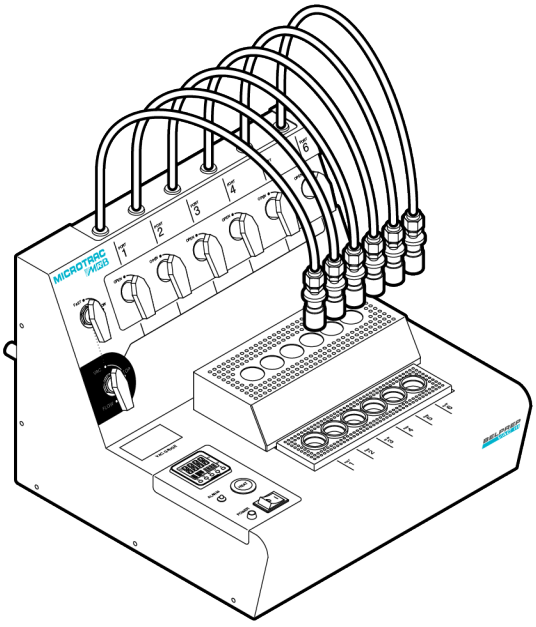
MICROTRAC MRB
PARTICLE CHARACTERIZATION

Gas/Vapor Adsorption Measurement
Pretreatment Instrument

BELPREP VAC III

USER'S MANUAL



Thank you for purchasing this product.

- Read the user's manual thoroughly, and then use the device correctly and safely.
- **Before use, be sure to read "SAFETY PRECAUTIONS (pages 1 to 5)."**
- After reading the user's manual, store it safely in a location where it can be accessed whenever necessary.

SAFETY PRECAUTIONS

About this product

- **To use this product safely, this product must only be used by people who have mastered the required techniques or by people who have received instructions from instructors who have mastered the required techniques.**
- MicrotracBEL accepts no responsibility for device or optional equipment being damaged due to incorrect usage.
- This product's warranty lasts for 1 year after delivery.
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About this manual

- MicrotracBEL accepts no responsibility for any effects resulting from the use of this manual.
- This manual is copyrighted by MicrotracBEL Corp.
- Do not use or copy this manual in whole or in part without permission.
- The contents of this manual may be changed without notification.

Explanation of warning statements

Precautions are expressed in this manual according to the classifications or icons shown below.

Fully understand the precautions written in this manual before using this product.

⚠ **WARNING**	Failure to follow the precautions indicated with this mark may lead to death or serious injury.
⚠ **CAUTION**	Failure to follow the precautions indicated with this mark may lead to injury or damage to peripheral equipment.
	This mark indicates actions that are prohibited.
	This mark indicates actions that must be performed.

During Installation

⚠ WARNING

Do not install the device in a location such as those described below.

Doing so may lead to fire, electric shock, injury, or malfunctions.

- Unstable locations
- Locations close to open flames
- High temperature or high humidity locations
  Installation environment specifications
  Temperature: 10°C to 35°C
  Humidity: 20%RH to 80%RH
- Locations subject to water
- Locations where powerful magnetic fields or radio waves are present
- Locations subject to direct sunlight
- Locations where ventilation equipment is not present
- On a stand that has poor heat resistance

Install the device in a level location with minimal vibrations and implement countermeasures to prevent the device from falling over.

Failing to do so may lead to injury or malfunctions arising from the device or optional equipment tipping over or falling down.

Power Cable and Plug

⚠ WARNING

Do not damage the power cable.

Doing so may lead to electric shock or malfunctions.
Do not damage the power cable or bend it forcefully.
Also, do not use damaged power cables.

Do not replace the power cable with one that has inappropriate ratings.

Doing so may lead to electric shock or malfunctions.
Use the included power cable.

Do not use an unstable power supply.

Doing so may lead to electric shock or malfunctions. Use a power supply with a voltage fluctuation within 10%.

Use the device with the specified power supply voltage and ground the device.

Doing so may lead to electric shock or malfunctions.
Use the device or optional equipment with the single-phase, AC power supply displayed on the back of the device and ground the device with the included power cable with grounding wire.

Fix the power cable and plug in place securely to ensure that they do not fall out.

Failing to do so may lead to fire.
The power cable has its own weight, and tension acts on the connection, so fix the power cable in place securely.

⚠ WARNING

When disconnecting the power cable, be sure to pull it from the power plug.
Failing to do so may lead to electric shock or fire.

Before moving the device or optional equipment, turn off the device and remove the power plug from the outlet.
Failing to do so may lead to electric shock or injury.

When the device or optional equipment will not be used for a long period of time, turn it off and remove the power plug from the outlet.
Failing to do so may lead to electric shock, electric leakage, or fire arising from insulation degradation.

If you detect a problem, turn off the device and remove the power plug from the outlet.
Using the device while an error has occurred (such as when you detect smoke, a strange odor, or abnormal noises) may lead to fire or electric shock.
Contact MicrotracBEL immediately.

If water spills inside the device or optional equipment, turn off the device and remove the power plug from the outlet.
Using the device or optional equipment in this state may lead to fire or electric shock.
Contact MicrotracBEL immediately.

During Use

⚠ WARNING

Do not disassemble, modify, or repair the device.
Doing so may lead to electric shock, fire, injury, or malfunctions.

Do not touch the device or optional equipment with wet hands.
Doing so may lead to electric shock.

Do not insert conductive objects into the inside of the device or optional equipment.
Doing so may lead to electric shock, short circuits, or fire.

Do not subject the device or optional equipment to water.
Doing so may lead to electric shock or short circuits.

During use and for some time after use, do not touch the heater, Sample cell, or other such parts that are hot.
Doing so may lead to burns.
Before performing operations such as piping work and cleaning, wait for parts such as the heater and sample cell to cool down.
Furthermore, do not allow people who have no knowledge of the device or optional equipment to touch it.

⚠ WARNING

Do not set temperature controller beyond the maximum operating temperature of the heater.

Normally, the temperature controller will not allow you to set the temperature beyond the maximum operating temperature of the heater. It is very dangerous if you set the temperature beyond the maximum operating temperature by overriding this protective function. You must never override this protective temperature setting function. Never set the temperature above the maximum operating temperature of the heater.

⚠ CAUTION

Do not subject the device or optional equipment to strong impacts.

Doing so may lead to malfunctions or damage.

Do not cover the device's or optional equipment's air intake and exhaust ports.

Doing so will cause heat to build up within the device or optional equipment, which may lead to malfunctions.

Only use accessories and optional products recommended by MicrotracBEL.

MicrotracBEL accepts no responsibility for the device or optional equipment malfunctioning or being damaged due to the use of non-recommended products.

Do not place objects or hands on the top or bottom of the elevator while operating the elevator.

Doing so may lead to injury or malfunctions.

Do not apply a pressure higher than 0.2 MPa (gauge pressure) .

The internal parts may be damaged.

Do not use harmful, corrosive, combustible, or poisonous gasses.

Check for any leaks from the tubes. There should not be any leakage.

Please handle to connect the vent of the pump to air duct appropriately.

Be careful when handling compressed gas, such as found in a gas cylinder.

Be careful not to overshoot the processing temperature.

When the heater temperature increases, the processing temperature may exceed the temperature setting. To prevent overshooting, take appropriate measures such as inserting the sample cell into the heater only after the heater temperature has stabilized.

If dust or other such debris builds up inside of the device or optional equipment, clean the inside of the device.

Failing to do so may lead to fire or malfunctions.
Contact MicrotracBEL to have the inside of the device or optional equipment cleaned.

⚠ CAUTION

Before moving or disposing of the device or optional equipment, contact MicrotracBEL.

CONTENTS

Advantages of BELPREP VAC III

This product is capable of eliminating gas and moisture contained in a sample in pre-treating the sample for a gas/vapor adsorption measurement. It offers two types of pretreatment method—pressure-reducing and heating, in which the sample is treated while heating under a reduced pressure, and flow heating (option), in which the sample is treated while a purge gas is circulated. For the gas/vapor adsorption measurement, use the BELSORP series products which are sold separately.

- With BELPREP VAC III, you can pre-treat 6 samples at a time.
- With BELPREP VAC III, you can set the heating temperature in a range from room temperature to 450□C according to the sample property.
- It is also possible to set up a program that enables the user to specify the rate of temperature rise and temperature retention time.
- Up to eight different programs may be registered.
- When using the pretreatment of flow heating method (option) by BELPREP VAC III, you can adjust the purge gas flow rate according to the sample property.

To Measure the Adsorption Isotherm Accurately

To measure the adsorption isotherm accurately, It is important "to pre-treat the sample under appropriate conditions" and "to determine the exact sample mass."

Before the Gas/Vapor Adsorption Measurement

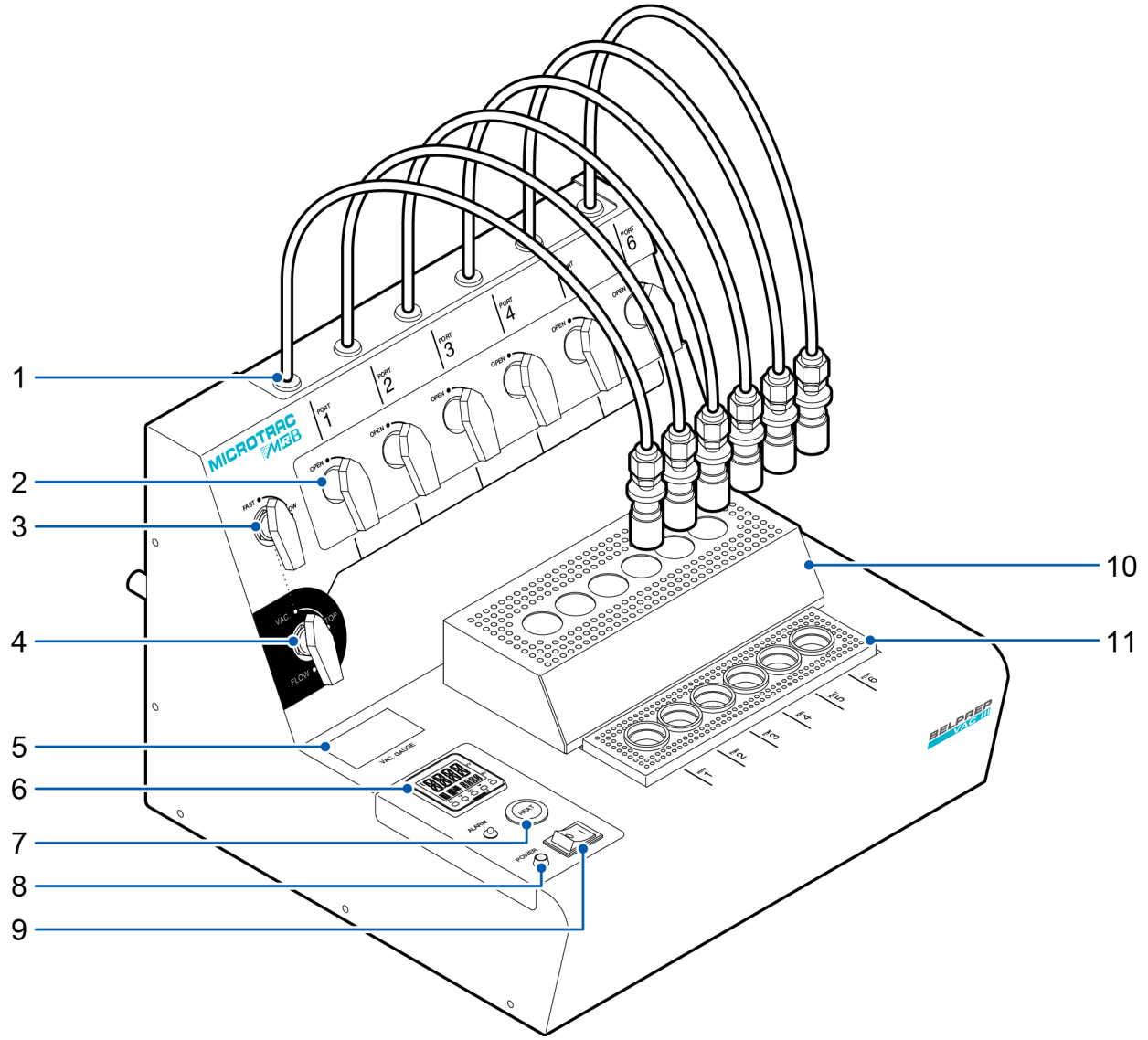
Before the gas/vapor adsorption measurement, it is necessary to pre-treat the sample appropriately. Adjust the heating temperature, the vacuuming rate, and the inert gas flow rate so that the sample surface property may not be affected by the pretreatment, but the gas and/or the moisture adsorbed on the surface can be removed.

