Installation, Operation and Maintenance Instructions
1600 °C Tube Furnace (3-zone) - TZF Model: 450mm
No Controller

TZF 16/90/450 + No Controller
Contents

This manual is for guidance on the use of the Carbolite Gero product specified on the front cover. This manual should be read thoroughly before unpacking and using the furnace or oven. The model details and serial number are shown on the back of this manual. Use the product for the purpose for which it is intended.

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1.0 Symbols and Warnings

1.1 Switches and Lights

Instrument switch: when the instrument switch is operated the temperature control circuit is energised.

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

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 product.

1.2 General Warnings

DANGER – Electric shock. Read any warning printed next to this symbol.
WARNING: Risk of fatal injury.

DANGER – Hot surface. Read any warning printed next to this symbol.
WARNING: All surfaces of a product may be hot.

DANGER – Read any warning printed next to this symbol.
Caution – Double Pole/Neutral Fusing
2.0 Installation

2.1 Unpacking and Handling

When unpacking or moving the product 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. Use two or more people to carry the product and control box. Remove any packing material from inside the product before use.

If an optional or special stand is separately supplied, assemble the product on to it. Some models may be supplied for customer mounting and may require customer preparation of mounting components before installation.

NOTE: This product contains Refractory Ceramic Fibre (also known as Alumino Silicate Wool - ASW). For precautions and advice on handling this material see section 6.2.

2.2 Siting and Setting Up

Place the product on a level surface in a well ventilated area.

Site away from other sources of heat and on a non-flammable surface that is resistant to accidental spillage or hot materials.

The surface on which the equipment is mounted should be stable and not subject to movement or vibrations.

The height of the mounting surface is important to avoid operator strain when loading and unloading samples.

Unless otherwise stated elsewhere in this manual, ensure that there is at least 150 mm of free space around the back and sides of the product. Clear space is required above the product to dissipate heat.

Work tubes:

It is recommended that the work tube has either insulation plugs or radiation shields fitted to minimise heat loss from both ends of the work tube. If the work tube has open ends, a significant amount of energy could be radiated from the ends of the work tube. Adjacent surfaces should always be made from a non-flammable material.

Ensure that the ends of the work tube are positioned at least 500 mm away from any adjacent surface so that any energy radiated cannot heat an adjacent surface to a dangerous temperature.
Depending on the application of the product, it may be appropriate to position it under an extraction hood. Ensure the extraction hood is switched on during use.

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

Under no circumstances should any objects be placed on top of the product. Always ensure that any vents on the top of the product are clear of any obstruction. Always ensure all cooling vents and cooling fans (if fitted) are clear of any obstruction.

If the product is supplied with a work tube then the holes at the end of the product chamber should be supplied at the correct size. Carefully line up the tube and ease it through the chamber.

For a tube of customer supply, ensure that there is approximately 1 mm free play at each end; if the tube is too tight, it may crack when heated. Increase the diameter of the hole by rotating the tube, which is abrasive. Remove loose powdered ceramic fibre with a vacuum cleaner and see section 6.0.

Contact Carbolite Gero if the holes in the product chamber are too large.

Ensure that the tube is centrally placed and reaches to or through the product end covers, so that there is no access to exposed electrical connections.
2.3 Tube Fitting

**Vertical Mode.** The product (if a tube is also supplied) has a plate or clip to retain the tube in position. See fig. 1.

![Diagram of Vertical Tube Retention]

**Key**
- A: End guard
- B: Plate
- C: Standard tube
- D: Long tube
- E: Strap
- F: Ring clip

*Fig 1 - Vertical Tube Retention*

![Diagram of Insulating End Plug]

**Key**
- A: Furnace body
- B: Tube
- C: Insulating plug
- D: End guard
- E: Stem

*Fig 2 - Insulating End Plug*

Fit any accessories supplied. For optimum temperature uniformity, ceramic insulation plugs or radiation shields should be placed in the tube ends as shown in fig. 2. The ends of the insulation plugs or radiation shields should not protrude outside of the work tube.

