Class B Steam Sterilizer
Technical Manual

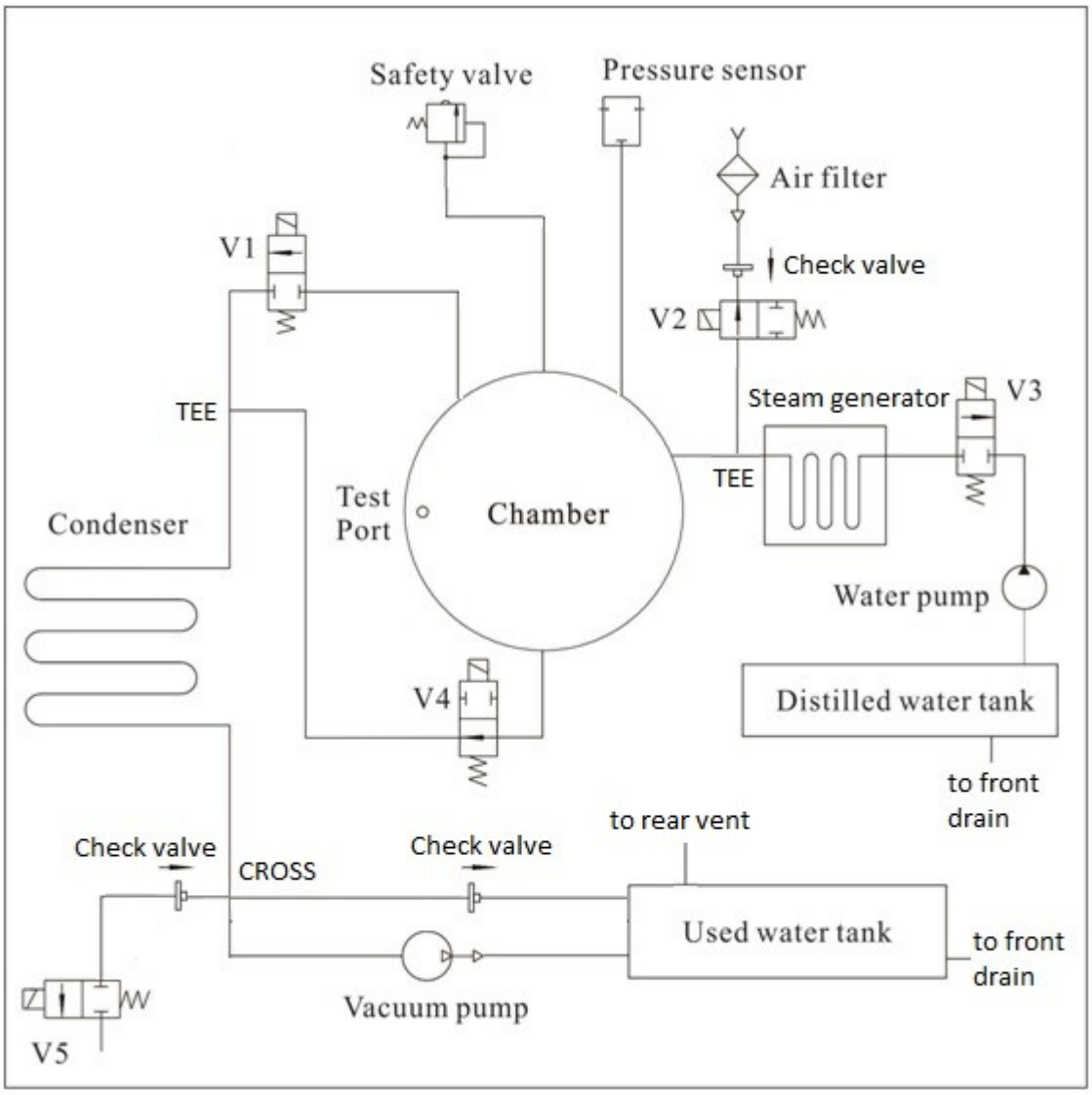
Model Clave B

Distributed by

FLIGHT DENTAL SYSTEMS

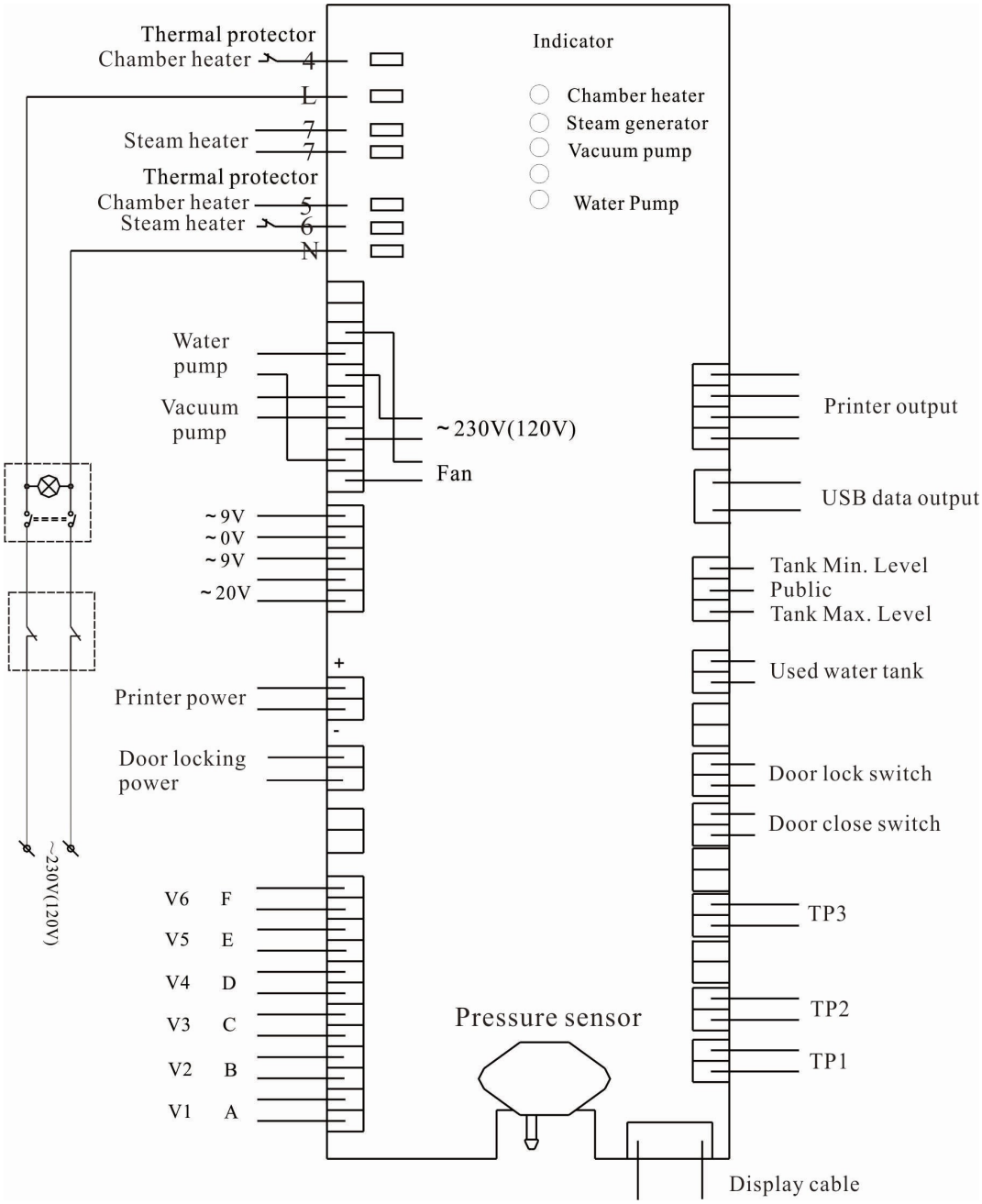
1. Working process

1.1 Hydraulic drawing



V1: Steam release valve (Normally closed) P/N 90012025
V2: Air filter valve (Normally open) P/N 90012077
V3: Pump valve (Normally closed) P/N 90012025
V4: Water release valve (Normally open) P/N 90012077
V5: Vacuum pump valve (Normally closed) P/N 90012025

