CARBOLITE GERO 30-3000°C

Installation and Operation Instructions

1100°C Coke Reactivity Furnace - Model: CRI

CRI

MEN-CRI-IO (21-10-2022)

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 Introduction

1.1 Scope and Purpose

This product is intended to be used within a laboratory or industrial environment to test the strength of coke after reaction. It is designed to meet the requirements of the Standard Test Method for Measuring Coke Reactivity Index (ASTM D5341-19/D5341M-19 and ISO 18894-2018).

It must be installed, commissioned, and operated in accordance with the instructions contained within this manual, and only by trained personnel.

For maintenance assistance, please contact Carbolite Gero.

Note: Depending on customer specifications at the time of order, this product may incorporate bespoke design features that are not covered in this manual. Please refer to the supplementary product documentation pack and/or contact Carbolite Gero for additional assistance.



Note: If this product is used for any application other than its intended purpose, as stated by Carbolite Gero, the protection provided by this equipment may be impaired.

Note: Failure to comply with the instructions as stated within this manual will constitute misuse and subsequently void any warranty provided by Carbolite Gero.



This product is supplied with a documentation pack, including instruction manuals and supplementary technical information. Read all documentation before proceeding with the installation and operation of this product.

1.1.1 Responsibilities

The customer is responsible for conducting their own risk assessment and ensuring that any materials to be processed within the product are suitable to be safely heated to the required temperature, and that appropriate safety measures are taken when handling such materials:

- Any material that is combustible or liable to cause explosions or generate combustible gas must not be processed unless the product is supplied with specialist equipment designed to manage such reactions

- The customer must provide an adequate ventilation and fume extraction system to manage any fumes given off by materials during processing

The customer is responsible for providing and maintaining the connections for the electrical power supply. The furnace should not be operated until all required supplies are connected.

This product should not be modified or used for any purpose other than that for which it is intended.

1.2 Prerequisites to Use

Prior to the commissioning and use of this product, all personnel involved in its installation, operation and maintenance must be deemed competent and have:

- Read and understood the information contained within this manual
- Received the relevant training with regard to safety and operation of the product
- Been provided with the appropriate PPE (Personal Protective Equipment) required for the safe operation of this product

Note: The customer is responsible for ensuring that all of the above conditions are satisfied before the product is commissioned for use.

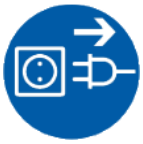
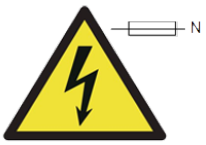


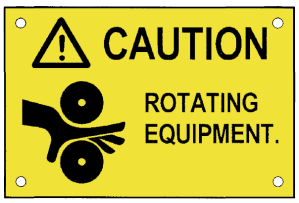
Note: Unless otherwise specified, the customer is responsible for the installation of this product and the safe connection of any additional equipment and gas or liquid supply lines.

2.0 Safety

2.1 Symbols and Warnings

Note: Observe and take the appropriate precautions if any of the following warning symbols are displayed on this product or in your working environment.

	Refer to the instruction manual before operating or maintaining the equipment		Disconnect the product from the power supply before performing any maintenance
	Wear eye protection		Wear a heat-resistant face shield
	Wear heat-resistant gloves		Wear breathing apparatus
	Wear protective footwear		Wear protective clothing
	Minimum of 2 people required to lift		DANGER: Heavy load. Specialist equipment required!
	WARNING!		DANGER: Risk of electric shock!
	DANGER: Fire risk!		DANGER: Hot surface!
	CAUTION: Double Pole/ Neutral Fusing!		DANGER: Risk of slipping!

	DANGER: Suspended loads!		WARNING: Adequate ventilation required!
	CAUTION: ROTATING EQUIPMENT		DANGER: Risk of crushing injury!
	DANGER: Explosive materials / atmosphere!		Any action noted beside this symbol is strictly forbidden!
	DO NOT use this product to cook or heat food or beverages!		DO NOT dispose! Recycle according to WEEE Regulation guidelines!

2.2 Operator Safety

Note: It is the responsibility of the customer to ensure that all personnel required to operate this product are fully trained and equipped with the appropriate PPE (Personal Protective Equipment).

Carbolite Gero recommend that the appropriate PPE is worn at all times whilst working with and around this product.

2.3 Risk Prevention and Mitigating Residual Risks

Risk		Prevention Measures
	Hot Surface	• Wear appropriate PPE e.g. heat resistant gloves • Do not place any objects on top of the product • Ensure the product is sited on a non-flammable surface, and that all adjacent surfaces are also non-flammable

	Ventilation required	• Only operate in a well ventilated area • If necessary, only operate in a fume cupboard
	Fire / Explosion	• Only trained operators should use this equipment • Only process materials for which a suitable risk assessment has been carried out
	Exposure to hazardous material	• Wear appropriate PPE e.g. protective gloves, dust masks, eye protection • Avoid breaking up insulation material • Please refer to section 2.4 for further details • If in doubt, please contact Carbolite Gero Service
	Electric shock	• Ensure the product is isolated from the electrical supply before performing maintenance
	Unit Toppling Over	• Ensure that the correct manual handling procedures are followed when manoeuvring the product

2.4 Safety Warning - Refractory Fibre Insulation



Insulation made from High Temperature Insulation Wool

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

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

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

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

Exposure to fibre dust may cause respiratory disease.

