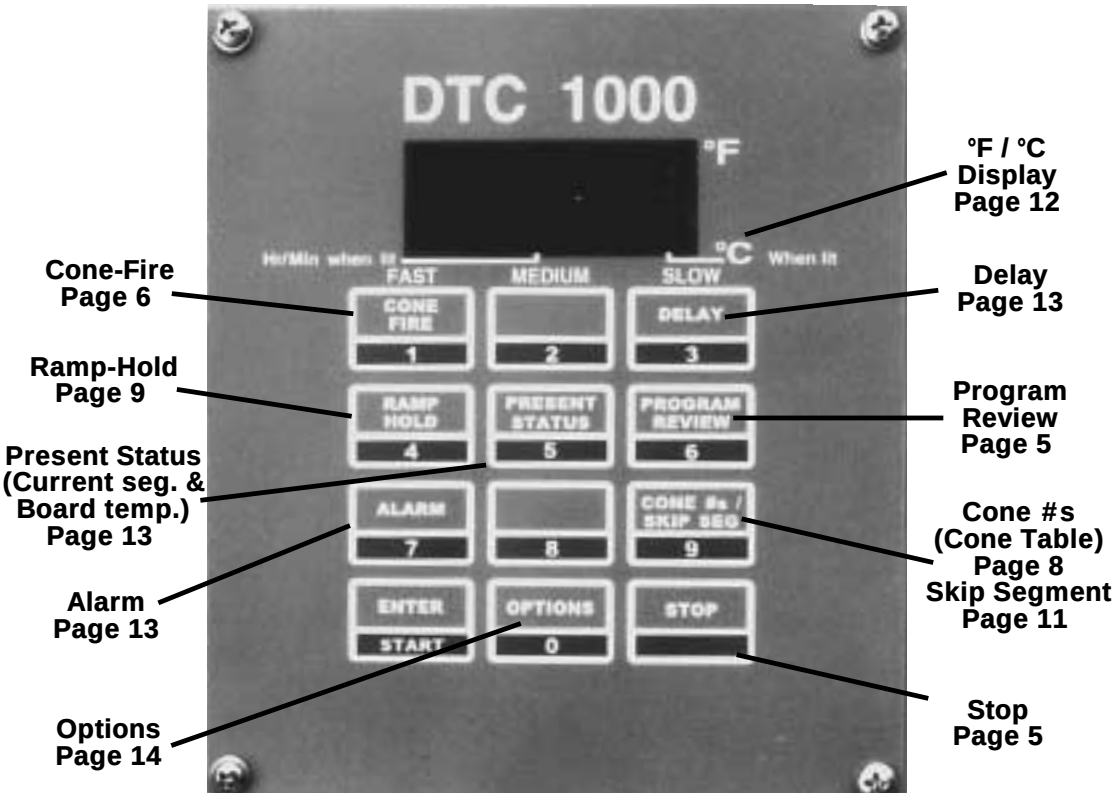
DTC 1000

Digital Temperature Controller

Complete Operation & Maintenance Instructions

See page 22 for instructions on upgrading your DTC 100, 600 or 800 series board to the DTC 1000.



The Keypad

The controller is easy to master once you understand that the keys have two functions:

1 Select an operation.

Press a key to start the operation shown in the top half of the key. Most operations begin by pressing **START** from **IdLE** display. Some operations begin during firing.

2 Type Numbers.

After beginning an operation, press keys to enter numbers, such as time and temperature.

Introduction

Thank you for purchasing the DTC 1000 controller, our latest generation of digital controllers.

The DTC 1000 operates in Cone-Fire and Ramp-Hold the same as the earlier DTC 600 and 800 series. If you are already familiar with the earlier controllers, you can follow most of the same operating procedures with the DTC 1000.

The DTC 1000 includes new features not found in earlier controllers. These features are accessed through the Options key. If you do not need them, they will remain hidden until you press Options. Thus, the DTC 1000 remains as simple to operate as earlier controllers.

The Cone-Fire mode applies to ceramics only. If you purchased a heat treating, glass fusing, enameling or jewelry furnace, your version of the DTC 1000 will include only the Ramp-Hold mode, not the Cone-Fire. In this case, please disregard "FAST," "MED," "SLOW," "Cone Fire" and "Cone #s" on your keypad.

If you purchased the TnF II portable controller, you should find a TnF II installation instruction sheet in addition to these instructions.

Though you should read this entire manual to fully enjoy your DTC 1000, you can begin firing after reading these sections: "Safety Rules" page 4, "Getting Started" pages 4-6, and the basics section of "Cone-Fire" pages 6-8 or "Ramp-Hold" pages 9-10. Though the DTC 1000 is simple to operate, using it without reading instructions could ruin your kiln or the ware inside. This is not covered by warranty. The time you spend reading now could save you untold hours of wasted effort later when you begin firing.

Once you learn the basic features of the DTC 1000, you will be able to control every stage of firing. This offers learning opportunities and convenience difficult to imagine with a manual-controlled kiln.

We thank those who helped produce this manual, especially Amy Parker and Steven Drollinger, who offered many suggestions.

Contents

Safety Rules

The warranty on your DTC 1000 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 or furnace manual.

When not in use, unplug kiln or furnace or turn off breaker.

Do not leave the kiln unattended, especially near the expected shut-off time.

Wear firing safety glasses (available from Paragon) when looking into peephole of a hot kiln.

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

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

Do not open lid or door until kiln or furnace has cooled and all switches are off.

Fire only in a well-ventilated, covered and protected area away from flammable materials. Keep cordset away from hot sides of kiln or furnace.

DANGEROUS VOLTAGE! Do not touch heating elements with anything. Disconnect kiln or furnace before servicing.

Do not operate if the controller itself is hotter than 150°F/66°C. (See instructions on page 13 for checking board temperature.) Never allow the firing room temperature to exceed 110°F/43°C. (Measure room temperature at least three feet away from the kiln.)

Getting Started

Do NOT fire your kiln or furnace until you have read this section and "Cone-Fire Basics" or "Ramp-Hold Basics." To use your controller to its fullest capacity, read the advanced sections and "Additional Features."

Testing and Recording

You will learn much by testing. How slowly should clay be heated through quartz inversion? How slowly must you cool glass through the annealing range? Find out for yourself by testing. The DTC 1000 can precisely control every stage of firing, so you can easily experiment and test.

Keep a notebook of firing records. When you fire similar projects weeks later, after you have forgotten the details of your previous firing, you will be grateful for your records.

Room Temperature and Humidity

It is okay to store the DTC 1000 at sub-zero temperatures. But before operating, raise the room temperature to at least 0°F/-18°C.

The circuit board is rated for 155°F/68°C maximum operating temperature. However, maximum temperature for rated accuracy is 125°F/52°C. If the board gets hotter, open windows and exhaust hot air from the room. (See page 13 for instructions on checking circuit board temperature.)

High humidity will not adversely affect the DTC 1000 unless water condenses on the circuit board. If this happens, do not fire the kiln until the moisture has evaporated from the board.

IdLE and CPL Messages

The controller displays **ErrP** when you first apply power. Press **ENTER**. **ErrP** will change to **IdLE** and a flashing temperature. Operations begin from **IdLE**.

If the display shows **FAIL** instead of **IdLE**, the thermocouple is either disconnected or burned out. (See page 18.)

CPL means "completed." The controller will display **CPL**, then **IdLE**, after it performs actions such as changing °F to °C display. **CPL** may remain for awhile before **IdLE** appears. Please be patient—the controller is processing data.

Which Instructions to Use

The DTC 1000 fires in two modes:

1) **Ceramic Cone-Fire**, based on pyrometric cones.

2) **Ramp-Hold**, based on firing rates and target temperatures.

Ceramic kilns, usually top-loading, use both Cone-Fire and Ramp-Hold. Heat treating, glass fusing, and enameling furnaces and kilns usually come with Ramp-Hold only.

FAST, MEDIUM, SLOW, CONE-FIRE, and Cone #s printed on the controller faceplate apply only to Cone-Fire mode.

How to Tell if You Have Cone-Fire

1 From **IdLE** display, press **ENTER**, then **1**. If **ConE** appears, you have Cone-Fire mode. If **----** appears, you have Ramp-Hold mode only.

2 Bring the controller back to **IdLE** display:

a) From **----**, press **STOP**. **IdLE** will appear.

b) From **ConE**, press **ENTER** 3 times slowly. **CPL**, then **IdLE**, will appear.

If you have Cone-Fire, all of this manual applies to your controller. If you have Ramp-Hold only, skip Cone-Fire on pages 6-9.

Care of the Thermocouple

The small metal rod protruding into the firing chamber is the temperature sensor, or thermocouple. Do not let shelves, posts or ware touch the thermocouple. This could affect the temperature reading.

Bumping the thermocouple during loading can damage it or push it out of the firing chamber. It should protrude into the firing chamber at least ½" - ⅝". (Do not be concerned if your thermocouple extends into the firing chamber even farther.)

Avoid firing clay with a high sulphur content. The sulphur eats into the thermocouple, making it brittle and easy to break.

Display Dots

Single Center Dot: Time

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

Single Right-Hand Dot: °C

When a temperature is displayed in °C, a lighted dot appears in the lower right. In °F it disappears.

Three Dot Display: Power Monitoring

To adjust temperature, the DTC 1000 sends power to the relay(s) intermittently. The relays, in turn, power the heating elements. To monitor when the relays are turned on, press **8** during firing. When three dots appear along the bottom display, relays are receiving power.

