Installation, Operation and Maintenance Instructions
1200°C Tube Furnace (3-zone) EHC Model: 450mm
No Controller

EHC 12/450B + 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.
1.3 Warning Labels

On the front control panel there are 2 warning labels as shown in figure 1.3.1; they are numbered 7 and 8. These warnings must be followed for the safe operation of this furnace.

7- Warning label - Do not operate without a work tube.
The furnace must not be operated without the correctly sized work tube and correspond work tube adaptors or it could be possible for an operator to access electrically live element coils that could cause serious injury or death.

8- Warning label - Switch off the furnace before loading and unloading.
The furnace heaters must be switched OFF using the heater switch, item 2 in figure 1.3.1, when the furnace is being loaded or unloaded. The work tube can become electrically conductive at high temperatures, presenting a possible hazard to the operator. If element failure is left undetected the element could collapse onto the work tube.
Index to numbered items in Figure 1.3.1 and 1.3.2

1. Electrical supply switch - switches electrical power ON and OFF to the furnace.
2. Heater switch - switches electrical power ON and OFF to the furnace heating elements.
3. Heater ON light - indicates that the furnace heating elements are energized.
4. Product rating label indicating the product serial number and electrical information.
5. Access holes to front panel fixing screws.
6. Warning label - Disconnect the mains supply before removing this cover.
7. Warning label - Do not operate without a work tube.
8. Warning label - Switch OFF the furnace before loading and unloading.
9. Electrical power lead socket.
2.0 Installation

If the product has been transported or stored in humid conditions it must be dried out completely before operating the furnace. Contact Carbolite Gero Service for instructions.

2.1 Unpacking and Handling

When unpacking or moving the product, always lift it by its base or both ends of the main body. Never lift it by the end insulation or by a work tube. It may take 2 or 3 people to lift the furnace, depending on the size and configuration.

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

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.
2.0 Installation

If the product is to be used in a process which could liberate hazardous gases, then it should be installed together with a suitable fume extraction system.

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

2.3 Setting Up

The horizontal models must have work tubes fitted before being used. The diameter of the work tube is a customer order option and therefore varies between tube furnaces.

Note: If a metal work tube is being used in the furnace, ensure that it is earthed. See 4.6.

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.

**Fitting the standard length work tube to furnace**

Tools required: 4 mm Allen key

Fitting work tube is as follows with reference to Figure 2.3.2. Please note that standard length work tubes are also referred to as tubes suitable for working in air. They are 150
mm longer than the heated length of the furnace (see the Specifications table at the back of this manual). Read section 6.2 before fitting the work tube.

Index to numbered items in Figure 2.3.2

1. Tube furnace body
2. Work tube (diameter customer option)
3. Work tube adaptor (size dependent on work tube diameter)
4. Work tube adaptor fixing bracket
5. Work tube end stop (size dependent on work tube diameter)
6. Fixing screws M6 x 15
7. Washer M6
8. Tube furnace end guard

- Remove the work tube end guard (8) then remove the work tube adaptor fixing bracket (4) that holds in place the work tube end stop (5) and the end adaptor (3) from one side only. Note that if a different work tube with a different outer diameter is being fitted it will be necessary to fit new correctly sized work tube adaptors (3) in which case both end guards and work tube adaptor fixing brackets (4) will need removing.
- Slide the work tube into the furnace through the work tube adaptor (3) until it reaches the opposite work tube end stop (5). Note that the work might be a tight fit when it is new and may need to be twisted backwards and forwards slightly as it slides in. For long work tubes it may be necessary to use a long wooden pole to support and line up the work tube as it pushed through. It may also take 2 people to perform this operation.
- Reassemble the work tube end stop (5), work tube adaptor bracket (4) and tube end guard (8).

**Fitting the extended work tube in the furnace**

Tools required 4 mm Allen key.

