

Arrow Springs

Model ASC/5 Temperature Controller

Addendum to the Orton AutoFire Express Manual

The Arrow Springs model ASC/5 temperature controller incorporates the Orton AutoFire Express circuitry, well known for its capabilities, reliability and affordable price. The ASC/5 holds up to 9 programs, all of which are user definable. Arrow Springs has pre-loaded 4 programs commonly used in the artistic glass industry for your convenience. All of them can be modified, changed or deleted by the user.

This addendum explains how to setup the temperature controller with your oven (annealer, fuser or kiln), briefly how a temperature controller works and what the 4 pre-loaded programs are and how to use them. It lists several other programs not pre-loaded that you may find useful. It also lists Quick Start instructions for starting the pre-loaded programs and Quick Start instructions for entering a new program. These additional instructions compliment the enclosed Orton instruction manual and will further extend your understanding of the operation of the temperature controller.

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 manufacture. 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 ASC/5 uses a Type K thermocouple. If the temperature controller has a mercury relay, it will be labeled so on its top. The temperature controller must then be securely mounted to a wall or other stable surface so that the controller is always in its upright position. Controllers without a mercury relay are not position sensitive. Next, plug the temperature controller into an appropriate electrical outlet, and then plug the oven into the temperature controller. 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. The temperature controller will momentarily display 00.00 then E-4 when first turned on.

How a temperature controller operates

A temperature controller is a device that controls the operation 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, how fast to heat up or cool down to that temperature (called a Ramp), whether or not to hold a steady temperature over a period of time (called a Hold or Soak), whether or not to repeat any of these instructions and how to vary them, and finally, to 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 are called Steps or Segments. If a Step is angled, either up or down from horizontal, it is called a Ramp Step. A horizontal Step is called a Hold. The bottom horizontal scale of the graph shows time passing from left to right, and on the left vertical scale, temperature is shown to increase from bottom to top. So, a Step that is angled like this /, is a heating Ramp. The temperature inside the oven increases as time passes. A Step angled like this \, is a cooling Ramp. The temperature inside the oven decreases as time passes. A horizontal Step like this —, is a Hold Step. The temperature inside the oven remains the same as time passes. The ASC/5 temperature controller considers a Hold Step as the last part of the preceding Ramp Step and therefore does not count it as a separate and independent Step.

When you start the temperature controller in a program, it will go to the first Step, Step 1, and beginning running. When the temperature controller has made the oven perform what you programmed that Step to do, for instance, ramp up or down to a temperature, at the rate set, and hold it there for the amount of time set, it will then go to the next Step, Step 2, for further instructions. The controller carries on in this manner until it completes the last programmed Step, at which time the program is complete and temperature controller turns off power to the oven until you start a program again.

Description of Programs

Programs 2 and 3 are variations of Program 1. To better understand them, you should examine Program 1 first.

Program 1: Lampwork annealing for soft glasses, such as Bullseye, Effetre (Moretti), Creation is Messy, Uroboros and Vetrofond. Use this program when you place hot glass items directly into a pre-heated annealer. This program works well for small to medium size glass items, such as beads. Listed at the end of this addendum is an optional program suggestion for larger glass items.

Starting the program begins with Step 1 (a step is also known as a segment). Your annealer turns on and ramps up to 960° F (516° C) as fast as the annealer is capable. After reaching 960° F (516° C), the temperature is held for 12 hours (a hold is also known as a soak or dwell). At the end of the 12 hour hold time, the program will automatically advance to step 2. The 12 hour hold time is really an arbitrary number. This is the portion of the program during which you are lampworking and putting your hot glass items into the annealer. If you do not intercede with the normal running of the program, the entire hold time of 12 hours for Step 1 will be maintained at a steady temperature of 960° F (516° C). Only after the 12 hour hold time has expired will the temperature controller automatically advance to Step 2 and then eventually to off.

The 12 hour hold time was chosen for several reasons. 12 hours is a long enough working time for most lampworkers, even with breaks. With a shorter time you might find the annealer cycling down while you are still working. Should you forget to cycle down the annealer and leave it unattended (not recommended), the program will automatically begin to cycle down to off after the 12 hour hold time has expired. If 12 hours is not enough working time, you have several options: 1) You can lengthen the time before starting the program: 2) You can lengthen the time while the program is running: 3) You can restart the program.

