

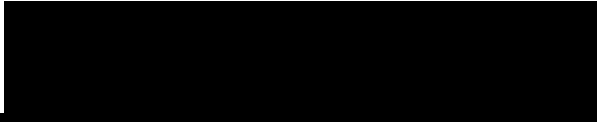
### **Installation, Operation and Maintenance Instructions** 1100 °C Chamber Furnace - CWF Model: 23 Litre 2416 Controller

CWF 11/23 + 2416 Controller

## Contents

This manual is for the guidance on the use of the Carbolite Gero product specified on the front cover and should be read thoroughly before the furnace or oven is connected to the electricity supply. 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 .....	4
1.1	Switches and Lights .....	4
1.2	General Warnings .....	4
2.0	Installation .....	5
2.1	Unpacking and Handling .....	5
2.2	Siting and Setting Up .....	5
2.3	Chimney .....	6
2.4	Electrical Connections .....	6
3.0	2416 Controller .....	8
3.1	Description .....	8
3.2	Operation .....	9
3.3	Programming .....	10
3.3.1	Programming Tips .....	11
3.3.2	Multi-program model (2416P8) .....	11
3.3.3	Holdback .....	11
3.3.4	Program Cycling .....	12
3.3.5	Running a Program .....	12
3.3.6	Program example .....	13
3.4	Controller Options .....	14
3.4.1	Digital Communications - RS232 .....	14
3.4.2	Digital Communications - RS485 .....	14
3.4.3	Comms Address .....	14
3.4.4	Alarm Option .....	15
3.5	Temperature Controller Replacement .....	15
3.6	Navigation Diagram .....	16
4.0	2132 Over-temperature Controller Description (if fitted) .....	17
4.1	Description .....	17
4.2	Operation .....	17
4.2.1	Controls .....	17
4.2.2	Operation .....	17
4.2.3	Over-temperature Operation .....	18
4.2.4	Over-Temperature Alarm .....	18
4.2.5	Resetting the Over-Temperature Alarm .....	18
4.2.6	Sensor Break .....	18
4.3	Audible Alarm .....	18
4.4	Navigation Diagram .....	19
5.0	Operation .....	20
5.1	Operating Cycle .....	20
5.2	General Operating Notes .....	20
5.3	Use of Probes .....	21
5.4	Atmospheres .....	21
5.5	Operator Safety .....	21
5.6	Power Adjustment .....	21
6.0	Maintenance .....	23
6.1	General Maintenance .....	23
6.1.1	Cleaning .....	23
6.1.2	Safety Switch .....	23
6.2	Calibration .....	23
6.3	After-Sales Service .....	23



- 6.4 Recommended Spares Kit .....24
- 7.0 Repairs and Replacements .....25
  - 7.1 Safety Warning - Disconnection from Supply .....25
  - 7.2 Safety Warning - Refractory Fibre Insulation .....25
  - 7.3 Temperature Controller Replacement .....25
  - 7.4 Solid-state Relay Replacement .....26
  - 7.5 Thermocouple Replacement .....26
  - 7.6 Panel Element Replacement .....27
  - 7.7 Door Plug Replacement .....28
  - 7.8 Fuse Replacement .....28
- 8.0 Fault Analysis .....29
  - A. Furnace Does Not Heat Up .....29
  - B. Product Overheats .....29
- 9.0 Wiring Diagrams .....30
  - 9.1 WA-U3-30 .....30
  - 9.2 WA-U3-31 .....31
- 10.0 Fuses and Power Settings .....32
  - 10.1 Fuses .....32
  - 10.2 Power Limit .....32
- 11.0 Specifications .....33
  - 11.1 Environment .....33

## 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 of electrical shock– read any warning printed next to this symbol.

WARNING: risk of fatal injury.

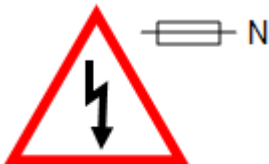


DANGER – hot surface. Read any warning printed next to this symbol.

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 or 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). For precautions and advice in handling this material see section 7.0.

### 2.2 Siting and Setting Up

Place the product on a level surface in a well ventilated area, away from other sources of heat and on a non-flammable surface that is resistant to accidental spillage of 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.

Ensure that there is free space around the sides and back 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.

Do not obstruct any of the case vents; they are needed to keep the controls and the case exterior cool.

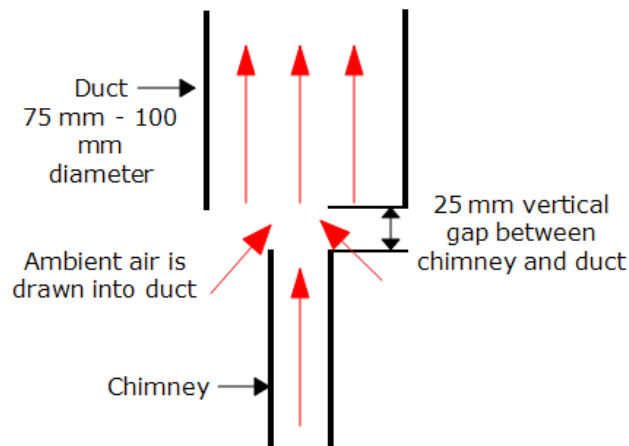
Ensure that the product is placed in such a way that it can be quickly switched off or disconnected from the electrical supply.

### 2.3 Chimney

The chimney is a short length of ceramic tubing. If it is supplied unfitted, then fit it through the hole in the top of the product case.

If the product is to be used to heat substances that emit fumes, then a fume extraction duct of approximately 75 mm - 100 mm inlet diameter may be placed directly above the chimney outlet.