Fitting of the work tube is as follows with reference to Figure 2.3.2 to 2.3.8.
Before the extended work tube can be fitted, the work tube end stops for the standard length work tube (item 5 in figure 2.3.2) must be removed from both ends of the furnace. This is done by removing the furnace end guard (8) and the work tube adaptor brackets (4) to release the work tube end stop (5). The brackets should then be refitted.

- Fit the tube support bracket, (5), figure 2.3.4. Use the M6 button head screws and washers supplied.
- Fit the extended work tube guard, (4), figure 2.3.5. Use the M6 button head screws and washers supplied.
- Re-fit furnace end guard, (3), figure 2.3.6. Use the M6 button head screws and washers supplied.
- If supplied, fit the optional tube end seal assembly as shown in figures 2.3.9 and 2.3.10. Refer to manual MEN-ENDSEALS-01 for detailed fitting instructions.
- Fit the tube support bracket, (1), figure 2.3.7. Use the M6 button head screws and washers supplied.
- Finally, fit tube support collar, (2) and secure figure tight using (6) until the tube is secure to be used in a vertical arrangement. The fitting arrangement is shown in figure 2.3.8.

- Figure 2.3.3 - shows an exploded view of all the required parts.
- Figure 2.3.8 - shows the assembled parts as they would be used.
2.0 Installation
2.0 Installation

Figure 2.3.9 - Tube support and end seal assembly

Figure 2.3.10 - Tube support and end seal assembly

Index to numbered items in figure 2.3.3 - 2.3.10

1. Tube support bracket
2. Tube support collar
3. End guards
4. Extended work tube guard
5. End adaptor
6. Fluted grip knob

**Fitting the Optional Insulation Plugs and Radiation Shield**

For optimum temperature uniformity, insulation plugs or radiation shields should be placed in the work tube ends as shown below. With a standard work tube, the insulation plug must be fitted as shown in figure A.

If a gas/vacuum end seal is fitted, either horizontally or vertically, the insulation plug hooks onto the end seal hook; see figure B.

Alignment of radiation shields is similar to that of insulation plugs, see figure C.

If a metal work tube is being used in the furnace, ensure that it is earthed. See the safety warning in section 4.6.

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Figure A- Cross-section view showing standard length work tube insulation plug fitted

Figure B- Cross-section view showing extended work tube insulation plug fitted

Figure C- Cross-section view showing an extended length work tube with a radiation shield fitted
2.4 Electrical Connections

Connection by a qualified electrician is recommended.

All furnaces in the range are single-phase and operate over the voltage ranges 100 to 110 volts or 200 - 240 volts. Check the rating label before connection, see "Warning Labels" for location of rating label. To check that the OP.Hi setting is correct for the appropriate voltage, or to change to another setting, follow the instructions in section 9.2.

The electrical supply should be fused at the next standard size equal to or higher than the design current. Where a supply cable is supplied there are internal supply fuses, in which case customer fusing is preferred but not essential. See section 9.0 for furnace rating power, current and fusing information.

The external connection should be either a permanent connection to a fused isolator supply or to a socket on a fused isolator supply; the isolating switch must operate on both conductors. Make sure that the isolator switch is within easy reach of the furnace operator.

<table>
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<tr>
<th>Supply</th>
<th>Terminal Label</th>
<th>UK/ Europe Cable Colour</th>
<th>USA/ Canada Common Cable Colours</th>
<th>Supply Type</th>
</tr>
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<tr>
<td></td>
<td>L</td>
<td>Brown</td>
<td>Red or Black</td>
<td>Live - Neutral to live to either power conductor</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Blue</td>
<td>White</td>
<td>To neutral to the other power conductor</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Green/ Yellow</td>
<td>Green or Yellow (ground)</td>
<td>To earth (ground) to earth (ground)</td>
</tr>
</tbody>
</table>
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.

Turn on the instrument switch to activate the temperature controllers. The controllers illuminate and go 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.

Switch on the heater switch, located on the instrument panel. Unless a time switch is fitted and is switched off, the product will start to heat up. The Heat light(s) glow steadily at first and then flash as the product approaches the desired temperature or a program setpoint.

