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Томск (3822)98-41-53
Тула (4872)33-79-87
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CARBOLITE

IGERO 30-3000°C

Installation, Operation and Maintenance Instructions
1530°C Dental Furnace - CDF Model: 1 Litre
302P4 Controller

CDF 15/1C + 302P4 Controller

MEN-CDF151C-01_302P4 (01-08-2019)

part of **VERDER**
scientific

Contents

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

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1.0 Symbols and Warnings

1.1 Switches and Lights



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



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

1.2 General Warnings



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



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



DANGER – Read any warning printed next to this symbol.



Caution – Double Pole/Neutral Fusing

2.0 Installation

2.1 Unpacking and Handling

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

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



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

2.2 Siting and Setting Up

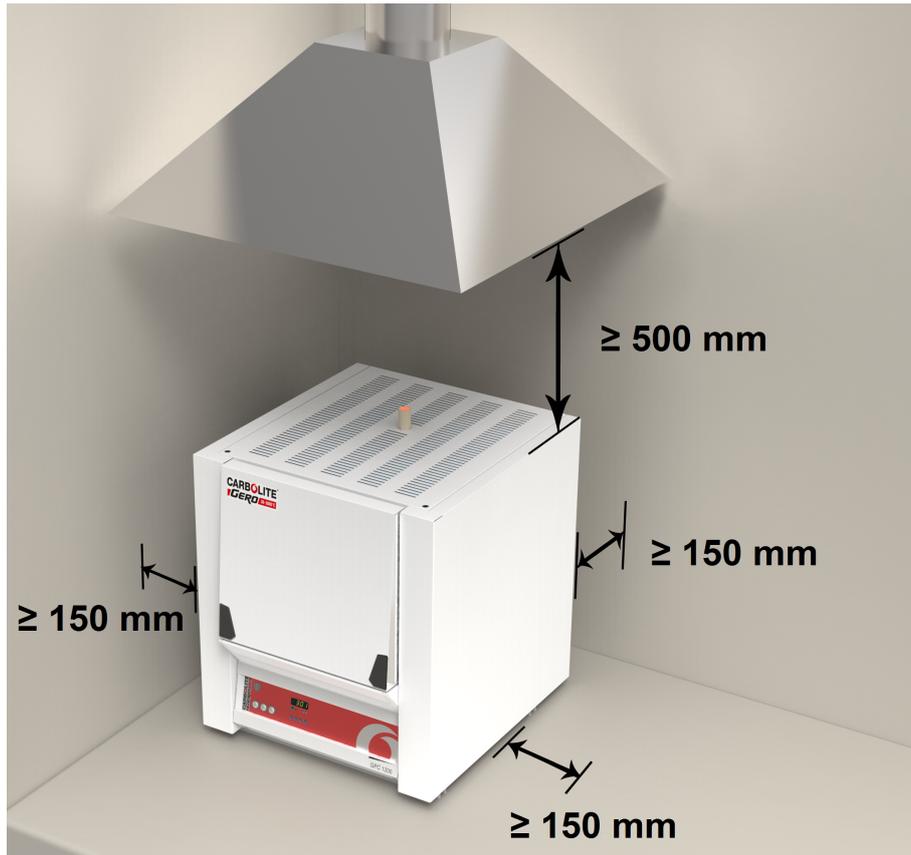
Place the product on a level surface in a well ventilated area.

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

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

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

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



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

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



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

2.3 Hearth Tile

The cast hearth is packed separately and should be fitted into the recess in the bottom of the chamber before the elements are fitted (See Photo Below).



2.4 Heating Elements

The silicon carbide elements are VERY FRAGILE and are packed separately. Fit them accordingly to the instructions in section 7.0 for element fitting and replacement instructions.

2.5 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 current on the label.

The supply should be fused at the next size equal to, or higher than the current on the label. A table of the most common fuse ratings is also given towards the back of this manual. When the mains cable is factory fitted, internal fuses are also fitted. It is essential that the operator ensures that the product is correctly fused.

Products with a factory fitted supply cable are designed to be wired directly to an isolator or fitted with a line plug.

Products without a factory fitted supply cable require a permanent connection to a fused and isolated supply. The product's electrical access panel should be temporarily removed, and connections made to the internal terminals.

If the product is to be connected by line plug. The plug should be within reach of the operator and should be easy to remove.

When connecting the product to an isolating switch ensure that both conductors (single phase) or on all live conductors (three phase), and should be within reach of the operator.

The supply MUST incorporate an earth (ground).

Electrical Connection Details:

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

Technical Notes

This model has an electronically controlled power limit. Do not attempt to calculate the Amps from the Wattage. High break capacity fuses should be used. Avoid fast-blow fuses and magnetic trip circuit breakers - consult Carbolite Gero if in doubt.

3.0 302P4 Controller

3.1 PID control

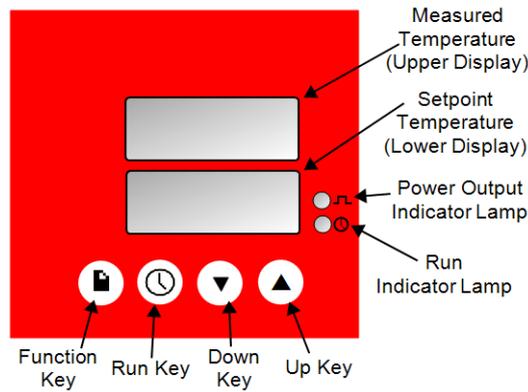
This controller uses PID (Proportional Integral Derivative) temperature control. This type of control uses a complex mathematical control system to adjust the heating power and achieve the desired temperature.

3.2 Introduction

The 302P4 Controller is a digital temperature controller which uses PID algorithms to give excellent temperature control when properly set. This controller can store 4 programs of 4 ramp/ dwell segments. Programs 1, 2 & 3 are protected by password and program 4 is open to edit.

3.3 Operation

3.3.1 Controller Layout



3.3.2 Keys

Function Key		The function key is used to: <ul style="list-style-type: none"> • Scroll down parameters. • Store modified parameters. • Review program parameters in basic operation mode.
Run Key		The run key is used to: <ul style="list-style-type: none"> • Start the program cycle when pressed for more than 1.5 seconds. • Hold program cycle when pressed for more than 1.5 seconds while program is operating. • Stop program when pressed for more than 5 seconds while program is operating or in hold. • Scroll up parameters in set up operator mode or configuration mode.
Function + Run Keys		When pressed simultaneously for more than 3 seconds is used to: Start the procedure to select operating mode.
Arrow Keys		The arrow keys are used: individually to adjust the selected parameters.
Down + Function Keys		When pressed simultaneously: Are used to enable "lamp test" in Basic mode
Down + Run Keys		When pressed simultaneously: Used to reach minimum value during parameter modify
Up + Run Keys		When pressed simultaneously: Used to reach maximum value during parameter modify

Note: In operator set up mode, 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.

3.4 Quick Start Guide

3.4.1 Home display

When switched on, the controller goes through a short lamp test routine and then displays the process value in the upper display and "rdy" in the lower display. This is known as the "Home Display".

3.4.2 Selecting a Program

With basic operator mode selected "OP.b" (see section 3.4.6) press the function key once to display "nprG" in the lower display and the program number in the upper display. Select the required program number using the down ▼ or up ▲. After selection press the function key  to store the parameter.

