CARBOLITE GERO 30-3000°C

Installation, Operation and Maintenance Instructions

Laboratory Gas Safety System

Laboratory Gas Safety System

MEN-LGSS-IO (13-06-2022)

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

The laboratory gas safety system (LGSS) is designed to work with a range of Carbolite Gero laboratory furnaces to facilitate the safe flow of low-pressure hydrogen through the sealed retort or work tube.

Often the safest method of managing waste hydrogen gas is to expel it outside the building to safely disperse. However, this is not possible for many buildings and laboratories.

The LGSS manages the supply of hydrogen and two independent supplies of nitrogen to provide a set air purge and a contained and monitored hydrogen burn together with a safety purge response.

- It regulates gas pressure and flow so as not to damage the furnace equipment and monitors the supply and burn of gases for abnormal conditions.
- It automatically responds to large gas leaks by isolating the inlets to the system.
- It receives a signal from the Carbolite Gero furnace that the furnace is hot enough to accept the flow of hydrogen removing the risk of creating an explosive mixture.
- It utilises a ceramic ignitor to combust the waste hydrogen as it vents. This electric ignitor replaces previous butane burner systems and removes hazardous material from the equipment.
- It allows for the blending of hydrogen and nitrogen to dilute hydrogen concentration if required.

Important Notes:

- The LGSS can be adapted for use with various combustible gases, however, this manual refers to hydrogen (H_2) at all times.
- Similarly, alternative inert gases may be used to purge the vessel / system, however this manual refers to nitrogen (N_2) at all times.
- All installations utilising flammable gases should be risk assessed by the operator or installer. Additional facility safety measures such as gas and fire detection systems should be considered.
- The Carbolite Gero LGSS safety risk assessment and Hazard and Operability study (HAZOP) can be provided on request to assist with customer risk assessments.
- Compatible furnaces must be preconfigured to provide a signal to the gas safety system when at safe temperature. Please check with Carbolite Gero to ensure that the furnace is compatible.

2.0 Scope and Purpose

This product is intended to be used within a laboratory environment to introduce hydrogen gas into a sealed vessel heated above 750°C.

This equipment is designed to be connected only to the pre-configured Carbolite Gero product(s) with which it is supplied.

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

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.

2.0.1 Responsibilities

- The customer is responsible for conducting their own risk assessment and ensuring that any materials to be processed 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 operator training. All operators should be trained in pressurised and flammable gas hazards. All operators should be familiar with furnaces and burners with hot surfaces.

Note: This product should not be modified or used for any purpose other than that for which it is intended, and MUST NOT be used outside of the parameters as stated within this manual.

Note: Carbolite Gero does not accept any liability for injury to personnel or damage to equipment as a result of misuse or failure to comply with safety guidance.

2.1 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 supply lines.

Note: Throughout this manual, written instructions are accompanied by diagrams. Diagrams may be highlighted in different colours and do not reflect the actual colouration of the product.
Parts that are to be moved are highlighted in **YELLOW** and are intended to be fixed to, or removed from, surfaces highlighted in **BLUE**. Where applicable, arrows show the direction of movement.

3.0 Safety

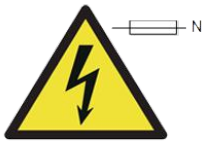
3.1 Operator Safety

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.

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!

3.2 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

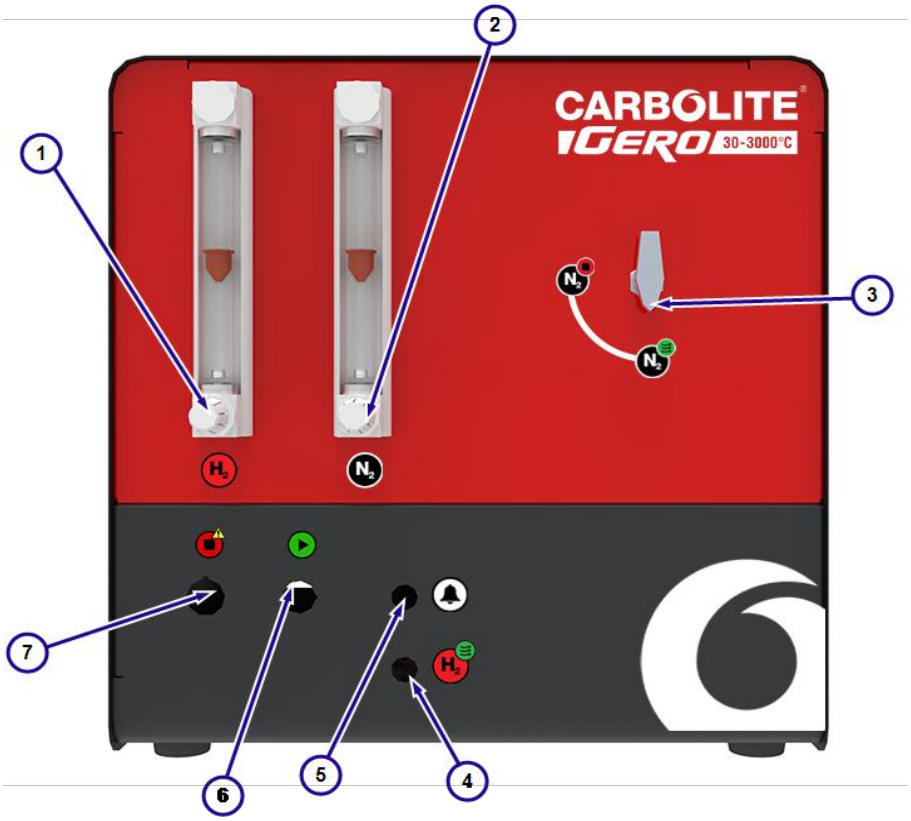
	Fire / Explosion	• Only trained operators should use this equipment • Only process materials for which a suitable risk assessment has been carried out

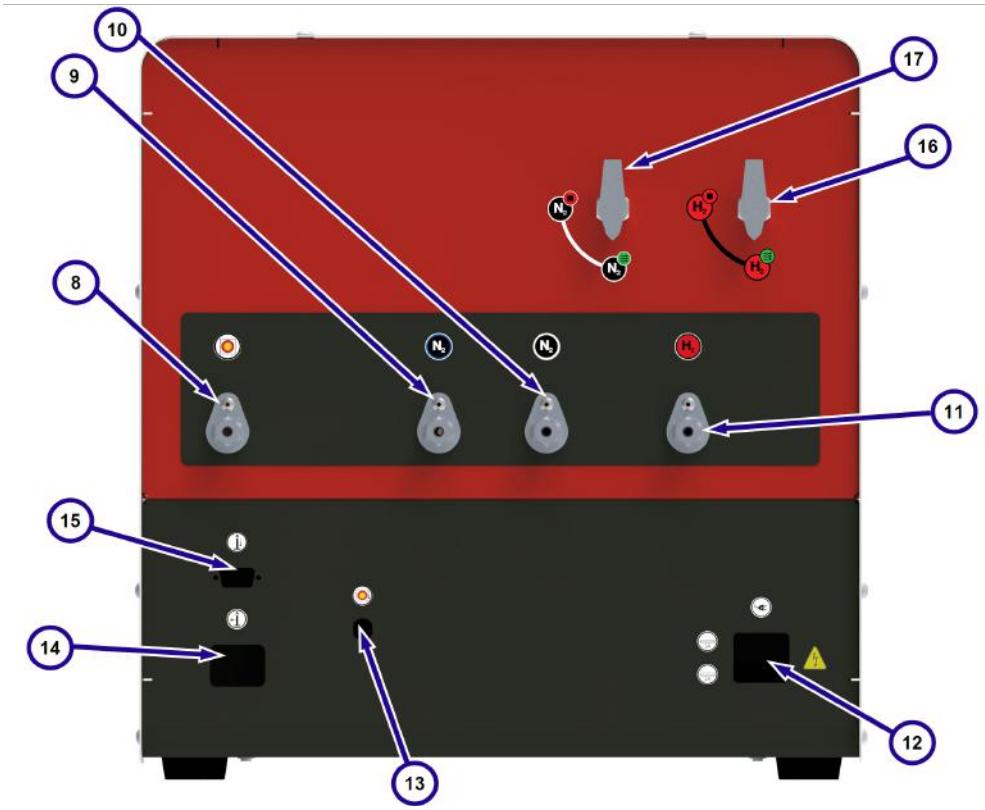
4.0 Parts Supplied

Please check that all the following parts are present and undamaged before proceeding with installation:

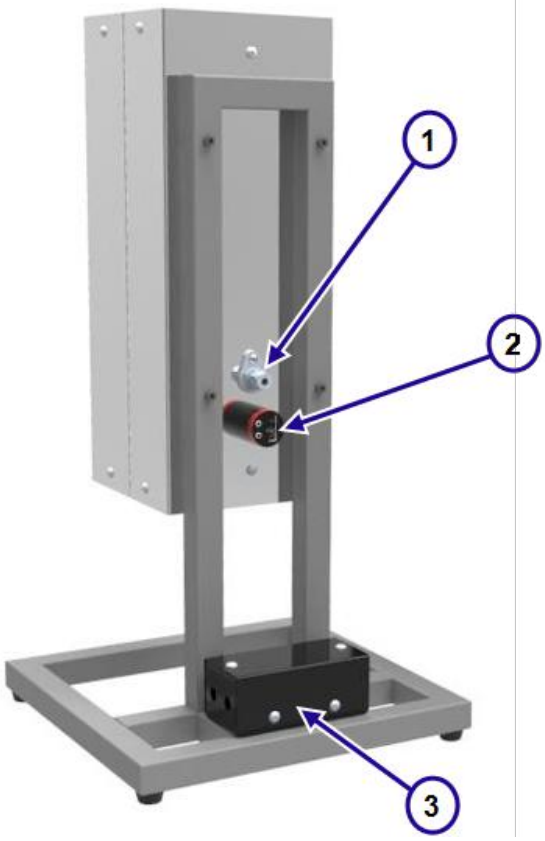
- Gas Control Box
- Burner Box
- Ceramic Ignitor
- Furnace Inlet Hose (from Gas Control Box to Furnace)
- Furnace Outlet House (from Furnace to Burner Box)
- 2 x 6mm straight union connectors
- Hose extension for use with vertical tube furnaces (if supplied)

5.0 Product Diagrams





1	Hydrogen Flowmeter
2	Nitrogen Flowmeter
3	Process Nitrogen Isolation Valve (V1)
4	Hydrogen Flow Indicator
5	Alarm Indicator
6	Start Button
7	Emergency Stop
8	Gas outlet to Furnace
9	Safety Nitrogen inlet
10	Nitrogen inlet
11	Hydrogen inlet
12	Mains Power Supply Inlet
13	Furnace Temperature Monitor Connection
14	Power Supply Outlet to Burner Box
15	Burner Box Temperature Monitor Connection
16	Hydrogen Isolation Valve
17	Nitrogen Isolation Valve



1	Connections from Furnace Gas Outlet
2	Infrared Temperature Monitor
3	Electrical Connections Box

H_2	Hydrogen		Emergency Stop
N_2	Process Nitrogen		Gas Connection to Furnace
N_2	Safety Nitrogen		Furnace Temperature Monitor Connection
N_2	Process Nitrogen Flow On		Power Supply Inlet
N_2	Process Nitrogen Flow Off		Power Supply Outlet to Burner
H_2	Hydrogen Flow On		Burner Temperature Monitor
	Alarm		Exhaust Gas Inlet (Burner Box)

6.0 Specifications

Gas Safety System - Gas Control Box	
Height x Width x Depth (mm)	440 x 425 x 525
Approximate Weight (kg)	20

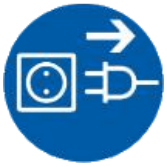
Gas Safety System - Burner Box	
Height x Width x Depth (mm)	650 x 300 x 340
Approximate Weight (kg)	10

6.1 Electrical Specifications

This equipment MUST be earthed!

6.1.1 Mains Supply Cable

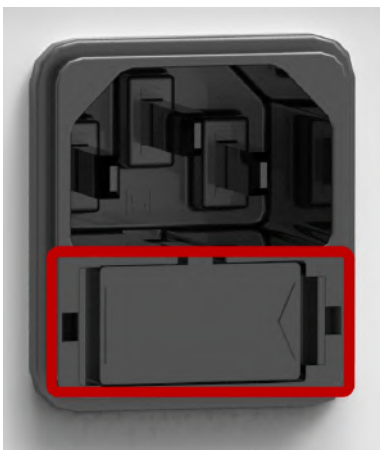
IEC	3-core, 1.0mm^2 rated to 10 Amp (PVC)



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.

6.1.2 Fuses

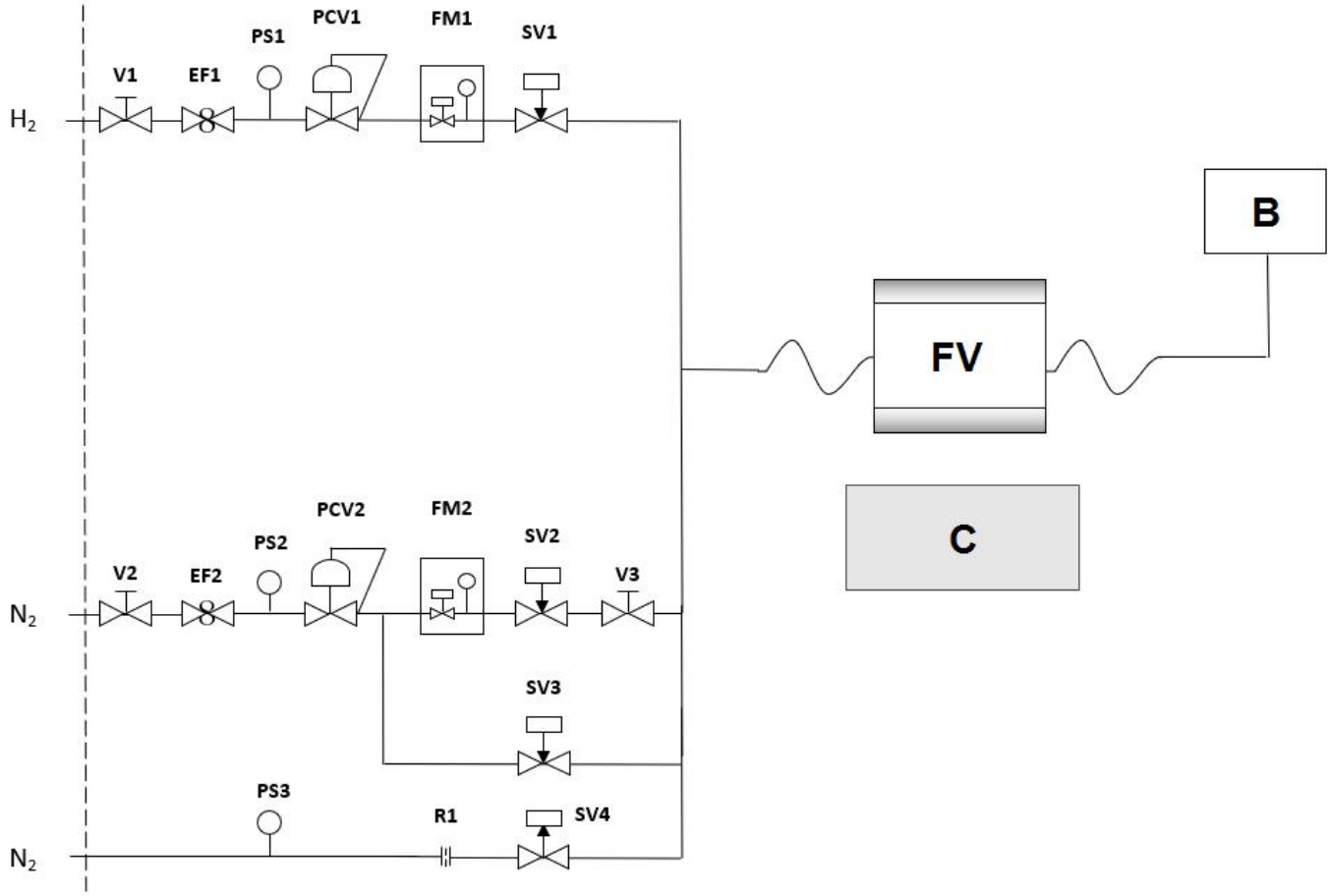
The main fuses for the Laboratory Gas Safety System are located in an external fuse holder positioned next to the IEC socket for the power supply cable.



Note: The external fuse holder contains two **2A, 5 x 20 mm** anti-surge fuses. Only replace fuses with those of the same size and rating.

7.0 System Description

The diagram below shows the piping schematic of the Laboratory Gas Safety System:



EF	Excess Flow Valve
PCV	Pressure Control Valve
FM	Flowmeter
SV	Solenoid Valve
V	Valve
PS	Pressure Switch
R	Restriction Orifice
FV	Furnace Vessel (sealed)
C	Furnace Controller with 750°C Relay Trip
B	Ceramic Burner with Infra-red Monitor

- The gas control system is supplied as standard as a control box and burner, with electrical and gas connection lines to link between gas safety system and furnace.
- An electrical supply is required: single phase or one phase of a 3-phase supply. The supply lead is separate from that of the furnace. A power failure or deliberate

disconnection of the supply (for example an emergency stop) causes the hydrogen supply to immediately shut off and initiates safety nitrogen purging.
- The gas safety system is designed to be able to safely purge a vessel with a maximum volume capacity of 45 litres
- The gas safety system has three gas inlets:
  - **Hydrogen** - reducing gas
  - **Nitrogen** - purge gas
  - **Safety Nitrogen** - backup purge initiated by alarm

Note: The supply of safety nitrogen should be independent of process nitrogen. A separate cylinder or supply line is recommended.

Note: The flow of safety nitrogen in the event of an alarm or power cut will continue until the nitrogen is consumed or system reset. The customer's risk assessment should examine the consequences of this release.

Note: If the supply is persistent or room ventilation poor then it is recommended that a small cylinder of nitrogen with limited volume is used.

