Installation, Operation and Maintenance Instructions
1000 °C Volatile Matter Test Furnace - VMF Model: 50 mm Ø
2132 Controller

VMF-ASTM + 2132 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 ........................................................................................................... 5
  1.1 Switches and Lights ........................................................................................................... 5
  1.2 General Warnings ............................................................................................................. 5

2.0 Installation .......................................................................................................................... 6
  2.1 Unpacking and Handling ................................................................................................. 6
  2.2 Siting and Setting Up ...................................................................................................... 6
  2.3 Electrical Connections ..................................................................................................... 7

3.0 2132 Controller .................................................................................................................. 9
  3.1 Description ....................................................................................................................... 9
  3.2 2132 Controller Operation ............................................................................................. 9
    3.2.1 Controls .................................................................................................................... 9
    3.2.2 2132 Controller Operation ................................................................................... 10
    3.2.3 Basic Operation ....................................................................................................... 10
    3.2.4 Altering the Setpoint ............................................................................................... 10
    3.2.5 Stopping and Starting Control ................................................................................ 11
    3.2.6 Altering the Ramp Rate ........................................................................................... 11
  3.3 Operating with the Timer ............................................................................................... 12
    3.3.1 Setting the Timer Mode .......................................................................................... 14
    3.3.2 Setting the Time Period .......................................................................................... 14
    3.3.3 Running with the Timer .......................................................................................... 14
    3.3.4 Stopping the Timer .................................................................................................. 15
    3.3.5 End of Time Period ................................................................................................. 16
    3.3.6 Cancelling the Alarm .............................................................................................. 16
    3.3.7 Program Example ................................................................................................... 16
  3.4 Altering Power Limit ....................................................................................................... 16
  3.5 Audible Alarm ................................................................................................................ 19
  3.6 Temperature Controller Replacement .......................................................................... 19
  3.7 Navigation Diagram ....................................................................................................... 20

4.0 2132 Over-Temperature Controller Description (if fitted) ............................................... 22
  4.1 Description ...................................................................................................................... 22
  4.2 Operation ......................................................................................................................... 22
    4.2.1 Controls .................................................................................................................. 22
    4.2.2 Operation ................................................................................................................. 23
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 7.2.

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.
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 product is supplied with a crucible holder (a small component made of wire). Ensure that this is present.

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 Electrical Connections

Connection by a qualified electrician is recommended.

This product requires a single-phase A.C. supply with earth (ground), which may be Live to Neutral non-reversible (polarised), Live to Neutral reversible (non-polarised), or Live to Live.

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

The supply should be fused at the next size equal to, or higher than the current on the label. A table of the most common fuse ratings is also given towards the back of this
2.0 Installation

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>1-phase</td>
<td>L</td>
<td>Brown</td>
<td>Live - Neutral to live</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>to either power conductor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(For USA 200-240V, connect L1)</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Blue</td>
<td>Live - Live to neutral</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>to the other power conductor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(For USA 200-240V, connect L2)</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Green/ Yellow</td>
<td>to earth (ground)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>to earth (ground)</td>
</tr>
</tbody>
</table>
3.0 2132 Controller

3.1 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.

3.2 2132 Controller Operation

3.2.1 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.
3.2.2 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. See section 4.4.

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.

3.2.3 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.

3.2.4 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.
3.2.5 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.

3.2.6 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 3.3.1 and 3.3.2).

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).
3.3 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.

Key

<table>
<thead>
<tr>
<th>T1</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<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>
<th>3.0  2132 Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>mode 1</td>
<td>Timed dwell and switch off</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>
<td>On while temperature is reaching setpoint. On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 2</td>
<td>Timed dwell and stay on</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>
<td>On while temperature is reaching setpoint. On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 3, with SPrr off</td>
<td>Time from cold and switch off</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>
<td>On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 3, with SPrr active</td>
<td>Dwell from working setpoint and switch off</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>
<td>On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 4, with SPrr off</td>
<td>Time from cold and stay on</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>
<td>On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 4, with SPrr active</td>
<td>Dwell from working setpoint and stay on</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>
<td>On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 5</td>
<td>Delayed switch on</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>
<td>On during the timing period. Off from the end of the timing period.</td>
</tr>
</tbody>
</table>
3.3.1 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.

3.3.2 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.

