Installation and Operation Manual

Thermo Scientific
Thermolyne Furnace:
Premium Large Muffle/
Atmosphere Controlled Ashing

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S C I E N T I F I C

Type F6000 Furnace

OPERATION MANUAL
AND PARTS LIST
Series 1249

Single Setpoint Models	F6010, F6010CN, F6018
Single Setpoint Models with OTP	F6020C, F6020C-33, F6020C-33-60, F6020C-60, F6028C, F6028C-60
8 Segment Programmable Models with OTP	F6020C-33-60-80, F6020C-33-80, F6020C-60-80, F6020C-80, F6028C-60-80, F6028C-80
4 X 16 Segment Programmable Models with OTP & RS232 Communication	F6030CM, F6030CM-33, F6030CM-33-60, F6030CM-60, F6038CM, F6038CM-60

(-60 Models) - Ashing furnace

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.

Safety Information

Alert Signals

Warning
Warnings alert you to a possibility of personal injury.

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

Note
Notes alert you to pertinent facts and conditions.

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

Your Thermo Scientific Thermolyne Type F6000 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 signals throughout the manual.

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

Warnings

To avoid electrical shock, this furnace must:
1. Use a properly grounded electrical outlet of correct voltage and current handling capacity.

2. Be disconnected from the power supply prior to maintenance and servicing.

3. Have the door switch operating properly.

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. Caution: Hot Surface - Avoid Contact. To avoid burns, do not touch the exterior or interior surfaces of this furnace during use or for a period of time after use.

3. Always wear safety glasses or a safety shield and high temperature gloves when loading or unloading the furnace. Long sleeved, fire retardant clothing and a fire retardant apron is also recommended.

4. Refer servicing to qualified personnel.

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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 1-800-438-4851.
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Introduction

Intended Use

The Type F6000 furnaces are general purpose laboratory and heat treating furnaces. For optimum element life, we recommend observing these temperature ranges: from 100°C (212°F) to 1093°C (2000°F) continuous use or from 1093°C (2000°F) to 1200C (2192°F) for intermittent use. (-60) Ashing models continuous temperature range is 100°C (212°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.

All furnaces consist of: 1) a vented heating chamber; 2) a temperature controller; and 3) a door safety switch for operator safety.

General Usage

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

Principles of Operation

The furnace chamber is heated by electric resistance elements and is insulated with ceramic fiber insulation. The controller 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 temperature is controlled by one of three types of controllers. The (-60) models operate the same as the other models except at a lower temperature and can inject gas into the chamber.

General Specifications

For F6000 Furnace

Model #

			F6020C	F6028C	F6010	F6018
			F6020C-33	F6028C-60	F6010CN	
			F6020C-33-60	F6028C-60-80		
			F6020C-33-60-80	F6028C-80		
			F6020C-33-80	F6038CM		
			F6020C-60	F6038CM-60		
			F6020C-60-80			
			F6020C-80			
			F6030CM			
			F6030CM-33-60			
			F6030CM-33-60			
			F6030CM-60			

Dimensions	**Overall**	**Width**	19.25(48.9)	19.25(48.9)	19.25(48.9)	19.25(48.9)
in. (cm)		**Height**	21 (53.3)	21 (53.3)	21 (53.3)	21 (53.3)
		Depth	20 (50.8)	20 (50.8)	20 (50.8)	20 (50.8)
	Chamber	**Width**	12.75 (32.4)	12.75 (32.4)	12.75 (32.4)	12.75 (32.4)
		Height	6.75 (17.1)	6.75 (17.1)	6.75 (17.1)	6.75 (17.1)
		Depth	10 (25.4)	10 (25.4)	10 (25.4)	10 (25.4)
Weight	**LBS. 9kg)**		96 (43.5)	96 (43.5)	96 (43.5)	96 (43.5)
Electrical	**Volts**		220-240	208	220-240	208
Ratings	**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)**		212-2192°F (100-1200°C) *212-1787°F (*100-975°C)	212-2192°F (100-1200°C) *212-1787°F (*100-975°C)	212-2192°F (100-1200°C)	212-2192°F (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

Environmental Conditions

Operating: 17°C to 27°C; 20% to 80% relative humidity, non-condensing. Installation Category II (overvoltage) 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 85% relative humidity

Declaration of Conformity

We hereby declare under our sole responsibility that this product conforms with the technical requirements of the following standards (-33 Models Only):

EMC: EN 61000-3-2   Limits for Harmonic Current Emissions
       EN 61000-3-3   Limits for Voltage Fluctuations and Flicker
       EN 61326-1   Electrical Equipment for Measurement, Control and Laboratory Use; Part I: General Requirements

Safety: EN 61010-1   Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use; Part I: General Requirements
       EN 61010-2-010 Part II: Particular Requirements for Laboratory Equipment for the Heating of Materials

per the provisions of the Electromagnetic Compatibility Directive 2006/95/EC,
and per the provisions of the Low Voltage Directive 2004/108/EC.

The authorized representative located within the European Community is:

Thermo Fisher Scientific
419 Sutton Road
Southend On Sea
Essex SS2 5PH
United Kingdom

Copies of the Declaration of Conformity are available upon request.

Unpacking

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

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 and F6018 are supplied with cord and plug).

1. Visually check for any physical damage to the shipping container.

2. Inspect the equipment surfaces that are adjacent to any damaged area.

3. Open the furnace door and remove the packing material from inside the furnace chamber.

4. Vacuum the chamber prior to use to remove the insulation dust due to shipment.

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

Installation

Caution
Be sure ambient temperature does not exceed 104°F (40°C). Ambients above this level may result in damage to the controller.

Allow at least six inches of space between the furnace and any vertical surface. This permits the heat from furnace case to escape so as not to create a possible fire hazard.

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

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.

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.

Hot Surface
"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.

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

Electrical Connections
1. The electrical specifications are located on the specification plate on the back of the furnace. Consult customer service 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.

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.

NOTE: Please observe the alert signals on the lefthand side of this page before operating your furnace.

Models F6010, F6010-33, F6018

Operation, All Models

Warning
To avoid personal injury do not use in the presence of flammable or combustible chemicals; fire or explosion may result. This device contains components which may ignite such materials.

Hot Surface
Caution: 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.

Warning
Always wear safety glasses or a safety shield and high temperature gloves when loading or unloading the furnace. Long sleeved, fire retardant clothing and a fire retardant apron is also recommended.

Warning
To avoid electrical shock, the door safety switch must be operating properly.

Power Switch
Both the ON/OFF power switch and the digital display will illuminate when power is switched ON. The furnace will begin to heat to its controller's current setpoint. (See the instructions for your type of controller for information on checking and setting the setpoint.)
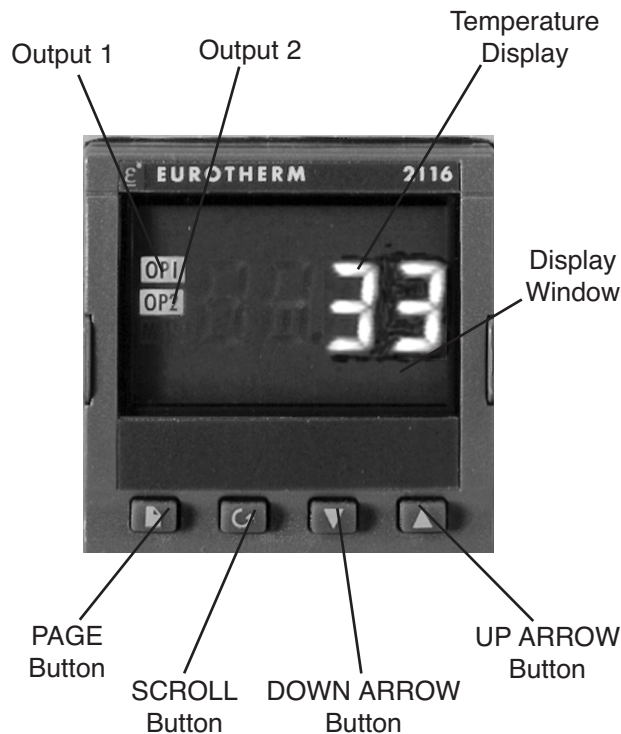
Cycle Light
The amber cycle light will illuminate whenever the power is being applied to the heating elements. The cycle light will turn on and off as the furnace reaches the setpoint.