The Skip Step feature of the temperature controller allows you to skip forward, any time during the 12 hour hold, to the next step in the program and abandon any remaining time of that hold. For example, let's say you are lampworking using Program 1. The temperature controller is running in the 12 hour hold portion of Step 1. You decide to work for four hours, but after only three hours, you call it a day. With only three button pushes, you advance the temperature controller to Step 2. This drops off the remaining 9 hours of hold time in Step 1. This saves you from always reprogramming the temperature controller to the amount of time you think you will work that day.

In Step 2, the temperature ramps up to 960° F (516° C) as fast as the annealer is capable. The temperature should already be at or very near there. If you had just opened the annealer's door to place a hot glass item in, it will have caused the temperature to drop a few degrees. Since you only advance to Step 2 after your last item has been placed into the annealer, Step 2's undisturbed hold time of 30 minutes becomes the actual annealing portion of Program 1. After the 30 minute hold time in Step 2 expires, the temperature controller automatically advances to Step 3.

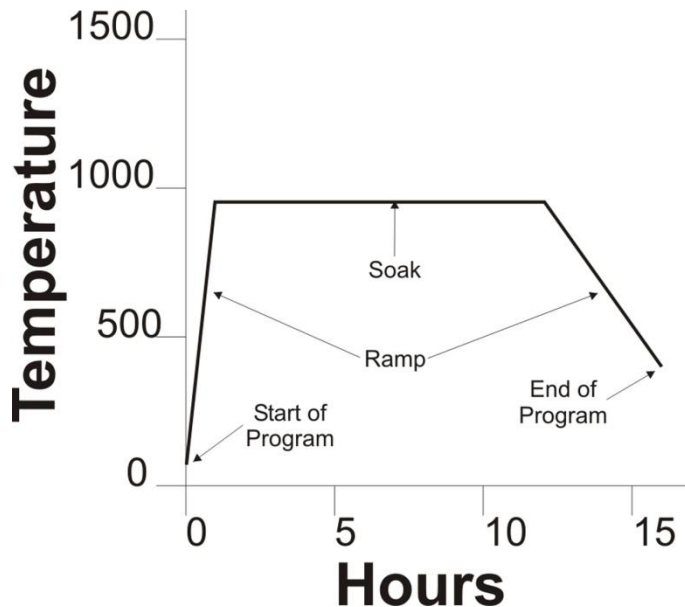
Step 3 is the cooling portion of the annealing cycle. The temperature is cooled down from 960° F (516° C) to 400° F (204° C) at a ramp rate of 400° F (222° C) per hour. When 400° F (204° C) is reached, the temperature controller will then hold that temperature for the programmed amount of time, in this case zero. The controller will then automatically advance to Step 4, which has a ramp rate set to zero and is therefore not considered part of the program. The temperature controller determines that the firing is complete and the program running terminates. The annealer will remain off until you again start a program.

About Annealing

Annealing is accomplished only by holding a steady temperature over a period of time. The temperature and time are determined by the type of glass and its size and shape. Lower COE glasses develop less stress than higher COE glasses for a given set of circumstances. The thickness of the glass has a large influence on the length of time needed to anneal and cool the glass. However, a larger piece with the same thickness also influences annealing hold time and cooling rate. Annealing can only remove stresses that develop during the manufacturing process. Annealing cannot remove stresses due to variations in COE of the different glasses used within the item.

There are several kinds of stresses in glass that can cause it to break. If any single stress is large enough, or a combination of stresses is large enough, a critical level is reached and the glass will break. Stress caused by differences in COE within the glass item cannot be annealed away, so you need to use glasses that are compatible within the glass item. This is not always easy when that special color you want to use has a COE different enough from the other glasses that it may cause the glass item to break if not otherwise nicely annealed. Given that you properly annealed the glass to remove manufacturing stress, and not considering thermal shock and impact shock, stress developed during cooling adds to the COE stress and can be all it takes to break the item. Cooling actually puts stresses back into the glass. Cooling slowly adds less stress than cooling at a faster rate. A lesser amount of cooling stress added to the COE stress may be all it takes to keep the glass below the stress threshold that would otherwise break it. As with the annealing portion of the annealing cycle, the cooling rate is determined by the type of glass and its size and shape.

