Installation, Operation and Maintenance Instructions
1200°C G-Range Tube Furnace - GVA Model: 450mm
2416 Controller

GVA 12/450 + 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.

1.0 Symbols and Warnings ........................................................................................................... 5
  1.1 Switches and Lights ............................................................................................................. 5
  1.2 General Warnings ............................................................................................................... 5

2.0 Installation ............................................................................................................................... 6
  2.1 Unpacking and Handling ..................................................................................................... 6
  2.2 Siting and Setting Up .......................................................................................................... 6
  2.3 Work Tubes and Fitting ....................................................................................................... 8
  2.4 Assembly of Tube Support ................................................................................................. 11
  2.5 Electrical Connections ....................................................................................................... 12
  2.6 Reconfiguring and Adjusting for Voltage ......................................................................... 14

3.0 2416 Controller ...................................................................................................................... 15
  3.1 Description ......................................................................................................................... 15
  3.2 Operation ........................................................................................................................... 17
  3.3 Programming ....................................................................................................................... 19
    3.3.1 Programming Tips ......................................................................................................... 19
    3.3.2 Multi-program model (2416P8) .................................................................................. 20
    3.3.3 Holdback ..................................................................................................................... 20
    3.3.4 Program Cycling .......................................................................................................... 20
    3.3.5 Running a Program ..................................................................................................... 20
    3.3.6 Program example ......................................................................................................... 21
  3.4 Controller Options ............................................................................................................... 22
    3.4.1 Digital Communications - RS232 .............................................................................. 22
    3.4.2 Digital Communications - RS485 .............................................................................. 22
    3.4.3 Comms Address ......................................................................................................... 22
    3.4.4 Alarm Option .............................................................................................................. 23
  3.5 Temperature Controller Replacement .............................................................................. 23
  3.6 Navigation Diagram ........................................................................................................... 24

4.0 2132 Over-Temperature Controller Description (if fitted) .................................................. 25
  4.1 Description ........................................................................................................................ 25
  4.2 Operation ........................................................................................................................... 25
    4.2.1 Controls ....................................................................................................................... 25
    4.2.2 Operation ................................................................................................................... 26
    4.2.3 Over-Temperature Operation ....................................................................................... 26
10.2 Power Settings ................................................................. 44
11.0 Specifications ............................................................... 45
11.1 Environment ................................................................. 45
1.0 Symbols and Warnings

1.1 Switches and Lights

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

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

1.2 General Warnings

DANGER – Electric shock. Read any warning printed next to this symbol.
WARNING: Risk of fatal injury.

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

DANGER – Read any warning printed next to this symbol.

Caution – Double Pole/Neutral Fusing
2.0 Installation

2.1 Unpacking and Handling

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

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

**NOTE:** This product contains Refractory Ceramic Fibre (also known as Alumino Silicate Wool - ASW). For precautions and advice on handling this material see section 7.2.

2.2 Siting and Setting Up

Place the product on a level surface in a well ventilated area.

Site away from other sources of heat and on a non-flammable surface that is resistant to accidental spillage or hot materials.

The surface on which the equipment is mounted should be stable and not subject to movement or vibrations.

The height of the mounting surface is important to avoid operator strain when loading and unloading samples.

Unless otherwise stated elsewhere in this manual, ensure that there is at least 150 mm of free space around the back and sides of the product. Clear space is required above the product to dissipate heat.

**Work tubes:**

It is recommended that the work tube has either insulation plugs or radiation shields fitted to minimise heat loss from both ends of the work tube. If the work tube has open ends, a significant amount of energy could be radiated from the ends of the work tube. Adjacent surfaces should always be made from a non-flammable material.

