



Sentry Xpress 5.0



Digital Temperature Controller

Cone-Fire and Ramp-Hold Instructions



°C Display Dot

Temperature Display

No Display Dot: Temperature display is in °F.

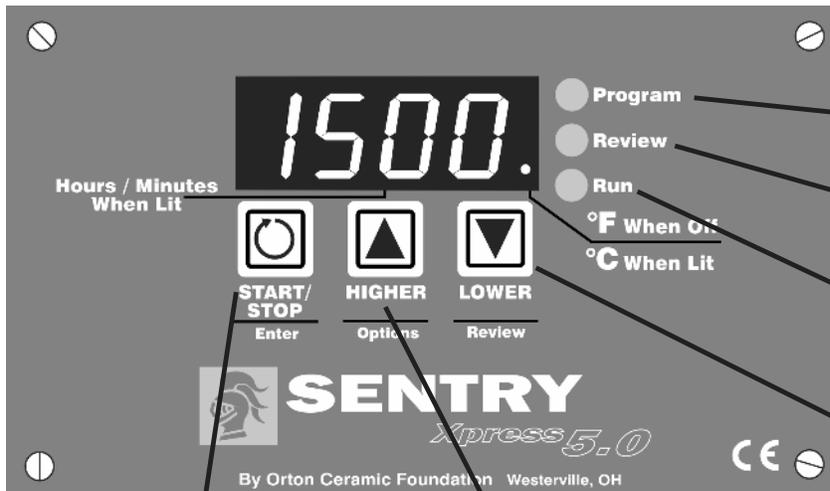
Right-Hand Display Dot: Temperature display is in °C. See page 19 for instructions on selecting °F and °C.



Time Display

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

To stop a firing, press Start/Stop key at any time. ABRT will appear, and the heating elements will turn off. Press Start/Stop again to return to IDLE.



Indicator Lights

Top: Light is on during programming.

Middle: Light is on during program review.

Bottom: Light turns on only when the elements are on during a firing.

Down Arrow Key

- 1) Lower Numbers**
- 2) Repeat the Last Firing:** From [IDLE] press **Down Arrow**. The program you have selected will appear one step at a time. When [STRT] appears, press **Start/Stop**. Page 5
- 4) Review a Program:** During firing, press **Down Arrow**. The program you entered will appear one step at a time. Page 5

Start/Stop Key

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

Up Arrow Key

- 1) Raise Numbers**
- 2) Select a Firing Mode:** From [IDLE] press **Start/Stop**. Press **Up Arrow** to select Cone-Fire or Ramp-Hold.
- 3) Edit a Program While the Kiln is Firing p16:**

- [SKIP] Skip a segment
- [HLDT] Change hold time
- [CHGT] Change end temperature
- 4) All Other Options:**
- [DELA] Select how Delay works. p17
- [TC] Select thermocouple type. p18
- [ALAR] Set temperature alarm. p18
- [DIAG] Check amps. p19
- [F/C] Select °F or °C display p19
- [LIM] Set max temperature. p19
- [COST] Look up cost of a firing. 19
- [EXIT] Press **Start/Stop** to return to IDLE.
- [OPT2] Press **Start/Stop** to see level 2 options.
- [OFST] Adj. cone temperature. p16
- [TCOS] Adjust thermocouple. p20

- [TEDE] Change sensitivity of the FTH, FTC and LTDE warning alarms. p20
- [HTDE] Change sensitivity of the HTDE shut down alarm. p21
- [LOCK] Lock programs. p21
- [AOP1] For kilns with the optional AOP switch box electrical outlet. p22
- [ELEC] Check circuit board temperature, useful in hot weather. p22
- [EXIT] Press **Start/Stop** to return to IDLE.
- [OPT3] Press **Start/Stop** to see level 3 options.
- [COOL] Select Slow Cooling so it appears during Cone-Fire programming. p17
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- [CENT] Enter cost of electricity. 23
- [KW] Enter kiln's wattage. p23
- [SFTY] See kiln's max temperature. p24
- [SOFT] See software version. p24
- [CFG] Shows controller model.24
- [RST] Reset the controller to its factory default settings. p24

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Before You Begin

Thank you for purchasing the Sentry Xpress 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 Display Messages on pages 28 - 29.

The back cover is a shorthand guide to programming, to be used after you have read the programming instructions on pages 10 and 13.

You can customize the programming (pages 10 and 13) by adding or removing these steps:

Delay: Schedule a firing for later. This works in all firings. Page 17

Fan: If your kiln is set up with a vent and switch box outlet, or, socket, you can turn the fan on or off for Ramp-Hold segments. Page 22.

Lock: Passcode-protect individual Ramp-Hold programs. Page 21

Slow Cooling: Enhance certain glazes in Cone-Fire mode. Page 17.

If you don't need these features, streamline programming by removing their display prompts. Turn to the pages shown above for instructions.

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. It is also normal for the temperature to fluctuate up and down as the kiln heats up. Please don't be concerned.

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.

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

Write notes on the controller features that you use. Then if you are away from your kiln for a period, you can review your notes to refresh your memory. The cover shows the controller options at a glance. Use the cover as a quick index.

Use Program Review (page 5) every time you fire the kiln. This is your assurance that you are firing the correct program. Check the program in the display against a written copy.



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Safety Rules

The warranty on your Sentry Xpress controller does not cover damage from overfiring, regardless of the circumstances. It is the operator's responsibility to make sure the kiln turns off at the 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 22 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 Start/Stop button, not by only 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 top of the kiln, 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 tripping hazards from around the kiln. Keep the kiln's supply cord out of traffic areas.
- Avoid using 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 (socket) 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
- Disable the audible alarm

Time and Temperature Displays

Center Dot: Time

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



Time

Right-Hand Dot: °C

When temperature is displayed in °C, a dot appears in the lower right. In °F display, it disappears. You can choose between Fahrenheit and Celsius display. See page 19.



°C

Operation Begins from the IDLE Display

[IDLE] must appear before you can fire the kiln.



- If [CPLT], [PF3], or other message appears instead of [IDLE] when the kiln is first turned on, press the **Start/Stop** key (the key with the circular arrow). [IDLE] will appear.
- If you press **Start/Stop** during a firing, [ABRT] will appear. To get back to [IDLE], press **Start/Stop** again.
- If the display shows an error message such as [FAIL] instead of [IDLE], see pages 25-27.

[CPLT] (firing completed) appears at the end of a firing. To make [IDLE] appear, press **Start/Stop**.

Thermocouple Inspection

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

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



Pointer: 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.

How to Scroll Numbers Rapidly

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

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

Program Review & Repeat Firing

Program Review lets you check that the program in the controller is accurate. Use Program Review before every firing. It takes only seconds. Program Review shows the values for the program in active memory. Use Program Review from [IDLE] to repeat the last program you fired. The program in active memory is 1) the program that you fired last, or 2) the program that you entered or selected since the last firing.

- Using Program Review during firing: Press the **Down Arrow** key. The rate, temperature, hold, etc. will display one after the other. The firing will continue.
- To repeat a firing, use Program Review from [IDLE]: Press the **Down Arrow** key. After rate, temperature, hold, etc., [STRT] will appear. Press **Start/Stop**. [DELA] will appear unless it has been removed in Options. Enter the delay time, or press the **Start/Stop** key. [-ON-] will appear, and the kiln will begin firing the program just reviewed.

Pointer: When [DELA] flashes after [STRT], you can end the firing before it begins. Do nothing for 60 seconds. The display will return to [IDLE].

Note: In Program Review, Cone-Fire speed is displayed as the RA (ramp) part of each segment. Cone-Fire Review shows the segments and ramp rates listed in the charts on pages 30-31.

Delay

Delay is a count-down timer. The kiln begins firing when the timer runs out of time. Use delay to fit a firing into your schedule. See also page 17.

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

- 1 After you have selected a program and the controller is ready to begin firing, **[STRT]** will appear.
- 2 Press the **Start/Stop** key once. **[DELA]** will appear, alternating with **[00.00]**.
- 3 Use the arrow keys to enter delay time. (The decimal separates hours and minutes. Example: 1 hour and 10 minutes = 01.10) Then press **Start/Stop**. **[-ON-]** will appear, then **[DELA]** alternating with time left until the firing begins.

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

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 LID Message

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 26.

Power Failures

After a power failure, the controller will continue firing provided—

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

Power Failure Messages

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

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

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

CPLT Message: Firing Completed

When the firing has successfully completed, the Sentry Xpress will 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.

Hot and Cold Weather; Storage Sheds

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



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.

The Sentry Xpress 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 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 ELEC, page 22, to check circuit board temperature.)

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

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.



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.)

