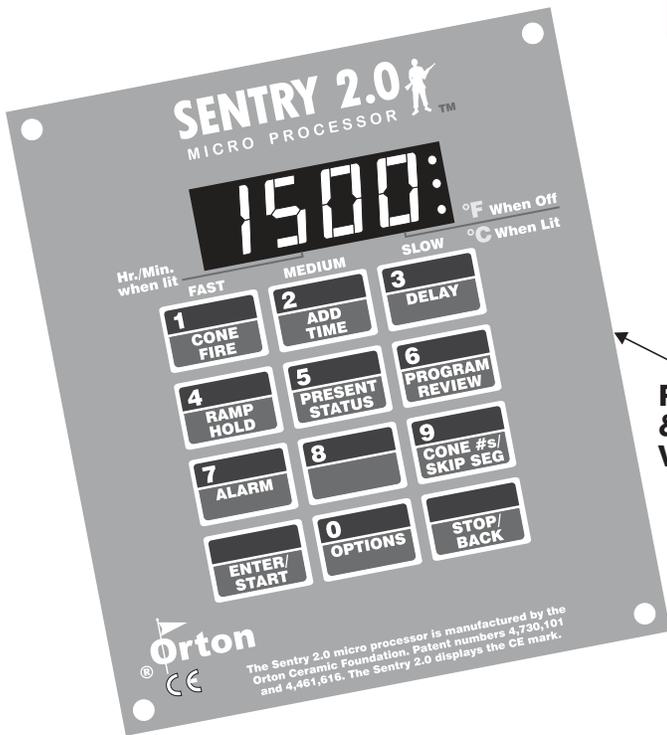
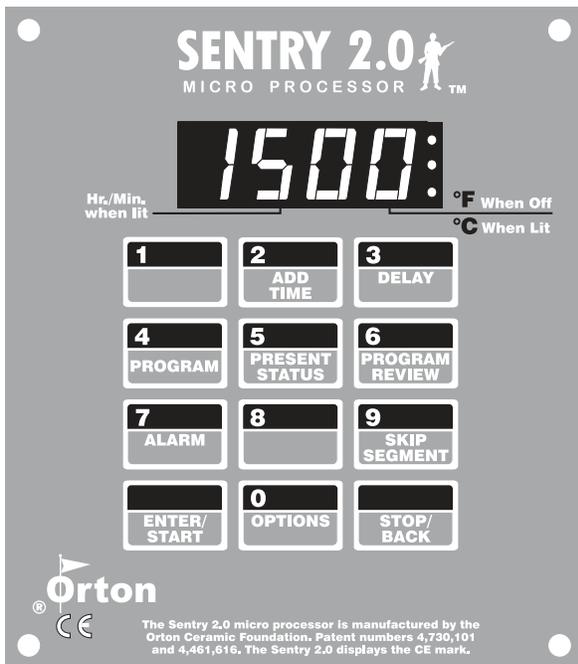


# Trouble Shooter for the Sentry Controller



Ramp-Hold & Cone-Fire Version



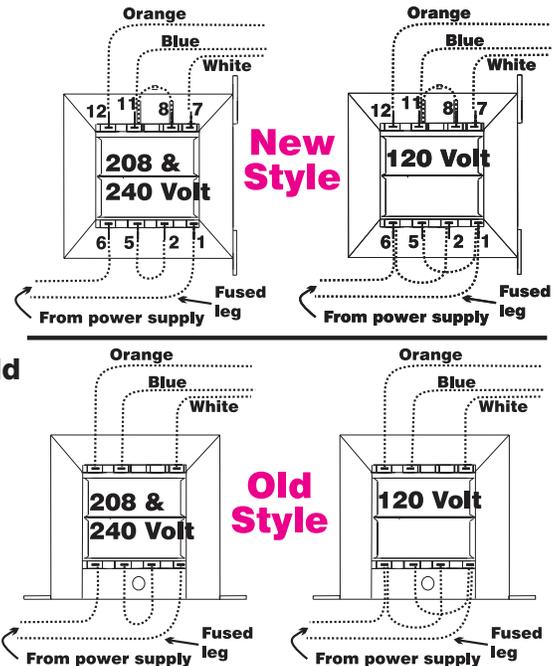
Ramp-Hold Version

Static electricity can damage the controller. Before handling the board, touch a grounded object. When shipping the controller for repairs, do not pack in bubble wrap or styro-foam peanuts. These materials can build up a static charge. Instead, use anti-static foam or even newspaper.

**⚡**  
Disconnect Power before removing controller and switch box.

## Transformers

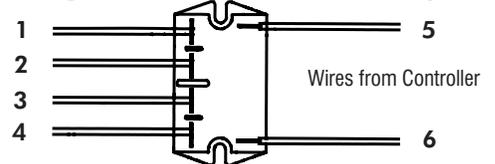
Using a transformer of the wrong voltage or connecting the wrong wires to the transformer terminals can damage the controller and cause the relays to chatter. Always make sure your new transformer is the correct voltage before installing. You can tell by looking at the jumper wires attached to the terminals.



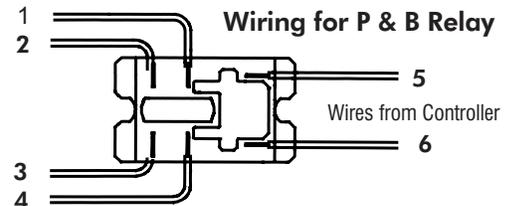
## Relay Conversion Chart

Sometimes a replacement relay will be of a different brand than the relay in your kiln. If so, transfer the wires from the old relay to the new one by the numbers on this chart. Ignore the terminal numbers printed on the relay bodies when referring to the numbers on this chart.

