Installation, Operation and Maintenance Instructions
1200°C Tube Furnace (3-zone) - EZS Model: 450mm
No Controller + 2132 End Zone Controllers

EZS 12/450B + No Controller + 2132 End Zone Controllers
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 ........................................................................................................... 5
   1.1 Switches and Lights .............................................................................................................. 5
   1.2 General Warnings ............................................................................................................... 5
   1.3 Warning Labels .................................................................................................................... 6

2.0 Installation .............................................................................................................................. 8
   2.1 Unpacking and Handling .................................................................................................... 8
   2.2 Siting .................................................................................................................................. 8
   2.3 Setting Up ........................................................................................................................... 9
   2.4 Electrical Connections ....................................................................................................... 16

3.0 Temperature Controller ........................................................................................................ 17

4.0 2132 Controller .................................................................................................................... 18
   4.1 Description ......................................................................................................................... 18
   4.2 2132 Controller Operation ................................................................................................ 18
       4.2.1 Controls ....................................................................................................................... 18
       4.2.2 2132 Controller Operation ......................................................................................... 19
       4.2.3 Basic Operation .......................................................................................................... 19
       4.2.4 Altering the Setpoint ................................................................................................. 19
       4.2.5 Stopping and Starting Control ................................................................................. 20
       4.2.6 Altering the Ramp Rate ............................................................................................ 20
   4.3 Operating with the Timer .................................................................................................... 21
       4.3.1 Setting the Timer Mode ............................................................................................. 23
       4.3.2 Setting the Time Period ............................................................................................. 23
       4.3.3 Running with the Timer ............................................................................................. 23
       4.3.4 Stopping the Timer .................................................................................................... 24
       4.3.5 End of Time Period .................................................................................................... 25
       4.3.6 Cancelling the Alarm ................................................................................................. 25
       4.3.7 Program Example ....................................................................................................... 25
   4.4 Altering Power Limit ........................................................................................................... 25
   4.5 Audible Alarm .................................................................................................................... 28
   4.6 Temperature Controller Replacement .............................................................................. 28
   4.7 Navigation Diagram .......................................................................................................... 29

5.0 2132 Over-Temperature Controller Description (if fitted) .................................................... 31
   5.1 Description ......................................................................................................................... 31
5.2 Operation
5.2.1 Controls
5.2.2 Operation
5.2.3 Over-Temperature Operation
5.2.4 Over-Temperature Alarm
5.2.5 Resetting the Over-Temperature Alarm
5.2.6 Sensor Break
5.3 Audible Alarm
5.4 Navigation Diagram

6.0 Operation
6.1 Operating Cycle
6.2 Control Method
6.3 Safe Operation of the Furnace
6.4 3-Zone Control Methods
   A. Back-to-Back Thermocouples
   B. Retransmission of Setpoint
   C. Independent Control
6.5 General Operating Advice
6.6 Operator Safety
6.7 Tube Life
6.8 Pressure
6.9 Gas Tightness

7.0 Maintenance
7.1 General Maintenance
7.2 Maintenance Schedule
   7.2.1 Cleaning
   7.2.2 Safety Switch
7.3 Calibration
7.4 After-Sales Service
7.5 Recommended Spare Parts and Spare Parts Kit

8.0 Repairs and Replacements
8.1 Safety Warning - Disconnection from Power Supply
8.2 Safety Warning - Refractory Fibre Insulation
8.3 Temperature Controller Replacement
8.4 Solid-state Relay Replacement
8.5 Thermocouple Replacement
8.6 Element Replacement
8.7 Fuse Replacement
9.0 Fault Analysis ..........................................................................................................................47
   A. Furnace Does Not Heat Up ....................................................................................................47
   B. Product Overheats ..............................................................................................................48

10.0 Wiring Diagrams ..................................................................................................................49
    10.1 WC-13-70 .....................................................................................................................49
    10.2 WC-13-71 .....................................................................................................................50

11.0 Fuses and Power Settings ..................................................................................................51
    11.1 Fuses .............................................................................................................................51
    11.2 Power Settings ................................................................................................................52

12.0 Specifications .....................................................................................................................53
    12.1 Environment ...................................................................................................................53
        Furnace drying out process ..............................................................................................54
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.
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 8.2.

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.
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 furnace models must have a work tube 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 6.6.