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 switch off when the door is opened. If this condition is not true, consult the Troubleshooting section before proceeding. This check must be done when the furnace is heating and the cycle light is illuminated.

Single Setpoint Models &
Single Setpoint Models w/OTP

Output 1   Output 2   Temperature Display

OP1
OP2

Display Window

PAGE Button   UP ARROW Button

SCROLL Button   DOWN ARROW Button

Single Setpoint Models

Note
If at any time you want to return to the HOME DISPLAY, simultaneously press the PAGE and SCROLL buttons.

The **single setpoint model** furnace controller is a single setpoint controller which provides a single digital display to indicate the current chamber temperature or setpoint temperature. This temperature controller features sensor break protection and self-tuning capability.

The **single setpoint model w/ OTP** furnace controller is a single setpoint controller which provides a single digital display to indicate the current chamber temperature or setpoint temperature. This temperature controller features sensor break protection, self-tuning capability and over temperature protection (OTP) with an additional OTP relay device.

Basic Operation
When the controller is turned ON it will perform a short self-test and then display the measured value (process value) in the HOME DISPLAY.

Buttons and Indicators
OP1 (Output 1): Illuminates when the logic output is ON.

OP2 (Output 2): Illuminates when the relay output is ON (will go out during an alarm situation).

PAGE button: Allows you to select a new list of parameters.

SCROLL button: Allows you to select a parameter within a list of parameters.

DOWN button: Allows you to decrease a value.

UP button: Allows you to increase a value.

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To View or Change the Setpoint

To view the setpoint, press and release the UP or DOWN buttons. If you want to change the setpoint, continue pressing until the desired setpoint value is displayed and then release the button. A few seconds after the button is released, the controller will accept the new value and revert to the HOME DISPLAY.

To View the Display Units

From the HOME DISPLAY press the SCROLL button. The display will show the temperature units in °C/F/K and then return to the HOME DISPLAY. (Call Customer Service if you require a different temperature unit.)

To View the % Output Power

From the HOME DISPLAY press the SCROLL button twice. Press and release the UP or DOWN button to view the % output power. This value is a read-only value and cannot be changed.

Controller Parameters

Home display
°C: Temperature units in Celsius. Temperature units can not be changed without entering the configuration. Contact Customer Service if a different temperature unit is required.

OP: % output power demand.

IdHi: Deviation high alarm.

AI List
IdHi: Deviation high alarm.

Atun List
tunE: One-shot autotune enable.

Pid List
Pb: Proportional band (in display units).

ti: Integral time in seconds.

td: Derivative time in seconds.

ACCS List Code: Access code (Code needed to enter or change the other configuration parameters which are not normally accessible.) Not accessible.

Alarms
The controller will flash an alarm message in the home display if an alarm condition is detected.

2FSH: Measured value full scale high alarm.

IdHi: Measured value deviation high alarm.

S.br: Sensor break: check that sensor is connected correctly.

L.br: Loop break: check that the heating circuits are working properly.

Ld.F: Heater Circuit fault: indication of either an open or short solid sate relay, a blown fuse, missing supply or open circuit heater.

Note
The following alarm messages are factory default settings and may vary if you have changed the configuration of your controller:

IDHi: = 50°C
2FSH = 1225°C (All models except -60)
2FSH = 1000°C (-60 models)

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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 blink "S.br" and the power to the heating element will be shut OFF (Cycle light will extinguish).

Over-Temperature Protection (OTP)

The OTP will be in effect during any alarm condition when the temperature of the furnace has deviated beyond the limit. The "Deviation High" alarm is the only alarm value which can be changed. To change it, press the SCROLL button until "IdHi" appears on the display. Press the UP or DOWN button to select the OTP value you desire. We recommend a value of 20° above your working temperature to provide protection for your workload.

In addition to over-temperature protection, units containing a single setpoint controller w/OTP feature a mechanical OTP relay device which disconnects power from the elements in an alarm condition (only in furnaces with OTP relay). See models listed on front page.

Tuning

This controller incorporates a self-tuning feature which determines the optimum control parameters for the best temperature accuracy with your load and setpoint. Use this feature the first time you use your furnace and each time you change either your setpoint or the type of load you are

heating. We recommend you use this feature to provide the best temperature accuracy the controller can attain. To use the tuning feature:

1. Adjust the setpoint to your desired value.

2. Press the PAGE button until display reads, "Atun."

3. Press the SCROLL button. Display will read, "tunE."

4. Press the UP or DOWN button to select, "on."

5. Simultaneously press the PAGE and SCROLL buttons to return to the HOME DISPLAY. The display will alternately flash between "tunE" and the HOME DISPLAY while tuning is in progress.

6. The controller will then turn the heating on and off to induce an oscillation. When the measured value reaches the required setpoint the first cycle will end.

7. Tuning will be complete after two oscillation cycles and then the tuner will turn itself off.

8. Normal control function will resume after the controller calculates tuning parameters.

Note
Furnace must be at ambient temperature before starting a tune.

Note
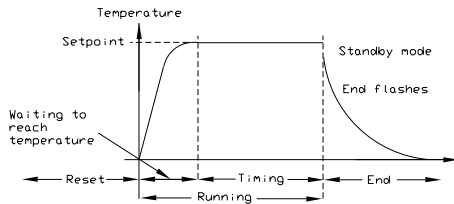"Stat" and "Sp.rr" in Sp list must be set to OFF or "tunE" will not initiate.

Note
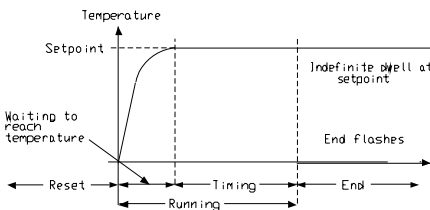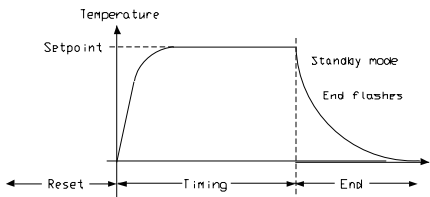Tune has completed when "tunE" stops flashing on display.
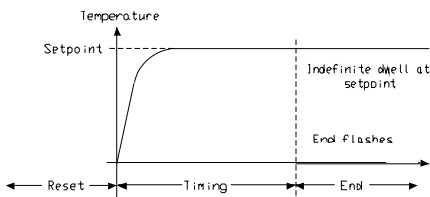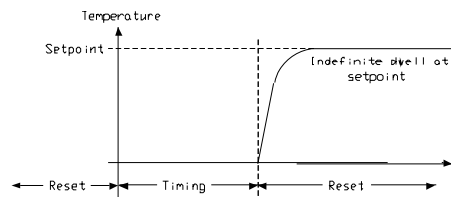
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Single Ramp & Dwell

Mode 1 (Opt. 1)

Mode 2 (Opt. 2)

Mode 3 (Opt. 3)

Mode 4 (Opt. 4)

Mode 5 (Opt. 5)

Functions
This type of controller has single ramp and dwell programming capabilities. The Ramp and Dwell can be configured to five different modes.

