Installation, Operation & Maintenance Instructions

1100°C Chamber Furnaces
ELF models

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.

INTRODUCTION

1.1 Models Covered by this Manual

This manual covers the Carbolite furnace models ELF 11/6B and ELF 11/14B. The B suffix indicates differences from earlier models, in particular that the heating element is enclosed in an inner metal chamber, and the heating wires are partly exposed in the chamber sides and radiate freely into the chamber. The B models were not made before mid-2001.

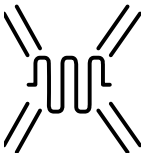
The B versions also allow for a simple customer adjustment to increase the air flow through the chamber. Carbolite do not claim that this adjustment makes the furnace suitable for ashing or burn-off applications.

The B versions may be set to operate on any single-phase voltage in the range 200-240V (or 100-120V to order) by correct setting of the power limit parameter in the controller.

Because of model changes it is very important when ordering spares to state the furnace serial number or otherwise to identify the model correctly.

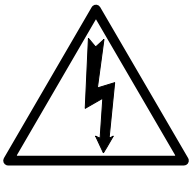
1.2 Switches and Lights

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

1.3 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 & Handling

When unpacking or handling the furnace always lift it by its base. Never lift it by the door. Use two people to unpack and carry the furnace.

Carefully remove any packing material from the furnace chamber. Avoid damaging the surrounding insulation when removing packing materials.

2.2 Siting & Setting Up

Place the furnace in a well ventilated room, away from other sources of heat, and on a non-inflammable surface that is resistant to accidental spillage of hot materials.

Ensure that there is free space of at least 50mm around the furnace. Do not obstruct any of the case vents: they are needed to keep the controls and the case exterior cool.

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

2.3 Chimney

The chimney is a short length of ceramic tubing. If it is supplied unfitted, then fit it through the hole in the top of the furnace case.

If the furnace is to be used to heat substances that emit fumes, then a fume extraction duct of about 150mm inlet diameter may be placed directly above the chimney outlet. Do not attempt make a sealed connection to the furnace chimney as this causes excessive airflow through the chamber and results in poor temperature uniformity.

2.4 Hearth

The chamber floor (hearth) is supplied with a ceramic tile. This may already be in position in the chamber. If it is packed separately, unwrap it and place it carefully on the chamber floor.

2.5 Door Vents

There is a plate fixed to the inner door panel (door plug carrier), accessible by removing the door insulation piece. This can be positioned to open up holes in the inner door, to allow an increased air flow in the chamber. Decide on the required position and fix the plate accordingly (see section 7.8).

2.6

Electrical Connections

Connection by a qualified electrician is recommended.

The furnace requires a single-phase A.C. supply with earth (ground), which may be Live to Neutral non-reversible (polarised), Live to Neutral reversible (non-polarised), or Live to Live.

⚠ Check the following before connection, by reference to the furnace rating label.

Voltage range: the voltage on the label and the actual supply voltage should be in the same range – either the range 200-240V or the range 100-120V. The furnace must not be connected to the wrong range. *If the voltage is different but in the same range, see section 2.7.*

Amps: the actual supply must be capable of supplying the required amps. It should be fused at the next available fuse size equal to or greater than the amps on the rating label.

A supply cable is fitted to 200-240V models, but may not be to 110-120V models. In there is no cable, remove the back panel and connect a suitably rated cable to the internal terminals.

Either wire the supply cable directly to an isolator or fit it with a line plug. The plug or isolator should be within easy reach of the operator to permit quick disconnection of the power.

⚠ For operator safety the supply MUST incorporate an earth (ground).

CONNECTION DETAILS			***supply type***	
Supply	**Terminal label**	**Cable colour**	*Live-Neutral*	*Reversible or Live-Live*
1-phase	L	Brown	To live	to either power conductor
	N	Blue	To neutral	to the other power conductor
	PE	Green/Yellow	To earth (ground)	to earth (ground)

2.7 Voltage Level

⚠ Check the furnace rating label voltage. If the actual supply is not the same as the voltage on the label, then the controller power limit should be adjusted.

