Installation, Operation and Maintenance Instructions

600°C High Temperature Oven - HT Model: 350 Litres
301 Controller

HT 6/350 + 301 Controller
Contents

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

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1.0 Symbols and Warnings

1.1 Switches and Lights

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

Solenoid valve (if fitted): see section 4.6 for full details

Variable speed fan (if fitted): see section 4.7 for full details

Exhaust fan (if fitted): see section 4.8 for full details

Stoving and curing (if fitted): see section 4.9 for full details

1.2 General Warnings

DANGER – Electric shock. Read any warning printed next to this symbol.

WARNING: Risk of fatal injury.

DANGER – Hot surface. Read any warning printed next to this symbol.

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

Caution – Double Pole/Neutral Fusing
2.0 Installation

2.1 Unpacking and Handling

When unpacking or moving the product, always lift by its base; do not use the door or any other projecting cover or component to support the equipment when moving it. Use a fork lift or pallet truck to move the product; position the product on a level surface and use an adequate number of personnel to safely move the product into position. Carefully remove any packing material from inside and around the product before use. Avoid damaging the surrounding insulation when removing packing materials. Locate the shelves as required.

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

2.2 Siting and Setting Up

Place the product on a level surface in a well ventilated area. Site away from other sources of heat and on a non-flammable surface that is resistant to accidental spillage or hot materials. The surface on which the equipment is mounted should be stable and not subject to movement or vibrations. The height of the mounting surface is important to avoid operator strain when loading and unloading samples. Unless otherwise stated elsewhere in this manual, ensure that there is at least 150 mm of free space around the back and sides of the product. Clear space is required above the product to dissipate heat.
Depending on the application of the product, it may be appropriate to position it under an extraction hood. Ensure the extraction hood is switched on during use.

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

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

2.3 Electrical Connections

Connection by a qualified electrician is recommended.

All models covered by this manual may be ordered for single phase A.C. supply, which may be Live to Neutral non-reversible, Live to Neutral reversible or Live to Live. Check the product rating label before connection. The supply voltage should agree with the voltage on the label and the supply capacity should be sufficient for the current on the label.

The supply should be fused at the next size equal to, or higher than the current on the label. A table of the most common fuse ratings is also given towards the back of this
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></td>
<td></td>
<td></td>
<td>Live - Neutral</td>
</tr>
<tr>
<td>1-phase</td>
<td>L</td>
<td>Brown</td>
<td>to live</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Blue</td>
<td>to neutral</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Green/ Yellow</td>
<td>to earth (ground)</td>
</tr>
<tr>
<td>2- or 3-phase</td>
<td>L1</td>
<td>Black</td>
<td>to phase 1</td>
</tr>
<tr>
<td></td>
<td>L2</td>
<td>Black</td>
<td>to phase 2</td>
</tr>
<tr>
<td></td>
<td>L3</td>
<td>Black</td>
<td>to phase 3 (except 2-phase)</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Light Blue</td>
<td>to neutral (except delta)</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Green/ Yellow</td>
<td>to earth (ground)</td>
</tr>
</tbody>
</table>
3.0 301 Controller

Due to the complex nature of the furnace or oven control the use of technical terms throughout this manual is unavoidable. Explanations of these terms can be found in the "Glossary of Terms".

3.1 PID control

This controller uses PID (Proportional Integral Derivative) temperature control. This type of control uses a complex mathematical control system to adjust the heating power and achieve the desired temperature.

3.2 Basic Operation of the 301 Controller

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Display</td>
</tr>
<tr>
<td>B</td>
<td>Over-Temperature Key (if fitted) The Over-Temperature key is used to access the over-temperature menu. Note: Over-Temperature is an option.</td>
</tr>
<tr>
<td>C</td>
<td>Page Key The Page key is used to scroll through the parameters and switch between menus.</td>
</tr>
<tr>
<td>D</td>
<td>Timer Key The Timer key is used to start, view, pause and reset the timer.</td>
</tr>
<tr>
<td>E</td>
<td>Arrow Keys The Arrow keys are used to adjust the value of the selected parameter and pause the output power.</td>
</tr>
<tr>
<td>F</td>
<td>Over-Temperature Indicator (if fitted) The Over-Temperature indicator shows green in normal use. It flashes red when over-temperature is triggered and is constantly red when over-temperature is reset and waiting for the temperature to drop.</td>
</tr>
</tbody>
</table>
### 3.0 301 Controller

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>G</strong></td>
<td>Timer Indicator</td>
<td>The Timer indicator shows when the timer is active.</td>
</tr>
<tr>
<td><strong>H</strong></td>
<td>Output Indicator</td>
<td>The Output indicator shows when the controller is switching on the heating elements.</td>
</tr>
</tbody>
</table>

#### 3.2.1 Menu System

The 301 Controller is divided into two menus; the Home Menu and the Setup Menu. The Home Menu contains all the basic operating controls: setpoint, setpoint ramp rate and timer time. The Setup menu contains all the set up features: timer type, timer band, output power and customer calibration. The features available vary depending on operator input or product specification.

#### 3.2.2 Navigation Diagram

The following diagram details how to navigate to the various menu options within the 301 Controller. At each option, values can be set using the arrow keys.
HM