3.3.3 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.
### 3.0 2132 Controller

#### 3.3.4 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.

---

<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>

---

**Fig 3 - Timer Modes**

![Diagram of Timer Modes](image-url)
3.3.5 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.

3.3.6 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.

3.3.7 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.

3.4 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 \( \text{ hasta } \) until oP (output list) is displayed. Press scroll \( \text{ hasta } \) until OP.Hi (Output High) is displayed. Press down \( \text{ hasta } \) or up \( \text{ hasta } \) once to display the value of OP.Hi and write down the value. To alter the value, use down \( \text{ hasta } \) or up \( \text{ hasta } \).

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.

![Fig 4 - 2-Point Calibration](image-url)
### 3.5 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 3.3.6.

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

### 3.6 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.
3.7 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>
4.0 2132 Over-Temperature Controller Description (if fitted)

4.1 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.

4.2 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 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. See section 4.4.

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.

4.2.3 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).

4.2.4 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.

4.2.5 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.

4.2.6 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.
4.3 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 4.2.

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

4.4 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>!</td>
<td>For factory access to list and parameters not available to the operator.</td>
</tr>
</tbody>
</table>
5.0 Operation

5.1 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.

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

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

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

To turn the product off, set the instrument switch to its off position. The controller display will go blank. If the product is to be left unattended, isolate it from the electrical supply.

5.2 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 11.0 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.
5.3 Notes on Test


Before commencing the test, the furnace chamber lid should be opened and the temperature allowed to stabilise for no longer than 2 minutes. The test should be conducted with the furnace lid open. When the test is completed, close the lid to conserve energy and prolong element life.

5.4 Operator Safety

Ceramic materials used in the furnace insulation can become conducting at high temperatures; therefore there is a potential danger to the operator, as this furnace is designed to be used with the chamber lid open.

To guard against this danger, the furnace is fitted with a 30mA earth leakage (residual current) circuit breaker mounted in the back of the case. This trips out in the event of accidental contact with the heating element or current leakage through the insulation. The device may be reset after tripping out. From time to time, test it using the integral test button.
6.0 Maintenance

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

6.2 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>Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Set an over-temperature setpoint lower than the displayed temperature and check for an over-temperature alarm as detailed in this manual</td>
<td>🟢</td>
</tr>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Electrical measurement</td>
<td>🟢</td>
</tr>
<tr>
<td>Lid Insulation</td>
<td>Visual inspection, checking the seal and whether it is free of damage</td>
<td>🟢</td>
</tr>
<tr>
<td>Lid Insulation</td>
<td>Replacement where necessary</td>
<td>🟢</td>
</tr>
<tr>
<td>Electrical Safety (external)</td>
<td>Test the 30mA RCD trip with the test button daily before use.</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>Function</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>Performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Element Circuit</td>
<td>Electrical measurement</td>
<td>🟢</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>Measure the current drawn on each phase / circuit</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------</td>
<td>---</td>
</tr>
</tbody>
</table>
6.2.1 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.

6.3 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.

6.4 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.

6.5 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 one thermocouple, one solid state relay, one element and one lid insulation piece.

When ordering spare kits please quote the model details as requested above.

Crucibles with lids and spare crucible holders, can also be supplied.

6.6 Power Adjustment
The control system incorporates electronic power limiting, but for the model listed in this manual the power limit is set to 100%. The power limit parameter OP.Hi may be accessible to the operator, but should not generally be altered.
In some cases the supply voltage may be outside the range 220-240 V or the 3-phase equivalent, the power limit parameter may be set to a value other than 100%. Do not increase the value to 100%, see section 10.0 for details of power limit settings.
7.0 Repairs and Replacements

7.1 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.

7.2 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.

7.3 Panel Removal

Except for temperature controller replacement, access to components is by removal of the top panel. Remove 10 self-tapping screws. Carefully save the 10 spacers (between the product case and the top panel). Lift off the top panel; ensure there is somewhere to place it without pulling on the wire connections.
7.0 Repairs and Replacements

7.4 Temperature Controller Replacement

Refer to the controller instructions for more information on how to replace the temperature controller.

