

Thermolyne

Barnstead|Thermolyne Corporation

Type F6000 Furnace OPERATION MANUAL AND PARTS LIST *Series 711*

MODEL NUMBER	VOLTAGE	CONTROL	DISPLAY (°C&°F)	RS232 COMM.
F6010	220-240	Basic Automatic	X (°C only)	
F6010-33	220-240	Basic Automatic	X (°C only)	
F6018	208	Basic Automatic	X (°C only)	
F6020C	220-240	Automatic	X	
F6020C-33	220-240	Automatic	X	
F6020C-33-60-70	220-240	Automatic	X	
F6020C-70	220-240	Programmable	X	
F6020C-33-70	220-240	Programmable	X	
F6028C	208	Automatic	X	
F6028C-70	208	Programmable	X	
F6030CM	220-240	Programmable	X	X
F6038CM	208	Programmable	X	X
F6020C-60	220-240	Automatic	X	
F6020C-60-70	220-240	Programmable	X	
F6028C-60	208	Automatic	X	
F6028C-60-70	208	Programmable	X	
F6030CM-60	220-240	Programmable	X	X
F6038CM-60	208	Programmable	X	X

(-60 Models) - Ashing furnace

LT711X1• 9/27/2006

Serial Number: _____

IMPORTANT INFORMATION

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.

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Safety Information

Your Thermolyne F6000 type furnace has been designed with function, reliability, and safety in mind. It is your responsibility to install it in conformance with local electrical codes. For safe operation, please pay attention to the alert boxes throughout the manual.

Alert Boxes



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.

Warnings

WARNING

To avoid electrical shock, this furnace must:

1. Be installed by a competent, qualified electrician who insures compatibility among furnace specifications, power source and grounding code requirements.
2. Be disconnected from the power supply before servicing.
3. Have the door switch operating properly.

To avoid burns, this furnace must:

1. Not be touched on the exterior or interior surfaces during use or for a period of time after use.
2. "Caution: Hot Surface. Avoid Contact."

To avoid personal injury:

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

2. Refer servicing to qualified personnel.

3. THIS FURNACE CONTAINS REFRACTORY CERAMIC INSULATION WHICH CAN PRODUCE RESPIRABLE FIBERS AND DUST WHEN HANDLED. THESE FIBERS CAN CAUSE IRRITATION AND CAN AGGRAVATE PRE-EXISTING RESPIRATORY DISEASE. THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC) HAS CLASSIFIED REFRACTORY CERAMIC FIBER AS POSSIBLY CARCINOGENIC.

AFTER SERVICE REFRACTORY CERAMIC FIBER DUST MAY CONTAIN CRYSTALLINE SILICA, WHICH MAY CAUSE LUNG DAMAGE (SILICOSIS) AND WHICH HAS BEEN CLASSIFIED BY IARC AS A PROBABLE CARCINOGEN.

The refractory ceramic materials are located in the door, the hearth collar bricks, and in the chamber of the furnace. Tests performed by the manufacturer indicate that there is no significant risk of exposure to dust or respirable refractory ceramic fiber resulting from operation of the equipment under normal conditions. However, there may be a risk of exposure to respirable refractory ceramic dust or fiber 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.

Introduction

Intended Use

The Type 6000 Manual, Automatic and Programmable furnaces are general laboratory and heat treating furnaces. For optimum element life, observe the following temperature ranges. These furnace models are intended for applications requiring temperatures from 100°C (212°F) to 893°C (1640°F) for continuous use, or temperatures from 893°C (1640°F) to 1200°C (2192°F) for intermittent use.

(-60) Coal Ashing models continuous temperature range is from 100°C (212°F) to 893°C (1640°F). Intermittent temperature range is from 893°C (1640°F) to 975°C (1787°F). Continuous use is operating the furnace for more than 3 hours and intermittent use is operating the furnace for less than 3 hours.

The unit consists of: 1) a heating chamber; 2) a basic automatic control without over temperature protection OR an automatic proportioning-digital set, digital read control with over temperature protection; 3) a door interlock relay for user safety.

The Type 6000 Programmable furnace is designed to control a programmed temperature profile. The profile is in the format of ramps and dwell segments. The first ramp, RAMP 1, starts at the initial measured furnace temperature. This ramp is positive going at a programmed rate until the programmed level is reached. The setpoint will stay at this level for a period determined by the setting of DWELL 1. Additional positive or negative going ramps are now initiated starting at the level at the end of DWELL 1. When the second ramp reaches the second programmed level, the setpoint stays at that level for the duration of the segment. Depending upon the model ordered, additional ramp and dwell segments may be added. See specific model number below for total number of program segments.

The Type 6000 Programmable Ashing Furnace (-60) is designed to operate like the programmable type 6000 described above plus the ability to inject and control an inert atmosphere.

MODEL NUMBER	DIGITAL COMMUM.	NUMBER OF RAMP SEGMENTS	NUMBER OF DWELL SEGMENTS	NUMBER OF STORED PROGRAMS
F6028C-70	NO	2	2	1
F6020C-70	NO	2	2	1
F6020C-33-70	NO	2	2	1
F6020C-60-70	NO	2	2	1
F6020C-33-60-70	NO	2	2	1
F6028C-60-70	NO	2	2	1
F6030CM	YES	8	8	4
F6030CM-60	YES	8	8	4
F6038CM	YES	8	8	4
F6038CM-60	YES	8	8	4

The Type 6000 Automatic furnace is designed as a single set point automatic temperature controlled furnace able to reach and maintain one temperature value.

Principles of Operation

Furnace:

The furnace chamber is heated by four electric resistance heaters which are embedded in a refractory material. The chamber is insulated with a ceramic fiber insulation. The control is located under the furnace chamber and is well insulated from the heat generated in the furnace chamber. A door safety switch removes power to the heating elements whenever the furnace door is opened. The choices of temperature controllers are as follows:

Temperature Controller: "Basic Automatic":

The basic automatic control provides simple automatic control to one setpoint temperature. A single digital display will indicate either furnace chamber temperature or setpoint temperature. This controller does not provide over temperature protection.

Temperature Controller: "Automatic":

This furnace controller consists of a microprocessor based three mode temperature controller having adjustable over temperature protection and appropriate output switching devices to control the furnace.

Temperature Controller: "Programmable":

This furnace controller consists of a microprocessor based three mode temperature controller/programmer with adjustable over temperature protection and appropriate output switching devices to control the furnace.



NOTE

When in the program RUN mode, the programmer/controller serves to provide a programmed temperature profile as described earlier. When in the AUTOMATIC mode, the unit serves as a single setpoint automatic temperature controller.

General Specifications

For F6000 Furnace

Model #		F6020C F6020C-33 F6020C-70 F6020C-33-70 F6020C-60 F6020C-60-70 F6020C-33-60-70 F6030CM F6030CM-60	F6028C F6028C-70 F6028C-60 F6028C-60-70 F6038CM F6038CM-60	F6010 F6010-33	F6018	
Dimensions in.	Overall	Width	19.25	19.25	19.25	19.25
		Height	21	21	21	21
		Depth	20	20	20	20
	Chamber	Width	12.75	12.75	12.75	12.75
		Height	6.75	6.75	6.75	6.75
		Depth	10	10	10	10
Weight	LBS.		96	96	96	96
Electrical Ratings	Volts		220-240	208	220-240	208
	Amps		18.3	19.2	12.9	11.2
	Watts		4400	4000	3095	2325
	Freq.		50/60	50/60	50/60	50/60
	Phase		1	1	1	1
Oper. Temp. Range	°F/°C		100-1200°C *100-975°C	100-1200°C *100-975°C	100-1200°C	100-1200°C

NOTES: The maximum ramp rates for this furnace for heat up are: 12°C (22°F) per min. from 25°C - 537°C (75°F-1000°F), 10°C(18°F) per min. from 537°C-1093°C (1000°F-2000°F).

