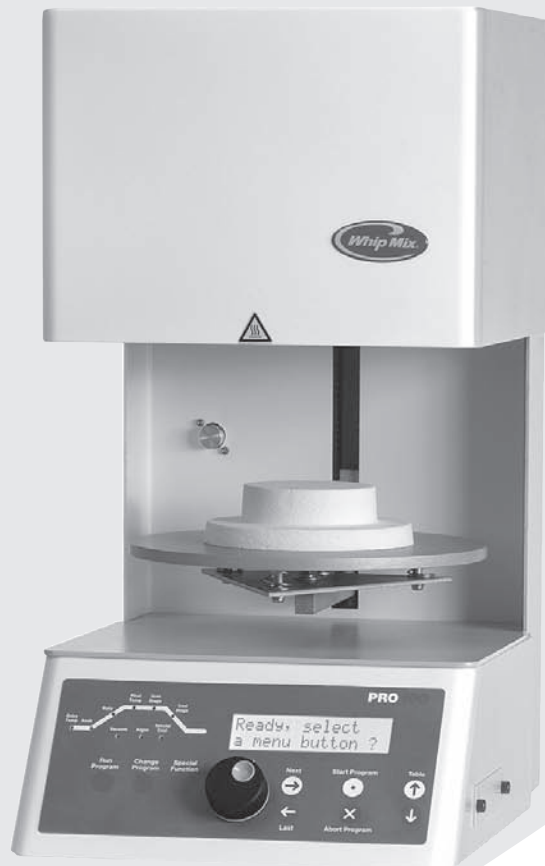




# Pro Series Furnace Operation Manual



**Pro Press 100**



**Pro 100**

## Warnings



**DO NOT OPERATE THIS FURNACE WITH ANY OTHER POWER CORD.**

**DO NOT OPERATE WITH AN EXTENSION CORD.**

**OPERATING THIS FURNACE ON A CIRCUIT WITH OTHER FURNACES OR ELECTRICAL APPLIANCES THAT REQUIRE SIGNIFICANT POWER MAY CAUSE A CIRCUIT BREAKER TO TRIP.**

**WHEN OPERATING THE PRO 100, USE ONLY ARGON GAS. ATTACHING ANY FLAMMABLE OR NOXIOUS GAS IN THIS FURNACE COULD CAUSE EXPLOSION OR PERSONAL INJURY!**

## Warranty

### United States and Canada

Whip Mix Corporation warrants the Pro 100 and Pro Press 100 to the original purchaser against defective workmanship and materials under normal procedures of installation, use and service within the dental profession, for a period of three years or 3750 muffle hours, whichever occurs first. During which time Whip Mix Corporation will replace, repair or deny warranty coverage at its discretion. Heat treating refractory materials, misuse, improper installation, improper maintenance, accident or abuse will void the warranty. Whip Mix coverage only applies to Whip Mix supplied parts, and repairs performed by Whip Mix certified repair technicians. Repairs performed during the warranty period do not extend the warranty period. Warranty coverage under these terms extends only to furnaces produced or sold to the original purchaser after 12/31/04. Shipping damage is only covered from Whip Mix to the intended recipient.

### International

Two years parts and labor from date of purchase from dealer.

## Recommendations

**Note:** During shipping the muffle might absorb moisture from the air. So, it is recommended you heat the muffle to dry the moisture any porcelain. To dry the muffle, set the idle temperature to 400° C for one hour and 600° C for one hour. Follow the numbered instructions in this section to set the ideal temperature to the temperatures mentioned above.

Whip Mix recommends leaving the furnace on at all times. Turning the furnace off overnight may cause damage to the muffle, contamination and void the warranty. Leaving your furnace on will also extend the life of your furnace. See **Night Mode**, page 10 for further information. Leaving the furnace on will also extend the life of the battery on the main board. If the furnace is off and the battery fails, all software, calibrations and programs will be lost.

## Accessories

| Pro Press 100                       | Pro 100                             |
|-------------------------------------|-------------------------------------|
| Manual                              | Manual                              |
| Cooling Tray                        | Cooling Tray                        |
| Firing Tray                         | Firing Tray                         |
| Press Firing Tray                   | Power Cord                          |
| Power Cord                          | Temperature Calibration Certificate |
| Temperature Calibration Certificate |                                     |
| Ceramic Insert                      |                                     |
| Press Air Regulator                 |                                     |



**IMPORTANT: CONTACT YOUR DEALER OR THE FACTORY FOR COMPLETE INSTRUCTIONS ON CONVERTING THE FURNACE BETWEEN 115 VAC AND 220 VAC.**

# Table of Contents

## Chapter One — Getting Started

|   |    |
|---|----|
| External Component Locator .....                      | 4  |
| Before Unpacking .....                                | 5  |
| Unpacking.....  | 5  |
| Press Regulator Set-Up .....                          | 5  |
| Installing the Vacuum Pump .....                      | 5  |
| Quick-Cool Jet Installation for Pro 100 Furnace ..... | 6  |
| Power.....  | 7  |
| Front Panel Controls .....                            | 7  |
| Menu Selection Buttons .....                          | 8  |
| Information Entry.....                                | 9  |
| Program Start/Abort.....                              | 9  |
| Table Control .....                                   | 9  |
| Adjust Speaker Volume.....                            | 10 |
| Using the Furnace .....                               | 10 |

## Chapter Two — Special Functions Menu

|   |    |
|---|----|
| Special Functions Menu .....                                | 11 |
| Configuring, Initiating and Setting-Up Night Mode.....      | 11 |
| Change Idle Temperature.....                                | 11 |
| Set Vacuum Level.....                                       | 12 |
| Degrees Centigrade or Fahrenheit .....                      | 12 |
| Set Program Start Delay .....                               | 12 |
| Select Constant/Intermittant Vacuum .....                   | 13 |
| Special Cool Position .....                                 | 13 |
| Select Upper or Lower Case Letters .....                    | 13 |
| Porcelain Names .....                                       | 14 |
| Adjust Calibration to Match Porcelain .....                 | 14 |
| Adjust Low-Fusing Porcelain Calibration .....               | 15 |
| Adjust High-Fusing Porcelain Calibration.....               | 15 |
| Adjust Press Temp. Calibration<br>(Pro Press 100 only)..... | 16 |
| Print Form .....  | 16 |
| Transferring Programs to Other Furnaces .....               | 16 |
| Testing the Furnace.....                                    | 17 |
| Calibrate Oven .....  | 17 |
| Fast Cool with Vacuum On.....                               | 17 |
| Wide or Narrow Print .....                                  | 17 |
| Enable Program Password Protection .....                    | 17 |
| Use Timed Press.....  | 17 |
| Print Form .....  | 17 |
| Load Code from “Blue Smart Box”.....                        | 17 |

## Chapter Three — Change Program Menu

|   |    |
|---|----|
| Change Program Menu.....  | 18 |
| Program Number/Name Description .....                             | 18 |
| Look at a Program.....  | 18 |
| Add a Program .....   | 19 |
| Normal Porcelain Firing Cycle Program .....                       | 19 |
| Press Firing Cycle Program (Pro Press 100 only) .....             | 20 |
| Special Porcelain Firing Cycle Program.....                       | 21 |
| Titanium to Porcelain Firing Cycle Program<br>(Pro 100 only)..... | 23 |
| Sintering Firing Cycle Program (Pro 100 only) .....               | 24 |
| In-Ceram® Firing Cycle Program (Pro Press 100 only)....           | 25 |
| Change a Program .....  | 26 |
| Copy/Change a Program .....                                       | 26 |
| Move a Program.....   | 26 |
| Erase a Program.....  | 27 |
| Print Programs .....  | 27 |

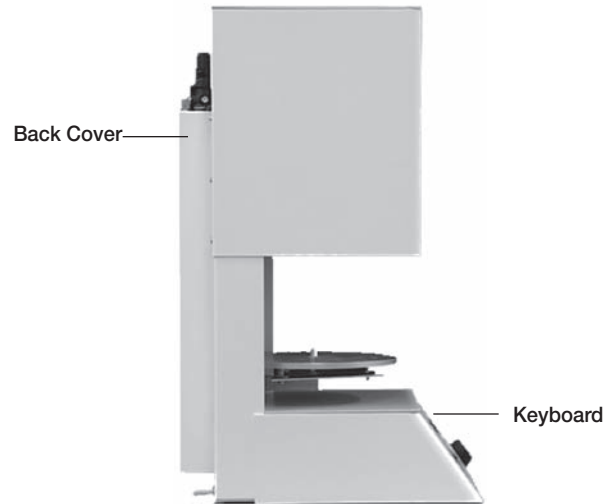
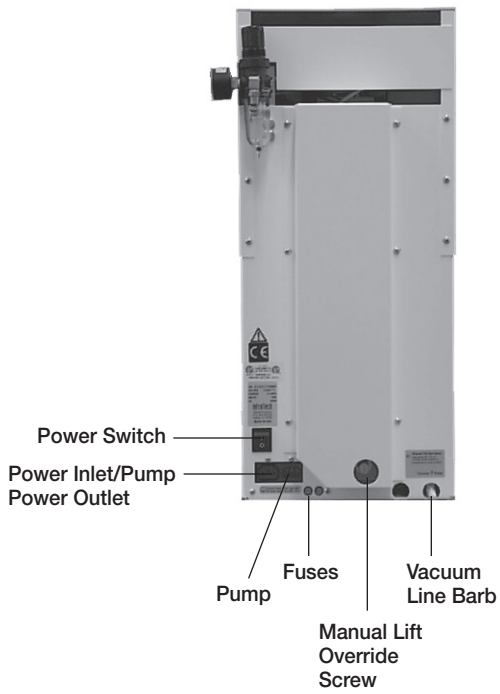
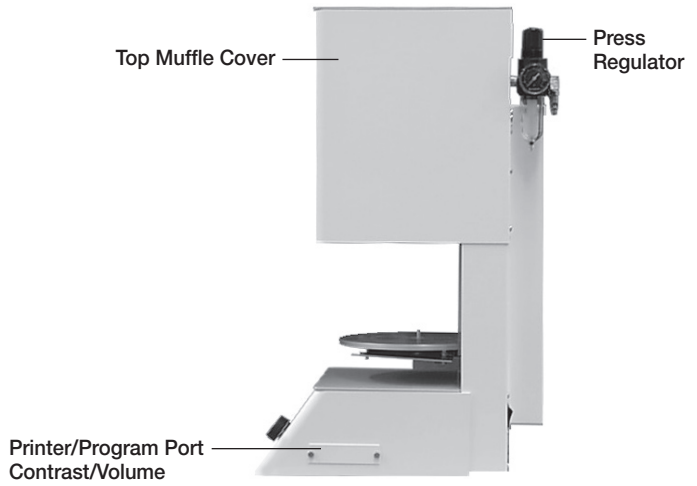
## Chapter Four — Run Program Menu

|  |    |
|--|----|
| Running a Program .....                              | 28 |
| Repeat Programs .....                                | 28 |
| Features and Displays .....                          | 28 |
| Running a Pressing Program (Pro Press 100 only)..... | 30 |
| Running a Re-Press Program .....                     | 30 |
| Running a Manual Glazing Program .....               | 31 |

