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Model

Vacuum Oven

User Manual

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1. Adaptable scope:

This vacuum drying oven is for various laboratories of factories, enterprises, mines, universities and research institutes to dry and heat objects in vacuum environment. To dry and heat objects in vacuum environment has following advantages:

- (1) Decrease dry temperature (low pressure and low temperature)
- (2) Avoid oxidation of objects when being heated and prevent objects from damage caused by dirt.
- (3) Avoid heated air killing biological cells.

2. Technical index (See Table 1)

3. Structure and working principles

Vacuum drying ovens (Hereafter referred as drying oven) are all desk-top type except for model 6090 and model 6210 that are standing type. Generally speaking, drying oven is made up of a cabinet, an internal bladder (working room), a vacuumizing system, and a temperature-control system.

The cabinet is made up of high-quality sheet with sprayed plastic surface. So the exterior surface is bright in color. Internal bladder is made up of galvanized armor plate or stainless steel armor plate with the shape of semi-arc. The space between the internal bladder and the out shell is filled with super-thin glass wool for insulating heat. In the middle of cabinet door, there is a view window made up of double-layer bulletproof glass. In the inner part beside the door, a thick safety glass and a long column like door pin are used. The distance between them is very convenient to adjust so that the door presses the rubber airproof enclosure after the cabinet is closed. Thus air leakage when vacuumizing is prevented. (Note: The rubber airproof enclosure is not oil-proof.)

The vacuumizing system is made up of vacuum pump, vacuum meter, vacuum valve (For model 6090 and model 6210, we have vacuum pump. And vacuum valve is replaced by electromagnetic valve) and air-release valve. According to user's need, drying (cleaning) filter pot (equipment) or air-inlet valve can be equipped. Vacuum pump for other model is optional. (The velocity of vacuum pump you selected should not be less than 2L/S.)

Temperature-control system is made up of sensor (Pt100 platinum resistance), temperature controller, and heater. When receiving output resistance signal ($100\ \Omega$ for 0°C , 0°C) from sensor, temperature controller will display in PV screen real temperature tested from inside of working room. When input signal is less than set value, the power tube (bidirectional silicon controlled rectifier) is open and the heater gets enough electrical power to create heat. Otherwise, there is no power in the power tube and the heater does not heat. The temperature controller has the special function of adjusting output power with PID, testing and correcting temperature error and timing function. If the power is high than the set value, there will be a warning light and automatic cutting function will be effective.

Among our products, except for model 6050, model 6050B, model 6051, and model 6053 that are bladder-heating type, heaters of all other drying oven are installed in the shelf. For model 6090 / model 6210, there are 2 / 3 temperature controllers.

6000 Series Vacuum Drying oven Technical Index (Table 1)

Type Index Name	6021	6020	6030(A)	6030B	6050B	6050 6053CR	6051	6090	6210	6500
voltage	AC220-240V 50-60Hz									
Input power (W)	400	500	250	600	1400	1300	2050	3750		
Control scope (°C)	RT+10~200 (250)		RT+10~65		RT+10~200 (250)					
Fluctuating degree (°C)	1.0									
Attainable Vacuum degree	133Pa									
Shelf (layer)	1			2	2 3	2		3	4	
Bladder Material	cold rolled plate	stainless steel				cold rolled plate	stainless steel			
Size of the Bladder (mm)	300×295×275		320×320×300		415×373×345		450×453 ×603	560×450 ×640	630×810 ×845	
Out size(mm)	585×472×450		610×487×481		708×545×542		610×592 ×1350	720×1260 ×1550	790×1030 ×1855	

