



Furnace Instructions & Operation Manual



An ISO 9001 : 2015 Certified Company

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SAFTherm

WHO ARE WE

SAFTHERM is one of the leading electric heat furnace manufacturers in China.

The company designs, manufactures and sells kinds of electric resistance furnaces and provides the professional solutions for customers in lab and heat industry.

SAFTHERM has delivered its furnaces to more than 85 countries and the team is fully dedicated to working for their beloved career.

For more information in web : www.saftherm.com

Preface

Dear User,

Firstly thanks for your choosing SAFTHERM furnace products. For your safety and interest consideration, please read this operation manual carefully before using the equipment to avoid misusing or any damage. During the operation process, please contact us freely if you met any problems.

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SAFTHERM people uphold the concept of "Honesty, Customer first, Innovation, Harmony and Win-win", and aim to provide first-class laboratory & industrial heating equipment and solutions for customers. We have achieved breakthroughs in this field. In the process of continuous innovation to meet the prospective demand of customers by providing excellent service and good-quality products. SAFTHERM look forward to becoming a first-class enterprise in domestic and overseas electric furnace market, and finally realizing the harmonious coexistence with partners.

SAFTHERM are very pleased to serve you!

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Furnace Equipment Operation Process

- 01 • Turn on the air switch on the side of furnace / rear side of small cabinet / inner part of separate stand cabinet
- 02 • Turn on the power switch on the front control panel
- 03 • Temperature instrument self-inspection and displaying room temperature
- 04 • Open the chamber furnace door and put the sintering samples and then close the furnace door (For tube furnace , put on the two ends ceramic plugs and sealing flanges after loaded samples)
 - For Vacuum Tube/Chamber Furnace : Start the Vacuum Pump to get the designed vacuum degree level , and then turn off the vacuum flanges valve and vacuum pump to keep vacuum
 - For Low Vacuum Atmosphere Furnace : Start the Vacuum Pump to get the designed vacuum degree level about -0.08Mpa (20000Pa) , and then turn off the vacuum flanges valve and vacuum pump to keep vacuum
- 05 • Set the sintering temperature program process curve on controller & save it . Then run the program on controller
- 06 • Finally press the "Start" button after the controller program is running and furnace will begin to heat.
- 07 • When the program finished, it will end automatically and wait for temperature cooling to room temperature to fetch the heated samples
- 08 • Turn off the power switch and air switch in turn
- 09

Attention:

- (1) Check the condition of the equipment carefully after opening the furnace package.
- (2) Check the sintering temperature program curve again to see whether the program has been wrongly set. (Different series furnace has different controllers and heating rate, please refer to the relative temperature controller operation part.)
- (3) The furnace door can not be opened until the temperature below 200°C, and it is better to open the furnace door at room temperature.
- (4) Be careful of high temperature and pay attention to the accident high temperature burn.
- (5) If 15 days or longer time no using of the furnace, please warm up the furnace for some hours to remove moisture of chamber to use as suggestion.

Attention Matters of Furnace Operating

- Before operating, please check the wire connection as per the electric wiring requirement to ensure the power cord, plug and switch capacity match the power of equipment.
- The furnace circuit must be grounded to ensure safety.
- For first time using of furnace, please warm up furnace to 600C for two hours to totally remove moisture environment in the furnace. 1700C furnace suggest warm up to 1200C
- After longer time no using, please warm up furnace again before normal work .
- Do not get directly reached by liquids and acidic corrosive materials to alumina ceramic fiber chamber line and heaters . The user should put a protective pad plate at the bottom of chamber if available.
- When operating the furnace, the sample material should not reach the heating elements and a safe distance must be kept to avoid any short circuit and electric shock.
- Flammable and explosive materials mustn't be placed into the furnace and keep away from the danger of explosion.
- Sample materials with large amount moisture water or large gas smoke produced during the heating process is not suitable for standard furnaces and should have gas out accessories to protect furnace chamber line and heating element .
- The furnace alumina chamber has low strength, please operate the sample carefully. Do not make furnace door insulating fiber touch the samples when closing the furnace door .
- If any abnormality is found In the process of operation, please turn off the power switch and air switch immediately and contact the professional electrician personnel to check it.
- When it is needed to open the furnace door under high temperature, please turn off the power of furnace to keep safe and also be careful of burnt .
- Furnace door should be closed immediately after the sample was taken out in high temperature. Try to avoid the door being open for long time at high temperature to prevent the chamber line fracture crack or any other problem caused by sharp cooling with temperature difference .
- The alumina chamber material made by wet way of vacuum suction filter molding and it is a kind of porous inorganic materials. With the principle " Expand with heat and contract with cold " , the surface of chamber structure may has the condition of surface external crack or scaling when it is in the process of operating with heating and cooling frequently for some times or opens the furnace door in the high temperature. And these are normal phenomenon with this kind material features and it does not affect the normal use . And high solid refractory brick chamber is better with good thermal shock features.
- When you use the furnace for the first time , the ceramic fiber chamber may appear a slight white smoke. The reason is that the alumina ceramic fiber board containing 4%-5% organic compounds. For the first time using, when the temperature reached some degrees and the organic compounds will volatile, the fiber board will have a slight white smoke or local yellow color on the chamber and this is the normal phenomenon and it does not affect using. When the organic substance volatilized, this condition will not happen again. Warm up furnace operation for the first time using , please refer to the manual operation .
- Check regularly whether the electrical connection of temperature control system is fixed well, and pay special attention of whether the connecting point of heating element is fastened.

- When loading samples in chamber furnace , please try to keep some distance from samples to edge of furnace chamber and furnace bottom for hot air flow in chamber to get good heating effect . Too full load is not good for samples heating and furnace working .
- When using the furnace from cold state, the heating rate of the low temperature section should not be too fast since the furnace is cold and need a lot of heat absorption. And the heating rate of each temperature section should not be with large difference.
- The physical and chemical properties of the fired material should be fully considered when setting the heating rate to avoid the phenomenon of heating material spraying and contaminated or break the furnace reactor tube .

Attentions for PID parameters

- a.The temperature control instrument uses advanced PID adjustment algorithm that integrates the artificial intelligence technology, and has solved the overshoot problem of the standard PID algorithm, and enables high precision of control. When operating, user can start the auto-tuning function to help to determine the PID and other parameters.
- b.When using, record the parameters(P, I, D) to prevent the control accuracy from being affected by accidental loss of operation.
- c.The parameter lock is not permitted to modify by user, otherwise the control programs may be disordered.