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

Canceling a New Program

It's okay if you pause while entering a program. There is no time out. If you change your mind and want to cancel a new program, turn off the power to the controller. Or continue entering a program. When **[STRT]** appears, press the Down Arrow key. The controller will cancel the firing and go back to **[IDLE]**.

Cone-Fire and Ramp-Hold

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

Cone-Fire Mode (see pages 8-11)

Cone-Fire mode fires the ware to a pyrometric cone number using the Orton cone tables on page 32. This mode is for ceramics, pottery, stoneware, and glazes. Your supplier can tell you which cone number to program.

Ramp-Hold Mode (see pages 12-15)

Use Ramp-Hold mode to create custom firings. Select your own firing speed, temperature, and hold time in up to 20 steps, or segments.

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

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

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 18) 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.

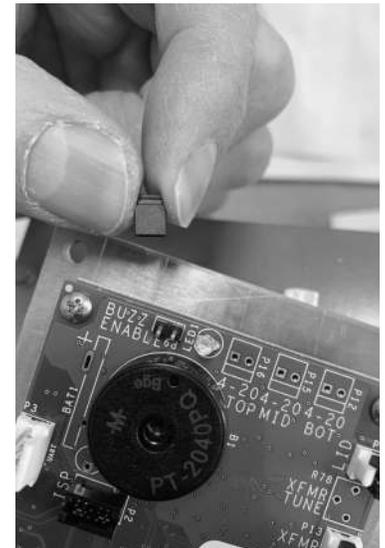


Pointer: Set a wristwatch alarm, cell phone, or even an alarm clock to remind yourself to check on your kiln.

How to Disable the Audible Alarm

The Sentry Xpress makes a beeping noise when it fires to completion and when it displays error messages. Some people prefer not to have an audible alarm. You can disable the alarm by removing a jumper on the back of the controller. Replace the jumper when you want the alarm again.

- 1 Disconnect the kiln from the power.
- 2 Remove the four corner screws that hold the controller to the switch box. Lift out the controller.
- 3 Find the 2-pin jumper plug for the alarm on the back of the controller. It is on the connection pins labeled BUZZ ENABLE. Remove and save the jumper plug.



Remove the 2-pin jumper plug from the connectors labeled BUZZ ENABLE to silence the beeping alarm. You will find the connectors on the back of the controller.

- 4 Reinstall the controller being careful not to tug on the wires.

Chapter 2 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 Orton pyrometric cones. It is not designed for heat treating, glass fusing and enameling. For these firings, see "Ramp-Hold," pages 12-15. Use Ramp-Hold to fire ceramic pieces that require a custom firing schedule, such as some types of stone-ware 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 Xpress 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.

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.

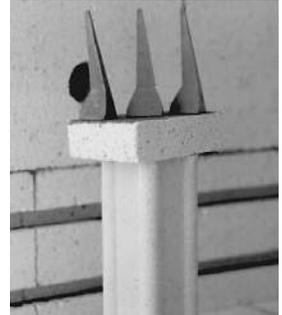
Note: If the bending of the witness cone does not match the Cone-Fire shut-off, you may want to adjust Cone Offset (page 16) or Thermocouple Offset (page 20). If the witness cones bend inconsistently from one firing to another, see "Sentry Troubleshooter," a separate publication.

How to Position Cones on the Shelf (for Ceramic Kilns)

Position the witness cones so 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.

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.

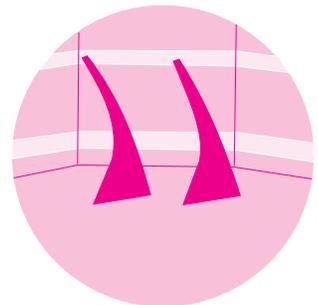


Use self-supporting witness cones on the shelf. They stand upright without cone holders.



The heating element in the background should be lined up with the lower part of the witness cones. If the element is too high, the tips of the cones will disappear from view when they bend.

- 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.)



Silhouette the lower part of the cone against an element. Keep the cone 8" - 12" away from the peephole.

- 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 ranges of firing schedules:

- Low fire cones 022 - 011
- Medium fire cones 010 - 01
- High fire cones 1 - 10

The firing schedules programmed into Cone-Fire mode are listed on pages 30-31. 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 11).

CAUTION: Cone numbers beginning with 0 are lower in temperature than those without the 0. When programming a Cone-Fire, be sure you know the difference between an 05 and 5. See “Temperature Equivalents Chart for Orton Self-Supporting Pyrometric Cones,” page 32.

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.

How to Interpret the Bending of a Pyrometric Cone

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

1. Correct Bend

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



2. Under-Fired Cone

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



3. Over-Fired Cone

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



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

How to Correct for Under- or Over-Fired Cones

Before changing a firing because of an under- or over-fired cone, make sure the correct cone was in the kiln. For instance, if you fired to cone 05, make sure the cone in the kiln was not a cone 5 instead. (See the cone temperature chart on page 32.) Try the following ideas, one at a time:

Compensating for an Under-Fired Cone

- Fire to the same cone number next time, but add hold time. How much to add is a matter of experimentation. A general guideline would be 10-30 minutes.
- If the kiln still does not fire hot enough, then fire to the next hotter cone number, without hold time.
- Adjust the Thermocouple Offset. See page 20.
- Customize the firing in Ramp-Hold. See page 11.

Compensating for an Over-Fired Cone

- Fire to the next cooler cone number.
- If firing to the next cooler cone number results in under-firing, add hold time.
- Adjust the Thermocouple Offset. See page 20.
- Customize the firing in Ramp-Hold. See page 11.

Cone-Fire Programming Instructions

Lock, Slow Cooling, and Delay can each be turned on or off as programming steps. Ignore the steps below that you have deactivated. See LOCK, page 21; COOL, page 17; and DELA, page 17.

- 1 From **[IDLE]**, press **Start/Stop** (left button).
- 2 Using the **Up Arrow** key (not the **Down Arrow**), skip past **[USER]** and select **[CONE]**. Then press **Start/Stop**.
- 3 The last pyrometric cone you fired will appear. Use the arrow keys to change the cone number. Then press **Start/Stop**.
- 4 If the program is locked, **[UNLO]** (Unlock) will appear alternating with **[0000]**. If you want to change the program, enter your passcode. Otherwise press **Start/Stop**, which will take you to Step 9.
- 5 **[SPD]** alternating with **[SLOW]**, **[STD]** (standard) or **[FAST]** will appear. Use the arrow keys to change speed. Then press **Start/Stop**.
- 6 **[HOLD]** and the hold time from the last firing will appear. (Example: 1 hour and 10 minutes = 01.10) Use the arrow keys to change the hold time. Then press **Start/Stop**.
- 7 **[COOL]** will appear. Enter a slow cooling rate as degrees per hour. (180°F/82°C is the maximum cooling rate. Enter 0 to turn Slow Cooling off.) Then press **Start/Stop**.
- 8 **[LOCK]** alternating with **[0000]** will appear. Enter your passcode to lock the program, or press **Start/Stop** to leave it unlocked.
- 9 **[STRT]** will appear. Press **Start/Stop**. **[DELA]** will appear. Set a delay time. If you don't need to delay the firing, leave the time at **[00.00]**. Then press **Start/Stop**. **[-ON-]** will appear, the Run indicator light will begin blinking, and the kiln will begin firing. If Delay was programmed, **[DELA]** will appear, then time remaining until start.

To stop a firing before completion, press **Start/Stop**. **[ABRT]** (abort), the firing time, final firing temperature, and current temperature will appear.

When the kiln fires to completion, it will beep for 30 seconds. **[CPLT]** (fired to completion), the firing time, final firing temperature, and current temperature will appear.

To return to **[IDLE]**, press **Start/Stop**.

To fire the same program again, see "Program Review & Repeat Firing," page 5.

Entering a Cone-Fire Program

Firing Speed [SPD]

When you select Medium speed in a Cone-Fire program, the kiln uses the standard firing schedules listed on pages 30-31. When you select Fast, the standard schedules fire 20% faster. On Slow, they fire 20% slower.

Pointer: The Medium speed appears in the display as **[STD]** (Standard).

Note: The final segment heating rate will not change. It will always be 108°F/60°C per hour. Slow and Fast speeds affect only the earlier ramp segments of the Cone-Fire schedules on pages 30-31.

Hold at Cone Temperature [HOLD]

Cone-Fire Hold heat-soaks the ware at the cone temperature. Without Hold, the kiln shuts off after it reaches the cone temperature or Slow Cooling begins. Hold maintains the cone temperature for the length of time you specify.

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

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

CAUTION: 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 it.

One way to add hold time without over-firing is to fire to one cone cooler than needed. Then add enough hold time to bend the next hotter cone. Hold time needed to bend the next cone will vary. As a rule of thumb, 20 minutes of hold = one cone of heat work.