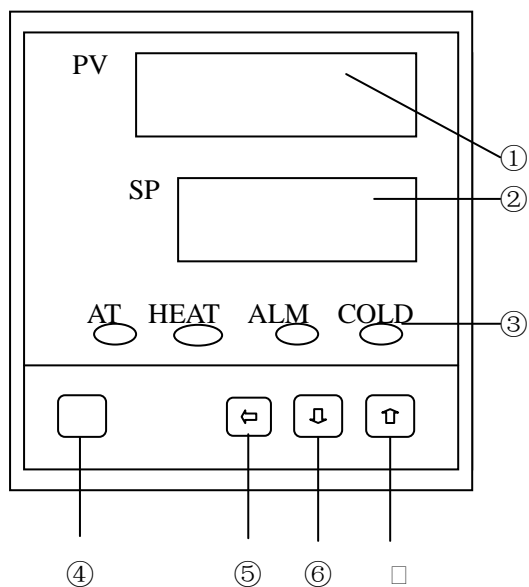
Note: 1. This product is produced according to Q/TIWY7-2004.

2. RT refers to environment temperature.

3. All technological indexes are get under the situation with environment temperature 25°C, relative humidity \cong 85% and vacuum degree is \cong 0.1Mpa. And all data are tested with mercurial thermometer whose precision is \pm 0.1°C. The mercurial head of the thermometer should touch the surface of the shelf inside the cabinet well.

4. Operating method of the controller

1. Energization to start up



- PV display unit(Red)
 - Displays measured value or the various characters depending the statue of the instrument
- ②SV display unit(Green)
 - Displays the set value or the timing and rated parameters
- ③Indicators
 - AT working indicator(Green),Flashes during auto-tuning execution
 - HEAT heating output indicator(Green), turned on when outputs operate
 - ALM alarming indicator(Red),turned on when alarming output operate and the buzzer sounds