**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.

**Note:** Despite its vertical orientation, the heated zones of the KVZ model are labelled to correspond with the relevant control module on the CC-T1 touchscreen controller display (Left, Main, Right).

4.3 Safe Operation of the Furnace

For the safe operation of this furnace the following warnings must be followed:
Explosive Materials
The furnace must not be used to heat materials which could explode, or which could emit gases that could form explosive mixtures. If the safe heating of a material is dependent on its temperature, only heat these type of materials if the furnace has the optional over-temperature protection device fitted. Ensure that the over-temperature device is calibrated and set to an over-temperature safety limit that is sufficiently large as to avoid any hazards. If in doubt, seek expert advice before proceeding. Customers are responsible for carrying out their own risk assessments on the heating of materials.

Do not operate without a work tube. The furnace must not be operated without the correctly sized work tube and correspond work tube adaptor. Otherwise, an operator can access electrically live element coils that could cause serious injury or death.

Switch off the furnace before loading and unloading. The furnace elements must be switched off using the heater switch, item 2 in "Warning Labels", when the furnace is being loaded or unloaded. The work tube can become electrically conductive at high temperatures. If an element has failed and collapsed onto the work tube, the work tube will become live causing serious injury or death.

4.4 3-Zone Control Methods
There are three different control options (A, B & C).
(A) Back to back thermocouples
(B) Retransmission of Setpoint
(C) Independent control
The models listed in this manual are designed to achieve an extended uniform temperature zone, through use of three control zones, rather than achieving different temperatures in each zone.
For A & B, the control zones are linked so that they all follow the centre zone controller in a master-slave approach

Note:
- Option A is NOT applicable when using the CC-T1 controller
- Option B is NOT applicable when using the Eurotherm 2132 End Zone Controller

A. Back-to-Back Thermocouples
This is the most commonly supplied option. The centre zone of the tube furnace is controlled directly by the centre zone temperature controller. The two end zone
thermocouples are wired in opposition to the centre zone reference thermocouple. If the temperatures of the centre and end zones are the same then 0°C will be displayed on the end zone controllers. If the end zone temperatures are either higher or lower than the centre zone, the end zone controller will display the difference in temperature (higher = positive value, lower = negative value).

It is best practice to set the setpoint of the two end zone controllers to zero. Alternatively, a small temperature difference (offset) can be created by setting a non-zero value, for example to compensate for heat losses at the end or where using a gas flow. However, the sum of the centre zone controller setpoint and the end zone controller offset MUST NOT exceed the furnace maximum temperature.

**To alter the setpoint with the display showing the Home screen, press Down ▼ or Up ▲ once to display the setpoint and then press again or hold down to adjust it. The display returns to the measured temperature when no key is pressed for a short period of time.**

Sometimes a furnace using this type of control does not cool down because the end zones lose heat first and therefore the end zone controllers try to compensate for this by switching on the end zone elements, preventing the furnace from cooling.

**B. Retransmission of Setpoint**

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.

For products with the CC-T1 controller, please refer to the separate CC-T1 controller manual for details on enabling and disabling setpoint retransmission.

For other products, additional communication modules are fitted in the controllers. 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 the 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 buttons and select NO. Where the end zone controller is a 3508 use the ▲ up ▼ down buttons 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.

For products with the CC-T1 controller, please refer to the separate CC-T1 controller manual for details on how to set an offset trim.
To make this adjustment on other controllers, enter the level 2 menu of the end zone controllers (see controller operating instruction), scroll to LOC.T (local trim) and use the ▲ up ▼ down buttons 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 by the use of three control zones rather than achieving different temperatures in each zone.

4.5 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.

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.

4.6 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.
4.7 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).

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 $400 \div \text{internal diameter in mm}$ to give ($°C/\text{min}$); 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.

4.8 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.

