LINDBERG/BLUE M

BF51643
Laboratory Box Furnace

Installation and Operation Manual

L-91131-51643

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SECTION 1

DESCRIPTION

1.1 INTRODUCTION

This manual and related drawings provide the necessary instructions to install, operate and maintain the Lindberg's Model 51643, 1500°C Box Furnace. It is recommended that these instructions be read carefully BEFORE installing and operating the furnace and its related equipment.

WARNING

PERSONAL INJURY MAY RESULT IF THIS EQUIPMENT IS OPERATED OR MAINTAINED BY UNTRAINED PERSONNEL WHO ARE NOT PROFICIENT IN THE FUNCTIONS OF ALL OF ITS SYSTEMS NOR IN THE HANDLING OF MATERIALS BEING PROCESSED. THE FOLLOWING MUST BE OBSERVED IN ORDER TO AVOID PERSONAL INJURY.

- Refer to the instruction manual and supplied drawings BEFORE operating or maintaining this equipment. Installation, operation and maintenance must be entrusted only to technically competent and authorized personnel.
- DO NOT remove or bypass any safety items or electrical circuits.
- Avoid contact with hot surfaces and electrical cables and connections.
- Disconnect all electrical power supplies to any item being serviced before doing any maintenance work on it.
- Shutting off the furnace at the control panel DOES NOT mean that the power supply is disconnected from the control console or the transformer. Personnel must be thoroughly trained in the proper methods for disconnecting power in order to do maintenance work.

1.2 GENERAL DESCRIPTION

The Lindberg 1500°C Box Furnace is designed for heating laboratory process applications and small production work loads to a maximum temperature of 1500°C (2732°F) and maintain a temperature chamber uniformity of ±1°C at the thermocouple. Furnace Model 51643, when operating at maximum output, will reach maximum temperature in 60 minutes. The complete furnace assembly consists of the box furnace and a control panel featuring a digital display electronic controller, an ammeter, and a single circuit breaker for the furnace heating system. The following paragraphs describe more specific details of the Lindberg Model 51643 1500°C Box Furnace. The Silicon Controlled Rectifier (SCR) is in the base.

1.2.1 Specifications - Furnace:

Overall Outside Dimensions: 28" High x 27½" Wide x 30" Deep

Inside Heating Chamber Dimensions: 10" High x 15" Wide x 15-1/2" Deep

Vestibule (Door) Opening: 9" High x 11" Wide x 2½" Deep

Maximum Work Area: 9" x High x 11" Wide x 14" Deep

Weight: 320 Lbs.

Maximum Operating Temperature: 1500°C (2732°F)

Heating Elements: Silicon Carbide Bayonet Type

Number of Elements: 8

Elements' Melting Temperature: 2200°C

Thermocouple: Type R
Platinum/Platinum - 13% Rhodium Wire

Wattage: 14,750

Power: 208/240 VAC, 1 phase, 50/60 Hz.

1.2.2 Control Console:

The temperature control system for the 1500°C Box Furnace is conveniently housed beneath the furnace. The controls are briefly described below:

- Programmable, Digital Indicating Controller, with a dual four-digit display screen. (Front control panel)

- Modular SCR Unit with these features and indicators:

  1. SCR Fuse.
  2. Fuse Failure Indicator Light (Front Control Panel).
  3. Integral Ammeter (located on Front Control Panel).

- Red Lamp, load fail indicator light identifying open heater circuit.

- Current Limit Potentiometer (Front control panel - left side)

- Amber lamp, located on the front right side of panel on the face of the console, which illuminates whenever electrical power is supplied to the unit--and the fans are operating--whether or not heat is being applied to the furnace.

- Control system comes equipped with RS232 digital communications to allow modification and interrogation of all instrument control and configuration parameters from a remote computer. Software provided is Lindberg's Tem Con I Communication Program on a 5¼" floppy disk.

1.2.3 Heating Elements:

The silicon carbide heating elements are designed in a unique spiral configuration to ensure the longest possible life, a minimum degree of distortion at extreme temperatures, and ease of replacement. Although these furnaces have been designed for rapid heat-up, it is recommended that the furnace be maintained between 800°C to 1000°C when not in use. This procedure reduces material surface reaction created at lower temperatures that will eventually shorten the life of the heating elements. For prolonged periods of inactivity, the furnace may be turned off completely.

Inactive Time	Furnace Range	
	1200 C	1500 C
Hours	Off to 650 C	800 - 1000 C
Days	Off	Off

WARNING

AS THE FURNACE TEMPERATURE APPROACHES THE WHITE-HOT RANGE (BEGINNING AT APPROXIMATELY 1300°C, TINTED SAFETY GLASSES MUST BE WORN WHEN OPENING THE FURNACE DOOR AND LOOKING INSIDE. DAMAGE TO THE NAKED EYE CAN OCCUR WHILE LOOKING AT LIGHT IN THE WHITE-HOT RANGE. FOR SAFETY IT IS ADVISABLE TO WEAR THESE SAFETY GLASSES WHEN LOOKING INTO THIS FURNACE AT ANY TIME WHILE IT IS OPERATING.

CAUTION

Silicon carbide heating elements are extremely fragile and must be handled only with the greatest of care.

1.2.4 Furnace Construction:

The 1500°C Box Furnace design utilizes double shell construction which assures very low outside surface temperatures even while the inside chamber is operating at maximum temperature. At 1500°C inside temperature, for example, the skin temperature of the outside shell averages approximately 120°F.

The furnace contains a removable hood type cabinet and rear plate, that provide easy access to the heating element terminals and the thermocouple. Heating element assemblies are easily removable and replaceable from the rear of the furnace. The hearth plate is also removable from the front of the chamber. Element sleeves are provided with each furnace. They are required to prevent heating elements from contacting furnace insulation.

The operator is guarded against an immediate heat surge when opening the furnace door. The door is designed so that, after pulling it out about 8-10", it swings to the left to allow the initial furnace heat to escape. The design of this door arrangement also permits the furnace to occupy a smaller space than is required by furnaces with different door arrangements.

SECTION 2

INSTALLATION

2.1 HANDLING AND UNPACKING

Before the furnace or any related components are unpacked, a visual inspection of all packaging should be made. If there is evidence of damage during transit, the carrier should be contacted so that an inspector can be present to verify any damage before the furnace and its components are unpacked.

If no damage is apparent, proceed as follows:

1. Before unpacking, move the shipping container to the furnace's designated location.

2. Open container and remove contents and all packing material.

3. Do not throw away any packing materials until the furnace assembly is complete and all components are working.

2.2 FURNACE ASSEMBLY

The furnace is shipped completely assembled with all heating elements and the thermocouple installed.

Inspect the furnace as follows:

1. Check to make sure all packaging materials have been removed from the furnace and the control console.

2. Check to make sure there are no damaged, misaligned, or missing parts or components. If anything is wrong, contact Lindberg in order to facilitate repair or correction before completing the installation.

Lindberg
304 Hart Street
Watertown, WI 53094
Phone 1-800-657-0770
FAX 1-800-873-2952

3. Unscrew and remove the access viewing panels located on the rear and top of the cabinet. Visually inspect the element leadwire connections. Tighten if necessary.

   The top access panel allows for inspection and replacement of thermocouple as necessary.

NOTE

The RED thermocouple extension lead is always NEGATIVE.

