Installation, Operation & Maintenance Instructions

1200°C Thermocouple Calibration Furnace
type PTC 12/20/150

This manual is for the guidance of operators of the above Carbolite products and should be read before the furnace is connected to the electricity supply.

CONTENTS

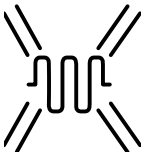
This manual should supply all the information required for safe and trouble-free furnace operation. Information on controller operation is included.

1.0

SYMBOLS & WARNINGS

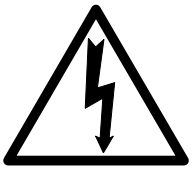
1.1 Switches and Lights

Supply Light: when the furnace is connected to the electrical supply the light in the adjacent switch glows



Heat Light: the adjacent light glows or flashes to indicate that power is being supplied to the elements

1.2 Warning Symbols



DANGER of electrical shock– read any warning printed by this symbol.

DANGER – hot surface. Read any warning printed by this symbol.
WARNING: all surfaces of a furnace may be hot.

DANGER – read any warning printed by this symbol.

2.0

INSTALLATION

2.1 Unpacking

Unpack the furnace and remove the transit clamp from the working end of the furnace as follows:

- loosen the locking nut on the central clamp bolt;
- turn the bolt clockwise with a screwdriver to release the force on the clamping device;
- remove the two screws which hold the transit clamp to the furnace;
- carefully withdraw the transit clamp;
- retain the clamp.

If at any time the furnace is returned for repair or otherwise subject to arduous travel, refit the transit clamp. The furnace must be cold before the clamp is fitted.

2.2 Setting Up

Underneath the furnace is a dual voltage switch. Set this correctly for the supply to be used: 115V for 110-120V, 230V for 220-240V.

Ensure that there is free space around the furnace. Do not obstruct any of the vents: they are needed to keep the controls cool.

Ensure that the furnace is placed in such a way that it can be quickly switched off or disconnected from the electrical supply - see below.

Do not place the furnace on an inflammable surface.

2.3 Electrical Connections

The furnace requires a single-phase A.C. supply with earth (ground). The supply may be Live to Neutral non-reversible, Live to Neutral with reversible plug, or Live to Live. Check that the supply voltage is compatible with the voltage on the furnace rating label, and that the voltage switch referred to above is correctly set.

The furnace is internally fused at 10 Amps. A 110-120V supply should be fused externally at 10 Amps. A 220-240V supply should be fused externally at 5 Amps.

In the event of the furnace being used on 230V when the voltage switch is set to 115V, a fast-blow fuse protects the circuit. This is located in a panel mounted holder adjacent to the voltage switch.

The furnace is supplied with a plug-in cable which may be wired directly to an isolator which operates on both conductors, or fitted with a line plug which may be quickly disconnected from the supply. The isolator or the plug should be within easy reach of the operator. The supply must incorporate an earth (ground).

Connect the supply as follows:

Cable colour	**Terminal label**	***supply type***	
		Live-Neutral	**Reversible or Live-Live**
Brown	L	to live	to either power conductor
Blue	N	to neutral	to the other power conductor
Green/Yellow	PE	to earth	to earth

3.0

OPERATING INSTRUCTIONS

3.1 Operating Cycle

The furnace is fitted with a combined Supply light and Instrument switch. The light comes on whenever the furnace is connected to the supply. The switch cuts off power to the controller.

Connect the furnace to the electrical supply. The Supply light should glow.

Operate the instrument switch, located on the front panel, to activate the temperature controller; the **O** position is *off*, the **I** position *on*. The controller becomes illuminated and goes through a short test cycle. Set the temperature as required - see section 4.0.

As the furnace heats up the Heat light glows steadily at first and then flashes as the furnace approaches the desired temperature. For further information on temperature control see section 4.0.

To switch off, set the instrument switch to **O**. If the furnace is to be left off, isolate it from the electrical supply.

3.2 General Operating Notes

Heating element life is shortened by use at temperatures close to maximum. Do not leave the furnace at high temperature when not required. The maximum temperature is given on the furnace rating label and on the back page of this manual.

