Installation, Operation and Maintenance Instructions
800°C Afterburner Ashing Furnace - ABA Model: 28 Litres
2416 Controller

ABF 8/28 + 2416 Controller
Contents
This manual is for guidance on the use of the Carbolite Gero product specified on the front cover. This manual should be read thoroughly before unpacking and using the furnace or oven. The model details and serial number are shown on the back of this manual. Use the product for the purpose for which it is intended.

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1.0 Symbols and Warnings

1.1 Switches and Lights

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

- Heat light: the adjacent light glows or flashes to indicate that power is being supplied to the elements.

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
1.3 Access to the Plenum Chamber

Soot can accumulate in the airway following the after-burner, giving rise to fire risk.

There is a plenum chamber with removable panels to give access to cleaning; see section 8.3.

The operator is responsible for maintaining a clean plenum chamber and also for regular cleaning of the chimney and the external flue or ducting system.

1.4 Maintenance or Dismantling

The operator should read the warning on refractory fibre insulation, given in section 9.2, before undertaking any work involving exposure to the internal insulation material.

The operator should disconnect the equipment from the electrical supply before removing panels to access the electrical connections and control equipment.

2.0 Supplied Items List

2.1 Parts Supplied

The following items should be present. These should all be checked and identified as soon as possible after receipt of the equipment.

<table>
<thead>
<tr>
<th>quantity</th>
<th>item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Afterburner Ashing Furnace: ABF 8/28</td>
</tr>
<tr>
<td>1</td>
<td>Chimney</td>
</tr>
<tr>
<td>1</td>
<td>Basket Set</td>
</tr>
<tr>
<td>1</td>
<td>Basket Set loading handle</td>
</tr>
<tr>
<td>(1)</td>
<td>Stand (only if ordered)</td>
</tr>
</tbody>
</table>

In addition, any spare parts ordered should be separately identified and put aside in safe storage.

2.2 Tools Required

10 mm spanner, 12 mm spanner, cross point screwdriver, flat blade screwdriver.
3.0 Installation

3.1 Unpacking & 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.

NOTE: This product contains Refractory Ceramic Fibre (also known as Alumino Silicate Wool - ASW). For precautions and advice on handling this material see section 9.2.

3.2 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.

### 3.3 Fitting the Chimney

- Remove the chimney panel, (see Fig 10.)
- Fasten the chimney to the top of the product using the screws provided, (see Fig 12.)
- Replace the chimney panel, (see Fig 11.)
3.4 Ducting

The chimney must either be placed under a powered exhaust hood, or connected directly to a 76 mm duct (not supplied) to the outside of the building; any such duct must NOT have powered extraction.

The fumes should be ducted by either of the above methods to at least 1 metre above the level of the building.

Rules for ducting:

- Ducting diameter must be 76 mm or more.
- Ducting must be 76 mm where it connects to the chimney.
- Ducting length must not exceed 3 metre for 76 mm diameter; for longer lengths consult a ducting engineer.
- Flexible ducting, if used, must be suitable for exhaust gas extraction.
- If an extraction fan is fitted an extraction hood is required with free flow of air around the chimney.
- Do not connect more than one product to a single duct. (Exception: where a fanned duct with hoods is used)
3.5 Electrical Connections

Connection by a qualified electrician is recommended.

For electrical connection details of the ABF 8/28 refer to drawing 00348-1-5003

Look at the rating label before connection to check the electrical supply voltage and frequency for which the product is configured. If there is a difference between the actual supply and the rating label, please call Carbolite Gero.

Either wire directly to an isolator or fit with a line plug. An isolating switch should operate on all live conductors (three phase); it should be within reach of the operator. A line plug should be easily removable and should be within reach of the operator.

The electrical supply MUST incorporate an earth (ground).

Failure to wire to the appropriate diagram may damage the ABF.
Fig 14 - Schematic for Mains Electrical Connections
4.0 2416 Controller

4.1 Description

This manual applies to the 2416, 2416CG and 2416P8 controllers. Special customer requirements may result in changes to the available parameters and the navigation diagram. It is not possible to list all the possibilities in this manual.

2416CG Controller

The Eurotherm model 2416CG is a digital instrument with PID control algorithms which may be used as a simple controller or an 8-segment programmer. The 2416P8 is an eight-program model in which the programs can be stored independently or can be linked by a “call” parameter to form a single long program.

