



**HANDBOOK
for
GAS TIGHT OVEN**

Customer Coopervision Ltd

Model 220 litre Special

Job ref SPLO 108545

Serial No. 20 - 501725

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INTRODUCTION

This handbook contains information for the guidance of the operators of CARBOLITE Ovens.

It should be read fully before the equipment is connected to the electricity supply

The manual contains a full description of the unit together with information on the installation, operation and maintenance procedures.

It is hoped that it will supply all the information needed to operate the unit in its most efficient manner. If however there are any other questions to which you require answers then please contact our Technical Support Team who will be pleased to help you.

In the unlikely event of a breakdown then please contact our Service Department who will arrange for one of our service engineers to visit you.

TECHNICAL SPECIFICATION

DESCRIPTION OF EQUIPMENT

Controlled Atmosphere Oven suitable for use in a batch production environment. The oven is suitable for use with inert gases such as nitrogen. The fully sealed inner case enables oxygen levels of less than 50ppm to be achieved in the work chamber.

INTERIOR CHAMBER DIMENSIONS

610mm high x 610mm wide x 610mm deep

NORMAL WORKING TEMPERATURE RANGE

50°C to 200°C

MAXIMUM OPERATING TEMPERATURE

200°C

TEMPERATURE STABILITY

Better than $\pm 1^\circ\text{C}$ under steady state conditions.

TEMPERATURE UNIFORMITY

Better than $\pm 5^\circ\text{C}$ over the full working range.
Better than $\pm 2^\circ\text{C}$ up to 130°C.

TEMPERATURE SENSOR

Type "K" Mineral Insulated Thermocouples.
A separate 15mm OD pipe with a gas tight end seal is provided to enable survey thermocouples to enter the chamber.

TEMPERATURE CONTROL

Eurotherm 2404 digital solid state Time/Temperature programme controller with 0-10 volt analogue retransmission of the measured value. The signal is brought out to a multiway connector on the rear of the control cabinet.

POWER CONTROL

Thyristor based solid state relay working in the fast cycle zero voltage-switching mode.

OVERTEMPERATURE PROTECTION

Eurotherm 2116 on/off controller and separate safety contactor. This controller will shut down the heating elements in an over temperature condition but the main fan and nitrogen gas flow will continue.

AIR CIRCULATION

Forced air circulation by top mounted fan and air guide system. A nitrogen gas purge around the fan shaft helps to reduce contamination around the motor seal. The motor is stationary during the nitrogen purge stage of the cycle and runs during the heating and cooling stages.

LOCATION OF CONTROLS

All controls including the Oxygen analyser are mounted in a control box on the top of the oven. A large indicator lamp is fitted to show that an oven cycle is running. The light is steady when the cycle is running and flashing when the cycle is complete. All the wiring within the control cabinet will be in PTFE insulated cable.

INTERIOR CHAMBER MATERIALS

Grade 430 dull polished ferritic stainless steel fully seam welded to form a gas tight enclosure. The heaters and thermocouples are sealed into the inner chamber with compression fittings located on the outside of the main case.

EXTERIOR MATERIALS AND FINISH

Stainless steel rectangular hollow section tube panelled with zinc coated mild steel sheet and finished with two-pack epoxy semi gloss paint. The main body of the oven and the control panel is in Cream RAL 9001 and the door is finished in Blue RAL5015.

NVP EXTRACTION

On either side of the oven at the front are two 50mm ports complete with stainless steel ball valves to enable the chamber to be manually purged with air prior to opening the door. A 75mm OD tube facing upwards is provided to connect to the customers extract system.

THERMAL INSULATION

High quality mineral wool blanket.

CHAMBER ACCESS

Centrally pivoting door with two over centre toggle clamps on each side. This arrangement allows the door to fit squarely to the front of the oven and reduce the stress on the door seal close to the hinges. A door switch is fitted. The design is improved to eliminate the use of a striker plate that might interfere with the swinging operation of the door.

SHELVES & RUNNERS

The chamber is supplied with 6 pairs of shelf runners at 100mm centres. Six nickel-plated wire grid shelves are supplied. The shelf runners are removable should the method of loading the oven be changed in the future.

HEATING ELEMENTS

Mineral Insulated metal sheathed elements sealed with compression fittings where they pass into the chamber.

POWER REQUIREMENTS

Total heating power is 3.0kW

POWER SUPPLY REQUIRED

240 volts single phase and neutral 50Hz. The supply cable is 2 metres long and fitted with an industrial 16amp 3 pin industrial plug.

The control circuit is energised from a central UPS. An IEC connector is provided on the rear of the control cabinet to accept the supply.

