Small Plasma Unit
PR200

Instruction Manual

First Edition

- Thank you for purchasing " Small Plasma Unit PR200" of Yamato Scientific Co., Ltd.
- To use this unit properly, read this "Instruction Manual" thoroughly before using this unit.
  Keep this instruction manual around this unit for referring at anytime.

⚠WARNING!:
Carefully read and thoroughly understand the important warning items described in this manual before using this unit.

Yamato Scientific America Inc.
Santa Clara, CA

Printed on recycled paper.

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1. Safety Precautions

Explanation of symbols

About symbols

Various symbols are provided in this Instruction Manual and on the product to ensure safe operation. Improper handling of this Equipment without understanding their contents will lead to the results classified below. Be sure to fully understand the description of symbols below before proceeding to the text of this Manual.

Warning Indicates a situation which may result in death or serious injury (Note 1.)

Caution Indicates a situation which may result in minor injury (Note 2) and property damages (Note 3.)

（Note 1）Serious injury means a wound, an electrical shock, a bone fracture or intoxication that may leave after effects or require hospitalization or outpatient visits for a long time

（Note 2）Minor injury means a wound or an electrical shock that does not require hospitalization or outpatient visits for a long time.

（Note 3）Property damage means damage to facilities, devices and buildings or other properties.

Meanings of symbols

This symbol indicates a matter urging user to follow the warning (“caution” included).
Specific description of warning is indicated near this symbol.

This symbol indicates prohibitions.
Specific prohibition is indicated near this symbol.

This symbol indicates matters that the user must perform.
Specific instruction is indicated near this symbol.

1. Safety Precautions

List of symbols

Warning


General Warnings


Danger!: High Voltage


Danger!: High Temperature


Danger!: Moving Part


Danger!: Explosion Hazard

Caution


General Cautions


Caution: Electrical Shock!


Caution: Burns!


Caution: Heating Container without water!


Caution: Water Leak!

Caution: For water only


Caution: Toxic Chemicals

Prohibitions


General Prohibited Actions


No open flame


Do not disassemble


Do not touch

Compulsions


General Mandatory Actions


Connect grounding wire

Leveled Installation

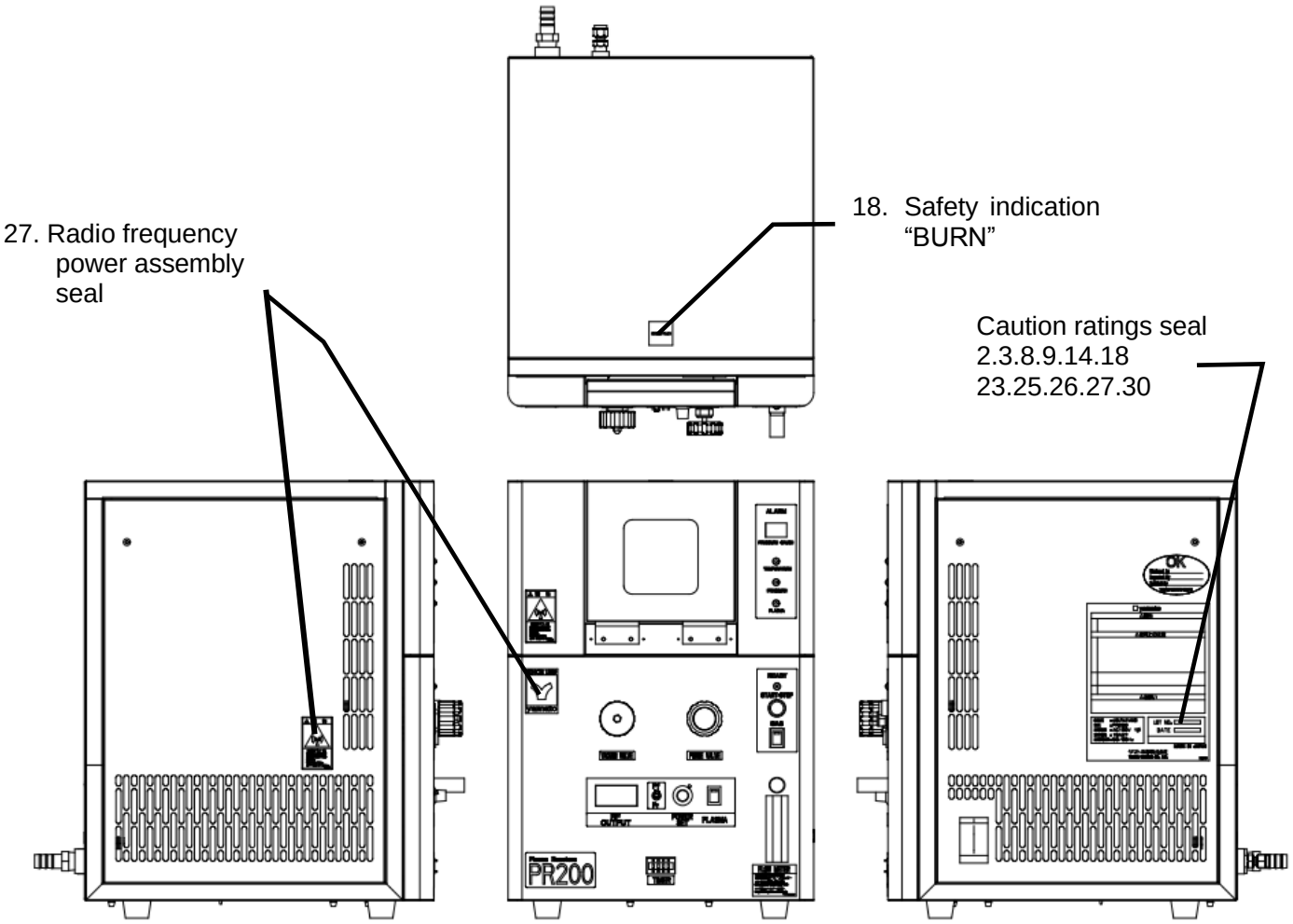

Disconnect Power


Regular Inspection

1. Safety Precautions

Residual risk map

The figure shows the position to apply the caution seal.
The numbers shown in the figure represent the numbers of residual risk relevant to the location concerned, which are provided in the List of Residual Risks for this product. For details of individual residual risks, see the List of Residual Risks.



※ Contact us when the caution texts are illegible because the nameplate has peeled off or characters are eliminated. We will send you a new name plate (for value)

List of residual risks (Instructions for avoiding risks)

This list summarizes residual risks to avoid personal injuries or damages to properties during or related to the use of the product.

Be sure to fully understand or receive instructions on how to use, maintain and inspection of the product before starting operation.

	During or on carrying-in or installation			
№	Degree of risks	Details of risks	Protective measures to be implemented by the machine users	Relevant sections
1	Caution	Injury	Use cargo handling equipment for carrying and installation. Two or more people shall be necessary when transporting by humans.	Section 2.2
2	Warning	Fire or electrical shock	Carefully select an installation site and take care for the installation environment.	Section 2.1
3	Caution	Injury	Install on a level surface.	Section 2.2
4	Caution	Injury	Implement safety measures for installation.	Section 2.3
5	Caution	Injury	Implement appropriate safety measures after installation.	Section 2.4
6	Warning	Fire	Assure sufficient ventilation for the unit.	Section 2.5
7	Warning	Fire or electrical shock	Do not use the unit at a place that may be subject to splashes of liquid.	Section 2.6
8	Warning	Explosion or fire	Do not use the unit in a flammable or an explosive atmosphere.	Section 2.7
9	Warning	Fire or electrical shock	Be sure to connect the earth wire.	Section 2.8
10	Warning	Fire or electrical shock	Connect the power supply to the dedicated outlet.	Section 2.9
11	Warning	Fire or electrical shock	Take care for handling of the power cord.	Section 2.10
12	Warning	Fire or electrical shock	Do not disassemble nor modify the Equipment.	Section 2.11
13	Warning	Explosion or fire	Connect to the vacuum pump.	Section 2.12

	During operation			
№	Degree of risks	Details of risks	Protective measures to be implemented by the machine users	Relevant sections
14	Warning	Explosion and fire	Do not use an explosive or combustible substance.	Section 7.1
15	Warning	Explosion and fire	Take sufficient care when using a resin container.	Section 7.2
16	Warning	Fire or electrical shock	Immediately turn the ELB off when an abnormality should occur.	Section 7.3
17	Warning	Burning	Take extreme care for handling of specimens after operation at a high temperature.	Section 7.4
18	Warning	Burning	Do not touch any hot surfaces.	Section 7.5
19	Caution	Injury	Do not attempt to climb on the unit.	Section 7.6

List of residual risks

	During operation			
№	Degree of risks	Details of risks	Protective measures to be implemented by the machine users	Relevant sections
20	Caution	Injury	Do not put any objects on the unit.	Section 7.7
21	Caution	Injury	Do not give shocks.	Section 7.8
22	Warning	Fire	Turn the ELB off when thunder is heard.	Section 7.10
23	Warning	Explosion, fire, injury	Do not transport the unit while it is in operation.	Section 7.9
24	Caution	Fire, electric shock	Let specimen dry.	Section 7.12
25	Warning	Fire, electric shock	Do not put too much specimen.	Section 7.13
26	Warning	Burning	Take care when taking out specimen, which may be hot.	Section 7.15
27	Caution	Electric shock	Take care for possible adverse effects of radio frequency.	Section 7.17
28	Warning	Explosion, fire	Take care for gas pressure.	Section 7.20
29	Warning	Fire or electrical shock	Inspect the ELB and the standalone overheat preventive unit at regular intervals.	Section 7.22

	During inspection and maintenance			
№	Degree of risks	Details of risks	Protective measures to be implemented by the machine users	Relevant chapters
30	Warning	Fire or electrical shock	Remove the power cord before inspection or maintenance.	Chapter 8
31	Warning	Burning	Start maintenance only after the device has returned to the normal temperature.	Chapter 8
32	Warning	Fire or electrical shock	Do not attempt to disassembly the devices.	Chapter 8

	When you are not going to use the unit for a long time or when discarding the unit			
№	Degree of risks	Details of risks	Protective measures to be implemented by the machine users	Relevant chapters
33	Warning	Fire or electrical shock	Turn power off and remove the power cord.	Chapter 9
34	Caution	Injury, trapping	Do not leave the unit at a place where children may play.	Chapter 9
35	Caution	Injury, trapping	Before disposing the product, remember to remove the hinges and other locking mechanisms to prevent the doors from being closed airtight.	Chapter 9

1. Safety precautions

Warning & Caution

⚠ Warning

Apply for the authorization for the unit.

This product emits radio frequency of 13.56MHz. Be sure to submit “Application for radio frequency facilities” attached to The Bureau of Telecommunications and obtain the authorization.
Note that unauthorized use of this unit is against the relevant laws and regulations.
*Refer to the “Guidance on the application for radio frequency facilities” for details.

Do not use this unit in an area where there is flammable or explosive gas

Never use this unit in an area where there is flammable or explosive gas. This product is not explosion-proof and turning switches “ON” or “OFF” and any operations may produce arks, which may lead to a fire or an explosion. Refer to “P.37 List of dangerous substances”.