3.4.3 Starting the Program Cycle

To start the program the "Run" button  must be pressed and held down for 1.5 seconds. After 1.5 seconds the lower run indicator lamp will be lit continually and the displays will show the program setpoint ("PSP"); lower display, current temperature; upper display.

3.4.4 Program Cycle

Once the program has been started, the heat light (situated below the power switch) and the upper power output indicator lamp will initially display a long pulse at a continuous cycle rate, these display pulses will reduce within the same cycle rate, as the product approaches the desired temperature or a program setpoint. As the program is operating, the lower indicator lamp will be lit continuously.

When the program has finished its cycle the lower indicator lamp will be switched off and the lower display will show "End".

3.4.5 Program Hold and Cancel

To hold the program, the "Run" button  must be pressed and held down for 1.5 seconds, while the program is operating. When the program is in hold, the lower display will flash between the word "hoLd" and current program setpoint and the lower indicator lamp will flash continually. To remove the hold status, the "Run" button must be pressed and held down for 1.5 seconds. After 1.5 seconds the lower display will no longer display hold and the lower indicator lamp will be lit continually. The program will then continue from the current process value indicated on the upper display.

To cancel a program, either while the program is operating or in the hold condition, the "Run" button must be pressed and held down for 5 seconds. After 5 seconds the lower indicator lamp will switch off, the lower display will show "rdy", and the upper display will show the current process value.

To restart the program refer to the section 3.4.3.

3.4.6 Understanding Operator Levels

There are three user levels in the controller; "Op.b" (Basic Operator Mode) "OP.E" (Enhanced Mode) and "OP.P" (Program Edit Mode).

There are also three further engineering levels indicated by "OPS", "CP1" and "CnF" which are factory set and not covered within this manual.

"Op.b" (Basic Operator Mode) is for operating the program only. No other parameters are available.

"OP.E" (Enhanced Mode) is for calibration and address assignment. Access to these is protected by security code =17.

"OP.P" (Program editing mode) provides access to programming parameters.

To Enter "OP.E" (Enhanced mode) starting from basic operator mode ("OP.b").

1. From the home display press and hold the function and run keys  +  simultaneously for more than 3 seconds.
2. The display will show "OPr" lower display and "OP.b" upper display ("Op.b" being the current active mode)
3. Press the up  or down  to choose "OP.E"
4. Press  to enter selected level.
5. The word pass will be shown on the bottom display and ---- on the top display. This will time out after 10 seconds, during this period the password should be selected using the up  or down 
6. Press  to enter the password.
7. When the correct password has been entered the upper display will flash "PASS". If an incorrect password is entered the upper display will flash "Err" then return to the home display.

Once in "Enhanced" mode, the parameters within this level can be accessed by pressing page  to descend the list, or run to ascend the list.

When "OP.E" operations have been completed, "OP.b" mode must be returned to manually as outlined below.

To Enter OP.P (Program Editing Mode).

8. From the home display press and hold the function and run keys  +  simultaneously for more than 3 seconds.
9. The display will show "OPr" lower display and "OP.b" upper display ("Op.b" being the current active mode)
10. Press the up  or down  to choose "OP.P"
11. Press  to enter selected level.
12. Once in the 'Program Edit' mode the parameters within this mode can be accessed by pressing page  to descend the list, or run to ascend the list.

Note: There is no time out or power cycling function, whereby the instrument automatically returns to a lower operating mode.

When "OP.P" operations have been completed, "OP.b" mode must be returned to manually as outlined below.

To exit OP.E ('Enhanced' mode) or OP.P ('Program Editing' mode) and return to OP.b ('Basic Operator' mode).

1. Return to the top level home display of the "OP.E" or "OP.s" list. This will be where the displays show the, program setpoint (PSP) in the lower display and current temperature in the upper display. This can be done either by leaving the current selected parameter to time out after 10 seconds, or by pressing the page  or Run  to scroll through the parameter list and return to the top level home display.
2. Press and hold function and run  +  simultaneously for more than 3 seconds.
3. The display will show "OPr" lower display and "OP.E" or "OP.P" upper display ("OP.E" or "OP.P" being the current active mode)
4. Press the up  or down  to choose "OP.b"
5. Press  to enter selected level.
6. No password is required to enter a lower level of operation, therefore the display will return to basic operator mode and show the program setpoint (PSP); lower display and current temperature; upper display. Check that no parameters are not available by pressing the page or run keys.

Table showing parameters accessible in "OP.b", "OP.E" and "OP.P" modes.

BASIC OPR MODE OP.b	ENHANCED MODE OP.E	Program Editing Mode OP.P	Description
home display	home display	home display	
	OP		SELECTED SETPOINT
	CL.ST		CUSTOMER CALIBRATION
	OFST		OFFSET FOR 1 POINT CALIBRATION OR COEFFICIENTS "b"
	SLOP		COEFFICIENT "a" (Slope)
	CAL.L		LOW POINT FOR 2 POINT CALIBRATION
	OFS.L		OFFSET ON LOW POINT FOR 2 POINT CALIBRATION
	CAL.H		HIGH POINT FOR 2 POINT CALIBRATION
	OFS.H		OFFSET ON HIGH POINT FOR 2 POINT CALIBRATION
	ADr		MODBUS ADDRESS
nPrG			SELECTED PROGRAM
SEG			SEGMENT IN EXECUTION

BASIC OPR MODE OP.b	ENHANCED MODE OP.E	Program Editing Mode OP.P	Description
rT			TIME REMAINING TO THE END OF PROGRAM
r.rPt			REPETITIONS REMAINING TO THE END
rPt			TIME REMAINING UNTIL THE END
ITSP#		ITSP	INITIAL SET POINT
SP.1#		SP.1	SEGMENT 1 TARGET SET POINT
rr.1#		rr.1	SEGMENT 1 RAMP RATE TO SP 1
TH 1#		TH 1	SEGMENT 1 TIME HELD AT SP 1
SP.2#		SP.2	SEGMENT 2 TARGET SET POINT
rr.2#		rr.2	SEGMENT 2 RAMP RATE TO SP 2
TH 2#		TH 2	SEGMENT 2 TIME HELD AT SP 2
SP.3#		SP.3	SEGMENT 3 TARGET SET POINT
rr.3#		rr.3	SEGMENT 3 RAMP RATE TO SP 3
TH 3#		TH 3	SEGMENT 3 TIME HELD AT SP 3
SP.4#		SP.4	SEGMENT 4 TARGET SET POINT
rr.4#		rr.4	SEGMENT 4 RAMP RATE TO SP 4
TH 4#		TH 4	SEGMENT 4 TIME HELD AT SP 4
Rpt#		rPT	PROGRAM EXECUTION REPETITIONS
CET#		CET	CYCLE END THRESHOLD

NOTE: In basic mode these parameters are not alterable

3.5 Programming

3.5.1 Program Parameters

In the basic operator mode – the below list of parameters are available.

nPrg

Meaning:	number of the selected program
Range:	from 1 to 4
Available:	Always
Alterable:	only when the programmer state is idle

SEG

Meaning:	number of the segment execution
Range:	from "1 r" to "4 d" The segment number is followed by the segment stage, "r" for ramp and "d" for dwell. Example: 1 r: ramp stage of the first segment 4 d: dwell stage of the fourth segment
Available:	only when the programmer state is run or hold
Alterable:	never

rt.

