Installation, Operation and Maintenance Instructions
1200°C Tube Furnace (3-zone) - GHC Model: 900mm
No Controller

GHC 12/900 + 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.

1.0 Symbols and Warnings ................................................................. 4
  1.1 Switches and Lights ............................................................... 4
  1.2 General Warnings ................................................................. 4

2.0 Installation .............................................................................. 5
  2.1 Unpacking and Handling ....................................................... 5
  2.2 Siting and Setting Up ............................................................. 5
  2.3 Work Tubes and Fittings ....................................................... 7
  2.4 Electrical Connections .......................................................... 9
  2.5 Reconfiguring and Adjusting for Voltage ......................... 12

3.0 Temperature Controller .......................................................... 13

4.0 Operation .............................................................................. 14
  4.1 Operating Cycle ..................................................................... 14
  4.2 Control Method ..................................................................... 14
  4.3 3-Zone Control Methods ...................................................... 15
    A. Back-to-Back Thermocouples ............................................ 16
    B. Retransmission of Setpoint ............................................... 16
    C. Independent Control ......................................................... 17
  4.4 General Operating Advice .................................................... 17
  4.5 Operator Safety ..................................................................... 17
  4.6 Tube Life ............................................................................. 18
  4.7 Pressure .............................................................................. 18
  4.8 Gas Tightness ....................................................................... 19
  4.9 Running at Low Temperatures ............................................. 19

5.0 Maintenance .......................................................................... 20
  5.1 General Maintenance ........................................................... 20
  5.2 Maintenance Schedule ........................................................ 20
    5.2.1 Cleaning ........................................................................ 22
  5.3 Calibration .......................................................................... 22
  5.4 After-Sales Service ............................................................... 22
  5.5 Recommended Spare Parts and Spare Parts Kit ................... 22

6.0 Repairs and Replacements ...................................................... 23
  6.1 Safety Warning - Disconnection from Power Supply ........... 23
6.2 Safety Warning - Refractory Fibre Insulation .................................................. 23
6.3 Temperature Controller Replacement ............................................................. 23
6.4 Solid-state Relay Replacement ...................................................................... 24
6.5 Thermocouple Replacement ......................................................................... 24
6.6 Element Replacement ...................................................................................... 25
6.7 Fuse Replacement ........................................................................................... 26

7.0 Fault Analysis .................................................................................................. 27
   A. Furnace Does Not Heat Up ........................................................................... 27
   B. Product Overheats ....................................................................................... 28

8.0 Wiring Diagrams ............................................................................................. 29
   8.1 WC-13-31 .................................................................................................... 29
   8.2 WC-U3-31 .................................................................................................. 30
   8.3 WC-U4-31 .................................................................................................. 31
   8.4 Higher Voltages .......................................................................................... 32
   8.5 Three-Zone Models .................................................................................... 32
   8.6 Control by Broadcast Comms (control method B) ......................................... 32

9.0 Fuses and Power Settings ............................................................................... 34
   9.1 Fuses ........................................................................................................... 34
   9.2 Power Settings ............................................................................................ 35

10.0 Specifications ................................................................................................. 36
   10.1 Environment ............................................................................................... 36
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.

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 and handling the product, always lift it by its base. Do not use the door or any other projecting cover or component to support the equipment when moving it. Use two or more people to carry the product where possible.

Carefully remove any packing material from inside and around the product before use. Avoid damaging the surrounding insulation when removing packing materials.

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.
2.0 Installation

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

This horizontal tube product is supplied with the controls in an integral base (or, to order, with the base control panel blanked off and the controls in a separate box). A horizontal tube support kit.

All G-range tube furnaces have “modular” heating elements in which resistance wire is partially embedded in vacuum formed light-weight refractory fibre. The modules are 150 mm long. In all standard models the two end elements (one at each end) are rated at 1170 W maximum, while the other (centre) elements are rated at 780 W.

All models are supplied with a pair of “tube adaptors”, which can be made to suit any work tube size up to 170 mm outside diameter. Spare or replacement adaptors can be ordered.

The horizontal models generally require no special setting up. Observe the above paragraph on siting. See section 2.3 for work tube and end adaptor considerations.

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.
2.3 Work Tubes and Fittings

Tubes of various diameters and lengths may be fitted.