If the actual voltage is higher than the label voltage, then read section 4.15 before switching on. Either switch on and immediately reduce the setpoint to zero to prevent heating, or follow the instructions in section 4.15 as quickly as possible. Heating with too high a power limit can burn out the heating elements or blow a fuse.

If the actual voltage is lower than the label voltage, then the furnace is safe but underpowered. To regain full power, adjust the power limit as explained in section 4.15.

3.0

OPERATION

3.1 Operating Cycle

The furnace is fitted with a combined Supply light and Instrument switch. The light is 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.

Close the furnace door and adjust the temperature controller – 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 for ELF models is 1100°C (2012°2F).

When heating large objects, in particular poor conductors, avoid shielding the thermocouple from the heating elements. The thermocouple is intended to sense the temperature near the heating element, but if a large cold object is placed in the chamber it may record the average temperature of the object and the element, which can lead to overheating of the element. Allow large objects to gain heat at a lower temperature and then adjust the controller setpoint to a temperature close to the desired maximum.

Materials such as case hardening compounds and other reactive salts may attack the wire elements, causing premature failure. The insulation chamber includes a ceramic hearth that helps to protect the insulated floor.

Note that if the door vents are open then the entry of cold air through the vents can give rise to a cool area in the chamber.

The moulded light weight ceramic fibre insulation can easily be marked by accidental contact with tongs etc.. Some fine cracks may be visible at the front of the insulation, or may develop in the surface of the chamber due to the progressive shrinkage of the ceramic fibres. Cracks are not usually detrimental to the functioning of the furnace.

When heating materials that produce smoke or fumes, the chimney must be correctly fitted and unobstructed. Otherwise, soot may accumulate in the chamber and could possibly cause an electrical breakdown of the heating element. To prevent this, regularly heat the furnace up to maximum temperature for one hour without load to burn away the soot.

3.3 Atmospheres

When an optional gas inlet is fitted there is a label near the inlet saying "INERT GAS ONLY". In practice *inert* or *oxidising* gases may be used, but *not combustible or toxic gases*. Chamber furnaces are not gas tight, so it should be understood that gas usage may be high, and that the chamber is likely always to contain some air. Residual oxygen levels of 1% are to be expected.

3.4 Operator Safety

The furnace incorporates a pair of switches that safely interrupt the heating element circuit when the door is opened. This prevents the user touching a live heating element, but also prevents the furnace from heating up if the door is left open.

4.0

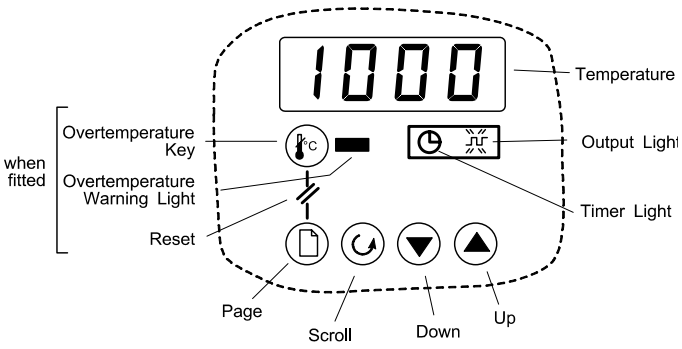
CONTROLLER OPERATION

The controller normally fitted to this furnace is the Carbolite 201 made by Eurotherm.

If any other controller is fitted, then a separate manual is supplied.

If a time switch is fitted, then a separate manual is supplied.

4.1 201 – Basic Features



Note: on the 201 display the letters m and w look like **n** and **u**. In these instructions the letters are described as m and w.

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 that 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 201 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 201, 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.