Meaning: time remaining to the end of the program

This value refers to the time remaining to the end of the current execution, regardless the programmed number of executions.

- Range:
- from 1 second to 99 min 59 sec
 - the upper display shows 12.30 (12 min 30 sec)
 - the lower display shows rt.S

 - from 1 h 40 min to 99 h 59 min
 - the upper display shows 18.45 (18 h 45 min)
 - the lower display shows rt.H

 - from 100 to 9999 hours
 - the upper display shows 125 (125 h)
 - the lower display shows rt.H

 - over 9999 hours
 - the upper display shows %%%%
 - the lower display shows rt.H

Available: only when the programmer state is run or hold

Alterable: never

r. rpt

- Meaning: repetitions remaining to the end
-
- Range: from 0 to 9999 and then inF
The figure shows the remaining repetitions after the current execution. For example 0 means that the program stops at the end of the current execution, while inF means that the device is set for endless repetitions.
-
- Available: only when the programmer state is run or hold and the "Program execution repetitions" parameter is different from 0
-
- Alterable: never

rpt...

Meaning: time remaining to the end of the program, considering also the remaining repetitions

Range: -

- from 1 second to 99 min 59 sec
- the upper display shows 12.30 (12 min 30 sec)
- the lower display shows rpt.S

- from 1 h 40 min to 99 h 59 min
- the upper display shows 18.45 (18 h 45 min)
- the lower display shows rpt.H

- from 100 to 9999 hours
- the upper display shows 125 (125 h)
- the lower display shows rpt.H

- over 9999 hours
- the upper display shows %%%%
- the lower display shows rpt.H

Available: only when the programmer state is run or hold and the "Program execution repetitions" parameter is different from 0

Alterable: never

itSp, Sp. 1, rr. 1, TH. 1, SP 2, tH. 2, Sp. 3, rr. 3, tH. 3, Sp. 4, rr. 4, tH. 4.
(see section 3.5.2)

Available: only when the programmer state is run or hold for review
only

Alterable: only in "OP.P" mode

3.5.2 Program editing

To select the program to edit, change the "nPrg" parameter to show the program you wish to edit.

Then access the program edit operative mode "OP.P" to address the below parameters:
(The normal 10 s time out is removed during monitor/ modify the program parameters)

itSp

Meaning:	initial setpoint, it is the setpoint used by the programmer during the "idle" state.
Range:	OFF and then from 0 °C - 1500 °C The OFF value means that the control output(s) will be disabled during the "idle" state; at program start up the setpoint will be aligned to measure value and then ramps to SP. 1.
Available:	Always
Alterable:	only when the programmer state is idle or, for program 1-2-3, if the edit is enabled

Sp. 1

Meaning:	target setpoint of the first segment
Range:	0 °C - 1500 °C
Available:	Always
Alterable:	only when the programmer state is idle and, for program 1-2-3, the edit is enabled

rr. 1

Meaning: ramp rate to SP1.

Range: from 0.1 to 12 °C (Engineering units (°C) per minute)

Available: Always

Alterable: only when the programmer state is idle and for program 1-2-3, the edit is enabled

TH. 1

Meaning: time held (dwell) at SP1

Range: from 0 min to 99 h 59 min

Available: Always

Alterable: only when the programmer state is idle and, for program 1-2-3, the edit is enabled

Sp. 2

Meaning:	target setpoint of the second segment
Range:	Range: End and then from 0 °C – 1500 °C The End value, selectable from the second to the fourth setpoint, is used to end the program before the last – fourth - segment. This avoid to edit unnecessary parameters for programs shorter than four segments.
Available:	Always
Alterable:	only when the programmer state is idle and, for program 1-2-3, the edit is enabled.

Then rr. 2 , tH. 2, Sp. 3 , rr. 3 , tH. 3 , Sp. 4 , rr. 4 , tH. 4 as above.

rpt

Meaning: number of program repetitions of the selected program

Range: - from 0 to 9999 and then inF

Range: The figure expresses the repetitions after the first execution. For example, if 2 is selected, the program will be executed 3 times, while inF means that the device is set for endless repetitions.

Available: Always

Alterable: only when the programmer state is idle and, for program 1-2-3, the edit is enabled

Cet

Meaning: cycle end temperature

Range: OFF and then from 0 °C (low scale range value) to 1530 °C (high scale range value)

Available: Always

Alterable: only in "Program Edit" mode, when the programmer state is idle or, for program 1-2-3, if the edit is enabled

Note: See "Program End Feature" for operation description

3.5.3 Creating a program

Programs are created in the programming level "OP.P". There are 4 programs available.

Each of the 4 programs contains 4 ramp/ dwell pairs.

3.5.4 Enter Program Edit level

Press and hold the function and run keys  +  simultaneously for more than 3 seconds.

The display will show "OPr" lower display and "OP.b" upper display ("Op.b" being the current active mode)

Press the up  or down  to choose "OP.P".

Press  to enter selected level.

3.5.5 Programming

Note: the normal 10 seconds time out is removed while editing the program list.

Program Number

Press function  to show "nPrG" lower display and the program number in the upper display.

Press the up  or down  to choose the program number.

Press  to enter the selected program number.

Initial Setpoint

After confirming password for program 1, 2, 3 or selecting program 4, the display will then show, "itSP" lower display and the value in the upper display.

Use the up  or down  to select the initial setpoint.

NOTE: It is recommended that this value is set to "OFF" for the controller to display "rdy" in the home menu (see "Home Display" under "Quick Start Guide") If a value is assigned, the display will show this value in place of "rdy".

Press  to confirm.

Setpoint 1

After confirming selection, the display will then show, "SP.1" lower display and the value in the upper display.

Use the up  or down  to select setpoint 1.

Press  to confirm.

Ramp Rate

After confirming selection, the display will then show, "rr.1" lower display and the value in the upper display.

Use the up  or down  to select a value for ramp rate.

Press  to confirm

Time Held (Dwell)

After confirming selection, the display will then show, "tH.1" lower display and the value in the upper display.

Use the up ▲ or down ▼ to select a value for time held (dwell).

Press  to confirm.

Setpoint 2 onwards

After confirming selection, the display will then show, "SP.2" lower display and the value in the upper display.

Use the up ▲ or down ▼ to select a value for "Setpoint 1", or reduce the value to below the minimum to select "End", if no further segments are required

Press  to confirm.

This process is repeated for each of the 4 segments of the program.

Repeat Program

After confirming selection, of the last parameter in the program, the display will then show, "rPt". lower display and the value in the upper display.

Use the up ▲ or down ▼ to select how many times the program requires repeating

Press  to confirm.

Cycle End Temperature

After confirming selection, of the last parameter in the program, the display will then show, "CEt" lower display and the value in the upper display.

Use the up ▲ or down ▼ to select the temperature at which the program cycle will end.

Note: Below Zero the cycle end temperature will display off, when set at this value the program will display "End" after last dwell period.

Press  to confirm

3.5.6 Program Review

Programs 1, 2, 3, 4 can be reviewed while in the program level.

Note: the normal 10 seconds time out is removed while reviewing the program list.

At the home display of the programming level, press  to show "nPrG" lower display and the program number in the upper display.

