

BARNSTEAD|THERMOLYNE CORPORATION

High Temperature Muffle Furnace

OPERATION MANUAL AND PARTS LIST

Model Numbers

F46110CM
F46110CM-33
F46118CM
F46120CM
F46120CM-33
F46128CM
F46120CM-75
F46120CM-33-75
F46128CM-75

F46230CM
F46230CM-33
F46238CM
F46240CM
F46240CM-33
F46248CM
F46240CM-75
F46240CM-33-75
F46248CM-75

Automatic
Automatic
Automatic
Multi-Programmable
Multi-Programmable
Multi-Programmable
Multi-Programmable
Multi-Programmable
Multi-Programmable

Table of Contents

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.

Table of Contents	
Safety Information	4
Alert Boxes	4
Warnings	5
Description	7
Intended Use	7
General Usage	7
Principles of Operation	7
Types of Controllers	8
General Specifications	9
General Specifications	10
Environmental Conditions	10
Declaration of Conformity	11
Unpacking	12
Installation	13
Furnace Connection	13
Initial heat-up procedure:	13
General Operation of Furnace	14
Power Switch	14
Cycle Indicator	14
Circuit Breaker	15
Fans	15
Controllers	15
Operation of Automatic Models	16
Control Parameters	16
Tuning Your Furnace	17
Single Set Point Operation	18
Program Ramp Rate	19
Program Ramp Reset	19
Operation of Programmable Models	20
Control Parameters	20
Tuning Your Furnace	22
Operating the Controller	23
Single Set Point Operation	23
Programming Controller	23
Multi-Programmable Controller Program Entry (Models F46120CM, F46120CM-33, F46120CM-33-75, F46120CM-75, F46128CM, F46128CM-75, F46240CM, F46240CM-33, F46240CM-33-75, F46240CM-75, F46248CM, F46248CM-75)	24
Program Entry (all models)	25
Implementing Programs	27
Program Execution	27
Parameter Change While Running	27
Loop Count	27
Program Hold	27
Program Reset	28

TABLE OF CONTENTS

Furnace Loading:	29
Furnace Atmospheres	30
Preventive Maintenance	31
General Cleaning Instructions	32
Problem Solving Guide	33
Maintenance and Servicing	34
Wiring Diagram	38
Wiring Diagram	39
Wiring Diagram	40
Wiring Diagram	41
Replacement Parts List	42
Ordering Procedures	43
Material Safety Data Sheet	44
Warranty	47

Safety Information

Safety Information

Your Thermolyne 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 boxes throughout the manual.

Alert Boxes



WARNING

Warning alerts apply when there is a possibility of personal injury.



CAUTION

Caution alerts apply when there is a possibility of damage to the equipment.



NOTE

Notes alert the manual user 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.

Because of the nature of this product, considerably more care is required in operating and servicing this furnace than for lower temperature laboratory furnaces. For maximum safety and longest furnace life, be sure to observe the various cautions and warnings throughout this manual.

SAFETY INFORMATION

WARNING

To avoid electrical shock, this furnace must:

1. Be installed by a competent, qualified electrician who insures compatibility among furnace specifications, electrical source and grounding code requirements.
2. Always be disconnected from the electrical supply prior to maintenance and servicing.

To avoid personal injury:

1. Do not stand directly in front of the chamber without wearing a heat resistant face shield, gloves and apron.
2. Do not operate or clean furnace without proper eye protection.
3. 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.
4. Refer servicing to qualified personnel.
5. Caution: Hot Surface. Avoid Contact.
6. To AVOID EYE DAMAGE in operating or cleaning furnace, proper eye protection must be worn.
7. To AVOID BURNS, do not stand directly in front of the chamber without wearing a heat resistant faceshield, gloves and apron.
8. To AVOID FIRE, do not place combustible materials where exposed to heat from open door.



HOT SURFACE

Caution: Hot Surface. Avoid Contact.

SAFETY INFORMATION

Please note the following WARNINGS:

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 pre-existing 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.

WARNING

REFER SERVICING TO QUALIFIED PERSONNEL.

Description



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 continuously ventilated. Without ventilation, residual heat from the furnace chamber can cause overheating after the furnace is turned off.



CAUTION

Do not completely remove electricity from the furnace until chamber temperature falls below 500°C. Do not touch exposed elements.

Intended Use

Types 461 and 462 are general purpose laboratory furnaces intended for applications requiring temperatures from 800-1700 degrees C.

General Usage

Do not use this product for anything other than its intended usage.

Principles of Operation

The chamber section is heated by six (in type F46100 furnaces) or eight (in type F46200 furnaces) Super Kanthal 33 heating elements suspended in a chamber made of alumina and silica 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 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 in millivolts.

DESCRIPTION

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 (by means of the thermocouple) and adjusts electricity to the heating elements by means of the current controller.

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

The transformer supplies the proper electrical voltage to the heating elements.

The contactor removes electricity 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 electrical supply in the event that the furnace draws too much electrical current.

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

A fan is provided in each section of the furnace to provide forced air cooling.

Types of Controllers

1. The automatic (single set point) digital model enables the user to program a single set point temperature which the furnace will heat and hold.
2. The 4 program, programmable digital model enables the operator to program up to 8 ramp segments (heat-up or cool-down rate) and 8 dwell segments (soak) for applications that require time and temperature relationship for up to 4 separate or linkable programs.
3. The 15 program, programmable digital model enables the operator to program up to 8 ramp segments (heat-up or cool-down rate) and 8 dwell segments (soak) for up to 15 separate or linkable programs.