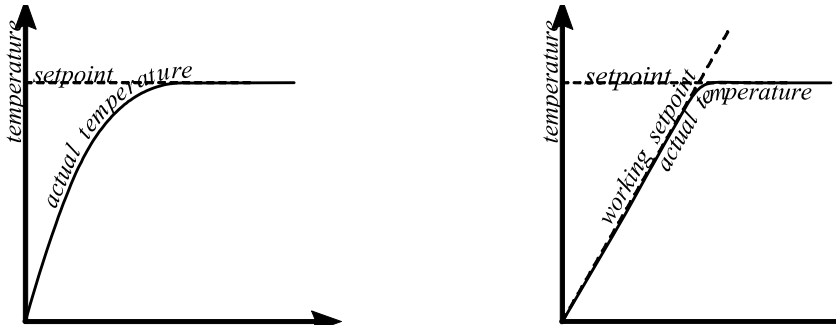
Note that timer modes 1 & 3 set the controller to mAn at the end of the timing period. If the controller unexpectedly does not control it may be in manual mode, possibly as the result of previous use of the timer function.

4.5 Altering the Ramp Rate

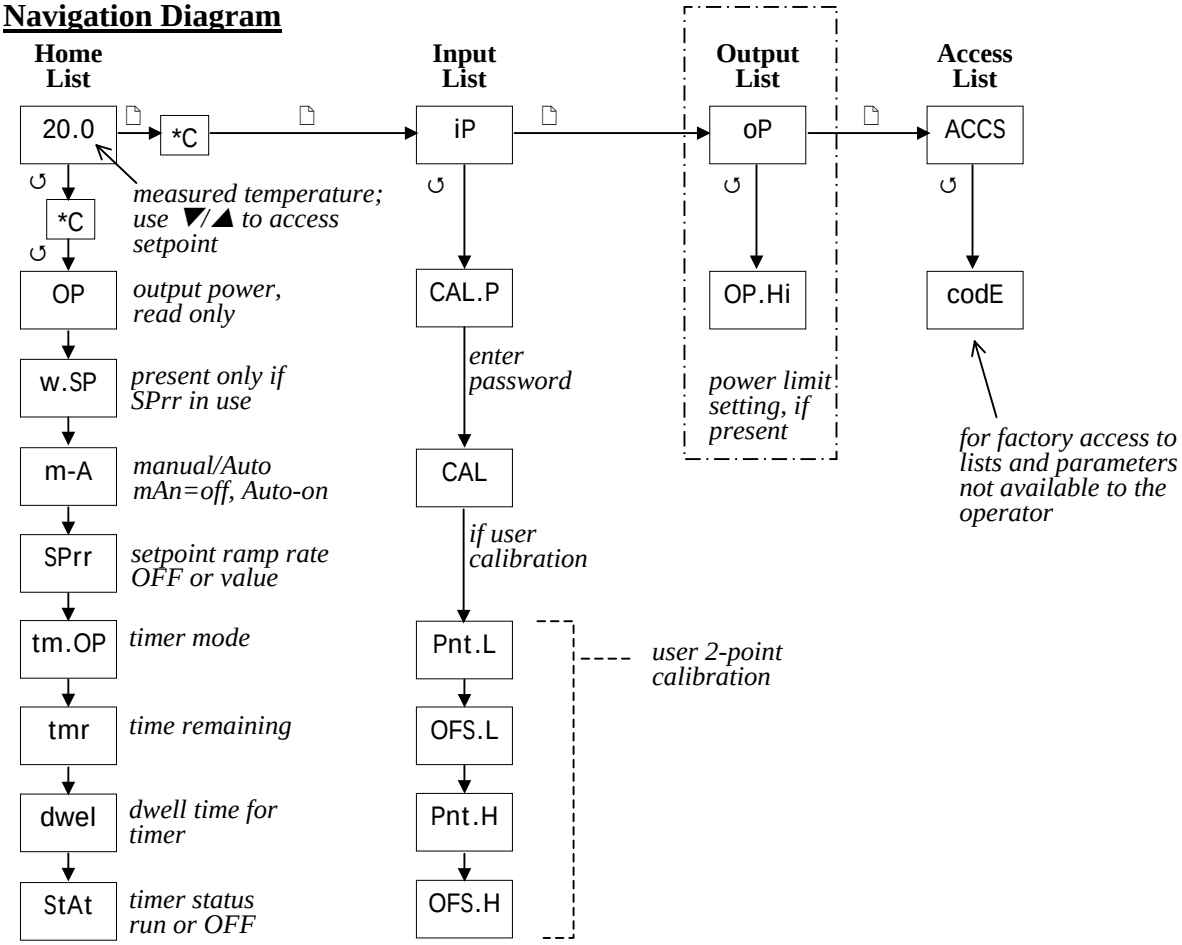
It is possible to limit the rate of heating by setting a ramp rate. Press Scroll ↺ until the legend SPrr (SetPoint ramp rate) is displayed. Use Down ▼ or Up ▲ to display and adjust the value.

