

# Instructions

## Fisher Scientific Isotemp<sup>®</sup> Muffle Furnaces 650 Series

Model 14  
Cat. No. 10-650-14 & 14A

Model 58  
Cat. No. 10-650-58

Model 126  
Cat. No. 10-650-126



**Warning:** *This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications.*

*It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment.*

*Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.*

2-1018-02

Model ~~58~~ 58

# Table of Contents

<b>Introduction</b>	1
<b>Installation</b>	
Selecting a Location	2
Unpacking	2
Preparing the Furnace	3
208 Volt Installations	3
Special Precautions	3
<b>Controls</b>	
Display	4
Keypad	5
<b>Operation</b>	
Control Mode	6
Ramp and Soak Mode	
Program Steps	7
Creating a Ramp and Soak Program	8
Running, Stopping or Resuming a Program	12
Viewing Program Status	13
An Example Program	15
Safety Considerations	17
<b>Limit Alarms</b>	
Tips on Setting Alarms	18
Setting the Alarms	18
<b>Display Offsets</b>	20
<b>Factory Settings</b>	21
<b>Service</b>	
Replacing a Heater	22
Replacing the Control Thermocouple	23
<b>Trouble-Shooting Table</b>	24
<b>Replacement Parts</b>	26
<b>Accessories and Supplies</b>	27
<b>Performance Characteristics</b>	28
<b>Specifications</b>	29

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## **Introduction**

Fisher Isotemp 650 Series programmable muffle furnaces are available in three sizes: small (Model 14), medium (Model 58) and large (Model 126). All models provide PID microprocessor control at operating temperatures of up to 1125 °C (2057 °F).

Furnace chambers are molded from alumina silicate ceramic fibers. Use of this material provides low thermal mass for fast heat-up and cool-down, as well as an unusually low exterior furnace temperature for safe operation. The furnace is heated by electric resistance elements embedded in the chamber's easily removable bottom and side walls. The heating elements are designed to ensure extended service life, even in atmospheres characteristic of high-sulfur coal and coke samples.

Temperature readouts and control parameters are shown on two red vacuum fluorescent displays. Two additional LED's indicate when heater power is being applied or an error condition is encountered.

For operation with chamber atmospheres other than air (N<sub>2</sub>, CO<sub>2</sub>, etc), external gas supplies connect easily through a provided 3/8-inch port. A top-mounted exhaust port allows convenient venting of the chamber.

Isotemp furnaces incorporate a variety of safety features. When the furnace door is opened, the system microprocessor automatically cuts power to the chamber heating elements. If either the maximum furnace operating temperature, or a user-entered maximum deviation from the set temperature, is exceeded, the heating elements are turned off and an error code is displayed. A ventilated base design prevents damage to the bench or countertop.

The system microprocessor permits the user to customize a heating program of up to 8 heating/cooling ramps. If desired, a soak period of up to 23 hours and 59 minutes may be interspersed between any two successive ramps.

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## Installation

### Selecting a Location

Choose a location for the furnace which will provide an area of approximately four square feet (2 ft x 2 ft). The bench or table selected must be capable of supporting at least 60 lbs for the Model 14, 90 lbs for the Model 58 or 110 lbs for the Model 126. Appropriate electrical power must be available. Locate the furnace within three feet of the power outlet so that no extension cord is required.

It is recommended that the site have facilities for venting an accessory Exhaust Tube Assembly (Cat. No. 10-490-10) which is available for use with the furnace. Alternatively, the furnace may be located in a fume hood if samples are expected to produce toxic volatiles.

### Unpacking

Fisher Isotemp<sup>®</sup> muffle furnaces are shipped in a single carton. After unpacking, locate each item shown in the list below. Report any missing items, by name and part number, to your Fisher branch or representative. In the event of shipping damage, retain the carton and packing material and file a claim with the final carrier.

#### Item

##### Furnace Assembly

Model 14  
120 V, 50/60 Hz  
208/240 V, 50/60 Hz

Model 58  
208/240 V, 60/50 Hz

Model 126  
208/240 V, 60/50 Hz

##### Hearth Plate

Model 14  
Model 58  
Model 126

##### Shelf (Model 126 Only)

##### Instruction Manual

##### Warranty Card

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## **Preparing the Furnace**

To prepare the muffle furnace for operation, perform the following procedures:

1. Place hearth plate on furnace floor. Orient hearth plate such that smooth surface faces upward.
2. *With the Model 126*, supplied shelf may be used. If desired, install shelf by sliding it onto top of ledge which protrudes from mid-lines of side and rear walls.
3. Make certain all packing material has been removed from furnace chamber.
4. *If installing the accessory Exhaust Tube Assembly*, first locate exhaust port at top of furnace. Use three screws securing port flange to attach exhaust tube.

Finally, route free end of tube to fumehood or other outside vent. If desired, exhaust tube may be cut to length using a hacksaw.

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## **208 Volt Installations**

If only 208 V line voltage is available, all furnaces factory wired for 230 V may be operated at 208 V without requiring wiring changes.

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## **Special Precautions**

Isotemp muffle furnace chambers contain alumina silicate ceramic fibers. With continued use at temperatures above 1000 °C (1832 °F), this material slowly converts to crystalline silica (cristobalite). Long-term exposure to airborne cristobalite may result in severe respiratory diseases in humans. Tests with laboratory animals suggest that cristobalite is a possible carcinogen. Short-term effects may include irritation to skin, eyes and the respiratory tract. Please consult the Material Safety Data Sheet (MSDS) provided by Fisher Scientific for further information.

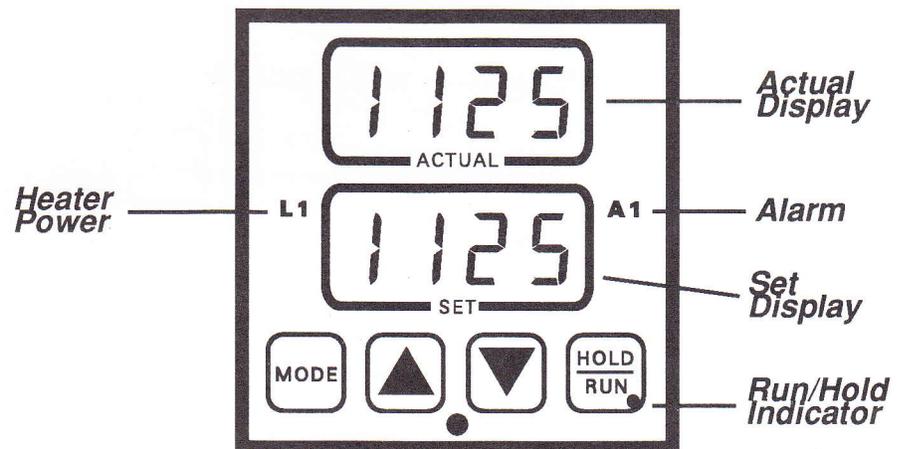
## Controls

The following sections briefly describe the locations and functions of various display fields and keypad controls. More detailed descriptions are provided, when required, in the operating sections of the manual.