Always ground this unit

Always ground this unit on the power equipment side in order to avoid electrical shock due to a power surge. See “**Must connect grounding wire properly**” on page.9

Ban on use of explosive or flammable substances

Never attempt to use explosive or flammable substances and those contain them. This product is not equipped with any safety functions against such substances. An explosion or a fire may result.

Ban on use during an abnormal status

If you should notice a smoke or a strange odor, immediately turn the ELB of the unit off and the power supply for the distribution board of the building. An explosion or a fire may result.

Never disassembly nor modify the Equipment

Never disassemble nor modify this Equipment. Those actions may cause this Equipment malfunction, fire or electric shock.

Be sure to use the specified reactive gas.

Be sure to use the specified oxygen gas (or suctioning atmospheric air) as the processing gas. Otherwise, a malfunction or insufficient cleaning effect or other troubles may result.

1. Safety precautions

⚠ Warning

Handling of power code

- Do not entangle the power cord. This will cause overheating and possibly a fire.
- Do not bend or twist the power cord, or apply excessive tension to it. This may cause a fire and electrical shock.
- Do not lay the power cord under a desk or chair, and do not allow it to be pinched in order to prevent it from being damaged and to avoid a fire or electrical shock.
- Keep the power cord away from any heating equipment such as a room heater. The cord's insulation may melt and cause a fire or electrical shock.
- If the power cord becomes damaged (wiring exposed, breakage, etc.), immediately turn off the power of this unit and shut off the main supply power. Then contact your nearest dealer for replacement of the power cord. Leaving it may cause a fire or electrical shock.
- Use only one power cord for connection. Do not lengthen the cable using an extension cable. Loosened screws or other reasons may lead to a fire or an electric shock depending on the connecting method.

⚠ Caution

When a thunder is heard, immediately turn the power and the ELB of this product off.

When a thunder is heard, immediately turn the power and the ELB of this product off. Otherwise, a fire or an electric shock may result.

Precautions regarding the radio frequency power assembly

Heating from radio frequency may cause malfunction to electronic components or other device. Never open any covers other than the doors.

2. Before operating the Equipment

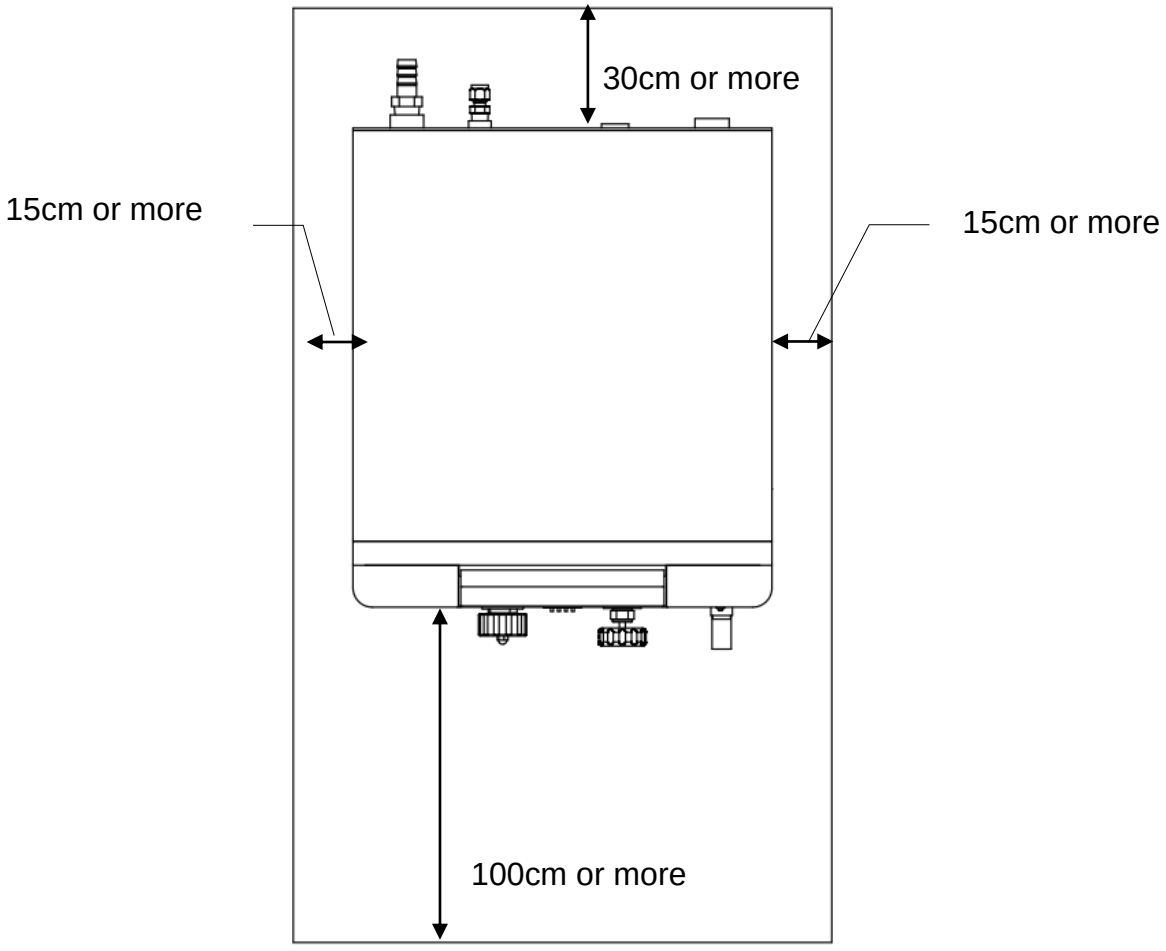
Precautions when installing the Equipment

1. Take care for the place and the environment of installation.

Do not install the unit at places listed below:

- Uneven surface, dirty surface, unstable place, slanted place
- Where flammable gas, explosive gas, or corrosive gas exists
- Where environmental temperature is 35℃ or higher or 5℃ or below
- Place that may be subject to splashes
- Where temperature fluctuations are excessive
- Where much dirt, dusts, or humidity exist
- Place that is subject to direct sunlight
- Where vibrations are excessive
- Where only unstable power supply is available
- Outdoors

Assure spaces around each of the products as shown in the diagram below.
There are a gas connecting port, a vacuum pump connecting port and an exhaust port on the rear of the main unit. Take care so that any flammable items or other devices are not placed in the back space of the unit.



2. Installation on horizontal surface

Place this unit as flat a place as possible. If the casters are not in uniform contact with the floor surface, noise or vibration may result. Additionally, the unit may cause a problem or malfunctio

Weight of this product is approx.25 kg.
Take extreme care for handling, transportation and installation of this product.

3. Implement safety measures when installing the unit.

May be injured by moved and/or fallen this Equipment down by earthquake and/or unexpected impact. Recommend to install this Equipment at the place away from the access door and to take other safety steps.

4. Implement appropriate safety measures after installation.

May be injured by moved and/or fallen this Equipment down by earthquake and/or unexpected impact.
To ensure the safety, be sure to provide any adequate measur to the main body and to the installation surface to prevent overturn.

5. Assure sufficient ventilation for the unit.

Do not operate the unit with the radiation ports (slits) on the sides and the rear of the unit blocked.
Internal temperature will rise, causing a malfunction of the controller to compromise the performance as well as to cause a possible accident or a fire.

6. Do not operate the unit at a place that is subject to splashes.

Do not operate this Equipment at the location of liquid splashing. If Controller of this Equipment will be wetted by splashing any kind of liquid, it may cause accident, controller malfunction, electrical shock and/or fire.

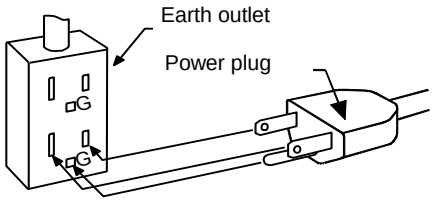
7. Never operate in an atmosphere where flammable or explosive gas is present.

Never operate this Equipment in an atmosphere where flammable or explosive gas is present. This Equipment is not explosion-proof. Spark may be discharged by switching Earth Leakage Breaker (ELB) “ON(|)” and “OFF(○)” and also relay during operation, and then it may cause fire or explosion.
See “List of Dangerous Substances” for flammable and explosive gases on page 37.

8. Must connect grounding wire properly.

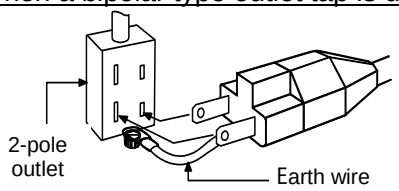
- When there is no earth terminal available, consult your dealer, one of our sales office or general customer service center for class D earth work.
- Be sure to connect the earth wire securely to the outlet.

We recommend use of a ground type outlet tap



When there is no ground terminal.
Require to ground by Electrical Equipment Technical Standards Section 19-calss D in Japan. Please contact with local dealer, local electrician, or Yamato Customer Service Center

When a bipolar type outlet tap is use



Insert the ground adaptor ((non-standard accessory) into a power plug confirming the polarity of the outlet. Connect the grounding wire (green) of the ground adaptor to the ground terminal on the power supply equipment

Never connect grounding wire to gas line pipe, water line pipe or telephone grounding wire due to fire or electric shock.

9. Connect Power Cord/Power Cable to receptacle or switch board of facilities.

Connect Power Cord/Power Cable to suitable receptacle/switch board of facilities according to electrical requirements as follows.

Electrical requirements: Single phase 115V 50/60Hz 13.5A or less (incld. vacuum pump) (ELB capacity；15A）

The operational voltage range is ±10%, the voltage range where the specified performance is guaranteed is rating±5%, the frequency is rating±1%.

※Check line voltage of its receptacle/switch board of facilities and/or whether utilize the same line with other equipments or not, if this Equipment does not start up/operate even to turn Earth Leakage Breaker(ELB) On(｜). Take correct action for the solution, such as changing its power source away from other equipment.

10. Take care for handling of the power cord.

- Do not entangle the power cord. This will cause overheating and possibly a fire.
- Do not bend or twist the power cord, or apply excessive tension to it. This may cause a fire and electrical shock.
- Do not lay the power cord under a desk or chair, and do not allow it to be pinched in order to prevent it from being damaged and to avoid a fire or electrical shock.
- Keep the power cord away from any heating equipment such as a room heater. The cord's insulation may melt and cause a fire or electrical shock.
- If the power cord becomes damaged (wiring exposed, breakage, etc.), immediately turn off the power of this unit and shut off the main supply power. Then contact your nearest dealer for replacement of the power cord. Leaving it may cause a fire or electrical shock.
- Use only one power cord for connection. Do not lengthen the cable using an extension cable. Loosened screws or other reasons may lead to a fire or an electric shock depending on the connecting method.

11. Never disassembly nor modify the Equipment.

Never disassemble nor modify this Equipment. Those actions may cause this Equipment malfunction, fire or electric shock.

12. Connect to the vacuum pump.

- Prepare ad vacuum pump whose displacement is about 30～70L/min.
- When you are going to use a corrosive gas, use a pump that can discharge a corrosive gas or consult us.
- A corrosive gas may be generated depending on materials to plasma-process, in which case use a pump that can discharge a corrosive gas or consult us.

