Muffle Furnace

OPERATION MANUAL
AND PARTS LIST
Series 1256 & 1257

Model	Voltage	Control	Display
5300A01/FB1315M-TS	120V	Single Setpoint	°C
5300A05/FB1415M-TS	120V	Single Setpoint	°C

LT1256X6 • Rev B

Trademarks

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Safety Information

Alert Signals

Warning
Warnings alert you to a possibility of personal injury.

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

Note
Notes alert you to pertinent facts and conditions.

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

Important Information

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 equipment.

Your Thermo Scientific 5300A01/FB1315M-TS or 5300A05/FB1415M-TS Muffle 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.

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 before servicing.

3. Have the door switch operating properly.

To avoid burns:

1. “Caution: Hot Surface. Avoid Contact.” Do not touch the exterior or interior surfaces of the furnace during use or for a period of time after use.

To avoid personal injury:

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

2. Refer servicing to qualified personnel.

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 1-800-345-2100.

Introduction

Intended Use

The 5300A01/FB1315M-TS and 5300A05/FB1415M-TS furnaces are general purpose laboratory and heat treating furnaces. For optimum element life, observe the following temperature ranges:
100°C (212°F) to 982°C (1800°F) for continuous use, or from 982°C (1800°F) to 1100°C (2012°F) for intermittent use. Continuous use is operating the furnace for more than three straight hours, and intermittent use is operating the furnace for less than three hours.

The unit consists of a heating chamber and a digital controller.

General Usage

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

Principles of Operation

The furnace chamber is heated by a single three section resistant heater which is embedded in a refractory material. The chamber is insulated with ceramic fiber insulation. The temperature is controlled by an electronic control. The temperature is measured by a thermocouple and is registered on a digital display. For safety, door switches are incorporated to remove power from the heating elements when the door is opened. The furnace is supported by the control section which also houses the electrical connections.

General Specifications

Models 5300A01/FB1315M-TS

Dimensions: (handle not included)
Chamber: 4” W x 3.75” H x 4.5” D (10.2 x 9.5 x 11.4 cm)
Overall: 7.9” W x 13.8” H x 8.5” D (20.0 x 34.9 x 21.6cm)

Weight: 15.7 lb. (7.1 kg)
Electrical Ratings:

Model #	Volts	Amps	Watts	Phase	Frequency
5300A01/FB1315M-TS	120	8.9	1060	1	50/60

Temperature: Operating Range (continuous): 982°C; (intermittent): 1100°C.

Environmental Conditions:
Operating: 17°C - 27°C; 20% - 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 - 65°C; 20% - 80% relative humidity.

Models 5300A05/FB1415M-TS

Dimensions: (handle not included)
Chamber: 5.00” W x 4.25” H x 6.00” D (12.7 x 10.8 x 15.2 cm)
Overall: 9.7” W x 15.8” H x 11.1” D (24.6 x 39.0 x 28.3cm)
Weight: 23 lb. (10.4 kg)
Electrical Ratings:

Model #	Volts	Amps	Watts	Phase	Frequency
5300A05/FB1415M-TS	120	12	1450	1	50/60

Temperature: Operating Range (continuous): 982°C; (intermittent): 1100°C.

Environmental Conditions:
Operating: 17°C - 27°C; 20% - 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 - 65°C; 20% - 80% relative humidity.

Unpacking

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.

Note
The 5300A01/FB1315M-TS and 5300A05/FB1415M-TS furnaces are supplied with cord and plug (240V, 15 amp cord set).

Installation

Caution
Be sure ambient temperature does not exceed 40°C (104°F). The recommended ambient temperature is 17°C - 27°C. Ambients above this level may result in damage to the controller.

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

Warning
To avoid electrical shock, this furnace must always use a properly grounded outlet of correct voltage and current handling capacity.

Site Selection

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

Electrical Connections

The electrical ratings are located on the specification plate on the back of the furnace. Consult Thomas Scientific if your electrical service is different than those listed on the specification plate. Be sure the front power switch is in the OFF position before connecting the furnace to your electrical supply. The 5300A01/FB1315M-TS and 5300A05/FB1415M-TS furnaces are supplied with a power cord rated at 120V, 15 amps.

Operation, All Modes

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 the controller's current setpoint. (See the instructions for your type of controller for information on checking and setting the setpoint.)

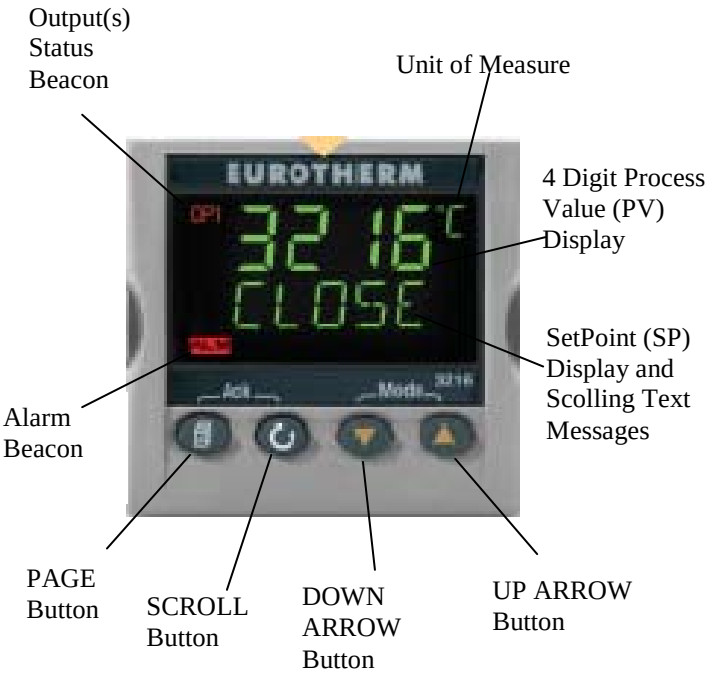
Cycle Light

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 Controller



Eurotherm 3216 Controller Operation

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 a default page. The measured value (process value) is found in the upper display and the setpoint is found in the lower display.

Note:
If at any time you want to return to the HOME DISPLAY, press PAGE button.

Buttons and Indicators

OP1 (Output 1): Illuminates when the output is ON (normally heating).

OP2 (Output 2): Illuminates when the output is ON (normally cooling).