## Display

The 650 Series controller features two bright, one-half inch LED numeric displays used in setting up the furnace program or reading out the furnace temperature. Two smaller LED's indicate, respectively, an alarm condition or when power is being applied to the furnace heaters. Each display field is discussed separately below.

Figure 1. Display Fields



### Set Display

In the *Control* and *Ramp and Soak* modes, shows the furnace set temperature. During setup and programming, indicates control parameters to be set.

### Actual Display

In the *Control* and *Ramp and Soak* modes, shows the actual furnace temperature. During setup and programming, indicates the numerical value assigned to the currently displayed control parameter.

### Heater Power (L1)

Lights when power is being supplied to the furnace heaters.

### Alarm (A1)

Lights if the actual furnace temperature exceeds the alarm temperature. The alarm temperature is factory-adjusted to be 25 °C above the set temperature.

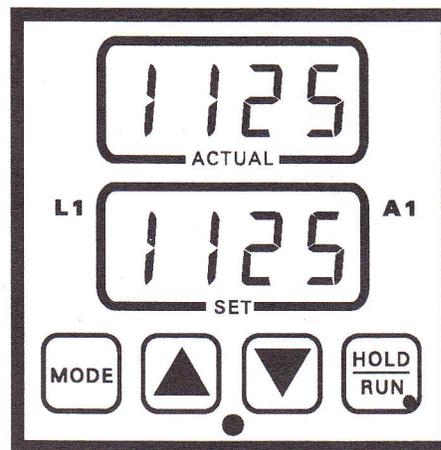
**Hold/Run Indicator**

Indicates current operating mode. In the *Control* mode, the Hold/Run LED is off; in the *Ramp and Soak* mode, the LED is on.

**Keypad**

The 650 Series incorporates a four-key, tactile keypad. The function of each key is discussed individually below.

**Figure 2. The Keypad**



During programming or setup, successively pressing **MODE** causes the controller display to sequentially step through menu selections.



In *Control* mode, pressing  increases the furnace set temperature, as indicated on the Set Display. During programming or setup, used to step through menu options.



In *Control* mode, pressing  decreases the furnace set temperature, as indicated on the Set Display. During programming or setup, used to step through menu options.



Alternates muffle furnace operation between the *Control* and *Ramp and Soak* modes.

## Operation

The 650 Series muffle furnaces feature two operating modes:

- *Control*
- *Ramp and Soak*

Each is discussed separately in the following sections.

### Control Mode

In *Control* mode operation, the muffle furnace maintains a set temperature until that set temperature is changed.

To set a temperature and initiate *Control* mode operation, perform the following:

1. Place the power switch in the ON position.
2. If the Run/Hold indicator is lit or blinking, press  until the indicator remains off.
3. Observe the set temperature in the Set Display window.
4. *To decrease the set temperature*, press .
5. *To increase the set temperature*, press .
6. When the desired set temperature is shown, release the  or  keys. The muffle furnace automatically begins to control at the set temperature.

**Note:**

*To rapidly increase or decrease the set temperature **press and hold** the appropriate arrow key. To slowly increment or decrement the set temperature one degree at a time, **press and immediately release** the arrow key.*

## Ramp and Soak Mode

In *Ramp and Soak* mode operation, the muffle furnace executes a sequence of "ramps" and "soaks" programmed by the operator. During a ramp period, the muffle furnace temperature is controlled to increase at a linear rate set by the operator. During a soak period, the furnace maintains a constant temperature for a time interval selected by the operator.

### Program Steps

A program consists of a sequence of operations or "steps" which the muffle furnace controller may be set up to perform. The programmed operations are executed in the order entered: step 1, step 2, step 3, etc. A program may have a maximum of eight steps, or as few as two (one must be an End).

Program steps may be selected from among the four basic operations described below. The corresponding LED display for each operation is shown at the left:

StPt

A Set Point program step causes the furnace set temperature (shown in the Set Display) to be linearly increased or decreased ("ramped") at a selected rate. The StPt operation begins at the current set temperature and finishes at the programmed Set Point temperature.

Soak

Soak causes the final set temperature from the preceding step to be held for a time interval of up to 23 hours, 59 minutes and 59 seconds. This duration may be extended by adding further Soak steps or using a Jump Loop (see below).

JL

A Jump Loop operation causes program execution to jump to another designated program step. Each program step, up to the Jump Loop, is then sequentially repeated. Use of a Jump Loop allows a programmed temperature cycle to be repeated up to 100 times. A Jump Loop cannot be used as the first step in a program.

**End**

Program execution proceeds sequentially through each program step until an End is encountered, or until all eight program steps have been completed. An End may be set up to cause the furnace to maintain the final set temperature indefinitely or simply to turn off heater power.

If no End is used, all eight program steps will be completed, then the furnace will maintain the final programmed set temperature.

### Creating a Ramp and Soak Program

Creating a program consists of constructing a sequence of the four basic operations (Set Point, Soak, Jump Loop and End) to produce a desired temperature cycle. For each operation selected, several options also must be specified. To enter a ramp and soak program, perform the following procedures:

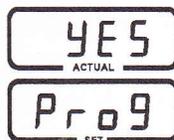
**Note:** During programming, the MODE key serves as an "enter" key to select a value shown on the Actual Display for a corresponding parameter shown on the Set Display.

1. Press **HOLD RUN** until the Hold/Run indicator light is off.
2. Press **MODE**. The display should appear:



**Note:** If no key is pressed for one minute, the display always automatically reverts to Control mode.

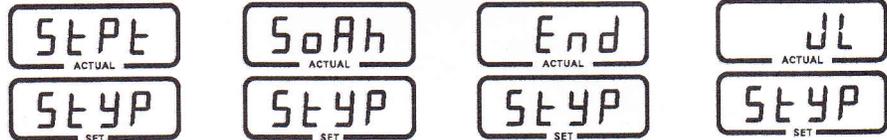
3. Press **▲** once to present the program entry menu selection. Observe:



4. Press **MODE** to initiate entry of the first program step.



5. Press  or  until the Actual Display shows the number of the program step to be set up. Press **MODE** to enter the desired program step.
6. The Set Display then indicates "StyP" to signify that the step type must be selected from a menu of four operations being shown in the Actual Display. The four menu selections are Set Point, Soak, End or Jump Loop. Repeatedly press  or  until the desired step type appears:



**Note:** For Step 1 in a program, the Jump Loop option is not available.

7. *If the desired program step is an End*, press **MODE** to select it. Otherwise, skip to step 10.
8. If End is selected, the Set Display shows "End" and the Actual Display shows one of the two options for an End step. To view the two selections, repeatedly press either  or . The options appear as:



9. If the final temperature is to be held indefinitely at the end of the ramp and soak program, press **MODE** when "HoLd" is displayed on the Actual Display. If heater power is to be turned off at the end of the program, press **MODE** when Actual Display indicates "OFF." Proceed to step 20.

