P C — 1 0

Puller

Contents

Precautions in Handling

This is a high precision instrument for use in micron level and thus finely adjusted. Exercise added care on the following precautions in order that the instrument can be used safely over a long period of time.

1. Handle with care so as not to drop the instrument on your hands or feet to avoid injuries.

2. Handle carefully not to give impacts to the instrument by dropping or bumping against it.

3. Do not loosen the clamps of the structure. Do not disassemble the instrument for repair or reconstruction.

4. Avoid staining the instrument with blood, chemicals or water. Do not install it in a place where it may be exposed to them.

5. Stains from blood or chemicals should be removed with an organic solvent such as alcohol. Avoid sterilizing by boiling.

6. Do not install the instrument in a humid place.

7. Install the instrument horizontally on a level surface. Do not install it in an unstable place where shocks or vibrations may occur.

8. Do not expose the instrument to dust or direct sunlight.

9. Do not install the instrument in a place adjacent to monitors or speakers that are highly magnetic.

10. Use the specified power input voltage for this instrument. For details, refer to "Maintenance – Change of the Working Voltage".

11. While the power switch is on, the heating element keeps generating heat. Residual heat remains for a while after the power supply is turned off. Do not touch the heating element directly to avoid burns. When adjusting the heater or replacing the element, let the heating element completely cool off before starting the procedure. For details, refer to "Initial Setting – Adjustment of the Heater Block" and "Maintenance – Replacing the Heating Element, respectively.

12. Be careful not to overheat the heating element to avoid deterioration of the element as well as the acrylic hood.

13. Do not put your fingers underneath the moving slider during operation to avoid injuries caused by getting your fingers caught in the moving slider.

14. The tip of a micropipette after heated and processed is very hot. Do not touch it to avoid burns.

15. The tip of a processed micropipette is very sharp. Extreme caution should be exercised to avoid serious injury.

16. Be aware that, to prevent deterioration of the heating element and to ensure safety, heat generation of the heating element is limited to 90 seconds. For details, refer to "Error Messages"– E_02.

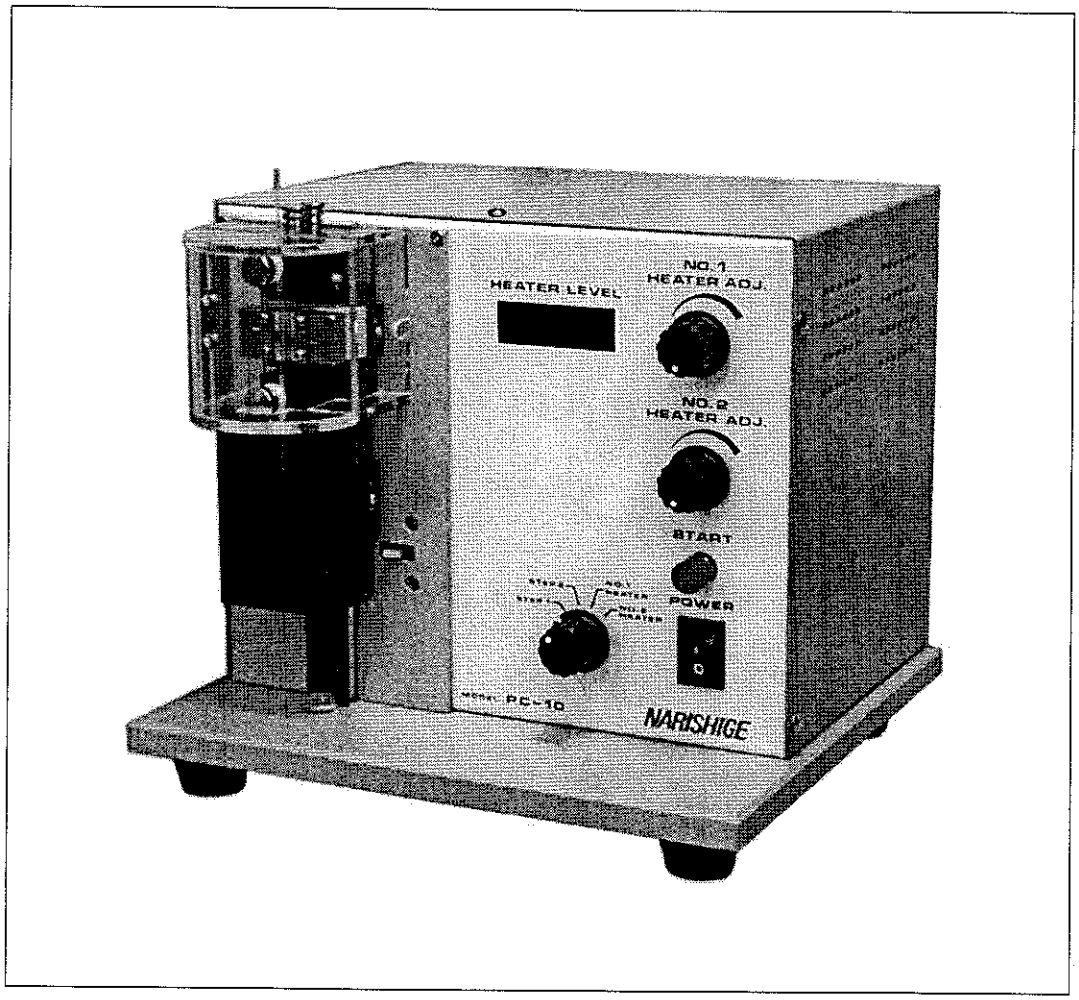
17.Should this instrument not perform properly or further assistance be required, please contact your local Narishige representative.

□The design of the product is under constant review and whilst every effort is made to keep the instruction manual up to date, the right is reserved to change specifications and equipment at any time without prior notice.

General Description

Thank you for purchasing the Model PC-10 Puller.

This instrument is designed to produce micropipettes of any and all kinds including pipettes with tips of several ten μm to be used for the experiments in biotechnology or those with tips of a few μm to be used for the experiments in electrophysiology, or even those with tips in the region of 1 μm. The primary feature of this instrument is its built-in stabilized power supply to minimize variations of the output voltage and the digital display showing the status of the output voltage of the heating element allows the heater settings to be finely controlled for improved reproducibility of micropipettes. In addition, the procedures required in the conventional two stage pulling have become completely automatic. Of the two channels for the heater control, a ten-turn adjusting knob is provided for the control side requiring fine adjustment, enabling ultra fine control. This instrument applies free fall by gravity as its pulling force (or descending by the action of a weight), thus it is provided with two types of weights to choose from, a light type and a heavy type, two pieces each, depending on the purposes, enabling you to pull various kinds of micropipettes satisfying diverse needs. The acrylic hood covering the entire heating unit keeps it from being exposed to the outside atmosphere and thus it is hardly affected by the influence from the outside.



