

### **Installation, Operation and Maintenance Instructions**

1200°C E-Range Tube Furnace - EVA Model: 150mm  
3216 Controller

EVA 12/150B + 3216 Controller

## Contents

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

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## 1.0 Symbols and Warnings

### 1.1 Switches and Lights



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



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



Heat switch: the switch disconnects power to the heating elements; unless this switch is OFF there is a danger of electric shock when inserting objects into the product.

### 1.2 General Warnings



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

**WARNING:** Risk of fatal injury.

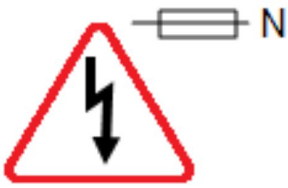


**DANGER** – Hot surface. Read any warning printed next to this symbol.

**WARNING:** All surfaces of a product may be hot.



**DANGER** – Read any warning printed next to this symbol.



Caution – Double Pole/Neutral Fusing

### 1.3 Warning Labels

On the front control panel there are 2 warning labels as shown in figure 1.3.1; they are numbered 7 and 8. These warnings must be followed for the safe operation of this furnace.



#### **7- Warning label - Do not operate without a work tube.**

The furnace must not be operated without the correctly sized work tube and correspond work tube adaptors or it could be possible for an operator to access electrically live element coils that could cause serious injury or death.



#### **8- Warning label - Switch off the furnace before loading and unloading.**

The furnace heaters must be switched OFF using the heater switch, item 2 in figure 1.3.1, when the furnace is being loaded or unloaded. The work tube can become electrically conductive at high temperatures, presenting a possible hazard to the operator. If element failure is left undetected the element could collapse onto the work tube.



1.0 Symbols and Warnings

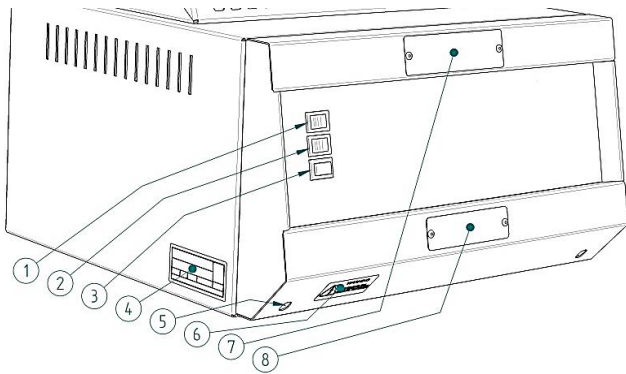


Figure 1.3.1 - Control Box layout and warning labels.

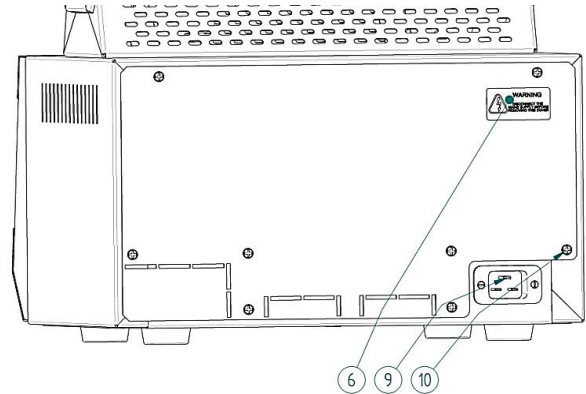


Figure 1.3.2- Back of control box showing mains lead socket

Index to numbered items in Figure 1.3.1 and 1.3.2

1. Electrical supply switch - switches electrical power ON and OFF to the furnace.
2. Heater switch - switches electrical power ON and OFF to the furnace heating elements.
3. Heater ON light - indicates that the furnace heating elements are energized.
4. Product rating label indicating the product serial number and electrical information.
5. Access holes to front panel fixing screws.
6. Warning label - Disconnect the mains supply before removing this cover.
7. Warning label - Do not operate without a work tube.
8. Warning label - Switch OFF the furnace before loading and unloading.
9. Electrical power lead socket.
10. Back panel fixing screws.



## 2.0 Installation



If the product has been transported or stored in humid conditions it must be dried out completely before operating the furnace. Contact Carbolite Gero Service for instructions.

### 2.1 Unpacking and Handling

When unpacking or moving the product, always lift it by its base or both ends of the main body. Never lift it by the end insulation or by a work tube. It may take 2 or 3 people to lift the furnace, depending on the size and configuration.



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

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

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

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

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

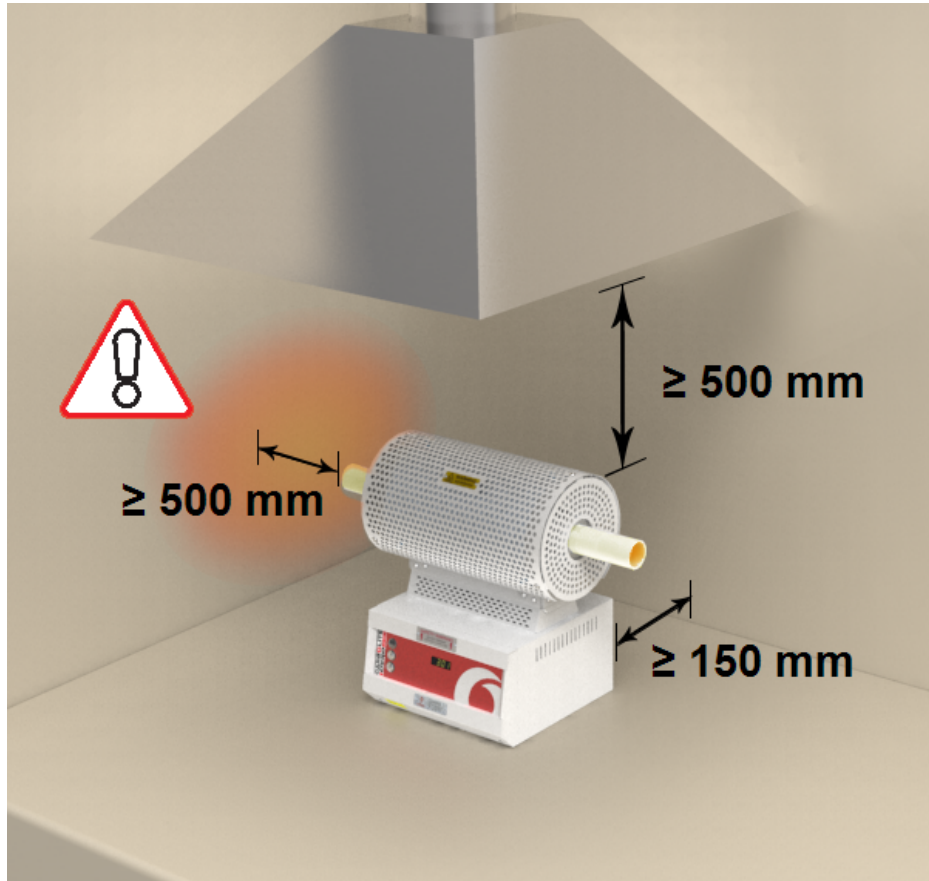
Unless otherwise stated elsewhere in this manual, ensure that there is **at least 150 mm** of free space around the back and sides of the product. Clear space is required above the product to dissipate heat.

#### Work tubes:



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

Ensure that the ends of the work tube are positioned **at least 500 mm** away from any adjacent surface so that any energy radiated cannot heat an adjacent surface to a dangerous temperature.



If the product is to be used in a process which could liberate hazardous gases, then it should be installed together with a suitable fume extraction system.

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 Setting Up

The vertical tube furnace models must have their stands assembled, the furnace mounted on the stand and their work tubes fitted before they can be used.