Home Menu

Page Key

Black = Progress

SM

Setup Menu

Hold for 1.5 seconds

White = Return

OTHM

Over-Temperature Home Menu

Keep Held

OTSM

Over-Temperature Setup Menu

Press Page Key multiple times

3.0 301 Controller
3.2.3 Basic Function Guide

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hold</strong></td>
<td>Used to pause the current program and set new parameters.</td>
</tr>
<tr>
<td><strong>SP°C</strong></td>
<td>Used to set the desired temperature (setpoint) of the product (°C).</td>
</tr>
<tr>
<td><strong>SPrr</strong></td>
<td>Used to set the heating rate of the product, e.g. increase by 5°C per minute.</td>
</tr>
<tr>
<td><strong>t1, t2, t3, t4, t5</strong></td>
<td>Indicates the timer type in use. See section 3.5 for more details.</td>
</tr>
<tr>
<td><strong>tEP</strong></td>
<td>Used to set the timer type.</td>
</tr>
<tr>
<td><strong>t.bnd</strong></td>
<td>Available when t1 or t4 is in use. Allows the timer to start the countdown before the desired setpoint is reached.</td>
</tr>
<tr>
<td><strong>rSt</strong></td>
<td>Used to reset the timer.</td>
</tr>
<tr>
<td><strong>OPHi</strong></td>
<td>Used to set the maximum output power.</td>
</tr>
<tr>
<td><strong>CLSt</strong></td>
<td>Used to set the customer calibration type.</td>
</tr>
<tr>
<td><strong>FACT</strong></td>
<td>Used to select the factory calibration settings.</td>
</tr>
<tr>
<td><strong>PASS</strong></td>
<td>Flashes when a password is required to access further options.</td>
</tr>
<tr>
<td><strong>CCL1</strong></td>
<td>Select to access the single point calibration option.</td>
</tr>
<tr>
<td><strong>CCL2</strong></td>
<td>Select to access the dual point calibration options.</td>
</tr>
<tr>
<td><strong>OFSt</strong></td>
<td>Used to set the single point calibration offset temperature (°C).</td>
</tr>
<tr>
<td><strong>CALL</strong></td>
<td>Used to set the low temperature point (°C) for dual point calibration.</td>
</tr>
<tr>
<td><strong>CALH</strong></td>
<td>Used to set the high temperature point (°C) for dual point calibration.</td>
</tr>
<tr>
<td><strong>OFSL</strong></td>
<td>Used to set the offset value for the low temperature point (°C) for dual point calibration.</td>
</tr>
<tr>
<td><strong>OFSH</strong></td>
<td>Used to set the offset value for the high temperature point (°C) for dual point calibration.</td>
</tr>
<tr>
<td><strong>Ot</strong></td>
<td>Used to set the Over-Temperature limit (°C).</td>
</tr>
<tr>
<td><strong>OtE</strong></td>
<td>Displayed when the Over-Temperature protection has been activated.</td>
</tr>
<tr>
<td><strong>PV</strong></td>
<td>Displayed before the current temperature when checking the Over-Temperature sensor temperature.</td>
</tr>
</tbody>
</table>
3.2.4 Home Display

The Home Display is the first display you see when the controller is switched on, it shows the actual temperature of the product. When entering the menus, the controller will automatically return to the Home Display if no keys are pressed for 30 seconds.

Finding the Home Display

- To find the Home Display from the Home Menu, press the Page key until the current temperature is shown on the display.
- To find the Home Display from the Setup Menu, press and hold the Page key for 1.5 seconds.

3.2.5 Hold Mode

'Hold' mode turns the output off; this allows parameters to be set without the controller instantly trying to control at the new settings.

When the output indicator is off, the Home Display flashes between the current temperature and Hold.

**To enter 'Hold' mode:**

- Start at the Home Display.
- Press and hold the up and down Arrow keys together for 1.5 seconds
- The display will flash Hold to show that 'Hold' mode has been entered.

**To exit 'Hold' mode:**

- Start at the Home Display.
- Press and hold the up and down Arrow keys together for 1.5 seconds OR start the timer (See "The Timer ").
- Note: The 'Hold' mode function is disabled when the timer function is operating.
3.0 301 Controller

3.2.6 Checking the Temperature Setpoint from the Home Display

- Start at the Home Display.
- Press either the up or down Arrow key.
- The setpoint will show on the display for 3 seconds before returning to the home display.

3.2.7 Changing the Temperature Setpoint

- Start at the Home Display.
- Repeatedly press the Page key to scroll through the Home Menu until $SP{PC}$ is displayed.
- Use the up and down Arrow keys to alter the value.
- A single press of the up or down Arrow key shows the current setting.
- To alter this, either keep the key pressed or press it again. The value will then be stored without any further input.

3.2.8 Changing the Temperature Setpoint Ramp Rate

- Start at the Home Display.
- Repeatedly press the Page key to scroll through home menu until $SP{PR}$ is displayed.
- Use the up and down Arrow keys to turn off or alter the value.
- A single press of either the up or down Arrow key shows the current setting. To alter, either keep pressed or press again. The value will then be stored without any further input.
- See section 3.4 for more information.

This will cause the product to heat as quickly as possible which may not be appropriate where the product contains sensitive ceramic components. For products with ceramic components, e.g. a tube furnaces fitted with a long ceramic work tube, use the ramp rate feature set with a low heating rate such as 5°C per minute (300°C per hour), to prevent damage.
3.2.9 Changing the Timer Time

- Start at the Home Display.
- Repeatedly press the Page key to scroll through the Home Menu until \( \mathcal{E} \), \( \mathcal{E}^2 \), \( \mathcal{E}^3 \), \( \mathcal{E}^4 \) or \( \mathcal{E}^5 \) shows on the display.
- Use the up and down Arrow keys to turn off, or alter the value.
- A single press of either the up or down Arrow key shows the current setting (Hr:Min).
- To alter this, either keep pressed or press again. The value will then be stored without any further input.
- See 3.5 for more information.

3.3 Advanced Operation

3.3.1 Entering the Setup menu

- Start at the Home Display.
- Press and hold the Page key for 1.5 seconds
- The display will change to the first parameter in the Setup Menu.

3.3.2 Changing the Timer Type

- Start at the Home Display.
- Hold the Page key for 1.5 seconds to enter the set-up menu.
- Once entered, repeatedly press the Page key until \( \mathcal{E} \mathcal{E} \mathcal{N} \mathcal{P} \) is displayed.
- Use the up and down Arrow keys to alter the value.

To alter this, either keep pressed or press again. The value will then be stored without any further input. A single press of the up or down key shows the current setting.

Note: This function is disabled when the timer is operating. See section 3.5 for more information on the timer types and functions.
3.3.3 Changing the Timer Band

- Start at the Home Display.
- Hold the Page key for 1.5 seconds to enter the Setup Menu.
- Once entered, repeatedly press the Page key until \( t_{bnd} \) is displayed.
- Use the up and down Arrow keys to turn off or alter the value.

A single press of the up or down key shows the current setting. To alter this, either keep pressed or press again. The value will then be stored without any further input. See section 3.5 for more information.

**Note:** This is only available when timer type 1 or 4 is selected.

3.3.4 Changing the Maximum Output Power

**Note:** Output Power is a product specific setting and will not appear on all furnaces and ovens.

- Start at the Home Display.
- Hold the Page key for 1.5 seconds to enter the set-up menu.
- Once entered, repeatedly press the Page key until \( OPH \) is displayed.
- Use the up and down Arrow keys to alter the value.

A single press shows the current setting. To alter this, either keep pressed or press again. The value will then be stored without any further input.

**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. Refer to the Fuses and Power Settings section of your product manual (section 9.0 for more information on power limits.)
3.3.5 Changing the Customer Calibration Type

- Start at the Home Display.
- Hold page key for 1.5 seconds to enter the set-up menu.
- Once entered, repeatedly press page key until \( \text{CLST} \) is displayed.
- Use the up and down Arrow keys to display the current calibration type.
- Use the up and down Arrow keys to display the password screen.
- Use the up and down Arrow keys to enter the Calibration Password (see 3.3.6).
- Press the page key to confirm password. The value will then be stored without any further input.
- See section 3.8 for more information.