Type C: minimum length for the product.

Type D: 400 mm longer than C, to allow for the fitting of end seals.

A pair of removable 'end adaptors' form part of the end insulation. These may be blank (no hole) or may have a hole to suit a work tube, depending on the customer order. Additional adaptors may be ordered to suit different work tube sizes. Check that the end adaptors are correct for the tube: if not, seek advice from Carbolite Gero. Small alterations to the hole in the adaptors may be made with a file, but first read the section on ceramic fibre safety 6.2. To insert a work tube it is often convenient to use a long pole (such as a broom handle) to guide it into the far end of the product.

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.

Horizontal use: 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. A horizontal tube support kit can be supplied for this purpose.

If a metal work tube is being used in the product, ensure that it is earthed. See the "Safety Warning" under "Operator Safety".
2.0 Installation

Fig 1 - Insulating Plug (standard length tube)

Fig 2 - Insulating Plug (long work tube)

<table>
<thead>
<tr>
<th>Key</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Tube</td>
</tr>
<tr>
<td>B</td>
<td>Insulating Plug</td>
</tr>
<tr>
<td>C</td>
<td>Stem</td>
</tr>
</tbody>
</table>
Fig 3 ‘Twin Clamp’ End Seal

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

2.4 Electrical Connections

Connection by a qualified electrician is recommended.

The product covered by this manual normally requires a single phase A.C. supply, which may be Live to Neutral non-reversible, Live to Neutral reversible or Live to Live. Some models may be ordered for 3-phase use, which may be star or delta.
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><strong>Live - Neutral</strong></td>
</tr>
<tr>
<td>1-phase</td>
<td>L</td>
<td>Brown</td>
<td>to live</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Blue</td>
<td>to neutral</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Green/ Yellow</td>
<td>to earth (ground)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supply</th>
<th>Terminal Label</th>
<th>Cable Colour</th>
<th>Supply Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-phase</td>
<td>L1</td>
<td>Black</td>
<td>to phase 1</td>
</tr>
<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</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 product ordered for three phase use to a single phase supply or to the wrong type of three phase supply.
2.5 Reconfiguring and Adjusting for Voltage

The standard single-phase models can operate over the voltage range 200 - 240 V. The 2-phase models can operate over the range 380/220 V to 415/240 V. The 3-phase models can operate over the range 380/220 V to 415/240 V.

The product is wired according to the original order and conversion from 1-phase to 2-phase or 1-phase to 3-phase is not possible. To check for voltage setting within the appropriate range, or to change to another setting, follow the instructions in section 9.0.

Special Voltages

The products can be specially made to suit certain special voltages, such as 440/254 or 480/277.

Due to unbalanced phases, the furnaces cannot be made to suit 3-phase without neutral of 380 V or above.

Products made for special voltages are generally not convertible between configurations and voltages.
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.
The two images below are typical examples of control panel layouts.

4.3 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.
4.0 Operation

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.

4.4 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.

- 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 $400 \div$ 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.

### 4.7 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.
4.8  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.

4.9  Running at Low Temperatures

The power limit may be adjusted to a low level in order to achieve better control when operating the product at a low temperature. Before changing the power limit, record the default settings for possible future use. Refer to the Power Settings section of this manual for default power limits. If the product fails to reach the desired temperature, refer to the Temperature Controller and Fault Analysis sections.
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>Daily</td>
</tr>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Electrical measurement</td>
<td>Weekly</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>
</tbody>
</table>

**Function**

<p>| Temperature Calibration                     | Tested using certified equipment, frequency dependent on the standard required |           |
| Operational Check                          | Check that all functions are working normally      |           |
| Operational Check                          | Thorough inspection and report incorporating a test of all functions |           |
| Work Tube Position                         | Visually check that the tube is central to the heated zone (horizontally / vertically) |           |
| End Plugs / Radiation Shields              | Visual check for damage or wear, and cor- |           |</p>
<table>
<thead>
<tr>
<th>Performance</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>

- **Seals (if fitted)**: Check all seals and O-rings and clamps
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 length, one solid state relay and two heating elements (1 of each wattage).

When ordering spare kits please quote the model details: model type and serial number.
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.
6.0 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

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

See section 6.2 - wearing a face mask is required.