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

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

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

When Hold is set to 99.59 hours, the Sentry Xpress will remain at that temperature indefinitely, until the **Start/Stop** key is pressed.

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 development, 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 the Slow Cooling Option. See page 17.
- The Sentry's Slow Cooling begins after the cone firing and ends at 800°F / 426°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 the **Down Arrow** for Present Status. Check the Slow Cooling rate. The firing time can extend for many hours if the cooling rate is too slow. This also adds to element wear.

How to Customize Cone-Fire

You can customize a Cone-Fire program using Ramp-Hold. (See the next section.) On pages 30-31, tables show the segments used to program each cone number in Cone-Fire. For instance, a cone 016 firing at medium speed **[STD]** uses these two segments:

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

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

$$1422 + 25 = 1447$$

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

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

You could also easily add a slow cooling segment:

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

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

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

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. You must select **[VFAN]** (Vent Fan) in the **[AOP1]** option. See page 22.



The Orton Vent Master can be turned on or off throughout the firing through the controller.

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. Program for a hotter cone following the instructions in the red box, page 10. The kiln will begin firing, taking up where it left off.

Note: By seeing the witness cones through a peep-hole, 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 K-Type thermocouple is installed on your kiln, but S-Type is selected in Options, the kiln will continually underfire by a wide margin. (The kiln will overfire if S-Type is installed and K-Type is selected.) See the TC option, page 18, to check the thermocouple type selected.

Starting a Firing in a Hot Kiln

If you ever need to begin a firing when the kiln is already hot, begin the program as you normally would. The Sentry Xpress will automatically begin firing from the first segment that matches the current kiln temperature.

Chapter 3 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

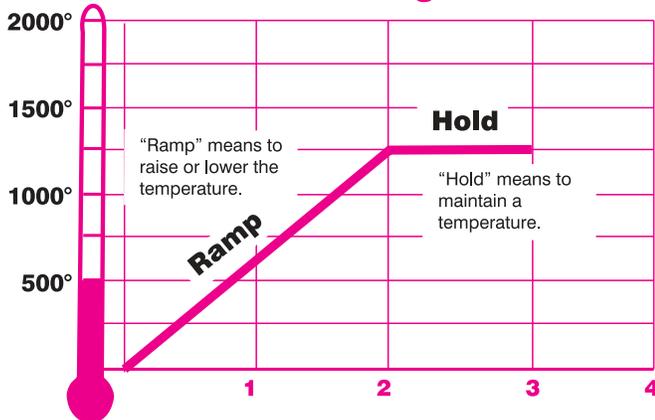
The temperature you are firing to in Ramp-Hold is called the target temperature. After the Sentry Xpress reaches the target temperature, it can hold, or soak, the kiln at that temperature for the length of time that you program.

The Sentry Xpress fires at a controlled heating rate. The rate is usually 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.

Ramp-Hold mode does three basic tasks:

- 1) It fires at a controlled heating rate, or speed, usually 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.

Parts of a Segment



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

The Sentry Xpress 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 above 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 at a rate that you select.
- **Hold:** The temperature remains the same.

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 in degrees per hour, see the Rate option, pages 13-14.

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:

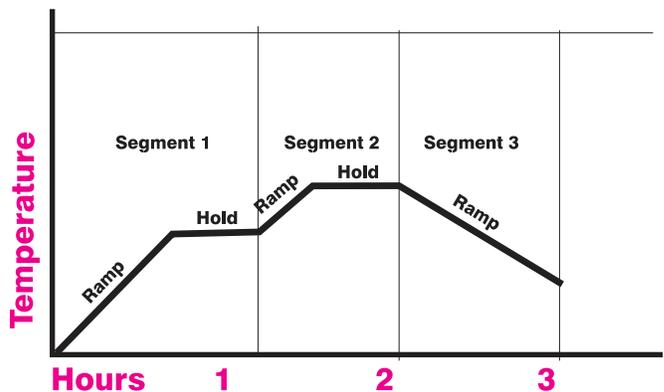
- To change the heating rate.
- To add a hold somewhere in the firing.
- To control the cooling rate.

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 $1250^\circ - 80^\circ$ (room temperature) = $1170 \div 625 = 1.87$ hours.

After the Sentry Xpress has finished firing the last segment, it will turn off the heating elements.

Note: If you enter a rate of 0000 in segment 1, or if the target temperature in segment 1 is lower than the current temperature, [BADP] (Bad Program) will appear in the display.



Here is a simple 3-segment program. Segments 1 and 2 each have a hold. Segment 3 is a controlled cooling segment.

How to Store Programs

The controller can retain 25 Ramp-Hold programs that can each fire up to 20 speeds and temperatures. (Each set of speeds and temperatures is called a segment.) The pro-

grams stay in memory even when the power is turned off. Programs are numbered 1 - 25.

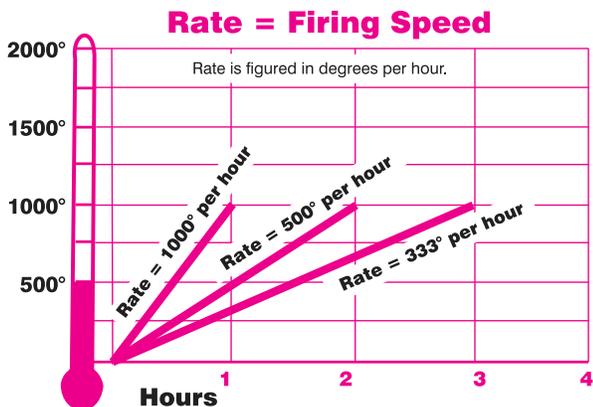
The first message to appear after you plug in your Sentry Xpress is [IDLE]. Press **Start/Stop**. Then press the **Up Arrow** key twice to scroll through two messages: [USER] and [CONE].

To use Ramp-Hold mode, select [USER]. Press the **Start/Stop** key. Then follow the boxed instructions in the next column to enter temperature, heating rate, etc.

[PRO1] is Program 1. When you fire the kiln again, you can repeat Program 1 by selecting [PRO1]. When you are ready to fire a different program, select [PRO2], which is program 2. Then enter temperatures, heating rates, etc. Select programs [PRO3] - [PR25] the same way.

Pointer: To Select a high number Ramp-Hold program from [PRO1], press the **Down Arrow**. You will go to [PR25], the highest program number. Use the up and down arrow keys to scroll through your stored programs.

To over-write a program, select it and enter new rates and temperatures. This automatically over-writes the previous program. Write down your programs in a notebook. Make copies of the blank firing record on page 33.



Three Types of Rate

In the Rate option, page 22, 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 Degrees Per Hour

Each segment must include a rate, which is the firing speed of that segment. We usually 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.

The diagram above 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.

Ramp-Hold Programming Instructions

You have up to 20 segments available in Ramp-Hold. Zero out segments that you don't need. See step 9 below.

Lock, Fan, and Delay can each be turned on or off as programming steps. Ignore the steps below that you have deactivated. See LOCK (page 21), FN (selected in AOP1, page 22), and DELA, (page 17).

- 1 From [IDLE], press **Start/Stop** (the left button).
 - 2 Using the **Up Arrow** key (not the **Down Arrow**), skip past [CONE] and select [USER]. Then press **Start/Stop**.
 - 3 Press the up and down arrow keys to select a program, from [PRO1] to [PR25]. Then press **Start/Stop**.
 - 4 If the program is locked, [UNLO] (Unlock) will appear alternating with [0000]. If you want to change the program, enter your passcode. (Otherwise press **Start/Stop** to go to Step 11.)
 - 5 [RA 1] will appear. Enter firing rate (temperature change per hour) for segment 1. (1° = slowest rate. 1799°F / 999°C = full power.) Then press **Start/Stop**.
 - 6 [°F 1] or [°C 1] and the target temperature from the last firing will appear. Use the arrow keys to change the temperature. Then press **Start/Stop**.
 - 7 [HD 1] and the hold time from the last firing will appear. (Example: 1 hour, 10 minutes = 01.10). Use the arrow keys to change the hold time. Then press **Start/Stop**. (No hold = 00.00)
 - 8 If your kiln is set up with a vent fan, [FN 1] will appear. Press **Start/Stop**. Use the arrow keys to select [ON] or [OFF]. Press **Start/Stop**.
 - 9 Continue entering values for the segments needed. When [RA _] appears for the next segment that you don't need, select [0000]. Then press **Start/Stop**. This will zero out the remaining segments. (Example: You need only 1 segment. When [RA 2] appears, enter 0000.)
 - 10 [LOCK] alternating with [0000] will appear. Enter your passcode to lock the program, or press **Start/Stop** to leave it unlocked.
 - 11 [STRT] will appear. Press **Start/Stop**. [DELA] will appear. Set a delay time. If you don't need to delay the firing, leave the time at [00.00]. Then press **Start/Stop**. [-ON-] will appear, and the kiln will begin firing. If Delay was programmed, [DELA] will appear and time remaining until start.
- To stop a firing before completion, press **Start/Stop**. [ABRT] (abort) will appear.
- When kiln fires to completion, it will beep for 30 seconds. [CPLT] (fired to completion), the firing time, final firing temperature, and current temperature will appear.

