206-98394B

SHIMADZU

Atomic Absorption Spectrophotometer

AA-7000

Service Manual

Read the instruction manual thoroughly before you use the product.
Keep this instruction manual for future reference.

SHIMADZU CORPORATION
KYOTO JAPAN

ANALYTICAL & MEASURING INSTRUMENTS DIVISION

Contents

1. Introduction

1.1 Background

Atomic absorption spectrophotometers are used for environmental analysis, including the monitoring of air pollution and water contamination, the analysis of heavy metals in pharmaceuticals and food products, the analysis of metallic materials, and the analysis of trace metals in living organisms.

Atomic Absorption Spectrophotometry

In the 1960's, atomic absorption spectrometry was mostly performed using the flame method. From the mid-1970's, however, the furnace atomic absorption (flameless atomic absorption) replaced the flame method as the most prominent technique, and the range of detection increased significantly. Nearly all inorganic elements can be measured using atomic absorption spectrophotometry, and measurement of approx. 60 elements is possible.
A few application examples are given below.

(1) Analysis of Water

Water quality standards and official analysis methods for river water, tap water, lake water, and seawater, are specified by Water Works Law and Water Pollution Control Law. (This is an example in Japan.)

(2) Applications to Biology and Medicine

Atomic absorption spectrophotometry is used for the analysis of metals in biological specimens, cells, and tissue. The elements often encountered when performing biological analysis of animals and plants are Si, P, Mg, Ca, Cu, Na, K, Zn, Al, Fe, and so on.
In the field of medicine, this method has a large range of application in the research of toxic substances. For example, it is used to analyze (or examine) the amount of lead and copper that has accumulated in the blood and tissue of people who are exposed to vapor or dust containing these metals as part of their everyday work. It is also used to analyze inorganic elements in saliva and urine and to detect Na, Mg, Ca, P, Si, and Cu in serums.

(3) Applications to the Analysis of Food Products

In the food-product industry, atomic absorption spectrophotometry is used to analyze minute amounts of substances contained within food products or food containers that may be beneficial or harmful to the human body. For example, it is used to analyze soil that has been sprayed with agricultural chemicals, fruits, tinned food, and the metal content in bottled beer.

(4) Applications to the Analysis of Pollutants

Pollutants can be found in many different types of media: air-borne dust, water, oil, soil, and sediment. It is necessary to be able to analyze pollutants in these media quickly and at low concentrations.
The analysis of Ag, Be, Bi, Co, Cr, Cu, Hg, Ni, Mn, P, Pb, Sb, Sn, etc. in rivers and factory effluent is carried out. A great number of elements (approx. 60) are contained in soil.

1.2 Overview

The AA-7000 Atomic Absorption Spectrophotometer is equipped with a flame burner as a standard feature, and linking with the autosampler (ASC) provided as a special accessory makes it possible to perform automatic continuous measurement using the flame method.

Connecting to the graphite furnace atomizer (GFA-7000) provided as a special accessory makes it possible to perform furnace analysis, and linking with the autosampler (ASC-7000) allows the use of automatic addition and dilution functions for the pretreatment of samples and reagents.

Furthermore, using the microsampling kit provided as a special accessory makes it possible to use the flame microsampling method (flame single drop method), and linking with the autosampler (ASC-7000) allows the use of automatic addition and dilution functions for the pretreatment of samples and reagents, even with flame analysis.

Systems based on the AA-7000 use the WizAArd software, which runs on Microsoft Windows, to perform centralized control of the AA-7000 itself as well as peripheral devices (e.g., the GFA and ASC), and combining with CLASS-Agent enables compliance with FDA 21 CFR Part 11.

1.3 Service Training

The prescribed service training is required to use this Service Manual correctly. We cannot take responsibility for any problems caused by personnel using this manual without taking service training.

1.4 Warning Labels on the Instrument

The AA-7000 uses the following warning labels. The positions where these labels are affixed are shown in the yellow pages of the instruction manual.

(1) Warning label: HOT SURFACE/BURNS

Warning points:
- Before replacing the deuterium lamp, wait at least 30 minutes after turning OFF the lamp. (Deuterium lamp cover)
- During flame combustion, do NOT look into from above the chimney. Before starting maintenance of the burner compartment, wait at least 30 minutes after turning OFF the flame. Before starting ignition, be sure to set the chimney and front-panel. (Instrument top surface)

(2) Warning label: HAZARDOUS VOLTAGE

Warning points:
- Do NOT touch the lamp socket electrode while power is being supplied. To prevent electrical shocks, attach the accessory cap to the empty power socket. (Lamp turret)
- Before starting ignition, be sure to close the door of the chimney. (Instrument top surface)

(3) Warning label: FLAMMABLE GAS/EXPLOSION POTENTIAL

Warning points:
- During flame combustion, do NOT remove any parts of the burner compartment. After using a gas, be sure to close the main valve of the gas cylinder. (Instrument top surface)
- Do NOT use oxygen gas mixture. (Gas controller piping)

2. Installation

2.1 Checking the Installation Environment

This instrument cannot be started up in a safe state unless installation procedures are observed. For example, there will be the risk of gas leaks and accidents, such as flashback, if the appropriate piping (material, bore, etc.) is not selected.

[Reference Materials]
◆Pre Installation Requirements (Installation Preparations/Confirmation) (ZE7D-9411)
◆AA-7000 IMD News (B101-0544), AA-7000F/AAC IMD News (B101-0575)

Install the instrument at a site that satisfies the following conditions.

- Away from instruments that generate strong magnetic field, electrical field, high frequency, etc.
- Well-ventilated sites
- Sites subject to little vibration
- Sites subject to little dust or humidity, and free of corrosive gases
- When the lighting of the instrument installation site is a fluorescent lamp, ensure that luminance is 1300 Lx max., 800 Lx max. in the case of indirect light, and 400 Lx max. in the case of light sources such as incandescent lamps.
- Operating temperature range 10 to 35 °C, operating humidity range 20 to 80 % (70 % max. at operating temperature of 30 °C or more)
- Ensure that the instrument's ground conforms to Class D electrical facilities technical standards.

Use the following installation stand and firm stand that can withstand the weight of the PC system.
Stands designated for use with atomic absorption spectrophotometers in the specifications are recommended.

To ensure safe use of the instrument, please explain to the customer and conduct checks referring to the following chapters of the AA-7000 Instruction Manual.

- "Installation Site Precautions" (yellow page ii)
- "Installation Precautions" (yellow page iii)
- "Precautions on Handling Gas" (yellow page v)
- "10.5 Instrument Placement and Site Requirements"
- "10.6 Equipment Requirements"
- "10.1.2 Flame Specifications: Usable Chemicals"
  O-rings or drain tubes must be replaced with optional tubes at installation depending on the chemical used.

2.2 Checking the Standard Accessories

Check that the standard accessories are all provided while referring to AA-7000 Instruction Manual "1.2 Parts Information".

2.3 Assembling the AA-7000

Assembly involves installing the PC software (WizAArd), and installing the chimney, drain Assy, etc. and connecting the respective gas hoses in the case of a flame model (AA-7000F). In the case of a furnace model (AA-7000G), assembly involves installing the graphite furnace, cooling water piping, etc.
Next, inspect for gas leaks on the piping in the instrument installation room according to the AA-7000 Instruction Manual "8.5 Gas Leak Inspection".

For education in safety, also point out piping locations that cannot be removed by the customer, and explain the life of the atomizer and other parts, and resistance to chemicals.

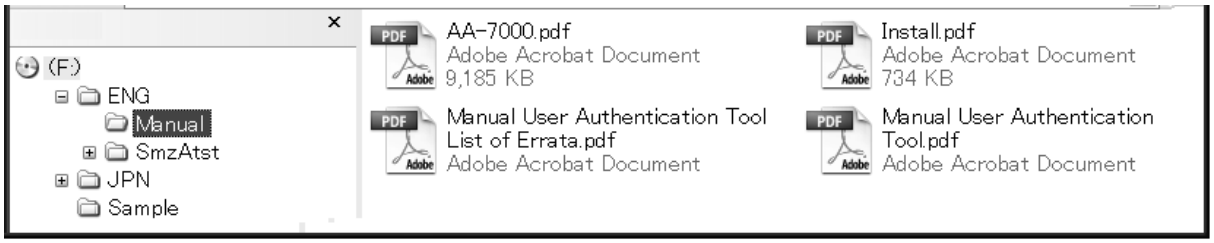
2.3.1 Installing the PC Software

Refer to the WizAArd Installation Manual (206-97230).
When a PC set for the AA-7000 is bought, the PC software is already installed as the AA-7000F.

◇ When the instrument to install is an AA-7000G, delete WizAArd from the Control Panel, and select and re-install AA-7000G from the Installer.

◇ When the instrument to install is an AA-7000F/AAC, delete WizAArd from the Control Panel, and select and re-install AA-7000 from the Installer.

◇ The WizAArd Installation Manual (Install.pdf) is located in the Manual folder of the PC software (WizAArd) CD-R.



2.3.2 Attaching the "Caution: Injury" Warning Label (AA-7000F)

Instruct the customer not to use waste liquid containers made of glass, and attach the warning label (standard accessory, P/N 037-72409-25) at an easy-to-see location on the instrument front.

2.3.3 Removing the Chimney Plate (When GFA-7000 Is Used)

When the GFA-7000 is used, remove the chimney plate (1 plate) shown in the photo below since it comes into contact with the GFA furnace.

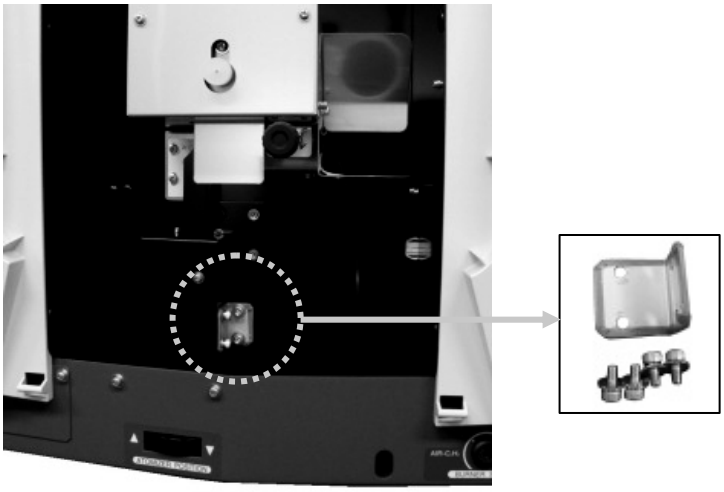
Remove the plate and the four screws on the left and right securing the plate in place.

2.3.4 Removing the Transportation Bracket

Remove the transportation bracket from the AA-7000F/G.

1. Remove the front panel referring to the AA-7000 Instruction Manual, "2.4 Removing and Installing the Front Panel".

2. Remove the hexagon head screws securing the transportation bracket in place in the photo below, and remove the bracket.

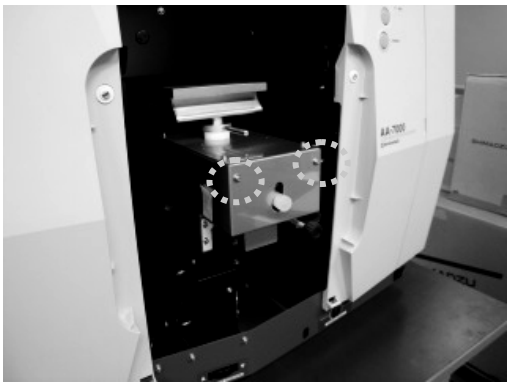


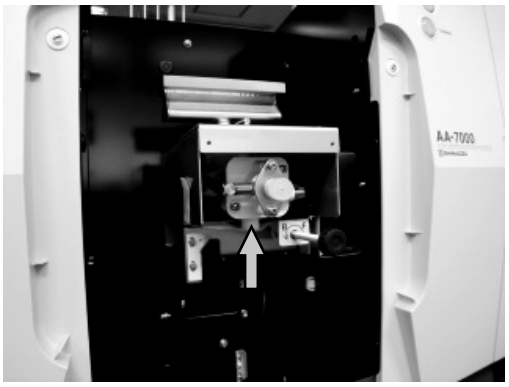
Two transportation brackets are provided on the AA-7000F/AAC.
The transportation brackets on this instrument are fixed at the above position and at its inner side.

2.3.5 Installing the Drain Assy (Procedure Not Required on AA-7000G)

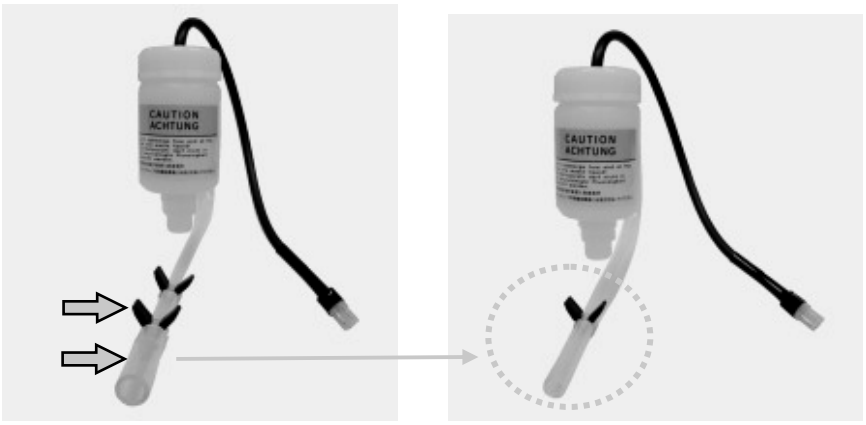
Install the drain Assy and PE drain tube. Fill the drain tank with water up to the specified water level. Install the drain Assy by the following procedure.

1. Remove the two screws from the front of the plate shown in the photo on the left, and remove the plate. Next, remove the protective tape attached to the connecting section at the bottom of the chamber.

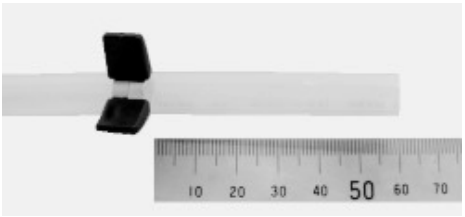




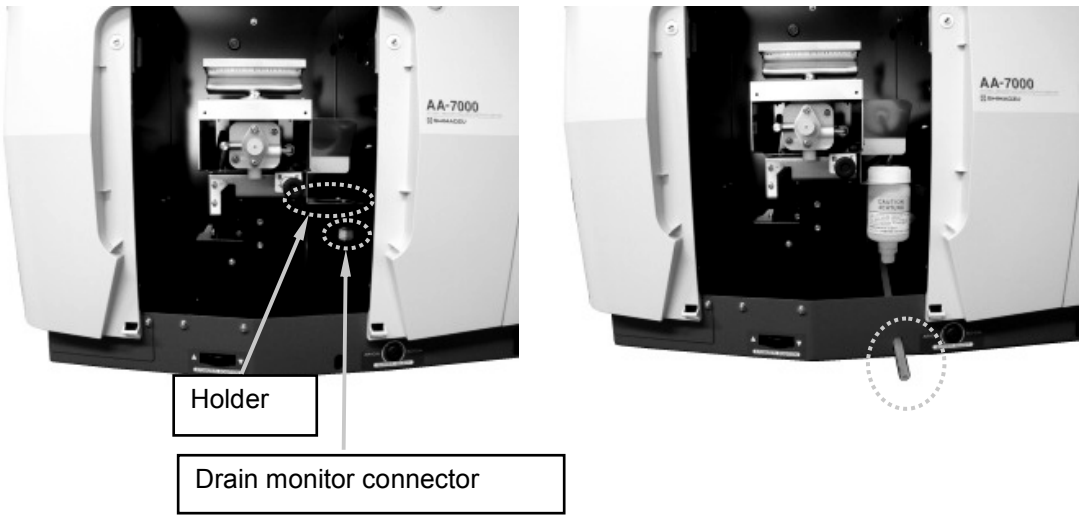
2. Remove the tube inserted into the tube tip on the drain Assy (standard accessory) and hose band on the operator side.



Hold the hose with the hose band at approx. 60 mm from the tube tip.

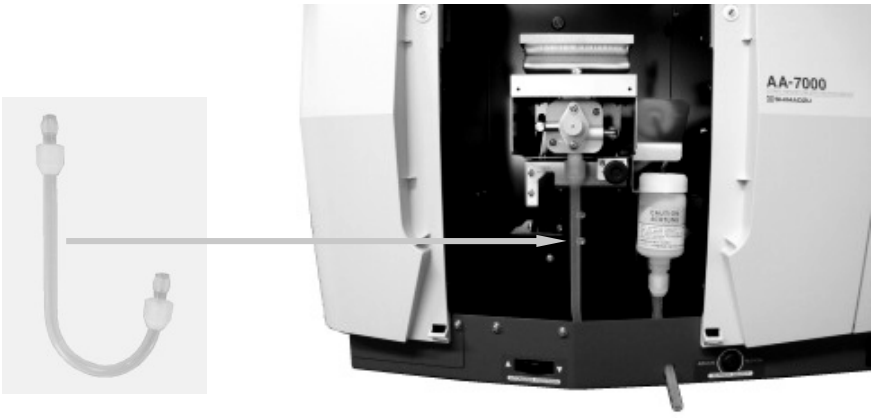


3. Remove the cover from the drain tank (drain Assy), and install the drain tank at the right side of the chamber. Draw out the tube from the hole at the bottom of the instrument.

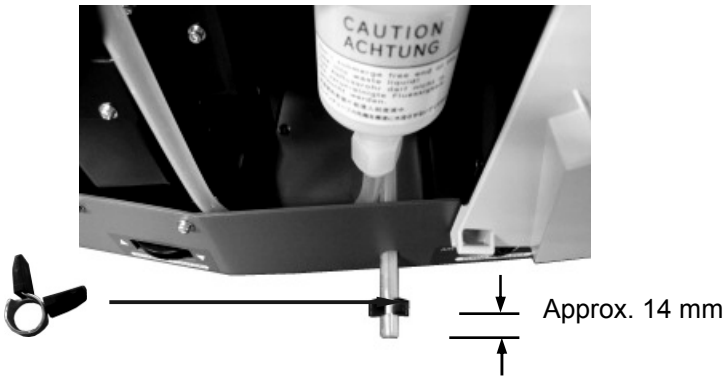


4. Connect the drain Assy cable to the drain monitor connector on the inside wall of the combustion chamber.

5. Connect the PE drain tube (standard accessory) to the drain tank and the joint at the bottom of the chamber. Fully tighten the nut on this tube by hand. Tightening the nut with a tool might destroy the screw threads.
(Note: Make sure that there are no leaks from this connecting section when the drain tank is filled with water.)

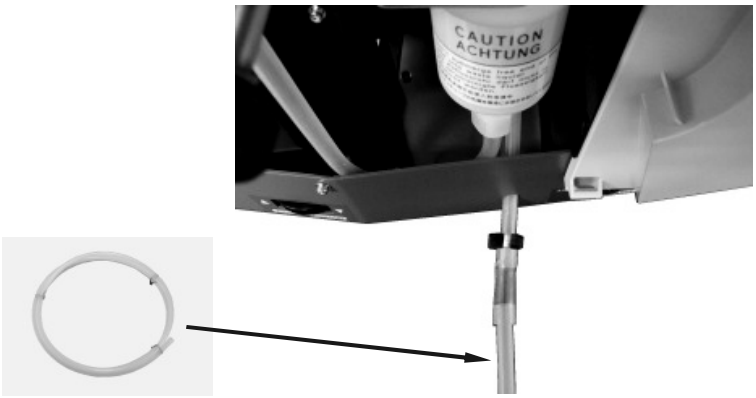


6. Insert the hose band that was removed in step 2. into the drain tube.
Secure the hose band at approx. 14 mm from the tube tip.

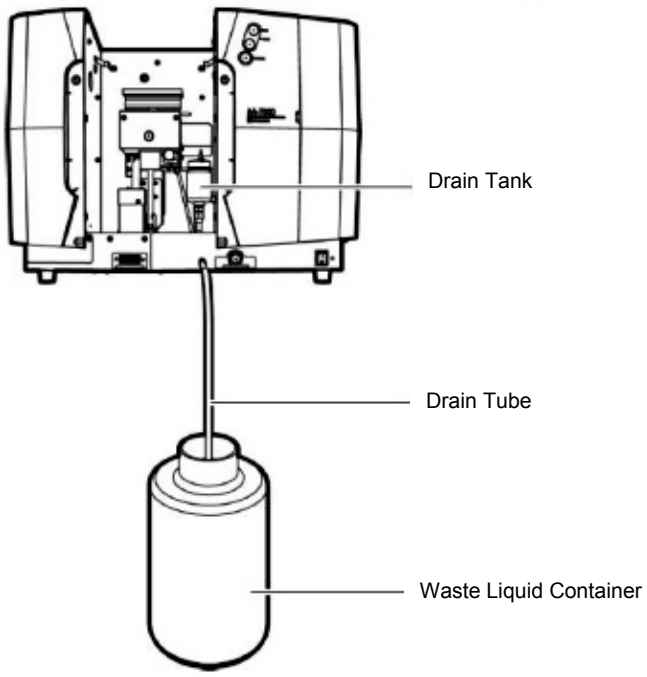


7. Likewise, insert the tube that was removed in step 2. until it comes in contact with the hose band.

8. Connect the PE tube (provided) to the tube on the discharge side of the drain tank.



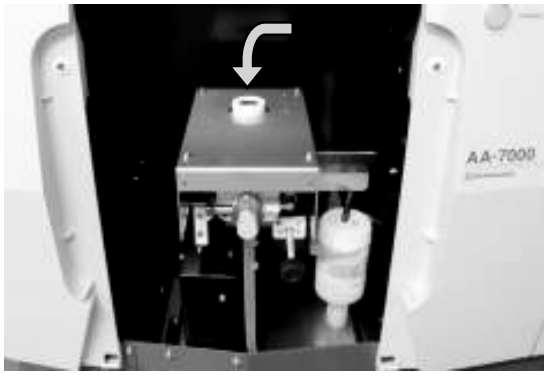
9. Prepare a suitable waste liquid container for receiving the waste liquid. (Use of a glass bottle is forbidden.)



10. Cut the PE drain tube to a suitable length. The tube should be cut short enough so that its tip will not dip into waste liquid if it accumulates inside the container.

11. Draw out the burner head straight upwards to pour water into the drain tank. (If it is difficult to draw out the burner head, try turning it to the left and right while pulling it up.)

12. Pour in water a little at a time into the burner socket (burner head insert port). Pour water into the burner socket until it overflows from the drain tank out into the drain tube.
Note: If the water level is too low, the level sensor will be actuated to prevent ignition.



Pay attention to the following points so that waste liquid flows out smoothly.

(a) Set the drain tube so that it dangles downwards as cleanly as possible.

(b) The drain tube must be cut to a length so that its tip does not dip into the waste liquid.
Note that, if the tube tip dips into the waste liquid, liquid will not flow smoothly, resulting in increased noise and poorer reproducibility.

13. Insert the burner head firmly into the burner socket as far as it can go.

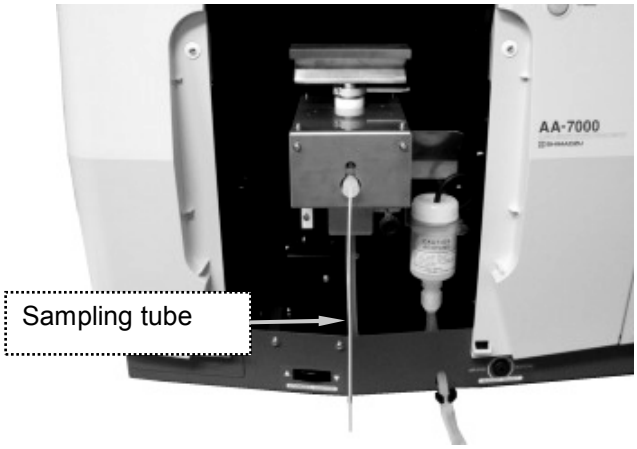
14. Install the chamber front plate, and secure it in place with screws.

CAUTION

1. In particular, for organic solvents, prepare a chemical-resistant waste liquid container of appropriate size (approx. 10 L).
2. Do not use glass containers that are likely to break.
3. Properly treat waste liquids that generate hazardous gases before disposing them.
4. Dispose of waste liquid in accordance with national or local laws and regulations.

2.3.6 Installing the Sample Suction Tube

1. Carefully insert the end of the PTFE sampling tube (standard accessory) cut straight at right angles into the nebulizer capillary as far as it can go.



2. Install the front panel onto the front of the combustion chamber. Also, install the chimney.

Caution

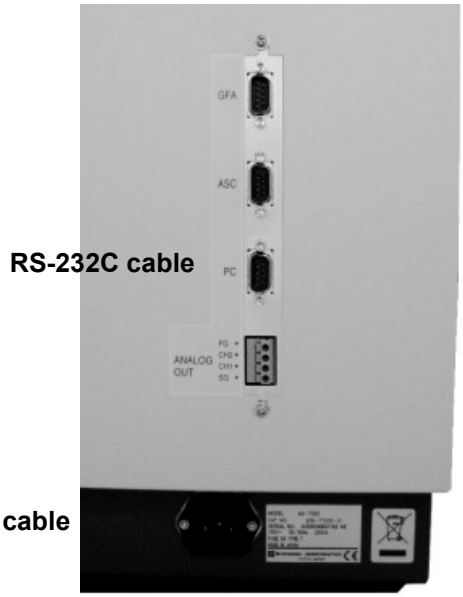
1. If the sampling tube cannot easily be inserted into the capillary, heat the tube tip slightly by the flame of a cigarette lighter, for example, and enlarge the hole at the tube tip using a toothpick or similar pointed object. ◇ The nebulizer capillary is thin and soft. Take care not to break it.
2. A PE tube is inserted into the nebulizer capillary. This PE tube is used to ensure that the PTFE tube is firmly held onto the capillary. (Refer to the AA-7000 Instruction Manual, "8.2.2 Nebulizer Maintenance".)
3. When removing and re-installing the nebulizer, make sure that the nebulizer is firmly inserted as far as it can go. If the nebulizer is insufficiently inserted, this might cause burned gas inside the chamber to leak or sensitivity to drop.

2.3.7 Connecting Cables

Connect each of the cables (standard accessories) to the AA main unit, PC and other equipment.

1. Connecting the AC cable
   Before connecting the AC cable to the power outlet, make sure that the power switch at the bottom right at the front of the AA main unit is turned OFF.

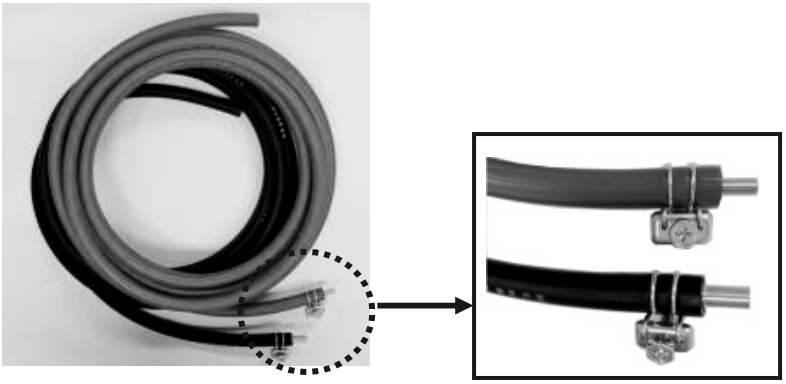
2. Connecting the RS-232C cable
   Connect the RS-232C cable to the connector marked "PC" on the right side of the AA main unit and to the serial port (or COM or RS-232C port) on the PC.
   For details on connecting the display, keyboard, mouse, printer, and other devices to the PC, refer to the respective instruction manual.



2.3.8 Connecting Gas Hoses

Connect the gas hoses (acetylene, air, etc.) to the AA main unit.
The joints of each gas hose (standard accessory) are connected according to the following combinations:

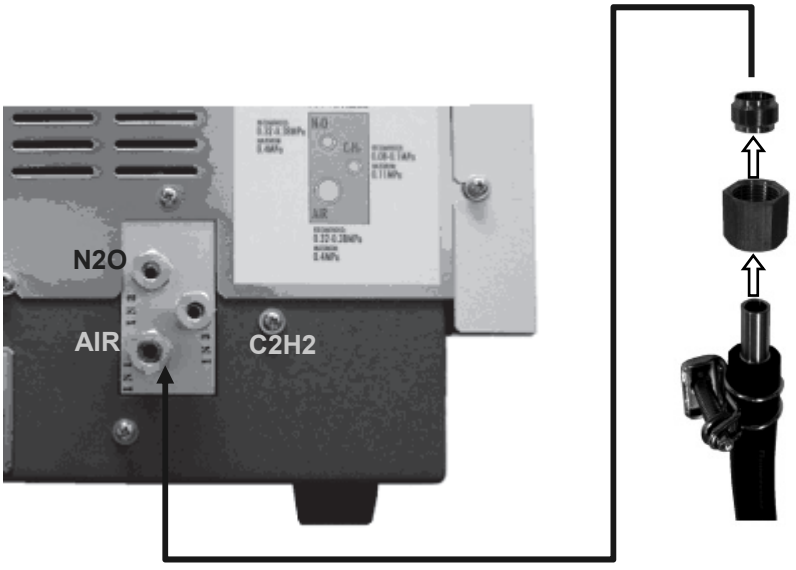
- Black gas hose for air, joint (large)
- Red gas hose for acetylene, joint (small)



- Green gas hose for nitrogen dioxide (when a high-temperature burner head is used), joint (small)

1. Connect the air gas hose to the air compressor and AA main unit.
   Connect the other end of the black gas hose without the joint to the joint on the air compressor, and firmly tighten it with the hose band to prevent gas leaks.

2. A cap nut and sleeve are provided on the gas supply port on the left rear side of the AA main unit. Remove this cap nut and sleeve, and pass the joint on the air gas hose through them.



WARNING

Oxygen gas cannot be used.

3. Fully insert the hose joint into the gas supply port, and tighten the cap nut by hand. Finally, secure the nut on the instrument side in place using a spanner, and also tighten the cap nut using a spanner to ensure that there are no gas leaks. (Note: A loose nut on the instrument side might cause a gas leak.)

4. Next, connect the acetylene gas hose.
   Connect the other end of the red gas hose without the joint to the pressure regulator on the acetylene gas cylinder, and secure it with the hose band.
   Next, remove the cap nut and sleeve from the acetylene (N2O) gas supply port on the left rear side of the AA main unit, connect the gas hose in the same way as for the air gas hose, and tighten the cap nut using a spanner to ensure that there are no gas leaks.

2.3.9 Gas Leak Check

Inspect for gas leaks according to the AA-7000 Instruction Manual "8.5 Gas Leak Inspection".

2.4 Reading (Saving) and Writing Adjustment Parameters

The EEPROM mounted on the AA-7000 CPU board cannot be replaced. For this reason, read and record (save) the adjustment parameters at installation.
Since adjustment parameters are not written to the new CPU board that will replace the old CPU board, the adjustment parameters recorded (saved) in this chapter must be written to the new CPU board. If the adjustment parameters are not recorded (saved), this means that jigs must be used to perform the various adjustments.
Read and record (save) the adjustment parameters by the following procedure.

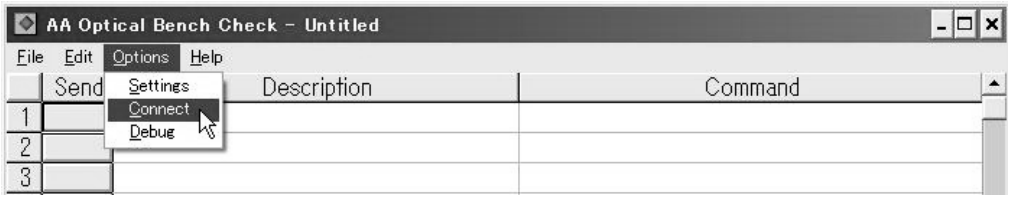
2.4.1 AA-7000 Adjustment Parameter Read (Save) Procedure

Required software: AAOBCHK (Install on any folder on the PC.)

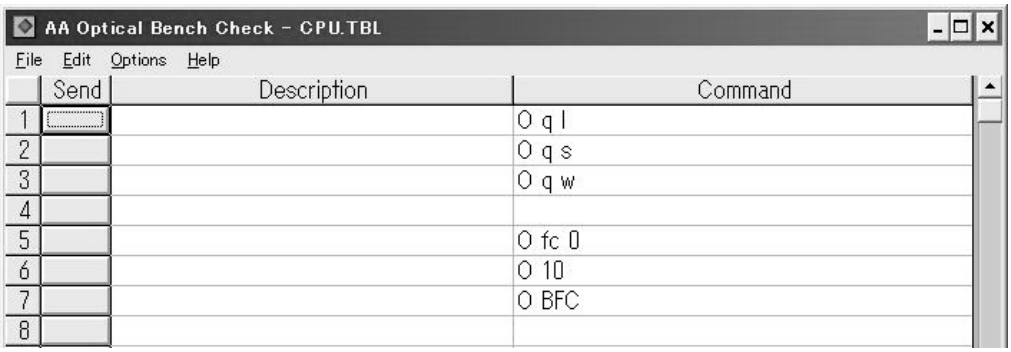
1. Turn the AA-7000 power switch ON.
   After the power switch is turned ON, you will hear the buzzer sounding a short high-pitched sound, followed a few seconds later by three short high-pitched sounds.

2. Start up the PC, and launch AAOBCHK.EXE.

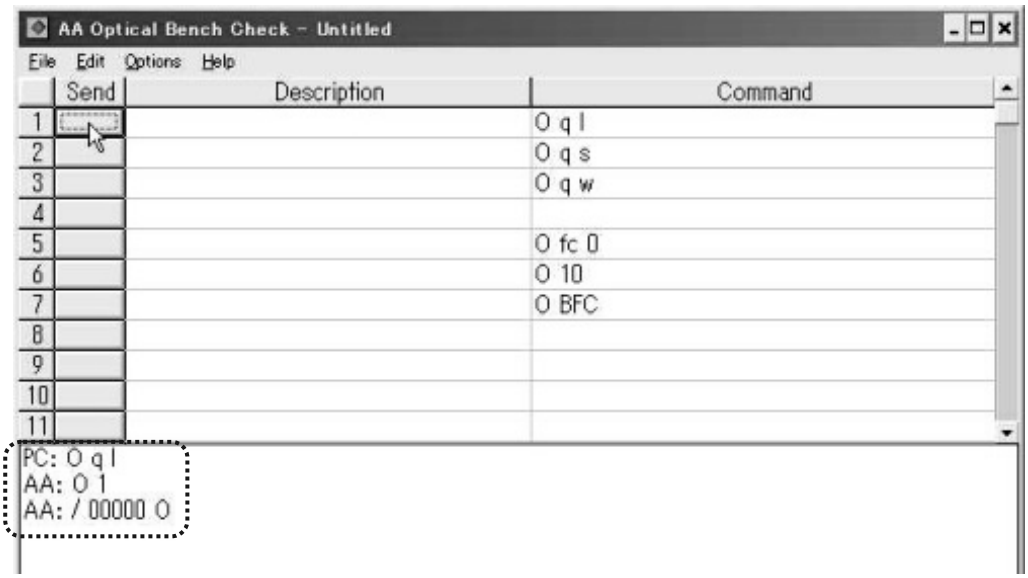
3. Pull down the [Options] menu, and click "Connect" to establish the connection.



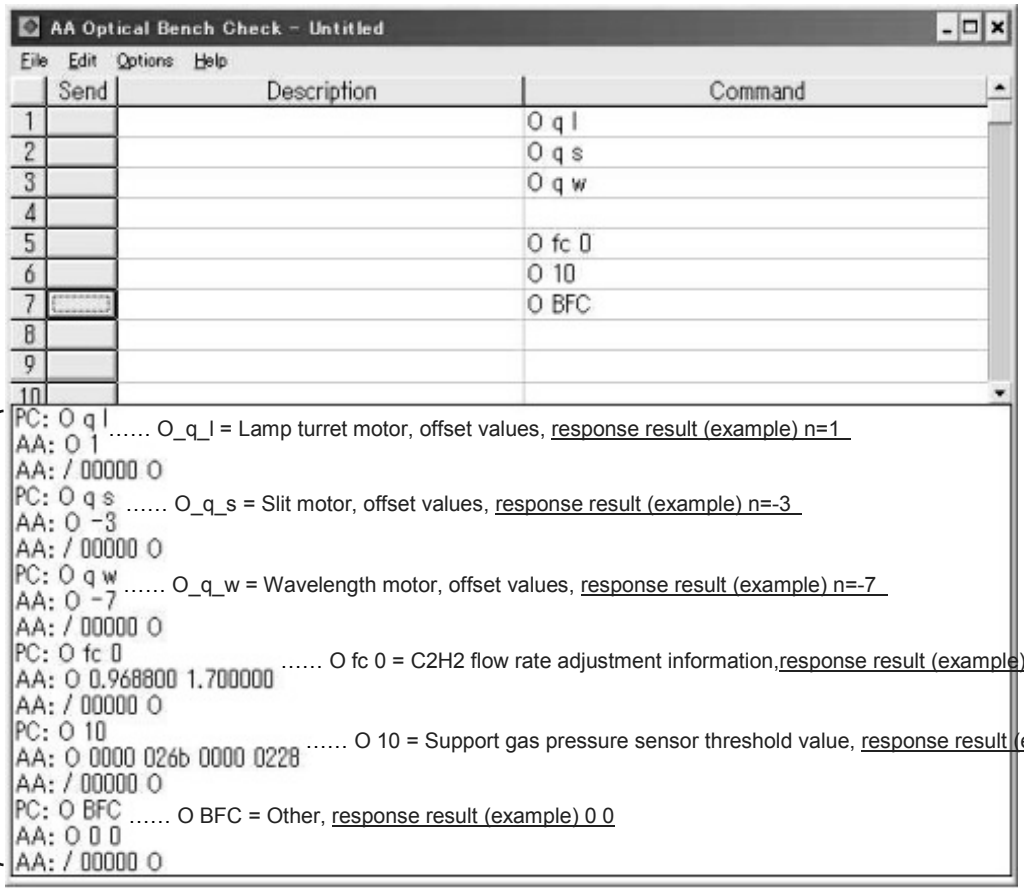
4. Enter the following commands on the Command column: "O_q_l", "O_q_s", "O_q_w", "O_fc_0", "O_10", and "O_BFC".



5. Click the [Send] button for the "O_q_l" command. When this button is clicked, the response result is displayed as follows.

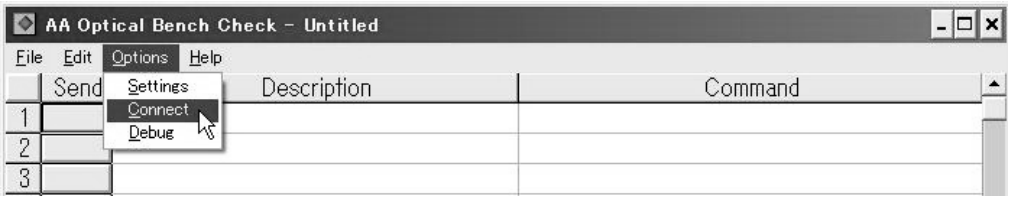


6. Next, click the [Send] button for each of the "O_q_s", "O_q_w", "O_fc_0", "O_10", and "O_BFC" commands.



* Either note down this content, or make a copy of this screen by PrintScreen, create a new folder on the customer's PC and save the copy of the screen to this folder. Also, be sure to back up this data.

7. Pull down the [Options] menu, and click "Connect" to break off the connection.



Item	Read Command
Common	
Lamp turret motor, offset values	O q l
Slit motor, offset values	O q s
Wavelength motor, offset values	O q w
Flame model only	
C2H2 flow rate adjustment information	O fc 0
Support gas pressure sensor threshold value	O 10
Other	O BFC

2.4.2 Adjustment Parameter Write Procedure

Required software and jigs: 1. AAOBCHK software
2. Hg hollow cathode lamp (used for wavelength calibration)
3. Prepare the adjustment parameters that were recorded (saved) at installation.

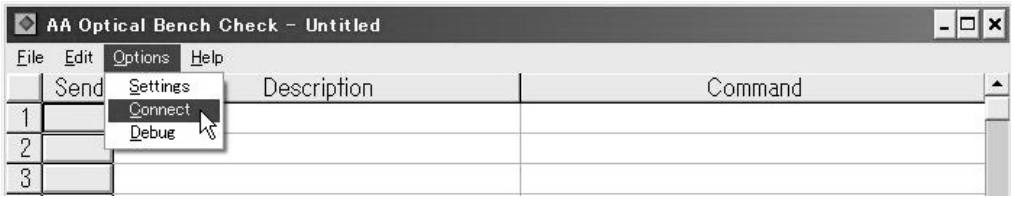
1. Replace the AA-7000 CPU board.

> When replacing the CPU board, be sure to check the firmware version, and upgrade the firmware, if necessary.

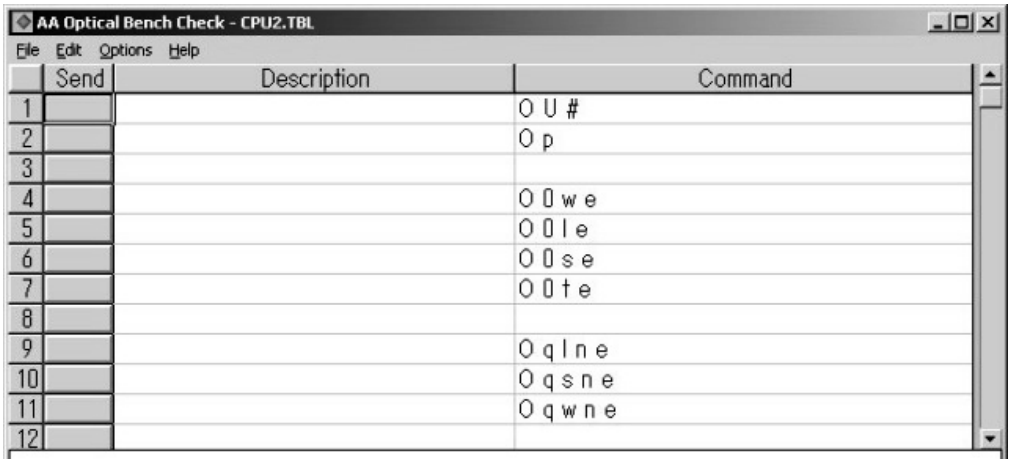
2. Turn the AA-7000 power switch ON.

3. Start up the PC, and launch AAOBCHK.EXE.

4. Pull down the [Options] menu, and click "Connect" to establish the connection.



5. Enter the following commands on the Command column.



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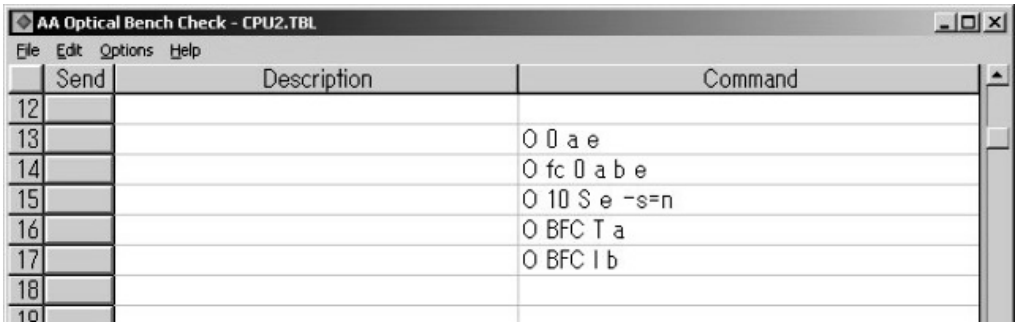


6. Write the items in the following table (instrument name, serial No., motor excitation pattern, etc.) and the recorded (saved) adjustment parameters to the CPU board using the write commands.

The following table shows a list of CPU board adjustment parameter read and write commands.

Item	Read Command	Write Command
Common		
Instrument name	O U	O U #
Serial No.	-	O p
Wavelength motor, excitation pattern	-	O o w e
Lamp turret motor, excitation pattern	-	O o l e
Slit motor, excitation pattern	-	O o s e
Attenuator motor, excitation pattern	-	O o t e
Lamp turret motor, offset values	O q l Response: ***n***	O q l ***n*** e
Slit motor, offset values	O q s Response: ***n***	O q s ***n*** e
Wavelength motor, offset values	O q w Response: ***n***	O q w ***n*** e
Wavelength calibration information	None	Wavelength calibration by Hg, HCL (Note)
Flame model only		
C2H2 needle monitor, excitation pattern	-	O o a e
C2H2 flow rate adjustment information	O fc 0 Response: ***a b***	O fc 0 ***a b*** e
Support gas pressure sensor threshold value	O 10 Response: 0000 ***n*** 0000 0228	O 10 S e -s=***n***
Other	O BFC Response: ***a b***	O BFC T ***a*** O BFC I ***b***
When AAC is installed		
Atomizer up/down monitor, excitation pattern	-	O o j e
Atomizer backward/forward monitor, excitation pattern	-	O o z e
Burner origin	-	Burner origin position setting
Furnace origin	-	Furnace origin position setting

(Note) After writing all excitation patterns and offset values, perform wavelength calibration from [Instrument]-[Maintenance]-[Wavelength Calibration] in WizAArd.

2.5 Installing the AAC-7000 Auto Burner

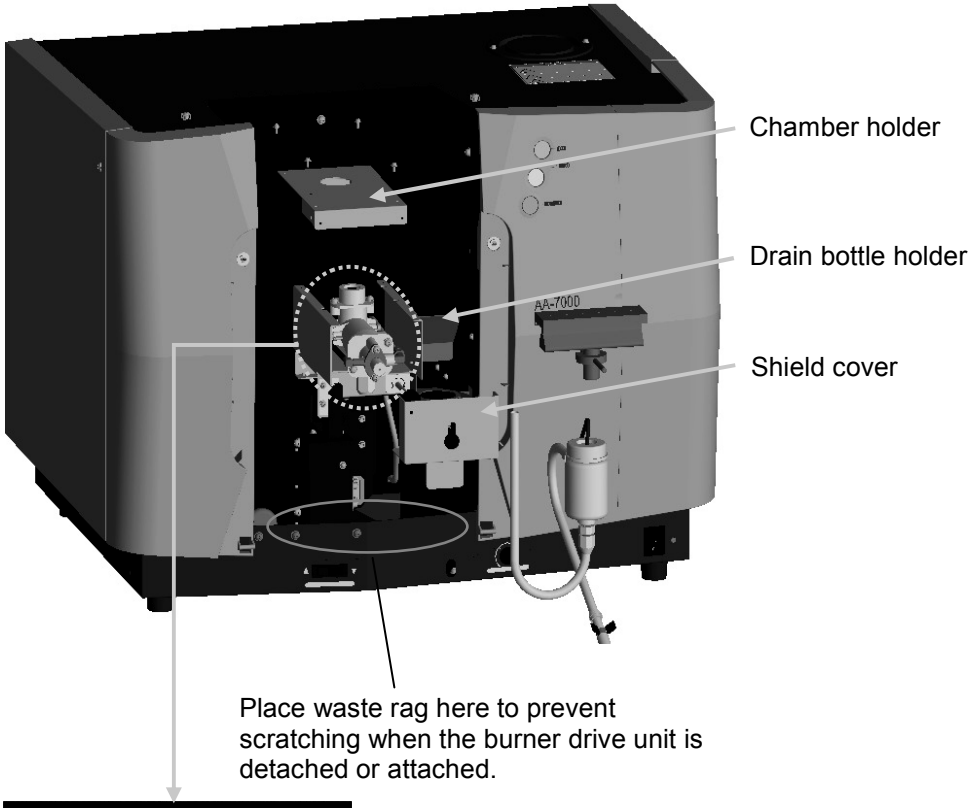
This section describes the procedure for installing the AAC-7000 on the AA-7000.
Note that the AA-7000F/AAC (Auto Atomizer Changer) has a built-in AAC-7000 auto burner.

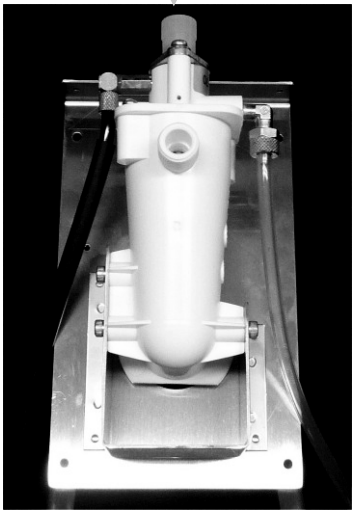
AAC components

Parts that are removed from the AA main unit
at installation and are not used

2.5.1 Removing the Manual Drive Unit (AA-7000F)

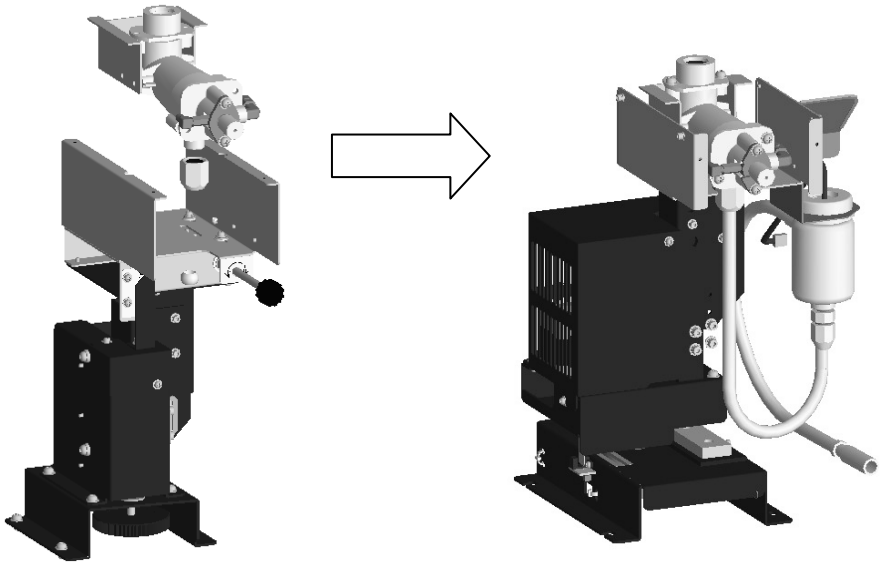
- Disconnect the connectors from the burner and drain sensor on the AA-7000F.
- Remove the chamber U-tube, and remove the drain bottle from the drain bottle holder. (Note that the waste liquid in the drain tank will spill when adding on an AAC later on.)
- Remove the shield cover/drain bottle holder.
- Remove the chamber from the chamber holder and the piping connected to the nebulizer and AA main unit.
- Remove the drain and manual drive unit from the main unit.





2.5.2 Installing Shared Parts (AA-7000F)

・Install the drain bottle holder, drain bottle and chamber U-tube that were removed from the manual drive unit onto the motor drive unit. Before performing this procedure, first remove the chamber holder, chamber and burner head.
・Also, remove the two transportation brackets from the AAC.

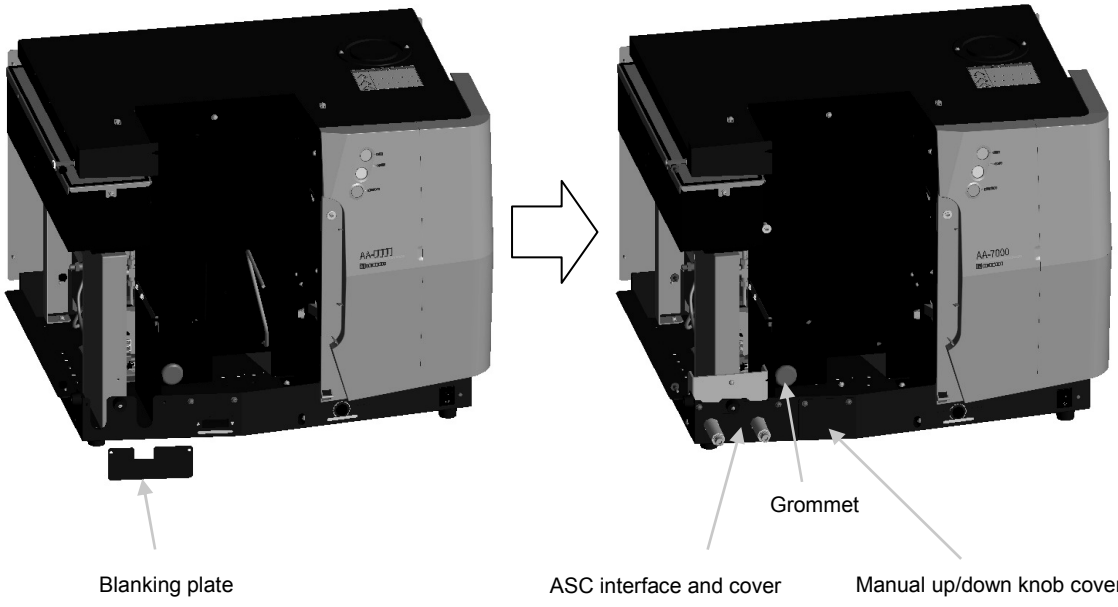


Manual drive unit **Motor drive unit**

2.5.3 Installing the ASC Interface (AA-7000F)

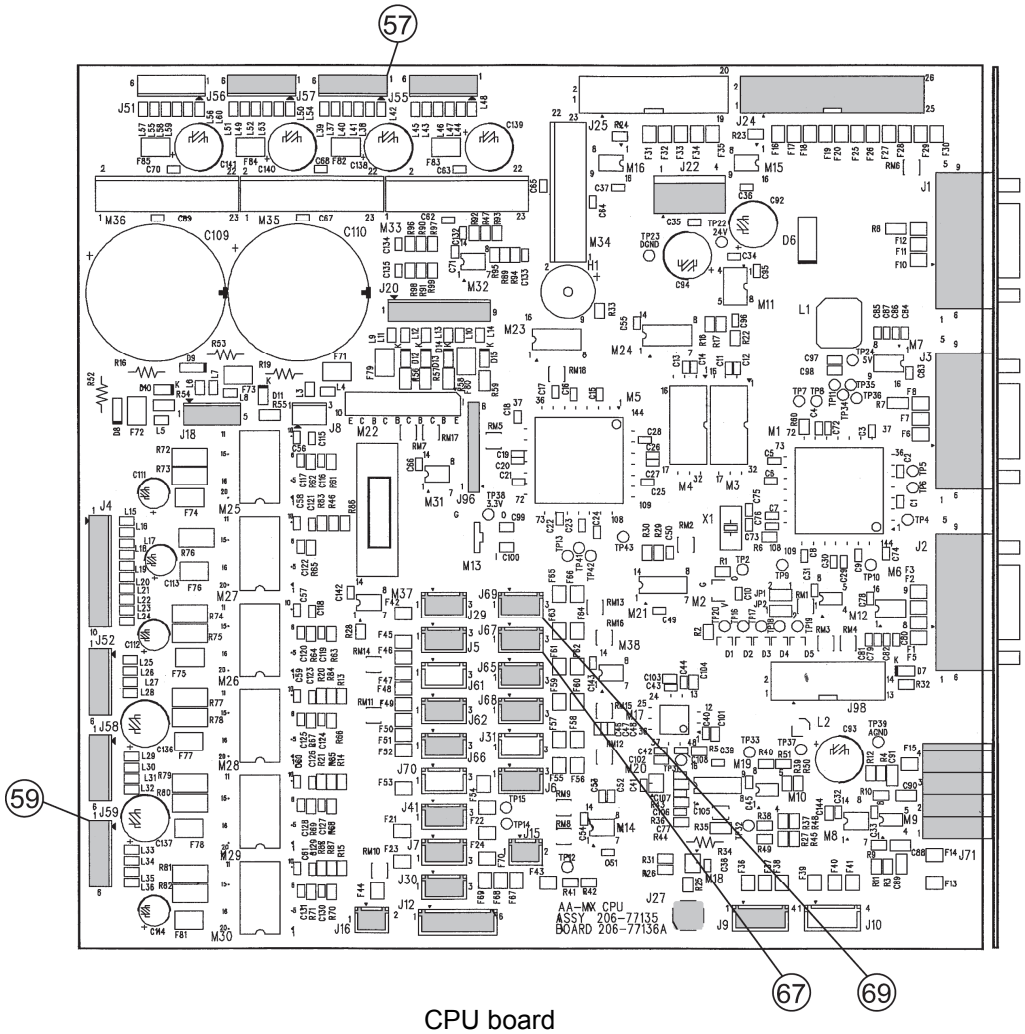
・Remove the left cover, left front cover, right back cover, left front blanking plate, and grommet from the main unit.
・If the back cover must be removed, disconnect the heat sink fan connector.
・Install the ASC connecting section, ASC connecting section cover and manual up/down knob cover.

