



Installation, Operation & Maintenance Instructions

1200°C Tube furnaces - LTF

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	Symbols & Warnings	2
2.0	Installation	3
3.0	Operation	5
4.0	Maintenance	7
5.0	Repairs & Replacements	8
6.0	Fault Analysis	11
7.0	Circuit Diagrams	12
8.0	Fuses & Power Settings	14
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.

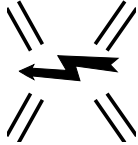


1.0 SYMBOLS & WARNINGS

1.1 Switches and Lights



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

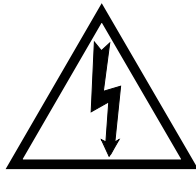


Heat Switch: the switch disconnects power to the heating elements; unless this switch is off there is a danger of electric shock when inserting objects into the furnace



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 & Handling

When unpacking or moving the furnace always lift it by its base or by both ends of the main body. Never lift it by its work tube or the surrounding insulation. For the larger models, or where the furnace and control box are not fixed together, use two people to carry the furnace.

Remove any packing material from inside the furnace before use.

2.2 Siting

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.

2.3 Setting Up

A furnace ordered for vertical use has a small clip or plate at one end to prevent a work tube element or a work tube from slipping downwards. Mount the furnace so that this clip is at the bottom. In models with one thermocouple the thermocouple should be near the top rather than the bottom.

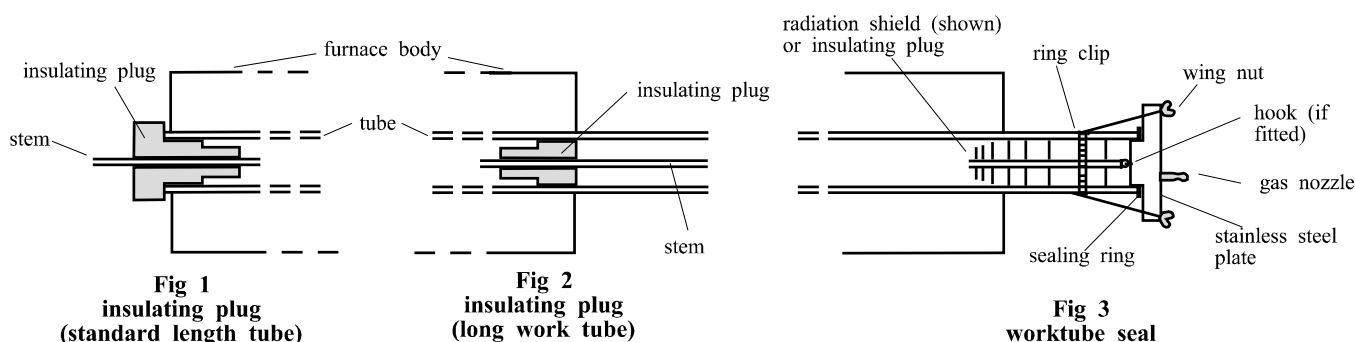
If the furnace is supplied with a separate work tube or any accessories fit these into position.

For optimum temperature uniformity, insulating plugs should be placed in the tube ends as shown in fig.1. With a long work tube, the stem of the plug assembly should line up with the end of the tube as in fig.2. Alignment of radiation shields is similar to that of plugs.

If stainless steel seals with gas inlets are supplied they are to be fitted as shown in fig.3; the stem of any insulating plug should touch the seal. *Stainless steel seals for vertical use:* a hook and eye arrangement holds the upper insulating plug assembly; alternatively a gland nut.

Horizontal models: if heavy fittings are to be clamped to the end of an extended work tube they can increase the bending stress at the centre of the tube. Support such fittings in such a way that expansion of the tube is allowed.

If a metal work tube is being used in the furnace, ensure that it is earthed. It should be mounted so as not to touch the furnace ceramic tube. See the safety warning in section 3.3.



2.4 Electrical Connections

Connection by a qualified electrician is recommended.

All furnaces covered by this manual are designed as standard for single phase A.C. supply, which may be Live to Neutral non-reversible, Live to Neutral reversible or Live to Live.

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 0 of this manual. Where a supply cable is present there are internal supply fuses; customer fusing is preferred but not essential.

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

Furnace without supply cable: a permanent connection to a fused and isolated supply should be made to the internal terminals after temporary removal of the furnace back panel.

