Installation, Operation and Maintenance Instructions
1200 °C Split Tube Furnace - TVS Model: 600mm
No Controller

TVS 12/600 + No Controller

MEN-TVS120600-16_NOCTRL (05-08-2019)
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.

Heat switch: the switch disconnects power to the heating elements; unless this switch is OFF there is a danger of electric shock when inserting objects into the product.

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
2.0 Installation

2.1 Unpacking and Handling

When unpacking or moving the product always lift it by its base or by both ends of the main body. Never lift it by its work tube or the surrounding insulation. Use two or more people to carry the product and control box. Remove any packing material from inside the product before use.

If an optional or special stand is separately supplied, assemble the product on to it. Some models may be supplied for customer mounting and may require customer preparation of mounting components before installation.

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.

Work tubes:

It is recommended that the work tube has either insulation plugs or radiation shields fitted to minimise heat loss from both ends of the work tube. If the work tube has open ends, a significant amount of energy could be radiated from the ends of the work tube. Adjacent surfaces should always be made from a non-flammable material.

Ensure that the ends of the work tube are positioned at least 500 mm away from any adjacent surface so that any energy radiated cannot heat an adjacent surface to a dangerous temperature.
Ensure that the product is placed in such a way that it can be quickly switched off or disconnected from the electrical supply.

If the product is supplied with a work tube or any accessories fit these into position.

For optimum temperature uniformity, insulating plugs should be placed in the tube ends as shown in fig.1. With a long work tube, the stem of the plug assembly should line up with the end of the tube as in fig.2. Alignment of radiation shields is similar to that of plugs.

If stainless steel seals with gas inlets are supplied, they are to be fitted as shown in fig.3; the stem of any insulating plug should touch the seal.

For vertical models with stainless steel seals, a hook and eye arrangement holds the upper insulating plug assembly.

Horizontal models: if heavy fittings are to be clamped to the end of an extended work tube they can increase the bending stress at the centre of the tube. Support such fittings in such a way that expansion of the tube is allowed.

If a metal work tube is being used in the product, ensure that it is earthed for operator safety.
2.0 Installation

Fig 1 - Insulating Plug (standard length tube)

Key
A Tube
B Insulating Plug
C Stem

Fig 2 - Insulating Plug (long work tube)
Fig 3 'Twin Clamp' End Seal

For assembly details refer to the separate work tube end seal manual.

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.
2.0 Installation

The product covered by this manual normally requires a single phase A.C. supply, which may be Live to Neutral non-reversible, Live to Neutral reversible or Live to Live. Some models may be ordered for 3-phase use, which may be star or delta.

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. A table of the most common fuse ratings is also given towards the back of this manual. 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.

If the product is to be connected by line plug. The plug should be within reach of the operator and should be easy to remove.

When connecting the product to an isolating switch ensure that both conductors (single phase) or on all live conductors (three phase), and should be within reach of the operator.

The supply MUST incorporate an earth (ground).

Electrical Connection Details:

<table>
<thead>
<tr>
<th>Supply</th>
<th>Terminal Label</th>
<th>Cable Colour</th>
<th>Supply Types</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Live - Neutral</td>
</tr>
<tr>
<td>1-phase</td>
<td>L</td>
<td>Brown</td>
<td>to live</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Blue</td>
<td>to neutral</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Green/ Yellow</td>
<td>to earth (ground)</td>
</tr>
</tbody>
</table>

A table of the most common fuse ratings is also given towards the back of this manual.
<table>
<thead>
<tr>
<th>3-phase</th>
<th>L1</th>
<th>Black</th>
<th>to phase 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L2</td>
<td>Black</td>
<td>to phase 2</td>
</tr>
<tr>
<td></td>
<td>L3</td>
<td>Black</td>
<td>to phase 3</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Light Blue</td>
<td>to neutral (except delta)</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Green/Yellow</td>
<td>to earth (ground)</td>
</tr>
</tbody>
</table>

**DO NOT** connect a product ordered for three phase use to a single phase supply or to the wrong type of three phase supply.
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.

There is also a heater switch which can be used to disconnect power to the elements.

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

Over-Temperature option only. If the digital over-temperature option has not yet been set as required, set and activate it according to the over-temperature controller instructions.