The 2416 Controller features:

- Easy use as a simple temperature controller, where on setting the required temperature the controller immediately attempts to reach and maintain it. Fig.1 indicates the type of temperature response when used in this way.
- By using one program segment, the control can be extended to include ramp-to-set-point. Fig.2 shows the effect.
- Alternatively, the 2416 Controller may be used as an 8-segment programmer, with each segment being a "Ramp", a "Step", a "Dwell", or "End". The program can be set to cycle if required. See fig. 3.
- Optional “modules” are available, in particular:
  - RS232 and RS432/485 digital communications modules;
  - Analogue communication modules;
  - "PDSIO" modules for communication with other controllers of similar or higher specification, for example, to allow cascade control;
  - Alarm modules, which can be used to drive visible or audible alarms, or to provide volt-free contacts for customer use.
**Fig 1 - Simple Control**

*Fig 2 - Control with Ramp-to-Setpoint*

Seg 1 = Ramp  
Sep 2 = End (Dwell)

**Fig 3 - A Program**

<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>AT</td>
<td>Actual Temperature</td>
</tr>
<tr>
<td>WSP</td>
<td>Working Setpoint</td>
</tr>
<tr>
<td>R</td>
<td>Ramp</td>
</tr>
<tr>
<td>D</td>
<td>Dwell</td>
</tr>
<tr>
<td>S</td>
<td>Step</td>
</tr>
<tr>
<td>E</td>
<td>End</td>
</tr>
</tbody>
</table>
4.2 Operation

Most Carbolite Gero products are fitted with an instrument switch which cuts off power to the controller and other parts of the control circuit. See section 7.0 for operating instructions.

To operate the 2416 Controller there must be power to the furnace or oven and the instrument switch must be on. If a time switch is included in the furnace or oven circuit, this must be in an ON position.

2416CG - Operation

When switched on, the controller lights up, goes through a short test routine and then displays the measured temperature and setpoint. Depending on its state when it was last switched off, it may start to control to the current setpoint of program. The output light glows or flashes to indicate that the control is occurring.

The buttons and indicators are used for the following purposes:

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Output Light</td>
</tr>
<tr>
<td>B</td>
<td>Not Used</td>
</tr>
<tr>
<td>C</td>
<td>Page</td>
</tr>
<tr>
<td>D</td>
<td>Scroll</td>
</tr>
<tr>
<td>E</td>
<td>Down</td>
</tr>
<tr>
<td>F</td>
<td>Up</td>
</tr>
<tr>
<td>G</td>
<td>Run/Hold</td>
</tr>
<tr>
<td>H</td>
<td>Setpoint Temperature (SP)</td>
</tr>
<tr>
<td>I</td>
<td>Measured Temperature</td>
</tr>
</tbody>
</table>
### Auto/Manual

<table>
<thead>
<tr>
<th>Auto/Manual</th>
<th>Disabled.</th>
<th>The unit is always in 'Auto' mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUN/HOLD</td>
<td>-</td>
<td>Used to start, stop or pause a program. Short presses cause it to alternate between 'Run' and 'Hold', but if it is held for 2 seconds the programmer goes into 'Reset' mode where it behaves as a simple controller.</td>
</tr>
<tr>
<td>Up + Down</td>
<td>▲ + ▼</td>
<td>To adjust the value of a parameter. Used to change the setpoint when the unit is being used as a simple controller ('Reset' mode). Holding down gives an accelerated parameter change.</td>
</tr>
<tr>
<td>Page</td>
<td></td>
<td>Allows access to the parameters within the controller; most lists and parameters are hidden from the operator as they contain factory-set values which should not be altered. A single press of the page key shows the temperature units, normally °C; further presses reveal the lists indicated in the Navigation Diagram.</td>
</tr>
<tr>
<td>Scroll</td>
<td></td>
<td>Allows access to the parameters within a list. A single press displays the temperature units; further presses reveal the parameters in the current list. Some parameters are display-only, others may be altered by the operator.</td>
</tr>
<tr>
<td>Page + Scroll</td>
<td>▼ + ▲</td>
<td>Press together to cause an immediate return to the 'Home List'.</td>
</tr>
</tbody>
</table>

### Operation as a Simple Controller

Press RUN/HOLD for 2 seconds to go into 'Reset' mode. Use down ▼ or up ▲ from the 'Home List' (i.e. when the temperature is displayed) to adjust the setpoint. The unit starts to control in the way indicated in Fig. 1.