GAS CONTROL

Four solenoid valves, two flowmeters, and needle valves are supplied to ensure safe automatic working of the gas system. A timer is fitted to control the initial purge time during which a high gas flow clears the oxygen from the chamber. At the end of this period the flow reduces and the oven starts to heat up. The estimated high purge gas flow is 40 litres per minute for 90 minutes reducing to around 1 litre per minute during the heating and cooling phase of the process cycle. The purge flowmeter is scaled 10-100 litres per minute and the low flowmeter is scaled 0.6-5 litres per minute. A wash bottle/bubbler is mounted on the front of the control panel to give a visual indication of gas flow and create a small back pressure while the oven is running. A large bubble pot is located at the rear of the oven to act as an over pressure relief valve.

The gas exhaust pipe is located in the base of the chamber at the front left hand side. The 22mm OD pipe from the oven connects to a catchpot. The exhaust pipe from the catchpot is 22mm OD and runs at an angle up the left hand side of the oven.

OXYGEN ANALYSER

Provision is made for an Oxygen analyser to be fitted at a later date.

A separate sample pipe is provided in the top rear of the oven to connect to the analyser cell.

OVEN STAND

An integral stand, fabricated from stainless steel, is included to raise the oven hearth to 700mm above floor level.

INSTALLATION

1. When unpacking always lift the equipment by its base. Do not use door handles, projecting motors or terminal boxes for lifting.
2. Remove any packing materials from inside the chamber.
3. Electrical supply:
The oven is designed to run from two independent 240volt single phase and neutral supplies:
The heaters and fan motor are supplied via a three core mains cable that is colour coded as follows:

BROWN - LIVE (L)
BLUE - NEUTRAL (N)
GREEN/YELLOW - EARTH (E)

The cable is fitted with a 16amp three pin industrial plug.

The instrumentation is designed to be supplied from an uninterruptible power supply. The supply input is via an IEC chassis mounted plug on the rear of the control cabinet. An IEC line socket complete with a length of three core cable is provided.
The cable is colour coded as follows:

BROWN - LIVE (L)
BLUE - NEUTRAL (N)
GREEN/YELLOW - EARTH (E)

4. Connections to the mains supply should be made only by a competent electrician.
5. Gas Supply
The oven requires a supply of oxygen free nitrogen gas from either high pressure cylinders or a bulk supply of liquid nitrogen.
The gas supply line pressure should be sufficient to enable a maximum flow rate of 50 litres per minute to be achieved.
The gas supply is connected to the oven via a 10mm OD tube bulkhead connector.
6. Provision is made to retransmit the oven temperature and the oxygen level (if fitted) to a central data logger. A 25 way D socket is provided on the rear of the control cabinet. Please refer to the wiring schematic for the pin details on this connector.

OPERATING INSTRUCTIONS FOR OPERATORS

1. Switch on the Electricity and Gas supplies to the oven.
2. Load the oven and close the door securely. Turn the two large ball valve handles so that they lie across the front of the door.
3. The oven is fitted with a mains supply light and instrument switch. The light will be on whenever the chamber is connected to the supply. The switch cuts off power to the controllers. Operate the switch to activate the temperature controllers. The controllers become illuminated and go through a short test cycle.
4. Check that the purge timer is correctly set to the desired value.
5. Press the start push button. A flow of around 40 litres per minute will be indicated on the high range flowmeter.
6. At the end of the purge time the flowrate will automatically reduce to around 1.2 litres per minute as indicated on the low range flowmeter. The air recirculation fan will be energised and the oven will start warm up at the controlled rate.
7. The oven will proceed through its programme and then cool down.
8. When the chamber has cooled down sufficiently for the door to be opened without damaging the work open the two ball valves to admit air and flush out the chamber. Wait a few minutes for the air to purge the chamber then press the stop button.
9. Pressing the stop button automatically resets the timer and programme controller. Opening the door when the oven is running will have exactly the same effect.
10. Open the door and unload the oven.
11. The oven can then be reloaded and the process repeated.

