

LINDBERG/BLUE 

HTF55000 Series Hinged Tube Furnaces

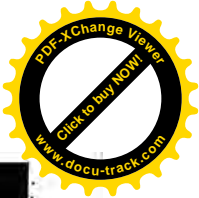
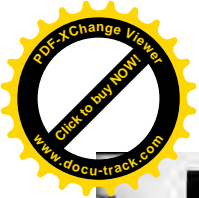
Installation and Operation Manual

Replacement TC
7299-1104-OAES
\$101

573557

L-87118-55122-1

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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.

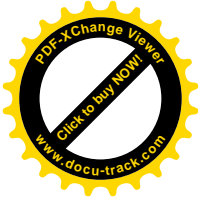
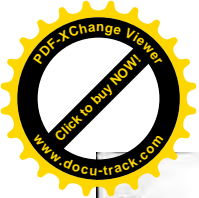
As minimum protection, use a high efficiency air purifying half-face respirator equipped with HEPA filter cartridges if airborne fiber levels or cristobalite concentrations are not known.

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.

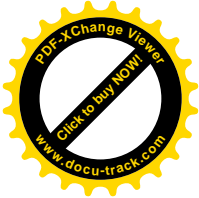
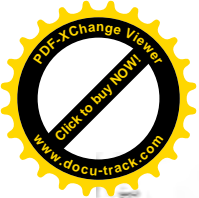


**55000 SERIES
MOLDATHERM® HINGED TUBE FURNACES**

SPECIFICATIONS

<u>Furnace Model #</u>	<u>Maximum Usable O.D. Tube</u>	<u>Heated Length</u>	<u>Maximum Operating Temperature</u>	<u>AC Volts Single Phase 50/60 HZ.</u>	<u>Power (Watts)</u>	<u>Control Console Model #</u>
<u>SINGLE ZONE</u>						
55122	1"	12"	1200°C	120	1330	58114
55322	3"	12"	1200°C	120/240	2675	58114
55332	3"	18"	1200°C	240	4240	58114
55342	3"	24"	1200°C	240	5440	58114
55642	6"	24"	1200°C	240	8710	58124
55662	6"	36"	1200°C	240	12195	58124
<u>THREE ZONE</u>						
55347	3"	24"	1200°C	240	5355	58434
55367	3"	36"	1200°C	240	8025	58434
55647	6"	24"	1200°C	240	7840	58434
55667	6"	36"	1200°C	240	11760	58434

NOTE: Heated Zone Length: Model #55347 & 55647 - 8"
 Model #55367 & 55667 - 12"



UNPACKING

1. Carefully unpack and inspect the furnace for damage. If there is any damage, report it to the appropriate carrier and retain packing materials.
2. Locate the furnace on a level surface free from vibration.
3. Allow a minimum of three (3) inches of space for air flow around the unit.

DESCRIPTION

All Lindberg Hinged 55000 series laboratory tube furnaces feature Moldatherm®, Lindberg's vacuum formed ceramic fiber insulation and patented LGO™ (light gauge overbend) heating elements. Available in standard single-zone and three-zone heated chambers for process tubes from 3/4 to 6 inches, these versatile tube furnaces are adaptable to a wide variety of processes. In addition, these furnaces are designed to operate in either a horizontal or vertical position. Please contact Lindberg for information on available vertical stands. All 55000 series tube furnaces are designed for use with standard Lindberg 58000 series control consoles.

INSTALLATION

SPECIAL NOTE

The heating element and tube adapters consist of Moldatherm insulation. This thermal efficient insulating material possesses sufficient strength and durability to withstand minor mechanical shock. However, care should be taken when installing a process tube and performing other maintenance, so as not to damage the Moldatherm insulation components.

Each furnace is designed for the electrical and temperature ratings shown on the data plate. Do not exceed these power and temperature specifications.

Locate the furnace on a level surface that provides sufficient operating space around the unit, allows easy access for routine maintenance and is convenient to a power source. The distance between the furnace and the control console is limited to six (6) feet which is the approximate length of the thermocouple leadwire. Leadwires CANNOT be spliced. If a longer thermocouple leadwire or extension is needed, please contact Lindberg.

CAUTION
 IMPROPER OPERATION OF THIS APPARATUS COULD RESULT IN DANGEROUS CONDITIONS. TO PRECLUDE HAZARD AND MINIMIZE RISK FOLLOW ALL INSTRUCTIONS.

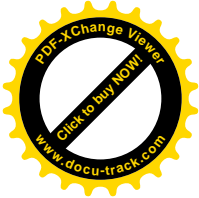
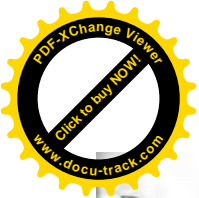
FURNACE ASSEMBLY

The furnace is shipped assembled with all heating elements and thermocouple(s) installed. The customer must install furnace L-shaped support legs, tube adapters, and wire the furnace to the control console and the power source.

Support Leg Installation

(Horizontal Furnace Position)

Close, latch and tilt furnace forward. Remove bolt and two flat washers located in the base of the furnace. Position L-shaped support legs between the two washers and over black plastic feet. Tighten bolts and reset furnace in horizontal position. These L-shaped support legs are designed to support the furnace top assembly when opened.



(Vertical Furnace Position)

The 55000 series tube furnace can be mounted in the vertical position with no modifications to the furnace. Lindberg offers standard vertical mounting stands designed to support the furnace in an upright position.

CAUTION
TO AVOID HAZARDOUS CONDITIONS
DISCONNECT ELECTRICAL POWER
FROM APPARATUS BEFORE
ATTEMPTING ANY REPAIR.

POWER WIRING

The 1200°C tube furnaces are designed to operate on 240 VAC 50/60 Hz, single phase. The customer is to provide the following according to local electrical codes; an on/off main power switch or circuit breaker, correct size power and ground wires to control console and interconnecting power and ground wires to the furnace. The wires should correspond with those carrying similar loads already installed by Lindberg in the control console and furnace. Reference Wiring Diagram.

NOTE: If other than a Lindberg control console is used to control the furnace, it is necessary to verify the feasibility of using an alternate control system with Lindberg prior to installation.

Model 55122 - 120 VAC Operation

Model 55122 is designed to operate only on 120 VAC, 50/60 Hz, single phase. Power wiring instructions are included in the wiring kit which is provided with the furnace. Model 55122 will draw approximately 11.1 amps on a 120 VAC line.

240 VAC Operation

1. Since interconnecting power and ground wires are not provided with the furnace and control console, suitable lengths of properly sized wires must be acquired prior to installation. Determination must be made regarding the length of wire needed depending on the distance between the furnace and control console. Minimum recommended wire gauge sizes are as follows:

<u>Furnace Model</u>	<u>Furnace to Control Wire Size</u>	<u>Ground Wire Size</u>
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Single Zone

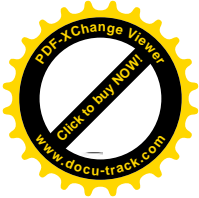
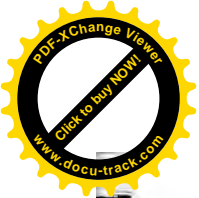
55322	12 ga	14 ga
55332	14 ga	16 ga
55342	12 ga	14 ga
55642	12 ga	14 ga
55662	10 ga	12 ga

Three Zone

55347	14 ga	16 ga
55367	14 ga	16 ga
55647	14 ga	16 ga
55667	14 ga	16 ga

Wire rated at 50°C minimum is suggested to be used for all connections between furnace and control console.