3. Major objectives of use

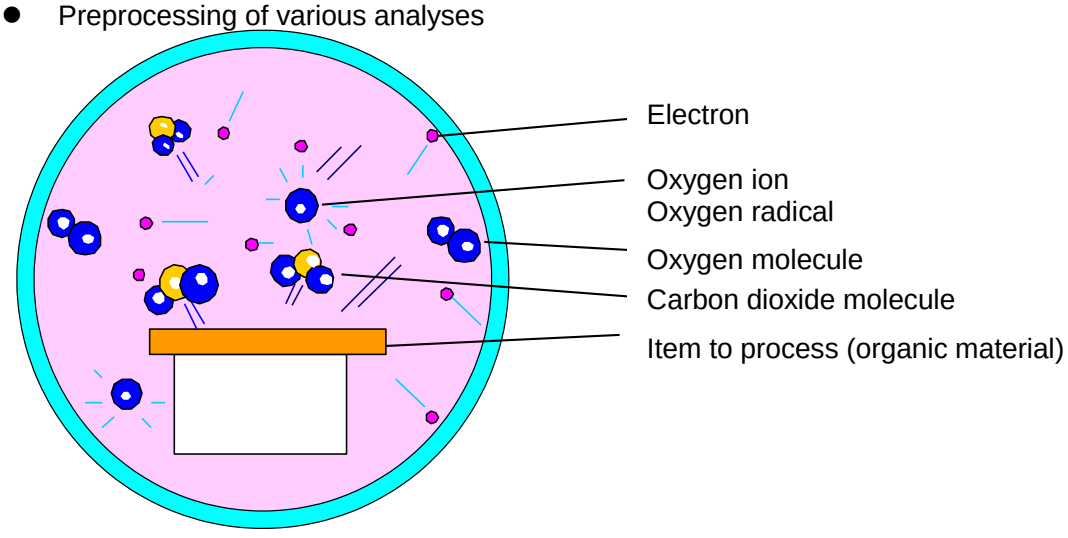
Objectives of use

This unit is used to improve or clean surfaces of target items (specimens) by plasma processing. Use this for reforming surfaces or removing organic soils of target items.

Plasma processing can improve surfaces and clean of organic matters by chemically changing them through actions of O2 radicals on the target surfaces. Oxygen ion or oxygen radicals in plasma spread non-directionally in the vacuum chamber and therefore all surfaces on the specimen installed in the chamber and are in contact with the plasma will be treated.

Application examples

- Cleaning
  - Removal of organic films (removal of oil, wax or other organic films)
  - Cleaning or preprocessing plating or coating of electronic components, optical components or fine mechanism components
  - Disinfection of bacteria (Etching of cell membranes with organic radicals or disinfection by ultraviolet ray)
- Surface reforming
  - Giving of functional groups onto polymer molecule surfaces⇒Improvement of adhesiveness or contact property (Show below is a popular theory)
    As a result of oxidization, functional groups such as -OH, >C=O, -COOH will be generated on surfaces (small amount of moisture or carbon dioxide also have some effects).
    The surface will take nitrogen atoms in nitrogen plasma, functional groups such as $-NH_2$ will be generated.
  - Improvement of adhesiveness of various polymers or improvement of biological compatibility of medical or dental materials.
  - Processing of petri dishes allows even application of medium.
- Ashing
  - Oxygen acts as an etching gas to organic polymers enabling light etching of resists.
- Others
  - Biomedical applications such as an experiment of promotion of seeds germination.
  - Preprocessing for bonding of filters or paper
  - Preprocessing of various analyses

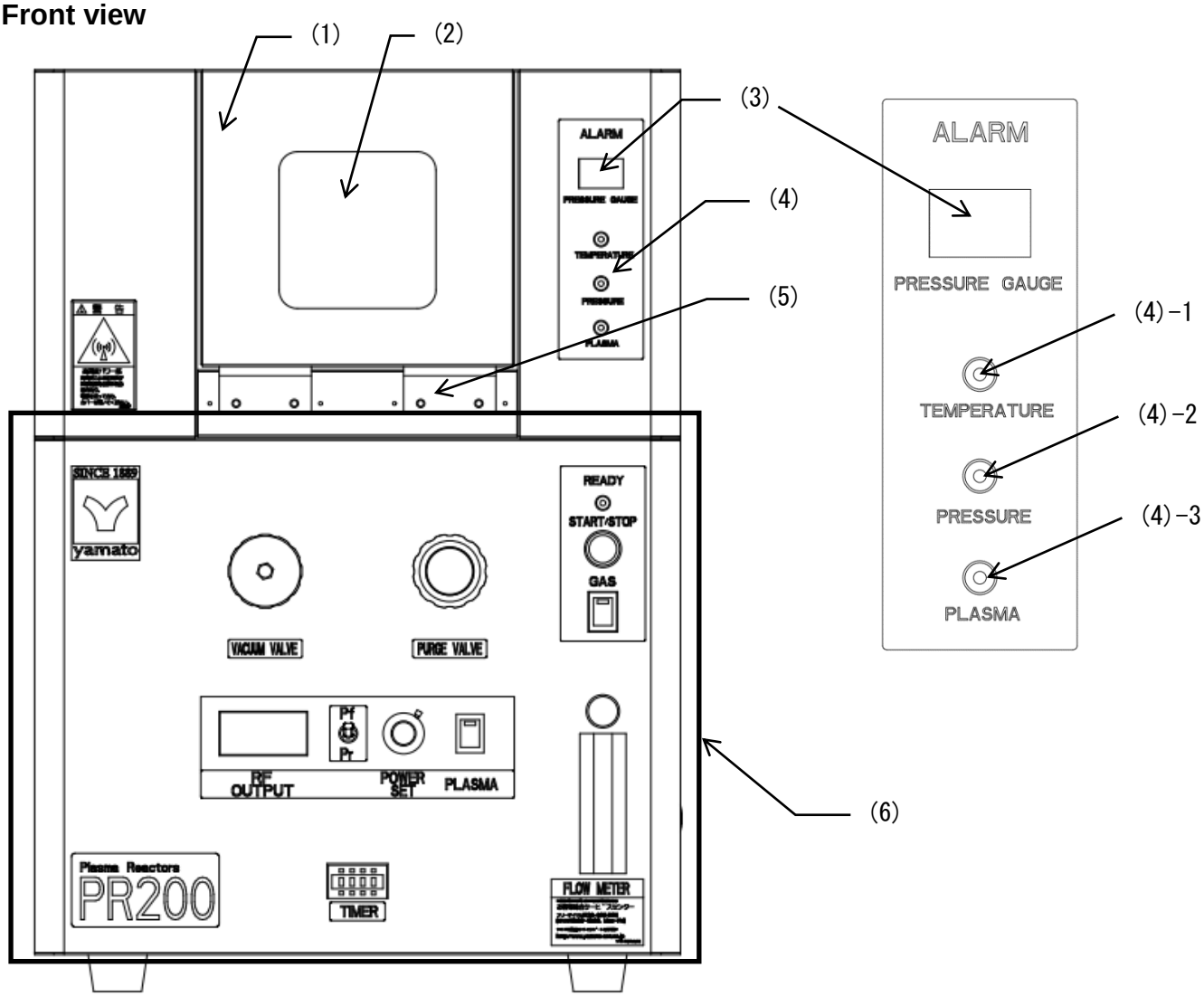


Reference：Schematic diagram of plasma in a chamber

4. Names and functions of parts

Outer appearance/front view of the product

Front view

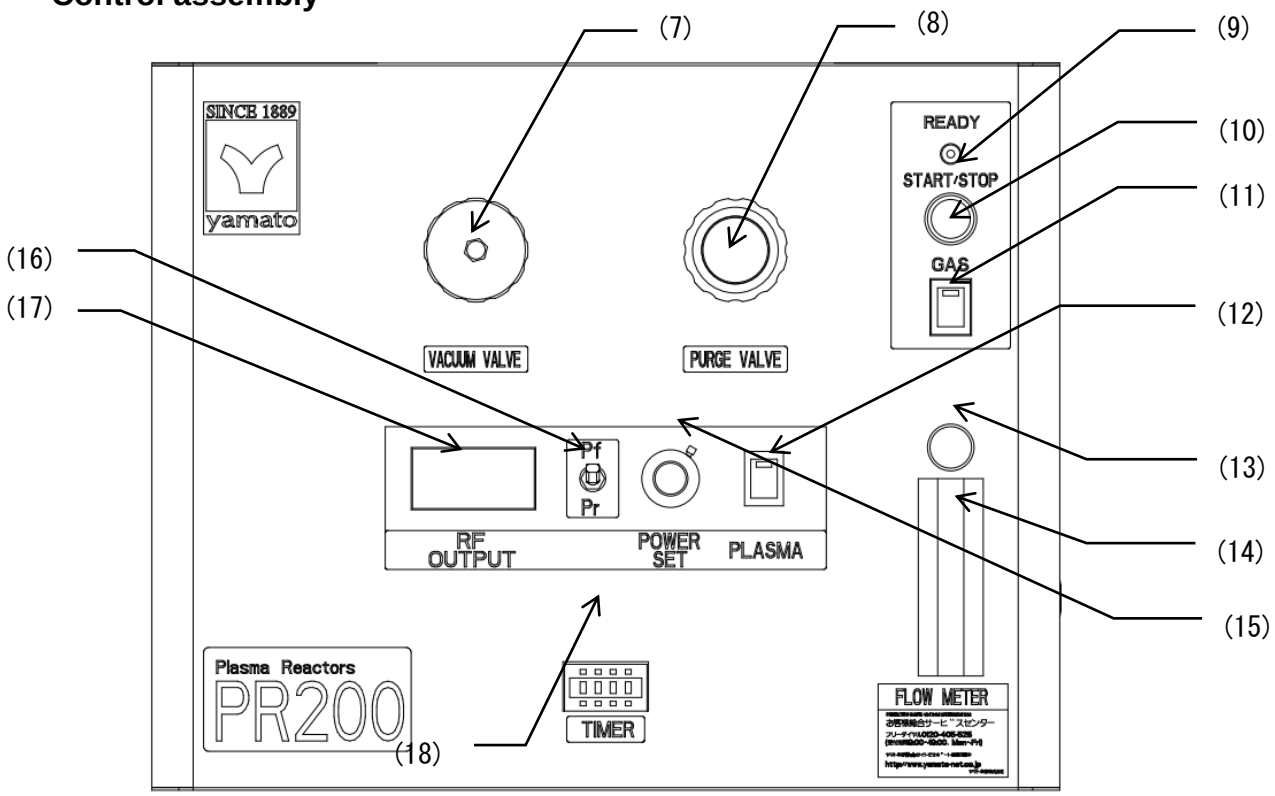


(1) Door	Manually operated door.
(2) Observation window	The window is used to confirm the state of plasma.
(3) Pressure meter	This indicates pressure in the chamber. Pressure is always indicated wh power is supplied.
(4) ALARM lamp	This lamp comes on when an abnormality occurs.
(4)-1 TEMPERRATURE Temperature error lamp	This lamp indicates a temperature abnormality of the RF power supply.
(4)-2 PRESSURE Evacuation error lamp	This lamp indicates a evacuation abnormality.
(4)-3 PLASMA RF short-circuit error lamp	This lamp indicates an RF power supply short circuit.
(5) Door hinge	(1)Door hinge.
(6) Control assembly	See the next page for details.

