



Installation, Operation & Maintenance Instructions

1100°C - 1200°C Chamber Furnaces
types CSF, BOF & RHF

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.

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**Manuals are supplied separately for the furnace controller
(and overtemperature controller when fitted).**

Please read the controller manuals before operating the furnace.

1.0



INTRODUCTION

This is “retro” manual, made out to cover the range of 1100-1200°C chamber furnaces, types CSF, BOF and RHF, made over a period from 1988-1995. The manual does not document detailed changes over this period.

The controller manuals are not included – manuals or basic instructions are available separately.

In other respects there is some additional material in this manual that was not present in the original manuals issued with the furnaces.

2.0 INSTALLATION

2.1 Unpacking & Handling

When unpacking or moving the furnace always lift it by its base. Never lift it by the door. Use two people to carry the furnace where possible.

Remove any packing material from the door gear and furnace chamber before use.

2.2 Siting & Setting Up

Place the furnace in a well ventilated room, away from other sources of heat, and on a surface which is resistant to accidental spillage of hot materials. Do not mount the furnace on an inflammable surface.

Ensure that there is free space around the furnace. Do not obstruct any of the vents in the control section: 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.

If the chimney is supplied unfitted, then fit it into the hole in the top of the furnace case.

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

2.3 Electrical Connections

Connection by a qualified electrician is recommended

All furnaces covered by this manual are for single phase A.C. supply. Check the furnace rating label before connection. The supply voltage should agree with the voltage on the label, and the supply capacity should be sufficient for the amperage on the label.

The supply should be fused at the next size equal to or higher than the amperage on the label. A table of the most common fuse ratings is also given in section 8.0 of this manual.

Furnace with supply cable: either wire directly to an isolator or fit with a line plug.

Furnace without supply cable: connect to a fused and isolated supply.

Connection by line plug: the plug should be within reach of the operator, and should be quickly removable.

Connection to isolating switch: this should operate on both conductors (single phase) or on all live conductors (three phase), and should be within reach of the operator.

The supply MUST incorporate an earth (ground).

3.0

OPERATION

The instructions for operating the temperature controller are given in a separate manual. If the furnace is fitted with a time switch, see also the appropriate supplementary manual. If cascade control is fitted, see the supplementary manual MS07.

3.1 Operating Cycle

The furnace is fitted with a Supply light and an Instrument switch. The light is on whenever the furnace is connected to the supply. The switch cuts off power to the control circuit.

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

Operate the instrument switch to activate the temperature controller. The controller becomes illuminated and goes through a short test cycle.

Close the furnace door and adjust the temperature controller – see the controller manual.

Overtemperature option only. If the overtemperature controller has not yet been set as required, set it and activate it according to the instructions in the appropriate manual.

Unless a time switch is fitted and is off, the furnace starts to heat up. The Heat light(s) glow steadily at first and then flash as the furnace approaches the desired temperature or a program setpoint.

Overtemperature option only. If the overtemperature trip operates then an indicator in the overtemperature controller flashes, and the heating elements are isolated. Find and correct the cause before resetting the overtemperature controller according to the instructions supplied.

To switch the furnace off, set the Instrument switch off. If the furnace is to be left off, isolate it 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 shown on the furnace rating label and on the back page of this manual.

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 object is placed in the chamber it may record the average temperature of the object and the elements, which can lead to overheating of the elements. Allow large objects to gain heat at a lower temperature and then reset the controller to a temperature close to the desired maximum.

When heating materials which produce smoke or fumes, the chimney must be correctly fitted and unobstructed. Otherwise, soot accumulates in the chamber and could possibly cause an electrical breakdown of the heating element. If the furnace is used to heat materials which emit smoke or fumes, regularly heat it up to maximum temperature for one hour without load to burn away the soot.

Materials such as case hardening compounds and other reactive salts may penetrate the furnace chamber lining and attack the wire elements, causing premature failure. Use of a hearth tile may be advisable: please consult our technical department.

3.3 Use of Probes

Any metal object used to probe into the furnace chamber while the furnace is connected to the supply must be earthed (grounded). This applies in particular to metal sheathed thermocouples, where the sheaths must be earthed. The refractory material of the chamber lining becomes partly conducting at high temperatures, and the electric potential inside the chamber can be at any value between zero and the supply voltage. Unearthed probes can cause serious electric shock.