Attentions for 1700/1800 furnace

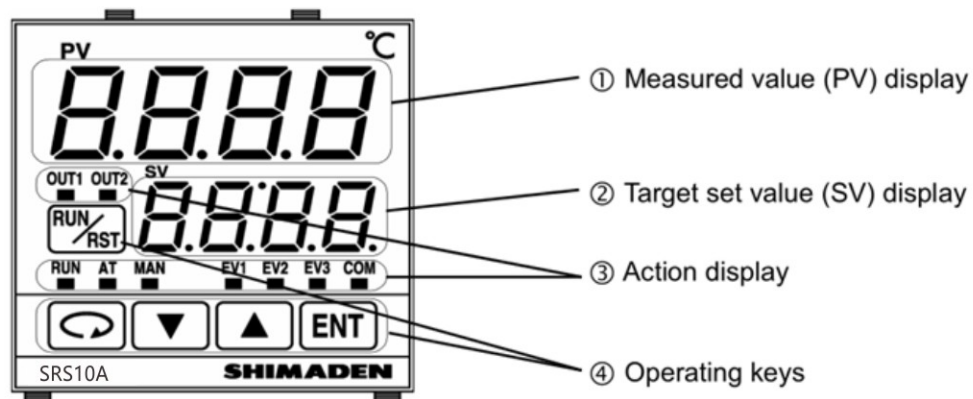
- a.If the customer use the Mosi2 rod heating element furnace, please do not randomly disassemble and move it and that is because of there is toughness of Mosi2 rods at normal temperature and very easily broken .
- b.The electric furnace with Mosi2 rod as heating element is designed for high temperature using and should not run for a long time or always below 1200°C , or the Mosi2 rods will be oxidized at low temperature and reduce the service life.



1200/1400°C Series Furnace Operation Manual SHIMADEN SRS10 Series Controller



Names and functions of parts on front panel



Name	Function
① Measured value (PV) display	<ul style="list-style-type: none"> (1) Measured value display LED (red) • Displays current measured value (PV) on basic screen (screen 0-0). • Displays type of parameter on each respective parameter display screen.
② Target set value (SV) display	<ul style="list-style-type: none"> (2) Target value display LED (green) • Displays current target value (SV) on basic screen (screen 0-0). • Displays set values on each respective parameter setting screen.
③ Action display	<p>Displays status of controller.</p> <ul style="list-style-type: none"> • RUN: Action display LED (green) Off: Control halt status (STBY or RST) On: Running by fixed value control status (FIX) Flashing: Running by program control status (RUN) • AT: Auto tuning LED (green) Off: Auto tuning not executed O n: Auto tuning standby Flashing: Auto tuning being executed • MAN: Manual control LED (green) Off: Automatic control operating status Flashing: Manual control operating status • OUT1: Control output 1 (green) • OUT2: Control output 2 (green) <p>For output by contact or SSR drive voltage:</p> <ul style="list-style-type: none"> Off: Output is OFF. On: Output is ON. <p>For voltage/current output:</p> <p>Brightness changes according to the output ratio. (Light illuminates brightly when output is 100% and dimly when output is 0%.)</p> <ul style="list-style-type: none"> • EV1: Event output 1 (orange) • EV2: Event output 2 (orange) • EV3: Event output 3 (orange) Off: Event output is OFF. On: Event output is ON. <p>Note: Always off when event output is not selected as an optional item.</p> <ul style="list-style-type: none"> • COM: Communications mode (green) Off: Communications LOC mode On: Communications COM mode <p>Note: Always off if communication function is not selected as an optional item.</p>
④ Operating keys	<ul style="list-style-type: none"> : Parameter key Displays the next screen in various screen groups. Pressing and holding for at least 3 seconds on 0-0 screen displays 4-0 initial settings screen group. : Down key Decrements set values. : Up key Increments set values. : Enter key Confirms set values. Displays various screen groups if no SV values are being modified on the basic screen. : RUN/RST key Pressing and holding for at least 2 seconds on basic screen (0-0) switches between control operating status and control halt status. <ul style="list-style-type: none"> • When fixed value control (FIX mode), it switches control execution status (EXE) and control standby status (STBY). • When program control (PROG mode), it switches between halt status (RST) and execution status (RUN).

Step by Step for Program Setting (Shimaden SRS 10 Series Controller)

For example, you have three steps of the programs :

STEP 1 Take 20 minutes from room temperature rise to 200°C

STEP 2 Holds 10 minutes at 200°C

STEP 3 Takes 59 minutes from 200°C to 1100°C

After finished the above 3 steps, set one more step (step 4) as bellow:

STEP 4 S_04=0, T_04=0 (It means the furnace will automatically stop after the set programs finished)

Parameter setting on the display panel :

- As above description , final step like S_04=0 and T_04=0 must be set finally, or the program will not stop.
- It is not recommended to modify the program by the operator if not skilled for operating.

