Sentry 3.0

Digital Temperature Controller for 703-017 and 703-022
Cone-Fire and Ramp-Hold Instructions

Cone-Fire (pg 10-13)
From IDLE, press 1.
Basic firing to a cone number. Enter cone number, speed, pre-heat, hold, and slow cool.

Ramp-Hold (pg 14-18)
From IDLE, press 4.
Select stored program (1 - 4). Enter rate, temperature, and hold for each segment.

Edit Ramp-Hold (pg 7)
During firing, press 4.
Change the current segment rate. Press ENTER. Change temperature. Press ENTER. Change the hold. Press ENTER. The kiln will continue firing.

Alarm (pg 8-9)
From IDLE or during firing, press 7.
Enter a temperature. When alarm sounds during firing, press 7. To silence, press 0, then Enter.

Enter/Start
Press ENTER/Start after each step in programming a firing.

Press ENTER/Start once from **[IDLE]** to begin firing.

Firing Cost (pg 9)
Press 8 after the kiln fires to completion.
The cost of the last firing will appear. (First enter electrical cost in the **[CENT]** option and kiln wattage in the **[KW]** option, pg 23.)

SENTRY Controller 3.0

1500:

Hours/Minutes When Lit

°F When Off
°C When Lit

Fast   Medium   Slow

Cone Fire **1**   Add Time **2**   Delay **3**

Ramp Hold **4**   Present Status **5**   Program Review **6**

Alarm **7**   Firing Cost **8**   Cone #s/ Skip Seg **9**

Enter/ Start   Options **0**   Stop/ Back

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Westerville, OH   C E

Options (Next Page)
From IDLE, press 0. Press ENTER for the option displayed.
Turn the page to explore the ways you can customize your controller.

Stop/Back (pg 10)
Press during firing or programming.
1) Stops a firing.
2) In Options, takes you back to **[IDLE]**.
3) During programming, takes you back one step each time key is pressed.

Delay (pg 7)
From IDLE, press 3.
Enter time in hours:minutes. Delays the start of firing.

Add Time (pg 7)
During firing, press 2.
Each additional key press adds five minutes to a hold. It works in both Ramp-Hold and Cone-Fire.

Present Status (pg 8)
During firing, press 5.
Shows the rate of heating or cooling and the segment that is currently firing. Works in both Ramp-Hold and Cone-Fire.

Program Review (pg 8)
From IDLE or during firing, press 6.
Shows the program that is loaded in memory and ready to fire, or the one that is firing.
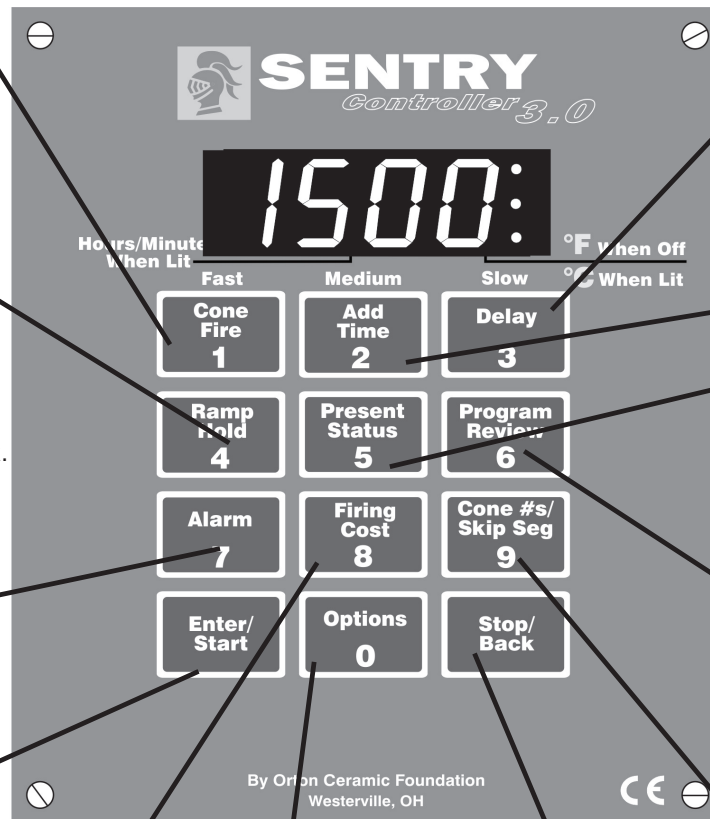
Cone Table & Skip Segment (pg 9)
From IDLE or during firing, press 9.
From IDLE, shows temperature for the cone # you enter.

While firing in Ramp-Hold, skips to any ramp you select.

While firing In Cone-Fire, skips out of Pre-Heat or Hold.

Quick Cone-Fire programming . . . page 11

Ramp-Hold programming for the power user . . . page 15

Error messages . . . pages 27 - 29

Confused about display messages? . . . pages 30 - 31

The Options

Customize your Sentry with the Options key. From IDLE, press Options (the 0 key) repeatedly until you see the desired option listed below. Then press ENTER. See pages 19 - 26 for details.

[SPD] Speed Alter the Fast, Medium, or Slow speeds of a Cone-Fire program. (Pg 19)

[OFST] Cone Offset Adjust Cone-Fire to match the bending of the witness cone. (Pg 20)

[COOL] Slow Cooling Turn on controlled cooling in Cone-Fire. This can dramatically affect glazes. (Pg 21)

[FAN] Vent Fan Select when the vent fan will operate in Cone-Fire. (This is an optional kiln upgrade.) (Page 21)

[DIAG] Amperage Test Find out why your kiln is slowing down. Kiln must be equipped with an amp sensor. (Pg 21)

[TC] Thermocouple Type Select Type K, N, S or R thermocouple. Use caution! Selecting the wrong type can over or underfire your kiln. (Pg 21)

[F/C] Select °F or °C temperature display. (Pg 22)

[TCOS] Thermocouple Offset If your controller is firing too hot or cold, adjust the thermocouple setting. (Pg 22)

[AOP1] [AOP2] AOP Outlet Select vent fan or alarm if your kiln has an auxiliary output. This is a special-order kiln feature. (Pg 22)

[RATE] Rate Calculation Type Your controller is set for degrees-per-hour rate by default. You can change the rate to temperature-reached-in-elapsed-time. (Pg 23)

[CENT] Electric Rate Enter rate shown on electric bill so your controller can estimate the firing cost. (Pg 23)

[KW] The Cost to Fire Kiln Enter your kiln's wattage. (Pg 23)

[TEDE] Temperature Deviation Set temperature sensitivity for FTH, FTC & LTdE errors. (Pg 24)

[HTDE] High Temperature Error Code Change the high temperature shutoff setting. (Pg. 24)

[SFTY] Maximum temperature rating of your kiln. (P 25)

[LIM] Set Max. Temp. Set your own maximum temperature. (Pg. 25)

[ELEC] Electronics Temp. Check the circuit board temperature for overheating. Useful in the summer. (Pg 25)

[LOCK] Program Lock Make a program tamper-proof. Lock individual Ramp-Hold programs. (Pg 25)

[CFG] Configuration Code For technicians. (Pg 26)

[SOFT] Software # (Pg 26)

[TEST] Element Test (Pg 26)

[RST] Reset Removes the thermocouple offset and returns the board to factory defaults. (Pg 26)

[DIFF] Difference Multi-zone kilns: Shows the difference in temperature between top and bottom zones. (Pg 26)

[T123] Zone Temperatures Multi-zone kilns: Shows the temperature of each zone. (Pg 26)

Before You Begin

Thank you for purchasing the Sentry 3.0 temperature controller. As you read the manual, pull up a chair and sit in front of your kiln so you can try out the keys.

The controller display messages are limited to four characters. If at any time you are confused by these messages, turn to Appendix A: Display Messages on pages 30 - 31.

The back cover is a shorthand guide to programming, to be used after you have read the programming instructions on pages 10 and 14.

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

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 end of the firing.

Instructions for multiple-zone kilns are included in this manual. If you are not sure whether your kiln is multiple-zone, look into the firing chamber. If you see two or three thermocouple tips, your kiln is multiple-zone. If you see only one thermocouple, skip multiple-zone instructions.

New Features With the Sentry 3.0, we are introducing the amperage test (DIAG option, page 21). The controller now has 35 programs in Ramp-Hold, with 20 segments each. Lock individual programs with Program Lock (page 25). Adjust the maximum temperature of your kiln (page 25), and use a rate of temperature-reached-in-elapsed time if you prefer (page 23).

Contents

Safety Rules

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 end of the firing.

Follow these safety rules in addition to the ones in your kiln manual:

● When the kiln is not in use, disconnect the power and keep the lid or door closed. (For larger kilns with heavy cordsets, we recommend a power disconnect box near the kiln.)

Large studio kilns should have a power disconnect box for the kiln. Place the box in the kiln room.

● Do not leave the kiln unattended, especially near the expected shut-off time. Do not leave a kiln turned on at your studio while you are at home sleeping.

● Wear green #3 firing safety glasses when looking into the peephole of a hot kiln.

● Do not touch hot sides of kiln. Keep unsupervised children away.

● Install your kiln at least 12 - 18 inches from any wall or combustible surface. (See manufacturer's recommendation for your model.)

● 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 flammable materials. Keep cordset away from hot sides of kiln.

● **DANGEROUS VOLTAGE!** Do not touch heating elements with anything. Disconnect kiln before servicing.

● Do not operate if the controller itself is hotter than 158°F / 70°C. (See instructions on page 25 for checking circuit board temperature.) Never allow the firing room temperature to exceed 110°F / 43°C. (Measure room temperature three feet from the kiln.)

● Stop a firing by pressing the STOP button, not by disconnecting the power. In certain conditions, the controller will interpret a power interruption as a power failure and turn the kiln back on when you reconnect the power.

● Place the kiln on the stand recommended by the manufacturer. When a kiln is safety tested, the lab fires the kiln on the stand designed for the kiln. Cinder blocks or bricks can inhibit the flow of air under the kiln. They can also change the kiln's heating characteristics.

● Place the kiln on a non-combustible surface.

● Keep the kiln lid or door closed when the kiln is not in use. This keeps dust out of the kiln. Also, should someone turn on the kiln while you are away, the closed lid will keep the heat safely inside the firing chamber.

● Never place anything on the kiln lid, even when the kiln is idle. If people become accustomed to placing papers and other objects on the kiln, they may forget and do that while the kiln is firing.

● Remove all tripping hazards from around the kiln. Keep the kiln's supply cord out of traffic areas.

● Avoid extension cords.

● Never fire tempered glass inside a kiln. It could explode.

● Greenware, which is unfired clay, must be bone dry before firing. Moist greenware can explode inside the kiln, damaging the ware and the kiln. Place a piece of greenware against the inside of your wrist. If it feels cool, it is too wet to fire.

● Store kiln shelves in a dry area. Moist shelves can explode inside a kiln.

● If you smell burning plastic, turn the kiln off. Examine the wall outlet and supply cord for signs of burning.

● Never place extra insulation around the kiln in an attempt to conserve energy. The extra insulation can cause the wiring and the steel case to over-heat.

Chapter 1
Basic Pointers

In This Chapter you will learn to . . .
- Choose between Cone-Fire and Ramp-Hold
- Use the controller in freezing or hot weather
- Understand the display window layout
- Easily repeat the last firing
- Make a quick visual check of your thermocouple
- Avoid overfiring your kiln

Two Ways to Fire Your Controller

The Sentry fires in two modes:

- **Cone-Fire**, based on pyrometric cones (page 10). Quickly program a ceramic firing by selecting a cone number and firing speed.

- **Ramp-Hold** is for those who want to design their own firing schedules. Program custom firing rates and target temperatures (page 14).

Ceramic kilns come with both Cone-Fire and Ramp-Hold. Heat treating, glass fusing, and enameling kilns come with Ramp-Hold only.

1 From **[IDLE]** display, press 1. If **[CONE]** appears, you have Cone-Fire mode. If the 1 key does not respond, you have Ramp-Hold mode only.

2 Press **STOP** to bring the controller back to **[IDLE]**.

If you have Ramp-Hold only, skip pages 10 - 13.

Hot and Cold Weather; Storage Sheds

It is okay to store the Sentry at sub-zero temperatures. But before operating, raise the room temperature to at least 32°F / 0°C.

The Sentry will register sub-zero °F / °C temperatures. However, 32°F / 0°C is the lowest recommended operating temperature.

Pointer: Raise the room temperature with a space heater before firing the kiln. Place the space heater within a couple of feet of the control panel and let it run for an hour or so. Or even hang a shop light
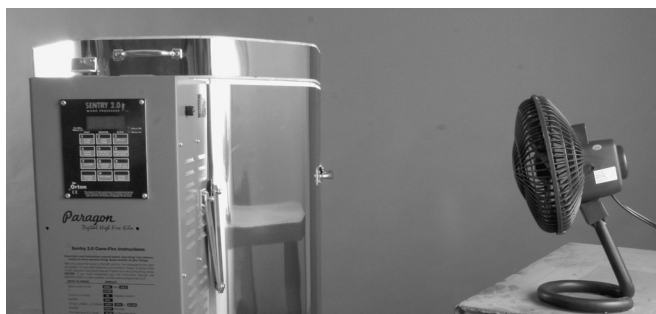
Hot weather pointer: Blow a gentle stream of air through the control panel of the kiln to reduce the temperature of the controller circuit board.

near the kiln to raise the temperature above freezing.

The circuit board is rated for 176°F / 80°C maximum operating temperature. However, the maximum recommended temperature is 158°F / 70°C, measured at the controller inside the kiln switch box. To lower the temperature, open windows and blow air across the kiln's switch box with a fan. Place several fans in the room during hot weather. (See page 25 to check circuit board temperature.)

High humidity will not adversely affect the Sentry unless water condenses on the circuit board. In this case, do not fire the kiln until the moisture has evaporated from the board.

Try to avoid firing your kiln during thunderstorms. Keep the kiln disconnected from the power when not in use. (Lake Grapevine, Texas. Photo by Jared Davidson.)

Thunder Storms and Power Surges

Unplug the kiln when not in use, especially during thunder storms and in areas that have frequent power surges. If the kiln is part way through a firing when a storm begins, it may be okay to continue the firing. When the kiln shuts off, disconnect the power.

CAUTION: When firing the kiln during a storm, do not leave the kiln unattended.

How to Read the Display

Center Dot: Time

A center dot appears when time is displayed. The dot separates hours from minutes (i.e. 1 hour, 30 minutes = 01.30). During temperature display, the dot disappears.

Three-Light Display

The Sentry turns on the heating elements through relays. Power output lights appear in the right side of the display when the Sentry sends a signal to turn on the relays. This lets you know when the elements turn on.

- **Single-Zone Kiln** When the Sentry turns on the relays, the lights will appear. The number of lights that appear depend on the number of relays in your kiln.

- **Multiple-Zone Kiln** The top light indicates power to the top section of the kiln, the middle light power to the middle section, and the bottom light power to the bot-

tom section. (Two-zone kilns: The middle light does not turn on.)

Note: Though power output lights are on, mechanical problems can prevent the elements themselves from turning on.

Single 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 the F / C option, page 22.

IDLE Display: Kiln is Ready to Begin

The controller displays **[IDLE]** when you first apply power to the kiln. Operation begins from **[IDLE]**. You can't fire the kiln until **[IDLE]** appears. It means the kiln is ready to be programmed or to begin firing.

■ If you press STOP during a firing, **[ABRT]** will appear. To get back to **[IDLE]**, press any key.

■ If the display shows an error message such as **[FAIL]** instead of **[IDLE]**, Press any key to make **[IDLE]** appear. (See pages 27 - 29 for error messages.)

■ **[CPLT]** (firing completed) appears at the end of a firing. To make **[IDLE]** appear, press any key.

CPLT Message: Firing Completed

When the firing has successfully completed, the Sentry will beep for 60 seconds and shut off the elements. Then four messages will cycle one after the other:

1 **[CPLT]** (complete)

2 Firing time in hours and minutes

3 The temperature reached during the last segment that you programmed

4 The current kiln temperature

Note: After the kiln fires to completion, disconnect the power. It is okay to turn off the power to the controller while the kiln cools to room temperature.

Note: If the temperature alarm sounded (see page 9) before the kiln fired to completion, you will see **[ALAR]** instead of **[CPLT]**. Press **ENTER**. **[CPLT]** will appear.

LID Display

This indicates that your kiln is equipped with a lid or door safety switch, and the lid or door is open. This will turn off the elements.

If your kiln does not have a safety switch, or the kiln is closed, please see page 28.

Repeat Firings

To repeat the last firing, press **ENTER** from **[IDLE]**. The kiln will begin firing. This works in both Cone-Fire and Ramp-Hold. But first, make sure you are repeating the correct firing by using Program Review (see page 8). For repeat firings that you don't want to inadvertently change, see Program Lock, page 25. Program Lock is especially useful in classroom settings.

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. Bumping the thermocouple could also cause inaccurate readings.

