



# 1700°C Tube Furnace

Models: STF54434C  
STF54454C

## Owner's Manual



**L-92137-54434 Rev. A**

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## 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 Tube 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

The Lindberg/Blue M 1700°C Tube Furnace is designed for heating laboratory process applications and small production work loads to a maximum temperature of 1700°C (3092°F) and maintain a temperature accuracy of  $\pm 1^\circ\text{C}$ .

## Section 1

The complete furnace assembly consists of the tube furnace itself and a separate control console, featuring a digital display electronic controller, a Silicon Controlled Rectifier (SCR), and a single circuit breaker for the furnace heating system. The control console used with this unit includes the UP550 multi-segmented programmable controller. There are two furnace model sizes, the STF54434C and the STF54454C.

The following paragraph describe more specific details of the Lindberg/Blue M 1700°C Tube Furnace.

### 1.2.1 Specification for Furnace Model 54434:

- A. Overall Outside Dimensions: 14-1/2" High x 12" Wide x 16-1/2" Long
- B. Inside Heating Chamber Dimensions: 3" Vestibule I.D. x 12" Long
- C. Interchangeable Vestibule I.D.'s: 1" and 2" (optional)
- D. Weight: 70 lbs.
- E. Maximum Operating Temperature: 1700°C (3092°F)
- F. Heating Elements: Molybdenum Disilicide
- G. Number of Elements: 10
- H. Elements' Melting Temperature: 1871°C (3400°F)
- I. Thermocouple: Type B  
(Negative Wire: 94% Platinum, 6% Rhodium  
Positive Wire: 70% Platinum, 30% Rhodium)
- J. Control Console Number: 59256-P-COM
- K. Wattage: 5000

### 1.2.2 Control Console:

The temperature control system for the 1700°C Tube Furnace is housed in a separate instrument console. Console Model Number 59256-P-COM is briefly described below:

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
  - D. Current Limit Potentiometer
3. 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 12.)
4. Amber lamp, located near the Lindberg 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 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: 0-1700°C

NOTE

Maximum operating temperature of the furnace is 1700°C.

- D. Thermocouple Input: Type B (See Page 3)
- E. Furnace Number: 54434
- F. Electric Power Requirements: 208/240 Volts AC, 1 Phase, 50/60 Hertz
- G. 16 Segment Programmable Controller
- H. RS485 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 for prolonged periods of time with no adverse effects.

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 Tube 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 110°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.

## 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 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 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.

4. 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 WIRING**

The 1700°C Tube 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 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. Leadwires CANNOT BE spliced. If a longer thermocouple leadwire is needed, please contact the factory.

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

CAUTION

Be sure that main power is switched OFF while making the following connections.

1. With the Lindberg nameplate towards you, remove the front base panel of the furnace by taking out the necessary screws.
2. With the rear of the control console towards you, remove the rear panel by taking out the necessary screws.
3. Connect two leads of 240 volt, single phase, 50/60 Hz. power supply to the customer's disconnect switch. Label the wires  $L_1$  and  $L_2$ . Thread the wires through the center port into the control console. Connect to the right-hand (as you face the rear of the console) terminal block, labeled 1TB. Be sure that wire  $L_1$  is connected to terminal  $L_1$  and wire  $L_2$  to terminal  $L_2$ . A screwdriver is generally all that is needed to connect the leads to the terminal.
4. Connect a 10-gauge ground wire from the main lug on the ground bar in the control console to an appropriate ground in the customer's facility. This wire should also be threaded through the center port on the rear of the control console. (Be sure to follow local electrical codes.)
5. Connect two properly sized power wires to the spaces labeled  $L_1$  and  $L_2$  on 1TB. Mark the wires respectively  $1L_1$  and  $1L_2$ . These wires are to connect the fans. Thread the connected wires through the right-hand port on the control console rear panel. Continue to run the wires through the 9/16" port on the rear base of the furnace. Bring the wires up the front and connect to the terminal block on the left side. Be sure that wire  $L_1$  is connected to terminal  $L_1$  and wire  $L_2$  to terminal  $L_2$ .

