



FASTcal 3000

User's Guide



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Preface

Welcome to the FASTcal 3000 user guide. This guide provides detailed information about all the product options and features, and explains how to use the product and configure basic settings to suit your requirements.

This user manual contains information about the product and its proper use and should be kept in a place where it will be easy to access. This user manual also provides safety precautions in using this product.

Safety Information

This chapter contains important information for the safety. If the instructions contained are not followed properly, particularly the safety guidelines, it could result in serious personal injury or can cause serious damage to the unit and to the components of system it is connected to. Use the instrument only as specified in this manual. Otherwise, the protection provided by the instrument may be impaired.

Refer to the safety information below and throughout the manual.

In order to assure the device operates safely, the operator needs to act effectively and be conscious of safety problems.

The terms "Warning" and "Caution" have the following definition:

- **"Warning"** indicates conditions or behaviors that could endanger the user.
- **"Caution"** denotes situations or behaviors that may endanger the instrument in use.

The following safety symbols may appear on FASTcal 3000 unit:

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	Risk of Danger. Important information. See Manual		Hazardous voltage. Risk of electric shock
	Caution, Hot Surface		Protective Earth Ground

Electrical Safety

WARNING:

- **Before using this equipment, make sure it is properly grounded. Make sure the ground conductor wire (colored green) in the main power cable is connected to a protective earth/ground. If the equipment is not properly grounded, the high voltage may flow through the equipment body (chassis). If safety procedures are not followed, SEVERE INJURY OR DEATH may occur.**
- **Do not remove the panels from the equipment without proper safety measures to avoid internal main power supply voltage hazard.**
- **High current is present in the enclosure.**

Follow these precautions to avoid electric shock or personal injury:

- ⊕ This equipment uses protective earth circuit to ensure that the conductive parts do not store electric charges or conduct electricity if insulation fails.
 - Before connecting the equipment to the electricity supply, understand the parts of the calibrator with the help of operating manual.
 - Replace the main power cable if the insulation is damaged, or if the insulation shows signs of wear and tear.
 - DO NOT use the product if it operates incorrectly.
 - If the power cable requires replacement, replace only with equal, approved cable.
 - Cabinet covers may be removed while in operation if required for trouble shooting only.
 - Do not look into the blackbody cavity when temperatures are above 1100°C. Temporary flash blindness can occur at temperatures > 1200°C assuming eye blink response of 0.15s. Permanent eye damage could occur if you continuously stare at blackbody temperature above 1200°C without protection.
 - Do not attempt to operate with any of the safety features bypassed or disconnected.
 - There are NO user serviceable part parts inside. Contact us for repair.
 - Do not use the apparatus outside its recommended range i.e., +500 to 3000°C.
 - Ensure inflammable materials, are kept away from the hot parts of the apparatus, to prevent fire risk.
 - Check and take necessary while observing alarm- water flow, gas flow, RTD temperature alarm.

Health and Safety Instructions

 **WARNING: BURN HAZARD - DO NOT touch the well access surface of the unit at high temperature**

To avoid possible health and safety concerns, follow these guidelines.

- Wear appropriate protective clothing before using the equipment.
- Operators of this equipment should be adequately trained in the handling of hot and cold items and liquids.
- Do not use the apparatus for jobs other than those for which it was designed, that is, the calibration of pyrometers.
- Do not touch the apparatus when it is hot (or cold), without wearing the appropriate protective clothing and having the necessary training.
- Do not drill, modify or otherwise change the shape of the apparatus.
- Do not use the apparatus outside its recommended temperature range.
- There are no user serviceable parts inside. When required, contact Tempsens agent for repair.
- Ensure all materials, especially flammable materials are kept away from the hot parts of the apparatus, to prevent fire risk.
- Do not use the product around explosive gas, vapor, or in damp or wet environments.
- Make sure that the space around the product meets minimum space requirements.
- The top sheet metal of the furnace may exhibit extreme temperatures for areas close to the well access.
- Materials used in this furnace may be irritating to skin, eyes, and respiratory tract. Consult the material manufacturer's Material Safety Data Sheet (MSDS) to learn about those materials before using.

Cautions and Preventions

To avoid possible damage to the instrument, follow these guidelines:

- Before working inside the equipment, turn the power off and disconnect the power cord.
- Do not use this unit for any other application other than calibration work.
- Before connecting to the electricity supply, please familiarize yourself with the parts of the calibrator with the help of operating manual.
- Calibration equipment should only be used by Trained personnel.
- Use of this instrument at HIGH TEMPERATURES for extended periods of time requires caution.
- Components and cavity lifetime can be shortened by continuous high temperature operation.
- DO NOT use fluids to clean out the furnace.

Document Conventions

The documentation uses the following conventions.

 Note:	Configuration notes
 Tip:	Recommendations or suggestions
 Important:	Information regarding required or default configuration settings and product limitations
 WARNING:	Critical actions and configuration options
 WARNING:	

Chapter 1

Introduction

1.1 About FASTcal 3000

The FASTcal 3000 are high temperature blackbody calibrators that can produce a very high temperature, high emissivity targets, and at the same time stabilize at the required temperature within a few minutes of switch-on.

The cavity is a graphite tube target which is available 25mm (1.00") (Other size also available as per request) with an effective emissivity of 0.99. Target is sensed by a rapid response pyrometer which drives a PID controller to regulate the target temperature precisely to the desired value.



Front View



Back View

1.2 Basic Working Model of FASTcal 3000

FASTcal is a transportable unit designed for use on any reasonable flat surface. It is based on the principle of direct resistance heating of a graphite rod using large AC current and low voltage to put large amount of power into an insulated heater element. The target is a graphite rod, which allows the source to heat up to 3000°C in about 5 minutes. The graphite heater element is adequately insulated so that it can cool down as fast as it heats up. The copper block house consist of RTDs, which is used to sense the temperature and output of RTD given to PLC for safety interlocks.



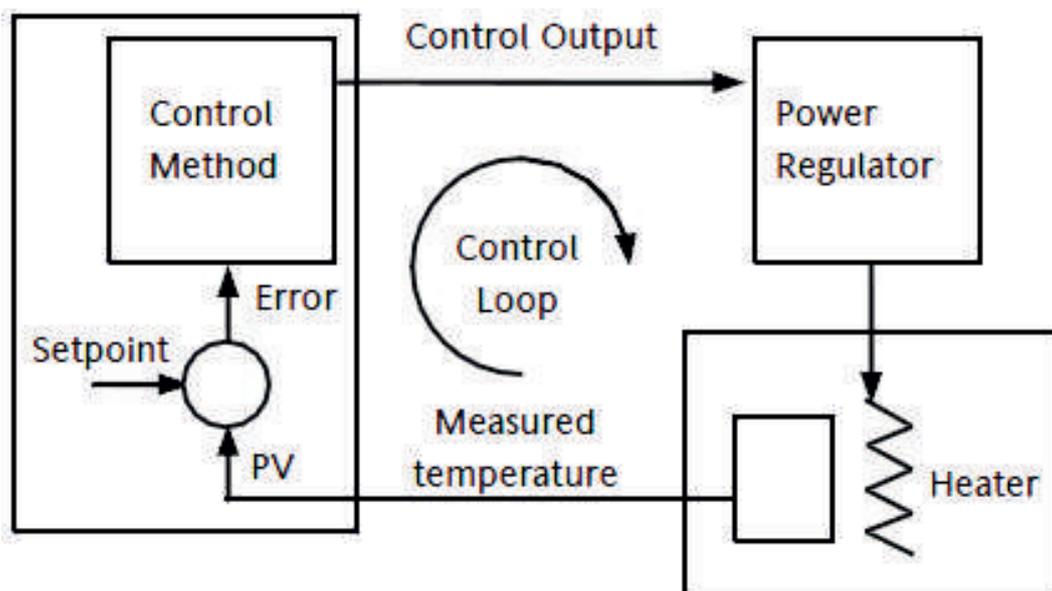
Note :

- It may take some time for the temperature to get stable. Make sure to calibrate once the temperature is stable.

