No. P01G-004-A

HIRAYAMA

# SERVICE MANUAL

# for "HICLAVE"

# HVE-50

27-JUL-2001

# Introduction

- This manual was created to support smooth service of the HVE-50 autoclave. Use the manual as a reference in addition to the operation manual.



The contents of this document are subject to change without notice.

This document has been carefully compiled. If you have any questions or require information not covered in the manual, please contact :

Amerex Instruments, Inc.
P.O. Box 787
Lafayette, CA 94549
U.S.A.
TEL: 925-299-0743
FAX: 925-299-0745
E-mail: marketing@amerexinst.com

- In this manual the following headwords are applied to items to which great attention should be given:

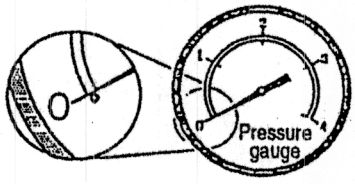
⚠ **WARNING:** Precaution describing an imminent dangerous situation that will lead to death or serious injury if it is not avoided.

⚠ **CAUTION:** Precaution describing a dangerous situation that may lead to moderate or minor injury if it is not avoided.

(!) **IMPORTANT:** Items the operator is strongly advised to obey.

## ⚠ WARNING

- Check to see that the pressure has drop 0 kgf/cm$^2$ before opening the lid.




## ⚠ CAUTION

- Wait until the body has cooled sufficiently to perform maintenance and service work.
- Wait until the water in the bottle has cooled sufficiently to take out the exhaust bottle.
- Do not take out the exhaust bottle or drain the working chamber when the interior of the chamber is under pressure. Otherwise, boiling water and steam will gush out, and you may burn yourself.
- The heater is provided with a temperature sensor. Be careful not to damage it while cleaning.
- Be sure to securely tighten the heater holding nuts when replacing the heater. Water may leak and cause short circuits if the nuts are loose.
- Be sure to securely tighten terminal holding nut A when replacing the heater. Heat may be generated from the terminal and burn damage may result if the nut is loose.

- This manual consists of the following sections covering the information required for proper operation of the autoclave **HVE-25/50**:

## Chapter 1. Maintenance and Adjustment5

This section describes the maintenance procedures for the unit as well as the methods for replacing and adjusting the main parts.

## Chapter 2. Troubleshooting Chart

This section describes the items to check and measures to take when a problem occurs.

## Chapter 3. Product Description

This section describes the operations and internal structural parts of the product.

## Chapter 4. Operation Check Procedure

This section describes the method for checking the operation of electrical parts using the check program.

## Chapter 5. Main Parts List

The code numbers of the main parts are listed in the table here.

# Contents

**⚠ WARNING**

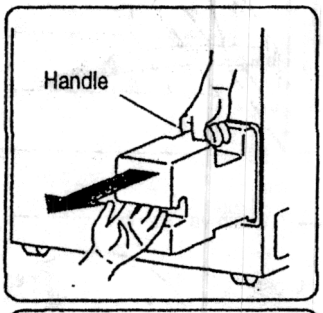
- Wait until the body has cooled sufficiently to perform maintenance and service work.
- Turn off the earth-leakage circuit breaker before replacing any parts.

## 1. Draining Water from the Exhaust Bottle

- Since the water level in the exhaust bottle increases with continued operation, water must be drained using the procedure below when water reaches the HIGH level.

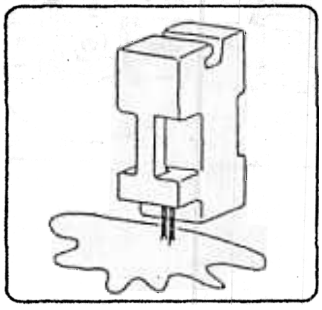
**⚠ WARNING**

- Wait until the water in the bottle has cooled sufficiently to take out the exhaust bottle.



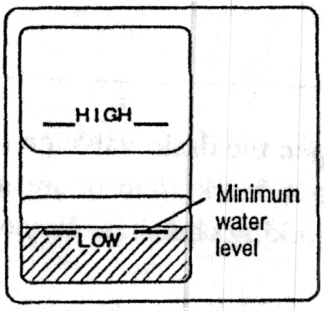

① Remove the exhaust bottle from the body.

- Pull the bottle out until the handle can be grasped then hold and remove.



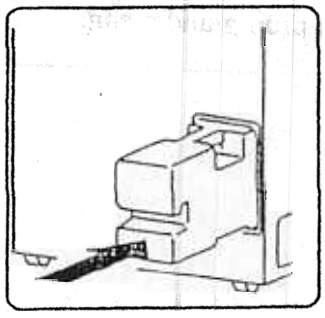
② Place the drain/supply port face down in a level sink.

- Excess water will drain out until the LOW level is reached.




③ Cnfirm that the water is at the LOW level

- Since steam cools in the exhaust bottle, be sure to leave the water at the LOW level.



④ Replace the exhaust bottle in the housing area.

- If the bottle is not pushed completely into the housing, an error ( ) will occur when operation starts.

## 2. Draining the Working Chamber

- Drain water using the following procedure after confirming that the inside of the working chamber has cooled sufficiently.

**⚠ WARNING**

- Do not unload the exhaust bottle or drain the working chamber when the chamber is under pressure. Boiling water or steam may gust out causing burns.

① Open the lid.

② Connect one end of the accessory drain hose to the tap of the drain valve located at the lower part of the right side of the body.

③ Put the other end of the hose in a container.

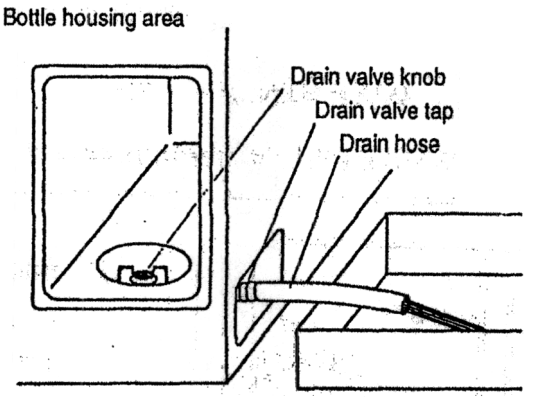
④ Remove the exhaust bottle from the body.

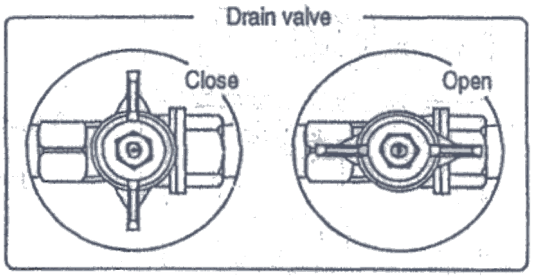
⑤ Turn the drain valve knob, located at the bottom of the exhaust bottle housing area, counterclockwise to open.

⑥ Check that draining of the working chamber is complete.

⑦ Turn the knob clockwise to close the drain valve.

Be sure the exhaust valve is closed.




### When drain pipes are clogged

- Connect the drain port to a faucet using a pressure-tight hose, open the drain valve on the body, and gradually open the faucet. When the water supply pressure is 1 kgf/cm² or greater, any foreign matters jammed in the drain pipe will flow into the working chamber. Remove the foreign matter, and then drain the chamber.
- If the clog is not removed by the above procedure, diassemble the piping and clean.

## 3. Cleaning the Working Chamber

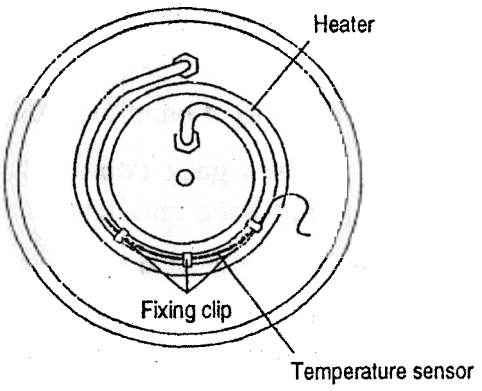
**⚠ WARNING**

- The heater is provided with a temperature sensor. Be careful not to damage this sensor when cleaning.

① Remove the bottom plate to see if the bottom of the working chamber or the surface of the heater is dirty. after draining the chamber, clean these areas with a soft brush or other tool while applying water and keeping the drain valve open.

② Reattach the fixing clip of the temprature sensor if it has come off or is loose. Attach the clip so that the temperature sensor comes into close contact with the heater.

Inside of the Working Chamber




## 4. Body Repairs

**(!) IMPORTANT**

- Do not use benzene or thinner to clean the body. Also, make sure that volatile substances such as insecticides do not come into contact with the body as these may cause deterioration and stripping of the pain.

① Gently wipe stains from the body with a soft cloth. To remove stubborn stains, wipe with a moistened cloth using neutral detergent diluted in water. Wipe off any remaining moisture with a dry cloth.

## 5. Lid Gasket

- When the end of the lid gasket becomes discolored and whitened, replace the gasket in accordance with the following procedure. A worn gasket may cause steam leakage.

① Open the lid.

② Lift out and remove the old gasket insulation.

③ Using a waste cloth, wipe dirt off the area of the working chamber where the gasket was.

④ Remove the gasket band from the old gasket, and wipe dirt off the band using a waste cloth.

⑤ Attach the gasket band to a new gasket

- Lay the new gasket on the chamber and press the gasket band into the groove.

⑥ Attach the new gasket to the working chamber.

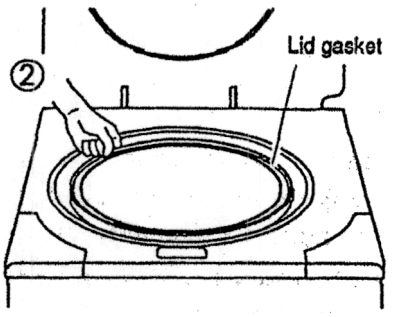
- Attach while making sure the gasket band remains properly positioned.

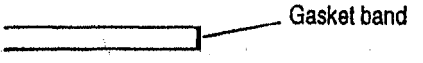
  If the gasket band comes out of the groove, press in the band using a flat-blade screwdriver or similar tool.

⑦ Push the new gasket down with the fingers to eliminate any unevenness.

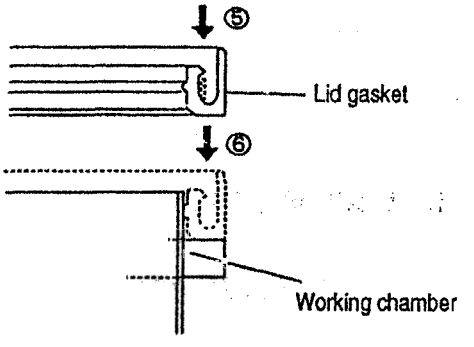
- Unevenness in the gasket can cause leaks.

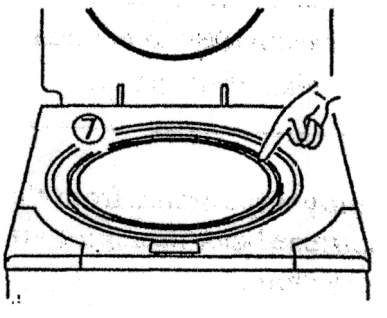
⑧ Start normal operations and confirm that there are no leaks from the lid gasket.




Working chamber cross-section



## 6. Solid State Relay (SSR) Replacement

① Pull out the connector from the solid state relay (SSR).

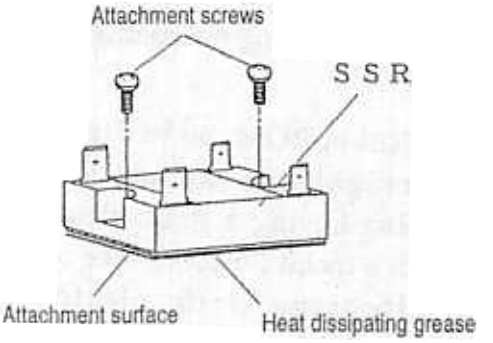
② Turn the SSR holding screws and remove the SSR form the switchboard.

③ Wipe off the heat dissipating grease, dust, and other matter adhering to the switchboard in the vicinity of the SSR attachment screw hole.

④ Clean the attachment surface of the new SSR, then evenly apply heat dissipating grease to the surface.

⑤ Attach the SSR to the switchboard and plug in the connector.

- Since the IN side of the SSR has +/– polarity, be sure to attach this side in the original connection direction.

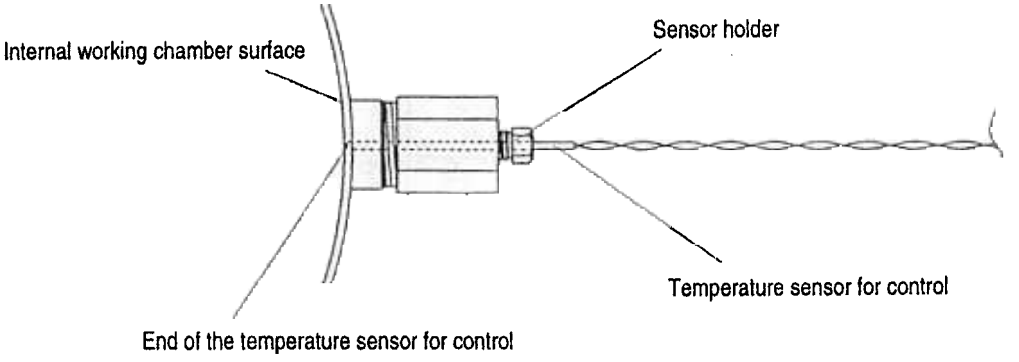



## 7. Replacement of Temperature Sensor for Control

① Hold the sensor and loosen.

② Pull the temperature sensor for control from the sensor holding hole.

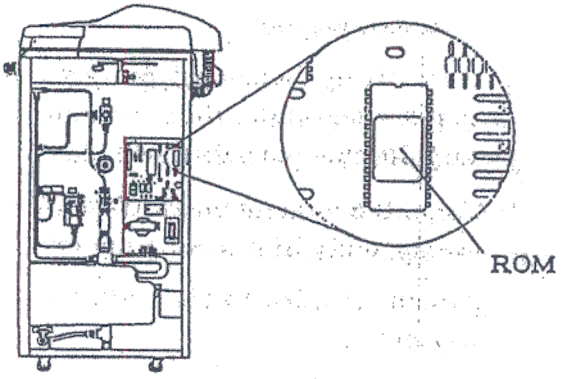
③ Insert the new sensor through the sensor holding hole, adjust so the internal working chamber surface and the end of the temperature sensor are at the same position, and firmly tighten the sensor holder using the fingers and not a monkey wrench or other tool.