## Chapter Five — Maintenance

|   |    |
|---|----|
| Cleaning the Furnace.....                                       | 32 |
| Battery Replacement .....                                       | 32 |
| Software Version Upgrades.....                                  | 32 |
| Printer Requirements and Installation.....                      | 33 |
| Argon Gas Requirements and Installation<br>(Pro 100 only) ..... | 34 |
| Replacing the Muffle .....                                      | 35 |
| Troubleshooting Guide.....                                      | 38 |
| Description of Error Codes .....                                | 38 |
| Vacuum Test .....   | 39 |
| Fuses.....  | 40 |
| If More Help is Needed .....                                    | 40 |
| Replacement Parts.....  | 41 |
| Other Products from Whip Mix .....                              | 41 |
| Pro Series Accessories .....                                    | 42 |
| Centigrade/Fahrenheit Conversion Table .....                    | 43 |

# External Component Locator



## Chapter One — Getting Started

You are undoubtedly eager to unpack, set up, and begin using your new furnace. Getting started will be much easier if you carefully review the information in this chapter and follow the steps as outlined.

### Before Unpacking

- Save the carton and packing materials. These can be used again if there is ever a need to ship or return equipment.
- Read and save the printed shipping material packed with your furnace — it contains valuable information!
- DO NOT turn on the power to your furnace until you are instructed to do so, or you will damage your furnace!

### Unpacking

- If the packaging materials and/or the furnace appear to be damaged, please call your dealer before continuing.
- Remove the furnace from the packing materials and place it on a flat surface in the upright position.
- Look up into the muffle area and locate the orange shipping bar and wing nuts. Remove the wing nuts, push the two bolts and attached brackets out of the orange bar. Finally remove the orange bar by sliding it out sideways. Keep these parts in case there is a need to ship the furnace.

### Press Regulator Set-Up

The Pro Press 100 requires compressed air to run a press cycle. A minimum air pressure of 63 psi/4.25 BAR and a maximum of 150 psi/10 BAR.



**INPUTTING MORE PRESSURE COULD CAUSE AN EXPLOSION!**



- Remove the regulator from the accessory box.
- Look at the female end of the brass quick connect and check for obstructions or foreign objects.



- With the clear plastic portion facing down, push the regulator onto the quick connect fitting at the

back of the furnace, as shown. Make sure the quick connect is fastened.



- Connect the compressed air supply to the regulator using a standard pneumatic fitting.
- Adjust the pressure regulator to 63 psi or 4.25 BAR.

If problems arise:

- Check the air supply for sufficient pressure
- Check all connections

If problems persist, write down your serial number and call Technical Support.

### Installing the Vacuum Pump

If you have a Whip Mix vacuum pump, plug it directly into the furnace where indicated on the back. If the pump is not a Whip Mix pump, follow the instructions as follows:

- Plug the vacuum pump's power cord into the outlet end of the short power cord supplied with the furnace. (Inside the accessory box.)
- Attach the other end of this short power cord to the international standard outlet on the rear of the furnace. (Next to the furnace power inlet.)

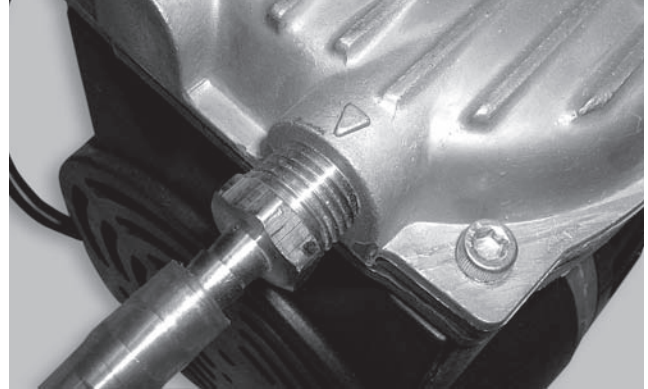
- Attach a 1/4" inch vacuum rated hose from the vacuum pump to the brass fitting marked **VACUUM PUMP** at the rear of the furnace.

**DO NOT** attach the Argon gas system to the **Pro 100** until the furnace is installed, operating, and the setup procedures in the **Special Functions** chapter of this manual have been completed.

## Quick-Cool Jet Installation for Pro 100 Furnaces with Air Cool Jet

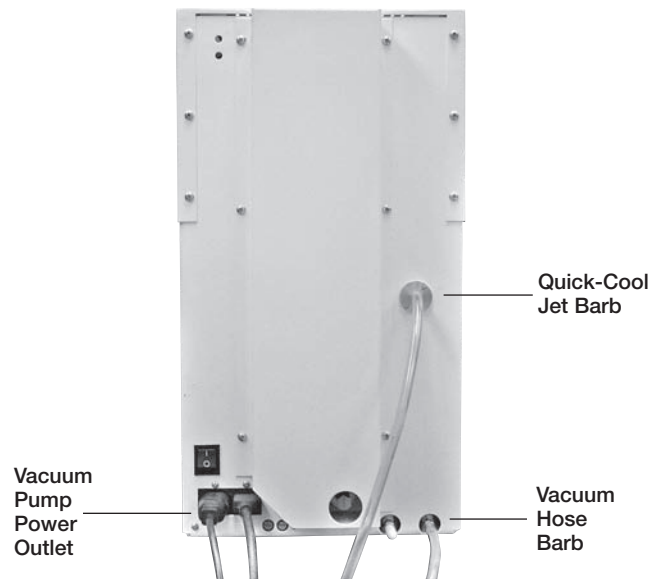
### Preparation:

1. Remove the vacuum pump from its box.
2. Remove the brass hose barb from the accessory box.
3. Remove the muffler from the output end of the vacuum pump. (The input and output valves are identified by arrow indicators on the vacuum pump near inlet or outlet.)
4. Install the brass barb to output end of the vacuum pump. (Where the muffler used to be.)
5. There should be two hoses included. One in the accessory box, the other inside the vacuum pump box. Use the hose included in the accessory box for the Quick-Cool Air Jet.



### Installation:

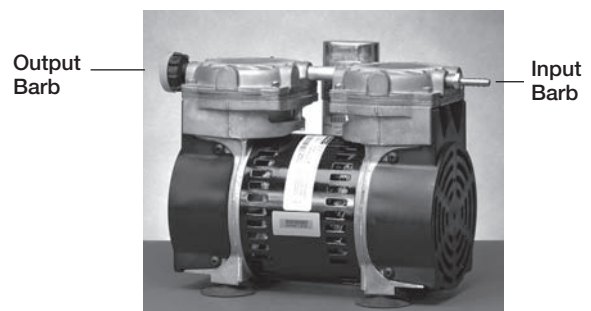
1. Push one end of the clear hose included in the accessory box over the output barb fitting at the output end of the vacuum pump.
2. Place the other end over the Quick-Cool Jet barb located on the back of the furnace. (See below.)
3. Using the other pink hose, place one end over the input side barb of the vacuum pump.
4. Place the other end over the vacuum barb at the back of the furnace.
5. Plug the power cord into the power outlet at the back of the furnace next to the furnace power inlet.



### Using the Quick-Cool Jet:

The Quick-Cool Jet will activate when a program has been started with a lower entry temperature than the furnace's current temperature.

1. To enable the Quick-Cool Jet, select and run a program with an entry temperature lower than the current temperature.
2. Once a program is complete, start the next program and the Quick-Cool Jet will engage.



## Power

- The furnace requires 115 VAC and 12 Amps of current in the United States and 220–240 VAC and 6.3 Amps of current in Europe and some parts of Asia. A special heavy-duty power cord has been supplied with your furnace.



**DO NOT OPERATE WITH ANY OTHER POWER CORD. DO NOT OPERATE WITH AN EXTENSION CORD. OPERATING THIS FURNACE ON A CIRCUIT WITH OTHER FURNACES OR ELECTRICAL APPLIANCES THAT REQUIRE SIGNIFICANT POWER MAY CAUSE A CIRCUIT BREAKER TO TRIP, A LOW VOLTAGE WARNING OR OTHER PROBLEMS WITH THE FURNACE. INSTALL THE HEAVY-DUTY POWER CORD AND PLUG THE FURNACE INTO A GROUNDED OUTLET.**

- Position the furnace so that the front is facing you. You should be able to reach the power switch on the right side of the furnace at the rear. Be sure to have at least 8 inches on all sides of the furnace to allow sufficient airflow to keep the furnace cool. Do not place anything flammable near the furnace.

- Turn the furnace on using the power switch. The display should light up with a message like the one shown in Figure 1, with the X's replaced by numbers.

The furnace will perform an internal self test for about 30 seconds and will then display the following screens:

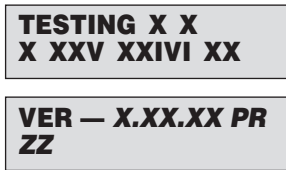


Figure 1

**Note:** The actual version number of your furnace will replace X.XX.XX in the above illustration. The PR represents a **Pro Press** and P1 represents a **Pro 100**.

