

Model OC-1 Temperature Controller

The model OC-1 temperature controller holds up to 20 PID controlled programs, all of which are user definable. 14 commonly used programs for the metal clay and artistic glass industries have already been programmed into the temperature controller for your convenience, all of which can be modified, changed or deleted by the user.

This manual explains how to setup the temperature controller with your oven (annealer, fuser or kiln), briefly how a temperature controller works, how to program and run the controller and what the 14 pre-loaded programs are and how to use them.

Setup

First, make sure the temperature controller is turned off. This is done by placing the power switch, located on the panel to the right of the temperature controller's face, in the down position. Next, insert the thermocouple into the oven as described by the oven manufacturer. The thermocouple is the temperature sensor the temperature controller uses to make its decisions whether to turn the oven on or off. It is the very tip of the thermocouple that senses the temperature and it is very important that the tip is well into the oven, not in the wall of the oven. If it is in the wall, the temperature controller will be reading the wrong temperature and cause the oven to actually become hotter than the temperature controller thinks it is. The OC-1 uses a Type K thermocouple.

Next, plug the temperature controller into an appropriate electrical outlet, but **DO NOT** plug the oven into the controller yet. If the oven has an infinite control switch, turn it to high and always leave it there while operating the oven with the temperature controller. After you power up the temperature controller and determine that it is not set to immediately start powering the oven do you plug the oven into the temperature controller. This will be discussed shortly.

How the temperature controller operates

A temperature controller is a device that controls the operation of an oven connected to it, through the use of a program. A program is a set of instructions that the temperature controller uses for this operation. These instructions include information of what temperature to go to, called the Target Temperature, how fast to heat up or cool down to that temperature, called a Ramp Rate (also known as a Ramp), whether or not to hold a steady temperature over a period of time, called a Soak (also known as a Hold), whether or not to repeat any of these instruction sets that make up what are called Segments (also known as Steps) and how to vary them, and finally, to end or terminate the program.

If you were to study how a program is displayed in a typical firing graph, you will see that there are lines to represent what the program has the temperature controller do for the operation of the oven. These lines and their intersections are called Segments. If a Segment is angled, either up or down from horizontal, it is called a Ramp Segment. A horizontal Segment is called a Soak. The bottom horizontal scale of the following graph shows time passing from left to right, and on the left vertical scale, temperature is shown to increase from bottom to top. If a Segment is angled like this /, it is a heating Ramp. The temperature inside the oven increases as time passes. A Segment angled like this \, is a cooling Ramp. The temperature inside the oven decreases as time passes. A horizontal Segment like this —, is a Soak. The temperature inside the oven remains the same as