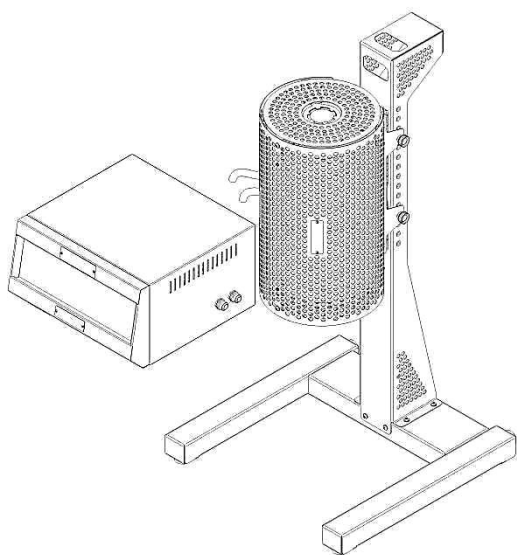
#### Assembling the stand and mounting the furnace

Tools required: 4 mm Allen key.

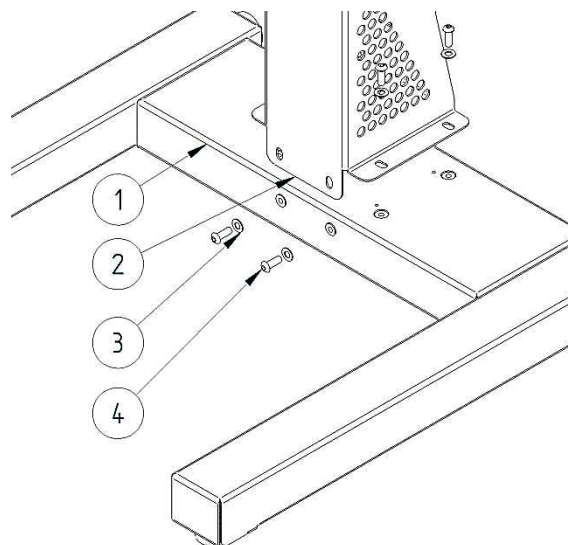
The assembly of the vertical stand is as follows with reference to 2.3.1, 2.3.2 and 2.3.3.

Place the vertical stand base item (1) on the floor or bench on which it is to be assembled.

- Position the vertical stand upright (2) on the stand base in line with the fixing holder.
- Secure the stand upright to the base using the 6 x M6 dome cap screws (4) and washers (3) supplied.
- Partially screw in the top M6 screw knobs, 2 x (6) into the frame upright as shown in 2.3.3.
- Hook the furnace onto the top screw knobs. This may take 2 people to lift the furnace.
- Fit the bottom screw knobs x 2 and tighten all four.



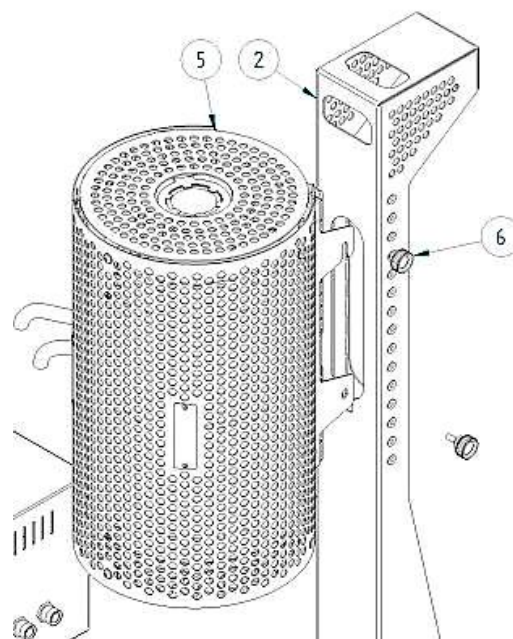
2.3.1 Figure - Vertical tube furnace model mounted on its stand.



2.3.2 Figure - Assembling the stand.

Index to numbered items in Figure 2.3.2 and Figure 2.3.3

1. Vertical stand base
2. Vertical stand upright
3. Fixing screws M6 x 16 dome cap screw
4. Washer M6
5. Tube furnace
6. M6 screw knob



2.3.3 Figure - Mounting the furnace onto the vertical stand.

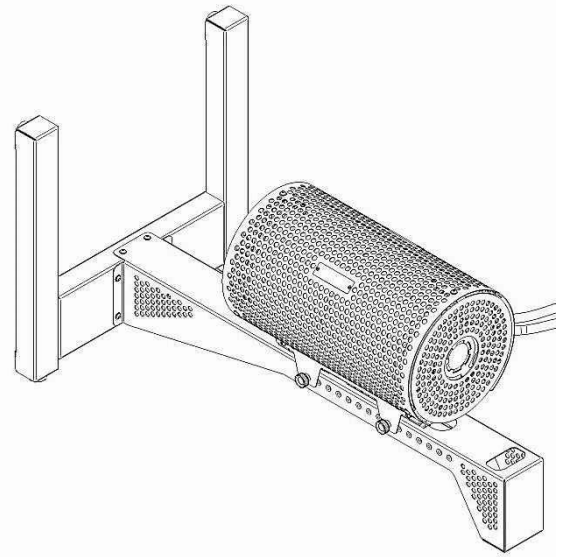
### Using the tube furnace horizontally

The furnace can be used either with the stand vertically as shown in 2.3.3 or horizontally as shown in 2.3.4.

To use horizontally simply tip the stand over into the horizontal position making sure that the flexible conduits are not trapped beneath the frame. This may take 2 people to do on the largest models.

The position of the furnace on the stand can be adjusted if necessary.

Note: To prevent injury to the operator and damage to the furnace this must only be done when the furnace is switched OFF and is cold.



2.3.4 Figure -Tube furnace positioned horizontally on the stand.

### Fitting the standard length work tube in the furnace.

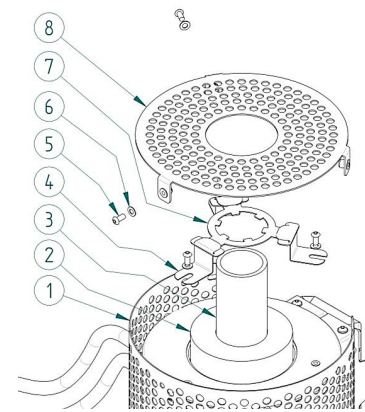
Tools required: 4 mm Allen key.

Note that the split tube furnace can only be used with the extended length work tube. This is to allow the work tube to be held in place when the furnace is opened in the vertical position. The diameter of the work tube is a customer order option and therefore varies between tube furnaces. The fitting of the work tube is as follows with reference to 2.3.5. Note that standard length work tubes are also referred to as tubes suitable for working in air; they are 150 mm longer than the heated length of the furnace (see the table in section 11.0). Read section 7.2 before fitting the work tube.

- Remove the top work tube end guard (item 8) then remove the work tube adaptor fixing bracket (4) that holds the work tube end stop (7) and the work tube adaptor (3) in place.  
 Note (1) it might be easier to do this with the furnace in the horizontal position as shown in 2.3.4.  
 Note (2) if a different work tube with a different outer diameter is being fitted it will be necessary to fit new correctly sized work tube adaptors (3). In which case, both end guards and work tube adaptor fixing brackets (4) will need removing.
- Slide the work tube into the furnace through the work tube adaptor (3) until it reaches the opposite work tube bottom stop (7). Note that the work tube might be a tight fit when it is new and may need to be twisted backwards and forwards slightly as it slides in. For long work tubes it is important to support and line up the work tube as it is pushed through the furnace. It may also take 2 people to perform this operation.
- Reassemble the work tube end stop (7), work tube adaptor bracket (4) and the tube end guard (8).

Index to numbered items in Figure 2.3.5

1. Tube furnace
2. Work tube adaptor (size dependent on work tube diameter)
3. Work tube (size diameter customer option)
4. Work tube adaptor fixing bracket
5. Fixing screws M6 x 15
6. Washer M6
7. Work tube end stop (dependent on work tube diameter)
8. Tube furnace end guard



2.3.5 Figure - Exploded view showing how to fit the work tube in the EVA

### Fitting the extended work tube in a furnace

Tools required: 4 mm Allen key

The fitting of the work tube is as follows with reference to Figure 2.3.5. Extended work tubes are 450 mm longer than the heated length of the furnace (see the table in section 11.0). Read section 7.2 before fitting the work tube.