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

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

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

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

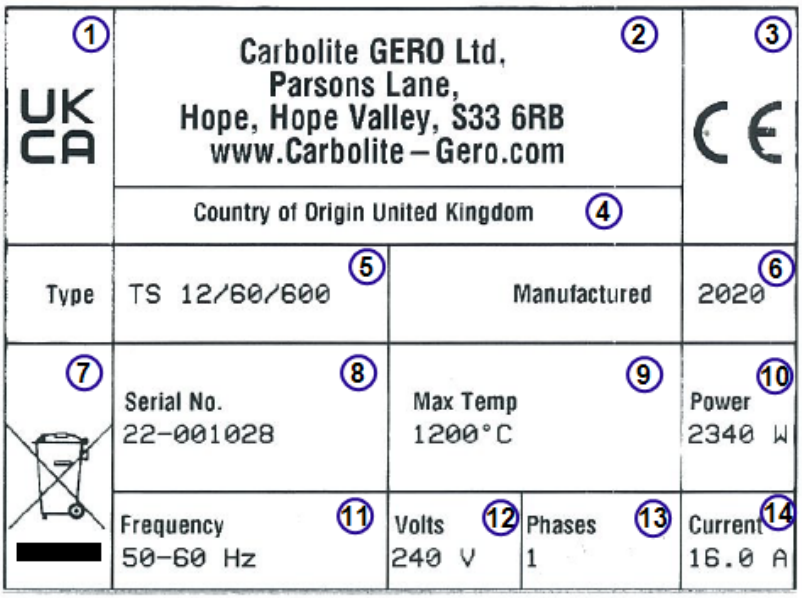
Further information can be provided on request. Alternatively, Carbolite Gero Service can quote for any repairs to be carried out either on site or at the Carbolite Gero factory.

3.0 Product Overview

3.1 Product Rating Label

The product rating label is located on the side of the product control box.

Note: The image below is an example and does not reflect the product(s) covered by this manual.



1	UKCA Mark
2	Carbolite Gero address and website
3	CE Mark
4	Country of Origin
5	Product Model
6	Year of Manufacture
7	Dispose of according to WEEE regulations (Waste Electrical and Electronic Equipment Directive)
8	Product Serial Number
9	Maximum Temperature
10	Power Rating
11	Frequency (Hertz)
12	Design Voltage
13	Design Phases
14	Current (Amps)

3.2 Part Identification

Note: Some models may have additional options and features that are not represented by the following images.



1	Exhaust Gas Burner
2	Furnace
3	Foot Pedal
4	Retort Cooling Section
5	Mains Isolator
6	Control Panel
7	Gas Flowmeters
8	Flame Failure Monitor
9	Retort Loading Arm

4.0 Specifications



Note: Please refer to the separate product documentation pack for additional specifications relevant to your product.

Note: Product dimensions can be found on the general assembly drawing.

5.0 Electrical Specifications



This equipment MUST be earthed!

5.1 Fuses and Power Settings

Please refer to the supplementary electrical information in the product document pack provided with this product.

5.2 Operating / Storage Environment

The products covered by this manual contain electrical parts and should be stored and used in indoor conditions as follows:

Temperature:	5°C - 40°C
Relative humidity:	Maximum 80% up to 31°C decreasing linearly to 50% at 40°C
Altitude:	Not exceeding 2000 metres

6.0 Options and Accessories

Note: Any additional equipment to be used with this product should be supplied by Carbolite Gero. Accessories from third-party sources are not designed to Carbolite Gero's specifications and may result in poor performance, damage to equipment or dangerous working conditions.

7.0 Installation

7.1 Manual Handling



Refer to section 0.1 of this manual for product dimensions.



Mechanical lifting equipment may be necessary!
Consult personnel responsible for health and safety before attempting to move this product!

It is the responsibility of the customer to provide any mechanical lifting aids, such as pallet trucks, forklifts or cranes, and to ensure that all operators of such equipment are fully trained and qualified.



All manual handling must be carried out according to local health and safety guidelines.

Note: The customer is responsible for all manual handling procedures performed on their own premises.

7.2 Unpacking

Note: Check that all items intended for delivery are present and undamaged before proceeding to install the product.

For safety and manoeuvrability, the product is delivered secured to a pallet inside a crate.

It is advised that the product is left on the pallet until it has been moved as close as possible to its intended installation location.

- Using the appropriate tools, carefully open the crate and remove all external packaging. Retain the crate panels and packaging.
- Ensuring that the product is stable and secure, remove any straps retaining the product to the pallet.
- If using a crane, attach appropriate straps or hooks to the four lifting eyes on the top of the furnace and ensure they are secure before proceeding.
- Manoeuvre the furnace into the desired position, ensuring that there is sufficient clearance above and around the sides of the furnace body.
- Remove the straps/hooks from the lifting eyes.

