



Installation, Operation & Maintenance Instructions

1100°C Chamber Furnaces

EF 11/8 & AF 11/6

(B models)

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

CONTENTS

Section		page
1.0	Introduction	2
2.0	Installation	3
3.0	Operation	5
4.0	Maintenance	6
5.0	Repairs & Replacements	8
6.0	Fault Analysis	11
7.0	Circuit Diagram	12
8.0	Fuses & Power Control	13
9.0	Specifications	16

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

1.1 Models Covered by this Manual

This manual covers current models EF and AF. Please note that changes were made to the range from late 2001; these changes affect both the case and the internal design. Models made after the change are suffixed with the letter B on the rating label. *If a manual for the earlier design is required, please contact Lenton.*

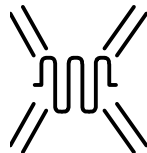
Model EF 11/8B may be set to operate on any voltage in the range 200-240V (or 100-120V to order) by correct setting of the power limit parameter in the controller. For model AF 11/6B the equivalent range is 220-240V.

Because of the 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

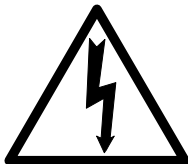


Supply Light: when the furnace is connected to the electrical supply the light in the adjacent switch glows



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.

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 case: 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 - see below.

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.

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: the voltage on the label and the actual supply voltage should be compatible – if in doubt contact Lenton. See section 2.4

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 normally fitted. 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			<i>supply type</i>	
Supply	Terminal label	Cable colour	<i>Live-Neutral</i>	<i>Reversible or Live-Live</i>
<i>1-phase</i>	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)

2.4 Voltage Level & Power Adjustment



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.

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 do the following operations quickly and immediately after switch-on. (Alternatively, temporarily reduce the temperature setpoint to zero to prevent heating.)

Press Page until (output list) is displayed. Press Scroll until (Output High) is displayed. Press Down or Up once to display the value of (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.

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 supplementary manual provided.

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 the separate manual supplied. Unless a time switch is fitted and is off, the furnace starts to heat up.

As the furnace heats up the Heat light glows steadily at first and then flashes as the furnace approaches the desired temperature.

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.

AF: The element life can be reduced by use of non-metallic hearth plates or other non-conducting material covering the hearth. Raise the temperature slowly over the last 300°C, allowing 10 minutes soak at 100°C intervals.

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.

When heating materials which 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.

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.

3.5 Control at Low Temperatures

If the furnace is to be used at temperatures much lower than its design maximum, control stability can often be improved by reducing the power limit. Remember to make a record of the original setting before altering 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.

3.6 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. The operation of this switch should be checked periodically – see section 4.1.2.

4.0 MAINTENANCE

4.1 General Maintenance

Preventive rather than reactive maintenance is to be preferred. The type and frequency depends on furnace use: the following are recommended.

4.1.1 Cleaning

Soot deposits may form inside the furnace, depending on the process. At appropriate intervals remove these by heating as indicated in section 3.2.

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.

4.1.2 Safety Switch

The door switch operation mentioned in 3.6 should be checked periodically to ensure that heating elements are isolated when the door is opened. In normal conditions the safety arrangement should outlast the furnace, but it could be affected by rough handling, a corrosive environment or work materials, or exceptional frequency of use.

A qualified electrician should check that the supply to the heating elements is cut, with and without power being on, when the door is open partially and fully; it is important that isolation is not just marginally achieved. The check is best made on the element terminals after removal of the furnace back: probing the element surface inside the furnace could be inconclusive because of surface oxidation. Note that both live and neutral sides of the element should be isolated when the door is opened.

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.

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

4.3 After Sales Service

Lenton'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 Lenton. 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 Lenton see the back page of this manual.

4.4 Recommended Spares Kits

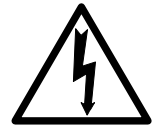
Lenton can supply individual spares, or a kit of the items most likely to be required. Ordering a kit in advance can save time in the event of a breakdown.

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

2216, 2416, 2408 etc. Ease apart the two lugs at the side; grip the instrument and withdraw it from its sleeve; push in the replacement.