(Caution) The screws on the right side can be tightened only if the ASC connecting section is installed before installing the AAC.
Return the left cover and left front cover to their original positions on the main unit.



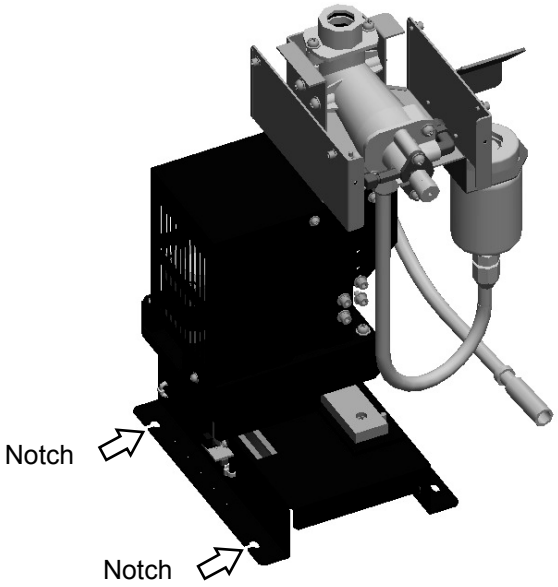
2.5.4 Temporarily Fastening the Motor Drive Unit (AA-7000F)

- Place waste rag, etc.（250 mm wide, 250 mm or longer）at the front of the AA main unit base, and temporarily place the AAC motor drive unit on the AA main unit taking care not to scratch the base. Do not tighten the screws.
- Pass the AAC wiring into the instrument through the hole where the grommet was originally inserted.
- Connect the AAC wiring to the J57, J59, J67, and J69 connectors on the CPU board after securing to the clamp on the rear side of the inner wall. (Do not allow the wiring to come into contact with the transformer.)



CPU board

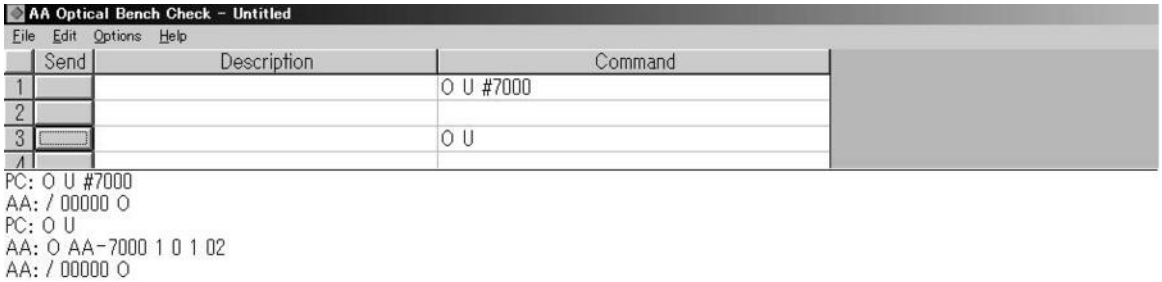
・Make sure that the screws are properly inserted inside the notches on the AAC left side, and then temporarily screw-fasten the tray and drive unit on the right side. (The fixing screws on the left side are also tightened onto the inner wall. Work can be performed more easily if the screws are inserted into the notches beforehand for screw-fastening.)
・The screws on the AA main unit（standard model）are also shared for use as these fixing screws.



・After temporarily fastening the drive unit, connect the chamber piping, and install the chamber cover onto the motor drive unit.
・When assembling the chamber, make sure that the top surface of the burner head is horizontal in the forward direction. (Use of a spirit level is recommended.) If the top surface is not horizontal, adjust the installation position of the chamber.

2.5.5 Setting the Instrument Name (AA-7000F)

・The buzzer sounds if the power is turned ON with the back cover removed and the heat sink fan connector disconnected. So, install the back cover and connect the connectors.
・The buzzer sounds as the instrument type does not match the preset type when the instrument is turned ON.
(An error is output and the buzzer sounds since the AAC is connected even though the instrument name is set as an AA-7000F exclusive model.)
・Connect the PC, start up the OB-CHECK software, and send "O_U_#7000" to set the instrument type for both models. Check the instrument type in the OB-CHECK software after turning the instrument OFF then back ON again.
・The system is judged as normal if "O_U" is output in response to the sent command "O_AA-7000_X_X_X_XX". (X_X_X_XX is the version number.)



(Reference)

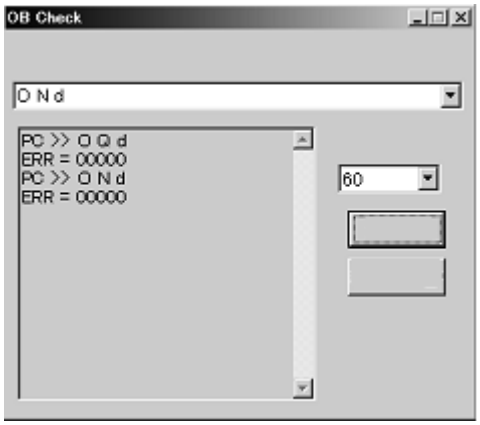
"O_U_#7001" : Write instrument type 7000F

"O_U_#7002" : Write instrument type 7000G

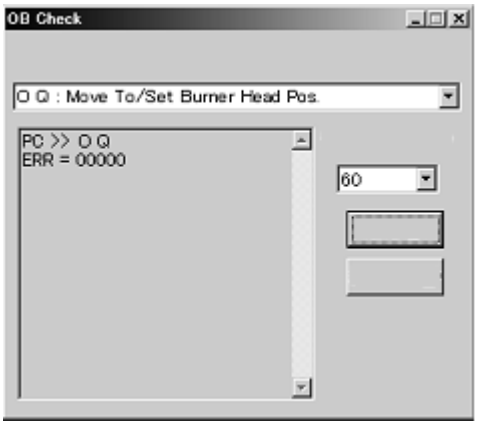
2.5.6 Adjusting the AAC Installation Position (AA-7000F)

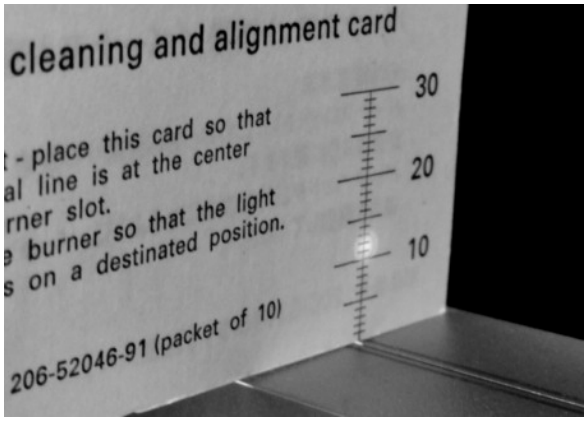
Turn the instrument ON, perform a line search by NON-BGC in WizAArd, and initialize the AAC origin position setting by WizAArd instrument maintenance. Send the "O_Q_d" and "O_N_d" commands.

(Caution) The AAC does not operate.



Send the "O_Q" command to move the AAC to the flame position, adjust the position so that the optical axis (light from HCL) is aligned with the burner slot, and firmly tighten the two mounting screws on the rear side.





Send the "O_N" command to move the AAC to the furnace position, and fully tighten the mounting screws（2 pcs）on the front side.

After fully tightening the screws, connect the drain tube protruding from the drain bottle to the main unit, and secure it with the hose band.

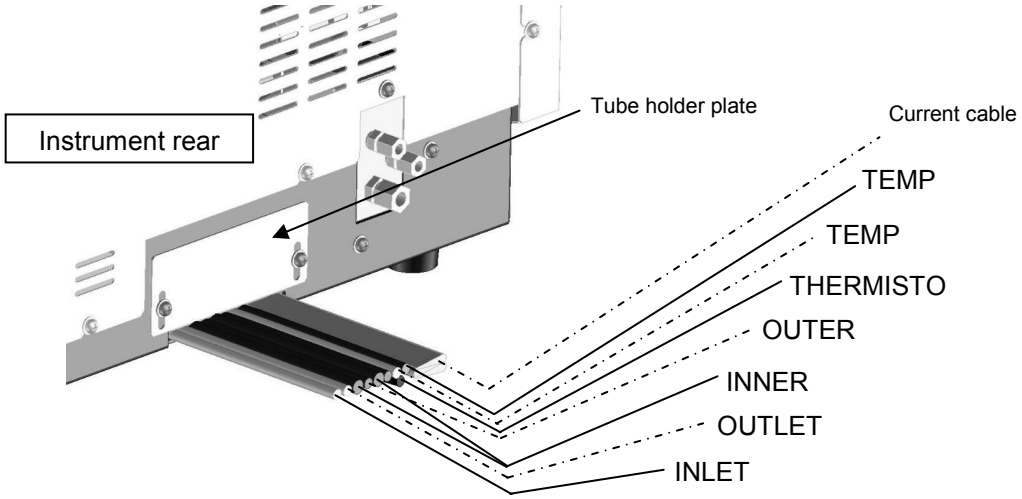
(Reference)

"O_Q" : Move atomizer to flame origin position

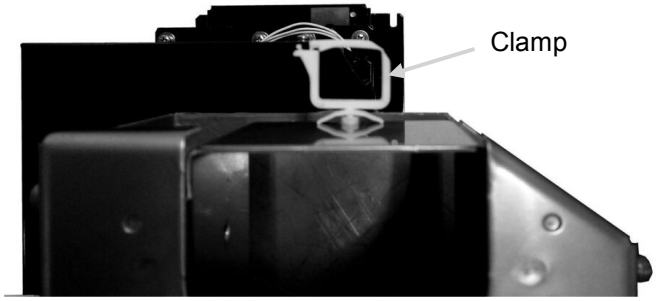
"O_N" : Move atomizer to furnace origin position

2.5.7 Installing the Graphite Furnace Chamber

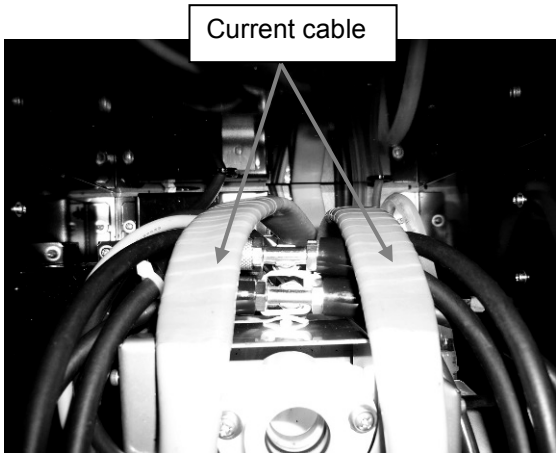
- To install the furnace, move the drive unit backwards to the burner position, and install the furnace.
- Send the "O_Q" command to move the AAC to the flame position, and remove the tube holder plate from the instrument rear.
- After installing the furnace onto the chamber cover, pass the furnace tubes to the instrument rear through the hole at the bottom of the inner wall. ◇ This operation can be made easier by leaving the vinyl attached to the tips of the furnace tubes at packing and passing it through the tunnel.
- Try to arrange the tubes as horizontally as possible, and fasten them by the tube holder plate.



- After routing the piping, fasten the lower side of the two T-joints onto the clamp on the rear side of the chamber cover.



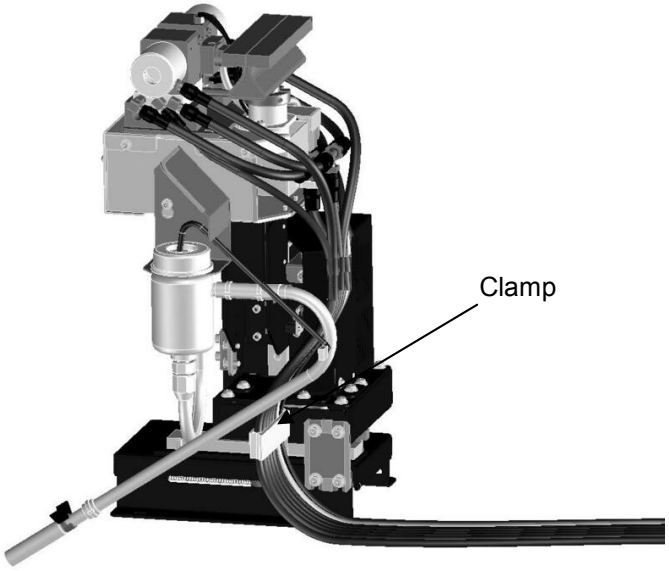
- After connecting the tubes to the GFA power supply unit, pass the current cable through the inner wall from the rear of the chimney and connect to the furnace.



・When connection of the furnace tubes and current cable is finished, screw-fasten the tube holder plate so that the tubes and current cable are fixed in place at the wiring band position.

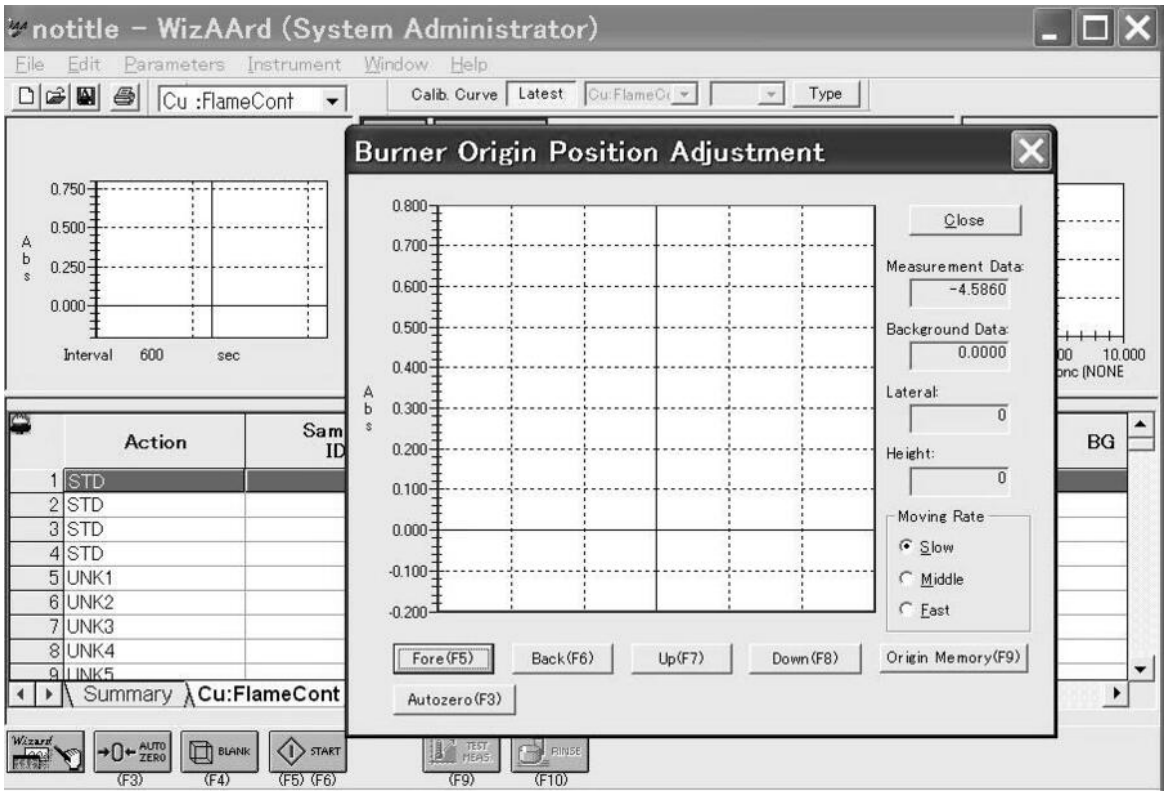
・After routing the piping, make three reciprocal moves to the burner position by the "O_Q" command and to the furnace position by the "O_N" command, and make sure that that the motors are not out-of-sync and that stress is not being applied to the piping.

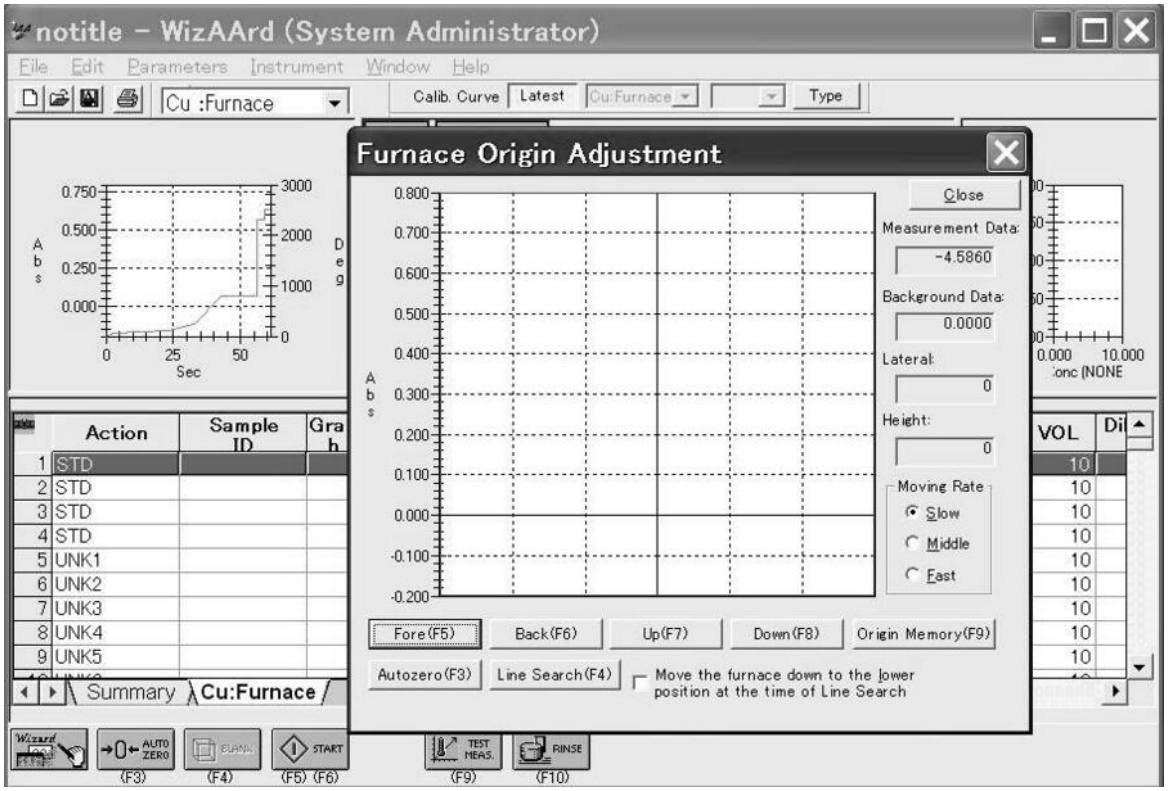
◇ If the motors are out-of-sync and piping is subjected to stress, loosen the tube holder screws, and adjust the piping position to remove any stress placed on the piping. (If the power cable is stiff, this can sometimes be remedied by swapping the left and right cables.)



2.5.8 Adjusting the Burner and Furnace Origin Positions

- Adjust the burner and furnace origin positions using WizAArd.
- The position 10 mm from the optical axis center is taken as the flame origin adjustment position.

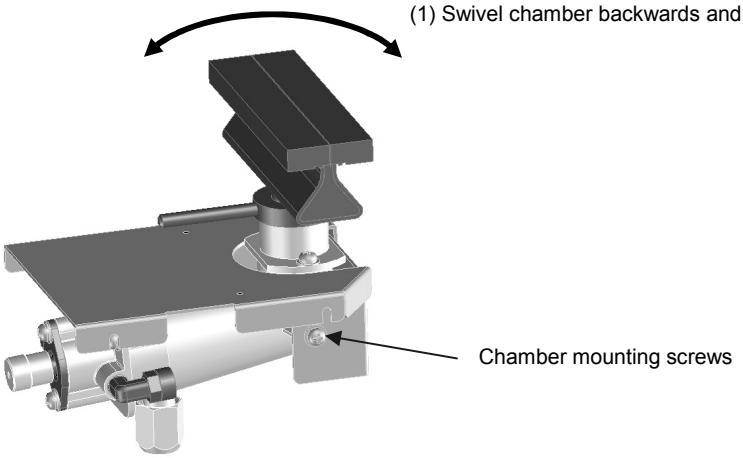




2.5.9 Origin Position Fine-Adjustment Method (AA-7000F)

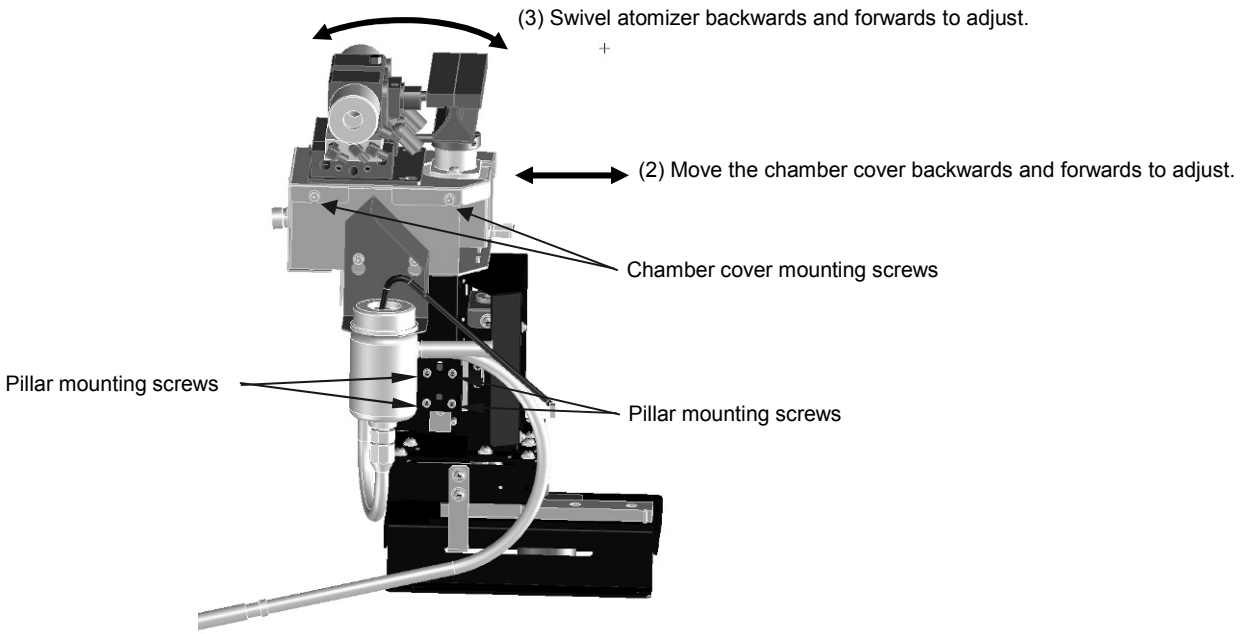
Because the forward/backward adjustment range of the AAC is narrow, there is the risk that assembly of the main unit will cause the deviation between the AAC and the optical axis center to exceed the origin position adjustment range. ◇ For this reason, the following additionally explains how to adjust the forward/backward position on the AAC. If the deviation of the optical axis exceeds the adjustment range, adjust the origin position in the order indicated (1) to (4) below.
For details on the origin position adjustment method, see "*** Adjusting the AAC Installation Position."

(1) Adjust the chamber holder and chamber mounting angles.
Loosen the chamber holder and chamber mounting screws, and change the chamber mounting angle.
The burner forward/backward position can be adjusted by approx. 3 to 4 mm by adjusting the chamber tilt.
◇This adjustment must be performed before installing the furnace since installation of the furnace will prevent the adjustment.

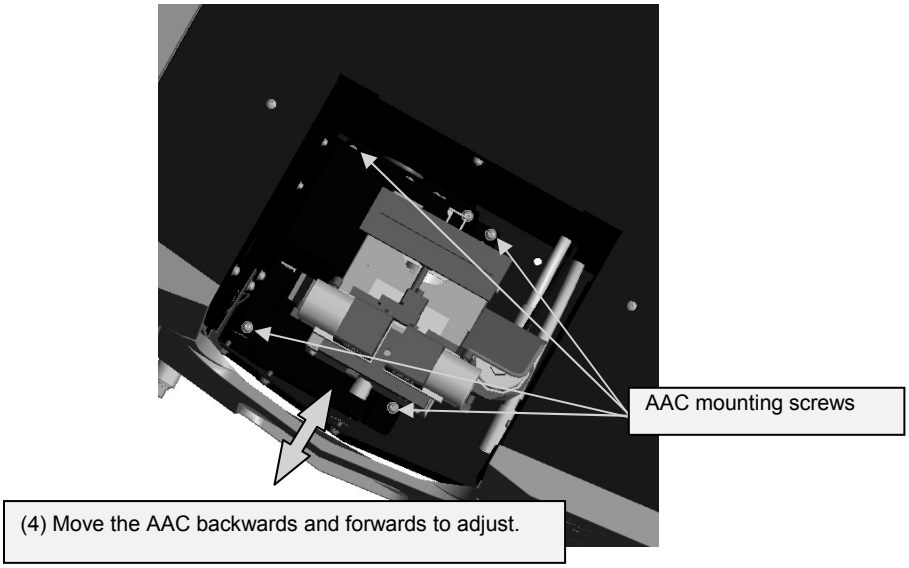


(2) Adjust the forward/backward position using the hole on the chamber holder.
Slide the chamber cover and chamber holder mounting positions to adjust the forward/backward position.
The mounting positions can be adjusted by only approx. 0.5 mm since adjustment is performed using the M3 screw and 4 mm dia. mounting hole.

(3) Loosen the pillar mounting screws, and adjust the forward/backward angle of the pillar to adjust the forward/backward position of the burner.
The forward/backward position of the burner can be adjusted within the 1 to 2 mm range by loosening the pillar mounting screws.
After adjustment, firmly fasten the burner using the screws because this is a drive unit.

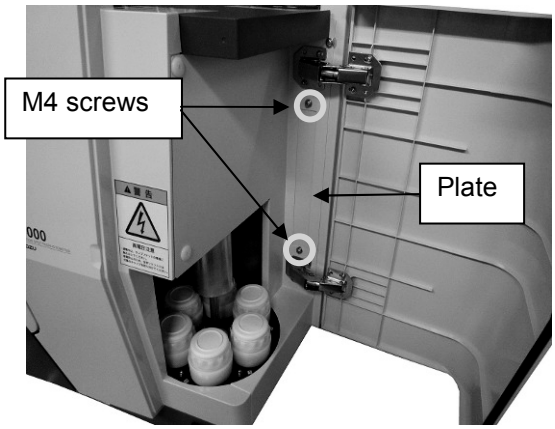


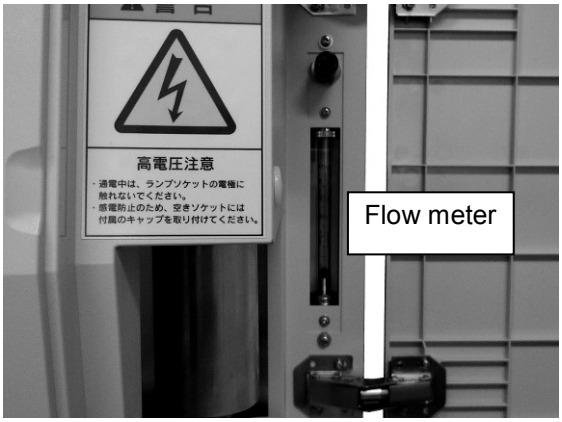
(4) Loosen the AAC and main unit base mounting screws to adjust the backward/forward position.
During this step, the initial position of the furnace must be adjusted.



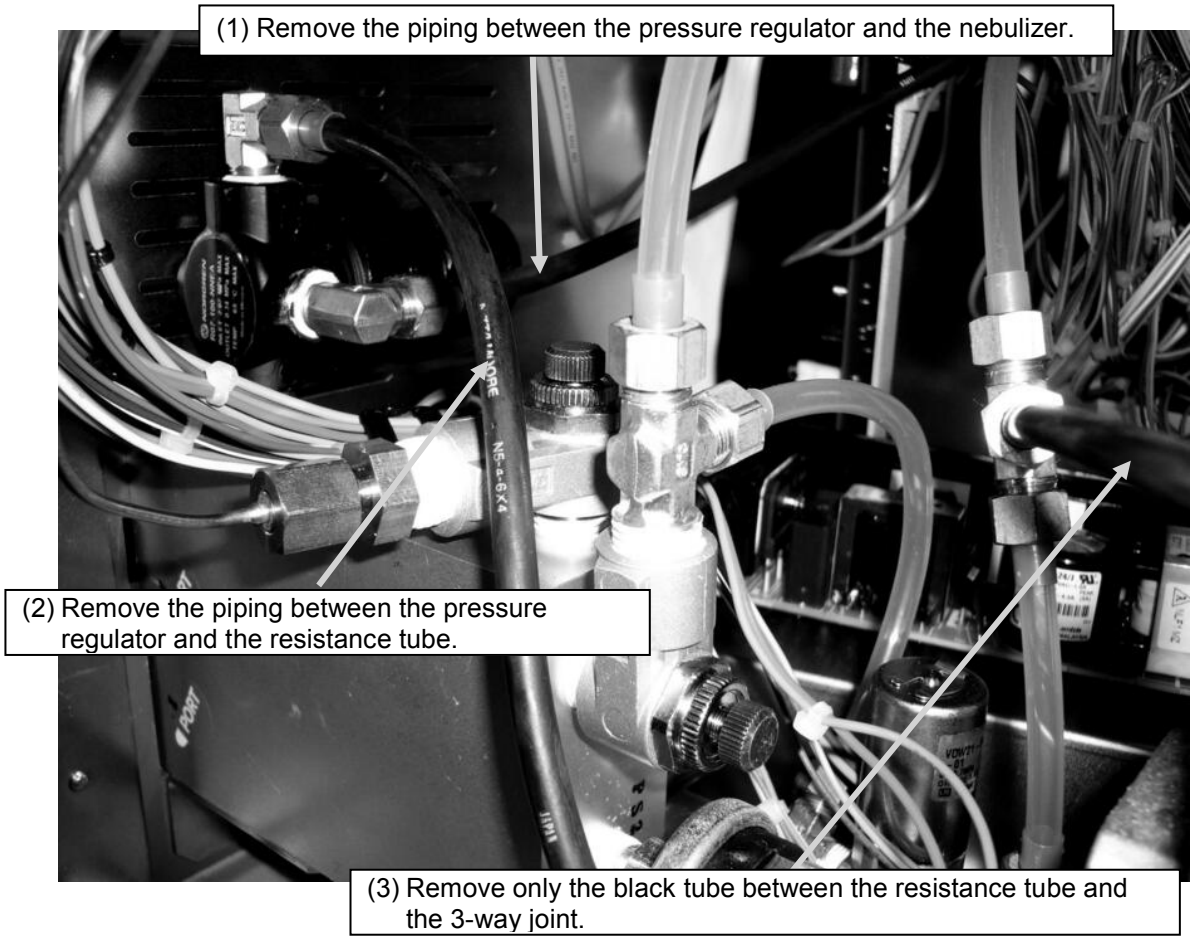
2.6 Assembling the Flow Meter Kit

- Remove the main unit left cover, left front cover and right back cover.
- Remove the plate and the screws (M4×2) securing the plate inside the lamp house cover. Use these screws to install the flow meter.

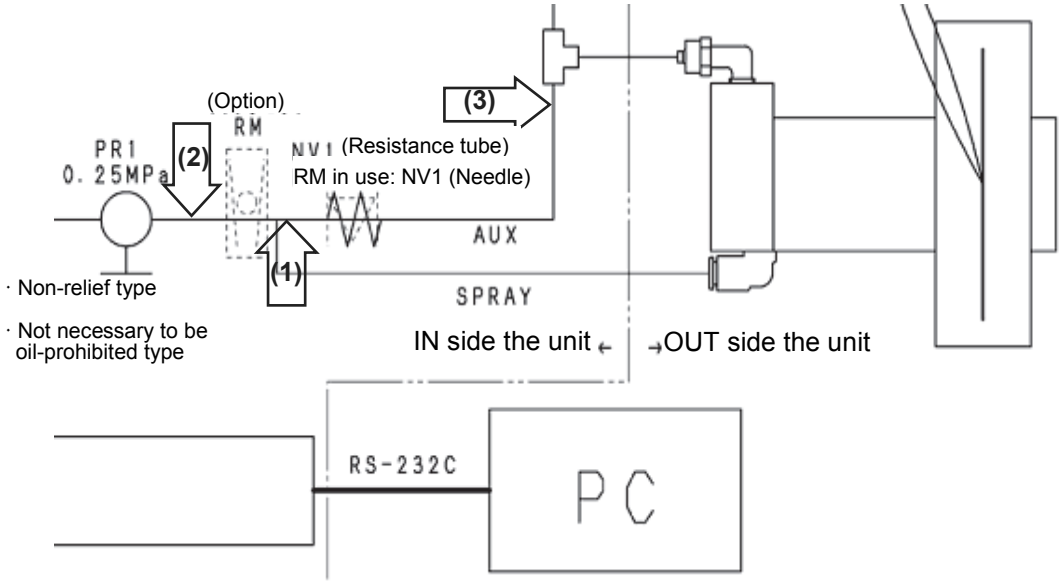


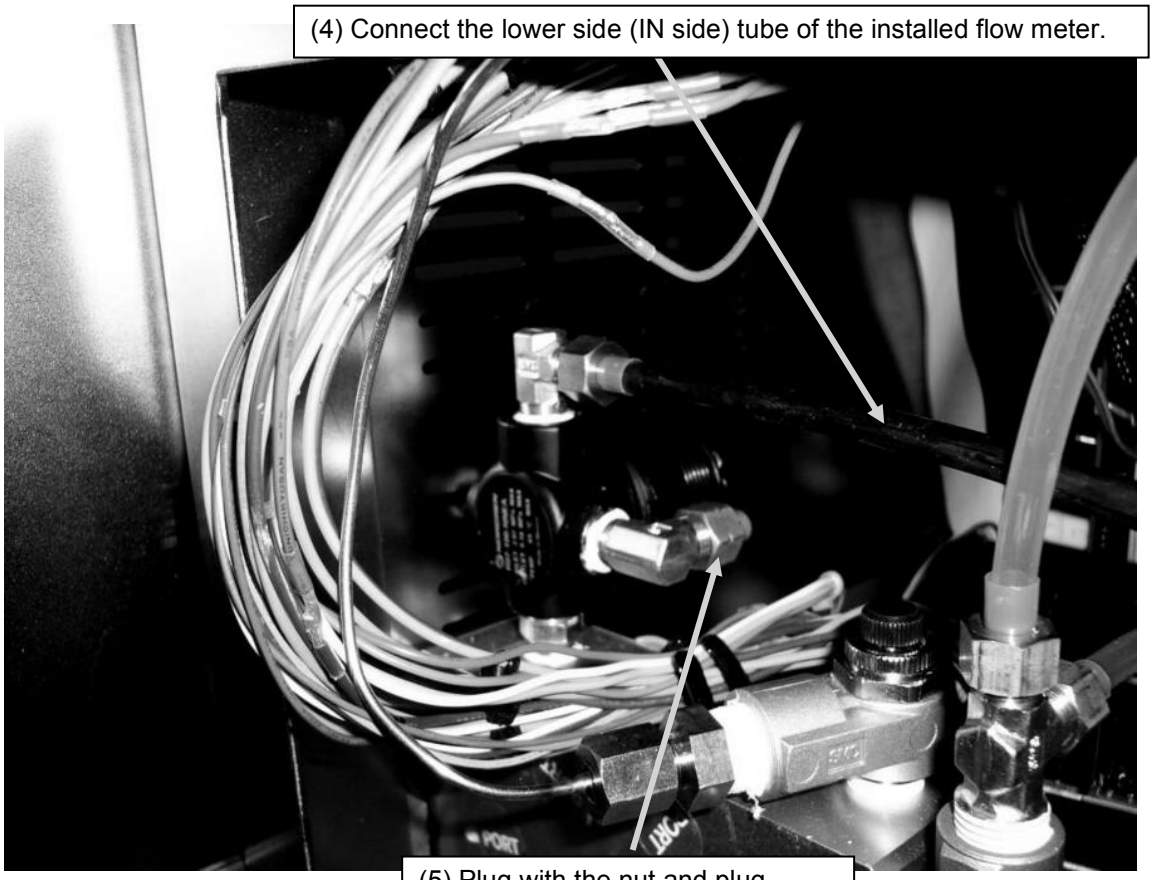


- Route the various pipes.

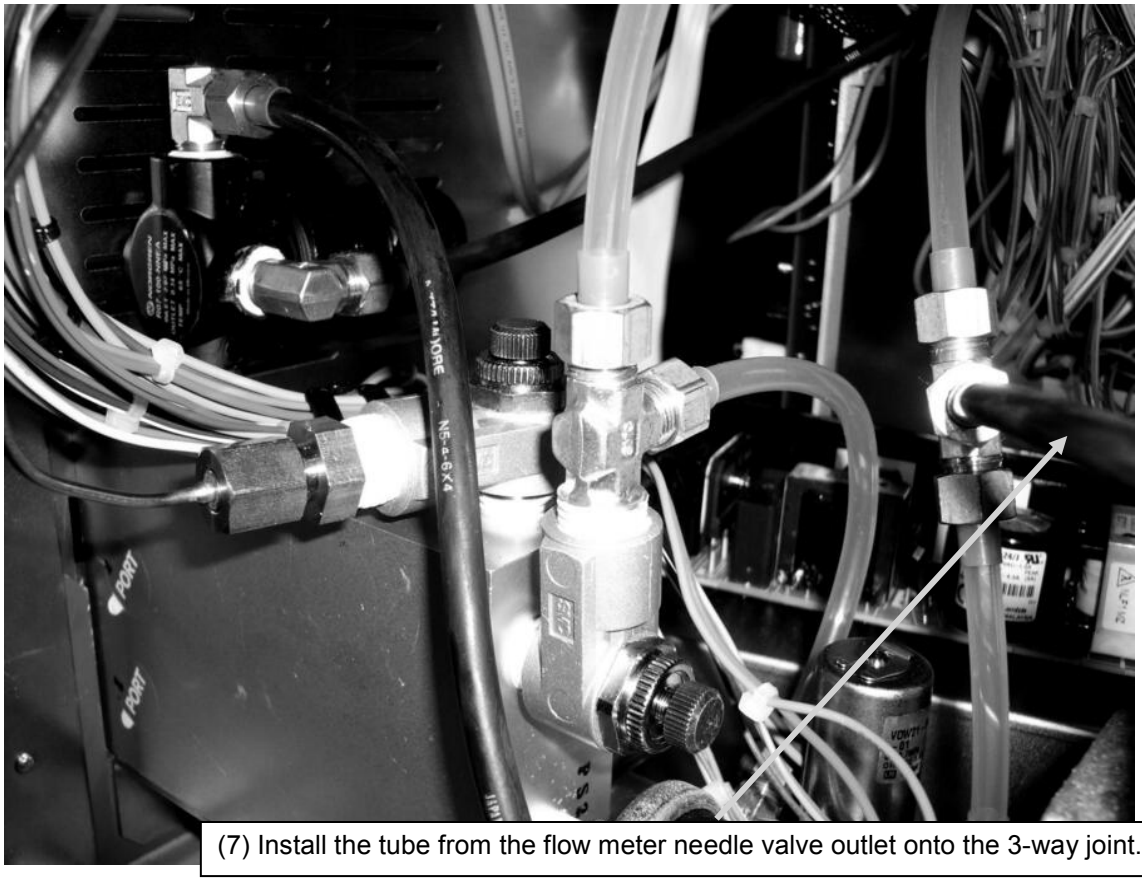


(Reference) The location of removed piping is indicated in the drawing.





(6) Install the upper side (OUT side) tube of the installed flow meter to the nebulizer.



(7) Install the tube from the flow meter needle valve outlet onto the 3-way joint.

(8) Also clamp the tube between the flow meter and gas controller to the SUS piping clamp.

3. Performance Check

3.1 Acceptance Inspection Items

Item	Specification
Wavelength Accuracy 253.65 nm, 365.01 nm, 435.84 nm, 546.08 nm 585.25 nm, 640.22 nm, 724.52 nm	Within ± 0.30 nm
NON-BGC Noise Level	0.0100 Abs max.
BGC-D2 Noise Level	0.0150 Abs max.
Baseline Drift	0.0050 Abs/30 min max.
Absorbance (Flame)	0.2300 Abs min.
Repeatability (Flame)	2.00 % max. (confidence limit: 95 %)
Detection Lower Limit (Flame)	0.00600 ppm max.
Stability (Flame)	6.0 % max.

3.2 Required Items

- Hg hollow cathode lamp (P/N 200-38422-28)
- Se hollow cathode lamp (P/N 200-38422-46)
- Cu hollow cathode lamp (P/N 200-38422-08)
- Zero calibration solution
- Standard Cu solution (2.0 ppm)

[Method for Creating Zero Calibration Solution]

The zero calibration solution is created by dissolving 8 ml of nitric acid (JIS K8541 analytical grade reagent; Japanese) in distilled water to obtain a solution of 1000 ml.
Note: The distilled water is created using the ion exchange method or the distillation method.

[Method for Creating 2.0 ppm Standard Cu Solution]

Zero calibration solution is added to 20 ml of standard Cu solution for atomic absorption (1000 ppm solution for atomic absorption manufactured by Wako Pure Chemical Industries; Japanese) to obtain a solution of precisely 100 ml (thus creating 200 ppm standard Cu solution). Next, zero calibration solution is added to 1 ml of this 200 ppm standard Cu solution to obtain a solution of precisely 100 ml (thus creating 2 ppm standard Cu solution).

3.3 Method for Obtaining Data

Using validation software, measure the items listed previously using the information provided in the Instruction Manual: "7 Hardware Validation." The default settings of the parameters agree with the previously specified values and so perform measurement without changing the parameters.
The default measurement parameters for the inspection items are given below. Measurement can also be performed using WizAArd with the same parameters.

Wavelength Accuracy Element : Hg Wavelength : 253.65 nm, 365.01 nm, 435.84 nm, 546.08 nm, 585.25 nm, 640.22 nm, 724.52 nm Lamp Current Low : 4 mA Slit Width : 0.2 nm
NON-BGC Noise Level, BGC-D2 Noise Level Element : Se Wavelength : 196.0 nm Lamp Current Low : 23 mA Slit Width : 0.7 nm Response Time : 1 Pre-Spray Time : 0 sec Integration Time : 198 sec
Baseline Drift Element : Cu Wavelength : 324.8 nm Lamp Current Low : 8 mA Slit Width : 0.2 nm Response Time : 1 Pre-Spray Time : 0 sec Integration Time : 1800 sec (30 min)

Absorbance and Repeatability (Flame) Element : Cu Wavelength : 324.8 nm Lamp Current Low : 8 mA Slit Width : 0.7 nm Lamp Mode : NON-BGC Concentration : 2.0 ppm Burner Height : 7 mm Fuel Gas Flow Rate : 1.8 L/min Support Gas Flow Rate : 15.0 L/min Pre-Spray Time : 3 sec Integration Time : 5 sec Response Time : 2	Stability (Flame) Element : Cu Wavelength : 324.8 nm Lamp Current Low : 8 mA Slit Width : 0.7 nm Lamp Mode : NON-BGC Concentration : 2.0 ppm Burner Height : 7 mm Fuel Gas Flow Rate : 1.8 L/min Support Gas Flow Rate : 15.0 L/min Pre-Spray Time : 5 sec Integration Time : 30 sec Response Time : 2

4. Periodic Inspection

4.1 Gas Leak Check

Perform a gas leak check on the gas piping (installed by customer), gas hoses (standard accessories) and gas controller inside the instrument according to the following procedures. The gas leak check described here is based on the recommended piping example described in the Instruction Manual (refer to 10.6.3).

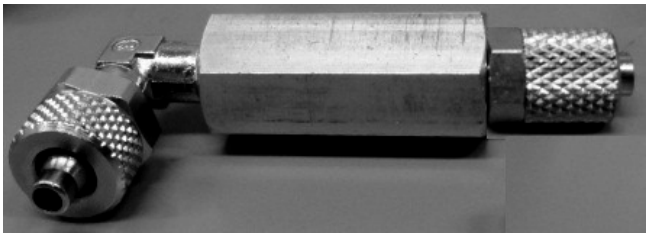
4.1.1 Checking for Gas Leaks Outside of Instrument

Inspect for gas leaks outside of instrument by following Instruction Manual (P/N 206-97176) "8.5 Checking for Gas Leaks."

4.1.2 Gas Leak Check from Gas Controller Up to Burner

Since the instrument internal gas leak check is performed by the instrument automatic leak check, in this check perform only the gas leak from the gas controller up to the burner according to the following procedures.

1. Supply air at a pressure of 0.35 MPa.
2. Connect the SPRAY and FUEL + AUX piping using sealing joints (P/N: 206-52039-93). (in same way as for AA-6300)



3. Set the gas controller to the manual mode at OBCHK. [0 F X 0]
4. Open MV1, MV4 and MV8 at OBCHK. [0 8 00000013]
5. Close the air main valve, and observe the pressure drop for 30 minutes. Make sure that the pressure is 0.05 MPa max.
6. Send the command [0 8 00000000] to close the solenoid valve.
7. Send the command [0 F X 1] to return the gas controller to the automatic control mode.
8. Restore the piping to its original state.

4.2 Operation Checks for Safety Mechanisms

Inspect the flame monitor in addition to performing the following checks for safety mechanisms at initialization:

- Fuel gas pressure monitor check
- Support gas pressure monitor check
- Burner select sensor check (only when using N2O-C2H2)
- Drain sensor check

Perform the flame monitor inspection using the following procedure:

1. Ignite the Air-C2H2 flame with a C2H2 flow rate of 1.8 L/min and an air flow rate of 15.0 L/min.
2. Reduce the C2H2 flow rate down to approx. 1.5 L/min, and blow out the flame.
3. Check that the gas automatically stops and that the message [Flame has been extinguished.] is displayed.

4.3 Inspection

Replace the required parts while referring to Instruction Manual (P/N 206-97176) "8.10 Maintenance Parts."
For details on the chemical resistance of parts in the atomizer, check Instruction Manual (P/N 206-97176) "10.1.2 Flame Specifications."

- Inspection of High-Temperature Burner
- Check for widening of the burner slot using the procedure described in the high-temperature burner Instruction Manual.

4.4 Performance Check

Check performance according to "3 Performance Check."

5. Operating Principles

5.1 Initialization

5.1.1 Function Overview

The system is initialized when the instrument is turned ON.

5.1.2 Operating Conditions

At power ON

5.1.3 Processing Flow

1) Initialization of CPU and internal peripheral devices:

- Initial setting of stack pointer
- Initialization of SH7085 internal peripheral devices
  - Initialization of clock oscillator (CPG)
  - Initialization of peripheral module states relating to power save modes
  - Initialization of bus state controller (BSC)
  - Initialization of pin function controller (PFC)
- Initialization of sections
  - Initialization of non-initialized data area to zero
  - Copying of initialization data from ROM to RAM
- Recovery of parameters from EEPROM
- Initialization of A/D converter

2) Initialization and startup of OS

- Kernel initialization
- Generation of tasks
- Generation of objects other than tasks
- Initialization of semaphores
- Startup of tasks
- Startup of system

5.1.4 Error Processing

None

5.2 Lamp Illumination Mode and Data Acquisition Methods

5.2.1 Types of Data

Data handled on the AA-7000 can be broadly classified into the following three categories:

1) Raw data:

This is ADC data obtained by A/D conversion performed on signals from detectors. Sector Mirror (Chopper) states:

- Differences in the data based on "Sample-side beam," or data based on "Reference-side beam," and lamp type and lamp on/off states at that time
- According to the data when "HCL" is lit, or data when "D2 lamp" is lit, or data when lamps are off, there are six states annotated as follows:

(1) H_S: HCL-Sample
(2) H_R: HCL-Reference
(3) D_S: D2-Sample
(4) D_R: D2-Reference
(5) DK_S: Dark-Sample
(6) DK_R: Dark-Reference

Unless otherwise mentioned, "raw data" refers to corrected raw data after correction by dark data (DK_S, DK_R), specifically:

(1) H_S: $=H_S - DK_S$
(2) H_R: $=H_R - DK_R$
(3) D_S: $=D_S - DK_S$
(4) D_R: $=D_R - DK_R$

2) Auto-zero data:

Above raw data (4 types: H_{S0}, H_{R0}, D_{S0}, D_{R0}) measured when there is no measurement sample present (atomization has not been performed).

3) Measurement data:

Transmittance or absorbance calculated from the above raw data and auto-zero data. This data is divided as follows according to differences in measurement method (single beam or double beam) and according to whether or not correction is to be performed.

☐ Measurement data (without background correction)

i.) Transmittance (HCL):

$$T_H = \frac{H_S \times H_{R0}}{H_R \times H_{S0}}$$ (double-beam data)

(Single-beam data is calculated taking H_R, H_{R0} above to be "1".)

ii.) Absorbance (HCL):

$$A_H = -\log_{10} T_H$$

iii.) Energy (HCL):

$$E_H = C \cdot H_S$$ (where, C: an appropriate constant for scaling)

☐ **Background data**

i.) Transmittance (D2):

$$T_D = \frac{D_S \times D_{R0}}{D_R \times D_{S0}}$$ (double-beam data)

(Single-beam data is calculated taking D_R, D_{R0} above to be "1".)

ii.) Absorbance (D2):

$$A_D = -\log_{10} T_D$$

☐ **Measurement data (with background correction)**

i.) Transmittance (BGC):

$$T_{BGC} = \frac{T_H}{T_D} = \frac{H_S \times H_{R0} \times D_R \times D_{S0}}{H_R \times H_{S0} \times D_S \times D_{R0}}$$ (double-beam data)

(Single-beam data is calculated taking H_R, H_{R0}, D_R, D_{R0} above to be "1".)

ii.) Absorbance (BGC):

$$A_{BGC} = -\log_{10} T_{BGC}$$

Supplementary Explanation

If we consider light incident on the sample and light transmitted through the sample including background substances in two stages, then it can be expressed as follows:

I → Sample → I' → BG → I"

whereupon,

T_H = I" / I (transmittance of sample + BG), T_D = I" / I' (transmittance of only BG)

therefore,

T_{BGC} = I' / I = T_H / T_D

5.2.2 Lamp Mode and Data Acquisition Method

The AA-7000 has the following seven lamp illumination modes (see figure below) as illumination modes (types of lighting/extinguish sequence) for acquiring data for the HCL and D2 lamps. The AA-7000 executes lighting/extinguish of the light source lamp (HCL/D2) and switching between sample/reference of the sector mirror while synchronizing these operations according to the lamp illumination mode specified by the user, and recording the detector output (0.01 ms sampling) within each cycle to data buffers on two channels. The firmware (CPU) extracts significant data from the above buffers as raw data (or auto-zero data) according to the specified lamp illumination mode.

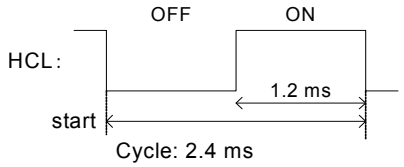
The lamp lighting/extinguish timing in each lamp illumination mode is set to the CPLD by the CPU (firmware) before actual execution of data acquisition. Synchronization control of the sector mirrors and lamps, A/D conversion and writing to buffer at data acquisition are performed by CPLD. The lamp lighting/extinguish timing is basically fixed in each lamp illumination mode. However, it is changed according to the instrument's power supply frequency (50 Hz or 60 Hz) only in the double beam mode. (The final extraction time point of the data is taken to be 72 % of time widths S or R. For example, when the frequency is 60 Hz, the final extraction time point of the HCL lighting data in the HCL-Double mode becomes $8.33 \times 0.72 = 6.0$ ms.) Note, however, that in the BGC-D2-Double mode, if the frequency is 60 Hz, the final extraction time point of the D2 lighting data is 60 ms, though, at that point in time, the D2 lamp will not go out and stay on up to the S/R switching time point. (This is a measure for preventing D2 lamp extinguishing.)

During analysis and measurement, the firmware combines the extracted raw data and previously acquired auto-zero data to calculate the measurement data (energy (in EMS mode), transmittance or absorbance), and sends this to the PC if necessary.
For example, in the EMS mode, to acquire H_S and H_{S0}, the data for when HCL is ON is extracted from buffer addresses 120 to 239.

AA-7000 Lamp Illumination Modes

(1) EMS (Energy Measuring Single) mode:

SM: Always S



Cycle: 2.4 ms
A/D sampling: 0.01 ms (240 points/cycle)

CPLD ⇨

A/D data buffer:
Ch1: 0 ... 239
Ch2: 0 ... 239

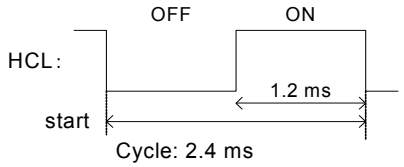
Data for 1 cycle is recorded alternately to Ch1 and Ch2.

CPU(FW) ⇨

Acquired data:
H_S
→
$E_H = C \cdot H_S$

(2) HCL (Non-BGC)-Single mode:

SM: Always S



Cycle: 2.4 ms
A/D sampling: 0.01 ms (240 points/cycle)

CPLD ⇨

A/D data buffer:
Ch1: 0 ... 239
Ch2: 0 ... 239

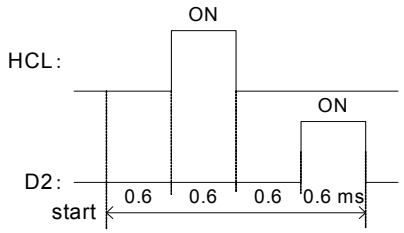
Data for 1 cycle is recorded alternately to Ch1 and Ch2.

CPU(FW) ⇨

Measurement data:
$H_S(H_{S0})$
→
$T_H = H_S/H_{S0}$

(3) BGC-D2-Single mode:

SM: Always S



Cycle: 2.4 ms
A/D sampling: 0.01 ms (240 points/cycle)

CPLD ⇨

A/D data buffer:
Ch1: 0 ... 239
Ch2: 0 ... 239

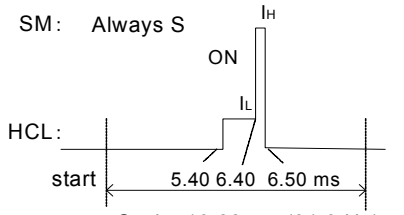
Data for 1 cycle is recorded alternately to Ch1 and Ch2.