Thermocouples come in different widths. The wider the thermocouple, the farther it should extend into the firing chamber. A ¼" - ½" diameter thermocouple should extend into the kiln about ¾" - 1". (Do not be concerned if your thermocouple extends into the firing chamber even farther.)

Note: Keep shelves, posts and ware 1" - 1 ½" away from the thermocouple. Keep an extra thermocouple on hand, especially if you fire hotter than 2000°F / 1093°C.

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

If you are using a separate portable controller, you will need to install the thermocouple on the kiln. See the separate TnF 2 installation instructions.

Preventing an Overfire

Even though a digital controller turns off the kiln automatically, you should monitor the kiln during firing. This is to prevent a possible overfire.

1 Remain nearby while the kiln is firing. Check the kiln occasionally.

2 Set the temperature alarm (page 8) to remind yourself to check the kiln. If you are too far away to hear the alarm, you might try using a baby monitor.

3 After the kiln fires to completion, disconnect the power. It is okay to turn off the power to the controller while the kiln cools to room temperature.

Set a wristwatch alarm, cell phone, or even an alarm clock to remind you to check on your

Chapter 2
The 12 Keys

In This Chapter you will learn to . . .

- Check for mistakes before firing a program
- Edit a program during a firing
- Delay a firing to suit your schedule
- Know which segment is firing at any time
- Set an audible temperature alarm
- Find out the electrical cost of a firing

Correcting Entries

If you enter the wrong temperature, cone, time, etc., while programming, enter 0000. Then enter the correct numbers before pressing ENTER. See also the Stop/Back Key, page 10.

> **Note:** During programming mode on the previous Sentry 2.0 controllers, the display went back to **[IDLE]** if you paused for one minute. On your new Sentry 3.0, the display will no longer time out during programming. You must advance or go back to exit programming.

The 1 Key / Cone-Fire

Cone-Fire mode fires your kiln to a pyrometric cone. See Chapter 3, page 10, for details. To find out if your Sentry includes Cone-Fire:

1 From **[IDLE]** display, press 1. If **[CONE]** appears, you have Cone-Fire mode. If the 1 key does not respond, you have Ramp-Hold mode only.

2 Press **STOP** to bring the controller back to **[IDLE]** .

The 2 Key / Add Time

This key adds five minutes to a Hold. It is designed for ceramists who watch witness cones and for glass artists who watch the glass near the fusing temperature.

1 During a firing, press **2**. **[HD]** plus the segment number, and hold time, will appear. If that segment has no hold time, **[00.00]** will appear.

2 Press 2 again. The time shown will increase by 5 minutes.

3 To return to the temperature display, press any key (except **2**) or wait 10 seconds.

> **Note:** Add Time will add 5 minutes to a hold even if no hold had been programmed before. After hold time appears in the display, 5 minutes will be added with each press of the key.

The 3 Key / Delay Fire

This delays the start of the firing by the amount of time entered. Use it to fit a firing into your schedule or to take advantage of lower electric rates at night. Delay zeroes out
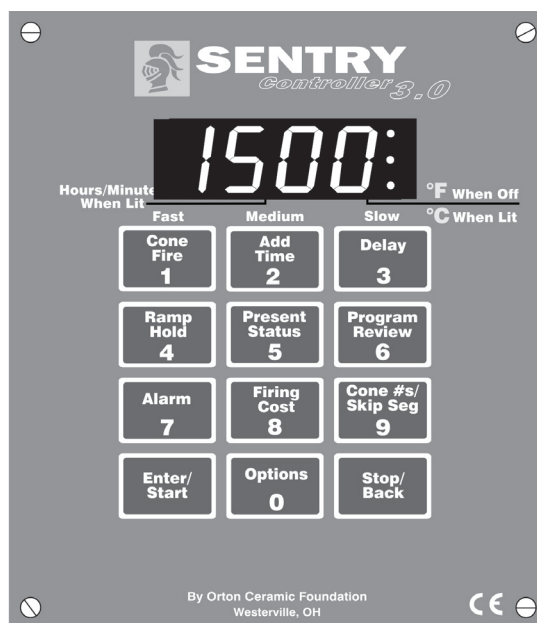
after each firing. Therefore, it must be programmed again for each firing. The maximum delay is 99 hours and 59 minutes.

1 First, enter the Cone-Fire or Ramp-Hold program you are going to fire.

2 From **[IDLE]** press 3. Enter delay time (i.e., 5 ½ hours = 05.30). Press **ENTER**.

3 To begin Delay, press **ENTER** once from **[IDLE]**. A Delay count-down timer will appear.

> **Note:** Press **START** during delay to end the delay and begin the firing. (You could also press **STOP** to end the delay and then **START** to begin the firing.)

> **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. The operator assumes full responsibility for shutting the kiln off at the proper time.

The 4 Key / Ramp-Hold / Edit

Ramp-Hold fires the kiln to the temperature you specify, whereas Cone-Fire fires to a pyrometric cone. Press 4 from **[IDLE]** to program a Ramp-Hold firing or to select a stored Ramp-Hold program. See "Ramp-Hold," page 14.

Editing the Current Segment During Ramp-Hold Firing

> **Note:** This feature works only in Ramp-Hold, not in Cone-Fire.

While the kiln is firing in Ramp-Hold, you can change the target temperature, ramp rate, and hold time of the current segment. (You can edit only the segment that is firing.

To edit other segments, wait until the firing has progressed to those segments.)

If the current segment has already started its hold time, you can edit only the hold time.

1 During firing, press 4.

2 The display will show the rate of the current segment. Use the number keys to change the rate. Then press **ENTER**.

3 The display will show the target temperature of the current segment. Use the number keys to change the temperature. Then press **ENTER**.

4 The display will then show the hold time of the current segment (or **[00.00]** if there is no hold time). Change the time, if needed, and press **ENTER**. The kiln will resume firing.

The 5 Key / Present Status

Press **5** during a firing to display the current segment that is firing. (See page 14 for the definition of segments, rate, and hold.) The messages that can appear in Present Status:

■ **[RA   ]** , the segment number, and the actual rate: The Sentry is in the ramp part of a segment.

■ **[HD   ]** and segment number: The Sentry is in the hold part of a segment.

■ **[PRHT]** Cone-Fire Pre-Heat (see page 12).

■ **[COOL]** Cone-Fire Slow Cooling (see page 13).

Uses for Present Status:

■ You are firing a program that contains several heating and cooling segments. Without Present Status, it would be easy to lose track of which segment is firing.

■ In Cone-Fire, you may think the kiln has fired too long when it is actually only in a slow cooling.

Note: Present Status shows the actual firing rate of the current segment instead of only the rate you programmed. This is very useful in knowing how fast your kiln can actually fire.

The 6 Key / Program Review

Pointer: Use Program Review before every firing! It takes only seconds.

When you press **ENTER** to begin firing, the controller will fire the program that is in active memory. Program Review shows the values for that program. The program in active memory is—

■ The program that you fired last, or

■ The program that you entered or selected since the last firing.

Start Program Review from **[IDLE]**, or while firing, by pressing **6**.
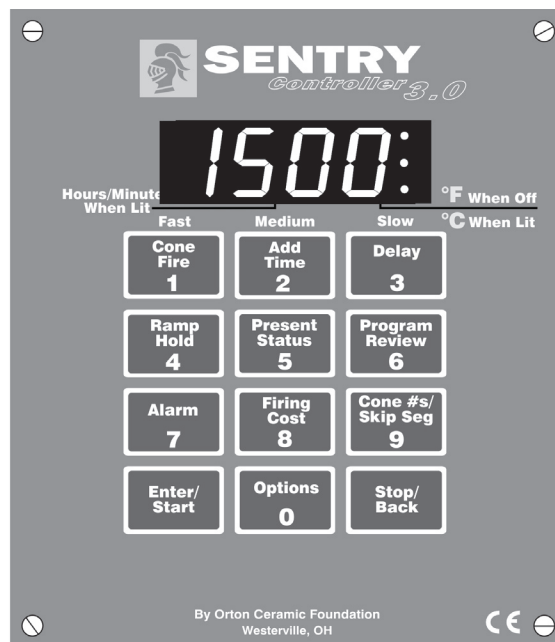
Note: In Program Review, Cone-Fire speed is displayed as the RA part of each segment. Cone-Fire Review shows the segments and ramp rates listed in the charts on pages 32 - 33.

The 7 Key / Temperature Alarm

If you need to know when your kiln reaches a particular temperature, set the alarm. The controller will beep and **[ALAR]** will flash when the kiln reaches the alarm temperature that you enter. Use the alarm to alert you to—

■ Lower the lid from the venting position and insert the peephole plugs.

■ Check the witness cone near shut-off time.

■ Check the glass before the expected fusing or slumping temperature. You can see the glass through a kiln window.

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 only for higher temperatures and not for cooling temperatures.

After the alarm beeps, the alarm temperature will stay in memory for future firings until you replace it with a new temperature.

Monitoring the Alarm from a Distance

Place an inexpensive baby monitor near the kiln. From another location in your building, you will be able to hear the temperature alarm beeping and even the relays clicking if your kiln has mechanical relays.

Setting the Alarm From IDLE

1 From **[IDLE]**, press **7**. **[ALAR]** will appear alternating with the last alarm temperature entered.

2 Enter new alarm temperature. Press **ENTER**. **[IDLE]** will appear. (To disable the alarm, set the alarm temperature to **0**.)

Setting the Alarm During Firing

1 The alarm beeps while the kiln is firing. **[ALAR]** will appear, alternating with the temperture. Press **7**.

2 Enter the new temperature. (To disable the alarm, set the alarm temperature to **0**.)

3 Press **ENTER**. **[ALAR]** will disappear, and the kiln will continue firing.

If you touch **7**, enter a new temperature, and forget to press **ENTER**, the controller will continue firing without resetting the alarm. **[ALAR]** will continue alternating with the kiln temperature.

> **Question** The alarm on my Sentry sounds a minute into each firing. Why is the alarm going off?

> **Answer** The alarm was set to a temperature below the current temperature. To deactivate the alarm for your next firing, set it to 0.

The 8 Key / Estimating the Firing Cost

Your Sentry can give you the electrical cost of a firing. Photo by Nick Casberg.

The Sentry controller can figure the electrical cost of a firing. Set up the controller as follows:

In the **[CENT]** option, enter the cost of a kilowatt-hour of electricity. See page 23.

In the **[KW]** option, enter the wattage for your kiln. See page 23.

After the kiln fires to completion, **[CPLT]** will flash. Press the **8** key; **[IDLE]** will appear. Press again; the cost of electricity to fire the last load will appear. To return to temperature display, press **ENTER**.

> **Note:** If you enter the kiln wattage in the **[KW]** option but you do not enter cost per kilowatt-hour in the **[CENT]** option, the controller will display kilowatt-hours instead of firing cost.

> **Note:** By pressing the **8** key during a firing, you can see how much the cost increases as the firing progresses.

> **Pointer:** If you wonder how much Slow Cooling adds to the cost of a firing, press the **8** key before Slow Cooling begins, and press it again after the kiln has fired to completion.

The 9 Key / Look Up Cone Numbers & Skip a Segment

Cone Table

Look up a cone temperature with the **9** key. (See the next page for information on cones.)

1 From **[IDLE]** , press **9**. **[CONE]** will appear, then the cone, if any, currently programmed in Cone-Fire.

2 Enter a pyrometric cone number. Press **ENTER**. The display will show the temperature for that cone. If you enter a non-existent cone number, the display will repeat the last cone number that you looked up.

> **Note:** Do not be concerned if the actual cone shut-off temperature does not match the Cone Table. The temperature of a cone varies with firing speed. The cone temperatures in Cone Table are for self-supporting cones fired at a rate of 108°F / 60°C per hour during the last hour of firing.

Skip a Segment

Skip Segment works only during a firing. It jumps from the current segment to the next one.

To skip a segment, press **9**. **[SKIP]** will appear alternating with the number of the next segment. Press   .

If you change your mind and don't want to skip that segment, wait 10 seconds without pressing any key. You will exit the Skip option, and the firing will continue in the same segment as before.

Skip More Than One Segment

1 Press **9**. **[SKIP]** will appear alternating with the number of the next segment.

2 Press the **1** (or **3**) key. Keep pressing the **1** (or **3**) key to scroll through the available segments. When you see the segment you want to skip to, press **ENTER**. The temperature display will return, and the kiln will fire in your chosen segment.

> **Note:** As you scroll through the available segments, one of the options is **[CANC]** (Cancel). If you don't want to skip to a different segment after all, press **ENTER** when **[CANC]** appears.

Skip Segment in Cone-Fire

See the segments in the Cone-Fire firing schedules on pages 32 - 33. Reasons to skip a segment in Cone-Fire:

■ To skip out of Pre-Heat and begin the cone firing. You might do this if the ware is dry and ready to fire before

Pre-Heat has ended. (You can tell by placing a small mirror near an open peephole.)

■ To skip out of Cone-Fire Hold. Slow Cooling will begin. (If the firing does not include Slow Cooling, Skip Segment will not end a Hold. Press **STOP** to end the firing.)

Skip Segment in Ramp-Hold

In Ramp-Hold, the firing will skip to the next segment from either a ramp or hold of the current segment. (See pages 14 - 18 for details on ramps, holds, and segments.)

   Note: Skip Segment does not skip from a ramp to a hold. It skips to the new ramp.

Skip Segment Examples

For additional examples, see pages 17 - 18.

Cone-Fire

■ In Cone-Fire you are firing to an 05 witness cone for the first time. You select cone 04 with a 40 minute hold and a slow cooling. You can see the witness cone through a peephole. After 20 minutes in hold, the 05 witness cone bends to maturity. Use Skip Segment to end the hold and begin Slow Cooling.

   Pointer: Once you know how much hold time will bend the witness cone, program that much hold for the next firing.

Ramp-Hold

■ **Skipping to a Cooling Segment:** You have programmed 2167°F for a cone 5 glaze firing, followed by a segment for slow cooling. Watching the witness cone through the peephole, you notice that cone 5 is bending at 2150°F. Use Skip Segment to end the firing segment and begin the one for slow cooling.

   Pointer: Make a note of the temperature at which the cone bent. Program that temperature for the next firing. Adds comments like this to a firing log.

The ENTER/Start Key

■ Press **ENTER** after each step in programming a firing.

■ From **[IDLE]** press **ENTER** once to begin firing.

■ Press **ENTER** to access an Option. See pages 19 - 26.

0 / The Options Key

See Chapter 6, page 19.

The Stop/Back Key

You can stop a firing at any time by pressing **STOP**. If you inadvertently enter Ramp-Hold or Options, you do not have to go through all the prompts to get back out. Press **STOP** to go to **[IDLE]**.

The **STOP/BACK** key works in Cone-Fire and Ramp-Hold. It will take you back one step with each key press.

Chapter 3
Cone-Fire

In this chapter you will learn to . . .
● See witness cones at high temperatures
● Program a Cone-Fire program in minutes
● Pre-heat the ware so it doesn't explode
● Bend a cone by adding extra hold time
● Cool slowly (called down fire) to alter glazes

Cone-Fire mode is based on pyrometric cones. It is not designed for heat treating, glass fusing and enameling. For these firings, see "Ramp-Hold," pages 14 - 18. Use Ramp-Hold to fire ceramic pieces that require a custom firing schedule, such as some types of stoneware sculpture or crystalline glaze.

Before using Cone-Fire mode, read all of this chapter. Have your controller in front of you so you can try out the keys as you read. For more details on pyrometric cones, please see your kiln manual.

Pyrometric Witness Cones

Question A cone 5 firing was 7°F below the target listed in your manual, and a cone 6 firing was 22°F below the target. Is this typical and okay? Is the digital controller on my kiln operating normally even though it did not achieve the controller temperatures that were programmed at cone 5 and 6?

Answer This is normal for Cone-Fire operation. If the kiln fires slower than the normal rate, it will shut off at a lower temperature. If the kiln fires faster than a normal rate, it will shut off at a higher temperature, sometimes by only a few degrees.

The Sentry controller shuts off automatically without cones. Nevertheless, every ceramic firing should include at least one witness cone (also called the shelf cone). The witness cone is placed inside the kiln. The witness cone is the most accurate measurement of heat work in a ceramic firing.
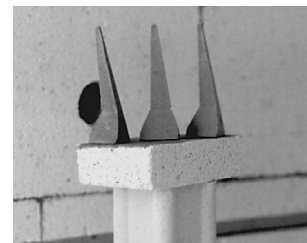
Use self-supporting witness cones on the shelf. They stand upright without cone holders.

If you fire the same size load and type of ware regularly, the witness cones let you compare one firing to the next and alert you when something is wrong. For example, if the witness cone bends farther and farther with each consecutive firing, this may indicate thermocouple temperature drift.

Note: If the bending of the witness cone does not match the Cone-Fire shut-off, you may want to adjust Cone Offset or Thermocouple Offset. See pages 20 - 21. If the witness cones bend inconsistently from one firing to another, see "Sentry Troubleshooter," a separate publication.