- The pressures and flow rates of these gas supply lines are controlled by internal instruments and are started / stopped by independent solenoid valves
- Pressure switches are used to detect low pressure in each of the gas supplies
- A white warning light signals that the H2 valve is open and hydrogen is flowing
- A red alarm light signals that the unit is in alarm. The alarms are:
  - Stop button
  - Low ignitor temperature
  - Low hydrogen supply pressure
  - Low nitrogen supply pressure
  - Low safety nitrogen supply pressure

- In alarm, the hydrogen flow is stopped, and a safety nitrogen purge is performed
- Hydrogen may not be admitted into the vessel below 750°C. When the furnace is above 750°C a signal is sent to the gas safety system via a pre-configured relay switch within the furnace controller. The signal instructs the system to permit the flow of hydrogen into the vessel.
- A ceramic ignitor housed in a specialist burner box is provided to burn exhaust gas safely. If hydrogen flow temporarily stops, the flame will go out but will automatically reignite when flow resumes. The ignitor temperature is directly monitored using an infrared (IR) detector.

Note: The ceramic ignitor will operate for thousands of hours. However, it is recommended that the gas safety system is powered off when not in use in order to preserve the ignitor lifetime.

- The flow of process nitrogen may be controlled during use.
- An internal timer fixes a minimum purge time to remove air from the furnace vessel. This timer is preset to 30 minutes to match the largest volume vessel in the range.

Note: Even if the furnace is above temperature, the 30 minute purge timer has to conclude before hydrogen flow is initiated. Resetting the system (power cut or alarm) will return the timer to zero and require a new start button command.

8.0 Installation

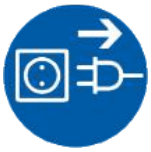
8.1 Siting

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.

Ensure that there is at least 1200mm of clearance above the top of the burner box to allow for heat dissipation.

Note: For additional recommendations on siting and setting up, please refer to the product manual for your Carbolite Gero furnace.

8.2 Gas Supply Requirements

8.2.1 Hydrogen

- The hydrogen supply must be regulated between 1.5 to 2.0 bar_g.
- If the regulated supply pressure drops below 1.0 bar, an automatic safety purge is initiated.
- It must have a supply stop valve (e.g. cylinder valve) to enable the operator to turn off the supply.
- After a connection test, a periodic leak test on this supply should be conducted every 12 months.

Note: It is possible to increase the hydrogen flow by adjusting the inlet pressure, however the hydrogen inlet pressure **MUST NOT** be set above 2 bar as it can result in high hydrogen flow and hazardous temperatures at the burner!

8.2.2 Nitrogen

- The nitrogen supply must be regulated between 1.5 to 2.0 bar_g.
- The supply must have isolation valves to enable the operator to turn it off.
- The flow rate of the process purge is pre-set internally to ~5 litres per minute
- If the pressure in the supply line drops below 1.0 bar then the system, an automatic safety purge is initiated.

8.2.3 Safety Nitrogen

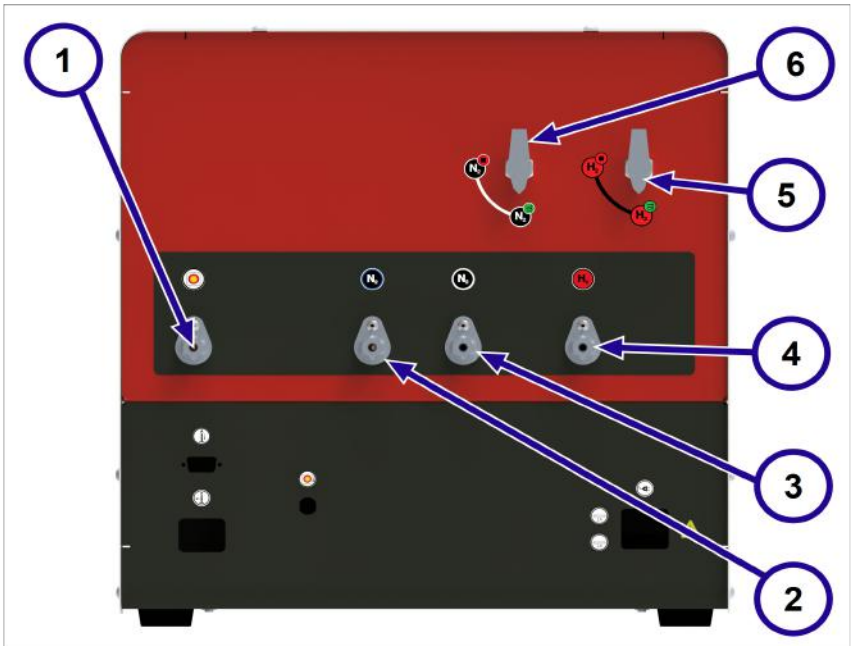
- The nitrogen supply must be regulated between 1.5 to 2.0 bar_g.
- The supply must have isolation valves to enable the operator to turn it off.
- The flow rate of the safety purge is pre-set internally to ~10 litres per minute.
- If the pressure in the supply line drops below 1.0 bar then the system will enter an alarm state, stop hydrogen flow and purge with process nitrogen.

Safety nitrogen will pass through the system when it is powered off. Therefore, the safety nitrogen supply should be isolated prior to powering off the system. Similarly, the system should be powered on before the safety nitrogen supply is opened.

8.3 Gas Connections

The gas control box features 4 labelled gas connections at the rear:

- Hydrogen inlet
- Process nitrogen inlet
- Safety nitrogen inlet
- Gas outlet to furnace

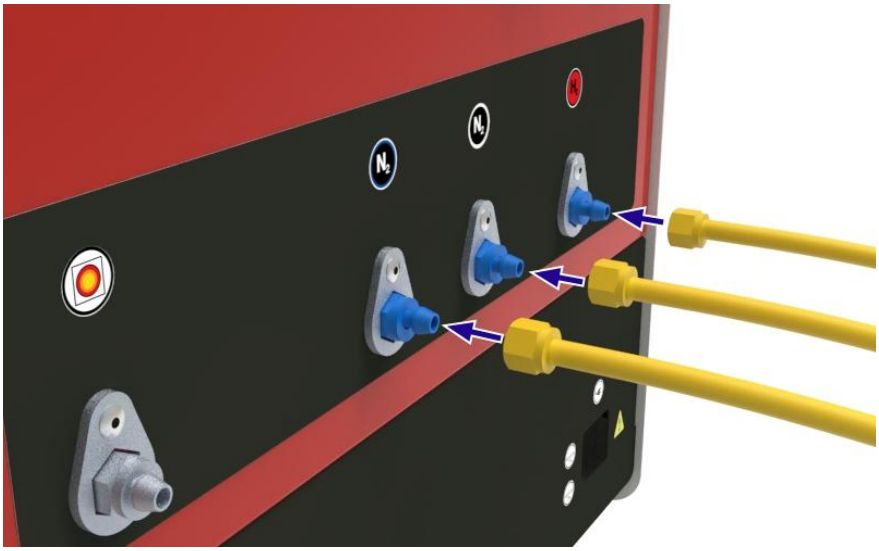
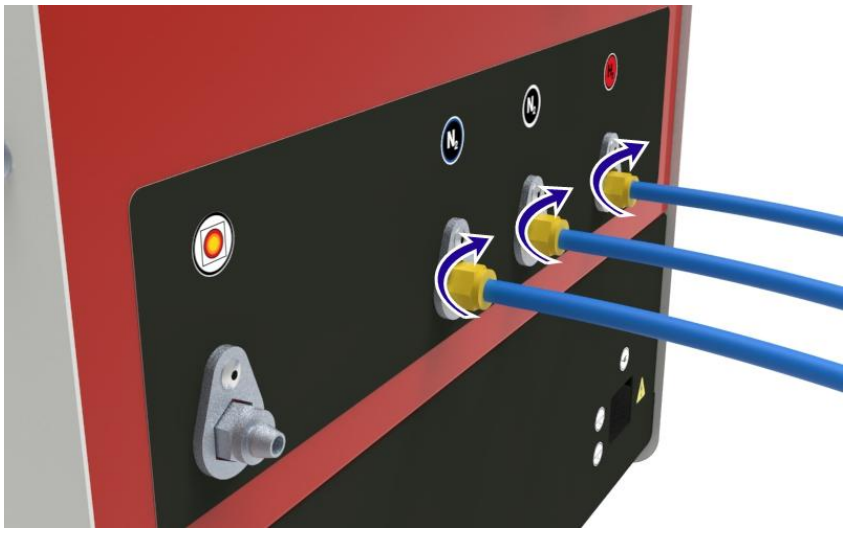
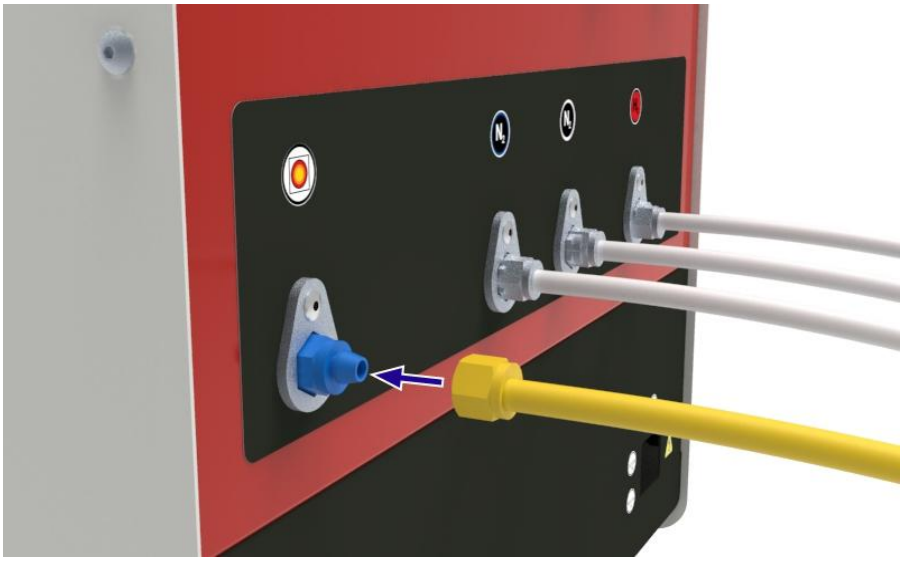