Ensure that the ends of the work tube are positioned at least 500 mm away from any adjacent surface so that any energy radiated cannot heat an adjacent surface to a dangerous temperature.
Ensure that the product is placed in such a way that it can be quickly switched off or disconnected from the electrical supply.
2.0 Installation

The full stand kit may be used in several combinations.
- Vertical use, bench or floor mounted: assemble the two long rails to the foot.
- Vertical/ horizontal: as above, add one wall bracket; the combination of foot and bracket makes the product body level in the horizontal position.
- Horizontal use only: the foot is not required; instead, a second bracket is fitted.
- Wall mounting: the same as horizontal use only: two rails and two brackets.
- No stand: mounting of the product is entirely at the customer’s discretion, but if the product is to be used at 1100 °C or more in a horizontal position, the face of the cylinder opposite the terminal cover should be uppermost. Failure to position this face uppermost can lead to high case temperatures and the customer may need to provide additional operator protection from hot surfaces.

- Horizontal with heavy tubes: the rails fix to the base and the horizontal tube supports to the rails.

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

2.3 Work Tubes and Fitting

Tubes of various diameters and lengths may be fitted.
Type C: minimum length for the product.
Type D: 400 mm longer than C, to allow for the fitting of end seals.
2.0 Installation

A pair of removable 'end adaptors' form part of the end insulation. These may be blank (no hole) or may have a hole to suit a work tube, depending on the customer order. Additional adaptors may be ordered to suit different work tube sizes. Check that the end adaptors are correct for the tube: if not, seek advice from Carbolite Gero. Small alterations to the hole in the adaptors may be made with a file, but first read the section on ceramic fibre safety 7.2. To insert a work tube it is often convenient to use a long pole (such as a broom handle) to guide it into the far end of the product.

For optimum temperature uniformity, insulating plugs should be placed in the tube ends as shown in fig.1. With a long work tube, the stem of the plug assembly should line up with the end of the tube as in fig.2. Alignment of radiation shields is similar to that of plugs.

For vertical models with stainless steel seals, a hook and eye arrangement holds the upper insulating plug assembly.

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

![Insulating Plug Diagram](image1.png)

**Fig 1 - Insulating Plug**
*(standard length tube)*

**Key**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Tube</td>
</tr>
<tr>
<td>B</td>
<td>Insulating Plug</td>
</tr>
<tr>
<td>C</td>
<td>Stem</td>
</tr>
</tbody>
</table>

![Insulating Plug Diagram](image2.png)

**Fig 2 - Insulating Plug**
*(long work tube)*
2.0 Installation

**Key**

<table>
<thead>
<tr>
<th>A</th>
<th>Clamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Seal plate</td>
</tr>
<tr>
<td>C</td>
<td>'O' Ring seal</td>
</tr>
<tr>
<td>D</td>
<td>Seal sleeve</td>
</tr>
<tr>
<td>E</td>
<td>Clamp seal</td>
</tr>
<tr>
<td>F</td>
<td>End plate</td>
</tr>
</tbody>
</table>

**Fig 3 'Twin Clamp' End Seal**

For assembly details refer to the separate work tube end seal manual.
2.4 Assembly of Tube Support

Slowly insert the work tube into the furnace until it protrudes equally through both ends and temporarily supports the tube in position.

Loosen the three screws on the end cap (image 2) and assemble the end guard ensuring the open side is facing the terminal cover.
2.0 Installation

Once the guard is in position, assemble the tube supports onto the same screws (image 4). Note: Ensure that the correct supports are used for the top and the bottom (Image 5 - top support, Image 6 - bottom support).

With the tube supports in position place the circlip over the work tube and the three tube supports (image 4).

When the circlip is in position, locate the end plug support into the slot on the end of the end plug tube (image 3). Carefully insert the end plug into the end of the tube until the tabs on either side of the tube support are located into the jubilee clip.

Now tighten the Jubilee clip enough to grip the tube and end plug supports. Care should be taken not to over-tighten as this may crack the tube as shown in image 4.

Repeat the process for the opposite end.

When both ends have been securely tightened, carefully remove the temporary support from the tube, ensuring that the tube is gripped at both ends.

2.5 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 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></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Blue</td>
<td>to neutral</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Green/ Yellow</td>
<td>to earth (ground)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supply</th>
<th>Terminal Label</th>
<th>Cable Colour</th>
<th>Supply Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>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>
2.6 Reconfiguring and Adjusting for Voltage

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

The product is wired according to the original order and conversion from 1-phase to 2-phase or 1-phase to 3-phase is not possible. To check for voltage setting within the appropriate range, or to change to another setting, follow the instructions in section 10.0.