1. Mode 1 (Opt. 1) is a Ramp (if needed) to the Setpoint temperature, a Dwell, and then a cool down.

2. Mode 2 (Opt. 2) is the same as mode 1, except the controller continues to heat at the Setpoint after the Dwell has completed. (This mode does not cool down.)

3. Mode 3 (Opt. 3) is the same as mode 1, except the Dwell time includes the Ramp (if needed).

4. Mode 4 (Opt. 4) is the same as mode 2, except the Dwell time includes the Ramp (if needed).

5. Mode 5 (Opt. 5) is a Dwell (delay time) before the controller Ramps (if needed) to the Setpoint temperature.

Program Overview
*   A program mode can be set by changing the "tm.OP" variable to "Opt. 1, Opt. 2, Opt. 3, Opt. 4, or Opt. 5.

*   A Ramp rate may be set by changing the "SPrr" variable to a value. The Ramp rate units are in degrees per minute.

*   The Dwell time can be set by changing

the "dwEll" variable to the desired value. Dwell time units are in minutes.

•   The program Status can be set by changing the "StAt" variable to "run" or "oFF." This variable will start or stop the program.

Program Setup

Note
The program must be stopped and the controller must be displaying the actual temperature before beginning the Setup.

1. Press the PAGE button until the "SP" is displayed.

2. Press the SCROLL button once, "SPrr" (Ramp Rate) will be displayed, set the desired Ramp rate with the UP or DOWN buttons, if the ramp to setpoint feature is needed. If the Ramp rate is not needed, then set to "OFF" with the UP or DOWN buttons.

3. Press the SCROLL button once, "tm.OP" (Ramp & Dwell mode) will be displayed, select the desired mode with the UP or DOWN buttons. (Opt. 1, Opt. 2, Opt. 3, Opt. 4, Opt. 5)

4. Press the SCROLL button once, "dwEll" will be displayed, set the desired Dwell time with the UP or DOWN buttons. (Dwell in minutes.)

5. Press the PAGE button until the Actual temperature is displayed.

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Running the Program

1. Press the SCROLL button until "StAt" is displayed, set to "run" with the UP or DOWN buttons.

2. Press the PAGE button to display Actual temperature.

Stopping the Program

Press the SCROLL button until "StAt" is displayed, set to "oFF" with the UP or DOWN buttons.

Clearing the Flashing End

Press the PAGE and SCROLL buttons at the same time.

Verifying a Running Program

Press the SCROLL button until "StAt" is displayed. The display will show "run" if the program is running, or "oFF" if it is not running. Press the PAGE button to display Actual temperature.

8 Segment & 4x16 Segment Programmable Models w/OTP

Note
The controller will return to the HOME DISPLAY if left idle for more than a few seconds.

Note
Once the desired parameter has been selected, depressing either the UP or DOWN button will change the parameter value. In all cases, the value shown on the display is the current working value of that parameter.

AUTO/MAN Button
Output 1
Display Window

EUROTHERM 2416

OP1

Upper Display

Lower Display

RUN/HOLD Button

UP ARROW Button

PAGE Button
SCROLL Button
DOWN ARROW Button

The **8 segment programmable** controller consists of a microprocessor based three-mode PID (Proportional, Integral, Derivative) programmable temperature controller with over-temperature protection and appropriate output switching devices to control the furnace. The digital readout continuously displays chamber (upper display) and setpoint (lower display) temperatures unless the SCROLL or PAGE button is depressed. The programmable controller can be used as a single setpoint controller or as a programmable controller. The 8 segment digital model enables eight segments of programming.

The **4x16 segment programmable** controller consists of a microprocessor based three-mode PID (Proportional, Integral, Derivative) programmable temperature controller with over-temperature protection and appropriate output switching devices to control the furnace. The digital readout continuously displays chamber (upper display) and setpoint (lower display) temperatures unless the SCROLL or PAGE button is depressed. The programmable controller can be used as a single setpoint controller or as a programmable controller. The 4 program controller has four 16 segment programs.
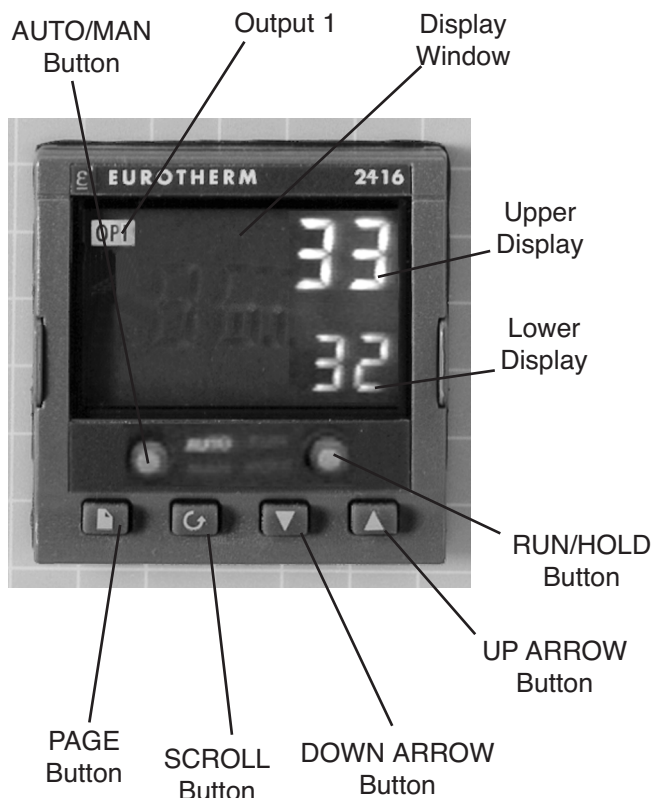
Basic Operation
When the controller is turned ON, it will perform a short self-test and then change to the HOME DISPLAY. The HOME DISPLAY shows the measured temperature (process value) in the upper display and the desired value (setpoint) in the lower display.

To Change the Setpoint
If you want to change the setpoint, press the UP or DOWN button until the desired setpoint value is displayed in the lower display and then release the button.

To View Display Units
From the HOME DISPLAY press the SCROLL button. The display will briefly show the temperature units in °C/F/K and then return to the HOME DISPLAY. (If you require a different temperature unit call Customer Service.)

To View the % Output Power
From the HOME DISPLAY press the SCROLL button twice. This value is a read-only value and cannot be changed.

Buttons and Indicators

OP1 (Output 1): illuminates when the heating output of the temperature controller is on.

AUTO/MAN: (Auto/Manual Mode): when the controller is in the automatic mode the output automatically adjusts to keep the temperature or process value at the setpoint. The "AUTO" light will illuminate. The manual mode has been disabled through factory configuration. Call Customer Service for further information.

RUN/HOLD (Run/Hold button):
  • Starts a program when pressed once—RUN light illuminates.

- Holds a program when pressed again—HOLD light illuminates.

- Cancels hold and continues running when pressed again—HOLD light is off and RUN light illuminates.

- Exits a program when the button is held down for two seconds—RUN and HOLD lights are off.

- At the end of a program the RUN light will flash.

- During holdback the HOLD light will flash.

PAGE button: allows you to choose a parameter from a list of parameters.

SCROLL button: allows you to choose a parameter within a list of parameters.

UP button: allows you to increase the value in the lower display.

DOWN button: allows you to decrease the value in the lower display.

Controller Parameters
Home Display
°C: measured temperature in Celsius. Temperature units can not be changed without entering the configuration. Contact Customer Service if a different temperature unit is required.

OP: % output power demand; displayed in lower display (cannot be changed).

C.id: Controller identification number.

PrG: Program number (displayed when a program is running; 4x16 programmable models only.)