The product will heat up according to the controller setpoint or program, unless a time switch is fitted and switched off.

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.

Over-Temperature option only. If the over-temperature circuit has tripped, an indicator on the over-temperature controller flashes and the heating elements are isolated. Find and correct the cause before resetting the over-temperature controller according to the instructions supplied.

To switch off power to the heating elements, use the heater switch. To switch the product off, use both the heater switch and the instrument switch. If the product is to be left switched off and unattended, isolate it from the electrical supply.

4.2 Control Method

Set the three temperature controllers to the desired setpoints. The setting and operation of the end zone controllers depends on the 3-zone control options selected when the product was ordered. These options are described in the 3-zone control methods section.

Note: Despite its vertical orientation, the heated zones of the KVZ model are labelled to correspond with the relevant control module on the CC-T1 touchscreen controller display (Left, Main, Right).

4.3 3-Zone Control Methods

There are three different control options (A, B & C).

(A) Back to back thermocouples

(B) Retransmission of Setpoint

(C) Independent control
The models listed in this manual are designed to achieve an extended uniform temperature zone, through use of three control zones, rather than achieving different temperatures in each zone.

For A & B, the control zones are linked so that they all follow the centre zone controller in a master-slave approach.

**Note:**
- Option A is **NOT** applicable when using the CC-T1 controller
- Option B is **NOT** applicable when using the Eurotherm 2132 End Zone Controller

### A. Back-to-Back Thermocouples

This is the most commonly supplied option. The centre zone of the tube furnace is controlled directly by the centre zone temperature controller. The two end zone thermocouples are wired in opposition to the centre zone reference thermocouple. If the temperatures of the centre and end zones are the same then 0°C will be displayed on the end zone controllers. If the end zone temperatures are either higher or lower than the centre zone, the end zone controller will display the difference in temperature (higher = positive value, lower = negative value).

It is best practice to set the setpoint of the two end zone controllers to zero. Alternatively, a small temperature difference (offset) can be created by setting a non-zero value, for example to compensate for heat losses at the end or where using a gas flow. However, the sum of the centre zone controller setpoint and the end zone controller offset MUST NOT exceed the furnace maximum temperature.

**To alter the setpoint with the display showing the Home screen, press Down or Up once to display the setpoint and then press again or hold down to adjust it. The display returns to the measured temperature when no key is pressed for a short period of time.**

Sometimes a furnace using this type of control does not cool down because the end zones lose heat first and therefore the end zone controllers try to compensate for this by switching on the end zone elements, preventing the furnace from cooling.

### B. Retransmission of Setpoint

Three independent thermocouples are connected to three controllers. The three controllers are linked together and the centre zone controller communicates the desired setpoint to the end zone controllers. If the centre zone controller is set to a setpoint or is running a program, the end zone controllers will automatically follow.

For products with the CC-T1 controller, please refer to the separate CC-T1 controller manual for details on enabling and disabling setpoint retransmission.

For other products, additional communication modules are fitted in the controllers. The communication between the controllers of the Eurotherm 3000 series is known as Broadcast communications. It is possible to switch off the linked control and allow the
controllers to work independently. In the level 2 menu of the end zone controllers (see controller operating instruction), scroll to L-r. Where the end zone controller is a 3216 use the up down buttons and select NO. Where the end zone controller is a 3508 use the up down buttons to select SP1, (SP1 = Local, and SP2 = Remote). There is no need to alter the centre zone controller.

It is possible to set an offset (local trim) between the centre and end zone controllers. This can be either a positive or negative difference from the centre zone temperature. Once entered, this offset will always be added to, or subtracted from, the retransmitted setpoint temperature.

For products with the CC-T1 controller, please refer to the separate CC-T1 controller manual for details on how to set an offset trim.

To make this adjustment on other controllers, enter the level 2 menu of the end zone controllers (see controller operating instruction), scroll to LOC.T (local trim) and use the up down buttons to enter the desired positive or negative value. This will then be added to, or subtract from, the end zone set temperature. There is no need to alter the centre zone controller.

C. Independent Control
The three controllers are completely independent. Note that it is not possible to maintain very different temperatures in the three zones because of heat transfer between the zones. The models listed in this manual are designed to achieve an extended uniform temperature zone by the use of three control zones rather than achieving different temperatures in each zone.

