JOHNS HOPKINS ENTERPRISE
1708 GS FL(C) FURNACE
S/N 150508
INSTRUCTION manual

CM FURNACES INC.
103 Dewey Street
Bloomfield, NJ 07003
Phone (973) 338-6500
Fax (973) 338-1625
Worldwide Web Site:http://www.cm furnaces.com
E-Mail Address: info@cmfurnaces.com
Although this furnace has been completely factory tested, it has **not** been operated to full temperature.

Because the insulating system contains various binders which may out gas during initial usage, this furnace **MUST** be initially operated in a well-ventilated area.
READ THIS INSTRUCTION MANUAL PRIOR TO INSTALLING, OPERATING, OR SERVICING THIS EQUIPMENT.

FAILURE TO READ THIS INSTRUCTION MANUAL MAY RESULT IN DAMAGE TO THE EQUIPMENT AS WELL AS A SAFETY HAZARD TO PERSONNEL.
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CUSTOMER: JOHNS HOPKINS ENTERPRISE

MODEL NUMBER: 1708 GS FL (C)

SERIAL NUMBER: 150508

POWER RATING (KW): 7.5 KVA

SUPPLY LINE VOLTAGE: 208 V

AMPS – MAXIMUM FURNACE LOAD: 37 AMPS

AMPS – CIRCUIT BREAKING RATING: 45 AMPS

SUPPLY LINE PHASE(S): 1

SUPPLY LINE FREQUENCY (HZ): 60

MAXIMUM TEMPERATURE: 1700°C

PROCESS ATMOSPHERE: INERT

PROTECTIVE ATMOSPHERE: N/A

NUMBER OF CONTROL ZONES: 1

[Signature]
July 13, 2015

Attn: Bryan Crawford
Johns Hopkins Enterprise
Rm: 205 Floor: 2 Bldg.: MARYLAND
10 N. Charles Street
Baltimore, MD 21201

ENGINEERING SPECIFICATIONS
FOR SERVICES REQUIRED

Thank you for your Purchase Order No. 2002571031 for a CM 1700 Series Model 1708 GS FL (C) furnace system. This unit shall be Serial Number 150508. One or more of the following services are required at the equipment location for proper operation.

--- SCFH clean compressed air at 90–120 PSIG
--- GPH of clean filtered water at 45-85 PSIG at 50-60°F (delivery rate)
25 GPH of clean filtered water at 45-85 PSIG at 50-60°F (nominal use rate)
--- SCFH city gas – 4 oz. pressure
--- SCFM peak delivery rate of Hydrogen or Dissociated Ammonia
--- SCFH of Hydrogen or Dissociated Ammonia gas consumed at 20–50 PSIG
15-25 SCFH Inert gas 20-50 PSIG
--- SCFH Helium gas 20-50- PSIG
--- SCFH Argon gas 20-50 PSIG
208 Volts
37 Amps – maximum furnace load
45 Amps – circuit breaking rating
1 Phase, 2 wire (plus ground)
60 Hz.
N/A Secure internet access for PLC & HMI Login

It is the customer's responsibility to connect all services to the furnace, as well as all interconnecting wiring and piping, in accordance to all local codes. A CM Technician can provide startup and training but is not licensed to install equipment.
DOMESTIC PURCHASE ORDER TERMS AND CONDITIONS

(1) ACCEPTANCE
Any purchase order placed with CM Furnaces, Inc., herein referred to as CM, shall not be binding on CM until accepted in writing by an authorized employee of CM at its place of business in Bloomfield, New Jersey.

Upon acceptance by CM, each purchase order will be subject to and be deemed to include these conditions of sale. Failure by CM to object to provisions contained in any purchase or in any related communication from the purchaser shall not be construed as a waiver of CM's conditions of sale nor an acceptance of such provisions from the purchaser.

IMPORTANT NOTES
THE BUYER MUST NOTIFY CM IF THE POWER SUPPLY REQUIREMENT DIFFERS FROM THAT QUOTED.

ALL MODIFICATIONS OF ANY CM QUOTED EQUIPMENT TO MEET SPECIAL INSURANCE REQUIREMENTS OR ELECTRICAL CODES WILL BE QUOTED ON OR AFTER RECEIPT BY CM FROM THE BUYER OF DETAILED SPECIFIC REQUIREMENTS.

AFTER AN ORDER IS ACCEPTED BY CM, NO CANCELLATION OR CHANGES CAN BE EFFECTIVE UNLESS ACCEPTED BY CM IN WRITING.

(2) DELIVERY
Delivery promise will be given by CM and delivery to a carrier at CM's plant will constitute delivery to the buyer unless other terms are accepted by CM in writing. All risks of loss or damage in transit shall be borne by the buyer.

No claims for shortages or other errors in delivery will be considered by CM unless a written claim specifying the alleged shortage or error is made upon CM within 10 days after receipt of the goods.