2. Wires should be labeled at each end A1 & B1 (single zone) or A1 & B1, A2 & B2, A3 & B3 (three zone) and ground per wiring diagram.
3. Remove access panel located in the lower back panel by removing appropriate screws.
4. Push out plastic hole plug from inside the plastic bushing.



5. Thread power wires and ground wire through the bushing. This hole may be used to mount a standard 1/2 inch electrical conduit connector when black plastic bushing is removed.

6. Connections between furnace and the control console are to be made as follows:

A. Single-zone furnace connect wire labeled A1 to terminal #A1, wire B1 to terminal #B1, and ground wire to ground lug near the terminal block.

B. Three-zone furnace connections are to be done as listed below:

- A1 & B1 to terminal A1 & B1
- A2 & B2 to terminal A2 & B2
- A3 & B3 to terminal A3 & B3

7. As a final inspection step, check that all electrical connections are secure. Reference Power and Wiring Drawings.

8. Replace the access panel.

208 Volt Operation

The Moldatherm hinged tube furnace is wired for operation on a 240 volt power source. If your facility has 208 volt line, the furnace is to be connected in the same manner as a 240 VAC. Heat-up and recovery times may be slightly longer when operated on 208 VAC.

Tube Adapter Installation

Each 55000 series tube furnace is designed for use with one pair of Moldatherm Tube Adapters, and customer supplied process tube. Additional adapters with varying inner diameters for use with different diameter process tubes.

are available from Lindberg. Refer to the Parts Specification Sheet for tube adapters that are compatible with your model furnace.

1. Shut off power at control console and allow furnace to cool to room temperature before installing or replacing tube adapters.

2. Loosen chrome plated tube support by unscrewing Allen head set screw through square hole on end of furnace.

3. Place adapter onto heating element and position tightly against end of chamber insulation. Filing or sanding outside of circular portion of adapter may be necessary.

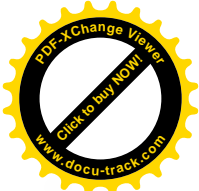
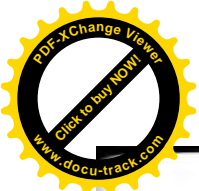
4. Install process tube (customer supplied).

5. Position chrome plated tube support bracket against outside of tube adapter and slide up or down to support the process tube. Care must be taken not to apply excessive pressure against the tube adapter when adjusting the support bracket. It may be necessary to install additional washers between the frame and support bracket.

6. Bulk ceramic fiber may be used to seal any gaps that may exist between the Moldatherm tube adapter and process tube to reduce heat loss.

INITIAL START-UP

It is recommended the furnace be initially operated for approximately one hour at 550°C. This will verify proper operation of the furnace and control system. Also, refer to the 58000 Series Control Console Operation and



Maintenance Manual for instructions of the control system.

Observe the following safety precautions during furnace operations.

A. DO NOT EXCEED recommended maximum outside diameter of process tube.

B. Wear heat protective gloves and use tongs or a push rod to position or remove loads.

TEMPERATURE PROFILING

The three-zone tube furnace has been designed with equally sized zones in both length and power output. Typically a three-zone furnace is utilized, when greater linear temperature uniformity is required, than can be obtained with a single-zone furnace. The uniform temperature zone normally extends beyond the center zone length into each end zone. Factors which affect temperature uniformity include process load, atmosphere flow, operating temperature and an open or sealed process tube.

To profile a three-zone furnace for the best flat zone, it is necessary to use a separate monitoring thermocouple in conjunction with an appropriate recording instrument. It is recommended that temperature measurements be taken in 1" increments in order to profile the chamber. By recording the temperature at various points inside the process tube, a plot of temperature versus furnace heated length may be made illustrating uniformity within the chamber. Individual temperature adjustment of each end zone and additional profile temperature measurements will finally produce the best profile and largest uniform temperature zone.

IDLING OR NONPRODUCTIVE PERIODS

Since furnaces designed with Moldatherm heating units have rapid heat-up rates, it is recommended that the furnace be turned off completely when not in use. No damage to the Moldatherm heating unit will be caused by rapid heating and cooling cycles.

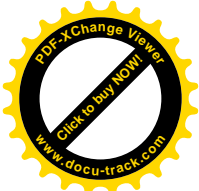
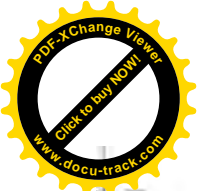
HEATING ELEMENTS

The chamber of these furnaces is comprised of two semi-cylindrical heating modules. Each module is a composite unit of Moldatherm, Lindberg's high temperature ceramic fiber insulation, and a LGO embedded alloy heating element. The unit is rated for a maximum operating temperature of 1200°C. After prolonged use, hairline cracks may develop in the Moldatherm insulation. Minor cracks will not affect the furnace performance.

THERMOCOUPLES

The furnaces are equipped with a Platinel II thermocouple. Platinel II thermocouples have longer life and greater stability than base metal thermocouples such as Chromel-Alumel (Type K).

All thermocouples are subject to aging and deterioration over a period of time. Thermocouple deterioration is usually indicated by pit marks in the wire immediately behind the welded junction. This condition will be indicated by a gradual drop in millivolt output for any given temperature, and result in furnace operation at a higher temperature than the controlling instrument indicates. The amount of deviation will vary with operating temperatures and thermocouple life. For critical processes, it is advisable to



periodically check (every 6 months) the furnace chamber temperature with a reference thermocouple and instrument to determine the amount of error.

The most obvious thermocouple failure is complete breakage. The break usually occurs at the welded junction tip and is recognized by a complete lack of output by the controlling instrument. Occasionally the ceramic support tube will crack or break. The thermocouple will continue to function until the broken end twists or bends causing the two wires to touch in the broken area. This situation causes another reference junction. The thermocouple should then be replaced.

MAINTENANCE

CAUTION
 TO AVOID HAZARDOUS CONDITIONS, ALWAYS DISCONNECT ELECTRICAL POWER FROM APPARATUS BEFORE ATTEMPTING ANY REPAIR.

Thermocouple Replacement

1. Remove the top center cover of the furnace to provide access to the thermocouple.
2. Take note of polarity and wire location. Red is always negative. Loosen the terminal screws and remove the thermocouple lead wires.
3. Remove the thermocouple mounting screws. Gently pull the thermocouple out and away from the furnace.
4. Carefully install the replacement thermocouple by reversing the above procedure. Use care in sliding the

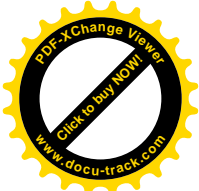
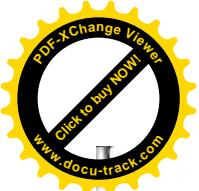
thermocouple through the insulation so as not to bend thermocouple wire.

NOTE: When reconnecting the lead wire to the thermocouple, observe the proper polarity. Red is ALWAYS negative. (If the extension leads are black and white, white is negative.)

Heating Element Replacement Furnace Shell

Replacement of lower or upper Moldatherm heating units are the same except for removal of the thermocouple(s). A level work surface as large as the furnace when opened like a book is needed. Depending on the furnace size, it may take two persons at different times to assist in the replacement of the Moldatherm heating element(s).

