

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

200°C Minimum Free Space Oven - MFS Model: MFS1 ISO/ASTM  
No Controller

## MFS1 ISO/ASTM + No Controller

## Contents

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

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## 1.0 Symbols and Warnings

### 1.1 Switches and Lights



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



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

### 1.2 General Warnings



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

WARNING: Risk of fatal injury.



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

WARNING: All surfaces of a product may be hot.



DANGER – Read any warning printed next to this symbol.



Caution – Double Pole/Neutral Fusing

### 1.3 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 Installation

### 2.1 Unpacking and Handling

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

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



NOTE: This product contains Refractory Ceramic Fibre (also known as Alumino Silicate Wool - ASW). For precautions and advice on handling this material see section 6.2.

### 2.2 Siting and Setting Up

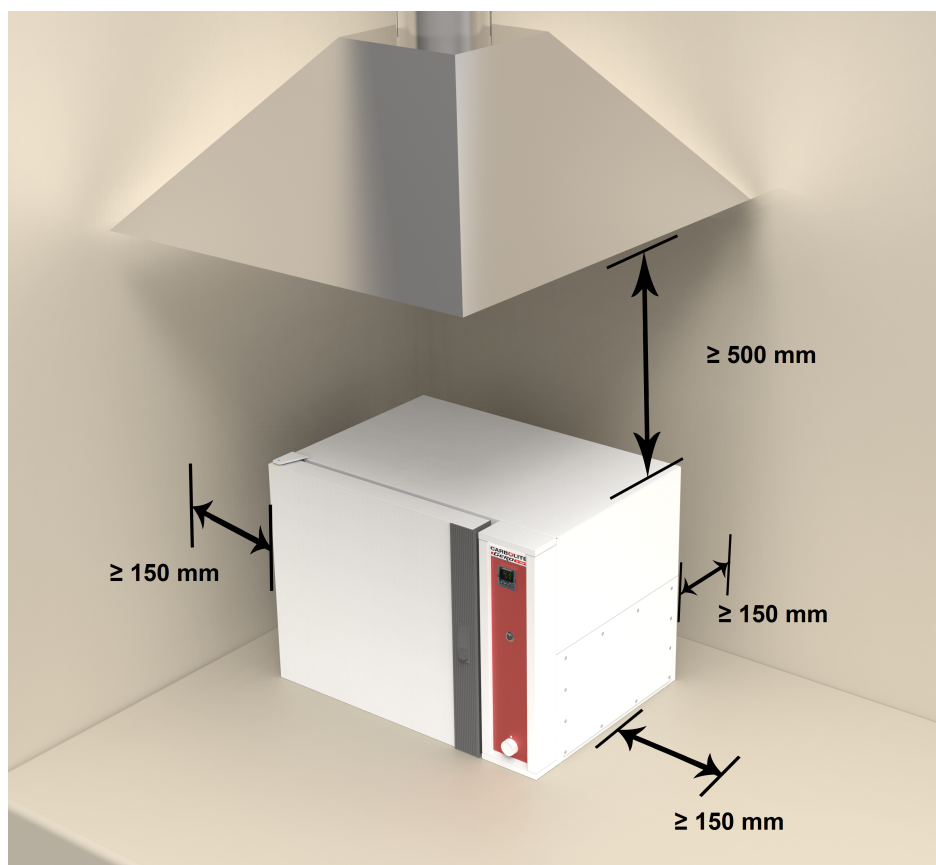
Place the product on a level surface in a well ventilated area.

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

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

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

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



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

Each chamber is fitted with an air guide (a horizontal plate dividing the top from the bottom), and a sample tray (in the lower part of the chamber). Ensure that these items are present. Do not remove the guide - it is required for correct gas flow within the unit.



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

## 2.3 Electrical Connections



Connection by a qualified electrician is recommended.

This product requires a single-phase A.C. supply with earth (ground), which may be Live to Neutral non-reversible (polarised), Live to Neutral reversible (non-polarised), or Live to Live.

Check the product rating label before connection. The supply voltage should agree with the voltage on the label and the supply capacity should be sufficient for the current on the label.

The supply should be fused at the next size equal to, or higher than the current on the label. This manual contains a table of the most common fuse ratings.

When the mains cable is factory fitted, internal fuses are also fitted. It is essential that the operator ensures that the product is correctly fused.

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

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

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

The supply **MUST** incorporate an earth (ground).

Electrical Connection Details:

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

## 2.4 Gas Supply

The MFS/1 ISO is intended to be used with nitrogen gas and is fitted with nitrogen flowmeters.