If you want the kiln to fire at full speed, enter a rate of 9999. See step 5, 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 Xpress 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 21.

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

Rate as Degrees Per Minute

Rate as degrees of temperature change per minute works the same as temperature change per hour. Only the math is different.

A maximum (Full) rate per minute is 29.97°F / 16.65°C.

After you have entered all the segments for your program, zero out the remaining available segments. Do that by entering 0 for the next available ramp rate.

Rate as Time Needed to Reach the Target Temperature

After selecting **[TIME]** in the RATE option, page 22, 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.

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

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

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 7, previous page, enter the hold time. When hold is set to 99.99 hours, the Sentry Xpress will

remain at that temperature indefinitely until you press the **Start/Stop** key.

Ceramics: Watch the pyrometric witness cones through a peephole during hold. Press the **Start/Stop** key 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.

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.

AOP: Turn on a Fan, Light, or Alarm

The AOP (auxiliary output) is an optional receptacle, or socket, mounted on the kiln. If your kiln has the auxiliary output receptacle and you want to use it, see the AOP1 option on page 22. Follow the instructions to activate the AOP.

Plug a kiln vent, light, or bell into the receptacle, and use your controller to turn the receptacle on or off for each segment. (The light or bell act as alarms.)

During programming, **[FN]** will appear for each segment (**[FN 1]** **[FN 2]** **[FN 3]** etc.). Use the up and down arrow keys to select ON or OFF for each segment. **[FN]** will appear only if the auxiliary output has been activated in the AOP1 option, page 22.

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 in 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

Segment 1 is the heating segment. Segment 2 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. Segment 2 will lower the temperature to 700°F / 371°C.

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 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 Full. 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 20, for information on error codes that may appear during crash cooling. To turn these codes off, program a crash cooling rate of Full. 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 the **Down Arrow** key to turn off the alarm.) **The controller, of course, cannot speed cooling beyond the kiln's natural cooling rate.**

A Ramp-Hold Practice Program

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

Use the programming instructions on page 13 to enter this firing schedule. Then use Program Review (page 5) to check for accuracy.

PrO1

rA1 = 250

°F 1 = 750

HLd 1 = 00.00

rA2 = 900

°F 2 = 1425

HLd 2 = 00.30

rA3 = 150

°F 3 = 750

HLd 3 = 00.00

rA4 = 0000 (zeroes cancel segments 4-25)

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. The kiln will begin firing, taking up where it left off.

Starting a Firing in a Hot Kiln

If you ever need to begin a firing when the kiln is already hot, begin the program as you normally would. The Sentry Xpress will automatically begin firing from the first segment that matches the current kiln temperature.

Chapter 4 Customize Your Controller with Options

In this chapter you will learn to . . .

- Activate slow cooling in Cone-Fire
- Check the amperage that your kiln pulls
- Choose Fahrenheit or Centigrade display
- 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 give you access to special features and adjustments in your Sentry Xpress. With each press of the **Up Arrow** key, the controller will display the next option. Press the **Up Arrow** either while the kiln is firing or from **IDLE**.

- 1** When you find the option you want to use, press the **Start/Stop** key again.
- 2** Use the arrow keys to select changes for that option.
- 3** After making a selection for an option, press the **Start/Stop** key.

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

- 1** Press the **Start/Stop** key.
- 2** Do nothing for 60 seconds while in an option. You will automatically be taken out of the option and back to **[IDLE]**.

How to Edit a Program During a Firing

See pages 12-15 for details on ramps, holds, and segments. While the kiln is firing, you can edit the program in three ways:

- Skip out of a segment and into another segment.
- Change the hold time of the current segment.
- Change the target temperature of the current segment.

Why would you ever want to edit a program during a firing? Suppose you have programmed 2167°F for a cone 5 glaze firing, followed by a segment for slow cooling. Watching the witness cone through a peephole, you notice that cone 5 is bending at 2150°F, so the kiln doesn't need to fire

to 2167°F as you had programmed. Skip to the next segment, which is a slow cooling one. If the firing does not include a slow cooling segment, and you are in the last segment, Skip Segment will not end a Hold. Press the **Start/Stop** key to end the firing.

Pointer: Make a note of the temperature at which the cone bent. Program that temperature for the next firing. This is the type of information that should be recorded in a kiln firing log book if you have one.

You can see the segments in the Cone-Fire firing schedules on pages 30-31.

The **[SKIP]** option does not skip from a ramp to a hold of the same segment. It skips to the next segment from either a ramp or hold of the current segment.

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

Note: If you wait 60 seconds without touching a key during editing, the controller will exit editing without changing the settings. The firing will continue.

Skip to the Next Segment

- 1 During a Cone-Fire or Ramp-Hold firing, press the **Up Arrow**. **[SKIP]** will appear.
- 2 To skip to another segment, press **Start/Stop**. The next segment will appear. Each time you press the **Up Arrow**, another segment will appear, if another has been programmed, followed by **CANC** (Cancel).
- 3 Press the **Up Arrow** until the segment that you want to skip to appears. Press **Start/Stop**. The kiln will continue to fire in the segment you selected.
- 4 If you don't want to skip to another segment after all, press the **Up Arrow** until **CANC** appears. Then press **Start/Stop**. The kiln will continue to fire as before.

Change the Hold Time of the Current Segment

- 1 During a Cone-Fire or Ramp-Hold firing, press the **Up Arrow** twice. **[HLDT]** (Hold Time) will appear.
- 2 To change the hold time of the current segment, press **Start/Stop**.
- 3 Use the arrow keys to change the hold time. Each time you press an arrow key, the hold time will increase or decrease by 5 minutes. Then press **Start/Stop**. (If you don't want to change the hold time after all, leave the setting alone and press **Start/Stop**.)

Change the Target Temperature of the Current Segment

- 1 During a Cone-Fire or Ramp-Hold firing, press the **Up Arrow** 3 times. **[CHGT]** (change temperature) will appear. Press **Start/Stop**.
- 2 Use the arrow keys to change the temperature. Then press **Start/Stop**.

Cone-Fire Options

These options appear only if a Cone-Fire program has been selected. If your controller doesn't have Cone-Fire mode, skip to General Options, next page.

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: TCOS, Thermocouple Offset, page 20, adjusts all temperature readings. Cone Offset changes only the last heating segment of all the Cone-Fire firings. You can see the Cone-Fire schedules on pages 30-31.

Follow these guidelines before deciding to use Cone Offset:

- The thermocouple (temperature sensor) must protrude into the firing chamber the correct distance: about $\frac{3}{4}$ " for $\frac{1}{4}$ " wide thermocouples, $\frac{1}{2}$ " - $\frac{5}{8}$ " for $\frac{1}{8}$ " wide thermocouples.
- Keep shelves 1" - 1 $\frac{1}{2}$ " away from the thermocouple.
- Keep pyrometric 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, next page.

- 1 First, program a Cone-Fire. See page 10.
- 2 From **[IDLE]**, press the **Up Arrow** repeatedly until **[OFST]** appears.
Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the **Up Arrow** again to see more options. When **[OPT2]** appears, press **Start/Stop**. That will take you to more options.
- 3 When you see **[OFST]** press the **Start/Stop** key. The current Cone Offset adjustment number will appear.
- 4 Using the arrow keys, select a new adjustment number (see chart, next column). Then press the **Start/Stop** key. **[IDLE]** will appear.

Cone Offset Settings

Note: You must have a Cone-Fire program in active memory before you can change 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

You can change the cone offset or remove it at any time. A cone offset is also removed when the Reset option is used. (See RST, page 24).

Interpreting Cone Bending to Set a Cone Offset

Position the witness cones in the kiln according to the instructions on page 8.

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 fairly even with the cone base.

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. See TCOS, page 20.

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 starting 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. You would need Ramp-Hold mode to do this. See pages 12-15.

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. But first you have to turn on Slow Cooling in options. If you don't

turn on the option, the Slow Cooling prompt will remain hidden in Cone-Fire programming.

1 First, program a Cone-Fire. See page 10.

2 From **[IDLE]** press the **Up Arrow** repeatedly until **[COOL]** appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the **Up Arrow** again to see more options. When **[OPT2]** appears, press **Start/Stop**. That will take you to more options. Follow the same steps to go past **[OPT3]**.

1 When you see **[COOL]**, press the **Start/Stop** key.

2 Using the **1** key, select **[YES]** or **[NO]**. If you want to use Slow Cooling, select yes. If you never use it, select no. Then press **Start/Stop**. **[IDLE]** will appear.