3.4 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.

If a metal retort is supplied with this furnace, please see the supplementary manual MS05.

3.5 Operator Safety

The furnace incorporates a safety switch which interrupts 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.

Avoid burns. Carbolite can supply tongs, face masks, and heat resistant gloves. Before you remove a hot object from the furnace make sure you have a safe place to put it down.

4.0 MAINTENANCE

4.1 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.

4.2 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.

Depending on the controller, the controller manual may contain calibration instructions.

4.3 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.

4.4 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, one sheath, one solid state relay, one door insulation piece, and one element or set of elements. For the RHF models, the element is supplied in its metal housing or insulation box; for the CSF & BOF models, the two side elements are supplied together with the hearth. Individual spares are also available.

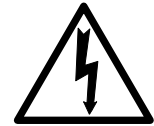
When ordering spares please quote the model details as requested above.

5.0

REPAIRS & REPLACEMENTS

5.1 Safety Warning – Disconnection from Supply

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



5.2 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.

5.3 Temperature Controller Replacement

CAL 8000 or 9000 Series

Disconnect the furnace from the mains supply and remove the furnace rear panel. Make a note of the wire connections to the back of the instrument, and disconnect them.

Remove the plastic clamp around the instrument by pushing the tabs in sideways. Take the instrument out of the panel from the front.

Reverse the above procedure to install a new instrument.

Eurotherm 103 - Open the flap and withdraw the controller by pulling outwards.

Eurotherm 90 series - Pinch the ribbed areas at the top and bottom of the front surround and pull outwards.

Eurotherm 800 series - Undo the screw located behind the lower flap and withdraw the controller.

Eurotherm 900 series - If the instrument is fitted in a recess, grip firmly and withdraw. If the top and bottom of the instrument are accessible, pinch the top and bottom and withdraw.

5.4 Solid-state Relay Replacement

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

Make a note how the wires are connected to the solid state relay, and disconnect them.

Remove the solid state relay from the base panel or aluminium plate.

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.

Replace the removed panel.

5.5 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:

<i>Negative</i>	<i>positive (type K)</i>	<i>positive (type R)</i>
White	green	orange

Disconnect the thermocouple from its terminal block.

Release the screw which secures the thermocouple sheath., withdraw the sheath, and shake out any fragments of thermocouple.

Re-assemble with a new thermocouple observing the colour coding, ensuring that the thermocouple is not twisted as it is being inserted.

5.6 Panel Element Replacement (CSF & BOF)



See section 5.2 - wearing a face mask is recommended.

The chambers have two side-mounted refractory panels in which coiled heating elements are inserted, and one unheated hearth slab.

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

Make a written plan showing the element connections. It is important to make this plan for each individual furnace.

Disconnect all the element wire tails and thermocouple cables from their terminal blocks. Straighten all the element tails. Note that these become brittle with use.

Open the furnace door and slide out the faulty element(s). Pushing on the tails may sometimes help to start the slab moving. If two elements have fused together both will have to be replaced.

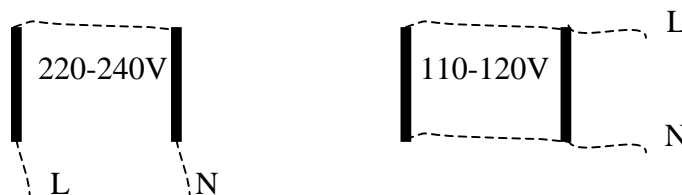
Slide in the new element(s). Guide the tails through the existing holes in the insulation and re-connect the element terminal blocks.

As necessary, shorten the element tails by clipping to length. Remake all the element connections according to the individual plan.

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. Some smoke may be observed during this process, which 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.

Connections: as shown – but remember to check against your own plan



5.7 RHF Element Replacement



See section 5.2- wearing a face mask is recommended.

Elements supplied for these models may not have the original black interior surface. They are just as good as the originals.

The special heating elements form the chamber sides, back and roof in a single 'U' shaped module. The element is very fragile, so spare elements are supplied complete in a "Brick Box" to avoid damage. The hard crust-like surface of the element is easily broken by firm finger pressure: try not to touch it (see also 6 below - always lift the brickbox by its metal casing).

Disconnect the furnace from the mains supply.

Remove the furnace case back panel.