Note it is easier to fit the work tube with the furnace in the horizontal position as shown in figure 2.3.4.

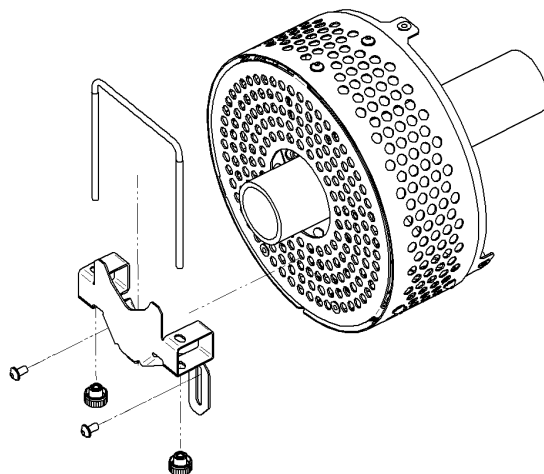
To fit the work tube in a vertical orientation follow the steps below. Omit the use of the end seal if not required. The same tube support design will work with or without the tube end seal in place.



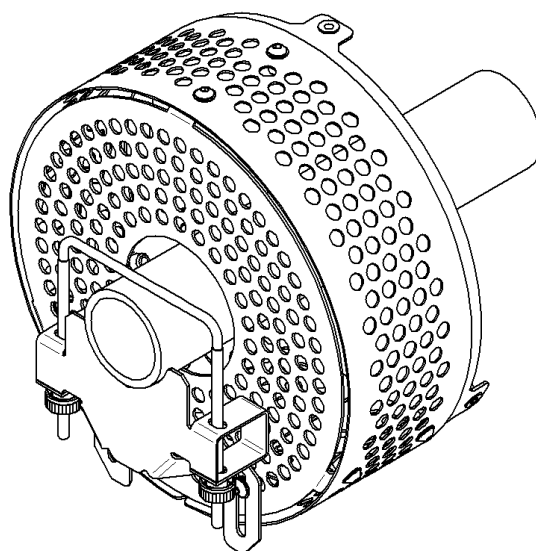
**WARNING** - If clamps are used without an end seal, care should be taken not to over tighten on to a bare tube, especially if the tube is either quartz or thin wall section.

- Before the extended work tube can be fitted, the work tube end stops for the standard length work tube must be removed from both ends of the furnace. This is done by removing the furnace end guard (8) and the work tube adaptor brackets (4) to release the work tube end stop. The guards and brackets should then be refitted.
- Fit the tube support bracket, item 15, figure 2.2. Use supplied M6 button head screws and supplied washers.
- Fit the extended work tube guard, item 14, figure 2.2. Use supplied M6 button head screws and supplied washers.
- Re-fit furnace end guard, item 13, figure 2.2. Use supplied M6 button head screws and supplied washers.
- Fit tube end seal assembly as shown in figure 2.2. refer to manual that was provided with the replacement end seals or detailed fitting instructions.
- Fit tube support bracket, item 7, figure 2.2. Use supplied M6 button head screws and supplied washers.
- Finally, fit tube support collar, (5) using item (6) until the tube is secure enough for use in a vertical arrangement. Fitting arrangement is shown in figure 2.2.

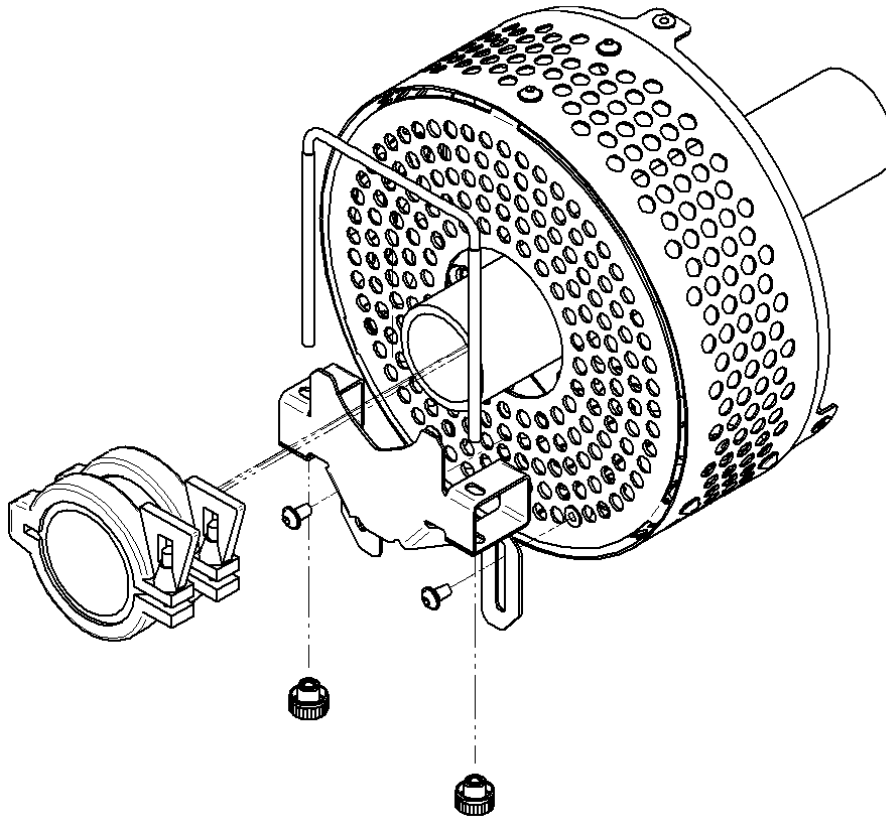
- Figure 2.2 - shows an exploded view of all the required parts.
- Figure 2.2 - shows the assembled parts as they would be used.



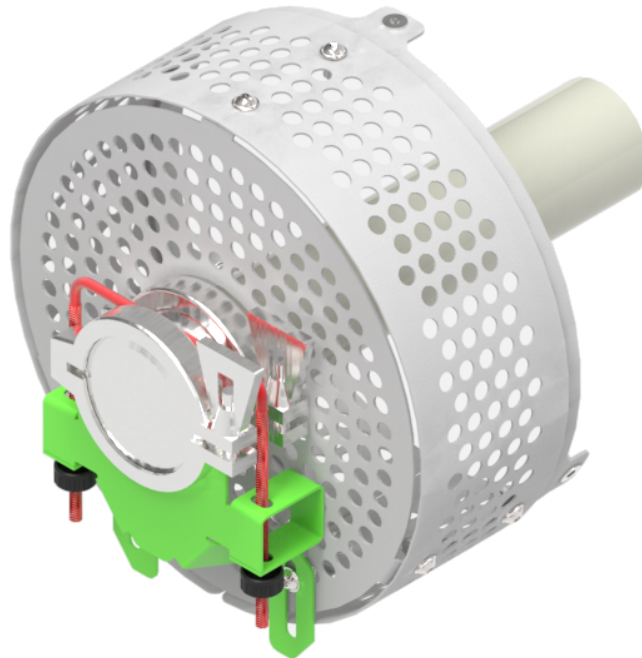
2.3.6 Figure - Tube support



2.3.7 Figure - Tube support assembly

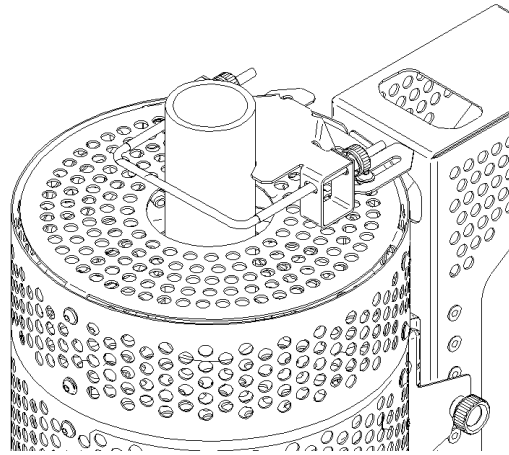


2.3.8 Figure - Tube support and end seal assembly



2.3.9 Figure - Tube support and end seal assembly

For extra stability of the tube, repeat the assembly instructions above (as shown in figure 2.3.10)



