)	1000	500	35	3.0 (42.7)	—
2.3 (0.09)	2000 (78.7)	1000	700	50	3.0 (42.7)	—
2.3 (0.09)	3500 (138)	1000	1500	65	3.0 (42.7)	
3.2 (0.13)	Piercing	1000	200	20	1.0 (14.3)	3.0
3.2 (0.13)	300 (11.8)	1000	300	25	3.0 (42.7)	
3.2 (0.13)	1200 (47.2)	1000	600	35	3.0 (42.7)	—
3.2 (0.13)	2000 (78.7)	1000	800	55	3.0 (42.7)	—
3.2 (0.13)	3000 (118)	1000	1500	90	3.0 (42.7)	
4.5 (0.18)	Piercing	1000	200	20	1.0 (14.3)	4.5
4.5 (0.18)	300 (11.8)	1000	150	35	3.0 (42.7)	
4.5 (0.18)	800 (31.5)	1000	500	40	3.0 (42.7)	—
4.5 (0.18)	1500 (59.1)	1000	1000	65	3.0 (42.7)	—
4.5 (0.18)	2000 (78.7)	1000	2000	90	3.0 (42.7)	
6.0 (0.24)	Piercing	1000	200	20	1.0 (14.3)	6.0
6.0 (0.24)	200 (7.9)	1000	200	45	3.0 (42.7)	
6.0 (0.24)	600 (23.6)	1000	500	45	3.0 (42.7)	—
6.0 (0.24)	1000 (39.4)	1000	500	70	3.0 (42.7)	—
6.0 (0.24)	1300 (51.2)	1000	1000	75	3.0 (42.7)	—

**STAINLESS STEEL**

(The laser duty is shown for reference only and should be set appropriately.)

Worksheet thickness	Cutting rate	Laser output	Laser frequency	Laser duty	Asst. gas (O <sub>2</sub> ) pressure	Dwell time
mm (inch)	mm/min (ipm)	watt	HZ	%	kgf/cm <sup>2</sup> (psi)	sec
1.0 (0.04)	Piercing	000	200	20	1.0 (14.3)	1.0
1.0 (0.04)	300 (11.8)	500	300	10	4.0-5.0 (57-71)	
1.0 (0.04)	1200 (47.2)	700	500	20	4.0-5.0 (57-71)	
1.0 (0.04)	2500 (98.4)	1000	1000	35	4.0-5.0 (57-71)	
1.0 (0.04)	4000 (157)	000	2000	45	4.0-5.0 (57-71)	
1.5 (0.06)	Piercing	1000	200	20	1.5 (21.4)	1.5
1.5 (0.06)	300 (11.8)	500	150	15	4.0-5.0 (57-71)	
1.5 (0.06)	1200 (47.2)	750	500	25	4.0-5.0 (57-71)	
1.5 (0.06)	2500 (98.4)	000	2000	40	4.0-5.0 (57-71)	
1.5 (0.06)	4000 (157)	1000	1000	55	4.0-5.0 (57-71)	
2.0 (0.08)	Piercing	1000	200	20	2.0 (28.5)	2.0
2.0 (0.08)	300 (11.8)	500	150	25	4.0-5.0 (57-71)	
2.0 (0.08)	1200 (47.2)	1000	2000	25	4.0-5.0 (57-71)	
2.0 (0.08)	2500 (98.4)	1000	2000	55	4.0-5.0 (57-71)	
2.0 (0.08)	4000 (157)	1000	2000	90	4.0-5.0 (57-71)	
3.0 (0.12)	Piercing	1000	200	20	3.0 (42.7)	3.0
3.0 (0.12)	300 (11.8)	750	100	20	4.0-5.0 (57-71)	
3.0 (0.12)	800 (31.5)	1000	2000	30	4.0-5.0 (57-71)	
3.0 (0.12)	1500 (59.1)	1000	300	60	4.0-5.0 (57-71)	
3.0 (0.12)	2500 (98.4)	1000	2000	90	4.0-5.0 (57-71)	

**ZINC PLATED STEEL**

(The laser duty is shown for reference only and should be set appropriately.)

Worksheet thickness	Cutting rate	Laser output	Laser frequency	Laser duty	Asst. gas (O <sub>2</sub> ) pressure	Dwell time
mm (inch)	mm/min (ipm)	watt	HZ	%	kgf/cm <sup>2</sup> (psi)	sec
1.0 (0.04)	Piercing	1000	200	20	1.0 (14.3)	1.0
1.0 (0.04)	300 (11.8)	1000	150	10	4.0-5.0 (57-71)	
1.0 (0.04)	1200 (47.2)	1000	500	30	4.0-5.0 (57-71)	
1.0 (0.04)	2500 (98.4)	1000	2000	25	4.0-5.0 (57-71)	
1.0 (0.04)	2500 (98.4)	1000	2000	25	4.0-5.0 (57-71)	
1.2 (0.05)	Piercing	1000	200	20	1.0 (14.3)	1.0
1.2 (0.05)	300 (11.8)	1000	150	10	4.0-5.0 (57-71)	
1.2 (0.05)	1200 (47.2)	1000	500	35	4.0-5.0 (57-71)	
1.2 (0.05)	2500 (98.4)	1000	2000	30	4.0-5.0 (57-71)	
1.2 (0.05)	2500 (98.4)	1000	2000	30	4.0-5.0 (57-71)	
1.6 (0.06)	Piercing	1000	200	20	1.0 (14.3)	1.5
1.6 (0.06)	300 (11.8)	1000	150	20	4.0-5.0 (57-71)	
1.6 (0.06)	1200 (47.2)	1000	500	35	4.0-5.0 (57-71)	
1.6 (0.06)	2500 (98.4)	1000	2000	40	4.0-5.0 (57-71)	
1.6 (0.06)	2500 (98.4)	1000	2000	40	4.0-5.0 (57-71)	
2.3 (0.09)	Piercing	1000	200	20	1.0 (14.3)	2.5
2.3 (0.09)	300 (11.8)	1000	150	20	4.0-5.0 (57-71)	
2.3 (0.09)	1200 (47.2)	1000	500	40	4.0-5.0 (57-71)	
2.3 (0.09)	2000 (78.7)	1000	700	55	4.0-5.0 (57-71)	
2.3 (0.09)	2000 (78.7)	1000	700	55	4.0-5.0 (57-71)	
3.2 (0.13)	Piercing	1000	200	20	1.0 (14.3)	3.0
3.2 (0.13)	300 (11.8)	1000	150	25	4.0-5.0 (57-71)	
3.2 (0.13)	1200 (47.2)	1000	600	45	4.0-5.0 (57-71)	
3.2 (0.13)	2000 (78.7)	1000	800	60	4.0-5.0 (57-71)	
3.2 (0.13)	2000 (78.7)	1000	800	60	4.0-5.0 (57-71)	

## MACHINE STATUS INDICATION

The current machine status can be confirmed on the CRT screen by a number accompanied with a brief message as described below.

Nos. 01 to 23 indicate the NC status and can be shown on the ALARM/MESSAGE display by pressing the I/ALARM key together with the SELECT key.

Nos. 56 to 2055 indicate the machine status that requires action and will be automatically shown on the display.

NO. & MESSAGE	DESCRIPTION
01 EXEC MF/TF/EF	M- or T-codecommand is being executed or external device is being operated and FIN signal has not been received.
02 DISTRIBUTE	Axis travel command is being executed.
03 DWELL	Dwell command is being executed.
04 NOT IN-POSITION	In-position check is being performed.
05 OVERRIDE 0%	Override is set at 0%.
06 INTERLOCK	Interlock is not released.
09 REWIND	Tape is being rewound.
14 EMERGENCY/RESET	Emergency stop or reset signal is on.
17 WAIT PRESS START	Start-wait signal PFW is not turned off.
18 WAIT PRESS END	One press cycle has not yet been completed.
19 WAIT PUNCH END	One punching cycle has not yet been completed.
20 WAIT PRESS END (NBL)	Nibble-press has not yet been completed.
21 WAIT PUNCH END (NBL)	Nibble-punching has not yet been completed.
22 TOOL NOT SELECTED	Tool has not been selected.
23 MANUAL PRESS	Punching is being performed in MDI or MANUAL mode.
56 Y OFFSET OVER	Detection range has been exceeded in automatic position offset for laser head. (Contact AMADA if this message appears.)

1000 INDEX TOOL NOT SELECTED	C-code command has been given to a non-auto-index turret station. (Reset NC and then correct program or remake tape.)
4001 INDEX ALARM (1)	Irregular signal has been transmitted during auto-indexing. (Contact AMADA if this message appears.)
1005 Z-INSTRUCTION ERROR	Z-code command in program has error. (Reset NC and then correct program or remake tape.)
1015 AL CUT TROUBLE	Optional aluminum cut equipment is not properly operating. (Turn off NC and then turn it on again.)
1100 G92-G05 ALARM	G92 has been commanded before G05. (Reset NC and then correct program or remake tape.)
1101 M33-G05 ALARM	M33 has been commanded before G05. (Reset NC and then correct program or remake tape.)
2000 INDEX NOT PREPARED	Auto-index device is not ready for indexing. (Reset NC and then return all machine axes to their origins.)
2001 INDEX NOT CLAMPED	Auto-index device is not clamped. (Contact AMADA if this message appears.)
2002 INDEX BRAKE (B) NOT OPEN	Auto-index brake "B" is not released. (Contact AMADA if this message appears.)
2003 INDEX BRAKE (A) NOT OPEN	Auto-index brake "A" is not released (Contact AMADA if this message appears.)
2007 BATTERY	NC memory backup cell voltage has been reduced. (Refer to Part V, Maintenance, for replacement procedure.)
2008 Z ORIGIN-LS	Z-axis origin limit switch is not properly functioning. (Contact AMADA if this message appears.)
2010 PRESS MOTOR OFF	Press motor is not turned on. (Turn machine circuit breaker switch to OFF, turn PRESS MOTOR switch to ON, and then turn the circuit breaker switch to ON.)
2013 X ORIGIN-LS	X-axis origin limit switch is not properly functioning. (Contact AMADA if this message appears.)
2014 Y ORIGIN-LS	Y-axis origin limit switch is not properly functioning. (Contact AMADA if this message appears.)
2016 CRANK OVERRUN	Crankshaft is not at top dead center. (Refer to Part III, Operation, "Interruption & restarting," for remedy.)

2047 WATCH DOG TIMER	M-code signal has not been received. (Contact AMADA if this message appears.)
2018 PRESS CONTROL	Clutch-off or nibbling-start limit switch is not properly functioning. (Contact AMADA if this message appears.)
2019 TOOL LIFE OVER	Number of punching hits has exceeded that preset to determine tool life. (Inspect tool for wear and change it if necessary.)
2025 LASER STOP	Machine is not properly switched for laser cutting or punching. (Contact AMADA if this message appears.)
2026 AIR PRESSURE	Operating air pressure has been reduced below 3.0 kgf/cm <sup>2</sup> (42.6 psi). (Refer to Part III, Operation, "Interruption & restarting," for remedy.)
2027 Z-BREAKDOWN	Laser head has been collapsed. (Contact AMADA if this message appears.)
2028 OIL TEMPERATURE	Clutch-brake hydraulic oil temperature has decreased below preset temperature. (Contact AMADA if this message appears.)
2029 LUBRICATION	Automatic lubrication system is not properly functioning. (Refer to Part III, Operation, "Interruption & restarting," for remedy.)
2030 STRIP MISS	Stripping failure has been detected. (Refer to Part III, Operation, "Interruption & restarting," for remedy.)
2031 TOOL CHANGE SW	TOOL CHANGE switch is turned to ON. (Turn the switch to OFF and then reset NC.)
2032 TOOL CHANGE DOOR	Either tool change door, either turret door, or scrap bin door is open. (Refer to Part III, Operation, "Interruption & restarting," for remedy.)
2033 REPOSITIONING	Confirmation for repositioning is required. (Refer to Part III, Operation, "Interruption & restarting," for remedy.)
2054 AL CUT HIGH POWER	Discharged CO <sub>2</sub> laser beam had been reflected back into laser oscillator. (Reset NC.)
2055 DROP MISS	Workchute failure has been detected. (Refer to Part III, Operation, "Interruption & restarting," for remedy.)

## ALARMS

An alarm can be identified by a number shown automatically on the ALARM/MESSAGE display. To proceed, remove the cause of the alarm, reset the NC, correct the program or remake the tape if necessary, return all the machine axes to their origins, and then restart operation from the beginning.