1.2 Electrical drawing

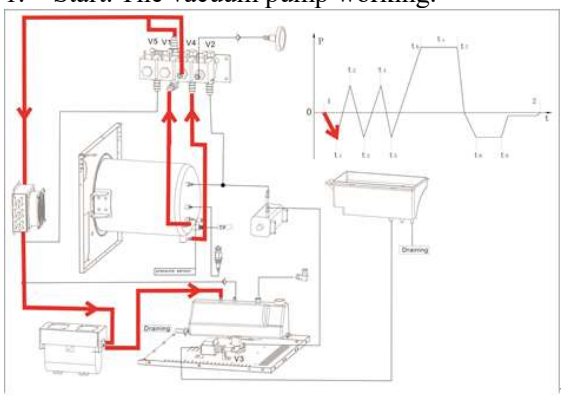


TP1: Steam generator temperature sensor
TP2: Inner temperature sensor
TP3: Chamber wall temperature sensor

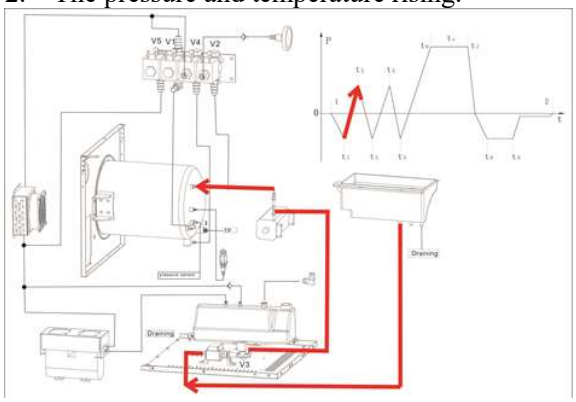
V1: Steam release valve
V2: Air filter valve
V3: Pump valve
V4: Water release valve
V5: Vacuum pump valve
V6: Vacuum pump fan

1.3 Working process

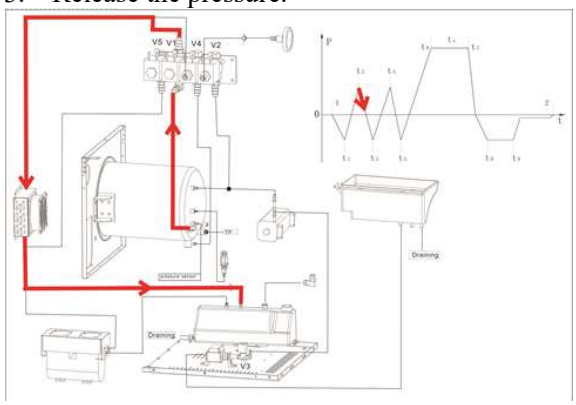
1. Start. The vacuum pump working.



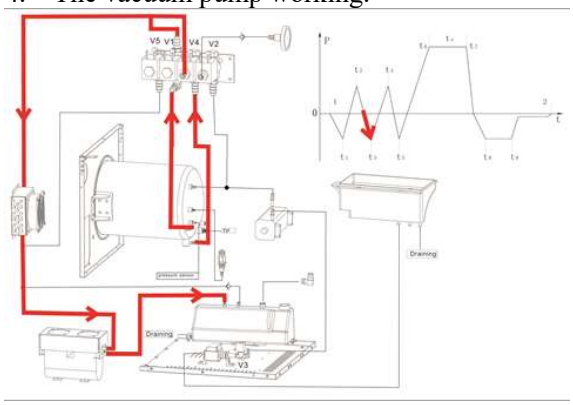
2. The pressure and temperature rising.



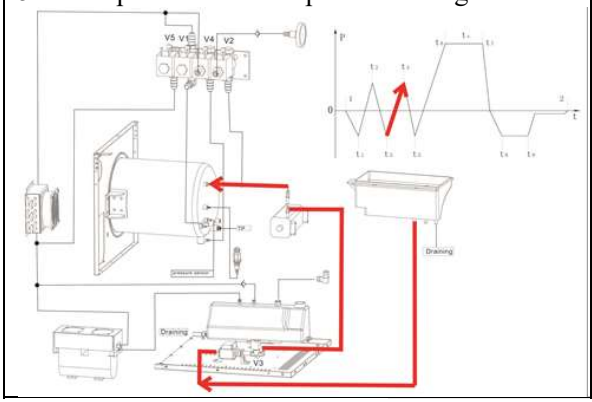
3. Release the pressure.



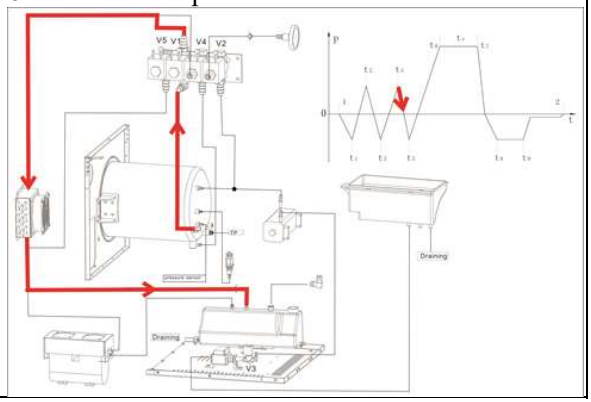
4. The vacuum pump working.



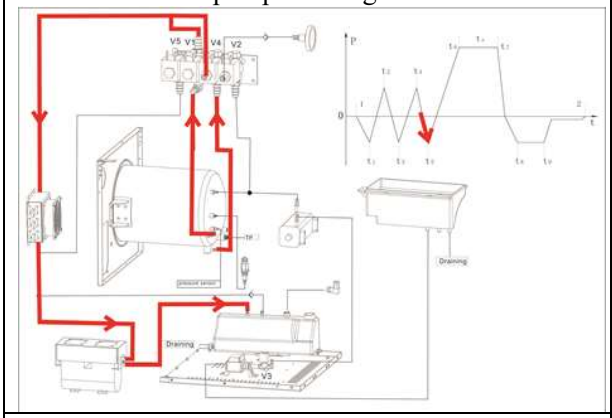
5. The pressure and temperature rising.



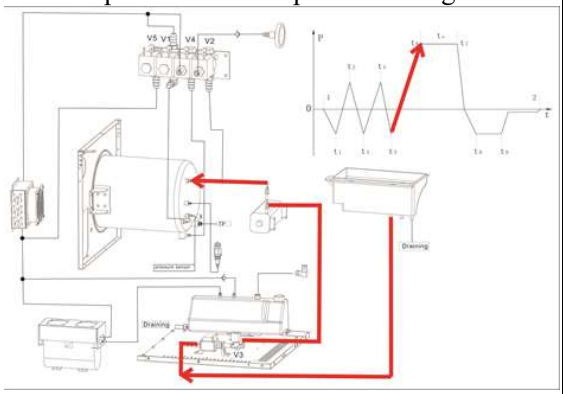
6. Release the pressure.



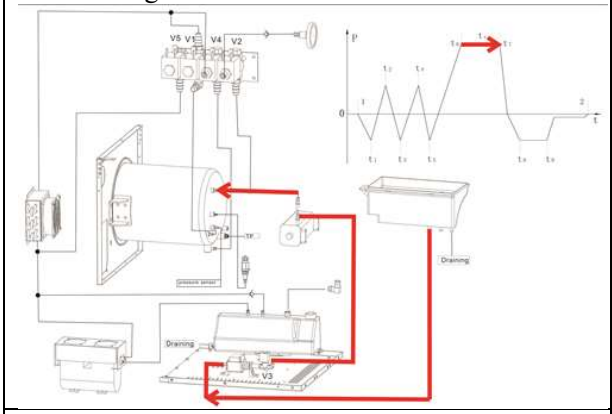
7. The vacuum pump working.



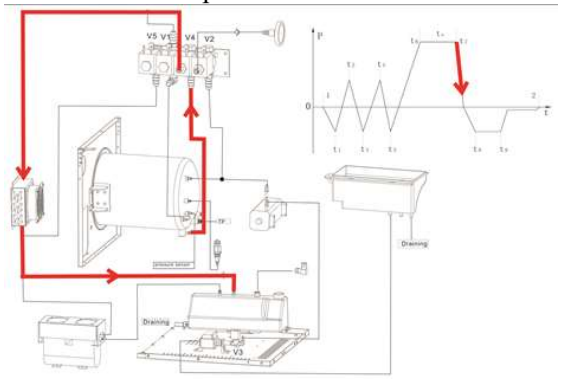
8. The pressure and temperature rising.