Press the up ▲ or down ▼ to choose the program number.

Press  to select the required program number.

Press the up ▲ or down ▼ to choose the program number.

Subsequent presses of  will scroll through each segment of the program.

Note: If the operator tries to modify a segment while reviewing programs 1,2,3, the upper display will show "Loc".

3.5.7 Exit Program level

There is no time out or power cycling function, whereby the instrument automatically exits to a lower operating mode.

When OP.P functions have been completed, "OP.b" mode must be returned to manually as outlined below.

Return to the top level home display of the "OP.P" list. This will be where the displays shows the program setpoint (PSP) in the lower display and current temperature in the upper display. This can be done either by leaving the current selected parameter to time out after 10 seconds, or by pressing the page  or run to scroll through the parameter list and return to the top level home display.

Press and hold function and run  simultaneously for more than 3 seconds. The display will show "O.Pr" lower display and "OP.P" upper display.

Press the up  or down  to choose "OP.b"

Press  to enter selected level.

No password is required to enter a lower level of operation, therefore the display will return to basic operator mode and show the, program setpoint (PSP) in the lower display and current temperature in the upper display.

Check that no parameters are available by pressing the page or run keys.

3.5.8 Running a program

Ensure the controller is in the basic operator mode parameter "OP.b".

Press function  to show "nPrG" lower display and the program number in the upper display.

Press the up  or down  to choose the program number.

Press  to enter to select the required program number.

Table below shows the key presses to operate a program

Operation	Action	Indication
To RUN a program	Press  for more than 1.5 seconds.	Run indicator = ON
To HOLD a program	Press  for more than 1.5 seconds.	Run indicator = ON Lower Display = HOLD
To CANCEL a program	Press  for more than 5 seconds	Run indicator = Off

	Program Ended	Run indicator = Off Lower Display = END
To RESET after a program has completed	Press  or  or  or  once	Run indicator = Off

3.5.9 Program Status

The controller can be in one of the following states.

State	Controller	RUN indicator	Lower display in "Normal display mode"	Program Editing
Ready rdy	Controls at ITSP	OFF	SP, steady	Allowed
Run	Executes the program	ON	SP, steady	Not allowed, read only
Wait*	Pauses the program	ON	Blink SP/ trAc	
Recovery*	Ramps to dwell SP	ON	Blink SP/ rEC	
Natural Cool	Power OFF	ON	CooL	
Hold	Pauses the program	Blink	Blink SP/ HoLd	

The program status can be changed by RUN key only if device is in "Normal" display mode.

*The wait and recovery states are not under the control of the operator.

The wait state is entered/ exited automatically by the relationship between the SP and current temperature values. The instrument will go into the recovery state, until setpoint is achieved, after a power failure, during a dwell or after using hold

3.5.10 Program Review

While the program is operating and the controller is in the basic operator mode the status of the program can be observed by pressing the function key .

From the home display, press  to cycle through each of the following parameters (for details see section 3.5.1)

nPrG, SEG, rT S, rrPt, rPt, itSp, Sp. 1, rr. 1, TH. 1, SP 2, tH. 2, Sp. 3, rr. 3, tH. 3, Sp. 4, rr. 4, tH. 4, rPt, CEt

Note: Review of the program parameters while the program is in the run status, can only be accessed sequentially using the  key .

3.5.11 Program End Feature

A program can end in one of two ways, either after the unit temperature has dropped below the cycle end threshold "CEt" which is the general method for most programs or after the last program repetition, if "CEt" has been set to OFF.

Program end with a cycle end threshold value.

When a program has a cycle end threshold value assigned and the last program repetition is finished the device is turned off and naturally cooled until the temperature value is less than threshold established by "Cet". During this phase the lower display shows "Cool" while the upper display shows the temperature value.

After this period, when the temperature value is less than the cycle end threshold the unit will still cool naturally to ambient but the display will show "End" on the lower display and the temperature value on the upper display, indicating that the full program cycle is completed.

Note: It is recommended that the cycle end threshold is no greater than 600 °C. This maybe less, depending on the work piece.

Program end with cycle end threshold set to off.

If a program has the cycle end threshold set to "OFF" the natural cool phase is removed, which means when the last program repetition is finished, the controller immediately displays "End" the device is then turned off and will naturally cool to ambient.

Note: There is no cool period indicated with this method and therefore the product door may inadvertently be opened straight after a high temperature cycle, causing damage to the work piece and/ or elements. It is therefore recommended that the cycle end threshold has a value set to it.

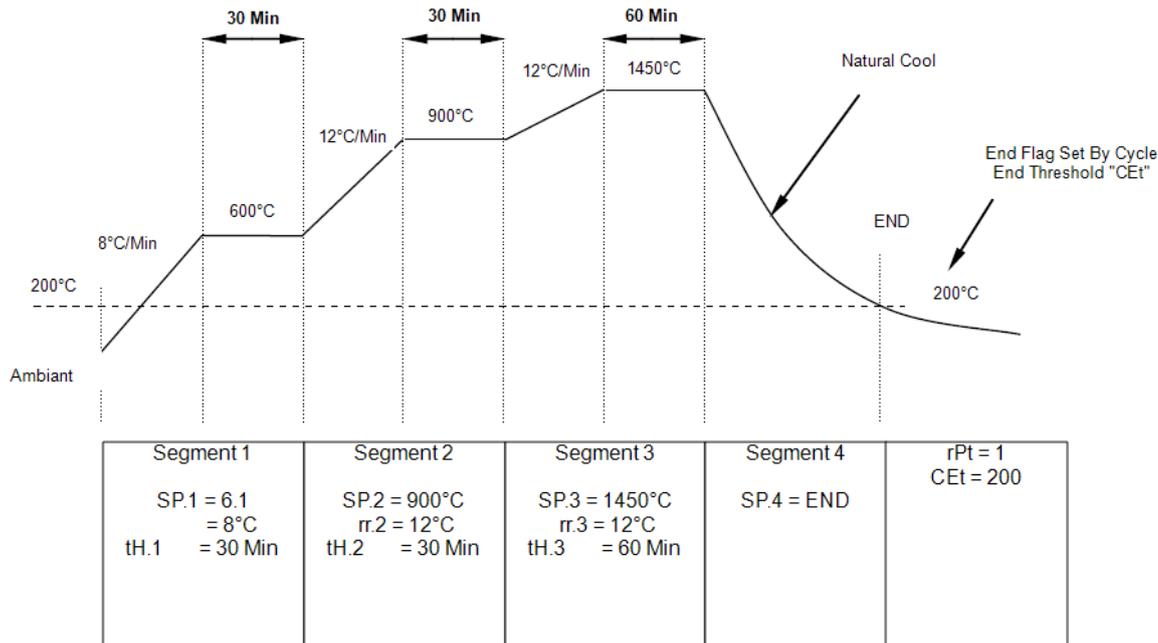
In either of the above cases the display will continue to display "End" until it has been acknowledged by pressing any of the four controller keys. After pressing one of the keys the display will show "rdy" on the lower display and the temperature value on the upper display, indicating that the program is ready to be operated.