IdHi: Deviation High Alarm

tunE: One-shot autotune enable.

run LiSt (Program Run List)
PrG: Currently running program (only used on 4x16 programmable models)

StAt: Displays the program status [OFF, run (running active program), hoLd (program on hold), HbAc (waiting for process to catch up), End (program completed)] in the lower display. The controller will default to "OFF."

FASt: Fast run through program (no/YES). The controller will default to "no."

SEG.d: Flash active segment type in the lower display of the home display (no/YES). The controller will default to "no."

ProG LiSt (Program Edit List)
PrG.n: Press the UP or DOWN ARROW to select the program number (program number will be displayed in lower display on 4x16 programmable models only.)

Hb: Press the UP or DOWN ARROW to select the holdback type [OFF (disables holdback), Lo (deviation low holdback), Hi (deviation high holdback) or bAnd (deviation band holdback)] for the entire program. The controller will default to "OFF."

Hb.U: Press the UP or DOWN ARROW to select the holdback value (in display units).

rmP.U: Press the UP or DOWN ARROW to toggle between ramp units (SEc, min or Hour). Controller will default to "SEc."

dwL.U: Press the UP or DOWN ARROW to toggle between dwell units (SEc, min or Hour). Controller will default to "SEc."

Cyc.n: Press the UP or DOWN ARROW to set the number of program cycles (1 to 999 or cont). The controller will default to "cont."

SEG.n: Press the UP or DOWN ARROW to select the segment number (1-8 in 8 segment models, 1-16 in 4x16 models).

tYPE: Press the UP or DOWN ARROW to select the segment type [End (end of program), rmP.r = ramp rate (ramp to a specified setpoint at a set rate), rmp.t = ramp time (ramp to a specified temperature in a set time), dwEll (to maintain a constant temperature for a set time), StEP (climb instantaneously from current to specified temperature), cALL (to call a program as a subroutine, available only on 4x16 programmable models)]. The controller will default to "End." Other parameters used with tYPE include; tGt target setpoint), Rate (rate of temperature increase) and dur (time to target setpoint or time to dwell).

End.t: End segment type: dwELL (dwell continuous), rSEt (reset) and S OP (End Segment Output power level.

AL LiSt (Alarm List)
IdHi: Deviation High Alarm.

Atun LiSt: (Autotune List)

tunE: One-shot autotune enable.

drA: Adaptive tune enable.

drA.t: Adaptive tune trigger level in display units. Range = 1 9999.

Pid LiSt
G.SP (Gain Setpoint): Is the temperature at which the controller switches from the (SEt1) PID values to the (SEt 2) PID values.

Pb: Proportional band in display units. (SEt 1)

ti: Integral time in seconds. (SEt 1)

td: Derivative time in seconds. (SEt 1)

Pb2: Proportional band. (SEt 2)

ti2: Integral time in seconds. (SEt 2)

td2: Derivative time in seconds. (SEt 2)

ACCS LiSt (Access List)
Access Code (Code needed to enter or change the other configuration parameters which are not normally accessible.) Not accessible.

Note
The following alarm messages are factory default settings and may vary if you have changed the configuration of your controller:

IDHi: =   50°C
2FSH = 1225°C (All models except -60)
2FSH = 1000°C (-60 models)

Alarms
The controller will flash an alarm message in the home display if an alarm condition is detected.

IdHi: PV deviation high alarm.

2FSH: PV full scale high alarm.

LCr: load current low alarm.

HCr: load current high alarm.

S.br: Sensor break: check that sensor is connected correctly.

L.br: Loop Break: Check that the heating circuits are working properly.

Ld.F: Heater Circuit Fault: indication of either an open or short solid sate relay, a blown fuse, missing supply or open circuit heater.

SSr.F: Solid state relay failure indications in a solid state relay: indicates either an open or short circuit in the SSR.

Htr.F: Heater failure: Indication that there is a fault in the heating circuit: indicates either a blown fuse, missing supply or open circuit heater.

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 Blink "S.br" and the power to the heating element will be shut OFF (Cycle light will extinguish).

Over-Temperature Protection (OTP)

The OTP will be in effect during any alarm condition when the temperature of the furnace has deviated beyond the limit. The "Deviation High" alarm is the only alarm value which can be changed. To change it, press the SCROLL button until "idHi" appears on

the display. Press the UP or DOWN button to select the OTP value you desire. We recommend a value of 20° above your working temperature to provide protection for your workload.

To Operate the Controller as a Single Setpoint Controller

1. Switch the circuit breaker to the "ON" position. The setpoint temperature presently set in the controller will appear in the lower display. (The upper display indicates the actual chamber temperature.)

2. To change the setpoint, press the UP or DOWN button until the desired setpoint value is displayed; then release the button.

3. The furnace will begin to heat if the new setpoint temperature is higher than the present chamber temperature.

Programming the Controller

The controller is capable of varying temperature or process value with time through programming. A program is stored as a series of segments and can be run once, repeated a set number of times or run continuously. To create a customized program using the controller parameters listed under "Controller Parameters" at the beginning of this section, follow the procedures outlined in the proceeding sections of this manual.

Creating a New Program or Editing an Existing Program (4x16 Segment Programmable Models Only)

The same steps are used when creating a new program and editing an existing program with the exception being that a new program starts with all its segments set to End in the tYPE parameter. Temporary changes can be made to these parameters when the program is in the hold state but permanent changes must be made in the reset state. Follow the steps below to create or edit a program.

1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads, "PrG.n."

3. Press the UP or DOWN button to select a number for a new program or to edit an existing program.

Hb: Holdback

Holdback consists of a value and a type. If the measured value lags behind the setpoint by an undesirable amount during a ramp or dwell, the holdback feature can be used to freeze the program at its current state (the HOLD light will flash). The program will resume when the error comes within the holdback value.

OFF: holdback is disabled.

Lo (Deviation Low Holdback): holds the program back when process variable deviates

below the setpoint by more than the holdback value.

Hi (Deviation High Holdback): holds the program back when process variable deviates above the setpoint by more than the holdback value.

bAnd (Deviation Band Holdback): combines the features of the high and low deviation holdback in that it holds the program back when the process variable deviates above or below the setpoint by more than the holdback value.

To set the holdback type:
1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads, "Hb."

3. Press the UP or DOWN button to toggle between "bAnd, Hi, Lo and OFF."

Hb U: Holdback Value
To set the holdback value:
1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads, "Hb.U."

3. Press the UP or DOWN button to enter a holdback value.

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rmP.U: Setting Ramp Units
Ramp units are time units which are used in "rmP.r" segments (ramp to a setpoint at degrees per second, minute or hour) and "rmP.t" segments (ramp to setpoint in a specific amount of

time). See "Setting the Segment Type" for an explanation on how to set a ramp segment.

1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads, "rmP.U."

3. Press the UP or DOWN button to toggle between seconds, minutes and hours.

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dwL.U: Setting Dwell Units
Dwell units are time units which are used in "dwELL" segments (amount of time to remain at a specific temperature). See "Setting the Segment Type" for an explanation on how to set a dwell segment.

1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads, "dwL.U."

3. Press the UP or DOWN button to toggle between seconds, minutes and hours.

CYC.n: Setting the Number of Cycles
Set the number of times a group of segments or programs are to be repeated by following the steps listed below.

1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads,"CYC.n."

3. Press the UP or DOWN button to select the number of cycles you want to run or,

Note
The program ramp rate is designed to reduce the heatup 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.

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

press the DOWN button to select "cont." so the program will run continuously.

Setting the Segment Type

There are five segment types. Proceed with the following steps according to the type of segment you have selected.

rmP.r (Ramp)
To ramp linearly at a set rate to a specified temperature:

1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads,"tYPE."

