CARBOLITE GERO

30-3000°C

CDHT 450 + 3216 Controller

part of **VERDER** scientific

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

1.1   Switches and Lights

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

1.2   General Warnings

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

WARNING: Risk of fatal injury.

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

WARNING: All surfaces of a product may be hot.

DANGER – Read any warning printed next to this symbol.

Caution – Double Pole/Neutral Fusing

2.0 Installation

2.1 Unpacking and Handling

When unpacking or moving the product, always lift by its base; do not use the door or any other projecting cover or component to support the equipment when moving it. Use a fork lift or pallet truck to move the product; position the product on a level surface and use an adequate number of personnel to safely move the product into position.

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

Locate the shelves as required.

Some models may be lifted by fitting lifting bolts to captive threads which are fitted in the top of the case, whilst others may have welded on lifting eyes.

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.
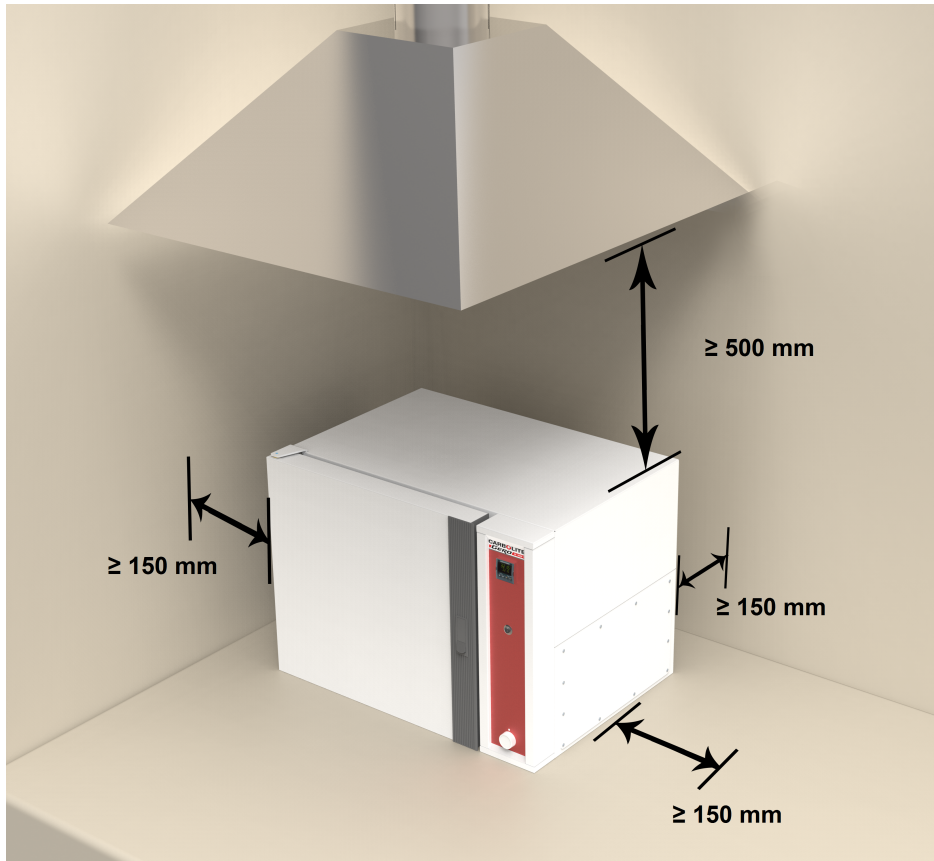
Depending on the application of the product, it may be appropriate to position it under an extraction hood. Ensure the extraction hood is switched on during use.

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

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

2.3   Electrical Connections

Connection by a qualified electrician is recommended.

The product covered by this manual usually requires a single phase A.C. supply, which may be Live to Neutral non-reversible, Live to Neutral reversible or Live to Live. Some models may be ordered for 3-phase use, which may be star or delta.

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

A table of the most common fuse ratings is also given in section 8.0 towards the back of this manual. Ensure that the correct fuse is used for the product supplied. When the mains cable is factory fitted internal fuses are also fitted. Customer fusing is essential.

Product with supply cable: either wire directly to an isolator or fit with a line plug.

Product without supply cable: a permanent connection to a fused and isolated supply should be made to the internal terminals after temporary removal of the product access panel. The access panel is located at the top of the 'A' models and the right hand side of the 'B' models.

Connection by line plug: the plug should be within reach of the operator and should be easy to remove.

Connection to isolating switch: this should operate on both conductors (single phase) or on all live conductors (three phase), and should be within reach of the operator.

The electrical supply MUST incorporate an earth (ground).

Electrical Connection Details:

Supply	Terminal Label	Cable Colour	Supply Types	
			Live - Neutral	Reversible or Live-Live
1-phase	L	Brown	to live	to either power conductor (For USA 200-240V, connect L1)
	N	Blue	to neutral	to the other power conductor (For USA 200-240V, connect L2)
	PE	Green/ Yellow	to earth (ground)	to earth (ground)

3-phase	L1	Black	to phase 1	
	L2	Black	to phase 2	
	L3	Black	to phase 3	
	N	Light Blue	to neutral (**except delta**)	
	PE	Green/ Yellow	to earth (**ground**)	

DO NOT connect a product ordered for three phase use to a single phase supply or to the wrong type of three phase supply.

