BOX FURNACE

1200°C Furnace

Operational Manual

Laboratory Equipment Pty Ltd

Contents

Thank you for purchasing Labec Furnace. To avoid any misuse and damage, please read the operation instruction carefully before operation.

1. Product Description

· Maximum energy efficiency is achieved by surrounding the chamber with thermo-efficient alumina fiber ceramic insulation
· Three sides resistance wire element for fast and uniform heating.
· Heavy duty double layer structure with cooling fan. Cool temperature outside casing.
· K type thermocouple sensor
· PID automatic control via current limiting phase angle fired the resistor

2. Technical Specifications

Name	Unit	Parameter
Voltage	V	AC 240V 1 phase 50 Hz
Max. Temperature	ºC	1200
Continuous working temperature	ºC	1100
Suggested heating rate	ºC/ min	≤ 20
Temperature accuracy controlled	ºC	± 1
Heating element		Fe-Cr-Al spiral wire
Connection of heating element		Series connection
Thermocouple		K type
Special requirement		With one SiC plate to put on bottom

3. Furnace Structure

4. Instruction of the 708 Intelligent Temperature Controller

（1）Main Features：

• The 708P temperature controller uses advanced AI intelligent adjustment method, no over shooting, and has an auto tune function.
• Both of Input and output employ digital calibration system and ensure accurate and stable measurement.
• Measuring accuracy: 0.2% in full scale.
• Alarm function: Up limit and input open circuit.
• 51 segments programmable. Auto and manual operation can be switched without disturbing.

• Power off protection. In the case power off or other disturbing, input data can be saved via smart EPROM IC to ensure continuously running once power resume.
• Universal switching power: 85V -264V AC, 50 – 60 Hz
• Power consumption: ≤ 5W

（2）Temperature Controller Connections：

There are 20 connectors in the backside of temperature controller. The connection is shown as

