

# Cone Fire/Ramp-Hold Version



# Sentry Xpress

## Digital Temperature Controller



°C Display Dot

### Temperature Display

**No Display Dot:** Temperature display is in °F.

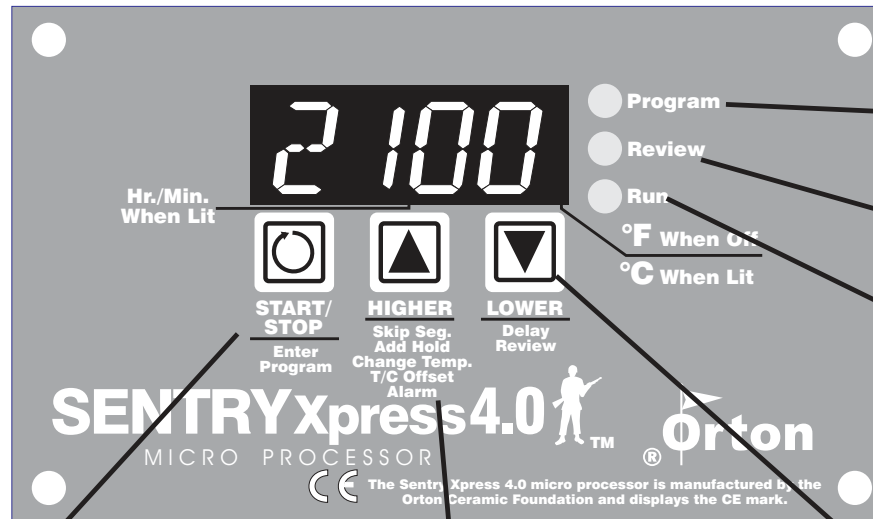
**Right-Hand Display Dot:** Temperature display is in °C.

See page 13 for instructions on selecting °F and °C.



### Time Display

**Center Display Dot:** Separates hours from minutes. Example: Display shown above is 1 hour and 30 minutes.



### Indicator Lights

**Top:** Light is on during programming.

**Middle:** Light is on during program review.

**Bottom:** Light blinks during firing.

### START/STOP Key

- 1) **On/Off:** Starts and stops a firing.
- 2) **Enter Data:** Press after each programming step. It works like the Enter key on a computer.

### Up Arrow Key

- 1) **Raise Numbers**
- 2) **Select a Firing Mode:** From **IdLE** press **START**. Press **Up Arrow** to select Cone-Fire or Ramp-Hold. Pages 6, 8
- 3) **Skip a Segment:** During a Ramp-Hold firing, press the **Up Arrow**. **SStP** will appear. Press **START**. The current segment ramp or hold number will appear. To skip, press **START** again. Page 10
- \*4) **Add Hold Time:** During a Ramp-Hold firing, press **Up Arrow** repeatedly until **HLdt** appears. Press **START**. Each time you press the **Up Arrow**, the hold time for the current segment will increase by 5 minutes. Then press **START**. Page 10

\*5) **Change Target Temperature:** During a Ramp-Hold firing, press **Up Arrow** repeatedly until **CHGt** appears. Press **START**. Use the arrow keys to change the target temperature for the current segment. Then press **START**. Page 10

\*6) **Set the Alarm:** During a firing, press **Up Arrow** repeatedly until **ALAR** appears. Press **START**. Use the arrow keys to change the alarm temperature. Press **START**. To silence the alarm, press any key. Page 10

\*7) **Adjust Thermocouple Offset:** At the **Strt** display, press **Up Arrow**. **tCOS** will appear. Use arrow keys to adjust the controller to fire hotter or cooler. Press **START** to return to **Strt**. Page 13

### Down Arrow Key

- 1) **Lower Numbers**
- 2) **Repeat the Last Firing:** From **IdLE** press **Down Arrow**. The program you have selected will appear one step at a time. When **Strt** appears, press **START**. Page 4
- 3) **Delay a Firing:** From **Strt** press **Down Arrow**. Enter delay time. Press **START**. Page 4
- 4) **Review a Program:** During firing, press **Down Arrow**. The program you entered will appear one step at a time. Page 4

\*These features are new with the Sentry Xpress 4.0. This manual, nevertheless, is backward compatible with earlier controllers.

# Introduction

Thank you for buying the Sentry Xpress micro processor. We appreciate your business.

When you first connect the power, the controller will display these messages, one after the other:

**8888**

**----** or a software code (such as 3F-1)

**IdLE**

If your controller shows **----** instead of a software code before **IdLE** appears, then the controller includes only Skip Segment from the “Advanced Features” on page 10. If your controller shows a software code such as 3F-1 before **IdLE** appears, then the controller has all the features in this manual.

The code that appears when you first turn on the power to the controller is the software version installed in the memory chip. The code is not an error message and is not in the manual, because every time the software is updated, that code number changes.

Do not worry if you hear a clicking noise during operation. Mechanical relays click as they turn the heating elements on and off.

We are constantly trying to find better ways to make kilns, and your kiln is extremely reliable. Nevertheless, it contains mechanical parts that eventually wear out. In some cases, a parts failure can lead to a kiln overfire. Therefore it is important that you occasionally check on the kiln during operation. Although the kiln does not require constant attention, it should never be left unattended. Please check the kiln especially during the later stages of firing.

Please read the manual. Damage caused by failure to follow instructions is not covered by warranty.

Write notes on the controller features that you use. Then if you are away from your kiln for a period, you can review your notes to refresh your memory. When you need to use additional controller features, such as the temperature alarm, refer back to the instruction manual. The cover shows all the controller features at a glance.

Use Program Review (see page 4) every time you fire the kiln. This is your assurance that you are firing the correct program. If necessary, check the program in the display against a written copy.

We trust that you will enjoy your kiln. Once you learn the basic features of the Sentry Xpress, you will be able to control every stage of firing. This offers learning opportunities and convenience difficult to imagine with a manual-controlled kiln.

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# Safety

The warranty on your Sentry Xpress controller does not cover damage from overfiring, regardless of the circumstances. It is the operator's responsibility to make sure the kiln turns off at the proper time.

- When the kiln is not in use, disconnect the power.
- Do not leave the kiln unattended, especially near the expected shut-off time.
- Wear green #3 firing safety glasses when looking into the firing chamber of a hot kiln.
- Do not touch hot sides of kiln. Keep unsupervised children away.
- Install your kiln at least 12 inches from any wall or combustible surface.
- Do not open lid or door until kiln has cooled and all switches are off.
- Fire only in a well-ventilated, covered and protected area away from combustible materials.
- Keep cordset away from hot sides of kiln or furnace.
- DANGEROUS VOLTAGE! Do not touch heating elements with anything. Disconnect before servicing.
- When vacuuming the kiln, keep the nozzle away from the controller and the thermocouple. Vacuum cleaners create a static charge that can damage the controller.

**Question:** Would unplugging the kiln erase the digital programs? Should the kiln be unplugged when not in use?

**Answer:** You can unplug the kiln. The digital programs will stay in memory even without power. For safety, you should unplug the kiln or disconnect the power when the kiln is not in use.

# General Guidelines

## Time and Temperature Displays

### Center Dot: Time

A center dot appears during time display. It separates hours from minutes (Example: 1 hour, 30 minutes displays as 01.30.) During temperature display, the dot disappears.



The center display dot indicates time instead of temperature.

### Right-Hand Dot: °C

When temperature is displayed in °C, a dot appears in the lower right. In °F display, it disappears. You can choose between Fahrenheit and Celsius display. See page 13.



## Operation Begins from the IdLE Display

**IdLE** must appear before you can fire the kiln.

- If **CPLt**, **STOP**, or other message appears instead of **IdLE** when the kiln is first turned on, press the **START/STOP** key (the key with the circular arrow). **IdLE** will appear.
- If you press **START/STOP** during a firing, **STOP** will appear. To get back to **IdLE**, press **START/STOP** again.
- If the display shows an error message such as **FAIL** instead of **IdLE**, see page 12.
- **CPLt** (firing completed) appears at the end of a firing. To make **IdLE** appear, press **START/STOP**.