10. *If the desired program step is a ramp to a Set Point*, press **MODE** to select it when the Actual Display reads "StPt." Otherwise, skip to step 13.
11. If a ramp to a Set Point is selected, the Set Display first indicates "SP" to signify that the operator must select a final target temperature, or set point. Use  or  to adjust the Actual Display to indicate the desired final temperature for the ramp.



Press **MODE** to enter the selected set point temperature.

12. The Set Display then indicates "rAtE" to prompt the operator to select a desired heating or cooling rate in °C/min. Press and hold  or  until the desired rate is shown in the Actual Display.



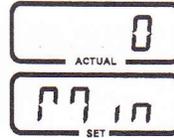
Press **MODE** to enter the selected rate. Proceed to step 20.

13. *If the desired program step is a Soak*, press **MODE** to select it when the Actual Display shows "SoAh." Otherwise, skip to step 17.
14. If a Soak is selected, the Set Display first indicates "HOuR" to signify that the operator must select the number of hours for which the current set temperature will be maintained. Use  or  to adjust the Actual Display to indicate the desired number of soak hours (maximum of 23 hours)



Press **MODE** to enter the selected number of soak hours.

15. The Set Display then shows "Min" to indicate that the operator must select the number of additional minutes for which the current set temperature will be held. Use  or  to set the Actual Display to the desired number of soak minutes (maximum of 59).



Press **MODE** to enter the selected number of soak minutes.

16. The Set Display then shows "SEC" to indicate that the operator must select the number of additional seconds for which the current set temperature will be held. Use or to adjust the Actual Display to indicate the desired number of soak seconds (maximum of 59).



Press **MODE** to enter the selected number of soak seconds. Proceed to step 20.

17. *If the desired program step is a Jump Loop*, press **MODE** to select it when the Actual Display shows "JL." Otherwise, skip to step 20.
18. If a Jump Loop is selected, the Set Display first indicates "JS" to signify that the operator must select the step number destination for the jump. Use or to adjust the Actual Display to indicate the desired step number.

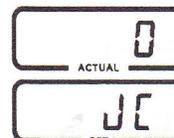


**Note:**

*The jump step number must be lower than the current step number. The jump cannot be to the current step or a higher step.*

Press **MODE** to enter the selected jump step.

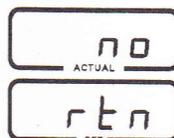
19. The Set Display then shows "JC" to indicate that the operator must select the number of times the jump loop is to be repeated.



Use  or  to adjust the Actual Display to select the number of times the loop is to be repeated.

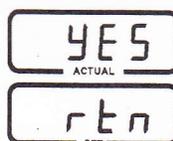
Press  to enter the selected number of loop repeats.

20. The displays indicate "no rtn:"



*If further steps are to be programmed*, press  to continue programming, but advanced to the next step number. Continue setting up the program at step 5 of this procedure.

21. *If no further program steps are required*, press . The displays indicate "YES rtn:"



Press  to return to Control mode operation. To initiate the program, see *Running a Program*.

### ***Running, Stopping or Resuming a Program***

Prior to running the program in memory, first *make certain* that the current set temperature is the temperature from which the program is to start. For example, a program *intended* to ramp the furnace temperature from ambient to 600 °C, if started with the current set temperature at 1000 °C, will actually ramp the temperature *down* from 1000 °C to 600 °C.

*To run the program currently in memory*, perform the following steps:

1. Press  once. The Run/Hold indicator light begins to flash and the displays indicate (Set Display flashing):



2. Use  to adjust the Actual Display to show the number of the program step at which the run is to begin. Press  to initiate the run, beginning at the program step number shown.

Observe that the Hold/Run indicator comes on full signifying that the furnace is in the ramp and soak mode with a program underway.

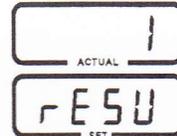
**To stop a running program**, press . Furnace operation then returns to the *Control* mode, with the set temperature at the last value achieved by the program.

**To resume a stopped program**, perform the following steps:

1. Press  until the Run/Hold indicator light begins to flash and the displays indicate (Set Display flashing):



2. Press . Observe the displays:



3. Press . The Hold/Run indicator comes on full signifying that the furnace has resumed the ramp and soak program *at the step at which it was stopped*.

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### Viewing Program Status

While a ramp and soak program is running, the status of the current program step may be viewed. With the Run/Hold LED lit to indicate the program is running, successively press . Each control parameter associated with the current program step then is displayed sequentially. The parameter type is indicated in the Set Display, while the value for the parameter appears in the Actual Display. A final press of  returns the displays to tracking the actual and set temperatures.

The specific control parameters displayed in any instance depend upon whether the current step is a Set Point or a Soak operation. The sequence

of control parameters displayed in each case, and the corresponding Set Display messages, is as follows:

### *Set Point Step*



Target final temperature at the completion of the ramp.



Rate of change of temperature, in °C/min, for the ramp.



If a Jump Loop is in progress, indicates the number of times the loop has been repeated.



Current program step.

### *Soak Step*



The soak temperature.



Hours remaining in the soak step.



Minutes remaining in the soak step.



Seconds remaining in the soak step.



If a Jump Loop is in progress, indicates the number of times the loop has been repeated.



Current program step.

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### **An Example Program**

The ASTM method for Ash Analysis of Coal and Coke (D 3174-89)<sup>1</sup> specifies the following ramp and soak operations:

Step 1: Ramp from ambient to 500 °C at 8.0 °C/min (i.e., in 1 hour)

Step 2: Ramp from 500 °C to 750 °C at 4.2 °C/min (i.e., in 1 hour)

Step 3: Soak at 750 °C for two hours

Step 4: Turn off power to the heaters and allow to cool

To set up and run this program, perform the following procedures.

