



Installation, Operation & Maintenance Instructions

1530°C Chamber Furnaces

CDF 15/1b

This manual is for the guidance of operators of the above Carbolite Gero products and should be read before the furnace is connected to the electricity supply.

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1.0 SYMBOLS & WARNINGS

1.1 Switches and Lights

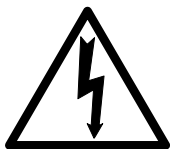


Instrument switch: when the instrument switch is operated the temperature control circuit is energised.



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

1.2 Warning Symbols



DANGER of electrical shock– read any warning printed by this symbol.



DANGER – hot surface. Read any warning printed by this symbol.
WARNING: all surfaces of a furnace may be hot.



DANGER – read any warning printed by this symbol.



Caution: Double pole/neutral fusing.

2.0 INSTALLATION

2.1 Unpacking & Handling

When unpacking or moving the furnace always lift it by its base. Never lift it by the door. Use two or more people to carry the furnace where possible. Remove any packing material from the door gear and furnace chamber before use.

NOTE: This product contains **Refractory Ceramic Fibre** (better described as **Alumino Silicate Wool**) for precautions and advice in handling this material see the ‘Repairs and Replacements’ section.

2.2 Siting & Setting Up

Place the furnace in a well ventilated room, away from other sources of heat, and on a surface which is resistant to accidental spillage of hot materials. Do not mount the furnace on an inflammable surface.

Ensure that there is free space around the furnace. Do not obstruct any of the vents in the control section: they are needed to keep the controls cool.

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

If the chimney is supplied unfitted, then fit it into the hole in the top of the furnace case. If the furnace is to be used to heat substances which emit fumes, then a fume extraction duct of about 150mm inlet diameter may be placed directly above the chimney outlet. Do not make a sealed connection to the furnace chimney as this causes excessive airflow through the chamber and results in poor temperature uniformity.

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)



2.4 Heating Elements

The Silicon Carbide elements are VERY FRAGILE and are packed separately. Fit them according to the instructions in section 5.7.

2.5 Electrical Connections

Connection by a qualified electrician is recommended.

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

The supply should be fused at the next size equal to or higher than the amperage on the label. A table of the most common fuse ratings is also given in section 8.1 of this manual.

The furnace is supplied with a 16 amp IEC plug and should be connected using a suitably rated mains cable.

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

Connection to isolating switch: this should operate on both conductors (single phase).

The supply MUST incorporate an earth (ground).

ELECTRICAL CONNECTION DETAILS			<i>supply type</i>	
Supply	Terminal label	Cable colour	<i>Live-Neutral</i>	<i>Reversible or Live-Live</i>
<i>1-phase</i>	L	Brown	To live	to either power conductor
	N	Blue	To neutral	to the other power conductor
	PE	Green/Yellow	To earth (ground)	to earth (ground)

Technical Notes

The furnaces covered by this manual have electronically controlled power limits. 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 OPERATION**3.1 Operating Cycle**

The furnace is fitted with an Instrument switch. The switch cuts off power to the control circuit.

Connect the furnace to the electrical supply.

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

Close the furnace door and adjust the temperature controller – see the controller manual.

To turn the Furnace off, set the Instrument switch to it's off position; the controller display will go blank. If the furnace is to be left off unattended, isolate it the electrical supply.

3.2 General Operating Advice

Heating element life is shortened by use at temperatures close to maximum. Do not leave the furnace at high temperature when not required. The maximum temperature is shown on the furnace rating label and on the back page 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 element, but if a large object is placed in the chamber it may record the average temperature of the object and the elements, which can lead to overheating of the elements. Allow large objects to gain heat at a lower temperature and then reset the controller to a temperature close to the desired maximum.

When heating materials which produce smoke or fumes, the chimney must be correctly fitted and unobstructed. Otherwise, soot can accumulate in the chamber and could possibly cause an electrical breakdown of the heating element.

If the furnace is used to heat materials which emit smoke or fumes, regularly heat it up to maximum temperature for one hour without load to burn away the soot.

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

Light weight ceramic fibre insulation can easily be marked by accidental contact. Some fine cracks may be visible on the surface of the insulation, or may develop in the surface of the chamber due to the progressive shrinkage of the insulation materials. Cracks are not usually detrimental to the functioning or the safety of the furnace.

3.3 Use of Probes

Any metal object used to probe into the furnace chamber while the furnace is connected to the supply must be earthed (grounded). This applies in particular to metal sheathed thermocouples, where the sheaths must be earthed. The refractory



material of the chamber lining becomes partly conducting 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.