**NOTE:** Insulation plugs or Radiation shields are strongly recommended for this product. Contact Carbolite Gero or Carbolite Gero Service for further information.
2.0 Installation

Expanded View of “Twin Clamp” End Seals:

Fig 3 ‘Twin Clamp’ End Seal

For assembly details refer to separate work tube and end seal manual.

If stainless steel end 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 end plate.

When stainless steel end seals are fitted in the vertical mode, a hook and eye, on the end of the plate holds the upper insulating plug or radiation shield assembly.

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 the fittings in such a way that longitudinal expansion of the tube is allowed.

If a metal work tube is being used in the product, ensure that it is earthed (grounded). There can be leakage of current through ceramic insulation at high temperatures.
2.0 Installation

Under no circumstances should any objects be placed on top of the product. Always ensure that any vents on the top of the product are clear of any obstruction. Always ensure all cooling vents and cooling fans (if fitted) are clear of any obstruction.

2.4 Heating Elements

The silicon carbide elements are VERY FRAGILE and are packed separately. Fit them accordingly to the instructions in section 6.6.

2.5 Electrical Connections

Connection by a qualified electrician is recommended.

All models covered by this manual may be ordered for single phase A.C. supply, which may be Live to Neutral non-reversible, Live to Neutral reversible or Live to Live.

Check the product rating label before connection. The supply voltage should agree with the voltage on the label and the supply capacity should be sufficient for the current on the label.

The supply should be fused at the next size equal to, or higher than the current on the label. A table of the most common fuse ratings is also given towards the back of this manual. When the mains cable is factory fitted, internal fuses are also fitted. It is essential that the operator ensures that the product is correctly fused.

Products with a factory fitted supply cable are designed to be wired directly to an isolator or fitted with a line plug.

Products without a factory fitted supply cable require a permanent connection to a fused and isolated supply. The product's electrical access panel should be temporarily removed, and connections made to the internal terminals.

If the product is to be connected by line plug. The plug should be within reach of the operator and should be easy to remove.

When connecting the product to an isolating switch ensure that 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).
### Electrical Connection Details:

<table>
<thead>
<tr>
<th>Supply</th>
<th>Terminal Label</th>
<th>Cable Colour</th>
<th>Supply Types</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Live - Neutral</td>
</tr>
<tr>
<td>1-phase</td>
<td>L</td>
<td>Brown</td>
<td>Reversible or Live-Live</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Blue</td>
<td>to live</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Green/ Yellow</td>
<td>to earth (ground)</td>
</tr>
</tbody>
</table>

#### Live - Neutral:
- to live
- to neutral
- to earth (ground)
- to either power conductor (For USA 200-240V, connect L1)
- to the other power conductor (For USA 200-240V, connect L2)

#### 2- or 3-phase:

<table>
<thead>
<tr>
<th></th>
<th>L1</th>
<th>Black</th>
<th>to phase 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L2</td>
<td>Black</td>
<td>to phase 2</td>
</tr>
<tr>
<td></td>
<td>L3</td>
<td>Black</td>
<td>to phase 3 (except 2-phase)</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Light Blue</td>
<td>to neutral (except delta)</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Green/ Yellow</td>
<td>to earth (ground)</td>
</tr>
</tbody>
</table>

**DO NOT** connect a model ordered for three phase use to a single phase supply or to the wrong type of three phase supply.

### Technical Notes

This model has an electronically controlled power limit. Do not attempt to calculate the Amps from the Wattage. High break capacity fuses should be used. Avoid fast-blow fuses and magnetic trip circuit breakers - consult Carbolite Gero if in doubt.
3.0 Temperature Controller

If this product is fitted with a temperature controller, instructions are provided separately.
4.0 Operation

4.1 Operating Cycle

This product is fitted with an instrument switch which cuts off power to the control circuit.