## Section 2

6. Connect a properly-sized ground wire from the furnace to the ground bar in the control console. The ground wire should be threaded through the 7/8" port in the rear base of the furnace and the right port on the control console.
7. Connect two properly-sized power wires to the spaces labeled A<sub>1</sub> and B<sub>1</sub> on the left side terminal block, labeled 2TB, in the control console. Mark the wires respectively A<sub>1</sub> and B<sub>1</sub>. Thread the wires through the left-hand port on the rear panel of the control console. Continue to run the wires through the 7/8" port in the rear panel of the furnace. Bring the wires up to the front and connect to the terminal block on the right side. Be sure to connect wire A<sub>1</sub> to terminal A<sub>1</sub> and wire B<sub>1</sub> to terminal B<sub>1</sub>. In the control console, the A<sub>1</sub> and B<sub>1</sub> terminals connect directly to the transformer.
8. Remove the furnace top access panel by taking out the screws that hold it in place.
9. 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.)
10. As a final installation step, perform a visual inspection of the furnace and control console, including the furnace chamber and all electrical connections.
11. Replace and secure the back panel of the control console, using the necessary screws.
12. 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.
13. Replace and secure the furnace top and front face panel using the necessary screws.

2.4        CONVERSION TO 208 VOLT POWER SOURCE

The 1700°C Tube 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.
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 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. Using the UP550 control provided with the control console, set the high temperature alarm to 825°C. Refer to the user's manual and the UP550 manual for alarm setting procedures.

3. Using the UP550 control, 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.
4. 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.
5. 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 CIRCUIT BREAKER, THE CUSTOMER'S POWER STILL REMAINS "ON" AT THE CONTROL CONSOLE AND THE FANS WILL CONTINUE TO OPERATE. DO NOT SHUT OFF THE CUSTOMER'S POWER UNTIL THE FANS HAVE COOLED THE FURNACE BACK TO AMBIENT (ROOM) TEMPERATURE. DAMAGE TO THE FANS COULD RESULT IF THEIR POWER IS CUT WHILE THE FURNACE IS VERY HOT.

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

### WARNING

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

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

## SECTION 4

### MAINTENANCE

#### 4.1 SERVICE STATEMENT

For furnace service and troubleshooting, contact the manufacturer at 1-800-438-4851.

#### 4.2 TEMPERATURE CONTROLLER

For UP550 instructions, refer to the manuals provided with your control console.

#### 4.3 THYRISTOR SCR UNIT

Typical conditions for improper output are:

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

Eliminate these conditions before investigating further causes for improper output.

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

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.

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.

#### NOTE

Please contact the factory regarding questions on the effect of specific atmospheres on your furnace performance.

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. With the Lindberg nameplate towards you, remove the furnace front and/or rear access panels.
3. Carefully remove the stainless winged "M" clamps holding the braided aluminum interconnecting straps to the aluminized terminal ends 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.
5. Remove the six screws from the trim on the end panel nearest the element(s) to be replaced. Remove trim and gently pull entire blue end panel out of the furnace.
6. Remove the two screws from one inch square clip holding the insulation in place. Remove clips.
7. Very carefully remove the square tube vestibule and the three sections of insulation pads. Now the inner chamber should be completely exposed.



8. Very carefully pull the heating element to be replaced through its holes in the insulation completely into the furnace chamber and then angle each one out through the end opening.
9. Very carefully unpack the replacement heating element(s) 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.

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 OPTIONAL INTERCHANGEABLE VESTIBULES

Interchangeable vestibules allow the use of 1" and 2" O.D. customer-supplied process tubes. To change the vestibules, proceed according to the following method:

1. Shut off all power to the control console and the furnace at the customer's disconnect switch.
2. Remove the six screws from the trim on each end panel. Remove the trim. Gently pull both blue end panels out of the furnace.
3. Very carefully pull the square vestibule piece from the surrounding insulation pads. If the vestibule sticks in place do NOT use excessive force. Slide a thin blade between the vestibule and the surrounding insulation and run it around the vestibule to free it.

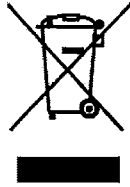
#### 4.9 INSULATION

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.

# WEEE Compliance

## Great Britain



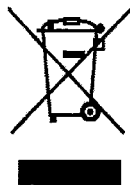
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## Deutschland



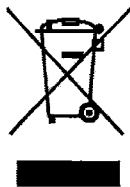
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## Italia



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## France



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## **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.

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### **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

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