CPU(FW) ⇨

Measurement data:
$H_S(H_{S0})$, $D_S(D_{S0})$
→
$T_{BGC} = (H_S \cdot D_{S0})/(H_{S0} \cdot D_S)$

(4) BGC-SR-Single mode:

SM: Always S



Cycle: 10.88 ms (91.9 Hz)
A/D sampling: 0.01 ms (1088 points/cycle)

CPLD ⇨

A/D data buffer:
Ch1: 0 ... 1087
Ch2: 0 ... 1087

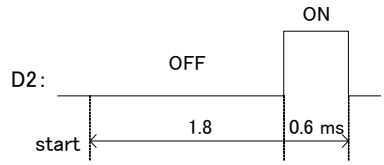
Data for 1 cycle is recorded alternately to Ch1 and Ch2.

CPU(FW) ⇨

Measurement data:
I_L: $H_S(H_{S0})$
I_H: $B_S(B_{S0})$
→
$T_{BGC} = (H_S \cdot B_{S0})/(H_{S0} \cdot B_S)$

(5) D2-Single mode:

SM: Always S



CPLD ⇨

A/D data buffer:
Ch1 : 0 ... 239
Ch2 : 0 ... 239

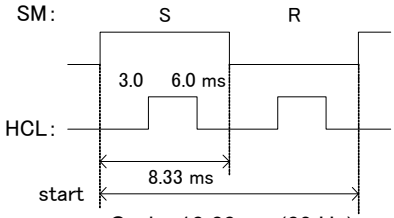
CPU(FW) ⇨

Measurement data:
$D_S(D_{S0})$
→
$T_D = D_S/D_{S0}$

Cycle: 2.4 ms
A/D sampling: 0.01 ms (240 points/cycle)

Data for 1 cycle is recorded alternately to Ch1 and Ch2.

(6) HCL (Non-BGC)-Double mode:



CPLD ⇨

A/D data buffer:
Ch1 : 0 ... 832
Ch2 : 0 ... 832

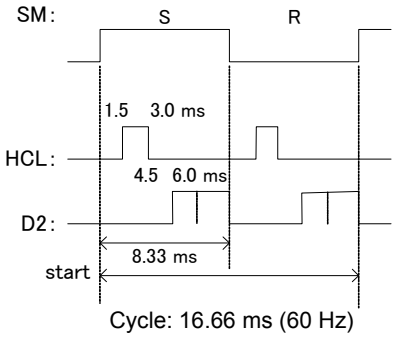
CPU(FW) ⇨

Measurement data:
$H_S(H_{S0})$, $H_R(H_{R0})$
→
$T_H = (H_S \cdot H_{R0})/(H_R \cdot H_{S0})$

Cycle: 16.66 ms (60 Hz)
A/D sampling: 0.01 ms (1666 points/cycle)

S and R data is recorded alternately to Ch1 and Ch2.

(7) BGC-D2-Double mode:



CPLD ⇨

A/D data buffer:
Ch1 : 0 ... 832
Ch2 : 0 ... 832

CPU(FW) ⇨

Measurement data:
$H_S(H_{S0})$, $H_R(H_{R0})$
$D_S(D_{S0})$, $D_R(D_{R0})$
→
$T_{BGC} = \dfrac{H_S \cdot H_{R0} \cdot D_R \cdot D_{S0}}{H_R \cdot H_{S0} \cdot D_S \cdot D_{R0}}$

Cycle: 16.66 ms (60 Hz)
A/D sampling: 0.01 ms (1666 points/cycle)

S and R data is recorded alternately to Ch1 and Ch2.

5.2.3 Types of Measurement Modes

The AA-7000 instrument is provided with the following three "measurement modes" for determining how samples should be atomized:

- Flame Continuous Mode
- Microsampling Mode
- Furnace Mode

In other words, this means that measurement modes are provided for the number of combinations of the above "lamp illumination modes" (optical system settings) and "measurement modes" (atomizer settings).

5.3 Wavelength Calibration

5.3.1 Function Overview

The correction coefficients for each of the wavelengths is obtained by measuring the difference between the pulse position obtained from the design values of the wavelength motor and the pulse position where the emission line peaks of a particular wavelength are actually detected when the wavelength of a certain peak is specified, using several reference peaks for wavelength calibration. Wavelength calibration is performed using the "O w" command.

5.3.2 Operating Conditions

None

5.3.3 Processing Flow

The execution mode for the "O w" command is specified as an option.

The following two execution modes are available.

Execution Mode	Description	Notes
1 (default)	Execution of 1st-order wavelength calibration	Wavelength calibration is performed for the 656.1 nm emission line and zero-order light using the D2 lamp.
2	Execution of the first half of 2nd-order wavelength calibration	Wavelength calibration is performed for emission lines of 12 wavelengths using the D2 lamp and the Hg-HCL.

- Lighting of lamps required for peak detection and extinguishing of unwanted lamps is executed within these commands.
- The peak detection method is the same for all calibration procedures (height mode).
- If the "-d" option is specified, the detected data is transferred to the PC after execution of calibration processing.
  The format of data transferred to the PC is as follows:
  "O <Wavelength> <Theoretical value> <Measured value> <Judgment>,
  <Wavelength 2> ... and so forth"
  Wavelength: Wavelength of analysis line, ASCII (xxx.x)
  Theoretical value: Design value for the number of pulses, ASCII (xxxxx)
  Measured value: Number of pulses for detected peak, ASCII (xxxxx)
  Judgment: Successful detection, ASCII ("OK")
  Unsuccessful detection, ASCII ("NG")
  If the "-1" option is specified, the lamp is not extinguished when execution is completed. It is, however, extinguished if this option is not specified.

5.3.3.1 First-Order Calibration (Conventional Wavelength Calibration)

Wavelength calibration is performed for zero-order light and the 656.1 nm emission line using the D2 lamp.

1) Detection of zero-order light
   The 0.2 nm slit is used.
   The scanning range is the design position of the zero-order light ± 13.7 nm (± 400 pulses).
   The photomultiplier gain is adjusted in the same way as for peak search.
2) Detection of 656.1 nm emission line
   The 0.7 nm slit is used.
   The scanning range is the design position of the 656.1 nm ± 4.0 nm (± 117 pulses).
   The photomultiplier gain is adjusted in the same way as for peak search.
3) Storing calibration result
   The following information is stored to EEPROM as the calibration result:
   - Origin information of zero-order light (offset, excitation pattern)
   - Grating constants
   - Information of the 656.1 nm emission line (wavelength and peak pulse position)

5.3.3.2 Second-Order Calibration (First Half)

Wavelength calibration is executed on the emission lines of 12 wavelengths using the D2 lamp and Hg-HCL.
The 0.2 nm slit is used for wavelengths of less than 656.1 nm, and the 0.7 nm slit is used for wavelengths of 656.1 nm or more.
The range of 3.2 nm (94 pulses) either side of the central wavelength is searched (scanned) and peaks are detected in the case of wavelengths of less than 656.1 nm. In the case of wavelengths 656.1 nm or more, the range of 4.1 nm (120 pulses) either side of the central wavelength is searched (scanned) and peaks are detected.
The wavelength and pulse position of detected peaks are stored as parameters.
Movement to the central wavelength is executed based on the result of the first-order calibration (grating constants).

5.3.3.3 Data Stored in EEPROM

The calibration data (offset data from the photo-interrupter, excitation patterns, grating constants) obtained by first-order calibration is stored to EEPROM as in conventional systems.
Regarding the calibration data obtained by second-order calibration, the design wavelength and actually measured number of pulses (2 bytes each) are stored in EEPROM.

5.3.3.4 Calibration Wavelength Table

The following table shows the wavelengths and parameters corresponding to different calibration levels.

Calibration Level	Calibration Wavelength (nm)	Slit (nm)	Lamp Used	Current (mA)	D2 attenuator	Peak Search Range (nm)
1st order	0.0	0.2	D2	300	100 %	± 13.7 (± 400 p)
2nd order, 1st half	194.23	0.2	Hg	6	-	± 3.2 (± 94 p)
2nd order, 1st half	253.65	0.2	Hg	6	-	± 3.2 (± 94 p)
2nd order, 1st half	296.73	0.2	Hg	6	-	± 3.2 (± 94 p)
2nd order, 1st half	313.16	0.2	Hg	6	-	± 3.2 (± 94 p)
2nd order, 1st half	365.02	0.2	Hg	6	-	± 3.2 (± 94 p)
2nd order, 1st half	435.83	0.2	Hg	6	-	± 3.2 (± 94 p)
2nd order, 1st half	486.00	0.2	D2	450	100 %	± 3.2 (± 94 p)
2nd order, 1st half	546.07	0.2	Hg	6	-	± 3.2 (± 94 p)
2nd order, 1st half	585.25	0.2	Hg (Ne)	6	-	± 3.2 (± 94 p)
1st order	656.10	0.7	D2	450	100 %	± 4.0 (± 117 p)
2nd order, 1st half	667.80	0.7	Hg (Ne)	6	-	± 4.2 (± 120 p)
2nd order, 1st half	703.24	0.7	Hg (Ne)	6	-	± 4.2 (± 120 p)
2nd order, 1st half	724.52	0.7	Hg (Ne)	6	-	± 4.2 (± 120 p)

5.3.4 Error Processing

・Motor origin detection failure
・Chopper motor abnormal rotation/stop failure
・D2 lamp defective lighting
etc.

5.4 Line Search

5.4.1 Function Overview

Peaks are detected in the wavelength range of 1.2 nm either side of the wavelength specified by the "O l" command. Of the peaks that are found, analysis lines are selected by the analysis line[1] search method (peak having largest area, highest peak, peak nearest the specified wavelength) specified by the command, and the wavelength is set to the analysis line position. The profile data obtained by measurement in the above wavelength range is sent as the response.
Then, the peak data (position of all detected peaks) is sent to the PC as the response by the "O K" command.

5.4.2 Operating Conditions

Wavelength calibration must be completed.

5.4.3 Processing Flow

1) Execution of line search by "O l" command:

Input:

- Analysis wavelength, analysis line search method << "O l" command
- Detector output data << detector A/D

Output:

- Profile data >> instrument internal information, PC
- Peak data >> instrument internal information
- Analysis lines (wavelength position) >> instrument internal information
- High-sensitivity HCL lamp position >> instrument internal information
- Optimum detector HV value >> instrument internal information, detector HV D/A

Processing:

(1) The parameters are checked by the "O l" command.
(2) The Illumination mode is set to the "EMS mode."
(3) **Scan processing** 2) is executed within the range 1.2 nm either side of the specified wavelength, and the "profile data" is obtained.
(4) The "profile data" is transferred to the PC.
(5) **Peak detection processing** 3) is performed from the above "profile data" to create "peak data."
(6) The analysis line (peak wavelength position for analysis) is selected by the analysis line search method (peak having largest area, highest peak, peak nearest the specified wavelength) specified by the command.
(7) The wavelength is moved to the analysis line.
(8) Finally, **Sensitivity adjustment** 4) is performed taking the "HCL lamp position" and "detector HV" (gain) as the parameters.

2) Scan processing:

Input:

- Analysis wavelength << "O l" command

[1] The peak used in analysis

- Scan width (1.2 nm) << instrument internal information (constants)
- Detector output data << detector A/D
- Lower and upper limits of the maximum value in profile data << instrument internal information (constants)

Output:

- Step signal >> wavelength data
- Profile data >> instrument internal information

Processing:

(1) The detector HV value is set as the default (1/2 of maximum range).

(2) The detector output data (that is, the energy value since the illumination mode is the EMS mode) at the present wavelength position is acquired while moving the wavelength one pulse at a time within the range 1.2 nm either side of the specified wavelength to create the "profile data."

(3) Whether or not the maximum value in the "profile data" above is within the pre-determined range (that is, lower limit (20 %) or more, upper limit (80 %) max.) is investigated.

(4) Processing ends if the result of (3) is within the range. Otherwise, change the detector HV value and return to (2) (re-scan).

3) Peak detection processing:

Input:

- Profile data << instrument internal information

Output:

- Peak data >> instrument internal information

Processing:

All peaks in the profile data created by scan processing in (2) are detected, and the wavelength position, height and area of each peak are saved to instrument internal information as peak data. The definition of peak is as follows: wavelength position corresponding to the maximum value when a value increases continuously by double-sampling (0.1 nm steps) and decreases continuously by double-sampling.

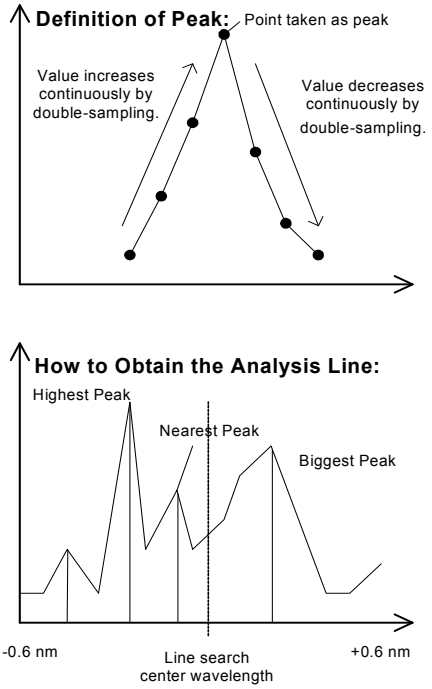


Fig. 1 Definition of Peak and How to Obtain the Analysis Line

4) Sensitivity adjustment:

Input:

- Detector output data << detector A/D

Output:

- Step signal >> HCL lamp turret motor
- High-sensitivity HCL lamp position >> instrument internal information
- Optimum detector HV value >> instrument internal information, detector HV D/A

Processing:

(1) The detector output data (= d0) at the current wavelength position (analysis line wavelength position) is read.

(2) The HCL lamp turret motor is moved in +1 step, and the detector output data (= d1) is read.

(3) d0 and d1 are compared. If d0 < d1, the turret is moved in the positive direction, and if d0 > d1, the turret is moved in the negative direction. While the turret is being moved in this way (up to 24 steps), the pulse position of the turret where the detector output data is maximum (that is, the position of maximum HCL lamp sensitivity) is found, and held in instrument internal information.

(4) If, in the state in (3) above, the detector output data is saturated, find the optimum detector HV value while lowering the detector HV 5 V at a time until the detector output data is no longer saturated, and hold the HV value at that time (optimum detector HV value) as instrument internal information.

5) Transfer of "peak detection result" by "O K" command:

Input:

- << "O K" command

Output:

- Peak data >> PC
- Analysis lines (wavelength position) >> PC

Processing:

The "peak data" and "analysis line (wavelength position)" made in steps (1) to (4) above is sent as the response by the "O K" command from the PC.

5.4.4 Error Processing

- The parameters of the "O I" command are incorrect.
- The energy of the HCL is too low.
- Peak detection error (peak is not found)

5.5 Beam Balance

5.5.1 Function Overview

If the specified mode is the mode for performing background correction using the D2 lamp (that is, BGC-D2-Single or BGC-D2-Double mode), when the "data acquisition mode" has been set by the "O v" command from the software running on the PC, adjust the beam intensity balance between the HCL and D2 lamps by switching the attenuation rate of the D2 lamp and attenuator so that the intensities of the HCL and D2 lamps become the same. (As a guideline, rough-adjust in transmittance 0.5 % increments until the relative intensity becomes D2/HCL = 1.)
The attenuator attenuation rate above can also be set manually by the "O DA" command.

5.5.2 Operating Conditions

None

5.5.3 Processing Flow

1) "O v" command processing:

Input:

- Data acquisition mode << "O v" command, instrument internal information
- Measurement mode << "O v" command, instrument internal information
- AGC target voltage value << "O v" command, instrument internal information

Output:

- Data acquisition mode >> instrument internal information, PC
- Measurement mode >> instrument internal information, PC
- AGC target voltage value >> instrument internal information, PC

Processing:

(1) The "O v" command is received from the PC.
(2) If the argument of the "O v" command is not specified, the current "data acquisition mode," "measurement mode" and "AGC target voltage value" are sent to the PC as the response.
(3) If the argument of the "O v" command is specified, the data acquisition mode and measurement mode (may be omitted) are set (stored and held). (When the measurement mode parameter is omitted, only the data acquisition mode is set. In this instance, the previously set mode is used as the measurement mode.)
(4) The integrated count of the data (Flame Continuous Mode: 200 ms/lamp lighting cycle, Microsampling Mode/Furnace Mode: 200 ms/lamp lighting cycle) is set according to the set data acquisition mode (→lamp lighting cycle is determined) and measurement mode (→integrating time of raw data is determined).
(5) The digital filter of the measurement data is initialized.
(6) AGC (Auto Gain Control) is executed on the HCL signal intensity. At this time, on a standard instrument, the target voltage value is 1.5 V. However, when the -v=<AgcVol> option is specified, the AGC target voltage value (0 to 250 [× 0.01 V]) also can be specified.
(7) If the preset data acquisition mode is the mode for performing background correction using the D2 lamp (that is, BGC-D2-Single or BGC-D2-Double mode), **beam scan processing** 2) is executed.

2) Beam balance processing:

Input:

- Data acquisition mode << instrument internal information
- Detector output data (sample-side data for both HCL and D2) << detector A/D
- "D2 lamp and attenuator attenuation rate vs. pulse position" table

Output:

- D2 lamp and attenuator attenuation rate >> instrument internal information
- HCL, D2 amplifier gain >> detector output signal amplifier
- Pulse position >> D2 lamp, attenuator, motor

Processing:

(1) Move the 2D lamp and attenuator so that the attenuation rate of the D2 lamp and attenuator is 0 %.

(2) Set the amplifier gain of the D2 lamp to the same as that for the HCL lamp.

(3) Increment the attenuation rate of the D2 lamp and attenuator in 10 % increments, and stop at the position where HCL intensity < D2 intensity.

(4) Even if the attenuation rate of the D2 lamp and attenuator is at 100 %, when HCL intensity > D2 intensity, increase the D2 amplifier gain until the D2 lamp intensity is 1/4 or more of the HCL intensity, and end processing. (The D2 amplifier gain can be adjusted × 4 times at a time twice up to the maximum.)

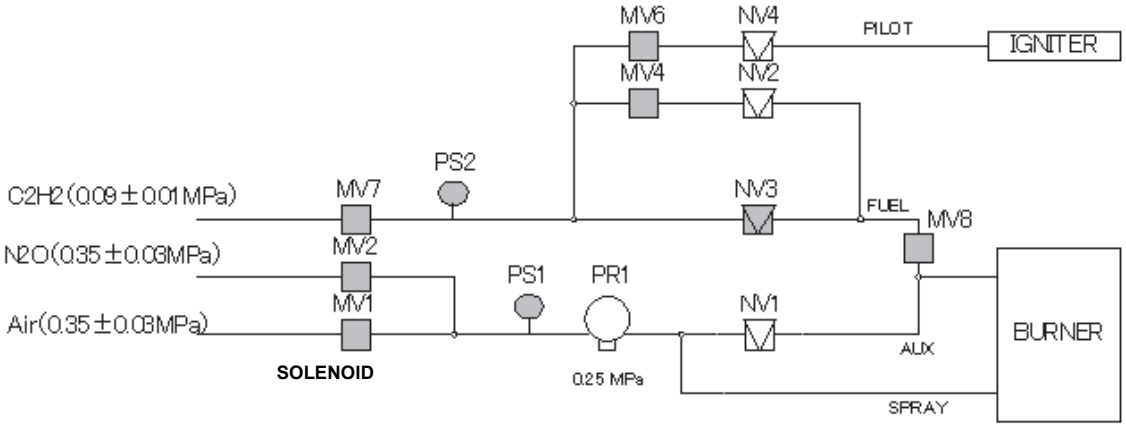
(5) In cases other than (4) above, make sure that the D2 lamp is not saturating, then decrease the attenuation rate of the D2 lamp and attenuator in 1 % increments, and stop at the position where HCL intensity > D2 intensity.

(6) In the same way as in (5), increment the attenuation rate of the D2 lamp and attenuator in 0.5 % increments, and stop at the position where HCL intensity < D2 intensity. End processing.

5.5.4 Error Processing

- The "data acquisition mode" received by the "O v" command does not match the "lamp illumination mode" preset by the "O Y" command.
- HCL light intensity (Hs) and D2 lamp light intensity (Ds) defective data (values have not reached specified threshold values.)

5.6 Gas Control



5.6.1 Flame Ignition

5.6.1.1 Function Overview

The flame is ignited by holding down the [IGNITE] and [PURGE] switches at the same time (AND of two switch states).

5.6.1.2 Operating Conditions

(1) The gas controller must be mounted.
(2) There must be no errors occurring on the safety mechanisms (see 5.6.6) of the gas controller.
(3) The ignition enable command "O F F 1" must be sent.

5.6.1.3 Processing Flow

○ **For Air-C_2H_2:**

(1) Confirmation of operating conditions and preparation for ignition
- Make sure that the ignition enable command "O F F 1" has been sent.
- Check that the water level is appropriate using the water level sensor. (Make sure that drain bottle is filled with solvent (e.g. water).)
- Adjust the gas flow rate adjusting valve (NV3) to the flow rate setting.

(2) When the [IGNITE] and [PURGE] switches are pressed simultaneously, the flame monitor signal is checked.

[Error] If the flame monitor signal level is "too bright," ignition processing is cancelled.

(3) The Air valve (MV1) is opened, and whether or not the pressure of the pressure sensor (PS1) is appropriate is checked.

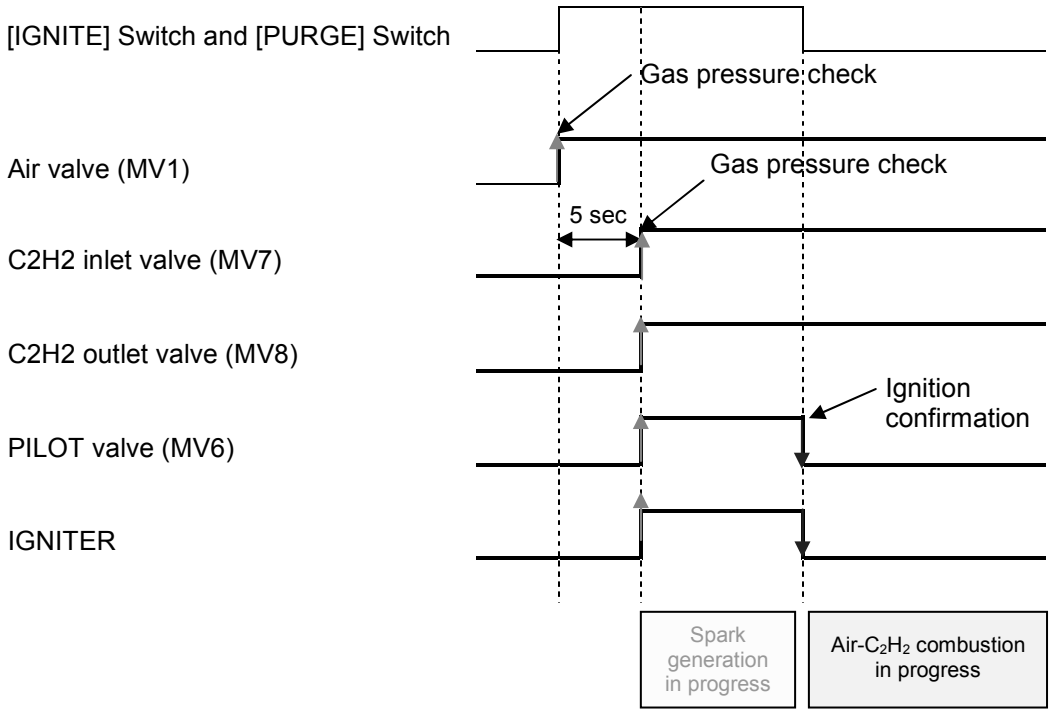
[Error] If the pressure is not appropriate, this is judged to be an error, and the Air valve (MV1) is closed.

(4) After five seconds, the inlet valve (MV7) and outlet valve (MV8) of the C_2H_2 line open, and whether or not the pressure of the pressure sensor (PS2) is appropriate is checked.

[Error] If there is an abnormality, this is judged to be an error, and the C_2H_2 valve (MV7, MV8) and Air valve (MV1) are closed.

(5) The PILOT valve (MV6) is opened, and the IGNITER is turned ON.

(6) If the [IGNITE] switch is turned OFF, or ten seconds elapses since the [IGNITE] switch is pressed, the PILOT valve (MV6) is closed, and IGNITER is turned OFF.
[Error] If the Air-C_2H_2 level cannot be confirmed by the flame monitor signal, the PILOT valve (MV6) is closed, the IGNITER is turned OFF, and the C_2H_2 valves (MV7, MV8) and Air valve (MV1) are closed.



○ **For N_2O-C_2H_2:**

(1) Confirmation of operating conditions and preparation for ignition
- Make sure that the ignition enable command "O F F 1" has been sent.
- Make sure that the high-temperature burner head is attached using the key switch.
- Check that the water level is appropriate using the water level sensor. (Make sure that drain bottle is filled with solvent (e.g. water).)
- Adjust the gas flow rate adjusting valve (NV3) to the flow rate setting.

(2) When the [IGNITE] and [PURGE] switches are pressed simultaneously, the flame monitor signal is checked.

[Error] If the flame monitor signal level is "too bright," ignition processing is cancelled.

(3) The Air valve (MV1) is opened, and whether or not the pressure of the pressure sensor (PS1) is appropriate is checked.

[Error] If the pressure is not appropriate, this is judged to be an error, and the Air valve (MV1) is closed.

(4) After five seconds, the inlet valve (MV7) and outlet valve (MV8) of the C_2H_2 line open, and whether or not the pressure of the pressure sensor (PS2) is appropriate is checked.

[Error] If there is an abnormality, this is judged to be an error, and the C_2H_2 valve (MV7, MV8) and Air valve (MV1) are closed.

(5) The PILOT valve (MV6) is opened, and the IGNITER is turned ON.

(6) If the [IGNITE] switch is turned OFF, or ten seconds elapses since the [IGNITE] switch is pressed, the PILOT valve (MV6) is closed, and IGNITER is turned OFF.

[Error] If the Air-C_2H_2 level cannot be confirmed by the flame monitor signal, the PILOT valve (MV6) is closed, the IGNITER is turned OFF, and the C_2H_2 valves (MV7, MV8) and Air valve (MV1) are closed.

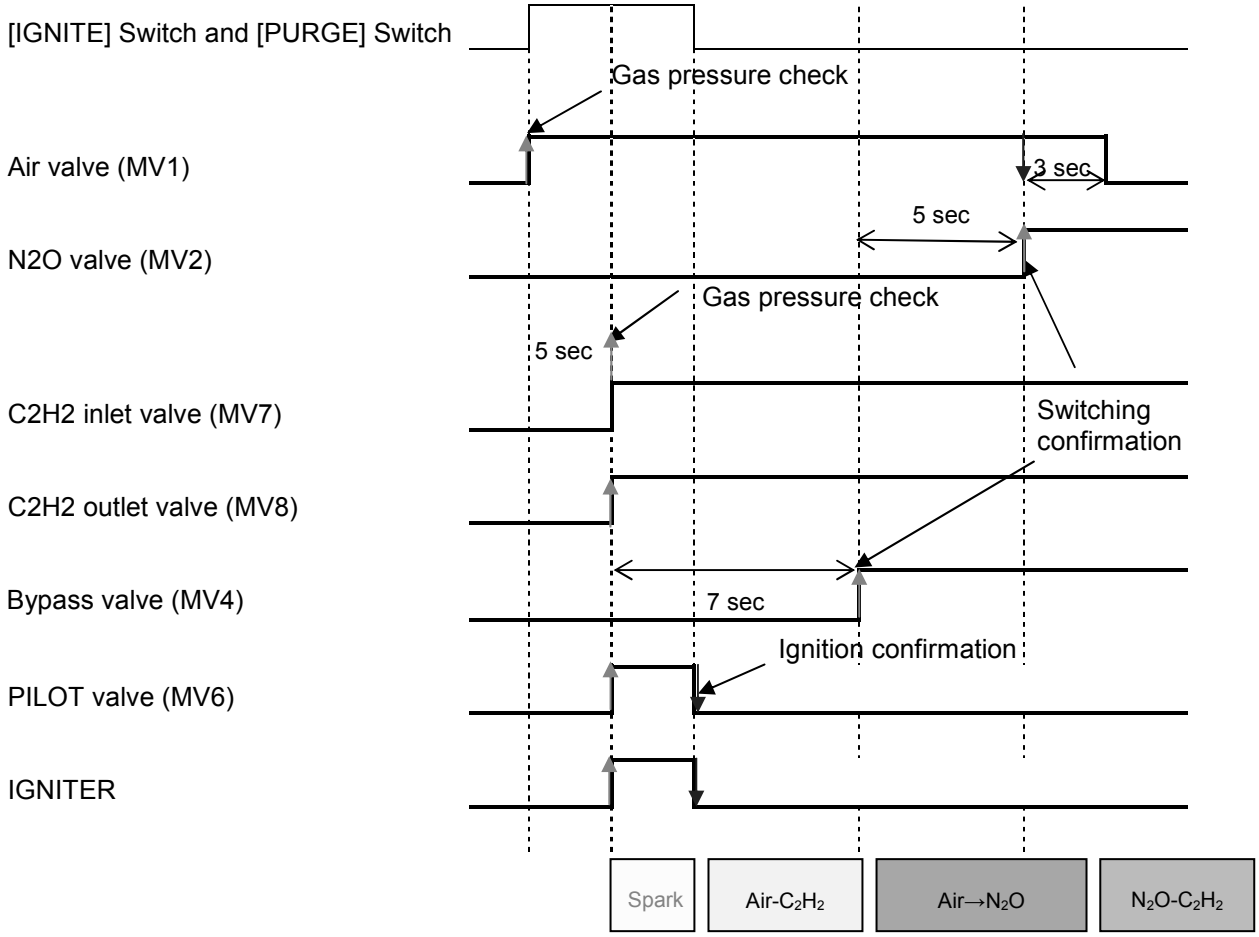
(7) Seven seconds after (4), the bypass valve (MV4) is opened, the level of the Air-C_2H_2 (5 L increment) is checked by the flame monitor signal.

[Error] If the level cannot be confirmed, the bypass valve (MV4) is closed, and the extinguish sequence is executed.

(8) Five seconds after (7), the N_2O valve (MV2) is opened, and whether or not the pressure of the pressure sensor (PS1) is appropriate is checked. Also, the N_2O-C_2H_2 level is checked by the flame monitor signal.

[Error] If there is an abnormality, this is judged to be an error, the N_2O valve (MV2) and bypass (MV4) valve are closed, and the extinguish sequence is executed.

(9) The Air valve (MV1) is closed. (The 3-second timer is achieved on the hardware.)



5.6.1.4 Error processing

When the following occur, an error code is returned as the response of the ignition command:

- The Air and C_2H_2 gas pressure are in abnormal.
- The amount of drain solvent is insufficient.
- Safety confirmation error
- The ignition enable command has not been sent.
- At N_2O ignition
- The high-temperature burner head is not mounted.
- The N_2O gas pressure is abnormal.
- C_2H_2 increment failure
- Ignition failure

5.6.2 Flame Ignition

5.6.2.1 Function Overview

Extinguish the flame by the [EXTINGUISH] switch.

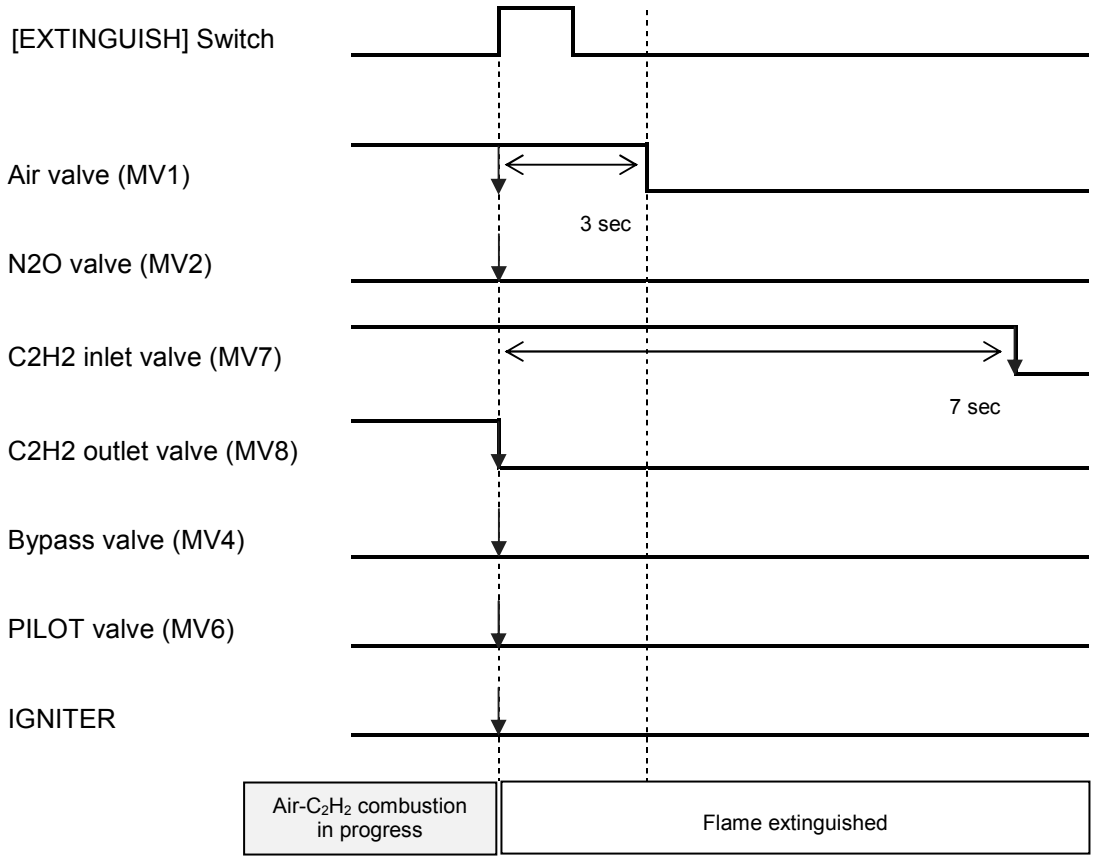
5.6.2.2 Operating Conditions

(1) The gas controller must be mounted.
(2) Processing is performed by one of the following conditions (OR):
- Reception of extinguish command "O F F 0"
- Detection of pressing of [EXTINGUISH] switch
- Execution of the extinguish sequence by safety mechanisms (See 0 5.6.6)

5.6.2.3 Processing Flow

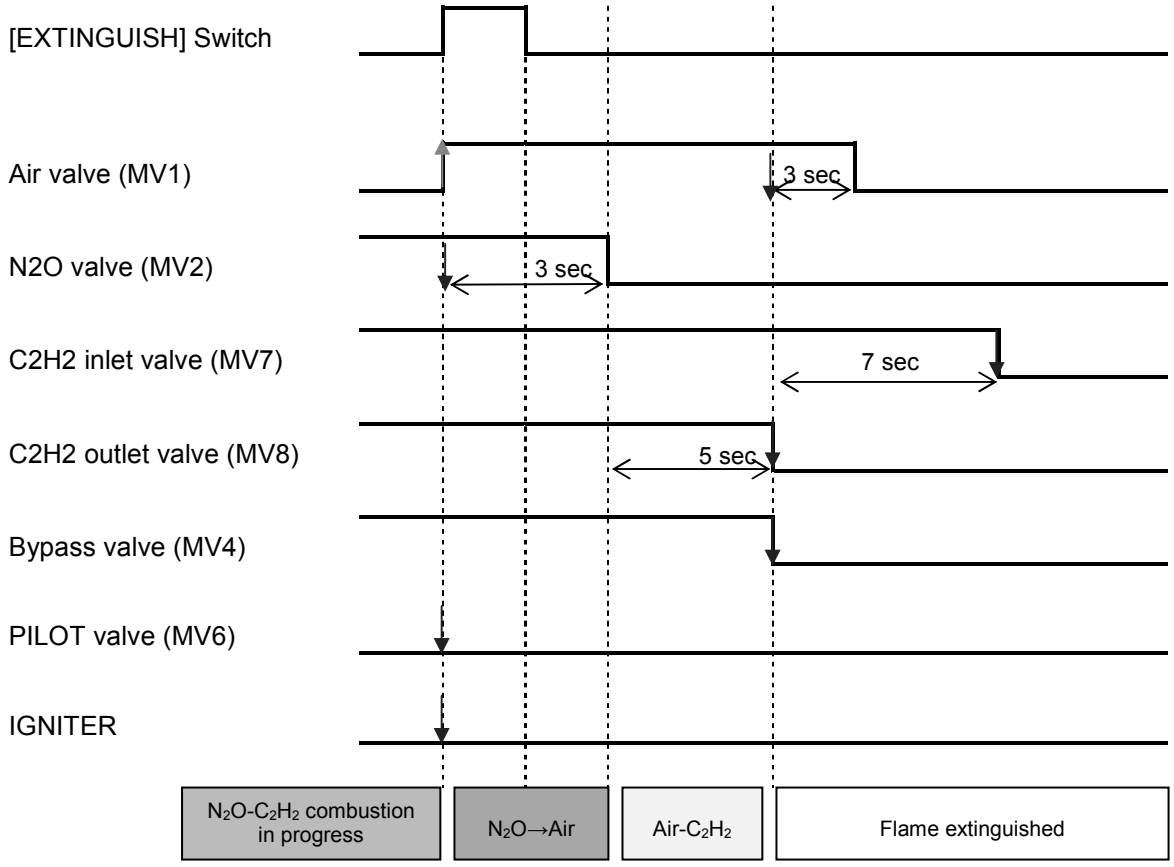
○ **For Air- C_2H_2:**

(1) The [EXTINGUISH] switch is turned ON. (Or, the extinguish command "O F F 0" is received, or the safety mechanism operates to generate an extinguish sequence execution request.)
(2) The C_2H_2 outlet valve (MV8) is closed.
(3) Three seconds after (1), the Air valve (MV1) is closed.
(4) Seven seconds after (1), the C_2H_2 inlet valve (MV7) is closed.



○ **For N_2O- C_2H_2:**

(1) The [EXTINGUISH] switch is turned ON. (Or, the extinguish command "O F F 0" is received, or the safety mechanism operates to generate an extinguish sequence execution request.)
(2) The Air valve (MV1) is opened.
(3) Two seconds after (1), the N_2O valve (MV2) is closed.
(4) Five seconds after (3), the C_2H_2 outlet valve (MV8) and the bypass valve (MV4) are closed.
(5) Three seconds after (4), the Air valve (MV1) is closed.
(6) Seven seconds after (4), the C_2H_2 inlet valve (MV7) is closed.



5.6.2.4 Error Processing

None

5.6.3 Switching Air/N_2O

5.6.3.1 Function Overview

The flame is switched between Air and N_2O by the "O F A" command and the burner selection key.

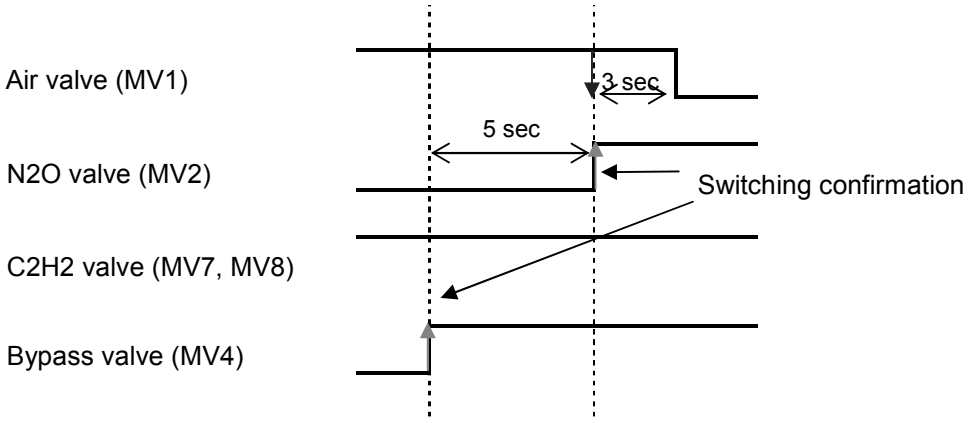
5.6.3.2 Operating Conditions

(1) The gas controller must be mounted.
(2) Processing is performed when the following conditions are satisfied:
- At Air to N_2O switching:
  The high-temperature burner head must be mounted.
  The N_2O gas pressure me be appropriate.

5.6.3.3 Processing Flow

○ **For Air→N_2O:**

(1) The bypass valve (MV4) is opened.
(2) The Air- C_2H_2 (5 L increment) is checked by the flame monitor signal.
[Error] If the level cannot be confirmed, the bypass valve (MV4) is closed, and the extinguish sequence is executed.
(3) Five seconds after (1), the N_2O valve (MV2) is opened, and whether or not the pressure of the pressure sensor (PS1) is appropriate is checked. Also, the level of the Air/ N_2O - C_2H_2 (5 L increment) is checked by the flame monitor signal.
[Error] If there is an abnormality, this is judged to be an error, the N_2O valve (MV2) and bypass (MV4) valve are closed.
(4) The Air valve (MV1) is closed. (The 3-second delay is achieved on the hardware.)

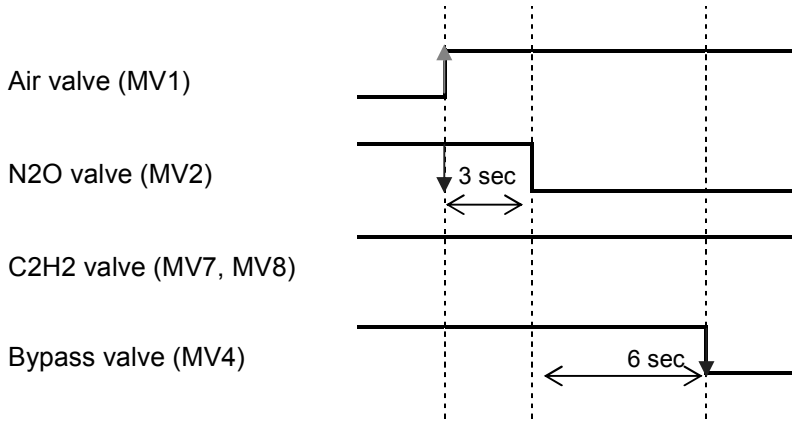


○ **For N_2O→Air:**

(1) The Air valve (MV1) is opened.

(2) Three seconds after (1), the N_2O valve (MV2) is closed. (The 3-second delay is achieved on the hardware.)

(3) Six seconds after (1), the bypass valve (MV4) is closed.



5.6.3.4 Error Processing

With the following errors, an error code is returned by the response of the switching command:

- At Air to N_2O switching:
  - The high-temperature burner head is not mounted.
  - The N_2O gas pressure is abnormal.
    - C_2H_2 increment failure

5.6.4 Purging of Support Gas by Purge Switch

5.6.4.1 Function Overview

The support gas is released (purged) by the [PURGE] switch.

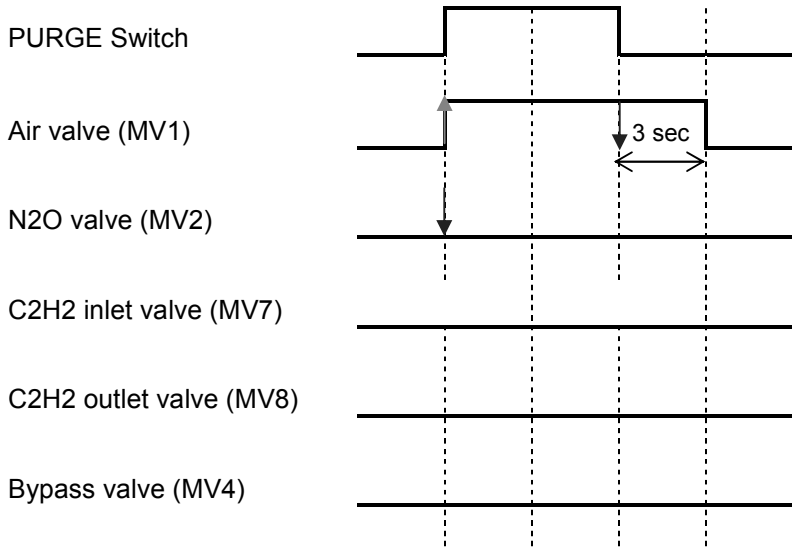
5.6.4.2 Operating Conditions

(1) The gas controller must be mounted.
(2) The "O F B 1" (enable [PURGE] button) command must be set from the PC.
(3) N_2O-C_2H_2:
- The "O F A 0" (support gas = N_2O) command must be set from the PC.
- Also, the burner selection key must be set to the N_2O-C_2H_2 side.

5.6.4.3 Processing Flow

○ **For Air- C_2H_2:**

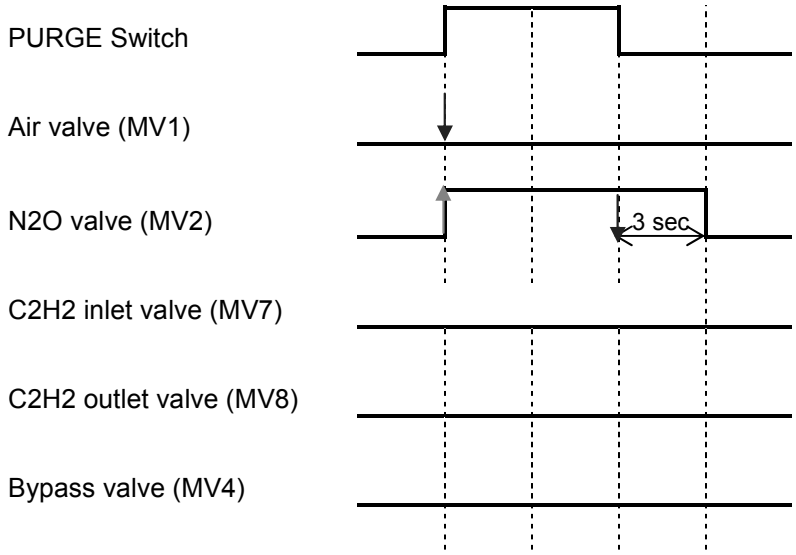
The Air valve (MV1) is opened while the [PURGE] switch is pressed. (The 2-second delay for MV1 is achieved on the hardware.)
Note, however, that the Air valve (MV1) is closed ten seconds after the [PURGE] switch is pressed even if the [PURGE] switch is held down continuously.



○ **For N_2O- C_2H_2:**

The N_2O valve (MV2) is opened while the [PURGE] switch is pressed. (The 2-second delay for MV2 is achieved on the hardware.)

Note, however, that the Air valve (MV1) is closed ten seconds after the [PURGE] switch is pressed even if the [PURGE] switch is held down continuously.



5.6.4.4 Error Processing

None

5.6.5 Setting the Gas Flow Rate

5.6.5.1 Function Overview

The needle valve is controlled by commands from the PC in accordance with the flow rate setting for the fuel gas specified by the command.

5.6.5.2 Operating Conditions

The gas controller must be mounted.

5.6.5.3 Processing Flow

○ **Fuel gas:**

(1) Correction of the fuel gas (acetylene) flow rate
The fuel gas (C_2H_2) flow rate set by the "O f" command is corrected by the correction coefficient set by the "O fc" command.

Correction formula: Corrected flow rate = (correction coefficient linear term) × (set flow rate) + (correction coefficient constant term)

(2) Conversion to needle valve (NV3) rotation amount
The corrected flow rate is converted to the rotation amount of the needle valve (NV3).

(3) Needle valve (NV3) is rotated to the above calculated position.

5.6.5.4 Error Processing

None

5.6.6 Safety Mechanisms

5.6.6.1 Function Overview

The following are performed by commands from the PC:
(1) Confirmation of safety device states
(2) Testing of the support gas valve (MV1, MV2) close delay times
(3) Bleeding of fuel gas (C_2H_2) (release to air)
(4) Automatic checking of fuel gas (C_2H_2) leaks
The following is also performed periodically by commands from the PC:
(5) Safety monitoring
The flame is extinguished immediately if abnormalities are found.

5.6.6.2 Operating Conditions

The gas controller must be mounted.

5.6.6.3 Processing Flow

1) Confirmation of safety device states:

Input:

- "O 8" (acquire gas controller state) command << PC
- Flame monitor value << flame sensor A/D
- Flame monitor threshold value << instrument internal information (fixed)
- Gas pressure value << pressure sensor (two channels: PS1 and PS2) A/D
- Gas pressure threshold value << instrument internal information (non-volatile memory (EEPROM))
- Burner head mounting state (standard burner/high-temperature burner) << status register
- ON/OFF state of float switch for drain tank level << status register

Output:

State of gas controller safety devices:

- State (normal/abnormal) of flame monitor
- State (pressurized/air pressure) of gas pressure value
- Burner head mounting state (standard burner/high-temperature burner)
- ON/OFF state of float switch for drain tank level

>> PC

Processing:

(1) The "O 8" (acquire gas controller state) command is received from the PC.
(2) The above input items are read from A/D or the status register, and the above output items are judged.
(3) The judgment results of (2) are sent to the PC as the response.

2) Testing of the support gas valve (MV1, MV2) close delay times:

Input:

- Valve (MV1 or MV2) to be tested << "O TV" command
- Gas pressure value << pressure monitor (PS1) A/D
- Gas pressure threshold value << instrument internal information (non-volatile memory (EEPROM))

- Valve close delay time (2 seconds) << instrument internal information (fixed)
- Valve close delay time allowable error (1 second)<< instrument internal information (fixed)

Output:

- Support gas valve (MV1, MV2) open/close >> control registers
- Test result (normal/abnormal gas pressure/abnormal delay time) >> PC

Processing:

(1) The "O TV" (execute solenoid valve delay test) command is received from the PC.
(2) The support gas valve (MV1 or MV2) specified by command parameters is opened.
(3) The value of the pressure sensor (PS1) is read. If the value is the threshold value or below, the result is judged to be abnormal gas pressure, processing is ended, and the result is sent to the PC as the response.
(4) The support gas valve (MV1 or MV2) is closed. (The valve is actually closed after the preset delay time has elapsed since closing of the valve involves a hardware delay.)
(5) The value of the pressure sensor (PS1) is read 0.1 second at a time for the duration of the test time:
   - During 0 to (delay time - allowable error) seconds: If the gas pressure is the pressure threshold value or below, the result is judged to be abnormal delay time, processing is ended, and the result is sent to the PC as the response.
   - (delay time + allowable error) seconds to test time: If the gas pressure is the pressure threshold value or above, the result is judged to be abnormal delay time, processing is ended, and the result is sent to the PC as the response.
(6) From (4) above, the result is judged to be normal after the test time has elapsed (that is, no errors occurred in (5)), processing is ended, and the result is sent to the PC as the response.

3) Bleeding of fuel gas (C_2H_2) (release to air):

Input:

- "O F O" (bleed gas from fuel gas pipe) command << PC
- Gas bleed time << instrument internal information (fixed)

Output:

- C2H2 outlet valve (MV8) open/close >> control registers

Processing:

(1) The "O F O 1" (execute bleeding of gas (release to air) from fuel gas pipe) command is received from the PC.
(2) The C2H2 outlet valve (MV8) is opened with the C2H2 inlet valve (MV7) still closed.
(3) The C2H2 outlet valve (MV8) is closed when the "O F O 0" (stop bleeding of gas (release to air) from fuel gas pipe) command is received from the PC, or the gas bleed time elapses.

4) Automatic checking of fuel gas (C2H2) leaks:

Input:

- "O F L" (gas leak check (start/stop)) command:
  Gas external leak check ON
  Gas internal leak check ON
  Gas leak check OFF
  << PC
- "O F C" (acquire gas leak check state) command << PC
- Flame control state (idle/ignited/extinguished/combustion in progress) << instrument

internal information
- Pressure switch state (pressurized/air pressure) << pressure switch (PS2) A/D
- Gas leak check time << instrument internal information (fixed) or PC
- Gas bleed time << instrument internal information (fixed)

Output:
- Gas open/close valve:
  C2H2 inlet valve (MV7) open/close
  C2H2 outlet valve (MV8) open/close
  PILOT valve (MV6) open/close
  Bypass valve (MV4) open/close
  >> control registers
- C2H2 gas flow rate control valve (MV3) setting state >> motor for C2H2 gas flow rate control
- Gas (internal and external) leak check state:
  Implementation of check (checked/not checked), check result (normal/abnormal), check execution status (in progress/not in progress)
  >> instrument internal information, PC

Processing:

○ Gas external leak check :
- MV8 (internal or external) leak or
- MV6 (internal or external) leak or
- MV4 (external) leak or
- PS2 (external) leak or
- NV3 (external) leak

[Checking using commands]

(1) The "O F L" (parameter = gas external leak check ON) command is received from the PC.
(2) The flame control state is checked. If it is not idle, then the response is judged to be impossible to check gas leak, processing is ended, and the response is sent to the PC.
(3) The gas leak check state "check execution status" is set to "in progress."
(4) The C2H2 outlet valve (MV8), PILOT valve (MV6) and bypass valve (MV4) are closed, and the C2H2 inlet valve (MV7) is opened.
(5) Seven seconds after (4), the pressure switch state is checked. If the state is "pressurized,"
The gas leak check state "check result" is set to "abnormal."
The gas leak check state "check execution status" is set to "not in progress," and processing is ended.
(6) The C2H2 inlet valve (MV7) is closed.
(7) Until the gas leak check time elapses,
the pressure switch state is checked periodically (every 1 second). If the state is "air pressure,"
The gas leak check state "check result" is set to "abnormal."
The gas leak check state "implementation of check" is set to "checked."
The gas leak check state "check execution status" is set to "not in progress," and processing is ended.
At this time, the "O F L" command is received. If the parameter is "gas leak check OFF" (ignored if state is otherwise), then

The gas leak check state "check execution status" is set to "not in progress," and processing is ended.

(8) After the gas leak check time elapses (if processing of (7) is finished),
The gas leak check state "check result" is set to "normal."
The gas leak check state "implementation of check" is set to "checked."
The gas leak check state "check execution status" is set to "not in progress," and processing is ended.

[In the case of the automatic check after extinguish]

After extinguishing the flame by the extinguish button, (3) to (8) above are executed by the instrument itself.

○ Gas internal leak check: MV7 (internal) leak

[Checking using commands]

(1) The "O F L" (parameter = gas internal leak check ON) command is received from the PC.
(2) The flame control state is checked. If it is not idle, then the response is judged to be impossible to check gas leak, processing is ended, and the response is sent to the PC.
(3) The gas leak check state "check execution status" is set to "in progress."
(4) The C2H2 outlet valve (MV8), PILOT valve (MV6) and bypass valve (MV4) are closed, and the C2H2 inlet valve (MV7) is opened.
(5) Seven seconds after (4), the pressure switch state is checked. If the state is "pressurized,"
The gas leak check state "check result" is set to "abnormal."
The gas leak check state "check execution status" is set to "not in progress," and processing is ended.
(6) The C2H2 inlet valve (MV7) is closed, and the C2H2 outlet valve (MV8) is opened.
(7) After the gas bleed time has elapsed since (6), the pressure switch state is checked. If the state is not "air pressure,"
The gas leak check state "check result" is set to "abnormal."
The gas leak check state "check execution status" is set to "not in progress," and processing is ended.
(8) The C2H2outlet valve (MV8) is closed.
(9) Until the gas leak check time elapses,
the pressure switch state is checked periodically (every 1 second). If the state is "pressurized,"
The gas leak check state "check result" is set to "abnormal."
The gas leak check state "implementation of check" is set to "checked."
The gas leak check state "check execution status" is set to "not in progress," and processing is ended.
At this time, the "O F L" command is received. If the parameter is "gas leak check OFF" (ignored if state is otherwise), then
The gas leak check state "check execution status" is set to "not in progress," and processing is ended.
(10) After the gas leak check time elapses (if processing of (7) is skipped),
The gas leak check state "check result" is set to "normal."
The gas leak check state "implementation of check" is set to "checked."