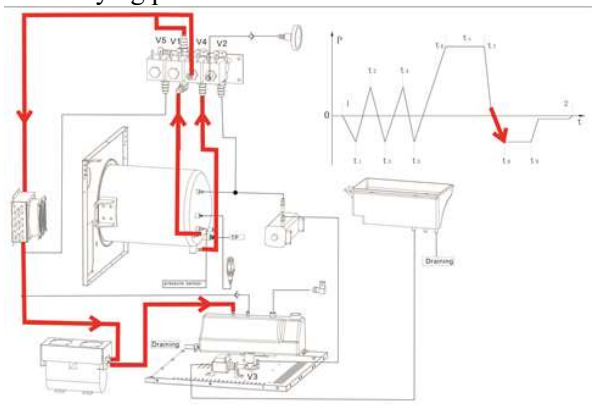
9. Holding time



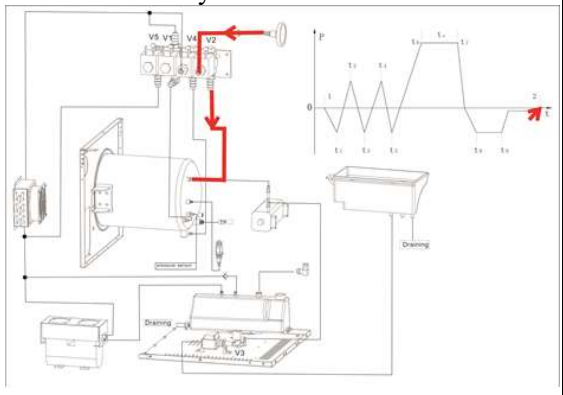
10. Release the pressure



11. Drying period



12. Finish the cycle



2. Malfunction

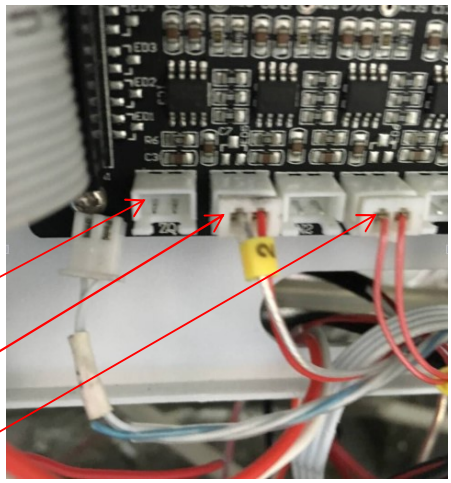
2.1 E1, E2, E3

Alarm condition:

E1: the temperature of the steam generator is higher than 230℃ or the cable is disconnected.

E2: the temperature of the chamber sensor is higher than 140℃ or the cable is disconnected.

E3: the temperature of the chamber wall is higher than 160℃ or the cable is disconnected.



Steam generator sensor

Inner chamber sensor

Outer chamber wall sensor

Case 1. The sensor cable is disconnected, or the sensor doesn't work.

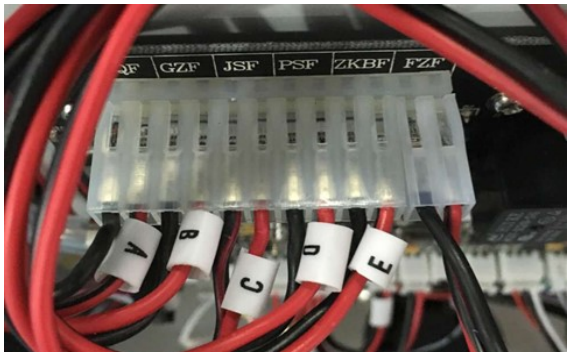
Solution: Check the cable connector on the mainboard. Measure the resistance of the sensor. The resistance should be 1000Ω to 1900Ω. If the value is out of that range, it means the cable is broken or the sensor is defective. Sometimes when the machine starts to work, it may alarm. But, if after measuring the resistance, the value is normal, the sensor still needs to be replaced.

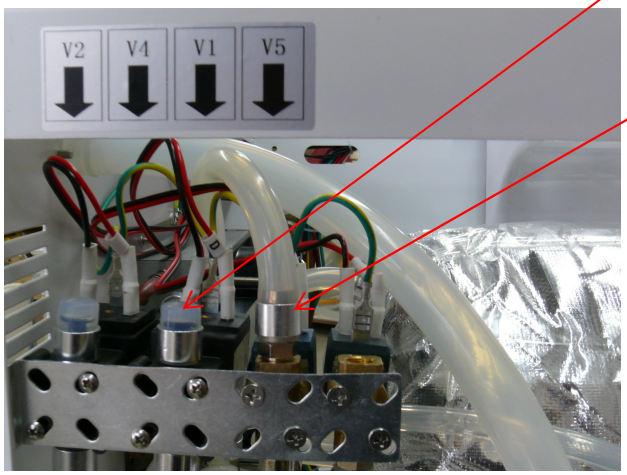
Case 2.The sensor doesn't make good contact with the steam generator

Solution: Check the sensor assembly. Fix it tightly to the steam generator.

2.2 E5

Alarm condition:
Failure to release pressure in 5 minutes or it is over-pressured.
Caution: Please do not try to open the door before the pressure is zero. Wait for the chamber to cool down and the pressure reaches zero. Or carefully pull out the ring of the safety valve to release the pressure.
Case 1: There are too many instruments inside the chamber.
Solution: Make sure it isn't overloaded and try it again.
Case 2: V1 didn't work.
The V1 (A) opens (with power applied) to release the pressure at the period of t5-t7
Solution: Replace the defective solenoid valve.





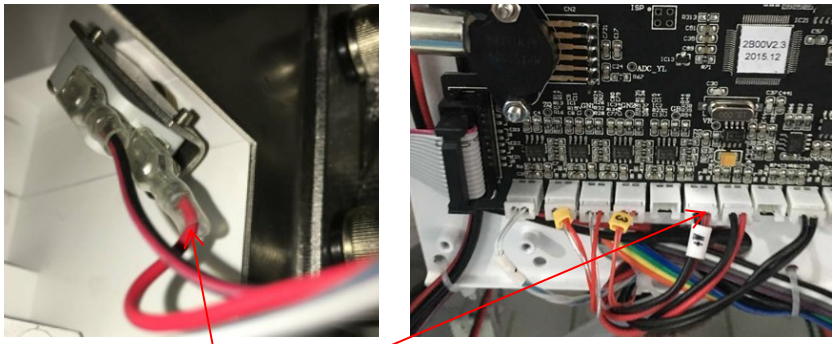
Water release valve V4 (D)

Steam release valve V1 (A)

2.3 E6

Alarm condition: The door close switch is disconnected during a cycle.

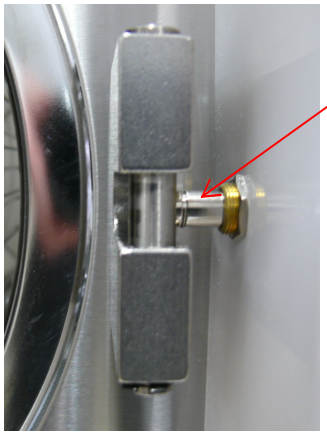
Clave B



Door switch cable

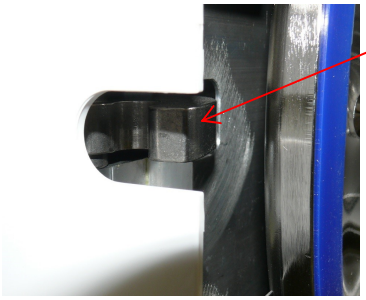
Case 1：The door switch cable is disconnected. Check the connector on the mainboard and the switch.

Case 2: 2.1 The door switch piston does not connect well with the door lock claw. Adjust the position of the switch (for Clave B).

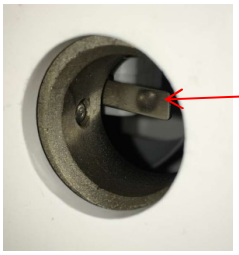


Actuator of the push button micro switch

Door lock claw



2.2 The door slide does not connect well with the door close switch. Adjust the lever of the micro switch; bend the lever to make the door slide connect well after the door is closed (for model C).