3.3.6 Calibration Password

Once entered the calibration password remains active for 30 seconds after leaving the set up menu to allow time to revisit if necessary.

The Calibration Password for this instrument is: 525

3.4 Temperature Setpoint Ramp Rate

3.4.1 Setpoint Ramp Rate

The SPrr controls the rate at which the temperature in a furnace or oven changes per minute. When SPrr has a numeric value, e.g. 5 °C/ min, the product will attempt to heat or cool at that rate. When the value of Sprr = off, the product will heat or cool as quickly as possible.

Setpoint ramp rate is useful when materials susceptible to thermal shock are being heated.

3.4.2 Limitations of Setpoint Ramp Rate

The setpoint ramp rate should not be set higher than the maximum heat up or cool down rate of the furnace or oven.

The setpoint ramp rate only resets its start position when the ramp rate is changed or the controller is taken out of 'Hold' mode.

Changes in the temperature setpoint do not affect the ramp rate.

If the temperature is set below the current temperature of the furnace or oven then after a period of time adjusted to a temperature higher than the current temperature
without adjustment of the ramp rate, the controller can become out of step and appear to switch off.

Putting the controller into, then out of 'Hold' mode will reset the ramp rate and force the controller back into control.

### 3.5 The Timer

#### 3.5.1 Starting the Timer

- Start at the Home Display.
- Press the Timer key once to start the timer.

If the 301 Controller is in 'Hold' mode, pressing the Timer key will automatically exit 'Hold' mode and the controller will start to operate.

#### 3.5.2 Checking the Time Remaining

- Start at the Home Display
- Press the Timer key once to check the time remaining.
- The display will flash £ 3 times.
- It will return to the Home Display automatically.

#### 3.5.3 Pausing the Timer

- Start at the Home Display
- Press and hold the Timer key for 1.5 seconds; the display alternately shows £ I and the current temperature.
- To resume the timer, press the Timer key once.
3.5.4 Resetting the Timer

- When the timer count has ended, or the timer is paused, start at the Home Display.
- Press and hold the Timer key for 1.5 seconds.
- r5E is displayed to indicate timer reset.

3.5.5 Timer Function Description

The 301 Controller has an in-built timer, which can be set to one of five types:

**Timer Type t1**

On pressing the Timer key; 'Timer Type 1' waits for the setpoint to be reached, then begins the countdown. On completion of the countdown, the product switches off power to the elements ('End' flashes on the display).

**Timer Type t2**

On pressing the Timer key; 'Timer Type 2' starts the countdown immediately. On completion of the countdown, the product switches off power to the elements ('End' flashes on the display).

**Timer Type t3**

On pressing the Timer key; 'Timer Type 3' immediately switches the product heating off and starts to countdown. On completion of the countdown, the furnace or oven switches on the power to the elements. This can be used to delay the start of heating.

**Timer Type t4**

On pressing the Timer key; 'Timer Type 4' waits for the setpoint to be reached, then begins the countdown. On completion of the countdown, the product continues to control as normal ('End' flashes on the display).
3.5.6 The Timer Temperature Band

Timer type \( t \) or \( t^4 \) starts the countdown when the setpoint temperature is reached. It is possible to set the timer running before the setpoint is reached by adjustment of the timer temperature band \( t.bnd \), e.g. \( t.bnd \) set to a value of 3 will result in the timer starting to countdown 3°C before the temperature setpoint is reached. This is useful when furnaces or ovens that take a long time to reach setpoint, are at a sufficiently high temperature for a specific customer process to occur.
### 3.5.7 Timer Function Table

<table>
<thead>
<tr>
<th>t.typ</th>
<th>On Pressing the Timer Key</th>
<th>During the Countdown</th>
<th>Completion of the Countdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>t1</td>
<td>Heating ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>Timer Starts when setpoint reached</td>
<td>Counts Down</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>Display Flashes t1 3 times. Shows Time remaining.</td>
<td>Current Temperature</td>
<td>Cycling Current Temperature/ End</td>
</tr>
<tr>
<td></td>
<td>Timer Indicator Flashing until setpoint reached</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>t2</td>
<td>Heating ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>Timer Start Immediately</td>
<td>Counts Down</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>Display Flashes t2 3 times Shows Time remaining.</td>
<td>Current Temperature</td>
<td>Cycling Current Temperature/ End</td>
</tr>
<tr>
<td></td>
<td>Timer Indicator ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>t3</td>
<td>Output OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>Timer Starts Immediately</td>
<td>Counts Down</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>Display Flashes t3 3 times Shows Time remaining</td>
<td>Time Remaining</td>
<td>END shows for 3 seconds then the Current Temperature.</td>
</tr>
<tr>
<td></td>
<td>Indicator ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>t4</td>
<td>Heating ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>Timer Starts when setpoint reached</td>
<td>Counts Down</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>Display Flashes t4 3 times Shows time remaining</td>
<td>Current Temperature</td>
<td>Cycling Current Temperature/ End</td>
</tr>
<tr>
<td></td>
<td>Timer Indicator ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>t5</td>
<td>Heating ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>Timer Starts Immediately</td>
<td>Counts Down</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>Display Flashes t 3 times Shows Time remaining</td>
<td>Current Temperature</td>
<td>Cycling Current Temperature/ End</td>
</tr>
<tr>
<td></td>
<td>Timer Indicator ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>
3.6  Ramp Dwell Programming

The 301 Controller has the capability to follow a Ramp Dwell program.

3.6.1  Setting up a Ramp Dwell program

Set the Controller to Hold Mode:

- Start at the home display
- Press and hold the up and down keys together for 1.5 seconds.
- The display will flash Hold to show that 'Hold' mode has been entered.

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Temperature</td>
</tr>
<tr>
<td>B</td>
<td>Time</td>
</tr>
<tr>
<td>SPrr</td>
<td>Setpoint Ramp Rate (SPrr)</td>
</tr>
<tr>
<td>DT</td>
<td>Dwell Time t1</td>
</tr>
<tr>
<td>NCD</td>
<td>Natural Cool Down</td>
</tr>
</tbody>
</table>
Set the Timer Type to \( t_1 \)

- Start at the home display
- Press and hold the Page key for 1.5 seconds to enter the Setup Menu.
- Repeatedly press the Page key until \( t_1YP \) shows on the display.
- Use the up and down Arrow keys to set the value to \( t_1 \).
- The value will then be stored without any further input.
- See the 3.5 for more information.
- Press and hold down the page key for 1.5 seconds to return to Home Menu.