The gas leak check state "check execution status" is set to "not in progress," and processing is ended.

[In the case of the automatic check after extinguish]

After extinguishing the flame by the extinguish button, (3) to (10) above are executed by the instrument itself.

○ Acquisition of gas leak check state

When the "O F C" (acquire gas leak check state) command is received from the PC, the gas leak check state is sent as the response.

5) Periodic safety monitoring:

Input:

- Flame monitor value << flame sensor A/D
- Flame monitor "monitor threshold value" << instrument internal information (fixed)
- Gas pressure value << pressure sensor (two channels: PS1 and PS2) A/D
- Gas pressure threshold value << instrument internal information (non-volatile memory (EEPROM))
- Burner head mounting state (standard burner/high-temperature burner) << status register
- ON/OFF state of float switch for drain tank level << status register
- ON/OFF state of earthquake sensor << status register
- ON/OFF state of fan lock sensor << status register
- "O F" command << PC
- "O SS" command << PC

Output:

- Extinguish flame >> input of 0.
- Switching of Air/N2O >> input of 0.

Processing:

● The following are monitored periodically (every 200 ms):
(1) ON/OFF state of earthquake sensor: earthquake sensor
(2) ON/OFF state of fan lock sensor: fan lock sensor
If there is an abnormality, notification of the following errors is sent to the PC:
  - Earthquake sensor error
  - Fan lock sensor error

and the flame is extinguished if combustion is in progress.

● In addition to the above, when the measurement mode is Flame Continuous Mode or Microsampling Mode, the following are monitored:
(3) C2H2 gas pressure (pressurized/air pressure): pressure switch
(4) Support gas pressure (pressure value): pressure sensor
(5) Drain tank level (ON/OFF): float switch
(6) Flame state: flame sensor
If there is an abnormality, notification of the following errors is sent to the PC:
  - C2H2 gas pressure error
  - Support gas pressure error
  - Drain level error
  - Flame monitor error

and the flame is extinguished if combustion is in progress.
Note, however, that only when the earthquake sensor error occurs, the air extinguish

sequence is executed regardless of the type of support gas being burned. (This is to extinguish the flame as quickly as possible for safety sake even though there may even be the risk of flashback.)

- After ignite, when the flame setting from the PC is N2O:

  (7) The mounted burner head type (Air/N2O) (burner identification sensor) is monitored, and when the burner selection key is changed from N2O to Air, the gas is switched from N2O to Air. When the burner selection key is changed from Air to N2O, the gas is switched from Air to N2O.

  (8) When the flame is burning with N2O, the flashback error is judged when the flame burns out, and ignition is no longer possible from then on. (This state is held even if the instrument is turned OFF then back ON again.) The flashback error state can be canceled only by a command from the PC.

- When the "O F" command is received from the PC, the following occurrence states (error occurred/error not occurred),
  - Drain level error
  - C2H2 gas pressure error
  - Earthquake sensor error
  - Fan lock sensor error
  - Flame monitor error
  - Support gas pressure error

  and the following
  - Flame state (combustion in progress/extinguished (extinguish in progress))
  - Burner head type (standard burner (Air)/high-temperature burner (N2O))
  - Ignition enable state

  are sent to the PC as the response.
- By the "O F M" command from the PC, when detection of the following
  - Flame monitor error

  is turned ON ("O F M 1")/OFF ("O F M 0"). (When OFF, the state of the flame monitor behaves as if it is normal at all times. In other words, the flame ignition sequence can be executed regardless of the state of the flame monitor.)
- By the "O F P" command from the PC, when detection of the following
  - C2H2 gas pressure error
  - Support gas pressure error

  is turned ON ("O F P 1")/OFF ("O F P 0"). (When OFF, the state of the gas pressure behaves as if it is normal at all times. In other words, the flame ignition sequence can be executed regardless of the state of the gas pressure.)
- When the "O SS" command is received from the PC, the following states
  - Earthquake sensor state (1/0) and respective latch state (1/0)
  - Fan lock sensor state (1/0) and respective latch state (1/0)

  are sent to the PC as the response.
- Each of the bits of the above latch states are canceled (reset to 0 (zero)) by reception of the "O SS R <bit string>" command. Note, however, that at this time <bit string> is a 16-bit bit string containing the bit to be canceled set to "1".
- Monitoring of the earthquake sensor and fan lock sensor is masked by reception of the "O SS M" <bit string>" command from the PC. Note, however, that at this time <bit string> is a 16-bit bit string containing the bits expressing the respective sensor state to be masked set to "1".

- The above gas control functions (automatically by the firmware) are turned ON ("O F X 1")/OFF ("O F X 0") by the "O F X" command from the PC. (When OFF, all sequence control relating to gas control (including error detection) is not performed.)

Each of the errors are detected by the following methods.

Error	Detection Method	Detection Conditions
Drain level error	Float sensor ON	Measurement mode is Flame Continuous Mode/Microsampling Mode.
C2H2 gas pressure error	Support gas pressure value < lower limit threshold value	Measurement mode is Flame Continuous Mode/Microsampling Mode.
Support gas pressure error	Support gas pressure value < lower limit threshold value	Measurement mode is Flame Continuous Mode/Microsampling Mode.
Flame monitor error (flame extinguishing error)	Flame monitor value < monitor threshold value	Measurement mode is Flame Continuous Mode/Microsampling Mode.
Earthquake sensor error	Earthquake sensor ON	At all times (unconditional)
Fan lock sensor error	Fan lock sensor ON	At all times (unconditional)

5.6.6.4 Error Processing

None

6. Troubleshooting

The possible causes for each problem are given in the order in which they should be investigated. Investigate the causes in the order given.

6.1 Power Supply

6.1.1 The POWER LED does not light when the [POWER] switch is turned ON. (The AA-7000 does not operate.) The cooling fan on the back of the instrument does not operate.

(1)	The AC power supply does not reach the instrument.	Turn ON the breaker.
(2)	The AC cable is not inserted properly.	Insert the cable fully.
(3)	The main fuse has blown.	See 6.1.2.
(4)	The cooling fan on the back of the instrument does not operate.	There is a contact failure in the POWER LED's connector. Repair connector J16 on the CPU.
(5)	There is a fault in the POWER LED.	Replace the POWER LED.

6.1.2 The main fuse (5 A) blows when the [POWER] switch is turned ON.

Remove connectors J412, J416, and J421 from the POWER board.		
↓		
Does the main fuse blow when the [POWER] switch is turned ON in this state?	→ YES	There is a wiring fault between the inlet and the switch or the switch and connector J412, or there may be electrical leakage.
↓NO		
If the fuse does not blow, insert connector J412. Does the main fuse blow when the [POWER] switch is turned ON in this state?	→ YES	There is a fault in the POWER board.
↓NO		
If the fuse does not blow, insert connector J421. Does the main fuse blow when the [POWER] switch is turned ON in this state?	→ YES	There is a fault in the switching power supply (24 V).
↓NO		
If the fuse does not blow, insert connector J416. Does the main fuse blow when the [POWER] switch is turned ON in this state?	→ YES	There is a fault in the transformer.

6.1.3 Fuse F7 for the D2 lamp blows.

(1)	Excessive illumination pulses are occurring at TP11 on the POWER board.	There is a fault in M13 (D/A).
(2)	Excessive illumination pulses are occurring at pin 1 of M11 on the POWER board.	There is a fault in the IC of M11.
(3)	Other	There is a fault in the POWER board's constant-current FET of Q7.

6.1.4 Fuse F1 for the HCL blows.

(1)	Excessive illumination pulses are occurring at TP14 on the POWER board.	There is a fault in M13 (D/A) or M7 (analog switch).
(2)	Excessive illumination pulses are occurring at pin 1 of M6 on the POWER board.	There is a fault in the IC of M6.
(3)	Other	There is a fault in the POWER board's constant-current FET of Q9.
(4)	Excessive illumination pulses are occurring at TP16 on the POWER board.	There is a fault in M13 (D/A) or M7 (analog switch).
(5)	Excessive illumination pulses are occurring at pin 1 of M12 on the POWER board.	There is a fault in the IC of M12.
(6)	Other	There is a fault in the POWER board's constant-current FET of Q8.

6.1.5 Fuse F6 for the D2 lamp power supply blows.

(1)	There is a fault in the diode bridge D9.	

6.1.6 Fuse F3 for the HCL power supply blows.

(1)	There is a fault in the constant-voltage transistor Q2.	
(2)	There is a fault in the diode bridge D6.	

6.1.7 Fuse F4 or F5 for the D2 lamp filament blows.

(1)	There is a fault in the D2 lamp.	Replace the lamp with one that is not faulty.

6.1.8 Fuse F2 for the chopper motor and the igniter blows.

(1)	F2 blows when the chopper motor is turned.	There is a fault in the chopper motor or the phototriac PC4.
(2)	F2 blows when the igniter is discharged.	There is a fault in the igniter or the phototriac PC1.

6.2 Initialization

6.2.1 Initialization is not performed when the POWER is turned ON and an attempt to start initialization is made from the PC.

(1)	The communication cable between the AA-7000 and the PC is not connected properly.	Fully insert the connectors at both the PC and the AA-7000 sides and secure them with screws.
(2)	There is a shield defect on the communication cable between the AA-7000 and the PC.	Correct so that there is continuity across the connector covers on both ends of the communication cable.
(3)	There is a defective writing of firmware.	Defective FLASH ROM in CPU. Write firmware again.
(4)	The CPU is not operating.	There is a fault in the CPU board.

6.2.2 Initialization items differ with anticipated instrument type.

(1)	Wrong identification of instrument type.	Review internal wiring for mistakes and disconnections.
		Set the instrument type again. On CPU boards shipped from the Parts Center, the instrument type is set to AA-7000G. The commands for setting instrument type are as follows: AA-7000F: O U #7001 AA-7000G: O U #7002 AA-7000F + AAC-7000: O U #7000 The instrument configuration is checked only when the power is turned ON. The AA main unit must be restarted after the instrument type is set.
		Re-install WizAArd with the appropriate instrument type and options.

6.2.3 Option (ASC/GFA) connection NG (unsuccessful)

(1)	The option is not turned ON.	Turn the option ON.
(2)	The communication cable between the AA-7000 and the option is not correctly connected.	Fully insert the connectors at both the option and AA-7000 sides, and secure them with screws.
(3)	There is a shield defect on the communication cable between the AA-7000 and the option.	Correct so that there is continuity across the connector covers on both ends of the communication cable.
(4)	There is a contact failure in the CPU board-side connector.	Repair connector J3/J1 on the CPU.
(5)	There is a fault in the CPU board.	Replace the CPU board.
(6)	There is a fault on the option.	Perform troubleshooting on options.

6.2.4 Slit origin search NG (unsuccessful)

(1)	The slit plate rotates but overtravels the origin position.	There is a contact failure in a photo-interrupter connector. Repair connector J62 on the CPU.
	There is a fault in the photo-interrupter.	Replace the photo-interrupter.
(2)	The slit plate does not rotate, or it rotates out-of-sync.	There is a contact failure in a motor connector. Repair connector J52 on the CPU.
	There is a fault in the motor.	Replace the motor.

6.2.5 Wavelength Origin Search NG (Unsuccessful)

(1)	The D2 lamp does not light during wavelength origin initialization.	See 6.3.1 to 6.3.5.
(2)	There is an object obstructing the reference light between the D2 lamp and the detector.	Remove the object.
(3)	Defective D2 attenuator operation	The attenuator disk is caught on the cable.
(4)	TP9 (reference of the negative high voltage) on the POWER board does not attain a voltage approx. between 1.0 and 4.4 V.	There is a contact failure in a flat cable connector. Repair connector J24 on the CPU or connector J401 on the POWER board. There may be a fault in the POWER board.
(5)	The motor is rotating but does not stop when the pin passes through the photo-interrupter.	There is a contact failure in a photo-interrupter connector. Repair connector J5 on the CPU.
	There is a fault in the photo-interrupter.	Replace the photo-interrupter.
(6)	Open the optical cover (remove the photomultiplier cable) and confirm initialization.	
	The wavelength motor is not rotating, or is rotating out of sync.	There is a contact failure in a wavelength motor connector. Repair connector J4 on the CPU.
	There is a fault in the wavelength motor.	Replace the wavelength motor.

6.2.6 Turret origin search NG (unsuccessful)

(1)	An excessively heavy object is placed on the turret.	Remove the object.
(2)	The HCL turret rotates but overtravels the origin position.	There is a contact failure in a photo-interrupter connector. Repair connector J66 on the CPU.
	There is a fault in the photo-interrupter.	Replace the photo-interrupter.
(3)	The HCL turret does not rotate, or it rotates out-of-sync.	There is a contact failure in a motor connector. Repair connector J56 on the CPU.
	There is a fault in the motor.	Replace the motor.

6.2.7 Atomizer vertical / forward/backward movement NG (unsuccessful)

(1)	Piping and wiring is causing resistance.	Redo the piping and wiring so that the atomizer operates without any problems.
(2)	The AAC cable is not connected.	Correctly connect the cable, and set the instrument type.
(3)	The atomizer is operating but overtravels the origin position.	There is a contact failure in a photo-interrupter connector. Repair connector J67/J69 on the CPU.
	There is a fault in the photo-interrupter.	Replace the photo-interrupter.
(4)	The atomizer does not operate, or it operates out-of-sync.	There is a contact failure in a motor connector. Repair connector J57/J59 on the CPU.
	There is a fault in the motor.	Replace the motor.

6.2.8 C2H2 valve origin search NG (unsuccessful)

(1)	Gear engagement is stiff.	Appropriately engage the gears, and adjust the C2H2 gas flow rate.
(2)	The HCL turret rotates but overtravels the origin position.	There is a contact failure in a photo-interrupter connector. Repair connector J65 on the CPU.
	There is a fault in the photo-interrupter.	Replace the photo-interrupter.
(3)	The HCL turret does not rotate, or it rotates out-of-sync.	There is a contact failure in a motor connector. Repair connector J55 on the CPU.
	There is a fault in the motor.	Replace the motor.

6.2.9 Flame monitor check NG (unsuccessful)

(1)	Instrument surrounding is too light.	Install the chimney correctly. Adjust the illumination angle.
(2)	There is a fault in the flame monitor.	Replace.

6.2.10 Burner identification sensor check NG (unsuccessful)

(1)	There is a contact failure in a connector.	Repair connector J6 on the CPU.
(2)	There is a failure in a key cylinder.	Replace the key cylinder.

6.2.11 Drain sensor check NG (unsuccessful)

(1)	There is a failure in a float sensor.	Replace the float sensor.
(2)	There is a contact failure in a connector.	Repair connector J68 inside the atomizer and on the CPU.

6.2.12 Gas pressure monitor check NG (unsuccessful)

(1)	The feed gas pressure is too high.	Temporarily lower the feed gas pressure, and gradually raise the feed gas pressure. Set the pressure while feeding the gas in the gas purge window at initialization.
(2)	The feed gas pressure is too low.	Gradually raise the feed gas to the appropriate pressure. Set the pressure while feeding the gas in the gas purge window at initialization.
(3)	The [FUEL PRESSURE] switch thresholds have shifted (in case of fuel gas).	Adjust the [FUEL PRESSURE] switch thresholds. Or, replace the [FUEL PRESSURE] switch.
(4)	The delay time is too short (in case of support gas).	Insufficient capacity of electrolytic capacitor on CPU board. Replace the CPU board.

6.2.13 Initialization of the AA-7000 continues indefinitely.

(1)	There is a fault in the CPU board.	Replace the CPU board.

6.2.14 Gas leak is detected.

(1)	C2H2 is leaking on the gas controller.	Immediately stop C2H2 feed, and pinpoint the leaking spot. Pay attention to safety. TYPE A An external leak has occurred. Feed air to the C2H2 line to pinpoint the leaking spot using a snoop or similar tool. If the leaking spot cannot be pinpointed, replace the entire gas controller. A probable cause is a leak inside MV8. TYPE B An internal leak has occurred. Flow out of MV7. Replace the manifold.
(2)	The [FUEL PRESSURE] switch is malfunctioning.	There is a contact failure in a connector. Repair connector J29 on the CPU. Defective adjustment. Go to Pressure Sensor Adjustment Procedure. Replace the [FUEL PRESSURE] switch.
(3)	There is a fault in the CPU board.	Replace the CPU board.

6.3 Light Source

6.3.1 The D2 lamp's heater does not light or discharge (and there is no flash of purple light when it does discharge).

(1)	The D2 lamp is not properly inserted in the socket.	Insert the lamp properly.
(2)	There is contact failure in a connector.	Repair connector J411 on the POWER board.
(3)	There is a fault in the lamp.	Replace the lamp with one that is not faulty.

6.3.2 The D2 lamp's heater does not light but it does flash with a purple light.

(1)	The voltage between TP13 and TP22 is not in the range 2.9 to 3.9 VAC when D2 illumination starts.	There is a fault in the POWER board.

6.3.3 The D2 lamp's heater lights but it does not flash with a purple light.

(1)	The voltage between TP28 and TPG is not in the range +485 to +593 VDC.	There is a fault in the POWER board.
(2)	Fuse F3 for the HCL power supply has blown.	See 6.1.6.

6.3.4 The D2 lamp's heater lights and starts to discharge but is soon extinguished.

(1)	Fuse F7 for the D2 lamp has blown.	See 6.1.3.
(2)	Fuse F6 for the D2 lamp power supply has blown.	See 6.1.5.
(3)	No illumination pulses are being generated.	
	The chopper motor is not rotating.	There is a contact failure in a connector. Repair connector J410 on the POWER board. Replace the chopper motor.
	The photo-interrupter is malfunctioning.	There is a contact failure in a connector. Repair connector J7/J41 on the CPU board. Replace photo-interrupter R. Replace photo-interrupter S.
(4)	No illumination pulses are being emitted to pin 9 of J24 on the CPU board.	There is a fault in the CPU board.
(5)	No illumination pulses are being emitted to the top part of R73 on the POWER board.	There is a contact failure in a flat cable connector. Repair J24 on the CPU board and connector J401 on the POWER board.
(6)	Abnormal illumination pulses are being generated at TP12 on the POWER board.	See 6.1.3.

6.3.5 The D2 lamp lights but is unstable.

(1)	The voltage between TP21 and TPG is not in the range +134 to +181 VDC.	There is a fault in the POWER board.
(2)	No illumination pulses are being generated.	See the item (3) in 6.3.4.
(3)	No illumination pulses are being emitted to pin 9 of J24 on the CPU board.	There is a fault in the CPU board.
(4)	Abnormal illumination pulses are being generated at TP12 on the POWER board.	See 6.1.3.

6.3.6 An HCL does not light.

(1)	The current is set to 0 mA.	Set the current to the optimum value.
(2)	The lamp is not mounted properly.	Mount the lamp properly.
(3)	There is a contact failure in an HCL connector.	Repair connectors J432, J428, J431, J427, J430, and J426 on the POWER board.
(4)	No illumination pulses are being generated.	
	The chopper motor is not rotating.	There is a contact failure in a connector. Repair connector J410 on the POWER board. Replace the chopper motor.
	The photo-interrupter is malfunctioning.	There is a contact failure in a connector. Repair connector J7/J41 on the CPU board. Replace photo-interrupter R. Replace photo-interrupter S.
(5)	No illumination pulses are being emitted to pin 10 or pin 12 of J24 on the CPU board.	There is a fault in the CPU board.
(6)	No illumination pulses are being emitted to pin 1 or pin 9 of M7 on the POWER board.	There is contact failure in a flat cable connector. Repair connector J24 on the CPU board or connector J401 on the POWER board.
(7)	Fuse F1 for the HCL has blown.	See 6.1.4.
(8)	The voltage between TP27 and TPG is not in the range +538 to +729 VDC.	There is a fault in the POWER board.
(9)	Fuse F3 for the HCL power supply has blown.	See 6.1.6.
(10)	There is no switching between relays K1 to K12.	There is a fault in the POWER board.
(11)	There is a fault in the HCL.	Replace the HCL with one that is not faulty.

6.3.7 The brightness of the HCL does not change when the current value is changed.

(1)	Abnormal illumination pulses are being generated at TP15(17) on the POWER board.	See 6.1.4.

6.3.8 The HCL lights but discharge is unstable.

(1)	Abnormal illumination pulses are being generated at TP15(17) on the POWER board.	See 6.1.4.

6.4 Baseline/Noise (When Flame is OFF)

6.4.1 There is a large amount of noise/drift.

(1)	The slit width is inappropriate.	Set the slit width correctly.
(2)	The position of the HCL/D2 is not adjusted.	Adjust so as to attain the maximum brightness.
(3)	There is a fault in the HCL/D2 lamp.	Replace the faulty lamp.
(4)	The window plate is dirty.	Wipe with alcohol.
(5)	With wavelengths less than 200 nm, the optical axis bends when the burner head becomes hot.	
	Perform measurement again after the burner head has cooled down.	Do not remove the burner head as the sample will evaporate out of the chamber.
(6)	The slit position is inappropriate.	Readjust the optical system.
(7)	There is a fault in the photomultiplier.	Replace the photomultiplier.
(8)	The chopper mirror vibrates excessively.	Readjust the optical system.
(9)	The light beam does not enter the photomultiplier at the optimum position.	Readjust the optical system.
(10)	The optical axis is not adjusted properly.	Readjust the optical system.

6.4.2 There is a large amount of noise at the NON-BGC mode's base (Abs.0).

(1)	First see 6.4.1.	
(2)	Line search has not been completed.	Execute line search.
(3)	Abnormal illumination pulses are being generated at TP15(17) on the POWER board.	See 6.1.4.
(4)	There is a large amount of noise at TP9 (negative high voltage signal) on the POWER board.	There is a fault in the POWER board.
(5)	There is a large amount of noise at TP31 (detector signal) on the CPU board.	There is a fault in the CPU board.

6.4.3 There is a large amount of drift at the NON-BGC mode's base (Abs.0).

(1)	First see 6.4.1.	
(2)	The optical axes on the S (sample) side and the R (reference) side do not agree.	Readjust the optical system.
(3)	The optical system has not warmed up.	After turning the power ON, wait 30 minutes before performing measurement.
(4)	Surrounding temperature changes are too large.	Eliminate temperature changes. (Changes must be at 1 °C/30 min max.)

6.4.4 There is a large amount of noise in BGC-D2 mode (Abs.0).

(1)	First see 6.4.1.	
(2)	Abnormal illumination pulses are being generated at TP12 on the POWER board.	There is a fault in the POWER board.
(3)	There is a large amount of noise at TP31 (detector signal) on the CPU board.	There is a fault in the CPU board.

6.4.5 There is a large amount of drift in BGC-D2 mode (Abs.0).

(1) First see 6.4.1.	
(2) First see 6.4.3.	

6.5 Ignition and Extinguishing

6.5.1 First, check the [Gas Controller Status] dialog box.

(1)	[Gas Leak Check]	Ignition is not possible in a non-checked state or with a gas leak detected. After turning the power ON, ignition is not possible even while the initial gas leak check is being executed. Start and complete the gas leak check from the [Instrument] - [Gas Leak Check] menu.
(2)	[Drain Level]	Ignition is not possible in an NG (unsuccessful) state. Fill up the drain bottle with water.
(3)	[Vibration Sensor]	Ignition is not possible in an NG (unsuccessful) state. After checking the safety of the surrounding area, click the [Reset] button to set to the OK state.
(4)	[Fan Stop Sensor]	Ignition is not possible in an NG (unsuccessful) state. Turn the instrument OFF, then check the fan.
(5)	[Burner Select Sensor Check] [Drain Level Sensor Check] [Support Gas Pressure Monitor Check (Air)]	Ignition is not possible in a non-checked state or beyond the inspection time limit. Initialize and check the instrument again.
(6)	[Support Gas Pressure Monitor Check (N2O)]	The N2O-C2H2 flame cannot be used in a non-checked state or beyond the inspection time limit. Initialize and check the instrument again.
(7)	[Fuel Gas Pressure Monitor Check]	Ignition is not possible in a non-checked state. Initialize and check the instrument again.
(8)	[Flashback Monitor]	Ignition is not possible with flashback detected. Check and remove the cause of the flashback, and then click the [Instrument] - [Gas Controller Status] menu with the Ctrl + Shift + Alt keys held down to open the password entry window. Enter the service password, and cancel the ignition lock. Note, however, that the ignition lock cannot be canceled when the total flashback count has reached or exceeded 4. In this instance, contact the Quality Assurance Dept.

6.5.2 No gas flows when the ignition button or the purge button is pressed.

(1)	Gas leak check is in progress.	Wait for the gas leak check to end.
(2)	No gas is being supplied.	The cylinder is empty. The main valve is closed. The gas tube is detached.
(3)	The gas flow rate setting is inappropriate.	Adjust the C2H2 flow rate setting from the [Atomizer/Gas Flow Rate Setup] window.
(4)	There is a contact failure in an ignition/purge connector.	Repair connector J12 on the CPU board.

6.5.3 The pilot flame does not ignite when the ignition button is pressed.

(1)	There are no communications with the PC.	Connect to the PC using the RS-232C cable and initialize the AA-7000.
(2)	No gas is being supplied.	The cylinder is empty. The main valve is closed. The gas tube is detached.
(3)	[FUEL PRESSURE] switch is malfunctioning.	There is a contact failure in a connector. Repair connector J29 on the CPU board. Adjustment has not been performed properly. See the procedure for adjusting the pressure sensor. Replace the [FUEL PRESSURE] switch.
(4)	The surroundings are too bright.	Mount the chimney properly. Adjusting the lighting orientation.
(5)	The pilot flow rate has not been adjusted properly.	Readjust the pilot flow rate.

6.5.4 The pilot flame ignites but does not ignite the burner.

(1)	First see 6.5.2.	
(2)	PRESSURE SENSOR-S is malfunctioning.	There is a contact failure in a connector. Repair connector J9 on the CPU board. Adjustment has not been performed properly. See the procedure for adjusting the pressure sensor. Replace PRESSURE SENSOR-S.
(3)	The drain tank is malfunctioning.	Add solvent. There is a contact failure in a connector. Repair connector J68 or the relay connector on the CPU board. Replace the drain sensor.
(4)	Gas is leaking along the gas route from the gas controller to the burner head.	Pinpoint the leaking spot and correct.

6.5.5 The burner is ignited but the flame is extinguished when the ignition button is released.

(1)	The flame monitor is malfunctioning.	There is a contact failure in a connector. Repair connector J15 on the CPU board.
(2)	The flame monitor has failed.	Replace the flame monitor.
(3)	Gas is leaking along the gas route from the gas controller to the burner head.	Pinpoint the leaking spot and correct.

6.5.6 The gas does not switch from Air-C2H2 to N2O-C2H2.

(1)	N2O gas is not supplied.	The cylinder is empty. The main valve is closed. The gas tube is detached.
(2)	The PC is not set to N2O-C2H2.	Change the setting to N2O-C2H2.
(3)	The N2O-C2H2 key has not been turned.	Turn it to the N2O-C2H2 side.
(4)	PRESSURE SENSOR-S is malfunctioning.	See the item (2) in 6.5.3.
(5)	The N2O-C2H2 key is malfunctioning.	There is a contact failure in a connector. Repair connector J6 on the CPU board or replace the key.

6.5.7 The N2O-C2H2 flame is split immediately after switching from Air-C2H2.

(1)	The burner head is not sufficiently warmed up.	Switch after holding for a while using Air-C2H2. (Waiting in this state allows the symptom to remedy itself.)
(2)	The burner slot is widened.	Check the burner head using a feeler gauge, and replace the burner head if the clearance is 0.55 mm or more.

6.5.8 The flame is not extinguished when the extinguish button is pressed.

(1)	The flame can be extinguished safely by turning OFF the AA-7000's power supply.	
(2)	The extinguish button is malfunctioning.	There is a contact failure in a connector. Repair connector J12 on the CPU board or replace the switch.

6.5.9 Flashback was detected.

(1)	Flashback is considered when a flame extinguishing error is detected during N2O-C2H2 combustion.	See the item (8) in 6.5.1.

6.6 Operation

6.6.1 Line Search NG (unsuccessful)

(1)	There is an object obstructing the light between the HCL and the detector.	Remove the object.
(2)	The other lamp is lit.	Switch the lamp turret.
(3)	The wrong element is used.	Mount the lamp specified in the PC settings.
(4)	The slit is too narrow.	Switch the slit width to either 0.7 or 1.3 nm.
(5)	An incorrect memory wavelength is stored.	Perform line search after clearing the memory wavelength.
(6)	The wavelength motor is not rotating.	There is a contact failure in a connector. Repair connector J4 on the CPU board.
	There is a fault in the wavelength motor.	Replace the wavelength motor.
(7)	The HCL is not lit.	See 6.3.6.
(8)	There seems to be a large amount of noise at the NON-BGC mode's base (Abs.0).	See 6.4.2.

6.6.2 Beam Balance NG (unsuccessful)

(1)	First see 6.6.1.	
(2)	There is an object obstructing the light between the D2 and the beam splitter.	Remove the object.
(3)	BGC-D2 mode is set at a wavelength (423 nm or higher) that cannot be handled by the BGC-D2.	Change to NON-BGC mode.
(4)	The slit width is inappropriate.	Change the slit width to 0.2, 0.7, or 1.3 nm after referring to the analysis conditions.
(5)	The D2 lamp is not lit.	See 6.3.1 to 6.3.5.
(6)	There seems to be a large amount of noise in BGC-D2 mode (Abs.0).	See 6.4.4.
(7)	Defective D2 attenuator operation (in case of BGC-D2)	The attenuator disk is caught on the cable.

6.6.3 Connection is not established with an optional accessory (ASC or GFA).

(1)	The ASC or GFA was not connected when the AA-7000 was initialized.	Connect the ASC or GFA and perform the connection procedure for optional accessories.
(2)	The ASC or GFA was connected when the AA-7000 was initialized.	See 6.2.2.

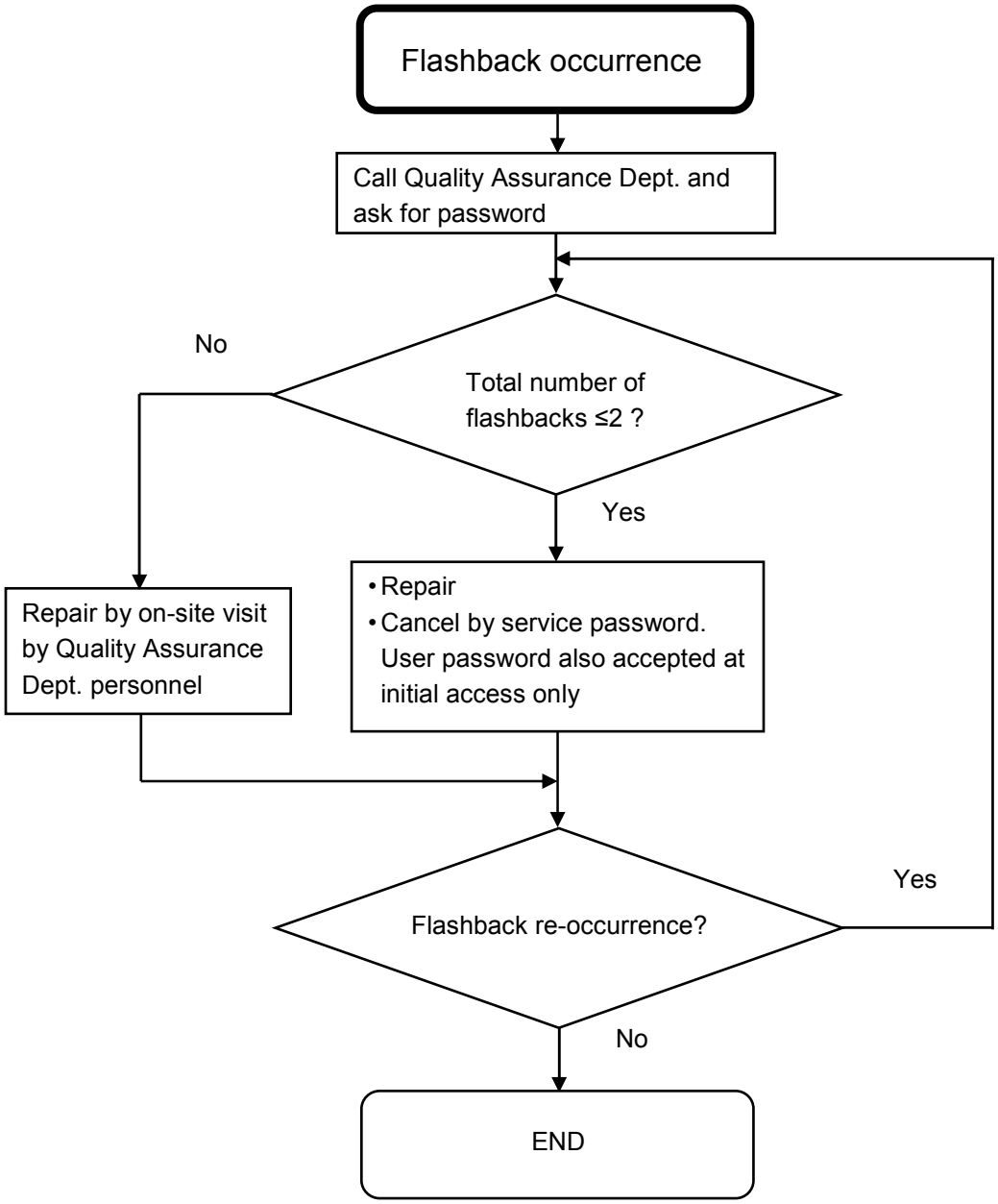
6.7 Flashback

6.7.1 Flashbacks

"Flashback" is the phenomenon where the flame returns to the inside of the burner when the balance between the speed at which fuel burns or the "combustion speed" and the jet emission speed of gas from inside the burner is disrupted, causing the gas combustion speed to become smaller than the combustion speed of the mixed gas.

Though flashback itself is not an accident, attention must be paid since it produces a loud sound of approx. 100 dB.
When flashback occurs, probable causes are the installation environment or the instrument. So, the cause of flashback must be investigated and removed before measurement can be restarted. For example, flashback can damage the nebulizer, chamber or other parts and cause gas leaks.

To ensure user safety, the instrument cannot be re-ignited after flashback, and ignition by the user is disabled. The instrument can only be restored to ignitable status by a service personnel visiting the installation site and entering the flashback cancel password.



6.7.2 Remedies When Flashback Occurs

The service personnel checks the following points on the instrument when flashback occurs.

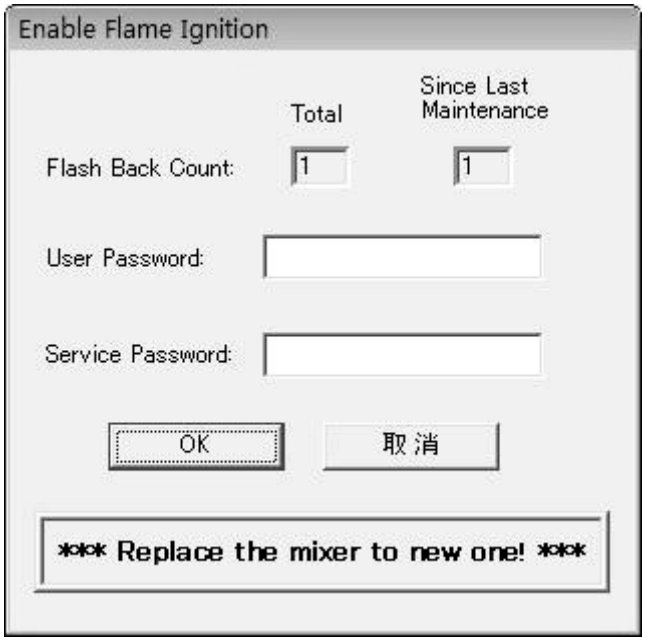
- Cracking on the chamber, nebulizer, drain tube, mixer, and gas tubes (fastened to chamber)
- Cracking and deterioration of the O-rings on the nebulizer
- Burner condition (clogging of burner slot, widening of slot)
- Cracking and deterioration of three O-rings on burner socket by removal of the burner head
- Drain sensors and other safety devices by initialization of the instrument
- Gas leak check described in 4.1

6.7.3 Flashback Cancel Password

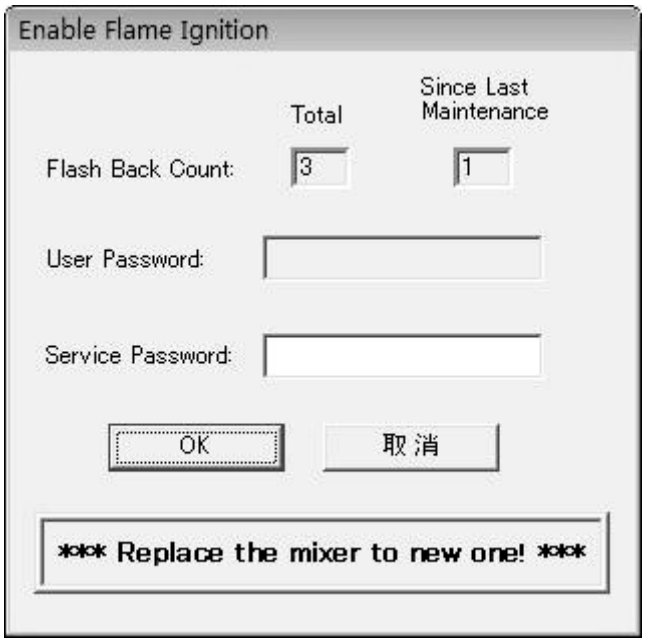
When a flashback occurs, notify the Quality Assurance Dept. of the following information, and obtain the flashback cancel password.
The user or service personnel from other companies must not be told the service password.

1. Customer name and installation date
2. Instrument serial No.
3. Circumstances in which flashback occurred and work environment (installation procedure)
4. Details of repairs so far
5. Reason, if any, for service personnel to not visit for repair

To enter the flashback cancel password, click the [Instrument] - [Gas Controller Status] menu with Ctrl + Alt + Shift held down. At the initial flashback, the user password and service password can be entered in the following dialog box.



From the second flashback onwards, only the service password can be entered. When flashback occurs after the second repair by a service personnel, the service password can no longer be entered and entry of the QA password is required.
For details of the password text string required when a problem occurs, contact the Quality Assurance Dept.



In the above example, the [Total] value refers to the total number of flashbacks, and the [Since Last Maintenance] value refers to the number of flashbacks since the last visit by a service personnel.

6.7.4 Flashback Safety Measures

Easy use of the instrument by the user is disabled when a flashback occurs. When a flashback occurs, the firmware detects the flashback, and the firmware operates to inhibit ignition of the flame from then onwards.
To cancel inhibition of flame ignition, issue the flame ignition inhibit cancel command from WizAArd. In principle, someone from the Quality Assurance Dept. or service personnel at Shimadzu Corporation will cancel the flame ignition inhibit.

When a flashback occurs at user sites that are within the low service network, service personnel sometimes cannot immediately visit the user site. Moreover, when the user must continue using the instrument, there is the possibility that the user may have dissatisfaction since only someone from the Quality Assurance Dept. or service department at Shimadzu Corporation can cancel flame ignition inhibit. For this reason, we have added a specification (USER PASSWORD) that allows the user to cancel the flame ignition inhibit under the following exceptional conditions even though only Shimadzu Corporation personnel, in principle, are allowed to cancel the flame ignition inhibit.

Basic Policy

- If a flashback occurs for the second time without Shimadzu Corporation's Quality Assurance Dept. or service department having inspected or repaired the instrument, the user cannot cancel flame ignition inhibit.
- When a maximum of six flashbacks have occurred, someone from Quality Assurance Dept. or service department will visit and take back the instrument for repair at Shimadzu Corporation depending on the circumstances.
- So that the user can cancel flame ignition inhibit by himself, the user must call service department and obtain the user password. (This is limited to when flashback occurs for the first time.)

- When a call for service personnel has occurred twice, only the Quality Assurance Dept. can cancel flame ignition inhibit.

The firmware manages the history of flashback occurrence count (total and since last maintenance).

Title	Description	Default
Total	・ Total number of times that flashback occurred since the instrument was installed ・ This is incremented each time that a flashback occurs.	0
Since Last Maintenance	・ Total number of times that flashback occurred since the instrument was repaired by service personnel or Quality Assurance Dept. ・ This is incremented each time that a flashback occurs. ・ This is reset to "0" (zero) when the instrument is repaired by service personnel.	0

The tasks performed by the Quality Assurance Dept. and the service department are as follows:

- ・ Preparation of password by Quality Assurance Dept.
- ・ Preparation of password corresponding to the total number of times that flashback occurred

Total	User Password	Service Password	QA Password
1	User Password 1	Service Password 1	QA Password 1
2	-	Service Password 2	QA Password 1
3	-	Service Password 3	QA Password 1
4	-	-	QA Password 1

When the customer must cancel the flame ignition inhibit, call the service personnel to obtain the passward, and enter the password. (Service personnel may be told the password up to the 3rd repair.)
When the 2nd flashback occurs without repairs having been performed by Quality Assurance Dept. or service personnel, the user cannot cancel the flame ignition inhibit.

The user may be told the password for the 1st flashback.
For the 2nd and 3rd flashbacks, be sure to call the service personnel, enter the password, and repair the instrument. (Do not tell the service password to the customer.)
For repair of the 4th flashback, the flashback can be canceled by the password only by the Quality Assurance Dept. (Do not tell service personnel the password.)

6.8 Other Problems

6.8.1 Absorbance of -1 is detected in flame measurement. ("-1" has a special meaning.)

(1)	The signal is saturated. HCL light and D2 light do not coincide. (BGC-D2 mode only.)	Adjust the D2 lamp's position so that the HCL light and D2 light coincide inside the atomizer.
(2)	The signal is saturated. Operation is influenced by light emission. (Light emitted by the N2O-C2H2 flame) (Light emitted by Na or K when performing measurement for Na or K.)	Perform the beam-balance procedure while blank liquid is absorbed. If this is unsuccessful, proceed as follows: Perform the beam-balance procedure while standard liquid with maximum measurable concentration is absorbed, and then perform auto-zero while blank liquid is absorbed. (If the concentration of the standard liquid is too high, there will be a large amount of noise for liquids with low concentrations.) If this is unsuccessful, proceed as follows: Try repeating the above with a reduced C2H2 flow rate or a different burner angle.

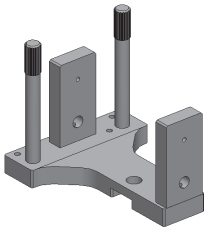
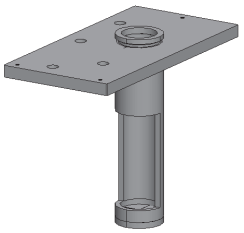
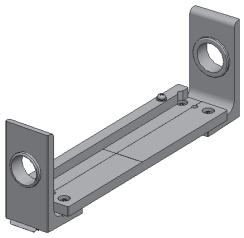
6.8.2 Buzzer sounds (Items not mentioned in the Instruction Manual)

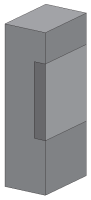
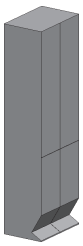
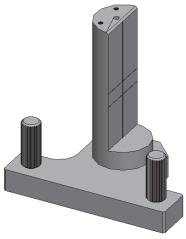
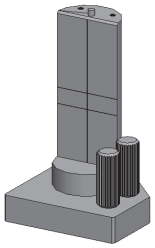
(1)	The buzzer sounds continuously (pip pip, pip pip) immediately after the power is turned ON. The preset instrument type differs from the actual instrument configuration.	See 6.2.2.

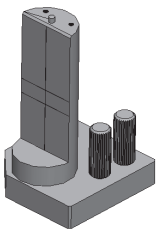
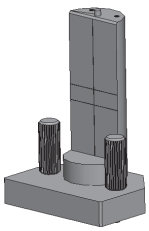
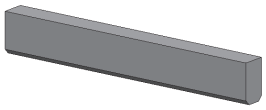
7. Adjustment Procedure

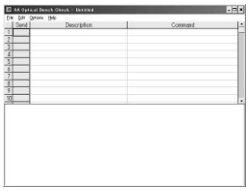
7.1 Adjustment of the Optical System

7.1.1 Jigs Required for Adjustment

WI light source jig	Initial optical axis limiting jig	Target jig for lamp house	Atomizer optical axis adjustment base
P/N 206-58488-91	P/N 206-77332-91	P/N 206-77270-91	P/N 206-77251-91
			

Plane mirror jig	Target jig	Target jig for chopper	Target jig M05 for mirror
P/N 206-77511-91	P/N 775-04313-11	P/N 206-77265-94	P/N 206-77265-91
			

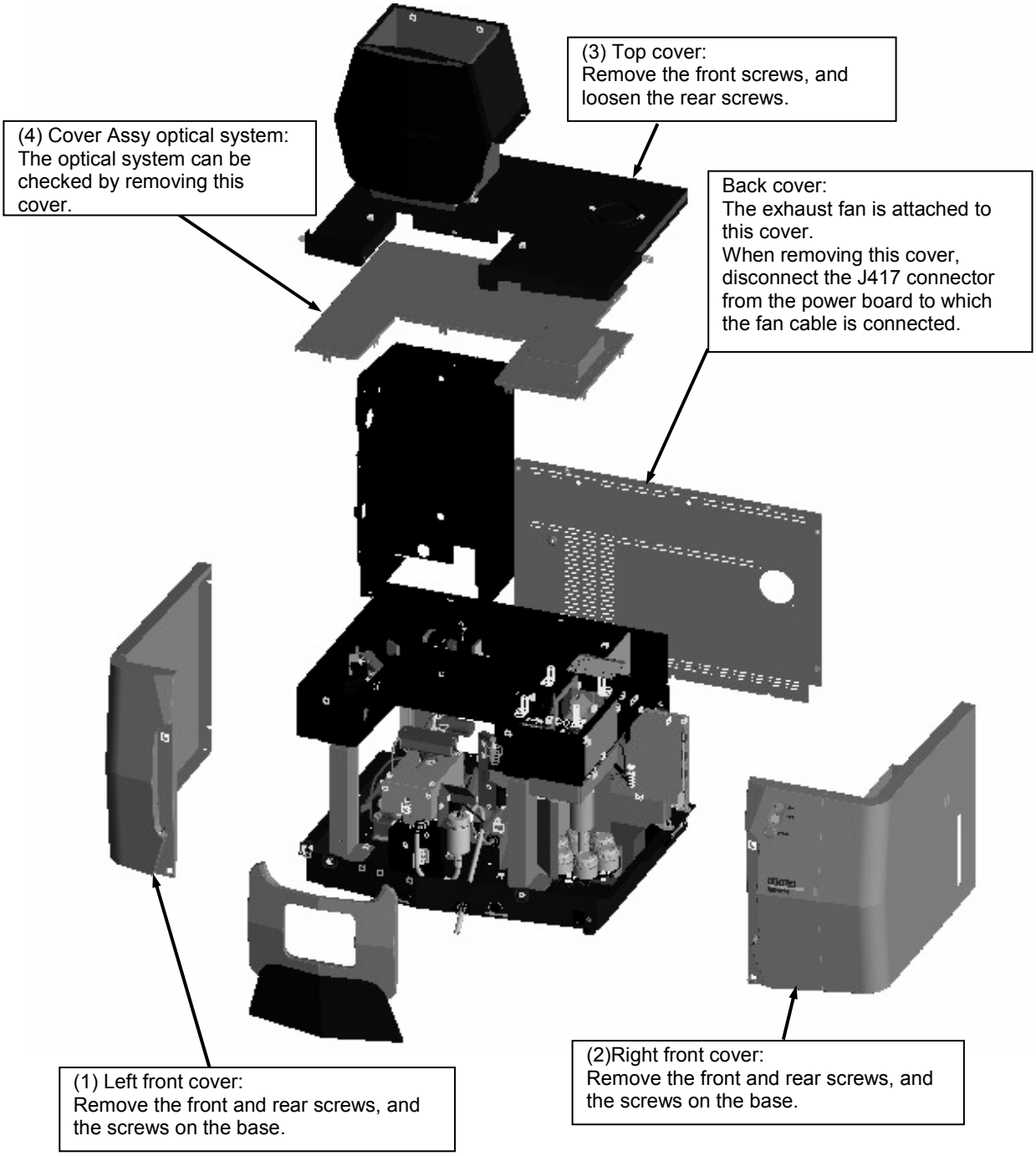
Target jig M10 for mirror	Target jig M11 for mirror	Slit horizontal gauge	
P/N 206-77265-92	P/N 206-77265-93	P/N 206-77313	
			

Hollow cathode lamp K	Hollow cathode lamp Hg	AAOBCHK program	
P/N 206-77771-22	P/N 206-77771-28	-	
			

* Note: A lamp that has undergone optical axis inspection is required for the hollow cathode lamp.

7.1.2 Removing Covers

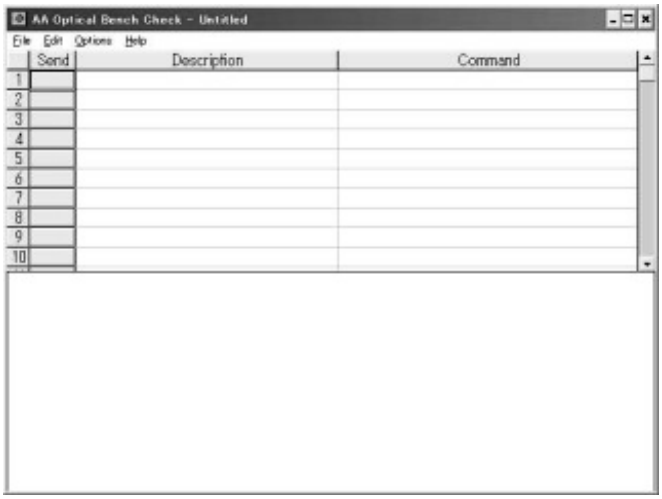
Turn the AA-7000 OFF, and remove the covers in the order of the numbers shown in the photo below.



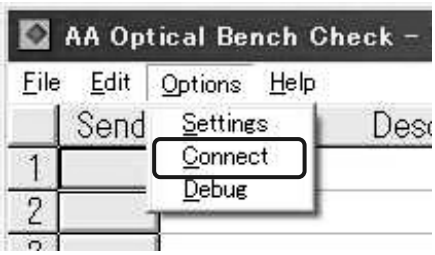
7.1.3 Pre-Adjustment Settings

"_" in AAOBCHK commands (e.g. O_U_#7001) referred to in this manual indicates a space.

1. Connect the AA-7000 to the PC with the communication cable, and turn the AA-7000 and the PC ON. Next, start up AAOBCHK.

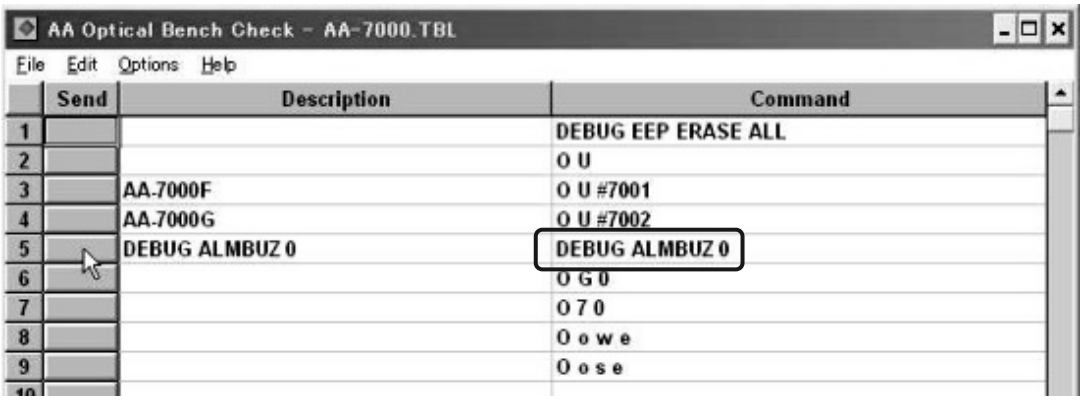


2. Connect communications by [Options] - [Connect] on the menu. (The buzzer sounds when communications begins.)



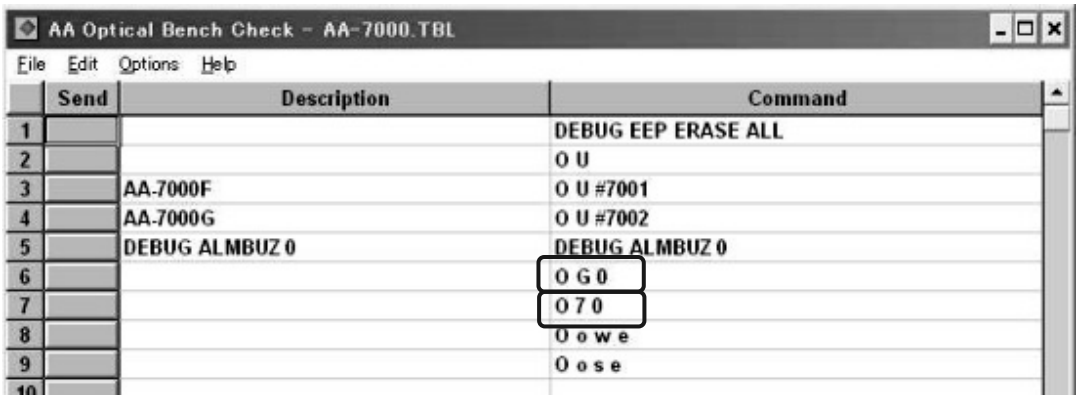
* When the back cover is removed, the buzzer sounds since the connector (J417) for the fan connected to the power board will be disconnected.

3. To stop the buzzer sounding, send the "DEBUG_ALMBUZ_0" command.

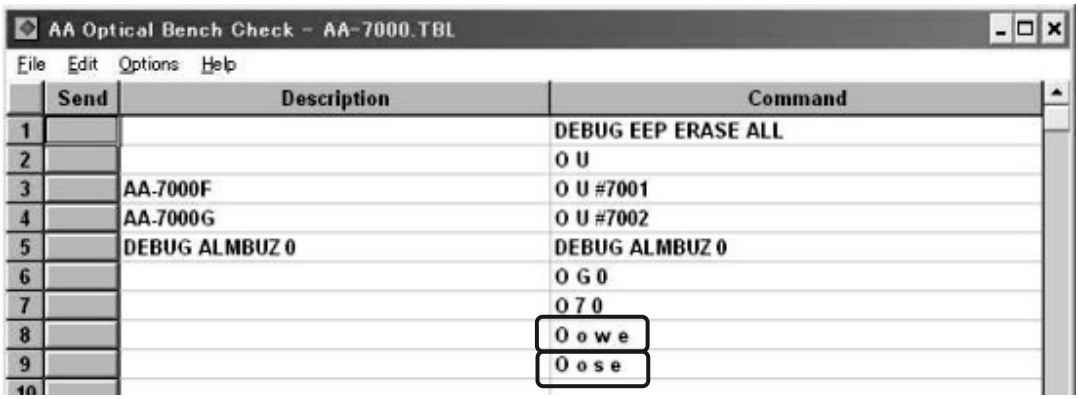


4. To prevent photomultiplier (negative high voltage) and chopper mirror accidents, set the photomultiplier negative high voltage to 0 V, and to stop chopper mirror rotation, set as follows. ◇ Always perform this before adjusting the optical axis.