④Function key

·Used for displaying the change and confirm of the parameters

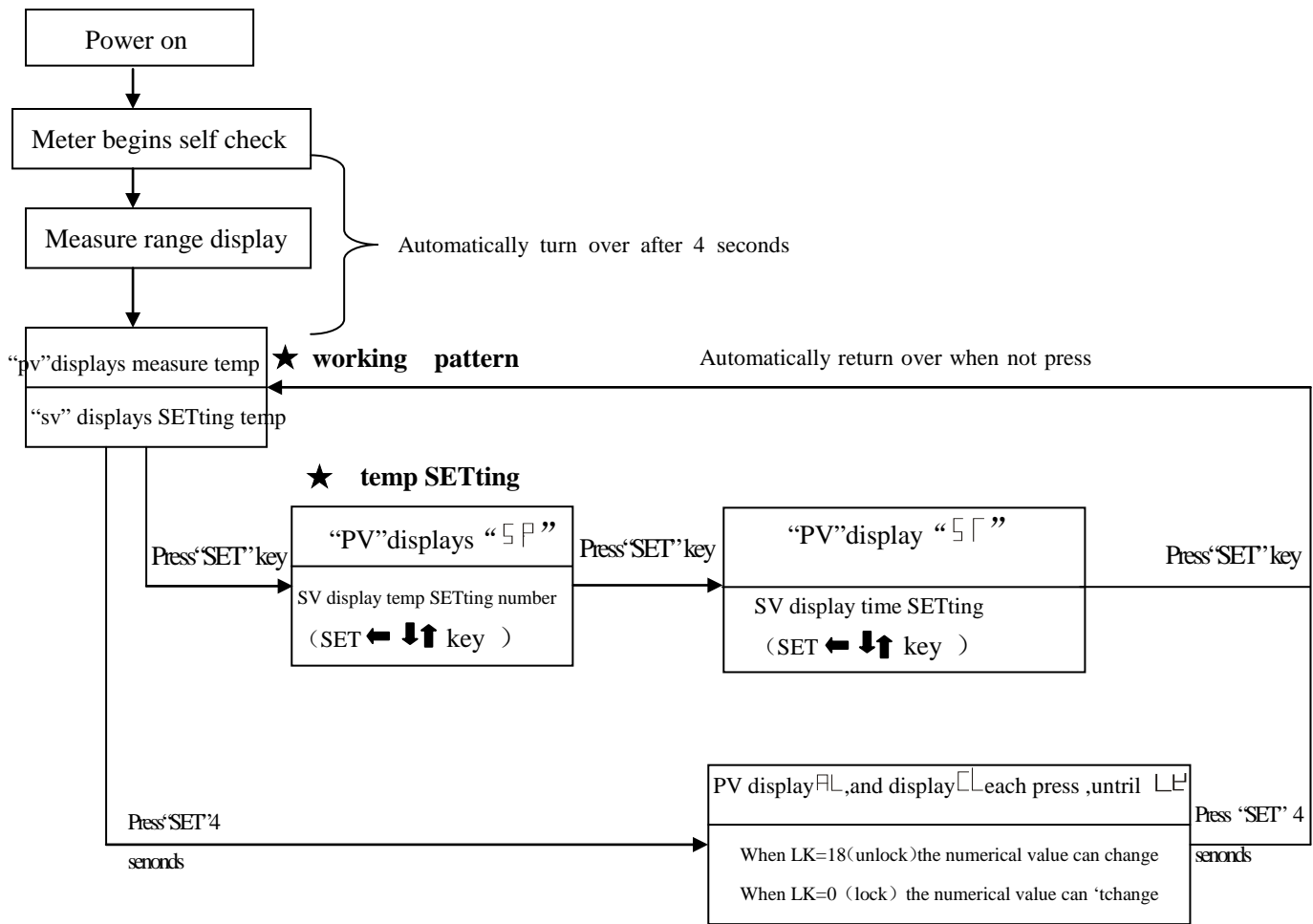
⑤shift key

shifting the set value or observing

⑥and □ Add or Subtract key for changing the digital code and/or the key to express entering the auto-tuning state

·Used for adjusting the digital code displayed or entering the auto-tuning state

◆ **Sequence to pick up the functions of the instrument**



★ LE is code lock, AL CL...meanings please check sheet "7_Page"

- ◆ The detail description for every function
- ◆ **Explanations to change of various functional parameters**

1. Timing

When ST is set as 0, the timing function is cancelled (situation set by manufacturer). Only when ST is not 0 that the apparatus has timing function.

Connect this apparatus with power, finish timing setting and start it. When the time reaches the set value (The scope for timing is 1 to 9999 seconds), the heater output is shut off. The buzzer will sing for 4 times for reminding. (If start auto-tuning during the working time of the apparatus, the timing function will be shut off. Only when the auto-tuning function is finished that the timing function will be started). During working time of the apparatus, modifying ST is permitted and previous accumulative operating time will be "remembered" and the apparatus will work till newly set time. If the newly set time ST is smaller than previous accumulative working time, heating output will be shut off immediately and the buzzer will sing for 4 times to remind you.

2. Time setting

When using time-setting function, if PV displays "5 P", SV displays "0", set the time you want with + key (second). Press SET to make the cabinet in working situation after finish your setting.

(Note: The time-count function begins to work after finished setting of time. And the period before entering working situation is counted in. So you should take in account the time of heating the drying oven, keeping it in constant temperature and drying together when setting time. If you want to change the set of timing when the cabinet in drying situation, switch off power about 10s and restart it again after finishing your setting.

3. Change method for control parameters

Since the product has passed strict test before delivering from the factory, generally there is no need to modify. But after the product is used for a period of time for the first time, or when it is used in sever environment, or the environment temperature is different from that is imagined in factory, or changing temperature greatly after using it, the temperature value displayed may different from real temperature inside the cabinet or there will be overshoot situation. If the value is over technical index scope, change the parameter to reach the standard of delivery.

Press SET for over 4 seconds. When PV displays “PL”, release SET key. And press SET for several times to find “PL” prompt. Press \uparrow to make SV display 18. Press SET key for several times to find control parameter prompt that you want. Press \square or \square to make this prompt display the value you want. Several control parameters can be adjusted in one time. Then press SET for over 4 seconds and it will return back to normal working situation. (It will return to normal working situation 1 minute after there is no key is pressed).