## 8. ROM Replacement

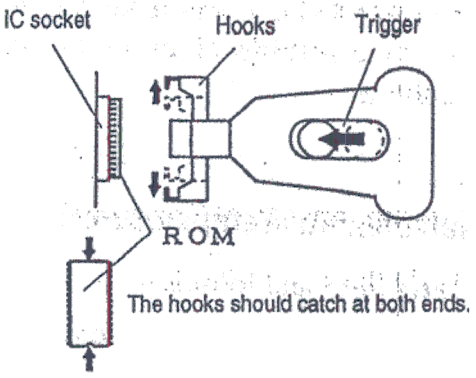
**(!) IMPORTANT**

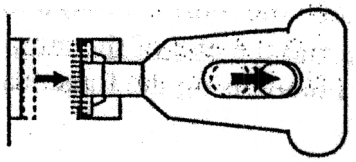
- When replacing the ROM, use a special tool to avoid damaging the control PCB or the new ROM.
- The PCB or ROM can be damaged if touched or brought into contact with people or clothing having a static electricity charge. Touch a metal object or take other measures to discharge static electricity before performing these operations.



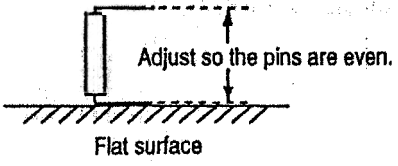

① Use the procedure below and remove the ROM from the IC socket using a ROM puler (Available form Hirayama).

- Push the trigger on the puller to open the hooks.
- Set the ends of the hooks to catch on the bottom of the ROM.
- Pull the trigger to remove the ROM.

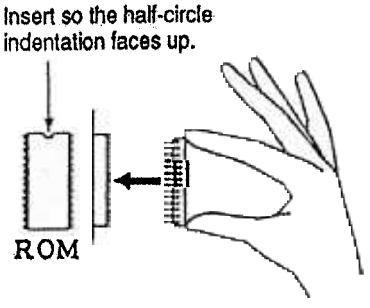


② Confirm that the pins on the new ROM are all even. If pins are bent outward, use a flat surface to realign them.




③ Taking care to get the proper orientation, insert the new ROM into the IC socket (The half-circle indentation should face left).



## 9. Heater Replacement

**⚠ CAUTION**

- Be sure to securely tighten the heater holding nuts when replacing the heater. Water may leak and cause short circuits if the nuts are loose.

  Be sure to securely tighten terminal holding nut A when replacing the heater. Heat may be generated from the terminal and burn damage may result if the nut is loose.

■ Required tools

- Monkey wrench (with maximum opening width of 23 mm or more)
- Spanners, etc. (for 7 mm nut )

① Drain the water from the working chamber.

② Turn off the earth-leakage circuit breaker located on the right side of the body.

③ Remove the plate from the rear of the body.

④ Pull the temperature sensor out from the sensor fixing tube on the heater.

⑤ Loosen terminal holding nut A and remove the round terminal.

⑥ Remove the neater holding nuts.

- If the nut cannot be removed using a monkey wrench, lay the body down, and insert a box spanner into the hole on the underside to remove the nut.

⑦ Remove the heater from the working chamber.

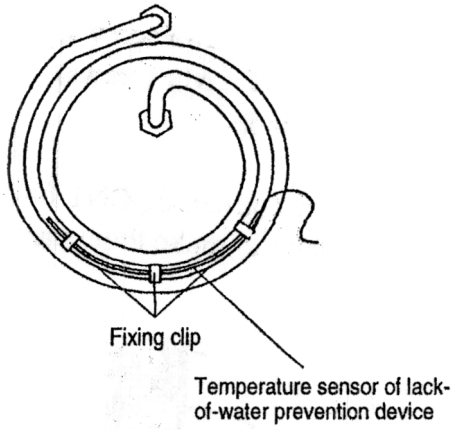
⑧ Remove any bilge or other matter from the area around the heater attachment holes.

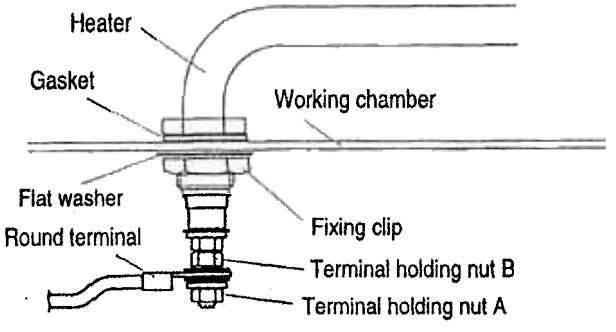
⑨ Remove the heater holding nuts and flat washers attached to the new heater.

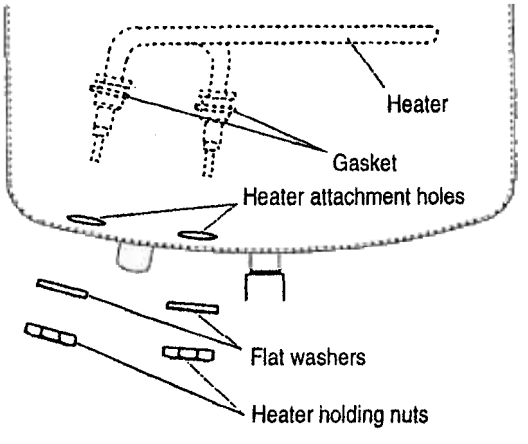
⑩ Bring the heater screw sections through the attachment holes on the bottom of the working chamber. Be careful that the gaskets do not come out and fall into the chamber during this operation.

⑪ Attach the flat washers, then tighten the heater holding nuts.

⑫ Remove terminal holding nut A from the newly attached heater.



⑬ Attach the round terminaland tighten terminal holding nut A. At this point, secure terminal holding nut B with a wrench and strongly tighten nut A.

⑭ Insert the temperature sensor into the fixing tubes.

⑮ Place water in the working chamber and check for leaks from the heater attachment areas.

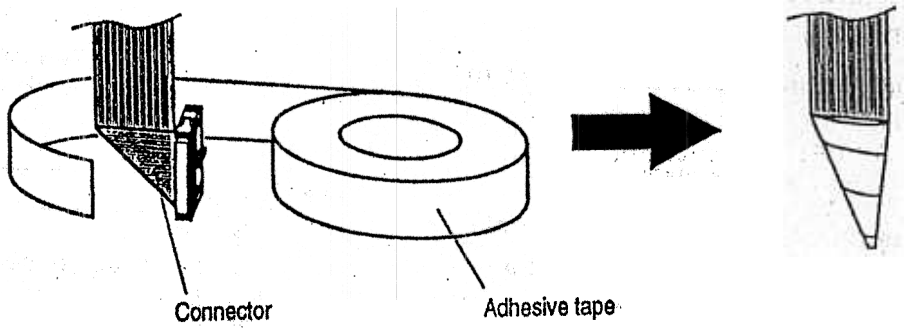
⑯ Turn on the earth-leakage circuit breaker, and begin operation in accordance with the ordinary operation procedure. Check to see that there is no leakage from the heater installation area while pressure is increasing. Install the plate on the rear of the body.

## 10. Display Board Replacement

■ Required tools

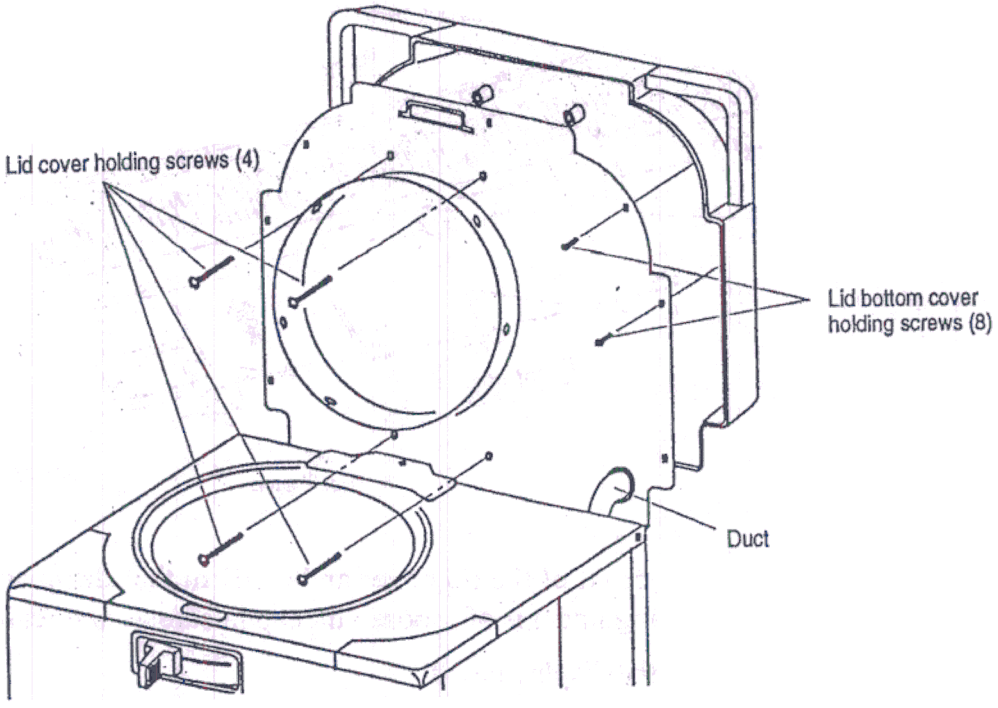
- Plus driver (for M5 screws)
- Plus driver (for M3 screws)
- Adhesive tape

① Disconnect connector CN1 on the control PCB. Wrap the connector and bracket cable in adhesive tape to make them pass through the duct easily.



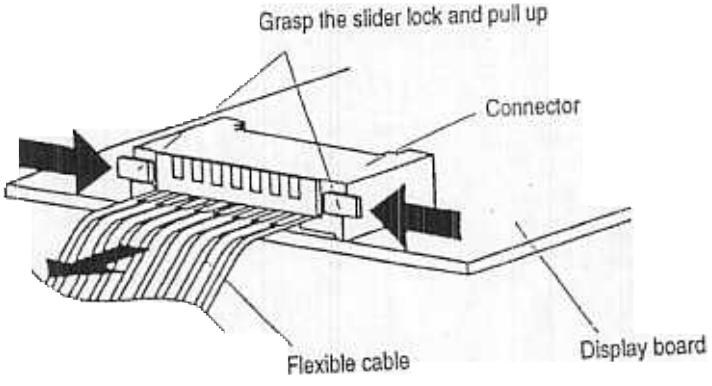

② Open the lid and remove the holding screws for the lid bottom cover.

③ Remove the lid cover holding screws.




④ Bring the flat cable of the display board through the duct and remove the lid cover.

⑤ Remove the flexible cable connected to the display board.

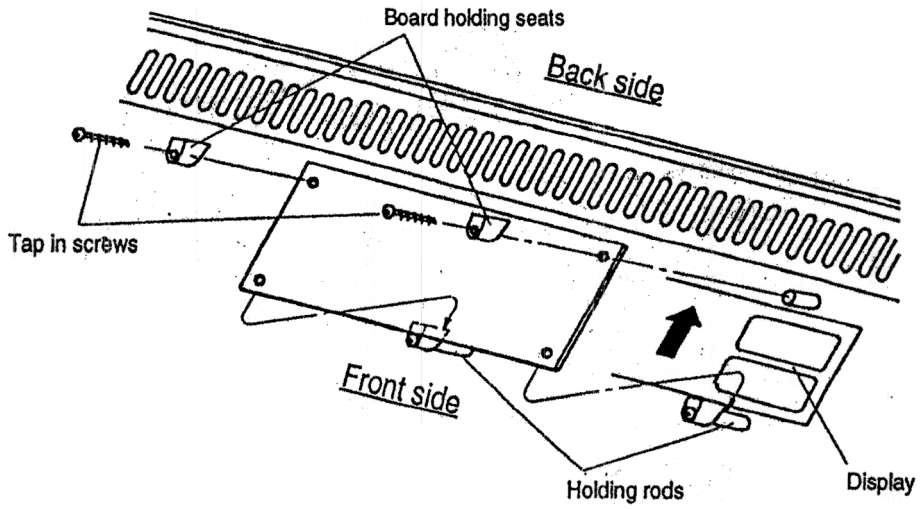



⑥ Remove the 2 tap in screws on the back and remove the display board.

⑦ Loosen the 2 tap in screws on the front by 1 or 2 turns.

⑧ Press the display to the front and bring the new display board into contact with the holding rods. Pass the tap in screws through the board holding seats and display board holding holes and attach to the lid cover.

⑨ Tighten the front side tap in screws.




⑩ Look at the display from the front of the lid cover and confirm that the character window is aligned with the LED. If the alignment is off, loosen the tap in screws and realign.

⑪ Connect the flexible cable to the display board.

⑫ Wrap the connector and flat cable in adhesive tape and pass them through the duct.

⑬ Remove the tape from the flat cable and connect the connector to CN1 on the control PCB.

⑭ Attach the lid cover using the holding screws.

⑮ Attach the lid bottom cover using the holding screws.