To turn off Power Monitoring, press **8** again. This feature is used mostly for diagnostics.

Correcting Entries

If you enter the wrong temperature, cone, time, etc., while programming, enter 0000. Then enter the correct numbers before pressing **ENTER**.

The Stop Key

You can stop a firing at any time by pressing **STOP**.

If you inadvertently enter Ramp-Hold, you do not have to go through all the prompts to get back out. Press **STOP** when **USEr** appears. That will take you back to **IdLE**.

If you inadvertently enter Cone-Fire, **STOP** will NOT take you back to **IdLE**. Press **ENTER** after each Cone-Fire prompt until **CPL**, then **IdLE**, appears.

If you inadvertently press **OPTIONS**, you can get back to **IdLE** by pressing **STOP**.

Cool-Down Temperature Display

When the firing is finished, **CPLt** will display alternating with the total firing time in hours and minutes. To view the current kiln temperature as the kiln cools, press **ENTER**. **CPLt** will disappear. Then temperature will display.

Repeat Firings

To repeat the last firing, press **ENTER** twice from **IdLE**. The kiln will begin firing. This works in both Cone-Fire and Ramp-Hold. But first, make sure you are repeating the correct firing by using "Program Review" below.

Program Review

When you select a firing program in Cone-Fire or Ramp-Hold and go back to **IdLE**, you have called a program from storage. It is then ready to fire. "Program Review" shows you the values for that program.

To start Program Review from **IdLE**, press **ENTER**, then **6**. Values for the program selected for firing will display one after the other. You can also use Program Review during firing simply by pressing **6**.

TIP: In Program Review, values for a program display about one per second. You can speed up this display by pressing ***1*** *repeatedly. If you hold down the* ***1*** *key, values will speed by. This works from both* **IdLE** *and during firing.*

Pyrometric Witness Cones in Ceramic Firings

Though the DTC 1000 fires electronically, every ceramic firing should include shelf, or witness, cones. They measure heat work accurately and give a history of the firing.

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

Keep cones 3" from the peephole to avoid cool air drafts. Wear firing safety glasses when viewing the cones at high temperature. Your dealer can tell you which cone number to use for each clay and glaze.

When Kiln Shuts Off Too Soon

If the kiln shuts off below maturity, you can turn it back on and keep firing. Simply program a higher temperature or hotter cone. Then from **IdLE**, press **START** twice. The kiln will begin firing, taking up where it left off.

Ceramic firings: 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 pyrometric witness cones in the kiln. Once the cones 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.

Portable Controller (TnF II) Installation

The wall-hanging portable DTC 1000 TnF II includes a temperature sensor called a thermocouple. Keep the thermocouple wire away from electrical wires. Wrapping the thermocouple wire around the kiln's power cord or taping it to the cord may cause erratic temperature display.

Ceramic Cone-Fire

Cone-Fire mode is based on pyrometric cones. It is not designed for heat treating, glass fusing and enameling. For these firings, see "Ramp-Hold," page 9. Use Ramp-Hold to fire ceramic pieces that require a custom firing schedule, such as some types of stoneware sculpture or crystalline glaze. To fire faster than Cone-Fire Fast speed, use Ramp-Hold.

Do NOT use Cone-Fire until you have read "Cone-Fire Basics" and "Cone-Fire Programming." To take full advantage of other features in Cone-Fire mode, read "Advanced Cone-Fire," pg 8.

Cone-Fire Basics

Firing Speeds

Cone-Fire operates in Fast, Medium or Slow speed. The instructions that follow will show you how to select speed.

To view the firing segment of a cone-fire, press **5** during firing. (See "Present Status," page 13.) The segment number will appear (see left column in the following charts), informing you of how far the firing has progressed.

Fast (1)

Consider Fast for overglazes, decals, china paint, or small, thin-walled ceramic greenware.

Cone-Fire Fast Firing Schedule

Segment in "Present Status"	Actual Segment	Rate of Firing Per Hour
5	—	Pre-Heat (if any)
6	1	570° F. per hour until the last 250° F.
7	2	200° F. per hour during last 250° F.

Cone-Fire Programming

Use these instructions for your first firings. Later you may prefer "Cone-Fire Quick Reference," pg. 23.

As the DTC 1000 prompts for cone, speed, etc., values entered for the last firing will appear. To use these values again, press **ENTER**.

To fire without Delay or Alarm: Follow steps 1 through 6 below. Then from **IdLE** press **START** twice. To use Delay or Alarm, first read page 13.

1 Apply power to the kiln.

2 **ErrP** will appear. Press **ENTER**. **IdLE** will appear.

3 Press **ENTER** then **1**. **ConE** will appear. Enter cone number. (If **----** appears instead of **ConE**, your controller uses Ramp-Hold only.)

4 Press **ENTER**. **SPd** will appear. Enter speed: FAST (**1**), MEDIUM (**2**), SLOW (**3**).

5 Press **ENTER**. **HLd** will appear. Enter hold time, if any, in hours and minutes (e.g. 12 hours, 30 minutes = 12.30). No hold = 00.00.

6 Press **ENTER**. **IdLE** will appear.

7 To set alarm, press **ENTER** then **7**. **ALAr** will appear. Enter alarm temperature. (Enter **9999** to turn alarm off.) Then press **ENTER**.

8 To set delay fire, press **ENTER** then **3**. **dELA** will appear. Enter delay time in hours and minutes (e.g. 12 hours, 30 minutes = 12.30). Press **ENTER**. (Delay zeroes out after each firing.)

9 To start program, press **ENTER** twice. **-On-** will appear, then kiln temperature. If a delay was programmed, **-On-** will appear, then time remaining until start. To stop the program during firing, press **STOP**.

When program fires to completion, **CPLt** will appear alternating with total firing time in hours and

Medium (2)

Use Medium for larger slip-cast pieces or more tightly loaded kilns.

Cone-Fire Medium Firing Schedule

Segment in "Present Status"	Actual Segment	Rate of Firing Per Hour
4	—	Pre-Heat (if any)
5	1	110° F. per hour until 250° F.
6	2	400° F. per hour until the last 250° F.
7	3	120° F. per hour during the last 250° F.

Slow (3)

Use Slow for hand-thrown or heavily-cast pieces, stoneware and porcelain.

Cone-Fire Slow Firing Profile

Segment in "Present Status"	Actual Segment	Rate of Firing Per Hour
2	—	Pre-Heat (if any)
3	1	80°F per hour to 250°F
4	2	250°F per hour until temperature reaches 950°F
5	3	110°F per hour until temperature reaches 1100°F
6	4	225°F per hour until the last 200°F
7	5	90°F per hour during the last 200°F of firing
8	6	150°F per hour, cooling down to 1000°F

Hold

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

CAUTION: *Too much hold time can overfire your ware and burn out colors.*

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

Example: to fire to cone 05½, program Cone-Fire for 05 and add 30 minutes of hold time.

Watch the pyrometric shelf cones through the peephole. Press **STOP** when the correct shelf cone bends, noting how much Hold time was needed. Program that much Hold time the next time you fire the same type of ware loaded to the same capacity. You can hold for up to 99 hours and 99 minutes.

You will learn by experimenting with ceramics. Hold is one more tool to experiment with.

Pre-Heating the Ware

Moist greenware can explode during firing. This happens when the moisture in the clay turns to steam rapidly and cannot easily escape. The DTC 1000 "Pre-Heat" feature dries the ware at low temperature before the moisture can turn to steam.

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

TIP: *During Pre-Heat, vent the lid. Otherwise the firebricks will absorb moisture, leading to rust behind the stainless steel case. Moisture in the firebrick will also slow the kiln to a crawl when firing begins.*

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

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

CAUTION: *At high altitude, water boils at a lower temperature. This may cause the ware to dry too rapidly even during Pre-Heat.*

After entering cone number, speed, etc., in the Cone-Fire program, activate Pre-Heat as follows. Then begin firing.

1 Press **ENTER**.

2 Press **0** repeatedly until **PrHt** appears.

3 Press **ENTER**. **Hld** will appear, alternating with **00.00**.

4 Enter Pre-Heat hold time in hours and minutes (i.e. 1 hour, 30 minutes = 01.30).

5 Press **ENTER**. **CPL** will appear, then **IdLE**.

Mirror Test

Knowing how much Pre-Heat to use is a matter of experience. There is no substitute. However, this mirror test will help. Occasionally during Pre-Heat, hold a mirror near the top peephole. (Be careful to avoid burns.) The mirror must be at room temperature, not hot, so hold it near the peephole for only several seconds.

If the mirror fogs, moisture is still escaping from the ware. When the mirror no longer fogs, make a note of how much Pre-Heat time your ware needed. That will help you determine how much Pre-Heat to use next time.

If you decide to interrupt Pre-Heat and begin firing to the cone in Cone-Fire, press **STOP**. Follow the steps above that you used to program Pre-Heat. But instead of entering Pre-Heat hold time, enter 00.00. Press **ENTER** to go back to **IdLE**. Press **ENTER** twice to begin firing again.

AOP

The optional "AOP" (Auxiliary Output) is an electrical outlet, usually mounted in the kiln's switch box. The AOP outlet can power a kiln vent or other appliance. If your kiln is equipped with AOP, **AOP** will appear in Cone-Fire after **HoLD**. (If **AOP** does not appear in the display, your kiln is not equipped with AOP.)

When set to OFF, the AOP outlet receives power during the Cone-Fire firing. At the end of the firing, the AOP shuts off.