Set the Temperature Setpoint

- Start at the Home Display.
- Repeatedly press the Page key until \( SP^{\circ}C \) shows on the display.
- Use the up and down Arrow keys to alter the value \((^\circ C)\).
- The value will then be stored without any further input.
- Press and hold down the Page key for 1.5 seconds to return to the Home Menu.

Set the Setpoint Ramp Rate

- Start at the Home Display.
- Repeatedly press the Page key until \( SPrr \) shows on the display.
- Use the up and down Arrow keys to alter the value \((^\circ C/\text{Min})\).
- The value will then be stored without any further input.
- Press and hold down the Page key for 1.5 seconds to return to the Home Menu.

Set the Dwell Time

- Start at the Home Display.
- Repeatedly press the Page key until \( t_1 \) shows on the display.
- Use the up and down Arrow keys to either switch off or alter the value \((\text{Hr}:\text{Min})\).
- The value will then be stored without any further input.
- Press and hold down the Page key for 1.5 seconds to return to the Home Menu.
Start the Timer

- Start at the Home Display.
- Pressing the Timer key starts the program.
- Pressing the Timer key will automatically exit 'Hold' mode if set (see section 3.2.5 for more information) and the controller will start to operate.
- Press and hold down the Page key for 1.5 seconds to return to the Home Menu.

3.7 Maximum Output Setting

Depending on the furnace or oven model the maximum output power setting OP.Hi may be accessible or hidden.

For silicon carbide heated furnaces the parameter is accessible to allow compensation for element ageing, see the Fuses and Power Settings section of your product manual (section 9.0) for more information on power limits.

In many models the maximum output power setting depends on the supply voltage, refer to the Fuses and Power Settings section of your product manual (section 9.0).

3.8 Customer Calibration

The controller is calibrated for life at manufacture, there may however be sensor or other system errors which affect the accuracy of the measured temperature. Customer calibration is used to compensate for these errors. Access to this function is disabled when the timer is operating.

The 301 Controller has three types of customer calibration: factory calibration, single point calibration and dual point calibration. See sections 3.3.5 & 3.3.6 to access these.

3.8.1 Factory Calibration - \texttt{FC}\texttt{E}

Factory calibration is the default setting, which has no offset adjustment. It simply displays the temperature measured by the control thermocouple.

3.8.2 Single Point Calibration - \texttt{C}\texttt{E}\texttt{L} \texttt{I}

Single point calibration uses an offset value to adjust the temperature over its whole range.

Single point calibration accurately sets the temperature for setpoint values close to the temperature at which the calibration offset is made. The accuracy is reduced for setpoint temperatures which are significantly higher or lower than the calibration offset.

Table showing examples of how to determine offset values:
The calibration temperature may be measured at the centre of the chamber or through a specially fitted port.

New Offset Value = Old Offset Value + New Offset adjustment

New Offset Adjustment = Measured Calibration Temperature – Displayed Temperature

Caution! - The procedure to determine the calibration temperature at the centre of a chamber is not covered in these instructions. If you are unsure how to do this safely, then seek advice as there is a risk of electric shock if done incorrectly.

3.8.3 Changing the Single Point Calibration Offset - **OFSE**

1. Start at the home display.
2. Hold the Page Key for 1.5 seconds to access the Setup Menu.
3. Repeatedly press the Page key until **OFSE** is displayed.
4. Press the up or down Arrow keys to display the current calibration offset.
5. If a password is required to access **CL1**, enter the password using the up and down Arrow keys and press the Page key to accept. You will be returned to **OFSE**.
6. Use the up and down Arrow keys to scroll to **CL1**.
7. Press the Page key to access **OFSE**.
8. Press the up or down Arrow keys to change the offset value.
9. The value will then be stored without any further input.

Once **CL1** has been selected as the customer calibration type, it is possible to start from the home display and go to **OFSE** directly, and enter the password at this point when the calibration adjustment is required again.

3.8.4 Dual Point Calibration - **CL2**

Dual point calibration uses two offset values at two corresponding temperatures to progressively change the calibration as the temperature increases or decreases. This is a more accurate representation of how the temperature difference will occur.

Caution! - Do not make **CALL** and **CALH** the same value as the controller will not work correctly and could cause the furnace or oven to overheat.
3.8.5 Changing the Calibration, Low Temperature - \textit{CALL}

- Start at the home display.
- Hold the Page Key for 1.5 seconds to access the Setup Menu.
- Press the Page key until \textit{CL SE} is displayed.
- Press the up or down Arrow keys to display the current calibration offset.
- If a password is required to access \textit{CL2}, enter the password using the up and down Arrow keys and press the Page key to accept. You will be returned to \textit{CL SE}.
- Use the up and down Arrow keys to scroll to \textit{CL2}.
- Press the Page key to access \textit{CALL}.
- Press the up or down Arrow keys to change the offset value.
- The value will then be stored without any further input.

Once \textit{CL2} has been selected as the customer calibration type, it is possible to start from the home display and go to \textit{CALL} directly (or any of the other settings in \textit{CL2}) and enter the password at this point when calibration adjustment is required again.

3.8.6 Changing the Calibration, Low Temperature Offset - \textit{OFSL}

- Start at the home display.
- Hold the Page Key for 1.5 seconds to access the Setup Menu.
- Repeatedly press the Page key until \textit{CL SE} is displayed.
- Press the up or down Arrow keys to display the current calibration offset.
- If a password is required to access \textit{CL2}, enter the password using the up and down Arrow keys and press the Page key to accept. You will be returned to \textit{CL SE}.
- Use the up and down Arrow keys to scroll to \textit{CL2}.
- Press the Page key twice to access \textit{OFSL}.
- Press the up or down Arrow keys to change the offset value.
- The value will then be stored without any further input.

3.8.7 Changing the Calibration, High Temperature - \textit{CAL H}

- Start at the home display.
- Hold the Page Key for 1.5 seconds to access the Setup Menu.
- Repeatedly press the Page key until \textit{CL SE} is displayed.
- Press the up or down Arrow keys to display the current calibration offset.
- If a password is required to access \textit{CL2}, enter the password using the up and down Arrow keys and press the Page key to accept. You will be returned to \textit{CL SE}.
- Use the up and down Arrow keys to scroll to \textit{CL2}.
- Press the Page key three times to access \textit{CAL H}.
- Press the up or down Arrow keys to change the offset value.
- The value will then be stored without any further input.
3.8.8 Changing the Calibration, High Temperature Offset - **OF5H**

- Start at the home display.
- Hold the Page Key for 1.5 seconds to access the Setup Menu.
- Repeatedly press the Page key until **CL5E** is displayed.
- Press the up or down Arrow keys to display the current calibration offset.
- If a password is required to access **CL2**, enter the password using the up and down Arrow keys and press the Page key to accept. You will be returned to **CL5E**.
- Use the up and down Arrow keys to scroll to **CL2**.
- Press the Page key four times to access **OF5H**.
- Press the up or down Arrow keys to change the offset value.
- The value will then be stored without any further input.
3.9 Over-Temperature Protection

This controller may be fitted with the over-temperature protection option. If the over-temperature option is fitted the 301 display will include the Over-Temperature key and indicator (as shown in the diagram above). An independent control circuit and temperature sensor provide the over-temperature protection.