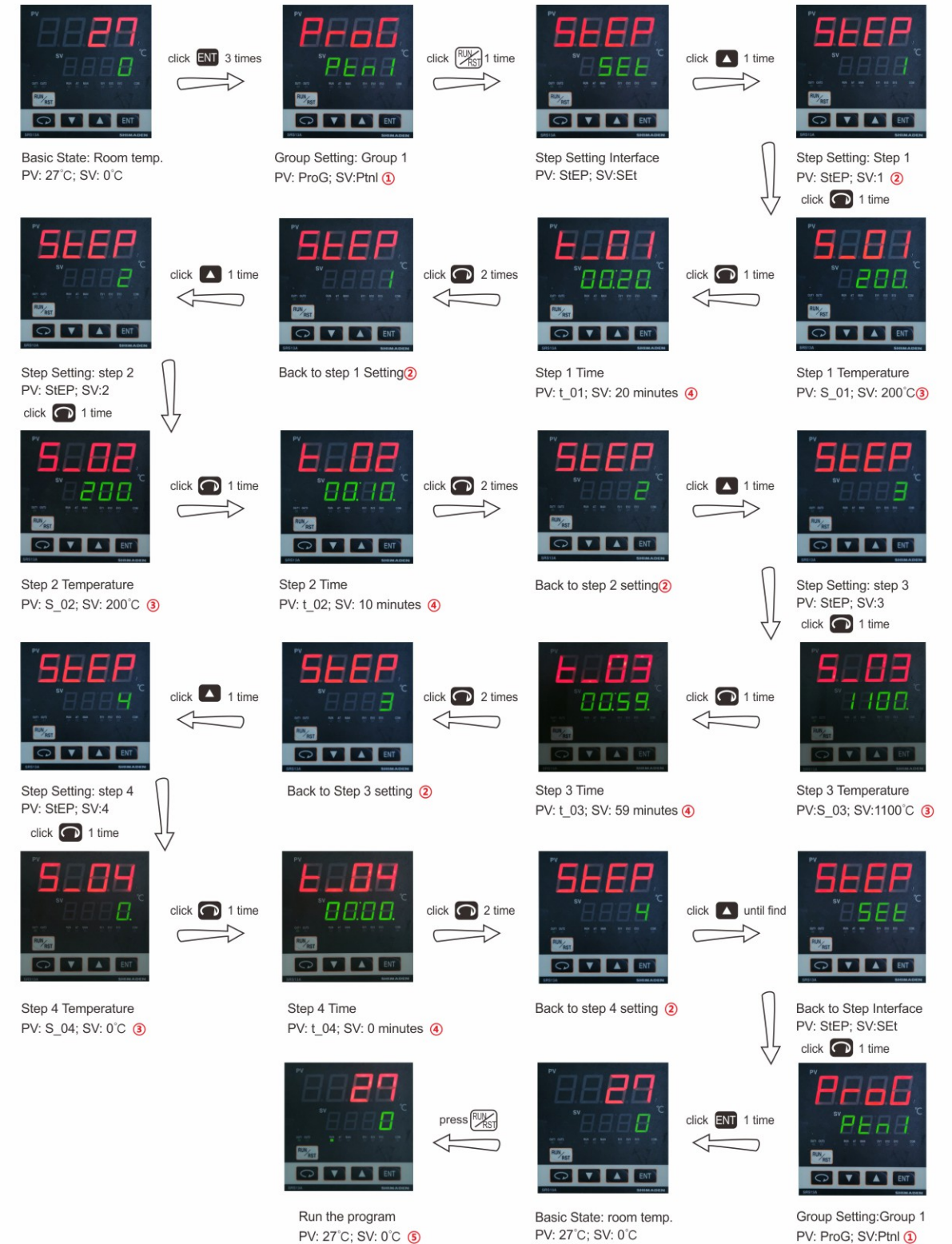
Step	Display Statues	SV values setting	Content
1	S_01	200°C	First target set temperature
	T_01	20 minutes	First running time
2	S_02	200°C	Second target set temperature
	T_02	10 minutes	Second running time
3	S_03	1100°C	Third target set temperature
	T_03	59 minutes	Third running time
4	S_04	0	Program stop and return to first paragraph. then for natural cooling.
	T_04	0	

Notice :

The SHIMADEN SRS10 series controller can set 4 programs (groups)and each program can set 8 steps (segments) and totally 32 steps (segments)

Refer to the following note for the label ①②③④⑤ on the right part with program step by step setting.

- Program (group) Setting: Adjust groups via key ▲ or ▼ , four groups are available
- Step (segment) setting: Adjust steps via key ▲ or ▼ , 8 steps are available
- Temperature setting: Do remember to click the key ENT to store the value after set the temperature
- Time setting: Do remember to click the key ENT to store the value after set the time
- Run the programs: In basic state, press the key RUN/RS1 around 3 seconds until the green light glitters



1700/1800°C Series Furnace Operation Manual Yudian 518 Series Controller

1700/1800°C series furnace is ideal for heat treating, reacting studies, sintering processes, and ceramic firing etc. SAFTherm furnaces temperatures can reach up to 1800 degrees Celsius and capacities can be done according to customer request. Many important factors should be considered when looking for a laboratory furnace, including the process temperature, control requirements, dimensions of sample and inner dimensions of chamber or tube, and pressure range etc.

Furnace chamber adopted high quality 1800/1900 grade alumina polycrystalline fiber, which used Japanese technology (vac-sorb forming alumina polycrystalline fiber) with good insulation and durability properties, high tensile strength and no miscellaneous ball; The furnace is much more energy saving than the furnace use common fiber materials.

Heating elements adopt 1800/1850 grade Silicon Molybdenum rods, Max temperature 1800°C, continuous working temperature 1600/1700°C degree, Resistance value of a MoSi2 heating element does not change under normal use, and it can be mixed with new and old elements together. The furnace temperature profile can be set up by 30 segments and run automatically by the 518P type advanced temperature controller.

Installation :

This series of resistance furnaces do not require special installation, and can be put on a flat indoor floor or a workbench table.

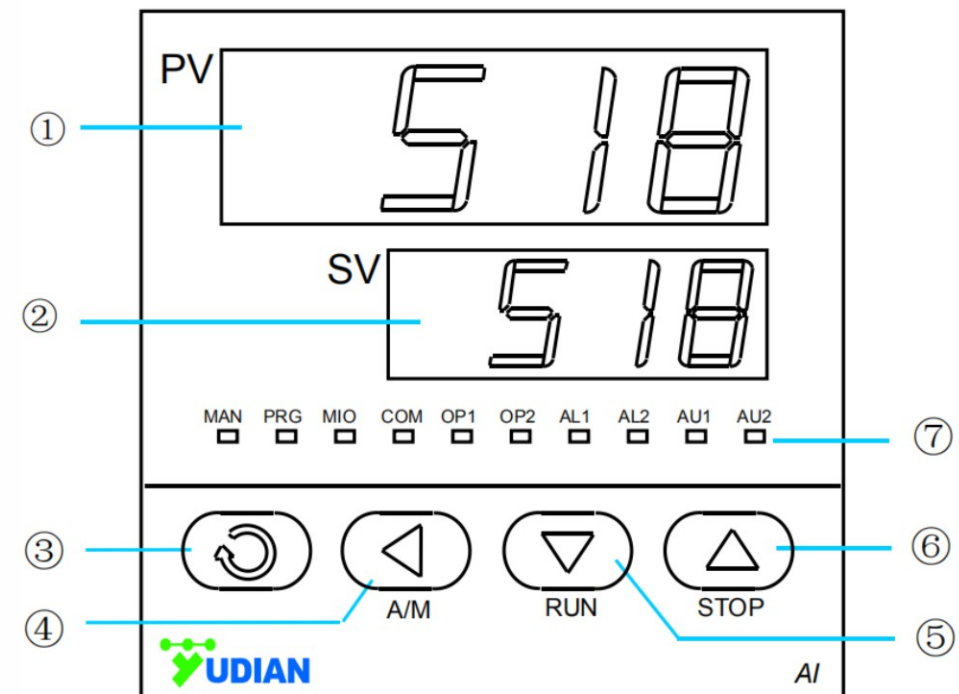
Power installation:

- Please supply power according to the specifications (Single/three-phase) set by the appliance.
- The voltage change rate must be controlled within the rated value $\pm 10V$.
- Check whether the three-phase power supply is lack of phase, and the equipment can not be run in phase failure.
- To avoid accidents caused by electric shock, the fuselage must be grounded.