The MFS/1 ASTM is intended to be used with air and is fitted with air flowmeters.

There are two gas connections at the back of the product. The upper gas connection is the gas inlet; the lower gas connection is the gas outlet.

The maximum gas supply pressure must be regulated to 200 mbar (0.3 psi).

There are two flowmeters mounted in the control panel. The left hand flowmeter is used to adjust the flow rate of the gas passing into the oven chamber. The incoming gas passes through this flowmeter then into the heated chamber. The gas enters the upper part of the chamber behind the air guide where it is pre-heated and brought to the front of the chamber. The gas then enters the portion of the chamber that contains the

test samples flowing over and around the samples and exiting at the back of the chamber.

The flowmeter on the right is only used to test for leaks in the MFS/1 gas flow. The gas exiting the chamber passes through the valve positioned at the back of the product labelled "OFF/ TEST". The normal operating position for this valve is "OFF". With the valve in this position the outlet gas passes directly from the chamber to the gas outlet connection. With the valve in the position "TEST" the gas exiting the chamber passes through the right hand flowmeter before passing to the gas outlet. With the valve in the "TEST" position the flow rates of both flowmeters should be equal. If the flowmeter on the right shows a lower flow rate this indicates there is a gas leak; check the door is sealed correctly as this is the most likely cause for a leak.

Do not leave the valve in the "TEST" position longer than is necessary to carry out the leakage check; otherwise water vapour will build up inside the right hand flowmeter.

## **2.5 Desiccator (if supplied)**

The optional desiccator is designed for separate use and is not connected to the oven in any way. It is used for cooling the sample. Gas inlet and outlet are provided so that nitrogen can be passed over the cooling sample.

The maximum gas supply pressure must be regulated to 1 bar.

### 3.0 Temperature Controller

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

## **4.0 Operation**

### **4.1 Operating Cycle**

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

Connect the product to the electrical supply.

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

As the product heats up, the heat light glows steadily at first and then flashes as the product approaches the desired temperature. For more information on temperature control see the controller instructions.

To turn the product off, set the instrument switch to its off position. The controller display will go blank. If the product is to be left unattended, isolate it from the electrical supply.

### **4.2 Operator Safety**

The chamber of the product is earthed (grounded), and the door may be opened safely while the product is switched on.

Always disconnect the product from the electrical supply before making any repairs.

## 5.0 Maintenance

### 5.1 General Maintenance

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

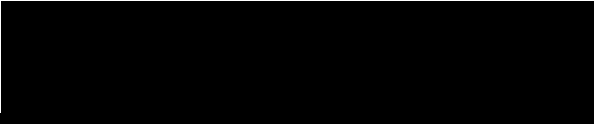
### 5.2 Maintenance Schedule

 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                                      |                                                                                                                                                             |           |        |         |             |                                                                                       |
| 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 relevant controller manual |           |        |         |             |                                                                                       |
| Over-Temperature Safety Circuit (if fitted) | Electrical measurement                                                   |           |        |         |             |  |
| Door Seal                                   | Visual inspection - check for splits and make sure it seals                                                                                                 |           |        |         |             |                                                                                       |
| Door Seal                                   | Replacement                                                                                                                                                 |           |        |         |             |  |
| Electrical Safety (external)                | Visual check of external cables and plugs                                                                                                                   |           |        |         |             |                                                                                       |
| Electrical Safety (internal)                | Physically check all connections and cleaning of the power plate area                                                                                       |           |        |         |             |  |
| Gas Safety - ISO model (external)           | Carry out the leak test as detailed in this manual.                                                                                                         |           |        |         |             |                                                                                       |
| Gas Safety – ISO model (internal)           | If the leak test has failed and the door is making a good seal then an internal leak test is needed.                                                        |           |        |         |             |  |
| Air System Integrity (ASTM model)           | Carry out the leak test as detailed in this manual.                                                                                                         |           |        |         |             |                                                                                       |
|                                             |                                                                                                                                                             |           |        |         |             |                                                                                       |
| 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                 |                                                                                                          |  |  |  |  |  |
| Circulating Fan (if fitted) | Visual check to see if it is running                                                                     |  |  |  |  |  |
| Element Circuit             | Electrical measurement  |  |  |  |  |  |

### 5.2.1 Cleaning

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



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

## 5.3 Calibration

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

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

## 5.4 After-Sales Service

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

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

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

## 5.5 Recommended Spare Parts and Spare Parts Kit

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

Each kit consists of one thermocouple, one solid state relay and one heating element. When ordering spare parts please quote the model details as requested above.