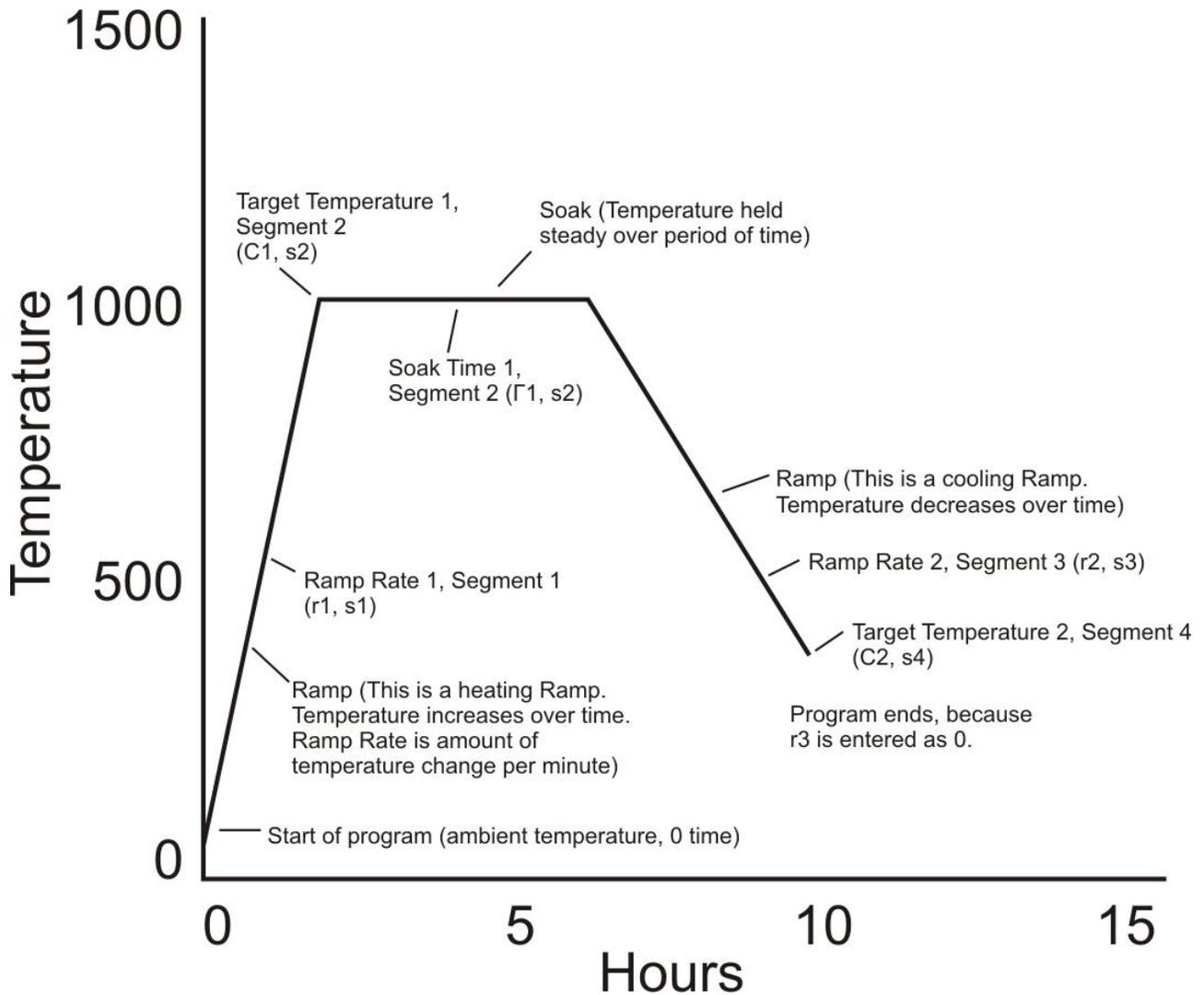
time passes. At the end of a Ramp is the Target Temperature, the temperature the oven is to reach. **The OC-1 temperature controller labels a Ramp as an individual Segment and a Target Temperature combined with its following Soak as an individual Segment.**

When you start the temperature controller in a program, it will go to the first Segment, Segment 1, and beginning running. It may not start in Segment 1 if you are resuming a program that did not complete or you select a different Segment to start in. The temperature controller has the oven perform what you programmed that Segment to do, which is first Ramp up or down towards a temperature, at the Ramp Rate set. The first Ramp is Segment 1. The Temperature that Segment 1 is heading for is Segment 2. The Soak that follows the Segment 2 Temperature is also part of Segment 2. A Soak can have a zero amount of time to it. After the Soak time has lapsed, the controller begins the next Ramp, if it is programmed to do so. This second Ramp is Segment 3 and the Temperature this second Ramp is heading for is Segment 4, as is the Soak at that temperature, if there is one. The controller continues on in this manner until the Program ends and the temperature controller turns off power to the oven until you start a different program or this program again.

The temperature controller firing data is entered into the controller in groups of three data, in this order: Ramp Rate, Soak Time and Target Temperature. The display will show **r** to represent Ramp Rate, **Γ** to represent Soak Time and **C** to represent Target Temperature. Note that the order the data entered is not necessarily in the same order we refer to it. In other words, we talk about ramping to a temperature and holding it there for a period of time. Also, this first group of data of the Program is made up of two Segments; one Segment for the Ramp and a second Segment for the combined Target Temperature and Soak. Each group of data is represented by a number. For example, the first group will be **r1, Γ 1 and C1** for Ramp Rate 1, Soak Time 1 and Target Temperature 1. The second group is **r2, Γ 2 and C2** and so on.