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 in a split tube furnace

No tools required.
The fitting of the work tube is as follows with reference to figure 2.3.1. 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 table in section 12.0). Read section 8.2 before fitting the work tube.

![Diagram of split tube furnace with numbered parts](image)

Figure 2.3.1 - view showing how to fit the standard length work tube in the split tube furnace. Note that the right hand furnace end guard (8) has been removed from the view for clarity to show the end adaptor and tube end stop.

- Release the fixing clips (9 in figure 2.3.1), lift the lid by the handle (1).
- Place the work tube into the bottom half of the furnace in the tube adaptors, between the work tube end stops (5). Note that the work tube might be a tight fit when it is new and may need to be twisted backwards and forwards slightly as it is placed.
- Lower the lid by the handle and refasten the clips.
- Note in Figure 2.3.1 the right hand furnace end guard (8) is not shown so that the end adaptor (3) and tube end stop (5) can be seen. It is not necessary to remove the guards to fit the work tube.

Index to numbered items in Figure 2.3.1 and 2.3.2

1. Top lifting handle
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
9. Fixing clip
Figure 2.3.2 - Close-up view of the tube end stop for a standard length work tube on the split tube furnace. Note that the right hand furnace end guard (8) has been removed from the view for clarity to show the end adaptor and tube end stop.

**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 figures 2.3.1 to 2.3.10.

Before the extended work tube can be fitted, the work tube end stops for the standard length work tube (item 5 in figure 2.3.1 and 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. The guards and brackets should then be refitted.

- Fit the tube support bracket, see (5) figure 2.3.5. Use the M6 button head screws and washers supplied.
- Fit the extended work tube guard, see (4) figure 2.3.6. Use the M6 button head screws and washers supplied.
- Re-fit furnace end guards, see (3) figure 2.3.7. Use the M6 button head screws and supplied washers.
- If supplied, fit the optional tube end seal assembly as shown in figures 2.3.11 and 2.3.12. **Refer to manual MEN-ENDSEALS-01** for detailed fitting instructions.
- Fit the tube support bracket, see (1) figure 2.3.8. Use the M6 button head screws and washers supplied.
- Finally, fit the tube support collar, (2) and secure tightly using (6), until the tube is secure to be used in a vertical arrangement. The fitting arrangement is shown in figure 2.3.9.
- Figure 2.3.3 shows an exploded view of all the required parts.
- Figure 2.3.9 shows the assembled parts as they would be used.
2.0 Installation

Figure 2.3.3

Figure 2.3.4

Figure 2.3.5

Figure 2.3.6
2.0 Installation

Figure 2.3.7

Figure 2.3.8

Figure 2.3.9

Figure 2.3.10- Tube support assembled
Index to numbered items in Figure 2.3.3 - 2.3.12

1. Tube support bracket
2. Tube support collar
3. End guard
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 6.6.

*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 0.1.

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 11.0 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.

### Terminal Connection Details

<table>
<thead>
<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>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Live - Neutral</td>
</tr>
<tr>
<td>1-phase</td>
<td>L</td>
<td>Brown</td>
<td>Red or Black</td>
<td>To live</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Blue</td>
<td>White</td>
<td>To neutral</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Green/ Yellow</td>
<td>Green or Green/ Yellow</td>
<td>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 2132 Controller

4.1 Description

The 2132 Controller is made by Eurotherm, and is fitted and configured by Carbolite Gero for immediate use. It is a digital instrument with PID control algorithms.

The 2132 Controller features:

- Easy use as a simple temperature controller, where on setting the required temperature the controller immediately attempts to reach and maintain it.
- A ramp-to-setpoint feature, which may be used to limit the heating (or cooling).
- A timer function which allows for heating for a predetermined time, either from start or from reaching temperature; or alternatively for delaying the start of heating.
- An alarm output which may be used in conjunction with the timer, for example to give an audible alarm at the end of the timing period.

4.2 2132 Controller Operation

4.2.1 Controls

Most Carbolite Gero products are fitted with an instrument switch which cuts off power to the controller and other parts of the control circuit.

To operate the controller, power must be supplied to the product and the instrument switch must be on. If a time switch is included in the product circuit, this must be in the 'ON' position.