### Wiring for Omron & Arowmat Relays



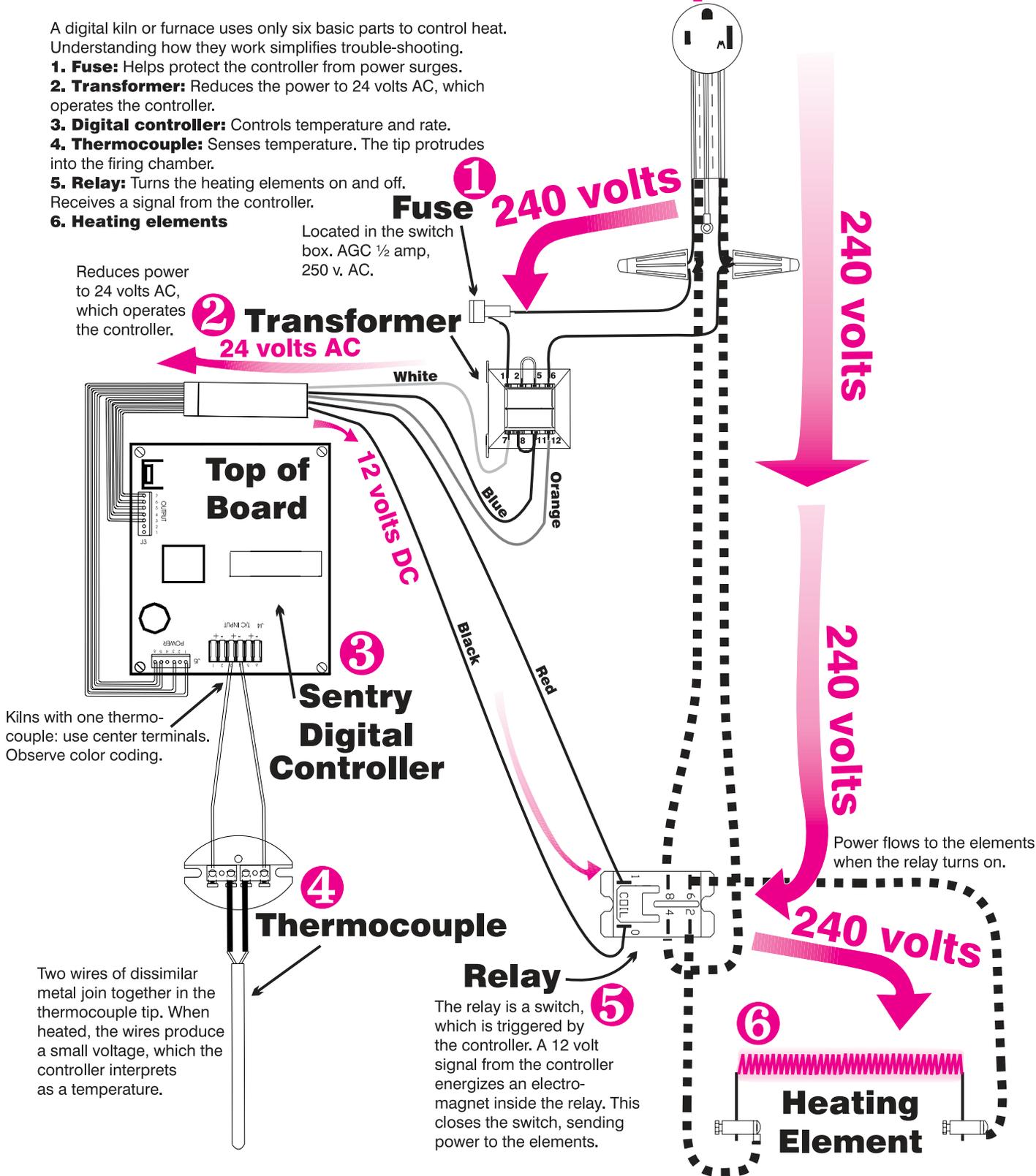
### Wiring for P & B Relay



# Digital Temperature Control Made Simple

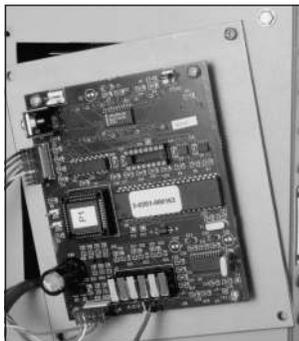
A digital kiln or furnace uses only six basic parts to control heat. Understanding how they work simplifies trouble-shooting.

- 1. Fuse:** Helps protect the controller from power surges.
- 2. Transformer:** Reduces the power to 24 volts AC, which operates the controller.
- 3. Digital controller:** Controls temperature and rate.
- 4. Thermocouple:** Senses temperature. The tip protrudes into the firing chamber.
- 5. Relay:** Turns the heating elements on and off. Receives a signal from the controller.
- 6. Heating elements**



## How to Remove the Controller

The controller is easy to remove from the switch box. First, disconnect the power. (Certain components on the back of the controller can be damaged if they touch a grounded object while the kiln is plugged in.)



Disconnect power before removing the board from the switch box.

Remove the 4 screws holding the controller board faceplate to the switch box. Lift faceplate out of box and let the board hang on the box with the back of the board facing you.

## How to Open the Kiln Switch Box

UNPLUG the kiln or disconnect the power.

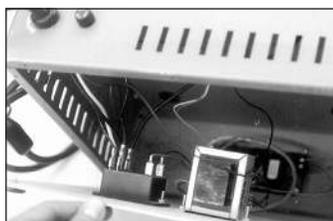
### Top-Loading Kilns

Does your kiln switch box have a support arm on the side? If so, remove two screws from the top of the switch box. The box is hinged on the bottom and will open forward. If your kiln does not have a support arm on the side of the switch box, remove the screws on each side of the switch box. Gently remove the box from the kiln.



### Front-Loading Kilns

If the switch box is mounted to the side of the kiln, remove the screws holding the box. Gently lift the box away from the kiln.



Electrical components under a small front-loading kiln.

When the controller is mounted under the kiln, remove the four screws holding the controller in place. You can gain access to the electrical components by removing a front, bottom, or back panel.

## Reinstalling a Switch Box

After you have finished the kiln repair, arrange the switch box wires so that when the switch box is placed against the kiln, no wire touches an element connector or the kiln case. These get hot enough to eventually burn off wire insulation. If your kiln includes wire nuts inside the switch box, tuck them out of the way. They must not contact the kiln case or element connectors.

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# Electrical Power Problems

## **PROBLEM** Controller display does NOT turn on. No heat in kiln.

### Is the kiln connected to the power?

Make sure the kiln is plugged in. If the kiln's wall circuit includes a power disconnect lever, make sure the lever is in the on position. Does your kiln have an on-off switch? If so, make sure the switch is turned on.



Know the location of the circuit breaker panel. Label the breaker that controls your kiln's circuit.



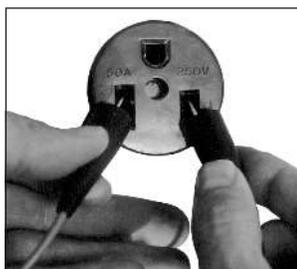
Be sure the power disconnect switch is in the on position.

### Has the circuit breaker tripped or has a fuse blown?

### Is power reaching the wall receptacle? Test with a voltmeter.

#### Wall Receptacle No-Load Test

This test should be performed only by an experienced repair person. Touch only the plastic or rubber handle of the voltmeter probes during this test. Do not remove the receptacle faceplate.



Place voltmeter probes in the two slotted, hot connections of the outlet.

Follow the instructions that came with your voltmeter, setting it to the AC mode. Insert the voltmeter probes in the receptacle's two slotted connections. You could also test the outlet with a voltage detector, which is an inexpensive instrument with a light that blinks when placed near a live wire or outlet.



6-30R  
2" dia.



6-50R  
2" dia.



6-20R  
1 3/8" dia.



5-20R  
1 3/8" dia.



5-15R  
1 3/8" dia.

### Has the kiln switch box 1/2 amp fuse blown?

#### Switch Box 1/2 Amp Fuse Ohmmeter Test

The kiln's 1/2 amp fuse is located in the switch box. Remove by pressing the fuse holder and turning counter-clockwise half a turn. Check the fuse by placing the probes of an ohmmeter on the ends of the fuse. If the ohmmeter reads less than an ohm (digital meter) or reads 0 ohms (analog meter), the fuse is okay. If the reading is OPEN (digital meter) or infinity/no needle movement (analog meter), the fuse is bad. Replacement fuse:



The fuse holder is on the side of most kiln switch boxes. Even if the wire in the fuse looks okay, the fuse could still be bad. Check with an ohmmeter.



Use an ohmmeter to test the switch box fuse.

#### AGC 1/2 A 250V AC

If replacement kiln switch box fuses keep blowing, see "Kiln switch box 1/2 amp fuses keep blowing," page 9.

*If you do not have an ohmmeter, visually inspect the fuse. You will see a thin strand of unbroken wire in a good fuse. The wire usually appears broken in a burned fuse, similar to the broken filament in a lightbulb.*

### Is the controller receiving power? Test INPUTS with a voltmeter.

#### Controller Power Input Test

Make sure the kiln is unplugged, and remove the 4 screws holding the controller board faceplate to the switch box. Lift faceplate out of box and let the board hang on the box with the back of the board facing you. Plug the kiln back in. Touch voltmeter probes (in AC mode) to both power INPUT connections. These are the white and orange wires plugged into the back of the board. You will find them in the bottom connector.



Disconnect power before removing the board from the switch box.



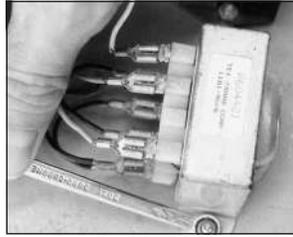
Testing for voltage at the controller's INPUT terminals.

*Do not let the back of the board touch a grounded object. Make sure the voltmeter is*

in the AC mode when placing the probes on INPUT connections. You should have 20 - 24 volts AC between the white and orange wires.

› **Controller Input Test Result: The controller is not getting power.**

UNPLUG kiln. Check the switch box for disconnected wires between the cord, transformer, and controller. Also check for any bare wires (where insulation has been damaged) touching the case. A short at a lid switch or relay can cause a 0 voltage reading at the transformer.



The transformer.