How to Position Cones on the Shelf

Position the witness cones so that you can see them through a peephole during firing. If the kiln takes longer than usual to fire, you may wonder if something has gone wrong and the kiln is over-firing. But by seeing the cones, you will know how the firing is actually progressing.
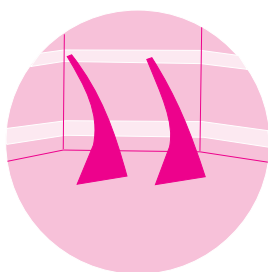
Silhouette the lower part of the cone against an element. Keep the cone 8" - 12" away from the peephole.

If you follow these guidelines, you should be able to see the cones even at cone 10:

1 Place the cones 8" - 12" away from a peephole. Positioning them closer makes them difficult to see.

2 Have enough space around the cones to keep them from touching a piece of ware when they bend.

3 Position cones so that when viewed from the peephole, they are silhouetted by a glowing heating element on the opposite kiln wall. (Keep cones at least 2" from an element.)

4 The element that silhouettes the cones should be level with the lower part of the cone. If the element is in line with the upper part of the cone, you won't be able to see the cone when it bends.

5 If you use the three cone system, always have the higher temperature cone on the same side in every firing. Otherwise you can lose track of which cone is which.

6 Wear green #3 kiln firing safety glasses when viewing the cones through the peephole.

See your dealer if in doubt about which cone number to use with each clay and glaze.

Firing Schedules

Cone-Fire uses three firing schedules:

■ Low fire cones 022 - 011

■ Medium fire cones 010 - 01

■ High fire cones 1 - 10

Cone-Fire Programming

Use these instructions for your first firings. Later you may prefer "Cone-Fire Shorthand Programming," page 40.

As the Sentry prompts for cone, speed, pre-heat, hold, and slow cooling, values entered for the last firing will appear. To use these values again, press **ENTER**.

To fire without Delay or Alarm: Follow steps 1 through 7 below. Then from **[IDLE]** press **START**. To use Delay or Alarm, see also pages 8 - 9.

1 Apply power to the kiln. **[8888]** then **[IDLE]** will appear. (Press **ENTER** if **[IDLE]** does not appear.)

2 Press **1**. **[CONE]** will appear. Enter cone number. (If the **1** key does not respond, your controller has Ramp-Hold only.)

3 Press **ENTER**. **[SPD]** will appear. Enter speed: FAST (**1**), MEDIUM (**2**), SLOW (**3**). (Medium speed will display as **[STD]**.)

4 Press **ENTER**. **[PRHT]** will appear. To use Pre-Heat (p. 12), enter time. Otherwise enter **0**.

5 Press **ENTER**. **[HOLD]** will appear (pg 13). To soak the ware at the end of firing, enter a hold time. Otherwise enter **0**.

6 Press **ENTER**. **[COOL]** will appear (after you have turned it on in Options, pg 13). To use Slow Cooling, enter cooling rate as degrees per hour. (180°F/82°C is the maximum cooling rate. Set **0** to turn Slow Cooling off.)

7 Press **ENTER**. **[IDLE]** will appear.

8 **To set Alarm**: Press **7**. **[ALAR]** will appear. Enter alarm temperature. (Press **0** to turn alarm off.) Then press **ENTER**.

9 **To set Delay:** Press **3**. **[DELA]** will appear. Enter delay time. Press **ENTER**. (Delay zeroes out after each firing.)

10 To start the firing, press **ENTER** once. **[STRT]** will appear, then temperature. If Delay was programmed, **[DELA]** will appear, then time remaining until start. To stop the program during firing, press **STOP**.

When program fires to completion, **[CPLT]** will appear and the controller will beep. Press **ENTER**. **[IDLE]** will appear. To shut off the alarm when it sounds during a firing, press **ENTER**.

The firing schedules programmed into Cone-Fire mode are listed in Appendix B, pages 32 - 33. Should you ever want to customize a Cone-Fire program, make the desired changes to a firing schedule and program it in Ramp-Hold (page 14).

During a cone firing, press **5** (Present Status) to see which stage, or segment, of the firing the kiln has reached. The number displayed will be a segment number from the schedule listed in Appendix B that you are firing.

> **Note:** Pre-Heat shows in Present Status as **[PRHT]**. It is not given a separate segment number.

> **CAUTION:** Cone numbers beginning with 0 are lower in temperature than those without the 0. When programing a Cone-Fire, be sure you know the difference between an 05 and 5. See "Temperature Equivalents Chart for Orton Self-Supporting Pyrometric Cones," Appendix D, page 36.

Low Fire Cones 022 - 011

This range includes decals, over-decorations, lusters, and golds. You can usually fire fast. Good venting is important because of the oils and other organics. Do not close the lid from the vented position until all odor has disappeared.

Middle Fire Cones 010 - 01

Glazes fired on bisque ware (ware that has already been fired) can be fired faster than greenware.

High Fire Cones 1 -10

This is the firing range for porcelain and stoneware. These bodies fire nearly to vitrification and can shrink up to 16%. Water, carbon and sulfur burn out during the early stages and must be vented. The amount of oxygen in the kiln affects the color of the fired clay. The high fire schedules programmed into Cone-Fire slow down during the last 216°F/120°C (two hours) to produce better density in the ware.

Cone-Fire Features

Speed [SPD]

When you select Medium speed in a Cone-Fire program, the kiln uses the standard firing schedules listed on pages 32 - 33. When you select Fast (1), the standard schedules fire 20% faster. On Slow (3), they fire 20% slower.

You can alter the firing speed even more under Speed (SPD) in Options. You can increase or decrease the firing time of a standard schedule by up to 40%. For instance, if you are on a tight deadline, you can reduce a 7 hour fast cone firing to 5 ½ hours.

> **Note:** The final segment heating rate will not change. It will always be 108°F/60°C per hour. SPD option affects only the earlier ramp segments.

Pre-Heat [PRHT]

Moist greenware can explode during firing. This happens when the moisture in the clay rapidly turns to steam and cannot escape from the clay fast enough. The Sentry Pre-Heat feature dries the ware at low temperature before the moisture can turn to steam.

Pre-Heat is sometimes necessary when firing thick greenware. It may also be necessary in humid weather, which inhibits drying. If possible, however, avoid using Pre-Heat to dry greenware. If the greenware feels damp or cool when you touch it to your cheek, dry it longer outside the kiln before firing. Use a dehumidifier in humid weather. Drying greenware in the kiln tends to rust the kiln.

> **Note:** During Pre-Heat, vent the lid or use the optional Orton Vent Master. Otherwise the firebricks will absorb moisture, leading to rust behind the steel case. Moisture in the firebricks can also slow down the firing.

> **CAUTION:** Venting the lid during Pre-Heat is so important that some ceramists use the extended vent position. If you do this, you must be near your kiln at the end of Pre-Heat to lower the lid.

Pre-Heat raises the temperature 60°F/33°C per hour to 200°F/93°C. Then it holds at 200°F/93°C for the period of time that you specify. Pre-Heat works in Cone-Fire only. After Pre-Heat is finished, the kiln will automatically begin firing to the cone you have selected.

> **Note:** Above an altitude of 6,000 feet / 9,656 kilometers, water boils at a lower temperature. This may cause moisture in the ware to turn to steam even during Pre-Heat.

Mirror Test

This test will help you determine how much Pre-Heat to use.

Occasionally during Pre-Heat, hold a mirror near the top peephole. (Be careful to avoid burns.) The mirror must be at room temperature, so hold it near the peephole for only several seconds at a time.

Vent the kiln until moisture no longer fogs a mirror.

If the mirror fogs, moisture is still escaping from the ware. When the mirror no longer fogs, you can exit Pre-Heat and begin the firing.

To interrupt Pre-Heat and begin firing to the cone in Cone-Fire, press **9** (Skip Segment). **[SKIP]**, alternating with **[RA 2]**, will appear. Press **ENTER**. Segment 1 of the main firing will now begin.

Note: If you are using a vent fan, such as the Orton Vent Master, leave the fan on during Pre-Heat. The fan will help to remove moisture. (Kilns equipped with the AOP Fan: see the Fan option, page 21.)

How to Use Pre-Heat When Kiln is Already Above 200°F/93°C at Beginning of Firing

If you begin firing with Pre-Heat in a kiln that is already hotter than the Pre-Heat temperature, the kiln will skip Pre-Heat and begin firing to the cone. There are two ways to use Pre-Heat in this situation:

■ Wait until the kiln cools below 200°F / 93°C before starting the firing. This is the preferred method.

■ Load the kiln and start the firing, but include enough time in Delay for the kiln to cool below 200°F / 93°C before Pre-Heat begins.

Temperature Hold [HOLD]

Cone-Fire Hold heat-soaks the ware at the cone temperature. Without Hold, the kiln shuts off after it reaches the cone temperature. Hold maintains the cone temperature for the period you specify. Hold helps even out the temperature throughout the kiln. It also helps the heat to penetrate completely into the clay. (Rapid firing is like cooking: the turkey will be done on the outside but not always on the inside.) Hold helps glaze absorb china paint for saturated colors. It may heal glaze defects such as bubbles. A little hold time can yield dramatic results.

Pointer: Too much hold time can overfire your ware and burn out colors. Be sure to experiment with hold before firing a full load of ware with hold.

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. As a rule of thumb, roughly 20 minutes of hold = one cone of heat work.

Example: to fire to cone 05, program Cone-Fire for 06 and add about 20 minutes of hold time.

Watch the pyrometric witness cones through a peephole. Press **STOP** when the correct witness cone bends, noting how much Hold time was needed. Program that much Hold time the next time you fire the same type of ware. (During Hold, the temperature will alternate with time left in Hold. Subtract that amount from the total Hold time entered.)

When Hold is set to 99.59 hours or higher, the Sentry will remain at that temperature indefinitely, until you press **STOP**.

Slow Cooling [COOL]

Slow cooling, also called down firing, enhances the quality of some ceramic glazes and may heal glaze bubbles. Slow cooling encourages crystal develoment, deeper gloss, and sometimes startling color shifts. Iron red glazes seem to respond well to slow cooling.

■ The COOL prompt does not appear in the display during programming until you activate Slow Cooling with the Options key. See page 21.

■ The Sentry's Slow Cooling begins after the cone firing and ends at 1500°F / 815°C.

■ When **[COOL]** appears in Cone-Fire programming, enter a cooling rate between 1°F - 180°F / 1°C - 82°C per hour. A good starting point is a rate of 90°F / 50°C.

■ Enter a rate of 0 to turn Slow Cooling off.

Pointer: If the kiln seems to take forever to shut off, press **5** for Present Status. Check the Slow Cooling rate. The firing time can extend for many hours if the cooling rate is too slow.

When the Kiln Shuts Off Too Soon

If the kiln shuts off before the pyrometric witness cone bends, you can turn the kiln back on and keep firing. Simply program the next hotter cone in Cone-Fire. Then from **[IDLE]**, press **START**. The kiln will begin firing, taking up where it left off.

Note: Look at the witness cones through a peephole to know if the kiln shuts off too soon.

If the kiln shuts off within 100°F/55°C of maturity, and the temperature drops 50°F/28°C or more after the kiln shuts off, do not depend on the witness cones. Once they cool 50°F/28°C after they have been heated to within 100°F/55°C of maturity, they will not bend properly. This is because they form a hard shell.

Wrong Thermocouple Type

If a Type-K thermocouple is installed on your kiln, but your controller is set for Type-S, the kiln will underfire. See the TC option, page 21, to check the thermocouple type.

For Kilns with the AOP Outlet

The AOP (auxiliary output) is an optional receptacle, or socket, mounted on the kiln. Plug a kiln vent into the receptacle, and use your controller to turn on the vent automatically. That is done through the Fan option.

But before **[FAN]** will appear in the Options list, (1) you must enter a Cone-Fire program in active memory and (2) you must select **[VFAN]** in the **[AOP1]** or **[AOP2]** option. (See page 22 for instructions on selecting **[VFAN]**.)

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[FAN]** appears.

2 Press **ENTER**. Use the **1** and **2** keys to select one of these settings:

■ **[ON]** The vent is on during Pre-Heat, the cone firing, and Slow Cooling. It turns off at 212°F/100°C.

■ **[OPT]** The vent is on during Pre-Heat and the cone firing. It is off during Slow Cooling.

■ **[OFF]** The vent is off all the time.

3 After selecting one of the above, press **ENTER**. Press **STOP** to return to **[IDLE]**.

Chapter 4
Ramp-Hold

In this chapter you will learn to . . .
- Program a Ramp-Hold firing
- Store programs in memory
- Turn a vent fan on or off throughout the firing
- Control the cooling rates for down firing

Before using Ramp-Hold, read all of this chapter with your controller in front of you so you can press the keys as you read.

Theory of Ramp-Hold Operation

The temperature you are firing to in Ramp-Hold is called the target temperature. After the Sentry reaches the target temperature, it can hold, or soak, the kiln at that temperature for the length of time that you program.

The Sentry 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, Ramp-Hold mode 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, or soak, the target temperature for a period of time.

The Sentry fires in segments, or stages. A segment is a controlled heating rate to a target temperature. A segment can also have a hold. Shown in the chart below is a segment with a target temperature of 1250°, a rate of 625°, and a hold of one hour.

A segment has two parts:

- **Ramp**: The temperature changes.
- **Hold**: The temperature remains the same.

Parts of a Segment
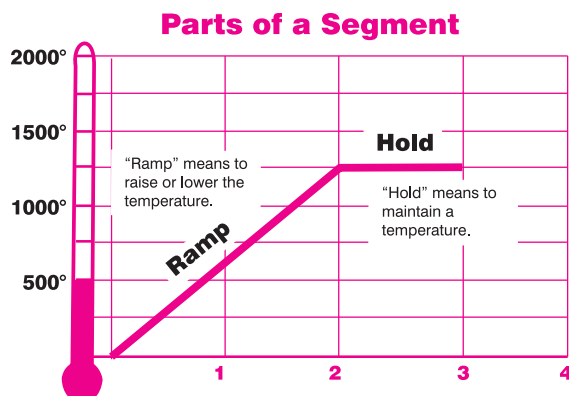
This segment will reach the target temperature of 1250° in 2 hours, then hold that temperature for 1 hour.

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

Note: Some brands of controllers fire to a temperature in a given length of time. If you would prefer to program that way instead of at a rate per hour, see the Rate option, page 23.

A segment can have only one ramp and only one hold. Therefore, if you need more than one hold, add more segments to the firing. Firing to a temperature at a single rate would need only one segment. Reasons to add more segments:

- To change the heating rate
- To add a hold somewhere below the shut-off temperature
- To control the cooling rate.

The diagram below shows a 3 segment firing. Segments 1 and 2 were used on the way up in temperature. Segment 3 was added to control the cooling rate.

To figure how many hours a segment will take to fire, subtract the current temperature from the target temperature and divide the result by the heating rate. In the diagram in the left column, the firing time is 1250° - 80° (room temperature) = 1170 ÷ 625 = 1.87 hours.

After the Sentry has finished firing the last segment, it will turn off the heating elements.
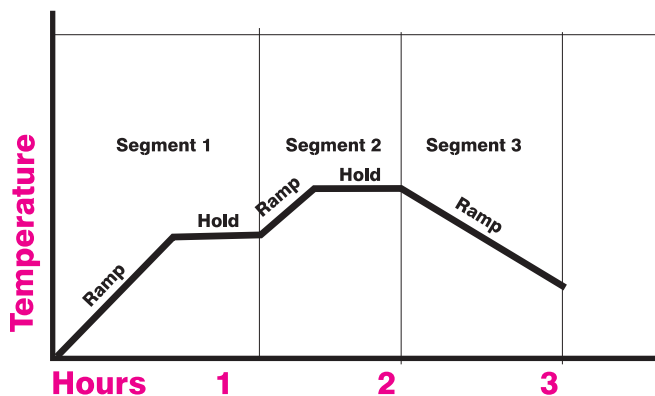
Here is a simple 3-segment program. Segments 1 and 2 each have a hold. Segment 3 is a controlled cooling segment.

Storing "USER" Programs

To program the controller in Ramp-Hold, **[IDLE]** must appear. From **[IDLE]** press **4**. **[USER]** will appear. The controller is ready for you to choose a stored program or to enter a new one. (See next page for programming instructions.)

The controller can hold 35 programs in memory. They stay in memory even when the power is turned off. Stored programs are numbered 1 - 35. Each program can have up to 20 segments. You don't have to use all the segments available—use only the number needed. Sometimes one segment is all you will need.

Step 7 of Ramp-Hold Programming in the red box at right shows you how to zero out the segments you don't need. (Entering a rate of 0 for the first segment you don't need zeroes out the rest of the segments.)

When entering a Ramp-Hold program for the first time, press **1** after **[USER]** appears. Your first firing will be stored as Program 1. (See Step 2 at right.)

Each time you store another program, select the next available number, such as 2, at the **[USER]** prompt. Selecting a number for a new program over-writes (erases) any program stored there. Write down your user programs for quick reference. (Copy the blank forms on page 37 and keep them in a 3-ring binder.)

