



# Sentry Xpress

## Digital Temperature Controller

### Single Segment, Ramp-Hold & Cone-Fire Instructions



**°F Temperature Display**  
**No Display Dot:** Temperature display, °F.

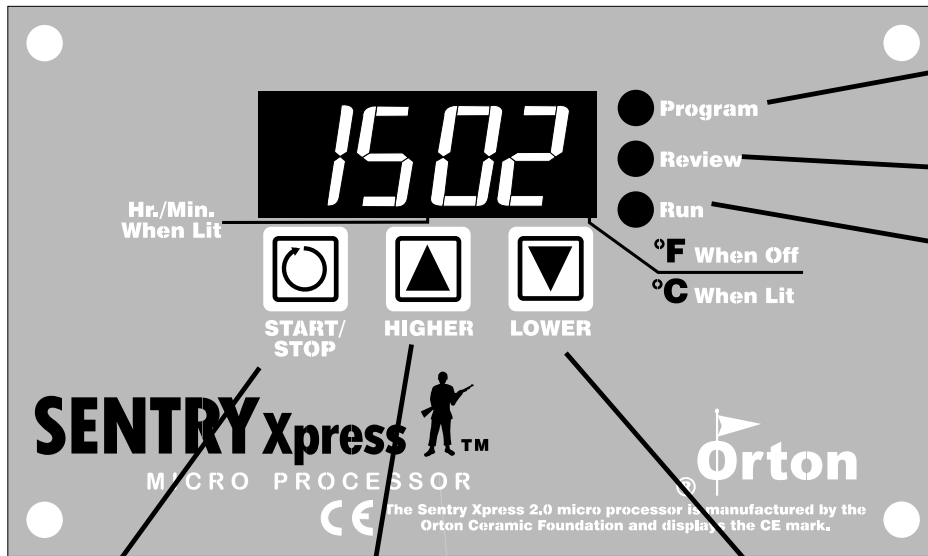


**Time Display**  
**Center Display Dot:** Separates hours from minutes.



**°C Right Display Dot:** Temperature display, °C.  
 See page 9 for instructions on selecting °F and °C.

Display Dot



#### Indicator Lights

**Top:** On during programming.

**Middle:** On during program review.

**Bottom:** Blinks during firing.

#### START/STOP Key

- 1) On/Off:** Starts and stops a firing.
- 2) Enters Data:** Press after each programming step.

#### Up Arrow Key

- 1) Increases** values during Programming.
- 2) Select Mode:** from **IdLE** press START. Press Up Arrow to select mode.
- 3) Skip Segment:** during Ramp-Hold firing, skips to the next segment. After pressing Up Arrow, **SStP** will appear. To skip, press Up Arrow.

#### Down Arrow Key

- 1) Decreases** values during programming.
- 2) Review:** from **IdLE** or during firing, press Down Arrow. The program will appear one step at a time.
- 3) Delay:** from **Strt** press Down Arrow.