4. Names and functions of parts

Outer appearance/control assembly

Control assembly

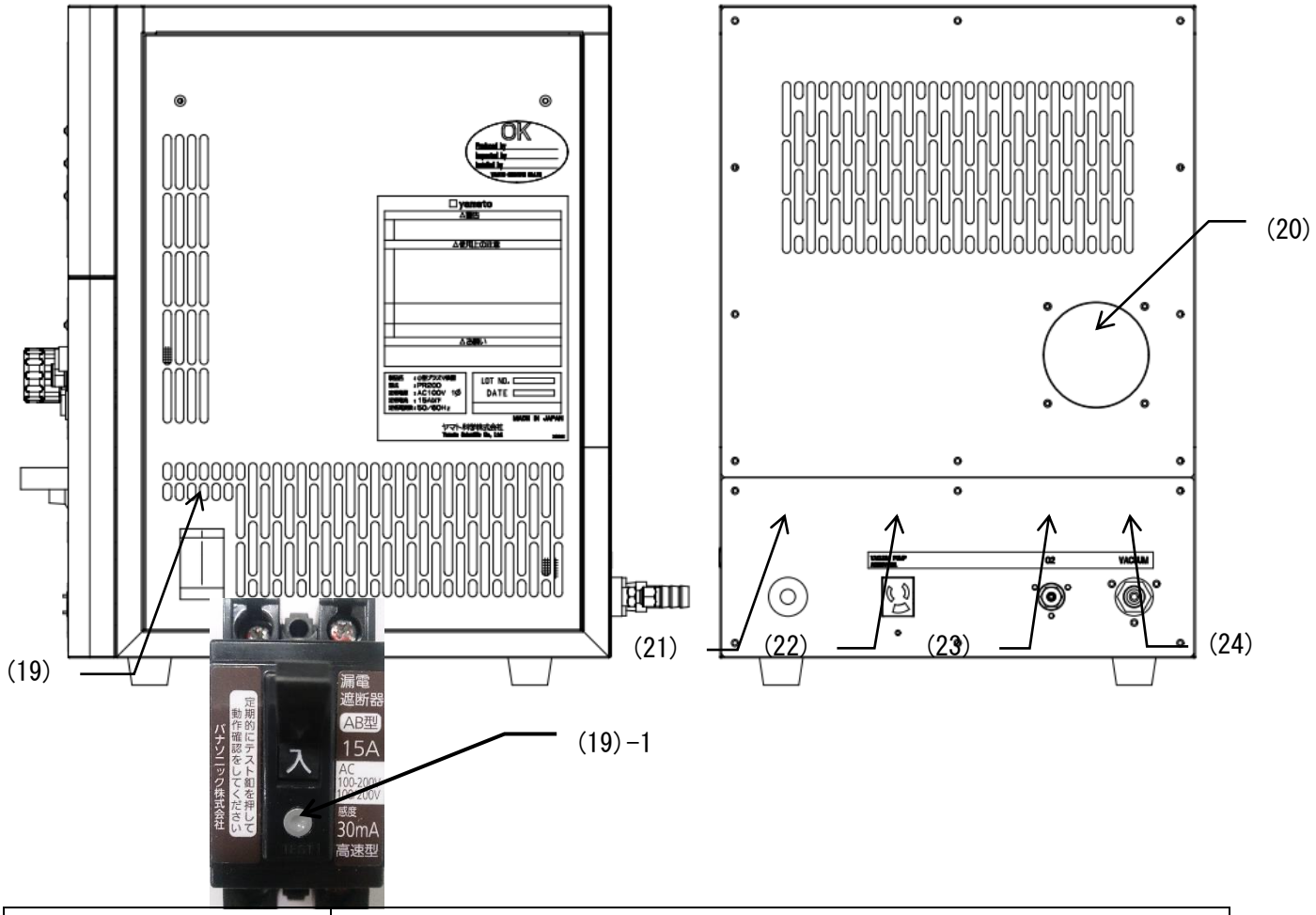


(7) Vacuum valve	This valve is opened when carrying out evacuation.
(8) Purge valve	Close this valve when performing evacuation. Open this when performing purge (open to the atmosphere).
(9) READY lamp	This lamp comes on when inside the chamber is vacuum and injection of gas and radiation of plasma discharge (application of high voltage) are possible.
(10) START/STOP switch	This switch is used to start and stop operation.
(11) GAS switch	After the READY lamp comes on, open the solenoid valve for injecting gas.
(12) PLASMA switch	After the READY comes on, plasma is discharged.
(13) FLOW METER adjusting knob	This knob is used to adjust the amount of gas to inject.
(14)Flow meter	This is a monitor for injected gas.
(15)POWER SET knob (Output adjusting knob)	This knob is used to control and adjust plasma output.
(16) Pf/Pr selector switch	This switch is used to toggle the display of a progressive wave and a reflective wave.
(17) Output display panel	This meter indicates a plasma output power.
(18) TIMER(Timer)	This timer is used to set a time while plasma is discharged.

4. Names and functions of parts

Outer appearance/left and rear sides of the product

Left side of the main body **Rear side of the main body**



(19) ELB	Turn this ELB ON to supply power to the unit. This device shuts off power to protect people and the units when electric leakage of 30mA or occurs and/or overcurrent of 16A or more flows.
(19)-1 ELB test button	This button is used during a regular maintenance to check that the ELB is operating correctly.
(20) Exhaust fan	This is the exhaust fan for the inside of the RF power assembly. Assure at least 30cm of spaces behind the rear of the unit not to interfere with the air flow.
(21) Power cord	This cord is connected to an outlet of the building. See P6 & 7 for connection.
(22) Vacuum pump outlet	This supplies power to the vacuum pump. (AC115V 8A max.)
(23) Oxygen (O_2) gas connecting port	1/4 inch(φ6.35 ㎜)bite type coupling (SUS) An oxygen (O_2) gas pipe is connected here. Pressure shall be adjusted to 0.1MPa or lower. See the next page for connection.
(24) Vacuum nozzle	O.D. φ15mm hose coupling (barbed coupling) The vacuum pump is connected here. See P16 for connection.

5. Installation procedures

1. Connecting gas pipes

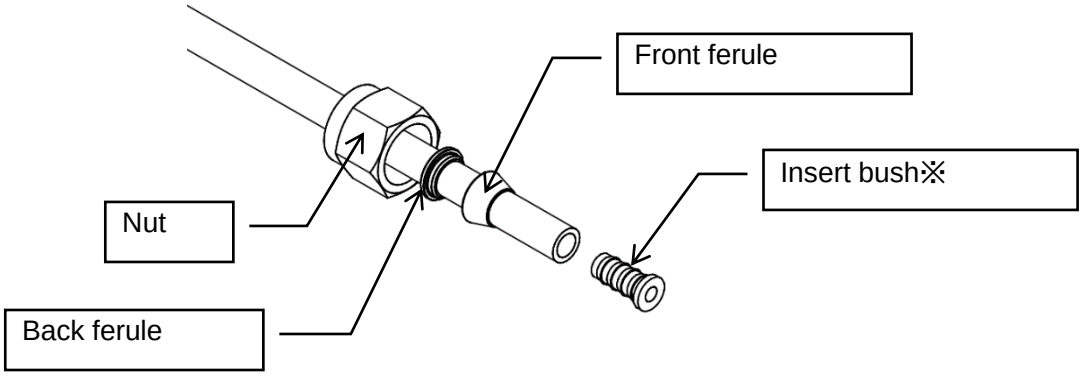
Gas pipe to the unit shall be supplied by the customer. Connect the pipe to the gas supply port on the rear of the unit and supply gas at the specified pressure. Use the **1/4 inch (φ6.35mm) bite type coupling** included as the rear coupling for the main unit and the pipes and tighten as follows.

■Keep the oxygen gas supply pressure to **0.1Mpa or less**.

Note that the flow meter may not operate properly at a higher supply pressure.

■Tightening procedures for a bite type coupling are as follows.

① Run the nut, the back ferule, the front ferule (attached to the coupling on the rear of the main unit) and the insert bush (included in the separate package) through the pipe.



※Use to prevent leak only when the pipe supplied by the customer is made of resin (tube pipe). It is not used for a metal pipe.

② Insert the pipe into the coupling up to the specified position. (Pipe diameter : **1/4 inch (φ6.35 ㎜)**)

③ Tighten the nut as tight as possible by hand.

Take care not to bend pipes and cause a drag.

④ Retighten the nut with a wrench to prevent it from coming off.

2. Connecting electric facilities

This product requires an electric capacity of single phase, AC115V and 15A or more. The customer shall prepare a wire and connect between the distribution board of the building side and the unit.（Provision of a 115V outlet）

Be sure to connect the ground terminal to the ground terminal of the building side. See ﾄﾞ the section ”P.9 Connecting the earth wire”.

3. Connecting to the vacuum pump

A vacuum pump is necessary to start the unit.

The customer shall prepare a vacuum pump or purchase a commercially available vacuum pump.

- Vacuum pumps that can be used shall have the **rating of AC115V／8A or less**.
  - ※ Vacuum pumps whose rating exceeds 8A is outside the electric capacity of the unit and cannot be used.
- Use the outlet for the vacuum pump on the rear of the unit for a vacuum pump.
  - ※ The outlet on the rear is linked with the main unit for the power supply. If the outlet on the rear is not used, the vacuum pump will operate as a standalone unit and only the pump will operate while an error has occurred to the unit. (Some types of vacuum pump cannot be linked with the main unit.)
- Use a vacuum pump whose displacement is about **30～70ℓ/min**.
  - ※ Proper plasma state may not be attained either when the displacement is large or small.
- The connection port to the vacuum pump is **O.D. φ15mm hose coupling (barbed coupling)**. Be sure to use a correct vacuum hose (I.D.:φ12mm).
- Be sure to refer to the instruction manual of the vacuum pump to use when connecting it to the unit.

- Connecting procedures to the vacuum pump are as follows:
  - ① Fill the vacuum pump with oil referring to the instruction manual of the vacuum pump supplied with the unit.
  - ② Place the vacuum pump on a level floor or on a firm stand.
  - ③ Connect the power cable of the vacuum pump to the vacuum pump outlet on the main unit.
  - ④ Install the oil mist filter to the vacuum pump with a clamp.
  - ⑤ Connect the main unit nozzle and the vacuum pump with a vacuum hose.
  - ⑥ Turn the ON/OFF switch of the vacuum pump ON.

Recommended vacuum facilities

Item name	Model	Product code	Remark
Vacuum pump	PQ-30	242284	Vacuum pump recommended for PR200
Oil mist trap	OMT-050A	242058	Oil mist trap for PQ-30.
Vacuum pump oil (for PQ)R-2	1ℓ can	242338	
	4ℓ can	242339	
	20ℓ can	242373	
Vacuum hose	I.D.:15mm	281014	Rubber tube, length: 2m

1.How to start up the unit

When gas pipes and the vacuum pump have been connected, follow the procedures below to start up the unit.

① Connect the power cable plug on the rear of the unit to an AC115V outlet.

② Turn the ELB on the unit ON.

The pressure display comes on.

2.Processing procedures and operating procedures

When the units above have been started up, follow the procedures below to plasma-process the specimen.