* (-60) coal-ashing furnaces

Figure 1 Basic Automatic Controller

Figure 2 Single Setpoint Controller

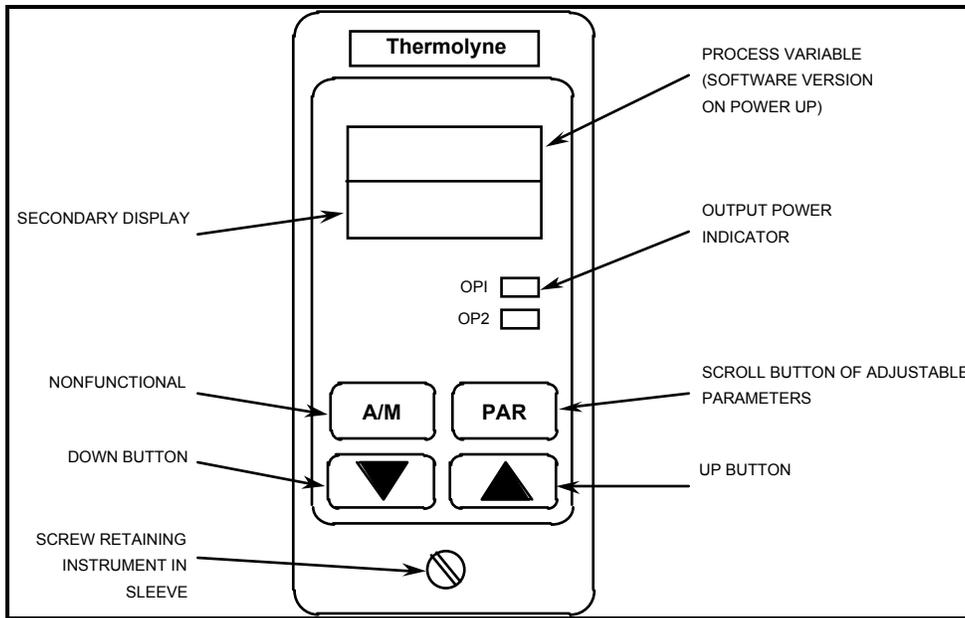


Figure 3
Programmable (2 Ramp & 2 Dwell)

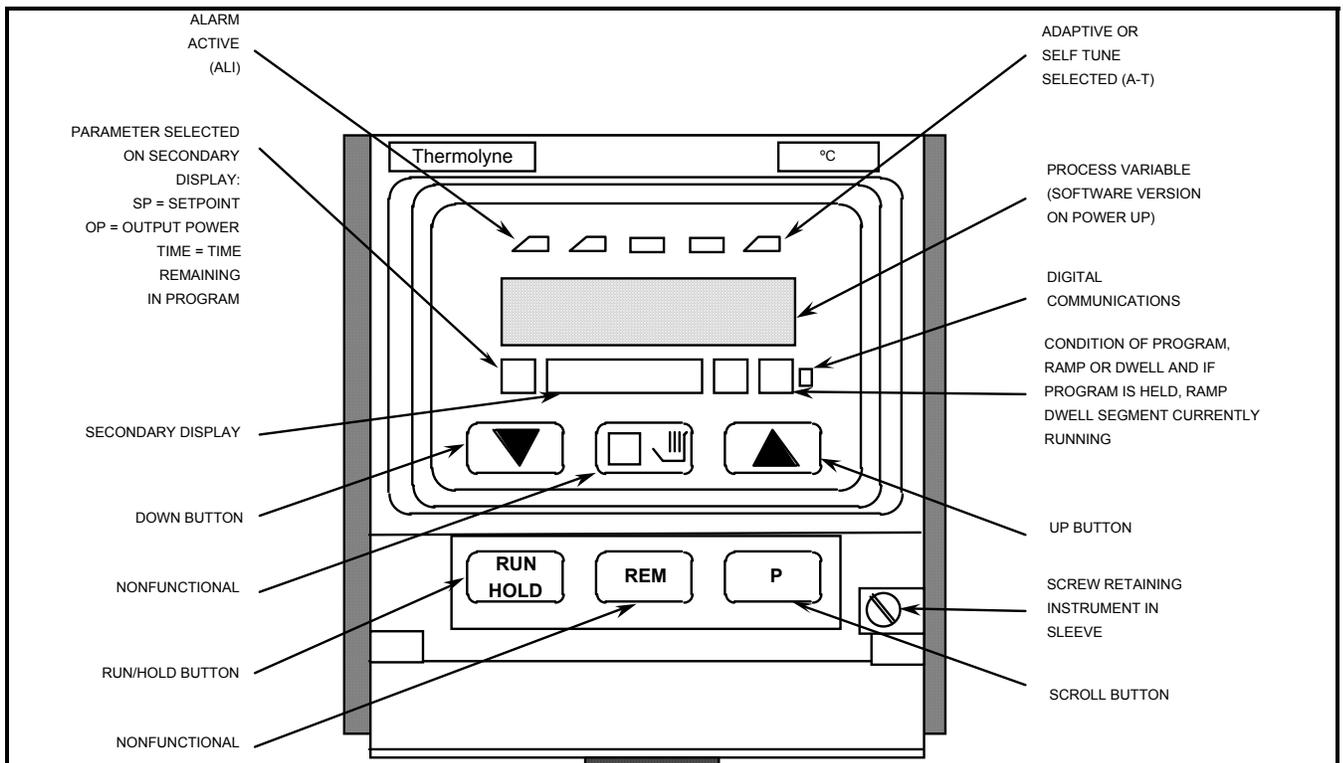


Figure 4
Multi-Programmable Control (8 Ramp & 8 Dwell)

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 door and remove packing material from inside the furnace chamber. Vacuum the chamber prior to use to remove the insulation dust due to shipment.



NOTE

(-60) Models are supplied with two stainless steel trays, handle and porcelain pegs.

Retain the original packaging material if re-shipment is foreseen or required.



NOTE

The Type 6000 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. (F6010, F6010-33 and F6018 are supplied with cord and plug).

Installation

Site Selection

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



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.

Electrical Connections

1. 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 Type 6000 furnace to your electrical supply, be sure the front power switch is in the OFF position.



WARNING

To avoid electrical shock, this furnace must be installed by a competent, qualified electrician who insures compatibility among furnace specifications, power source and grounding code requirements. (Disregard Step 2 if you have Model F6010, F6010-33 or F6018.)

2. Your 6000 furnace may be wired either directly through a conduit system or by using a power cord and plug which conforms to the National Electrical Codes and electrical code requirements of your area. The terminal block to be used in wiring is located on the lower rear of the furnace.



CAUTION

For supply connections, use 10 AWG or larger wires suitable for at least 90°C. Failure to observe this caution could result in damage to furnace.

Observe these two warnings before operating your 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 material.

“Caution: Hot Surface. Avoid Contact.” To avoid burns, this furnace must not be touched on the exterior or interior surfaces during use or for a period of time after use.

Basic Automatic Temperature Control Operation (F6010, F6010-33, F6018)

Power Switch

The On/OFF power switch will illuminate when power is turned ON. Also, the digital display will illuminate.

Cycle Light

The amber cycle light will illuminate whenever the power is being applied to the heating elements. The cycle light will turn on and off as furnace reaches setpoint.

Door Safety Switch

The door safety switch removes power from the heating elements when the door is opened. Open and close the door a few times; note that the amber CYCLE light will be out when door is open. This check must be done when furnace is heating or when cycle light is illuminated. If this condition is not true, consult the Troubleshooting section before proceeding.



WARNING

To avoid electrical shock, this furnace must have the door switch operating properly.

Digital Readout

The digital readout continuously displays chamber temperature unless the Push To Set Temperature button is depressed. Then setpoint temperature is displayed.

Push To Set Temperature Button

When this button is depressed, the digital display will indicate setpoint temperature. When the button is released, the actual chamber temperature is displayed.

Temperature Adjustment Knob

Turning this knob clockwise will increase setpoint temperature. Turning the knob counterclockwise will decrease temperature.

Temperature Controller

This controller provides accurate control at one single temperature setting. To set temperature, simply:

- a) Turn Power switch ON.
- b) While depressing the Push To Set Temperature button, turn the temperature knob until you reach the desired setpoint temperature as indicated on digital display.
- c) Release the Push To Set Temperature button.

The digital display will now indicate the actual chamber temperature. The furnace will heat to the new setpoint temperature. The CYCLE light will remain on until the furnace temperature is within 1°C of the setpoint temperature; then the CYCLE light will turn on and off as the controller maintains the setpoint temperature.



NOTE

If **at any time** the Temperature Adjustment knob is turned in either direction, **the setpoint will change, even if the Push To Set Temperature button is not depressed**. To view the current setpoint temperature, depress the Push To Set Temperature button.

Sensor Break Protection

This controller provides sensor break protection in the event the thermocouple opens. If an open thermocouple condition occurs, the digital display will indicate 5 degrees or less and the power to the heating element will be shut off (CYCLE light will extinguish).

Automatic Models

(F6020C, F6020C-33, F6020C-60, F6028C, F6028C-60)



NOTE

The temperature control in these models is a single set-point device. By using the "UP" or "DOWN" buttons a specific temperature can be chosen. 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.

Controls and Displays

Power Switch:

Switch power switch to the "ON" position. The CONTROLLER will illuminate when power is on.

Furnace Power Indicator:

The amber furnace power light will illuminate whenever the door is closed. This light will go out only when the door is open or when there is an over-temperature condition.

Door Safety Switch:

The door safety switch removes power from the heating elements when the door is opened. Open and close the door a few times, note that the amber furnace power light will go out while the door is open. If the furnace power light does not go out while the door is open, consult the Troubleshooting section before proceeding.



WARNING

To avoid electrical shock, this furnace must have the door switch connected and operating properly. If the furnace power light does not go out while the door is open, consult the Troubleshooting section before proceeding.

Control Buttons

To illuminate the "DOWN" button, "SCROLL" button, and "UP" button, touch anywhere on the front panel.



NOTE

When performing the operations with the controller, remember that if more than eight to ten seconds elapse before the buttons are used again, the display screen will automatically switch back to displaying chamber temperature. If this happens, light up the front panel again and step through each parameter until you reach the point at which the interruption occurred. The parameter values you adjusted earlier, however, will not be lost or altered. Holding down on the "SCROLL" button allows longer viewing time.

Digital Readout:

The Digital Readout continuously displays chamber (upper display) and setpoint (lower display) temperatures unless the "SCROLL" button is depressed.