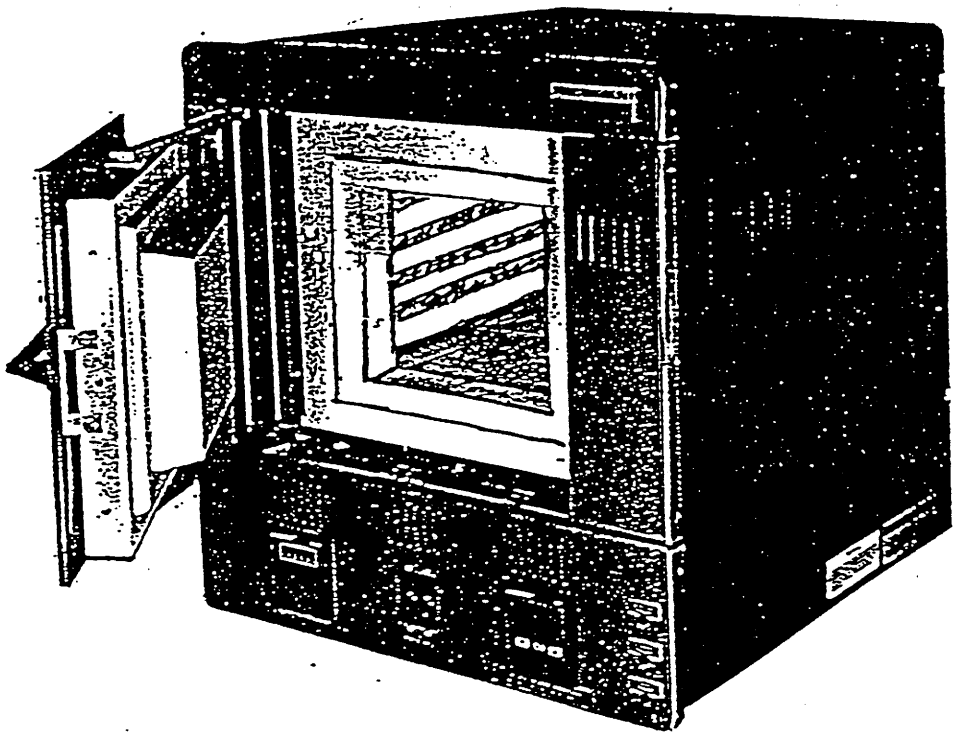


FIGURE 2-1

4. Open the furnace door using both hands. Pull the door handle straight back. The door will initially come back about 8-10" and then it swings to the left giving the operator direct access to the furnace.

NOTE

The back side of the door is fitted with insulation which acts as an insulating plug and it should mate properly with the furnace vestibule opening.

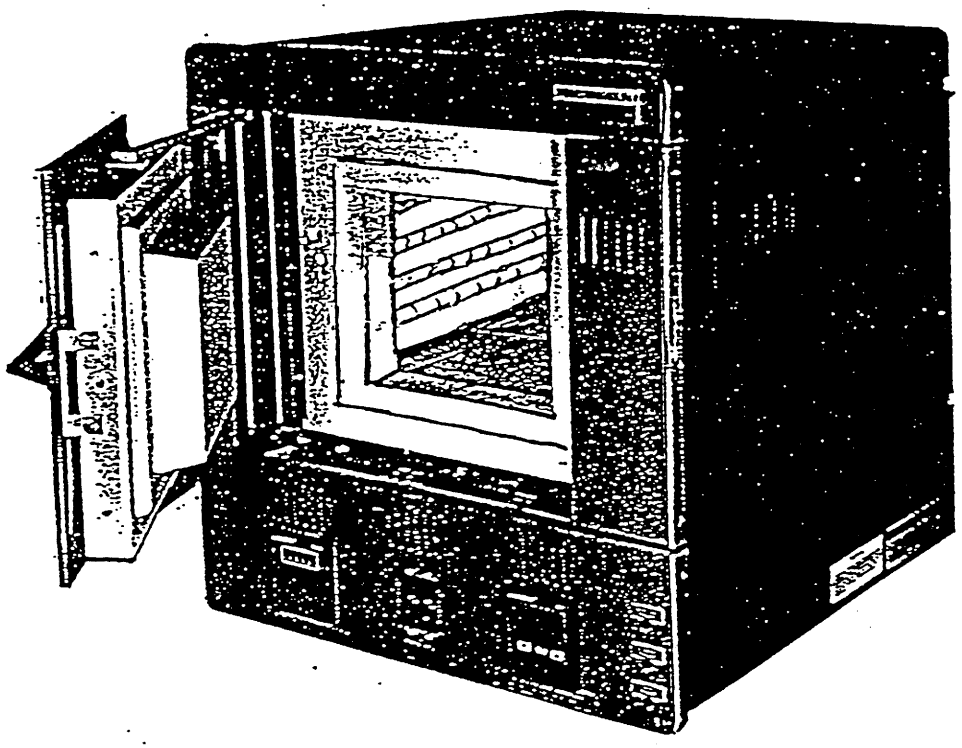


FIGURE 2-2
DOOR OPERATION

5. The thermocouple protrudes through the furnace top. Check to ensure it is not broken. It should hang down into the work area about 4 inches.

6. Inspect the three rear cooling fans for damage to ensure that they rotate and turn freely.

2.3 POWER WIRING

The 1500°C Box Furnace with control console is designed to operate on a power source of either 240 or 208 volts, single phase, at 50 or 60 Hertz.

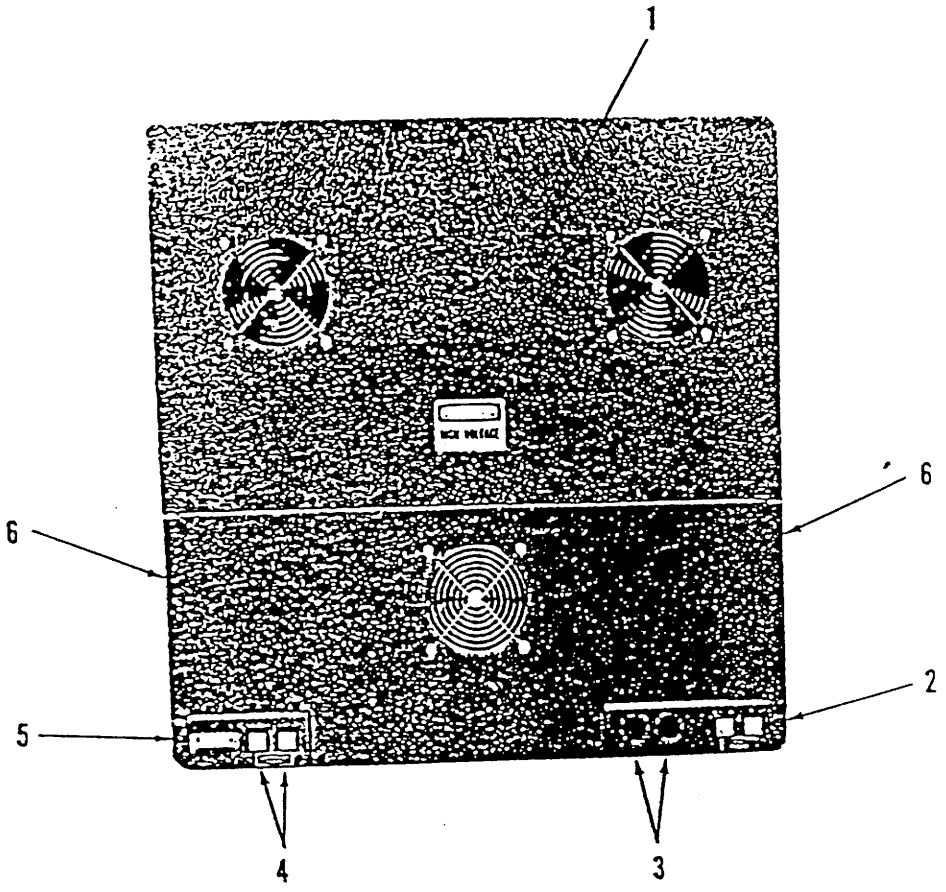
The customer must provide power connection wires between the customer's main power junction, circuit breaker box or disconnect switch and the furnace. Two holes at the rear (with bottom covers) provide access for the power connection wires.