Heating Elements Installation:

Normally we have installed perfectly the heating elements in the furnace chamber, but heating elements are consumable parts, it needs to be replaced regularly if operated in high frequency use. Please check the heaters replacement details in next part.

Yudian 518 Controller Operating



1.The Front Panel Description

Sr. No.	Item Name	Function or additional functions
①		Displays PV(process value), parameter code, etc
②		Displays SV(set value), parameter value or alarm message
③		For accessing parameter table and conforming parameter
④		Data shift, Auto-tuning
⑤		Data decrease, run
⑥		Data increase, stop
⑦	 10 LED indicators	"MAN, MIO, COM, OP2, AL2, AU1"
		"RUN"led on, it means AL-518P running program is going on
		"OP1" shining, it means in the process of heating
		"AL1" led on, it means over-temperature alarm output

Note:

- When the power turns on, the upper display window shows the process value of (PV) and the lower window shows the set value (SV).
- In the initial state, PV window shows as 49°C or 50°C; SV shows as "Stop" in glittering status.
- The SV window also can alternately display following: letters : "HIAL" means the high limit alarm "Stop" means the status is stop

2.Program Setting

Take the following program setting as example:

- STEP 1 Takes 35 minutes from room temperature to 200°C(Heating rate: 5°C /minute)
- STEP 2 Takes 120 minutes from 200°C to 1200°C (Heating rate: 8.5°C /minute)
- STEP 3 Holds 10 minutes at 1200°C
- STEP 4 Takes 60 minutes from 1200°C to 1500°C (Heating rate: 5°C /minute)
- STEP 5 Takes 30 minutes from 1500°C to 1600°C (Heating rate 3°C /minute)
- STEP 6 Hold 20 minutes at 1600°C
- STEP 7 SET THE LAST PROGRAM tx=-121
(Then program will stop working automatically after the holding temperature for 20 minutes)

Notice:

Rising time and target temperature can be set according to the customer request.
The characteristic of Mosi2 heating element is used in high temperature, so we suggest to setting heating rate as following for longevity of the furnace:

- Room temp---200°C Heating Rate : 5-6°C / minute
- 200°C---1200°C Heating Rate : 7-10°C / minute
- 1200°C---1500°C Heating Rate : 5-6°C/ minute
- 1500°C--- 1600°C Heating Rate : 3-4°C/ minute

3. Operating Instructions

- Step 1 Connect the general power supply, and then turn on the air switch.
- Step 2 Turn on the power switch button on the control panel, and light the intelligent temperature controller instrument.
- Step 3 The temperature controller display the local room temperature (B type thermocouple shows as: PV: 49~50 SV: Stop in window panel) PV shows the actual temperature value, SV shows the setting temperature value.
- Step 4 Input the temperature program

Note: Detail temperature controller operating please check bellow part.

Step by Step for Program Setting: (Yudian 518 Controller)



Notice:

- After set the last program tx=-121, press the key around 3 seconds to run the program.
- When set the time or temperature, click the key to move the decimal.
- In running state interface, click the key to check the running step and running time.
- In running state interface, press the key around 3 seconds, the present temperature will be hold.
- In running state interface, press the key around 3 seconds, the program will stop.

Parameter setting data on the display panel:

Step	Display Statues	SV values setting	Description
1	C_01	0°C	Start temperature (°C)
	T_01	35	First running time (minutes)
2	C_02	200°C	First target temperature (°C)
	T_02	120	Second running time (minutes)
3	C_03	1200°C	Second target temperature (°C)
	T_03	10	Third running time (minutes)
4	C_04	1200°C	Third target temperature (°C)
	T_04	60	Fourth running time (minutes)
5	C_05	1500°C	Fourth target set temperature (°C)
	T_05	30	Fifth running time (minutes)
6	C_06	1600°C	Fifth target set temperature (°C)
	T_06	20	Sixth running time (minutes)
7	C_07	1600°C	Sixth target set temperature (°C)
	T_07	-121	Set running time as "-121", the furnace will perform natural cooling (Annealing)

1. After finishing the above programs, we need to back to the initial interface by clicking the button + at the same time, or simply wait 15 seconds goes back to the initial interface.
2. When back to the initial interface, press at least three seconds button , when the SV shows “run” letter, then the program starts to work with the rising temperature curve according to the above set values
3. Then press the green color “Start” button on the right part of control panel .
4. The furnace will be automatically stop working after the programs had been finished

Note:

To stop the program running, the operator can press the STOP key for 3 seconds until the SV shows the “Stop” mark. The rising temperature control will stop running. Turn off the general power supply after the experiment.

Replacement for MoSi2 Heating Elements



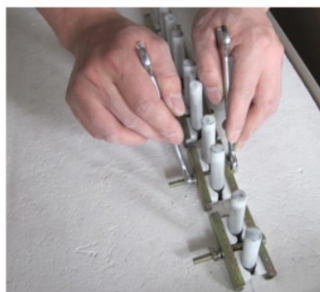
Step 1:
Take off the furnace top cover



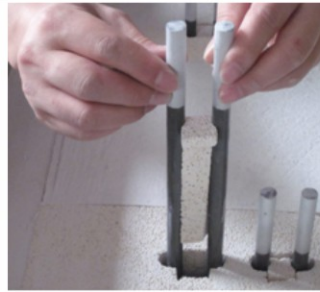
Step 2: Unscrew the fixture of the top end of the heating element carefully



Step 3: Remove the Connecting Alumina Foil Clamp



Step 4:
Remove the Porcelain Clamp



Step 5: Take the alumina plug and the broken heater out carefully. Then put the new MoSi2 heater with Alumina plug at the same time.



Step 6: Lift the MoSi2 rod around 10mm. The top end of U rod should have 10 mm distance to furnace bottom to avoid heater heat expansion distortion.



Step 7: Keep 10mm distance from U rod top to furnace bottom as picture .



Step 8:
Tighten up the Porcelain Clamp



Step 9: Reassembly the Connecting Alumina Foil Clamp

Attentions of Mosi2 Rod Heater Furnace

After checking the wiring of each part is correct, it can be powered to operate the controller.

1. When the furnace is used for the first time or longtime no using, it must be dried.

Specific steps for drying:

The chamber refractory of the new furnace contains moisture, and in order to make the heating element form an oxide layer on the surface, before starting to use, set the furnace temperature from room temperature to 200°C in 4 hours, and then from 200°C to 1200°C in 4 hours.

2. The furnace input power must not exceed the rated power, and the furnace temperature must not exceed the rated temperature .