3.5.12 Program Example

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

1. Press  until the lower display shows "itSP". Select 10.
2. Press  until the lower display shows "SP. 1". Select 600
3. Press  until the lower display shows "rr. 1". Select 8
4. Press  until the lower display shows "t.H. 1". Select 30
5. Press  until the lower display shows "SP. 2". Select 900
6. Press  until the lower display shows "rr. 2". Select 12
7. Press  until the lower display shows "t.H.2". Select 30
8. Press  until the lower display shows "SP. 3". Select 1450
9. Press  until the lower display shows "rr. 3". Select 12

10. Press  until the lower display shows "t.H. 3". Select 60
11. Press  until the lower display shows "SP. 4". Select END
12. Press  until the lower display shows "rPt". Select 1
13. Press  until the lower display shows "CEt". Select 200
11. Press  until the lower display shows the home display



3.6 Enhanced Mode

In enhanced mode the following parameters are available.

CUSTOMER CALIBRATION TYPE SELECTION

Identification code: CL.st

Range: FACT Factory calibration (a = 1 b = 0)

C.CL1 1 point calibration (a = 1 b = OFSt)

C.CL2 2 point calibration (a = x b = x)

C.CL3 2 coefficients calibration (a = SLOP b = OFSt)

OFFSET

(This parameter is always available but can be modified only if CL.ST = C.CL1, C.CL3)

Identification code: OFSt

Range: -199.9 / 199.9

SLOPE

(This parameter is always available but can be modified only if CL.ST = C.CL3)

Identification code: SLOP

Range: 0.500 / 2.000

LOW POINT CALIBRATION

(This parameter is available only if CL.ST = C.CL2)

Identification code: CaL.L

Range: Value in engineering units between min/ max range value

OFFSET ON LOW POINT

(This parameter is available only if CL.ST = C.CL2)

Identification code: OFS.L

Range: -199.9 / 199.9

HIGH POINT CALIBRATION

(This parameter is available only if CL.ST = C.CL2)

Identification code: CaL.H

Range: Value in engineering units between min/ max range value

OFFSET ON HIGH POINT

(This parameter is available only if CL.ST = C.CL2)

Identification code: OFS.H

Range: -199.9 / 199.9

MODBUS ADDRESS

Identification code: adr

Range: 0 (Interface disable) 1 up to 254

3.6.1 Customer Calibration

The 302P4 Controller is 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.

Ensure the controller is in the Enhanced mode OP.E

1 Point Calibration CL.St = C.CL1

1 point calibration uses one offset value across the temperature range.

Clear any previous coefficient adjustment.

Press function  until CL.St is shown in the lower display

Press the up  or down  to C.CL1 in the upper display

Press function  to confirm selection and display OFSt

Press the up  or down  to enter the offset value required across the temperature range.

This can be a negative or positive value.

Press function  to confirm selection.

2 Point Calibration CL.St = C.CL2

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

Clear any previous coefficient adjustment.

Press function  until CL.St is shown in the lower display

Press the up  or down  to C.CL2 in the upper display

Press function  until CAL.L is displayed

Press the up  or down  to enter the lower calibration temperature to which the offset is to be applied. Example. 300 °C.

Press function  until OFS.L is displayed

Press the up  or down  to enter the offset to be applied to the lower calibration temperature. Example: If at the calibrated temperature of 300 °C the controller is reading 296.7, the offset will be 3.3 °C (300-296.7 = 3.3)

Press function  until CALH is displayed

Press the up  or down  to enter the lower calibration temperature to which the offset is to be applied. Example. 1400 °C

Press function  until OFS.H is displayed

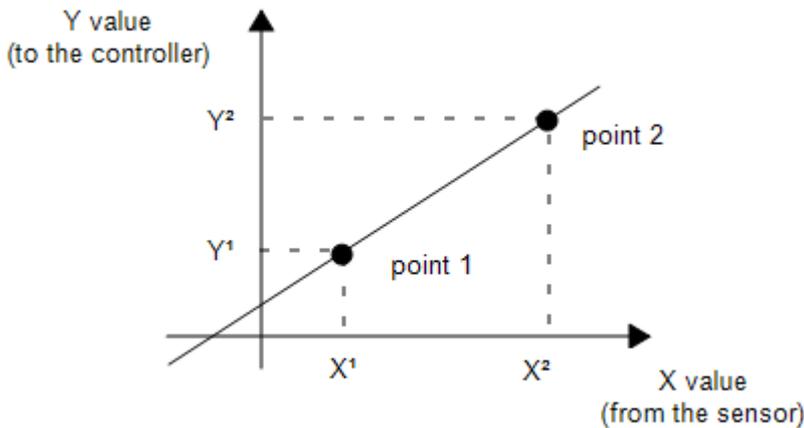
Press the up ▲ or down ▼ to enter the offset to be applied to the lower calibration temperature. Example: If at the calibrated temperature of 1400 °C the controller is reading 1402.1, the offset will be -2.1 °C (1402.1-1400 = 2.1)

Press function  to confirm selection.

Slope and offset calibration CL.St = C.CL3

To calculate an offset and slope.

Select two points within the measure range. In these points the error will be zeroed by the offset and slope adjustment procedure. Mark the co-ordinates of the two points.



If CL.St is set to C.CL3 compute and set the "SLOP" and "OFSt" values using the below formulas "SLOP " = $(Y2 - Y1) / (X2 - X1)$

"OFSt " = $Y1 - X1 * (Y2 - Y1) / (X2 - X1)$

or the below spreadsheet with same examples:

Point 1	X1	20	20	0	20.1
	Y1	20	24	0	18.5
Point 2	X2	90	90	70	80.4
	Y2	90	94	77	85.3
Coefficient	"OFSt"	0.0	4.0	0.0	-3.8
	"SLOP"	1.000	1.000	1.100	1.108
Comments		No Adjustment	Offset Adjustment	Slope Adjustment	Offset and Slope Adjustment

To adjust both offset and slope.

Clear any previous coefficient adjustment.

Press function  until CL.St is shown in the lower display

Press the up ▲ or down ▼ to C.CL3 in the upper display

Press function  to confirm selection and display OFSt

Press the up ▲ or down ▼ to enter the offset value required across the temperature range (see above formula). This can be a negative or positive value.

Press function  to confirm selection and display SLOP

Press the up ▲ or down ▼ to enter the slope value required (see above formula).

Press function  to confirm.