OP4 (Output 4): Illuminates when the AA relay output is ON (will go on 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.

To Change the Setpoint

If you want to change the setpoint, press the **SCROLL** button until "**SP1**" is displayed. Press the UP or DOWN button 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 is indicated by a brief flash of the display. Press **PAGE** button to return to HOME DISPLAY.

To View the Display Units

Press SCROLL until **"UNITS"** is displayed. The temperature units are also shown on the HOME DISPLAY to the right of the measured value (process value).

Temperature Units can be changed by pressing up and down buttons. Choice of Celsius **(°C), Fahrenheit (°F), Kelvin (°K), Percentage (%),** or **None (nonE).**

Controller Parameters

Home display

°C ,°F, °K, %, or None: Temperature units in Celsius (default), Fahrenheit, Kelvin, Percentage (PErc), or None (nonE).

A1.DHI: Deviation high alarm.
A2.HI: High Limit alarm. Read Only.
A3.LO: Low Limit alarm. Read Only.
A.TUNE (tune): One-shot autotune enable.
WRK.OP: Working Output power. Read Only.
PV.OFS: Process Value Offset. Read Only.
SP.RAT: Ramp Rate Setpoint (default units is minutes).
RAMPU: Ramp Unit of measure (seconds, minutes and hours).
DWELL: Time for dwell or delay (default units is minutes).

T.STAT: Timer Status. Active only when timer is active.
TM.CFG: Timer configuration.
TM.RES: Timer Resolution (minutes and hours).
THRES: Timer start threshold (default is OFF).
END.T: Timer End Type (default is DWELL).

Pid List

PB: Proportional band (in display units).

TI: Integral time in seconds.

TD: Derivative time in seconds.

ACCESS 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.

A2.HI: Measured value full scale high alarm.

A1.DHI: Measured value deviation high alarm.
S.br: Sensor break: check that sensor is connected correctly.

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

Ld.F: Heater Circuit fault: indication of either an open or short solid state relay, 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 “A1.DHi” 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.

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. Thermo Fisher Scientific recommends you use this feature to provide the best temperature accuracy the controller can attain. To use the tuning feature:

Note:
Furnace must be at ambient temperature before starting a tune. “Stat” and “Sp.rr” must be set to OFF or “tunE” will not initiate.

1. Start tuning with the process at ambient temperature. This allows the tuner to calculate the low cutback and high cutback values more accurately.

2. Adjust the setpoint to your desired value.

3. Press the **SCROLL** button until display reads, “**A.TUNE**.”

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

5. Press the **PAGE** button to return to the HOME DISPLAY. The display will alternately flash between "**tunE**" and the HOME DISPLAY while tuning is in progress.

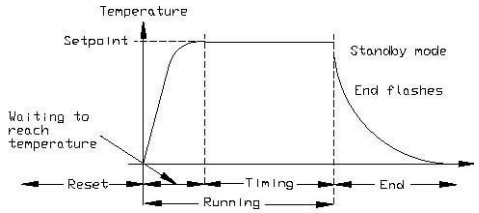
6. The controller will then turn the heating on and off to induce an oscillation. When the measured value reaches the required setpoint the first cycle will end.

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

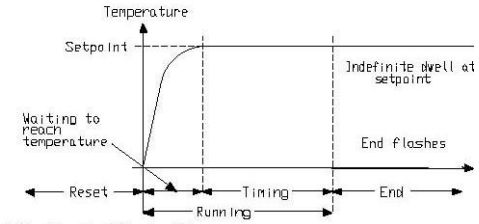
8. Normal control function will resume after the controller calculates tuning parameters.

Note:
Tune has completed when "tunE" stops flashing on display.

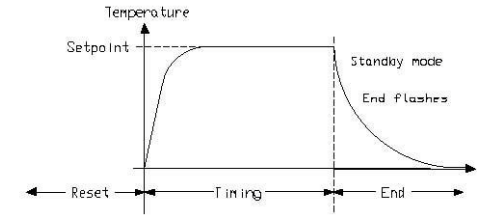
Single Ramp & Dwell



Mode 1 (Opt. 1)



Mode 2 (Opt. 2)



Mode 3 (Opt. 3)

Functions

This type of controller has two step ramp and dwell programming capabilities. The Ramp and Dwell can be configured to three different modes.

1. **Mode 1** (**DWELL**) The dwell time begins once the setpoint reaches the set threshold. The END TYPE action is executed when the dwell timer reaches the end.

2. **Mode 2** (**DELY**) The timer starts immediately upon instrument power-up, or when run is selected. The instrument remains in standby until the time has elapsed. After the time has elapsed, the instrument controls up to setpoint.

3. **Mode 3** (**SF.ST**) Starts automatically on power up. This is a soft-start function. If the PV is below the Soft Start Threshold, then the power is limited to the Soft Start Limit until the threshold is met.

Program Overview

- A program mode can be set by changing the "**TM.CFG**" variable (in the 'Timer' menu) to "DWEL, DELY, or SF.ST. Note: value of "None" deactivates the timer.
- A Ramp rate may be set by changing the "**SP.RAT**" variable (in the 'SP' menu) to a value. The Ramp rate units are set with the "**RAMPU**" variable (in the 'SP' menu). The selections are Hour / Min / Sec.
- The Dwell time can be set by changing the "**DWELL**" variable (in the 'Timer' menu) to the desired value. Dwell time units are set with the "**TM.RES**" variable (in the 'Timer' menu). The selections are Hour / Min.

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

- The program Status can be set by changing the "**T.STAT**" variable to "**run**", **"hold**", or "**res**." This variable will start, hold, or stop the program.
- The Timer End Type can be set by changing the **"END.T"** to one of the four options:
  ► **OFF** - When the timer completes its dwell, the instrument will be put into Standby mode. The output power will be set to 0%, and the standard home display will display PV and OFF instead of setpoint.
  ► **DWELL** - When the timer completes, the controller will continue to control at setpoint.
  ► **SP2** - When the timer completes the target setpoint will switch to setpoint 2. The setpoint 2 may be a lower or a higher temperature.
  ► Reset (rES)**-** The timer or program will reset on completion, reverting to the setpoint used at the point it was started.

Note:
The above four options is to set what is expected of the unit to do once the program is complete.
For example, if it is desired for the controller to stop doing anything at all once the timer is finished, set End.T to OFF. If it is desired to revert back to the ambient temp setpoint at which the program started, set END.T to rES.