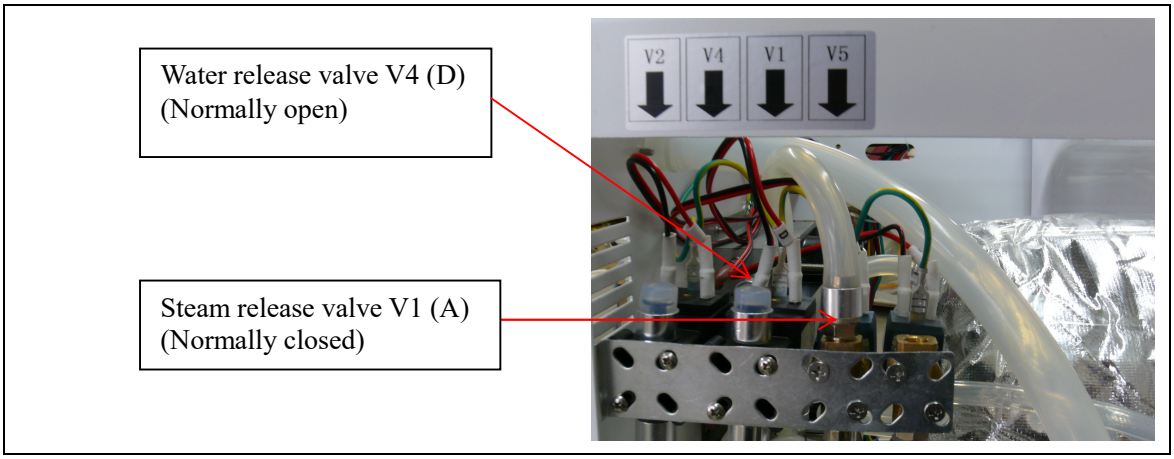


Door switch pole

2.4 E9

Alarm condition: In the holding time phase, the inner temperature is lower than the pre-setting temperature (lower than 134℃ for 134℃ program or lower than 121℃ for 121℃program). That means the steam inside the chamber is not enough to hold the requested temperature. There are many possibilities that can cause this problem: such as temperature deviation, problem of closed or stuck valve, steam generator not working properly, leak, etc.

Case 1: It continues to release the pressure during the holding time.
Solution: Adjust the temperature deviation.
Case 2: Check the water release valve V4 (D) and air release valve V1 (A). Check if they close completely. Refer to E24 case 3.

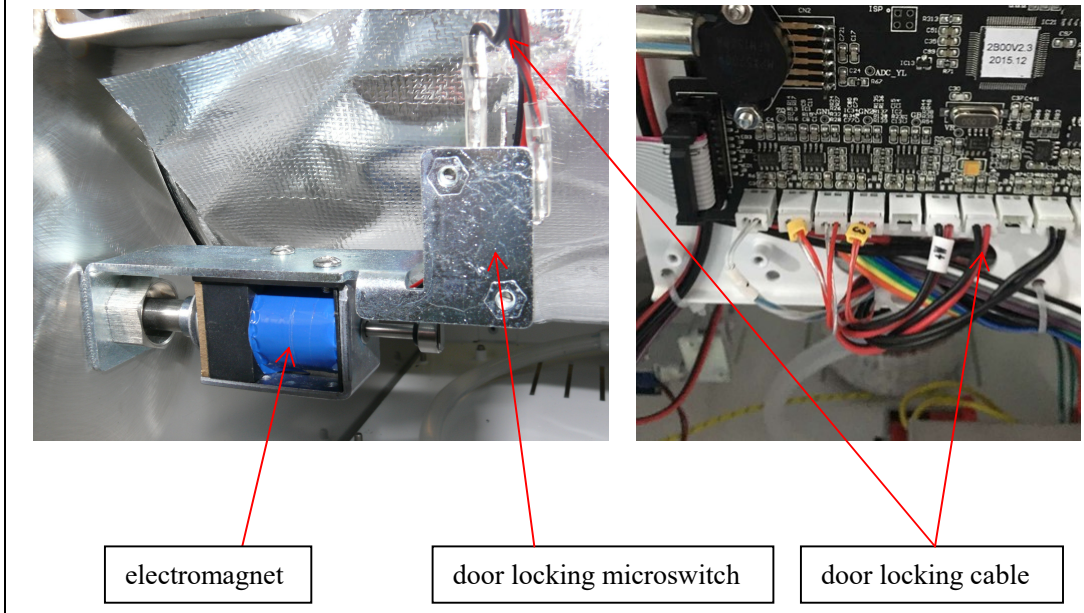


Case 3: There is a leak somewhere.
Solution：Check the chamber tube connections; the tubes connected to the chamber, the solenoid valve connected to the chamber. Refer to E24 case 3.

Case 4: The steam generator doesn't work properly.
Solution: Refer to E24 case 4.

2.5 E10

Alarm condition: The door locking system doesn't work. The door lock switch gives the wrong signal. That means the signal should be closed (zero ohms) when the door is locked.
The signal should be open (infinite ohms) when the door lock is released.
Solution: Check if the door locking cable is disconnected or broken.
Check if the door locking switch is defective.
Check the electromagnet. The voltage of electromagnet is 24V DC. It can hold in two positions. The pole pushes out when given a positive voltage and the pole pulls in when given a negative voltage.
NOTICE: The position on the micro switch connection.

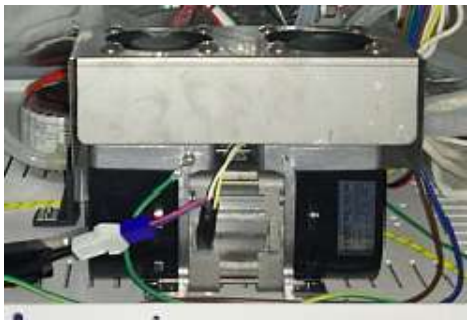


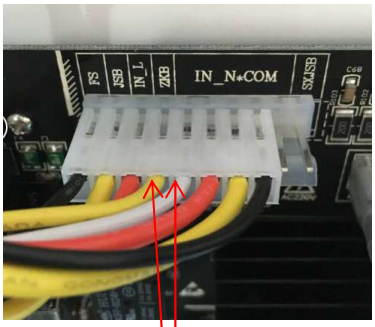
2.6 E13

Alarm condition: The machine fails to vacuum when running a cycle. It only appears at the vacuuming phase. The pressure can't reach lower than -30kPa.

Principle of vacuum phase: the vacuum pump is working, and the air flow is from the chamber to the steam release valve V1 (A) to the condenser to the vacuum pump and finally to the used water tank.

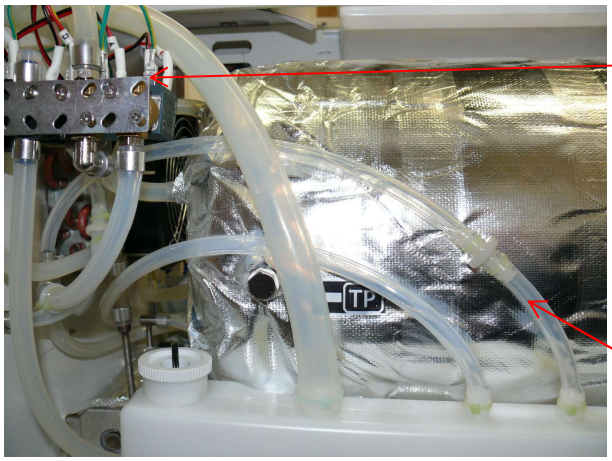
Case 1: The vacuum pump does not work. The vacuum pump fan doesn't rotate. The power cable to the vacuum pump is disconnected or broken or there is no power from the circuit board.
Solution: Drain the water inside the tube if needed. Check the vacuum pump cable. Check the vacuum pump connector on the circuit board.





The vacuum pump cable

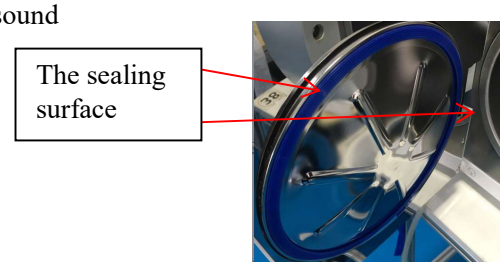
Case 2: The vacuum pump valve V5 (E) or the check valve is leaking.
Solution: Check the inlet of the valve. There should be no suction on the inlet when the vacuum pump is working. Check the outlet of the check valve. There should be no suction on the outlet when the vacuum pump is working.



The inlet of V5

The outlet of check valve. The check valve 'points' to the tank.