3. It is forbidden to directly pour various liquids and molten metals into the furnace. Regularly remove iron filings and oxides inside the furnace to keep the furnace clean.

4. The furnace door should be closed and opened gently to prevent damages to the machine parts.

5. When taking and placing samples with crucible tongs, please handled gently to ensure safety and avoid damage to the furnace. When placing the samples in the furnace, open the furnace door slightly, and the sample should be carefully gripped with the tongs after the sample has cooled.

6. After setting the temperature, the operator must put the door fire barrier (fire door block) before heating up. On the one hand, it can play a role of safety and heat insulation, on the other hand to keep the temperature uniformity inside the furnace for high temperature furnace.

7. After the experiment is completed, the sample should be taken out of the heating chamber and turn off the power.

8. When handling the muffle furnace, pay attention to avoiding serious resonance, and keep away from flammable, explosive, water and other objects.

9. It is not recommended to operate the furnace in the temperature range of 400°C to 700°C, because the heating elements (silicon molybdenum rods) will undergo low-temperature oxidation so as to damage the component.

10. The heating element of silicon molybdenum rod is suitable for using in air and neutral atmosphere. The reducing atmosphere such as hydrogen will destroy the protective layer, and the steam of chlorine and sulfur will directly damage the element.

11. Regularly check and make sure the connections of the electric furnace and the temperature controller conductive system are in good contact.

12. This series of furnaces are suitable for the following working conditions:

- (1) Indoor use.
- (2) The altitude does not exceed 1000 meters.
- (3) Ambient temperature is in the range of + 5 ~ 40°C.
- (4) The relative humidity of the surrounding environment does not exceed 85%.
- (5) There is no conductive dust, explosive gas and corrosive gas that can seriously damage the metal and insulation around the furnace.
- (6) No obvious vibration and bumps.

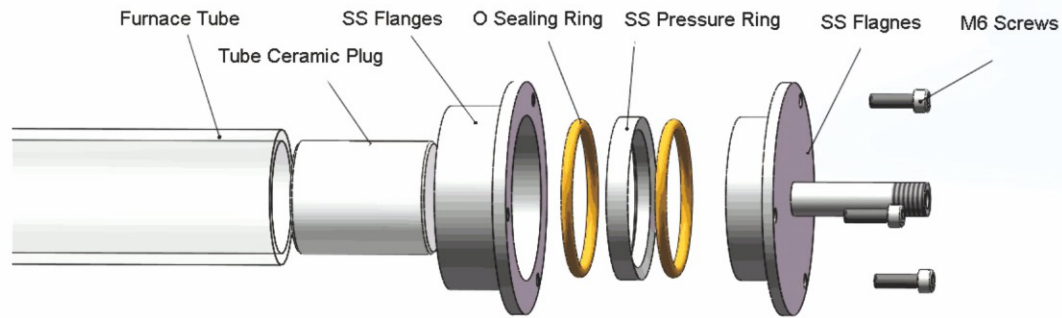
13. The product is guaranteed for one year from the date of shipment (excluding consumable spare parts such as silicon molybdenum rods and thermocouples)

14. Since the characteristic of chamber material (alumina ceramic fiber) is easy to crack under the conditions of rapid cooling and heating, so it is normal condition and does not affect the using.

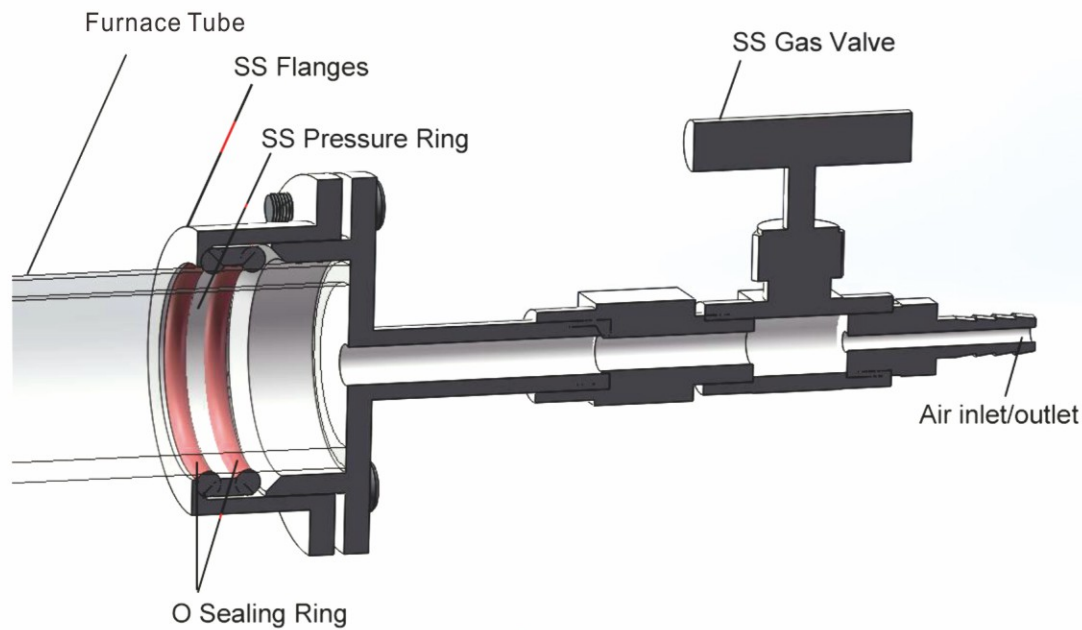
15. Silicon molybdenum rods are wearing parts. Its characteristics are fragile and aging, so users need to be careful during installation and use to avoid breakage and damage.