4.9 Gas Tightness

Work tubes of IAP material are impervious. Sillimanite may look similar but is porous. Ensure that the correct tube material is in use before connecting and using gases other
than inert gases, such as nitrogen.
# 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

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**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><strong>Safety</strong></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>Daily</td>
</tr>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Electrical measurement</td>
<td>Bi-monthly</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>Monthly</td>
</tr>
<tr>
<td>Safety Switch Function (split models only)</td>
<td>Electrical measurement</td>
<td>Bi-annually</td>
</tr>
<tr>
<td>Electrical Safety (external)</td>
<td>Visual check of external cables and plugs</td>
<td>Annually</td>
</tr>
<tr>
<td>Electrical Safety (internal)</td>
<td>Physically check all connections and cleaning of the power plate area</td>
<td></td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Calibration</td>
<td>Tested using certified equipment, frequency dependent on the standard required</td>
<td>Daily</td>
</tr>
<tr>
<td>Operational Check</td>
<td>Check that all functions are working normally</td>
<td>Monthly</td>
</tr>
<tr>
<td>Operational Check</td>
<td>Thorough inspection and report incorporating a test of all functions</td>
<td>Bi-annually</td>
</tr>
<tr>
<td>Work Tube Position</td>
<td>Visually check that the tube is central to the heated zone (horizontally / vertically)</td>
<td>Monthly</td>
</tr>
<tr>
<td>End Plugs / Radiation Shields</td>
<td>Visual check for damage or wear, and cleaning of the power plate area</td>
<td>Bi-annually</td>
</tr>
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### Maintenance

<table>
<thead>
<tr>
<th><strong>Performance</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Element Circuit</strong></td>
<td>Electrical measurement</td>
</tr>
<tr>
<td><strong>Power Consumption</strong></td>
<td>Measure the current drawn on each phase / circuit</td>
</tr>
<tr>
<td><strong>Cooling Fans (if fitted)</strong></td>
<td>Check whether the cooling fans are working</td>
</tr>
</tbody>
</table>

#### Rect Positioning

Check all seals and O-rings and clamps

#### Seals (if fitted)
5.0 Maintenance

5.2.1 Cleaning
Soot deposits may form inside the furnace, depending on the process. At appropriate intervals remove these by heating as indicated in the General Operation Notes.

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.

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.

Each kit consists of two thermocouples of different lengths, one solid state relay and one complete tube body element set. When ordering spare parts please quote the model details i.e. model type and serial number as stated on the rating label.
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-e.g. 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.
6.4 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

For vertical models it may be necessary to dismount the furnace from its stand and remove the terminal cover.

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 N)</td>
<td>pink</td>
</tr>
<tr>
<td>negative</td>
<td>white</td>
</tr>
</tbody>
</table>

Disconnect the thermocouple from its terminal block.
Carefully withdraw the thermocouple from the product and remove any broken bits of thermocouple.
Bend the new thermocouple carefully to match the shape of the original (working from the terminal end). Should the length differ from that of the original this is usually not important provided that the thermocouple tip is within a work 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.

6.6 Element Replacement

Individual elements are not available for this model of product, if an element fails then a complete element assembly is required. For details and fitting instructions contact Carbolite Gero Service, see the back page of this manual for contact information.
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></th>
<th>Description</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The HEAT light is ON</td>
<td>The heating element has failed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check also that the SSR is working correctly</td>
</tr>
<tr>
<td>2</td>
<td>The HEAT light is OFF</td>
<td>The controller shows a very high temperature or code such as S.br</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The thermocouple has broken or has a wiring fault</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The controller shows a low temperature</td>
</tr>
<tr>
<td></td>
<td></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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or a wiring fault.</td>
</tr>
</tbody>
</table>
## 7.0 Fault Analysis

### 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>The controller shows a low temperature</td>
<td>The thermocouple may be faulty or may have been removed out of the heating chamber</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The thermocouple may be connected the wrong way around</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The controller may be faulty</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-13-30

Connections below show single phase with indirect safety switches and over-temperature control.

8.2 WC-13-31
# 9.0 Fuses and Power Settings

## 9.1 Fuses

F1 - F2: Refer to the circuit diagrams.

