



APPRECIATES YOUR BUSINESS

We thank you for purchasing a Thermcraft, Inc. heat treating furnace. Since our establishment in 1971, Thermcraft, Inc. has manufactured reliable, high quality, electric resistance and gas equipment. Our products are used in a variety of applications both domestically and around the world.

For over 40 years, Thermcraft, Inc. has manufactured furnaces and ovens to comply with predetermined custom and industrial specifications. This furnace has been completely checked for mechanical and electrical compliance prior to shipment.

We trust you have received your furnace in acceptable condition and that you will find it meets or exceeds your expectations and requirements.

Prior to installation and operation of your new Thermcraft, Inc. furnace, we strongly urge you to read this manual in its entirety and comply with all instructions herein.

If you have any questions, feel free to contact us.



Made in the U.S.A

Sincerely,

Thermcraft, Inc.
3950 Overdale Road
Winston-Salem, NC 27117-2037, U.S.A.
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THERMCRAFT, INC.

INSTRUCTION MANUAL

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1.) FURNACE SPECIFICATIONS

Furnace Type:

Model #: LBO-32-10-10-11-5005

Serial #: 1313209/B

Weight:

Maximum Temperature: 600°F

Heater Type: ICONEL COVERED AIR HEATERS

Incoming Power:

Volts 208/230

Amps 14

Watts 3000

Phase 1

Hertz 50/60

Control System:

Model #: 1-1-30-230-E60ST-J5929/7EAD

Temperature Controller Type and Model:
EUROTHERM 2404/CP/VH/LH/TC/XX/XX/XXA2/XX/ENG

Power Requirement:

Volts: 230

Amps: 30

Thermocouple Type: T

2.) INSPECTION AND DAMAGED INSTRUCTIONS

INSPECTION

Upon receipt of your new furnace, inspect for visible exterior damage. Note and describe any damage found on the freight bill and file a claim with the carrier.

Once unpacked, carefully inspect for concealed loss or damage on the unit itself, both the interior and exterior. If necessary, the carrier will arrange for official inspection to substantiate your claim.

Verify that all of the equipment shown on the packing slip is included with the unit. Carefully check all packing materials.

RETURN SHIPMENT

Save the shipping box/crate until you are sure all is well. If for any reason you must return the unit, first contact our Sales Department at 336-784-4800. Please have the unit's serial number and model number available when you call (located on the rating plate). Note: all returns MUST have a Return Authorization Number.

3.) ACCESSORIES / OPTIONS PURCHASED

<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	LOAD PORTS	QTY <u>2</u>
<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	VIEWPORT	QTY <u>1</u>
<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	CRYOGENIC GAS INJECTOR	QTY <u>2</u>
<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	EXHAUST PORT	QTY <u>1</u>
<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	DOOR INTERLOCK SAFETY	
<input type="checkbox"/> YES	<input checked="" type="checkbox"/> NO	HAND PORT	
<input type="checkbox"/> YES	<input checked="" type="checkbox"/> NO	PORTABLE OVEN DOLLY	
<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	OVER-TEMP. CONTROL SYSTEM	
<input type="checkbox"/> YES	<input checked="" type="checkbox"/> NO	TEMPERATURE RECORDER	

4.) ASSEMBLY

The furnace will arrive pre-assembled; however, some assembly may be required prior to start-up.

NOTE: These furnaces are heavy and care should be taken to use lifting devices which are sufficiently rated for these loads. Doors, handles and knobs are not adequate for lifting or stabilization. The unit should be completely restrained to prevent tipping during lifting and transport.

For larger furnaces some parts such as doors, door tracks, car bottom tracks, elevator lifts, blower motors, and conveyors may have been disassembled from the furnace to accommodate shipping. Before proceeding with installation, review all of drawings and diagrams included in this manual.

1. Refer to designs, making sure all furnace stands, control boxes, terminal boxes, doors, etc., are in place and secure. If not, locate the appropriate parts that are included in the shipment and follow the furnace design drawings in order to complete the assembly.
2. Locate the thermocouple hole and carefully pull out the alignment pin. Carefully slide thermocouple into the hole, do not force.

If any questions arise concerning assembly of the furnace, please contact Thermcraft, Inc. at 336-784-4800.

5.) CONTROL ENVIRONMENTAL CONDITIONS

Normal Operating Conditions

1. Ambient temperature: 0 – 50 °C
2. Rate of change in temperature: 10 °C/h or less
3. Ambient humidity: 20-90% RH (no condensation allowed)
4. Altitude: 2000m or less above sea level

Maximum Effects from Operating Conditions

- 1) Temperature effects
 - 1.1. Thermocouple, DC mV and DC V input: $\pm 2 \mu\text{V}/^\circ\text{C}$ or $\pm 0.02\%$ of F.S./ $^\circ\text{C}$, whichever is the larger
 - 1.2. Resistance temperature detector: $\pm 0.05^\circ\text{C}/^\circ\text{C}$
 - 1.3. Analog output: $\pm 0.05\%$ of F.S./ $^\circ\text{C}$
- 2) Effect from fluctuation of power supply voltage (within rated voltage range)
 - 2.1. Analog input: $\pm 0.2 \mu\text{V}/\text{V}$ or $\pm 0.002\%$ of F.S./V, whichever is the larger
 - 2.2. Analog output: $\pm 0.05\%$ of F.S./V

Transportation and Storage Conditions

- 1) Temperature: -25 to 70 °C
- 2) Humidity: 5 to 95% RH (no condensation allowed)

6.) INSTALLATION AND POWER CONNECTION

After the above assembly procedures have been completed, the furnace is ready for connection to incoming power as follows:

1. Open the furnace and remove the protective packing covering the heating elements.
2. Consult an electrical professional and the NEC (National Electric Code) specifications to select wire size to adequately carry the line amperage shown in section 1.) Furnace Specifications: Connect electrical service to a fused power source disconnect. Such disconnect device shall be marked as a disconnect device for the furnace.
3. For overcurrent protection device selection, please refer to amperage shown on the furnace rating plate.

NOTE: Be sure to check all external strain relief fittings for tightness. See Torque Recommendation for Strain Relief Fittings chart below:

TORQUE RECOMMENDATIONS FOR STRAIN RELIEF FITTINGS

Torque in Inch Pounds - in lb (Newton Meters - Nm)

	METAL STRAIN RELIEF FITTINGS		PLASTIC STRAIN RELIEF FITTINGS	
	DOME NUTS	THREAD AND LOCK NUTS	DOME NUTS	THREAD AND LOCK NUTS
PG 7, M12x1.5	36.9 (4.17)	55.3 (6.25)	14.4 (1.62)	22.1 (2.50)
PG 9, PG 11, M16, PG 13.5, 3/8" NPT, 1/2" NPT, M16x1.5, M20x1.5	36.9 (4.17)	55.3 (6.25)	22.1 (2.50)	33.2 (3.75)
PG 16, 1/2"NPT-E	44.2 (5.00)	66.4 (7.50)	29.5 (3.33)	44.2 (5.00)
PG 21, PG 29, PG 36, PG 42, PG 48, 3/4"NPT, 1"NPT, 1-1/4"NPT, 1-1/2"NPT, M25x1.5, M32x1.5, M40x1.5, M50x1.5, M63x1.5	59.0 (6.67)	88.5 (10.00)	44.2 (5.00)	66.4 (7.50)

Note: The values shown above are for reference only.

Note: Nylon strain relief fittings installed in a threaded connection and exposed to elevated temperature should be retained with a sealant such as Loctite® to avoid a loose connection when temperature fluctuates.

7.) OPERATIONAL SAFETY

Safe operation of your new furnace is mandatory. As manufacturer of your furnace, we at Thermcraft, Inc. have adhered to all known safety standards and strongly suggest you install your furnace in accordance with national electric and fire protection codes. Do not exceed the electrical and temperature rating printed on the furnace rating plate.

It is important to pay particular attention to those regulations that are applicable to the specific governing operations entities including, but not limited to legislated and accredited national and local industry standards and the type of facility in which the furnace will be employed, including zoning requirements, local building codes, and local electrical codes.

SYMBOLS USED ON THE EQUIPMENT



Caution: risk of electric shock.



Caution: hot surface.



Caution: refer to accompanying documents.

- The potential for electric shock is always present when electrically operated equipment is in use. The following suggestions are recommended for your protection:
1. Before beginning service / maintenance procedures on your furnace, the power source must be locked out and tagged out per Occupational Safety and Health Administration (OSHA) regulations.
 2. Insure the furnace is properly grounded and electrically protected. Grounding lugs and ground wires have been installed prior to shipment. The ground wire will terminate within the external terminal box and is visible to the installer / operator. If unsure of the grounding status of the equipment, consult the NEC (National Electric Code) or a licensed professional.
 3. If electrically conductive material is to be heat treated, the operator must be protected from becoming a conductor to the ground. To avoid electric shock observe the following operating practices:
 - a. Wear insulated gloves specific to the task that guard against electric shock if the operator will be in contact with an electric current.
 - b. When using any metallic instrument to introduce items into the furnace, insure the handle is properly insulated and the instrument is adequately grounded.
 - c. Install rubber mats in front of and behind the equipment to protect the operator.



CAUTION: If this equipment is used in a manner other than described in this manual, protection provided by the equipment may be compromised or impaired. To preclude hazard and minimize risk, follow all instructions and operate within the design limits noted on the rating plate.

Do not use components or materials not specifically designed for this equipment. Failure to comply with this precaution could result in damage to the equipment used or the furnace and may create an overheat situation. Also, do not use anything other than OEM exact replacement parts. Not using OEM replacement parts could cause faulty instrumentation readings, inoperative equipment, or a temperature overshoot.

Avoid combustible product which generate toxic or hazardous vapor or fumes. Work should be done in a properly vented environment. Observe the following precautions:

- * Never stand in front of an open hot furnace.
- * Wear protective eyewear.
- * Wear protective gloves.
- * Use tongs to insert and remove furnace load.
- * Do not allow the load to touch the furnace walls.



WARNING: Do not use combustible gases directly in this furnace. Process gasses must always be contained in a separate tube.

Modification of equipment for use other than that for which it is explicitly designed for could cause severe injury or death. Any customer after market retrofit violates the warranty.

Do not modify or disconnect any safety features provided. Disconnection of the units safety features could allow the unit to become overheated and start on fire, causing personal injury or death, product and property damage.

Periodically disconnect power from the equipment and allow it to cool completely. Once cool, inspect for loose or broken heaters and for worn wire coils on the inside of the heated chamber. Heaters may have to be replaced if damage is severe. Avoid contact with any exposed heater coils / elements. Do not touch elements with bare hands or oily gloves. Contact Thermcraft, Inc. if unsure of the safety of the heating elements in the conditions you have observed.

Only qualified electrical professionals should remove the upper and lower terminal covers of the terminal boxes. Keep all guards (guide-tabs, backstops, upper and lower terminal covers) provided with the equipment in place while the furnace is in operation. Observe all safety labels. If questions arise concerning the operation of your furnace, contact Thermcraft, Inc. at (336) 784-4800, fax at (336) 784-0634 or email at sales@thermcraftinc.com.

8.) GENERAL INFORMATION FOR TEST FRAME OVENS



CAUTION! Failure to check thermocouple wiring and connection before initial start up could result in damage to the furnace.

INSPECTION

Carefully inspect the oven upon its arrival for possible damage incurred during shipment. If damage is evident, immediately notify the carrier and file a claim.

Do not discard any shipping packages until you are sure all components are accounted for.

Most options will be attached to or are part of the oven itself. The solenoid valves are located within the rear cover. The main items not attached to the oven are the port plugs and mounting shaft collars, if purchased.

DESCRIPTION

The oven's function is to heat and/or cool samples. Please review the Oven-Test Chamber Specifications page for your oven's limitations.