# Chapter 2. Troubleshooting Chart

## 1. Error Detection (Alarms)

| Display | Cause | Items to check | Remedy |
|---|---|---|---|
| **Er1** (Lack-of-water alarm) | 1) Water was not placed in the working chamber | User check | User instruction |
| | 2) Water was not replenished during continuous operation | User check | User instruction |
| | 3) Defective contact point operation of the lack-of-water prevention device | Check contact/open activation distance | Lack-of-water prevention device replacement |
| | 4) Defective input circuit for the lack-of-water prevention device on the control PCB | Check using the check program " **c4**" | Control PCB replacement |
| | 5) Wiring contact problem between the lack-of-water prevention device and the control PCB | Check wiring | Wiring repair |
| **Er2** (Broken wiring for temperature sensor for control) | 1) Defective temperature sensor | Measure temperature sensor resistance value (at normal temperature: resistance between white and yellow wires is 79 – 156 KΩ) | Replace sensor |
| | 2) Defective input circuit for the temperature control sensor on the control PCB | Check using the check program " **c6**" (display of **47 – 91** is normal at normal temperatures)<br>Check using the check program " **c7**" (display of **175** is normal at 121°C) | Replace control PCB |
| **Er3** (Excessive temperature alarm) | 1) Defective solid state relay (SSR) output circuit on the control PCB | Check using the check program " **c3**" | Replace control PCB |
| | 2) Defective SSR | Check contact/open activation distance | Replace SSR |
| **Er4** (Excessive cooling alarm) | 1) Defective heater operation | Refer to trouble shooting measures to take when the temperature in the working chamber will not rise | |
| | 2) Defective temperature sensor for control | Measure temperature sensor resistance value (at 100°C: resistance between white and yellow wires is about 63 KΩ) | Replace the sensor |

| Display | Cause | Items to check | Remedy |
|---|---|---|---|
| | 3) Defective input circuit for the temperature control sensor on the control PCB | Check using the check program " **c7**" (a display value of **92** is normal at 100°C) | Replace the control PCB |
| **Er5** (Excessive pressure alarm) | 1) Defective solenoid-controlled valve operation | Refer to trouble shooting measures to take when the air in the working chamber will not purge | |
| | 2) Defective over-pressurization prevention switch | Check whether the contact make/break is disabled | Replace over-pressurization prevention switch. |
| | 3) Defective input circuit for the over-pressurization prevention switch on the control PCB | Check using the check program " **c11**" (a display value of " **107**" is normal at 100°C) | Replace the control PCB |
| **Er6** (Lid abnormality alarm) | 1) Lock plate attachment is loose | Check the looseness of the lock plate attachment screws | Tighten the screws |
| | 2) Limit switch LSW1 attachment is loose | Check the looseness of the limit switch LSW1 attachment screws | Tighten the screws |
| | 3) Defective limit switch LSW1 | Check contact/open activation distance | Replace the limit switch |
| | 4) Defective input circuit for limit switch LSW1 on the control PCB | Check using the check program "**c4**" | Replace the control PCB |
| **Er9** (Sterilization heater abnormal-ity alarm) | Same as " **Er4.**" | | |
| **ErL** (Open/ close lever lock abnormality alarm) | 1) Limit switch LSW2 attachment is loose | Check the looseness of the limit switch LSW1) attachment | Tighten screws |
| | 2) Defective limit switch LSW2 | Check contact/open activation distance | Replace limit switch |
| | 3) Defective input circuit for limit switch LSW2) on the control PCB | Check using the check program " **c4**)" | Replace control PCB |
| | 4) Solenoid attachment loose | Check the looseness of the solenoid | Tighten screws |

| Display | Cause | Items to check | Remedy |
|---|---|---|---|
| | 5) Defective solenoid of 4X relay | Check using the check program " **c3**" | Replace defective parts |
| **ErE** (Exhaust bottle abnormality alarm) | 1) Exhaust bottle was removed during operation or while the pressure in the working chamber was 0.5kgf/cm$^2$ or more | User check | User instruction |
| | 2) Limit switch LSW3 attachment is loose | Check looseness of limit switch LSW3) | Tighten screws |
| | 3) Defective limit switch LSW3 | Check contact/open activation distance | Replace limit switch |
| | 4) Defective input circuit for limit switch LSW3 on the control PCB | Check using the check program " **c4**" | Replace control PCB |

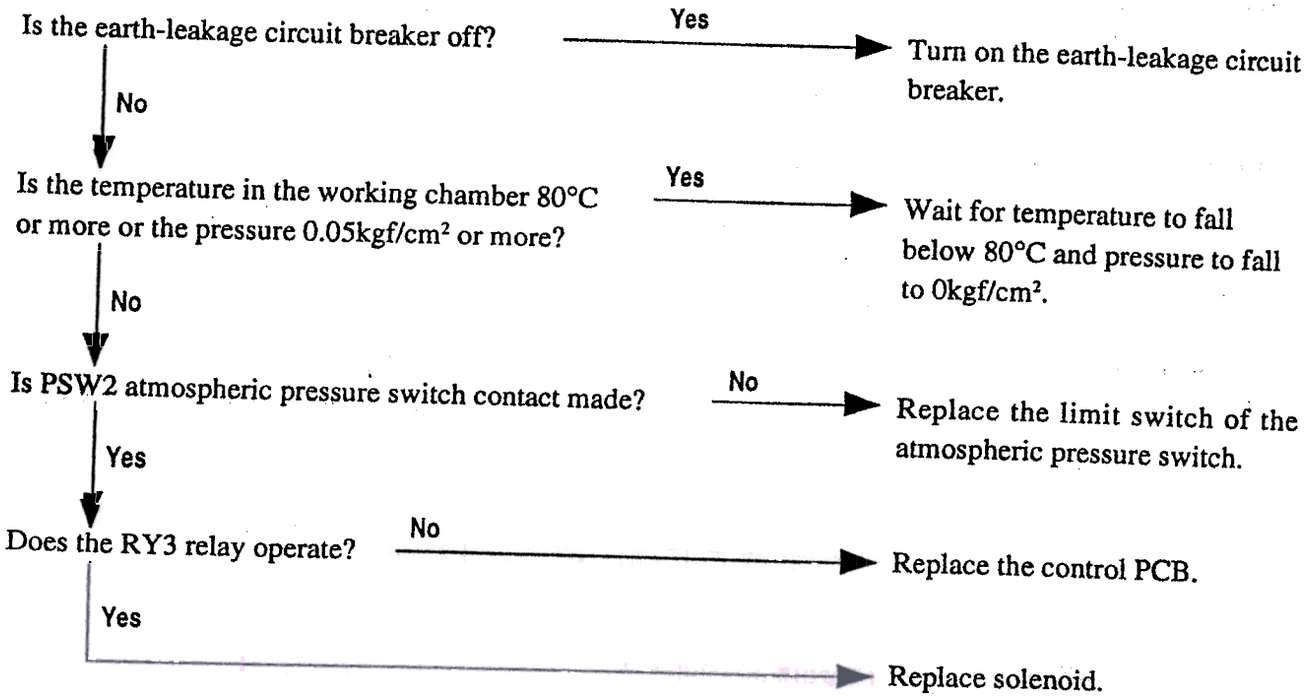
## 2. Early Troubleshooting

| Condition | Cause | Items to check | Remedy |
|---|---|---|---|
| Displays do not light when the **power switch (breaker)** is turned on. | 1) Poor connection or contact at terminals and connectors | Power cord connection<br>Breaker (power switch) connection<br>Tab terminal connection<br>Connection of CN2connector on the control PCB<br>Connection of CN1) connector on the control PCB | Repair or replace defective parts |
| | 2) No power | Power socket (rated voltage) | Correct the problem with the facilities |
| | 3) Power cord broken | Power side of breaker (rated voltage) | Replace the power cord |
| | 4) Breaker broken | Breaker load (rated voltage) | Replace the breaker |
| | 5) Transformer broken | Between terminals 1 and 2 on connector CN1 on the control PCB (AC14V) | Replace the transformer |
| | 6) Defective parts in the control PCB | Between terminals 12V and 0V (DC+12V) | Check, repair, or replace the short |
| | 7) Defective parts in the control PCB | Between terminals 5V and 0V (DC+5V) | Replace the control PCB |
| | 8) Blown fuse in the control PCB | Check visually | Correct the reason for the blown fuse and replace the fuse |

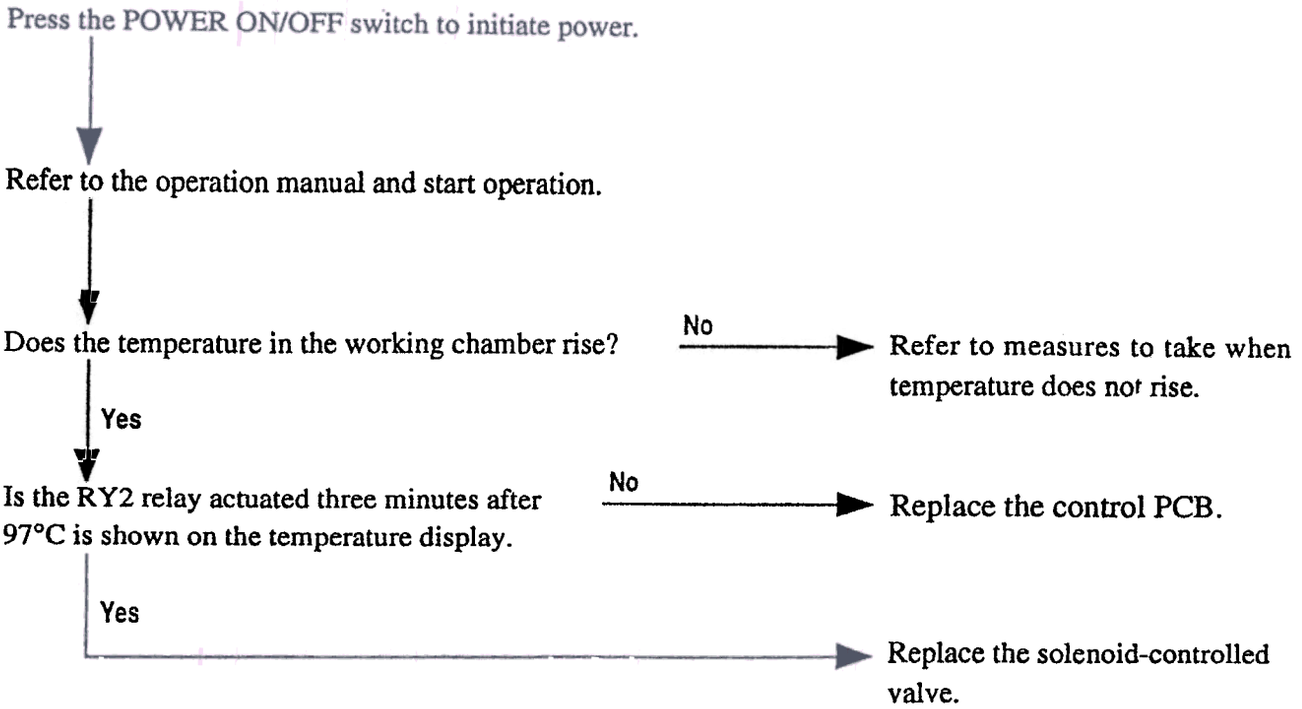
| Condition | Cause | Items to check | Remedy |
|---|---|---|---|
| One digit on the LED display does not light | 1) Defective circuit | LED soldering points | Repair soldering points |
| | 2) Defective LED | LED broken | Replace LED |
| Pressure in working chamber will not rise | 1) Defective safety valve | Leak from safety valve | Repair or replace safety valve |
| | 2) Broken pressure gauge | Pressure gauge needle | Replace pressure gauge |
| | 3) Piping loose or damaged | Steam leaks from piping | Repair leaking section |
| | 4) Refer to trouble shooting section | | |
| Air not purged from working chamber | 1) Refer to trouble shooting section | | |
| Steam leak from the lid gasket | 1) Old or damaged lid gasket | Visually check the deterioration and damage to the gasket | Replace the lid gasket |
| | 2) Improper lid gasket attachment | Visually check the gasket attachment | Attach the gasket evenly |
| | 3) Adhering foreign matter | Visually check for foreign matter adhering to the lid or lid gasket | Remove contaminants |
| Water leak form the bottom of the body | 1) Leak from heater attachment nut section | Looseness of heater attachment nuts | Tighten attachment nuts |
| | | Gasket deterioration | Replace gasket |
| | 2) Leak from lack-of-water prevention device attachment nut section | Looseness of lack-of-water prevention device attachment nuts | Tighten attachment nuts |
| | 3) Leak from piping | Piping looseness | Tighten piping |
| | 4) Leak from exhaust bottle | Damage to exhaust bottle | Replace exhaust bottle |
| | 5) Leak from exhaust hose | Cracks in exhaust hose | Replace exhaust hose |
| | 6) Leak from exhaust port due to open exhaust valve | State of the exhaust valve | Close exhaust valve |
| Open/close lever will not move | Refer to the trouble shooting section | | |
| Lid will not raise or lower | 1) Open/close lever is not completely to one side | Check lever position (right end) | Slide lever completely to the right end |