Startup Display:

When the power switch is turned on, the controller will perform a self-test to make sure controller is operating properly. (If all four 1's do not light up or fails to go to "8888" contact Thermolyne.)

Adjusting Furnace Setpoint Temperature

To illuminate the "DOWN" button, "SCROLL" button, and "UP" button, touch anywhere on the front panel.

Push the "UP" button or the "DOWN" button to modify the temperature setpoint (lower digital display).



CAUTION

Do not exceed limitations for continuous or intermittent operating temperature shown in the General Specifications. Exceeding these limits will result in severely reduced heating element life.

Tuning:

This control incorporates a self tuning feature which determines the optimum control parameters for the best temperature accuracy. We recommend that you tune the furnace to your specific application to obtain the best results. Perform the following procedures when you first set up your furnace and each time you change your load type or operating temperature.

To tune your furnace:

Load your furnace with a load characteristic of those you intend to heat in it.

Set the furnace's setpoint to the temperature you intend to use for your application.

Push the "SCROLL" button until 'tunE' appears. To start the tuning function, push the "UP" button.

When the tuning process is started, the lower display will flash 'tunE' along with the furnace temperature setpoint. During tuning, the temperature setpoint cannot be changed. To change temperature setpoint 'tunE' must be turned "OFF." (To stop the tuning function, push the "DOWN" button.)



NOTE

If the power to furnace is "turned off" or interrupted while in "tuning," upon returning power to furnace, the controller display will indicate "LinE FAIL" because sampled data could be questionable. To restart tuning, refer to "Tuning" procedure.

If the controller cannot maintain temperature setpoint, "tunE FAIL" will appear on display. First, correct problem responsible for not maintaining the temperature setpoint, then restart the "tuning" procedure.

Changing Temperature Indication:

Push "SCROLL" button once, "°C" will appear. This indicates temperature measurement. (Contact Thermolyne if control needs to be changed to °F.)

Setting the High Alarm Temperature (Over Temperature Protection OTP):

Push "SCROLL" button until "AL.SP" (Alarm Setpoint) appears. The lower display should indicate 1100°C.



NOTE

HIAL- HIGH ALARM. (over-temperature protection, OTP)

The controller is fitted with a mechanical relay which is de-energized in the alarm mode. This relay, when de-energized, removes power from the heating elements. If the primary control circuit fails, the OTP will control the furnace temperature at the preset value you have entered. It does not shut off the furnace. but will maintain the chamber temperature at that value.

Depress either the "UP" or "DOWN" button to select the OTP value you desire. Thermolyne recommends that you set the value either at the maximum operating temperature of the furnace or a value of 20 degrees above your working temperature if you desire to provide protection for your workload.

Programmable Control Models (2 ramp & 2 dwell) F6020C-70, F6020C-33-70, F6028C-70, F6020C-60-70, F6020C-33-60-70, F6028C-60-70)

Controls and Displays

Digital Readout:

The digital readout continuously displays chamber (upper display) and setpoint (lower display) temperatures unless the PAR (parameter) button is depressed.

If a program is in either run, Hb or Hold, pressing "PAR" once causes the lower display to indicate the current segment of the program (r1, d1, r2, d2, or Hb) along with °C or °F. If the program is currently in either d1 and d2, the value shown below these parameters (d1 and d2) reflects the time remaining in the segment.

While the program is in run, Hold, or Hb, the set point shown on the bottom display is the current working set point.

When the controller is in idle, depressing PAR shows each parameter and its current value in turn on the display. The parameter value can either be modified with the "up" or "down" push buttons or left unmodified.

See **Parameters** for a list of the controller parameters in order.



NOTE

In the event of a thermocouple break (open circuit), the numeric display increases rapidly upscale, then displays "Sn b" (sensor break), and may alternatively flash "HiAL" (high alarm) and/or dAL (deviation alarm) and the sensor break power value.

A reversed thermocouple connection or incorrect thermocouple will cause the display to read "ur" (underrange) and the control will maintain the sensor break power output value selected.



NOTE

When performing operations with the controller, if you depress and release either the "PAR," scroll "up," or scroll "down" push buttons and more than 6 seconds elapse before the buttons are used again, the display screen will automatically switch to displaying chamber 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 adjusted earlier, however, will not be lost or altered. Holding down on "PAR" allows longer viewing time.

Power Switch: Set power switch to the "ON" position. The CONTROLLER will illuminate when power is on.



CAUTION

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

Furnace Power Indicator:

The amber furnace power light will illuminate whenever the door is closed. This light will go out only when the door is open or when there is an over-temperature condition.

The door safety switch removes power from the heating elements when the door is opened. Open and close the door a few times, note that the amber furnace power light will go out while the door is open. If the furnace power light does not go out while the door is open, consult the Troubleshooting section before proceeding.



WARNING

To avoid electrical shock, this furnace must have the door switch connected and operating properly. If the furnace power light does not go out while the door is open, consult the Troubleshooting section before proceeding.



NOTE

Pushbutton "A/M" and light "OP2" are inactive and not used.

Parameters

PROG - program options . By pushing up or down buttons, three options can be chosen: run - to start program; idle - to end program; hold - to hold program until further action.

SP - set point temperature. When running a program, it is the last temperature value attained. Push up or down button to set.

TUNE - self-tuning feature. Push up or down button to set.

LC - loop count. The number of times the program is repeated. Push up or down button to set.

r1 - ramp rate #1. The rate of heat increase or decrease in °/minute. Push up or down button to set.

L1 - temp level #1. The temp level that r1 will attain. Push up or down button to set.

d1 - dwell (soak) time #1. The amount of time in minutes to hold L1 temp level #1. Push up or down button to set.

r2 - ramp rate #2. The rate of heat increase or decrease in °C/minute. Push up or down button to set.

L2 - temp level #2. The temperature level r2 will attain. Push up or down button to set.

d2 - dwell (soak) time #2. The amount of time in minutes to hold L2 temperature level #2. Push up or down button to set.

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 to set.

HiAL - high alarm (over temperature protection). Push up or down button to set. Thermolyne recommends that you set the value either at the maximum operating temperature of the furnace or a value of 20 degrees above your working temperature if you desire to provide protection for your workload.



NOTE

The controller is fitted with a mechanical relay which is de-energized in the alarm mode. This relay, when de-energized, removes power from the heating elements. If the primary control circuit fails, the OTP will control the furnace temperature at the preset value you have entered. It does not shut off the furnace but will maintain the chamber temperature at that value.

The next three parameters - Proportional Band, Integral and Derivatives - are the three control parameters of a P.I.D. control system. These parameters will be set when you tune your furnace. (See **Tuning.**)

Prop - Proportional Band.

Int.t - Integral Time.

dEr.t - Derivative Time.

HPI - High Power Limit (%) This parameter limits the average maximum power that is applied to the heating elements. Remember that this parameter does not reduce the voltage to the elements. It reduces the average power to the elements by cycling power on and off.

C/F - Centigrade/Fahrenheit. Choose the desired temperature unit by depressing the "UP" or "DOWN" pushbutton.



NOTE

All temperature dependent parameters are automatically converted when the temperature unit (C or F) is changed.

Tuning Your Controller

This programmable control has an automatic tuning feature which installs optimum tuning parameters to give the best temperature accuracy. No manual loading of tuning parameters is needed. We **highly** recommend using this feature to provide the best temperature accuracy the controller can attain. Perform the following procedures when you first set up your furnace and each time you change your load type, operating temperature, or program.

To initiate the self tune feature:

Load your furnace with a load characteristic of those you intend to heat in it.

If you will be using the controller as a single Setpoint Controller, set the furnace's setpoint to the temperature you intend to use for your application.

If you will be running a multi-step program, set the furnace's setpoint to the value of **L1 (temp level #1)**.

Push "PAR" button until TUNE is displayed, then push "UP" or "DOWN" button to turn tune "ON."

During the operation, TUNE flashes in the lower display. Do not make any adjustments to the controller parameters during this period. The self tuning is finished when TUNE no longer flashes in the lower display.

Self tuning will calculate values for:

Proportional band - prop

Integral time - Int.t

Derivative time - der.t

- Self tuning cannot be initiated while running a program.
- A power failure will cause the TUNE parameter to revert back to NO. (Reset tune parameter to YES).
- If there are alarm conditions during self tuning, they flash alternately with TUNE.

Operating the Controller



CAUTION

Do not exceed limitations for continuous or intermittent operating temperature shown in the General Specifications (in furnace manual). Exceeding these limits will result in severely reduced heating element life.

Single Set Point Operation

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. The control will cause the furnace chamber to heat to the chosen temperature and hold this temperature until the power switch is set to OFF or another temperature is selected.

- a. The setpoint temperature presently set in the control will be read out on the lower display.
- b. To change this set point, depress the "UP" or "DOWN" push button until the desired setpoint value is displayed then release the button.
- c. 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.

Programming Controller

To run a program, first determine your ramp rate, dwell times, and program levels. It is helpful to graph your program out for ease of loading the program into controller.