3.3 Operator Safety

Ceramic materials used in furnace manufacture become electrically conducting at high temperature.

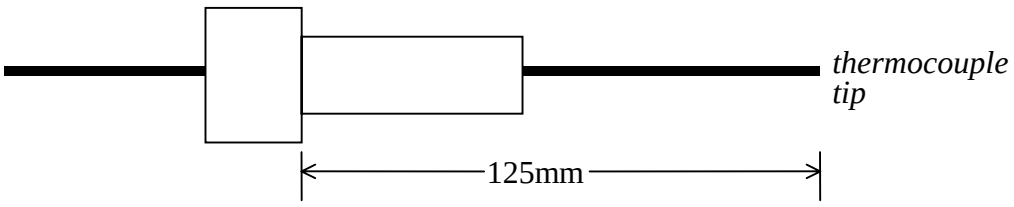
The furnace incorporates a Heater Switch on the control panel which safely interrupts the heating element circuit. Use this switch when inserting anything into the furnace chamber which might touch the interior. Do not rely upon the instrument switch for this purpose.

3.4 Instructions for Use as a Calibration Furnace

The PTC 12/20/150 is designed for calibration by the comparison method, which consists of comparing the thermocouple under test with a reference thermocouple. This reference thermocouple can have traceability to national standards, either if it is ordered with this requirement, or by getting it independently calibrated.

In the PTC 12/20/150 the reference thermocouple is built in and has its own indicator marked Reference Temperature. It is located within the work tube such that its tip is positioned close to that of the thermocouple to be tested in the part of the tube which has the most uniform temperature.

The thermocouple to be calibrated should be passed through an end plug with a suitable size hole, with the tip 120 to 130mm from the step in the plug.



If thermocouples with different outer diameters are to be calibrated then end plugs with different size holes should be used. These may be ordered from Carbolite. The maximum recommended diameter is 7.5mm - larger diameters may experience too much heat conduction and give an incorrect calibration.

Insert the thermocouple and end plug and support the cold end to ensure that the assembly lines up with the axis of the furnace tube.

Switch on the instrument switch and set the desired temperature on the controller. Allow the unit to warm up and stabilise. The reference temperature may be slightly lower than the control temperature so adjustment can be made to the control setting to bring the reference temperature to the exact temperature if desired; allow it to stabilise.

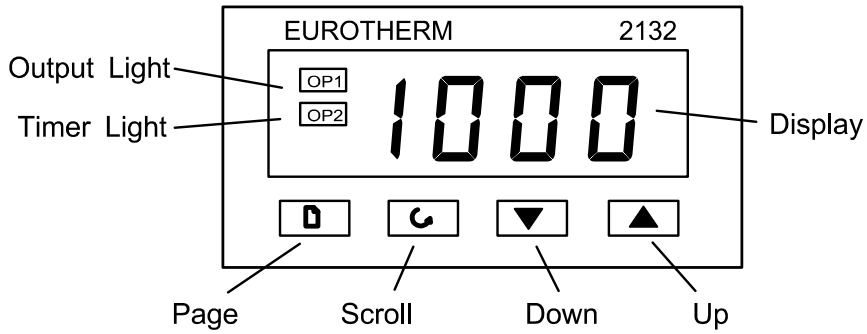
Either the output of the thermocouple or an indicated temperature can be checked against the reference temperature and any error noted. This error can now be used to correct any readings taken by the thermocouple. The noted error is the calibration of the thermocouple. Remember to include the reference thermocouple error in calculating the calibration - see the reference thermocouple certificate.

The calibration should be made at temperatures at which the thermocouple is to be used. If it is to be used over a range of temperatures then calibrate it at a number of points over the range (for example at every 100°), and plot a graph of error against temperature. A curve drawn through the points can then be used to find the error at any temperature.

4.0

CONTROLLER OPERATION

4.1 Eurotherm 2132



When switched on, the controller lights up, goes through a short test routine, and then displays the measured temperature and starts to control. The output light glows or flashes as heating occurs.

The **Page** key 🗋 allows access to parameter lists within the controller; most lists and parameters are hidden and cannot be accessed by the operator because they contain factory-set parameters which should not be changed.