SetPoint Rate Limit Setup

1. Press the **SCROLL** button until the "**SP.RAT**" (Ramp Rate) is displayed.

2. 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 until "**TM.CFG**" (Ramp & Dwell mode) will be displayed, select the desired mode with the UP or DOWN buttons. (DWEL, DELY, or SF.ST.)
4. Press the **SCROLL** button until "**DWELL**" will be displayed set the desired Dwell time with the UP or DOWN buttons.
5. Press the **PAGE** button and **SCROLL** button together until the Actual temperature is displayed.

Running the Program

1. Press the **SCROLL** button until "**T.STAT**" is displayed set to "**run**" with the UP or DOWN buttons; or from the HOME DISPLAY, press **UP and DOWN** arrows together.

2. Press the **PAGE** button to display Actual temperature.

Holding the Program

1. Press the **SCROLL** button until "**T.STAT**" is displayed set to "hold" with the UP or DOWN buttons; or from the HOME DISPLAY, press **UP and DOWN** arrows together.

2. Press the **PAGE** button to display Actual temperature.

Stopping the Program

Press the **SCROLL** button until "**T.STAT**" is displayed set to "res" with the UP or DOWN buttons.

Clearing the Flashing End

Press the PAGE and SCROLL buttons at the same time. It can also be cleared by pressing and holding the UP and DOWN arrows simultaneously until **A-M** (Auto/Manual) is displayed. Then select "**Auto**" and unit will clear program and revert to normal operation.

Verifying a Running Program

Press the **SCROLL** button until "**T.STAT**" is displayed. The display will show "run" if the program is running, "**hold**" if it is paused or "**res**" if it is not running. Press the **PAGE** button to display actual temperature.

Furnace Loading

Caution
Do not overload your furnace chamber or allow the load to touch the thermo-couple. If the load is to be heated uniformly, it should not occupy more than two-thirds of any dimension of the chamber. Failure to observe these cautions could result in damage to furnace components and/or load.

- For best results of furnace loading, use less than two-thirds of any dimension of the chamber. Maintain a 3/4" clearance between the load and the sides of the chamber.
- If you are heating a number of small parts, spread them throughout the middle two thirds of the chamber.
- Keep objects away from thermocouple.
- Raise your load up off the furnace floor with small pieces of ceramic or a hearth plate to promote even heating.
- Use insulated tongs and mittens when loading and unloading furnace.
- Always wear safety glasses.

Preventive Maintenance

Note:
Discoloration of chassis paint (especially above the door) is to be expected over time. This is normal wear and tear due to heat escaping the chamber when the door is opened.

Warning
Before using any cleaning or decontamination method except those recommended by the manufacturer, users should check with customer service that the proposed method will not damage the equipment.

Warning
Disconnect the furnace from power supply before cleaning.

Warning
Opening the door for an extended period of time will cause the painted surfaces above the door to be discolored or burnt.

Contamination is a major cause of element failure, therefore, when possible, removes the fume forming material before heating (e.g., cleaning cutting oil from tool steel).

The resistance wire is high-grade nickel-chromium. Some chemicals notably sulphur, halogens, and cyanides, attack this wire at high temperatures, so avoid spilling these chemicals in the furnace or heating them any hotter than necessary. The refractory cement helps to protect the wire, but will not completely immunize it from damage.

All heating elements must be considered expendable, and replacement is expected; however, reasonable care in their use will greatly extend the service they will give. As the manufacturer has no control over the use or care of the elements, no specific service guarantee can be made.

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. Run for approximately two hours with the door slightly open. See warning.

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).

During normal use, the thermocouple in your furnace can become oxidized and cause inaccurate readings; therefore, we suggest that if you regularly use your furnace you should change your thermo- couple once every six months to assure the accuracy of your controller readings.

General Cleaning Instructions

Wipe exterior surfaces with a dampened cloth and mild soap solution.

Troubleshooting

Problem	Possible Causes	Corrective Action
The furnace does not heat (CYCLE light does not illuminate).	No power.	Check power source and fuses or breakers.
	Defective electrical hookup.	Repair electrical hookup.
	Thermocouple has oxidized and opened the circuit. (Open thermocouple is indicated on the display as a temperature of 0-5 degrees).	Replace thermocouple.
	Fuse(s) blown.	Replace fuse(s).
	Controller malfunction.	Replace controller.
	Door switches malfunction.	Re-align or replace door safety switches.
	Defective solid state relay.	Replace output relay.
Power is not cut to heating elements when the door is open.	Door switches are not functioning.	Re-align or replace door switches.
Slow heatup.	Low line voltage.	Install line of sufficient size and proper voltage. (Isolate furnace from other electrical loads.)
	Heavy load in chamber.	Lighten load in chamber.
	Wrong heating element.	Install proper element.
Repeated element burnout.	Overheating furnace.	Keep furnace under maximum temperature.
	Heating harmful materials.	Enclose material in container. Clean up spills in and on chamber. Ventilate chamber by opening door slightly when heating known harmful reagents.
	Contamination present from pervious burnout.	Replace insulation material.
Inaccurate temperature readout.	Oxidized or contaminated thermocouple.	Replace thermocouple.
	Poor thermocouple connection.	Tighten connections.
	Improper loading procedures.	Use proper loading procedures.
	Poor ventilation of base.	Clear area around furnace base.
	Thermocouple connections reversed. (Indicated by downscaling of temperature on display.)	Reconnect thermocouple correctly.

Maintenance and Servicing

Warning
Disconnect the furnace from the power supply before servicing. Refer servicing to qualified personnel.

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

Note
It is seldom necessary to disconnect the thermocouple from the controller if the thermocouple is in good condition.

To Replace Heating Element

1. Set the furnace on its top. (See Figure 3). Remove thermocouple cover (If equipped).
2. Remove screw and clamp holding thermocouple, then grasp the thermocouple at the bend where it enters the furnace chamber and pull straight back. Retain porcelain insulator.
3. When the thermocouple tip is clear of the furnace back, bend it out of the way.
4. Remove the screws holding the steel back plate to the case.
5. Remove the steel back plate.