The customer must also provide a main-line disconnect switch or main-line circuit breaker at the power supply, according to local electrical codes, which corresponds in size to the furnace requirements. Local electrical codes must also be observed in grounding the furnace and in sizing the power line from the customer's disconnect switch to the furnace. The wires, in general, should correspond with those carrying similar loads already installed by Lindberg in the furnace.

For best results the furnace should be located in a level area which is free of vibration, convenient to the power source and readily accessible for routine inspection and maintenance.

NOTE

Be sure the furnace is grounded 100%. DO NOT ground furnace to a painted surface. The ground connection must be to a clean, bare metal surface to assure proper furnace operation.



1. Heating Element Access Panel
2. Fan Fuses (2)
3. Power Cable Inlet
4. Controller Fuses
5. RS232 Digital Communications Corrections
6. Lower, Rear Access Panel

FIGURE 2-3

Connect power to the furnace according to the following procedure:

1. Remove the rear panel of the furnace by taking out the necessary screws.

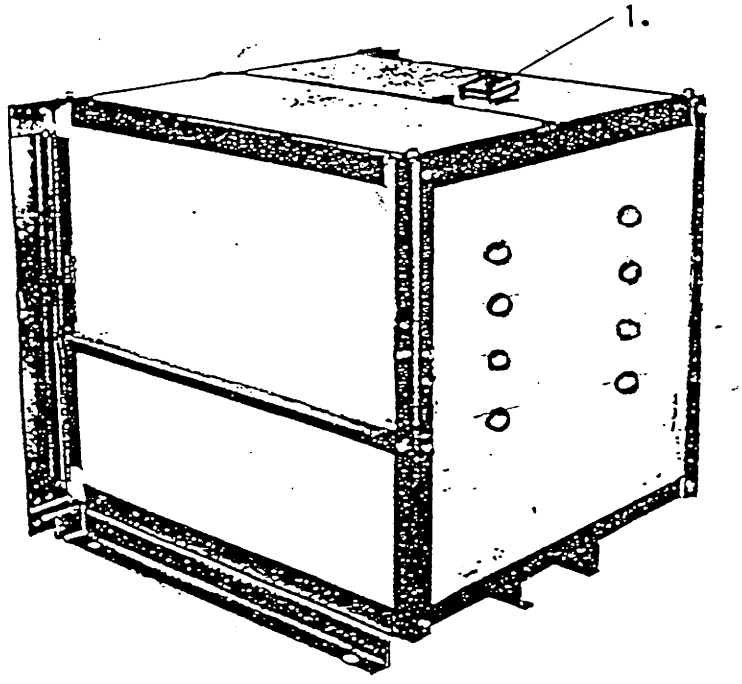
2. Thread the wires through the holes in the panel before making any connections. Connect two leads of 208/240 volt, single phase, 50/60 Hz. power supply, (using labels L_1 and L_2), from the customer main power disconnect switch to the right hand (as you face the rear of the console) terminal block, labeled 1TB, in the control console. A screwdriver is generally all that is needed to connect the leads to the terminal. Be sure wire L_1 is connected to terminal L_1 and wire L_2 to terminal L_2.

WARNING

BE SURE ALSO THAT POWER IS SWITCHED OFF WHILE MAKING THESE AND THE FOLLOWING CONNECTIONS. (Refer to the supplied Power and Control Wiring drawing.)

3. Connect a properly-sized ground wire from the main lug on the ground bar at the left of 1TB to an appropriate ground in the customer's facility. Be sure ground wire connects to bare metal surface. (Be sure to follow local electrical codes).

4. Replace and secure the lower rear access panel of the control console, using the necessary screws.



1. Thermocouple

FIGURE 2-4

5. Replace and secure the furnace side, top and back panels, using the necessary screws. (See NOTE below).

NOTE

As a final installation step, perform a visual inspection of the furnace and control console, including the furnace chamber and all electrical connections, and then replace all access panels. The furnace should then be ready for operation.

SECTION 3

OPERATION

3.1 INITIAL START-UP PROCEDURE

Become familiar with the condition of the furnace by reviewing Section 2 (Installation) to verify that the furnace is in operating condition. Also, become familiar with the various adjustments on the Controller/Programmer before attempting to operate the furnace for the first time. Refer to Section 1.2.2 and the Controller/ Programmer Type 818 Operating Instructions provided.

CAUTION

This furnace should not be left unattended during the initial break-in period.

1. Turn on the main power at the customer-provided disconnect switch or main-line circuit breaker. Make sure that the circuit breaker on the front of the control panel is also in the "ON" position.

NOTE

The cooling fans in the rear, which cool the furnace and control will begin operating as soon as the customer's main power is turned on at the main disconnect switch. The amber light beneath the nameplate on the control panel will also illuminate indicating that power is "ON" and that the fans are operating.

2. Factory set current limit of the Power Controller (SCR) is standard.

   Since the Controller can not operate in a manual mode, program a higher temperature set point such as 1000°C. This should be done when the furnace is cold. The furnace will go to 100% power within seconds.

   To check, switch Controller to "OP" (output power) and it should 100% power or 20 milliamp signal to the power module. The power module operates on a control signal of 4-20 milliamps.

4 milliamps = 0% power
20 milliamps = 100% power

Should it be necessary to reset the current limit of the SCR refer to Section 3.3.

3.2 INITIAL START UP

Although the furnace heating chamber is insulated with Moldatherm®, it is advisable to initially start the furnace from cold at a slower dryout rate to drive the moisture out and to minimize the effect of thermal shock.

1. Set the controller temperature set-point for 800°C after setting the alarm setpoint for 825°C. Allow the furnace to operate for at least 1 hour after reaching temperature.

2. Re-set the alarm setpoint for 1600°C, the controller temperature setpoint for 1500°C and allow the furnace to reach maximum temperature and operate for another hour.

3. When the furnace arrives at its setpoint temperature and <u>if all controls and indications as described above are working properly</u>, the system is now ready for normal customer use. At this point, the following procedures are possible:

   a. Readjust both the Alarm Setpoint Control and the desired furnace setpoint, and begin to heat the first process load.

NOTE

It is always a good practice, <u>before</u> changing the furnace setpoint, to first change the Alarm Setpoint Control. In increasing the furnace setpoint, for example, this practice will avoid unnecessarily putting the furnace into an alarm condition.

   b. Readjust the furnace setpoint to ambient temperature and, when the furnace has cooled, shut it off at the customer's disconnect switch.

NOTE

The furnace itself can be shut off at the circuit breaker, but the power should never be disconnected until the furnace has cooled.

WARNING

EVEN IF POWER TO THE FURNACE IS SHUT OFF AT THE FRONT PANEL CIRCUIT BREAKER, POWER IS STILL APPLIED TO BUILT IN FANS. DO NOT SHUT OFF THE CUSTOMER'S POWER UNTIL THE FANS HAVE COOLED THE FURNACE BACK TO AMBIENT (ROOM) TEMPERATURE. DAMAGE TO THE FANS COULD RESULT IF THEIR POWER IS CUT WHILE THE FURNACE IS VERY HOT.