2.3.10 Figure - View showing how to support the work tube in a vertical orientation.

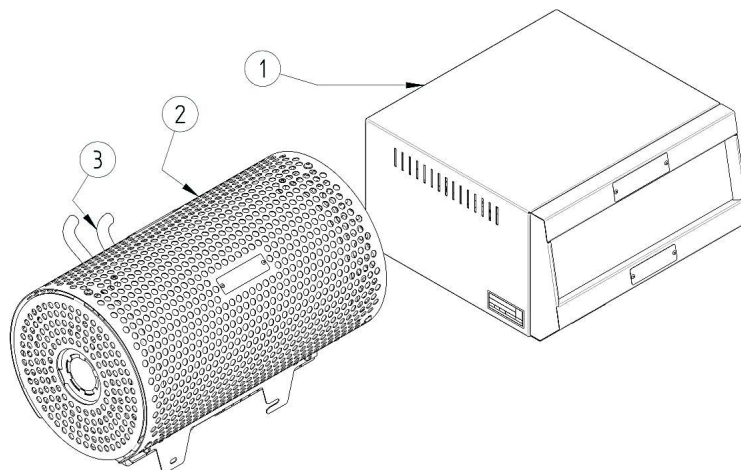
## 2.4 Setting Up - Without a Stand

Any of the E-range vertical furnaces can be supplied without a stand for either wall mounting (using wall bracket order option) or installation in customer's test rig/mounting frame.



It is the customer's responsibility to carry out a risk assessment on the siting and mounting of the furnace and to ensure that it is operated in a safe manner, see section 2.2 for the recommended siting instructions.

The fitting of the work tube is covered in the previous section.



2.4.1 Figure - Tube furnace shown without a stand for customer's own mounting as an example.



Index to numbered items in Figure 2.4.1

1. Control Box
2. Furnace Body
3. Connecting conduit between furnace and control box

**Fitting the Optional Insulation Plugs and Radiation Shield**

For optimum temperature uniformity, insulation plugs or radiation shields should be placed in the work tube ends as shown below. With a standard work tube, the insulation plug must be fitted as shown in figure A.

If a gas/vacuum end seal is fitted, either horizontally or vertically, the insulation plug hooks onto the end seal hook; see figure B.

Alignment of radiation shields is similar to that of insulation plugs, see figure C.

If a metal work tube is being used in the furnace, ensure that it is earthed. See the safety warning in section 5.4.

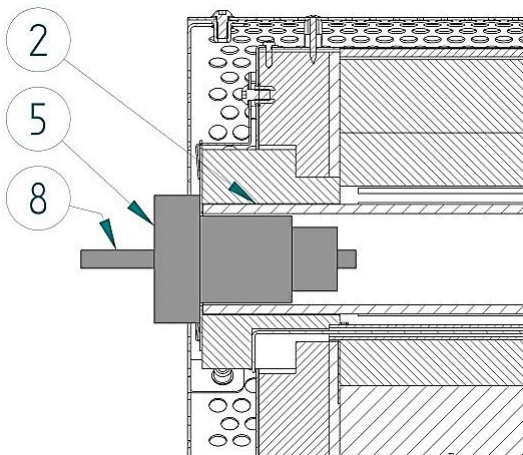


Figure A- Cross-section view showing standard length work tube insulation plug fitted

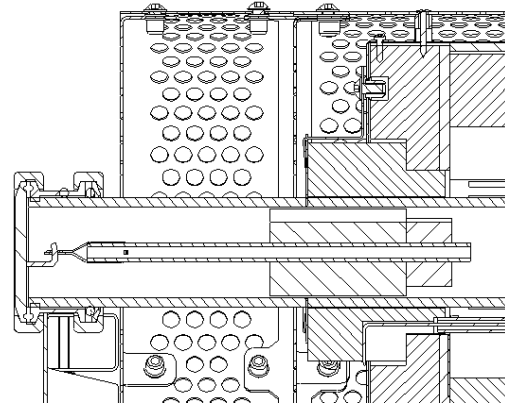


Figure B- Cross-section view showing extended work tube insulation plug fitted

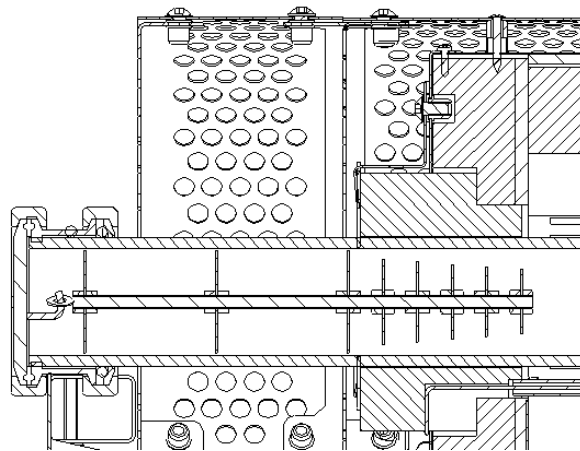


Figure C- Cross-section view showing an extended length work tube with a radiation shield fitted



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.

## 2.5 Electrical Connections



Connection by a qualified electrician is recommended.

All furnaces in the range are single-phase and operate over the voltage ranges 100 to 110 volts or 200 - 240 volts. Check the rating label before connection, see "Warning Labels" for location of rating label. To check that the OP.Hi setting is correct for the appropriate voltage, or to change to another setting, follow the instructions in section 10.2.

The electrical supply should be fused at the next standard size equal to or higher than the design current. Where a supply cable is supplied there are internal supply fuses, in which case customer fusing is preferred but not essential. See section 10.0 for furnace rating power, current and fusing information.

The external connection should be either a permanent connection to a fused isolator supply or to a socket on a fused isolator supply; the isolating switch must operate on both conductors. Make sure that the isolator switch is within easy reach of the furnace operator.

Terminal Connection Details

Supply	Terminal Label	UK/ Europe Cable Colour	USA/ Canada Common Cable Colours	Supply Type	
				Live - Neutral	Reversible or Live - Live
1-phase	L	Brown	Red or Black	To live	to either power conductor
	N	Blue	White	To neutral	to the other power conductor
	PE	Green/ Yellow	Green or Green/ Yellow	To earth (ground)	to earth (ground)

## 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		When pressed simultaneously the ACK function is used to:
Page and Scroll		<ul style="list-style-type: none"> <li>• Return to the Home Menu</li> <li>• Acknowledge an alarm if activated.</li> <li>• Reset a program after the program has ended.</li> </ul>
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 10.0.

#### 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.

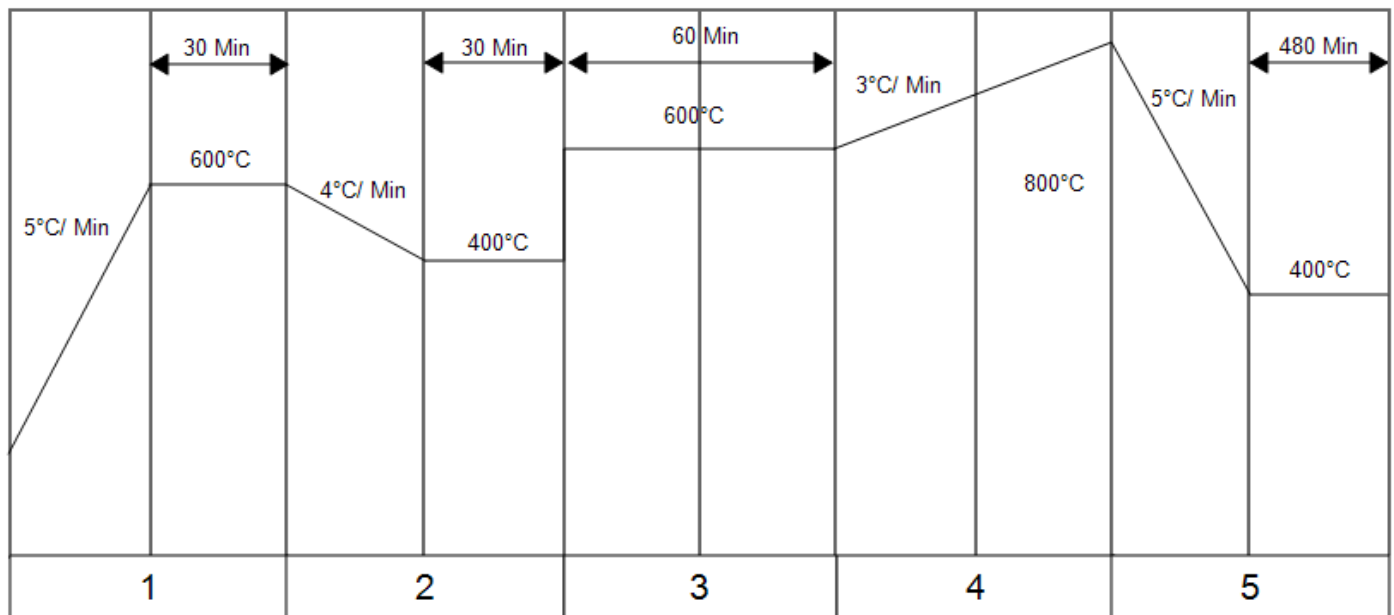
To acknowledge an alarm and cancel the "ALM" indicator, press "ACK" function.