# Contents

<b>General Guidelines</b> .....	<b>2</b>
Thermocouple Inspection .....	2
How to Display <b>IDLE</b> .....	3
Which Instructions In This Manual Apply To Your Controller .....	3
A Rapid Way to Scroll Numbers .....	3
Program Review & Repeat Firing .....	3
Hold .....	3
Delay .....	3
Power Failures .....	4
Thunder Storms & Power Surges.....	4
Starting a Firing in a Hot Kiln.....	4
<b>Understanding Segments</b> .....	<b>4</b>
Definition of a Segment .....	4
Rate .....	5
Temperature Over-Shoot .....	5
<b>Single Segment Firing Instructions</b> .....	<b>5</b>
<b>Ramp-Hold Mode</b> .....	<b>6</b>
Skipping a Segment in Ramp-Hold .....	6
Controlled Cooling in Ramp-Hold .....	6
<b>Ramp-Hold Firing Instructions</b> .....	<b>6</b>
<b>Cone-Fire Mode</b> .....	<b>7</b>
Pyrometric Witness Cones .....	7
How to Interpret Cone Bending .....	7
How to Correct for Under or Over-Fired Cones.....	7
Cone-Fire Hold.....	7
When the Kiln Shuts Off Too Soon .....	8
How to Customize Cone-Fire.....	8
<b>Cone-Fire Firing Instructions</b> .....	<b>8</b>
<b>Error Messages</b> .....	<b>9</b>
<b>BadP</b> / Bad Programming .....	9
<b>EtH</b> / Electronics Too Hot.....	9
<b>FAIL</b> / Thermocouple Failure .....	9
<b>TCR</b> / Thermocouple Reversed .....	9
<b>FtL</b> / Fired Too Long .....	9
<b>PF 1</b> / Power Failure.....	9
<b>PF 2</b> / Power Failure.....	9
<b>TcO</b> / Thermocouple Failure .....	9
<b>Selecting °F or °C Display</b> .....	<b>9</b>
<b>Display Messages</b> .....	<b>10</b>
<b>Trouble Shooter</b> .....	<b>10</b>
<b>Cone-Fire Schedules</b> .....	<b>12</b>
<b>Orton Pyrometric Cone Chart</b> .....	<b>14</b>
<b>Shorthand Instructions</b> .....	<b>15</b>

# Safety

**The warranty on your Sentry 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. Follow these safety rules in addition to the ones in your kiln or furnace manual.**

- When the kiln is not in use, disconnect the power.
- Do not leave the kiln unattended, especially near the expected shut-off time.
- Wear firing safety glasses when looking into the firing chamber of a hot kiln.
- Do not touch hot sides of kiln or furnace. Keep unsupervised children away.
- Install your kiln or furnace at least 12 inches from any wall or combustible surface.
- Do not open lid or door until kiln or furnace 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 kiln or furnace before servicing.

## General Guidelines

### 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! The controller does not contain an alarm to detect this type of failure.

- 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.

## How to Display IdLE

**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 9.
- **CPLt** (firing completed) appears at the end of a firing. To make **IdLE** appear, press **START/STOP**.

## Which Instructions Apply To You

For greater flexibility in the types of ware you can fire, we have installed two firing modes in your controller. Follow steps 1 - 3 to find out which modes you have:

- 1 From **IdLE** press **START/STOP** once.
- 2 Press the **Up Arrow** key several times. You will see the following display messages:  
**COne** and **ProG**  
or  
**SPd1** - **SPd5** / temperature and **ProG**
- 3 Press **START/STOP** repeatedly until **IdLE** appears.

### **COne** Cone-Fire Mode (see page 7)

Cone-Fire mode fires the ware to a pyrometric cone number using the Orton cone tables on page 14. This mode is used for ceramics, pottery, stoneware, and glazes. Your supplier can tell you which cone number to program.

### **SPd1** - **SPd5** Single Segment Mode (see page 5)

Choose one of five firing speeds. Then enter the temperature you are firing to. This mode is for firings that need only one rate, such as Art Clay Silver and Precious Metal Clay.

### **ProG** Ramp-Hold Mode (see page 6)

Ramp-Hold mode offers the most flexibility. Use it to create custom firings with multiple rates and temperatures. Use this mode for glass fusing and glass slumping. Some of the reasons to use Ramp-Hold mode:

- To use two or more firing rates
- To cool at a controlled rate
- To modify a Cone-Fire program

Type of Firing	Suggested Firing Mode
China Painting	Cone-Fire
Decals	Cone-Fire
Enameling	Single Segment
Glass Bead Annealing	Ramp-Hold
Glass Fusing	Ramp-Hold
Glass Slumping	Ramp-Hold
Glaze	Cone-Fire
Greenware	Cone-Fire
Silver Clay	Single Segment

## A Rapid Way to Scroll Numbers

The **Up Arrow** and **Down Arrow** keys change number settings during programming. 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 maximum setting, 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**.