For heating up the furnace a second (and each subsequent) time, it is not necessary to readjust the control functions unless this is desired. (The first 800°C heat-up is simply a system electrical and mechanical check-out procedure.)

WARNING

IF THE CONTROLS AND INDICATIONS AS DESCRIBED ABOVE ARE NOT WORKING PROPERLY, FIRST:

1. Shut off the circuit breaker.
2. Shut off the customer's power to the system before attempting any maintenance or repair.
3. See the Maintenance Section of this manual.

3.3 SETTING CURRENT LIMIT OF SCR

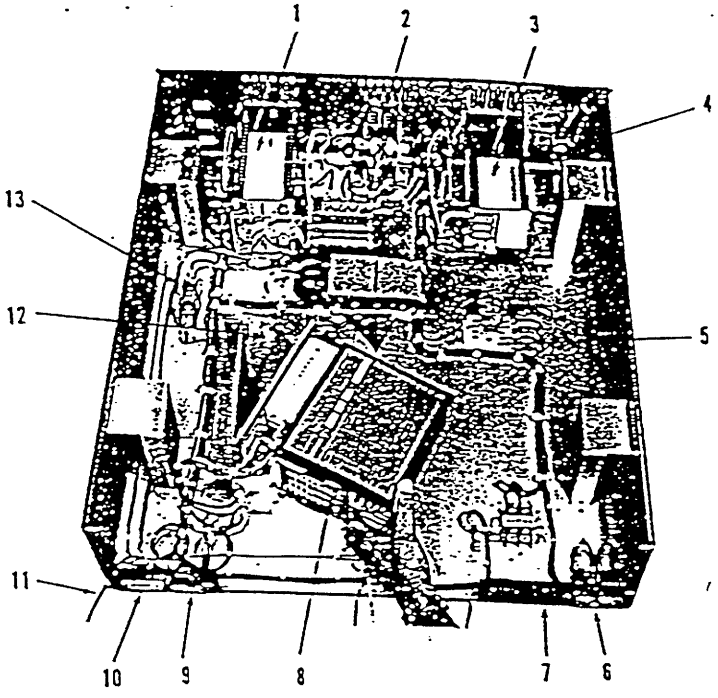
WARNING

BEFORE MAKING THIS ADJUSTMENT, TURN OFF THE MAIN POWER AT THE CUSTOMER - PROVIDED DISCONNECT SWITCH OR MAIN-LINE CIRCUIT BREAKER.

Remove access panel at the lower back of the furnace. The SCR is located approximately in the center, see Figure 3-1.

The SCR is mounted on a hinged bracket with a magnetic catch. Easy access to the SCR is obtained by freeing the magnetic by pulling back on the SCR. Swing the unit back as far left as possible.

Adjust the SCR current limit by locating the current limit pot labeled "Current Limit" on the SCR. Refer to the electrical schematic for suggested setting. Current adjustment should be done within a short period of time when the furnace is cold. (Reference Model 461 Current Limit Operation sheet.)



1. Temperature/Time Controller
2. Furnace Circuit Breaker
3. Ammeter
4. Current Limit Adjustment
5. Time Delay Relay
6. Fan Fuses (2)
7. L1, L2 Power Terminals
8. Power Controller
9. Controller Fuse (2)
10. RS232 Digital Communications Corrections
11. Furnace Ground Wire
12. Magnetic Latch Power Controller
13. Power Fuse (1)

FIGURE 3-1

3.4 LOAD FAIL LIGHT

Control panel indicator will light when current drops indicating possible resistance such as a broken heating element. After taking corrective action, set load fail adjustment. Power at 100% is maximum current. Turn adjustment screw so light goes off, then turn ¼ more turn.

3.5 CONFIGURATION CODES

All configuration codes are factory set with ramp degrees in minutes, dwell in hours. These codes can be found on the drawings supplied.

3.6 SCR FUSE

If the SCR fuse failure light comes on, it will be necessary to replace the fuse. However, if the fuse fails, it was for a reason. It will be necessary to locate the reason since the fuse will not exceed its rating. Failure to isolate the problem could result in damage to the power module. A common problem could be the shorting of the braided cable connecting the elements. This could be caused by a shorted frayed cable.

Eurotherm 818P4 Programming Hints and Examples

The Eurotherm temperature controller/programmer model 818P4 is capable of storing and operating 4 separate programs containing up to 16 segments comprised of 8 ramp and 8 dwell values.

Glossary of Eurotherm model 818P4 Terminology:

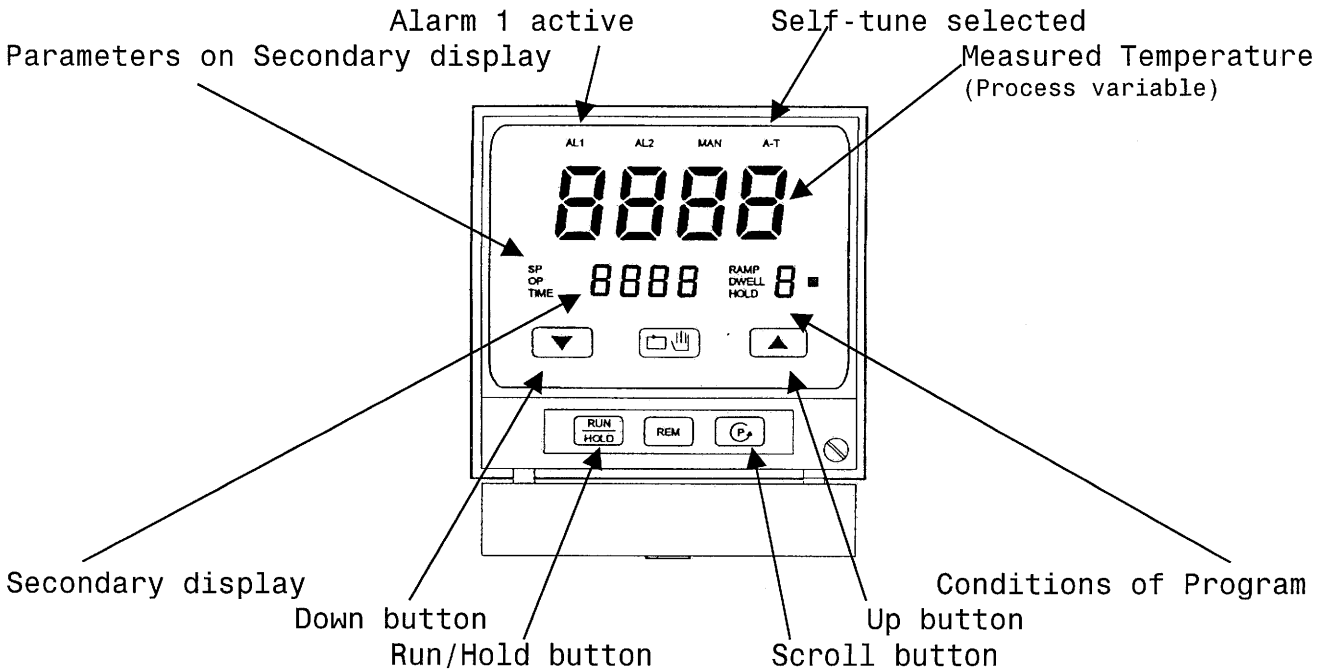
A program is a set of commands that are recorded and played back to produce certain results.

A segment is the portion of a program that is played in a specific sequence.