Connect the product to the electrical supply.

There is also a heater switch which can be used to disconnect power to the elements. Operate the instrument switch to activate the temperature controller. The controller becomes illuminated and goes through a short test cycle.

**Over-Temperature option only.** If the digital over-temperature option has not yet been set as required, set and activate it according to the over-temperature controller instructions.

The product will heat up according to the controller setpoint or program, unless a time switch is fitted and switched off.

As the product heats up, the heat light glows steadily at first and then flashes as the product approaches the desired temperature. For more information on temperature control see the controller instructions.

**Over-Temperature option only.** If the over-temperature circuit has tripped, an indicator on the over-temperature controller flashes and the heating elements are isolated. Find and correct the cause before resetting the over-temperature controller according to the instructions supplied.

To switch off power to the heating elements, use the heater switch. To switch the product off, use both the heater switch and the instrument switch. If the product is to be left switched off and unattended, isolate it from the electrical supply.

4.2 Control Method

Set the three temperature controllers to the desired setpoints. The setting and operation of the end zone controllers depends on the 3-zone control options selected when the product was ordered. These options are described in the 3-zone control methods section.

4.3 3-Zone Control Methods

There are two different control options (B & C).

(B) Retransmission of Setpoint using Broadcast Communications.

(C) Independent control

The models listed in this manual are designed to achieve an extended uniform temperature zone with the use of three control zones rather than achieving different temperatures in each zone.

For method B, the control zones are linked so that they all follow the centre zone controller in a master-slave approach.
B. Retransmission of Setpoint using Broadcast communications

Three independent thermocouples are connected to three controllers. The three controllers are linked together and the centre zone controller communicates the desired setpoint to the end zone controllers. If the centre zone controller is set to a setpoint or is running a program, the end zone controllers will automatically follow.

Additional communication modules are fitted in the controllers, rather than an additional thermocouple. The communication between the controllers of the Eurotherm 3000 series is known as Broadcast communications. It is possible to switch off the linked control and allow the controllers to work independently. In level 2 menu of the end zone controllers (see controller operating instruction), scroll to L-r. Where the end zone controller is a 3216 use the ▲ up ▼ down and select NO. Where the end zone controller is a 3508 use the ▲ up ▼ down to select SP1, (SP1 = Local, and SP2 = Remote). There is no need to alter the centre zone controller.

It is possible to set an offset (local trim) between the centre and end zone controllers. This can be either a positive or negative difference from the centre zone temperature. Once entered, this offset will always be added to, or subtracted from, the retransmitted setpoint temperature (unless edited). To make this adjustment, enter level 2 menu of the end zone controllers (see controller operating instruction), scroll to LOC.T (local trim) and use the ▲ up ▼ down to enter the desired positive or negative value. This will then be added to, or subtract from, the end zone set temperature. There is no need to alter the centre zone controller.

C. Independent Control

The three controllers are completely independent. Note that it is not possible to maintain very different temperatures in the three zones because of heat transfer between the zones. The models listed in this manual are designed to achieve an extended uniform temperature zone with the use of three control zones rather than achieving different temperatures in each zone.

4.4 General Operating Advice

Heating element life is shortened by overheating. Do not leave the product at high temperature when it is not required. The maximum temperature is shown on the product rating label and in section 10.0 towards the back of this manual.

![Warning](Image)

Lightweight ceramic fibre insulation can easily be marked by accidental contact. Some fine cracks may develop in the surface of the insulation due to the progressive shrinkage of the insulation materials. Cracks are not usually detrimental to the functioning or the safety of the product.

Clean up any spillages in the insulation, as these can increase the rate of degradation of the insulation material.
4.5 Operator Safety

The ceramic materials used in the product manufacture become electrically conductive to some extent at high temperatures. DO NOT use any conductive tools within the product 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 product. The elements are isolated when the heater switch is OFF. This switch cuts both sides of the circuit via a contactor.

