

I N S T R U C T I O N S

for

LINDBERG / BLUE M

1700°C BOX FURNACE

and

CONTROL CONSOLE

L-92134-51314

March 1992

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1 DESCRIPTION	
1.1 INTRODUCTION	1
1.2 GENERAL DESCRIPTION	1
1.2.1 Specifications	2
1.2.2 Control Console	3
1.2.3 Control Console Specifications	4
1.2.4 Heating Elements	5
1.2.5 Furnace Construction	6
2 INSTALLATION	
2.1 HANDLING AND UNPACKING	7
2.2 FURNACE ASSEMBLY	7
2.3 POWER WIRING	9
2.4 CONVERSION TO 208 VOLT POWER SOURCE	12
3 OPERATION	
3.1 INITIAL START UP PROCEDURE	13
4 MAINTENANCE	
4.1 SERVICE STATEMENT	16
4.2 TEMPERATURE CONTROLLER	16
4.2.1 Programming Procedure	17
4.2.2 Tuning Parameter	18
4.2.3 Auto-tune Procedure	18
4.3 THYRISTOR SCR UNIT	18
4.4 HEATING ELEMENTS	19
4.5 HEATING ELEMENT REPLACEMENT	20
4.6 THERMOCOUPLE	23
4.7 THERMOCOUPLE REPLACEMENT	24
4.8 INSULATION	25
4.9 REMOTE COMPUTER OPERATION	25

SECTION 1

DESCRIPTION

1.1 INTRODUCTION

The intent of this manual and related drawings is to provide the necessary instructions to install, operate, and maintain Lindberg's 1700°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.

1. Refer to the instruction manual and supplied drawings BEFORE operating or maintaining this equipment.
2. DO NOT remove or bypass any safety items or electrical circuits.
3. Avoid contact with hot surfaces and electrical cables and connections.
4. Disconnect all electrical power supplies to any item being serviced before doing any maintenance work on it.
5. Shutting off the furnace at the control console 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

Lindberg/Blue M 1700°C Box Furnace's are designed for general purpose heating laboratory process applications and small production work loads to a maximum temperature of 1700°C (3092°F).

The complete furnace assembly consists of the box furnace i.e., model 51314 or 51524 and a separate control console i.e., model 59246-P-COM or 59256-P-COM, featuring a digital display electronic controller, a Silicon Controlled Rectifier (SCR), and a single circuit breaker for the furnace heating system. A multi-segment programmer/controller is standard in the control console. The 1700°F Box Furnace is manufactured in two model sizes, with each one having the same design characteristics and control features. It is recommended that only recommended Lindberg/Blue M Control Consoles be used to power and control Lindberg/Blue M Laboratory furnaces.

The following paragraphs describe more specific details of the Lindberg 1700°C Box Furnace.

1.2.1 Specifications:

- Furnace Model 51314
- A. Overall Outside Dimensions: 14-9/16" High x 16" Wide x 18-13/32" Deep
- B. Inside Heating Chamber Dimensions: 6-1/2" High x 6-1/2" Wide x 6-1/8" Deep
- C. Vestibule (Door) Opening: 5" High x 5" Wide x 1-1/2" Deep
- D. Maximum Work Area: 4-7/8" High x 4-7/8" Wide x 6" Deep
- E. Weight: 50 lbs.
- F. Maximum Operating Temperature: 1700°C (3092°F)
- G. Heating Elements: Molybdenum Disilicide
- H. Number of Elements: 6
- I. Elements' Melting Temperature: 1871°C (3400°F)
- J. Thermocouple: Type B
(Negative Wire: 94% Platinum, 6% Rhodium
Positive Wire: 70% Platinum, 30% Rhodium)
- K. Control Console Number: 59246-P-COM
- L. Wattage: 3500

• Furnace Model 51524

- A. Overall Outside Dimensions: 16-1/16" High x 19-1/2" Wide x 22-13/32" Deep
- B. Inside Heating Chamber Dimensions: 8" High x 10" Wide x 10-1/8" Deep
- C. Vestibule (Door) Opening: 6-1/2" High x 8-1/2" Wide x 1-1/2" Deep
- D. Maximum Work Area: 6-3/8" High x 8-3/8" Wide x 10" Deep
- E. Weight: 73 lbs.
- F. Maximum Operating Temperature: 1700°C (3092°F)
- G. Heating Elements: Molybdenum Disilicide
- H. Number of Elements: 10
- I. Elements' Melting Temperature: 1871°C (3400°F)
- J. Thermocouple: Type B
(Negative Wire: 94% Platinum, 6% Rhodium
Positive Wire: 70% Platinum, 30% Rhodium)
- K. Control Console Number: 59256-P-COM
- L. Wattage: 5000

1.2.2 Control Console:

NOTE

Use only recommended Lindberg/Blue M Laboratory Control Console to power and control furnace.

The temperature control system for the 1700°C Box Furnace is housed in a separate instrument console, which is manufactured in two different models to correspond with each of the two furnace sizes. Console Model Number 59246-P-COM is used with the Model 51314 furnace, and Console Model Number 59256-P-COM is used with the Model 51524 furnace. The controls mounted in each console are the same, and they are briefly described below:

Furnace should not be mounted directly on top of the control console. It is recommended that control console be remotely placed near the furnace.

1. Digital Indicating Controller, with a four-digit temperature display screen calibrated in degrees Centigrade.
2. Modular SCR Unit with these features and indicators:
 - A. SCR Fuse
 - B. Fuse Failure Indicator Light
 - C. Integral Ammeter
3. Current Limit Potentiometer
4. On/Off Temperature Control System Circuit Breaker, which is one switch with a dual function. It provides furnace overload protection and excess temperature protection. (See Special Note on Page 15.)
5. Amber lamp, located near the Lindberg/Blue M nameplate 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.

1.2.3 Control Console Specifications:

- Control Console Model 59246-P-COM
- A. Overall Dimensions: 9-1/2" High x 21" Wide x 15-1/4" Deep
- B. Weight: 71 lbs.
- C. Instrument Control Range: 0-1800°C

NOTE

Maximum operating temperature of the furnace is 1700°C.

- D. Thermocouple Input: Type B (See Page 3)
- E. Furnace Number: 51314
- F. Electric Power Requirements: 208/240 Volts AC, 1 Phase, 50/60 Hertz
- G. 16 Segment Programmable Controller
- H. RS232 Communications Kit

- Control Console Model 59256-P-COM
- A. Overall Dimensions: 9-1/2" High x 21" Wide x 15-1/4" Deep
- B. Weight: 88 lbs.
- C. Instrument Control Range: 0-1800°C

NOTE

Maximum operating temperature of the furnace is 1700°C.