When set to On, the AOP remains powered during both ConeFire firing and cooling. It shuts off after the kiln cools to °150F/66°C.

TIP: For slow cooling in Cone-Fire, select AOP OFF.

Adjusting AOP in Cone-Fire

1. After programming Cone, Speed and Hold, **AOP** will appear, alternating with **On** or **OFF**.
2. To change the setting, press **1**, then **ENTER**. **CPL** will appear, followed by **IdLE**.

Advanced Cone-Fire

Built-in Cone Table

For your convenience, the controller can look up a pyrometric cone temperature. Do not be concerned, however, if your kiln's cone shut-off temperature does not match the temperature in the Cone Table. The temperature of a cone varies depending on firing speed.

1. From **IdLE**, touch **ENTER** then **9**. **ConE** will appear, then the cone currently programmed in Cone-Fire Mode.
2. Enter the pyrometric cone number you are looking up. Then touch **ENTER**. The display will show the cone temperature. If you enter a non-existent cone number, the display will show **ConE**, ready for you to enter a different cone number.

Cone temperatures displayed are for self-supporting cones fired at a rate of 108° F. during the last hour.

Firing History in Cone-Fire

When the kiln fires to completion, **CPLt** with flash, alternating with total firing time in hours/minutes. To view the final temperature the kiln reached, press **ENTER**. **IdLE** will appear. Press **ENTER**, then **6** (Program Review). Final firing temperature will display along with the cone, speed and hold.

Fine-Tuning Shelf Cones With Cone Offset (CnoS)

Sometimes the pyrometric cone programmed in Cone-Fire does not match the bending of the cone on the kiln shelf. Using "Cone Offset," you can adjust Cone-Fire to fire hotter or cooler.

IMPORTANT: Cone Offset adjusts the firing temperature individually for each pyrometric cone number. Adjusting one cone has no effect on the other cones. To adjust all the cones equally, use "Thermocouple Offsets," page 14.

For instance, the controller fires shelf cone 018 to a perfect six o'clock bend. But at cone 6, the shelf cone over-fires. Using Cone Offset, you could lower cone 6 firing temperature without affecting the perfect results you are getting at cone 018.

TIP: Before using Cone Offset, check that the thermocouple is protruding into the firing chamber by at least ½" - ⅝". Sometimes bumping a shelf against the thermocouple pushes it out of the firing chamber, thereby preventing accurate temperature readings.

How to Use Cone Offset

1. From **IdLE**, press **ENTER**.
2. Press **0** until **CnoS** appears.
3. Press **ENTER**. **ConE** will appear, alternating with the last cone number entered in Cone-Fire. Enter the new cone number.
4. Press **ENTER**. **°FOS** (or **°COS** for Celcius) will appear, alternating with **9000** or an adjustment number.
5. Enter adjustment number (see chart). Then press **ENTER**. **CPL** will appear, then temperature and **IdLE**.

You can raise or lower firing chamber temperature for each cone from 1 - 50 °F/1 - 28°C. Place 00 in front of the number to make the kiln fire hotter. Place 90 in front to make it fire cooler.

The following chart contains seven examples of Cone Offsets. Program any temperature in the 01 - 50°F/1 - 28°C range, hotter or cooler, using these examples as a guide:

Cone Offset Examples, °F

0001	Kiln will fire 1°F Hotter
0030	Kiln will fire 30°F Hotter
0049	Kiln will fire 49°F Hotter
0000 or 9000	No Adjustment
9005	Kiln will fire 5°F Cooler
9040	Kiln will fire 40°F Cooler
9049	Kiln will fire 49°F Cooler

*Cone Offset works in °C the same as in °F. In the above examples, replace °F temperatures with equivalent °C.

Once you enter a Cone Offset number, Cone-Fire will remain adjusted to that number for that cone until you change it again. Keep a written record of Cone Offset adjustments.

Interpreting Cone Bending

The large cone on the kiln shelf should be visible through a peephole. Avoid exposure to cool air by keeping the cone at least 3" from the peephole. Program the DTC 1000 for the cone on the shelf and fire. After cooling, check the cone:

The cone bent to 6 o'clock: In this case, the controller is matched to your kiln. The self-supporting cone illustrated has fired to maturity when the tip is even with the base as shown.

The cone did not bend far enough: Use a 00_ _ Cone Offset number for a hotter firing. (About 0025 for the cone at right.)

The cone bent too far: Use a 90_ _ Cone Offset for a cooler firing. (9045 for the over-fired cone at right. This varies depending on cone number.)

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.

When Cone Temperature Is Off More Than 50°F

Suppose you are firing to cone 017 (1360°F), but the next hotter cone, 016 (1422°F) bends to 6 o'clock. The kiln is firing 62°F too hot (1422 - 1360 = 62). 62°F is beyond the 50°F maximum adjustment of Cone Offset.

When thermocouple inaccuracy exceeds 50°F, replace the thermocouple. If you must fire the kiln before installing the new thermocouple, combine Thermocouple Offset and Hold time. Reminder: as a rule of thumb,

One Hour Of Hold = One Cone Of Heat Work

Ramp-Hold

Ramp-Hold fires in segments. Each segment has an end temperature, a degrees per hour rate to reach that temperature, and a hold time. Do NOT use Ramp-Hold until you have read "Ramp-Hold Basics" and "Ramp-Hold Programming." To take full advantage of other features, read "Advanced Ramp-Hold," page 11.

Ramp-Hold Basics

User Programs

When you enter Ramp-Hold mode, the first prompt to appear is **USEr**, meaning, "Select a User Program." A User Program is a firing schedule stored in memory. It includes

1) number of segments needed

2) rate (how fast temperature changes in degrees per hour) for each segment

3) target temperature for each segment

4) hold, if any, for each segment

5) alarm temperature, if any.

The controller can retain six user programs in memory even when power to the kiln is turned off.

If using Ramp-Hold for the first time, press **1** when **USEr** appears. Your first firing will be stored as User Program #1.

Each time you store another program, select the next available number, such as 2, at the **USEr** prompt. Write down the firing profiles of your User Programs.

To use a stored program, select the program number at the **USEr** prompt. Press **ENTER**. If there are no changes to the program, press **STOP**. **CPL** will appear, then **IdLE**. The controller is ready to fire your selected program. To begin firing, press **ENTER** twice. (See "Program Review," page 5, before firing.)

Segments

A "Segment" fires to a target temperature. It includes a rate and, if needed, a hold. Every time you need to change firing speed or hold a temperature, add another segment. You have up to eight segments available in a User Program. You don't have to use all eight segments—only the number needed per firing. Often one segment is all you will need.

For complex firings, Ramp-Hold can be fired in 16 segments instead of the standard eight. See "16 Segment Firing," page 12.

Rate

Each segment must include a rate, programmed as degrees of temperature change per hour. One way to figure rate is to divide firing temperature by number of hours needed to fire. Maximum rate is 9999. When you enter 9999, the controller will heat as fast as your furnace or kiln is capable.

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

Hold

"Hold" in Ramp-Hold maintains the target temperature of a segment for the time you specify. Hold gives the temperature time to become more even throughout the kiln. See page 7 for more information on hold time in ceramic firings. Hold can be used in either heating up or cooling down segments.

Wearing firing safety glasses, watch the pyrometric cones on the shelf near the end of the firing. When the shelf cone bends, note the hold time. The next time you fire the same type of ware loaded to the same capacity, program that amount of hold time.

AOP

The optional "AOP" (Auxiliary Output) is an electrical outlet, usually mounted to the kiln's switch box. The AOP outlet can power a kiln vent or other appliance. If your kiln is equipped with AOP, **AOP** will appear in Ramp-Hold after **SEG**. (If **AOP** does not appear in the display, your kiln is not equipped with AOP.) In Ramp-Hold, AOP can be turned on or off for each segment.

Adjusting AOP in Ramp-Hold

1 After selecting the User Program and number of segments, **AOP1**, alternating with **On** or **OFF**, will appear.

2 To change the setting, press **1**, then **ENTER**. Continue entering rate, temperature, hold, etc. for segment 1. As you continue programming, turn AOP on or off in each segment.

Ramp-Hold Programming

Use these instructions for your first firings. Later you may prefer "Ramp-Hold Quick Reference," page 24.

As the program prompts for segments, rate, temperature, etc., you will see values from the last firing. To use these again, press **ENTER**. To control cooling, set the segment to a lower temperature than that of the preceding segment.

To fire without a timed Delay: Follow steps 1 through 8. Then press **START** twice.

1 Apply power to the kiln. **ErrP** will appear. Press **ENTER**. **IdLE** and kiln temperature will appear.

2 Press **ENTER** then **4**. **USEr** will appear. Enter a number from 1 to 6 for the stored program desired.

3 Press **ENTER**. **SEGS** will appear. Enter number of segments needed.

4 Press **ENTER**. **rA 1** will appear. Enter firing rate for segment 1 (temperature change per hour: from 1° to 9999°).

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

6 Press **ENTER**. **HLd1** will appear. Enter segment 1 hold time in hours/minutes (e.g. 12 hours, 30 minutes = 12.30). No hold = 00.00.

7 Press **ENTER**. Continue entering values for all segments.

8 Press **ENTER**. **AlAr** will appear. Enter alarm temperature. (Enter **9999** to turn alarm off.) Then press **ENTER**. **CPL** will appear, then **IdLE**.

9 To set Delay Fire, press **ENTER** then **3**. **dELA** will appear. Enter delay time in hours/minutes (e.g. 12 hours, 30 minutes = 12.30). Then press **ENTER**. (Delay zeroes out after each completed firing.). **CPL** will appear, then **IdLE**.

