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VCC

VACUUM CENTRIFUGAL CASTING MACHINE

OPERATIONS MANUAL

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CONTENTS

1. SAFETY INFORMATION

Please be sure to read this instructions manual thoroughly before use.

This instructions manual is for MODEL *VCC - 20A* (SERIAL NO. S301 and upper numbers). MODEL name and SERIAL number are printed on the label affixed on the machine.

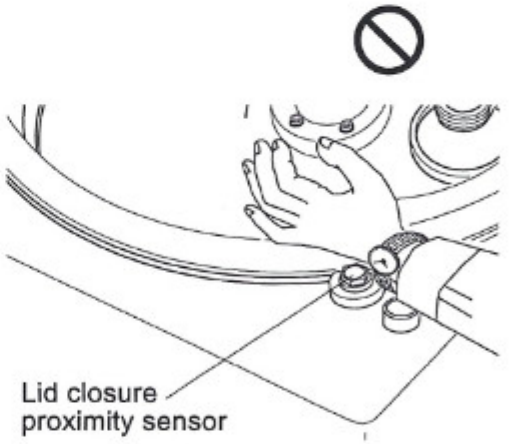
⚠DANGER

1. Never touch metals in the crucible, the coil and its surrounding area with bare hands or with electrically conductive material (such as a graphite (carbon) stirring rod, and a metal rod) when power switch is turned ON. As electric current of high voltage is flowing on metals in the crucible and on the coil, when either of [COIL] key, [HEAT] key or [HEAT-2] button is ON, careless touching to those areas could cause hazardous consequences.

2. Temperature of the crucible, the heating coil and their surrounding area is extremely high, during heating and after heating. Always take care that your fingers will not be burned by heat of the coil, or its surrounding area.

⚠WARNING

1. This sensor reacts to metals. Do not place any metallic material (such as a wrist watch, finger-ring, bracelet, metal button, screwdriver, coin etc.) on and around this sensor (P.8).



2. HEATING

(1) Check that no crack or breakage is observed on the crucible prior to its setting.

(2) When a crucible is damp, it may easily break down at the time of metal melting. Preheating is necessary to dry the crucible before standard heating.

(3) Do not push the crucible body or the metal in the crucible strongly.

(4) When a crucible cracks, melted metal may drop outside and cause critical damage in the instrument.

(5) Crucibles have their casting lives. Do not use a deteriorated crucible. Check its deterioration time before use.

(6) Damages to the instrument and/or human bodies resulting from a crucible are not compensated by the manufacturer.

(7) Close the lid during heating. Although melting is possible by [HEAT-2] button even when the lid is opened, close the lid whenever its closing is possible. (P.9)

(8) Do not stare into the melted metal directly, because it could be harmful to your eyes. Always use a eye-protection device. When you view the metal through the inspection window of the instrument, use the eye-protection glasses, and be sure not to continue viewing for a long period of time.

(9) When you leave the instrument, turn power off.

3. ROTATION

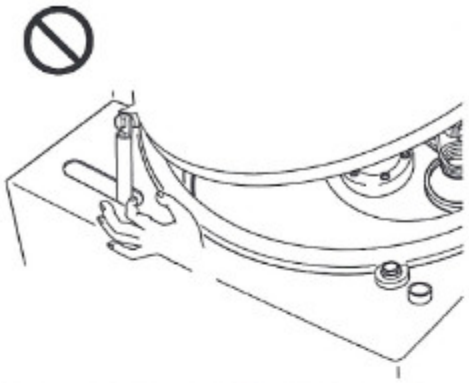
(1) Adjust balancing of the arm before rotation.

(When balance of the arm is not good, the instrument may be damaged by dropping of the flask etc.) Be sure to screw in the center knob after balancing of the arm is finished. (P.26)

(2) When you open the lid after the arm is rotated, be sure to check that rotation of the arm is already stopped.

⚠CAUTION

When you close the lid, take care that your finger will not be caught and pressed by the slot hole located near the rear of the top cover.



-THE MANUFACTURER SHALL IN NO EVENT BE LIABLE FOR ANY DAMAGE RESULTING FROM FAILURE TO OBSERVE THE INSTRUCTIONS MANUAL OR THE LABELS ON THE MACHINE, MISTAKEN OPERATION, IMPROPER USE, UNSKILLFULNESS, USE IN ENVIRONMENTS OTHER THAN SPECIFIED, NEGLIGENCE TO FOLLOW THE WARNINGS AND CAUTIONS IN THE INSTRUCTIONS MANUAL OR THE LABELS ON THE MACHINE, USE OF NON-ORIGINAL OPTIONAL/CONSUMABLE ACCESSORIES/SPARE PARTS, NON-AUTHORIZED MODIFICATION.

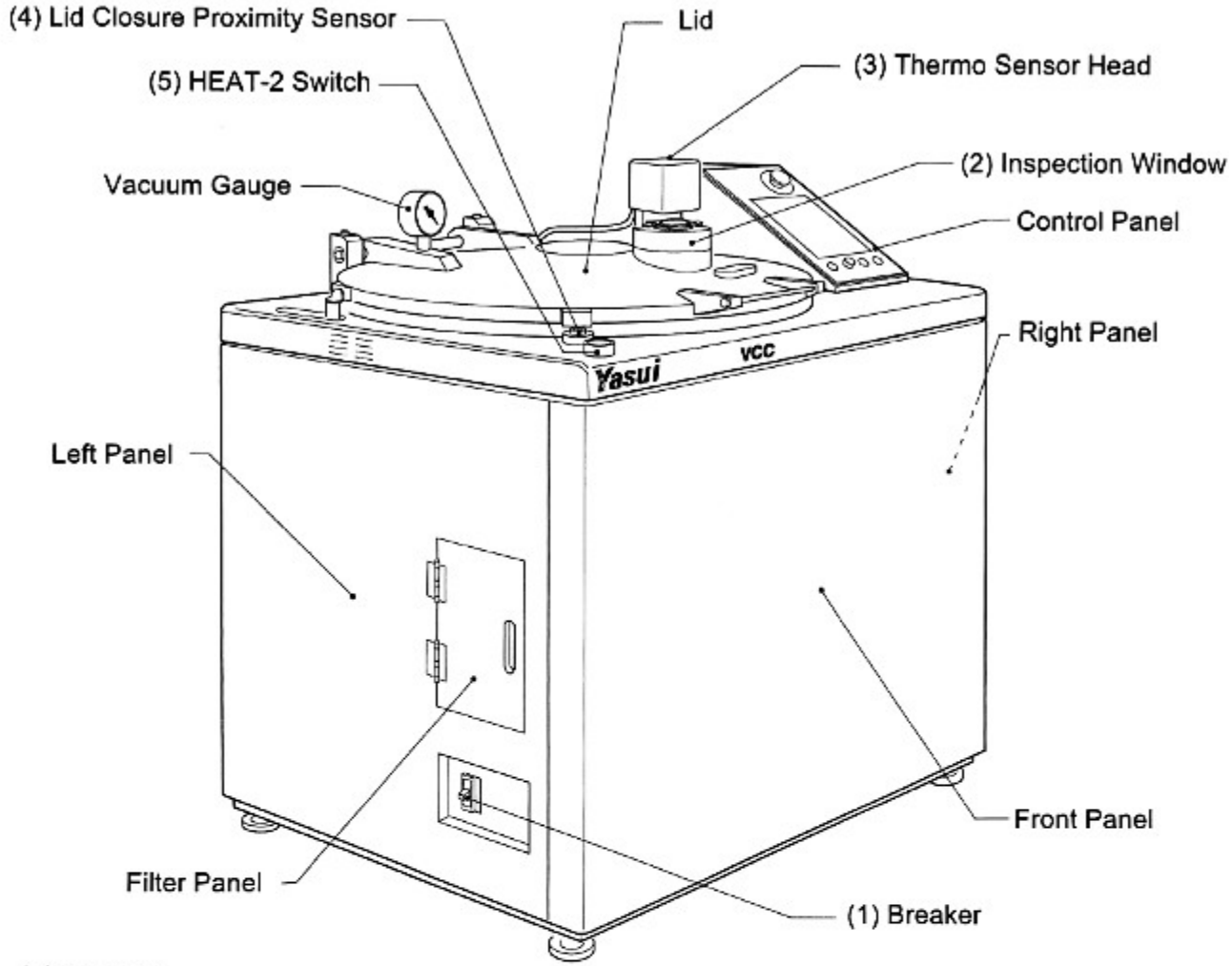
-THE MANUFACTURER SHALL IN NO EVENT BE LIABLE FOR ANY CONSEQUENTIAL OR INDIRECT DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PRODUCTION OR LOSS OF PROFIT OR DAMAGES DUE TO MACHINE DOWNTIME.

-CASTING RESULTS BY THE MACHINE OR BY THIS MANUAL ARE NOT COMPENSATED BY THE MANUFACTURER.

-NO PART OF THIS DOCUMENT MAY BE COPIED OR IN ANY WAY REPRODUCED WITHOUT THE EXPRESSED WRITTEN CONSENT OF THE MANUFACTURER.

2. NOMENCLATURE

2-1. MAIN BODY



(1) Breaker
When it is set to upper ON position, the internal pump for cooling water circulation will be activated.

(2) Inspection window
You can observe melting condition through this window. The thermo sensor detects metal temperature through this window. Therefore, this window must be always kept clean for daily work.

⚠CAUTION

When the glass has many cracks or scratches, accuracy of temperature sensor may be lost. Furthermore, earlier replacement is recommended to avoid hazardous consequences to your eyes by cracked glass. Spare of the glass is stocked at the factory as consumable parts. Consult your distributor for order of replacement.

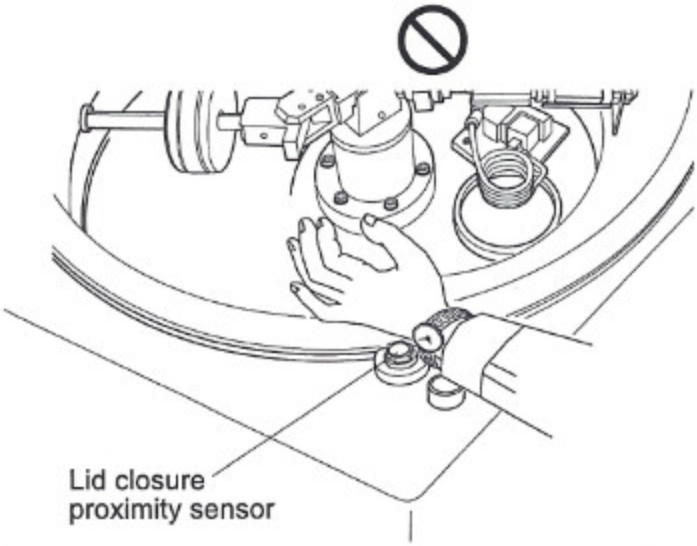
IMPORTANT: When there is too much dirt or dust on the window glass surface, temperature display may show large discrepancy from true value. Clean it periodically.

(3) Thermo sensor head
Radiated energy from the metal is captured by the thermo sensor head. Its controller is built-in in the main body of this machine.

(4) Lid closure proximity sensor
This sensor is provided for safety purposes. When the lid is opened (the lid closure proximity sensor is OFF), it is not possible to rotate the arm and to heat by [HEAT] key on the control panel. (However, [HEAT-2] button becomes effective. See P.9 for how to use it.)

⚠WARNING

This sensor reacts to metals. Do not place any metallic material (such as a wrist watch, finger-ring, bracelet, cuff button/link, screwdriver, coin etc.) on and around this sensor.



(5) HEAT-2 button (usable in the MANUAL mode only)
If [HEAT] key is pressed to ON while the lid is opened, the Second Heating Mode ([HEAT-2] button is effective) starts with signal sound.
If [HEAT-2] button is pressed and held during the Second Heating Mode, heating is applied while [HEAT-2] button is pressed and held. If the lid is once closed at this time, the Second Heating Mode is finished and [HEAT-2] button becomes ineffective.