HEATING

Heat is provided by tubular heating elements located at the rear of the plenum. Air is recirculated over the elements to generate heat.

COOLING

Cooling is provided by injecting liquid N₂ or CO₂ thru the rear of the oven. (See the Oven - Test Chamber Specifications page to see which specific option is being used.) The cold gas is mixed with the recirculating air.

POWER REQUIREMENTS

Refer to the Oven - Test Chamber Specifications page for details.

SENSOR

A thermocouple sensor has been provided with the oven. The final positioning is covered further in this section under Control Thermocouple Positioning. Other thermocouple types are also available and can be easily installed.

INSTALLATION

After completing any minor assembly procedures, the oven is ready for connection to your services. Install as follows:

1. Remove any packing from the interior of the oven.
2. **NOTE:** The oven has already gone through a partial bake out procedure required for the fiberglass insulation. This partial bake out is done during quality control testing and causes discoloration of the inside liner. The discoloration does not affect the oven's performance. Some smoke or moisture may be emitted by the oven during the initial burn in. Please ensure that ventilation is provided to prevent excessive build-up in the test area.

MOUNTING

All ovens are supplied with slide mounting brackets. **Before moving the oven, make sure the locking pins are engaged to prevent the slides from moving.**

The oven should only be moved via an overhead crane or fork truck using the supplied eyebolts on the top of the oven. Position the oven between the slide mounting brackets and align the front two holes in the slide assembly over the tapped holes in the test frame.

CAUTION: Do not block the perforated areas on the rear cover. Cooling is required for the electronics and the blower motor.

ELECTRICAL WIRING CONNECTIONS

The control system has been connected to the chamber before shipment. A conduit feed through has been provided on the lower feed through panel to allow the wiring to remain in place when removing the rear cover. The feed through panel can be removed if necessary. Any conduit provided shall be permanently secured / mounted during installation. Please make sure that any additional wiring meets all local electrical codes.

NOTE: The control system is supplied with a power cord and plug. Refer to the Oven-Test Chamber Specifications page for a description of the cord and plug. Ovens shipping to Europe will also include a matching IEC receptacle.

NOTE: The oven door has a safety interlock switch. The door must be closed for the oven to operate. This feature was designed to protect the operator from hot or cold air blowing directly on them while accessing the oven.

THERMOCOUPLE

The thermocouple measures the voltage that is generated as the temperature increases. A current will flow providing an input signal for the control system to monitor and provide operational control.

The tip of the thermocouple must be in the heated chamber and not covered or shielded to the point where it cannot sense the actual temperature.

If the temperature controller displays the message "S.br" (sensor break), the thermocouple circuit is faulty. A loose connection, broken wire or burned out thermocouple could be the cause.

When replacing thermocouples, remember to use the same type thermocouple. Extension wires and connectors must also be compatible with the thermocouple and controller. Be sure to observe correct polarity of thermocouple extension wire. Red leg is always negative for thermocouples.

NOTE: The thermocouple has not been calibrated unless specifically ordered as such. Upon request, calibration will be performed on the thermocouple and a calibration report will be enclosed in the appendix.

NOTE: Be sure to check all external strain relief fittings for tightness. See Torque Recommendation for Strain Relief Fittings chart on the next page.

OPERATION

Once the control system has been wired to the block, the conduit permanently secured and the rear cover installed, apply power to the control system to test the oven's components. Then run the oven up to 200F to verify proper operation.

CAUTION: Do not run up to maximum operating temperature until the control thermocouple has been positioned properly. Its current location may allow the oven to exceed operating range and cause damage to the elements, the load train and/or your specimen.

OPERATING CONTROLS

1. The main circuit breaker is located at the rear of the control cabinet. When the circuit breaker is in the off position, all power is removed from the oven. The control cabinet should not be positioned such that it is difficult to operate the disconnecting device.
2. The control power switch is located on the front of the control cabinet. This switch must be in the on position for the oven to operate.
3. The light switch is located on the front of the control cabinet and is used to control the interior light.
4. The reset switch is located on the front of the control cabinet. It is used to reset the high limit controller should the chamber temperature exceed the limit setting.
5. The high limit controller is located on the front of the control cabinet and is used to protect the chamber from excess temperature. The high limit backs up the main temperature controller. If the set point is exceeded, an alarm message will be flashed on the display. After the temperature has returned to normal, push the reset switch.

CONTROL THERMOCOUPLE POSITIONING

The final position of the control thermocouple is determined by your requirements. This may be determined by a trial and error process. It is recommended to have an additional thermocouple and recorder for the test. A flexible thermocouple has been provided for the control sensor.

1. Position the monitoring thermocouple on the specimen or in the air near the specimen. Thermocouple response time is dependent on the location and load.
2. Position the control thermocouple in the air exhaust, mark this location A. This will provide the slowest response in the system and the specimen may never see the control temperature. This initial test will ensure that the exhaust temperature will never be above the maximum for the oven.
3. If the specimen does not reach operating temperature, save the information. Now reposition the control thermocouple between the exhaust and inlet, mark this one B.
4. Conduct the test again and compare the results with the first run. If the specimen reached temperature and the tuning for the controller is satisfactory, you may either stop or reposition the thermocouple at another location of your choice to see if any further improvement can be made.

You may have to repeat the test several times before the results meet your specifications. It is difficult to position the control thermocouple at the factory due to the limited information on the exact load being used.

AIR FLOW PATTERN

An Oven Air Flow Pattern drawing for this oven is included in this manual. The exhaust is top and bottom with the inlet in the middle. The main plenum protects the working chamber from direct radiation from the heating elements. The secondary plenum adds turbulence and prevents the air from directly recirculating. The secondary plenum also protects the operator from coming in direct contact with the blower wheel.

Air uniformity will be affected by large specimens and/or load trains. The amount of air reaching the front of the oven will be reduced by larger specimens. **CAUTION:** Do not block the air flow inlet or exhaust. This will restrict air flow and affect the uniformity of the oven and may damage the elements.

COOLING OPTION

1. CO₂ systems have a single injector assembly. An extra injector assembly will be present at the bottom if conversion to LN₂ medium is required. The solenoid valve provided will be set up for either 300 or 1000 psi service per your order. A 1/4" NPT fitting is provided for your connection. This can be found on the rear feed through panel.
2. LN₂ systems have dual injectors plumbed from one solenoid valve. The dual injectors allow the lower pressured LN₂ to be distributed evenly. Normal supply pressure from a 160 liter liquid exceller tank is approximately 25 psi.

VENTILATION

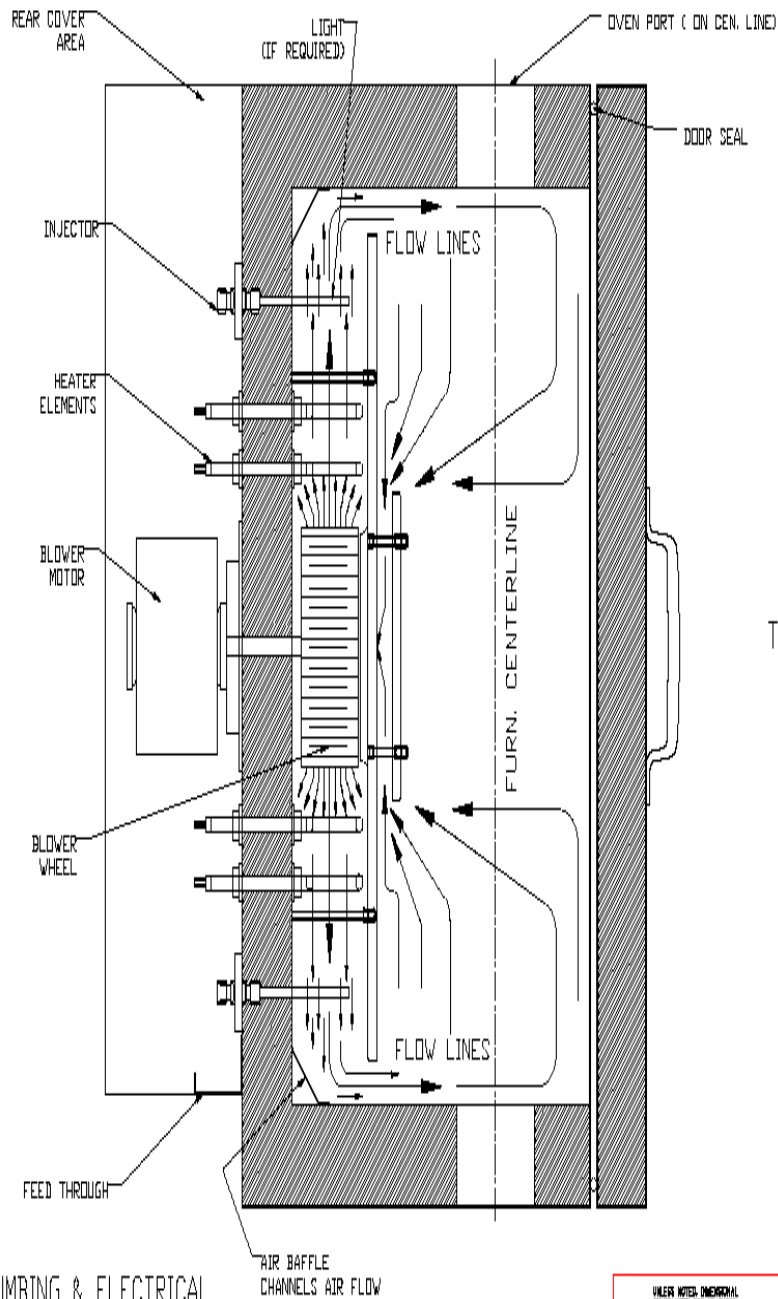
It is **IMPORTANT** to have adequate ventilation when using CO₂ or LN₂. A vent hood may be necessary.

SHUT DOWN PROCEDURES FOR FURNACES WITH COOL DOWN BLOWERS:




CAUTION! Do not shut the blower off until the furnace has cooled down. Change to the controller set point down to 100° F. Allow the oven to cool down to 100° F then switch the power button to the off position.

For conducting service work, follow your companies log out/ tag out procedure.



NOTE: AIR FLOW FOR
CONVENTIONAL OVEN IN
TYPICAL MOUNTING POSITION

ALL PLUMBING & ELECTRICAL
ENTER @ FEED THROUGH

LEGAL AGREEMENT OF DRAWING		APPROVAL	DATE	PROJECT TYPE	INCH METAL PARTS	METAL PARTS	CERAMIC FIBER PRODUCTS	CERAMIC FIBER PRODUCT	CAST CERAMIC PRODUCT	LET	REVISION	DTM#	DATE				
DESIGN AND/OR INFORMATION SHOWN ON THIS DRAWING ARE PROPRIETARY. THE RECIPIENT AGREES NOT TO DISCLOSE OR REPRODUCE THIS INFORMATION IN PART OR IN WHOLE WITHOUT EXPRESS WRITTEN CONSENT OF THERMOCRAFT INC.				DRN	RJC	10/10/13	XXX	1/2-20	1/2-20	1/2-20							
				CHK			DECIMLES	1/2-20	1/2-20	1/2-20	1/2-20						
				APPD			XXX	1/2-20	1/2-20	1/2-20	1/2-20						
				APPD			XXX	1/2-20	1/2-20	1/2-20	1/2-20						
				CORPORATION/COMPANY		UNLESS NOTED OTHERWISE, TOLERANCES ARE AS SHOWN											
				REMOVE ALL SURFS UNLESS ALL DIMENSIONS													
										 Thermcraft incorporated P.O. Box 12637 2820 Quailside Road Winston-Salem, N.C. 27107							
										OVEN AIR FLOW PATTERN							
										AIR		PLOT SCALE NTS		DRAWING NO. A-7540		REV. SHEET OF - 1-1	

9.) PREVENTIVE MAINTENANCE



CAUTION: Maintenance should only be performed by trained personnel.