3.0   3216 Controller

3.1   PID control

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

3.2   3216P1

The 3216P1 is a digital temperature controller which uses PID algorithms to give excellent temperature control. This controller can store and operate a single program of 8 ramp/ dwell segments. The 3216P1 can also be used as a simple temperature controller.

3.3   3216P5

The 3216P5 is a digital temperature controller which uses PID algorithms to give excellent temperature control. This controller can store up to 5 programs of 8 ramp/ dwell segments. The 3216P5 can also be used as a simple temperature controller.

3.4   Operation

3.4.1   Controller Layout

Key	
A	Power Output Indicator
B	Alarm Indicator
C	Remote Indicator (when configured)
D	Page
E	Scroll
F	Down
G	Up
H	Run Indicator
I	Hold Indicator
J	Setpoint Temperature (SP)
K	Measurement Temperature

3.4.2 Keys

Page Key	🗎	The page key is used to access level 2 when held down for 3 seconds.
Scroll Key	🗗	The scroll key is used to scroll through parameters.
Ack Page and Scroll	🗎 + 🗗	When pressed simultaneously the ACK function is used to: • Return to the Home Menu • Acknowledge an alarm if activated. • Reset a program after the program has ended.
Arrow Keys	▲ + ▼	The arrow keys are used individually to adjust the selected parameters and in combinations to operate a program.

Note: If a parameter is selected and no further action is taken, the display will time out and revert back to the home display in its working level after approximately 1 minute.

3.5   Quick Start Guide

3.5.1   Operation as a simple controller

When switched on, the controller goes through a short test routine and then shows the measured temperature (PV = Process Value) in the upper part of the display and below it, the desired temperature (Setpoint).

3.5.2   Changing the Setpoint

Press Up ▲ or Down ▼ to select the required SP. If the SP is higher than the measured temperature, the OP1 indicator will illuminate in the top left corner of the display, indicating that the controller is calling for power (giving an output).

The controller will immediately attempt to reach the setpoint and then maintain it.

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

3.5.3   Using the Controller

The parameters in the controller are first shown by a short code (mnemonic). After 5 Seconds a description of the parameter will scroll once along the display and then revert back to the mnemonic. The scrolling text can be interrupted at any time by a single press of any of the buttons, but will not scroll again until the parameter is returned to.

In this manual the mnemonic will be shown first, followed by the scrolling text in brackets; e.g. PROG <PROGRAM NUMBER>

3.5.4   Understanding User Levels

There are two user levels in the controller; Level 1 (Operator) and Level 2 (Supervisor).

Level 1 (Operator) is for the day to day operation of the controller. These parameters are not protected by a security code.

Level 2 (Supervisor) provides access to additional parameters. Access to this level protected by a security code

To Enter Level 2

1. Press and hold the page key ⬛ for 3 seconds.

2. The display will show LEu 1 GOTO

3. Release the page Key

4. Press the up ▲ or down ▼ to choose LEu 2 (level 2)

5. Press the up ▲ or down ▼ to enter the code (Level 2 Code = 9).

If the correct code is entered, PASS should momentarily be displayed and then revert to the level 2 home display.

If an incorrect code is entered the display reverts back to Level 1 home display.

When level 2 operations have been completed, the supervisor must return to Level 1 either manually or by switching the instrument off and back on. There is no time out function.

To Return to Level 1

1. Press and hold the page Key ⬛

2. Press down ▼ to select LEu 1

It is not necessary to enter a code when going from a higher level to a lower level. When level 1 is selected, the display reverts to the home display (See Controller Layout)

Table showing parameters accessible in level 1 and Level 2

Operator LEVEL 1	Supervisor LEVEL 2
home display	home display
Programming	Programming
Program Status	Program Status
	Alarms (if configured)
	Current Transformer Input (if configured)
	Comms (if configured)
	Controller Setup
	Customer Calibration

TIP

If while navigating the controller, a parameter has been passed or you need to access parameters which would be at the end of a scroll list, press and hold scroll ⎗ and use up ▲ to return to a previous parameter.

3.6   Setting up the Controller

Before using the controller (or during its lifetime) certain parameters may have to be set, depending on specific requirements. To do this the controller must be set to supervisor level (Level 2).

3.6.1   Maximum Output Power

Press scroll ⎗ until the display shows OP.HI <OUTPUT HIGH>. Use the up ▲ and down ▼ keys to select the output power required as a percentage. Once the setting is made, turn the instrument switch off and on to power cycle the temperature controller.

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

For silicon carbide heated furnaces, the parameter is accessible to allow compensation for element ageing.

In many models the maximum output power setting depends on the supply voltage, see section 8.0.

3.6.2   Customer ID

A furnace or oven identification number can be entered if required. This maybe used to identify one of many units for production or quality control systems.

Press scroll ⎗ until the display shows ID <CUSTOMER ID>. Use the up ▲ and down ▼ keys to enter your own identification number. This can range from 1-9999.

3.6.3   Units

Press scroll ⎗ until the display shows UNITS <DISPLAY UNITS>. Use the up ▲ or down ▼ keys to select the required units.

Mnemonic	Description
NONE	No units (Default °C)
°C	Celsius
°F	Fahrenheit
°K	Kelvin
PERC	% (shows °C value)

3.6.4   Language

The scrolling text on the 3216 can be shown in different languages, this can only be set at the factory and therefore must be specified at the time of placing an order.

3.6.5   Scrolling Text

If at any time the scrolling text is not required.

Press and hold the page 🖿 for three seconds until "GOTO" is displayed.