There are two uses for over-temperature protection:

1. To prevent a sample being heated in a furnace or oven from over-heating.
2. To provide an extra safety system to prevent the furnace or oven from heating in the event of a fault.

3.9.1 Over-Temperature (O/T) home display

When the Over-Temperature key is pressed and held the O/T home display is shown. The home display shows the over-temperature limit setting.

**Finding the O/T home display from the O/T Home Menu:**

- Press and hold the Over-Temperature key.
- Repeatedly press the Page key until the O/T limit value shows on the display.

**Finding the O/T home display from the O/T Setup Menu:**

- Press and hold the Over-Temperature key.
- Press and hold the Page key for 1.5 seconds.
3.9.2 Changing the Over-Temperature Limit

Note: If protection of the sample being processed is required, the over-temperature limit is normally set 15 °C above the temperature setpoint of the controller. If protection of the furnace or oven is required, the over-temperature limit is normally set 15 °C above the maximum setpoint of the furnace or oven.

- Start at the home display.
- Press and hold the Over-Temperature key.
- Repeatedly press the Page key until OE shows on the display.
- Use the up and down Arrow keys to change the offset value.

A single press shows the current setting. To alter either keep pressed or press again. The value will then be stored without any further input.

3.9.3 Checking the Over-Temperature Sensor Temperature

- Start at the home display.
- Press and hold the Over-Temperature key.
- Press and hold the Page key for 1.5 seconds.
- Current temperature (PV) is displayed for 1 second, followed by the over-temperature sensor value for 3 seconds; this sequence is then repeated.
3.0 301 Controller

3.9.4 Over-Temperature Protection Calibration

The over-temperature protection circuit can be calibrated in the same way as the main controller. However, this is not normally necessary as the level of accuracy required for over-temperature protection is not as critical as it is for the main control temperature.

- Start at the home display.
- Press and hold the Over-Temperature key.
- Press and hold the Page key for 1.5 seconds.
- Repeatedly press the Page key until CL.5E is displayed.

Now follow the procedure in "Customer Calibration".

3.9.5 Over-Temperature Activation

During normal operation, the over-temperature indicator is green. If the temperature of the furnace or oven goes above the over-temperature limit, the over-temperature circuit activates. The power supply to the heating elements is switched off and the over-temperature indicator changes to flashing red.

Pressing the over-temperature key shows OEE in the display to indicate that the over-temperature has been triggered.

The reason for the over-temperature activation must be investigated; an incorrect setting in the over-temperature limit is may be the cause. When you are satisfied with the reason for the over-temperature activation it can be reset.
3.9.6 Resetting Over-Temperature Activation

- Start at the home display.
- Press and hold the Over-Temperature key until OT is displayed.
- Repeatedly press the Page key until OT is displayed and the red indicator stops flashing.
- Press the up or down Arrow key to check the over-temperature limit value.
- Press the up or down Arrow key to alter the value if necessary.
- Press the Page key to return to the over-temperature display.

The over-temperature has now been reset.

If the temperature is still above the over-temperature setpoint then over-temperature indicator will be red but not flashing.

When the temperature falls below the over-temperature limit, the indicator changes back to green.

When the current temperature falls below the over-temperature setpoint, the furnace/oven starts to heat again.
### 3.10 RS232 Communication Option

The 301 Controller can be supplied with the capability to communicate with other devices via an RS232 link. If this option has been ordered, the furnace or oven will be supplied with a 9 pin ‘D’ socket for connecting to an external device. Plugging this into a computer will allow the controller to be accessed from that computer. The computer must have appropriate communication software installed such as Eurotherm’s ‘i-Tools’.

#### RS232 Communication Addressing:

<table>
<thead>
<tr>
<th>Modbus Address (Main)</th>
<th>= 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modbus Address (O/Temp)</td>
<td>= 3</td>
</tr>
<tr>
<td>Baud Rate</td>
<td>= 9600</td>
</tr>
<tr>
<td>Byte Format</td>
<td>= 8</td>
</tr>
</tbody>
</table>

#### RS232 Communication Cables

Connecting the furnace or oven to a computer is done via a "straight" cable as follows:

<table>
<thead>
<tr>
<th>Product end of cable female 9-pin</th>
<th>RS232 Cable: product to PC</th>
<th>Computer end of cable 9-pin male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rx</td>
<td>___________________________</td>
<td>3</td>
</tr>
<tr>
<td>Tx</td>
<td>___________________________</td>
<td>2</td>
</tr>
<tr>
<td>Com</td>
<td>___________________________</td>
<td>5</td>
</tr>
</tbody>
</table>

### 3.11 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.

If the temperature controller is fitted to the back of the control panel it can be separated from the base by removal of the screws. If the temperature controller is fitted inside the product base it can be separated from the top by removal of the screws.
3.12 Glossary of Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setpoint (SP)</td>
<td>The target temperature the furnace or oven is trying to reach.</td>
<td>°C</td>
</tr>
<tr>
<td>Setpoint Ramp Rate (SPrr)</td>
<td>The speed at which the furnace or oven is allowed to heat up or cool down</td>
<td>°C/ Min</td>
</tr>
<tr>
<td>Element</td>
<td>The heating device used in the furnace or oven.</td>
<td>-</td>
</tr>
<tr>
<td>Thermocouple</td>
<td>A thermoelectric device for measuring temperature.</td>
<td>-</td>
</tr>
<tr>
<td>PID</td>
<td>Proportional Integral Derivative: the control system used by the controller</td>
<td>-</td>
</tr>
<tr>
<td>Over-Temperature</td>
<td>The condition which a furnace or oven may enter if part of the main control circuit fails.</td>
<td>-</td>
</tr>
<tr>
<td>Over-Temperature Protection</td>
<td>A system to prevent the product or process being damaged if it has gone into an Over-Temperature condition.</td>
<td>-</td>
</tr>
<tr>
<td>Furnace or Oven</td>
<td>This refers to the product purchased from Carbolite Gero</td>
<td>-</td>
</tr>
</tbody>
</table>

3.13 Controller Fault

Fault Code Diagnostic Table

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Explanation</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>5br</td>
<td>Temperature sensor failure</td>
<td>Check all terminal connections between the temperature sensor (thermocouple) and temperature controller. It is recommended to loosen then tighten the screws in the terminal blocks in case the connections are oxidised. If this does not correct the error then replace the furnace or oven temperature sensor (thermocouple).</td>
</tr>
<tr>
<td>0000</td>
<td>Input over range</td>
<td></td>
</tr>
<tr>
<td>0000</td>
<td>Input under range</td>
<td></td>
</tr>
<tr>
<td>E- followed by numerical code</td>
<td>Controller Error</td>
<td>Turn the furnace or oven off and back on to see if this clears the error. If not contact Carbolite Gero Service – (see back cover)</td>
</tr>
</tbody>
</table>
4.0 Operation

4.1 Operating Cycle

The product is fitted with an instrument switch. The switch cuts off power to the controllers and elements. The circulation fan will operate when the instrument switch is on. An optional door switch may be fitted. If so, ensure that the door is closed to operate the fans and heating elements.