## Thermocouple Inspection

The small rod protruding into the firing chamber is the temperature sensor, or thermocouple.

**CAUTION:** *Bumping the thermocouple can push it out of the firing chamber. This could cause an overfire! Bumping the thermocouple could also cause inaccurate readings.*

- A 1/8" diameter thermocouple should extend into the firing chamber 1/2" - 5/8".
- A 1/4" diameter thermocouple should extend into the firing chamber 1" or more.
- Keep shelves, posts and ware 1" - 1 1/2" away from the thermocouple.

## Scrolling Numbers Rapidly

During programming, hold an arrow key down several seconds, and numbers will begin to scroll rapidly. Ordinarily, you would press **Up Arrow** to raise a number and **Down Arrow** to lower it. But sometimes it is faster to press the opposite key. This is because the numbers scroll below 0000 to the highest number, and vice versa. Examples:

- To program a 99.59 hour Hold when the display shows 00.00, press the **Down Arrow** once.
- To program a FULL rate when the display shows 0000, press the **Down Arrow** once.
- To program a temperature of 200°F when the display shows 1800°F, press the **Up Arrow**. That is faster than pressing the **Down Arrow**.

## Program Review & Repeat Firing

Program Review lets you check that the information programmed into the controller is correct. Program Review shows the values for the program in active memory. Use Program Review from **IdLE** to repeat the last program you fired.

- **Using Program Review during firing:** Press the **Down Arrow** key. The rate, temperature, hold, etc. will display one after the other. Firing will continue.
- **To repeat a firing, use Program Review from IdLE:** Press the **Down Arrow** key. After rate, temperature, hold, etc., **Strt** will appear. Press **START**. **-On-** will appear, and the kiln will begin firing the program just reviewed.

## Delay

Delay is a count-down timer. The kiln begins firing when the timer runs out of time. Use delay to fit a firing into your schedule.

**CAUTION:** *For safety, do not leave the kiln alone during a delay or a firing. We cannot guarantee your kiln against overfiring even though the controller is automatic.*

- 1 After you have selected a program and the controller is ready to begin firing, **Strt** will appear.
- 2 Press the **Down Arrow** key once. **dELA** will appear, alternating with **00.00**.
- 3 Use the arrow keys to enter delay time. (The decimal separates hours and minutes. Example: 1 hour and 10 minutes = 01.10) Then press **START** twice. **dELA** will appear, alternating with time left until the firing begins.

**Note:** Press **START** during delay to end the delay and begin the firing. The maximum delay is 99 hours and 59 minutes.

## Power Failures

After a power failure, the controller will continue firing provided that:

- The kiln temperature is above 212°F / 100°C when the power comes back on.
- The temperature dropped no more than 180°F / 100°C while the power was off.

### Power Failure Messages

**PF 1** The power failed during a cooling segment, and the kiln cooled past the target temperature while the power was off.

**PF 2** The power failed during firing and kiln temperature was below 212°F / 100°C when the power came back on.

**PF 3** The power failed during firing and temperature dropped more than 72°F / 40°C by the time the power came back on.

## CPLT Message: Firing Completed

When the firing has successfully completed, the Sentry Xpress will shut off power to the elements and sound an alarm for 30 seconds. Then three messages will cycle one after the other:

- 1 **CPLT** (complete)
- 2 Firing time in hours and minutes
- 3 The current kiln temperature



## Adverse Weather

It is okay to store the controller at sub-zero temperatures. But before operating, raise the room temperature to at least 32°F / 0°C. Place a space heater within a couple of feet of the control panel and let the heater run for an hour or so. Or hang a shop light near the kiln to raise the temperature.

### Thunder Storms and Power Surges

Unplug the kiln or disconnect the power when the kiln is not in use, especially during thunder storms and in areas with frequent power surges. If the kiln is part way through a firing when a storm begins, it is probably okay to continue the firing with close supervision. Do not leave the kiln unattended.

## Canceling a New Program

If you do not touch the keys for one minute during programming, the controller will go back to the **IdLE** display. The controller will also discard the program you were entering and will retain the previous program in memory.

This is useful if you change your mind during programming and decide to keep the previous program. Instead of completing the new program, wait a minute and let the controller return to **IdLE**.



## Two Firing Modes: Cone-Fire and Ramp-Hold

To give you greater flexibility, your controller has two firing modes: Cone-Fire and Ramp-Hold.

### Cone-Fire Mode (see below)

Cone-Fire mode fires the ware to a pyrometric cone number using the Orton cone tables on page 17. This mode is for ceramics, pottery, stoneware, and glazes. Your supplier can tell you which cone number to program.

### Ramp-Hold Mode (see page 7)

Use Ramp-Hold mode to create custom firings. Select your own firing speed, temperature, and temperature hold time in up to 8 steps, or segments.

The chart shows the recommended firing mode for several types of ware:

Type of Firing	Suggested Firing Mode
China Painting	Cone-Fire
Ceramic Decals	Cone-Fire
Ceramic Glaze	Cone-Fire
Ceramic Greenware	Cone-Fire
Glass Bead Annealing	Ramp-Hold
Glass Fusing	Ramp-Hold
Glass Slumping	Ramp-Hold
Lost Wax	Ramp-Hold

## Cone-Fire

Cone-Fire mode fires the ware to a pyrometric cone. Cone-Fire is not designed for heat treating, glass fusing and enameling. For these firings, use Ramp-Hold mode (page 7). You can also use Ramp-Hold to fire ceramic pieces that require a custom firing schedule.

## Pyrometric Witness Cones

It is important to understand pyrometric witness cones, because clay and glazes are rated to cone numbers. Pyrometric cones are small pyramids of clay that bend when exposed to the correct amount of heat work. Cones are rated by number. See page 17 for a list of cone numbers and their temperatures.

When a witness cone bends during firing, the clay and glaze in that firing, rated to that cone number, have received the correct amount of heat.

Place the pyrometric witness cone on the kiln shelf near the ware you are firing. Use the cone to check for firing accuracy. The cone is the most accurate measurement of heat work in a ceramic firing. This is because the cone measures the combined effects of time, kiln atmosphere, and temperature.

We suggest using the witness cone to trouble shoot problems with the ware. If china paints appear faded and you suspect it is due to over-firing, test fire with a witness cone. Another example: glaze crazing due to under-fired bisque.

## How to Interpret the Bending of a Pyrometric Cone

The cones illustrated here are called self-supporting cones. They are the easiest type of witness cone to use.

### 1. Correct Bend

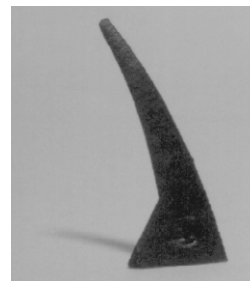
When the self-supporting cone bends so that the tip is approximately even with the top of the base, the cone has been exposed to the correct amount of heat work for that cone number. This is called a 6 o'clock bend.



A cone fired to maturity.

### 2. Under-Fired Cone

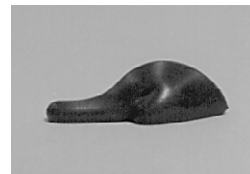
The cone in this photo has not bent far enough. It indicates that the kiln did not fire long enough or hot enough.



An under-fired cone.

### 3. Over-Fired Cone

When a cone collapses or puddles, it indicates that the kiln over-fired the ware rated to that cone number.



An over-fired cone.

**Note:** Do not be overly concerned with achieving an exact 6 o'clock bend. The difference between a 3 o'clock and a 6 o'clock bend is only a few degrees of temperature.

## How to Correct for Under- or Over-Fired Cones

Before changing a firing because of an under- or over-fired cone, make sure the correct cone was in the kiln. For instance, if you fired to cone 05, make sure the cone in the kiln was not a cone 5 instead. (See the cone temperature chart on page 17.)

### Compensating for an Under-Fired Cone

- Fire to the same cone number next time, but add hold time. How much hold time to add is a matter of experimentation. A general guideline would be 10-30 minutes.