WARNING: Prior to performing maintenance to the furnace or the controls, the main power must be disconnected. Prior to maintaining this equipment, read the applicable MSDS at the back of the manual.

General Furnace Maintenance

1. Inspect and verify all electrical connections for tightness. Due to thermal expansion during the heat- up/cool-down cycles electrical connection may become loosened.
2. Inspect the heating elements. Do not allow build up of foreign material on the element. Oil should be cleaned off of any part of the furnace prior to heating. Use caution not to displace the heating elements as the wire may be brittle and break easily.
3. If furnace has a door, verify that the door safety switch is operating and cutting the power to the heaters once the door is opened.
4. If your furnace is equipped with a blower motor, or has moving parts, lubricate grease fittings as required.
5. Check all hardware fasteners to ensure that they are tight.
6. Inspect the tip of the thermocouple for excessive heat deterioration.

General Control Cabinet Maintenance

1. Verify that all electrical connections are tight.
2. If applicable, clean the cabinet cooling fan filter.
3. Check all cabinet to furnace interconnection wiring.
4. If applicable, check to ensure that all signal lamps light.
5. If applicable, check to ensure that all alarms sound.

REPLACEMENT PARTS

It is recommended that you obtain replacement parts from Thermcraft Inc. to insure that system safeguards are not compromised. Variations in component specifications could cause the equipment to be unsafe.

BLOWER MOTOR

Most motors used with the oven will require some oiling every six (6) months.

ELEMENTS HEATING

The elements should last more than three (3) years unless overheated due to restricted air flow or a malfunction of the control system. No other maintenance is required.

FUSE REPLACEMENT

Replace fuses with the same size and type as supplied.

1FU - Bussmann FNQ-R-3Y> (3.5 A, 600 V Dual element time delay fuse)

2FU, 3FU - Bussmann FNQ-R-1 (1 A, 600 V Dual element time delay fuse)

4FU - Bussmann FNM-1 Y. (1.25 A, 250 V Dual element time delay fuse)

PORT PLUG MACHINING OPTION

Port plugs can be purchased with or without a bore. If purchased without a bore, the following steps may help you with machining them to fit your needs:

1. Most plugs will be sent split in half with a 1/4" center hole. This will allow you to band the half sections together with a hose clamp and use the 1/4" hole as the center. Make sure you use a wood backing to drill into as this will prevent breakage of the plug. For smaller holes, use a regular drill bit. It may dull faster if you are drilling multiple holes. For large holes, purchase a hole saw with the correct size for your requirements.
2. With the correct size hole saw, place the port plug in a drill press or drill. Drill into the plug keeping a vacuum sweeper handy to collect the dust and pieces. A normal hole saw does not have the depth required for a 2" thick piece. It may require you to flip the piece over and continue drilling. Discard center pieces and check for fit.

INTERNAL OVEN CHAMBER LIGHT (OPTIONAL)

The current light cannot be operated above 600 Deg. F (315 Deg. C). If you are planning to conduct testing above 600 Deg. F, you must remove the light bulb and replace it with the insulation plug provided. If your oven was not rated for operation above 600 Deg. F, then no insulation plug was provided. Operation above 600 Deg. F with the light bulb in place will cause early failure of the bulb and perhaps cause the bulb to explode.

SLIDE ASSEMBLY MOUNTING BRACKETS OPTION

This option allows the oven to slide backwards out of the test frame. This exposes the oven's working area for ambient testing when needed. The locking pins on the side hold the oven in the forward position.

10.) THERMOCOUPLE

A thermocouple is used to measure the voltage that is generated as the temperature increases. It provides an input signal for the control system that monitors the temperature of the heated chamber.

At high temperatures, the elements within the thermocouple may undergo some oxidation or corrosion causing the signals to be read incorrectly by the control system.

To monitor temperature, if possible, the tip of the thermocouple must be inside the heated chamber at least 1/8 deep. Also, the thermocouple tip must not be blocked or shielded by items being heat treated.

If the control system indicates that a thermocouple is no longer functioning, it is important to replace the malfunctioning thermocouple with the same type model thermocouple that was originally provided with the furnace. Replacement extension wires and connectors must also be compatible with the thermocouple and the controller. If your system has a Eurotherm controller a failed thermocouple will be indicated by SBR on the display and for a Yokogawa controller it will indicate B.OUT. Refer to the replacement parts list to determine the type of thermocouple required.

For optimal performance the thermocouple should be replaced once a year. In some cases a more frequent replacement schedule may be required.

NOTE: Polarity of the thermocouple extension wires is the OPPOSITE of the polarity of typical electrical wiring. The red leg is always negative for thermocouples while the black leg is always positive.

11.) CERAMIC FIBER INSULATION SAFETY

Dear Valued Customer:

Please keep in mind that your Thermcraft, Inc. furnace is completely safe when used for its intended purpose and with the precautions listed herein. The following information is to make you aware of the potential health effects of the ceramic and insulation components incorporated into your furnace.

Thermcraft, Inc. manufactures a broad range of high temperature furnace systems. These systems incorporate various ceramic materials. Airborne particulates produced in the handling of these materials should be considered nuisance dust. Always wear a dust mask and safety glasses to avoid such irritation due to inhalation of, or eye contact with, this or any other ceramic dust.

Chronic Effect – there has been no increased incidence of respiratory disease in the Refractory Ceramic Fiber Coalition's studies examining occupationally exposed workers. In their animal testing, long-term laboratory exposure to doses hundreds of times higher than normal occupational exposures has produced fibrosis, lung cancer, and mesothelioma in rats or hamsters. The fibers used in those studies were specially sized to maximize rodent reparability. Please go to the Refractory Ceramic Fiber Coalition's website at www.rcfc.net for up-to-date information.

The recommended handling procedures for these ceramic materials are outlined on the next page (Section 9) as well as in the Fibercraft Material Safety Data Sheets (MSDS) at the end of this manual. Please make sure this information is available to all personnel who may be operating, handling or repairing this furnace.

As always, if you have any questions or concerns, please feel free to contact Thermcraft, Inc. at (336) 784-4800, fax at (336) 784-0634 or email at sales@thermcraftinc.com.

Recommended Safe Handling Procedures for Ceramic Fiber Products

1. Minimize presence of airborne fiber at all times by avoiding applications of pressurized air from air canisters or pneumatic systems to any fibers that have already been heated.
2. Wear an appropriate NIOSH – or MSHA-approved high efficiency air purifying respirator mask when handling any ceramic fiber products.
3. Wear long-sleeved, loose-fitting clothing when handling ceramic fiber products. Use protective coveralls over clothing. Do not wear contact lenses and always wear safety glasses. Do not allow employees to take soiled clothing, or any clothing in which fibers have become embedded from the facility where the furnace is employed to his/her dwelling. Have employees store, maintain and wash work clothing on site separately from other clothing. Rinse washing machine thoroughly after washing clothing worn when handling ceramic fibers.
4. Wear eye protection (safety glasses or goggles) and protective gloves at all times.
5. Wash exposed skin areas gently with soap and **cold** water immediately after handling ceramic fiber product.
6. Particular care should be taken when working with “used” material which has been in service at elevated temperatures (greater than 1600° F). Such products may undergo partial conversion to Cristobalite, a form of crystalline silica that can cause respiratory disease.

12.) ENABLING THE COOLING FUNCTION

Thermcraft, Inc. does not enable the cooling function of your oven prior to shipment.

Following are instructions to do so.

To enable output 2A, access the configuration mode.

Put in code, if any. Default is 2.

Using the page down button, select parameter 2A.

Make the following selections:

10 :SSR

Func: Cool

Val-l: 0

Val-h: 100

Out-l: 0

Out-h: 100

Return to the main menu

Using the page button, select Access

Select Full

Using Page Button, select OP

Set Output low = -100

Set Output high = +100

SPL(-328)

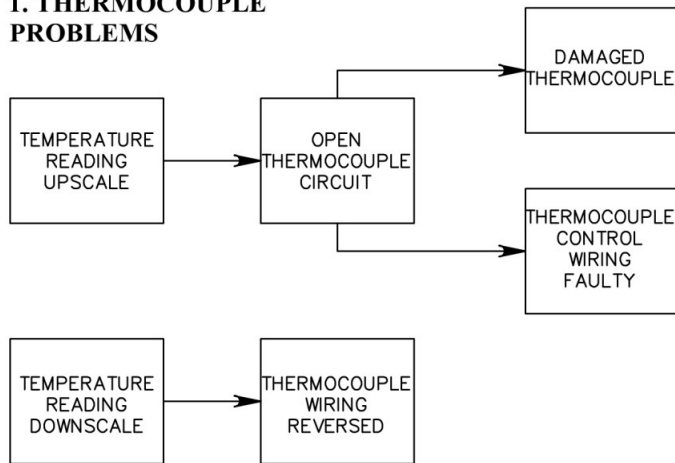
13.) REPLACEMENT PARTS LIST

Description	Item #	Quantity Included
THERMOCOUPLE	A-7502	1
HEATER ELEMENT	A-7506	4
FAN MOTOR	F1	1
CONTROL TRANS PRIMARY	F2 – 3	2
CONTROL TRANS SECONDARY	F4	1

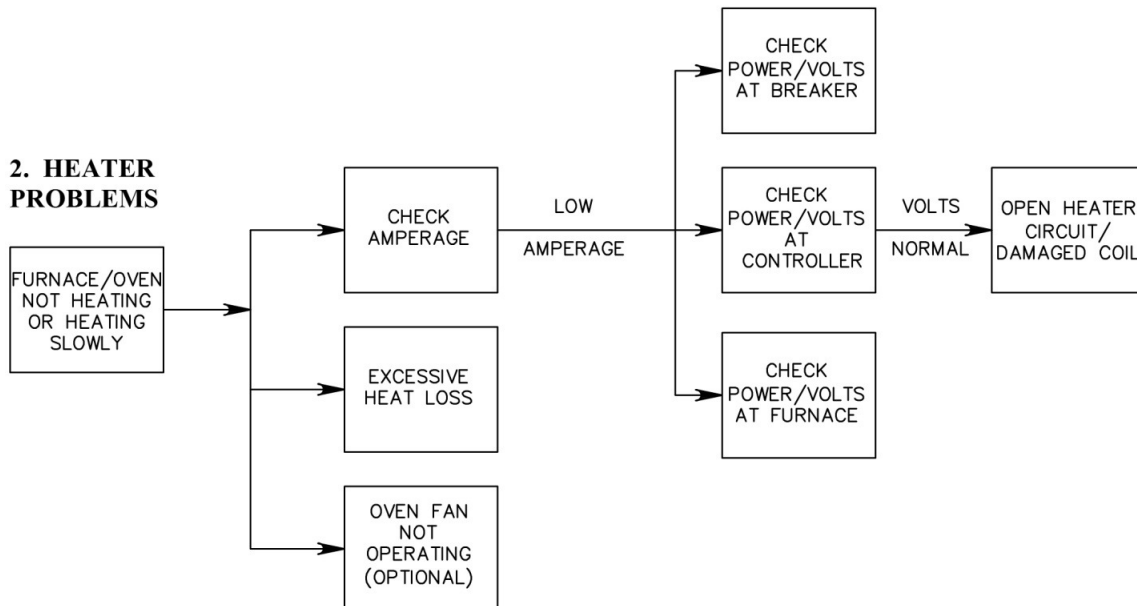
14.) FURNACE TROUBLE SHOOTING

TROUBLE SHOOTING FOR FURNACE / OVEN PROBLEMS

1. THERMOCOUPLE PROBLEMS



2. HEATER PROBLEMS



15) MSDS

MATERIAL SAFETY DATA SHEET

MSDS No. 1

Effective Date: 03/19/2013

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Names: *Fibercraft*

Product Group: REFRACTORY CERAMIC FIBER PRODUCT
Chemical Name: VITROUS ALUMINOSILICATE FIBER
Synonym(s): RCF, ceramic fiber, synthetic vitreous fiber (SVF), man-made vitreous fiber (MMVF), man-made mineral fiber (MMMMF)
Manufacturer/Supplier: Thermcraft, Inc.
3950 Overdale road
Winston-Salem, N.C. 27107
336-784-4800

Product Stewardship Information Hotline
1-800-322-2293 (Monday - Friday 8:00 a.m. - 4:30 p.m. EST)

CHEMTREC Assist: CHEMTREC will provide assistance for chemical emergencies.
Call 1-800-424-9300

2. COMPOSITION / INFORMATION ON INGREDIENTS

<u>COMPONENTS</u>	<u>CAS NUMBER</u>	<u>% BY WEIGHT</u>
Refractories, Fibers, Aluminosilicate	142844-00-6	100

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING!
POSSIBLE CANCER HAZARD BY INHALATION.
(See Section 11 for more information)

CHRONIC EFFECT

There has been no increased incidence of respiratory disease in studies examining occupationally exposed workers. In animal studies, long-term laboratory exposure to doses hundreds of times higher than normal occupational exposures has produced fibrosis, lung cancer, and mesothelioma in rats or hamsters. The fibers used in those studies were specially sized to maximize rodent respirability.