Disconnect the 2 element power leads and the thermocouple connections. Remove the thermocouple and support tube.

Remove the back panel of the control box and using a socket undo the two bolts that hold in the insulation box. These are located in the roof of the control box. Two more bolts are to be found below the front shelf of the furnace.

Using the new brick box repeat the instructions above in reverse order. Do not support the element by putting your hand inside the chamber - the element is fragile.

After replacing the back panel and reconnecting the mains supply, run the furnace for a minimum of 30 minutes at 800°C with the chimney open, to ensure complete burn-off of organic binders. Do not interrupt this initial heat-up cycle. Some smoke may be observed during this process.

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.

5.8 Door Plug Replacement (early models)

If the door plug is held in position by spikes and adhesive, please contact Carbolite' service department.

5.9 Door Plug Replacement (later models)

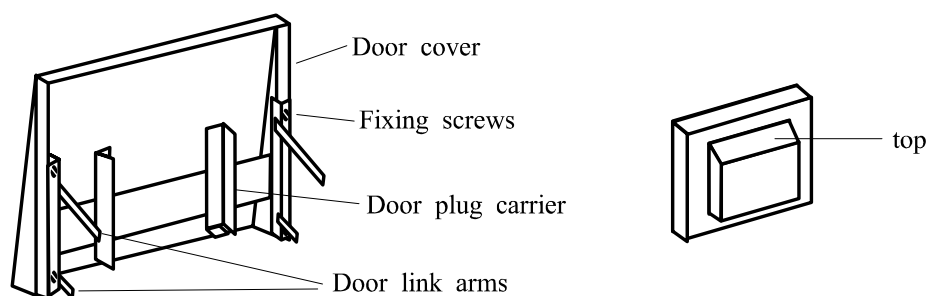
Lift the furnace door to the open position and remove the door cover from the plug carrier assembly. Take care: removal of the carrier reduces the weight of the door and affects the counterbalance effect.

Remove the old door plug by sliding it upwards out of its carrier.

Slide the new plug into the carrier assembly making sure that the plug is the correct way up.

Refit the door cover.

When first heating the furnace after a replacement, ensure that the ventilation is good: emission of some fumes may be expected.



Door

(seen from the back)

Door Plug

5.10 Fuse Replacement

Fuses are marked on the circuit diagram (section 7.0) with type codes, e.g. F1, F2. A list of the correct fuses is given in section 8.0. *Depending on model and voltage, the different fuse types may or may not be fitted.*

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.

6.0

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 |

7.0

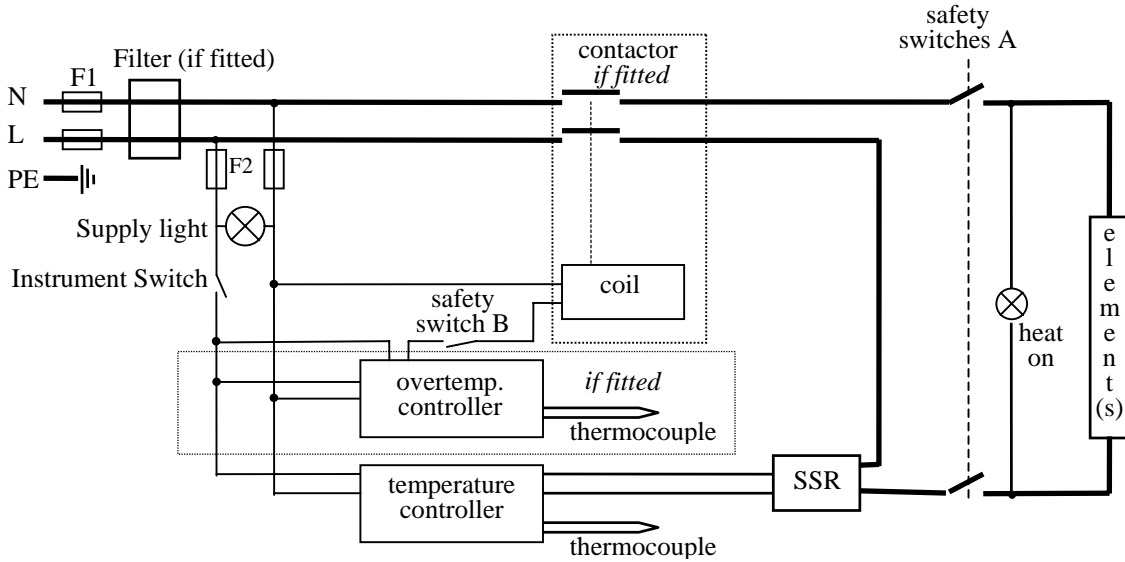
CIRCUIT DIAGRAMS

There are some minor variations of the diagram below.