! Important:

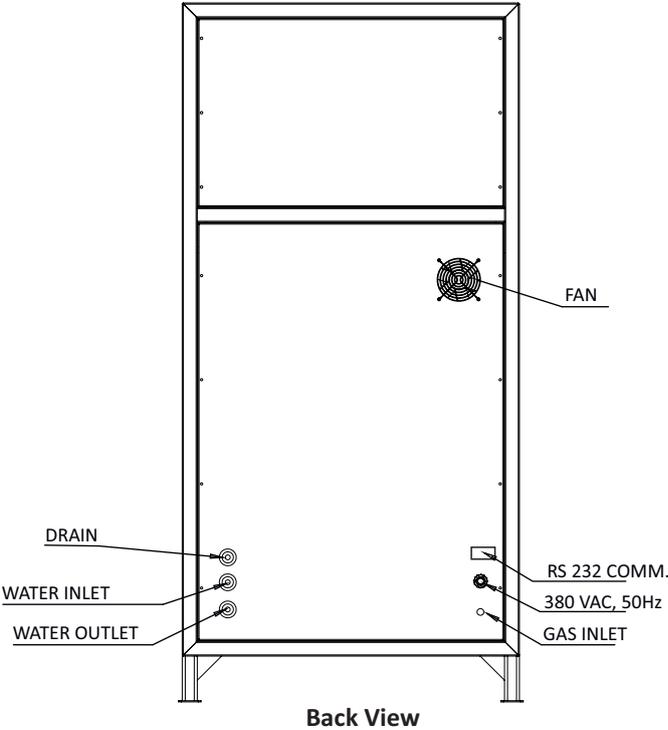
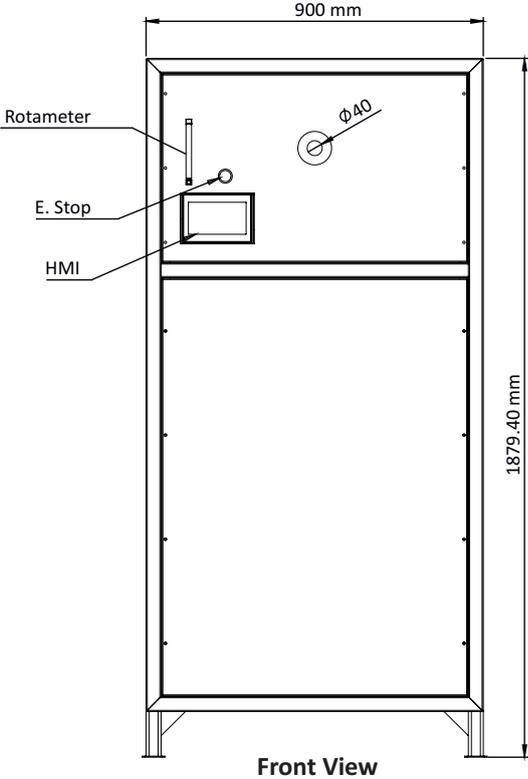
- **Before using the equipment, read the safety guidelines and operating procedures of the calibrator as described in the of this user manual.**

The basic working model for FASTcal 3000 is as follows:

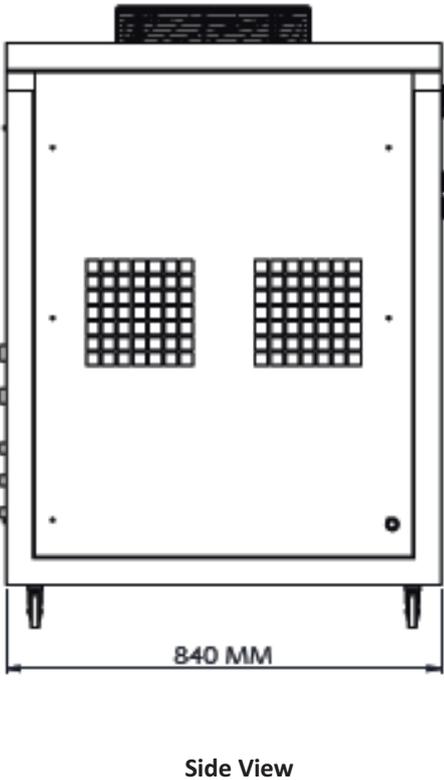
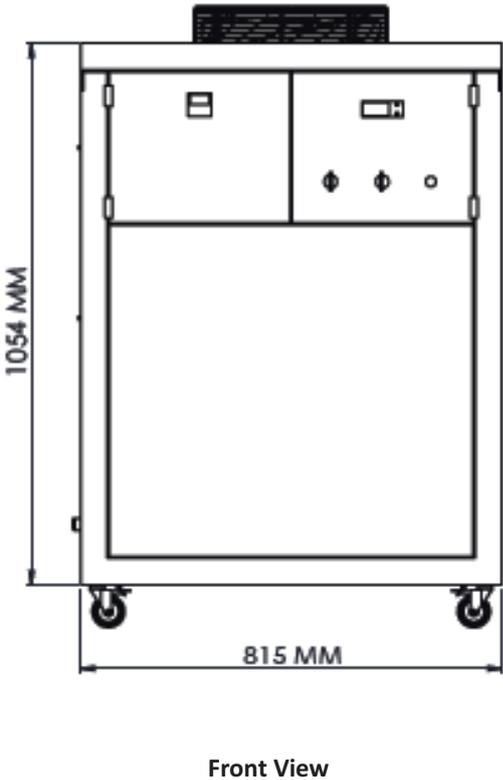


1.3 Physical Measurement

FASTcal Dimensions :



Chiller Dimensions :



1.4 Technical Specification

FASTcal 3000 has following technical specification:

PARAMETER	SPECIFICATION
Temperature Range	600°C to 3000°C
Method of Control	PID controller Eurotherm make 2604
Controlling Sensor	Pyrometer, Make AST model 250
Wavelength	1000 nm or 1600 nm(Pyrometer)
Temperature Resolution	0.1°C
Emissivity	0.995 ±0.005
Cavity	Graphite Dual cavity blackbody, one side for control and one side for measurement
Heating Aperture	25mm
Cooling	Water cooling system through chiller unit
Water in chiller	Only demineralised water
Purge Gas	Argon gas flow with 15-20 LPM
Purity of gas	99.99%
Heating Time	Approx 5 minute from ambient to 3000°C
Safety Interlocks	Cooling water over temperature, Low purge gas flow, cooling water flow, overcurrent and over temperature protection.
Ambient Temperature	Ambient ±15°C
Power	380VAC, Two Phase AC (Without neutral), 50Hz, 60KW
Dimension of Chiller	1310mm(H) x 820mm(W) x 850mm(D)
Dimension of FASTcal 3000	1880mm(H) x 900mm(W) x 1205mm(D)
Weight of Chiller	200 Kg
Weight of FASTcal 3000	755 Kg

Chapter 2

Setting up FASTcal 3000

2.1 Installation

Place the calibrator on a flat surface with at least 1.5 meters of free space around the instrument. Overhead clearance is required.