Press scroll 🕒 until the display shows. TEXT <ENABLE/ DISABLE SCROLLING TEXT>
Use the up ▲ and down ▼ keys to select ON or OFF.

3.6.6   Customer Calibration

The 3216 Controller series are calibrated for life at manufacture, there may however be sensor or other system errors, which affect the accuracy of the measured temperature. Customer calibration can be used to compensate for these errors.

Dual Offset

Dual point calibration uses two offset values at two corresponding temperatures; this changes the calibration linearly as the temperature increases or decreases.

Press scroll 🕒 until the display shows CAL.P (Enter Calibration Code) Use the up ▲

down ▼ keys to enter the password code. (Calibration Pass Code = 95). When the correct password has been entered the display will show PNT.LO. If the wrong pass code is entered the display will revert to zero pass code, until the correct pass code is entered.

When the correct pass code is entered and PNT.LO (Adjust Low Point) is displayed. Use

the up ▲ and down ▼ keys to enter the Low Temperature Point, which you want to apply an Offset.

Press scroll 🕒 until the display shows OFS.LO (Adjust Low OFFset). Use the up ▲ and

down ▼ keys to enter the amount Offset you want to apply to the Low Temperature Point.

Press scroll 🕒 until the display shows PNT.HI (Adjust High Point). Use the up ▲ and down ▼ keys to enter the High Temperature Point, which you want to apply an Offset.

Press scroll 🕒 until the display shows OFS.HI (Adjust High OFFset). Use the up ▲ and down ▼ keys to enter the amount Offset you want to apply the High Temperature

Point.

Once the calibration details have been entered, press scroll 🕒 until the display shows the next required parameter or return to the home list. The calibration data will now be protected by the pass code. To edit the data the above procedure must be followed.

Single Offset

If a constant offset is required across the temperature range, set the required "High Point" (PNT.HI) and "Low Point" (PNT.LO) to the required values (not the same), then set the "low Offset" (OFS.LO) and "High Offset" (OFS.HI) to the same value.

Caution! - Do not make PNT.LO and PNT.HI the same value as the controller will not work correctly and could cause the product to overheat.

3.6.7   Holdback

If the temperature ramp rate of the program is quicker than the product can achieve, the program will wait until the temperature of the product catches up.

e.g. If a holdback value of 10 is set and the program is set to ramp to a setpoint of 600 °C, the program will reach 600 °C, then go into a hold state; the hold indicator will light until the product temperature reaches 590 °C, the program will then continue to control again.

The holdback will only apply once per segment, therefore when control has been re-established, the holdback will not apply again to that segment, even if the product temperature goes outside the holdback band.

Holdback can only be accessed in supervisor level (level 2) by scrolling with the scroll

until the display shows H.BACK <PROGRAM HOLDBACK>: Use the up ▲ and down ▼ keys to select the required Holdback value.

If a multi programmer is used, each program can have its own holdback value assigned to it.

Note: When a holdback is set, each segment used must have a Ramp Rate assigned to it, in order for it to be recognised by the program.

3.7   Programming

3.7.1   Creating a Program

Programs can be created in level 1 or level 2 of the 3216P1 and 3216P5. Each program contains 8 Ramp/ Dwell pairs.

> Note: A currently active program cannot be altered. Go into 'Reset' mode before starting to create or modify a program

3.7.2   Program Number (3216P5 Only)

Press scroll ⎇ until the display shows PROG <PROGRAM NUMBER.> Select the program number.

3.7.3   Ramp Units

Press scroll ⎇ until the display shows RAMP.U <Ramp Units>: Use the up ▲ down ▼ to select the Ramp Units of Hour, Min or Seconds.

3.7.4   Dwell Units

Press scroll ⎇ until the display shows DWEL.U <Dwell Units>: Use the up ▲ down ▼ to select the Dwell Units of Hour or Min.

3.7.5   Holdback

see section 3.6. Press scroll ⎇ until the display shows H.BACK <Program Holdback>: If a holdback value is required, use the up ▲ down ▼ to enter the required value or select "OFF" if no holdback is required.

3.7.6   Ramp Rate

Press scroll ⎇ until the display shows RMP.1 <Ramp Rate 1>: Using the up ▲ down ▼ enter the value for the first ramp rate depending on the Ramp Units selected. If the Ramp segment is not required select "OFF".

3.7.7   Target Setpoint

Press scroll ⎇ until the display shows T.SP 1 <Target SP 1>: Enter the temperature that you want the product to ramp up to using "Ramp rate 1".

If "Ramp Rate 1" has been set to "OFF". The product will Heat/ Cool directly to the Target SP.

3.7.8   Dwell Time

Press scroll ⎇ until the display shows DWELL. 1 <DWELL TIME 1>: Enter the time to dwell at "Target SP 1". If the dwell segment is not required, use the down ▼ to select OFF, which is below the Zero value.

This Process is repeated for each of the 8 segments of the program.

If not all the segments are used for a program, the Ramp & Dwell of each of the subsequent segments should be set to OFF.

A program will end in one of two ways, either revert to the control setpoint or dwell at the temperature set in the last segment used. When a program finishes on a dwell and the dwell time expires the temperature will revert to the control setpoint.

> Note: Before operating a program ensure that the control setpoint is set to Zero to avoid unexpected heating at the end of the program.

3.7.9   Running a Program

If using the 3216P5 controller press scroll ⎙ to display PROG <PROGRAM NUMBER>. Select the required Program Number before operating a Program.