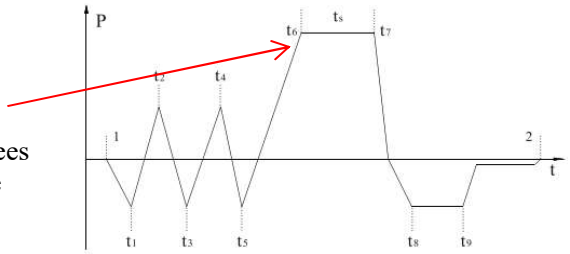
Case 3: There is a big leak somewhere. You will hear the sound of leaking air if there is a big leak somewhere.
Solution: Check the door seal.
Clean the door seal ring and the surface of the chamber.
Tighten the door. Refer to the instruction manual.
The other cause may be a damaged or loose tube.



Case 4: The pressure sensor is damaged. If an E13 error code appears and you try to open the door but feel a strong resistance, and the pressure shows zero….
Solution: Replace the circuit board.

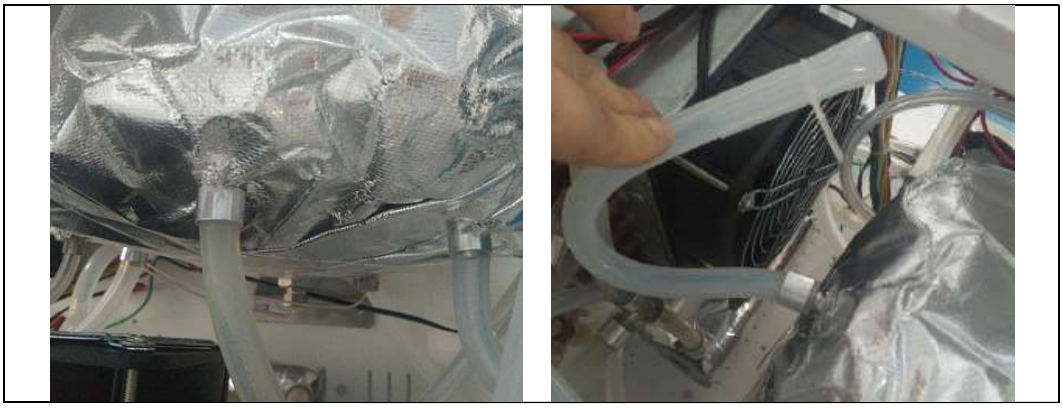
2.7 E20
Alarm condition: The cycle is interrupted manually.
Solution: Shut off the power and restart the machine.

2.8 E21
Alarm condition: The temperature and pressure can't reach holding time. It is not able to arrive at holding time after the temperature reaches 133 degrees (for 134 cycle) or 120 degrees (for 121 cycle) in 5 minutes. The principle is similar with the E24 but at a different period.



Solution: 1.Check for leaks.
2. The temperature deviation should be adjusted. Refer to E24 case 3.

2.9 E22
Alarm condition: Vacuum test failure.
Solution: 1. Check the door seal. Clean the door sealing surface. Tighten the door if it is loose.
2. The leak is from another area. If you can't find the part that is leaking, you may find it by the following way. Check every tube that connects with the chamber by pulling out the tube from the chamber. Replace it with a tube that is plugged on one end. Then run a vacuum test to check if the leak is from this tube and the parts connected with this tube. Test the tube connections on the chamber one by one.
3. Check the weld line on the chamber if you can't find the leakage by the above method.

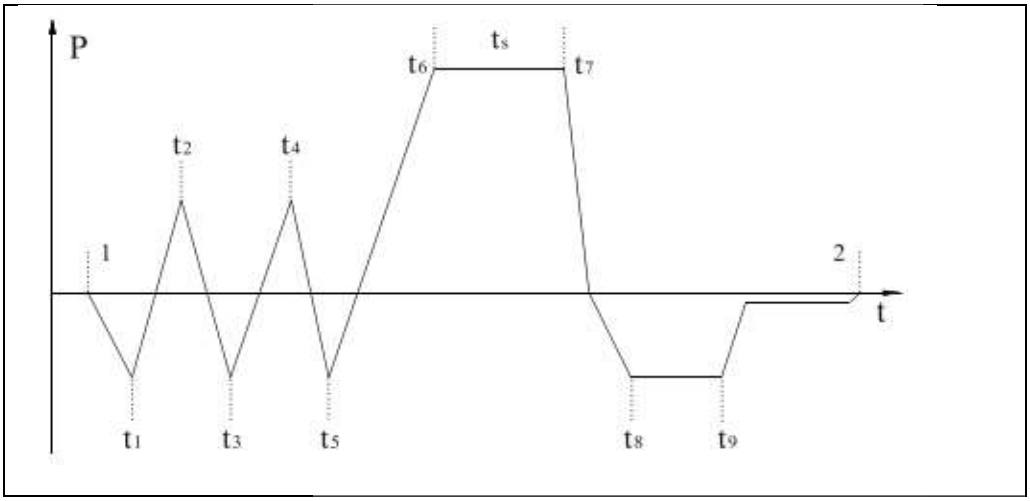


2.10 E23

Alarm condition: Result of vacuum test is void.

Solution: The temperature of the chamber is high. Try again after the chamber cools down.

2.11 E24



Alarm condition: At the rising pressure phase, it takes excessive time to reach the next status. From t1 to t2, t3 to t4, t5 to t6

Case 1: During t5-t6, the pressure is higher than 230kPa (130kPa), and the temperature is lower than 133.0 (120.0).

Solution: Please adjust the temperature deviation

1. Hold START button for 3 seconds while powering on. Enter the menu and then release the button.
2. Press ⇧ ⇩ button to adjust the value. Temperature adjustment range is +8.0 ~ -4.0.

The normal temperature and pressure value during holding stage is:

Temperature 121.3~121.8 ℃, Pressure 1.10~1.25 bar;

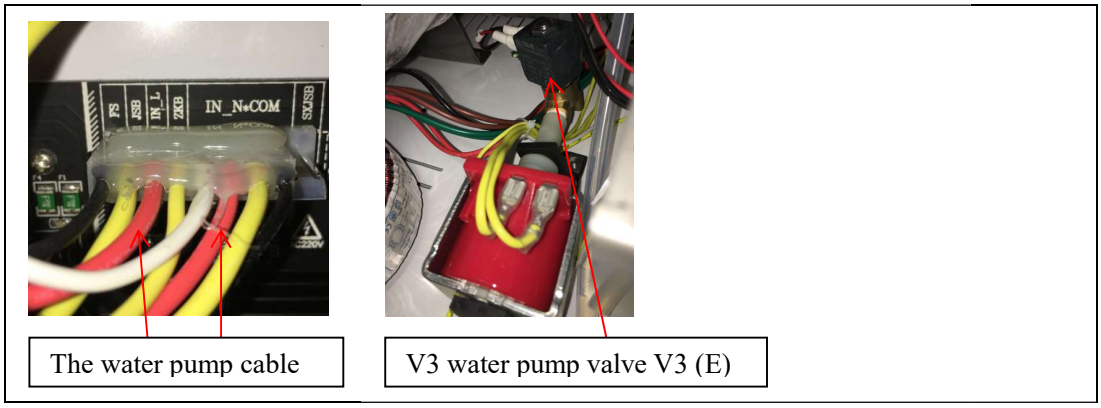
Temperature 134.3~134.8 ℃, Pressure 2.10~2.25 bar.

When the value of pressure is higher than the normal value, adjust the parameter up.

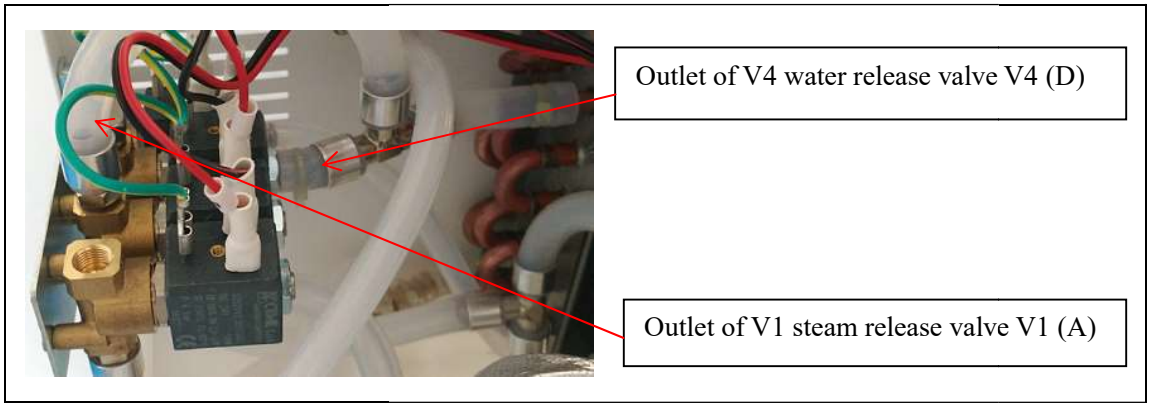
When the value of temperature is higher than the normal value, adjust the parameter down.