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" that 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 201 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 201. 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.

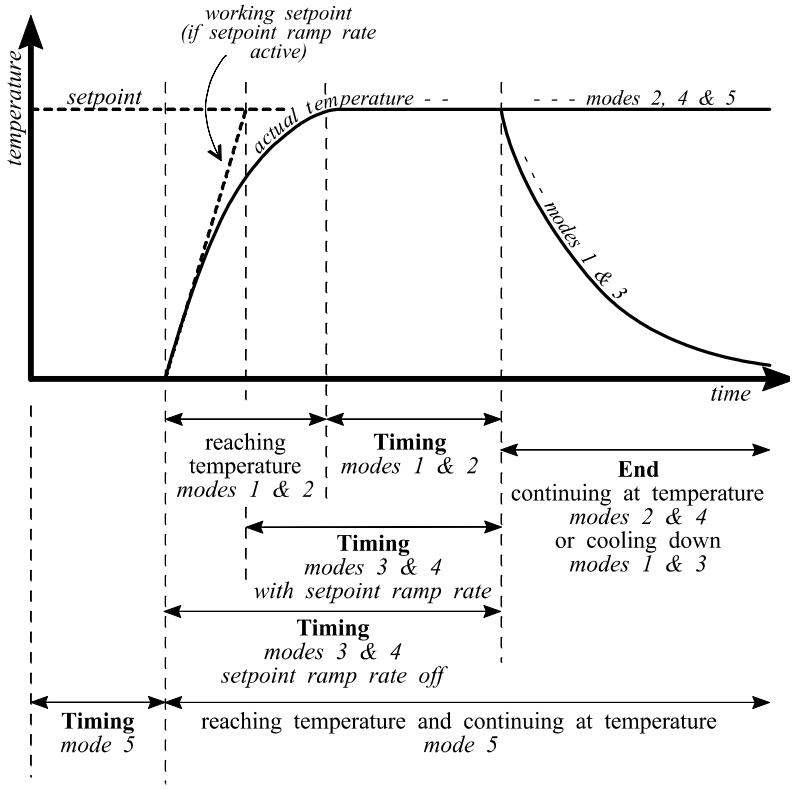


fig 3 - timer modes

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.

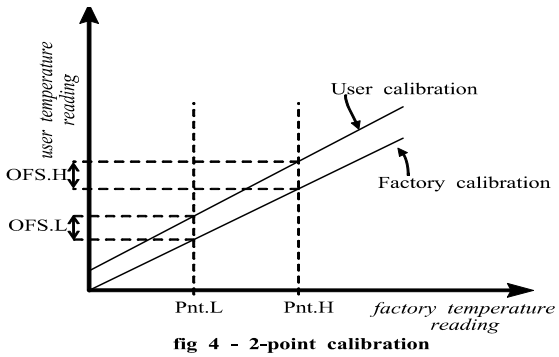


fig 4 - 2-point calibration

4.15 Power Adjustment

The furnace control system incorporates electronic power control, including a "power limit" parameter that is used to reduce the effective voltage to 208V (or 104V); the values of the power limit OP.Hi parameter for different voltages are as follows:

ELF 11/6B & ELF 11/14B	voltage:	100 200	208	110 220	115 230	120 240
	OP.Hi:	100%	100%	89%	81%	75%

To alter the power limit

If the actual supply voltage is higher than the voltage on the rating label or the voltage for which the furnace was last set, then please perform the following operations quickly and immediately after switch-on. (Alternatively, temporarily reduce the temperature setpoint to zero to prevent heating.)