① Set the specimen in the chamber and close the door.

② Open the vacuum valve and close the purge valve.

③ Press the **START/STOP** switch to start operation and evacuation.

* If light specimen might be disperse from evacuation, press the **START/STOP** switch with the vacuum valve closed and then gradually open the vacuum valve. Note that the vacuum error lamp (**PRESSURE**) will come on and the unit will stop if the specified pressure (-95kPa) is not attained.

* Some vacuum pumps may not be linked depending on the models. In that case, manually operate the vacuum pump.

④ Set the plasma processing time on the timer.

* About the timer

(1) You can set the time between 0.1s and 9990h while the continuous operation time of the unit is24h. Note that plasma process will be forced to stop in 24h.

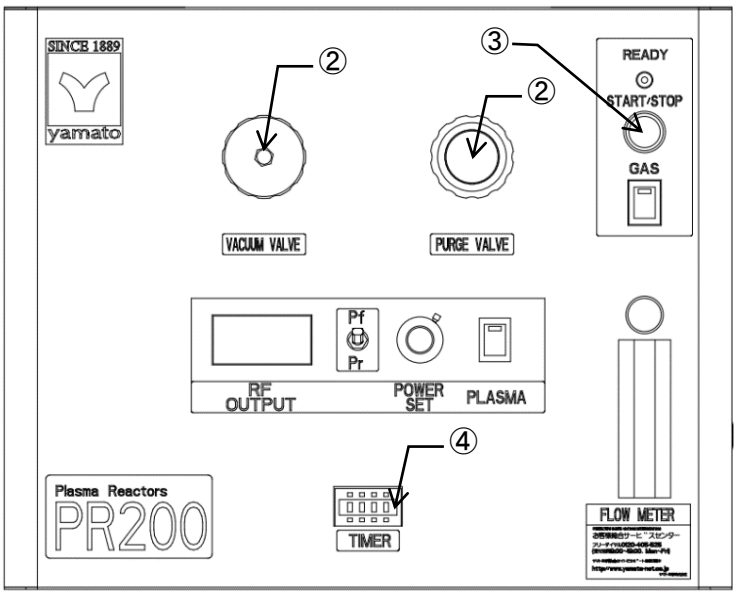
(2) Note that the unit itself may become hot after a long time operation.

(3) If you change the timer setting while the unit is in operation, the time will be changed to the new setting.

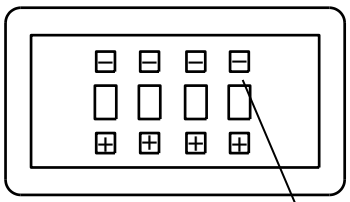
When the set time is longer, the time will be changed to that time and when shorter, plasma irradiation will be stopped.

(4) How to set the timer

Press the time unit selector switch at the rightmost end to change to the time unit you want. Then set a time using the switch.



④



Time unit selector switch

Each press changes the time as:0.1 s → s →0.1 m → m →0.1 h → h →10h.

2. Processing procedures and operating procedures

⑤ After about 2 minutes, the **READY** lamp comes on and the unit is ready for injection of gas and discharge of plasma.

⑥ Pressing the **GAS** switch will make its lamp come on and injection of gas starts.

Adjust the amount of gas to inject on the flow meter.

⑦ After turning the **GAS** switch ON, wait for at least 10 seconds and then turn the **LASMA** switch ON.

While the **PLASMA** switch is ON, its lamp is on and plasma is discharged in the chamber.

*Turning the **PLASMA** switch earlier will cause a malfunction.

⑧ Adjust the output with the **Output adjust knob**.

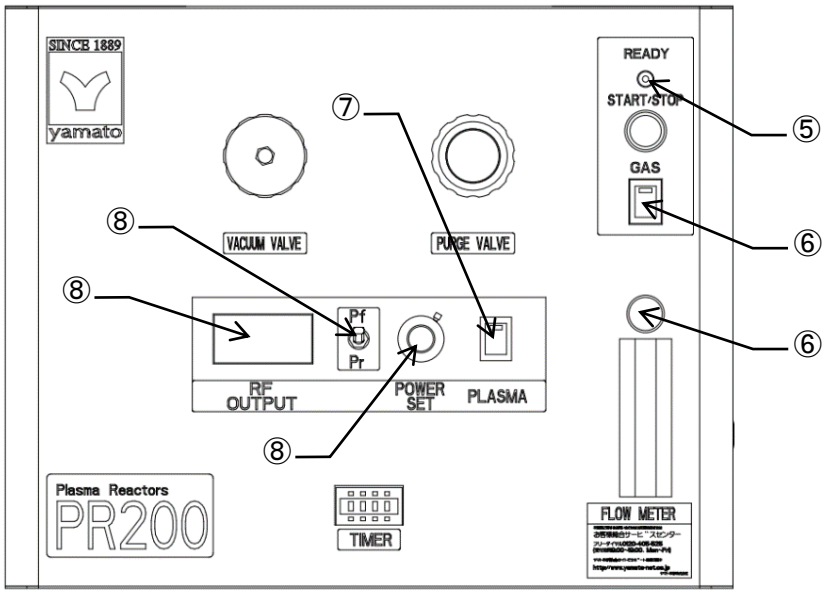
(1) Switch the Pf/Pr selector switch to Pf and turn the knob to the output you want.

(2) Switch the Pf/Pr selector switch to Pr and check the reflective wave. If the 反射波を reflective wave is 10W or more, refer to “P.30.Solutions for troubles/malfunctions”.

(3) Return the **Pf/Pr** selector switch to **Pf**.

⑨ Turning the **PLASMA** switch OFF before the time set on the timer will stop plasma discharge in the chamber. Even if you turn the switch ON, operation will not resume. Wait for about 10 seconds or longer and turn the plasma switch ON.

The time on the timer will also be reset. If you are going to start a next operating session soon, first check the timer setting.



3. How to stop the unit

Follow the procedures below to stop the unit.

① Pressing the **PLASMA** switch turns the lamp off and stops plasma discharge.

② Pressing the **GAS** switch turns the lamp off and stops gas supply.

③ Pressing the START/STOP **switch stops operation and air purge is started. (Normal operation)**

* If you are going to perform air purge slowly before taking out the specimen, turn the **START/STOP** switch OFF.

First close the vacuum valve and then gradually open the purge valve. When the pressure reaches the predefined level, the vacuum error lamp (**PRESSURE**) comes on and the unit stops. (To resume operation, turn the ELB OFF and then ON to restart the unit.)

④ Open the door and take out the specimen.

***Specimen is hot and sufficient care is need when taking it out.**

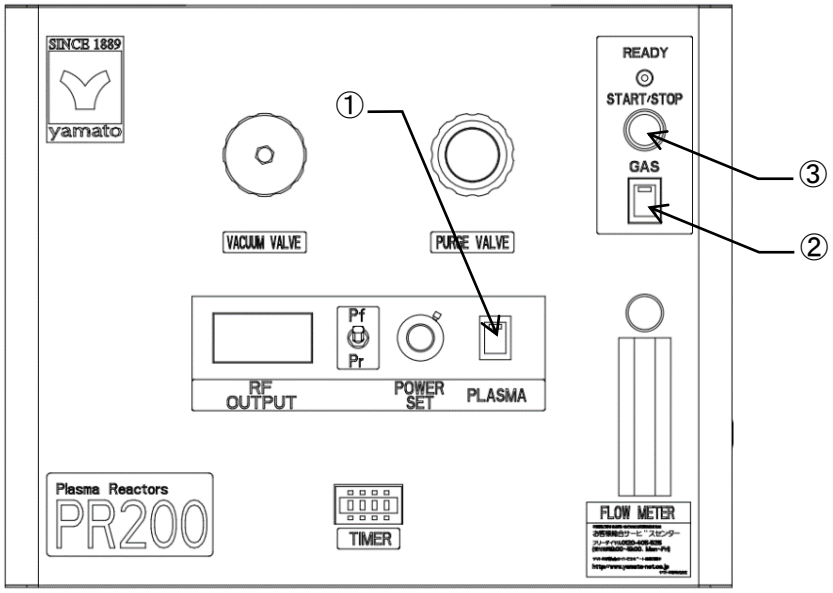
⑤ Turn the ELB OFF to finish processing.

⑥ Turn the vacuum pump switch OFF.

When the vacuum pump is linked to the unit (the outlet on the rear of the unit is used), turning the ELB ON/OFF will also turn the vacuum pump power ON/OFF.

* When the vacuum pump is operated manually, turn the vacuum pump alone OFF.

⑥ Remove the power cable plug from the outlet on the rear of the unit.



4. When you are going to continue processing

When you are going to continue processing, repeat procedures from ① of "**2. Processing procedures and operating procedures"** to ④ of "**3.How to stop the unit**".

5. Operations during a power failure

When a power failure occurs, all operations will stop and their states will not be stored. The unit will be in th**e** initial state when recovered from the power failure. Return the switches to OFF and resume ordinary operations.

6. Operations on an alarm

① When an alarm occurs, the alarm LED lamp comes on to indicate that an abnormality has occurred.

② Check the details of the trouble and turn the ELB OFF.

③ Eliminate the causes of the error or implement solutions and then turn the power on again.

(Start the procedure with **1.How to start the unit** above to turn power on again.）

*Causes and solutions of alarms are listed in the section “P.29 When an alarm occurred”.

7. Emergency stop

If you need to stop the unit immediately due to an emergency, press the **START/STOP** switch or turn the ELB OFF. Such operation will suddenly purge the chamber and extreme care must be taken for possible belching of specimen.

Never fail to remove the causes of the emergency before restarting the unit.

（Start the procedure with **1.How to start the unit** above to turn power on again.）

8.Interlock

The unit is equipped with the interlocking mechanism below to prevent a dangerous situation from a malfunction.

Operation or state	Interlock
START switch	Operation (START) is not possible unless the door is closed.
GAS switch	Interlock will be enabled only after operation has started and the **READY** lamp is on. （Turning this switch ON before the **READY** lamp comes on will not introduce gas. ） While gas is being introduced, the lamp in the switch will on.
PLASMA switch	Interlock will be enabled only while the lamp in the **GAS** switch is on (gas is being introduced). (Plasma is not discharged if the **GAS** switch is turned ON before the lamp comes on.) The switch lamp is on while plasma is discharged. Even if you turn the **PLASMA** switch OFF and then ON during plasma discharge, operation will not resume immediately. Wait for about 10 seconds or longer and turn the **PLASMA** switch ON.
Timer	The time is used to control duration for plasma discharge. Plasma discharge and introduction of gas will stop when the set time comes. (The lamps in the **PLASMA** switch/ **GAS** switch will also go off.) To resume plasma discharge, turn both the **PLASMA** switch and the **GAS** switch OFF, wait for about 10 seconds or longer and turn the **GAS** switch and then the **PLASMA** switch ON in this order.

7. Handling precautions

⚠ Warnings

1. Never use any explosive or flammable substances.

Never process any explosive, flammable samples and also samples contained with those substances. It will cause fire/explosion. (See Chapter 15. List of dangerous materials on page 37.