CM will not be liable for any failure of, or delay in performance caused by invasion, insurrection, riot, war, military or usurped power, or by fire, flood, strike or labor difficulty or by any other cause beyond CM's reasonable control.

(3) INSTALLATION
All equipment is to be installed by and at the expense of the purchaser unless other terms are offered in writing by CM.

CM will provide written instructions, and upon request, will quote on-site instruction. In such a case, the purchaser must provide qualified individuals to be instructed and/or aid in the start-up.

(4) PRICES - PAYMENT
All prices quoted are firm for a period of 60 days and are CM factory floor, Bloomfield, New Jersey, unless amended in writing by CM. Stacking, crating, and rigging charges for shipment via common carrier and/or Air Ride Van are not included in the quoted price unless so indicated, and are the responsibility of the customer.

All new accounts must be approved by CM Accounting Department prior to formal acceptance of the purchase order. Once credit is established, payment is due in accordance with the following schedule:

<table>
<thead>
<tr>
<th>For Orders Valued At:</th>
<th>Terms:</th>
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<tbody>
<tr>
<td>0-34,999</td>
<td>Net 30 Days</td>
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<tr>
<td>35,000 to 100,000</td>
<td>40% with purchase order</td>
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<td></td>
<td>50% upon completion, testing and acceptance by customer personnel at CM facilities prior to shipment.</td>
</tr>
<tr>
<td>Above 100,000</td>
<td>10% Net 30 Days</td>
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<tr>
<td></td>
<td>Terms to be arranged.</td>
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</table>

(5) LIMITED WARRANTY
CM warrants equipment and parts manufactured by it to be free of defects in material and workmanship for a period of one (1) year after final invoicing by CM, subject to the following conditions: CM obligation under this warranty is to repair or replace, at its option, any parts which upon CM's examination prove to be defective in material or workmanship, provided written notice is given to CM within ten (10) days after discovery and within the warranty period.

This warranty does not apply where, in CM's judgment, the defect is due to causes beyond CM's control including, but not limited to, such things as service and alteration by someone other than CM, negligence, accident, and operation, maintenance or storage under other than normal and proper conditions. Furnace elements or thermocouples are not warranted. All warranty service calls will be scheduled against customer purchase order with appropriate billing submitted by CM for service or material not covered by the warranty, including customer-caused problems.

THE WARRANTY OF MERCHANTABILITY IS EXPRESSLY EXCLUDED; THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THESE STATED, INCLUDING FITNESS FOR A PARTICULAR PURPOSE.

No agent, employee or representative of CM has any authority to bind it to any affirmation, representation or warranty which is not specifically included herein.

(6) CONSEQUENTIAL DAMAGES AND PROCESS
CM shall not be liable for any consequential, contingent or incidental damages. CM is also not responsible for customer's process.

(7) SOFTWARE POLICY
The software instructions ("program") developed by CM which define the operating logic of electronic devices contained in equipment supplied by CM is considered proprietary information. A detailed description of the programming will not be released to the customer. CM will provide support in the event the customer wishes to modify the program logic. Customer-requested modifications shall be provided free of charge during the initial start-up period (90 days), and for up to one (1) year from the date of shipment in the event of any defects in the logic as programmed by CM. Thereafter, any programming modifications will be quoted and invoiced by CM as appropriate based on the scope of the changes requested.

(8) GENERAL
The foregoing listed conditions, and any written modification accepted by CM in the manner described previously, are and shall be deemed the complete and exclusive expression of the agreement between CM and the purchaser.
CM Furnaces has incorporated all appropriate safety features in the manufacture of your Furnace system. The system must be installed in accordance with all National Electrical and Fire Codes as well as all local codes.

CM Furnaces has engineered into your furnace system all appropriate operational safety features. To ensure a safe operating environment we recommend you follow all safety instructions contained in this manual as well as your own laboratory safety practices. Familiarize yourself with these procedures.

Mechanically fastened guards protect potentially hazardous areas of your furnace. These guards require the appropriate tool to gain access. When service or maintenance is required only qualified technical personnel may remove these guards. Guards, which are removed for service or maintenance, must be installed prior to operating the equipment.

Do not apply voltage or current to the heating elements, which exceed that noted on the electrical schematic.

**CAUTION**

The exposed heating elements are electrically live. If an electrically conductive material is being introduced into the furnace be sure that the operator does not become a conductor to ground. The following procedures should be implemented:

A. Always be certain that the furnace is properly grounded.

B. Wear protective insulating gloves.

C. If using a metal rod or tongs, make certain that the handle is insulated and properly grounded.

D. A rubber mat should be placed on the floor in front of the furnace to isolate the operator from ground.

**CAUTION**

The outer furnace shell may be in excess of room temperature. These temperatures are within normal safe limits. We recommend "Hot Surface" signs are displayed to indicate that the furnace is in use.