4.4 General Operating Advice

Heating element life is shortened by overheating. Do not leave the product at high temperature when it is not required. The maximum temperature is shown on the product rating label and in section 10.0 towards the back of this manual.

Lightweight ceramic fibre insulation can easily be marked by accidental contact. Some fine cracks may develop in the surface of the insulation due to the progressive shrinkage of the insulation materials. Cracks are not usually detrimental to the functioning or the safety of the product.

Clean up any spillages in the insulation, as these can increase the rate of degradation of the insulation material.
4.0 Operation

4.5 Operator Safety

The ceramic materials used in the product manufacture become electrically conductive to some extent at high temperatures. DO NOT use any conductive tools within the product without isolating it. If a metal work tube is used, it must be earthed (grounded).

Switch off the heater switch whenever loading or unloading the product. The elements are isolated when the heater switch is OFF. This switch cuts both sides of the circuit via a contactor.

4.6 Tube Life

A ceramic work tube may crack if work pieces are inserted too quickly or at temperatures below 900 °C (when the tube is more brittle). Large work pieces should also be heated slowly to ensure that large temperature differences do not arise.

Poor thermal contact should be encouraged between the work piece and the tube; crucibles or boats should be of low thermal mass and should have feet to reduce the contact with the tube (fig. 4).

![Fig 4 - Avoidance of thermal contact](image)

<table>
<thead>
<tr>
<th>Key</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Tube</td>
</tr>
<tr>
<td>B</td>
<td>Crucible</td>
</tr>
</tbody>
</table>

Do not set too high a heating or cooling rate. As tubes are susceptible to thermal shock and may break. Tubes which extend beyond the heated part of the furnace are more at risk. A general rule for maximum heating or cooling rate is $400 \div \text{internal diameter in mm}$ to give ($\degree$C/ min); for 75 mm i/ d tubes this comes to 5 °C per minute. The controller can be set to limit both the heating and cooling rate.

4.7 Pressure

Work tubes are not able to accept high internal pressure. When gas seals or similar fittings are in use, the gas pressure should be restricted to a maximum of 0.2 bar (3 psi). A pressure of approximately half of that should normally be sufficient to achieve the desired flow rate. The operator must ensure that the exhaust path from the tube is not blocked, so that excess pressure does not occur.
A suitably regulated gas supply should always be used.
It is recommended that a pressure relief system should be used to avoid an over pressurisation of the work tube.
Please note: A product should not be heated up if any valves that have been fitted are closed to create a sealed volume. A sealed work tube should not be heated from cold due to the pressure increase caused by the trapped air or gas expanding during the heating process.

4.8 Power Adjustment

The control system incorporates electronic power limiting. The power limit parameter OP.Hi is accessible to the operator and can be used to adjust the furnace to the actual supply voltage.

The models covered by this manual are designed for use over the range of voltages 200 V - 250 V (or, if ordered, 100 V - 125 V), and the power limit parameter is set accordingly. These models may be adjusted to a different voltage within the range: the power limit should be reset to match OP.Hi, see 9.0

Refer to section 3.0 for power adjustment instructions.

4.9 Running at Low Temperatures

The power limit may be adjusted to a low level in order to achieve better control when operating the product at a low temperature. Before changing the power limit, record the default settings for possible future use. Refer to the Power Settings section of this manual for default power limits. If the product fails to reach the desired temperature, refer to the Temperature Controller and Fault Analysis sections.
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.