Safety switches A are door switches that apply when there is no contactor present.

Safety switch B is a door switch that applies where there is a contactor present. A contactor is present if overtemperature control is fitted, or if the current rating exceeds 25A.

7.1 Single Phase



8.0

FUSES

F1-F3: Refer to the circuit diagrams.

<i>F1</i>	Internal supply fuses	Fitted if supply cable fitted. Fitted on board to some types of EMC filter.	on-board and up to 16 Amps: 32mm x 6mm type F other: GEC Safeclip
<i>F2</i>	Auxiliary circuit fuses	Fitted on board to some types of EMC filter. May be omitted up to 25Amp/phase supply rating.	2 Amps glass type F On board: 20mm x 5mm Other: 32mm x 6mm
	Customer fuses	Required if no supply cable fitted. Recommended if cable fitted.	See rating label for amperage; see table below for fuse rating.

Model	Phases	Volts	Supply Fuse Rating	Volts	Supply Fuse Rating
CSF -/3	1-phase	220-240	10A	110-120	15-16A
CSF -/3	1-phase	208	10A	100	16A
CSF -/7	1-phase	220-240	10A	110 / 120	20
CSF -/7	1-phase	208	13A	100	15A
CSF -/13	1-phase	220-240	13A	110 / 120	25A
CSF -/13	1-phase	208	15-16A	100	30-32A
RHF -/3	1-phase	220-240	10A		
RHF -/7	1-phase	220-240	13A		
RHF -/13	1-phase	220-240	25A		

BOF range - same as CSF

9.0

SPECIFICATIONS

Carbolite reserves the right to change specifications without notice.

9.1 Models Covered by this Manual

MODEL	Max. Temp. (°C)	Max. Power (kW)	Chamber Size (mm)			type of heating
			H	W	D	
<i>Chamber furnaces heated by resistance wire inserted in refractory formers.</i>						
CSF 11/3	1100°C	1.7	145	135	175	slabs (2)
CSF 11/7	1100°C	2.4	175	170	245	slabs (2)
CSF 11/13	1100°C	3.0	210	205	300	slabs (2)
CSF 12/3	1200°C	1.7	145	135	175	slabs (2)
CSF 12/7	1200°C	2.4	175	170	245	slabs (2)
CSF 12/13	1200°C	3.0	210	205	300	slabs (2)
<i>Burn-off versions of the above.</i>						
BOF 11/13	1100°C	3.0	210	205	300	slabs (2)
BOF 12/13	1200°C	3.0	210	205	300	slabs (2)
<i>Chamber furnaces heated by resistance wire embedded in low thermal mass insulation.</i>						
RHF 12/3	1200°C	2.1	140	150	165	vac-formed
RHF 12/7	1200°C	3.0	165	190	235	vac-formed
RHF 12/13	1200°C	5.3	200	300	290	vac-formed

9.2 Environment

The furnaces contain electrical parts and should be stored and used in indoor conditions as follows:

temperature: 5°C - 40°C
relative humidity: maximum 80% up to 31°C decreasing linearly to 50% at 40°C

The products covered in this manual are only a small part of the wide range of ovens, chamber furnaces and tube furnaces manufactured by Carbolite for laboratory and industrial use. For further details of our standard or custom built products please contact us at the address below, or ask your nearest stockist.

For preventive maintenance, repair and calibration of all Furnace and Oven products, please contact:

Thermal Engineering Services

Telephone: UK: 0845 3308035 Int: +44 1433 623335

Fax: UK: 0845 3308036 Int: +44 1433 623336

Email: thermalservice@dial.pipex.com



MF49-1.01

30/3/04

CSF retro

Carbolite, Parsons Lane, Hope, Hope Valley, S33 6RB, England.

Telephone: (01433) 620011

Int: +44 1433 620011

Facsimile: (01433) 621198

Int: +44 1433 621198

E-mail: info@carbolite.com