Use dark glasses when viewing any glowing heating element. The eyes are subjected to potential damage when observing temperatures above 1400°C (2550°F).
Heating elements, which have been operating at high temperature for a long time and have then cooled down may have internal stress, which can cause the protective glaze to splinter into small fragments. There have been instances where heating elements, which have been cold for several days, have emitted a shower of fine glaze particles when touched. Always use eye protection and gloves when loading and unloading the furnace and when handling heating elements.

The heating elements will react with carbon monoxide, carbon dioxide, and other materials that react with silica.

New furnace linings are organic free but may contain trace amounts of absorbed volatiles. These volatiles may be released from the insulation upon initial heating.

All fibrous furnace chambers are designed for rapid temperature cycling and initial bake out is not necessary.

The furnace door or opening should remain shut while the furnace is hot to prolong the life of the door insulation.

The stability of fibrous ceramic thermal insulation depends on a delicate chemical balance. It is important that materials, which may contaminate and or react with the furnace lining, be removed prior to heating the furnace chamber. Typical contaminants are:

a) Previously processed material remnants
b) Vitreous silica which is spalled from the heating elements.
c) Any other foreign materials not supplied with the furnace.
d) Fluxing agents containing halogens, lead, etc.
In accordance with CM Furnaces Inc. corporate policy and our commitment to keep customers informed regarding the potential health effects of materials used in the manufacture of our furnace systems we would like to make you aware of the following information.

It is important to keep in mind that complete furnace systems as received from CM Furnaces Inc. are safe for the purpose for which they are intended. The comments regarding safety, as outlined below, are intended primarily for routine maintenance and future repair.

CM Furnaces Inc. manufactures a broad range of high-temperature furnace systems incorporating ceramic materials including zirconia and alumina based fiber and brick products. At this time, of particular concern regarding safety is the use of refractory ceramic fiber (RCF) which is a man-made material which plays an important energy efficiency role throughout the world by saving as much as 25 to 50% in energy consumption. Ongoing studies of the health of both current and former workers in the RCF industry have found to date no clinically significant disease as a result of exposure to RCF.

Preliminary results of (laboratory animal) inhalation tests performed at the Los Alamos National Laboratory under the sponsorship of the Thermal Insulation Manufacturers Association (TIMA) as well as testing done by other internationally renown organizations show that RCF causes fibrosis and lung and pleural cancer when administered at very high dosages in laboratory test animals. It is too early to determine definitely whether RCF causes cancer or other serious disease in people based on the animal study results to date.

Many national and international regulatory bodies including the U.S. Environmental Protection Agency (EPA) and the World Health Organizations International Agency for Research on Cancer (IARC), believe that substances that cause cancer in animals at very high doses may present a corresponding hazard to people. However, since people tend to be exposed to comparatively low doses an increasing number of scientists believe that the human risk may be very different. Regardless, RCF has been classified by IARC as 2(b) – a possible human carcinogen.

While at the present time there is no clinically significant indication of chronic health effects in humans from long exposure to RCF the interim results from the animal study are of concern to us. These preliminary results serve to reinforce our convictions that while performing routine maintenance on CM Furnaces, ceramic fiber material should be handled in accordance with the recommended safety procedures outlined below:
a) Minimize airborne fiber at all times.

b) Wear a half-face, air-purifying respirator equipped with a high-efficiency particulate air (HEPA) filter cartridge (e.g. 3M 6000 Series or equivalent).

c) Wear long sleeved loose fitting clothing. Use protective coveralls. Do not wear contact lenses. Avoid taking soiled clothing home. Wash work clothing separately from other clothing. Rinse washing machine thoroughly after use.

d) Wear eye protection and protective gloves.

e) Wash exposed skin area gently with soap and warm water after handling ceramic fiber insulation.

f) Particular care should be taken when working with used material which has been in service at elevated temperature greater than 1600°F.

You are urged to make this information available to all employees who may be maintaining or repairing CM Furnace systems. If you need any additional information please contact our customer service department in Bloomfield, New Jersey at (973) 338-6500.
CONGRATULATIONS:

You have just received a CM Furnace System. CM Furnaces offers a variety of system types and options. Therefore, it will be necessary to become familiar with your particular system. Individual manufacturer instruction manuals, instruction sheets and blueprints have been included for this purpose.

Your furnace system has been manufactured in our factory and tested before shipment. For shipping purposes, some components may have been removed and packed separately.

Some assembly may be required (refer to installation instructions).

If you have questions regarding the installation or operation of this equipment, contact CM Customer Service at (973) 338-6500.

To better aid us in helping you, please have the furnace specification sheet available for reference.

Replies will be greatly facilitated when complete serial number and specific problems are fully and clearly stated.
UNPACKING/INITIAL INSPECTION

Your Furnace System has been carefully packaged to prevent shipping damage. Upon receiving the furnace system, carefully inspect all boxes for any evidence of mishandling. Carefully inspect the equipment for any signs of damage, which may have occurred during shipment. All claims should be made against the transportation company immediately. Any damage should be reported immediately to CM Furnaces in writing.