Table below shows the key presses to operate a program.

Operation	Action	Indication
To RUN a program	Press and quickly release ▲ + ▼	Indicator – RUN = ON Scrolling Display – Current Program state
To HOLD a program	Press and quickly release ▲ + ▼	Indicator – RUN = Flashing Scrolling Display – Program Hold
To RESET a program	Press and hold ▲ + ▼ for more than 1 second	Indicator – RUN = OFF Scrolling Display - None
	Program Ended	Indicator – RUN = OFF Scrolling Text – Program End
To RESET a program after it has completed	Press and hold ▲ + ▼ for more than 1 second or press and quickly release Ack ⎙	Indicator – RUN = OFF Scrolling Display - None

3.7.10   Program Status

While the program is operating in level 1 or level 2, the home display shows two values at any one time:

3.7.11   Process Value

The upper display shows the current temperature of the product.

3.7.12   PSP, Segment Type and Number

The lower display continually alternates between the programs current set value (Program SP = PSP) and scrolling text, indicating the current status of the program whether RAMP or DWELLING followed by the segment number.

Additional information can be obtained using the scroll ⎙ key while the program is operating.

Working Output Power

From the home display, press scroll ⊔ until the display shows WRK.OP <WORKING OUTPUT POWER>. This shows the power being used as a percentage.

Time Remaining

Press scroll ⊔ until the display shows T.REMN <TIME REMAINING>. This shows the dwell time remaining for the current segment. There is no value for "Ramp Time Remaining" therefore when the program is ramping the dwell time set will be shown and will only begin to count down when the ramp has finished.

Program Review

Further presses of scroll ⊔ will reveal the settings of the current program operating. These parameters are locked, while the program is operating.

Program Hold with Holdback

If a holdback value has been set (see section 3.6) and the program goes into a hold state, the red "HLD" indicator will light, until the current temperature catches up.

If while in this condition the program itself is put into "Hold" by pressing the up ▲, down ▼ together, the "HLD" indicator will turn off and the "Run" indicator will flash, indicating the program is on hold. When the program is started again by pressing the up ▲, down ▼ together, the "Run" indicator will stop flashing and show continually and the "HLD" indicator will light, if the current temperature has not caught up with the program.

Power Failure

If there is a power failure while the program is operating and the power is subsequently restored, the scrolling text will read <POWER FAIL - PROGRAM RESET>.

Press the "ACK" function to acknowledge this message, press the "ACK" function again to reset the program.

Alarms

Alarms are used to alert the operator when a pre-set level has been exceeded or a function error has occurred such as a sensor break. They are indicated by a scrolling message on the display and a flashing red ALM (Alarm) indicator. The alarm may also switch an output – usually a relay to allow external devices to be operated when an alarm occurs. Alarms only operate if they have been configured and are dependent on customer requirements.

How to acknowledge an alarm will depend on the type of latching which has been configured. A non-latched alarm will reset itself when the alarm condition is removed. A latched alarm requires acknowledgement with the "ACK" function before it is reset.

If an alarm has been activated the red "ALM" indicator will light and the scrolling text will indicate the type of alarm.

To acknowledge an alarm and cancel the "ALM" indicator, press "ACK" function.

> Note: The alarm indicator may seem to be permanently on when viewed from above. When an alarm is active the indicator should only be flashing, to confirm this, the controller must be viewed directly from the front.

Program Example

The following sequence of entries creates and runs the program shown graphically below.