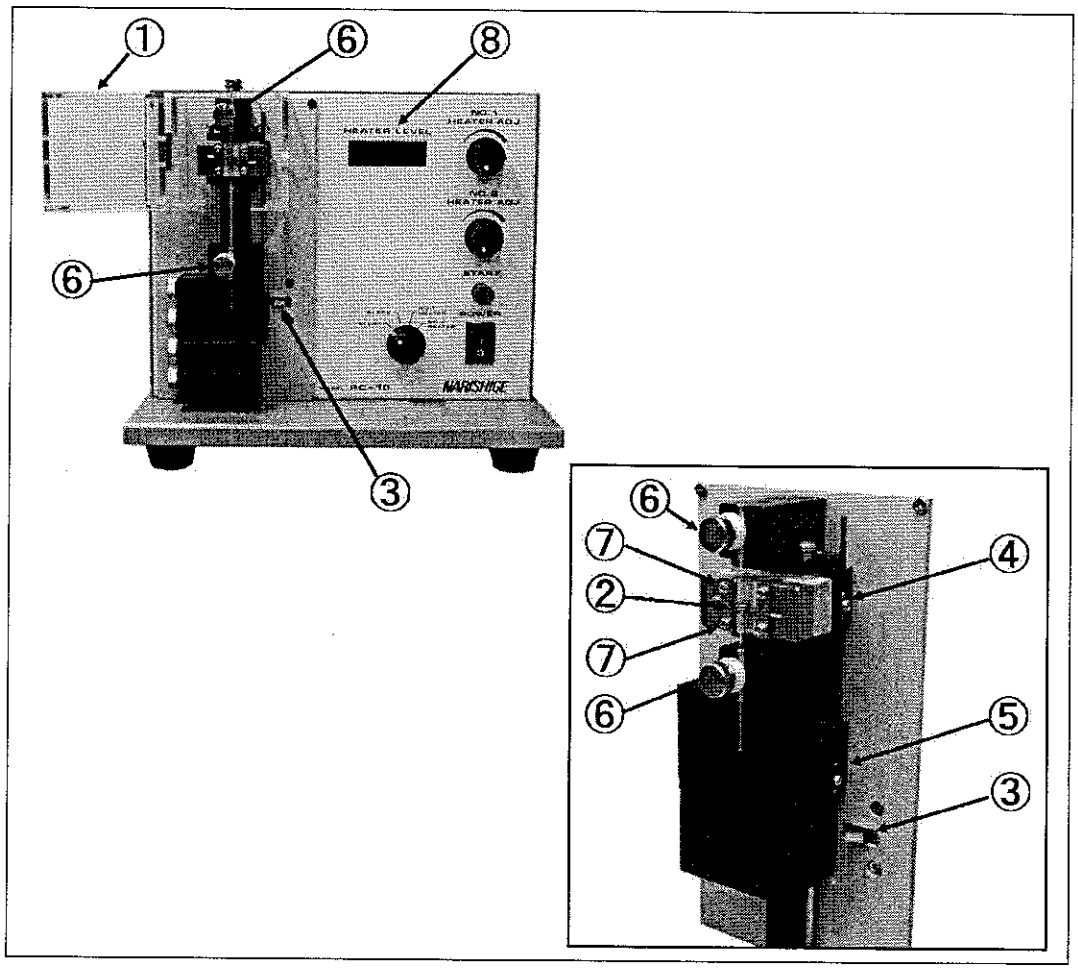
Items Supplied

The housing case of this instrument comes complete with the items listed on this page. Should any of the under-mentioned items be missing in the case at the time of purchase, please contact your local Narishige representative.

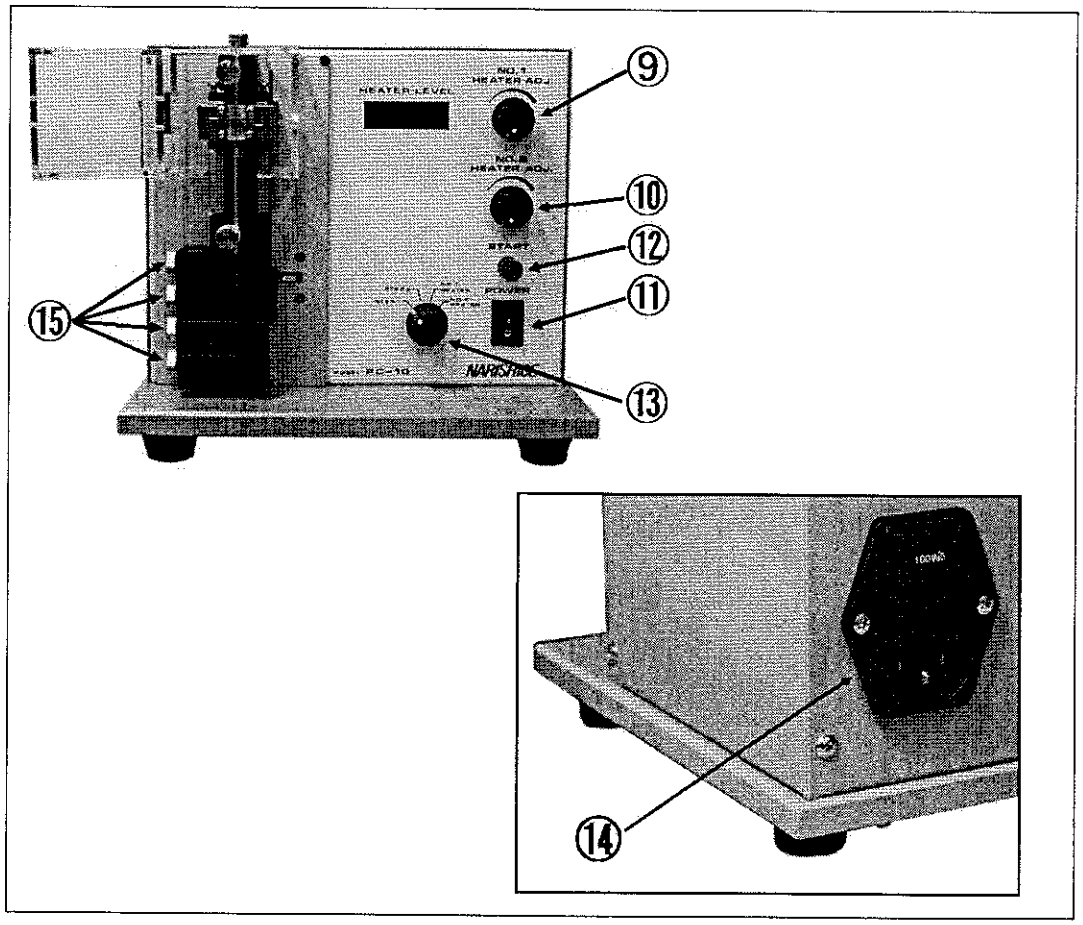
☐Main Unit	1 unit
☐Glass Capillary with Cored Glass Fiber (Model GD-1)	100 pieces
☐Spare Heating Element (Kanthal wire)	2 pieces
☐Power Cable	1 piece