4. Examples:

- (1) If the temperature controller is not correct and the temperature is lower (or higher) than that you want and the error is caused, but the system is still stable:
 - a) If actual temperature is lower than the temperature you want, adjust p to smaller value (Adjusting once makes a change 3-5). But generally it should not be 0. Or you can adjust Ar to larger value (Adjusting once makes a change 5-10). Generally modify Ar firstly. If it still cannot satisfy your needs, adjust P. Adjust till get satisfied.
 - b) If real temperature is higher than the temperature you want, adjust Ar to smaller value. But it should not be smaller than 10.
- 2) If temperature overshoot is too large, adjust Ar to smaller value. If it still cannot satisfy you, adjust P to smaller value.
- 3) Correct the error of tested temperature to real temperature inside the cabinet
 - a) Put mercurial thermometer (whose precision is 0.1°C) inside the working room. The head with mercury should be stick to shelf surface and keep they touch well.
 - b) Select any temperature. When the drying oven enters constant temperature situation (Real temperature equals 2h of set temperature). Calculate according to the following method:
$$PK = \frac{[(\text{displayed value of the apparatus} - \text{tested value of the mercurial thermometer}) / \text{tested value of the mercurial thermometer}] \times 4000}{}$$
- C) Input above PK value (If it cannot be corrected in one time. Try more times till it is corrected.)
- d) In general situation, there is no need to modify Pb. But if there is error for temperature less than 80°C, calculate according to the following method:
Propose $\Delta 1$ and $\Delta 2$ are two arbitral temperatures to be tested (Such as $\Delta 1=30^\circ\text{C}$, $\Delta 2=60^\circ\text{C}$), Then
$$Pb = \Delta 2 - (\Delta 1 \times 2)$$

Table of parameters

Prompt	Name	Set scope	Explanation	Set by manufacturer			
				First shelf	Second shelf	Third shelf	fourth shelf
AL/AL	upper deviation warning setting	0~full scale range 0.0~full scale range	When temperature is over the valve of SP+AL, ALM light on, buzzer rings, heating power is cut off.				
CL/CL	Refrigeration control setting	0~full scale range 0.0~ full scale range	When the temperature is over SP+CL value, COLD light on, refrigeration connector is connected and compressor is started.	Without this function			
P/P	Proportion belt	1~full scale range 1.0~ full scale range	Only effects on heating side. The larger the P, the smaller the system plus. Reduce P can improve system control precision and cancel offset.				
I/I	Integral time (Readjusting time)	0-3600 S	Integral action time constant. The larger the I, the more delicate the integral action and the more stable the system.				
d/d	Differential coefficient time (pre-adjusting time)	0-3600S	Differential coefficient action time constant. The bigger the D, the stronger the differential coefficient action. And exceeding adjustment can be conquered. I=0, D=0, is called half proportion control. Generally $d=2I$ or $d=I$.				
Ar/Ar	Overshoot control (reset proportion)	0~100%	Change output power. Increase Ar, and temperature increasing speed will increase. It is good for remove offset and decrease Ar. Overshoot situation can be avoided.				
T/T	Heating period	1-300S	The output of controllable silicon is generally 2-3 seconds. To those equipments with big surplus power, increasing T can decrease offset caused because of PID control.				
Pd/Pb	Adjust 0 position (intercept)	-100~100 -100.0~100	When "0" position of the apparatus has great error and the full range has relative small error, adjust it. Generally for Pt100, this value is seldom adjusted.				
PK/PK	Full scale range adjust (slope)	-1000~1000S	When full range of the apparatus has great error and the "0" position has relative small error, adjust it. $PK=4000 \times (\text{set value} - \text{really displayed value}) / \text{really displayed value}$. For general Pt 100, adjust it first.				
CT/CT	Refrigeration control time prolong	0-3600S	When tested value reaches warning value, the warning relay will export signal after CT time.	Without this function			
/FN	fan control	0~100	When set to 0, the low fan work when set to 50, mid-range fan work when set to 100, the work of high-grade fan	Without this function			

LH/LK	Code lock	0-255	When LK=18, above parameters can be changed. (When the apparatus is working. AT light is off LK=128)				
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※ 1. All products have passed strict test before delivery. When the technical index of the drying oven is in accordance with request and it works normally, generally there is no need to modify the parameters.

