High Temperature Tube Furnaces

OPERATION MANUAL AND PARTS LIST

Series 705 & 706

1500°C	1700°C	
F54530CM	F59330CM	Automatic
F54538CM	F59338CM	Automatic
F54540CM	F59340CM	Programmable
F54548CM	F59348CM	Programmable
F59348CM-75		Multi-Programmable
F59340CM-75		Multi-Programmable

LT705X1 10/26/98

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Safety Information

Alert Signals

Warning
Warnings alert you to a possibility of personal injury.

Caution
Cautions alert you to a possibility of damage to the equipment.

Note
Notes alert you to pertinent facts and conditions.

Hot Surface
Hot surfaces alert you to a possibility of personal injury if you come in contact with a surface during use or for a period of time after use.

Your Thermolyne High Temperature Tube Furnace has been designed with function, reliability, and safety in mind. It is the user's responsibility to install it in conformance with local electrical codes. For safe operation, please pay attention to the alert signals throughout the manual.

This manual contains important operating and safety information. The user must carefully read and understand the contents of this manual prior to the use of this equipment.

Warnings

To avoid electrical shock:

1. This furnace must be installed by a competent, qualified electrician who ensures compatibility among furnace specification, power source and ground code requirements.

2. Disconnect from the power supply prior to maintenance and servicing.

To avoid personal injury:

1. To avoid burns, do not touch or stand directly in front of the chamber ends without wearing a heat resistant face shield, gloves and apron.

2. To avoid eye damage, do not operate or clean furnace without wearing proper eye protection.

3. To avoid fire, do not place combustible materials where exposed to heat from open chamber ends.

4. To avoid burns, do not open heating chamber or replace tube unless unit is cooled to ambient temperature.

5. Do not use in the presence of flammable or combustible materials; fire or explosion may result. This device contains components which may ignite such materials.

6. Refer servicing to qualified personnel.

Warning

This warning is presented for compliance with California Proposition 65 and other regulatory agencies and only applies to the insulation in this product. This product contains refractory ceramic, refractory ceramic fiber or fiberglass insulation, which can produce respirable dust or fibers during disassembly. Dust or fibers can cause irritation and can aggravate preexisting respiratory diseases. Refractory ceramic and refractory ceramic fibers (after reaching 1000°C) contain crystalline silica, which can cause lung damage (silicosis). The International Agency for Research on Cancer (IARC) has classified refractory ceramic fiber and fiberglass as possibly carcinogenic (Group 2B), and crystalline silica as carcinogenic to humans (Group 1).

The insulating materials can be located in the door, the hearth collar, in the chamber of the product or under the hot plate top. Tests performed by the manufacturer indicate that there is no risk of exposure to dust or respirable fibers resulting from operation of this product under normal conditions. However, there may be a risk of exposure to respirable dust or fibers when repairing or maintaining the insulating materials, or when otherwise disturbing them in a manner which causes release of dust or fibers. By using proper handling procedures and protective equipment you can work safely with these insulating materials and minimize any exposure. Refer to the appropriate Material Safety Data Sheets (MSDS) for information regarding proper handling and recommended protective equipment. For additional MSDS copies, or additional information concerning the handling of refractory ceramic products, please contact the Customer Service Department at Barnstead|Thermolyne Corporation at 1-800-553-0039.I

Introduction

Intended Use

The type F54500 (1500°C) & type F59300 (1700°C) are general purpose laboratory tube furnaces intended for applications requiring temperatures up to 1500°C or 1700°C.

Principles of Operation

The chamber section is heated by eight Super Kanthal 33 type heating elements suspended in a chamber made of a special very high temperature refractory fiber.

This high temperature refractory fiber is in the form of blocks which line the inside of the chamber. Because of the stresses caused by the extremely high temperature operation, these blocks will show some surface cracking. This cracking is not detrimental to the operation of the furnace.

A precious metal type B thermocouple senses the temperature in the chamber and transmits this information to the temperature control as a very small voltage.

The control section consists of a temperature controller, a current controller, a transformer, a contactor (relay), a circuit breaker, and a pilot light.

The temperature controller senses the furnace temperature via the thermocouple and adjusts power to the heating elements by means of the current controller.

The current controller controls power to the heating elements by limiting the magnitude of the current (rather than turning the power completely on or off). This is the preferred method of controlling power to molybdenum disilicide heating elements.

The transformer supplies the proper voltage to the heating elements.

The contactor removes power from the heating elements if the furnace temperature equals or exceeds the high limit set point of the controller. The circuit breaker is used to turn the furnace on and off and also protects the power line in the event that the furnace draws too much current.

Note
The fans operate continuously, even when the circuit breaker is OFF, to assure that the control section and the terminals of the heating elements are kept cool at all times, otherwise residual heat from the furnace chamber can cause overheating after the furnace is turned off.

Caution
Do not completely remove power from the furnace until furnace temperature falls below 500°C.

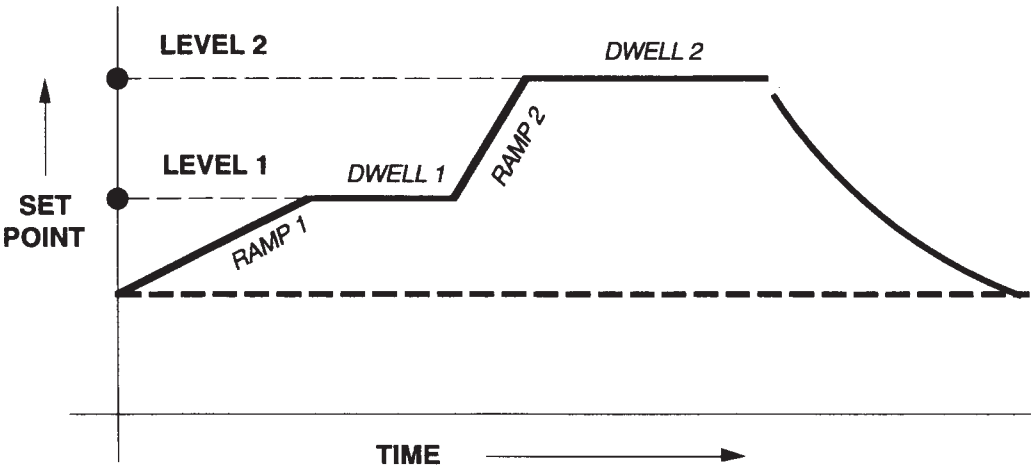
The pilot light indicates that the circuit breaker is ON and that the controller is being supplied with power.

Two fans in the furnace provide forced air cooling.