For example, the current pressure is 2.30 bar, temperature is 133.8℃, the parameter is 0.2. The adjustment value is 134.6-133.8+1=1.8, then 0.2 add 1.8, the parameter change to 2.0.

Case 2: There is no steam inside the chamber after E24 appears.
Solution: Possibility 1, the water pump doesn't work. The water pump cable may be disconnected.
Possibility 2, the water pump valve V3 (E) doesn't work. Measure the resistance of the valve coil.
Check the LED indicator of the valve on the mainboard. The LED indicator will light when V3 has power and the water pump is working.
Possibility 3, the mainboard doesn't work if the LED indicator is off when water pump is working. Replace the mainboard.



Case 3: The temperature is higher than 100℃ and there is water inside the chamber when E24 appears. There is a leak somewhere.
Solution: Check the water release valve V4 (D) and air release valve V1 (A). They should close completely. Please observe the tubes connected to the outlet of the valves during the state t1-t2, t3-t4, t5-t6. You will see the steam or water flowing continuously from the chamber to the condenser if the valve doesn't close completely.



Check the door seal. Clean the contact surface. Adjust the door a little tighter. Check other places that may be leaking, such as other valves, other tubes, the safety valve, etc.

Case 4: The temperature and pressure can't reach the setting temperature. And you don't find any place that is leaking. The steam generator doesn't work properly. There is a lot of water with steam passing by the outlet tube.
Solution: Replace the steam generator.

2.12 E27
Alarm condition: Vacuum test will not start. The chamber is too warm. The vacuum test must be done when the chamber is cold. Do it as the first test.

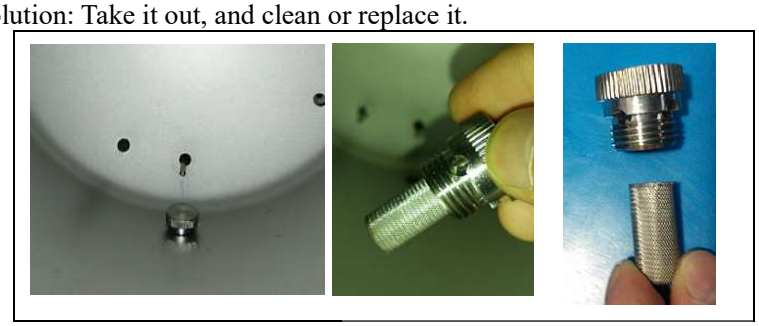
2.13 The LCD is dark
Solution: Check the cable connection from the mainboard to the LCD. Check if the mainboard works or not. For example, push the level float of the distilled water tank to the bottom. If there is an alarm for lack of water, that means the mainboard works and you need to replace the LCD.

2.14 The LCD is blank
Solution: Restart the machine. If it is still blank, replace the LCD.

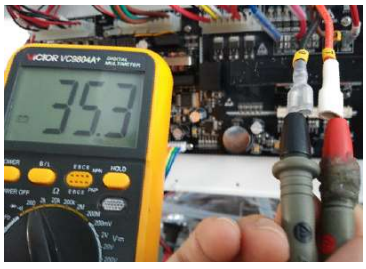
2.15 The touchpad does not work
Solution: 1. Check the cable connection to the touchpad.
2. Replace the touchpad.
Caution: Don't reverse the direction of the touchpad cable when you insert the connector.

2.16 Lots of water is left inside the chamber after a cycle finishes.
Case 1: The front of the machine should be higher than the back so that the water can flow to the outlet.
Solution: Raise up the feet on the front of the machine.

Case 2. The filter inside the chamber is blocked.
Solution: Take it out, and clean or replace it.



Case 3: The water release valve is blocked or does not work.
Solution: replace the water release valve V4 (D).



3. Function of the Parts

3.1 The steam generator
The steam generator is composed of a body, heater, thermal protector, and temperature sensor.
Function: Changes the water to steam by heating it.

3.1.1 The heater
Pull out the No.6 and one of the No.7 cable. Measure the resistance of the heater.
The resistance should be about 35 Ω .

3.1.2 The thermal protector
It will disconnect the power to the heater if the steam generator gets too hot.
It should be a closed circuit between the two pins normally.

3.1.3 The temperature sensor

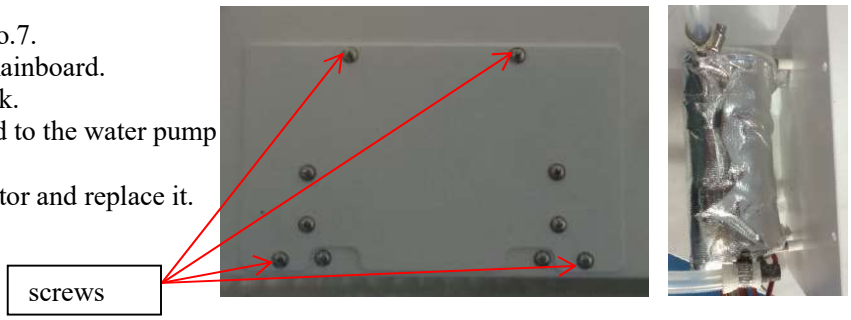
The temperature sensor can short circuit or fail to work properly. Measure the resistance of the sensor (No.1).

The normal resistance is 1000~1900Ω (depending on temperature).

The sensor is inserted in the hole of the steam generator directly.

Replace the steam generator.

1. Pull out connector No.6 and No.7.
2. Pull out cable No.1 from the mainboard.
3. Unscrew the 4 bolts on the back.
4. Disconnect the tubes connected to the water pump valve and chamber.
5. Then pull out the steam generator and replace it.

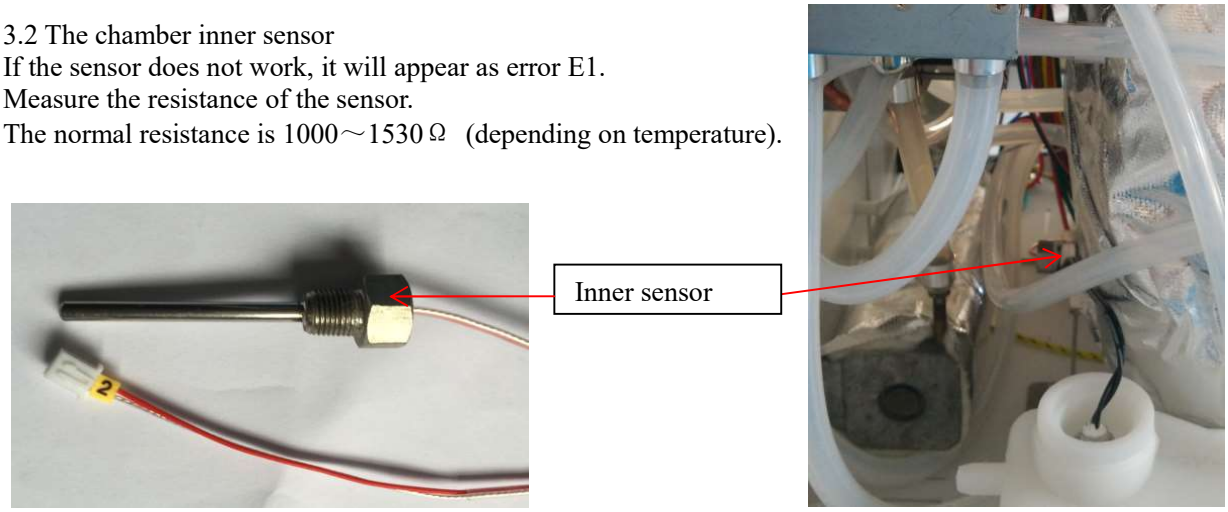


3.2 The chamber inner sensor

If the sensor does not work, it will appear as error E1.