A maximum of 2 ramp and 2 dwell segment combinations are available, thus enabling 2 different set point levels to be achieved. Each ramp is programmed by specifying the temperature level (L1) and the required ramp rate (r1). The programmer then automatically calculates the time that is required to attain the temperature level (L1) based on the desired ramp rate (r1). Dwell segments (d1) then can be attached to each temperature level (L1) to hold that temperature for a specified amount of time.

Make sure the PROG parameter is set to idle (to stop program) when entering program values. (See **Parameters**.)

Push "PAR" until "r1" is displayed. Push "UP" or "DOWN" buttons and set ramp rate "r1" (heat increase or decrease) in °C/minute.

Push "PAR" until "L1" is displayed. Push "UP" or "DOWN" buttons and set temperature level "L1." This is the target temperature for the first ramp.

Push "PAR" until "d1" is displayed. Push "UP" or "DOWN" buttons and set dwell (soak) time "d1" in minutes.

Push "PAR" until "r2" is displayed. Push "UP" or "DOWN" buttons and set ramp rate "r2" in C/minutes.

Push "PAR" until "L2" is displayed. Push "UP" or "DOWN" buttons and set temperature level "L2." This is the target temperature for the second ramp.

Push "PAR" until "d2" is displayed. Push "UP" or "DOWN" buttons and set dwell (soak) time "d2" in minutes.

Push "PAR" until "SP" is displayed. Push "UP" or "DOWN" buttons and modify set point temperature. After "d2" dwell time has expired, thus ending the program, the last temperature level to be attained will be equal to "SP" temperature. For example, if after your program has been completed, you want the furnace to cool to ambient, set "SP" to 20. This will be the last temperature level attained.

Push "PAR" until "LC" is displayed. Push "UP" or "DOWN" buttons and set "LC" (loop count - number of times program is repeated).

Skipping Segments

If you desire to skip a ramp or dwell segment, follow this procedure:

- for a dwell segment, enter a setting of "0" minutes.
- for a ramp segment, enter a high value such as 100°/min. This will cause controller to skip to next segment as fast as the furnace is capable.

Setting the Holdback Feature

This controller features a holdback (Hb) function to ensure programmed parameter values are adhered to. Holdback is set in display units (degrees C or F) and represents the allowable excursion of measured value away from the current set point, either above or below, before the program is forced into hold (clock stops).

The program will remain in hold until the measured value comes within holdback band (clock starts). This feature is active the whole time that the program is running. (Holdback functions only while running a program).

Push PAR until "Hb" is displayed. Select desired holdback setting - a setting of 20° is recommended.

If a running program is forced into holdback, the illuminated dot below the "R" symbol on controller will flash and the PROG parameter will indicate "Hb." When the program is in "holdback," it effectively lengthens the time of the program - if the holdback band "Hb" is set too low, the program will never escape the holdback band, thus the program will never be completed. If you do not want to use the holdback function, set "Hb" to an extremely large value.

Implementing Programs

When you have finished programming and are ready to run your program, push "PAR" until PROG is displayed. Pushing the "UP" or "DOWN" buttons, you have three options: "Run" (to start program), "idle" (to stop program), "hold" (to hold program) - parameter values can be changed when hold is chosen.

Program Execution

When "run" is selected, the program will start from the actual furnace temperature at that point in time. Also, the dot under "R" on the control will illuminate to indicate the program is running.



NOTE

Notes alert the manual user to pertinent facts and conditions.

Parameter values r1, L1, D1, r2, L2, D2 and LC cannot be adjusted while running a program.

Program Hold

To adjust parameters while running a program, you must put control into "Hold." Push "PAR" until "prog" is displayed. Push "UP" or "DOWN" buttons until Hold is displayed. When the dot underneath "R" on controller flashes and "Hold" is indicated at the "prog" parameter, the controller is in Hold. Now you are able to adjust all parameters. To restart the program, set "prog" to "run" again.

Program Idle

To stop program, push "PAR" button until "prog" is displayed. Push "UP" or "DOWN" buttons until "idle" is displayed. This will terminate program.

Multi-Programmable Control Models (8 ramp & 8 dwell) (F6030CM, F6030CM-60, F6038CM, F6038CM-60)

Controls and Displays

Digital Readout:

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.

See **Parameters** for a list of the controller parameters in order.



NOTE

When performing operations with the controller, 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 adjusted earlier, however, will not be lost or altered.



NOTE

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

Power Switch: Turn power switch to the "ON" position.



CAUTION

Remember that whenever the power switch is turned "ON," the furnace will begin to heat at 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.

Furnace Power Indicator:

The amber furnace power light will illuminate whenever the door is closed. This light will go out only when the door is open or when there is an over-temperature condition.

Door Safety Switch:

The door safety switch removes power from the heating elements when the door is opened. Open and close door a few times, note that the amber furnace power light will go out while the door is open. If the

furnace power light does not go out while the door is open, consult the Troubleshooting section before proceeding.



WARNING

To avoid electrical shock, this furnace must have the door switch connected and operating properly. If the furnace power light does not go out while the door is open, consult the Troubleshooting section before proceeding.



NOTE

The two center push buttons are inactive and not used.

Parameters

Pnr - Program Number. The program number of the program you are going to work with. By pushing the up or down button you can select a program numbered from 1 to 4.

PR1 - Program Ramp Rate. The rate of heat increase or decrease in °C/minutes. Pushing the up or down button will give current setting of this ramp.

PL1 - Program Level. The temperature to which the furnace needs to attain. Push up or down button to set.

PD1 - Program Dwell 1. Amount of time in minutes to hold PL1 program level temperature entered. Push up or down button to set.

You will use the same descriptions and procedures used for PR1, PL1, PD1 for the remaining Program Ramp Rates PR2 - PR8, Program Levels PL2 - PL8, and Program Dwells PD2 - PD8.

Cnt - Continue. Allows linking of programs. You may select Cnt as "y" (yes) or "n" (no) by pushing the up or down button.

HB - Holdback. Automatically places the programmer into "Hold" if the measured value deviates more than a specified amount from programmer setpoint. When measured value re-enters 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 to set.

PLC - Program Loop Count. The number of times a program will be repeated. Push up or down button to set.

SP1 - Setpoint One. Indicates current setpoint. Push up or down button to set.

SP2 - Setpoint two. Not configured into control and nonfunctional. Set to "20".

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).

ATR - Adaptive Tune Range setting. Determines the operational band width of the adaptive tuning function. Self Tuning automatically determines this setting.

AL1 - Alarm 1. 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. Push up or down button to set.



NOTE

Thermolyne recommends that you set the value either at maximum operating temperature of the furnace (1100°C = 2012°F) or a value of 20 degrees above your working temperature if you desire to provide protection for your workload.

The next three parameters - Proportional (PB) Integral (+i) and Derivative (+d) - are the three control parameters of a P.I.D. control system. These parameters will be set when you tune your furnace. (See **Self-Adaptive Tuning**.)

Pb - Proportional.

(+i) - Integral.

(+d) - Derivative.

The next two parameters - cutback low (**cbi**) and cutback high (**cbh**) - are to aid the control in preventing temperature overshoots and undershoots. The point from setpoint where the power starts "cutting back" is defined as the cutback value. These values are also automatically adjusted by the Self Tuning and Adaptive Tuning features. These values cannot be changed by the user; the controller automatically installs optimum cutback values when in Self Tuning and Adaptive Tuning.

HL - Output Power limits the average maximum power that is applied to the heating elements. Normal setting is 100%. If you plan to use the furnace below 260°C (500°F) the output power may be reduced. This will significantly shorten the time it takes for stabilization. It will also reduce drastic temperature overshoots. Contact **Barnstead/Thermolyne** Customer Service for advice on the proper value to use. Remember that this parameter does not reduce the voltage to the elements. It reduces the average power to the elements by cycling power on and off.

HC - Cycle Time is the rate at which power is supplied to power control switch. Push up or down button to set.

Sbr - the percent of power that is supplied to the control output terminals if an open thermocouple condition exists. Push up or down button to check. 0.0 will be displayed. This parameter cannot be changed; if 0.0 is not displayed, contact Barnstead/Thermolyne. The upper display will flash "OR" if an open thermocouple condition exists.

Tuning Your Controller

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. We **highly** recommend using these features to provide the best temperature accuracy the controller can attain. Perform the following procedures when you first set up your furnace and each time you change your load type, operating temperature, or program.

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-time 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.

To initiate the tuning feature:

Load your furnace with a load characteristic of those you intend to heat in it.

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, if it is required to retune at a new setpoint either above or below the process value indicated on the upper display. *(If you will be using the controller as a single Setpoint Controller, set the furnace's setpoint to the temperature you intend to use for your application. If you will*

*be running a multi-step program, set the furnace's setpoint to the value of **PL1 (Program Level #1).**) 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.

Operating the Controller



CAUTION

Do not exceed limitations for continuous or intermittent operating temperature shown in the General Specifications. Exceeding these limits will result in severely reduced heating element life.

Single Set Point Operation

This 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. 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.

- a. The setpoint temperature presently set in the control will be read out on the lower display.
- b. To change this set point, depress the "UP" or "DOWN" push button until the desired setpoint value is displayed then release the button.
- c. 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.
- d. The upper display indicates the actual furnace temperature.