3. Press the UP or DOWN button until display reads, "rmP.r."

Steps 4 and 5 are used in the 4 program model only. If you are using an 8 segment program, skip to step 6.

4. Press the SCROLL button until display reads "Hb."

5. Press the UP or DOWN button to toggle between "bAnd, Hi, Lo and OFF."

6. Press the SCROLL button until display reads, "tGt."

7. Press the UP or DOWN button to set a target setpoint.

8. Press the SCROLL button until display reads,"rAtE."

9. Press the UP or DOWN button to select a value in ramp units (seconds, minutes or hours; set in the "rmP.U" parameter).

rmP.t

To ramp to a specified temperature at a set time:

1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads, "tYPE."

3. Press the UP or DOWN button until display reads, "rmP.t."

4. Press the SCROLL button until display reads, "tGt."

5. Press the UP or DOWN button to set a target setpoint.

6. Press the SCROLL button until display reads, "dur."

7. Press the UP or DOWN button to select a time in ramp units (seconds, minutes or hours; set in the "rmP.U" parameter.

dwEll

To maintain a constant temperature for a specified time:

1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads, "tYPE."

3. Press the UP or DOWN button until display reads, "dwEll."

4. Press the SCROLL button until display reads, "dur."

5. Press the UP or DOWN button to select a time in dwell units (seconds, minutes or hours; set in the "dwL.U" parameter).

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StEP
To climb instantaneously from the current temperature to a specified temperature.

1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads, tYPE."

3. Press the UP or DOWN button until the display reads, "StEP."

4. Press the SCROLL button until display reads, "tGt."

5. Press the UP or DOWN button to set a target setpoint.

cALL (Running Multiple Programs; 4x16 Segment Programmable Models Only)
To call a program as a subroutine:
If you want to run multiple programs, you can program the controller to "call" or link one program to another. This makes it possible to run one program at any time during another program and also return to the original program if desired.

1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads, "tYPE."

3. Press the UP or DOWN button until display reads, "cALL."

4. Press the SCROLL button until display reads, "PrG.n."

5. Press the UP or DOWN button to select a program number to be linked.

6. Press the SCROLL button until display reads, "CYC.n."

7. Press the UP or DOWN button to select the number of cycles the linked program is to be run.

End
To end or repeat a program:
1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads, "tYPE."

3. Press the UP or DOWN button until display reads, "End."

4. Press the SCROLL button until display reads, "End.t."

5. Press the UP or DOWN button to toggle between "dwEll" (an indefinite dwell), "S OP" (End Segment Output Power) and "rSET" (reset).

Setting the Target Setpoint (4x16 Segment Programmable Models Only)

1. Press the PAGE button until you reach the program list (ProG LiSt).

2. Press the SCROLL button until display reads, "tGt."

3. Press the UP or DOWN button to set the target setpoint temperature.

Running a Program (8 Segment Programmable Models)

To run a program, press the RUN/HOLD button. (The RUN light will illuminate.)

Running a Program (4x16 Segment Programmable Models)

To run a program, press the RUN/HOLD button. (The RUN light will illuminate) or:

1. Press the PAGE button until you reach the run list (run LiSt).

2. Press the SCROLL button until display reads, "PrG."

3. Press the UP or DOWN button to select the program number you want to run.

4. Press the RUN/HOLD button once to start the program. (The RUN light will illuminate.)

Note
Display will flash "tu.ER" if an error occurs during tuning. To clear the error and restart tuning, simultaneously press the PAGE and SCROLL buttons and follow the steps outlined in "Autotuning."

Note
To stop the tuning function, simultaneously press the PAGE and SCROLL buttons.

Holding a Program
To put a running program on hold, press the RUN/HOLD button. (The HOLD light will illuminate.)

Cancelling a Program
To cancel a program, hold the RUN/HOLD button down until the RUN and HOLD lights go off.

Tuning your Furnace
The purpose of tuning your furnace is to match the characteristics of your controller to the characteristics of the process being controlled. Good control is evidenced by: stable, straight-line control of the setpoint temperature with no fluctuations; No overshoot or undershoot of the setpoint temperature; rapid restoration of the setpoint temperature when external disturbances cause deviations from the setpoint.

This controller 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.

Tuning Error
The display will flash "tu.ER" if an error occurs during tuning. To clear the error and restart tuning, simultaneously press the PAGE and SCROLL buttons and follow the steps outlined in "Autotuning."

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Gain Scheduling

G.SP: Gain Scheduling
Gain scheduling is the automatic transfer of control between two sets of PID values. The 2416 controller does this at a presettable process value. Gain scheduling is used for difficult control processes which show large changes in their response time or sensitivity at high or low temperatures, or when heating or cooling.

The G.SP gain schedule setpoint is factory set at 700° C. The G.SP must be adjusted to 200°C from the desired setpoint temperature when tuning.

Setting the Transfer Point
If gain scheduling has been enabled, "G.SP will appear at the top of the PID list. This sets the value at which the transfer will occur. When the process value is below this level, PID1 will be active and when it is above, Pid2 will be active. Set a value between the control regions that show the greatest change to achieve the best point of transfer.

Tuning
The two sets of PID values can be manually set or automatically tuned. To tune automatically you must tune above and below the transfer point G.SP. If the process value is below the transfer point G.SP, the calculated values will automatically be inserted into the (SEt 1) set and if the process value is above G.SP, the calculated values will automatically be inserted into the (SEt 2).

Autotuning

The Autotune feature automatically sets up the PID values in the control parameters to suit new process conditions.

To tune your furnace using autotuning:

1. Load your furnace with a load similar to your normal load and close the door.

2. Set the setpoint temperature.

3. Press the PAGE button until the display reads, "Atun LiSt."

4. Press the SCROLL button until "tunE OFF" is displayed.

5. Press the UP or DOWN button to select "on."

6. Simultaneously press the PAGE and SCROLL buttons to return to the HOME DISPLAY. The display will flash "tunE" while tuning is in progress.

Adaptive Tuning

Adaptive tuning continuously evaluates tuning parameters. Adaptive tuning automatically installs new values if better accuracy is possible. Adaptive tuning should be used when the characteristics of a process change due to load or setpoint changes or, in a process that can not handle the oscillation caused by a one-shot tune.

To tune your furnace using adaptive tuning:

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

2. Press the PAGE button until display

reads, "Atun LiSt."

3. Press the SCROLL button until "drA OFF" is displayed.

4. Press the UP or DOWN button to select "on."

5. Press the SCROLL button until "drA.t" is displayed.

6. Press the UP or DOWN button until the desired trigger value is achieved.

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.

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

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

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

Note
Appropriate exhaust must be provided to remove smoke and gases proceeding 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.

Installation

Compressed Air Hook-Up

1. A 0.250 inch tube fitting is located at the rear of the furnace.

2. Using 0.250 inch I.D. rubber tubing, connect a piece 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, ensure that the regulator is completely closed (0 psi).

4. Turn flow control valve located at the bottom of the flow meter (front control panel) clockwise to closed positions.

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 40-45 liters per minute flow rate.

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 to off (clockwise).

Exhaust Tubing Hook-Up
Using accessory stainless steel tubing (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

Note
Appropriate exhaust must be provided to remove smoke and gases proceeding 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.

appropriate negative pressure exhaust system. This exhaust system must be capable of handling smoke and gases produced in an ashing procedure.

Furnace Programming

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

(Ramp 1) value is 8°C/minute
Target SP value is 500°C
(Dwell 1) value is 0 minute
(Ramp 2) value is 6°C/minute
Target SP value is 750°C
(Dwell 2) value is 120 minute
(Ramp 3) value is END (4 program models)
Cycles 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 diameter 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. Ensure the exhaust system is operating.

4. Set flow control valve so flow indicator reads between 40 and 45 liters per minute. (Check regulator to ensure 20 psi pressure).