When an over-temperature condition occurs, the controller cuts the power to a contactor, which in turn cuts power to the heating elements. Power is not restored until the controller is 'reset'.

Some components will operate after the over-temperature feature isolates the power supply e.g. cooling fans will continue to operate, provided that there is a power supply to the product. In some cases the product may not do so, if other options (such as a door switch) are fitted.
4.2.2 2132 Controller Operation

When switched on, the controller lights up, goes through a short test routine and then displays the measured temperature or the over-temperature setpoint.

The page key allows access to parameter lists within the controller.

A single press of the page key displays the temperature units, normally set to °C; further presses reveal the lists indicated in the navigation diagram.

The scroll key allows access to the parameters within a list. Some parameters are display-only; others may be altered by the operator.

A single press of the scroll key in the 'Home' list displays the temperature units; further presses reveal the parameters in the current list indicated in the navigation diagram.

To return to the 'Home' list at any time, press page and scroll together, or wait for 45 seconds.

The down and up keys are used to alter the setpoint or other parameter values.

4.2.3 Basic Operation

Normally no operator action is required other than entering the setpoint, as the controller starts to control on being switched on, as described above.

4.2.4 Altering the Setpoint

With the display at 'Home', showing the measured temperature, press down or up once to display the setpoint; press again or hold down to adjust it. The display returns to the measured temperature when no key is pressed for 30 seconds.
4.2.5 Stopping and Starting Control

It is possible to stop and start the controller without altering the setpoint. Press scroll  until the legend 'm-A' (manual/auto) appears. In this controller, manual means OFF and auto means ON. Press down ▼ or up ▲ once to show the current on/off state: 'mAn' for OFF and 'Auto' for ON. Press down ▼ or up ▲ to change between manual and auto (off and on) as required.

Note that timer modes 1 & 3 set the controller to 'mAn' at the end of the timing period. If the controller unexpectedly does not control it may be in manual, possibly as the result of previous use of the timer function.

4.2.6 Altering the Ramp Rate

It is only possible to limit the rate of heating by setting a ramp rate if the timer feature is not in use.

To enable direct setting of the ramp rate, first ensure that the 'StAt' parameter and 'dwEll' parameter are both set to OFF (see sections 4.3.1 and 4.3.2).

Press scroll  until 'SPrr' (setpoint ramp rate) is displayed. Use down ▼ or up ▲ to display and adjust the value.

The ramp rate sets the maximum rate of heating or cooling in degrees per minute. A value of OFF cancels the ramp rate, allowing heating and cooling at the maximum rate. When this feature is in use, there is a “working setpoint” which can be viewed at any time by scrolling to 'w.SP' and pressing ▼ or ▲.

Fig 1 and fig 2 indicate the possible difference between operating without and with a ramp-to-setpoint value (depending on the load and the value used).
### 4.3 Operating with the Timer

This controller can be used as a process timer allowing timed heating or timed delay, according to the options in the table. There are 5 timer modes, but 2 of them are affected by whether the setpoint ramp rate feature is being used, making 7 entries in the table. The table also shows the status of the timer light on the controller. A visual impression of the different modes is given in fig 3.

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Temperature</td>
</tr>
<tr>
<td>T2</td>
<td>Time</td>
</tr>
<tr>
<td>SP</td>
<td>Setpoint</td>
</tr>
<tr>
<td>WSP</td>
<td>Working Setpoint</td>
</tr>
<tr>
<td>AT</td>
<td>Actual Temperature</td>
</tr>
</tbody>
</table>