Do not discard any packing material until all system components are accounted for and all claims have been satisfied. Refer to the packing list for a complete list of these components. Any missing components must be reported immediately to CM Furnaces.

A standard furnace system consists of the following components:

- Furnace
- Power Supply
- Heating Elements (quantities vary)
- Thermocouples (quantity of two)
- Interconnecting wires, ten feet
  (power and thermocouple extension)
- Instruction Manual
- Accessories, quantities vary
  (straps, clamps, floor plate, gas ports)
- Optional Accessories
  (tube, end seals, auxiliary thermocouples)

Locate and become familiar with these components prior to assembly.
1. Remove all interior packing material from furnace chamber.

2. Inspect the furnace interior for damage.

3. Remove the furnace top cover. To do this, unscrew the screws, which hold the top cover in place. Remove all packing material in this area.

4. Carefully unpack the heating elements. They are very fragile; handle them as you would handle glass.

5. On some extended length and large diameter horizontal tube furnaces ceramic posts must be positioned inside the furnace to support the process tube. These posts are supplied by CM Furnaces Inc., but must be installed by the customer. Please refer to the insulation diagram in this manual.

6. Carefully insert the heating elements through the roof access ports. The heating elements should rest flat on the roof and be parallel to the interior wall.

7. For 6/12 Elements: Carefully slide the clamps on the braided straps onto the heating element terminals. These clamps require nuts and bolts. Make sure to tighten the bolts to ensure proper electrical connection. Refer to the Furnace Assembly Drawing for further details.

8. For 3/6 Elements: Carefully install clamps on the element terminals. Squeeze the clamp levers to open the jaws. Carefully slide the clamps on the element terminal over the braided straps. Do not allow adjacent clamps to touch one another. Refer to the Element Installation/Replacement Procedure for additional detailed instructions. On some furnace systems, these clamps utilize nuts and bolts.

9. Install the furnace top cover.

10. Insert the two thermocouples through the access ports.

11. Connect the thermocouples to the screw terminals on the furnace. The thermocouples are marked regarding their polarity with a negative mark on the ceramic lead end. Connect the negative lead to the red lead wire.

12. If the furnace is a box type, place the alumina floor plate in the center of the floor of the furnace chamber. This provides a dense surface and protects the fiber floor from excessive wear.

13. If the furnace is a tube type, insert a ceramic work tube through the furnace openings.

14. For tube furnaces, assemble and install the gas tight tube end seals if required.
15. On front and bottom loading models, gas ports can be installed by drilling two holes through the rear ports in the furnace shell. Slide the ceramic gas port tubes through these holes and fasten them with the setscrew collar provided.

16. On bottom loading models, plug the fan/lift cord into a wall outlet.

17. On gas sealed models be sure to connect gas and water in accordance with the gas sealed addendum in this manual.

18. **For Tube Furnaces:**

   If baffles are used within the ceramic work tube to protect the end seals or enhance the effective hot zone they must be located directly adjacent to the end seal or end of the work tube – *not* in or near the hot zone. If the baffles are located within or too close to the hot zone they may melt or subject the tube to thermal shock resulting in tube breakage.

**FOR GAS SEALED FURNACE:**

After one run at operating temperature remove top cover and re-tighten bolts on sealing plate.
INSTALLATION NOTICE

At the time of installation it is the customer's responsibility to determine that the available plant voltage and line phasing is in accordance with the furnace design as indicated in the CM Furnaces Inc. electrical schematic.

The furnace must be connected to the building ground system via the ground bus located in the control cabinet. The customer must ensure the furnace installation is in accordance with all local codes and the National Electrical Codes.
1. Follow the latest revision of the National Electric Code as well as all appropriate local codes regarding the installation of this power supply. Refer to the enclosed electrical schematic.

2. Remove the power supply cabinet rear cover.

3. Utilize the appropriate size holes in the cabinet to route the interconnecting wires to the furnace. The thermocouple extension wires must be routed separately from all other wires.

4. Connect the power wires to the terminals in the power supply labeled "FURNACE". Each terminal will be marked with a corresponding wire #. Tighten these connections.

5. Connect the other end of the power wires to the rear brass terminals (or labeled bus bars) on the furnace. Tighten these connections.

6. Connect the green ground wire to the ground bar in the power supply cabinet. Tighten this connection.

7. Connect the other end of the green ground wire to the green ground screw on the furnace shell. Tighten this connection.

8. Connect the thermocouple extension wire to the terminals in the power supply cabinet labeled "T/C 1" and "T/C 2". The red lead is negative (-), the other lead is positive (+). Tighten these connections.

9. Connect the other end of the thermocouple extension wire to the screw terminals on the furnace. The red lead is negative (-), the other lead is positive (+). Tighten these connections.