- D. Thermocouple Input: Type B (See Page 3)
- E. Furnace Number: 51524
- F. Electric Power Requirements: 208/240 Volts AC, 1 Phase, 50/60 Hertz
- G. 16 Segment Programmable Controller
- H. RS232 Communications Kit

1.2.4 Heating Elements:

The molybdenum disilicide heating elements are designed in a unique "L-shaped" configuration to ensure the longest possible life, a minimum degree of distortion at extreme temperatures, and ease of replacement. These elements are resistant to thermal shock and can be subjected to extremely rapid heat-cool cycling.

Also, the resistance of these high temperature heating elements does not change with use, which allows for replacement of individual elements at any time without having to match resistance values of new elements to older ones.

CAUTION

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

1.2.5 Furnace Construction:

The 1700°C Box Furnace design utilizes double shell construction and forced air cooling, all of which contribute to very low outside surface temperatures even while the inside chamber is operating at maximum temperature. At 1700°C inside temperature, for example, the skin temperature of the outside shell averages approximately 120°F.

The furnace shell contains removable louvered panels that provide easy access to the heating element terminals and the thermocouple. Heating elements and the ceramic fiber insulation assemblies are easily removable and replaceable from the inside of the heating chamber itself. The hearth plate is also removable.

To guard the operator against an immediate heat surge when the furnace door is opened, it is vertically hinged and designed to lift open in a vertical plane, providing the operator with a heat shield until the door is lifted above the furnace opening. 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(s) to the furnace's designated location.
2. Open all containers and remove all contents and all packing material.
3. DO NOT THROW AWAY ANY PACKING MATERIALS until the furnace/control 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, but the customer must provide power connection wires to and between the control console and the furnace itself. Other connections must be made as well.

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/Blue M in order to facilitate repair or correction before-completing the installation.
3. Unscrew and remove the furnace top and side access panels in the outside shell and visually inspect the thermocouple and element leadwire connections. Tighten if necessary.

NOTE

The RED thermocouple extension lead is always NEGATIVE.

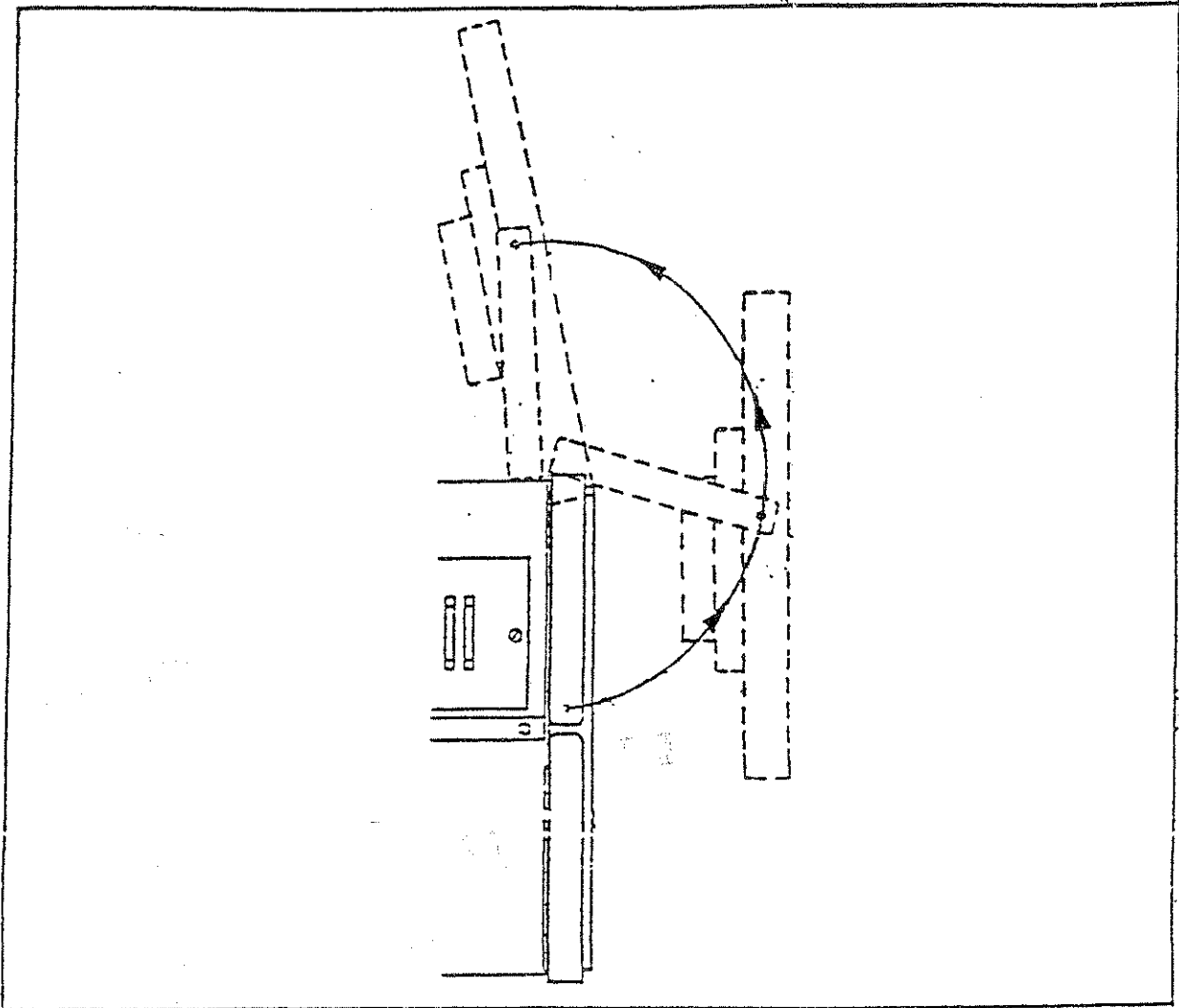


Figure 2-1: Door Operation

4. Open the furnace door by grasping the handle and extending the thumb to the surface of the door for balance and control. Pull the door away from the furnace and upwards in one smooth, continuous motion (see Figure 2-1). The door is closed in the same way, moving in the opposite direction.

NOTE

The door insulation plug should mate properly with the furnace vestibule opening.

5. Check to make sure that the "U" (hot section) of each element is located approximately 1/2 inch from the inside surface of each side chamber wall. This distance is easily adjusted simply by grasping the terminal ends of each element and pushing or pulling the element through the holes in the insulation. **HANDLE THESE ELEMENTS ONLY WITH GREAT CARE. THEY ARE EXTREMELY FRAGILE.**

NOTE

Molybdenum disilicide heating elements tend to wobble on initial heating and may bow, but once radiant temperature is reached, this condition will correct itself.

2.3 POWER AND CONTROL WIRING

The 1700°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 control console is wired at the factory for 240 volts at 60 Hertz. (For conversion to 208 volts, see Paragraph 2.4.)