5. Switch power switch to "ON".

6. Depress run button. The 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 Target SP until the program is cancelled. It will not automatically cool to ambient unless last programmed Target SP is set at ambient. When a program is cancelled the controller will maintain the chamber temperature at a value equal to the main set point . To cancel a program depress and hold the run button until the "run" light extinguishes.

8. At the end of the program, turn the flow control valve fully clockwise to the closed position.

Furnace Loading

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

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

- If you are heating a number of small
  parts, spread them throughout the cen-
  ter of the furnace chamber.

- Keep objects away from thermocouple.

- Use insulated tongs and mittens when
  loading and unloading furnace.

- Always wear safety glasses.

- Use Thermolyne hearth plates if you
  place load on bottom of chamber. Part
  #PHX2 (three are required).

Maintenance and Servicing

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).

Housekeeping is vital to your electric furnace - KEEP IT CLEAN. Run your furnace up to 871°C (1600°F) empty occasionally to burn off the contamination that may exist on the insulation and elements. Maintain 871°C (1600°F) for at least 4 hours to ensure complete ashing of foreign materials.

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 260°C (500°F).

Change the thermocouple every six months.

General Cleaning Instructions

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

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

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 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

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. 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 opera-tion of furnace.

To Replace Solid State Relay

1. Disconnect furnace from power supply.

2. Remove back control cover. (Note con-nection and placement of wires to relay). Remove the front control panel screws to provide access to solid state relay. Slide control section forward.

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 covers.

8. Reconnect furnace to power supply.

9. Test operation of furnace.

To Replace Door 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 door switch(es).

6. Insert new door switch(es) and secure with screws and nuts removed in Step 5.

7. Reconnect wires identified or marked in Step 4 to new door switch(es).

8. To realign door switch see "To Realign Door Switch" section.

9. Slide control section back in and replace the screws described in Step 2.

10. Reconnect to power supply.

11. Test operation of door switch. (See "To Realign Door Switch" section.)

To Realign Door 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 of switch until you hear a click.

6. Open and close the door; the switch should click approximately 1" to 1.5" before the door is closed.

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 setting high enough to keep the control from cycling, open and close the door; the cycle light should turn off approximately 1" to 1.5" before the door is closed.

To Replace the Controller

The controller plugs into a panel mounting sleeve which should be left permanently installed in the furnace housing. To remove the controller, release the side clips and slide the controller out. Do not attempt to dismantle this unit further.

Troubleshooting

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
The power switch does not illuminate.	The furnace is not connected to power supply.	Check furnace connection to power source.
	ON and OFF power switch is defective.	Replace power switch.
	Fuses blown.	Replace fuses.
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.	No power.	Check power source and fuses or breakers.
	Two or more heating elements in 208V or 240V furnaces are burned out.	Replace defective elements.
	Thermocouple has oxidized and opened the circuit.	Replace thermocouple.
	Defective electrical hookup.	Repair electrical hookup.
	Door switch malfunction.	Re-align or replace door safety switch.
	Defective mechanical relay coil or contacts.	Replace relay.
No temperature control.	Shorted thermocouple circuit.	Check thermocouple connection and/or replace thermocouple.
	Shorted solid state relay - over temperature protection may be activated.	Replace solid state relay.
	Defective control - error message on display may appear.	Return control for repair or replace.
	Thermocouple leads are reversed.	Connect leads correctly (see manual).
Slow heat-up.	One or two heating elements are burned out.	Replace burned out elements.
	Heavy load in chamber.	Lighten load in chamber to allow heat to circulate.
	Low line voltage.	Install line of sufficient size and proper voltage (isolate furnace from other electrical loads).
	Wrong heating elements.	Install proper elements.

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TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
Door switch does not cut power to the furnace chamber.	Door switch is not functioning.	Re-align or replace door safety switch.
	Mechanical relay contacts sticking.	Replace relay.
Repeated element burnout.	Chamber improperly loaded.	See loading procedures in start-up procedure.
	Heating harmful materials.	Enclose material in container. Clean up spills on chamber. Ventilate chamber by leaving door cracked slightly open when heating known harmful reagents.
	Overheating furnace.	Keep furnace under maximum temperature. Closer supervision of control setting.

Repeated element burnout (cont.)

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
Wrong element.	Install proper element.	
	Oxidized thermocouple.	Replace thermocouple.
	Contamination present from previous burnout.	Replace insulation material.
	Wired improperly.	Check wiring diagram for correct wiring of your furnace.
Inaccurate temperature display.	Oxidized or contaminated thermocouple.	Replace thermocouple.
	Improper loading.	Use proper loading procedures. Refer to start-up procedure.
	Poor thermocouple connection.	Tighten connections.
	Solid state relay malfunction.	Replace solid state relay.
	Thermocouple connections	Reconnect thermocouple correctly.

Replacement Parts List

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 PART	DESCRIPTION	MODELS USED ON
CN71X82	Controller	F6010, F6010CN, F6018
CN71X93	Controller	F6020C, (-33), F6028C
CN71X85	Controller	F6020C-33-60, F6020C-60, F6028C-60
CN71X83	Controller	F6020C-33-80, F6020C-80, F6028C-80
CN71X86	Controller	F6020C-60-80, F6020C-33-60-80, F6028C-60-80
CN71X84	Controller	F6030CM, F6030CM-33, F6038CM
CN71X87	Controller	F6030CM-33-60, F6030CM-60, F6038CM-60
PLX82	Pilot Light	All models
EL408X1	Heating Element, Top	F6020C , (-33), (-33-60), (-33-80), (-33-60-80), (-60), (-60-80) & (-80), F6030CM, (-33), (-33-60) & (-60)
EL408X10	Heating Element, Top	F6010, F6010CN, F6018
EL408X2	Heating Element, Top	F6028C, (-60), (-60-80) & (-80), F6038CM & (-60)
EL408X5	Heating Element, bottom	F6020C , (-33), (-33-60), (-33-80), (-33-60-80), (-60), (-60-80) & (-80), F6030CM, (-33), (-33-60) & (-60)
EL408X4	Heating Element, bottom	F6028C, (-60), (-60-80) & (-80), F6038CM & (-60)
EL408X9	Heating Element, bottom	F6010, F6010CN, F6018
EL205X6	Heating Element, side	F6020C , (-33), (-33-60), (-33-80), (-33-60-80), (-60), (-60-80) & (-80), F6030CM, (-33), (-33-60) & (-60)
EL408X3	Heating Element, side	F6028C, (-60), (-60-80) & (-80), F6038CM & (-60)
EL408X11	Heating Element, side	F6010, F6010CN, F6010-33, F6018
RYX57	Relay	All models except F6010, F6010CN, F6010-33, F6018
RYX34	Solid State Relay	All models
SWX144	Power Switch	All models
SW1172X1	Micro Switch	All models except F6010, F6010CN, F6018,
SWX163	Micro Switch (2)	F6010, F6010CN, F6018
TC1249X1	Thermocouple, Type K	F6010, F6010CN, F6018
TC327X1	Thermocouple, Platinel	All models except F6010, F6010CN, F6018
CAX99	Filter, EMI	-33 models
FZX26	Fuse Holder	F6010, F6010CN, F6018 only
2-58147	Fuse	F6010, F6010CN, F6018 only

Accessories

ACCESSORY	DESCRIPTION
PH177X1	Hearth Tray 10.75 in (27.3 cm) x 0.75 (1.9) x 9 (22.8)
PHX1	Hearth Tray 4 in. (10.1 cm) x.0.5 (1.3) x 3.3 (8.2)
PHX2	Hearth Tray 3.9 in. (9.6 cm) x 0.75 (1.9) x 8 (20.3)
SH408X1	Stainless Steel Shelf 12in. (33 cm) x 8.3 (21)
JSX16	Porcelain Pegs for Shelf (4 required)
AY408X1A	Stainless steel flexible exhaust tubing kit; 2.5 in. I.D x 5 in. long; used for venting fumes to proper exhaust system; includes mounting hardware.