A single press of the page key 🗋 displays the temperature units, normally set to °C; further presses reveal the lists indicated in the Navigation Diagram in section 4.6.

The **Scroll** key ↺ allows access to the parameters within a list. Some parameters are display-only; others may be altered by the operator. Some parameters only appear in appropriate circumstances – for example, working setpoint does not appear if setpoint ramp rate is Off.

A single press of the scroll key ↺ displays the temperature units; further presses reveal the parameters in the current list indicated in the Navigation Diagram.

To return to the Home list at any time, press Page 🗋 and Scroll ↺ together, or wait for 45 seconds.

The **Down** ▼ and **Up** ▲ keys are used to alter the setpoint or other parameter values.

4.2 Basic Operation

Normally no operator action is required other than entering the setpoint, as the 2132 starts to control on being switched on, as described above.

4.3 Altering the Setpoint

With the display at "home", showing the measured temperature, press Down ▼ or Up ▲ once to display the setpoint; press again or hold down to adjust it. The display returns to the measured temperature when no key is pressed for 0.5 seconds.

4.4 Stopping and Starting Control

It is possible to stop and start the controller without altering the setpoint. Press Scroll ↺ until the legend m-A (manual/auto) appears. In the 2132, manual means "off" and auto means "on". Press Down ▼ or Up ▲ once to show the current on/off state: mAn for off, and Auto for on. Press ▼ or ▲ to change between manual and auto (off and on) as required.

Note that timer modes 1 & 3 set the controller to mAn at the end of the timing period. If the controller unexpectedly does not control it may be in manual, possibly as the result of previous use of the timer function.