Press Page 🗋 until oP (output list) is displayed. Press Scroll ↺ until OP.Hi (Output High) is displayed. Press Down ▼ or Up ▲ once to display the value of OP.Hi (it is good practice to write down the original value).

To alter the parameter to the desired value use Down ▼ or Up ▲.

Caution: Do not increase the power limit value to a value above the correct level for the supply voltage. The heating elements could burn out, or a fuse could blow.

Note that setting the power limit to zero prevents the furnace from heating.

4.16 Control at Low Temperatures

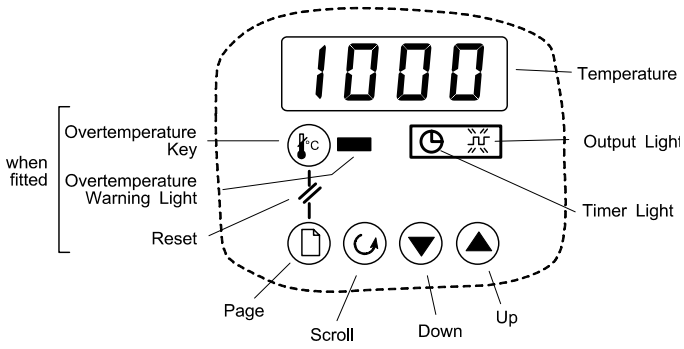
If the furnace is to be used at temperatures much lower than its design maximum, control stability may be improved by reducing the power limit.

Example: It is desired to run the furnace at 300°C. The normal control settings can be expected to cause excessive overshoot as the furnace reaches temperature. Try a setting of 40%, which should greatly reduce this overshoot. Experiment may be required to achieve a good result; avoid power limits below about 30%, as control accuracy falls off at such levels. Note that setting the value to zero prevents the furnace from heating.

5.0

OVERTEMPERATURE CONTROL OPTION

This is only fitted when the overtemperature option is ordered. To identify whether it is fitted, observe the controller panel: if it is fitted the overtemperature key and warning light are present.



Note: on the 201 display the letters m and w look like **n** and **u**. In these instructions the letters are described as m and w.

The overtemperature key must be held depressed continuously while viewing or adjusting the overtemperature controller. If the Overtemperature key is released, the display reverts to the main controller.

With the key pressed the overtemperature setpoint is normally displayed. To alter the value, use Down and Up. To view the measured temperature, press Scroll until PV (process variable) is displayed, then press Down or Up. Keep the overtemperature key depressed during these operations.

When an overtemperature condition is reached, the overtemperature warning light changes from green to flashing red. To “accept” or “reset” this alarm condition, press the Overtemperature key and the Page key together; the warning light changes to continuous red. Once the overtemperature condition is cleared (by the temperature falling), the light changes to green and normal operation resumes.

6.0

MAINTENANCE

6.1 General Maintenance

No routine maintenance is required other than removal of soot deposits mentioned in 3.2 and 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 or chamber. Do not clean with organic solvents.

6.2 Calibration

After prolonged use the controller and/or thermocouple could require recalibration. This would be important for processes that require accurate temperature readings or that 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.

6.3 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.

6.4 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 one thermocouple and sheath, one solid state relay, one door insulation piece, and one complete heating chamber.

When ordering spares please quote the model details as requested above.

7.0

REPAIRS & REPLACEMENTS

7.1 Safety Warning – Disconnection from Supply

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

7.2 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 that 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.