<table>
<thead>
<tr>
<th>Maintenance Procedure</th>
<th>Method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Set an over-temperature setpoint lower than the displayed temperature and check for an over-temperature alarm as detailed in this manual</td>
<td>Daily</td>
</tr>
<tr>
<td>Over-Temperature Safety Circuit (if fitted)</td>
<td>Electrical measurement</td>
<td>6</td>
</tr>
<tr>
<td>Safety Switch Function (split models only)</td>
<td>Set a safe temperature above ambient, and open the furnace to see if the heater light goes out</td>
<td>Daily</td>
</tr>
<tr>
<td>Safety Switch Function (split models only)</td>
<td>Electrical measurement</td>
<td>6</td>
</tr>
<tr>
<td>Electrical Safety (external)</td>
<td>Visual check of external cables and plugs</td>
<td></td>
</tr>
<tr>
<td>Electrical Safety (internal)</td>
<td>Physically check all connections and cleaning of the power plate area</td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Calibration</td>
<td>Tested using certified equipment, frequency dependent on the standard required</td>
<td>Daily</td>
</tr>
<tr>
<td>Operational Check</td>
<td>Check that all functions are working normally</td>
<td></td>
</tr>
<tr>
<td>Operational Check</td>
<td>Thorough inspection and report incorporating a test of all functions</td>
<td></td>
</tr>
<tr>
<td>Work Tube Position</td>
<td>Visually check that the tube is central to the heated zone (horizontally / vertically)</td>
<td></td>
</tr>
<tr>
<td>End Plugs / Radiation Shields</td>
<td>Visual check for damage or wear, and cor-</td>
<td></td>
</tr>
</tbody>
</table>
### 5.0 Maintenance

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>rect positioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seals (if fitted)</td>
<td>Check all seals and O-rings and clamps</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Performance**

<table>
<thead>
<tr>
<th>Element Circuit</th>
<th>Electrical measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Consumption</td>
<td>Measure the current drawn on each phase / circuit</td>
</tr>
<tr>
<td>Cooling Fans (if fitted)</td>
<td>Check whether the cooling fans are working</td>
</tr>
</tbody>
</table>
5.0 Maintenance

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.

5.2.2 Safety Switch
When correctly functioning, the safety switch will isolate all live conductors (live and neutral connections) within the heating element circuit(s) when the product door is opened. The safety switch should be checked regularly to ensure that this occurs.

The safety switch should not fail under normal working conditions, however rough handling, exposure to corrosive materials/environments, or exceptionally frequent use, could compromise the safety system.

**Weekly check:**
The following check can be carried out by a general operator:

- On the temperature controller, set a safe temperature above ambient. The heater lights should illuminate.
- Open the door and check the heater lights. They should no longer be illuminated.

If the heater lights remain illuminated when the door is open, discontinue use and contact Carbolite Gero Service.

**Annual check:**
The following checks should be carried out by a qualified electrician, as specified in the "Maintenance Schedule" section of this manual:

- Remove the element access panel and take a voltage measurement from the heating element terminals. Do not attempt to take a reading from the heating element itself as surface oxidation will give an unreliable contact.
- Ensure that power to the heating elements is switched off when the door is opened.

Contact Carbolite Gero Service and discontinue use of the product if it is found that the heating elements are not fully isolated during these checks.

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 of each type of thermocouple, one solid state relay and two heating elements.

When ordering spare parts please quote the model details as requested above.
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).

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

For vertical models it may be necessary to dismount the furnace from its stand and remove the terminal cover.

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

Thermocouple cable colour codings are:

<table>
<thead>
<tr>
<th>thermocouple leg</th>
<th>colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>positive (type N)</td>
<td>pink</td>
</tr>
<tr>
<td>negative</td>
<td>white</td>
</tr>
</tbody>
</table>

Disconnect the thermocouple from its terminal block.
Carefully withdraw the thermocouple from the product and remove any broken bits of thermocouple.
Bend the new thermocouple carefully to match the shape of the original (working from the terminal end). Should the length differ from that of the original this is usually not important provided that the thermocouple tip is within a work tube diameter's distance from the furnace centre.
Insert the new thermocouple into position, restoring any removed porcelain spacers and ensuring correct polarity.
Re-assemble the furnace.

6.6 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.

6.7 Element Replacement

See section 6.2 - wearing a face mask is required.

Remove the three screws from each end and lift out the half-circular insulation assembly.

Make a plan of all the cable connections and disconnect the cables.

Remove the thermocouple(s) by withdrawing them from the sheaths built into the elements. Remove the plates through which the element tails are located. Remove the keep plates from each side of the insulation assembly.

Lift out the element to be replaced; save any insulation sleeves for possible reuse.

Bend or cut the new element tails as necessary and fit any insulation sleeves; feed the tails through and fit the element into place.