Programming Controller

The multi-programmable controller in these units provides up to 4 separate programs of 8 ramps and 8 dwells each. This controller also allows you to link programs together, which allows you to achieve 64 total segments (4 programs X 16 segments). These functions are controlled by the controller's first two programming parameters, "Pnr" and "Cnt."

A maximum of 8 ramp and 8 dwell segment combinations are available per program, 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 time.

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.

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 4.

Program Entry

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 #4 will initiate the start of program #1 upon the completion of program #4. Each program will complete the selected number of loops before continuing (see Loop Count). If you do not want to link programs, set Cnt to "Cnt n" (continue no).



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.

Set Ramp Rates

1. 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 ramp as quickly as possible to the next temperature level.

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

Set Level Temperatures

2. 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.

Set Dwell Times

3. 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.

Set the Number of Times to Repeat the Program

4. 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.

Set the Holdback Feature

5. 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.

Implementing Programs

Program Execution

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



NOTE

Be sure to select the program number before pressing "Run/Hold."

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 parameter, 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.

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.



NOTE

The temperature control in these models is a programmable "and" automatic single setpoint device. 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 setpoint (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 or below degrees as described earlier in this manual.

Installation and Operation of Air Control



NOTE

Coal ashing furnaces -60 models contain a feature to provide air (or inert gas) flow within the furnace chamber.

Installation



NOTE

A pressurized air line with a minimum working pressure range of 0 to 20 psi is required.

Compressed air hook-up

1. At the rear of the furnace is located a 0.250 inch tube fitting.
2. Using 0.250 inch I.D. rubber tubing, connect a length of tubing from this input fitting to a corresponding 0.250 inch fitting located on the regulated side of a pressurized air service line.
3. Prior to making connections at the regulator, insure that the regulator is turned fully closed (0 psi).
4. Turn flow control valve located at the bottom of the flowmeter (front control panel) fully clockwise to closed position.
5. Turn regulator to maximum output pressure of 20 psi. Check for any leaks at connection points of connecting tubing.
6. Open flow control valve slowly until ball in flow meter reads between 40 to 45 liters per minute flow rate.



NOTE

A flow rate of 40 to 45 liters per minute will provide three air exchanges of the chamber per minute.

7. Open furnace door and check that air is exhausting from the manifold located at the bottom rear of the chamber.
8. Turn flow control valve to off (fully clockwise).

**NOTE**

If furnace is to be used regularly, the airline regulator may be left open to 20 psi.

Exhaust tubing hook-up.**NOTE**

Appropriate exhaust must be provided to remove smoke and gases produced in an ashing procedure.

Using accessory stainless steel tubing available from **Barnstead/Thermolyne** Corporation (part number AY408X1A) or equal quality 2.5 inch I.D. stainless steel tubing, connect flexible tubing from vent port at top of furnace case to an appropriate negative pressure exhaust system. This exhaust system must be capable of handling smoke and gases produced in an ashing procedure.

**NOTE**

Failure to connect the exhaust port to an appropriate exhaust system will result in smoke and gases filling the work area. Without the connection, gases and smoke will escape around the door seal and at the rear of the furnace.

Furnace Programming

Refer to "Programmable Models" in this manual to program in the following values for performing ASTM specification D3174.

- PR1 (Ramp 1) value is 8°C/minutes
- PL1 (Level 1) value is 500°C
- PD1 (Dwell 1) value is 0 minutes
- PR2 (Ramp 2) value is 6°C/minutes
- PL2 (Level 2) value is 750°C
- PD2 (Dwell 2) value is 120 minutes
- PR3 (Ramp 3) value is END (for 8 ramp & 8 dwell controller)
- SP (Setpoint) value is 20° (for 2 ramp & 2 dwell controller)
- PLC (Loop Center) value is 1

Included with this furnace are two stainless steel trays which will hold crucibles of quartz jars. Use the appropriate side for the type of crucible you are using. A removable handle is also provided to use in loading and unloading the trays from the furnace.

Shelf location

1. The side walls of the chamber contain twenty four holes (.250 inch dia.) which allow adjustment of the two perforated shelves at various heights within the chamber.
2. Using the eight, .250 inch diam. porcelain pegs, insert four pegs in the bottom row of holes.
3. Next insert the remaining four pegs in fourth row of holes and insert the two perforated shelves .
4. Check for proper fit at this point by inserting the crucible trays.

Operation

1. Insert crucible trays. One tray per shelf.
2. Close the furnace door.
3. Insure the exhaust system is operating.
4. Set flow control valve so flow indicator reads between 40 and 45 liters per minute. (Check regulator to insure 20 psi pressure).
5. Switch power switch to "ON".
6. Depress run button. Controller will automatically step the program through the various steps outlined earlier.
7. 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 setpoint (SP1 or SP). To cancel a program depress and release the "UP" and "DOWN" pushbuttons simultaneously. Be sure single set point mode is set to 20 degrees as described earlier in this manual.
8. At the end of the program, turn the flow control valve fully clockwise to the closed position.

Furnace Loading

For best results, use only the center two-thirds of the furnace chamber.



CAUTION

Do not overload your furnace chamber. If the load is to be heated uniformly, it should not occupy more than two-thirds of the furnace chamber. Failure to observe this caution could result in damage to furnace components.

1. If you are heating a number of small parts, spread them throughout the center of the furnace chamber.
2. Keep objects away from thermocouple.
3. Use insulated tongs and mittens when loading and unloading furnace.
4. Always wear safety glasses.
5. Use Thermolyne hearth plates if you place load on bottom of chamber. Part #PHX2 (three are required).

Maintenance and Servicing



WARNING

THIS FURNACE CONTAINS REFRACTORY CERAMIC INSULATION WHICH CAN PRODUCE RESPIRABLE FIBERS AND DUST WHEN HANDLED. THESE FIBERS CAN CAUSE IRRITATION AND CAN AGGRAVATE PRE-EXISTING RESPIRATORY DISEASE. THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC) HAS CLASSIFIED REFRACTORY CERAMIC FIBER AS POSSIBLY CARCINOGENIC.

AFTER SERVICE REFRACTORY CERAMIC FIBER DUST MAY CONTAIN CRYSTALLINE SILICA, WHICH MAY CAUSE LUNG DAMAGE (SILICOSIS) AND WHICH HAS BEEN CLASSIFIED BY IARC AS A PROBABLE CARCINOGEN.

The refractory ceramic materials are located in the door, the hearth collar bricks, and in the chamber of the furnace. Tests performed by the manufacturer indicate that there is no significant risk of exposure to dust or respirable refractory ceramic fiber resulting from operation of the equipment under normal conditions. However, there may be a risk of exposure to respirable refractory ceramic dust or fiber 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.

REFER SERVICING TO QUALIFIED PERSONNEL.



WARNING

Disconnect from the power supply prior to maintenance and servicing.

“Caution: Hot Surface. Avoid Contact.” To avoid burns, this furnace must not be touched on the exterior or interior surfaces during use or for a period of time after use.

Refer servicing to qualified personnel.



NOTE

Perform only maintenance described in this manual. Contact an authorized dealer or our factory for parts and assistance.

Preventative Maintenance

This unit is equipped with a venting system on the top of the furnace. This is for the removal of fumes from the chamber of the unit. Contamination is a major cause of element failure, therefore, remove all fume forming material before heating. (e.g. clean cutting oil from tool steel).

1. Housekeeping is vital to your electric furnace - KEEP IT CLEAN. Run your furnace up to 1600°F empty occasionally to burn off the contamination that may exist on the insulation and elements. Maintain 1600°F for at least 4 hours to insure complete ashing of foreign materials.

2. Element life is reduced somewhat by repeated heating and cooling. If the furnace is to be used again within a few hours, it is best to keep it at the operating temperature or at a reduced level such as 500°F (260°C).
3. Change the thermocouple every six months.

Troubleshooting

The Troubleshooting Tips section is intended to aid in defining and correcting possible service problems. When using the chart, select the problem category that resembles the malfunction. Then proceed to the possible causes category and take necessary corrective action.

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
The power light does not illuminate.	The furnace is not connected to power supply. ON and OFF power switch is defective.	Check furnace connection to power source. Replace power switch.
The furnace does not heat, cycle light illuminated.	Heating elements burned out or improper connections.	Replace heating elements or repair connections.
The furnace does not heat, cycle light not illuminated.	No power. Two or more heating elements in 208V or 240V furnaces are burned out. Thermocouple has oxidized and opened the circuit. Indicated by: <ul style="list-style-type: none"> a) basic automatic control - 1-5 degrees on display b) automatic control - "OR" on display. c) Prog. 2 ramp & 2 dwell - "SNB" on display. d) Prog. 8 ramp & 8 dwell - "OR" on display. Defective electrical hookup. Set point set too low. High power limit set to a low level. Door switch malfunction. Defective mechanical door switch relay coil or contacts.	Check power source and fuses or breakers. Replace defective elements. Replace thermocouple. Repair electrical hookup. Reset setpoint to a higher value. Reset level to a higher value. Re-align or replace door safety switch. Replace relay.