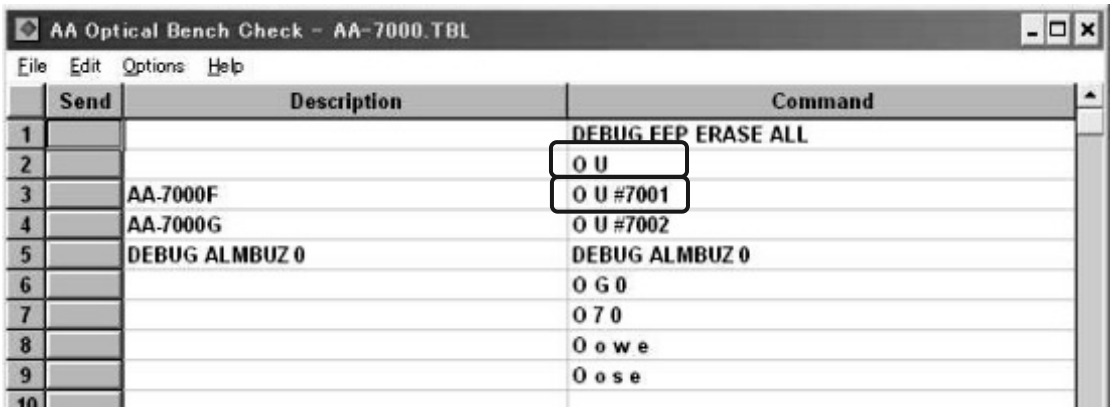
   ・ To set the photomultiplier negative high voltage to 0 V, send the "O_G_0" command.
   ・ To stop chopper mirror rotation, send the "O_7_0" command.



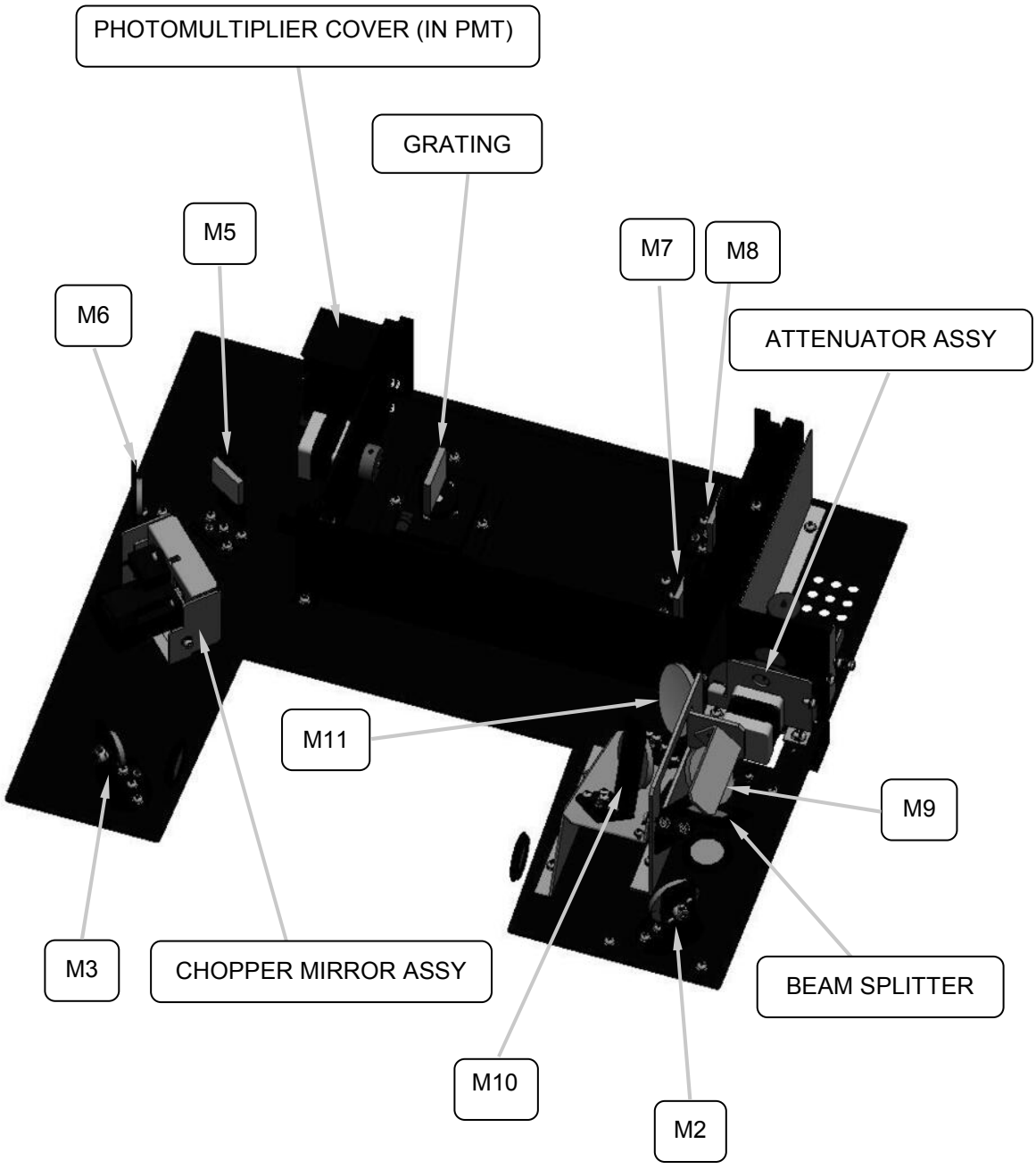
5. Write the excitation pattern of each stepping motor to EEPROM.
   ・ Wavelength drive motor Send the "O_o_w_e" command. (When this command is sent, the wavelength motor starts to operate. It takes approx. 30 seconds for motor operation to complete.)
   ・ Slit motor Send the "O_o_s_e" command.



Remarks: To write the instrument type, ・AA-7000F: send the "O_U_#7001" command.
・AA-7000G: send the "O_U_#7002" command.

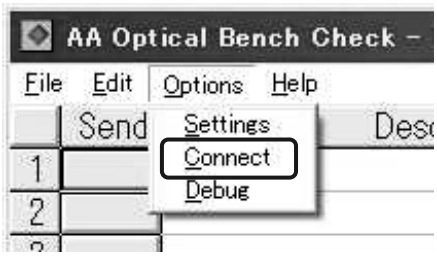


Layout of Optical System



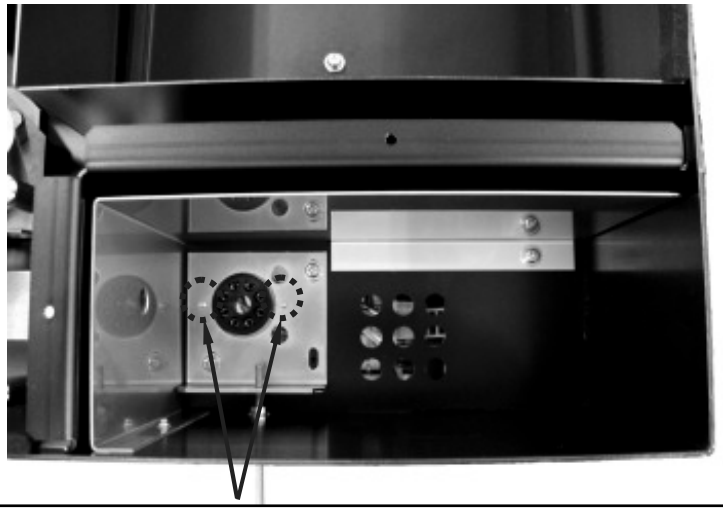
7.1.4 Installing the Jigs

1. Disconnect communications by [Options] - [Connect], and then turn the AA-7000 OFF.

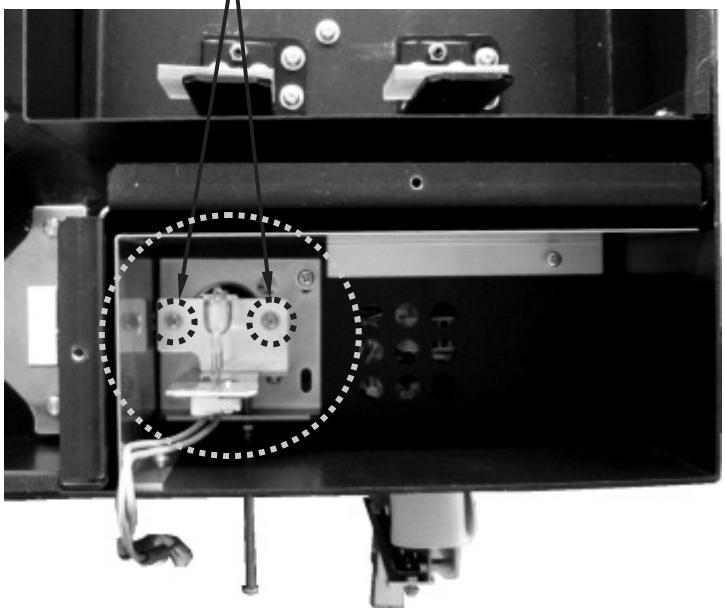


2. Remove the photomultiplier cover and photomultiplier.

3. Install the WI light source jig on the D2 lamp socket.

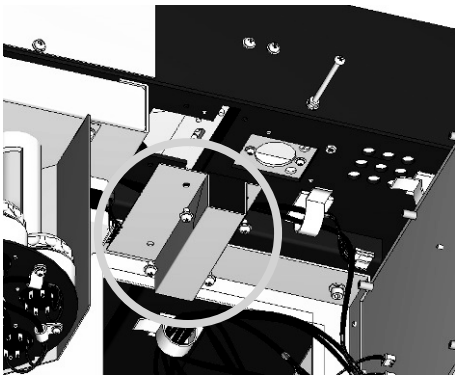


The D2 lamp socket fixing screws protrude from below. Lightly tighten the screw (nut) of the WI light source jig, and fasten in place on these screws.

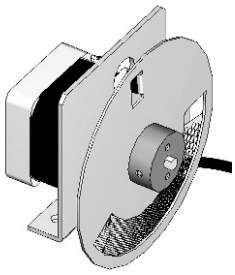


4. Place the cooling fan provided with the WI light source jig on the cover.

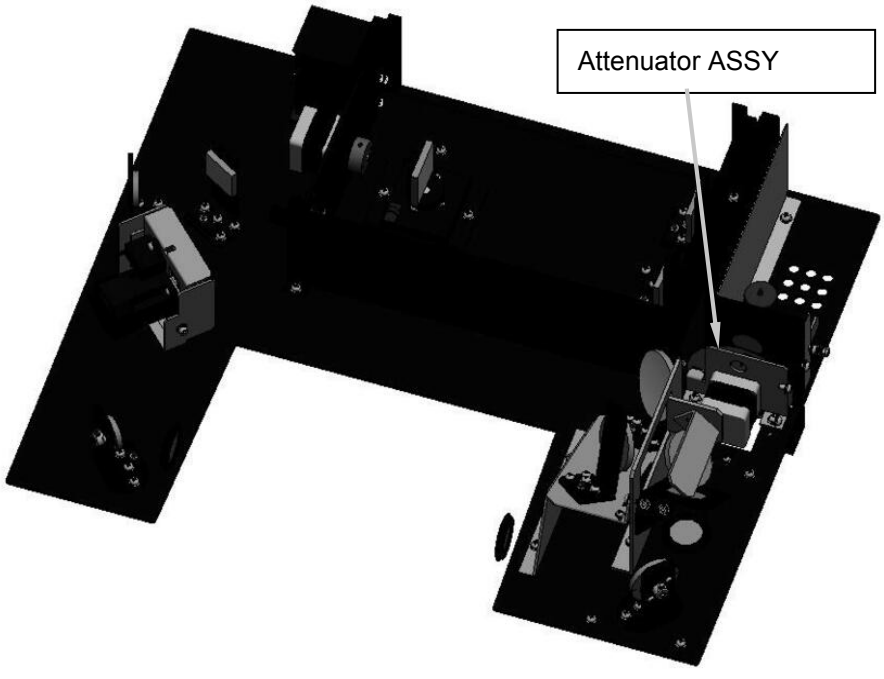
5. Remove the cover from the rear side of the attenuator ASSY, and remove the attenuator ASSY.



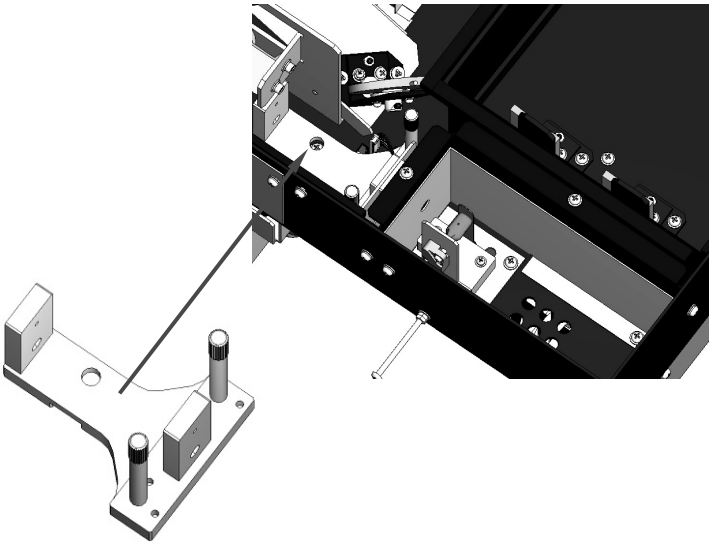
Attenuator cover



Attenuator ASSY



6. After removing the attenuator ASSY, install the initial optical axis limiting jig.

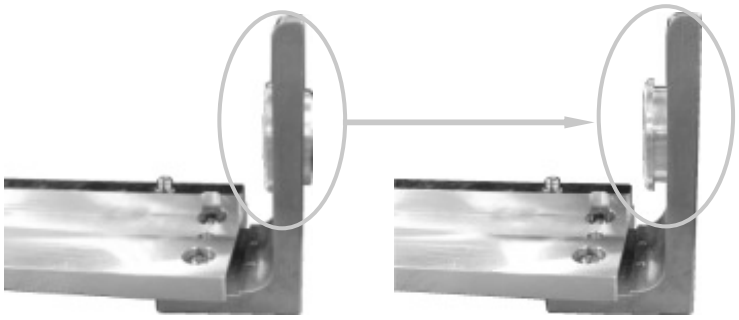


Initial optical axis limiting jig

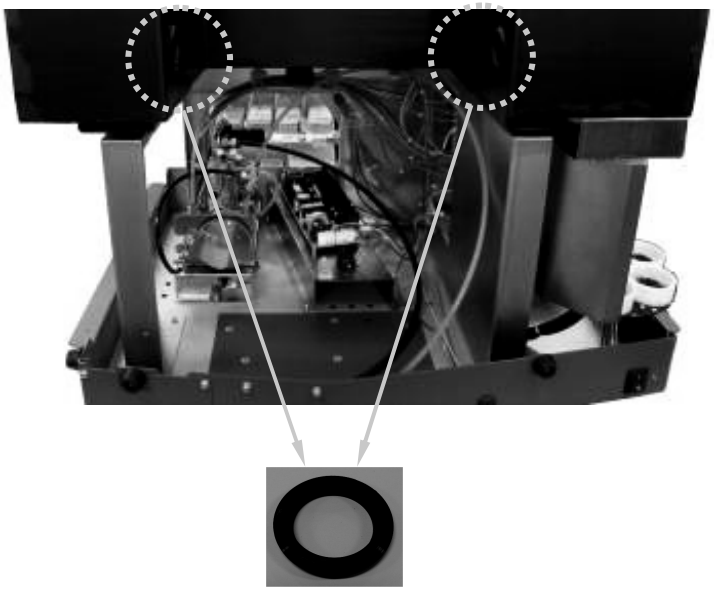
7.1.5 Installing the Atomizer Optical Axis Adjustment Base

1. Loosen the two screws on one side of the atomizer optical axis adjustment base.

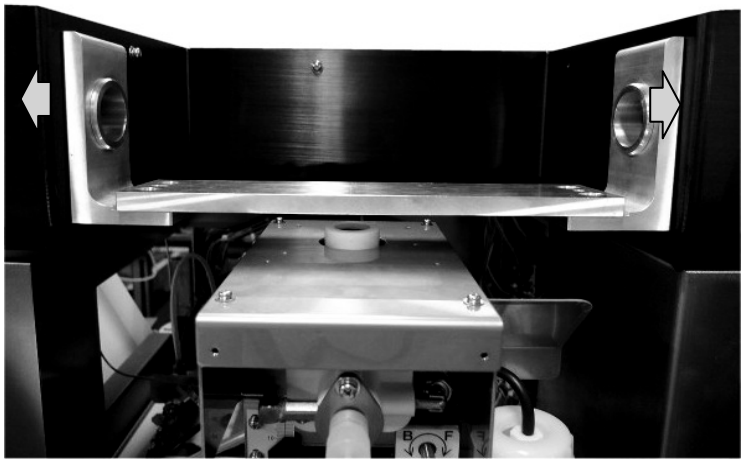
2. Place the left and right holders of the optical axis adjustment base on the inside as shown in the photos below.



3. Remove the window plate ASSYs on the left and right of the atomizer. (The ASSYs come loose by pulling the window plate holders.)



4. Press in the left and right holders of the optical axis adjustment base into the holes in which the window plate ASSYs were originally installed to hold the adjustment base in contact, and tighten the screws that were loosened in step "1". Pay attention to the horizontal and vertical positioning with respect to the optical base as shown in the photo below.



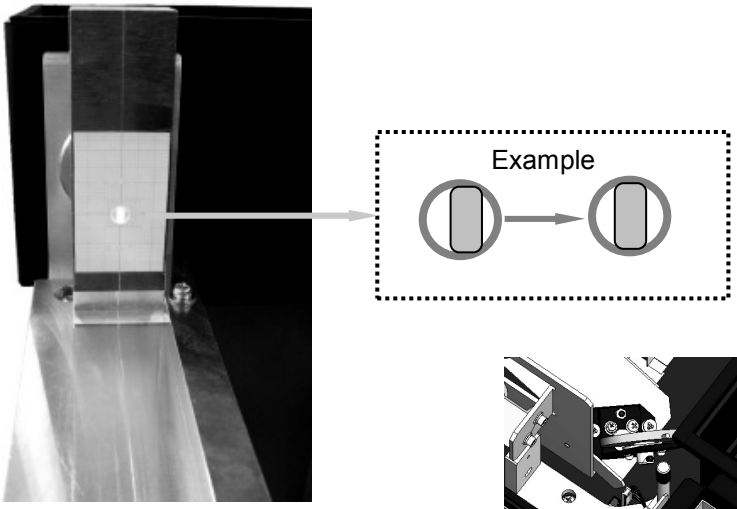
Installing the Atomizer Optical Axis Adjustment Base

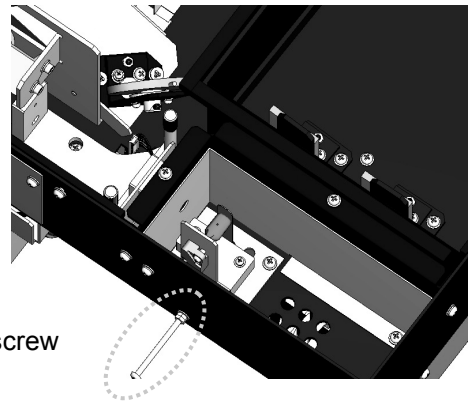
7.1.6 Adjusting the WI Light Source Jig

1. Turn the WI light source jig power switch ON to light the lamp.

2. Set the target upright in the center of the atomizer optical axis adjustment base.

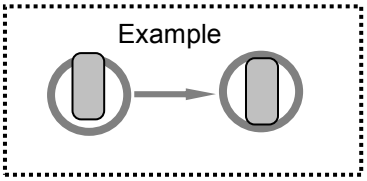
3. Turn the position adjustment screw of the D2 lamp so that the rectangular light flux is aligned with the center of the contour projected on the target.



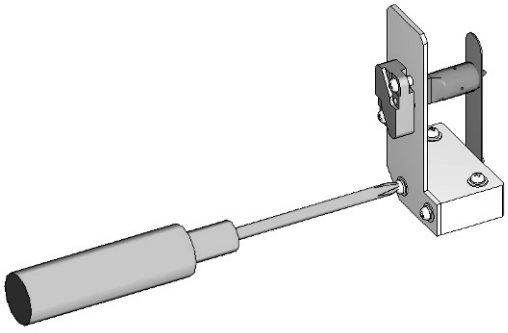


D2 lamp position adjusting screw

4. Next, if the light flux is out-of-alignment in the vertical direction, vertically fine-adjust the lamp of the WI light source jig using a screwdriver so that the light flux comes to the center.

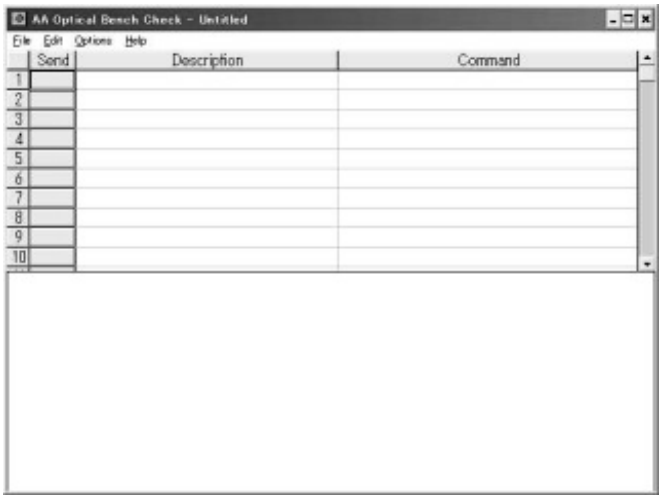


Also, correct the lamp position because the WI light source is tilting at an angle in the vertical direction.

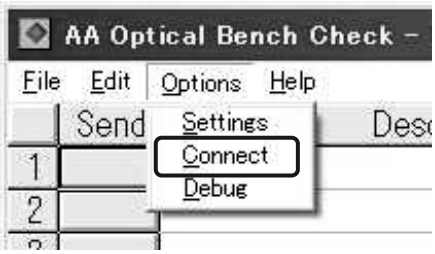


7.1.7 Adjusting the Slit

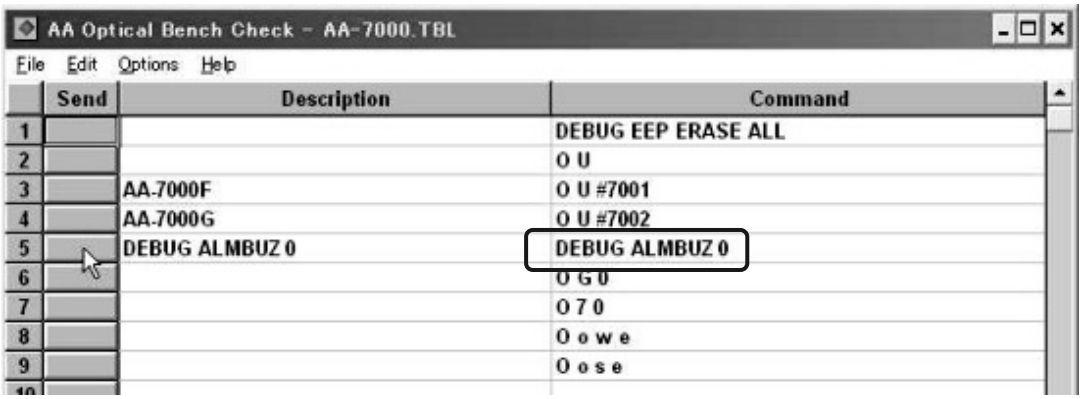
1. Turn the AA-7000 ON, and start up AAOBCHK.



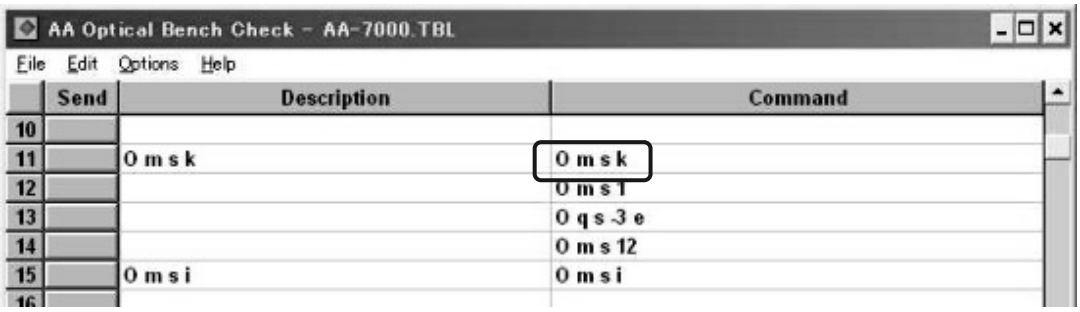
2. Connect communications by [Options] - [Connect] on the menu. (The buzzer sounds when communications begins.)



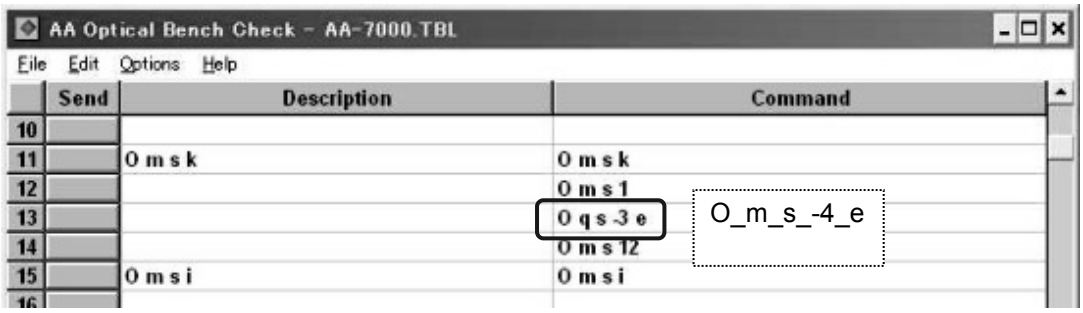
3. Send the "DEBUG_ALMBUZ_0" command to stop the buzzer sounding.



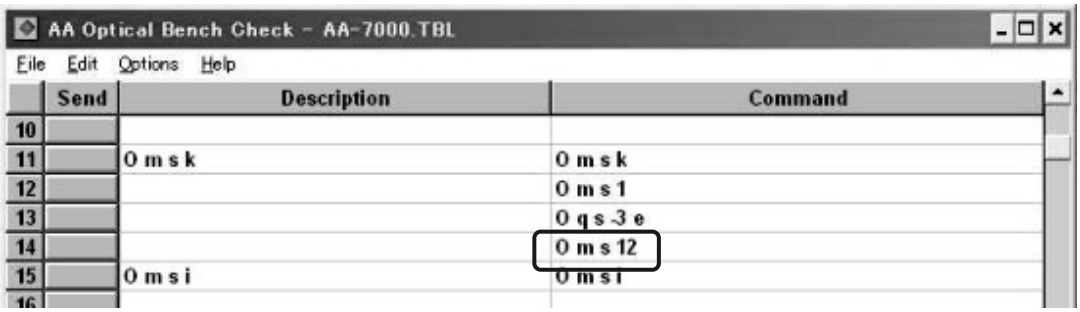
4. Send the "O_m_s_k" command to detect the slit origin.



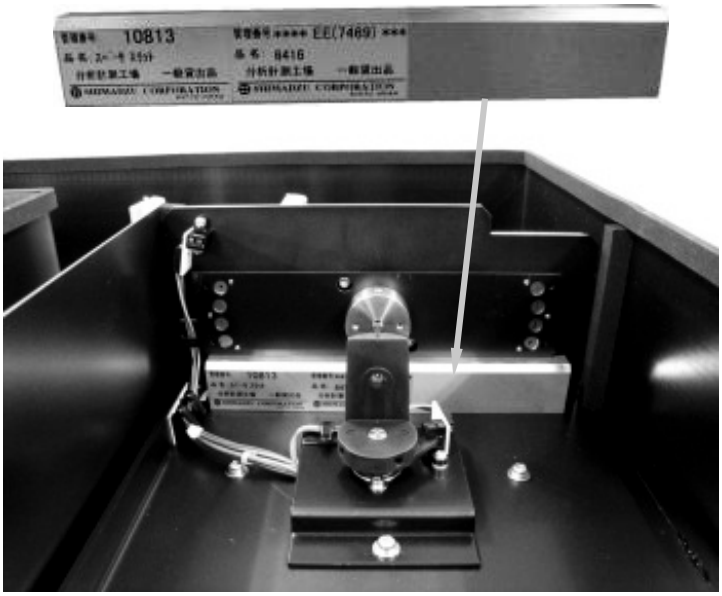
5. Send the "O_m_s_-3_ e" (or "O_m_s_-4_e") command so that the slit ASSY is aligned almost horizontally.
(If the slit ASSY cannot be aligned horizontally even by setting a "-3" or "-4" value, enter other numerical values.)



6. Next, send the "O_m_s_12" command.

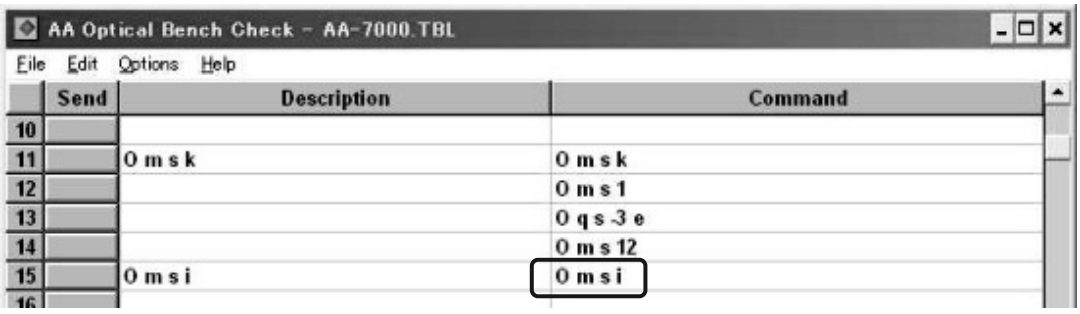


7. Check that the slit horizontal gauge can be inserted under the slit ASSY. (This is to check horizontality.)



* If the slit ASSY is not horizontal, loosen the motor fixing screws and fine-adjust until the ASSY is horizontal.

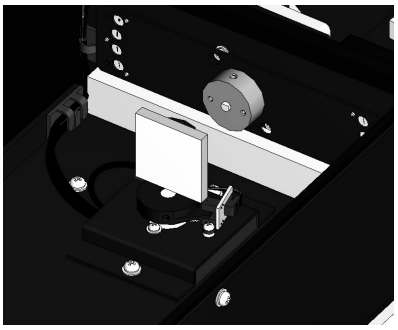
8. Send the "O_m_s_i" command to make sure that the 0.2 nm slit is set.



Caution

When the slit cannot be adjusted according to the above-mentioned simple procedure, it is possible to adjust it according to the following procedure.

Turn the instrument ON, connect the PC and start up AAOBCHK.
Establish communications by [Options] - [Connect].
To stop the buzzer, send the [DEBUG_ALMBUZ_0] command.
Send the [O_m_s_k] command to detect the slit origin.
Send the [O_m_s_1] command to rotate the slit motor one pulse at a time so that the slit assembly is almost horizontal.
When the slit assembly is most horizontal, subtract "12" from the pulse count (number of times command is sent) and write this value to EEPROM by sending the [O_q_s_offset value_e] command.
Send the [O_m_s_12] command, place the slit horizontal gauge under the slit assembly, and check the horizontality of the slit assembly.
If the slit assembly is not horizontal, loose the motor fixing screws to fine-adjust so that the slit assembly becomes horizontal.
Send the [O_m_s_i] command to check that the 0.2 nm slit is set.

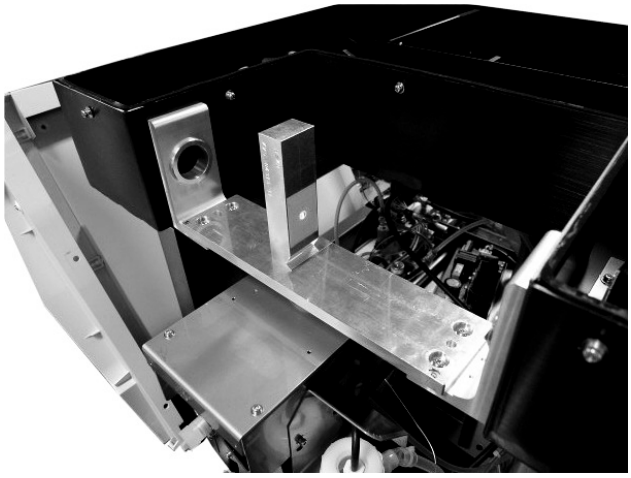


Slit horizontal

7.1.8 Adjusting the Sample-Side Optical Axis

1. Rough-adjustment of M2 mirror

Place the target jig at the center of the atomizer optical axis adjustment base, and rough-adjust the M2 mirror so that the optical axis is aligned with the center of the target.



Atomizer optical axis adjustment base and target jig

2. Adjustment of direction of M2 mirror rotation (Bring the M2 mirror towards the front and temporarily fasten in place.)

1) Loosen the M2 mirror hexagon head screws (rear screws on the mirror holder) to turn the mirror, and temporarily fasten it at the position where the light flux is projected as a square on the target.
   * Make sure that the projected image is a vertical rectangle.

Image at center of atomizer optical axis adjustment base

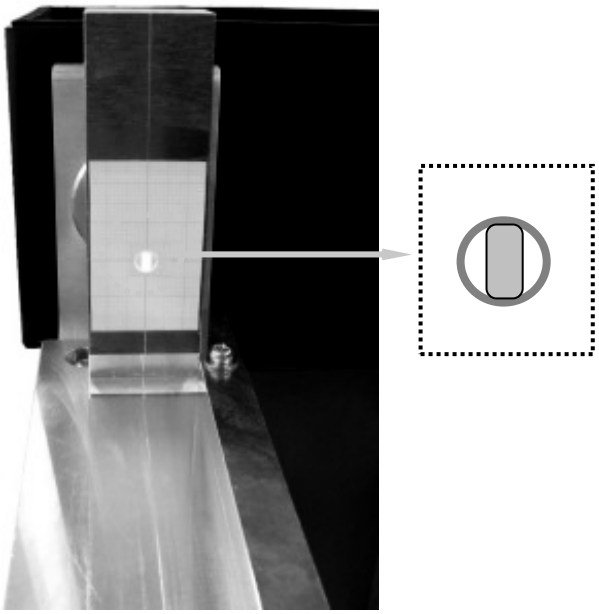
2) Remove the initial optical axis limiting jig, and make sure that the light flux on the target is rectangular.
   If the light flux is not rectangular, loosen the M2 mirror hexagon head screws and re-adjust.

3) After making sure that the image is rectangular, and install the initial optical axis limiting jig at its original position.

Caution

About the initial optical axis limiting jig, we should adjust an optical adjustment using the initial optical axis limiting jig before entering the adjustment of monochromator.
But, when adjusting the toroidal mirror of M2/M3/M11, remove the the initial optical axis limiting jig once and turn the mirror, and make sure that the image is not distorted.
When Reinstalling the initial optical axis limiting jig again, place the target jig at the center of the atomizer optical axis adjustment base and adjust the installation position of the initial optical axis limiting jig so that the rectangular light flux is aligned with the center of the contour projected on the target.

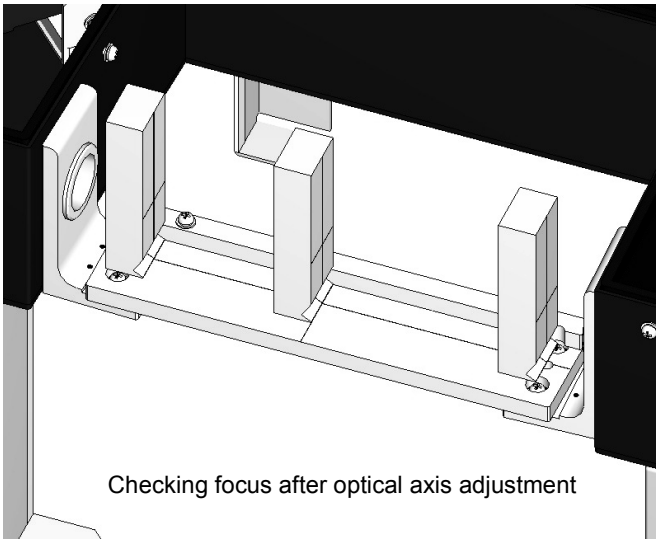
4) Place the target at the center of the atomizer optical axis adjustment base, and adjust the installation position of the initial optical axis limiting jig so that the rectangular light flux is aligned with the center of the contour projected on the target.



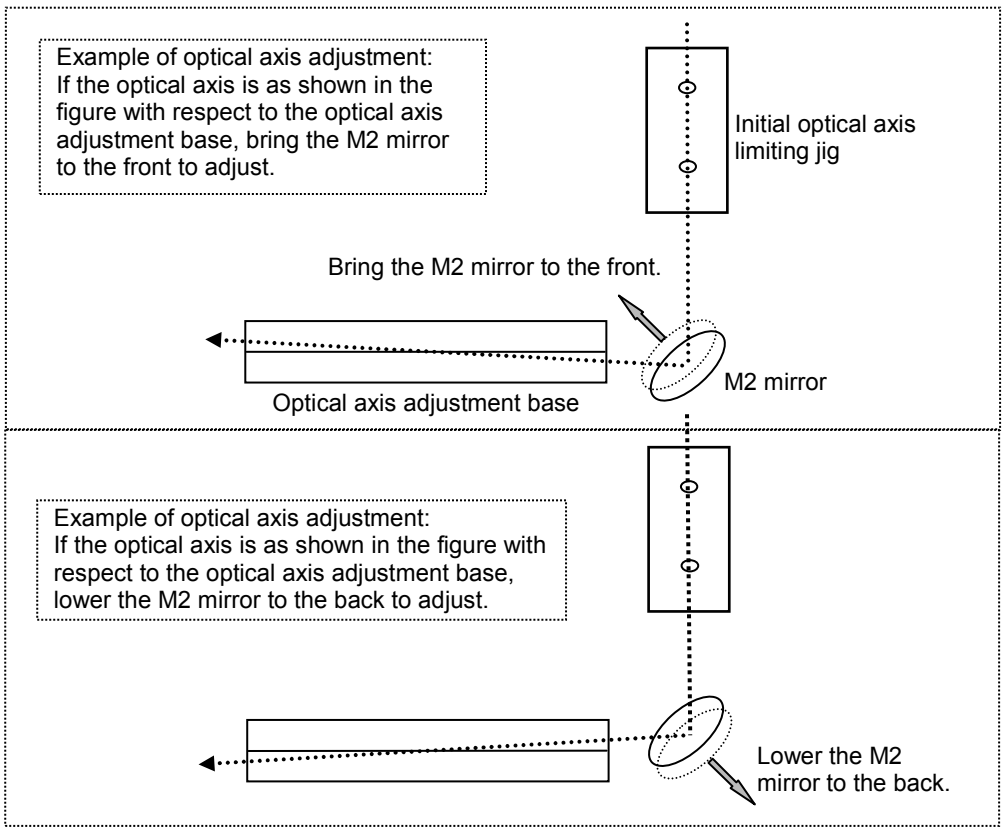
3. Adjusting the optical axis of the atomizer

1) Adjust the M2 mirror in its height direction. Adjust the orientation and position of the M2 mirror so that the height of the light flux is aligned with the center of the target (horizontal) on both the left and right sides of the optical axis adjustment base, and then fasten the M2 mirror in place.

2) Next, adjust the M2 mirror in the horizontal direction. Adjust the position (forward/backward direction and orientation) of the M2 mirror so that the forward/backward position of the light flux is aligned with the center of the target on both the left and right sides of the optical axis adjustment base, and then fasten the M2 mirror in place.
   ◇ Make sure that the light flux is focused at approx. 10 mm before or behind the center of the optical axis adjustment base.

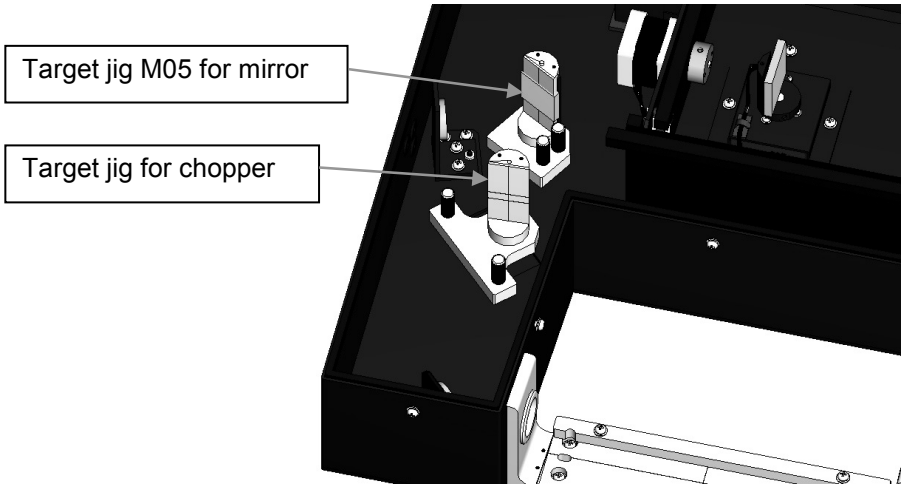


Checking focus after optical axis adjustment



4. Installing the target jig for chopper and target jig for M5 mirror

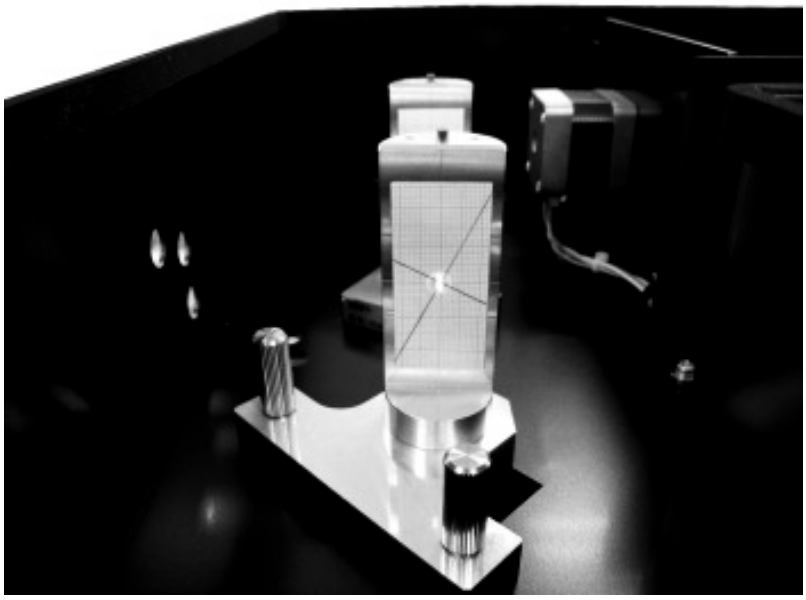
1) Remove the chopper assembly, and draw out the cable.
2) Install the target jig for chopper.
3) Remove the M5 mirror, and install the target jig M05 for mirror.



Target jig for chopper and target jig M05 for mirror

5. Rough-adjustment of M3 mirror (Bring the M3 mirror towards the front and temporarily fasten in place.)

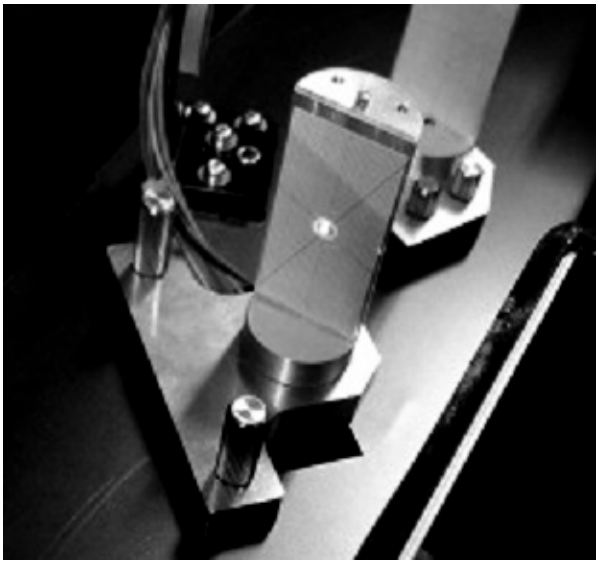
Turn the target jig for chopper towards the M3 mirror side, and adjust the M3 mirror so that the optical axis is aligned with the center of the target jig.



Rough-adjustment of M3 mirror

6. Adjustment of M3 mirror rotation

Remove the initial optical axis limiting jig. Loosen the M3 mirror fastening screws to turn the mirror, and temporarily fasten the M3 mirror at the position where the light flux is projected as a square on the target. Make sure that the projected image is a vertical rectangle and in-focus. Place the initial optical axis limiting jig at its original position.

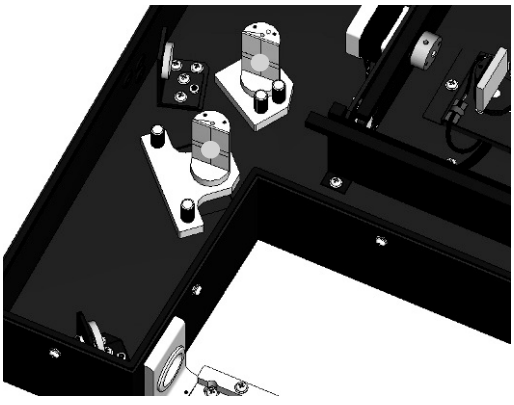


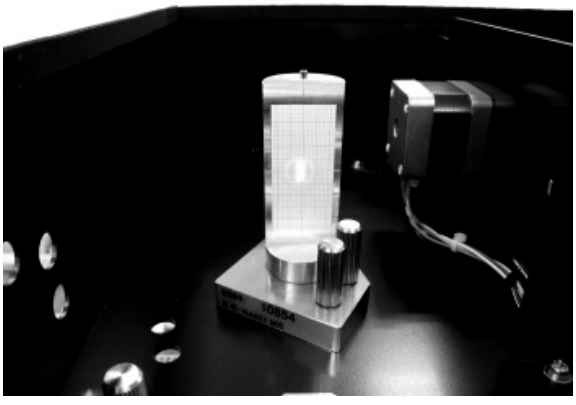
Target jig for chopper, WI lamp image

7. Adjustment of M3 mirror optical axis

1) Adjust the orientation and position of the M3 mirror so that the light flux is aligned with the center of both the target jig for chopper and target jig M05 for mirror.

2) The target jig for chopper comes loose in the upward direction. Adjust the M3 mirror so that the optical axis is aligned with the center of the target M05 for mirror (right photo) and target jig for chopper in both the height and horizontal directions.



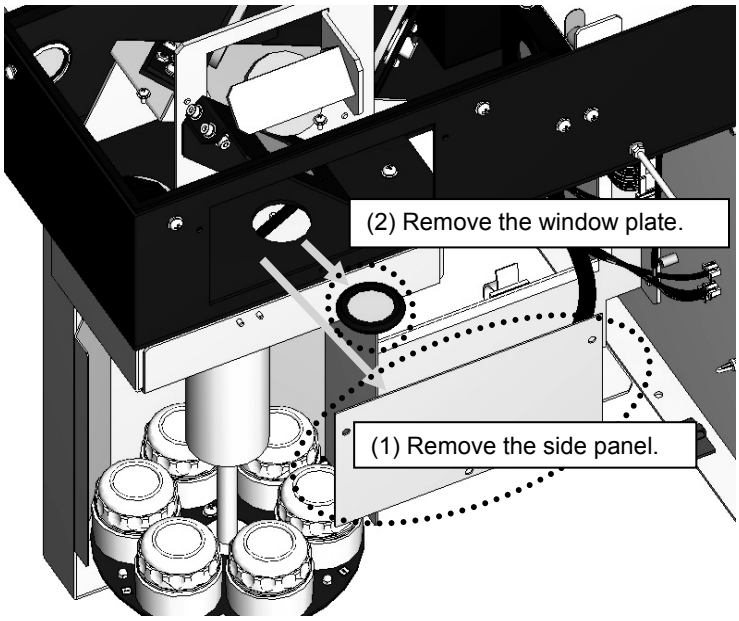


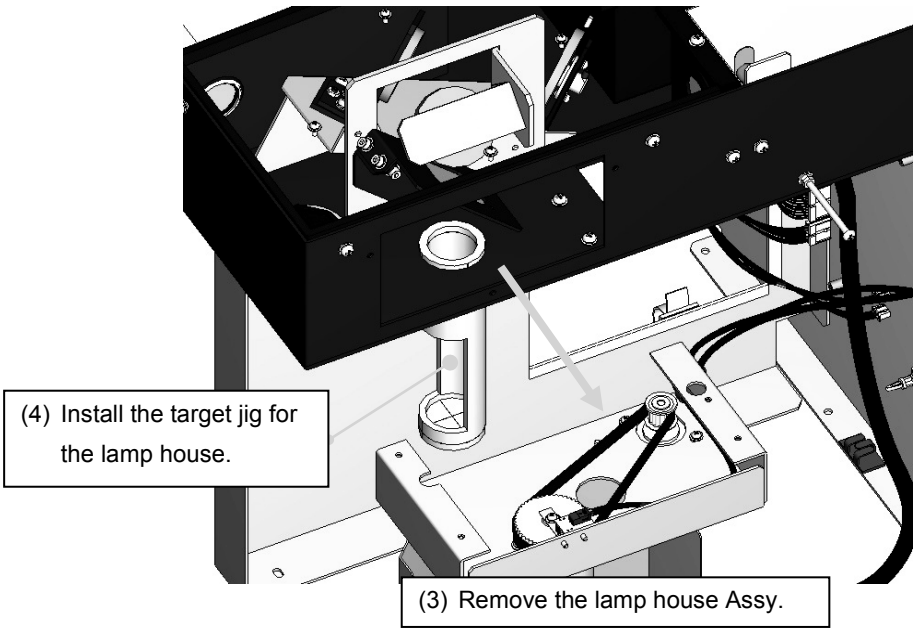
Adjustment of M3 mirror optical axis

7.1.9 Adjusting the Reference-Side Optical Axis

1. Installation of target jig for lamp house

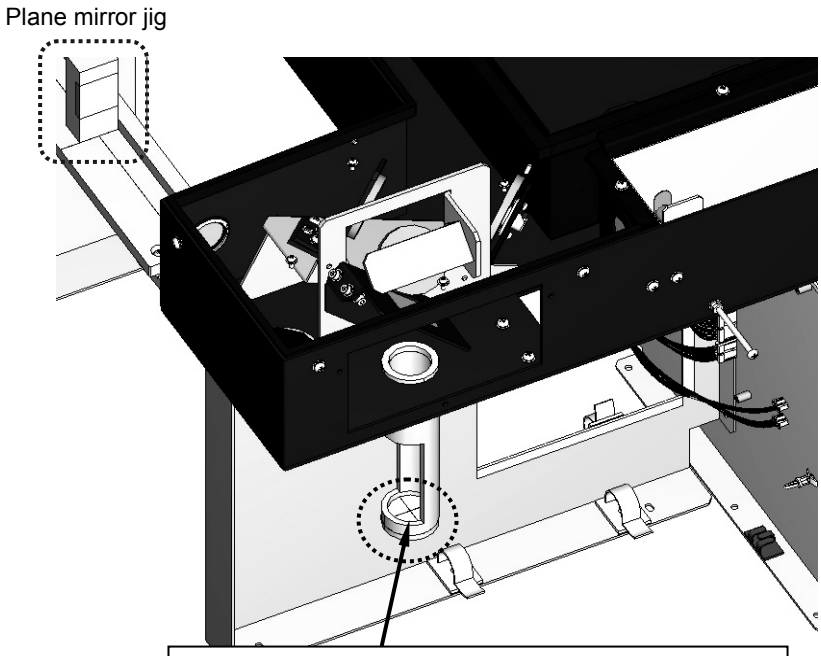
Remove the initial optical axis limiting jig.
Remove the lamp house assembly and window plate assembly, and install the target jig for lamp house.

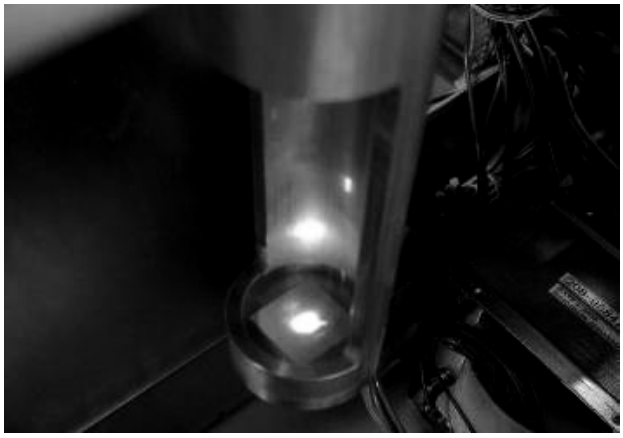




2. Adjustment of half mirror

Place the plane mirror jig aligned with the scribed lines on the atomizer optical axis adjustment base.
Adjust the half mirror so that the optical axis is aligned with the center of the target jig for lamp house.

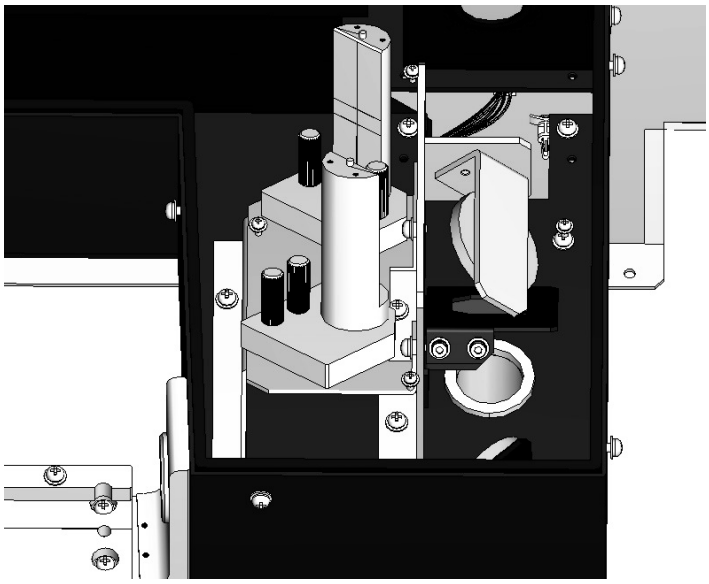




Target jig for lamp house, WI lamp image

3. Installation of target jigs for M10/M11 mirrors

Remove the M10/M11 mirrors, and install the target jig M10 for mirror at the M10 mirror position and the target jig M11 for mirror at the M11 mirror position.