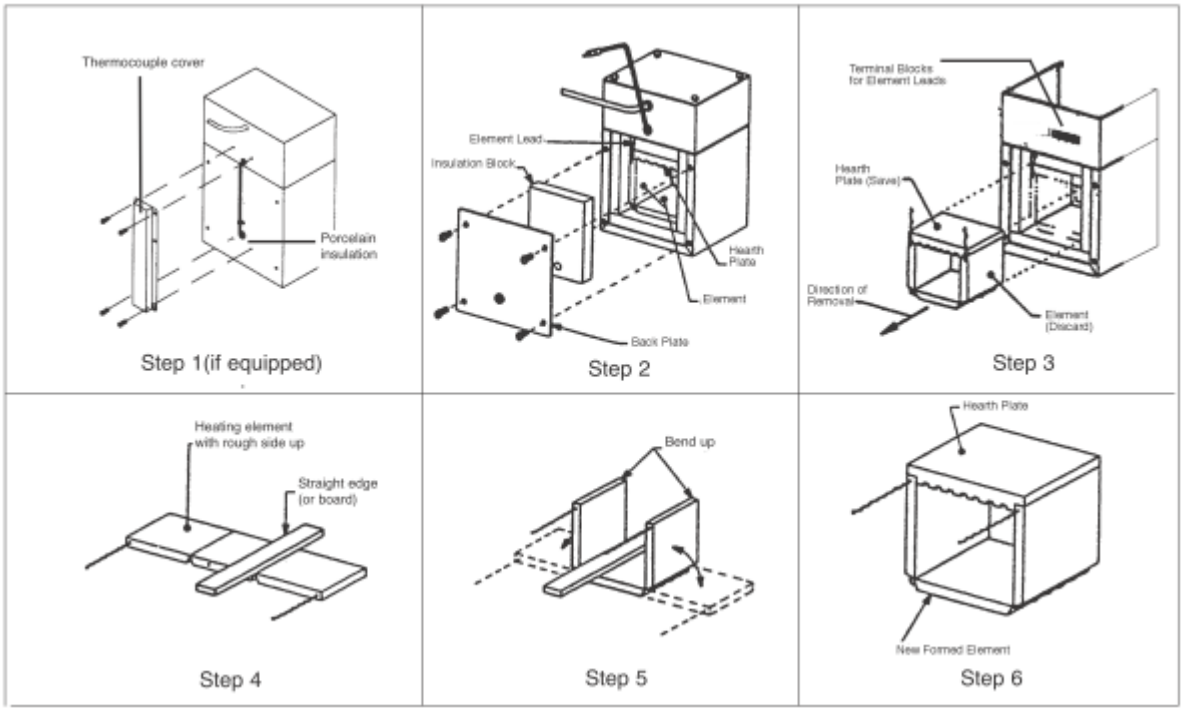


Figure 3: Replacement of a Heating Element

6. Remove the back insulation block by opening the door and gently pushing it out. Support this insulation block while removing it, as it is quite soft and easily crumbled at the edges.

7. Remove bottom cover to obtain access to terminals.

These steps will expose the heating element leads and insulating bushings in the bottom plate of the furnace.

8. Cut the element leads between the element and the terminal block. (There are two leads.) The element and hearth plate unit may now be removed by pushing it straight back out of the furnace. Use care not to damage the chamber insulation when removing the hearth plate and element as it can be reused if it has not been contaminated.

Note
The hearth plate contains no heating coil, and may be saved for reinstallation if it is in good condition. The hearth plate is replaceable independent of the heating element.

9. Remove the old element lead wire and power wires from the terminal block, and save the sleeving for re-installation on the new element leads. Sleeving must be replaced if cracked or brittle!

10. New elements are shipped flat to protect them from damage in shipment, and to save space in storage. They must be formed before installation.

11. Place the element on a flat surface with the rough side up. Place a board or other straight edge along one row of notches.

12. Gently bend the element along the straight edge. The refractory cement will break along the row of notches. Make the bend 90°, avoiding excessive bending. (The element wires will be exposed at the corner thus formed. This will not affect its life or performance.

Make the bend 90°, avoiding excessive bending. (The element wires will be exposed at the corner thus formed. This will not affect its life or performance.)

13. Bend the other side of the element.

14. Place the hearth plate across the open end of the ‘’U” shaped element.

15. Slide the element and hearth plate unit into the chamber, pushing it firmly against the hearth collar. Use care not to damage the soft insulation. Remove any crumbs of insulation that may get between the unit and the hearth collar.

Note
Nicking or damaging the element leads will cause premature element failure.

16. Thread the element leads through the ceramic bushings. Bend the leads so they lie close to the refractory plate and the bottom insulation block. (The easiest and safest way to do this is to press the wire flat with a stick or blunt pusher. Do not use a sharp object or nick the wire.)

17. Replace the sleeving and bend the lead 3/4 turn around the terminal screw. Cut off the excess wire. Replace power wires on top of element lead wires and tighten screw. Do not cross the wire over itself around the terminal; this makes it difficult to keep the connection tight and prevents good electrical contact. If you have excess wire, cut it off. Make sure element lead wires are not touching any other wires.

18. Replace the back insulation block and back plate.

19. If replacement of back insulation is necessary, carefully redrill hole for thermocouple, using back cover as guide.

20. Examine the thermocouple, and, if it is good, reinsert it into the chamber. It should extend about 1-1/2" into the chamber. Make sure porcelain insulator is in place for the thermocouple to pass through on the steel back plate. Replace clamp and screw. (Excessive scaling, pitting, or cracks are some indications that the thermocouple may need to be replaced.)

21. Replace bottom cover of control unit.
22. Replace thermocouple cover.
23. Reconnect furnace to power supply.
24. Test operation of furnace.

To Replace Thermocouple

Warning
Disconnect the furnace from the power supply before servicing.

1. Set furnace on its top.
2. Remove thermocouple cover. (If equipped.)
3. Remove screw and clamp holding the thermocouple, then grasp the thermocouple at the bend where it enters the chamber and pull it straight back from the furnace. Retain porcelain insulator.
4. Remove bottom cover.

Note
If the thermocouple touches metal, this could short out the signal, causing the control to display room temperature. This could cause the furnace temperature to run away, possibly damaging furnace components.

5. Disconnect the thermocouple from the terminal block by removing the screws on the terminals. Pull the thermocouple through the hole in the furnace base and discard.
6. Insert the new thermocouple into the back of the furnace chamber. Make sure the porcelain insulator extends through the steel back plate to prevent the lead wires from touching metal.
7. Thread the thermocouple through the hole in the base which has a nylon insulator, replace clamp and screw.
8. Bend the thermocouple sharply toward terminal block.