- If the kiln still does not fire hot enough, then fire to the next hotter cone number, without hold time.
- Adjust the Thermocouple Offset. See page 13.
- Customize the firing in Ramp-Hold. See the next page.

### Compensating for an Over-Fired Cone

- Fire to the next cooler cone number.
- If firing to the next cooler cone number results in under-firing, add hold time.
- Adjust the Thermocouple Offset. See page 13.
- Customize the firing in Ramp-Hold. See the next page.

## Cone-Fire Hold

Cone-Fire Hold heat-soaks the ware at the cone temperature at the end of the firing. Without Hold, the kiln shuts off after it reaches the cone temperature. Hold maintains the cone temperature for the period you specify.

Hold is not needed in every firing. Experience will help you decide when to use Hold. Some of the reasons you might consider using it:

- To even out the temperature throughout the kiln.
- To allow heat to penetrate more completely into the clay. (Rapid firing is like cooking: the turkey will be done on the outside but not on the inside.)
- To help glaze absorb china paint.
- To heal glaze defects such as bubbles.

**CAUTION:** *Use hold sparingly. A little hold time can yield dramatic results. But too much can overfire your ware and burn out colors.*

One way to add hold time without over-firing is to fire to one cone cooler than needed. Then add enough hold time to bend the next hotter cone. Hold time needed to bend the next cone will vary. As a rule of thumb, 45 - 60 minutes of hold = one cone of heat work.

Example: to fire to cone 05, program Cone-Fire for 06 and add 45-60 minutes of hold time.

If your kiln has a peephole, watch the pyrometric witness cones during firing. Press **STOP** when the correct witness cone bends. Note how much Hold time was needed. Program that much Hold time the next time you fire the same type of ware.

**Note:** *During Hold, the display temperature will alternate with time left in Hold. To figure hold time for the next firing, subtract time left in Hold from the total hold time entered.*

When Hold is set to 99.99 hours, the Sentry Xpress will remain at that temperature indefinitely, until **STOP** is pressed.



## Cone-Fire Programming Instructions

- 1 From **IdLE**, press **START** (the left button).
- 2 Using the **Up Arrow** key (not the **Down Arrow**), skip past **PrO1** **PrO2** **PrO3** **PrO4** and select **COne**. Then press **START**.
- 3 The last pyrometric cone you fired, and its temperature, will appear. Use the arrow keys to change the cone number. Then press **START**.
- 4 **SLO** (slow) **Ed** (medium) or **FAST** will appear. Use the arrow keys to change speed. Then press **START**.
- 5 **Hld** and the hold time from the last firing will appear. (Example: 1 hour and 10 minutes = 01.10) Use the arrow keys to change the hold time. Then press **START**.
- 6 **Strt** will appear. Press **START**. **-On-** will appear, the Run indicator light will begin blinking, and the kiln will begin firing.

To stop a firing before completion, press **START/STOP**. **StOP** will appear, alternating with kiln temperature.

**Note:** *Do not be concerned if your kiln makes a clicking sound during firing. Kilns use relays to power the elements. The relays click each time their electrical contacts come together.*

**Note:** *The kiln's actual firing rate may be less than the rate you programmed, depending on the kiln model, available voltage, and density of the load you are firing.*

When the kiln fires to completion, it will beep for 30 seconds. The display will show the following:

- Firing time
- Present temperature
- **CPLt** = fired to completion

To return to **IdLE**, press **START**.

To fire the same program again, see "Program Review & Repeat Firing," page 4.

## When the Kiln Shuts Off Too Soon

If the kiln shuts off before the pyrometric witness cone bends, you can turn the hot kiln back on and keep firing.

- 1 Press **STOP** twice.
- 2 From **IdLE**, program the next hotter cone in Cone-Fire.
- 3 **Strt** will appear. To begin firing, press **START**. **-On-** will appear and the Run indicator light will begin blinking. The hot kiln will begin firing, taking up where it left off.

## How to Customize Cone-Fire

You can customize a Cone-Fire program using Ramp-Hold. (See the next section.) On pages 15 and 16, tables show the segments used to program each cone number in Cone-Fire. For instance, a cone 016 firing at medium speed ( **Ed** ) uses these two segments:

Segment	Rate °F/°C	Temp. °F/°C	Hold
1	396 / 220	1314 / 712	00.00
2	108 / 60	1422 / 772	00.00

Suppose your 016 witness cone, at a medium speed firing, only barely started to bend. To fire 25° hotter, raise the target temperature of segment 2 by 25°:

$$1422 + 25 = 1447$$

This is the program you would enter in Ramp-Hold:

Segment	Rate °F/°C	Temp. °F/°C	Hold
1	396 / 220	1314 / 712	00.00
2	108 / 60	1447 / 786	00.00

You could also easily add a slow cooling segment:

Segment	Rate °F/°C	Temp. °F/°C	Hold
1	396 / 220	1314 / 712	00.00
2	108 / 60	1447 / 786	00.00
3	100 / 55	1000 / 537	00.00

**Question:** My digital kiln is taking too long to fire: 9 ½ hours to cone 6. I want the kiln to fire in 4 hours.

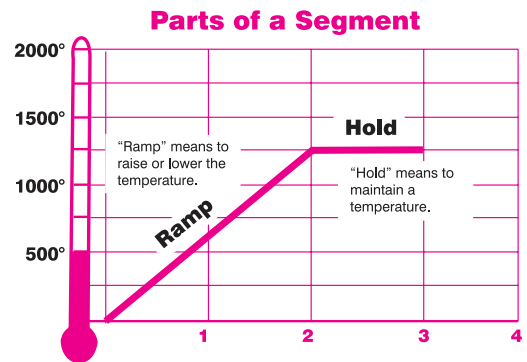
**Answer:** 9 ½ hours is the firing time programmed into the Sentry Xpress Cone-Fire mode at fast speed. The easiest way to go faster is to use Ramp-Hold mode, where you can program the exact speed that you want. Note, however, that the firing speed is limited to the kiln's heating capacity.

# Ramp-Hold Mode

## Theory of Operation

The temperature you are firing to is called the target temperature. After the controller reaches the target temperature, it can also hold that temperature.

The controller fires at a controlled heating rate. The rate is figured in degrees per hour. If you selected a rate of 100° per hour, it would take 10 hours for the kiln to reach 1000°. Rate is similar to “miles per hour.”



In summary, the controller does three basic tasks:

- 1) It fires at a controlled heating rate, or speed, measured in degrees of temperature change per hour.
- 2) It fires to a target temperature.
- 3) It can hold the target temperature.

The controller fires in segments, or stages. A segment is a given heating rate to a target temperature. Shown in the chart above is a segment with a target temperature of 1250° and a rate of 625°, with a hold of one hour.

Heating rate is figured in degrees per hour. The recommended heating rate for the material you are firing is usually available from your supplier. It also varies depending on the thickness of the material.

To figure how long a firing segment will take, subtract the current temperature from the target temperature and divide the resultant temperature by the heating rate. In the diagram above, the firing time is  $1250^\circ - 80^\circ$  (room temperature) =  $1170 \div 625 = 1.87$  hours.

The controller can fire up to 8 segments per firing. One segment is often all that is needed, though.

After the controller has finished firing the last segment, it will turn off power to the elements.

**Note:** If you enter a rate of 0000 in segment 1, or if the target temperature in segment 1 is lower than the current temperature, **badP** will appear in the display.

## Storing Programs

The controller can retain four Ramp-Hold programs in memory even when power is turned off. Programs are numbered 1 - 4.

The first message to appear after you plug in your Sentry Xpress is a software code and then **IdLE**. Press **START**. Then use the **Up Arrow** key to scroll through these messages: **PrO1 PrO2 PrO3 PrO4 COnE**.

To use Ramp-Hold mode for the first time, select **PrO1**. You do that by pressing the **START** key after **PrO1** appears. Then follow the boxed instructions in the next column to enter temperature, heating rate, etc.

**PrO1** is Program 1. When you fire the kiln again, you can repeat Program 1 by selecting **PrO1**. When you are ready to fire a different program, select **PrO2**, which is Program 2. Then enter temperatures, heating rates, etc. Select Program 3 and 4 the same way.