Note that to use the Ramp Rate feature, as in Fig. 2, it is necessary to create a program. See the following sections.
4.3 Programming

Note that a currently active segment cannot be altered - put the programmer into 'Hold' or 'Reset' whenever it is necessary to do so to alter a parameter. Go into 'Reset' mode (i.e. press RUN/HOLD for 2 seconds) before starting to create or modify a program.

Press page \( \text{ página } \) until 'ProG LiSt' is displayed.

Press scroll \( \text{ scroll } \) to reveal the 'Holdback' and 'Loop Count' parameters. See sections 4.3.3 and 4.3.4 for a description of these.

Press scroll \( \text{ scroll } \) to display 'SEG.n' (segment number); use down \( \downarrow \) or up \( \uparrow \) to move to the segment to be adjusted or created.

Press scroll \( \text{ scroll } \) to see the 'tYPE' (segment type); use down \( \downarrow \) or up \( \uparrow \) to change the required segment type – see the table below.

Press scroll \( \text{ scroll } \) to access the parameters appropriate to the type of segment chosen – see the following table – and use down \( \downarrow \) or up \( \uparrow \) to alter the values.

The final segment should be of type 'End', unless all program segments are used. Segments after 'End' are ignored.

### Table: Segment Parameters

<table>
<thead>
<tr>
<th>Segment Type</th>
<th>Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>RmP.r</td>
<td>TGt</td>
<td>The target setpoint for this segment</td>
</tr>
<tr>
<td></td>
<td>rATE</td>
<td>The ramp rate (rate of temperature change) in °/ minute</td>
</tr>
<tr>
<td>RmP.t</td>
<td>TGt</td>
<td>The target setpoint for this segment</td>
</tr>
<tr>
<td></td>
<td>dur</td>
<td>The duration of the segment. The controller calculates the rate of temperature rise necessary to achieve this duration.</td>
</tr>
<tr>
<td>Dwel</td>
<td>dur</td>
<td>The time in minutes to remain at the previous target temperature. 10ths of a minutes are allowed.</td>
</tr>
<tr>
<td>SteP</td>
<td>tGt</td>
<td>A new target temperature to be achieved as quickly as possible.</td>
</tr>
<tr>
<td>CaLL</td>
<td>PrG.n</td>
<td>Only applicable to 2416P8. Calls another stored program given by 'PrG.n' as a subroutine, running it the number of times given by 'cyc.n&quot;.</td>
</tr>
<tr>
<td></td>
<td>cyc.n</td>
<td></td>
</tr>
<tr>
<td>End</td>
<td>End.t</td>
<td>'Dwel!' holds the temperature at the last target value. 'RSET' returns to simple controller operation; if the setpoint is set to zero then this effectively turns the heating off. 'SoP' sets the power to 0% – use of this is not recommended.</td>
</tr>
</tbody>
</table>

### 4.3.1 Programming Tips

Make sure the basic setpoint is set to zero to avoid unexpected heating at the end of a program.
If all segments are used so that there is no 'End' segment, then on completion the program automatically goes into 'Dwell'. Dwell segments of length zero can be included. This is a way of allowing space for future program changes. For an example of program creation, see section 4.3.6.

4.3.2 Multi-program model (2416P8)
The 'Program Edit' list contains the extra parameter 'PrG.n' and the 'Run' list contains the extra parameter 'PrG'. These features allow selection of the program to be edited or to be operated. The extra segment type 'cALL' allows one program to call another as a subroutine; use this feature to create one or more long programs.

4.3.3 Holdback

"Holdback' can be used to prevent the program from operating ahead of the actual heating or cooling.

In the program list, scroll ⬇ to the 'Holdback' parameter and use down ▼ or up ▲ to set the holdback type as follows:

<table>
<thead>
<tr>
<th>Band</th>
<th>Holdback applies to both heating and cooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lo</td>
<td>Holdback applies to heating only</td>
</tr>
<tr>
<td>Hi</td>
<td>Holdback applies to cooling only</td>
</tr>
<tr>
<td>Off</td>
<td>Holdback is off</td>
</tr>
</tbody>
</table>

Set 'Hb.V' to the value in °C beyond which holdback is to operate. Type 'BAnd' and a value of 10 °C is often a suitable combination, if holdback is required. In this case, if the actual temperature deviates outside ±10 °C from the working setpoint, the holdback lamp of the front of the controller flashes and the program is held up until the temperature comes within range again.