5.4 Solid-state Relay Replacement

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

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

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

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

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 Fuse Replacement

Fuses are marked on the circuit diagram (section 7.1) with type codes, e.g. F1, F2. A list of the correct fuses is given in section 0. *Fuse types F2 and F3 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 Lenton.

Access is by removal of the control panel.

5.6 **Thermocouple Replacement**

Models EF and AF use the same type of thermocouple.

Disconnect the furnace from the supply, and remove the back panel. The thermocouple enters the chamber through the back in a thin refractory tube, which is located in the back panel of the chamber box. The wire tails are connected to a small porcelain terminal block on the chamber back.

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, retain the porcelain beads, and withdraw it from the refractory tube.

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

Refit the back panel and its earth wire if disconnected.

5.7 **Element Replacement – EF**



See section 5.2- wearing a face mask is recommended.

The EF chamber insulation is in 4 pieces: the heating element which forms the chamber top and sides; the chamber back; blanket packing around the back; and the chamber base board.

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

Remove the hearth tile if necessary.

See section 5.6 above that refers to the thermocouple colour coding and replacement instructions. Make a note of the thermocouple connections. Unfasten the connections and remove the thermocouple.

Disconnect the element tails and earth wire. Retain any insulation sleeves to refit later.

To remove the chamber box, slacken the 4 bolts on the underside, then slide the chamber box out the back of the case. Be careful: the chamber is heavy.

Remove the top and back of the chamber box.

Remove the packing blanket as necessary.

Lift out the heating element and back insulation together. The element tails pass through the back insulation. Gently pull the back off the element tails.

If necessary, cut the tails of the new element to match the length of the old.

Line up the new element with the back and push the tails through. Fit the new element and back into the chamber box, replace the packing blanket. Some trimming of the element may be necessary.

Refit the chamber top and back.

Refit the chamber box into the case and retighten the 4 bolts.

Refit and connect the thermocouple, element tails with insulation sleeves, and earth wire.

Refit the back panel reconnecting its earth wire, and refit the chimney.

Switch the furnace ON and heat to 900° without interruption, then soak for 1 hour. 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 the previous element failed because of a fault in the control circuit.

5.8 Element Replacement – AF



See section 5.2- wearing a face mask is recommended.

The AF chamber is formed by winding resistance heating wire on to a refractory muffle former. In the event of failure, the whole “wound muffle” assembly must be replaced.

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

See section 5.6 above that refers to the thermocouple colour coding and replacement instructions. Make a note of the thermocouple connections. Unfasten the connections and remove the thermocouple.

Disconnect the element tails and earth wire. Retain any insulation sleeves to refit later.

To remove the chamber box, slacken the 4 bolts on the underside, then slide the chamber box out the back of the case. Be careful: the chamber is heavy.

Remove the top and back of the chamber box.

Remove the insulation boards and brick pieces as necessary to expose the muffle, making note of their location for refitting. Remove the muffle.

If necessary, cut the tails of the new element to match those of the old.

Fit the new element into place.

Refit the insulation boards and brick pieces.

Refit the chamber top and back.

Refit the chamber box into the case and retighten the 4 bolts.

Refit and connect the thermocouple, element tails with insulation sleeves, and earth wire.

Refit the back panel reconnecting its earth wire, and refit the chimney.

Switch the furnace ON and heat to 900° without interruption, then soak for 1 hour. 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 the previous element failed because of a fault in the control circuit.