Installation of target jigs for M10 and M11 mirrors

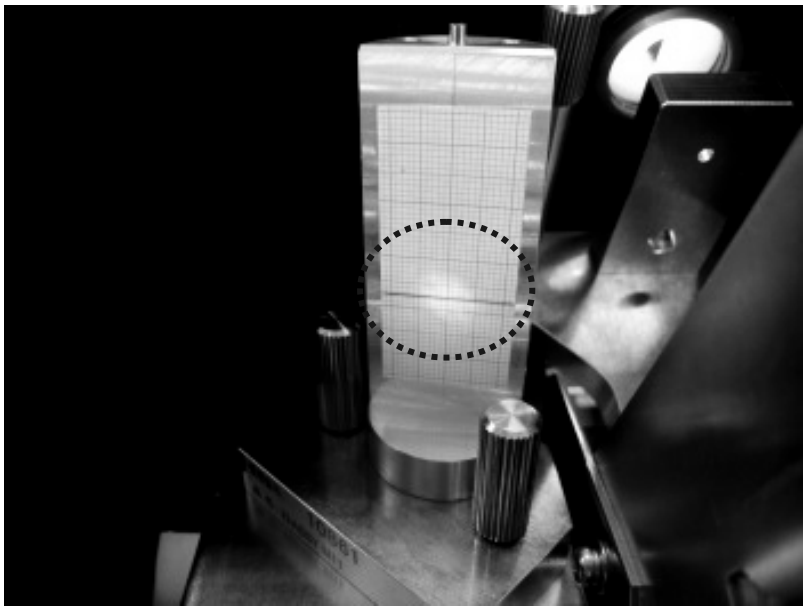
4. Adjustment of M9 mirror

Adjust the M9 mirror so that the optical axis is close to the center of target jig M10 for mirror.
The optical axis cannot be completely aligned with the center of the target since the M9 mirror does not have an optical axis adjustment mechanism.

Target jig M10 for mirror, WI lamp image

5. Installation and adjustment of M10 mirror

Remove the target jig M10 for mirror, and install the M10 mirror.
Adjust the M10 mirror so that the optical axis is aligned with the center of target jig M11 for mirror.



Target jig M11 for mirror, WI lamp image

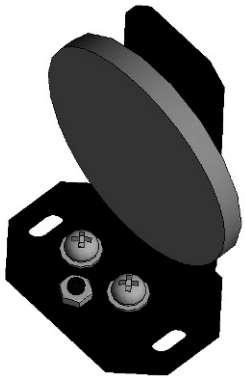
6. Installation and adjustment of M11 mirror

Remove the target jig M11 for mirror, and install the M11 mirror.
Point the target jig for chopper towards the M11 mirror side, and adjust the M11 mirror so that the light reflected from the M11 mirror is roughly positioned at the center of the target jig.

Target jig for chopper, WI lamp image

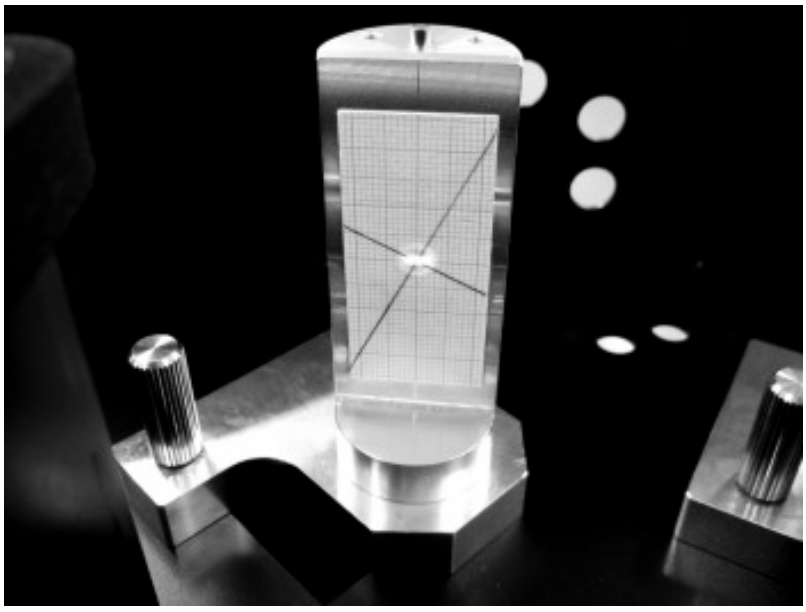
7. Adjustment of M11 mirror rotation

Remove the initial optical axis limiting jig. Loosen the M11 mirror set screws, rotate the mirror, and fasten the mirror with the set screws at the position where the WI lamp image is projected clearly on the target jig.



Racetrack holes in M11 mirror base

Make sure that the projected image is a horizontal rectangle and in-focus.
If the image is out-of-focus, change the mounting position of the racetrack holes in the M10 mirror base to adjust the focus.



Place the initial optical axis limiting jig at its original position.

8. Adjustment of M11 mirror

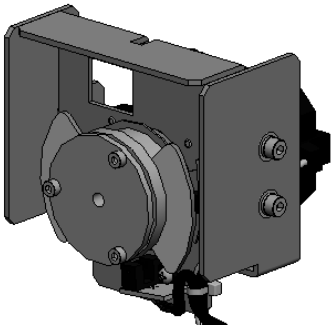
Turn the target jig for chopper 45 degrees, and adjust the M11 mirror so that the center of the light reflected from the M11 mirror overlaps the light reflected from the M3 mirror on the target jig.

Adjustment of M11 mirror

7.1.10 Adjusting the Chopper Assembly

1. Preventing deflection of chopper assembly

Measures to prevent deflection (tilt adjustment) of the chopper assembly have already been implemented on the assembly itself.



Chopper assembly

2. Adjustment of optical axis of chopper assembly

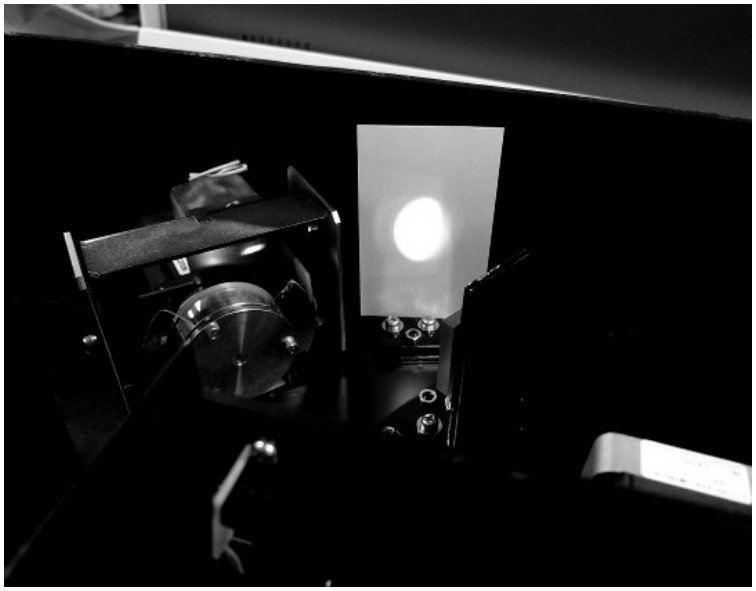
1) Turn the WI light source ON.
2) Adjust the left/right direction and elevation angle of the chopper motor assembly so that the optical axes on the sample side and reference side overlap on target jig M05 for mirror.
   Rough adjustment of the left/right direction of rotation is acceptable.

Target jig M05 for mirror, WI lamp image

7.1.11 Adjusting the Optical System in Front of Monochromator

1. Installation and rough-adjustment of M5 mirror

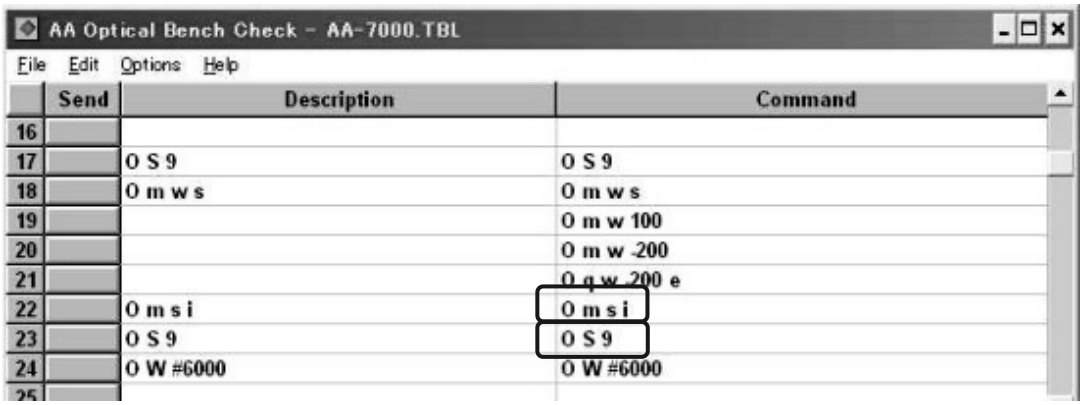
1) Position the chopper mirror in the path of the sample light.
2) Install the M5 mirror, and adjust the M5 mirror so that the optical axis of the sample is aligned with the center of the M6 mirror.



M6 mirror, WI lamp image

2. Optical axis adjustment from entrance slit to the M7 mirror

1) Send the "O_m_s_i" and "O_S _9" commands to set the slit to 1.3 nm, and adjust the M6 mirror so that the center of the optical axis is aligned with the center of the slit hole.



2) During this procedure, the light flux on the slit can be confirmed more easily by using the peep window.
3) Press down the entrance slit side of the slit assembly plate downward by hand until it makes contact to free the slit.
4) Check that the light flux on the M7 mirror of the monochromator is positioned at the center in the horizontal and vertical directions.
   If light flux is deviating, alternately check the M5 and M6 mirrors, so that the light flux is centered on both the entrance slit and M7 mirror.

3. Optical axis adjustment from entrance slit of reference light to the M7 mirror

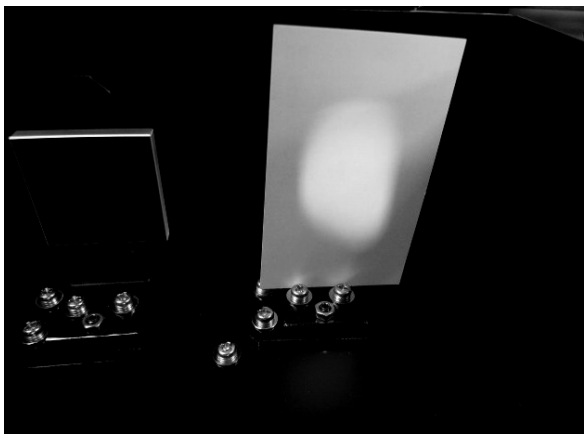
1) Position the chopper mirror in the path of the reference light.
2) Send the "O_m_s_i" and "O_S_9" commands to set the slit to 1.3 nm.

AA Optical Bench Check - AA-7000.TBL

File Edit Options Help

	Send	Description	Command
16			
17		O S 9	O S 9
18		O m w s	O m w s
19			O m w 100
20			O m w -200
21			O q w -200 e
22		O m s i	O m s i
23		O S 9	O S 9
24		O W #6000	O W #6000
25			

3) Adjust the left/right rotation of the chopper assembly so that the center of the optical axis is aligned with the center of the 1.3 nm slit hole.
4) In the same way as for sample light, check that the light flux on the M7 mirror of the monochromator is positioned at the center in the horizontal and vertical directions in a slit-free state.
   If the light flux is deviating, move the chopper assembly forwards/backwards to adjust the light flux to the left and right.
5) It is important that the sample light and reference light are aligned on both the entrance slit and M7 mirror. To do this, try turning the chopper by hand.
   The shape of the image on the entrance slit also is important.

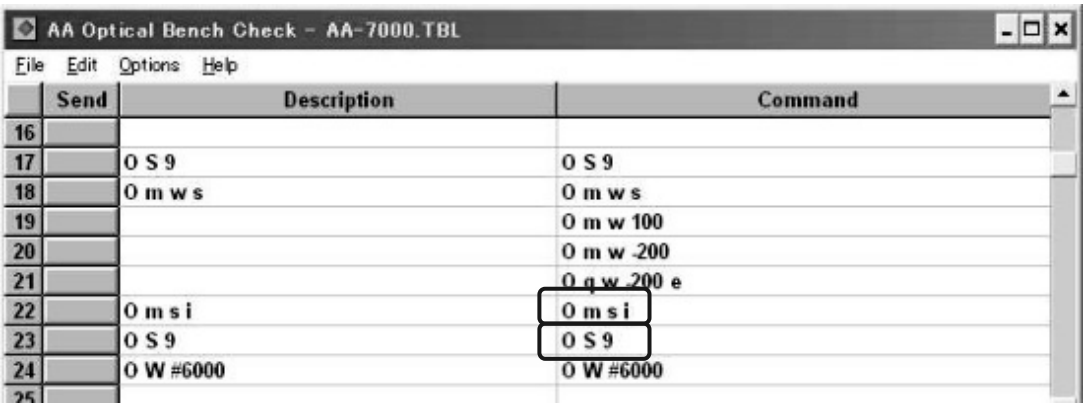


M7 mirror, WI lamp image

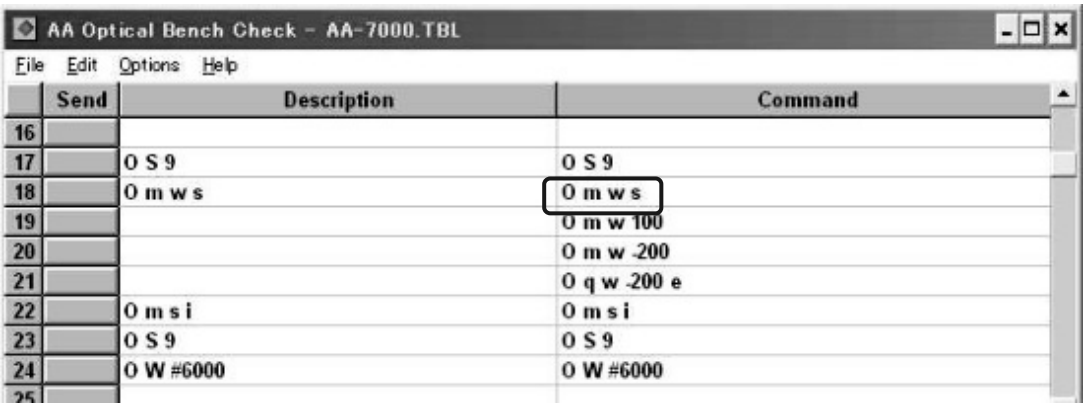
7.1.12 Adjusting the Monochromator

1. Adjustment of M7 mirror

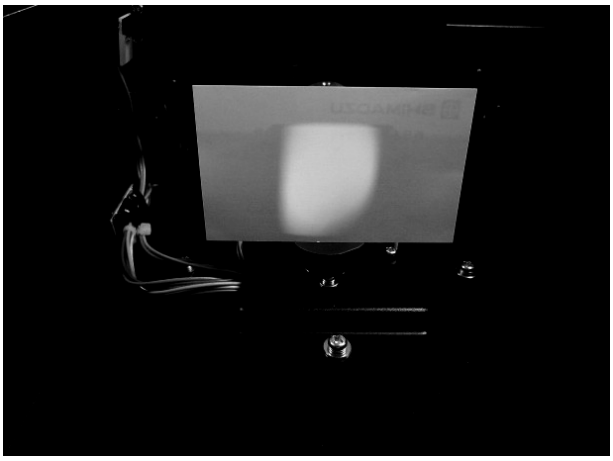
1) Remove the initial optical axis limiting jig. Send the "O_m_s_i" and "O_S_9" commands to set the slit to 1.3 nm, and position the chopper mirror in the path of the sample light.



2) Send the "O_m_w_s" command to turn the wavelength motor (grating) to its origin position.



3) Adjust the M7 mirror so that the center of the light flux is aligned with the center of the grating.



Grating, WI lamp image

2. Adjustment of M8 mirror and grating

1) Send the "O_m_w_number of pulses" command so that the light reflected from the grating is irradiated on the horizontal center of the M8 mirror.
   The number of pulses is approx. + 500 pulses from the origin, but can be changed in 100-pulse increments. During this procedure, take the number of pulses to be "xxx".

AA Optical Bench Check - AA-7000.TBL

File Edit Options Help

	Send	Description	Command
16			
17		O S 9	O S 9
18		O m w s	O m w s
19			O m w 100
20			O m w -200
21			O q w -200 e
22		O m s i	O m s i
23		O S 9	O S 9
24		O W #6000	O W #6000

Numerical values on the left are reference values.

2) In this state, adjust the M8 mirror so that the light flux from the M8 mirror is roughly irradiated on the exit slit.
3) Since this position is taken to be the default, send the "O_q_w_xxx_e" command to write this position to EEPROM.

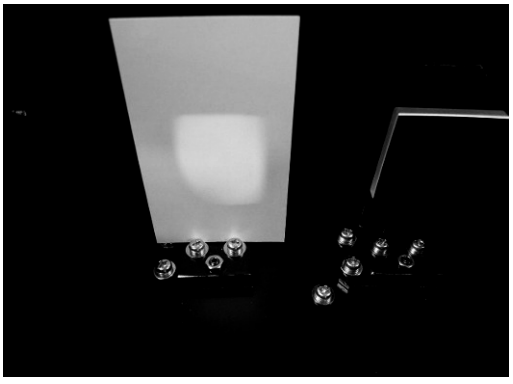
AA Optical Bench Check - AA-7000.TBL

File Edit Options Help

	Send	Description	Command
16			
17		O S 9	O S 9
18		O m w s	O m w s
19			O m w 100
20			O m w -200
21			O q w -200 e
22		O m s i	O m s i
23		O S 9	O S 9
24		O W #6000	O W #6000

Numerical values on the left are reference values.

4) Send the "O_m_w_s" and "O_m_w_xxx" commands.
5) Rotate the wavelength motor (grating) to its origin position, and set this as the default.
6) The adjustment is OK if light flux is irradiated on the M8 mirror without any tilting, the reflected light is incident to the exit slit, and there is still margin left for adjusting the focus.



M8 mirror, WI lamp image

3. Confirmation of alignment between sample light and reference light

1) Place the target jig in front of the exit slit.

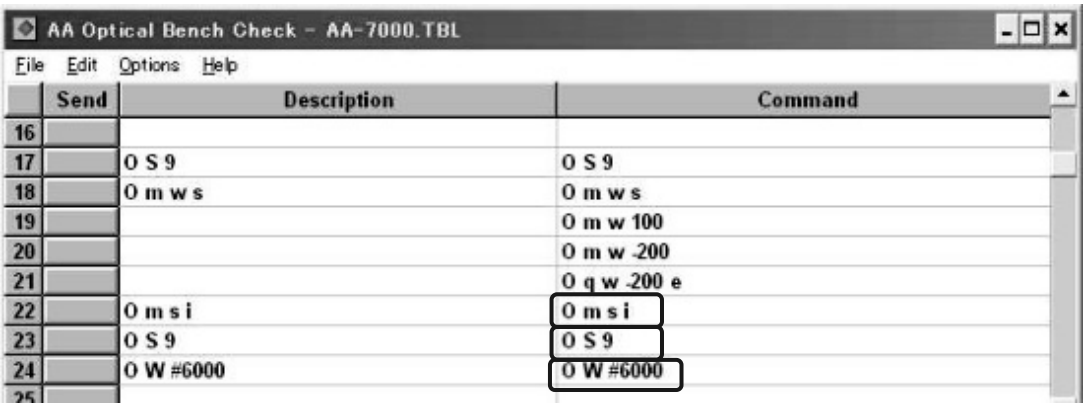
WI lamp image in front of exit slit

2) Press down the entrance slit side of the slit assembly plate downward by hand until it makes contact to free the slit.

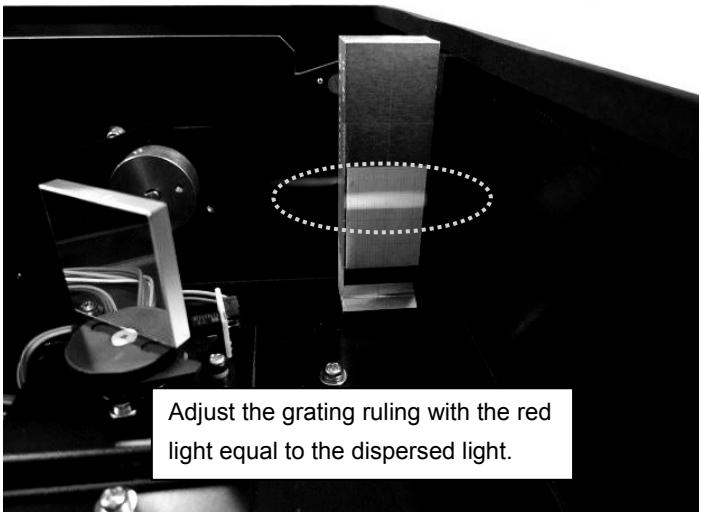
3) Try turning the chopper mirror by hand taking care to prevent fingerprints from transferring to the mirror, and make sure that the sample light and reference light are aligned before the exit slit.
If the sample light and reference light are out-of-alignment, a probable cause is insufficient adjustment of the left/right rotation of the chopper assembly. Return to this adjustment and re-adjust.

4. Adjustment of grating ruling

1) Position the chopper mirror in the path of the sample light.
2) Send the "O_m_s_i" and "O_S _9" commands to set the slit to 1.3 nm, and send the "O_W_#6000" command to match the wavelength to approx. 600 nm (red light).

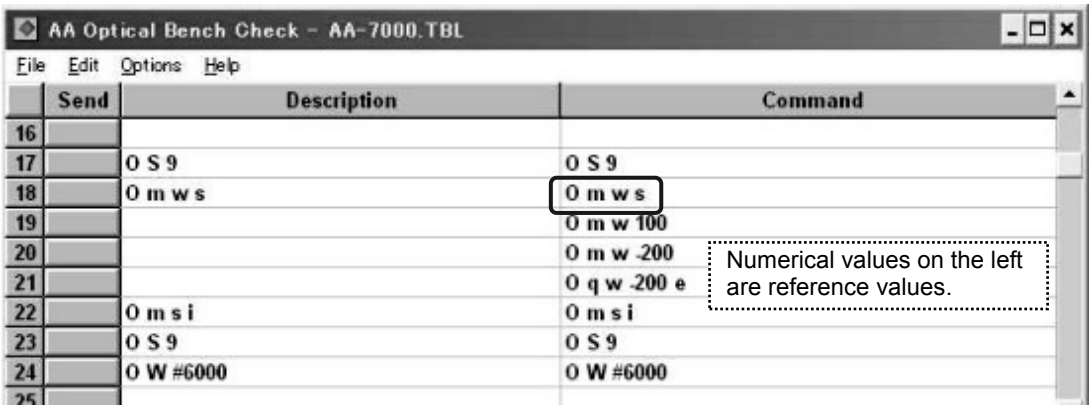


3) Loosen the set screws that fix the grating in place, and adjust the direction of grating rotation so that red light is uniformly irradiated vertically on the exit slit.



Adjustment of grating ruling

4) Send the "O_m_w_s" and "O_m_w_xxx" commands to check zero-order light, too.



5. Adjustment of monochromator focus

1) Send the "O_m_s_i" command to change the slit to 0.2 nm.

AA Optical Bench Check - AA-7000.TBL

File Edit Options Help

	Send	Description	Command
16			
17		O S 9	O S 9
18		O m w s	O m w s
19			O m w 100
20			O m w -200
21			O q w -200 e
22		O m s i	O m s i
23		O S 9	O S 9
24		O W #6000	O W #6000

2) Send the "O_m_w_s" and "O_m_w_xxx" commands so that zero-order light is irradiated on the exit slit.
Place the target jig behind the exit slit.

AA Optical Bench Check - AA-7000.TBL

File Edit Options Help

	Send	Description	Command
16			
17		O S 9	O S 9
18		O m w s	O m w s
19			O m w 100
20			O m w -200
21			O q w -200 e
22		O m s i	O m s i
23		O S 9	O S 9
24		O W #6000	O W #6000

Numerical values on the left are reference values.

3) The monochromator is in-focus if the light flux projected on the target jig becomes uniformly darker when the M8 mirror is lightly twisted towards the grating side.

◇ If there are still light areas on the left side of the target jig facing the target jig, push the M8 mirror slightly towards the back to re-adjust.

◇ If there are still light areas on the right side, bring the M8 mirror a little towards the front to re-adjust.

Adjustment of monochrometer focus

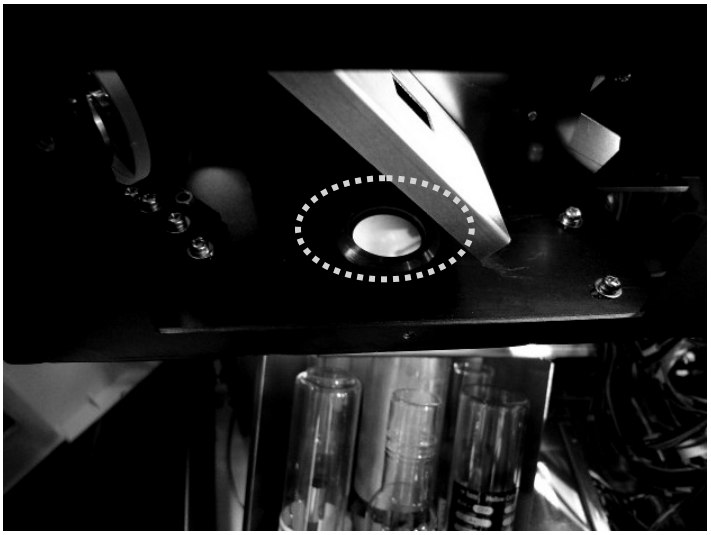
7.1.13 Adjusting the Lamp House

1. Installation of lamp house assembly

1) Remove the target jig for lamp house, and install the window plate assembly and lamp house assembly.

2) Loosen the two disc set screws. (At "Temporary fastening the disc set screws," screw-fasten the disc with it aligned in position.)
   - Set screws are located between lamp numbers #1 and #2 and #2 and #3.

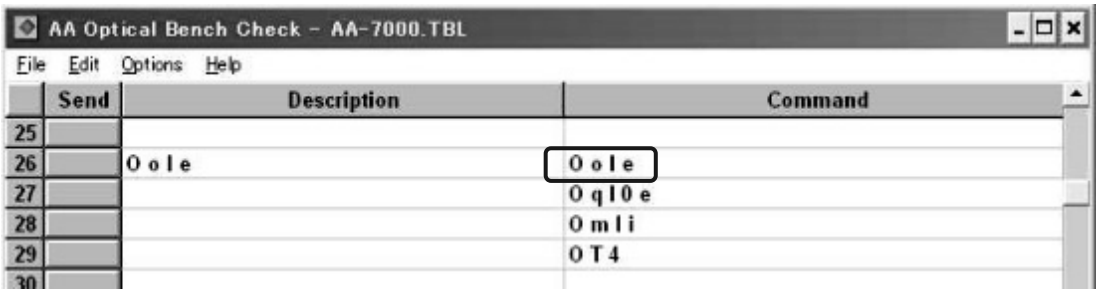
3) Remove the covers on the right side of the lamp house and install the window plate assembly.



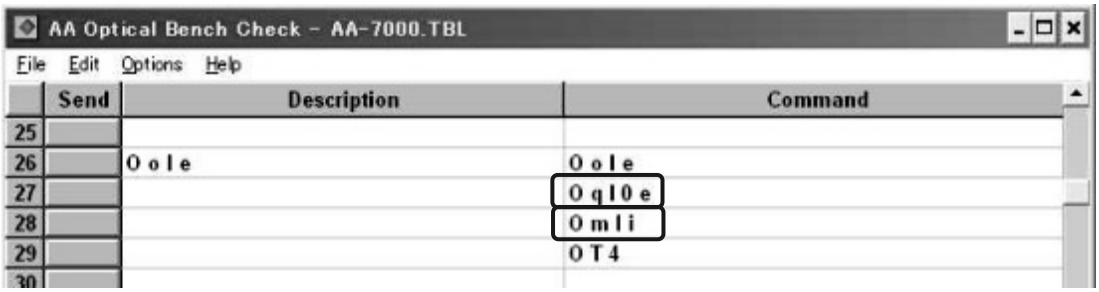
Installation of window plate assembly

2. Initialization of the turret drive motor and clamping of cable

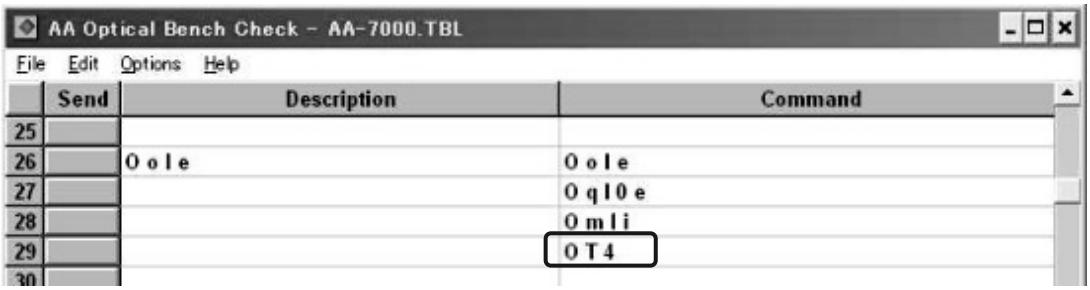
1) Send the "O_o_l_e" command to write the initial excitation pattern for the turret drive motor to EEPROM.



2) Send the "O_q_l_0_e" and "O_m_l_i" commands to move the turret to its origin position.

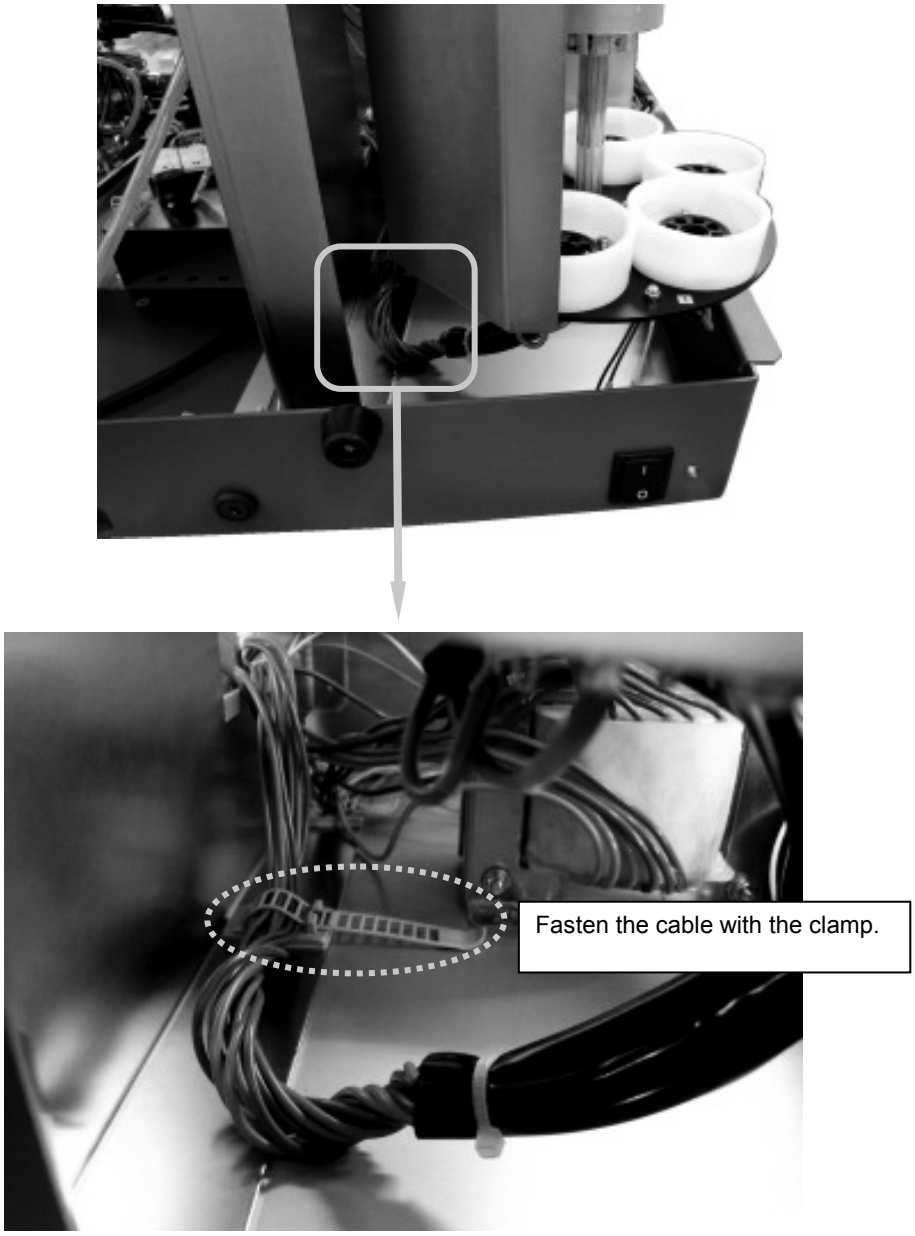


3) Send the "O_T_4" command.



3. Temporarily fastening the disc set screws

Turn the disc two full turns in the counterclockwise direction with the two disc set screws loosened to twist the HCL cable bundle. Then temporarily fasten the set screws between #2 and #3.



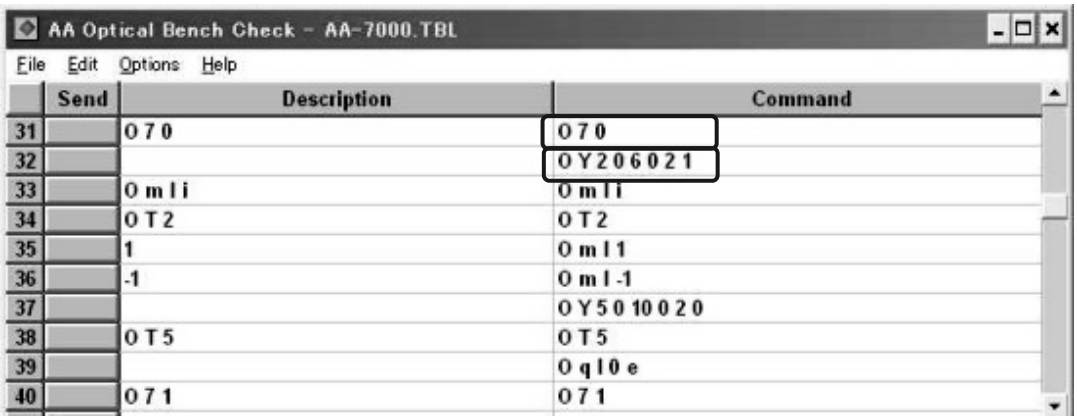
4. Installation of hollow cathode lamp

Install Hg cathode lamp on turret #2 and K cathode lamp on turret #5.

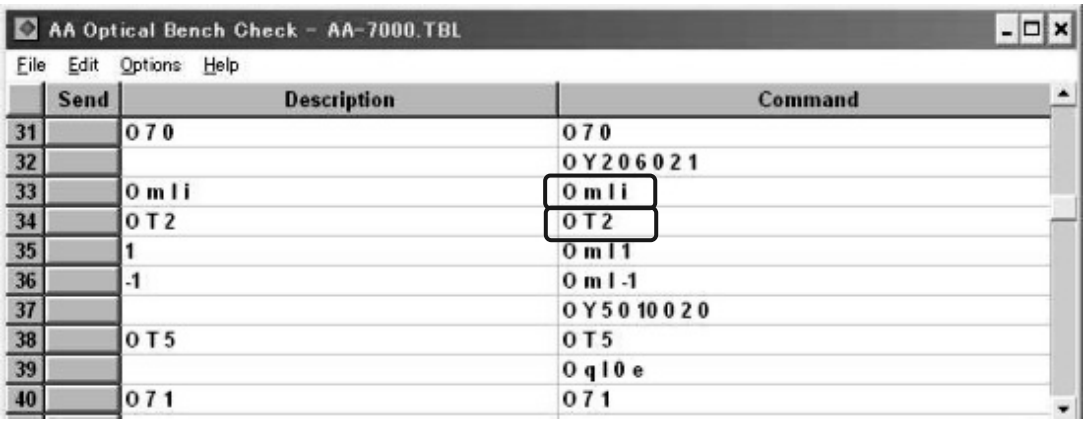
Installation of hollow cathode lamp

5. Adjustment of lamp house assembly position

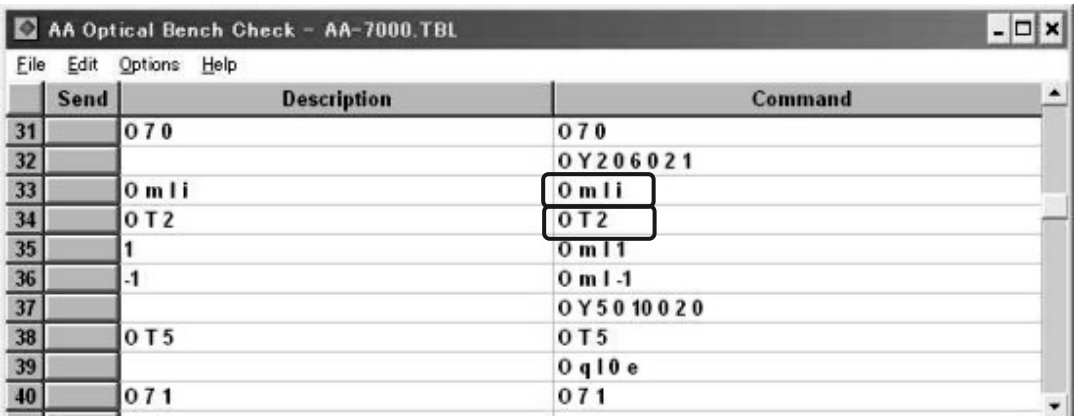
1) After checking that the WI lamp image is aligned with the center of the entrance slit, turn the lamp OFF.
2) Send the "O_7_0" and "O_Y_2_0_6_0_2_1" commands to turn the Hg lamp ON.



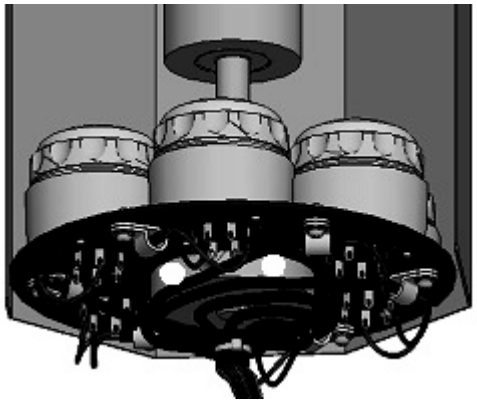
3) Send the "O_m_l_i" and "O_T_2" commands.



4) Check the movement of the light flux in two directions, direction in which the entire lamp house assembly is moved on the entrance slit and direction in which the turret is rotated. The motor will rotate out-of-sync; however, this is not a problem.
5) Turn the chopper mirror by hand taking care to prevent fingerprints from transferring to the mirror, and make sure that the chopper mirror is at the position where sample light and reference light are overlapping at the entrance slit.
6) Send the "O_m_l_i" and "O_T_2" commands.



7) Loosen the set screw between the #2 and #3 turret and the other set screw, turn the disc a little at a time to find the position where the sample light and reference light are overlapping on the entrance slit (confirmed in step 4)), and tighten the set screws while taking care to prevent disc movement. Also, tighten the other set screw.



Location of two disc set screws

8) Send the "O_m_l_i" and "O_T_2" commands.

AA Optical Bench Check - AA-7000.TBL

File Edit Options Help

	Send	Description	Command
31		O 7 0	O 7 0
32			O Y 2 0 6 0 2 1
33		O m l i	O m l i
34		O T 2	O T 2
35		1	O m l 1
36		-1	O m l -1
37			O Y 5 0 1 0 0 2 0
38		O T 5	O T 5
39			O q l 0 e
40		O 7 1	O 7 1

9) While manually switching between the sample and reference on the chopper mirror, adjust the installation position of the entire lamp house assembly so that the light flux is at the horizontal and vertical centers of the entrance slit.
If the light flux is not aligned, send the "O_m_l_number of pulses" command to align the light flux and adjust the installation position of the entire lamp house assembly.

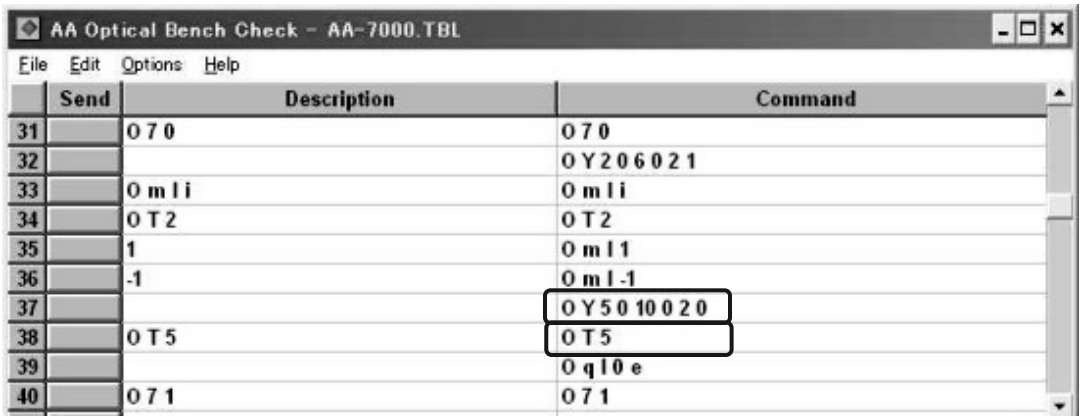
◇ Note down this number of pulses since it will be written to EEPROM later on.

◇ It is important that the chopper mirror is turned so that both the sample light and reference light are at the center on the entrance slit.

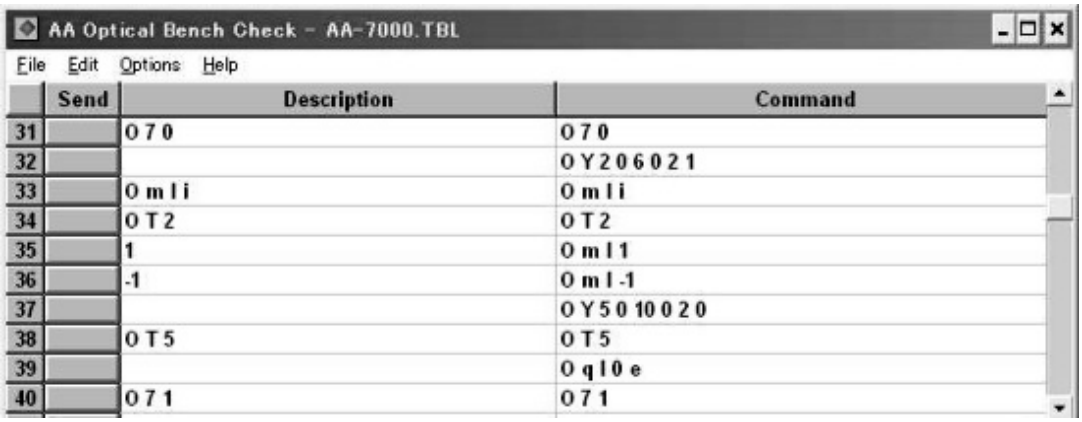
Caution

The lamp house assembly sometimes bumps against the exterior covers when the installation position of the lamp house assembly is set to the right hand front limit of the racetrack hole adjustment range. Set to within 1.5 mm (limit: 3 mm) from the center of the racetrack hole in the right hand front direction.

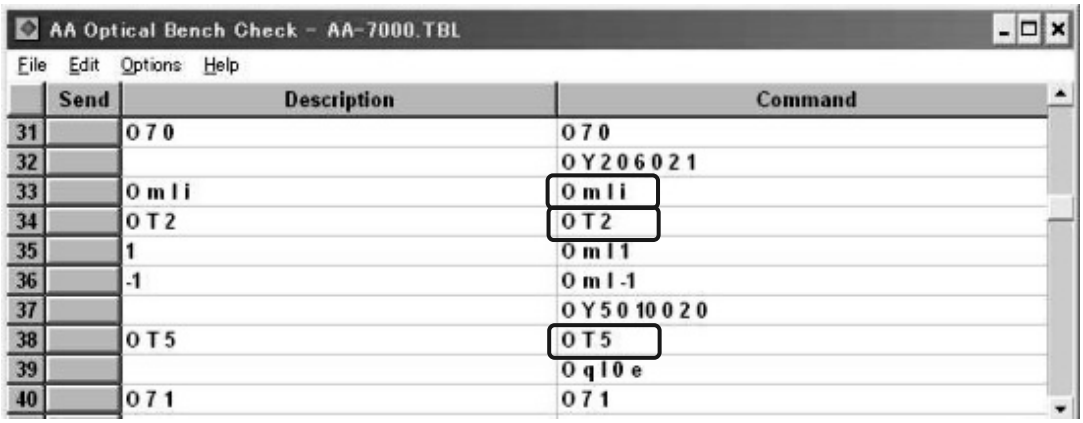
10) Send the "O_Y_5_0_10_0_2_0" and "O_T_5" commands, and perform the same check for hollow cathode lamp K also.



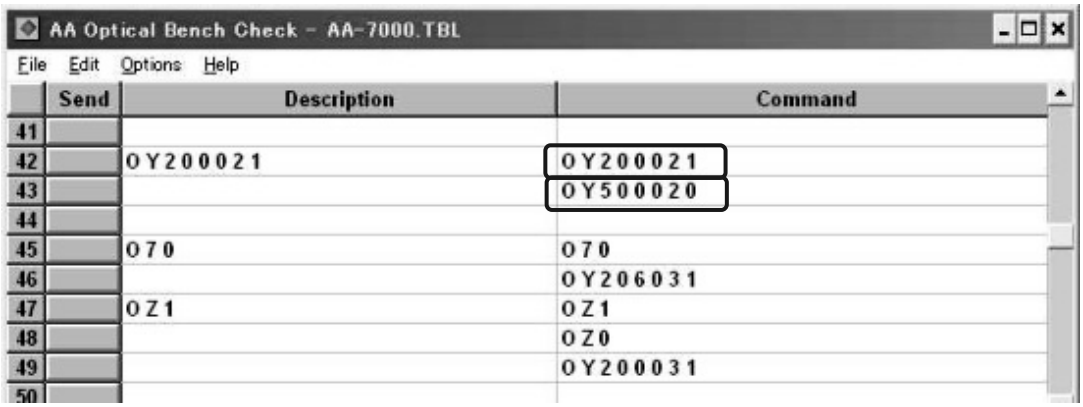
11) Perform this check separately when the optimum position of the entire lamp house assembly differs for each of the Hg and K lamps.
If the number of pulses for the turret is different, take the average of the two values.
Write the number of pulses to EEPROM by the "O_q_l_xxx_e" command, where "xxx" is the average of the two values.



12) Check the image of turrets #2 and #5 by the "O_m_l_i", "O_T_2" and "O_T_5" commands.
The turret should be at the optimum position after the "O_m_l_number of pulses" command is sent.

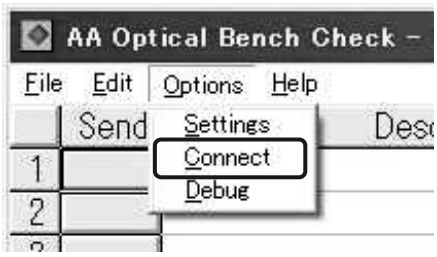


13) When adjustment is finished, send the "O_Y_2_0_0_0_2_1" and "O_Y_5_0_0_0_2_0" commands to turn the lamp OFF.



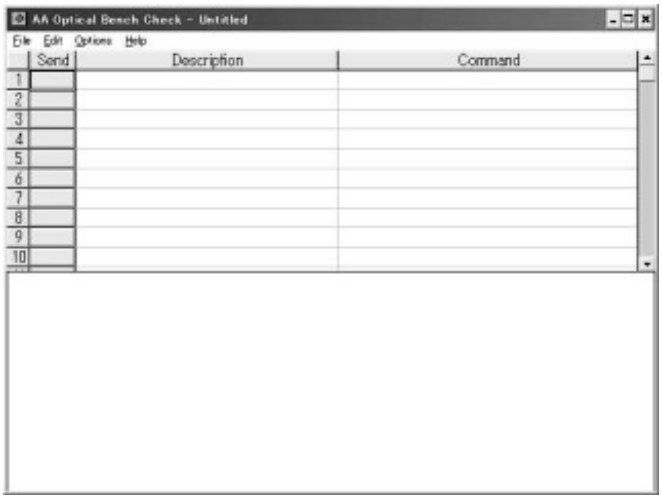
7.1.14 Adjusting the Position of the D2 Lamp

1) Disconnect communications by [Options] - [Connect] on the menu.

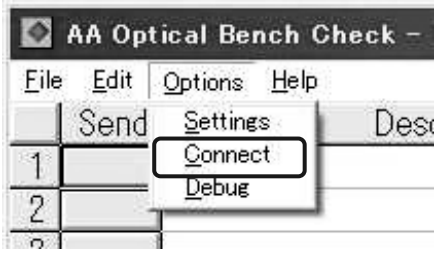


2) Turn the instrument OFF, remove the WI light source jig.

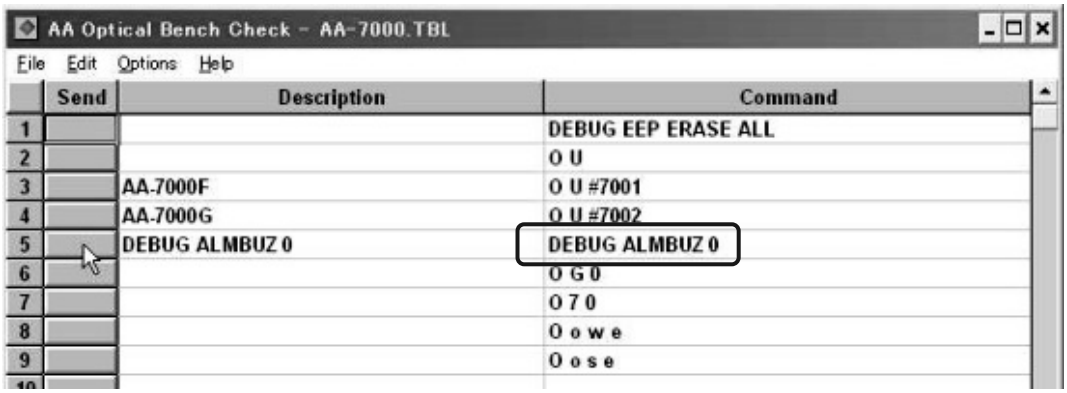
3) Turn the AA-7000 ON, and start up AAOBCHK.



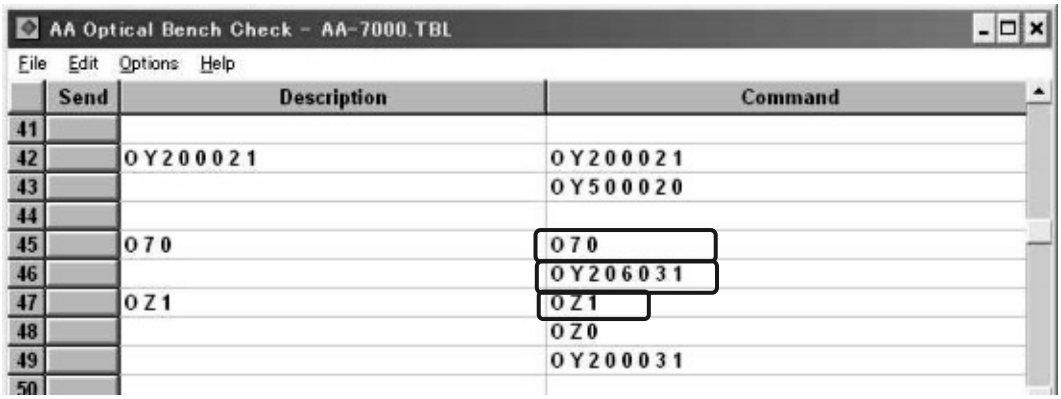
4) Connect communications by [Options] - [Connect] on the menu. (The buzzer sounds when communications begins.)



5) To stop the buzzer, send the "DEBUG_ALMBUZ_0" command.



6) Send the "O_7_0", "O_Y_2_0_6_0_3_1" and "O_Z_1" commands to turn the D2 lamp ON.
The D2 lamp can be turned ON only when the hollow cathode lamp is turned ON.

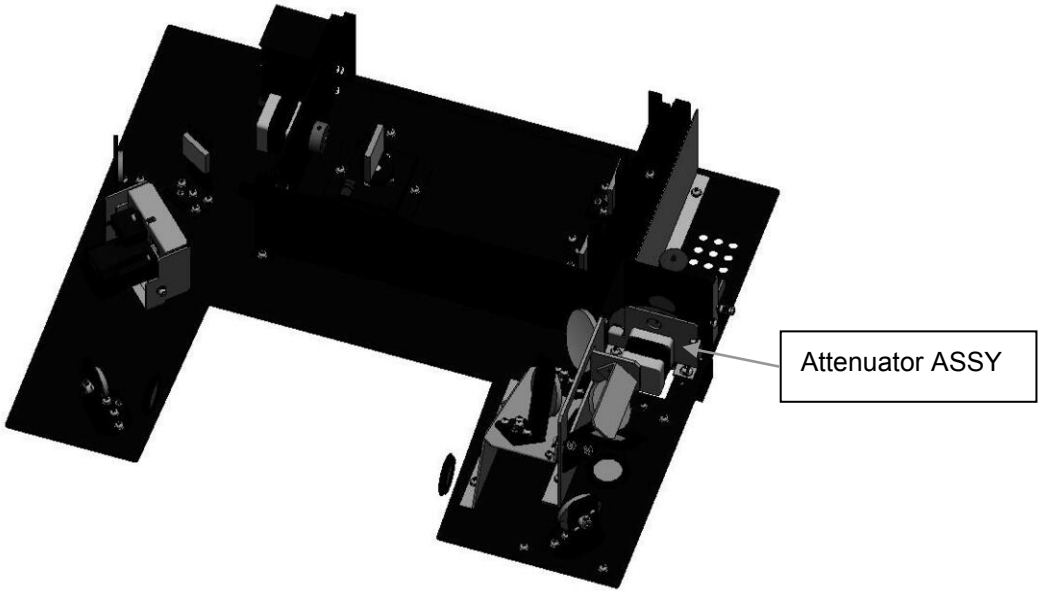


7) Adjust the D2 lamp adjusting plate so that the light flux of the sample light and reference light irradiated on the entrance slit are aligned on the slit and so that they are irradiated within ± 0.5 nm of the center of the slit.

8) Send the "O_Z_0" command to turn the D2 lamp OFF.

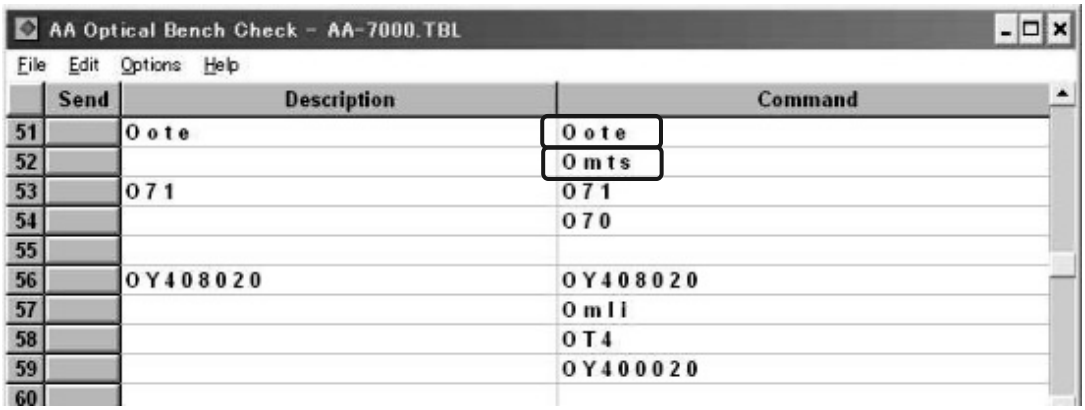
7.1.15 Installing the Attenuator

1) Exit AAOBCHK, turn the instrument OFF, install the attenuator assembly and its lower cover, and wire the cables.