DO NOT Place this unit under a cabinet or structure. Plug the power cord into a grounded mains outlet located on the controlling unit rear panel. Observe that the nominal voltage corresponds to that indicated in the [Technical Specifications](#) in [Chapter 1](#) of this user's guide.

2.2 Optimal Environmental Conditions

Although the instrument has been designed for optimum durability and trouble-free operation, it must be handled with care. The instrument should not be operated in an excessively dusty or dirty environment. Refer to [Chapter 8, Service & Maintenance](#) in this user's manual for routine service and cleaning recommendations.

The instrument operates safely under the following conditions:

- Temperature range: 20°C - 25°C (68°F - 77°F)
- Ambient relative humidity: 15 - 50%
- Pressure: 75kPa - 106kPa
- Mains voltage within $\pm 10\%$ of nominal
- Altitude less than 2000 meters

2.3 Unpacking and Initial Inspection

FASTcal 3000 is packed in custom-designed packaging to send out your unit. Unpack the furnace carefully. Inspect the unit after unpacking for any signs of damage, and confirm that your delivery is in accordance with the packing note. If you find any damage to the unit or an item is missing, notify TempSENS immediately.

The following accessories are included in the package:

- FASTcal 3000
- Radiation block – 1 set
- Heating assembly - 2 set
- Chiller unit



FASTcal 3000



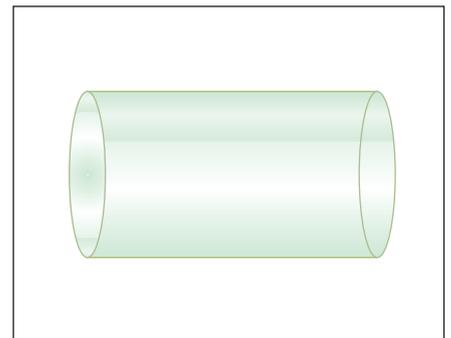
Chiller Unit



Cavity



Cavity support Block



Quartz Glass



Radiation Block

Chapter 3

Installation of FASTcal 3000

3.1 Unpacking

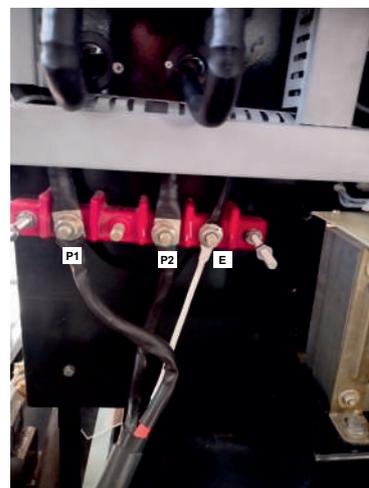
Open the wooden box and unpack the furnace carefully. Check the furnace for any damage that might have occurred during shipment, if damaged, inform the carrier right away.

3.2 Installation

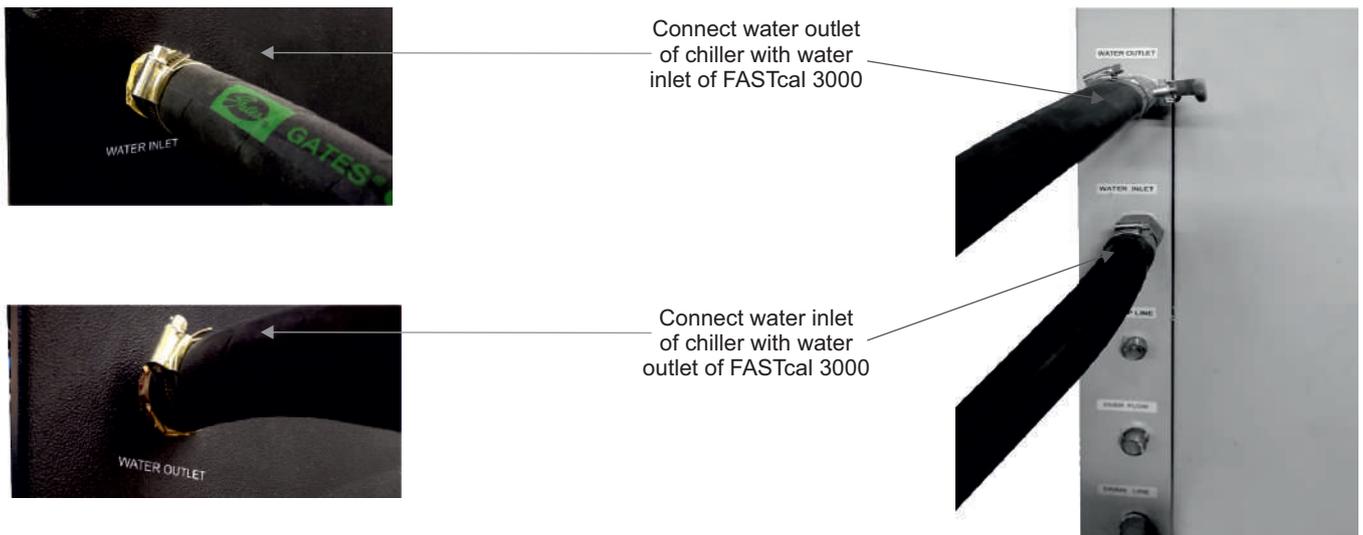
1. Open the side door with the help of allen key, and disconnect the water pipes from inside. Now open the back door.
2. Remove the packing sheets from inside with utmost care.



3. Connect the mains cable to P1, P2 and E terminal of the TB. Refer to the below shown image.



4. After connecting the mains cable attach the back door.
5. Now, connect the water pipes from inside, make sure to tighten the connections enough so that no leakage of water will occur.
6. Now attach the side door.
7. Connect the chiller unit with the the FASTcal. Make sure while assembling the chiller unit it should not be tilted and must be upright properly. Connect the chiller unit with 220 VAC, 50 Hz.