Alarm numbers and their categories, in which they are listed in this section, are as follows:

000 to 199	Program alarms ... <i>(page 9)</i>
210 to 253	Overtravel alarms ... <i>(page 17)</i>
310 to 358	APC (absolute pulse-coder) alarms ... <i>(page 18)</i>
400 to 457	Servosystem alarms ... <i>(page 20)</i>
600 to 605	PMC alarms ... <i>(page 23)</i>
660 to 683	Laser alarms ... <i>(page 23)</i>
700 to 703	Overheat alarms ... <i>(page 24)</i>
910 to 998	System alarms ... <i>(page 25)</i>

## PROGRAM ALARMS

000	NC must be turned off. (Turn off NC and then turn it on again.)
001	TH alarm. Incorrect number of holes punched for character in tape. (Remake tape.)
002	TV alarm — caused only when TV check is effective. Incorrect number of characters punched for block in tape. (Remake tape.)
003	Data with excessive number of digits has been found. (Correct program or remake tape.)
004	Block without address and beginning with numeral, minus sign or decimal point has been found. (Correct program or remake tape.)
005	Block without data following address and followed by next block's address or end-of-block code has been found. (Correct program or remake tape.)
006	Word with misplaced minus sign or two minus signs has been found. (Correct program or remake tape.)
007	Word with misplaced decimal point or two decimal points has been found. (Correct program or remake tape.)
009	Illegal characters have been found in significant block of data. (Correct program or remake tape.)
010	Invalid G-code command has been found. (Correct program or remake tape.)

- 011 Cutting feedrate is not specified or invalid. (Correct program or remake tape.)
- 017 Illegal axis travel has been commanded. (Correct program or remake tape.)
- 023 Zero is entered as R-data for arc. (Correct program or remake tape.)
- 029 Saved offset data has 6 or more digits. (Correct program or remake tape.)
- 030 D-data specifying laser beam path compensation is too large. (Correct program or remake tape.)
- 031 P-data is too large or not specified for G30 or custom macro. (Correct program or remake tape.)
- 032 R-data is too large for G30 or custom macro. (Correct program or remake tape.)
- 033 Intersection point cannot be calculated for laser beam path compensation. (Correct program or remake tape.)
- 034 Startup or cancellation has been attempted during execution of GO2 or GO3 for laser beam path compensation. (Correct program or remake tape.)
- 035 G25, G27, G75, G76, or pattern punching has been commanded during laser beam path compensation. (Correct program or remake tape.)
- 038 Radius at arc start or end is zero for laser beam path compensation and likely to cause overcutting. (Correct program or remake tape.)
- 041 Laser beam path compensation may result overcutting (Correct program or remake tape.)
- 044 G11 block has incorrect data (I, J, K, R, H, E, or L). (Correct program or remake tape.)
- 045 G 12 block has incorrect data (I, J, K, H, E, or L). (Correct program or remake tape.)
- 046 G13 block has incorrect data (I, J, K, H, E, or L). (Correct program or remake tape.)
- 048 Axis travel is commanded despite that machine axes have not been zero-returned after power-on or emergency stop. (Zero-return all axes.)
- 059 Specified program number is not found.

- 060 Specified sequence number is not found.
- 061 G30 block has no N- or R-data. (Correct program or remake tape.)
- 062 G30 block has incorrect parameter setting. (Correct program or remake tape.)
- 063 G30 block has out-of-range parameter setting. (Correct program or remake tape.)
- 070 Memory is not sufficient. (Delete unwanted programs to increase available memory.)
- 071 Specified address is not found.
- 072 Memory is full with 191 programs registered. (Delete unwanted programs to free memory.)
- 073 Program number entered for registration is already used. (Change number and reenter.)
- 074 Program number other than 1 to 9999 is specified. (Change number and reenter.)
- 075 Program's first block has no program or sequence number. (Correct program or remake tape.)
- 076 M98, G95, or G96 block has no P-data. (Correct program or remake tape.)
- 077 Five levels of nested subprograms are being called. (Correct program or remake tape.)
- 078 P-data for M98, M99, G95, or G96 block is not found in memory. Or program or sequence number is not found. (Correct program or remake tape.)
- 079 Programs in memory and tape do not agree in contents.
- 085 Input device is not correctly selected and data cannot be read. (Check and correct setting on SETTING (SET DATA) display.)
- 086 Data transmission is irregular or external device is not properly functioning and data cannot be read or output. (Check and correct function of external device.)
- 087 More than ten characters were read following DC3 stop code. (Remake tape.)

- 090 Signals are not received from pulse-coder and machine axes cannot be zero-returned. (Contact AMADA.)
- 091 Pulse-coder signals and reference 'counter are not synchronized and machine axes cannot be zero-returned. (Contact AMADA.)
- 100 Parameter set "1" has been selected on SETTING (SET DATA) display. (Change to parameter set "0".)
- 101 Power was turned off inadvertently during editing. (Contact AMADA.)
- 109 Power was turned off inadvertently during communication with MMC System. (Contact AMADA.)
- 110 Fixed-point absolute data is out of range. (Correct program or remake tape.)
- 111 Floating-point exponent data is out of range. (Correct program or remake tape.)
- 112 Zero is entered as divisor. (Correct program or remake tape.)
- 114 Error was found in format other than expression format. (Correct program or remake tape.)
- 115 Undefined variable is specified. (Correct program or remake tape.)
- 116 Illegal variable is assigned in left statement. (Correct program or remake tape.)
- 118 Parenthetic multiplicity exceeds algebraic nesting limit of five levels. (Correct program or remake tape.)
- 119 Negative argument is entered for SORT or BCD. Or argument for 'BCD contains data other than 0 to 9. (Correct program or remake tape.)
- 122 Nested macroprograms are being called exceeding four levels. (Correct program or remake tape.)
- 123 Macro control command is used in AUTO mode "tape" operation. (Remake tape.)
- 124 DO and END are specified incorrectly, which must have relationship of 1 :1. (Correct program or remake tape.)

- 125 Error was found in format of expressions. (Correct program or remake tape.)
- 126 "n" is specified incorrectly in DOn, which must be  $1 \leq n \leq 3$ . (Correct program or remake tape.)
- 127 NC command and macro command are in one block. (Correct program or remake tape.)
- 128 "n" is specified incorrectly in GOTOn, which must be  $0 \leq n \leq 9999$ . (Correct program or remake tape.)
- 129 Invalid address is used in argument. (Correct program or remake tape.)
- 130 Error is found in large segment data in external device.
- 131 Five or more alarms are caused in external device.
- 132 Alarm without assigned number is caused in external device.
- 133 Error is found in small segment data in external device.
- 136 Nibbling or pattern punching is commanded after M100 Or M101 is commanded in spite of G32 command. (Correct program or remake tape.)
- 137 Specified laser output, pulse frequency, or pulse duty is out of range (Correct program or remake tape.)
- 138 G31 block has incorrect data (I, J, P, or O). (Correct program or remake tape.)
- 139 G32 block has out-of-range P-data. (Correct program or remake tape.)
- 140 G24 block has out-of-range data (S, P, Q, or L) or contains M-code command. (Correct program or remake tape.)
- 141 Parameter No. 46, 47, or 4047 to 4051 has out-of-range setting.
- 142 G94 block has missing data (P, K, or Q). (Correct program or remake tape.)
- 143 T- or C-code command is in G01, G02, or G03 block. (Correct program or remake tape.)

- 144 T- or M-code command, or G04, G70, G25, or G27 command, is included in nibbling. Or T-code command is in G72, G93, G75, or G76 block. (Correct program or remake tape.)
- 145 G25 or G27 command is in GO2 or GO3 block. (Correct program or remake tape.)
- 146 Invalid T-code command is found. (Correct program or remake tape.)
- 147 X- or Y-axis increment for nibbling is too large. (Correct program or remake tape.)
- 148 C-axis increment for nibbling in G68 block exceeds limit. (Correct program or remake tape.)
- 150 G26 block has zero or negative I-data, zero K-data, or missing data (I, J, or K). (Correct program or remake tape.)
- 151 G28 block has zero or negative K-data, or missing data (I, J, or K). (Correct program or remake tape.)
- 152 G29 block has zero or negative I- or K-data, or missing data (I, J, K, or P). (Correct program or remake tape.)
- 153 G36 or G37 block has zero or negative K- or P-data, or missing data (I, J, K, or P). (Correct program or remake tape.)
- 154 G66 block has zero P-data, I-data less than 1.5 times P-data, or missing data (I, J, or P). (Correct program or remake tape.)
- 155 G67 block has zero or negative P- or Q-data, I- or J-data less than 3 times P- or Q-data, or missing data (I, J, P, or Q). (Correct program or remake tape.)
- 156 G68 block has zero or negative Q-data or that exceeds limit, zero or negative I-data; or missing data (I, J, K, P, or Q). (Correct program or remake tape.)
- 157 G69 block has zero or negative Q-data or that exceeds limit, or missing data (I, J, P, or Q). (Correct program or remake tape.)
- 158 G78 block has zero or negative Q-data or that is smaller than D-data or larger than arc length, zero or negative I- or D-data, or missing data (I, J, K, P, or Q). (Correct program or remake tape.)

- 159 G79 block has zero or negative Q-data or that is smaller than D-data or larger than I-data, zero or negative D-data, or missing data (I, J, P, or Q). (Correct program or remake tape.)
- 160 X-data exceeds stored stroke limit "1" in plus direction. (Correct program or remake tape.)
- 161 X-data exceeds stored stroke limit "1" in minus direction. (Correct program or remake tape.)
- 162 Y-data exceeds stored stroke limit "1" in plus direction. (Correct program or remake tape.)
- 163 Y-data exceeds stored stroke limit "1" in minus direction. (Correct program or remake tape.)
- 164 Z-data exceeds stored stroke limit "1" in plus direction. (Correct program or remake tape.)
- 165 Z-data exceeds stored stroke limit "1" in minus direction. (Correct program or remake tape.)
- 170 Editing has been attempted in program numbered 8000 to 9999.
- 172 Macro pattern repeat instruction contains M-, T-, or C-code command.
- 173 Macro pattern repeat instruction contains illegal G-code command.
- 174 Macro calling block contains macro pattern repeat instruction.
- 175 Macro calling block contains G93 and G94 commands.
- 183 G56 block has incorrect I- or J-data, which must have relationship of  $-10 \leq n < 9$ . (Correct program or remake tape.)
- 184 Specified pattern memory/recall number is not 1 to 5. (Correct program or remake tape.)
- 185 Another macro-saving was attempted during macro-saving, V-code command is given despite absence of U-code command, or U- and V-macro numbers do not agree. (Correct program or remake tape.)
- 186 Illegal macro number is entered. (Correct program or remake tape.)

- 187 Macro saving is attempted in excess of available memory. (Correct program or remake tape.)
- 188 Macro that is not in memory is called. (Correct program or remake tape.)
- 189 More than three levels of macros are called, or saving of more than 15 macros is attempted for macro numbers 90 to 99. (Correct program or remake tape.)
- 190 G75 or G76 block has no Q- or W-data. (Correct program or remake tape.)
- 491 G75 or G76 block has incorrect Q-data. (Correct program or remake tape.)
- 192 Macro that is not in memory is called in G75 or G76 block. (Correct program or remake tape.)
- 193 None of MULTI-PART MODE keys is lighted in spite of G75 or G76 command. (Press to light required key.)
- 194 G75 or G76 is commanded during macro saving. (Correct program or remake tape.)
- 195 G77 block has no J-, Q-, or W-data. (Correct program or remake tape.)
- 196 G75 is commanded despite that G98 block has zero P-data, or G76 is commanded despite that G98 has zero K-data. (Correct program or remake tape.)
- 197 G76 block has Q-data that is not 1 or 3 despite that G98 block has zero P-data. Or G75 block has Q-data that is not 1 or 2 despite that G98 has zero K-data. (Correct program or remake tape.)
- 198 G73 block has no Q- or W-data, or incorrect Q-data. (Correct program or remake tape.)
- 199 Macro that is not in memory is called in G73 or G77 block. (Correct program or remake tape.)

**OVERTRAVEL ALARMS**

Refer to Part III, Operation, "Interruption & restarting", for the procedure to release these alarms.