SETTING UP INSTRUCTIONS

1. Switch on the supply to the oven.
2. The oven is fitted with a combined supply light and instrument switch. The light will be on whenever the chamber is connected to the supply. The switch cuts off power to the controllers. Operate the switch to activate the temperature controllers; the O position is off the I position is on. The controllers become illuminated and go through a short test cycle.
3. Set the desired time/temperature programme on the main temperature controller as described on the enclosed user guide. This is the temperature controller on the left hand side of the control panel. The manufacturer's handbook is enclosed with these instructions and gives full details of setting up the controller. Please note that the controller has been fully configured and set up at the factory prior to despatch. The following programme has been installed:

Hb	0
CYC.n	1
Seg.n	1
Type	rmPr
Hb	OFF
TGt	50
rAtE	30.0
SEG.n	2
tYPE	dwEll
Hb	OFF
dur	7.2
Seg.n	3
Type	rmPr
Hb	OFF
TGt	130
rAtE	20.0
SEG.n	4
tYPE	dwEll
Hb	OFF
dur	1.2
Seg.n	5
Type	StEP
Hb	OFF
TGt	1
SEG.n	6
tYPE	dwEll
Hb	OFF
dur	100
SEG.n	7
tYPE	End
End.t	dwEll

4. Set the desired over temperature value on the Eurotherm 2116 over temperature controller. The over temperature set point should be set about 20°C higher than the maximum working temperature set in the main programme. The value has been factory set at 200°C. Refer to the Eurotherm 2116 user guide for details of changing this value.
5. A purge time of 1.5 hours has been preset on the purge timer. Refer to the user guide for the Syrelec M814HV Timer for details of changing the time.
6. Without any load in the oven close the door securely.
7. Press the start push button. Adjust the needle valve at the base of the high range flowmeter to give an indicated flowrate of 40 litres per minute.
8. Allow the oven chamber to purge for the set time. At the end of the purge time note that the high range flowmeter shuts down and flow is indicated on the low range flowmeter. Adjust the low range flowmeter to give a flowrate of about 1 litre/minute or sufficient to ensure a small flow of gas through the glass bubbler bottle mounted on the oven.
9. Check that the oven is starting to heat up. Press the stop push button to stop the oven fan and reset the timer and programmer.
10. The oven door may now be opened and the chamber loaded with work.
11. Be aware that opening the door when the oven is running will switch the gas and fan motor off and reset the timer and programmer. After the door has been reclosed the start button must be pressed again and oven will go through its automatic purge cycle before it starts to heat up again irrespective of what temperature the oven chamber is at.
12. **WARNING** Opening the door when the oven is hot will destroy the atmosphere and oxidise the work.

MAINTENANCE

Carbolite Ovens are designed to run for long periods without any regular maintenance. There are however some area's where periodic checking may prevent more serious problems occurring.

[1]

Listen to the fans running and check for any excessive noise which may indicate bearing or fan problems.

[2]

Check the total current being drawn on heat up and compare with the design load. If it shows a reduced loading this will probably indicate an element or SSR failure.

Carbolite Ovens will run quite happily with a significant reduction in heater power. The only noticeable effect will be an elongated heat up and recovery time. However faulty heaters should be replaced at the earliest opportunity as prolonged running with an unbalanced load may cause damage to either the solid state relay firing modules or the remaining heaters.

It is recommended that the above checks are carried out at 6 monthly intervals.

TEMPERATURE CHECK

In applications where a precise temperature is required then we recommend that regular checks are made on the set point temperature.

This can be done in one of two ways.

[1] Compare with a calibrated thermocouple and test instrument.

[2] Inject a mV input into the controller and check its response.

Should you not have the facilities to carry out such checks or require a full temperature survey carried out please contact our service department and we can arrange either for one of our engineers to carry out the test or put you in touch with one of the recognised independent test houses who will carry out the work for you.

FAULT FINDING GUIDE

SYMPTOM - OVEN DOES NOT HEAT UP

[1] No power from mains

The power on lamp will not be illuminated.

Check the mains input voltage and main fuses.

[2] Control Thermocouple Broken

Set the oven to heat up and check the controller display. If the temperature appears to rise rapidly to the instrument maximum and then cuts off it is likely the thermocouple is faulty. Check instrument by connecting to the other thermocouple in the oven.

[3] Solid State Relay Failure

If the temperature controller continues to show a static temperature or appears to peak at a temperature below set point but the temperature controller is still calling for heat as shown by the output LED or output power indication on the controller it is likely that one or more solid state relays have failed.

Please contact our service department to ensure that the correct replacement is fitted. FITTING of an INCORRECT unit may cause damage to the other SSR's or the control instrumentation.

SYMPTOM - OVEN OVERHEATS

[1] Solid State Relay Failure

If the unit continues to rise in temperature after the set point has been reached and the instrument output LED is off or output power indication is zero it is likely one or more solid state relays have failed.

These units should be replaced following the guidelines given in [3] above.

[2] Temperature Controller Failure

If the unit continues to rise in temperature after the set point has been reached and the instrument output LED is on or the output power indication is still calling for heat it is likely there is an instrument fault.

Please contact our service department who will advise you of the checks that can be made relevant to the particular instrument fitted to your unit.

Our service department is always available to advise on any particular problems you may encounter backed up by the Carbolite team of service engineers.