OTHER POTENTIAL EFFECTS

TARGET ORGANS:

Respiratory Tract (nose & throat), Eyes, Skin

RESPIRATORY TRACT (nose & throat) IRRITATION:

If inhaled in sufficient quantity, may cause temporary, mild mechanical irritation to respiratory tract. Symptoms may include scratchiness of the nose or throat, cough or chest discomfort.

EYE IRRITATION:

May cause temporary, mild mechanical irritation. Fibers may be abrasive; prolonged contact may cause damage to the outer surface of the eye.

SKIN IRRITATION:

May cause temporary, mild mechanical irritation. Exposure may also result in inflammation, rash or itching.

GASTROINTESTINAL IRRITATION:

Unlikely route of exposure.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

Pre-existing medical conditions, including dermatitis, asthma or chronic lung disease may be aggravated by exposure; individuals who have a history of allergies may experience greater amounts of skin and respiratory irritation.

HAZARD CLASSIFICATION

Although studies, involving occupationally exposed workers, have not identified any increased incidence of respiratory disease, results from animal testing have been used as the basis for hazard classification. In each of the following cases, the conclusions are qualitative only and do not rest upon any quantitative analysis suggesting that the hazard actually may occur at current occupational exposure levels.

In October 2001, the **International Agency for Research on Cancer (IARC)** confirmed that Group 2b (possible human carcinogen) remains the appropriate IARC classification for RCF.

The Seventh Annual Report on Carcinogens (1994), prepared by the **National Toxicology Program (NTP)**, classified respirable RCF as "reasonably anticipated" to be a carcinogen.

The **American Conference of Governmental Industrial Hygienists (ACGIH)** has classified RCF as "A2-Suspected Human Carcinogen."

The **Commission of The European Communities (DG XI)** has classified RCF as a substance that should be regarded as if it is carcinogenic to man.

The **State of California**, pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, has listed "ceramic fibers (airborne fibers of respirable size)" as a chemical known to the State of California to cause cancer.

The **Canadian Environmental Protection Agency (CEPA)** has classified RCF as "probably carcinogenic" (Group 2).

The **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects

The **Hazardous Materials Identification System (HMIS)** –
Health 1* Flammability 0 Reactivity 0 Personal Protection Index: X (Employer Determined)
(* denotes potential for chronic effects)

4. FIRST AID MEASURES

FIRST AID PROCEDURES

RESPIRATORY TRACT (nose & throat) IRRITATION:

If respiratory tract irritation develops, move the person to a dust free location. Get medical attention if the irritation continues. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION:

If eyes become irritated, flush immediately with large amounts of lukewarm water for at least 15 minutes.

Eyelids should be held away from the eyeball to ensure thorough rinsing. Do not rub eyes. Get medical attention if irritation persists.

SKIN IRRITATION:

If skin becomes irritated, remove soiled clothing. Do not rub or scratch exposed skin. Wash area of contact thoroughly with soap and water. Using a skin cream or lotion after washing may be helpful.

GASTROINTESTINAL IRRITATION:

If gastrointestinal tract irritation develops, move the person to a dust free environment.

NOTES TO PHYSICIANS:

Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

NFPA Codes: Flammability: 0 Health: 1 Reactivity: 0 Special: 0

NFPA Unusual Hazards: None

Flammable Properties: None

Flash Point: None

Hazardous Decomposition Products: None

Unusual Fire and Explosion Hazard: None

Extinguishing Media: Use extinguishing media suitable for type of surrounding fire.

6. ACCIDENTAL RELEASE MEASURES**SPILL PROCEDURES**

Minimize creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum must be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE**STORAGE**

Store in original container in a dry area. Keep container closed when not in use.

HANDLING

Handle ceramic fiber carefully. Limit use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION**EXPOSURE GUIDELINES****COMPONENTS**

Refractories, Fibers,
Aluminosilicate

OSHA PEL

None Established*

MANUFACTURER REG

0.5 f/cc, 8-hr. TWA**

* There is no specific regulatory standard for RCF in the U.S. OSHA's "Particulate Not Otherwise Regulated (PNOR)" standard [29 CFR 1910.1000, Subpart Z, Air Contaminants] applies generally; Total Dust 15 mg/m³; Respirable Fraction 5 mg/m³.

** The Refractory Ceramic Fibers Coalition (RCFC) has sponsored comprehensive toxicology and epidemiology studies to identify potential RCF-related health effects [see Section 11 for more details], consulted experts familiar with fiber and particle science, conducted a thorough review of the RCF-related scientific literature, and further evaluated the data in a state-of-the-art quantitative risk assessment. Based on these efforts and in the absence of an OSHA PEL, RCFC has adopted a recommended exposure guideline, as measured under NIOSH Method 7400 B. The manufacturers' REG is intended to promote occupational health and safety through prudent exposure control and reduction and it reflects relative technical and economic feasibility as determined by extensive industrial hygiene monitoring efforts undertaken pursuant to an agreement with the U.S. Occupational Safety and Health Administration (OSHA).

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

RCF-related occupational exposure limits vary internationally. Regulatory OEL examples include: Canada –0.2 to 1.0 f/cc; Non-regulatory OEL examples include: ACGIH TLV 0.2 f/cc; RCFC REG 0.5 f/cc. The objectives and criteria underlying each of these OEL decisions also vary. The evaluation of occupational exposure limits and determining their relative applicability to the workplace is best performed, on a case-by case basis, by a qualified Industrial Hygienist.

ENVIRONMENTAL CONTROLS

Use environmental controls such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment designed to minimize airborne fiber emissions.

PERSONAL PROTECTION EQUIPMENT

Respiratory Protection – RCF:

When engineering and/or administrative controls are insufficient to maintain workplace concentrations within the 0.5 f/cc REG, the use of appropriate respiratory protection, pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103, is recommended. The following information is provided as an example of appropriate respiratory protection for aluminosilicate fibers. The evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified Industrial Hygienist.

MANUFACTURER’S RESPIRATORY PROTECTION RECOMMENDATIONS WHEN HANDLING RCF PRODUCTS

Respirable Airborne Fiber Concentration (levels are 8-hr. time-weighted averages)	Respirator Recommendation†
Not yet determined but expected to be below 5.0 f/cc based on operation	A respirator with a filter efficiency of at least 95%
"Reliably" less than 0.5 f/cc	Optional
0.5 f/cc to 5.0 f/cc	A single use respirator or half-face, air purifying respirator with a filter efficiency of at least 95%
5.0 f/cc to 25 f/cc	Full-face piece, air purifying respirator equipped with a NIOSH certified particulate filter cartridge with a filter efficiency of at least 95% or PAPR
Greater than 25 f/cc	PAPR with tight-fitting full face piece or a supplied air respirator in continuous flow mode
When individual workers request respiratory use Protection as a matter of personal comfort least or choice where exposures are “reliably” below .0.5 f/cc	A NIOSH certified respirator, such as a single particulate respirator with a filter efficiency of a 95%

†The 95% filter efficiency recommendation is based on NIOSH respirator selection logic sequence for exposure to particulates. Selection of filter efficiency (i.e. 95%, 99% or 99.9 7%) depends on how much filter leakage can be accepted. Higher filter efficiency means lower filter leakage. Other factors to consider are the NIOSH filter series N, R or P. (N) **Not** resistant to oil, (R) **Resistant** to oil and (P) oil **Proof**. These recommendations are not designed to limit informed choices, provided that respiratory protection decisions comply with 29 CFR 1910.134.

Other Information

-Concentrations based upon an eight hour time weighted average (TWA) as determined by air samples collected and analyzed pursuant to NIOSH method 7400 (B) for airborne fibers.
-The manufacturer recommends the use of a full face piece air purifying respirator equipped with an appropriate particulate filter cartridge during furnace tear out events and the removal of used RCF to control exposures to airborne fiber and the potential presence of crystalline silica. If exposure levels are known, the respiratory protection charge provided above may be applied. - Potential exposure to other airborne contaminants should be evaluated by a qualified industrial hygienist for the selection of appropriate respiratory protection and air monitoring.

Skin Protection:

Wear gloves, head coverings and full body clothing as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed clothing home. If soiled work clothing must be taken home, employers should ensure employees are thoroughly trained on the best practices to minimize non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other household clothes, etc.).

Eye Protection:

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	White, odorless, fibrous material
CHEMICAL FAMILY:	Vitreous Aluminosilicate Fibers
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Not Soluble in Water
MELTING POINT:	1760° C (3200° F)
SPECIFIC GRAVITY:	2.50 – 2.75
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY:	Stable under conditions of normal use.
INCOMPATIBILITY:	Soluble in hydrofluoric acid, phosphoric acid, and concentrated alkali.
CONDITIONS TO AVOID:	None.
HAZARDOUS DECOMPOSITION PRODUCTS:	None.
HAZARDOUS POLYMERIZATION:	Not Applicable.

11. TOXICOLOGICAL INFORMATION

HEALTH DATA SUMMARY

Epidemiological studies of RCF production workers have indicated no increased incidence of respiratory disease nor other significant health effects. In animal studies, long-term, high-dose inhalation exposure resulted in the development of respiratory disease in rats and hamsters.

EPIDEMIOLOGY

In order to determine possible human health effects following RCF exposure, the University of Cincinnati in the United States and the Institute of Occupational Medicine (IOM) in Europe have conducted medical surveillance studies on RCF workers in U.S. and European manufacturing facilities. The University of Cincinnati study has been in progress for over 20-years, collecting data from respiratory questionnaires, lung function tests, chest X-rays, exposure monitoring, and worker mortality.

The results of this study of RCF plant workers exposed from 1953 to the present have shown (LeMasters *et al.*, 2003): No excess mortality related to all deaths, all cancers, or lung cancer. No statistically significant increase in interstitial findings (fibrosis), and No mesotheliomas or increase in lung cancer. The initial cross-sectional spirometry studies in the U.S. (LeMasters *et al.*, 1998) and Europe (Cowie *et al.*, 2001) revealed lung function decrements in the RCF-exposed cohort that were associated with heavier historical exposures. Subsequently, longitudinal studies have revealed no RCF exposure related decrements in lung function associated with current exposure levels.

Through 1996, pleural plaques seen on chest X-rays in 2.7% of the workers. Pleural plaques are considered a marker of exposure and not disease. The prevalence of pleural plaques has remained relatively constant over time, perhaps as a result of lower current exposure levels. Thus, this long term epidemiology study has demonstrated an absence of interstitial fibrosis, no increased mortality risk and no decrement in lung function associated with current exposures.