Do not make a sealed connection to the product chimney as this causes excessive airflow through the chamber and results in poor temperature uniformity.



### 2.4 Electrical Connections



Connection by a qualified electrician is recommended.

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

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

The supply should be fused at the next size equal to or higher than the amperage on the label. A table of the most common fuse ratings is also given in the section 10.0 towards the back of this manual. Where a supply cable is present there are internal supply fuses; customer fusing is preferred but not 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 back panel.

Connection by line plug: the plug should be within reach of the operator and should be quickly removable.

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 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
	N	Blue	to neutral	to the other power conductor
	PE	Green/ Yellow	to earth (ground)	to earth (ground)

## 3.0 2416 Controller

### 3.1 Description

In this manual the temperature controller/ programmer is called the 2416 or the 2416CG. The manual also applies to the multi-program version 2416P8. This manual accords with software version 3.06 and to any other software versions where the instrument can be configured in accordance with the navigation diagram and other instructions given in this manual.

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-setpoint. 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 communicate 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.

It does not contain a real-time calendar and is not subject to century-end date problems.

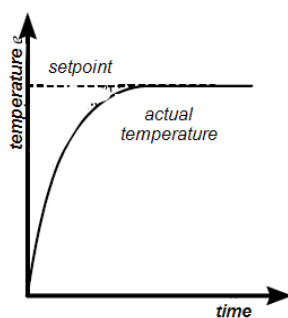


fig 1 - simple control

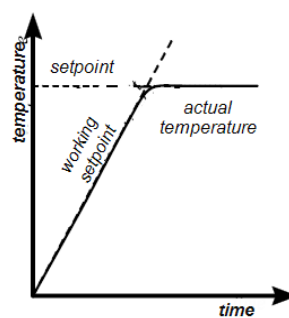


fig 2 - control with ramp-to-setpoint

seg 1 = ramp, seg 2 = end (dwell)

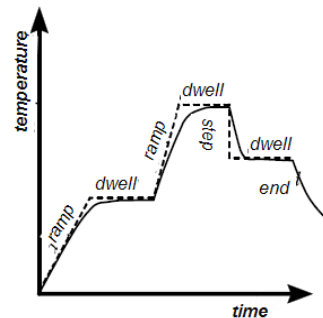


fig 3 - a program



### 3.2 Operation

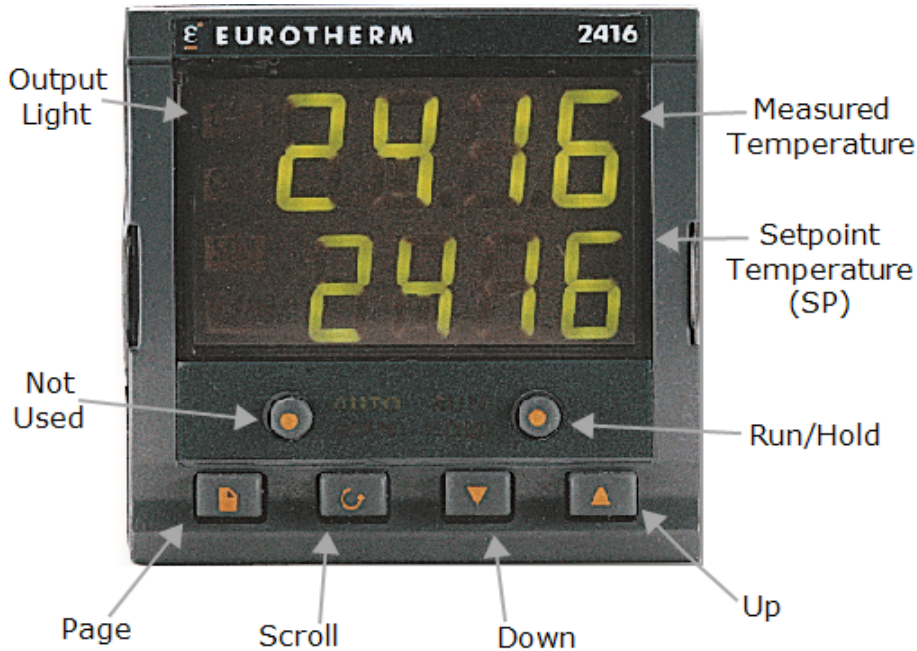
Most Carbolite Gero products are fitted with an instrument switch which cuts off power to the controller and other parts of the control circuit. See the section 5.0 for operating instructions.

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 period.




#### 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:



Auto/ Manual	Disabled.	The unit is always in 'Auto' mode
RUN/ HOLD	-	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.
Up + Down	▲ + ▼	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.
Page	📄	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.
Scroll		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.
Page + Scroll	 + 	Press together to cause an immediate return to the 'Home List'
Run & Hold		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).
Output Indicator		OP1 indicates that the programmer is calling for heat to be supplied.  OP2 is not used.
SP2 and REM		Not generally used; indicate 'Second' or 'Remote' setpoint in use.

### 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  until 'ProG LiSt' is displayed.

Press scroll  to reveal the 'Holdback' and 'Loop Count' parameters. See the sections 3.3.1 and 3.3.4 for a description of these.

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

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

Press scroll  to access the parameters appropriate to the type of segment chosen – see the following table – and use down ▼ or up ▲ to alter the values.

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

Segment Type	Parameter	Function
RmP.r	TGt rATE	The target setpoint for this segment The ramp rate (rate of temperature change) in °/ minute
RmP.t	TGt dur	The target setpoint for this segment The duration of the segment. The controller calculates the rate of temperature rise necessary to achieve this duration.
Dwel	dur	The time in minutes to remain at the previous target temperature. 10ths of a minutes are allowed.
SteP	tGt	A new target temperature to be achieved as quickly as possible.
CaLL	PrG.n cyc.n	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'.
End	End.t	'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.