- 210 X-axis stroke limit switch on plus side has been actuated.
- 211 X-axis stroke limit switch on minus side has been actuated.
- 212 X axis has traveled beyond stored stroke limit "1" in plus direction.
- 213 X axis has traveled beyond stored stroke limit "1" in minus direction.
- 214 X axis has traveled beyond stored stroke limit "2" in plus direction.
- 215 X axis has traveled beyond stored stroke limit "2" in minus direction.
- 220 Y-axis stroke limit switch on plus side has been actuated.
- 221 Y-axis stroke limit switch on minus side has been actuated.
- 222 Y axis has traveled beyond stored stroke limit "1" in plus direction.
- 223 Y axis has traveled beyond stored stroke limit "1" in minus direction.
- 224 Y axis has traveled beyond stored stroke limit "2" in plus direction.
- 225 Y axis has traveled beyond stored stroke limit "2" in minus direction.
- 230 T-axis stroke limit switch on plus side has been actuated.
- 231 T-axis stroke limit switch on minus side has been actuated.
- 240 C-axis stroke limit switch on plus side has been actuated.
- 241 C-axis stroke limit switch on minus side has been actuated.
- 250 Z-axis stroke limit switch on plus side has been actuated.
- 251 Z-axis stroke limit switch on minus side has been actuated.
- 252 Z axis has traveled beyond stored stroke limit "1" in plus direction.
- 253 Z axis has traveled beyond stored stroke limit "1" in minus direction.

## **APC (ABSOLUTE PULSE-CODER) ALARMS**

Contact AMADA if any of these alarms has been caused — except alarm Nos. 310, 320, 330, 340, and 350.

- 310 X axis must be zero-returned manually.
- 311 Communication error has been caused with X-axis APC.
- 312 Overtime error has been caused with X-axis APC.
- 313 Framing error has been caused with X-axis APC.
- 344 Parity error has been caused with X-axis APC.
- 315 Missed-pulse error has been caused with X-axis APC.
- 316 Voltage of X-axis APC cell has been reduced briefly to level that cannot hold data.
- 317 X-axis APC cell has almost been consumed and must be changed.
- 318 Voltage of X-axis APC cell has been reduced briefly (including times when power was turned off) to level that it must be changed.
- 320 Y axis must be zero-returned manually
- 321 Communication error has been caused with Y-axis APC.
- 322 Overtime error has been caused with Y-axis APC.
- 323 Framing error has been caused with Y-axis APC.
- 324 Parity error has been caused with Y-axis APC.
- 325 Missed-pulse error has been caused with Y-axis APC.
- 326 Voltage of Y-axis APC cell has been reduced briefly to level that cannot hold data.
- 327 Y-axis APC cell has almost been consumed and must be changed.
- 328 Voltage of Y-axis APC cell has been reduced briefly (including times when power was turned off) to level that it must be changed.
- 330 T axis must be zero-returned manually

- 331 Communication error has been caused with T-axis APC.
- 332 Overtime error has been caused with T-axis APC.
- 333 Framing error has been caused with T-axis APC.
- 334 Parity error has been caused with T-axis APC.
- 335 Missed-pulse error has been caused with T-axis APC.
- 336 Voltage of T-axis APC cell has been reduced briefly to level that cannot hold data.
- 337 T-axis APC cell has almost been consumed and must be changed.
- 338 Voltage of T-axis APC cell has been reduced briefly (including times when power was turned off) to level that must be changed.
- 340 C axis must be zero-returned manually.
- 341 Communication error has been caused with C-axis APC.
- 342 Overtime error has been caused with C-axis APC
- 343 Framing error has been caused with C-axis APC
- 344 Parity error has been caused with C-axis APC.
- 345 Missed-pulse error has been caused with C-axis APC.
- 346 Voltage of C-axis APC cell has been reduced briefly to level that cannot hold data.
- 347 C-axis APC cell has almost been consumed and must be changed.
- 348 Voltage of C-axis APC cell has been reduced briefly (including times when power was turned off) to level that must be changed.
- 350 Z axis must be zero-returned manually.
- 351 Communication error has been caused with Z-axis APC
- 352 Overtime error has been caused with Z-axis APC.
- 353 Framing error has been caused with Z-axis APC.

- 354 Parity error has been caused with Z-axis APC.
- 355 Missed-pulse error has been caused with Z-axis APC.
- 356 Voltage of Z-axis APC cell has been reduced briefly to level that cannot hold data.
- 357 Z-axis APC cell has almost been consumed and must be changed.
- 358 Voltage of Z-axis APC cell has been reduced briefly (including times when power was turned off) to level that it must be changed.

### **SERVOSYSTEM ALARMS**

Contact AMADA if any of these alarms has been caused.

- 400 Overload signal is on for X or Y axis.
- 401 Velocity control ready (VRDY) signal is off for X or Y axis
- 402 Overload signal is on for T or C axis.
- 403 VRDY signal is off for T or C axis.
- 404 VRDY signal is not turned off despite that PRDY (position control ready) signal has been turned off. Or VRDY signal is on despite that PRDY signal has not been turned on when power was turned on.
- 405 Machine axes may not have been returned to their origins properly due to servosystem or NC irregularity.
- 407 Overload signal is on for Z axis. Or VRDY signal is off for Z axis.
- 410 X-axis positional deviation is larger than set data when stopped.
- 411 X-axis positional deviation is larger than set data during travel.
- 413 X-axis positional deviation has exceeded  $\pm 32767$  or DA converter's velocity setting is outside required range of +8191 to -8192. (This alarm is caused normally due to parameter setting error.)

- 414 Alarm condition has been caused in X-axis digital servosystem.
- 415 Velocity of over 511875 detection units per second has been instructed to X axis. (This alarm is caused due to error in CMR parameter setting.)
- 416 irregularity (wire breakage, etc.) has been caused in X-axis pulse-coder's position detection system.
- 417 Error has been found in parameter setting for X-axis digital servosystem.
- 420 Y-axis positional deviation is larger than set data when stopped.
- 421 Y-axis positional deviation is larger than set data during travel.
- 423 Y-axis positional deviation has exceeded  $\pm 32767$  or DA converter's velocity setting is outside required range of +8191 to -8192. (This alarm is caused normally due to parameter setting error.)
- 424 Alarm condition has been caused in Y-axis digital servosystem.
- 425 Velocity of over 511875 detection units per second has been instructed to Y axis. (This alarm is caused due to error in CMR parameter setting.)
- 426 Irregularity (wire breakage, etc.) has been caused in Y-axis pulse-coder's position detection system.
- 427 Error has been found in parameter setting for Y-axis digital servosystem.
- 430 T-axis positional deviation is larger than set data when stopped.
- 431 T-axis positional deviation is larger than set data during travel.
- 433 T-axis positional deviation has exceeded  $\pm 32767$  or DA converter's velocity setting is outside required range of +8191 to -8192. (This alarm is caused normally due to parameter setting error.)
- 434 Alarm condition has been caused in T-axis digital servosystem.
- 435 Velocity of over 511875 detection units per second has been instructed to T axis. (This alarm is caused due to error in CMR parameter setting.)

- 436 Irregularity (wire breakage, etc.) has been caused in T-axis pulse-coder's position detection system.
- 437 Error has been found in parameter setting for T-axis digital servosystem.
- 440 C-axis positional deviation is larger than set data when stopped.
- 441 C-axis positional deviation is larger than set data during travel.
- 443 C-axis positional deviation has exceeded  $\pm 32767$  or DA converter's velocity setting is outside required range of +8191 to -8192. (This alarm is caused normally due to parameter setting error.)
- 444 Alarm condition has been caused in C-axis digital servosystem.
- 445 Velocity of over 511875 detection units per second has been instructed to C axis. (This alarm is caused due to error in CMR parameter setting.)
- 446 Irregularity (wire breakage, etc.) has been caused in C-axis pulse-coder's position detection system.
- 447 Error has been found in parameter setting for C-axis digital servosystem.
- 450 Z-axis positional deviation is larger than set data when stopped.
- 451 Z-axis positional deviation is larger than set data during travel.
- 453 Z-axis positional deviation has exceeded  $\pm 32767$  or DA converter's velocity setting is outside required range of +8191 to -8192. (This alarm is caused normally due to parameter setting error.)
- 454 Alarm condition has been caused in Z-axis digital servosystem.
- 455 Velocity of over 511875 detection units per second has been instructed to Z axis. (This alarm is caused due to error in CMR parameter setting.)
- 456 Irregularity (wire breakage, etc.) has been caused in Z-axis pulse-coder's position detection system.
- 457 Error has been found in parameter setting for Z-axis digital servosystem.

**PMC ALARMS**

Contact AMADA if any of these alarms has been caused.

- 600 Illegal command has caused interruption.
- 601 Parity error has been caused in RAM.
- 602 Error has been caused in serial data transmission.
- 603 Watchdog error has been caused.
- 604 Parity error has been caused in ROM.
- 605 Ladder diagram exceeds storage capacity.

**LASER ALARMS**

- 660 Allowance for Z-axis tracking sensor is excessive. (Reset NC.)
- 661 AD converter "1" has irregularity. (Contact AMADA.)
- 662 AD converter "2" has irregularity. (Contact AMADA.)
- 663 RF power source has irregularity. (Contact AMADA.)
- 665 Shutter has irregularity. (Contact AMADA.)
- 666 Some discharge tubes are not functioning. (Contact AMADA.)
- 667 Temperature in laser oscillator has greatly increased (Take measures to lower ambient temperature.)
- 668 Discharged CO<sub>2</sub> laser beam had been reflected back into resonator. (Decrease laser output.)
- 669 Laser interface printed circuit board has irregularity in power supply. (Contact AMADA.)
- 670 Cooling unit is not ready for operation. (Check and prepare unit.)
- 671 Assist gas supply is not ready for operation. (Check remaining pressure in bomb.)

- 672 Cooling water level is low. (Check cooling unit.)
- 673 Laser gas pressure is low. (Check remaining pressure in bomb.)
- 674 Air blower is overheated. (Contact AMADA.)
- 675 Cooling water temperature is too low and dew is formed on piping in RF power source. (Change setting to higher temperature.)
- 676 CO2 laser output or discharge voltage has been reduced (Contact AMADA.)
- 677 Laser beam absorber is overheated. (Contact AMADA.)
- 678 Laser gas pressure in discharge tube is not normal. (Contact AMADA.)
- 679 EMERGENCY STOP button has been pressed and is locked. (Remove cause of stop and unlock button.)
- 680 Laser gas is leaking from discharge tube or gas piping. (Contact AMADA.)
- 681 Required pressure has not been obtained inside discharge tubes in given time. (Contact AMADA.)
- 682 Negative pressure sensor has irregularity. (Contact AMADA.)
- 683 Discharge tube is faulty, assist gas is not being discharged, or shutter is not opened. (Contact AMADA.)

### **OVERHEAT ALARMS**

Contact AMADA if any of these alarms has been caused.

- 700 Master printed circuit board is overheated.
- 702 X- or Y-axis AC servomotor is overheated.
- 703 Z-axis AC servomotor is overheated.

**SYSTEM ALARMS**

Contact AMADA if any of these alarms has been caused.

- 910 Low-byte parity error has been caused in RAM.
- 911 High-byte parity error has been caused in RAM.
- 912 Low-byte parity error has been caused in RAM shared with digital servosystem.
- 913 High-byte parity error has been caused in RAM shared with digital servosystem.
- 914 Parity error has been caused in local RAM for digital servosystem.
- 920 Watchdog alarm has been caused.
- 922 Servosystem error has been caused for C axis.
- 930 Abnormal interrupt error has been caused in CPU.
- 940 Digital servosystem printed circuit board is faulty.
- 941 Error has been caused in memory printed circuit board.
- 950 Fuse is blown. (Use +24E FX14 fuse for replacement.)
- 960 Stack overflow has been caused.
- 998 Parity error has been caused in ROM.

# INSTALLATION OF EQUIPMENT

This section describes the procedure for the installation of the machine and equipment.

## LOCATION

Determine the location of installation and the required space for the machine, NC-electrical control cabinet, laser equipment, etc. and provide the required foundation according to the plan supplied by AMADA.

Be sure to reserve ample space around the machine and its equipment to allow tool storage as well as obstacle-free worksheet handling and maintenance operation.

The location requires the following conditions:

- It is well away from any equipment that produces vibration, dust, fumes, or electrical noise and they will not affect the machine and its equipment. Take necessary protection measures against them if unavoidable.
- It is outside of inflammable or contaminable environments and will not be directly exposed to direct sunlight, or hot or cold air. The ambient temperature should be between 5 to 40°C (41 to 104°F) with a relative humidity of below 75% and without dew condensation.