Ideally, successful annealing is done by placing just made glass items into a pre-heated annealer set at or a little cooler than annealing temperature, before the item cools much below the annealing temperature. This helps prevent the item from breaking before it has had a chance to be annealed by eliminating the possibility of thermal shock and by the fact that while glass is very hot it is not as adversely affected by stresses. Essentially, it is best to remove the stress while the glass is hot, because the stresses in glass at lower temperatures can more easily break the glass.



Program 2: Lampwork batch annealing for soft glasses, such as Bullseye, Effetre (Moretti), Creation is Messy, Uroboros and Vetrofond. Use this program when you place cold, unannealed glass items directly into a cold annealer.

If you have glass items that were never annealed or improperly annealed, you can anneal them in what is called batch annealing. Batch annealing does not heal broken glass. Just because a cold unannealed glass item is not broken does not mean it will not break in the future. For instance, dropping a glass item adds stress to it as well as taking it from a warm house and stepping out into a blizzard. These stresses add to the potentially huge amount of manufacturing stress left in the glass. It is their combined stresses that can easily break the glass. The use of a ceramic fiber blanket or vermiculite does not anneal glass. It only reduces the cooling rate a little, which does reduce the amount of cooling stress the glass acquires, and it reduces the amount of thermal shock the glass is subjected to. Fortunately, small glass items are far less subject to developing fatal amounts of stress than larger glass items. Unfortunately, it is hard to define what is a smaller glass item, because it is determined by the type of glass, its shape and by how well the piece was flame annealed, before it cooled. Anecdotally, glass spherical shapes, such as beads, that are around 1/2" (12 mm) in diameter do very well. Even a little larger if you are deft at flame annealing.

The only difference in Program 2 from Program 1 is in Step 1. The heating rate is set to 900° F (5000° C) per hour, which means that any room temperature glass put into a room

temperature annealer will heat up to 960° F (516° C) over the course of approximately one hour. This slow rise prevents breakage caused by thermal shock. When the annealer reaches, or is very close to the temperature in Step 1, you have several options. You can make new glass items and add them to the other items already in the annealer as if you were running Program 1. Or, you can advance forward to Step 2 to the annealing portion of the cycle. Or, you may chose to use an entirely different program. Perhaps one of the optional programs listed below that only slowly heats up to the annealing temperature and then anneals without the 12 hour hold time.

Program 3: Lampwork annealing for borosilicate hard glasses, such as Glass Alchemy, Northstar Glassworks, Pyrex, Simax and Trautman Art Glass.

The only difference in Program 3 from Program 1 is that in Step 1 and Step 2, the temperature is set to 1050° F (566° C).

Program 4: Jewelry scale fusing for soft glasses, such as Bullseye, Spectrum and Uroboros.

Like the annealing programs listed above, there is no single perfect or better firing program. There are as many ways to write a fusing program as there are people that fuse. This program is a generic program that is widely used with great success. Firing programs for glass items larger than jewelry scale have a slower heat up rate, a longer annealing hold time and a slower cooling rate.

Starting Program 4 begins with Step 1. Your kiln turns on and ramps up to 1000° F (538° C) at 1000° F (556° C) per hour. After reaching temperature, the temperature controller will then hold that temperature for the programmed amount of time. Since the hold time for Step 1 is set for zero, the controller will then automatically advance to Step 2.

In Step 2, the temperature ramps up to 1500° F (816° C) as fast as the kiln is capable. After reaching 1500° F (816° C), the temperature controller will then hold that temperature for the programmed amount of time, 30 minutes. At the end of the 30 minute hold time for fusing, the program will automatically advance to Step 3.

In Step 3, the temperature ramps down to 960° F (516° C) as fast as the kiln is capable. After reaching 960° F (516° C), the temperature controller will then hold that temperature for the programmed amount of time, 30 minutes. Step 3 is the crashing and annealing portion of the program. Crashing is forcing a quick drop in temperature after the glass has fused to the desired amount. Crashing stops the fusing process and helps prevent devitrification (the dull and matted look glass can develop by spending too much time around 1400° F(760° C)). At the end of the 30 minute hold time for annealing, the program will automatically advance to Step 4.