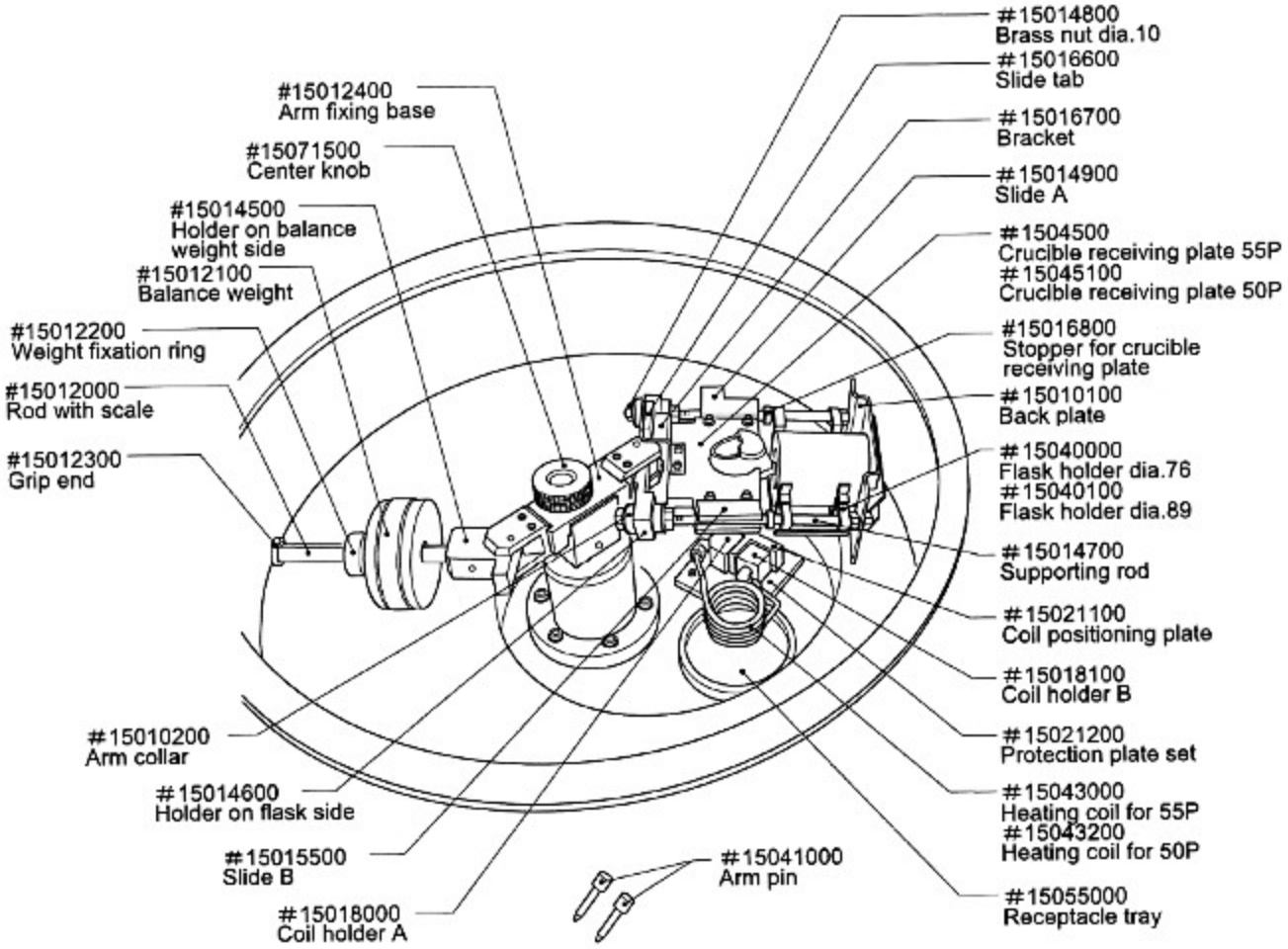
⚠DANGER

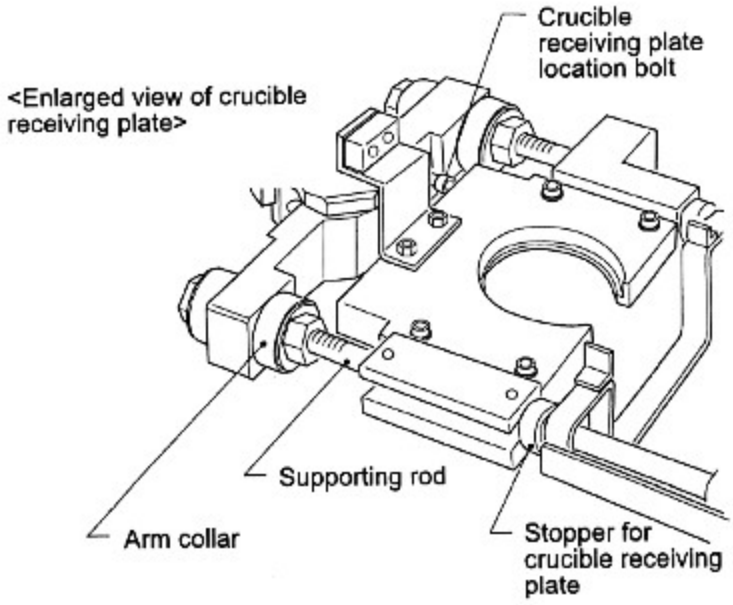
1. When [HEAT-2] button is ON, never touch the metals in the crucible, the coil and its surrounding area with bare hands or with electrically conductive material (such as a graphite (carbon) stirring rod, and a metal rod). As electric current of high voltage is flowing on the metals in the crucible and on the coil, careless touching to those areas could cause electric shock.
2. Temperature of the crucible, the heating coil and their surrounding area is extremely high, during heating and after heating. Always take care that your fingers will not be burned by heat of the coil or its surrounding area.

HEAT key and HEAT-2 button

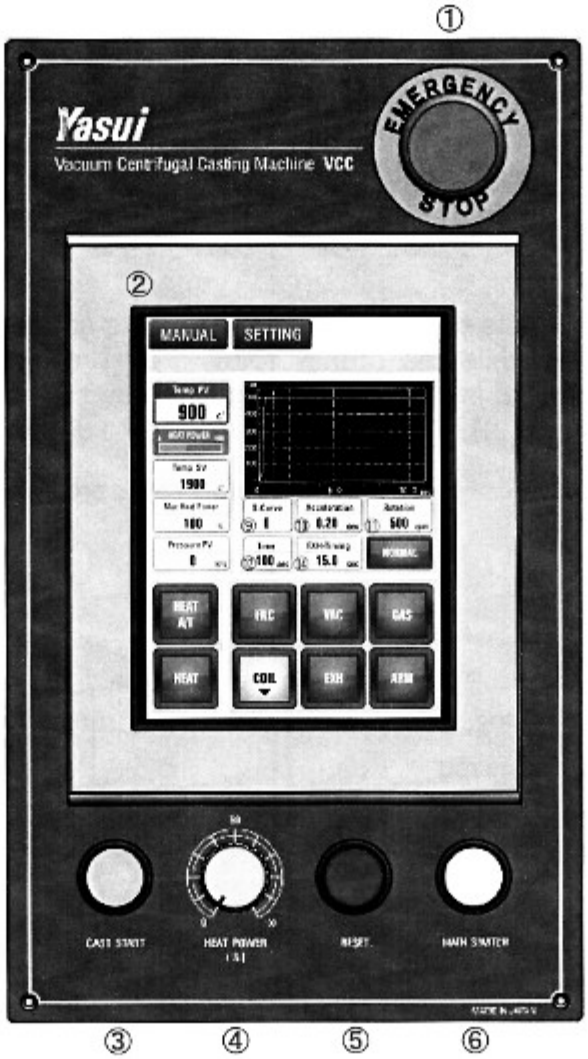
	Switch	Lid	Heating	Arm rotation
When the heating coil is lifted.	[HEAT] key of the control panel is turned ON. ([HEAT-2] button is not pressed.)	Close	When the lid is closed, heating can be applied. (During heating, the lamp of [HEAT] key is lighted.)	When the lid is closed, arm rotation is possible. The coil is lowered, the arm is rotated, and heating is stopped.
		Open	When the lid is opened, the lid closure proximity sensor detects opening of the lid, and stops flowing of electric current of high voltage on the heating coil, so that heating is not applied.	When the lid is opened, arm rotation is not possible.
	When the lid is opened and [HEAT] key of the control panel is turned on, the lamp of [HEAT] key flashes and beeps sound. At this time, [HEAT-2] button is pressed and held.	Open	Although the lid is opened, electric current of high voltage flows on the heating coil and heating is applied, only when [HEAT-2] button is pressed and held. (During heating, the lamp of [HEAT] key is lighted.) (P.5 2.- (7)) Once the lid is closed, heating is stopped.	Arm rotation is not possible.

2-2. ARM AND COIL





2-3. OPERATION PANEL



(1) EMERGENCY STOP (button)
- Anytime this button is pressed, the action of the machine will be suspended.
(Power supply for operation control will be kept on, but power for the motor will be turned off.)
- For recovery, rotate this button clockwise, then the button will pop out.

NOTE: When the machine is recovered, recovery action (exhaustion etc.) is performed, however this not a malfunction.

- Then, when you press [BACK] key on [ALARM] screen, the screen returns to normal operation screen.

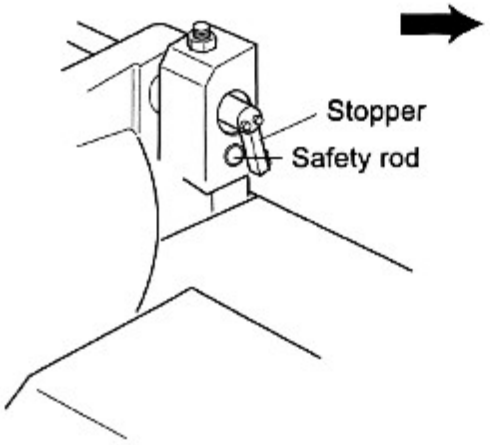
(2) LCD (touch panel)
- This LCD is used for settings and operation of the machine.

(3) CAST START (button)
- The arm starts to rotate according to the setting of rotation parameters.
- The opportunity for use of this button is limited. When this button is usable, its LED flashes.
- Even when this button is pressed while its LED is not flashing, no reaction will be possible.
- Refer to the following pages for details.

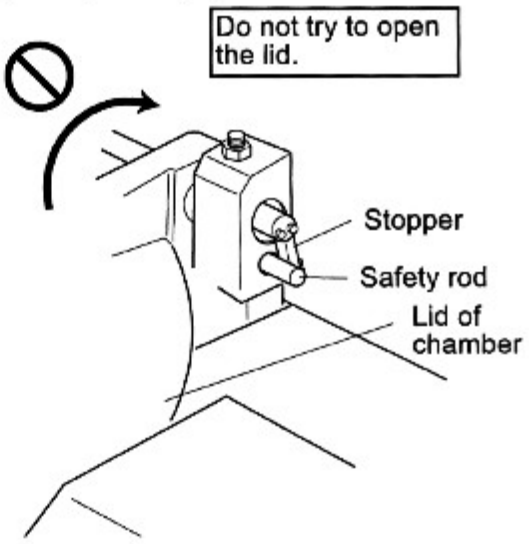
⚠CAUTION

The safety rod on right side of the rear part of the lid is normally housed. (below figure (1)). However, while the arm is rotating by pressing [CAST START] button, the rod is projected in front of the stopper, so that the chamber lid cannot be opened (below figure (2)). At this time, do not try to open the lid by force.

(1) Safety rod is housed.



(2) Safety rod is projected.



(4) HEAT POWER (control dial)
- This dial can be used for setting the upper limit of heat output power.
- Set value is displayed in the LCD.

(5) RESET (button)
- When this button is pressed, all actions will be suspended.
- When this button is pressed while the alarm is activating, the alarm will be reset.

(6) MAIN SWITCH (button)
- This button is a power switch for starting operation control of the machine.
- This button can be turned on when its LED is flashing.
- While power for operation control is on, the LED of the button is kept illuminated.
- This button is also used for clearing an alarm and for recovery action.
- When this button is kept pressed for 3 seconds while power for operation control is on (while the LED of the button is lighted), operation control will be turned off and the screen will return to [STANDBY] screen.

3. LCD (Touch Panel)

3-1. FLOW CHART OF SCREENS

Line Power On

(1) STANDBY SCREEN

Screen changes by pressing [Initial Setting] key

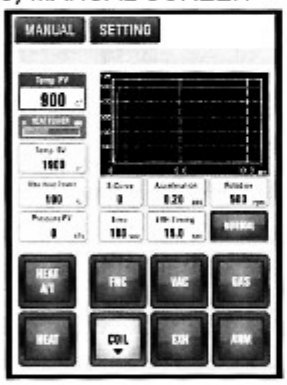
Screen changes by pressing [BACK] key

(2) INITIAL SETTING SCREEN

Screen changes by pressing [MAIN SWTICH] button

Screen changes from any screen by keeping [MAIN SWTICH] button pressed for 3 seconds.

(3) MANUAL SCREEN



Screen changes by pressing [SETTING] key

Screen changes by pressing [BACK] key

(5) SETTING SCREEN

Screen changes by pressing [SETTING] key

Screen changes by pressing [MANUAL] key

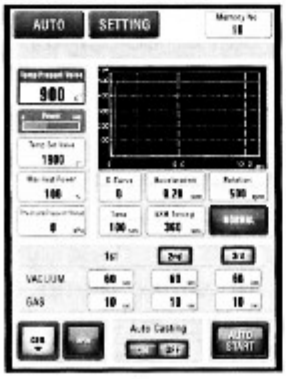
Screen changes by pressing [AUTO] key

Screen changes by pressing [BACK] key

*Screen changes to (6) [ALARM] screen when an alarm occurs.

Screen changes to (1) [STANDBY] screen by pressing [BACK] key

(4) AUTO SCREEN



(6) ALARM SCREEN

*Unless the alarm is cancelled by pressing [RESET] button, [BACK] key remains invalid.

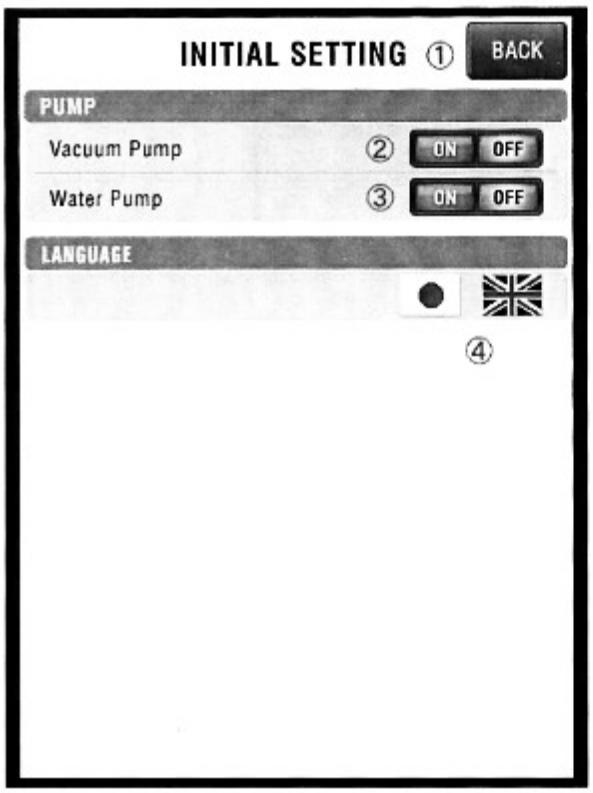
3-2. DESCRIPTIONS OF SCREENS

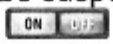
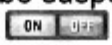
3-2-1. STANDBY SCREEN

(1) Initial Setting
When this key is pressed, the screen changes to [INITIAL SETTING] screen.
(2) PLC Ver, LCD Ver
Version numbers are displayed.

NOTE:
1. When the breaker of the machine is switched on, this screen will be displayed.
2. When [MAIN SWITCH] button is pressed, the screen changes to [MANUAL] screen.
3. Whatever other screen is being displayed, the screen returns back to this [STANDBY] screen, if [MAIN SWITCH] button is kept pressed for 3 seconds.

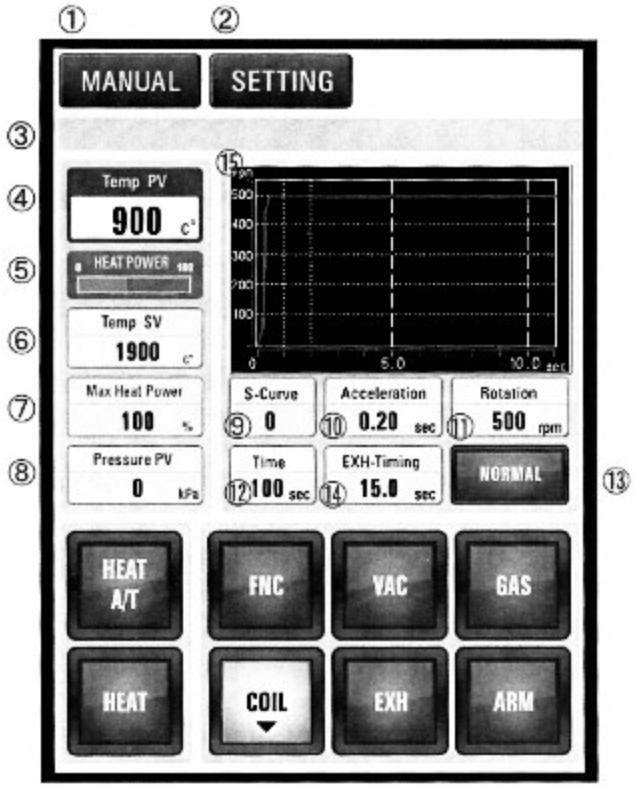
3-2-2. INITIAL SETTING SCREEN



(1) BACK
When this key is turned on, the screen changes to [STANDBY] screen.
(2) Vacuum Pump
When [ON] key is pressed, the vacuum pump starts to actuate.
When [OFF] key is pressed, the vacuum pump will be suspended.
ON: 
(3) Water Pump
When [ON] key is pressed, the water pump starts to actuate.
When [OFF] key is pressed, the water pump will be suspended.
ON: 
(4) LANGUAGE
Display language can be selected by pressing a corresponding key.