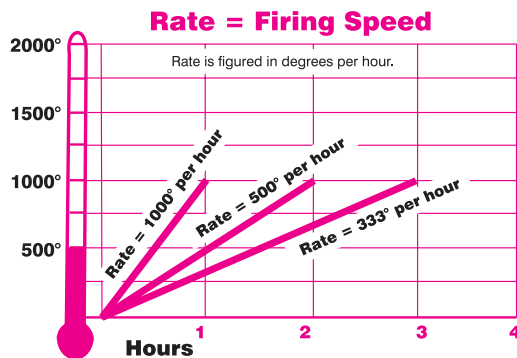
To over-write a program, select it and enter new rates and temperatures. This automatically over-writes the previous program. Write down your programs in a notebook and record firing results for all firings.

## Rate

Each segment must include a rate, which is degrees of temperature change per hour.

The kiln will fire at full power when the rate is 1799°F / 999°C. Full power displays as **FULL**.

**Note:** To select full power from **0000**, press the **Down Arrow** key once.



**Question:** I programmed a **FULL** rate, yet my kiln heated at only 550°F per hour.

**Answer:** The controller is limited by the heating capacity of each kiln. Your kiln heated at 550° per hour because that is its maximum heating rate.

## Ramp-Hold Programming Instructions

**Note:** You have up to 8 segments available in Ramp-Hold. If you don't need all 8, zero out the unused segments. See step 6 below.

- 1 From **IdLE**, press **START** (the left button).
- 2 Press the **Up Arrow** key (not the **Down Arrow**). **PrO1 PrO2 PrO3** and **PrO4** are Ramp-Hold programs. When the one you want appears, press **START**. (Ignore **COnE**.)
- 3 **rA 1** will appear. Enter firing rate (temperature change per hour) for segment 1. (1° = slowest rate. 1799°F / 999°C = full power.) Then press **START**.
- 4 **°F 1** or **°C 1** and the target temperature from the last firing will appear. Use the arrow keys to change the temperature. Then press **START**.
- 5 **HLd 1** and the hold time from the last firing will appear (Example: 1 hour 10 minutes = 01.10). Use the arrow keys to change the hold time. Then press **START**. (No hold = 00.00)
- 6 Continue entering values for the segments needed. When **rA** appears for the next segment that you don't need, select **0000**. Then press **ENTER**. This will zero out the remaining segments. (Example: You need only 1 segment. When **rA 2** appears, enter **0000**.)
- 7 **Strt** will appear. Press **START** to begin firing. **-On-** will appear and the Run indicator light will begin blinking. The kiln is now firing.

To stop a firing before completion, press **START/STOP**. **STOP** will appear, alternating with total firing time and kiln temperature.

**Note:** Do not be concerned if your kiln makes a clicking sound during firing. Kilns use relays to power the elements. The relays click each time their electrical contacts come together.

**Note:** The kiln's actual firing rate may be less than the rate you programmed, depending on the kiln model, available voltage, and density of the load you are firing.

When the kiln fires to completion, it will beep for 30 seconds. The display will show the following:

- Firing time
- Present temperature
- **CPLt** = Fired to completion

To return to **IdLE**, press **START**.

To fire the same program again, see "Program Review & Repeat Firing," page 4.



## Hold

Hold is the length of time that you want the kiln to remain at the target temperature. Hold is also called soak or dwell time. Hold maintains a steady temperature for the length of time you specify. You can use Hold in both heating-up and cooling-down segments.

When Hold is set to 99.59 hours, the controller will remain at that temperature indefinitely, until you press **STOP**. To enter a 99.59 hour Hold, press the **Down Arrow** once from 00.00 during programming.

**Note:** During firing, the display shows Hold temperature and time left in Hold.

**Question:** Should a hold time be programmed as total number of minutes, or hours and minutes?

**Answer:** Program a hold as hours and minutes rather than the total number of minutes. (i.e., 90 minutes is programmed as 1:30.)

**Question:** What is the maximum number of times per minute that the Sentry Xpress controller can turn on the relay during a hold?

**Answer:** The maximum number of relay cycles is 6 times a minute.

## Temperature Over-Shoot

When a kiln is heated too fast, it may over-shoot the target temperature, especially in small kilns at lower temperatures. To avoid this, add an extra segment in a Ramp-Hold program to slow the firing. The segment with the slower rate should begin approximately 40° - 60° below the target temperature.

## Programming a Cooling Segment

For controlled cooling, program a segment to a lower target temperature than that of the preceding segment.

Example: You fire at a rate of 500°F per hour to 1450°F with your first segment. You want the kiln to cool at a rate of 100°F per hour down to 700°F. Here is how you would program the two segments:

Segment	Rate °F/°C	Temp. °F/°C	Hold
1	500 / 277	1450 / 788	00.00
2	100 / 55	700 / 371	00.00

The first segment is the heating segment. The second one is the cooling segment. The controller does not use minus numbers for cooling. Just enter a lower target temperature than that of the previous segment.

If you prop the lid or door for a fast cooling, program a fast cooling rate for that segment. If you lower the temperature quickly by propping the lid but program a slow cooling rate, the controller will just raise the temperature again.

Example: Some glass artists flash-cool the glass just after it fuses. They open the door a few inches to remove heat, then close it again. This takes the glass down rapidly through the devitrification range. To program a flash-cool, use maximum rate. This shuts off the heating elements during that segment, allowing the kiln to cool rapidly.

**Note:** During fast cooling, do not open the door all the way. Do not force-cool the kiln with a fan.

## A Ramp-Hold Practice Program

Seg	Rate	Temp	Hold
1	250	750	—
2	900	1425	.30
3	150	750	—

Make a simple chart like the one above when planning a firing program.

To practice using the controller, we will enter a program that includes three segments. The last segment is a cooling segment.

Using the programming instructions on page 8, enter this firing schedule. Then use Program Review (page 4) to check for accuracy.

**PrO1**

**rA1 = 250**

**°F 1 = 750**

**HLd 1 = 00.00**

**rA2 = 900**

**°F 2 = 1425**

**HLd 2 = 00.30**

**rA3 = 150**

**°F 3 = 750**

**HLd 3 = 00.00**

**rA4 = 0000 (zeroes cancel segments 4-8)**

**Question:** If you stop/abort a firing to change a temperature and then resume firing, do you need to skip segments to get back to where you were before?

**Answer:** When you press Stop during a firing, re-program the controller, and then press Start, the controller will go to the first segment that matches the temperature inside the kiln. For instance, if segment 3 starts at 1200 and ends at 1700, and the kiln temperature is 1600 when you press Start, the controller will go directly to segment 3.

---

# Advanced Features

Skip Segment and Temperature Edit work only in Ramp-Hold firings. Add Hold Time and Alarm work in both Cone-Fire and Ramp-Hold firings.

## Skip Segment

Skip Segment jumps the firing from the current segment to the next one.

- 1 During a Ramp-Hold firing, press the **Up Arrow**.
- 2 **SStP** will appear.
- 3 Press **START**. The current segment ramp or hold number will appear.
- 4 Press **START** again. (If you change your mind and don't want to skip that segment, don't press **START** after **SStP** appears. The firing will continue in the same segment and the temperature will appear after one minute.)

Skip Segment skips to the ramp of the next segment from either a ramp or hold of the current segment. (Skip Segment does nothing during the final segment. To end the final segment, press **STOP**.)

### Skip Segment Example

**Skipping to a Cooling Segment:** You have programmed a target temperature of 1425°F for glass fusing, followed by a segment for controlled cooling. Watching the glass through the peephole, you notice that the glass edges have rounded nicely at 1315°. Use Skip Segment to end the firing segment and to begin the one for slow cooling.

***Note:** Make a note of the temperature at which the glass fused. Program that temperature for the next firing of that type of glass.*

## Add Hold Time

Add Hold Time adds 5 minutes to a hold. It is designed for ceramists who watch witness cones and for glass artists who inspect the glass near the end of firing.