## 5.6 Power Adjustment

The control system incorporates electronic power limiting, but for the model listed in this manual the power limit is set to 100%. The power limit parameter OP.Hi may be accessible to the operator, but should not generally be altered.

In some cases the supply voltage may be outside the range 220-240 V or the 3-phase equivalent, the power limit parameter may be set to a value other than 100%. Do not increase the value to 100%, see section 9.0 for details of power limit settings.

## 6.0 Repairs and Replacements

### 6.1 Safety Warning - Disconnection from Power Supply



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



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

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

### 6.2 Safety Warning - Refractory Fibre Insulation



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

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

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

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

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

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

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

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

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

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

### 6.3 Temperature Controller Replacement

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

## 6.4 Solid-State Relay Replacement



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

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

## 6.5 Thermocouple Replacement



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

Thermocouple cable colour codings are:

| thermocouple leg  | colour |
|-------------------|--------|
| positive (type K) | green  |
| negative          | white  |

Disconnect the thermocouple from its terminal block.

Remove the gland nut from the rear of the chamber; it may be necessary temporarily to remove some insulation material. Withdraw the thermocouple.

Fit the replacement thermocouple and reconnect, observing the colour coding and refit the element access panel.

## 6.6 Element Replacement



**See section 6.2 - wearing a face mask is required.**

Disconnect the product from the electrical supply and remove the back panel.

Make a note of the wiring and piping connections; see section above which refers to the thermocouple colour coding.

Disconnect terminal blocks, thermocouple and gas pipes to obtain access to the slab element which lies beneath the chamber casting. If necessary, undo the door hinges to allow the whole assembly to slide out. Make a note of all disconnections.

Replace the element with the new one and reverse the assembly procedure.

## 6.7 Fuse Replacement

Fuses are marked on the wiring diagram with type codes, e.g. F1, F2. For more information on fuses refer to section 9.0.

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

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

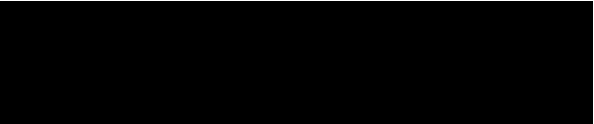
Replace any failed fuses with the correct type. For safety reasons do not fit larger capacity fuses without first consulting Carbolite Gero.

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

## 7.0 Fault Analysis

| A. Oven Does Not Heat Up |                                   |   |                                                                                   |   |                                                                                                                              |
|--------------------------|-----------------------------------|---|-----------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------|
| 1.                       | The temperature controller is OFF | ▶ | No power from supply                                                              | ▶ | Check the fuses in the supply line                                                                                           |
| 2.                       | The temperature controller is ON  | ▶ | The controller shows a very high temperature or a code such as EEE or --- or S.br | ▶ | The temperature sensor has broken or has a wiring fault                                                                      |
|                          |                                   | ▶ | The controller shows a low temperature                                            | ▶ | 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                                     | ▶ | The controller may be faulty or not receiving a supply due to a faulty switch or a wiring fault                              |

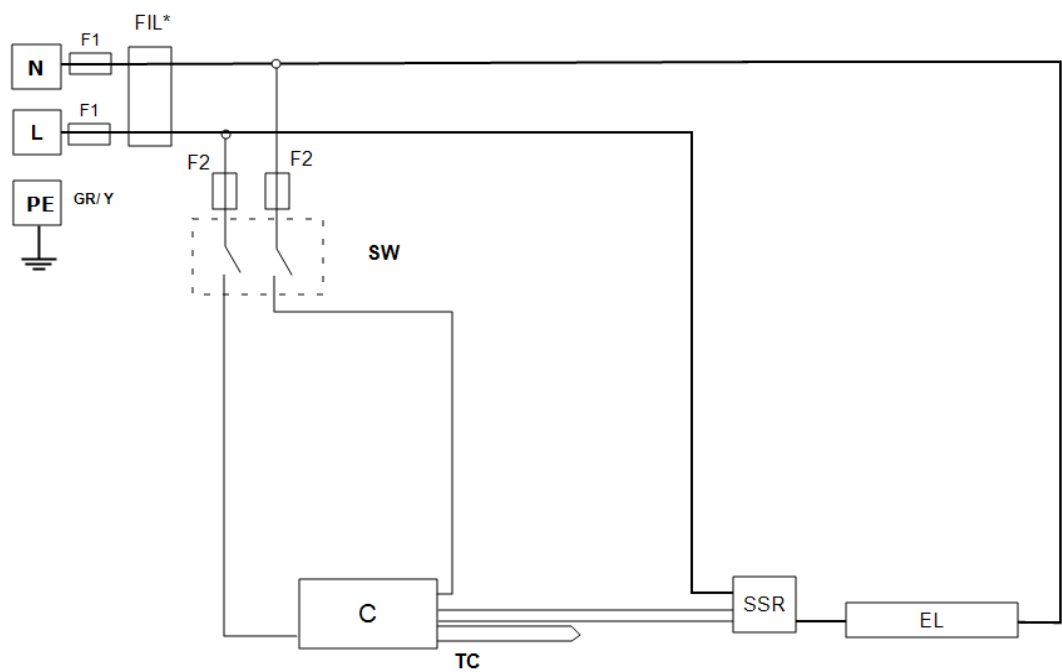
| B. Oven Overheats |                                                     |   |                                              |   |                                                                                           |
|-------------------|-----------------------------------------------------|---|----------------------------------------------|---|-------------------------------------------------------------------------------------------|
| 1.                | Oven 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 have been shorted out or may have been moved out of the oven         |
|                   |                                                     |   |                                              | ▶ | The thermocouple may be connected the wrong way round                                     |
|                   |                                                     |   |                                              | ▶ | The controller may be faulty                                                              |
| 2.                | Oven heats up when the instrument switch is OFF     | ▶ | The SSR has failed "ON"                      | ▶ | Replace the SSR. Check for an accidental wiring fault which could have overloaded the SSR |