<table>
<thead>
<tr>
<th>F1 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 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>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>

### Model Phases Volts Supply Fuse Rating (Amps) F1

<table>
<thead>
<tr>
<th>Model</th>
<th>Phases</th>
<th>Volts</th>
<th>Supply Fuse Rating (Amps) F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHC 12/450B</td>
<td>1-phase</td>
<td>200-208</td>
<td>10 A</td>
</tr>
<tr>
<td>EHC 12/450B</td>
<td>1-phase</td>
<td>220-240</td>
<td>10 A</td>
</tr>
</tbody>
</table>

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31
9.0 Fuses and Power Settings

9.2 Power Settings

The power limit settings (OP.Hi) for this model is as follows. 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 one from the table. To adjust the parameter refer to the "Changing the Maximum Output Power" of the control section of the manual.

All standard models covered by this manual are fitted with elements designed for use over the range of voltages 100 V-120 V and 200 V-240 V; the power limit parameter is set according to the table below.

The power limit depends on the voltages follows:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>100 V</th>
<th>120 V</th>
<th>200 V</th>
<th>208 V</th>
<th>220 V</th>
<th>230 V</th>
<th>240 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage (%)</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>100</td>
<td>89</td>
<td>81</td>
<td>75</td>
</tr>
</tbody>
</table>

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

Carbolite Gero reserves the right to change the specification without notice.
All models have cylindrical elements with wire mounted in the surface of the insulation material.
All models can accept work tubes up to a maximum outside diameter of 60 mm.
All models have a maximum operation temperature of 1200°C (1100°C continuous).

<table>
<thead>
<tr>
<th>Model</th>
<th>Max Temp (°C)</th>
<th>Max Power (kW)</th>
<th>Minimum Work Tube Length (mm)</th>
<th>Tube length for use with modified atmosphere (mm)</th>
<th>Heated Length (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHC 12/450B</td>
<td>1200</td>
<td>2.0</td>
<td>600</td>
<td>900</td>
<td>450</td>
<td>20</td>
</tr>
</tbody>
</table>

Work tube adaptors, extended work tube supports, insulation plugs and gas/vacuum end seals are available from Carbolite Gero for work tubes with outside diameters of 32 mm, 46 mm and 60 mm.

10.1 Environment

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

**Ambient temperature working range**

Temperature: 5 °C to 40 °C

Note: when operating the furnace at temperatures close to the maximum and the ambient temperature is above 30 °C, the allowed external temperature defined in EN 61010-1:2010 may be exceeded.

**Relative humidity**

Maximum 80% up to 31 °C, decreasing linearly to 50% at 40 °C.

**Important safety notice:**

After transportation or storage in humid conditions, the furnace could fail to meet all the safety requirements of BSEN 61010-2-010 until it has completed the drying out process to restore its normal condition.

**Warning:**

It cannot be assumed that the furnace will meet all the safety requirements of BSEN 61010-2-010 during the drying out process.
Furnace drying out process
Step 1. Before the furnace is connected to the electrical supply, remove the back panel and check for signs of moisture on the electrical circuits. If visible signs of moisture are present then allow it to dry out in ambient temperature for at least 24 hours. If the problem persists ensure that the furnace is isolated and contact Carbolite Gero Service for more information.

Step 2. Complete the Installation procedure (see section 2.1
Step 3. After reading the controller operation instructions, heat the furnace following the temperature profile given below. This will need to be done manually on furnaces with basic control option or programmed into the controller if an advanced control option is fitted:

- Ramp the setpoint temperature @ 2 °C/ minute to 100 °C and dwell for 2 hours.
- Ramp the setpoint temperature @ 2 °C/ minute to 300 °C and dwell for 3 hours.
- Ramp the setpoint temperature @ 3 °C/ minute to 1100 °C and dwell for 1 hour.
- Cool naturally to ambient temperature.
- Furnace drying out process is complete.
Service Record

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

**Carbolite Gero Service**

Telephone: + 44 (0) 1433 624242  
Fax: +44 (0) 1433 624243  
Email: ServiceUK@carbolite-gero.com

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