10 To start program, press **ENTER** twice. **-On-** will appear, then kiln temperature. If a delay was programmed, **-On-** will appear, then time remaining until start.

To stop the firing, press **STOP**. When program fires to completion, **CPLt** will appear. Press **STOP**. **IdLE** will appear, alternating with cool-down temperature. To shut off the alarm when it sounds during a firing, press **ENTER**.

Advanced Ramp-Hold

Segments for Controlled Cooling

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

If you prop the lid for a fast cooling, program a fast rate. If you program a slow cooling rate, but lower the temperature quickly by propping the lid, the controller will defeat your fast cooling. It will raise the temperature again.

For instance, glass fusers sometimes flash-cool the glass at the end of fusing. They lift the lid slightly to remove heat, then close the lid again. This takes the glass down rapidly through the devitrification range. To program a flash-cool, the artist would program a lower temperature segment with a rate of 9999.

Suppose you enter a cooling rate that is faster than the kiln's natural cooling rate? The controller will wait for the kiln to catch up. Then it will continue its controlled cooling. The controller, of course, cannot speed cooling beyond the kiln's natural cooling rate.

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

Skip Segment

You may need to skip a segment in Ramp-Hold. For instance, you are firing to cone 05 for the first time. You program the last segment to soak for 30 minutes at 1850°F. (This is a few degrees below cone 05.) You are not sure at what temperature the cone will bend during this first firing.

At 1850°F, the alarm beeps, alerting you to check the witness cone on the kiln shelf. You look into the peephole every few minutes to check the cone. After a 10 minute hold, the shelf cone 05 bends to maturity. Using "Skip Segment," the controller begins a cool-down segment. Skip Segment stops the current segment and starts the next segment.

Skip Segment works only during firing and only in Ramp-Hold, not Cone-Fire. To skip a segment, press **9**. **SStP** will appear. If you change your mind and don't want to skip that segment, do nothing and the firing will continue as it was. If you still want to skip the segment, press **ENTER**. **rA** will appear along with the segment number you just skipped to.

Press **5** *("Present Status") if you are not sure which segment the firing has reached. Then skip the segment.*

Sample Firing Schedules

We have included these firing schedules only as examples. Each one illustrates a different way to use your DTC 1000. When designing a firing schedule for materials you are unfamiliar with, or when using one of these schedules, test-fire samples first. Firing schedule temperatures are shown in °F for simplicity.

To fire ceramics in Ramp-Hold, set the last firing segment to a cone temperature. If you use a temperature in the Cone-Fire Cone Table, set the last firing segment rate to 108°F/60°C hour. (Cone temperatures in the Cone Table are based upon a rate of 108°F/60°C during the last 1 - 2 hours.)

Cone-Fire Program Modified in Ramp-Hold

The following firing schedule is similar to the Medium Speed Cone-Fire program, fired to cone 04. A slow-cooling segment was added. (Cone-Fire Medium firing schedule is shown on page 7.)

Segment	Rate Per Hour	Target Temp.	Hold
1	110°F	250°F	00.00
2	400°F	1695°F	00.00
3	108°F	1945°F	00.00
4	150°F	1000°F	00.00

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

Sculptured Stoneware Bisque Firing Schedule, Cone 04

This slow firing is for thick stoneware. Change the target temperature in segment 4 when firing to a different pyrometric cone. The ware should be bone dry. Test sample pieces.

Leave peephole plugs out and vent the lid. Set the alarm to °1000 F. When the alarm sounds, close the lid from venting position. Set the alarm again, this time to 1850° F. When it sounds, check the witness cone through the peephole. When the cone bends to six o'clock, write down the temperature. (Use that temperature in segment 4 on your next firing of the same type of ware.) Then press **9**, **ENTER** (Skip Segment).

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

Segment	Rate Per Hour	Target Temp.	Hold
1	60°F	200°F	03.00
2	80°F	700°F	02.00
3	80°F	1100°F	00.00
4	108°F	1945°F	00.00
5	150°F	1400°F	00.00

Glass Fusing Firing Schedule

(See next page.) Stained glass, ⅛", 2 layers, full fuse. The fusing temperature will vary depending on the brand of glass, and even upon the color. Set the alarm to 500°F. When the alarm sounds, close the lid from venting position and insert peephole plugs. Set the alarm again, this time to 1350°F. When it sounds, check the glass through the peephole. When the glass fuses to your satisfaction, write down the temperature and hold time for future firings, and press **9**, **ENTER** (Skip Segment).

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

Segment	Rate Per Hour	Target Temp.	Hold
1	250	750	00.00
2	900	1425	00.30
3	9999	1050	00.00
4	150	750	00.00

Glass Slumping Firing Schedule

Stained glass, ⅛", 2 fused layers, 12" circular pieces, slumped into a bowl. Set the alarm to 500° F. When the alarm sounds, close the lid from venting position and insert peephole plugs. Set the alarm again, this time to 1150° F. When it sounds, check the glass through the peephole. When the glass slumps into the bowl, write down the temperature and hold time for future firings, and press **9**, **ENTER** (Skip Segment).

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

Segment	Rate Per Hour	Target Temp.	Hold
1	250	750	00.00
2	900	1250	00.30
3	9999	1050	00.00
4	150	750	00.00

16 Segment Firing (16-S)

16 segment firing combines Ramp-Hold user programs 5 and 6 into one continuous firing. You can use all 16 segments, or only a few segments from each program. Program 5 will fire first, then program 6.

1 Press **ENTER**, then **4**. **USEr** will appear, alternating with the last user program entered.

2 Press **5** (user program 5), then **ENTER**. Using Ramp-Hold instructions, enter the values for all segments needed in program 5.

3 **IdLE** and temperature will display after program 5 is entered. From **IdLE**, press **ENTER**, then **4**.

4 **USEr** will appear, alternating with 5. Press **6** (user program 6), then press **ENTER**. As before with program 5, enter the values for all segments needed in program 6.

5 **IdLE** will appear after program 6 is entered. Press **ENTER**, then **PROGRAM REVIEW**. Make sure all values for user program 6 are correct. After reviewing the program, **IdLE** will appear.

6 From **IdLE**, press **ENTER**, then **4**. **USEr** will appear, alternating with 6. Press **5**, then **ENTER**.

7 Press **STOP**. **CPL** will appear, then **IdLE** and temperature. Program 5 is now selected in Ramp-Hold.

8 From **IdLE**, press **0** repeatedly until **16-S** appears. Press **ENTER**.

9 **OFF** or **ON** will appear. Press **1** to change **OFF** to **ON**. **On** will appear. Press **ENTER**. **CPL** will appear, then **IdLE**.

10 Begin firing by pressing **ENTER** twice.

16-S *appears under* **OPTIONS** *only after user program 5 has been selected in Ramp-Hold.*

When you use Program Review for a 16 segment firing, user program 5 will appear. Then **16-S**, **On**, *to confirm that your program is the 16 segment. However, the values for user program 6 will not appear in Program Review.*

Additional Features

Selecting °F or °C (CHG°)

The controller operates in your choice of °F or °C 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 **ENTER**.

2 Press **0** repeatedly until **CHG°** appears.

3 Press **ENTER**. **°F** or **°C** will appear.

4 To change, press **1**.

5 Press **ENTER**. **CPL** will appear, meaning the change has been completed.

°F/°C Temperature Conversion Formula

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

Firing Temperature

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

(°C x 1.8) +32 = °F

(°F - 32) ÷ 1.8 = °C

Firing Rate and Temperature Change

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

°C x 1.8 = °F

°F ÷ 1.8 = °C

Delay Fire

The Delay Fire programs the kiln to begin firing later. Use it to adjust the firing to suit your schedule or to take advantage of lower electric rates at night.

It zeroes out after each completed firing. To set the Delay, follow earlier instructions for entering Cone-Fire or Ramp-Hold firing program. Then press **ENTER**, **3**. Enter delay time in hours/minutes (i.e. 5 hours, 30 minutes = 05.30). To begin firing, press **ENTER** twice.

WARNING: *Never leave your kiln unattended near the end of 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.*

Temperature Alarm

The alarm beeps when a preset temperature is reached. Use the alarm to alert you to—

1) lower the lid from venting position.

2) check the witness cone near shut-off time.

3) check the fusing or slumping of glass.

4) remove the knife blade from the furnace at the end of heat treating.

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. You can enter a higher or lower temperature than the current temperature.

Setting Alarm From Idle

1 From **IdLE**, press **ENTER** then **7**. **AlAr** will appear alternating with the last alarm temperature entered.

2 Enter alarm temperature. Then touch **ENTER**. **IdLE** will appear. (Enter **9999** to turn alarm off.)

When the alarm sounds, shut it off by pressing **ENTER**. (Do not press **STOP** to turn off the alarm.) If the alarm sounds as soon as the furnace or kiln begins firing, it is because the alarm was set to **0000**, or any temperature below room temperature.

Setting Alarm During Firing

1 The alarm beeps while the kiln is firing. Touch **7**.

2 Enter the new temperature.

3 Touch **ENTER**. The kiln will continue firing.

CAUTION: *if you touch* **7**, *enter a new temperature, and forget to press* **ENTER**, *the firing will stop and the kiln will begin to cool down. You must press* **ENTER** *after entering the new alarm temperature.*

Present Status: Current Segment & Circuit Board Temperature

"Present Status" displays the current segment of a firing and temperature of the circuit board.