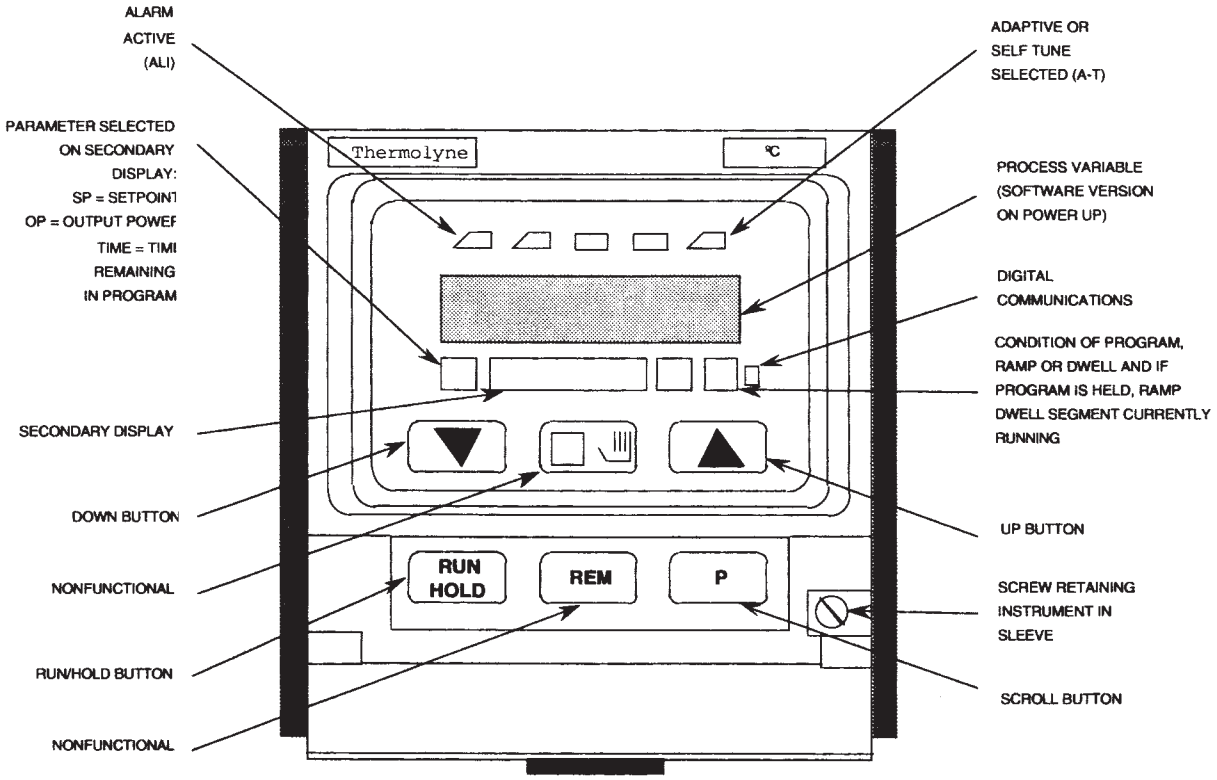
Two Types of Controllers

The automatic (single set point) digital models enables the user to bring the furnace up to a preset point and hold the temperature.

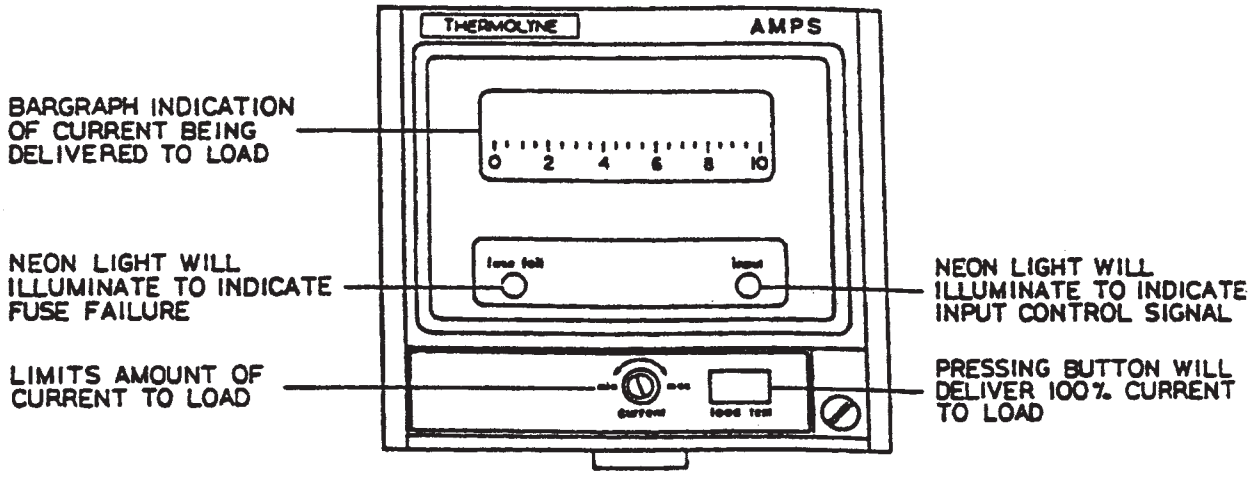
The programmable digital models enable the operator to program up to 8 ramp segments (heat up rate) and 8 dwell segments (soak) for applications that require time and temperature relationship.



Typical profile for programmable models. Other profiles may be formed.



Programmable Control and Automatic Control



*Do not alter this setting.

Current Control

General Specifications

F5400 Tube Furnace

Dimensions

Overall

	F54540CM	F54530CM	F54548CM	F54538CM
Width:	22.74 (57.8)	22.75 (57.8)	22.75 (57.8)	22.75 (57.8)
Height:	28.5 (72.4)	28.5 (72.4)	28.5 (72.4)	28.5 (72.4)
Depth:	22 (55.9)	22 (55.9)	22 (55.9)	22 (55.9)

Chamber

Width:	3” dia. max.	3” dia. max.	3” dia. max.	3” dia. max.
Depth:	20”	20”	20”	20”

Weight (in Lbs. (kg)

160 (72.6)	160 (72.6)	160 (72.6)	160 (72.6)

Electrical

Volts	240	240	208	208
Amps	40	40	40	40
Watts	3500	3500	3500	3500
Freq.	50/60	50/60	50/60	50/60
Phase	1	1	1	1

Operating Temp Range

800°C -1500°C	800°C -1500°C	800°C -1500°C	800°C -1500°C

F59300 Tube Furnace

Dimensions

Overall

	F59340CM & F59340CM-75	F59330CM	F59348CM &F59348CM-75	F59338CM
Width:	20.5 (52.1)	20.5 (52.1)	20.5 (52.1)	22.75 (57.8)
Height:	28.5 (72.4)	28.5 (72.4)	28.5 (72.4)	28.5 (72.4)
Depth:	22 (55.9)	22 (55.9)	22 (55.9)	22 (55.9)
Chamber				
Width:	3” dia. max.	3” dia. max.	3” dia. max.	3” dia. max.
Depth:	20”	20”	20”	**20”**

Weight (in Lbs. (kg)

	160 (72.6)	160 (72.6)	160 (72.6)	160 (72.6)

Electrical

Volts	240	240	208	208
Amps	40	40	40	40
Watts	3500	3500	3500	3500
Freq.	50/60	50/60	50/60	50/60
Phase	1	1	1	1

Operating Temp Range

	800°C -1700°C	800°C -1700°C	800°C -1700°C	800°C -1700°C

Unpacking

Visually check for any physical damage to the shipping container. Inspect the equipment surfaces that are adjacent to any damaged area. Open the furnace chamber and remove packing material from inside the furnace chamber. Vacuum the chamber prior to use to remove the insulation dust due to shipment.

Packaged with the furnace are four ceramic sleeves: 2 - 2" (dia.) and 2 - 1" (dia.) collars.

Retain the original packaging material if reshipment is foreseen or required.

The tube furnaces do not come with a power cord because current requirements are too great to be handled by ordinary power cords and standard wall supply.

Installation

Caution
Be sure ambient temperature does not exceed 104°F (40°C). Ambients above this level may result in damage to the controller. Allow at least six inches of space between the furnace and any vertical surface. This permits the heat from furnace case to escape so as not to create a possible fire hazard.

Note
It is recommended to use a dedicated power source to furnace in order to minimize possibility of line interference.

Warning
To avoid electrical shock, this furnace must be installed by a competent, qualified electrician who ensures compatibility among furnace specification, power source and ground code requirements.

Caution
For supply connections, use 8 AWG or larger wires suitable for at least 90°C. Failure to observe this caution could result in damage to furnace.

Site Selection

Install furnace on a sturdy surface and allow space for ventilation.

The electrical specifications are located on the specification plate on the back of the furnace. Consult Barnstead/Thermolyne if your electrical service is different than those listed on the specification plate. Prior to connecting your tube furnace to your electrical supply, be sure the front circuit breaker is in the OFF position.

Furnace Connection

Remove cover plate for access to the electrical connections. Connect power to the three terminals found behind this plate; one side of the 208 or 240 volt service to the top terminal, L1; the other side of the 208 or 240 volt service to the bottom terminal, L2, and the ground (usually green wire) to the center terminal marked GND. For 220 volt service, connect the neutral to the top terminal (marked L1); the 220 volt line to the bottom terminal, L2, and the ground to the center terminal marked GND. Power is brought to the furnace through an appropriate conduit system, through the hole in the back panel at the bottom left rear of the furnace, and connected as described. Be sure to observe local wiring codes in connecting.