10. Connect the cooling fan cord to the terminals in the power supply cabinet labeled "FAN". The black wire is the hot wire. The white wire is the neutral wire. The green wire is the ground wire. An additional ground terminal has been provided on the ground bar for the fan ground wire. Tighten these connections. On bottom loading models, the fan is powered by means of the plug in cord.

11. Connect the main electrical service. Terminals have been supplied in the power supply cabinet for this purpose and are labeled with the proper supply voltage. For 480 Volt systems, the main electrical service connects directly into the circuit breaker enclosure.

12. Connect the main electrical ground wire to the ground bar in the power supply cabinet. An additional ground terminal has been provided for this purpose. For 480 Volt systems, the ground bar is located in the circuit breaker enclosure.

13. Install the power supply cabinet rear cover.
The heating elements in your CM Furnace are connected to each other and to the power terminals by means of aluminum braided connector straps. It is extremely important that the heating elements be connected properly to prolong the life of both the connector straps and the heating elements.

New Straps as received from CM Furnaces are pre-formed at the ends for connection to the heating elements. This pre-bending provides a 360° contact with the heating element terminal surface. Good contact is vital to good performance. The straps are held securely in place using spring clamps. It is very important that these clamps be installed with the contacting surface fully engaged with the pre-formed strap. There should be one clamp per terminal on 3/6mm elements. The clamps for the 6/12mm and 9/18mm elements are an integral part of the strap. If you’re in doubt regarding which size of heating elements you have please contact CM’s Customer Service Department indicating the serial number of your furnace system. It is important to periodically inspect the quality of the connection between the aluminum braid and the heating element terminal. It is recommended that a spare set of straps and clamps be kept on hand in the event they are needed for replacement.

A faulty connection between the braid and the heating element terminal may cause the fuse protecting the SCR power controller to blow and/or cause the strap to begin to melt between the strap and terminal contact where it is concealed from normal view. Left unattended this can lead to complete melting of the strap and ultimately cracking of the heating element terminal. The two straps which connect the first two heating elements to the power terminals should be inspected periodically and tightened at the brass screw terminal if necessary. The first signs of problems at the power terminal connection point will be discoloration and preliminary melting of the aluminum braid.

Your CM Furnace system has been designed for long life. If there are any indications of reoccurring problems in any portion of the furnace system and particularly in the heating element/aluminum connector area please contact CM Furnaces Customer Service Department immediately at (973) 338-6500.
OPERATING PROCEDURES

1. Before loading the furnace with product, inspect the furnace interior for any unusual heating element or insulation appearance. Refer to the "MAINTENANCE" section for detailed furnace inspection information.

   CAUTION

   Always use eye protection when inspecting the furnace interior.

2. Load the furnace with product.

3. Close the furnace door or opening. If you have a tube furnace install the tube end seals as appropriate. If you have a bottom-loading furnace close the lift safety doors and raise the lift platform. To do this, select the direction switch to the up position.

4. Turn the power supply circuit breaker on. The furnace cooling fans will start if so equipped.

5. Turn the green master switch on. The green master light and the temperature controllers will illuminate. If there is a digital overtemp controller, it will also illuminate.

6. Set the temperature controllers according to the manufacturer's instruction manual (program or setpoint entry).

7. Set the overtemp controllers alarms approximately 50° above the process temperature. Refer to the overtemp controller instruction manual.

8. Set the temperature controllers to 0% output for start-up. This can be accomplished by lowering the setpoint to 0°C in automatic control or by lowering the output to 0% in manual control. Refer to the temperature controller instruction manual.

9. Transfer the temperature controllers to automatic. If the system is equipped with a programmable temperature controllers, run the program. If the system is not equipped with programmers, adjust the setpoint to the proper value. Current and voltage will be viewed on the panel ammeter at this time.

HEAT UP AND COOL DOWN RATES:

1600 and 1700 Series Box Furnaces:

   No Restrictions
Bottom Loading Furnaces with an Atmosphere Dome:

100°C per hour up to 800°C, then 50°C per hour to maximum temperature.

1800 Series Box Furnace:

a) During normal operation heat-up rate should not exceed 500°C per hour up to 1700°C and 100°C per hour from 1700°C to 1800°C.

b) At temperatures above 300°C cold air should not be introduced into the furnace cavity. Allow heating to cool at natural rate.

1600, 1700, 1800 Tube Furnaces:

For tubes up to 4” in diameter 200°C per hour up to 800°C, then 100°C per hour to maximum temperature.

NOTE

The temperature controller and SCR power controller have been properly matched and configured specifically for your furnace system. The only adjustments that may require fine-tuning are the tuning parameters such as proportional band (gain), reset (integral), and rate (derivative). These are sometimes referred to as PID adjustments. Refer to the temperature controller operator instruction manual regarding the fine-tuning of these settings. These adjustments have been preset during the factory testing of this equipment; however, they may require additional fine-tuning for your particular application. We do not recommend using the auto tune or self-tune feature of your temperature controller.
RAPID TEMP
GAS SEALED OPERATING GUIDELINES

CM Gas Sealed Rapid Temp Furnace systems are designed for use with non-combustible, non-toxic and non-corrosive atmospheres only. Listed below are the maximum furnace temperatures for Rapid Temp Gas Sealed Furnaces in various gas atmospheres.