## Program Review & Repeat Firing

Program Review lets you check that the information programmed into the controller is correct. It is a good habit to use Program Review before every firing.

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

## Hold

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 Hold temperature alternates with time left in Hold.

## 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 programmed the controller and it 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 (e.g. 1 hour 10 minutes = 01.10). Then press **START**. **dELA** will appear, alternating with time left until the firing begins.

## 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 firing, and temperature dropped more than 180°F/100°C.

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

## 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. Do not leave the kiln unattended.

## Starting a Firing in a Hot Kiln

After a temporary power failure, or when the kiln has shut off too soon, it may be necessary to turn the kiln back on.

After you press **START**, the controller will begin firing from the current temperature to the target temperature. In Ramp-Hold, the firing will begin from the first segment that encompasses the current temperature.

**Note:** If the kiln is already hotter than the programmed target temperature when you begin firing, **CPLt** will flash.

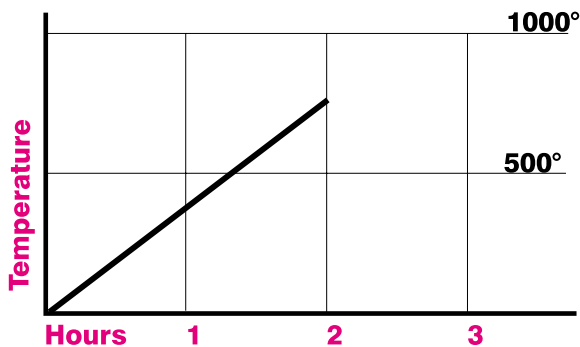
# Segments

If you are using Cone-Fire mode only, skip to page 7.

## Definition of a Segment

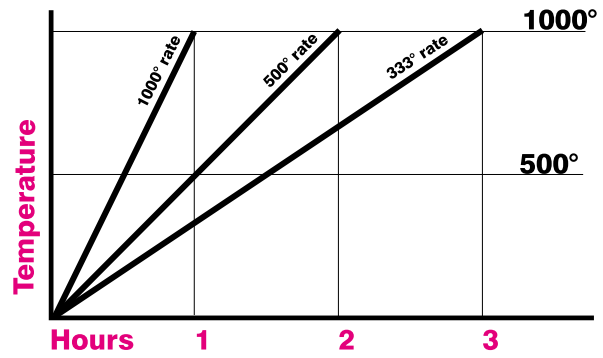
A segment is the most basic part of a firing. A segment includes a target temperature and a heating rate to reach that temperature. Shown below is a segment with a target temperature of 750°.

Firing rate is figured in degrees of temperature per hour. Since the temperature in the chart below takes two hours to reach 750°, the rate is  $750 \div 2 = 375^\circ$  per hour.



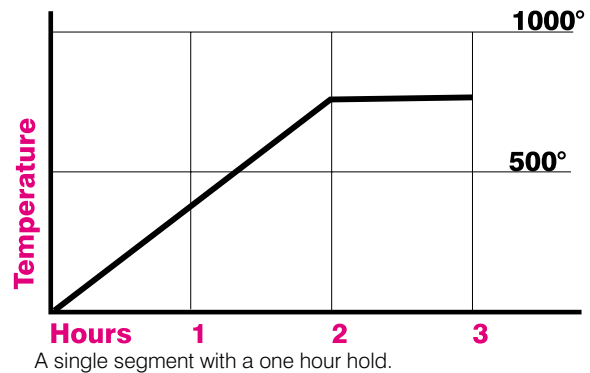
A single segment with a rate of 375°.

The next diagram, below, shows three rates. A rate of 1000° will reach 1000° in 1 hour. A rate of 500° will reach 1000° in 2 hours. A rate of 333° will reach 1000° in 3 hours.



Rate is degrees per hour. This diagram shows 3 rates.

A segment, which is a target temperature and a rate of heating to reach that temperature, can also have a hold. Hold means maintaining the target temperature for a length of time. (See next diagram.)