9. Secure the two yellow wires marked “+” together on the terminal block. Secure the two red wires “-” together on the adjacent terminal. Make sure connections are secure to terminal block.

Note
If the control temperature display moves downward, the thermocouple leads are reversed.

A polarity test of the thermocouple and lead wire is easily made with the use of a magnet. On chromel alumel thermocouples and lead wire, the non-magnetic wire is positive (+) and the magnetic wire is negative (-).

10. Replace bottom plate.
11. Replace thermocouple cover. (If equipped.)
12. Reconnect furnace to power supply.
13. Test operation of furnace.

To Replace Insulation

Warning
Disconnect furnace from power supply before servicing.

1. Remove thermocouple cover. (If equipped.)
2. Set furnace on its top and remove screw and clamp securing thermocouple, then grasp thermocouple and remove by pulling it straight back. Retain porcelain insulator.
3. Remove back plate.
4. Remove bottom cover.
5. Disconnect the element leads from terminal block.

Note
Identify or mark wires disconnected to ensure proper placement and connection when reinstalling.

6. Disconnect thermocouple leads from terminal block.

7. Remove four nuts holding control section to furnace chamber.

8. Remove the ground nut.

9. Remove the control section from the furnace chamber. Remove plates, screws, spacers and nuts. Be sure to note how plates are assembled together for reassembly.

10. Remove back piece of insulation by opening door and pushing it out gently.

11. Remove bottom piece of insulation by lifting it out.

12. Remove element and hearth plate by pulling it straight back out of the furnace chamber. (Be careful not to damage elements.)

13. Remove side insulating pieces.

14. To remove top insulating piece and hearth collar, position the furnace on its side. Remove both objects from furnace.

15. Reposition furnace on its top. Reinsert new hearth collar and the new top piece of insulation. Insert the new side pieces of insulation last.

16. Reinsert element and hearth plate unit into the chamber, pushing it firmly against the hearth collar. (Be careful not to damage insulation.)

17. Reinsert new bottom piece of insulation over hearth plate. (Element leads and ceramic bushings should be exposed above insulation bottom piece.)

18. Thread the element leads and ceramic bushings through the bottom plate. Bend the leads so they lie close to the refractory plate and the bottom insulation block. (The easiest and safest way to do this is to press the wire flat with a stick or blunt pusher. Do not use a sharp object or nick the wire.) Secure plate to furnace chamber.

19. Reverse steps 1-9 to reassemble furnace.

To Replace Door Switches

Warning
Disconnect furnace from power supply before servicing.

1. Place furnace upside down and remove bottom cover.

2. Disconnect wires from door switches. Identify or mark wires disconnected from door switches to ensure proper placement and connection when reinstalling.

3. Remove two screws and nuts from door switches and slide door switches out.

4. Install new door switches to bracket. Place furnace in an upright position. Adjust door switches until a click is heard from the switches, when furnace door is approximately 2" from being completely closed. Secure door switches to bracket.

5. Place furnace upside down. Reconnect the wires to new door switches.

6. Replace bottom cover and place furnace upright.

7. Reconnect furnace to power supply.

8. Test operation of door switches as described in step 4.

To Replace Solid State Relay

Warning
Disconnect furnace from power supply before servicing.

1. Place furnace upside down and remove the bottom cover.
2. Disconnect the wires from the solid state relay. Identify or mark the wires disconnected to ensure proper placement and connection when re-installing.
3. Remove solid state relay from bottom cover. Note placement of solid state relay.
4. Install new solid state relay and reconnect wires.
5. Replace bottom cover and place furnace upright.
6. Reconnect furnace to power supply.

To Replace Controller

Warning
Disconnect furnace from power supply before servicing.

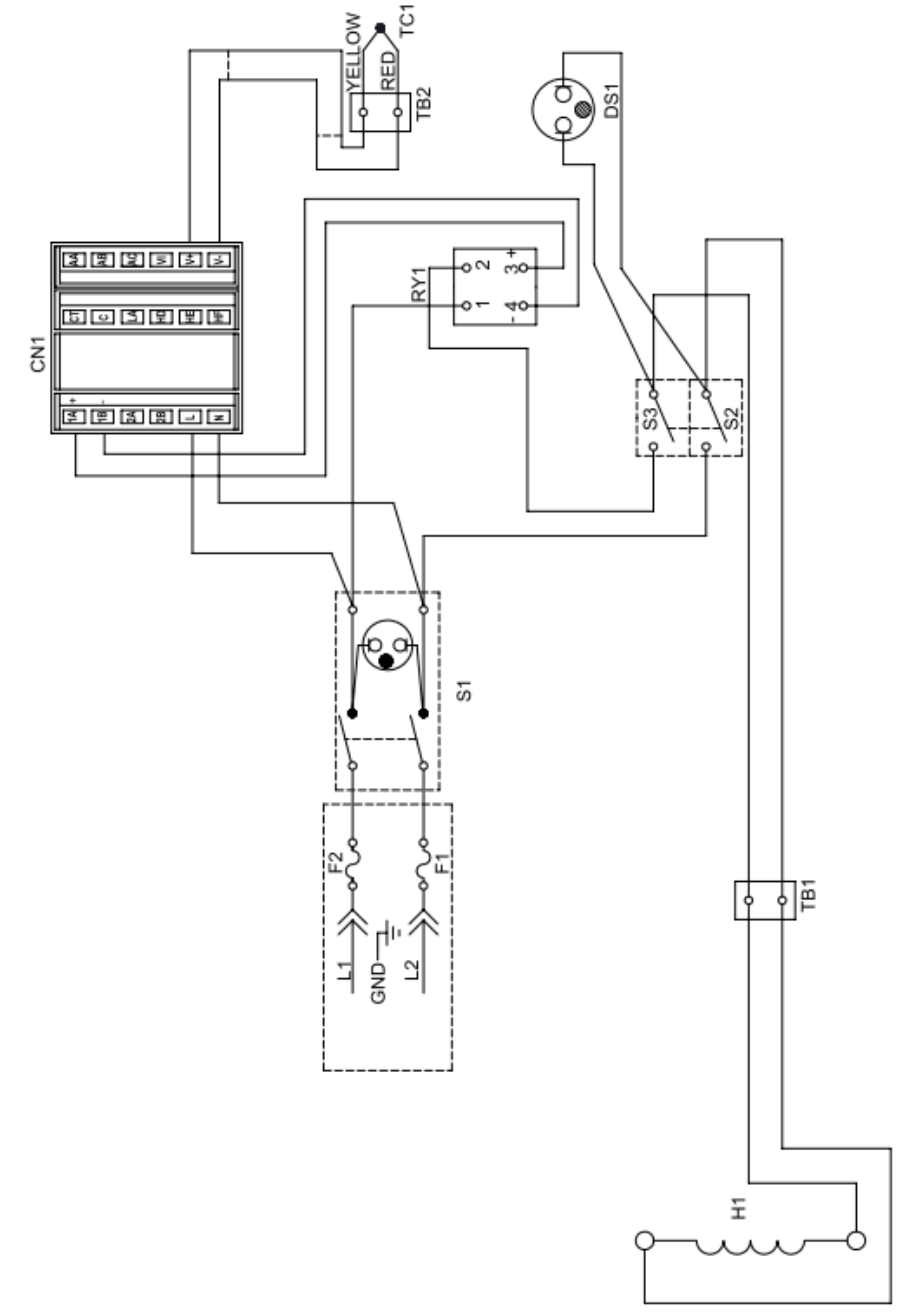
1. Place furnace upside down and remove bottom cover.
2. Disconnect wires from the controller. Identify or mark wires disconnected to ensure proper placement and connection when re-installing.
3. Remove the controller from bottom cover.
4. Install new controller and secure.
5. Reconnect wires identified in step 3 to new controller.
6. Replace bottom cover and place furnace upright.
7. Reconnect furnace to power supply.