## LIFTING



**DANGER**

Have qualified operators perform the lifting work.



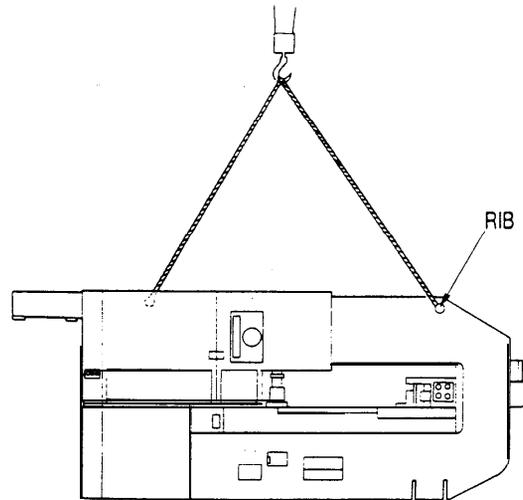
**DANGER**

Use a crane and wire ropes that have ample capacities to lift each equipment.

### MACHINE

The machine weighs 15 metric tons (17 short tons).

Apply the wire ropes to the four ribs projecting from the upper machine frame. Balance the machine carefully when lifting it and lower it slowly with care protecting it against impacts.



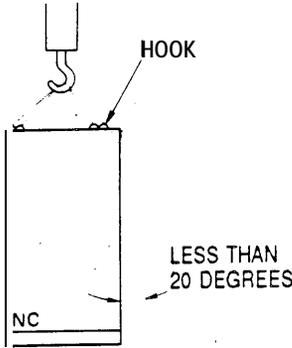
### LASER OSCILLATOR

AMADA will install the laser oscillator.

NC & DUST COLLECTOR UNITS

The NC unit weighs 600 kg (1400 lb). The dust collector unit weighs 110 kg (250 lb).

Apply the wire ropes to the four hooks on the top of each unit. Balance the unit carefully when lifting it and lower it slowly with care protecting it against impacts.



**CAUTION**

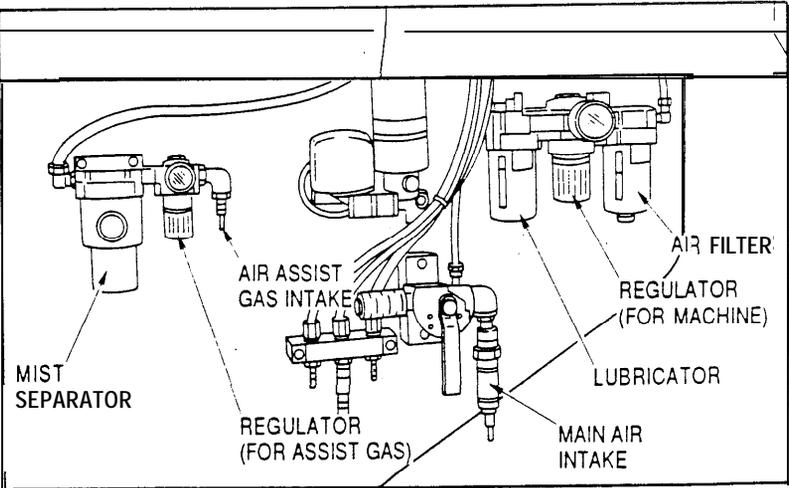
Keep the NC unit upright — leaning no more than 20° degrees-when handling it.

**AIR SUPPLY**

Connect an air dryer, which is compatible with the required compressed air (see below), with the shop air source or an air compressor by using suitable pipes or hoses. Then connect the air dryer to the main air intake on the back of the machine by using a hose with an inner diameter of 1/2". When using air as assist gas, the air dryer must also be connected to the air assist gas intake on the back of the machine by using a hose with an inner diameter of 1/4".

**CAUTION**

Install the air compressor, if used, as close to the machine as possible.



COMPRESSED AIR REQUIREMENTS

When assist gas is air:  
8.5 kgf/cm<sup>2</sup> (121 psi)  
600 liters/min (21.2 ft<sup>3</sup>/min) or 3.7 kW compressor

When assist gas is other than air:  
5.0 kgf/cm<sup>2</sup> (72 psi)  
300 liters/min (10.6 ft<sup>3</sup>/min) or 2.2 kW compressor

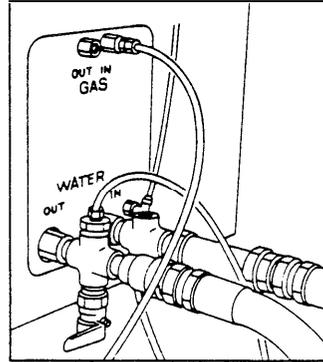
Make adjustments (refer to Part V, Maintenance) after the connections are completed.

## LASER GAS SUPPLY



**WARNING** Fix the laser gas bomb carefully so that it will not move or fall down accidentally.

Connect the primary connector of the regulator directly to the laser gas bomb. Then connect the regulator's secondary connector with the "GAS IN" connector on the laser oscillator by using the accessory hose.



### GAS REQUIREMENTS

Ratio of mixed gases: 5% CO<sub>2</sub>, 55% N<sub>2</sub>, 40% He  
 Accuracy of ratio, Less than ±5%  
 Purity of gases: Over 99.99%

### REGULATOR (with stop valve) REQUIREMENTS

Maximum flow rate: 6 m<sup>3</sup>/h (220 ft<sup>3</sup>/h)  
 Primary gauge: Readable up to 250 kgf/cm<sup>2</sup> (3600 psi)  
 Secondary gauge: Readable up to 3 kgf/cm<sup>2</sup> (45 psi)  
 Primary connector: Compatible with born b connector  
 Secondary connector: 6 mm O.D.

## ASSIST GAS SUPPLY

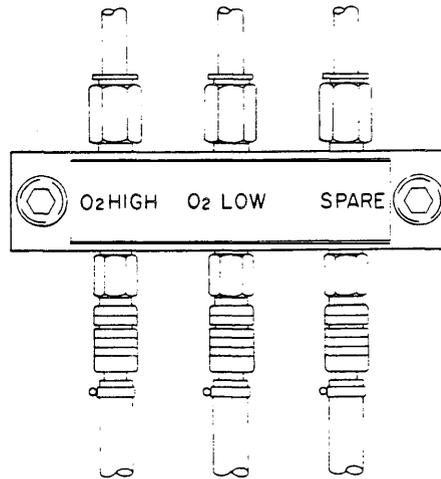


**DANGER** Have the assist gas bomb supplier connect the bomb and the evaporator.



**WARNING** Fix the assist gas bomb carefully so that it will not move or fall down accidentally.

Connect the assist gas bomb with an evaporator, which has a capacity of 20 m<sup>3</sup>/h (710 ft<sup>3</sup>/h) and is equipped with a pressure gauge. Then connect the evaporator to the regulator's primary connector and the regulator's secondary connector 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 & INTAKES USED

Liquefied O<sub>2</sub>: O<sub>2</sub> HIGH or O<sub>2</sub> LOW intake

Liquefied N<sub>2</sub>: SPARE intake

#### REGULATOR

Maximum flow rate: 200 liters/min (7.1ft<sup>3</sup>/min)

Secondary gauge: Readable up to 15kgf/cm<sup>2</sup> (220 psi)

Primary connector: Compatible with evaporator connector

Secondary connector: 15 mm I.D for pipe, 1/4" I.D for hose

#### CONNECTING PIPES & HOSES

Born b-regulator: Copper pipe with thickness of over 1 mm or hose, both of compatible size.

Regulator-machine: Copper pipe with thickness of over 1 mm and 15 mm I.D. or hose with 1/4" I.D.

## ELECTRIC POWER SUPPLY



Have a qualified electrician carry out the electrical connection work.

Connect the primary terminals of the accessory transformer unit with the shop circuit breaker, which is compatible with the shop power supply, by using a 3-phase cable of the size, which also is compatible with the shop power supply (see next page for the required voltage, etc.)

Electrical wiring and connections from the transformer's secondary terminals to the machine will be made by an AMADA engineer.

#### POWER SUPPLY REQUIREMENTS

230/400/460V ( $\pm 10\%$ ), AC, 50/60 Hz (fl Hz), 75 kVA, 3-phase

CAUTION

Use separate sources for an air compressor, cooling unit, welder, or equipment that uses a large motor, which is likely to cause noise or voltage fluctuation, adversely affecting the operation of the laser oscillator and the NC.

Upon completion of the connections turn on the power, open the cover for the punching mechanism on the back of the machine, and confirm that the flywheel is rotating in the arrow-indicated direction. If not, turn off the power immediately and interchange connections of the 3-phase cable at two terminals in the machine circuit breaker inside the electrical control cabinet.

#### HYDRAULIC OIL SUPPLY

Fill the hydraulic oil in the clutch-brake hydraulic unit and the laser oscillator's air blower and vacuum pump. Refer to Part V, Maintenance for procedures and specified hydraulic oils.

#### RUST PREVENTIVE GREASE REMOVAL

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

CAUTION

Do not use a solvent to remove grease — it will damage the surface coating.

## SPECIFICATIONS

### MACHINE

Max. worksheet size	3660 x 1270 mm (444 x 50")
Max. worksheet thickness	6.0 mm (0.24") 3.0 mm (0.12") for stainless steel when laser-cutting
Max. worksheet weight	100 kg (220 lb)
Carriage (X axis) travel	1830 mm (72")
Table (Y axis) travel	1270 mm (50")
Laser head (Z axis) travel	300 mm (12")
Max. cutting feedrate (X & Y)	15 m/min (49 fpm) for laser-cutting
Max. rapid feed	X & Y: 50 m/min (164 fpm) Z: 12 m/min (39 fpm) T: 30 rpm C: 60 rpm
Positioning accuracy	±0.03 mm/1000 mm
Positioning repeatability	±0.01 mm
Punching accuracy	±0.1 mm (0.004")
Press capacity	30 metric tons (33 short tons)
Press stroke	32 mm
No. of press strokes	350 strokes/min
Max. punching hits	200 hits/min at 25.4 mm (1") pitch
No. of turret stations	58 (2 equipped with auto-index)
Compressed air supply	Over 8.5 kgf/cm <sup>2</sup> (121 psi), 603 liters/min (21.2 ft <sup>3</sup> /min); or 5.0 kgf/cm <sup>2</sup> (72 psi) 300 liters/min (10.6 ft <sup>3</sup> /min)
Power supply	200V(±10%), AC, 50/60 Hz (±1 Hz), 37 kVA. 3-phase
Dimensions (W x H x D)	5570 x 2343 x 4544 mm (219.3 x 92.3 x 178.9")
Weight	15 metric tons (17 short tons)

### NC UNIT

Model	AMADAN-05PL·A
Controlled axes	X, Y, Z, T, C (3 axes simultaneously controlled)
Positioning method	Absolute or relative
Minimum dimensional unit	0.01 mm (0.001 "), 0.01 deg
Memory capacity	Equivalent to 320 m (1040 ft)
I/O tape code	ISO or EIA
I/O interface	RS232C
Dimensions (W x H x D)	1900 x 1700 x 700 mm (74.9 x 67.0 x 27.6")
Weight	600 kg (1400 lb)

**LASER OSCILLATOR**

Model	FANUC C-I 00011
Rated output	1 000W
Output range	0 to 1000W
Frequency range	5 to 2000 Hz
Duty range	0 to 100%
Laser beam	CO2 laser
Laser beam wavelength	10.6 μm
Laser beam mode	Low-dimension, single
Laser beam diameter	Approx. 17 mm (0.67") at source
Laser beam dispersion angle	Below 2 mrad
Laser gas supply	1.5 kgf/cm <sup>2</sup> (21.4 psi), 20 liters/h (0.71 ft <sup>3</sup> /h)
Cooling water supply	3.5±1kgf/cm <sup>2</sup> (49.8±14.2 psi), 50 liters/min (13.3 US gal/min)
Bend mirrors	2 mirrors equipped
Circular polarization device	Equipped
Dimensions (W x H x D)	2115 x 1500 x 750 mm (83.3 x 59.1 x 29.6")
Weight	1300 kg (2900 lb)

**MILD STEEL**

(The laser duty is shown for reference only and should be set appropriately.)