The Gas/Vapor Adsorption Measurement

The gas/vapor adsorption measurement determines the adsorptions per the sample of 1g. If there is an error of 1% in mass, it will directly affect the measurement accuracy. Determine the sample mass accurately from the sample cell mass after the pretreatment by measuring the blank sample cell mass.

Main Unit

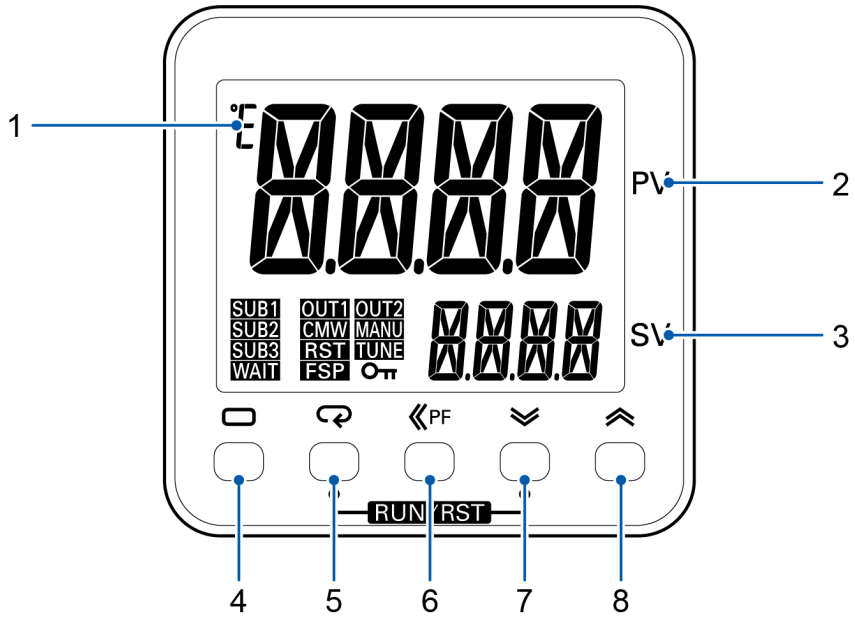
Front



1	**Tube port**	Sample cell connection tubes are in place. • For the pressure-reducing and heating method, connect sample cells to the sample cell connection tubes. • For the flow heating method, connect the purge gas flow tubes to the sample cell connection tubes. • When connecting a sample tube with an outer diameter of 14 mm, attach Conversion fitting from φ 9 to φ 14 to the sample tube mounting tube.

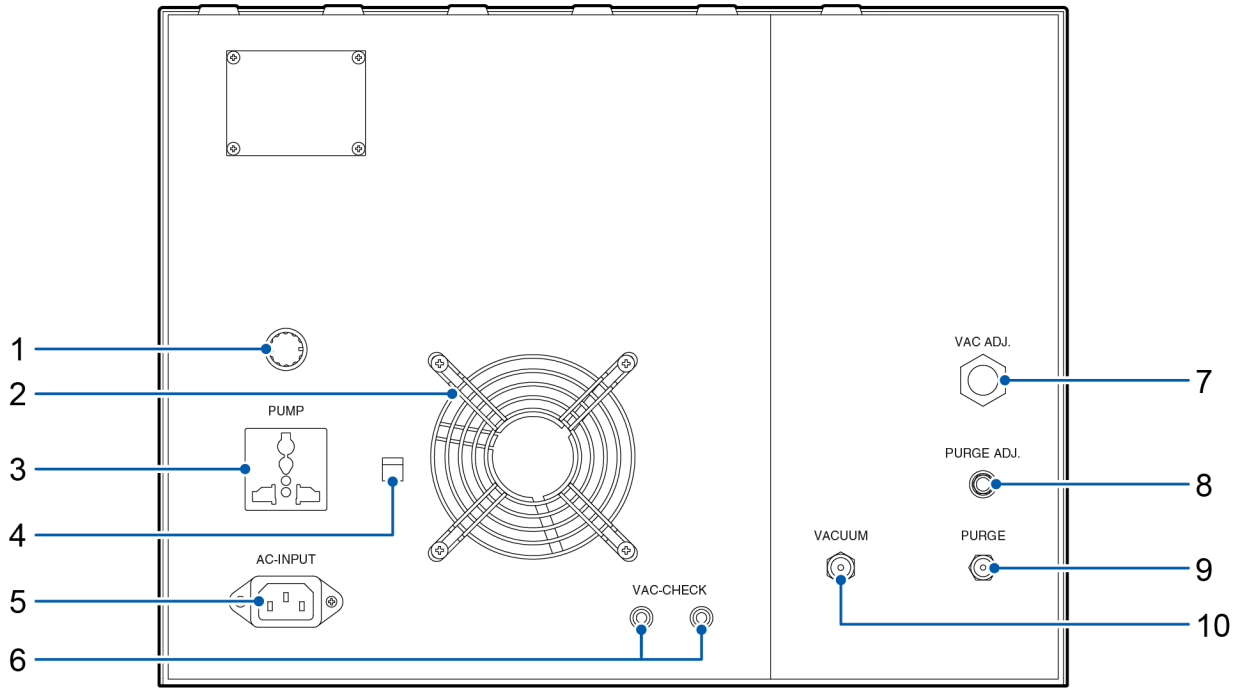
2	**Port valve**	These are open/close valves for respective ports. Do not operate these valves while vacuuming to prevent scattering of samples.
3	**Vacuuming rate switch valve**	Set the valve to SLOW to discharge air in the system slowly. Set it to FAST to discharge air rapidly. • If there is a possibility that the samples may scatter, always set the valve to SLOW for vacuuming.
4	**Vacuum/purge switch valve**	Set this valve to VAC to vacuum the system. Set it to FLOW to circulate the purge gas in the system. Setting it to STOP will stop the circulation. • Prior to the pretreatment, adjust the vacuuming rate and the purge gas flow rate. • To restore the system to the atmospheric pressure, open the port valves before attaching the sample cells. If the port valves were opened after vacuuming has started, there is a possibility that the samples may be dispersed.
5	**Vacuum indicator**	The vacuum level of the system is indicated by an analog gauge. • The vacuum indicator shows the atomospheric pressure at approx. 50 to 100 kPa depends on the specifications of the vacuum gauge. It is a normal operation and does not affect the displayed value of the vacuum degree.
6	**Temperature controller**	This is for temperature control of the pretreatment heater.
7	**Heater switch**	Press this switch to start temperature control for all ports (1 to 6). Heating will be done to the temperature set on the temperature controller or in accordance with the program.
8	**Power lamp**	This lamp is on by turning on the power breaker.
8	**Power switch**	Turn the power switch ON to power the main unit.
10	**Pretreatment heater**	This heats up the sample cell. The treatment temperature can be adjusted in a range from room temperature to 450°C using temperature controller. • During and immediately after heating with the heater, the sample cell and the pretreatment heater section may be hot. Carefully handle these parts.
11	**Radiation zone**	Insert the sample cell after heating into this zone to radiate it. • The radiation zone is made of metal. Insert the sample cell slowly so that it may not be broken.

Temperature Controller



1	**Temperature unit**	Displays the temperature unit (°C).
2	**No. 1 display**	PV or specified monitor/setting item.
3	**No. 2 display**	SP or specified monitor/setting value.
4	**Level Key**	Selects the setting level. The next setting level depends on how long the key is pressed.
5	**Mode Key**	Changes the parameter that is displayed within a setting level. Keep this key pressed to return to the previous parameter.
6	**Shift Key (PF Key)**	Operates as a user-defined function key. While setting values, use this key to switch the unit.
7	**Down Key**	Use this key to move to the segment parameter setting (selection of displayed segment) of currently selected program and to set the value.
8	**Up Key**	Use this key to move to the segment parameter setting (selection of displayed segment) of currently selected program and to set the value.

Back

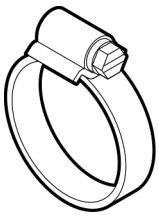


1	**Fuse holder**	The fuse is contained here.
2	**Fan**	This fan discharges hot air inside the housing.
3	**Vacuum indicator**	This is a power outlet for the rotary pump. Connect the power cable of the rotary pump here. • Pay attention to the power supply capacity.
4	**Voltage selector switch**	Select the input voltage. When switching the voltage, operate the voltage selector switch with a tool such as a flat-blade screwdriver.
5	**Power inlet**	Connect the power cord supplied.
6	**Tester connection port for checking vacuum gauge output**	This allows the user to read the vacuum gauge output in voltage. Read the voltage to check the vacuum level accurately.
7	**Vacuuming rate adjustment knob**	This knob allows the user to adjust the vacuuming rate when the vacuuming rate switch valve is set to SLOW. Turn the knob counterclockwise to increase the vacuuming rate. • Turning the knob during vacuuming may scatter samples. Adjust the flow rate before the pretreatment.

8	**Purge gas flow rate adjustment knob**	This knob is to adjust the needle valve for adjusting the purge gas flow rate. Turn the knob counterclockwise to increase the flow rate. • Use this knob to adjust the purge gas flow rate when the vacuum/purge switch valve is set to PURGE. Turn the knob counterclockwise to increase the flow rate.
9	**Purge gas connection port**	Connect the purge gas cylinder of 0.1 Mpa ±0.02 MPa (gauge pressure) (nitrogen gas is recommended). For the connection with the cylinder, use a pipe of 1/8 inch diameter.
10	**Vacuum rubber tube connection port**	Insert the vacuum rubber tubing (ID 9 mm) from the rotary pump. After inserting a vacuum rubber tube, ensure to secure it with a hose band.