## 3. Troubleshooting

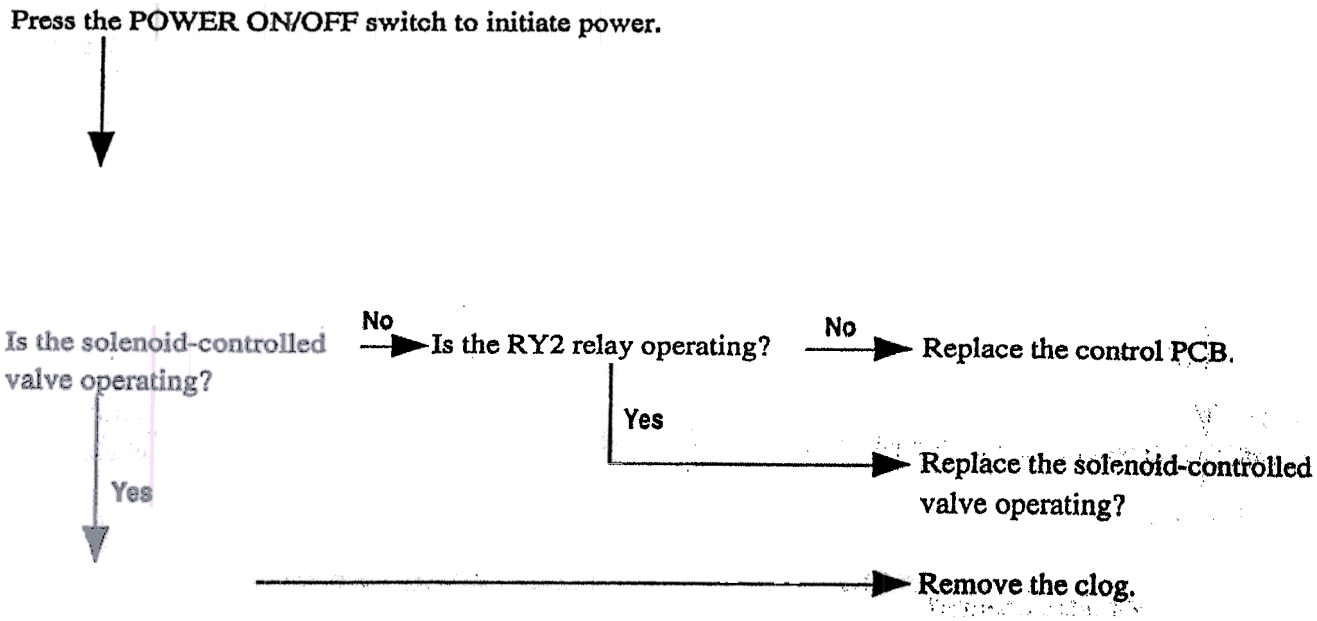
### ● Open/close lever does not move



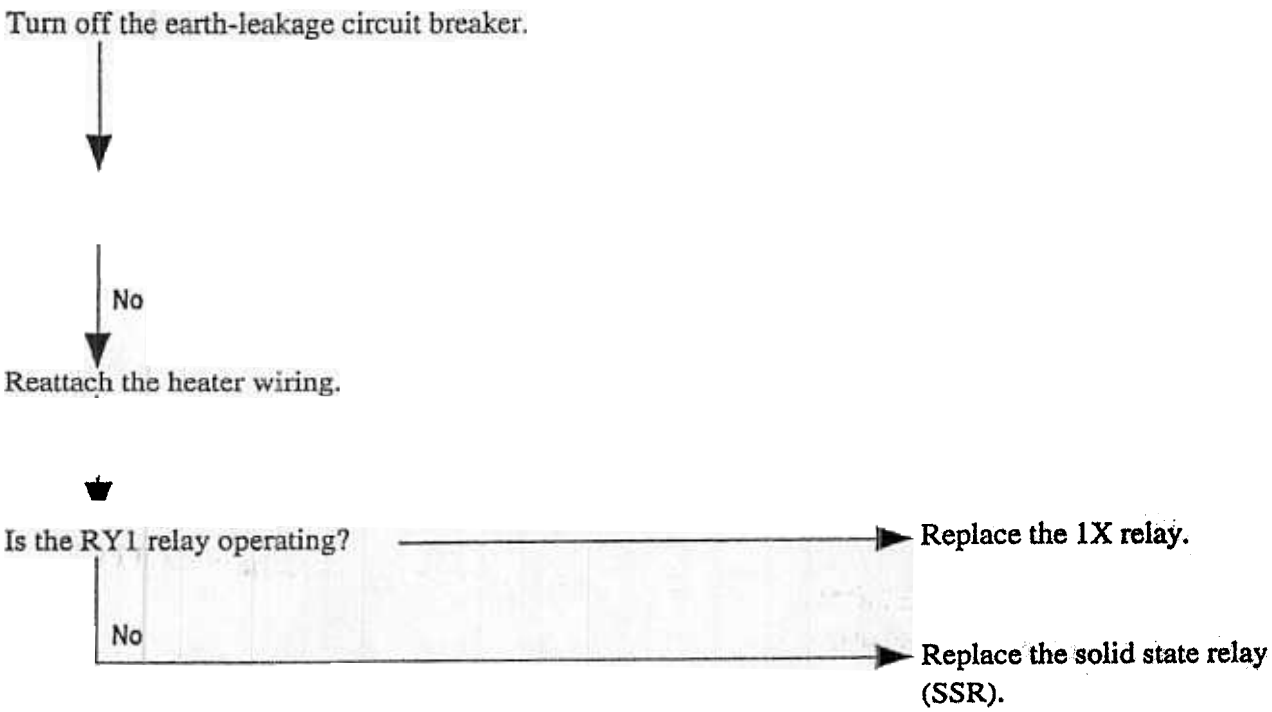

### ● Pressure will not rise in the working chamber



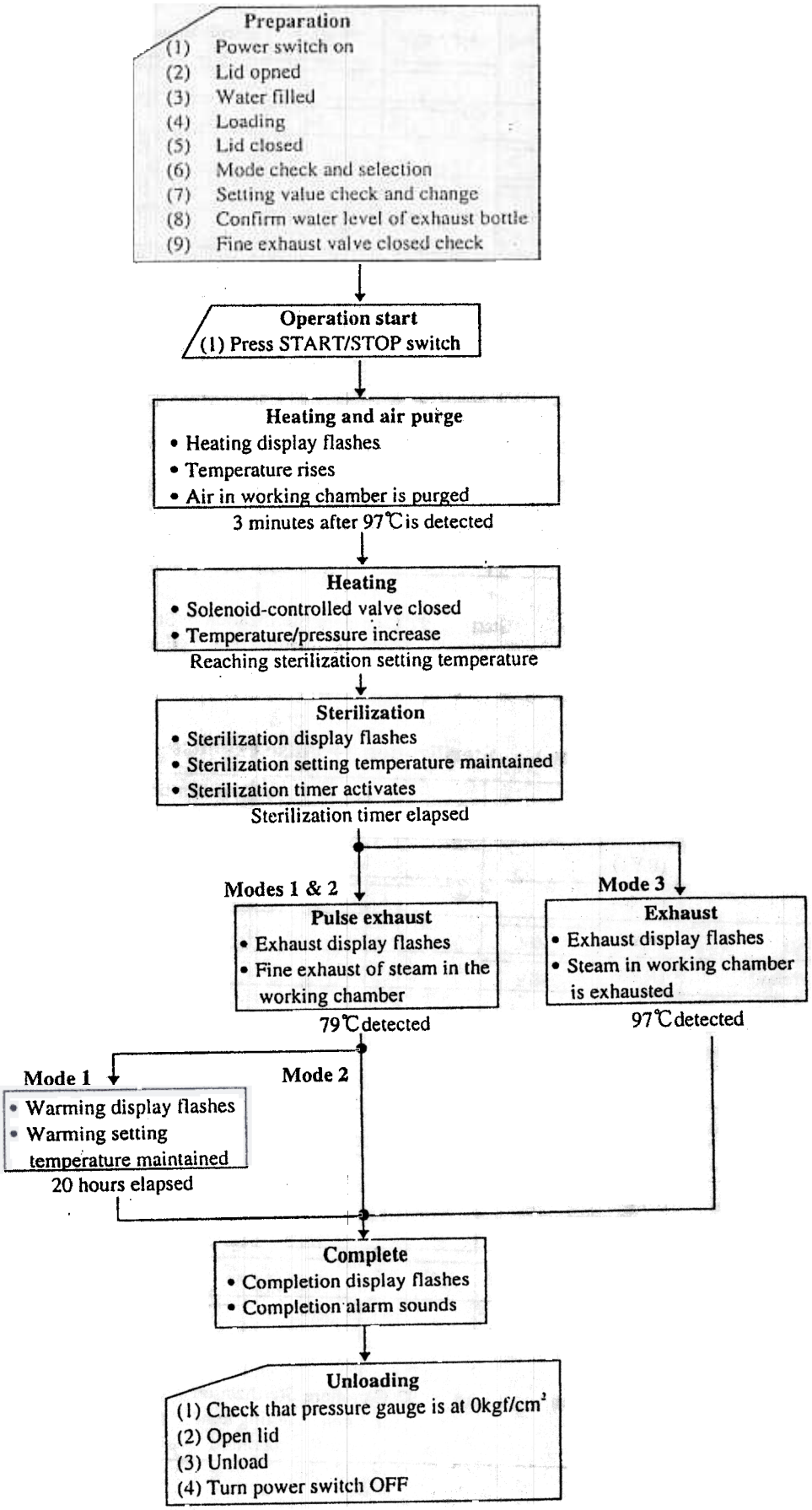
## ● Pressure is not purged from within the working chamber




## ● Temperature does not rise in the working chamber



## ● Operation sequence/procedure flow chart



## ● Timing Charts

### ● Mode 1 (liquid sterilization)  Sterilization → Pulse exhaust → Warming

| Output \ Process | | Preparation | Air purge | Heating | Sterilization | Pulse exhaust | Warming | Complete |
|---|---|---|---|---|---|---|---|---|
| Heater/relay | (RY1) | | | | | ① | | ① |
| | | | ② | | Temp. control | | ② Temp. control | |
| | | ※1 | | | | ※3 | | ※1 |
| | | ※2 | | | | | | ※2 |
| | | | | | | | ③ ※4 | ※5 |
| Process display LED | Preparation (L7) | Flashing | | | | | | |
| | Heating (L8) | | Flashing | | | | | |
| | Sterilization (L9) | | | | Flashing | | | |
| | Purging air (L10) | | | | | Flashing | | |
| | Warming (L11) | | | | | | Flashing | |
| | Complete (L12) | | | | | | | Flashing |
| 7seg LED | Upper side (seg1-3) | Setting value | | | Display of temperature in working chamber | | | |
| | Lower side (seg 4-6) | Setting value | | | Remaining time of sterilization timer | | | |
| Conditions | | ↑ Power on Stop | ↑ Start | ↑ 97°C or more for 3 min | ↑ Sterilization setting temperature | Steriliza-tion timer time up | 79°C | Warming timer time up |

### ● Mode 2 (liquid sterilization)  Sterilization → Pulse exhaust

| Output \ Process | | Preparation | Air purge | Heating | Steriliza-tion | Pulse exhaust | Complete |
|---|---|---|---|---|---|---|---|
| Heater/relay | (RY1) | | | | | ① | |
| SSR | (CN4) | | ② | | Temp. control | | |
| Motor/relay | (RY2) | ※1 | | | | ※3 | ※1 |
| Solenoid/relay | (RY3) | ※2 | | | | | ※2 |
| Alarm | | | | | | | ※5 |
| Process display LED | Preparation (L7) | Flashing | | | | | |
| | Heating (L8) | | Flashing | | | | |
| | Sterilization (L9) | | | | Flashing | | |
| | Purging air (L10) | | | | | Flashing | |
| | Warming (L11) | | | | | | |
| | Complete (L12) | | | | | | Flashing |
| 7seg LED | Upper side (seg1-3) | Setting value | | | Display of temperature in working chamber | | |
| | Lower side (seg 4-6) | Setting value | | | Remaining time of sterilization timer | | |
| Conditions | | Power on Stop | ↑ Start | ↑ 97°C or more for 3 min | ↑ Sterilization setting temperature | ↑ Steriliza-tion timer time up | ↑ 79°C |

● **Mode 3 (liquid sterilization)  Sterilization → Exhaust**

| Output \ Process | | | Preparation | Air purge | Heating | Steriliza-tion | Pulse exhaust | Complete |
|---|---|---|---|---|---|---|---|---|
| Heater/relay | | (RY1) | | | | | ① | |
| SSR | | (CN4) | | ② | | Temp. control | | |
| Motor/relay | | (RY2) | ※1 | | | | | |
| Solenoid/relay | | (RY3) | ※6 | | | | | ※6 |
| Alarm | | | | | | | | ※5 |
| Process display LED | Preparation | (L7) | Flashing | | | | | |
| | Heating | (L8) | | Flashing | | | | |
| | Sterilization | (L9) | | | | Flashing | | |
| | Purging air | (L10) | | | | | Flashing | |
| | Warming | (L11) | | | | | | |
| | Complete | (L12) | | | | | | Flashing |
| 7seg LED | Upper side (seg1-3) | | Setting value | | | Display of temperature in working chamber | | |
| | Lower side (seg 4-6) | | Setting value | | | Remaining time of sterilization timer | | |
| Conditions | | | Power on Stop | Start | 97°C or more for 3 min | Sterilization setting temperature | Steriliza-tion timer time up | 97°C |

① Goes off 0.5 seconds after the SSR goes off.

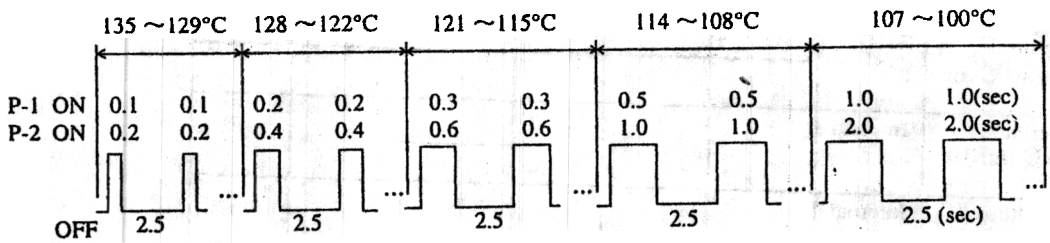
② Goes on 0.5 seconds after the heater/relay goes on.

③ Sounds when the temperature in the working chamber falls to the warming setting temperature.

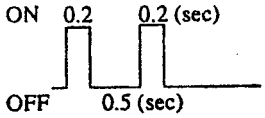
※1 Turns on when the temperature in the working chamber falls to 99℃.

※2 Turns on when the pressure in the working chamber falls to 0.1 kgf/cm$^2$ and the temperature in the working chamber falls to 79℃.

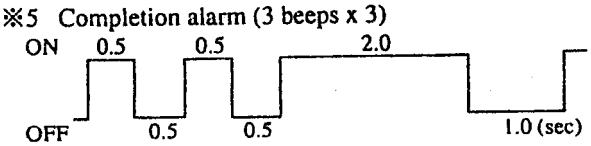
※3 Turns on/off as shown below depending on the setting of the exhaust pattern (P-1, P2). (Kept off in P-0.)




※4 Alarm when warming temperature is reached (2 beeps)




※5 Completion alarm (3 beeps x 3)




※6 Turns on when the pressure in the working chamber falls to 0.1 kgf/cm$^2$ and the temperature in the working chamber falls to 97°C.