No temperature control.	<p>Shorted thermocouple circuit.</p> <p>Shorted solid state relay - over temperature protection may be activated.</p> <p>Defective control - error message on display may appear.</p> <p>Thermocouple leads are reversed.</p>	<p>Check thermocouple connection and/or replace thermocouple.</p> <p>Replace solid state relay.</p> <p>Return control for repair or replace. Connect leads correctly (see manual).</p>
Slow heat-up.	<p>One or two heating elements are burned out.</p> <p>Heavy load in chamber.</p> <p>Low line voltage.</p> <p>Incorrect parameter setting "HL" high power limit.</p> <p>Wired improperly.</p> <p>Wrong heating element.</p>	<p>Replace burned out elements.</p> <p>Lighten load in chamber to allow heat to circulate.</p> <p>Install line of sufficient size and proper voltage (isolate furnace from other electrical loads).</p> <p>Set "HL" to 100.</p> <p>Check wiring diagram for correct wiring of your furnace.</p> <p>Install proper element.</p>
Door switch does not cut power to the furnace chamber.	<p>Door switch is not functioning.</p> <p>Mechanical relay contacts sticking.</p>	<p>Re-align or replace door safety switch.</p> <p>Replace relay.</p>
Repeated element burnout.	<p>Chamber improperly loaded.</p> <p>Heating harmful materials.</p> <p>Overheating furnace.</p> <p>Wrong element.</p> <p>Oxidized thermocouple.</p> <p>Contamination present from previous burnout.</p> <p>Wired improperly.</p>	<p>See loading procedures in start-up procedure.</p> <p>Enclose material in container. Clean up spills on chamber. Ventilate chamber by leaving door cracked slightly open when heating known harmful reagents.</p> <p>Keep furnace under maximum temperature. Closer supervision of control setting.</p> <p>Install proper element.</p> <p>Replace thermocouple.</p> <p>Replace insulation material.</p> <p>Check wiring diagram for correct wiring of your furnace.</p>

Inaccurate temperature display.	Oxidized or contaminated thermocouple. Improper loading. Ambient temperature too high. Poor thermocouple connection. Solid state relay malfunction. Thermocouple connections reversed. Control out of calibration.	Replace thermocouple. Use proper loading procedures. Refer to start-up procedure. Keep ambient temperature under 100°F. Tighten connections. Replace solid state relay. Reconnect thermocouple correctly. Contact Thermolyne.
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To Replace a Heating Element:

1. Disconnect furnace from power supply.
2. Remove the back terminal cover of the furnace. (*Note placement and connections of wires*)
3. Loosen the nuts on the terminals of the element to be replaced.
4. Open the door and pull the defective element out. (It may be easiest to turn the furnace so that the element to be removed is on top).
5. Slide the new element into place, threading the leads through the insulating porcelain bushing on the back of the furnace.
6. Tighten the nuts securely. Cut off any excess lead wire.
7. Replace the back terminal cover.
8. Reconnect furnace to power supply.
9. Test operation of furnace.

To Replace a Platinel II Thermocouple in Programmable and Automatic Furnaces:

1. Disconnect furnace from power supply.
2. Remove the back terminal cover of the furnace. (*Note placement and connection of wires*).
3. Remove the screws on the thermocouple terminals and pull the thermocouple straight out.
4. Insert the new thermocouple into the furnace with blue and yellow beaded lead connected to the positive (+) marked terminal and other lead to negative (-) terminal.
5. Secure connections with screws removed in step 3.
6. Replace the back terminal cover.
7. Reconnect the furnace to power supply.
8. Test operation of furnace.

To Replace a Chromel/Alumel Thermocouple (Basic Automatic Furnaces):

1. Disconnect furnace from power supply.
2. Remove both back covers. (*Note placement and connection of wires*).
3. Remove clip holding thermocouple in place (1 screw) and remove the two screws on the thermocouple terminals.
4. Remove the thermocouple. *Pull thermocouple straight out of hole in the chamber first to avoid damage to the insulation.*
5. Guide the looped ends of the new thermocouple through the plastic bushings with the red (-) lead to the right as you face the back of the furnace.
6. Form a 90° bend, towards the furnace, between the 2" long and 1" long ceramic insulators with the red (-) lead to the right. Insert the thermocouple straight through the hole in the chamber.

7. Secure the thermocouple with clip and screw. Connect the looped ends of the thermocouple to the terminals with + to + (yellow wire). Chromel/Alumel thermocouples and lead wire are easily tested with a magnet. The non-magnetic wire is positive (+) and the magnetic wire is negative (-).
8. Replace both back covers.
9. Reconnect to power supply. Test operation of furnace.

To Replace Solid State Relay:

1. Disconnect furnace from power supply.
2. Remove back control cover. (*Note connection and placement of wires to relay*).
NOTE: For basic automatic control models, remove both the back cover and the front control panel to provide access to solid state relay.
3. Disconnect wires from terminals. Identify or mark wires.
4. Remove nuts, washers, and screws from relay, then remove relay.
5. Install new relay.
6. Reconnect the wires identified or marked in step 3.
7. Replace back control cover.
8. Reconnect furnace to power supply.
9. Test operation of furnace.

To Replace Door Switch (Micro Switch):

1. Disconnect furnace from power supply.
2. Remove the four top screws on the front dial and the four bottom screws on the back cover.
3. Slide the control section forward. (*Do not pull excessively on the internal wires*).
4. Disconnect the wires from the door switch. (*Note connection and placement of wires to micro switch*). Identify or mark wires.
5. Remove the two screws and nuts from the micro switch.
6. Insert new micro switch and secure with screws and nuts removed in Step 5.
7. Reconnect wires identified or marked in Step 4 to new door switch.
8. To realign door switch see below, steps 5 through 7.
9. Slide control section back and replace the screws described in Step 2.
10. Reconnect to power supply.
11. Test operation of door switch. (See below, step 10.).

To Realign Door Switch (Micro Switch):

1. Disconnect furnace from power supply.
2. Remove the four top screws on the front dial and the four bottom screws on the back cover.
3. Slide the control section forward. (*Do not pull excessively on the internal wires*).
4. With the door closed loosen the screws on the microswitch and slide the switch downward, so that the screws are at the bottom of the slots in the mounting bracket.
5. Finger tighten both screws. While holding down the rear of the micro switch housing, gently push up on the front switch until you hear a click.
6. Open and close the door; the switch should click when the door is opened approximately 1" and 1/2" to 1" before the door is closed. Slide the front of the switch up to increase the distance, down to decrease the distance.
7. Tighten the two screws to secure the micro switch. Check the operation of the switch as described in Step 6 after tightening the screws.
8. Slide control section back and replace the screws described in Step 2.
9. Reconnect to power supply.
10. To test the operation of the door switch: turn the power switch on, set the control to c setting high enough to keep the control from cycling, open and close the door; the cycle

light should turn off when the door is opened approximately 1" and on 1/2" to 1" before the door is closed.

To Replace Control Module:

Programmable models

1. Turn the screw on the control counterclockwise.
2. As the control module starts to disengage, pull it straight out of the control sleeve.

Automatic models

1. Grasp top and bottom of control, squeeze and pull straight out.

Basic Automatic Control - PC board

1. Disconnect from power supply.
2. Remove lower back cover and remove screws from front cover.
3. Pull control section out to gain access to PC board.

Replacement Parts List

SERIES 711

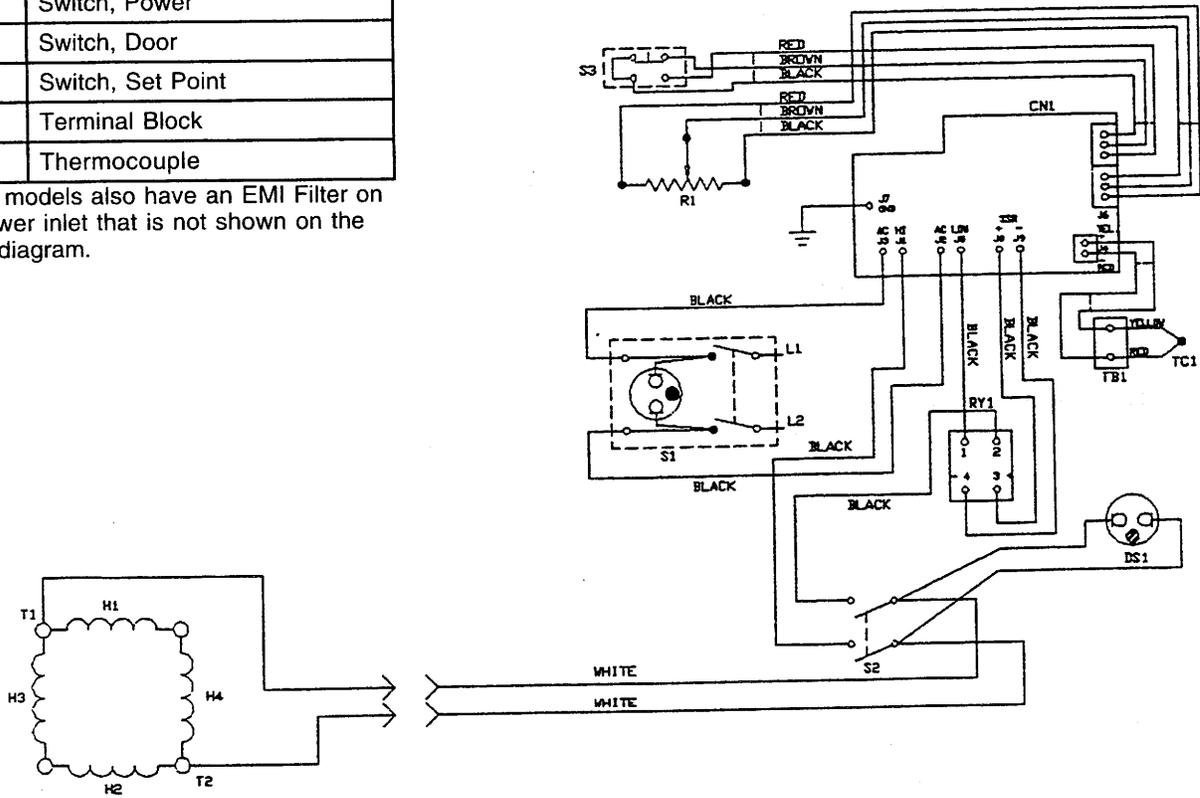
Listed below is the common replacement parts for all models of the 6000 furnace. The far left column contains the letter designation found on the circuit diagrams. Be sure to identify the correct part number with respect to the exact model number found on your furnace.