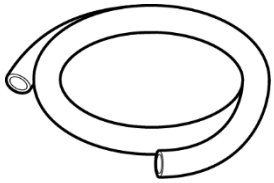
Accessories

Make sure that all accessories are present.

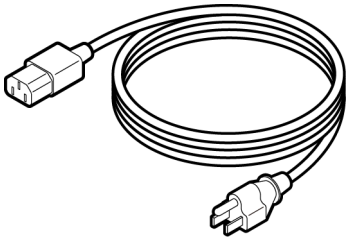


Hose band
2 pcs.

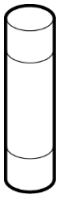
O ring
9 pcs.



Vacuum rubber tubing
1 pc.



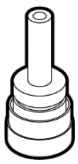
Power cable
1 pc.



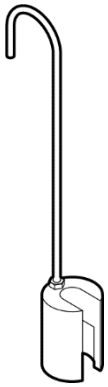
Spare Fuse
Size: φ6.35 × 31.8 mm
250 V - 10A
2 pcs.

Optional Products

Purge gas flow tubing /
Purge gas flow tube holder



Conversion fitting
from φ9 to φ14



Heater spacer

Other Requisites

To operate BELPREP VAC III, the following parts are required in addition to the packaged accessories as a standard. Prepare the relevant parts according to the "Requirements" column.

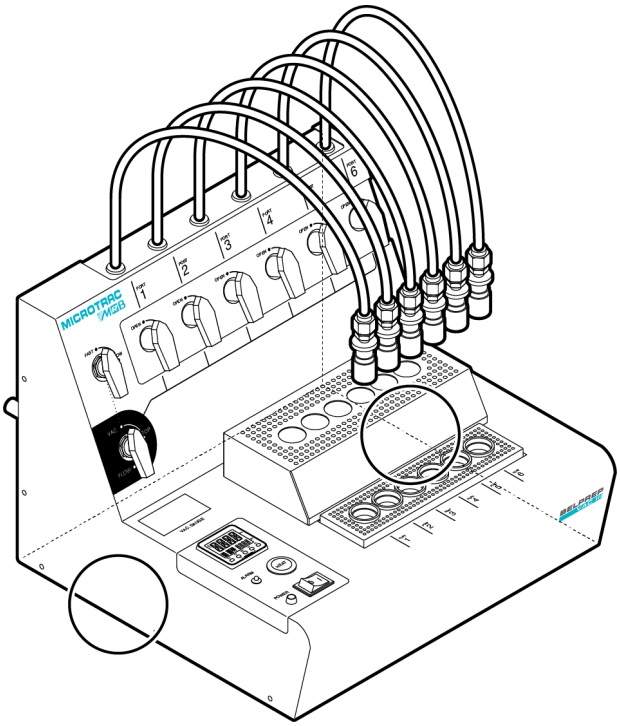
- These parts are available from our company; therefore, please contact us.

Requisites	Requirements
Rotary pump	Displacement: 20 L/min or more Ultimate pressure: 1 Pa or less Vacuum rubber tube connection port : ID 9mm • Do not connect to any pump that has the max. power over 600 W. • Please use rotary pump with overcurrent protection by fuse or breaker.
Purge gas	Inert gas • It is recommended to use nitrogen gas. When using other type of gas, the vacuum indicator may not show the correct pressure value.
Gas piping	Main unit connector : 1/8'' swage lock

Main unit carrying and installation

When the main unit taken out of a box or carried, please lift the right and left side which are surrounded in the frame of the chart below with both hands.

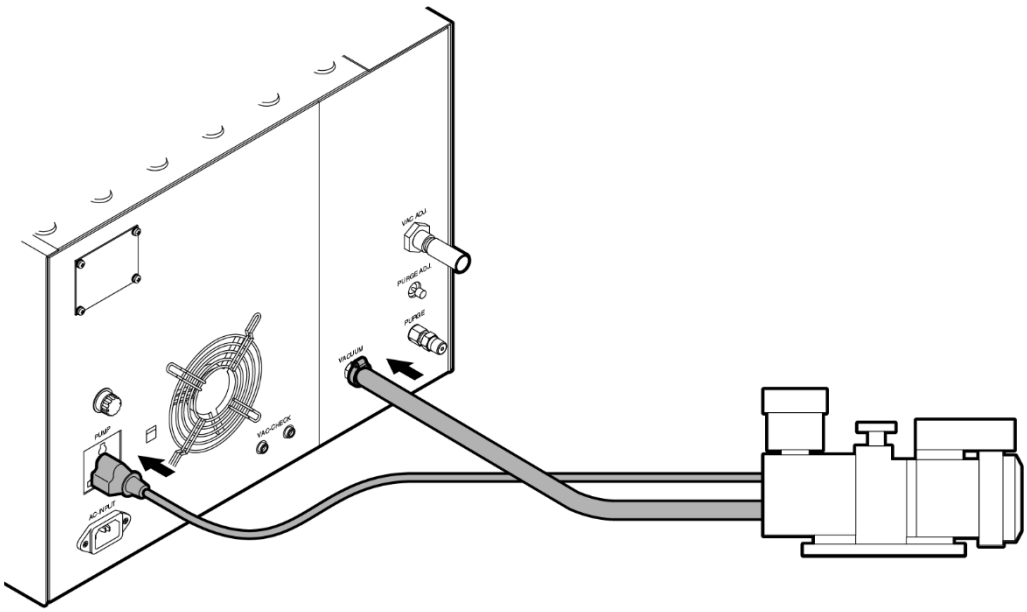
- Install the main unit in a horizontal place, and ensure that it is firmly fixed.
- In installing the main unit, ensure that there is a gap of at least 10 cm between the rear panel and the wall.



Connecting the Rotary Pump

Connect the power cable and vacuum hose of the rotary pump to the back of the main unit.

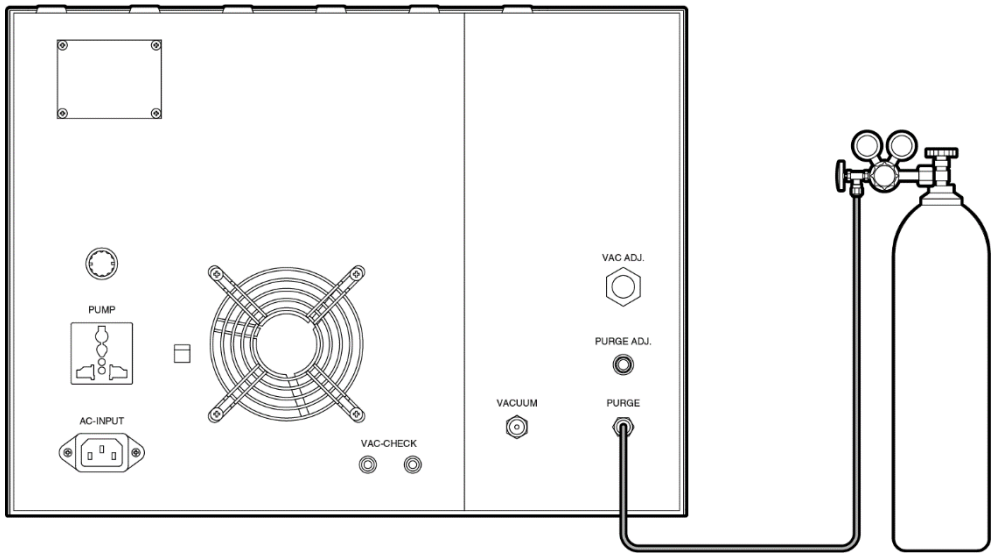
- Surely insert the vacuum rubber tubing to the bottom end, and fasten it firmly with a hose band.
- Be sure to mount it firmly. Otherwise, it may result in leakage.
- The oil mist from the rotary pump is human hazard. Be sure to connect the exhaust duct to the exhaust port of the rotary pump.



Connecting the Gas Piping

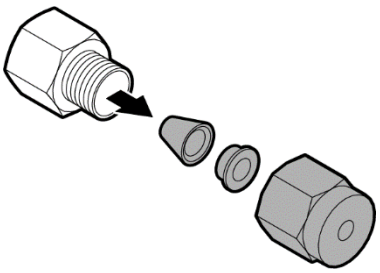
Use gas piping to connect the main unit to the purge gas cylinder.

- Prepare a gas piping for the purge gas, gas cylinder for the purge gas (inert gas: nitrogen gas is recommended), and a regulator.
- The purge gas connection port uses a 1/8'' swage lock.
- The standard BELPREP VAC III product does not include a gas piping, purge gas source, and a regulator. Please contact our company if any questions.



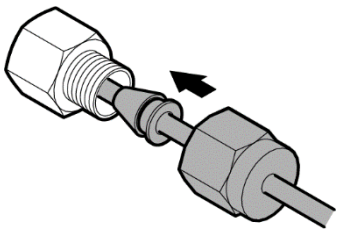
Connecting the Gas Piping

1 Remove the nut, back ferrule, and front ferrule from the purge gas connection port.

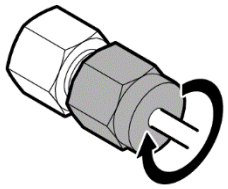


2 Pass the gas pipe through the nut, back ferrule, and front ferrule, and then insert the gas pipe into the purge gas connection port.

- Be sure to finish the cut face flat.
- Securely insert the gas pipe as far as it will go.

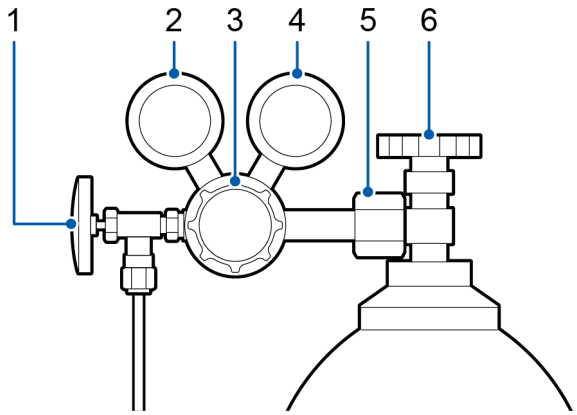


3 Tighten the nut by hand as much as possible. Then, use a tool to further tighten the nut through 3/4 of a turn.



Adjusting the Gas Pressure

Check the gas piping for leakage and adjust the gas pressure.



1	Stop valve
2	Secondary pressure
3	Regulator valve
4	Primary pressure
5	Regulator connection section
6	Main valve

1 Open the cylinder main valve, and then close it again 2 to 3 seconds later.

2 Verify that the primary pressure does not fall for several minutes.

- When the primary pressure decreases, possibly it may be due to leakage from the connection section between the cylinder and the regulator. Reconnect them so that there is no leakage.

3 If there is no leakage, adjust the gas pressure by turning slowly the regulator valve clockwise. Adjust the pressure so that the secondary pressure is 0.1 MPa (gauge pressure) .

- Do not apply a pressure higher than 0.2 MPa (gauge pressure)

4 Open the stop valve by turning it counterclockwise. Open the cylinder main valve, and then close it again 2 to 3 seconds later.