General Operation of Furnace

Warning
Do not use in the presence of flammable or combustible materials; fire or explosion may result. This device contains components which may ignite such materials. To avoid burns, do not touch or stand directly in front of the chamber ends without wearing a heat resistant face shield, gloves and apron. To avoid eye damage, do not operate or clean furnace without wearing proper eye protection. To avoid fire, do not place combustible materials where exposed to heat from open chamber ends. To avoid burns, do not open heating chamber or replace tube unless unit is cooled to ambient temperature.

Caution
If the power supply must be disconnected from the furnace at any time, be sure the chamber temperature is 500°C or less before doing so.

Note
To prevent chamber damage, remember to support chamber with one hand when removing the chamber from vertical or angular position, to the horizontal position.

OBSERVE THESE WARNINGS BEFORE OPERATING YOUR FURNACE:

Circuit Breaker

A double pole circuit breaker is located at the right side of the control section. It serves to turn power ON and OFF and to protect the electrical circuit.

Fans

The fans, located in the rear of the heating section, will run continuously as long as power is supplied to the furnace, even when the furnace panel circuit breaker is OFF. This serves to remove residual heat after the furnace is turned OFF so the heat does not cause damage to sensitive electronic components.

Chamber Opening

The heating chamber is of split tube design to allow access to inside of chamber. While supporting front half of chamber, unhook latches and move front half towards control section. To close chamber, move front chamber half towards rear half and relatch.

Chamber Repositioning (Only On F54530CM, F54538CM, F54540CM, F54548CM):

Due to the unique design, the chamber can be used in the horizontal, angular or vertical position. To reposition chamber, simply unlock lever and move chamber to the desired position, then relock lever to hold furnace chamber into position.

Installing Tubes

The furnace is supplied with (2) 3” dia. collars, (2) 2" dia. collars and (2) 1" dia. collars. The 3" dia. collars are installed in the furnace from the factory.

To install 1" dia. or 2” dia. tubes, simply open furnace chamber and slide appropriate sized ceramic collars over tube. Insert tube and ceramic collars in front half of chamber. Slowly, move front chamber half towards rear half and relatch.

Tube bracket

Since the chamber can be moved to the vertical position, a stop is needed to keep the tube secured in the chamber. Whenever a 2” dia. or a 1" dia. tube is used, be sure to adjust the stop. The stop is located at the left end of chamber and is secured with two screws. One adjustable bracket is supplied with the furnace.

Automatic Control Models

(Models F54530CM, F54538CM, F59330CM, F59338CM)

This furnace controller consists of a microprocessor based three-mode (Proportional, Integral, Derivative), programmable control with overtemperature protection and appropriate output switching devices to control the furnace. The digital readout continuously displays chamber (upper display) and setpoint (lower display) temperatures unless the scroll button is depressed.

If the scroll button is depressed and released, the lower display will indicate output power (OP) or setpoint (SP). This is referred to as the “short scroll”. Continued single step action of scroll button will cause lower display to alternate between setpoint (SP) and output power (OP).

To enter the main scroll list (list of all controller parameters that are accessed through front keyboard), the scroll button should be held depressed. “PR” (program ramp rate will appear). To progress through the parameter list, the scroll button must first be released, subsequent single step depression will advance you through the list. Rapid progression through the parameter list is achieved by holding the scroll button depressed.

Note
When performing the operational check, it is important that the setpoint be set at twenty so that the furnace is not heating during the check out procedures.

Note
If you depress and release either the “scroll”, “up”, or “down” push buttons and more than 8 seconds elapse before the buttons are used again, the display screen will automatically switch back to displaying setpoint temperature. If this happens, you will have to step through each parameter until you reach the point at which the interruption occurred. The parameter values you checked earlier, however, will not be lost or altered.

Control Parameters

To be sure the temperature control parameter values have not been altered during shipment, follow the subsequent procedures:

1. Switch the power source to the unit “ON”.

2. Switch the “ON/OFF” front circuit breaker switch to “ON”. The digital display should be displaying chamber (upper display) and setpoint “sp” (lower display) temperatures

3. Depress and hold the “DOWN” push button until the setpoint (lower) display reads twenty.

4. Verify that the proper parameter values are still loaded into the controller’s memory by performing the following procedure:

Note
Once the desired parameter has been selected, depressing either the raise or lower button will cause the parameter to be replaced with the new value. At this point, the “top dot” of the least significant digit of the secondary display will flash on and off. Any further use of up or down buttons will change parameter value. In all cases, the value shown on the display is the current working value of that parameter.

Note
Thermolyne recommends that you set the value either at maximum operating temperature of the furnace (1500°C) Type F54500 & (1700°C) Type F59300 or a value of 20 degrees above your working temperature if you desire to provide protection for your workload. Push up or down button, (1500°C) Type F54500 or (1700°C) Type F59300 should be displayed, if it is not, depress up button until 1500°C or 1700°C is displayed.

- Depress and hold scroll button until “PR” appears on lower display. “PR” = program ramp rate which is the rate of heat increase or decrease in °C/ minute. Pushing the up or down button will give current setting of this ramp. Setting will indicate “1.” If it does not, depress down button until “1” is displayed.

- Depress and release scroll button, “SP1” will be displayed. SP1 = set point one which indicates current set point. Push up or down button. Setting will be “20.” If it is not, depress down button until “20” is displayed.

- Depress and release scroll button, “SP2” will be displayed. Setpoint two = is not configured into control and is nonfunctional. Push up or down button. Setting will be “20.” If it is not, depress down button until “20” is displayed.

- Depress and release scroll button, “ST” will be displayed. ST = Self Tune automatically loads PID values on initial start up. This function does not have a value, it is either ON or OFF. (See Furnace Operation for function of Self Tune).

- Depress and release scroll button, “AT” will be displayed. AT = Adaptive Tune analyzes and inputs optimum PID values when temperature has reached set point, or “OFF.” (See Furnace Operation for function of Adaptive Tune).

- Depress and release scroll button, “SAT” will be displayed. SAT = Self Adaptive Tune when engaged starts controller off in self-tune mode then automatically switches to Adaptive Tune (AT). This function does not have a value, it is either “ON” or “OFF” (See Furnace Operation for function of Adaptive Tune).

- Depress and release scroll button, “ATR” will be displayed. ATR = Adaptive Tune Band setting determines the operational band width of the adaptive tuning function. Self-tuning automatically determines this setting.

Note
The parameters proportional (PB), integral (+i) and derivative (+d) are for high accuracy control. Thermolyne has installed values that will generally give good results for most applications. These parameters cannot be changed by user. (See Self-Adaptive Tuning in Furnace Operation).

- Depress and release scroll button, “AL1” will be displayed. AL1 = Alarm 1 is a full scale alarm which protects load and furnace when temperature exceeds preset value. Furnace will control temperature at the preset temperature value, it will not shut off furnace.
- Depress and release scroll button, (Pb) will be displayed. Push up or down button; proportional band setting will be 60.
- Depress and release scroll button, (+i) will be displayed. Push up or down button. Integral setting will be 300.
- Depress and release scroll button, (+d) will be displayed. Push up or down button. Derivative setting should be 60.
- The next two parameters, cutback low (cbl) and cutback high (cbh), are to aid the control in preventing temperature overshoots and temperature undershoots. The point from setpoint where the power starts “cutting back” is defined as the cutback value. Push up or down button, both cbh and cbl will be “OFF”. These values are also automatically adjusted by the Self and Adaptive tuning features. These values cannot be changed by the user; the controller automatically installs optimum cutback values when in Self and Adaptive Tuning.

Note
“OR” will be displayed if an open thermocouple condition exists.

- Depress and release scroll button, HL will be displayed. HL = Output Power limits the average maximum power that is applied to the heating elements.
- Depress and release up or down button, 100 will be displayed. If “100” is not displayed, depress the “UP” or “DOWN” push button until the proper value is displayed.
- Depress and release scroll button, Sbr will be displayed. Sbr is the power that is required to indicate if an open thermocouple condition exists. Push up or down button. 0.0 will be displayed. This parameter cannot be changed. If 0.0 is not displayed, contact **Barnstead/Thermolyne.**

Note
To change from °C to °F indication, contact **Barnstead/Thermolyne**.