Exterior Features

①Acrylic hood
It is used for shutting out the wind, breath and other influences from the outside.
②Heating element
It is used for heat processing glass capillaries.
③Stopper
This stopper is automatically activated to stop the first pull in the two stage pulling.
④Heating unit travel adjustment slider
This travel adjustment slider is used to move the heating element to the heating position of the second pull in the two stage pulling. It is most desirable to be set to half the value of "⑤ " below.
⑤Terminating position adjusting slider for the first pull
It is used for adjusting the terminating position of the first pull in the two stage pulling.
⑥Capillary retaining knob
These knobs are used for retaining the upper and lower parts of a glass capillary.
⑦Heating element positioning screw
It is used for positioning the heating element in order that a glass capillary can be placed in the center of the element.
⑧HEATER LEVEL (Error code display)
It digitally displays the status of the heater as well. It also displays an error code in the event of misoperation or that a failure occurs in the system.



⑨NO.1 HEATER adjusting knob
It is used for adjusting the heating value (output voltage) of the first pull in the two stage pulling.
⑩NO.2 HEATER adjusting knob
It is used for adjusting the heating value in the single stage pulling or adjusting the same of the second pull in the two stage pulling.
⑪Power switch
It turns the power on and off. While it is on, HEATER LEVEL illuminates.
⑫Start switch
It starts the production of a micropipette.
⑬Mode-selector knob
It enables you to switch among the following four modes.
STEP 1: for starting the single stage pulling when turning the start switch on
STEP 2: for starting the two stage pulling when turning the start switch on
NO.1 HEATER: for displaying the heating value of NO.1 HEATER on HEATER LEVEL and letting the heating element generate heat at the set value. The heating value can be adjusted or changed with NO.1 HEATER adjusting knob.
NO.2 HEATER: for displaying the heating value of NO.2 HEATER on HEATER LEVEL and let the heating element generate heat at the set value. The heating value can be adjusted or changed with NO.2 HEATER adjusting knob)
⑭Power input port (Fuse holder / Changeover of the input voltage)
The power cable is plugged in. Replacement of the fuse or changeover of the input voltage also can be conducted. For details, refer to "Maintenance – Replacing the Fuse and Change of the Working Voltage".
⑮Weight (a heavy type / a light type --- 2 pieces each)
They are used for adjusting the pulling force in pulling a heated glass capillary.



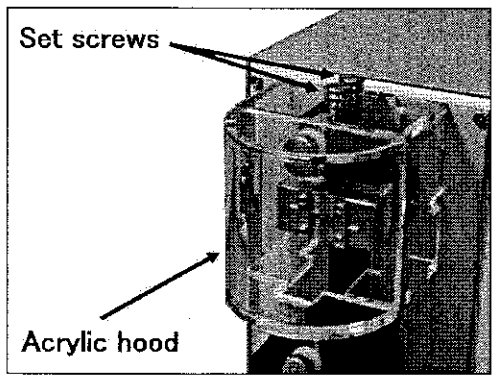
Initial Setting

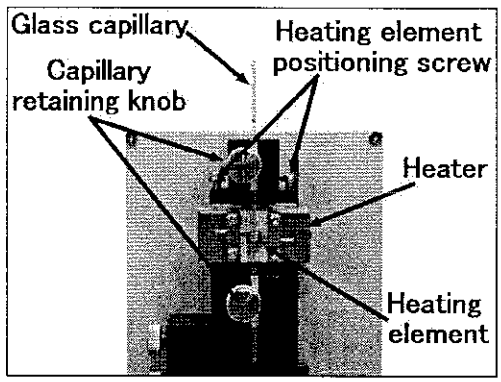
Adjustment of the Heater Block

This instrument is designed to pull a glass capillary by applying heat to produce a micropipette. In pulling a glass capillary into a micropipette, it is necessary to adjust the position of the heater block in order that a glass capillary can be heated in the center of the heater block so as to produce a micropipette of good shape.

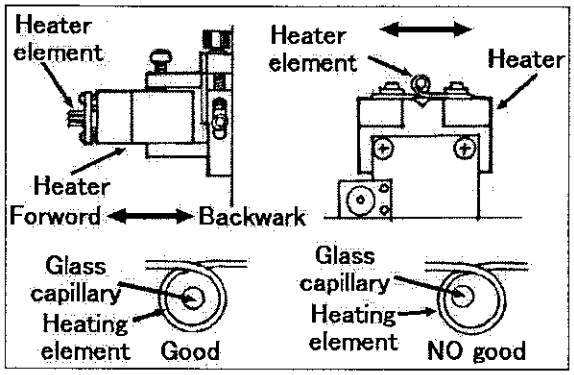
CAUTION!

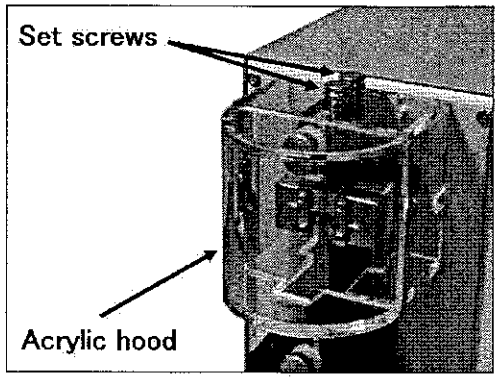
Ensure that the power supply is turned off and both the heated element and the heater block are completely cooled off before starting this procedure. Do not turn the power supply back on until all the procedures are completed.





1. Unfasten the set screws on the top to remove the acrylic hood.
2. Put a glass capillary (or a rod of 1mm diameter) through the heating element and fix it with the capillary retaining knob and then loosen the heating element positioning screw to let the heater block move freely.





3. Adjust the heater block so as to center the glass capillary in the heating element by moving the heater block to-and-fro, from side to side and then fasten the heating element positioning screw so as not to let the heater block slip out of place.