Understanding the difference between how the data is labeled as **r, Γ** and **C** and how they apply to Segments is important, because there may be instances when you may want to move forward or backward in a running Program. An example is Program 1, for Fusing Jewelry Scale Glass. Say the glass has already reached 1500° F and is in the middle of a 30 minute Soak. You look at it and decide that you do not want the glass to be at that temperature for the remainder of the time left in the Soak. So, you move forward in the program to the next Segment, which says to Ramp at Full speed to an annealing temperature of 960° F, Soak for 30 minutes and so on through to the completion of the program. You accomplish this task of jumping ahead in the running program. This is done by entering the running program (discussed below) and seeing that the controller is running in Segment 4 (S4 as seen on the chart on page 11, displayed as SEG 4 on the controller), then going to Segment 5 (S5, SEG 4). This corresponds to being in the second programmed Temperature and Soak (**Γ02 and C02**) and then going to the third programmed Temperature and Soak (**Γ03 and C03**).

This Firing Graph illustrates a simple program



Ramp is listed as degrees per minute.
Multiply Ramp Rate by 60 to convert to degrees per hour.
A Ramp of 200 indicates a FULL SPEED Ramp.

Soak is listed as total minutes.
Divide Soak time by 60 to convert to decimal hours.
Example: A Soak of 90 means 90 minutes. To convert to hours, divide by 60 = 1.5 hours, which can be expressed as 1:30.

There are two options to choose from for how the temperature controller operates the connected oven.

Running a Program

To run one of the firing programs that came preinstalled with your temperature controller or a program you have programmed in yourself, do the following.

Turn on the temperature controller on by moving the toggle switch, located on the right hand side of the display, to the up position.

After approximately 3 seconds the controller will have booted up. The red-lighted top display will show the current temperature at the thermocouple (temperature sensor) tip. The green-lighted bottom display will show the temperature that the temperature controller is currently targeted to go to. At the bottom of the temperature controller panel, press the Set button and the A/M button simultaneously and hold until the display changes to read “run X”, where X is either 0, 1, 2 or 3. “run” will be in the top display and the number will be in the bottom display. Using the up and down arrows as necessary, make the displays show “run 3”. If the oven has not yet been plugged into the controller, set to “run 1”, then press the Set button and the A/M button simultaneously before. After plugging in the oven, set to “run 3”.

run 0 = Set Point Operation. See below.

run 1 = Off, cease Program or Set Point operation. Display shows oven temperature in the top display and the target temperature of the selected or first Segment of the selected Program in the bottom display.

run 2 = Pause, hold temperature as programmed in the running Segment of the running Program and suspend the countdown of the Soak time

run 3 = Start a selected Program or resume a selected Program that was interrupted by a power failure to the temperature controller.

Once run 3 is selected, press the Set button once again to have the displays show the last program used or a program that may actually be running. Using the up and down arrows as necessary, make the displays show the desired program number you wish to run. At this point all you need to do is press the Set button and the A/M button simultaneously to start the selected program. However, the selected program may NOT be queued up to start the program in Segment 1. To know for sure, in instead, do the following:

1. After the controller is powered up, press the Set button and the A/M button simultaneously and hold until the display changes. Set the value of “run” to be 3.
2. Press the Set button once again to have the displays show the last program used or a program that may actually be running. Set the value of “Pro” to 1 (in this example).
3. Press the Set button once again to have the displays show the Segment the controller is either idling in or is running in. For this example we want to run Program 1 from the beginning of the program, so set the “SEG” value to 1, if it isn't already.
4. At this point, to start the selected program, Program 1, at Segment 1, simply the press the Set button and the A/M button simultaneously. You will exit the interaction

with the controller. The top display will now show the actual temperature inside the oven (where the thermocouple is) and the bottom display will now show you the target temperature or the temperature that the oven should be at in a Ramp. The controller will continue to operate through to the completion of the program, then set itself to “run 1”, its off state.

This procedure can be performed either when the temperature controller is running any of its stored programs or it is idling.

If you want to review, modify or create a program before starting it or even while another program is running, only follow steps 1, 2 and 3, as outlined above, then resume with instructions 4 through 9 from below:

4. Press the Set button once again to have the top display show tE. The value in the bottom display cannot be changed. This menu item displays elapsed time, in minutes, in a running program.
5. Press the Set button once again to have the top display show r01, representing Ramp Rate number 1. The bottom display will show the value set for r01. For Program 1, the factory setting is 16.7. This means that the Ramp Rate, the rate of temperature change over time, is set for 16.7° F per minute. To convert this value to degrees per hour, multiple 16.7 by 60. The results are 1002°. The chart on page 11 rounds this off to 1000° for simplicity. Use the Up and Down arrows to change the value. This is what Segment 1 is. This part of your interaction with the controller, during reviewing, modifying or programming, does not inform you which segment number of the program you are dealing with. Segment numbers are revealed as in instruction number 3, described above.
6. Press the Set button once again to have the top display show Γ01, representing Soak Time number 1. The bottom display will show the value set for Γ01. For Program 1, the factory setting is 0. This means that the Soak Time, the length of time that the oven will be held at a steady temperature, as described in instruction number 7 below, is set for 0 minutes. The Up and Down arrows are used to change this value.
7. Press the Set button once again to have the top display show C01, representing Target Temperature number 1. The bottom display will show the value set for C01. For Program 1, the factory setting is 1000. This means that the Target Temperature, the temperature you have set for the controller to head for, is 1000° F. Use the Up and Down arrows to change this value.
8. To continue reviewing, modifying or adding to a program, repeat the instructions as described in instruction numbers 5, 6 and 7. The Set button has the display scroll to r02, followed by Γ02 and C02, then r03, followed by Γ03 and C03, and so on through to the end of the program. A program can contain up to 32 data sets, that is r01, Γ01 and C01 through r32, Γ32 and C32.

A program ends when a Ramp Rate value is set to 0. There is no such thing as a zero Ramp Rate; therefore, the program ends with the previous set parameters of r, Γ and C. A Ramp Rate set to 200 directs the controller to not follow a specific ramp rate, but to instead heat the oven as fast as possible to the Target Temperature. However, you will notice that as the Target Temperature is approached, the

controller will begin to perform a ramp (approach the Target Temperature slowly) to prevent overshooting of the Target temperature. This is a feature of the PID operating software. Any data entered after a value of 0 is entered for r are ignored by the controller.

9. At this point, to start the selected program, Program 1, at the first segment, Segment 1, simply the press the Set button and the A/M button simultaneously. You will exit the interaction with the controller. The top display will now show the actual temperature inside the oven (where the thermocouple is) and the bottom display will now show you the target temperature. The controller will continue to operate through to the end of the program, then set itself to “run 1”, its off state.

This procedure can be performed either when the temperature controller is running any of its stored programs or it is idling.

To execute the example scenario of jumping forward in running Program 1, as described at the bottom of page 2, you will need to go from SEG 4 to SEG 5. If the Target Temperature of 1500 has been reached, the Soak will have started and the controller will be in Segment 4 (S4 as seen in the chart on page 11). Following the instructions in first three instructions above, you will see that the running controller is in SEG 4. Use the Up arrow to change the SEG value to 5. Press the Set button and the A/M button simultaneously. The controller will now be running in Segment 5. You will exit the interaction with the controller. The top display will now show the actual temperature inside the oven (where the thermocouple is) and the bottom display will now show you the target temperature. The controller will continue to operate through to the end of the program, then set itself to “run 1”, its off state.

Note: Not taking the action of pressing a button or buttons causes the temperature controller to Time Out. Whatever is displayed as a value or command is automatically activated and the display returns to its standard default of displaying the current temperature on the top display and the target temperature on the bottom display.

If you turn off the power switch while the controller is running a program, the program will stop and no longer be controlling the oven. As soon as the controller is powered back up, the controller will immediately resume operation and turn on the oven to continue running the program. If you allow the program to run its course, uninterrupted, the controller will automatically place itself in “run 1” state upon the normal completion of the program. To stop the controller from controlling the oven, whether operating as a Set Point Controller or running a multi step, ramping program, select “run 1” and press the Set and A/M buttons simultaneously.

Operating as a simple Set Point controller

The temperature controller can be operated as a simple Set Point controller. This type of function is similar to a thermostat control on your home heating and cooling system. All Set Point control does is make the oven go to a single programmed temperature as fast as possible and stay there indefinitely.

To have the temperature controller operate as a Set Point Controller, start out, as described above under the Running a Program section, by pressing the Set button and the A/M button simultaneously and holding it until the display changes to read “run X”, where X is either 0, 1, 2 or 3. Using the up and down arrows as necessary, make the displays show

“run 0”, then press the Set and A/M buttons simultaneously. The controller is now operating as a Set Point Controller. All it will do is set the Ramp speed to Full and indefinitely Soak the temperature that has been set.