### 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 the 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:

Band	Holdback applies to both heating and cooling
Lo	Holdback applies to heating only
Hi	Holdback applies to cooling only
Off	Holdback is off

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  $\pm 10$  °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  to access the 'Run' list page and scroll  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 shown graphically below.

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

### 3.4 Controller Options

Because 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 modes, a security code is needed. Please consult Carbolite Gero.

#### 3.4.1 Digital Communications - RS232

If the RS232 option is supplied, then 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

#### 3.4.2 Digital Communications - RS485

If an RS485 option is supplied, then 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 product	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

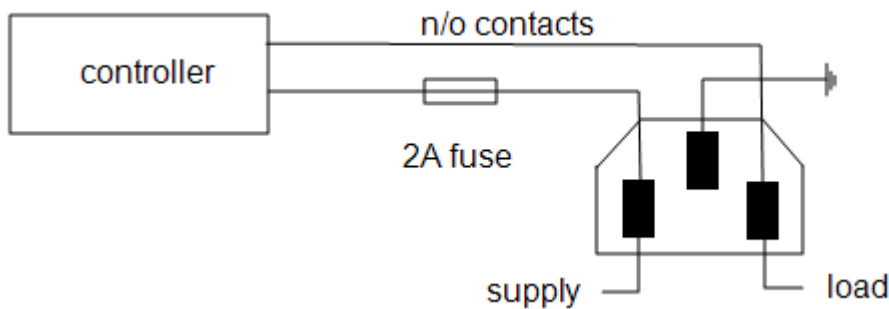
If a boxed KD485 RS485 to RS232 converter is supplied, then the connection cable from furnace to KD485 should be a "straight" cable, the same as the furnace-to-furnace cable. The connection between the KD485 and the PC should be a "crossover" cable, the same as the Furnace to PC cable in section Digital Communications - RS232.

#### 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 with free contacts for customer use, the contacts are taken to a panel plug on the control panel, wired as indicated:



The purpose of the 2 amp fuse is to protect the internal circuitry from excess electrical current.

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

### Program segment output

When the customer requirement is for program segment output, an extra parameter is revealed in the PROG list. For each program segment, after the segment type and settings, the parameter EVENT OUTS appears. This has values on and off. If the value is set to on, then the relay closes during the segment and a small 1 appears in the top left of the screen.

If more than one program segment output is fitted, then there are extra boxes depending on how many event outputs there are.