4. Remove the capillary and reattach the acrylic hood.

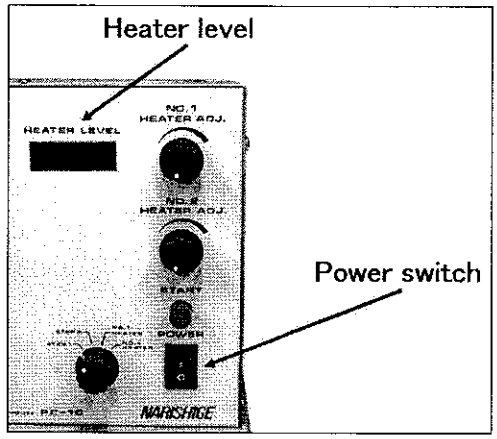
CAUTION!

Do not fasten the heating element positioning screw too tightly, or it may cause breakage of the heater block.

How to Operate

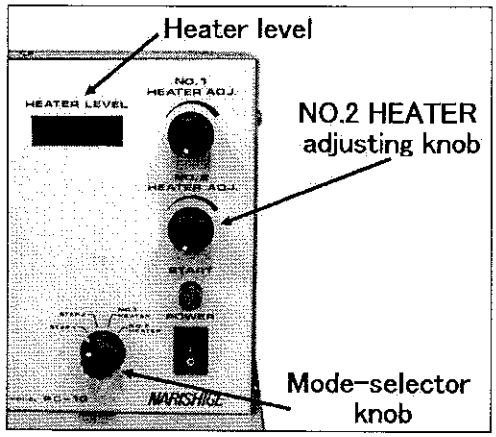
(1) Single Stage Pulling

1. Turning the power supply on



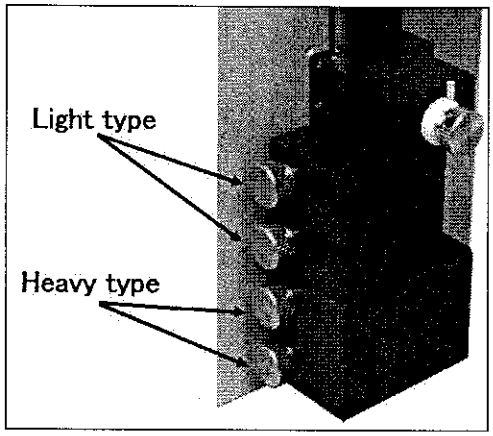
Turn the power switch on after the initial setting is completed in accordance with "Initial setting". Ensure that HEATER LEVEL illuminates to display a value in the region of 25, which means it is in preheating condition.

2. Setting a heating value



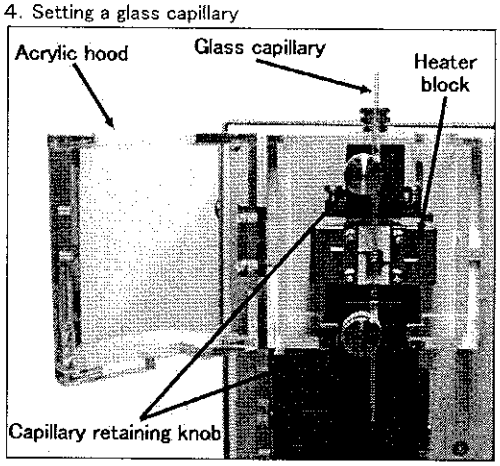
Set the mode-selector knob to NO.2 HEATER and adjust the heating value with NO.2 HEATER adjusting knob. In this procedure, if the HEATER LEVEL is set higher, a pipette's taper shank tends to be longer while set lower, it tends to be shorter. Finish the setting as swiftly as possible and switch the mode selector to STEP 1. Taking more than 90 seconds to make this setting causes an error code to appear on HEATER LEVEL halting the operation of this instrument. For details, refer to "Error messages".

3. Putting the weights on the sliding unit



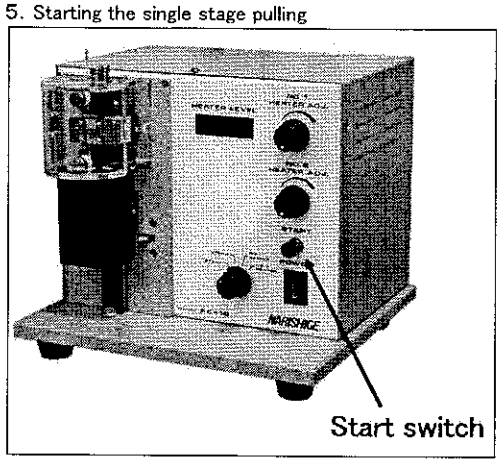
Put the proper weights on the sliding unit. As the weights can be attached or detached with the screws on the left side of the weights, adjust the number of weights to the most desirable weight. It is better to have the weight a little too heavy than too light. As the weight is heavier, the micropipette tends to be shorter while lighter, it tends to be longer. If, however, the weight is too light, it may result in a failure to produce a micropipette.

4. Setting a glass capillary



Switch the mode-selector knob to "STEP 1" and ensure that the heater block is lifted up to its upper limit. Then, open the cover of the semicircular acrylic hood, loosen the capillary retaining knob on the upper side and insert a glass capillary from the upper side of the acrylic hood. Fix the glass capillary in order that the center of the heating element can be positioned at the midpoint of the overall length of the capillary. Loosen the capillary retaining knob on the lower side, lift up the movable slider to its upper limit and fix the other end of the glass capillary. When lifting the movable slider up to its limit, be careful not to hit and break one end of the glass capillary.

5. Starting the single stage pulling



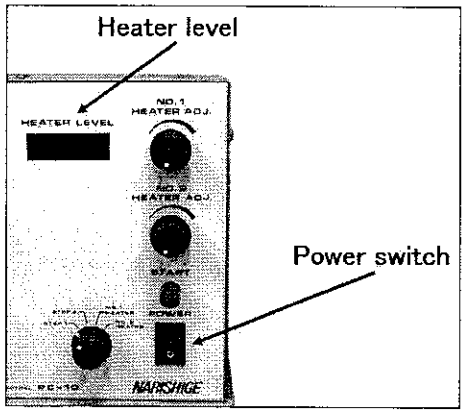
Press the start switch. The heating element will get heated to melt the glass capillary and then the melted capillary is pulled by the weight of the movable slider to produce a micropipette. This completes the procedure of the single stage pulling. If a pipette production is not finished within 90 seconds or so due to an insufficient heat, an error code is displayed on HEATER LEVEL halting the operation of this instrument. In that event, refer to "Error messages" to reset the heating value and restart the single stage pulling.

6. Finding an ideal setting

Repeat the above pulling procedures to find out an ideal setting for your purposes. Pulling in the same setting enables you to reproduce micropipettes of nearly the same shape in every attempt.