Disconnect the product from the electrical supply.

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

Disconnect all electrical leads from the terminal blocks on the product 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(s).

Lay the product body horizontally with the split in the cylindrical case uppermost. Remove the two metal end-caps from the body. Undo the self-tapping screws that hold the terminal strip to the case join. The case will spring open slightly. Remove the ceramic board disc from one end.

Cut through the outer wrap of blanket insulation. Note how the element tails are connected and disconnect all of them. Lift out the elements through the end of the cylindrical case.

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 product again, refitting the terminal strip and 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 the Carbolite Gero Service.

Reverse the rest of the dis-assembly process. Take care to make all connections to the correct terminals. Do not over-tighten the connectors in the porcelain terminal blocks.

Let the product heat up at its maximum rate to 900 °C without interruption and then dwell for 1 hour. Fumes may be emitted: this should be done in an environment with good ventilation.

Note on Elements: The end and centre elements look the same but have different wattages. On standard models the two end elements are 1170 W and all the centre elements are 780 W. Ensure that elements are correctly replaced.

Check that the product 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 the Carbolite Gero Service.
6.0 Repairs and Replacements

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

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></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>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 controller shows a low temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## B. Product Overheats

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Product only heats up when the instrument switch is ON</td>
<td>The controller shows a very high temperature</td>
<td>The controller is faulty</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. Product heats up when the instrument switch is OFF</td>
<td>The SSR has failed &quot;ON&quot;</td>
<td>Check for an accidental wiring fault that could have overloaded the SSR</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.
8.2 WC-U3-31

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

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 WC-U4-31

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

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.
8.4 Higher Voltages

For 254 V or above 1-phase or 440/254 V or above 3-phase, an isolating transformer is included in the control circuit after the F2 fuses.

8.5 Three-Zone Models

The element circuit in the 3-zone versions remains the same as in the above diagrams, but the control circuit contains three controllers and additional thermocouples. The sub-circuits for the three control methods referred to in section 4.3 are:

- **Control Type A**
  - Slave Controller
  - Master Controller
  - Slave Controller

- **Control Type C**
  - Slave Controller
  - Master Controller
  - Slave Controller

Control type B - the diagram is like C, plus the connections between the controllers indicated in 4.3 C. Independent Control.

8.6 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:
8.0 Wiring Diagrams

```
master
HD
HE
HF

slave
HD
HE
HF

slave
HD
HE
HF
```
## 9.0 Fuses and Power Settings

### 9.1 Fuses

**F1 - F2:** Refer to the circuit diagrams.

<table>
<thead>
<tr>
<th></th>
<th></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><strong>F1</strong></td>
<td>Internal Supply Fuses</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>F2</strong></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><strong>Customer Fuses</strong></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>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GHC 12/900</td>
<td>6 x 12 A</td>
<td>32 A</td>
<td>12 A/ ph</td>
<td>20 A/ ph</td>
</tr>
</tbody>
</table>
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 200 V-240 V; the power limit parameter is set according to the table below.

<table>
<thead>
<tr>
<th>Voltage</th>
<th>200 V</th>
<th>208 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>
<th>440 V</th>
<th>480 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>100</td>
<td>89</td>
<td>82</td>
<td>75</td>
<td>90</td>
<td>97</td>
<td>75</td>
<td>67</td>
<td>56</td>
<td></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 formed in the surface of the insulation material.

All models can accept work tubes up to a maximum outside diameter of 170 mm.

All models have a maximum operating 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>Heated Length (mm)</th>
<th>Type C Work Tube</th>
<th>Type D Work Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHC 12/900</td>
<td>1200</td>
<td>5.4</td>
<td>1080</td>
<td>900</td>
<td>1200</td>
<td>1500</td>
</tr>
</tbody>
</table>

**10.1 Environment**

The models listed in this manual contains 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>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</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

---

**Carbolite Gero Ltd,**
Parsons Lane, Hope, Hope Valley, S33 6RB, England.
Telephone: + 44 (0) 1433 620011
Fax: + 44 (0) 1433 621198
Email: Info@carbolite-gero.com
www.carbolite-gero.com

Copyright © 2019 Carbolite Gero Limited