Worksheet thickness	Cutting rate	Laser output	Laser frequency	Laser duty	Asst. gas (O <sub>2</sub> ) pressure	Dwell time
mm (inch)	mm/min (ipm)	watt	Hz	%	kgf/cm <sup>2</sup>	sec
1.2 (0.05)	Piercing	1500	80	25	1	1.0
1.2 (0.05)	300 (11.8)	400	50	20	1-2	
	1200 (47.2)	1500	300	30	1~2	
	2500 (98.4)	1250	2000	45	1-2	
	4000 (157.5)	1500	1500	80	1-2	
1.6 (0.06)	Piercing	1500	80	25	1	1.0
1.6 (0.06)	300 (11.8)	1500	50	15	1-2	
	1200 (47.2)	1500	300	35	1-2	
	2500 (98.4)	1250	2000	50	1-2	
	4000 (157.5)	1500	1500	80	1-2	
2.3 (0.09)	Piercing	1500	80	25		1.0
2.3 (0.09)	300 (11.8)	1500	100	15	1-2	
	1200 (47.2)	1500	2000	30	1-2	
	2500 (98.4)	1500	2000	50	1-2	
	4000 (157.5)	1500	2000	80	1-2	
3.2 (0.13)	Piercing	1500	80	25		1.5
3.2 (0.13)	300 (11.8)	1500	100	15	1-2	
	1200 (47.2)	1000	1000	50	1-2	
	2500 (98.4)	1500	2000	80	1-2	
	3200 (126.0)	1500	1500	90	1-2	
4.5 (0.18)	Piercing	1500	80	25		2.0
4.5 (0.18)	300 (11.8)	1500	80	30		
	800 (31.5)	1250	300	40		
	1500 (59.1)	1500	2000	60		
	2000 (78.7)	1500	1500	95		
6.0 (0.35)	Piercing	1500	80	25		3.0
6.0 (0.35)	200 (7.9)	1500	200	25		
	600 (23.6)	1500	400	30		
	1200 (47.2)	1500	1500	75		
	1800 (70.9)	1500	1500	90		

**STAINLESS STEEL**

(The laser duty is shown for reference **only** and should be set appropriately.)

Worksheet thickness	Cutting rate	Laser output	Laser frequency	Laser duty	Asst. gas (O <sub>2</sub> ) pressure	Dwell time
mm (inch)	mm/min (ipm)	watt	HZ	%	kgf/cm <sup>2</sup>	sec
1.0 (0.04)	Piercing	1500	80	25	1	1.0
1.0 (0.04)	300 (11.8)	1500	100	10	5	
	4200 (47.2)	1250	500	20	5	
	2500 (98.4)	1500	1500	30	5	
	4000 (157.5)	1500	2000	30	5	
1.5 (0.06)	Piercing	1500	80	25		1.0
1.5 (0.06)	300 (11.8)	1000	100	10	5	
	1200 (47.2)	1500	1000	15	5	
	2500 (98.4)	1500	2000	30	5	
	4000 (157.5)	1500	2000	40	5	
2.0 (0.08)	Piercing	1500	80	25	1	1.0
2.0 (0.08)	300 (11.8)	1000	100	10	5	
	1200 (47.2)	1500	500	20	5	
	2500 (98.4)	1500	1000	60	5	
	4000 (157.5)	1500	1500	90	5	
3.0 (0.12)	Piercing	1500	80	25		1.5
3.0 (0.12)	300 (11.8)	1500	50	10	5	
	800 (31.5)	1250	1000	20	5	
	1500 (59.1)	1000	500	60	5	
	2500 (98.4)	1250	500	80	5	
4.0 (0.16)	Piercing	1500	80	25		2.0
4.0 (0.16)	200 (7.9)	1500	50	10	5	
	400 (15.7)	1500	500	30	5	
	800 (31.5)	1500	1000	20	5	
	1200 (47.2)	1500	500	40	5	
6.0 (0.24)	Piercing	1500	80	25		3.0
6.0 (0.24)	100 (3.9)	1500	100	20	5	
	200 (7.9)	1500	30	20	5	
	400 (15.7)	1500	50	35	5	
	600 (23.6)	1500	50	45	5	

**STAINLESS STEEL** (optional **CLEAN CUT** accessory)(The laser duty is shown for reference **only** and should be set appropriately.)

Worksheet thickness	Cutting rate	Laser output	Laser frequency	Laser duty	Asst. gas (N <sub>2</sub> ) pressure	Dwell time
mm (inch)	mm/min (ipm)	watt	HZ	%	kgf/cm <sup>2</sup>	sec
1.0 (0.04)	Piercing	<b>1500</b>	80	95	8	1.0
1.0 (0.04)	300 (11.8)	1500	150	10	8	—
	<b>1200</b> (47.2)	<b>1500</b>	1000	25	8	—
	2500 (98.4)	1500	2000	65	8	—
	3500 (137.8)	1500	2000	100	8	—
1.5 (0.06)	Piercing	1500	80	95	8	<b>1.0</b>
1.5 (0.06)	300 (11.8)	1500	300	<b>15</b>	8	—
	1200 (47.2)	1500	1000	35	8	—
	2000 (78.7)	1500	2000	50	8	—
	3000 (118.1)	1500	1500	90	<b>8</b>	—
2.0 (0.08)	Piercing	1500	80	95	<b>8</b>	1.5
2.0 (0.08)	300 (11.8)	1500	300	20	<b>8</b>	—
	1200 (47.2)	<b>1500</b>	1000	45	<b>8</b>	—
	2000 (78.7)	1500	1500	80	<b>8</b>	—
3.0 (0.12)	Piercing	1500	80	95	<b>8</b>	2.0
3.0 (0.12)	300 (11.8)	1500	200	25	<b>8</b>	—
	1200 (47.2)	1500	1500	60	<b>8</b>	—
	1800 (70.9)	1500	2000	100	<b>8</b>	—

**ALUMINIUM** (optional **ALUMINIUM CUT** accessory)(The laser duty is shown for reference **only** and should be set appropriately.)

Worksheet thickness	Cutting rate	Laser output	Laser frequency	Laser duty	Asst. gas (AIR) pressure	Dwell time
mm (inch)	mm/min (ipm)	watt	HZ	%	kgf/cm <sup>2</sup>	sec
1.0 (0.04)	Piercing	1500	80	95	8	1.0
1.0 (0.04)	300 (11.8)	1500	500	30	8	—
	1200 (47.2)	1500	500	50	8	—
	2000 (78.7)	1500	500	60	8	—
	4000 (157.5)	1500	500	95	8	—
1.5 (0.06)	Piercing	1500	80	95	8	<b>1.0</b>
1.5 (0.06)	300 (11.8)	1500	1500	40	8	—
	1200 (47.2)	1500	500	55	8	—
	2000 (78.7)	1500	1000	70	8	—
	3000 (118.1)	1500	1000	95	8	—
2.0 (0.08)	Piercing	1500	80	95	8	<b>1.5</b>
2.0 (0.08)	300 (11.8)	1500	1000	50	8	—
	1200 (47.2)	1500	2000	75	8	—
	2000 (78.7)	1500	1500	80	8	—
3.0 (0.12)	Piercing	1500	80	95	8	2.0
3.0 (0.12)	300 (11.8)	1500	500	65	8	—
	800 (31.5)	1500	1500	85	8	—

## MACHINE STATUS INDICATION

The current machine status can be confirmed on the CRT screen by a number accompanied with a brief message as described below.

Nos. 01 to 23 indicate the NC status and can be shown on the ALARM/MESSAGE display by pressing the J/ALARM key together with the SELECT key.

Nos. 56 to 2055 indicate the machine status that requires action and will be automatically shown on the display.

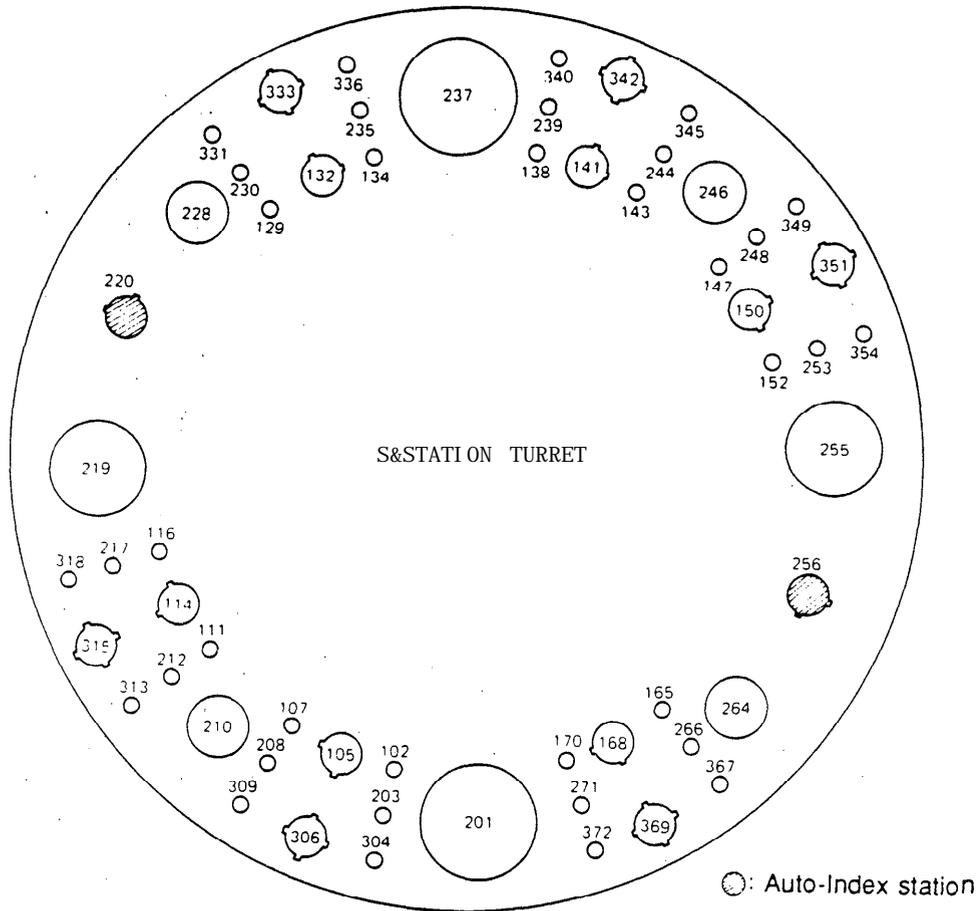
NO.	& MESSAGE	DESCRIPTION
01	EXEC MF/TF/EF	M- or T-code command is being executed or external device is being operated and FIN signal has not been received.
02	DISTRIBUTE	Axis travel command is being executed.
03	DWELL	Dwell command is being executed.
04	NOT IN-POSITION	In-position check is being performed.
05	OVERRIDE 0%	Override is set at 0%.
06	INTERLOCK	Interlock is not released.
09	REWIND	Tape is being rewound.
14	EMERGENCY/RESET	Emergency stop or reset signal is on.
17	WAIT PRESS START	Start-wait signal PFW is not turned off.
18	WAIT PRESS END	One press cycle has not yet been completed.
19	WAIT PUNCH END	One punching cycle has not yet been completed.
20	WAIT PRESS END (NBL)	Nibble-press has not yet been completed.
21	WAIT PUNCH END (NBL)	Nibble-punching has not yet been completed.
22	TOOL NOT SELECTED	Tool has not been selected.
23	MANUAL PRESS	Punching is being performed in MDI or MANUAL mode.
56	Y OFFSET OVER	Detection range has been exceeded in automatic position offset for laser head. (Contact AMADA if this message appears.)