> **Pointer:** For repeat firings that you don't want to inadvertently change, see Program Lock, page 25.

Firing a Stored User Program

After you enter a new program and the display shows **[IDLE]**, the new program is in memory and ready to fire.

Selecting a different stored program takes only seconds:

1 From **[IDLE]** press **4**.

2 **[USER]** will appear. Enter the program number (1 - 35).

3 If there are no changes to the program, press **STOP**. **[IDLE]** will appear. The controller is ready to fire your selected program. To begin firing, press **ENTER** once.

> **Pointer:** Use Program Review to be sure you are firing the correct program! From **[IDLE]** or even after the firing has started, press **6**. The values for the program will appear.

Rate as Degrees Per Hour

Rate = Firing Speed

Rate is figured in degrees per hour.

Rate = 1000° per hour
Rate = 500° per hour
Rate = 333° per hour

Hours
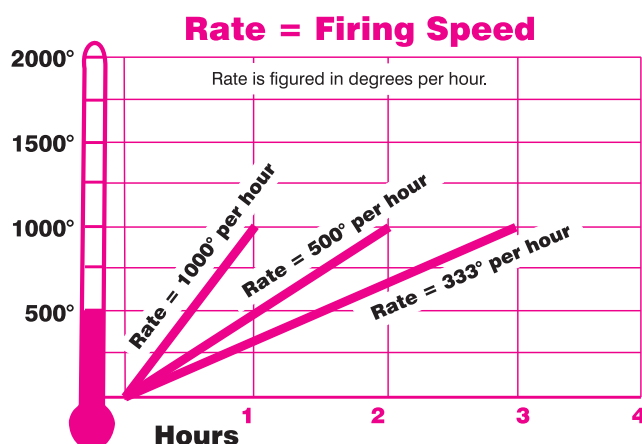
Each segment must include a rate, which is the firing speed of that segment. We measure rate as degrees per hour. This is similar to miles per hour; just replace miles with degrees. During programming, enter the rate when **[RA]** appears. (**[RA]** will also include the segment number: **[RA 1] [RA 2]** etc.)

Ramp-Hold Programming

Use these instructions for your first firings. Later you may prefer "Ramp-Hold Shorthand Instructions," inside back cover.

As you follow these steps, you will see values (temperatures, rates, etc.) from the last firing. To use these again, press **ENTER**. To program a controlled cooling, set the segment to a lower target temperature than that of the previous segment.

To fire without Alarm or Delay: Follow steps 1 through 7. Then press **START** once.

1 Apply power to the kiln. **[8888]** then **[IDLE]** will appear. (Press **ENTER** if **[IDLE]** does not appear.)

2 Press **4**. **[USER]** will appear. Enter a program number from 1 to 35.

3 Press **ENTER**. **[RA 1]** will appear. Enter firing rate for segment 1 (temperature change per hour: from 1° to 9999°).

Note: If you have selected Time in the Rate option, enter the time needed to reach the target temperature for that segment. (See next page.)

4 Press **ENTER**. **[°F 1]** (or **[°C 1]**) will appear. Enter the target temperature of segment 1.

5 Press **ENTER**. **[HD 1]** will appear. Enter segment 1 hold time in hours / minutes (e.g. 12 hours, 30 minutes = 12.30). No hold = 00.00.

6 Press **ENTER**. If **[FN 1]** appears, and you have an AOP receptacle on your kiln, use the 1 or 2 key to select ON or OFF. Press **ENTER**. (For more details on AOP, see next page.)

7 Continue entering values for the segments needed. When **[RA _]** appears for the first segment you don't need, press **0** then **ENTER**. **[IDLE]** will appear. The kiln is ready to fire.

8 **To set Alarm:** press **7**. **[ALAR]** will appear. Enter alarm temperature. (Enter **0** to turn alarm off.) Then press **ENTER**. **[IDLE]** will appear.

9 **To set Delay:** press **3**. **[DELA]** will appear. Enter delay time (i.e. 12 hours, 30 minutes = 12.30). Then press **ENTER**. **[IDLE]** will appear. (Delay zeroes out after each completed firing.)

10 **To start program:** From **[IDLE]** press **ENTER** once. **[-ON-]** will appear, then kiln temperature. If a delay was programmed, **[DELA]** will appear, then time remaining until start. To stop the firing at any time, press **STOP.**

We recommend using Program Review (page 8) before firing. When the program fires to completion, **[CPLT]** will appear and the controller will beep. Press **ENTER**. **[IDLE]** will appear.

The diagram at the bottom of the previous page shows three rates. A rate of 1000° per hour 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.

If you want the kiln to fire at full speed, enter a rate of 9999. See step 3, inside the red box on the previous page.

Note: In Program Review, a heating rate of 9999 is displayed as **[FULL]**. When a kiln is heated at full power, it may overshoot the target temperature, especially in the lower range. To avoid this, add an extra segment with a slower rate for the last 50 degrees of temperature rise.

CAUTION: The Sentry includes error messages to warn you when the kiln is at the wrong temperature. Firing the kiln at full rate turns off some of these warnings. See TEDE, Temperature Deviation, and HTDE, High Temperature Deviation, page 24.

If you are not sure how fast to fire, remember an old firing adage: When in doubt, slow it down.

Note: In the Rate option, page 23, you can set up your controller to calculate rate in one of three ways: 1) degrees of temperature change per hour 2) degrees of temperature change per minute, or 3) elapsed time needed to reach a temperature. The normal setting is degrees per hour. If you are having problems entering rate, check the RATE option to be sure your controller is set for degrees per hour.

Rate as Time Needed to Reach the Target Temperature

After selecting **[TIME]** in the RATE option, program the amount of time that each segment should take to reach its target temperature. For example, 1 hour and 30 minutes is programmed in Rate as 01.30.

The Time mode in some ways is different and opposite the standard degrees-per-hour rate explained above:

■ For a Full rate, or the fastest that the kiln will fire, select a time rate of 00.00.

■ After you have entered all of the segments for your program, you will need to zero out the remaining available segments. To do this, select a rate of 99.00 hours.

Hold (HD #)

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 helps even out the temperature throughout the kiln. Hold can be used in either heating or cooling segments.

In programming step 5, previous page, enter the hold time. When hold is set to 99.99 hours, the Sentry will remain at that temperature indefinitely until you press **STOP**.

Ceramics: Watch the pyrometric witness cones through a peephole. Press **STOP** when the correct witness

cone bends, noting how much Hold time was needed. Program that much Hold time the next time you fire the same type of ware. (During Hold, the temperature will alternate with time left in Hold. Subtract that amount from the total Hold time entered.)

AOP: Turn on a Fan, Light, or Alarm

The AOP (auxiliary output) is an optional receptacle, or socket, mounted on the kiln. Plug a kiln vent, light, or bell into the receptacle, and use your controller to turn the receptacle on or off for each segment.

If your kiln has the AOP receptacle and you want to use it, see the AOP1, AOP2 option on page 22. Follow the instructions to activate the AOP.

During programming, **[FN]** will appear for each segment (**[FN 1] [FN 2] [FN 3]** etc.). Use the 1 and 2 keys to select On or Off for each segment. **[FN]** will appear only if the AOP has been activated in the AOP1 or AOP2 Option.

Programming a Cooling Segment

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

Example: You fire at a rate of 500°F per hour to 1450°F with your first segment. Then 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.

Pointer: If you prop the lid or door of the kiln 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 a rate of 9999. 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.

Note: See Temperature Deviation (TEDE), page 24, for information on error codes that may appear during crash cooling. To turn these codes off, program a crash cooling rate of 9999. This turns off TEDE error codes only for that particular segment. The TEDE codes still work on the hold and the other segments.

Suppose you enter a cooling rate that is faster than the kiln can cool? Depending on the rate you enter, you may get an alarm message. (Press **ENTER** to turn off the alarm.) **The controller, of course, cannot speed cooling beyond the kiln's natural cooling rate.**

Temperature Overshoot

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

A Practice Program

To practice using the controller, we will enter a program

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

that includes three segments. The last segment is a cooling segment.

Using the instructions in the red box on page 15, enter this firing schedule. Then use Program Review to check for accuracy.

USER = 1
RA1 = 250
°F 1 = 750
HD 1 = 00.00
RA2 = 900
°F 2 = 1425
HD 2 = 00.30
RA3 = 150
°F 3 = 750
HD 3 = 00.00
RA4 = 0

> **Note:** Enter 0 for the rate in segment 4. This zeroes out all the segments past segment 3.

Sample Firing Schedules

These sample firing schedules illustrate different ways to program the Sentry. When designing a firing schedule for materials you are unfamiliar with, or when using one of these schedules, always test-fire samples first. This is because these generalized schedules may not suit the clay or glass that you use.

For practice, you might want to enter these programs even though you may never actually use them.

Cone-Fire Program Customized in Ramp-Hold

This is the cone 04 Cone-Fire schedule at standard (Medium) speed with an added slow-cooling segment. (See Cone-Fire schedules on pages 32 - 33.)

Segment	Rate °F/°C	Temp. °F/°C	Hold
1	324/180	1022/550	00.00
2	153/85	1112/600	00.00
3	180/100	1837/1003	00.00
4	108/60	1945/1063	00.00
5	150/83	1000/537	00.00

In this schedule, the kiln will cool at 150°F/83°C per hour to 1000°F/537°C. Some ceramists use slow cooling to enhance certain glazes.

Sculptured Stoneware Bisque Firing Schedule, Cone 04

Segment	Rate °F/°C	Temp. °F/°C	Hold
1	60/33	200/93	03.00
2	80/44	700/371	02.00
3	80/44	1100/593	00.00
4	108/60	1945/1062	00.00
5	150/83	1400/760	00.00

This slow firing is for thick stoneware. Change the target temperature in segment 4 when firing to a different pyrometric cone. The ware should be bone dry. Test samples until you are sure the schedule works for your ware.

If you are not using a kiln vent, leave peephole plugs out and prop the lid in the vented position. Set the alarm to 1000°F/537°C. When the alarm sounds, close the lid from the venting position.

Set the alarm again, this time to 1850°F/1010°C. When it sounds, check the witness cone through a peephole. When the cone bends to six o'clock, write down the temperature. (Use that temperature in segment 4 on your next firing of the same type of ware.) Then press **9**, **ENTER** (Skip Segment).

This will advance you to segment 5, a slow cooling segment. Do not open the lid until the kiln has cooled to room temperature.

Glass Fusing Firing Schedule

Segment	Rate °F / °C	Temp. °F / °C	Hold
1	250 / 138	750 / 398	00.00
2	900 / 500	1425 / 773	00.30
3	9999 / 9999	1050 / 565	00.00
4	150 / 83	750 / 398	00.00

Stained glass, ⅛", 2 layers, full fuse. The fusing temperature will vary depending on the brand of glass, the batch,

and even the color. Vent the lid. Set the alarm to 500°F/260°C. When the alarm sounds, close the lid from the venting position and insert the peephole plugs.

Set the alarm again, this time to 1350°F/732°C. When it sounds, check the glass through the peephole or kiln window. When the glass fuses to your satisfaction, write down the temperature and hold time for future firings, and press **9**, then **ENTER** (Skip Segment).

This will advance the kiln to segment 3, a flash cooling segment. Lift the kiln lid slightly or open the door ajar until the temperature drops to 1050°F/565°C. Then close the door / lid. The kiln will cool slowly through the annealing range, then turn off.

> **Note:** A cooling rate of 9999 (FULL) shuts off the warning alarm (error message) that sometimes sounds during rapid cooling. This turns off the alarm only for that particular ramp. The alarm codes still work on the hold and the other programmed segments. For details about error messages, see pages 27 - 29.

Starting a Firing in a Hot Kiln

Sometimes a firing begins in a hot kiln after a power failure or other interruption. In this case, the Sentry will begin firing from the first segment that matches the current temperature. See Power Failures, page 29.

When the Kiln Shuts Off Too Soon

Ceramic Firings

If the kiln fires to completion before the pyrometric witness cone bends, you can turn the kiln back on and keep firing. First, program a hotter temperature. Then from **[IDLE]**, press **START**. The kiln will begin firing, taking up where it left off.

> **Note:** By looking at the witness cones through a peephole, you will know if the kiln shuts off too soon.

If the kiln shuts off within 100°F/55°C of maturity, and the temperature drops 50°F/28°C or more after the kiln shuts off, do not depend on the witness cones. Once they cool 50°F/28°C after they have been heated to within 100°F/55°C of maturity, they will not bend properly. This is because they form a hard shell.

Wrong Thermocouple Type

If a Type-K thermocouple is installed on your kiln, but Type-S is selected in Options, the kiln will continually underfire by a wide margin. (The kiln will overfire if Type-S is installed and Type-K is selected.) See page 21 to check the thermocouple type selected in Options.

Chapter 5
Multiple Zone Kilns

In this chapter you will learn to . . .
- Understand multi-zone kilns
- Know when one of the thermocouples fails
- Understand which zone is turning on
- Test the elements

> **Note:** See also Multiple Zone Options, page 26.

An Overview of Multiple-Zone Firing

If you are not sure how many zones your kiln has, look into the firing chamber. The number of thermocouple tips indicates the number of zones.

In single-zone kilns, the Sentry measures the temperature from one location. In the standard single-zone design, when the controller turns on the heat, all the elements turn on at the same time.

With two- and three-zone kilns, the Sentry measures the temperature from each individual zone. It then adjusts the heat separately for each zone to improve temperature uniformity.

To maintain even temperature, the Sentry calculates not only the temperature difference between zones, but also the length of time needed to adjust the temperature of the zones. By carefully timing heat output, it maintains even temperature with a minimal loss in firing speed.

> **Note:** Multiple-zone kilns use the same Cone-Fire and Ramp- Hold programming instructions as single-zone kilns.

> **Note:** Firing a Ramp-Hold program at FULL rate (9999) shuts off multiple-zone control for that firing. The kiln then fires as a single-zone kiln.

Thermocouple Failure
In a Multiple-Zone Kiln

In a multiple-zone kiln, if a thermocouple fails, the firing will continue as a single-zone kiln so long as one thermocouple still operates. **[TC 1] [TC 2]** or **[TC 3]** will appear, indicating which thermocouple(s) failed. (See page 27 for multiple-zone thermocouple error messages.)

Power Output Lights

The three lights on the right of the temperature display turn on when the controller sends a signal to the relays.

■ **Single-Zone Kiln** When the Sentry sends a signal to the relays, these lights appear:

Kilns with 1 relay: middle light only

Kilns with 2 relays: top and bottom lights

Kilns with 3 relays: all 3 lights

- **Two-Zone Kiln** The top light indicates power to the top section of the kiln. The bottom light indicates power to the bottom section. Ignore the center light.
- **Three-Zone Kiln** The top light indicates power to the top section, the middle light is power to the middle section, and the bottom light is power to the bottom section.

When a zone temperature is too low, its indicator light will flash rapidly. The heating elements in that zone will stay on continuously, and the controller will attempt to balance the heat in the other two zones.

Checking Multiple-Zone Elements and Relays for Proper Wiring

When relays or thermocouples are connected to the wrong controller terminals, the zones will show a wide temperature difference. To make sure the thermocouples are wired to the correct relays, trace the switch box wires, one at a time, and compare them with the kiln's wiring diagram.

Also, see "Element Test," page 26.
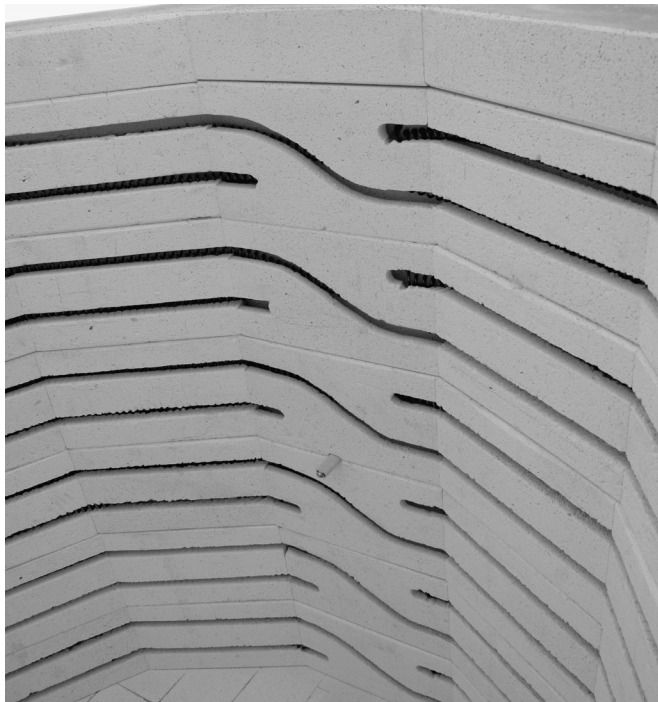
If you are not sure how many zones your kiln has, look inside and count the thermocouples. The kiln has a zone for each thermocouple. In this photo, the kiln is single-zone because it has only one thermocouple.