4.6 Tube Life

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

Poor thermal contact should be encouraged between the work piece 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](image)

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

4.7 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 approximately half of that should normally be sufficient to achieve the desired flow rate. The operator must ensure that the exhaust path from the tube is not blocked, so that excess pressure does not occur.

A suitably regulated gas supply should always be used.
It is recommended that a pressure relief system should be used to avoid an over pressurisation of the work tube.

Please note: A product should not be heated up if any valves that have been fitted are closed to create a sealed volume. A sealed work tube should not be heated from cold due to the pressure increase caused by the trapped air or gas expanding during the heating process.
5.0 Maintenance

5.1 General Maintenance

Preventive rather than reactive maintenance is recommended. The type and frequency depends on the product use; the following are recommended.

5.2 Maintenance Schedule

CUSTOMER QUALIFIED PERSONNEL

DANGER! ELECTRIC SHOCK. Risk of fatal injury. Only electrically qualified personnel should attempt these maintenance procedures.

<table>
<thead>
<tr>
<th>Maintenance Procedure</th>
<th>Method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Set an over-temperature setpoint lower than the displayed temperature and check for an over-temperature alarm as detailed in this manual</td>
<td></td>
</tr>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Electrical measurement</td>
<td>6</td>
</tr>
<tr>
<td>Safety Switch Function (split models only)</td>
<td>Set a safe temperature above ambient, and open the furnace to see if the heater light goes out</td>
<td>6</td>
</tr>
<tr>
<td>Safety Switch Function (split models only)</td>
<td>Electrical measurement</td>
<td>6</td>
</tr>
<tr>
<td>Electrical Safety (external)</td>
<td>Visual check of external cables and plugs</td>
<td>6</td>
</tr>
<tr>
<td>Electrical Safety (internal)</td>
<td>Physically check all connections and cleaning of the power plate area</td>
<td>6</td>
</tr>
</tbody>
</table>

Function

<table>
<thead>
<tr>
<th>Maintenance Procedure</th>
<th>Method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Calibration</td>
<td>Tested using certified equipment, frequency dependent on the standard required</td>
<td>6</td>
</tr>
<tr>
<td>Operational Check</td>
<td>Check that all functions are working normally</td>
<td></td>
</tr>
<tr>
<td>Operational Check</td>
<td>Thorough inspection and report incorporating a test of all functions</td>
<td>6</td>
</tr>
<tr>
<td>Work Tube Position</td>
<td>Visually check that the tube is central to the heated zone (horizontally / vertically)</td>
<td></td>
</tr>
<tr>
<td>End Plugs / Radiation Shields</td>
<td>Visual check for damage or wear, and correct positioning</td>
<td></td>
</tr>
</tbody>
</table>
## 5.0 Maintenance

<table>
<thead>
<tr>
<th>Component</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seals (if fitted)</td>
<td>Check all seals and O-rings and clamps</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td>Element Circuit</td>
<td>Electrical measurement</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>Measure the current drawn on each phase / circuit</td>
</tr>
<tr>
<td>Cooling Fans (if fitted)</td>
<td>Check whether the cooling fans are working</td>
</tr>
</tbody>
</table>
5.2.1 Cleaning

The product's 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.

![Warning]
Under no circumstances should any objects be placed on top of the product. Always ensure that any vents on the top of the product are clear of any obstruction. Always ensure all cooling vents and cooling fans (if fitted) are clear of any obstruction.

5.3 Calibration

After prolonged use, the controller and/or thermocouple may require recalibration. This is important for processes that require accurate temperature readings or for those that use the product 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 Gero can supply these items. Depending on the controller fitted, the controller instructions may contain calibration instructions.

5.4 After-Sales Service

Carbolite Gero Service has a team of Service Engineers who can offer repair, calibration and preventive maintenance of furnace and oven products both at the Carbolite Gero factory and at customers’ premises throughout the world. A telephone call or email often enables a fault to be diagnosed and the necessary parts to be despatched.