2. Take extreme care when using a resin container.

Be sure to check the withstand temperature before using a resin container. Using such a container under a temperature beyond its withstand temperature will melt resin and a fire or an explosion may result

3. Turn the ELB off when an abnormality occurs.

Turn immediately off Earth Leakage Breaker (ELB) of this Equipment and disconnect Power Cord/Power Cable from receptacle or switch board of facilities, if smoke or strange smell is generated from it by any chance.
Contact with local dealer or Yamato sales office and/or Yamato Customer service Center and ask them to inspect it. If nothing is done to it, fire or electrical shock may result.
Never repair it by customer themselves to avoid any dangers.

4. Take extreme care for handling of samples after operation at a higher temperature.

Take care not to touch samples when taking them in or out since inside the chamber, internal wall of the door or samples are still hot for some time after operation at a higher temperature. Be sure to put on heat-resistance gloves and take extreme care for burning when handling samples.

5. Never attempt to touch hot surfaces.

Do not touch the ceiling and the door during and immediately after operation because these are still hot. Otherwise burning may result.

⚠ Cautions

6. Do not climb on the Equipment.

Do not climb on this Equipment. May cause personal injury and/or its failure by tipping it over and being damaged.

7. Do not place any stuff on the Equipment

Do not place any stuff on this Equipment. May cause personal injury falling it off.
Do not close up any flammable materials such as paper around it.

8. Do not give shocks.

Never give shocks to the door or the whole unit while the chamber is still in the vacuum state, which might cause the chamber to rupture and lead to a dangerous situation.

9. Never attempt to transport the unit while it is in operation.

Transporting the unit while it is in operation may cause a malfunction of the unit or a personal injury.
Never attempt to transport the unit while it is in operation.

10. When a thunder is heard, immediately turn the ELB product off.

When a thunder is heard, immediately turn the power and the ELB of the controller of this product off and shut down the power supply. Otherwise, a fire may result from lightening.

11. Check the following during a power failure or after recovery.

When the unit stops its operation from a power failure, all operations will stop and their states will not be stored. The unit will be in the initial state when recovered from the power failure. See “P.19 Operation during a power failure” for details.

12. Let specimen dry.

If specimen is wet, evacuation will take excessive time causing the evacuation alarm. Also, moisture condensates in the vacuum pump and lead to a malfunction. Let specimen sufficiently dry before plasma washing to prevent vacuum performance from being compromised.

13. Do not place too much specimen.

If too much specimen come into contact with the chamber, the electrode and the chamber will be short-circuited and the specimen and the unit may be damaged. Place specimen on the lower electrode and assure some spaces between the chamber and the specimen.

14. Take sufficient care when placing specimen.

Placing too much specimen may prevent proper performance due to overload. Rough guidance of specimen amount is 5% or less of the chamber capacity.

7. Precautions for handling

⚠Caution

15. Take care for high temperature when taking out the specimen.

When taking out the specimen from the chamber, take care not to directly touch the chamber or the electrodes which may be still hot. Otherwise burning may result.

16. Carry out maintenance of the chamber door.

⚠ As the unit is used, reactive product of specimen will attach onto the glass inside the chamber door and it will be difficult to observe inside the chamber through the observation window. Frequently clean the glass inside the door.

17. Effects from radio frequency

⚠ When the unit is operated with other device in parallel, it may be subject to adverse effects of radio frequency. If parallel operation is inevitable, separate other device as far from this unit as possible and supply power from a different power circuit.

18. Application for radio frequency facilities

⚠ This product is radio frequency facility and requires the permission by the chief of The Bureau of Telecommunications as stipulated in the Radio Act.
To apply for the permission, fill in the application form included, include a return mail envelope (with the return address written and stamp(s) for the necessary amount is pasted, and send to the Broadcasting bureau, the Broadcasting department of the local Bureau of Telecommunications with jurisdiction over the installation site of the unit.

◆**For new application**		
1	Application for radio frequency facilities	1 copy
2	Attachments to the Application for radio frequency facilities	2 copies
3	Diagram that indicates buildings and other facilities in the vicinity of the installation site.	2 copies
4	Appearance drawing of the plasma unit	2 copies
5	Letter of attorney when application is made by an attorney	1 copy
6	Return mail envelope and stamp(s)	1 copy
◆Application has already made and will be modified or added		
1	Application for changes of radio frequency facilities	1 copy
2	Attachments to the Application for radio frequency facilities	2 copies
3	Diagram that indicates buildings and other facilities in the vicinity of the installation site.	2 copies
4	Appearance drawing of the plasma unit	2 copies
5	Documents in which the radio frequency facilities with permission are indicated	Required number of copies
6	Letter of attorney when application is made by an attorney	1 copy
7	Return mail envelope and stamp(s)	1 copy

*** Documents 1～4 are included in the package of "Application for radio frequency facilities" included with the unit.**
Carefully read the "Guidance on the application for radio frequency facilities" before making an application.

7. Precautions for handling

⚠Caution

19. Take care for the selection of the supply gas.

⚠ This product supports the specified oxygen gas or atmospheric air. Using any other gas may cause a malfunction.

20. Adjusting gas pressure

⚠ When supplying gas to the introduction port from a gas cylinder, adjust the secondary pressure to 0.1Mpa or lower using the pressure regulator.

21. Never use thinner, benzine, scouring powder or alcohol to remove dirt on the unit.

⃠ Never use thinner, benzine, scouring powder or alcohol to remove dirt on the unit. Its coating may peel off or deformation, discoloration or degradation may result. Be sure to turn the ELB on the right side of the unit before carrying out maintenance.

22. Never fail to perform periodic inspection.

❗ Check regularly Earth Leakage Breaker (ELB) which it is key part/Device for the safety of this Equipment.
Refer to Maintenance Method on page 25 to 27.

23 Be sure to read the operating instructions.

❗ Be sure to read the operating instructions before using the unit.

8. Maintenance method

Daily inspection/maintenance

Warning

- Be sure to turn off Earth Leakage Breaker(ELB) of this Equipment before daily inspection and maintenance
- Inspect and maintenance this Equipment at ambient temperature on its Chamber.
- Never disassemble this Equipment.

Caution

- Wipe dirt off with wrung tightly soft cloth.
  Never clean this Equipment with benzene, thinner, scouring powder or alchols, or rub with a scrubbing brush.
  May cause deformation, degradation and/or discoloration.

Regular Inspection Table

№	Inspection point	Description of inspection	Judgment criteria	Check	Remark
1	Cooling fan	Sound	Rotation without any abnormal noise		
		Vibration	Free of abnormal vibrations		
		Odor	Free of strange odor		
2	Chamber door	Opening/Closing	Opens/closes smoothly		
		Completeness of closure	There shall be no gap between the chamber and the door. O ring is free of deterioration or cracks.		
		Dirt	Glass part inside the chamber door is not dirty.		
3	Supply gas	Pressure	Processing gas＝Supply pressure: 0.1MPa or less (Atmospheric air can be drawn at the normal pressure)		
4	Gas connection	Gas leak	There shall be no gas leak.		
5	Vacuum discharge connection	Tightening	There shall be no loosening.		
6	Commercial input wiring	Connection state	There shall be no loosening on the outlet plug.		
			There shall be not abnormal increase in temperature on the outlet plug.		
7	Vacuum pump	Oil level	Between the level lines		
		Oil color	Not dirty		
		Sound	Free of abnormal noise		
		Vibrations	Free of abnormal vibrations		
		Oil leak	There shall be no leak.		
		Connecting wire	There shall be no loosening of connection.		
		Instruction manual of the vacuum pump	Refer to the section on the handling of the vacuum pump.		

8. Maintenance procedures

Regular inspection/Maintenance

Carry out regular inspection as per the inspection intervals in the table below.

Every month					
Inspection date : Year Month Day Temperature : ℃ Humidity : % Inspector :					
№	Inspection points	Description of inspection	Judgment criteria	Check	Remark
1	ELB	Check for electric leakage	After supplying power for the product, press the power test button to shut power off		If power is not shut off, the ELB must be replaced.
2	Exhaust speed test	No-liquid operation, vacuum valve fully open	1 minutes or less from the atmospheric pressure to -95kPa		Oil must be exchanged or inspected when the judgment criteria is not met or the oil is dirty.
3	Vacuum leak test	Close the vacuum valve after evacuation	Starting from the vacuum level when the vacuum valve is closed, the vacuum level after 3 minutes is within -95kPa		Check the O ring of the door part. Connection within the piping routes

1 : Inspection of the ELB functions

- Conduct the test with the power cord connected and power is supplied.
- First turn the ELB “ON(|)”.
- Then press the test button on the ELB with a pointed object such as a ballpoint pen to check that the ELB is turned “OFF(○)”, which indicates the normal state.

* Note that operation check of the ELB must be carried out before long time continuous operation or unmanned operation during nighttime.

2 : Inspection by conducting the exhaust speed test

- Carry out operation stipulated in the section “1. Starting the unit” on page 17.
- It is normal if the pressure display shows a pressure of -95kPa or less within 1 minute.

3 : Inspection by conducting the vacuum leak test

- Close the vacuum valve after evacuation.
- It is normal if the pressure display shows a pressure of -95kPa or less.

■About the vacuum pump

- Although frequency of exchanging of vacuum pump oil will greatly change depending on use conditions, rough standard will be 3 to 6 months.
- The standards are for reference only since the exhaust speed or attained vacuum level will differ depending on the vacuum pump used.

8. Maintenance procedures

Regular inspection/Maintenance

Carry out regular inspection as per the inspection intervals in the table below.

Every year					
Inspection date： Year Month Day Temperature： ℃ Humidity： % Inspector：					
№	Inspection points	Description of inspection	Judgment criteria	Check	Remark
1	Retightening of connecting screws	Conduct during total stop	There shall be no loosening.		
2	Retightening of pipe couplings	Conduct during total stop	There shall be no loosening.		
3	Replacement of the O ring	Conduct during total stop	There shall be no flaws or attachment of foreign objects.		

1：Retightening of connecting screws

・Remove the power cord and retighten the screws.
Points to retighten：Door hinge & vacuum pump connecting port

2：Retightening of pipe coupling

・Remove the power cord and retighten the coupling of the oxygen gas introduction port on the rear.
・Check the retightening of the vacuum hose.
・When the vacuum hose is made of rubber, check for cracks.

3：Replacing the O ring

・Check the O rings of the chamber and the door.
・Replace if a crack or a breakage is found.

◆Replacement frequency of parts shown above is for reference only. Earlier replacement is necessary depending on the frequency of use.
◆If there is unclear point, immediately contact you dealer, one of our sales offices or the general customer service center.

9. Long storage and scrap

When not using the Equipment for a long time / when scrapping

⚠ Warning	⚠ Caution
Do not operate this Equipment for the time being. ● Turn Earth Leakage Breaker(ELB) off and disconnect Power Cord/Cable from receptacle /switch board of facilities.	Scrap this Equipment. ●Do not leave this Equipment alone where children may play and get at it. ●Before discarding the equipment, be sure to remove the hinge and the door lock assembly so that you cannot close the door hermetically

Matters to consider when scrapping the Equipment

Pay attention always to the preservation of the global environment.

We, as Yamato Scientific Co., Ltd. highly recommend taking this Equipment apart as far as possible for separation or recycling to contribute to the preservation of the global environment according to the specified garbage collection method stipulated by each local government.