1. Shut off power at main power circuit breaker and control console circuit breaker.
 2. Remove process tube and tube adapters.
 3. Close, latch, and tilt furnace forward. Remove the two L-shaped support legs. Reposition furnace.
- (RETAIN ALL HARDWARE for reassembly.)
4. Remove the lower two end caps from each end of the furnace, four total; two screws and two washers per cap.
 5. Remove wiring access panel from back bottom panel.
 6. Remove back bottom and front bottom cover panels, two screws per each end of panel. It is not necessary to remove louvered end center covers.



Heating Element Replacement
Moldatherm

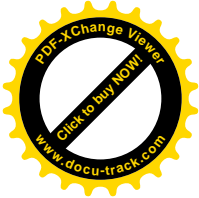
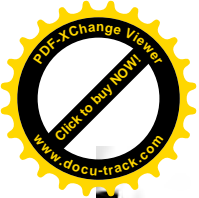
7. While holding bottom half secure, carefully open furnace top and tilt fully back until furnace is in an open book form.
8. Loosen the end bracket by entering through the large round hole on the end of the furnace frame, loosen hex head screws, two screws per end.
9. On the front and back sides of the heating element aluminum shell, loosen only round head screws; turn screws clockwise to loosen. These screws are used to adjust the square pressure pads that secure and align the Moldatherm unit.
10. On the front and back sides of the aluminum shell, remove completely the two (2) hex head screws located inside the vertical channel shaped support brace.
11. Note the position of ridges and terminal location within the Moldatherm unit in relationship to the furnace. Label wires and terminals if necessary. Remove wires from terminals.
12. Raise Moldatherm unit and three piece shell up and out. The vertical channel shaped braces need to be pulled away from the shell to allow the round head screws to pass by.
13. Position Moldatherm heating unit and shell on a level surface. While removing the remaining hex head screws, mark with a pencil the screws

and the adjacent holes on the aluminum shell. This is done for reassembly. Remove side panels.

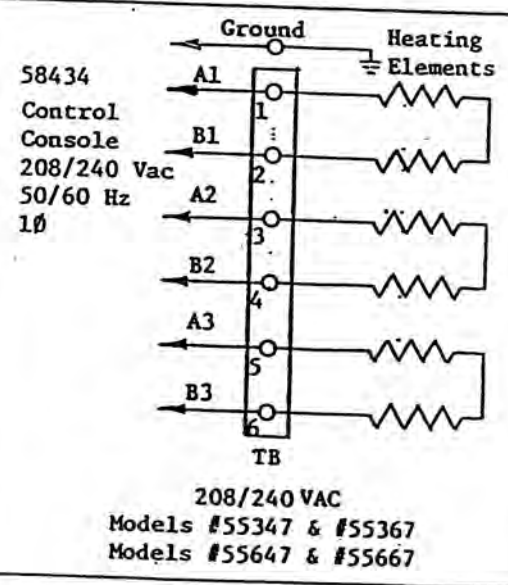
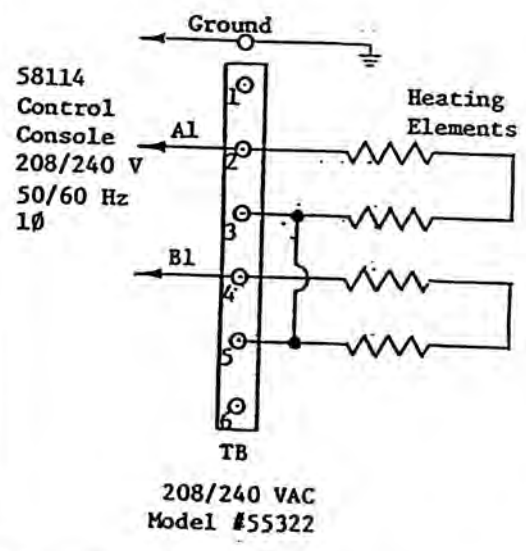
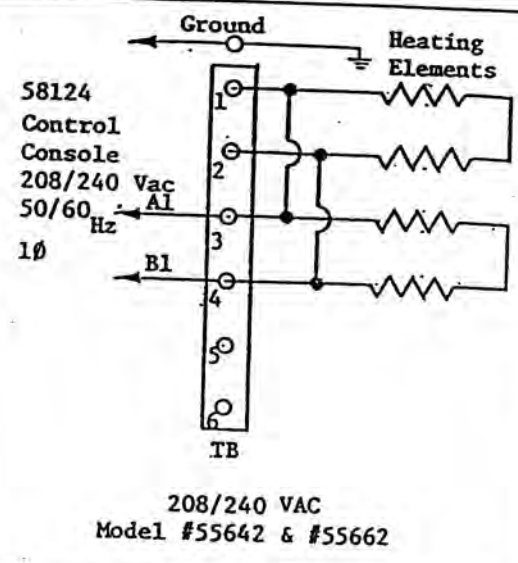
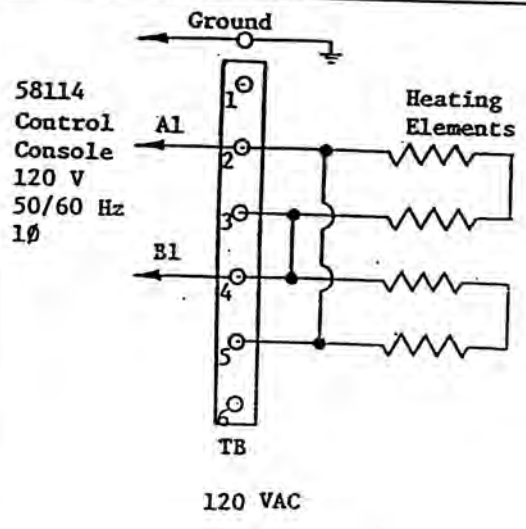
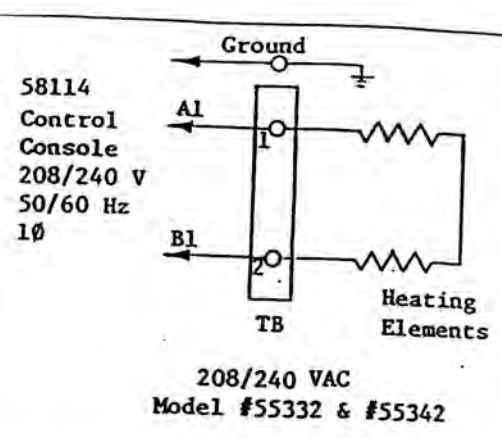
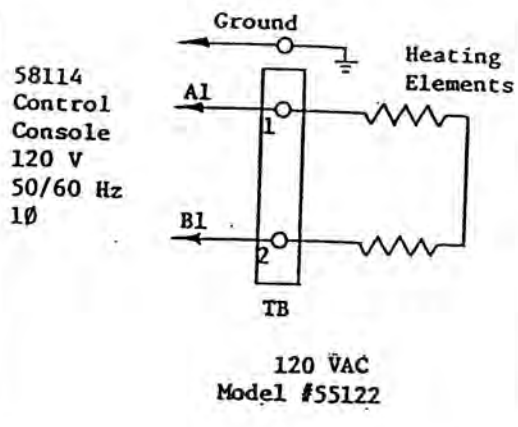
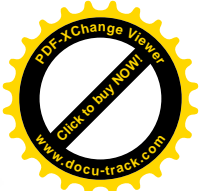
14. Remove heating unit. Seal Moldatherm unit and dispose of properly. (Reference: Material Safety Data Sheet)