The customer must provide power connection wires between the customer's main power junction or circuit breaker box or disconnect switch and the control console. The customer must also provide power connection wires between the control console and the furnace.

CAUTION

The furnace must not be operated directly on line voltage. Customer's power must be connected to the control console and not directly to the furnace.

The customer must also provide a main-line disconnect switch or main-line circuit breaker on 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 the control console and in sizing the power line from the customer's disconnect switch to the appropriate control console terminal block and in sizing all power lines between the control console and the furnace. The wires, in general, should correspond with those carrying similar loads already installed by Lindberg/Blue M in the control console and 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. The distance between the furnace and the control console is necessarily limited to six (6) feet, which is the length of the thermocouple leadwire. For distances greater than this, more thermocouple wire will be necessary.

NOTE

Consult local electrical codes for proper sizing of power and control wiring.

Connect power to the furnace and control console according to the following procedure:

1. Remove the rear panels of both the furnace and the control console by taking out the necessary screws.
2. Connect two leads of 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 .

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

NOTE

The back panels of the furnace and control console have pre-drilled holes for wires. It will be necessary to thread the wires through the holes in the panels before making any connections.

3. Connect a properly-sized ground wire from the main lug on the ground bar in the control console to an appropriate ground in the customer's facility. (Be sure to follow local electrical codes.)
4. Connect two wires of the same type as used L_1 and L_2 between 1TB in the console (at the side opposite the connections) and the left-hand (as you face the rear of the furnace) terminal block in the furnace. These wires are to connect the fans. Mark the wires $1L_1$ and $1L_2$ and connect each to its identically labeled terminal in both the console and the furnace. (See NOTE after Instruction #2.)

Section 2

5. Connect a properly-sized ground wire from the furnace to the ground bar in the control console. (Refer to the supplied Furnace Wiring drawing and see NOTE after Instruction #2.)
6. Connect two properly-sized power wires, marking them A1 and B1, from the left-hand terminal block, labeled 2TB, in the control console to the right-hand terminal block in the furnace. Connections at each terminal block are marked. Be sure to connect console A1 to furnace A1 and console B1 to furnace B1. The furnace A1 terminal connects power to the heating elements on the right side of the furnace (as you face the rear), and the furnace B1 terminal connects power to the heating elements on the left side. In the control console, the A1 and B1 terminals connect directly to the transformer. (See NOTE after Instruction #2.)
7. Remove the furnace top access panel by taking out the screws that hold it in place.
8. Make sure the thermocouple is securely in place in the roof of the furnace, that it is not cracked or damaged, and that the wiring connections are correct and secure. (Red is negative.)
9. Replace and secure the back panel of the control console, using the necessary screws.
10. Insert the white thermocouple plug at the end of the leadwire coming from the furnace thermocouple into its thermocouple jack at the rear of the control console. Observe the proper polarity, although the plug should only fit one way into the jack. (See NOTE after Instruction #2.)
11. Replace and secure the furnace 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.

2.4 CONVERSION TO 208 VOLT POWER SOURCE

The 1700°C Box Furnace comes from the factory prewired to operate on a supply source of 240 volts. If the supply source is 208 volts, all that is required is a simple conversion in the control console to enable the furnace to operate.

Use the following procedure in converting to 208 volt operation:

1. Refer to the supplied Power and Control Wiring drawing, especially Note "C".
2. Make sure there is no power whatsoever coming into the control console while this procedure is being performed.
3. Remove the top covering panel of the control console by taking out the necessary top, rear, and side screws. Some screws are located in the top chrome trim piece.
4. Disconnect the wire from the H3 tap on the primary side of the transformer (just behind the front panel of the control console), and reconnect it to the H2 tap. This is all the rewiring that needs to be done.
5. Replace the top covering panel of the control console, using the necessary screws.

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, review the provided 818 Operation Manual before attempting to operate the furnace for the first time.

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 shunt-trip breaker is also in the "ON" position.

NOTE

The cooling fans in both the control console and the furnace 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 will also illuminate indicating that the power is "ON" and that the fans are operating.

2. Adjust the current limit of the model 832 ammeter to approximately 50% of the potentiometer range. This is adjusted by using a small screwdriver in the potentiometer beneath the small door on the 832 ammeter.

NOTE

This adjustable setting allows the current limit level to be set at the maximum furnace value. The maximum value is given on the furnace data plate (W/E). The reading on the front of the ammeter should be approximately this maximum value.

3. Using the P key, scroll to the parameter AL1. This is the high alarm setting. Using the up ↑ or down ↓ arrow key, set the alarm at 825°C. Allow the control to return to the original display.

4. Using the up ↑ arrow key, adjust the setpoint temperature to 800°C. Allow the furnace to run at 800°C for at least 1 hour. Observe amperage reading on the ammeter as the furnace is heating. Adjust the ammeter potentiometer, if necessary.
5. Reset the alarm setpoint (AL1) to 1725°C, and the temperature setpoint to 1650°C. Allow the furnace to reach 1650°C, and to run at this temperature for one hour.
6. After completing the start-up procedure, and if all controls and indications are working properly, the system is now ready for normal customer use.
 - a. Readjust alarm and temperature setpoints as necessary, and begin to heat the first process load.

WARNING

EVEN IF POWER TO THE FURNACE IS SHUT OFF AT THE SHUNT TRIP CIRCUIT BREAKER, POWER STILL REMAINS "ON" AT THE CONTROL CONSOLE AND THE FANS WILL CONTINUE TO OPERATE. DO NOT SHUT OFF 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 shunt trip circuit breaker.
2. Shut off power to the system before attempting any maintenance or repair.
3. See the Maintenance Section of this manual.

TIME DELAY EXCESS TEMPERATURE

TO OVERCOME THE TENDENCY OF THE EXCESS TEMPERATURE FUNCTION TO SHUT OFF POWER TO THE FURNACE WHENEVER THE SHUNT TRIP CIRCUIT BREAKER IS PLACED IN ITS "ON" POSITION, LINDBERG HAS INSTALLED AN ON-DELAY TIMING MODULE INSIDE THE CONTROL CONSOLE. THIS TIMING MODULE IS ADJUSTABLE FROM .1 TO 45 SECONDS AND HAS BEEN SET FOR MINIMUM TIME DELAY AT THE FACTORY.

DURING FURNACE OPERATION THIS TIME DELAY HAS THE EFFECT OF DELAYING EXCESS TEMPERATURE PROTECTION, AS THE SHUNT TRIP CIRCUIT BREAKER WILL NOT BE TRIPPED "OFF" (WHENEVER THE FURNACE ARRIVES AT AN OVER TEMPERATURE CONDITION) UNTIL THIS TIMING MODULE TIMES OUT. SHOULD THE PRESET TIME DELAY PROVE UNSATISFACTORY, THE SETTING MAY BE ADJUSTED.