In all correspondence please quote the serial number and model type given on the rating label of the product. The serial number and model type are also given on the back of this manual when supplied with the product.

Carbolite Gero Service and Carbolite Gero contact information can be found on the back page of this manual.

5.5 Recommended Spare Parts and Spare Parts Kit

Carbolite Gero can supply individual spare parts 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.

Please consult Carbolite Gero's Sales Department for details of recommended spare parts.

5.6 Power Adjustment

The product's control system incorporates electronic power limiting. Power is supplied to the elements in bursts of approximately 0.33 seconds duration. This prevents overheating of the elements. The power limit is programmed into the product controller.

A table of standard power limits is supplied with new products, it is given in section 9.0
5.7 Element Ageing

Silicon carbide elements gradually increase in resistance with use; a process known as ageing. Their heating power reduces correspondingly. To ensure sufficient power to the product, it may be necessary to adjust the power limit and, ultimately, replace the elements - taking care to readjust the power limit.

If the product does not reach temperature, or is slow, check the power limit setting and increase the value by 5%. It is recommended to make a note of the new settings and the date of the adjustment in section 9.0. Increase the power limit in steps of 5% until the product regains its original performance.

If the power limit is set to 100% a new set of heating elements is required.

Please note: it is not possible to use the cold resistance of the element as a measure of ageing as the cold resistance is not an accurate indicator of hot resistance. Hot resistance is used to calculate furnace power.

See the controller instructions for how to adjust the controller. Always record the setting when first making an adjustment. If new elements are fitted, return the adjustments to the original value. A table of standard power limits is given in section 9.0.
6.0 Repairs and Replacements

6.1 Safety Warning - Disconnection from Power Supply

Immediately switch the product off in the event of unforeseen circumstances (e.g. large amount of smoke). Allow the product to return to room temperature before inspection.

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

Caution: Double pole/neutral fusing may be used in this product.

6.2 Safety Warning - Refractory Fibre Insulation

Insulation made from High Temperature Insulation Wool
Refractory Ceramic Fibre, better known as (Alumina silicate wool - ASW).

This product contains alumino silicate wool products in its thermal insulation. These materials may be in the form of blanket or felt, formed board or shapes, slab or loose fill wool.

Typical use 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, it is strongly recommended that safety precautions are taken whenever the materials are handled.

Exposure to fibre dust may cause respiratory disease.

When handling the material, always use approved respiratory protection equipment (RPE-eg. FFP3), eye protection, gloves and long sleeved clothing.

Avoid breaking up waste material. Dispose of waste 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 it is recommended to make reference to the European Association representing the High Temperature Insulation Wool industry (www.ecfia.eu).

Further information can be provided on request. Alternatively, Carbolite Gero Service can quote for any repairs to be carried out either on site or at the Carbolite Gero factory.

6.3 Temperature Controller Replacement

Refer to the controller instructions for more information on how to replace the temperature controller.
6.0 Repairs and Replacements

6.4 Solid-State Relay Replacement

Disconnect the product from the power supply and remove the appropriate cover as given above.

Make a note of the wire connections 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 bottom of it has good thermal contact with the base panel or aluminium plate. Replace the access panel.

6.5 Thermocouple Replacement

Disconnect the product from the power supply. Remove terminal cover to gain access to the thermocouple connections. Make a note of the thermocouple connections.

Thermocouple cable colour codings are:

<table>
<thead>
<tr>
<th>Thermocouple leg</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>positive (type R)</td>
<td>orange</td>
</tr>
<tr>
<td>negative</td>
<td>white</td>
</tr>
</tbody>
</table>

Disconnect the thermocouple from its terminal block and withdraw the thermocouple from its sheath by bending the metal tag or releasing the screw to release. It is also advisable to remove the sheath and shake out any broken pieces of thermocouple. Re-assemble with a new thermocouple, observing the colour coding, ensuring that the thermocouple is not twisted as it is being inserted and that the metal tag is bent back to grip the sheath.