General Specifications

General Specifications

Model#			F46110CM, F46110CM-33	F46118	F46120CM F46120CM-33	F46128	F46120CM-75 F46120CM-33-75	F46128CM-75
Dimensions	Overall-in (cm)	Width	28-1/8 (71.4)	28-1/8 (71.4)	28-1/8 (71.4)	28-1/8 (71.4)	28-1/8 (71.4)	28-1/8 (71.4)
		Height	18-1/2 (47)	18-1/2 (47)	18-1/2 (47)	18-1/2 (47)	18-1/2 (47)	18-1/2 (47)
		Depth	19 (48.3)	19 (48.3)	19 (48.3)	19 (48.3)	19 (48.3)	19 (48.3)
	Chamber-in (cm)	Width	6 (15.2)	6 (15.2)	6 (15.2)	6 (15.2)	6 (15.2)	6 (15.2)
		Height	6-1/2 (16.5)	6-1/2 (16.5)	6-1/2 (16.5)	6-1/2 (16.5)	6-1/2 (16.5)	6-1/2 (16.5)
		Depth	6-1/4 (15.9)	6-1/4 (15.9)	6-1/4 (15.9)	6-1/4 (15.9)	6-1/4 (15.9)	6-1/4 (15.9)
Weight	LBS.(kg)	156 (70.9)	156 (70.9)	156 (70.9)	156 (70.9)	156 (70.9)	156(70.	
Electrical	Volts	240	208	240	208	240	208	
Rating	Amps	40*/10.4#	40*/12#	40*/10.4#	40*/12#	40*/10.4#	40*/12#	
	Watts	9600* 2500#	8320* 2500#	9600* 2500#	8320* 2500#	9600* 2500#	8320* 2500#	
	Phase	1	1	1	1	1	1	
Temp. Range	Cont.	1700°C	1700°C	1700°C	1700°C	1700°C	1700°C	
Controller		Automatic	Automatic	4-Program.	4-Program.	Multi-Prog.	Multi-Prog.	

NOTES:*Inrush power and current.

Power and current required to maintain maximum temperature after stabilization.

The maximum current is determined by the limiting factor set by the current controller. In the event that 40 amperes is not available, the current controller may be set to limit the current to some smaller value at the expense of a somewhat longer heat-up time.

The variation in current is a result of molybdenum disilicide heating elements having a large decrease in resistance with increasing temperature.

NOTES: The maximum ramp rates for this furnace for heat-up are: 100°C per minute from 25°C-1000°C and 15°C per minute from 1000°C-1700°C.

GENERAL SPECIFICATIONS

Model#		F46230CM, F46230CM-33	F46238	F46240CM F46240CM,-33	F46248	F46240CM-75 F46240CM-33-75	F46248CM-75
Dimensions	Overall-in (cm)	Width	34-1/8 (86.7)	34-1/8 (86.7)	34-1/8 (86.7)	34-1/8 (86.7)	34-1/8 (86.7)
		Height	22-1/2 (57.2)	22-1/2 (57.2)	22-1/2 (57.2)	22-1/2 (57.2)	22-1/2 (57.2)
		Depth	23 (58.4)	23 (58.4)	23 (58.4)	23 (58.4)	23 (58.4)
	Chamber-in (cm)	Width	10 (25.4)	10 (25.4)	10 (25.4)	10 (25.4)	10 (25.4)
		Height	10-1/4 (26)	10-1/4 (26)	10-1/4 (26)	10-1/4 (26)	10-1/4 (26)
		Depth	9-3/4 (24.8)	9-3/4 (24.8)	9-3/4 (24.8)	9-3/4 (24.8)	9-3/4 (24.8)
Weight	LBS.(kg)	234 (106.3)	234 (106.3)	234 (106.3)	234 (106.3)	234 (106.3)	234 (106.3)
Electrical	Volts	240	208	240	208	240	208
Rating	Amps	40*/20.8#	40*/24#	40*/20.8#	40*/24#	40*/20.8#	40*/24#
	Watts	9600* 5000#	8320* 5000#	9600* 5000#	8320* 5000#	9600* 5000#	8320* 5000#
	Phase	1	1	1	1	1	1
	Temp. Range	Cont.	1700°C	1700°C	1700°C	1700°C	1700°C
Controller		Automatic	Automatic	4-Program.	4-Program.	Multi-Prog.	Multi-Prog.

Power and current required to maintain maximum temperature after stabilization.

The maximum current is determined by the limiting factor set by the current controller. In the event that 40 amperes is not available, the current controller may be set to limit the current to some smaller value at the expense of a somewhat longer heat-up time.

The variation in current is a result of molybdenum disilicide heating elements having a large decrease in resistance with increasing temperature.

NOTES: The maximum ramp rates for this furnace for heat-up are: 100°C per minute from 25°C-1000°C and 15°C per minute from 1000°C-1700°C.

Environmental Conditions

Operating: 17°C-27°C; 20% to 80% relative humidity,
 non-condensing. Installation Category II (over-voltage) in accordance with IEC 664.
 Pollution Degree 2 in accordance with IEC 664. Altitude limit: 2,000
 meters.

Storage: -25°C to 65°C; 20% to 80% relative humidity.

Declaration of Conformity



NOTE

The Type 46100 and 46200 furnaces do not come with an electrical cord because current requirements are too great to be handled by ordinary electrical cords and standard wall electrical outlets.

Declaration of Conformity

(-33 models only)

Barnstead|Thermolyne hereby declares under its sole responsibility that this product conforms with the technical requirements of the following standards:

EMC: EN 50081-1 Generic Emission Standard;

EN 50082-1 Generic Immunity Standard;

Safety: IEC 1010-1-92 Safety requirements for electrical equipment for measurement, control, and laboratory use; Part I:

General Requirements

IEC 1010-2-010 Part II: Particular requirements for laboratory equipment for the heating of materials

per the provisions of the Electromagnetic Compatibility Directive 89/336/EEC, as amended by 92/31/EEC and 93/68/EEC, and per the provisions of the Low Voltage Directive 73/23/EEC, as amended by 93/68/EEC.

The authorized representative located within the European Community is:

European Manager

Barnstead|Thermolyne

Saarbrückener Str. 248

D-38116 Braunschweig

Germany

Copies of the Declaration of Conformity are available upon request.

Unpacking



CAUTION

Be sure ambient temperature does not exceed 104°F (40°C). Ambient temperatures above 104°F (40°C) may result in damage to the controller. Allow at least six inches (15 cm) of space between the furnace on all sides and the top. This permits the heat from the furnace case to escape.



WARNING

To avoid electrical shock, this furnace must be installed by a competent, qualified electrician who insures compatibility among furnace specifications, electrical source and grounding code requirements. Ensure unit is properly grounded.