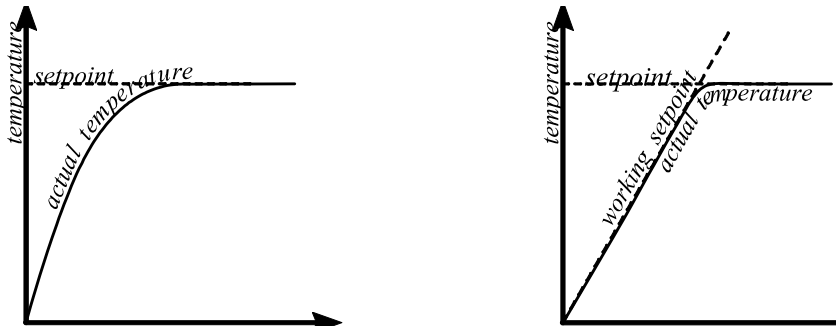
4.5

Altering the Ramp Rate

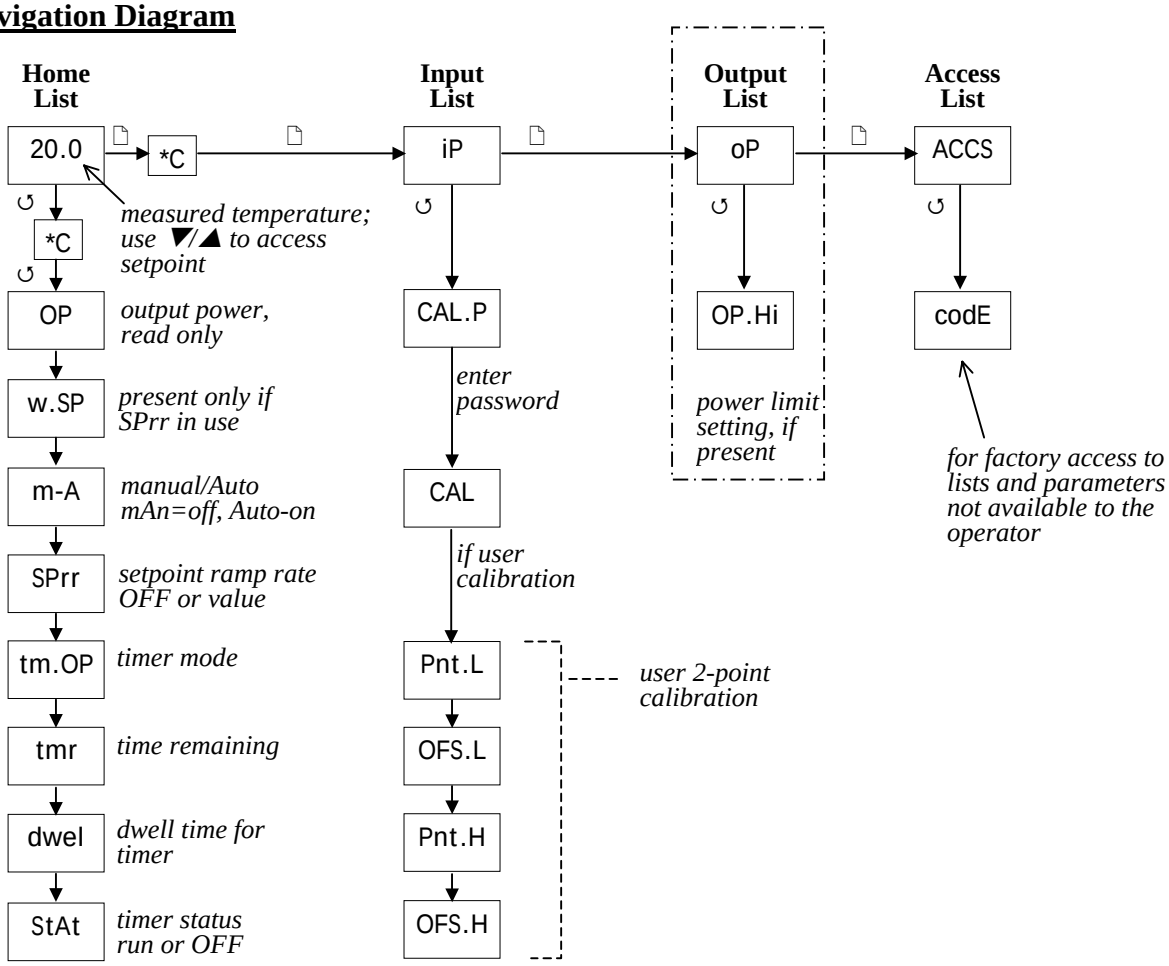
It is possible to limit the rate of heating by setting a ramp rate. Press Scroll ↺ until the legend SPrr (SetPoint ramp rate) is displayed. Use Down ▼ or Up ▲ to display and adjust the value.

The ramp rate sets the maximum rate of heating or cooling in degrees per minute. A value of OFF cancels the ramp rate, allowing heating and cooling at the maximum rate. When this feature is in use, there is a "working setpoint" which can be viewed at any time by scrolling to w.SP and pressing ▼ or ▲.

Fig 1 and fig 2 indicate the possible difference between running without and with a ramp-to-setpoint value (depending on the load and the value used).



4.6 Navigation Diagram



4.7 Operation With the Timer

The 2132 can be used as a process timer allowing timed heating or timed delay, according to the options in the table. There are 5 timer modes, but 2 of them are affected by whether the setpoint ramp rate feature is being used, making 7 entries in the table. The table also shows the status of the Timer Light on the 2132. A visual impression of the different modes is given in fig 3.

timer mode	description	timer light
mode 1 *Timed dwell and switch off*	The timer starts timing when the actual temperature is within 1°C of the setpoint. At the end of the timing period, control switches off (i.e. goes into Manual) to allow cooling, and EnD flashes on the display.	On while temperature is reaching setpoint. On during the timing period. Off from the end of the timing period.
mode 2 *Timed dwell and stay on*	The timer starts timing when the actual temperature is within 1°C of the setpoint. At the end of the timing period, control remains on, maintaining the setpoint temperature, and End flashes on the display.	On while temperature is reaching setpoint. On during the timing period. Off from the end of the timing period.
mode 3, with SPrr off *Time from cold and switch off*	The timer starts timing immediately. At the end of the timing period, control switches off (i.e. goes into Manual) to allow cooling, and End flashes on the display.	On during the timing period. Off from the end of the timing period.
mode 3, with SPrr active *Dwell from working setpoint and switch off*	The timer starts timing when the working setpoint is within 1°C of the setpoint. At the end of the timing period, control switches off (i.e. goes into Manual) to allow cooling, and End flashes on the display.	On during the timing period. Off from the end of the timing period.
mode 4, with Sprr off *Time from cold and stay on*	The timer starts timing immediately. At the end of the timing period, control remains on, maintaining the setpoint temperature, and End flashes on the display.	On during the timing period. Off from the end of the timing period.
mode 4, with Sprr active *Dwell from working setpoint and stay on*	The timer starts timing when the working setpoint is within 1°C of the setpoint. At the end of the timing period, control remains on, maintaining the setpoint temperature, and End flashes on the display.	On during the timing period. Off from the end of the timing period.
mode 5 *Delayed switch on*	The timer starts timing immediately, and control starts at the end of the timing period. There is no “END” condition in this mode.	On during the timing period. Off from the end of the timing period.