Special Voltages

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

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

Products made for special voltages are generally not convertible between configurations and voltages.
3.0 2416 Controller

3.1 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.
3.0 2416 Controller

**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>
3.2 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 5.0 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>Purpose</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>
### 3.0 2416 Controller

<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>
<tr>
<td>Run &amp; Hold</td>
<td></td>
<td>Indicate the current mode: 'Run', 'Hold', or 'Reset' (Reset: both lights off). 'Run' flashes at the end of a program. 'Hold' flashes during holdback (when the program is paused to allow the temperature to catch up with a heating or cooling rate which is too fast).</td>
</tr>
<tr>
<td>Output Indicator</td>
<td></td>
<td>OP1 indicates that the programmer is calling for heat to be supplied. OP2 is not used.</td>
</tr>
<tr>
<td>SP2 and REM</td>
<td></td>
<td>Not generally used; indicate 'Second' or 'Remote' setpoint in use.</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.
### 3.3 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 \(\downarrow\) until 'ProG LiSt' is displayed.

Press scroll \(\uparrow\) to reveal the 'Holdback' and 'Loop Count' parameters. See sections 3.3.3 and 3.3.4 for a description of these.

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

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

Press scroll \(\downarrow\) 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>
<thead>
<tr>
<th>Segment Type</th>
<th>Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>RmP.r</td>
<td>TGttRATr</td>
<td>The target setpoint for this segment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The ramp rate (rate of temperature change) in °/ minute</td>
</tr>
<tr>
<td>RmP.t</td>
<td>TGtdur</td>
<td>The target setpoint for this segment</td>
</tr>
<tr>
<td></td>
<td></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>durt</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>tGtt</td>
<td>A new target temperature to be achieved as quickly as possible.</td>
</tr>
<tr>
<td>CaLL</td>
<td>PrGncyc.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''.</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>

#### 3.3.1 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 3.3.6.

3.3.2 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.

3.3.3 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.

3.3.4 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.

3.3.5 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 \( \text{\textsuperscript{\textregistered}} \) to access the 'Run' list page and scroll \( \text{\textsuperscript{\textregistered}} \) 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.

### 3.3.6 Program example

The following sequence of entries creates and runs the program.

1. Press page \( \text{\textsuperscript{\textregistered}} \) key until 'ProG LiSt' is displayed.
2. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'CYC.n' is displayed and use the arrow key to select 1.
3. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'SEG.n' is displayed and use the arrow key to select 1.
4. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'tYPE' is displayed and use the arrow key to select rmP.r.
5. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'tGt' is displayed and use the arrow key to select 600.
6. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'rAtE' is displayed and use the arrow key to select 5.0.
7. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'SEG.n' is displayed and use the arrow key to select 2.
8. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'tYPE' is displayed and use the arrow key to select dwEl.
9. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'dur' is displayed and use the arrow key to select 60.0.
10. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'SEG.n' is displayed and use the arrow key to select 3.
11. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'tYPE' is displayed and use the arrow key to select rmP.t.
12. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'tGt' is displayed and use the arrow key to select 400.
13. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'dur' is displayed and use the arrow key to select 60.0.
14. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'SEG.n' is displayed and use the arrow key to select 4.
15. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'tYPE' is displayed and use the arrow key to select 'dwEl'.
16. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'dur' is displayed and use the arrow key to select 30.
17. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'SEG.n' is displayed and use the arrow key to select 5.
18. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'tYPE' is displayed and use the arrow key to select rmP.r.
19. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'tGt' is displayed and use the arrow key to select 30.
20. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'rAtE' is displayed and use the arrow key to select 5.0.
21. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'SEG.n' is displayed and use the arrow key to select 6.
22. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'tYPE' is displayed and use the arrow key to select 'End'.
23. Press scroll \( \text{\textsuperscript{\textregistered}} \) until 'End.t' is displayed and use the arrow key to select 'dwEl'.
24. Press the page \( \text{\textsuperscript{\textregistered}} \) key until you return to the main display.
25. Press the 'Run' key. The program operates.
3.4 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.