Vacuum Tube Furnace Installation and Attentions

1. When received the equipment, please open the package carefully and check each parts according to the packing list.
2. Put the tube furnace body on the well prepared bench or other platform and keep horizontal placed.
3. Install the tube two ends vacuum flange parts according to the schematic diagram of installation structure as below:



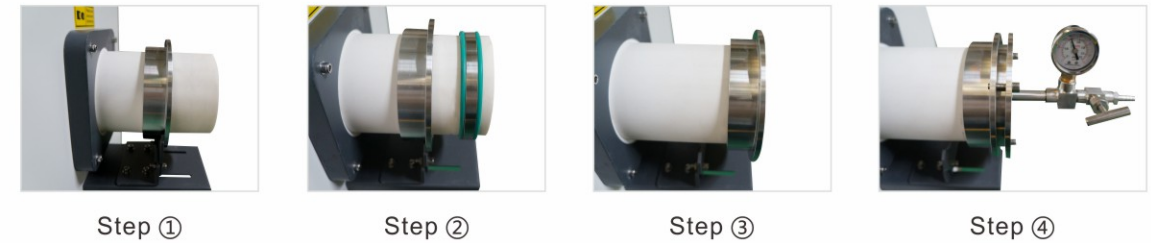
SS Flanges Installing Schematic Structures (1)



SS Flanges Installing Schematic Structures (2)

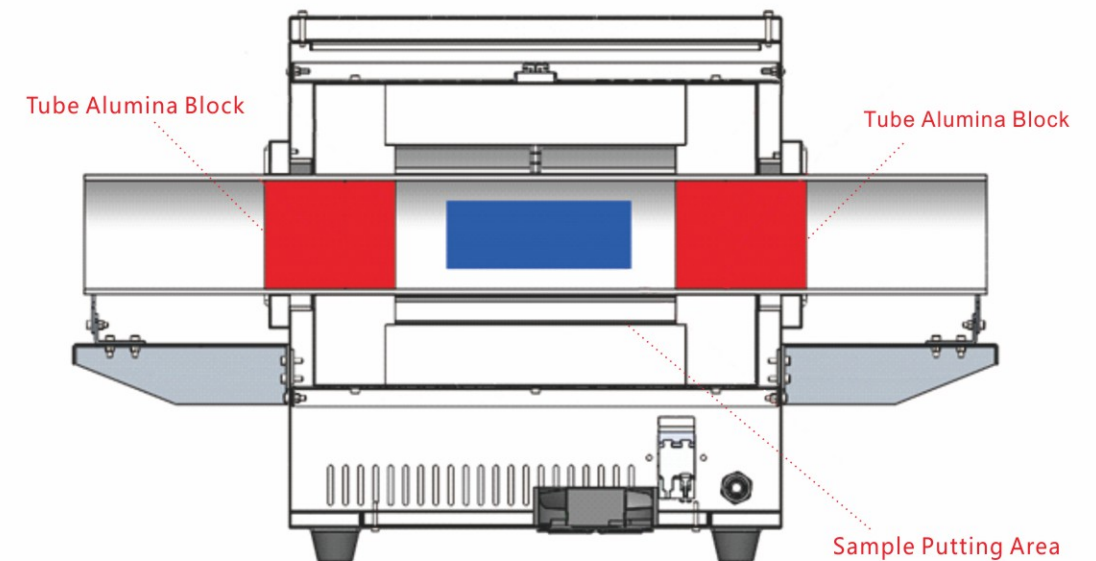
Flanges Installation and Attentions

Steps For Vacuum Flanges Instaling



1. Install the " SS Flanges " first①.
2. Intall two pcs rubber O sealing ring and middle part SS pressure ring as above showing②. And the distance between right side O sealing ring and edge of furnace tube end should be $\leq 10\text{mm}$
3. The falnge end cover in step 1 should totally cover O sealing rings and SS pressure ring like in step ③.
4. Intall the front end cover with valve and fix flanges tightly with bolts evenly in Step ④

Tube Furnace Two Ends Alumina Block Installing Place (Red Part)

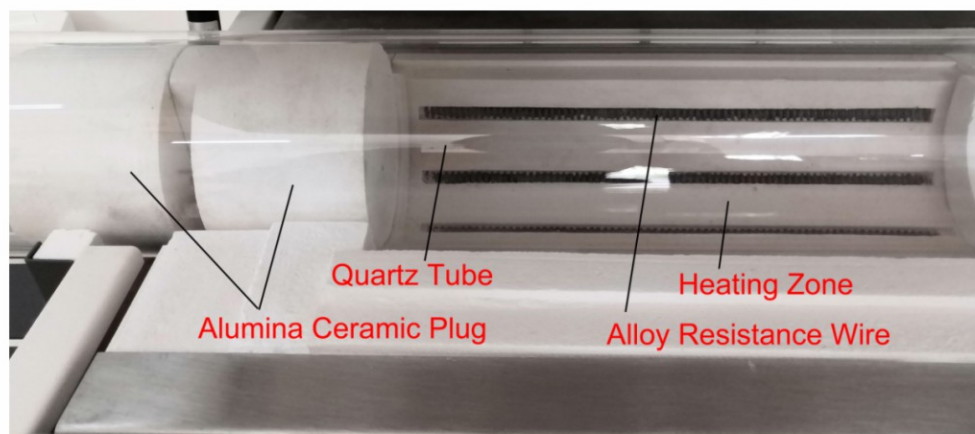


Operating Instruction

- ① Install the flange parts according to the schematic diagram and evenly tighten the screws. Pay attention to the direction and place of the mechanical vacuum pressure gauge during installation.
- ② There are air breath ports with SS valve on the both ends of stainless steel sealing flanges, which can be used for getting vacuum by vacuum pump and in-letting the protective inert atmosphere gas. Both ends breath ports can be used as vacuum ports or protective gas inlet port according to the actual operating space and convenience .
>When the breath port is used for evacuating, firstly to close the SS valve on vacuum flanges on other side to keep a confined space.
>Then turn on the vacuum pump and open the SS valve connected to the vacuum pump.
>Next step to close this SS valve first after the vacuum degree is reached to the request level max -0.1 Mpa according to vacuum gauge reading.
>Finally turn off the vacuum pump to prevent the vacuum pump oil from falling down into the furnace tube.
- ③ When introducing the protective gas, pay attention to checking the pressure gauge data value. First open the outlet port, and then open the inlet port slowly. The maximum pressure level does not exceed 0.02Mpa, otherwise it will damage the furnace tube.
- ④ When using tube furnace, both ends must be plugged with ceramic plugs as the standard device , otherwise it will burn the sealing ring of the sealing flange.
- ⑤ When the experiment is finished and ready to open the sealing flange to take the samples, make sure to check the readings value of the pressure gauge. The pointer of the pressure gauge must point to 0 to ensure no pressure inside the furnace tube. Otherwise it will damage the furnace tube or injure the operator.
- ⑥ Do not open the furnace upper lid when the split tube furnace is working at high temperature. If it is necessary to open it, it is recommended to open below 200°C for safety and be careful of burning.
- ⑦ The type of furnace tube is generally divided into quartz tube and alumina corundum tube. The maximum operating temperature of quartz tube is 1150°C, and the maximum operating temperature of alumina corundum tube is 1650°C. Do not use it with overheating. The furnace tube is a fragile part and should be handled with caution .