Mnemonic	Parameter	Specified Value	User Access
SP	Setpoint	20	Yes
OP	Output	0.0	
Pr	Program ramp rate	1	Yes
SP 1	Main setpoint	20	Yes
SP 2	Second setpoint	20	Yes
St	Selftune	-	Yes
At	Adaptive tune	-	Yes
SAt	Self-adaptive tune	-	Yes
ATR	Adaptive tune band	-	Yes
AL 1	Alarm 1	1500°C (1700°C)*	Yes
Pb	Proportional band	60	No
ti	Integral time	300	No
td	Derivative time	60	No
cb1	Cutback low	OFF	No
cbh	Cutback high	OFF	No
Hl	Output 1 limit	100	No
Sbr	Sensor break power	0.0	No

** (1700°C) Type F59300*

Caution
Do not operate furnace under 800°C. The element life is reduced when operating below this temperature because the protective layer of silica glass is not formed.

Note
Temperature setpoint or out power is indicated on lower display, single depression of scroll button will alternate between these two parameters. This is referred to as the “short scroll”. The control will cause the furnace chamber to heat to the chosen temperature and hold it at this temperature until you turn off the power switch or select another temperature.

Note
Initial heat-up procedure:
The elements may bend slightly sideways due to electromagnetic forces generated between the element shanks. To prevent this bending, heat the furnace up to 1500°C and hold at this temperature for 10 - 20 minutes. Then let furnace cool to ambient temperature. (For 1700°C model heat furnace to 1600°C & hold for 10-20 minutes, then let furnace cool to ambient temperature).

Caution
Remember that whenever the power switch is turned “ON,” the furnace will begin to heat to the setpoint temperature that was previously set in. This value will remain unchanged for up to a year without power being applied to the control.

Note
The two center push buttons are inactive and not used.

Operation

Single Set Point

The automatic control is used as a single setpoint control which includes one ramp to setpoint capability. To use as a single set point control, push up or down buttons to choose a specific temperature.

To operate the control:
Turn power switch to the “ON” position.

Cycle Indicator: The amber cycle light will illuminate whenever the power is being applied to the elements.

The setpoint temperature presently set in the control will be read out on the lower display.

To change this set point, depress the “UP” or “DOWN” push button until the desired setpoint value is displayed, then release the button.

At this point the furnace will begin to heat, if the new set point temperature you have chosen is higher than the present chamber temperature.

The upper display indicates actual furnace temperature.

Note
The program ramp rate is designed to reduce the heat up rate or cooling rate that the furnace normally exhibits. When not using this feature, the furnace will operate at its maximum heating and cooling capability.

Program Ramp Rate

If you desire to ramp to the set temperature at a specified rate, depress scroll button until “PR” appears. (“PR” = program ramp rate, which is the rate of heat increase or decrease in °C/minute). Depress up or down button to give current setting of ramp rate.Depress up or down button again until you achieve desired setting.

To start the temperature ramp, push the run button. With the run initiated, the program will commence and the legend on the display will indicate “RAMP.” While a ramp is running, the short scroll will contain three parameters. SP = setpoint. OP = output power. Time = time remaining in program ramp to reach setpoint temperature. Single depression of the scroll button will allow you to view each of these parameters.

When the program ramp has ended, an “E” will appear on the display.

Note
When the program ramp has ended or has been reset, the furnace will continue to maintain setpoint temperature. It will not cool to ambient temperature unless setpoint is set to ambient temperature.

Program Ramp Reset

A running or finished program can be reset by depressing the up and down buttons together.

When the reset has been enabled, the parts of the display associated with programming will be extinguished and the controller will operate as a single setpoint control as described before.

Note
The automatic control has automatic tuning features which install optimum tuning parameters to attain the best temperature accuracy. No manual loading of tuning parameters is needed. Thermolyne highly recommends using these features to provide the best temperature accuracy the controller can attain.

SAT (Self Adaptive Tuning)

The following procedure is instruction on how to initiate the SAT (Self and Adaptive Tuning) feature. This feature starts the controller in the Self Tune mode then automatically switches over to the Adaptive Tuning Feature. Self Tuning is a onetime function which permits the user to retune the instrument control parameters to suit new process conditions.

Adaptive tuning takes over when the self tune is completed and continuously reevaluates tuning parameters. Adaptive tuning will then automatically install new values if a better response could have been attained.

Note
The self tune and adaptive tune features are inactive when a program ramp (PR) is initiated.

Depress scroll button until SAT is displayed. Depress the up and down buttons simultaneously to start self tuning. The A-T indicator is then illuminated (upper right hand corner) and the lower display indicates the setpoint at which the self-tune sequence will occur. The “SP” indicator will flash for 1 minute, during which time the setpoint may be changed (use temperature setpoint that your application requires), if it is required to retune at a new setpoint either above or below the process value indicated on the upper display. At the end of the minute, the “SP” indicator will stop flashing, indicating that the setpoint can no longer be changed. The A-T indicator will start flashing and continue to flash until the self tune has completed. Once the self tune is completed, adaptive tune takes over and the A-T indicator will remain illuminated.

To stop tuning function scroll until SAT is displayed and simultaneously push up and down buttons.

Programmable Models

(F54540CM, F54548CM, F59340CM, F59348CM, F59340-75, F59348CM-75)

This furnace controller consists of a microprocessor based three-mode (Proportional, Integral, Derivative), programmable control with overtemperature protection and appropriate output switching devices to control the furnace. The digital readout continuously displays chamber (upper display) and setpoint (lower display) temperatures unless the scroll button is depressed.

If the scroll button is depressed and released, the lower display will indicate output power (OP) or setpoint (SP). This is referred to as the “short scroll.” Continued single step action of scroll button will cause lower display to alternate between setpoint (SP) and output power (OP).

To enter the main scroll list (list of all controller parameters that are accessed through front keyboard), the scroll button should be held depressed. PR1 (program ramp rate 1) will appear. To progress through the parameter list, the scroll button must first be released, subsequent single step depression will advance you through the list. Rapid progression through the parameter list is achieved by holding the scroll button depressed.

Note
When performing “operational check,” it is important that the setpoint be set at twenty so that the furnace is not heating during the check out procedures.

Note
If you depress and release either the “scroll,” “up,” or “down” push buttons and more than 8 seconds elapse before the buttons are used again, the display screen will automatically switch back to displaying setpoint temperature. If this happens, you will have to step through each parameter until you reach the point at which the interruption occurred. The parameter values you checked earlier, however, will not be lost or altered.

Control Parameters

To be sure the temperature control parameter values have not been altered during shipment, follow the subsequent procedures:

1. Switch the power source to the unit “ON.”

2. Switch the “ON/OFF” front power switch to “ON.” The digital display should be displaying chamber (upper display) and setpoint “sp” (lower display) temperatures.

3. Depress and hold the “Down” push button until the setpoint (lower) display reads twenty.

Note
MODELS F59340CM-75 & F59348CM-75: The procedure in Step 4 varies slightly for these two models. To verify that the proper parameter values are still loaded into the controller's memory, depress and hold the scroll button until "Pnr 1" is displayed. Pnr is the program number selected. By pushing the up or down button, you can select a program from 1 to 15. Depress and release the scroll button; "Cnt n" will be displayed. Cnt is used to allow linking of programs. Cnt (continued) may be selected as "y" (yes) or "n" (no) by pushing the up or down button. This parameter should be set to "Cnt n" (continued no). The remaining parameters will follow the sequence listed in Step 4.

Note
Once the desired parameter has been selected, depressing either the raise or lower button will cause the parameter to be replaced with the new value. At this point, the "top dot" of the least significant digit of the secondary display will flash on and off. Any further use of up or down buttons will change parameter value. In all cases, the value shown on the display is the current working value of that parameter.

4. Verify that the proper parameter values are still loaded into the controller's memory by performing the following procedure:

- Depress and hold scroll button until "PR" appears on lower display. "PR1" = program ramp rate which is the rate of heat increase or decrease in °C/minute. Pushing the up or down button will give current setting of this ramp. Setting will indicate "END," if it does not, depress down button until "END" is displayed.