3.4.1 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</th>
<th>RS232 Cable: product to PC</th>
<th>Computer end of cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>female (25-pin) 9-pin</td>
<td></td>
<td>9-pin (25-pin) male</td>
</tr>
<tr>
<td>Rx</td>
<td>(2)</td>
<td>3</td>
</tr>
<tr>
<td>Tx</td>
<td>(3)</td>
<td>2</td>
</tr>
<tr>
<td>Com</td>
<td>(7)</td>
<td>5</td>
</tr>
</tbody>
</table>

3.4.2 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</th>
<th>RS485 Cable: product to PC</th>
<th>Computer end of cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>female (25-pin) 9-pin</td>
<td></td>
<td>9-pin (25-pin) female</td>
</tr>
<tr>
<td>-</td>
<td>(2)</td>
<td>3</td>
</tr>
<tr>
<td>+</td>
<td>(3)</td>
<td>2</td>
</tr>
<tr>
<td>Com</td>
<td>(7)</td>
<td>5</td>
</tr>
</tbody>
</table>

3.4.3 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.
3.4.4 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 indicated:

![Alarm Option Diagram]

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Temperature Controller</td>
</tr>
<tr>
<td>F</td>
<td>Fuse (2A)</td>
</tr>
<tr>
<td>S</td>
<td>Supply</td>
</tr>
<tr>
<td>L</td>
<td>Load</td>
</tr>
<tr>
<td>RO</td>
<td>Normally open relay contacts</td>
</tr>
<tr>
<td>RO</td>
<td>Relay Output 240V 2A MAX</td>
</tr>
</tbody>
</table>

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.

3.5 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.
4.0 2132 Over-Temperature Controller Description (if fitted)

4.1 Description

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

4.2 Operation

4.2.1 Controls

Most Carbolite Gero products are fitted with an instrument switch which cuts off power to the controller and other parts of the control circuit. To operate the controller, power must be supplied to the product and the instrument switch must be on. If a time switch is included in the product circuit, this must be in the 'ON' position.

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

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

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

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

A single press of the page key  displays the temperature units, normally set to °C; further presses reveal the lists indicated in the navigation diagram. See section 4.4.

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

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

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

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

4.2.3 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).

4.2.4 Over-Temperature Alarm

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

4.2.5 Resetting the Over-Temperature Alarm

To acknowledge the alarm press scroll  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.

4.2.6 Sensor Break

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

If an audible alarm is supplied for use with the over-temperature controller, it is normally configured to sound on over-temperature condition and to stop sounding when the alarm is acknowledged as given in section 4.2.

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

4.4 Navigation Diagram

<table>
<thead>
<tr>
<th>HL</th>
<th>Home List</th>
<th>Page Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTSP</td>
<td>Over-Temperature Setpoint</td>
<td>Scroll Key</td>
</tr>
<tr>
<td>AL</td>
<td>Access List</td>
<td>For factory access to list and parameters not available to the operator.</td>
</tr>
</tbody>
</table>

Black = Progress

Dashed = Through to other options
5.0 Operation

5.1 Operating Cycle

This product is fitted with an instrument switch which cuts off power to the control circuit.

Connect the product to the electrical supply.

Turn on the instrument switch to activate the temperature controllers. The controllers illuminate and go through a short test cycle.

**Over-Temperature option only.** If the digital over-temperature option has not yet been set as required, set and activate it according to the over-temperature controller instructions.

Switch on the heater switch, located on the instrument panel. Unless a time switch is fitted and is switched off, the product will start to heat up. The Heat light(s) glow steadily at first and then flash as the product approaches the desired temperature or a program setpoint.

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

To switch off power to the heating elements, use the heater switch. To switch the product off, use both the heater switch and the instrument switch. If the product is to be left switched off and unattended, isolate it from the electrical supply.

5.2 General Operating Advice

Heating element life is shortened by overheating. Do not leave the product at high temperature when it is not required. The maximum temperature is shown on the product rating label and in section 11.0 towards the back of this manual.