General Options

DELA / Delay the Firing for Later

Most controllers come from the factory with delay-fire added to the programming. After you program a firing, you will see **[DELA]** in the display window. If you want the kiln to turn on later, enter the delay time with the arrow keys. Use this format:

Hours.Minutes

Example: 4 hours, 30 minutes = 04.30

Enter hours to the left of the decimal point and minutes to the right of it. If you don't need a delay, leave the setting at 00.00.

The delay time will zero out after each firing. You can change the way delay works by adjusting it in Options as follows.

1 From **[IDLE]**, press the **Up Arrow** key to get to **[DELA]**.

2 When **[DELA]** appears, press the **Start/Stop** key. Using an arrow key, scroll through the following choices. To select a choice, press **Start/Stop**.

■ **[DFLT]** This is the default factory setting. **[DELA]** appears after you enter a program and before you start the kiln. The delay time that you enter zeroes out after each firing.

■ **[ALL]** The **[DELA]** prompt appears before you start a firing, just as above. However, the delay time doesn't zero out after each firing. It stays in memory for all your future firings or until you change the delay time again.

■ **[OFF]** This turns off the **[DELA]** prompt. If you select Off, you won't see the delay prompt again before firing the kiln. Turn the delay prompt off if you never use it. That will help streamline your programming steps.

TC / Choose Thermocouple Type

Select K-Type, -N, -S or -R Thermocouple

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

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 S- or R-Type, but your kiln is equipped with a K-Type, your kiln will underfire. If you select K-Type and your kiln is equipped with an S- or R-Type, your kiln will OVERFIRE. After using the Reset (RST) option, page 24, use the Thermocouple (TC) option, page 18, to select the correct thermocouple. (For safety, RST changes the thermocouple selection to S-Type.)

Because the kiln will over- or underfire if the wrong thermocouple type is chosen in Options, we have locked the thermocouple option so it cannot be unintentionally changed. Here are instructions for unlocking it:

- 1 From [IDLE], press the **Up Arrow** repeatedly until [TC] appears.
- 2 Press **Start/Stop**.
- 3 [PASS] will appear alternating with 0000. The thermocouple option is locked. To unlock it, press the arrow keys to enter this password:
0155
- 4 After you enter the password, press **Start/Stop**. The thermocouple setting will appear.
- 5 Use an arrow key to select [K], [N], [R] or [S].
- 6 After selecting one of the above, press **Start/Stop**. [IDLE] will appear.

ALAR / 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. Use the alarm to alert you to—

- Lower the lid from the venting position and insert the peephole plugs.
- Check the witness cone through a peephole near the expected shut-off time.
- Visually 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 one.

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 the **Up Arrow** key repeatedly until [ALAR] appears. Press **Start/Stop**.
- 2 Using the arrow keys, enter an alarm temperature. (To disable the alarm, set the alarm temperature to 32°F / 0°C.) Press **Start/Stop**. [IDLE] will appear.
- 3 When the alarm temperature is reached during a firing, the controller will beep and [ALAR] will appear. Press the **Down Arrow** to turn off the alarm.

Setting the Alarm During a Firing

- 1 The alarm beeps while the kiln is firing. [ALAR] will appear, alternating with the temperature. Press the **Down Arrow** to turn off the alarm.
- 2 Press the **Up Arrow** key repeatedly until a steady [ALAR] appears. Press **Start/Stop**.
- 3 Enter the new temperature with the arrow keys. (To disable the alarm, set the alarm temperature to 32°F / 0°C.) Press **Start/Stop**. The kiln will continue firing.

If you enter a new alarm temperature, and forget to press **Start/Stop**, 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 32°F / 0°C.

DIAG (Diagnostics) / Check the Amperage, Test the Relays, and the AOP1 Outlet

Check Your Kiln's Amperage (If Your Kiln Has an Amp Sensor)

If you are wondering why your kiln is taking so long to reach temperature, you can check the amperage that the kiln is pulling. (To check the amperage, your kiln must be equipped with an amperage sensor.)

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 or worn elements can cause a low amperage reading. Before deciding that the elements are worn out, also check the voltage.

Check the Amperage at IDLE or While Firing

- 1 From **[IDLE]**, press the **Up Arrow** repeatedly until **[DIAG]** appears. Press **Start/Stop**.
- 2 With the arrow keys, you can rotate between **[AMPS]** and **[TEST]**. Select **[AMPS]** and press **Start/Stop**. The amperage that the kiln is pulling will appear.

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]**.

Test the Heating Elements, Relays, and AOP1 Outlet

Use this option when testing thermocouples with a cigarette lighter or other heat source.

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 26.

- 1 From **[IDLE]**, press the **Up Arrow** repeatedly until **[DIAG]** appears. Press **Start/Stop**.
- 2 With the arrow keys, you can rotate between **[AMPS]** and **[TEST]**. Select **[TEST]** and press **Start/Stop**. Each relay will turn on for 2 minutes, one relay at a time.
- 3 After testing the relays, kilns equipped with the AOP1 outlet will display **[J3-3]** for two minutes to test power to the AOP outlet.

Pointer: The relays are tested for 2 minutes each, followed by the AOP1 outlet. You can press the **Start/Stop** key during a 2-minute test to advance to the next relay before the 2 minutes are over.

F/C / Select 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 the **Up Arrow** repeatedly until **[F/C]** appears.
- 2 Press **Start/Stop**. Use the arrow keys to select **[F]** or **[C]**.
- 3 After selecting one of the above, press **Start/Stop**. **[IDLE]** will appear.

°F/°C Temperature Conversion Formulas

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

Firing to a Temperature

(i.e. "Fire to 1600°F." $1600^{\circ}\text{F} = 871^{\circ}\text{C}$)

$$(^{\circ}\text{C} \times 1.8) + 32 = ^{\circ}\text{F}$$

$$(^{\circ}\text{F} - 32) \div 1.8 = ^{\circ}\text{C}$$

Firing Rate or Temperature Change

(i.e. "Fire at 200°F per hour" or "Fire 200°F hotter." $200^{\circ}\text{F} = 111^{\circ}\text{C}$)

$$^{\circ}\text{C} \times 1.8 = ^{\circ}\text{F}$$

$$^{\circ}\text{F} \div 1.8 = ^{\circ}\text{C}$$

LIM / Set a Maximum Temperature for Your Kiln

Your kiln has a maximum temperature rating, which is listed on its electrical data plate. In a classroom setting where students use kilns, you may want to lower the maximum rating to the temperature of a particular clay or glass. The **[LIM]** option allows you to do that.

Set the maximum temperature of the clay or glass in the **[LIM]** (temperature limit) option. When the kiln goes 1 degree over that temperature, the kiln will shut off. **[OTL]** (Over Temperature Limit) will appear in the display.

The adjustment range is from 200°F / 93°C up to the temperature rating listed on the safety data plate of your kiln.

- 1 From **[IDLE]**, press the **Up Arrow** key repeatedly until **[LIM]** appears.
- 2 Press **Start/Stop**. Change the maximum temperature with the arrow keys.
- 3 Press **Start/Stop** to return to **[IDLE]**.

COST / View the Electrical Cost of a Firing

Your Sentry Xpress controller can give you the electrical cost of a firing. This will help you determine how much to charge for the ware that you sell. It will also enable you to experiment with saving electricity by adjusting your firing schedules. For instance, how much extra electricity would you use if you slowed the firing rate? How much does it cost to add slow cooling to a ceramic glaze firing?

Before the controller can give you the cost of your firings, you will need to enter the wattage of your kiln in the **[KW]** option, page 23, and the cost of electricity in the **[CENT]** option, page 23.

After you have set up the [KW] and [CENT] options, you can check the progressive cost of a firing while the kiln is on, and you can check the total cost after the kiln fires to completion.

- 1 While the kiln is firing, or from [IDLE], press the **Up Arrow** key repeatedly until [COST] appears. Press **Start/Stop**.
- 2 The cost of the firing will appear.
- 3 Press **Start/Stop** to return to the normal display.

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 the firing cost.

Note: By checking the [COST] option 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, check the [COST] option before Slow Cooling begins, and check it again after the kiln has fired to completion.

TCOS / Thermocouple Offset

Calibrate the Thermocouple(s)

The thermocouple is the rod extending into the firing chamber. The thermocouple measures the 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 3/4” for 1/4” wide thermocouples, 1/2” - 5/8” for 1/8” wide thermocouples.

How to Set 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 the **Up Arrow** repeatedly until [TCOS] appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see [EXIT], press the **Up Arrow** again to see more options. When [OPT2] appears, press **Start/Stop**. That will take you to more options.
- 2 When you see [TCOS] press the **Start/Stop** key. The current Thermocouple Offset adjustment number will appear.
- 3 Using the arrow keys, select a new adjustment number (see chart, next column). Then press the **Start/Stop** key. [IDLE] will appear.
- 4 From [IDLE], press the **Up Arrow** repeatedly until [TCOS] appears.