Heating Element Replacement
Alignment

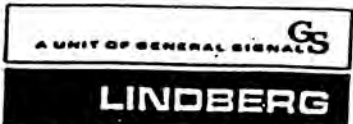
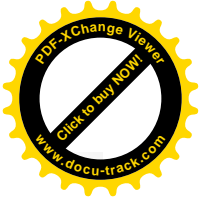
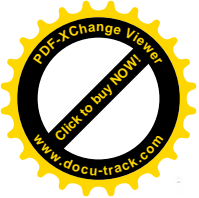
15. Lay aluminum shell bottom panel flat and rotate all square pressure pads to be approximately the same height, 5/8" from panel.
16. Position and center new Moldatherm heating unit onto the bottom panel. Unit will rest on the pads; screws will impale into the Moldatherm.
17. Rotate all square pressure pads on each side panel to be approximately the same height, 5/8" from panel.
18. Reverse step 13. Pads may or may not touch Moldatherm sides and screws will impale into Moldatherm. Note: When returning screws into previously marked holes in shell screw only until snug. Bent edge of side panel should seat in outer most ledge of Moldatherm.
19. Before repositioning the heating unit into the frame, refer to step 11 and loosen the horizontal spacers that the unit will rest upon. Reverse step 12.
20. Reverse step 10. Do not over tighten screws.
21. Position horizontal spacers firmly against bottom aluminum shell.



22. Using a straight edge as long as the furnace, span the Moldatherm unit touching the center ledge of the unit and the top edge of both ends of the furnace frame.
 23. To adjust Moldatherm unit to align with straight edge, rotate the round head screws on the bottom of aluminum shell.
 24. Access to bottom screws is done by removing perforated bottom guard off furnace frame. Turn screws counter clockwise to adjust Moldatherm unit. Or remove top center cover to access screws for top Moldatherm unit.
 25. To adjust unit left or right rotate round head screw on the sides of the unit. Reverse step 9.
- NOTE: The two Moldatherm heating elements should seal completely over the entire length of the unit assembly when the furnace is in the closed position. A slight taper on the ends of the Moldatherm heating units may exist, which will create a small gap between top and bottom heating units. This small gap will not be detrimental to the performance of this furnace.
26. Reverse steps 8 through 3.
 27. Check that all electrical connects are secure. Reference Wiring Diagram.



55000 Series Furnaces
Wiring Diagrams



PARTS SPECIFICATIONS
 304 HART STREET • WATERTOWN, W.I. 53094
 PHONE 414-281-7000

General Assembly: 7212-0016-00B
 Wiring: 7212-2146-00A

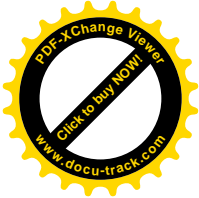
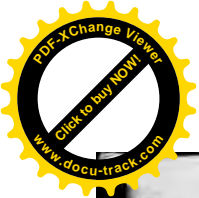
Serial #
 August, 1987
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MODEL 55667
HINGED TUBE FURNACE

<u>ITEM</u>	<u>PART DESCRIPTION</u>	<u>PART NUMBER</u>	<u>QTY PER ASSY</u>
+ 1.	Heating Unit	7212-2109-00A	2
+ 2.	Thermocouple, Platinel II	-	3
	a) Single	7299-1104-OAES	-
	b) Double	7299-1110-00B 7299-1202-0BV	-
	c) Triple	7299-1303-0AG	-
3.	Thermocouple Head	7299-1104-00Z HEAD ASSEM	3
	a) Single	7214-2051-00A	-
	b) Double	7299-1403-00B	-
	c) Triple	7299-1403-00B	-
4.	1/2 Lb. Bag Bulk Fiber	35066-001	5
5.	Tube Adapter 3"	59535	2
6.	Tube Adapter 4"	59536	2
7.	Tube Adapter 5"	59537	2
8.	Tube Adapter 6"	59538	2
9.	Tube Adapter Blank (Solid)	59539	2
0.	TC Extension Wire, Platinel II	33940-006	as required
1.	Terminal Block, Power	33407-003	1

1998

* SUGGESTED SPARES THAT SHOULD BE HELD IN YOUR STOCK FOR NORMAL AND EMERGENCY REPAIRS



LINDBERG/BLUE

Control Consoles

Models: CC58434C/CC58434BC
CC58434PC/CC58434PBC
CC584343PC/CC584343PBC

Installation and Operation Manual



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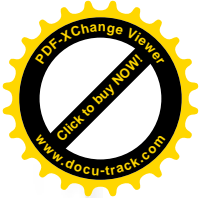
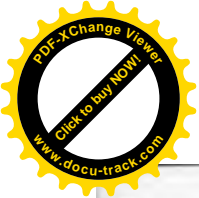


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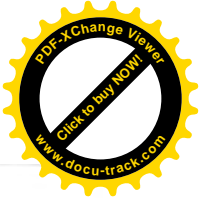
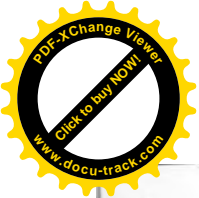
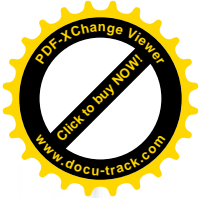
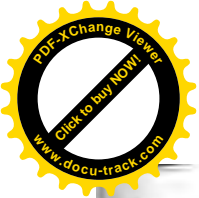


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Control Consoles

1 Introduction

Lindberg/Blue M 58434 series control consoles are complete three zone temperature control systems containing microprocessor-based digital temperature controllers or programmers and featuring an Over Temperature Protection (OTP) system.

Model CC58434C features three independent temperature controllers. CC584343PC has three independent temperature programmers. Model CC53434PC is a master/slave system with a master temperature programmer for the main furnace zone and slave temperature controllers for the two other zones. The slave controllers aim to duplicate or track the main zone temperature.

Each console is equipped with three solid state power modules, a power contactor (for OTP), panel mounted circuit breaker and polarized thermocouple jacks.

"B" models also include Over Temperature Control (OTC) by an independent digital controller.

The consoles are designed to operate Lindberg/Blue M 1200°C three zone laboratory tube furnaces.

2 Safety Considerations



WARNING: Do not modify or use equipment in a manner other than expressly intended. Modification of equipment other than that for which it is explicitly designed could cause severe injury or death. Any customer after-market retrofit violates the warranty of the equipment.

Do not reconfigure the controller(s). Any reconfiguration of the control instrument(s) could cause inaccurate readings, faulty instrument values, and may cause the furnace to become overheated and start on fire, causing personal injury or death, product and property damage.

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

Do not use components or materials not specifically designed for this equipment. Failure to comply with this precaution could result in damage to equipment used or the unit and may create an overheat situation. Also, do not use anything other than OEM exact replacement equipment and parts. Not using OEM replacement parts could cause faulty instrumentation readings, inoperable equipment, or temperature overshoot. Both situations may cause personal injury or death, product, and property damage.

Before using, user shall determine the suitability and integrity of the product for the intended use and that the unit has not been altered in any way. Misapplication may compromise the safety of the end user or the life of the product.

3 Unpacking

Carefully unpack and inspect the unit and all accessories for damage. If you find any damage, keep the packing materials and immediately report the damage to the carrier. We will assist you with your claim, if requested. Do not return goods to Lindberg/Blue M without written authorization. When submitting a claim for shipping damage, request that the carrier inspect the shipping container and equipment.

4 Installation

Do not exceed the electrical and temperature ratings printed on the dataplate of the control console.



WARNING: Improper operation of the control console could result in dangerous conditions. To preclude hazard and minimize risk, follow all instructions and operate within design limits noted on the dataplate.