7.3 Siting and Setting Up



The product should be sited in a well ventilated area, away from other sources of heat.

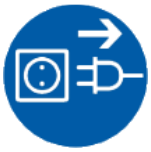
Note: If required, it is the customer's responsibility to provide an adequate extraction system. Under no circumstances should such an extraction system be connected directly to the product as this will affect product performance and may damage equipment.



Use the manual handling method recommended by your health and safety officer to place the product on a level, stable surface that is not prone to vibration or movement. The surface upon which the product is placed must be of a height suitable to allow the operator to easily and safely use the equipment.



The product should be placed on a non-flammable surface, resistant to the accidental spillage of hot materials. All adjacent surfaces should also be non-flammable.



Ensure that the power supply or isolating switch is easily accessible to the operator.

- 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 1000 mm** of free space around the back and **at least 500mm** of free space at the sides of the product. Clear space is required above the product to dissipate heat.

Note: Adequate space must be provided to accommodate the furnace with the door open.



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.

7.4 Gas Supply Connections

Note: The customer is responsible for providing the gas supply and connecting pipes/hoses.

The gas inlet connections are located at the rear of the furnace, and are fitted with swagelok bulkhead connectors. The incoming gas supplies should be of the following specifications:

Gas	Supply Pipe Diameter (mm)	Supply Pressure (bar)
Nitrogen	8	1
Carbon Dioxide	8	1
Propane	6	0.037

7.5 Electrical Connections



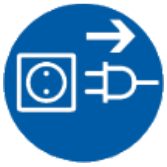
For products supplied without pre-fitted plugs, it is recommended that all electrical connections are carried out by a qualified electrician.

The product covered by this manual normally requires a single phase A.C. supply, which may be "Live to Neutral non-reversible", "Live to Neutral reversible" or "Live to Live". Some models may be ordered for 3-phase use, which may be with or without neutral.

Check the product rating label before connection. The supply voltage should correspond 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. This manual contains a table of the most common fuse ratings.

- When the mains cable is factory-fitted / supplied, internal fuses are also fitted. It is essential that the operator ensures that the power supply is correctly fused.
- Products with a factory fitted supply cable but without a plug are designed to be wired directly to an isolator or fitted with a line plug compliant with the customer's local regulations and supply.
- Products without a factory-fitted supply cable require a permanent connection to a fused and isolated supply. The product's electrical component access panel should be temporarily removed, and connections made to the internal terminals / fuse holder.



When connecting the product to the power supply, the plug or isolating switch should be accessible, easy to remove / operate, and within reach of the operator.

Note: The supply MUST incorporate an earth (ground).

7.5.1 3-Phase Connections

Terminal Label	Cable Colour	Connection
L1	Black	to phase 1
L2	Black	to phase 2
L3	Black	to phase 3
N	Light Blue	to neutral (if fitted)
PE	Green / Yellow	to earth (ground)

8.0 Temperature Controller

Please refer to the separate temperature controller manual(s) provided.

9.0 Commissioning

Note: This equipment should not be put into use until it has been commissioned by a competent person in accordance with the instructions contained within this manual, and any local regulations. Carbolite Gero offer an installation and commissioning service. Please contact Carbolite Gero Service for details.

9.1 Pre-Commissioning

When the product is cold and disconnected from the power supply, visually check the following:		**Checked by:**
Siting / Securing	Check that the product is placed on a secure, level surface and cannot topple over.	
Packaging	Check that all packaging material has been removed from inside and around the product.	
General Condition	Check that no damage has occurred during delivery and siting.	
Panels	Check that all covers and access panels are securely fitted.	
General Access	Check that there is sufficient clearance around the top and all sides of the product (refer to section 7.3).	
Ventilation	Check that the product has been installed in a well ventilated area.	
Gas Supply	Check that the gas supplies (not supplied by Carbolite Gero) are correct and appropriate for the equipment.	
Extraction	If a room extraction system is in operation (not supplied by Carbolite Gero), check that there is sufficient clearance between the extraction hood and the product.	
Electrical Supply	• Check that the voltage stated on the product rating label matches the electrical supply of the installation site. • Check that all electrical supply cables are securely attached to/ plugged into the product.	
Gas Connections	Check that all connections between the equipment have been made as detailed in this manual: • Gas supply to furnace • Gas supply to retort	
Earth Connection	Check that an earth connection has been made. The control cabinet and all removable panels on the furnace should be earthed.	
Thermocouples	Check that the required thermocouples between the retort and the furnace are connected.	

Rating Label / Warning Labels	Check that all labels are fitted and all information is legible.	

9.2 Commissioning - Initial Function Checks

When the product has been connected to the mains electrical supply, check the following:		**Checked by:**
Power Switch	Check that when turned to the ON position, the instrumentation on the control cabinet illuminates.	
Safety Switch	• Check that the power to the heating elements is switched off when the door is opened. • Check each door independently.	
Gas Connections	• Check that all the connections to the gas supply are secure and that gas flows correctly through the system e.g. flowmeters register, solenoid valves open. • Set the desired gas flow rates.	
Gas Pressure / Exhaust Gas Burner	• Connect the gas supplies and install the retort. • Turn on the gas supplies and allow them to pass through the retort and out of the exhaust pipe. • Manually light the gas at the exhaust gas burner and regulate the gas supply until the flame covers the exhaust pipe of the retort. • Turn off the gas supplies.	
Foot Pedal / Retort Arm	Operate the foot pedal and check that the retort arm lifts up.	
Electrical Access Panels	Check that the electrical access panel doors are locked to prevent unauthorised access/gas flow adjustments.	