To change the temperature while operating as a Set Point Controller, press and hold the Up arrow button until the temperature changes. Once the temperature starts to change, the Down arrow button is enabled and now both the Up and Down arrow buttons can be used to change the temperature. Press the Set button or both the Set and A/M buttons simultaneously to make the new Set temperature take effect. Not pressing any button will automatically make the new temperature take effect after about six seconds. The number in the top display is the actual temperature in the oven. The number in the bottom display is the Set or target temperature.

If you turn off the power switch, the controller will shut down and no longer be controlling the oven. As soon as the controller is powered back up, the controller will immediately resume operation as a Set Point Controller and turn on the oven. To stop the controller from controlling the oven, whether operating as a Set Point Controller or running a multi step, ramping Program, select “run 1” and press the Set and A/M buttons simultaneously.

Advanced Menu

Pressing the Set button by itself until the display changes enters you into the Advanced Menu features. To alter most of the parameters already set in this menu you need to have a very good understanding of process controllers. These parameters have already been optimized for most of the types of programs and ovens this controller is sold to use with. The two Advanced Menu items you may want to consider modifying are Auto Tuning and Switching Cycle Rate.

The Switching Cycle Rate should only be cautiously modified. A faster switching cycle rate than what is set by the factory enables the controller to hold a tighter temperature with less temperature wandering, but also puts more wear on the relay, potentially shortening its life span greatly. The switching cycle rate is modified by the “t” value located in the Advanced Menu. Factory default is 10. A higher value slows the switching cycle rate and a lower number speeds it up. Generally, larger ovens do not benefit as much from a faster switching rate. Smaller ovens see less temperature fluctuation at a faster switching cycle rate, because of their usually higher power to volume ratio, temperature changes take place quicker. A relay is a mechanical device that sends electricity to the oven’s heating element. Do not set the switching cycle rate below 4. Avoid setting it below 6. Maximum is 120.

Auto Tuning enables the controller to optimize the performance of its PID software by running a test firing. The controller analyzes how the oven reacts to the controller’s commands and adjusts its PID parameters within the software. This is to help the controller have the operation of the oven closely follow the profile of a program. Increased accuracy of the controller can be noticeable on the operation of small ovens, especially at lower temperatures, because of their usually higher power to volume ratio, temperature changes take place quicker. Medium and larger ovens can benefit too, but the increased performance may not be so noticeable.

To run Auto Tune, change the “At” value in the Advanced Menu from 0 to 1. When you next run a program, Auto Tune will modify the PID software parameters. To indicate that

Auto Tune is queued to run or is running, the bottom display will alternate between showing “At” and the temperature. After Auto Tune has completed, the display will go back to just displaying the temperature, the program that you started will be running and the controller resets its “At” value back to 0. Do not interrupt the Auto Tune process. If you do, rerun Auto Tune. The modification will be permanent unless you specifically manually change the P, I and D values or rerun Auto Tune. For best results, run Auto Tune when the oven is at or close to room temperature. Fire the oven empty during the Auto Tune procedure.

If you change the Switching Cycle Rate after running the Auto Tune feature, you should rerun Auto Tune.

Some of the Advanced Menu features are hidden from view. To reveal them, change the value of “LoCk” from 0 to 15. Exit the menu and reenter to see all of them.

To exit the Advanced Menu, either scroll to the end of the menu by repeatedly pressing the Set button or press the Set button and the A/M button simultaneously.

Maintenance

You should regularly inspect the thermocouple for wear and damage. A damaged thermocouple can give the controller false information that the controller may not be able to detect. This can lead to overheating and subsequent damage to the oven and its contents. Replace it as necessary.

A mechanical relay is the only moving part on the controller. For the factory setting of the controller’s switching cycle rate, a typical mechanical relay should be replaced as routine maintenance after about three years of service, where the total use time is equal to about five full days of use per week, every week of the year for about three years. If the controller is only used once a week, the life of the relay extends from about three years to about fifteen years. Modifying the controller’s switching cycle rate will affect the life of the relay.

Warranty: 6 months from date of purchase.

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List of the 14 pre-entered programs describing them.