List major components and their materials for this Equipment as follows:

Names of major parts	Material
Major components of the Equipment	
External Structure	Chrome free electrogalvanized carbon steel sheet coated w/Chemical-proof baking finish
Chamber	Pyrex glass
Electrode	Cupper plate
Door and the observation window	Heat resistant reinforced glass, acrylic plate, chrome-free galvanized steel chemical resistant bake finish
Pipes and pipe couplings	Fluorine resin
Suction and exhaust valves	SUS316
Door packing	Silicon rubber
Major components of electrical parts	
Switch and Relay	Composite of resin, cupper and other materials
Printed Circuit Boards	Composite of fiber glass and other materials
Power Cord/Cable	Composite of synthesized rubber coating, cupper, nickel and other compound materials
Wires	Composite of fiber glass, fire-retardant vinyl, cupper, nickel and other materials
Stickers	Resin materials

10. When a trouble occurs

When an alarm occurred

When an alarm occurs, implement the following solutions. If any of the causes listed are not regarded as a cause, move to the fault diagnostics on the next page.

Alarm display (lamp on)	Suspected causes	Solutions
PLASMA (RF short circuit error)	High pressure power supply is short circuited	Replacement of the high pressure power supply is necessary. (service call)
	Plasma is not be generated because the vacuum level is too high or too low.	Adjust the gas flow. Check the following: ・Upper pressure limit : Be sure to flow gas. ・Lower pressure limit : Higher than -95kPa ・Inspect the vacuum pump.
PRESSURE （Evacuation error）	**The vacuum valve is closed or** its **openness is small.**	Open the vacuum valve.
	The purge valve is open	Close the purge valve.
	Leak ・The O ring has an foreign object bitten, dirt, a flaw or a crack ・The pipe is loosened	・Inspect, clean or replace the O ring. ・Check the pump power, connection, flaws or cracks of the hose.
TEMPERRATURE (temperature error)	・Heat sink temperature of the high voltage power unit exceeded 90℃. ・The rear fan is stopped	・Stop operation until the high voltage power unit cools down and check for any clogging of the exhaust fan on the rear of the unit. ・Check the environment, temperature and the space of the installation site. ・Replacement of the rear fan is necessary. (service call)

10. When a trouble occurs

Solutions for troubles/malfunctions

When the unit presents any troubles other than alarms, the following causes are suspected.

Symptom	Causes	Solutions
Turning the ELB will not show any numeric values on the pressure display.	・Power is not supplied. ・ELB is defective.	・First check that power is connected before supplying power. ・Replace the ELB. (service call)
Turning the **START/STOP** switch will not start the pump.	・Vacuum pump cable is not connected securely. ・Power of the vacuum pump is not turned ON. ・The vacuum pump has come off. ・The door is open.	・Check that the cable is securely connected. ・Turn the vacuum pump power ON. ・Check the hose connections. ・Securely close the door.
Evacuation error Insufficient vacuum level	・Door packing has come off ・Door packing has been deteriorated ・Pump oil has deteriorated ・Specimen is wet necessitating more time for air purge. ・There is a leak at the pipe coupling.	・Securely put the door packing and check for any foreign objects. ・Replacement of the door packing is necessary. ・Exchange the pump oil. ・First let the specimen dry before loading. ・Carry out the leak test and retighten the pipe coupling.
Gas will not be supplied	・Gas main valve is closed. ・Gas cylinder is empty.	・Open the gas main valve. ・Replace the gas cylinder.
Turning the **PLASMA** switch ON cannot attain the RF output.	・Gas is not supplied. ・RF power is defective.	・Turn the **GAS** switch ON. ・Inspect/replace the RF power supply.
Pr：When reactive is wave large	・Check for vacuum leak. ・Check that gas amount is correct. ・If the specimen is too much or not.	・Check for vacuum leak. ・Change the gas amount ・Reduce the specimen volume.

❖ In the case if the error other than listed above occurred, contact the shop of your purchase or nearest Yamato Scientific Service Office.

11. After sales service and warranty

Request to repair parts

When any abnormality occurs immediately stop operation, turn the controller power and the ELB off and contact your dealer, one of our sales offices or the customer service center.

Require the following information for repair.
- Model name of Yamato products
- Serial Number
- Date (year/month/date) of purchase
- Description of trouble in detail as possible

Refer to the warranty card or see the nameplate for cautions and ratings placed on the main unit.

Be sure to present the warranty card to Yamato service representative.

Keep Warranty Card with care.(attached separately)

- Keep Warranty Card with care.
  Warranty Card would be given by local dealer or one of Yamato sales offices.
  Date of purchase of this Equipment and other information should be filled in Warranty Card.
  Please send Warranty Card to Yamato Customer Service Center(Yamato CSC) by facsimile described Fax number in the left top corner of it.
  Then, keep its Card with good care.

- Repair this Equipment for free of charge according to the contents on Warranty Card.
  Warranty period is 1(one) year from date of purchase.

- Consult with local dealer, one of Yamato sales office or Yamato CSC for any repair after warranty ended.
  Charged repair service of this Equipment will be available on customer's request when it can be maintained functional by its repair.

Guarantee for maximum storage period of repair parts.

Guarantee that maximum storage period of repair parts will be 7(seven) years after end of their production.
Repair parts will be defined the parts to maintain this Equipment performance.

12. Specifications

Specifications

Item name		Small plasma unit
Model		PR200
Processing chamber		Drum type horizontal glass chamber
Operating environmental temperature range		5℃～35℃
Power supply		Single phase 115V±10%, common for 50/60Hz
		Unit rated current：13.5A ・Main unit rated current：5.5A ・Max. outlet permissible current：8A
Performance ※1	Radio frequency output	Max.200W
	Oscillating frequency	13.56Mz±1kHz
	Continuous processing time	24 hours
Configuration	Exterior	Chrome free electrogalvanized steel plate (SECC) Chemical proof bake finished
	Interior	Pyrex glass
	Door	Vertical manual open/close system
	Observation window	Rectangle observation window
	Electrode structure	Warp plate electrode at the outside of the chamber
	Vacuum meter	Digital vacuum sensor
	Flow meter	Flow meter (For O_2)
	Vacuum, purge adjusting valve	Manual vacuum valve and purge adjusting valve
	Timer	0.1s～9990h (The continuous operating time of the unit is 24h or less)
	Vacuum pump connecting port	O.D.:φ15mm hose coupling(barbed coupling)
	Required exhaust speed of the vacuum pump	30～70L/min ※2
Gas system	Reactive gas ※3	O_2(1 system)
	Flow	Max 300mL/min
	Gas connecting port	O.D.:φ6.35mm, pipe connecting coupling, supply pressure:0.1MPa or less
	Purge gas	Atmospheric air
Controller	Type	Programmable relay
	Control system	Manual＋sequential control
Safety unit	ELB	15A
		Protection against electric leakage, short circuit, over current Rated sensed current:30mA
	Error display	RF short circuit error, evacuation error, temperature error
	Door switch	Door open：START/STOP switch disabled Door close：START/STOP switch enabled
Standard	External dimensions ※4	W350mm×D400mm×H500mm
	Chamber dimensions	I.D.φ100mm×approx.160mm
	Capacity	Approx. 1.3ℓ
	Weight	Approx.25kg

12. Specifications

・Specifications

Accessories	Specimen stand	1
	Insert bush for the gas connecting port	1
	Instruction manual	This document：1 copy
	Warranty card	1 copy
	Application for radio frequency facilities	1 set
Article	※1：Performances have been measured at: Rated source voltage, single phase:115V±5%; room temperature:23℃±5℃; humidity:65%±20%; and no load. ※2：Vacuum pump is not included. The customer shall prepare a vacuum pump or purchase a commercially available vacuum pump. ※3：Drawing atmospheric air is acceptable as a reactive gas, whose flow may not be correct. ※4：Protrusions are excluded.	

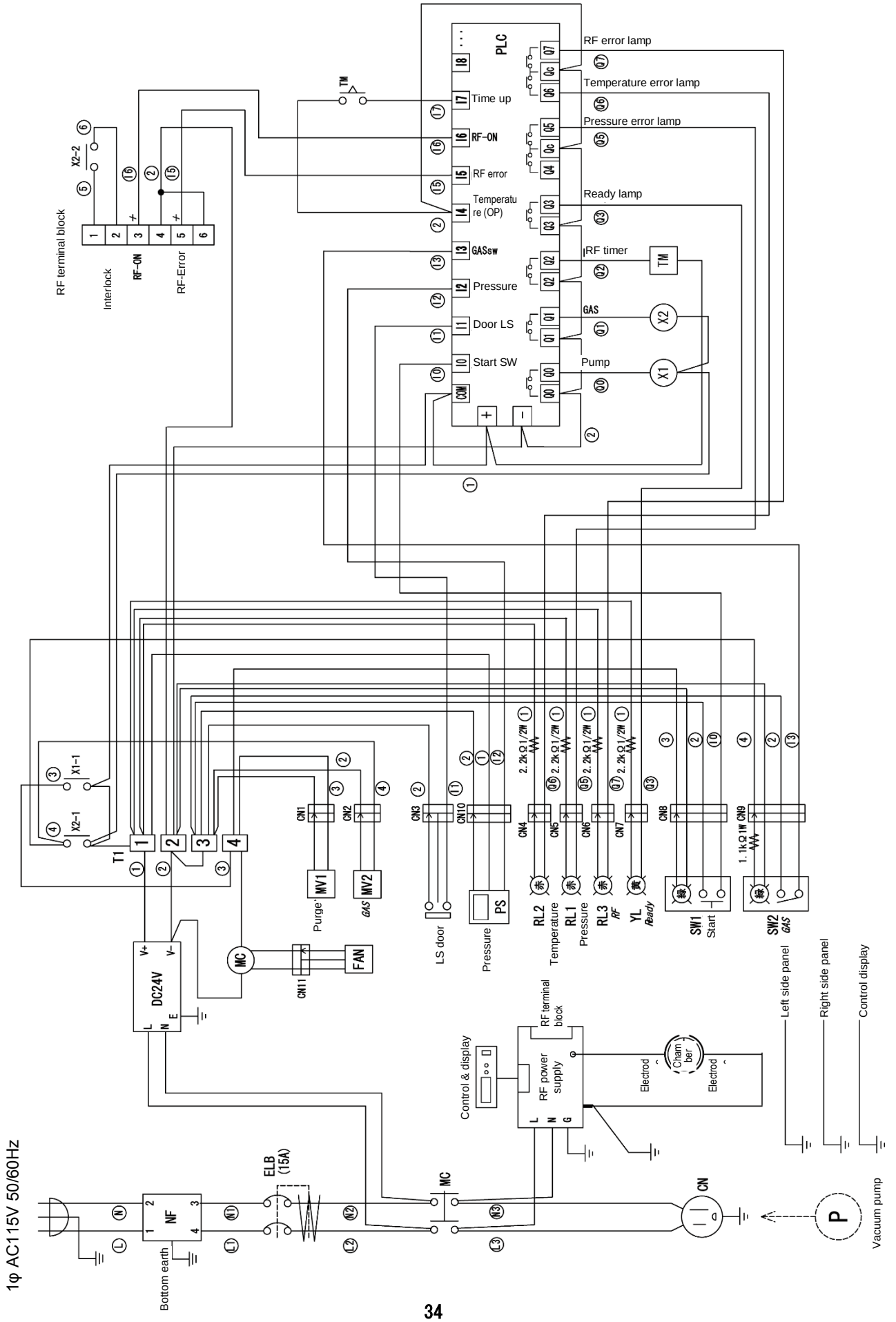
・List of optional parts

Item name	Model	Product code	Remark
Vacuum pump	PQ-30	242284	Vacuum pump recommended for PR200.
Oil mist trap	OMT-050A	242058	Oil mist trap for PQ-30
Vacuum pump oil (For PQ)R-2	1ℓ can	242338	
	4ℓ can	242339	
	20ℓ can	242373	
Vacuum hose	I.D.:15mm	281014	Rubber tube, length:2m
Plasma chemical indicator	PLAZMARK No.1	215093	
	PLAZMARK No.2	215094	
	PLAZMARK No.3	215095	
PR200 stand	OPR12	215070	Work stand on which the main unit is placed. The main body and the stand can be fixed together for operation.
PR200 anti seismic clamp	OPR14	215071	Clamps used to fix the main unit to a work table.