7.5 Thermocouple Replacement

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

Thermocouple cable colour codings are:

<table>
<thead>
<tr>
<th>Thermocouple Leg</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>positive (type K)</td>
<td>green</td>
</tr>
<tr>
<td>negative</td>
<td>white</td>
</tr>
</tbody>
</table>

Disconnect the thermocouple to be replaced from its terminal block and withdraw it. Re-assemble the new thermocouple, observing the colour coding. Refit the element access panel.

7.6 Element Replacement

See section 7.2 - wearing a face mask is required.

Remove the top panel as above.
The heating chamber is suspended from the top plate. Make a note of the wiring connections; identify those to the heating element and disconnect it.
Separate the inner chamber by removing 4 screws. The heating element with its surrounding insulation can then be lifted out of the chamber.
Replace the element with the new one and reverse the disassembly procedure.

7.7 Fuse Replacement

Fuses are marked on the wiring diagram with type codes, e.g. F1, F2. For more information on fuses refer to section 10.0. 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.
7.8 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.
## 8.0 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. The temperature controller is OFF</td>
<td>No power from the supply</td>
<td>Check the fuses in the supply line</td>
</tr>
<tr>
<td></td>
<td>There are no lights glowing on the controller</td>
<td>The controller may be faulty or not receiving a supply due to a faulty switch or a wiring fault</td>
</tr>
<tr>
<td>2. The temperature controller is ON</td>
<td>The controller shows a very high temperature or a 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 SSR could be failing to switch on due to internal failure, faulty logic wiring faulty which could have overloaded the SSR</td>
</tr>
</tbody>
</table>
### 8.0 Fault Analysis

#### B. Product Overheats

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

9.1 WA-11-00
Connections below show single phase.

Key

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>F1, F2, F3</td>
<td>Fuses</td>
</tr>
<tr>
<td>FIL</td>
<td>Filter</td>
</tr>
<tr>
<td>C</td>
<td>Temperature Controller</td>
</tr>
<tr>
<td>TC</td>
<td>Control Thermocouple</td>
</tr>
<tr>
<td>SSR</td>
<td>Solid State Relay</td>
</tr>
<tr>
<td>H</td>
<td>Heat Lamp</td>
</tr>
<tr>
<td>EL</td>
<td>Element(s)</td>
</tr>
<tr>
<td>SW</td>
<td>Instrument Switch(es)</td>
</tr>
<tr>
<td>FM</td>
<td>Fan Motor</td>
</tr>
<tr>
<td>*</td>
<td>Fan Models Only</td>
</tr>
<tr>
<td>N</td>
<td>Neutral</td>
</tr>
<tr>
<td>L</td>
<td>Live</td>
</tr>
<tr>
<td>PE</td>
<td>Earth</td>
</tr>
</tbody>
</table>

Cables

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BU</td>
<td>Blue</td>
</tr>
<tr>
<td>R</td>
<td>Red</td>
</tr>
<tr>
<td>GR/Y</td>
<td>Green + Yellow</td>
</tr>
<tr>
<td>G</td>
<td>Grey</td>
</tr>
<tr>
<td>P</td>
<td>Pink</td>
</tr>
</tbody>
</table>
9.2 WA-11-01
Connections below show single phase with over-temperature controller.
10.0 Fuses and Power Settings

10.1 Fuses

F1: 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>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Volts</th>
<th>Phases</th>
<th>Supply Fuse Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMF/ASTM</td>
<td>220-240</td>
<td>1-phase</td>
<td>4 A</td>
</tr>
</tbody>
</table>

10.2 Power Settings

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

<table>
<thead>
<tr>
<th>Volts (V)</th>
<th>200</th>
<th>208</th>
<th>220</th>
<th>230</th>
<th>240</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power (%)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Model</th>
<th>Max Temp (°C)</th>
<th>Max Power (kW)</th>
<th>Chamber Size (mm)</th>
<th>Net Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swelling Number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furnace</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMF/ ASTM 1000</td>
<td>1000</td>
<td>1.0</td>
<td>50 dia x 140 deep</td>
<td>26</td>
</tr>
</tbody>
</table>

11.1 Environment

The models listed in this manual contain electrical parts and should be stored and used in indoor conditions as follows:

Temperature: 5 °C - 40 °C

Relative humidity: Maximum 80 % up to 31 °C decreasing linearly to 50 % at 40 °C
<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

Copyright © 2018 Carbolite Gero Limited