2. When the product has 2 or 3 temperature controller, from left to right, it is the parameter of the first temperature controller, the second and the third one by one.

Auto-tuning and timing function: Generally it is not used.

5. How to use

(1) Environment request

a) Temperature 5~40℃

b) Relevant humidity: $\leq 85\%$

c) Power: AC220V $\pm 10\%$ 50Hz

d) There is no strong tremble around or corrosive air around.

(2). Vacuumizing debug

a) Close the cabinet door and turn the door pin to tight place. Close air-release valve (Make the hole in rubber stop is in 90° angle to the hole in air-release valve.) Open vacuum valve (turn 90° anticlockwise.)

The vacuum valve may be tight in first use.



(2) Connect vacuum drying oven vacuumizing pipes (exterior diameter: $\Phi=16\text{mm}$) with vacuum pump (2XZ-2 model, exterior diameter for air entering mouth: $\Phi=16\text{mm}$) well (for model 6090 and model 6210, the have been connected well) through a vacuum connecting pipe (interior diameter: $\Phi=16\text{mm}$, thickness of the pipe wall=10mm) packaged with the machine. Switch on power of the vacuum pump and it begins to draw air. When the vacuum indicating meter points to -0.1Mp, **close vacuum vale first, and then switch off vacuum pump power to avoid oil of vacuum pump flowing back into the working room. (For model 6090 and model 6210, there is no vacuum pump)**. You can switch off power of the vacuum pump directly). Now the cabinet is in vacuum situation.

(3) Debug of the vacuum cabinet

Carry on the following operation after vacuum debugging:

(a) Switch on the power of the vacuum cabinet and now power indicating light is on (For mode 6090 and model 6210, you have to push on the switch of temperature controller). Now power of temperature controller is switched on and it begins self-inspection. PV displays testing temperature of the working room and SV displays the set value set when delivery. AT and HEAT light in temperature controller should be on. It shows that the apparatus is in heating situation.

(b) Modify set temperature value

First, press function key of temperature controller (SET). PV displays SP. You can modify the set value through press  or . (For model 6090 and model 6210, you have to modify the set value separately for the 2 or 3 temperature controllers. Following is similar.)

Second, after finishing modifying, press SET again. PV displays ST. **(If you do not need the function of timing, let ST=0).** Press SET again to make PV display the temperature of the working room. SV will display the newly set value. Apparatus's AT and HEAT light should be on. Now the apparatus is in heating situation again.

(c) When the temperature inside the working room is close to the set value, HEAT light will blink. It shows that the apparatus is in PID adjusting phase. Sometimes the testes temperature is higher than the set value and sometimes it is lower than the set value. These are normal situations. When testes temperature is close to or equals to the set value, after 1-2h, the working room is in constant temperature situation. And the object is in drying situation.

Note: When the temperature you need is very low, you can finish the setting of temperature in two times. For instance, if the temperature you want is 70°C, set the temperature as 60°C in the first time. Then set for the second time as 70°C so as to reduce or refuse temperature overshoot and enter constant temperature quickly.

(d) After finishing drying of the objects, switch off the power. If you want to decrease the temperature quickly, open air release valve to make the vacuum degree equals to 0. Wait for 5 minutes before open the cabinet door (Because it maybe impossible to open the door if you try to open it immediately.)

(4) The humidity of the object inside the dry cabinet is relatively large. The steam generated when drying may affect the performance of the vacuum pump. It is suggested to add a desiccator/filter between the dry cabinet and the vacuum pump. Our company can equip a desiccator with the out shape of $\Phi 120 \times 300$ mm and the interface mouth diameter $\Phi 16$ (have indicated in the contract) according to request.

(4) If in the procedure of drying goods, there is the need of adding nitrogen or other inert gas, it should be listed in the contract and we will add another air entering valve.

Note: (a). If the vacuum pump works normal and is in accordance with technical request, but it cannot draw air to make the room in vacuum situation, open the cabinet door and screw tight the door pin with plank we prepared for you in accessories box. Close the door and try again.