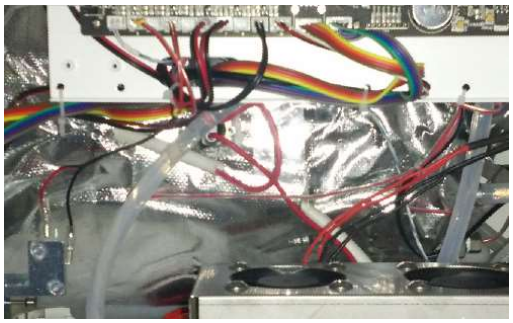
Measure the resistance of the sensor.

The normal resistance is 1000～1530Ω (depending on temperature).



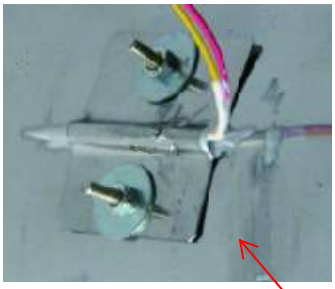
3.3 Chamber heater
The chamber heater is composed of a heater, thermal protector, and chamber wall temperature sensor
Function: Heats the chamber wall.

3.3.1 Chamber wall temperature sensor
If the sensor does not work, it will appear as error E3.
You can measure the resistance of the sensor.
The normal resistance is 1000~1700Ω.

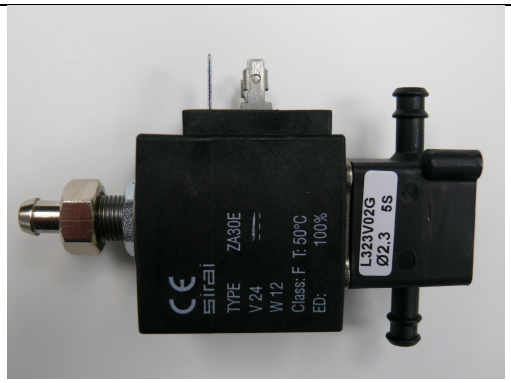
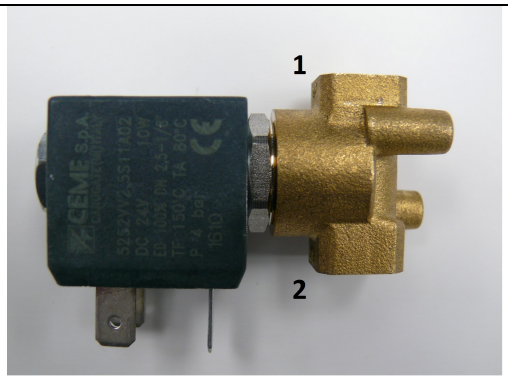
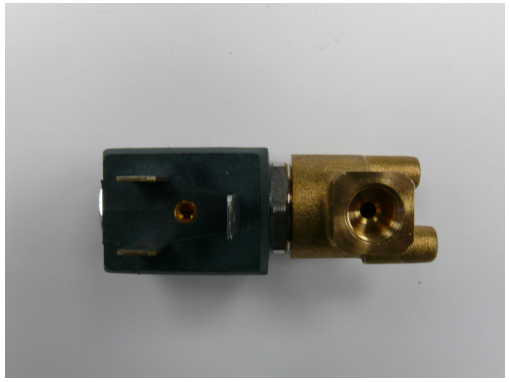


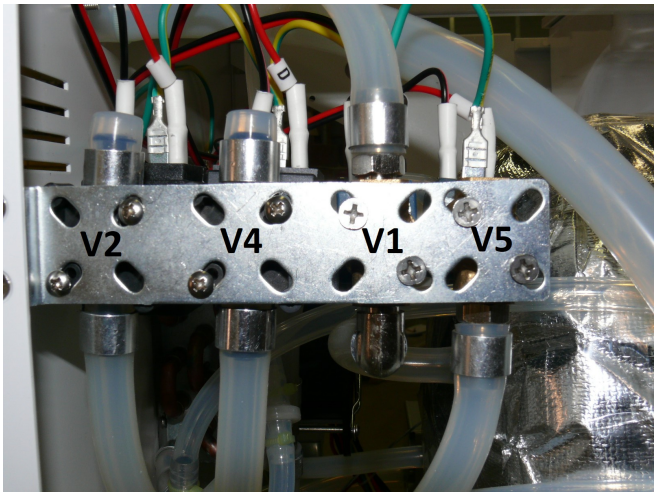
3.3.2 The thermal protector
It will disconnect the power to the heater if it overheats.
It should be a closed circuit between the two pins normally.

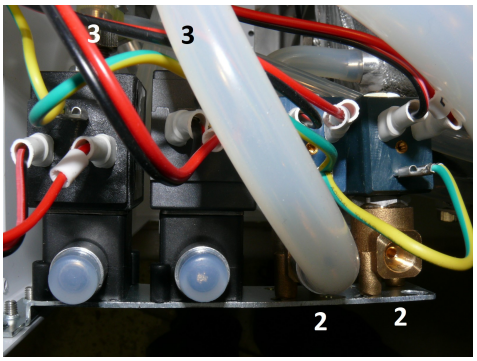
3.3.3 Replace the chamber wall sensor
1. Locate the position of the sensor and cut the heat insulation.
2. Unfasten the nut
3. Replace the sensor.
4. Use heat sink compound between the sensor and the chamber.



3.4 Solenoid valve

  P/N 90012077	  P/N 90012025
Normally open valve (V2 & V4)	Normally closed valve (V1, V3 & V5)





The coil voltage is 24V DC, and the resistance of the coil is about 60Ω.
Orient the direction of the valve the same way as the original when replacing it. Numbers are on the brass fitting end.

Error code summary

E1, E2, E3 Temperature sensor error
E1: steam generator
E2: inside chamber
E3: chamber wall
Check that the temperature sensor is installed properly & tightly;
Check the cable connection to the PCB;
Measure the resistance of the temperature sensor. Compare with another one at the same temperature (in the same unit).

E5 Failure to release pressure or it is over-pressurized inside the chamber
Check if the chamber was overloaded;
Check if there is too much water inside the chamber. If yes, check the water filter inside the chamber;
Check valves V1 and V4.

E6, E7 Micro switch error
E6: door micro switch error
E7: micro switch in the electromagnetic lock error (K series only)

Check the position of the switch;
Check the door lock claw (K series) position;
Check the connections to the micro switch;
Measure the micro switch resistance.

E10 Electromagnetic lock error (K series only)
Check the micro switch of the electromagnetic lock, same as for the E7 error;
Check the connections of the electromagnetic coil;
Measure the resistance of the electromagnetic coil.

E20 The cycle is interrupted manually
Turn off the power, wait a few seconds and turn on the power.
Press the SELECT button and hold for 3 seconds to cancel the error.
Check the switch in the control panel. Verify if it is working well or not.

E11, E12 Heater error
E11: Steam generator heater;
E12: Chamber heater.

Check the connections of the heaters;
Measure the resistance of the heaters.

E13 Vacuum failure
This only appears at the vacuuming phase. Vacuum could not reach lower than -30Kpa.

Check the vacuum pump;
Check the solenoid valve V5, if it did not close completely;
Check the check valve going to the waste water tank;
Check if there is a leak.

E9, E21, E24 Temperature and pressure take a long time to reach the setting value

E9: Holding temperature failure
Check if the chamber is overloaded, or if the pouches overlap;
If the temperature is over 136°C or the pressure is over 230Kpa, correct the temperature deviation (refer to the manual on how to do a temperature deviation adjustment);
Check the steam generator heater;
Check if there is a leak somewhere.

E21: Occurs at the rising pressure phase, near the holding time and near the start of t7
Same solution as for an E9 error.

E24: At the rising pressure phase, t1 to t2, t3 to t4 or t5 to t6

If there is no steam inside the chamber after the error appears, check if the water pump is feeding water.
Check the filter inside the distilled water tank. Check V3. Measure the resistance of steam generator heater.
If the temperature can reach about 100°C, check if there is a big leak somewhere.
During t5 to t6, if the temperature is over 136°C or pressure is over 230Kpa, correct the temperature deviation (refer to the manual on how to do a temperature deviation adjustment)

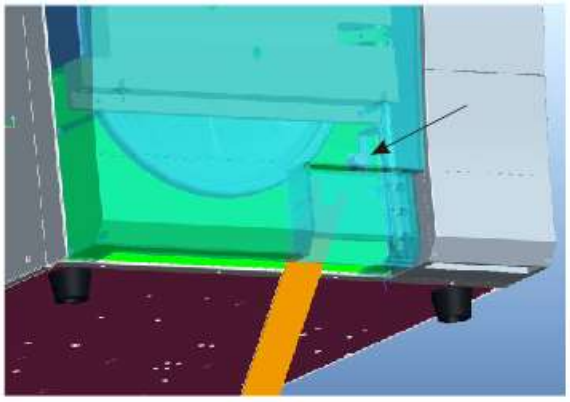
E22, E23 Vacuum test error
E22: Vacuum Test Failure
Check for leaks.
E23: Result of vacuum test is void.
The temperature of the chamber is too high. Try to run the vacuum test again after the chamber cools down. Turn off the unit and open the door to allow the chamber to cool down.