7.3 Temperature Controller Replacement

The 201 controller is fitted inside the furnace base, which can be separated from the top by removal of six screws.

Before handling the controller: **wear an anti-static wrist strap** or otherwise avoid any possibility of damage to the unit by static electricity.

See the instructions supplied with the replacement controller.

7.4 Solid-state Relay Replacement

Disconnect the furnace from the supply and remove the furnace back panel.

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 base panel or aluminium plate.

Replace the removed panel.

7.5

Thermocouple Replacement

Disconnect the furnace from the supply, and remove the furnace back panel.

Make a note of the thermocouple connections. The negative leg of the thermocouple is marked blue. Compensating cable colour codings are:

negative:	white
positive (type K):	green

Disconnect the thermocouple from its terminal block and withdraw the thermocouple from its sheath. It is advisable also to remove the sheath and shake out any broken pieces of thermocouple.

Fit the replacement thermocouple and reconnect, observing the colour coding.

Refit the back panel.

7.6 Element Replacement

See section 7.2 - wearing a face mask is recommended.

The element is supplied in the form of a complete inner chamber.

Disconnect the furnace from the supply and remove the furnace case back panel. Pull the chimney out of the top of the furnace.

Make a note of the wiring connections (see also thermocouple colours, section 7.5.)

Disconnect the element power leads and the thermocouple connections. Remove the thermocouple and support tube.

Using a socket spanner undo the four bolts that fasten the insulation box. These are located under the insulation box in the two cross supports.

Remove the insulation box by carefully sliding it out through the back of the furnace case.
Take the new insulation box and carefully slide it into the back of the furnace up to the front face. DO NOT support the insulation box by putting your hand inside it – the insulation is fragile.

Locate the insulation box fixing holes and replace the four bolts.

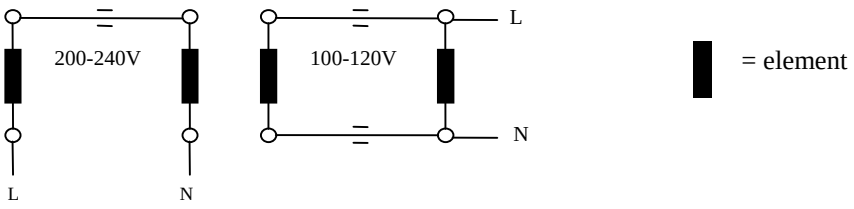
Refit the chimney, thermocouple support tube and thermocouple.

Remake all the thermocouple and element connections according to the notes made. If in doubt, see the diagram below: on the 200-240V models there are two heating coils in series; on the 100-120V models two in parallel.

Refit the back panel and run the furnace for 30 minutes at 800°C without interruption to ensure complete burn-off of any organic binders. Smoke may be observed during this process, so it should be carried out in a well-ventilated area.

Check that the furnace is controlling properly to rule out the possibility that previous element failed because of a fault elsewhere in the control circuit.

Example Connections



7.7

Door Plug Replacement

The "door plug" is also known as the "door insulation piece".

Lower the furnace door to the fully open position.

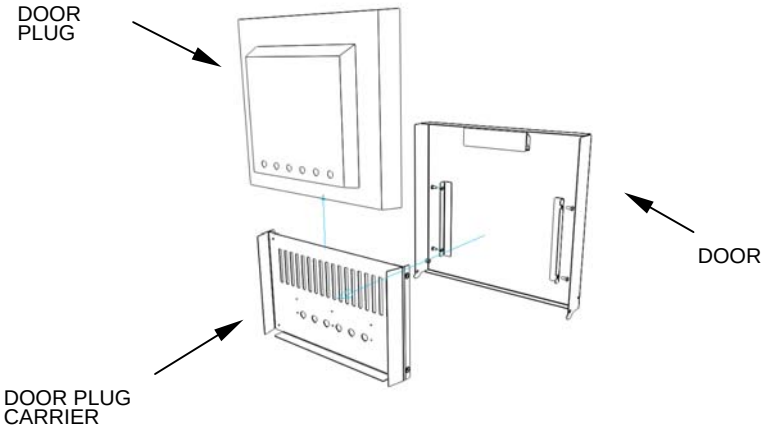
Loosen the four M6 Screws, two on either side of the door plug carrier.