(b) This vacuum dry cabinet should not be used as electric heating and drying cabinet. Since the working room is not in vacuum situation, the tested temperature is much different from real temperature.

6. Precautions

(1) The shell of the vacuum cabinet should be connected with the ground well to ensure safety.

(2) The vacuum cabinet should be in the environment that its relative humidity is $\leq 85\%$, there is no corrective air, no strong shock source and strong electromagnetic field.

(3) There is no anti explosive and anti corrosive equipment in the working room of the cabinet, so combustible, explosive objects or objects that easily create corrosive gas should not be put in the cabinet for drying.

(4) The vacuum pump should not be working for a long time. So when the vacuum degree reaches the point you want, shut off the vacuum pump first and then switch off the power of the vacuum pump.

When the vacuum degree cannot meet your need, switch on the vacuum pump again. So the lifespan of the pump is prolonged.

(5) If the object for drying is damp, add a filter between the vacuum pump and the cabinet to avoid steam entering the pump and causing any problems.

(6) If the object for drying is light and small in size (grains), a defending net should be added in the mouth for vacuum pump inside the working room to avoid absorbing any grains and damaging the pump (or electromagnetic valve).

(7) After being used for several times, the cabinet may not able to be in vacuum situation. Now you have to replace the door airproof tool or adjust the door pin of the cabinet. When drying temperature of the cabinet is over 200°C, there may be air leakage (Except model 6050, 6050B, 6051, and 6053). Now take off the back board of the cabinet body and screw loose heater seat with spanner, replace “0” shaped airproof enclosure or screw tight the heater seat.

(8) If the air release rubber stop is difficult to turn, wipe some fat (such as Vaseline).

(9) Except for repairing, the left cabinet cover should not be opened (except for model 6090 and model 6210) to avoid damaging of electric control system.

(10) The vacuum cabinet should be always clean. It is forbidden to clean the glass on the cabinet door with chemical solution. It should be cleaned with soft cotton cloth.

(11) If the cabinet is not in-use for a long time, clean exposed plated parts and coat them with neutral fat to avoid erosion. Cover it with plastic film to avoid dirt and place it in dry room to avoid damage to electric parts.

7 Failure treatment (See Table 2)

Failure phenomena	Possible reasons	Treatment
No power	The out power socket had no power,	Check whether the lines are connected well and whether the socket is well.
	The power plug is not inserted well in the socket or the line is cut off.	Re-insert the plug or repair the line.
	The fuse is broken or there is no fuse.	Check whether there is any short circuit; replace the fuse (short circuit for apparatus power transformer, short circuit for heater, short circuit for grounding and others short circuit all can cause breaking of fuse.
PV display "□□□□"	Temperature sensor Pt100 is damaged	Check Pt100, replace it(0℃, 100 Ω, 0.3 Ω/℃)
	Temperature sensor line is not connected well.	Connect lines again.
	Test scope of the apparatus is not correct	Re-set again.
The temperature does not increase	The set value is too low	Set temperature $SV \geq RT + 10^\circ\text{C}$ RT is environment temperature
	The output circuit of the apparatus is falling off.	Connect the lines again.
	Temperature controller has no output signal or is damaged or the controllable silicon is damaged,	Replace it.
	The heater is damaged(short circuit, or open circuit)	Replace it.
	Use timing function or the setting is not correct.	ST=0 or ST=(heating time +constant temperature time
The temperature is out of control or there is offset or overshoot because of the error between tested temperature and real temperature	The output of temperature controller is out of control.	3041 or BTA is damaged and replace it.
	Not qualified to use	$SV \geq RT + 10^\circ\text{C}$
	Pt sensor doest connects well.	Get rid off grounding resistance.
	Relevant parameters are not correctly set.	Re-set relevant parameters, such as Ar、P and so on.
There is big difference between tested temperature and real temperature.	No vacuum situation.	Vacuumizing.
	The mercurial thermometer head is not on the shelf.	Replace it.
	The apparatus or parameter is changing.	Re arrange Pb、Pk parameters.
The cabinet cannot be vacuumized.	The vacuum pump is not of the correct model and size.	The vacuumizing speed should not be less than 2 L/S.
	Various connecting pipe is too loose.	Replace it.
	The vacuum meter is damaged.	Replace it.
	The door is not closed well.	Adjust the door pin distance.
	The door airproof rubber is aged and lack of elasticity.	Replace it.
	Air release valve and vacuum vale is not in the correct place.	Adjust them.
	The electromagnetic valve is damaged. (model 6090, model 6210)	Replace electromagnetic valve
Air leakage (the vacuum degree decrease to 0.092 Mpa from 0.1Mpa within 24 hours.	There is air leakage in various connect pipes.	Check and replace it.
	Except for model 6050、6050B、6051、6053, the distortion of heater "O" shaped airproof circle causes air leakage.	Screw tight the heater seat (in the back of the inner bladder.) or replace "O" shaped airproof circle.
	The air release valve is not in the right place.	Place it in the right place.
	There is air leakage in vacuum valve.	Replace it
	The electromagnetic valve cannot be closed well and there is air leakage. (for model 6090 and model 6210)	Replace it.