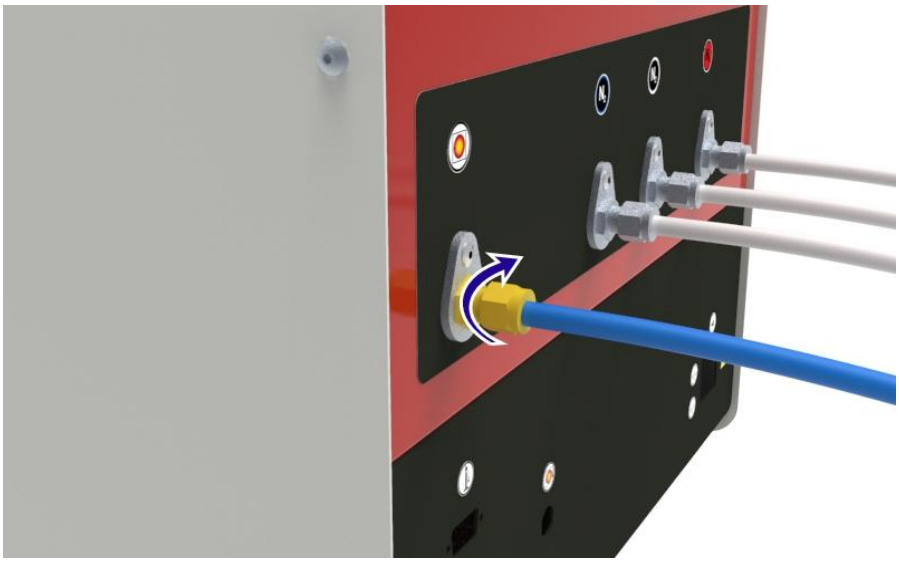
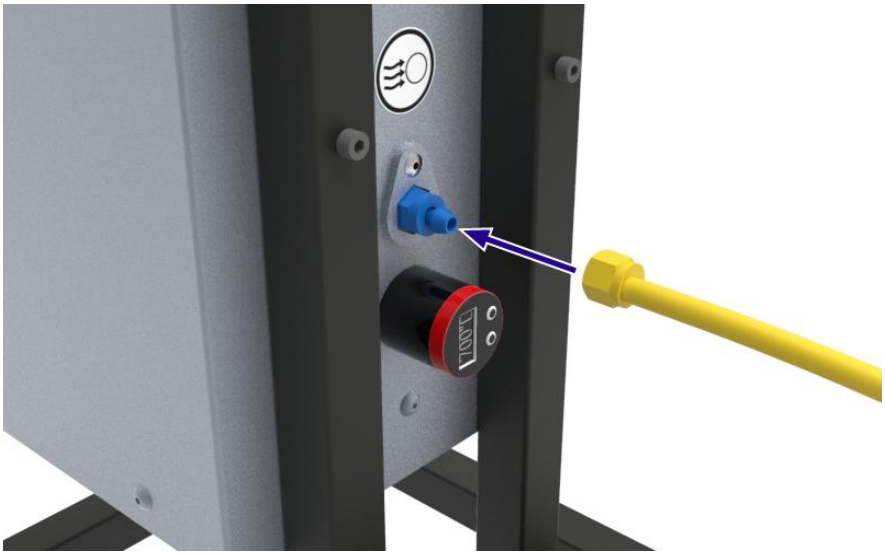
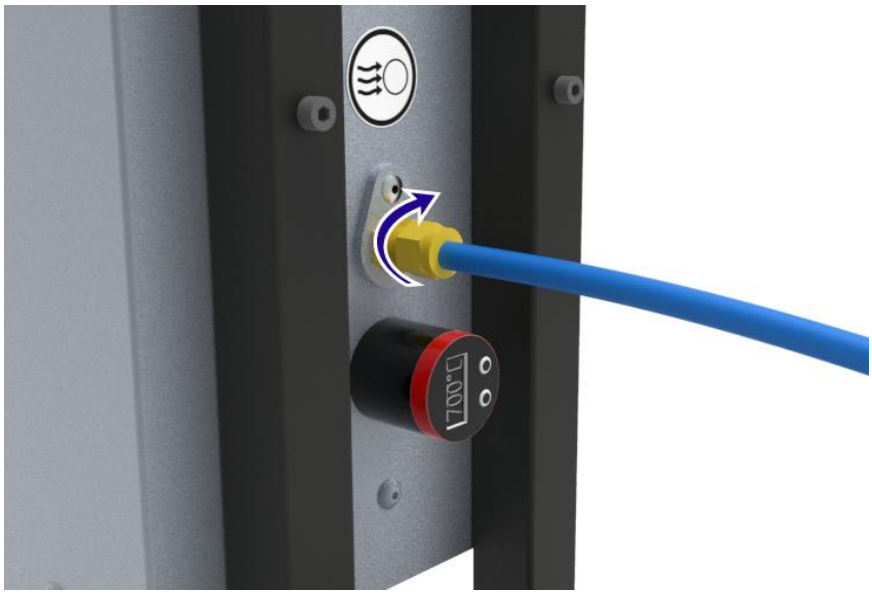
1	Gas to furnace (outlet)
2	Safety Nitrogen Supply (inlet)
3	Process Nitrogen Supply (inlet)
4	Hydrogen Supply (inlet)
5	Hydrogen Isolation Valve
6	Process Nitrogen Isolation Valve

Although it is possible to connect the same nitrogen supply to both nitrogen inlets, a truly separate safety nitrogen supply should be used as the system will automatically switch to the safety inlet if at any time the main supply is insufficient to provide a safe purge.

Note: The Hydrogen and Nitrogen On/Off valves, V1 and V2 respectively (see section 7.0), should be opened once the gas supplies are connected. These valves are not used during operation but allow isolation of the gas supply from the equipment during maintenance.

To connect the gas supplies to the furnace and afterburner:

• Install the vessel (work tube or retort) into the furnace and attach the appropriate seals, including inlets and outlets. • Connect a pre-swaged 6mm hose or tube, onto each of the gas inlets at the rear of the gas control box. All inlets are labelled with the required gas and utilise 6mm compression fittings.	
• Tighten the nut on each of the compression fittings by 0.25 turns. • Connect each H_2 and N_2 inlet hose/tube to the relevant gas supply.	
• Connect the 6mm furnace inlet hose provided to the output compression fitting.	

• Tighten the compression fitting by 0.25 turns. • Connect the other end of the braided hose to the inlet on the vessel.	
• Connect the 6mm furnace outlet hose to the gas outlet pipe on the vessel. • Connect the other end of the braided hose to the exhaust inlet at the rear of the exhaust gas burner box.	
• Tighten the nut on the compression fitting by 0.25 turns.	

Note: If the system is to be used with a tube furnace, radiation shields must be fitted within the work tube in order to protect the end seals and subsequent gas connections from damage caused by radiant heat.

If your system could cause condensates or debris to build up in the exhaust outlet and hose, you must introduce a procedure to ensure that the outlet pipe is cleared of any material regularly. Failure to do so may result in gas line blockages and possible leaks from the system.