# TOOLING

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# STATION ARRANGEMENT

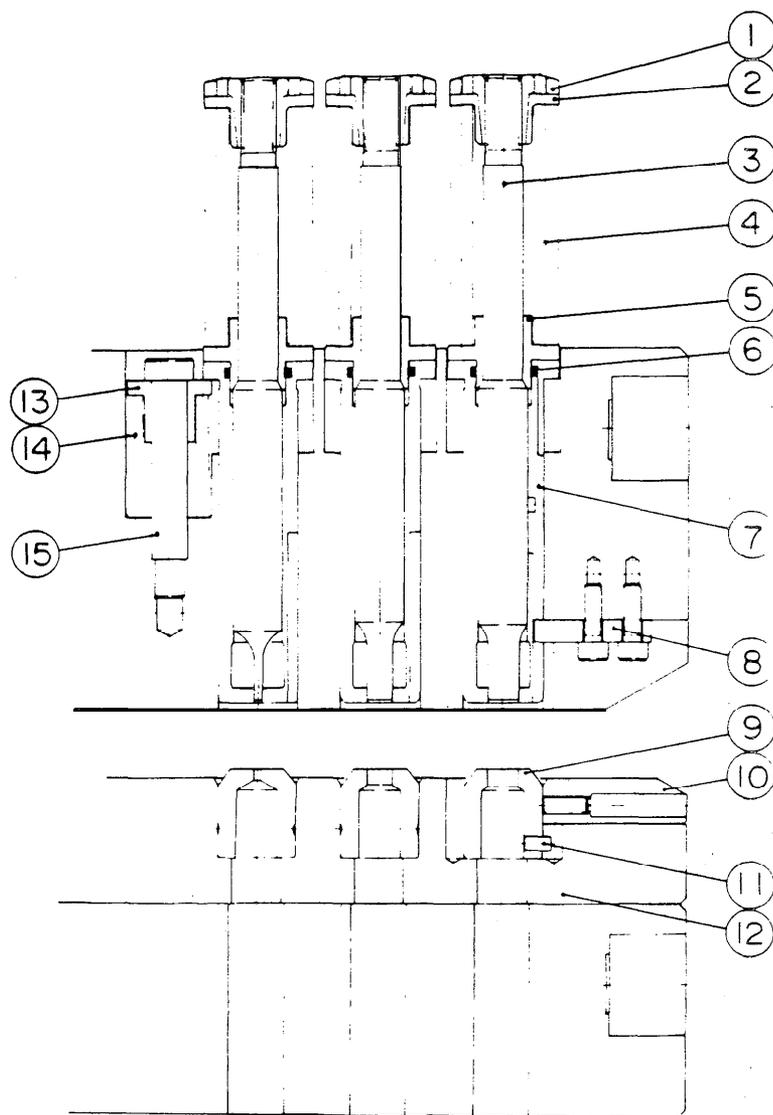


<u>Tool Type</u>	<u>Nominal Tool Size</u>	<u>Standard Punch Size</u>	<u>Number of Stations*</u>
A	1/2"	1.6 - 12.7 mm dia. (0.063" - 0.5" dia.)	36 (12)
B	1-1/4"	12.8 - 31.7 mm dia. (0.501" - 1.25" dia.)	14 (14)
C	2"	31.8 - 50.8 mm dia. (1.251" - 2" dia.)	4 (4)
D	3-1/2"	50.9 - 88.9 mm dia. (2.001" - 3.5" dia.)	2 (2)
E	4-1/2"	89.0 - 114.3 mm dia. (3.501" - 4.5" dia.)	2 (2)

\* The numerals in parentheses indicate the number of stations which can accept shaped tools.

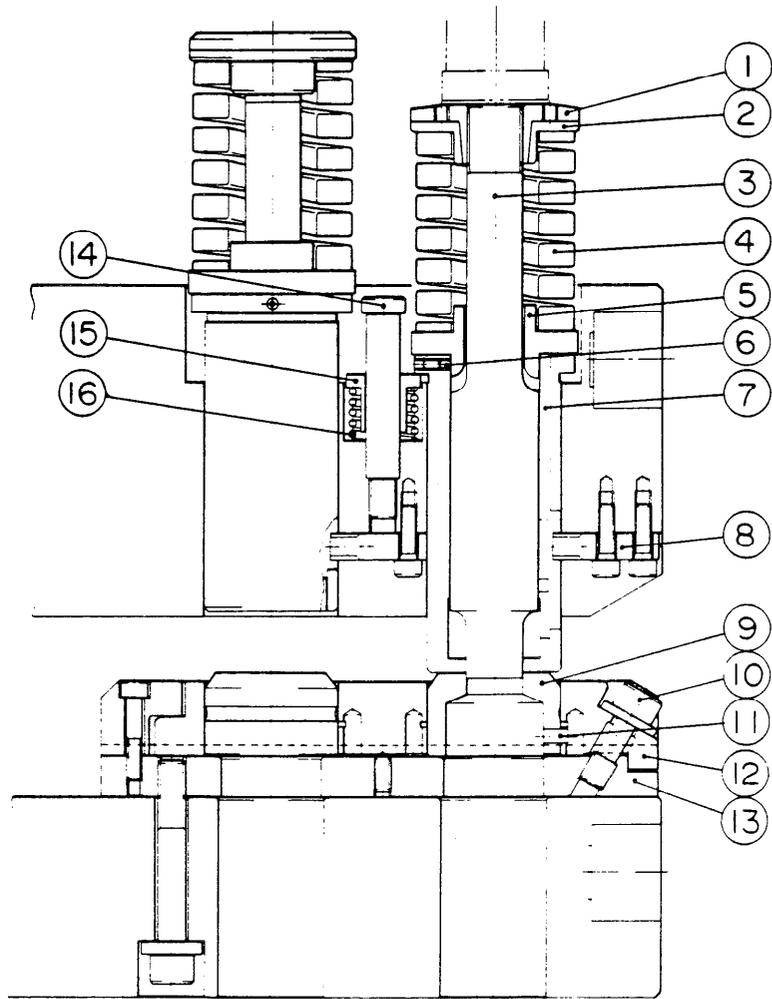
TOOL TYPES

TYPE A (1/2")



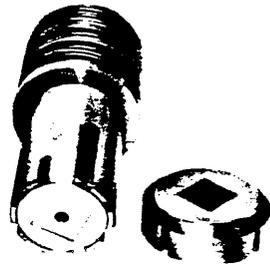
1. PUNCH HEAD
2. PUNCH HEAD COLLAR
3. PUNCH BODY
4. STRIPPING SPRING
5. RETAINER COLLAR
6. RETAINER RING
7. PUNCH GUIDE
8. GUIDE KEY
9. DIE
10. DIE SPACER
11. KEY
12. DIE HOLDER
13. LIFT RING
14. LIFT SPRING
15. SHOULDER SCREW

TYPE B (I-114")



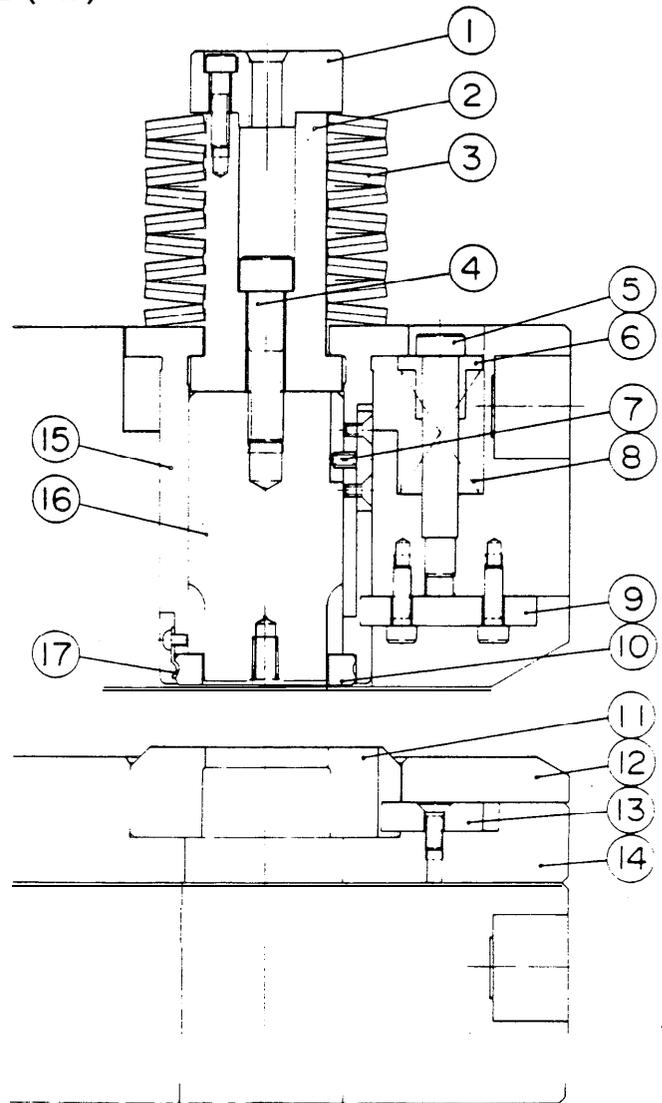
- 1. PUNCH HEAD
- 2. PUNCH HEAD COLLAR
- 3. PUNCH BODY
- 4. STRIPPING SPRING
- 5. RETAINER COLLAR
- 6. SETSCREW
- 7. PUNCH GUIDE
- a. GUIDE KEY
- 9. DIE
- 10. UPPER DIE HOLDER  
FIXING BOLT
- 11. KEY
- 12. UPPER DIE HOLDER
- 13. LOWER DIE HOLDER
- 14. SHOULDER SCREW
- 15. LIFT RING
- 16. LIFT SPRING

TYPES C (2"), D (3-W") AND E (4-W')



(Type C)

1. PUNCH HEAD
2. PUNCH DRIVER
3. STRIPPING SPRING
4. PUNCH TIP FIXING BOLT
5. SHOULDER SCREW
6. LIFT RING
7. PUNCH KEY
8. LIFT SPRING
9. GUIDE KEY
10. STRIPPER PLATE
11. DIE
12. DIE SPACER
13. DIE KEY
14. DIE HOLDER
15. PUNCH GUIDE
16. PUNCH TIP
17. STRIPPER PLATE SPRING



(Type C)

## MOUNTING AND DISMOUNTING PUNCHES AND DIES

### IN MANUAL MODE:

1. Make sure that the AXES REFERENCE light is on.
2. Turn the SAFETY DEVICE switch to MAINTENANCE, unlighting the SAFETY DEVICE ON light.
3. Turn the MODE CHANGE switch to ON.
4. Press the MANUAL mode key, lighting its light.
5. Return the MODE CHANGE switch to OFF.
6. Turn the TOOL CHANGE switch to ON, lighting the TOOL CHANGE ON light.
7. Open the tool change doors and the front turret door.
8. Make sure that the INDEX PIN OUT light is on.
9. Rotate the turret to bring the required station to the tool change position by pressing one of the TURRET ON buttons together with the TURRET JOG ON/Z AXIS O.T. RELEASE button.

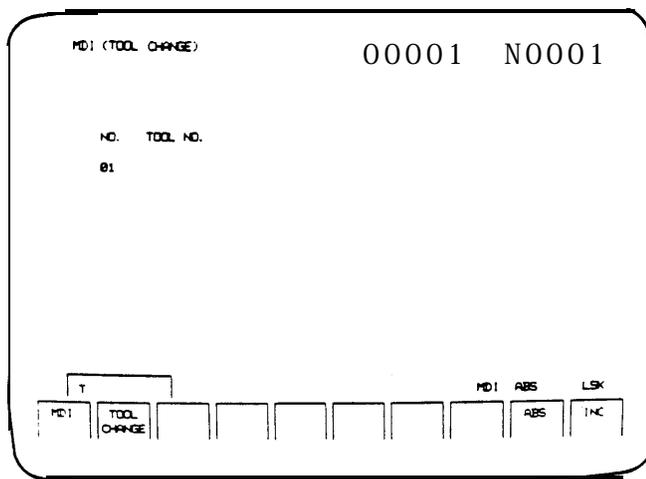


**DANGER** Perform this step by oneself as far apart as possible from the turret.

10. Turn the INDEX PIN switch to the right, lighting the INDEX PIN IN light.
11. Mount or dismount the tools according to their type as described below.
12. Turn the INDEX PIN switch to the left, lighting the INDEX PIN OUT light.
13. Close the tool change doors and the turret door.
14. Turn the TOOL CHANGE switch to OFF, unlighting the TOOL CHANGE ON light.
15. Turn the SAFETY DEVICE switch to OPERATION, lighting the SAFETY DEVICE ON light.
16. Press the RESET key to reset the NC.

## IN MDI MODE:

1. Make sure that the AXES REFERENCE light and the SAFETY DEVICE ON light are OR.
2. Turn the MODE CHANGE switch to ON.
3. Press the MDI mode key, lighting its light.
4. Return the MODE CHANGE switch to OFF.
5. Press the SELECT key and the ←/MDI key together, showing the MDI display on the CRT screen.
6. Press the TOOL CHANGE soft key, changing the display to the MDI (TOOL CHANGE) display.