*Fig 1 - Control without Ramp-to-Setpoint  Fig 2 - Control with Ramp-to-Setpoint*
<table>
<thead>
<tr>
<th>Timer Mode</th>
<th>Description</th>
<th>Timer Light</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>mode 1</strong></td>
<td><strong>Timed dwell and switch off</strong></td>
<td>The timer starts timing when the actual temperature is within 1 °C of the setpoint. At the end of the timing period, control switches off (i.e. goes into Manual) to allow cooling and 'End' flashes on the display.</td>
</tr>
<tr>
<td><strong>mode 2</strong></td>
<td><strong>Timed dwell and stay on</strong></td>
<td>The timer starts timing when the actual temperature is within 1 °C of the setpoint. At the end of the timing period, control remains on, maintaining the setpoint temperature and 'End' flashes on the display.</td>
</tr>
<tr>
<td><strong>mode 3</strong>, with SPrr off</td>
<td><strong>Time from cold and switch off</strong></td>
<td>The timer starts timing immediately. At the end of the timing period, control switches off (i.e. goes into Manual) to allow cooling and 'End' flashes on the display.</td>
</tr>
<tr>
<td><strong>mode 3</strong>, with SPrr active</td>
<td><strong>Dwell from working setpoint and switch off</strong></td>
<td>The timer starts timing when the working setpoint is within 1 °C of the setpoint. At the end of the timing period, control switches off (i.e. goes into Manual) to allow cooling and 'End' flashes on the display.</td>
</tr>
<tr>
<td><strong>mode 4</strong>, with SPrr off</td>
<td><strong>Time from cold and stay on</strong></td>
<td>The timer starts timing immediately. At the end of the timing period, control remains on, maintaining the setpoint temperature and 'End' flashes on the display.</td>
</tr>
<tr>
<td><strong>mode 4</strong>, with SPrr active</td>
<td><strong>Dwell from working setpoint and stay on</strong></td>
<td>The timer starts timing when the working setpoint is within 1 °C of the setpoint. At the end of the timing period, control remains on, maintaining the setpoint temperature and 'End' flashes on the display.</td>
</tr>
<tr>
<td><strong>mode 5</strong></td>
<td><strong>Delayed switch on</strong></td>
<td>The timer starts timing immediately and control starts at the end of the timing period. There is no 'End' condition in this mode.</td>
</tr>
</tbody>
</table>
4.3.1 Setting the Timer Mode

Scroll to 'tm.OP'; use ▲ or ▼ to view and alter the mode. The mode shows as 'OPt.1' to 'OPt.5'.

It is not possible to alter the mode while the timer is operating; if the mode cannot be altered, scroll to the 'StAt' parameter and set its value to OFF.

4.3.2 Setting the Time Period

Method 1

Scroll to 'tmr' (time remaining). Use ▲ or ▼ to view the remaining time; the units are always in minutes. Use ▲ or ▼ to set or alter the time. Setting 'tmr' automatically activates the timer; the 'm-A' parameter changes to 'Auto' and the 'StAt' parameter changes to run.

Note that the 'tmr' display shows 0 (zero) during the last minute of timing and also shows 0 when the time has expired. The timer light indicates whether timing is still in progress.

Method 2

Scroll to 'dwEll' and use ▲ or ▼ to set the timing duration. The advantage of method 2 is that 'dwEll' need only be set once if repeated use of the same time period is required.

Scroll to 'StAt' and use ▲ or ▼ to set the parameter value to run. This copies the dwell time into 'tmr' and activates the timer as in method 1.

4.3.3 Running with the Timer

Once the timer is activated by method 1 or 2 above, the control sequence depends on the 'Timer' mode, as previously given in the table. Fig 3 gives another representation of the timer action.
4.0 2132 Controller

**Fig 3 - Timer Modes**

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Temperature</td>
</tr>
<tr>
<td>T2</td>
<td>Time</td>
</tr>
<tr>
<td>SP</td>
<td>Setpoint</td>
</tr>
<tr>
<td>WSP</td>
<td>Working Setpoint (if setpoint ramp rate active)</td>
</tr>
<tr>
<td>AT</td>
<td>Actual Temperature</td>
</tr>
<tr>
<td>M245</td>
<td>Modes 2, 4 &amp; 5</td>
</tr>
<tr>
<td>M13</td>
<td>Modes 1 &amp; 3</td>
</tr>
<tr>
<td>TM</td>
<td>Timing</td>
</tr>
<tr>
<td>E</td>
<td>End</td>
</tr>
<tr>
<td>1</td>
<td>Mode 5</td>
</tr>
<tr>
<td>2</td>
<td>Reaching Temperature Modes 1 &amp; 2</td>
</tr>
<tr>
<td>3</td>
<td>Modes 1 &amp; 2</td>
</tr>
<tr>
<td>4</td>
<td>Modes 3 &amp; 4 with setpoint ramp rate</td>
</tr>
<tr>
<td>5</td>
<td>Modes 3 &amp; 4 with setpoint ramp rate off</td>
</tr>
<tr>
<td>6</td>
<td>Reaching temperature and continuing temperature Mode 5</td>
</tr>
<tr>
<td>7</td>
<td>Continuing at temperature modes 2 &amp; 4, or cooling down modes 1 &amp; 3</td>
</tr>
</tbody>
</table>

4.3.4 Stopping the Timer

To stop the timer at any time while it is operating, change the 'StAt User Calibration' parameter to OFF. This is the same as reducing 'tmr' to zero. The controller then acts as
though it has reached the end of the time period.