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Wiring Diagrams
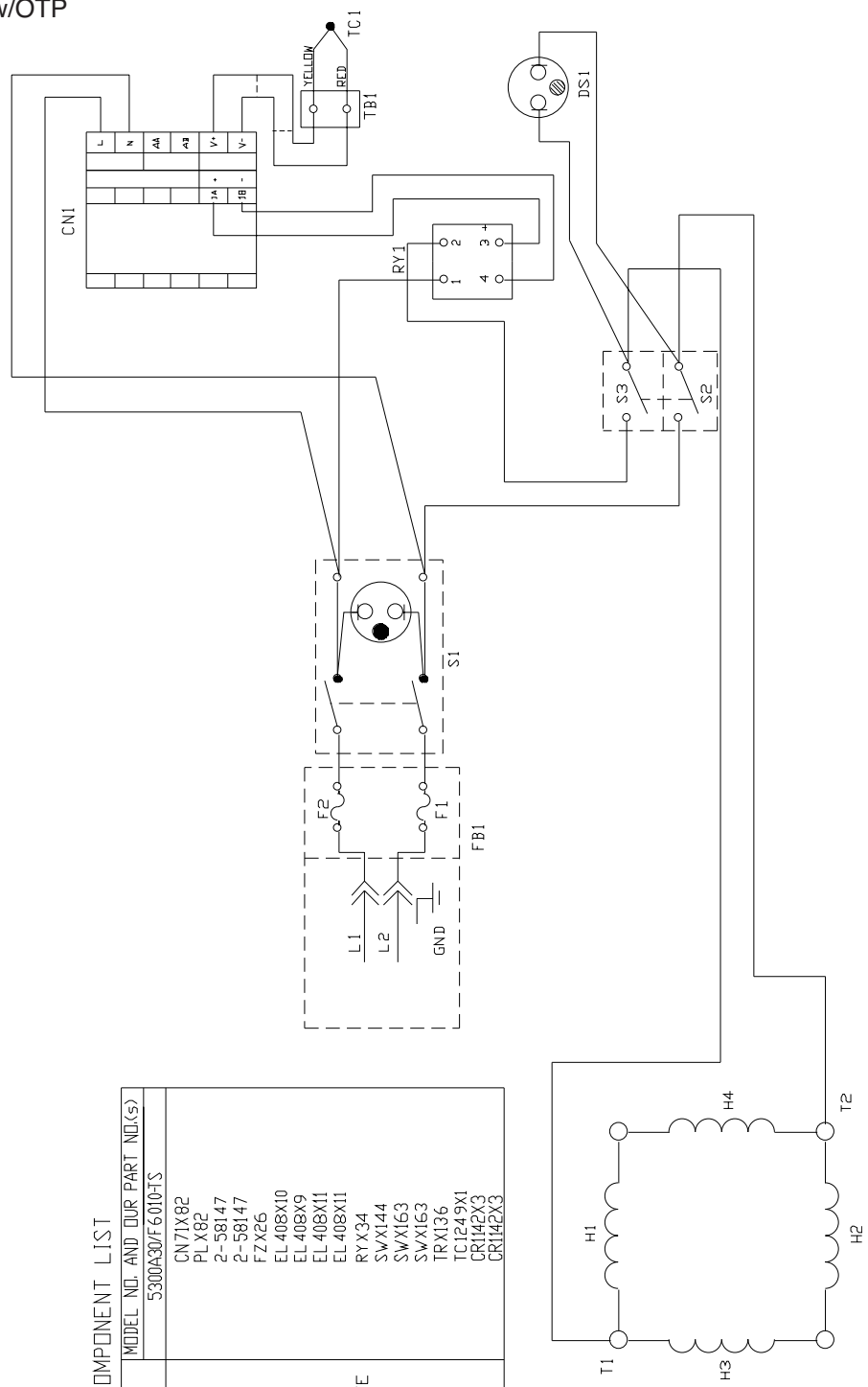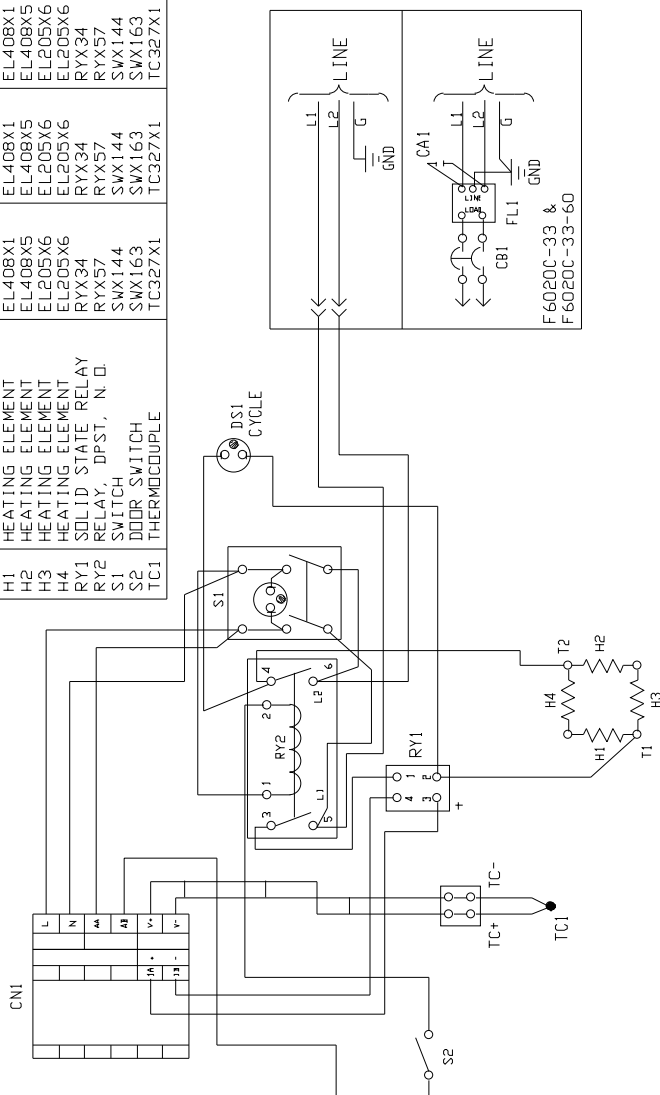
Single Setpoint Control w/OTP

Single Setpoint Control w/OTP

DIAGRAM COMPONENT LIST

REF. NO.	DESCRIPTION	MODEL NO. AND OUR PART NO.(s)						
		F6020C	F6020C-33	F6020C-33-60	F6020C-60	F6028C	F6028C-60
CA1	CAPACITOR ASSEMBLY		CA1249X1	CA1249X1			
CN1	CONTROL	CN71X99	CN71X99	CN71X85	CN71X85	CN71X99	CN71X85
CB1	CURCUIT BREAKER		SWX103	SWX103			
DS1	PILOT LIGHT, NEON	PLX82	PLX82	PLX82	PLX82	PLX82	PLX82
FL1	FILTER, EMI		CAX99	CAX99			
H1	HEATING ELEMENT	EL408X1	EL408X1	EL408X1	EL408X1	EL408X2	EL408X2
H2	HEATING ELEMENT	EL408X5	EL408X5	EL408X5	EL408X5	EL408X4	EL408X4
H3	HEATING ELEMENT	EL205X6	EL205X6	EL205X6	EL205X6	EL408X3	EL408X3
H4	HEATING ELEMENT	EL205X6	EL205X6	EL205X6	EL205X6	EL408X3	EL408X3
RY1	SOLID STATE RELAY	RYX34	RYX34	RYX34	RYX34	RYX34	RYX34
RY2	RELAY, DPST, N.O.	RYX57	RYX57	RYX57	RYX57	RYX57	RYX57
S1	SWITCH	SWX144	SWX144	SWX144	SWX144	SWX144	SWX144
S2	DOOR SWITCH	SWX163	SWX163	SWX163	SWX163	SWX163	SWX163
TC1	THERMOCOUPLE	TC327X1	TC327X1	TC327X1	TC327X1	TC327X1	TC327X1