5 Verify that the primary pressure does not fall for several minutes.

- When the primary pressure decreases, possibly it may be due to leakage from the connection section between the cylinder and the regulator. Reconnect them so that there is no leakage.

6 Open one of the port valves to release the system to the atmosphere.

7 Set the vacuum/purge switch valve to “PURGE” and return it to “STOP” immediately.

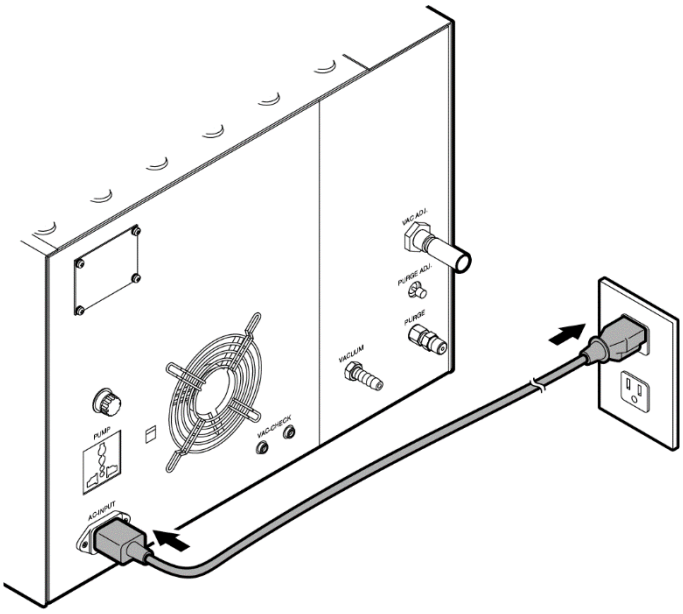
8 Repeat steps 4 to 7 another two times.

- It is not necessary to check for leakage from the second time onward.

9 After flowing the gas three times, open the main valve on the cylinder after ensuring that the vacuum/purge switch valve is set to “STOP”.

Connecting the Power Cable

Connect the power cable to the power inlet on the back of the main unit, and then connect the power plug to an electrical outlet.

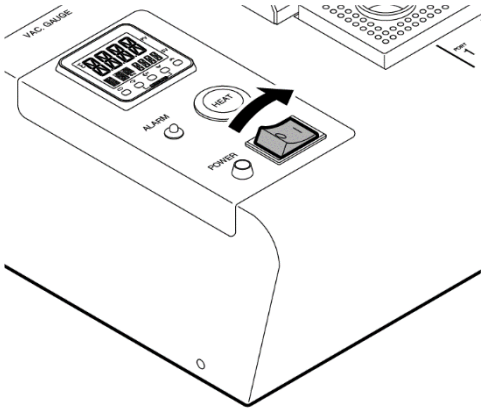


STARTING AND STOPPING

Starting

1 Turn on the main unit power.

The power lamp lights in the power turn on.



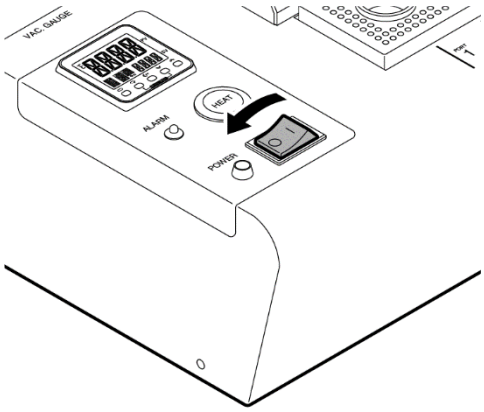
2 Turn on the rotary pump power.

- When the unit has not been used for a long period, check the piping for leakage and adjust the gas pressure.

Stopping

1 Turn off the main unit power.

The power lamp turns off when the main unit turns off.



2 Turn off the rotary pump power.

- The rotary pump oil may go up into the system unless the power is off, which may result in failure. Be sure to turn off the main unit power, immediately after the rotary pump power is off.

- When stopping use of the device for a long time (1 month or longer), close the gas cylinder main valve.

Pretreatment flow

The standard pretreatment procedure is as follow. Weigh the sample cell, and determine the sample mass before and after the pretreatment.

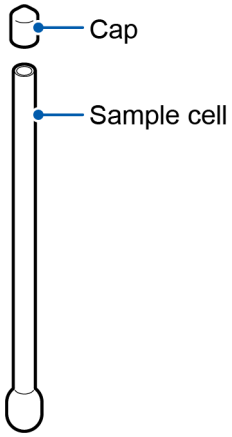
- For the adsorption measurement, use the sample mass after the pretreatment.

Preparation	Preparing the sample cell.
↓	
Measuring the blank sample cell mass	Displace inside the sample cell with the purge gas.
	Weigh the blank sample cell mass [W]. **Pressure-reducing and heating method** ・[W] = Sample cell + Cap + Glass rod + Filter **Flow heating method** ・[W] = Sample cell + Cap
↓	
Measuring the sample mass (Before the pretreatment)	Add the sample into the sample cell.
	Weigh the sample cell mass [Wa]. **Pressure-reducing and heating method** ・[Wa] = Sample cell + Cap + Glass rod + Filter + Sample **Flow heating method** ・[Wa] = Sample cell + Cap + Sample
	Determine the sample mass before the pretreatment [Wb]. ・[Wb] = [Wa] – [W]
↓	
Sample pretreatment	Pre-treat the sample.
	Cool the sample in the radiation zone.
↓	
Measuring the sample mass (After the pretreatment)	Displace inside the sample cell with the purge gas.
	Weigh the sample cell mass [Wc]. **Pressure-reducing and heating method** ・[Wc] = Sample cell + Cap + Glass rod + Filter + Sample **Flow heating method** ・[Wc] = Sample cell + Cap + Sample
	Determine the sample mass after the pretreatment [Wd]. ・[Wd] = [Wc] – [W]

Preparation

Sample cell and cap

Prepare a sample cell and a cap, which have been sufficiently washed and dried.



- Use the same cap, from the step "Measuring the Blank Sample Cell Mass" to the step "
- Measuring the Sample Mass
  (After the Pretreatment)". If the cap mass changes, the sample mass cannot be obtained accurately.
- For pretreatment of two or more samples, it is convenient to number the sample cell and the cap, and make a list of the blank mass for individual sets.

Adjusting the vacuuming rate

This section describes how to adjust the vacuuming rate while the vacuuming rate switching valve on the main unit front panel is set to SLOW. Vacuuming at a rapid rate can be done by setting the vacuuming rate switching valve to FAST.

Adjust the vacuuming rate using the vacuuming rate adjustment knob on the rear of the main unit. Turn this vacuuming rate adjustment knob counterclockwise to increase the vacuuming rate, or turn it clockwise to decrease the vacuuming rate. For samples liable to scatter, adjust the vacuuming rate to a lower level to pre-treat the samples.

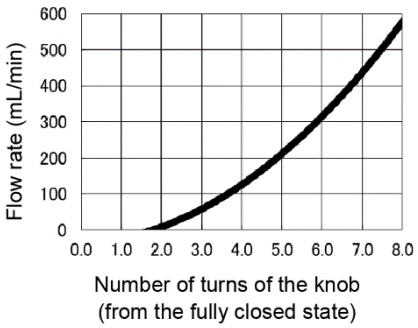
- In performing a fast vacuuming, be extremely careful not to scatter samples.
- In order to adjust the number of turns of the knob, fully close the vacuuming rate adjustment knob before adjusting it.
- For samples liable to scatter, adjust the vacuuming rate on an as-needed basis.

Adjusting the purge gas flow rate

For the pretreatment of reducing pressure and heating, it is necessary to purge gas before and after the pretreatment. Before the pretreatment, adjust the flow rate according to the following procedure.

In order to prevent the sample from scattering, adjust the purge gas flow rate using the purge gas flow rate adjustment knob on the main unit - back. Turn this purge gas flow rate adjustment knob counterclockwise to increase the flow rate, or turn it clockwise to decrease the flow rate. If the secondary pressure of the purge gas cylinder is set to 0.1MPa(gauge pressure) , the flow rate will become as shown in the right figure.

Relationship between the number of turns of the knob and flow rate



- The figure above shows the flow rate with an inert gas flown into only 1 port. To flow the gas into 2 ports, divide the flow rate shown in the figure above into two equal parts. To flow the gas into 6 ports, divide it into six equal parts.
- The purge gas flow rate adjustment knob is fixed with a stopper on the purge gas flow rate adjustment knob. Turning the stopper counterclockwise makes it possible to turn the purge gas flow rate adjustment knob. In order to adjust the number of turns of the knob, loosen the stopper to a maximum extent, and then fully close the purge gas flow rate adjustment knob before adjusting it.
- For samples liable to scatter, adjust the vacuuming rate on an as-needed basis.
- The flow rate varies with slight differences in adjustment of the secondary pressure of the cylinder or the purge gas flow rate adjustment knob. Refer to the figure above absolutely as a guideline. If optional parts are selected, the actual flow rate is measureable.

Example of purge gas measurement

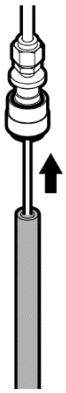
1 Connect the purge gas flow tubing to the sample cell connection tubing.

→ “Adjusting the purge gas flow rate and setting the sample cell” on page 32.

2

Connect rubber tubing to the purge gas flow tubing.

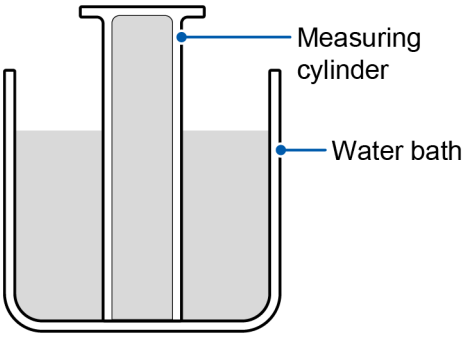
- Suitable rubber tubing is to be prepared.



3

Installing a water bath.

Fill a measuring cylinder with water, and then erect it upside-down in a water bath.

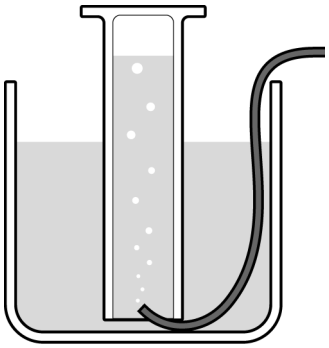


4

Measuring the flow rate.

Insert rubber tubing in the measuring cylinder, and then press the port valve switch to open the port valve.

The measuring cylinder is filled with gas. Calculate a flow rate according to the amount of gas filled for a period of 1 minute.



Measuring the Blank Sample Cell Mass

The gas adsorption measurement determines the "adsorption per the sample of 1 g". If there is an error of 1 % in mass, it will directly affect the measurement accuracy. Determine the sample mass accurately from the sample cell mass after the pretreatment by measuring the blank sample cell mass.

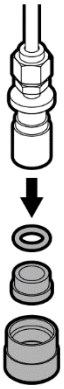
- When using nitrogen gas as the purge gas, the difference between the blank sample cell mass (air) and the blank sample cell mass (nitrogen gas) is less than 0.0004 g. When such an error does not become an issue, it is not necessary to displace inside the sample cell with nitrogen gas.