TOXICOLOGY

Early animal studies of RCF effects by intraperitoneal and intrapleural injections, as well as by inhalation, resulted in mostly negative results. In an effort to eliminate any questions posed by the results of these early studies, a definitive *Maximum Tolerated Dose Study* (MTD) by nose only, lifetime inhalation in rats and hamsters, was designed in the 1980s. The MTD study appeared to confirm that RCF was an animal carcinogen under certain test conditions, e.g., extremely high concentrations of approximately 200 f/cc inhaled directly into the lungs.

A later review of the MTD pathology indicated that the animals' lungs were likely "overloaded" because of large quantities of non-fibrous particles, and that this overload condition was likely responsible for the disease observed. In fact, evaluation of the aerosol samples used confirmed the presence of significant quantities of particulate matter.

In a subsequent multi-dose animal inhalation study at 25 f/cc, 75 f/cc, and 115 f/cc; a *no observed effect level* (NOEL) was found at 25 f/cc. This level is 50 times the RCFC recommended REG of 0.5 f/cc for humans.

12. ECOLOGICAL INFORMATION

No ecological concerns have been identified.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT

To prevent waste materials from becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended.

DISPOSAL

RCF, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

Hazard Class: Not Regulated United Nations (UN) Number: Not Applicable

Labels: Not Applicable North America (NA) Number: Not Applicable

Placards: Not Applicable Bill of Lading: Product Name

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated

Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS

EPA: **Superfund Amendments and Reauthorization Act (SARA)** Title III – This product does not contain any substances reportable under Sections 302, 304, 313, (40 CFR 372). Sections 311 and 312 (40 CFR 370) apply (delayed hazard). **Toxic Substances Control Act (TSCA)** - RCF has been assigned a CAS number; however, it is an "article" under TSCA and therefore exempt from listing on the TSCA inventory.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the **Clean Air Act (CAA)** - RCF contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.

OSHA: Comply with **Hazard Communication Standards** 29 CFR 1910.1200 and 29 CFR 1926.59 and the **Respiratory Protection Standards** 29 CFR 1910.134 and 29 CFR 1926.103.

Ceramic fibers (airborne particles of respirable size)" is listed in **Proposition 65, The California: Safe Drinking Water and Toxic Enforcement Act of 1986** as a chemical known to the State of California to cause cancer.

Other States: RCF products are not known to be regulated by states other than California however, state and local OSHA and EPA regulations may apply to these products. If in doubt, contact your local regulatory agency.

INTERNATIONAL REGULATIONS

Canada: **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects **Canadian Environmental Protection Act (CEPA)** - All substances in this product are listed, as required, on the Domestic Substance List (DSL)

European **European Directive 97/69/EC** classified RCF as a Category 2 carcinogen; that is it "should be regarded as if it is carcinogenic to man."

16. OTHER INFORMATION

RCF DEVITRIFICATION

As produced, all RCF fibers are vitreous (glassy) materials which do not contain crystalline silica. Continued exposure to elevated temperatures may cause these fibers to devitrify (become crystalline). The first crystalline formation (mullite) begins to occur at approximately 985° C (1805° F). Crystalline phase silica may begin to form at temperatures of approximately 1200° C (2192° F). When the glass RCF fibers devitrify, they form a mixed mineral crystalline silica containing dust. The crystalline silica is trapped in grain boundaries within a matrix predominately consisting of mullite. The occurrence and extent of crystalline phase formation is dependent on the duration and temperature of exposure, fiber chemistry and/or the presence of fluxing agents. The presence of crystalline phases can be confirmed only through laboratory analysis of the "hot face" fiber.

IARC's evaluation of crystalline silica states "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)" and additionally notes "carcinogenicity in humans was not detected in all industrial circumstances studied." IARC also studied mixed mineral crystalline silica containing dusts such as coal dusts (containing 5 – 15 % crystalline silica) and diatomaceous earth without seeing any evidence of disease. (IARC Monograph Vol. 68, 1997). NTP lists all polymorphs of crystalline silica amongst substances which may "reasonably be anticipated to be carcinogens".

IARC and NTP did not evaluate after-service RCF, which may contain various crystalline phases. However, an analysis of after-service RCF samples obtained pursuant to an exposure monitoring agreement with the USEPA, found that in the furnace conditions sampled, most did not contain detectable levels of crystalline silica. Other relevant RCF studies found that (1) simulated after-service RCF showed little, or no, activity where exposure was by inhalation or by intraperitoneal injection; and (2) after-service RCF was not cytotoxic to macrophage-like cells at concentrations up to 320 g/cm² - by comparison, pure quartz or cristobalite were significantly active at much lower levels (circa 20 g/cm²).

RCF AFTER-SERVICE REMOVAL

Respiratory protection should be provided in compliance with OSHA standards. During removal operations, a full face respirator is recommended to reduce inhalation exposure along with eye and respiratory tract irritation. A specific evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified industrial hygiene professional.

PRODUCT STEWARDSHIP PROGRAM

The Refractory Ceramic Fibers Coalition (RCFC) and the U.S. Occupational Safety and Health Administration (OSHA) introduced a voluntary worker protection program entitled PSP HTW (High Temperature Wools), a comprehensive, multi-faceted risk management program designed to control and reduce workplace exposures to refractory ceramic fiber (RCF). For more information regarding PSP HTW, please refer to the RCFC web site: <http://www.rcfc.net>.

MSDS Prepared By: RISK MANAGEMENT DEPARTMENT

DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Material Safety Data Sheet. Employers may use this MSDS to supplement other information gathered by them in their efforts to assure the health and safety of their employees and the proper use of the product. This summary of the relevant data reflects professional judgment; employers should note that information perceived to be less relevant has not been included in this MSDS. Therefore, given the summary nature of this document, Thermcraft, Inc. does not extend any warranty (expressed or implied), assume any responsibility, or make any representation regarding the completeness of this information or its suitability for the purposes envisioned by the user.

DEFINITIONS

ACGIH: American Conference of Governmental Industrial Hygienists
ADR: Carriage of Dangerous Goods by Road (International Regulation)
CAA: Clean Air Act
CAS: Chemical Abstracts Service
CERCLA: Comprehensive Environmental Response, Compensation and Liability Act
DSL: Domestic Substances List
EPA: Environmental Protection Agency
EU: European Union
f/cc: Fibers per cubic centimeter
HEPA: High Efficiency Particulate Air
HMIS: Hazardous Materials Identification System
HTW: High Temperature Woods
IARC: International Agency for Research on Cancer
IATA: International Air Transport Association
IMDG: International Maritime Dangerous Goods Code
mg/m³: Milligrams per cubic meter of air
mmpcf: Million particles per cubic meter
NFPA: National Fire Protection Association
NIOSH: National Institute for Occupational Safety and Health
OSHA: Occupational Safety and Health Administration
29 CFR 1910.134 & 1926.103: OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59: OSHA Hazard Communication Standards
PEL: Permissible Exposure Limit (OSHA)
PIN: Product Identification Number
PNOC: Particulates Not Otherwise Classified
PNOR: Particulates Not Otherwise Regulated
PSP: Product Stewardship Program
RCFC: Refractory Ceramic Fibers Coalition
RCRA: Resource Conservation and Recovery Act
REG: Recommended Exposure Guideline (RCFC)
REL: Recommended Exposure Limit (NIOSH)
RID: Carriage of Dangerous Goods by Rail (International Regulations)
SARA: Superfund Amendments and Reauthorization Act
SARA Title III: Emergency Planning and Community Right to Know Act
SARA Section 302: Extremely Hazardous Substances
SARA Section 304: Emergency Release
SARA Section 311: MSDS/List of Chemicals and Hazardous Inventory
SARA Section 312: Emergency and Hazardous Inventory
SARA Section 313: Toxic Chemicals and Release Reporting
STEL: Short Term Exposure Limit
SVF: Synthetic Vitreous Fiber
TDG: Transportation of Dangerous Goods
TLV: Threshold Limit Value (ACGIH)
TSCA: Toxic Substances Control Act
TWA: Time Weighted Average
WHMIS: Workplace Hazardous Materials Information System (Canada)

18.) CONTROL SYSTEM OPERATION

The temperature control system controls the amount of power to the resistive heating elements in order to achieve and maintain the desired temperature as measured through the control thermocouple.

The temperature control system consists of the following:

1. Setpoint temperature controller
2. Solid state power controller or mechanical contactor
3. Matching control thermocouple

Heat/cool control systems provide heating control to the unit in addition to cooling control.

Additional optional features include:

1. Over-temperature controller
2. Current limit SCR power controller
3. Multiple zone independent control

INSTALLATION

1. Position control cabinet in the desired location making sure it is permanently secured. NOTE: Do not position controller in such a manner as to be difficult to operate disconnect.
2. Study all instrument manuals before energizing the control system and furnace.
3. Review all electrical wiring diagrams.
4. Make all external wire connections specified in the electrical wiring diagrams including connection of the cables between the furnace and the control console. All conduit supplied shall be permanently secured / mounted during the installation process. CAUTION: Control system must be grounded according to local wiring requirements.
5. Connect the thermocouple to the control system.
6. Close main circuit breaker or disconnect switch.
7. Turn on main power.
8. Check red and green indicating lights on control cabinet and temperature controller for control power indication.
9. Set temperature controller and over temperature controller to desired temperature setting. (Check instrument control manuals for fine-tuning).
10. Turn on control cabinet power. The furnace will continue to heat until the controller setpoint is reached. The controller will start cycling to maintain selected setpoint.