Wiring Diagrams

FB 1400 models

DIAGRAM COMPONENT LIST

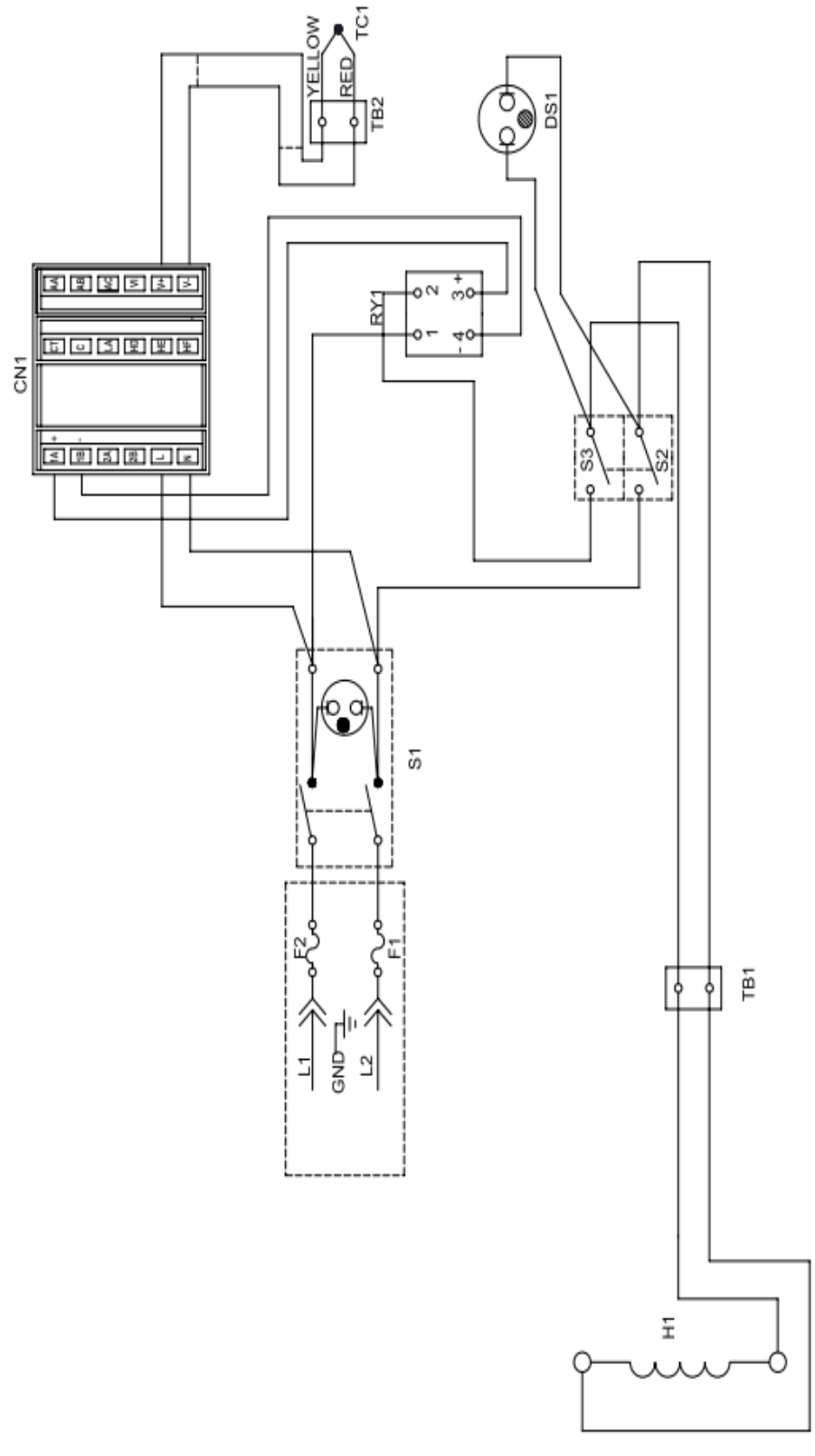
REF. NO.	DESCRIPTION	MODEL NO. AND OUR PART NO.(s) 5300A05/FB1415M-TS
CN1	CONTROL	CN71X184
DS1	PILOT LIGHT	PLX76
F1	FUSE	2-58147
F2	FUSE	2-58147
FL1	CAPACITOR	
H1	HEATING ELEMENT	EL48X1
RY1	RELAY, SOLID STATE	RYX34
S1	SWITCH, POWER	SWX143
S2	SWITCH, DOOR	SWX163
S3	SWITCH, DOOR	SWX163
TB1	TERMINAL BLOCK	TRX96
TB2	TERMINAL BLOCK	TRX136
TC1	THERMOCOUPLE	TC746X1A