- 1 During a Cone-Fire or Ramp-Hold firing, press the **Up Arrow** repeatedly until **HLdt** appears.
- 2 Press **START**. The hold time for the current segment will appear.
- 3 Press the **Up Arrow**. Each time you press the **Up Arrow**, the hold time will increase by 5 minutes.
- 4 Press **START**. The normal temperature will appear.

***Note:** Add Time will add 5 minutes to a hold even if no hold had been programmed.*

## Editing the Target Temperature

While the kiln is firing, you can change the target temperature. You can edit only the segment that is firing. So if the first segment is the current one, you can edit only the first segment. To edit other segments, wait until the firing has progressed to those segments.

Even if the current segment has already started its hold time, you can still edit the segment's target temperature. The controller will go back out of hold and fire to the new target temperature at the original rate. (You cannot edit the rate, however.)

- 1 During a Ramp-Hold firing, press the **Up Arrow** repeatedly until **CHGt** appears.
- 2 Press **START**. The target temperature for the current segment will appear.
- 3 Use the arrow keys to change the target temperature.
- 4 Press **START**. The normal kiln temperature will appear.

## The Alarm

While the kiln is firing, you can set the alarm, which sounds when the kiln reaches the alarm temperature. Use the alarm as a reminder to look at the glass during fusing or slumping, to look at witness cones, to close the lid from vented position, etc.

You can enter only one alarm temperature at a time. However, after the alarm beeps, you can set the alarm for another temperature, as many times as you want, during the firing. Entering an alarm temperature automatically erases the previous alarm temperature.

***Note:** The alarm temperature that you set during a firing must be higher than the current display temperature. The alarm is designed for higher temperatures and not for cooling temperatures.*

- 1 During a Cone-Fire or Ramp-Hold firing, press the **Up Arrow** repeatedly until **ALAR** appears.
- 2 Press **START**. The current alarm temperature will appear.
- 3 Use the arrow keys to change the alarm temperature.
- 4 Press **START**. The normal kiln temperature will appear.

To silence the alarm when it sounds, press any key.

***Note:** If you do not want to use the alarm, set the alarm temperature to 32°F / 0°C. This setting will turn off the alarm feature.*

# Lost Wax Burnout

**CAUTION:** Only kilns with vent holes are designed for lost wax burnout. However, you can use a kiln without the vent hole provided that you open the door ½” during venting.

**CAUTION:** Always use a wax tray.

**Note:** These instructions apply to injection wax that melts at 200°F, not pattern waxes and plastics that melt at higher temperatures. If smoke appears during wax elimination, turn off the kiln. Smoking wax means the kiln fired hotter than 300° / 148°C.

## Overview

Lost wax casting is the process of carving a shape in wax, making a mold, and then casting that shape in metal. After the wax has been carved, a mold is made of the wax shape. The mold is a negative image of the wax. The wax is later melted out of the mold through hollow channels called sprues.

Lost wax burnout is the process of preparing a casting mold for the melted metal that will be poured into it. The steps in lost wax burnout:

- 1 Melt the wax from the mold.
- 2 Remove wax from the kiln before raising the temperature higher than 300°F / 148°C.
- 3 Harden the mold at high temperature.
- 4 Maintain the mold at the casting temperature recommended for the type of metal that will be poured into the mold.

**CAUTION:** Prevent wax or carbon from contacting the kiln’s walls and elements. Carbon build-up inside a kiln ruins the interior. Carbon conducts electricity and causes elements to short circuit. Damage to elements from contact with foreign materials is not covered by warranty.

## A Sample Program

See instructions on page 8 to enter this program:

Segment	Rate °F/°C	Temp. °F/°C	Hold
1	500 / 277	300 / 148	01.00
2	500 / 277	1350 / 732	01.00
3	450 / 250	800 / 426	02.00

Segment 1 heats the wax to 300°F / 148°C and holds it for one hour, allowing it to drip from the mold.

Segment 2 hardens the mold.

Segment 3 lowers temperature to 800°F / 426°C, the typical casting temperature for silver. (Most types of gold cast at 900°F / 482°C.)

**Note:** Casting temperature depends on the size of the mold. The temperatures above are only a guide. See your jewelry supply dealer for temperature recommendations.

## Burnout Instructions

- 1 Place a metal tray inside the kiln on three ½” posts. Place the mold on a wire mesh screen on top of the tray. The mold’s sprue hole should be down. The tray will catch melting wax as it drips from the sprue hole.
- 2 Keep the kiln’s vent hole(s), if any, open during wax elimination. If the kiln has no vent hole, leave the door open ½”. This allows fumes to escape the kiln. Heat the kiln to 300°F / 148°C and hold it at that temperature for at least one hour.

**Note:** Do NOT heat the wax above 300°F / 148°C. Hold at 300°F / 148°C for at least one hour. During this hour, the wax will melt from the mold and drip into the tray. If the kiln gets hotter than 300°F / 148°C, the wax may smoke and deposit carbon inside your kiln, causing expensive damage.

- 3 After one hour at 300°F / 148°C, open the kiln. Remove the mold and wax tray. Pour the wax from the tray and leave the tray out of the kiln until your next wax elimination. (Do not leave the tray in the kiln!)
- 4 Heat the mold to the temperature recommended by your jewelers’ supply house where you purchased the mold material. This is usually around 1350°F / 732°C.
- 5 Lower the temperature to the casting temperature of the metal. Hold at that temperature until you are ready to begin casting. Remove the mold with tongs. Wear protective gloves and safety glasses.

## Saving a Carbon-Damaged Kiln

If you follow the above directions, your kiln should be safe from wax damage. In some cases, a small amount of carbon may form on the walls over a period of time. This is due to the burning of wax residue that was left in the mold. For this reason we recommend that you periodically fire the kiln to 1500°F / 815°C as follows:

- 1 Open the vent cover(s) or leave the door ajar ½”.
- 2 Fire the kiln empty to 1500°F / 815°C at a rate of 300°F / 166°C with a one hour hold (01.00).

# Error Messages

## bAdP / Bad Programming

The kiln will not fire because a) the Ramp-Hold program just entered has a rate of 0000 in segment 1, or b) the target temperature in segment 1 of Ramp-Hold is lower than the current temperature.

## EtH / Electronics Too Hot

The circuit board temperature is above 176°F / 80°C. Press any key to return to **IdLE**.

To lower the board temperature, use a fan to blow air across the kiln switch box into the louvers. (But do not blow air into the kiln's peepholes.) 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.)

## Fail / Thermocouple Failure

The thermocouple, or temperature sensor, failed during firing. Causes:

- Defective thermocouple or disconnected/loose wires
- Defective controller
- Electrical noise

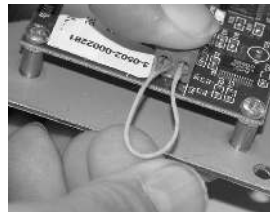
### Thermocouple Paperclip Test

Check the thermocouple wire connections. (See your kiln instruction manual.) If connections are tight, perform this test:

- 1 UNPLUG the kiln or disconnect the power. Remove the controller. Remove the two thermocouple wires from the back of the controller.
- 2 Cut a thin paperclip in half. Insert a U-shaped paperclip piece, or other piece of thin wire, where you removed the thermocouple wires.
- 3 Plug in the kiln. **Fail** will appear. Press **START**. Test results:

A) If the controller displays room temperature and **IdLE** after you press **START**, replace the thermocouple.

B) If the display still shows **Fail** after you press **START**, return the controller for repair or replacement.



## FE Error Messages

Message	Problem
FE 1	Memory Read/Write Failure
FE 2	RAM Failure
FE 3	OEM Factory Data Corruption
FE 4	Thermocouple "Noise"
FE 5	Software Error

### To return to **IdLE** from an FE code

Try pressing any key. If that doesn't work, turn the power off for 10 seconds. Call the factory if the error message remains when you turn the power back on.

If you get an **FE 4** message, check the wire connections going from the back of the controller to the thermocouple. A loose connection can cause the **FE 4** message.