## 3.5 Temperature Controller Replacement

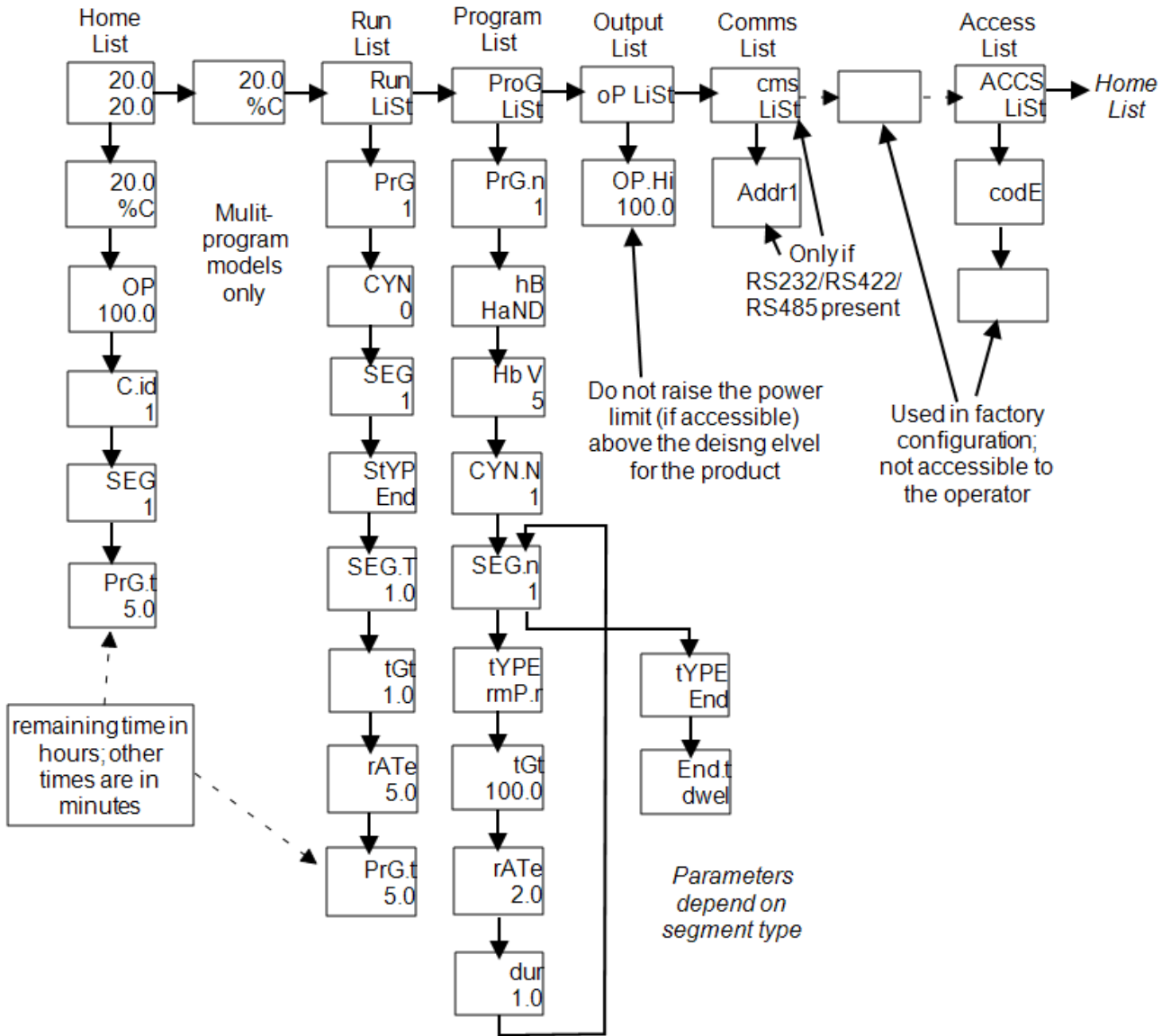


Before handling the controller: wear an anti-static wrist strap or otherwise avoid any possibility of damage to the unit by static electricity.

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.

3.6 Navigation Diagram





## 4.0 2132 Over-temperature Controller Description (if fitted)

### 4.1 Description



This over-temperature controller is made by Eurotherm, and is fitted and supplied ready to use by Carbolite Gero.

They are digital instruments with a latching alarm, requiring no additional panel controls. The controller features easy setting of over-temperature setpoint and reading of current temperature at the over-temperature sensor.

It does not contain a real-time calendar and is not subject to century-end date problems.

### 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 there must be power to the product and the instrument switch must be on. If a time switch is included in the product circuit, this must be in an ON period.


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'.


The power to other components is not normally cut on over-temperature; some fans usually continue operating, but 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; most lists and parameters are hidden and cannot be accessed by the operator because they contain factory-set parameters which should not be changed.

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.



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 maximum 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  to view the present temperature as seen by the over-temperature controller. Press it twice, because the first press shows the temperature units (°C) and the second press shows the set value.

### 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.

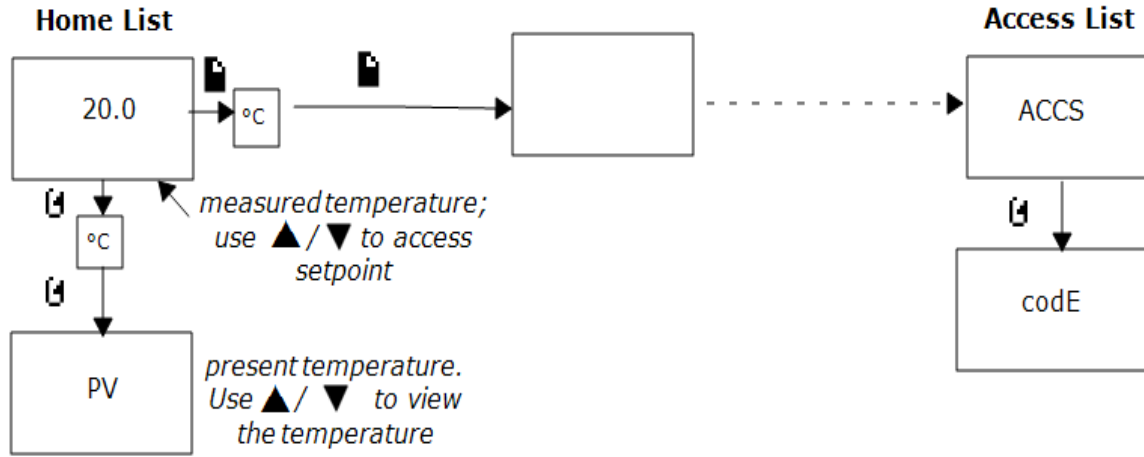
## 4.3 Audible Alarm

If an audible alarm is supplied for use with the over-temperature controller, then 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.

It is not feasible to include other possible alarm features which may be included by customer special order, in this manual.

#### 4.4 Navigation Diagram



## 5.0 Operation

### 5.1 Operating Cycle

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

Connect the product to the electrical supply.

Operate the instrument switch to activate the temperature controller. The controller becomes illuminated and goes through a short test cycle.

Close the product door and adjust the temperature controller - see controller instructions.

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

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

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

**Over-temperature option only.** If the over-temperature trip operates then an indicator in the over-temperature controller flashes and the heating elements are isolated. Find and correct the cause before resetting the over-temperature controller according to the instructions supplied.

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

### 5.2 General Operating Notes



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

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

When heating materials which produce smoke or fumes, the chimney must be correctly fitted and unobstructed. Otherwise, soot accumulates in the chamber and could possibly cause an electrical breakdown of the heating element. If the furnace is used to heat

materials which emit smoke or fumes, regularly heat it up to maximum temperature for one hour with the chamber empty to burn away the soot.

Materials such as case hardening compounds and other reactive salts may penetrate the furnace chamber lining and attack the wire elements, causing premature failure. Use of a hearth tile may be advisable: please consult the Carbolite Gero technical department.

### 5.3 Use of Probes



Any metal object used to probe into the product chamber while the product is connected to the electrical supply must be earthed (grounded). This applies in particular to metal sheathed thermocouples, where the sheaths must be earthed. The refractory material of the chamber lining becomes partly conductive at high temperatures and the electric potential inside the chamber can be at any value between zero and the supply voltage. Unearthed probes can cause serious electric shock.

### 5.4 Atmospheres

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

Chamber products are not gas tight, so it should be understood that gas usage may be high and that the chamber is always likely to contain some air. Residual oxygen levels of 1% are to be expected.

### 5.5 Operator Safety



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



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

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

When the door of a hot product is opened there is considerable radiative heat. Do not keep any inflammable objects near the product, nor objects which could be damaged by radiated heat.