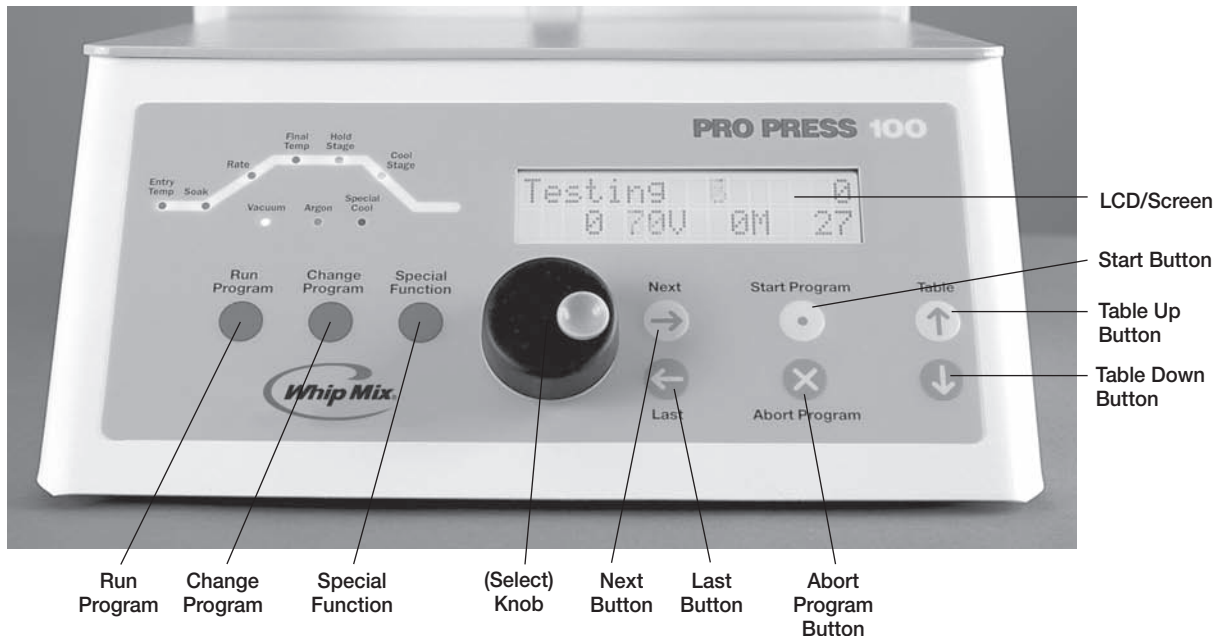
## Front Panel Controls

The front panel controls and their basic functions are described in this section. **Please read this section carefully.** (For further detail see the illustration on this page.)

The front panel controls are divided into four groups:

- Menu selection buttons: **Run Program**, **Change Program**, and **Special Functions**

- Information entry: **Select Knob**, **Next** and **Last**
- Program **Start/Abort** buttons
- Table control buttons: **Up/Down**



## Menu Selection Buttons

The three menu selection buttons (Run Program, Change Program and Special Functions) will display different options. The menu options can be seen by turning the **Select Knob**.

**Run Program** — Press the **Run Program** button to:

- Select a program to run.
- Review the program that is currently running.
- Display the current temperature if no program is running.

**Change Program** — the following actions may be initiated by first pressing the **Change Program** button, then turning the **Select Knob** to display the following options:

- Look at a program
- Add a program
- Change a program
- Copy/change a program
- Move a program
- Erase a program
- Print programs (or a single program)

**Special Functions** — press this button and turn the **Select Knob** to one of the following actions:

- Start Night mode
- Change Idle temperatures
- Set vacuum level
- Select degree C (Centigrade), or F (Fahrenheit) as well as Inches or Centimeters
- Set program start delay
- Set Night mode temperature
- Select between constant vacuum pump or intermittent cycle vacuum pump
- Select Special Cool position
- Select upper or lower case letters on the display
- Change/set porcelain names
- Adjust temperature **calibration for low-fusing porcelains**
- Adjust temperature **calibration for high-fusing porcelains**
- Adjust temperature **calibration for pressing temperature** (Pro Press 100 only)
- Print last program run
- Time and Date
- Programs ➡ Box: copy programs from furnace to “Red Smart Box”
- Programs ← Box: copy programs from “Red Smart Box” to furnace
- Test Furnace
  - Vacuum
  - Press (Pro Press 100 only)
  - Argon Valve (Pro 100 only)
  - Motor up
  - Motor down
  - Muffle hours (hours the muffle has been above 651° C)
  - Muffle test
- Calibrate Oven — See page 16 for further information.



## Information Entry

**DISPLAY** — All information and user prompts will be shown on the display (two lines, sixteen characters each).

**SELECT** — Turn the **Select Knob** left or right to select options or to adjust parameters.

**NEXT** — Press the **Next** button to proceed to the next step within a function or program.

**LAST** — Press this button to return to the preceding step within a function or program.

---

## Program Start/Abort

**START PROGRAM** — Press the **Start Program** button to start a program. First press the **Run Program** button, turn the **Select Knob** to display the proper program, then press the **Start Program** button. Pressing **Start** after a program has just finished will restart the same program.

If a program is not displayed then the furnace will beep to indicate an error.

**ABORT PROGRAM** — Press this button to **ABORT** a program at any time.

---

## Table Control

**TABLE UP** — Press the **↑ Up** arrow button to manually raise the table. Press the **↑ Up** arrow button a second time and the table will stop.

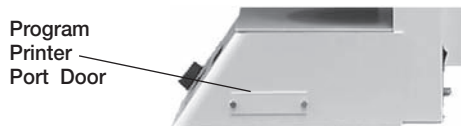
**TABLE DOWN** — Press the **↓ Down** arrow button to manually lower the table. Press the **↓ Down** arrow button a second time and the table will stop.

The table control button will not operate while a program is running.

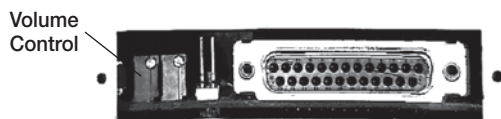
## Adjusting Speaker Volume

This feature allows you to adjust the volume of the warning/alert speaker inside the furnace and the display contrast.

1. Locate the door on the right side of the furnace. Remove the two thumbscrews and the door.



2. With the door removed, a connector and one small blue cube can be seen. The cube has a small screw near the top.



3. Turn the screw on the blue cube to adjust volume. This is a multi-turn potentiometer, so many revolutions of the screw may be necessary. Counter-clockwise will reduce the volume, clockwise will increase the volume.

## Note

It is very important to set up the operating features of the furnace before you attempt to program the furnace or run programs.

For best results in learning to use your new furnace, follow these steps in this order:

1. Set up the operating features of the furnace by reading and following the instructions in **Chapter 2 — Special Functions**. This is **VERY IMPORTANT** because these operating features will affect how you enter and run programs.
2. Learn to program the furnace by reading **Chapter 3 — Change Program**. Enter a few of your own programs.
3. Read **Chapter 4 — Run Program** to understand how to run programs and what features are available while running a program.

## Using the Furnace

After the furnace has completed the self-test at power up, the Version screen appears. Press the **Next** button to continue. The display should read:

**READY, SELECT  
MENU BUTTON?**

**Figure 2**

Now you must select one of the menu selection buttons on the left side of the front panel. To continue setting up the furnace, press the **Special Functions** button and the display will read:

**SELECT ITEM:  
NITE MODE**

**Figure 3**

## Chapter Two — Special Functions

### Menu

The **Special Functions** menu allows you to set up the operating features of the furnace. This menu is reached by pressing the **Special Functions** button. Most Special Functions can be performed while a program is running, however this is not recommended because changing the operating features could affect how the current program runs.

To look at or change a feature, press the **Special Functions** button. The display will read:



SELECT ITEM:  
NITE MODE

Figure 4

Turn the **Select Knob** clockwise or counterclockwise until the desired feature is displayed. Press the **Next** button to look at or change this feature. Each feature will be described in this chapter.

### Setting the Night Mode Temperature and Activation

The furnace has a **Night Mode** feature that will reduce the temperature in the muffle and raise the lift to prevent moisture build up. The **Night Mode** can be started from idle mode or while a program is running. The furnace will auto-matically enter **Night Mode** if no buttons have been pressed for 2 hours, or 45 minutes have passed since the last run program and no buttons have been pressed.

The furnace comes from the factory with the **Night Mode** temperature set at 150° C. This temperature may be adjusted from 0 to 400° C. If **Night Mode** is activated while a program is running, the furnace will go to the night mode temperature after the completion of the program and will maintain the **Night Mode** temperature until any button is pressed or the power is turned off.

#### To adjust the Night Mode temperature:

1. Press the **Special Functions** button.
2. Turn the **Select Knob** until the display reads NIGHT MODE TEMP.
3. Press the **Next** button to look at or change the night mode temperature.

4. Turn the **Select Knob** to change the temperature as desired.
5. Press the **Next** button to enter the temperature.

After the **Night Mode Temperature** has been set, follow these steps to activate night mode from idle mode or during a program.

1. Press the **Special Function** button. The display will read "**Night Mode?**"
2. Press the **Next** button to activate **Night Mode**.
  - To start **Night Mode** at the end of the program while a program is running.
  - Turn the **Select Knob** to NEXT = NIGHT MODE



SELECT ITEM:  
NEXT = NITE MODE

Figure 5

- Press the **Next** button.
- Night mode is activated.

### Change Idle Temperature

The idle temperature is the temperature at which the furnace will maintain between programs.

The furnace comes from the factory with the idle temperatures set at 0° C, so you must adjust this feature to suit your needs.

1. Press the **Special Functions** button.
2. Turn the **Select Knob** to display CHANGE IDLE TEMP.
3. Press the **Next** button to look at or change the idle temperature.
4. The current setting will be displayed. Turn the **Select Knob** to change the temperature.

5. Press the **Next** button to enter the temperature.

**Note:** During shipping the muffle might absorb moisture from the air. So, it is recommended you heat the muffle to dry the moisture before firing any porcelain. To dry the muffle, set the idle temperature to 400° C for one hour and 600° C for one hour. Follow the numbered instructions in this section to set the ideal temperature to the temperatures mentioned above.

It is also recommended you keep the furnace ON with sufficient night mode temperature to prevent moisture from accumulating inside the muffle. The recommended temperature is a minimum of 150° C.

## Set Vacuum Level

The factory setting for vacuum is 71 cm of mercury. The acceptable level is from 22 cm to 74–75 cm of mercury or 9.0 inches to 28.0 inches of mercury.

If the furnace does not pull a minimum vacuum of 10 inches within 20 seconds of calling for it, the program will be aborted and the furnace will display "Vacuum Error." Additionally, if the target vacuum level has not been reached within 1.5 inches of the target by 100 seconds, the program will be aborted and a warning screen will be displayed, indicating a vacuum error.