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.

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. A hearth plate is supplied with the furnace to be placed on bottom of furnace chamber.

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

Installation

Installation

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 Type 46100 or 46200 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 electricity 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. Electricity must be 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.

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 1650°C for 10-20 minutes. Then let furnace cool to ambient temperature. See Operation for your particular controller for information on setting temperature setpoints.

General Operation of Furnace

General Operation of Furnace

Observe these Warnings before operating your furnace:

WARNING

CAUTION

Remember that when the power switch is turned "ON", the furnace will begin to heat to the set point temperature that was previously set in the controller. This value will remain unchanged for up to a year without electricity being supplied to the controller.

CAUTION

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

To avoid electrical shock, this furnace must:

1. Be installed by a competent, qualified electrician who insures compatibility among furnace specifications, electrical source and grounding code requirements.
2. Always be disconnected from the electrical supply prior to maintenance and servicing.

To avoid personal injury:

1. Do not stand directly in front of the chamber without wearing a heat resistant faceshield, gloves and apron.
2. Do not operate or clean furnace without proper eye protection.
3. 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.
4. Refer servicing to qualified personnel.
5. Caution: Hot Surface. Avoid Contact.
6. To AVOID EYE DAMAGE in operating or cleaning furnace, proper eye protection must be worn.
7. To AVOID BURNS, do not stand directly in front of the chamber without wearing a heat resistant faceshield, gloves and apron.
8. To AVOID FIRE, do not place combustible materials where exposed to heat from open door.

HOT SURFACE

Caution: Hot Surface. Avoid Contact.

Power Switch

Controls power to the furnace. Switch to the "ON" position to energize the elements and the controller.

Cycle Indicator

The amber cycle light will illuminate when electricity is being supplied to the elements.

GENERAL OPERATION OF FURNACE



NOTE

When performing operations on the controller, remember that 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 set point 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

Due to the High Temperature design of the thermocouple, the controller will indicate a temperature of 70°-90°C at ambient temperature.

Circuit Breaker

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

Fans

The fans, located in the rear of the heating section and the control section, will run continuously as long as electricity 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 the controls.

Controllers

Your furnace’s 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 set point (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 set point (SP). This is referred to as the “short scroll”. Continued single step depression of scroll button will cause lower display to alternate between set point (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. On the Automatic Models, PR (program ramp rate) will appear. On the Programmable Models, 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 Control Parameters for your particular controller for a list of parameters.)

Operation of Automatic Controls

Operation of Automatic Models

(Models F46110CM, F46110CM-33, F46118CM, F46230CM, F46230CM-33, F46238CM)

Control Parameters



NOTE

Thermolyne recommends that you set the value of AL 1 either at 1710°C (3092°F) or at a value of 20 degrees above your working temperature if you desire to provide protection for your workload.



NOTE

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



NOTE

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



NOTE

The automatic 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 recommend that you tune the furnace to your specific application to obtain the best results. To provide the best temperature accuracy possible, use these features when you install your furnace and whenever you change your application or procedure.

PR = program ramp rate, the rate of heat increase or decrease in °C/minute. Pushing the up or down button will give the current setting of this ramp. Push up or down button to set.

SP2. SP2 is not configured into control and nonfunctional. Set to 20.

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).

AT = Adaptive Tune, which analyzes and inputs optimum PID values when temperature has reached set point. This function does not have a value, it is either “ON” or “OFF”. (See Furnace Operation for function of Adaptive Tune).

SAT = Self-Adaptive Tune when engaged starts controller 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).

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

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.

The next five parameters: proportional (PB), integral (+i), derivative (+d), cutback low (cbl) and cut back high (cbh) are for high accuracy control. These parameters are set during Self-Adaptive Tune. (See Tuning Your Furnace.)

OPERATION OF AUTOMATIC CONTROLS



NOTE

The self-tune feature will be inactive if you implement a ramp to setpoint. If you implement a ramp to setpoint, the adaptive tune feature will be active only after you reach your setpoint. See Program Ramp Rate for more information on ramping to setpoint.



CAUTION

Minimize operation of furnace under 800°C. Element life is reduced when operating below 800°C because the protective layer of silica glass takes longer to form.



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



NOTE

The two center push buttons are non-functional.



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.

HL = Output Power limits the average maximum percentage of electricity that is applied to the heating elements. Depress and release up or down button, if 100 is not displayed, contact Barnstead/Thermolyne.

Sbr = the power that is required to indicate an open thermocouple condition exists. Push up or down button, if 0.0 is not displayed, contact Barnstead/Thermolyne.

Tuning Your Furnace

The SAT Self and Adaptive Tuning feature starts the controller in the Self-tune mode, then automatically switches over to the Adaptive Tuning mode. Self-Tuning is a one-time function which permits the user to tune the instrument control parameters to suit new process conditions.

Adaptive tuning takes over when the self-tune is completed and continuously evaluates tuning parameters. Adaptive tuning automatically installs new values if better accuracy is possible.

To Tune Your Furnace:

1. Load your furnace with a load characteristic of those you intend to heat in it.
2. Depress scroll button until SAT is displayed. Depress the up and down buttons simultaneously to start self-tuning.

During Tuning, the A-T indicator is illuminated (upper right hand corner) and the lower display indicates the set point at which the self-tune sequence will occur. The “SP” indicator will flash for 1 minute, during which time the set point may be changed (use temperature set point that your application requires). At the end of one minute, the “SP” indicator will stop flashing, indicating that the set point can no longer be changed. The A-T indicator will start flashing and continue to flash until the self-tune is completed. After the self-tune is completed, adaptive tune takes over and the A-T indicator will remain illuminated.

OPERATION OF AUTOMATIC CONTROLS

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

Single Set Point Operation

The automatic control is used as a single set point control, which includes one ramp to set point capability. 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 it at this temperature until you turn off the front circuit breaker switch or select another temperature.

To operate the control:

1. Turn power switch to the "ON" position. The set point temperature presently set in the control will appear on the lower display.
2. To change this set point, depress the "UP" or "DOWN" push button until the desired set point value is displayed then release the button.
3. The furnace will begin to heat if the new set point temperature you have chosen is higher than the present chamber temperature.
4. The upper display indicates actual chamber temperature.