Lightweight ceramic fibre insulation can easily be marked by accidental contact. Some fine cracks may develop in the surface of the insulation due to the progressive shrinkage of the insulation materials. Cracks are not usually detrimental to the functioning or the safety of the product.

Clean up any spillages in the insulation, as these can increase the rate of degradation of the insulation material.
5.3 Operator Safety

The ceramic materials used in the product manufacture become electrically conductive to some extent at high temperatures. DO NOT use any conductive tools within the product without isolating it. If a metal work tube is used, it must be earthed (grounded).

Switch off the heater switch whenever loading or unloading the product. The elements are isolated when the heater switch is OFF. This switch cuts both sides of the circuit via a contactor.

5.4 Tube Life

A ceramic work tube may crack if work pieces are inserted too quickly or at temperatures below 900 °C (when the tube is more brittle). Large work pieces should also be heated slowly to ensure that large temperature differences do not arise.

Poor thermal contact should be encouraged between the work piece and the tube; crucibles or boats should be of low thermal mass and should have feet to reduce the contact with the tube (fig. 4).

Do not set too high a heating or cooling rate. As tubes are susceptible to thermal shock and may break. Tubes which extend beyond the heated part of the furnace are more at risk. A general rule for maximum heating or cooling rate is 400 ÷ internal diameter in mm to give (°C/ min); for 75 mm i/ d tubes this comes to 5 °C per minute. The controller can be set to limit both the heating and cooling rate.

5.5 Pressure

Work tubes are not able to accept high internal pressure. When gas seals or similar fittings are in use, the gas pressure should be restricted to a maximum of 0.2 bar (3 psi). A pressure of approximately half of that should normally be sufficient to achieve the desired flow rate. The operator must ensure that the exhaust path from the tube is not blocked, so that excess pressure does not occur.

A suitably regulated gas supply should always be used.
5.0 Operation

It is recommended that a pressure relief system should be used to avoid an over pressurisation of the work tube.

Please note: A product should not be heated up if any valves that have been fitted are closed to create a sealed volume. A sealed work tube should not be heated from cold due to the pressure increase caused by the trapped air or gas expanding during the heating process.

5.6 Gas Tightness

Work tubes of IAP material are impervious. Sillimanite may look similar but is porous. Ensure that the correct tube material is in use before connecting and using gases other than inert gases, such as nitrogen.

5.7 Running at Low Temperatures

The power limit may be adjusted to a low level in order to achieve better control when operating the product at a low temperature. Before changing the power limit, record the default settings for possible future use. Refer to the Power Settings section of this manual for default power limits. If the product fails to reach the desired temperature, refer to the Temperature Controller and Fault Analysis sections.
## 6.0 Maintenance

### 6.1 General Maintenance

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

### 6.2 Maintenance Schedule

![CUSTOMER QUALIFIED PERSONNEL]

---

<table>
<thead>
<tr>
<th>Safety Procedure</th>
<th>Method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Set an over-temperature setpoint lower than the displayed temperature and check for an over-temperature alarm as detailed in this manual</td>
<td></td>
</tr>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Electrical measurement</td>
<td></td>
</tr>
<tr>
<td>Safety Switch Function (split models only)</td>
<td>Set a safe temperature above ambient, and open the furnace to see if the heater light goes out</td>
<td></td>
</tr>
<tr>
<td>Safety Switch Function (split models only)</td>
<td>Electrical measurement</td>
<td></td>
</tr>
<tr>
<td>Electrical Safety (external)</td>
<td>Visual check of external cables and plugs</td>
<td></td>
</tr>
<tr>
<td>Electrical Safety (internal)</td>
<td>Physically check all connections and cleaning of the power plate area</td>
<td></td>
</tr>
</tbody>
</table>

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

---

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

<table>
<thead>
<tr>
<th>Component</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seals (if fitted)</td>
<td>Check all seals and O-rings and clamps</td>
</tr>
<tr>
<td>Performance</td>
<td></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>Cooling Fans (if fitted)</td>
<td>Check whether the cooling fans are working</td>
</tr>
</tbody>
</table>
6.2.1 Cleaning
Soot deposits may form inside the furnace, depending on the process. At appropriate intervals remove these by heating as indicated in the General Operation Notes.