The standard setting for holdback is OFF.

4.3.4 Program Cycling
The 'Loop Count' parameter 'CYC.n' can be set to control the number of times the program is run.
If 'CYC.n' = 1, the program stops at the end segment.
If 'CYC.n' = 5 (for example), the program runs 5 times: at the 'End' segment it returns to segment 1, until the 5th time through when it stops.
If 'CYC.n' = cont, the program never ends: it cycles continuously.

4.3.5 Running a Program
Press Run/ Hold to light up the 'Run' light. The program starts to operate.
To view the progress of a program from the 'Home' list, press scroll ⬇ to reveal the current segment ('SEG') and the total program time remaining in hours ('PrG.t').
For a more detailed view, press page \( \text{P} \) to access the 'Run' list page and scroll \( \text{S} \) to see its contents as shown in the Navigation Diagram below. Provided the unit is first put into 'Hold' mode, temporary changes may be made to parameters; these apply only until the program ends or is reset.

To pause a program, press Run/ Hold; the 'Hold' light comes on. To terminate a program, press Run/ Hold for 2 seconds; the 'Run' and 'Hold' lights go out.

While the program is operating, the working setpoint is shown in the lower display.

4.3.6 Program example

The following sequence of entries creates and runs the program.

1. Press page \( \text{P} \) key until 'ProG LiSt' is displayed.
2. Press scroll \( \text{S} \) until 'CYC.n' is displayed and use the arrow key to select 1.
3. Press scroll \( \text{S} \) until 'SEG.n' is displayed and use the arrow key to select 1.
4. Press scroll \( \text{S} \) until 'tYPE' is displayed and use the arrow key to select rmP.r.
5. Press scroll \( \text{S} \) until 'tGt' is displayed and use the arrow key to select 600.
6. Press scroll \( \text{S} \) until 'rAtE' is displayed and use the arrow key to select 5.0.
7. Press scroll \( \text{S} \) until 'SEG.n' is displayed and use the arrow key to select 2.
8. Press scroll \( \text{S} \) until 'tYPE' is displayed and use the arrow key to select dwEl.
9. Press scroll \( \text{S} \) until 'dur' is displayed and use the arrow key to select 60.0.
10. Press scroll \( \text{S} \) until 'SEG.n' is displayed and use the arrow key to select 3.
11. Press scroll \( \text{S} \) until 'tYPE' is displayed and use the arrow key to select rmP.t.
12. Press scroll \( \text{S} \) until 'tGt' is displayed and use the arrow key to select 400.
13. Press scroll \( \text{S} \) until 'dur' is displayed and use the arrow key to select 60.0.
14. Press scroll \( \text{S} \) until 'SEG.n' is displayed and use the arrow key to select 4.
15. Press scroll \( \text{S} \) until 'tYPE' is displayed and use the arrow key to select 'dwEll'.
16. Press scroll \( \text{S} \) until 'dur' is displayed and use the arrow key to select 30.
17. Press scroll \( \text{S} \) until 'SEG.n' is displayed and use the arrow key to select 5.
18. Press scroll \( \text{S} \) until 'tYPE' is displayed and use the arrow key to select rmP.r.
19. Press scroll \( \text{S} \) until 'tGt' is displayed and use the arrow key to select 30.
20. Press scroll \( \text{S} \) until 'rAtE' is displayed and use the arrow key to select 5.0.
21. Press scroll \( \text{S} \) until 'SEG.n' is displayed and use the arrow key to select 6.
22. Press scroll \( \text{S} \) until 'tYPE' is displayed and use the arrow key to select 'End'.
23. Press scroll \( \text{S} \) until 'End.t' is displayed and use the arrow key to select 'dwEll'.
24. Press the page \( \text{P} \) key until you return to the main display.
25. Press the 'Run' key. The program operates.
4.4 Controller Options

As options can be ordered in a variety of combinations and for a variety of purposes, exact instructions are not given here. The full Eurotherm manual may be required to determine customer parameter settings. To reveal or hide parameters in the controllers it is necessary to go into configuration mode, a security code is needed. Please consult Carbolite Gero.