Knowing which segment you are in is especially useful for firings with both heating-up and cooling-down segments. Present Status works with both Cone-Fire and Ramp-Hold. (See Cone-Fire firing schedules, pages 6-7.)

To use Present Status, press **5** during a firing. The following information will display momentarily. Then normal temperature display will return:

1) Ramp (**Ra**) or Hold (**HLd**) followed by segment number

2) Local Set Point (temperature the controller is trying to reach to maintain the correct rate)

3) Circuit Board Temperature

High temperatures in the switch box can damage the controller circuit board. The circuit board is rated for 155°F/68°C maximum operating temperature. Maximum temperature for rated accuracy is 125°F/52°C. The controller board can operate safely at 155°F/68°C, though 125°F/52°C is preferable. If necessary, exhaust hot air from the room to lower board temperature.When firing several kilns, position them at least three feet apart to allow adequate air circulation.

The DTC 1000 maximum operating temperature is the same as the earlier DTC 600 and 800 series. The new Circuit Board Temperature feature has been added merely to help you attain maximum life from your controller.

Checking Circuit Board Temperature From IdLE

1 Press **ENTER**.

2 Press **0** repeatedly until **bd t** (board temperature) appears.

3 Press **ENTER**. The board temperature will appear, followed by **STOP**, and then the firing chamber temperature.

Power Failures

The DTC 1000 handles a power failure in two ways:

1) A **PF** display, alternating with firing temperature, means firing was interrupted by a brief power failure. The firing will continue. **PF** is only to inform you of a brief power failure. Press **ENTER**, and normal temperature display will return.

2) A steady **ErrP** display means firing was interrupted by an extended power failure. When **ErrP** appears, the kiln heating elements will stay shut off. The following three situations cause the **ErrP** message:

a) The power failure lasted longer than 1 ½ hours.

b) The kiln cooled more than 250°F/139°C while the power was off.

c) Cone-Fire mode only: the power failed within 100°F/56°C of the shut-off temperature.

When the **ErrP** power failure message appears, press **ENTER**. The hours fired and temperature reached before the power failed will appear, then **IdLE**.

To resume firing, press **ENTER** twice. The kiln will begin firing again from its present temperature. For example, the kiln reached 1000°F/538°C before power failed. When you turn the kiln back on, the temperature is 700°F/371°C. Firing will resume from 700°F/371°C. You need not cool the kiln to room temperature before starting over unless you use new witness cones. (See next section.)

When you resume firing by pressing **ENTER** twice, the controller begins firing again from segment 1. If the temperature is already higher than that of segment 1, the controller skips to the next segment. When it finds a segment with a higher target temperature, it begins firing in that segment. For this reason, a power failure during a ramping down (cooling) segment can confuse the controller. When you resume firing, the controller will begin firing from a ramping up (heating) segment rather than a ramping down segment.

Firing Ceramics After an Extended Power Failure

1) The firing was interrupted below 100°F/56°C of maturity: 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.

2) The ware fired to within 100°F/56°C of maturity: Fire the ware again. Do not use the same witness cones. Use new ones.

Options Quick Reference List

RSEt Sets the Thermocouple Offset to 0 and turns error codes on; page 15.

PrHt Used in Cone-Fire only: Pre-Heat; page 7.

Id Identifies the kiln for interface with a personal computer. Ignore.

CnoS Used in Cone-Fire only: Cone Offset; changes the temperature shut-off of individual cones; page 8.

ChG° Changes temperature read-out between °F and °C.; page 12.

ErCd Error Codes: Turns error codes Err1, Err2, Err3and Err4 off. Designed for applications where the furnace door is opened at high temperature, such as heat treating; page 15.

tCoS Thermocouple Offset: calibrates the thermocouple read-out; page 14.

bdt Board Temperature: shows the temperature of the circuit board; page 13.

Thermocouple Offset (tCoS)

The thermocouple is the ⅛" diameter rod protruding into the firing chamber. It measures temperature. Thermocouples can "drift" as they age, causing inaccurate temperature readings. (This may be so slight that you won't notice it.) To calibrate the controller to compensate for drift, use "Thermocouple Offset."

TIP: Before using Thermocouple Offset, check that the thermocouple is protruding into the firing chamber by at least ½" - ⅝". Sometimes bumping a shelf against the thermocouple pushes it out of the firing chamber, thereby preventing accurate temperature readings.

Thermocouple Offset for Ceramic Firings

In ceramics, Cone Offset (see page 8) adjusts each pyrometric cone without affecting the other cones. Thermocouple Offset, on the other hand, affects all cones equally, and all Ramp-Hold firings. A 5°F hotter setting in Thermocouple Offset fires everything 5º hotter.

If you find that all your cones are consistently under- or over-firing, adjust Thermocouple Offset. If you need to adjust only a particular cone, use Cone Offset.

Calibrating Thermocouple Offset with a Thermocouple Standard or Pyrometer

A thermocouple standard is a device that calibrates pyrometers and controllers. If you do not have a thermocouple standard, you can calibrate Thermocouple Offset using a calibrated digital pyrometer. One way to calibrate your digital pyrometer is to take it to a heat treater or other location that has a calibrated controller you can trust. Take a reading with your pyrometer. Either zero it out to match the other heat source, or write down the temperature difference between your pyrometer and the reliable source. Store your pyrometer. Use it only for calibrating controllers. Thus, it remains a reliable calibration standard.

Adjust Thermocouple Offset to compensate for any temperature difference between the controller and the calibrated pyrometer or thermocouple standard.

Setting Thermocouple Offset

You can enter a temperature change up to 50°F/28°C higher or lower than the zero factory setting. If the kiln fires too hot, enter 00 and a temperature from 01 - 50°F/1 - 28°C. If the kiln fires too cool, enter 90 and 01 - 50°F/1 - 28°C.

The chart below contains seven examples of Thermocouple Offsets. Program any temperature in the 01 - 50°F/1 - 28°C range, hotter or cooler, using these examples as a guide:

Thermocouple Offset Examples*

0001	Kiln will fire 1°F Cooler
0030	Kiln will fire 30°F Cooler
0049	Kiln will fire 49°F Cooler
0000 or 9000	No Adjustment
9005	Kiln will fire 5°F Hotter
9040	Kiln will fire 40°F Hotter
9049	Kiln will fire 49°F Hotter

*Cone Offset works in °C the same as in °F. In the above examples, replace °F temperatures with equivalent °C.

Directions for Thermocouple Offsets:

1 From **IdLE**, press **ENTER**.

2 Press **0** repeatedly until **tCoS** appears.

3 Press **ENTER**. **°FOS** (or **°COS**) will appear, alternating with the current thermocouple offset. (Factory setting is 00.00).

4 Enter the new offset (e.g. 9005). Press **ENTER**. **IdLE** will appear.

To reset thermocouple offset back to 0000, press **ENTER**, **0**. **RSEt** *will appear. Press* **ENTER**.

Turning Off Error Codes (ErCd)

The DTC 1000 uses error codes to alert you to firing problems. In certain applications, it may be desirable to turn off some of the error codes.

For instance, error code **Err1** appears when temperature rises slower than 12°F/12°C per hour. (In Ramp-Hold, the temperature is also below the programmed temperature.) **Err1** may interfere when the door of the kiln is opened to remove certain materials, such as enameled pieces or heat treated steel.

"Error Codes" **ErCd**, when set to OFF, turns off error codes **Err1**, **Err2**, **Err3** and **Err4**. (See page 18 for a discussion of these error codes.)

During the last 250°F/139°C of a Cone-Fire program, the **Err1** *code will become active again even when* **ErCd** *is turned off.*

Setting Error Codes ON or OFF

1 Press **ENTER** from **IdLE**.

2 Press **0** repeatedly until **ErCd** appears.

3 Press **ENTER**. **On** or **OFF** will appear. Press **1** to change this setting.

4 Press **ENTER**. **CPL** will appear, followed by temperature and **IdLE**.

RSEt *(from OPTIONS key) can turn on error codes.*

Trouble-Shooting & Maintenance

Furnace or Kiln Wiring Diagram

Your wiring diagram will show you how the controller, relays, transformer and heating elements are connected. It will aid you in tracking down problems. If you need a replacement diagram, call us.

Protecting the Controller From Static

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

Element Glow Test: A Quick Test Of Elements and Relays

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

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

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

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

The center elements in most 7, 8, 10 and 12 sided kilns will not glow brightly, but there should be a faint redness. It may be easier to see the elements by turning off the room lights.

Test result: All the elements for one relay remain dark.

The relay is probably defective.

Test result: One element remains dark, others glow.

If more than one element is wired to the relay, the dark element is probably burned out. The problem is not the relay.

On completion of firing, the display will show firing time in hours/minutes. Firing time will help you or your repair technician determine if the kiln is firing fast enough.

How to Remove Controller

SWITCH BOX WARNING: UNPLUG kiln or furnace before opening switch box or removing faceplate. Touching a live connection inside switch box could be fatal. Kiln must be unplugged anytime switch box is removed from kiln.

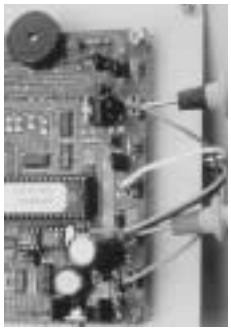
UNPLUG the kiln (or TnF II). Remove the four screws holding the faceplate to the switch box.

TnF II owners: UNPLUG the TnF II from the wall outlet whenever these instructions say to unplug the kiln.