Displacing with the purge gas

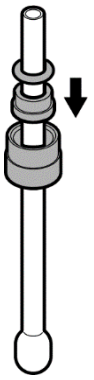
- The sample cell should be fixed by removing the mounting fittings and the O-ring temporarily. If the sample cell is fixed without removing the mounting fittings, the O-ring may be deformed causing leakage.

1 Insert the glass rod into the sample cell and attach the filter.

2 Remove the nut, sleeve, and O-ring from the sample cell connection tubing.



3 Pass the nut, sleeve, and O-ring onto the sample cell.



4 Insert the sample cell into the sample cell connection tubing, and then tighten the nut to fix it in place.

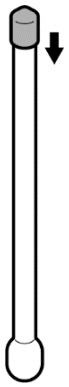
5 Insert the sample cell into the radiation zone.

6 Open the port valves to be used for pretreatment.

7 Set the vacuum/purge switching valve on the main unit front panel to VAC and vacuum the sample cell.

8 Set the vacuum/purge switching valve to FLOW to fill the sample cell with the purge gas.

9 Remove the sample cell from the tubing, and immediately seal it with a sample cell cap.



Weighing the sample cell

1 Remove the sample cell from the radiation zone.

2 Weigh the blank sample cell mass.

- Pressure-reducing and heating method

  Blank sample cell mass = Sample cell + Cap + Glass rod + Filter

- Flow heating method

  Blank sample cell mass = Sample cell + Cap

Measuring the Sample Mass (Before the Pretreatment)

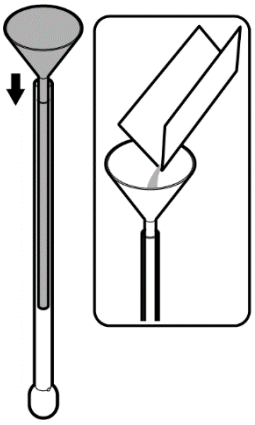
The sample mass before the pretreatment is not used for the sample gas adsorption measurement; however, it may be important data to indicate how much impurity is removed by the pretreatment. It is recommended, therefore, to measure the sample mass before the pretreatment.

Adding the sample into the sample cell

- The sample cells and the liq. bottles are made of glass. Careful attention is required for the handling.

1 Insert a funnel tube to the sample cell, and add the sample from the upper part of the funnel tube.

- Use the sample that has been dried in advance.



Weighing the sample cell

1 Remove the funnel tube while preventing the sample from sticking to the sample cell inner wall, and attach a cap.

2 Weigh the sample cell mass.

- Pressure-reducing and heating method

  Sample cell mass = Sample cell + Cap + Glass rod + Filter + Sample
- Flow heating method

  Sample cell mass = Sample cell + Cap + Sample

Calculating the sample mass

1 Calculate the sample mass before the pretreatment.

- Sample mass = Sample cell mass - Blank sample cell mass

Sample Pretreatment

With BELPREP VAC III, you can select the pretreatment system according to the sample property, from the system of reducing pressure and heating or flow heating method; and set the heating temperature in a range from room temperature to 450°C. Pre-treat the sample under appropriate conditions.

Pressure-Reducing and Heating Method

Setting the sample cell

1 After ensuring that the vacuum/purge switching valve is set to STOP and the vacuuming rate switching valve is set to SLOW, open the port valves for the ports to be used.

- In order to restore the system in the main unit to the atmospheric pressure, open the port valves before installing the sample cell. If the port valves are opened after the start of vacuuming, there is a possibility that the sample will be scattered.

2 Fix the sample cell onto the sample cell mounting tube and then insert it to the radiation zone.

3 After adjusting the vacuuming rate, set the vacuum/purge switching valve to VAC to vacuum the sample cell.

4 Perform vacuuming with the vacuuming rate set to SLOW while the reading on the vacuum gauge is in the yellow zone. If the vacuum gauge reading goes into the blue zone, set the vacuuming rate switching valve to FAST.

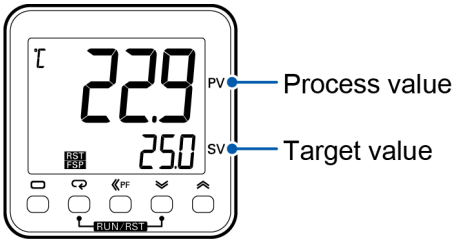
Heating with the heater

Set the heating temperature according to the sample property. When selecting no-heating, jump to the next section "Pre-treating the sample".

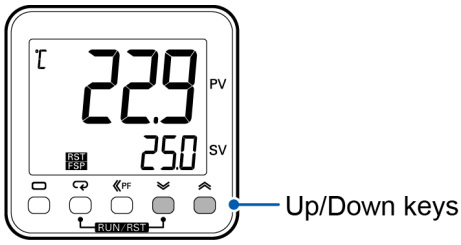
- At heating, the heater temperature may exceed the setting temperature (overshoot). To avoid overshooting, heat up to the pretreatment temperature first, stabilize the heater temperature, and then insert the sample cell into the heater.
  Heaing with the pretreatment heater => Adjusting the purge gas => Setting the sample
- Once the temperature controller's setting temperature is changed, it is controlled by the self tuning function while calculating the PID parameters. At heating after the setting temperature is changed,

therefore, overshooting may occur to a large extent.

1 When power is supplied to the main unit, the process value will be displayed in the first field and the target value will be displayed on the second field.



2 The target value may be changed by pressing the Up/Down keys.



3 Turn on the heater switch to start heating up to the setting temperature.

Pre-treating the sample

Pre-treat the sample for an appropriate time period according to the sample property, the sample quantity, etc. Remove the moisture contained in the sample by heating, where applicable.

1 Once the temperature of the pretreatment heater has stabilized, insert the sample cell into the pretreatment heater.
When using the heater spacer, insert the heater spacer over the sample cell and insert the sample cell and heater spacer together into the pretreatment heater.

2 After the sample pretreatment, move the sample cell from the heater to the radiation zone. When heater spacer was used, insert the heater spacer into the pretreatment heater again.

- The sample cell and the pretreatment heater may be hot. Be careful not to be suffered from burn injury.
- When using the heater spacer, be sure to hold the handle part and do not touch other parts.
- Do not place the heated heater spacer in a location other than the pretreatment heater until cooling can be confirmed by the temperature controller.

3 Turn off the heater switch.

4 Cool the sample in the radiation zone, while vacuuming.

5 If the sample cell has cooled down sufficiently, set the vacuum/purge switching valve to FLOW to fill it with the purge gas. Purge gas is sufficiently filled in 15 seconds after the indication of the degree of vacuum indicator is about 50 to 100 kPa.

6 Upon filling the purge gas, set the vacuum/purge switching valve to STOP to terminate the purging. Remove the sample cell from the tubing and seal it with a cap.

- Do not touch the pretreatment heater when it is hot.

Flow Heating Method

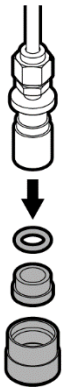
- Since the edge of purge gas flow tubing is sharp, be careful to avoid any injures when inserting the holder.
- If purge gas flow tubing is inserted into the sample, the sample can be easily dispersed. Make sure purge gas flow tubing does not touch the sample.

Adjusting the purge gas flow rate and setting the sample cell

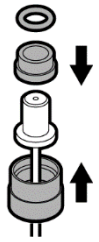
1 Verify that the end of the purge gas flow tubing is clean.

- Wipe it off with a dry cloth, etc. if it is contaminated.
- Remove the sample stuffed in the tubing, if any.

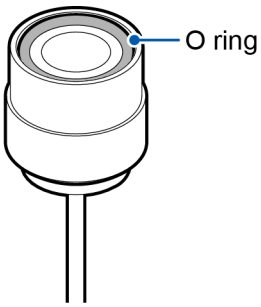
2 Remove the nut, sleeve, and O-ring from the sample cell connection tubing.



3 Pass the nut, sleeve, and O-ring onto the purge gas flow tubing.

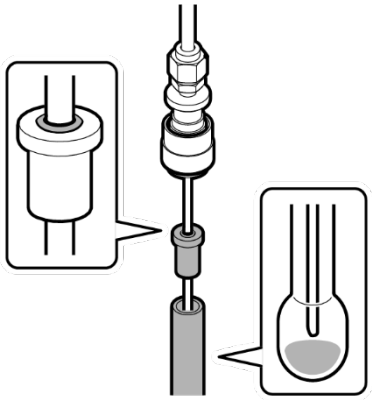


- Mount the purge gas flow tubing, as shown above, to the sample cell connection tubing.

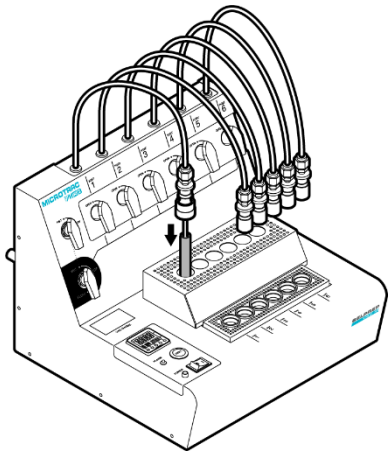


4 Insert purge gas flow tubing into the holder.

- Make sure the O-ring is fitted in the groove of the holder.
- Adjust the height of purge gas flow tubing to avoid with sample.



5 Set the sample cell to the main unit.



6 Adjust the purge gas flow rate according to the sample property. After the flow rate adjustment, turn the stopper clockwise to fix the flow rate adjustment knob.

- When the sample is liable to scatter, adjust the purge gas flow rate low.

→ “Adjusting the purge gas flow rate” on page 24.

Heating with the heater

Follow the same procedure as for the pressure-reducing and heating method.

→ “Heating with the heater” on page 30.

Pre-treating the sample

Pre-treat the sample for an appropriate time period according to the sample property, the quantity, etc. Remove the moisture contained in the sample by heating, where applicable.

1. Once the pretreatment heater temperature has stabilized, set the vacuum/purge switching valve on the main unit front panel to FLOW, insert the purge gas flow tubing to the bottom of the sample cell and insert the sample cell into the pretreatment heater.
2. After the sample pretreatment, move the sample cell from the heater to the radiation zone.
   - The sample cell and the heater may be hot. Be careful no to be suffered from burn injury.
3. When the sample cell is sufficiently cooled, remove the purge gas flow tubing, and then seal it with a cap.
4. Turn OFF the vacuum/purge switching valve.

Measuring the Sample Mass (After the Pretreatment)

Use this "sample mass after the pretreatment" in the adsorption measurement.

After the pretreatment

1. Stop the main unit.

Weighing the sample cell

1 Weigh the sample cell mass.

- Pressure-reducing and heating method

  Sample cell mass = Sample cell + Cap + Glass rod + Filter + Sample

- Flow heating method

  Sample cell mass = Sample cell + Cap + Sample

Calculating the sample mass

1 Calculate the sample mass after the pretreatment.

- Sample mass = Sample cell mass - Blank sample cell mass

Operation Method

This manual explains the basic operation and setting methods for the temperature regulator.

To perform more advanced operations, you need to read the user's manual (a separate manual) for the temperature regulator.