- Depress and release scroll button, PL1 will be displayed. PL1 = program level is the temperature to which the furnace needs to attain. Push up or down button. Setting will indicate "20." If it does not, depress up or down until "20" is displayed.

- Depress and release scroll button, PD1 will be displayed. PD1 = program dwell "1" is amount of time in minutes to hold PL1 program temperature level entered. Push up or down button. Setting will indicate "END", if it is not, depress the down button until "END" is displayed.

- Repeat the previous procedures used for PR1, PL1, PD1 for the remaining Program Ramp Rates PR2 - PR8, Program Levels PL2 - PL8, and Program Dwells PD2 - PD8.

- After PD8 depress and release scroll button. "HB" will be displayed. HB = "Holdback" automatically places the programmer into "Hold" if the measured value deviates more than a specified amount from programmer setpoint. When measured value reenters the holdback band, the timing for the segment resumes. (Parameter is expressed in °C and only functions when running a program). Push up or down button. Setting will be "OFF", if it is not, depress down button until "OFF" is displayed.

- Depress and release scroll button, “PLC” will be displayed. PLC = Program Loop Count is the number of times a program will be repeated. Push up or down button. Setting will be “1.” If it is not, depress down button until “1” is displayed.

- Depress and release scroll button, “SP1” will be displayed. SP1 = setpoint one which indicates current setpoint. Push up or down button. Setting will be “20.” If it is not, depress down button until “20” is displayed.

- Depress and release scroll button, “SP2” will be displayed. Setpoint two = is not configured into control and is nonfunctional. Push up or down button. Setting will be “20.” If it is not, depress down button until “20” is displayed.

- Depress and release scroll button, “ST” will be displayed. ST = Self Tune automatically loads PID values on initial start up. This function does not have a value, it is either ON or OFF. (See Furnace Operation for function of Self Tune.

- Depress and release scroll button, “AT” will be displayed. AT = Adaptive Tune analyzes and inputs optimum PID values when temperature has reached setpoint. This function does not have a value, it is either “ON” or “OFF.” (See Furnace Operation for function of Adaptive Tune.)

- Depress and release scroll button. SAT will be displayed. SAT = Self Adaptive Tune when engaged starts controller off in self-tune mode then automatically switches to Adaptive Tune (AT). This function does not have a value, it is either “ON” or “OFF”. (See Furnace Operation for function of Adaptive Tune).

- Depress and release scroll button, “ATR” will be displayed. ATR = Adaptive Tune Band setting determines the operational band width of the adaptive tuning function. Self-tuning automatically determines this setting.

Note
Thermolyne recommends that you set the value either at maximum operating temperature of the furnace (1500°C - Type F54500 or 1700°C -Type F59300) or a value of 20 degrees above your working temperature if you desire to provide protection for your workload. Push up or down button, 1500°C or 1700°C should be displayed, if it is not, depress up button until 1500°C or 1700°C is displayed.

Note
The next three parameters proportional (PB), integral (+i) and derivative (+d) are for high accuracy control. Thermolyne has installed values that will generally give good results for most applications. These parameters cannot be changed by user. (See self-adaptive tuning in furnace operation).

Note
The upper display will flash “OR” if an open thermocouple condition exists.

Note
To change from °C indication to °F indication, contact **Barnstead|Thermolyne.**

- Depress and release scroll button, AL1 will be displayed. AL1 = Alarm 1 is a full scale alarm which protects load and furnace when temperature exceeds preset value. Furnace will control temperature at the preset temperature value, it will not shut off furnace.
- Depress and release scroll button, Pb will be displayed. Push up or down button proportional band setting will be 60.
- Depress and release scroll button, (+i) will be displayed. Push up or down button. Integral setting will be 300.
- Depress and release scroll button, (+d) will be displayed. Push up or down button. Derivative setting should be 60.
- The next two parameters cutback low (cbl) and cutback high (cbh) are to aid the control in preventing temperature overshoots and temperature undershoots. The point from setpoint where the power starts “cutting back” is defined as the cutback value. Push up or down button; both cbh and cbl will be “OFF.” These values are also automatically adjusted by the Self and Adaptive tuning features. These values cannot be changed by the user; the controller automatically installs optimum cutback values when in Self and Adaptive Tuning.
- Depress and release scroll button, HL will be displayed. HL = Output Power limits the average maximum power that is applied to the heating elements.
- Depress and release up or down button, 100 will be displayed. If “100” is not displayed, depress the “UP” or “DOWN” push button until the proper value is displayed.
- Depress and release scroll button, Sbr will be displayed. Sbr = is the percent of power that is supplied to the control output terminals if an open thermocouple condition exists. Push up or down button, 0.0 will be displayed. This parameter cannot be changed. If 0.0 is not displayed, contact **Barnstead|Thermolyne.**

Mnemonic	Parameter	Specified Value	User Access
SP	Setpoint	20	Yes
OP	Output	0.0	
**Prr 1-15	Program number	Pnr 1	Yes
**Cnt	Continue	Cnt n	Yes
Pr 1-8	Ramp 1 thru 8	End	Yes
PL 1-8	Level 1 thru 8	20	Yes
Pd 1-8	Dwell 1 thru 8	End	Yes
Hb	Holdback	OFF	Yes
PLC	Loop counts	1	Yes
SP 1	Main setpoint	20	Yes
SP 2	Second setpoint	20	Yes
St	Selftune	-	Yes
At	Adaptive tune	-	Yes
SAt	Self-adaptive tune	-	Yes
ATR	Adaptive tune band	-	Yes
AL 1	Alarm 1	1500°C (1700°C)*	Yes
Pb	Proportional band	60	No
ti	Integral time	300	No
td	Derivative time	60	No
cb1	Cutback low	OFF	No
cbh	Cutback high	OFF	No
Hl	Output 1 limit	100	No
Sbr	Sensor break power	0.0	No

** (1700°C) Type F59300*
*** For Models F59340CM-75 and F59348CM-75*

Note
To change from °C indication to °F indication, contact Barnstead|Thermolyne.

Caution
Do not operate furnace under 800°C. The element life is reduced when operating below this temperature because the protective layer of silica glass is not formed.

Note
Initial start-up procedure
The elements may bend slightly sideways due to electromagnetic force generated between the element shanks. To prevent this bending, heat the furnace up to 1500°C and hold at this temperature for 10-20 minutes, then let furnace cool to ambient temperature. (For 1700°C model heat furnace to 1600°C & hold for 10-20 minutes, then let furnace cool to ambient temperature.)

Note
Temperature setpoint or output power is indicated on lower display, single depression of scroll button will alternate between these two parameters. The control will cause the furnace chamber to heat to the chosen temperature and hold it at this temperature until you turn off the power switch or select another temperature.

Caution
Remember that whenever the power switch is turned “ON,” the furnace will begin to heat to the setpoint temperature that was previously set in. This value will remain unchanged for up to a year without power being applied to the control.

Note
The two center push buttons are inactive and not used.

Operation

Single Set Point

The programmable control can be used as a single setpoint control or as a programmable control. To use as a single set point control simply push up or down buttons to choose a specific temperature.

1 . To operate the control:

Turn power switch to the “ON” position.

Cycle Indicator: The amber cycle light will illuminate whenever the power is being applied to the elements.

The setpoint temperature presently set in the control will be read out on the lower display.

To change this set point, depress the “UP” or “DOWN” push button until the desired setpoint value is displayed then release the button.

At this point the furnace will begin to heat if the new set point temperature you have chosen is higher than the present chamber temperature.

The upper display indicates actual furnace temperature.

Note
The programmable control has automatic tuning features which install optimum tuning parameters to give the best temperature accuracy. No manual loading of tuning parameters is needed. Thermolyne highly recommends using these features to provide the best temperature accuracy the controller can attain.

Note
The self-tune feature is inactive while running a program. The adaptive tune feature is active only in the dwell segments of a program.

SAT (Self Adaptive Tuning)

The following procedure is instruction on how to initiate the SAT (Self and Adaptive Tuning) feature. This feature starts the controller in the Self Tune mode then automatically switches over to the Adaptive Tuning Feature. Self Tuning is a one-shot function which permits the user to retune the instrument control parameters to suit new process conditions.