Removing Controller for Voltmeter Check

When checking controller board with a voltmeter multitester, remove only controller faceplate and not the kiln switch box. Before removing controller board, *UNPLUG* the kiln. Then let the controller board hang on the switch box with the back of the board facing you. Plug the kiln back in before testing the board. The reason to unplug the kiln before you re-

move the controller board is that some electronic components will be destroyed if they touch a grounded object with the kiln plugged in. See chart, page 22, for connection numbers on back of board.



WARNING: Keep away from switch box opening when testing the board. Switch box contains live wires!

Problem: Controller Display Does Not Light Up

Probable Causes:

- **Tripped Circuit Breaker or Blown Fuse, Kiln Unplugged**
- **Blown Kiln Switch Box Fuse**
- **Defective Transformer**
- **Defective Controller Board**
- **Disconnected Switch Box Wire**

Check circuit breaker or fuse for the wall outlet. If power is reaching the kiln, turn off the power for ten seconds. The board may light up when you turn the power back on. If it does not, remove the kiln's fuse. It is located in the switch box. Remove by pressing on the fuse holder and turning counter-clockwise half a turn. Check the fuse by placing the probes of an ohmmeter on the ends of the fuse. If the ohmmeter reads less than an ohm (digital meter) or reads 0 ohms (analog meter), the fuse is okay. If the reading is OPEN (digital meter) or infinity/no needle movement (analog meter), the fuse is bad. Replacement fuse:

AGC 1/2 A 250V AC

If replacement kiln fuses keep blowing, check the kiln's transformer. (See below and "Kiln Switch Box Fuse Blows Repeatedly," page 20, to check transformer.)

Next check the controller board with a voltmeter multitester. Make sure kiln is unplugged, and remove the 4 screws holding the controller board faceplate to the switch box. Lift faceplate out of box and let the board hang on the box with the back of the board facing you. Plug the kiln back in. Touch voltmeter probes (in AC mode) to connectors 5 and 7. This should be the white and orange wires. (See diagram, page 22.)

Make sure the voltmeter is in the AC mode when placing the probes on connectors 5 and 7.

If you find voltage (at least 20 volts AC), it means current is reaching the board from the transformer, so the board is probably defective. If there is no voltage, the transformer may be defective. But before replacing the transformer, *UNPLUG* kiln, remove switch box, and look for a disconnected wire between the cord set and transformer or between the transformer and controller board.

Problem: Controller Display Lights Up Normally, Some or All Heating Elements Do Not Fire

Probable Causes:

- **Worn or Burned Out Elements**
- **Defective Controller Board**
- **Defective Relay(s)**
- **Disconnected Wire in Switch Box**
- **Programmed Hold or Delay**

Be sure you have not inadvertently programmed a long Delay. If firing is excessively slow, a Hold in Ramp-Hold may have been programmed. See "Element Glow Test," page 15.

Check the controller board with a voltmeter. *UNPLUG* the kiln and remove the 4 screws holding the controller board faceplate to the switch box. Lift faceplate out of box and let the board hang on the outside of the box with the back of the board facing you. Then plug the kiln back in. Program the controller to fire to 1000°F at 9999°F rate in Ramp-Hold mode. Press **START**.

Put the voltmeter in DC mode. (It *must* be in DC mode.) Touch probes to connectors 3 and 6 for at least 12 seconds. (See diagram, page 22.) If the meter reads 11 - 14 volts, the board is sending correct voltage to the relays, so the board is okay. Less than 11 volts at 3 and 6 means a weak transformer. No voltage at 3 and 6 means a defective controller board.

If the controller board checks out okay, *UNPLUG* kiln and remove switch box. Look for loose or disconnected board-to-relay, relay-to-element, and cordset-to-relay wires.

If you still haven't found the problem, check elements with an ohmmeter.

Kiln is still UNPLUGGED. If the elements are hot from the previous test, please use caution. Wait for the elements to cool, if necessary.

Touch the ohmmeter leads to the two element connectors of each element. OPEN (digital meter) or no-needle movement (analog meter) indicates a broken (burned out) element.

If the element you are testing has two or more element lead wires attached to the same element connector, you must temporarily disconnect those wires from the connector. Hold element connector with pliers as you remove the screw. Be gentle to avoid breaking the element. (Elements are brittle after being fired.) Do not disturb the screw holding the element, only the one holding the lead wires. Reconnect the wires securely after testing the element.

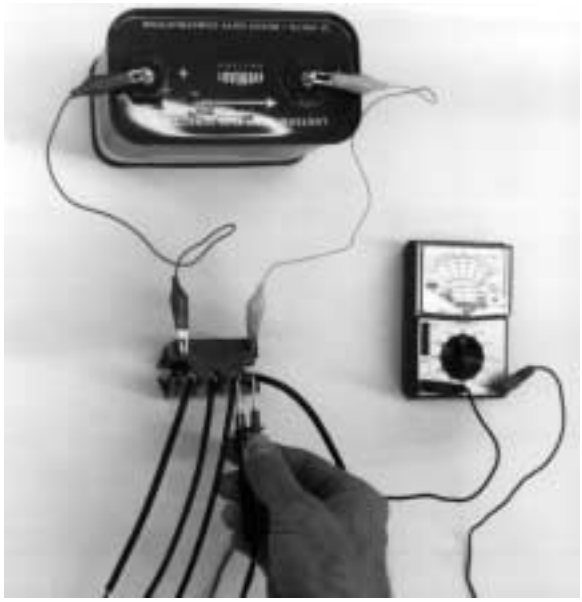
If the elements and wiring check out okay, the problem is most likely a relay.

When a relay chatters or buzzes instead of clicks, the problem may be a weak transformer. A chattering relay can cause erratic temperature readings.

How to Test a Relay: You will need an ohmmeter, 12 volt battery and 2 clip wires. (Or you could test the relays by performing the Element Glow Test, page 15.)

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

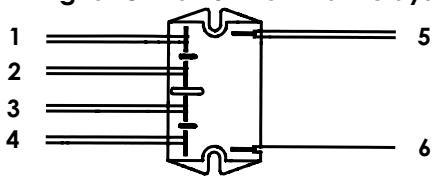
1 *UNPLUG* kiln and remove switch box. Find the two wires going from the controller board to the relay you are testing. Disconnect these wires from the relay. Then connect a 12 volt lantern battery to the same relay terminals (#5 and #6 on diagrams below) using clip wires. You should hear a clicking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



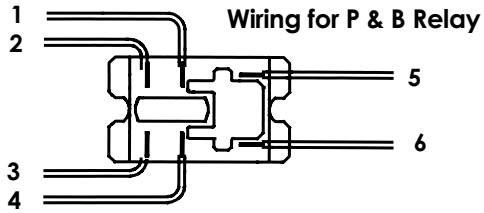
2 Touch ohmmeter lead wires to relay terminals marked #1 and #2 in the diagram. With the battery still connected, you should get a continuity reading (0 ohms) on the ohmmeter. If you get a no-needle movement when the battery is connected, replace the relay. Place the ohmmeter wires on relay terminals marked 3 and 4 on the diagram and test the same way.

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

Wiring for Omron & Arowmat Relays



Wiring for P & B Relay



Problem: Firing Interrupted by PF or ErrP

Probable Causes:

- **Temporary Power Failure**
- **Low Voltage at Wall Receptacle**
- **Corroded Cord Plug or Wall Receptacle**
- **Defective Transformer**
- **Disconnected or Loose Wire**
- **Electrical Noise**

PF alternates with the temperature display during firing: this means the power went off for a moment during firing. Then firing resumed. To go back to a normal temperature display, press **ENTER**.

Steady ErrP, no temperature display: this means a firing has been interrupted by a longer power failure.

For a more detailed explanation of power failure messages, see page 13.

Low voltage can also cause the kiln to shut off and display either **PF** or a blank display. If this happens and you did not have a power failure, have the power company or an electrician check the wall receptacle, while the kiln fires, for low voltage. Sometimes there is just enough voltage to program the board. But when the relays turn on, the voltage from the transformer drops below the minimum operating level, and the display goes blank.

ErrP displays even though power did not fail: If the voltage at the wall receptacle is okay, *UNPLUG* kiln, remove switch box, and look for a wire that has become disconnected from a relay. If a wire comes loose from a relay and touches anything grounded in the switch box, the board will read **ErrP** when you start the program. Electrical noise can also cause an **ErrP** display.

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

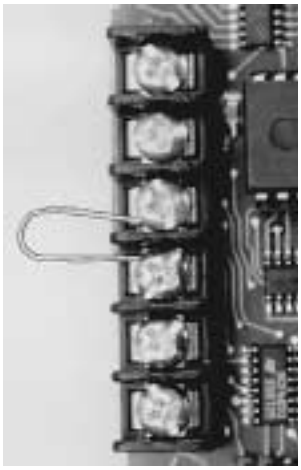
Check transformer if the wall receptacle voltage and switch box wiring are okay. (See "Controller Display Does Not Light Up," page 16, and "Kiln Switch Box Fuse Blows Repeatedly," page 20.)