NOTE

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

OPERATION OF AUTOMATIC CONTROLS

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/minutes). 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 program is running, the short scroll will contain three parameters. SP = set point. OP = output power. Time = time remaining in program ramp to reach set point 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.

Program Ramp Reset

A running or finished program can be reset by depressing the run/hold button.

After depressing the run/hold button, the parts of the display associated with programming will be extinguished and the controller will operate as a single set point control as described before.

Operation of Programmable Models



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



MODELS F46120CM, F46120CM-33, F46120CM-33-75, F46120CM-75, F46128CM, F46128CM-75, F46240CM, F46240CM-33, F46240CM-33-75, F46240CM-75, F46248CM, F46248CM-75

NOTE

These models have two additional parameters at the beginning of the parameter list;
Pnr is the program number selected. By pushing the up or down button, you can select a program from 1 to 15. On the F46120CM, F46120CM-33, F46128CM, F46240CM, F46240CM-33 and F46248CM models, this is selected between 1-4.
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. The remaining parameters will follow in the sequence listed.

Operation of Programmable Models

(F46120CM, F46120CM-33, F46120CM-33-75, F46120CM-75, F46128CM, F46128CM-75, F46240CM, F46240CM-33, F46240CM-33-75, F46240CM-75, F46248CM, F46248-75)

Control Parameters

PR1 = program ramp rate is the rate of heat increase or decrease in °C/minute. Pushing the up or down button to set.

PL1 = program level is the temperature which the furnace needs to attain. Push up or down button to set.

PD1 = program dwell “1” is amount of time, in minutes, to hold the PL1 program temperature level entered. Push up or down button to set.

The remaining Program Ramp Rates PR2 - PR8, Program Levels PL2 - PL8, and Program Dwells PD2 - PD8 follow in the same manner as PR1, PL1 and PD1. (After PD8).

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 is the number of times a program will be repeated. Push up or down button to set.

SP1 = setpoint one which indicates current setpoint. Push up or down button to set.

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

OPERATION OF PROGRAMMABLE MODELS



NOTE

Barnstead|Thermolyne recommends that you set the value of AL1 either at maximum operating temperature of the furnace or at a value of 20 degrees above your working temperature if you desire to provide protection for your workload.



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.

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.)

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).

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).

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

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.

The next five parameters, proportional (PB), integral (+i), derivative (+d), cutback low (cbl) and cutback high (cbh), are for high accuracy control. These values cannot be changed by the user; the controller automatically installs optimum values when in Self and Adaptive Tuning.(See Tuning Your Furnace for more information.)

HL = Output Power limits the average maximum percentage of electricity that is applied to the heating elements. Depress and release up or down button. If "100" is not displayed, contact Barnstead/Thermolyne.

Sbr = the percent of power that is supplied to the control output terminals if an open thermocouple condition exists.

Push up or down button. This parameter cannot be changed, if 0.0 is not displayed, contact Barnstead/Thermolyne.

OPERATION OF PROGRAMMABLE MODELS



NOTE

The automatic 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 recommend that you tune the furnace to your specific application to obtain the best results. To provide the best temperature accuracy possible, use these features when you install your furnace and whenever you change your application or procedure.



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.

Tuning Your Furnace

The SAT Self and Adaptive Tuning feature starts the controller in the Self Tune mode, then automatically switches over to the Adaptive Tuning mode. Self Tuning is a one-time function which permits the user to tune the instrument control parameters to suit new process conditions.

Adaptive tuning takes over when the self tune is completed and continuously evaluates the tuned parameters. Adaptive tuning automatically install new values if better accuracy is possible.

To Tune Your Furnace:

1. Load your furnace with a load characteristic of those you intend to heat in it.
2. Depress scroll button until SAT is displayed. Depress the up and down buttons simultaneously to start self-tuning.

During Tuning, the A-T indicator is illuminated (upper right hand corner) and the lower display indicates the set point at which the self-tune sequence will occur. The "SP" indicator will flash for 1 minute, during which time the set point may be changed. (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 one minute, the "SP" indicator will stop flashing, indicating that the set point can no longer be changed. The A-T indicator will start flashing and continue to flash until the self-tune is completed. After the self-tune is completed, adaptive tune takes over and the A-T indicator will remain illuminated.

4. To stop tuning function, scroll until SAT is displayed and simultaneously push up and down buttons.
5. Operate your controller normally as described in Operating the Controller.

OPERATION OF PROGRAMMABLE MODELS



CAUTION

Minimize operation of furnace under 800°C. Element life is reduced when operating below 800°C because the protective layer of silica glass takes longer to form.



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 front circuit breaker 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 programmed. This value will remain unchanged for up to a year without electricity being applied to the control.



NOTE

The two center push buttons are non-functional.

Operating the Controller

The programmable control can be used as a single setpoint control or as a programmable control.

Single Set Point Operation

To use as a single set point control simply push up or down buttons to choose a setpoint temperature.

To operate the control as a single set point control:

1. Turn front circuit breaker switch to the "ON" position. The setpoint temperature presently set in the control will appear on the lower display.
2. To change this set point, depress the "UP" or "DOWN" push button until the desired setpoint value is displayed, then release the button.
3. 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.
4. The upper display indicates actual chamber temperature.

Programming Controller

To run a program, first determine your ramp rate, dwell times, program levels. It is helpful to graph your program for ease of loading program into controller. Observe maximum ramp rates (heat up time) on the general specifications page before programming 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 control automatically calculates the time that is required to attain the program level (PL) based on

OPERATION OF PROGRAMMABLE MODELS

desired ramp rate (PR). Dwell segments (PD) can be attached to each program level (PL) to hold that temperature for a specified number of minutes.

Multi-Programmable Controller Program Entry

(Models F46120CM, F46120CM-33, F46120CM-33-75, F46120CM-75, F46128CM, F46128CM-75, F46240CM, F46240CM-33, F46240CM-33-75, **F46240CM-75, F46248CM, F46248CM-75**)

The multi-programmable controller in the F46120CM-75, F46128CM-75, F46240CM-75 and F46248CM-75 units provides up to 15 separate programs of 8 ramps and 8 dwells each. The F46120CM, 46128CM, F46240CM and F46248CM models have four separate programs. These controllers allow 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. On the F46120CM, F46120CM-33, F46128CM, F46240CM, F46240CM-33 and F46248CM models, this is selected between 1-4.