A ramp is a type of segment during which the temperature of the chamber is changed higher or lower from the previous temperature.

A dwell is a type of segment during which a temperature is maintained for a specified time interval.

Refer to the diagram of the controller for the buttons used in the following explanations and examples. After 10 seconds of inactive buttons, the controller display returns to the standard display.



To Operate the Stored Program, complete the following steps:

1. Use the "P" button to select the desired program number, at parameter "Pnr #" where # represents the program number.
2. Press the "RUN/HOLD" button once to start the selected program.
3. As soon as the program starts, the controller display will illuminate "RAMP 1". This display will change as the program progresses. At the conclusion of the program an "E" will display on the controller bottom right corner.
4. Pressing the "RUN/HOLD" button while the program is running will cause the program to enter a hold state and display "HOLD". Pressing the "RUN/HOLD" button while in the hold state will place the program into the running state and extinguish the "HOLD" display.
5. A running or completed program can be reset by pressing both the "up and down arrow" buttons simultaneously. This places the controller into the single setpoint operation state in which the lower digital setpoint value becomes the new controller target temperature.
6. During the program operation the output percentage to the power module, the current target temperature, and the time remaining in the current segment, can be viewed in the lower portion of the controller by pressing and releasing the "P" button.

To Operate the controller as a Single Setpoint Temperature controller:

1. Press both the "up and down arrow" buttons simultaneously to place the controller into the single setpoint operation state, in which the lower digital setpoint value becomes the controller's target temperature.
2. Select the desired temperature setpoint with the up and down arrow buttons.
3. The controller will recognize the setpoint changes after 10 seconds.
4. This is a setpoint step change in which the controller will signal the power module for either 0 or 100% output to the heating elements to make this new setpoint temperature as quick a possible.

To Enter a Program, complete the following steps:

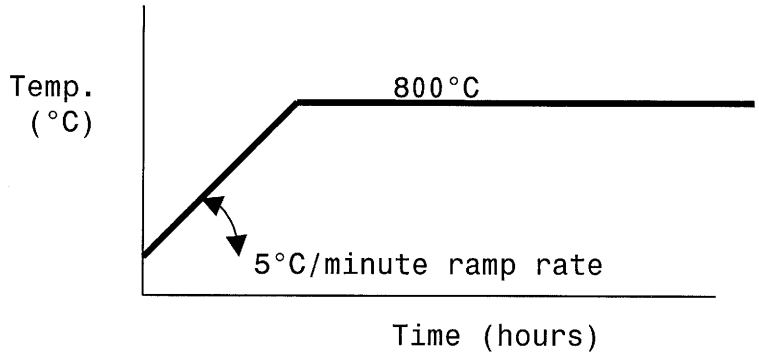
1. Define the temperature profile desired for the furnace. A graph will help illustrate your profile.
   – Define the rate of temperature change as the program ramp rate in °C/minute, or a "STEP" function that provides an instantaneous setpoint change, or an "END" point for the temperature program.
   – Define the target temperature in °C.
   – Define the hold time (dwell) at each target temperature in minutes, or as the program "END" point for the temperature program.
   – Each of these are selections made for up to 8 segment pairs in each program.

2. Access the Temperature Program by pressing and holding the "P" button (behind the small access door) for a few second to display 'Pnr 1' which represents the program number that your are accessing [four are available in the 818P4 model controller].

3. Continue using the "P" button to continue scrolling through each parameter and select the appropriate value per your defined temperature profile.
   – Program ramp parameters ("Pr1", "Pr2", etc.) are each segment pair's ramp rate values, or "STEP", or "END" program commands.
   – Program temperature level parameters ("PL1", "PL2", etc.) are each segment pair's target temperature values.
   – Program dwell time parameters ("Pd1", "Pd2", etc.) are each segment pair's hold time values for the target temperature, or "STEP", or "END" program commands.
   – The "STEP" and "END" program commands are accessed by hold the 'down arrow' button below the zero value in the program ramp or program dwell selections.

4. After making the segment selections, several selections are necessary regarding the program as a whole. Scroll to these by using the "P" button.
   – If the current program is to be linked to the next program, select "Cnt y" with the 'up arrow'. If no program linking is desired, select "Cnt n" with the 'down arrow'.
   – A temperature Deviation Band value is selected at parameter "Hb" and represents an area above and below the target temperature where the measured temperature can fluctuate and allow the program to continue. If the measured temperature falls below or rises above the band area, the program is placed on hold until the measured temperature is within the band area. While in this holdback state the "HOLD" display is illuminated in the bottom right corner of the controller.
   – Select the Program Loop Counter parameter "PLc" value for the number of times the program is to be run.

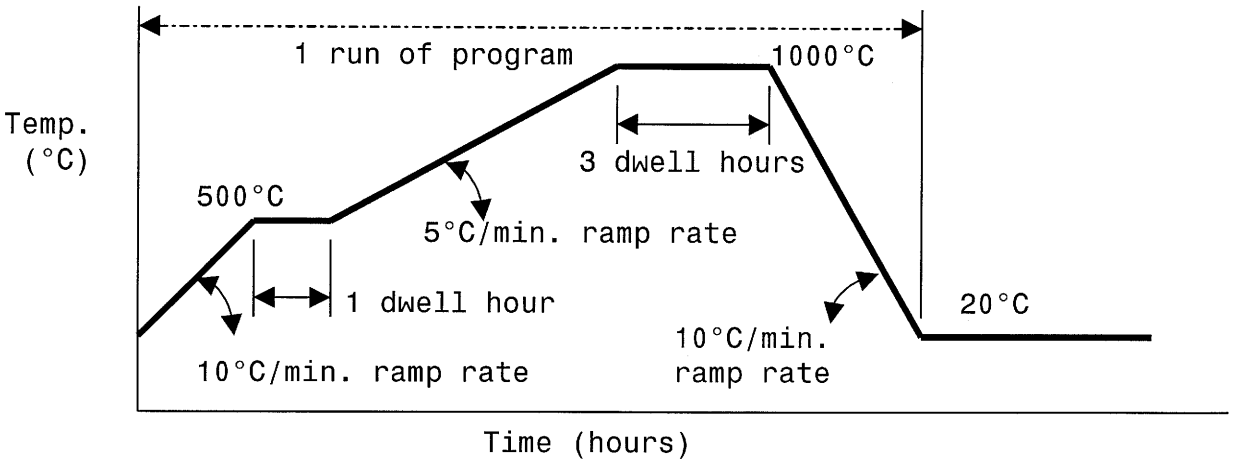
Example of typical furnace profile and programming steps:



A. Ramp to target temperature and dwell:
(This is used to make the furnace temperature change at a selected ramp rate to the target temperature and then remain there until changed by the operator.)

1. Press and hold "P" button to display "Pnr 1".
2. Press and release "P" button to display "Pr1", press the arrow buttons to select "5" (for 5°C/minute ramp rate).
3. Press and release "P" button to display "PL1", press the arrow buttons to select "800" (for target temperature of 800°C).
4. Press and release the "P" button to display "Pd1", press the down arrow to select "END" (for the controller to end the program with holding this temperature, until the program is reset by the operator).
5. Press and release the "P" button to display "Cnt n" (for NOT linking to the next program). Use down arrow button select "Cnt n", if "Cnt y" is displayed.
6. Press and release the "P" button to display "Hb". Use down arrow button to select "OFF" (to disable the holdback feature).
7. Press and release the "P" button to display "PLc". Use arrow buttons to select "1" (for 1 run of the program).
8. Program is completed, see section on operating stored programs.