4.8

Setting the Timer Mode

Scroll to tm.OP; use ▼ or ▲ to view and alter the mode. The mode shows as OPt.1 to OPt.5.

It is not possible to alter the mode while the timer is running; if the mode cannot be altered, scroll to the StAt parameter and set its value to OFF.

4.9 Setting the Time Period

Method 1

Scroll to tmr (time remaining). Use ▼ or ▲ to view the remaining time; the units are always in minutes. Use ▼ and ▲ to set or alter the time. Setting tmr automatically activates the timer; the m-A parameter changes to Auto and the StAt parameter changes to run.

Note that the tmr display shows 0 (zero) during the last minute of timing, and also shows 0 when the time has expired. The timer light indicates whether timing is still in progress.

Method 2

Scroll to dwEl, and use▼ and ▲ to set the timing duration. The advantage of method 2 is that dwEl need only be set once if repeated use of the same time period is required.

Scroll to StAt, and use ▼ or ▲ to set the parameter value to run. This copies the dwell time into tmr and activates the timer as in method 1.

4.10 Running with the Timer

Once the timer is activated by method 1 or 2 above, the control sequence depends on the timer ode, as previously given in the table. Fig 3 gives another representation of the timer action.

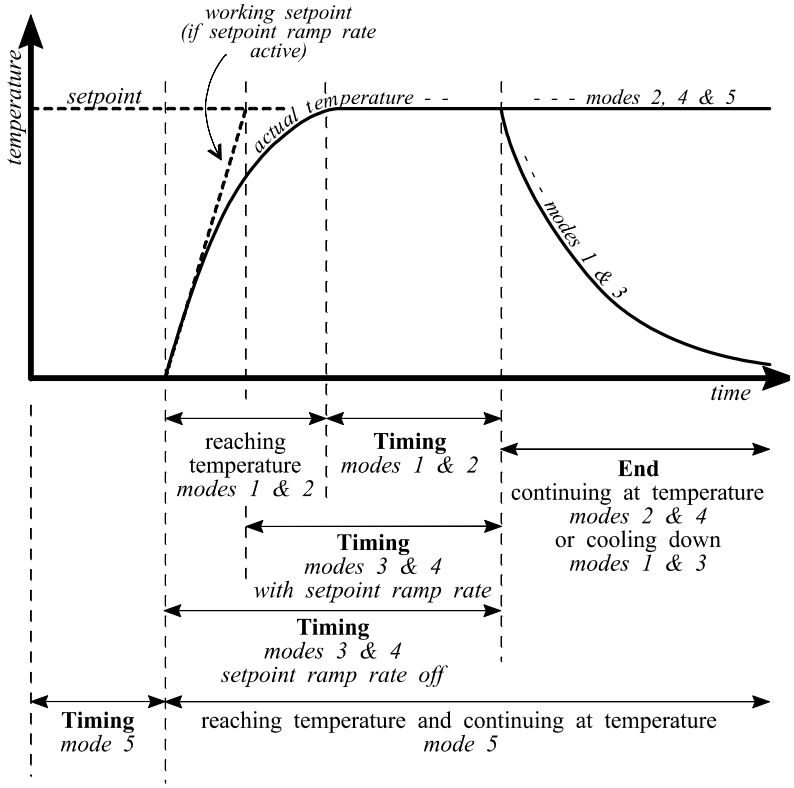


fig 3 - timer modes

4.11 Stopping the Timer

To stop the timer at any time while it is running, change the StAt parameter to OFF. This is the same as reducing tmr to zero. The controller then acts as though at has reached the end of the time period.