Chapter 6
The Options Key

In this chapter you will learn to . . .
- Activate slow cooling in Cone-Fire
- Check the amperage that your kiln pulls
- Display temperature in Fahrenheit or Centigrade
- Choose from three types of rates used in programming
- Set up your controller to give the cost of electricity
- Activate Program Lock so you can protect stored Ramp-Hold programs
- Check the circuit board temperature, adjust error messages, check the software version, and more

The Options key gives you access to a list of special features and adjustments in your Sentry. With each press of the Options key, the controller will display the next option.

1 When you find the option you want to use, press **ENTER**.

2 Use the **1** and **3** keys to select changes for that option.

3 After making a selection for an option, press **ENTER**. The display code for the option you just changed will appear. You are then ready to go to the next option.

- In Cone-Fire mode, you will see more options than in Ramp-Hold mode.
- If you select a change for an option but don't press **ENTER**, the change will not go into effect.

There are two ways to get out of Options and back to **[IDLE]**:

1 Press **STOP**.

2 Do nothing for 90 seconds in Options. You will automatically be taken out of the Options display and back to **[IDLE]**.

Note: If you are firing the kiln while in Options, pressing **STOP** takes you out of Options and back to the firing display. But it does not stop the firing.

Cone-Fire Options

These options appear only if a Cone-Fire program has been selected. If your controller has Ramp-Hold mode only, skip to General Options, page 21.

SPD / Cone-Fire Speed
Adjust Cone-Fire Speed
Beyond Slow, Medium & Fast
There are two ways to adjust the speed of a cone fire:

1 Select Fast (1), Medium (2), or Slow (3) when programming a firing.

2 Alter a speed in the Speed **[SPD]** option.

Every cone has a standard firing schedule, shown on pages 32 - 33. Select Medium speed (the 2 key) during Cone-Fire programming, and the cone will fire to the standard schedule. Select Fast (1), and the standard schedule will speed up by 20%. Select Slow (3), and the standard schedule will slow down by 20%.

In the Speed option, you can further adjust the speed of a standard schedule 10 - 40% slower or faster:

1 First, program a Cone-Fire.

2 After programming a Cone-Fire, **[IDLE]]** will appear. From **[IDLE]** , press **OPTIONS** until **[SPD]** appears.

3 Press **ENTER**. Use the **1** or **3** key to scroll through this selection:

[STD] Same as Medium in cone programming

[F10] 10% faster than standard

[F20] Same as Fast in cone programming

[F30] 30% faster than standard

[F40] 40% faster than standard

[S40] 40% slower than standard

[S30] 30% slower than standard

[S20] Same as Slow in cone programming

[S10] 10% slower than standard

When the speed of choice appears, press **ENTER**.

4 To go back to **[IDLE]** , press **STOP**.

The kiln is now ready to fire with the new speed.

> **Note:** SPD settings do not affect the final ramp segment of the cone program.

> **Pointer:** If you are not sure whether the Cone-Fire speeds have been altered, check by going to the SPD option and pressing Enter.

OFST / Cone Offset
Calibrate Cone-Fire to a Witness Cone

Sometimes the pyrometric cones programmed in Cone-Fire do not match the bending of the witness cones. Cone Offset will adjust Cone-Fire to bend the cones.

> **Note:** Thermocouple Offset (see page 22) adjusts all temperature readings. Cone Offset changes only the last heating segment of the cone firings. In the earlier Sentry 2.0 controller, Cone Offset adjusted one particular temperature range of cones. Cone Offset in the Sentry 3.0 adjusts all the cones instead of only a range of cones.

Follow these guidelines before deciding that you need to use Cone Offset:

- The thermocouple must protrude into the firing chamber the correct distance: about ¾" for ¼" wide thermocouples, ½" - 5/8" for 1/8" wide thermocouples.
- Keep shelves 1" - 1 ½" away from the thermocouple.
- Keep witness cones at least 2" away from heating elements.
- Place witness cones in several locations in the kiln.

How to Use Cone Offset

Cone Offset changes the shut-off point of the cone by the degrees of temperature shown in the chart below.

1 First, program a Cone-Fire.

2 From **[IDLE]** , press **OPTIONS** until **[OFST]** appears.

3 Press **ENTER**. The current Cone Offset adjustment number will appear.

4 Using the **1** and **3** keys, select a new adjustment number (see chart below). Then press **ENTER**. **[OFST]** will appear. To return to **[IDLE]**, press **STOP**.

Cone Offset Settings

Note: select a cone in Cone-Fire before changing Cone Offset.

°F Setting	°C Setting	Result
0	0	No adjustment
5	3	Kiln will fire hotter
10	6	Kiln will fire hotter
15	8	Kiln will fire hotter
20	11	Kiln will fire hotter
-5	-3	Kiln will fire cooler
-10	-6	Kiln will fire cooler
-15	-8	Kiln will fire cooler
-20	-11	Kiln will fire cooler

A cone offset remains in memory unless you use the Reset option (page 26).

Interpreting Cone Bending

Position the witness cones in the kiln according to the instructions on page 11.

The cone bent to 6 o'clock: No calibration in Cone Offset needed. The self-supporting cone has fired to maturity when the tip is close to even with the cone base as shown.

The cone did not bend far enough: Use a positive Cone Offset number for a hotter firing, such as 10 (°F).
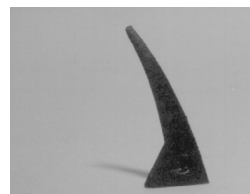
The cone bent too far: Use a negative Cone Offset for a cooler firing, such as -10 (°F).

> **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.

When Cone Temperature Is Off More Than 20°F/11°C

The maximum amount that Cone Offset can change the temperature is 20°F/11°C. When the temperature is off more than that amount, correct with Thermocouple Offset.

COOL / Slow Cooling for Glazes
Add Slow Cooling to Cone-Fire Programming

Slowing down the cooling rate in Cone-Fire mode can totally change the appearance of many glazes. Copper red glaze, for instance, is enhanced by cooling slowly at around 1750°F / 954°C.

For the full benefit of slow cooling, you can bring the temperature back up several times as the glaze cools using Ramp-Hold mode.

You can also slow the cooling in Cone-Fire mode by turning on the Slow Cooling feature. It will appear as the **[COOL]** prompt during Cone-Fire programming.

1 From **[IDLE]**, press **OPTIONS** until **[COOL]** appears.

2 Press **ENTER**. Using the **1** key, select **[YES]** or **[NO]]**. Then press **ENTER**. **[COOL]** will appear.

3 To return to **[IDLE]**, press **STOP**.

FAN / Kiln Vent Control
Control the Optional AOP Receptacle in Cone-Fire

The AOP (auxiliary output) is a special-order kiln switch box receptacle. The Sentry controls the power to the AOP receptacle. The AOP is usually used to power a kiln vent. In the Fan option, select when an AOP-powered kiln vent will turn on during Cone-Fire.

Before the Fan option will appear on the Options list, (1) you must enter a Cone-Fire program in active memory and (2) you must select **[VFAN]** in the AOP1 or AOP2 option. (See next page for instructions on selecting **[VFAN]**.)

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[FAN]** appears.

2 Press **ENTER**. Use the **1** and **2** keys to select one of these settings:

■ **[ON]** The vent is on during Pre-Heat, the cone firing, and Slow Cooling. It turns off at 212°F/100°C.

■ **[OPT]** The vent is on during Pre-Heat and the cone firing. Then it shuts off. (It is off during Slow Cooling.)

■ **[OFF]** The vent is off all the time.

3 After selecting one of the three settings, press **ENTER**. Press **STOP** to return to **[IDLE]**.

General Options

General options are available on all Sentry controllers.

DIAG / Amperage Test
Check Your Kiln's Amperage

If you are wondering why your kiln is taking so long to reach temperature, you can check the amperage that the kiln is pulling. The DIAG option turns the kiln on for 10 seconds.

Compare the amperage reading with the amps listed on the kiln's electrical data plate. (For most models, the data plate, or label, is on the side of the kiln's switch box.)

> **Note:** Low voltage can cause a low amperage reading. Before deciding that the elements are worn out, also check the voltage.

> **Note:** To use the Diagnostics option, your kiln must be equipped with an amperage sensor.

Check the Amperage During IDLE or While Firing

During the amperage test, the three display dots on the right side of the display window will light up. When the test is finished, the dots will turn off and the reading will appear.

1 From **[IDLE]**, press **OPTIONS** until **[DIAG]** appears.

2 Press **ENTER**. **[AMPS]** will appear, alternating with the amperage that the kiln is pulling.

If your kiln has more than one relay, the display will show the amperage for the elements connected to each relay, with these codes: **[AMP1] [AMP2] [AMP3]**.

TC / Choose Thermocouple Type
Select Type-K, -N, -S or -R Thermocouple

The Sentry can use Type-K, -N, -S or -R thermocouples. If you specialize in firings above 2200°F / 1204°C, you might consider obtaining the Type-S or -R. Type-K is best suited for temperatures below 2200°F / 1204°C.

The controller cannot detect the type of thermocouple installed in your kiln. So if you change the thermocouple to a different type, be sure to select the new thermocouple type in the TC option.

> **Note:** Ask your kiln supplier if you are not sure about the type of thermocouple in your kiln.

> **CAUTION:** Be careful about changing the thermocouple type! If you select Type-S or -R, but your kiln is wired with a Type-K, your kiln will underfire. If you select Type-K and your kiln is wired with a Type-S or -R, your kiln will OVERFIRE. After using the Reset (RST) option (page 26), use the TC option to select the correct thermocouple. Reset-

ting the controller changes the thermocouple selection to Type-S.

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[TC]** appears.

2 Press **ENTER**. Use the **1** or **3** key to select **[K]**, **[N]**, **[R]** or **[S]**.

3 After selecting one of the above, press **ENTER**. Press **STOP** to return to **[IDLE]**.

F/C / Selecting Between °F and °C Temperature Display

The controller operates in your choice of Fahrenheit or Celsius temperature. In °C display, a lighted dot appears in the lower right. In °F, it disappears. To switch from °F to °C or vice versa:

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[F/C]** appears.

2 Press **ENTER**. Use the **1** or **3** key to select **[F]** or **[C.]**.

3 After selecting one of the above, press **ENTER**. Press **STOP** to return to **[IDLE]**.

°F/°C Temperature Conversion Formulas

Below are formulas for converting temperture between °F and °C. Converting a firing rate requires a different formula than converting a firing temperature:

Firing to a Temperature

(i.e. "Fire to 1600°F." 1600°F = 871°C)

$$(°C \times 1.8) + 32 = °F$$

$$(°F - 32) \div 1.8 = °C$$

Firing Rate or Temperature Change

(i.e. "Fire at 200°F per hour" or "Fire 200°F hotter." 200°F = 111°C)

$$°C \times 1.8 = °F$$

$$°F \div 1.8 = °C$$

TCOS / Thermocouple Offset
Calibrate the Thermocouple(s)

The thermocouple is the rod protruding into the firing chamber. It measures temperature. K-Type thermocouples can "drift" as they age, causing a gradual shift in temperature readings. Thermocouple Offset calibrates the controller to compensate for drift.

> **Note:** The thermocouple must protrude into the firing chamber the correct distance: about ¾" for ¼" wide thermocouples, ½" - 5/8" for 1/8" wide thermocouples.

Setting Thermocouple Offset

You can enter a temperature change up to 45°F/25°C higher or lower than the zero factory setting.

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[TCOS]** appears.

2 Press **ENTER**. **[O]**, or a Thermocouple Offset, will appear.

3 Using the **1** and **3** keys, enter the new offset. Press **ENTER**. **[TCOS]** will appear. To return to **[IDLE]**, press **STOP**.

Thermocouple Offset Settings

°F Setting	°C Setting	Result
0	0	No adjustment
H 1-45	H 1-25	Kiln will fire hotter
C 1-45	C 1-25	Kiln will fire cooler

Thermocouple Offset Examples

Setting	Result
H 1	Kiln will fire 1° hotter
H 17	Kiln will fire 17° hotter
C 12	Kiln will fire 12° cooler

Multiple-Zone Thermocouple Offset

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[TCOS]** appears.

2 Press **ENTER**. **[TC1]** (top thermocouple) will appear.

3 While **[TC1]** displays, press **OPTIONS**. The other thermocouple(s), then **[TCOS]**, will appear with each press of the **OPTIONS** key.

3 zone kilns: **[TC1] [TC2] [TC3] [TCOS]**

2 zone kilns: **[TC 1] [TC3] [TCOS]**

4 When the correct thermocouple appears, press **ENTER**.

5 Using the **1** and **2** keys, enter the new offset. (See charts above.) Press **ENTER**. The thermocouple you adjusted (i.e. **[TC1]**) will appear. Select another thermocouple, if necessary, or return to **[IDLE]** by pressing **STOP**.

AOP1, AOP2 / Auxiliary Outputs
Select Vent Fan or Alarm for the Auxiliary Outputs

The **[AOP1]** and **[AOP2]** (Auxiliary Outputs) are for receptacles (called sockets in England) mounted on the kiln switch box. The outlets can power a kiln vent or an external alarm, such as a bell. (An AOP outlet is optional and might not be included on your kiln.)

The choices in the **[AOP1]** and **[AOP2]** options:

■ **[VFAN] Kiln Vent or Gas Outlet:** This option adds a display prompt for fan (**[FN]**) to each segment during Ramp-Hold programming (page 15).

■ **[CPT]** When the kiln fires to completion, and **[CPTL]** appears in the display, the controller will turn on power to the AOP outlet. Plug a bell or other alarm into the AOP outlet to notify you that the firing is done.

■ **[ALRM] Alarm:** This choice sends power to the AOP receptacle whenever the alarm sounds. (See Tempera-

ture Alarm, page 8.) Plug in a loud bell to alert you that the kiln has reached the alarm temperature.

■ **[NONE] None:** Use this setting if your kiln does not have the AOP outlet.

■ **[SAFE]** This is for an optional safety relay and is used with the **[LIM]** option. In **[LIM]**, program the maximum temperature that you want for your kiln. If the kiln is 1 degree hotter than that temperature, the kiln will shut off. See page 25.

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[AOP1]** or **[AOP2]** appears.

2 Press **ENTER**. Use the **1** or **3** key to select one of the above options.

3 Press **ENTER**. Press **STOP** to return to **[IDLE]**.

RATE / Select Preferred Type of Rate
Choose 1) Rate Per Hour, 2) Rate Per Minute, or 3) Elapsed Time to Temperature

Rate is how fast the kiln heats or cools. Rate as degrees of temperature change per hour is the most widely used rate system in America.

Some brands of controllers, though, measure the rate as an amount of time needed to reach a temperature. If you are accustomed to that type of programming, you can continue to program with that method. Change the type of rate in the **[RATE]** option of your Sentry controller to the **[TIME]** setting. You then won't have to change your firing schedules to degrees per hour rate.

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[RATE]** appears.

2 Press **ENTER**. Use the **1** or **3** key to select the type of rate that you prefer:

[HOUR] (Degrees of temperature change per hour; the most common rate method in use)

[MIN] (Degrees of temperature change per minute)

[TIME] (Elapsed time needed to reach a temperature)

3 Press **ENTER**. Press **STOP** to return to **[IDLE]**.

How to Program in Ramp-Hold with TIME Selected in Rate

After selecting **[TIME]** in the RATE option, program the amount of time that each segment should take to reach its target temperature. Hours and minutes are separated by the center display dot. For example, 1 hour and 30 minutes is programmed in rate as 01.30.

The Time mode in some ways is different and opposite the standard degrees of temperature per hour rate:

■ For a Full rate, or the fastest that the kiln will fire, select a time rate of 00.00.

■ After you have entered all of the segments for your program, you will need to zero out the remaining available segments. To do this, select a rate of 99.00 hours.

CENT / Cost Per Kilowatt-Hour from Your Electric Bill (for Firing Cost)

The controller can figure the electrical cost of a firing if you enter 1) the cost of electricity from your electric bill and 2) the wattage of your kiln. The cost of electricity is entered in the CENT option. The wattage of your kiln is entered in the KW option. (See next option below.)

> **Pointer:** The cost of electricity is figured in kilowatt-hours (KWh). A kilowatt-hour is 1,000 watts of electricity running for 1 hour. (10 – 100-watt light bulbs glowing for one hour consume 1 KWh of electricity.)

To find what the power company charges you for a kilowatt-hour, look at your electric bill, call your power company, or visit their website. The electric rate may vary depending on the time of year and amount of electricity you use. In the summer, the electric rate may go up.

On your electric bill, you will find the cost per kilowatt-hour along with other charges such as a delivery charge and taxes. Divide the total amount of your bill by the number of kilowatt-hours on your bill.

Electric bills can get complicated. The rates can vary by time of day or the day of the week. On an electric bill, this is called peak and off-peak rates. You may be paying less than the above calculation if you fire your kiln during off-peak periods.

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[CENT]** appears. Press **ENTER**.

2 From an electric bill, enter the cost of a kilowatt-hour. Place cents to the right of the decimal. Round off fractions. (Example: Enter 9.25 cents per kilowatt-hour as 00.09.) Then press **ENTER**.