LCD problem
If the LCD is dark, check the connection;
If the LCD is blank with no words, replace the LCD.

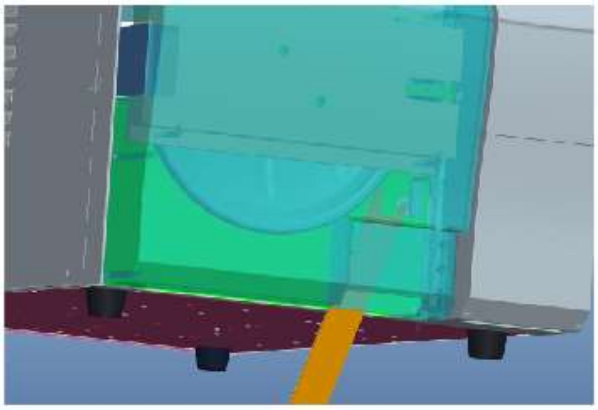
Water not released from the chamber
Check the filter inside the chamber;
Check the water release valve V4;

Maintenance Setting
If the wrench icon shows on the screen, have a maintenance service done and reset the maintenance counter. (refer to the manual for a PM checklist and how to reset the counter).

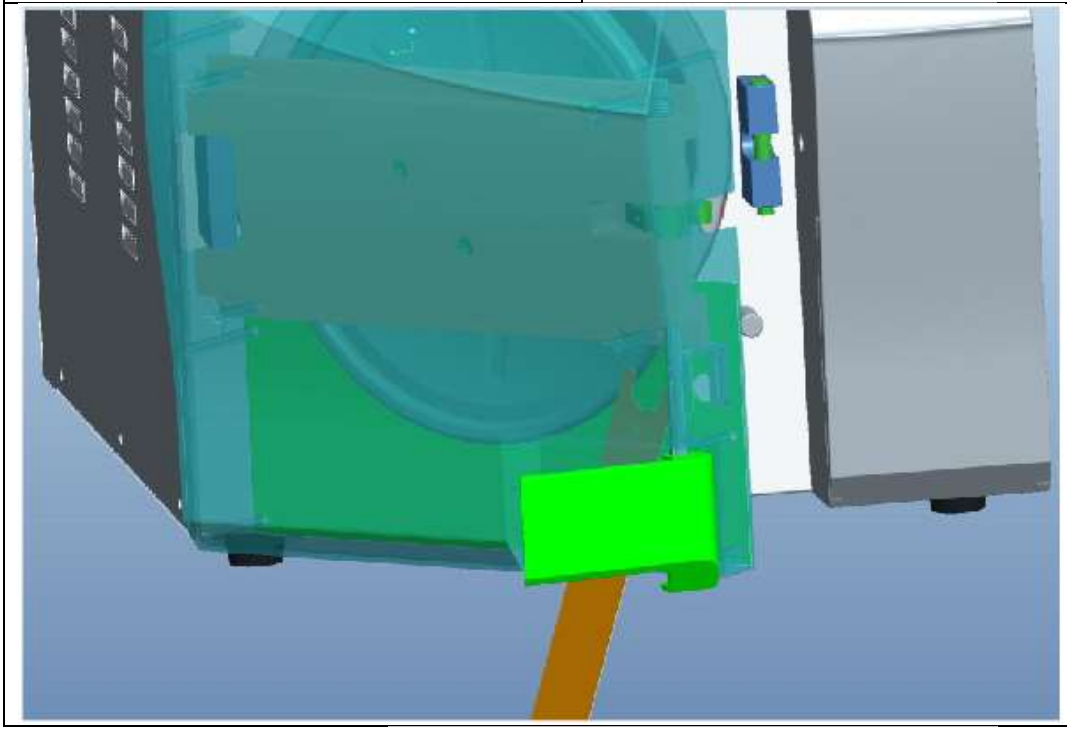
4 How to open the door in the case of power outage



1. Put the spanner between the metal plate and door.



2. Press the button by the spanner and pull the door handle at the same time.



5 How to replace the door handle

1. Remove the bottom part of the metal plate.

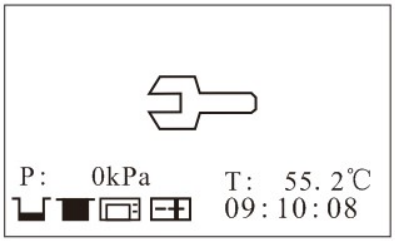
2.You will see the screws that hold the door handle.

3.Remove the screws.

4.Take the door handle from the bottom and replace it.

6 Maintenance

Needs Maintenance




```
==============================
Program:          WRAPPED
Temperature: 134C
Pressure: 206.0 kPa
Drying Time: 08Min
Holding Time: 4.0Min
---------------------------------
            Time        Temp.      Pressure
Start    21:33:19 032.5C
T1:        21:36:03 040.0C -074.9kPa
T2:        21:40:33 105.6C 051.6kPa
T3:        21:43:00 066.9C -074.9kPa
T4:        21:45:05 111.3C 052.1kPa
T5:        21:47:45 066.9C -074.9kPa
T6:        21:52:30 134.2C 206.2kPa
TS:                        134.6C 207.4kPa
Max. Temperature:135.1C
Min. Temperature:134.0C
Max. Pressure:212.1kPa
Min. Pressure:202.7kPa
T7:        21:56:30 134.8C 205.9kPa
T8:        21:58:50 089.0C -040.0kPa
T9:        22:00:18 081.2C -040.0kPa
End        22:07:10 102.8C
---------------------------------
Cycle No.: 00007
Ster. Value: Success
Date: 2016-03-01
SN:E00001
Operator:
2B00V2.3 E88
==============================
```

If this icon appears on the screen when powered on and E88 appears on the report, this machine needs maintenance.

6.1 Maintenance Interface

Hold the two buttons ⇧ ⇩ for about 3 seconds while powering on.
Release the buttons after entering the interface.
The ↖ button is to save and exit.

The ⋈ button is to cancel changes and exit.

P Select
Device No.
Counter
Maintenance

6.1.1 Select the "Maintenance" by pressing ⇧ ⇩ button.
6.1.2 Press ↖ button to enter the setting interface.
Start 01-02-18 is the start day for this autoclave. dd-mm-yy.
End 01-02-23 is the expired day. dd-mm-yy.
Cycle No. 500 means there are 500 cycles left before the maintenance reminder. Or the end date, whichever comes first.
It will subtract one cycle every time you press the START button to start a program.
The date will be set automatically after the system cycle number starts to count.

Start:01-02-18
End:01-02-23
Cycle No.:0500

6.1.3 You can adjust the value of maintenance cycles and end date.
6.1.4 Press ↖ button to select the item.

6.1.5 Press ⇧ ⇩ button to change the value.
6.1.6 After adjusting the Cycle No. and date. Press ↖ button. The value will be saved.

6.2 Maintenance Procedure

This is a periodic maintenance request from the steam sterilizer after the maintenance icon appears, in order to ensure that the steam sterilizer works normally.

1. Inspect the tightness of the door. After door adjustment, run the vacuum test with a cold chamber. An E27 error may show up if the chamber is hot.
If the vacuum test fails, there is a leak. Clean the door seal ring and chamber (where the door seal ring touches the chamber).
Restart the vacuum test and adjust the door (or seal) until the result is OK.

2. Check silicone tube.
Remove the metal covers from both sides. Check if the silicone tube has hardened or is loose. Especially check the steam generator outlet and inlet tubes. Replace any bad ones.
Check that all tubes and parts connect well. Look for any corrosion.
Run the 134 C wrapped program. Check if there is a leak somewhere.

3.Temperature and pressure calibration. (If necessary)
Put the temperature and pressure test device inside the chamber, connect printer and USB, run the 134 C wrapped program.
After this program is finished, compare the value of the test device with the test report output from the machine, then reset the temperature deviation.
Run Helix test program.
After Helix test, check the result.