- 5 Press **Start/Stop**. [O], or a Thermocouple Offset, will appear.
- 6 Using the arrow keys, enter the new offset. Press **Start/Stop**. [IDLE] will appear.

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

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 Xpress 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 25):

[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 25). We ordinarily 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.)

Changing the Deviation Temperature

If an alarm is triggered by flash-cooling the kiln or opening a bead door, raise the **[TEDE]** temperature.

- 1 From **[IDLE]**, press the **Up Arrow** repeatedly until **[TEDE]** appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the **Up Arrow** again to see more options. When **[OPT2]** appears, press **Start/Stop**. That will take you to more options.

- 2 When you see **[TEDE]** press the **Start/Stop** key.
- 3 Change the deviation temperature with the arrow keys. The higher the number, the less likely you will activate the alarms.
- 4 Press **Start/Stop**. **[IDLE]** will appear.

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 kiln temperature can exceed the programmed temperature before the kiln shuts off. The factory **[HTDE]** setting is 100°F / 56°C. The adjustment range is 18°F - 200°F / 10°C - 111°C.

- 1 From **[IDLE]**, press the **Up Arrow** repeatedly until **[HTDE]** appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the **Up Arrow** again to see more options. When **[OPT2]** appears, press **Start/Stop**. That will take you to more options.

- 2 When you see **[HTDE]** press the **Start/Stop** key. The current high temperature shutoff setting will appear.
- 3 Using the arrow keys, change the deviation temperature. The higher the number, the less likely you will activate the alarms. Then press the **Start/Stop** key. **[IDLE]** will appear.

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.

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!

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, page 24. 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 the **Up Arrow** repeatedly until **[LOCK]** appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the **Up Arrow** again to see more options. When **[OPT2]** appears, press **Start/Stop**. That will take you to more options.

- 2 When you see **[LOCK]**, press the **Start/Stop** key.
- 3 **[PASS]** will appear.
- 4 Press the **Up Arrow** 3 times to enter the default passcode, **3**. Then press **Start/Stop**. (If you use the wrong passcode, the display will return to **[IDLE]**.)
- 5 Use the keys to choose **[SET]** or **[OFF]**. (**SET** means you are setting a new passcode. **OFF** means you are not setting a new passcode and are not going to lock programs.) Then press **Start/Stop**.
- 6 If you chose **[SET]**, then use the arrow keys to enter a new passcode. It can be a number of one to four digits. Press **Start/Stop**. **[IDLE]** will appear. Be sure to write down your new passcode. The inside cover of this manual would be a good place to store your passcode.

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 that is 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. This means the program is unlocked.
- 2** To lock a program, enter the passcode using the arrow keys. Then press **Start/Stop**. (To leave the program unlocked, do not enter your passcode. Just press **Start/Stop** when **[LOCK]** appears.)

Note: After you have locked a program, you will see **[UNLO]** before you fire it. You don't have to enter your passcode to fire the program. The passcode is needed only if you alter the program.

How to Unlock and Edit a Program

You have locked a program and would like to edit it. Go into programming, page 13. One of the first prompts you will see is **[UNLO]**. Enter your passcode with the arrow keys. Then press **Start/Stop** 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.) After you unlock and edit a program, you can lock it again or leave it unlocked.

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.

AOP1 / Auxiliary Output

Select Vent Fan or Alarm for the Auxiliary Output

The **[AOP1]** (Auxiliary Output) is for a receptacle (called a socket in England) mounted on the kiln switch box. The outlet 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]** option:

- **[VFAN] Kiln Vent or Gas Outlet:** This option adds a display prompt for fan (**[FN]**) to each segment during Ramp-Hold programming, page 13.
- **[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 19.

- 1** From **[IDLE]**, press the **Up Arrow** repeatedly until **[AOP1]** appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the **Up Arrow** again to see more options. When **[OPT2]** appears, press **Start/Stop**. That will take you to more options.

- 2** When you see **[AOP1]**, press the **Start/Stop** key.

- 3** Use the arrow keys to select one of the above options. Then press **Start/Stop**.

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 the board temperature, use a fan to blow air across the kiln switch box into the ventilation slots. (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.

- 1** From **[IDLE]** or while firing, press the **Up Arrow** repeatedly until **[ELEC]** appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the **Up Arrow** again to see more options. When **[OPT2]** appears, press **Start/Stop**. That will take you to more options.

- 2** When you see **[ELEC]**, press the **Start/Stop** key. The temperature of the circuit board will appear.

- 3** Press **Start/Stop** to return to the normal display.

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

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 Xpress controller to the **[TIME]** setting. You then won't have to change your firing schedules to degrees per hour rate.

- 1** From **[IDLE]** or while firing, press the **Up Arrow** repeatedly until **[RATE]** appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the **Up Arrow** again to see more options. When **[OPT2]** appears, press **Start/Stop** followed by the **Up Arrow**. That will take you to more options. Repeat with **[OPT3]**.

- 2** When **[RATE]** appears, press the **Start/Stop** key.

- 3** Use the arrow keys to select the desired type of rate:

[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)

4 Press **Start/Stop**. [IDLE] will appear.

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)



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

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, right column.)

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] or while firing, press the **Up Arrow** repeatedly until [CENT] appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see [EXIT], press the **Up Arrow** again to see more options. When [OPT2] appears, press **Start/Stop** followed by the **Up Arrow**. That will take you to more options. Repeat with [OPT3].

2 When [CENT] appears, press the **Start/Stop** key.

3 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 **Start/Stop**. [IDLE] will appear.

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:

$$10,800 \text{ watts} \div 1000 = 010.8$$

$$4,800 \text{ watts} \div 1000 = 004.8$$

$$800 \text{ watts} \div 1000 = 000.8$$

Enter that amount in the KW option:

1 From [IDLE] or while firing, press the **Up Arrow** repeatedly until [KW] appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see [EXIT], press the **Up Arrow** again to see more options. When [OPT2] appears, press **Start/Stop** followed by the **Up Arrow**. That will take you to more options. Repeat with [OPT3].

2 When [KW] appears, press the **Start/Stop** key.

3 The controller shows 4 digits for entering kilowatts: [00.00]. Enter kilowatts for your kiln.

4 Press **Start/Stop**. **[IDLE]** will appear.

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.

You can see the progressive cost of a firing during kiln operation (like looking at a taxi meter). Or check the total cost after the firing when the controller flashes **[CPTL]**.

1 While the kiln is firing, or from **IDLE**, press the **Up Arrow** key repeatedly until **[COST]** appears. Press **Start/Stop**.

2 The cost of the firing will appear.

3 Press **Start/Stop** to return to the normal display.

SFTY / Maximum Temperature

View the Kiln's Maximum Operating Temperature

1 From **[IDLE]** or while firing, press the **Up Arrow** repeatedly until **[SFTY]** appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the **Up Arrow** again to see more options. When **[OPT2]** appears, press **Start/Stop** followed by the **Up Arrow**. That will take you to more options. Repeat with **[OPT3]**.

2 When **[SFTY]** appears, press the **Start/Stop** key.

The temperature displayed is the maximum operating temperature programmed in the Sentry Xpress 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 **Start/Stop** to return to **[IDLE]**.

SOFT / Software Version

Knowing the software version number of your controller is often vital in helping a kiln technician to diagnose a problem that may arise.

1 From **[IDLE]** or while firing, press the **Up Arrow** repeatedly until **[SOFT]** appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the **Up Arrow** again to see more options. When **[OPT2]** appears, press **Start/Stop** followed by the **Up Arrow**. That will take you to more options. Repeat with **[OPT3]**.

2 When **[SOFT]** appears, press the **Start/Stop** key. The software version will appear. Press **Start/Stop** to return to **[IDLE]**. The software version can be changed only at the factory.

CFG / Configuration Code

1 From **[IDLE]** or while firing, press the **Up Arrow** repeatedly until **[CFG]** appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the

Up Arrow again to see more options. When **[OPT2]** appears, press **Start/Stop** followed by the **Up Arrow**. That will take you to more options. Repeat with **[OPT3]**.

2 When **[CFG]** appears, press the **Start/Stop** key. The configuration code will appear. Press **Start/Stop** to return to **[IDLE]**. You can change the configuration settings by obtaining instructions from the factory.

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 S-Type 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 K-Type thermocouple, the Sentry Xpress will underfire after a reset! Use the Thermocouple Option (TC, page 18) to select K-Type again.