## ● Error Monitoring Charts

### ● Mode 1 (Sterilization → Pulse exhaust → Heating)

| Display | Name | Detection | Prepara-tion | Air purge | Heating | Steriliza-tion | Pulse exhaust | Warm-ing | Com-plete | |
|---|---|---|---|---|---|---|---|---|---|---|
| Er1 | Lack-of-water alarm | EGO | | | | | | | | External output off. |
| Er2 | Control temperature sensor wire broken | CN2 | | | | | | | | Error buzzer sound. |
| Er3 | Over temperature (upper limit temperature +3℃ or more) | Internal | | | | | | | | |
| Er3 | Over temperature (setting +5℃ for 10 minutes) | Internal | | | | | | | | |
| Er3 | Over temperature (setting +10℃ for 15 minutes) | Internal | | | | | | | | |
| Er4 | Over cooling | Internal | | | | | | | | |
| Er5 | Over pressure | Internal | | | | | | | | |
| Er6 | Lid abnormal | LSW1 | | | | | | | | |
| Er9 | Heater abnormal | Internal | | | | | | | | |
| ErL | Open/close knob lock abnormal | LSW2 | - - - - - - - *3 | | | | | | - - - - - - *3 | |
| ErE | Exhaust bottle abnormal | LSW4 | - - - - - - - *3 | | | | | | - - - - - - *3 | |
| *1 | Over temperature (setting +2℃ or more) | Internal | | | | | | | | |
| *2 | Over cooling (setting -1℃ or less) | Internal | | | | | | | | Timer stop. |

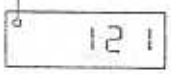
### ● Mode 2 (Sterilization → Pulse exhaust)

| Display | Name | Detection | Prepara-tion | Air purge | Heating | Steriliza-tion | Pulse exhaust | Com-plete | |
|---|---|---|---|---|---|---|---|---|---|
| Er1 | Lack-of-water alarm | EGO | | | | | | | External output off. |
| Er2 | Control temperature sensor wire broken | CN2 | | | | | | | Error buzzer sound. |
| Er3 | Over temperature (upper limit temperature +3℃ or more) | Internal | | | | | | | |
| Er3 | Over temperature (setting +5℃ for 10 minutes) | Internal | | | | | | | |
| Er3 | Over temperature (setting +10℃ for 15 minutes) | Internal | | | | | | | |
| Er4 | Over cooling | Internal | | | | | | | |
| Er5 | Over pressure | Internal | | | | | | | |
| Er6 | Lid abnormal | LSW1 | | | | | | | |
| Er9 | Heater abnormal | Internal | | | | | | | |
| ErL | Open/close knob lock abnormal | LSW2 | - - - - - - - *3 | | | | | - - - - - - *3 | |
| ErE | Exhaust bottle abnormal | LSW4 | - - - - - - - *3 | | | | | - - - - - - *3 | |
| *1 | Over temperature (setting +2℃ or more) | Internal | | | | | | | |
| *2 | Over cooling (setting -1℃ or less) | Internal | | | | | | | Timer stop. |

● Mode 3 (Sterilization → Exhaust)

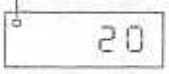
| Display | Name | Detection | Prepara-tion | Air purge | Heating | Steriliza-tion | Pulse exhaust | Com-plete | |
|---|---|---|---|---|---|---|---|---|---|
| Er1 | Lack-of-water alarm | EGO | | | | | | | External output off.<br>Error buzzer sound. |
| Er2 | Control temperature sensor wire broken | CN2 | | | | | | | |
| Er3 | Over temperature (upper limit temperature +3℃ or more) | Internal | | | | | | | |
| Er3 | Over temperature (setting +5℃ for 10 minutes) | Internal | | | | | | | |
| Er3 | Over temperature (setting +10℃ for 15 minutes) | Internal | | | | | | | |
| Er4 | Over cooling | Internal | | | | | | | |
| Er5 | Over pressure | Internal | | | | | | | |
| Er6 | Lid abnormal | LSW1 | | | | | | | |
| Er9 | Heater abnormal | Internal | | | | | | | |
| ErL | Open/close knob lock abnormal | LSW2 | *4 | | | | | *4 | |
| ErE | Exhaust bottle abnormal | LSW4 | *4 | | | | | *4 | |
| *1 | Over temperature (setting +2℃ or more) | Internal | | | | | | | |
| *2 | Over cooling (setting -1℃ or less) | Internal | | | | | | | Timer stop. |

*1 Over-heating mark lit




Temperature in the working chamber

*2 Over-cooling mark lit

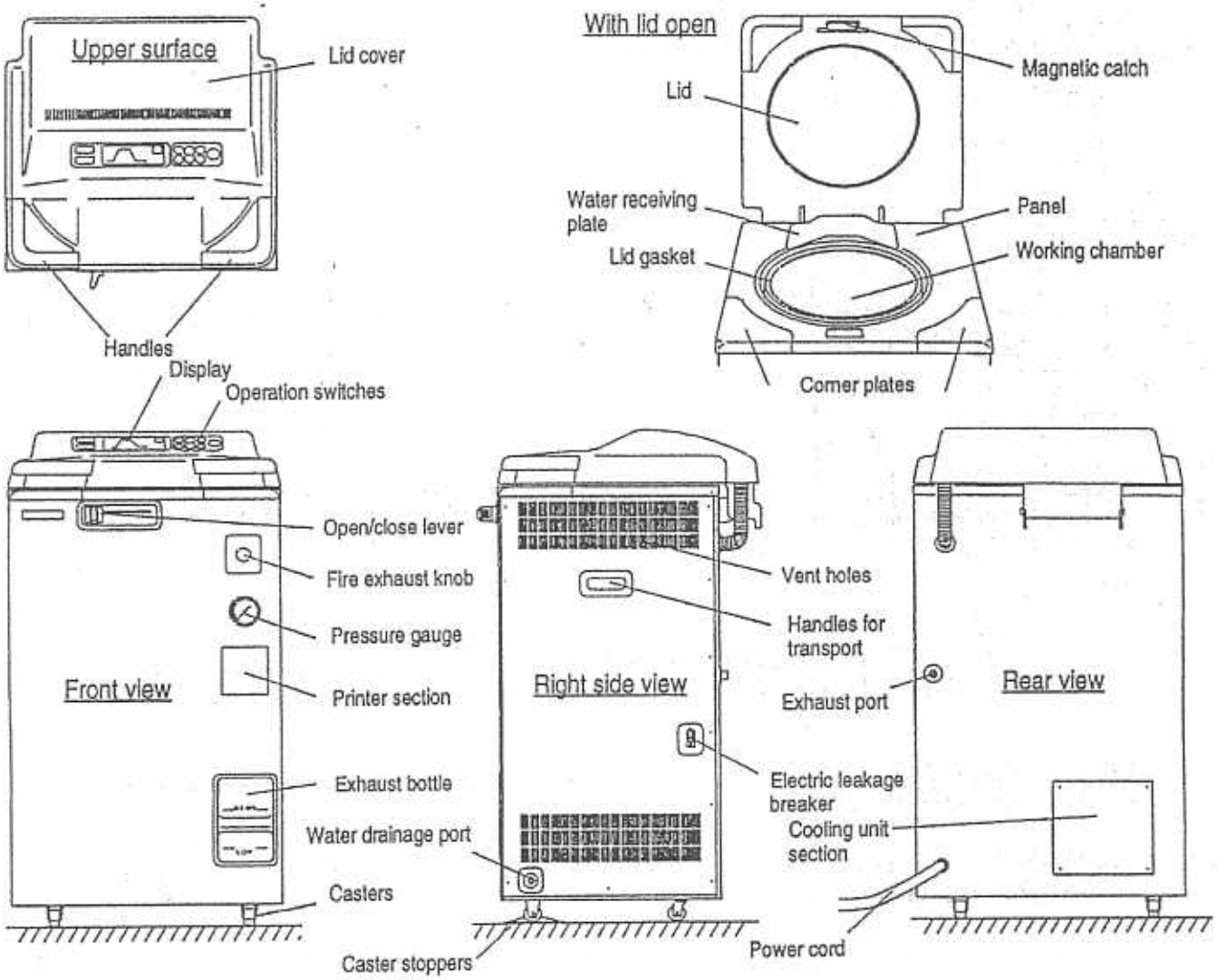



Sterilization timer display

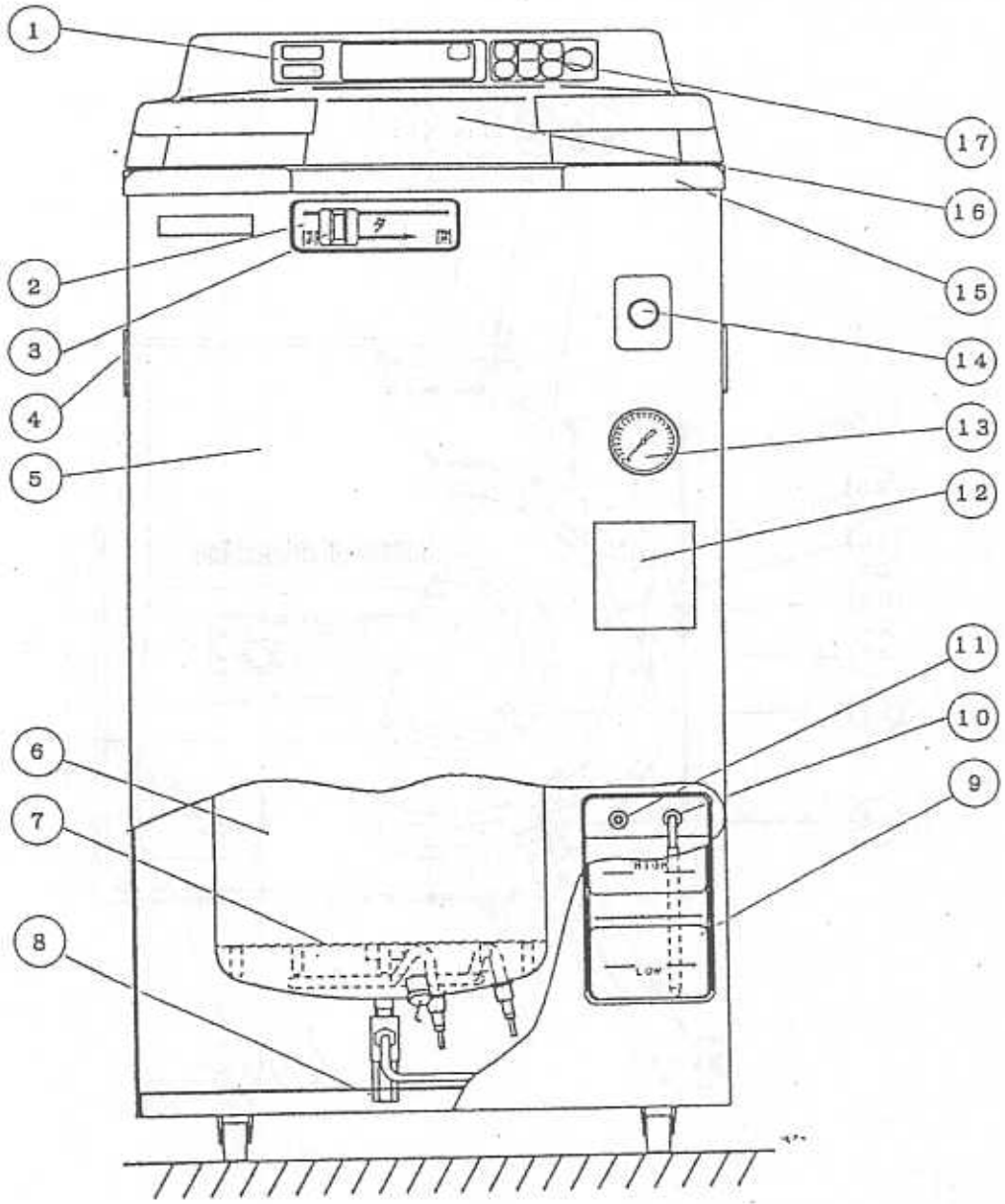
※3 Not detected when the pressure in the working chamber falls to 0.1 kgf/cm$^2$ and the temperature in the working chamber falls to 79°C.

※4 Not detected when the pressure in the working chamber falls to 0.1 kgf/cm$^2$ and the temperature in the working chamber falls to 97°C.

## External Appearance



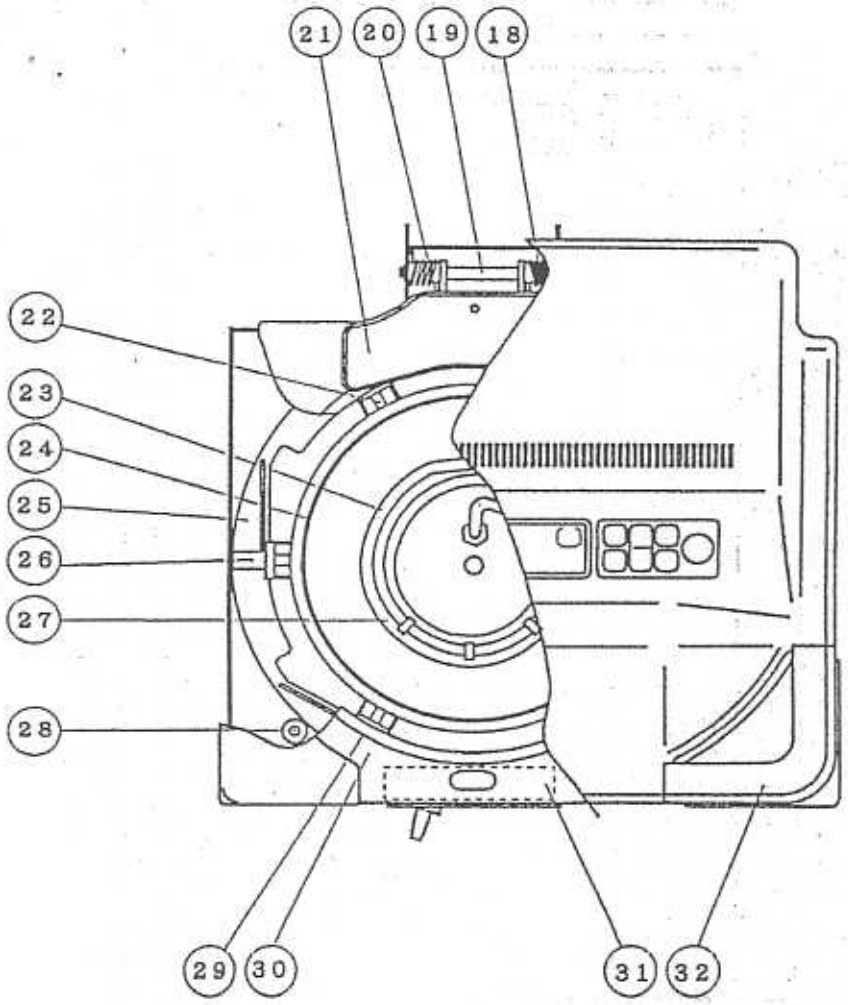
## ● Assembly Diagram (Front)




| Code | Part name |
|---|---|
| 9 | Exhaust bottle |
| 8 | Special plate |
| 7 | Bottom plate |
| 6 | Working chamber |
| 5 | Body |
| 4 | Transporting handles |
| 3 | Open/close lever |
| 2 | Knob case |
| 1 | Display |

| Code | Part name |
|---|---|
| 17 | Operation switches [SW] |
| 16 | Lid cover |
| 15 | Corner plate |
| 14 | Fire exhaust knob |
| 13 | Pressure gauge [P] |
| 12 | Printer plate |
| 11 | Bottle connection gasket B |
| 10 | Bottle connection gasket A |
| | |