3.4 Atmospheres

Chamber furnaces are not gas tight, so it should be understood that gas usage may be high, and that the chamber is likely always to contain some air. Residual oxygen levels of 1% are to be expected. In practice *inert* or *oxidising* gases may be used, but *not combustible or toxic gases*.

3.5 Operator Safety

The furnace incorporates a safety switch which interrupts the heating element circuit when the door is opened. This prevents the user touching a live heating element, but also prevents the furnace from heating up if the door is left open. The operation of this switch should be checked periodically – see section 4.1.2.

Avoid burns: furnace surfaces can be hot. Before you remove a hot object from the furnace make sure you have a safe place to put it down.

4.0 MAINTENANCE

4.1 General Maintenance

Preventive rather than reactive maintenance is to be preferred. The type and frequency depends on furnace use: the following are recommended.

4.1.1 Cleaning

Soot deposits may form inside the furnace, depending on the process. At appropriate intervals remove these by heating as indicated in section 3.2.

The furnace 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.

4.1.2 Safety Switch

The door switch operation mentioned in 3.5 should be checked periodically to ensure that heating elements are isolated when the door is opened. In normal conditions the safety arrangement should outlast the furnace, but it could be affected by rough handling, a corrosive environment or work materials, or exceptional frequency of use.

A qualified electrician should check that the supply to the heating elements is cut, with and without power being on, when the door is open partially and fully; it is important that isolation is not just marginally achieved. The check is best made on the element terminals after removal of the furnace back: probing the element surface inside the furnace could be inconclusive because of surface oxidation. Note that both live and neutral of a 1-phase supply, should be isolated when the door is opened.

4.1.3 Element Ageing and Power Adjustment

See sections 4.5 and 4.6.

4.2 Calibration

After prolonged use the controller and/or thermocouple could require recalibration. This would be important for processes which require accurate temperature readings or which use the furnace 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, the controller manual may contain calibration instructions.

4.3 After Sales Service

Carbolite Gero's service division (Carbolite Gero Service) has a team of Service Engineers capable of repair, calibration and preventive maintenance of furnace and oven products at our customers' premises throughout the world. We also sell spares by mail order. A telephone call or fax often enables a fault to be diagnosed and the necessary spare part despatched.

Each furnace has its own record card at Carbolite Gero. In all correspondence please quote the serial number, model type and voltage given on the rating label of the furnace. The serial number and model type are also given on the front of this booklet when supplied with a furnace.

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

4.4 Recommended Spares Kits

Carbolite Gero can supply individual spares, or a kit of the items most likely to be required. This can save time in the event of a breakdown. Each kit comprises one thermocouple, one sheath, one solid state relay, one door insulation piece, a set of elements, and a set of braids. Individual spares are also available.

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

4.5 Element Ageing

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

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

4.6 Power Adjustment

The furnace control system incorporates electronic power limiting. Power is supplied to the elements in bursts of about 1/3rd second duration. This prevents overheating of the elements. The power limit is compensated for, by the aid of the soft start function which will limit the initial output power until a programmed temperature is reached, whereby the furnace can control the ramp rate of the program without applying full power.

5.0 REPAIRS & REPLACEMENTS

5.1 Safety Warning – Disconnection from Supply



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

5.2 Safety Note - Refractory Fibrous Insulation



Insulation made from High Temperature Insulation Wool

Refractory Ceramic Fibre, (better described as Alumino Silicate Wool) (ASW)

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

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

Exposure to fibrous dust may cause respiratory disease.

When handling the material always use an approved respiratory protection equipment (RPE-i.e. 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 we recommend reference to the European Association representing the High Temperature Insulation Wool industry (www.ecfia.eu)

We can provide further information on request. Alternatively our service division can quote for any repairs to be carried out at your premises or ours.

5.3 Temperature Controller Replacement

301. These controllers are fitted to the back of the control panel, which can be separated from the base by removal of two screws.



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 instructions supplied with the replacement controller.

5.4 Solid-state Relay Replacement

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

Make a note how the wires are connected to the solid state relay, and disconnect them.

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

Replace and reconnect the solid state relay ensuring that the heat-conducting thermal pad is sandwiched between the relay and the base panel or aluminium plate. Alternatively a thin layer of white, heat-conducting silicon paste may be applied between the new relay and the plate.

The new solid state relay contains a built-in MOV which protects it from short periods of excess voltage.

Replace the removed panel.

5.5 Fuse Replacement

Fuses are marked on the circuit diagram (section 7.0) with type codes, e.g. F1, F2. A list of the correct fuses is given in section 8.1.