Example of typical furnace profile and programming steps:



B. Ramps and dwells for heating and cooling profile:
(This profile is typical where the product temperature must be slowly raised, stabilized, raised again to the final temperature, then cooled at a specific rate.)

1. Press and hold "P" button to display "Pnr 1".
2. Press and release up arrow button to display "Pnr 2".
3. Press and release "P" button to display "Pr1", press the arrow buttons to select "10" (for 10°C/minute ramp rate).
4. Press and release "P" button to display "PL1", press the arrow buttons to select "500" (for target temperature of 500°C).
5. Press and release the "P" button to display "Pd1", press the arrow buttons to select "1.0" (for 1 hour of dwell time).
6. Press and release "P" button to display "Pr2", press the arrow buttons to select "5" (for 5°C/minute ramp rate).
7. Press and release "P" button to display "PL2", press the arrow buttons to select "1000" (for target temperature of 1000°C).
8. Press and release the "P" button to display "Pd2", press the arrow buttons to select "3.0" (for 3 hours of dwell time).
9. Press and release "P" button to display "Pr3", press the arrow buttons to select "10" (for 10°C/minute ramp rate).
10. Press and release "P" button to display "PL3", press the arrow buttons to select "20" (for target temperature of 20°C).
11. Press and release the "P" button to display "Pd3", press the arrow buttons to select "END" (for continuous dwell time).
12. Press and release the "P" button to display "Cnt n" (for NOT linking to the next program). Use down arrow button select "Cnt n", if "Cnt y" is displayed.
13. Press and release the "P" button to display "Hb". Use down arrow button to select "20" (to set a 20°C holdback band).
14. Press and release the "P" button to display "PLc". Use arrow buttons to select "1" (for 1 run of the program).
15. Program is completed, see section on operating stored programs.

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PROGRAMMING WORK SHEET

	Mnemonic	Value
Program (1-2-3-4)	Pnr __	_____
Ramp 1	Pr1	_____
Ramp Level 1	PL1	_____
Dwell 1	Pd1	_____
Ramp 2	Pr2	_____
Ramp Level 2	PL2	_____
Dwell 2	Pd2	_____
Ramp 3	Pr3	_____
Ramp Level 3	PL3	_____
Dwell 3	Pd3	_____
Ramp 4	Pr4	_____
Ramp Level 4	PL4	_____
Dwell 4	Pd4	_____
Ramp 5	Pr5	_____
Ramp Level 5	PL5	_____
Dwell 5	Pd5	_____
Ramp 6	Pr6	_____
Ramp Level 6	PL6	_____
Dwell 6	Pd6	_____
Ramp 7	Pr7	_____
Ramp Level 7	PL7	_____
Dwell 7	Pd7	_____
Ramp 8	Pr8	_____
Ramp Level 8	PL8	_____
Dwell 8	Pd8	_____

SECTION 4

MAINTENANCE

4.1 SERVICE STATEMENT

Service of Lindberg Laboratory Products can be handled in one of several ways.

1. Contact the nearest Authorized Lindberg Distributor service department.

2. Call Lindberg in Watertown, Wisconsin. The specific problem and behavior characteristics of the equipment can be discussed through a trouble-shooting approach and Lindberg can supply the necessary repair parts.

3. Obtain Lindberg's authorization first and then return the necessary equipment to the factory in Watertown, Wisconsin, to be repaired by Lindberg's full service repair center.

IMPORTANT

For your future reference and when contacting the factory, please have the following information readily available.

- **MODEL NUMBER:** _____

- **SERIAL NUMBER:** _____

The above information can typically be found on a data plate located on the right rear side of your equipment.

4.2 TEMPERATURE CONTROLLER

For specific trouble-shooting and maintenance procedures regarding the Digital Indicating Temperature Controller, refer to the Eurotherm Instruction Manual.

4.3 THYRISTOR SCR UNIT

Typical conditions for improper output are:

a. External fuses open.
b. SCR fuse open.
c. Load open.
d. No input pulses from the temperature controller.

Eliminate these conditions before investigating further causes for improper output.

Frequent SCR fuse failure on start-up is usually caused by low cold resistance loads with incorrect or with no current limit adjustment (see Operation Section).

For further trouble-shooting and maintenance procedures regarding this instrument, refer to the Eurotherm Instruction Manual.

4.4 HEATING ELEMENTS

The Electrical current for the heating elements (primary amps) is displayed on the ammeter. The absence of current and the presence of voltage on the element input terminal may mean that a silicon carbide heating element is cracked (or otherwise open).

All the heating elements are wired in series/parallel. One open element means that no power whatsoever is getting to that particular set of two (2) in series. (There are four (4) sets of two (2) each in this furnace.)

The unique design of these elements permits the furnace to operate with minimum heat loss through the roof, but this necessitates careful monitoring of the elements in relation to the sidewalls.

Lindbar elements are grouped in matched sets which fall within the elements specified amperage tolerance. The amp rating of each element is marked on the element insulator along with the code date. Select and match Lindbar elements by resistance, based on the electrical hookup of the element and furnace design.

Elements connected in series should have amp ratings that are within ± 5%. Elements connected in parallel should have amp ratings that are within ± 10%.

Element sleeves are provided with each furnace. These are required to prevent heating element contact with furnace insulation.

CAUTION

The heating elements as well as the furnace insulation pieces are extremely fragile and must be handled with great care. Avoid mechanical abuse.

WARNING

AS THE FURNACE TEMPERATURE APPROACHES THE WHITE-HOT RANGE (BEGINNING AT APPROXIMATELY 1300°C) TINTED SAFETY GLASSES MUST BE WORN WHEN OPENING THE FURNACE DOOR AND LOOKING INSIDE. DAMAGE TO THE NAKED EYE CAN OCCUR WHILE LOOKING AT LIGHT IN THE WHITE-HOT RANGE. FOR SAFETY IT IS ADVISABLE TO WEAR THESE SAFETY GLASSES WHEN LOOKING INTO THIS FURNACE AT ANY TIME WHILE IT IS OPERATING.

4.5 HEATING ELEMENT REPLACEMENT

CAUTION

Silicon carbide heating elements are extremely fragile and must be handled only with the greatest of care.

To replace any heating element in the furnace, proceed according to the following method.

1. Shut off all power to the control housing and the furnace at the customer's disconnect switch.
2. Remove the furnace rear access panel. Refer to Section 1.2.3 before proceeding.
3. Insert element sleeves into the standard heating element holes.
4. Insert heating elements through element sleeves until only the insulation head is protruding.

5. Connect the aluminum braided terminal straps to terminals. (Reference the furnace schematics.)

NOTE

Refer to the exact furnace model number when using the schematic drawing.

6. Check that elements are tight against rear furnace panel so that proper clearance is maintained between the element terminals and the rear access panel.

7. Loosely pack any gaps existing between the elements, sleeves, and furnace wall with the ceramic fiber provided.

8. Very carefully unpack the replacement heating elements and install each by following the reverse of the above procedure.

NOTES

a. When installing the replacement heating element(s), carefully guide the open end of each element through the original holes of the insulated furnace wall.

b. The heating elements are connected in series/parallel. Refer to the wiring diagram, 1-7219-1163-00A.

4.6 THERMOCOUPLE

The Type R, like all thermocouples, is subject to aging and deterioration. This condition will be indicated by a gradual drop in millivolt output for any given temperature and by furnace operation at a higher temperature than the controller indicates. The amount of deviation will vary with operating temperatures and with the age of the thermocouple. For critical processes, it is advisable to periodically check the furnace chamber temperature with a separate thermocouple and instrument in order to determine the amount of error.