10.0 Operation

10.1 Safe Operation



This product can be operated continuously up to **100°C below** the maximum operating temperature, however constant use at high temperatures can accelerate the degradation process of various components which will require replacement.



Note: DO NOT leave the product operating unattended unless the over-temperature protection option is fitted.



Refer to the "Safety" section of this manual for details on ensuring operator safety.

Explosive materials:



- The furnace must not be used to heat materials that could explode, or that could emit gases that could form explosive mixtures. If the safe heating of a material is dependent on its temperature, only heat these types 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 appropriate for the material being heated so 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.

Switch off the furnace before loading and unloading:



- The furnace elements must be switched off using the instrument switch when the furnace is being loaded or unloaded.
- Ceramic materials can become electrically conductive at high temperatures.

10.2 Gas System

The standard CRI gas system is designed for use with the following three gases:

- Carbon Dioxide (CO_2) - Process gas
- Nitrogen (N_2) - Process / Cooling gas
- Propane (C_3H_8) - Exhaust burner gas

All gas flows are preset in accordance to the relevant standard / customer specification. Any adjustments can be made using the mass flow controllers.



Note: Please refer to the gas schematic in the separate product documentation pack for details on flow rates, and use these to gauge the effect of any adjustments.

10.2.1 Process and Cooling Gases

The gas connectors to the retort are quick release snap connectors that automatically seal when disconnected. The CO_2 supply piping is fitted with normally closed solenoid valves, whilst the N_2 supply piping is fitted with normally open solenoid valves.

Note: If the gas supplies are turned on before the electrical power supply to the CRI unit is turned on, then the flow of CO_2 will be prevented, however, nitrogen will still be allowed to flow. The electrical supply must be turned on in order to control the flow of nitrogen.

10.2.2 Exhaust Burner Gas

Switching on the "Flame Failure" detection unit will open a normally closed solenoid valve, allowing propane to flow, and also apply a high-intensity spark at the exhaust burner nozzle to ignite the gas. If a flame is established, it will be monitored continuously by the flame failure unit.

Note: When first igniting the exhaust gas burner, it may take two or three attempts to achieve a stable flame. If this is the case, then switch off the flame failure unit, wait for 20 seconds, switch the flame failure unit back on and press the red reset button.

- Once a stable flame has been established, should it be extinguished for any reason, the unit will attempt to reignite the flame for approximately 20 seconds.

- If the flame fails to reignite, the gas supply solenoid valve will close, the "FLAME FAILURE" warning light will illuminate, and the continuous alarm will sound.

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10.3 Alarm Types

The CRI features two different alarm types to warn operators of various conditions or malfunctions within the system.

10.3.1 Intermittent Siren

The intermittent siren is activated when manual intervention is required in order to continue processing, e.g. loading the retort into the furnace.

If the intermittent siren and the "PROCESS COMPLETE" lamp is illuminated, then the reduction process is now complete, and the retort can be either allowed to cool within the furnace, or removed and placed in the cooling section of the unit.

10.3.2 Continuous Siren

The continuous siren is activated when an emergency situation arises that requires immediate manual intervention.

The following conditions can trigger the alarm:

Condition	Other Indicators	Action
Flame Failure	"FLAME FAILURE" lamp illuminated	• Gas system shut off • Retort purged with nitrogen • Program aborted
Over-Temperature	"OVER-TEMP. ALARM" lamp illuminated	• Gas system shut off • Retort purged with nitrogen • Program aborted • Power to heating elements shut off and remain off until the alarm is reset
Gas System Failure	"GAS SYSTEM FAILURE" lamp illuminated	• Gas system shut off • Retort purged with nitrogen • Program aborted
During Reduction Process	"GAS SYSTEM FAILURE" / "FLAME FAILURE" lamp illuminated	• Gas system shut off • Retort purged with nitrogen • Program aborted
Temperature in Retort Too Low	N/A	• Gas system shut-off • Retort purged with nitrogen • Program aborted