NOTE:
1. Turn each pump to [OFF] before moving to another screen.
2. Operation or rotation direction of the vacuum pump or water pump can be checked by each ON/OFF key.

3-2-3. MANUAL SCREEN



(1) MANUAL
When this key is pressed, the screen changes to [AUTO] screen.

(2) SETTING
When this key is pressed, the screen changes to [SETTING] screen.

(3) CAUTION bar
Description of CAUTION is displayed. When this bar is pressed, the screen changes to [ALARM] screen.

(4) Temp PV
Current process temperature value measured by the thermal sensor is displayed.
Display range: 900 to 2200 degrees Celsius
('LOW' is displayed in the case of less than 900 degrees Celsius)

(5) HEAT POWER
Heat output power is displayed by this bar.

(6) Temp SV
Temperature set value for heating.
Input range: 900 to 2100 degrees Celsius

(7) Max Heat Power
Set value of [HEAT POWER] control dial is displayed.
Display range: 0 to 100 %

(8) Pressure PV
Current pressure process value inside the chamber is displayed.
Display range: - (minus) 100 to 0 kPa

(9) S-curve
Kind of S-curve pattern for start and finish of the servomotor can be selected. Selectable from 4 kinds of patterns.
Input range: 0, 1, 2, 3
(0: S-curve is not used,
1: weak, 2: medium,
3: strong)

(10) Acceleration
Time required to reach the preset rotation speed of the arm can be set.
Input range: 0.10 to 2.00 sec

(11) Rotation
Final rotation speed of the arm can be set.
Input range: 0 to 500 rpm

(12) Time
Time period of rotation of the arm at the speed preset by the above (11) can be set.
Input range: 0 to 999 sec

(13) Selecting timing of exhaust
Timing of opening the chamber to air after starting rotation of the arm can be selected.

Each time the button is pressed, its setting is changed as follows.
[NORMAL] =>
[AFTER ROTATION START] =>
[AFTER ROTATION KEEP] =>
Returns to [NORMAL]

[NORMAL] is on:
Arm is rotated for the time set by (12), then after its time is up, air is introduced into the chamber.

[AFTER ROTATION START] is on:

Arm starts its rotation for the time set by (12), then after the time set by (14), air is introduced into the chamber.

[AFTER ROTATION KEEP] is on:

Arm is rotated for the time set by (12), then after its time is up, inside air pressure is kept for the time set by (14). Then, air is introduced into the chamber.

(14) EXT-Timing
Setting range differs depending upon selection of (13).

[NORMAL] is on:
No time setting. No display of input value.

[AFTER ROTATION START] is on:

After the arm starts its rotation and after the time preset here, air is introduced into the chamber.
Input range: 00.0 to 99.9 sec

NOTE: If this time is set longer than (12) [Time], setting of [AFTER ROTATION START] takes priority.

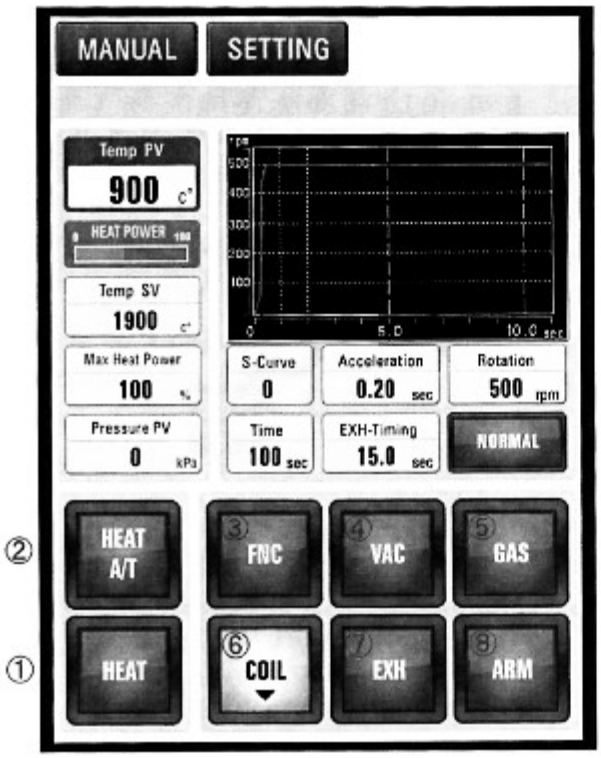
Example: If (12) [Time] is set to 10 sec., and [AFTER ROTATION START] is set to 20 sec., rotation is performed for 10 sec. Then its 10 sec. later air is introduced into the chamber.

[AFTER ROTATION KEEP] is on:

After finish of arm rotation, inside air pressure is kept for the time preset here. Then, air is introduced into the chamber.
Input range: 0 to 999 sec

(15) Revolutions graph
Graph based on the settings by the above (9) and (11).

NOTE: Each set value can be changed while an action corresponding to the setting is not performed.



(1) HEAT
ON/OFF of heating.

- Effective when [COIL] is set to UP and the proximity sensor for the lid is on.
- If this key is turned on while the lid is being opened, this key flashes and [HEAT-2] button becomes effective. (Heating is not applied while the key is flashing.)

ON: 

(2) HEAT A/T
Auto tuning of P.I.D. (Effective during heating only)

ON: 

- When this button is turned on while (1) [HEAT] key is on, temperature goes up and down against the set temperature, and then this key is automatically turned off.
- When this key is turned off, P.I.D. input is replaced by adjusted values.
- P.I.D. values can be checked on [SETTING] screen.
- When it has become necessary to stop during P.I.D. adjustment process, press this key again. P.I.D. values will not be changed.

(3) FNC
Selecting Alternate mode/Momentary mode.

- Alternate mode: Turned ON once a key is pressed. Returns to its OFF state when the key is pressed again.
- Momentary mode: Kept ON as long as a key is held down. Returns to its OFF state upon release.

Effective to (4) and (5) in the next page.

ON: 

(4) VAC
ON/OFF of evacuation.
- Normal: Momentary
- Air in the chamber is drawn out by the external vacuum pump.
- Pressure in the chamber can be checked by the vacuum gauge on the lid or by the indication of PV value on the LCD.

ON: 

<green lamp on>

FNC ON: 

<green lamp off>

IMPORTANT:
The O-ring of the lid should be in firm contact with the top surface of the chamber, otherwise evacuation will be impossible.

(5) GAS
ON/OFF of gas charge.
- Normal: Momentary
- Inert gas is charged into the chamber from the external gas cylinder.

ON: 

<green lamp on>

FNC ON: 

<green lamp off>

(6) COIL
ON/OFF of coil elevation.
- When the coil is positioned at the lowest level, it will move upward by pressing this key. When the coil is positioned at the highest level, it will move downward by pressing this key.
- The coil can be moved, only when [ARM] key is lighted.

ON (up): 

<blue lamp on>

OFF (down): 

<yellow lamp on>

⚠CAUTION
Movement of the coil is quite independent from position of the arm. Take care not to bump the coil against the rotating arm. After you turn on [COIL] key, , you can lower the coil by immediately pressing [COIL] key again.

(7) EXH
ON/OFF of open to air.
- Air is introduced into the chamber, so that inside pressure will restore atmospheric pressure.
- When the lid is opened, this key is also turned off.

ON: 

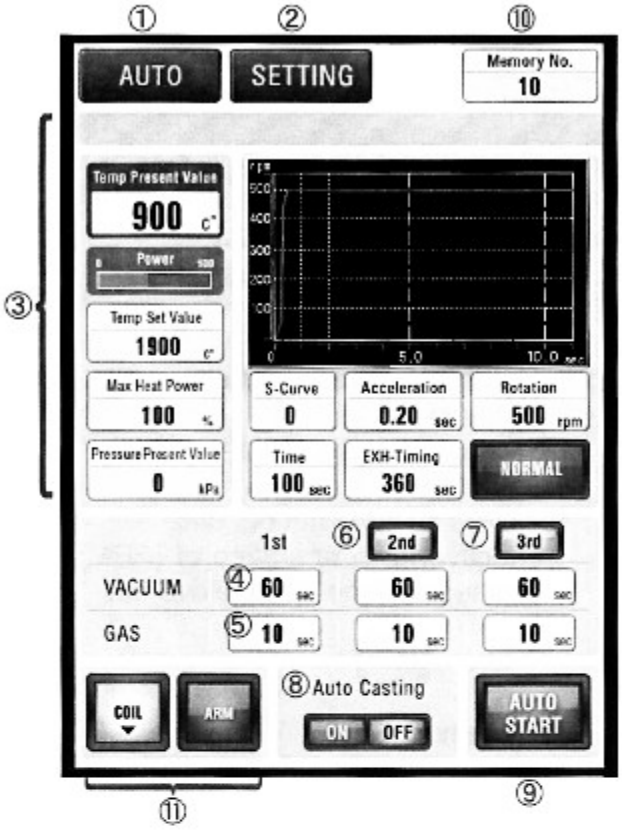
<blue lamp on>

(8) ARM
ON/OFF of arm return to origin point.
- This key flashes during arm rotation.
- When the rotation is completed, the key is kept lighted.

ON: 

<blue lamp on>

3-2-4. AUTO SCREEN



(1) AUTO
When this key pressed, the screen changes to [MANUAL] screen.

*(2) and (3) are same as the items in [MANUAL] screen. Refer to P. 15-16. "3-2-3. MANU SCREEN".

(4) VACUUM
Setting of evacuation time.
Input range: 0 to 999 sec

(5) GAS
Setting of gas charge time.
(Starting after finish of evacuation time)
Input range: 0 to 99 sec

(6) 2nd
ON/OFF key for the 2nd process of VACUUM and GAS.
- When this key is turned on, 2nd VAC will be started after finish of 1st GAS. Then, after finish of VAC, 2nd GAS will be started.
- Input range is same as 1st.
- When the key is not turned on, set values are not displayed.

ON: 2nd

(7) 3rd
ON/OFF key for the 3rd process of VACUUM and GAS.
- When this key is turned on, 3rd VAC will be started after finish of 2nd GAS. Then, after finish of VAC, 3rd GAS will be started.
- Input range is same as 1st.
- When the key is not turned on, set values are not displayed.
- If the 2nd process is not turned on, it is not possible to turn the 3rd process on.

ON: 3rd

(8) Auto Casting
ON/OFF of auto casting.
- Standard setting is [OFF].
- Memory registration is not possible.
- Every time after casting, [OFF] is restored automatically.

[ON]: Arm rotation is automatically started according to the preset rotation pattern at CAST TIMING(*) of preset temperature for heating.

[OFF]: [CAST START] button flashes at CAST TIMING(*) of preset temperature for heating. When [CAST START] button is pressed to on, arm rotation is automatically started according to the preset rotation pattern. Until [CAST START] button is pressed to on, heating and pressurization are maintained.

(*)CAST TIMING:
Based on information of preset temperature for heating, CAST TIMING is determined when it has been checked that the machine was kept within the range set by [Casting Keep Time] and [Casting Range Degree] of [SETTING] screen.

ON: 

(9) AUTO START
ON/OFF of starting automatic operation by the settings of the above (1) to (8).

Operation cycle is briefly as follows.
1. VAC => 2. GAS =>
3. 2nd/3rd => 4. HEATING =>
5. Reaching preset temperature =>
6. CAST TIMING =>
7. (CAST START) =>
8. Rotation by preset pattern =>
9. Exhaust =>
10. Return to origin point => Finish

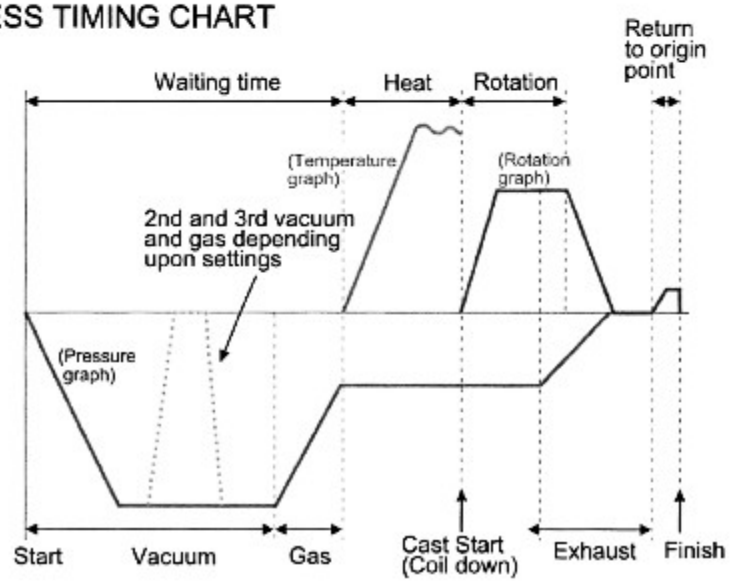
- This key does not become effective, until operation of [ARM] is finished and the coil is elevated.

ON: 

(10) Memory No.
Recipe memory number is displayed.
Input range: 0 to 99
- Recipes containing various settings can be stored.

(11) COIL, ARM
Same as [COIL] and [ARM] of [MANUAL] screen.
- Unless both of these two keys are turned on (LED lighted), auto casting cannot be ready.

AUTO PROCESS TIMING CHART



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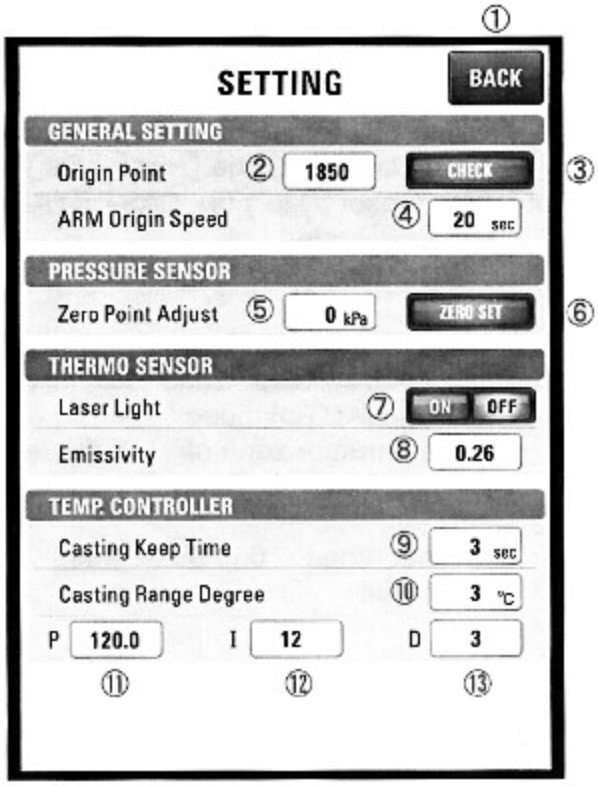
3-2-5. SETTING SCREEN



(1) BACK
When this key is turned on, the screen changes to previous [MANUAL] or [AUTO] screen.

(2) Origin Point
Origin point position data of the arm.
- Travel amount from initial base point.
  Input range: 0 to 9999 (Standard set value is around 1850)

(3) CHECK
When this key is pressed, action same as [ARM] key of [MANUAL] screen will be performed.
- Be sure to close the lid before starting this checking.
- The key flashes during action. After finish of action, the key will be lighted.