FRONT PANEL LAYOUTS

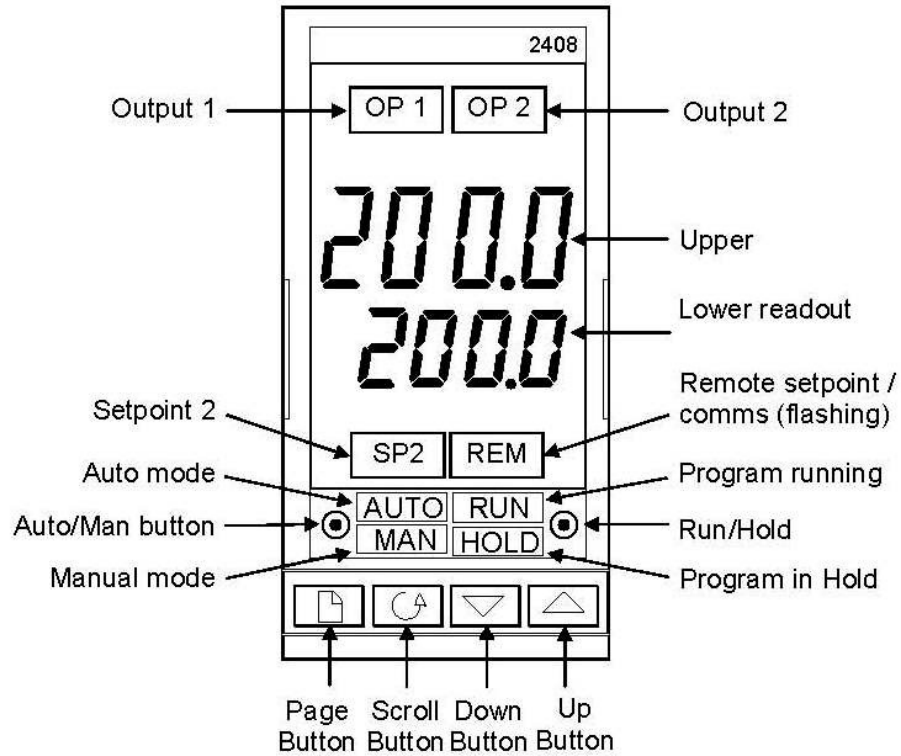


Figure 2-1 Model 2408 front panel layout

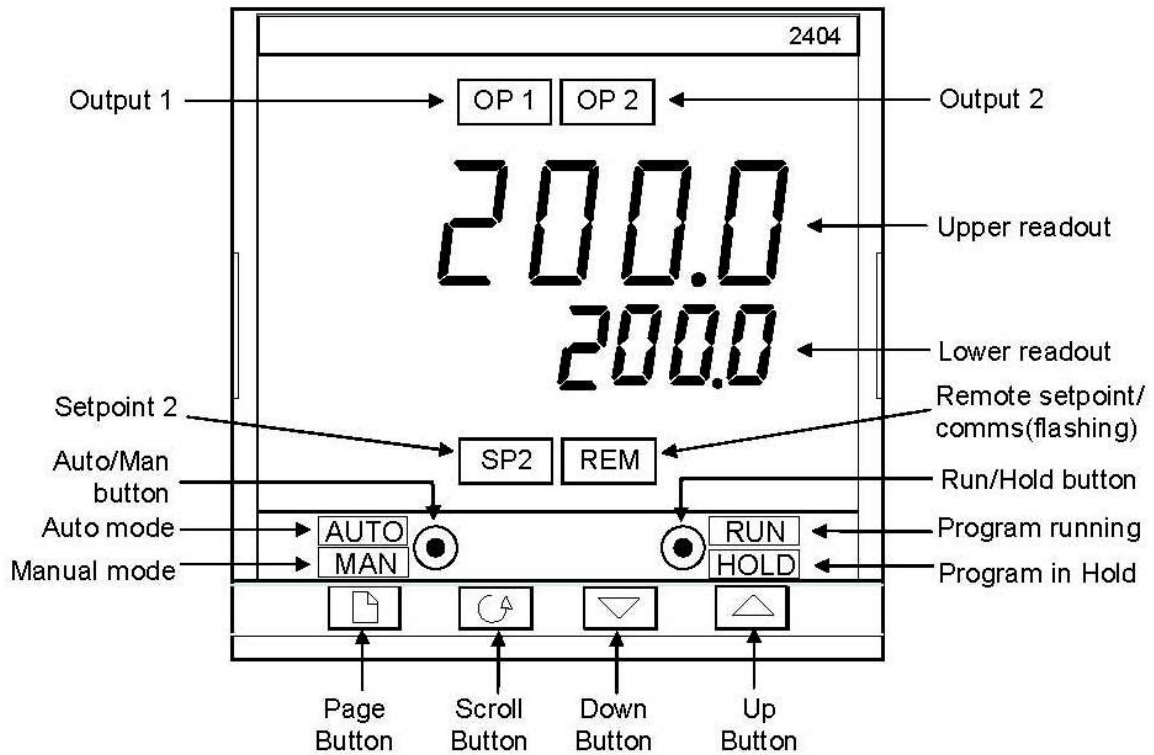


Figure 2-2 Model 2404 front panel layout







Button or indicator	Name	Explanation
OP1	Output 1	When lit, it indicates that the output installed in module position 1 is on. This is normally the heating output on a temperature controller.
OP2	Output 2	When lit, it indicates that the output installed in module position 2 is on. This is normally the cooling output on a temperature controller.
SP2	Setpoint 2	When lit, this indicates that setpoint 2, (or a setpoint 3-16) has been selected.
REM	Remote setpoint	When lit, this indicates that a remote setpoint input has been selected. 'REM' will also flash when communications is active.
	Auto/Manual button	When pressed, this toggles between automatic and manual mode: <ul style="list-style-type: none"> • If the controller is in automatic mode the AUTO light will be lit. • If the controller is in manual mode, the MAN light will be lit. The Auto/Manual button can be disabled in configuration level.
	Run/Hold button	<ul style="list-style-type: none"> • Press once to start a program (RUN light on.) • Press again to hold a program (HOLD light on) • Press again to cancel hold and continue running (HOLD light off and RUN light ON) • Press and hold in for two seconds to reset a program (RUN and HOLD lights off) The RUN light will flash at the end of a program. The HOLD light will flash during holdback or when a PDS retransmission output is open circuit.
	Page button	Press to select a new list of parameters.
	Scroll button	Press to select a new parameter in a list.
	Down button	Press to decrease a value in the lower readout.
	Up button	Press to increase a value in lower readout.

Figure 2-3 Controller buttons and indicators

BASIC OPERATION

Switch on the power to the controller. It runs through a self-test sequence for about three seconds and then shows the measured temperature, or process value, in the upper readout and the target value, called the *setpoint*, in the lower readout. This is called the **Home** display.

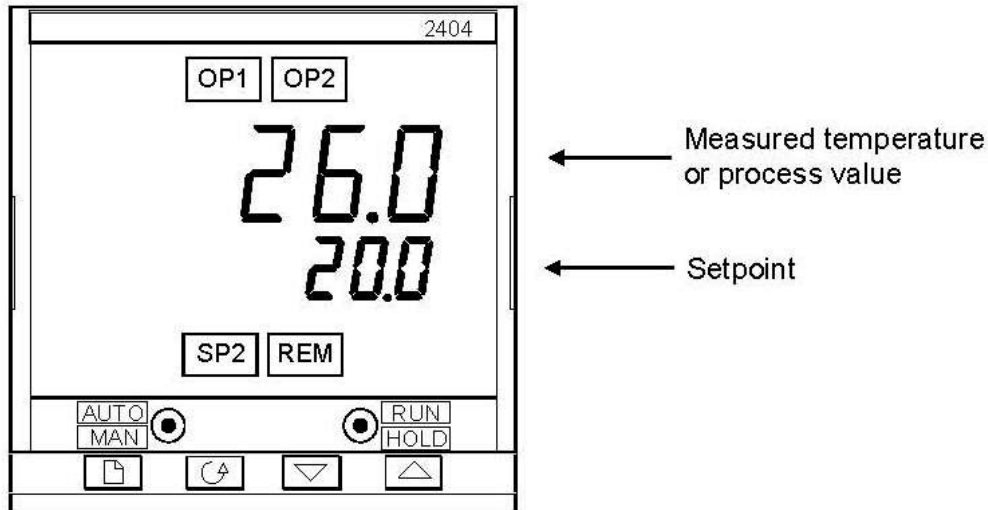






Figure 2-4 Home display

You can adjust the setpoint by pressing the  or  buttons. Two seconds after releasing either button, the display blinks to show that the controller has accepted the new value.

OP1 will light whenever output 1 is ON. This is normally the heating output when used as a temperature controller.

OP2 will light whenever output 2 is ON. This is normally the cooling output when used as a temperature controller.

Note: You can get back to this display at any time by pressing  and  together. Alternatively, you will always be returned to this display if no button is pressed for 45 seconds, or whenever the power is turned on.

Alarms

If the controller detects an alarm condition, it flashes an alarm message in the Home display. For a list of all the alarm messages, their meaning and what to do about them, see *Alarms* at the end of this chapter.

OPERATING MODES

The controller has two basic modes of operation:

- **Automatic mode** in which the output is automatically adjusted to maintain the temperature or process value at the setpoint.
- **Manual mode** in which you can adjust the output independently of the setpoint.

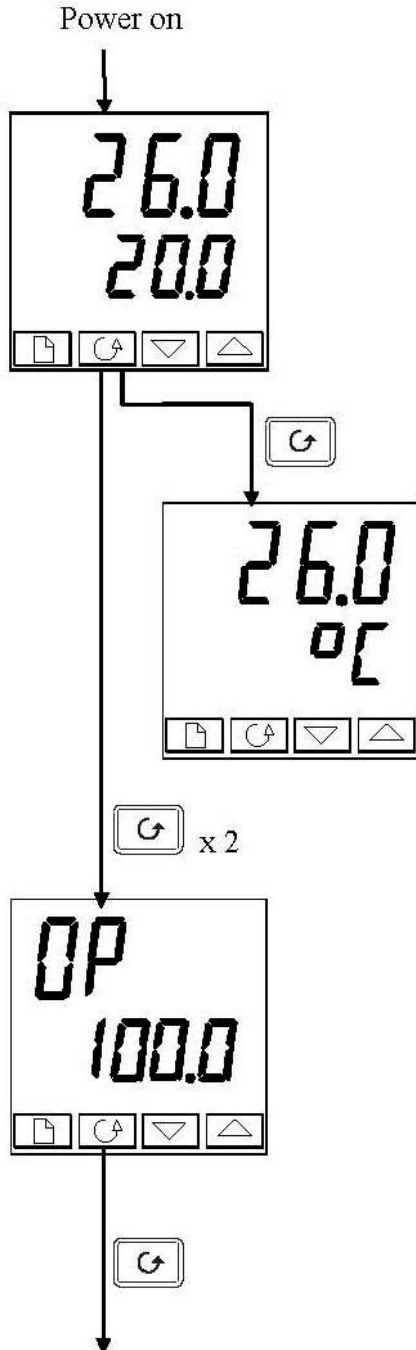
You toggle between the modes by pressing the AUTO/MAN button. The displays which appear in each of these modes are explained in this chapter.

Two other modes are also available:

- **Remote Setpoint mode**, in which the setpoint is generated from an external source. In this mode, the REM light will be on.
- **Programmer mode** which is explained in Chapter 5, *Programmer Operation*.

AUTOMATIC MODE

You will normally work with the controller in automatic mode. If the MAN light is on, press the AUTO/MAN button to select automatic mode. The AUTO light comes on.



The Home display

Check that the AUTO light is on.

The upper readout shows the measured temperature.


The lower readout shows the setpoint.

To adjust the setpoint up or down, press ▲ or ▼.

(Note: If Setpoint Rate Limit has been enabled, then the lower readout will show the active setpoint. If ▲ or ▼ is pressed, it will change to show and allow adjustment of, the target setpoint.)

Press  once.

Display units



A single press of  will flash the display units for 0.5 seconds, after which you will be returned to the **Home** display.

Flashing of the display units may have been disabled in configuration in which case a single press will take you straight to the display shown below.



Press  twice

% Output power demand

The % output power demand is displayed in the lower readout. This is a read-only value. You cannot adjust it.

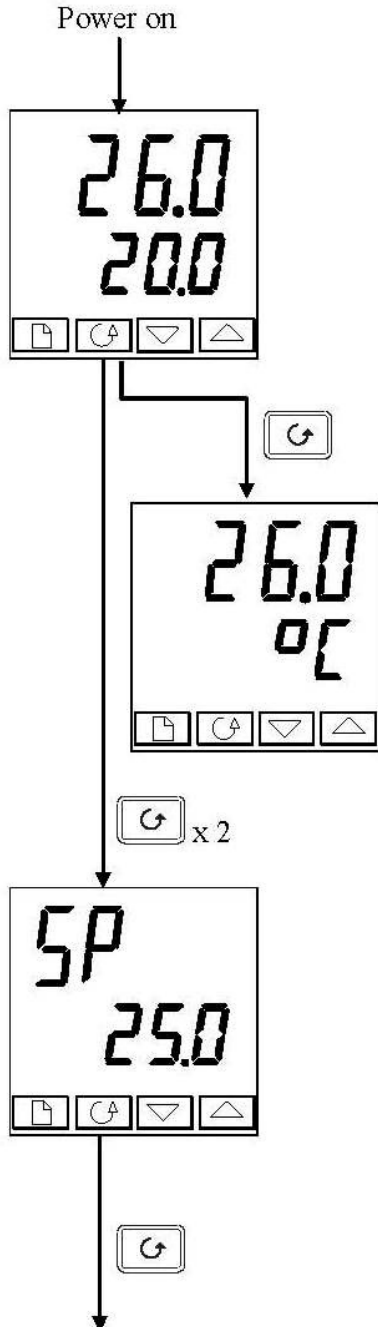
Press  and  together to return to the **Home** display.