TIME DELAY ADJUSTMENT

SIMPLY REMOVE THE BACK PANEL OF THE CONTROL CONSOLE, LOCATE THE TIMING MODULE ON THE BASE OF THE CONSOLE, AND ADJUST THE POT IN THE CENTER OF THE UNIT WITH A SMALL SCREWDRIVER. TURN THE POT IN THE DIRECTION OF THE ARROW TO INCREASE THE TIME DELAY, OR TURN IT IN THE OPPOSITE DIRECTION TO DECREASE THE TIME DELAY. TEST THE UNIT. THE RED LIGHT WILL ILLUMINATE ONLY WHILE THE MODULE IS TIMING. REPLACE THE BACK PANEL AFTER ALL ADJUSTING IS COMPLETED.

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 troubleshooting 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.

4.2 TEMPERATURE CONTROLLER

The 59246-P-COM and 59256-P-COM use a Eurotherm 818P4 programmable controller. The 818P4 allows up to 4 separate programs consisting of 16 steps (8 ramps/8 dwells).

The 818P4 can also be used as a setpoint controller, by simply adjusting the setpoint temperature (lower display) using the arrow keys.

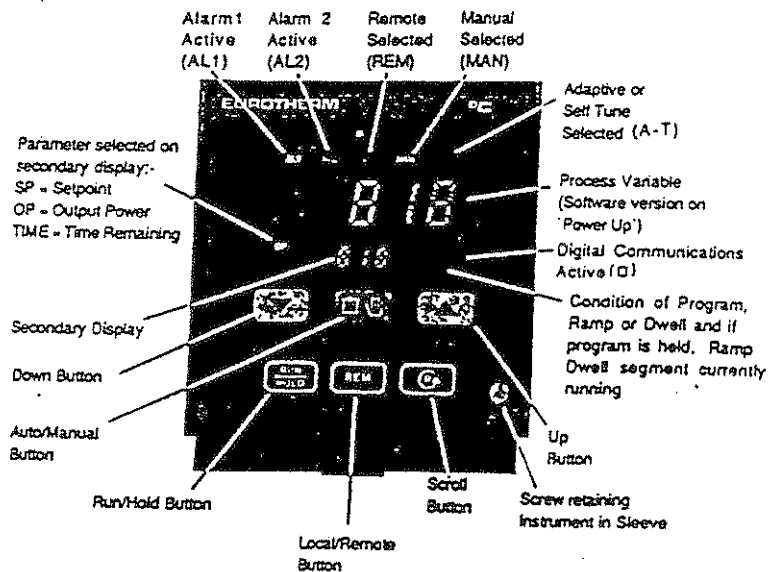


Figure 4.1: Eurotherm Controller Model 818P4

4.2.1 Programming Procedure:

The program parameters are set through the use of the parameters Pr1-8 (ramps), Pl1-8 (temperature levels), and Pd1-8 (dwell times). The units are factory set to degrees C/min for ramp rates, degrees C for the temperature levels, and hours for dwell times.

1. Sketch out your desired temperature profile. (See Figure 4.2 for a sample 818P profile).
2. Determine the ramp rates, temperature levels, and dwell times of your desired profile. Set those values into the program by scrolling to the parameters pr1, pd1, pl1, etc., and entering the values by using the up or down arrow keys. For multiple programs scroll to "pnr_" and select up to four possible programs.

* Heat-up and cool-down rates will be limited by the natural system response.

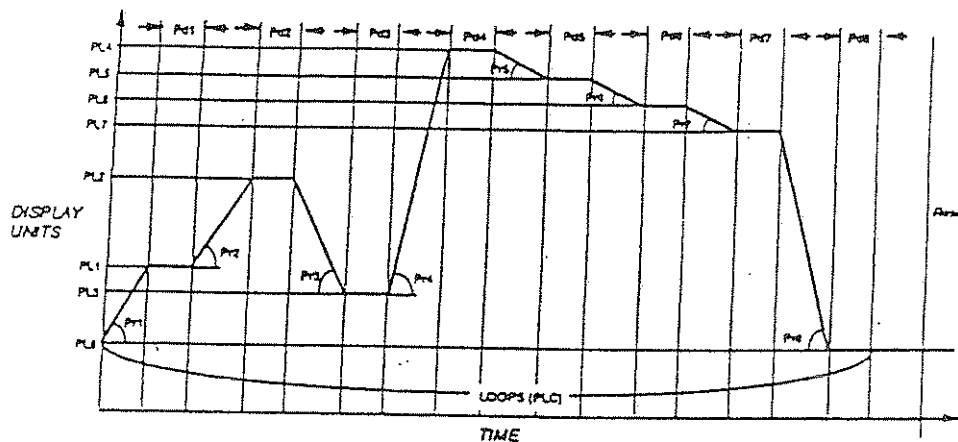


Figure 4.2: Sample 818P4 Program

The program is initiated by scrolling to the parameter "pnr1-4" and pressing the Run/hold key at the desired program number. The program will automatically begin and run until an end statement, at which time the program display displays an E.

The program mode can be exited by simultaneously depressing the up and down arrow keys.

4.2.2 Tuning Parameters:

Preset factory PID parameters should provide for good control at most temperatures. If furnace temperatures overshoot the setpoint excessively and/or are not stable at setpoint, modification of the PID and other tuning parameters may be necessary. Modification can be accomplished by using the self tuning feature (refer to p.72-76 in the 818 manual) or by manually tuning the instrument (p.86-93, 818 manual).

4.2.3 Auto-tune Procedure:

1. Scroll, using the P key until you reach the parameter "st". At "st" depress the up and down arrow keys simultaneously. This will put the programmer in tuning mode, indicated by the A-T display on the controller face.
2. While the "SP" indicator is blinking, change the setpoint temperature, using the up arrow key, to approximately 60% of your maximum temperature level. The tuning program will initiate, and will need 15 - 45 minutes to complete. Upon completion of tuning, the "A-T" indicator light will extinguish.

The tuning parameters now will be set to a desirable level for most program steps. The tuning procedure does not have to be repeated unless greatly different temperatures are desired.

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.

SCR (I^2t) fuse failure on start up is usually caused by low cold resistance loads with incorrect or with no current limit adjustment (see Operation Section, Page 13).

For further troubleshooting and maintenance procedures regarding this instrument, refer to the manufacturer's instruction manual.

4.4 HEATING ELEMENTS

The electrical current for the heating elements (primary amps) is displayed on the Thyristor SCR Unit ammeter. The absence of current and the presence of voltage on the element input terminal may mean that a molybdenum disilicide heating element is cracked (or otherwise open).

All the heating elements are in series, and so one open element means that no power whatsoever is getting inside the furnace.