8 Packing list

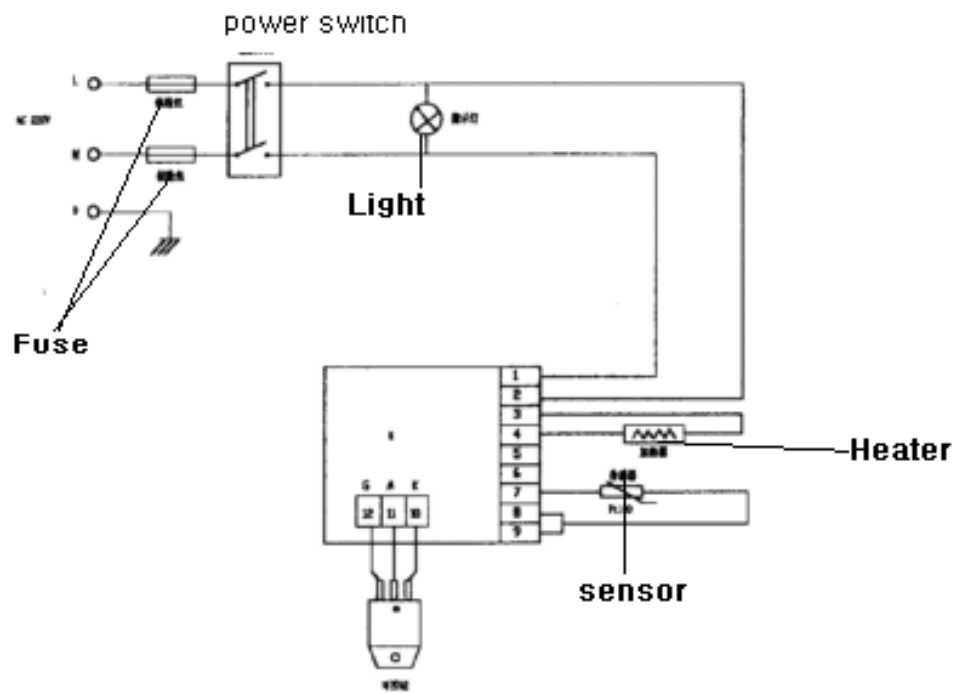
Packing List

Serial No	Type	Name	Unit	Quantity	Remark
1	File	User manual		1	
2	File	Packing list		1	
3	File	Qualification Certificate		1	
4	Spare part	Fuse		2	
5	Fittings	Vacuum connecting pipe		1	Except for model 6090 and model 6210
6	Fittings	spanner		2	

The articles listed here is in accordance with the articles packed in the box.