ON: 

(4) ARM Origin Speed
Setting of rotation speed at the time of return to origin point. This setting is for the above (3) or [ARM] action.
Input range: 0 to 30 rpm

(5) Zero Point Adjust
Current pressure is displayed.
Display range: - (minus) 100 to 100 kPa

(6) ZERO SET
If this key is turned on, current pressure is set to 0 kPa.
- Display value on this [SETTING] screen is not changed, however the value in [MANUAL] or [AUTO] screen is changed to '0 (zero)'.
- The key will be lighted only when it is selected.

Selected: 

(7) Laser Light
ON/OFF of alignment beam for the thermal sensor.
- Automatically turned off, when on-state is kept for certain period of time.
ON: 

(8) Emissivity
Setting of emissivity for the thermal emission sensor.
Input range: 0.00 to 0.99
(Standard set value for Pt 1000 is 0.26)

IMPORTANT: Standard set value of emissivity for Pt 1000 is 0.26. Therefore, do not operate this key, unless reading of the set value is largely deviated.

IMPORTANT: When it has become necessary to change the setting of emissivity, always check the melting temperature data.
Example: If the emissivity is increased, the indication of meltdown temperature by the temperature controller becomes lower.

(9) Casting Keep Time
Keep time of CAST TIMING(*) in [AUTO] mode.
- When temperature has been kept within the temp. zone of the below "(10) Casting Range Degree" for the time preset by this (9), CAST START will be actuated.
Input range: 0 to 99 sec.

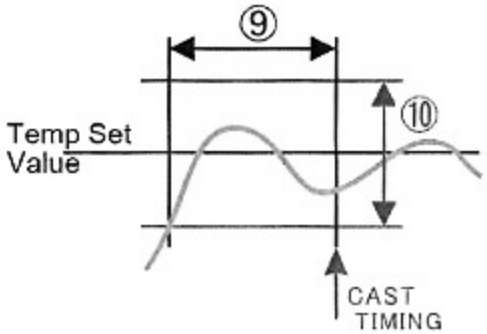
(10) Casting Range Degree
Temperature keep zone for CAST TIMING in [AUTO] mode.
- Temperature zone of +/- X degrees Celsius from the Temp Set Value is set.
Input range: 0 to 99 degrees Celsius

(11) P
Writing to 'P' setting in the temperature controller.
Input range: 0.0 to 100.0

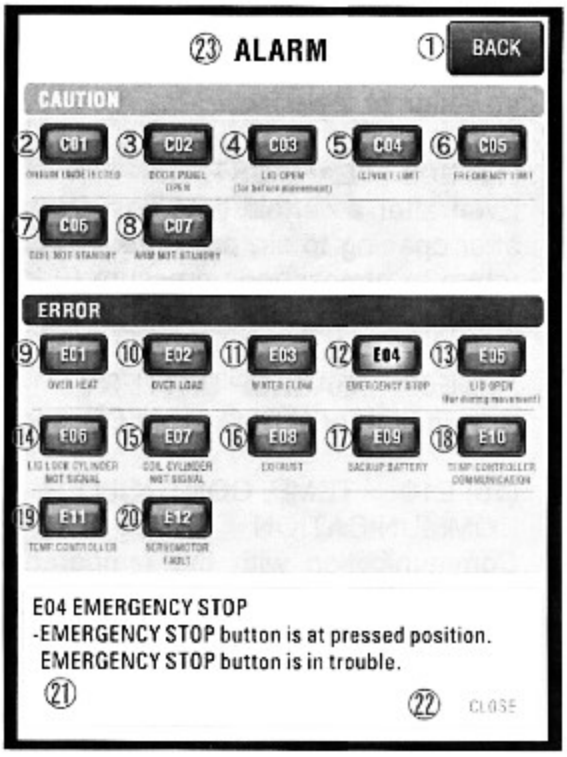
(12) I
Writing to 'I' setting in the temperature controller.
Input range: 1 to 3600

(13) D
Writing to 'D' setting in the temperature controller.
Input range: 1 to 3600

*CAST TIMING
This timing is when temperature has been kept within the temp. zone of (10) around the Temp Set Value for the time of (9).



3-2-6. ALARM SCREEN



(1) BACK
When this key is turned on, the screen changes to [STANDBY] screen.
(When CAUTION is on, the screen returns to previous screen.)
Note that this key becomes effective only after the alarm is cancelled by pressing [RESET] button.

(2) C01 ORIGIN UNDETECTED
Initial base point cannot be detected at the time of return to origin point, or there is no information of fixed point.
(Arm rotation does not stop for a certain period of time ... about three rotations)

(3) C02 DOOR PANEL OPEN
Side panel for the machine body is open.

(4) C03 LID OPEN
(for before movement)
While the lid was open, either key for starting action (return to origin point, pattern rotation, heating) or for AUTO process was pressed to turn on.

(5) C04 (C)VOLT LIMIT
Heat output power is automatically limited ... Too small load at heating.

(6) C05 FREQUENCY LIMIT
Heat frequency is automatically limited ... No load at heating.

(7) C06 COIL NOT STANDBY
When the arm is rotated according to the preset pattern, the coil is not moved to the correct (elevated) position.

(8) C07 ARM NOT STANDBY
When the coil is elevated, the arm is not set to the origin point position (No action to move to the origin point).

LED indication example of CAUTION ON: C02

(9) E01 OVER HEAT
Temperature inside the oscillator is abnormal.

(10) E02 OVER LOAD
Line voltage is over the rated value, or voltage in the machine is abnormal.

(11) E03 WATER FLOW
Cooling water is not circulated, or the water flow switch is broken.

(12) E04 EMERGENCY STOP
[EMERGENCY STOP] button was pressed in.

(13) E05 LID OPEN
(for during movement)
While either action of return to origin point, pattern rotation, heating, or AUTO casting process was being performed, the lid was opened.

(14) E06 LID LOCK CYLINDER NOT SIGNAL
Signal from the lid lock cylinder cannot be detected during a certain time (at the time of locking or unlocking).

(15) E07 COIL CYLINDER NOT SIGNAL
Signal from the coil cylinder cannot be detected during a certain time (during elevation or lowering).

(16) E08 EXHAUST
Even after a certain time has elapsed after opening to air, pressure does not return to atmospheric pressure (0 kPa +/- 5).

(17) E09 BACKUP BATTERY
Built-in battery of PLC or of LCD is low.

(18) E10 TEMP. CONTROLLER COMMUNICATION
Communication with the temperature controller is abnormal.

(19) E11 TEMP. CONTROLLER
Internal malfunction of the temperature controller.

(20) E12 SERVOMOTOR FAULT
Malfunction of the servomotor is detected.

* LED indication example of ERROR ON : 

(21) Description
When a key for CAUTION or ERROR is on, its detailed information will be displayed.

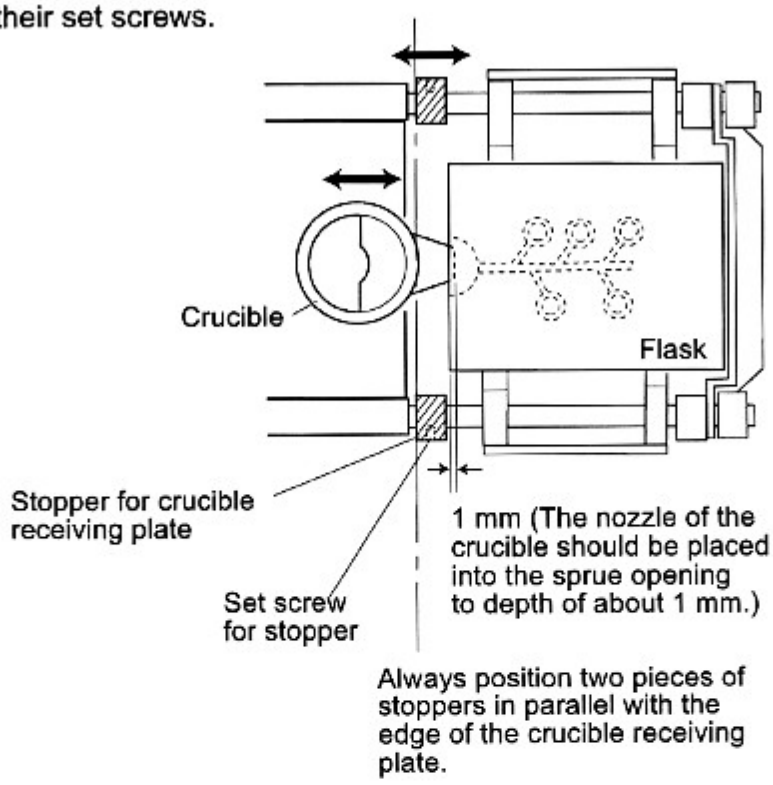
(22) CLOSE
Detailed information of the above (21) is turned off.

(23) ALARM
(for stopping ERROR buzzer)
When this area is pressed while the ERROR buzzer is sounding, the buzzer is suspended.

4. CASTING PROCEDURE

4-1. PREPARATION

1) Determine the position of the stoppers for the crucible receiving plate. Then tighten their set screws.

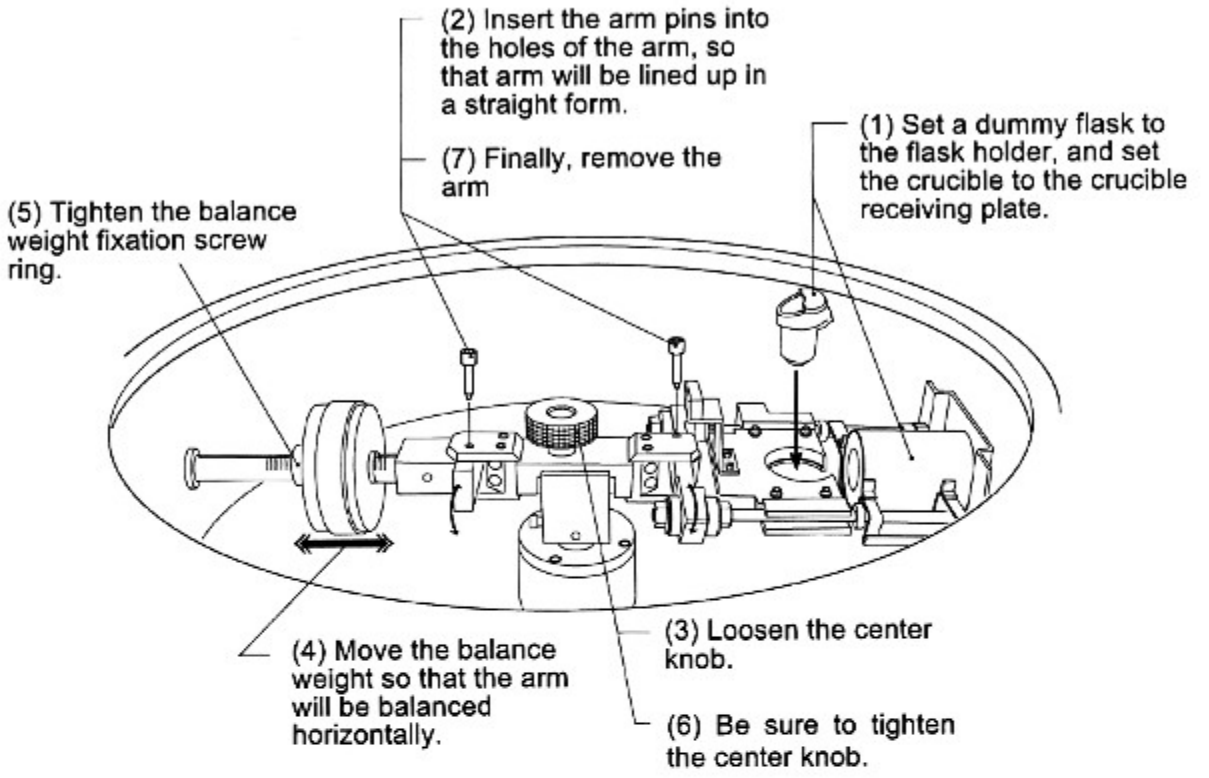


2) Check that both water and gas are supplied to the machine.

3) Turn the Breaker switch to ON. Little while later, the screen is turned on and [STANDBY] screen is displayed.

4) Turn on [MAIN SWITCH] button on the control panel.

5) Balance the arm. (Below figure (1) to (7))
(When the rotating arm is set to the holding state, press [RESET] button, so that movement of the rotating arm will be free.)



Considering weight of the metal to be charged, balancing of the arm should be adjusted so that its balance-side arm will be tilted downward a little.

6) After closing the lid, press [ARM] key.
The arm slowly rotates, and will stop when it reaches the origin point at its second turn.
Check that the crucible is positioned above the coil
* If the crucible is not positioned above the coil, adjust the position by hand or by [SETTING] screen.

7) Press [COIL] key. At this time, check relative positions of the opening of crucible receiving plate and the coil. The coil will move up.

8) Place the crucible in position.
Check if clearance between the crucible and the coil is proper. (P.38)

⚠WARNING
Check beforehand that the crucible itself has no crack, and the crucible is not damp. Do not push the crucible body or metals in the crucible with strong force. When the crucible cracks during melting, the melted metal may drop and cause critical damages in the instrument. (P.5)

4-2. CASTING

There are two methods of casting procedure.

"FLASK FIRST-TO-SET METHOD" : First, the metal is charged into the crucible and also the flask is set in position at this time. Then, the lid is closed, and the sequential process of heating, evacuation, melting is performed.

"FLASK SET-AFTER-PRELIMINARY-MELTING METHOD" : The metal in the crucible is melted preliminarily. Then, the flask is set in position. In case amount of the metal is large or the metal is difficult to melt due to its shape, it may take time to melt the metal, so it is recommended to melt the metal preliminarily by this "FLASK SET-AFTER-PRELIMINARY-MELTING METHOD".

The following is standard procedure of
"FLASK SET-AFTER-PRELIMINARY-MELTING METHOD"

1) Charge the metal into the crucible.

2) Set the melting temperature on the control panel.

3) Close the lid, and turn on [HEAT] key on the control panel to melt the metal preliminarily.

At this time, it is possible to automatically set optimum P.I.D. value suitable for the amount and kind of the metal to be cast by [HEAT A/T] key on the control panel. (P.30 "5. ADJUSTING P.I.D.").