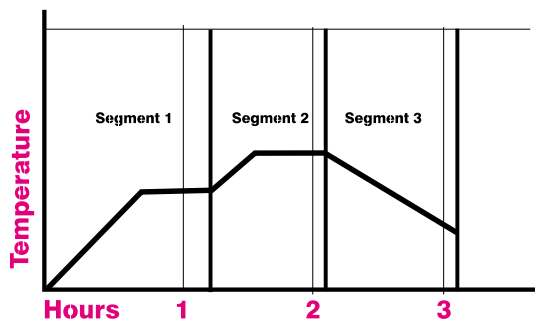


A single segment with a one hour hold.

Firing to a temperature at a single rate would need only one segment. Reasons to add more segments:

- To have more than one heating rate
- To add a hold somewhere below the shut-off temperature (see Segment 1 in diagram below)
- To control the cooling rate.

The diagram below shows a 3 segment firing. The first two segments were used on the way up in temperature. The last segment was added for controlled cooling.



A 3 segment firing. Segments 1 and 2 include a Hold. Segment 3 controls cooling rate.

## Rate

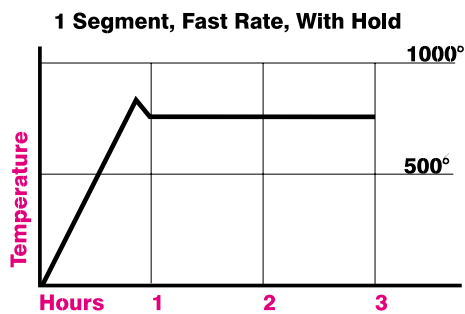
Each segment must include a rate, which is degrees of temperature change per hour. Single Segment mode has only one rate.

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

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

## Temperature Over-Shoot

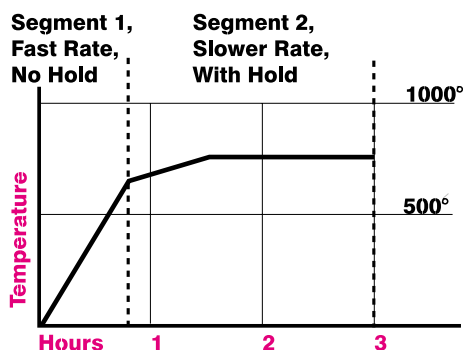
When a kiln is heated too fast, it may over-shoot the target temperature, especially in small kilns at lower temperatures. To avoid this, add an extra segment to slow the firing. If you experience over-shoot in Single Segment mode, either slow the rate, or use Ramp-Hold to add a slow segment near the target temperature.



A fast rate (above diagram) can cause the temperature to over-shoot the target temperature.



The simplest solution to temperature over-shoot is to slow the rate, as in diagram above.



Another solution to temperature over-shoot: in Ramp-Hold (select the **ProG** prompt), add a segment with a slower rate, to begin approximately 40° - 60° below the target temperature.

# Single Segment Firing Instructions

**Note:** Single Segment firing is all you will ever need if you are enameling or firing silver clay.

**1** From **IdLE**, press **START**.

**2** Use the **Up Arrow** key (not the **Down Arrow**) to select a firing rate (temperature rise per hour) from 1 through 5:

**SPd1** / (200°F or 111°C)

**SPd2** / (500°F or 277°C)

**SPd3** / (1000°F or 555°C)

**SPd4** / (1500°F or 833°C)

**SPd5** / (Full Power)

**ProG** (Selects Ramp-Hold mode: see next page.)

Then press **START**.

**3** **°F** or **°C** and the target temperature from the last firing will appear. Use the arrow keys to change the target temperature. Then press **START**.

**4** **HLd** and the hold time from the last firing will appear (e.g. 1 hour 10 minutes = 01.10). Use the arrow keys to change the hold time. Then press **START**.

**5** **Strt** will appear. Press **START** to begin firing. **-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 firing speed you select (see step 2) is a pre-programmed speed. The kiln's actual firing speed may be less, depending on the kiln model, available voltage, and density of load you are firing.