Adaptive tuning takes over when the self tune is completed and continuously reevaluates the tuned parameters. Adaptive tuning will then automatically install new values if a better response could have been attained.

a. Depress scroll button until SAT is displayed. Depress the up and down buttons simultaneously to start self tuning. The A-T indicator is then illuminated (upper right hand corner) and the lower display indicates the setpoint at which the self-tune sequence will occur. The “SP” indicator will flash for 1 minute, during which time the setpoint may be changed (use temperature setpoint that your application requires), if it is required to retune at a new setpoint either above or below the process value indicated on the upper display. At the end of the minute, the “SP” indicator will stop flashing, indicating that the setpoint can no longer be changed. The A-T indicator will start flashing and continue to flash until the self tune has completed. Once the self tune is completed, adaptive tune takes over and the A-T indicator will remain illuminated.

   To stop tuning function scroll until SAT is displayed and simultaneously push up and down buttons.

Programming Controller

To run a program, first determine your ramp rate, dwell times, program levels. It is helpful to graph your program out for ease of loading program into controller. Observe maximum ramp rates (heat up time) on specification sheet before programming in ramp rates.

A maximum of 8 ramp and 8 dwell segment combinations are available, thus enabling eight different setpoint levels to be achieved. Each ramp is programmed by specifying the program level (PL) and the required ramp rate (PR). The programmer then automatically calculates the time that is required to attain the program level (PL) based on desired ramp rate (PR). Dwell segments (soak) then can be attached to each program level (PL) to hold that temperature for a specified amount of time.

Multi-Programmable Controller Program Entry (Models F59340CM-75 and F59348CM-75)

The multi-programmable controller in these units provides up to 15 separate programs of 8 ramps and 8 dwells each. This controller also allows you to link programs together. These functions are governed by the controller's first two programming parameters, "Pnr" and Cnt."

To Select Program Number

Push scroll button until "Pnr 1" is displayed. Push the up or down button to select a program number from 1 to 15.

To Link Programs Together

Push scroll button until "Cnt n" is displayed. Press and release the up and down buttons to switch between "Cnt y" (continue yes) and "Cnt n" (continue no). The effect of selecting "Cnt y" is to continue the program to the next program number. For example, if in program #3 you select "Cnt y," when program #3 is complete, program #4 will run automatically. Setting "Cnt y" in program #15 will initiate the start of program #1 upon the completion of program #15. Each program will complete the selected number of loops before continuing (see Loop Count).

These two parameters ("Pnr" and "Cnt") are the only ones that differ from the single program 8 ramp and 8 dwell control. Program entry for the multi-programmable models continues with the following instructions, which are applicable to both the multi-programmable and single programmable models

Program Entry (all models)

With the programmer not operating, indicated by the bottom right hand side of the display extinguished, depress scroll button until “PR1” is displayed. Push the up or down button to scroll to the desired value, which is degrees per minute.

Scrolling down below zero will give three other options for the ramp:

NONE — which will force the program to skip to the next segment;

END — which will cause the program to stop or restart if loops remaining is not zero;

STEP — which will cause the program to jump to the next level.

All other ramps in the program are set in a similar fashion by selecting “PR” followed by the relevant ramp number.

The level to which the first ramp is aiming is entered by scrolling through the main scroll list until “PL1” is displayed. By pressing either the up or down button the present value of this level is indicated in display units. Using the up or down button will scroll the present value to the new value required. All other levels in the program are set in a similar fashion by selecting “PL” followed by the relevant number.

To set the dwell time for the first level scroll through the main scroll list until “Pd1” is displayed. Pressing the up or down button will reveal the current value of time in minutes. Using the up or down button will scroll the present value to the new value required. Scrolling this value downscale will allow a setting of “END.” A setting of “END” will terminate the program, or force it to restart if loops remaining are not zero at the beginning of that dwell.

All other dwells in the program can be set in a similar fashion by selecting “PD” followed by the relevant dwell number.

Note

The temperature control in these models is a programmable and automatic single set point device. When a program has ended, the controller will maintain the chamber temperature at a value equal to the last programmed level until the program is cancelled. When a program is cancelled, the controller will maintain the chamber temperature at a value equal to the main set point (SP1 or SP). To cancel a program, depress and release the “UP” and “DOWN” push buttons simultaneously.

Scrolling through the main scroll until the parameter “PLC” is displayed and then depressing the up or down button will reveal the present setting of the loop count. This is the number of times that the entered program will be repeated before a continuous setpoint at the last level of the program is achieved. By pushing the up or down button the number of loops can be set at any value from 1 to 999.

Holdback

Scroll through the main scroll list until “HB” is displayed. Push the up or down button to reveal the current value of holdback. The up or down button can now be depressed to scroll to the required value. Holdback is set in display units and represents the allowable excursion of measured value away from the current setpoint, either above or below, before the program is forced into hold. The program will remain in hold until the measured value comes within holdback limits. This feature is active the whole time that the program is running. When hold is forced onto the program by holdback, the “HOLD” legend is not illuminated but either the “RAMP” or “DWELL” legend will flash.

Once the program has been entered it can be set running by depressing the “RUN/HOLD” push button on the front.

With the run initiated, the program will commence and the legend on the display will indicate if a ramp or dwell is being performed. While a program is running the short scroll will contain a third parameter “TIME.” Push scroll button once, time remaining for the current segment, either ramp or dwell will be indicated. If the loop counter has been set to any value other than one, then the above procedure will be repeated for each loop.

At the end of the complete program, an “E” will appear on the display.

Parameter Change While Running

The previous parameters can be inspected but not changed while a program is running. If it is necessary to alter a parameter while a program is running, the program must be placed into the hold condition. To put program into hold, push run/hold button once. After modification of the param-

eter, returning the program to the run state will cause the program to continue with the changed value(s) installed. Push run/hold button again to restart program.

Loop Count

If the loop count is set to values other than one, then the number of loops remaining in a running program can be displayed. To determine which loop is being performed depress scroll button until “LR” is displayed and by pushing either the up or down button the remaining number of loops, excluding the one being executed, is displayed.

Program Hold

A running program can be forced into hold at any stage by depressing the “RUN/HOLD” push button on the front. When a running program is forced into hold, “HOLD” legend will appear on the display together with the segment type and will be flashing. Pushing “RUN/HOLD” button again will return the program to a run situation and extinguish the “HOLD” legend.

Note
When the program has ended, the controller will maintain the chamber temperature at a value equal to the last programmed level (PL) until the program is cancelled. It will not automatically cool to ambient unless last programmed level (PL) is set at ambient. When a program is cancelled, the controller will maintain the chamber temperature at a value equal to the main set point (SP1 or SP). To cancel a program, depress and release the “UP” and “DOWN” push buttons simultaneously. Be sure single set point mode is set to 20° value as described earlier in this manual.

Program Reset

A running, held or finished program can be reset by depressing the up and down push buttons together.

When the reset has been enabled the parts of the display associated with programming will be extinguished and the controller will operate as a single setpoint control.

Furnace Loading

Caution
Be sure to use great care in loading and unloading the furnace chamber. Molybdenum disilicide heating elements are extremely fragile and can crack or break with just a slight bump.

Be sure not to block the flow of radiant heat from the heating elements to the thermocouple; the thermocouple must be able to respond directly to the heating elements. Failure to observe this will permit the heating elements to overheat and possible burn out. Poor temperature control can also result from improper loading.

For best results, use the center 12" of the heating zone. The optimum temperature uniformity and stability is in the geometric center of heating zone (10").

In general, space should be left on all sides of a load or on all sides of individual components of a load so that heat can penetrate through the surfaces. The load should not occupy more than half to two-thirds of the inside dimensions of the chamber.

The extent to which a furnace may be loaded depends upon such factors as operating temperature, desired accuracy, and type of material. A furnace may be loaded more heavily at lower temperatures, if highest accuracy is not needed, and if the material of the load absorbs heat easily.

Furnace Atmospheres

These furnaces are designed to be used to 1500°C (F54500) or 1700°C (F59300) in pure air only. It may be used with nitrogen, argon, or helium atmospheres to 1500°C (F54500) or 1700°C (F59300). Reducing atmospheres are not recommended.