4.3.5 End of Time Period

Modes 1 and 3: heating stops at the end of timing; the 'm-A' parameter changes to 'mAn'.

Modes 2 and 4: heating continues at the end of timing; the 'm-A' parameter remains at 'Auto'.

Mode 5: heating starts at the end of the timing period; the 'm-A' parameter remains at 'Auto'.

In modes 1 to 4 the alarm message 'End' flashes on the display at the end of timing; the 'StAt' parameter remains at run.

In mode 5 there is no 'End' message; the 'StAt' parameter changes to OFF at the end of timing.

4.3.6 Cancelling the Alarm

To acknowledge (cancel) the 'End' alarm, press page and scroll together; the 'StAt' parameter changes to OFF.

Alternatively cancel the alarm by directly changing the 'StAt' parameter from run to OFF.

4.3.7 Program Example

To heat up at 10 °C per minute to 500 °C; to hold at 500 °C for 1 hour; then to allow to cool down.

(This example uses timing mode 1, as on the first row of the timer table, but also includes the use of ramp rate).

To create this program

1. Start with display at home; use arrow keys to alter the setpoint to 500.
2. Press scroll until 'sp.rr' shows; use arrow key to set value to 10 (if you do not want to limit the ramp rate, ignore this step or set the value to OFF)
3. Press scroll until 'tm.op' shows; use arrow key to set value to opt.1
4. Press scroll until 'dwell' shows; use arrow key to set value to 60

To operate this program

5. Press scroll until 'stat' shows; use arrow key to set value to run
   - heating starts when run is set;
   - timing starts when the working setpoint reaches 499 °C;
   - heating stops 61* minutes later and 'End' flashes on the display.
6. Cancel 'End' by pressing page and scroll together.

* note that the timer runs for an extra minute, when tmr has counted down to zero; allow for this when testing the system with short durations such as 1 or 2 minutes.

4.4 Altering Power Limit

Overview
Depending on the furnace or oven model the power limit parameter OP.Hi (Output High) may be accessible or hidden.

For silicon carbide heated furnaces the parameter is accessible to allow for compensation for element ageing. In wire-heated chamber or tube furnaces, reducing the power limit is a convenient method of improving control at low temperatures, as outlined below.

The power limit may be set to zero to permit demonstration of the controls without heating.

In many models the power limit setting depends on the supply voltage; usually the furnace or oven manual contains details: if in doubt, contact Carbolite Gero for advice. The power limit parameter does not apply to the over-temperature controller, if fitted.

**Altering the value**

Press page until oP (output list) is displayed. Press scroll until OP.Hi (Output High) is displayed. Press down ▼ or up ▲ once to display the value of OP.Hi and write down the value. To alter the value, use down ▼ or up ▲.

Note: setting the value to zero prevents the furnace or oven from heating.

Caution: Do not increase the power limit value to a value above the design level for the oven or furnace model, or to a value above that correctly calculated for silicon carbide elements. The heating elements could burn out, or other damage could be caused.

**Control at Low Temperatures**

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

Example: It is desired to operate a 1200 °C furnace at 300 °C. The normal control settings can be expected to cause excessive overshoot as the furnace reaches temperature. If the power limit OP.Hi is normally set to 100%, try a setting of 40%. This should greatly reduce the overshoot. (There is no firm calculation rule to get this example setting of 40% – experimentation may be required to achieve a good result. Avoid power limits below approximately 30% – control accuracy is reduced at such levels.)

Depending on the furnace or oven model the power limit parameter OP.Hi (Output High) may be accessible or hidden.

For silicon carbide heated furnaces the parameter is accessible to allow for compensation for element ageing. In wire-heated chamber or tube furnaces, reducing the power limit is a convenient method of improving control at low temperatures, as outlined above.

The power limit may be set to zero to permit demonstration of the controls without heating.