1. Press scroll ⤸ until the display shows RAMP.U <SP RAMP UNITS>. Select MIN.
2. Press scroll ⤸ until the display shows DWELL.U <DWELL UNITS>. Select MIN.
3. Press scroll ⤸ until the display shows RMP.1 <RAMP RATE 1>. Select 5
4. Press scroll ⤸ until the display shows T.SP1 <TARGET SP 1>. Select 600
5. Press scroll ⤸ until the display shows DWEL.1 <DWELL TIME 1>. Select 30
6. Press scroll ⤸ until the display shows RMP.2 <RAMP RATE 2>. Select 4
7. Press scroll ⤸ until the display shows T.SP2 <TARGET SP 2>. Select 400
8. Press scroll ⤸ until the display shows DWEL.2 <DWELL TIME 2>. Select 30
9. Press scroll ⤸ until the display shows RMP.3 <RAMP RATE 3>. Select OFF
10. Press scroll ⤸ until the display shows T.SP3 <TARGET SP 3>. Select 600
11. Press scroll ⤸ until the display shows DWEL.3 <DWELL TIME 3>. Select 60
12. Press scroll ⤸ until the display shows RMP.4 <RAMP RATE 4>. Select 3
13. Press scroll ⤸ until the display shows T.SP4 <TARGET SP 4>. Select 800
14. Press scroll ⤸ until the display shows DWEL.4 <DWELL TIME 4>. Select OFF
15. Press scroll ⤸ until the display shows RMP.5 <RAMP RATE 5>. Select 5
16. Press scroll ⤸ until the display shows T.SP5 <TARGET SP 5>. Select 400
17. Press scroll ⤸ until the display shows DWEL.5 <DWELL TIME 5>. Select 480
18. Press the ACK function to return to the home display.
19. Press the up ▲ and down ▼ keys together, to operate the program.
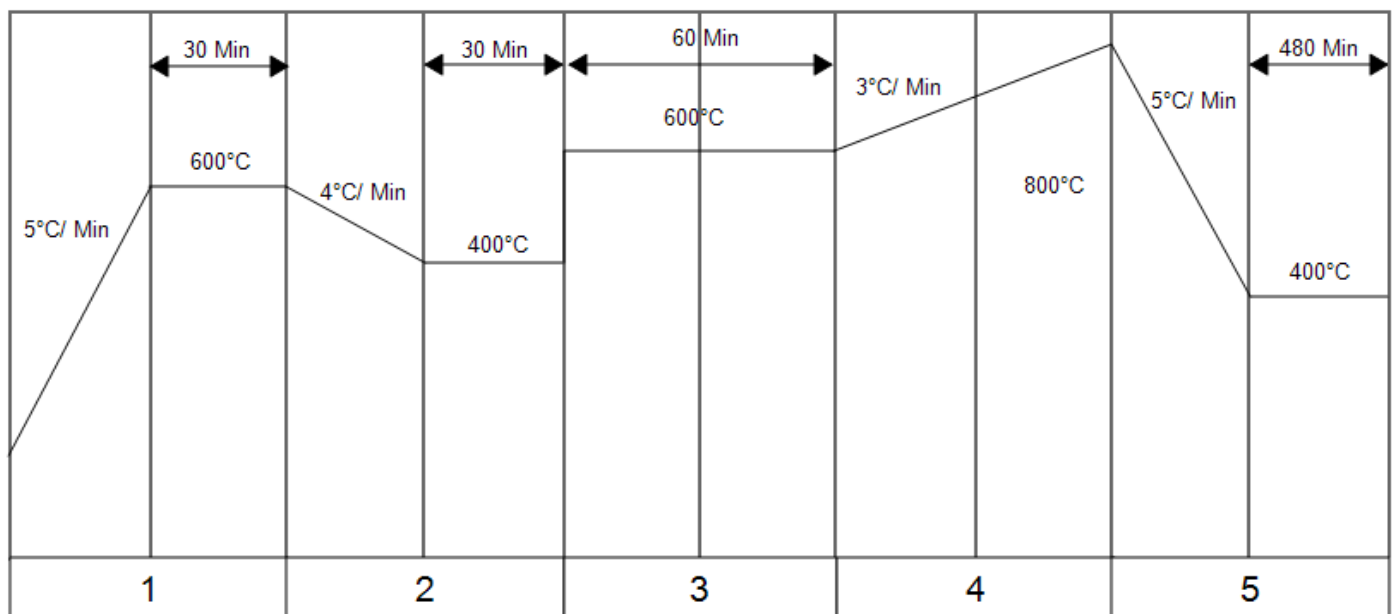
Segment

1	2	3	4	5
RMP.1= 5°C/Min	RMP.1= 4°C/Min	RMP.1= OFF	RMP.1= 3°C/Min	RMP.1=5°C
T.SP1= 600°C	T.SP1= 400°C	T.SP1= 600°C	T.SP1= 800°C	T.SP1= 400°C
Dwel.1= 30 Min	Dwel.1= 30 Min	Dwel.1= 60 Min	Dwel.1= OFF	Dwel.1= 480 Min

3.8   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.

3.8.1   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.

Product end of cable female (25-pin) 9-pin			RS232 Cable: product to PC	Computer end of cable 9-pin (25-pin) male		
Rx	(2)	3	———————	3	(2)	Tx
Tx	(3)	2	———————	2	(3)	Rx
Com	(7)	5	———————	5	(7)	Com
				7,8	(4,5)	Link together
				1,4,6	(6,8,20)	Link together

3.8.2   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:

Product end of cable female (25-pin) 9-pin			RS485 Cable: product to PC	Computer end of cable 9-pin (25-pin) female		
-	(2)	3	>—<—>—<—>—<	3	(2)	Tx
+	(3)	2		2	(3)	Rx
Com	(7)	5	———————	5	(7)	Com

3.8.3   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.

3.8.4   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:
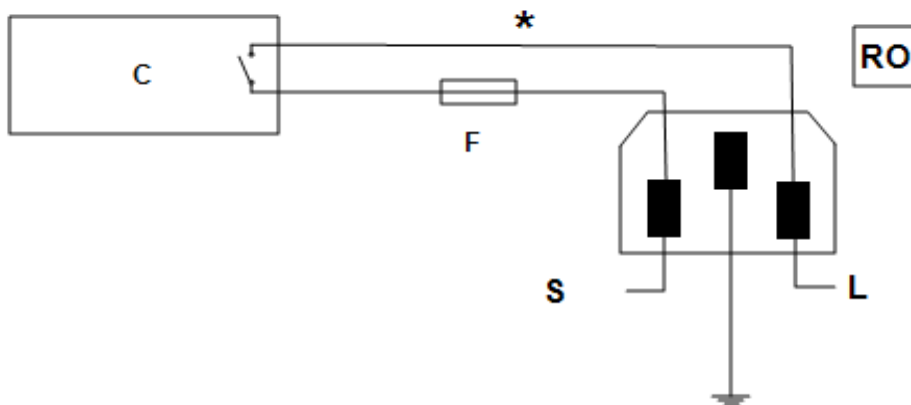
Key	
C	Temperature Controller
F	Fuse (2A)
S	Supply
L	Load
*	Normally open relay contacts
RO	Relay Output 240V 2A MAX

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.

3.9   Temperature Controller Replacement

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

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

3.10   3216 Controller Navigation Diagram

The following diagram details how to navigate to the various menu options within the 3216 Controller. At each option, values can be set using the arrow keys.