If CONTINUOUS VC PUMP has been selected by using the **Special Functions** menu, the vacuum pump will run throughout the vacuum cycle. If CONTINUOUS VC PUMP has not been selected, the vacuum pump will shut off after the target level has been reached and at least 5 seconds have elapsed. The vacuum pump will be restarted when the vacuum level has dropped to 1 inch below the target value.

**The furnace uses an absolute vacuum sensor. With an absolute sensor, adjustments are not necessary at high altitudes.**

To set the vacuum level for all programs do the following:

1. Press the **Special Functions** button.
2. Turn the **Select Knob** until SET VACUUM LEVEL is displayed.
3. Press the **Next** button to look at or change the vacuum level.
4. The current setting will be displayed. Turn the **Select Knob** to change this value.
5. Press the **Next** button to accept the new value.

## Degrees F or Degrees C

The furnace may be set to display all values using the metric system with degrees in Centigrade and vacuum in centimeters of mercury or to display all values using the American/English (standard) system of degrees Fahrenheit and vacuum in inches of mercury.

1. Press the **Special Functions** button.
2. Turn the **Select Knob** until TEMP IN C OR F? is displayed.

3. Press the **Next** button to look at or change the measurement system in use.
4. TEMP CENTIGRADE? Will be displayed. Turn the **Select Knob** to select YES for metric units or to NO for American/English (standard) units.
5. Press the **Next** button.

## Set Program Start Delay

The furnace has a unique feature that allows the operator to program a delay to occur before the start of all programs. This delay occurs before the entry time set into each program begins. This feature may be changed without affecting the programs or calibrations stored in the furnace.

1. Press the **Special Functions** button.
2. Turn the **Select Knob** until second line on the display reads PROG START DELAY.
3. Press the **Next** button to look at or change the start delay time.
4. The display will read TIME = 0.00 or any time delay previously entered. Turn the **Select Knob** to change the time as desired.
5. Press the **Next** button.

**Note:** The delay subtracts the time it takes to heat the muffle to the entry temperature so the delay time may appear shorter than originally programmed. As an example; let's assume the delay is set for 30 minutes, the entry temperature is 500° C, and the time it takes the furnace to reach 500° C is 15 minutes. The furnace would count down 15 minutes to the beginning of the program and then would begin heating to the entry temperature. This gives us a total of 30 minutes before the table rises to the muffle.

## Select Constant Vacuum

Selecting constant vacuum will cause the vacuum pump to run continuously during the vacuum cycle of a program.

1. Press the **Special Functions** button.
2. Turn the **Select Knob** until the display reads CONSTANT VC PUMP.
3. Press the **Next** button.
4. Turn the **Select Knob** to display YES or NO. A selection of YES will cause the vacuum pump to run continuously during the vacuum cycle of a program.

A selection of NO will allow the vacuum pump to turn off and on to maintain the set vacuum level. If intermittent vacuum is selected but the vacuum pump runs continuously during the program cycle, the vacuum level is set too high. The actual level is within 3% of the selected level, but the pump cannot reach the full selected level. This can be corrected by reducing the vacuum level. See page 11 for more detail.

5. Press the **Next** button.
- 

## Special Cool Position

**This feature is only available when running a Special Porcelain Program. For further information, see page 20.**

This feature allows the user to select the height that the table lowers to for cooling during the special cool time. This feature is used only when running a “Spec” special porcelain program. The default number is 50. The higher the number, the further the table will drop. See Chapter Three — Special Firing Cycle Program for more detail.

To set the height of the table follow these directions:

1. Press the **Special Functions** button.

2. Turn the **Select Knob** until the display reads SP COOL POSITION. Press the **Next** button.
  3. SPECIAL COOL TIME = 50 is now displayed. Turn the **Select Knob** to select a new position value. To determine the value desired, turn the **Select Knob** until the number displayed will not go any higher. This highest number represents the table fully down position. You can then divide by 2 for 1/2-way down, 3 for 1/3-way down, 4 for 1/4-way down, at a time.
  4. Press the **Next** button.
- 

## Select Upper or Lower Case Letters

This feature allows you to select whether the display reads in all capital letters or lower case and capital. Selecting YES will cause the furnace to display in all capital letters. Selecting NO will cause the furnace to display lower and uppercase lettering.

1. Press **Special Functions**.
2. Turn the **Select Knob** until the display reads CAPITAL LETTERS?

3. Press the **Next** button and turn the **Select Knob** to display YES or to display NO.

Selecting YES will cause only capital letters to be displayed, selecting NO will allow both capitals and lower case letters to display.

4. Press the **Next** button.

## Porcelain Names

The first four types of programs are for normal porcelain firing cycles. These four types of programs have a unique feature, they can be named to aid in the identification of the programs to be run. Most technicians name the program groups for the porcelain brands that they use on a regular basis. For example:

1. SYNS—named for Synspar (Jeneric) porcelain
2. ELIT—named for Elite porcelain
3. VITA—named for VITA porcelain
4. CMCO—named for Ceramco porcelain

**Note:** Do not attempt to change CERM, PRES, or SPEC. These are special types of programs for In-Ceram,<sup>®</sup> pressing, and Custom (SPEC) parameter needs.

In the procedure for changing names that follows, please be aware of the following items:

- While any number, letter, space, or special character may be selected, only four characters per name can be used.
- An underline will indicate the current character position.
- Pressing the **Next** button moves underline to next position.
- Pressing the **Last** button moves underline to previous position.

## Procedures:

1. Press the **Special Functions** button.
2. Turn the **Select Knob** until the display reads PORCELAIN NAMES.
3. Press the **Next** button. The furnace will display the first two porcelain names. The underline (cursor) will be under the first character of the first porcelain name.
4. Turning the **Select Knob** will cause the character above the underline (cursor) to cycle through numbers, letters, and other characters available. Press the **Next** button to enter characters and the **Last** button to go back.
5. When the **Next** button is pressed and the last character in the porcelain name has been selected, the underline will move to the first character in the next name. Repeat the above procedure for each of the remaining porcelain names you wish to change.

## Adjust Calibration to Match Your Porcelain

Porcelain fires according to energy, temperature (singular) and time. All porcelain furnaces fire slightly different. Even porcelain furnaces from the same manufacturer can fire porcelains at slightly different temperatures. The **Pro Series furnaces** address this problem by allowing you to customize the calibration.

The furnace comes with a **Certificate of Temperature Calibration**. This certificate shows the actual temperature in the muffle for several temperatures as displayed by the furnace. Special instrumentation is used at the factory to achieve these close calibration tolerances. Adjusting the calibration as described here will allow you to globally adjust the temperature for all programs.

Both the **Pro 100** and **Pro Press 100** calibrations can be adjusted for normal **high-fusing** porcelains and for **low-fusing** porcelains (see pages 14 and 15). Use the low-fusing adjustments if your porcelain fires at or below 800° C/ 1470° F. Use the high-fusing adjustments if your porcelain fires above 800° C/1470° F.

These adjustments do not affect each other, so both adjustments can be used if you fire both types of porcelain.

**The Pro Press 100 has another calibration adjustment specifically for pressing programs. This feature (CAL PRES TEMP) can be adjusted just like the high- and low-fusing adjustments.**

## Adjust Low-Fusing Porcelain Calibration (800° C/1470° F or below)

1. Press the **Special Functions** button.
2. Turn the **Select Knob** until display reads CAL LOW FUSING.



Figure 6

3. Press the **Next** button. The display will ask LOW OVERFIRES?



Figure 7

4. Turn the **Select Knob** to display either YES or NO. Selecting YES will allow you to adjust for low-fusing porcelain **overfires**. Selecting NO will allow you to adjust for low-fusing porcelain **underfires**.
5. Press the **Next** button.

6. Turn the **Select Knob** to enter a temperature to adjust. If YES was selected in the previous step, this value will adjust the temperature downward. If NO was selected, this value will adjust the temperature upward.



Figure 8

7. Press the **Next** button.
 

**Example:** If your porcelain appears to be overfired by 25°, you would answer YES to question 3, then turn the **Select Knob** to 25° and Press the **Next** button. Now, fire again. If your porcelain appears to be underfired by 10° after making the 25° adjustment, you would again answer YES, then change the 25° to 15°.

## Adjust High-Fusing Porcelain Calibration (800° C/1470° F or above)

1. Press the **Special Functions** button.
2. Turn **Select Knob** until display reads CAL HIGH FUSING.



Figure 9

3. Press the **Next** button. The display will ask HIGH OVERFIRES?



Figure 10

4. Turn the **Select Knob** to display either YES or NO. Selecting YES will allow you to adjust for high-fusing porcelain **overfires**. Selecting NO will allow you to adjust for high-fusing porcelain **underfires**.
5. Press the **Next** button.

6. Turn the **Select Knob** to enter the number of degrees you would like to adjust the temperature. If YES was selected in the previous step, this value will adjust the temperature downward. If NO was selected, this



Figure 11

- value will adjust the temperature upward.
7. Press the **Next** button to accept the displayed value.
 

**Example:** If your porcelain appears to be overfired by 25°, you would answer YES to question 3, then dial to 25° and press the **Next** button. Now, fire again. If your porcelain appears to be underfired by 10° after making the 25° adjustment, you would again answer YES, then change the 25° to 15°.

## Adjust Press (Temp.) Calibration (Pro Press 100 only)

(This procedure will adjust the Pressing Program temperature on the Pro Press 100 only.)

1. Press the **Special Functions** button.
2. Turn the **Select Knob** until the display reads CAL PRESS TEMP.



Figure 12

3. Press the **Next** button. The display will ask, PRESS OVERFIRES?



Figure 13

4. Turn the **Select Knob** to select either YES or NO. Selecting YES will allow you to adjust for pressing overfires. Selecting NO will allow adjusting for **Pressing** underfires.
5. Press the **Next** button. Turn the **Select Knob** to enter the number of degrees you would like to adjust the temperature. If YES was selected, this value will adjust the temperature downward. If NO was selected, this value will adjust the temperature upward.
6. Press the **Next** button to accept the displayed value.

## Printing Forms

This function enables easy printing of a currently running program or the last run program. To use this function press the **Special Function** button, turn the **Select Knob** to PRINT FORM and press the **Next** button. If the furnace

is currently running a program, that program and its information will print out. If the furnace has just finished running a program and the furnace button has not been touched since the program was run, that program will be printed out.