The product’s outer surface may be cleaned with a damp cloth. Do not allow water to enter the interior of the case or chamber. Do not clean with organic solvents.

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

6.4 After-Sales Service
Carbolite Gero Service has a team of Service Engineers who can offer repair, calibration and preventive maintenance of furnace and oven products both at the Carbolite Gero factory and at customers’ premises throughout the world. A telephone call or email often enables a fault to be diagnosed and the necessary parts to be despatched.
In all correspondence please quote the serial number and model type given on the rating label of the product. The serial number and model type are also given on the back of this manual when supplied with the product.
Carbolite Gero Service and Carbolite Gero contact information can be found on the back page of this manual.

6.5 Recommended Spare Parts and Spare Parts Kit
Carbolite Gero can supply individual spare parts or a kit of the items most likely to be required. Ordering a kit in advance can save time in the event of a breakdown.
Each kit consists of one thermocouple, one solid state relay and a heating element of each wattage (normally 2 elements, but 1 in the case of model -/300).
When ordering spare parts please quote the model details: model type and serial number.
7.0 Repairs and Replacements

7.1 Safety Warning - Disconnection from Power Supply

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

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

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

7.2 Safety Warning - Refractory Fibre Insulation

**Insulation made from High Temperature Insulation Wool**

**Refractory Ceramic Fibre, better known as (Alumina silicate wool - ASW).**

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

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

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

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

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

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

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

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

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

7.3 Temperature Controller Replacement

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

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

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

7.5 **Thermocouple Replacement**

For vertical models it may be necessary to dismount the furnace from its stand and remove the terminal cover.

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

Thermocouple cable colour codings are:

<table>
<thead>
<tr>
<th>thermocouple leg</th>
<th>colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>positive (type N)</td>
<td>pink</td>
</tr>
<tr>
<td>negative</td>
<td>white</td>
</tr>
</tbody>
</table>

Disconnect the thermocouple from its terminal block.

Carefully withdraw the thermocouple from the product and remove any broken bits of thermocouple.

Bend the new thermocouple carefully to match the shape of the original (working from the terminal end). Should the length differ from that of the original this is usually not important provided that the thermocouple tip is within a work tube diameter's distance from the furnace centre.

Insert the new thermocouple into position, restoring any removed porcelain spacers and ensuring correct polarity.

Re-assemble the furnace.
7.6 Element Replacement

See section 7.2 - wearing a face mask is required.

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

Disconnect all electrical leads from the terminal blocks on the product case. Note the colours and positions of the connecting leads to enable correct reassembly. Take care not to crack porcelain terminal blocks - use two spanners where appropriate.

Remove the thermocouple(s).

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

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

Check the cylindrical case and clean out as appropriate.

Remove any insulation sleeving from the tails of the old element and fit to the replacement element.

Slide in the new element(s). Close up the product again, refitting the terminal strip and the end-caps. Any cut made in the insulation should close up completely: if the insulation appears loose or damaged in any way, please contact the Carbolite Gero Service.

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

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

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

Check that the product is controlling properly to rule out the possibility that the element failed because of a fault in the control system.

If you have any problems with this procedure, please contact the Carbolite Gero Service.
7.7  Fuse Replacement

Fuses are marked on the wiring diagram with type codes, e.g. F1, F2. For more information on fuses refer to section 10.0.

*Depending on model and voltage, the different fuse types may or may not be fitted.*

If any fuse has failed, it is advisable for an electrician to check the internal circuits.

Replace any failed fuses with the correct type. For safety reasons do not fit larger capacity fuses without first consulting Carbolite Gero.