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

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

The fuses are near the cable entry point, and access is by removal of the back panel.

5.6 Thermocouple Replacement

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

Make a note of the thermocouple connections. The negative leg of the thermocouple is marked blue. Compensating cable colour codings are:

negative: white *positive (type R):* orange

Disconnect the thermocouple from its terminal block.

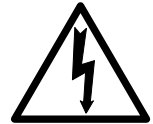
Bend the metal tag, or release the screw, to release the thermocouple sheath; withdraw the sheath, and shake out any fragments of thermocouple.

Re-assemble with a new thermocouple observing the colour coding, ensuring that the thermocouple is not twisted as it is being inserted and that sheath is refastened.

5.7 Element Fitting and Replacement

Replacements: read the section on element ageing (4.5).

Disconnect the furnace from the electrical supply and remove the furnace back panel to gain access to the element 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.

5.7.1 Fitting 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 furnace, 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 brickbox (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).

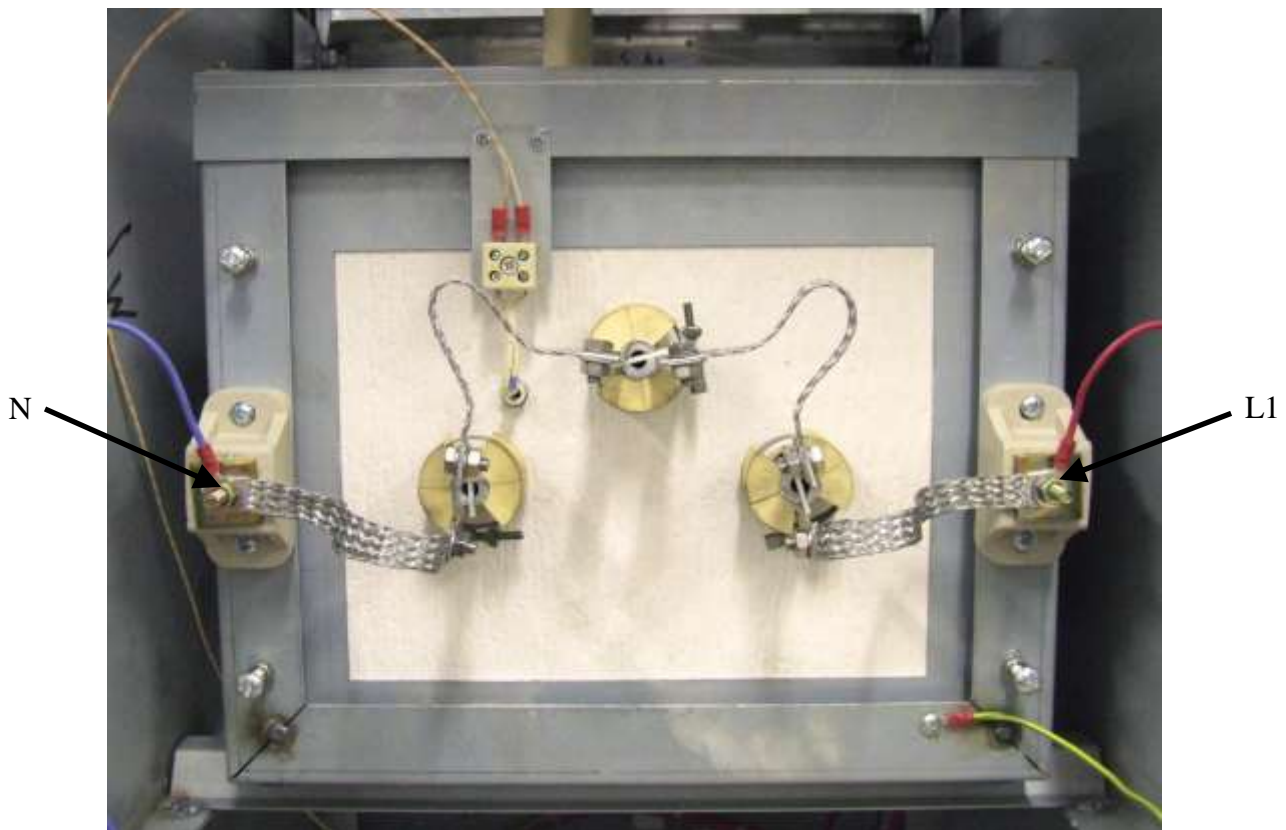
New furnace: the diagrams indicate the connections. If you have any problems with this procedure, please contact our service division. A common feature of CDF models is that elements are in series between 200-240 volts.