Refit the element access panel.
6.6 Element Fitting and Replacement

Replacements: see section 5.7. If at any time the power limit has been increased, reset it to its original value (see section 9.0 at the back of this manual for the original value).

New elements must not be mixed with aged elements. If a single element fails in an aged set of elements then replace with a new set. The remaining aged elements can be used as spare parts in the future.

Disconnect the product from the electrical supply.

Remove the end guards to gain access to the element connections.

Remember that the elements are fragile and expensive and that they can be damaged by contamination: handle them with care and keep them clean.

Replacements: make a note of the actual braid and cable connections to the elements. For rod elements disconnect the clips, lift off the braids and carefully withdraw each element. Refer to the image below.

Carefully insert the new elements into the product. Ensure that the rod elements are placed centrally: the same length should be outside the insulation at each end.

TZF: The 3 rod elements are connected in series, using braids. The 6 double-spiral elements are fitted 3 in series at each end, connected by 10 mm cable. See fig. 9. In the case of 3-phase + neutral, each set of elements is connected to a live from an SSR at one end, at to neutral at the other. In the case of 3-phase delta (no neutral), each set of elements is connected to a live from an SSR at one end and a direct live from another phase at the other. The normal phase connections are A1-C, B1-A, C1-B.

Replace the end guards and connect the product to the electrical supply.

If aged elements have been replaced, reset the products power limit.

If you have any problems with this procedure, please contact the Carbolite Gero service division.
6.7 **Fuse Replacement**

Fuses are marked on the wiring diagram with type codes, e.g. F1, F2. For more information on fuses refer to section 9.0.

*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 Gero.

The fuses are located at the cable entry point. Remove the back panel or control box back panel to gain access to the fuses.
### 7.0 Fault Analysis

#### A. Furnace Does Not Heat Up

<table>
<thead>
<tr>
<th>1. The HEAT light is ON</th>
<th>The heating element has failed</th>
<th>Check also that the SSR is working correctly</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. The HEAT light is OFF</td>
<td>The controller shows a very high temperature or code such as S.br</td>
<td>The thermocouple has broken or has a wiring fault</td>
</tr>
<tr>
<td></td>
<td>The controller shows a low temperature</td>
<td>The door switch(es) (if fitted) may be faulty or need adjustment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The contactor/relay (if fitted) may be faulty</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The heater switch (if fitted) may be faulty or need adjustment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The SSR could be failing to switch on due to internal failure, faulty logic wiring from the controller, or faulty controller</td>
</tr>
<tr>
<td></td>
<td>There are no lights glowing on the controller</td>
<td>Check the supply fuses and any fuses in the furnace control compartment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The controller may be faulty or not receiving a supply due to a faulty switch or a wiring fault.</td>
</tr>
</tbody>
</table>
## B. Product Overheats

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Product only heats up when the instrument switch is ON</td>
<td>The controller shows a very high temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The controller shows a low temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Product heats up when the instrument switch is OFF</td>
<td>The SSR has failed &quot;ON&quot;</td>
</tr>
</tbody>
</table>
8.0 Wiring Diagrams

8.1 WC-13-31
Connections below show single phase with indirect safety switches and over-temperature control.
8.0 Wiring Diagrams

8.2 WC-U3-31
Connections below show 3-phase +N with safety switches and over-temperature control.

![Wiring Diagram](image)

Products with this wiring arrangement may be converted between the following supply voltages (please refer to the table within section 9.0 for compatible phases with the product):

- 3-phase + neutral in the range 380/220 V - 415/240 V
- 3-phase delta in the range 220 V - 240 V
- Single phase in the range 220 V - 240 V
- 208 V model: *can be converted between 208 V delta and 208 V 1-phase*

Please contact Carbolite Gero Service for details.
8.3 Control by Broadcast Comms (control method B)

When this is ordered there are three independent thermocouples connected to the three controllers; the controllers are linked together (not shown), and remain “master” and “slave”.