The most obvious thermocouple failure is complete breakage. This usually occurs at the junction tip and is recognized by a complete lack of output by the controlling instrument.

Occasionally, the ceramic support tube for the thermocouple will crack. This will not render the thermocouple inoperable unless the broken end bends or twists, causing the two wires to touch in the broken area. This situation causes yet another reference junction, and the thermocouple should then be replaced.

It is suggested that occasional visual inspection of the thermocouple be made in order to anticipate possible failure and to reduce the chance of failure during critical work. Thermocouple deterioration is usually indicated by a reduction of diameter in the wire immediately behind the welded junction.

Regular replacement of the thermocouple in this furnace is dependent upon the amount and the extremities of its use. For replacing the thermocouple, refer to the thermocouple installation instructions given in the Installation Section.

NOTE

Before suspecting a faulty thermocouple, however, first verify the soundness of the controller signal output and the SCR firing circuit.

Thermocouple fault protection is a standard feature of the furnace control system. An open thermocouple automatically removes power from the heating elements. The thermocouple break protection circuit reduces power to the elements to zero, and the internal ammeter on the Thyristor SCR Unit will indicate zero amps.

Reversed thermocouple polarity is indicated by a "negative" indication of the controller deviation LED and by the fact that the heating elements will not shut off. (A shorted thermocouple will also cause the heating elements not to shut off.) If this is the case, switch off the circuit breaker, allow the furnace to cool, shut off the main power, and search for the fault. Replacing the thermocouple may prove to be necessary.

4.7 THERMOCOUPLE REPLACEMENT

NOTE

Power need not be turned off for merely replacing the thermocouple.

1. Remove the furnace top access panel by taking out the screws that hold it in place.

2. Disconnect the positive and negative thermocouple leadwire extension leads from their terminal screws.

3. Remove the thermocouple from the furnace by taking out the two (2) sheet metal mounting screws holding it in place and then lifting the thermocouple out of its hole in the top insulation.

4. Install the replacement thermocouple by reversing the above procedure.

NOTE

When reconnecting the wire extension leads to the thermocouple, observe the proper polarity. RED IS ALWAYS NEGATIVE. (If the extension leads are black and white, WHITE IS NEGATIVE.)

4.8 INSULATION

The furnace has been tested for 1500°C continuous-duty operation. It is recommended, however, that the furnace be operated at less than 1500°C for continuous temperature in order to prolong the life of the furnace components, heating elements, thermocouple and insulation.

Continuous use of the furnace at high temperatures may cause surface cracks to appear in the insulation hot faces, and some slight amount of insulation shrinkage will occur. However, these two phenomena will have little effect upon the furnace performance or upon the overall quality of the furnace system.

4.9 FUSE REPLACEMENT

- Two fan fuses are located at rear of furnace (lower right side). Replace as needed.

- Two controller fuses are located at rear of furnace (lower left side). Replace as needed. See figure 3-1.

- Power fuse is located in middle, on left side. See figure 3-1.

4.10 REMOTE COMPUTER OPERATION

The furnace is equipped with RS232 Digital Communications and the receptacle is located at the rear of the furnace, lower left hand corner. See figure 2-3. A remote computer may be connected to allow modification and interrogation of all instrument control and configuration parameters. Software is Lindberg's Tem Con I Communications program on a 5¼" floppy disk.

4.11 MAINTENANCE TIPS

1. Handle Lindbars CAREFULLY at all times.
2. Store Lindbars in a dry and protected storage area where they cannot be accidently bumped and broken.
3. All elements in the furnace must be operative.
4. Don't mix new elements with old elements.
5. Install elements carefully and be sure they are free to expand and contract at all times--when the furnace is hot as well as cold.
6. Don't subject the elements to unnecessary thermal shock.
7. Never try to measure the resistance of a cold element--it must be hot to obtain a reliable value.
8. Maintain matched resistance circuits at all times. Establish a good maintenance program with periodic inspection of the Lindbar elements and control equipment.
9. The silicon carbide elements are prone to aging and will increase in resistance with normal use. Eventually the Lindbars will have to be replaced. It is advisable to replace the silicon carbide heating elements in sets.
10. Keep at least one spare set of Lindbar elements in stock at all times. Be sure spare elements are of the correct physical and electrical specifications for your particular furnace.