4.12 End of Time Period

Modes 1 and 3: heating stops at the end of timing; the m-A parameter changes to mAn.

Modes 2 and 4: heating continues at the end of timing; the m-A parameter remains at Auto.

Mode 5: heating starts at the end of the timing period; the m-A parameter remains at Auto.

In modes 1 to 4 the alarm message EnD flashes on the display at the end of timing; the StAt parameter remains at run.

In mode 5 there is no End message; the StAt parameter changes to OFF at the end of timing.

4.13 Cancelling the Alarm

To acknowledge (cancel) the EnD alarm, press Page and Scroll together; the StAt parameter changes to OFF.

Alternatively the alarm may be cancelled by directly changing the StAt parameter from run to OFF.

4.14 User Calibration

The controller is calibrated for life at manufacture against known reference sources, but there may be sensor errors or other system errors. User calibration allows compensation for such errors, and the 2132 allows for a user 2-point calibration. This setting is password protected to avoid accidental alteration.

Page to iP, scroll to CAL.P, and use Up ▲ to alter the password. The password is 3. If the correct password is entered, the display shows PASS. Scroll to CAL and use ▼ or ▲ to observe the setting FACt (factory values, as manufactured) or USEr (user values). Change to USEr.

NOTE: before checking the calibration of the controller, or of the complete system, remember to reset the 2132 to factory calibration values by setting the CAL.P parameter to FACt.

To enter a user calibration, scroll to each or the following parameters in turn and set the desired values.

Pnt.L low temperature for which an offset is to be entered

OFS.L offset value for the low temperature

Pnt.H high temperature for which an offset is to be entered

OFS.H offset value for the high temperature

Example: the controller reads 3°C low at 400°C, and 5°C low at 1000°C. The parameter values should be Pnt.L=400, OFS.L=3, Pnt.H=1000, OFS.H=5.

Negative or positive values can be entered: if the controller is reading high, negative offsets would be appropriate.

Fig 4 gives a graphical representation of the 2-point calibration.

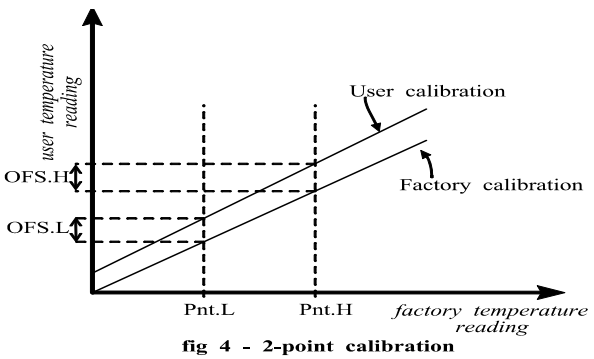


fig 4 - 2-point calibration

5.0

MAINTENANCE

5.1 General Maintenance

No routine maintenance is required other than the occasional replacement of consumable items.

The furnace outer surface may be cleaned with a damp cloth. Do not allow water to enter the interior of the case. Do not clean with organic solvents.

5.2 Controller Calibration

After prolonged use the controller and/or thermocouple could require recalibration. This would be important for processes which require accurate temperature readings or which use the furnace close to its maximum temperature. A quick check using an independent thermocouple and temperature indicator should be made from time to time to determine whether full calibration is required. Carbolite can supply these items.

See also the instructions for calibrating the controller, section 4.14.

5.3 After Sales Service

Carbolite's service division (Thermal Engineering Services) has a team of Service Engineers capable of repair, calibration and preventive maintenance of furnace and oven products at our customers' premises throughout the world. We also sell spares by mail order. A telephone call or fax often enables a fault to be diagnosed and the necessary spare part despatched.