#### **Programming Step 1:**

1. Press  until the Run/Hold indicator light is off.
2. Press  to enter the *Setup* mode. Displays should show ("no Prog")
3. Press  to display the program entry option. ("YES Prog") Press  to select program entry. ("1 StEP")
4. Press  to display current program step 1.
5. Use  to display the ramp to a Set Point operation. ("StPt StyP"). Press  to select a Set Point operation as the new program step 1.
6. Use  to adjust the Actual Display to indicate the final temperature for the first ramp, namely 500 °C. ("500 SP") Press  to enter.
7. Use  to adjust the Actual Display to indicate the desired heating rate for the first ramp, namely 8.0 °C/min. ("8.0 rAtE") Press  to enter. ("no rtn")

#### **Programming Step 2:**

8. Press  to advance to the second program step. ("2 StEP") Press  to initiate programming the second step.

<sup>1</sup> *American Society for Testing and Materials, Gaseous Fuels: Coal and Coke, Vol. 05.05, Section 5, pp. 326-8*

9. Use  to display the ramp to a Set Point operation. ("StPt StyP"). Press  to select Set Point ramp.
10. Use  to adjust the Actual Display to indicate the final temperature for the second ramp, namely 750 °C. ("750 SP") Press  to enter.
11. Use  to adjust the Actual Display to indicate the desired heating rate for the second ramp, namely 4.2 °C/min. ("4.2 rAtE") Press  to enter. ("no rtn")

### ***Programming Step 3:***

12. Press  to advance to the third program step. ("3 StEP") Press  to initiate programming the third step.
13. Use  to display the Soak operation. ("SoAh StyP"). Press  to select a constant temperature soak period.
14. Use  to adjust the Actual Display to indicate the desired soak hours, namely 2. ("2 HOuRS") Press  to enter. ("0 Min")
15. Press  to enter zero additional soak minutes. ("0 SEC")
16. Press  to enter zero additional soak seconds. ("no rtn")

### ***Programming Step 4:***

17. Press  to advance to the fourth program step. ("4 StEP") Press  to initiate programming the fourth step.
18. Use  to display the End operation. ("End StyP"). Press  to select End.
19. Use  to display the option to turn off power to the heaters and cool down at the program end. ("OFF End") Press  to select this End option. ("no rtn")
20. Use  to display. ("yES rtn") Press . The furnace returns to *Control* mode with the program in memory.

Prior to running the program, use  to adjust the Set Display to a set temperature at or below the current furnace temperature.

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### **Safety Considerations**

When operating muffle furnaces, *always* observe the following safety precautions:

- Wear insulated gloves.
- Use tongs.
- Never stand in front of an open furnace.
- Use the supplied hearth plate on the chamber bottom.
- Use safety goggles.

## Limit Alarms

The 650 Series controllers feature a deviation alarm which alerts the operator and interrupts heater power whenever the actual furnace temperature differs from the set temperature by more than set limits. Independent high and low alarm limits may be entered by the operator. The high and low alarm limits are factory-set at 25 °C and -999 °C, respectively.

If the actual temperature exceeds the high alarm limit, the "A1" indicator will light and the Set Display will flash "HI." If the actual temperature falls below the low alarm limit, the "A1" indicator will light and the Set Display will flash "LO."

The reference point for the alarms is the set temperature (Set Display). Any change in the set temperature will cause a corresponding shift in the high and low alarm temperatures.

### Example:

Suppose the high alarm limit is set at 25 °C and the low alarm limit at -100 °C. If the set temperature is 500 °C, the high alarm will trip at 525 °C and the low alarm at 400 °C. If the set temperature is changed to 700 °C, the high and low alarms will follow the set temperature and then trip at 725 °C and 600 °C, respectively.

## Tips on Setting Alarms

Changing the set temperature to a value outside an alarm limit will trip the alarm, activating the "HI" or "LO" indication. Power is removed from the heaters when an alarm condition occurs.

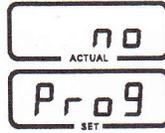
After turning on the furnace power switch, the low alarm is blocked ("silenced") *until the furnace achieves its set temperature the first time*. From that point on, the low alarm will function normally unless the furnace power switch is again cycled on and off. If the "LO" indication is flashing, and furnace is not heating, cycle the furnace power switch off then back on to silence the low alarm and the furnace will resume heating.

Particular care is required in setting the low alarm. For most purposes, the low alarm should be simply set at its minimum value of -999 °C.

## Setting the Alarms

To set the alarm limits, perform the following procedures.

1. Press **HOLD RUN** until the Hold/Run indicator light is off.
2. Press **MODE**. The display should appear:



3. Press **MODE** to initiate furnace setup "no prog."
4. Press **MODE** four times to advance to entry of the low alarm limit. The Set Display should indicate "AILO."

**Note:**

*The setup parameters (except display offset) which precede and follow the high and low alarm limits are factory set at their optimal values. Should these be inadvertently altered, consult Factory Settings and return them to their original values.*

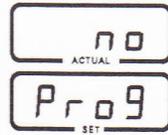
5. Press  or  until the Actual Display indicates the desired low alarm limit. Press **MODE** to enter the value.
6. The Set Display shows "AIHI" to signify that the high alarm limit is to be set up. Press  or  until the Actual Display indicates the desired high alarm limit. Press **MODE** to enter the value.
7. Press **MODE** twice more to return to *Control* mode operation with the new alarm limits set.

## Display Offsets

The 650 Series controllers permit the operator to select an offset temperature for the Actual Display. With a display offset entered, the temperature shown on the Actual Display will be the actual furnace temperature (measured at the control thermocouple) *plus or minus* the display offset selected. Functionally, the offset feature permits the operator to measure and calibrate such that the display will indicate the temperature *at a specific point or zone* within the furnace.

To enter a display offset, carry out the following steps:

1. Press **HOLD RUN** until the Hold/Run indicator light is off.
2. Press **MODE**. The display should appear:



3. Press **MODE** to initiate furnace setup "no prog."
4. Press **MODE** six times to advance to entry of the display offset temperature. The Set Display should indicate "CAL."

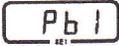
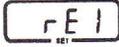
**Note:**

*The setup parameters (except the high and low alarm limits) which precede and follow the display offset are factory set at their optimal values. Should these be inadvertently altered, consult Factory Settings and return them to their original values.*

5. Press **▲** or **▼** until the Actual Display indicates the desired display offset. Press **MODE** to enter the value.
6. Press **MODE** once more to return to *Control* mode operation.

## Factory Settings

The parameters in the following table appear on the setup menu, but are factory-set to values which are optimal for the muffle furnace. Consequently, they should not be changed. If accidentally altered, return them to their factory-set values listed below:

<i>Set Display</i>	<i>Models 14 &amp; 58</i>	<i>Model 126</i>
	8	24
	0.38	0.38
	0.12	0.40
	1	1
	0	0

Copies of the controller manufacturer's manual (part number SPN 83998) may be obtained by contacting your nearest Fisher Instrument Service Division location.

The manual provides development details on altering controller parameters which are currently optimized for furnace control and stored. The manual is available, **but not recommended**, since no alteration will improve furnace operation, while some may cause serious damage to the product.

**Note:**

Record the CAL # on your furnace on this page of the manual. This number is the furnace temperature offset value which appears when using  to step through setup parameters. This setting will assure highest accuracy over the range of 400 to 1125 °C. This value was established by means of a series of tests in Quality Assurance during the final inspection of your furnace.