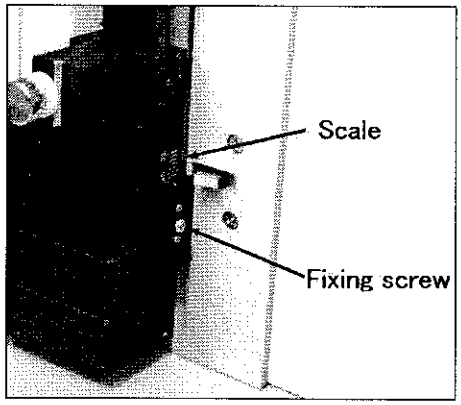
(2) Two Stage Pulling

1. Turning the power supply on



Turn the power switch on after the initial setting is completed in accordance with "Initial setting". Ensure that HEATER LEVEL illuminates to display a value in the region of 25, which means it is in preheating condition.

2. Setting the pulling length of the first pull

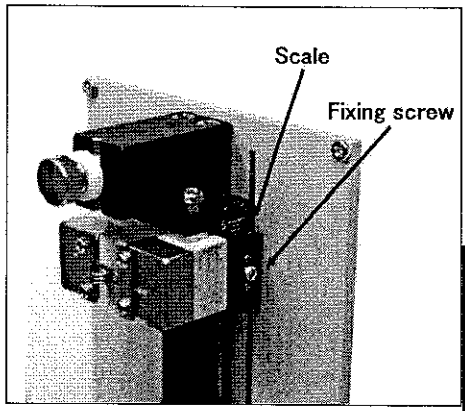


Determine the pulling length of the first pull with the terminating position adjusting slider for the first pull. Loosen the fixing screw on the right side of the slider and fasten the fixing screw at the most preferred position by referring to the scale on the side of the slider. If the pulling length is too long, the capillary may break at the beginning of the second pull.

CAUTION!

If the adjusting block is fixed tilted, it will cause an error code "E_01" to appear. When fixing the adjusting block, therefore, press it lightly against the front panel so as not to have it tilted.

3. Setting the heating position of the second pull



The heating position where the glass capillary is heated in the second pull can be determined with the heating unit travel adjustment slider. Loosen the fixing screw on the right side of the slider and fasten the fixing screw at a position half the length (scale) of that set with the terminating position adjusting slider for the first pull by referring to the scale on the side of the slider.

CAUTION!

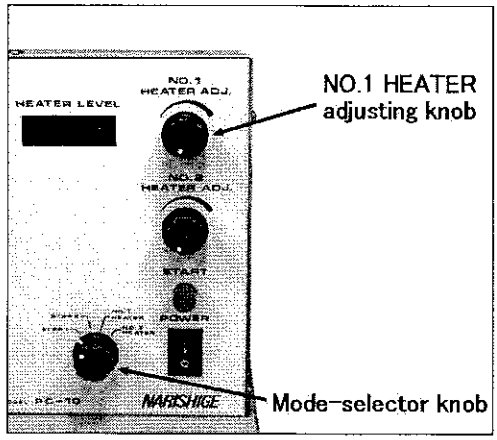
Ensure that a traveling length of the heater is set shorter than a pulling length of the first pull. If a traveling length of the heater is longer, ascent/descent gears of the heater may break off and cause a mechanical failure.

Traveling length of the heater < Pulling length of the first pull

CAUTION!

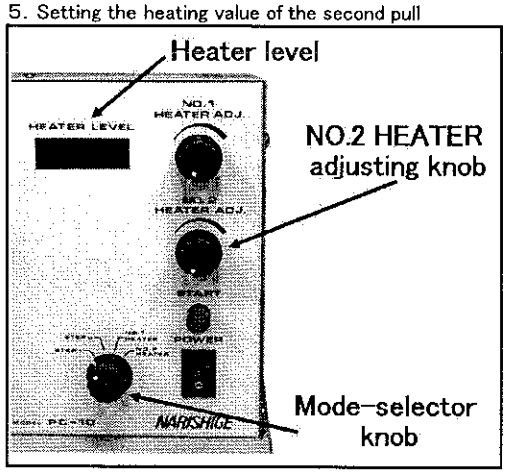
If the adjusting block is fixed tilted, it will cause an error code "E_01" to appear. When fixing the adjusting block, therefore, press it lightly against the front panel so as not to have it tilted.

4. Setting the heating value of the first pull



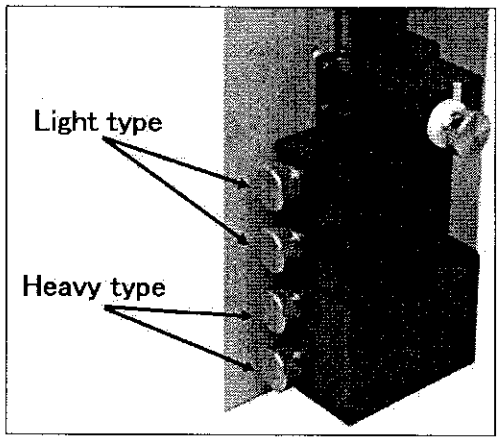
Set the mode-selector knob to NO.1 HEATER and adjust the heating value with the NO.1 HEATER adjusting knob. Finish the setting as swiftly as possible and switch the mode selector to STEP 2. Taking more than 90 seconds to make this setting causes an error code to appear on HEATER LEVEL halting the operation of this instrument. For details, refer to "Error messages".

5. Setting the heating value of the second pull



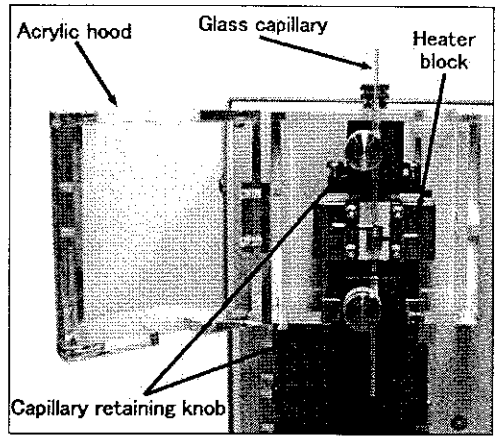
Set the mode-selector knob to NO.2 HEATER and adjust the heating value with the NO.2 HEATER adjusting knob. In this procedure, though it depends on the length pulled in the first pull, if the HEATER LEVEL is set higher, a pipette's taper shank tends to be longer while set lower, it tends to be shorter. Finish the setting as swiftly as possible and switch the mode selector to STEP 2. Taking more than 90 seconds to make this setting causes an error code to appear on HEATER LEVEL halting the operation of this instrument. For details, refer to "Error messages".