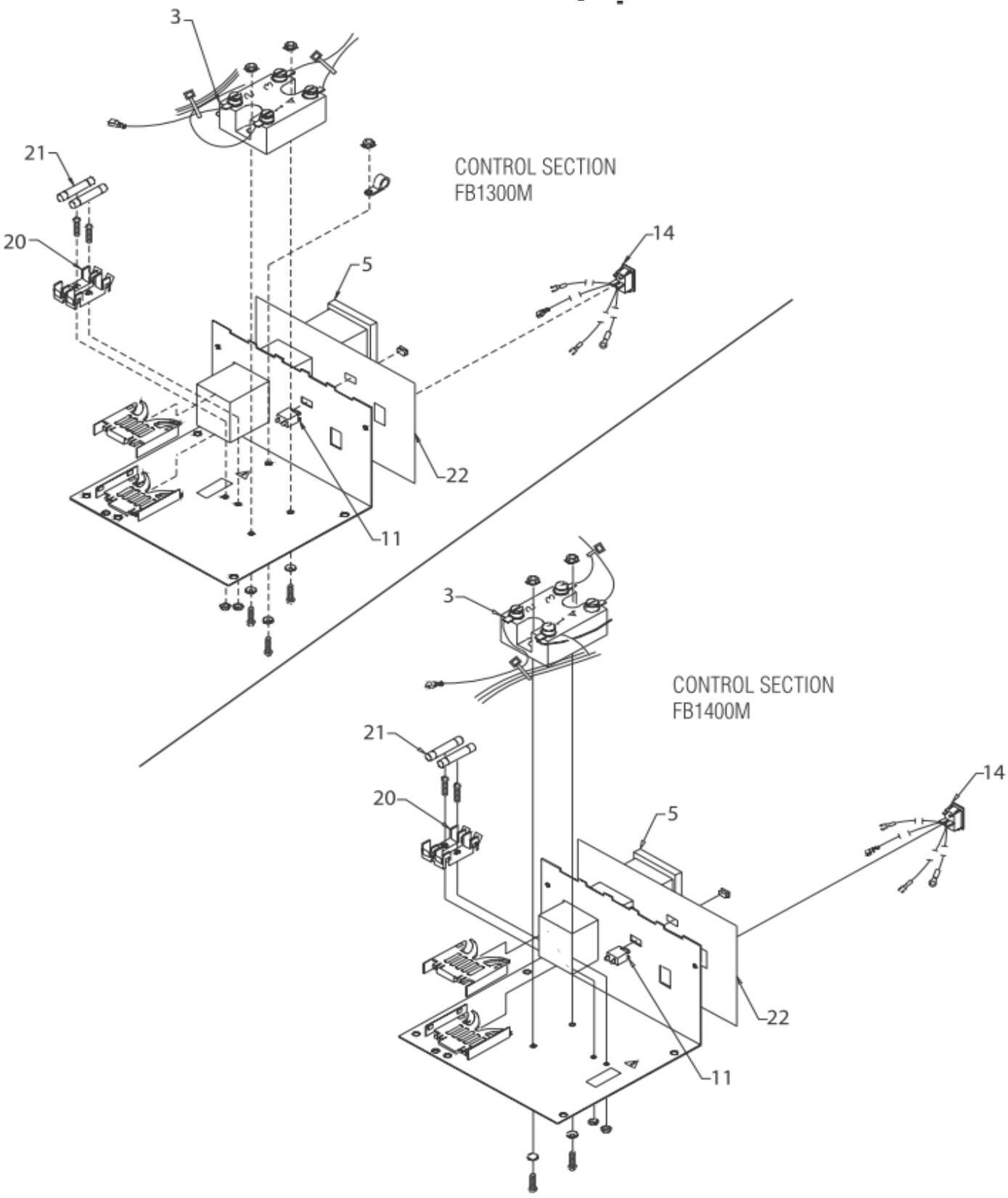
FB1300 models

DIAGRAM COMPONENT LIST

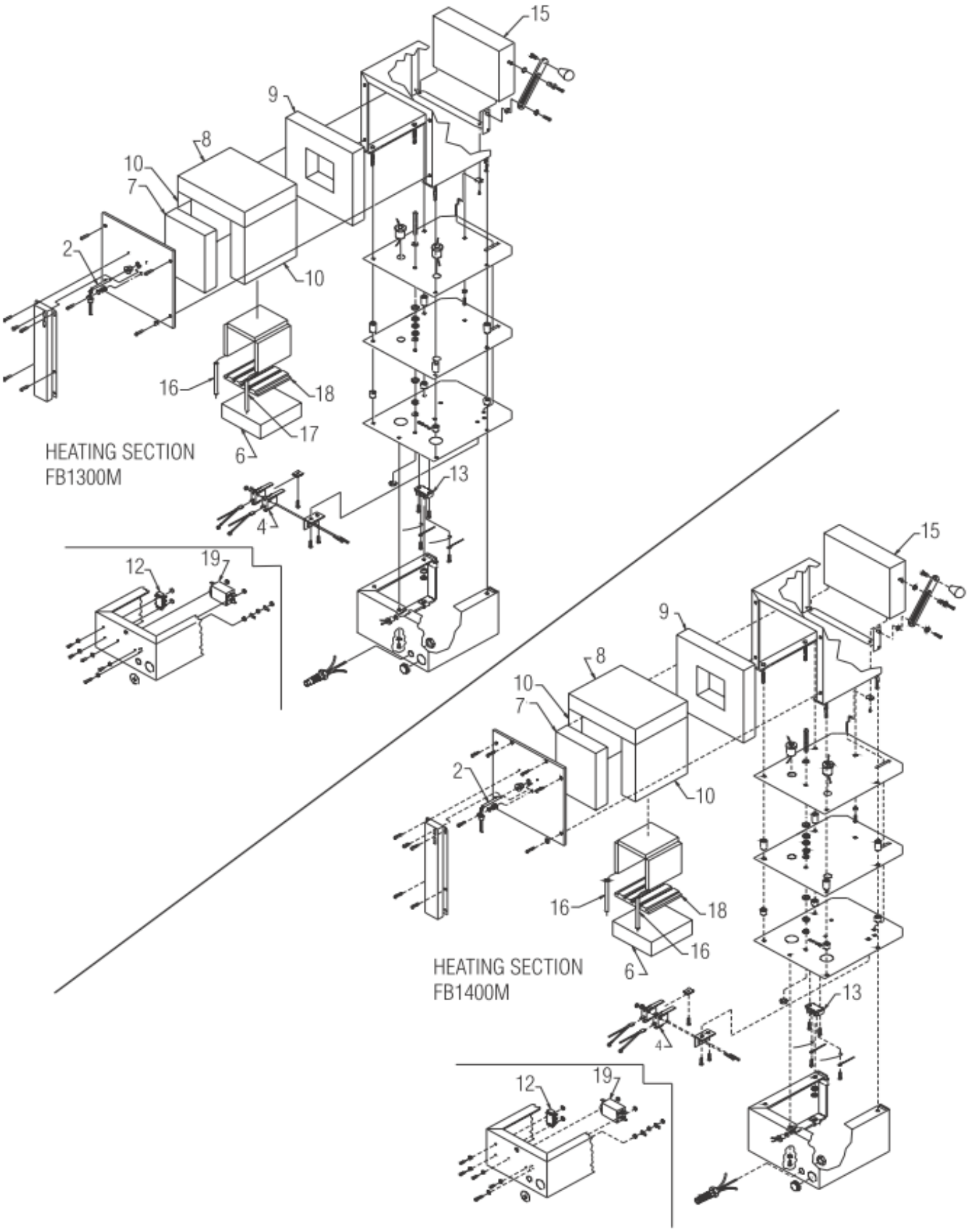
REF. NO.	DESCRIPTION	MODEL NO. AND OUR PART NO.(s)
		5300A01/FB1315M-TS
CN1	CONTROL	CN71X184
DS1	PILOT LIGHT	PLX76
F1	FUSE	2-58147
F2	FUSE	2-58147
FL1	CAPACITOR	
H1	HEATING ELEMENT	EL44X1
RY1	RELAY, SOLID STATE	RYX34
S1	SWITCH, POWER	SWX143
S2	SWITCH, DOOR	SWX163
S3	SWITCH, DOOR	SWX163
TB1	TERMINAL BLOCK	TRX96
TB2	TERMINAL BLOCK	TRX136
TC1	THERMOCOUPLE	TC745X1A