Problem: FAIL Message

Probable Causes:

- **Defective Thermocouple**
- **Disconnected Thermocouple Lead Wires**
- **Defective Board**
- **Electrical Noise**

UNPLUG kiln. Remove the 4 screws holding the controller board faceplate to the switch box. Lift faceplate out of box. Look at the back of the board. You should see a yellow wire and a red wire connected to connectors 10 and 11 (back of board). (See diagram, page 22.) If one of these wires is disconnected or loose, reconnect or tighten. (Grasp connector block to prevent block from twisting.) The controller should work now. If the wires were attached securely to their connectors, perform this test:



1 Remove thermocouple wires from connections 10 & 11.

2 Cut a paperclip in half. Insert a U-shaped paperclip piece between connectors 10 & 11. Tighten screws.

3 Place the faceplate back into the switchbox with a couple of screws.

4 Plug in the kiln or turn on the breaker. If the board reads room temperature, replace the thermocouple. If it reads **FAIL**, replace the board. The thermocouple and thermocouple lead wires are sold as a single unit. Therefore, damaged thermocouple lead wires call for replacement of the thermocouple itself.

If you still get a **FAIL** message after replacing the thermocouple, watch for an erratic temperature display. The problem may be due to electrical noise. See "Erratic Temperature Readings," page 20.

Problem: Err 0 Message

Probable Causes:

- **Electrical Spike or surge**
- **Arcing on Relay**

Electrical spikes or noise can cause the processor to jump a step or malfunction. When **Err 0** appears, unplug the kiln or furnace for 10 seconds. This will reset the system. The display should go back to **ErrP**. Check your program to make sure it wasn't corrupted. Then fire your kiln again. If **Err0** persists, have the controller serviced or replaced.

Problem: Err 1 Message

Probable Causes:

- **Temperature Rise Slower Than 12° Per Hour**
- **Electrical Noise from Relays**
- **Worn Thermocouple**

Err1 appears when temperature rise is slower than 12°F/12°C per hour in Cone-Fire and Ramp-Hold. (In Ramp-Hold, the temperature must also be below the local set point, which is the temperature the board is trying to reach to maintain correct rate. Ramp-Hold can be programmed for a rate slower than 12º per hour without setting off the **Err1** message.) When **Err1** appears, the heating elements will shut off.

A kiln that fires this slowly may need new elements, voltage may be low, or you may be trying to fire hotter than the kiln was designed for. If it happens in the summer during hot weather, it is likely due to low voltage during peak electrical demand.

Did the firings gradually take longer? Did **Err1** appear only near the end of the firing? If yes to both questions, you probably have worn elements.

If **Err1** appeared well below the target temperature, such as 1000°F for an 1800°F firing, you probably have a burned out element or relay. See page 16, "Controller Display Lights Up Normally, Some or All Heating Elements Do Not Fire" and "Element Glow Test," page 15.

Electrical noise from a chattering or buzzing relay can cause an **Err1** message. So can a worn thermocouple. Grasp the thermocouple, which protrudes into the firing chamber. Gently move the thermocouple back and forth. If the temperature reading jumps, replace the thermocouple.

After **Err1** appears, press **1**. The display will show the last temperature the kiln reached and the hours fired before it shut off. Then it will go back to **IdLE**.

Problem: Err 2 Message

Probable Causes:

- **Stuck Relay**
- **Defective Controller**

Err2 appears when the temperature rises over 50°above a Hold temperature. It must remain over 50° for 18 seconds. It appears only during a Hold segment.

Err2 is caused by a stuck relay or defective controller. If the elements remain on after **Err2** appears, check the relays as shown on page 17. If the relays are okay and the elements turn on when you reconnect the controller wires to the relays, replace the controller.

Problem: Err 3 Message

Probable Causes:

- **Opening the Door**
- **Burned-Out Element**
- **Defective Relay**

Err3 appears when the temperature falls more than 50° below the Hold temperature during a Hold segment. See "Element Glow Test," page 15, or test the relays and elements as shown on page 17.

Problem: Err 4 Message

Probable Causes:

- **Stuck Relay**
- **Defective Controller**

Err4 is the same as **Err2** except temperature rises 50° above a Ramp temperature instead of a Hold temperature.

Problem: Err 6 Message

Probable Cause:

- **Thermocouple Leads Hooked Up Backwards**
- **Room Temperature Below 0ºF or 0ºC**
- **Board Damaged by Static Electricity**

UNPLUG kiln and remove the controller from the switch box. If the yellow and red wires are attached to the incorrect terminals (see diagram on page 22), reverse the wires. Reinstall the controller.

If room temperature is below 0ºF or 0ºC, raise temperature.

Perform the paperclip test described under "FAIL Message," page 18. When the paperclip is in place, the board should show room temperature. If it shows a negative number, replace or repair the board.

Problem: Err 8 Message

Probable Cause:

- **Burned out element or loss of power to elements**
- **Defective relay**
- **The Kiln Sitter® shut off (applies to TnFIl models)**

Err8 appears when the temperature drops for 18 seconds during the last phase of firing in Cone-Fire.

When **Err8** appears, press **1**. The display will show the last temperature the kiln reached and the hours fired before it shut off. Then it will go back to **IdLE**. See page 16, "Controller Display Lights Up Normally, Some or All Heating Elements Do Not Fire" and "Element Glow Test," page 15.

Problem: Err A Message

Probable Cause:

- **Software Error**

Err A indicates an error in software, usually with the computer-connected version of the DTC 1000. **ErrA** can be caused by random electrical noise. Reprogram the controller. If the error returns, return the board for servicing.

Problem: Err B Message

Probable Cause:

- **Circuit Board Temperature above 250° F.**
- **Defective Board**
- **Electrical Noise**

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

If **ErrB** persists when the circuit board temperature is normal, replace the board.

Problem: Err d Message

Probable Causes:

- **Stuck Relay**
- **Electrical Noise**
- **Over-Shoot During Low Temperature Firing**

Errd appears when the temperature is more than 100°F above the programmed temperature. It can occur during a ramp or during hold. Check relays as described on pages 15 & 16.

If you fire to around 300°F/149°C, **Errd** may appear due to a temperature over-shoot. Fire at a slower rate.

Problem: Err E Message

Probable Cause:

- **Defective Controller**

The controller detected a defective component on the circuit board. Replace the board.

Problem: Err H Message

Probable Cause:

- **Defective Controller**

The controller detected an error in a self-diagnostic check. If the error persists, replace the board.

Problem: Err t

Probable Cause:

- **Memory Chip Defective**

The write cycle to the non-volatile memory chip took too long. Have controller serviced.

Problem: Err -

Probable Cause:

- **Power Loss During Processing**

There was a power loss to the controller while sending data to a memory chip. Use "Program Review" to be sure your program is still in memory. If you get an **Err -** regularly, the controller may need servicing.

Problem: StUC Message

Probable Causes:

- **Stuck Key**
- **Solder Joint Failure**

Return the controller for servicing.

Problem: Erratic Temperature Readings

Probable Causes:

- **Thermocouple Lead Wires Attached to Wrong Terminals or Too Close to Other Wires**
- **Thermocouple Lead Wires Touch at Bare Ends**
- **Electrical Noise**
- **Poor Electrical Circuit Ground**
- **Defective Relay or Transformer**
- **Defective Thermocouple**
- **Thermocouple Touching Metal Case of Kiln**

Even though protected by insulation, the thermocouple wires are sensitive to electromagnetic waves. Position them away from other wires inside the switch box. Thermocouple wires must be attached to the correct terminals. Check that the thermocouple wire ends are separated where the insulation has been stripped. Electrical "noise" from a chattering relay or nearby arc welding machines can cause erratic readings.

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

If the erratic temperture readings display only while the elements are powered, the problem may be a defective relay or transformer.

A worn thermocouple can cause erratic temperature readings. Wiggle the thermocouple tip. If the temperature jumps by a wide margin, replace thermocouple.

Problem: Overfire

Probable Causes:

- **Thermocouple Pushed Out of Firing Chamber**
- **Stuck Relay**
- **Defective Thermocouple**
- **Thermocouple Touching Metal Case of Kiln**

(Ceramics: use witness cones.) Check that the thermocouple is protruding into the firing chamber by at least ½" - ⅝". Sometimes bumping a shelf against the thermocouple pushes it out of the firing chamber, altering the temperature readings.

If an element stays on after pressing **STOP**, a relay is stuck. Replace the relay. If the temperature reading is over 100° higher than the actual temperature, replace the thermocouple. Note: a defective thermocouple can read correct room temperature and be inaccurate at high temperatures.

Make sure the thermocouple, including the spring on the end of the thermocouple, is not touching the kiln's metal case.

Problem: Stuck Display

Probable Causes:

- **Stuck Key**
- **Electrical Noise**

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

Problem: Relay Chatters or Buzzes

Probable Causes:

- **Defective Transformer**
- **Defective Transistor on Controller**
- **Low Line Voltage**
- **Weak Relay**

Voltage at controller board connectors 3 and 6 should be 12 - 14 volts DC. Voltage in the 10 - 11 range may not be enough to drive the relays, or may cause a relay to chatter. See "Controller Display Lights Up Normally, Some or All Heating Elements Do Not Fire," page 16, to check the board with a voltmeter.

Low voltage at connectors 3 and 6 can be caused by a defective transformer, a defective transistor on the board, or low line voltage. To diagnose the cause, check the voltage from the transformer at connectors 5 and 7. Correct voltage is 20 - 24 volts AC. When voltage falls below 20 volts, the board will malfunction or will not have enough voltage to drive the relays.

If low voltage is detected at connectors 3 and 6 or 5 and 7, replace the transformer.

Problem: Kiln Switch Box Fuse Blows Repeatedly

Probable Causes:

- **Wrong Fuse**
- **Defective Transformer**
- **Shorted Relay**
- **Defective Controller**

Check the fuse in the kiln's switch box. The fuse holder is near the bottom of the switch box. Remove fuse by pressing on the fuse holder and turning counter-clockwise half a turn.