Each furnace has its own record card at Carbolite. In all correspondence please quote the serial number, model type and voltage given on the rating label of the furnace. The serial number and model type are also given on the front of this booklet when supplied with a furnace.

To contact Thermal Engineering Services or Carbolite see the back page of this manual.

5.4 Recommended Spares Kits

Carbolite can supply individual spares, or a kit of the items most likely to be required. Ordering a kit in advance can save time in the event of a breakdown.

Each kit comprises a pair of thermocouples, one solid state relay and one heating element.

Ceramic end plugs with a variety of centre holes can also be obtained from Carbolite.

5.5 Power Adjustment

The furnace control system incorporates electronic power limiting. In this model the power limit parameter OP.Hi is usually set to 100%. It may be accessible to the operator, but should not generally be altered.

See section 9.2 for any exceptions.

6.0

REPAIRS & REPLACEMENTS

6.1 Safety Warning – Disconnection from Supply

Always ensure that the furnace is disconnected from the supply before repair work is carried out.

6.2 Safety Warning - Refractory Fibrous Insulation

This furnace contains refractory fibres in its thermal insulation. These materials may be in the form of fibre blanket or felt, vacuum formed board or shapes, mineral wool slab or loose fill fibre.

Normal use of the furnace does not result in any significant level of airborne dust from these materials, but much higher levels may be encountered during maintenance or repair.

Whilst there is no evidence of any long term health hazards, we strongly recommend that safety precautions are taken whenever the materials are handled.

Exposure to dust from fibre which has been used at high temperatures may cause respiratory disease.

When handling fibre always use an approved mask, eye protection, gloves and long sleeved clothing.

Avoid breaking up waste material. Dispose of waste fibre in sealed containers.

After handling rinse exposed skin with water before washing gently with soap (not detergent). Wash work clothing separately.

Before commencing any major repairs we recommend reference to the European Ceramic Fibre Industry Association Bulletin No. 11 and the UK Health and Safety Executive Guidance Note EH46.

We can provide further information on request. Alternatively our service division can quote for any repairs to be carried out at your premises or ours.

6.3 Temperature Controller Replacement

Ease apart the two lugs at the side; grip the instrument and withdraw it from its sleeve; push in the replacement.

6.4 Solid State Relay Replacement

Disconnect the furnace from the supply; remove the front panel and optionally separate the lower part of the furnace using the screws underneath.

Make a note of the wire connections to the solid state relay, and disconnect them. Remove the solid state relay from the base panel.

Replace and reconnect the solid state relay ensuring that the heat-conducting thermal pad is sandwiched between the relay and the base panel or aluminium plate. Alternatively a thin layer of white, heat-conducting silicon paste may be applied between the new relay and the plate.

The new solid state relay contains a built-in MOV which protects it from short periods of excess voltage. If the old relay had a separate disc-shaped "MOV" connected between the high voltage terminals of the old relay, discard the old MOV.

6.5

Thermocouple Replacement

Disconnect the furnace from the supply, and remove the furnace back panel (opposite the working end). Make a note of the thermocouple positions; the 3mm upper thermocouple is the control thermocouple; the 1.5mm entering in the centre is the reference.

Disconnect the thermocouple to be replaced from its terminal block and withdraw it.

Fit the replacement thermocouple, with the same length inside the furnace body as before, observing the colour coding: negative = white; positive (type N) = green.

6.6 Element Replacement

See section 6.2- wearing a face mask is recommended.

This involves dismantling the outer case, disconnecting the electrical leads, and removing the inner furnace chamber. Make a sketch of the layout inside the back panel before attempting this. It is recommended that you contact Carbolite for advice before starting the operation.