3 Press **STOP** to return to **[IDLE]**.

> **Pointer:** You can enter the cost in U. S., Canadian, or Euro cents, British pence, Indian paisas, or any other money system that is based upon 100 units (i.e. 100 cents = 1 dollar.) If your system is based upon 1000 units, such as the Libyan dirham, the Oman baiza, or the Kuwait fil, divide the cost by 10. Example: Enter 140 as 00.14. Then multiply by 10 the cost of a firing shown in the controller display.

KW / Kilowatts of Your Kiln (Needed to Calculate Firing Cost)

To figure the cost to fire your kiln, the controller needs to know how many kilowatts your kiln uses. Look at your kiln's electrical data plate. It is usually on the side of the switch box. The data plate lists the watts, amps, and volts. If watts are not listed, multiply amps x volts. (Example: 15 amps x 240 volts = 3,600 watts.)

Divide the wattage of your kiln by 1000, which gives the kilowatts.

3 examples:

To figure the cost to fire your kiln, the controller needs to know how many kilowatts your kiln uses. Look at your kiln's electrical data plate for the watts and divide by 1,000. (Carry the decimal 3 places to the left. In the above photo, the wattage is 1680. Enter 1.68 in the KW option.)

10,800 watts ÷ 1000 = 010.8

4,800 watts ÷ 1000 = 004.8

800 watts ÷ 1000 = 000.8

Enter that amount in the KW option:

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[KW]** appears. Press **ENTER**.

2 The controller shows 4 digits for entering kilowatts: **[000.0]**. Enter kilowatts for your kiln.

3 Press **ENTER**.

4 Press **STOP** to return to **[IDLE]**.

Note: Please do not confuse kilowatts with kilowatt-hours. A kilowatt is 1,000 watts. A kilowatt-hour is 1,000 watts powered for one hour.

To view the cost of a firing, press the **8** key after the kiln has fired to completion and **[CPLT]** flashes.

TEDE / Temperature Deviation
Adjust Temperature Sensitivity of Error Codes

The temperature that the controller is trying to reach, at any given time, is called the set point. During heating or cooling, the set point changes at the rate you programmed. During a hold, the set point remains steady.

The Sentry shows error messages when it can't maintain the set point temperature. The cushion, or leeway, allowed before an error message flashes is called Temperature Deviation. When the temperature in the kiln is off target by more than the Temperature Deviation setting, the alarm sounds. Temperature Deviation affects these error messages (see page 27):

[FTH] Fail to Heat

[FTC] Fail to Cool

[LTDE] Low Temperature Deviation

Some people worry when **[FTH]**, **[FTC]** or **[LTDE]** appears. They wonder if something is wrong with the kiln

when in many cases there isn't. Here are four ways to stop the alarm messages from appearing during routine firings:

Method 1: Test your kiln to find its fastest firing rate and its slowest cooling rate. Then program the controller using rates within the range of the kiln's heating/cooling capacity. Example: If your fastest heating rate is 600° per hour, enter a rate no faster than 600°.

Method 2: Set the deviation temperature to a higher number in the **[TEDE]** option. The higher the number, the less likely that an alarm message will appear.

Method 3: Set the deviation temperature to 0 in the **[TEDE]** option. This turns off the **[FTH]**, **[FTC]** and **[LTDE]** alarms (page 27). We do not recommend a 0 setting.

Method 4: Program a segment at FULL rate (9999°). This will shut off the deviation alarms for that segment. (However, deviation alarms will continue to work during the hold and all other segments with slower rates.)

CAUTION: The High Temperature Deviation (HTDE) alarm shuts off the kiln to prevent an overfire. On controllers with pre-18D software, entering a temperature deviation of 0 turns off this important alarm! On all controllers, entering a FULL rate also turns off this alarm for the segment with the FULL rate.

Changing the Deviation Temperature

If you flash cool the kiln by venting the lid, or if a bead door triggers an alarm, raise the **[TEDE]** temperature.

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[TEDE]** appears.

2 Press **ENTER**. Change the deviation temperature. The higher the number, the less likely you will activate the alarms.

3 Press **ENTER**. Press **STOP** to return to **[IDLE]**.

Note: The factory default **[TEDE]** setting is 100°F / 56°C.

Example: The Fail to Heat code **[FTH]** appears during a firing when the kiln cannot heat as fast as programmed. The Temperature Deviation **[TEDE]** is set to 100°F / 56°C. The Fail to Heat code will appear if the temperature is 100°F / 56°C or more below the set point.

HTDE / Adjust High Temperature Deviation
Change The High Temperature Shutoff Setting

The **[HTDE]** setting is the amount that the temperature can exceed the programmed temperature before the kiln shuts off. The factory **[HTDE]** setting is 100°F / 65°C. The adjustment range is 18°F - 200°F / 10°C - 111°C.

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[HTDE]** appears.

2 Press **ENTER**. Change the deviation temperature. The higher the number, the less likely you will activate the alarms.

3 Press **ENTER**. Press **STOP** to return to **[IDLE]**.

Note: The adjustment range is 18°F - 200°F / 10°C - 111°C. The most sensitive setting is 18°F / 10°C. The higher the number, the looser the setting. Use a lower number when you want the kiln to shut off if it can't keep up with your program. Use a high number if the kiln shuts off when you don't want it to, such as when the lid is vented or a bead door is open when you load a bead rod.

SFTY / Maximum Temperature
View the Kiln's Maximum Operating Temperature

From **[IDLE]**, press **OPTIONS** repeatedly until **[SFTY]** appears. Press **ENTER**. The temperature displayed is the maximum operating temperature programmed in the Sentry for your kiln. (This temperature is also shown on the kiln's electrical data plate.) It can be altered only at the factory. The controller will not fire hotter than that temperature. Press **ENTER**. Press **STOP** to return to **[IDLE]**.

LIM / Set Maximum Temperature
Set a Maximum Temperture for Your Kiln

You can set a maximum temperature for your kiln if your AOP1 or AOP2 option has a safety relay. When the kiln goes 1 degree over the temperature that you set in **[LIM]**, the kiln will shut off.

The adjustment range is from 32°F / to the temperature rating listed on the safety data plate of your kiln.

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[LIM]** appears.

2 Press **ENTER**. Change the maximum temperature.

3 Press **ENTER**. Press **STOP** to return to **[IDLE]**.

ELEC / Electronics Temperature
Check the Circuit Board Temperature

High temperatures in the switch box can damage the controller circuit board, which is rated for 176°F / 80°C maximum operating temperature. To lower 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.) When firing several kilns, position them at least three feet apart to allow adequate air circulation.

From **[IDLE]** or while firing, press **OPTIONS** repeatedly until **[ELEC]** appears. Press **ENTER**. The temperature of the circuit board will appear. Press **ENTER**. Press **STOP** to return to **[IDLE]**.

CAUTION: Do not operate the kiln if the ELEC display is above 158°F / 70°C.

LOCK / Program Lock
Tamper-Proof Individual Programs

By default, Program Lock is inactive. When it has been activated, a stored Cone-Fire or Ramp-Hold program cannot be altered or removed from memory unless you enter a passcode. Use Program Lock for repeat firings that you don't want to inadvertently change.

The pre-installed passcode is the number **3**. You can change the passcode to any number combination of one to four digits.

If you forget your passcode, you can reset the controller back to the factory settings using the **[RST]** option, next page. The passcode will then go back to the number 3.

Note: Program Lock does not save a Delay setting. While a program is locked, you can enter a new Delay.

How to Activate the Lock Option

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[LOCK]** appears.

2 Press **ENTER**. **[PASS]** will appear.

3 Press **3**. Then press **ENTER**. (If you use the wrong passcode, the display will return to **[IDLE]**.)

4 Use the **1** or **3** button to select **[SET]**. Then press **ENTER**.

5 Enter a new passcode of one to four numbers. If you want to use the number **3**, then enter **3**. Press **ENTER**. Press **STOP** to return to **[IDLE]**.

How to Lock Individual Programs

After you have activated the **[LOCK]** option by selecting **[SET]**, you will be able to lock the Cone-Fire program in active memory, or any Ramp-Hold program. Each Ramp-Hold program can be individually locked or left unlocked.

1 **[LOCK]** will appear at the end of Cone-Fire and Ramp-Hold programming.

2 To lock a program, enter the passcode using the **1** and **3** keys. Then press **ENTER**. (To leave the program unlocked, do not enter your passcode. Just press **ENTER** when **[LOCK]** appears.)

How to Unlock and Edit a Program

You have locked a program and would like to edit it. Go into programming (see pages 11 and 15). The first prompt you will see is **[UNLO]**. Enter your passcode with the **1** and **3** keys. Then press **ENTER** and edit the program. (If you don't enter the passcode, you will not be able to edit the program, but you can still fire the kiln with it.)

Note: If your kiln is used in a classroom, you may want to lock only the programs that you don't want students to change.

Note: Even though you cannot edit a locked program, you can still see the settings in Program Review.

CFG / Configuration Code

From **[IDLE]**, press **OPTIONS** repeatedly until **[CFG]** appears. Press **ENTER**. The factory configuration code will appear. Press **ENTER**. Press **STOP** to return to **[IDLE]**. The configuration code can be changed only at the factory.

SOFT / Software Version

From **[IDLE]**, press **OPTIONS** repeatedly until **[SOFT]** appears. Press **ENTER**. The software version will appear. Press **ENTER**. Press **STOP** to return to **[IDLE]**. The software version can be changed only at the factory.

TEST / Element Test
Test the Heating Elements and Relays

This test is useful when measuring the wall receptacle voltage under load, and amperage with an ammeter. On a multiple-zone kiln, the test helps determine if the relays and thermocouples are wired to the correct zones. If you test thermocouples with a cigarette lighter or other heat source, use this option.

> **Pointer:** Raising the thermocouple temperature fast with a lighter or propane torch may cause an **[FE4]** error. This will not harm the controller, though. See page 28.

Single-Zone Kiln

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[TEST]** appears.

2 Press **ENTER**. **[POWR]** will appear, alternating with kiln temperature. The elements will turn on for two minutes. Press any key to abort the test.

Multiple-Zone Kiln

1 From **[IDLE]** press **OPTIONS** repeatedly until **[TEST]** appears.

2 Press **ENTER**. **[TOP]** will appear, alternating with the temperature of the top zone. The elements will turn on for two minutes. Then **[MID]** will appear, with temperature for the middle zone, and **[BOT]** with temperature for the bottom zone. (A two-zone kiln shows only **[TOP]** and **[BOT]** temperatures.)

3 During the two-minute test, press any key to end a zone test. The controller will then begin to test the next zone.

AOP Outlet

After the above test, kilns equipped with the AOP outlet will display **[J3-3]** for two minutes to test power to the AOP outlet. If your kiln has 2 AOP outlets, the second AOP will turn on after the first.

RST / Reset
Reset the Controller to Most Factory Defaults

Reset the controller to a known state in case the controller locks up, the memory is corrupted, or you have made many changes and would like to clear your settings.

Reset does the following:

- Resets the LOCK passcode to 3.
- Selects Type-S thermocouple.
- Selects °F.
- Erases a cone offset.
- Erases a thermocouple offset.
- Erases Ramp-Hold User programs stored in memory.
- Changes Temperature Deviation **[TEDE]]** back to the factory setting of 100°F / 56°C.

> **CAUTION:** If your kiln uses a Type-K thermocouple, the Sentry will underfire after a reset! Use the Thermocouple Option (page 21) to select Type-K again.

1 From **[IDLE]**, press **OPTIONS** repeatedly until **[RST]** appears.

2 Press **ENTER**. Use the **1** or **2** key to select **[NO]** or **[YES]**.

3 After selecting **[YES]]**, press **ENTER**. **[WAIT]** will appear, then **[IDLE]**.

4 After doing a reset, check the **[TC]** and **[F / C]** options to be sure your controller is set for the correct thermocouple type and fahrenheit or celcius.

Multiple-Zone Options

These options appear only on multiple-zone kilns.

DIFF / Zone Temperature Difference
View Maximum Temperature Spread

For a 2-zone or 3-zone kiln, this option shows temperature difference between the top and bottom zones. If the temperature shown is larger than expected, go to option T123 to view the temperature of each zone.

1 Press **OPTIONS** repeatedly until **[DIFF]** appears. Press **ENTER**.

2 The maximum difference in temperature between the top and bottom zones will display. (Example: **[-003]** = 3°)

T123 / Zone Temperature Display
View Temperature of Each Zone

1 Press **OPTIONS** repeatedly until **[T123]** appears. Press **ENTER**.

2 The temperature for each zone will display one after the other, cycling for one minute. Then normal temperature display will return. For example:

- Top zone: **[TC 1] [1250]**
- Middle zone: **[TC 2] [1251]**
- Bottom zone: **[TC 3] [1249]**

Chapter 7
Error Messages

■ Error messages are accompanied by an alarm.

■ Non-interrupting messages do not stop the firing. Terminating error messages do.

■ **[FTH]**, **[FTC]**, and **[LTDE]** error messages are based upon the adjustable setting in the Temperature Deviation **[TEDE]** option (page 24).

Non-Interrupting Error Messages

Press **ENTER** to silence the alarm. (Do not press **STOP** to silence the alarm.) The error message will remain but the kiln will continue firing. Even though the following error messages appear, the kiln will continue its normal operation. The messages are only to alert you that the kiln could not cool or heat as fast as you had programmed. But they will not shut off the kiln or affect the firing in any way.

Definition of "Set Point"
The temperature that the controller is trying to reach, at any given time, is called the set point. During heating or cooling, the set point changes at the rate you programmed. During a hold, the set point remains steady.

FTC / Failed to Cool

■ During a cooling-down ramp, the programmed rate is faster than the kiln can cool. The temperature is above the set point temperature by more than the deviation setting. (See Temperature Deviation, page 24.) Program a slower cooling rate.

  Note: Use Present Status to compare the actual rate of the current Ramp-Hold segment with the rate you programmed. (See page 8.)

  Note: In Ramp-Hold, use a FULL rate to turn off the FTC alarm for that particular segment.

FTH / Failed to Heat

■ During a heating-up ramp, the programmed rate is faster than the kiln can heat. The temperature is below the set point temperature by more than the deviation setting. (See Temperature Deviation, page 24.)

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

  Note: Use Present Status to compare the actual rate of the current Ramp-Hold segment with the rate you programmed. (See page 8.)

  Note: In Ramp-Hold, use a FULL rate to turn off the FTH alarm for that particular segment.

LTDE / Low Temperature Deviation

■ During a cooling-down ramp or a hold, the temperature is below the set point temperature by more than the deviation setting. (See Temperature Deviation, page 24.) Check for a bad relay, worn or burned out elements, low voltage or a defective thermocouple.

  Pointer: During a firing, Present Status shows the actual firing rate of the current Ramp-Hold segment instead of the rate you programmed. If you think your kiln is heating or cooling too slowly, compare the rate shown in Present Status with the rate you programmed for that segment. This is another reason you should always keep a written record of your firing programs.

  Note: Using a FULL rate will turn off the LTDE alarm for that particular segment.

PF / Power Failure

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

TC and 1, 2, or 3 / Multiple-Zone Kiln Thermocouple Failure

If a thermocouple fails in a multi-zone kiln, the kiln will continue to fire as long as at least one thermocouple is working. The thermocouple(s) that failed will alternate with the kiln temperature as follows:

  [TC1] Top thermocouple failed

  [TC2] Middle thermocouple failed

  [TC3] Bottom thermocouple failed

  [TC1] / **[TC2]** Top and middle thermocouples failed

  [TC2] / **[TC3]** Middle and bottom thermocouples failed

  [TC1] / **[TC3]** Top and bottom thermocouples failed

Terminating Error Messages

[HTDE] [ETH] [FAIL] [FTL] and **[TCDE]** error messages turn off the kiln and flash the following:

■ Total firing time in hours and minutes

■ The kiln shutoff temperature

■ The current kiln temperature

- - - - / No Thermocouple

After the controller was plugged in, it could not detect a thermocouple.

BADP / Bad Programming

Causes:

■ When you press **START**, all programmed temperatures are below the current kiln temperature of a Ramp-Hold firing.

ETH / Electronics Too Hot

■ The circuit board temperature is above 176°F / 80°C.

To lower 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 3 feet away from the kiln.)

FAIL / Thermocouple Failure

The controller is no longer receiving voltage from the thermocouple. Causes:

■ Defective thermocouple

■ Disconnected thermocouple lead wires

■ Defective circuit board

FE 1 / Failed to Read/Write To Memory

1 Press any key to clear the **[FE 1]** message.

2 Turn off the power to the controller for 10 seconds. Then restart.

If the **[FE 1]** error persists, return the controller to the factory for evaluation.

FE 4 / Unstable Analog-to-Digital Conversion; Errors Detecting Thermocouple Signal

The Sentry controller checks the temperature every second. If the temperature changes by more than 80°F / 26°C during a 10-second period, **[FE 4]** will appear in the display. Reasons:

■ A failed component on the circuit board

■ You have checked the thermocouple with a propane torch or match, raising the temperature very fast.