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			<b>RS232 Cable: product to PC</b>	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 1,4,6	(4,5) (6,8,20)	Link together 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			<b>RS485 Cable: product to PC</b>	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

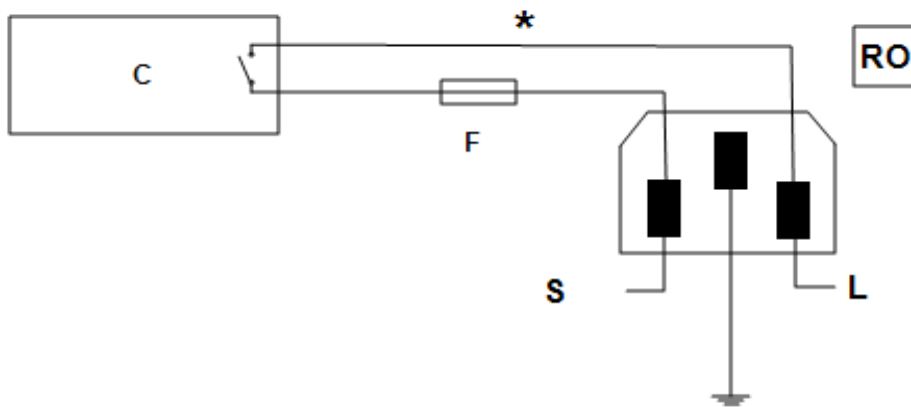
#### 3.8.3 Comms Address

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

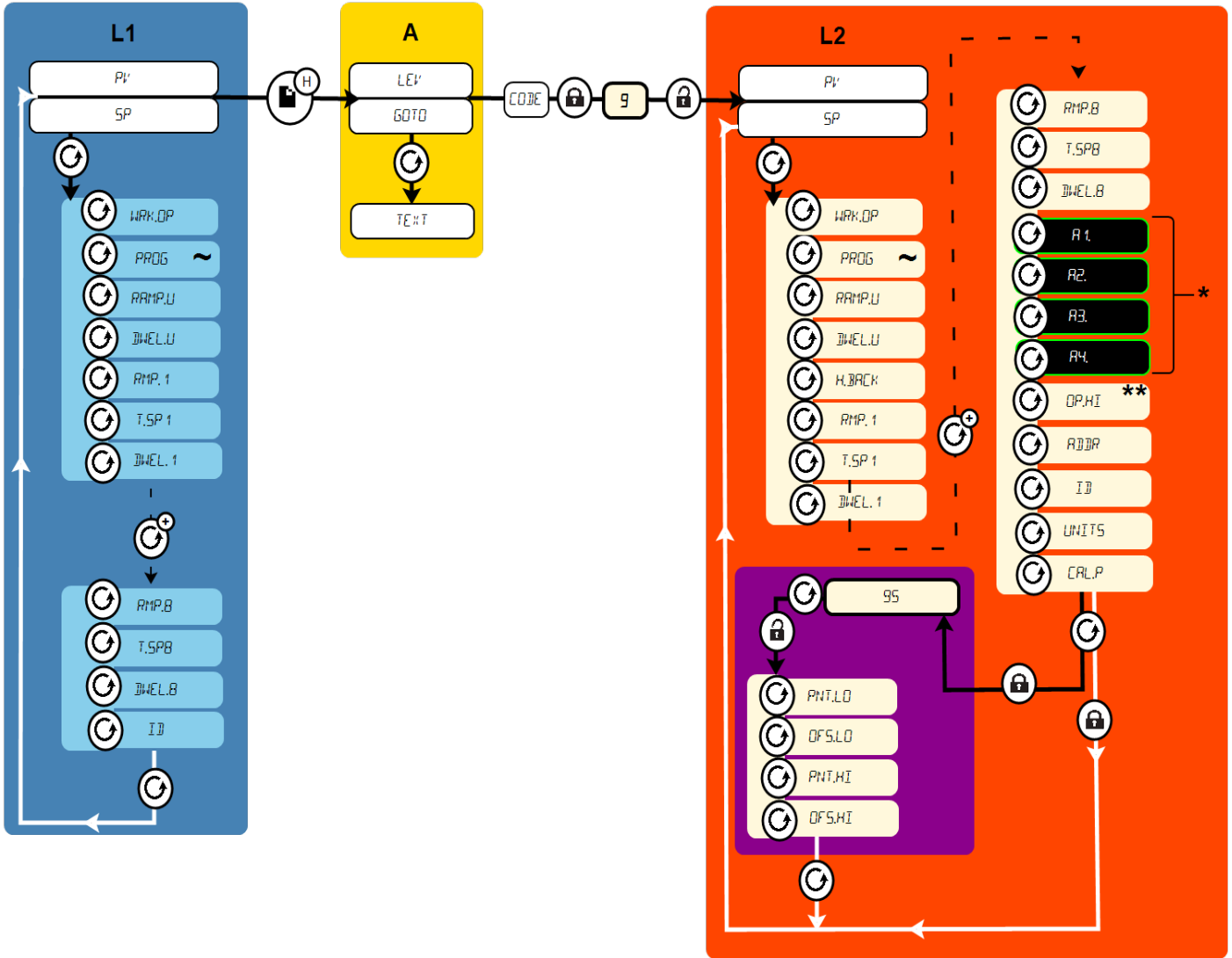


Before handling the controller: wear an anti-static wrist strap or otherwise avoid any possibility of damage to the unit by static electricity. Refer to the detailed instructions supplied with the replacement controller.

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	Level 1		Press the Scroll Key		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



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.