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

- Firing time
- Present temperature
- **CPLt**

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

# Ramp-Hold

## Skipping a Segment in Ramp-Hold

In Ramp-Hold firing, you can skip a segment as follows:

- 1 The kiln is firing. Press the **Up Arrow** key.
- 2 **SStP** will appear. Press the **Up Arrow** key again. The firing will skip to the next segment.

## Controlled Cooling in Ramp-Hold

Use Ramp-Hold mode to program a slow cooling. This is the only firing mode that can control cooling rate.

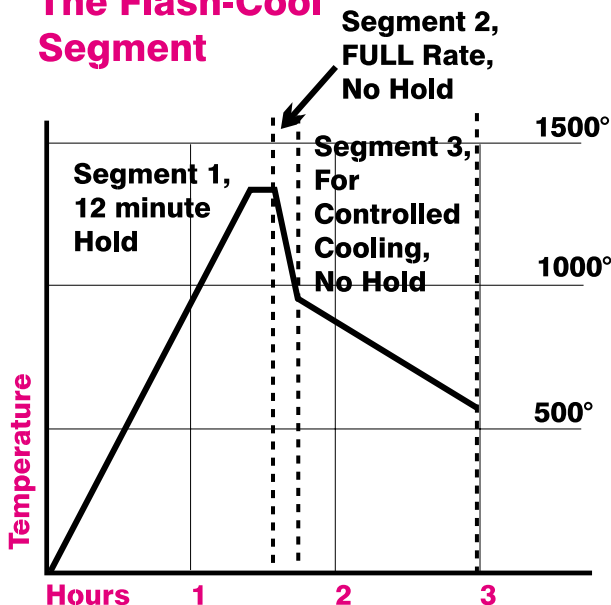
Slow cooling enhances the quality of some ceramic glazes. Slow cooling encourages crystal development, deeper gloss, and sometimes startling color shifts. Iron red glazes seem to respond well to slow cooling.

For controlled cooling, program a segment to a lower target temperature than that of the preceding segment. The controller, of course, cannot speed cooling beyond the kiln's natural cooling rate.

Glass artists sometimes flash-cool the glass after it has fused. They lift the lid slightly for a few minutes to allow heat to escape. To flash-cool the glass, you will need to add a segment with a rate of FULL. Otherwise, after the flash-cool, the controller will raise the temperature again.

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

## The Flash-Cool Segment



The above firing would be programmed as follows:

Segment	Rate °F/°C	Temp. °F/°C	Hold
1	950/527	1350/732	00.12
2	FULL	950/510	00.00
3	300/166	550/287	00.00

# Ramp-Hold Firing Instructions

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

- 1 From **IdLE**, press **START**.
- 2 Using the **Up Arrow** key (not the **Down Arrow**), by-pass firing speeds or **COLE** and select **ProG**. Then press **START**.
- 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 (e.g. 1 hour 10 minutes = 01.10). Use the arrow keys to change the hold time. Then press **START**.
- 6 Continue entering values for the segments needed. When **ra\_** appears for the first segment you don't need, select **0000**. Then press **ENTER**. This will zero out the remaining segments.
- 7 **Strt** will appear. Press **START** to begin firing. **-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 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**

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



# Cone-Fire

Cone-Fire mode is based on pyrometric cones. It is not designed for heat treating, glass fusing and enameling. For these firings, use Ramp-Hold mode (page 6). Use Ramp-Hold to fire ceramic pieces that require a custom firing schedule. You can also use Ramp-Hold to add a slow cooling.

## 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 14 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 Cone Bending

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

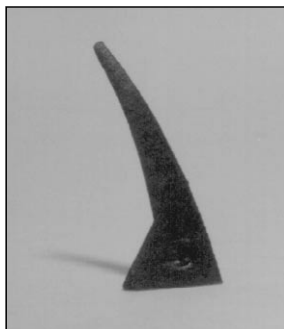
### 1. Correct Bend

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.