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.

OPERATION OF PROGRAMMABLE MODELS



NOTE

Be sure to select the program number before pressing "Run/Hold." (Models F46120CM, F46120CM-33, F46120CM-33-75, F46120CM-75, F46128CM, F46128CM-75, F46240CM, F46240CM-33, F46240CM-33-75, F46240CM-75, F46248CM and F46248CM-75)

Program Entry (all models)

Set Ramp Rates

1. With the controller 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.

OPERATION OF PROGRAMMABLE MODELS

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.



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.

Implementing Programs

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.

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

IMPLEMENTING PROGRAMS

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.

Furnace Loading

Furnace Loading:

Be sure to use 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 possibly burn out. Poor temperature control can also result from improper loading.

Because of the possibility of erosion of the insulation on the floor of the furnace chamber, a separate hearth plate should be used when possible.

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 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 LOADING

Furnace Atmospheres

This furnace is designed to be used to 1700°C in pure air only. It may be used with nitrogen, argon, or helium atmospheres to 1600°C. Reducing atmospheres are not recommended.

The heating elements in this furnace are attacked by fluorine, chlorine, sodium and potassium compounds and also by molten metals. This furnace may be used for metal melting if care is taken not to splash molten metal on the heating elements.

Preventive Maintenance

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 pre-existing 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.



WARNING

To avoid electrical shock, this furnace must always be disconnected from the electrical supply prior to maintenance and servicing.

Do not clean furnace without proper eye protection.

Refer servicing to qualified personnel.

PREVENTIVE MAINTENANCE

General Cleaning Instructions

Wipe exterior surfaces with lightly dampened cloth containing mild soap solution.

A few simple procedures will help insure 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 reaction is detrimental to operation.
2. Clean exterior surfaces with lightly dampened cloth containing mild soap solution.
3. Occasionally check the electrical connections in the control section. Repeated heating and cooling can cause terminals to loosen.
4. 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.
5. Check the cooling fans at regular intervals to be sure they are functioning properly and are not obstructed.

Problem Solving 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 or write Barnstead/Thermolyne at (1-800-553-0039).

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Inaccurate temperatures.	Contaminated thermocouple.	Replace thermocouple.
Repeated element burn-out.	Continuous operation below 800°C. Heating element contamination.	Do not continuously operate below 800°C. Contact Barnstead/Thermolyne
"OR" displayed.	Open thermocouple.	Replace thermocouple.
Slow heat-up.	Operating 240V furnace on 208V supply. Furnace chamber overloaded.	Increase voltage to proper level. Lighten load.
Building or laboratory main fuses blow or circuit breakers trip.	Fuses or breakers not properly rated to furnace electrical requirements.	Install service line of sufficient size to match furnace electrical requirements. Contact Barnstead/Thermolyne for assistance.
CH. C, CH.. H, Err-r displayed.		Contact Barnstead/Thermolyne

Maintenance and Servicing

WARNING

To avoid electrical shock, this furnace must always be disconnected from the electrical supply prior to maintenance and servicing. Refer servicing to qualified personnel.



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 pre-existing 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.



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.

MAINTENANCE AND SERVICING

To avoid premature burnout of a replacement heating element, be sure that the insulation tail supplied with the replacement element is inserted between the two legs of the element as shown in the drawing. Also be sure that the heating element projects sufficiently into the chamber. Insert element until welded portion (where large diameter meets small diameter) projects approximately 1/4" into inside of furnace chamber.

To replace a heating element: (refer to Fig. 1A).

- a. Remove top cover from heating chamber side of furnace.
- b. Remove the clips holding the connector cable (4) 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.
- d. Remove the element ceramic holder, noting its exact position on the heating element.
- e. Fasten the element ceramic holder on the new element in exactly the same position it was on the old element.
- 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.
- 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 the 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 tail. Complete insertion of

MAINTENANCE AND SERVICING

the heating element until the element ceramic holder rests on top the main insulation. 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). Carefully wrap the connector cable around the element ends; fasten with clips. Replace top cover.

To replace thermocouple:

- a. Remove top cover from the heating chamber 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 displays upscale.
- i. Replace cover.