In many models the power limit setting depends on the supply voltage; usually the furnace or oven manual contains details: if in doubt, contact Carbolite Gero for advice.
User Calibration

The controller is calibrated for life at manufacture against known reference sources, but there may be sensor errors or other system errors. User calibration allows compensation for such errors and this controller allows for a user 2-point calibration. This setting is password protected to avoid accidental alteration.

Page to iP, scroll to CAL.P and use up ▲ to alter the password. The password is 3. If the correct password is entered, the display shows PASS. Scroll to CAL and use up ▲ or down ▼ to observe the setting FACt (factory values, as manufactured) or USEr (user values). Change to USEr.

NOTE: before checking the calibration of the controller, or of the complete system, remember to reset the controller to factory calibration values by setting the CAL.P parameter to FACt.

To enter a user calibration, scroll to each of the following parameters in turn and set the desired values.

Pnt.L low temperature for which an offset is to be entered
OFS.L offset value for the low temperature
Pnt.H high temperature for which an offset is to be entered
OFS.H offset value for the high temperature
Example: the controller reads 3 °C low at 400 °C and 5 °C low at 1000 °C. The parameter values should be Pnt.L=400, OFS.L=3, Pnt.H=1000, OFS.H=5.
Negative or positive values can be entered: if the controller is reading high, negative offsets would be appropriate.

Fig 4 gives a graphical representation of the 2-point calibration.
4.0 2132 Controller

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>User Temperature Reading</td>
</tr>
<tr>
<td>B</td>
<td>Factory Temperature Reading</td>
</tr>
<tr>
<td>UC</td>
<td>User Calibration</td>
</tr>
<tr>
<td>UF</td>
<td>Factory Calibration</td>
</tr>
</tbody>
</table>

4.5 Audible Alarm

If an audible alarm is supplied for use with the timer function, then it is normally configured to sound at the 'End' condition and to go off when the alarm is acknowledged as given in section 4.3.6.

It is not feasible to cover all possible alarm features which may be included by customer special order, within this manual.

4.6 Temperature Controller Replacement

Before handling the controller: wear an anti-static wrist strap or otherwise avoid any possibility of damage to the unit by static electricity. Refer to the detailed instructions supplied with the replacement controller.

Ease apart the two lugs at the side; grip the instrument and withdraw it from its sleeve; push in the replacement.
4.7 Navigation Diagram
### Key

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HL</td>
<td>Home List</td>
</tr>
<tr>
<td>IL</td>
<td>Input List</td>
</tr>
<tr>
<td>OL</td>
<td>Output List</td>
</tr>
<tr>
<td>AL</td>
<td>Access List</td>
</tr>
<tr>
<td>1</td>
<td>Measured temperature; use arrow keys to access setpoint</td>
</tr>
<tr>
<td>2</td>
<td>Output power (read only)</td>
</tr>
<tr>
<td>3</td>
<td>Present only if SPrr in use</td>
</tr>
<tr>
<td>4</td>
<td>Manual/Auto (mAn = off, Auto = on)</td>
</tr>
<tr>
<td>5</td>
<td>Setpoint ramp rate OFF or value</td>
</tr>
<tr>
<td>6</td>
<td>Timer mode</td>
</tr>
<tr>
<td>7</td>
<td>Time remaining</td>
</tr>
<tr>
<td>8</td>
<td>Dwell time for timer</td>
</tr>
<tr>
<td>9</td>
<td>Timer status run or OFF</td>
</tr>
<tr>
<td>10</td>
<td>Enter password</td>
</tr>
<tr>
<td>11</td>
<td>If User Calibration</td>
</tr>
<tr>
<td>12</td>
<td>User 2-Point Calibration</td>
</tr>
<tr>
<td>13</td>
<td>Power limit setting, if present</td>
</tr>
<tr>
<td>14</td>
<td>For factory access to lists and parameters not available to the operator</td>
</tr>
</tbody>
</table>
5.0 2132 Over-Temperature Controller Description (if fitted)

5.1 Description

This over-temperature controller is fitted and supplied ready to use by Carbolite Gero. It is a digital instrument with a latching alarm, requiring no additional panel controls. The controller features easy setting of over-temperature setpoint and reading of current temperature by the over-temperature sensor.