The unique design of these elements permits the furnace to operate with minimum heat losses through the roof, but this necessitates careful monitoring of the elements in relation to the sidewalls. Due to construction and design, the elements may wobble and curl away from the wall nearest them. If an element should curl towards the wall and touch the insulation, shut off the furnace immediately and, after it cools, relocate the element farther away from the wall. All the elements will straighten out at high temperatures.

CAUTION

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

Do not try to physically or mechanically reshape the element. The element should reform itself under temperature.

Molybdenum disilicide heating elements are essentially inert, and they are normally unaffected by most furnace atmospheres or by reducing or oxidizing gases. Also, in normal operation the elements will not contaminate any process load.

Molybdenum disilicide elements which have been operating for a long time at high temperature and have then cooled down, sometimes have internal stresses which cause the glaze to splinter into small fragments. There have been instances where elements which have been cold for several days have emitted a shower of fine glaze particles when touched. Always use eye protection even when handling cooled-down molybdenum disilicide elements.

Oxidation resistance is provided by a coating of silicon dioxide that forms on the elements when they are heated in air above 995°C. If this coating should become cracked for any reason, simply reheating the elements above 995°C will restore the coating. If a foreign substance should adhere to any element, it will often spall away, and the silicon dioxide will repair itself above this temperature. If the particle does not spall away, the silicon dioxide surrounds it with a compound of a low melting point which washes it away.

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

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

Should it become necessary to replace any heating element in the furnace, proceed according to the following method.

1. Shut off all the power to the control console and the furnace at the customer's disconnect switch.
2. Remove the furnace side access panels.
3. Carefully remove the stainless winged "M" clamps holding the braided aluminum interconnecting straps to the aluminized terminal extensions (lead sections) of each heating element to be replaced. The clamps are opened by squeezing together on the clamp wings, which opens the clamp jaws.
4. Carefully remove the interconnecting straps themselves and tag or label them as to their position for re-attaching them later.

Section 4

5. Remove the metal retainer above the furnace opening by taking out the holding screws. (See the exploded view diagram in Figure 4.3.)
6. Very carefully remove the furnace doorway insulation pieces according to Figure 4.3.
7. Very carefully pull each heating element through its holes in the insulation completely into the furnace chamber and then angle each one out through the doorway.
8. Very carefully unpack the replacement heating elements and install each by following the reverse of the above procedure.

NOTE

- a. The heating elements are connected in series.
- b. The interconnecting straps and "M" clamps are designed to fit over the outside circumference of each heating element terminal lead section. The straps may require a small amount of hand forming for good contact between the terminal and strap. Open the clamp jaws by squeezing the wings together, slip the jaws over the strapped terminal, and then release the wings.

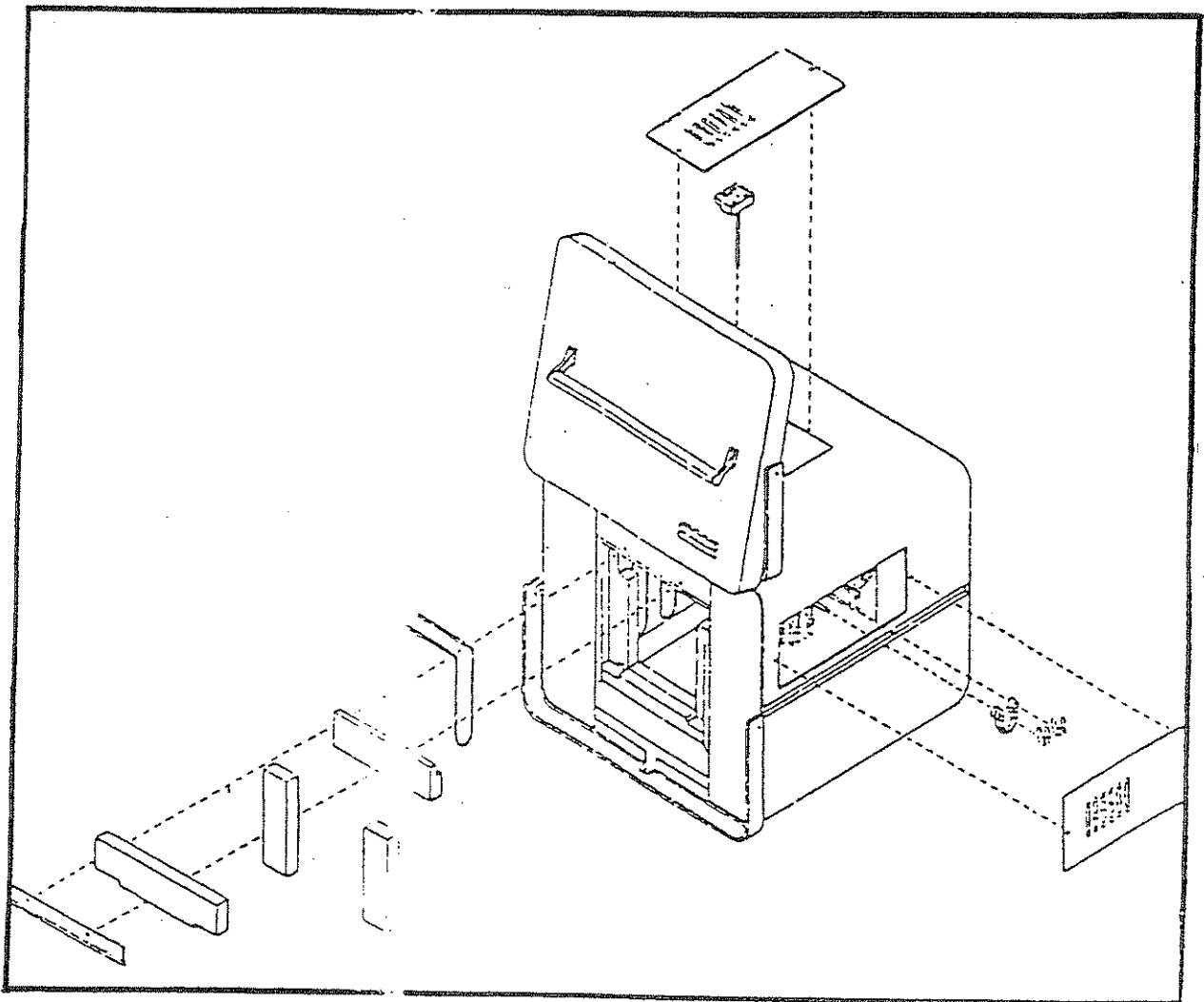


Figure .3: Exploded View Diagram

CAUTION

Do not rotate the clamp and strap about the terminal, as this induced torsion (rotational stress) may break the heating element.