Step 4 is the cooling portion of the annealing cycle. The temperature is cooled down from 960° F (516° C) to 400° F (204° C) at a ramp rate of 400° F (222° C) per hour. When 400° F (204° C) is reached, the temperature controller will then hold the temperature for the programmed amount of time. Since the hold time for Step 4 is set for zero, the controller will then automatically advance to what would have been Step 5. Step 5 has a ramp rate set to zero and is therefore not considered part of the program. The temperature controller determines that the firing is complete and the program running terminates. The kiln will remain off until you again start a program.

The 30 minute hold time in Step 2 is an arbitrary time set for the fusing portion of the program. 30 minutes is not so long that glass items will over fire and become unusable should you not monitor the kiln during the firing. More than likely, you will want to do what many fusers do; peek at the glass during the fusing process to make a determination of when it has arrived at the optimum amount of fusing. For example, let's say you are fusing using Program 4. The temperature controller has already run through Step 1 where it heated the kiln to the 1000° F (538° C). It is now in Step 2. The temperature is now at 1500° F (816° C) and the 30 minutes hold time is counting down. This is where the actual fusing happens. You look at the glass item 20 minutes into the 30 minute hold time to check its progress. You determine it has fused as much as you want it to. With only three button pushes, you advance the temperature controller to Step 3. This skips the remaining 10 minutes of hold time in Step 2. Step 3 is the annealing step. The ramp rate for Step 3 is set at full. This helps to quickly cool the glass to "Freeze" its shape and to also help the temperature to quickly pass through the devitrification temperature range around 1400° F (760° C). The glass is still very hot. Breakage from thermal shock can not happen. You can open the kiln during the crash period as an option to crash the temperature faster. Always wear appropriate eye, hand and body protection when working with a hot kiln or annealer. In Step 3, the temperature is set for 960° F (516° C) with a hold time of 30 minutes. After the 30 minutes has expired, the temperature controller automatically advances to Step 4 and cools down to 400° F (204° C) at the rate of 400° F (222° C) per hour and then terminates the program. If you open the kiln during the crash period, advance forward from Step 2 to Step 3 first. Close the kiln before the temperature reaches 960° F (516° C) or you may trigger an alarm and the program may terminate.

How to run the 4 pre-loaded programs

To start one of the 4 pre-loaded programs, begin with the display showing the temperature alternating with IdLE. If the display shows something else, press the left button, repeatedly if necessary, until it does. Use this method to stop a running program or to exit from having pushed a wrong button.

Press the left button once. The display will show PrO and a number from 1 to 9, as in PrO1, PrO2, etcetera. PrO represents Program and the number refers to one of the 9 possible programs the temperature controller can contain. A steady lit light to the right of the display and to the left of the printed word PROGRAM indicates a program number is displayed.

Using *only* the center button, scroll through the nine available programs until you have displayed the program to run.

You have two choices on how to start the program. For the first and quickest method, press the right button. The display will begin a review of the details of each step in the program, starting with the amount of time you may have set for a delayed start (refer to Orton's AutoFire Express manual for setting a delayed start). This review can be canceled by pressing the right button again. While the review is displayed, a steady lit light to the right of the display and to the left of the printed word REVIEW indicates a program is being reviewed.

After you allow the review to finish displaying or after you cancel the review, the display will show Strt, representing start. The program is now loaded and ready to start. The light next to the printed word PROGRAM is once again steady lit.

Press the left button once to start the program. The display will show -On- for a moment, then will show the temperature. A blinking light to the right of the display and to the left of the printed word RUN indicates the program is running.

The second method of starting a program also allows you to modify an existing program before starting it or to create a program where one does not exist. After you have a program number showing in the display, press the left button instead of the right button. The display will show the ramp rate for Step 1. You have the opportunity to change it or you can chose to leave it as it is. Press the left button again and the temperature for Step 1 is displayed. As before, change it or leave it as is. Press the left button again and the hold time is displayed. As before, change it or leave it as is. Press the left button to repeat the procedure for Step 2 and so on to the end of the program. When you reach the end of the program, you will see one more step with a ramp rate set to 0000. If you leave this as is, the temperature controller interprets this as the end of the program and the display will show Strt. As described above, press the left button once to start the program.