1 From **[IDLE]** or while firing, press the **Up Arrow** repeatedly until **[RST]** appears.

Note: With each **Up Arrow** key press, you will see the next option. When you see **[EXIT]**, press the **Up Arrow** again to see more options. When **[OPT2]** appears, press **Start/Stop** followed by the **Up Arrow**. That will take you to more options. Repeat with **[OPT3]**.

2 When **[RST]** appears, press the **Start/Stop** key. Use the arrow keys to select **[NO]** or **[YES]**. Press the **Start/Stop** key. **[IDLE]** will appear.

Pointer: Check the temperature after a reset. If it is no longer accurate, check the **[TC]** and **[F / C]** options to be sure your controller is set for the correct thermocouple type and fahrenheit or celcius. See pages 18-19.

Chapter 5

Error Messages

- Error messages are accompanied by an alarm.
- **[FTH]**, **[FTC]**, and **[LTDE]** error messages are based upon the adjustable setting in the Temperature Deviation **[TEDE]** option (page 20).

Non-Interrupting Error Messages

Press **Down Arrow** 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.

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 20.) 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 5.)

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 20.)

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 5.)

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 20.) 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 a firing. After power was restored, the firing resumed.

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 start a Ramp-Hold firing, all programmed temperatures are below the current kiln temperature.
- A Ramp-Hold program has 0 rate in the first segment.

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 ventilation slots. (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

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 tested 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. It doesn't appear during 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 segments.

Note: To avoid the [FTL] message, 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.

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

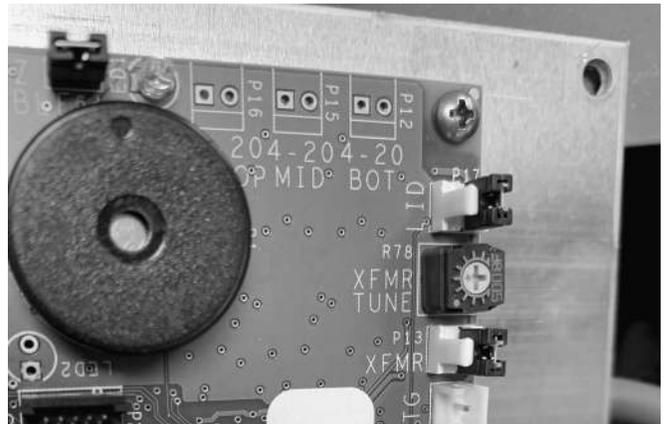
The heating rate is slower than 9°F / 5°C per hour and the kiln temperature is more than 100°F / 56°C away from the programmed temperature. The LAG error is inactive above 500°F/260°C.

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 for Lid or Door



The lid switch two-pin terminal is on the back of the circuit board in the upper right corner. Look for the connector marked LID.

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 Xpress 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.)
- 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 19. This problem takes only a moment to fix in the [LIM] option.

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.

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

TC 2 / Thermocouple Failure

The thermocouple failed while the controller was at [IDLE].

TCR / Thermocouple Leads Reversed

Check that the thermocouple lead wires are connected to the correct terminals on the back of the controller and on the thermocouple connection block.



Basic Power Failure Principles

The Sentry Xpress handles a power failure in two ways:

- 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.

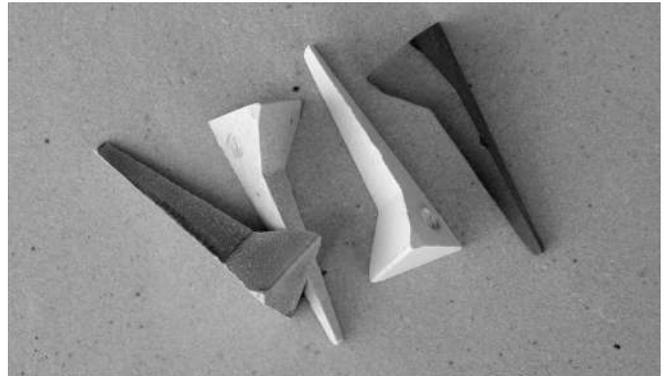
When the Sentry Xpress aborts a firing after a power failure, the display will show the following:

- [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, restart the program. 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 **Start/Stop**, 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



Orton self-supporting pyrometric cones.

- **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.

Display Messages

Message	Definition	Page Reference	Message	Definition	Page Reference
[ABRT]	Abort The firing was stopped.	10, 13	[°F 1] or [°C 1]	Target Temperature This prompt, which appears in Ramp-Hold programming, is asking for a target temperature. The number is the segment of the program.	13
[ALAR]	Alarm ALAR appears either when you are entering an alarm temperature or when the alarm is sounding during a firing. To stop an alarm, press the Down Arrow key. If the alarm goes off when you first begin firing, it is because it was set for a lower temperature than the present temperature.	5, 7, 14, 15, 18, 20, 22	[FAIL]	Thermocouple Failed The thermocouple failed. This can be due to a broken thermocouple, loose thermocouple connection on the back of the Sentry Xpress, disconnected thermocouple wire, or a defective controller.	25
[AOP1]	Auxiliary Output The AOP1 option is for kilns equipped with a special-order kiln switch box receptacle called the Auxiliary Output.	11, 13, 14, 19, 22	[FAST]	Fast Speed In Cone-Fire programming, if you press Start/Stop when FAST appears, the kiln will program to fire at fast speed.	10
[BADP]	Bad Programming 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.	25	[FE 1] & [FE 4]	Failed Component 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.	26
[CENT]	Electrical Rate Enter the electric rate shown on your electric bill. Example: 9.25 cents per KWh is entered as 00.09.	20, 23	[FN 1]	Fan 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. See also AOP1, left column.	13
[CFG]	Configuration Code This is an option that shows the factory configuration code for your Sentry. This is for technicians who call the factory for support.	24	[FTC]	Failed to Cool This error message means the kiln cannot cool as fast as the cooling that you programmed.	20, 25
[CONE]	Cone-Fire The Sentry Xpress is ready for you to enter a cone number.	8-11	[FTH]	Failed to Heat The kiln cannot heat as fast as you programmed.	20, 21, 25
[COOL]	Slow Cooling 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.	2, 10, 11, 17	[FTL]	Firing Too Long 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.	25, 26
[CPLT]	Completed Firing 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.	6, 10, 13	[FULL]	Full Speed This rate, or temperature change per hour, is maximum.	13, 14, 15, 21, 23, 25, 26
[DIAG]	Amperage Check Check the amperage. Test the relays.	19	[HD 1]	Temperature Hold 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.	13
[DELA]	Delay DELA is a timer that starts the kiln later. Delay time appears in hours and minutes. You can turn off the DELA prompt in Options.	2, 5, 6, 10, 13, 17, 21	[HOLD]	Temperature Hold 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).	11, 13
[ELEC]	Electronics Temperature The Sentry Xpress circuit board is rated for operation at temperatures up to 176°F / 80°C. When the circuit board gets hotter, the Sentry Xpress shuts off. The ELEC option shows you the temperature of the circuit board.	22	[HTDE]	High Temperature Deviation During a heating-up ramp or a hold, the temperature is 100°F / 56°C above the programmed temperature.	14, 21, 25, 26
[ETH]	Electronics Too Hot The Sentry Xpress circuit board is too hot, so the kiln shut off.	22, 25	[IDLE]	Ready to Begin The Sentry Xpress must display the IDLE message before you can begin firing or programming.	Cover, 5, 10, 13
[F / C]	Change °F / °C Choose between operation in degrees F or degrees C.	19			

Message Definition	Page Reference
[KW] Kilowatts 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. 10,800 watts ÷ 1000 = 10.8.	19, 23
[LID] Lid/Door is Open 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.	6, 28
[LOCK] Program Lock With this option activated, a stored program cannot be altered or removed from memory.	10, 13, 21
[LTDE] Low Temperature Deviation This message appears when the kiln is below the Temperature Deviation setting in the TEde option.	20, 25
[OFST] Cone Offset Adjust a Cone-Fire program to bend the matching witness cone on the kiln shelf.	16, 20
[-ON-] Firing Started This appears when firing begins. Do not be concerned if it takes a moment for the relays to turn on. The Sentry Xpress is processing data.	6, 10, 13
[OTL] Over Temperature Limit This means the kiln has fired hotter than the temperature set in the LIM option. It takes only a moment to reset the option.	19, 27
[PF 1] 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.	27
[PF 2] Power Failure The power failed. When power came back on, the temperature was below 212°F / 100°C.	27
[PF 3] Power Failure The power failed and the temperature dropped 72°F/ 40°C.	27
[PF] Power Failure There was a power failure during firing. The kiln continued firing after the power came back on.	27
[RA 1] Rate 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.	13
[RST] Reset The RST option erases cone and thermocouple offsets, selects °F operation, erases stored programs in Ramp-Hold, and selects S-Type thermocouple. Note that if you use Reset, and your kiln is equipped with a K-Type thermocouple, you must use the TC option to select K-Type. (Reset selects S-Type as a safety precaution. If you had a S-Type thermocouple and Reset selected K-Type, your kiln would overfire. On the other hand, if you had a K-Type thermocouple, S-Type selected would underfire your kiln, which is better than overfiring it. The K-Type thermocouple is on most kilns.)	17, 18, 21, 24