4.4.1 Digital Communications - RS232

If the RS232 option is supplied, the furnace is fitted with one sub-miniature D-socket connected to the controller comms module. RS232 is suitable for direct connection to a personal computer (PC) using a “straight through” cable as follows (the linked pins at the computer end are recommended but may not be necessary). The cable is usually 9-pin at the furnace end and 9-pin at the computer, but other alternatives are shown in parentheses.

<table>
<thead>
<tr>
<th>Product end of cable female (25-pin) 9-pin</th>
<th>RS232 Cable: product to PC</th>
<th>Computer end of cable 9-pin (25-pin) male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rx</td>
<td>3</td>
<td>3 (2) Tx</td>
</tr>
<tr>
<td>Tx</td>
<td>2</td>
<td>2 (3) Rx</td>
</tr>
<tr>
<td>Com</td>
<td>5</td>
<td>5 (7) Com</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,8 (4,5) Link together</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,4,6 (6,8,20) Link together</td>
</tr>
</tbody>
</table>

4.4.2 Digital Communications - RS485

If an RS485 option is supplied, the furnace is fitted with two D-sockets. Connection between products is by “straight” cable as follows:

<table>
<thead>
<tr>
<th>Product end of cable female (25-pin) 9-pin</th>
<th>RS485 Cable: product to PC</th>
<th>Computer end of cable 9-pin (25-pin) female</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>3</td>
<td>3 (2) Tx</td>
</tr>
<tr>
<td>+</td>
<td>2</td>
<td>2 (3) Rx</td>
</tr>
<tr>
<td>Com</td>
<td>5</td>
<td>5 (7) Com</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4,5 Link together</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6,8,20 Link together</td>
</tr>
</tbody>
</table>

4.4.3 Comms Address

Typically the comms address is set to 1, but this can be changed. In the case of RS485 and multiple instruments it is necessary to set different addresses. To change the address value, access the level 2 list. In level 2 press the page key until the COMMS parameter is displayed. Press up ▲ down ▼ to select the address value.

4.4.4 Alarm Option

When an alarm board is fitted, which consists of a relay with voltage free contacts, for operator use, the contacts are taken to a panel plug on the control panel, wired as
The purpose of the 2 amp fuse is to break the circuit to prevent overloading on the circuit due to high voltage.

The instrument configuration and parameters available to the operator depend on the customer requirements.

### 4.5 Temperature Controller Replacement

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

Ease apart the two lugs at the side; grip the instrument and withdraw it from its sleeve; push in the replacement.
4.6 Navigation Diagram
5.0 Afterburner 2132 Controller

5.1 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.

5.2 2132 Controller Operation

5.2.1 Controls

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

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

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

Some components will operate after the over-temperature feature isolates the power supply e.g. cooling fans will continue to operate, provided that there is a power supply to the product. In some cases the product may not do so, if other options (such as a door switch) are fitted.
5.2.2 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 \(\text{Page}\) allows access to parameter lists within the controller.

A single press of the page key \(\text{Page}\) displays the temperature units, normally set to \(^\circ\text{C}\); further presses reveal the lists indicated in the navigation diagram. See section 6.4.

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.

5.2.3 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.

5.2.4 Altering the Setpoint

With the display at 'Home', showing the measured temperature, press down \(\downarrow\) or up \(\uparrow\) 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.
5.0 Afterburner 2132 Controller

5.2.5 Stopping and Starting Control

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

5.2.6 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 5.3.1 and 5.3.2).

Press scroll \( \Downarrow \) until 'SPrr' (setpoint ramp rate) is displayed. Use down \( \Downarrow \) or up \( \Uparrow \) 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 \( \Downarrow \) or \( \Uparrow \).

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).
5.3 Operating with the Timer

This controller can be used as a process timer allowing timed heating or timed delay, according to the options in the table. There are 5 timer modes, but 2 of them are affected by whether the setpoint ramp rate feature is being used, making 7 entries in the table. The table also shows the status of the timer light on the controller. A visual impression of the different modes is given in fig 3.
<table>
<thead>
<tr>
<th>Timer Mode</th>
<th>Description</th>
<th>Timer Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>mode 1</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>Timed dwell and switch off</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mode 2</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>Timed dwell and stay on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mode 3, with SPrr 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>Time from cold and switch off</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mode 3, with SPrr active</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>Dwell from working setpoint and switch off</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mode 4, with SPrr off</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>Time from cold and stay on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mode 4, with SPrr active</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>Dwell from working setpoint and stay on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mode 5</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>
<tr>
<td>Delayed switch on</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.3.1 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.