## Service

All Fisher Isotemp 650 Series programmable muffle furnaces use both wall and floor heaters to maintain uniform heating. The following sections describe procedures for replacing a heater or the control thermocouple.

### Replacing a Heater

To replace a defective heater, proceed as follows:

1. Disconnect power cord from the electrical outlet.
2. Open the chamber door. Allow the door to remain open throughout the heater replacement procedure.

**Caution:**



*Allow furnace to cool to ambient temperature before attempting repair.*

3. Remove the screws that secure the perforated metal back panel of the furnace to main chassis. Remove the panel and set it aside.
4. Remove the two heater terminal screws located on the terminal barrier strip. Straighten the lead wires.
5. *Carefully* withdraw the defective heater from the furnace chamber. Ceramic wool insulation surrounding heater wires will fall into the furnace chamber. Remove it and set aside for later use.
6. *Carefully* install the replacement heater by reversing the procedure in step 5 above.

**Caution:**



*The heater panel material is fragile. Exercise care when inserting replacement panels into the furnace chamber. Likewise, bend or flex the heater leads gently if necessary.*

7. *Carefully* re-attach the heater terminals by reversing step 4. Then re-fill the holes around heater leads with ceramic wool preserved from step 5.
8. Re-install the perforated metal back panel of the furnace.
9. When the above steps are complete, return the power cord to the electrical outlet.

## **Replacing the Control Thermocouple**

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To replace a defective thermocouple, perform the following steps:

1. Perform steps 1 through 3 in *Replacing a Heater* (preceding page).
2. Unplug the thermocouple connector.
3. Withdraw the defective thermocouple from the hole in rear chamber wall.
4. Install the replacement thermocouple by reversing above procedures.

## Trouble-Shooting Table

This table is intended to assist in resolving user-correctable furnace problems by relating symptoms to their likely causes. If service beyond the scope of this table is required, contact your nearest Fisher Scientific Service District Office.

Symptom	Probable Cause	Action			
Furnace temperature erratically high	Defective control thermocouple	Replace control thermocouple			
Failure to heat	Heating program not entered or set temperature less than actual temperature	Refer to <i>Operation</i>			
	Defective control thermocouple	Replace control thermocouple			
	Poor heater connections	Tighten connections at terminal strip			
	Defective heater element		Check heater resistance, replace unless approximately:		
			Model 14		
<table border="0"> <tr> <td>Wall</td> <td>8 ohms</td> </tr> <tr> <td>Floor</td> <td>18 ohms</td> </tr> </table>			Wall	8 ohms	Floor
Wall	8 ohms				
Floor	18 ohms				
Model 58 & 126	<table border="0"> <tr> <td>Wall</td> <td>18 ohms</td> </tr> <tr> <td>Floor</td> <td>41 ohms</td> </tr> </table>	Wall	18 ohms	Floor	41 ohms
Wall	18 ohms				
Floor	41 ohms				
	Defective controller	Contact Fisher Service			
Set Display flashes "HI"	Set temperature has been changed to a value less than the actual temperature minus the high alarm limit	Wait for actual temperature to cool to the set temperature			
	Actual temperature has exceeded set temperature plus the high alarm limit	Check alarms. The high alarm limit may be set too low			

Defective controller

Contact Fisher Service

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Set Display flashes "LO"

Actual temperature is less than the set temperature minus the low alarm limit

May be normal operation. Refer to Tips on Setting Alarms

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Set Display shows "Er7"

Defective control thermocouple

Replace control thermocouple

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Set Display shows "Er1," "Er2," "Er3," "Er4," "Er5," or "Er6"

Possibly defective controller

Try turning the power switch off then back on. If this fails to relieve the error condition, contact Fisher Service

## Replacement Parts

Replacements for muffle furnace parts serviceable by the user may be ordered, by part number, from Fisher.

Item	Part Number
<u>Line Cord and Plug</u>	
Models 14 & 58	
120 V	SPN 83903
240 V	SPN 83910
Model 126	
208/240 V	SPN 83910
<u>Temperature Controller</u>	SPN 83922
<u>Fan</u>	
120 V	SPN 83915
240 V	SPN 83916
<u>Thermocouple Assembly</u>	SPN 83896
<u>Shelf (Model 126 Only)</u>	
For Loads < 3 lbs (supplied)	10-750S
For Loads > 3 lbs (accessory)	10-650H
<u>Hearth Plate</u>	
Model 14	10-651H
Model 58 & 126	10-650H
<u>Wall Heaters</u>	
Model 14 (two required)	SPN 83634
Model 58 (two required)	SPN 83633
Model 126 (four required)	SPN 83633
<u>Floor Heaters</u>	
Model 14	SPN 83637
Models 58 & 126	SPN 83638
<u>Ceramic Wool</u> (1-in wide strip)	SPN 40885
<u>Ledge (Model 126 Only)</u>	SPN 83985

## Accessories and Supplies

A variety of accessories and supplies suitable for use with the Isotemp muffle furnaces is available from Fisher. Catalog numbers of commonly used items are listed below for convenience.

Item	Catalog Number
Crucibles, Fused Quartz w/lid (set of 4)	10-490-4
Crucible, Porcelain, 10 mL	07-965C
Crucible, Porcelain, 15 mL	07-965D
Exhaust Tube Assembly	10-490-10
Gloves	11-393-78
Grinding Mill	08-415
High Temperature Markers	13-382-16
Jumbo Crucible Tongs, Stainless	15-207
Crucible Rack Handle	10-490-17
Free-Standing Shelf	10-651S
Crucible Racks (for Fused Quartz Crucibles)	
Model 14	10-490-6
Model 58	10-497-5
Model 126	10-497-5
Crucible Racks (for Porcelain Crucibles)	
Model 14	10-490-5
Model 58	10-497-10
Model 126	10-497-10

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## Performance Characteristics

Operating Range	Ambient to 1125 °C
Average Uniformity	+/- 5 °C
Set Point Repeatability	+/- 1 °C
Set Point Accuracy	
Models 14 & 58	+/- 5 °C
Model 126	+/- 15 °C
Rise Time <sup>1</sup>	
Model 14	15 min
Models 58 & 126	35 min
Recovery Time	10 min
Cool-Down, Door Open	
(1125 to 200 °C)	25 min

<sup>1</sup>Rise time is defined as the time required to achieve 63% of the maximum operating temperature of 1125 °C.