5.2 Operation

5.2.1 Controls

Most Carbolite Gero products are fitted with an instrument switch which cuts off power to the controller and other parts of the control circuit.

To operate the controller, power must be supplied to the product and the instrument switch must be on. If a time switch is included in the product circuit, this must be in the 'ON' position.

When an over-temperature condition occurs, the controller cuts the power to a contactor, which in turn cuts power to the heating elements. Power is not restored until the controller is 'reset'.

Some components will operate after the over-temperature feature isolates the power supply e.g. cooling fans will continue to operate, provided that there is a power supply to the product. In some cases the product may not do so, if other options (such as a door switch) are fitted.
5.2.2 Operation

When switched on, the controller lights up, goes through a short test routine and then displays the measured temperature or the over-temperature setpoint.

The page key \( \text{page} \) allows access to parameter lists within the controller.

A single press of the page key \( \text{page} \) displays the temperature units, normally set to °C; further presses reveal the lists indicated in the navigation diagram.

The scroll key \( \text{scroll} \) allows access to the parameters within a list. Some parameters are display-only; others may be altered by the operator.

A single press of the scroll key \( \text{scroll} \) in the 'Home' list displays the temperature units; further presses reveal the parameters in the current list indicated in the navigation diagram.

To return to the 'Home' list at any time, press page \( \text{page} \) and scroll \( \text{scroll} \) together, or wait for 45 seconds.

The down \( \downarrow \) and up \( \uparrow \) keys are used to alter the setpoint or other parameter values.

5.2.3 Over-Temperature Operation

Use down \( \downarrow \) and up \( \uparrow \) to alter the over-temperature setpoint. This should normally be set a little above the working temperature (for example 15 °C above). The product is supplied with the over-temperature set at 15 °C above the furnace or oven maximum working temperature.

Press scroll \( \text{scroll} \) twice view the present temperature as measured by the over-temperature controller. Press it twice, the first press shows the temperature units (°C).

5.2.4 Over-Temperature Alarm

If an over-temperature condition occurs, the OP2 indicator flashes and an alarm message 2FSH also flashes, alternating with the setpoint. Power to the heating elements is disconnected.

5.2.5 Resetting the Over-Temperature Alarm

To acknowledge the alarm press scroll \( \text{scroll} \) and page \( \text{page} \) together.

If the alarm is acknowledged while there is still an over-temperature condition, the OP2 indicator stops flashing but continues to glow. The 2FSH alarm continues to flash until the over-temperature condition is cleared (by the temperature falling), when normal operation resumes.

If the alarm is acknowledged when the temperature has dropped (or after the over-temperature setpoint has been raised) so that the over-temperature condition no longer exists, then the furnace or oven immediately resumes normal operation.

5.2.6 Sensor Break

The over-temperature cut-out system also operates if the over-temperature control thermocouple breaks or becomes disconnected. The message S.br flashes where the measured temperature is normally displayed.
5.3 Audible Alarm

If an audible alarm is supplied for use with the over-temperature controller, it is normally configured to sound on over-temperature condition and to stop sounding when the alarm is acknowledged as given in section 5.2.

Note: the alarm may sound during controller start-up.

5.4 Navigation Diagram

<table>
<thead>
<tr>
<th>HL</th>
<th>Home List</th>
<th>![Page Key]</th>
<th>Black = Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTSP</td>
<td>Over-Temperature Setpoint</td>
<td>![Scroll Key]</td>
<td>Dashed = Through to other options</td>
</tr>
<tr>
<td>AL</td>
<td>Access List</td>
<td>![Code]</td>
<td>For factory access to list and parameters not available to the operator.</td>
</tr>
</tbody>
</table>
6.0 Operation

6.1 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.

6.2 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).

6.3 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 of 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.

6.4 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.

6.5 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 12.0 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.

6.6 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.
6.7 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).

![Diagram of Tube and Crucible]

Fig 4 - Avoidance of thermal contact

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

6.8 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.