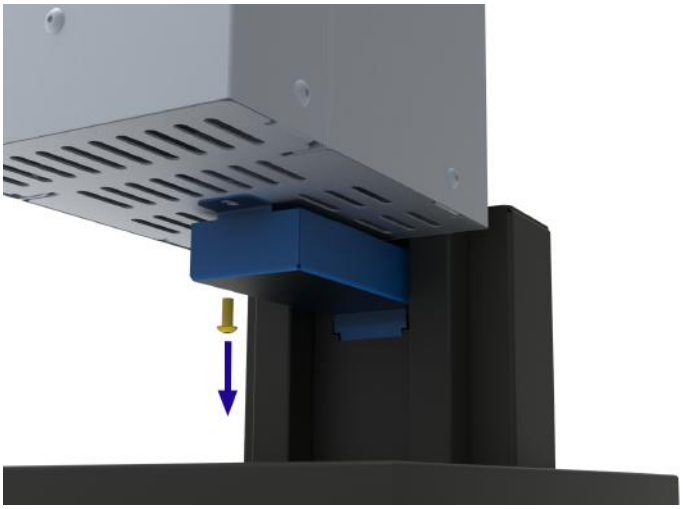
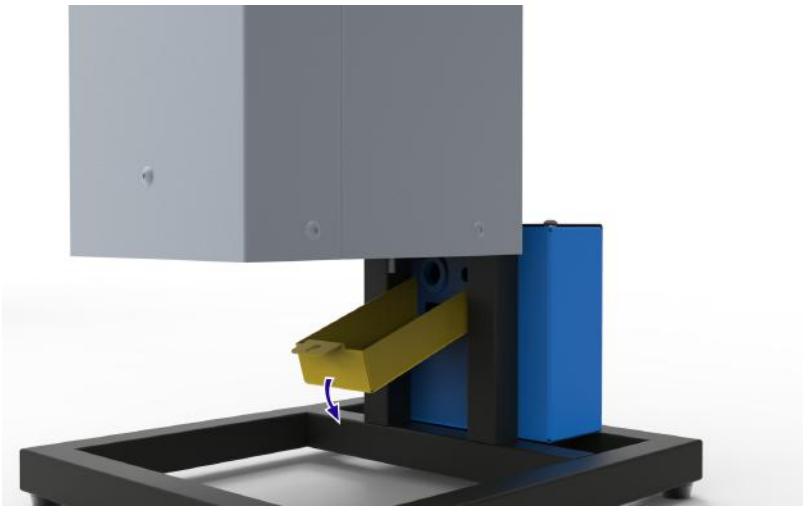
8.4 Installing the Ignitor

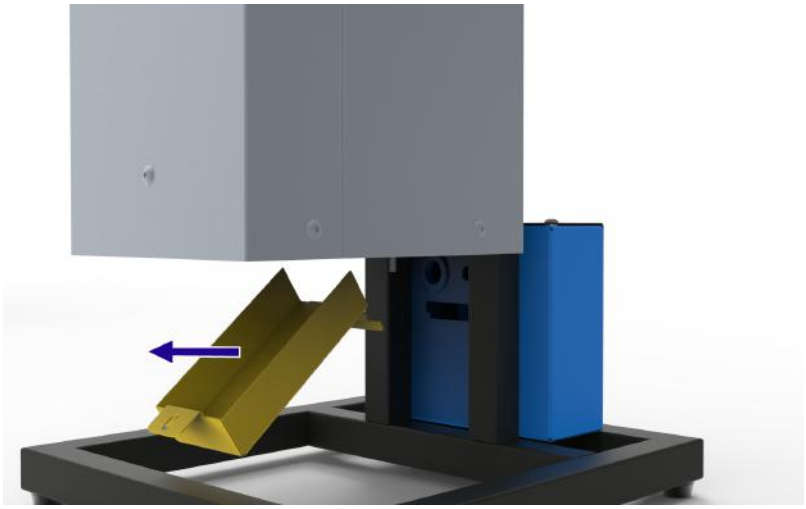
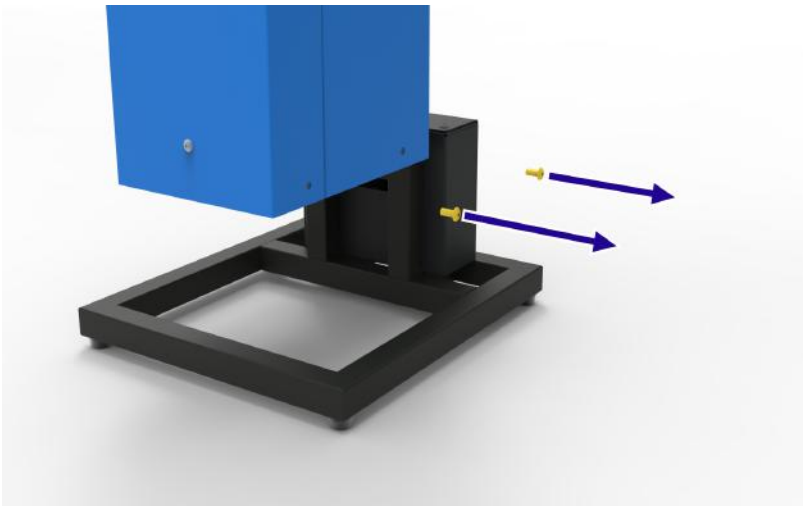
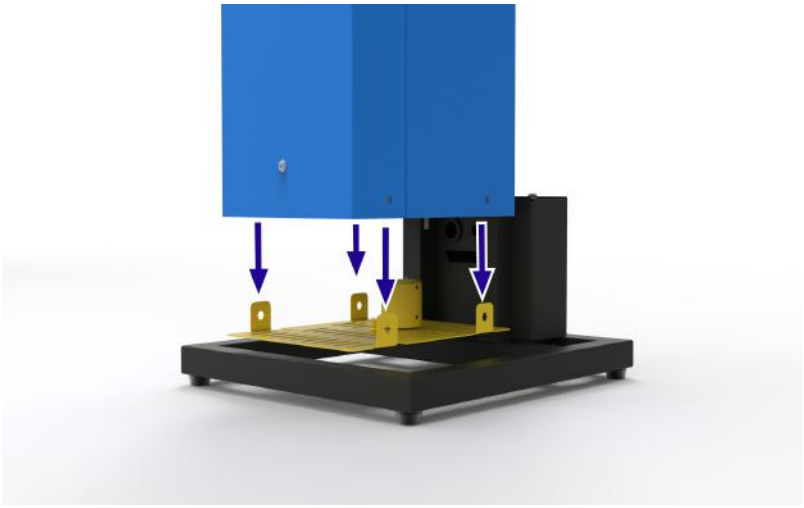
Note: The ceramic ignitor is packed separately as it is fragile and could become damaged during shipping; subsequently it needs to be fitted during the initial installation of the equipment.

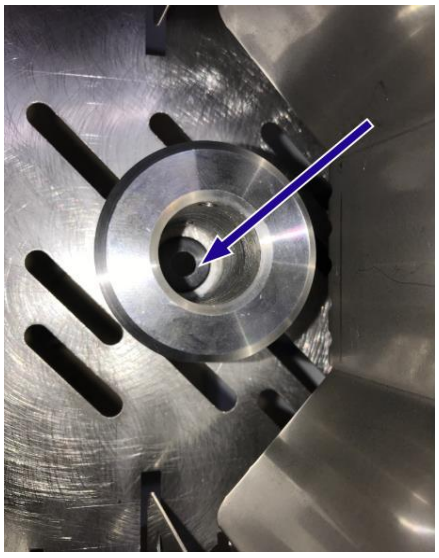
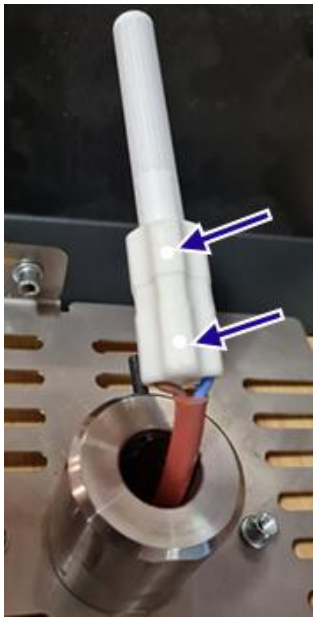
Note: Disconnect the product from the electrical supply before carrying out any maintenance procedures.