### 2. Under-Fired Cone

This cone has not bent far enough. It indicates that the kiln did not fire long enough or hot enough.



### 3. Over-Fired Cone

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



**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 14.)

### 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.
- Another option: 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.
- Another option: 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 hold time can easily 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.

## 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 From **IdLE**, program the next hotter cone in Cone-Fire.
- 2 **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. On pages 12 and 13, 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

# Cone-Fire Firing Instructions

- 1 From **IdLE**, press **START**.
- 2 Using the **Up Arrow** key (not the **Down Arrow**), by-pass **ProG** and select **COFE**. 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** **Ed** 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 (e.g. 1 hour 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 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**

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



# Error Messages

## BAdP / Bad Programming

The kiln will not fire because the Ramp-Hold program just entered has a rate of 0000 in segment 1. Program the firing again.

## EtH / Electronics Too Hot

The temperature of the electronic circuit board is above 185°F/85°C. This could damage the controller, so the firing has been stopped. To prevent this, keep the firing room cooler. Use better ventilation.

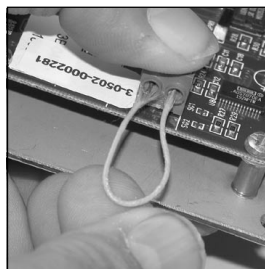
## Fail / Thermocouple Failure

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. (See photo at far right.) 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.
- 4 Plug in the kiln. If the controller displays room temperature, replace the thermocouple. If it shows **Fail**, replace the controller.

## TCR / Thermocouple Reversed

Thermocouple lead wires are reversed.

## 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 4 hours longer than programmed

See “Controller turns on. No heat in kiln,” page 11.

## PF 1 / Power Failure

The power failed during firing and temperature dropped more than 180°F/100°C by the time the power came back on.

## PF 2 / Power Failure

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

## TcO / Thermocouple Failure

The thermocouple failed during the **IdLE** display.

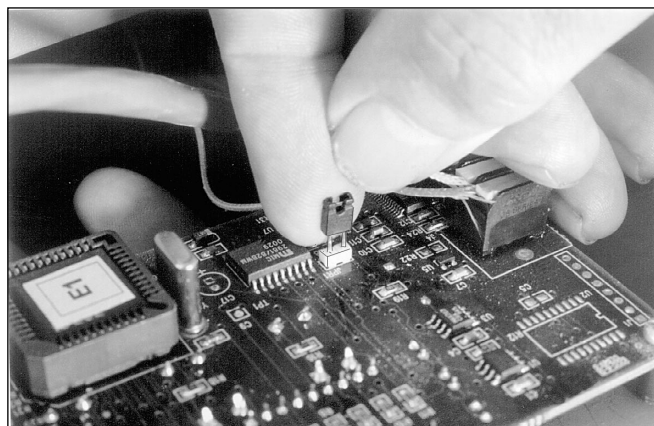
# Selecting °F or °C Display

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 front of the kiln. Carefully remove the controller from the kiln. Leave wires attached to the controller.



- 3 Look at the back of the controller. A plastic jumper on the back of the board determines the type of temperature display. When the jumper connects two pin-type terminals, 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.



# Display Messages

**Abrt** The firing was stopped.

**CO nE** (page 8) 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** Fired to completion. If the kiln is already hotter than the programmed target temperature when you begin firing, **CPLt** will appear immediately after you begin firing.

**dELA** (page 3) Delay is a count-down timer that starts the kiln when the time runs out.

**°F** or **°C** (and temperature) (pages 5 & 6) The target temperature (the temperature that the kiln will fire to). Each segment in Ramp-Hold has a target temperature. Single Segment mode has one target temperature.

**FULL** Full power firing rate. At this setting the kiln will fire at its fastest rate. There are two ways to select full power:

1) Select **SPd5** in Single Segment mode.

2) 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** (and time) (pages 5 & 6) Hold time of a segment, shown in hours and minutes. (i.e. 2 hours 15 minutes = 02.15.)