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<tr>
<th>1600 Series Furnaces</th>
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<tbody>
<tr>
<td>Air</td>
<td>Air</td>
<td>Air</td>
</tr>
<tr>
<td>1600°C</td>
<td>1700°C</td>
<td>1800°C</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>Nitrogen</td>
<td>Nitrogen</td>
</tr>
<tr>
<td>1600°C</td>
<td>1700°C</td>
<td>1800°C</td>
</tr>
<tr>
<td>Argon</td>
<td>Argon</td>
<td>Argon</td>
</tr>
<tr>
<td>1600°C</td>
<td>1700°C</td>
<td>1800°C</td>
</tr>
<tr>
<td>Helium</td>
<td>Helium</td>
<td>Helium</td>
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<tr>
<td>1600°C</td>
<td>1700°C</td>
<td>1800°C</td>
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<tr>
<td>Carbon</td>
<td>Carbon</td>
<td>Carbon</td>
</tr>
<tr>
<td>1500°C</td>
<td>1600°C</td>
<td>1700°C</td>
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<tr>
<td>Dioxide</td>
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NOTE: The standard gas sealed furnace system is **NOT SUITABLE** for pure oxygen atmospheres.

All temperatures refer to the maximum heating element temperature. This does not refer to the actual furnace temperature which may be lower depending on the process.

The gas sealed design requires a portion of the gas flow to be directed through the heating element terminal area as well as the work chamber. This aids in cooling the heating element terminals enhancing their useful operating life.

In the event one of the above mentioned gas atmospheres is not required for operation air flow must be utilized to allow for the convection cooling of the heating element terminal area.

Both inlet and outlet **gas ports** are labeled on the rear of the furnace. Connections to these points are made utilizing standard pipe fittings.

Customer is responsible for the safe and proper disposal (venting) of the hot exit gases from the outlet port.

If the furnace system is being utilized for binder removal or other processes Where in volatile materials are carried out of the system through the
burn-off stack, it is important that these volatiles do not condense within the burn-off stack assembly. This condition may cause plugging of the stack with the resulting possibility of over pressurization of the furnace system.

**DAMAGE TO THE EQUIPMENT AND INJURY TO PERSONNEL.**
If there is a potential for volatiles to condense and form solids, above ambient room temperature, consult the CM engineering department for appropriate “Stack Heater Operation” before operating the equipment.

Gas sealed thermocouples are normally supplied with the furnace system. It is necessary to use thread sealant on the thermocouple threads. This will ensure that the gas atmosphere integrity is maintained.

Upon installing the interior top cover, ensure that all perimeter hardware is tightened to maintain the atmosphere integrity. A silicon gasket is recommended for the top cover.

Upon closing the furnace door, ensure that all latching handles are fully tightened to maintain the atmosphere integrity. A rubber O-ring is used to seal the door.

Dry gas should be utilized to prevent internal chamber condensation.

Under no circumstances should the furnace chamber be pressurized or operated under reduced pressure. This is an atmosphere containment chamber only.

The furnace shell, front door and top cover requires water cooling.
DURING OPERATION, THIS COOLING WATER FLOW MUST REMAIN ON.

Both inlet and outlet water ports are labeled on the rear of the furnace. Connections to these points are made utilizing standard pipe fittings.

Due to the variety of process requirements the water and gas flows vary.

A gas flow between 15 and 25 scfh should be maintained to the furnace during operation.

A water flow of 25 gph should be maintained to the furnace during operation. During element replacement inspect all the components of the heating element terminal area for wear and tear. Prior to the installation of the internal top cover, inspect the silicon gasket for wear. Replace if necessary.

If there are any questions on the operation of this furnace system contact CM Furnaces Inc. at (973) 338-6500.
s/n 150508 2404 Temperature Controller
Programming Guide

Control Keys:

Run a program:

1) In order to run a program, the 2404 must be in auto mode. Depress the auto/manual button until “AUTO” is illuminated.

2) To verify that the program is running, check to see that the “RUN” lamp is illuminated next to the RUN/HOLD key.

Selecting the active program to be ran:

1) The 2404’s “RUN” list contains the program which will run upon starting the program.

2) To access the RUN list, repeatedly depress the page key until the RUN list appears.
3) Depress the scroll key ( \[ \text{Pr-Gn} \] ) will be displayed.
4) Use the up/down arrows ( \[ \text{Pr-Gn} \] ) to select the desired program to be ran.