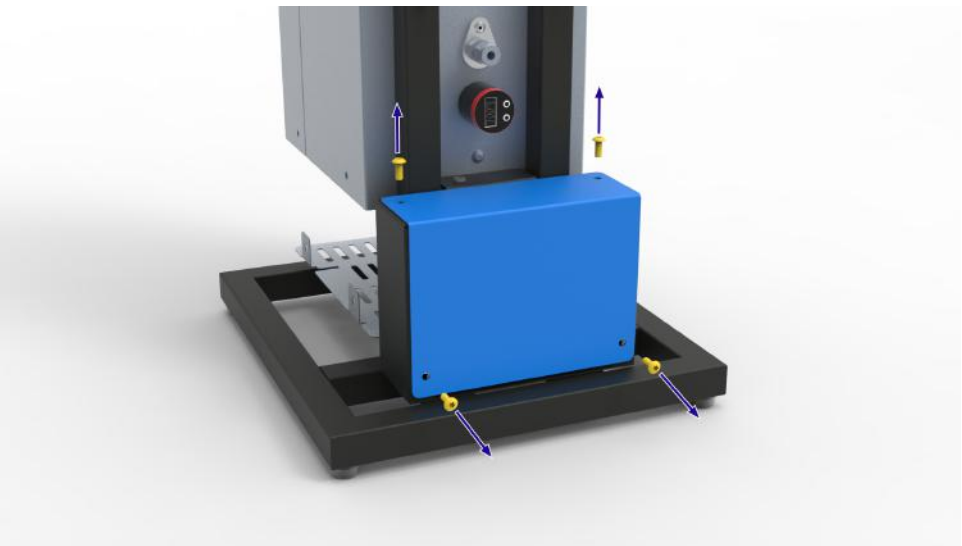
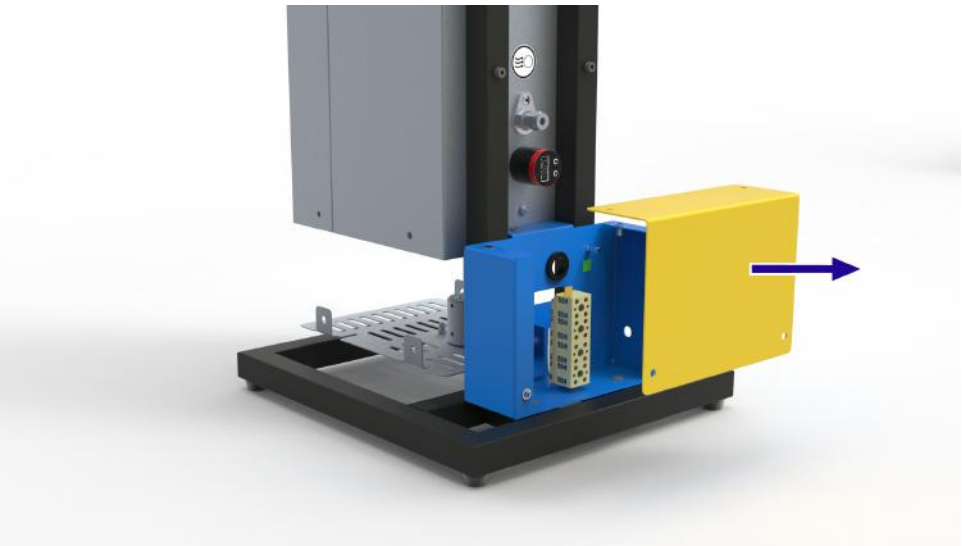
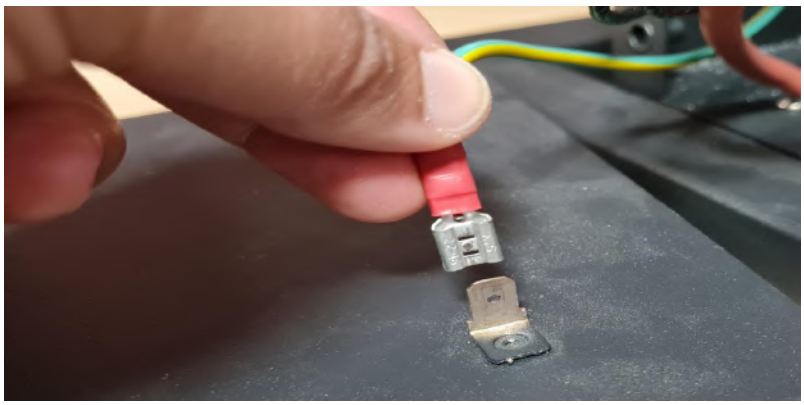
Note: Ceramic ignitors are vulnerable to vibration and shock. Avoid mechanical damage when handling or moving equipment.

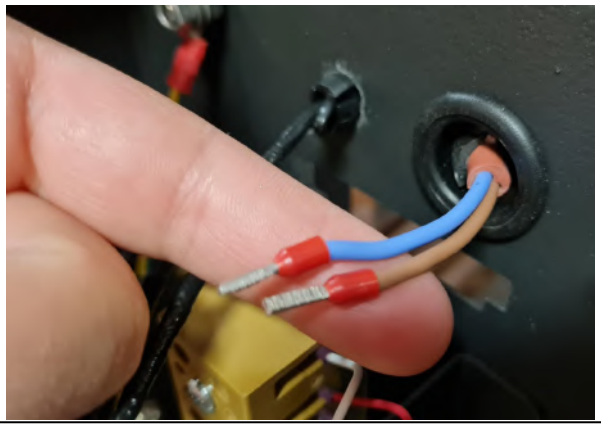
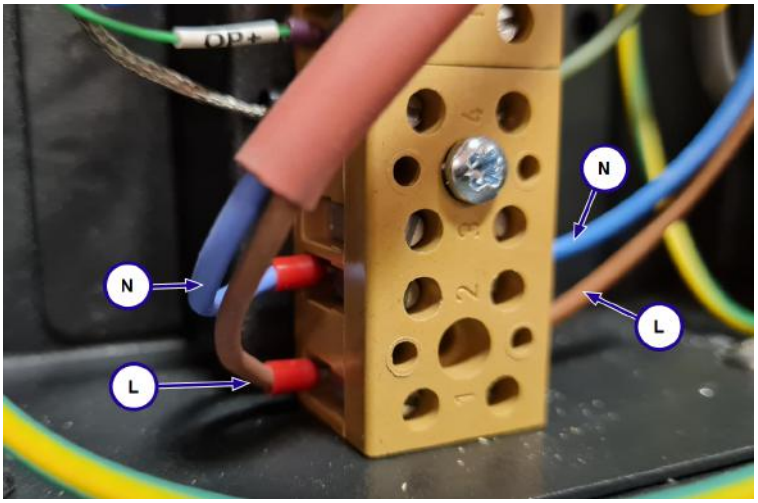
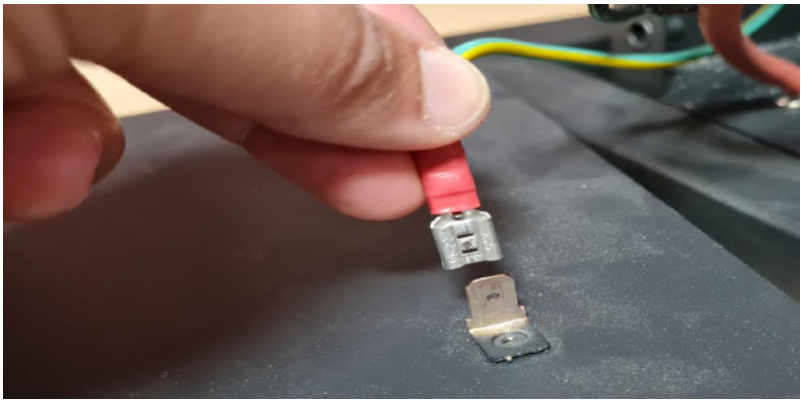
To install / replace the ignitor:

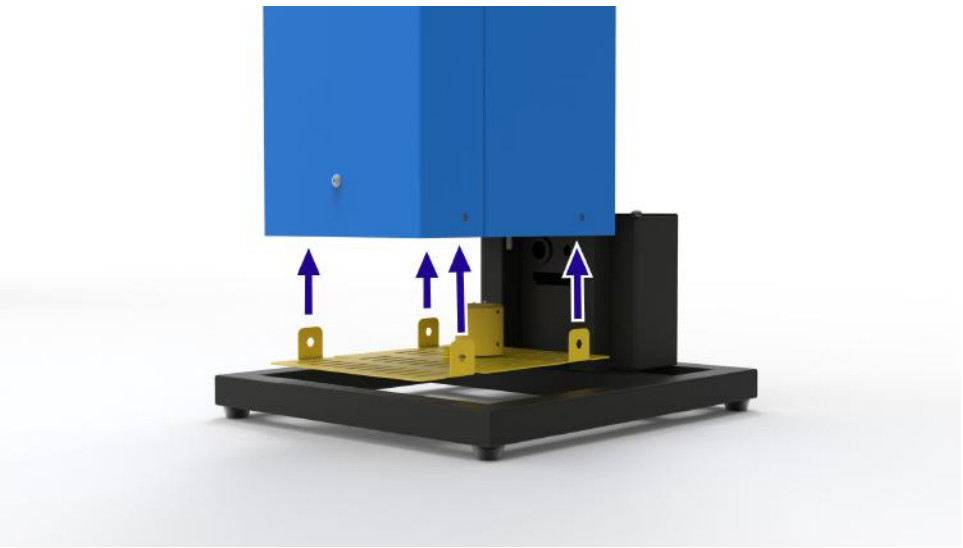
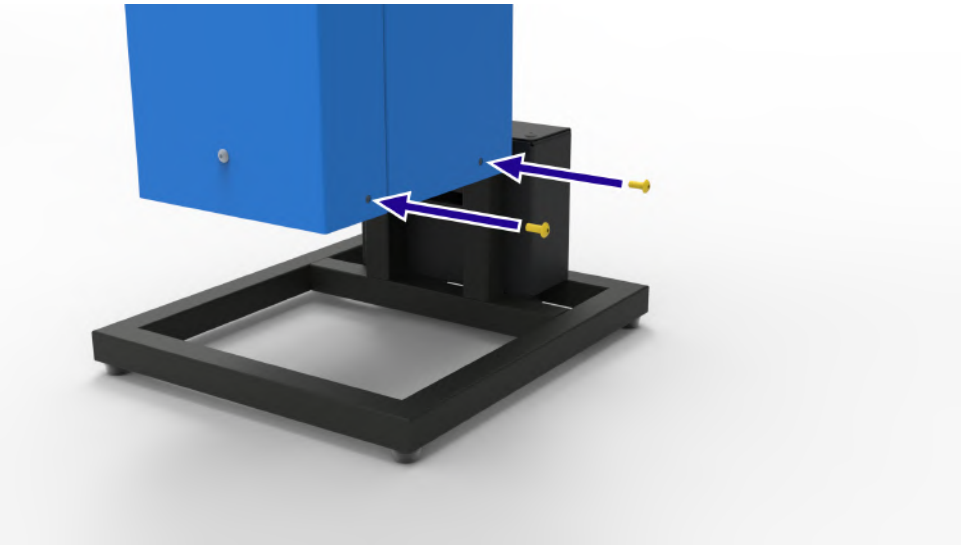
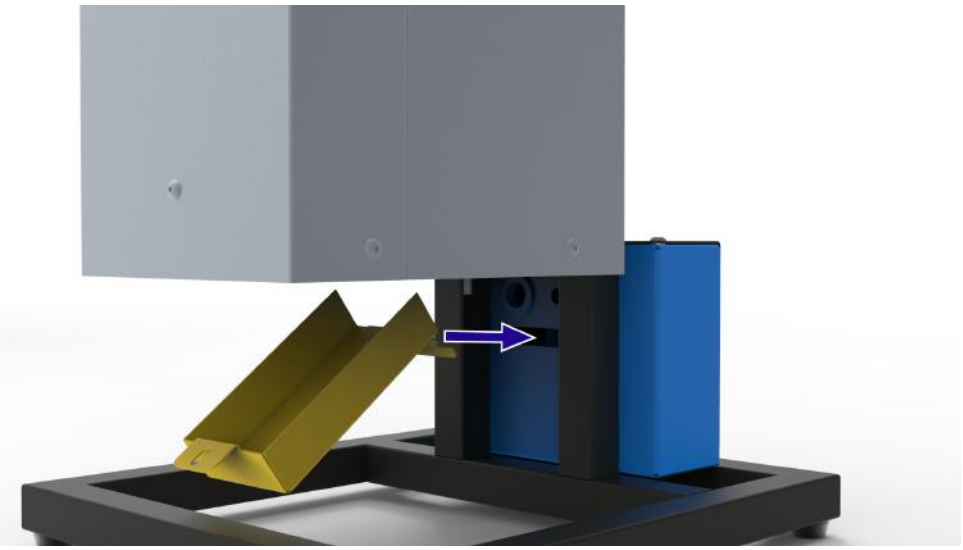
• Remove the screw securing the cable protection tray in place.	
• Carefully lower the tray, taking care to avoid trapping any cables between the metalwork.	