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 furnace 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 furnace back panel when connections are complete remembering to connect the earth cable to the back.

Element connections – 3 Elements



Photograph shows typical live and neutral connections

6.0 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 a code such as 0000 | → 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 (if fitted) may be faulty |
| | | | → 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. Furnace Overheats

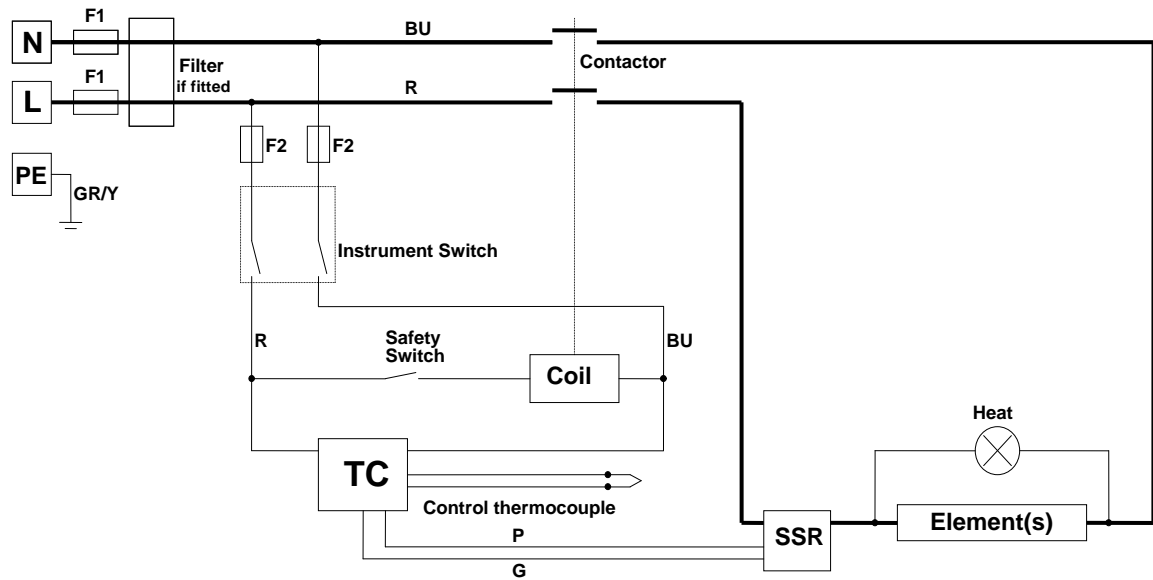
- | | | | |
|----|---|---|--|
| 1. | The HEAT light goes OFF with the instrument switch | → The controller shows a very high temperature | → The controller is faulty |
| | | → The controller shows a low temperature | → The thermocouple may have been shorted out or may have been moved out of the heating chamber |
| | | | → The thermocouple may be mounted the wrong way round |
| | | | → The controller may be faulty |
| 2. | The HEAT light does not go off with the instrument switch | → The SSR has failed “ON” | → Check for an accidental wiring fault which could have overloaded the SSR |

7.0 CIRCUIT DIAGRAMS

In all CDF models the safety switch in the diagram is a positive-break door switch.

EMC Filters (if fitted): dependent on the model there may be one filter, or more than one fitted in parallel. The circuit diagram example does not show multiple filter arrangements.

7.1 Single Phase



8.0 **FUSES & POWER SETTINGS**

8.1 **Fuses**

F1-F3: Refer to the circuit diagrams.

<i>F1</i>	Internal supply fuses	Fitted if supply cable fitted. Fitted on-board to some types of EMC filter.	16 Amps: 38mm x 10mm type F
<i>F2</i>	Auxiliary circuit fuses	Fitted on-board to some types of EMC filter. May be omitted up to 10 Amp/phase supply rating.	2 Amps glass type F On board: 32mm x 6mm
	Customer fuses	Recommended if cable fitted.	See rating label for amperage; see table below for fuse rating.

Model	phases	Volts	Supply Fuse Rating
CDF 15/1b	1-phase	200-230	13A/ph

9.0 **SPECIFICATIONS**

Carbolite Gero reserves the right to change specifications without notice.

9.1 **Models Covered by this Manual**

MODEL	Max. Temp.	Max. Power	Chamber Size (mm)			Approx. Capacity	Net Weight
	(°C)	(kW)	H	W	D	(l)	(kg)
Chamber Furnaces heated by Silicon Carbide elements.							
CDF 15/1b	1530°C	2.0	80	90	150	1.1	40

9.2 **Environment**

The furnaces 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

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:*

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