The heating elements in these furnaces are attacked by fluorine, chlorine, sodium and potassium compounds and also by molten metals.

Preventive Maintenance

Warning
Refer servicing to qualified personnel.

Warning
Disconnect from the power supply prior to maintenance and servicing. Refer servicing to qualified personnel.

Warning

This warning is presented for compliance with California Proposition 65 and other regulatory agencies and only applies to the insulation in this product. This product contains refractory ceramic, refractory ceramic fiber or fiberglass insulation, which can produce respirable dust or fibers during disassembly. Dust or fibers can cause irritation and can aggravate preexisting respiratory diseases. Refractory ceramic and refractory ceramic fibers (after reaching 1000°C) contain crystalline silica, which can cause lung damage (silicosis). The International Agency for Research on Cancer (IARC) has classified refractory ceramic fiber and fiberglass as possibly carcinogenic (Group 2B), and crystalline silica as carcinogenic to humans (Group 1). The insulating materials can be located in the door, the hearth collar, in the chamber of the product or under the hot plate top. Tests performed by the manufacturer indicate that there is no risk of exposure to dust or respirable fibers resulting from operation of this product under normal conditions. However, there may be a risk of exposure to respirable dust or fibers when repairing or maintaining the insulating materials, or when otherwise disturbing them in a manner which causes release of dust or fibers. By using proper handling procedures and protective equipment you can work safely with these insulating materials and minimize any exposure. Refer to the appropriate Material Safety Data Sheets (MSDS) for information regarding proper handling and recommended protective equipment. For additional MSDS copies, or additional information concerning the handling of refractory ceramic products, please contact the Customer Service Department at Barnstead|Thermolyne Corporation at 1-800-553-0039.

A few simple procedures will help ensure that your furnace will give you long service.

1 . Keep the chamber clean; this furnace is capable of achieving temperatures which will cause vaporization of many materials. In turn, these vapors can react with the heating elements, the insulation, or other materials you have placed in the chamber. In many instances this is detrimental to the operation.

2. Occasionally check the power connections in the control section. Repeated heating and cooling can cause terminals to loosen.

3. The type B thermocouple used in this furnace is matched to the temperature controller. It is possible that its calibration can drift, particularly when operated near the upper temperature limit, and especially in the presence of contaminants. It is a good idea to inspect it at regular intervals or when its accuracy is suspect.

4. Check the cooling fans at regular intervals to be sure they are functioning properly and are not obstructed by foreign matter.

Troubleshooting Guide

The following pages are intended to help you resolve functional problems with your furnace.

Thermolyne is always available to assist you with problems. If this guide does not direct you to your specific problem, call **Barnstead|Thermolyne** at (1-800-553-0039) or write to the address on the back cover of this manual.

Problem	**Possible Causes**	**Corrective Action**
Inaccurate temperatures.	Contaminated thermocouple.	Replace thermocouple.
Repeated element burn-out.	Loose element connections.	Check element connections.
	Heating element contamination.	Contact **Barnstead|Thermolyne.**
“OR” Displayed.	Open thermocouple.	Replace thermocouple.
Slow heat-up.	Operating 240V furnace on 208V line.	Contact **Barnstead|Thermolyne.**
	Furnace overloaded.	Lighten load.
Main fuses blow or circuit breakers trip.	Fuses or breakers not properly rated to furnace power requirements.	Install service line of sufficient size to match furnace power requirement. Contact qualified electrician for assistance.
CH.. C, DH.. H, Err-r Displayed.		Contact **Barnstead|Thermolyne**.
No heat.	Broken element.	Replace element.

Maintenance and Servicing

Warning
Disconnect from the power supply prior to maintenance and servicing. Refer servicing to qualified personnel.

Warning
Refer servicing to qualified personnel.

Warning

THIS PRODUCT CONTAINS REFRACTORY CERAMIC, REFRACTORY CERAMIC FIBER OR FIBERGLASS (GLASS WOOL) INSULATION WHICH CAN PRODUCE RESPIRABLE FIBERS AND DUST WHEN HANDLED. THESE FIBERS OR DUSTS CAN CAUSE IRRITATION AND CAN AGGRAVATE PRE—EXISTING RESPIRATORY DISEASE. REFRACTORY CERAMIC INSULATIONS MAY CONTAIN OR MAY FORM CRYSTALLINE SILICA (CRYSTOBALITE) WHICH MAY CAUSE LUNG DAMAGE (SILICOSIS). THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC) HAS CLASSIFIED REFRACTORY CERAMIC FIBER AND FIBERGLASS AS (2B) POSSIBLY CARCINOGENIC. IARC HAS CLASSIFIED CRYSTALLINE SILICA AS (2A) PROBABLY CARCINOGENIC. The insulating materials are located in the door, the hearth collar, in the chamber of the product or the top plate assembly. Tests performed by the manufacturer indicate that there is no significant risk of exposure to dust or respirable fibers resulting from operation of this equipment under normal conditions. However, there may be a risk of exposure to respirable dusts or fibers when repairing or maintaining the insulating materials, or when otherwise disturbing the materials in a manner which causes release of dust or fibers therefrom. Through the use of proper handling procedures you can work safely with these insulating materials and minimize any exposure. Accordingly, before you repair or replace any insulating materials, or perform any other servicing on this product which could disturb or cause exposure to dust from insulating materials, you should consult the appropriate Material Safety Data Sheets (MSDS's) for such products with respect to proper handling and appropriate protective equipment. For additional MSDS's, or additional information concerning the handling of refractory ceramic products, please contact the Customer Service Department of Barnstead|Thermolyne Corporation at 1-800-553-0039.

Caution
To avoid breakage of a replacement heating element, be sure that the slot into which the replacement heating element slides is free of all debris so that the element goes in very easily. Forcing an element into a slot, however slightly, can result in its breakage. Also be sure that the heating element projects sufficiently into the chamber. Element should extend into chamber until welded section (the larger diameter portion of element) protrudes approx. 1/4” inside of chamber. To avoid premature burnout of a replacement heating element, be sure that the insulation piece supplied with the replacement element is inserted between the two legs of the elements as shown in Figure 1.

To Replace a Heating Element (Refer to Figure 1)

a. Remove top cover from heating chamber side of furnace.

b. Remove the clips holding the connector cable to the defective heating element. Unwrap the connector cable from the element.

c. Slide the heating element with element ceramic holder attached upward out of the slot in the insulation. Save the blanket insulation for reuse. Discard element insulation tail.

d. Remove the element ceramic holder, noting its exact position on the heating element. Also be sure that the heating element projects sufficiently into the chamber as shown in Figure 1.

e. Fasten the element ceramic holder on the new element in exactly the same position it was on the old element. Maintain 1 13/16" space from ceramic holder to top of element tail.

f. Begin inserting the new element with element ceramic holder attached into the slot in the insulation; stop when there is just enough room left to insert the new element insulation tail.

g. Continue sliding the element with the element insulation tail into the slot. DO NOT FORCE - even slight pressure can fracture the heating element.

h. When the element ceramic holder is nearly seated against the main insulation, check the top of element insulation tail. In its final position, the top should be about 1/8 inch below the surface of the main insulation.

i. Position the blanket insulation piece from step c in the cavity over the insulation piece.

j. Complete insertion of the heating element until the element ceramic holder rests on top of the main insulation.

Note
Initial heat-up procedure
The elements may bend slightly sideways due to electromagnetic forces generated between the element shanks. To prevent this bending, heat the furnace up to *1500°C (F54500) and hold at this temperature for 10-20 minutes. Then let furnace cool to ambient temperature. (*1600°C for model F59300).

k. Check the heating element on the inside of the chamber. The large diameter section of the element must be flush with or slightly projecting from the surface of the insulation (if not, reposition element ceramic holder).

l. Carefully wrap the connector cable around the element ends; fasten with clips.

m. Replace top cover.

To Replace Thermocouple:

a. Remove top cover from the thermocouple side of furnace.

b. Loosen diagonal screw holding ceramic connection block.

c. Lift connection block.

d. Loosen connection block screws holding thermocouple; noting which side of block the side of the thermocouple with the colored bead is connected to.

e. Remove thermocouple.

f. Install new thermocouple with colored bead in same position.

g. With thermocouple through the hole in the insulation, replace block in its holder and retighten diagonal screw.

h. Turn furnace ON for a few minutes; check to be sure the temperature reads upscale.

i. Replace cover.