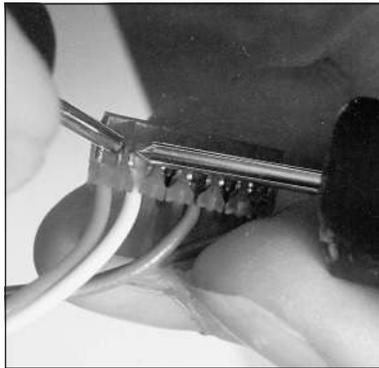
If wiring is okay, replace the transformer.

› **Controller Input Test Result: The controller is getting 20 - 24 volts AC.**

If you find 20 - 24 volts, correct voltage is reaching the board from the transformer. Since the board is not lighting up, it is probably defective. Try turning off the power for ten seconds. The board may light up when you turn the power back on. If it does not light up, return the controller for repair or replacement.

› **Controller Input Test Result: The controller is getting less than 20 volts AC.**

Did you recently replace the transformer? It may be wired for the wrong voltage. (See transformer diagrams on the cover.) Less than 20 volts is not enough voltage to operate the controller. To find out the cause of low voltage, continue below:



Testing for voltage with voltmeter probes at the disconnected INPUT wires (the white wire and orange wire).

The back of the board is still facing you. Unplug/disconnect the kiln. Remove the bottom plug from the back of the board. Touch a voltmeter probe to the white wire and the other probe to the orange wire. Plug the kiln back in.

**Result: Voltage at disconnected INPUT wires is less than 20:** There are two possible reasons: 1) Low voltage at the wall receptacle; 2) defective transformer. If wall receptacle voltage is correct, replace the transformer.

**Result: Voltage at disconnected INPUT wires is 20 - 24:** The transformer is sending correct voltage to the controller. Yet when the input wires were connected to the controller, voltage was less than 20. This means the controller is draining the voltage and is defective. Return the controller for repair or replacement.

## **PROBLEM** Controller display turns on. No heat in kiln.

### **Is the relay making its normal clicking sound?**

Program the kiln to ramp to 500°F at a rate of 100°F per hour. Start the program.

› **Yes, the relay is clicking.**

Test the elements with an ohmmeter:

#### **Element Ohmmeter Test**

1 UNPLUG kiln/disconnect the power. Open the kiln's switch box. Make sure the wires connecting the relays to the elements are secure. If connections are okay, check the elements with an ohmmeter as follows:

2 Touch the ohmmeter leads to the two element connectors of each element. Where you place the leads should be free of corrosion. A no-needle-movement reading on an analog meter, or OPEN on a digital meter, indicates a broken element.



The ohmmeter sends an electric current through the element. If the element is broken, the meter will show an OPEN circuit.

3 If your elements are wired in parallel, temporarily disconnect the lead wires from one end of the element you are testing. Hold element connector with pliers as you remove the screw. Be gentle to avoid breaking the element. Do not disturb the screw holding the element, only the one holding the lead wires.

*Rule of thumb: If both lead wires of an element connect to another element, the elements are wired in parallel. Disconnect the lead wire(s) from one end of the element you are testing.*

If the elements check out okay, perform the "Relay 12 Volt Battery Test," page 15.

› **No, the relay is not clicking.**

We know the controller is receiving voltage, because the display is lit. But the voltage from the transformer may be too low to power the relays. Perform the "Controller Power Input Test," page 4. If your controller passes the input test, perform the "Controller Power Output Test":

#### **Controller Power Output Test**

Is the controller sending voltage to the relays? Test OUTPUT with a voltmeter:

1 UNPLUG the kiln/disconnect the power. Remove the 4 screws holding the controller board faceplate to the switch

box. Lift faceplate out of box and let the board hang on the outside of the box with the back of the board facing you. Then plug the kiln back in. Use the Element Test option. (It appears as **TEST** in the display. See “Options” in the Sentry operator’s manual.) The Element Test option sends power to the relays.



Testing for voltage at the red and black output wires on the back of the Sentry.

- Put the voltmeter in DC mode. (It *must* be in DC mode when testing OUTPUT voltage.) Touch probes to the OUTPUT connections (red wire and black wire) for at least 12 seconds. The red and black wires are in the plug on the back of the controller near the top.

➤ **Output Test Result: No voltage at OUTPUT wires.**

The controller is not sending power to the relays. Return the controller for repair or replacement.

➤ **Output Test Result: 10 - 12 volts DC at OUTPUT wires.**

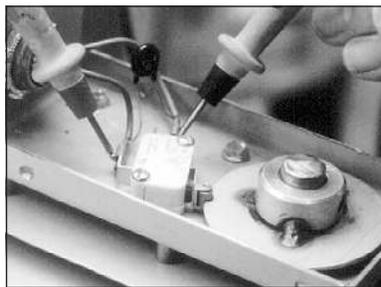
The controller is sending correct voltage to the relays. Unplug kiln/disconnect power. Remove the kiln switch box. Look for disconnected wires between the controller, relays, and elements. Check the wiring diagram to be sure wires are connected to the correct terminals. Be sure connections are tight. If the wiring is okay, perform the “Relay 12 Volt Battery Test,” page 15.

**Does the kiln have a door or lid switch?**

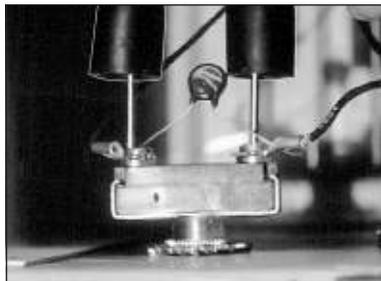
If the controller is sending correct voltage to the relays, test the door or lid switch.

**Door/Lid Switch Test**

First, UNPLUG kiln/disconnect power. Remove door/lid switch cover. Place ohmmeter leads across the two switch terminals. Open and close the door. You should get no continuity when lid/door is open. Replace or adjust the switch if you get a no continuity reading with the lid or door closed (no-needle-movement on an analog ohmmeter, OPEN reading on a digital meter).



Testing a door switch with an ohmmeter: This type of switch mounts on top of the kiln.



Testing a door switch with an ohmmeter: This switch mounts inside the main switch box.

**PROBLEM Kiln fires too slowly or will not reach temperature.**

**Is your kiln model rated to fire hot enough for the ware?**

The Sentry will not fire hotter than the maximum temperature rating of the kiln. That temperature is shown on the kiln’s electrical data plate and in the Sentry’s **SFTY** option. (See “Options” in the Sentry operator’s manual.)

**Does kiln voltage match circuit voltage?**

Be sure your 240 volt kiln is not plugged into a 208 volt outlet, and vice versa.

**Have you programmed an extended hold or Cone-Fire pre-heat?**

Check to see if you have programmed a long hold time that prevents the kiln from firing hotter.

Cone-Fire mode: If you have inadvertently programmed a pre-heat, the kiln will not heat past 200°F until pre-heat has fired to completion.

**Check wall outlet voltage with a voltmeter during firing.**

Low voltage can double firing time. Sometimes voltage is correct, but drops when the kiln turns on.

**Receptacle Under Load Test**

Only an experienced repair person should perform this test. Pull the kiln plug ¼” from the wall receptacle. Start the kiln. Place a voltmeter probe against each of the two “hot” blades of the cord plug to measure voltage. If voltage is low, try firing the kiln during periods of low demand when voltage is higher.



While the kiln is firing, measure voltage at the cord plug. Be sure not to touch the metal part of the voltmeter probes.

**Do you see water dripping from the kiln or condensing on the case?**

Dripping water means the ceramic greenware is wet. This slows the kiln to a crawl, because extra energy is needed to evaporate the water. The greenware should be bone dry before loading.

Vent the lid and fire no hotter than 200°F until moisture no longer fogs a mirror held near the top peephole. (Be careful to



With a mirror, you can detect moisture escaping from the kiln. Keep the lid in the vented position until the mirror no longer fogs.

avoid burns.) The mirror must be at room temperature, not hot, so hold it near the peephole for only several seconds.

## Did firing time suddenly, or gradually, become longer?

### › Suddenly:

This indicates a drop in voltage during peak demand, a bad relay or a broken element. See page 5 to test elements; page 15 to test relays.