## FtL / Fired Too Long

This message appears when both of the following conditions are met:

- The temperature rise is less than 27°F / 15°C per hour.
- The firing is 2 hours longer than programmed.

Programming a cooling segment target temperature that is below or even close to room temperature can also trigger the **FtL** message.

See "Controller display turns on. No heat in kiln," page 17.

**Question:** The controller on my Paragon SC-2 jewelry kiln flashes **FtL**, but only when I include a controlled cooling. What is happening?

**Answer:** **FtL** means "firing too long." But "firing too long" applies to cooling as well as to heating. **FtL** can appear if you program a segment for slow cooling and the kiln is taking too long to cool. Program a slower cooling rate. **FtL** will also appear if you program a cooling segment target temperature that is below or close to room temperature.

## HtdE / High Temperature Deviation

(This error message is accompanied by an audible alarm, which sounds for one minute.) Causes:

- During a heating-up ramp or a hold, the temperature is 100°F / 56°C above the programmed temperature.
- During a cooling-down segment, the temperature is 100°F / 56°C higher than the segment's starting temperature.
- A fast rate caused the controller to overshoot the target temperature.
- Check for a stuck relay.

## PF 1 / Power Failure

The power failed during a cooling segment, and the kiln cooled past the target temperature while the power was off. The kiln will not resume firing. To return to the **IdLE** display, press any key.

## PF 2 / Power Failure

The power failed during firing and kiln temperature was below 212°F / 100°C when the power came back on. The kiln will not resume firing. To return to the **IdLE** display, press any key.



## PF 3 / Power Failure

The power failed during firing and temperature dropped more than 72°F / 40°C by the time the power came back on. The kiln will not resume firing. To return to the **IdLE** display, press any key.

## tC / Thermocouple Failure

The thermocouple failed during the **IdLE** display. See the "paperclip" test under "FaIL," page 12.

## tCL / Thermocouple Lag

The heating rate is slower than 9°F / 5°C per hour and the actual kiln temperature is more than 100°F / 56°C away from the programmed temperature. The tCL alarm becomes inactive above 500°F. To return to the **IdLE** display, press any key. Causes:

- Worn or burned out elements, defective relays, low voltage, and defective thermocouple.
- On kilns that use a portable controller, the thermocouple has fallen out of the firing chamber.
- A bare spot on the thermocouple lead wires has touched a grounded object inside the kiln switch box causing the thermocouple to short out.
- You have programmed a cooling segment temperature that is below room temperature.

## tCr / Thermocouple Reversed

- This usually means the thermocouple lead wires are reversed. Check that the thermocouple lead wires are connected to the correct terminals. See your kiln's wiring diagram.
- The thermocouple may be starting to fail and is sending erratic signals to the controller.
- The thermocouple inside the kiln is much colder than the controller circuit board.

# Thermocouple Offset

You can calibrate the controller to fire up to 20°F / 11°C hotter or cooler than the zero factory setting.

- 1 From **IdLE**, press the **Down Arrow** key. After rate, temperature, hold, etc., **Strt** will appear.
- 2 With **Strt** shown in the display, press the **Up Arrow** key.
- 3 **tCOS** will appear. Press the arrow keys to change the controller temperature.
- 4 Press the **START** key to return to the **Strt** display.
- 5 To fire the controller, press **START**. **-On-** will appear. Or to return to **IdLE**, press **START** two more times.

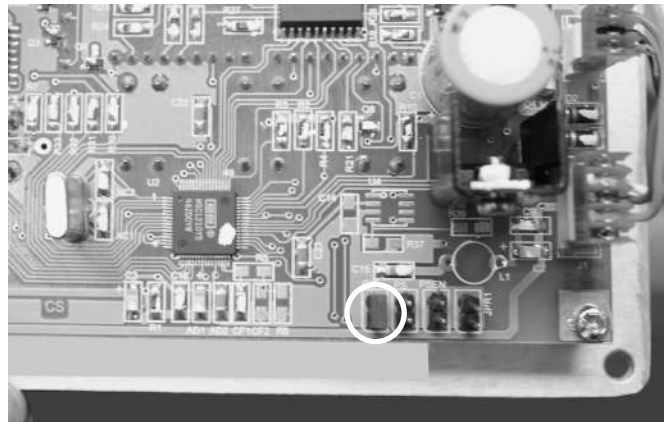
# Selecting °F or °C Display

The controller can display temperature in either °F or °C. If your controller shows a small display dot in the lower right corner of the display, the temperature shown is °C. No dot means °F. To change temperature display:

- 1 UNPLUG kiln or disconnect power.



- 2 Remove the four screws that hold the controller to the kiln. Carefully remove the controller from the kiln. Leave wires attached to the controller.



The C/F jumper terminal is on the back of the controller, circled above.

- 3 Look at the back of the controller. You will find a set of connector pins near the bottom labeled "C/F." When a jumper is placed on the C/F pins, the display reads °F. When the jumper is removed, display reads °C. Remove or insert the jumper as desired. (You can purchase the jumper from a computer supply store if necessary.)
- 4 Install the controller being careful not to jar components on the back of the controller against the kiln case.

# Cone-Fire Schedules - °F

Selecting a Fast speed in Cone-Fire increases the segment rates shown in this chart by 20%. Selecting a Slow speed decreases the segment rates by 20%. (However, the rate shown in this chart for the last segment remains the same whether you select Fast, Medium, and Slow speeds.)

Note: Your controller accepts only cone numbers that fall within the kiln's maximum temperature range.

## Low Fire Cones °F

Cone	Segment 1		Segment 2	
	Rate 1	Temp. 1	Rate 2	Temp. 2
022	396	979	108	1087
021	396	1004	108	1112
020	396	1051	108	1159
019	396	1144	108	1252
018	396	1211	108	1319
017	396	1252	108	1360
016	396	1314	108	1422
015	396	1348	108	1456
014	396	1377	108	1485
013	396	1431	108	1539
012	396	1474	108	1582
011	396	1499	108	1607

## Medium Fire Cones °F

Cone	Segment 1		Segment 2		Segment 3		Segment 4	
	Rate 1	Temp. 1	Rate 2	Temp. 2	Rate 3	Temp. 3	Rate 4	Temp. 4
010	324	1022	153	1112	180	1549	108	1657
09	324	1022	153	1112	180	1580	108	1688
08	324	1022	153	1112	180	1620	108	1728
07	324	1022	153	1112	180	1681	108	1789
06	324	1022	153	1112	180	1720	108	1828
05	324	1022	153	1112	180	1780	108	1888
04	324	1022	153	1112	180	1837	108	1945
03	324	1022	153	1112	180	1879	108	1987
02	324	1022	153	1112	180	1908	108	2016
01	324	1022	153	1112	180	1938	108	2046

## High Fire Cones °F

Cone	Segment 1		Segment 2		Segment 3		Segment 4	
	Rate 1	Temp. 1	Rate 2	Temp. 2	Rate 3	Temp. 3	Rate 4	Temp. 4
1	324	1022	153	1112	162	1863	108	2079
2	324	1022	153	1112	162	1872	108	2088
3	324	1022	153	1112	162	1890	108	2106
4	324	1022	153	1112	162	1908	108	2124
5	324	1022	153	1112	162	1951	108	2167
6	324	1022	153	1112	162	2016	108	2232
7	324	1022	153	1112	162	2046	108	2262
8	324	1022	153	1112	162	2064	108	2280
9	324	1022	153	1112	162	2084	108	2300
10	324	1022	153	1112	162	2129	108	2345

# Cone-Fire Schedules - °C

Selecting a Fast speed in Cone-Fire increases the segment rates shown in this chart by 20%. Selecting a Slow speed decreases the segment rates by 20%. (However, the rate shown in this chart for the last segment remains the same whether you select Fast, Medium, and Slow speeds.)

Note: Your controller accepts only cone numbers that fall within the kiln's maximum temperature range.