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 of a single phase supply.

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)

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 control circuit. There is also a Heater switch which can be used to disconnect power to the elements.

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

Operate the instrument switch to activate the temperature controller; the up position is *off*, the down position *on*. The controller becomes illuminated and goes through a short test cycle.

Set the temperature controller to the desired setpoint or program - 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.

Switch on the Heater switch, located on the instrument panel. 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 the instructions supplied.

To switch off power to the heating elements, use the Heater Switch. To switch the furnace off, use both the Heater switch and the Instrument switch. If the furnace is to be left off, isolate it from the electrical supply.

3.2 General Operating Advice

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.

3.3 Operator Safety



The ceramic materials used in furnace manufacture become electrically conductive to some extent at high temperatures. DO NOT use any conductive tools within the work tube without isolating it. If a metal work tube is used, it must be earthed (grounded).



Switch off the Heater switch whenever loading or unloading the furnace. The elements are isolated when the Heater switch is OFF. This switch cuts both sides of the circuit directly or via a contactor (a contactor is used in models where the rated current exceeds 16 Amps).

3.4 Tube Life

A ceramic work tube may be cracked if workpieces are inserted too quickly or at temperatures below 900°C (when the tube is more brittle). Large pieces should also be heated slowly to ensure that large temperature differences do not arise.

Poor thermal contact should be encouraged between the workpiece and the tube; crucibles or boats should be of low thermal mass and should have feet to reduce the contact with the tube (fig. 4).

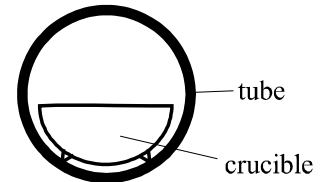


Fig 4
avoidance of thermal contact

Do not set too high a heating rate. Large diameter tubes are more susceptible to thermal shock than smaller. Tubes which extend beyond the heated part of the furnace are more at risk. A general rule for maximum heating rate is 400/internal diameter (°C/min); for 75mm i/d tubes this comes to 5°C per minute. The controller can be set to limit the heating rate.

3.5 Pressure

Work tubes are not able to accept high internal pressure. When gas seals or similar fittings are in use, the gas pressure should be restricted to a maximum of 0.2 bar (3 psi). A pressure of about half of that should normally be sufficient to achieve the desired flow rate. The customer must ensure that the exhaust path from the tube is not blocked, so that excess pressure does not occur.

4.0 MAINTENANCE

4.1 General Maintenance

No routine maintenance is required. The outer surfaces may be cleaned with a damp cloth. Do not allow water to enter the interior of the case, tube or control box. 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.

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. 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. Each kit comprises one thermocouple, one solid state relay, one heating element, and one of each type of internal fuse.

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

4.5 Power Adjustment

The furnace control system incorporates electronic power limiting. The furnaces covered by this manual use the power limit to compensate for the various voltages used world-wide, the aim being to achieve the same operating power regardless of voltage.

The power limit may not be accessible to the operator, in which case, if it is necessary to alter the limit, Lenton can assist with instructions.

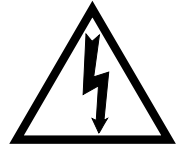
Occasionally the power limit is set to zero to permit demonstration of the controls without the heating elements taking power. In this case the power limit is accessible to the operator, and can be reset to its original value.

See section 8.2 for details of power limit settings. DO NOT adjust the power limit above the correct figure for the voltage - the heating element may fail prematurely, or a fuse could blow.

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 Department 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 back panel from the base or control box..

Make a note of how the wires are connected to the solid state relay, and disconnect them, and 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 base panel or aluminium 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

The coverings and guards which must be removed to gain access to the thermocouple depend on the model, its orientation (horizontal or vertical), and possibly other options and fittings. It will usually be necessary to separate the furnace from its base or stand.

Disconnect the furnace from the supply, and separate the furnace body and/or remove fittings as necessary.

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 N)</i>
white	green	pink

Disconnect the thermocouple from its terminal block.

Withdraw the thermocouple from its sheath (the narrow-bore wound-in tube) and remove any broken bits of thermocouple.

Bend the new thermocouple carefully to match the shape of the original. Should the length differ from that of the original this will usually not be important provided that the thermocouple tip is within a tube diameter's distance from the furnace centre.