Some optional components can be installed after delivery or installation of this product. Consult your dealer or one of our sales offices for optional components.

13. Wiring diagram

PR200 wiring diagram



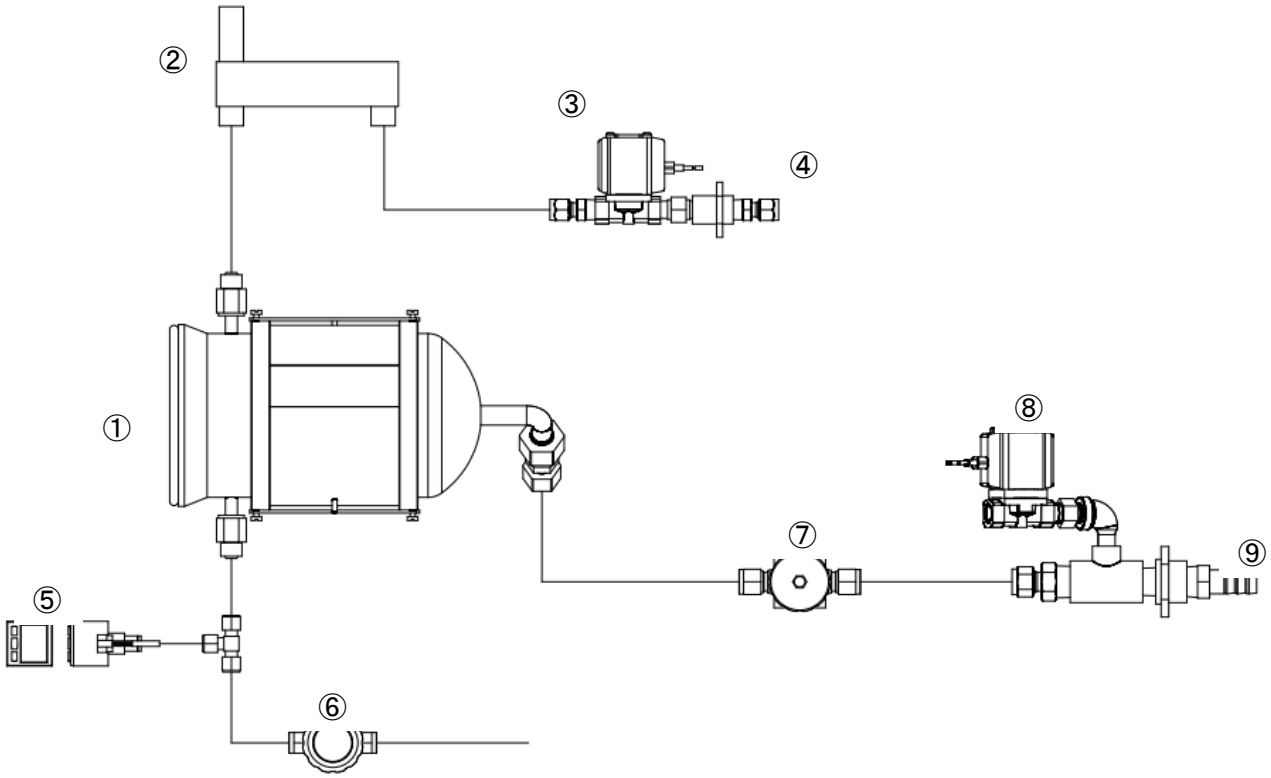
13. Wiring diagram

Part symbols of wiring diagram

Symbol	Name	Symbol	Name
ELB	Electric Leakage Breaker	RL1	Error lamp (pressure)
NF	Noise filter	RL2	Error lamp (temperature)
MC	VC relay	RL3	Error lamp (plasma)
CN	Outlet	YL	READY lamp
RF power supply	RF power supply	SW1	START/STOP switch lamp
DC24V	24V power supply	SW2	GAS switch lamp
FAN	Blower fan	PLC	Control unit
MV1	Purge solenoid valve	X1	Relay (pump)
MV2	O_2 solenoid valve	X2	Relay (GAS)
LS	Door switch	TM	Plasma processing time timer
PS	Pressure switch		

14. Pipe system diagram

Pipe system diagram



Number	Part name
①	Borosilicic acid chamber
②	Flow meter
③	Solenoid valve (for gas)
④	Oxygen（O_2） gas connecting port (pipe diameter:(pipe dia.：φ6.35㎜)
⑤	Pressure meter
⑥	Needle stop valve (purge)
⑦	Operation valve (evacuation)
⑧	Solenoid valve (for vacuum/purge)
⑨	Vacuum nozzle (O.D.:φ15㎜)

15. List of dangerous substances

Never process any explosive, flammable samples and also samples contained with those substances.

Explosive Substance	①Nitroglycol, Glycerine trinitrate, Cellulose Nitrate and other explosive nitrate esters
	②Trinitrobenzen, Trinitrotoluene, Picric Acid and other explosive nitro compounds
	③Acetyl Hydroperoxide, Methyl Ethyl Ketone Peroxide, Benzoyl Peroxide and other organic peroxides
	④Metallic Azide, including Sodium Azide, etc.
ExplosiveSsubstances	①Metal “Lithium” ②Metal “Potassium” ③Metal “Natrium” ④Yellow Phosphorus ⑤Phosphorus Sulfide ⑥Red Phosphorus⑦Phosphorus Sulfide ⑧Celluloids, Calcium Carbide (a.k.a, Carbide)⑨Lime Phosphide⑩Magnesium Powder ⑪Aluminum Powder ⑫Metal Powder other than Magnesium and Aluminum Powder ⑬Sodium Dithionous Acid (a.k.a., Hydrosulphite)
Oxidizing Substances	①Potassium Chlorate, Sodium Chlorate, Ammonium Chlorate, and other chlorates
	②Potassium Perchlorate, Sodium Perchlorate, Ammonium Perchlorate, and other perchlorates
	③Potassium Peroxide, Sodium Peroxide, Barium Peroxide, and other inorganic peroxides
	④Potassium Nitrate, Sodium Nitrate, Ammonium Nitrate, and other nitrates
	⑤Sodium Chlorite and other chlorites
	⑥Calcium Hypochlorite and other hypochlorites
Flammable Substances	① Ethyl Ether, Gasoline, Acetaldehyde, Propylene Chloride, Carbon Disulfide, and other substances with ignition point at a degree 30 or more degrees below zero.
	②n-hexane, Ethylene Oxide, Acetone, Benzene, Methyl Ethyl Ketone and other substances with ignition point between 30 degrees below zero and less than zero.
	③Methanol, Ethanol, Xylene, Pentyl n-acetate, (a.k.a.amyl n-acetate) and other substances with ignition point between zero and less than 30 degrees.
	④Kerosene, Light Oil, Terebinth Oil, Isopenthyl Alcohol(a.k.a. Isoamyl Alcohol), Acetic Acid and other substances with ignition point between 30 degrees and less than 65 degrees.
Combustible Gas	Hydrogen, Acetylene, Ethylene, Methane, Ethane, Propane, Butane and other gases combustible at 15℃ at one air pressure.

Excerpt from Table 1, Hazardous Substances, of Cabinet Order of the Occupational Safety and Health Law (substances related to Articles 1, 6, and 9)

16. Standard setup manual

*Install this Equipment according to following format (Check the format for options or customized specifications)

Model	Serial number	Installation Date	Charged Personnel or Company Name for Installation	Installation proved by	Judgment

№	Item	Implementation Method	Chapter No. & Reference page of Instruction Manual	Judg-ment
Specifications				
1	Accessories	Check for number of accessories Against to Accessories Column.	12. Specification P.33	
2	Installation	・ Check room environment visually. Caution: Take care for environment	2. Before operating the Equipment ・ Precautions when installing t・・・ P.8	
		・Make installation space.		
Equipment Operation				
1	Voltage of Power Source	・Measure line voltage (power distribution board of facilities, receptacle, etc.) with voltmeter. ・Measure line voltage during operation. (Must meet required voltage.) Caution: Check receptacle rating or breaker on power switch board rating to meet this Equipment requirement.	2. Before operating the Equipment P.9 ・Connect Power Cord/Power Cable・・・ P.10 ・Must connect grounding wire・・・ P.32 12.Specification ・Power Supply・・・	
2	Installation	・ Check of gas pipe connections (only when necessary)(Secondary pressure is adjusted to 0.1MPa or less) ・Check the vacuum pump connection	5. Installation procedures P.15 P.16	
3	Operation checking	・Description of names and functions of parts ・Check of plasma discharge Gas flow：100 ㎖/min Output：200W Timer setting time：1min	4.Names and functions of parts P12～14 P17～20 6.Operating the unit	
Description				
1	Operational descriptions	Explain operations of each component and handling precautions according to Instruction Manual.	6. Operating procedure ・.How to start up the unit ～Interlock P.17 P.20 1.Safety precautions P.6 8.Handling precautions P.21 17. List of dangerous substances P.37	
2	Solutions to alarms	Description of alarm displays and solutions as per the instruction manual.	10.When an alarm occurre P.29 11. After sales service and warranty P.31	
3	Maintenance and inspection	Explain operations of each component according to Instruction Manual.	9. Maintenance method ・Daily inspection/ maintenance P.25	
4	Completion of installation Entries	・Fill in Installation Date and Charged Personnel or Company Name on OK and Service seal of this Equipment. ・Fill in necessary information to Warranty Card and hand it over to customer. ・Explain how to contact with service personnel.	11 After sales service and warranty ・ Request to repair parts P.31 ・Warranty Car ・Repair p**arts**	

Limited liability

Be sure to use this Equipment strictly following the handling and operating instructions in this Instruction Manual.
Yamato Scientific Co., Ltd. assumes no responsibility for accident or malfunction caused by use of this Equipment in any way not specified in this Instruction Manual.
Never attempt to perform matters prohibited in this Instruction Manual.
Otherwise, unexpected accident may result.

Notice

- **Descriptions in this Instruction Manual are subject to change without notice.**
- **WE, as Yamato Scientific Co., Ltd. will replace this Instruction Manual with missing page or paging disorder.**

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Small Plasma Unit
PR200
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