4.6 THERMOCOUPLE

The Type B, 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 periodically to 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 shunt-trip 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 1700°C continuous-duty operation. It is recommended, however, that the furnace be operated at less than 1700°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 REMOTE COMPUTER OPERATION

The furnace is equipped with RS232 Digital Communications and the receptacle is located at the rear of the control console, lower left hand corner. 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 5- $\frac{1}{4}$ " floppy disk.

• ONE YEAR LIMITED WARRANTY •

All Lindberg/Blue M laboratory equipment and parts are warranted to be free from defects in materials and workmanship for a period of one (1) year from date of purchase. This warranty shall not apply to equipment or parts which have been subject to misuse, negligence, accidents or lack of proper maintenance. Furnace elements and thermocouples are not warranted because it is impossible to predict the temperature or severity of service to which they will be subjected.

This warranty is in lieu of all other warranties, expressed or implied, made during the sale of the product, including, but not limited to any expressed or implied warranty or merchantability of fitness for a particular purpose.

Lindberg/Blue M shall not be liable for any consequential, contingent, or incidental damages. Please contact Lindberg/Blue M for all warranty claims.

• RETURNED MATERIALS •

To return materials to Lindberg/Blue M please contact Lindberg/Blue M at (800) 657-0770 / (414) 261-7000. Lindberg/Blue M will not accept any unauthorized shipments.

To return an item please have the following information available:

MODEL NUMBER	
SERIAL NUMBER	
DATE OF PURCHASE	
LOCATION OF PURCHASE	

Ship the materials, prepaid to:

Lindberg/Blue M
304 Hart St.
Watertown, WI 53094

Upon receipt of the materials, Lindberg/Blue M will inspect and evaluate the materials and inform you of any corrective action required.

**1700° C.
BOX
FURNACE**

**Parts List
and
Exploded View**

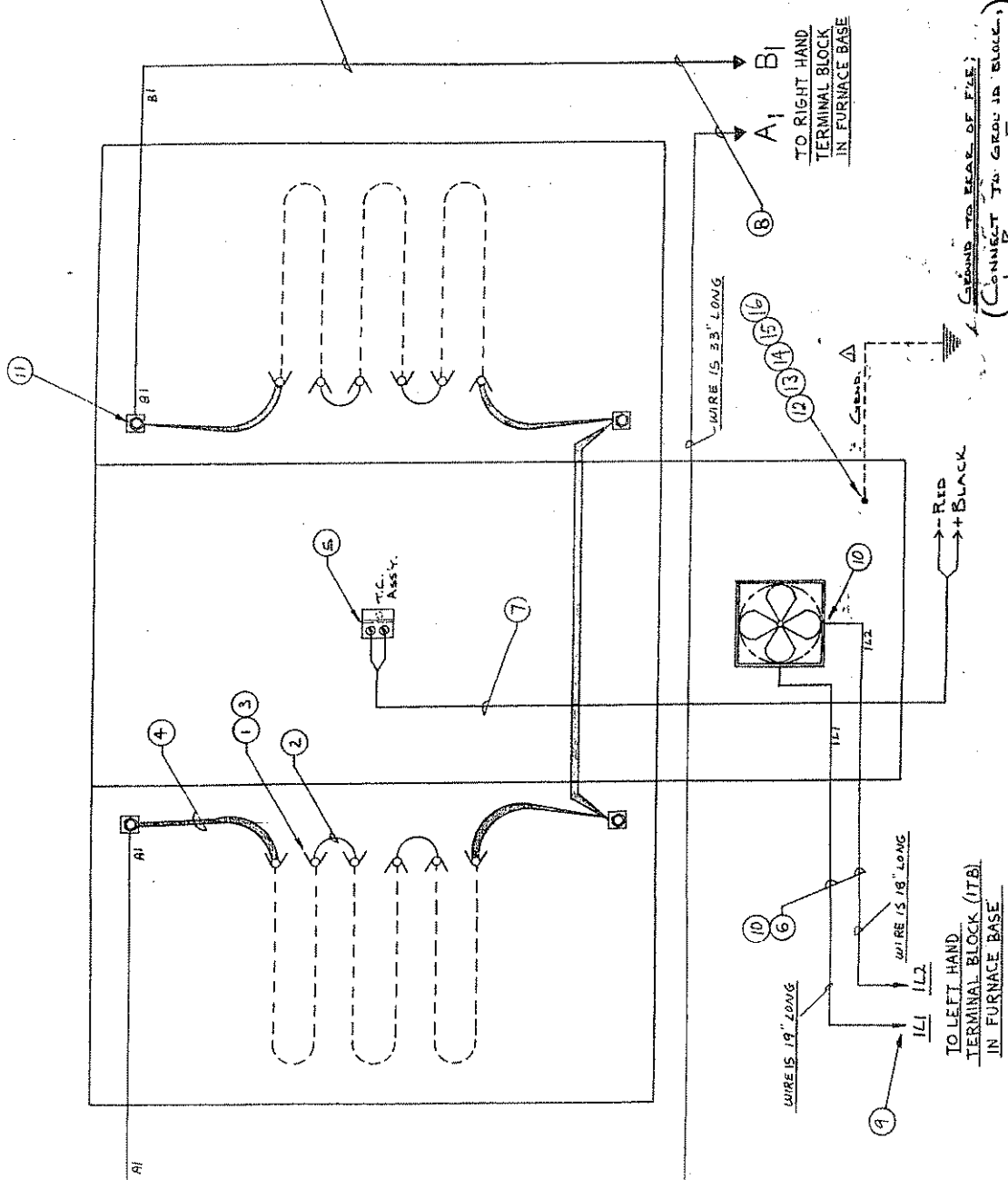
A UNIT OF GENERAL SIGNAL 

LINDBERG

MK	REVISION	BY	DATE	DWG No. 2-7219-1048
1	Added Ground Wire to D.A. Case	W.L.	12-2-81	
2	WAS 8 ADD ITEMS	W.L.	2-10-81	
3	WAS 8 ADD ITEMS	W.L.	2-10-81	
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99	WAS 8 ADD ITEMS	W.L.	2-10-81	
100	WAS 8 ADD ITEMS	W.L.	2-10-81	