4.1 Location

Keep line voltage variations to a minimum for best control accuracy. Do not locate unit in areas of wide ambient temperature variation, such as near vents or outdoor entrances. Allow at least three inches space all round the console, although more space may be required for ease of maintenance.

4.2 Power Wiring

All consoles are designed to operate on a 208V or 240V 50/60Hz single phase power source. The customer is to provide a main power disconnect switch or circuit breaker and correctly sized power and ground wires according to local electrical codes. The wiring gauges used should correspond with those carrying similar loads built into the console.



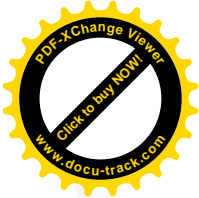
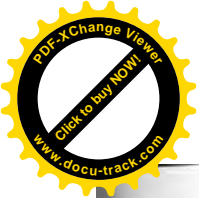
CAUTION: For personal safety and trouble-free operation, this unit must be properly grounded before it is used. Always conform to the National Electrical Code and local codes. Utilize proper grounding techniques to reduce RFI and EMI for electronic gear. Do not connect unit to already overloaded power lines; lower voltage to unit will decrease power to the heating elements.



CAUTION: Connect the console to the proper power source. Failure to use the specified voltage can result in damage to the unit

Information for sizing fuse, circuit breaker, or power lines appears on the control console dataplate. Fuse protection must never exceed 125% of console's current rating.

Wire rated at 50°C minimum is suggested to be used for the connections between the console and the power supply.



Control Consoles

4.3 Wiring Procedure



WARNING: Disconnect console from main power before attempting any maintenance

Remove both console side panels by undoing the appropriate screws. In the back panel, push out the two lower plastic hole plugs from inside the plastic bushing. If hard wiring is desired the bushings may be removed and the holes used to mount a standard 1/2" electrical conduit connector.

Insert the power and ground wires through one of the bushings. Connect the black wire to terminal L1, the white wire to terminal L2, and the green wire to the ground bar. The second bushing is used for the wiring to the furnace.

These control consoles can be used in conjunction with a large number of different furnaces. The internal connections must be made according to the wiring diagram relating to your particular furnace.

Check that all electrical connections are secure before replacing the console side panels.

4.4 Thermocouple Wiring Installation

Insert the thermocouple plugs into the thermocouple jacks on the console rear panel.

5 Initial Start-up

It is necessary to become familiar with the digital temperature controller(s) before attempting to operate the furnace for the first time. Examine the appropriate installation/operation instructions for the controller(s) which are included with the control console.

Refer to the separate furnace instruction manual for initial heat-up time and temperature recommendations.

6 Operation – 91e Controller

6.1 Setting the Temperature

Detailed instructions on operating the temperature controller are found in the *Model 91e Operation Manual*.

To set the temperature to the desired setpoint, complete the following steps:

1. Press any button on the controller keypad to illuminate the ▲, ▼, and ↻ keys.
2. Press ▲ or ▼ until the desired setpoint is indicated on the bottom line of the display.

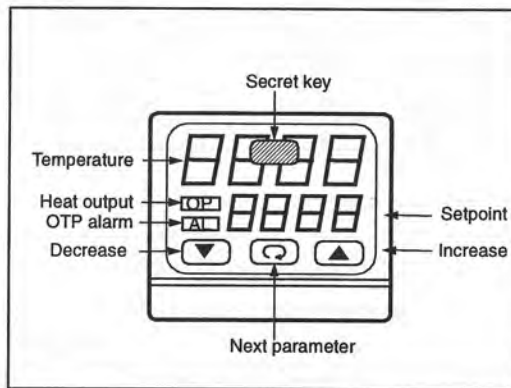
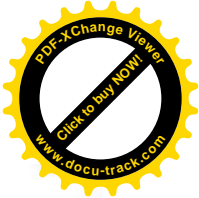
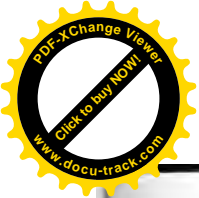


Figure 1. 91e Control Panel



Control Consoles

7 2416 Control Operation

“P” models use the Eurotherm 2416 programmable controller.

The controller is configured and tuned at the factory to function well for most applications. Occasionally, it may be advisable to configure the temperature controller differently to suit a particular working environment or process.



CAUTION! Before reconfiguring the controller, read this chapter and the *Model 2416 Installation and Operation Handbook*. Reconfiguring the controller can change the unit characteristics and design parameters, which can hamper performance and make the equipment dangerous to use.

7.1 Introduction

The 2416 controller includes an LED display and a pushbutton keypad (see Figure 2). You can use the Page, Scroll, Increase and Decrease buttons to check program status and to view and change pid settings and other parameters. When you are not using the pushbutton keypad, the upper display always shows process temperature and the lower display shows the current temperature setpoint value. This is the default, or Home, display.

You can operate the 2416 controller in either single setpoint or programming mode.

To run in single setpoint mode, verify that neither the RUN nor HOLD display is illuminated, then press ▲ or ▼ until the lower display shows the desired setpoint (see Section 7.2). The controller will then direct power output to the heating elements so that the setpoint is reached in the shortest possible time.

In 2416 programming mode, you can create, store and run a program that contains up to 16 segments. The main types of segments are *ramps* (periods of time during which setpoint temperature changes at a specified rate) and *dwells* (periods during which setpoint temperature remains constant). For programming techniques and examples, refer to Section 7.8.

The following sections provide brief instructions on how to:

- change the temperature setpoint
- change between Celsius and Fahrenheit
- start the Autotune function
- view current pid settings
- restore factory settings after Autotune
- create and run programs.

For complete instructions on configuring the temperature controller, refer to the *Model 2416 Installation and Operation Handbook*.

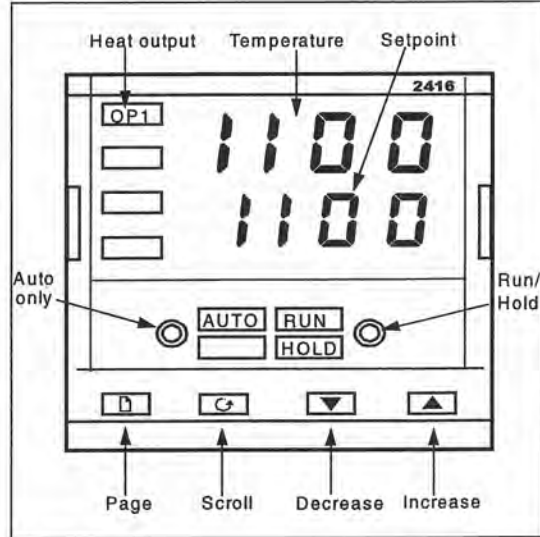
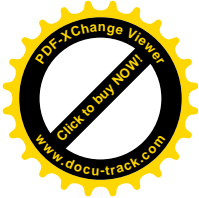
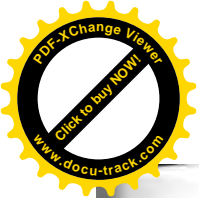


Figure 2. 2416 Control Panel

Table 2. 2416 Pushbutton Keypad Functions

Pushbutton	Description
	The page key advances the display to show units (°C, °F), programmer functions, alarm settings, tuning parameters (Atun), the Pid list, and access to the protected list (ACCS).
	The scroll key advances the display to show the next item within each page. While in the protected list the scroll key advances the display to the next parameter code and setting.
	The up arrow key is used to increase or change a setpoint or parameter setting.
	The down arrow key is used to decrease or change a setpoint or parameter setting.
Run/ Hold	The button to the right of the RUN and HOLD displays is used to start and stop the stored program or to put the program on hold, allowing temporary changes.