Insert the new thermocouple into position, restoring any removed porcelain spacers, and ensuring correct polarity.

Re-assemble the furnace.

5.6 Element Replacement

Please see safety note 5.2 - please wear a face mask.

The coverings and guards which must be removed to enable replacement of the wound tube element depend on the furnace model, its orientation (horizontal or vertical), and other options and fittings. The general procedure is:



Disconnect the furnace from the electrical supply.

Remove all outer guards, meshes and terminal covers from the furnace body. For a horizontally mounted furnace remove the furnace body from its base; to reach the bolts or screws which fix the body to the base, remove the back panel from the base.

Disconnect all electrical leads from the terminal blocks on the furnace case. Note the colours and positions of the connecting leads to enable correct reassembly. Take care not to crack porcelain terminal blocks - use two spanners where appropriate.

Remove the thermocouple.

Lay the furnace body horizontally with the split in the cylindrical case uppermost. Remove the two metal end-caps from the body. The case will spring open slightly. Remove the ceramic board disc from one end.

Use a sharp knife to cut right through the insulation down to the wire-wound tube element along the whole length of the body, but do not cut either of the ceramic board end discs. The knife cut must be in line with the element lead wires. Slide the element gently out through the end of the furnace body.

Check the cylindrical case and clean out as appropriate.

Remove any insulation sleeving from the tails of the old element and fit to the replacement element.

Slide in the new element(s). Close up the furnace again, refitting the end-caps. Any cut made in the insulation should close up completely: if the insulation appears loose or damaged in any way, please contact our Service Department.

Reverse the rest of the disassembly process. Take care to make all connections to the correct terminals. Do not overtighten the connectors in porcelain terminal blocks.

Let the furnace heat up at its maximum rate to 900°C without interruption, and then soak for 1 hour. Fumes may be emitted: this should be done in conditions of good ventilation.

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

If you have any problems with this procedure, please contact our Service Department.

5.7 **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 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 Lenton.

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

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

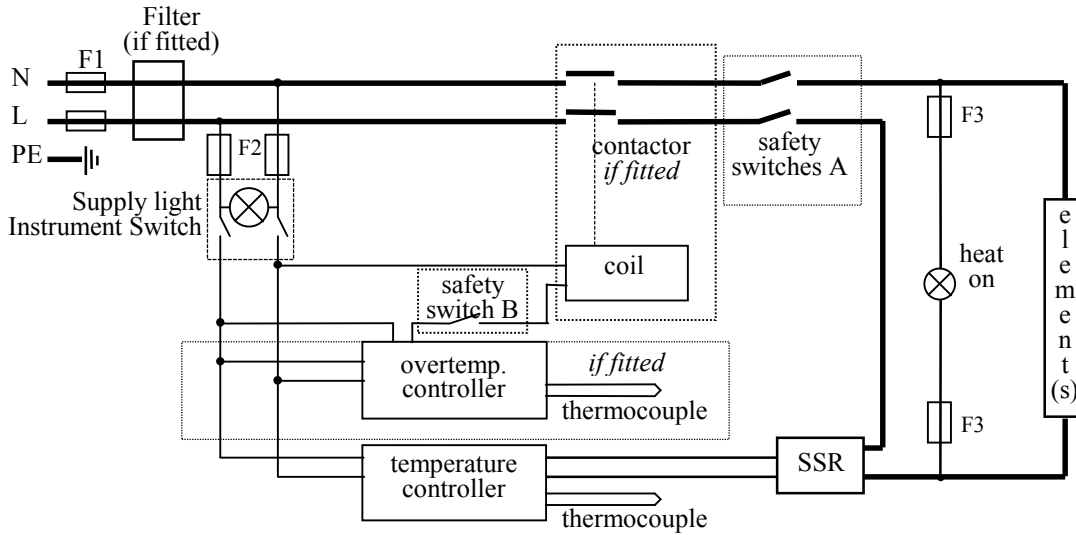
- | | | | |
|----|---|---|--|
| 1. | The HEAT light goes OFF with the instrument switch | → The controller shows a very high temperature | → The controller is faulty |
| | | → The controller shows a low temperature | → The thermocouple may have been shorted out or may have been moved out of the heating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

Safety Switches type A: a 2-pole Heater Switch is fitted directly in the element circuit in models up to 16A rating.