5.3.2 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.

5.3.3 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.
5.0 Afterburner 2132 Controller

5.3.4 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.

5.3.5 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.

5.3.6 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.

5.3.7 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.

5.4 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 2 until OP (output list) is displayed. Press scroll 1 until OP.Hi (Output High) is displayed. Press down ▼ or up ▲ once to display the value of OP.Hi and write down the value. To alter the value, use down ▼ or up ▲.

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

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

**Control at Low Temperatures**

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

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

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

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

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

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

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

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

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

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

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

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

![Fig 4 - 2-Point Calibration](image-url)
5.0 Afterburner 2132 Controller

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

5.5 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 5.3.6.

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

5.6 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.
5.7 Navigation Diagram

```
<table>
<thead>
<tr>
<th>HL</th>
<th>20.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1°C</td>
</tr>
<tr>
<td>OP</td>
<td></td>
</tr>
<tr>
<td>w.SP</td>
<td>3</td>
</tr>
<tr>
<td>m - A</td>
<td>4</td>
</tr>
<tr>
<td>SPrr</td>
<td>5</td>
</tr>
<tr>
<td>tm.OP</td>
<td>6</td>
</tr>
<tr>
<td>tmr</td>
<td>7</td>
</tr>
<tr>
<td>dwell</td>
<td>8</td>
</tr>
<tr>
<td>stAt</td>
<td>9</td>
</tr>
<tr>
<td>iP</td>
<td></td>
</tr>
<tr>
<td>CAL.P</td>
<td>2</td>
</tr>
<tr>
<td>CAL</td>
<td>10</td>
</tr>
<tr>
<td>Pnt.L</td>
<td>11</td>
</tr>
<tr>
<td>OFS.L</td>
<td>12</td>
</tr>
<tr>
<td>Pnt.H</td>
<td>13</td>
</tr>
<tr>
<td>OFS.H</td>
<td>14</td>
</tr>
<tr>
<td>oP</td>
<td></td>
</tr>
<tr>
<td>OP.Hi</td>
<td>13</td>
</tr>
<tr>
<td>ACCS</td>
<td>14</td>
</tr>
</tbody>
</table>
```

### Key

<table>
<thead>
<tr>
<th>HL</th>
<th>Home List</th>
</tr>
</thead>
<tbody>
<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>
6.0 2132 Over-Temperature Controller Description (if fitted)

6.1 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.

6.2 Operation

6.2.1 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.
6.2.2 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 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 6.4.

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.

6.2.3 Over-Temperature Operation

Use down and up 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 twice view the present temperature as measured by the over-temperature controller. Press it twice, the first press shows the temperature units (°C).

6.2.4 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.

6.2.5 Resetting the Over-Temperature Alarm

To acknowledge the alarm press scroll and 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.

6.2.6 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.
6.3 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 6.2.

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

6.4 Navigation Diagram

![Navigation Diagram]

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

7.1 Switches - Control Panel

The main control switches are on the left hand side of the control panel (photo 3.1).

The Instrument Switch cuts off power to the controllers, other devices (including the fan) and heating circuit contactors.

7.2 General Operating Notes

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 13.0 towards the back of this manual.

When heating large objects, in particular poor conductors, avoid shielding the thermocouple from the heating elements. The thermocouple is intended to sense the temperature near the heating elements. However, if a large object is placed in the chamber it may record the average temperature of the object and the elements, this can lead to overheating of the elements. Allow large objects to gain heat at a lower temperature and then reset the controller to a temperature close to the desired maximum, or heat using a slowly controlled ramp rate. For more information refer to the controller instructions.

When heating materials that produce smoke or fumes, the chimney must be correctly fitted and unobstructed. If not, soot will accumulate in the chamber and could possibly cause an electrical breakdown of the heating element. If the furnace is used to heat
materials that emit smoke or fumes, regularly heat it up to maximum temperature for one hour with the chamber empty to burn away the soot.

The product has been designed for ashing items that containing no more than 40 g of carbon.

Baskets are provided with a loading handle. These can be used to load and unload the items being ashed. Make sure a safe surface is available, which must not be flammable, available to place the basket when unloading.

### 7.3 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.

| ![Warning Icon] | Do not open the product door during an ashing procedure as combustion will be taking place within the chamber. |

### 7.4 Temperature Control

Main controller Eurotherm 3216 P1 maximum temperature 800 °C. See controller instructions.