6. Putting the weights on the sliding unit



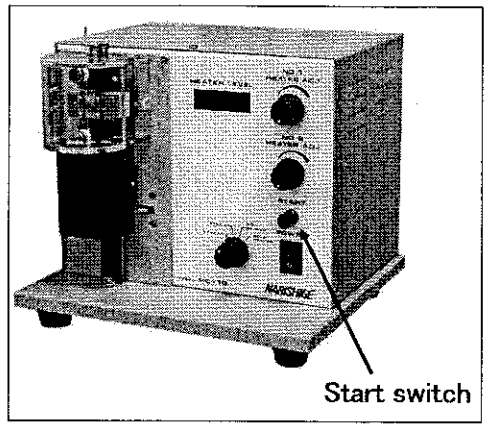
Put the proper weights on the sliding unit. As the weights can be attached or detached with the screws on the left side of the weights, adjust the number of weights to the most desirable weight. It is better to have the weight a little too light than too heavy. As the weight is heavier, the micropipette tends to be shorter while it is lighter, it tends to be longer. If, however, the weight is too light, it may result in a failure to produce a micropipette, while it is too heavy, the glass capillary may break at the beginning of the second pull.

7. Setting a glass capillary



Switch the mode-selector knob to "STEP 2" and ensure that the heater block is lifted up to its upper limit. Then, open the cover of the semicircular acrylic hood, loosen the capillary retaining knob on the upper side and insert a glass capillary from the upper side of the acrylic hood. Fix the glass capillary so as to coincide the center of the heating element with the midpoint of the overall length of the capillary. Loosen the capillary retaining knob on the lower side, lift up the movable slider to its upper limit and fix the other end of the glass capillary. When lifting the movable slider up to its limit, be careful not to strike and break one end of the glass capillary

8. Starting the two stage pulling



Pressing the start switch automatically activates the following operations.

1. The stopper is engaged ・ No.1 HEATER starts to heat (the first pull is initiated)
2. The movable slider descends to the stopper (the first pull is terminated)
3. Allow No.1 HEATER to cool by itself (about 20 seconds).
4. The heating unit moves to the processing position of the second pull.
The stopper is disengaged. ・ No.2 HEATER starts to heat (the second pull is initiated)
5. The movable slider descends to the lower limit (the second pull is terminated)
The heating unit returns to its initial setting (ascending to the upper limit). ・ Allowing No.2 HEATER to cool by itself (all operations are complete).

Do not apply loads to the adjusting units or operating units of each functional system until all operations come to a complete stop in order to avoid causing a breakdown. If the micropipette production is not finished within 90 seconds or so due to an insufficient heat, an error code is displayed on HEATER LEVEL halting the operation of this instrument. In that event, refer to "Error messages" to reset the heating value and restart the two stage pulling.

9. Finding an ideal setting

Repeat the above pulling procedures to find out an ideal setting for your purposes. Pulling in the same setting enables you to reproduce micropipettes of nearly the same shape in every attempt.

Error Messages

HEATER LEVEL also gives the error messages as shown below. When an error message appears on HEATER LEVEL, troubleshoot the problem by referring to the following table.

Error Codes	Causes	Remedies
E_01	The slider is not positioned correctly at its full height when pressing the start switch at the beginning of a pipette production.	Allow the slider to rise to its full height, reset the glass capillary and repeat the procedure.
E_01	The respective adjusting blocks fixing the heater unit travel adjustment slider and the first pull terminating position adjusting slider are tilted.	Loosen the fixing screws slightly and press the adjusting block lightly against the front panel to refasten the fixing screws.
E_02	It took more than 90 seconds to adjust the heating value of NO.1 and NO.2 HEATER. ※Internal protection circuit is under operating conditions.	Pressing the start switch clears the error message and permits the readjustment of the heating value.
E_04	During the two stage pulling, completion of the first pull was not detected.	Increase the output of NO.1 HEATER and repeat the procedure. (A glass capillary was not pulled due to low output.)
E_05	During the two stage pulling, the heater unit did not descend.	The ascent/descent mechanism of the heater unit in the inner workings of the instrument fails to work properly. Service is required.
E_06	During a pipette production, the movable slider did not descend to the lower limit.	Increase the output of NO.2 HEATER and repeat the procedure. (A glass capillary was not pulled due to low output.)
E_07	During the two stage pulling, the heater unit did not return (ascend) to the initial position.	The ascent/descent mechanism of the heater unit in the inner workings of the instrument fails to work properly. Service is required.
E_08	During the two stage pulling, the descending speed of the slider at the first pull was too fast and thus the slider bumped and bounced off the stopper.	Reduce the output of NO.1 HEATER or adjust the weight in order to reduce the descending speed of the slider at the first pull.
E_08	During the two stage pulling, the stopper malfunctions.	The solenoid coil activating the stopper in the inner workings of the instrument fails to function properly. Service is required.
E_99	Failed fixation of the heater (poor contact) or a break in the heater.	Tighten the fixing screw of the heater securely. If the heater is deteriorated and disconnected, replace the heater with a new one.

Error messages can be cleared by pressing the start switch. Please ensure that you realize the causes of the error messages and exercise care to avoid repeating the same errors. If the problem persists or "service is required" is mentioned in Remedies, please contact your local Narishige representative because the inner workings of the instrument may be faulty.

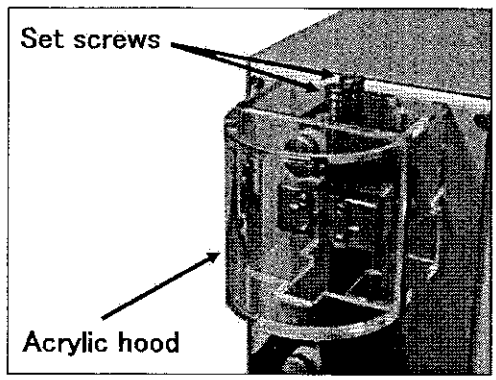
Maintenance

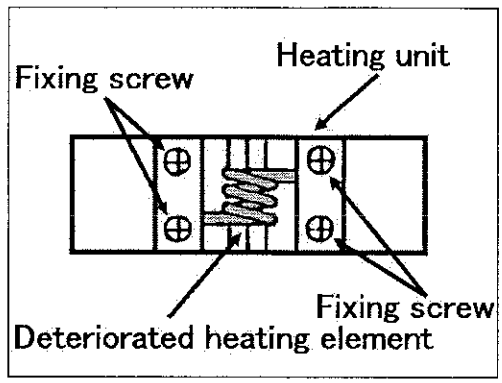
(1) Replacing the Heating Element

After extended periods of use, the heating element is oxidized and then deteriorated. Replace the element as necessary by following the procedure given below.