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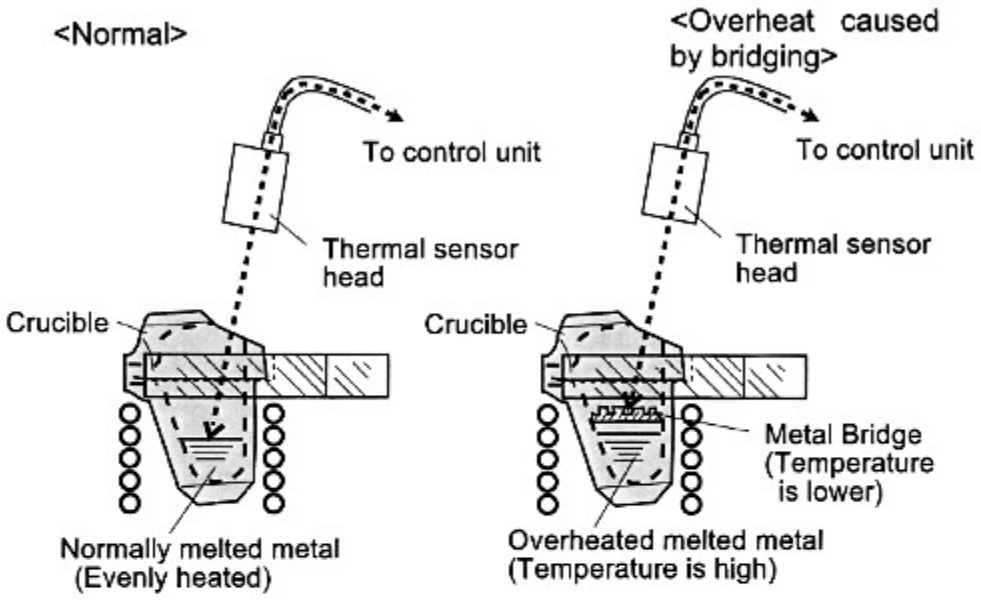
⚠CAUTION

Take care that 'bridge' of metal alloy is not produced in the crucible, because the metal in the lower part of the crucible is overheated and breakage of crucible may be resulted.



Preliminary melting is recommended to perform stable casting. Emissivity of the sensor has been adjusted for liquefied state of the metal. So, the temperature display before melting can be used for reference purpose only.

IMPORTANT:

1. The thermo sensor is sensing the surface temperature only of the melted metal. Use the current temperature PV display on the control panel for reference purpose only. Be sure to make a visual inspection of the metal to check its actual temperature, referring the display value, (Be sure to see the metal through an eye-protection device at this time.)
2. It is necessary to perform daily maintenance to obtain correct temperature measurement results. Observe maintenance method described in this manual and use the machine correctly.

4) Load the flask, which was withdrawn from the furnace, on the flask holder.

5) Close the lid. Then, press [HEAT] key so that heating will be started.

6) Evacuation

NOTE: When the lid is opened, evacuation is not possible.

Press [VAC] key. Air in the chamber will be evacuated. When proper vacuum degree is obtained, press [VAC] key again to stop evacuation.

7) Charging inert gas (Argon gas)

NOTE: when the lid is opened, gas injection is not possible.

Press [GAS] key. Inert gas (Argon or Nitrogen) will be charged. See the vacuum gauge and when expected vacuum degree is reached, press [GAS] key again to stop gas charge.

8) When the temperature of the metal reached proper casting temperature, press [CAST START] button. Then, the coil will move down and the arm will start to rotate. By this, the melted metal fills the flask cavity.

After start of rotation, heating will be automatically turned off. The arm increases its speed, keeps its speed, decreases its speed and stops automatically under the program.

⚠CAUTION

The safety rod on right side of the rear part of the lid is normally housed. (P.12 Figure (1)). However, while the arm is rotating by turning on [CAST START] button, the rod is projected in front of the stopper (P.12 Figure (2)). At this time, do not try to open the lid by force.

Next, air is introduced into the chamber. and inner pressure of the chamber will become zero. Then, the lid can be opened.
After elapse of certain period of time from the end of arm rotation, the chamber is automatically released to air, but when you wish to release to air earlier, press [RESET] button.

10) Withdraw the flask. Now, casting is finished.

⚠CAUTION

After releasing to air, you can open the lid by hand, however the arm once suspends its rotation, and after a few seconds it starts again to rotate slowly to find its origin point (arm return action to origin point). At this time, do not try to pick up the flask or to replace the crucible. Wait until the arm completely stops after finish of return action to origin point.

5. ADJUSTING P.I.D.

5-1. P.I.D.

Heating mode of so-called "P.I.D. control" is used in the *VCC* machine, so that heating will be smoothly applied to the metal by the built-in oscillation unit.

Standard values of P.I.D. are already preset at the factory. Do not try to change the set value unnecessarily. Use of the preset P.I.D. values is recommended, while you are not yet fully experienced with operation of the *VCC* machine with understandings of P.I.D. features.

When it is necessary to input optimum P.I.D. value depending upon the amount and kind of metal, follow the below "5-2. HOW TO ADJUST P.I.D."

> ⚠CAUTION
> Do not change other settings which are not instructed below. When changing the P.I.D. set value, follow the procedures described below deliberately and exactly. Otherwise, the machine capability will be affected.

5-2. HOW TO ADJUST P.I.D.

Standard values of P.I.D. are already preset at the factory, but it is possible to input optimum P.I.D. values automatically by auto tuning depending upon amount and kind of the metal to be used (P.17 (2)) .

To input new P.I.D. values automatically, follow the below procedure.

1) Charge the metal to be cast in the crucible.

2) Move to [MANUAL] screen.

3) Input the target SV temperature.

4) Turn on [HEAT] key.

5) Turn on [HEAT A/T key].

6) Heating is applied and temperature reaches to the set value, then temperature goes up and down a few times. After this, [HEAT A/T] key is turned off.

Now, new P.I.D. values have been input to replace the conventional P.I.D. values. (P.I.D. values can be checked on [SETTING] screen.)

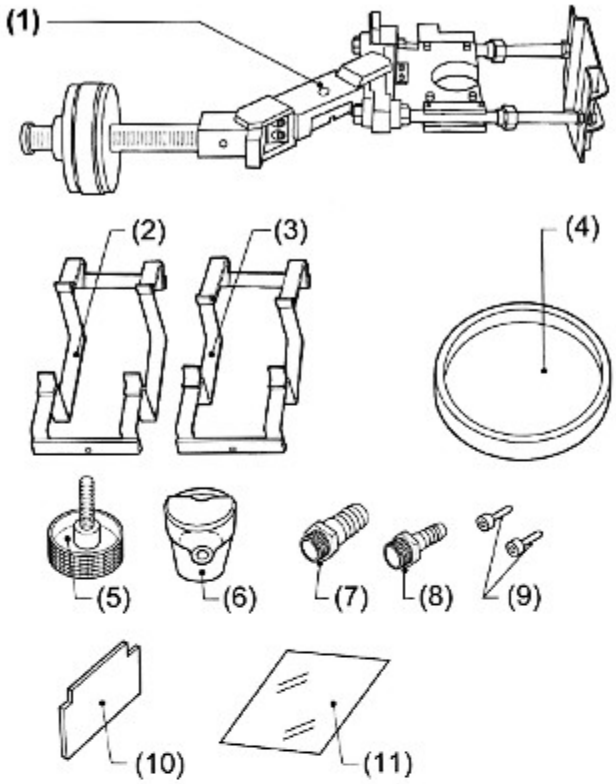
7) Finally, turn [HEAT] key OFF

6. INSTALLING

6-1. UNPACKING

The below accessories are provided with the main body of the machine.
Check them at the time of unpacking.

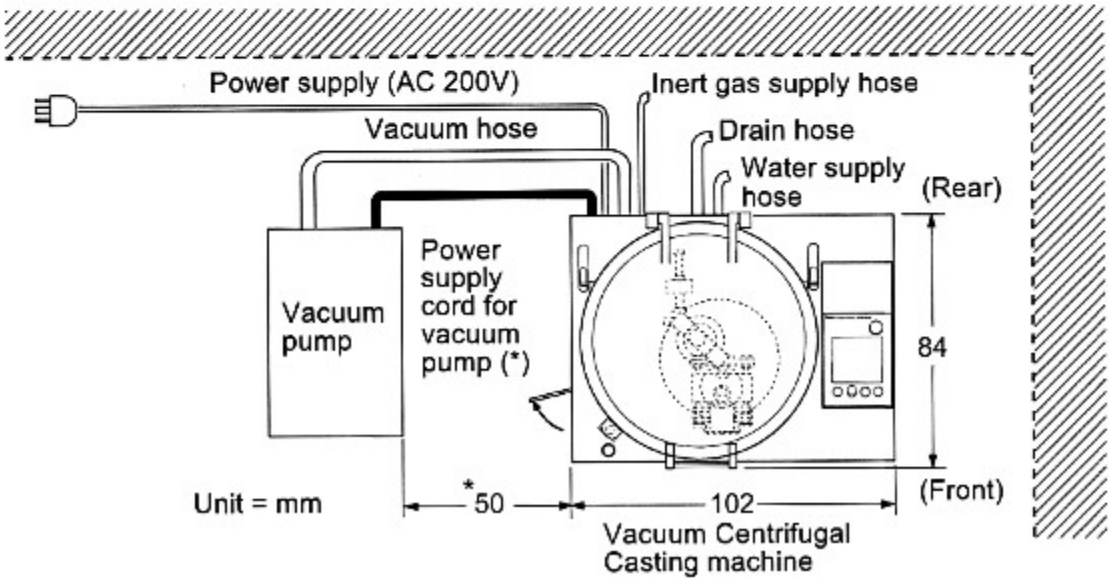
(1) Rotating arm
(2) Flask holder for dia.89 mm
(3) Flask holder for dia.76 mm
(4) Receptacle tray
(5) Center knob
(6) Crucible
(7) Coupling for water supply
(8) Coupling for inert gas
(9) Arm pins
(10) Glass removing tool
(11) LCD protection sheet



6-2. MAIN UNIT

Mount the machine on a place where the following conditions (1) to (3) can be satisfied.

(1) Sturdy and stable place.
(2) Endurable to weight. (Weight of the machine will be about 350 Kg.)
(3) Sufficient clear space is left around the machine so that daily work and maintenance should not be obstructed. There should be clearance for maintenance (at least 500 mm) on left side of the machine.



* If the pump is for exclusive use with the *VCC*, power cord can be connected to the *VCC* machine.

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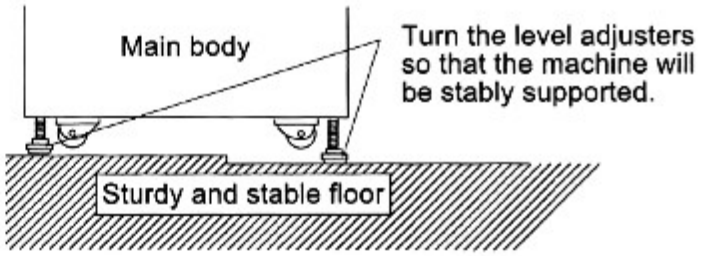
After placement of the machine, turn the level adjusters so that the machine will be stably supported by the level adjusters.



6-3. CONNECTING POWER SUPPLY

Use power supply of AC 200 V - three phase, 30 A, 50/60 Hz.
Do not use power supply line of other specification.

⚠WARNING

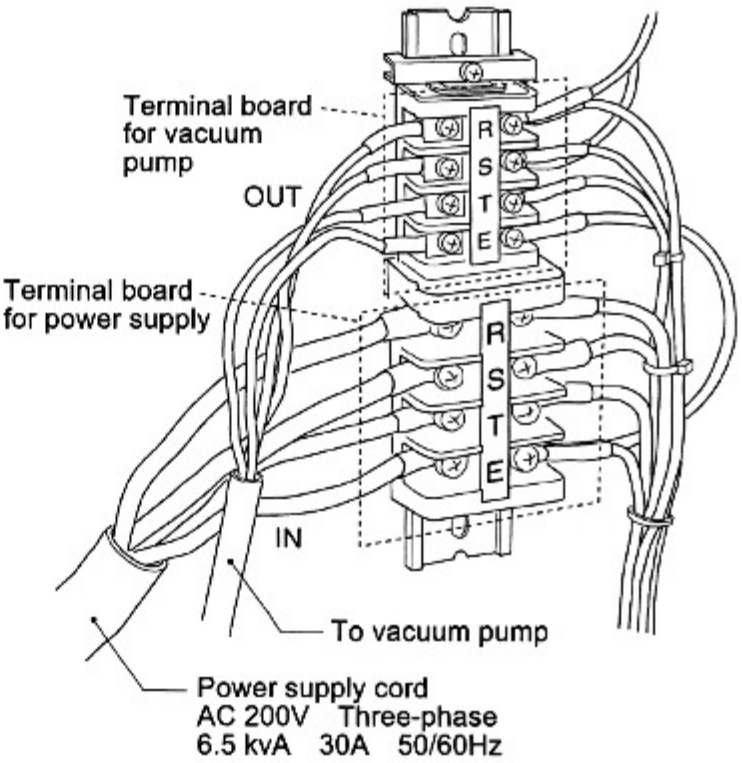
1. Connect a grounding wire for protecting human body from electric shock.
2. Wiring should be made by a qualified electric technician.

IMPORTANT: When you use the pump exclusively provided for use with this machine, you can connect the pump to this terminal block. However, when you use other type of pump, do not use this terminal.

1) Open the left side cover of the main body.

2) The terminal block for power supply will be shown.
Connect as the figure.

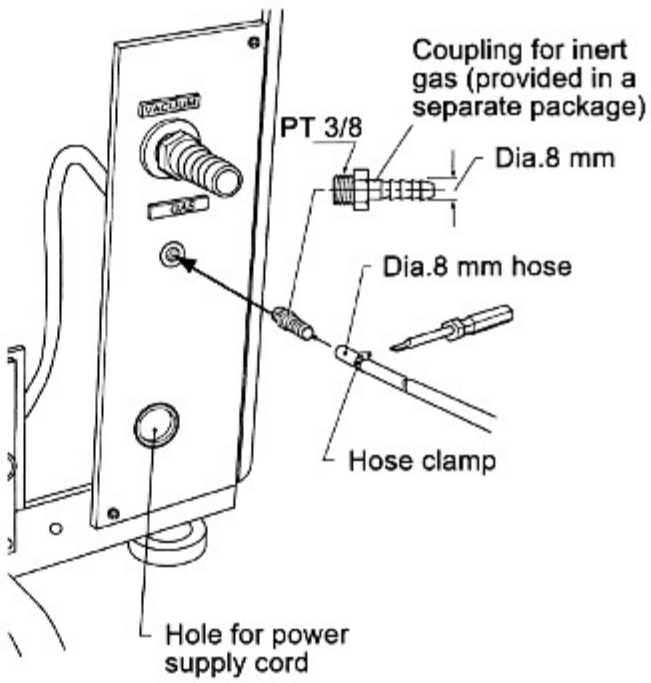
3) When the instrument is plugged into a wall outlet, first check rotation direction of the internal pump for water supply (phase checking). (P.36)
Second, check that rotation direction of the pump for vacuum is correct.



6-4. CONNECTING TO INERT GAS (ARGON ETC.)

It is possible to substitute with gas during melting in the case of this machine.

1) Screw the coupling for inert gas provided into the inlet of the machine.
2) Connect the hose to the coupling for inert gas, and fix it with the hose clamp.
3) Set the regulator of inert gas cylinder to pressure of 5 to 6 Kg/cm^2.



⚠DANGER

Never use inflammable gas such as hydrogen gas. Be sure to use inert gas.