Program 1: Jewelry scale fusing for soft glasses

Step 1: Ramp Rate 16.7° F per Minute (1000° F per Hour), Temperature 1000° F, Hold Time none

Step 2: 16.7° F per Minute (1000° F per hour), 1500° F, Hold Time 30 minutes

Step 3: Ramp Rate 200° F (Full Speed), Temperature 960° F, Hold Time 30 minutes

Step 4: Ramp Rate 6.7° F per Minute (400° F per Hour), Temperature 400° F, Hold Time none

End

Program 2: Jewelry scale fire polish for soft glasses

Step 1: Ramp Rate 16.7° F per Minute (1000° F per Hour), Temperature 1000° F, Hold Time none

Step 2: 16.7° F per Minute (1000° F per hour), 1275° F, Hold Time 30 minutes

Step 3: Ramp Rate 200° F (Full Speed), Temperature 960° F, Hold Time 30 minutes

Step 4: Ramp Rate 6.7° F per Minute (400° F per Hour), Temperature 400° F, Hold Time none

End

Program 3: Jewelry scale slumping for soft glasses

Step 1: Ramp Rate 16.7° F per Minute (1000° F per Hour), Temperature 1000° F, Hold Time none

Step 2: 16.7° F per Minute (1000° F per hour), 1400° F, Hold Time 30 minutes

Step 3: Ramp Rate 200° F (Full Speed), Temperature 960° F, Hold Time 30 minutes

Step 4: Ramp Rate 6.7° F per Minute (400° F per Hour), Temperature 400° F, Hold Time none

End

Program 4: PMC Standard - High temperature

Step 1: Ramp Rate 200° F (Full Speed), Temperature 1650° F, Hold Time 2 hours, End

Program 5: PMC Plus, PMC 3 and Silver Art Clay - High temperature

Step 1: Ramp Rate 200° F (Full Speed), Temperature 1650° F, Hold Time 10 minutes, End

Program 6: PMC Plus and Silver Art Clay - Middle temperature

Step 1: Ramp Rate 200° F (Full Speed), Temperature 1560° F, Hold Time 20 minutes End

Program 7: PMC Plus and Silver Art Clay - Low temperature

Step 1: Ramp Rate 200° F (Full Speed), Temperature 1470° F, Hold Time 30 minutes End

Program 8: PMC Plus and Silver Art Clay with glass - Low temperature

Step 1: Ramp Rate 16.7° F per Minute (1000° F per Hour), Temperature 1000° F, Hold Time none

Step 2: 16.7° F per Minute (1000° F per hour), 1470° F, Hold Time 30 minutes

Step 3: Ramp Rate 200° F (Full Speed), Temperature 960° F, Hold Time 30 minutes

Step 4: Ramp Rate 6.7° F per Minute (400° F per Hour), Temperature 400° F, Hold Time none

End

Program 9: PMC 3 - Middle temperature

Step 1: Ramp Rate 200° F (Full Speed), Temperature 1290° F, Hold Time 10 minutes

End

Program 10: PMC 3 - Low temperature

Step 1: Ramp Rate 200° F (Full Speed), Temperature 1200° F, Hold Time 20 minutes

End

Program 11: PMC 3 - Lowest temperature

Step 1: Ramp Rate 200° F (Full Speed), Temperature 1100° F, Hold Time 30 minutes

End

Program 12: PMC 3 with glass - Middle temperature

Step 1: Ramp Rate 16.7° F per Minute (1000° F per Hour), Temperature 1000° F, Hold Time none

Step 2: 16.7° F per Minute (1000° F per hour), 1290° F, Hold Time 30 minutes

Step 3: Ramp Rate 200° F (Full Speed), Temperature 960° F, Hold Time 30 minutes

Step 4: Ramp Rate 6.7° F per Minute (400° F per Hour), Temperature 400° F, Hold Time none

End

Program 13: PMC 3 with glass - Low temperature

Step 1: Step 1: Ramp Rate 16.7° F per Minute (1000° F per Hour), Temperature 1000° F, Hold Time none

Step 2: 16.7° F per Minute (1000° F per hour), 1200° F, Hold Time 30 minutes

Step 3: Ramp Rate 200° F (Full Speed), Temperature 960° F, Hold Time 30 minutes

Step 4: Ramp Rate 6.7° F per Minute (400° F per Hour), Temperature 400° F, Hold Time none

End

Program 14: PMC 3 with glass - Lowest temperature

Step 1: Ramp Rate 16.7° F per Minute (1000° F per Hour), Temperature 1000° F, Hold Time none

Step 2: 16.7° F per Minute (1000° F per hour), 1100° F, Hold Time 30 minutes

Step 3: Ramp Rate 200° F (Full Speed), Temperature 960° F, Hold Time 30 minutes

Step 4: Ramp Rate 6.7° F per Minute (400° F per Hour), Temperature 400° F, Hold Time none

End

Table of each of the 14 programs laid out to reflect the manner with which the controller displays the information during entering a program and during running a program.