## 8.0 Wiring Diagrams

### 8.1 WV-11-00

Connections below show single phase with instrument switch(es).



| Key       |                        |
|-----------|------------------------|
| F1, F2    | Fuses                  |
| FIL       | Filter                 |
| SW        | Instrument Switch      |
| C         | Temperature Controller |
| TC        | Thermocouple           |
| SSR       | Solid State Relay      |
| EL        | Element(s)             |
| *         | If Fitted              |
| L         | Live                   |
| N         | Neutral                |
| PE (GR/Y) | Earth (Green+Yellow)   |

## 9.0 Fuses and Power Settings

### 9.1 Fuses

F1-F2: Refer to the circuit diagrams.

|    |                       |                                                                                |                                                            |
|----|-----------------------|--------------------------------------------------------------------------------|------------------------------------------------------------|
| F1 | Internal Supply Fuses | Fitted if supply cable fitted.<br>Fitted on board to some types of EMC filter. | 38 mm x 10 mm type F fitted on EMC filter circuit board(s) |
|----|-----------------------|--------------------------------------------------------------------------------|------------------------------------------------------------|

|    |                          |  |                                                         |
|----|--------------------------|--|---------------------------------------------------------|
| F2 | Instrument Circuit Fuses |  | 20 mm x 5 mm glass,<br>2 Amps type F1; omitted in MFS/1 |
|----|--------------------------|--|---------------------------------------------------------|

| Model       | Volts       | Phase   | Supply Fuse Rating |
|-------------|-------------|---------|--------------------|
| MFS /1 ISO  | 220 - 240 V | 1-phase | 2 A                |
| MFS /1 ISO  | 110 - 120 V | 1-phase | 6 A                |
| MFS /1 ASTM | 220 - 240 V | 1-phase | 2 A                |
| MFS /1 ASTM | 110 - 120 V | 1-phase | 6 A                |

### 9.2 Power Settings

The setting for the power limit parameter in the controller (OP.Hi) should be 100% for the model listed in this manual.

Please refer to the rating label for product specific information.

## 10.0 Specifications

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

| Model                    | Max Temp (°C) | Max Power (kW) | Chamber Size |     |     | Approx Capacity (l) | Net Weight (kg) |
|--------------------------|---------------|----------------|--------------|-----|-----|---------------------|-----------------|
|                          |               |                | H            | W   | D   |                     |                 |
| Minimum Free space Ovens |               |                |              |     |     |                     |                 |
| MFS /1 ISO               | 210           | 0.5            | 25           | 185 | 290 | 1.4                 | 22              |
| MFS /1 ASTM              | 210           | 0.5            | 25           | 185 | 290 | 1.4                 | 22              |

### 10.1 Environment

The models listed in 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



| Engineer Name | Date | Record of Work |
|---------------|------|----------------|
|               |      |                |
|               |      |                |
|               |      |                |
|               |      |                |
|               |      |                |

ProductLabel

The products covered in this manual are only a small part of the wide range of ovens, chamber furnaces and tube furnaces manufactured by Carbolite Gero for laboratory and industrial use. For further details of our standard or custom built products please contact us at the address below, or ask your nearest stockist.

For preventive maintenance, repair and calibration of all furnace and oven products, please contact:

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