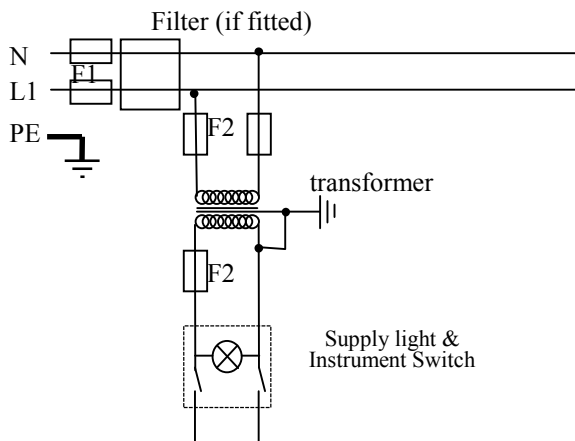
Safety Switch type B: a Heater Switch is fitted into the contactor coil circuit in models over 16A.

7.1 Single Phase



7.2 Higher Voltages (e.g. 254V)

For single phase models of 254V or above, a control circuit transformer is included as follows:



8.0 FUSES & POWER SETTINGS

Important: the data on this page applies to furnaces supplied from April 1999 onwards. Earlier models were all made to use 100% power limits settings, and the power achieved depended on the supply voltage.

8.1 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
<i>F3</i>	Heat Light fuses	May be omitted up to 25 Amp/phase 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 for amperage; see table below for fuse rating.

Model	phases	Volts	Supply Fuse Rating	Volts	Supply Fuse Rating
LTF 12/25/250	1-phase	208-240	5A	100-120	7A
LTF 12/25/500	1-phase	208-240	7A	110-120	12.5A
LTF 12/38/250	1-phase	208-240	5A	110-120	10A
LTF 12/38/500	1-phase	208-240	10A	110-120	16A
LTF 12/50/300	1-phase	208-240	7A	110-120	16A
LTF 12/50/610	1-phase	208-240	10A		
LTF 12/75/610	1-phase	208-240	12.5A		
LTF 12/75/750	1-phase	220-240	12.5A		
LTF 12/100/940	1-phase	208-240	16A		

other models or voltages: check the rating label for details of the supply.

8.2 Power Settings

The LTF models use the controller power limit parameter \overline{P}_H to achieve constant power where possible over a range of supply voltages. The \overline{P}_H settings are given in the table.

Increasing the power over the design value could result in heating element failure.

Model	Design power	208V	220V 110V	230V	240V 120V	254V
LTF 12/25/250	680W	100*	100	92	84	75
LTF 12/25/500	1200W	100	89	81	75	67
LTF 12/38/250	1000W	100	89	81	75	67
LTF 12/38/500	1400W	100	90	82	75	67
LTF 12/50/300	1520W	100*	100	92	84	75
LTF 12/50/610	2000W	100*	97	89	82	73
LTF 12/75/610	2600W	100	89	82	75	67
LTF 12/75/750	3000W		100*	100*	100	89
LTF 12/100/940	4000W	100	90	82	75	67

* in these cases the maximum power lies below the stated design power.

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)	Work Tube Bore (mm)	Work Tube Length (mm)	Heated Length (mm)
<i>Tube furnaces with a ceramic work tube wound with resistance wire</i>					
LTF 12/25/250	1200°C	0.7	25	310	250
LTF 12/25/500	1200°C	1.2	25	560	500
LTF 12/38/250	1200°C	1.0	38	310	250
LTF 12/38/500	1200°C	1.4	38	560	500
LTF 12/50/300	1200°C	1.5	50	360	300
LTF 12/50/610	1200°C	2.0	50	670	610
LTF 12/75/610	1200°C	2.6	75	670	610
LTF 12/75/750	1200°C	3.0	75	810	750
LTF 12/100/940	1200°C	4.0	100	1000	940
<i>also models based on the above, but of other diameters or lengths, supplied to special order</i>					

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

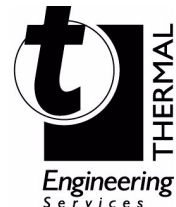
For preventive maintenance, repair and calibration of all Furnace and Oven products, please contact:

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