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.

**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 the product off, turn off the instrument switch. If the product is to be left unattended, isolate the electricity supply.

DO NOT switch off if the temperature is above 100 °C - damage could be caused to the fan and motor. Adjust the controller to allow the temperature to fall.

4.2 Over-Temperature Control (if fitted)

The over-temperature controller should typically be set at 15 °C above the main controller. If an over-temperature condition occurs, check the main controller is functioning correctly.

An over-temperature condition cuts off power to the heating elements. A light in the over-temperature controller flashes. To reset this, refer to the over-temperature control section of this manual.

4.3 Explosive Vapours

Unless your product includes the stoving and curing option, this model is not suitable for drying or heat treatment applications where vapours are released that are combustible or which can form explosive mixtures with air. Carbolite Gero manufactures other products suitable for these applications.
4.4 Atmospheres

When an optional gas inlet is fitted, there is a label near the inlet saying "INERT GAS ONLY". In practice, inert or oxidising gases may be used, but not combustible or toxic gases.

The chamber is not gas tight, the gas usage may be high and the chamber is always likely to contain some air. Residual oxygen of approximately 1% to 2% is to be expected.

4.5 Operator Safety

This product incorporates a safety switch which interrupts the heating element circuit when the furnace is opened. This prevents the operator touching a live heating element and also prevents the product from heating up if the furnace is left open. The operation of this switch should be checked periodically.

Depending on use, the surfaces in the working chamber and the chamber load may still be very hot after the appliance is switched off. Touching these surfaces may cause burns. Use suitable personal protective equipment or wait until the appliance cools down to ambient temperature.

Before removing a hot object from the product, make sure there is a safe place to put it down. If necessary use tongs, face masks and heat resistant gloves. Heat resistant clothing and face protection can guard against the effects of radiated heat when the furnace is open.

When the product is opened during operation there is considerable radiated heat. Do not keep any flammable objects near the product, nor objects which could be damaged by radiated heat.

4.6 Solenoid Valve with Manual Switch (if fitted)

If ordered the solenoid valve is operated using the panel mounted switch. When the switch is in the 'ON' position the solenoid valve will allow gas to flow. Ensure the installation and use of the product does not create a hazardous atmosphere. The workspace must have sufficient ventilation.
4.7 **Variable Speed Fan (if fitted)**

If fitted, the variable speed control is fitted in the air circulation fan circuit. A panel mounted rotary dial is used to control the speed.

Please note that there is a minimum setting at which the fan motor starts up when the product is switched on. It is recommended that the speed of the fan is not set below 50%, as there would be very little air flow around the chamber and also risk overheating the fan motor.

4.8 **Exhaust Fan (if fitted)**

To operate the exhaust fan use the fan switch on the control panel; this is only functional when the instrument switch is on.

The level of air exhaust can be controlled by adjusting the slider under the exhaust box.

When the exhaust fan is turned on, there may be a drop in internal temperature before the product recovers to the setpoint value.

The airflow should be adjusted to the minimum required by the process to reduce the amount of energy wasted in heating air.

4.9 **Stoving and Curing (if fitted)**

The stoving and curing option adds an explosion relief panel and a powered exhaust fan. With this option the exhaust fan operates continuously when the product is switched on.

A pressure switch detects that there is sufficient air flow through the chamber. If the pressure switch does not detect sufficient air flow, a fault light illuminates and heating is disabled.

At least 610 mm free space must be left around the explosion relief panel to allow this to break out if there is a rapid build up of pressure inside the chamber.

Please note that if the stoving and curing option is fitted, there may be an increase in the power rating of the product. See the product rating label located on the side panel of the product for correct power rating.

4.9.1 **Pre-heater (if fitted)**

Products with the stoving and curing option may also be fitted with a pre-heater that pre-heats the incoming air to the same temperature set on the main controller.

The temperature of the pre-heater is controlled by the main controller, but measured by a separate thermocouple.
5.0 Maintenance

5.1 General Maintenance

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

5.2 Maintenance Schedule

<table>
<thead>
<tr>
<th>Maintenance Procedure</th>
<th>Method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Daily Weekly Monthly Bi-Annually Annually</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>Door Seal</td>
<td>Visual inspection - check for splits or fraying</td>
<td></td>
</tr>
<tr>
<td>Door Seal</td>
<td>Replacement</td>
<td></td>
</tr>
<tr>
<td>Air Vent</td>
<td>Check and clean if necessary</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>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Component</th>
<th>Action Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling Fans (if fitted)</td>
<td>Check whether the cooling fans are working</td>
</tr>
<tr>
<td>Circulating Fan (if fitted)</td>
<td>Visual check to see if it is running</td>
</tr>
<tr>
<td>Circulating Fan (if fitted)</td>
<td>Check bearings and replace if necessary</td>
</tr>
<tr>
<td>Element Circuit</td>
<td>Electrical measurement</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>Measure the current drawn on each phase / circuit</td>
</tr>
<tr>
<td>Shelves</td>
<td>Visual check for fit and damage</td>
</tr>
</tbody>
</table>
5.3 Preventative Maintenance

It is suggested that a photographic record is taken during routine maintenance to help establish a record of the condition of the product and any changes that are occurring.

5.3.1 General Condition

With the product switched off and cold visually check general condition looking for signs of deterioration, over-heating and spillage damage. Repair or rectify as required.

5.3.2 Cleaning

With the product switched off, electrically isolated from the mains and cold, wipe over surfaces using a damp cloth but do not use solvents. If necessary vacuum out the heating chamber to remove any dust or minor debris and dispose of any material removed in accordance with local regulations to an approved disposal facility.

5.3.3 Thermal Insulation and Brickwork

Where thermal insulation or brick work is accessible in the heating chamber with the product switched off and cold visually check general condition. Look for signs of deterioration, cracking or missing insulation. Replace or repair as necessary refereeing to the general guidance notes in section 6.2.