Has anyone recently worked on your kiln? Some kilns with series-parallel elements will continue to fire even if they are mis-wired. But they will not fire as hot as they should. If you suspect this, unplug the kiln, open the kiln's switch box, and visually inspect the wiring. Compare it to the wiring diagram for your kiln.

### › Gradually:

This is usually caused by worn elements. Keep a record of firing times. When elements begin to wear, firing time will gradually increase.

## Does your kiln have infinite control switches?

If so, turn the switches to a higher setting.

## Does firing time vary depending on time of day or season?

This indicates low voltage during peak demand.

## Is the kiln on its own circuit, or does it share the circuit with other appliances?

The kiln should be on its own circuit. Other appliances on the circuit can slow down the firing.

## Is the circuit wire gauge heavy enough for the kiln's amperage?

See catalog specifications for your kiln, or the instruction manual. Use copper wire, not aluminum. Consult a qualified electrician.

## How far away is the breaker panel from the kiln?

If it is over 50 feet, the wire gauge should be one gauge heavier than the catalog recommendation.

## Check kiln amperage with an ammeter.

### Ammeter Test

The ammeter measures the amps that the kiln draws. If an element is burned out or a relay is broken, the kiln will draw less amperage. See the electrical data plate for your kiln's rated amperage. Before checking amps, check voltage under load, page 6. (If voltage is low, amperage will be low too.)

Only a qualified repair person or electrician should perform this test.

**1** Shut off circuit breaker for the kiln's wall receptacle.

**2** Open the kiln's switch box. Place the ammeter around either of the two hot wires coming into the switch box from the cord set.



The ammeter attaches to only one cord set hot wire. Be sure breaker is shut off before you remove the kiln's switch box. DO NOT TOUCH WIRES after you turn the breaker on.

**3** Leave the switch box open, but be careful not to touch the electrical components during step 4. Electrical parts inside the switch box carry live voltage when the power is turned on.

**4** Turn on the breaker. Start the kiln. Use the Element Test option. (It appears as **TEST** in the display. See "Options" in the Sentry operator's manual.) The ammeter will show the total amperage that the kiln is drawing.

*Kilns with more than one relay: By checking the amperage of each individual relay, you can find burned out elements or a bad relay. Clamp the ammeter around one wire that goes from the relay to the element(s).*

**› Result: Amperage is a little below normal.**

Consider replacing elements. The voltage could also be low.

**› Result: Amperage is way below normal.**

The problem is most likely a broken element or relay, or elements of the wrong resistance. See next section, "Some elements do not fire."

## **PROBLEM** Some elements do not fire.

### What is the kiln model? Which element is not firing?

See your wiring diagram. Perform either the Element Glow Test or the Scorched Paper Test:

#### Element Glow Test

**1** The kiln should be empty. Close the lid or door.

**2** In Ramp-Hold, fire at a rate of 9999 to 500°F/260°C. While the kiln is firing, study your kiln's wiring diagram. It will show which elements are wired to each relay.

**3** At around 400°F/204°C, carefully lift the lid or open the door slightly until you can see the glowing elements.

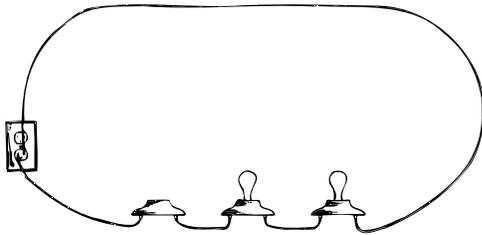
*Use a protective glove. Keep your face well away from the firing chamber. Do not reach inside the chamber. DO NOT TOUCH THE ELEMENTS WITH ANYTHING. Lift the lid for only a moment, then close.*

The center elements in most 7, 8, 10 and 12 sided kilns will not glow brightly, but there should be a faint redness. It is easier to see the elements with room lights turned off. Some kilns take 40 minutes before the elements glow red.

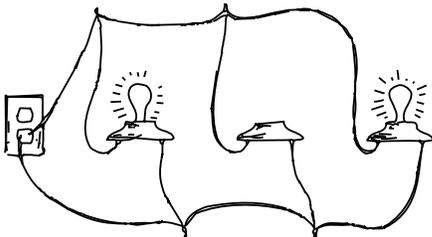
## Scorched Paper Element Test

- 1 Cut paper into 1" strips.
- 2 Turn the kiln on for a minute or two.
- 3 UNPLUG the kiln or disconnect the power.
- 4 Open the lid. Place a paper strip on an element for three to five seconds. If the paper darkens, the element is working.
- 5 Repeat for each element.

(This test is courtesy of Carl E. Bosard, kiln technician.)



Elements wired in series to the same relay: If one element is burned out, none of the elements will fire. See the light bulbs above.



Elements wired in parallel to the same relay: If one element is burned out, the other elements will still fire. See the light bulbs above.

### › Test result: All the elements for one relay remain off.

If all the elements on the same relay are out, try connecting that bank of elements to a different relay. If the elements fire on a different relay, unplug kiln and open the switch box. Look for a disconnected wire between controller, relay and elements. If wiring is okay, replace the relay the elements were originally connected to.

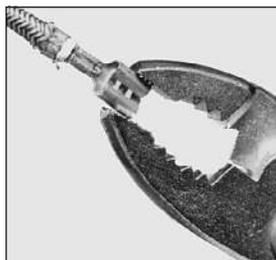
If the bank of elements do not fire after connecting to a different relay, test elements with an ohmmeter. See page 5.

### › Test result: Some, but not all, elements for one relay glow.

If more than one element is wired to the relay, the dark element is probably burned out. The problem is not the relay. Open the switch box. Look for a disconnected wire between the relay and element. If wiring is okay, test the elements with an ohmmeter. (See page 5.)

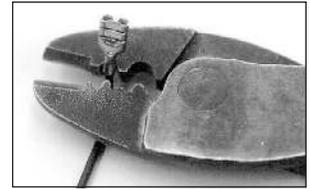
## Have you checked the kiln for loose connections?

UNPLUG kiln/disconnect the power. Open the kiln's switch box. Look for loose, corroded or



Tighten loose push-on connectors by squeezing gently with pliers.

discolored element connectors and wire terminals. They will appear dark, greenish-turquoise and sometimes white. Cut off over-heated wire terminals and crimp on new terminals. Remove the damaged element connector and inspect the element end. If the element is damaged, replace the element. Otherwise sand the element end and install a new element connector.



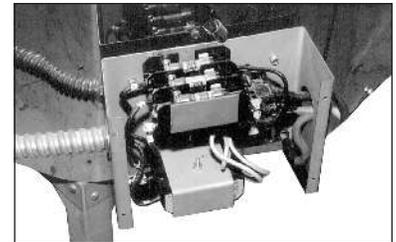
The indent on the crimping tool goes on the side opposite the seam of the connector. Test the crimp by pulling on the wire firmly.

Replace any wire in the switch box that is corroded or has brittle insulation.

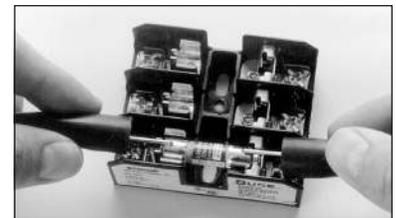
## Does the kiln have a high amperage fuse block?

### Kiln Switch Box High Amperage Fuse Test

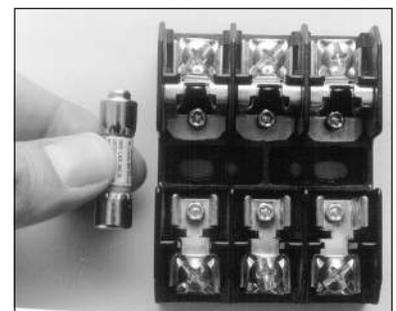
This fuse box is used only on high amperage kilns such as the Dragon, Viking-24 and Viking-28. The fuse box usually contains six fuses. If a fuse blows, one set of elements will stop working. To test fuses, disconnect the power. Place the leads of an ohmmeter on each end of a fuse. (It is okay to leave the fuse you are testing in the fuse holder.) An OPEN reading on a digital meter, or no-needle-movement of an analog meter, indicates a blown fuse. If fuses are inserted upside-down, they will be loose, which will reduce amperage available to the kiln. This could also cause the fuse to blow.