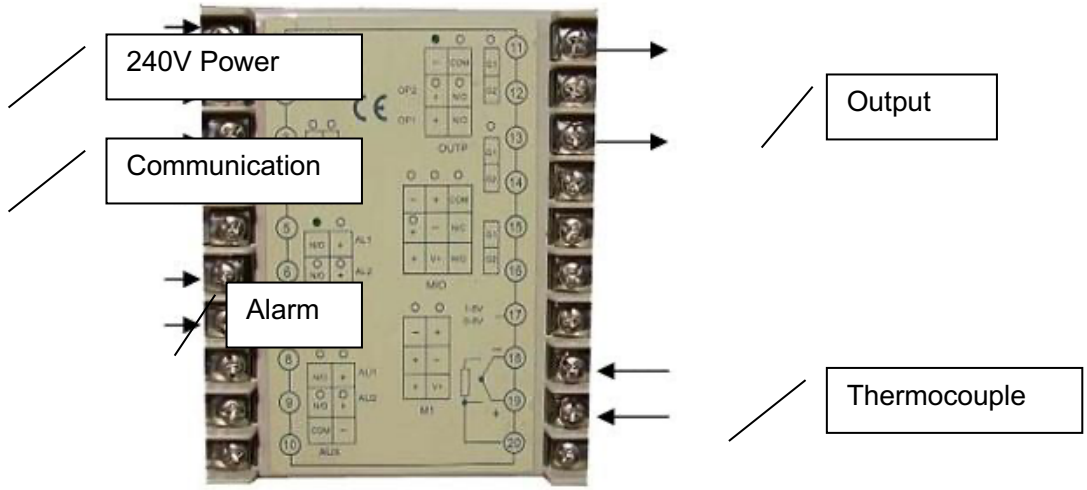

Fig. 1

(3) Indication of Front Panel of Temperature Controller：

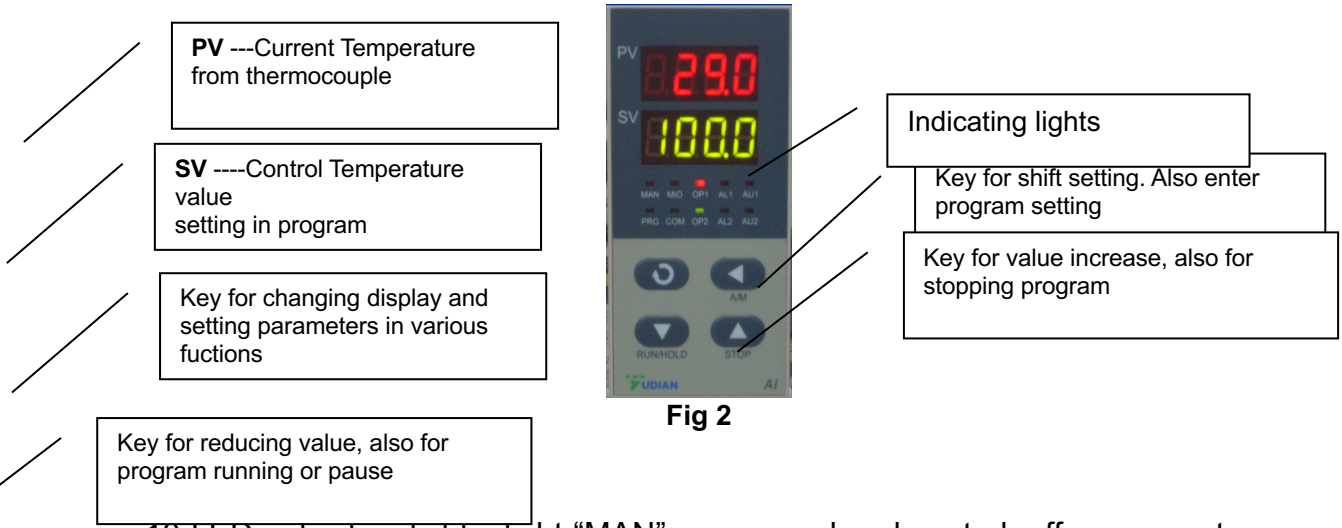

Fig 2

10 LED indicating lights, light “MAN” on means hand-control, off means auto-control；PRG means meters in the running state; M2，OP1，OP2，AL1，AL2，AU1，AU2 and so on mean output/input actions of corresponding module；Light “COM” means connecting with upper machine.

5．Setting Procedure for the 708 Temperature Controller

Before running the furnace, you must plug in to 240V AC power.
Install the thermocouple at the top of the furnace and make sure connection

correctly (blue wire connecting with negative; red wire connecting with positive, Fig.3) (installed in factory)
Then turn lock in clockwise rotation to get temperature controller power on (Fig.4)
After setting program in temperature controller, push “turn on” button to make A.C. contactor closed (Fig. 4)

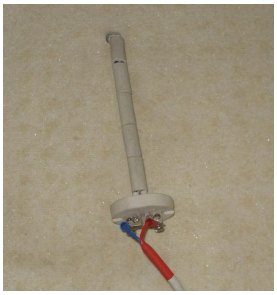

Figure 3

Figure 4

(1) *Starting State of Display of Controller Panel*

When turning power on, controller display shows the model No (708) of the controller, software version first. A few seconds later, controller will display temperature condition. PV shows real temperature, and SV shows setting temperature. If “SV” flashing and shows “Stop”, it means that control program is at stop state; If “SV” shows “Hold”, means that program is at the pause stage.

Fig. 5

Fig.6

Fig.7

Fig. 8

(2) Switching Function of Display

Under starting state of temperature display as Fig. 5, e.g. the panel can be switched to program setting function and parameter setting function by touching key: Touch key and holding for one second, PV will show “Step” and SV show Step # (Usually shows 1) as Fig. 6 Press key once again, PV will show the setting time in the step, and SV shows the time that has run in this step. Press key and hold for two seconds under “starting state”, Display will show parameter setting function as Fig 8, (PV shows M5, and SCV shows 289.7)
Please don’t change any parameters unless you understand what that parameter is affecting. Should you change the incorrect setting you may cause damage not covered by warranty.
The parameters have been preset according to our testing. The next chapter will explain how to change “Parameters “

Please be advised that *if you don’t touch any keys on the panel for 4 seconds, the display will return to*

*"**Starting State** "automatically. And all revised data will be saved.*

(2) *Setting Temperature Control Program*

In order to set temperature control program, you must switch display panel from "starting state "to
Fig. 7 state. (Please follow procedure from Fig. 4 to Fig 7)
Then touch Key ◄ and hold for one second, the Panel enters temperature program setting stage. On the display, (as Fig. 9)
PV shows first segment for temperature SV shows Initial temperature value.
Then touch Key◄, program enters holding time (as Fig. 10)

Fig. 9

Fig. 10

PV show the segment number for time.
SV shows time setting (Minutes) in this segment.
By touch key ▲ or▼, you can increase or decrease the value to be set.