### 5.6 Power Adjustment

The product control system incorporates electronic power limiting. Depending on the model and the destination country the power limit maybe set to 100% or a lower figure.

Where appropriate the power limit parameter OP.Hi is accessible to the operator, but it should not generally be altered.

See section 10.0 for details of the power limit settings. DO NOT adjust the power to a level higher than the design level states; this may cause a fuse to blow and could damage the heating elements.

The power limit may be set to a lower limit if the product is to be used at a low temperature only: this may give better control stability. It may be set to zero to permit demonstration of the controls without the heating elements taking power; to resume heating reset it to its standard value.

## 6.0 Maintenance

### 6.1 General Maintenance

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

#### 6.1.1 Cleaning

Soot deposits may form inside the product, depending on the process. At appropriate intervals remove these by heating as indicated in the General Operating Notes.



The products 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.

#### 6.1.2 Safety Switch

The door switch operation mentioned in section 5.0, should be checked periodically to ensure that heating elements are isolated when the door is opened. In normal conditions the safety arrangement should outlast the product, but it could be affected by rough handling, a corrosive environment or work materials, or exceptional frequency of use.

A qualified electrician should check that the supply to the heating elements is cut, with and without power being on, when the door is open partially and fully; it is important that isolation is not just marginally achieved. It is advisable to make the check on the element terminals after removal of the element access panel: probing the element surface inside the product could be inconclusive because of surface oxidation.

Note that for Single Phase, both live and neutral sides of the element should be isolated when the door is opened. Note that for 3-phase, all live supply wires of a 3-phase supply, should be isolated when the door is opened.

### 6.2 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.

For a quick check of the temperature shown by the control thermocouple and controller, a portable temperature indicator and probe thermocouple may be used.

Depending on the controller, the instructions may contain calibration instructions.

### 6.3 After-Sales Service

Carbolite Gero's service division (Carbolite Gero Service) has a team of Service Engineers capable of repair, calibration and preventive maintenance of furnace and oven products both at the Carbolite Gero factory and at customers' premises

throughout the world. Carbolite Gero also sell spare parts by mail order. A telephone call or email often enables a fault to be diagnosed and the necessary part despatched. Each product has its own record card at Carbolite Gero. In all correspondence please quote the serial number, model type and voltage given on the rating label of the product. The serial number and model type are also given on the back of this booklet when supplied with the product.

To contact Carbolite Gero Service or Carbolite Gero see the back page of this manual.

#### 6.4 Recommended Spares 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 sheath, one solid state relay, one door insulation piece, one element or set of elements and one hearth tile. Individual spares are also available.

When ordering spares please quote the model details as requested above.



## 7.0 Repairs and Replacements

### 7.1 Safety Warning - Disconnection from 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 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 described as Alumino 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, mineral wool 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 recommend 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 recommend making 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 the Carbolite Gero service division can quote for any repairs to be carried out at your premises or ours.

### 7.3 Temperature Controller Replacement

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

## 7.4 Solid-state Relay Replacement



Disconnect the product from the supply and remove the product's back panel.

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 the solid state relay has good contact with the base panel or aluminium plate, as good thermal contact is required.

Replace the removed panel.

The new solid state relay contains a built-in MOV which protects it from short periods of excess voltage. If the old relay had a separate disc-shaped "MOV" connected between the high voltage terminals of the old relay, discard the old MOV.

## 7.5 Thermocouple Replacement

Disconnect the product from the supply and remove the element access panel. Make a note of the thermocouple connections.

Compensating cable colour codings are:

thermocouple leg	colour
positive (type K)	green
positive (type R)	orange
negative	white

Disconnect the thermocouple from its terminal block and withdraw the thermocouple from its sheath by bending the metal tag or releasing the screw to release. It is advisable also to remove the sheath and shake out any broken pieces of thermocouple.

Re-assemble with a new thermocouple, observing the colour coding, ensuring that the thermocouple is not twisted as it is being inserted and that the metal tag is bent back to grip the sheath.

Refit the element access panel.

7.6 Panel Element Replacement



**See section 7.2 - wearing a face mask is recommended.**

The chambers have two side-mounted refractory panels in which coiled heating elements are inserted and one unheated hearth slab.

Disconnect the furnace from the supply and remove the furnace back panel.

Make a written plan showing ALL the element and thermocouple connections. It is important to make this plan for each individual furnace.

Disconnect all the element wire tails and thermocouple cables from their terminal blocks. Straighten all the element tails.

Note that these become brittle with use.

Unscrew the screws fixing the metal back piece from the inner chamber and withdraw this part backwards complete with thermocouple(s) and sheath(s).

Withdraw the back insulation piece. Handle with care. Observe the warning on handling of ceramic fibre insulation.

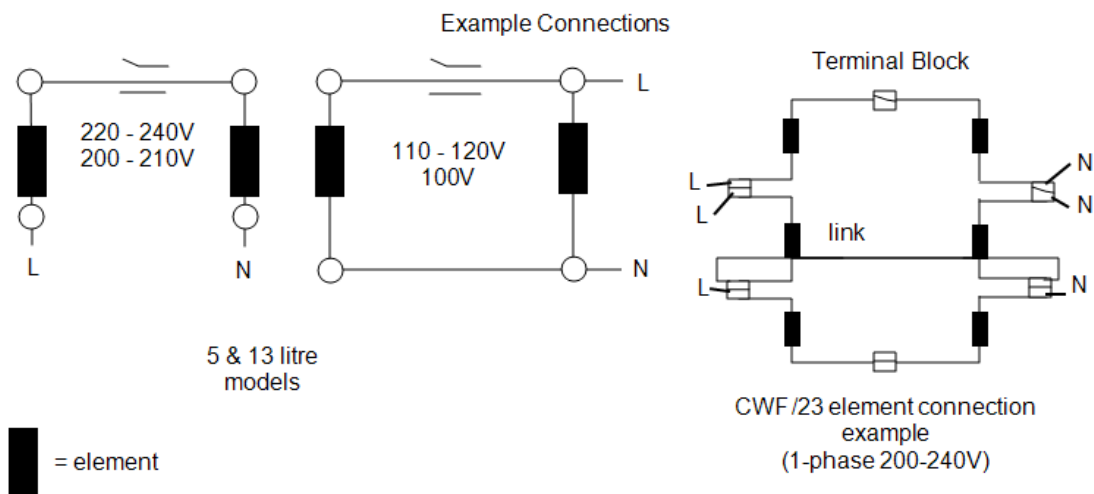
Withdraw the old element(s), and insert the new. Note that in some models the ceramic element carriers are in two parts: handle with care.