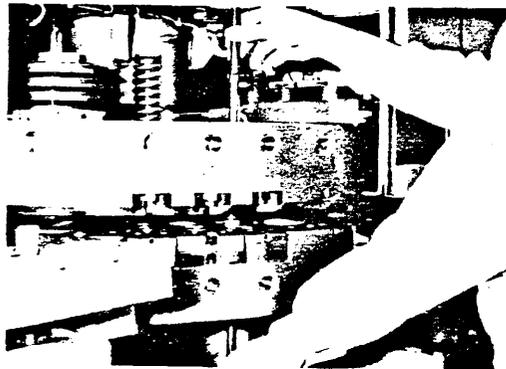
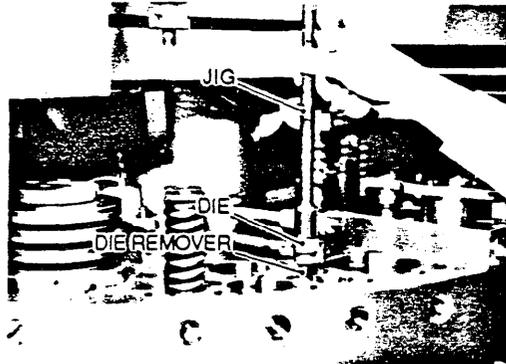


7. Key-in the required number for the turret station and then press the INPUT key.
8. Press a START button. The specified turret station will be moved to the tool change position.
9. Turn the SAFETY DEVICE switch to MAINTENANCE, unlighting the SAFETY DEVICE ON light.
10. Turn the TOOL CHANGE switch to ON, lighting the TOOL CHANGE ON light.
11. Open the tool change doors and the front turret door.
12. Mount or dismount the tools according to their type as described below.
13. Close the tool change doors and the turret door.
14. Turn the TOOL CHANGE switch to OFF, unlighting the TOOL CHANGE ON light.
15. Turn the SAFETY DEVICE switch to OPERATION, lighting the SAFETY DEVICE ON light.
16. Press the RESET key to reset the NC.

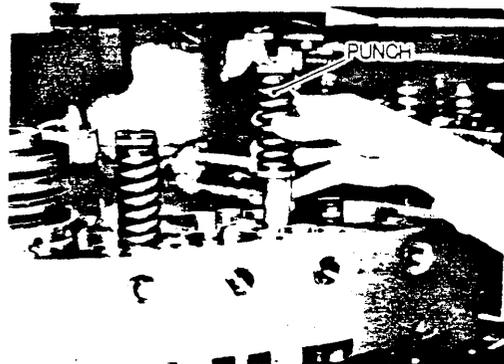
## TYPE A (1/2")

### Mounting on center and inner tracks

1. Insert the die remover up through the bottom of the lower turret until it protrudes from the top of the upper turret.
2. Place the die on the remover. Put the jig on the top of the die, and holding the die between the jig and remover, press the die down until it seats snugly into the die holder of the lower turret. Remove the jig and die remover.

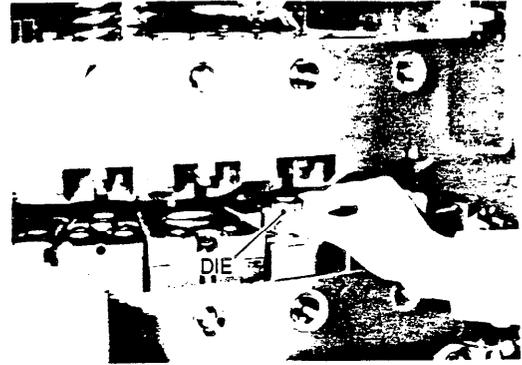


3. Insert the punch into the upper turret.



### Mounting on outer track

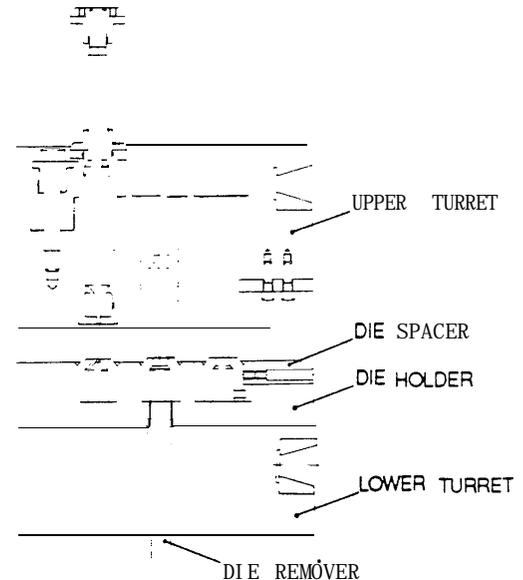
4. Remove the die spacer and insert the die into the die holder of the lower turret.
2. Push the die firmly into the die holder and make sure it is properly seated.
3. Re-install the die spacer.
4. Insert the punch into the upper turret.



- NOTE:**
- (a) Before mounting the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page 20.
  - (b) Round punches and dies can be mounted on any of the inner, center and outer tracks. However, shaped punches and dies can be mounted on only the outer track.
  - (c) When mounting a shaped punch, align the punch guide keyway with the key in the upper turret so that the orientation of the punch matches that of the die.

### Dismounting from center and inner tracks

1. Remove the punch from the upper turret.
2. Insert the die remover into the lower turret through the bottom of the lower turret.
3. Push the die upward with the die remover, and remove the die through the top of the upper turret.



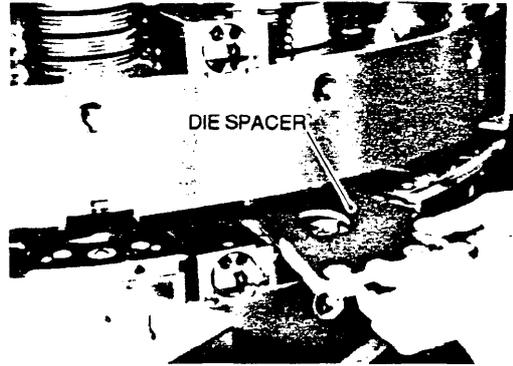
### Dismounting from outer track

1. Remove the punch from the upper turret and remove the die spacer from the lower turret.
2. Insert the die remover into the lower turret through the bottom of the lower turret.
3. Push the die upward with the die remover, and remove the die between the upper and lower turrets.

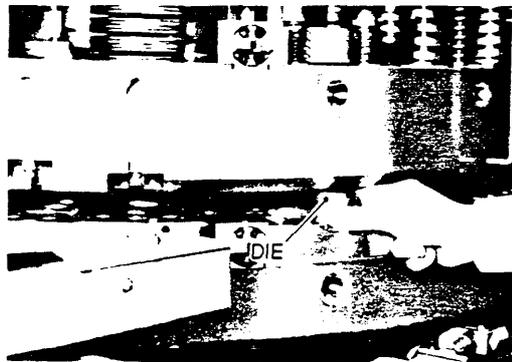
## TYPE B (1-1/4")

### Mounting on auto-index stations

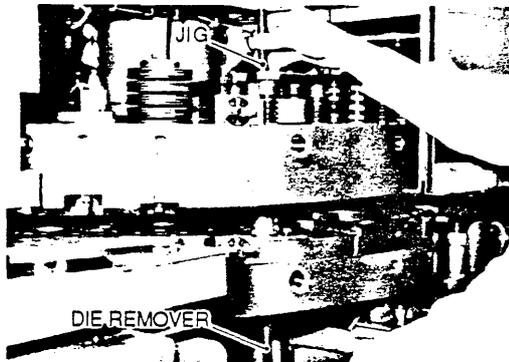
1. Remove the bolt securing the die spacer, and remove the die spacer.



2. Insert the die into the die holder of the lower turret.

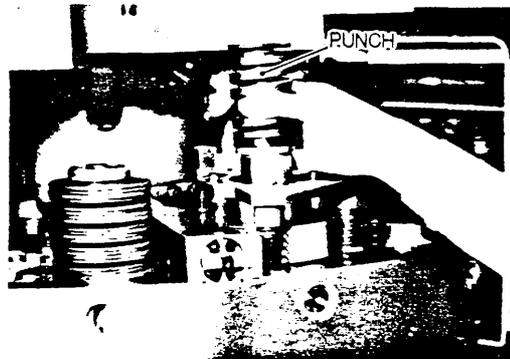


3. Insert the die remover up through the bottom of the lower turret. Insert the jig down through the top of the upper turret. Holding the die between the die remover and jig, set it firmly into the die holder.



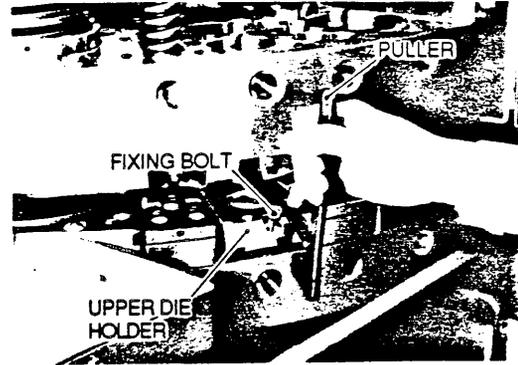
4. Re-install the die spacer and tighten the die spacer securing bolt.

5. Insert the punch into the upper turret.



### Mounting on standard stations

1. Loosen the upper die holder fixing bolt, and remove the upper die holder from the lower turret with a puller furnished as a standard accessory.



2. Insert the die into the upper die holder through the bottom of the upper die holder.
3. Re-install the upper die holder on the lower turret and tighten the upper die holder fixing bolt.
4. Insert the punch into the upper turret.



- NOTE:** (a) Before mounting the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page 20.
- (b) When mounting a shaped punch, align the punch guide keyway with the key in the upper turret so that the orientation of the punch matches that of the die.

### Dismounting from auto-index stations

1. Remove the punch from the upper turret.
2. Remove the bolt securing the die spacer, and remove the die spacer from the lower turret.
3. Push the die up with the die remover, and remove the die from the die holder.

### Dismounting from standard stations

1. Remove the punch from the upper turret.
2. Loosen the upper die holder fixing bolt, and remove the upper die holder from the lower turret with the puller.
3. Remove the die from the upper die holder by tapping the top of the die with a brass rod (standard accessory).

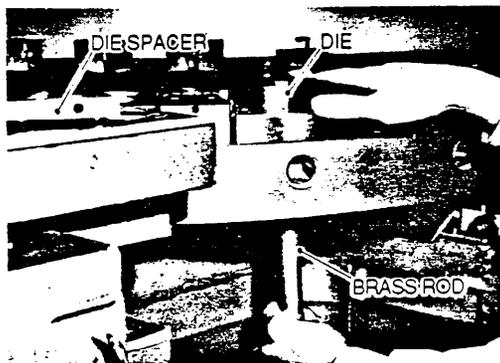
TYPES C (2"), D (3-1/2") AND E (4-1/2")



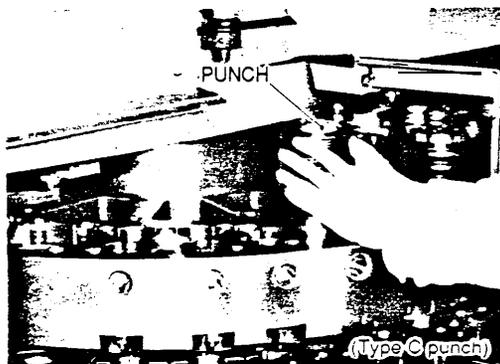
**WARNING** *Be sure to use the tool balancer when mounting or dismounting types D and E punches.*

**Mounting**

1. Remove the die spacer from the lower turret.
2. Insert the die into the die holder of the lower turret.
3. Insert a brass rod (standard accessory) into the lower turret through the bottom of the lower turret. Using the brass rod, place the die into the die holder securely.



4. Re-install the die spacer and insert the punch into the upper turret.



NOTE: (a) Before mounting the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page 20.

- (b) When mounting a shaped punch, align the punch guide keyway with the key in the upper turret so that the orientation of the punch matches that of the die.

**Dismounting**

1. Remove the punch from the upper turret.
2. Remove the die spacer from the lower turret and insert the brass rod into the lower turret through the bottom of the lower turret.
3. Push up the die with the brass rod and remove the die between the upper and lower turrets.