The fuses are located at the cable entry point. Remove the back panel or control box back panel to gain access to the fuses.
### A. Furnace Does Not Heat Up

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The HEAT light is ON</td>
<td>The heating element has failed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check also that the SSR is working correctly</td>
</tr>
<tr>
<td>2.</td>
<td>The HEAT light is OFF</td>
<td>The controller shows a very high temperature or code such as S.br</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The 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>
### 8.0 Fault Analysis

#### B. Product Overheats

<table>
<thead>
<tr>
<th></th>
<th>Product only heats up when the instrument switch is ON</th>
<th>The controller shows a very high temperature</th>
<th>The controller is faulty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The controller shows a low temperature</td>
<td>The thermocouple may be faulty or may have been removed out of the heating chamber</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The thermocouple may be connected the wrong way around</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The controller may be faulty</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Product heats up when the instrument switch is OFF</th>
<th>The SSR has failed &quot;ON&quot;</th>
<th>Check for an accidental wiring fault that could have overloaded the SSR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9.0 Wiring Diagrams

9.1 WA-11-31

Connections below show single phase with safety switches and over-temperature control.

![Wiring Diagram](image)

**Key**
- F1, F2, F3: Fuses
- FIL: Filter
- R1/1, R1/2: Relay Contactors
- R1: Relay
- C: Temperature Controller
- OT: Over-Temperature Controller
- OTC: Over-Temperature Thermocouple
- TC: Control Thermocouple
- SSR: Solid State Relay
- SSW: Safety Switch
- H: Heat Lamp
- EL: Element(s)
- SW: Instrument Switch(es)
- N: Neutral
- L: Live
- PE: Earth
- *: If Fitted

**Cables**
- BU: Blue
- R: Red
- GR/Y: Green + Yellow
- G: Grey
- P: Pink
9.2 WA-U3-31

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

![Wiring Diagram for WA-U3-31](image-url)

**Single Phase Connections**

**Delta Connections**

See below for other configurations.
Products with this wiring arrangement may be converted between the following supply voltages (please refer to the table within section 10.0 for compatible phases with the product):

- 3-phase + neutral in the range 380/220 V - 415/240 V
- 3-phase delta in the range 220 V - 240 V
- Single phase in the range 220 V - 240 V
- 208 V model: can be converted between 208 V delta and 208 V 1-phase

Please contact Carbolite Gero Service for details.
### 10.0 Fuses and Power Settings

#### 10.1 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></td>
<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>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Phases</th>
<th>Volts</th>
<th>Supply Fuse Rating (Amps) F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>GVA 12/450</td>
<td>1-phase</td>
<td>200-208</td>
<td>16 A</td>
</tr>
<tr>
<td>GVA 12/450</td>
<td>1-phase</td>
<td>220-240</td>
<td>16 A</td>
</tr>
<tr>
<td>GVA 12/450</td>
<td>3-phase +N</td>
<td>380-415</td>
<td>6 A/ph</td>
</tr>
</tbody>
</table>
10.2 Power Settings

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

All standard models covered by this manual are fitted with elements designed for use over the range of voltages 200 V-240 V; the power limit parameter is set according to the table below.

<table>
<thead>
<tr>
<th>Voltage</th>
<th>200 V</th>
<th>208 V</th>
<th>220 V</th>
<th>230 V</th>
<th>240 V</th>
<th>380 V</th>
<th>400 V</th>
<th>415 V</th>
<th>440 V</th>
<th>480 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>100</td>
<td>100</td>
<td>89</td>
<td>82</td>
<td>75</td>
<td>90</td>
<td>97</td>
<td>75</td>
<td>67</td>
<td>56</td>
</tr>
</tbody>
</table>

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

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

All models have cylindrical elements with wire formed in the surface of the insulation material.

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

All models have a maximum operating temperature of 1200 °C (1100°C continuous).

<table>
<thead>
<tr>
<th>Model</th>
<th>Max Temp (°C)</th>
<th>Max Power (kW)</th>
<th>Minimum Work Tube Length (mm)</th>
<th>Heated Length (mm)</th>
<th>Type C Work Tube</th>
<th>Type D Work Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>GVA 12/450</td>
<td>1200</td>
<td>3.1</td>
<td>650</td>
<td>450</td>
<td>750</td>
<td>1050</td>
</tr>
</tbody>
</table>

11.1 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
<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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</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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**Carbolite Gero Ltd,**
Parsons Lane, Hope, Hope Valley, S33 6RB, England.
Telephone: + 44 (0) 1433 620011
Fax: + 44 (0) 1433 621198
Email: Info@carbolite-gero.com
www.carbolite-gero.com

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