7.0

FAULT ANALYSIS

A. Furnace Does Not Heat Up

1. The **HEAT** light is **ON**
   - → The heating element has failed
     - → Check also that the SSR is working correctly

2. The **HEAT** light is **OFF**
   - The controller shows **a very high temperature** or a code such as S.br
     - → The thermocouple has broken or has a wiring fault
   - The controller shows a **low temperature**
     - → The door switch(es) (if fitted) may be faulty or need adjustment
     - → The contactor (if fitted) may be faulty
     - → The SSR could be failing to switch on due to internal failure, faulty logic wiring from the controller, or faulty controller
   - There are no lights glowing on the controller
     - → The **SUPPLY** light is **ON**
       - → The controller may be faulty or not receiving a supply due to a faulty switch or a wiring fault
     - → The **SUPPLY** light is **OFF**
       - → Check the supply fuses and any fuses in the furnace control compartment

B. Furnace Overheats

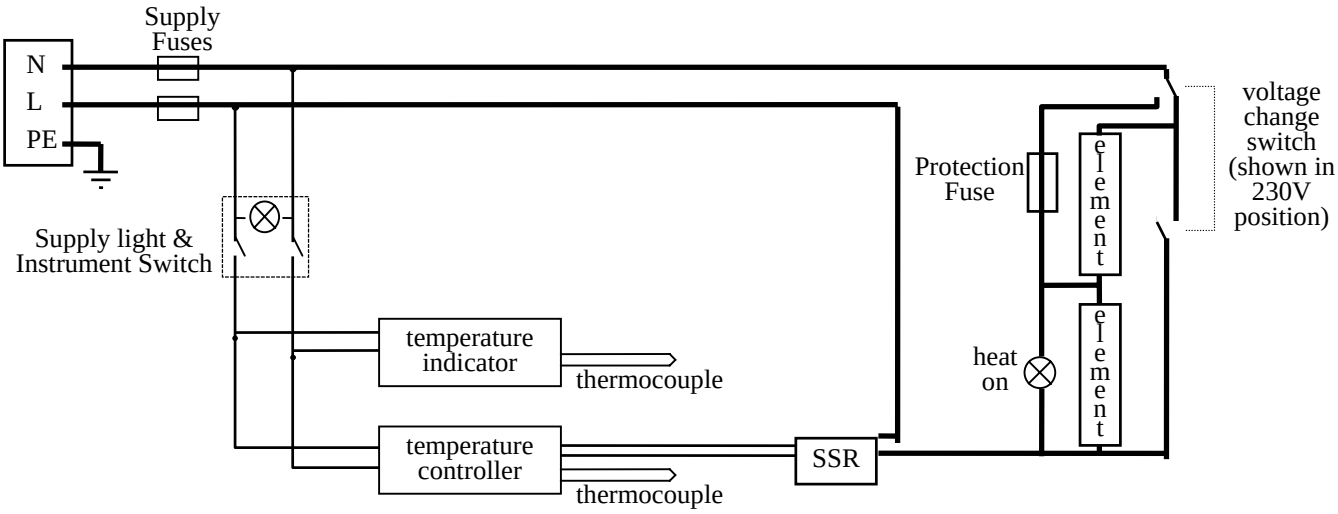
1. The **HEAT** light goes **OFF** with the instrument switch
   - → The controller shows a **very high** temperature
     - → The controller is faulty
   - → The controller shows a **low** temperature
     - → The thermocouple may have been shorted out or may have been moved out of the heating chamber
     - → The thermocouple may be mounted the wrong way round
     - → The controller may be faulty

2. The **HEAT** light **does not go off** with the instrument switch
   - → The SSR has failed "ON"
     - → Check for an accidental wiring fault which could have overloaded the SSR

8.0

CIRCUIT DIAGRAM

8.1 Circuit Diagram



9.0 FUSES & POWER CONTROL

9.1 Fuses

Supply Fuses: 32mm x 6mm type F1 (quick blow)10 Amp. Access by removal of the furnace back panel.

Protection Fuse: 20mm x 5mm type FF (ultra rapid) 10 Amp. Access by removing the holder underneath the furnace, using a screwdriver.

The purpose of the Protection Fuse is to ensure immediate power cut off if the voltage change switch is in the 115V position and the furnace is connected to a 220-240V supply.

9.2 Power Control

In this model the same heating element is used for 110-120V models and 220-240V models. Changing between the voltages is by the switch underneath the furnace – see section 2.2.

The correct power limit setting (parameter OP.Hi) for the furnace for all voltages is 100%.

Thank you for reading this data sheet.

For pricing or for further information, please contact us at our UK Office, using the details below.

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