Remove the door plug and carrier

Remove the air inlet blanking plate screws (section 7.8).

Slide the door plug upwards out of the carrier.

Slide the new door plug into the carrier ensuring that the air inlet holes are aligned, and re-assemble in the reverse order.



7.8 Air Inlet Adjustment

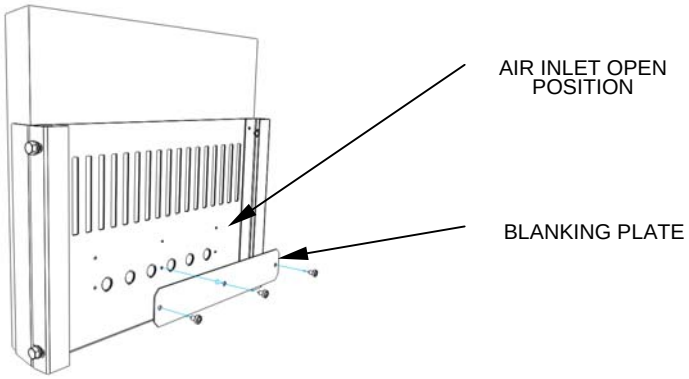
The air inlet is on the inner door panel (door plug carrier), and is supplied in the closed position. It can be altered to the open position as follows.

Remove the door plug and carrier as described in section 7.7.

Remove the three screws holding the blanking plate into position and remove the blanking plate.

Position the blanking plate in the upper position clear of the air inlet holes and align the screw holes.

Replace the three screws to hold the blanking plate in new position. Note that the screws must be replaced to fix the door plug into position.



7.9 Fuse Replacement

Fuses are marked on the circuit diagram (section 9.1) with type codes, e.g. F1, F2. A list of the correct fuses is given in section 9.3. *Fuses F2 may not be fitted on this furnace*.

If any fuse has failed, it is advisable for an electrician to check the internal circuits.

Replace any failed fuses with the correct type. For safety reasons do not fit larger capacity fuses without first consulting Carbolite.

The fuses are near the cable entry point, and access is by removal of the back panel.

In most models the fuses are mounted on an EMC filter circuit board. If there are 4 fuses, then the smaller pair is for the control circuit only.