High amperage fuses are located inside a junction box on some models.



Test a high amperage fuse with an ohmmeter. You can test the fuse without removing it from the fuse holder.



The fuse must be aligned as shown above. If it is inserted upside-down, it will not make good connection. If the prongs on the fuse holder are loose, squeeze with pliers to tighten.

## Does the kiln have an infinite control switch wired to the elements that do not fire?

If the relay and elements have tested okay, replace the switch.

## **PROBLEM** Kiln heats unevenly.

### **How uneven is the temperature in the firing chamber?**

#### › If only slightly uneven:

Load more ware in the hot section and less ware in the cool section. This balances the load.

#### › If very uneven:

Check for burned out elements and bad relays. See “Some elements do not fire,” page 7.

## **PROBLEM** Circuit breaker trips or circuit fuse blows.

### **Does the circuit breaker shut off immediately after the kiln is plugged in or turned on?**

#### › Breaker trips immediately after the kiln is plugged in.

The kiln plug, wall receptacle, or any connection between the power cord and relay(s) has a short-circuit. Check the plug for discoloration and heat damage. Replace the cord and wall receptacle when the plug shows heat damage.



#### › Breaker trips immediately after the kiln is programmed and the firing starts.

The kiln has a short-circuit somewhere between the relays and elements. Unplug the kiln/disconnect the power, remove the kiln’s switch box, and check for disconnected or damaged wires. Check for mis-wired elements. Keep the kiln unplugged until you have found the problem.

### **Does the circuit breaker/fuse shut off only after the kiln has fired for awhile?**

#### › Is the breaker and circuit wiring the recommended size for the kiln’s amperage?

Check the electrical requirements for your kiln in the catalog specifications page. If the kiln is direct-wired, make sure the wire between the kiln and wall is heavy enough.

#### › Have you had hotter elements than the standard elements installed in your kiln?

This could increase the kiln’s amperage, causing the breaker to shut off.

#### › Is the kiln too close to the circuit breaker or fuse panel?

Heat from the kiln may shut off the circuit breaker or blow a fuse.

#### › Check electrical connections for tightness.

Loose connections over-heat, build resistance, and trip the breaker/blow the fuse. Does the circuit breaker panel or wall outlet feel hot? If so, have repaired by an electrician.

Unplug kiln/disconnect the power. Open the kiln’s switch box and check for loose wires. Loose or corroded element connectors and wire terminals will appear black or greenish-turquoise. See “Have you checked the kiln for loose connections?” page 8.

#### › If the above checks out okay, replace the breaker.

As circuit breakers age, they sometimes weaken and trip too easily. Even a new circuit breaker can be defective. (A circuit breaker should be replaced only by a licensed electrician.)

## **PROBLEM** Kiln switch box high amperage fuse blows.

*The high amperage fuses are on kilns rated higher than 50 amps, such as the Paragon Dragon and Vikings.*

The high amperage fuse block usually contains six fuses. If a fuse blows, one set of elements will stop firing. (See page 8.)

### **Does the fuse blow immediately after the kiln is turned on?**

The kiln has a short-circuit. Disconnect the power, remove the switch box and check for disconnected wires or mis-wired elements. Keep the kiln disconnected until you have found the problem.

### **Does the fuse blow after the kiln has fired for awhile?**

Disconnect the power. Open the kiln’s switch box and check for loose wires. Make sure the fuses in the fuse holder are tight and aligned properly. (Upside-down fuses can be loose, over-heat, and blow. See photo, page 8.)

## **PROBLEM** Kiln switch box ½ amp fuses keep blowing.

### **What size fuse are you using?**

Correct fuse: AGC ½ A 250V AC.

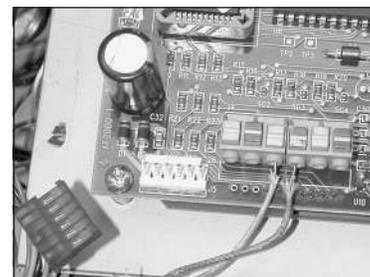
### **Test the ½ amp fuse.**

#### **Kiln Switch Box ½ Amp Fuse Power Test**

- 1 UNPLUG the kiln/disconnect the power. Remove the 4 screws holding the controller board faceplate to the switch box. Lift faceplate out of box and let the board hang on the outside of the box with the back of the board facing you. Disconnect the bottom plug



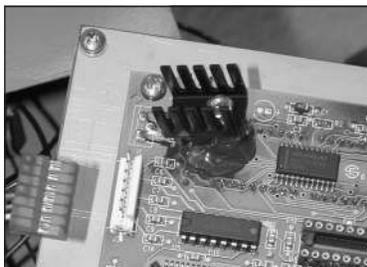
The kiln switch box fuse holder.



The power input plug has been removed from the bottom of the board.

from the back of the board. (That is the power input plug with the orange, white, blue, and green wires.) Apply power to kiln. If the ½ amp fuse blows, replace the transformer. (If the fuse does not blow, the problem is a board or relay. Go to step 2.)

- 2** Disconnect the power. Connect the bottom plug to the back of the board. Disconnect the top plug (the one with the black, brown, red, purple, and yellow power output wires). Apply power to the kiln again. Program the controller to fire to 1000°F at 9999° rate in Ramp-Hold mode. Press **START**. If the fuse blows, replace or service the board. (If the fuse does not blow, the problem is caused by a short in the coil of a relay. Go to step 3, below.)

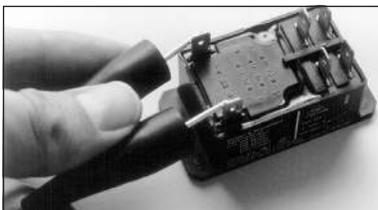


The top plug has been disconnected from the board. These are the wires that send a signal to the relay(s).

- 3** UNPLUG kiln/disconnect power. Reconnect the bottom plug to the back of the board. Reinstall the board in the switch box. Open switch box. If your kiln has one relay connected to the controller, replace the relay. Kilns with more than one relay: Perform the next test:

### Relay Coil Test

Disconnect the two controller-to-relay lead wires from the first relay. Touch ohmmeter probes to the same two terminals on the relay. A good relay reads about 80 ohms. A relay with a short in its electromagnet will read 0 - 2 ohms, which will blow the kiln's switch box fuse. Test each relay.



The ohmmeter probes are placed on the relay terminals that power its 12 volt electromagnet coil. See the relay diagrams on the cover and page 2.

### Check the fuse holder connections.

UNPLUG the kiln or disconnect the power. Open the switch box. Find the fuse holder. (See page 2.) Check the push-on connections for tightness. Loose connections can cause the fuse to blow. If they are loose, tighten with pliers. (See photo of pliers, page 8.)



Checking the push-on connectors for tightness on the ½ amp fuse holder.

## PROBLEM Wall outlet gets hot.

### Replace the wall outlet.

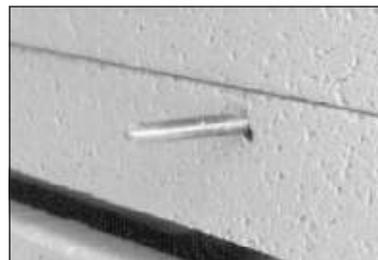
Are the receptacle and cord of the proper size for the kiln? If you smell burning plastic, turn off the breaker immediately. Touch the wall receptacle faceplate. If it feels hot, replace the receptacle. Replace the kiln cord if it has been damaged by heat from the outlet. **DO NOT FIRE THE KILN UNTIL THE RECEPTACLE AND CORD ARE REPAIRED!**

# Temperature, Display, and Keypad Problems

## PROBLEM Controller reads wrong temperature.

### What happens when you move the thermocouple tip?

Reach inside the firing chamber and wiggle the thermocouple tip. If the display makes a sizable jump in temperature, or the temperature becomes erratic, replace the thermocouple.



*This test does not apply to a thermocouple inside a protective ceramic tube.*

The ¼" thermocouple should protrude into the firing chamber ½" - ⅝". The ⅜" thermocouple should protrude into firing chamber 1".