Exploded View



EXPLODED VIEW



Replacement Parts List

Key#	Description	Quantity Required	PartNumber
1	Heating element	1	0165A46
1	Heating element	1	0165A48
2	Thermocouple (5300A01/FB1315M-TS models)	1	0165A85
2	Thermocouple (5300A05/FB1415M-TS models)	1	0165A88
3	Solid State Relay	1	0165A71
4	Door Switches	2	0165A80
5	Control	1	0165A26
6	Insulation Btm (5300A01/FB1315M-TS models)	1	0165A56
6	Insulation Btm (5300A05/FB1415M-TS models)	1	0165A61
7	Insulation Back (5300A01/FB1315M-TS models)	1	0165A58
7	Insulation Back (5300A05/FB1415M-TS models)	1	0165A60
8	Insulation Top (5300A01/FB1315M-TS models)	1	0165A57
8	Insulation Top (5300A05/FB1415M-TS models)	1	0165A62
9	Insulation Hearth Collar (5300A01/FB1315M-TS models)	1	0165A53
9	Insulation Hearth Collar (5300A05/FB1415M-TS models)	1	0165A54
10	Insulation Sides (5300A01/FB1315M-TS models)	2	0165A59
10	Insulation Sides (5300A05/FB1415M-TS models)	2	0165A63
11	Cycle Light (amber)	1	0165A68
12	Terminal Block	1	0165A89
13	Terminal Block	1	0165A93
14	Power Switch	1	0165A78
15	Door Assembly (5300A01/FB1315M-TS models)	1	0165A36
15	Door Assembly (5300A05/FB1415M-TS models)	1	0165A37
16	Element Sleeving (all models)	1	0165A76
17	Element Sleeving (5300A01/FB1315M-TS models)	1	0165A75
18	Hearth Plate (5300A01/FB1315M-TS models)	1	0165A66
18	Hearth Plate (5300A05/FB1415M-TS models)	1	0165A67
20	Fuse Holder (all models)	1	0165A50
21	Fuse 15 amp .25 x 1.25 (Buss™ Type ABC, 120V models)	2	0165A23
22	Dial Plate Label (5300A01/FB1315M-TS models)	1	0165A32
22	Dial Plate Label (5300A05/FB1415M-TS models)	1	0165A33

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.

Warranty Repair and Service

In addition to manufacturer warranties, Thomas Scientific (the Company) warrants all instruments and equipment (other than supplies, small items, reagents and chemicals) delivered to and retained by their original purchasers to be free from defect in material and workmanship for one year from the date of the Company's invoice to the purchaser (Thomas Scientific makes no warranty with respect to consumable parts or supplies). For a period of one year from the date of such invoice, the Company will correct, either by repair or replacement at the Company's sole election, any defect in material or workmanship (not including defects due to misuse, abuse, abnormal conditions or operation, accident, alteration, improper installation, acts of God, or service or modification of the product without prior authorization of the Company) without charge for labor, parts or shipment of the product to and from the service facility designated by the Company. Manufacturer warranties that extend beyond this 1-year period are the sole responsibility of the manufacturer.

The determination of whether any product has been subject to misuse or abuse will be made solely by the Company. The Company shall not be liable for any delay in performance under this warranty caused by any contingency beyond the Company's control, including war, government restrictions, strikes, acts of God, or reduced supply of materials. The Company shall not be liable for any special, incidental, or consequential damages, or any damage to plant, personnel, equipment or products, directly or indirectly resulting from the use or misuse of any product. Representations and warranties made by any person, including dealers and representatives of the Company which are inconsistent, in conflict with or in excess of the terms of this warranty shall not be binding upon the Company unless placed in writing and approved by an officer of the Company.

This warranty and all claims hereunder shall be governed by the laws of the State of New Jersey, United States of America.

The foregoing warranty is in lieu of all other warranties, guarantees, or representations, whether oral, written or implied, including any warranty of merchantability or fitness for use or purpose.

The Company's liability under this warranty or otherwise with respect to products of their use (including liability for negligence or otherwise in tort) is limited exclusively to the remedies provided herein and no other right or remedy shall be available to any person.

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