8.0

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

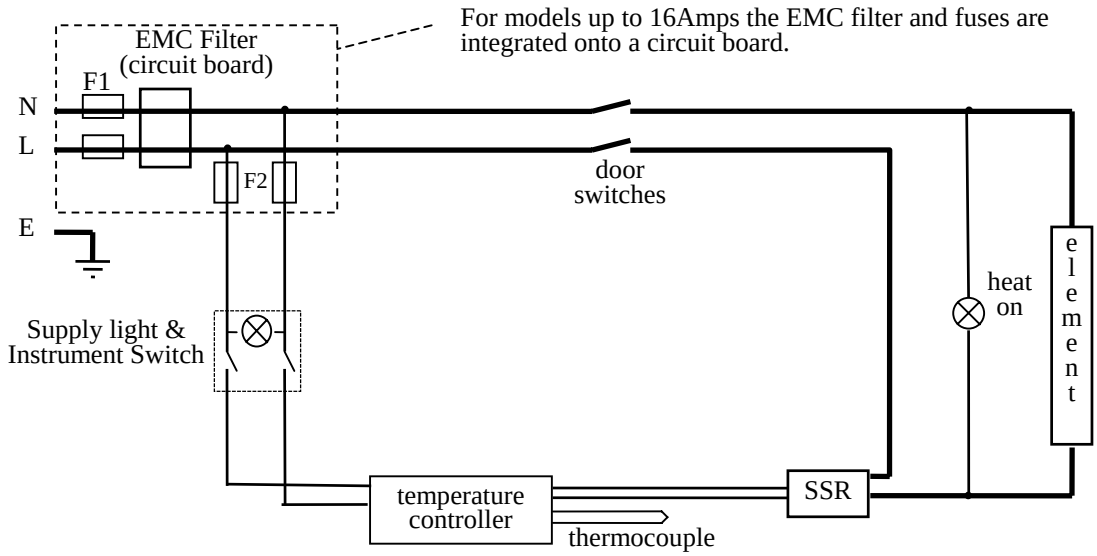
   → The controller may be faulty

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

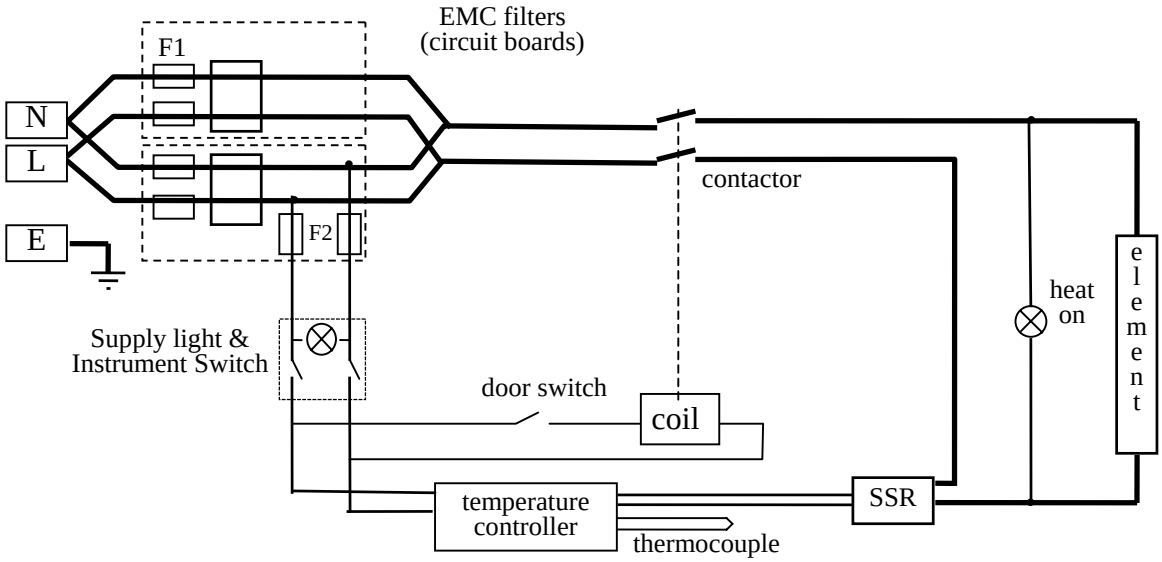
9.0

CIRCUIT DIAGRAM & FUSES

9.1 200-240V models



9.2 100-120V models



9.3 Fuses

F1-F3: Refer to the circuit diagram.

F1	Internal supply fuses	32mm x 6mm type F fitted on EMC filter circuit board(s)
F2	Auxiliary circuit fuses	20mm x 5mm type F fitted on EMC filter circuit board
	Customer fuses	Use fast-blow fuses to minimum rating shown

Model	phases	Volts	Supply Fuse Rating (Amps)	Aux. Fuse	Customer Fuse Rating
ELF 11/6B	1-phase	200-240V	10A (2 off)	2A*	10A
ELF 11/6B	1-phase	100-120V	10A (4 off)	2A	20A
ELF 11/14B	1-phase	200-240V	12.5A (2 off)	2A	12.5A
ELF 11/14B	1-phase	100-120V	12.5A (4 off)	2A	25A

* fuse not present unless overtemperature option is fitted