Usage of Alumina Ceramic Fiber Plug

The main purpose of putting ceramic fiber plug is to ensure the temperature uniformity in the tube, and also to prevent the sealing ring at two ends from being damaged by over-heating. It is usually made of light-weight insulation material or quartz material, which is fragile. Please use it carefully. Please put the alumina fiber plug from two ends of tube at suitable place after the sample material is placed, the location of the plug is shown as below for reference:



Attentions of Alumina Tube Using



Reasons and attentions of the fracture of the alumina tube:

The alumina corundum tube has the high-quality characteristics of high purity and high temperature, but the corundum material has poor thermal shock resistance and is not resistant to rapid cooling and rapid heating. It needs to be handled carefully during use, otherwise it will cause the furnace tube to burst and cause work interruption, and cause unnecessary loss.

- ① When using a corundum furnace tube to burn the sample to about 1300°C , the water content is required to be very less in samples. For samples with high water content in the crystallization water and the heating process, it is recommended to pre-fire the sample to drain the water first, and then put it into the alumina corundum furnace tube for sintering. The newly purchased furnace tube should be heated to 1300°C and baked with a heating rate of 5~8°C/min, and then used for work to eliminate stress and pollutants. The heating rate should not be too fast, and the cooling curve should be set for cooling. The heating rate should not be higher than 8°C/min, and the cooling rate should be lower than 8°C/min. Be sure to set the cooling rate, and do not directly suspend the program at a high temperature.
- ② The temperature should not be higher than 140°C when putting and getting out the samples. Sample arrangement in high temperature may cause the alumina corundum tube to break. Remember not to touch the furnace tube in high temperature with low temperature objects. When the corundum tube is used, a thermal plug should be placed in the tube. If it is necessary to pass the atmosphere, the air flow should not be excessive to avoid the rupture of the furnace tube caused by the large temperature difference. When using a high-temperature corundum furnace tube, brackets should be added on both sides of the tube to avoid deformation and fracture caused by the gravity of the tube.
- ③ The reason for the explosion of the furnace tube is mainly caused by the too large temperature difference . The heating and cooling rate of the high-temperature furnace tube is preferably 5°C/min. Rapid cooling and rapid heating is an important reason for the broken tube of the corundum furnace tube. Finally, it is necessary to keep the tube clean, clean the inner wall of the furnace tube, and do not leave any samples in the tube.

Vacuum Chamber Furnace Operation & Attentions

1. Vacuum Furnace Description :

The High Vacuum Degree Chamber Furnace mainly include furnace body heating system, vacuum device system, water chiller system and electric control system.

(1) Tank-shaped furnace body with heating system:

It is composed of tank-shaped furnace shell welding parts, tank hemispherical door, internal furnace body support, internal furnace body heating system and other accessories and is mainly used for heating the work pieces.

(2) Vacuum device system:

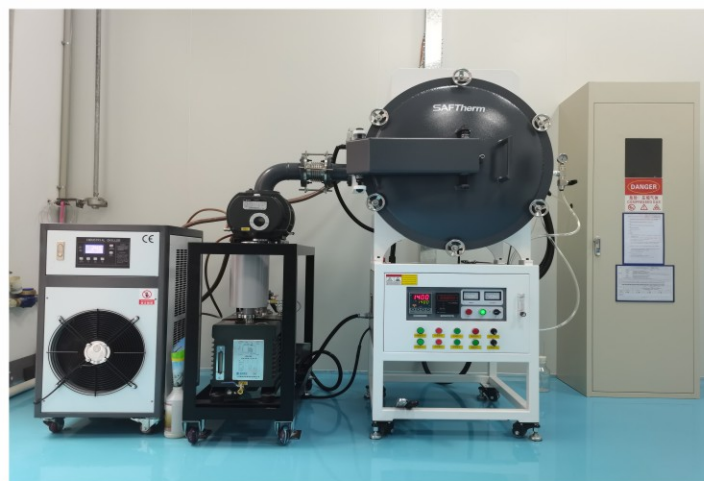
It is composed of vacuum pump and motor, vacuum pump bracket, connecting flanges and other valve assembly etc. It is mainly used for getting vacuum environment inside the round tank.

(3) Water chiller system:

Composed of water chiller and its connecting pipelines and mainly used for cooling of vacuum pumps; (For 1400/1700°C vacuum furnace, it has double shell structure for water circulating and also needs this water chiller system for normal working.)

(4) Electrical control system:

It is mainly composed of electrical control cabinet, temp controller, main electric parts and wire protection cover and others, which is mainly used for power supply control and automatic operation of equipment.



2 .Attention Matters :

- ① The vacuum chamber furnace is generally designed with a double furnace door system. The inner furnace door is used for fire blocking and insulating, and the outer round furnace door is used for tight sealing for vacuum. Make sure that the inner furnace door must be closed before operating, otherwise it will burn out outer door rubber sealing ring.
- ② When evacuating, firstly closed the gas inlet and outlet port valve on the side of furnace to get the sealed environment. Then turn on the vacuum pump for working. After the vacuum degree level reached to the request, firstly close the valve on the connecting pipe between the vacuum pump system and furnace body. Finally turn off the vacuum pump to prevent the vacuum pump oil from sinking into the furnace chamber.

- ③ When introducing protective gas, pay attention to the pressure gauge reading values. The maximum pressure does not exceed 0.02Mpa, otherwise it will damage the furnace body.
- ④ When opening the sealed furnace door after the experiment is completed, the operator must check the pressure gauge reading value first. The pressure gauge pointer must point to 0 Mpa to ensure no pressure inside the furnace chamber. Otherwise the furnace chamber may be damaged or the operator may be injured.
- ⑤ Do not open the furnace door when the vacuum furnace is in the high temperature . If it is necessary to open it, it is recommended to open door at temperature below 200°C for safety .

3. Furnace Test:

Before the equipment is put into production, the main parts should be checked to ensure that the equipment is connected correctly. The specific test requirements are as follows:

(1) Carefully Check Before Trial Test

- a. Whether the equipment installation meets the requirements of the furnace drawings design.
- b. Whether the capacity of the power distribution in the control room meets the requirements of the heater power.
- c. Check the installation and connection of instruments and control equipment meet the requirements or not.
- d. Visual inspection of the inside and outside of the furnace must be prepared well and free of abnormalities.

(2) Heating System Test

- a. Check the heater wiring to ensure that the wiring is correct and that there are no errors.
- b. The heater lead-out and wiring must not come into contact with other objects.
- c. The cable should not be directly attached to the furnace wall, and the connecting nuts of all parts should be tightened and must not be loosened.