L1

PV
SP

WRK.OP
PROG ~
RAMP.U
DWEL.U
RMP.1
T.SP1
DWEL.1

RMP.8
T.SP8
DWEL.8
ID

A

LEV
GOTO

TEXT

CODE 9

L2

PV
SP

WRK.OP
PROG ~
RAMP.U
DWEL.U
H.BACK
RMP.1
T.SP1
DWEL.1

RMP.8
T.SP8
DWEL.8
A1.
A2.
A3.
A4.   *
OP.HI **
ADDR
ID
UNITS
CAL.P

95

PNT.LO
OFS.LO
PNT.HI
OFS.HI
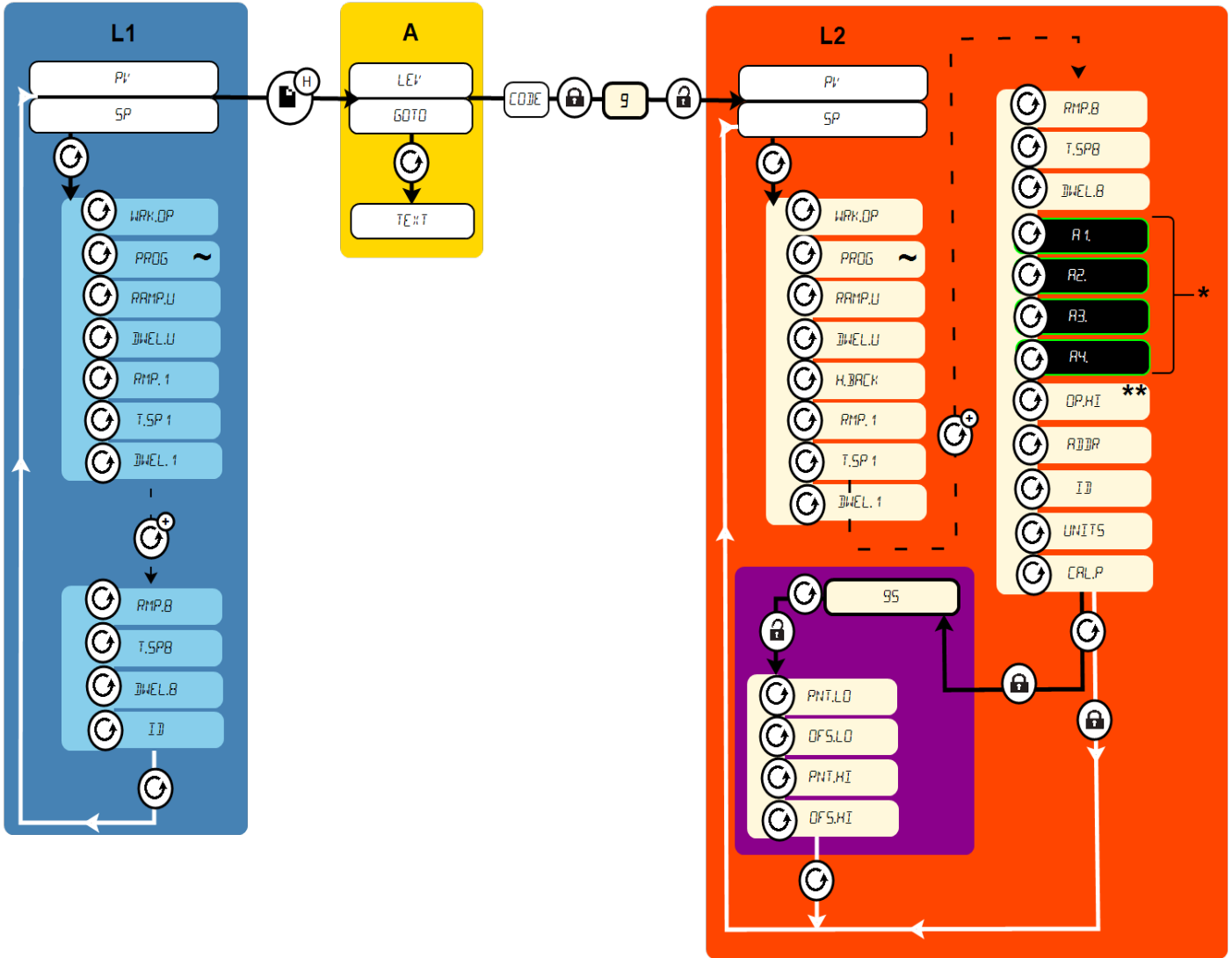
L1	Level 1	↻	Press the Scroll Key	📄 H	Hold the Page key for 3 seconds
L2	Level 2	↻⁺	Press the Scroll Key multiple times	🔒	Locked - password required
A	Access	*	If configured	🔓	Unlocked
**	Do not raise the power limit (if accessible) above the design level for the product	~	Multiple Program Only	→	Black = Progress / Dashed = Through multiple menus / White = Return

4.0 2132 Over-Temperature Controller Description (if fitted)