## Transferring Programs to Other Furnaces

This furnace has been designed to make it very easy to copy your programs to other furnaces. This feature is especially helpful if you have several furnaces. You need to program only one furnace, then use a “Red Smart Box” to transfer the programs to your other furnaces. This feature will copy all programs and will overwrite any programs on the furnace they are transferred to.

Contact your dealer to obtain a “Red Smart Box” and follow these directions to transfer your programs:

1. Locate the printer/program port door on the right side of the furnace. Remove the door.
2. With the printer/program port door removed, plug the “Red Smart Box” into the parallel port.
3. Press the **Special Functions** button.
4. Turn the **Select Knob** to the left until the display reads PROGRAMS ➔ BOX. Make sure the arrow is pointing to the word BOX.

5. Press the **Next** button.
6. The display will read SENDING NOW... When the transfer is finished, remove the “Red Smart Box,” and take it to the furnace to load the programs into.



**ANY PORCELAIN NAMES OR PROGRAMS THAT ARE ON THE SECOND FURNACE BEFORE THE TRANSFER WILL BE REPLACED.**

7. Plug the “Red Smart Box” into the second furnace. Press the **Special Functions** button. Turn the **Select Knob** to the left until the display reads PROGRAMS ← BOX. Make sure the arrow is pointing to the word PROGRAMS.
8. Press the **Next** button.
9. The programs will be copied to the second furnace. When the transfer is complete, remove the “Red Smart Box.”



## Testing Your Furnace

The **Pro 100** and **Pro Press 100** are capable of performing several tests to aid in diagnosing the furnace should a problem occur. A technician may ask you to run one or more of these tests to aid in diagnosing the problem. The tests include a vacuum test, a muffle test, a motor up test, a motor down test, and a muffle hour reading. The muffle hour reading is incremented by 1 for each hour the muffle temperature is above **651° C**.

1. Press the **Special Functions** button.
2. Turn the **Select Knob** until the display reads TEST FURNACE.
3. Press the **Next** button.
4. Turn the **Select Knob** until the test you require is displayed.

5. Press the **Next** button. The test that was selected will now begin.
6. Pressing the **Next** button will stop or pause the test. Pressing the **Next** button again will restart or stop the test.
7. Pressing any of the Menu buttons to the left of the **Select Knob** will end the test.

**Note:** The muffle test is used by technical support and engineering for troubleshooting muffle problems. The number on the left of the display is the current room temperature. The number in the middle is the thermocouple output. The number to the right indicates the current lift position (99 = up or down/0 = moving or between top and bottom).

## Calibrate Oven



**CAUTION: THIS ITEM OF THE SPECIAL FUNCTIONS MENU IS TYPICALLY RESERVED FOR CERTIFIED TECHNICIANS. ENTERING NUMBERS OTHER THAN THE SEVEN DESCRIBED BELOW COULD RESULT IN PROGRAM AND CALIBRATION LOSS.**

With this screen it is possible to activate the following features:

- **Fast Cool With Vacuum On (for cooling muffle to entry temp between programs)**  
Lowers the lift and runs the vacuum pump until the furnace reaches the entry temperature for a program. To activate this function, start a program with an entry temperature lower than the current temperature.
- **Wide or Narrow Printer**  
Select full-sized 8 1/2 x 11 inch paper or receipt size (Whip Mix Thermal Printer) paper.
- **Enable Program Password Protection**  
(Call Whip Mix.)
- **Use Timed Press Yes/No**  
Changes preference between Re-Press and Timed Press, press programs are factory set.
- **Print Form Yes / No**  
Tells the furnace to prompt you to print a form at the end of a program. (The furnace will ask for time and date at power up.) The time and date should be reset daily.
- **Load Code from “Blue Smart Box”**  
Enables you to order and upgrade software.

**To access one of seven functions, do the following:**

1. Press the **Special Functions** button.
2. Turn the **Select Knob** counter-clockwise to select CALIBRATE OVEN.
3. Press the **Next** button.
4. Turn the **Select Knob** to select the numerical password needed.

**Note:** In order to run any In-Ceram® program, In-Ceram® must be enabled (Pro Press 100 only). Call Whip Mix service technician if In-Ceram® program does not run.

| FUNCTION:   | PASSWORD NUMBER        |
|---|------------------------|
| 1. Fast Cool with Vacuum On   | 314                    |
| 2. Wide or Narrow Printer   | 320                    |
| 3. Enable Program Password Protection — Protects programs 70 and above from alteration  | (Call Whip Mix)        |
| 4. Use Timed Press Yes/No — If <b>No</b> is selected, then repress will automatically include four minutes press time on top of the time already selected for the program | 310<br>(Pro Press 100) |
| 5. Print Form Yes/No  | 327                    |
| 6. Load Code from “Blue Smart Box”  | 350                    |

5. Press the **Next** button.

## Chapter Three — Change Program Menu

The Change Program menu allows you to add, change, move, copy, print, or erase programmed firing cycles. This mode is reached by pressing the **Change Program** button. All of the features described here may be performed while a program is running.

### Program Number/ Name Description

Both the **Pro 100** and **Pro Press 100** furnaces use a unique method of numbering and naming programs to help the operator select the correct program to run. The following is an example of a program name.

**12 SYNS - BODY ADD**

**Figure 14**

The program number is 12. The next four characters contain the program type (firing cycle). There are several program types available:

**NORMAL** — Four normal porcelain firing cycles that can be named by the operator (see **Chapter Two — Special Functions**, page 13, under the heading **Porcelain Names**)

**PRES** — Press firing cycles (Pro Press 100 only)

**CERM** — In-Ceram® firing cycles (Pro Press 100 only)

**SPEC** — Special porcelain firing cycles

**TITN** — Firing cycle for porcelain to titanium with Argon (Pro 100 only)

**SINT** — Firing cycle for sintered products with Argon (Pro 100 only)

The next eight characters contain the name entered to describe this program. In the example, the user has entered BODY ADD to indicate that this is a body add-on program.

The following example names describe how a user could make program identification easy:

|                   |   |
|-------------------|---|
| 10 SYNS- DE GAS   | Synspar porcelain de-gas program        |
| 11 SYNS- OPAQUE   | Synspar porcelain opaque program        |
| 12 SYNS- BODY ADD | Synspar porcelain body add program      |
| 13 SYNS- GLAZE    | Synspar porcelain glaze program         |
| 20 VITA- DE GAS   | Vita porcelain de-gas program           |
| 21 VITA- OPAQUE   | Vita porcelain opaque program           |
| 22 VITA- BODY 1   | Vita porcelain first body bake program  |
| 23 VITA- BODY 2   | Vita porcelain second body bake program |
| 24 VITA- GLAZE    | Vita porcelain glaze program            |

### Look at a Program

The **Look at a Program** feature allows the operator to view a program without changing any values:

1. Press the **Change Program** button.
2. Turn the **Select Knob** until LOOK AT PROGRAM is now displayed.
3. Press the **Next** button to select this feature.
4. Turn the **Select Knob** to find the program you wish to view.
5. Press the **Next** button to continue through the program.

**0 SYNS - OPAQUE  
USE VACUUM - YES**

**Figure 15**

The first line in the display will identify the program being viewed. The second line displays a parameter in the firing cycle program and its value. This parameter cannot be changed while looking at a program. Pressing **Next** will let you look at the next item in a program, pressing **Last** will let you look at the preceding item in a program. When the last item has been viewed the display will return to SELECT MENU BUTTON screen. You may also stop viewing at any time by pressing one of the menu mode selection buttons on the left of the keyboard.

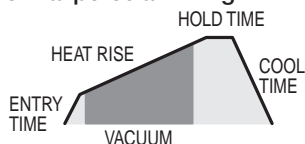
## Add a Program

**Add a Program** is used to enter a new program. This selection will describe how to enter each type of program as listed:

|  |                      |
|--|----------------------|
| Normal Porcelain Firing Cycle Program  | (BOTH)               |
| Pressing Program                       | (Pro Press 100 ONLY) |
| Special Porcelain Firing Cycle Program | (BOTH)               |
| Titanium Firing Cycle Program          | (Pro 100 ONLY)       |
| Sintering Firing Cycle Program         | (Pro 100 ONLY)       |
| In-Ceram® Firing Program               | (Pro Press 100 ONLY) |

### Normal Porcelain Firing Cycle Program

The first four firing cycles are normal porcelain firing cycles. The following procedure describes how to enter a normal porcelain program.



1. Press the **Change Program** button.
2. Turn the **Select Knob** until ADD A PROGRAM is displayed.
3. Press the **Next** button.
4. ADD: will be displayed. Turn the **Select Knob** to find the program number you want to add your new program into. If you select a program number that already has a program entered, you will overwrite the existing program with the new one. Press the **Next** button.
5. PORCELAIN TYPE will be displayed. Turn the **Select Knob** to find the porcelain type for this program. Press the **Next** button.  
**Note:** Normal porcelain firing cycles are the first four menu options displayed as the knob is rotated. (See **Chapter Two — Porcelain Names** for more information.)
6. ENTER PROG NAME will be displayed on the top line and the program number with the program type selected previously will be on the second line. Turn the **Select Knob** to change the character over the underline. Any letter, number, space, or special character may be selected. Pressing the **Next** button will move the underline (cursor) to the next character position, pressing the **Last** button will move the underline (cursor) back to the preceding character position. When all eight characters have been entered the display will step forward to the next program porcelain to be entered.

0 SYNS - OPAQUE  
ENTRY TIME - 0:00

Figure 16

7. Your display will look similar to the one above. Notice that the program number, program type, and the program name just entered are the first line. The second line is prompting for you to enter an entry time.

Turn the **Select Knob** to the entry time you require. This parameter specifies the time needed to raise the table into the muffle. The temperature will be raised or lowered to the entry temperature before entry time begins. Any program delay entered under **Special Functions** must expire before the entry time begins.

The time is displayed in **minutes and seconds**. The table will be raised in evenly spaced steps during the entry time. Press the **Next** button to continue.