To step forward in a running program as described in the section, Description of Programs, press the center button. The display will show SSTEP, representing Skip Step. Press the left button. The display will show you the ramp rate step number or the hold time step number the temperature controller is running in. Press the left button again to step forward in the program. The display goes back to showing the temperature. If you decide to cancel a step forward after you start the Skip Step procedure, but before you push the left button, press the right button. The display will show the temperature. This is also how you can take a look at what part of the program the annealer or kiln is running in.

To terminate the program early, press the left button. The display will show StOP alternating with the length of time the program ran. Press the left button one more time to have the display show the temperature alternating with IdLE. The temperature controller is now ready to run a program again.

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. A controller that has a solid state relay has no moving parts. 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. A mechanical mercury relay can last several times this, as can a solid state relay. A mechanical relay that is worn out past its useful life can cause several problems. It can stick closed, causing the oven to overheat, even if a program is not running. It can create intense electrical noise that can cause an error. It can also be so corroded that it may impede electrical flow to the oven, causing a failure to heat.

A solid state relay tends to have a long and reliable life, but will typically fuse closed when it fails. This causes the oven to overheat, even if a program is not running. Also, a solid state relay always “leaks” a few volts through itself to the oven, even if a program is not running.

Quick Start - Running an existing program



Press left button.

Display shows **PrOx**, where **x** is a number from **1** to **9**, representing the program number. If the display did not show **IdLE** before you press the left button you may need to press it more than one time.



Press center button until display shows desired program number.

Display shows **PrO1**, **PrO2**, etcetera. If display already shows the program number you want to run, you do not need to press this button.



Press right button.

Display begins a review of the selected program. If this button is pressed a second time, the review is canceled. Display shows **Strt** (Start) at end of review or after cancel. It is not necessary to wait for review to complete or be canceled before proceeding to next step.



Press left button.

Display shows **-On-** for a few moments then shows the temperature. To the left of the display, a light blinks next to **RUN**. Program is now running.

Option - To skip forward in the running program



Press the center button.

Display shows **SStP** (Skip Step).



Press the left button twice.

On the first button push, the display will show either **rA x**, where **x** is the step number of the Ramp in which the controller is running, or the display will show **HLdx**, where **x** is the step number of the Hold in which the controller is running.

The second button push advances the program to the next step and the display shows the temperature.



To cancel skipping forward in the program after pressing the PROGRAM START/STOP button (left button) once, press the DECREASE REVIEW button (right button) once. This is a best method to see which step in the running program the controller is currently running in without affecting the running program.

You cannot skip forward in a running program past the last step of a program.

Pre-Loaded Programs

Program 1: Lampwork annealing for soft glasses

Step 1: Ramp Rate Full, Temperature 960° F (516° C), Hold Time 12 hours
Step 2: Ramp Rate Full, Temperature 960° F (516° C), Hold Time 30 minutes
Step 3: Ramp Rate 400° F (222° C), Temperature 400° F (204° C), Hold Time none
End

Program 2: Lampwork batch annealing for soft glasses

Step 1: Ramp Rate 900° F (500° C), Temperature 960° F (516° C), Hold Time 12 hours
Step 2: Ramp Rate Full, Temperature 960° F (516° C), Hold Time 30 minutes
Step 3: Ramp Rate 400° F (222° C), Temperature 400° F (204° C), Hold Time none
End

Program 3: Lampwork annealing for borosilicate hard glasses

Step 1: Ramp Rate Full, Temperature 1050° F (566° C), Hold Time 12 hours
Step 2: Ramp Rate Full, Temperature 1050° F (566° C), Hold Time 30 minutes
Step 3: Ramp Rate 400° F (222° C), Temperature 400° F (204° C), Hold Time none
End

Program 4: Jewelry scale fusing for soft glasses

Step 1: Ramp Rate 1000° F (556° C), Temperature 1000° F (538° C), Hold Time none
Step 2: Ramp Rate Full, Temperature 1500° F (816° C), Hold Time 30 minutes
Step 3: Ramp Rate Full, Temperature 960° F (516° C), Hold Time 30 minutes
Step 4: Ramp Rate 400° F (222° C), Temperature 400° F (204° C), Hold Time none
End