## Low Fire Cones °C

Cone	Segment 1		Segment 2	
	Rate 1	Temp. 1	Rate 2	Temp. 2
022	220	526	60	586
021	220	540	60	600
020	220	566	60	626
019	220	618	60	678
018	220	655	60	715
017	220	678	60	738
016	220	712	60	772
015	220	731	60	791
014	220	747	60	807
013	220	777	60	837
012	220	801	60	861
011	220	815	60	875

## Medium Fire Cones °C

Cone	Segment 1		Segment 2		Segment 3		Segment 4	
	Rate 1	Temp. 1	Rate 2	Temp. 2	Rate 3	Temp. 3	Rate 4	Temp. 4
010	180	550	85	600	100	843	60	903
09	180	550	85	600	100	860	60	920
08	180	550	85	600	100	882	60	942
07	180	550	85	600	100	916	60	976
06	180	550	85	600	100	938	60	998
05	180	550	85	600	100	971	60	1031
04	180	550	85	600	100	1003	60	1063
03	180	550	85	600	100	1026	60	1086
02	180	550	85	600	100	1042	60	1102
01	180	550	85	600	100	1059	60	1119

## High Fire Cones °C

Cone	Segment 1		Segment 2		Segment 3		Segment 4	
	Rate 1	Temp. 1	Rate 2	Temp. 2	Rate 3	Temp. 3	Rate 4	Temp. 4
1	180	550	100	600	90	1017	60	1137
2	180	550	100	600	90	1022	60	1142
3	180	550	100	600	90	1032	60	1152
4	180	550	100	600	90	1042	60	1162
5	180	550	100	600	90	1066	60	1186
6	180	550	100	600	90	1102	60	1222
7	180	550	100	600	90	1119	60	1239
8	180	550	100	600	90	1129	60	1249
9	180	550	100	600	90	1140	60	1260
10	180	550	100	600	90	1165	60	1285

# Temperature Equivalents For Orton Self-Supporting Pyrometric Cones



°F

Cone Num-ber	Self-Supporting Cones			Pre-Fire Color
	Heated at: 27° F Per Hour*	108° F Per Hour*	270° F Per Hour*	
022	—	1087	1094	Green
021	—	1112	1143	Fuschia
020	—	1159	1180	Orange
019	1213	1252	1283	Yellow
018	1267	1319	1353	White
017	1301	1360	1405	Pink
016	1368	1422	1465	Light Blue
015	1382	1456	1504	Violet
014	1395	1485	1540	Gray
013	1485	1539	1582	Green
012	1549	1582	1620	Fuschia
011	1575	1607	1641	Orange
010	1636	1657	1679	Dark Red
09	1665	1688	1706	Dark Red
08	1692	1728	1753	Dark Red
07	1764	1789	1809	Dark Red
06	1798	1828	1855	Dark Red
05 1/2	1839	1859	1877	Dark Red
05	1870	1888	1911	Dark Red
04	1915	1945	1971	Dark Red
03	1960	1987	2019	Dark Red
02	1972	2016	2052	Dark Red
01	1999	2046	2080	Dark Red
1	2028	2079	2109	Dark Red
2	2034	2088	2127	Dark Red
3	2039	2106	2138	Dark Red
4	2086	2124	2161	Gray
5	2118	2167	2205	Green
5 1/2	2133	2197	2237	White
6	2165	2232	2269	Fuchsia
7	2194	2262	2295	Orange
8	2212	2280	2320	Yellow
9	2235	2300	2336	White
10	2284	2345	2381	Pink

\*Rate of temperature increase during last 90 - 120 minutes of firing. Tables by courtesy of the Edward Orton, Jr. Ceramic Foundation.

°C

Cone Number	Self-Supporting Cones			Pre-Fire Color
	Heated at: 15° C Per Hour*	60° C Per Hour*	150° C Per Hour*	
022	—	586	590	Green
021	—	600	617	Fuschia
020	—	626	638	Orange
019	656	678	695	Yellow
018	686	715	734	White
017	705	738	763	Pink
016	742	772	796	Light Blue
015	750	791	818	Violet
014	757	807	838	Gray
013	807	837	861	Green
012	843	861	882	Fuschia
011	857	875	894	Orange
010	891	903	915	Dark Red
09	907	920	930	Dark Red
08	922	942	956	Dark Red
07	962	976	987	Dark Red
06	981	998	1013	Dark Red
05 1/2	1004	1015	1025	Dark Red
05	1021	1031	1044	Dark Red
04	1046	1063	1077	Dark Red
03	1071	1086	1104	Dark Red
02	1078	1102	1122	Dark Red
01	1093	1119	1138	Dark Red
1	1109	1137	1154	Dark Red
2	1112	1142	1164	Dark Red
3	1115	1152	1170	Dark Red
4	1141	1162	1183	Gray
5	1159	1186	1207	Green
5 1/2	1167	1203	1225	White
6	1185	1222	1243	Fuchsia
7	1201	1239	1257	Orange
8	1211	1249	1271	Yellow
9	1224	1260	1280	White
10	1251	1285	1305	Pink

\*Rate of temperature increase during last 90 - 120 minutes of firing. Tables by courtesy of the Edward Orton, Jr. Ceramic Foundation.



# Display Messages

**Abrt** The firing was stopped.

**ALAr** (Page 10) Ready for you to enter an alarm temperature. When the kiln reaches that temperature, the alarm will sound.

**CHGt** (page 10) Ready for you to edit the target temperature of the current Ramp-Hold segment during firing. Example: You are fusing glass to a temperature of 1450°F. At 1445°F, you look at the glass through a peephole and realize that the glass will need at least another 50° to fuse fully. Change the target temperature to 1560° without having to turn off the kiln to reprogram it.

**COne** (page 6) This is the prompt for Cone-Fire mode. Press the **START** key to select Cone-Fire. The controller is then ready for you to select a pyrometric cone number.

**CPLt** (page 4) Fired to completion.

**dELA** (page 4) Delay is a count-down timer that starts the firing when the time runs out.

**°F 1** or **°C 1** (and temperature) (page 8) The controller is ready for you to enter the target temperature (the temperature that the kiln will fire to). Each segment in Ramp-Hold mode has a target temperature.

**FULL** (page 8) Full power firing rate. At this setting the kiln will fire at its fastest rate. Select a rate of 1799°F / 999°C at the **ra** prompt in Ramp-Hold mode. A fast way to do this is to press the **Down Arrow** key once from **0000**. **FULL** will appear.

**HLd 1** (page 8) Hold time of a segment, shown in hours and minutes. (Example: 2 hours and 15 minutes = 02.15)

**HLdt** (Page 10) Add Hold Time: During a firing, you can extend the hold time of a segment without having to first stop the firing to reprogram the controller.

**IdLE** (page 3) The controller is ready for you to enter a program or to begin a repeat firing.

**-On-** Firing has begun. A moment after **-On-** appears, you will hear the relay(s) clicking.

**PrO1 PrO2 PrO3 PrO4** (page 8) These are Ramp-Hold programs stored in memory.

**rA 1 rA 2** etc. (Rate) (page 8) This appears in Ramp-Hold programming for each segment. 1, 2, etc. are segment numbers. Enter the rate of temperature change for that segment. Rate is figured in degrees of temperature change per hour. Example:

A temperature rise of 100° in two hours = 50° rate.

A temperature drop of 200° in one hour = 200° rate.

**SStP** (Skip Step) (page 10) This message appears when you press the **Up Arrow** key during a Ramp-Hold firing. You can skip out of a segment into the next segment.

**StOP** The firing was stopped by pressing **START/STOP**.

**Strt** The "Ready to Start" message appears after programming a firing. Press **START** to begin firing. Thermo-couple Offset (press the **Up Arrow**) and Delay (press the **Down Arrow**) are accessed from the **Strt** message.

**TCOS** (Page 13) Adjust the controller to fire hotter or cooler.

## Trouble Shooter

### Problem: Controller display is blank. No heat in kiln.

- Is the kiln connected to the power?
- Has the circuit breaker tripped or fuse blown?
- Is power reaching the wall receptacle?  
Test with a voltmeter or a test light if you are not sure.
- Has the kiln switch box ½ amp fuse blown?