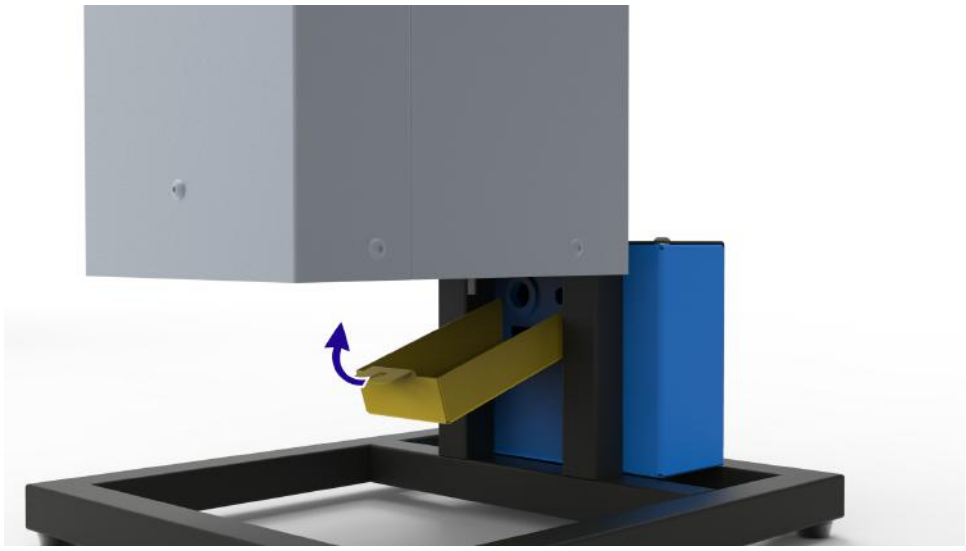
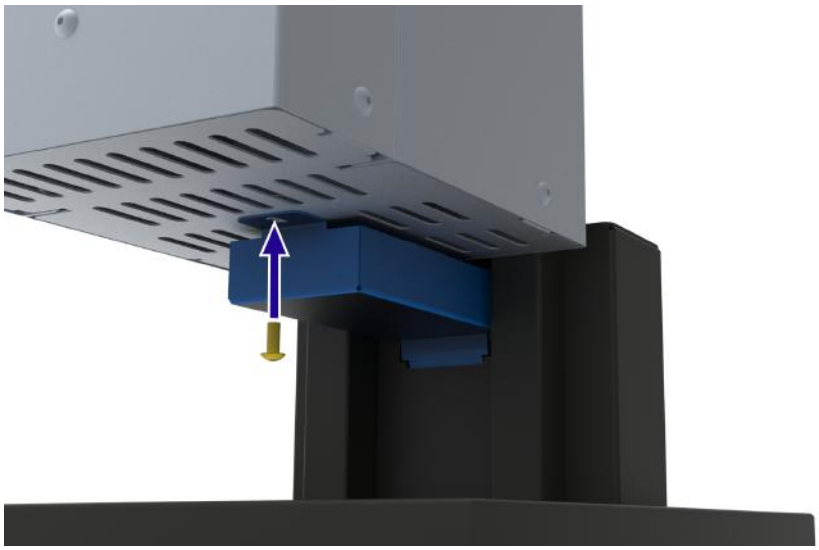
• Carefully remove the tray.	
• Remove the four screws at the bottom of the burner box (two on each side).	
• Carefully lower the bottom plate.	

• Ensure that the rubber grommet is in place at the base of the ignitor holder.	
• Remove the protective packing from the ignitor.	
• Feed the ignitor cables through the base of the holder. • Secure the ignitor in place by tightening the grub screws in the side of the holder with a hex key. The grub screws line up with the indentations on the side of the ceramic ignitor.	

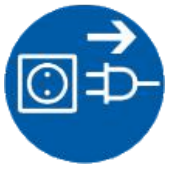
• Remove the four screws holding the electrical connections box panel in place.	
• Remove the panel.	
• Disconnect the earth connection,	

• Feed the ignitor cable through the gland at the back of the electrical connections box.	
• Connect the ignitor cable as shown. Always ensure that the wires you connect to the terminal block correspond with those already fitted.	
• Check all connections are secure, reconnect the earth, then refit the panel on the electrical connections box.	

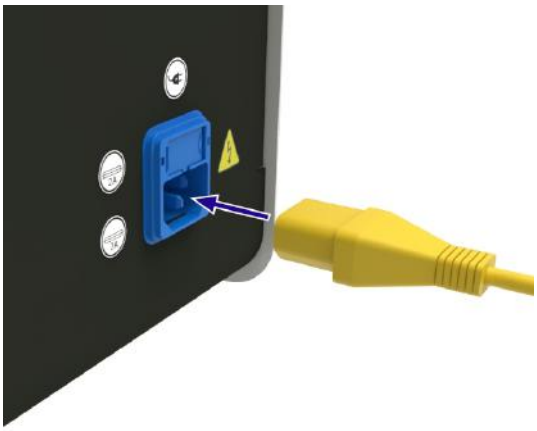
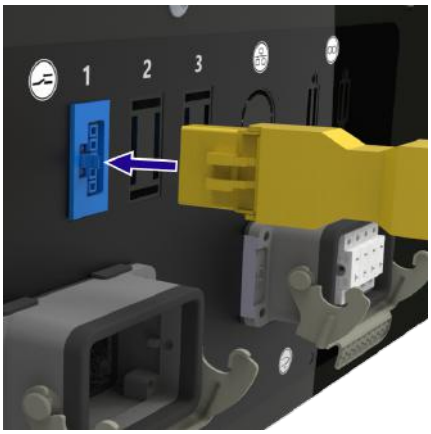
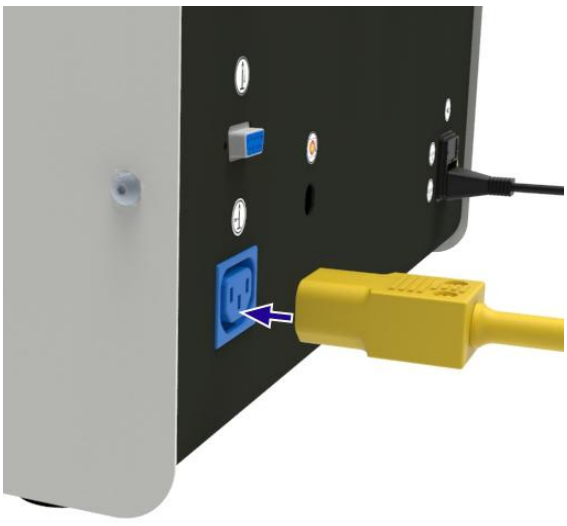
• Lift the bottom plate into position and hold it in place.	
• Secure the bottom plate in place with the four screws provided (two on each side).	
• Insert the tab of the cable protection tray into the slot on the electrical connections box.	