A UNIT OF GENERAL SIGNAL GS
LINDBERG
304 HART STREET • WATERTOWN, WI. 53094
PHONE 414-261-7000

PARTS SPECIFICATIONS

General Assembly: 7219-0093-00A
Wiring: 7219-1163-00A

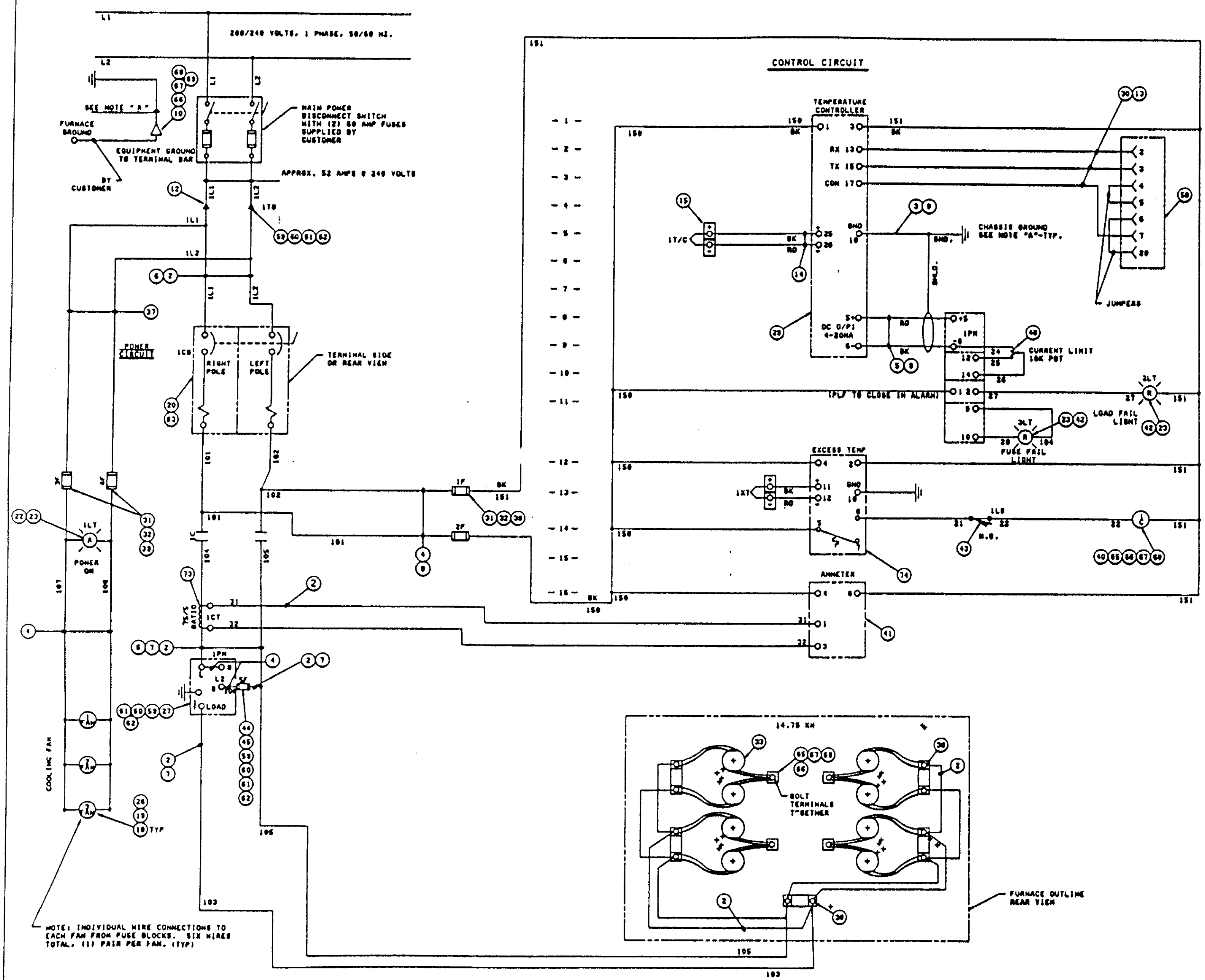
Serial #
September 25, 1991

New Sheet

MODEL 51643

BOX FURNACE

ITEM NO.	PART DESCRIPTION	PART NUMBER	QTY PER ASSY
+ 1.	Heating Element	7217-2100-014	8
+ 2.	Thermocouple, Plat. 13%		-
	a) Single	7299-1111-OAS	____
	b) Double	7299-1203-OAG	____
3.	Head, Thermocouple		-
	a) Single	7299-1406-OAF	____
	b) Double	7299-1405-OAC	____
4.	Cooling Fan	34057-128	3
5.	Hearth Plate	7100-2874-009	2
6.	Temperature Controller, #818P	103351	1
7.	Disk, Temcon I	101386	1
8.	Power Controller, 55 Amp	10479	1
9.	Ammeter, 75 Amp	10478	1
9.	Circuit Breaker, 60 Amp	105070	1
+ 11.	Fuses		-
	a) 1/2 Amp, 250 Volt	32655-006	1
	b) 3 Amp, 250 Volt	32656-022	4
	c) 90 Amp, SCR	12518	1
+ 12.	Lamp, 250 Volt		-
	a) Neon Red	33002-001	2
	b) Neon Amber	33002-005	1



CURRENT LIMIT ADJUSTMENT

A. FOR INITIAL SET-UP, TURN CURRENT LIMIT ADJUSTMENT (TITLED "I LIMIT") LOCATED ON THE SCR FULLY CLOCKWISE. ACCESS SCR THROUGH BACK PANEL OF FURNACE.

B. ADJUST TEMPERATURE CONTROL FOR 100% OUTPUT.

C. SET FRONT PANEL CURRENT LIMIT THRESHOLD ADJUSTMENT TO 35A. ACCESS ADJUSTMENT THROUGH HOLE LOCATED TO THE LEFT OF THE FRONT PANEL AMMETER.

D. READJUST INTERNAL CURRENT LIMIT SETTING LOCATED ON SCR BY TURNING COUNTERCLOCKWISE UNTIL THE POINT THAT THE CURRENT BEGINS TO DECLINE(THRESHOLD POINT).

NOTES:

A. FASTEN EQUIPMENT GROUND TO A PAINT FREE POINT IN CONTROL CONSOLE. CONNECT CHASSIS GROUNDS PLUS CUSTOMER SUPPLIED FURNACE GROUND TO EQUIPMENT GROUND TERMINAL BAR.

B. SHOP TO LEAVE ENOUGH SLACK IN ALL CONTROL PANEL WIRING SO THAT THE CONTROL PANEL CAN BE REMOVED.

CONFIGURATION CODES - MODEL 818P PROGRAMMER

MNEMONIC	FUNCTION	CODE	COMMENT
C1	INPUT & UNITS	0004	0-1500°C. TYPE R
C2	PID & OUTPUT	0100	REVERSE ACTING LOGIC
C3	ALARM DEFINITION	1400	
C4	SECURITY DEFINITION	0500	NO SECURITY
C5	COMMUNICATIONS	0000	
C6	CONTROLLER OPERATIONS	0000	STANDARD
C7	COMMUNICATIONS	0100	DIGITAL
C8	PROGRAMMER OPERATION	1204	PROGRAMMER FUNCTION
RANGE LIMITS			
DSL	DISPLAY LOW LIMIT	0°C	
DSH	DISPLAY HIGH LIMIT	1500	
SPL	SETPOINT 1 LOW LIMIT	0°C	
SPH	SETPOINT 1 HIGH LIMIT	1500	
S2L	SETPOINT 2 LOW LIMIT		NOT APPLICABLE
S2H	SETPOINT 2 HIGH LIMIT		NOT APPLICABLE
AH1	ALARM HYSTERESIS		NOT APPLICABLE
AH2	ALARM HYSTERESIS		NOT APPLICABLE
ADD	COMMUNICATION ADDRESS	0.0	
C1L	OUTPUT LOW LIMIT	0%	
C1H	OUTPUT HIGH LIMIT	100%	

HARDWARE CONFIGURATION

REFER TO THE EUROTHERM INSTRUCTION MANUAL. IT IS NECESSARY TO CLOSE THE CONFIGURATION LINK SWITCH BEFORE CONFIGURATION TAKES PLACE.

IN ORDER TO SAVE THE CONFIGURATION CODE, THE USER MUST SCROLL TO THE "CLR" MNEMONIC AND DEPRESS THE "UP" & "DOWN" BUTTONS SIMULTANEOUSLY.

ONCE CONFIGURATION IS COMPLETE, THE CONFIGURATION LINK SWITCH IS PLACED IN ITS ORIGINAL OPEN POSITION.

00A	LJL 9-91	MODEL 51643-B BOX FURNACE, 0-1500°C, W/ 818P, XT AND RS232 DIGITAL COMMUNICATIONS.

LINDBERG

TYPE MODEL 51643 818P COM.
PART POWER & CONTROL WIRING

DATE 9-9-91 | DRAWN BY LJL/AK | CHECKED BY AK | SCALE NTS

1-7219-1183 | DWG. NO. 1-7219-1183 | SHEET 1 OF 2

WARNING

THIS PRODUCT CONTAINS CERAMIC FIBER OR OTHER REFRACTORIES, WHICH CAN RESULT IN THE FOLLOWING:

May be irritating to skin, eyes, and respiratory tract.

May be harmful if inhaled.

May contain or form cristobalite (crystalline silica) with use at high temperatures (above 1600°F) which can cause severe respiratory disease.

Possible cancer hazard based on tests with laboratory animals. Animal studies to date are inconclusive. No human exposure studies with this product have been reported.

BEFORE MAINTAINING THIS EQUIPMENT, READ THE APPLICABLE MSDS (Material Safety Data Sheets).

WHEN INSTALLING, MAINTAINING, OR REMOVING THE REFRACTORY INSULATION, TAKE THE FOLLOWING PRECAUTIONS TO MINIMIZE EXPOSURE TO THE DUST AND/OR CERAMIC FIBER.

Keep personnel exposure to airborne dust and particles from the insulation as low as possible.

Use a good vacuum to clean area and equipment. Do NOT use compressed air.

Use a NIOSH high efficiency respirator (3M #8710 or equal.)

Wear long sleeve clothing, gloves, hat and eye protection to minimize skin and eye contact. Contact lenses should not be worn when handling.

Thoroughly wash self immediately after work is complete.

Launder work clothing separate from other clothes and thoroughly clean laundering equipment after use. If clothing contains a large amount of dust and/or ceramic fiber then dispose of rather than cleaning.

Promptly place used ceramic fiber parts and dust in plastic bags and dispose of properly.