### How close to the thermocouple are objects inside the firing chamber?

Keep shelves, posts, and ware 1 ½" away from the thermocouple.

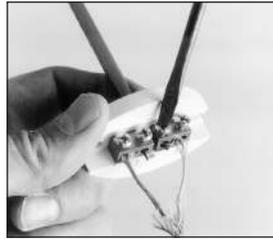
### Are thermocouple wires tight and connected to the correct terminals?

Inspect the thermocouple connections on the back of the board. (See page 3 for instructions on removing the board.) Pull the thermocouple wires to be sure they are tight. Sometimes the connector buttons can stick in the down position, resulting in a loose connection. But the connection looks okay, because the wires are still inserted all the way.

Does the thermocouple have a ceramic block? (It would be located on the other side of the wall where the thermocouple tip appears in the firing chamber. Be sure to unplug the kiln before removing switch box.) The screws in the ceramic block must be tight. Make sure the wires coming from the thermocouple and the thermocouple-to-controller wires are

connected with proper color polarity at the ceramic block and the back of board.

If the wires are reversed, the temperature will appear to cool rather than to heat. You will also get a **TCR** (Thermocouple Reversed) message. See page 16.



Tightening screw in the thermocouple ceramic block.

## Is the thermocouple or a bare thermocouple wire touching the metal case of kiln?

That can cause erratic temperature readings. Remove switch box to inspect. Also make sure the thermocouple wire insulation is in good condition. A bare spot touching the kiln case can throw the temperature readings off.

## Are you using the correct thermocouple wire?

If you are using the wrong wires to connect the thermocouple to the controller, the temperature will be inaccurate.

### Type-K Thermocouple Wire

Yellow wire (+ terminal)  
Red wire (- terminal)  
Brown or yellow outer wire insulation

### Type-S & Type-R Thermocouple Wire

Black wire (+ terminal)  
Red wire (- terminal)  
Green outer wire insulation

### Thermocouple Sheath Types

Type-K: Black or silver metal sheath  
Type-S: White ceramic 1/4" wide protection tube

## Is the correct thermocouple type selected in Options?

The Sentry can be used with Type-K, -S or -R thermocouples. Use the **TC** option, accessed through the Options key, to select the thermocouple type for your kiln. When the temperature reading is inaccurate, check that the correct thermocouple type has been selected.

If Type-S or -R has been selected, but your kiln is wired with a Type-K, your kiln will underfire. If you select Type-K and your kiln is wired with a Type-S or -R, your kiln will OVERFIRE.

Anytime you use the **RST** option (Reset), use the **TC** Option to select the correct thermocouple. The Reset option changes the thermocouple selection to Type-S. See your operator's manual for instructions on setting the options.

## Has a thermocouple offset or cone offset been entered that you forgot about?

See the **TCOS** option, which is accessed through the Options key, in your operating manual.

## How far off is the temperature?

Ceramics: Pyrometric shelf cones are the best calibration standard for ceramic firings. If all your cones consistently under- or over-fire, adjust the controller temperature using the methods below. Use witness cones in every firing. Keep a record of every firing.

**Compensating for temperature drift using offsets:** Use the **TCOS** option to adjust the temperature setting of your controller. Ceramic kilns: You could also use the **OFST** option. See your operator's manual.

**Compensating for temperature drift by programming:** Simply enter a temperature that will compensate for the thermocouple temperature drift. Cone-Fire mode on ceramic kilns: Enter a different cone number, or use hold, to compensate for temperature drift.

If the temperature is more than 45°F/25°C off, replace the thermocouple. If the temperature is still off after you replace the thermocouple, return the controller for repair.

## **PROBLEM** The kiln overfires.

See also "Controller reads wrong temperature," page 10.

## Were there error messages such as HTdE?

If not, the thermocouple gave a faulty reading, so the controller did not shut off the kiln.

## Has the thermocouple been pushed out of the firing chamber?

The 1/8" diameter thermocouple should protrude into the chamber at least 1/2" to 5/8". The 1/2" - 1/4" diameter thermocouples should protrude 1". Sometimes a shelf nudged against the thermocouple will push it out of the firing chamber.

If this has happened, remove the thermocouple ceramic block. (On most kilns, you will need to open the kiln switch box to gain access to the ceramic block.) Gently pull the thermocouple, straightening the wires attached to the ceramic block. If necessary, reposition the wires under the ceramic block screws. Reinstall the ceramic block.

## Do the elements stay on after you press STOP or after HTdE appears?

If so, the electrical contacts inside a relay are stuck in the closed position. This will also cause elements to turn on as soon as you plug in the kiln. Replace relay. See "Relay 12 Volt Battery Test," page 15.

## Is a portable wall-mounted controller positioned upright?

Portable TnF 2 wall-mounted controllers equipped with a mercury relay must be placed in an upright position. If they are placed flat on a table, the mercury relay will remain on all the time.

## **PROBLEM** The controller won't stay on hold.

### **Faulty relay.**

When you program a hold, but the temperature drops steadily, a relay may be worn out. A weak relay will shut off because the electromagnet inside the relay is too weak to turn on the power. Also, a relay with contacts stuck in the "on" position will cause the temperature to rise during hold.

## **PROBLEM** The display shows erratic temperature readings.

The controller measures firing chamber temperature every 10 seconds. The temperature shown in the display is the average of the last three samples. Thus, the displayed temperature is the average temperature for the past 30 seconds.

It is normal for the temperature to jump up or down a few degrees during firing. As temperature rises, the readout will not show a steady climb, but rather minor jumps up and down. This section of the troubleshooter is for readouts that are erratic by 10 - 15 degrees and more.

### **Does erratic temperature display start at around 1600°F?**

A poor circuit ground can cause high temperature erratic readings. So can a thermocouple that touches a grounded object such as the kiln case.

### **Is temperature erratic only when the elements are on?**

Power wires (cord-to-relay and relay-to-element wires) placed near the controller and thermocouple wire cause this type of fluctuation. Fire the kiln to around 600°F. Press STOP. This will shut off the elements. If the temperature display is no longer erratic at IdLE, try rearranging the wires inside the switch box.

### **Do the relays chatter? Does the temperature fluctuate in time with the clicking of the relays?**

A relay with a short in the electromagnet can cause an erratic display. The relay draws too much current, draining voltage from the board and interfering with normal display. Another cause is a bad transformer that produces low voltage. See "Controller Power Input Test," page 4.

Electrical "noise," which is random electromagnetic signals, can cause the controller temperature to become erratic. Sources of noise are a chattering relay, defective lid or door switch, nearby arc welding machines and heavy electric motors. Placing the controller or thermocouple wires too close to fluorescent lights can also cause noise. See "The relay chatters or buzzes," page 13.

## **Is the temperature display erratic at room temperature?**

Perform the "Thermocouple Test," page 14. If the display at room temperature is still erratic with the paperclip in place on the back of the board, the thermocouple is not the cause.

### **Has the thermocouple been installed correctly? Is the thermocouple worn out?**

Make sure the thermocouple remains out of contact with the kiln case or anything metallic. Position thermocouple lead wires away from other wires inside the switch box. Though protected by insulation, the thermocouple wires are sensitive to electromagnetic waves from other wires. Make sure thermocouple wires are attached to the correct terminals on the ceramic block (if any) and controller board. Be sure the thermocouple wire ends are separated where the insulation has been stripped. A worn thermocouple can cause erratic temperature readings. Wiggle the thermocouple tip. If the temperature jumps by a wide margin, replace the thermocouple.

### **What is the condition of the wall receptacle?**

A damaged, over-heated wall receptacle can destroy the grounding connection to the kiln, making the display more prone to erratic temperatures. Replace a damaged receptacle. If the cord shows heat damage, replace it also.

### **Have you recently changed circuit wiring (new location or new circuit)?**

If erratic temperatures appear momentarily each time the relays click on, have an electrician check the electrical circuit for a poorly connected grounding wire.

### **Did you recently change the transformer?**

A transformer of the wrong voltage can cause an erratic temperature display and missing display digits. (See the transformer diagrams on the cover.)