The communication between the controllers of the Eurotherm 3000 series is known as Broadcast comms. The wiring connections between the controllers are as follows:

![Wiring Diagram]

- **Master**: HD, HE, HF
- **Slaves**: HD, HE, HF
9.0 Fuses and Power Settings

9.1 Fuses

F1-F3: Refer to the circuit diagrams.

<table>
<thead>
<tr>
<th>F1</th>
<th>Internal Supply Fuses</th>
<th>Fitted if supply cable fitted. Fitted on board to some types of EMC filter.</th>
<th>GEC Safeclip of the type shown (glass type F up to 16 A) 38 mm x 10 mm type F fitted on EMC filter circuit board(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2</td>
<td>Auxiliary Circuit Fuses</td>
<td>Fitted on board to some types of EMC filter. May be omitted up to 25 Amp/phase supply rating.</td>
<td>2 Amps glass type F On board: 20 mm x 5 mm Other: 32 mm x 6 mm</td>
</tr>
<tr>
<td>F3</td>
<td>Heat Light Fuses</td>
<td>May be omitted up to 25 Amp/phase supply rating.</td>
<td>2 Amps glass type F 32 mm x 6 mm</td>
</tr>
<tr>
<td></td>
<td>Customer Fuses</td>
<td>Required if no supply cable fitted. Recommended if cable fitted.</td>
<td>See rating label for current; See table below for fuse rating.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Phases</th>
<th>Volts</th>
<th>Supply Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>TZF 16/450</td>
<td>1-phase</td>
<td>200-240</td>
<td>50 A</td>
</tr>
<tr>
<td>TZF 16/450</td>
<td>3-phase Delta</td>
<td>200-240</td>
<td>32 A</td>
</tr>
<tr>
<td>TZF 16/450</td>
<td>3-phase + N</td>
<td>380-415</td>
<td>25 A</td>
</tr>
</tbody>
</table>

9.2 Power Settings

The power limit settings (parameter OP.Hi) for this model are voltage dependant. The figures represent the maximum percentage of time that controlled power is supplied to the elements. Do not attempt to "improve performance" by setting a value higher than the recommended values. To adjust the parameter refer to the "Changing the Maximum Output Power" of the control section of the manual.

<table>
<thead>
<tr>
<th>Model</th>
<th>Volts:</th>
<th>208 V</th>
<th>200 V</th>
<th>220 V</th>
<th>230 V</th>
<th>240 V</th>
<th>380 V</th>
<th>400 V</th>
<th>415 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>TZF 16/450</td>
<td></td>
<td>27</td>
<td>57</td>
<td>27</td>
<td>29</td>
<td>62</td>
<td>29</td>
<td>24</td>
<td>51</td>
</tr>
</tbody>
</table>
### User Power Setting Adjustments

<table>
<thead>
<tr>
<th>Date</th>
<th>% Power</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

**Note:** If a new set of elements are fitted then return the power settings to the original value.

Please refer to the rating label for product specific information.
10.0 Specifications

Carbolite Gero reserves the right to change the specification without notice.

<table>
<thead>
<tr>
<th>Model</th>
<th>Max Temp (°C)</th>
<th>Max Power (kW)</th>
<th>Work Tube Bore (mm)</th>
<th>Work Tube Length (mm)</th>
<th>Heated Length (mm)</th>
<th>Net Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TZF 16/450</td>
<td>1600</td>
<td>6.8</td>
<td>90</td>
<td>900-1200</td>
<td>450</td>
<td>39</td>
</tr>
</tbody>
</table>

Note: Weights are approximate for horizontal models and do not include fittings or vertical stands.

10.1 Environment

The models listed in this manual 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
## Service Record

<table>
<thead>
<tr>
<th>Engineer Name</th>
<th>Date</th>
<th>Record of Work</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>
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 Gero 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:

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Fax: +44 (0) 1433 624243
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