**Note:**

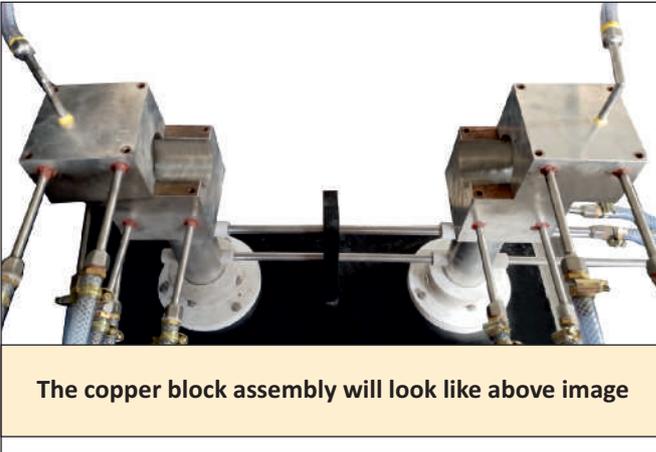
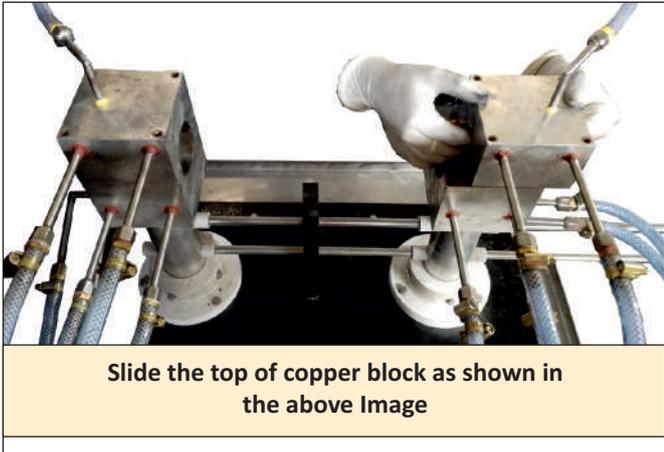
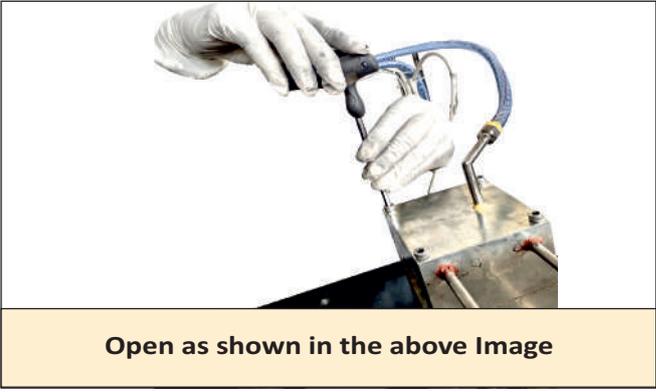
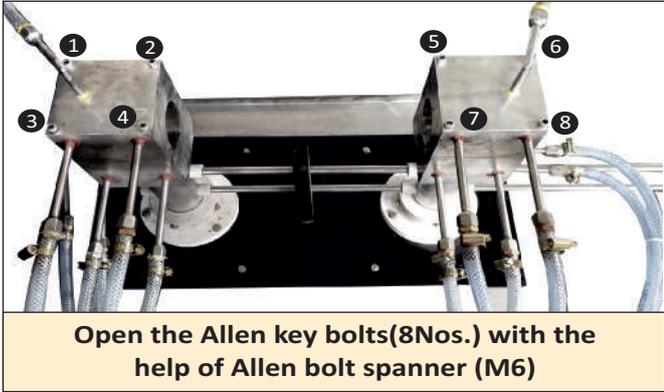
- Place the chiller unit on a flat surface with at least 1 meter of free space around it and it must have overhead clearance for adequate heat dissipation.
- It is recommended to make the chiller assembly stable for **3 hours**, and then only use it.
- Make sure to use only **demineralised water** to prevent contamination.
- Earthing should be done properly and avoid any loose contact.

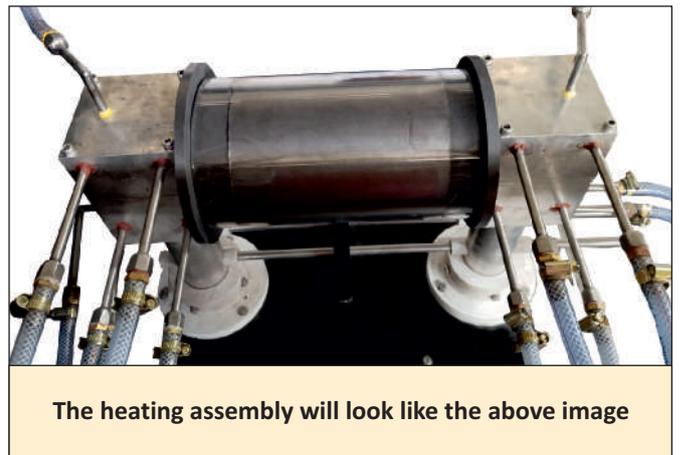
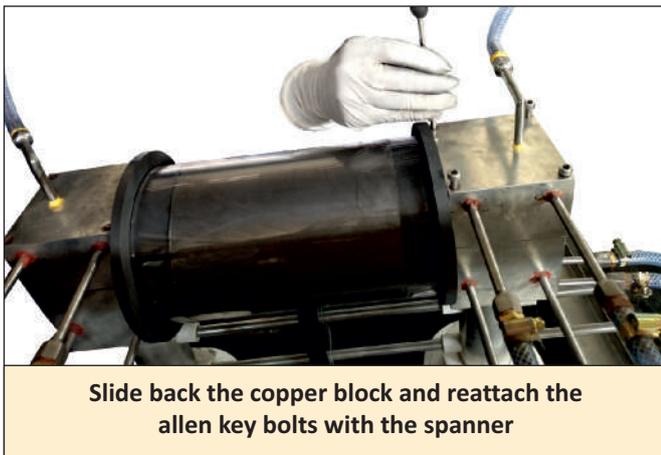
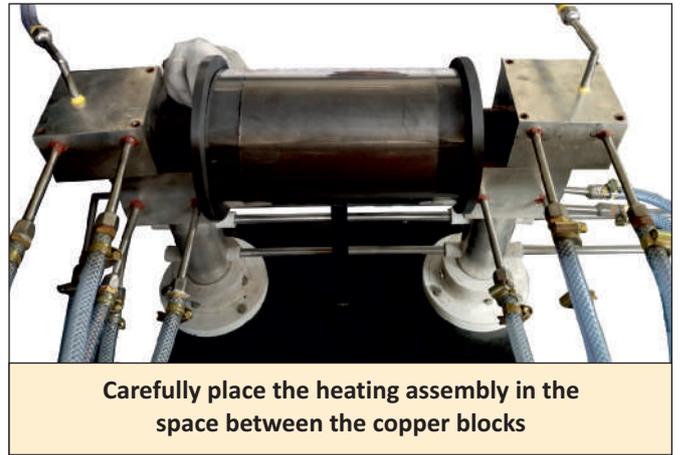
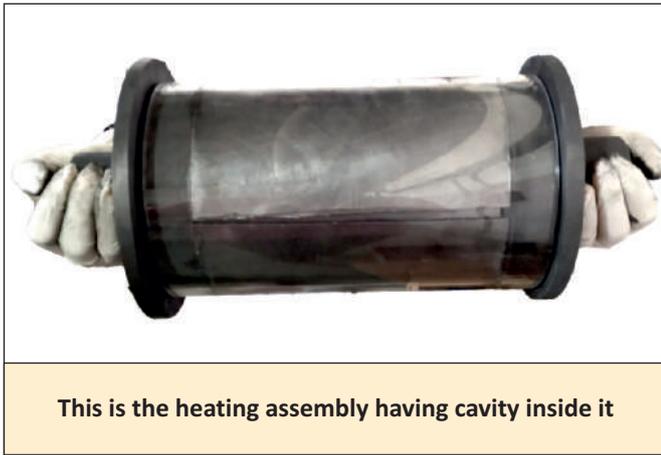
8. Connect the gas purge to a pre-purified **Argon** gas tank. Connect the gas pipe to the "GAS INLET" of the FASTcal 3000 as shown in the below image.



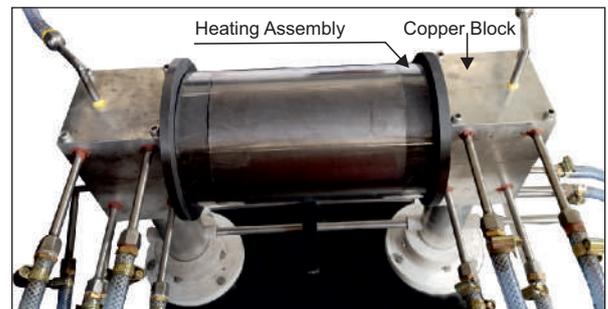
⚠ WARNING:
• Do not use flammable gas.