For details on the user's manual for the temperature regulator, contact MicrotracBEL.

⚠ WARNING

Do not set the heater to a temperature that exceeds its maximum usage temperature.

In the factory default settings, an upper limit is applied to the setting temperature to prevent it from exceeding the maximum usage temperature of the heater. Do not clear the upper limit setting as doing so and setting a temperature that exceeds the maximum usage temperature of the heater is extremely dangerous.

⚠ CAUTION

Exercise caution to prevent treatment temperature overshooting.

Overshooting (the treatment temperature exceeding the setting temperature) may occur when the heater temperature rises. To prevent overshooting, implement countermeasures such as inserting Sample cells into the heater after the heater temperature has stabilized.

Entering numeric values

Applying changes to numeric values

After you change a numeric value with the Up Down Keys, the changes are applied when 3 seconds elapses, when the Mode Key is pressed, or when the level is changed with the Level Key.

Always make sure that any changes to numeric values are applied for one of the three methods that are given above before you turn OFF the power supply.

- If you only change the values with the Up Down Keys and turn OFF the power supply before 3 seconds has elapsed, the changes will not be applied temperature of the heater.

Moving between Digits (Digit Shift Key)

Press the Shift Key (PF Key) to select the digit to change. This is useful when entering a numeric value with many digits.

Every time the Shift key was pressed, the cursor shift to the left (to the next higher digit). Press the Up + Down Keys to change the value of a digit.

Setting levels

The parameters are classified into levels according to their applications. These levels are called setting levels. The setting levels consist of 3 levels.

Operation Level	This level is displayed automatically when the power supply is turned ON. This level is used for the SP and other basic settings and monitoring. Normally, select this level for operation. • Alarm levels shall be set for each program number with the program setting level.
Program Setting Level	This level is used to set the parameters for the programs (SPs, rates of rise, times, etc.).
Adjustment Level	This is the setting level for tuning the system such as modifying the PID constant and executing AT.

Changing the setting levels

Upon turning ON the power switch on the main panel front panel, the operation level will be displayed on the temperature controller initially. The display changes from the operation level to the program setting level, followed by the adjustment level and back to the operation level each time the level key is pressed.

Modifying settings

Operation level

The screen changes each time the mode key is pressed.

Modifying settings (SV)		Modification shall be made with the process value (PV) and the set value (SV) displayed on the screen.
Selecting the program number		If the program mode is enabled, the program of which number is selected here will be executed.
Check the number of segments		If the unit is running in the program mode, the segment number being executed can be checked on this screen.

Run/Reset of program operation		Program operation starts when you change the Run/Reset parameter to Run. • Switching Run/Reset of program operation may be done by pressing the down key and the mode key simultaneously. • "Run" indicates that program operation is in progress."Reset" indicates that the program is stopped.

Program setting level

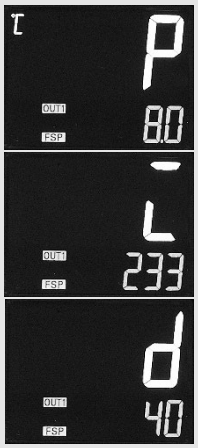
Pressing the level key while the operation level screen is displayed will bring up the program setting level screen. The screen display changes each time the mode key is pressed.

Set the program number parameter		Set the parameter to the number of the program to edit. When you change levels, the parameter for the currently selected program number is displayed. Eight different numbers, from 0 to 7, may be entered as the program number.
Set the number of segments used parameter		This parameter specifies the number of segments to use in the program. The user can set up to thirty two segments.
Set the segment number parameter		Set the parameter to the number of the segment to edit. When you change the display, END (do not edit segment parameters) is displayed.
Set the segment formats		This parameter sets the segment format for the specified segment number. RAMP specifies the target value (set point = SP) and the slope of the segment, SOAK specifies the duration of the segment and STEP specifies the target value of the segment.
Set the segment SPs		This parameter sets the SP for the specified segment number.
Set the segment slopes		This parameter sets the segment slope for the specified segment number. The unit for the slope to be set is °C/min.

Set the segment times		This parameter sets the segment time for the specified segment number. The unit for the time to be set is minute.

Adjustment levels

Pressing the level key while the program setting level screen is displayed will bring up the adjustment level screen. The screen display changes each time the mode key is pressed.

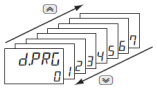
Auto-tuning		This parameter executes auto-tuning (AT). To perform an auto-tuning, set the target value (set point) in the fixed SP mode and turn ON the heating start switch in advance.
Changing between program mode and fixed SP mode		Changed from program mode to fixed SP mode.
PID setting		In this mode, the user can set all PIDs.

Details of Each Parameter

Operation level

Parameter	Display	Description	Setting range	Default range
PV/SP	25 0	PV is displayed in the first field and SP is displayed in the second.		
Program number	PRG 0	This parameter specifies the program number to use to start program operation.	0 to 7	0
Segments number	SEG 0	This parameter monitors the segment number that is being executed in the program before and after editing.		
Run/Reset	R-R RSt	This parameter specifies running or stopping the program.	RUN: Operation RST: Stop	RST

Program setting level

Parameter	Display	Description	Setting range	Default range
Display program selection		This parameter specifies the number of the program to be set.	0 to 7	Number of program currently used for control.
Number of segments used	5-NO 8	This parameter specifies the number of segments in the program.	1 to 32	8
Display segment selection		This parameter specifies the number of the segment to set in the program.	END or 0 to number of segments used −1	END
Segment n format (n = 0 to 31)	StYP RAMP	This parameter sets the segment type for the specified segment number to ramp, soak, or step.	RAMP SORK STEP	RAMP

Parameter	Display	Description	Setting range	Default range
Segment n SP (n = 0 to 31)	SP 0	This parameter sets SP for the specified segment number. When setting the slope, the target value to be reached should be set.	SP lower limit to SP upper limit	0
Segment n slope (n = 0 to 31)	PR 0	This parameter sets the amount of change per the time unit of the slope for the specified segment number. If this parameter is set to 0, the segment will be a step segment.	0 to 9999	0
Segment n time (n = 0 to 31)	tIME 0.00	This parameter sets the soak segment time for the specified segment number.	0.00 to 99.59	0.00

Adjustment level

Parameter	Display	Description	Setting range	Default range
AT execute/Cancel	AT oFF	This parameter executes auto-tuning (AT).	AT2: 100 % AT execute OFF: AT cancel	OFF
SP mode	SPMd PSP	This parameter sets the SP mode. In program SP mode, the SP from the set program will be used for control. In fixed SP mode, the fixed SP is used as the SP in control. Also, the FSP indicator will light.	PSP: Program SP FSP: Fixed SP	PSP
Proportional band	P 8.0	These parameters set the PID constants. If auto-tuning is executed, these parameters are set automatically.	0.1 to 999.9	8
Integral time	I 233		0 to 9999 1 to 9999 0.0 to 999.9 0.1 to 999.9	233 or 233.0
Derivative time	d 40		0 to 9999 0.0 to 999.9	40 or 40.0

Program Operation

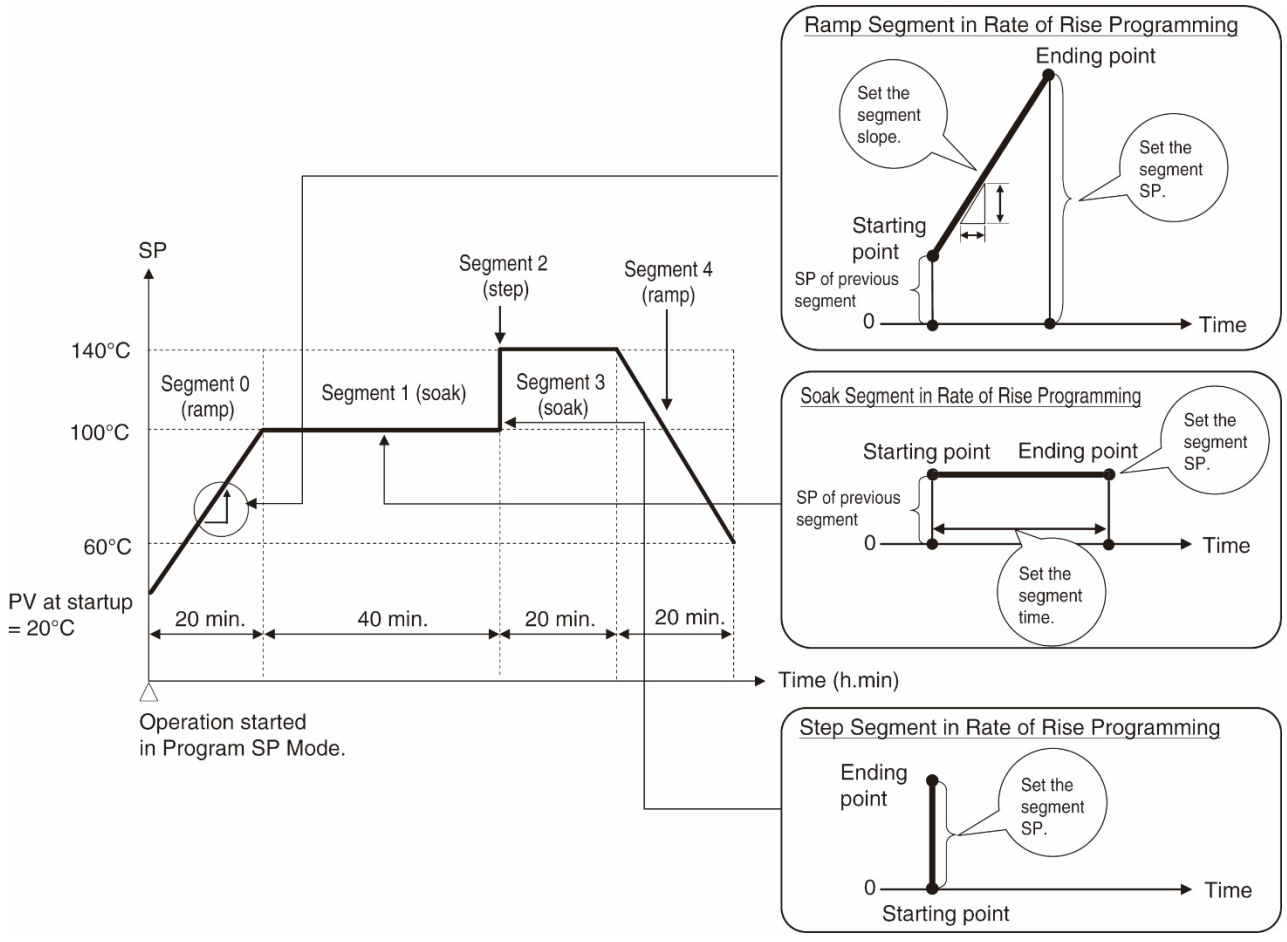
With program operation, the SP changes with time. The broken-line pattern that represents the changes in the SP over time is called a program. The programs are set in advance by the user. You can create up to eight programs (i.e., patterns). You can set up to 32 segments (i.e., straight lines) in each program. There are three segment formats: ramp (sloped), soak (horizontal), and step (vertical).