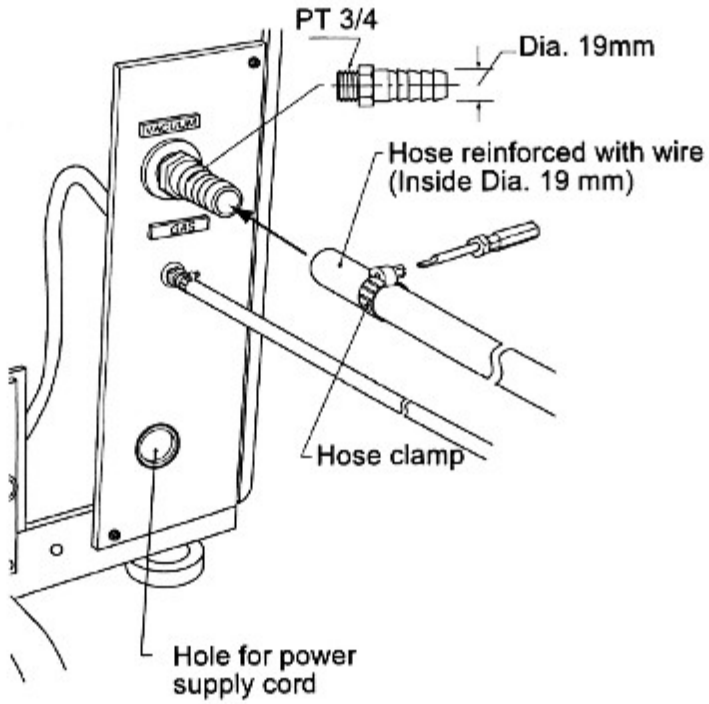
IMPORTANT:

1. Be sure to use a hose clamp and tighten the clamp sufficiently.
2. Use a pressure reinforced hose.
3. Place the gas cylinder to a position where you can always watch state of inert gas amount in the cylinder.
4. The instrument uses inert gas for elevation of the coil, too. Therefore, even when you do not use inert gas, be sure to connect to compressed air, which shall be used as pressure source. Even when you use compressed air, its pressure should be regulated within 5 to 6 Kg/cm^2.

6-5. CONNECTING TO VACUUM PUMP

For using the vacuum function of this machine, connection to the vacuum pump is necessary.

Connect to a vacuum pump of specified capability. (See below "CAUTION 4.")



⚠CAUTION

1. After connection to the vacuum pump, check rotating direction of the pump motor. If you use the machine when the pump motor is reversely rotating, oil will flow inside the main body, which will cause a machine trouble.
2. When connecting the hose, be sure to use a hose clamp and tighten the clamp sufficiently.
3. When using the pump exclusive for this machine, supply oil before use.
4. If you prepare the pump by yourself, observe the below specification.

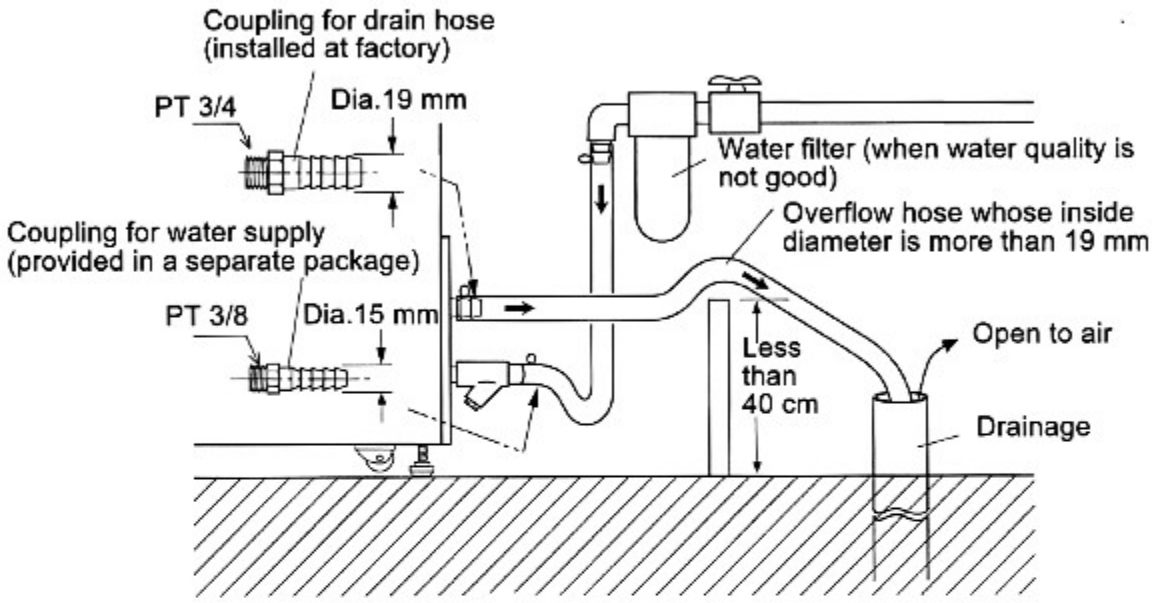
Ultimate vacuum	7.5×10^{-2} Torr
Pumping speed	more than 500 litre/min
Inner diameter of hose	not less than 19 mm

5. About maintenance of the pump, refer to the instructions provided with the vacuum pump.

6-6. CONNECTING WATER

The instrument needs cooling water. Connect to water supply of below specification.
- Average water pressure 2.0 to 3.0 Kg/cm^2
- More than 3 liters/min. at 2.0 Kg/cm^2

Connect hoses as below figure.



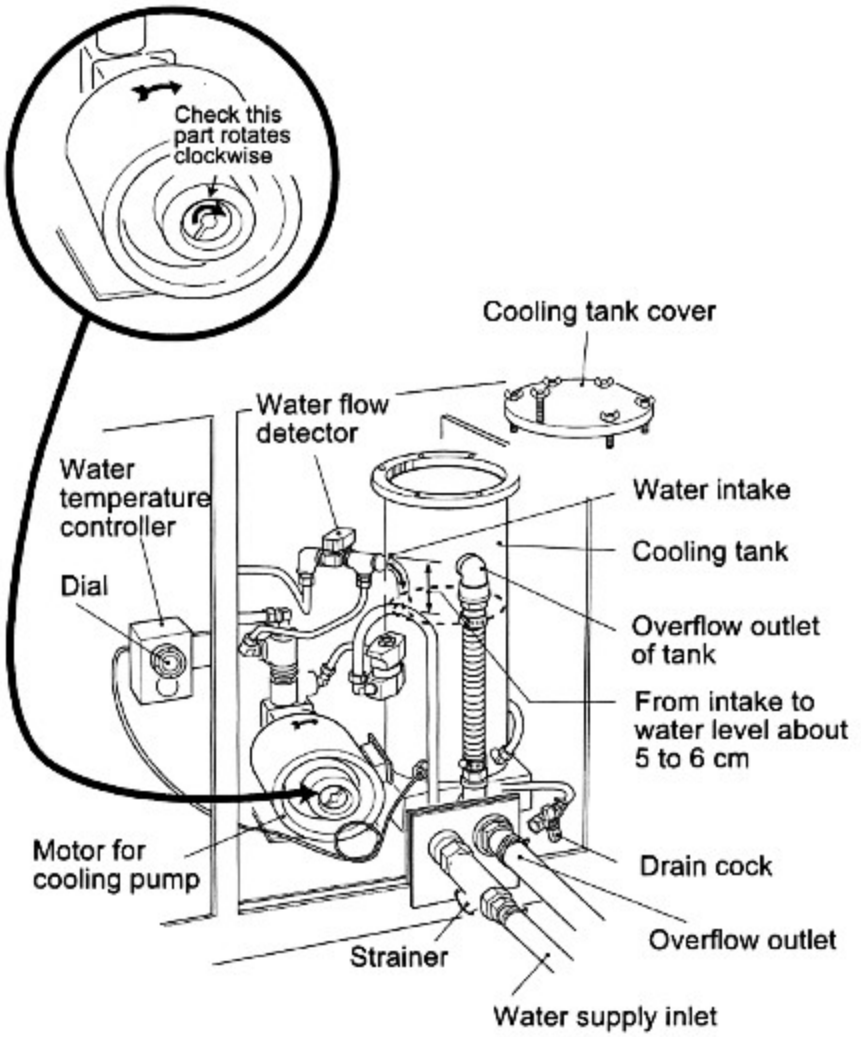
⚠CAUTION

1. When water quality is not good, use a water filter.
2. When connecting the hose, be sure to use a hose clamp and tighten the clamp sufficiently.
3. Care should be taken to height of the overflow hose. It should be placed lower than the instrument.
4. Be sure to supply water in the cooling tank at installing. (P.36 "6-7. CHECKING COOLING WATER PUMP")

6-7. CHECKING COOLING WATER PUMP

Supply water as the below procedure. Be sure to check rotating direction.

1) Open the tap water valve.
2) Open the cooling tank cover.
3) Set the dial of the water temperature controller to 0 degree Celsius.
4) Turn on the Breaker switch. Then, water flows into the tank.
5) When water is filled in the cooling tank to proper level (about 5 to 6 cm from the water Inlet to the water level as the below figure), turn the dial of the water temperature controller to 30 degrees Celsius. Then, water will stop.
6) Press [Initial Setting] key located in the upper right corner of [STANDBY] screen to change the screen to [INITIAL SETTING] screen. Then, press [ON] key of [Water Pump]. The motor for cooling pump starts to rotate. At this time, check rotating direction of the motor at this time.



7) Close the cooling tank cover. At this time, tighten the six wing nuts evenly so that water will not leak.

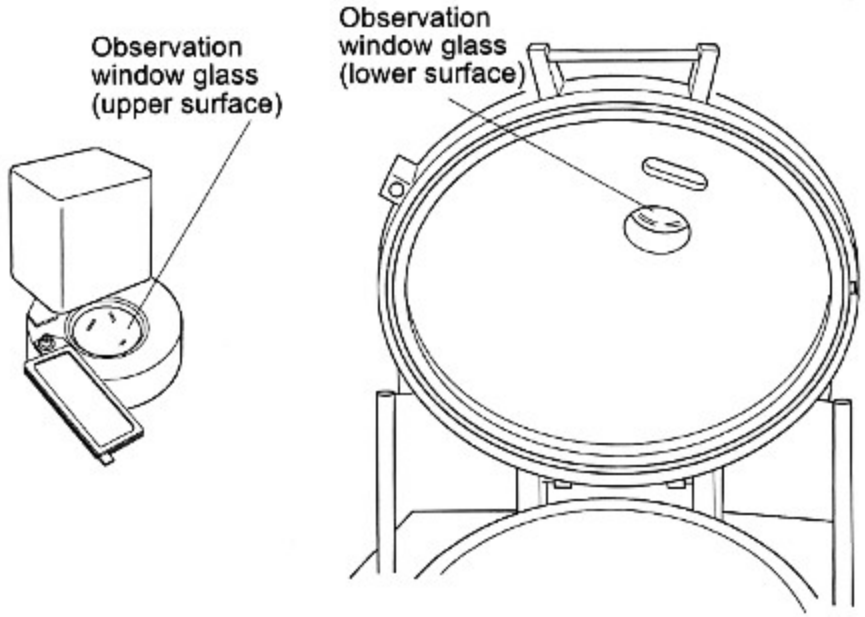
6-8. ADJUSTING THERMO SENSOR HEAD

⚠CAUTION

Correct measurement by the thermo sensor may be impossible in the below cases.
(1) Viewfield of the thermo sensor head is disturbed by obstacles (such as fumes).
(2) Dusts are accumulated on the surface of the lens or inspection window.
(3) Optical axis of the thermo sensor head is misaligned.

If you continue to use in the above cases, temperature control for casting may be affected, and in some cases heat control may become impossible, resulting in damage of the crucible or coil.

Especially, dusts easily stick on the observation glass surface of the lid every time a casting is made, so clean them frequently. Damp soft cloth with a little amount of lens-cleaning liquid available on the market, and rub the glass surface with it gently taking care that the glass surface will not be scratched.



The thermal sensor head is already aligned to proper position at the factory. Unless it has moved out of alignment during transportation, no further alignment is required. To find whether the head is correctly aligned to exact direction, refer to P.50 "9-2. ALIGNMENT OF OPTICAL AXIS OF THERMO SENSOR."

⚠CAUTION

When it becomes necessary to connect the electrical cord for the thermo sensor head, be sure to turn power off before connecting. (If the electrical cord is connected while power is ON, internal memory of parameters will be changed, and complicated readjustment by a technician will be required.)

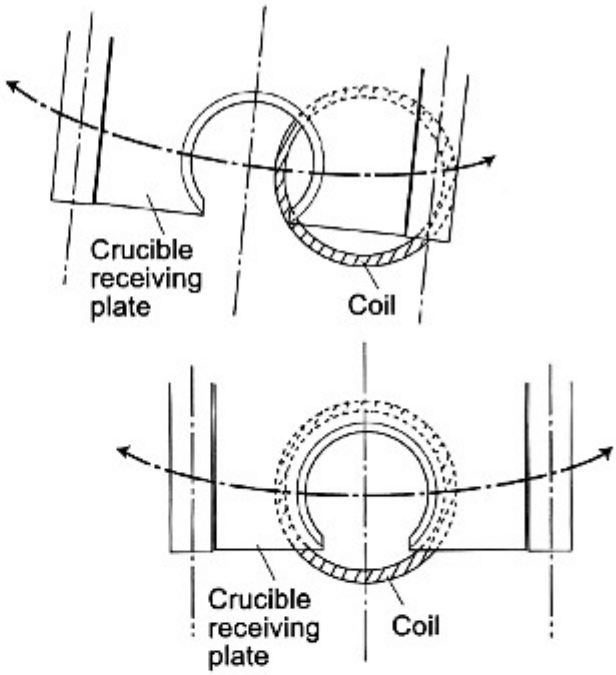
6-9. POSITIONS OF CRUCIBLE AND COIL

To position the crucible correctly, follow the below procedures 1) to 4).

1) Press [ARM] key. The arm will rotate and stop automatically at the origin point.

2) Press [COIL] key. The heating coil will move up.

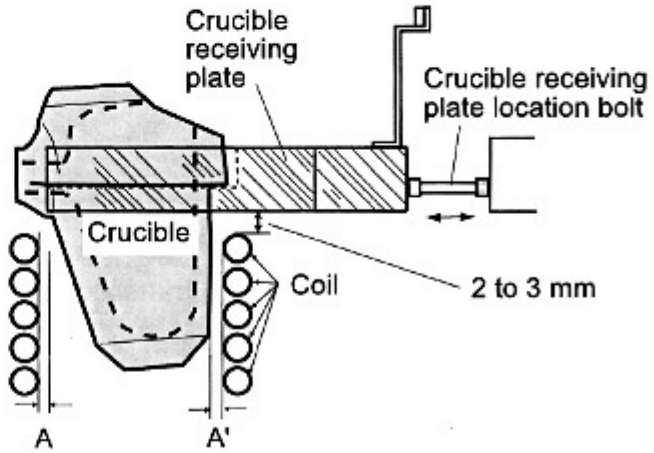
3) Correct position is such that the center of the crucible receiving plate coincides to the center of the coil. If it does not coincide, readjust the auto stop point of the arm (P.49).



4) Slide the crucible receiving plate until its edge will be blocked by the crucible receiving plate location bolt. Check at this time whether position of the crucible against the coil is proper.

Standard horizontal position of the coil is that clearance between inside periphery of the coil and the outside periphery of the crucible is equal. (Clearance A is equal to the clearance A' as shown in the figure.)