The correct fuse:

AGC ½ A 250V AC

Refer to the diagram on page 22. Disconnect the orange, white and black wires (#5, 6, 7) from the back of board. Apply power to kiln. If fuse blows, replace the transformer. If the fuse does not blow, then the problem is a board or relay.

Connect #5, 6 and 7 wires to the board again. Disconnect red wire, #3. Apply power. If the fuse blows, replace or service the board. If the fuse does not blow, the problem is caused by a short in the coil of a relay.

Disconnect each relay, one at a time, until you find the relay that blows the fuse.

Problem: Unwanted Beeping Sound

Cause:

- **Alarm Set to 0000**

When the controller emits a beeping sound at the beginning of firing, the alarm was probably set to 0000 or a temperature below room temperature. See "Temperature Alarm," page 13.

Replacing Switch Box Components

Important When Replacing Components: If a push-on terminal is loose, gently squeeze with pliers. Connections must be tight!

Replacing Circuit Board Fuse

The fuse holder is near the bottom of the switch box. Remove fuse by pressing on the fuse holder and turning counter-clockwise half a turn.

Replacement fuse: **AGC ½ A 250V AC**

WARNING: Replacing the fuse with one of a higher amperage will void your warranty.

Thermocouple Replacement

If your thermocouple needs replacing often, it may be due to sulphur in the clay you are firing. Sulphur makes the thermocouple sheath brittle so that if nudged during loading, it breaks.

TnF II: see next column.

1 *UNPLUG* kiln.

2 Remove screws on the sides of the switch box that hold it to the kiln, and let switch box hang by element-to-relay lead wires.

3 To prevent the thermocouple from touching anything metallic, it is held in place with a porcelain insulator. Remove the screw from the thermocouple fastener, which holds the porcelain insulator in place. Pull thermocouple from its firebrick hole.

4 Insert the new thermocouple into the firebrick hole so that it protrudes into the firing chamber ½" - ⅝". Place a mark on the thermocouple 1" past the outside firebrick wall surface.

5 Remove the thermocouple. Slide the porcelain insulator, wide end first, onto the thermocouple as far as it will go. Gently bend the thermocouple at the mark with your hands. Do not use pliers, or the thermocouple may kink.

6 Slide the thermocouple back into the hole. Position the thermocouple fastener so that it holds the porcelain insulator against the heat shield. Install the screw.

7 Position the thermocouple lead wires so they are away from the hot sides of the kiln case and electrical wiring. (Thermocouple wires next to or looped around other wires may cause erratic controller readings.) Do not allow the thermocouple, including its spring, to touch anything metallic, such as a heat shield.

8 Check to see that no wires are touching the kiln case or the element connectors. Wires touching element connectors or kiln case will burn out. Install switch box.

TnF 2 Thermocouple Replacement

1 *UNPLUG*. Remove TnF 2 controller faceplate.

2 Remove the thermocouple leads from connectors 10 & 11 (diagram page 22). Pull the thermocouple wire from the box.

3 Thread the end of the new thermocouple lead wire into its hole in the TnF 2 box.

4 Connect the new wire to connectors 10 & 11. Fasten faceplate to the front panel. See "Thermocouple Replacement," left column, to install the thermocouple onto the kiln. The thermocouple must not touch anything metallic.

Controller Board Replacement

1 *UNPLUG* kiln.

2 Remove the 4 corner screws holding the controller faceplate to the switch box. Carefully lift out faceplate.

3 Disconnect all wires from the back of the board.

4 Connect the wires to the new board following the diagram on page 22. Reinstall faceplate.

WARNING! Be careful to attach the wires to the correct terminals. Reversing wires on the board can burn out switch box components and the transformer. Damage from miswiring is not covered by warranty!

Transformer Replacement

1 *UNPLUG* kiln. Remove the screws that hold the switch box to the kiln, and let switch box hang by element-to-relay lead wires. (TnF II: Remove the front panel from the TnF II.)

2 Remove and transfer one wire at a time from the old transformer to the new one. Make sure each connection is tight.

3 Unbolt transformer from switch box. Examine new transformer to make sure the primary is properly wired for your kiln's voltage. (Refer to your kiln's wiring diagram.) Make sure push-on connectors do not touch each other.

4 Bolt new transformer into switch box. Check to see that wires are not touching kiln case or the element connectors. Wires touching element connectors or the kiln case will burn out. Move switch box into place and reinstall switch box screws.

Board Upgrades

WARNING! Be careful to attach the wires to the correct terminals. Reversing wires can burn up circuit board components and the transformer. Damage from miswiring is not covered by warranty!

Upgrading to the DTC 1000 Board From the DTC 100 Series

1 *UNPLUG* kiln.

2 Remove the 4 corner screws holding the DTC 100C or DTC 100 faceplate to the switch box. Lift out the faceplate.

3 Loosen screws along the terminal strip on the back of the board. Remove all connecting wires.

4 Cut off the wire connection terminals from the wire ends. (Except for thermocouple wires; they attach to the DTC 1000 the same way as the DTC 100 series.)

5 Strip 1/4" of insulation from the end of each wire. (Insulation must be kept out of the connector sleeve.) Crimp a push-on connector (furnished with replacement board) to the wires. If your DTC 100 series kiln has a green wire, crimp it together with the red wire. Also, crimp the blue and black wires together.

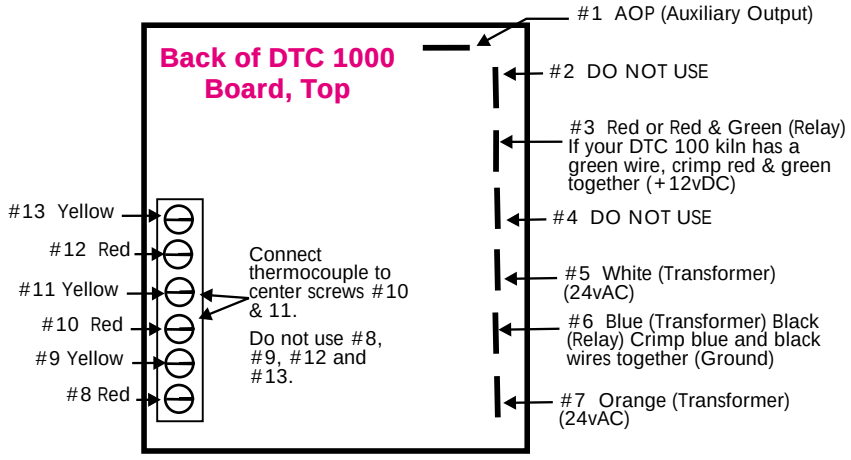
Use the type of crimping tool shown in the photo above. The indent goes on the side opposite the seam of the connector. Test each connection by grasping the push-on connector with one hand and pulling the wire firmly with the other.

6 Connect wires to board using the diagram below. Install DTC 1000 faceplate to the switch box.

Upgrading from DTC 600 & DTC 800 Series

UNPLUG kiln and remove the 4 corner screws holding the board to the switch box. Lift out the faceplate.

Transfer wires from your board to the new board. Use the color coding shown in the diagram. If your kiln used the AOP output, the AOP wire attaches to terminal #1.



DTC 1000 Cone-Fire Quick Reference

After you press the key(s) in the left column, the message to the right will appear. If after pressing **ENTER**, then **1**, only 4 horizontal lines appear, your controller does not have Cone-Fire.

NO DELAY FIRE, NO ALARM. IF ALARM SOUNDS DURING FIRING, PRESS ENTER.

KEYS TO PRESS	DISPLAY
Apply power to kiln	ErrP
ENTER	IdLE
ENTER	- - - -
1	ConE
Cone # of choice	05 Displays cone #
ENTER	SPd
1 (Fast), 2 (Med.), or 3 (Slow)	FASt Med or SLO
ENTER	HLd
Hold time (if any)	00.00 (or hold time)
ENTER	CPL IdLE and flashing temperature
ENTER	- - - -
ENTER	-On-

Kiln is now firing to the cone you selected.

DTC 1000 Ramp-Hold Quick Reference

After you press the keys in the left column, the message to the right will appear. If alarm sounds during a firing, press **ENTER**.

KEYS TO PRESS	DISPLAY
STORE A USER PROGRAM, THEN FIRE; NO DELAY FIRE.	
Apply power to kiln	ErrP
ENTER	IdLE
ENTER	- - - -
4	USEr / 1 etc.
Select program 1 through 6	1 etc. (displays # entered)
ENTER	SEG
Number of segments needed	1 etc. (displays # entered)
ENTER	rA 1
Temperature change per hour	0200 etc. (displays temp.)
ENTER	° F 1
Final temperature, segment 1	2000 etc. (displays temp.)
ENTER	HLd1
Hold time (if any)	00.00 (or hold time)
Repeat for number of segments desired.	
ENTER	ALAr (Alarm temperature)
Alarm temperature (OFF: 9999)	2000 etc. (displays temp.)
ENTER	CPL IdLE and flashing temperature
ENTER	- - - -
ENTER	-On-
Kiln is now firing.	
SELECT AND FIRE A STORED USER PROGRAM; NO DELAY FIRE.	
Apply power to kiln	ErrP
ENTER	IdLE
ENTER	- - - -
4	USEr / 1 etc. (Select program)
1 through 6	1 etc. (displays # entered)
ENTER	SEG
STOP	CPL IdLE and flashing temperature
ENTER	- - - -
ENTER	-On-
Kiln is now firing. (See separate Program Review instructions.)	