6.9 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.
## 7.0 Maintenance

### 7.1 General Maintenance

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

### 7.2 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></td>
<td></td>
<td>Daily</td>
</tr>
<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></td>
</tr>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Electrical measurement</td>
<td></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></td>
</tr>
<tr>
<td>Safety Switch Function (split models only)</td>
<td>Electrical measurement</td>
<td></td>
</tr>
<tr>
<td>Electrical Safety (external)</td>
<td>Visual check of external cables and plugs</td>
<td></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></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></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 cor-</td>
<td></td>
</tr>
</tbody>
</table>
### 7.0 Maintenance

<table>
<thead>
<tr>
<th>Performance</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>rect positioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seals (if fitted)</td>
<td>Check all seals and O-rings and clamps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Performance

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

7.2.1 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.

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.

7.2.2 Safety Switch
When correctly functioning, the safety switch will isolate all live conductors (live and neutral connections) within the heating element circuit(s) when the product door is opened. The safety switch should be checked regularly to ensure that this occurs.

The safety switch should not fail under normal working conditions, however rough handling, exposure to corrosive materials/environments, or exceptionally frequent use, could compromise the safety system.

Weekly check:
The following check can be carried out by a general operator:

- On the temperature controller, set a safe temperature above ambient. The heater lights should illuminate.
- Open the door and check the heater lights. They should no longer be illuminated.

If the heater lights remain illuminated when the door is open, discontinue use and contact Carbolite Gero Service.

Annual check:
The following checks should be carried out by a qualified electrician, as specified in the "Maintenance Schedule" section of this manual:

- Remove the element access panel and take a voltage measurement from the heating element terminals. Do not attempt to take a reading from the heating element itself as surface oxidation will give an unreliable contact.
- Ensure that power to the heating elements is switched off when the door is opened.

Contact Carbolite Gero Service and discontinue use of the product if it is found that the heating elements are not fully isolated during these checks.

7.3 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.

### 7.4 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.

### 7.5 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.
8.0 Repairs and Replacements

8.1 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.

8.2 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.

8.3 Temperature Controller Replacement

Refer to the controller instructions for more information on how to replace the temperature controller.
8.4 Solid-state Relay Replacement

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

1. Make a note of the wire connections to the solid state relay, then disconnect them.
2. Remove the solid state relay from the base panel or aluminium plate.
3. Replace and reconnect the solid state relay ensuring that the bottom of it has good thermal contact with the base panel or aluminium plate.
4. Replace the access panel.

8.5 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.

8.6 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.
8.7 **Fuse Replacement**

Fuses are marked on the wiring diagram with type codes, e.g. F1, F2. For more information on fuses refer to section 11.0.

*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.
## 9.0 Fault Analysis

### A. Furnace Does Not Heat Up

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> The HEAT light is ON</td>
<td>The heating element has failed</td>
<td>Check also that the SSR is working correctly</td>
</tr>
<tr>
<td><strong>2.</strong> 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><strong>1.</strong></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>The controller may be faulty</td>
</tr>
<tr>
<td><strong>2.</strong></td>
<td>Product heats up when the instrument switch is OFF</td>
<td>The SSR has failed &quot;ON&quot;</td>
</tr>
</tbody>
</table>
10.0  Wiring Diagrams

10.1  WC-13-70
Safety Switch A - A 2-pole Heater Switch is fitted directly in the element circuit in models up to 16 A rating.

Safety Switch B - A door switch is fitted into the contactor coil circuit. Above 16 A a 1-pole Heater Switch is fitted into the same circuit, in series.
10.2 WC-13-71
Connections below show single phase with indirect safety switches and over-temperature control.
11.0 Fuses and Power Settings

11.1 Fuses

F1 - F2: 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>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>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Phases</th>
<th>Volts</th>
<th>Supply Fuse Rating (Amps) F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>EZS 450B</td>
<td>1-phase</td>
<td>200-208 V</td>
<td>10 A</td>
</tr>
<tr>
<td>EZS 450B</td>
<td>1-phase</td>
<td>220-240 V</td>
<td>10 A</td>
</tr>
</tbody>
</table>
11.0 Fuses and Power Settings

11.2 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>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>100</td>
<td>100</td>
<td>89</td>
<td>82</td>
<td>77</td>
</tr>
</tbody>
</table>

Please refer to the rating label for product specific information.
12.0 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>EZS 12/450B</td>
<td>1200</td>
<td>2.0</td>
<td>600</td>
<td>900</td>
<td>450</td>
<td>21</td>
</tr>
</tbody>
</table>

Horizontal 3-zone tube furnaces.

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.

12.1 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.
12.0 Specifications

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>
<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