Control Consoles

7.2 Changing the Temperature Setpoint

During normal operation, the current temperature setpoint is displayed below the current process temperature.

To change the setpoint in single setpoint mode, verify that a program is not running (i.e., that the RUN and HOLD displays are not illuminated). Then press and hold ▲ or ▼ until the desired setpoint shows on the lower LED display. When the display shows the desired setpoint, release the button. After two seconds (during which the controller stores the new value) the display will blink, indicating that the new setpoint has been accepted.

If a program is running, then you can change it temporarily, revise the program, or stop it to operate in single setpoint mode (see Section 7.8.4).



CAUTION! Do not adjust the setpoint above 1200°C (2192°F).

7.3 Changing between Celsius (°C) and Fahrenheit (°F)

Changing the displayed units of measure requires paging to the protected list (ACCS), entering the appropriate access codes, and changing the setting of the unit parameter.



CAUTION! When changing units of measure, be sure that you follow the steps exactly and that you do not modify any other parameter settings. Changing parameter settings on the protected list (ACCS) can hamper performance and make the equipment dangerous to use.

To change from °C to °F or from °F to °C:

1. Press the page button **⏏** and release until ACCS is displayed.
2. Press the scroll button **⏏** once to display code.
3. Press **▲** to display the number 1. The control program will acknowledge this access code by displaying PASS.
4. Press **⏏** to display Goto, then press **▲** to display the value conF.
5. Press **⏏** to display Conf (note the capital "C").
6. Press **▲** to display the number 2. The control program will acknowledge this access code by displaying PASS.
7. Press **⏏** to display PU Conf, then Press **⏏** to display unit.
8. Press and release **▲** to display the choices C and F. Once the choice you want is displayed, press the page button **⏏** to display Exit.
9. Indicate you want to exit by pressing **▲** to display YES. The actual temperature display will return after two seconds.

To verify the units you chose, press and release **⏏**.

7.4 Auto Tune Operation

The factory set parameters are designed to optimize furnace performance under normal operating conditions. If you have unusual conditions or requirements — for example, high ambient temperatures or heavy shelf loading — you can use the Auto Tune function to change the furnace's performance characteristics.



CAUTION! Be sure that you analyze current performance carefully before deciding to do an Auto Tune operation.

If you are not satisfied with the results of an Auto Tune operation, you can restore the factory set parameter values by following the instructions in Section 7.6.

Before starting Auto Tune operation, be sure to have the furnace operating with typical load and ambient temperature conditions.

To start Auto Tune:

1. Press and release the page button **⏏** repeatedly until you reach the Atun LIST display.
2. Scroll (**⏏**) to display tunE.
3. Press **▲** to display on.
4. Press the **⏏** and **⏏** buttons *together* and release. At this point the actual temperature value and tunE will display alternately to indicate that tuning is in progress.

You can interrupt and terminate the Auto Tune operation at any time by scrolling to tunE (steps 1 and 2 above) and pressing **▲** to display OFF.

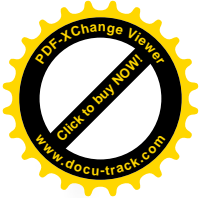
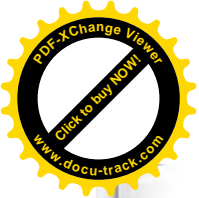
After a sufficient number of cycles of temperature oscillation (usually two), the tuning process is completed, the tuner switches itself off, and the controller resumes normal operation with the new proportional values.

After Auto Tune operation, you can view the changed settings for proportional values by following the steps described below in Section 7.5.

7.5 Viewing PID Settings

To view the current proportional values:

1. Press and release the page button repeatedly until you reach the display Pid LIST.
2. Press and release the scroll button to display each list item. The name of each item will appear in the upper display, its current value in the lower display.
3. The quickest way to return to the Home display is to press the page and scroll buttons simultaneously.



Control Consoles

7.6 Restoring Factory Set PID Values

The factory set proportional values are shown below in Table 3.

Table 3. Default Factory Parameter Settings

Parameter Code	Default Value	Description
Pb	20	Proportional band.
ti	120	Integral time.
td	30	Derivative time.
Hcb	Auto	High cutback.
Lcb	Auto	Low cutback.

If you have changed these settings by means of Auto Tune and have not experienced improved performance, you can restore the factory settings as follows:

- The values shown in Table 3 are based on Celsius (°C) display mode. If your current display mode is Fahrenheit (°F) you should temporarily change it to °C following the instructions in Section 7.3.
- Press the page button **⏪** and release to display ACCS.
- Press the scroll button **⏮** once to display codE.
- Press **▲** to display the number 1. The control program will acknowledge this access code by displaying PASS.
- Press **⏮** to display Goto, then press **▲** to display the value FULL.
- Press the page button **⏪** and release to display Pid LiSt.
- Press the scroll button **⏮** to display the name of the parameter you want to restore (the first one will be Pb).
- Press **▲** or **▼** until the factory set value is displayed (refer to Table 3).
- Repeat steps 7 and 8 for each of the remaining parameters ti, td, Hcb, and Lcb.
- When you have restored all parameter values, press the page button **⏪** to display ACCS.
- Press the scroll button **⏮** once to display codE.
- Press **▲** to display PASS.
- Press **⏮** to display Goto.
- Press **▲** to display the value oPEr.
- Press the page button **⏪** and release to return to the actual temperature display.

You can verify proportional values at any time by following the steps described in Section 7.5.

7.7 Setting the Overtemperature Alarm

The factory default setting for the overtemperature alarm is 1225°C. To change the alarm setpoint:

- Press the page button **⏪** until AL LiSt appears on the display.
- Press the scroll button **⏮** until 1FSH appears on the display.
- Press **▲** or **▼** until the desired setpoint is indicated on the bottom line of the display.



CAUTION! Do not adjust the alarm above 1250°C (2282°F).

7.8 Programming the 2416 Controller

You can use the 2416 program parameters to program the controller for specific applications. For sample programs refer to Section 7.8.2 and Section 7.8.3 below.

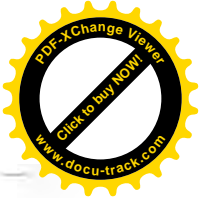
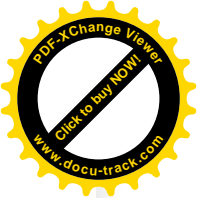
7.8.1 Entering a Program

The controller stores one program at a time. A program can have up to 16 segments. To enter a program:

- Page to run LiSt, scroll to StAt, and if necessary use the **▲** key to set the value StAt OFF.
- Page to ProG LiSt. Scrolling through this list enables you to enter, verify or change all the program parameters. For each parameter, the name appears in the upper display, the current value in the lower display. You can use the **▲** and **▼** keys to change a value or the scroll key **⏮** to display the next parameter.
- The first four parameters displayed in the ProG LiSt apply to the entire program. Hb U denotes width of the holdback band, or maximum deviation from temperature profile (the default value is 20°C). rmP.U and dwL.U denote units of time used for ramps and dwells. CyC.n denotes the number of cycles (times you want the program to run). The value of CyC.n can be 1 to 999, or cont for continuous cycling.
- The next parameter displayed will be SEG.n (the segment number) with the value 1. As you scroll through program parameters, segment numbers will appear in sequence automatically.
- The next parameter will be tYPE, which specifies the type of segment, for example ramp or dwell. For a given segment, the parameters you need to specify depend on the segment type, as shown below in Table 4.
- Once you have entered the complete program (through the End segment) you can run the program at any time following the instructions in Section 7.8.4.