Refit the keep plates on each side. Refit the tail termination plates, ensuring that the element tails do not touch any metal parts. Refit the thermocouple(s).

Connect all the wiring according to the plan previously made and complete the reassembly of the product.

Check that the product is controlling properly to rule out the possibility that the element failed because of a fault in the control system.

Wherever two different sizes of elements are fitted, the 150 mm elements are at the ends and the 200 mm elements in the centre.

<table>
<thead>
<tr>
<th>Model</th>
<th>Voltage</th>
<th>Description</th>
<th>Voltage</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 12/600</td>
<td>200-240 V</td>
<td>4 pair of 150 mm elements in parallel, each pair 2 in series</td>
<td>100-120 V</td>
<td>8 elements in parallel</td>
</tr>
<tr>
<td>Model 12/600 E</td>
<td>200-240 V</td>
<td>3 pairs of 200 mm elements in parallel, each pair 2 in series</td>
<td>100-120 V</td>
<td>6 elements in parallel</td>
</tr>
</tbody>
</table>
## 7.0 Fault Analysis

### A. Furnace Does Not Heat Up

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The HEAT light is ON</td>
<td>The heating element has failed</td>
</tr>
<tr>
<td>2.</td>
<td>The HEAT light is OFF</td>
<td>The controller shows a very high temperature or code such as S.br</td>
</tr>
<tr>
<td></td>
<td>The controller shows a low temperature</td>
<td>The door switch(es) (if fitted) may be faulty or need adjustment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The heater switch (if fitted) may be faulty or need adjustment</td>
</tr>
<tr>
<td></td>
<td>There are no lights glowing on the controller</td>
<td>The SSR could be failing to switch on due to internal failure, faulty logic wiring from the controller, or faulty controller</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the supply fuses and any fuses in the furnace control compartment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The controller may be faulty or not receiving a supply due to a faulty switch or a wiring fault.</td>
</tr>
</tbody>
</table>
## B. Product Overheats

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong></td>
<td><strong>Product only heats up when the instrument switch is ON</strong></td>
<td><strong>The controller shows a very high temperature</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>The controller shows a low temperature</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.</strong></td>
<td><strong>Product heats up when the instrument switch is OFF</strong></td>
<td><strong>The SSR has failed &quot;ON&quot;</strong></td>
</tr>
</tbody>
</table>
8.0 Wiring Diagrams

8.1 WC-13-70
Safety Switch A - A 2-pole Heater Switch is fitted directly in the element circuit in models up to 16 A rating.
Safety Switch B - A door switch is fitted into the contactor coil circuit. Above 16 A a 1-pole Heater Switch is fitted into the same circuit, in series.
8.2 WC-13-71
Connections below show single phase with indirect safety switches and over-temperature control.
8.3 2- and 3-phase With Neutral

Each SSR is connected to a different phase. The control circuit is taken between L1 and N.

Safety switch A applies for 2-phase. Safety switch B applies for 3-phase.

If type F1 fuse is present, one per phase if fitted.

If type F2 fuse is present, one is fitted; if type F3 fuse is present, one per phase is fitted.

Note that on 2- or 3-phase models there may be three separate neutrals taken to a common supply terminal, depending on EMC filter requirements.

8.4 Independent Zones (control method C)

When this is ordered there are three independent thermocouples (instead of the four shown) connected to the three controllers; the words “master” and “slave” may be replaced by “centre” and “end”.

8.5 Control by Broadcast Comms (control method B)

When this is ordered there are three independent thermocouples connected to the three controllers; the controllers are linked together (not shown), and remain “master” and “slave”.

The communication between the controllers of the Eurotherm 3000 series is known as Broadcast comms. The wiring connections between the controllers are as follows:

![Wiring Diagram](image)

8.6 Three-phase without neutral (star - e.g. 380-415 V)

The circuit is similar to "Control by Broadcast Comms (control method B)", but the “neutral” ends of the elements are not connected to a neutral terminal block.

The control circuit contains an isolating transformer to reduce the control voltage to 240 V or similar.
8.7 Higher Voltages

For 254 V or above 1-phase or 440/254 V or above 3-phase, an isolating transformer is included in the control circuit after the F2 fuses.
9.0 Fuses and Power Settings

9.1 Fuses

F1 - F3: Refer to the circuit diagrams.