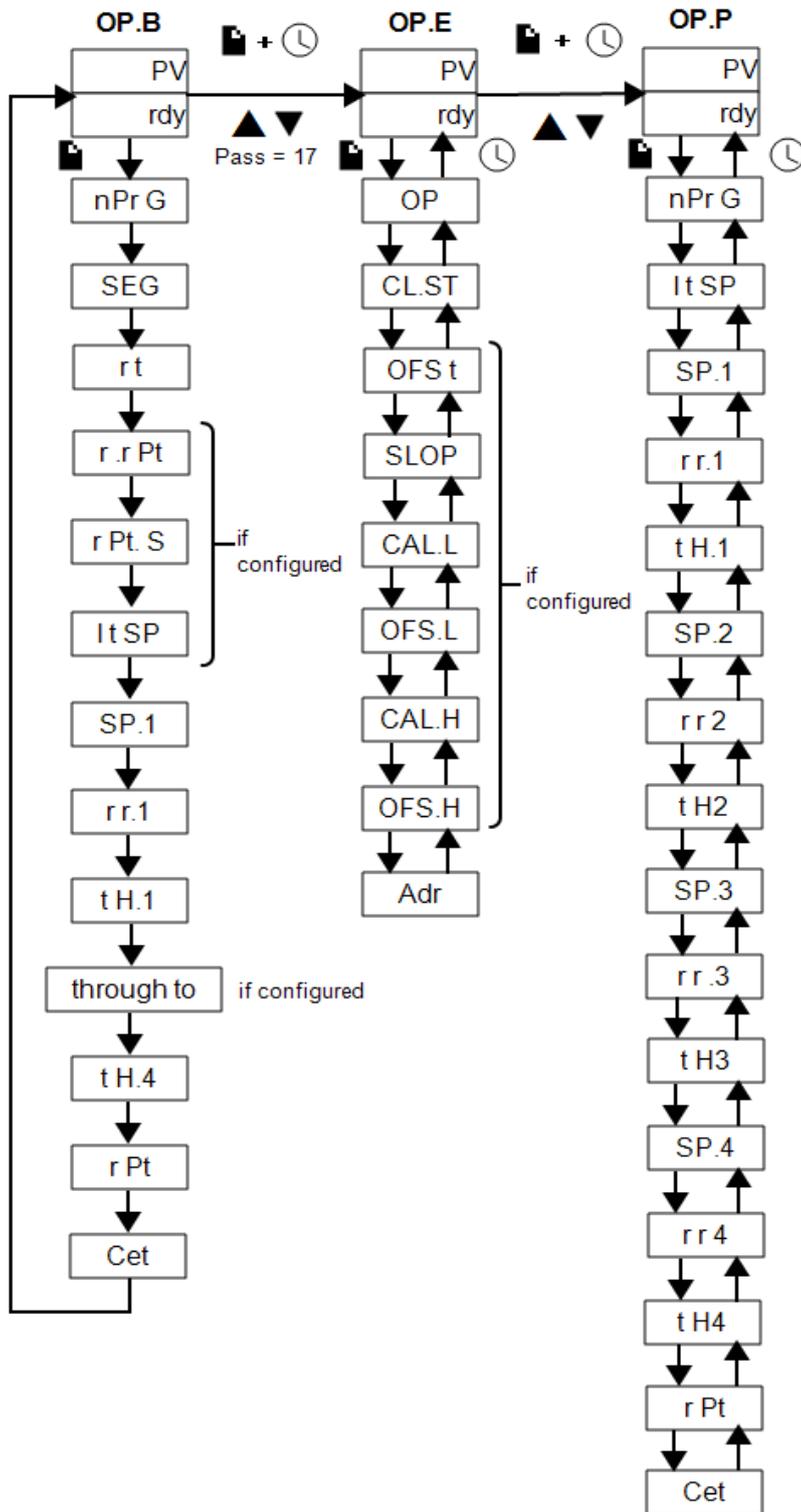
3.7 Temperature Controller Replacement



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.

This controller is fitted to the back of the control panel, which can be separated from the base by removal of two screws.

3.8 Navigation Diagram



4.0 Temperature Controller

If this product is fitted with a temperature controller, instructions are provided separately.

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.

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 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 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. However, if a large object is placed in the chamber it may record the average temperature of the object and the elements, this can lead to overheating of the elements. Allow large objects to gain heat at a lower temperature and then reset the controller to a temperature close to the desired maximum, or heat using a slowly controlled ramp rate. For more information refer to the controller instructions.

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. 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 Heating Elements

If SiC heating elements are used close to their maximum operation temperature of 1600 °C it is possible for bubbles of silica to form on the surface of the elements. The size of the bubbles can vary. This is an indication that the elements temperature has

exceeded 1625 °C. The silica bubble can be removed, if they are a nuisance to the application, by careful use of a vacuum cleaner with an appropriate exhaust filter. To reduce the likelihood of silica bubbles forming, heat the furnace using a reduced heating rate and if possible use a lower setpoint.

5.5 Operator Safety



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



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

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

When the product is opened during operation there is considerable radiated heat. Do not keep any flammable objects near the product, nor objects which could be damaged by radiated heat.

6.0 Maintenance

6.1 General Maintenance

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

6.2 Maintenance Schedule

 CUSTOMER

 QUALIFIED PERSONNEL



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

Maintenance Procedure	Method	Frequency				
		Daily	Weekly	Monthly	Bi-Annually	Annually
Safety						
Safety Switch Function	Set a safe temperature above ambient, and open the door to see if the heater light goes out					
Safety Switch Function	Electrical measurement 					
Over-Temperature Safety Circuit (if fitted)	Set an over-temperature setpoint lower than the displayed temperature and check for an over-temperature alarm as detailed in this manual					
Over-Temperature Safety Circuit (if fitted)	Electrical measurement 					
Door Plug	Visual inspection, checking the seal and whether it is free of damage					
Door Plug	Replacement where necessary					
Chimney / Extraction	Check and clean if necessary					
Electrical Safety (external)	Visual check of external cables and plugs					
Electrical Safety (internal)	Physically check all connections and cleaning of the power plate area					
Function						
Temperature Calibration	Tested using certified equipment, frequency dependent on the standard required					

Operational Check	Check that all functions are working normally					
Operational Check	Thorough inspection and report incorporating a test of all functions					6
Performance						
Element Circuit	Electrical measurement 					6
Power Consumption	Measure the current drawn on each phase / circuit					6
Hearth	Visual check for fit and damage					
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.

6.2.2 Safety Switch

When correctly functioning, the safety switch will isolate all live conductors (live and neutral connections) within the heating element circuit(s) when the product door is opened. The safety switch should be checked regularly to ensure that this occurs.

The safety switch should not fail under normal working conditions, however rough handling, exposure to corrosive materials/ environments, or exceptionally frequent use, could compromise the safety system.

Weekly check:

The following check can be carried out by a general operator:

- On the temperature controller, set a safe temperature above ambient. The heater lights should illuminate.
- Open the door and check the heater lights. They should no longer be illuminated.

If the heater lights remain illuminated when the door is open, discontinue use and contact Carbolite Gero Service.

Annual check:

The following checks should be carried out by a qualified electrician, as specified in the "Maintenance Schedule" section of this manual:

- Remove the element access panel and take a voltage measurement from the heating element terminals. Do not attempt to take a reading from the heating element itself as surface oxidation will give an unreliable contact.
- Ensure that power to the heating elements is switched off when the door is opened.

Contact Carbolite Gero Service and discontinue use of the product if it is found that the heating elements are not fully isolated during these checks.

6.3 Calibration

After prolonged use, the controller and/or thermocouple may require recalibration. This is important for processes that require accurate temperature readings or for those that use the product close to its maximum temperature. A quick check using an independent

thermocouple and temperature indicator should be made from time to time to determine whether full calibration is required. Carbolite Gero can supply these items. Depending on the controller fitted, the controller instructions may contain calibration instructions.

6.4 After-Sales Service

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

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

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

6.5 Recommended Spare Parts and Spare Parts Kit

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

Each kit consists of one thermocouple, one sheath, one solid-state relay, one door insulation piece, a set of elements and a set of braids. Individual spare parts are also available.

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

6.6 Element Ageing

Silicon carbide elements gradually increase in resistance with use; a process known as ageing. Their heating power reduces correspondingly.