Replace the back insulation piece and metal piece, together with the thermocouple(s) and sheath(s).

As necessary, shorten the element tails by clipping to the required length. Remake all the thermocouple and element connections according to the individual plan.

Refit the back panel and operate the furnace for 30 minutes at 800 °C without interruption to ensure complete burn-off of any organic binders. Some smoke may be observed during this process, which should be carried out in a well ventilated area.

Check that the furnace is controlling properly to rule out the possibility that the previous element failed because of a fault elsewhere in the control circuit.



## 7.7 Door Plug Replacement



**See section 7.2 - wearing a face mask is recommended.**

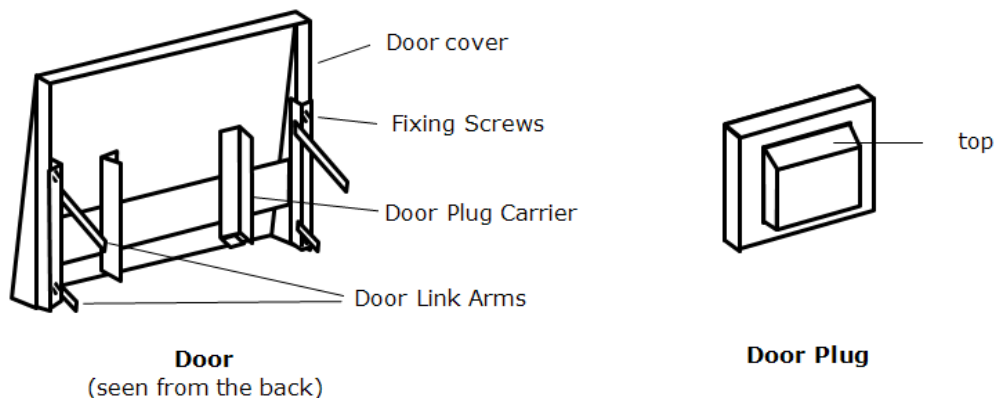
Lift the furnace door to the open position and remove the door cover from the plug carrier assembly.

Remove the old door plug by sliding it upwards out of its carrier.

Slide the new plug into the carrier assembly making sure that the plug is the correct way up.

Refit the door cover.

When first heating the furnace after a replacement, ensure that the ventilation is good: emission of some fumes may be expected.



## 7.8 Fuse Replacement

Fuses are marked on the wiring diagram with type codes, e.g. F1, F2. A list of the correct fuses is given in the section 10.0 towards the back of this manual.

*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 near the cable entry point and access is by removal of the back panel or control box.

## 8.0 Fault Analysis

### A. Furnace Does Not Heat Up

1. The HEAT light is ON
  - ▶ The heating element has failed
  - ▶ Check also that the SSR is working correctly
2. The HEAT light is OFF
  - ▶ The controller shows a very high temperature or code such as S.br
  - ▶ The thermocouple has broken or has a wiring fault
  - ▶ The controller shows a low temperature
  - ▶ The door switch(es) (if fitted) may be faulty or need adjustment
  - ▶ The contactor/ relay (if fitted) may be faulty
  - ▶ The heater switch (if fitted) may be faulty or need adjustment
  - ▶ 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
  - ▶ Check the supply fuses and any fuses in the furnace control compartment
  - ▶ The controller may be faulty or not receiving a supply due to a faulty switch or a wiring fault.