**Programming profile segments:**

****Holdback ( \[ \text{Hb} \] ) is generally not a used option. “Hb” (holdback) “Hb U” (Holdback Units) should be set to OFF. Reference the Eurotherm 2404 manual for holdback information****

1) Repeatedly depress the page key ( \[ \text{Pr-Gn} \] ) until the program list- \[ \text{Pr-Gn} \] appears.
   [From the program list, repeatedly depressing the scroll key \[ \text{Pr-Gn} \] will navigate the display through the entire program list menu.]

2) Press the scroll key until \[ \text{Pr-Gn} \] appears. If not, set to match the graphic in each step. If you intend on editing another program number, this is where you would use the up/down arrows to select the appropriate program you want to edit (program #2, 3, 4...).

3) Press the scroll key until \[ \text{Pr-Gn} \] appears. If not, set to match the graphic in each step. This is the ramp unit field. Choices are minutes, hours or seconds.

4) Press the scroll key- \[ \text{Pr-Gn} \] appears. If not, set to match the graphic in each step. This is the dwell unit field. Choices are minutes, hours or seconds.

5) Press the scroll key- \[ \text{Pr-Gn} \] appears. If not, set to match the graphic in each step. This is the number of program cycles. Use the up/down arrows to edit the field. Choices are 1-999 or cont. for continuous.

6) Press the scroll key- \[ \text{Pr-Gn} \] appears. This is the first segment of the program. If another segment is to be edited, use the up/down arrows to select the desired segment.

7) Press the scroll key- \[ \text{Pr-Gn} \] appears. If not, set to match the graphic in each step. This is the segment type field. (For this example we will use rmp.r.) Choices are:
   - Rmp.r- ramp to new setpoint at a set rate
   - Rmp.t- ramp to a new setpoint in a set time
   - Dwell- Dwell (hold) for a set time
   - Step- Not applicable for furnace use!
   - Cali- point to another program as a subroutine
   - End- Makes the current segment the end of program

8) Press the scroll key- \[ \text{Pr-Gn} \] appears. If not, set to match the graphic in each step. Holdback is not used.
9) Press the scroll key appears. If not, set to match the graphic in each step. Select the target temperature. In this case, 100 degrees.

10) Press the scroll key appears. If not, set to match the graphic in each step. Select the rate for heating. In this case, 5 degrees/min.

11) Press the scroll key appears. Output 1 controls the inert gas #1 solenoid.

12) Press the scroll key appears. Output 2 controls the inert gas #2 solenoid.

13) Outputs 3-8 must remain off. If not, set 3-8 OFF.

14) Press the scroll key appears. If not, set to match the graphic in each step.

15) Press the scroll key appears. If not, set to match the graphic in each step.

16) Press the scroll key appears. Holdback is not used. If not, set to match the graphic in each step.

17) Press the scroll key appears. (dwell for 5 min) If not, set to match the graphic in each step.

18) Press the scroll key appears. Output 1 controls the inert gas #1 solenoid.

19) Press the scroll key appears. Output 2 controls the inert gas #2 solenoid.

20) Press the scroll key appears. Outputs 3-8 must remain off. If not, set 3-8 OFF.
23) Press the scroll key-

24) Press the scroll key-

25) Press the scroll key-

26) Press the scroll key-

27) Press the scroll key-

28) Press the scroll key-

29) Press the scroll key-

30) Outputs 3-8 must remain off. If not, set 3-8 OFF.

31) Press the scroll key-

32) Press the scroll key-

33) Press the scroll key-

34) Press the scroll key-

35) Press the scroll key-

36) Press the scroll key-

37) Press the scroll key-

38) Press the scroll key-

39) Press the scroll key-
40) Press the scroll key-appears. If not, set to match the graphic in each step.

41) Press the scroll key-appears. Output 1 controls the inert gas #1 solenoid.

        turns off the inert gas #1 solenoid for the active segment.  turns on
        the inert gas #1 solenoid for the active segment.

42) Press the scroll key-appears. Output 2 controls the inert gas #2 solenoid.

        turns off the inert gas #2 solenoid for the active segment.  turns on
        the inert gas #2 solenoid for the active segment.

43) 

44) Press the scroll key-appears. Outputs 3-8 must remain off. If not, set 3-8 OFF.

45) Press the scroll key-appears.

46) Press the scroll key-appears. If not, set to match the graphic in each step.

47) Press the scroll key-appears. End type=dwell. End type DWELL will infinitely
dwell until the operator manually resets the program. If solenoid valves are on in the end
segment, they will remain on until the program is manually reset. (infinite dwell) If not, set to
match the graphic in each step.

48) Press the scroll key-appears. Output 1 controls the inert gas #1 solenoid.

        turns off the inert gas #1 solenoid for the active segment.  turns on
        the inert gas #1 solenoid for the active segment.

49) Press the scroll key-appears. Output 2 controls the inert gas #2 solenoid.

        turns off the inert gas #2 solenoid for the active segment.  turns on
        the inert gas #2 solenoid for the active segment.