When you find the crucible position is wrong, adjust it turning the crucible receiving plate location bolt, which determines position of the crucible receiving plate.



7. MAINTENANCE

7-1. ALARMS

C01 ORIGIN UNDETECTED

Casting operation: Casting operation is possible.

Cause:

Signal of origin point is not detected at the time of arm rotation.

Possible sources:

- Displacement of the sensor for origin point.
- Displacement of shielding plate of the sensor for origin point.
- Disconnection of wiring between the sensor and the sequencer.

Measures:

Check the above possible sources.

C02 DOOR PANEL OPEN

Casting operation: Casting operation possible.

Cause:

It was detected that either of the front, right side, or left side panel is open.

Possible sources:

- Either of the front, right side, or left side panel was improperly installed.
- Displacement of sensor.
- Disconnection of wiring for sensor.

Measures:

Casting could be completed to the end, but before starting next process, be sure to install the panel properly. When this alarm lamp is indicated again, consult a person in charge of service of the distributor.

C04 (C)VOLT LIMIT

Cause:

This indication means that heating power is automatically limited, to avoid overheat of electric circuit, due to various conditions such as the amount and shape of metal pieces, set temperature etc. This indication does not mean abnormality or malfunction of the machine.

Measures:

This indication may tend to appear at the beginning stage of heating, but it is no problem as far as the metal starts to melt after waiting some time. When the metal does not melt at all after this alarm is indicated, amount of the metal may be too small. (Use of about more than 50 grams of metal is necessary for each casting.) It is recommended to change the shape of metal to one that can be more easily melted (such as bar, big pellet etc.). Use of metal sand is not recommended. Consult a person in charge of service of the distributor.

C05 FREQUENCY LIMIT

Cause:

- Contact of the coil and the crucible receiving plate.
- Short-circuit of coil.
- Improper power supply etc.

Measures:

Casting could be completed to the end, but before starting next process, be sure to turn power OFF, and then check the coil and its surrounding area. When this alarm is indicated again after the above measures, consult a person in charge of service of the distributor.

E01 OVER HEAT

Casting operation: Stop casting.

Cause:

The thermo sensor in the cooling water circulation system is turned ON (because of abnormally high temperature).

Possible sources:

Check to see the below points.

- Water supply amount is insufficient, or water is not supplied.
- Temperature of supply water is higher than specified value.
- The water temperature controller is set to over 30 degrees Celsius. (Or, the water temperature controller is faulty.)
- The temperature sensor is faulty. (Or, it is short-circuited).
- Same possible sources as "E03 WATER FLOW".

Measures:

Check the above possible sources.

E02 OVER LOAD

Casting operation: Stop casting.

Cause:

Voltage of power supply is over the specified range.

Possible sources:

Check to see the below points.

- Voltage of power supply is too high.
- Voltage of power supply is too low.

Measures:

Check the above possible sources.

E03 WATER FLOW

Casting operation: Stop casting.

Cause:

The switch of the water flow detector in the cooling water circulation system is turned off (because of insufficient water flow).

Possible sources:

- Action of the flow switch is faulty, because of water deposit etc.
- The circulation pump does not operate.
- Efficiency of the pump is decreased.
- Rotation of the pump is reversed.
- No water is supplied into the water tank for circulation.
- Many air bubbles exist in the circulation system.

Measures:

Check the above possible sources.

E12 SERVOMOTOR FAULT

Casting operation: Stop casting.

Cause:

Alarm signal is generated from the servo-controller.

Possible sources:

- Input power for the servo-controller is over limit value.
- An alarm in the servo-controller is generated, so its alarm signal is sent.

Measures:

As to alarm except input power, consult a person in charge of service of distributor.

7-2. OTHER MALFUNCTION

7-2-1. IRREGULAR ELEVATION OF COIL

(1) When inert gas pressure for supply to the coil cylinder is abnormally low, up and down movement speed of the coil becomes slower or the coil cannot be elevated.
Check inert gas (Argon etc.) pressure.
Standard supply pressure is 5 to 6 Kg/cm^2.
(2) When the shaft (parallel) for coil movement has become dirty, or when its parallelism is lost, movement may become worse.
After checking that the coil holder and its surrounding area have cooled down to room temperature, press [COIL] key to turn on. Then, the coil moves up, and the supporting rod of coil holder appears. Clean the supporting rod with dry cloth.
After this, spread viscous silicone grease very lightly on the supporting rod.

> ⚠CAUTION
> 1. Never turn on any of other keys or buttons during the above work.
> 2. Never apply lubricating oil etc. except silicon grease, because oil may drop inside the chamber, or oil may splash and adhere to other parts.

If problem cannot be solved by checking the above parts, consult a person in charge of service of distributor.

7-2-2. IRREGULAR VACUUMING

(Abnormally slow vacuum or inability of maintaining the vacuum level)

(1) Clogging of filter element (due to fume, investment powder etc.)
Clean the filter element with a compressed air blower.
Replace the filter element (P.44).
(2) Inadequate fixation of the filter.
(3) Deterioration of oil in the vacuum pump.
(4) Deterioration of the O-ring for lid.
(5) Connection of tube is loose.

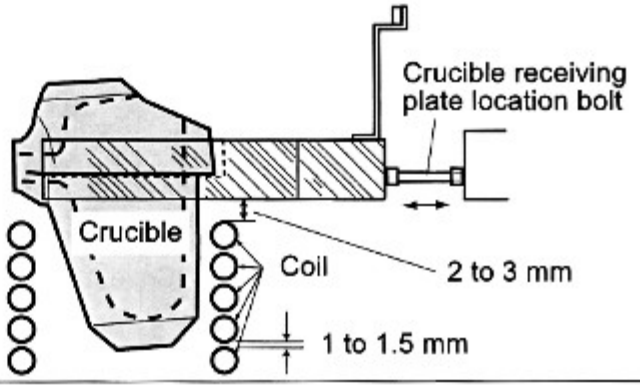
If problem cannot be solved by checking the above parts, consult a person in charge of service of distributor.

7-2-3. SLOW HEATING AND ABNORMALITY

(1) Coil position against the crucible may be inferior.

⚠CAUTION

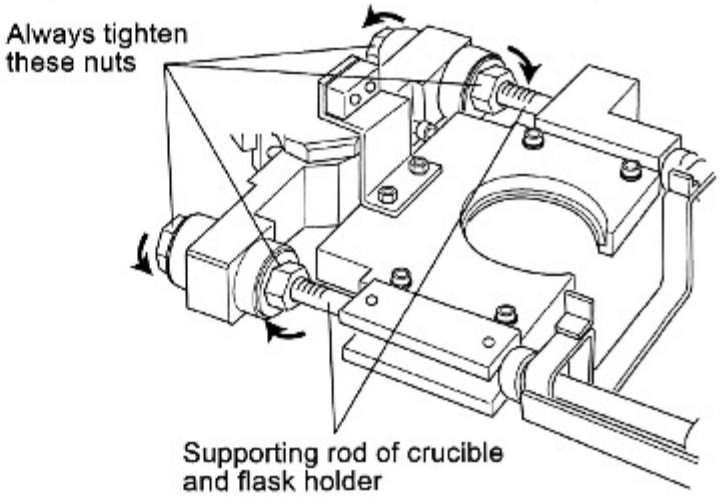
Especially when the coil position is too low, heating efficiency decreases and eventually life of crucible is shortened, which may cause danger.
After turning off the Breaker switch, and the coil and its surrounding area have cooled down to room temperature, adjust the position as the figure.



(2) When actual metal temperature in the crucible is abnormally high compared to displayed temperature, the optical axis of the thermo sensor may not be aligned to correct direction. Stop using immediately and align again the thermo sensor head (P.50).
(3) Upper surface or lower surface of the observation glass is dirty. Clean it.
(4) Thermo sensor surface is dirty. Clean it.
(5) 'Bridge' (P.28) may have been produced in the crucible.

7-2-4. REVOLUTION TROUBLE (VIBRATION OF ROTATION ARM)

(1) The arm is not balanced well (P.26) .
(2) The center knob of the arm is loose.
(3) Improper installation of the machine (P.31 to 32).
(4) Improper attachment of the front panel or the side panel etc.
(5) The nut for supporting rod of crucible and flask holder is loose.
(6) Other hex-socket head bolts or nuts in the arm assembly may be loose.

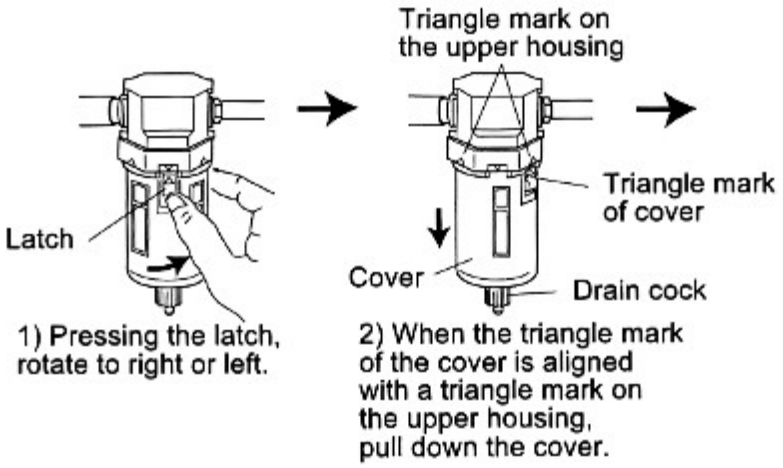


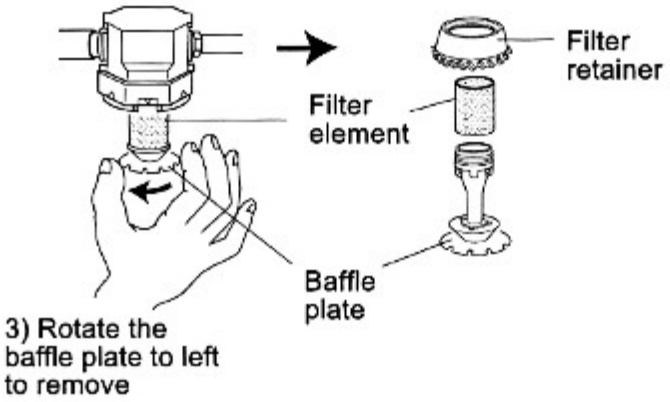
7-2-5. IMPROPER STOP POSITION

Origin point of the rotating arm is displaced. See P.49.

7-3. FILTER

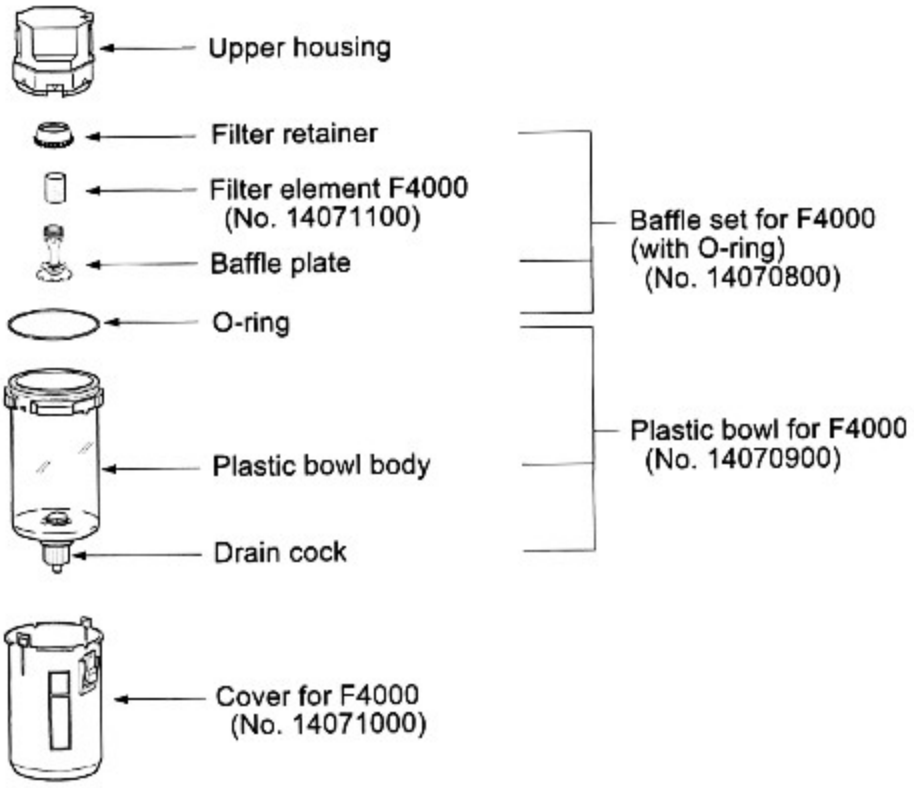
Replace the filter element of the vacuum filter regularly. Open the filter cover on the left panel of the machine body, and then remove the filter element as the below figure.





- Check that any foreign materials are not remained on the surface of O-ring.
- Be sure to close the drain cock by turning clockwise.

Filter parts
(Order placement is possible for the items with part Nos. See P.48.)



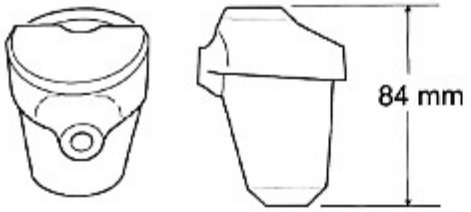
8. SPARE ACCESSORIES AND PARTS

LIST (1)

When you place an order, please mention item 'No.'