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

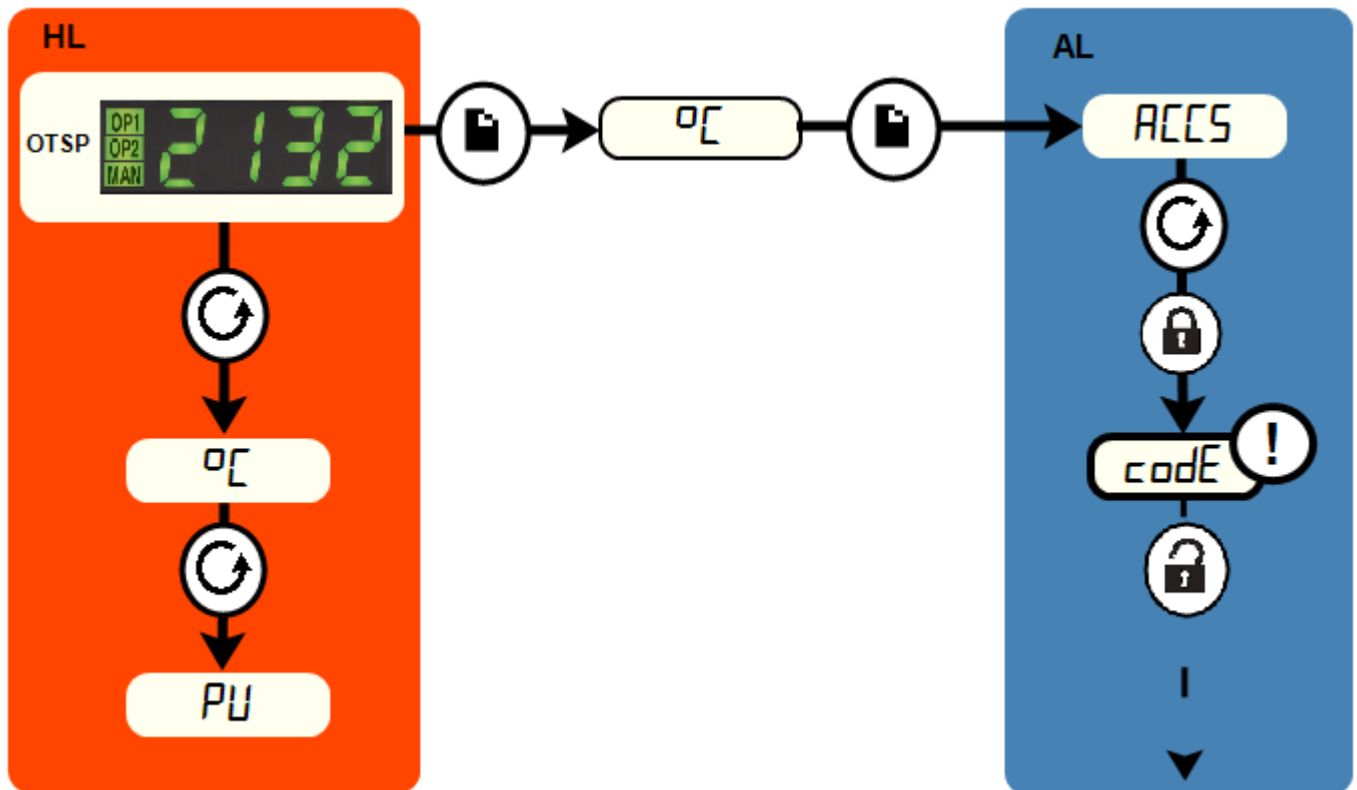
The over-temperature cut-out system also operates if the over-temperature control thermocouple breaks or becomes disconnected. The message S.br flashes where the measured temperature is normally displayed.

### 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

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

Connect the product to the electrical supply.

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

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

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

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

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

### 5.2 Safe Operation of the Furnace

For the safe operation of this furnace the following warnings must be followed:

**Explosive Materials**

The furnace must not be used to heat materials which could explode, or which could emit gases that could form explosive mixtures. If the safe heating of a material is dependent on its temperature, only heat these type of materials if the furnace has the optional over-temperature protection device fitted. Ensure that the over-temperature device is calibrated and set to an over-temperature safety limit that is sufficiently large as to avoid any hazards. If in doubt, seek expert advice before proceeding. Customers are responsible for carrying out their own risk assessments on the heating of materials.



**Do not operate without a work tube.** The furnace must not be operated without the correctly sized work tube and correspond work tube adaptor. Otherwise, an operator can access electrically live element coils that could cause serious injury or death.



**Switch off the furnace before loading and unloading.** The furnace elements must be switched off using the heater switch, item 2 in "Warning Labels", when the furnace is being loaded or unloaded. The work tube can become electrically conductive at high temperatures. If an element has failed and collapsed onto the work tube, the work tube will become live causing serious injury or death.

### 5.3 General Operating Advice



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



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

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

### 5.4 Operator Safety



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



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

## 5.5 Tube Life

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

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



Fig 4 - Avoidance of thermal contact

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

## 5.6 Pressure

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

A suitably regulated gas supply should always be used.

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

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

## 5.7 Gas Tightness

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

## 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
<b>Safety</b>						
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 					
Safety Switch Function (split models only)	Set a safe temperature above ambient, and open the furnace to see if the heater light goes out					
Safety Switch Function (split models only)	Electrical measurement 					
Electrical Safety (external)	Visual check of external cables and plugs					
Electrical Safety (internal)	Physically check all connections and cleaning of the power plate area					
<b>Function</b>						
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					
Work Tube Position	Visually check that the tube is central to the heated zone (horizontally / vertically)					
End Plugs / Radiation Shields	Visual check for damage or wear, and correct positioning					

Seals (if fitted)	Check all seals and O-rings and clamps					
<b>Performance</b>						
Element Circuit	Electrical measurement 					
Power Consumption	Measure the current drawn on each phase / circuit					
Cooling Fans (if fitted)	Check whether the cooling fans are working					



### 6.2.1 Cleaning

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



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

## 6.3 Calibration

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

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

## 6.4 After-Sales Service

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

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

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

## 6.5 Recommended Spare Parts and Spare Parts Kit

Carbolite Gero can supply individual spare parts or a kit of the items most likely to be required. Ordering a kit in advance can save time in the event of a breakdown.

Each kit consists of one thermocouple and one solid state relay.

When ordering spare parts please quote the model details i.e. model type and serial number as stated on the rating label.

## 7.0 Repairs and Replacements

### 7.1 Safety Warning - Disconnection from Power Supply



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



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

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

### 7.2 Safety Warning - Refractory Fibre Insulation



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

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

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

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

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

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

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

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

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

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

### 7.3 Temperature Controller Replacement

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

## 7.4 Solid-state Relay Replacement



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

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

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

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

Replace the access panel.

## 7.5 Thermocouple Replacement

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



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

Thermocouple cable colour codings are:

<b>thermocouple leg</b>	<b>colour</b>
positive (type N)	pink
negative	white

Disconnect the thermocouple from its terminal block.

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

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

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

Re-assemble the furnace.

## 7.6 Element Replacement

Individual elements are not available for this model of product, if an element fails then a complete element assembly is required. For details and fitting instructions contact Carbolite Gero Service, see the back page of this manual for contact information.

## 7.7 Fuse Replacement

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

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

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

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

The fuses are located at the cable entry point. Remove the back panel or control box back panel to gain access to the fuses.