Yudian 708 controller allows you to set one temperature profile up to 30 segments.
By touch key◄ and uses key ▲and▼ you can get in next segment for temperature or time setting.
During program setting, by touching ◄and holding for two seconds, you can return to previous setting and make revising.
By touching key ◄ first, then press key↺, you can exit program setting mode. If no key operation for 30 seconds, display exits program setting mode and returns to "starting state".

(3) *Example for Setting Temperature Control Program with 6-segment Profile.*

For a complicated temperature control profile, we strongly suggest you make drawing as Fig.11 then make form as table 1 to list all data in every segment.

Fig. 11 is the temperature profile that we would like to set.

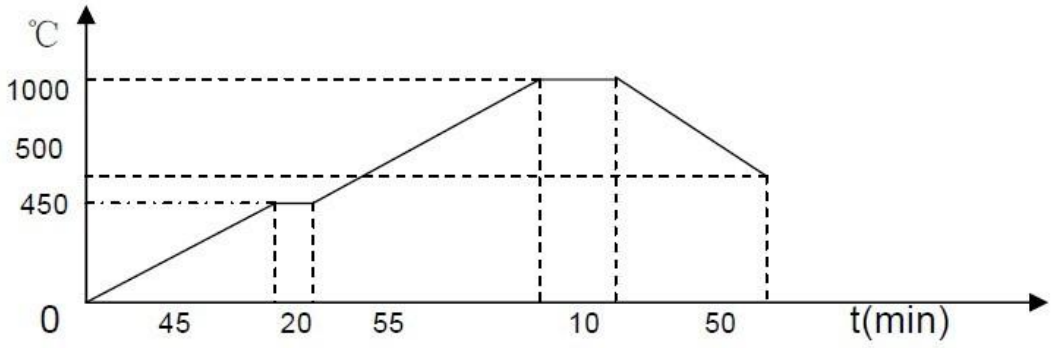

Fig. 11

According to this profile, you shall list all segments in the following Table.

Segment #	Symbol in Panel	Data to be In-put	Meaning in the program
1	**C 01**	**0** (℃)	Initial Temperature
2	**t 01**	**45**(min.)	Ramping time from 0 – 450℃ Average Heating rate is 10℃ /min. Max Rate 10 per minute
3	**C 02**	**450** (℃)	Target temperature value to first heating stage (450℃)
4	**t 02**	**20** (min.)	Soaring time at 450℃ stage
5	**C 03**	**450** (℃)	Temperature value at the heating flat
6	**t 03**	**55** (min.)	Second Heating time from 450 - 1000℃ Average heating rate is 10℃ /min Max Rate 10 per minute
7	**C 04**	**1000** (℃)	Target temperature value to peak heating stage (1000℃)
8	**t 04**	**10** (min.)	Soaring time at 1000℃ stage
9	**C 05**	**1000** (℃)	Temperature value at peak heating flat
10	**t 05**	**50** (min.)	Cooling time to 500℃ Cooling rate is 10℃ /min
11	**C 06**	**500** (℃)	Target temperature to be cooled (500℃)
12	**t 06**	**-121**	Program end, Out-put power off. Furnace cooling down naturally (t 06 = -120 is an order to stop running.

Using 4 keys of , , , enter data listed the above table into controller separately , then , you finish one temperature control program finish Please be noted that " t xx " is time value for XX segment. It can be set from

1- 9999 minutes. However, if “t xx “is set as the following values, it can be as a special order. These orders only can be used in complicated multi temperature profile program.
If **t xx = o:** Controller will be paused at xx segment (Hold)
If **txx = - (1-150)** Negative value is a control order, which let program stop running, or jump to another segment.
If **txx = - (Ax30+B)** , here B values is 1- 30. Which indicates program will jump to the segment at B value.
When **A=0**, only execute segment jump function.
When **A=1**, program will cut off power delay
When **A=4, B=1**, Program will execute “stop “order

(5) Run Temperature Control Program with Furnace

When temperature program set up ready, touch key and hold for two seconds, then display SV will show letter “run”, furnace will run automatically segment by segment according to program step by step.
Under furnace running state, “Out “indicator‘s brightness will change based on power out value.
If you want the furnace to stop running temporarily, please push key and hold for two seconds, then display SV will show letter “ Hold”, the furnace enters “pause state “. In the “pause state”, controller will keep furnace temperate at the value when “pause” order was given, but time running is stop.
Under the “ Pause “ state, push key for two seconds, SV display will shows “ run”. And furnace will start running again from the point where is paused.
If you want to stop running furnace, whatever under “ pause” or “ running “ state, you can push key and hold for two seconds, then, SV display shows “ stop” , furnace totally stop running and controller will be in “starting sate”. If you want to run again, the program will start at the beginning step. If furnace temperature still is higher than “ C 02”, program will not run until temperature going down to “ C 02”. In order to run faster, you can choose program run from “step 2”, or “step 3”.