9. Next step is to install the heating assembly. (As per Video)

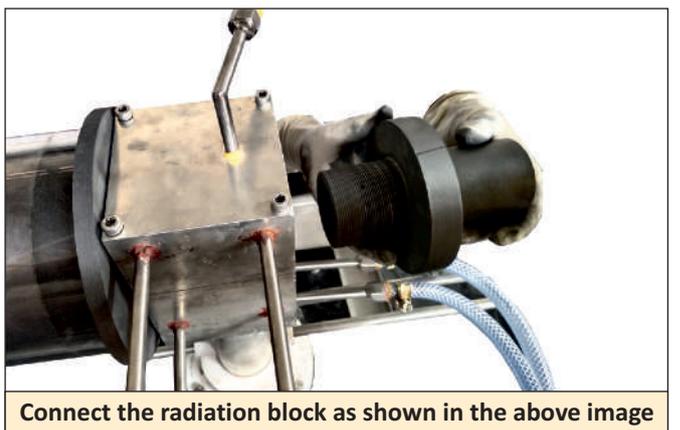
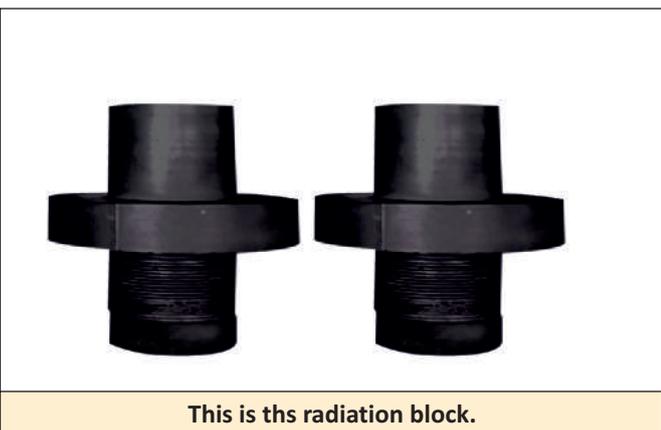


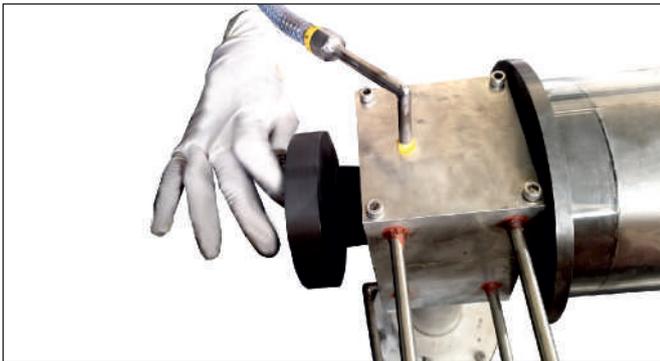


- ! Important:**
- **Avoid loose contact between copper block and heating assembly.**



10. Next step is to install the radiation block, refer to below images for assembling radiation block:





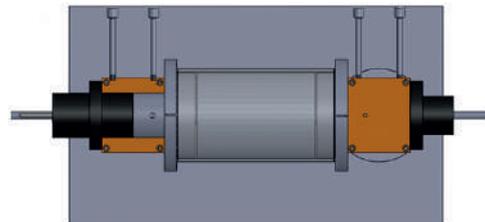
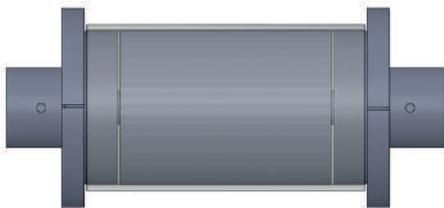
Connect the radiation block on the other side too.



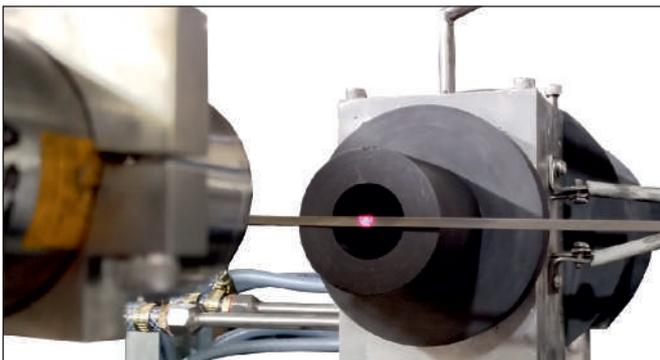
After connecting the radiation block, the whole assembly will look like the above image

! Important:

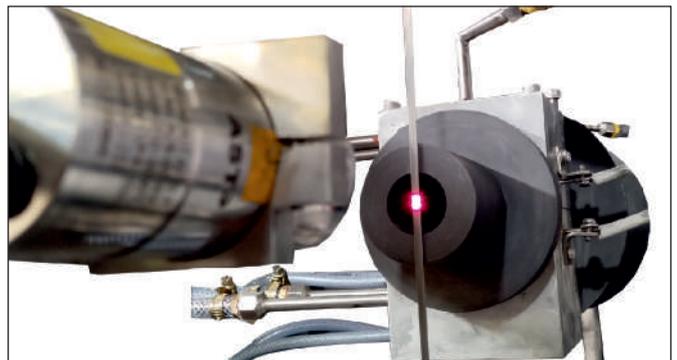
- Make sure the mark on the heating assembly should come on the upper side while tightening it, if it is not at the centre the holes for argon gas will get blocked and will stop the flow of gas, refer to below images for reference:



11. Next step is to align the pyrometer such that the laser of the pyrometer is at the center so as to detect the exact temperature. Use any thin strip to check the laser.



Check the horizontal alignment as shown in the image, It should be at the center



Check the vertical alignment as shown in the image, It should be at the center

⚠ WARNING:

- If the laser is not at the centre, deviation will occur in the reading and hence error in measurement. Cavity and graphite part can get burn due to high temperature.
- The above step is done just after turning ON the mains supply.

3.3 Water and Purge Gas Supply Requirements

A) Water

Flow rate of water is 8-12 LPM maximum, Outlet (drain) must not be blocked.



Note:

- Use only demineralised water.
 - The water must be clean otherwise impurities in the water can block the water passage in the copper block.
-

B) Purge Gas

High Purity (99.99% pure) Argon gas.

Flow rate : Regulated at 15-20 LPM

⚠ WARNING:

- **Do not use nitrogen (N₂) for purge gas. At high temperatures, cyanide gas could be generated.**
 - **Gas flow rate above 22 LPM can damage the gas flow switch, make sure the purge gas flow rate must be below 22 LPM.**
-

Chapter 4

Operating FASTcal 3000

1. Turn ON the mains power supply.

⚠ WARNING:

- **Do not connect or disconnect anything while power is ON. Do not attempt to operate without cables connected.**
-

2. Turn ON the chiller supply. Check the chiller water temperature; it should be between 15°C to 17°C.



Note:

- The valve of the chiller should always be ON.
-

3. Open valve at Argon purge tank. Adjust the gas flow meter to 15-20 LPM.



Note:

- The flow of the water and gas can be easily checked in the HMI. Instructions to check the same are given in chapter 5 on page no 22.
-