5.3.4 General Access

With the product switched off and cold visually check that the general access around, behind and above the product is clear and that combustible material is not stored in the area.

5.3.5 General Ventilation

With the product switched off and cold visually check the general ventilation around and above looking for evidence of heat or fume damage. In particular check the condition and operation of any fixed ventilation or extract system fitted that will have been supplied by others.

5.3.6 Door Seal, Hinges and Latches

With the product switched off and cold visually check serviceability of the door seal, hinges and latches. Check for deterioration and misalignment and adjust, replace or repair as required. Operate the product at normal operating temperature and check for any leakage from the door seal. If in any doubt use a smoke wand to check for air being drawn in or spilling out.

5.3.7 Air Inlet and Exhaust Vent

With product switched off and cold visually check dampers are set correctly and not blocked or obstructed.
5.3.8 Door Safety Switch

If fitted with the product switched off and cold visually check securely fixed and has not been by-passed.

With the product switched on but cold open door and check fans and heating elements do not operate.

5.3.9 Fan Operation

Switch on from cold and open door and visually check all fans are running or have run.

5.3.10 Shelves, Lights and Windows

If fitted with the product switched off visually check for serviceability and repair or replace as necessary.

5.3.11 Lifting Points

If fitted with the product switched off and cold inspect for serviceability and repair or replace as necessary. Seek specialist advice if needed on lifting points.

5.3.12 Stand and Castors

If fitted with the product switched off and cold inspect for serviceability and repair or replace as necessary.

5.3.13 Air Flow Safety Switch

If fitted with the product switched off and cold block the exhaust outlet and check heating elements do not operate. A “fan-fail” or similar alarm may indicate this if fitted. If a replacement switch has to be fitted always set the pressure adjuster to the correct value and seal the adjuster with red paint or similar.

5.3.14 Explosion Relief Panels

If fitted with the product switched off and cold visually check panels have not been disturbed by over-pressure and that the clearance area needed around them has not been obstructed.

5.3.15 Main temperature Controller and Over temperature Controller

Check the settings have not been adjusted and that the over-temperature controller if fitted is set to typically 15°C above the set-point of the main controller.

5.3.16 Thermocouples

With the product switched off and cold visually check that the thermocouples tips have not suffered mechanical damage while loading the chamber.

This may not be necessary if the thermocouples are located behind air guides or similar where they cannot normally be damaged. Replace if necessary.

5.3.17 Instrument ON/Off Switch

Check the product only starts to operate when the Instrument switch is set to ON and stops when switched to OFF.
5.3.18 Mains Electrical Lead and Plug
With product switched off at the mains and cold visually inspect the electrical lead and plug and look for signs of damage or deterioration. Repair or replace if necessary.

5.3.19 Gas Atmosphere Equipment
If gas flow meters or solenoid control valves have been fitted starting with the product switched off and cold test the meters are registering and solenoid valves switches on and off the gas flow correctly when operated normally.
The equipment providing and regulating the supply of gas will normally have been supplied by others.
Service it in accordance with the manufacturer’s instructions.

5.3.20 Data Plate and Safety Labels
With product switched off and cold visually check that the thermocouples tips have not suffered that these are fitted where required and legible. Replace with new ones if necessary.

5.3.21 Safety Guards and Covers
With the product switched off and cold visually check all safety guards are fitted and serviceable and if safety switches are fitted that they operate correctly and have not been by-passed.
Check that all covers over electrical controls and similar are securely fitted.

5.3.22 Electrical Checks
This can only be done by trained operatives.
It would only normally be done on an extended time basis or after a major refurbishment.
A specific test procedure for each oven / furnace model would have to be established first.
Voltage and Current
With oven / furnace cold switch ON and measure the incoming voltage and current on each phase.
Confirm agrees with Data Plate fitted.
General Electrical Inspection
With oven / furnace switched off and cold and electrically isolated from the mains supply remove the control panel cover and panels over the heating elements and other controls.
Visually inspect the cabling, connections and electrical devices looking for signs of overheating, cable-chaffing or general deterioration. In particular check for loose connections on heating elements or high power switching devices that could lead to local overheating.
If any such problems are found identify the cause and repair or replace as necessary.
Note: Earth Leakage
5.0 Maintenance

EMC filters are generally fitted and these may give false results as they may be designed to have a small leak to earth.

The insulation on heating elements generally has a small leakage particularly when older.

With the oven / furnace isolated and disconnected from the mains:

Earth Continuity:
Measure from main incoming earth point to any accessible conducting panel, screw head, frame member, controls mounting plate or earth connection point on any electrical device.

Limit: Continuity to be < 0.5 ohm

Electrical Resistance (Safety)
Test by using a Mega Tester or similar and apply 500V DC between:

L & Earth and N & Earth
before and after the main contactor and any switching / isolating devices.

Limit: Resistance to be > 1M ohm

High Voltage Flash Testing
Do not perform this as the digital controllers and solid state switching devices may be damaged.

PAT (Portable Appliance Testing) Testing
Small ovens and furnaces rated less than 3 kW fitted with a UK 13 Amp domestic plug can be tested using this technique if the tester is set to “computer or electronically sensitive equipment” mode. This is to protect the digital temperature controllers and solid state switching devices fitted.

Any faults should be investigated and rectified as necessary.

5.3.23 Final Inspection and Testing

Ensure the product is switched off and cool. Run the product through a normal operating cycle and confirm it heats up and cools down correctly as required by its temperature controller.

5.3.24 Power Limiting Control

If an older product fails to achieve the normal operating temperature in the required time, when it had originally not had this problem, it may be due to an age related performance reduction in the heating elements.

It may be possible to compensate for this by increasing the power output setting in the temperature controller’s parameter OP.Hi (if not already set to 100% - refer to power rating section 9.0 for setting values).

Resetting this should only be done if all other obvious causes have been eliminated and after consulting Carbolite as entering the wrong setting can cause damage.
5.4 Calibration

After prolonged use, the controller and/or thermocouple may require recalibration. This is important for processes that require accurate temperature readings or for those that use the product close to its maximum temperature. A quick check using an independent thermocouple and temperature indicator should be made from time to time to determine whether full calibration is required. Carbolite Gero can supply these items. Depending on the controller fitted, the controller instructions may contain calibration instructions.

5.5 After-Sales Service

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

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

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

5.6 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 a fan and motor assembly, a thermocouple, a solid state relay, an element (or set of elements) and a door seal. Individual spare parts are also available. When ordering spare parts please quote the model details as requested above.