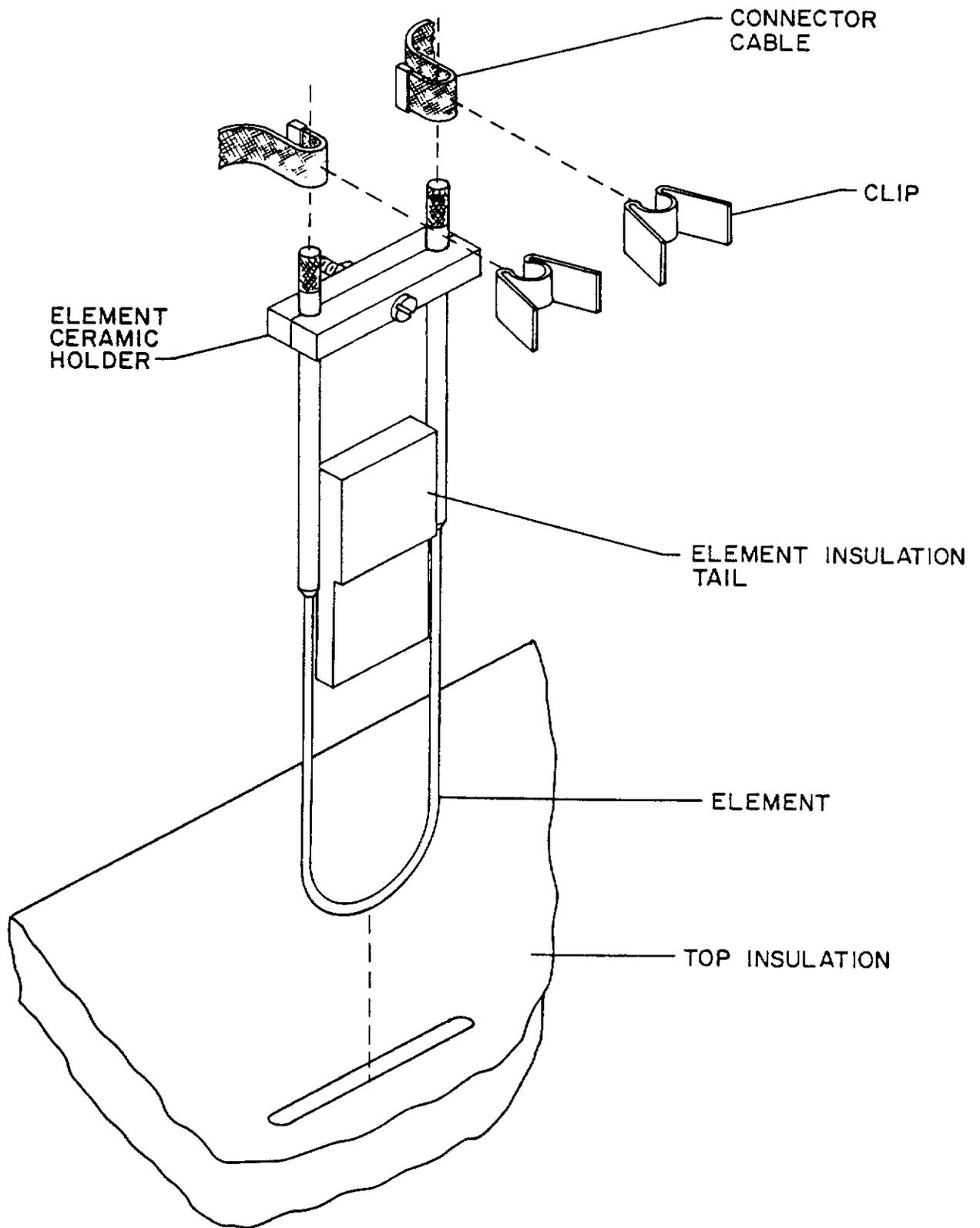


Figure 1A Element Replacement

Wiring Diagram

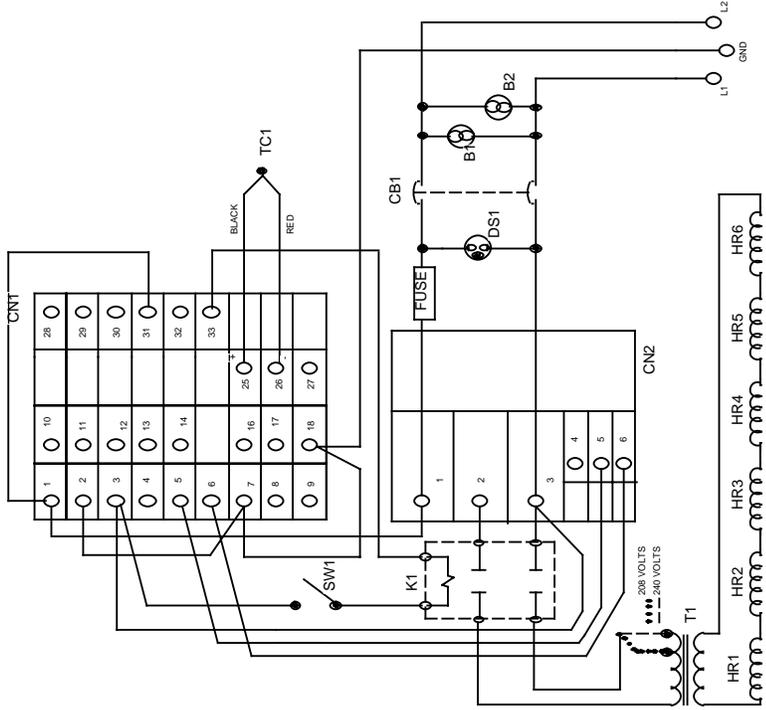
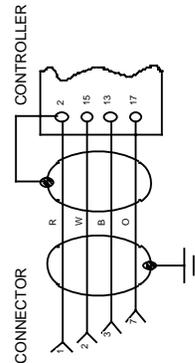


DIAGRAM COMPONENT LIST

PART NO.	DESCRIPTION
CN1	CONTROLLER, TEMPERATURE
CN2	CONTROLLER, CURRENT
CB1	CIRCUIT BREAKER
B1	FAN
B2	FAN
K1	CONTACTOR, MECHANICAL
T1	TRANSFORMER
TC1	THERMOCOUPLE
DS1	INDICATOR LAMP
HR1 to HR6	HEATING ELEMENT
SW1	DOOR SWITCH

INTERNAL COMMUNICATION CABLE WIRING



NOTES:
 FUSE AND FUSE HOLDER ARE
 SUPPLIED WITH CURRENT CONTROLLER.