R = Ramp Rate; T = Soak Time; C = Target Temperature; S = Segment

Program Number	Ramp °F/M			Soak Minutes			Temp °F		
	Seg			Seg			Seg		
1	Jewelry scale fusing for soft glasses								
	R1	s1	16.7	T1	s2	0	C1	s2	1000
	R2	s3	200.0	T2	s4	30	C2	s4	1500
	R3	s5	200.0	T3	s6	30	C3	s6	960
	R4	s7	6.7	T4	s8	0	C4	s8	400
	R5		0						
2	Jewelry scale fire polish for soft glasses								
	R1	s1	16.7	T1	s2	0	C1	s2	1000
	R2	s3	200.0	T2	s4	30	C2	s4	1275
	R3	s5	200.0	T3	s6	30	C3	s6	960
	R4	s7	6.7	T4	s8	0	C4	s8	400
	R5		0						
3	Jewelry scale slumping for soft glasses								
	R1	s1	16.7	T1	s2	0	C1	s2	1000
	R2	s3	200.0	T2	s4	30	C2	s4	1400
	R3	s5	200.0	T3	s6	30	C3	s6	960
	R4	s7	6.7	T4	s8	0	C4	s8	400
	R5		0						
4	PMC Standard - High temperature								
	R1	s1	200.0	T1	s2	120	C1	s2	1650
	R2	s3	0	T2	s4		C2	s4	
5	PMC Plus, PMC 3 and Silver Art Clay - High temperature								
	R1	s1	200.0	T1	s2	10	C1	s2	1650
	R2	s3	0	T2	s4		C2	s4	
6	PMC Plus and Silver Art Clay - Middle temperature								
	R1	s1	200.0	T1	s2	20	C1	s2	1560
	R2	s3	0	T2	s4		C2	s4	
7	PMC Plus and Silver Art Clay - Low temperature								
	R1	s1	200.0	T1	s2	30	C1	s2	1470
	R2	s3	0	T2	s4		C2	s4	

Program Number	Ramp			Soak			Temp		
	Seg	°F/M		Seg	Minutes		Seg	°F	
8	PMC Plus and Silver Art Clay with glass - Low temperature								
	R1	S1	16.7	T1	S2	0	C1	S2	1000
	R2	S3	200.0	T2	S4	30	C2	S4	1470
	R3	S5	200.0	T3	S6	30	C3	S6	960
	R4	S7	6.7	T4	S8	0	C4	S8	400
	R5		0						
9	PMC 3 - Middle temperature								
	R1	S1	200.0	T1	S2	10	C1	S2	1290
	R2	S3	0	T2	S4		C2	S4	
10	PMC 3 - Low temperature								
	R1	S1	200.0	T1	S2	20	C1	S2	1200
	R2	S3	0	T2	S4		C2	S4	
11	PMC 3 - Lowest temperature								
	R1	S1	200.0	T1	S2	30	C1	S2	1100
	R2	S3	0	T2	S4		C2	S4	
12	PMC 3 with glass - Middle temperature								
	R1	S1	16.7	T1	S2	0	C1	S2	1000
	R2	S3	200.0	T2	S4	10	C2	S4	1290
	R3	S5	200.0	T3	S6	30	C3	S6	960
	R4	S7	6.7	T4	S8	0	C4	S8	400
	R5		0						
13	PMC 3 with glass - Low temperature								
	R1	S1	16.7	T1	S2	0	C1	S2	1000
	R2	S3	200.0	T2	S4	20	C2	S4	1200
	R3	S5	200.0	T3	S6	30	C3	S6	960
	R4	S7	6.7	T4	S8	0	C4	S8	400
	R5		0						
14	PMC 3 with glass - Lowest temperature								
	R1	S1	16.7	T1	S2	0	C1	S2	1000
	R2	S3	200.0	T2	S4	30	C2	S4	1100
	R3	S5	200.0	T3	S6	30	C3	S6	960
	R4	S7	6.7	T4	S8	0	C4	S8	400
	R5		0						

Notes