## 8.0 Fault Analysis

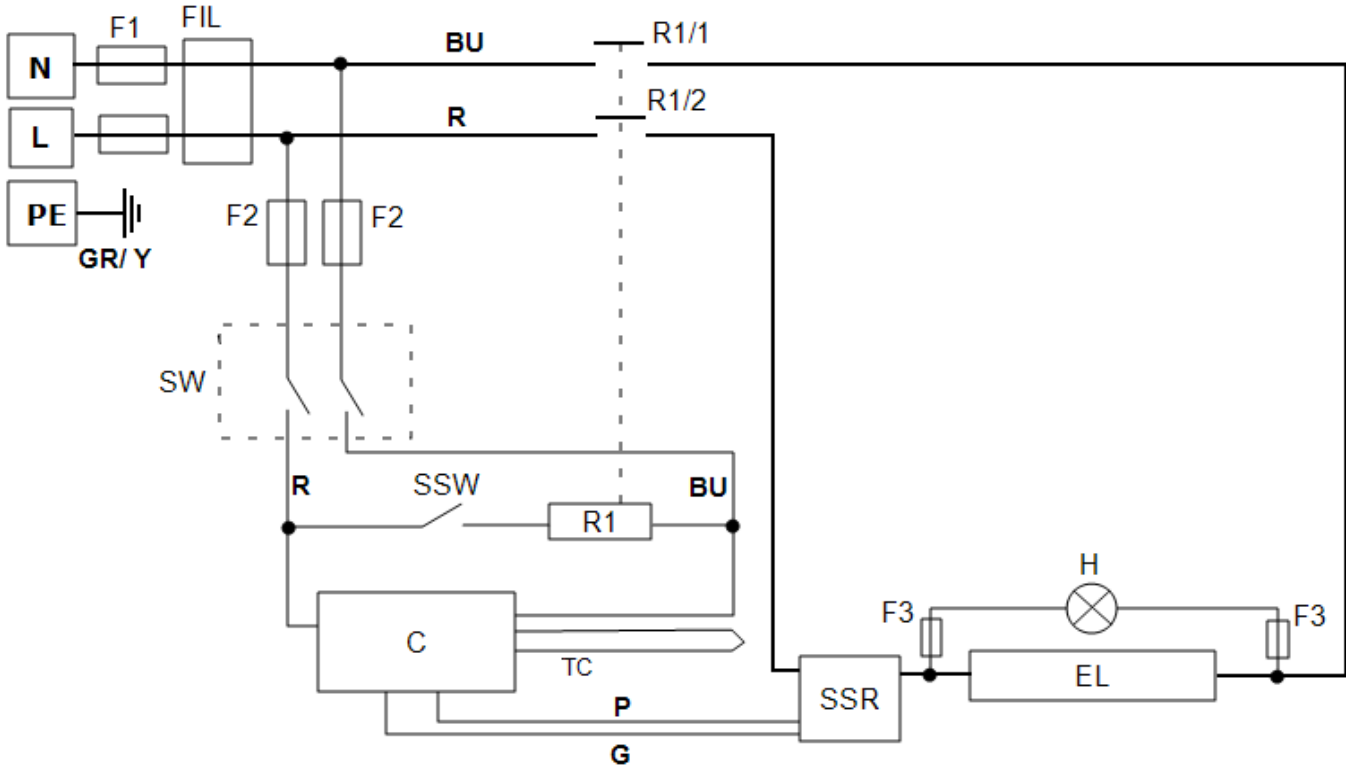
A. Furnace Does Not Heat Up				
1.	The HEAT light is ON	▶	The heating element has failed	▶ Check also that the SSR is working correctly
2.	The HEAT light is OFF	▶	The controller shows a very high temperature or code such as S.br	▶ The thermocouple has broken or has a wiring fault
		▶	The controller shows 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>B. Product Overheats</b>					
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 be faulty or may have been removed 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-11-30

Connections below show single phase with indirect safety switch(es).

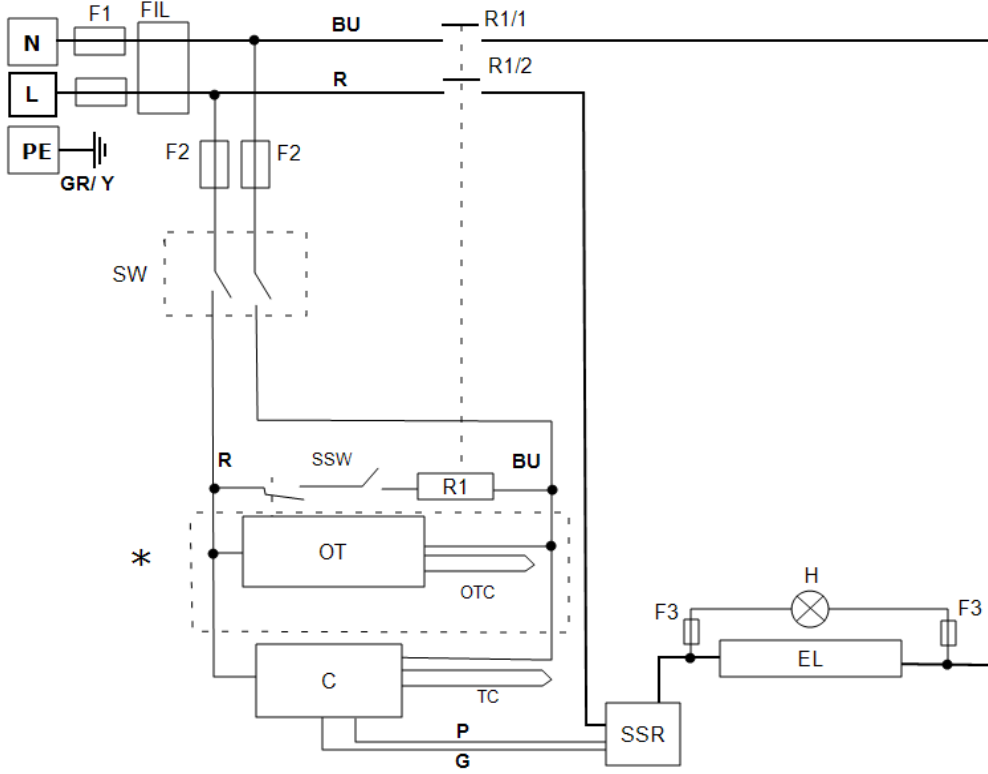


Key	
F1, F2, F3	Fuses
FIL	Filter
R1/1, R1/2	Relay Contactor
R1	Relay
C	Temperature Controller
TC	Control Thermocouple
SSR	Solid State Relay
SSW	Safety Switch
H	Heat Lamp
EL	Element(s)
SW	Instrument Switch(es)
N	Neutral
L	Live
PE	Earth