(6) Function Parameters Set Up and Revise

The following function parameters are preset in the temperature controller. They are very important for controlling furnace temperature stability and accurately. Unless you have enough experience, don’t change the preset parameters in the controller. In order to change the function parameters, follow procedure as below:
 Press key and hold for two seconds under “starting state”, display will enter parameter setting function.
 Touch key and hold for one second again, PV display will show symbol: “M5 “(Fig.12), “P” (Fig. 13), “t” (Fig. 14), “CtrL” (Fig 15) and “LOC” (Fig.16) respectively.
 Using and key to change the value under different parameter setting.
 Hold key for two seconds, setting will go back to previous parameter.
 Press Key, then push, Display will exist “parameter setting”.

Fig.12 **Fig.13** **Fig.14** **Fig.15** **Fig.16**

Table 2 lists the parameters and their meanings:

Parameter in Display Panel	Range to set	Parameter 's function	Preset value in the controller
M5 Maintenance parameter	0 -9999	Adjust temperature difference between set value and real value. the larger M5 value, the longer adjust time, and M5 smaller time is shorter	**60** (adjust between 200 – 500)
P Speed parameter	1-9999	Adjustment rate in controller. P value increases adjustment faster, decrease, adjustment slower	**50** (select between 3-10)
T Delay time parameter	0 - 2000	Control temperature over shooting. **t** value smaller, temperature overshoot smaller, otherwise, overshoot occurs.	**4** (3-10)
CtrL Control type	1, 2, 3, 4,	1= Auto tune from front panel 2= Auto tune first, then go to 3 or 4 automatically 3= built-in Auto tune, cannot be changed from front panel 4= more accurate auto tune	**3**
LOC Parameter lock	0 - 9999	Preset in controller. Please never change	**0**

Again, only in the case that you find temperature control is not stable during running, the parameters above may be considered to be adjusted.
Before adjusting the parameters, you shall use ***"Auto-Tune"*** function to achieve the best setting result. The procedure is as the following:

- let furnace stay in a temperature that is the most important for you.
- Set Loc value to 2.
- let display return to "starting state "
- Hold key for two seconds, then front panel of controller will flash with letter " AT", which means controller is in " Auto-Tune" state.
- After "Auto-Tune", AT letter will disappear and controller will select all M5, P

and t value automatically.
You may repeatedly set “Auto-tune “2-3 times to achieve the best result.
After Auto-tune please set Ctrl to 3.
If temperature is still not stable after Auto-tune; you may adjust M5, P, and t value manually.
The parameters have been preset according to our experience. Please don’t adjust the parameters unless you are very familiar with the function of parameters.

In order to adjust the parameters, you need to do as the following:
From function parameter state of “Loc” as shown in Fig. 16, change “Loc” value from “ 0” to
“808” as shown in Fig. 17

Fig.17 **Fig.18** **Fig.19** **Fig.20** **Fig.21** **Fig.22**

Then, you can revise the parameters from “HI AL” (Fig 18) ---- “Sn “(Fig 19) ---- “ oPL “(Fig20) --“ oPH” (Fig. 21) by The Key , , step by step.
After changing the parameter and make sure all parameters are correct, you need to change “LOC” to ‘0” as shown in Fig. 22.to lock all data entered without change.

6. Installation Procedures
Please follow the instructions as the below for furnace installation
Open shipping package to check if all components are good condition. If find any damage caused by shipping, please report it to **Brother Furnace Co.** immediately by email at sales@brofurnace.com
The furnace must be placed in flat surface to avoid vibration, where must keep from flammable and explosive materials.
The furnace uses AC 240V / 3.6KW power. Please make sure that power source in your lab is enough to meet this power requirement. You must use a power plug (not included) at > 32A current rating to connect furnace.
Firstly, open back cover of electric cabinet, you will see a wire terminal with 5 holes. (Fig.23). Please connect power cable to the terminals according to the signs. (Note: thermocouple wire has been connected well. Fig.23)