**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.

**ProG** (Program) (page 6) Select this option to program a Ramp-Hold firing.

**rA 1**, **rA 2**, etc. (Rate) (page 6) 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.

**SPd1**, **SPd2**, **SPd3**, **SPd4**, **SPd5** (page 5) These are firing rates, or speeds, in Single Segment mode.

**SStP** (Skip Step) (page 6) This message appears when you press the **Up Arrow** key during a Ramp-Hold firing. If you press the **Up Arrow** key again, the firing will skip to the next segment.

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

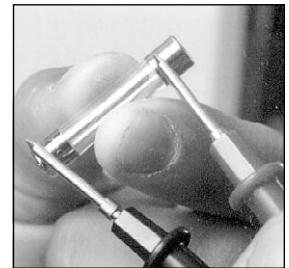
**Strt** The “Ready to Start” message appears after programming a firing. Press **START/STOP** to begin firing.

# 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 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. Replace-ment fuse:

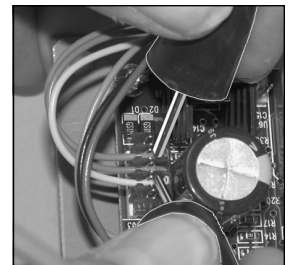


AGC 1/2 A 250V AC

- 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.

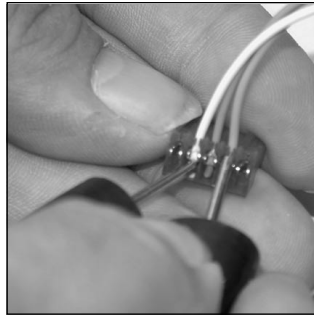
### Controller Power Input Test Result: less than 20 volts

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 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?

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," page 10. 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 con-

troller 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.

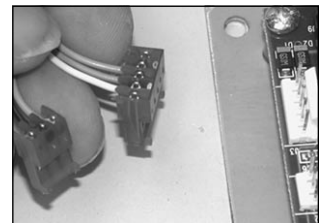
## Problem: Kiln switch box ½ amp fuses keep blowing.

- What size fuse are you using? Correct fuse: AGC ½ A 250V AC.

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

### 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. Then plug the kiln back in. Disconnect both wire plugs from the back of the controller. 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, green 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.

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

# Cone-Fire Schedules - °F

These are the Medium Speed firing schedules programmed in Cone-Fire mode. To customize a schedule, write down your changes on a separate sheet of paper. Then load your new schedule into Ramp-Hold.

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

These are the Medium Speed firing schedules programmed in Cone-Fire mode. To customize a schedule, write down your changes on a separate sheet of paper. Then load your new schedule into Ramp-Hold.

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.



# Shorthand Instructions

Read the safety guidelines, page 2. After pressing the keys in the left column, the message in the center will appear. For more detailed instructions, see page 8.











## Cone-Fire

Keys to Press	Display
	<b>IdLE</b>
	<b>CO nE</b> - <b>PrOG</b>
 (Not Down Arrow) Select CO nE	<b>CO nE</b>
	<b>06</b> / <b>1828</b> (Last cone fired)
  Select cone number	<b>06</b> / <b>1828</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>St r t</b>
	<b>-O n-</b> The kiln is now firing.














# Shorthand Instructions

Read the safety guidelines, page 2. After pressing the keys in the left column, the message in the center will appear. For more detailed instructions, see Single Segment, page 5, or Ramp-Hold, page 6.

## Single Segment

Keys to Press	Display
	<b>IdLE</b>
	<b>SPd1</b> - <b>PrOG</b>
 (Not Down Arrow) Select rate	<b>SPd1</b> (Sample rate)
	<b>°F</b> or <b>°C</b>
  Enter temperature	<b>1900</b> (Sample temperature)
	<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>SPd1</b> - <b>ProG</b>
 (Not Down Arrow) Select ProG	<b>ProG</b>
	<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.