Packer2

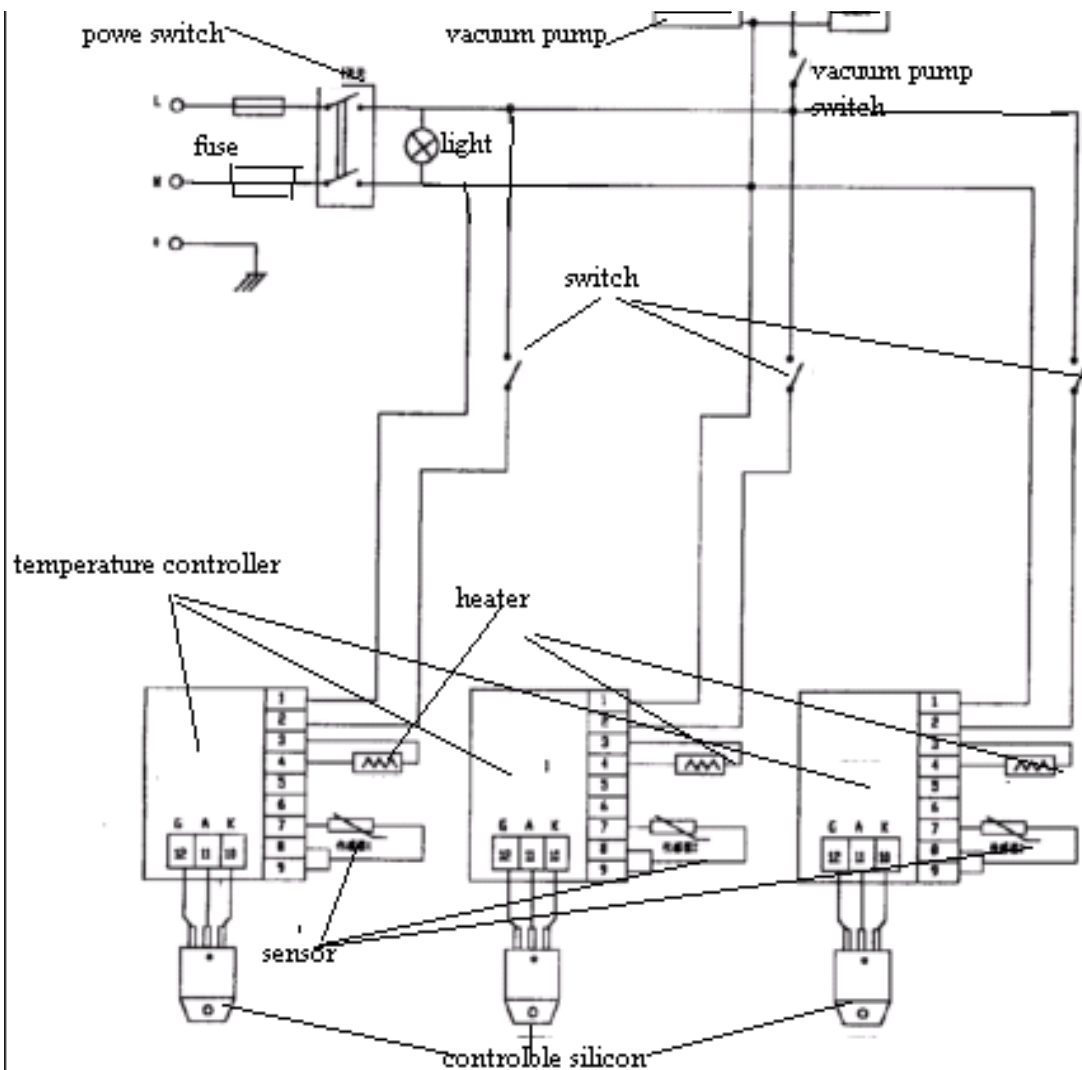
9. Connection principle for electrical parts (A)



Any change will not be informed.

Vacuum Oven(Except for mode 6090 and model 6210)

10. Connection principle for electrical parts (B)



- Explanation:
1. 6090 has two set of temperature controllers, heaters, and sensors.
 2. This diagram does not include vacuumizing system.
 3. Any change will not be informed.

6210 and 6090 model Vacuum oven