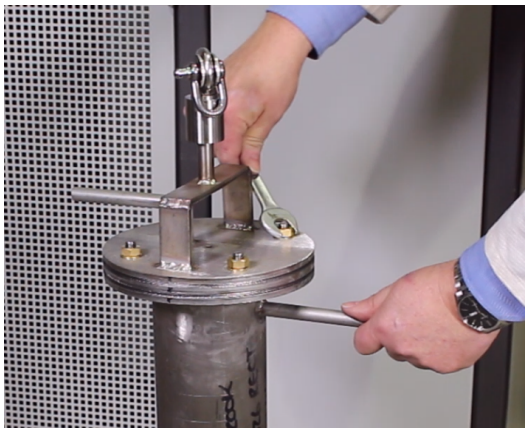
10.4 Loading the Retort

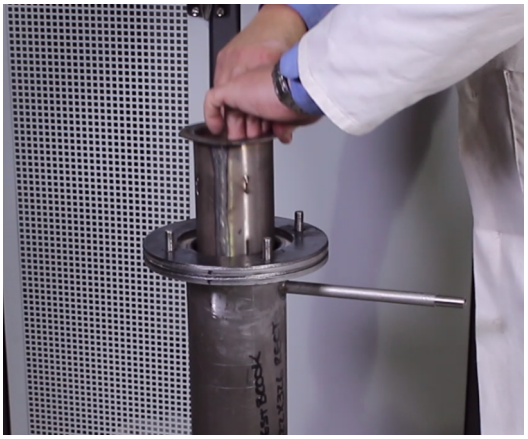
The retort comprises three main parts:

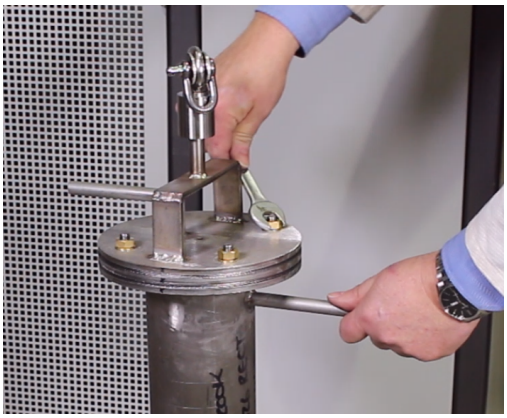
- The retort body with gas inlet pipe
- A liner with a perforated base to allow gas to flow up through the sample
- A lid with an insulation plug and exhaust gas outlet.

A set of ceramic balls are also provided, and should be inserted between the retort and the base of the liner. The balls retain heat and act as a pre-heater for the gas before it flows through the sample.

To load the sample into the retort:

• Unscrew the four bolts holding the retort lid in place.	
• Remove the retort lid.	

• Remove the retort liner.	
• Pour the alumina balls into the retort.	
• Insert the sample into the retort liner,	
• Insert the liner back into the retort.	

• Replace the retort lid; the holes on the lid should locate onto the bolts on the top of the retort. Secure the lid in place with the four bolts provided. The gas inlet and gas outlet pipes should be fitted at 180° to each other, as shown.	

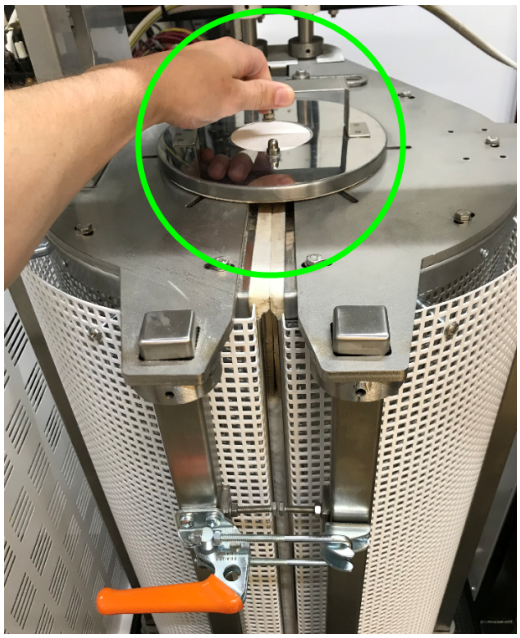
11.0 Operating Cycle

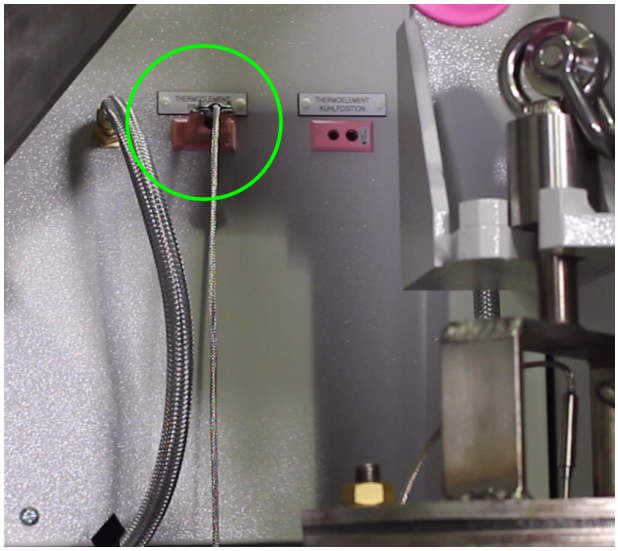
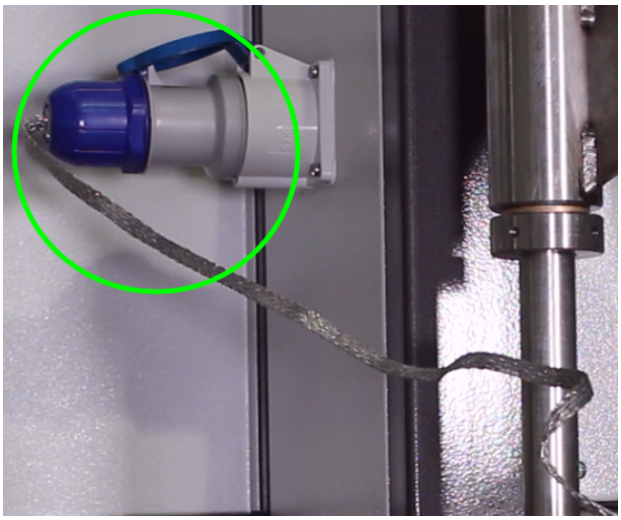