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## Specifications

### Electrical Requirements

Model 14	Cat. No. 10-650-14	120 V, 50/60 Hz
	Cat. No. 10-650-14A	208/240 V, 50/60 Hz
Model 58	Cat. No. 10-650-58A	208/240 V, 50/60 Hz
Model 126	Cat. No. 10-650-126	208/240 V, 50/60 Hz

### Power Requirements

Model 14	1700 W
Model 58	3000 W
Model 126	4600 W

### Chamber Volumes

Model 14	0.14 cu ft
Model 58	0.58 cu ft
Model 126	1.26 cu ft

### Chamber Dimensions (W x D x H)

Model 14	6 x 10 x 4 in
Model 58	12 x 14 x 6 in
Model 126	12 x 14 x 13 in

**REX ROTO**  
CORPORATION

MATERIAL SAFETY DATA SHEET

No. H5001-001 Rev. 10  
Revision Date: 6/15/90

I. PRODUCT IDENTIFICATION

Trade Name: PYROLITE; PYROBOARD; PYROWOOL

**Generic Name:** Refractory Ceramic Fiber  
Insulation

**Manufacturer:** Rex Roto Corporation

**Address:** P.O. Box 980

**Chemical Name:** N/A (Mixture)

Fowlerville, MI

48836

**CAS#:** None Assigned

**Telephone:** (517)223-3787

II. PRODUCT HAZARD SUMMARY

**Health:** Warning!  
May be harmful if inhaled.  
May be irritating to the skin, eyes and respiratory tract.  
Possible cancer hazard based on tests with laboratory animals.

**Flammability:** Non-combustible

**Reactivity:** Stable

III. HEALTH HAZARDS

A. Signs/Symptoms of Overexposure

**Ingestion:** May cause gastrointestinal disturbances such as irritation, nausea, vomiting and diarrhea.

**Eyes:** Slightly to moderately irritating. Abrasive action may cause damage to the outer surface of the eye.

**Skin:** Slight to moderate irritation or rash. Irritation is due to mechanical reaction to sharp, broken ends of fibers.

**Inhalation:** May cause irritation or soreness of throat and nose. Extreme exposures may produce coughing, congestion, and even difficulty breathing. Pre-existing medical conditions may be aggravated by exposure: e.g. bronchitis, emphysema, and asthma.

III. HEALTH HAZARDS

B. First Aid

**Ingestion:** Do not induce vomiting. Drink water and get medical attention if irritation persists.

**Skin:** Wash affected areas gently with soap and water. Using a skin cream or lotion may be helpful. Get medical attention if irritation persists.

**Eyes:** Flush immediately with large amounts of water. Do not rub eyes. Get medical attention if irritation persists.

**Inhalation:** Remove affected person from source of exposure. Drink water to clear throat, and blow nose to expel mist/dust. Avoid tobacco smoke. Get medical attention if irritation persists.

Currently, there are no known chronic health effects in humans from long-term exposure to ceramic fibers.

In animal studies, refractory ceramic fibers injected into the peritoneal (abdominal) cavity have caused acute abdominal hemorrhage in hamsters but not in rats. Such injections into the abdominal or pleural cavities have also produced tumors in life-time rat and hamster studies. In fact, similar results have been observed with numerous other fibrous and non-fibrous materials. In such experiments, this abnormally sensitive injection technique is a non-physiological method of exposure, bypassing both normal pulmonary protective and clearance mechanisms.

Recently published inhalation studies have provided contradictory results. One study, which used rats as the experimental animal, reported lung damage consisting of alveolar proteinosis and interstitial fibrosis, whereas, other studies using rats and hamsters, showed no similar effects.

Similarly, the pulmonary tumor-causing potential of refractory ceramic fibers in animals is unclear. Two inhalation studies suggest a low-order potential in inducing pulmonary tumors in animals, while other inhalation and intratracheal injection studies conclude that ceramic fibers are not tumorigenic in animals. The International Agency of Research on Cancer (IARC) has recently reviewed the animal, human and other relevant experimental data on man made mineral fibers in order to critically evaluate and classify the cancer causing potential of these materials. Based on its review, IARC classified fibrous glass wool, mineral wool (both rock wool and slag wool) and ceramic fiber as group 2B carcinogens. By definition, a group 2B agent is possibly carcinogenic to humans. For refractory ceramic fibers, IARC's 2B classification was based on sufficient evidence of carcinogenicity in experimental animals in the absence of human epidemiologic data.

Further animal and human health studies are planned. Pending the results of these studies, strict adherence to recommended safe work practices described elsewhere in this data sheet is advised. For further information regarding the safe handling and use of products containing refractory ceramic fibers, refer to Rex Roto Corporation's bulletin "Health and Safety Aspects of Bonded Ceramic Fiber Products".

#### IV. PERSONAL PROTECTION

**Eye Protection:** Safety glasses with sideshields or goggles are recommended, particularly when working overhead. Do not wear contact lenses.

**Skin Protection:** Wear gloves, hats, or loose fitting full body clothing as required to prevent skin irritation. Wash exposed areas with soap and warm water after handling. Wash work clothes separately from other clothing. Rinse washing machine thoroughly after use.

**Respiratory Protection:** Use mechanical ventilation with proper dust collection equipment to keep the dust level below the exposure limits listed in the Ingredients/Health Hazard Information section. Use NIOSH or MSHA approved equipment when airborne exposure limits are exceeded. Acceptable respirators recommended for various airborne fiber concentrations are:



IARC has recently reviewed the animal, human and other relevant experimental data on silica in order to critically evaluate and classify the cancer causing potential. Based on its review, IARC classified crystalline silica as a group 2A carcinogen. By definition, a group 2A carcinogen is probably carcinogenic to humans. For crystalline silica, IARC's 2A classification was based on limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals.

The OSHA permissible exposure limit (PEL) and the 1988-89 ACGIH threshold limit value (TLV) for cristobalite is 0.05 mg/M3 (respirable dust). Particular care should be taken when working with "used" material to minimize generation of dust. When removing and handling product used in high temperature applications, special caution should be taken to avoid unnecessary cutting and tearing of the used material to minimize generation of airborne dust. Use NIOSH or MSHA approved equipment when airborne exposure limits may be exceeded, especially in confined areas with inadequate ventilation. Acceptable respirators recommended for given airborne cristobalite concentrations are:

<u>Concentration</u>	<u>Respirator Type</u>
Up to 10 times the PEL	- Half-mask disposable air-purifying (3M 9900) or half-mask air-purifying with high-efficiency filters (MSA Comfo II with H filter)
10 to 100 times the PEL	- Full facepiece air-purifying with high-efficiency filters (MSA Ultra-Twin with H filter)
100 to 200 times the PEL	- Full facepiece supplied air-operated in continuous flow mode (MSA 01-00-06 with type C supplied-air unit)
> 200 times the PEL	- Full facepiece supplied-air operated in pressure demand mode (MSA 01-00-05 with type C supplied-air unit)