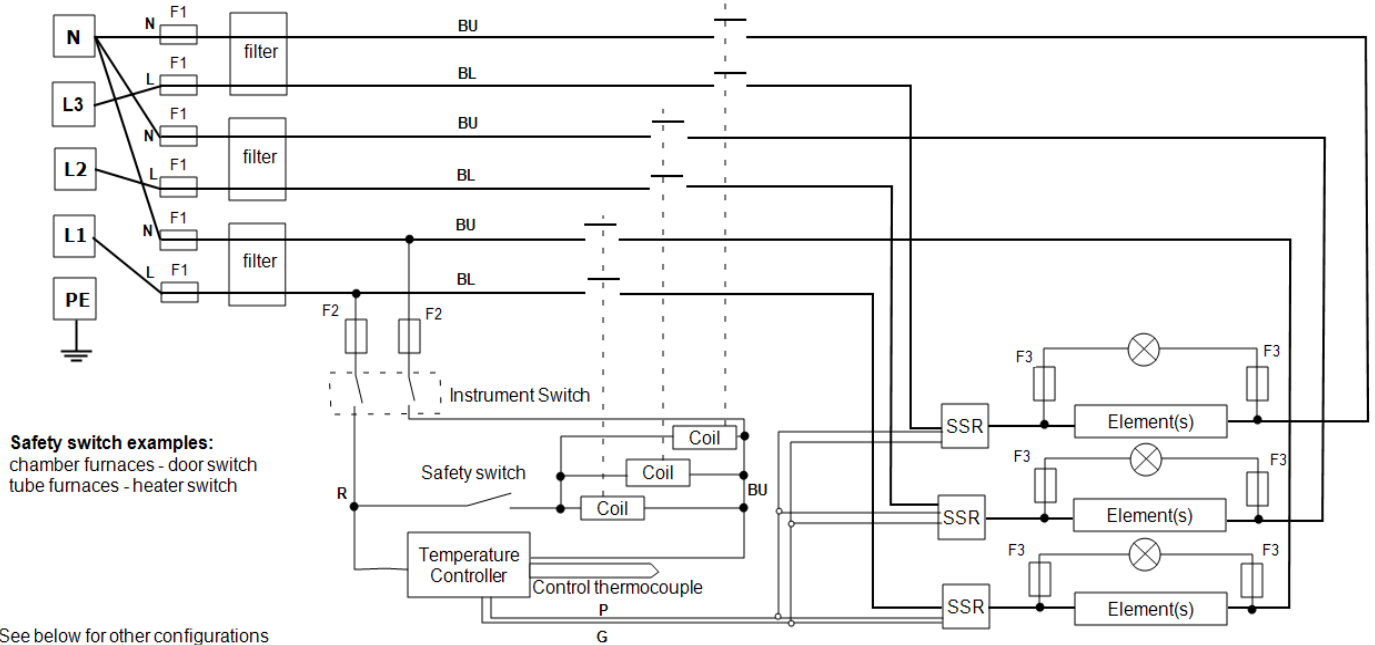
### B. Product Overheats

1. Product 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 heating chamber
  - ▶ The thermocouple may be connected the wrong way around
  - ▶ The controller may be faulty
2. Product heats up when the instrument switch is OFF
  - ▶ The SSR has failed "ON"
  - ▶ Check for an accidental wiring fault that could have overloaded the SSR

## 9.0 Wiring Diagrams

### 9.1 WA-U3-30

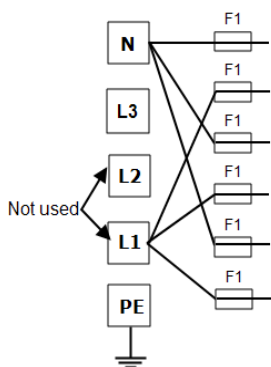
Connections below show 3-phase +N with indirect safety switches.



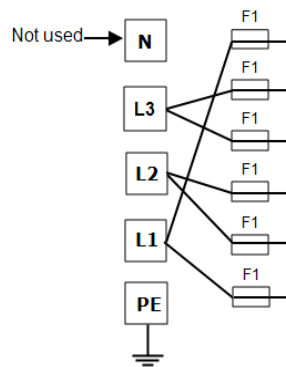
**Safety switch examples:**  
chamber furnaces - door switch  
tube furnaces - heater switch

See below for other configurations

#### Single Phase Connections



#### Delta Connections



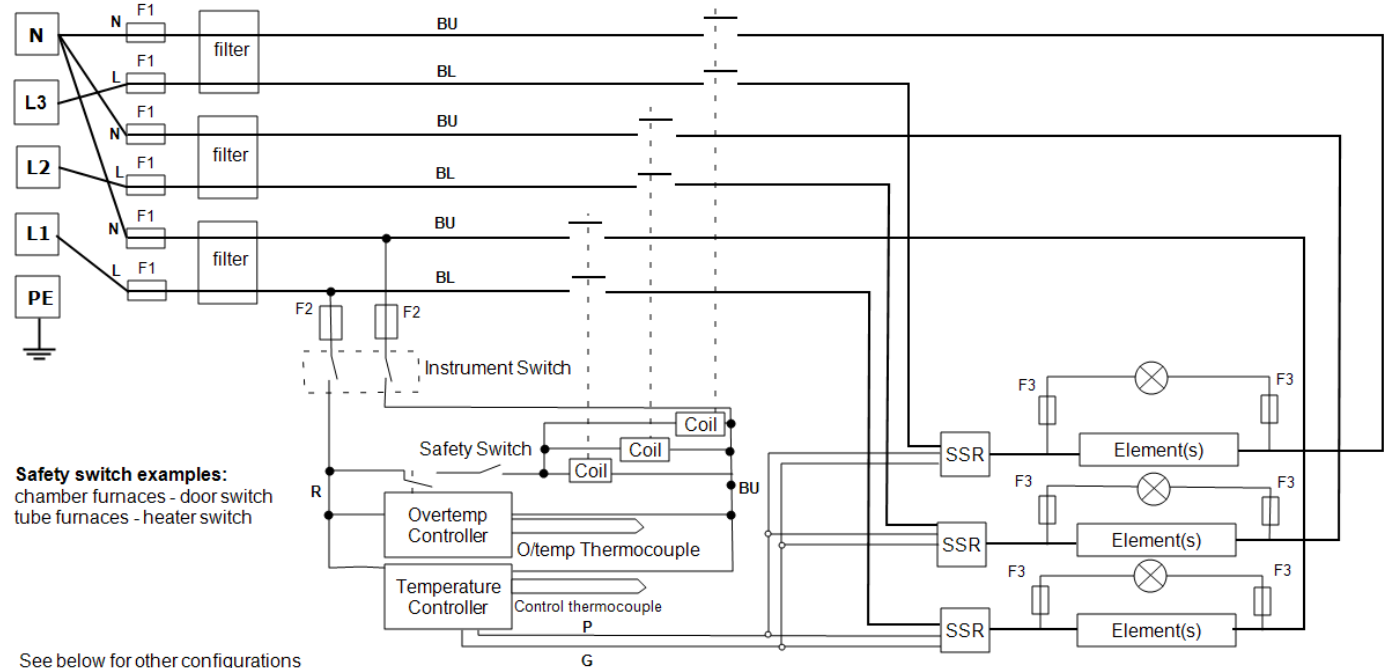
Products with this wiring arrangement may be converted between the following supply voltages (please refer to the table within section 10.0 for compatible phases with the product):

- 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 department for details.