50) 

51) Press the scroll key-appears. Outputs 3-8 must remain off. If not, set 3-8 OFF.

52) End Type may also be set to "RESET". End type reset will turn off both valves at the
completion of the program.
NOTE: Please refer to the Eurotherm 2404 controller manual included with the CM Furnace manual for additional details and descriptions not covered within this brief CM Furnaces overview/basic tutorial of furnace controls.
MAINTENANCE

Your CM Furnace system has been designed to require low maintenance. However, a periodic inspection of the system components for wear and tear will benefit both furnace performance and furnace life. Inspection of the furnace must be performed with the power off.

DAILY MAINTENANCE WITH MAIN POWER OFF

INSULATION:

1. Inspect the furnace interior for any evidence of deterioration or attack. It is normal for the ceramic fiber insulation to exhibit signs of cracking. Excessive cracking which prevents the normal use of the furnace requires insulation replacement.

HEATING ELEMENTS:

1. Inspect the heating elements for any evidence of deterioration or attack. It is normal for the heating elements to exhibit bowing or twisting along the heated length. Heating elements which bow within ¼" of the wall should be removed and turned 180° to bow inward. Heating elements which bow inward restricting the usable area of the furnace chamber should be replaced.

2. The heating elements have a built-in fiber heat sink that prevents excessive heat loss. The heat sink should not be broken and should be the same length as the roof thickness to fill the void between the heating elements. Replace broken heat sinks.

3. As heating elements are cycled in temperature they may exhibit a yellow colored powder layer. This indicates that the protective silica glaze has flaked off. The powdered layer is volatilized during the formation of the silica glaze, which will form over the affected area at temperatures above 800°C. This is normal and is not detrimental to the overall performance of the furnace.

MONTHLY MAINTENANCE WITH POWER OFF

1. Inspect the heating element electrical connections. Replace any connection components that have been badly oxidized or deteriorated.

2. Inspect all electrical connections. Tighten any loose connections.

3. Inspect the thermocouple tips for any evidence of deterioration or attack.

ON GAS SEALED MODELS:

4. Check and make sure the exhaust stack is free and clear of deposits or obstructions.

5. Inspect front door and top cover gaskets for integrity.

6. Re-Tighten bolts at least once a month.
FOR PARTS AND SERVICE INQUIRIES, YOU MAY CONTACT CM FURNACES AT THE FOLLOWING LOCATION:

CM FURNACES, INC.
103 DEWEY STREET
BLOOMFIELD, NJ 07003

PHONE: (973) 338-6500
FAX: (973) 338-1625
E-MAIL ADDRESS: info@cmfurnaces.com

PLEASE HAVE MODEL AND SERIAL NUMBER OF YOUR FURNACE AVAILABLE WHEN CONTACTING THE FACTORY.

PARTS REPLACEMENT:

Your Cm Furnace has been designed and manufactured to provide years of reliable service. In the event a component should fail, it is recommended that only CM approved parts be used as replacements. Please contact the CM Customer Service Department for component replacements or repairs. If a service technician is required, contact CM Customer Service Department for rates and to schedule a convenient service date. Do not attempt to alter the furnace system in any way without CM Furnaces authorization. CM Furnaces will not be held responsible for damage caused by unauthorized furnace modifications.

RECOMMENDED SPARE PARTS:

A spare parts list is provided at the back of this instruction manual. Long lead or special order items are designated by ** symbol. Contact the CM Customer Parts Department for delivery information on these items.
<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>20-0015-04</td>
<td>Type B Gas Sealed T/C</td>
</tr>
<tr>
<td>24-0079-13</td>
<td>Fuse, 63A, SCR</td>
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<tr>
<td>40-0045-02B</td>
<td>Heating Element Assy.</td>
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<tr>
<td>45-0004-01A</td>
<td>Clamp</td>
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<td>45-0006-05A</td>
<td>Strap, 5&quot;</td>
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<td>45-0006-10A</td>
<td>Strap, 10&quot;</td>
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<tr>
<td>45-0007-05A</td>
<td>Strap, 5&quot;</td>
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<td>63-0003-01</td>
<td>Alumina Plate, 5&quot; x 4&quot; x 1/4&quot;</td>
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<td>Description</td>
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<td>26-0137-166D</td>
<td>ELECTRICAL PANEL</td>
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<tr>
<td>30-0001-81D</td>
<td>INSULATION DIAGRAM</td>
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<tr>
<td>50-0001-01D</td>
<td>WATER &amp; GAS FLOW SCHEMATIC</td>
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<tr>
<td>50-0005-94C</td>
<td>WATER FLOW DIAGRAM</td>
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COMPONENT MANUALS

EUROTHERM 2404 TEMP. CONTROLLER
EUROTHERM 3216i O'TEMP CONTROLLER
EUROTHERM EFIT, 50A SCR