2) Turn the instrument ON, and start up AAOBCHK.

3) Send the "O_o_t_e" and "O_m_t_s" commands to check attenuator movement.



◇ To find the initial position, bring the attenuator into contact with the stopper several times.

7.1.16 Correcting the Wavelength

1) Exit AAOBCHK, turn the instrument OFF, remove all jigs, and install the photomultiplier, window plate, lid, upper cover, and back cover.

2) The back cover can be temporarily fastened since it is removed to adjust the photomultiplier position.

3) Install the Hg lamp on lamp turret #1.

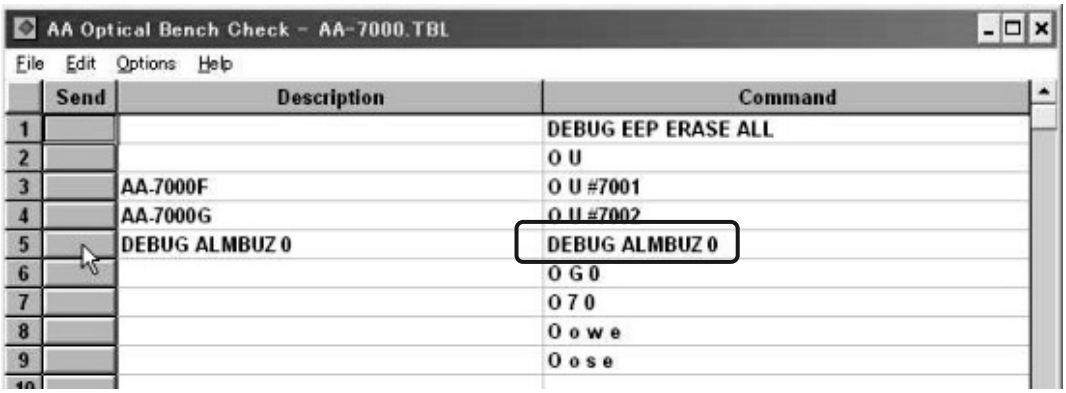
4) Turn the instrument ON, and connect in WizAArd.

5) When initialization is completed, execute [Instrument] - [Maintenance] - [Wavelength Adjustment] from the WizAArd menu.
   Wavelength calibration takes approx. 25 minutes to complete.

7.1.17 Adjusting the Photomultiplier Position

1) Remove the back cover.

2) The buzzer will sound because the radiator fan connector is disconnected from the back panel.
   To stop the buzzer, send the "DEBUG_ALMBUZ_0" command by AAOBCHK in WizAArd.

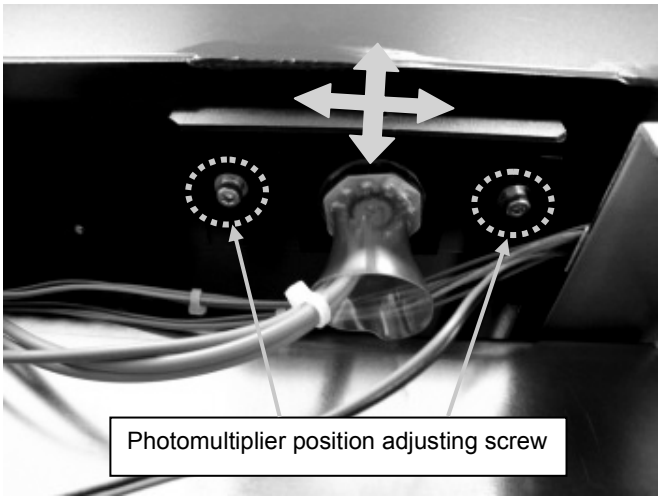


3) Exit AAOBCHK.

4) Install the Cu lamp on lamp turret #4.

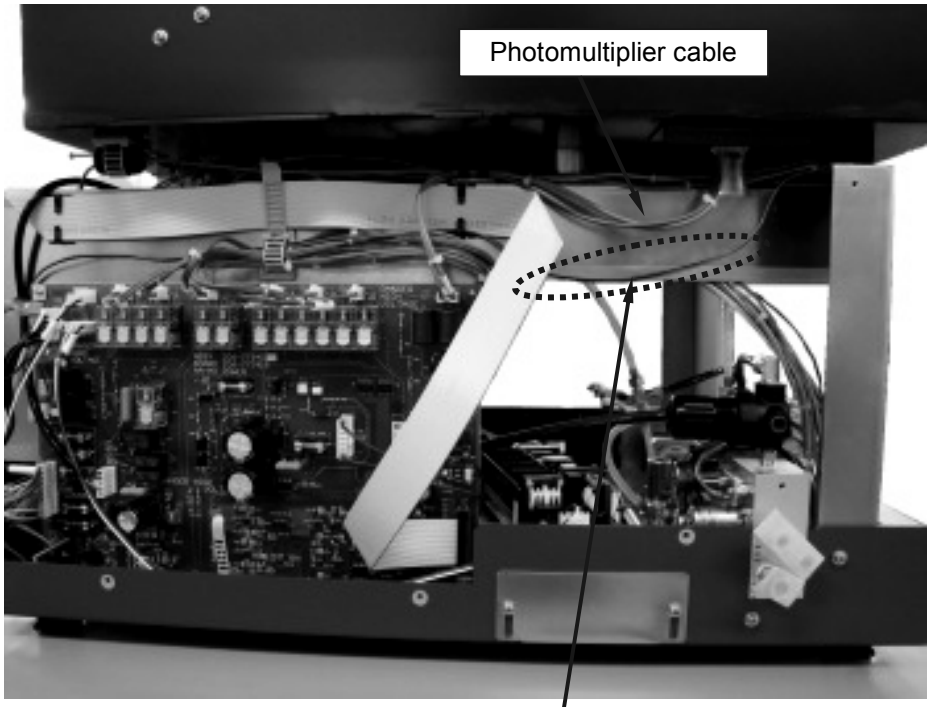
5) Set the flame measurement Cu lamp in WizAArd, and perform a line search in the EMISSION mode.

6) Loosen the two screws that fasten the photomultiplier in place, and adjust the depth direction and rotation point so that the energy value becomes the maximum value.
   If the energy value becomes "-1" during the adjustment, perform the line search again, and adjust the position of the photomultiplier.



7) After adjustment is finished, exit WizAArd, and turn the instrument OFF.

8) Sector Assy cable precautions



Do not bundle this cable in the sector Assy together with the photomultiplier cable.
Bundling them together might result in noise.

9) Install the back cover.

7.2 Adjusting the Gas Controller

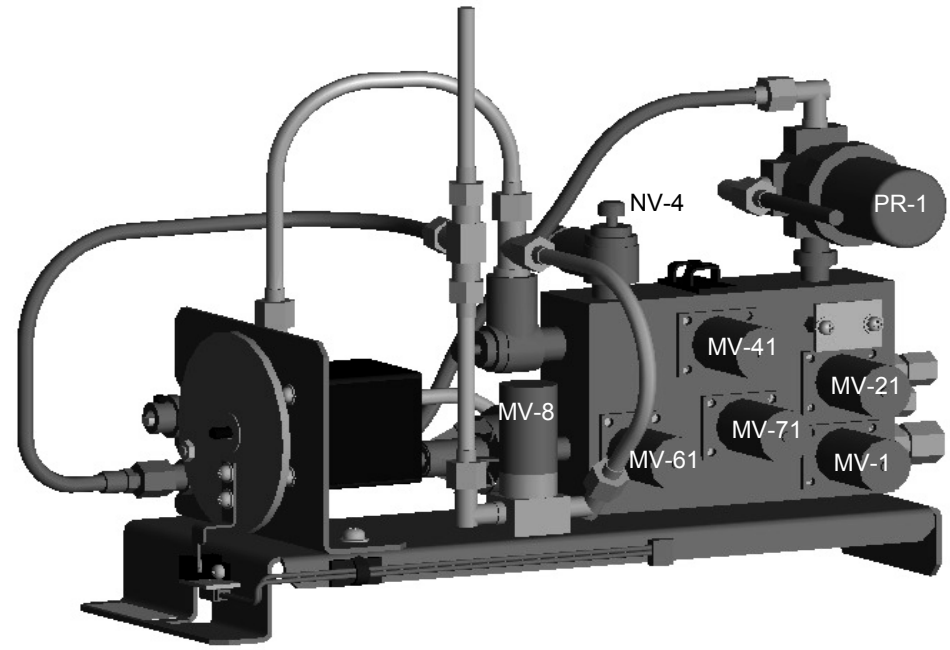
Pay sufficient attention to ventilation when passing C2H2 gas or N2O gas through the gas controller.

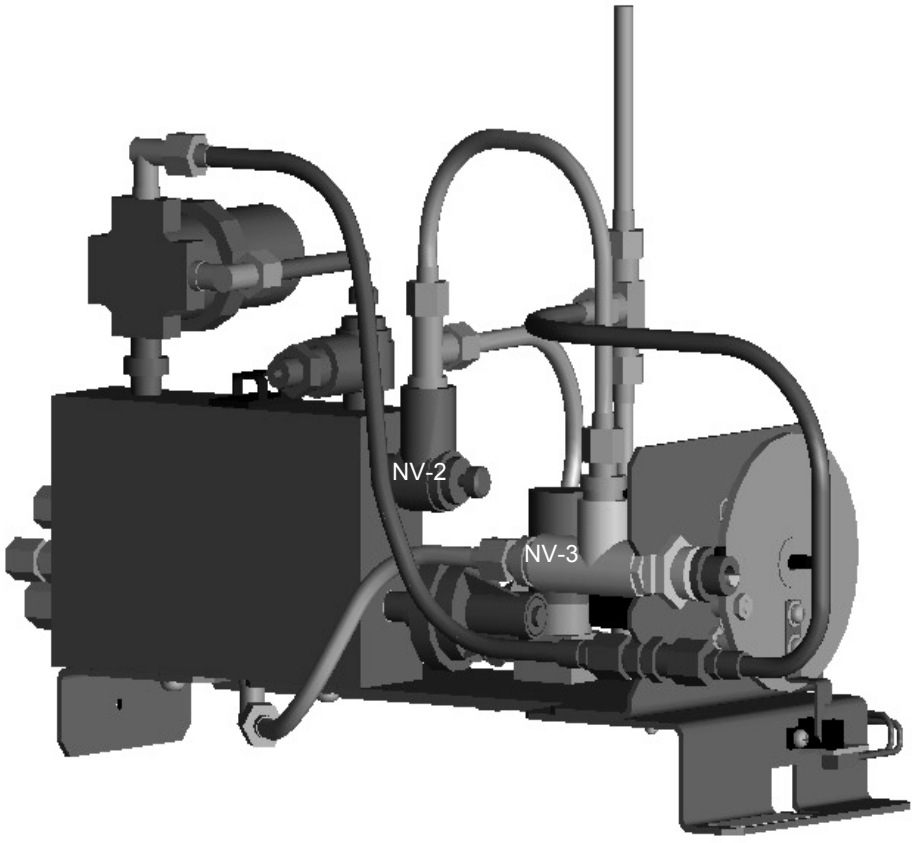
7.2.1 Tools Used

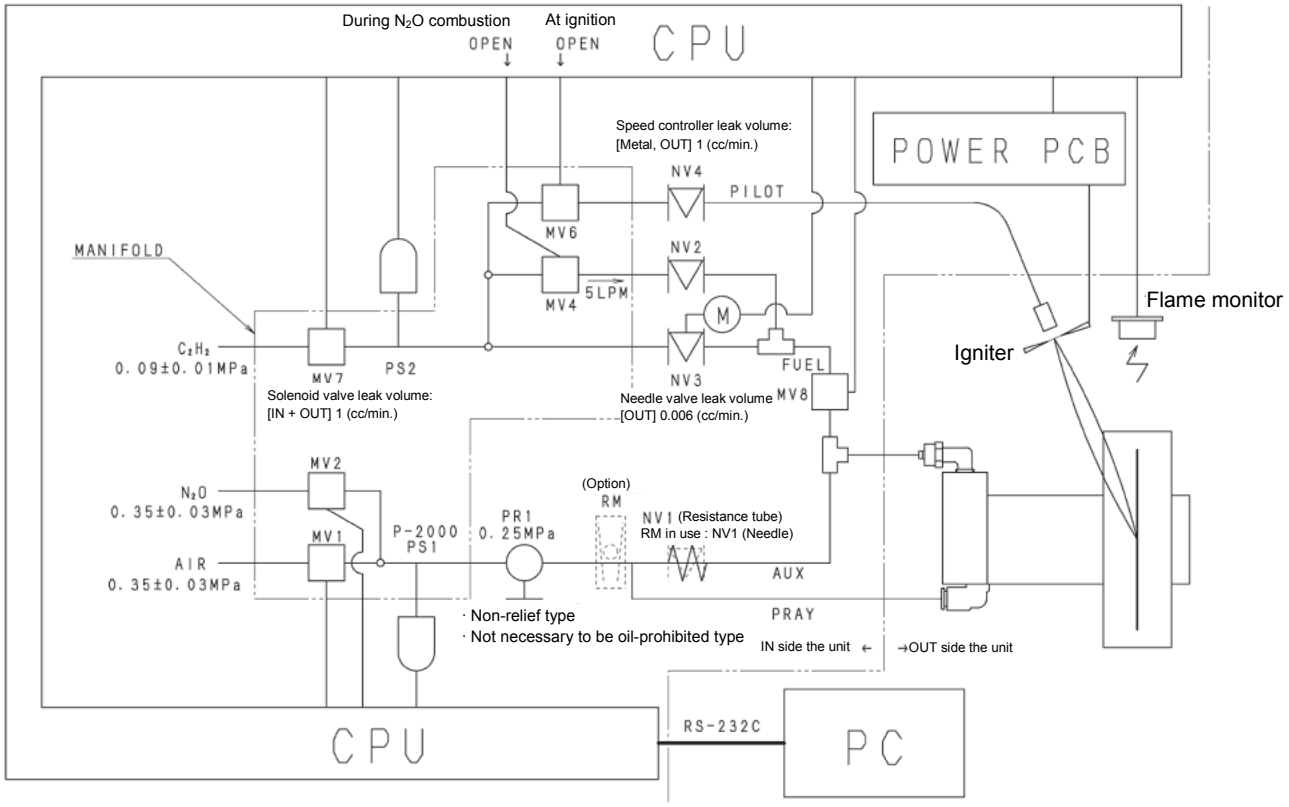
- Gas controller adjustment tool (P/N 206-77816-91)
- Air flowmeter (P/N 775-07708: flowmeter tool)
- AA OB Check (P/N 206-84384-91)
- High-temperature burner head (P/N 206-50300-93)
- Y-joint jig (P/N 035-60693-29)

The acetylene flowmeter jig is provided with a conversion table for calculating the actual flow rate.

Names of Parts and Pipes on the Gas Controller



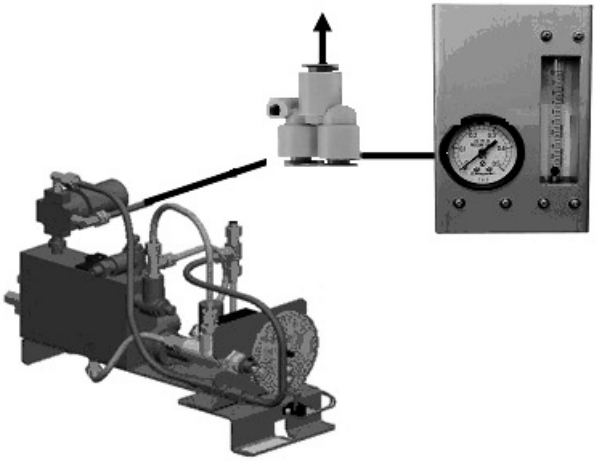




Solenoid valve

7.2.3 Adjusting AUX Regulator PR1

(1) Connect the pressure gauge and nebulizer to the SPRAY line using the Y-joint jig.



Connection of pressure gauge

(2) Supply air and N2O to the AA-7000. Adjust the supply pressure for both gases to 0.35 MPa when gas is flowing.

(3) Send the [O F X 0] command to set the gas controller to the manual control mode.
Send the [O 8 00000002] command to open the MV1 to release air.

(4) Pull the PR1 knob to unlock the knob, turn the knob, and adjust PR1 so that the reading on the pressure gauge is 0.25 MPa. After adjustment, push in the knob again to lock it in place.
During this step, make sure that the reading on the air flowmeter is 4.0 L/min.

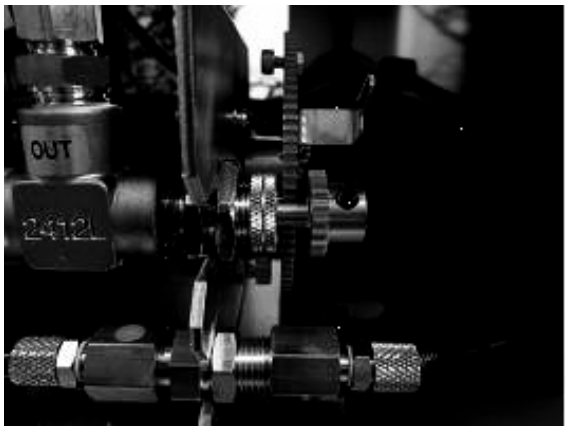
(5) Send the [O F X 1] command or turn the instrument OFF to return the gas controller to the automatic control mode.

(6) Return the pipes to their original state.

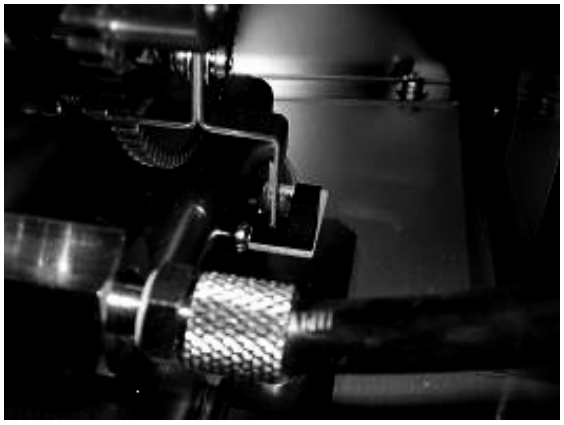
7.2.4 Adjusting FUEL Needle Valve NV3

Note: *Raw C2H2 gas is released during this procedure. Ensure that there is sufficient ventilation and that there are no flames in the environment.*

(1) Connect the C2H2 flowmeter to the FUEL line.
(2) After removing connector J55 on the CPU board, turn ON the AA-7000 power supply.
(3) Supply C2H2 to the AA-7000. Set the supply pressure to be 0.09 MPa when gas is flowing.
(4) Send the [O F X 0] command to set the gas controller to the manual control mode.
(5) Loosen the NV3 nut and ensure that the gears do not mesh.



(6) Turn the NV3's motor-side gear by hand so that the douser attached to the gear is aligned with the photo-interrupter.



(7) Turn the motor-side gear 90º from the position where the douser is in alignment with the photo-interrupter so that the douser is at the top (the needle valve mounting position).
(8) Send the [O 8 00000081] command to open the MV7 and MV8, and release the C2H2.
(9) Turn NV3 by hand so that the reading of the C2H2 flowmeter is 1.5 L/min (converted value). Engage the gears in this state. If the crests and troughs of the gear teeth are not in alignment, adjust by moving no more than the crest-to-crest distance.
(10) After mounting the gears, turn the motor-side gear by hand to the 0º, 90º, 180º, and 270º positions and check engagement in each position, before returning to the position described in step (7).
(11) Check that the reading of the C2H2 flowmeter is 1.5 L/min (converted value). If the flow rate is incorrect, return to step (1).
(12) Send the [O 8 00000000] command to close the MV7.
(13) Send the [O F X 1] command or turn OFF the AA-7000 power supply to return the gas controller to automatic control mode.
(14) Return the pipes and connectors to their original state.

7.2.5 Roughly Adjusting the Bypass Needle Valve NV2

Note: *Raw C2H2 gas is released during this procedure. Ensure that there is sufficient ventilation and that there are no flames in the environment.*

(1) Connect the C2H2 flowmeter to the FUEL line.

(2) After removing connector J55 on the CPU board, turn ON the AA-7000 power supply.

(3) Supply C2H2 to the AA-7000. Set the supply pressure to be 0.09 MPa when gas is flowing.

(4) Send the [O F X 0] command to set the gas controller to the manual control mode.

(5) Send the [O 8 00000081] command to open the MV7 and MV8, and release the C2H2.

(6) Turn the NV3's motor-side gear by hand so that the reading on the C2H2 flowmeter is 2.0 L/min (converted value).

(7) Send the [O 8 00000091] command to open the MV4, MV7 and MV8, and release the bypass.

(8) Adjust NV2 so that the reading on the C2H2 flowmeter is 7.0 L/min (converted value).

(9) Send the [O 8 00000081] command to close the MV4 and open MV7 and MV8, and check that the reading of the C2H2 flowmeter is 2.0 L/min (converted value).

(10) Send the [O 8 00000091] command to open the MV4, MV7 and MV8, and check that the reading of the C2H2 flowmeter is 7.0 L/min (converted value).

(11) If the flow rate is incorrect, return to step (4) and perform readjustment.

(12) If the flow rate is correct, send the [O 8 00000000] command to close the MV4, MV7 and MV8.

(13) Send the [O F X 1] command or turn OFF the AA-7000 power supply to return the gas controller to automatic control mode.

(14) Return the pipes and connectors to their original state.

7.2.6 Preparing Gas Flow Rate Adjustment

Perform the procedures described under "Adjusting PILOT Needle Valve NV4", "Adjusting C2H2 Flow Rate When Using Air-C2H2", "Adjusting C2H2 Flow Rate When Using N2O-C2H2", and "Adjusting Pressure Sensor" after carrying out the preparation described below.

(1) Connect the C2H2 flowmeter to the FUEL line.

(2) With all other parts in the usual state for ignition, turn ON the AA-7000 power supply.

(3) Supply air, C2H2, and N2O to the AA-7000. Set the supply pressure to take the following values when gas is flowing.
- Air: 0.35 MPa
- C2H2: 0.09 MPa
- N2O: 0.35 MPa

(4) Initialize the system with WizAArd. Check the safety mechanisms.

(5) Make the following parameter settings in the atomizer setting screen.
- Flame type: Air-C2H2
- Fuel-gas flow rate: 2.0 L/min
- Support-gas flow rate: 15.0 L/min

7.2.7 Adjusting PILOT Needle Valve NV4

(1) If there is a high-temperature burner head, replace the burner head with the high-temperature burner head.

(2) Ignite the air-C2H2 flame with the usual ignition operation. Keep the ignition button pressed so that the PILOT flame stays lit and adjust NV4 so that the length of the PILOT flame reaches the burner slot.

(3) Check the reliability of the ignition operation by igniting and extinguishing several times.

7.2.8 Adjustment of C2H2 Flow rate When Using Air-C2H2

(1) Send the [O fc 0] command from the WizAArd's OB Check to read the current C2H2 flow rate adjustment parameters. The response will be as follows:

O *a* *b*

Here, *a* and *b* are the coefficients in the linear equation Y = *a*X + *b* which describes a graph where the horizontal (X) axis represents 10 times the set flow rate and the vertical (Y) axis represents 10 times the measured flow rate. In other words, *a* represents the inclination and *b* represents the point where the graph cuts the Y-axis.

(2) Ignite the air-C2H2 flame.

(3) Send the [O f 15] command to set the C2H2 flow rate to 1.5 L/min and read the actual flow rate with the C2H2 flowmeter.

(4) Send the [O f 20] command to set the C2H2 flow rate to 2.0 L/min and read the actual flow rate with the C2H2 flowmeter.

(5) Send the [O f 38] command to set the C2H2 flow rate to 3.8 L/min and read the actual flow rate with the C2H2 flowmeter.

(6) Using these actual measurements of the C2H2 flow rate, convert the actual flow rate and change the values of *a* and *b* so that, based on the current C2H2 flow rate adjustment parameters, the difference between the set flow rate and the actual flow rate stays within 0.15 L/min. To do this, send the command [O fc 0 *a b* e]. Check that the parameters have been set by sending the [O fc 0] command.

(7) Repeat steps (3) to (6) until the differences between the set flow rates and the actual flow rates are all within 0.15 L/min.

(8) Send the [O f 20] command to return the C2H2 flow rate setting to 2.0 L/min.

(9) Extinguish the flame.

7.2.9 Adjustment of C2H2 Flow Rate When Using N2O-C2H2

This adjustment procedure is based on the assumption that the adjustment procedures described under "7.2.5 Roughly Adjusting the Bypass Needle Valve NV2" and "7.2.8 Adjusting C2H2 Flow Rate When Using Air-C2H2" were performed correctly.

(1) Mount the high-temperature burner head.

(2) Make the following parameter settings in the atomizer setting screen.
- Flame type: N2O-C2H2
- Fuel gas flow rate: 7.0 L/min
- Support gas flow rate: 11.0 L/min

(3) Move the burner selection key to the Air-C2H2 side, and ignite the Air-C2H2 flame.

(4) Move the burner selection key to the N2O-C2H2 side, and check that the flame switches to the N2O-C2H2 flame according to the prescribed sequence.

(5) Finely adjust the C2H2 flow rate to 7.0 L/min by turning NV2 while viewing the C2H2 flowmeter.

(6) Set the C2H2 flow rate to 6.7 L/min in the atomizer setting screen and check that the red area of the flame is at least 10 mm high. If the red area makes large vertical movements, there may be a fault in the nebulizer and so replace it.

7.2.10 Adjusting Pressure Sensor

(1) Ignite the air-C2H2 flame.

(2) Set the air supply pressure to 0.29 MPa.

(3) Send the [O 10 S e] command to set the current air supply pressure as the operating point.

(4) After returning the gas pressure settings to their original values (C2H2: 0.09 MPa; Air: 0.35 MPa), ignite the Air-C2H2 flame.

(5) Reduce the air supply pressure and check that the air supply pressure at which the flame is extinguished is 0.29 ± 0.02 MPa. After that, return the air gas pressure to its original setting of 0.35 MPa.

7.2.11 Easy On-Site Gas Flow Rate Adjustment Procedure

To adjust the C2H2 gas flow rate on site, set up the piping as follows:

- Disconnect the piping connected to the jacket, and connect the C2H2 flowmeter ahead of the jacket.
- Block ahead of the SPRAY line.
  (Otherwise, the gas flow rate cannot be measured correctly since gas will leak at a flow rate of approx. 0.1 L/min from the SPRAY line.)
  Send commands to release only C2H2 and measure the C2H2 flow rate.

The advantages of this method are as follows:

- The flow rate can be checked without opening covers.
- Adjustments can be performed without opening instrument covers merely for adjusting the needle.
  (With adjustment of the bypass needle valve, covers must be opened since the speed controller cannot be accessed from outside the instrument.)
- Pipes can be re-connected more easily than by regular methods on the AA-6300.

Adjustment Procedure (Be sure to turn ventilation facilities ON since C2H2 gas will be released.)

- Preparations

  Turn the instrument ON.
  - Send the [O m a i] command to initialize the needle valve.
  - Send the [O F X 0] command to set the gas controller to the manual mode.
  - Send the [O fc 0 1 0 e] command to initialize the adjustment coefficients.

- Needle adjustment
  1. Send the [O 8 00000081] command to open the MV7 and MV8.
  2. Send the [O f 15] command to set the C2H2 flow rate to 1.5 L/min.
     Take a reading of the flow rate (take readout value to be *A1*).
  3. Send the [O f 35] command to set the C2H2 flow rate to 3.5 L/min.
     Take a reading of the flow rate (take readout value to be *B1*).
  4. Send the [O 8 00000000] command to close the solenoid valve.
  5. Obtain the true flow rate from readout values *A1* and *B1* using the conversion table.
     (Take each of these true values to be *A2* and *B2*, respectively.)
     Using *A2* and *B2* calculates adjustment coefficients *a* and *b*. (horizontal axis: setting value $\times$ 10, vertical axis: readout value $\times$ 10)
  6. Send the [O fc 0 *a b* e] command to enter the adjustment coefficients.

- Checking the needle adjustment results
  1. Send the [O 8 00000081] command to open the MV7 and MV8.
  2. Send the [O f 15], [O f 20] and [O f 38] commands to set the C2H2 flow rate, and read their respective flow rates.
  3. Send the [O 8 00000000] command to close the solenoid valve.
  4. Obtain the true flow rates from the readout values using the conversion table. Make sure that the flow rates are within the setting value ± 0.15 L/min. (Repeat the procedure if the results are unsuccessful.)

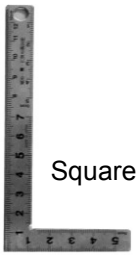
- Bypass adjustment
  1. Send the [O f 70] command to set the C2H2 flow rate to 7.0 L/min.
  2. Send the [O 8 00000091] command to open the MV4, MV7 and MV8. Adjust and lock the bypass speed controller so that the true flow rate becomes 7.0 L/min (readout value becomes 6.3 L/min).
  3. Send the [O 8 00000000] command to close the solenoid valve.

- At end of adjustment
  1. Send the [O F X 1] command to set the gas controller to the automatic mode.
  2. Turn the instrument OFF.

- Final check
  Initialize the instrument in WizAArd, and visually check the state of the flame (Air-C2H2, N2O-C2H2).

7.3 Adjusting the Atomizer Position

7.3.1 Jigs Used


Square

- WizAArd V5
- Hollow cathode lamp, HG (P/N 200-38422-28)
- 150-mm square

7.3.2 Adjusting the Drive Unit Position

(1) Make sure that the Hg hollow cathode lamp is mounted on turret #1.

(2) Make sure that the instrument and PC are connected by the RS-232C cable, and turn the instrument ON.

(3) Execute WizAArd, and select [Instrument] - [Connect] to establish communications between the instrument and the PC.

(4) Skip all safety instrument checks at initialization.

(5) Set the Hg conditions in selection of the element on WizAArd. When doing this, do not select the [MVU] checkbox.

(6) Make sure that there are no obstacles on the optical path in the burner compartment.

(7) Set the illumination mode to EMISSION, and execute [Line Search/Beam Balance].

[A] In case of flame (F) dedicated systems

(1) Set up the square near the center of the burner head, and adjust the forward/backward position adjusting knob and the up/down position adjusting knob so that the center of the light flux is 0 mm in front and behind the slot and at a height of 10 mm.

(2) Move the square to the left/right and center on the burner head so that all light flux is at a height of 10 mm. Loosen the five adjusting screws in the lower section of the following left figure to adjust the tilt of the burner head so that the height of the optical axis at the left and right edges of the burner is aligned with the height of the optical axis at the center of the burner. When loosening the lower left screw, temporarily move the burner upwards to adjust it to approx. 5 mm higher. When adjustment is finished, firmly tighten the screws.

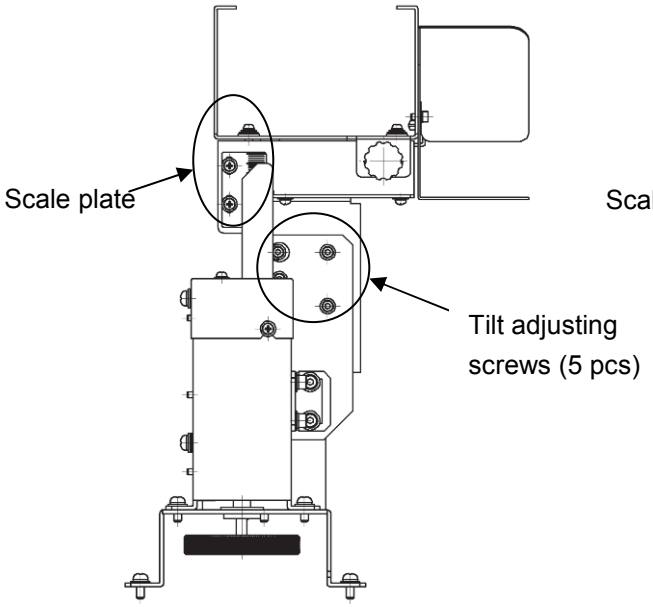
(3) Make sure that the light flux is at a height of 10 mm, and adjust the installation position so that the scale plate in the upper section of the following left figure indicates "10".

[B] In case of furnace (G) dedicated systems

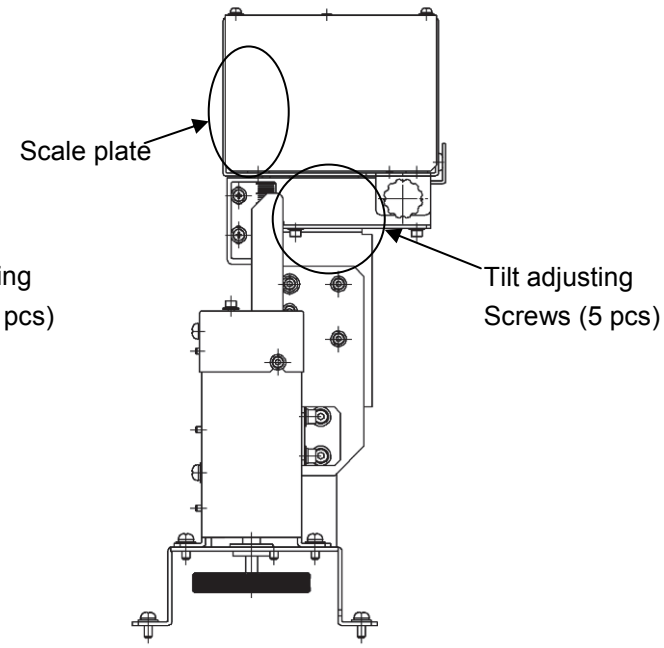
(1) Set up the square near the embossed section of the furnace holder, and adjust the forward/backward position adjusting knob and the up/down position adjusting knob so that the center of the light flux is roughly 0 mm in front and behind the center position of the graphite furnace, and at a height of 53 mm.

(2) Move the square to the left/right and center on the furnace holder so that all light flux is at a height of 53 mm. Loosen the five adjusting screws in the lower section of the following right figure to adjust the tilt of the furnace holder so that the height of the optical axis at the left and right edges of the furnace holder is aligned with the height of the optical axis at the center of the furnace holder. When loosening the lower left screw, temporarily move the furnace holder upwards to adjust it to approx. 5 mm higher. When adjustment is finished, firmly tighten the screws.

(3) Make sure that the light flux is at a height of 53 mm, and adjust the installation position so that the scale plate in the upper section of the following right figure indicates "0".



[A] Flame (F) dedicated system



[B] Furnace (G) dedicated system

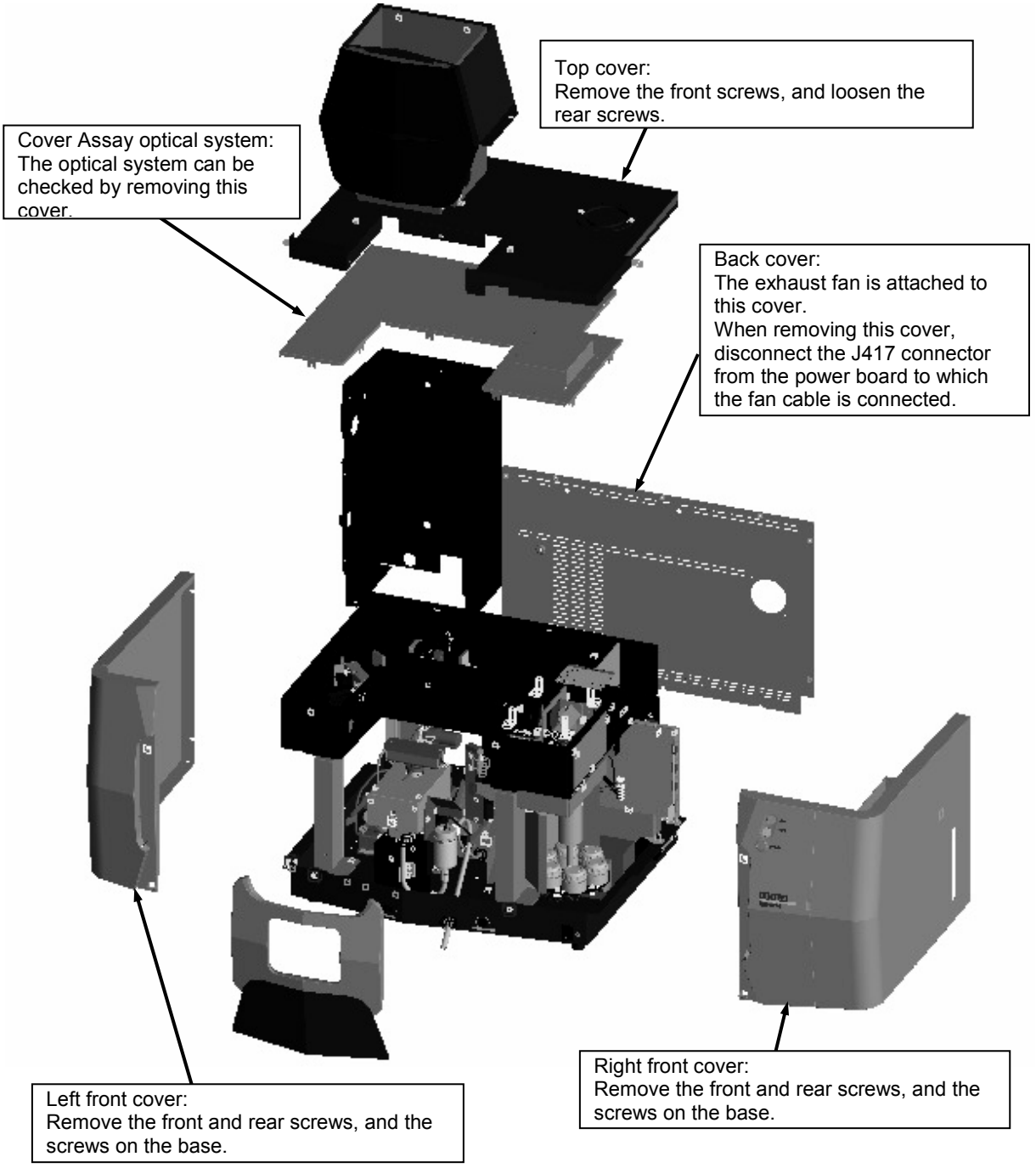
8. Procedures for Replacing Service Parts

8.1 Mounting Positions of Parts

For details on the mounting positions of parts, see the exploded view in "9 Parts List."

8.2 Attaching and Removing Covers

For details on how to attach and remove the covers, see AA-7000F exploded view in "9 Parts List."



(1) Top cover

Remove this cover, for example, to access the optical system. To remove this cover, the left and right covers must be removed.

(2) Back cover

Removing this cover allows access to the POWER board.

Note that the fan cable is connected to the POWER board.

(3) Right-side front cover
Removing this cover allows access to the HCL turret and the transformer.

(4) Right-side back cover
Removing this cover allows access to the CPU board.

(5) Right-front cover
Note that it is connected to switch cables. Removing this cover allows access to the igniter/flame monitor.

(6) Left-front cover and left-side cover
Removing these covers allows access to the gas controller.

8.3 Replacing the CPU Board

Remove the right-side back cover referring to "9 Parts List" AA-7000F1/2. Referring to "9 Parts List" MAIN UNIT F INNER exploded view, disconnect the wiring, replace the CPU board and re-connect the wiring. The connector numbers on the CPU board are difficult to identify visually, so see the Fig. 8.1.

- The initial mechanical position (adjustment position information) unique to the system is written to the EEPROM on the CPU board. The AA-7000 EEPROM cannot be swapped when the board is replaced since the CPU has a built-in EEPROM. See "8.10 Transferring Parameters at Replacement of CPU Board."
- Finally, screw-fasten the CPU board to the right-side cover. During replacement, the board installation position or guard position sometimes must be adjusted.
- After replacing the CPU board, be sure to check the firmware version. If necessary, update the firmware.

The figures below show the connector Nos. and test points on the CPU board.

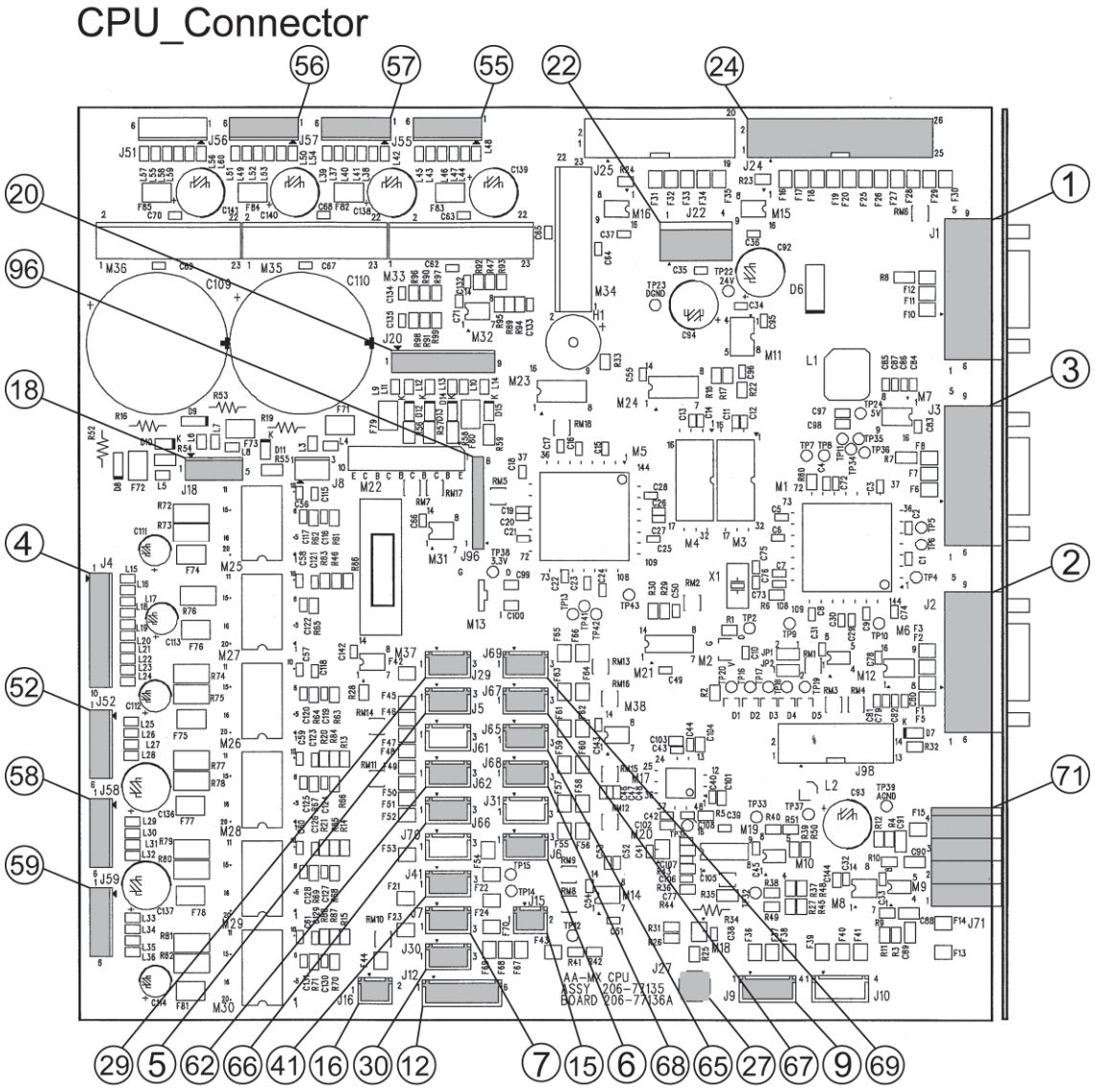


Fig. 8.1 Connector Nos. on the CPU Board

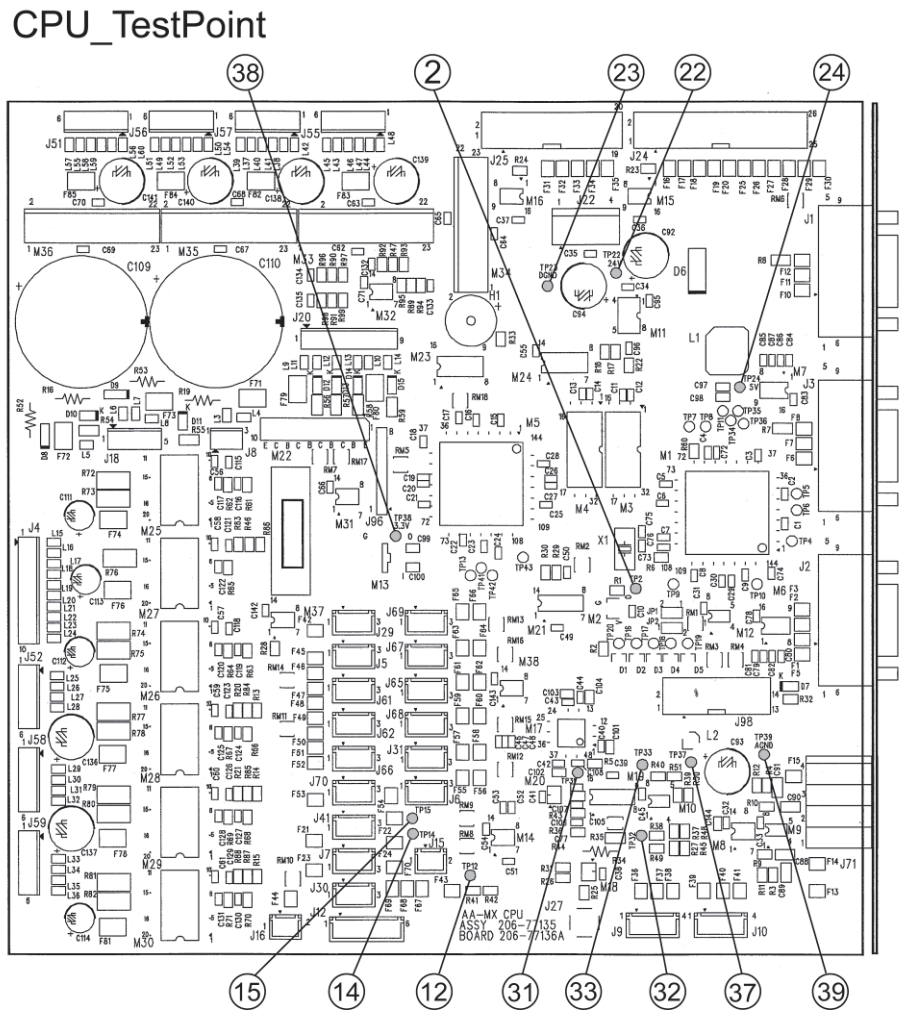


Fig. 8.2 Test Points on CPU Board

8.4 Replacing the POWER Board

Remove the back cover referring to "9 Parts List" AA-7000F1/2. Remove the wiring in "9 Parts List" MAIN UNIT 1/2, and replace the POWER board. Check the transformer's output voltage before connecting the wiring. (Be careful of electric shock.)

Transformer Secondary Output	
Pin No.	Voltage (V)
1-2 (SEC1)	14.5 V to 19.6 V
2-3 (SEC1)	14.5 V to 19.6 V
4-5 (SEC1)	103.5 V to 126.5 V
6-7 (SEC1)	1.3 V to 1.7 V
6-8 (SEC1)	2.9 V to 3.9 V
9-10 (SEC1)	90 V to 110 V
1-7 (SEC2)	391 V to 529 V
24 V output (SEC2)	22.8 V to 25.2 V

The figure below shows the connector Nos. on the POWER board.

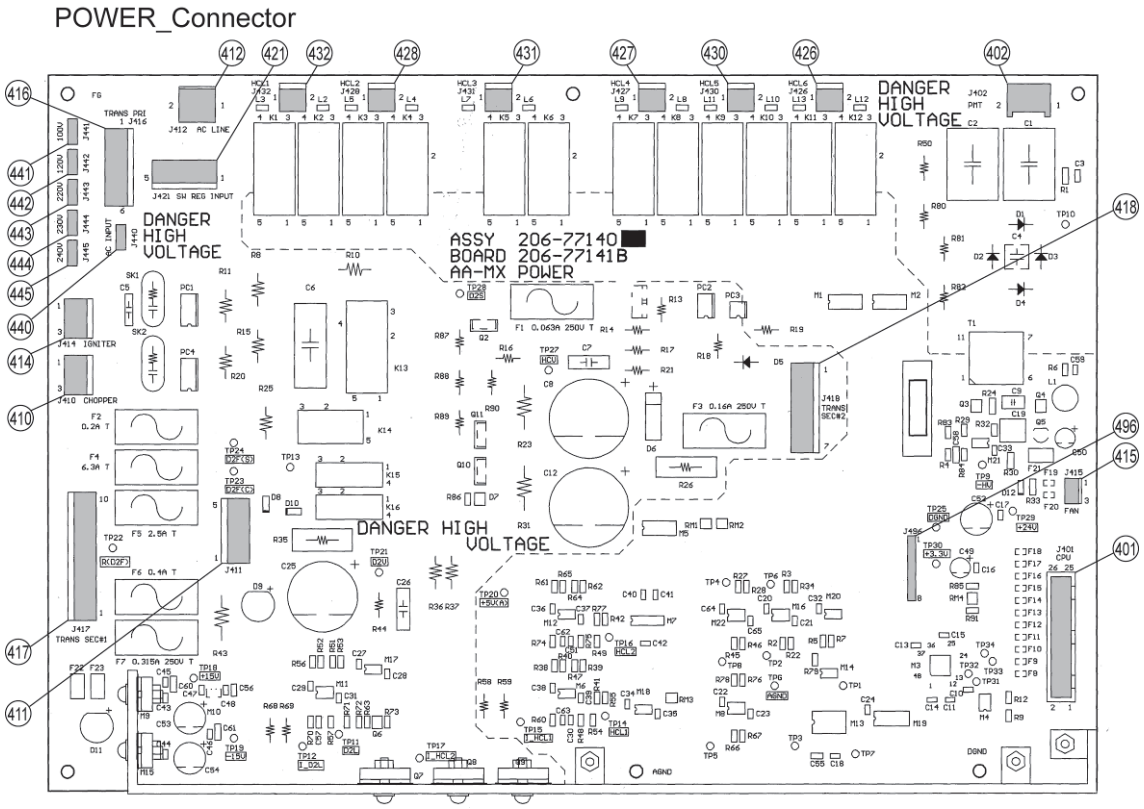


Fig. 8.3 Connector Nos. on the POWER Board

Check the POWER board's output voltage before re-connecting the wiring. (Be careful of electric shock.)
Measure with all connectors connected.

Test Point	Voltage (V)	Test Point	Voltage (V)
TP18-TPG	14.2 V to 15.8 V	TP24-TP22	2.9 V to 3.9 V (AC)
TP19-TPG	-15.8 V to -14.2 V	TP27-TPG	538 V to 729 V
TP20-TPG	4.6 V to 5.4 V	TP28-TPG	497 V to 577 V
TP21-TPG	134 V to 181 V	TP29-TPG	21.6 V to 26.4 V
TP23-TP22	1.3 V to 1.7 V (AC)	TP26-TPG	3.2 V to 3.4 V

POWER_TestPoint

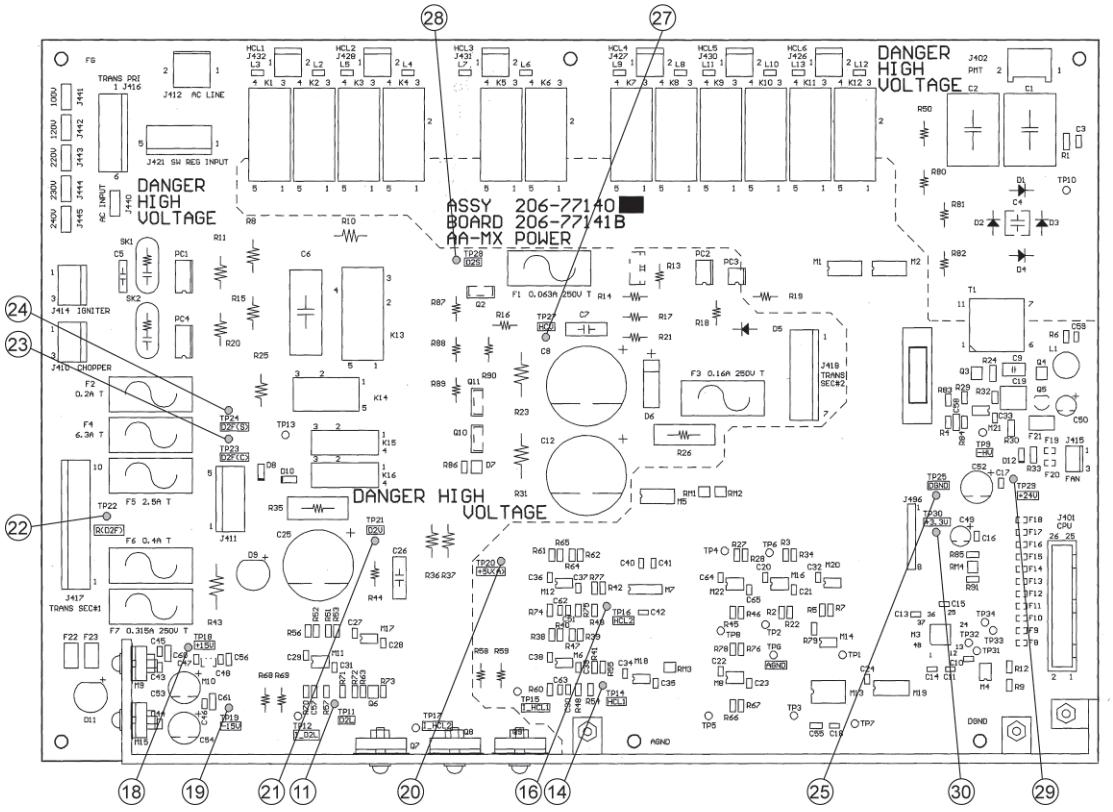


Fig. 8.4 Test Points on POWER Board

8.5 Replacing the HCL Turret

After replacement, adjust the position of the HCL turret and the M9 mirror.

8.6 Replacing the Gas Controller

After replacement, adjust the gas flow rate, check for gas leaks, and inspect the safety mechanisms.

8.7 Replacing the Atomizer Drive Unit

After replacement, adjust the atomizer's forward/backward and vertical positions.

8.8 Updating the Version -- AA-7000 ROM Update Tool

The AA-7000 ROM Update Tool (simply called "AARUT" from here on) is used for updating the AA-7000 ROM. This tool uses the user program mode of the CPU to update the Flash-ROM program (i.e. firmware) contained in the CPU mounted on the AA-7000 instrument main unit.

Operating environment

PC: General 32-bit Windows OS (Operation of this tool has already been confirmed on the Windows 2000 and Windows XP OSs.)