Wiring Diagram
 F46110CM, F46118CM, F46120CM, F46128CM, F46120CM-75, F46128CM-75

WIRING DIAGRAM

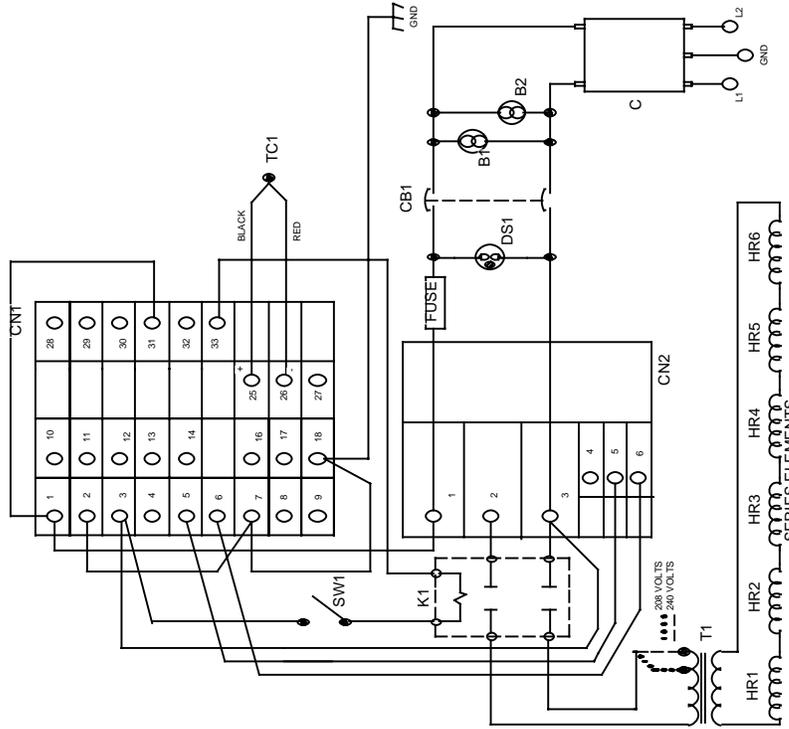
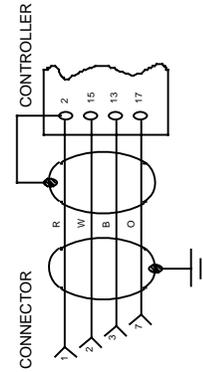


DIAGRAM COMPONENT LIST

PART NO.	DESCRIPTION
C	EMI LINE FILTER
CN1	CONTROLLER, TEMPERATURE
CN2	CONTROLLER, CURRENT
CB1	CIRCUIT BREAKER
B1	FAN
B2	FAN
K1	CONTACTOR, MECHANICAL
T1	TRANSFORMER
TC1	THERMOCOUPLE
DS1	INDICATOR LAMP
HR1 to HR6	HEATING ELEMENT
SW1	DOOR SWITCH

NOTES:
 FUSE AND FUSE HOLDER ARE SUPPLIED WITH CURRENT CONTROLLER.



WIRING DIAGRAM

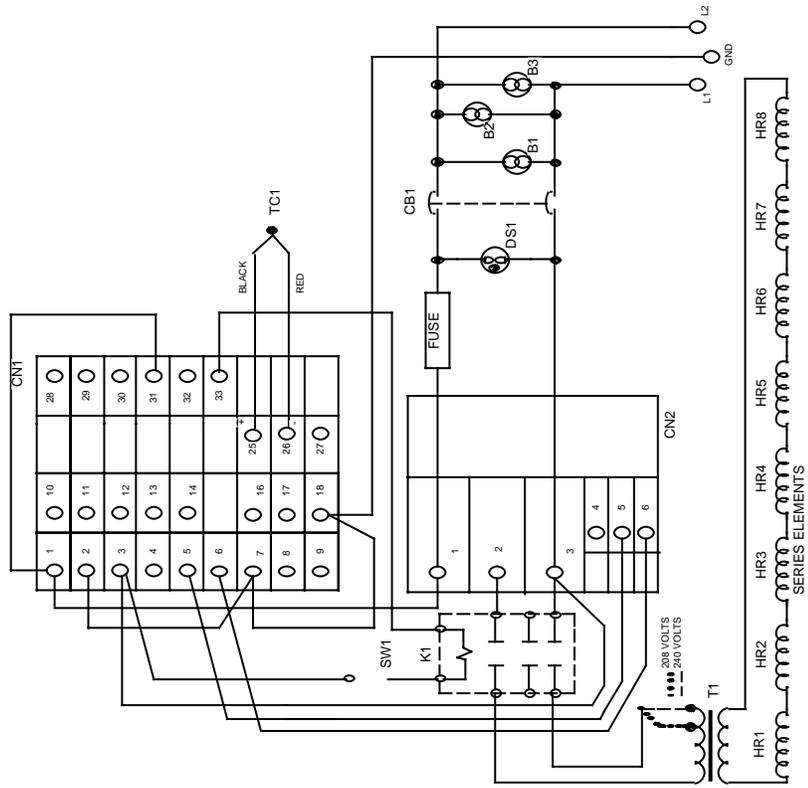
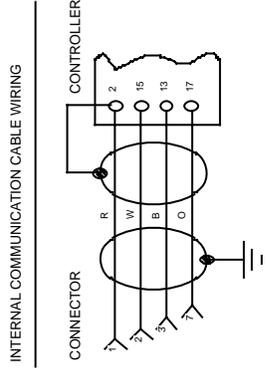


DIAGRAM COMPONENT LIST

PART NO.	DESCRIPTION
CN1	CONTROLLER, TEMPERATURE
CN2	CONTROLLER, CURRENT
CB1	CIRCUIT BREAKER
B1	FAN
B2 & 3	FAN
K1	CONTACTOR, MECHANICAL
T1	TRANSFORMER
TC1	THERMOCOUPLE
DS1	INDICATOR LAMP
HR1 to HR8	HEATING ELEMENT
SW1	DOOR SWITCH

NOTES:
 FUSE AND FUSE HOLDER ARE
 SUPPLIED WITH CURRENT CONTROLLER.



Wiring Diagram Wiring Diagram
 F46230CM, F46238CM, F46240CM, F46248CM, F46240CM-75, F46248CM-75