Press 

Pressing  from the Output Power display may access further parameters. These may be in this scroll list if the 'Promote' feature has been used (see Chapter 3, *Edit Level*). When you reach the end of this scroll list, pressing  will return you to the **Home** display.

MANUAL MODE

If the AUTO light is on, press the AUTO/MAN button to select manual mode. The MAN light comes on.



The Home display

Check that the MAN light is on.

The upper readout shows the measured temperature, or process value. The lower readout shows the % output.

To adjust the output, press or .

(Note: If Output Rate Limit has been enabled, then the lower readout will show the working output. If or is pressed, it will change to show and allow adjustment of, the target output.)

Press once.

Display units

A single press of flashes the display units for 0.5 seconds, after which you are returned to the Home display. Flashing of the display units may have been disabled in configuration, in which case a single press will take you straight to the display shown below.

Press twice.

Setpoint

To adjust the setpoint value, press or .

Press .

Pressing from the Output Power display may access further parameters. These may be in this scroll list if the 'Promote' feature has been used (see Chapter 3, *Edit Level*). When you reach the end of this scroll list, pressing will return you to the **Home** display.

Chapter 4 TUNING

Before tuning, please read Chapter 2, *Operation*, to learn how to select and change a parameter.

This chapter has five topics:

- WHAT IS TUNING?
- AUTOMATIC TUNING
- MANUAL TUNING
- COMMISSIONING OF MOTORISED VALVE CONTROLLERS
- GAIN SCHEDULING

WHAT IS TUNING?

In tuning, you match the characteristics of the controller to those of the process being controlled in order to obtain good control. Good control means:

- Stable, 'straight-line' control of the temperature at setpoint without fluctuation
- No overshoot, or undershoot, of the temperature setpoint
- Quick response to deviations from the setpoint caused by external disturbances, thereby rapidly restoring the temperature to the setpoint value.

Tuning involves calculating and setting the value of the parameters listed in Table 4-1. These parameters appear in the '*P, d*' list.

Parameter	Code	Meaning or Function
Proportional band	P_b	The bandwidth, in display units, over which the output power is proportioned between minimum and maximum.
Integral time	t_i	Determines the time taken by the controller to remove steady-state error signals.
Derivative time	t_d	Determines how strongly the controller will react to the rate-of-change of the measured value.
High Cutback	H_{cb}	The number of display units, above setpoint, at which the controller will increase the output power, in order to prevent undershoot on cool down.
Low cutback	L_{cb}	The number of display units, below setpoint, at which the controller will cutback the output power, in order to prevent overshoot on heat up.
Relative cool gain	r_{EL}	Only present if cooling has been configured and a module is fitted. Sets the cooling proportional band, which equals the P_b value divided by the r_{EL} value.

Table 4-1 Tuning parameters

AUTOMATIC TUNING

Two automatic tuning methods are provided in the 2408 and 2404:

- **A one-shot tuner**, which automatically sets up the initial values of the parameters listed in Table 4-1 on the previous page.
- **Adaptive tuning**, which continuously monitors the error from setpoint and modifies the PID values, if necessary.

One-shot Tuning

The 'one-shot' tuner works by switching the output on and off to induce an oscillation in the measured value. From the amplitude and period of the oscillation, it calculates the tuning parameter values.

If the process cannot tolerate full heating or cooling being applied during tuning, then the level of heating or cooling can be restricted by setting the heating and cooling power limits in the '**oP**' list. However, the measured value *must* oscillate to some degree for the tuner to be able to calculate values.

A One-shot Tune can be performed at any time, but normally it is performed only once during the initial commissioning of the process. However, if the process under control subsequently becomes unstable (because its characteristics have changed), you can re-tune again for the new conditions.

It is best to start tuning with the process at ambient temperature. This allows the tuner to calculate more accurately the low cutback and high cutback values which restrict the amount of overshoot, or undershoot.

How to tune

1. Set the setpoint to the value at which you will normally operate the process.
2. In the '**Atun**' list, select '**tunE**' and set it to '**on**'.
3. Press the Page and Scroll buttons together to return to the Home display. The display will flash '**tunE**' to indicate that tuning is in progress.
4. The controller induces an oscillation in the temperature by first turning the heating on, and then off. The first cycle is not complete until the measured value has reached the required setpoint.
5. After two cycles of oscillation the tuning is completed and the tuner switches itself off.
6. The controller then calculates the tuning parameters listed in Table 4-1 and resumes normal control action.

If you want 'Proportional only', 'PD', or 'PI' control, you should set the '**t_i**' or '**t_d**' parameters to **OFF** before commencing the tuning cycle. The tuner will leave them off and will not calculate a value for them.

19.) STANDARD CONFIGURATION

Operator.SP

Name	Description	Value	Comments
SPrHb	Rate Limit Holdback Status	OFF (0)	
RmpDis	Ramp Rate disable	0	
SRLAct	Rate Limit Active Status	0	
SRLSta	Rate Limit Complete Status	0	
Hbkdis	Holdback Disable	0	
SSEL	Select SP1 to SP16	SP 1 (0)	
SP_1	Set point 1	600.00	
SP_2	Set point 2	68.00	
SP_L	Set point 1 Low Limit	-328.00	
SP_H	Set point 1 High Limit	600.00	
SP2L	Set point 2-16 Low Limit	32.00	
SP2H	Set point 2-16 High Limit	600.00	
SPrr	SP Rate Limit	OFF (0)	
Hbty	SP Rate Limit Holdback Type	OFF (0)	

Operator.OP

Name	Description	Value	Comments
OPLo	Low Power Limit	0.00	
OPHi	High Power Limit	100.00	
Oprr	Output Rate Limit (/second)	OFF (0)	
CYCH	Ch 1 Cycle Time	1s	
ontH	Ch 1 Output Minimum On Time	AUTO (50)	
EndP	Power Level in End Segment	0.00	
SbOP	Sensor Break Power	0.00	

Config.INST

Name	Description	Value	Comments
Ctrl	Control Type	PID (0)	
Act	Control Action	REV (0)	
COOL	Cooling Type	LIN (0)	
titd	Integral and Derivative Time Units	SEC (0)	
dtYP	Derivative Type	PV (0)	
m-A	Manual Key Disable	ENAB (0)	
r-h	Run/Hold Key Disable	ENAB (0)	
PwrF	Power Feedback Enable	ON (1)	
Fwdt	Feedforward Type	NONE (0)	
Pdtr	Manual/Auto Transfer PD Control	??????	
Sbrt	Sensor Break Type	SB.OP (0)	
FOP	Forced Manual Output Mode	NO (0)	
bcd	BCD Input Function	NONE (0)	
GSch	Gain Schedule Enable	NO (0)	

Config.PV

Name	Description	Value	Comments
unit	Instrument Units	F (1)	
dEcP	Decimal Places in Display	NNNN (0)	
mGL	Process Value Low Limit	-328.00	
mGH	Process Value High Limit	600.00	

Config.IP

Name	Description	Value	Comments
inPt	Linearisation Type	T.TC (6)	
CJC	CJC Type	AUTO (0)	
imP	Sensor break impedance	AUTO (1)	

Config.SP

Name	Description	Value	Comments
nSP	Number of Set points available	2(1)	
nmTr	Remote Tracking	OFF (0)	
mTr	Manual Track	OFF (0)	
PrTr	Programmer Track when in Reset	OFF (0)	
nmPU	Rate Limit Units	PSEC (0)	
nmt	Remote Set point configuration	NONE (0)	

Config.HA

Name	Description	Value	Comments
FX	Comms Special Case Flags	0	
id	Module Identity	CMS (7)	
Func	Module Function	EIBI (66)	
bAud	Baud Rate	9600 (0)	
Prty	Comms Parity	NONE (0)	
rES	Comms Reolution	FULL (0)	
dELy	Comms Delay	NO (0)	

Config.1A

Name	Description	Value	Comments
DCOP	DC Output Telemetry	0.00	
id	Module Identity	LOG (3)	
Func	Module function	HEAT (2)	
VALL	Value giving minimum output	0.00	
VALH	Value giving maximum output	100.00	
OutL	Minimum Output	0.00	
OutH	Maximum Output	100.00	

Config.2A

Name	Description	Value	Comments
DCOP	DC Output Telemetry	0.00	
id	Module identity	SSR (5)	
Func	Module function	NONE (0)	

20.) OVER-TEMPERATURE CONTROLLER OPERATION (if applicable)

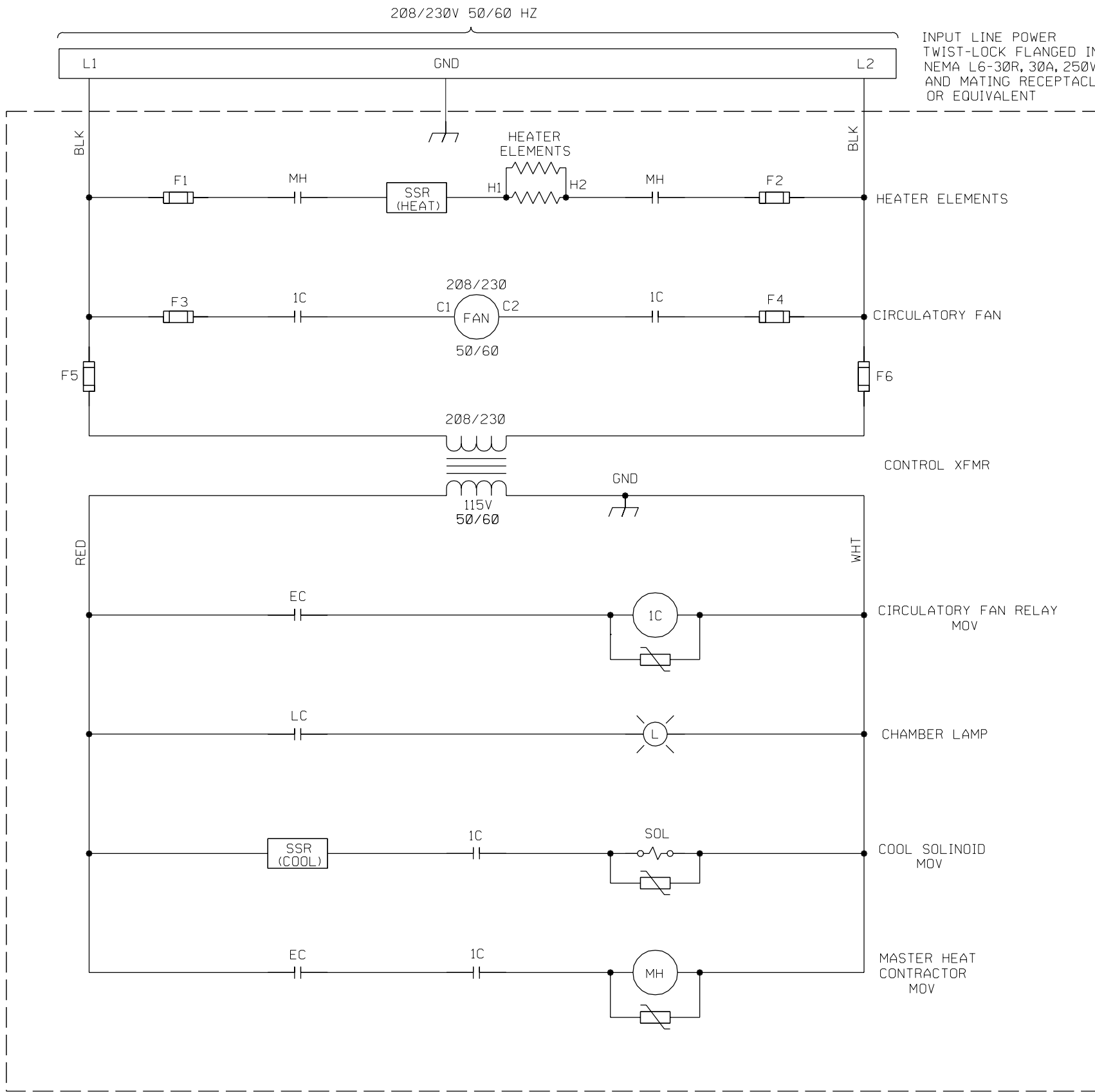
Furnaces equipped with this optional controller will have a complete independent control system, including a separate upper limit controller and a separate thermocouple.