1 Press any key to clear the **[FE 4]** message.

2 Turn off the power to the controller for 10 seconds. Then restart.

If the **[FE 4]** error persists, return the controller to the factory for evaluation.

FTL / Firing Too Long

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

■ **[FTL]** has been disabled for cooling segments.

■ A FULL rate doesn't shut off the **[FTL]** code.

Check for worn or burned out elements, defective relays, low voltage and defective thermocouple. Reprogram a slower rate in heating-up and cooling-down segments.

> **Note:** To avoid **[FTL]** messages, fire the kiln at a slower rate.

Pointer: During a Ramp-Hold firing, Present Status shows the actual firing rate of the current segment instead of the rate you programmed. If you think your kiln is heating or cooling too slowly, compare the rate shown in Present Status with the rate you programmed for that segment. This is another reason you should always keep a written record of your firing programs.

HTDE / High Temperature Deviation

[HTDE] appears along with a continuous beeping alarm. 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 above the segment's starting temperature.

■ A fast rate caused the controller to overshoot the target temperature.

■ A relay is stuck in the closed position, sending power to the elements.

See "Power Failures," next page.

> **Note:** You can disable the HTdE alarm for a segment by programming a FULL rate (9999°). HTdE will continue to operate during the hold and in all other segments that have slower rates.

LAG / Thermocouple Lag

The heating rate is slower than 9°F / 5°C per hour and the kiln temperature is more than 100°F / 56°C away from the programmed temperature. The LAG error is inactive above 500°F/260°C.

Causes:

■ On kilns that use a portable controller, the thermocouple fell 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.

> **Note:** Check for worn or burned out elements, defective relays, low voltage and defective thermocouple.

LID / Safety Switch

Reasons **[LID]** appears in the display:

■ The kiln is equipped with a safety switch, which turns off power to the elements when the lid or door is open. **[LID]** appears while the lid is open during firing.

■ The safety lid switch is out of adjustment and has shut off the elements even though the lid is closed.

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

■ The safety lid switch is broken, or a wire connected to the safety switch has come loose.

OTL / Over Temperature Limit

The kiln has shut off because the temperature is hotter than the one that was set in the **[LIM]** option. See page 25.

PF1 / Power Failure

The power failed during a controlled cooling segment. The kiln temperature was below the last active cooling segment temperature when the power came back on. The kiln will not resume firing. See "Power Failures," next column.

PF 2 / Power Failure

The power failed, and the kiln temperature was below 212°F / 100°C when the power came back on. The kiln will not resume firing. See "Power Failures," next column.

PF 3 / Power Failure

The power failed, and the temperature dropped 72°F / 40°C while the power was off. The kiln will not resume firing. See "Power Failures," next column.

Check for a loose wire between the transformer and the controller.

TC 2 / Thermocouple Failure

The thermocouple of a single-zone kiln or the middle thermocouple for a multi-zone kiln failed while the controller was at **[IDLE]**.

TCDE / Uneven Multiple-Zone Temperatures

The zones of a multiple-zone kiln are firing unevenly. Causes:

■ A burned out relay or element.

■ The thermocouples and elements are improperly wired. A thermocouple is turning on the elements to the wrong zone. For instance, if the top thermocouple turns on the bottom elements, the kiln will fire way out of balance. When zones are out of balance by 180°F / 100°C, **[TCDE]** will appear in the display.
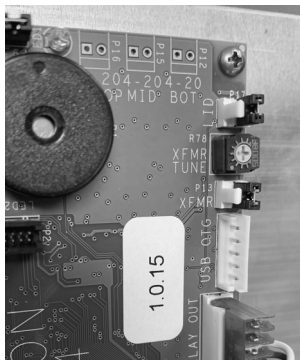
Visually compare the wiring of the thermocouples, relays and elements in your kiln to the kiln's wiring diagram. Also, use the Element Test option shown on page 26.

TCR / Thermocouple Leads Reversed

Check that the thermocouple lead wires are connected to the correct terminals.

Power Failures

The Sentry handles a power failure in two ways:

The lid switch two-pin terminal is on the back of the circuit board in the upper right corner.

1 After a brief power failure, the controller continues firing as before. It shows a normal temperature display alternating with **[PF]**.

2 After an extended power failure, **[PF 1] [PF 2]**] or **[PF3]** will appear. The kiln will NOT resume firing.

The kiln will remain turned off after a power failure if the temperature is below 212°F / 100°C when the power comes back on or if the temperature drops 72°F / 40°C or more while the power is off.

When the Sentry aborts a firing after a power failure, the display will show the following:

■ **[PF 1] [PF 2]** or **[PF 3]**

■ Total firing time before power failed

■ Temperature at the time of power failure

■ Current kiln temperature

To resume firing, select the program again and press **ENTER**. The kiln will begin firing again from its present temperature. For example, the kiln reached 1000°F / 538°C when the power failed. The temperature is 800°F / 426°C when you turn the kiln back on. Firing will resume from 800°F / 426°C. You need not cool the kiln to room temperature before starting a ceramic firing over unless you decide to use new witness cones.

When you resume firing by pressing **ENTER**, the controller will begin firing in the first segment that has a higher target temperature than the current kiln temperature. However, if the power failed during a ramping down (cooling) segment, the controller will resume firing from the same cooling segment.

Using Ceramic Witness (Shelf) Cones After an Extended Power Failure

■ **The firing was interrupted more than 100°F/56°C from the cone temperature:** Fire the ware again. It is okay to use the same partially fired witness cones, even if they cooled back down to room temperature. So long as the cones did not heat to within 100°F/56°C of maturity, they can be used again.

■ **The firing was interrupted less than 100°F/56°C from the cone temperature:** Fire the ware again. If the kiln shuts off within 100°F / 55°C of maturity, and the temperature drops 50°F / 28°C or more after the kiln shuts off, do not depend on the witness cones. Once they cool 50°F / 28°C after they have been heated to within 100°F / 55°C of maturity, they will not bend properly. This is because they form a hard shell.

Appendix A: Display Messages

Message	Definition	Page Reference

[ABRT] Abort 6

The firing was stopped.

[ALAR] Alarm 6, 8, 9, 11, 15

ALAR appears either when you are entering an alarm temperature or when the alarm is sounding during a firing. To stop an alarm, press any key except STOP. If the alarm goes off when you first begin firing, it is because it was set for a lower temperature than the present temperature.

[AOP1] [AOP2] Auxiliary Output 2, 13, 16, 21- 23, 25

The AOP option is for kilns equipped with a special-order kiln switch box receptacle called the Auxiliary Output.

[BADP] Bad Programming 27

This message appears when a Ramp-Hold firing has been programmed with 0 rate in the first segment or when all target temperatures are lower than the current kiln temperature.

[CENT] Electrical Rate 8, 23

Enter the electric rate shown on your electric bill. Example: 9.25 cents per KWh is entered as 00.09.

[CFG] Configuration Code 2, 26

This is an option that shows the factory configuration code for your Sentry. This is for technicians who call the factory for support.

[CONE] Cone-Fire 11

The Sentry is ready for you to enter a cone number.

[COOL] Slow Cooling 11, 13, 21

In Cone-Fire programming, Slow Cooling is shown as COOL. To program a slow cooling, enter the cooling rate in degrees per hour. Leave the setting at 0 if you do not want a slow cooling.

[CPLT] Completed Firing 6, 9, 11, 15, 24

This means the firing completed normally as programmed. These three messages will also cycle one after the other: firing time in hours and minutes, the temperature of the last segment, and the current kiln temperature.

[DIAG] Amperage Check 21

Check the amperage that your kiln is drawing.

[DELA] Delay 7, 11, 15

DELA is a timer that starts the kiln later. Delay time appears in hours and minutes.

[DIFF] Temperature Difference 26

This option shows the maximum temperature spread between zones in a multiple zone kiln.

[ELEC] Electronics Temperature 25

The Sentry circuit board is rated for operation at temperatures up to 176°F / 80°C. When the circuit board gets hotter, the Sentry shuts off. The ELEC option shows you the temperature of the circuit board.

[ETH] Electronics Too Hot 27, 28

The Sentry circuit board is too hot, so the kiln shut off.

[F / C] Change °F / °C 22

Choose between operation in degrees F or degrees C.

Message	Definition	Page Reference

[°F 1] or [°C 1] Target Temperature 15

This prompt, which appears in Ramp-Hold programming, is asking for a target temperature. The number is the segment of the program.

[F 20] Fast Speed 20

Cone-Fire fast speed shows in Program Review as F 20. This is also how Fast Speed is listed in the SPD Speed option.

[FAIL] Thermocouple Failed 28

The thermocouple failed. This can be due to a broken thermocouple, loose thermocouple connection on the back of the Sentry, disconnected thermocouple wire, or a defective controller.

[FAN] Vent Fan 13, 16, 21

The Fan option, accessed through the OPTIONS key, is for kilns equipped with a special-order kiln switch box receptacle called the Auxiliary Output.

[FAST] Fast Speed 11

In Cone-Fire programming, if you press ENTER when FAST appears, the kiln will program to fire at fast speed.

[FE 1] & [FE 4] Failed Component 28

These codes may mean a circuit board component has failed. But sometimes the problem can be cleared by turning the power off and restarting the controller.

[FN 1] Fan 15, 16, 22

If your kiln has the optional AOP outlet (for a kiln vent), the FN prompt will appear for each segment during Ramp-Hold programming. It is asking if you want the vent on or off for that segment.

[FTC] Failed to Cool 24, 27

This error message means the kiln cannot cool as fast as the cooling that you programmed.

[FTH] Failed to Heat 24, 27

The kiln cannot heat as fast as you programmed.

[FTL] Firing Too Long 27, 28

The temperature rise is less than 27° / 15°C per hour and the firing time is two hours longer than the current segment was programmed.

[FULL] Full Speed 16, 18, 24, 27, 28

The rate, or temperature change per hour, is maximum.

[HD 1] Temperature Hold 15, 16

When this message appears during Ramp-Hold programming, it is asking you if you want to hold, or maintain, the target temperature of that segment. If so, enter the length of hold time in hours and minutes (i.e. 1 hour 20 minutes = 01.20). The number after HD is the segment number.

[HOLD] Temperature Hold 11, 13

When this message appears during Cone-Fire programming, it is asking you if you want to hold, or maintain, the cone temperature at the end of the firing. If so, enter the length of hold time in hours and minutes (i.e. 1 hour 20 minutes = 01.20).

[HTDE] High Temperature Deviation 16, 24, 27, 28

During a heating-up ramp or a hold, the temperature is 100°F / 56°C above the programmed temperature.

Message	Definition	Page Reference

[IDLE] Ready to Begin 11, 15

The Sentry must display the IDLE message before you can begin firing or programming.

[KW] Kilowatts 9, 23

The controller can figure the cost to fire your kiln if you supply your kiln's wattage. (See the data plate on the switch box.) Divide wattage by 1000 to get kilowatts. Enter that amount: 10,800 watts ÷ 1000 = 10.8.

[LAG] Temperature Lag 28

The heating rate is slower than 9°F / 5°C per hour and the kiln temperature is more than 100°F / 56°C away from the programmed temperature.

[LID] Lid/Door is Open 6, 28

When LID appears, either a lid or door switch is out of adjustment or a two-pin connector on the back of the board is missing.

[LOCK] Program Lock 25

With this option activated, a stored program cannot be altered or removed from memory.

[LTDE] Low Temperature Deviation 24, 27

This message appears when the kiln is below the Temperature Deviation setting in the TEdE option.

[OFST] Cone Offset 20

Adjust a Cone-Fire program to bend the matching witness cone on the kiln shelf.

[-ON-] Firing Started 11, 15

This appears when firing begins. Do not be concerned if it takes a moment for the relays to turn on. The Sentry is processing data.

[PF 1] Power Failure 29

The power failed during a controlled cooling segment. The kiln temperature was below the last active cooling segment temperature when the power came back on.

[PF 2] Power Failure 29

The power failed. When power came back on, the temperature was below 212°F / 100°C.

[PF 3] Power Failure 29

The power failed and the temperature dropped 72°F/ 40°C.

[PF] Power Failure 27

There was a power failure during firing. The kiln continued firing after the power came back on.

[PRHT] Pre-Heat 8, 11, 12

In a Cone-Fire program, Pre-Heat heats the ware slowly to 200°F / 93°C for the length of time you specify. Pre-Heat is designed to remove moisture safely from greenware.

[RA 1] Rate 15

RA 1, RA 2, RA 3, etc., appear in Ramp-Hold programming, Program Review, and Present Status. When RA 1, 2, 3, etc. appear during programming, the controller is asking you for firing rate for each segment. Rate means how fast the firing progresses, in degrees of temperature per hour. Every segment must have a firing rate. The number after RA is the segment number.

[RST] Reset 26

The RST option erases cone and thermocouple offsets, selects °F operation, erases stored programs in Ramp-Hold, and selects Type-S thermocouple. Note that if you use Reset, and your kiln is equipped with a Type-K thermocouple, you must use the TC option to select Type-K. (Reset selects Type-S as a safety precaution. If you had a Type-S thermocouple and Reset selected Type-K, your kiln would overfire. On the other hand, if you had a Type-K thermo-

couple, Type-S selected would underfire your kiln, which is better than overfiring it. The K-Type thermocouple is standard on most kilns.)

[S 20] Slow Speed 20

Cone-Fire slow speed shows in Program Review as S 20. This is also how slow speed is listed in the SPD Speed option.

[SFTY] Safety 25

This is the maximum temperature the Sentry is programmed for your kiln. It can be altered only at the factory.

[SKIP] Skip Segment 9, 10, 12

If you press the Skip Segment key during a firing, SKIP will appear. If you press the key again, the firing will skip to the next segment. In Cone-Fire, Skip Segment takes you only out of Pre-Heat or Hold.

[SLOW] Slow Speed 11

In Cone-Fire programming, if you press ENTER when SLOW appears, the kiln will program to fire at slow speed.

[SOFT] Software Version 26

This option gives the version of software loaded into your Sentry.

[SPD] Speed 11, 19

The SPD message appears during Cone-Fire programming and in Options. **1)** In the SPD option, accessed through the option key, change the speed of a Cone-Fire program beyond the standard fast, medium or slow. **2)** While programming a firing for Cone-Fire, choose slow, medium or fast speed at the SPD prompt.

[STD] Standard Speed 11, 20

Cone-Fire medium speed appears in the Sentry as STD, or Standard. This is because medium speed is the standard firing program used in Cone-Fire. Fast and Slow speeds alter the standard firing program.

[T123] Zone Temperatures 26

This option shows temperatures in each zone.

[TC] Thermocouple Type 21, 26

Choose between types K, S, or R thermocouple. It is important to select the correct type, or the controller will not read temperature accurately.

[TCDE] Uneven Temperature 27, 29

This is an error message for multiple-zone kilns. It means the temperatures of the zones are out of balance by 180°F / 100°C. This is usually caused by a miswired kiln or by a defective relay.

[TCOS] Thermocouple Offset 22

Adjust the controller's temperature to compensate for temperature drift, or aging, of a thermocouple.

[TCR] Thermocouple Reversed 29

The thermocouple wires are reversed.

[TEDE] Temperature Deviation 24

The Sentry includes error messages to warn you that the kiln is not maintaining the programmed temperature. The sensitivity of the error messages is based on a temperature entered in the TEDE option.

[TEST] Element Test 26

This option is for testing the elements and thermocouples. If you test a thermocouple with a lighter, the temperature display responds faster during Test than during IDLE display.

[USER] User Program 15

In Ramp-Hold programming, the USER prompt is asking you where you want to place the program in memory. The Sentry has 9 spaces in memory. Keep a written record of the programs 1 - 9 in memory.

Keep the kiln lid or door closed when the kiln is not in use.

Appendix B: Preset Cone-Fire Programs - °F

These are the firing schedules programmed in Cone-Fire mode. To customize a schedule, write down your changes. Then load your new schedule into Ramp-Hold.

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

Do not leave your kiln unattended during operation.

Appendix B: Preset Cone-Fire Programs - °C

These are the firing schedules programmed in Cone-Fire mode. To customize a schedule, write down your changes. Then load your new schedule into Ramp-Hold.

Low Fire Cones °C

	Segment 1		Segment 2	
Cone	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

	Segment 1		Segment 2		Segment 3		Segment 4	
Cone	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

|	Segment 1		Segment 2		Segment 3		Segment 4	
Cone	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

Appendix C: Upgrading Instructions
## Upgrading the DTC 100, 600, 800 & 1000 Series to the Sentry

1 Unplug the kiln or disconnect the power. Remove the 4 screws holding the controller faceplate to the switch box. Gently remove the old controller.
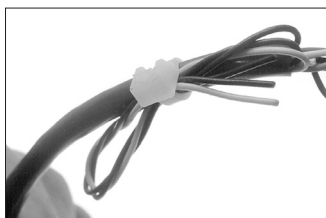
2 Disconnect the wires from the old controller.