## **PROBLEM** The display remains stuck.

### **Stuck key.**

Return the controller for replacement of key pad.

### **Electrical noise.**

Sometimes a chattering relay or other source of electrical noise freezes the display message. Turn off the power for ten seconds. If that does not correct the problem, return the board for servicing.

## **PROBLEM** Display digits burned out (parts of display missing).

### **Has the transformer been replaced recently?**

A 120 volt transformer installed on a 240 volt kiln can burn out display digits. (See the transformer diagrams on the cover.)

## Have you checked the transformer?

Low voltage from the transformer to the board can prevent a full display. The controller shows all 8s at start up to test the display. If the controller is underpowered, it will not get out of that test mode. This results in all 8s in the display, or only a center period. See “Controller Power Input Test,” page 4.

## **PROBLEM** The “1” and/or the “4” key does not respond.

### Have you turned on Program Lock?

Check the Program Lock (displayed as **LOCK**) in your operator’s manual in the “Options” section. It deactivates the programming keys so that programs cannot be tampered with.

## **PROBLEM** Ramp-Hold target temperature shown in Program Review is lower than the temperature you entered.

### What is the maximum temperature rating of your kiln?

The controller is set at the factory to fire no hotter than the maximum temperature of your kiln. If you enter a higher temperature than the maximum, the controller will default to the kiln’s maximum temperature.

The temperature rating of your kiln is listed on the electrical data plate on the side of the switch box. You can also check the **SFTY** option. (See your operator’s manual under Options.)

# Noises

## **PROBLEM** The relay chatters or buzzes.

### Has the relay been damaged by heat? Are the connections tight?

To turn on the elements, the Sentry controller sends power to the relays. Inside each relay, the power from the controller charges an electromagnet, which closes electrical contacts that turn on the elements.

During normal operation, a relay makes a clicking noise every time its electromagnet brings the contacts together. (Mercury relays are silent, however, because they don’t use mechanical contacts.)

Sometimes a relay makes a chattering or buzzing instead of a clicking noise. This is usually because the wires inside the electromagnet have over-heated, burning the insulation on

the wires and weakening the electromagnet. Since the magnet is no longer strong enough to pull the contacts tightly together, the contacts chatter instead of click.

Before you replace a chattering relay, check the wires connected to it. A loose connection can cause even a new relay to chatter.

## Are the relays receiving enough voltage?

Voltage at the red and black wires on the back of the controller should be 12 volts DC when the controller sends power to the relay(s). Voltage below 9 volts DC may not be enough to drive the relay(s), or may cause a relay to chatter. See “Controller Power Output Test,” page 5, and “Controller Power Input Test,” page 4. If these controller tests check out okay, replace the relay that chatters or buzzes.

## **PROBLEM** The controller keeps beeping.

### Alarm is set to a lower temperature.

Turn off the alarm by pressing **ENTER**. Then program the alarm to a different temperature. See the operator’s manual.

# Error Messages

Some error messages are accompanied by an alarm. To turn off the alarm, press **ENTER**.

## **PROBLEM** BAdP / Bad Programming

This message appears when a program has been entered with 0 rate in the first segment.

## **PROBLEM** ETH / Electronics Too Hot

The circuit board temperature is above 185°F/85°C. A relay with a short can cause the board to get too hot. Perform the “Relay Coil Test” shown on page 10.

The thermocouple or a bare part of the thermocouple wire touching a grounded object, such as the kiln case, can cause an **ETH** message.

## Is room temperature unusually high?

Open windows and use a fan to circulate air in the room before firing the kiln or furnace. If you have more than one kiln in the room, place them farther apart. Never allow the firing room temperature to exceed 110°F/43°C. (Measure room temperature three feet away from the kiln.)

## Defective controller

If **ETH** appears when the room is not hot, and the relays and thermocouple are okay, return the controller.

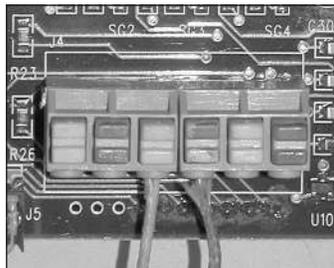
## **PROBLEM** FAIL / Thermocouple Failure

Keep a spare thermocouple on hand. Replace the thermocouple when you get a **FAIL** message. If the **FAIL** appears after you have replaced the thermocouple, try the following:

### **Are thermocouple wires connected to the board correctly?**

**UNPLUG** kiln. Remove the 4 screws holding the controller board faceplate to the switch box. Lift faceplate out of box. Look at the back of the board. You should see a yellow wire and a red wire connected to the thermocouple connection block at the bottom of the back of the board. (See diagram, page 2.) If one of these wires is disconnected or loose, reconnect or tighten.

**Button connectors:** It is possible that a wire pushed all the way into the connection can still be loose. This is because a button can stick, leaving the wire loose inside the connection. Test by pulling on each wire.



### **What is the condition of the thermocouple lead wires?**

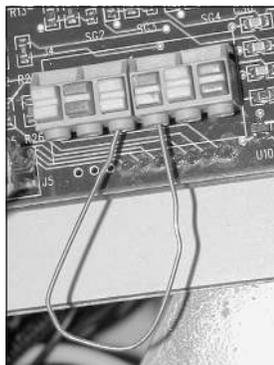
Check to make sure the insulation is in good condition. If the insulation rubs off and the bare thermocouple wire touches a grounded object inside the switch box, **FAIL** can appear. Also make sure that the thermocouple is not touching the kiln case.

### **Test the controller with a short piece of thin wire.**

If the wires were attached securely to their connectors, perform this test:

#### **Thermocouple Test**

- 1 Remove thermocouple wires from their connections. Some Sentry versions have lever connectors; others have push-button connectors.
- 2 Insert a thin piece of wire in the thermocouple connectors. (You could use a piece of thermocouple wire or paperclip.)
- 3 Place the faceplate onto the switchbox with a couple of screws.
- 4 Plug in the kiln/connect the power. If the board reads room temperature, replace the thermocouple. If it reads **FAIL**, replace the board.



A thin piece of wire being used to test the thermocouple circuit on the controller.

If you still get a **FAIL** message after replacing the thermocouple, watch for an erratic temperature display. The problem may be due to electrical noise. See “The display shows erratic temperature readings,” page 12.

### **Multiple-Zone kilns**

In a multiple-zone kiln, if a thermocouple fails, the firing will continue as a single-zone kiln so long as one thermocouple still operates. **FAIL** will appear, alternating with the thermocouple that failed (i.e. **TC 1**).

**TC 1** is connected to the left two thermocouple terminals on the back of the Sentry board; **TC 2** is connected to the center two terminals; **TC 3** is connected to the terminals on the right.

## **PROBLEM** FTC / Failed to Cool

During a cooling-down ramp, the programmed rate is faster than the kiln can cool. The temperature is above the deviation setting. (See Temperature Deviation in the operator’s manual.) Program a slower cooling rate.

## **PROBLEM** FTH / Failed to Heat

During a heating-up ramp, the programmed rate is faster than the kiln can heat. The temperature is below the deviation setting. (See Temperature Deviation in the operator’s manual.)

Program a slower rate. Or check for worn or burned out elements, defective relays, low voltage and defective thermocouple.

## **PROBLEM** FTL / Firing Too Long

The temperature change is less than 27°F/15°C per hour and the firing time is four hours longer than the current segment was programmed to fire. This message can appear during heating-up or cooling-down segments.

### **Was the firing too slow?**

If **FTL** appears well below the target temperature during a heating-up segment, such as 1000°F for an 1800°F firing, you probably have a burned out element or relay. See “Kiln fires too slowly or will not reach temperature,” page 6.

Check for worn or burned out elements, defective relays, low voltage and defective thermocouple.

### **Did FTL appear during a controlled cooling?**

If **FTL** appears during a cooling segment, it is usually because the segment was programmed to cool faster than the kiln’s natural cooling ability. To avoid getting the **FTL** message, program a slower cooling rate.