WIRING DIAGRAM

8 Segment Programmable Control

DIAGRAM COMPONENT LIST

REF. NO.	DESCRIPTION	MODEL NO. AND OUR PART NO.(s)					
		F6020C-80	F6020C-33-80	F6020C-33-60-80	F6020C-60-80	F6028C-80	F6028C-60-80
CA1	CAPACITOR ASSEMBLY		CA1249X1	CA1249X1			
CN1	CONTROL	CN71X83	CN71X83	CN71X86	CN71X86	CN71X83	CN71X86
CB1	CURCUIT BREAKER		SWX103	SWX103			
DS1	PILOT LIGHT, NEON	PLX82	PLX82	PLX82	PLX82	PLX82	PLX82
FL1	FILTER, EMI		CAX99	CAX99			
H1	HEATING ELEMENT	EL408X1	EL408X1	EL408X1	EL408X1	EL408X2	EL408X2
H2	HEATING ELEMENT	EL408X5	EL408X5	EL408X5	EL408X5	EL408X4	EL408X4
H3	HEATING ELEMENT	EL205X6	EL205X6	EL205X6	EL205X6	EL408X3	EL408X3
H4	HEATING ELEMENT	EL205X6	EL205X6	EL205X6	EL205X6	EL408X3	EL408X3
RY1	SOLID STATE RELAY	RYX34	RYX34	RYX34	RYX34	RYX34	RYX34
RY2	RELAY, DPST, N.O.	RYX57	RYX57	RYX57	RYX57	RYX57	RYX57
S1	SWITCH	SWX144	SWX144	SWX144	SWX144	SWX144	SWX144
S2	DOOR SWITCH	SWX163	SWX163	SWX163	SWX163	SWX163	SWX163
TC1	THERMOCOUPLE	TC327X1	TC327X1	TC327X1	TC327X1	TC327X1	TC327X1

WIRING DIAGRAM

4 X 16 Segment Programmable Control

DIAGRAM COMPONENT LIST

REF. NO.	DESCRIPTION	MODEL NO. AND OUR PART NO.(s)					
		F6030CM	F6030CM-33	F6030CM-33-60	F6030CM-60	F6038CM	F6038CM-60
CA1	CAPACITOR ASSEMBLY		CA1249X1	CA1249X1			
CN1	CONTROL	CN71X84	CN71X84	CN71X87	CN71X87	CN71X84	CN71X87
CB1	CIRCUIT BREAKER		SWX103	SWX103			
DS1	PILOT LIGHT, NEON	PLX82	PLX82	PLX82	PLX82	PLX82	PLX82
FL1	FILTER, EMI		CAX99	CAX99			
H1	HEATING ELEMENT	EL408X1	EL408X1	EL408X1	EL408X1	EL408X2	EL408X2
H2	HEATING ELEMENT	EL408X5	EL408X5	EL408X5	EL408X5	EL408X4	EL408X4
H3	HEATING ELEMENT	EL205X6	EL205X6	EL205X6	EL205X6	EL408X3	EL408X3
H4	HEATING ELEMENT	EL205X6	EL205X6	EL205X6	EL205X6	EL408X3	EL408X3
RY1	SOLID STATE RELAY	RYX34	RYX34	RYX34	RYX34	RYX34	RYX34
RY2	RELAY, DPST, N.O.	RYX57	RYX57	RYX57	RYX57	RYX57	RYX57
S1	SWITCH	SWX144	SWX144	SWX144	SWX144	SWX144	SWX144
S2	DOOR SWITCH	SWX163	SWX163	SWX163	SWX163	SWX163	SWX163
TC1	THERMOCOUPLE	TC327X1	TC327X1	TC327X1	TC327X1	TC327X1	TC327X1

COMMUNICATION CABLE WIRING

WIRING DIAGRAM

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 **Thermo Scientific** 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 800-438-4851.

Prior to returning any materials, please contact our Customer Service Department for a "Return Materials Authorization" number (RMA). Material returned without an RMA number will be refused.

WEEE Compliance

WEEE Compliance. This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96EC. It is marked with the following symbol. Thermo Fisher Scientific has contracted with one or more recycling/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on Thermo Fisher Scientific compliance with these Directives, the recyclers in your country, and information on Thermo Scientific products which may assist the detection of substances subject to the RoHS Directive are available at **www.thermo.com/**

Great Britain

WEEE Konformittät. Dieses Produkt muss die EU Waste Electrical & Electronic Equipment (WEEE) Richtlinie 2002/96EC erfüllen. Das Produkt ist durch folgendes Symbol gekennzeichnet. Thermo Fisher Scientific hat Vereinbarungen getroffen mit Verwertungs/Entsorgungsanlagen in allen EU-Mitgliederstaaten und dieses Produkt muss durch diese Firmen widerverwetet oder entsorgt werden. Mehr Informationen über die Einhaltung dieser Anweisungen durch Thermo Fisher Scientific, die Verwerter und Hinweise die Ihnen nützlich sein können, die Thermo Scientific Produkte zu identifizieren, die unter diese RoHS. Anweisungfallen, finden Sie unter **www.thermo.com/**

Deutschland

Conformità WEEE. Questo prodotto deve rispondere alla direttiva dell' Unione Europea 2002/96EC in merito ai Rifiuti degli Apparecchi Elettrici ed Elettronici (WEEE). È marcato col seguente simbolo.Thermo Fisher Scientific ha stipulato contratti con una o diverse società di riciclaggio/smaltimento in ognuno degli Stati Membri Europei. Questo prodotto verrà smaltito o riciclato tramite queste medesime. Ulteriori informazioni sulla conformità di Thermo Fisher Scientific con queste Direttive, l'elenco delle ditte di riciclaggio nel Vostro paese e informazioni sui prodotti Thermo Scientific che possono essere utili alla rilevazione di sostanze soggette alla Direttiva RoHS sono disponibili sul sito **www.thermo.com**/

Italia

Conformité WEEE. Ce produit doit être conforme à la directive européenne (2002/96EC) des Déchets d'Equipements Electriques et Electroniques (DEEE). Il est marqué par le symbole suivant. Thermo Fisher Scientific s'est associé avec une ou plusieurs compagnies de recyclage dans chaque état membre de l'union européenne et ce produit devraitêtre collecté ou recyclé par celles-ci. Davantage d'informations sur laconformité de Thermo Fisher Scientific à ces directives, les recycleurs dans votre pays et les informations sur les produits Thermo Scientific qui peuvent aider le détection des substances sujettes à la directive RoHS sont disponibles sur **www.thermo.com/**

France

Important

For your future reference and when contacting the factory, please have the following information readily available:

Model Number: _____

Serial Number: _____

Date Purchased: _____

The above information can be found on the dataplate attached to the equipment. If available, please provide the date purchased, the source of purchase (manufacturer or specific agent/rep organization), and purchase order number.

IF YOU NEED ASSISTANCE:

LABORATORY PARTS and SERVICE

    Phone: 800/438-4851

    FAX: 828/658-2576

TECHNICAL SUPPORT

    Phone: 800/438-4851

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