Optional Program Suggestions

Lampwork annealing for larger soft glass items

Step 1: Ramp Rate Full, Temperature 960° F (516° C), Hold Time 12 hours
Step 2: Ramp Rate Full, Temperature 960° F (516° C), Hold Time 1 hour
Step 3: Ramp Rate 200° F (112° C), Temperature 400° F (204° C), Hold Time none
End

Lampwork soft glass batch annealing only – No 12 hour hold as in Program 2

Step 1: Ramp Rate 900° F (500° C), Temperature 960° F (516° C), Hold Time 30 minutes
Step 2: Ramp Rate 400° F (222° C), Temperature 400° F (204° C), Hold Time none
End

Lampwork annealing for borosilicate hard glasses with a lower garage temperature to prevent early striking

Step 1: Ramp Rate Full, Temperature 850° F (455° C), Hold Time 12 hours
Step 2: Ramp Rate Full, Temperature 1050° F (565° C), Hold Time 30 minutes
Step 3: Ramp Rate 400° F (222° C), Temperature 400° F (204° C), Hold Time none
End

Lampwork annealing for Kinari and Satake soft glasses

Step 1: Ramp Rate Full, Temperature 880° F (472° C), Hold Time 12 hours

Step 2: Ramp Rate Full, Temperature 880° F (472° C), Hold Time 1 hour

Step 3: Ramp Rate 300° F (167° C), Temperature 400° F (204° C), Hold Time none

End

PMC Standard - Also can be used for PMC Plus and PMC 3

Step 1: Ramp Rate Full, Temperature 1650° F (999° C), Hold Time 2 hours

End

PMC Plus - Middle temperature

Step 1: Ramp Rate Full, Temperature 1560° F (849° C), Hold Time 20 minutes

End

PMC Plus - Low temperature

Step 1: Ramp Rate Full, Temperature 1470° F (799° C), Hold Time 30 minutes

End

PMC 3 - Middle temperature

Step 1: Ramp Rate Full, Temperature 1290° F (699° C), Hold Time 10 minutes

End

PMC 3 - Low temperature

Step 1: Ramp Rate Full, Temperature 1200° F (649° C), Hold Time 20 minutes

End

PMC 3 - Lowest temperature

Step 1: Ramp Rate Full, Temperature 1100° F (594° C), Hold Time 30 minutes

End

PMC 3 with glass - High temperature

Step 1: Ramp Rate 1000° F (556° C), Temperature 1000° F (538° C), Hold Time none

Step 2: Ramp Rate Full, Temperature 1290° F (699° C), Hold Time 10 minutes

Step 3: Ramp Rate Full, Temperature 960° F (516° C), Hold Time 30 minutes

Step 4: Ramp Rate 400° F (222° C), Temperature 400° F (204° C), Hold Time none

End

PMC 3 with glass - Middle temperature

Step 1: Ramp Rate 1000° F (556° C), Temperature 1000° F (538° C), Hold Time none

Step 2: Ramp Rate Full, Temperature 1200° F (500° C), Hold Time 20 minutes

Step 3: Ramp Rate Full, Temperature 960° F (516° C), Hold Time 30 minutes

Step 4: Ramp Rate 400° F (222° C), Temperature 400° F (204° C), Hold Time none

End

PMC 3 with glass - Low temperature

Step 1: Ramp Rate 1000° F (556° C), Temperature 1000° F (538° C), Hold Time none

Step 2: Ramp Rate Full, Temperature 1100° F (594° C), Hold Time 30 minutes

Step 3: Ramp Rate Full, Temperature 960° F (516° C), Hold Time 30 minutes

Step 4: Ramp Rate 400° F (222° C), Temperature 400° F (204° C), Hold Time none

End

Quick Start - Entering a new program

The following information takes you through, step-by-step, entering in a new program. The program we will use is from one of the Optional Program Suggestions listed above. We will enter it as program 5.

Lampwork soft glass batch annealing only – No 12 hour hold as in Program 2

Step 1: Ramp Rate 900° F (500° C), Temperature 960° F (516° C), Hold Time 30 minutes

Step 2: Ramp Rate 400° F (222° C), Temperature 400° F (204° C), Hold Time none

End



Press left button.