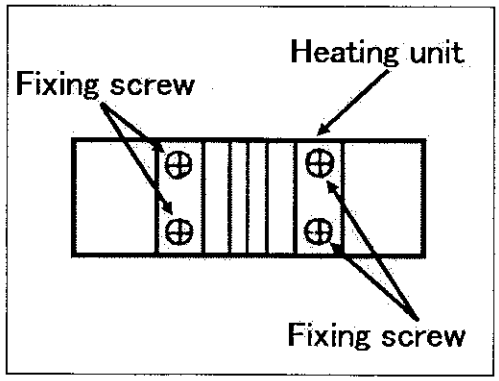
CAUTION !

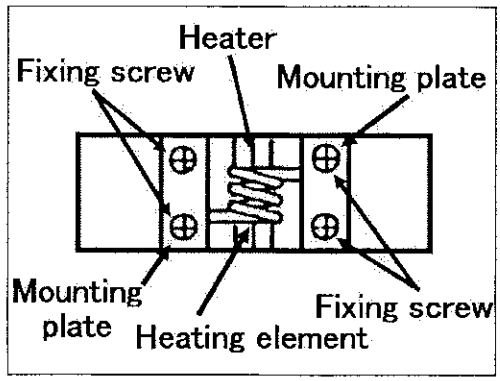
Please ensure that the main power supply is turned off and the heated element is completely cooled off before starting the procedure. Do not turn the power supply back on until all procedures are completed.





1. Unfasten the set screws on the top to remove the acrylic hood.
2. Unfasten the fixing screws at both ends of the heating element connecting terminal using a precision screwdriver and remove the deteriorated heating element.





3. Fix a new (spare) heating element temporarily by fastening the fixing screws lightly so as to put the heating element between the connecting terminals.
4. Loosen the screws to move the heating element to-and-fro, and then fasten the fixing screws of the respective terminals tightly at a position where the center of the element coincides with the center of the heater.
5. After the above procedure is completed, be sure to adjust the heater and the heater block by referring to "Initial Setting" – Adjustment of the Heater Block.
6. Attach the acrylic food to finish the procedure.

(2) Replacing the Fuse

This instrument has a fuse equipped at the power input port. For replacing the fuse, follow the directions given below.

CAUTION !

Ensure that the main power supply is turned off and the power cable is disconnected before starting the procedure. With the cable on the port, the cover cannot be opened. Do not turn the power supply back on until all the procedures are completed.

1. Put a flatblade screwdriver in the slot on the top of the power input port and pull it towards you to open the cover. (See the drawing)

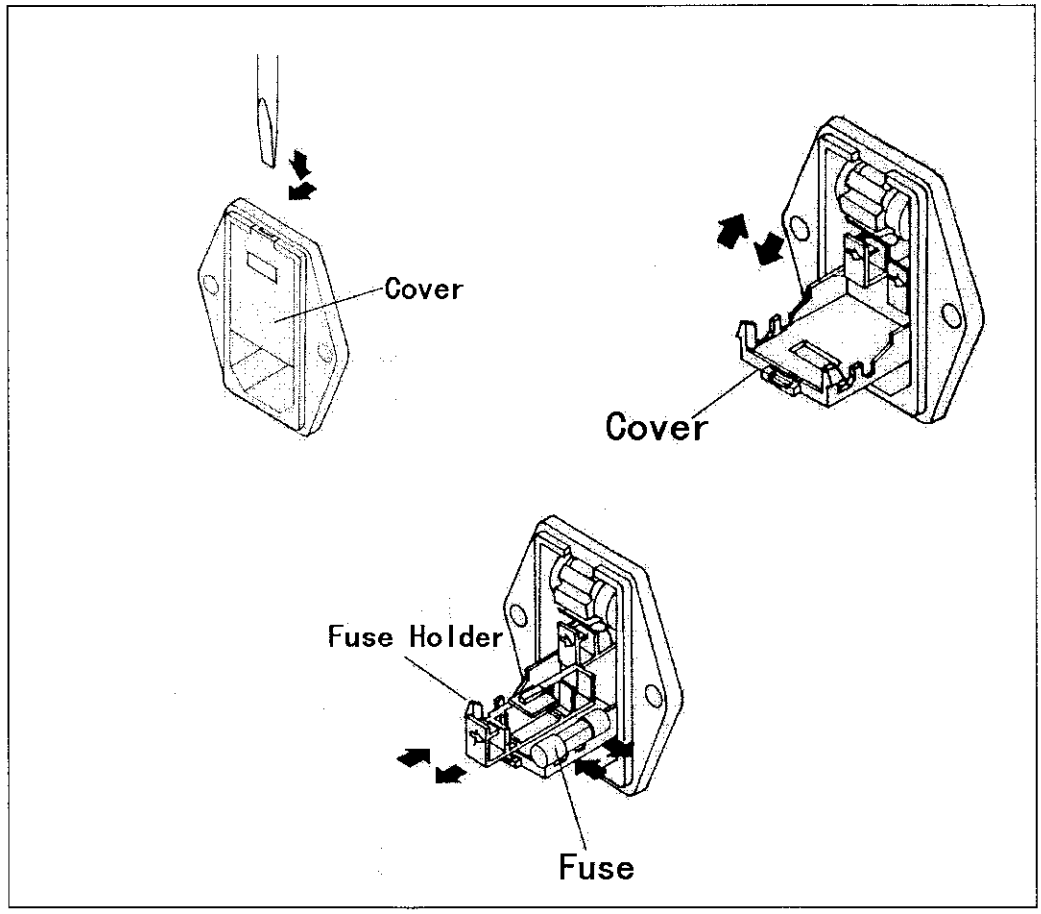
2. Pull out the fuse holder and replace the blown fuse with a new one with a capacity equal to the blown fuse.

3. Put the fuse holder back in place by referring to the direction of the indicated arrow.

4. Close the cover to finish the procedure.

CAUTION !

1. When replacing the fuse, be sure to use a new fuse with a capacity equal to the blown one.
2. Do not make changes to the voltage setting unit.



(3) Changing the Working Voltage

This instrument is made for use with the working voltages: AC100V/120V/220V/240V. Voltage selector has been incorporated into the Power Input Unit. Use the following procedure to change the working voltage as necessary. Depending on the working voltage to be changed to, the fuse capacity may need to be changed as well. Before starting the procedure, therefore, have a new fuse of the compatible capacity ready for use as necessary.

CAUTION!

If the power supply voltage is changed between 100V/120V and 220V/240V, be sure to replace the power fuse without fail. If a wrong capacity fuse should be used, the fuse may be blown frequently or may not be blown even if it exceeds the rated load.

Matching Table of Fuse Capacity

No	Current Voltage		Voltage After Change				Notes
			100V	120V	220V	240V	
1	100V	→		3A	2A	2A	Replace the fuse when changed to 220V/240V.
2	120V		3A		2A	2A	Replace the fuse when changed to 220V/240V.
3	220V		3A	3A		2A	Replace the fuse when changed to 100V/120V.
4	240V		3A	3A	2A		Replace the fuse when changed to 100V/120V.