### 9.2 WA-U3-31

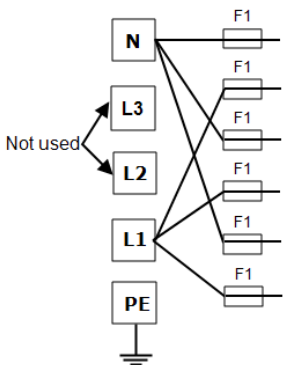
Connections below show 3-phase +N with safety switches and over-temperature control.



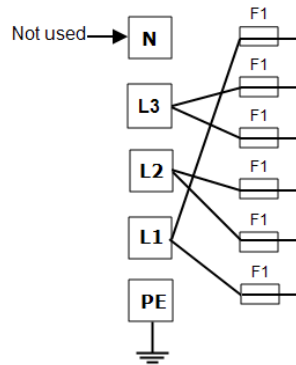
**Safety switch examples:**  
chamber furnaces - door switch  
tube furnaces - heater switch

See below for other configurations

#### Single Phase Connections



#### Delta Connections



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 department for details.

## 10.0 Fuses and Power Settings

### 10.1 Fuses

F1 - F3: 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
F3	Heat Light Fuses	May be omitted up to 25 Amp/phase supply rating.	2 Amps glass type F 32 mm x 6 mm
	Customer Fuses	Required if no supply cable fitted. Recommended if cable fitted.	See rating label for amperage; See table below for fuse rating.

Model	Phases	Volts	Supply Fuse Rating
CWF -/23	1-phase	220-240	32 A
CWF -/23	3-phase + N	380/220 - 415/240	12 A/ ph
CWF -/23	3-phase delta	220-240	20 A

### 10.2 Power Limit

The power limit settings (parameter OP.Hi) for this model on various supply voltages are 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 correct one from the table.

Voltage:		110 V	115 V	120 V	254 V
		220 V	230 V	240 V	440 V
		380 V	400 V	415 V	
Power (%):	1-phase	100	100	94	83
Power (%):	3-phase +N 3-phase delta	100	100	100	89



## 11.0 Specifications

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

Model	Max Temp (°C)	Max Power (kW)	Chamber Size (mm)			Approx Capacity (l)	Net Weight (kg)
			H	W	D		
Chamber furnaces heated by coiled resistance wire embedded in light weight ceramic fibre forming the furnace chamber.							
CWF 11/23	1100	7.5	235	245	400	23	68

### 11.1 Environment

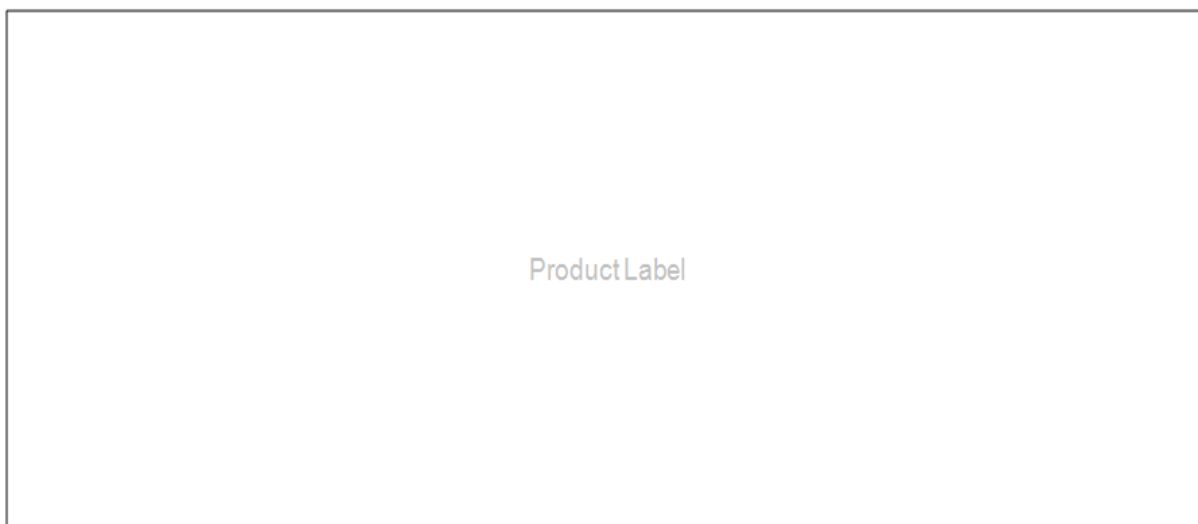
The model(s) listed in this manual contain electrical parts and should be stored and used in indoor conditions as follows:

temperature: 5 °C - 40 °C

relative humidity: maximum 80% up to 31 °C decreasing linearly to 50% at 40 °C

**This page is left blank intentionally.**

**This page is left blank intentionally.**



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](mailto:ServiceUK@carbolite-gero.com)

**CARBOLITE**  
**IGERO 30-3000°C**

**Carbolite Gero,**

Parsons Lane, Hope, Hope Valley, S33 6RB,  
England.

Telephone: + 44 (0) 1433 620011

Fax: + 44 (0) 1433 621198

Email: [Info@carbolite-gero.com](mailto:Info@carbolite-gero.com)