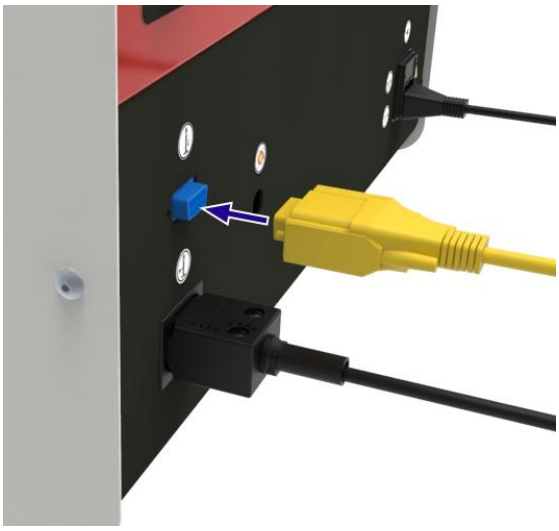
• Carefully lift the tray up into position, ensuring that any loose ignitor cable is tucked into the tray, and not trapped between the metalwork.	
• Secure the tray in place with a single screw.	

8.5 Electrical Connections



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.

• The gas control box requires a connection to a single-phase electrical supply as indicated on the rating label. Both the control box and the exhaust gas burner are electrically isolated when the controller box emergency stop is pressed.	
• An electrical signal cable is fitted to the rear of the gas control box. This cable connects directly to the furnace controller. In standard models, a plug and socket arrangement is fitted for easy connection.	
• An electrical connection to the exhaust gas burner box is required to power the ceramic ignitor and infrared (IR) temperature monitor. Power is provided directly from the gas control box. Connect the power supply cable from the electrical connections box at the rear of the exhaust gas burner to the "Power Outlet" port at the rear of the gas control box.	

• A communications connection between the burner box and the gas control box is also required to alert the system of the temperature of the ceramic ignitor. Connect the 9-pin D connector plug from the burner box to the port at the rear of the gas control box.	

Note: To prevent snagging or pulling, please coil and secure any excess cable lengths.

8.6 Installation Troubleshooting

Note: The following troubleshooting procedures should only be performed by suitable trained personnel. Please contact Carbolite Gero if you require any assistance.

8.6.1 Gas Flow

- The process flows of nitrogen and hydrogen are observed and adjusted by the flow meters. Flow can be further adjusted by increasing or decreasing supply pressure. Supply pressure should never exceed 2 bar_g as this may damage the system and result in a leak.
- If hydrogen does not begin to flow when the furnace is above 750°C, confirm that the closed circuit relay signal is functioning by continuity testing resistance using a multimeter or similar device.

8.6.2 Infrared Monitor

Note: The IR detector has been pre-set with an internal temperature trip. When the IR detector trips, it will wait for one minute to allow the ignitor to cool before power is restored.

Please refer to separate product instruction manual for details:

https://docs.rs-online.com/b161/0900766b81643240.pdf

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.	
General Access	Check that there is sufficient clearance around the top and all sides of the product.	
Ventilation	Check that the product has been installed in a well ventilated area.	
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.	
Gas Supplies	Check that the gas supplies (not supplied by Carbolite Gero) are correct and appropriate for the equipment.	
Panels	Check that all covers and access panels are securely fitted.	
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.	
Earth Connection	Check that an earth connection has been made. All removable panels should be earthed.	
Gas Connections	Check that all connections between the equipment have been made as detailed in this manual: • Gas supplies to gas control box • Gas control box to furnace inlet • Furnace outlet to burner box	

Relay Connections	Check that the relay connection between the gas control box and furnace has been made.	
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 alarm indicator illuminates.	
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, any solenoid valves open. • Set the desired gas flow rates. **Note:** The alarm indicator will remain illuminated until all gas pressures are set.	
Infrared Monitor (Burner Box)	Check that the IR monitor is displaying temperature readings.	

10.0 Operation

10.1 Typical Operation Sequence

1. Turn on power to the system.
2. Open the process nitrogen cylinder/supply.
3. Open the safety nitrogen cylinder/supply.

> **Note:** The safety nitrogen flow will start if the system is de-energised, thus the safety nitrogen cylinder should only be opened when the system is powered up and before the "start" button is pressed.

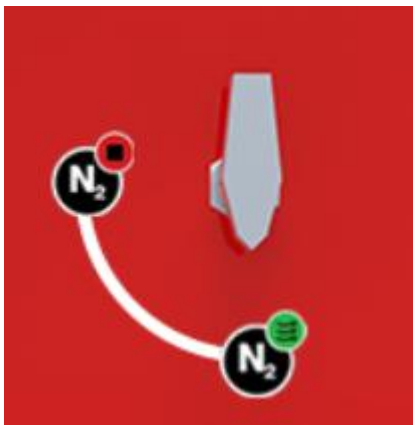
4. Open the process hydrogen cylinder/supply.
5. Press the "start" button.
6. The system is automatically purged with nitrogen for 30 minutes.
7. Process nitrogen flow begins automatically once the initial purge completes.

> **Note:** Process nitrogen can be metered using the control valve on the flowmeter.

8. When the furnace is hotter that 750°C, the hydrogen flow starts automatically.
9. When the furnace is cooler than 750°C, the hydrogen flow stops automatically.
10. The system is automatically purged with nitrogen for 30 minutes.
11. The process nitrogen flow automatically begins again to create protective blanket around sample inside the vessel.
12. Close the hydrogen cylinder.
13. Close the process nitrogen cylinder.
14. Close the safety nitrogen cylinder.
15. Turn off power to the system.

10.2 Process Nitrogen Isolation Valve

Hydrogen and nitrogen flows can be adjusted and set during the main part of the process. If only hydrogen is required, then nitrogen can be isolated by turning the V3 valve on the front of the control box (see section 7.0).



Valve Open

Valve Closed

11.0 System Shutdown

The system can be switched off in several ways:

- If the furnace controller is used to cool the furnace down, then hydrogen will continue to be released until the temperature falls to 750°C. Below 750°C the hydrogen will be switched off and a purge of nitrogen will start to remove hydrogen and prevent air and oxygen entering the furnace vessel before the work piece has sufficiently cooled. This flow can be stopped any time by turning power off to the control box.

Note: The supply of safety nitrogen should be isolated before switching off power to the control box.

- The furnace can be powered off mid-process, but this would stop the hydrogen flow and trigger the safety purge.
- Isolating the safety purge would stop hydrogen flow, irrespective of the temperature or purging, and allow air ingress to the sample being processed.

12.0 Fault Safety Features

Possible Occurrences	Safety Device
Temperature falls to 750 °C because of element failure of furnace control failure.	Relay in main controller switches hydrogen off and purges with nitrogen.
Electrical mains supply failure or emergency stop button	Gas valve arrangement shuts down the normally closed hydrogen solenoid valve and opens the normally open safety nitrogen solenoid valve.
Hydrogen supply failure	Pressure switch detects insufficient supply and initiates shut down with process nitrogen purge.
Process nitrogen supply failure	Pressure switch detects insufficient supply, isolates hydrogen flow and initiates shut down with safety nitrogen purge.
Safety nitrogen supply failure	Pressure switch detects insufficient safety nitrogen supply, isolates hydrogen flow and initiates shut down with process nitrogen purge.
Ceramic ignitor failure	System initiates shut down with process nitrogen purge.
Gross leak – hydrogen	System excess flow valve shuts off flow downstream of the control box
Gross leak – nitrogen	System excess flow valve shuts off flow downstream of the control box

13.0 Maintenance

13.1 General Maintenance

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

13.2 Maintenance Schedule

CUSTOMER
QUALIFIED PERSONNEL

Maintenance Procedure	Method	Frequency				
		Daily	Weekly	Monthly	Bi-Annually	Annually
Safety						
Maintain clean gas lines	Check gas lines for any moisture, blockages or leakages.		■			
Electrical Safety (external)	Visual check of external cables and plugs.			■		
Function						
Operational Check	Check that all functions are working normally.	■				
Operational Check	Thorough inspection and report incorporating a test of all functions.					●
Gas Connection Leak Test	Check all gas connections for potential leaks.				■	

13.3 Notes on Maintenance and Repair

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

Note: Always maintain clean gas lines. Clean regularly if debris can build up. A blockage in the vent line from the furnace to the burner can lead to a blockage in gas flow and possible equipment damage.

If your system could cause condensates to build up in the exhaust outlet you must introduce a procedure to ensure that the outlet pipe is cleared of any condensates regularly. Failure to do so will result in gases leaking from the system.

Maintenance must be conducted regularly and must include checking all inlet pressures of all gases.

Note: Ceramic ignitors are vulnerable to vibration and shock. Avoid mechanical damage when handling or moving equipment.

Note: For details on replacing the ceramic ignitor, please refer to section 8.4.

14.0 Decommissioning, Storage and Disposal

14.1 Decommissioning

1. Isolate all gas supplies.
2. Isolate the product from the power supply.
3. Disconnect the product from the power supply.
4. Disconnect all external connections e.g. gas supplies.

14.2 Storage (Long Term)

Store in a cool, dry place.

Note: If the product is exposed to a humid environment during storage, it must be fully dried out before recommissioning. 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.

Email: sales@norrscope.com

CARBOLITE GERO 30-3000°C