Message Definition	Page Reference
[SFTY] Safety This is the maximum temperature the Sentry Xpress is programmed for your kiln. It can be altered only at the factory.	24
[SKIP] Skip Segment 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.	10, 13, 15, 16
[SLOW] Slow Speed In Cone-Fire programming, if you press Start/Stop when SLOW appears, the kiln will program to fire at slow speed.	2, 10, 11, 15, 17, 20
[SOFT] Software Version This option gives the version of software in your Sentry Xpress.	24
[SPD] Speed 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.	10
[STD] Standard Speed Cone-Fire medium speed appears in the Sentry Xpress as STD, or Standard. This is because medium speed is the standard firing program used in Cone-Fire.	10
[TC] Thermocouple Type Choose between types K, S, or R thermocouple. It is important to select the correct type, or the controller will not read temperature accurately.	11, 18, 24
[TCOS] Thermocouple Offset Adjust the controller's temperature to compensate for temperature drift, or aging, of a thermocouple.	17, 20
[TCR] Thermocouple Reversed The thermocouple wires are reversed.	27
[TEDE] Temperature Deviation The Sentry Xpress 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 in TEDE.	14, 15, 20, 21, 24, 25
[TEST] Element Test 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 at IDLE display.	19
[USER] User Program In Ramp-Hold programming, the USER prompt is asking you where you want to place the program in memory. The Sentry Xpress has 9 spaces in memory. Keep a written record of the programs 1 - 9 in memory.	10, 13, 24

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

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

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

Medium Fire Cones °C

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

High Fire Cones °C

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

Temperature Equivalents For Orton Self-Supporting Pyrometric Cones

°F

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

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

°C

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

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

Ramp-Hold Firing Records

Date _____

Date _____

User Program _____

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 .	

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: _____

Type of firing: _____

Firing results: _____

Firing results: _____

Recommendations for the next firing of this type: _____

Recommendations for the next firing of this type: _____

Glossary

A

Amperage The amount of electricity the kiln pulls is measured in amps. The heating elements pull less amperage when they begin to wear.

AOP Auxiliary outlet. This is an electrical outlet, or socket, mounted on the kiln. The electricity to the outlet can be turned on or off by the controller. See the AOP1 option.

B

Bisque firing Firing the greenware to harden and prepare for glazing. Also called greenware firing.

C

Cone Offset In Cone-Fire mode, the witness cones inside the kiln should bend to 6 o'clock. you can adjust the controller

Cone-Fire The firing mode for ceramics. Choose the cone number and slow, standard, or fast speed. You don't have to enter the temperature.

Cone, pyrometric A small pyramid of ceramic materials that will react to the effect of time, temperature, and atmospheric condition inside the kiln in the same way as ceramic ware.

Controlled cooling Slowing the cooling rate of a kiln. Slow cooling relieves stresses in hot glass to prevent breakage. Slow cooling, also called down firing, can alter ceramic glazes.

E

Element A coil of wire that heats when electricity passes through it.

F

Firing schedule A set of instructions that tell the controller how hot to fire, and at what rate of temperature change.

G

Glaze A liquid composed of glass particles applied to ceramic ware.

Glaze firing The bisque or greenware firing hardens the ware and prepares it

for glaze. The glaze firing melts the glaze over the clay.

Greenware Unfired clay objects.

Greenware firing Firing the greenware to harden and prepare for glazing. Also called bisque firing.

H

Heat soak Maintaining a particular temperature inside a kiln.

Hold time The length of time that a temperature is maintained inside a kiln. See "heat soak."

hold

M

Maturing point The stage where clay or glaze has received the correct amount of "heat work." This is usually measured by the 6 o'clock bend of a large pyrometric cone placed on a kiln shelf beside the ware being fired.

O

Overfire When a kiln fires hotter than intended. Some kilns cannot overfire. They don't get hot enough.

Overshoot The temperature has risen higher than the controller was programmed. The temperature overshoots usually for a short time only.

P

Peephole The hole in the sidewall of a kiln used to see the interior of a hot kiln.

Pyrometric cone A small clay pyramid that stands upright on the kiln shelf. It measures the amount of heat work that ceramic ware is exposed to inside a kiln. Heat work is a combination of temperature plus the length of time the ware is exposed to heat.

R

Ramp Changing the temperature with a digital controller. If the temperature change is drawn in graph form, the resulting line looks like a ramp.

Ramp-Hold A firing mode where you choose the rate and temperature of each step in the firing.

Rate The controller needs to know the temperature you are firing to, and how fast you want to get to that temperature. The rate is like miles per hour, except we are dealing with temperature instead of distance.

Relay A switch triggered by an electromagnet. A digital controller sends power to the electromagnet, which closes a switch that turns on the heating elements.

S

Segment A set of programmed instructions for the digital controller in the Ramp-Hold mode. A segment can change the firing speed, temperature, and add a hold time.

set point

Slow cooling See "controlled cooling."

T

Target temperature This is the temperature that the controller is trying to reach. Each segment has a target temperature.

Thermocouple The measuring unit of a pyrometer that is inserted into the kiln's firing chamber.

Thermocouple Offset With thermocouple offset, you can adjust the controller so it fires hotter or cooler. This is like calibrating the controller.

Transformer An electrical device in the kiln's switch box that changes the higher voltage from the wall outlet to 24 volts. The lower voltage powers the digital controller.

V

Venting At the beginning of the firing, allowing air to come into the kiln and vapor and gases to escape. This is one of the most important steps in firing.

Sentry Xpress Ramp-Hold Shorthand Programming

After you press the key(s) in the left column, the message in the center will appear.

KEYS TO PRESS	DISPLAY	COMMENTS
Apply power to kiln	IDLE	Press Start/Stop if IDLE doesn't appear.
Start/Stop, Up Arrow (NOT down)	USER	Select USER.
Start/Stop, Up & Down Arrows	PR01	Select desired program number (1-25).
Start/Stop	UNLO	Program is locked.*
Up & Down Arrows	0000	Enter passcode to unlock.
Start/Stop	RA 1	Ready to enter a firing rate.
Up & Down Arrows	0000	Enter rate.
Start/Stop	°F 1	Ready to enter a firing temperature.
Up & Down Arrows	0200	Sample firing rate.
Start/Stop	HD 1	Ready to enter a hold time, if any.
Up & Down Arrows	00.00	Enter hold time. 00.00 = no hold time.
Repeat for other segments. Enter a rate of 0 for 1st segment not needed.		
Start/Stop	LOCK	Do you want to lock the program?*
Up & Down Arrows	0000	Enter passcode. 0000 = leave unlocked.
Start/Stop	STRT	The kiln is ready to fire.
Start/Stop	DELA	Do you want to delay the firing?
Up & Down Arrows	00.00	Enter delay time. 00.00 = no delay.
Start/Stop	-ON-	The kiln will begin firing in 30 seconds.
The kiln is now firing.		

*The LOCK and DELA prompts appear only after they have been turned on in Options. To turn them on or off, see Lock, page 21, or DELA, page 17. This takes only seconds.

Sentry Xpress Cone-Fire Shorthand Programming

After you press the key(s) in the left column, the message in the center will appear.

KEYS TO PRESS	DISPLAY	COMMENTS
Apply power to kiln	IDLE	Press Start/Stop if IDLE doesn't appear.
Start/Stop, Up Arrow (NOT down)	CONE	Select CONE.
Start/Stop, Up & Down Arrows	05	Select cone number.
Start/Stop	SPD	Ready to select a firing speed.
Up & Down Arrows	FAST	Select FAST, STD, or SLOW.
Start/Stop	HOLD	Ready to enter a hold time.
Up & Down Arrows	00.20	Sample. Enter hold (hrs.mins)
Start/Stop	COOL	Ready to enter a cooling rate.*
Up & Down Arrows	0200	Sample cooling rate.
Start/Stop	LOCK	Do you want to lock program?*
Up & Down Arrows	0000	Enter passcode to lock program.
Start/Stop	STRT	Kiln is ready to fire.
Start/Stop	DELA	Do you want to delay the firing?*
Up & Down Arrows	00.00	Enter delay time. 00.00 = no delay
Start/Stop	-ON-	The kiln is now firing.

The kiln is now firing to the cone you selected.

*The COOL, LOCK, and DELA prompts appear only after they have been turned on in Options. To turn them on or off, see Cool, page 17, Lock, page 21, or DELA, page 17. This takes only seconds.