BELPREP VAC III employs following program settings.

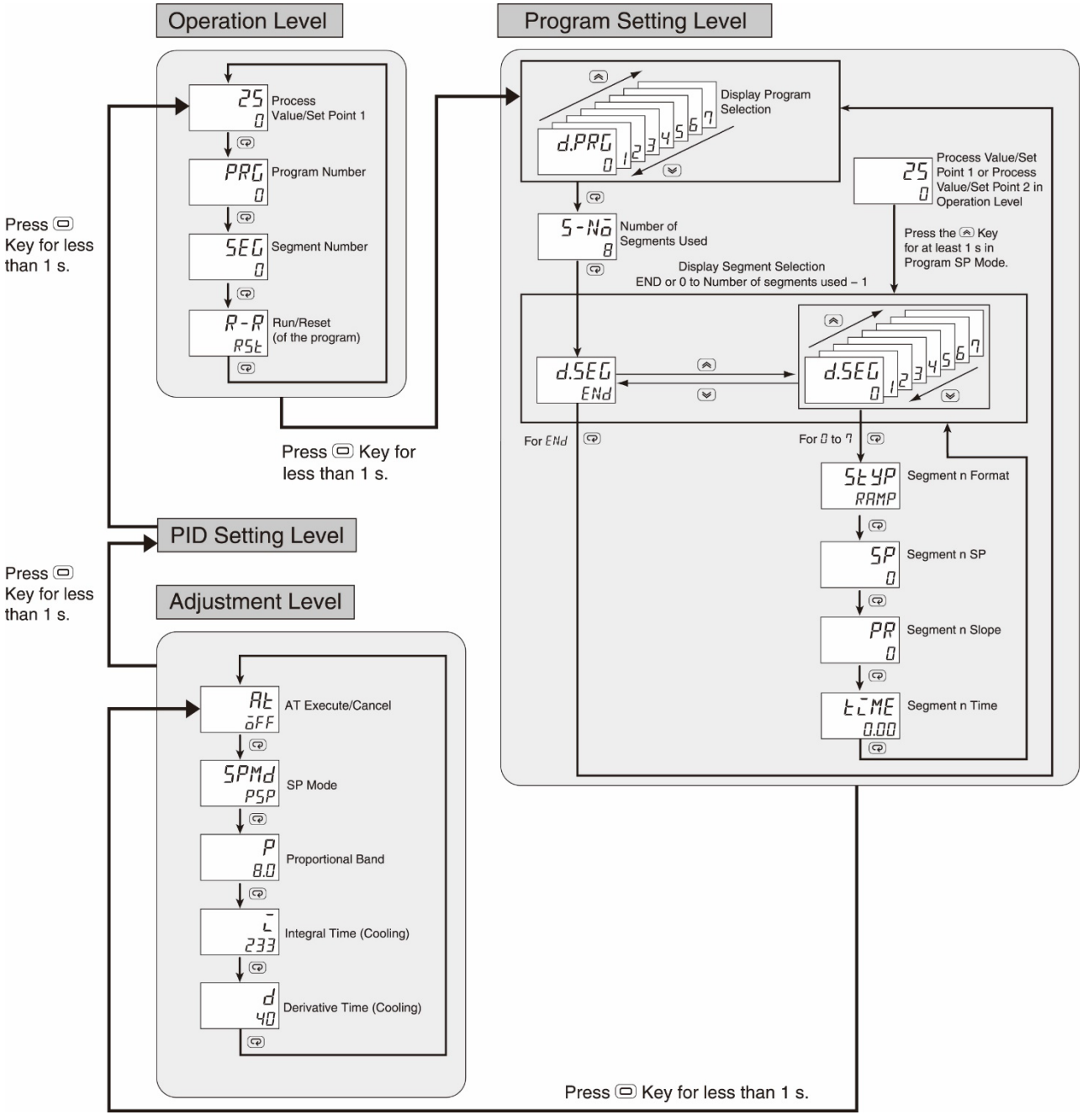
Slope setting scheme: Various parameters are programmed after specifying the segment format (Ramp, Soak or Step).

Ramp	You set only the SP and slope. You set the ending point as the SP and the slope until reaching the SP.
Soak	You set only the time.
Step	You set only the SP.

An example of settings for a program operation is given based on the program pattern shown below.



For the program operation setting, parameters [1] through [10] shall be used.

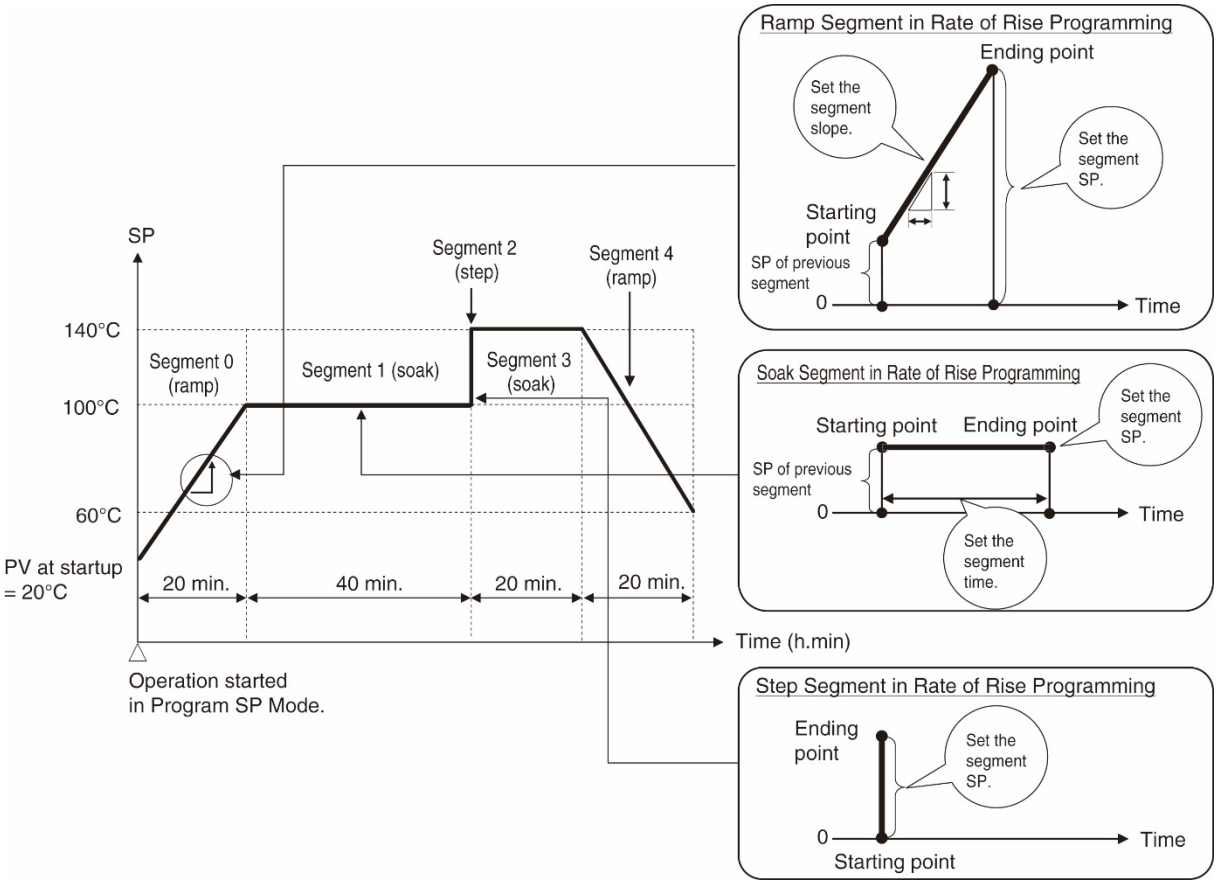


Each parameter shall be set in order in accordance with the table below.

No.	Parameter	Settings					Setting level
①	SP mode	PSP: Program SP					Adjustment level
②	Display program selection	0 to 7					Program setting level
③	Number of segments used	5					Program setting level
④	Segment number	0	1	2	3	4	Program setting level
⑤	Segment format	RAMP	SOAK	STEP	SOAK	RAMP	Program setting level
⑥	Segment SP	100	—	140	—	60	Program setting level
⑦	Segment slope	4	—	—	—	4	Program setting level
⑧	Segment time	—	0.40	—	0.20	—	Program setting level
⑨	Program number	Selects the program number selected in ②.					Operation level
⑩	Run/Reset (of the program)	RUN • The setting will change automatically to RST after the program operation. Reset it to RUN again.					Adjustment level

Upon completion of setting, heating will start by turning ON the heater switch.

The program operation starts from the process value (PV). If it is desired to start from a predefined target value, set the target temperature after setting the segment format of segment 0 to STEP.



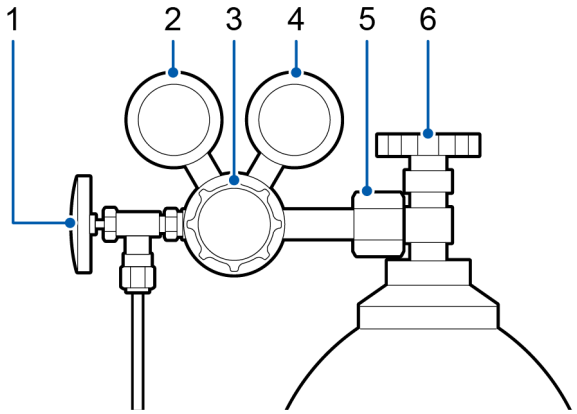
Daily Inspection

To perform accurate measurements, carry out daily inspections each day before starting measurement.

Inspection location	Inspection details
When turning on the power	・Check that the power lamp is lit. ・Check whether the vacuum pump operates normally. ・Check that the rotary pump's exhaust noise becomes quiet within 1 to 2 minutes after the power turns on. When a vent line or oil mist trap is connected, the amount that the exhaust noise changes become small. ・If you detect an error, turn off the device immediately, and then remove the power cable from the electrical outlet.
Rotary pump	・Perform appropriate maintenance on the rotary pump according to its user's manual. ・If you detect an abnormal sound or smoke, turn off the main unit immediately, and then remove the power cable from the electrical outlet. ・Properly handle the exhaust port of the rotary pump such as by connecting it to an exhaust duct. ・The rotary pump is a consumable product. Periodically replace its oil and its parts.
Power cable	・Check the power cable for deterioration and check whether these cables are connected to the device and the PC correctly. ・If you detect an error, turn off the main unit immediately, and then handle the issue in an appropriate manner such as by replacing the power cable.
Main unit cleaning	・If the surface of the main unit is covered in dust or grime, wipe it clean with a piece of dry, soft cloth such as eyeglass cleaning cloth.
Cleaning inside of main unit	・If samples have been scattered within the main unit system, an overhaul is required. Please contact us.

Replacing the Gas Cylinder

Replace the cylinder when the purge gas cylinder pressure falls to 1 MPa or less.



1	Stop valve	4	Primary pressure
2	Secondary pressure	5	Regulator connection section
3	Regulator valve	6	Main valve

Exhausting the Purge Gas in the Piping

1. Close the gas cylinder main valve by turning it clockwise.
2. Turn on the main unit power.
3. Open the sample cell port, turn on the purge switch, and then exhaust the purge gas in the piping.
4. Turn off the main unit power.