FURNACE SPECIFICATION
WATTAGE - 3500
VOLTAGE - 58 VAC
AMPS (APPROX) - 60.40

WIRE IS 20" LONG

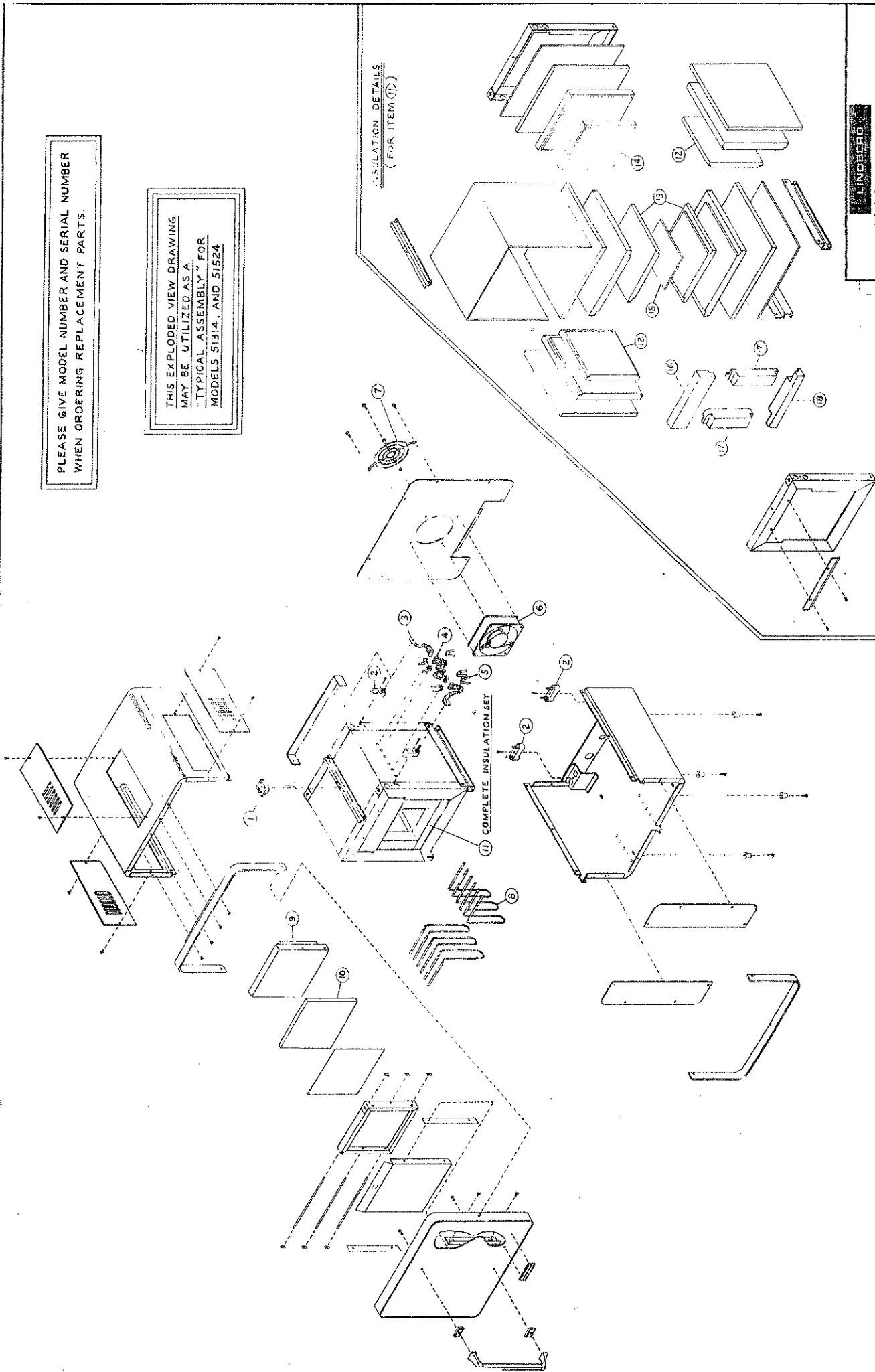


1	16	#10-32 NUT	C.P.	20102-013
1	15	#10 LOCKWASHER	C.P.	20084-003
1	14	#10 FLAT WASHER	C.P.	20087-001
1	13	10-32 X 1/2 R.H.D. SCREW	C.P.	20016-076
1	12	BURNDY, SCREW LUG		22078-002
4	11	#8 GA. TERMINAL RING, 10 STUD		22057-004
2	10	#16 GA. SLIP ON TAB		22012-001
2	9	#14-16 GA. WIRE, LUG, HI-TEMP		22060-075
5	8	#8 GA WIRE - SEW 2	SEW 2	22012-006
1	7	T.C. LEAD & PLUG	TYPE 'B'	M-7214-1439-801
3	6	#16 GA. WIRE, 2' BLACK	3m-2	22012-001
1	5	T.C. Ass'y (3 1/2" Lx)	1" B'	2-7299-1166-001
4	4	CONTACT CLIP 3/16 CLAMP		33810-001
12	3	CONTACT CLIP 3/16 CLAMP		33810-002
4	2	TERMINAL STRAP - EL TO EL		33810-003
6	1	KANTHAL SUPER 33-51/2		2-7219-1046-200
REV	ITEM	NAME	MAT.	DWG. or LOT NO.
1	1	WIRE		2-7219-1048
2	2	WIRE		2-7219-1048
3	3	WIRE		2-7219-1048
4	4	WIRE		2-7219-1048
5	5	WIRE		2-7219-1048
6	6	WIRE		2-7219-1048
7	7	WIRE		2-7219-1048
8	8	WIRE		2-7219-1048
9	9	WIRE		2-7219-1048
10	10	WIRE		2-7219-1048
11	11	WIRE		2-7219-1048
12	12	WIRE		2-7219-1048
13	13	WIRE		2-7219-1048
14	14	WIRE		2-7219-1048
15	15	WIRE		2-7219-1048
16	16	WIRE		2-7219-1048

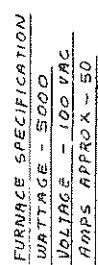
PLEASE GIVE MODEL NUMBER AND SERIAL NUMBER
WHEN ORDERING REPLACEMENT PARTS.

THIS EXPLODED VIEW DRAWING
MAY BE UTILIZED AS A
"TYPICAL ASSEMBLY" FOR
MODELS 51314, AND 51524

INSULATION DETAILS
(FOR ITEM 11)



REV	DATE	BY	DESCRIPTION	QUANTITY	UNIT	PRICE	TOTAL	REMARKS
1	12-2-81	TR	10000	10000	10000	10000	10000	10000
2	12-2-81	TR	10000	10000	10000	10000	10000	10000
3	12-2-81	TR	10000	10000	10000	10000	10000	10000
4	12-2-81	TR	10000	10000	10000	10000	10000	10000
5	12-2-81	TR	10000	10000	10000	10000	10000	10000
6	12-2-81	TR	10000	10000	10000	10000	10000	10000
7	12-2-81	TR	10000	10000	10000	10000	10000	10000
8	12-2-81	TR	10000	10000	10000	10000	10000	10000
9	12-2-81	TR	10000	10000	10000	10000	10000	10000
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37	12-2-81	TR	10000	10000	10000	10000	10000	10000
38	12-2-81	TR	10000	10000	10000	10000	10000	10000
39	12-2-81	TR	10000	10000	10000	10000	10000	10000
40	12-2-81	TR	10000	10000	10000	10000		