Table 4. Program Segment Types

Segment Type	Function	Required Parameters
rmP.r	Ramp temperature rate (rAtE) sets temperature rise per unit of ramp time (rmP.U)	Hb, tGt, rAtE
rmP.t	Ramp rate time (dur) sets amount of time to rise to target setpoint (tGt)	Hb, tGt, dur
dwEl	Keeps the temperature constant for a set period of time (dur)	Hb, dur
StEP	Instantaneously changes the target setpoint (tGt) to a new value	tGt
End	Indicates end sequence. The End.t (end type) parameter can specify dwell, reset, or S OP to set output power.	End.t, Pwr if End.t=S OP



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The following sections show some typical programming examples. For complete information on programming functions, refer to the *Model 2416 Installation and Operation Handbook*.

7.8.2 Example 1: Ramp and Hold

In the following simple program, segment 1 ramps to the temperature 1200°C at a rate of 20° per minute. Segment 2, the end segment, holds temperature at 1200°C indefinitely. The program is:

SEG.n	1	SEG.n	2
tYPe	rmPr	tYPe	End
Hb	bAnd	End.t	dwElI
tGt	1200		
rAtE	20		

7.8.3 Example 2: Three Ramps and Dwells

In the following program, there are three ramps and dwells. Segment 1 ramps slowly to 300°C at a rate of 5° per minute; segment 2 dwells at 300°C for 30 minutes. Segment 3 ramps to 900°C at a rate of 15° per minute; segment 4 dwells for 50 minutes. Segment 5 ramps to the furnace temperature 1100°C at a rate of 10° per minute; segment 6 dwells for 40 minutes. Segment 7 is a step segment specifying a setpoint of 30°C (close to ambient). The end segment, segment 8, halts the program and resets.

Note that the ramps and dwells (segments 1–6) have the Hb parameter (holdback) set to the value bAnd (deviation band holdback). Other possible values for Hb are OFF (disabled, as in segment 7), Lo (deviation low), and Hi (deviation high).

Each time this program runs it will produce the temperature profile shown in Figure 3.

The program is:

SEG.n	1	SEG.n	5
tYPe	rmPr	tYPe	rmPr
Hb	bAnd	Hb	bAnd
tGt	300	tGt	1100
rAtE	5	rAtE	10
SEG.n	2	SEG.n	6
tYPe	dwElI	tYPe	dwElI
Hb	bAnd	Hb	bAnd
dur	30	dur	40
SEG.n	3	SEG.n	7
tYPe	rmPr	tYPe	SIEP
Hb	bAnd	Hb	OFF
tGt	900	tGt	30
rAtE	15	SEG.n	8
SEG.n	4	tYPe	End
tYPe	dwElI	END.t	rSEt
Hb	bAnd		
dur	50		

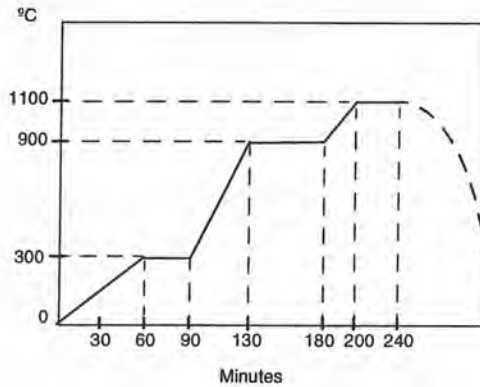


Figure 3. Three Ramps and Dwells

7.8.4 Run and Hold Functions

You can run a stored program by paging to run LIST, scrolling to the StAt parameter, and using the ▲ button to set the value run.

The Run/Hold button (see Figure 2 on page 3) provides an easier way to control program operation. Pressing Run/Hold once illuminates the RUN display and starts the stored program. Pressing it a second time halts the program temporarily and illuminates the HOLD display. When the program is in hold you can make temporary changes. Pressing the button again cancels the hold and resumes operation of the program.

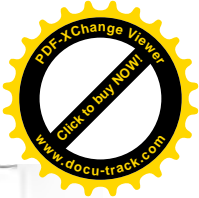
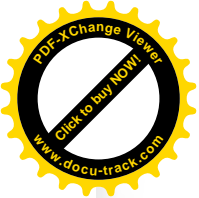
Pressing and holding the Run/Hold button for two seconds causes the program to stop, reset and erase any temporary changes made while in hold mode. This reset mode enables single setpoint operation.

7.8.5 Checking Program Status

To check on the status of the current program, page to run LIST and scroll through the following parameters to review their values:

Table 5. Run List Parameters

Parameter Code	Meaning
StAt	Program status. run = program is running; OFF = program is not running; hoLd = program halted, can be modified temporarily; End = program is processing last segment. Caution! When you view StAt be careful not to change program status by pressing the up and down keys.
PSP	Current segment setpoint target temperature
CYC	The number of cycles remaining in the program
SIYP	The active segment type
SEG.t	Time remaining in the current segment
PrG.t	Time remaining in the current program



Control Consoles

8 Setting the Over Temperature Protection (OTP) Alarm Temperature

Note: *A high limit alarm in each temperature controller disables all heater outputs and automatically resets when the temperature drops below the alarm setpoint.*

8.1 CC58434C & CC584343PC

In these consoles the three temperature controllers (or programmers) operate independently of each other. Each controller's alarm setpoint should be set to 15°C above its maximum main temperature setpoint, typically 1215°C.

8.2 CC58434PC

In these consoles a master programmer operates the furnace main zone and the slave controllers aim to duplicate or track the main zone temperature in their own zones. The slave zone controllers therefore usually have their main temperature setpoints set to 0°C, representing zero offset (although this can be adjusted +/- 50°C), so their alarm setpoints will typically be 15°C. The master programmer alarm setpoint is set as indicated in 8.1.

To set the temperature controller alarms for models with the 91e controller, complete the following steps:

1. Illuminate the keys by pressing the lower portion of the controller. Proceed directly to step 2 if the keys are already lit.
2. Press **↻** until **AL.SP** shows on the top line of the display.
3. Press **▲** or **▼** until the desired alarm setpoint shows on the bottom line of the display.

For instructions on resetting the temperature alarm with the 2416 controller, refer to Section 7.7 on page 5.

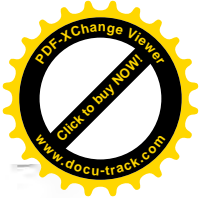
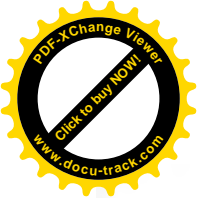
9 Resetting the Over Temperature Control (OTC) Alarm Temperature - "B" models only

Note: *The independent over temperature controller, fitted to "B" models only, disables all heater outputs until manually reset.*

The alarm setpoint on the over temperature controller is factory set. For details on how to adjust the alarm setpoint consult the *Model 93 Operation Manual* supplied with the console.

To acknowledge an OTC alarm following an over temperature condition (indicated by the red AL1 indicator flashing), complete the following steps:

1. Illuminate the keys by pressing the lower portion of the controller. Proceed directly to step 2 if the keys are already lit.
2. Press **↻** until **AL 1** shows on the top line of the display.
3. Press and hold **▲** or **▼** for several seconds until **CLr** shows on the top line of the display.
4. Press **▲** or **▼** again. The red indicator will stop flashing and remain on. It will go out and the alarm will reset when the temperature drops below the alarm setpoint.