Afterburner controller Eurotherm 2132 maximum temperature 950 °C. See controller instructions.

Element over-temperature controller 2132. This controller is mounted inside the furnace and has a set temperature of 900 °C. This controller automatically switches off the elements when the element chamber gets to hot and then switches back on. The element over-temperature controller is fitted as additional protection for the heating elements. This over-temperature is self resetting and should not need any user adjustment. It is accessed by removing the back panel – see photo 3.5 below:
7.0 Operation

Photo 3.5
# 8.0 Maintenance

## 8.1 General Maintenance

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

## 8.2 Maintenance Schedule

<table>
<thead>
<tr>
<th>CUSTOMER QUALIFIED PERSONNEL</th>
</tr>
</thead>
</table>

### 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>Safety Switch Function</td>
<td>Set a safe temperature above ambient, and open the door to see if the heater light goes out</td>
<td>Blue</td>
</tr>
<tr>
<td>Safety Switch Function</td>
<td>Electrical measurement</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>Blue</td>
</tr>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Electrical measurement</td>
<td></td>
</tr>
<tr>
<td>Door Plug</td>
<td>Visual inspection, checking the seal and whether it is free of damage</td>
<td>Blue</td>
</tr>
<tr>
<td>Door Plug</td>
<td>Replacement where necessary</td>
<td></td>
</tr>
<tr>
<td>Chimney / Extraction</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>
</tbody>
</table>
## 8.0 Maintenance

<table>
<thead>
<tr>
<th>Operational Check</th>
<th>Thorough inspection and report incorporating a test of all functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Element Circuit</strong></td>
<td>Electrical measurement</td>
</tr>
<tr>
<td><strong>Power Consumption</strong></td>
<td>Measure the current drawn on each phase / circuit</td>
</tr>
<tr>
<td><strong>Hearth</strong></td>
<td>Visual check for fit and damage</td>
</tr>
<tr>
<td><strong>Cooling Fans (if fitted)</strong></td>
<td>Check whether the cooling fans are working</td>
</tr>
</tbody>
</table>
8.2.1 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.

8.3 Cleaning the Plenum Chamber & Fan Impeller
Remove the upper side access panel and the cover of the plenum chamber (see Fig 75. and Fig 76.). Clean out all accumulated soot and debris using a vacuum cleaner. Also clean any accumulated soot and debris from the fan impeller located at the back of the plenum chamber. If the accumulation of soot on the impeller is significant, it may be necessary to remove the motor/impeller assembly from the back of the plenum chamber to give good access for cleaning.

8.4 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.

8.5 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...
8.0 Maintenance

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.

8.6 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.

Please consult Carbolite Gero’s Sales Department for details of recommended spare parts.
9.0 Repairs and Replacements

9.1 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.

9.2 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.

9.3 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.

9.4 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 from its terminal block and withdraw the thermocouple
from its sheath by bending the metal tag or releasing the screw to release. It is also
advisable to remove the sheath and shake out any broken pieces of thermocouple.
Re-assemble with a new thermocouple, observing the colour coding, ensuring that the
thermocouple is not twisted as it is being inserted and that the metal tag is bent back to
grip the sheath.
Refit the element access panel.

9.5 Element Replacement

If the elements should need replacing a complete insulation assembly or a new
insulated chamber will be supplied.

9.6 Door Plug Replacement

Contact Carbolite Gero Service Department should this need replacing.
## 10.0 Fault Analysis

### A. Furnace Does Not Heat Up

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. The HEAT light is ON</strong></td>
<td>The heating element has failed</td>
<td>Check also that the SSR is working correctly</td>
</tr>
<tr>
<td><strong>2. The HEAT light is OFF</strong></td>
<td>The controller shows a very high temperature or code such as S.br</td>
<td>The thermocouple has broken or has a wiring fault</td>
</tr>
<tr>
<td></td>
<td>The controller shows a low temperature</td>
<td>The door switch(es) (if fitted) may be faulty or need adjustment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The contactor/relay (if fitted) may be faulty</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The heater switch (if fitted) may be faulty or need adjustment</td>
</tr>
<tr>
<td></td>
<td>There are no lights glowing on the controller</td>
<td>The SSR could be failing to switch on due to internal failure, faulty logic wiring from the controller, or faulty controller</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the supply fuses and any fuses in the furnace control compartment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The controller may be faulty or not receiving a supply due to a faulty switch or a wiring fault.</td>
</tr>
</tbody>
</table>
## B. Product Overheats