4. Click ON the “START PROCESS”. Refer to chapter 5 on page no 23 for instructions.

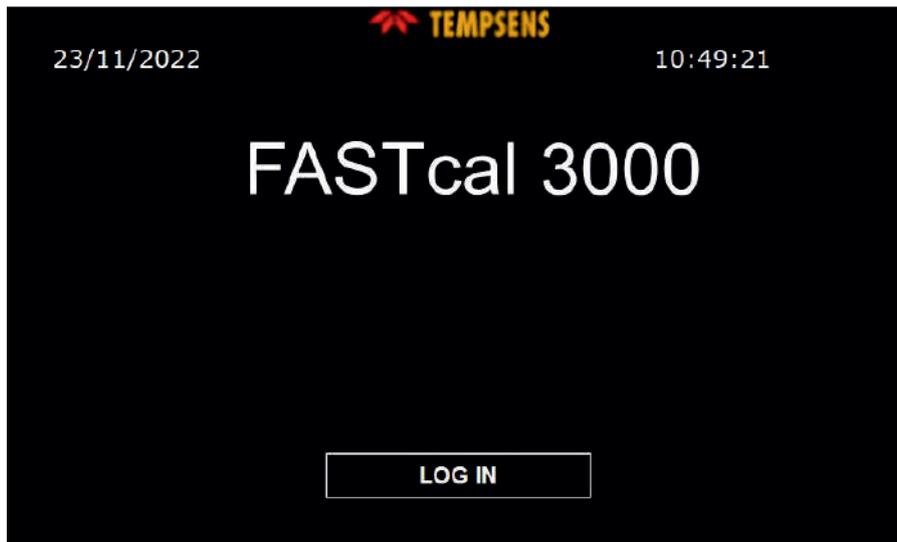
⚠ Important:

- **The time of operation must be less than 15 minutes.**
-

Chapter 5

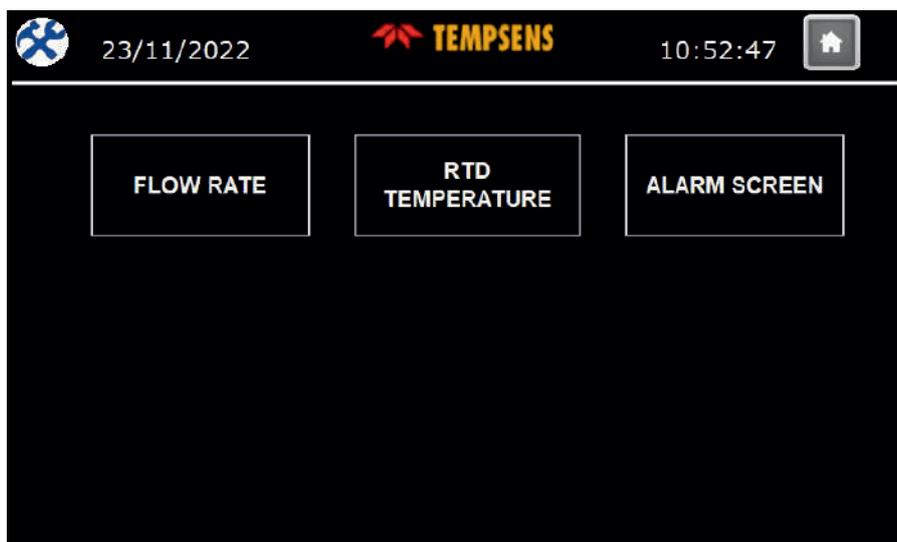
Operating HMI

When FASTcal 3000 is turned ON, the below screen will be shown in HMI.



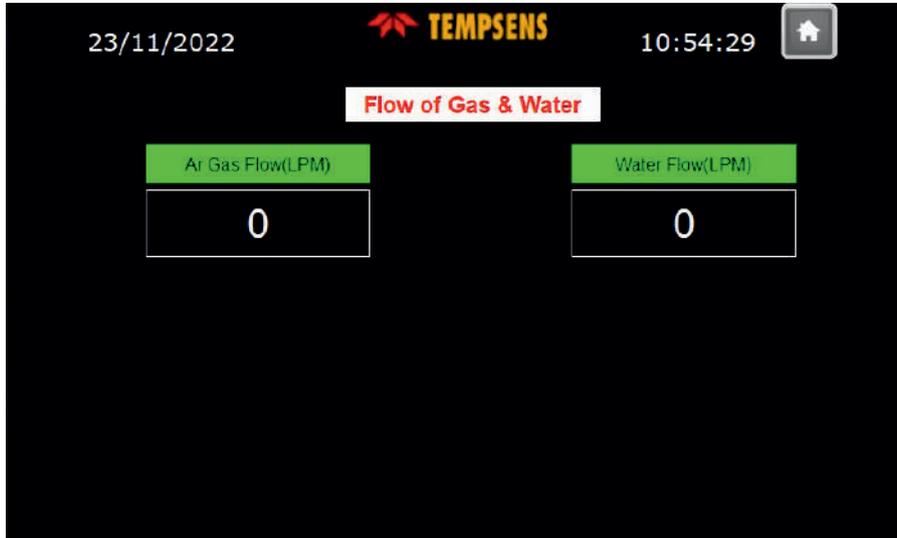
Click on "LOG IN" to operate FASTcal.

This is the Home Screen of the HMI.

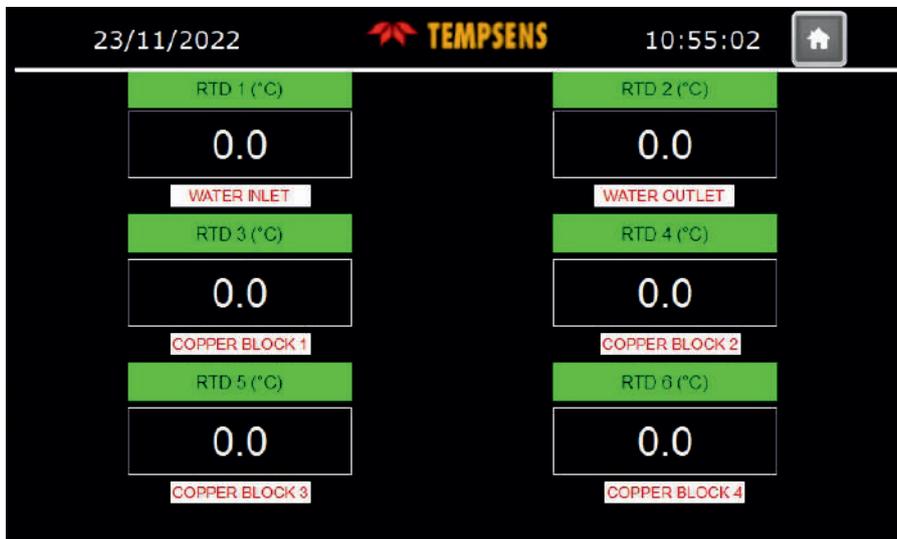


Following steps must be followed to operate the unit.

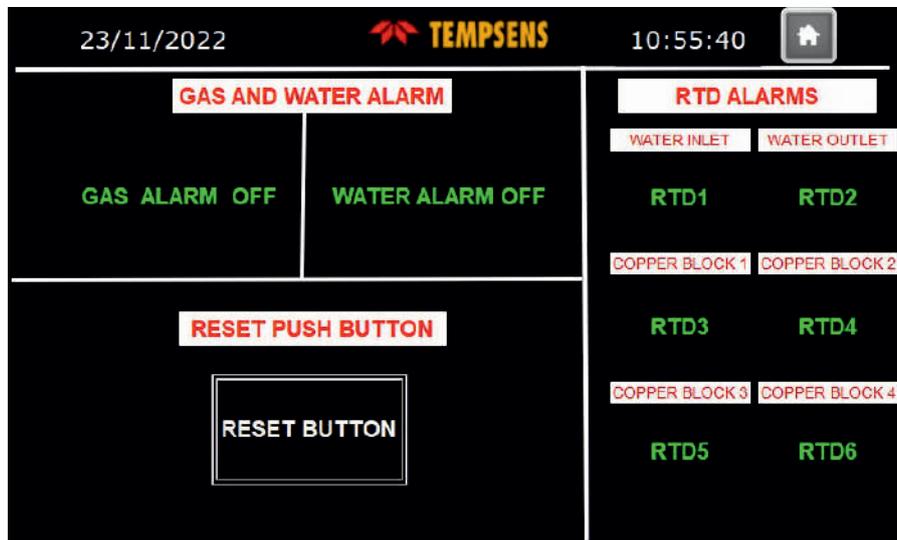
First click on “FLOW RATE” on the home screen to see the water and gas flow, below shown screen will get opened.