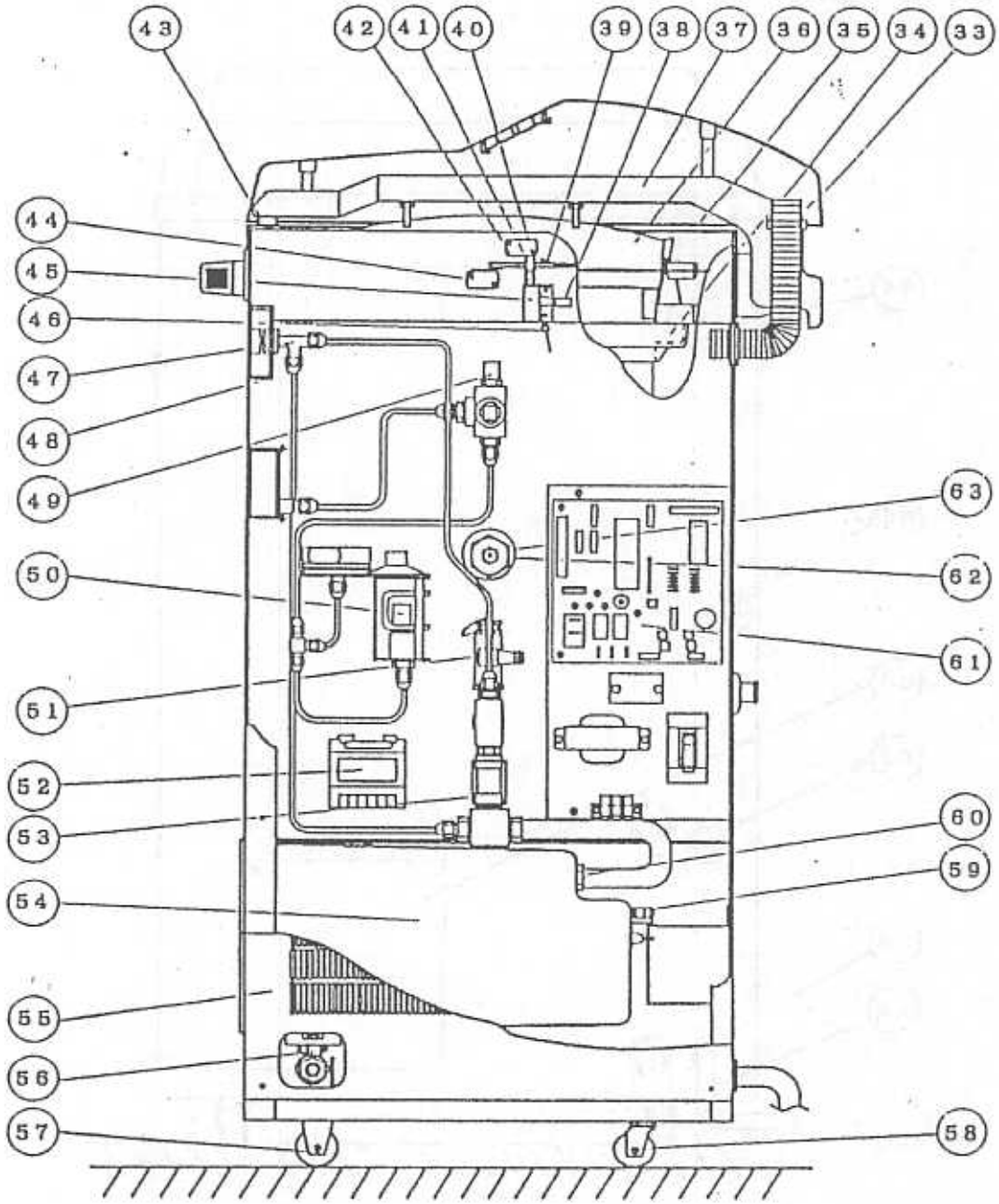
## Assembly Diagram (Top)




| Code | Part name |
|---|---|
| 25 | Surrounding plate |
| 24 | Lid gasket |
| 23 | Heater [H] |
| 22 | Pin |
| 21 | Water receiving plate |
| 20 | Right lid spring |
| 19 | Hinge axis |
| 18 | Left lid axis |

| Code | Part name |
|---|---|
| 32 | Handle |
| 31 | Reinforcement fixture |
| 30 | Top panel |
| 29 | Panel gasket |
| 28 | Bearing |
| 27 | Lack-of-water prevention device (temperature sensor part) |
| 26 | Pin guide |

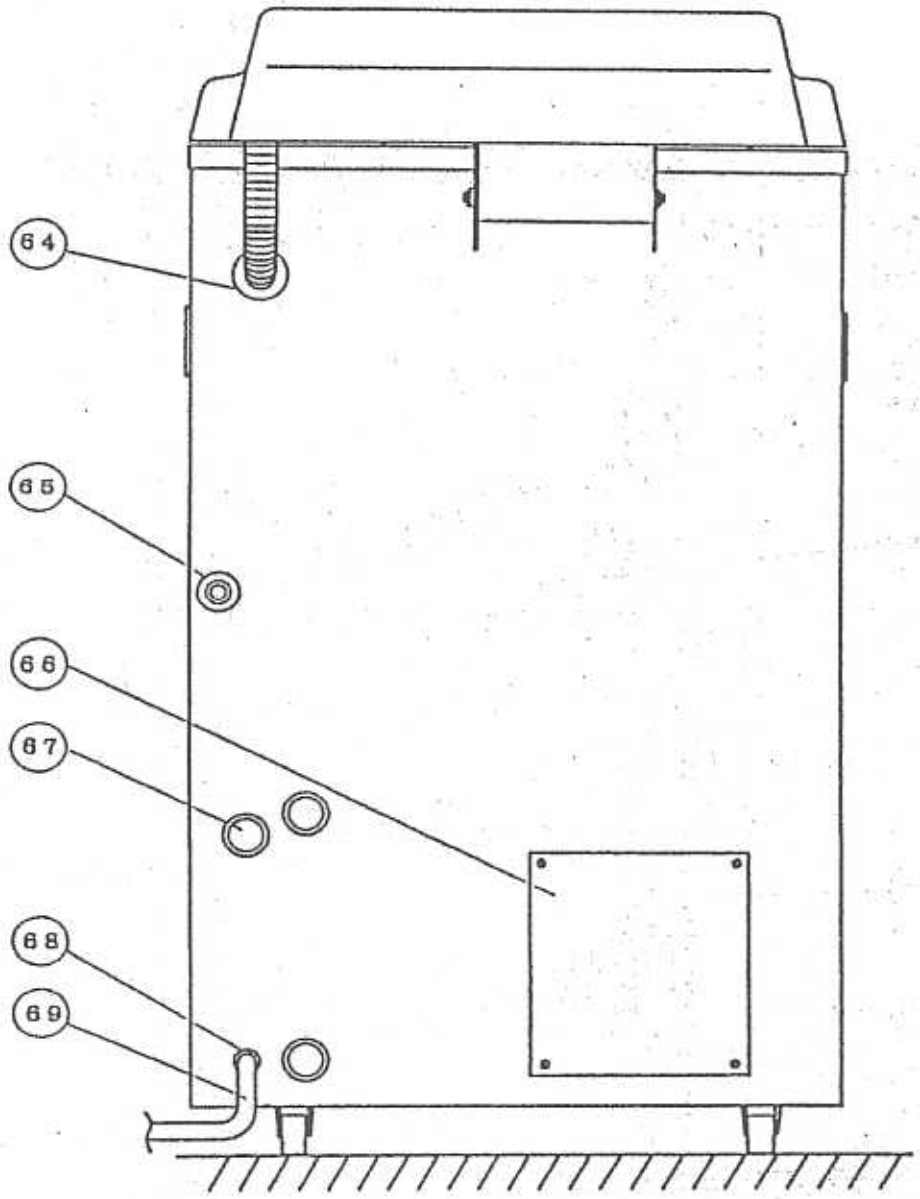
## Assembly Diagram (Right)




| Code | Part name |
|---|---|
| 47 | Fire exhaust knob |
| 46 | Diode [D] |
| 45 | Solenoid [SL] |
| 44 | Limit switch [LSW1] |
| 43 | Magnetic catch |
| 42 | Solenoid spring |
| 41 | Plunger |
| 40 | Limit switch [LSW2] |
| 39 | Lock plate |
| 38 | Electrolytic condenser [C1] |
| 37 | Lid holder |
| 36 | Lid |
| 35 | Lid bottom cover |
| 34 | Water resistant gasket |
| 33 | Duct |

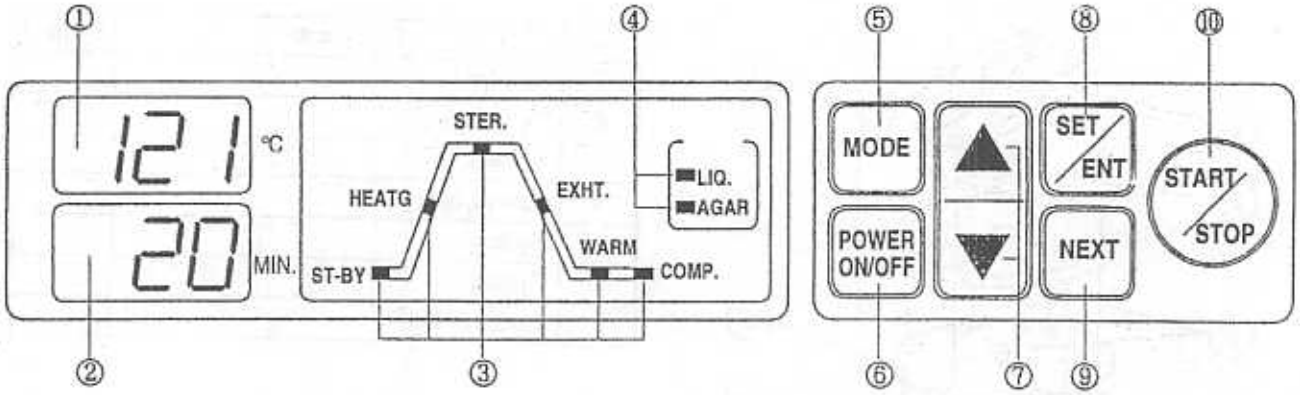
| Code | Part name |
|---|---|
| 63 | Sensor joint |
| 62 | Temperature sensor for control [S1] |
| 61 | Switchboard |
| 60 | Bottle connection hose port |
| 59 | Limit switch [LSW3] |
| 58 | Free-moving caster |
| 57 | Fixed caster |
| 56 | Drain valve |
| 55 | Side plate |
| 54 | Exhaust bottle case |
| 53 | Solenoid-controlled valve [SV] |
| 52 | Transformer |
| 51 | Safety valve |
| 50 | Over-pressurization prevention switch [PSW1] |
| 49 | Check valve |
| 48 | Exhaust valve holder |

## Assembly Diagram (Back)




| Code | Part name |
|---|---|
| 69 | Power cord |
| 68 | Plastic bushing |
| 67 | Grommet with membrane |
| 66 | Blank cover |
| 65 | Grommet (for exhaust) |
| 64 | Grommet |

● Detailed Display and Operation Switch Diagram




① Digital display
- Temperature – L1, L2, L3

② Digital display
- Time – L4, L5, L6

③ Step display
- **ST-BY** □ – L7
- **HEATG** □ – L8
- **STER.** □ – L9
- **EXHT** □ – L10
- **WARM** □ – L11
- **COMP.** □ – L12

④ Mode display
- **LIQ.** □ – L13
- **AGAR** □ – L14

⑤ Mode switch

⑥ Power ON/OFF switch

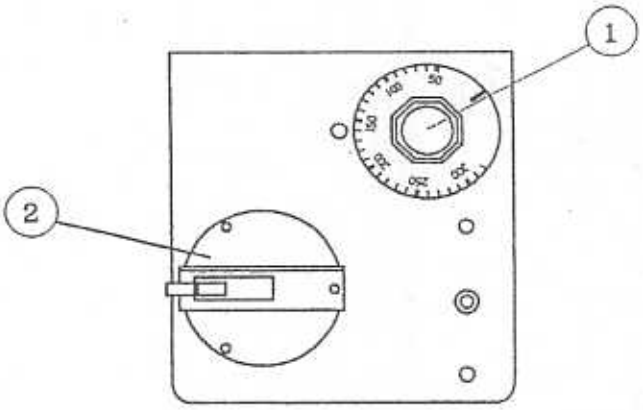
⑦ Setting value increase/decrease switches (▲, ▼)

⑧ SET/ENT switch

⑨ NEXT switch

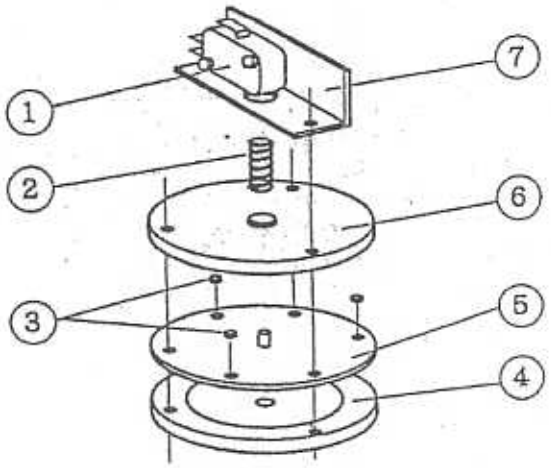
⑩ START/STOP switch

● Diagram of Over-pressurization Prevention Switch Area



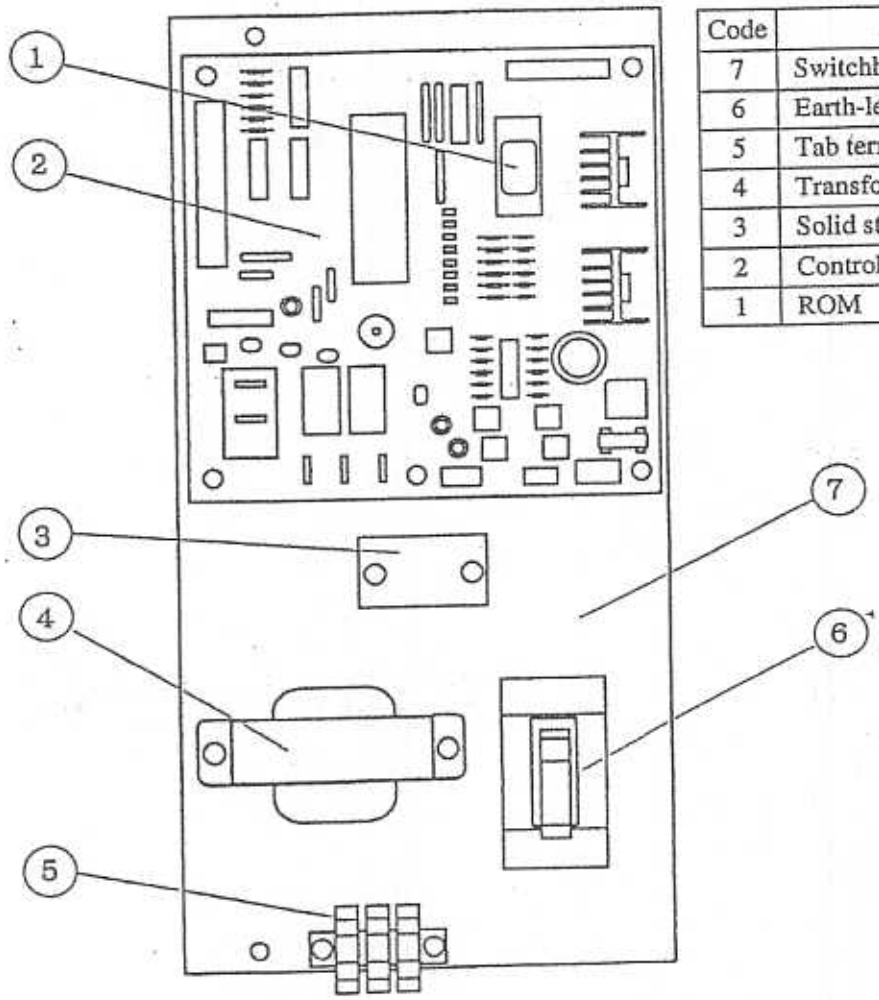

| Code | Part name | Symbol |
|---|---|---|
| 2 | Atmospheric pressure switch | PSW2 |
| 1 | Lack-of-water prevention device | EGO |