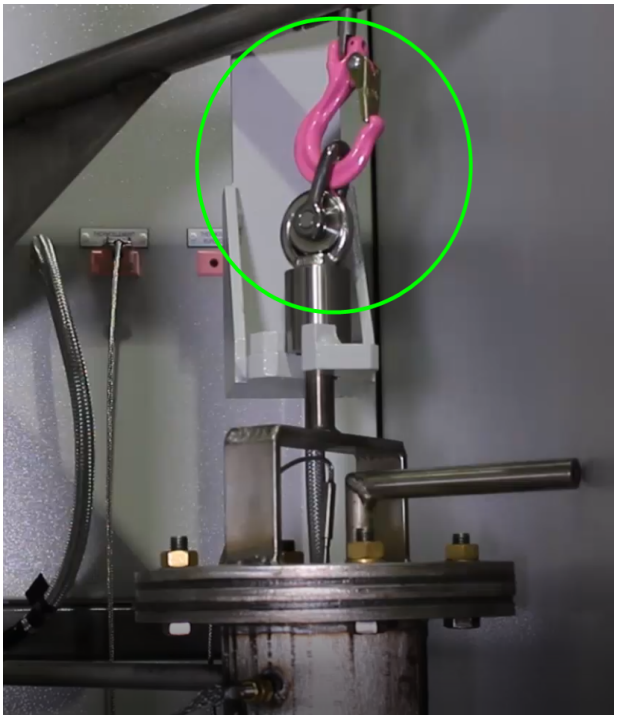
Use the manual handling method recommended by your health and safety officer when handling the retort.

After the retort has been loaded (see section 10.4), it can be installed into the cooling section of the CRI in preparation for processing.

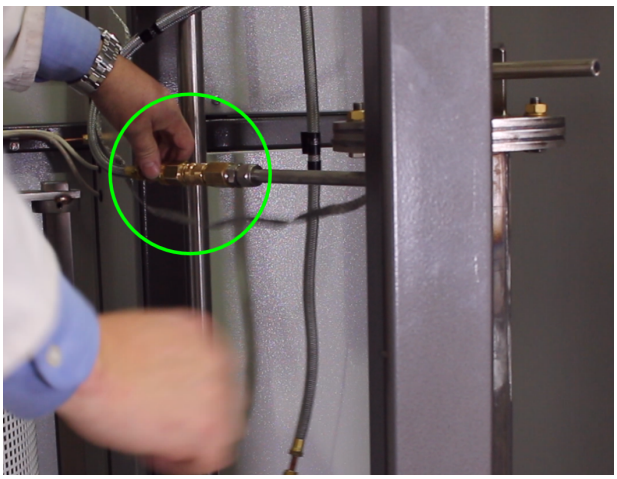
11.1 Initiate Processing

• Insert the probe thermocouple into the gland at the top of the retort. The tip of the thermocouple should be in the middle of the test sample.	
• Ensure that the vertical tube furnace is closed and clamped together, then insert the insulation plug into the top.	

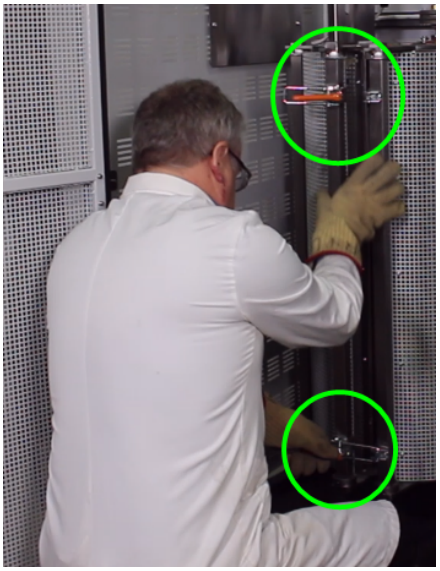
• Carefully lift the retort and place it onto the hanger in the retort cooling section of the furnace.	
• Plug the retort thermocouple into the left hand socket on the back of the retort cooling section.	
• Connect the earth plug from the retort to the socket at the rear of the furnace section.	

• Swing the retort loading arm over the retort hanger, and attach the hook to the loop at the top of the retort. The gas exhaust pipe should face to the right, so that it is in the correct position by the exhaust burner when the retort is moved across into the furnace.	
• Turn the mains isolator to the "ON" position. The white "MAINS ON" lamp will illuminate and the cabinet cooling fans will start.	