To see the RTD temperature screen click on “RTD TEMPERATURE' on home screen.



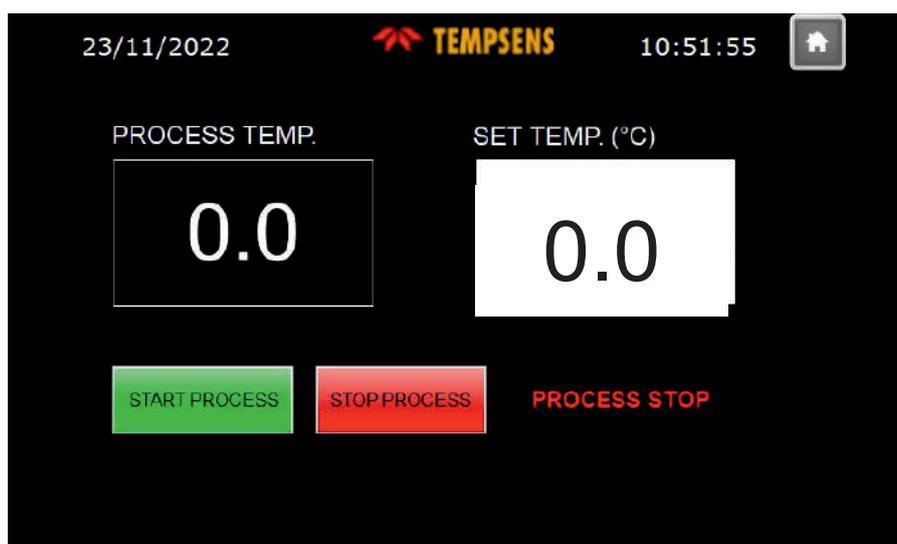
Now, check for alarm, to see the alarm screen click on “ALARM SCREEN' on home screen.



If it has any alarm, it will be in Red color, to operate further, the user have to reset the furnace by clicking on “RESET BUTTON” on the above screen.

Now, click on “HOME” logo on the above screen to see the control screen for further operations, below image will get opened:

Click on “START PROCESS” to turn the heater ON and set the temperature.



Chapter 6

Service & Maintenance

6.1 Cavity Assembly

The life expectancy of the graphite cavity depends on the time and temperature of operation. The higher the temperature, the shorter the life spans. At temperatures near 3000°C the life expectancy of the graphite cavity is approximately one half-hour. The life span is also affected by the gas purge purity. The presence of air or water will greatly shorten the life span when operating. We recommend an occasional visual check be made to ensure maximum system integrity.

If the user finds any damage in glass or cavity, then it must be replaced with the new cavity or glass, following instructions must be followed to change the cavity/glass:



Take the new quartz glass (when the glass is damaged) & cover it with graphite foil and felt of suitable dimensions



Insert the cavity in the cavity support block as shown in the above image.



Slowly tighten the cavity and make sure it is not loose.



Carefully attach the quartz glass and cavity support block. as shown in the above image.



Attach the top part (cavity support block) of the assembly as shown in the above image.



After assembling, the whole assembly will look like the above image.

6.2 Safety Interlocks

Automatic alarm signal indication will be shown in the “ALARM SCREEN” of the HMI if the water flow fails or reduces below 8 LPM or if the gas flow drops below 12 LPM, or if the region near the cavity exceeds ~100°C. Then after this heater contactor will turn off and disconnect the circuit. To again operate it, first the operating condition must be brought to normal, then click on the “**RESET BUTTON**” on the alarm screen, then it can be again started. The cooling fan will operate for internal circuit cooling.

6.3 Periodic Inspections

Check the following elements on a regular basis and after each use:

- Condition of all plastic tubes near the graphite core (must not be damaged).
- Check the electrical terminal connection of transformer, it must be tight.
- Condition of all piping external to the FASTcal 3000. (closed or frozen drain valves, supply valves, etc.)
- Quartz tube in center of furnace for cracks.
- Check for clogged electrode cooling cores by touching water out connections while furnace is running. If one electrode is very hot while the other electrode is not, a clog is occurring. The electrode cooling core will have to be removed and bench tested to determine if flow is restricted.
- Check all internal plastic tubing and fittings for water and gas leaks.
- Test low water flow and gas pressure interlocks once per month by temporarily shutting off water and gas purge for a few seconds. Each one should activate the alarms and turn off all power to the cavity.

6.4 Pyrometer Alignment Check

Refer to images on page no. 18 for correcting the alignment of pyrometer. This step is done after turning ON the mains supply so as to give power supply to pyrometer.

Chapter 7

Troubleshooting FASTcal 3000

7.1 FASTcal 3000 unit does not start

1. Check for alarm signal in the "ALARM SCREEN" of HMI. If the colour is red, then the problem can only be resolved when the system is returned back to its original condition of operation. Then press the "RESET BUTTON" to begin the operation. Now, this alarm signal can be because of

- Gas flow
- Water flow
- RTD temperature

Gas flow should be between **15-20 LPM**, any value outside this range will make the gas alarm ON.

Water flow should be in the range of **8-12 LPM**, any value outside this will make the water flow alarm ON.

There are 6 RTDs connected in the system, the copper block assembly consists of 4 RTDs while one is in water inlet and other is in water outlet.

The permissible temperature range of each RTD is given below, if the temperature rise beyond the permissible temperature range, it will make the heater stop. The operating time of FASTcal is less than 15 minutes, above this time limit; the RTD temperature tends to rise and when reached the maximum permissible limit, the heater will stop.

RTD NO.	LOCATION	MAX. TEMPERATURE
RTD 01	Water Inlet	60
RTD 02	Water Outlet	60
RTD 03	Cu block	100
RTD 04	Cu block	100
RTD 05	Cu block	100
RTD 06	Cu block	100

! Important:

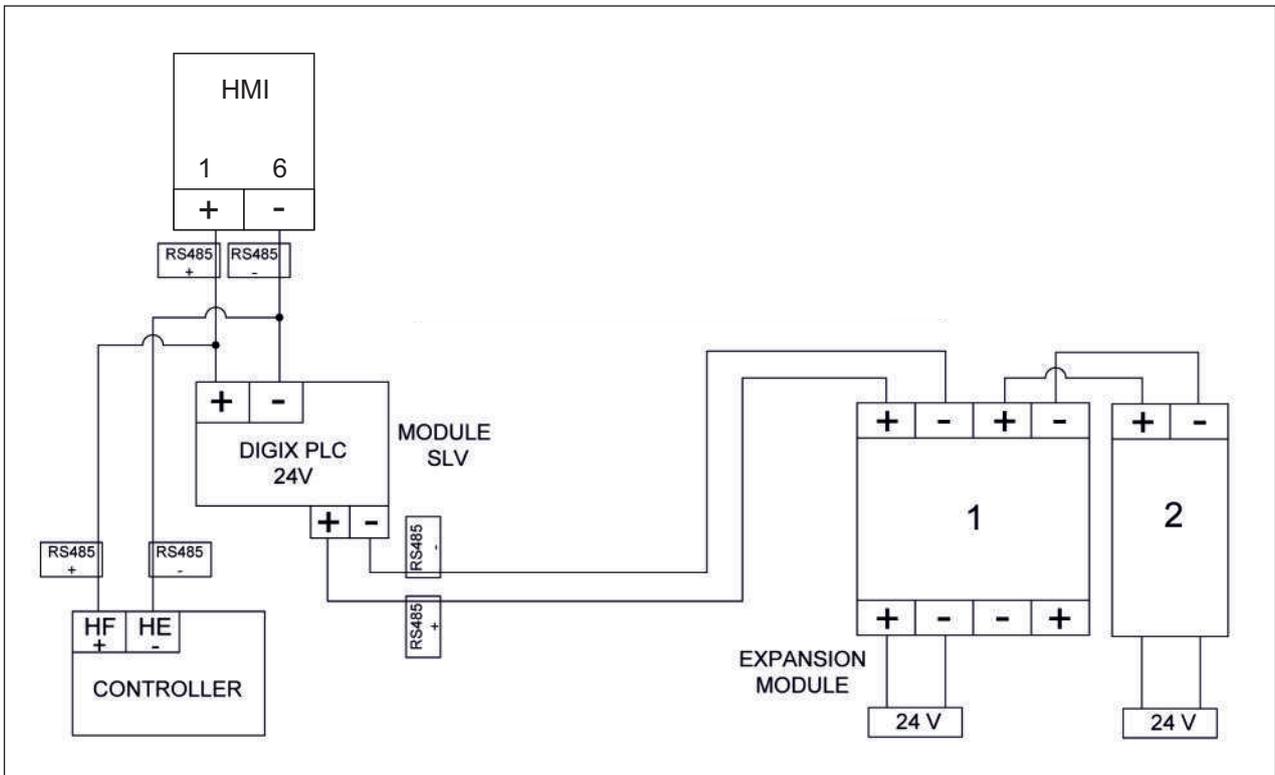
- **If the temperature of any RTD rise beyond its permissible limit, the heater contactor will turn off. Now, make sure to wait for at least 20 minutes to again start the calibration (this is to be done to lower the temperature of chiller unit).**

Another reason when the FASTcal fails to operate is when the quartz glass breaks or the cavity is damaged; to resolve this issue, the glass/cavity must be replaced with new glass/cavity, refer to page no. 24 for instructions on how to change the cavity/glass.

7.2 The HMI shows Communication Error

To resolve this problem check the communication wire connections into the PLC and controller.

The connections must be tight.



7.3 The temperature of the furnace is not rising

Even if all the conditions are fulfilled sometimes the temperature of the furnace does not rise, In this case, there may exist communication error, i.e. the furnace is not receiving the command from PC, to solve this issue check for the connection of RS 232 cable from PC to furnace and tight all the connections.

The other possibility for not rising the temperature of the furnace is E.STOP button present on the front side. Make sure it is opened during the operation of the furnace.

Appendix A: Calibration Services

Tempsens Calibration Center is an independent unit of Tempsens instruments (I) Pvt. Ltd, having laboratories at Udaipur, Vadodara & Bangalore. It is accredited for wide range of temperature calibration services.

It is the only private sector Laboratory in the country with accredited Fixed Point Temperature Calibration Facilities. The lab has highly stable calibration furnaces, measuring instruments and accurate master sensors traceable to National and International Standards.

The calibration center functions as per ISO 17025 / NABL standards. Calibration of contact type sensors can be made in temperature range of -196°C to 1600°C and Calibration of non-contact type sensors can be made in temperature range 0°C to 2900°C. Further the laboratory is accredited for onsite temperature calibration.

The lab offers both at Lab & On-Site Calibration of Furnace/Bath from -80°C to 1600°C and Black Body Calibration from 50°C to 1700°C. Furnace/Chamber Calibration (TUS) with multiple sensors from -80°C to 1200°C is also in the scope of the lab.

In House Calibration Facility

QUALITY MEASURED / INSTRUMENTS	TEMPERATURE RANGE	CALIBRATION & MEASUREMENT CAPABILITY
Contact Type RTD, Thermocouples Thermometers	-196°C	0.05°C
	-80 to -38°C	0.03°C
	-38°C to 0°C	0.03°C
	>0°C to 140°C	0.04°C
	>140°C to 250°C	0.04°C
	>250°C to 650°C	0.12°C
	>650°C to 1200°C	1.30°C
	>1200°C to 1600°C	2.60°C
Non-Contact Type Pyrometer	0°C to 250°C	1.5°C
	>250°C to 500°C	2.4°C
	>500°C to 1500°C	2.5°C
	>1500°C to 1700°C	3.2°C
	>1700°C to 2900°C	4.0°C

On-site Calibration Facility

QUALITY MEASURED / INSTRUMENTS	TEMPERATURE RANGE	CALIBRATION & MEASUREMENT CAPABILITY
Contact Type RTD, Thermocouples Thermometers	-25°C to 0°C >0°C to 140°C >140°C to 250°C >250°C to 650°C >650°C to 1200°C	0.07°C 0.04°C 0.09°C 0.12°C 1.30°C
Non-Contact Type Pyrometer	0°C to 250°C >250°C to 500°C >500°C to 1200°C	1.50°C 2.40°C 2.5°C
Multipoint Position Calibration of Chamber, Oven, Furnaces (Thermal Mapping(TUS))	-80°C to 200°C >200°C to 1200°C	2.8°C 4.1°C

Fixed-point Calibration Facilities

QUALITY MEASURED / INSTRUMENTS	TEMPERATURE RANGE	CALIBRATION & MEASUREMENT CAPABILITY
Calibration of SPRT/PRTS/thermocouple and so on.	Triple Point of Water (0.01°C) Melting Point of Gallium (29.7646°C) Freezing Point of Tin (231.928°C) Freezing Point of Zinc (419.527°C) Freezing Point of Aluminum (660.323°C)	0.0038°C 0.0065°C 0.0065°C 0.0071°C 0.0075°C
Calibration of Thermocouple at Secondary Fixed Point	Melting Point of Gold (1064.18 °C) >1500°C to 1700°C >1700°C to 2900°C	0.72°C 2.5°C 3.2°C 4.0°C
	Melting Point of Palladium(1554.8	0.83°C

Appendix B: Warranty

This instrument has been manufactured to exacting standards and is warranted for twelve months against electrical breakdown or mechanical failure caused through defective material or workmanship, provided the failure is not the result of misuse. In the event of failure covered by this warranty, the instrument must be returned, carriage paid, to the supplier for examination and will be replaced or repaired at our option.

FRAGILE CERAMIC AND/OR GLASS PARTS ARE NOT COVERED BY THIS GUARANTEE

INTERFERENCE WITH OR FAILURE TO PROPERLY MAINTAIN THIS INSTRUMENT MAY INVALIDATE THIS GUARANTEE

Limit of Liability

TEMPESENS is not liable for any damages that arise from the use of any examples or processes mentioned in these Specifications are subject to change without notice.

Caution in Using the Product

TEMPESENS PRODUCTS ARE INTENDED FOR USE BY TECHNICALLY TRAINED AND COMPETENT PERSONNEL FAMILIAR WITH GOOD MEASUREMENT PRACTICES.

IT IS EXPECTED THAT PERSONNEL USING THIS EQUIPMENT WILL BE COMPETENT WITH THE MANAGEMENT OF APPARATUS WHICH MAY BE POWERED OR UNDER EXTREMES OF TEMPERATURE, AND ARE ABLE TO APPRECIATE THE HAZARDS WHICH MAY BE ASSOCIATED WITH, AND THE PRECAUTIONS TO BE TAKEN WITH, SUCH EQUIPMENT



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