WIRING DIAGRAM

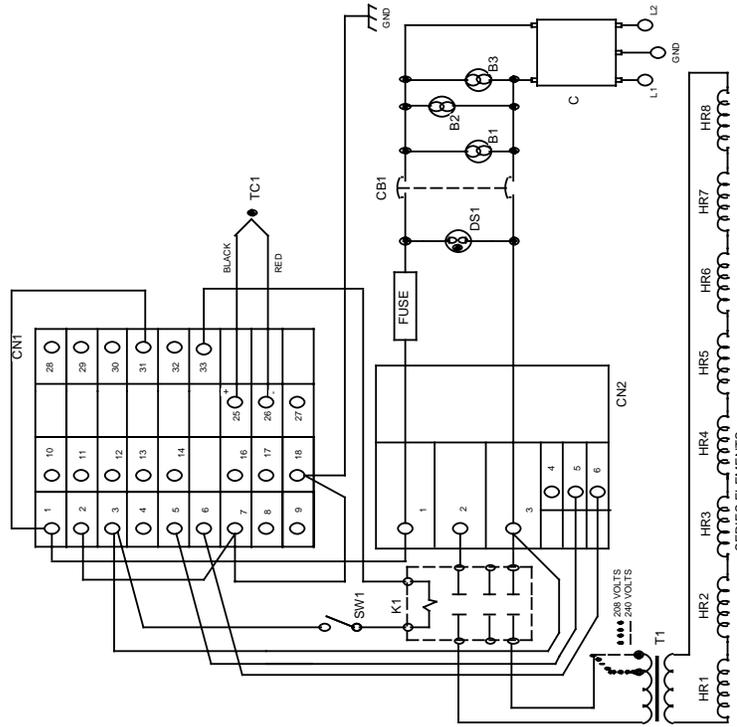
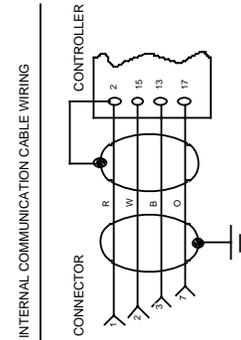


DIAGRAM COMPONENT LIST

PART NO.	DESCRIPTION
C	EMI LINE FILTER CONTROLLER, TEMPERATURE CONTROLLER, CURRENT CIRCUIT BREAKER
CN1	FAN
CN2	FAN
CB1	CONTACTOR, MECHANICAL
B1	TRANSFORMER
B2 & 3	THERMOCOUPLE
K1	INDICATOR LAMP
T1	HEATING ELEMENT
TC1	DOOR SWITCH
DS1	
HR1 to HR8	
SW1	

NOTES:
 FUSE AND FUSE HOLDER ARE
 SUPPLIED WITH CURRENT CONTROLLER.



Replacement Parts List

Description (Chamber)	SERIES 1077 Small (Models) (6"X6"X6")	SERIES 1078 Large (Models) (10"X10"X10")
Circuit breaker switch	SWX54	SWX54
Connector cable 30" long	CE557X1 (2 req'd)	CE557X1 (1 req'd)
Connector cable 36" long		CE558X1 (1 req'd)
Current controller	CNX125	CNX125
Elements	EL461X1 (6 req'd)	EL462X1 (8 req'd)
Element ceramic holder	HRX2 (6 req'd)	HRX2 (8 req'd)
Element connector clips	CEX135 (12 req'd)	CEX135 (16 req'd)
Element connector cable 4" lg	CE461X1 (4 req'd)	CE461X1 (6 req'd)
Element connector cable 10" lg	CE461X3	
Element connector cable 14" lg		CE462X1
Element connector cable 19" lg		CE462X2
Element Insulation tail	JN461X8 (6 req'd)	JN461X8 (8 req'd)
Fans	FAX7 (2 req'd)	FAX7 (3 req'd)
Fuse, Thyristor, Fast Blow, 250V, 45 Amp	FZX42	FZX42
Fuse Holder	FZX62	FZX62
Hearth Plate	PH461X1	PH462X1
Injection Port w/plug	JC633x1 & JC633X2 (plug)	JC633x1 & JC633X2 (plug)
Insulation - door	JN461X3	JN462X4
Insulation Kit - chamber	JN461X9A	JN462X7A
Multi-programmable control (8 ramp & 8 dwell, 15 programs, -75 models)	CN71X46 (F46120CM-75, F46120CM-33-75, F46128CM-75)	CN71X46 (F46240CM-75, F46240CM-33-75, F46248CM-75)
Relay	RYX62	RYX62
Temperature Control Automatic	CN71X59 (F46110CM, F46110CM-33, F46118CM)	CN71X59 (F46230CM, F46230CM-33, F46238CM)
Temperature Control Programmable (8 ramp and 8 dwell 4 program)	CN71X59 (F46120CM, F46120CM-33, F46128CM)	CN71X59 (F46240CM, F46240CM-33, F46248CM)
Thermocouple	TCX5	TCX5
Thermocouple terminal block	TRX137	TRX137
Transformer	TNX79	TNX80

NOTE: Service on control units - contact Barnstead/Thermolyne Corp (1-800-553-0039).

Ordering Procedures



WARNING

Replace fuses with the same type and rating.

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.

Material Safety Data Sheet

Thermal Ceramics Material Safety Data Sheet

Date Revised: 7/2/91

PRODUCT IDENTIFICATION

Trade Name(s):	CERAFIBER	CAS #:	65997-17-3
Generic Name:	REFRACTORY CERAMIC FIBER INSULATION	Formula:	MIXTURE
Chemical Name:	ALUMINA SILICA	Telephone:	(404) 796-4200
Manufacturer:	Thermal Ceramics		
Address:	P.O. BOX 923, 2102 Old Savannah Road		
City:	Augusta	State:	Georgia
		Zip:	30903

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- NUISANCE RESPIRABLE - OSHA	
10mg/M- NUISANCE TOTAL - ACGIH			
CRYSTALLINE SILICA (CRISTOBALITE) WILL FORM "AFTER SERVICE" AT TEMPERATURES >1000°C.			
14464-46-1	>20		0.05 mg/M- OSHA Respirable Dust

PHYSICAL DATA

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

FIRE AND EXPLOSION DATA

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

MATERIAL SAFETY DATA SHEET

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 (WORK-PLACE 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.

MATERIAL SAFETY DATA SHEET

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.

† Copyright© 1980, National Fire Protection Assoc., Quincy, MA 02269. This reprinted material is not the complete and official position of the NFPA on the referenced subject, which is represented only by the standard in its entirety. MSSM/226-21:26/00030

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

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**. 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.

Special Two Warranty on Control Module

There are no other warranties, expressed or implied, made in connection with the sales of this product. **Barnstead|Thermolyne** expressly disclaims any implied warranty of merchantability or fitness for specific use.

Barnstead | Thermolyne a subsidiary of
SYBRON
INTERNATIONAL



2555 Kerper Blvd.
P.O. Box 797
Dubuque, IA 52004-0797 USA
PHONE: 319-556-2241 • 800-553-0039
FAX: 319-556-0695
Web Address: <http://www.barnsteadthermolyne.com>