3 If your kiln is top-loading and originally came with a DTC 100 or 600, the heat shield inside the switch box may need to be moved to give more clearance for the new Sentry controller. Measure the space between the heat shield and the front of the box. If the space is less than 1 ¾", remove the screws that hold the bottom of the heat shield. These screws are on the sides near the louvers. Drill new holes in the switch box next to the bottom 2 holes used for the heat shield. Move the bottom of the heat shield back and fasten screws in the new holes.
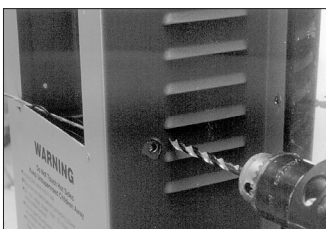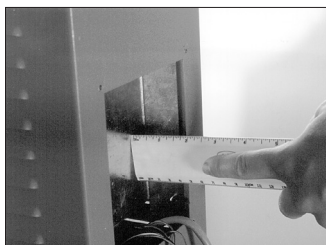
4 Thread the Sentry wiring harness into the switch box by inserting it in the opening where the controller goes. Let the end with the plugs hang out of the box.
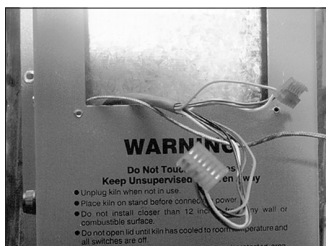
5 Remove the switch box from the kiln by removing the screws holding the box to the kiln.

The extra wires tied to the harness are for multiple zone kilns and the optional AOP electrical outlet. The green grounding wire is connected only if you use a computer interface.

6 The red wire from the old controller connects to the relay(s). The red wire in the Sentry wiring harness goes to the same relay terminal. (See diagram, facing page.) You will notice that the red Sentry wire has 3 push-on connectors with jumper wires. If your kiln has 3 relays, you will use all 3 push-on connectors, 1 for each relay. If you have 2 relays, cut off the last terminal and jumper wire. If your kiln has 1 relay, cut off two push-on connectors. Cut the wire close to the terminal that remains (see next photo).

CAUTION: Cut off the extra terminal(s) and jumper wire(s) unless they attach to relays. Unconnected wires that touch a grounded object can damage your controller!
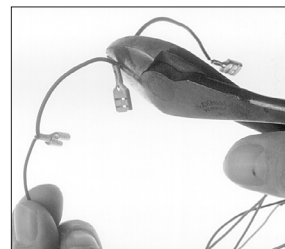
7 Attach the red wire terminal(s) to the relay(s). Follow steps 6 and 7 for the black wire, which also goes to the relays.

8 Note how the white, orange, and blue wires of the old controller are connected to the transformer. Removing and replacing one wire at a time, connect the Sentry white, orange, and blue wires to the transformer the same way. (See Transformers, next page. Cut off the extra blue wire terminal if your transformer doesn't need it.)

9 Remove the old wiring harness from the switch box. With the thermocouple wires and the Sentry connection plugs hanging out of the front of the switch box, move the box into place on the kiln. Arrange the wires so that when the switch box is fastened to the kiln, the wires and wire nuts will not touch an element connector or the kiln case. Install the screws that hold the switch box to the kiln.

10 Straighten the ends of the thermocouple wires. Attach them to the thermocouple terminals on the bottom of the Sentry. (Use the center connectors if your kiln has only one thermocouple.) Make sure the thermocouple wires are tight.
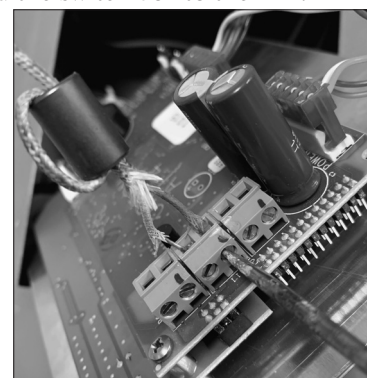
Tighten the thermocouple wires with a small slotted screwdriver. To avoid damaging the connection block, do not over-tighten the screws.

11 Attach the two plugs to the back of the Sentry controller. Carefully insert the Sentry into the controller opening on the switch box. Install 4 corner screws.
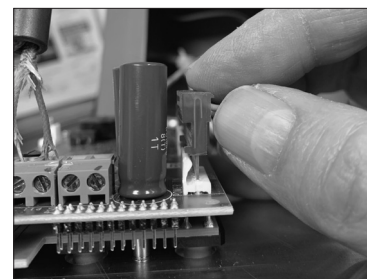
Inserting the plugs on the back of the Sentry.

How to Wire the Sentry

Sentry Controller

Top of Board

P9

P17
P13
P14
P7
P1

USB
relays

YEL
VIO
RED
BRN
BLK

thermocouples
P6 P11 P10

power

GRN
BLU
WHT
ORG

Factory UART
Factory ISP

Lid Switch

Amp Sensor

③

Thermocouple

Two wires of dissimilar metal join together in the thermocouple tip. When heated, the wires produce a small voltage, which the controller interprets as a temperature.
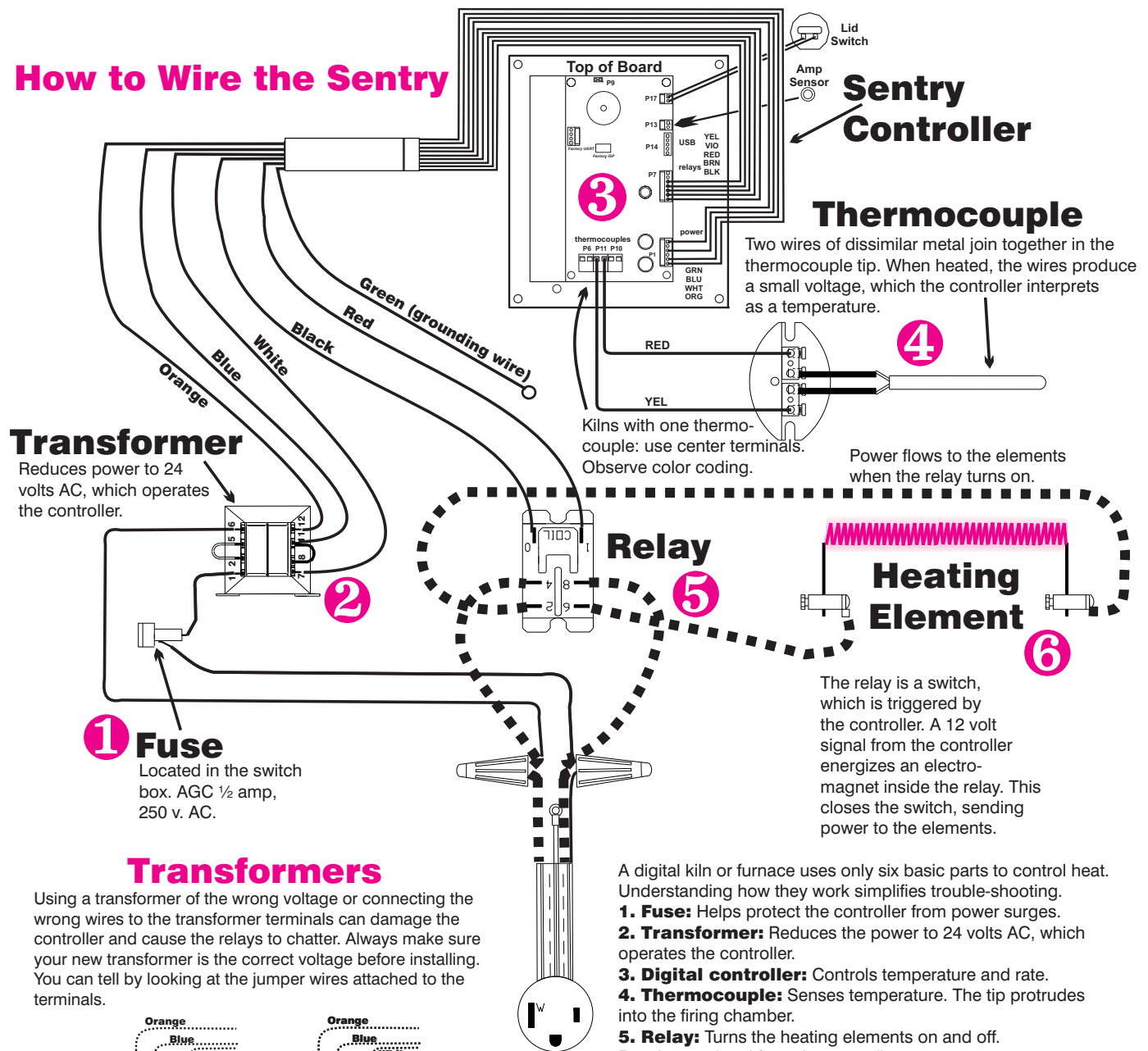
④

RED

YEL

Kilns with one thermocouple: use center terminals. Observe color coding.

Green (grounding wire)

Red

Black

White

Blue

Orange

Transformer

Reduces power to 24 volts AC, which operates the controller.

②

Power flows to the elements when the relay turns on.

COIL
0   1
4
8
6   2

Relay

⑤

Heating Element

⑥

The relay is a switch, which is triggered by the controller. A 12 volt signal from the controller energizes an electromagnet inside the relay. This closes the switch, sending power to the elements.

① ## Fuse

Located in the switch box. AGC ½ amp, 250 v. AC.
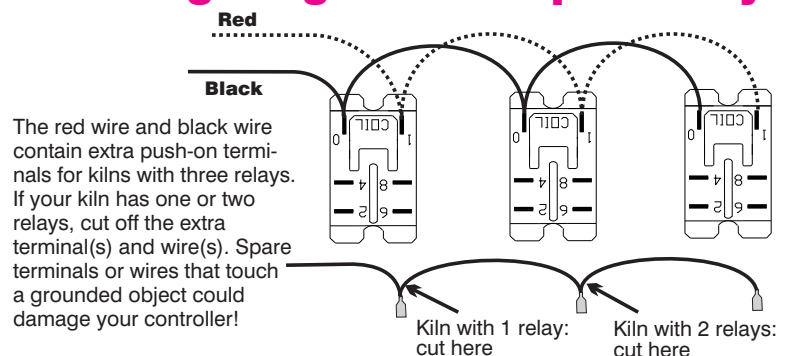
W

Transformers

Using a transformer of the wrong voltage or connecting the wrong wires to the transformer terminals can damage the controller and cause the relays to chatter. Always make sure your new transformer is the correct voltage before installing. You can tell by looking at the jumper wires attached to the terminals.
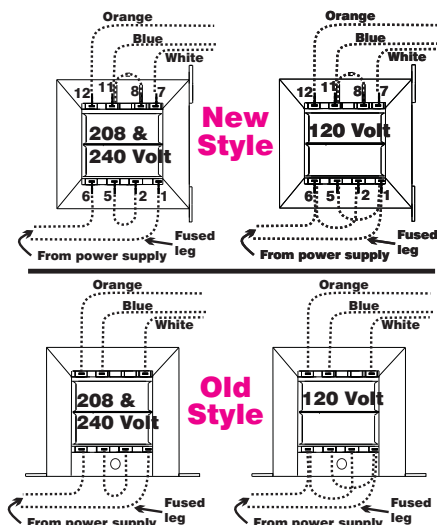
A digital kiln or furnace uses only six basic parts to control heat. Understanding how they work simplifies trouble-shooting.

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

Orange
Blue
White

12 11   8   7

New Style

208 & 240 Volt

6   5   2   1

Fused leg

From power supply

Orange
Blue
White

12 11   8   7

120 Volt

6   5   2   1

Fused leg

From power supply

Orange
Blue
White

208 & 240 Volt

Old Style

Fused leg

From power supply

Orange
Blue
White

120 Volt

Fused leg

From power supply

Wiring Single & Multiple Relays

Red

Black

The red wire and black wire contain extra push-on terminals for kilns with three relays. If your kiln has one or two relays, cut off the extra terminal(s) and wire(s). Spare terminals or wires that touch a grounded object could damage your controller!

COIL
0   1
4
8
6   2

COIL
0   1
4
8
6   2

COIL
0   1
4
8
6   2

Kiln with 1 relay: cut here

Kiln with 2 relays: cut here

Appendix D: Temperature Equivalents For Orton Self-Supporting Pyrometric Cones

°F

Cone Number Heated at:	Self-Supporting Cones 27° F Per Hour*	108° F Per Hour*	270° F Per Hour*	Pre-Fire Color
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 Heated at:	Self-Supporting Cones 15° C Per Hour*	60° C Per Hour*	150° C Per Hour*	Pre-Fire Color
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.

Date_____

Date_____

User Program _____

Rate °/Hour	Target Temperature	Hold Time Hours.Mins	Optional Fan On / Off
RA1	1	Hd1 .	
RA2	2	Hd2 .	
RA3	3	Hd3 .	
RA4	4	Hd4 .	
RA5	5	Hd5 .	
RA6	6	Hd6 .	
RA7	7	Hd7 .	
RA8	8	Hd8 .	
RA9	9	Hd9 .	
RA10	10	Hd10 .	
RA11	11	Hd11 .	
RA12	12	Hd12 .	
RA13	13	Hd13 .	
RA14	14	Hd14 .	
RA15	15	Hd15 .	
RA16	16	Hd16 .	
RA17	17	Hd17 .	
RA18	18	Hd18 .	
RA19	19	Hd19 .	
RA20	20	Hd20 .	

Type of firing:_____

_____

_____

_____

Firing results:_____

_____

_____

_____

Recommendations for the next firing of this type:

_____

_____

_____

_____

User Program _____

Rate °/Hour	Target Temperature	Hold Time Hours.Mins	Optional Fan On / Off
RA1	1	Hd1 .	
RA2	2	Hd2 .	
RA3	3	Hd3 .	
RA4	4	Hd4 .	
RA5	5	Hd5 .	
RA6	6	Hd6 .	
RA7	7	Hd7 .	
RA8	8	Hd8 .	
RA9	9	Hd9 .	
RA10	10	Hd10 .	
RA11	11	Hd11 .	
RA12	12	Hd12 .	
RA13	13	Hd13 .	
RA14	14	Hd14 .	
RA15	15	Hd15 .	
RA16	16	Hd16 .	
RA17	17	Hd17 .	
RA18	18	Hd18 .	
RA19	19	Hd19 .	
RA20	20	Hd20 .	

Type of firing:_____

_____

_____

_____

Firing results:_____

_____

_____

_____

Recommendations for the next firing of this type:

_____

_____

_____

_____

Index

Sentry Ramp-Hold Shorthand Instructions

After you press the keys in the left column, the message to the right will appear. (See also page 15.)

KEYS TO PRESS	DISPLAY	COMMENTS
PROGRAM AND FIRE THE KILN.		
Apply power to kiln	IDLE	Press Enter if IDLE does not appear.
4	USER	Enter program number.
A number from 1 to 35	1	Program number appears.35
ENTER	RA 1	Enter rate of segment 1.
Rate	0200	Rate appears.
ENTER	°F 1	Enter temperature of segment 1.
Temperature	2000	Temperature appears.
ENTER	HD 1	Next, enter hold time.
Hold time (0 if none)	00.00	Hold time appears.
Repeat for other segments. Enter rate of 0 for 1st segment not needed.		
ENTER	IDLE	The kiln is ready to fire.
ENTER	-ON-	Kiln is now firing.
SELECT AND FIRE A STORED USER PROGRAM.		
Apply power to kiln	IDLE	Press Enter if IDLE does not appear.
4	USER	Select a program number.
A number from 1 to 35	1	Displays the number you selected.
ENTER	RA1	
STOP, STOP	IDLE	Selected program is ready to fire.
ENTER	-ON-	

Kiln is now firing. (Use Program Review by pressing 6.)

Sentry Cone-Fire Shorthand Programming

After you press the key(s) in the left column, the message to the right will appear. Press **1** from **[IDLE]**. If the **1** key does not respond, your controller does not have Cone-Fire. (See also page 11.)

KEYS TO PRESS	DISPLAY	COMMENTS
Apply power to kiln	IDLE	Press Enter if IDLE doesn't appear.
1	CONE	Enter the cone number.
Cone # (i.e. 05)	05	
ENTER	SPD	Enter the firing speed.
1(Fast), 2 (Med.), or 3 (Slow)	FAST	The firing speed appears.
ENTER	PRHT	Enter Pre-heat time.
Pre-Heat time (0 if none)	00.00	Pre-heat time appears.
ENTER	HOLD	Enter hold time.
Hold time (0 if none)	00.00	Hold time appears.
ENTER	COOL	Enter slow cooling rate.*
Slow cooling rate (0 if none)	0000	Shows degrees per hour.
ENTER	IDLE	Kiln is ready to fire.
ENTER	-ON-	Kiln is now firing. Press 6 for Program Review.

The kiln is now firing to the cone you selected.

*The COOL prompt appears only after you have turned on the Slow Cooling option. See page 21.