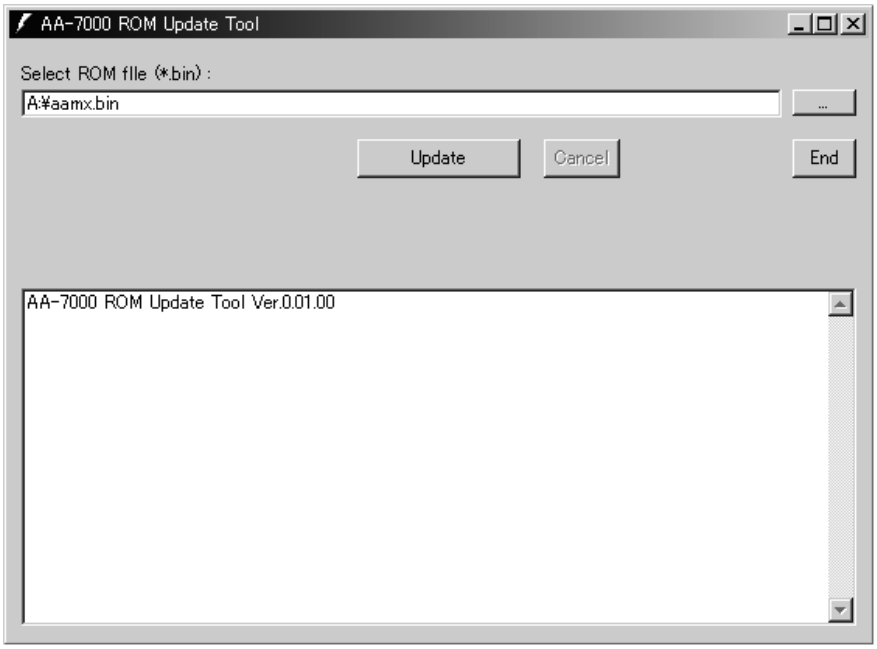
Compatible models: AA-7000, AA-7000F, AA-7000G

Firmware update procedure

(1) Connect the PC to the AA-7000 using the RS-232C serial cable.

(2) Turn the AA-7000 ON, and start up the PC.

(3) Start up the AA-7000 ROM Update Tool.



(4) The above window is displayed. Enter the directory path and file name (generally "aamx.bin") of the firmware (binary format) to be updated in the [Select ROM file (*.bin):] text box. (The default is "A:¥aamx.bin".) The directory path and file name can also be entered using browsing by the [...] button.
(5) Click the [Update] button to start the update. (After the update is started, the update can also be canceled midway by clicking the [Cancel] button.)
(6) The update progress is successively displayed in the message box.
(7) When the update is completed, a completion message (e.g. "SUCCEEDED") is displayed. After checking completion of the update, click the [End] button to exit the AARUT application.
(8) After completion of the update, turn the instrument OFF then back ON again to reset to the CPU.
(This starts up the instrument using the updated firmware.)

Send the following "O" command to check that the instrument type and version are correct:

- Command: O U
- Response (example): AA-7000 1 0 1 02

8.9 Reading (Saving) Adjustment Parameters When Replacing the CPU Board

The AA-7000's adjustment parameters are stored in EEPROM on the CPU board in the same way as on the AA-6300.

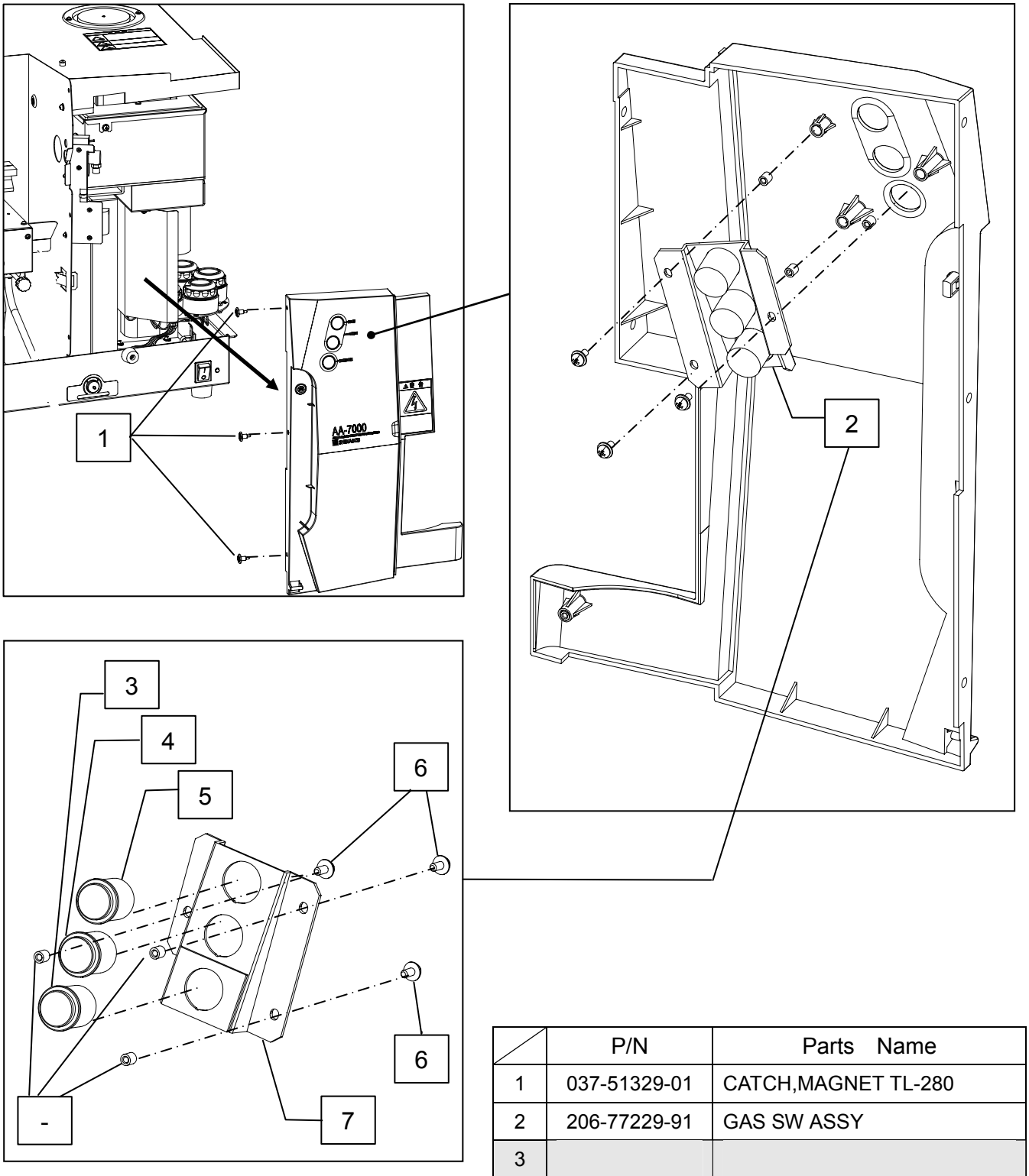
In the case of the AA-7000, the IC cannot be swapped because the parameters stored to EEPROM on the CPU board are used. All parameters in EEPROM must be read from EEPROM and written back to the new CPU when the CPU board is replaced.

For details on the parameter read procedure, see "2.4 Reading (Saving) and Writing Adjustment Parameters" in this manual.

The following table shows a list of CPU board adjustment parameter read and write commands.

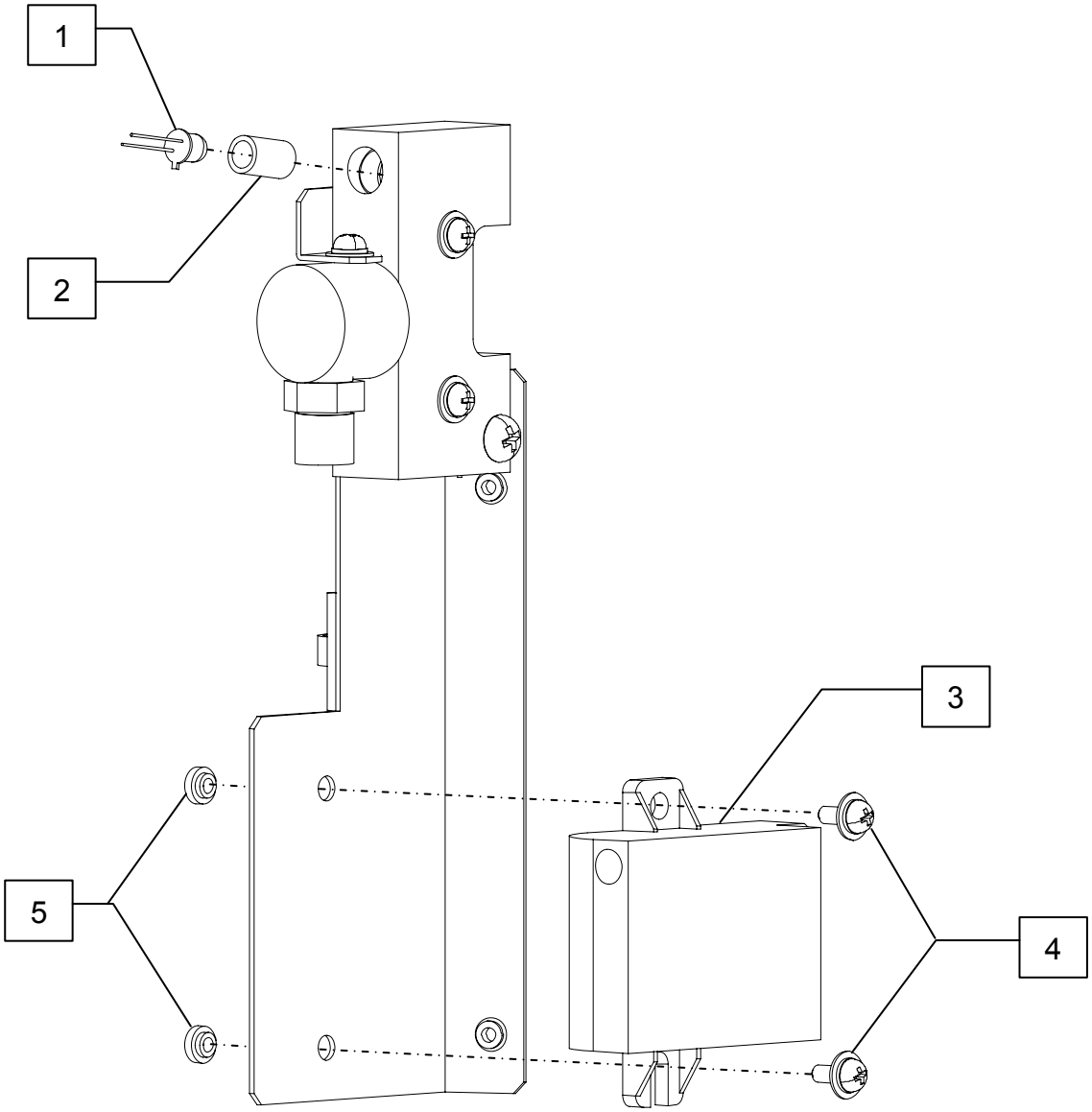
Item	Read Command	Write Command
Common		
Instrument name	O U	O U #
Serial No.	–	O p
Wavelength motor, excitation pattern	–	O o w e
Lamp turret motor, excitation pattern	–	O o l e
Slit motor, excitation pattern	–	O o s e
Attenuator motor, excitation pattern	–	O o t e
Lamp turret motor, offset values	O q l Response: ***n***	O q l ***n*** e
Slit motor, offset values	O q s Response: ***n***	O q s ***n*** e
Wavelength motor, offset values	O q w Response: ***n***	O q w ***n*** e
Wavelength calibration information	None	Wavelength calibration by Hg, HCL
Flame model only		
C2H2 needle monitor, excitation pattern	–	O o a e
C2H2 flow rate adjustment information	O fc 0 Response: ***a b***	O fc 0 ***a b*** e
Support gas pressure sensor threshold value	O 10 Response: 0000 ***n*** 0000 0228	O 10 S e -s=***n***
Other	O BFC Response: ***a b***	O BFC T ***a*** O BFC **I** ***b***
When AAC is installed		
Atomizer up/down monitor, excitation pattern	–	O o j e
Atomizer backward/forward monitor, excitation pattern	–	O o z e
Burner origin	–	Burner origin position setting
Furnace origin	–	Furnace origin position setting

P/N 206-77229-91 GAS SW ASSY



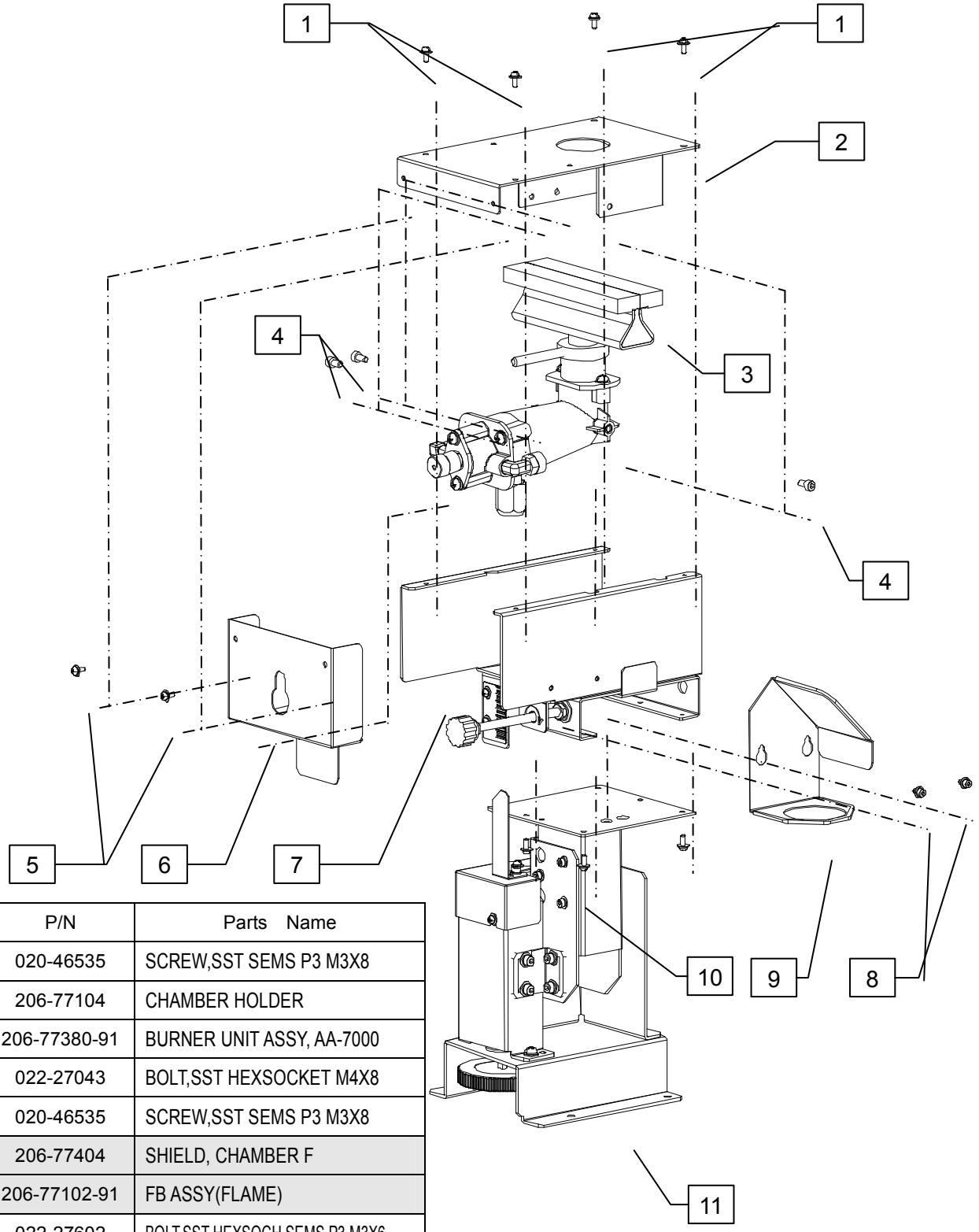
	P/N	Parts Name
1	037-51329-01	CATCH,MAGNET TL-280
2	206-77229-91	GAS SW ASSY
3	206-77228-94	GAS SW ASSY
4		
5		
6	020-46548	SCREW,SST SEMS P3 M4X10
7	20677171	HOLDER, SWITCH

P/N 206-77371-91 IGNITER ASSY



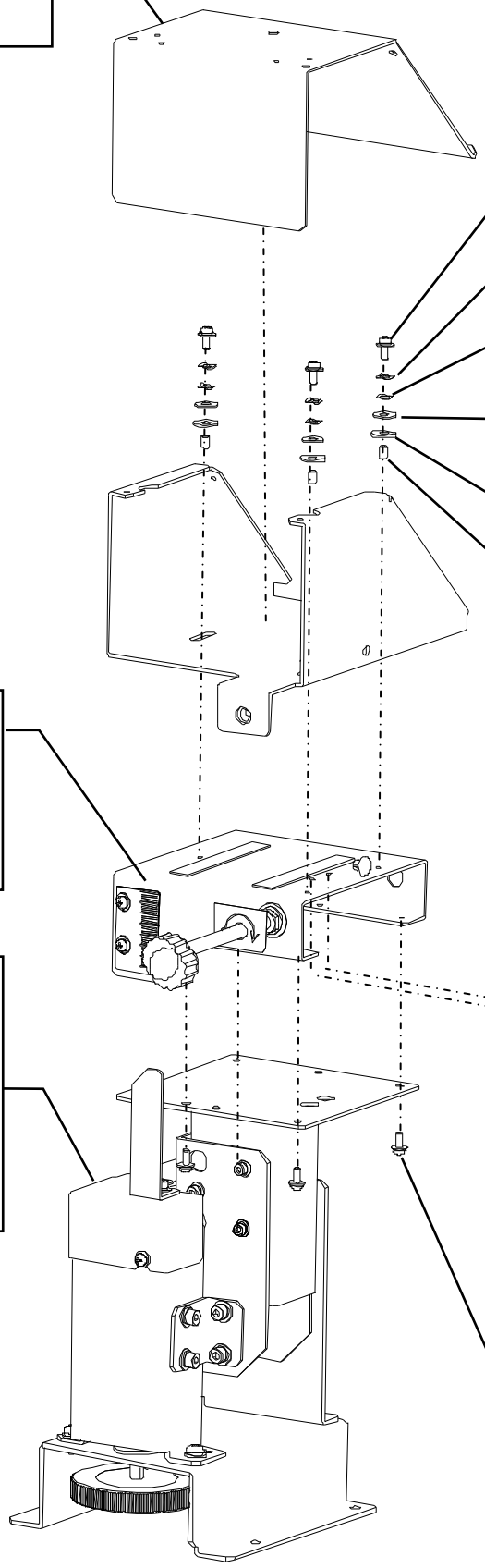
No	P/N	Parts Name	
1	061-70023-03	PHOTO TRANSISTOR,TPS601A-C	ASSY_FLAM
2	016-02401-02	FLUORO RUBBER TUBE,104-0040	E_SENSOR
3	078-91102-02	IGNITOR,SIG-500	
4	020-46535	SCREW,SST SEMS P3 M3X8	
5	023-22105-08	NUT,S-M3-1ZI	

P/N 206-77414-91 ATOMIZER ASSY, F



	P/N	Parts Name
1	020-46535	SCREW,SST SEMS P3 M3X8
2	206-77104	CHAMBER HOLDER
3	206-77380-91	BURNER UNIT ASSY, AA-7000
4	022-27043	BOLT,SST HEXSOCKET M4X8
5	020-46535	SCREW,SST SEMS P3 M3X8
6	206-77404	SHIELD, CHAMBER F
7	206-77102-91	FB ASSY(FLAME)
8	022-27602	BOLT,SST HEXSOCH SEMS P3 M3X6
9	206-77110	DRAIN BOTTLE HOLDER
10	020-46535	SCREW,SST SEMS P3 M3X8
11	206-77103	UD ASSY
12	206-77121	FITTING PLATE

P/N 206-77160-91 MANUAL ADJUST ASSY G



P/N 206-77162.1
FURNECE HOLDER

P/N 020-46535
SCREW,SST SEMS P3 M3X8

P/N 023-92054-01
WASHER,SST WAVE #4

P/N 023-92054-01
WASHER,SST WAVE #4

P/N 023-66140
WASHER,SST PLAIN M4

P/N 023-65102-03
WASHER,TT-0411-15

P/N 037-38714-12
SPACER,SPC 3X3 3C

P/N 206-77161-91
FB ASSY(GFA)

P/N 206-77483
BOND,FB,BASE

P/N 206-77107
GIDE

P/N 206-77103-91
UD_ASSY

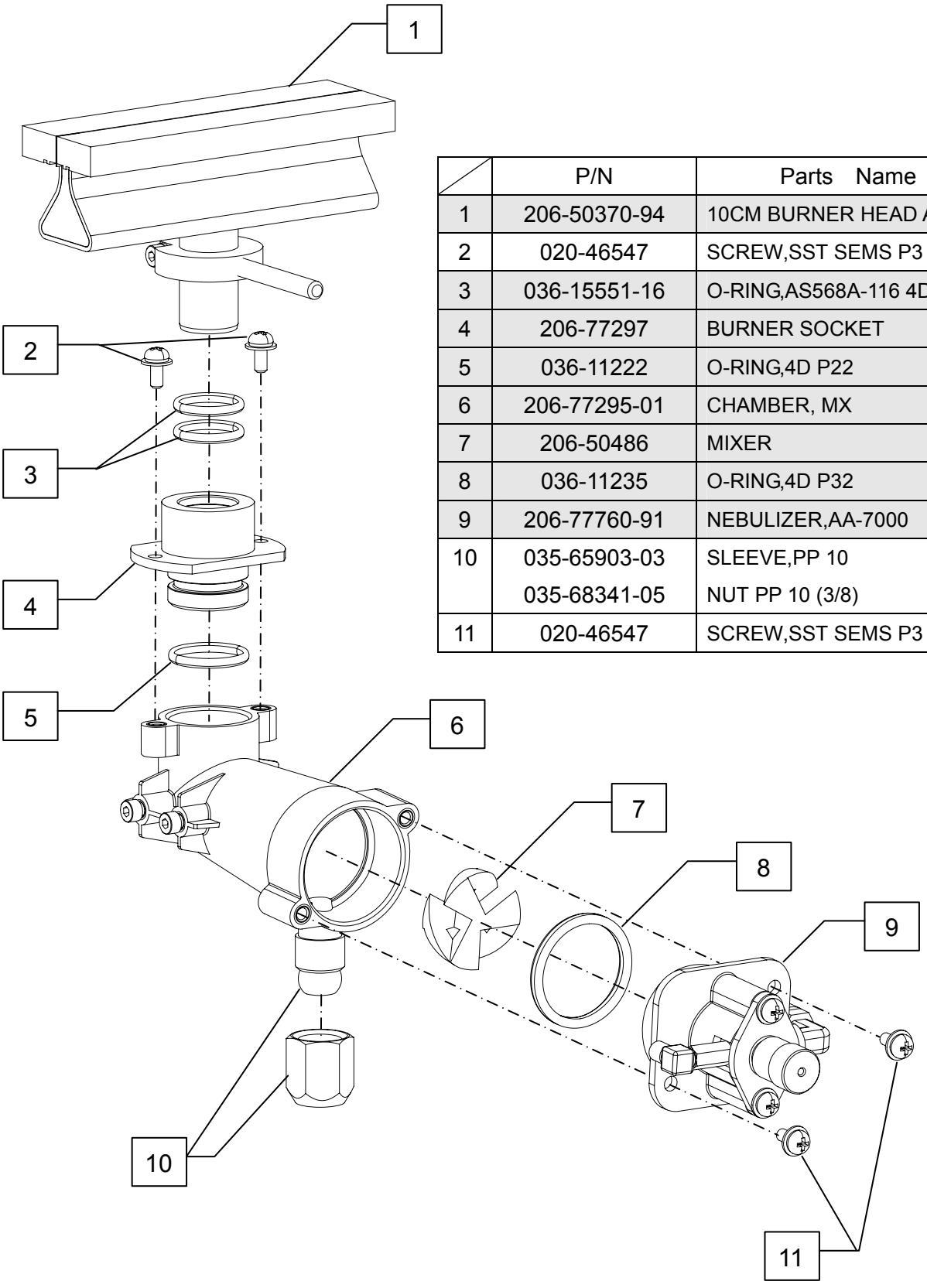
P/N 206-77108
PILLAR 1

P/N 206-77114
PILLAR 2

P/N 022-27602.
BOLT,SST HEXSOCH SEMS P3

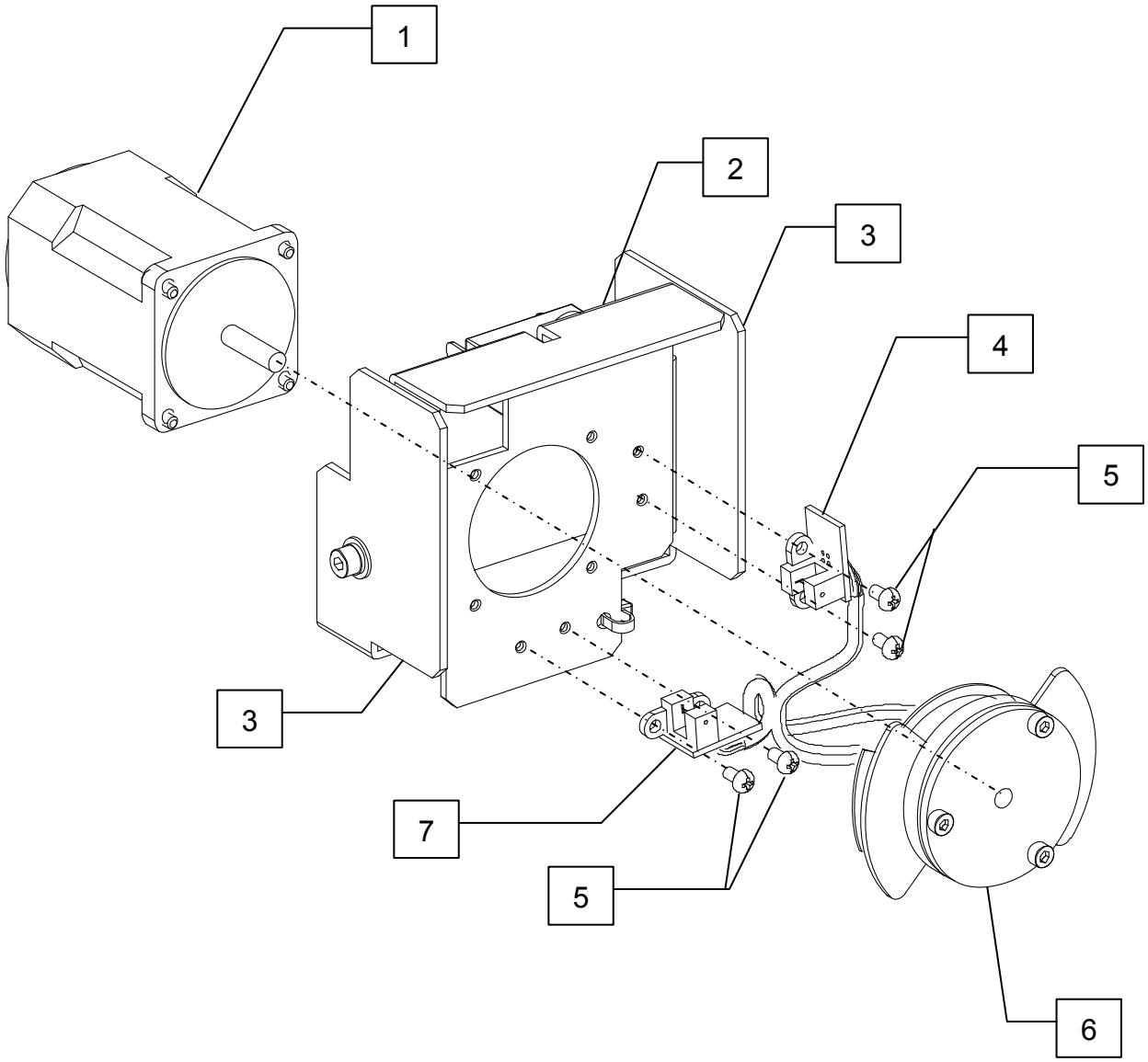
P/N 020-46535
SCREW,SST SEMS P3 M3X8

P/N 206-77380-91 BURNER UNIT ASSY, AA-7000



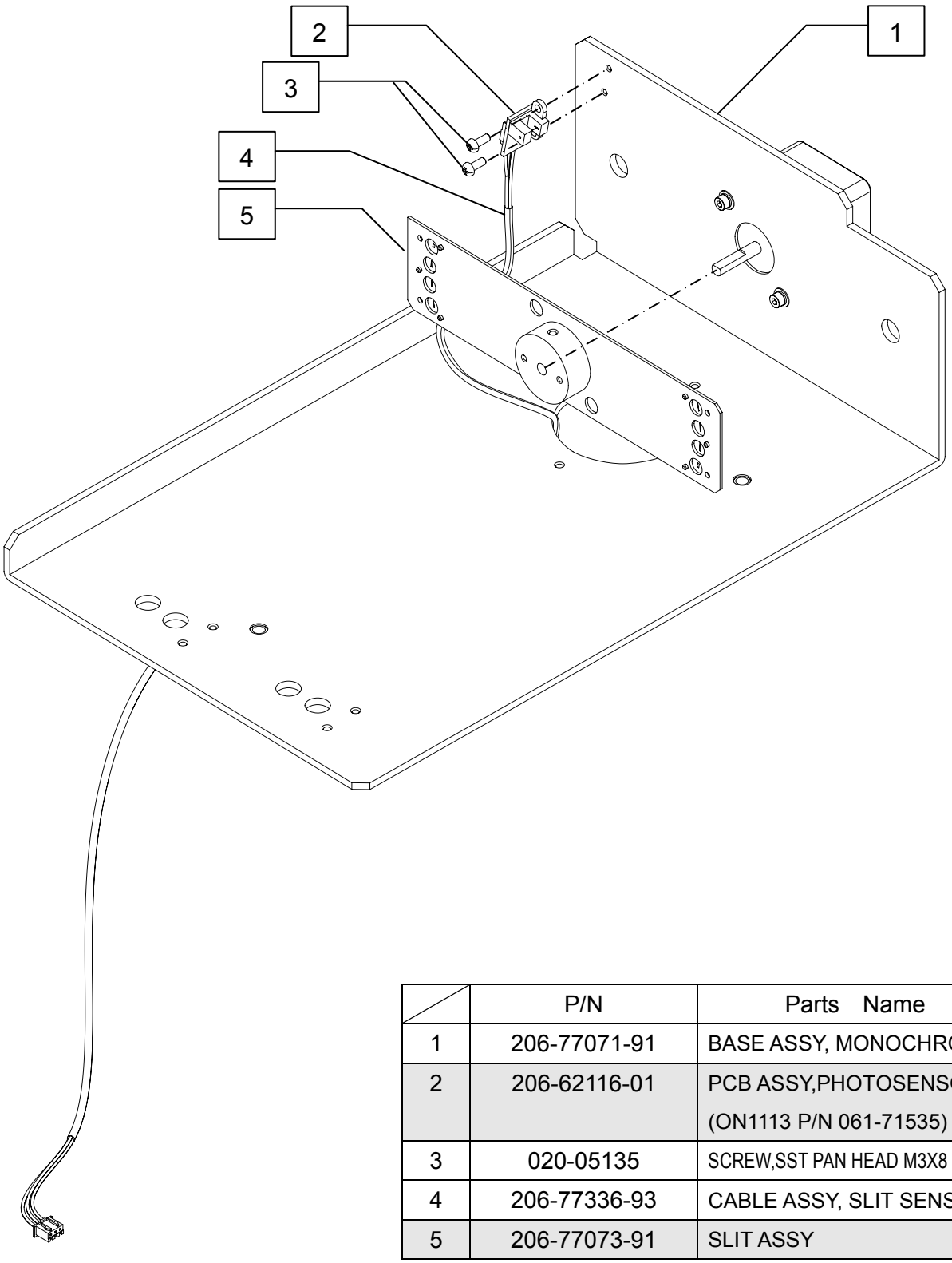
	P/N	Parts Name
1	206-50370-94	10CM BURNER HEAD ASSY
2	020-46547	SCREW,SST SEMS P3 M4X8
3	036-15551-16	O-RING,AS568A-116 4D
4	206-77297	BURNER SOCKET
5	036-11222	O-RING,4D P22
6	206-77295-01	CHAMBER, MX
7	206-50486	MIXER
8	036-11235	O-RING,4D P32
9	206-77760-91	NEBULIZER,AA-7000
10	035-65903-03	SLEEVE,PP 10
	035-68341-05	NUT PP 10 (3/8)
11	020-46547	SCREW,SST SEMS P3 M4X8

P/N 206-77057-91 SECTOR MIRROR ASSY



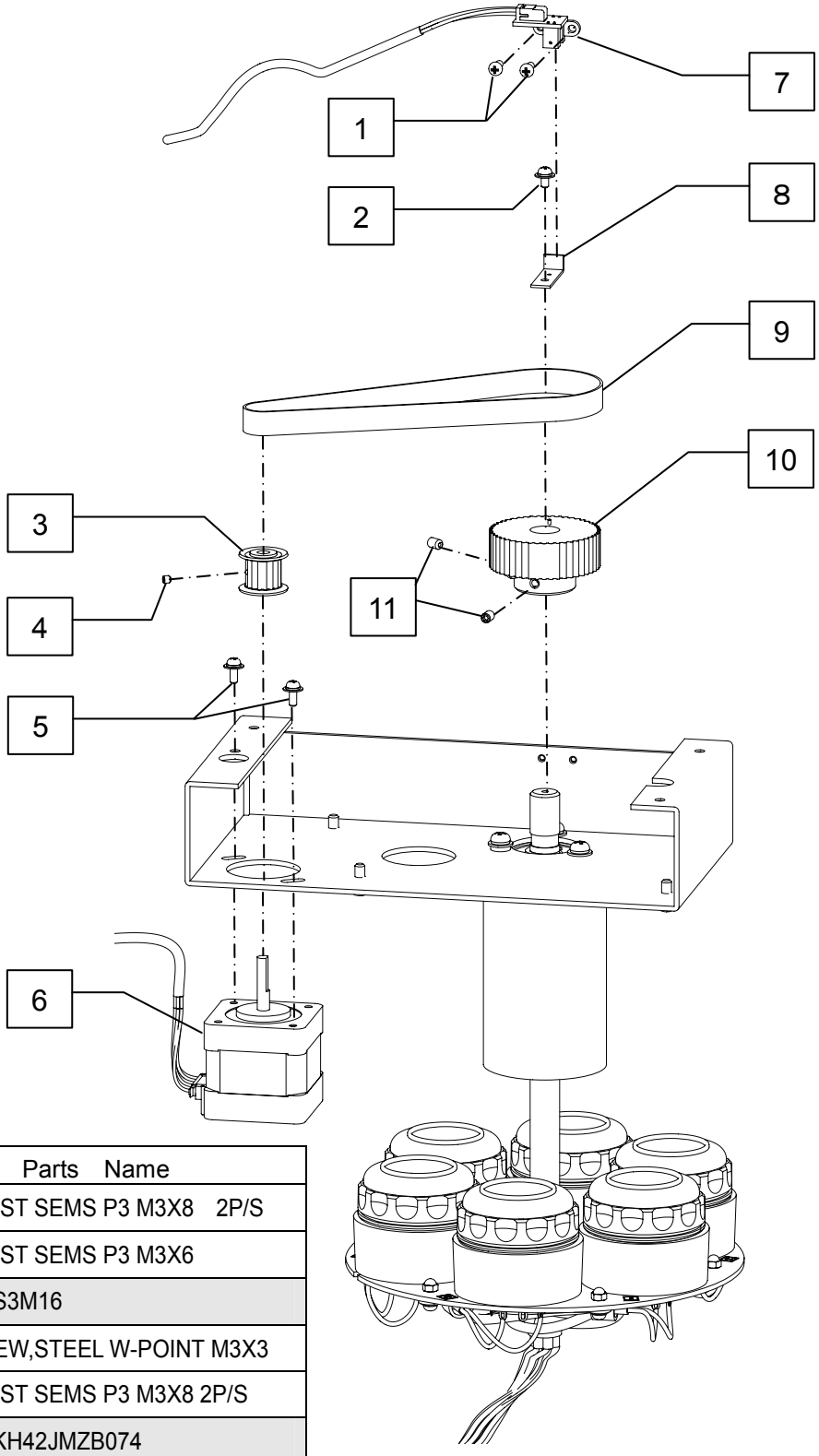
	P/N	Parts Name
1	208-96159	MOTOR, E4497-304
2	206-77005-01	HOLDER, SECTOR MIRROR
3	206-77006	BASE SECTOR
4	206-51986-89	PHOTO SENSOR WITH CABLE
5	020-05134	SCREW,SST PAN HEAD M3X6
6	206-77058-92	ASSY, SECTOR MIRROR
7	206-51986-90	PHOTO SENSOR WITH CABLE

P/N 206-77068-91 MONOCHRO ASSY (about SLIT)



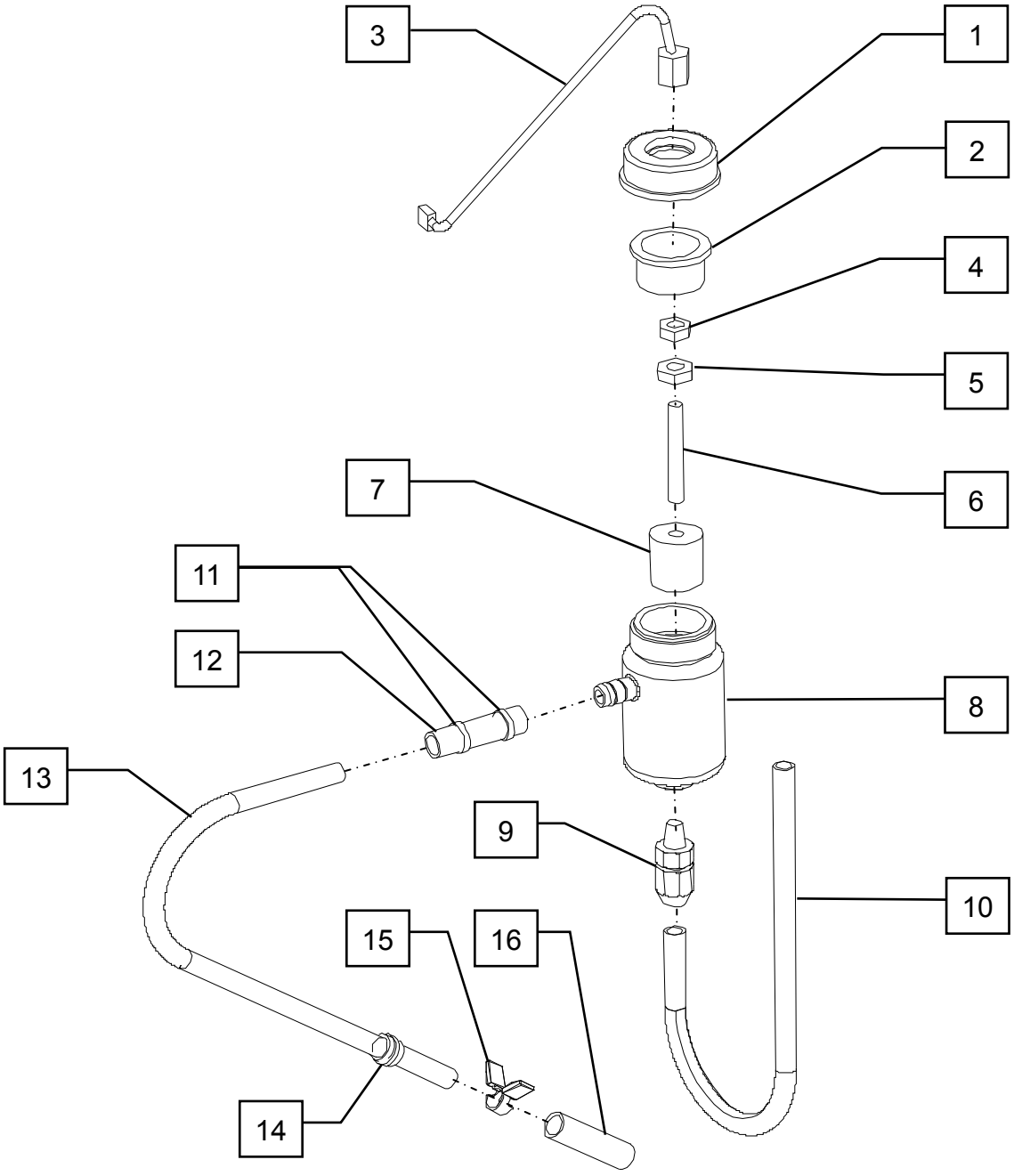
	P/N	Parts Name
1	206-77071-91	BASE ASSY, MONOCHRO
2	206-62116-01	PCB ASSY,PHOTOSENSOR (ON1113 P/N 061-71535)
3	020-05135	SCREW,SST PAN HEAD M3X8
4	206-77336-93	CABLE ASSY, SLIT SENSOR
5	206-77073-91	SLIT ASSY

P/N 206-77055-91 LAMP HOUSE ASSY



No	P/N	Parts Name
1	020-46535	SCREW,SST SEMS P3 M3X8 2P/S
2	020-46534	SCREW,SST SEMS P3 M3X6
3	206-77079	PULLEY, S3M16
4	021-04625	SET SCREW,STEEL W-POINT M3X3
5	020-46535	SCREW,SST SEMS P3 M3X8 2P/S
6	223-04575	MOTOR, KH42JMZB074
7	206-62116-01	PCB ASSY,PHOTOSENSOR (ON1113)
8	206-77388	INTERRUPTER
9	032-22472-40	BELT,B100S3M339-G
10	206-77080	PULLEY, S3M48
11	021-04634	SET SCREW,STEEL W-POINT M4X6

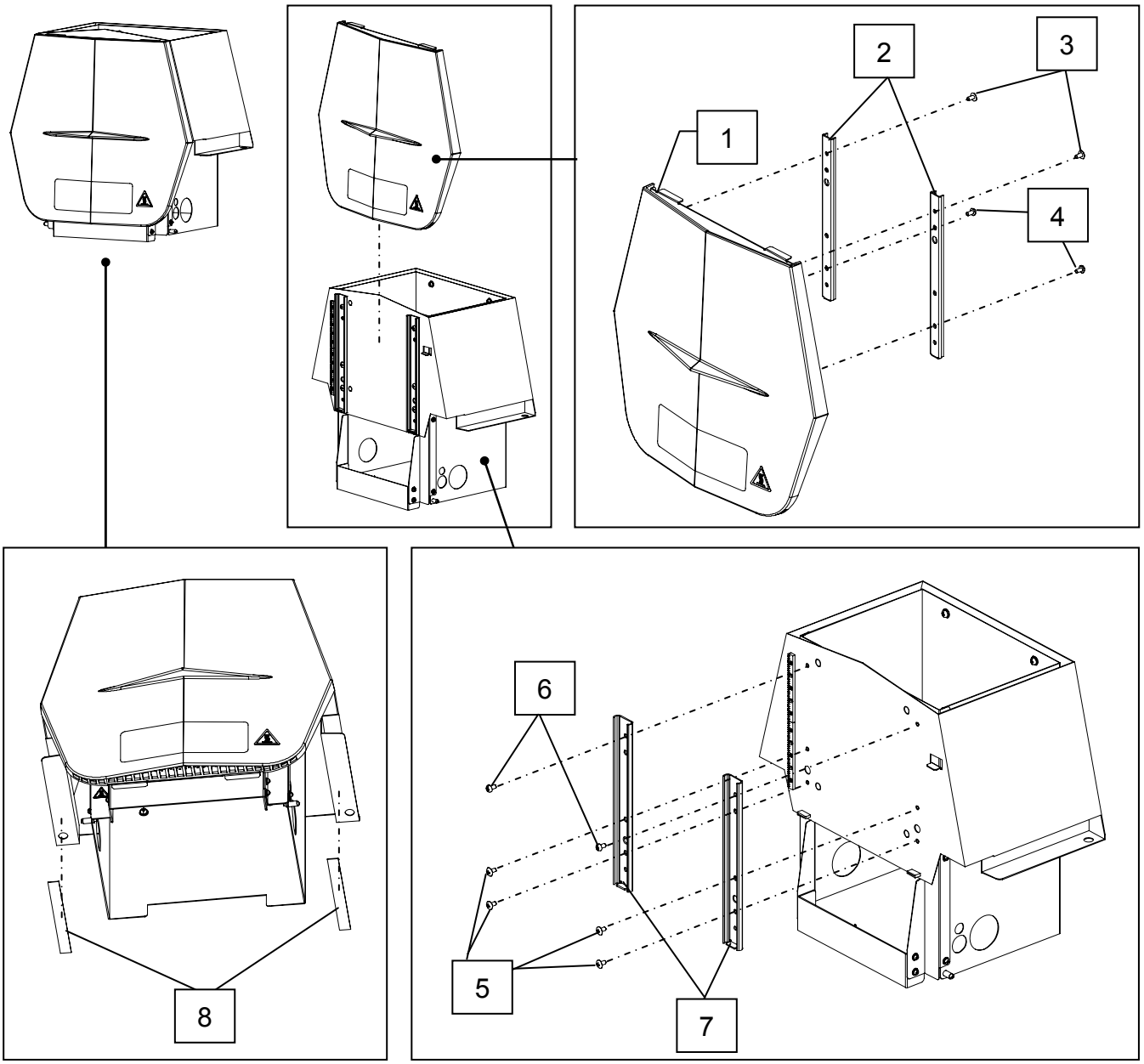
P/N 206-77413-91 DRAIN ASSY



No	P/N	Parts Name
1	206-63698	DRAIN BOTTLE
2	-	-
3	206-50735-93	LEVEL SW ASSY
4		
5		
6		
7		
8	206-52034-93	DRAIN BOTTLE ASSY

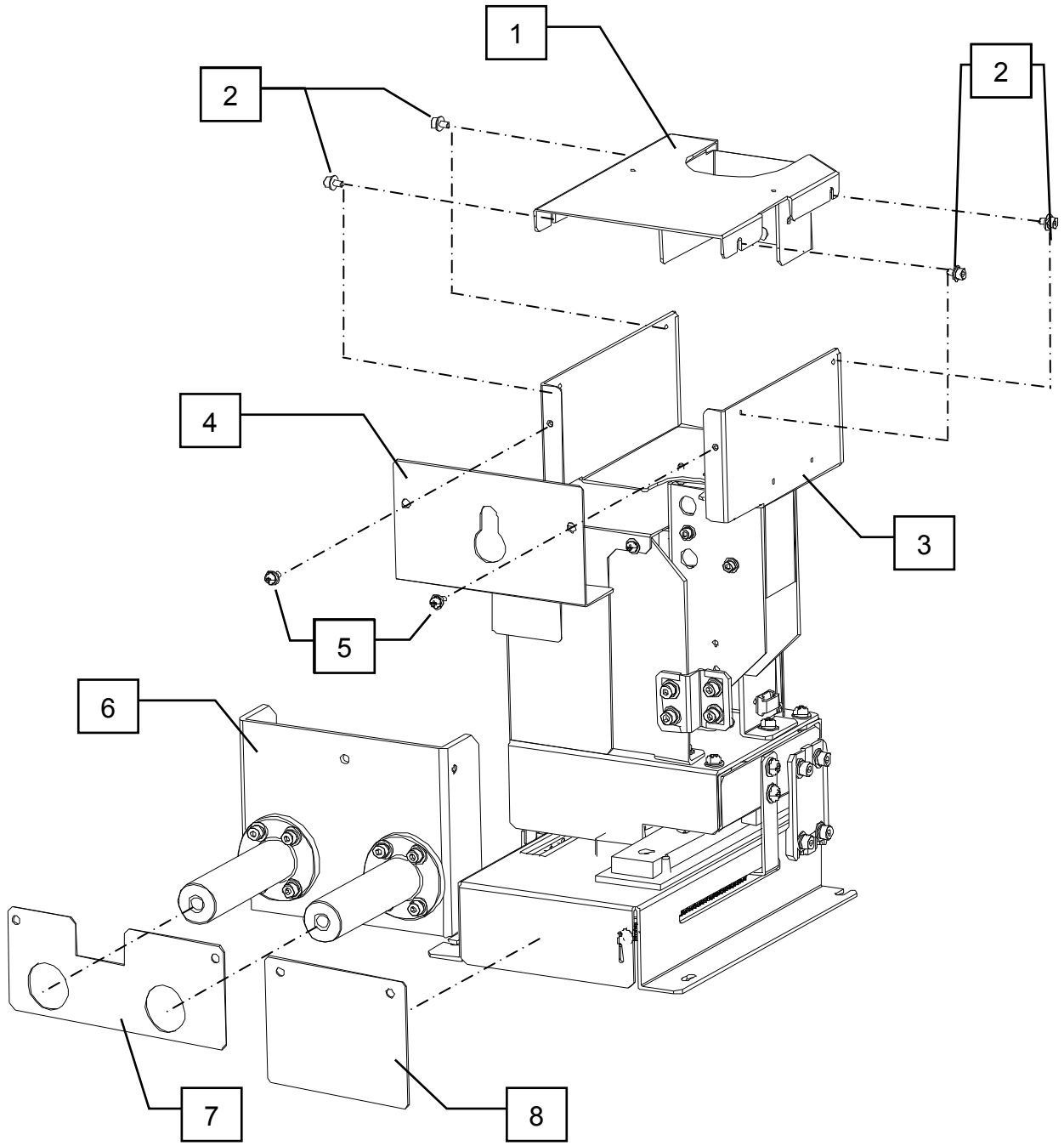
No	P/N	Parts Name
9	035-65014-14	HALF UNION,HZ10-02-PP
10	206-77391	U TUBE
11	072-60320-01	CABLE TIE,T18R
12	016-43200-08	TUBE,SUPER-CORN-ACE
13	206-77642	DRAIN TUBE
14	072-60320-01	CABLE TIE,T18RR
15	037-61121-01	HOSE CLAMP,T-10
16	016-43200-08	TUBE,SUPER-CORN-ACE

P/N 206-77243-91 FUNNEL ASSY



No.	P/N	Parts Name
1	206-77034	FRONT PANEL
2	037-38210-01	SLIDE RAIL,SNS27S-20
3	020-37054	SCREW,SST TRUSS HEAD M4X8
4	020-05147	SCREW,SST PAN HEAD M4X8
5	020-37054	SCREW,SST TRUSS HEAD M4X8
6	020-05147	SCREW,SST PAN HEAD M4X8
7	037-38210-01	SLIDE RAIL,SNS27S-20
8	067-06002-01	MAGNET,C-200-1

P/N 206-77701-91 AAC-7000



ITEM NO	P/N	DESCRIPTION
1	206-77218	CAMBER COVER
2	022-27602	BOLT,SST HEXSOCH SEMS M3X6
3	206-77200	ATOMIZER AUTO CHANGER
4	206-77405	SHIELD CHAMBER, A
5	020-46535	SCREW,SST SEMS P3 M3X8
6	206-77645-91	BASE ANGLE ASSY
7	206-77431	PANEL, ASC SLIDE G
8	206-77173	PANEL, FRONT

P/N 206-77135-92 PCB ASSY, AA-MX CPU

P/N	Name	Remark
206-77231	GUIDE, CPU	
070-02832-91	LOCK SCREW, JFS-4S-B1W	
060-02128-51	DIODE, 1SS396 (TE85L-F)	D 2-5
060-16506-51	DI, F2J4STP	D 6
061-78172-05	LED, TLGU1002A (T02)	D 7
060-11513-01	DI, CRG04 (TE85L, Q)	D 8-9
061-78172-05	LED, TLGU1002A (T02)	D 10-15
075-39979-01	IC, R5F70854AD80FPV	M 1
075-30022-22	IC, M62733ML 600C-TF0J	M 2
075-30845-02	IC, M5M5V108DVP-70H	M 3-4
206-77438	CPLD, AA-MX CPU	M 5
075-28039-06	IC, ICL3232ECV-16Z-T	M 6-7
075-21264-54	IC, SN74LVC04APWR	M 8
075-23947-16	IC, AD8692ARZ-REEL	M 9-10
075-24231-01	IC, MP1591DN-LF	M 11
075-26489-12	IC, M95320-WMN6P	M 12
075-33148-15	IC, TA48033F (TE16L1, NQ)	M 13
075-21264-51	IC, SN74LVC14APWR	M 14
075-19219-51	IC, SN65LVDS049PWR	M 15
075-23888-01	IC, AD7660ASTZ	M 17
075-11866-01	IC, LMV796MF-NOPB	M 18
075-23994-01	IC, ADG711BRZ	M 19
075-23934-61	IC, ADR391AUJZ-REEL7	M 20
075-31818-21	IC, UPC339G2-E1-A	M 21
075-39114-01	IC, TR ARRAY STA401A	M 22
075-20911-52	IC, ULN2003ANSR	M 23
075-33563-05	IC, TC74VHCT04AF-EL (F)	M 24
075-33149-51	IC, TA84002F (G-EL)	M 25-30
075-21264-73	IC, SN74LVC06APWR	M 31-32
075-39127-21	IC, SLA7072MPR	M 33-35
075-21264-51	IC, SN74LVC14APWR	M 37-38
061-86488-01	OSCILLATOR, NX8045GB-10.0MHZ-S*	X 1

P/N 206-77140-92 PCB ASSY, AA-MX POWER

P/N	Name	Remark
060-14826-01	DIODE, ESJA08-08	D 1-5
060-18923-04	DIODE, 2KBP08M-E4/5	D 6
060-14337-44	DIODE, RD24M-T1B-A_B3	D 7
060-11513-01	DI, CRG04 (TE85L, Q)	D 8, 10
060-18907-01	DIODE, W02G-E4/51	D 9, 11
061-78172-05	LED, TLGU1002A (T02)	D 12
072-02004-04	FUSE, 218.063P	F 1
072-02004-09	FUSE, 218.200P	F 2
072-02004-08	FUSE, 218.160P	F 3
072-02004-24	FUSE, 218 06.3P	F 4
072-02004-20	FUSE, 218 02.5P	F 5
072-02004-12	FUSE, 218.400P	F 6
072-02004-11	FUSE, 218.315P	F 7
065-51901-10	RELAY, G2R-1 DC24V	K 1-13
065-60051-01	RELAY, G5Q-1A4 DC24	K 14
065-61597-01	RELAY, G5NB-1A-SP DC24	K 15-16
058-82040-21	INDUCTOR, RCH895NP-471K	L 1
075-20911-52	IC, ULN2003ANSR	M 1-2, 5
206-77439	CPLD, AA-MX POWER	M 3
075-19219-51	IC, SN65LVDS049PWR	M 4
075-19085-01	IC, LF412CDR	M 6, 12, 17, 18
075-23831-12	IC, ADG444BRZ	M 7
075-31135-01	IC, UPC4558G2-A	M 8, 11, 16, 22
075-31134-12	IC, UPC7815AHF	M 9
075-33129-01	IC, TA78L05F (F)	M 10
075-19084-51	IC, TLV5628CDWR	M 13
075-19026-31	IC, TL431BCDR	M 14
075-31140-34	IC, UPC7915AHF-AZ	M 15
075-33563-05	IC, TC74VHCT04AF-EL (F)	M 19
075-19068-71	IC, LM358ADR	M 20-21
060-49779-03	INSULATOR, TC-30A (TO-220)	MI 9-15

065-68220-12	RELAY, SSR PR36MF11NSZ6	PC 1-4
061-70420-01	PHOTOCOUPLER, TLP590B (C, F)	PC 2
061-70384-05	PHOTOCOUPLER, TLP421(GB)	PC 3
060-38437-01	TRANSISTOR, 2SK2718 (Q)	Q 1
060-45460-01	TRANSISTOR, 2SC5460 (F)	Q 2
060-26712-02	TRANSISTOR, 2SC2712Y (TE85R, F)	Q 3-4
060-26655-02	TRANSISTOR, 2SC2655-Y (F)	Q 5
060-26712-02	TRANSISTOR, 2SC2712Y (TE85R, F)	Q 6
060-38410-01	TRANSISTOR, 2SK2610 (F)	Q 7-9
060-45460-01	TRANSISTOR, 2SC5460 (F)	Q 10-11
060-49779-04	INSULATOR, TC-30A (TO-3P)	QI 7-9
058-00002	SPARK KILLER, S1201	SK 1-2