8. ENTRY TEMP XXXC is displayed. Turn the **Select Knob** to the required entry temperature. This is the temperature at which you wish the furnace to be when the porcelain enters the muffle. Press the **Next** button.
9. HEAT RATE XXC/M is displayed. Turn the **Select Knob** to the required heat rate. C/M indicates degrees Centigrade per minute, F/M indicates degrees Fahrenheit per minute. Press the **Next** button.
10. FINAL TEMP XXXC is displayed. Turn the **Select Knob** to the final temperature for this program. Press the **Next** button.
11. HOLD TIME X: XX is displayed. Turn the **Select Knob** to the time you wish to hold the porcelain at the final temperature. Hold time includes the total time at the final temperature under vacuum. Press the **Next** button.
12. COOL TIME X: XX is displayed. Turn the **Select Knob** to the desired cool time. This is the time to lower the table to the fully down position. The table will be lowered in evenly spaced steps during the cool time. Press the **Next** button.

0 SYNS - OPAQUE  
USE VACUUM - YES

Figure 17

13. USE VACUUM - YES is displayed. The display will appear similar to the example. Turn the **Select Knob** to YES to use vacuum in your program or NO if you do not wish to use vacuum in this program. Press the **Next** button to continue. If your selection in this step was NO the display has returned to the ready select menu screen and you are finished adding this program. If your selection in this step was YES continue with the next step.



Figure 18

14. START VAC 0C is displayed. The display will be similar to the example. Turn the **Select Knob** to select a temperature for the vacuum to start. Press the **Next** button.

15. RELEASE VAC XXXC is now displayed. Turn the **Select Knob** to select a temperature to release the vacuum. Press the **Next** button. The program has been saved and the display will now return to the Ready Select Menu screen.

**Note:** If you wish to hold vacuum during the final temperature hold, you must use the Special Firing Cycle described on page 20.

## Press Firing Cycle Program (Pro Press 100 only)

The following procedures describe how to enter a pressing program:

1. Press the **Change Program** button
2. Turn the **Select Knob** until ADD A PROGRAM is displayed.
3. Press the **Next** button to add a program. ADD will now be displayed. Turn the **Select Knob** to find the number you want to add your new program into.
4. PORCELAIN TYPE will be displayed. Turn the **Select Knob** to find the firing cycle for the Press program. Press the **Next** button.
5. ENTER PROG NAME will be displayed on the top line and the program number with the program type selected previously will be on the second line. Turn the **Select Knob** to change the underlined characters.
6. ENTRY TEMP displays the current selected entry temperature. This is the temperature you wish the furnace to be when the porcelain enters the muffle. It is now displayed in Centigrade or Fahrenheit. Press the **Next** button.
7. HEAT RATE is displayed.
8. FINAL TEMP is displayed. This is the final temperature desired for this program. Press the **Next** button.

9. HOLD TIME is displayed. This is the amount of time desired to hold the porcelain at the final temperature, before the furnace begins to press. Press the **Next** button.

**(Re-Press is selected in the Calibrate Oven section of this Manual, using password 310.)**

10. PRESS TIME or RE-PRESS TIME is now displayed.
  - PRESS TIME — Turn the **Select Knob** to select the amount of time required to press. This function allows control of the initial amount of press time without a re-press time. This gives you what you enter in the program parameters.
 

Press the **Next** button to enter the program.
  - RE-PRESS TIME — Turn the **Select Knob** to select the amount of time required to Re-Press. This setting gives you automatic time of four minutes in addition to the time you enter in the parameter settings. The press rod stays extended during this period with no pause between the automatic four minutes and the additional time added in the program parameters.

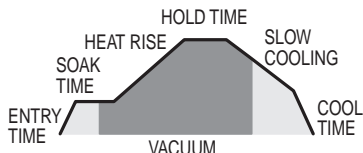
**Note:** The press rod stays extended during and between both the initial and re-press times.

## Special Firing Cycle Program

Some porcelains require special firing programs.

The furnace allows for programming with special heat soaks, different vacuum cycles,

and special cooling. The following procedure describes how to add a special program.



### Procedure:

1. Press the **Change Program** button.
2. Turn the **Select Knob** until ADD A PROGRAM is displayed. Press the **Next** button to add a program.

**SELECT ITEM:  
ADD A PROGRAM**

Figure 19

3. ADD: will be displayed. Turn the **Select Knob** to find the program number you want to add your new program into. If you select a program number that already has a program entered, you will overwrite the existing program. Press the **Next** button.

**12 SYNS - BODY  
ADD**

Figure 20

4. Turn the **Select Knob** to find the SPEC firing cycle for this program. Press the **Next** button.
5. ENTER PROG NAME: is displayed on the top line and the program number with the program type selected previously will be on the second line.

**38 CERM - BODY ADD  
ENTRY TIME 0:00**

Figure 21

6. The display will look similar to the previous example. Notice that the program number, program type, and the program name just entered are on the first line. The second line is prompting an entry time.

Select the required entry time. Entry time is the amount of time to raise the table into the muffle. The temperature will be raised or lowered to the entry temperature before entry time begins.

Any program delay entered under **Special Functions** must expire before entry time begins. The time is now displayed in minutes: seconds. The table will be raised in steps evenly spaced during entry time. Press the **Next** button.

7. ENTRY TEMP XXC is displayed. This is the temperature you want the muffle to be when the porcelain enters. Press the **Next** button.
8. SOAK TEMP XXXC is displayed. Select the amount of time required to hold at the soak temperature. This is the temperature required for soak time. The furnace will rise to this temperature and hold for the soak time entered in the next step. Press the **Next** button.
9. SOAK TIME X: XX is displayed. Press the **Next** button to continue.
10. HEAT RATE XXC/M is displayed. This is the required heat rate. Turn the **Select Knob** to the desired heat rate. Press the **Next** button.
11. FINAL TEMP XXXC is displayed. Press the **Next** button.
12. HOLD TIME X: XX is displayed. Select the amount of time to hold final temperature. Hold time includes the total time at the final temperature under vacuum plus under air. Press the **Next** button to continue.
13. SP COOL TIME X: XX is displayed. This is the amount of time desired to hold the porcelain at the **Special Cool Position** (See page 12). After the hold time, the table will lower to the position selected in the Special Functions Menu and hold until the special cool time temperature is reached. The table will then raise and hold the porcelain at the special cool time temperature until the special cool time has expired. Press the **Next** button.  
**Note:** This feature will add strength to low-fusing porcelains.
14. LOWER TABLE XXXC is displayed. This is the temperature to open the furnace and lower the table. The furnace will remain with the table in the up position until this temperature is reached in the cooling step. Press the **Next** button.
15. SP COOL TEMP XXXC is displayed. Select the appropriate temperature for the special cool time. If the special cool time temperature is not lower than the lower table temperature, the table will not lower after hold time. Press the **Next** button.
16. COOL TIME X: XX is displayed. This is the desired cooling time. This setting is the time it takes to lower the table to the fully down position. The table will be lowered in evenly spaced steps during the cool time.  
**Note:** Cool time will not start until the lower table temperature has been reached or special cool time has expired. Press the **Next** button.

- USE VACUUM - YES is displayed. Turn the **Select Knob** to YES to use vacuum in your program, use NO to not use vacuum in this program. Press the **Next** button.

If the selection in this step was NO, the display will be returned to the READY SELECT MENU screen and adding this program will be completed. If the selection in this step was YES, continue with the next step.

- VAC LEVEL XXCM is displayed. Select the vacuum level desired. Press the **Next** button.

**VAC START WITH ?  
DURING HEAT UP**

**Figure 22**

- The display will be similar to the example above. Turn the **Select Knob** to select DURING HEAT UP or SOAK TIME. DURING HEAT UP will start the vacuum at a temperature during the heat up step of the program (similar to a normal porcelain cycle). DURING SOAK TIME will start the vacuum during the soak time period. Press the **Next** button.

**Note:** Some operators prefer to select soak time to start the vacuum pump to allow the vacuum pump to pull a vacuum before the heat rise starts.

- START VAC XXXC or START VAC X: XX is displayed, depending on the previous selection. If DURING HEAT UP was selected, turn the **Select Knob** to desired temperature for vacuum to begin. If SOAK TIME was selected, turn the **Select Knob** to select the time when the vacuum begins. Press the **Next** button.

- VACUUM RELEASE - DURING HEAT UP is displayed.

Turn the **Select Knob** to select DURING HEAT UP, DURING HOLD TIME, DURING COOLING. DURING HEAT UP will release the vacuum at a specific temperature during the heat rise step. DURING HOLD TIME will release the vacuum after a specific time during the hold time step. DURING COOLING will release the vacuum at a specific temperature after the final hold during the cooling step. Press the **Next** button.

**DURING HEAT UP  
RELEASE VAC**

**Figure 23**

If DURING HEAT UP was selected, the screen above is displayed. Turn the **Select Knob** to the temperature of the vacuum release. Press the **Next** button.

The program has been saved and the display will return to the Ready Select Menu screen.

**DURING HOLD  
TIME RELEASE**

**Figure 24**

If DURING HOLD TIME was selected, the screen above is displayed. Turn the **Select Knob** to specify when to release the vacuum. In this example the furnace will hold vacuum for 30 seconds into the hold time step. Press the **Next** button.

The program has been saved and the display will now return to the Ready Select Menu screen.

**DURING COOLING  
RELEASE VAC**

**Figure 25**

If DURING COOL TIME was selected, the screen above is displayed. Turn the **Select Knob** to choose the vacuum release temperature. The furnace will hold vacuum through the heat rise step, the hold time step, and will release vacuum at the specified temperature during the cooling step. Press the **Next** button.

The program has been saved and the display will return to the Ready Select Menu screen.

## Titanium Firing Cycle Program (Pro 100 only)

The **Pro 100** includes hardware and a special firing cycle for titanium to porcelain.

Because titanium will oxidize, the **Pro 100** has a special firing program with Argon for firing porcelains to titanium.

In its titanium firing cycles the **Pro 100** automatically purges and maintains an inert condition for firing porcelain to titanium.

Before running this program type, Argon must be properly hooked up to the furnace. See page 33 for details.

### Procedure:

1. Press the **Change Program** button.
2. Turn the **Select Knob** until ADD A PROGRAM is displayed.
3. Press the **Next** button to add a program.
4. ADD: will be displayed. Turn the **Select Knob** to find the program number you want to add your new program into. If you select a program number that already has a program entered, you will overwrite the existing program. Press the **Next** button.