Replacing the Purge Gas Cylinder

1 Close the regulator valve by turning it counterclockwise.

- The regulator valve closes by turning counterclockwise to loosen it.

2 Close the stop valve by turning it clockwise.

3 Remove the connection section between the gas cylinder and the regulator.

4 Connect a new gas cylinder and a new regulator.

- Replace the gasket with new one when it is damaged.

Adjusting the Gas Pressure

1 Open the cylinder main valve, and then close it again 2 to 3 seconds later.

2 Verify that the primary pressure does not fall for several minutes.

- When the primary pressure decreases, possibly it may be due to leakage from the connection section between the cylinder and the regulator. Reconnect them so that there is no leakage.

3 If there is no leakage, adjust the gas pressure by turning slowly the regulator valve clockwise. Adjust the pressure so that the secondary pressure is 0.1 MPa (gauge pressure) .

- Do not apply a pressure higher than 0.2 MPa (gauge pressure) , otherwise it may damage a valve or a flow meter.

4 Open the stop valve by turning it counterclockwise. Open the cylinder main valve, and then close it again 2 to 3 seconds later.

5 Verify that the primary pressure does not fall for several minutes.

- When the primary pressure decreases, possibly it may be due to leakage from the connection section between the cylinder and the regulator. Reconnect them so that there is no leakage.

6 If there is no leakage, open one of the port valves to open the system to the atmosphere.

7 Set the vacuum/purge switch valve to “PURGE” and return it to “STOP” immediately.

8 Repeat steps 4 to 7 another two times.

- It is not necessary to check for leakage from the second time onward.

9 After running the gas three times, open the main valve on the cylinder after ensuring that the vacuum/purge switch valve is set to "STOP".

Replacing the Fuse

⚠ WARNING

Before replacing the fuse, be sure to first disconnect the power cable.
Performing this work without disconnecting the power cable may lead to electric shock.

⚠ CAUTION

If the fuse is blown, eliminate the cause and then replace the fuse.
If you replace the fuse without eliminating the cause, the device may be damaged.

1 Push the cover of the fuse holder on the back of the instrument and then turn it counterclockwise.

2 Remove the fuse from the fuse holder cover that has been removed, and replace with a new fuse.

- Use a fuse with the correct size.

3 Reinstall the cover on the fuse holder.
When installing the cover on the fuse holder, push the cover toward the bottom and then turn it clockwise.

When a Problem Occurs

According to the problem symptoms, check the locations listed below.

- If you cannot find any problems in the location to check, if the problem symptoms are not fixed even after you make the improvements listed here, or if other problem symptoms occur, contact MicrotracBEL.

Problem symptom	Location to check
Vacuum degree does not rise.	・Make sure the sample cell is properly connected. If the O-ring has been damaged, contact us. ・Make sure the Rotary pump switch turns ON. ・If the rotary pump oil is dirty, change oil in accordance with the instruction manual for the rotary pump. ・Make sure the vacuum rubber tubing is properly connected. ・Make sure the port valve is closed. ・Make sure the vacuuming rate adjustment knob is open.
Gas does not flow.	・Check if the cylinder is empty. If the cylinder is empty, replace it. ・Check for the valve. If the valve is closed, make adjustment of gas pressure. ・Check if the purge gas flow tubing is clogged with something. ・Make sure the purge gas flow rate adjustment knob is open.
Heating is not initiated or temperature drops during heating.	・If the alarm lamp located on the front of the main unit turns ON during heating, heating will be discontinued. The equipment may have caused the following trouble depending on the manner in which the alarm lamp turns ON. In this case, contact us. Blinking with an interval of 0.2 second: Overheat detection feature [2] has been triggered. Blinking with an interval of 1.0 second: Overheating within the main unit (The blinking of alarm lamp will stop once the pretreatment heater temperature drops.) Illuminated: Overheat detection feature [1] has been triggered. ・If the message “S. ERR” is displayed without the alarm lamp being illuminated, the temperature sensor is disconnected. Please contact us.
Temperature does not become stable.	・Conduct auto-tuning at the set temperature to update the PID parameter.
Fuse is blown	・Shut down the main unit, take out the fuse holder and replace the fuse with a spare fuse. If it was not possible to identify the cause, please contact us.

When a Safety Mechanism Activates

This product is equipped with safety mechanisms. When a safety mechanism activates, this main unit handles the issue automatically. After you eliminate the cause, restore the mein unit.

- If the safety mechanism is activated again or you sense the symptom of any abnormality even after resetting the system, please contact us.

Safety mechanism	Automatic handling	Restoration method
Detection of abnormal pressure in the system (Check valve)	If the pressure in the system exceeds 20 kPa (gauge pressure), the check valve will be activated to ensure safety, releasing excess pressure to open air.	Since the check valve closes when the pressure reduces, continue operating the system.
Temperature sensor disconnection detection	If the temperature sensor is disconnected, the temperature controller displays the message S.ERR.	Please contact us.
Warning for upper limit of temperature	If the process value (PV) of the temperature controller exceeds the preset value (460 °C), the controller issues an error and stops the heating. The heater switch lamp will be turned off and the alarm lamp blinks with an interval of 0.2 second.	Wait for the thermal devices to cool down and turn OFF the power switch on the main unit front panel to shut down the power supply to the main unit. Then, turn ON the main unit power to restore the system.
Warning for overheat	If the temperature on the overheating sensor exceeds the preset value (480 °C) or the overheating sensor is disconnected, the internal board issues an error and stops the heating. The heater switch lamp will be turned off and the alarm lamp will be lit.	Wait for the thermal devices to cool down and turn OFF the power switch on the main unit front panel to shut down the power supply to the main unit. Then, turn ON the main unit power to restore the system.
Mechanism of preventing temperature rise in the equipment main body (Fan failure detection mechanism)	If the cooling fan stops, the heating operation will stop. The heater switch lamp will be turned off and the alarm lamp blinks with an interval of 1.0 second.	Check the fan for clogging. Turn OFF the power switch and shut down the power supply for the main unit before eliminating the cause. The operation will be restored once the main unit is powered ON again. If the operation is not restored, contact us.

Moving/Disposing

Moving

Before moving the main unit or optional equipment, be sure to consult with MicrotracBEL.

Disposing

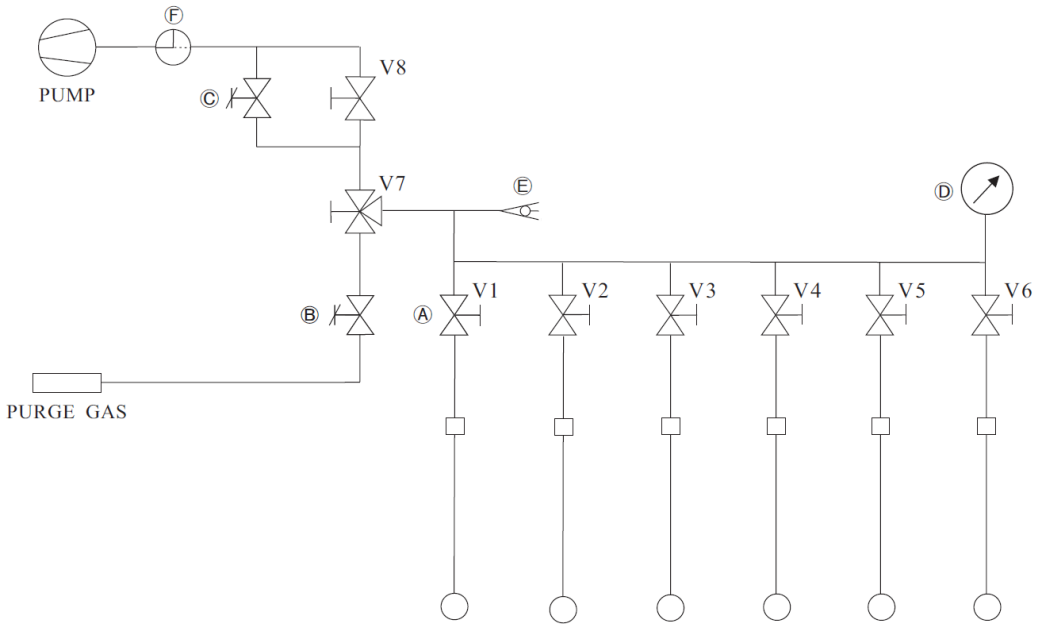
Dispose of this device and optional equipment as industrial waste in an appropriate manner in accordance with the regulations of your local government. Also contact MicrotracBEL to notify us that you have disposed of the main unit.

SPECIFICATIONS

Main Unit

Pretreatment		・Pressure-reducing and heating method ・Flow heating method (option)
Ultimate vacuum		2 Pa or less
Gases used		・N_2 ・Other inert gases • It is recommended to use nitrogen gas. When using other type of gas, the vacuum indicator may not show the correct pressure value.
Number of treatment ports		6 ports
Temperature range		Room temperature to 450 °C
Temperature control accuracy		± 5 °C
Temperature control system		PID control using a temperature controller
Utility		・Inert gas 0.1 ±0.02 MPa(gauge pressure) (1/8" swagelok connector) ・Rotary pump (Vacuum rubber tube connection port, ID 9 mm)
Dimension and weight		W 400 x H 317 x D 383 mm, 15 kg
Power supply	Rated voltage	・Switch view 115 V: Single phase 100 - 120 VAC ・Switch view 230 V: Single phase 200 - 240 VAC
	Rated current	10 A (including the rotary pump)
	Frequency	50/60 Hz
	Service outlet for rotary pump	600 W
	Power consumption	500 W (for the main unit only)
	Appliance class	Class I
Installation environment	Temperature	10 to 35 °C
	Humidity	20 to 80 % (no condensation)
	Altitude	2,000 m max.
	Installation category	Category II
	Pollution level	Pollution level 2 (must be used indoor)

Flow Diagram



Ⓐ	**Stop valve (V1 to V6)**	These valves open and close the corresponding sample cell line. Use the port valve on the main unit - front to operate the valve.
Ⓑ	**Needle valve for adjusting the purge gas flow rate**	This needle valve is for adjusting the purge gas flow rate. Adjust the purge gas flow rate using the purge gas flow rate adjustment knob on the rear side of equipment main body.
Ⓒ	**Needle valve for adjusting the vacuuming rate**	This is a needle valve for adjusting the vacuuming rate when the vacuuming rate switch valve on the front panel of the main unit is set to SLOW. The vacuuming rate is adjusted using the vacuuming rate adjusting knob on the rear of the main unit.
Ⓓ	**Pirani pressure sensor**	This sensor measures the vacuum level in the system.
Ⓔ	**Check valve**	This is for safety when the sample cell pressure rises. To ensure safety, excess pressure is released to open air when the pressure exceeds 120 kPa.
Ⓕ	**Vent valve**	This is a 3-way valve with a line to a system, and a line for vent. In order to prevent oil loss through the rotary pump piston, the system will be open to the atmosphere whenever the main unit power is shut down.

To order consumable products and to request servicing, contact the following offices.

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