(3) Vacuum pump motor steering direction test

- a. Connect the power cord according to the installation instructions. Pay attention to the wire line number marked when connecting.
- b. Turn on the power cord after all wires are sure to connect correctly.
- c. Turn on the power switch on the cabinet panel and press the button that controls the primary first stage pump to confirm that the pump rotation is consistent with the rotation direction marked on the pump body. If the directions are opposite, adjust the phase sequence of any two phase lines of the motor incoming line and reconfirm that the steering is consistent before proceeding.

(4) Vacuum Device Test

- a. Make sure that the chiller is fully filled with water and works normally. If it is found that the water is reduced greatly during the cycle, it should be replenished in time.
- b. Make sure that the valve on the connecting pipe between the vacuum pump system and furnace body is closed before test.
- c. Press the button on the control panel to start the primary first stage rotary vacuum pump first.
- d. Then open the the valve on the connecting pipe between the vacuum pump system and furnace body
- e. When the digital vacuum gauge shows that the vacuum in the tank is less than $1 * 10^3(1000\text{Pa})$, then start the secondary stage roots pump to continue pumping until the required vacuum is reached.
- f. When begin to close the pump system ,firstly close the valve on the connecting pipe between the vacuum pump system and furnace body and then to proceed next step.
- g. Turn off the secondary pump first. After the secondary pump motor stops rotating, press the primary pump stop button and finally turn off the chiller system.
- h. 1400/1700°C vacuum furnace working must ensure the water chiller system is in normal working all the time.

4. Furnace Preheating:

Before the heating furnace is normally put into use, the furnace body should be preheated for a certain period of time .

The new equipment has a large amount of moisture during the construction process. The purpose of preheating is to gradually heat up these refractory materials, and gradually remove the natural water and crystal water. A large amount of vaporization expansion may cause the furnace body to crack, bubble and deform, and even the furnace wall collapses. Through preheating operation, the strength of the material can be enhanced and the service life can be extended.

Only when the system works normally, the equipment is allowed to preheat. The sintering process is performed according to the bellow table:

Temp Range	Holding temp	Time (Heat time +Hold time)	Mark
25 ~ 200°C	200°C	3h	Suggest
200 ~ 400°C	400°C	2h	Suggest
400 ~ 550°C	550°C	2h	Suggest
550 ~ 650°C	650°C	1h	Suggest

When the furnace body is no using for a long time or more than six months, we strongly suggest preheating again according to the specifications in the table above.

After preheating process finished well, the vacuum furnace can be put into normal using.

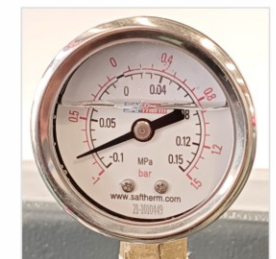
Lower Vacuum Atmosphere Furnace Operation



Lower Vacuum Furnace is one kind of good furnaces for kinds of application with lower vacuum and atmosphere working environment . Its design suitable for max -0.08Mpa (20000 Pa) vacuum degree for structure safety and can inlet kind of inert gas for operating .

Operation Steps :

- 1 Check each part is well connected for preparation work .
 - a. Furnace inner door is well closed and outer door is well tightly sealed for vacuum .
 - b. Gas Inlet valve is closed
 - c. Gas Outlet valve is closed .
- 2 Start the vacuum pump to get the designed vacuum degree level at max -0.08Mpa (20000 Pa) Then close the vacuum Port Valve and vacuum pump to keep vacuum degrees in negative pressure condition .
- 3 If need to inlet gas for protection and you can connected with gas tank and inlet gas from gas inlet port and also please mention above mechanical pressure gauge .The maximum pressure level does not exceed 0.02Mpa (Positive Pressure), otherwise it will be damage the furnace safety structure .
- 4 After finish the final working process, when you need to take the samples and please try to keep the furnace chamber in standard air pressure and that means the pointer refer the value "0" as bellow to open furnace door .





Furnace Troubleshooting Table

No	Common Faults	Phenomenon and Solutions
1	Abnormal Start(1)	The box furnace and tube furnace installed the device (for the function of door open and power off) may have the problem that the equipment can not heat normally after pressing the heating start button. At this time, please check whether the power off stroke switch works or not .
2	Abnormal Start(2)	The temperature control instrument runs normally and press the heating start button, the air switch on the furnace will be tripped. Please check whether there is a short circuit phenomenon; and please measure whether phase wire and the ground wire are connected, and also measures whether phase wire and the neutral wire is in conduction.
3	Abnormal Start(3)	When press the heating start button, it will be automatically disconnected. Please check whether the AC contactor damaged or the control wiring harness is off.
4	Heating Failure(1)	If the high temperature furnace with MoSi2 rods is not heated, please check the voltmeter and ammeter. If there is voltage and no current, please check the MoSi2 rods heaters are broken or damaged and replace the MoSi2 rods to test; if there is no voltage and no current, please contact supplier after-sales service department.
5	Heating Failure(2)	When the air switch is turned on, and the temperature control instrument is not running and the furnace temperature continue to rise rapidly after pressing the start heating button. This phenomenon indicates that the SSR or SCR has been broken down. Please turn off the central power supply and replace the suitable SSR or SCR carefully.
6	Abnormal vacuum degree of tube furnace	In the process of operating the tube furnace, the vacuum cannot be maintained continuously after reaching certain vacuum degree and stop pumping. Please check whether the flange seal is leaking, or the seal ring is damaged, or the furnace tube is damaged.
7	Abnormal ventilation of tube furnace	In the process of operating the tube furnace to feed the protective gas, and the pressure in the furnace tube continues to rise. Please stop the gas flowing into the tube immediately, and check whether the gas outlet port valve is open or there are blocks for it.
8	Abnormal vacuum degree of vacuum chamber furnace	In the process of operating the vacuum chamber furnace, the vacuum degree cannot be maintained continuously after the vacuum pump is stopped. Please check whether the furnace door flange seal is leaking or damaged; if it can not achieve the ideal predetermined vacuum degree, please check the tube pipes connecting or furnace body or valves is leaking .If it is not leaking, please replace the vacuum pump oil to check again.

Product Maintenance Card

User	Address		
Product Name	Product Model		
Distributor	Invoice No.		
Purchase Date	Manufacture Date		
Contact person	Telephone		
Reception Date	Record of Machine Fault and Maintenance	Repair Date	Repair Staff

Matters Attention:

1. The maintenance card is valid after stamped by company.
2. One year warranty (Consumable parts such as thermocouple, heating element and reactor quartz/alumina tube are not covered; Attention: any damages caused by the use of corrosives are not under the warranty.)
3. Private modification on the card is invalid.
4. The user should follow the manufacturer instructions for repairing
5. We has the final interpretation right for the terms of service.