REPLACEMENT	DESCRIPTION	MODELS USED ON
PC750X4A	Control Unit - PC Board	F6018
PC750X2A	Control Unit - PC Board	F6010, F6010-33
CN71X55	Control Unit, Automatic	F6020C, (-33), & (-60), F6028C & (-60)
CN71X40	Control Unit Prog. (2 Ramp & 2 Dwell)	F6020C-70 , (-33),& (-60), F6028C-70 & (-60)
CN71X56	Multi-Control Unit, Prog. (16 segment)	F6030CM& (-60), F6038CM & (-60)
PLX82	Pilot Light	All models except F6010, F6010-33, F6018
EL408X1	Heating Element, Top	F6030CM & (-60), F6020C , (-33), & (-60), F6020C-70, (-33) & (-60)
EL408X10	Heating Element, Top	F6018, F6010, F6010-33
EL408X2	Heating Element, Top	F6038CM & (-60), F6028C & (-60), F6028C-70 & (-60)
EL408X5	Heating Element, bottom	F6030CM & (-60), F6020C, (-33), & (-60), F6020C-70, (-33), & (-60),
EL408X4	Heating Element, bottom	F6038CM & (-60), F6028C & (-60), F6028C-70 & (-60)
EL408X9	Heating Element, bottom	F6018, F6010, F6010-33
EL205X6	Heating Element, side	F6030CM & (-60), F6020C, (-33), & (-60), F6020C-70, (-33), & (-60)
EL408X3	Heating Element, side	F6038CM & (-60), F6028C & (-60), F6028C-70 & (-60)
EL408X11	Heating Element, side	F6018, F6010
RYX10	Relay	All models except F6010, F6010-33, F6018
RYX34	Solid State Relay	All models except F6010, F6010-33, F6018
RYX54	Solid State Relay	F6010, F6010-33, F6018
SWX102	Power Switch	All models except F6010, F6010-33, F6018
SW356X1A	Micro Switch	All models
TC357X1A	Thermocouple, Type K	F6010, F6010-33, F6018
TC408X1A	Thermocouple, Type F	All models except F6010, F6010-33, F6018
SW745X1A	Push To Set Temp. Switch	F6010, F6010-33, F6018
SWX144	Power Switch	F6010, F6010-33, F6018
RS745X1A	Temp. Adjustment Rheostat	F6010, F6010-33, F6018
CAX94	Filter, EMI	F6010-33
CAX99	Filter, EMI	F6020C-33, (-33-60-70) & (-33-70), F6030CM, F6020C-60, F6030CM-60

DIAGRAM COMPONENT LIST

PART NO.	DESCRIPTION
CN1	Control
DS1	Pilot Light
H1	Heating Element
H2	Heating Element
H3	Heating Element
H4	Heating Element
R1	Resistor, Pot
RY1	Relay, Solid State
S1	Switch, Power
S2	Switch, Door
S3	Switch, Set Point
TB1	Terminal Block
TC1	Thermocouple

All -33 models also have an EMI Filter on the power inlet that is not shown on the wiring diagram.



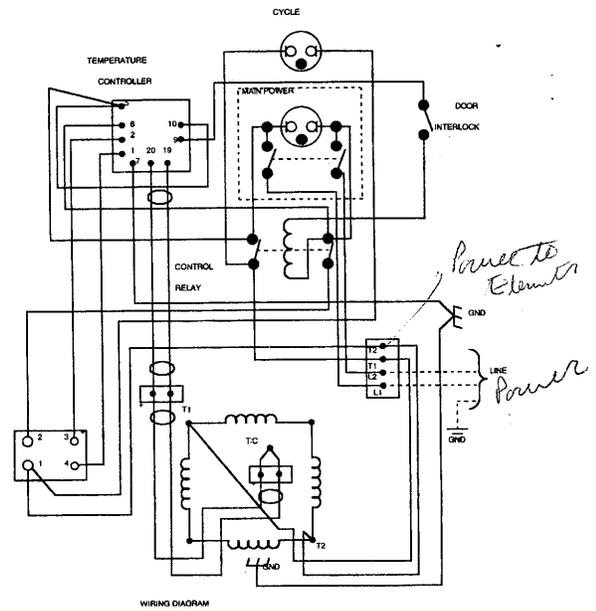
Wiring Diagram
F6010, F6010-33 & F6018

DIAGRAM COMPONENT LIST

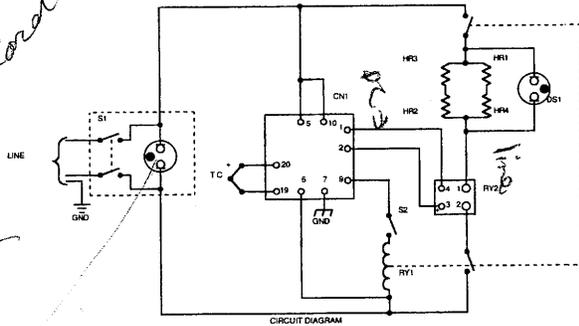
PART NO.	DESCRIPTION
S1	SWITCH, ROCKER, DPST, LIGHTED, 20A
CN1	CONTROLLER, AUTOMATIC
S2	SWITCH, MICRO, DPST, 20A
RY1	RELAY, DPST, N/O, 30A
RY2	SOLID STATE RELAY
DS1	PILOT LIGHT, NEON, 250V, 120K, 1/3W
HR1	ELEMENT, HEATING, TOP
HR2	ELEMENT, HEATING, BOTTOM
HR3	ELEMENT, HEATING, SIDE
HR4	ELEMENT, HEATING, SIDE

Power Switch

All -33 models also have an EMI Filter on the power inlet that is not shown on the wiring diagram.



Power Cord



*Power led
AC Voltage in*



NOTE

-70 Models have a jumper wire across terminals #16 & #17. Also, the negative side of the thermocouple is grounded.

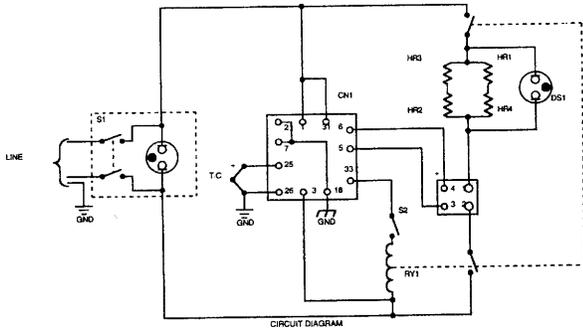
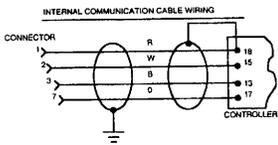
Wiring Diagram

F6020C, -33, & -60, F6028C & -60, FC6020C-70, -33,-60 & -33-60, FC6028C-70 & -60

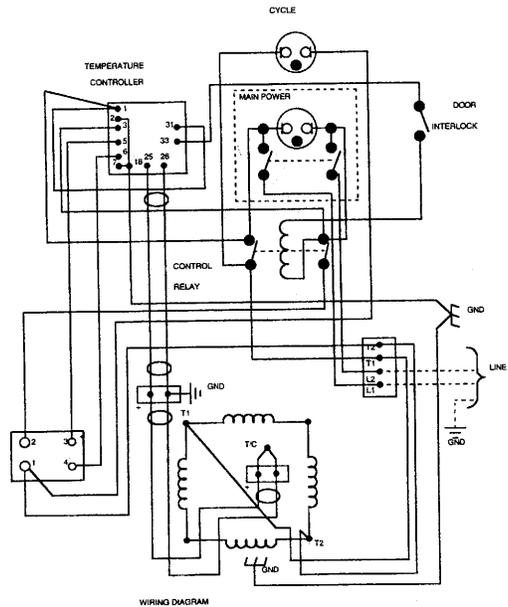
DIAGRAM COMPONENT LIST

REF. NO.	DESCRIPTION
S1	SWITCH, ROCKER, DPST, LIGHTED, 20A
CN1	CONTROLLER, Prog. Comm.
S2	SWITCH, MICRO, DPST, 20A
RY1	RELAY, DPST, N/O, 30A
RY2	SOLID STATE RELAY
DS1	PILOT LIGHT, NEON, 250V, 120K, 1/3W
HR1	ELEMENT, HEATING, TOP
HR2	ELEMENT, HEATING, BOTTOM
HR3	ELEMENT, HEATING, SIDE
HR4	ELEMENT, HEATING, SIDE

All models also have an EMI Filter on the power inlet that is not shown on the wiring diagram.