## Atmospheric Pressure Switch Diagram



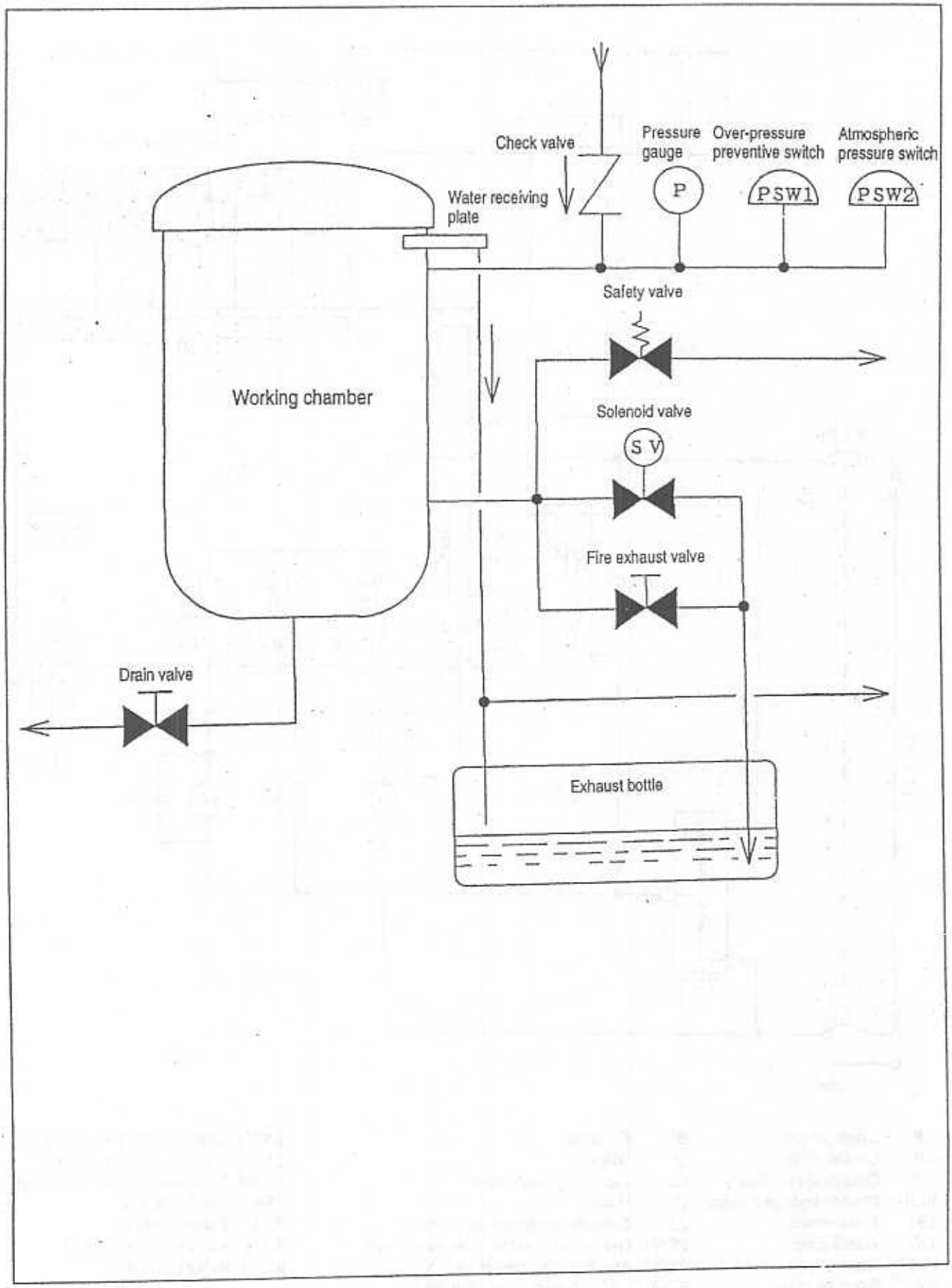

| Code | Part name | Symbol |
|---|---|---|
| 7 | Holder | |
| 6 | Upper case | |
| 5 | Gasket | |
| 4 | Lower case | |
| 3 | Spacer | |
| 2 | Spring | |
| 1 | Limit switch | |

## Switchboard Diagram

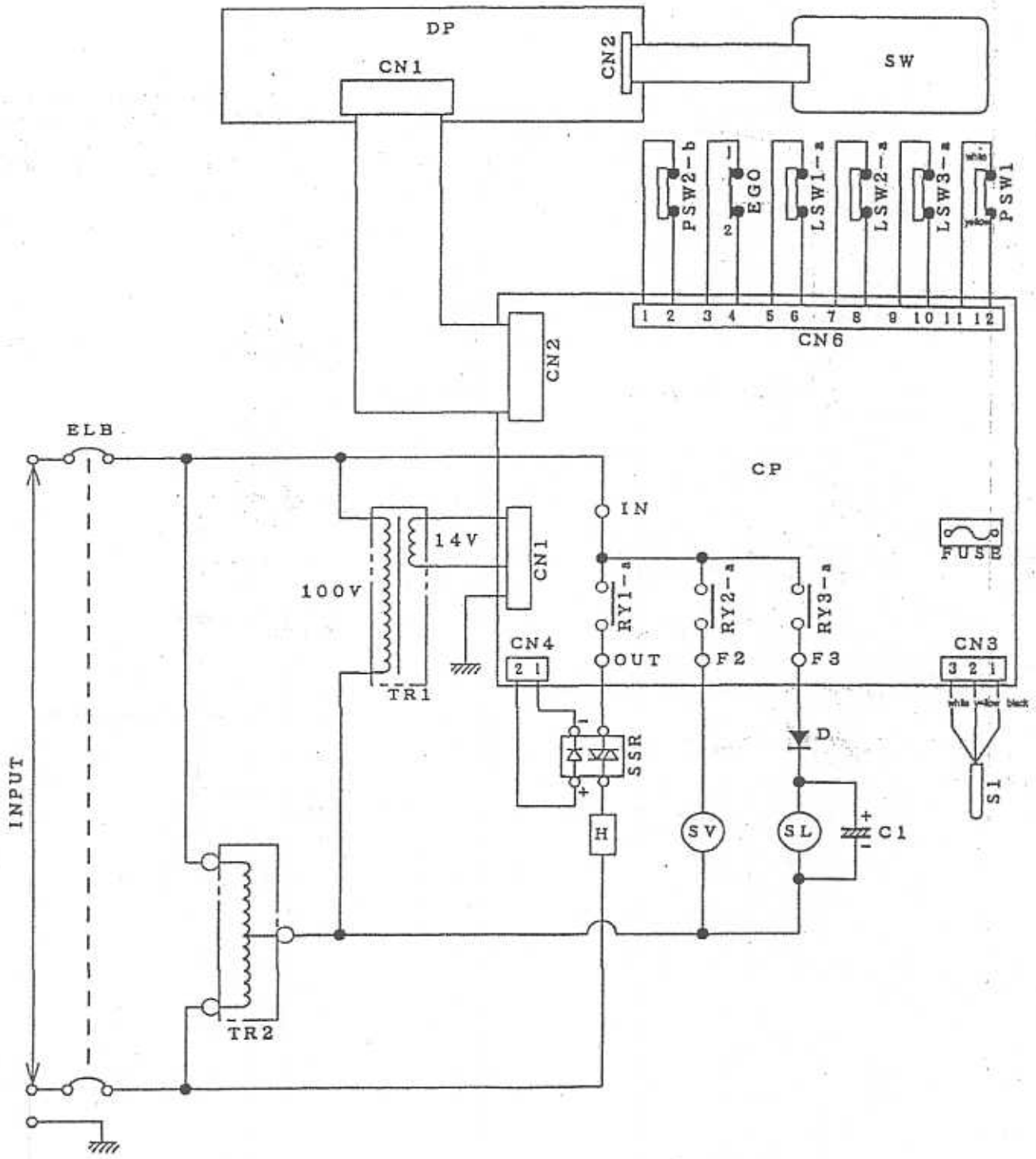



| Code | Part name | Symbol |
|---|---|---|
| 7 | Switchboard chassis | |
| 6 | Earth-leakage circuit breaker | ELB |
| 5 | Tab terminals | |
| 4 | Transformer | TR |
| 3 | Solid state relay | SSR |
| 2 | Control PCB | CP |
| 1 | ROM | |

## ● Piping Diagram



## Wiring Diagram




| | | | | | |
|---|---|---|---|---|---|
| DP | Display PCB | SL | Solenoid | LSW1 | Limit switch (lever open/close) |
| CP | Control PCB | D | Diode | LSW2 | Limit switch (lever lock) |
| SW | Operation switches | C1 | Electrolytic condenser | LSW3 | Limit switch (Bottle housing) |
| ELB | Electric leakage breaker | H | Heater | SSR | Solid state relay |
| TR1 | Transformer | S1 | Temperature sensor for control | RY1 | Relay (heater) |
| TR2 | Transformer | PSW1 | Over pressurization prevention switch | RY2 | Relay (Solenoid valve) |
| FUSE | Fuse | PSW2 | Atmospheric pressure switch | RY3 | Relay (solenoid) |
| SV | Solenoid valve | EGO | Lack-of-water prevention device | | |

## ● Connector Table

### • Control PCB

| | Connect-or No. | Terminal No. | Terminal function | Connected part | Connected part function |
|---|---|---|---|---|---|
| Power supply input | CN1 | 1 | AC14V input | TR1 transformer | PCB power supply |
| | | 2 | AC14V input | | |
| | | 3 | GND | | |
| Display PCB input and output | CN2 | 1-26 | LED output<br>Operation switch input | DP display PCB | LED lighting<br>Operations switch operations |
| Temperature input | CN3 | 1 | High temperature side Thermistor input | Temperature sensor S1 for control | Detects temperature in working chamber |
| | | 2 | Low temperature side Thermistor input | | |
| | | 3 | Common | | |
| External output | CN4 | 1 | Output (-) | SSR<br>Solid state relay | H<br>Heater control |
| | | 2 | +5 V | | |
| External output | CN5 | 1 | +12 V | None | |
| | | 2 | Output (-) | | |
| | | 3 | Output (-) | | |
| | | 4 | Output (-) | | |
| External input | CN6 | 1 | +12 V | PSW<br>Atmospheric pressure switch | 0 kgf/cm² detection |
| | | 2 | Input | | |
| | | 3 | +12 V | EGO<br>Lack-of-water prevention device | Lack-of-water detection |
| | | 4 | Input | | |
| | | 5 | +12 V | LSW1 Limit switch | Lever open/close detection |
| | | 6 | Input | | |
| | | 7 | +12 V | LSW2<br>Limit switch | Lever lock detection |
| | | 8 | Input | | |
| | | 9 | +12 V | LSW3<br>Limit switch | Exhaust bottle housing detection |
| | | 10 | Input | | |
| | | 11 | +12 V | PSW1<br>Over-pressure prevention switch | Over-pressure detection |
| | | 12 | Input | | |

### • Display PCV

| | Connect-or No. | Terminal No. | Terminal function | Connected part | Connected part function |
|---|---|---|---|---|---|
| Control PCB input and output | JN2 | 1 - 26 | LED output<br>Operation switch input | CP<br>Control PCB | LED control<br>Detection of operation switch operations |
| Operation switch input | JN3 | 1 - 8 | Operation switch input | SW<br>Operation switch | Operation switch operations |

# Chapter 4. Operation Check Procedure

● HVE series autoclaves contain a check program to ensure that the electronic parts operate properly.

## 1. Check Program Outline

"c1": Display PCB check ..... Checks LED lighting on the display PCB
"c2": Operation switch check ..... Checks input of operation switches
"c3": Relay operation check ..... Checks operation of relays (RY1, RY2, RY3), solenoid valves, and solenoids
"c4": External output check ..... Checks operation of CN5 connector connecting part
"c5": External input check ..... Checks operation of lack-of-water prevention device and each microswitch.
"c6": Temperature sensor check1 ..... Checks input of temperature sensor used for control (thermistor low temperature side)
"c7": Temperature sensor check2 ..... Checks input of temperature sensor used for control (thermistor high temperature side)
"c8": Check program termination acknowledgment ..... Choose whether to restart the check program or go to the standby state.

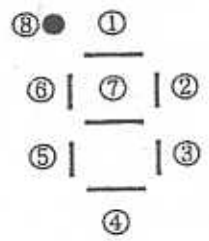
## 2. Check Program Startup

① Press the POWER ON/OFF switch to extinguish the display.
② Simultaneously press the MODE, ▲, and SET/ENT switches.
③ Check program "c1" will startup.

● During check program operation press START/STOP switch to move between items in the sequence shown below.

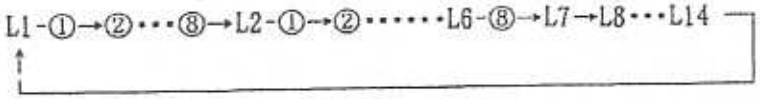
"c1" → "c2" → "c3" ... "c8" → "c1"

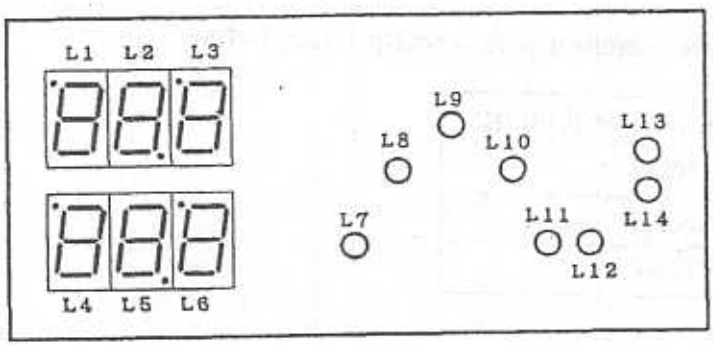
The 7 segment LEDs will light in order.