The over temperature controller is usually set 50°F higher than the furnace chamber controller. Under no circumstances should the high limit setpoint be set higher than the maximum temperature of the furnace. If the normal control system malfunctions and the temperature continues to rise above the control point, the over temperature controller will shut the power off when the set temperature is reached. On some models, this is a manual reset control. Power will not be restored until the reset button is pressed.

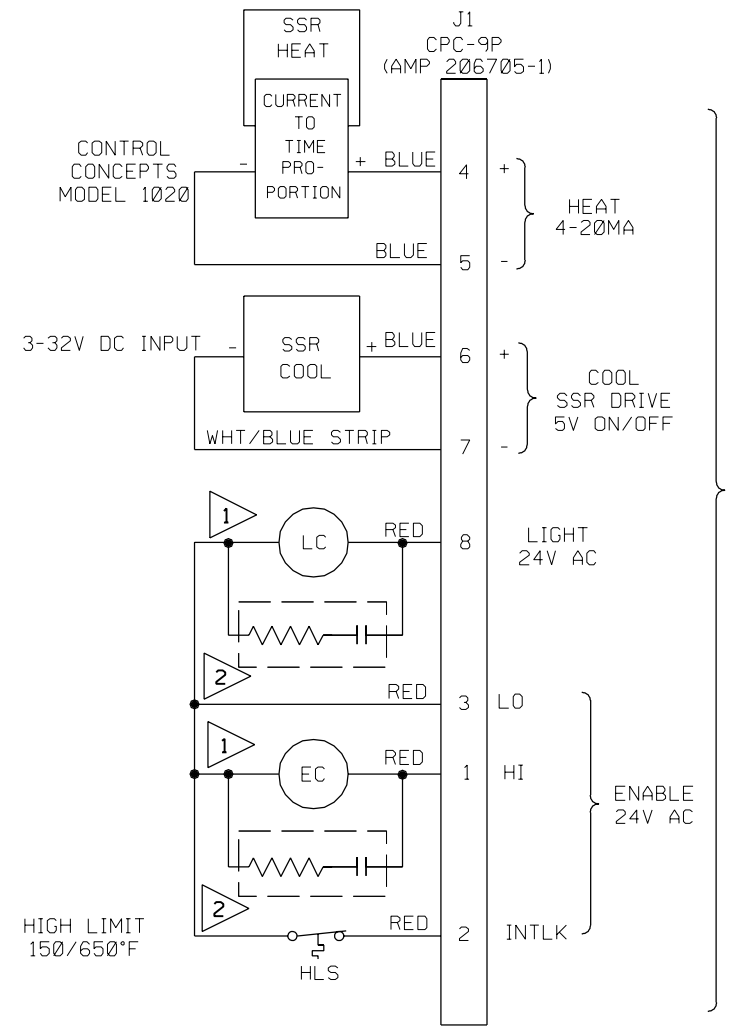
NOTE: During system start up, the system may tend to over- or undershoot the desired temperature setting. After proper adjustment of proportional band, rate and reset (when supplied), the controller will accurately hold the selected setpoint. See controller manual for instructions on setting these adjustments.

CAUTIONS:

1. Do not block cooling vents on control cabinet.
2. Do not operate temperature control system in ambient temperature higher than 120°F without using a cooling fan or air conditioning.
3. Make sure output power rating of temperature control system is higher than power rating of the furnace.
4. When changing fuses, use fuse types specified by the power controller manufacturer.
5. Use properly sized interconnecting cables to match ratings on data labels for the furnace and controller.
6. Use the appropriate thermocouple, including extension wires and connectors, in order to eliminate errors due to faulty control. Do not allow thermocouple to come in contact with others metals so as to avoid inaccuracies in the control readings.



REFERENCE ONLY, ACTUAL DESIGN AT DISCRETION OF VENDOR.

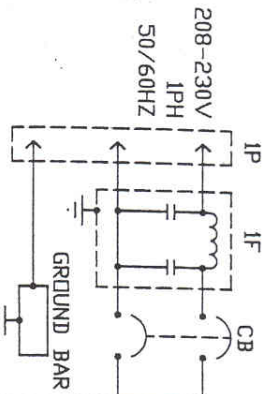


- NOTE:
- 1 POTTER AND BLUMFIELD KUP SERIES RELAY WITH 27E121 SOCKET OR EQUIVALENT.
 - 2 ELECTROCUBE RG 1782-6 OR EQUIVALENT. (100 OHMS, 1-2W, 0.1MFD, 600V)

REVISIONS				
DESCRIPTION	DATE	LETTER	ECO NO.	
DFTSMN	APPL	DATE	LETTER	ECO NO.

UNLESS OTHERWISE SPECIFIED				APPROVAL			
TOLERANCES	CAP. IN MFD ± 1/2 RES. IN OHMS ± 1/2 W	DFTSMN	CHECK	ENGR	MFG		
2 PLACES 3 PLACES	DRILL DEPTHS ARE TO FULL DIAMETER	KWJ		RWW			
INCHES 0.030	TAP DEPTHS ARE MINIMUM FULL THREADS	DATE	DATE	DATE	DATE		
INCHES 0.010	REMOVE ALL BURRS AND SHARP EDGES	4/91		4/91	4/91		
DO NOT SCALE DRAWING							
MATERIAL	MTS NO.	SURFACE FINISH 125	TITLE				
STOCK SIZE	QUANTITY	SCALE	WIRING DIAGRAM-651.XX				
FINISH	THIRD ANGLE PROJ.	FIRST USED ON	SIZE NUMBER	REV			
			D 473950-01	A			
MTS SYSTEMS CORPORATION		MODEL/SYSTEM NO.	V CARD/P/L				
MINNEAPOLIS, MINNESOTA 55424 U.S.A.		651.XXB		SHEET 1 OF 1			

VOLTS	3000W	4500W
230V	14.4A	20.9A
220V	13.8A	20.0A
208V	13.3A	19.2A



INTERCONNECTING CABLE

HEATER 3000W @230V

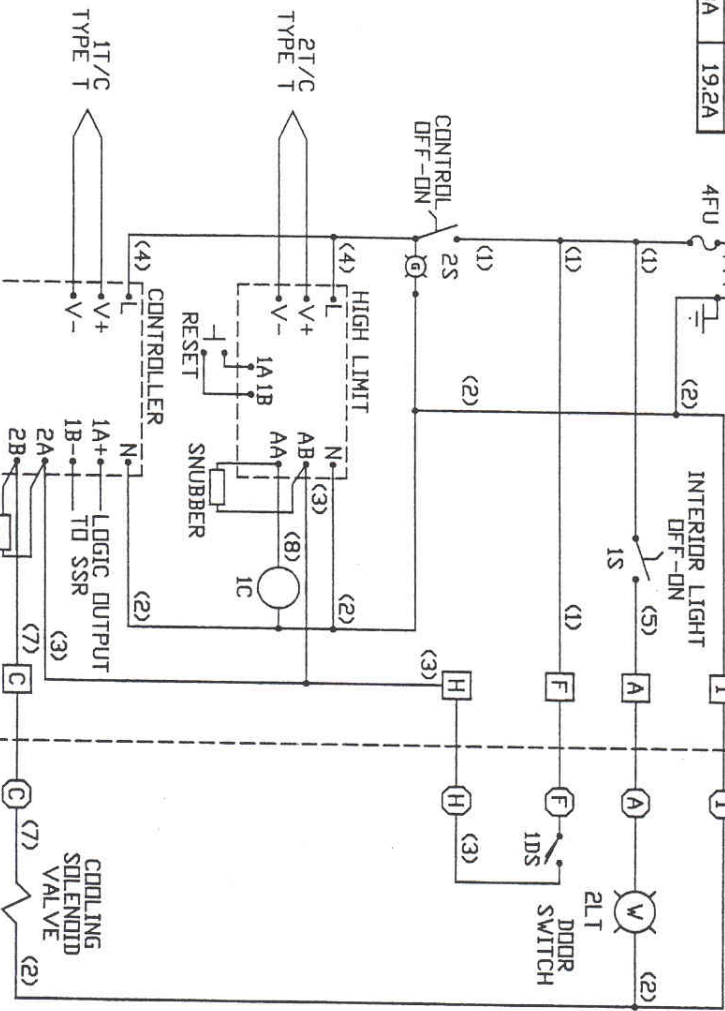
HEATER 4500W @230V

ACTUAL WATTS

230V	220V	208V
3000W	2730W	2460W
4500W	4095W	3690W

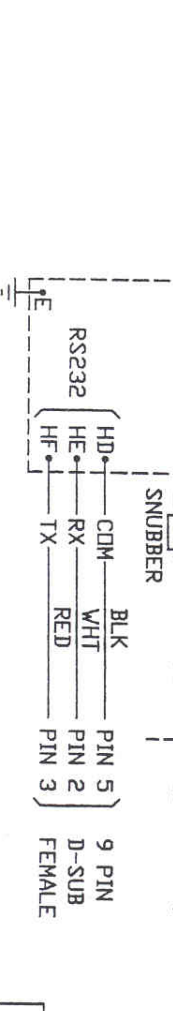
PLUG NEMA L6-30 CORD 10/3 SQ RECEPTACLE N/A

DOMESTIC	HUBBELL 2621	10/3 SQ	N/A
EXPORT	PANEL 84132201	3X4.0mm	IEC 60309
	PANEL 87520050	ASSEMBLY	PANEL 84232201



- CB - CIRCUIT BREAKER, CARLINGSWITCH CA2B034630121D
- 1F - RFI FILTER, CORCOM 30VK6
- 1C - CONTACTOR, SQUARE D 8910 DP12V02
- 1SSR - SOLID STATE RELAY, CRYDDM D2440
- CCT - CONTROL TRANSFORMER, SQUARE D 9070 TF100D1
- 1FU - FUSE, FNQ-R-3 1/2
- 1FB - FUSEBLOCK, BUSS CHCC1
- 2FU,3FU - FUSE, FNQ-R-1
- 4FU - FUSE, FNM-125
- 1DS - DOOR SWITCH, C&K 11TL602
- 1S - SWITCH, CARLINGSWITCH 622-132-88-NAXN
- 2S - LIGHTED SWITCH, ARCOLECTRIC C1353VQNAAC
- 2LT - INTERIOR LIGHT, 40 WATT APPLIANCE BULB
- RESET - ARCOLECTRIC C1501ATAAA
- CONTROLLER, EUROTHERM 2404/CP/VH/LH/TC/XX/XX/XX/A2/XX/ENG
- HIGH LIMIT, EUROTHERM 21161/FM/VH/ENG
- TERMINAL BLDCKS - SQUARE D 9080 GMS
- 1T/C, 2T/C - THERMOCOUPLE, OMEGA 5TC-GG-T-30-36
- GROUND BAR - SQUARE D PK4G1A

- TERMINAL IN CONTROL PANEL
- TERMINAL ON OVEN



LET	REVISION	DATE
B	CTRL PART NO.	8/30/02
A	GENERAL	12/12/01

Thermcraft
Incorporated

P.O. Box 12037
2820 Overdale Road
Winston-Salem, N.C. 27107

MODEL 1-1-30-230-E06ZT
LABTEMP CONTROL WIRING

APPROVAL	DATE
DRN. BVS	8/6/01
CHK.	
APP'D	
APP'D	

JOB	SCALE	DRAWING NO.	REV	SHEET	OF
MTS 4660	NONE	J5929_7EA	B	1	1