QTY	ITEM	NAME	MAT.	DWG. or LOT NO.	GROUP
1	16	#10-32 NUT	C.P.	20102-013	
1	15	#10 LOCK WASHER	C.P.	20084-003	
1	14	#10 FLAT WASHER	C.P.	20087-001	
1	13	10-32 x 1/2 Rd Hd SCREW	C.P.	20016-076	
1	12	BURNDY, SCREW LUG		22078002	
4	11	10GA. TERMINAL RING, #10 STUD		22055007	
4	10	#16 GA. SLIP ON TAB		22055007	
4	9	1/4-16 GA WIRE, LUG HITCH		13060075	
6 FT	8	10 GA WIRE - SEW-2		22012-011	
1	7	T.C. LEAD & PLUG	TYPE "B"	M-7214-1439	DOF
5 FT	6	16 GA WIRE - 1/2" - 2" - BULK	TYPE "B"	22012-001	
1	5	T.C. Assy. (3 1/2" LUG)		2-72799-1166	DOA
4	4	CONNECT STRUT 3/4" LUG		33810-001	
20	3	CON. ZINC PL. COG. 3/16" CLAMP		33810-002	
2	2	TERMINAL NO. 210-00001-04-20			
1	1	TERMINAL NO. 210-00301-06-00		33810-003	
10	1	KWINTHAL SUPER 33-7"		2-7219-1046	DOZ

LINDERBERG

DATE	7-20-21	DRAWN BY	M.K.V.	CHECKED BY	M. L. SCALE	N.T.S.	WORK SHEET NO.	17	DATE	7-20-21
TYPE		MODEL		51524		HI-TEMP FCE		-200°C		
PART		F55		W/INCG		8" x 10" x 10" A				
DWG. No.		2		7215		1047		SHEET		1 OF 1

1700° C BOX FURNACE PARTIAL PARTS LIST
(Dwg. No. 1-7219-0005)

Reference Number	Description	Part Number for 51314	Quantity	Part Number for 51524	Quantity
1	Thermocouple Assembly				
	Thermocouple Only "Type B", Single	H-7299-1165-001	1	H-7299-1165-001	1
	Thermocouple Head	S-7214-2051-00A	1	S-7214-2051-00A	1
	Thermocouple Leadwire	33940-021		33940-021	
2	Terminal Block	M-7218-2047-001	4	M-7218-2047-001	4
3	Contact Strap	33810-001	4	33810-001	4
4	Terminal Strap	33810-003	4	33810-003	8
5	Contact Clip	33810-002	12	33810-002	20
6	Fan	34057-128	1	34057-128	2
7	Fan Grill	34057-129	1	34057-129	2
8	Heating Elements	2-7219-1046-001	6	2-7219-1046-002	10
9	Door Plug	2-7219-2095-003	1	2-7219-2086-003	1
10	Door Insulation	2-7219-2095-005	1	2-7219-2086-005	1
11	Complete Insulation	1-7219-2107-00A Items 1-5 & 11 only	1	1-7219-2106-00A Items 1-6 & 12 only	1
12	Side, Hi-Temp Insulation	1-7219-2103-010	2	1-7219-2102-010	2
13	Hi-Temp Insulation				
	Top	1-7219-2103-008	1	1-7219-2102-008	1
	Bottom	1-7219-2103-015	1	1-7219-2102-015	1
14	Back, Hi-Temp Insulation	1-7219-2103-009	1	1-7219-2102-009	1
15	Hearth Plate	3-7219-2142-002	1	3-7219-2142-001	1
16	Top Vestibule	1-7219-2103-014	1	1-7219-2102-014	1
17	Right or Left Side Vestibule	1-7219-2103-013	1	1-7219-2102-013	1
18	Bottom Vestibule	1-7219-2103-012	1	1-7219-2102-013	1



WARNING

This product contains refractory ceramic fiber and/or firebrick (silica) insulation and, after services at temperatures greater than 1800°F, may form, and therefore may contain, cristobalite (crystalline silica). The following hazards pertain to exposure to insulation dusts:

DUST CAN CAUSE SEVERE RESPIRATORY DISEASE (SILICOSIS).
DUST MAY BE IRRITATING TO SKIN, EYES, AND RESPIRATORY TRACT.
SUSPECT CANCER HAZARD BY INHALATION.

Refractory Ceramic Fibers MAY CAUSE CANCER BASED ON ANIMAL
DATA and Cristobalite (Crystalline Silica) MAY CAUSE CANCER.

Risk of cancer depends on duration and level of exposure.

BEFORE USING OR MAINTAINING THIS EQUIPMENT, READ THE MATERIAL SAFETY DATA SHEET (MSDS) ON THIS INSULATION.

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

Avoid breathing dust. Keep personnel exposure to airborne dust and particles from the insulation as low as possible. Use engineering controls where feasible.

Avoid unnecessary cutting and tearing of the material to minimize generation of airborne dust.

Insulation surfaces should be lightly sprayed with water or other suitable wetting agents before removal to suppress dust. Spray additional water or wetting agents to replace liquids which evaporate during removal. A surfactant may aid the wetting process.

Dust suppressing cleaning methods, such as wet sweeping or vacuuming should be used to clean the work area. If dry vacuuming is used, the vacuum must be equipped with a HEPA filter. Air blowing or dry sweeping should not be used. Do NOT use compressed air. Dust suppressing compounds may be used to clean up light dust.

As minimum protection, use a high efficiency air purifying half-face respirator equipped with HEPA filter cartridges if airborne fiber levels or cristobalite concentrations are not known.

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

Wash thoroughly immediately after completing work.

Laundry work clothing separately from other clothes and thoroughly clean laundering equipment after use. Clothing which contains a large amount of dust and/or refractory ceramic fiber should be disposed.

Promptly place used refractory ceramic fiber parts and dusts in plastic bags or other suitable containers and dispose according to local, state, and federal waste disposal (environmental) regulations.

Lindberg, A Unit of General Signal
304 Hart Street
Watertown, WI 53094
(414) 261-7000

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 be found on the dataplate attached to the equipment. If available, please provide the date purchased, the source of purchase (Lindberg/Blue M or specific agent/rep organization), and purchase order number.

IF YOU NEED ASSISTANCE:

LINDBERG/BUE M SALES DIVISION

Phone: 828/658-2711
800/252-7100

FAX: 828/645-3368

LABORATORY PARTS and SERVICE

Phone: 828/658-2891
800/438-4851

FAX: 828/658-2576

TECHNICAL SUPPORT

Phone: 800/438-4851



275 Aiken Road
Asheville, NC 28804
U.S.A.