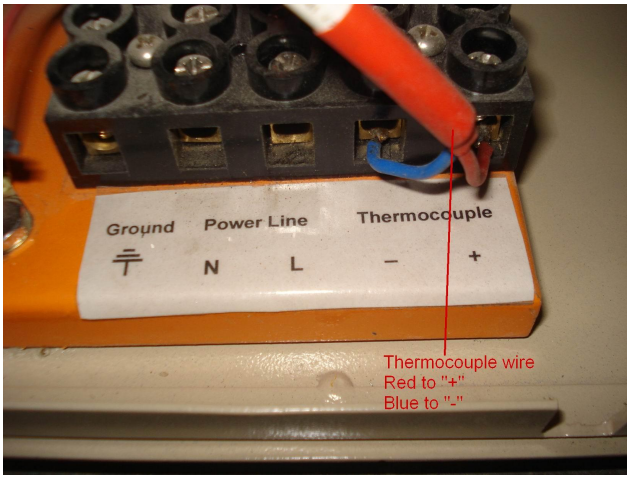

Fig. 23 : Wire terminals and thermocouple wire

Because there is heating wires at the furnace chamber bottom, it needs a SiC plate to put on the bottom. SiC plate is shipped with the furnace as accessory.(Note: SiC plate is hard. In order to avoid damage ceramic insulation, please be carefully to put SiC plate on chamber bottom). Fig.24

Fig.24

7. Instructions for Quick Start:

Procedure for running furnace.

 Plug in power (Green Power indicator is on, cooling fan run)

 Turn Power switch lock on, (Yudian 708P controller is on)

 Let 708P control display is at “starting state “, e.g. PV panel shows temperature value, and SV displays “stop”. If controller is no at the state, touch key, 708P controller shall be back to “starting state “

 Input temperature program. (Please be advised that heating rate shall not be too fast in low temperature stage to avoid damage furnace)

 Push green “Turn On “power switch button.

 Push Key on the controller and hold for 2 seconds, PV panel shows “Run”, now furnace is running automatically.

Procedure for shut down furnace

 Push key to make sure the controller is at “stop “state.

 Touch Red “Turn-Off” button shut down furnace power.

 Turn lock to close position to cut off power to control panel.

 If possible, close power switch from cable.

 End

8. Maintenance and Safety

a) When power on, if you cannot hear a sound from cooling fan, please don't continue to operate. You must shut down power to check or replace the cooling fan.

b) During furnace running, please don't touch furnace to avoid any high temperature burns to skin.

c) Please don't open the front door of the furnace above 300℃ to prevent insulation inside furnace from cracking.

d) If the furnace is used at first time or not use for long time, please preheat the furnace at 300℃ for at least 2 hours to remove moisture inside to avoid chamber cracking.

e) Please always keep inside clean before operation to avoid contamination to your sample.

f) Furnace must be used under following condition:

Temperature: -10 – 75℃; Elevate: < 1000 M, Humidity < 85%; Environment: no vibration and conductible dust, explosive, flammable and corrosive gases.

g)never operate the furnace without safety gloves and safety glasses and use tong for load/unloading.

h)the power to the elements will switch of when the door is opened by the micro-switch on the front panel. Check regularly this is not stuck down and is free to move when the door opens and closes.

9. Trouble shooting for typical Problems

Problems	Reason	Solution
Open Power Lock, no power indication	Fuse (4A) in control panel is broken	Check control panel, and replace fuse
Green Power indictor is off, but Red open circuit indicator is On	Fuse (50A) in main power circuit is broken	Open the cover of front panel and replace the fuse
No current shows in meter , but has Max. Voltage	Heating element broken Door microswitch is not closed or is broken	Find broken heating rod, and replace it
Controller display panel SV shows“ OraL”	Thermo couple broken	Replace Thermo couple (K type)
Controller display panel SV shows“ HI AL”	Furnace temperature > 1200℃ Protection from Alarm	Cool furnace down, and find reason why temperature is so high (program setting may be wrong)
Power and heating element are OK, but furnace can't be controlled by program.	Controller or related circuit may be damaged	Heck controller. If not, please inform manufacturer to check what the
Program running, but	oPL or oPH value is too	Incraese “oPL” and

furnace can not be heated, or real temperature is far behind the setting value	low due to local voltage lower or frenquency different	“oPH” value, and program runs smoothly
During heating below 300℃ the temperature value (PV) is not stable, and doesn’t match with setting program (SV)	It is normal because the furnace comes with a high temperature thermocouple, which is not sensitive at temperature below 300 ℃	Don’t worry. Let the furnace heat to 300°c then thermocouple will function stably with program. If the PV value at 300℃ is still less than that of SV, you may need to increase OPL value a little.