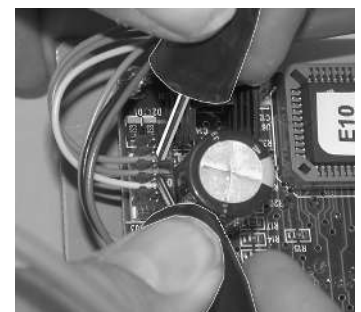
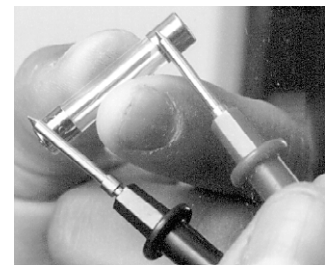
The kiln's ½ amp fuse is located in the kiln switch box. Remove by pressing the fuse holder and turning counter-clockwise half a turn. Check the fuse by placing the probes of an ohmmeter on the ends of the fuse. If the ohmmeter reads less than an ohm (digital meter) or reads 0 ohms (analog meter), the fuse is okay. If the reading is OPEN (digital meter) or infinity/no needle movement (analog meter), the fuse is bad. Replacement fuse:

AGC 1/2 A 250V AC

- Is the controller receiving power? Test the power INPUT connections on the back of the controller with a voltmeter.

### Controller Power Input Test

Unplug the kiln. Remove the 4 screws holding the controller 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 INPUT connections (the white and orange wires).

**CAUTION:** *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.*

#### **Controller Power Input Test Result: No voltage**

UNPLUG kiln. Check the switch box for disconnected wires between the cord, transformer, and controller. If wiring is okay, replace the transformer.

#### **Controller Power Input Test Result: 20 - 24 volts AC**

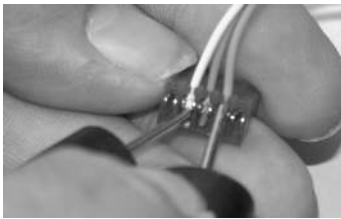
Correct current is reaching the board from the transformer. But since the board is not lighting up, it is probably defective. Return the controller for repair or replacement.

#### **Controller Power Input Test Result: less than 20 volts**

Did you recently replace the transformer? It may be the wrong voltage. The voltage is below 20, which is not enough power for the controller. To find out the cause of low voltage, continue below:

#### **Controller Input Test #2**

The back of the board is still facing you and the kiln is plugged in. Remove the INPUT plug, which is the white, orange, and blue wires, from the back of the controller. Touch a voltmeter probe to the white wire and the other probe to the orange wire.



#### **Input Test #2 Result: Less than 20 Volts AC**

There are two possible reasons: 1) Low voltage at the wall receptacle; 2) defective transformer. If wall receptacle voltage is correct, replace the transformer.

#### **Input Test #2 Result: 20 - 24 Volts AC**

The transformer is sending correct voltage to the controller. Yet when the INPUT plug was connected to the controller, voltage was less than 20. This means the controller is draining the voltage and may be 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?

**Yes, the relay is clicking.**

Test the elements with an ohmmeter:

#### **Element Resistance Test**

- 1 UNPLUG kiln/disconnect the power. Open the kiln's switch box. Make sure the wires connecting the relay to the elements are secure. If connections are okay, continue to step 2:
- 2 Touch the ohmmeter leads to the two element connectors of each element. A no-needle-movement

reading on an analog meter, or OPEN on a digital meter, indicates a broken element.

If the elements check out okay, replace the relay.

**Note:** *To replace relay, see your kiln's instruction and service manual.*

#### **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," left column. If your controller passes the Input Test, perform the "Controller Power Output Test":

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

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

- 1 UNPLUG the kiln/disconnect the power. Remove the 4 screws holding the controller faceplate to the switch box. Lift faceplate out of box and let the controller hang on the outside of the box with the back of the board facing you. Then plug the kiln back in. Program the controller to fire to 1000°F at FULL rate in Ramp-Hold mode. Press **START**.
- 2 Put the voltmeter in DC mode. (It must be in DC mode when testing OUTPUT voltage.) Touch probes to the red wire and black wire connections. Measure voltage when the relay clicks on.

#### **Output Test Result: No voltage at red and black wires**

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

#### **Output Test Result: 10 - 14 v. at red and black wires**

The controller is sending correct power to the relay. Unplug kiln/disconnect power. Remove the kiln switch box. Look for disconnected wires between the controller, relay 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, replace the relay.

**Note:** *To replace relay, see your kiln's instruction and service manual.*

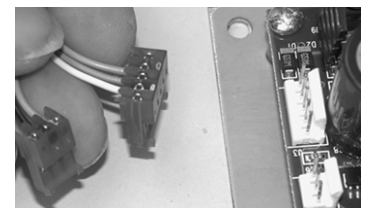
## **Problem: Kiln switch box 1/2 amp fuses keep blowing.**

■ What size fuse are you using? Correct fuse: AGC 1/2 A 250V AC

If the fuse is the correct size, perform the following test:

#### **Kiln Switch Box 1/2 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 both wire plugs from the back of the controller. Then plug the kiln back in. Apply power to kiln. If fuse blows, replace the transformer. (If the fuse does not blow, the problem is a board or relay. Go to step 2.)

- 2 Connect the INPUT plug (orange, blue, and white wires) to the board again. Leave off the OUTPUT wire plug (the one with the red and black wires). Program the controller to fire to 1000°F at FULL 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.)
- 3 UNPLUG kiln/disconnect power. Reconnect the OUTPUT wire plug. Reinstall the board in the switch box. Replace the relay.

## Problem: The kiln overfires.

■ Did you see an error message such as **HTdE** ?

If not, the thermocouple gave a faulty reading, so the controller did not shut off the kiln. Sometimes a shelf can bump against the thermocouple and push it out of the firing chamber. Make sure the thermocouple is pushed far enough into the firing chamber.

A 1/8" diameter thermocouple should extend into the firing chamber 1/2" - 5/8".

A 1/4" diameter thermocouple should extend into the firing chamber 1" or more.

Keep shelves, posts and ware 1" - 1 1/2" away from the thermocouple.

■ Do the elements stay on after you press **STOP**?

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 the relay.

**Question:** My kiln is not shutting off when it reaches cone 06. It is holding the temperature 1861°F for hours and hours. After the controller shows me "cone 06" I see "5. 20." How do I eliminate this?

**Answer:** Please check Program Review. A long hold time has been added to cone 06. The 5. 20 means the hold will continue for 5 hours and 20 minutes. To remove the hold time, please reprogram the kiln for cone 06. When you see the Hold prompt, enter 0000.

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# Shorthand Instructions

These instructions may be confusing until you have read more detailed instructions on Cone-Fire, page 6, or Ramp-Hold, page 8. Read the safety guidelines, page 3. After pressing the keys in the left column, the message in the center will appear.

## Cone-Fire

Keys to Press	Display
	<b>IdLE</b>
	<b>COnE PrO1 - PrO4</b>
(Not Down Arrow)	<b>COnE</b> Select COnE
	<b>06</b> / <b>1828</b> (Last cone fired)
Select cone number	<b>05</b> / <b>1888</b> (Sample cone)
	<b>FASt</b>
Select speed	<b>FASt</b> (Sample speed)
	<b>HLd</b>
Enter Hold Time	<b>00.00</b> (Or hold time)
	<b>S t r t</b>
	<b>-O n-</b> The kiln is now firing.

## Ramp-Hold

Keys to Press	Display
	<b>IdLE</b>
	<b>COnE PrO1 - PrO4</b>
(Not Down Arrow)	<b>Pro1</b> Select Program #1, 2, 3, or 4
	<b>rA 1</b>
Enter Segment 1 rate	<b>500</b> (Sample rate)
	<b>°F 1</b> or <b>°C 1</b>
Enter Temperature	<b>1900</b> (Sample temperature)
	<b>HLd1</b>
Enter Hold Time	<b>00.00</b> (Or hold time)
	First segment not needed: enter a rate of 0000.
	<b>S t r t</b>
	<b>-O n-</b> The kiln is now firing.