**Circuit
Diagram**



**Wiring
Diagram**

FC6030M & -60, FC6038CM & -60

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 a RGA number will be refused.

Thermal Ceramics

Material Safety Data Sheet

Date Revised: 7/2/91

PRODUCT IDENTIFICATION

Trade Name(s): CERAFIBER
Generic Name: REFRACTORY CERAMIC FIBER INSULATION
Chemical Name: ALUMINA SILICA
Manufacturer: Thermal Ceramics
Address: P.O. BOX 923, 2102 Old Savannah Road
City: Augusta **State:** Georgia **Zip:** 30903

CAS #: 65997-17-3
Formula: MIXTURE
Telephone: (404) 796-4200

PRODUCT INGREDIENTS

INGREDIENT NAME	CAS NUMBER	%	PEL and TLV (except as noted)
REFRACTORY CERAMIC FIBER	65997-17-3	100	1 FIBER/CC EXPOSURE GUIDELINE 5mg/M ³ - NUISANCE RESPIRABLE - OSHA 10mg/M ³ - NUISANCE TOTAL - ACGIH
CRYSTALLINE SILICA (CRISTOBALITE) WILL FORM "AFTER SERVICE" AT TEMPERATURES >1000°C.	14464-46-1	>20	0.05 mg/M ³ - OSHA Respirable Dust

PHYSICAL DATA

Appearance and Odor: WHITE FIBER-NO ODOR.
Boiling Point: NA **Evaporation Rate (NA = 1):** NA
Vapor Pressure: NA **Specific Gravity (water = 1):** 2.6
Water Solubility (%): NIL **Melting Point:** >3000°F
Vapor Density (Air= 1): NA **% Volatile by Volume:** 0

FIRE AND EXPLOSION DATA

Flash Point (Method): NONFLAMMABLE **Flammable Limits: LEL:** NA % **UEL:** NA %
NFPA Flammable/Combustible Liquid Classification: NA **Auto-ignition Temperature:** NA

HEALTH HAZARDS

Summary/Risks

Summary: EXPOSURE TO DUST FROM THIS PRODUCT SHOULD BE MINIMIZED. ANIMAL INHALATION AND ARTIFICIAL IMPLANTATION STUDIES HAVE REPORTED THE DEVELOPMENT OF TUMORS. BASED ON PRELIMINARY RESULTS, A NOTICE OF SUBSTANTIAL RISK HAS BEEN FILED WITH THE EPA ACCORDING TO SECTION 8(e) OF THE TOXIC SUBSTANCES CONTROL ACT. BASED ON ANIMAL STUDIES, IARC HAS CLASSIFIED RCF AS POSSIBLY CARCINOGENIC FOR HUMANS (2B). DATA FROM HUMAN EPIDEMIOLOGICAL STUDIES IS INSUFFICIENT. THIS SUBSTANCE OR MIXTURE HAS NOT BEEN CLASSIFIED A CARCINOGEN BY NTP OR OSHA.

Medical conditions which may be aggravated: AS WITH ANY DUST, PRE-EXISTING UPPER RESPIRATORY AND LUNG DISEASES MAY BE AGGRAVATED.

Target Organ(s): LUNGS, SKIN AND EYES .

Acute Health Effects: PRODUCT IS A MECHANICAL IRRITANT TO SKIN, EYES AND UPPER RESPIRATORY SYSTEM.

Chronic Health Effects: EXCESSIVE EXPOSURE TO RCF DUSTS AND AFTER SERVICE FIBERS MAY CAUSE LUNG DAMAGE (FIBROSIS). IARC STATES THERE IS SUFFICIENT EVIDENCE IN ANIMALS AND LIMITED EVIDENCE IN HUMANS TO CLASSIFY CRYSTALLINE SILICA AS A PROBABLE CARCINOGEN (2A) AND RCF AS A POSSIBLE CARCINOGEN (2B).

Primary Entry Route(s): INHALATION, SKIN AND EYE CONTACT.

Signs/Symptoms of Overexposure

Inhalation: IRRITATION OR SORENESS IN THROAT & NOSE. IN EXTREME EXPOSURES SOME CONGESTION MAY OCCUR.

Skin Contact: TEMPORARY IRRITATION OR RASH.

Skin Absorption: NA

Ingestion: NOT HAZARDOUS WHEN INGESTED. MAY CAUSE TEMPORARY IRRITATION TO GI TRACT.

Eyes: TEMPORARY IRRITATION OR INFLAMMATION

First Aid/Emergency Procedures

Inhalation: REMOVE TO FRESH AIR. DRINK WATER TO CLEAR THROAT AND BLOW NOSE TO EVACUATE FIBERS.

Skin Contact: WASH AFFECTED AREAS GENTLY WITH SOAP AND WARM WATER.

Skin Absorption: NA

Ingestion: NA

Eyes: FLUSH EYES WITH COPIOUS QUANTITIES OF WATER. IF IRRITATION PERSISTS CONSULT A PHYSICIAN.

REACTIVITY DATA

MATERIAL IS STABLE. HAZARDOUS POLYMERIZATION CANNOT OCCUR.

Chemical Incompatibilities: HYDROFLUORIC ACID

Conditions to Avoid: NONE IN DESIGNED USE.

Hazardous Decomposition Products: NONE

SPILL OR LEAK PROCEDURES

Procedures for Spill/Leak: VACUUM CLEAN DUST WITH EQUIPMENT FITTED WITH HEPA FILTER. IF SWEEPING IS NECESSARY USE A DUST SUPPRESSANT.

Waste Management: WASTES ARE NOT HAZARDOUS AS DEFINED BY RCRA (40 CFR PART 261) . COMPLY WITH FEDERAL, STATE & LOCAL REGULATIONS. METHOD OF DISPOSAL - LANDFILL. RQ - N/A.

SPECIAL PROTECTION INFORMATION

Goggles: GOGGLES OR SAFETY GLASSES WITH SIDE SHIELDS ARE RECOMMENDED.

Gloves: GLOVES ARE RECOMMENDED.

Respirator: <1 F/CC, USE 3M 9900; <10 F/CC, USE MSA COMFO II WITH H FILTER; <50 F/CC, USE MSA ULTRA-TWIN H FILTER; OR EQUIVALENTS. SEE SECTION IX-OTHER.

Ventilation: USE SUFFICIENT NATURAL OR MECHANICAL VENTILATION TO KEEP DUST LEVEL TO BELOW PEL/TLV/WEG (WORKPLACE EXPOSURE GUIDELINE) USE DUST COLLECTION WHEN TEARING OUT.

Other: WEAR LOOSE FITTING, LONG SLEEVED CLOTHING. WASH EXPOSED AREAS WITH SOAP & WARM WATER AFTER HANDLING. WASH WORK CLOTHES SEPARATELY FROM OTHER CLOTHING; RINSE WASHER THOROUGHLY.

Special Considerations for repair/maintenance of contaminated equipment: CRISTOBALITE RESPIRATOR: <10X PEL, USE 3M 9900; <100X PEL, USE MSA ULTRA-TWIN H FILTER; OR EQUIV. SEE SEC IX-OTHER.

SPECIAL PRECAUTIONS

***** ALWAYS SEGREGATE MATERIALS BY MAJOR HAZARD CLASS *****

THIS PRODUCT CONTAINS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Storage Segregation Hazard Classes: IRRITANT

Special Handling/Storage: KEEP MATERIAL DRY.

Special Workplace Engineering Controls: ADEQUATE VENTILATION TO KEEP DUST LEVEL TO BELOW PEL/TLV/WEG (WORKPLACE EXPOSURE GUIDELINE).

Other: ADDITIONAL INFORMATION ON THE HEALTH AND SAFETY ASPECTS OF REFRACTORY CERAMIC FIBERS IS AVAILABLE.

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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 law(s). However, no warranty or representation with respect to such information is intended or given.

MSDS/MSD3 FORM REV. 7/2/91

Barnstead|Thermolyne One Year Limited Warranty

Barnstead|Thermolyne Corporation warrants that if a product manufactured by **Barnstead|Thermolyne** and sold within the continental United States or Canada proves to be defective in material or construction, **Barnstead|Thermolyne** 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**. 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 or writing to:

Barnstead|Thermolyne
P.O. Box 797
2555 Kerper Boulevard
Dubuque, IA 52004-0797
USA
FAX: (319) 556-0695

Barnstead|Thermolyne's sole obligation with respect to its product shall be to repair or 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.

Barnstead|Thermolyne a subsidiary of
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INTERNATIONAL

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