Gray areas in the above table signify the need to change the fuse capacity. Have a compatible new fuse ready for use.

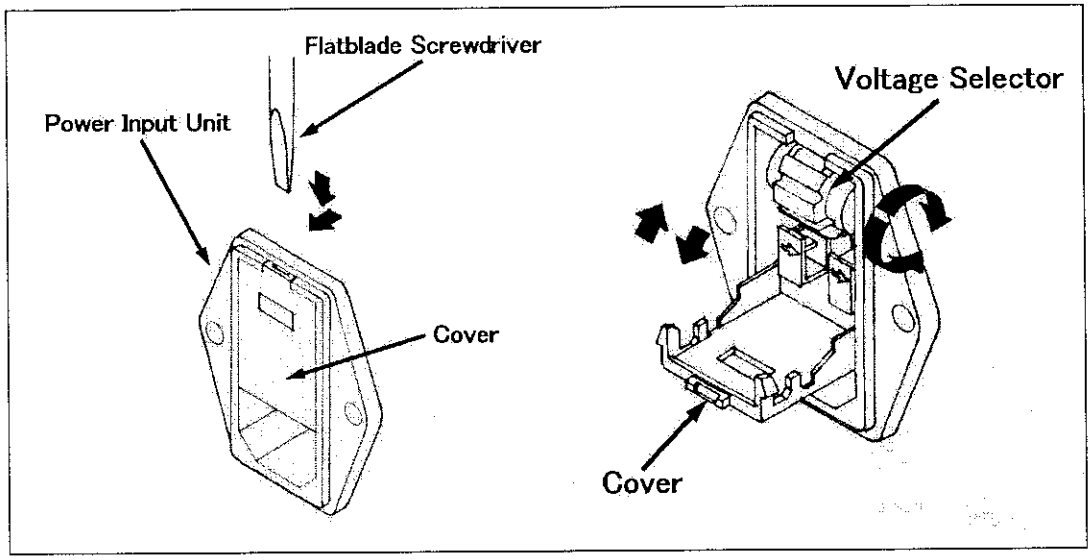
CAUTION!

Be sure to turn off the main power supply and unplug the power cord before changing the working voltage. With the power cord plugged in, the cover cannot be opened. Do not turn the power supply back on until all procedures are completed.

1. Put a flatblade screwdriver in the slot on top of the Power Input Unit to pull the cover toward you and open it. (As illustrated)
2. Make a new setting of the proper working voltage by scrolling the voltage selector.
3. Pull out the fuse holder and replace the fuse with a new one of the capacity compatible with the newly set power supply voltage. For replacing the fuse, refer to "7. Maintenance – (3) Replacing the Fuse".
4. After verifying that the set value of the voltage is correct, close the cover to finish the procedure.

CAUTION!

Ensure that the set value of the voltage agrees with the local working voltage. If set to a wrong voltage, it may cause a breakdown.



Specifications

■Designation : Puller

■Model Name : PC-10

■Dimensions : 205(W) x 190(D) x 185(H) mm

■Weight : 6.0 kg

■Workable Glass Capillary : ϕ1mm glass capillary (Pyrex glass capillary recommended)

■Heating Element : Kanthal wire heater / 2.5V at maximum

■Working Voltages : AC 100V, 120V, 220V, 240V – (rating) : +/–10%

■Power Consumption : 80VA

■Fuse
☐AC100V/AC120V —– 3A 250V 2 units (ϕ5 x 20mm)
☐AC220V/AC240V —– 2A 250V 2 units (ϕ5 x 20mm)

■Components
☐Main Body 1 unit
☐Power Cable 1 unit

■Attachments
☐Glass Capillary with Cored Glass Fiber (GD-1) 100 pieces
☐Spare Heating Element (Kanthal wire) 2 pieces

Troubleshooting

In the event of trouble, consult the following table for troubleshooting. If the trouble persists, contact your local Narishige representative. Please do not attempt to make repairs on this instrument for yourself.

Symptoms	Causes	Remedies
Even if the power switch is turned on, "HEATER LEVEL" does not illuminate.	AC cable is disconnected.	Plug the AC cable firmly in the receptacle.
	The voltage setting at the power input port does not agree to the working voltage.	Make a proper setting at the power input port conforming to the working voltage.
	The fuse at the power input port is blown.	Replace it with a new fuse. (Refer to P.15.)
An error code appears on HEATER LEVEL.	Refer to "Error Messages – Causes".	Refer to "Error Messages – Remedies". (Refer to P.13.)
The heating element generates no heat at all. (HEATER LEVEL illuminates)	Poor contact at the heating element fixed part or oxidation due to heat	Refasten the heating element fixing screws or polish the contact area lightly.
The heating element generates no heat at all. (HEATER LEVEL does not illuminate)	A break in the heating element. (Error message E_99 appears.)	Replace it with a new heating element. (Refer to P.14.)
Inconsistent or uneven heat generation	Deterioration of the heating element (Error message E_99 appears.)	Replace it with a new heating element. (Refer to P.14.)
	The heating unit is exposed to the wind blowing out of the air conditioner.	Change the direction of the wind or turn off the air conditioner.
When a glass capillary is pulled, it does not break up or is not separated.	The heater output is too high.	Decrease the No.2 heater output.
	The weight is too light.	Add more weights
When a glass capillary is pulled, it is pulled off center.	A glass capillary does not sit right at the center of the heating element.	Adjust the heating unit so as to place the glass capillary at the center of the heating element.
During the two stage pulling the instant that the second pull started after the first pull was terminated, the slider fell.	As the value of pulling length set by the first pull terminating position–adjusting slider was too long, the glass capillary broke in the first pull.	Make the setting value of pulling length shorter.
	As the value set by No.1 HEATER adjusting knob was too low, the glass capillary broke in the first pull.	Increase the setting value of No.1 HEATER adjusting knob.
	The weight is too heavy.	Change the weight to a lighter one or reduce the weight.
During the two stage pulling, the pulled capillary becomes constricted.	A failed setting of the heating unit travel adjustment slider.	Adjust the setting to one-half the set value of the first pull terminating position–adjusting slider.

During the two stage pulling, the pulled capillary has a bent tip.	When the movable slider descending at the first pull is stopped by the stopper, it bounces causing the tip of the pulled capillary to be deformed.	1. Make the value of pulling length set by the first pull terminating position–adjusting slider shorter. 2. Change the weight to a lighter one or reduce the weight. 3. Error message E_08 appears. Decrease the No.1 heater output.