4.1 Description

Key	
A	Alarm Light
B	Page
C	Scroll
D	Down
E	Up
F	Display

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
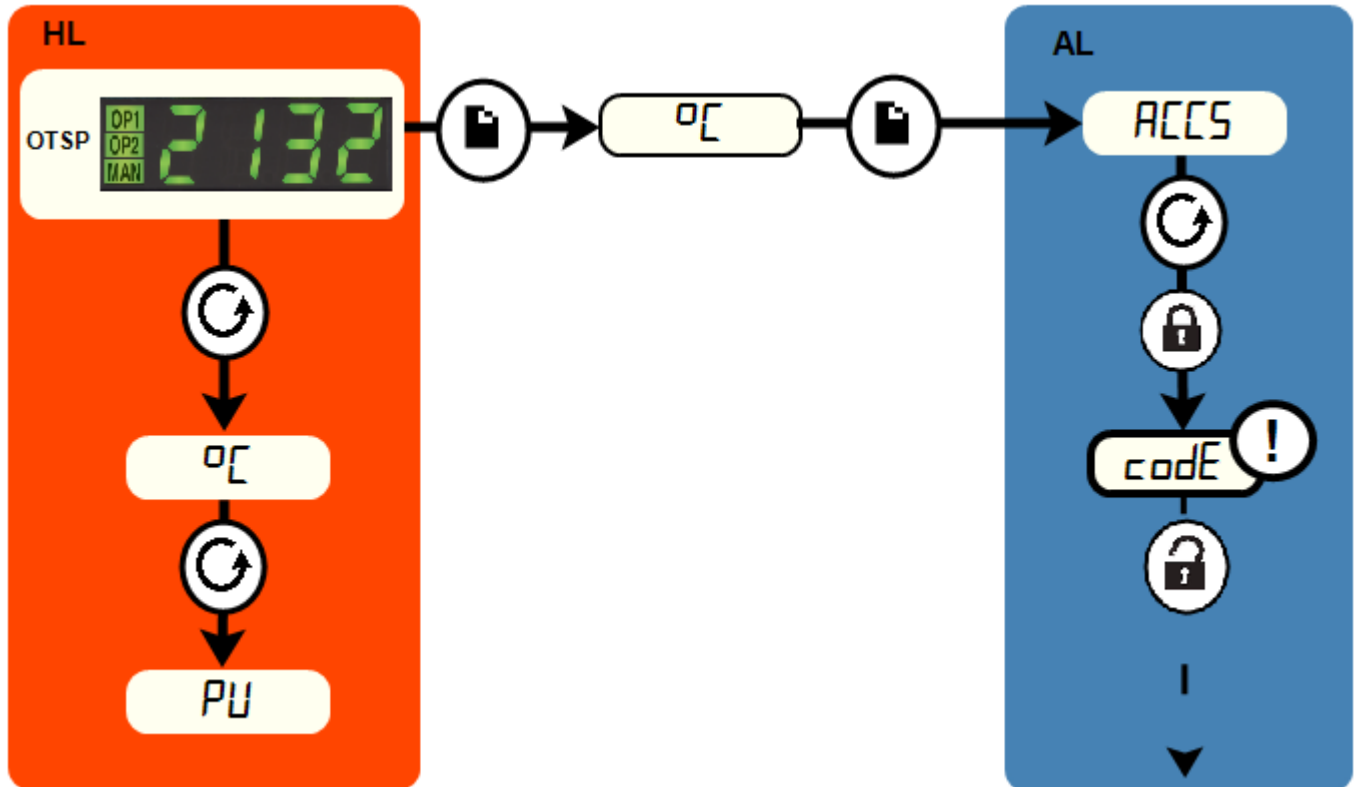
HL	Home List		Page Key		Black = Progress
OTSP	Over-Temperature Setpoint		Scroll Key		Dashed = Through to other options
AL	Access List		For factory access to list and parameters not available to the operator.		

5.0 Operation

5.1 Operating Cycle

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

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

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

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

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

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

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

5.2 Over-Temperature Control (if fitted)

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

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

5.3 Explosive Vapours

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

5.4   Cool Drying Application

The CDHT is designed to operate at typically 150°C - 200°C to dry and test coal samples in accordance with international standards.

The oven has air inlet and outlet vents designed to ensure a constant flow of fresh air to dry the samples and carry moisture away.

Open the inlet and outlet vents to the minimum amount required to ensure consistent drying results.

6.0   Maintenance

6.1   General Maintenance

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

6.2   Maintenance Schedule

■ CUSTOMER

◯ QUALIFIED PERSONNEL

> ⚠ **DANGER! ELECTRIC SHOCK**. Risk of fatal injury. Only electrically qualified personnel should attempt these maintenance procedures.

Maintenance Procedure	Method	Frequency				
		Daily	Weekly	Monthly	Bi-Annually	Annually
Safety						
Over-Temperature Safety Circuit (if fitted)	Set an over-temperature setpoint lower than the displayed temperature and check for an over-temperature alarm as detailed in this manual		■			
Over-Temperature Safety Circuit (if fitted)	Electrical measurement ⚠					◯
Door Seal	Visual inspection - check for splits or fraying		■			
Door Seal	Replacement					◯
Air Vent	Check and clean if necessary			■		◯
Electrical Safety (external)	Visual check of external cables and plugs			■		
Electrical Safety (internal)	Physically check all connections and cleaning of the power plate area					◯
Function						
Temperature Calibration	Tested using certified equipment, frequency dependent on the standard required			■	■	◯
Operational Check	Check that all functions are working normally	■				
Operational Check	Thorough inspection and report incorporating a test of all functions					◯
Performance						

Cooling Fans (if fitted)	Check whether the cooling fans are working	🟦				
Circulating Fan (if fitted)	Visual check to see if it is running		🟦			
Circulating Fan (if fitted)	Check bearings and replace if necessary					🔴
Element Circuit	Electrical measurement ⚠					🔴
Power Consumption	Measure the current drawn on each phase / circuit					🔴
Shelves	Visual check for fit and damage	🟦				

6.2.1 Cleaning

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

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

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 a fan and motor assembly, a thermocouple, a solid state relay, an element (or set of elements) and a door seal. Individual spare parts are also available.