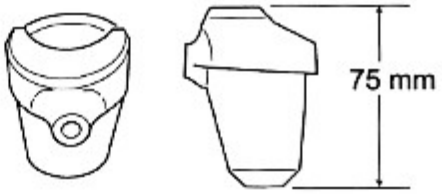
Crucible 55P for *VCC*

No. 25010000



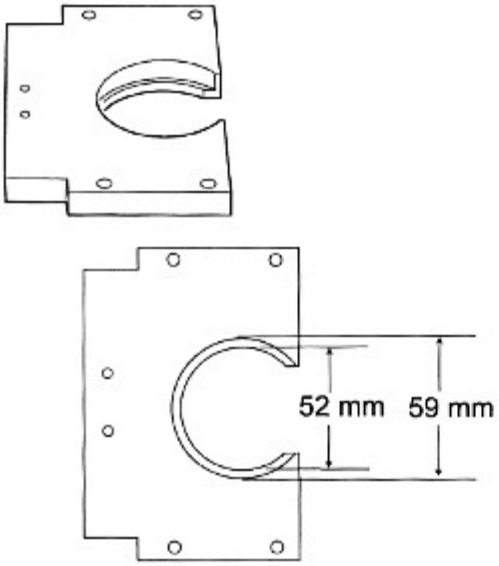
Crucible 50P for *VCC*

No. 25015000



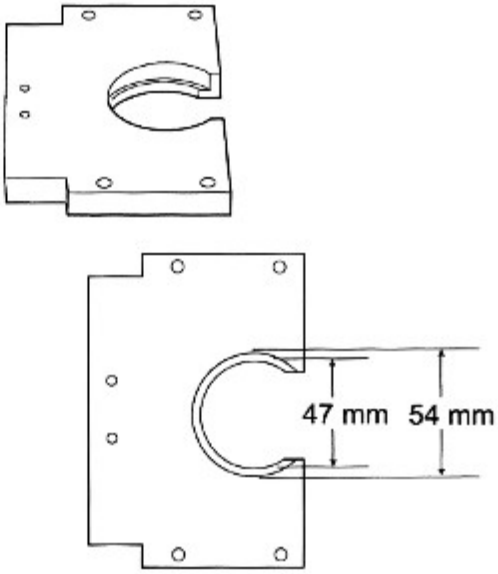
Crucible receiving plate
for 55P

No. 15045000



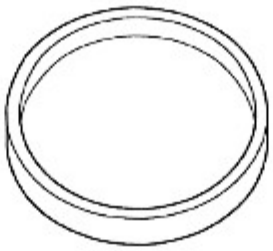
Crucible receiving plate
for 50P

No. 15045100



Receptacle tray

No. 15055000

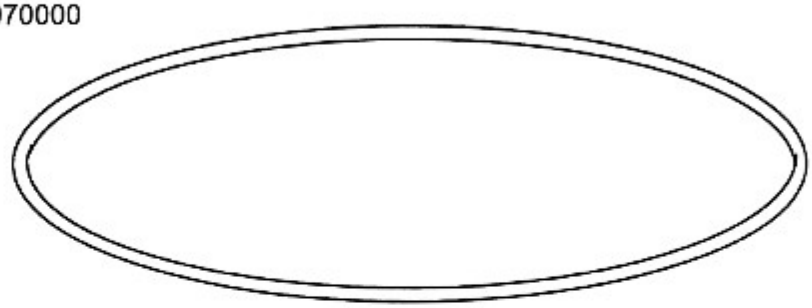


LIST (2)

When you place an order, please mention item 'No.'

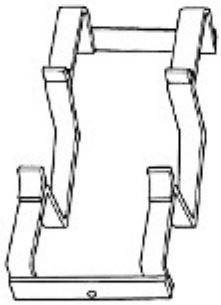
O-ring (V690) for lid

No. 15070000



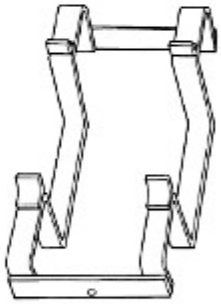
Flask holder
for dia.76 mm

No. 15040000



Flask holder
for dia.89 mm

No. 15040100



Arm collar

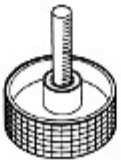
No. 15010200

Arm pin

No. 15041000

Center knob

No. 15071500



Back plate

No. 15010100

LIST (3)

When 14070800 is shipped, a white plastic filter element may be included, but do not install that white plastic filter element in the *VCC*.
Install the metal-made 'filter element F4000 (No.14071100)' only, that is exclusively designed for the *VCC*.

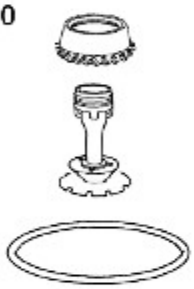
When you place an order, please mention item 'No.'

Filter element F4000

No. 14071100

Baffle set for F4000 (with O-ring)

No. 14070800

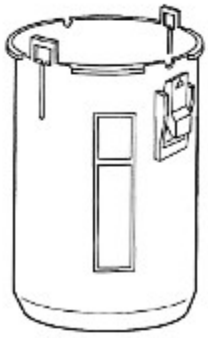


Plastic bowl for F4000

No. 14070900

Cover for F4000

No. 14071000



9. APPENDIX

9-1. READJUSTING AUTO STOP POINT OF ARM

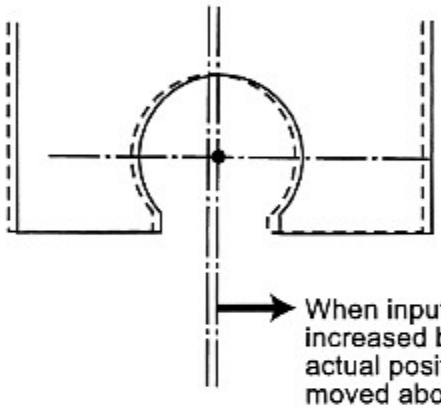
Best position is such that the center of the coil and the center of the crucible receptacle opening coincide (P.38). If they do not coincide, readjustment of origin point of the arm is necessary.

Readjusting procedure

1) First, check the current origin point value. The origin point value is displayed by four digits at [Origin Point] of [SETTING] screen.

2) Change the origin point value into a desired value.

Example: By inputting "1625" which is obtained by adding "5" to the original value "1620", auto stop point of the arm will move about 1 mm to right side. On the contrary, if you reduce "5" and input "1615", auto stop point of the arm will move about 1 mm to left side.



3) Close the lid of the chamber. Turn on [CHECK] key of [SETTING] screen to set the arm to origin point. The arm stops automatically. Then, that position is the new input position. If a gap remains, repeat from 2) to 3).

IMPORTANT: Do not press [CAST START] button. (Value of arm origin point is recognized as rotation pattern and rotation time by the machine. The arm will rotate in accordance with those values.)

9-2. ALIGNMENT OF OPTICAL AXIS OF THERMO SENSOR

When the measurement area (optical axis) of the thermo sensor and the surface of the metal are misaligned, correct measurement of metal temperature is impossible.
If metal temperature that you estimate from visual observation and display temperature of the temp. controller are deviated each other, the optical axis may be misaligned. Readjustment of optical axis is necessary.

NOTE: Current temperature is displayed from over 900 degrees Celsius. If actual temperature is less than 900 degrees, display will be 900 degrees Celsius, so actual temperature is not available on the display.

How to align optical axis

1) Press [ON] key of [Laser Light] on [SETTING] screen, so that the arm will stop at the auto stop point.

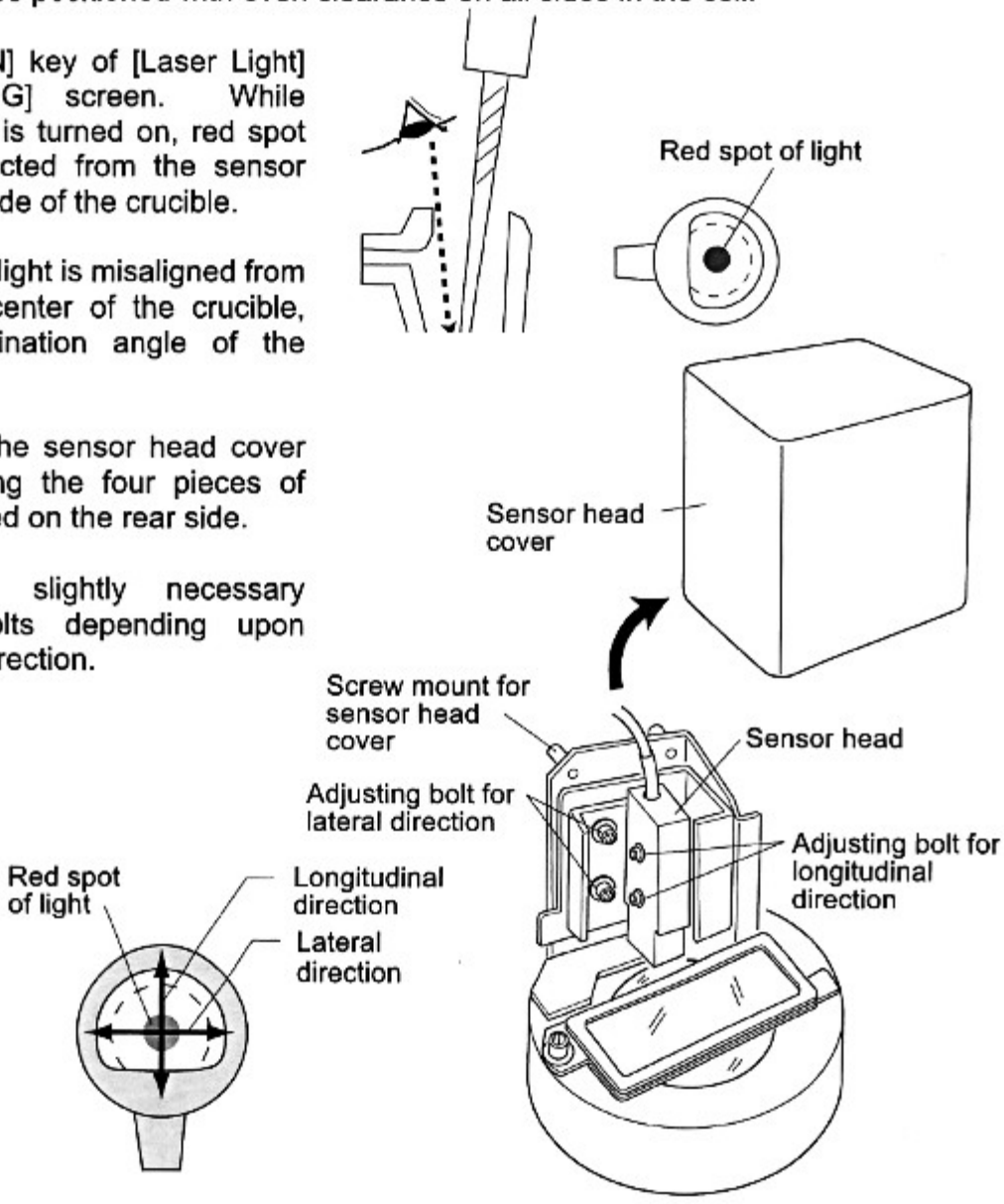
2) Move the coil up. Then, slide and adjust the crucible receiving plate, so that the crucible can be positioned with even clearance on all sides in the coil.

3) Press [ON] key of [Laser Light] on [SETTING] screen. While [Laser Light] is turned on, red spot light is projected from the sensor head into inside of the crucible.

4) If red spot light is misaligned from the bottom center of the crucible, readjust inclination angle of the sensor head.

5) Remove the sensor head cover by unscrewing the four pieces of screws located on the rear side.

6) Slacken slightly necessary adjusting bolts depending upon misaligned direction.



7) Move the sensor head with hand and make sure that the beam spot moves. When the spot comes to a proper position, tighten the adjusting bolts.

IMPORTANT: Be sure to close the lid of the chamber during this checking. Even if the lid is open very little, the spot position will be misaligned.

8) Press [OFF] key of [Laser Light] on [SETTING] screen.

IMPORTANT: While [Laser Light] is kept ON, heating cannot be operated.

9-3. REFERENCE DATA (ROTATION PATTERN)

The below table is reference values used by the old type version of *VCC*.

Normal rotation pattern

The below table is an example for setting normal rotation pattern.

		Final rotation speed (rpm)									
		V9	V8	V7	V6	V5	V4	V3	V2	V1	V0
		500	480	460	440	420	400	380	360	340	320
Time required for reaching preset rotation speed (sec)	9T	0.200	0.192	0.184	0.176	0.168	0.160	0.152	0.144	0.136	0.128
	8T	0.300	0.288	0.276	0.264	0.252	0.240	0.228	0.216	0.204	0.192
	7T	0.400	0.384	0.368	0.352	0.336	0.320	0.304	0.288	0.272	0.256
	6T	0.500	0.480	0.460	0.440	0.420	0.400	0.380	0.360	0.340	0.320
	5T	0.600	0.576	0.552	0.528	0.504	0.480	0.456	0.432	0.408	0.384
	4T	0.700	0.672	0.644	0.616	0.588	0.560	0.532	0.504	0.476	0.448
	3T	0.800	0.768	0.736	0.704	0.672	0.640	0.608	0.576	0.544	0.512
	2T	0.900	0.864	0.828	0.792	0.756	0.720	0.684	0.648	0.612	0.576
	1T	1.600	1.536	1.472	1.408	1.344	1.280	1.216	1.152	1.088	1.024
	0T	1.800	1.728	1.656	1.584	1.512	1.440	1.368	1.296	1.224	1.152

Low speed rotation pattern

The below table is an example for use in lower rotation speed area.

		Final rotation speed (rpm)									
		V9	V8	V7	V6	V5	V4	V3	V2	V1	V0
		500	480	460	440	420	400	380	360	340	320
Time required for reaching preset rotation speed (sec)	9T	1.00	0.96	0.92	0.88	0.84	0.80	0.76	0.72	0.68	0.64
	8T	1.10	1.06	0.88	0.97	0.92	1.38	0.84	0.79	0.75	0.70
	7T	1.20	1.15	1.10	1.06	1.01	0.96	0.91	0.86	0.82	0.77
	6T	1.30	1.25	1.20	1.14	1.09	1.04	0.99	0.94	0.88	0.83
	5T	1.40	1.34	1.29	1.23	1.18	1.12	1.06	1.01	0.95	0.90
	4T	1.50	1.44	1.38	1.32	1.26	1.20	1.14	1.08	1.02	0.96
	3T	1.60	1.54	1.47	1.41	1.34	1.28	1.22	1.15	1.09	1.02
	2T	1.70	1.63	1.56	1.50	1.43	1.36	1.29	1.22	1.16	1.09
	1T	1.80	1.73	1.66	1.58	1.51	1.44	1.37	1.30	1.22	1.15
	0T	1.90	1.82	1.75	1.67	1.60	1.52	1.44	1.37	1.29	1.22

10. SPECIFICATIONS

1. POWER SUPPLY	AC 200 V, 3 phase, 50/60 Hz	
2. POWER CONSUMPTION	6.5 KVA	
3. MELTING		
	BUILT-IN OSCILLATOR	Output power : Max. 5 KW Oscillation frequency : Approx. 100 KHz
	METAL CAPACITY	Pt. Max. 400 g
	TEMP. ADJUSTING RANGE	900 to 2100 degrees Celsius
	TEMP. SENSOR	Non-contact type measurement by Radiation Method Measurement wavelength: 1 micron
	TEMP. CONTROL	P.I.D. control
	EMISSIVITY ASJUSTMENT	Digital input
	COIL COOLING	Cooling water circulation system
4. ROTATION		
	ARM REVOLUTION DRIVE	High power servo motor 3 KW
	MAX. ACCELERATION	0.1 sec. to 500 rpm
	RECIPE MEMORY	Max. 100
	ARM ORIGIN	Automatic origin setting
	ARM STRUCTURE	Double knuckled swing arm
	ARM FIXATION METHOD	Eccentric arm fixing method (Japan Patent No. 3178748)
	FLASK	Dia.76 mm / 89 mm, Max length 100 mm
5. MECHANISM		
	SAFETY MECHANISM	Lid-lock system during arm drive
	ALARMS	19 kinds of alarms (caution alarm, malfunction alarm etc.)
	PROCESS	Vacuum, Gas charge, Open to air
6. AMBIENT CONDITIONS		
	WATER SUPPLY	More than 2 liters/min. Pressure 0.25 to 0.3 MPa Hardness: less than 17 degrees Quality: drinkable
	GAS	Argon gas: more than 0.5 MPa
	VACUUM PUMP	More than 500 liters/min.
7. SIZE		
	DIMENSIONS	1020 mm(W)x840 mm(D)x1180 mm(H)
	WEIGHT	Approx. 350 Kg

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