• Turn the "INSTRUMENTS" switch to the "ON" position. Power will be applied to the control circuit, and the controllers will illuminate and go through a short test sequence.	
• The alarm siren will sound as there will be a series of alarm conditions that require clearing. To silence the alarm, press the "ALARM ACCEPT" button. This will not cancel the alarms. The alarms will only clear when the conditions of each alarm have been met.	
• Press the "OVERTEMP RESET" button to reset the electrical contactor. Any required adjustments to the temperature controller can now be made. PLease refer to the separate temperature controller manuals for further details.	

• Turn the "FLAME FAIL" switch to the "ON" position to activate the flame failure unit. The flame failure unit will power on and an electrical spark will ignite the exhaust burner flame.	
• Connect the process gas pipe to the inlet on the retort.	
• Set the over-temperature controller temperature. This is typically 15°C above the main temperature controller setpoint.	

• Press the "CYCLE START/RESET" button to begin the heating process. The heater lamps on the control panel will flash to indicate that power is being directed to the heating elements. • Allow the furnace to heat up.	
• An alarm will sound and the "LOAD RETORT INTO FURNACE" lamp will illuminate when the furnace is ready for the retort to be loaded.	
• Press the "ALARM ACCEPT" button to silence the alarm siren.	

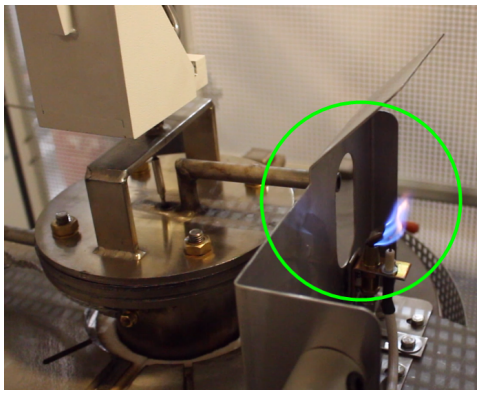
• Remove the insulation plug from the top of the furnace.	
• Open the furnace.	
• Push the foot pedal down to lift the retort out of the hanger. • Ensure that the retort is suspended securely from the retort loading arm.	

- Keep the foot pedal depressed and carefully swing the retort into the open furnace.



- Ensure that the retort exhaust pipe enters the hole at the exhaust gas burner section.

Note: Failure to have the exhaust pipe in the flame during processing will result in lethal gases being emitted into the atmosphere.



- Close the furnace.



• Unhook the retort from the retort loading arm, and swing the arm back into the cooling section.	
• Close and lock the safety cage doors.	
• Press the "CONTINUE" button to begin processing the sample.	

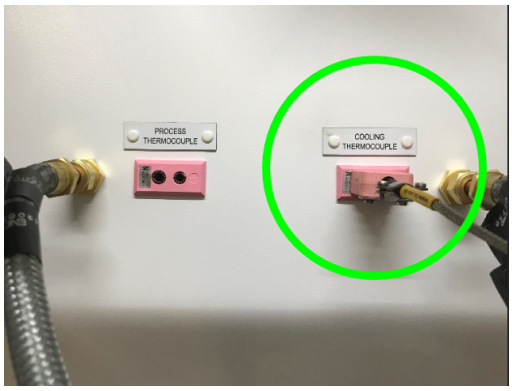
11.2 Post-Processing

• An intermittent siren will sound and the "PROCESS COMPLETE" lamp will illuminate to signal the end of the reaction process. • Reaction gases are switched off and the retort begins to cool under a flow of nitrogen.	
• Press the "ALARM ACCEPT" button to acknowledge the alarm and stop the siren.	
• Swing the retort loading arm back over the retort, and reattach the hook to the loop at the top of the retort • Open the furnace and wait for the retort to partly cool before attempting to move it into the retort cooling section.	

- Push the foot pedal down to lift the retort out of the hanger.
- Ensure that the retort is suspended securely from the retort loading arm.
- Keep the foot pedal depressed and carefully swing the retort out of the furnace.



- Unplug the retort thermocouple from the "PROCESS THERMOCOUPLE" socket, and plug it into the "COOLING THERMOCOUPLE" socket.



- Disconnect the process gas connection from the retort, and connect the cooling gas supply. The sample will now cool under a steady flow of nitrogen, preset to 20 litres per minute. The temperature of the sample is recorded on the data logger/chart recorder.