<table>
<thead>
<tr>
<th>F1</th>
<th>Internal Supply Fuses</th>
<th>Fitted if supply cable fitted. Fitted on board to some types of EMC filter.</th>
<th>GEC Safeclip of the type shown (glass type F up to 16 A) 38 mm x 10 mm type F fitted on EMC filter circuit board(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2</td>
<td>Auxiliary Circuit Fuses</td>
<td>Fitted on board to some types of EMC filter. May be omitted up to 25 Amp/phase supply rating.</td>
<td>2 Amps glass type F On board: 20 mm x 5 mm Other: 32 mm x 6 mm</td>
</tr>
<tr>
<td>F3</td>
<td>Heat Light Fuses</td>
<td>May be omitted up to 25 Amp/phase supply rating.</td>
<td>2 Amps glass type F 32 mm x 6 mm</td>
</tr>
<tr>
<td>Customer Fuses</td>
<td>Required if no supply cable fitted. Recommended if cable fitted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>See rating label for current; See table below for fuse rating.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Phases</th>
<th>Volts</th>
<th>Supply Fuse Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVS 12/600</td>
<td>1-phase</td>
<td>200-240</td>
<td>16 A</td>
</tr>
<tr>
<td>TVS 12/600</td>
<td>3-phase + N</td>
<td>380-415</td>
<td>10 A</td>
</tr>
<tr>
<td>TVS 12/600</td>
<td>3-phase Delta</td>
<td>200-240</td>
<td>10 A</td>
</tr>
<tr>
<td>TVS 12/600 E</td>
<td>1-phase</td>
<td>200-240</td>
<td>16 A</td>
</tr>
<tr>
<td>TVS 12/600 E</td>
<td>3-phase + N</td>
<td>380-415</td>
<td>10 A</td>
</tr>
<tr>
<td>TVS 12/600 E</td>
<td>3-phase Delta</td>
<td>200-240</td>
<td>10 A</td>
</tr>
</tbody>
</table>

9.2 Power Settings

The power limit settings (parameter OP.Hi) for this model are voltage dependant. The figures represent the maximum percentage of time that controlled power is supplied to the elements. Do not attempt to "improve performance" by setting a value higher than the recommended values. To adjust the parameter refer to the "Changing the Maximum Output Power" of the control section of the manual.

<table>
<thead>
<tr>
<th>Volts:</th>
<th>Power (%)</th>
<th>208 V</th>
<th>200 V</th>
<th>220 V</th>
<th>230 V</th>
<th>240 V</th>
<th>380 V</th>
<th>400 V</th>
<th>415 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volts:</td>
<td></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>89</td>
<td>89</td>
</tr>
</tbody>
</table>
### User Power Setting Adjustments

<table>
<thead>
<tr>
<th>Date</th>
<th>% Power</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>

Note: If a new set of elements are fitted then return the power settings to the original value.

Please refer to the rating label for product specific information.
10.0 Specifications

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

<table>
<thead>
<tr>
<th>Model</th>
<th>Max Temp (°C)</th>
<th>Max Power (kW)</th>
<th>Work Tube Bore (mm)</th>
<th>Recommended Work Tube Length for use in air (mm)</th>
<th>Heated Length (mm)</th>
<th>Net Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVS 12/600</td>
<td>1200</td>
<td>3.0</td>
<td>25-106</td>
<td>950</td>
<td>600</td>
<td>40</td>
</tr>
</tbody>
</table>

Note: Weights are approximate for horizontal models and do not include fittings or vertical stands.

10.1 Environment

The models listed in this manual contains 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
<table>
<thead>
<tr>
<th>Engineer Name</th>
<th>Date</th>
<th>Record of Work</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
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</tbody>
</table>
The products covered in this manual are only a small part of the wide range of ovens, chamber furnaces and tube furnaces manufactured by Carbolite Gero for laboratory and industrial use. For further details of our standard or custom built products please contact us at the address below, or ask your nearest stockist.

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

**Carbolite Gero Service**
Telephone: + 44 (0) 1433 624242
Fax: +44 (0) 1433 624243
Email: ServiceUK@carbolite-gero.com