**PORCELAIN TYPE:**  
1 TITN-

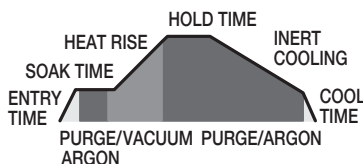
Figure 26

5. Turn the **Select Knob** to find the firing cycle for TITN. Press the **Next** button.
6. ENTER PROG NAME will be displayed on the top line and the program number with the program type selected previously will be on the second line. Turn the **Select Knob** to change the character over the underline. Press the **Next** button to enter the character.

**ENTER PROG NAME:**  
1 TITN-

Figure 27

7. Turn the **Select Knob** to the entry time you require. This is the time to raise the table into the furnace. Any program delay entered under **Special Function** must expire before entry time begins. The time is displayed in minutes: seconds.
8. ENTRY TEMP XXXC is displayed. This is the temperature at which you wish the furnace to be when the porcelain enters. Press the **Next** button.
9. SOAK TEMP XXXC is displayed. The furnace will rise to this temperature and hold for the soak time entered in the next step, before continuing with the rate rise (heat rate) step.



10. SOAK TIME X:XX is displayed. Most operators measure the time it takes to purge to an inert condition and set the soak time to this amount. Press the **Next** button.
11. HEAT RATE XXC/M is displayed. (Turn the **Select Knob** to change the heat rate.) Press the **Next** button to enter your change or merely skip to the next parameter when no change is selected.
12. FINAL TEMP XXXC is displayed. Press the **Next** button to skip or turn the **Select Knob** to change the final temperature, then press the **Next** button to go to the next parameter.
13. HOLD TIME X:XX is displayed. Hold time includes the total time at the final temperature under vacuum plus under air. Press the **Next** button.
14. LOWER TABLE XXXC is displayed. The furnace will remain in an inert condition with the table in the up position until this temperature is reached in the cooling step, then the muffle will be exposed to air and the table will be opened.
15. COOL TIME X:XX is displayed. This is the time to lower the table to the fully down position. The table will be lowered in steps evenly spaced during cool time. **Note:** Cool time will not start until the lower table temperature has been reached. Press the **Next** button.
16. USE VACUUM - NO is displayed. Turn the **Select Knob** to YES to use vacuum in your program, NO if you do not wish to use vacuum in this program. Selecting NO will force the furnace to purge to an inert condition at the beginning of the soak stage of a program and maintain that inert condition for the remainder of the program. Selecting YES will force the furnace to purge to an inert condition at the beginning of the soak stage of a program, pull a vacuum at the appropriate time, and purge on again to an inert condition when the vacuum is released. Press the **Next** button. If your selection in this step was NO the display has returned to the Ready Select Menu screen and you are finished adding this program. If your selection in this step was YES continue with the next step.
17. VAC LEVEL XXCM is displayed. Turn the **Select Knob** to the vacuum level desired. Press the **Next** button.
18. DURING HEAT UP or SOAK TIME. During heat up will start the vacuum at a temperature during the heat up step of the program (similar to a normal porcelain cycle). Soak time will start the vacuum during the soak time period. Some operators prefer to select soak time and set the vacuum start time to a time after the furnace has purged, and they set the soak time long enough for the furnace to purge and pull a vacuum before starting the heat rise step. Press the **Next** button to continue.

19. START VAC XXXC or START VAC X:XX will be displayed, depending on the previous selection. Press the **Next** button.
20. VACUUM RELEASE – DURING HEAT UP is displayed. Turn the **Select Knob** to select DURING HEAT UP, DURING HOLD TIME, or DURING COOLING. DURING HEAT UP will release the vacuum at a temperature during the heat rise step.  
  
DURING HOLD TIME will release the vacuum after a time during the hold time step.  
  
DURING COOLING will release the vacuum at a temperature during the cooling step. Press the **Next** button.  
  
If DURING HEAT UP was selected, the temperature you wish to release the vacuum will be displayed. The furnace will purge to an inert condition at this point.

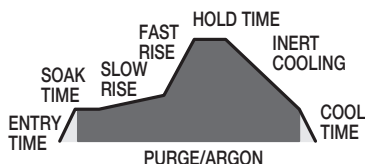
Press the **Next** button. The program has been saved and the display will return to the Ready Select Menu screen.

If DURING HOLD TIME was selected, the time during the hold time that you wish to release the vacuum will be displayed. In this example the furnace will purge to an inert condition 30 seconds into the hold time step. Press the **Next** button. The program has been saved and the display will return to the Ready Select Menu screen.

If DURING COOL TIME was selected, the temperature you wish to release the vacuum will be displayed. The furnace will purge to inert condition after the heat rise step, the hold time step, and at this temperature during the cooling step. Press the **Next** button. The program has been saved and the display will return to the Ready Select Menu screen.

## Sintering Firing Cycle Program (Pro 100 Only)

The sintering firing cycle on the **Pro 100** provides for inert conditions throughout the firing cycle to reduce or eliminate the oxide buildup on the material. The dual heat rates allow the furnace to burn off the binders at low temperatures and then sinter the metals at a high rate of rise. Argon must be properly hooked up to the furnace before this program type is run. See page 33 for details.



### Procedure:

1. Press the **Change Program** button.
2. Turn the **Select Knob** until ADD A PROGRAM is displayed.
3. Press the **Next** button to add a program.
4. ADD: will be displayed. Turn the **Select Knob** to find the program number you want to assign your new program. Press the **Next** button to continue.

**PORCELAIN TYPE:  
35 SINT**

Figure 28

5. Turn the **Select Knob** to find the SINT firing cycle for this program. Press the **Next** button.
6. ENTER PROG NAME: will be displayed on the top line and the program number with the program type selected previously will be on the second line.

**35 SINT - DENPAC  
ENTRY TIME X:XX**

Figure 29

7. Turn the **Select Knob** to select the entry time required. This is the time to raise the table into the furnace. Any program delay entered under the **Special Function Menu** must expire before entry time begins. The time is displayed in minutes: seconds. The table will be raised in steps evenly spaced during entry time. Press the **Next** button.
8. ENTRY TEMP XXXC is displayed. This is the temperature at which the porcelain enters the furnace. Press the **Next** button.
9. SOAK TIME X:XX is displayed. Select the time to hold the work at the entry temperature. Press the **Next** button.
10. 1ST RATE XXC/M is displayed. This is the desired first heat rate for this program. This heat rate is usually slow to burn off the binder materials. Press the **Next** button.
11. 1ST TEMP XXXC is displayed. This is the desired first temperature for this program. At this temperature the furnace will switch to the second heat rate until it reaches the final temperature. Press the **Next** button.
12. 2ND RATE XXC/M is displayed. This is the desired second heat rate for this program. This heat rate is usually fast to reach the sintering point of the metals. Press the **Next** button.
13. FINAL TEMP XXXC is displayed. This is the final temperature for this program. Press the **Next** button.
14. HOLD TIME X:XX is displayed. This is the time that will hold the porcelain at the final temperature. Press the **Next** button.



15. LOWER TABLE XXXC is displayed. This is the temperature to open the furnace and lower the table. The furnace will remain in an inert condition with the table in the fully up position until this temperature is reached in the cooling step.
16. COOL TIME X:XX is displayed. This is the time needed to lower the table to the fully down position. The table will be lowered in evenly spaced steps during cool time.  
**Note:** Cool time will not start until the lower table temperature has been reached.

Press the **Next** button.

17. USE VACUUM - NO is displayed. Turn the **Select Knob** to YES to use vacuum in your program, NO if you do not wish to use vacuum in this program. Selecting NO will force the furnace to purge to an inert condition at the beginning of the program and maintain that inert condition for the remainder of the program. Selecting YES will force the furnace to sinter the old way, using vacuum throughout the program.
18. Press the **Next** button. The program has been saved and the display will return to the Ready Select Menu screen.

### In-Ceram® Firing Cycle Program

1. Press the **Change Program** button.
2. Turn the **Select Knob** to select ADD A PROGRAM on the screen. Press the **Next** button to add a program.
3. ADD is displayed. Turn the **Select Knob** to find the program number you want to assign your new program.
4. PORCELAIN TYPE is displayed. Turn the **Select Knob** to find the firing cycle called CERM porcelain type. Press the **Next** button.
5. ENTER PROG NAME is displayed on the top line and the program number with the program type selected previously will be on the second line. Turn the **Select Knob** to change the underlined characters.



Figure 30

6. The display will look similar to the one shown above. Notice that the program number, program type and program name just entered are on the first line. The second line is prompting for an entry time. Turn the **Select Knob** to select the entry time required. This is the time it takes the table to rise to the muffle and fully close. The temperature will be raised or lowered to the entry temperature before the entry time begins.
7. ENTRY TEMP is displayed. This is the temperature the furnace will rise or fall to before the entry time begins. Press the **Next** button.

8. TIME 1 HR: MN X: XX is displayed. Press the **Next** button to proceed.
9. 1ST TEMP XXXC is displayed. Time one is the amount of time (heat rate) the furnace will take to rise to the next hold temperature. Turn the **Select Knob** to the desired amount of time. Press the **Next** button.
10. HOLD 1 HR: MN X: XX is displayed. To select a time in hours and minutes for the first hold time, press the **Next** button.
11. TIME 2 HR: MN X: XX is displayed. Time two is the amount of time (heat rate) the furnace will take to rise to the next hold temperature. Turn the **Select Knob** to the desired amount of time. Select a time in hours and minutes. Press the **Next** button.
12. FINAL TEMP is displayed. Turn the **Select Knob** to the desired temperature. Press the **Next** button.
13. HOLD 2 HR: MN X: XX is displayed. Enter the hold time in hours and minutes. Press the **Next** button.
14. LOWER TABLE XXXC is displayed. Enter the temperature at which the table will lower. Press the **Next** button.
15. COOL TIME XX: X is displayed. This is the time it takes the table to reach the fully down position. The time will then be divided among evenly-spaced steps down, according to special cool position set in the Special Function Menu. Press the **Next** button.

## Change a Program

Change a program is used to change an existing program. All program values will be displayed as they are currently in the program. It is possible to change these values when they are displayed.

### Procedures:

1. Press the **Change Program** button.
2. Turn **Select Knob** to CHANGE A PROGRAM. Press the **Next** button to select this feature.

3. CHANGE: 0 SYNS - OPAQUE is displayed. Turn the **Select Knob** to find the program to change. Press the **Next** button.
4. Changes are made in the same manner as in the **Add a Program** section of this chapter. Refer to that section for instructions specific to each type of firing cycle program.