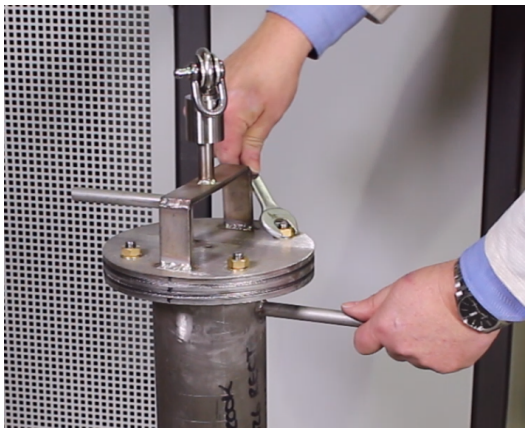
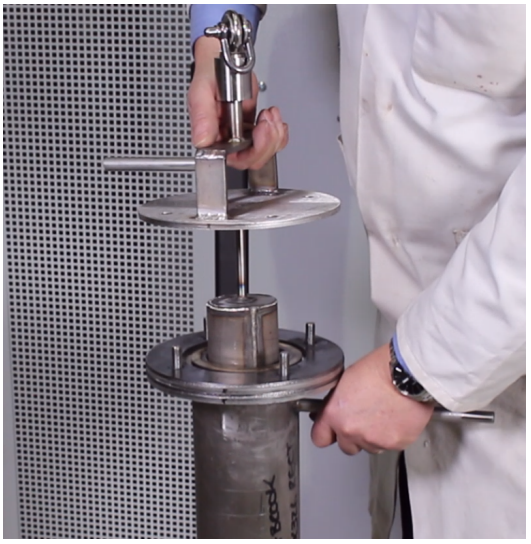
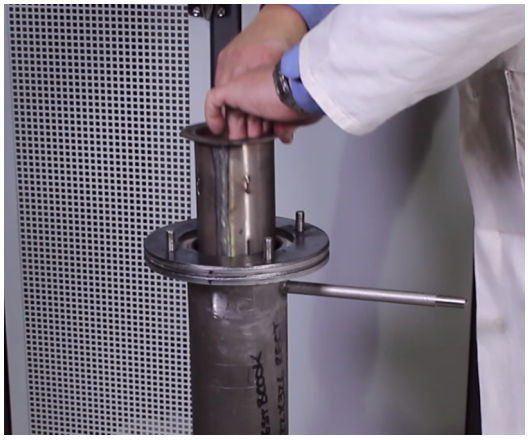


11.3 Unloading the Retort



Note: Always wait for the retort to fully cool before unloading!

To unload the sample from the retort:

• Unscrew the four bolts holding the retort lid in place.	
• Remove the retort lid.	
• Remove the retort liner.	

• Pour the sample out of the retort liner into an appropriate receptacle.	

11.4 Use of Probes and Metal Sheathed Thermocouples



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.

11.5 Power Adjustment

The product control system incorporates electronic power limiting. Depending on the model and the destination country the power limit maybe set to 100% or a lower figure. Where appropriate the power limit parameter OP.Hi is accessible to the operator, but it should not generally be altered.

See section 5.0 for details of the power limit settings. DO NOT adjust the power to a level higher than the design level states; this may cause a fuse to blow and could damage the heating elements.

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

11.6 Insulation Cracking

The insulation material in this furnace is susceptible to surface cracking as a result of temperature cycling. This is a normal occurrence and such cracking is not detrimental to the performance of the overall life of the furnace, under normal operation.

12.0 Maintenance

12.1 General Maintenance

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

12.2 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	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	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 the separate controller manual		■			
Over-Temperature Safety Circuit (if fitted)	Electrical measurement 					●
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					
Performance						
Element Circuit	Electrical measurement 					
Power Consumption	Measure the current drawn on each phase / circuit					
Cooling Fans (in control cabinet)	Check whether the cooling fans are working					

12.3 Cleaning



Note: Disconnect the product from the electrical supply before carrying out any maintenance procedures.

- With the product switched off, cold, and electrically isolated from the mains, wipe over surfaces using a damp cloth, wrung almost dry.
- **DO NOT** use solvents.
- If necessary, vacuum out the inside of the product to remove any dust or minor debris and dispose of any material removed, in accordance with local regulations, at an approved disposal facility.



Note: Care must be taken to ensure that no moisture enters the furnace or makes contact with any electrical components.

12.4 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.

12.5 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.

12.6 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.

12.7 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.

Please consult Carbolite Gero's Sales Department for details of recommended spare parts.

13.0 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

14.0 Decommissioning, Storage and Disposal

14.1 Decommissioning

1. Reduce the setpoint on all temperature controllers to 0°C so that heating cannot begin accidentally when the product is recommissioned
2. Isolate the product from the power supply
3. Allow the product to cool to room temperature
4. Disconnect the product from the power supply
5. Disconnect all additional equipment and external connections e.g. gas supplies

14.2 Storage (Long Term)

Store in a cool, dry place.



Note: If the furnace is exposed to a humid environment during storage, it must be fully dried out before recommissioning. All internal electrical circuits should be checked for signs of moisture. If there are visible signs of moisture, the product should be isolated from the power supply and allowed to dry out at ambient temperature for at least 24 hours. Please contact Carbolite Gero Service for further advice.

14.3 Disposal



Note: This product should only be disposed of in accordance with local regulations and requirements regarding electrical equipment.

Within the European Community the disposal of electrically operated devices is regulated according to guidance based on the EU Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE). Disposal regulations may differ worldwide.

If uncertain, please contact Carbolite Gero for advice on disposal.

Notes

Service Record

Engineer Name	Date	Record of Work



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

Carbolite Gero Ltd,

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

Telephone: + 44 (0) 1433 620011

Fax: + 44 (0) 1433 621198

Email: Info@carbolite-gero.com

www.carbolite-gero.com

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