If the product does not reach temperature, or is slow, the elements have aged to a higher resistance and it may be necessary to replace them.

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

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.

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

7.5 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.

7.6 Thermocouple Replacement



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

Thermocouple cable colour codings are:

Thermocouple leg	Colour
positive (type 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 also advisable to remove the sheath and shake out any broken pieces of thermocouple.

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

Refit the element access panel.

7.7 Element Fitting and Replacement

Replacements; Read section 6.6 for information on element ageing.



Disconnect the product from the electrical supply.

Remove the back panel of the product, to gain access to the elements connections. Remember that the elements are fragile and expensive and that they can be damaged by contamination; handle them with care and keep them clean.

7.7.1 Fitting the Heating Elements

Ensure that there is no packaging or other objects within the chamber.

Fit Hearth tile: Read section 2.3.

Remove rear panel by unscrewing the 6 retaining screws and disconnecting the earth cable.

From the rear of the product, visually check the element location holes for any obstructions.

Carefully unpack the 3 elements.

Carefully take an element and align with element locations hole, in the rear of the brick-box (see photo 1).

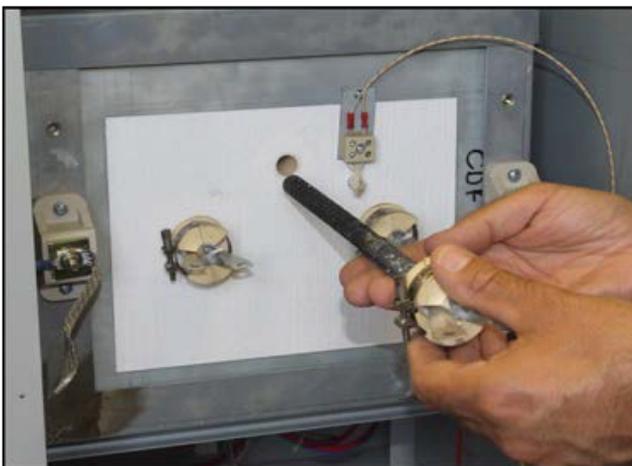


Photo 1

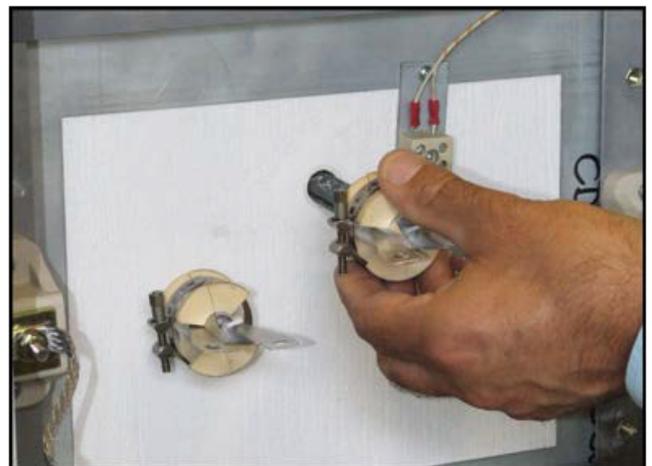


Photo 2

Gently insert the element into the location hole until it reaches the approximate depth of the front face insulation. (See photo 2) This should require no force at all.

Then with a slight twisting action locate the front end of the element in the front face location hole and gently insert element as far as possible. (See photo's 3 & 4) Again no force is required. There should be approximately 6-8 mm between the elements porcelain terminal connector and the rear insulation.



Photo 3

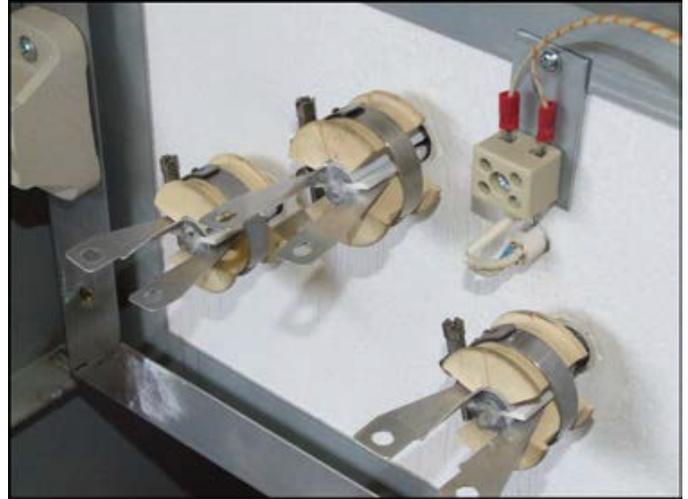


Photo 4

Repeat the above procedure for the other two elements.

The braids should then be connected as follows. Starting from one side.

Take the loose end of braid that is connected to the connection block (See Photo 5) and attach to the first element tail of the nearest element using M6 screw, washer, nut (See Photo 6).



Photo 5



Photo 6

Connect the second element tail of the same element to the first element tail of the centre element using the same method with the loose braids provided (See Photo 7). Repeat this process on the opposite side.



Photo 7



Photo 8

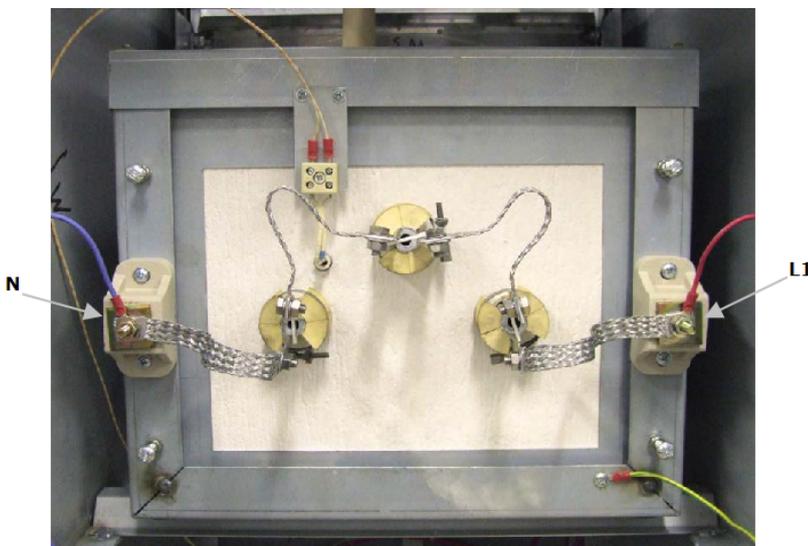
Once the braids are all connected and the fixings secured, carefully tidy the braids and ensure they are not touching each other or any other component (See Photo 8).

New furnace: the photographs indicate the connections. If you have any problems with this procedure, please contact the Carbolite Gero service division. A common feature of CDF models is that elements are in series between 200-240 volts. Replacements: make a note of the actual braid and cable connections to the elements. Using the reverse method described above, disconnect the braids or cables and carefully withdraw each element.

Carefully insert the new elements into the product and attach the braids according to the notes made, or according to the appropriate diagram below

Whether fitting new elements or replacing old, replace the products back panel when connections are complete remembering to connect the earth cable to the back.

Element connections - 3 Elements



The photograph above shows typical live and neutral connections.