**X. INGREDIENTS / HEALTH HAZARD INFORMATION**

<u>COMPONENT</u>	<u>CAS NO.</u>	<u>%</u>	<u>EXPOSURE LIMITS</u>
Refractory Ceramic Fiber	65997-17-3	40-95	2 fiber/cc Guideline-RRC* 5 mg/M3-Nuisance Respirable-OSHA* 10 mg/M3-Nuisance Total-ACGIH*
Amorphous Silica	7631-86-9	0-60	10 mg/M3 (total) TLV
Organic and Inorganic Binders **			NA
Remaining components not determined hazardous and/or hazardous components present at less than 1.0% (0.1% for carcinogens).	NA	Trace	NA

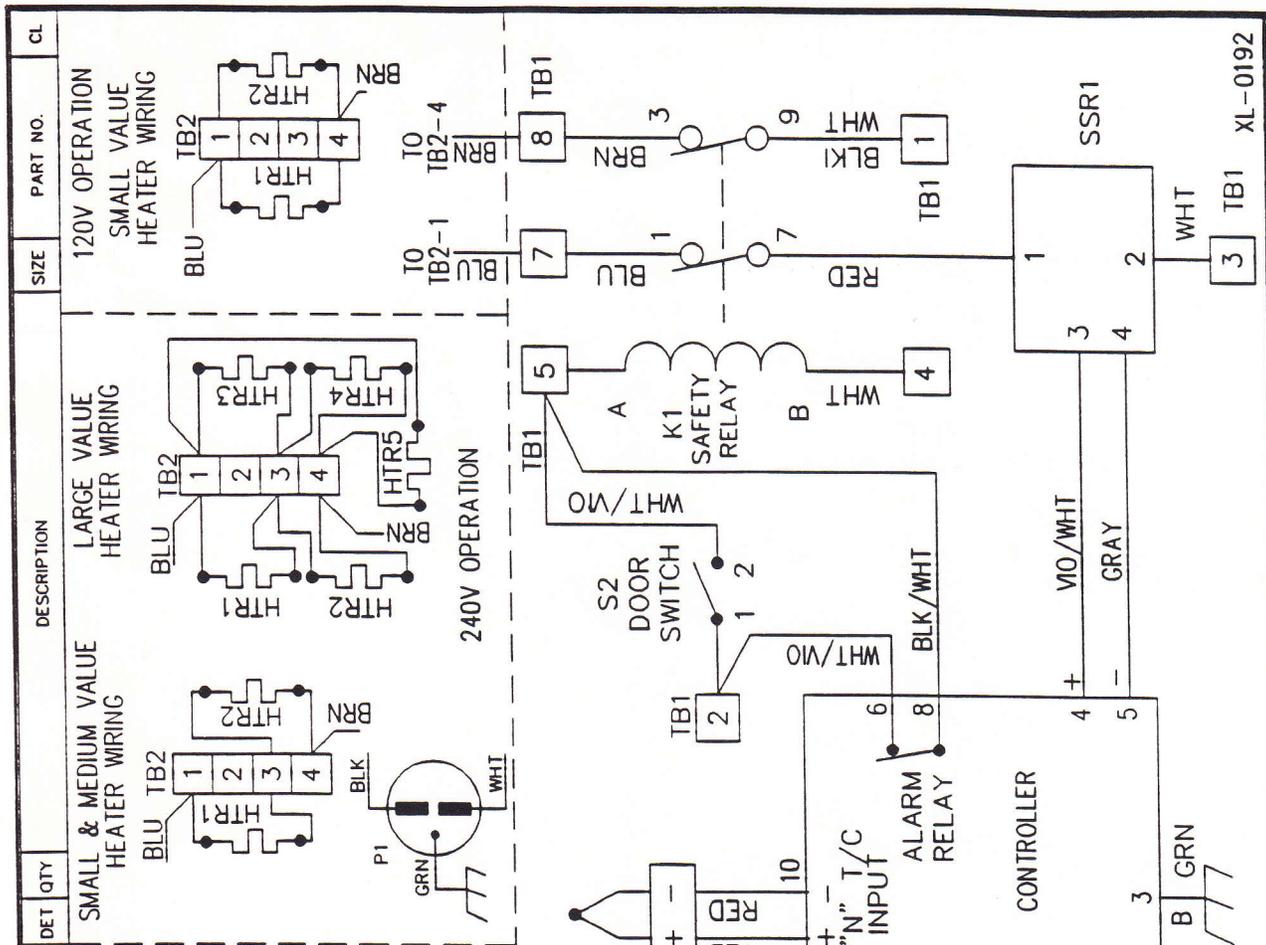
\* Pending the results of long-term health effects studies, airborne exposures should be controlled at or below the recommended industry exposure guidelines listed above.

\*\* Identity, CAS Numbers &/or percent composition are trade secrets.

**PREPARED BY:** J. J. Schweinsburg

**REPLACES SHEET DATED:** 3/23/88  
**EC #:**

As of the date of preparation of this document, the foregoing information is believed to be accurate and is provided in good faith to comply with applicable Federal and State laws. However, no warranty or representation, expressed or implied, is made as to the accuracy or completeness of the foregoing data.



DET	QTY	DESCRIPTION	SIZE	PART NO.	CL
		SMALL & MEDIUM VALUE HEATER WIRING	120V OPERATION		
		LARGE VALUE HEATER WIRING	240V OPERATION		
		SMALL VALUE HEATER WIRING	120V OPERATION		