## PROBLEM HTdE / High Temperature Deviation

During a heating-up ramp or a hold, the temperature is above the deviation setting. (See the Temperature Deviation option in the Sentry operator's manual.) The kiln will shut off when the **HTdE** error code appears.

This may be caused by a temperature overshoot. See the operator's manual. Check for a stuck relay.

### Check the relay(s).

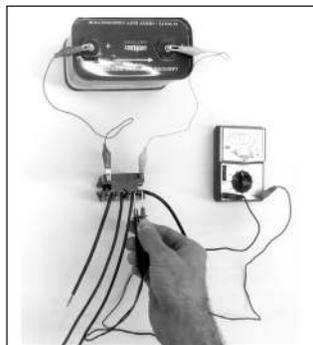
**HTdE** is caused by a stuck relay or defective controller. If the elements remain on after **HTdE** appears, check the relays as follows:

#### Relay 12 Volt Battery Test

You will need an ohmmeter, 12 volt battery and 2 clip wires.

*WARNING: You must disconnect the controller-to-relay wires to test the relay(s) with a battery. Leaving the wires connected could damage the controller.*

- 1 **UNPLUG** kiln/disconnect the power and remove switch box. Find the two wires going from the controller to the relay you are testing. Disconnect these wires from the relay. Then connect a 12 volt lantern battery to the same relay terminals (#5 and #6 on the diagrams shown on the cover) using clip wires. You should hear a click when you make the connection. If there is no click, the relay is probably defective. Make sure your battery is good before assuming the relay is bad.



Testing a relay with a 12 volt lantern battery.

- 2 Touch ohmmeter lead wires to relay terminals marked #1 and #2 in the diagrams on the cover. With the battery still connected, you should get a continuity reading (0 ohms) on the ohmmeter. (This is the same reading you would get if you touched the ohmmeter leads together.) If you get a no-needle movement when the battery is connected, replace the relay. Place the ohmmeter wires on relay terminals marked 3 and 4 on the diagrams and test the same way.
- 3 If the ohmmeter reading at terminals #1 and #2, and then #3 and #4, is 0 ohms when the battery is removed, the relay contacts are stuck. Replace the relay.

If the relays are okay and the elements turn on when you reconnect the controller wires to the relays, return the controller for repair.

## PROBLEM The "Lld" Display

Reasons **Lld** appears in the display:

1) The kiln is equipped with the optional lid safety switch. (The switch turns off power to the elements when the lid or door is open.) **Lld** appears in the display while the lid is open during firing.

2) On the back of the Sentry circuit board, at the top right side, is a small two-pin terminal. If the connector on that terminal is missing, **Lld** will appear in the display during firing. The elements will not turn on. (If the two-pin connector is missing, you can buy another from a computer supply store.)

3) The safety lid switch is defective or the safety switch wire is broken.

## PROBLEM LTdE / Low Temperature Deviation

During a cooling-down ramp or a hold, the temperature is below the deviation setting. (See "Temperature Deviation" in the operator's manual.)

Check for worn or burned out elements, defective relays, low voltage and defective thermocouple.

## PROBLEM PF, PF 2 or PF 3 during firing.

**PF** alternating with normal display means the power failed during firing. After power was restored, the firing resumed.

**PF 2** means the power failed. The kiln temperature was below 212°F/100°C when the power came back on. The kiln will not resume firing.

**PF 3** means the power failed during cone-fire mode. It can also apply to the final segment of a ramp-hold firing where that segment's rate was 108°F/60°C. The temperature dropped more than 72°F/40°C while the power was off. The kiln will not resume firing.

### Have you had a power failure?

➤ **PF, PF 2 or PF 3 message, no power failure.**

Low voltage can cause the kiln to shut off and display **PF PF 2 PF 3** or a blank display. If this happens and you did not have a power failure, check the wall receptacle, while the kiln fires, for low voltage. (See "Receptacle Under Load Test," page 6.) Sometimes there is just enough voltage to program the board. But when the relays turn on, the voltage from the transformer drops below the minimum operating level, and the display goes blank.

A corroded kiln cord plug or wall receptacle can cause a **PF PF 2 PF 3** or a blank display. Pull the plug from the wall. Clean the plug prongs with fine emery paper or a pencil eraser until the prongs are bright. If the plug or wall receptacle is blackened, replace. A loose wall receptacle screw or loose circuit breaker screw can also cause a power failure display.

Check transformer if the wall receptacle voltage is okay. See “Controller Power Input Test,” page 4.

## **PROBLEM PLOG Error Codes**

A PLOG error code means that the controller failed a self-diagnostics test. The controller will not operate while a PLOG message appears.

### **Has your controller been near a source of electrical “noise”?**

Electrical “noise” is electromagnetic interference that can affect the controller. A possible source of electrical “noise” is a chattering or buzzing relay. Other sources are fluorescent lights, large electric motors, and arc welders. Fluorescent lights can affect the controller if the thermocouple wire or controller is placed right next to a large number of lights. This is rare, though. If a nearby motor or arc welder is causing a PLOG error, move the kiln away from those sources. Does your kiln have mercury relays? If so, verify that MOVs, which reduce electrical “noise,” are installed.

### **How reliable is your electrical source?**

Low voltage and power spikes can cause PLOG errors.

Have you changed relays to a different type than the original installed on your kiln? The wrong relay type can cause a PLOG error by pulling too much power from the controller.

A relay with a short can cause a PLOG error. It can drain the power from the controller. Perform the “Relay Coil Test” shown on page 10.

### **What is the condition of your thermocouple?**

PLOG 11, 12 and 13 indicate that a thermocouple is about to fail or that electrical noise is affecting the thermocouple.

Try moving the thermocouple lead wires away from nearby electrical wires and relays.

Make sure the bare lead wires extending from the thermocouple are not touching the kiln case.

If the insulation anywhere on the thermocouple wires is rubbed off, a bare spot on the wire can touch the kiln case. This can result in a PLOG message. Check the wire for damaged insulation.

Check for loose thermocouple wire connections on the back of the controller and at the thermocouple. A PLOG error is often caused by loose screws on the thermocouple ceramic block. This is located on the other side of the kiln wall where the thermocouple extends into the firing chamber. (Note: Your kiln may not have a ceramic block.) It is also possible that the screws are tight but that the thermocouple wire under the screw is broken.

Replacing the thermocouple usually clears the PLOG 11, 12 or 13 code.

## **Were the relays chattering or buzzing?**

Electrical noise from a chattering or buzzing relay can cause a PLOG message. See page 13.

## **Clearing PLOG Error Codes**

- 1 Clear the PLOG error code by pressing **ENTER**.
- 2 If pressing **ENTER** does not clear a PLOG error, turn off power to the kiln for 10 seconds.
- 3 If the PLOG error code still appears, turn off the power. Hold down the **7** and **START** keys while you turn the power back on. This resets the controller, so you may need to reselect thermocouple type (**TC** option) and type of temperature display (**CHG** option). See “Options” in your operator’s manual.

After a PLOG error clears, it is okay to fire the kiln again with close supervision.

## **PROBLEM TCdE / Uneven Multiple Zone Temperatures**

On a multiple zone kiln, **TCdE** usually means the thermocouples and elements are improperly wired. A thermocouple is turning on the elements to the wrong zone. For instance, if the top thermocouple turns on the bottom elements, the kiln will fire out of balance. When zones are out of balance by 140°F/60°C, **TCdE** will appear in the display.

Visually compare the wiring of the thermocouples, relays and elements of your kiln to the kiln’s wiring diagram. Also, use the Element Test option. See “Options” in your operator’s manual.

## **TCR / Thermocouple Leads Reversed**

Check that the thermocouple lead wires are connected to the correct terminals. Observe correct color polarity. See your wiring diagram.

If the insulation on the thermocouple wires is rubbed off, a bare spot on the wire touching the kiln case can cause a **TCR** message. Check the wire for damaged insulation.

The thermocouple wires must be connected with correct color polarity at both the thermocouple ceramic block and the back of the controller. If you get a **TCR** message because the wires are reversed on the thermocouple block, do not correct the problem by reversing the wires on the back of the controller. If you do so, the **TCR** message will disappear, but the temperature will be less accurate.

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