8.0 Fault Analysis

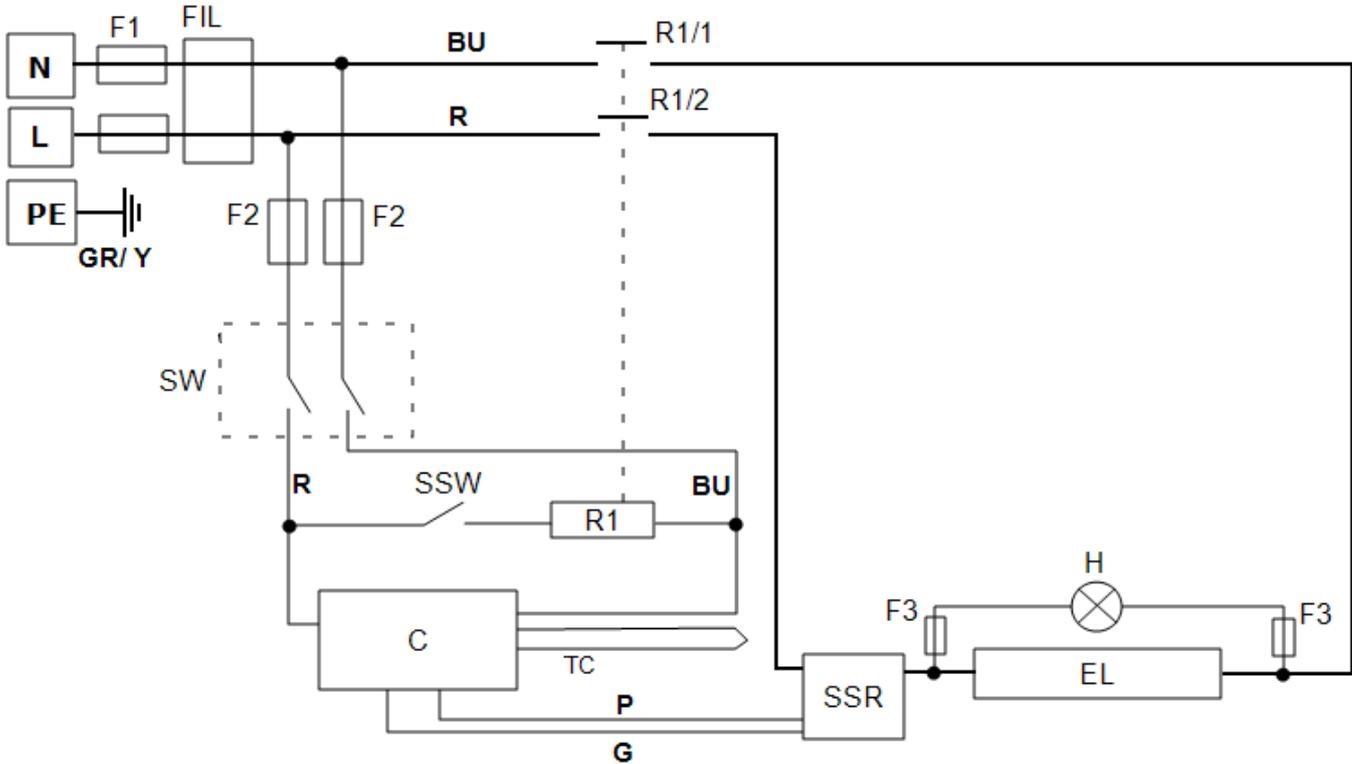
A. Furnace Does Not Heat Up				
1.	The HEAT light is ON	▶	The heating element has failed	▶ Check also that the SSR is working correctly
2.	The HEAT light is OFF	▶	The controller shows a very high temperature or code such as S.br	▶ The thermocouple has broken or has a wiring fault
		▶	The controller shows 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 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

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)
F2	Auxiliary Circuit Fuses	Fitted on board to some types of EMC filter. May be omitted up to 25 Amp/phase supply rating.	2 Amps glass type F On board: 20 mm x 5 mm Other: 32 mm x 6 mm
	Customer Fuses	Required if no supply cable fitted. Recommended if cable fitted.	See rating label for current; See table below for fuse rating.
Model	Phases	Volts	Supply Fuse Rating
CDF 15/1C	1-phase	200-230	16 A/ ph

Please refer to the rating label for product specific information.

11.0 Specifications

Carbolite Gero reserves the right to change the 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 silicon carbide elements.							
CDF 15/1C	1530	3.1	80	90	150	1.1	40

11.1 Environment

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

Temperature: 5 °C - 40 °C

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

Алматы (7273)495-231
 Ангарск (3955)60-70-56
 Архангельск (8182)63-90-72
 Астрахань (8512)99-46-04
 Барнаул (3852)73-04-60
 Белгород (4722)40-23-64
 Благовещенск (4162)22-76-07
 Брянск (4832)59-03-52
 Владивосток (423)249-28-31
 Владикавказ (8672)28-90-48
 Владимир (4922)49-43-18
 Волгоград (844)278-03-48
 Вологда (8172)26-41-59
 Воронеж (473)204-51-73
 Екатеринбург (343)384-55-89

Иваново (4932)77-34-06
 Ижевск (3412)26-03-58
 Иркутск (395)279-98-46
 Казань (843)206-01-48
 Калининград (4012)72-03-81
 Калуга (4842)92-23-67
 Кемерово (3842)65-04-62
 Киров (8332)68-02-04
 Коломна (4966)23-41-49
 Кострома (4942)77-07-48
 Краснодар (861)203-40-90
 Красноярск (391)204-63-61
 Курск (4712)77-13-04
 Курган (3522)50-90-47
 Липецк (4742)52-20-81

Магнитогорск (3519)55-03-13
 Москва (495)268-04-70
 Мурманск (8152)59-64-93
 Набережные Челны (8552)20-53-41
 Нижний Новгород (831)429-08-12
 Новокузнецк (3843)20-46-81
 Ноябрьск (3496)41-32-12
 Новосибирск (383)227-86-73
 Омск (3812)21-46-40
 Орел (4862)44-53-42
 Оренбург (3532)37-68-04
 Пенза (8412)22-31-16
 Петрозаводск (8142)55-98-37
 Псков (8112)59-10-37
 Пермь (342)205-81-47

Ростов-на-Дону (863)308-18-15
 Рязань (4912)46-61-64
 Самара (846)206-03-16
 Санкт-Петербург (812)309-46-40
 Саратов (845)249-38-78
 Севастополь (8692)22-31-93
 Саранск (8342)22-96-24
 Симферополь (3652)67-13-56
 Смоленск (4812)29-41-54
 Сочи (862)225-72-31
 Ставрополь (8652)20-65-13
 Сургут (3462)77-98-35
 Сыктывкар (8212)25-95-17
 Тамбов (4752)50-40-97
 Тверь (4822)63-31-35

Тольятти (8482)63-91-07
 Томск (3822)98-41-53
 Тула (4872)33-79-87
 Тюмень (3452)66-21-18
 Ульяновск (8422)24-23-59
 Улан-Удэ (3012)59-97-51
 Уфа (347)229-48-12
 Хабаровск (4212)92-98-04
 Чебоксары (8352)28-53-07
 Челябинск (351)202-03-61
 Череповец (8202)49-02-64
 Чита (3022)38-34-83
 Якутск (4112)23-90-97
 Ярославль (4852)69-52-93

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