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Product only heats up when the instrument switch is ON</strong></td>
<td><strong>The controller shows a very high temperature</strong></td>
</tr>
<tr>
<td></td>
<td><strong>The controller shows a low temperature</strong></td>
<td><strong>The thermocouple may be faulty or may have been removed out of the heating chamber</strong></td>
</tr>
<tr>
<td></td>
<td><strong>The controller may be connected the wrong way around</strong></td>
<td><strong>The controller may be faulty</strong></td>
</tr>
<tr>
<td>2.</td>
<td><strong>Product heats up when the instrument switch is OFF</strong></td>
<td><strong>The SSR has failed &quot;ON&quot;</strong></td>
</tr>
</tbody>
</table>

## C. Furnace Slow to Heat Up

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>One of the Heat lights does not light up</strong></td>
<td><strong>A fuse may have blown</strong></td>
</tr>
<tr>
<td>2.</td>
<td><strong>The heat lights all light up</strong></td>
<td><strong>An element may have failed</strong></td>
</tr>
</tbody>
</table>
## D. Chimney Emits Smoke

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Some light smoke is emitted in the middle of the test</td>
<td>No fault</td>
</tr>
<tr>
<td>2.</td>
<td>Dense smoke is emitted</td>
<td>Set the secondary controller temperature to 900 °C</td>
</tr>
<tr>
<td></td>
<td>The after-burner chamber temperature may not be set high enough</td>
<td>Investigate or contact Carbolite Gero</td>
</tr>
<tr>
<td></td>
<td>The after-burner elements or control may have failed</td>
<td>Check the supply fuses</td>
</tr>
<tr>
<td></td>
<td>A fuse may have blown</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Load containing too much carbon has been loaded</td>
<td>Reduce the size of the load. set a much slower heating rate-see temperature control instructions</td>
</tr>
</tbody>
</table>
A full size wiring diagram is available on request. Please contact Carbolite Gero Service.
12.0 Fuses and Power Settings

12.1 Fuses
The following fuses are present:
Supply Fuses: 38 mm x 10 mm type F, 16 A - 6 total
Auxiliary Fuses 20 mm x 5 mm glass type F, 5 A

12.2 Customer Supply Fusing
High break capacity fuses should be used. Avoid fast-blow fuses and magnetic trip circuit breakers - consult Carbolite Gero if in doubt.
The supply fuse rating should be as follows:

<table>
<thead>
<tr>
<th>Phases/ Volts</th>
<th>Supply Fuse Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-phase with neutral, 380/220 V to 415/240 V</td>
<td>16 A per phase</td>
</tr>
</tbody>
</table>

12.3 Power Settings
The furnace control system incorporates electronic power control, including a "power limit" parameter that is used to reduce the effective voltage to 208 V (or 104 V); the values of the power limit for different voltages are as follows:

<table>
<thead>
<tr>
<th>ABF 8/28</th>
<th>Voltage</th>
<th>200 V</th>
<th>208 V</th>
<th>220 V/380 V</th>
<th>230 V/400 V</th>
<th>240 V/415 V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Power (%)</td>
<td>100</td>
<td>92</td>
<td>83</td>
<td>76</td>
<td>69</td>
</tr>
</tbody>
</table>

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

Carbolite Gero reserves the right to change the specification without notice.
Carbolite Gero model ABF 8/28, Afterburner Ashing Furnace.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height without Chimney</td>
<td>980 mm</td>
</tr>
<tr>
<td>Height with Chimney</td>
<td>1160 mm</td>
</tr>
<tr>
<td>Width</td>
<td>600 mm</td>
</tr>
<tr>
<td>Depth (length)</td>
<td>750 mm</td>
</tr>
<tr>
<td>Optional Stand</td>
<td>600 mm high</td>
</tr>
<tr>
<td>Weight</td>
<td>120 kg (approximately)</td>
</tr>
<tr>
<td>Power Rating</td>
<td>8000 Watts</td>
</tr>
<tr>
<td>Maximum Temperature</td>
<td>800 °C</td>
</tr>
</tbody>
</table>

13.1 Environment

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

Temperature: 5 °C - 40 °C

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

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

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