Cables	
BU	Blue
R	Red
GR/Y	Green + Yellow
G	Grey
P	Pink

**9.2 WA-11-31**

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

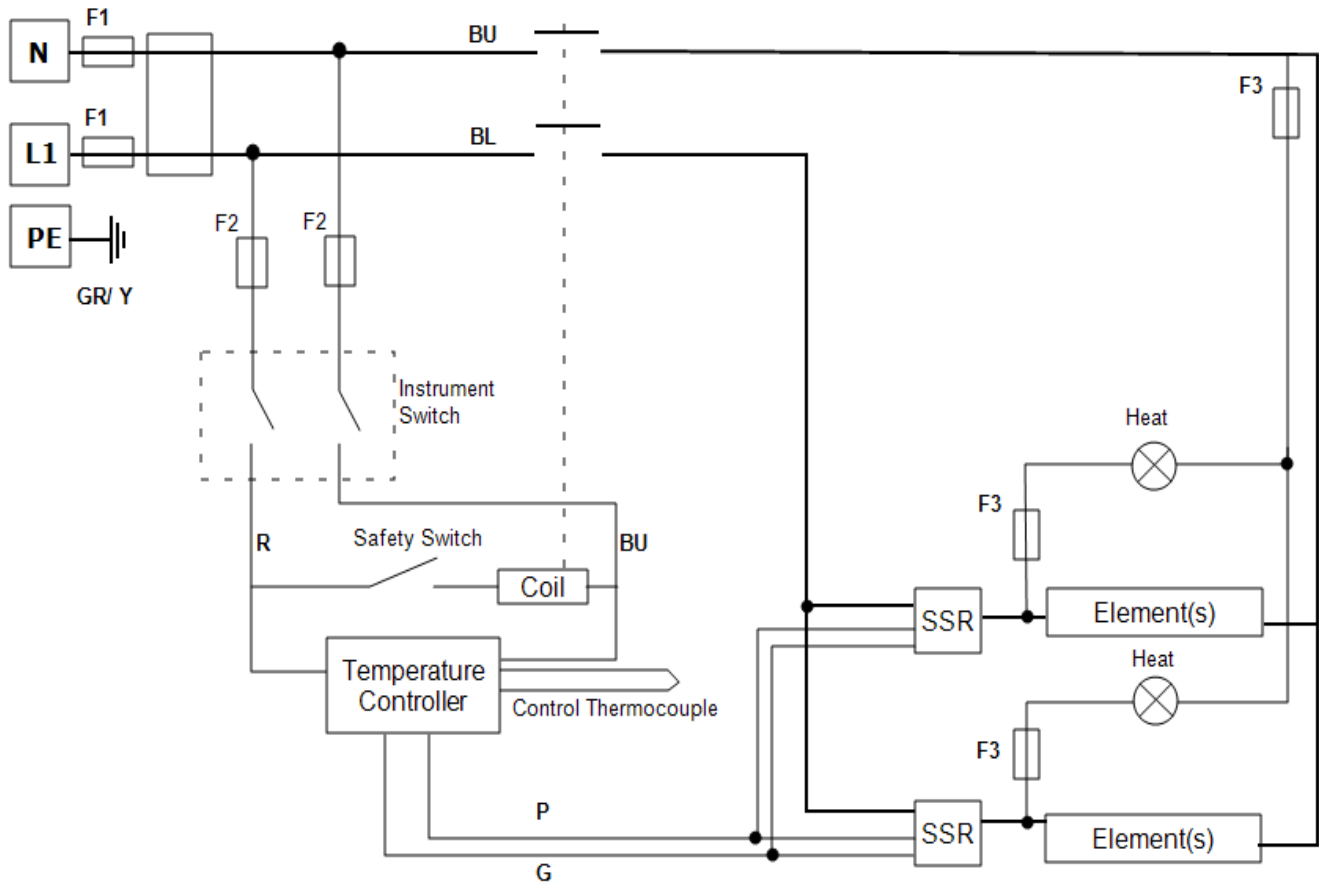


Key	
F1, F2, F3	Fuses
FIL	Filter
R1/1, R1/2	Relay Contactor
R1	Relay
C	Temperature Controller
OT	Over-Temperature Controller
OTC	Over-Temperature Thermocouple
TC	Control Thermocouple
SSR	Solid State Relay
SSW	Safety Switch
H	Heat Lamp
EL	Element(s)
SW	Instrument Switch(es)
N	Neutral
L	Live
PE	Earth
*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

Cables	
BU	Blue
R	Red
GR/Y	Green + Yellow
G	Grey
P	Pink

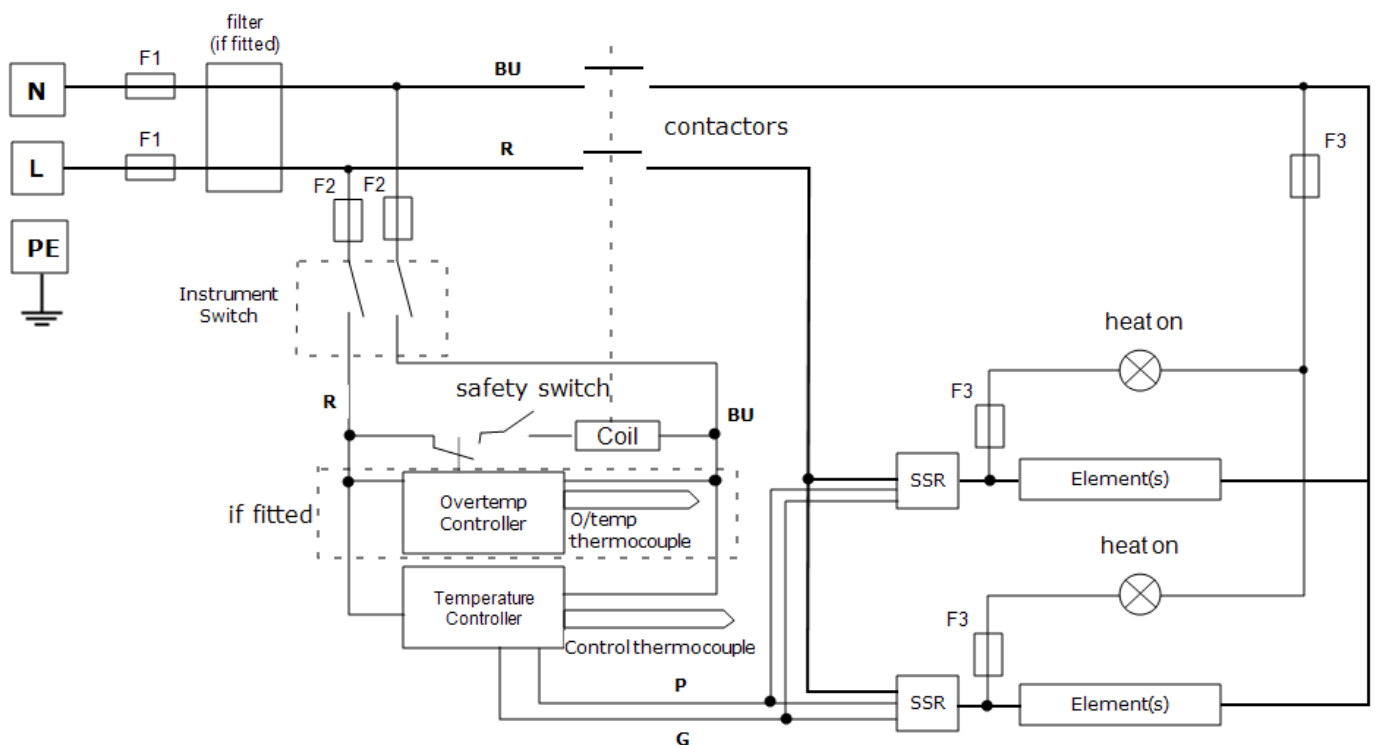


**9.3 WA-12-30**



**9.4 WA-12-31**

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



## 10.0 Fuses and Power Settings

### 10.1 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)
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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
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	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
EVA 12/150B	1-phase	100-120	10 A
EVA 12/150B	1-phase	200-208	4 A
EVA 12/150B	1-phase	220-240	4 A

## 10.2 Power Settings

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

All standard models covered by this manual are fitted with elements designed for use over the range of voltages 100 V-120 V and 200 V-240 V; the power limit parameter is set according to the table below.

The power limit depends on the voltages follows:

Voltage	100 V	120 V	200 V	208 V	220 V	230 V	240 V
Percentage (%)	100	75	100	100	89	82	75

Please refer to the rating label for product specific information.

## 11.0 Specifications

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

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

All models can accept work tubes up to a maximum outside diameter of 60 mm.

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

Model	Max Temp (°C)	Max Power (kW)	Minimum Work Tube Length (mm)	Tube length for use with modified atmosphere (mm)	Heated Length (mm)	Weight (kg)
Vertical single-zone tube furnaces.						
EVA 12/150B	1200	0.750	300	600	150	20

Work tube adaptors, extended work tube supports, insulation plugs and gas/ vacuum end seals are available from Carbolite Gero for work tubes with outside diameters of 32 mm, 46 mm and 60 mm.

### 11.1 Environment

The furnaces contain electrical parts and should be stored and used in indoor conditions as follows:

#### Ambient temperature working range

Temperature: 5 °C to 40 °C

Note: when operating the furnace at temperatures close to the maximum and the ambient temperature is above 30 °C, the allowed external temperature defined in EN 61010-1:2010 may be exceeded.

#### Relative humidity

Maximum 80% up to 31 °C, decreasing linearly to 50% at 40 °C.



#### Important safety notice:

After transportation or storage in humid conditions, the furnace could fail to meet all the safety requirements of BSEN 61010-2-010 until it has completed the drying out process to restore its normal condition.

#### Warning:

It cannot be assumed that the furnace will meet all the safety requirements of BSEN 61010-2-010 during the drying out process.

**Furnace drying out process**

Step 1. Before the furnace is connected to the electrical supply, remove the back panel and check for signs of moisture on the electrical circuits. If visible signs of moisture are present then allow it to dry out in ambient temperature for at least 24 hours. If the problem persists ensure that the furnace is isolated and contact Carbolite Gero Service for more information.

Step 2. Complete the Installation procedure (see section 2.1)

Step 3. After reading the controller operation instructions, heat the furnace following the temperature profile given below. This will need to be done manually on furnaces with basic control option or programmed into the controller if an advanced control option is fitted:

- Ramp the setpoint temperature @ 2 °C/ minute to 100 °C and dwell for 2 hours.
- Ramp the setpoint temperature @ 2 °C/ minute to 300 °C and dwell for 3 hours.
- Ramp the setpoint temperature @ 3 °C/ minute to 1100 °C and dwell for 1 hour.
- Cool naturally to ambient temperature.
- Furnace drying out process is complete.





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**

Telephone: + 44 (0) 1433 624242

Fax: +44 (0) 1433 624243

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

**Carbolite Gero Ltd,**

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

Telephone: + 44 (0) 1433 620011

Fax: + 44 (0) 1433 621198

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

[www.carbolite-gero.com](http://www.carbolite-gero.com)

**CARBOLITE**  
**GERO 30-3000°C**

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