## 3. Check Programs

● **c1: Display PCB check**
"c1" will be displayed in L1 and L2 for 2 seconds
▼
All LEDs on the display PCB will light (2.5 seconds)
▼
The LED will light in the following sequence



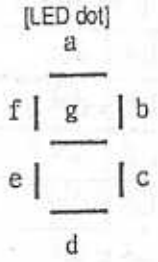




## ● c2: Operation switch check

"**c2**" will be displayed in L2 and L3

▼

When an operation switch is pressed the corresponding 7 segment LED dot will light (excluding the START/STOP switch).




| Operation switch | Lit up dot |
|---|---|
| [MODE] | L4 a dot |
| [ ▲ ] | L5 a dot |
| [SET/ENT] | L6 a dot |
| [FUNC.] | L4 d dot |
| [ ▼ ] | L5 d dot |
| [NEXT] | L6 d dot |

## ● c3: Relay Operation check

"**c3**" will be displayed in L2 and L3

▼

The relay corresponding to the operation switch will move.

| Operation switch | Moving part-1 | Moving part-2 |
|---|---|---|
| [SET/ENT] | RY1 (Relay 1) | H Heater |
| [ ▲ ] | CN4 (SSR) | |
| [MODE] | RY2 (Relay 2) | SV Solenoid valve |
| [NEXT] | RY3 (Relay 3) | SL Solenoid |

### ● c4: External output check

"**c4**" will be displayed in L2 and L3

▼

The CN5 connector corresponding to the operation switch will produce output.

| Operation switch | CN5 connector external output |
|---|---|
| [SET/ENT] | CN5-2 |
| [▲] | CN5-3 |
| [MODE] | CN5-4 |

### ● c5: External input check

"**c5**" will be displayed in L2 and L3

▼

The dots of the 7 segment LED will light according to each input of CN6-2, -4, -6, -8, -10, -12, and CN3.

| External input | Lit up dot |
|---|---|
| PSW2 Atmospheric pressure switch | L4 a dot |
| Lack of water prevention device | L5 a dot |
| Limit switch (lever open/close detection) | L6 a dot |
| Limit switch (lever lock detection) | L4 g dot |
| Limit switch (Exhaust bottle set detection) | L5 g dot |
| Over-pressurization prevention switch | L6 g dot |
| Temperature sensor for control (disconnection detection) | L4 d dot |

### ● c6: Temperature sensor for control check

"**c6**" will be displayed in L2 and L3

▼

When the temperature in the working chamber is 25°C:"**26**" is displayed in L4 – 6
When the temperature in the working chamber is 80°C: "**255**" is displayed in L4 – 6

### ● c7: Temperature sensor for control check (thermistor high temperature side)

"**c7**" will be displayed in L2 and L3

▼

When the temperature in the working chamber is 25°C:"**0**" is displayed in L4 – 6
When the temperature in the working chamber is 121°C: "**176**" is displayed in L4 – 6

### ● c8: Check program termination acknowledgment

"**c8**" will be displayed in L2 and L3

▼

- Pressing the POWER ON/OFF switch will terminate the check program and bring the equipment into the standby state.
- Pressing the START/STOP switch will return the equipment to "**c1**: Display PCB check."

## ● Reference Table for Temperature Sensor Used for Control

(Low temperature side: between white and yellow for temperature sensor)

| Temperature (°C) | Thermistor resistace value (kΩ) | AN0~0V voltage (V) | Check program display value | Reference HEX value |
|---|---|---|---|---|
| 0 | 329.4 | .342 | 17 | 11H |
| 1 | 312.7 | .373 | 19 | 13H |
| 2 | 297.0 | .406 | 20 | 14H |
| 3 | 282.2 | .439 | 22 | 16H |
| 4 | 268.2 | .474 | 24 | 18H |
| 5 | 255.0 | .510 | 26 | 1AH |
| 6 | 242.5 | .547 | 27 | 1BH |
| 7 | 230.6 | .586 | 29 | 1DH |
| 8 | 219.5 | .625 | 31 | 1FH |
| 9 | 208.9 | .666 | 33 | 21H |
| 10 | 198.9 | .708 | 36 | 24H |
| 11 | 189.4 | .751 | 38 | 26H |
| 12 | 180.5 | .796 | 40 | 28H |
| 13 | 172.0 | .842 | 42 | 2AH |
| 14 | 164.0 | .889 | 45 | 2DH |
| 15 | 156.3 | .937 | 47 | 2FH |
| 16 | 149.1 | .986 | 50 | 32H |
| 17 | 142.3 | 1.037 | 52 | 34H |
| 18 | 135.8 | 1.089 | 55 | 37H |
| 19 | 129.6 | 1.142 | 58 | 3AH |
| 20 | 123.8 | 1.197 | 61 | 3DH |
| 21 | 118.2 | 1.252 | 63 | 3FH |
| 22 | 112.9 | 1.309 | 66 | 42H |
| 23 | 107.9 | 1.366 | 69 | 45H |
| 24 | 103.2 | 1.424 | 72 | 48H |
| 25 | 98.63 | 1.484 | 75 | 4BH |
| 26 | 94.33 | 1.545 | 78 | 4EH |
| 27 | 90.24 | 1.607 | 81 | 51H |
| 28 | 86.35 | 1.670 | 85 | 55H |
| 29 | 82.65 | 1.734 | 88 | 58H |
| 30 | 79.13 | 1.798 | 91 | 5BH |
| 31 | 75.77 | 1.863 | 95 | 5FH |
| 32 | 72.58 | 1.930 | 98 | 62H |
| 33 | 69.53 | 1.996 | 101 | 65H |
| 34 | 66.64 | 2.063 | 105 | 68H |
| 35 | 63.84 | 2.131 | 108 | 6CH |
| 36 | 61.24 | 2.200 | 112 | 70H |
| 37 | 58.73 | 2.269 | 115 | 73H |
| 38 | 56.33 | 2.339 | 119 | 77H |
| 39 | 54.05 | 2.409 | 122 | 7AH |
| 40 | 51.87 | 2.479 | 126 | 7EH |
| 41 | 49.79 | 2.549 | 129 | 81H |
| 42 | 47.80 | 2.620 | 133 | 85H |
| 43 | 45.91 | 2.691 | 137 | 89H |
| 44 | 44.09 | 2.762 | 140 | 8CH |
| 45 | 42.53 | 2.833 | 144 | 90H |
| 46 | 40.71 | 2.904 | 148 | 94H |
| 47 | 39.13 | 2.975 | 151 | 97H |
| 48 | 37.62 | 3.046 | 155 | 9BH |
| 49 | 36.17 | 3.117 | 158 | 9EH |

| Temperature (°C) | Thermistor resistance value (kΩ) | AN0~0V voltage (V) | Check program display value | Reference HEX value |
|---|---|---|---|---|
| 50 | 34.79 | 3.187 | 162 | A2H |
| 51 | 33.47 | 3.257 | 166 | A6H |
| 52 | 32.20 | 3.327 | 169 | A9H |
| 53 | 30.99 | 3.396 | 173 | ADH |
| 54 | 29.83 | 3.465 | 176 | B0H |
| 55 | 28.72 | 3.534 | 180 | B4H |
| 56 | 27.66 | 3.602 | 183 | B7H |
| 57 | 26.64 | 3.669 | 187 | BBH |
| 58 | 25.66 | 3.736 | 190 | BEH |
| 59 | 24.73 | 3.802 | 193 | C1H |
| 60 | 23.83 | 3.868 | 197 | C5H |
| 61 | 22.97 | 3.932 | 200 | C8H |
| 62 | 22.15 | 3.997 | 203 | CBH |
| 63 | 21.36 | 4.060 | 207 | CFH |
| 64 | 20.60 | 4.123 | 210 | D2H |
| 65 | 19.87 | 4.184 | 213 | D5H |
| 66 | 19.17 | 4.254 | 216 | D8H |
| 67 | 18.18 | 4.305 | 219 | D8H |
| 68 | 17.86 | 4.363 | 222 | DEH |
| 69 | 17.24 | 4.422 | 225 | E1H |
| 70 | 16.64 | 4.480 | 228 | E4H |
| 71 | 16.07 | 4.536 | 231 | E7H |
| 72 | 15.52 | 4.591 | 234 | EAH |
| 73 | 15.00 | 4.645 | 236 | ECH |
| 74 | 14.49 | 4.699 | 239 | EFH |
| 75 | 14.00 | 4.752 | 242 | F2H |
| 76 | 13.54 | 4.803 | 244 | F4H |
| 77 | 13.09 | 4.853 | 247 | F7H |
| 78 | 12.65 | 4.903 | 250 | FAH |
| 79 | 12.24 | 4.952 | 252 | FCH |
| 80 | 11.83 | 5.000 | 255 | FFH |
| 81 | 11.45 | | | |
| 82 | 11.08 | | | |
| 83 | 10.72 | | | |
| 84 | 10.37 | | | |
| 85 | 10.04 | | | |
| 86 | 9.723 | | | |
| 87 | 9.414 | | | |
| 88 | 9.118 | | | |
| 89 | 8.832 | | | |
| 90 | 8.556 | | | |
| 91 | 8.290 | | | |
| 92 | 8.033 | | | |
| 93 | 7.786 | | | |
| 94 | 7.548 | | | |
| 95 | 7.317 | | | |
| 96 | 7.095 | | | |
| 97 | 6.881 | | | |
| 98 | 6.674 | | | |
| 99 | 6.475 | | | |

(High temperature side: between white and black for temperature sensor)

| Temperature (°C) | Thermistor resistance value (kΩ) | AN0~0V voltage (V) | Check program display value | Reference HEX value |
|---|---|---|---|---|
| 70 | 189.2 | | | |
| 71 | 181.9 | | | |
| 72 | 175.0 | | | |
| 73 | 168.3 | | | |
| 74 | 162.0 | | | |
| 75 | 155.9 | .278 | 14 | EH |
| 76 | 150.0 | .327 | 17 | 11H |
| 77 | 144.4 | .376 | 19 | 13H |
| 78 | 139.1 | .425 | 22 | 16H |
| 79 | 133.9 | .477 | 24 | 18H |
| 80 | 129.0 | .530 | 27 | 1BH |
| 81 | 124.3 | .583 | 30 | 1EH |
| 82 | 119.8 | .638 | 33 | 21H |
| 83 | 115.4 | .694 | 36 | 24H |
| 84 | 111.3 | .751 | 38 | 26H |
| 85 | 107.3 | .807 | 41 | 29H |
| 86 | 103.4 | .867 | 44 | 2CH |
| 87 | 99.75 | .927 | 47 | 2FH |
| 88 | 96.22 | .988 | 51 | 33H |
| 89 | 92.83 | 1.049 | 54 | 36H |
| 90 | 89.58 | 1.112 | 57 | 39H |
| 91 | 86.45 | 1.176 | 60 | 3CH |
| 92 | 83.45 | 1.241 | 64 | 40H |
| 93 | 80.56 | 1.307 | 67 | 43H |
| 94 | 77.79 | 1.373 | 70 | 46H |
| 95 | 75.12 | 1.441 | 74 | 4AH |
| 96 | 72.56 | 1.509 | 77 | 4DH |
| 97 | 70.10 | 1.579 | 81 | 51H |
| 98 | 67.73 | 1.649 | 84 | 54H |
| 99 | 65.45 | 1.719 | 88 | 58H |
| 100 | 63.26 | 1.791 | 92 | 5CH |
| 101 | 61.15 | 1.863 | 95 | 5FH |
| 102 | 59.12 | 1.936 | 99 | 63H |
| 103 | 57.17 | 2.010 | 103 | 67H |
| 104 | 55.29 | 2.084 | 107 | 6BH |
| 105 | 53.48 | 2.159 | 111 | 6FH |
| 106 | 51.74 | 2.235 | 114 | 72H |
| 107 | 50.06 | 2.311 | 118 | 76H |
| 108 | 48.44 | 2.387 | 122 | 7AH |
| 109 | 46.89 | 2.464 | 126 | 7EH |
| 110 | 45.39 | 2.542 | 130 | 82H |
| 111 | 43.94 | 2.619 | 134 | 86H |
| 112 | 42.55 | 2.698 | 138 | 8AH |
| 113 | 41.20 | 2.776 | 142 | 8EH |
| 114 | 39.91 | 2.855 | 146 | 92H |
| 115 | 38.66 | 2.934 | 150 | 96H |
| 116 | 37.45 | 3.013 | 154 | 9AH |
| 117 | 36.29 | 3.092 | 158 | 9EH |
| 118 | 35.17 | 3.171 | 162 | A2H |
| 119 | 34.09 | 3.252 | 166 | A6H |

| Temperature (°C) | Thermistor resistance value (kΩ) | AN0~0V voltage (V) | Check program display value | Reference HEX value |
|---|---|---|---|---|
| 120 | 33.04 | 3.331 | 171 | ABH |
| 121 | 32.03 | 3.410 | 175 | AFH |
| 122 | 31.06 | 3.490 | 179 | B3H |
| 123 | 30.12 | 3.570 | 183 | B7H |
| 124 | 29.22 | 3.649 | 187 | BBH |
| 125 | 28.34 | 3.727 | 191 | C7H |
| 126 | 27.50 | 3.807 | 195 | C3H |
| 127 | 26.68 | 3.885 | 199 | C7H |
| 128 | 25.89 | 3.963 | 203 | CBH |
| 129 | 25.13 | 4.042 | 207 | CFH |
| 130 | 24.39 | 4.119 | 210 | D3H |
| 131 | 23.68 | 4.197 | 213 | D7H |
| 132 | 22.99 | 4.273 | 219 | DBH |
| 133 | 22.32 | 4.351 | 223 | DFH |
| 134 | 21.68 | 4.426 | 227 | E3H |
| 135 | 21.06 | 4.503 | 231 | E7H |
| 136 | 20.45 | 4.578 | 234 | EAH |
| 137 | 19.87 | 4.652 | 238 | EEH |
| 138 | 19.31 | 4.726 | 242 | F2H |
| 139 | 18.79 | 4.800 | 246 | F6H |
| 140 | 18.23 | 4.876 | 250 | FAH |
| 141 | 17.72 | 4.945 | 253 | FDH |
| 142 | 17.23 | 5.000 | 255 | FFH |
| 143 | 16.75 | | | |
| 144 | 16.29 | | | |
| 145 | 15.84 | | | |
| 146 | 15.40 | | | |
| 147 | 14.98 | | | |
| 148 | 14.57 | | | |
| 149 | 14.18 | | | |