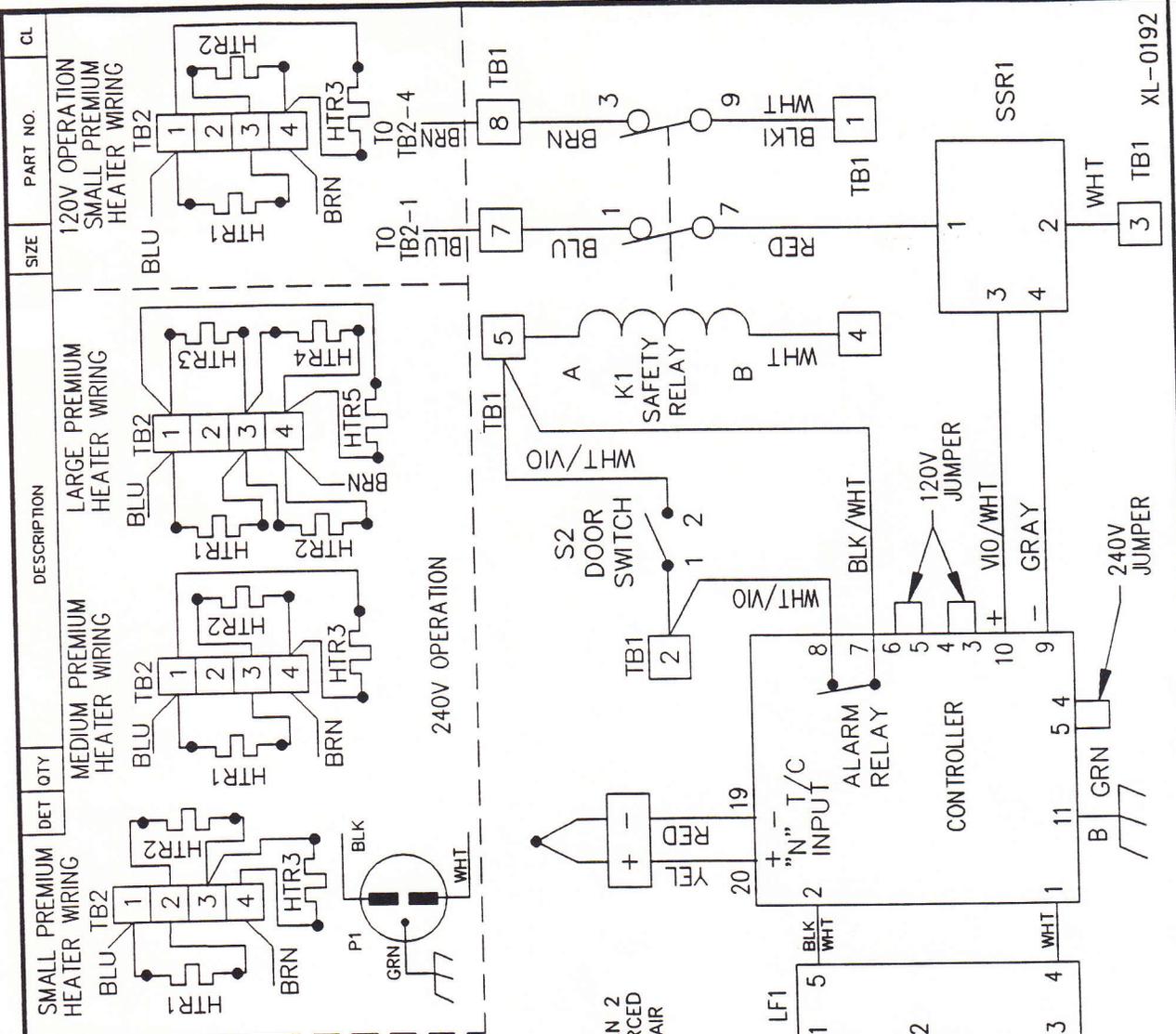
PART NO.		REV.		HEATER RESISTANCE				
A 83925		A		HTR1	HTR2	HTR3	HTR4	HTR5
REVISIONS				24 Ω	24 Ω	18 Ω	18 Ω	41.1 Ω
A BY S. HAND				24 Ω	24 Ω	18 Ω	18 Ω	
DATE 4/22/92				14.4 Ω	14.4 Ω	18 Ω	18 Ω	
ECR/ECO A2-0096				18 Ω	18 Ω	18 Ω	18 Ω	
ADDED LINE FILTER & UPDATED DRAWING								



PART NO.		REV.	
A 83925		A	
REVISIONS		SHT 1 OF 3	
DATE 4/22/92		83925	
ECR/ECO A2-0096		10-550-14	
ADDED LINE FILTER & UPDATED DRAWING		83856	

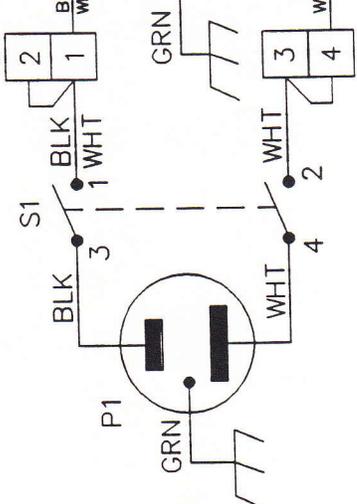
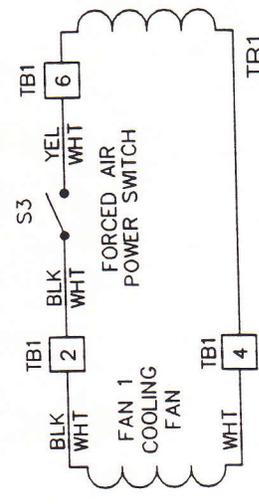
DIMENSIONS IN INCHES DO NOT SCALE  
 TOLERANCES ON DIMENSIONS UNLESS OTHERWISE SPECIFIED  
 DECIMAL .XX = ±0.015 .XXX = ±0.005 ANGULAR ± 1/2°  
 MATERIAL FINISH CLASS D  
 TITLE VALUE FURNACE SCHEMATIC  
 Fisher Scientific  
 10-550-14 83856  
 VALUE CONTROLLER 120V P/N 83884  
 VALUE CONTROLLER 240V P/N 83885





PART NO. 83925	REV. A	HEATER RESISTANCE				SMALL PREMIUM HEATER WIRING BLU TB2 HTR1 HTR2 HTR3 HTR5	MEDIUM PREMIUM HEATER WIRING BLU TB2 HTR1 HTR2 HTR3 HTR5	LARGE PREMIUM HEATER WIRING BLU TB2 HTR1 HTR2 HTR3 HTR5	120V OPERATION SMALL PREMIUM HEATER WIRING BLU TB2 HTR1 HTR2 HTR3 HTR5	CL
		HTR1	HTR2	HTR3	HTR4					
REVISIONS		SMALL 120V		SMALL 240V		MEDIUM 240V		LARGE 240V		
BY S. HAND DATE 4/22/92		8 Ω		8 Ω		18 Ω		18 Ω		
ECR/ECO A2-0096		8 Ω		8 Ω		41.1 Ω		18 Ω		
ADDED LINE FILTER & UPDATED DRAWING		18 Ω		18 Ω		18 Ω		41.1 Ω		

NOTES:  
 FOR 120V OPERATION CONNECT JUMPERS BETWEEN CONTROLLER PINS 3 & 4 AND 5 & 6.  
 FOR 240V OPERATION CONNECT JUMPERS BETWEEN CONTROLLER PINS 4 & 5.



DIMENSIONS IN INCHES DO NOT SCALE TOLERANCES ON DIMENSIONS UNLESS OTHERWISE SPECIFIED DECIMAL .XX = ±.015 .XXX = ±.005 ANGULAR ± 1/2°	BREAK ALL SHARP EDGES	DR. H. BRENDLINGER	DATE 10-5-91
	SCALE NONE	CHKD.	
MATERIAL	CLASS D	APPD.	

TITLE PREMIUM FURNACE SCHEMATIC	PART NO. SHT 3 OF 3 83925	REV. A
Fisher Scientific		10-750-14
83856		