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

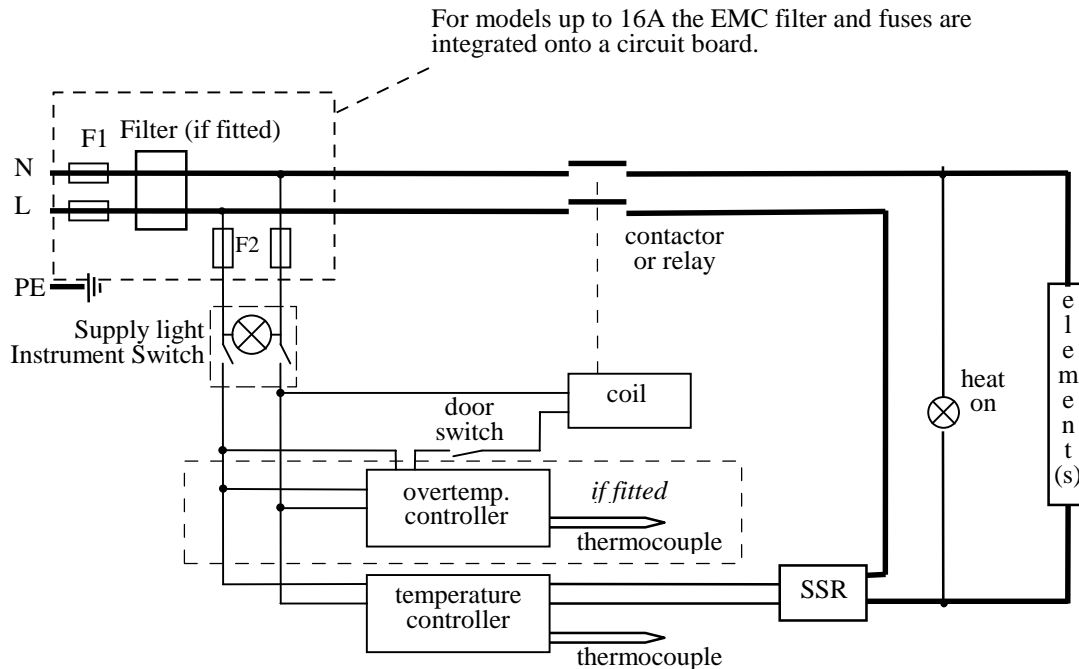
- | | | | |
|----|---|---|--|
| 1. | The HEAT light goes OFF with the instrument switch | → The controller shows a very high temperature | → The controller is faulty |
| | | → The controller shows a low temperature | → The thermocouple may have been shorted out or may have been moved out of the heating 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 DIAGRAM

7.1 EF & AF models

EMC Filters (if fitted): dependent on the model there may be one filter, or more than one fitted in parallel. The circuit diagram example does not show multiple filter arrangements.

NOTE – models before mid-2002: in some models two door switches were fitted directly in the element circuit, instead of a single switch and contactor.



8.0 FUSES & POWER CONTROL

8.1 Fuses

F1-F3: Refer to the circuit diagram.

<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 10 Amp supply rating.	2 Amps glass type F On board: 20mm x 5mm Other: 32mm x 6mm
<i>F3</i>	Heat Light fuses	May be omitted up to 25 Amp supply rating.	2 Amps glass type F 32mm x 6mm
	Customer fuses	Required if no supply cable fitted. Recommended if cable fitted.	See rating label or table below for recommended fuse rating.

Model	phases	Volts	Supply Fuse Rating
EF 11/8B	1-phase	200-240V	10A
EF 11/8B	1-phase	100-120V	20A
AF 11/6B	1-phase	220-240V	10A
AF 11/6B	1-phase	100-120V	20A

8.2 Power Control

The AF models and EF version B use the controller power limit parameter $\square PH_i$ to achieve constant power where possible over a range of supply voltages.

The $\square PH_i$ settings are given in the table.

Increasing the power over the design value could result in heating element failure. See also section 2.4.

Model	Design power	208V	220V 110V	230V 115V	240V 120V	254V
EF 11/8B	1700W	100	89	81	75	67
AF 11/6B	2200W		100	92	84	75

9.0 SPECIFICATIONS

Lenton 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)			Approx. Capacity (l)	Net Weight (kg)
			H	W	D		
<i>Chamber furnace heated by coiled resistance wire embedded in light weight ceramic fibre forming the furnace chamber.</i>							
EF 11/8B	1100°C	1.8	180	190	235	8	19
<i>Chamber furnaces heated by resistance wire wound onto refractory muffles, designed for ashing applications..</i>							
AF 11/6B	1100°C	2.2	125	178	305	6	33

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

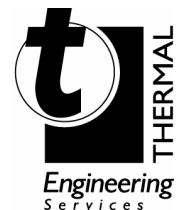
For preventive maintenance, repair and calibration of all Furnace and Oven products, please contact:

Thermal Engineering Services

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Lenton

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EF/AF(B)

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