5.7 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 9.0 for details of power limit settings.
6.0 Repairs and Replacements

6.1 Safety Warning - Disconnection from Power Supply

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

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

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

6.2 Safety Warning - Refractory Fibre Insulation

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

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

Typical use does not result in any significant level of airborne dust from these materials, but much higher levels may be encountered during maintenance or repair.

Whilst there is no evidence of any long term health hazards, it is strongly recommended that safety precautions are taken whenever the materials are handled.

**Exposure to fibre dust may cause respiratory disease.**

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

**Avoid breaking up waste material. Dispose of waste in sealed containers.**

**After handling, rinse exposed skin with water before washing gently with soap (not detergent). Wash work clothing separately.**

Before commencing any major repairs it is recommended to make reference to the European Association representing the High Temperature Insulation Wool industry (www.ecfia.eu).

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

6.3 Control Panel Removal

Disconnect the product from the electrical supply.
Control panel - HT models. Remove the screws holding the panel. Note that the panel remains connected by wiring. Do not disconnect any wiring without first making a careful note of all the connections.

Internal element cover. Open the door, remove any screws holding the panel and any clips holding thermocouples in position and remove the cover.

6.4 Temperature Controller Replacement

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

6.5 Solid-State Relay Replacement

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

Make a note of the wire connections to the solid state relay and disconnect them.

Remove the solid state relay from the base panel or aluminium plate.

Replace and reconnect the solid state relay ensuring that the bottom of it has good thermal contact with the base panel or aluminium plate.

Replace the access panel.

6.6 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.
6.7 Element Replacement

Remove the back panel and the internal cover as given above. The element terminals are accessed from the back.

Disconnect the wires from the element terminals. Remove any starlock washers - these may need to be cut with wire cutters. Remove any clips holding the element inside the chamber and withdraw the element.

Reverse the procedure with the new element.

To find out whether the element failure was caused by a fault in the control circuit, operate the product at a low temperature and check that it is functioning correctly.
## 7.0 Fault Analysis

### A. Oven Does Not Heat Up

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The temperature controller is OFF</td>
<td>No power from supply</td>
</tr>
<tr>
<td>2.</td>
<td>The temperature controller is ON</td>
<td>The controller shows a very high temperature or a code such as EEE or --- or S.br</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The controller shows a low temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>There are no lights glowing on the controller</td>
</tr>
</tbody>
</table>

### B. Oven Overheats

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Oven only heats up when the instrument switch is ON</td>
<td>The controller shows a very high temperature</td>
</tr>
<tr>
<td></td>
<td>The controller shows a low temperature</td>
<td>The thermocouple may have been shorted out or may have been moved out of the oven</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The thermocouple may be connected the wrong way round</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The controller may be faulty</td>
</tr>
<tr>
<td>2.</td>
<td>Oven heats up when the instrument switch is OFF</td>
<td>The SSR has failed &quot;ON&quot;</td>
</tr>
</tbody>
</table>
8.0  Wiring Diagrams

8.1  WV-11-00/01

Connections below show single phase with indirect safety switches, fan motor (if fitted) and over-temperature control.
8.2 WV-33-00/01
Connections below show 3-phase +N with indirect safety switches, fan motor (if fitted) and over-temperature control.

8.3 WV-43-00/01
Connections below show 3-phase Delta with indirect safety switches, fan motor (if fitted) and over-temperature control (if fitted).
8.0  Wiring Diagrams

8.4  WS-10-01 - Isolating for 208 V version only

The transformer changes the supply voltage of the control circuit into the desired operating range for the controller and other components.

The supply voltage as shown is taken from a single phase supply or from the phase-to-phase voltage of a 3-phase supply.

The instrument circuit is modified as follows.

![Wiring Diagram](image)

**Key**

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1, F2</td>
<td>Fuses</td>
</tr>
<tr>
<td>FIL</td>
<td>Filter (if fitted)</td>
</tr>
<tr>
<td>TX</td>
<td>Transformer</td>
</tr>
<tr>
<td>SW</td>
<td>Instrument Switch</td>
</tr>
<tr>
<td>N</td>
<td>Neutral</td>
</tr>
<tr>
<td>L1</td>
<td>Live</td>
</tr>
<tr>
<td>PE</td>
<td>Earth</td>
</tr>
</tbody>
</table>
8.5 WS-14-04

The supplementary wiring diagram below shows the connections for a door switch on a fan oven with an existing contactor but no spare contact. The door switch is included in the contactor coil circuit. If there is no spare contact available, an additional relay is required.

Key

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIF</td>
<td>Circulation Fan</td>
</tr>
<tr>
<td>CO</td>
<td>Coil</td>
</tr>
<tr>
<td>DS</td>
<td>Door Switch</td>
</tr>
<tr>
<td>FM</td>
<td>Fan Motor</td>
</tr>
<tr>
<td>OTC</td>
<td>Over-Temperature Controller</td>
</tr>
<tr>
<td>R</td>
<td>Relay</td>
</tr>
<tr>
<td>*</td>
<td>If fitted</td>
</tr>
</tbody>
</table>

![Wiring Diagram](image-url)
9.0 Fuses and Power Settings

9.1 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</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/18</td>
<td>1-phase</td>
<td>230</td>
<td>10 A</td>
</tr>
<tr>
<td>6/350</td>
<td>3-phase</td>
<td>200-210</td>
<td>25 A</td>
</tr>
<tr>
<td>6/350</td>
<td>3-phase</td>
<td>220-240</td>
<td>23 A</td>
</tr>
<tr>
<td>6/350</td>
<td>3-phase + N</td>
<td>380-415</td>
<td>13 A</td>
</tr>
<tr>
<td>6/500</td>
<td>3-phase + N</td>
<td>380-415</td>
<td>25 A</td>
</tr>
</tbody>
</table>

9.2 Power Settings

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

<table>
<thead>
<tr>
<th>Volts</th>
<th>208 V</th>
<th>220 V</th>
<th>230 V</th>
<th>240 V</th>
<th>380 V</th>
<th>400 V</th>
<th>415 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power (%)</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Power (%)</td>
<td>99</td>
<td>100</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.
10.0 Specifications

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

<table>
<thead>
<tr>
<th>Model</th>
<th>Max Temp (°C)</th>
<th>Max Power (kW)</th>
<th>Chamber Size (mm)</th>
<th>Approx Capacity (l)</th>
<th>Net Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>H</td>
<td>W</td>
<td>D</td>
</tr>
<tr>
<td>HT 6/350</td>
<td>600</td>
<td>9.0</td>
<td>700</td>
<td>700</td>
<td>700</td>
</tr>
</tbody>
</table>

10.1 Environment

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

- Temperature: 5 °C - 40 °C
- Relative humidity: Maximum 80 % up to 31 °C decreasing linearly to 50 % at 40 °C
## Service Record

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