**Operating tool balancer**

1. Press and turn the 4-1/2 and 3-1/2 switches to OFF.
2. Screw the tool-balancer tip into the threaded hole in the punch.
3. When the punch is type E (4-1/2"), turn the 4-1/2 switch to ON, and when the punch is type D (3-1/2"), turn the 3-1/2 switch to ON. (The punch is held by the balancer.)
4. Mount the punch on the turret or dismount it from the turret.
5. Press and turn the switch to OFF, and then remove the balancer from the punch.
6. Return the switch to ON.



## RE-GRINDING PUNCHES AND DIES

The punches and dies should be re-ground frequently to extend their service life. Observe the edges of the punch and die to be sure that they are sharp and lustrous. If the edges are rounded or have a frosted appearance, the punch and die should be re-ground. If grinding is not done frequently at the correct stage of wear, the extra force required by the already frosted edge causes increasingly rapid and intense wear. Proper grinding for one time would be 0.2 mm (0.008 in) for the punch and 0.4 mm (0.004 in) for the die. The punch can be ground a maximum of 2 mm (0.08 in) during its service life, and the die can be ground a maximum of 1 mm (0.04 in). After the punch and die have been ground, their edges should be finished with an oil stone.

## ADJUSTMENT OF PUNCH AND DIE HEIGHT

After grinding, the punch and die must be adjusted to their specified height. When adjusting the punch and die height, observe the following:

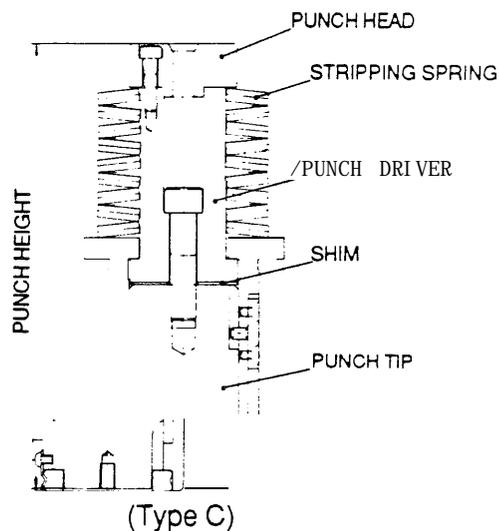
### Type A and B punches

Turn the punch head with the belt wrench until the specified punch height is obtained.  
 Specified punch height: 207.5 mm (8.17")

### Type C, D and E punches

Insert a shim (proportionate to the amount of grinding done) between the punch driver and the punch tip to adjust the punch height to specifications.

Specified punch height:  
 Type C ..... 208 mm (8.19")  
 Type D ..... 209 mm (8.23")  
 Type E ..... 210 mm (8.27")

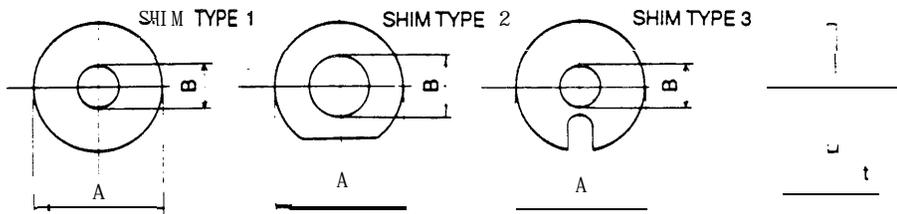
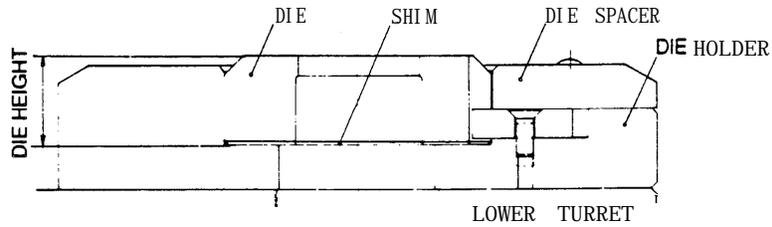


**Dies**

Insert a shim (proportionate to the amount of grinding done) between the die holder and the die.

Specified die height:

Types A, B, C, D and E . . . . . 30 mm (1.18")

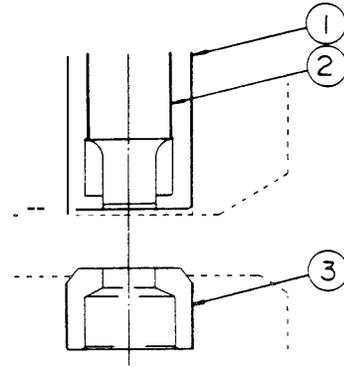


<u>SHIM</u>	<u>TYPE</u>	<u>SIZE A</u>	<u>SIZE B</u>	<u>THICKNESS</u>
For type C punches	1	40 mm	15 mm	0.4, 0.8, 1.2, 1.6 & 2.0 mm
For type D punches	3	89 mm	15 mm	Same as above.
For type E punches	3	114 mm	15 mm	Same as above.
For type A dies	1	25 mm	15 mm	0.4, 0.8 & 1.2 mm
For type B dies	1	47 mm	35 mm	Same as above.
For type C dies	2	88 mm	55 mm	Same as above.
For type D dies	2	125 mm	93 mm	Same as above.
For type E dies	2	158 mm	119 mm	Same as above.

## LUBRICATION

Before mounting the punch and die on the turret, apply machine oil to their lubrication points.

Lubrication points:



## INSPECTING PUNCHES AND DIES

1. Disassemble the punch and remove any accumulated scales.
2. If the edges of the punch and die are rounded or have a frosted appearance, regrind them.
3. If the stripping spring is fatigued, replace it with a new one.

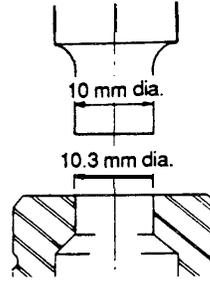
## INSPECTING WORKSHEETS

Check to make sure that the worksheet is not warped. Warped worksheet will cause the punch to stick to the worksheet.

## PUNCH-TO-DIE CLEARANCE

The punch-to-die clearance is indicated by the difference between the punch and die diameters. For example, when a 10 mm diameter punch and a 10.3 mm diameter die are used, the clearance is 0.3 mm.

$$10.3 - 10 = 0.3 = \text{Punch-to-die clearance}$$



The punch-to-die clearance must be determined according to the thickness and type of the worksheet as shown in the table below.

WORKSHEET THICKNESS	SUGGESTED PUNCH-TO-DIE CLEARANCES		
	MILD STEEL	ALUMINUM	STAINLESS STEEL
0.8-1.6 mm	0.15-0.3 mm	0.15-0.3 mm	0.2-0.35 mm
1.6-2.3 mm	0.3-0.4 mm	0.3-0.4 mm	0.4-0.5 mm
2.3-3.2 mm	0.4-0.6 mm	0.4-0.5 mm	0.5-0.7 mm
3.2-4.5 mm	0.6-0.9 mm	0.5-0.7 mm	0.7-1.2 mm
4.5-6.0 mm	0.9-1.2 mm	0.7-0.9 mm	—

## PUNCHING CAPACITY

The maximum punchable hole diameter is determined by the type and the thickness of the worksheet. The punching force required is generally calculated by using the following formula:

$$P \text{ (metric ton)} = \frac{A \text{ (mm)} \times t \text{ (mm)} \times \tau \text{ (kg/mm}^2\text{)}}{1000}$$

where, P: Force required

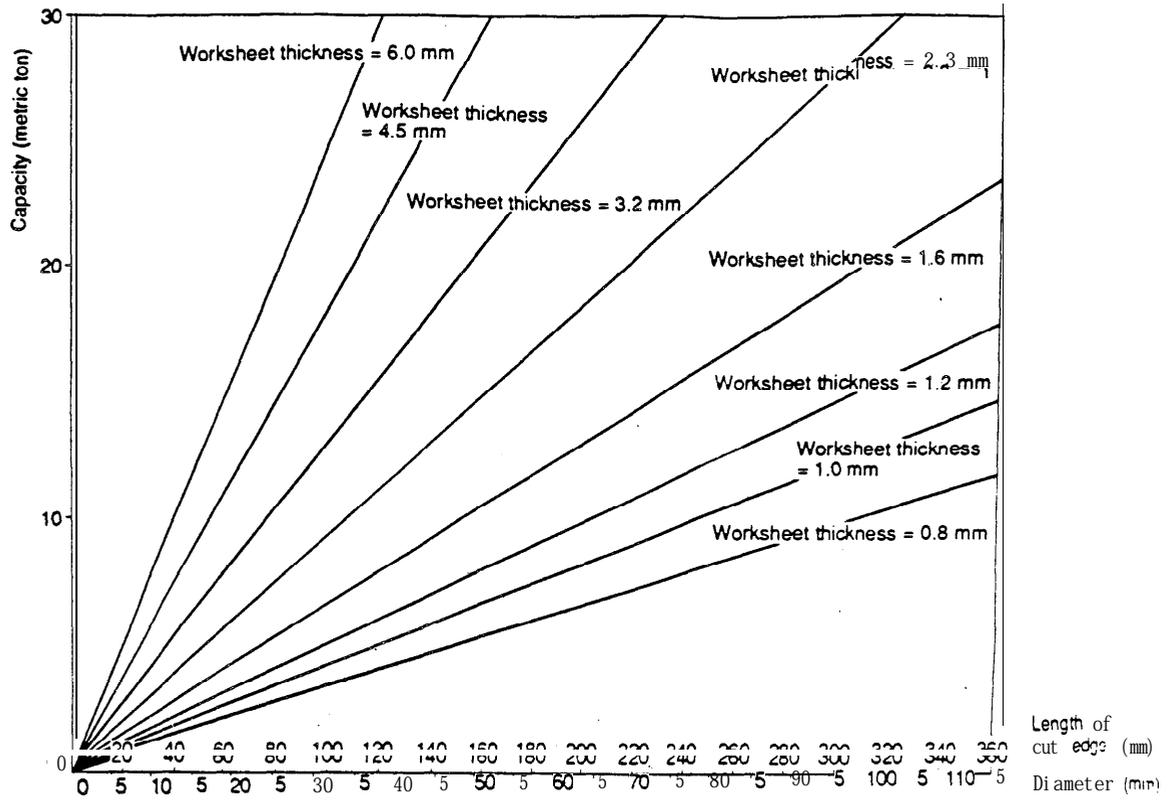
A: Length of cut edge

t: Thickness of worksheet

$\tau$ : Shearing strength of worksheet

If P does not exceed the machine capacity (30 metric tons), the worksheet is punchable. The calculation shows that 39.8 mm is the maximum punchable hole diameter when the worksheet thickness is 6 mm and the shearing strength is 40 kg/mm<sup>2</sup>. On page 22 is a graph showing the maximum punchable hole diameters for a variety of worksheet thicknesses. The graph is based on calculations using a mild steel having a shearing strength of 40 kg/mm<sup>2</sup>.

PUNCHING CAPACITY

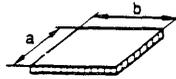


Length of Cut Edge (A)

Ex:



$$A = 2\pi r$$



$$A = 2(a + b)$$

## MINIMUM HOLE DIAMETER

The following table shows the minimum diameters of punchable holes.

<u>Material</u>	<u>Minimum hole diameter</u>
Mild steel	1.0 x t
Aluminum	1.0 x t
Stainless steel	2.0 x t

t: Thickness of worksheet

Example:

The minimum hole diameter for mild steel with a thickness of 2.3 mm is:  
 $1.0 \times 2.3 \text{ mm} = 2.3 \text{ mm dia.}$

## PRECAUTIONS FOR PUNCHING THICK WORKSHEETS

When punching the thick worksheet, use a tool one size larger than the normal usage size. If tools in the normal usage size are used, the punch head threads may be damaged.

<u>Material</u>	<u>Thickness</u>	<u>Hole diameter</u>
Mild steel (40 kg/mm*)	6.0 mm	8.2 – 12.7 mm
	4.5 mm	11.0 – 12.7 mm
Stainless steel (60 kg/mm*)	4.0 mm	8.2 – 12.7 mm

-USE TYPE B (1-1/4") PUNCHES.

<u>Material</u>	<u>Thickness</u>	<u>Hole diameter</u>
Mild steel (40 kg/mm <sup>2</sup> )	6.0 mm	22.9 – 31.7 mm
	4.5 mm	30.6 – 31.7 mm
Stainless steel (60 kg/mm <sup>2</sup> )	4.0 mm	22.9 – 31.7 mm

-USE TYPE C (2") PUNCHES.