Display shows **PrOx**, where **x** is a number from **1** to **9**, representing the program number. If the display did not show **IdLE** before you press the left button you may need to press it more than one time.



Press center button until display shows desired program number.

In this scenario, we want the display to show **PrO5**. If the display already shows **PrO5**, you do not need to press this button.



Press left button.

The display will show **rA 1**, representing the Ramp Rate of Step 1 of the program we are entering, Program 5. The display will alternate between **rA 1** and the current value of the Ramp Rate that is already there.



Press the center button to increase the Ramp Rate and press the right button to decrease the Ramp Rate.

Set the Ramp Rate for Step 1 to 900° F (500° C).



Press left button.

The display will show **°F 1**, representing the Fahrenheit Temperature of Step 1 (or **°C 1** representing the Celsius Temperature of Step 1) of the program we are entering. The display will alternate between **°F 1** and the current value of the Temperature that is already there.



Press the center button to increase the Temperature and press the right button to decrease the Temperature.

Set the Temperature for Step 1 to 960° F (516° C).



Press left button.

The display will show **HLd1**, representing the Hold Time of Step 1 of the program we are entering. The display will alternate between **HLd1** and the current value of the Hold Time that is already there.



Press the center button to increase the Hold Time and press the right button to decrease the Hold Time.

Set the Hold Time for Step 1 to 30 minutes. The display should show **00.30**.

You have just finished entering the Ramp Rate, Temperature and Hold Time for Step 1 of Program 5. Continuing on, we will now enter the Ramp Rate, Temperature and Hold Time for Step 2.



Press left button.

The display will show **rA 2**, representing the Ramp Rate of Step 2 of the program we are entering. The display will alternate between **rA 2** and the current value of the Ramp Rate that is already there.



Press the center button to increase the Ramp Rate and press the right button to decrease the Ramp Rate.

Set the Ramp Rate for Step 2 to 400° F (222° C).



Press left button.

The display will show **°F 2**, representing the Fahrenheit Temperature of Step 2 (or **°C 2** representing the Celsius Temperature of Step 2) of the program we are entering. The display will alternate between **°F 2** and the current value of the Temperature that is already there.



Press the center button to increase the Temperature and press the right button to decrease the Temperature.

Set the Temperature for Step 2 to 400° F (204° C).



Press left button.

The display will show **HLd2**, representing the Hold Time of Step 2 of the program we are entering. The display will alternate between **HLd2** and the current value of the Hold Time that is already there.



Press the center button to increase the Hold Time and press the right button to decrease the Hold Time.

Set the Hold Time for Step 1 to 0. The display should show **00.00**.

You have just finished entering the Ramp Rate, Temperature and Hold Time for both Steps 1 and 2 of Program 5. Continuing on, we will now enter the Ramp Rate for Step 3 as 0. If any Step has its Ramp Rate entered as 0, the temperature controller determines the program ends at the previous Step. In this scenario, Step 2 is the last step in Program 5.



Press left button.

The display will show **rA 3**, representing the Ramp Rate of Step 3 of the program we are entering. The display will alternate between **rA 3** and the current value of the Ramp Rate that is already there.



Press the center button to increase the Ramp Rate and press the right button to decrease the Ramp Rate.

Set the Ramp Rate for Step 3 to 0.



Press left button.

This time the display will not show **°F 3** (or **°C 3**), because when you entered a Ramp Rate of 0 for Step 3 the temperature controller determined the program ended at the previous step (Step 2) and therefore there is now no Step 3.

You have just created a new program and assigned it to Pr05. It is in now permanent memory and will remain there for you to retrieve. You can also delete it or modify it using the same method used to create it. To delete it, simply set the Ramp Rate of Step 1 to 0. To modify it, simply program over it.

The display now shows **Strt.** You have two options.



Press left button to start the program you just entered.

OR



Press left button three times to finish and NOT start the program just entered.

The first time the button is pushed the program actually starts with a 5 second delay. The display will show **-On-** for a few moments then will show the temperature. The second time the button is pushed the program is terminated. The display will show **StOP** alternating with how long the program ran the temperature. The third time the button is pushed returns the temperature controller to a ready state. The display will show **IdLE** alternating with the temperature.