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

6.6 Power Adjustment

The control system incorporates electronic power limiting, but for the model listed in this manual the power limit is set to 100%. The power limit parameter OP.Hi may be accessible to the operator, but should not generally be altered.

In some cases the supply voltage may be outside the range 220-240 V or the 3-phase equivalent, the power limit parameter may be set to a value other than 100%. Do not increase the value to 100%, see section 8.0 for details of power limit settings.

7.0   Repairs and Replacements

7.1   Safety Warning - Disconnection from Power Supply

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

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

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

7.2   Safety Warning - Refractory Fibre Insulation

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

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

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

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

Exposure to fibre dust may cause respiratory disease.

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

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

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

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

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

7.3   Panel Removal

Disconnect the product from the electrical supply.

Remove the screws holding the panel. Do not disconnect any wiring without first making a careful note of all the connections.

For the internal element cover. Open the door. Remove any screws holding the panel and any clips holding thermocouples in position. Remove the cover.

7.4   Temperature Controller Replacement

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

7.5   Fuse Replacement

Fuses are accessed by removal of the panel as explained in 'Panel Removal' section. Depending on the model, supply fuses and control circuit fuses may be mounted in their own holders, or may be on a circuit board that contains an EMC filter. The fuses are marked with their ratings.

Take care not to disconnect the wires leading from the EMC filter without first recording their positions: they must be reconnected to the correct terminals.

7.6   Element Replacement

- Remove the cover plate over the element tails on top of the oven.
- Open the door and remove the shelves and the element cover. The elements will be directly in front of you.
- Release the gland nut on the compression fitting holding the element, and remove the element.
- Fit the new element using new olives.
- Refit the electrical connections and covers.

7.7   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:

Thermocouple leg	Colour
positive (type K)	green
negative	white

Undo any clips holding the thermocouple. Remove the air guide from the oven chamber. Disconnect the thermocouple from its terminal block. Unscrew the compression fitting inside the chamber and pull the thermocouple into the chamber. Cut through the thermocouple behind the olive and remove the two parts. Loosely assemble compression fitting with a new ferrule. Feed in new thermocouple through from the

back. Tighten the compression fitting. Refit the air guide. Bend the thermocouple to match the shape of the previous part and refit any clips.

Refit the element access panel.

> Compression fittings are only fitted to moisture extraction and stoving and curing products. If fitted, ferrules need replacing.

7.8   Solid-state Relay Replacement

Disconnect the product from the electrical supply and remove the product's access panel. The access panel is located at the top of 'A' models and the right hand side of 'B' models.

Make a note of the wiring 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 the solid state relay connects securely to the base panel or aluminium plate, as good thermal contact is required.

Replace the removed panel.

8.0   Fuses and Power Settings

8.1   Fuses

F1 - F2: Refer to the circuit diagrams.

F1	Internal Supply Fuses	Fitted if supply cable fitted. Fitted on board to some types of EMC filter.	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)
F2	Auxiliary Circuit Fuses	Fitted on board to some types of EMC filter. May be omitted up to 25 Amp/ phase supply rating.	2 Amps glass type F On board: 20 mm x 5 mm Other: 32 mm x 6 mm
	Customer Fuses	Required if no supply cable fitted. Recommended if cable fitted.	See rating label for current; See table below for fuse rating.

Model	Phases	Volts	Supply Fuse Rating (Amps) F1
CDHT/450	3 Phase + No Neutral	208V	32 A

8.2   Power Settings

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

Please refer to the rating label for product specific information.

9.0   Fault Analysis

A.	Oven Does Not Heat Up				
1.	The temperature controller is OFF	▶	No power from supply	▶	Check the fuses in the supply line
2.	The temperature controller is ON	▶	The controller shows a very high temperature or a code such as EEE or --- or S.br	▶	The temperature sensor has broken or has a wiring fault
		▶	The controller shows a low temperature	▶	The SSR could be failing to switch on due to internal failure, faulty logic wiring from the controller, or faulty controller
		▶	There are no lights glowing on the controller	▶	The controller may be faulty or not receiving a supply due to a faulty switch or a wiring fault

B.	Oven Overheats				
1.	Oven only heats up when the instrument switch is ON	▶	The controller shows a very high temperature	▶	The controller is faulty
		▶	The controller shows a low temperature	▶	The thermocouple may have been shorted out or may have been moved out of the oven
				▶	The thermocouple may be connected the wrong way round
				▶	The controller may be faulty
2.	Oven heats up when the instrument switch is OFF	▶	The SSR has failed "ON"	▶	Replace the SSR. Check for an accidental wiring fault which could have overloaded the SSR

10.0   Wiring Diagrams

For wiring diagrams, please contact Carbolite Gero Service. Please quote the serial number and model.

11.0   Specifications

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

Model	Max Temp (°C)	Max Power (kW)	Chamber Size			Approx Capacity (l)	Net Weight (kg)
			H	W	D		
CD Range Ovens for Coal Drying							
CDHT/450	200	9	610	610	1220	454	400

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

Notes

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Service Record

Engineer Name	Date	Record of Work

ProductLabel

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

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