Control Consoles

10 Maintenance



CAUTION! Maintenance should only be performed by trained personnel.



WARNING: Disconnect console from main power before attempting any maintenance to console or its controls.

10.1 Temperature controller replacement

The temperature controller(s) plug into a sleeve mounted in the control console front panel.



CAUTION: The controller contains static-sensitive electronic devices. Do not touch the controller internal components.

To remove the controller from the sleeve, squeeze the top and bottom of the controller front face housing and gently pull it out of the sleeve.

To remove the mounting sleeve from the front panel, first remove the control console side panels. Disconnect the wires from the back of the sleeve, label the wires for reinstallation. Loosen the two clamp screws and slide the square collar off the back of the sleeve. Slide the sleeve out of the front of the panel.

To reinstall the controller, reverse the above procedure

10.2 Solid state relay (SSR) replacement

Remove the control console side panels. The SSR(s) are mounted on the inside surface of the back panel.

Disconnect the wires from the SSR and label the wires for reinstallation.

Undo the two screws holding the SSR to the rear panel and remove the SSR.

Smear a thin layer of heat-sink paste under the new SSR before fitting. Installation of the new SSR is the reverse of the above procedure.

11 Troubleshooting

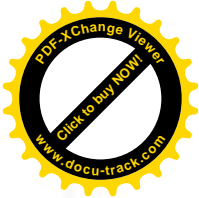
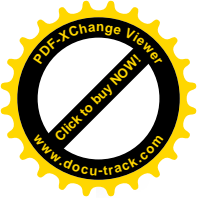


WARNING: Troubleshooting procedures involve working with high voltages which can cause injury or death. Troubleshooting should only be performed by trained personnel.

This section is a guide to troubleshooting controller problems. Refer to Table 6 for controller troubleshooting procedures.

Table 6. Controller Troubleshooting

Problem	Solution
91e Controller:	
Controller reads SnSr.	Thermocouple: <ol style="list-style-type: none"> 1. Check the thermocouple visually for breaks. If a break is evident, replace thermocouple. 2. Check the thermocouple for continuity with an ohmmeter. If there is no continuity, replace thermocouple. 3. Check all thermocouple connections. Connections should be clean and free of corrosion.
Controller reads tunE FAIL.	Self-tuning operation failed because controller cannot maintain setpoint: <ol style="list-style-type: none"> 1. Touch any key to acknowledge the message. 2. Remove the cause of failure, such as blown heater fuse, etc.
Controller reads LinE FAIL.	Loss of controller power during self-tuning operation renders sampled data questionable: <ol style="list-style-type: none"> 1. Touch any key to acknowledge the message. 2. Verify power supply. 3. Reinitiate self-tuning procedure.
2416 Controller:	
Controller reads S. br (Sensor break)	Thermocouple: <ol style="list-style-type: none"> 1. Check the thermocouple visually for breaks. If a break is evident, replace thermocouple. 2. Check the thermocouple for continuity with an ohmmeter. If there is no continuity, replace thermocouple. 3. Check all thermocouple connections. Connections should be clean and free of corrosion.
Controller reads 1FSH (Overtemperature)	Overtemperature: <ol style="list-style-type: none"> 1. Verify that the alarm setpoint is correctly set above the temperature setpoint. 2. If the alarm setpoint is set correctly, turn off the furnace and check for conditions that could cause overheating.
Controller reads L. br (Loop break)	Heating circuit: <p>Message indicates that there has been no rise or stabilization of temperature consistent with controller output. Check the heating circuits and elements.</p>



Control Consoles

12 Replacement Parts

All quantities are one each unless otherwise stated.

Part description	Part number
Solid state relay (3)	102460
Contactora	119750
91e Controller	118008
2416 Controller "P" models only	302545H01
Over Temperature Controller (OTC) "B" models only	16789
Heater fuse (6)	104839
Control fusa (2)	104828

13 Warranty

13.1 Domestic Warranty (United States and Canada)

Lindberg/Blue M warrants this product to the owner for a period of twelve (12) months from date of shipment by Lindberg/Blue M. Under this warranty Lindberg/Blue M through its authorized Dealer or service organizations, will repair or at its option replace any part found to contain a manufacturing defect in material or workmanship, without charge to the owner, for a period of ninety (90) days, the labor, and a period of one (1) year, the parts, necessary to remedy any such defect. All components used in the manufacture of this product are covered by this warranty excluding heating elements and thermocouples.

This warranty is limited to products purchased and installed in the United States and Canada. It does not apply to damage caused from failure to properly install, operate, or maintain the product in accordance with the printed instructions provided. This warranty shall not apply to equipment or parts which have been subjected to negligence, accident, or damage by circumstances beyond Lindberg/Blue M's control or improper operation, application, maintenance, or storage.

To obtain prompt warranty service, contact the nearest Lindberg/Blue M authorized service center or Dealer. A listing of these companies will be provided upon request. Lindberg/Blue M's own shipping records showing date of shipment shall be conclusive in establishing the warranty period.

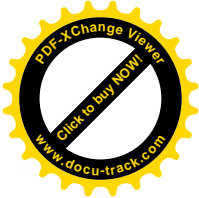
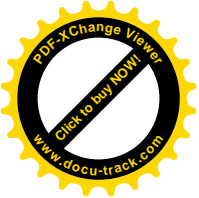
This warranty is in lieu of any other warranties, expressed or implied, including merchantability or fitness for a particular purpose. The owner agrees that Lindberg/Blue M's sole liability with respect to defective parts shall be as set forth in this warranty, and any claims for incidental or consequential damages are expressly excluded.

13.2 International Warranty (excluding Canada) 12 Months Parts Warranty

Lindberg/Blue M warrants this product to the original owner for a period of twelve (12) months from the date of shipment from the Lindberg/Blue M factory. Thermocouples and heating elements are excluded from this warranty. If any part is found to contain a manufacturing defect in material or workmanship Lindberg/Blue M will, at its option, repair or replace the part. Lindberg/Blue M assumes no responsibility for any labor expenses for service, removal, or reinstallation required to repair or replace the part, or for incidental repairs, and such costs are the responsibility of the Owner and his Dealer.

The warranty does not apply to damage caused by accidents, misuse, fire, flood, Acts of God or any other events beyond Lindberg/Blue M's control or to damage caused from failure to properly install, operate, or maintain the product in accordance with the printed instructions provided by Lindberg/Blue M. To obtain prompt warranty service, simply contact the Dealer from whom you purchased the product or the nearest Dealer handling Lindberg/Blue M products. Lindberg/Blue M's own shipping records showing date of shipment shall be conclusive in establishing the warranty period.

This warranty is in lieu of any other warranties, expressed or implied, including merchantability or fitness for a particular purpose. The owner agrees that its sole remedy and Lindberg/Blue M's sole liability with respect to defective parts or any other claim shall be as set forth in this warranty, and any claims for incidental, consequential or other damages are expressly excluded.



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 silver 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/BLUE M SALES DIVISION

Phone: 704/658-2711
800/252-7100

FAX: 704/645-3368

LABORATORY PARTS and SERVICE

Phone: 704/658-2891
800/438-4851

FAX: 704/658-2576

TECHNICAL SUPPORT

Phone: 800/438-4851

LINDBERG/BLUE

A General Signal Company
275 Aiken Road
Asheville, NC 28804
U.S.A.