Replacement Parts

Series 705 & 706

Description	Part No. (All Models Unless Specified)
Elements	EL461X1 (8 req'd)
Element ceramic holder	HRX2 (8 req'd)
Element connector clips	CEX135 (16 req'd)
Element connector cable 4" long	CE461X1 (6 req'd)
Circuit breaker switch	SWX54
Fans	FAX7 (3 req'd)
Relay	RYX31
Transformer	TNX80
Thermocouple	TCX5
Thermocouple terminal block	TRX137
Element Insulation tail	JN545X18 (8 req'd)
Connector cable 48" long	CE545X1 (3 req'd)
Sleeving for 48" cable	SL545X1 (3 req'd)
Temperature Control Automatic (Single Set Point)	CN71X36 (F54530CM & F54538CM)
Temperature Control Programmable	CN71X60
(8 ramp and 8 dwell 1 program)	(F54540CM & F59548CM)
Temperature Control Automatic (Single Set Point)	CN71X32 (F59330CM & F59338CM)
Temperature Control Programmable	CN71X59
(8 ramp and 8 dwell, 1 program)	(F59340CM & F59348CM)
Multi-Programmable Temperature Control	CN71X46
(8 ramp and 8 dwell, 15 programs)	(F59340CM-75 & F59348CM-75)
Current controller	CN71X50
1" diameter insulation sleeve	JN545X12 (2 req'd)
2" diameter insulation sleeve	JN545X13 (2 req'd)
3" diameter insulation collar	JN545X14 (4 req'd)
Controller fuse, 50 Amp	FZX42

Note
For service on control units - contact **Barnstead|Thermolyne** Corp. (1-800-553-0039)

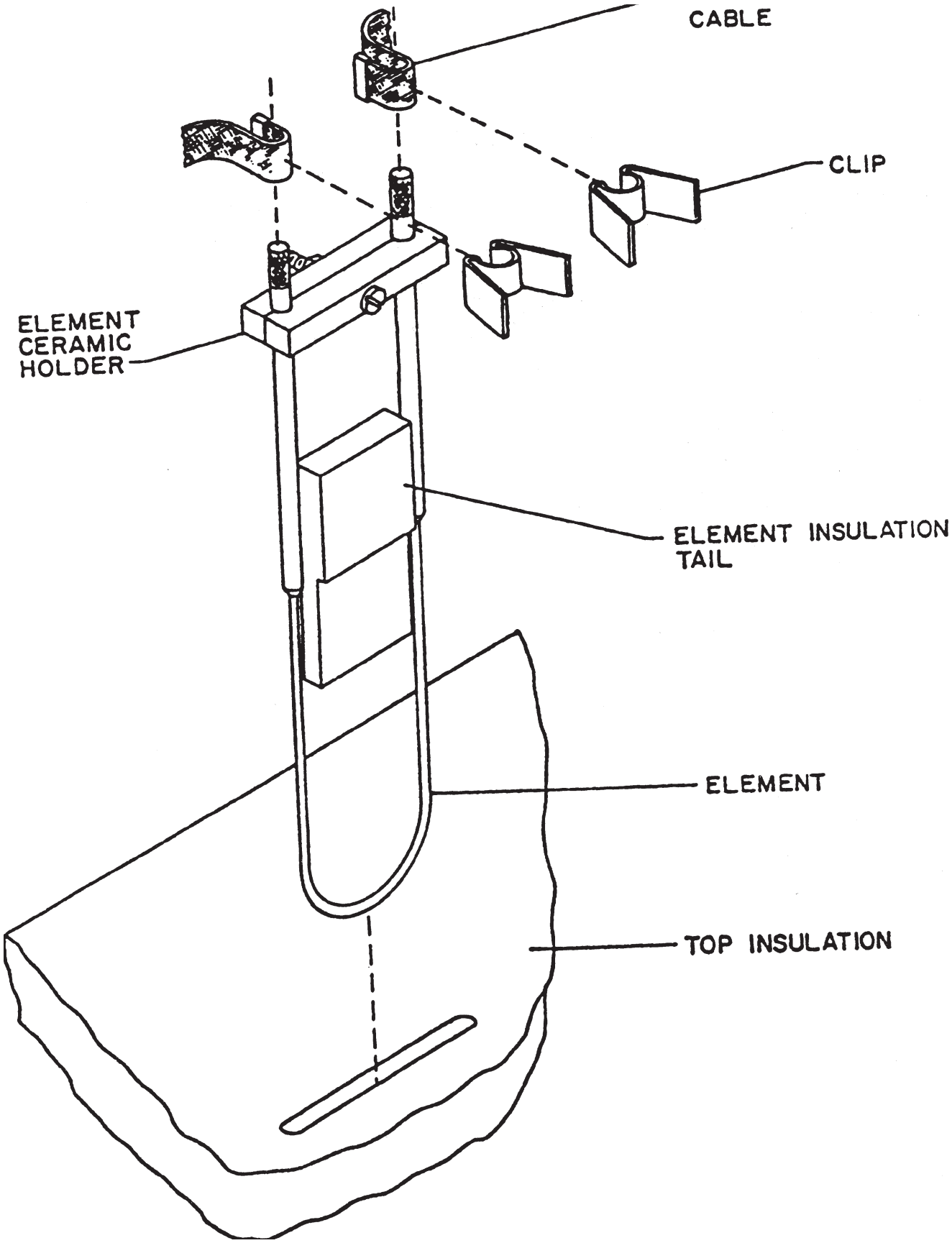


Figure 1: Element Replacement

Ordering Procedures

Please refer to the Specification Plate for the complete model number, serial number, and series number when requesting service, replacement parts or in any correspondence concerning this unit.

All parts listed herein may be ordered from the Barnstead|Thermolyne dealer from whom you purchased this unit or can be obtained promptly from the factory. When service or replacement parts are needed we ask that you check first with your dealer. If the dealer cannot handle your request, then contact our Customer Service Department at 319-556-2241 or 800-553-0039.

Prior to returning any materials to Barnstead|Thermolyne Corp., please contact our Customer Service Department for a “Return Goods Authorization” number (RGA). Material Returned without an RGA number will be returned.

One Year Limited Warranty

Barnstead|Thermolyne Corporation warrants that if a product manufactured by **Barnstead|Thermolyne** and sold by it within the continental United States or Canada proves to be defective in material or construction, it will provide you, without charge, for a period of ninety (90) days, the labor, and a period of one (1) year, the parts, necessary to remedy any such defect. Outside the continental United States and Canada, the warranty provides, for one (1) year, the parts necessary to remedy any such defect. The warranty period shall commence either six (6) months following the date the product is sold by **Barnstead|Thermolyne** or on the date it is purchased by the original retail consumer, whichever date occurs first.

All warranty inspections and repairs must be performed by and parts obtained from an authorized **Barnstead|Thermolyne** dealer or **Barnstead|Thermolyne** (at its own discretion). Heating elements, however, because of their susceptibility to overheating and contamination, must be returned to our factory, and if, upon inspection, it is concluded that failure is not due to excessive high temperature or contamination, warranty replacement will be provided by **Barnstead|Thermolyne**. The name of the authorized **Barnstead|Thermolyne** dealer nearest you may be obtained by calling 1-800-446-6060 (319-556-2241) or writing to:

Barnstead|Thermolyne
P.O. Box 797
2555 Kerper Boulevard
Dubuque, IA 52004-0797
USA
FAX: (319) 589-0516
E-MAIL ADDRESS: mkt@barnstead.com

Barnstead|Thermolyne's sole obligation with respect to its product shall be to repair or (at its own discretion) replace the product. Under no circumstances shall it be liable for incidental or consequential damage.

THE WARRANTY STATED HEREIN IS THE SOLE WARRANTY APPLICABLE TO **Barnstead|Thermolyne** PRODUCTS. **Barnstead|Thermolyne** EXPRESSLY DISCLAIMS ANY AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR USE.

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