---

## Copy/Change a Program

The copy/change a program feature allows a program to be copied from one program number to another and then changed. This feature is very useful when there are only minor differences between programs.

### Procedures:

1. Press the **Change Program** button.
2. Turn the **Select Knob** until COPY/CHANGE PROG is displayed. Press the **Next** button to select this feature.
3. COPY FROM: is displayed. The bottom line displays a program number and name. Turn the **Select Knob** to find the program to be copied. Press the **Next** button to continue.

4. COPY TO: is displayed. Turn the **Select Knob** to select a location for the copied program. If a program that is already entered is selected, you will write over the existing program. Press the **Next** button.
5. At this point, changes to the program may be made in the same manner as described in the section **Add a Program**. Refer to that section for instructions specific to each type of firing program.  
**Note:** The name of the new program must be changed because the furnace does not allow duplicate program names.

---

## Move a Program

The move program feature allows a program to be moved from one number to another. This feature is useful for grouping programs for operator convenience.

### Procedure:

1. Press the **Change Program** button.
2. Turn the **Select Knob** until MOVE PROGRAM is displayed. Press the **Next** button to select this feature.

3. MOVE FROM: is displayed. The bottom line displays a program number and name. Turn the **Select Knob** to find the program you wish to move. Press the **Next** button.
4. MOVE TO: is displayed. Turn the **Select Knob** to find the program number you wish to move to. If you select a program that is all ready entered, you will write over the existing program. Press the **Next** button to finish.

## Erase a Program

This feature allows you to erase a program from memory. The space occupied by any program erased will become available for adding a new program.

### Procedure:

1. Press the **Change Program** button.
2. Turn the **Select Knob** until ERASE A PROGRAM is displayed. Press the **Next** button to select this feature.

3. ERASE: is displayed. Turn the **Select Knob** to find the program you wish to erase. Press the **Next** button to continue.
4. ERASE ??? NO is displayed. Turn the **Select Knob** to YES to erase this program or NO to abort. Press the **Next** button to continue.

## Print Programs

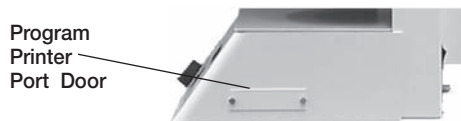
The print program feature allows you to print one or all of the programs for future reference. See **Chapter Five — Maintenance** for the printer requirements and hook up. The printout consists of two sections.

The first section contains a complete list of programs in a short format. This format shows the name and a partial list of the items contained in the programs. These items are designed to identify the programs quickly. Keep the list of programs next to the furnace for the operator to use in quickly identifying the programs to run.

The second section contains a complete listing of the programs and all of the items contained in the programs. Keep this list in your records for future reference.

### Procedures:

1. Turn the furnace off.
2. Locate the door on the right side of the furnace. Remove the two thumbscrews securing the door in place, and remove the door.



3. With the door removed, a connector and one small blue cube can be seen in the opening.



4. Plug the printer's parallel port cable into the connector. Turn the printer on.
5. Turn the furnace on. The furnace will perform a self-test. The furnace will reset the printer, so movement and noise from the printer are normal.
6. Press the **Change Program** button. Turn the **Select Knob** until PRINT PROGRAMS is displayed. Press the **Next** button.
7. Turn the **Select Knob** to display YES, press the **Next** button. The furnace will send the program data to the printer, where it will be printed.

## Chapter Four — Run Program Menu

**Note:** You must burn the moisture out of the muffle before firing the first time. See the notation under “Change Idle Temperature” on page 10.

### Running a Program



Figure 31

The **Run Program** mode allows you to run programs and to view programs as they are running. Pressing the **Run Program** button will display the above screen.

Turn the **Select Knob** until the desired program is displayed. If the table has not been lowered, do so now.

Press the **Start Program** button to begin this program. Continue through this chapter to learn all of the displays and features available while a program is running.

Press the **Change Program** button, or the **Special Functions** button at any time while a program is running in order to change or print programs.

### Repeat Programs

The furnace features a one-button repeat feature. If a program needs to be repeated, simply press the **Start Program** button and the last program run will be repeated.

**Note:** This feature is disabled if the **Special Functions Menu** or **Change Program Menu** buttons have been pressed after the last program was run.

### Features and Displays

#### Available while a Program Is Running

The furnace has several displays and features available while a program is running. There are two ways to activate these displays:

- By turning the **Select Knob** while a program is running.
- By pressing the **Run Program** button while a program is already running and turning the **Select Knob**.
- To change from one display to another, turn the **Select Knob**.

1. The first display shows the current stage and value:



Figure 32

The top line indicates the program running. The bottom line indicates the status of the program and the current temperature.

The various program status indicators are:

#### FAST

- Cooling to entry temperature.

#### FAST RISE

- Raising temperature to entry temperature.

#### PRE DRY

- Stepping table into the furnace (entry time).

#### SOAK TIME

- Holding the work at entry temperature.

#### RATE RISE

- Raising the temperature at a specific rate.

#### HOLD TEMP

- Holding constant at final temperature.

#### OPEN COOL

- Standard cooling sequence.

#### INRT COOL

- Cooling under inert conditions (Argon gas).

#### FINISHED

- Program has finished.

#### ABORTED

- Program was aborted by the **Abort Program** button.

#### ENERGY SAVER

- Furnace is in energy saver mode. Press any button to exit.

#### NIGHT MODE

- The furnace is in night mode. Press any button to exit.

The current temperature is followed by a C (Centigrade), or F (Fahrenheit). Following the temperature is a letter that indicates the status of the vacuum. Following are the various letters that may be shown.

- Flashing V** – Vacuum pump is on, furnace is pulling vacuum
- Steady V** – Vacuum pump is off, vacuum in chamber
- I** – Purging or inert gas in chamber
- Blank** – No vacuum

2. Turn the **Select Knob** clockwise and the second display reads TARGET TEMPERATURE:

**TARGET TEMP 1000C  
925C**

**Figure 33**

This display shows the target temperature for this program step in the top line, and the actual temperature in the bottom line.

3. Turn the **Select Knob** clockwise and the third display reads TIME:

**TIME LEFT 8:53  
STEP TIME 5:53**

**Figure 34**

STEP TIME indicates the time left for this step.

**Note:** The furnace does not include the time required for reaching the entry temperature.

4. Turn the **Select Knob** clockwise and the fourth display shows the vacuum:

**VACUUM - 72CM**

**Figure 35**

CM indicates centimeters of MERCURY, IN indicates inches of mercury.

**Note:** 72 cm indicates the range of 71.51 cm to 72.51 cm. If the vacuum level called for is 72 cm and the display shows 72 cm but the pump is still on, the actual level has not reached 72 cm.

5. Turn the **Select Knob** clockwise and the fifth display reads SKIP STEP:

**NEXT = SKIP STEP  
RATE RISE 653C**

**Figure 36**

The top line indicates that pressing the **Next** button will skip the current step of the program. The bottom line displays the current step and the current step's status.

By pressing the **Next** button, the current step will be aborted and the next step in the firing sequence will begin.

**Skip Step** can be repeated as many times as necessary.

6. Turn the **Select Knob** clockwise and the sixth display reads CHANGE THIS PROGRAM:

**NEXT = CHANGE  
THIS PROGRAM**

**Figure 37**

This feature allows you to make an immediate but temporary change to the program that is running. Press the **Next** button to begin making changes.

Any changes to a program made from this screen will alter the way the current program runs. Permanent changes to a program must be made in the **Change Program Menu** when program is not running.

See **Chapter Three — Change Program Menu** for details on making permanent changes to a program.

7. Turn the **Select Knob** clockwise and the seventh screen is NIGHT MODE:

This display indicates that you may activate the night mode, which will bring the furnace to the night mode temperature after the completion of this program.

**PRESS NEXT FOR  
"NITE" MODE - NO**

**Figure 38**

To activate the night mode press the **Next** button. YES will replace NO and night mode will activate upon completion of the program.

To de-activate night mode, Press the **Next** button again. NO is displayed. Night mode is now canceled.

## Running a Pressing Program (Pro Press 100 only)

1. If the muffle temperature is below the entry temperature specified in the program, the table will raise to the closed position while the temperature rises. If the muffle temperature is above the entry temperature specified in the program, the table will remain down while the muffle cools. When the entry temperature is reached, the furnace will begin to beep continuously. The display will read:

**NEXT = RAISE TBL**

Figure 39

2. After Pressing the **Next** button, the table will lower. Place the ring onto the firing table and press the **Next** button.
3. The Pressing program will begin running.

## Running a Re-Press Program

To run a Re-Press Program, Calibration Password number 310 must be set to "Timed Press = No"

Press **Special Functions** Key, then rotate knob to the "Calibration Password" prompt and press the **Next** key. At the password entry prompt rotate the knob until the display says "310" and press **Next** key.

**TIMED PRESS = NO**

Figure 40

Rotate the knob until the screen looks like the one above and press **Next** key. This has activated the Re-Press mode.

1. If the muffle temperature is below the entry temperature specified in the program, the table will raise to the closed position while the temperature rises. If the muffle temperature is above the entry temperature specified in the program, the table will remain down while the muffle cools. When the entry temperature is reached, the furnace will begin to beep continuously. The display will read as shown below:

**NEXT = RAISE TBL**

Figure 41

2. After pressing the **Next** button, the table will lower. Place the ring onto the firing table and press the **Next** button.
3. The Pressing program will begin running.

4. The temperature will now rise to the final temperature selected in the program. When the final temperature is reached, the hold time will begin.
5. When the hold time has expired the display will read as shown below. The furnace will begin the first press. The first press will continue for four minutes. After the first press has been completed re-pressing will occur if password 310 is activated. (See the Calibrate Oven section of this manual for further information.)

When running a re-press program the furnace will automatically press for four minutes and then the additional "Re-Press" time you add in the program parameters.

**PRESSING**

Figure 42

6. The display will now say RE-PRESSING and the furnace will begin to re-press the work for the amount of time specified in the program. When the re-press time has expired, the press will fully retract and the table will lower.

**RE-PRESSING**

Figure 43

## Running a Manual Glazing Program

The **Pro Series** furnaces allow users to quickly create a glazing program.

### Procedure:

1. Press the **Run Program** button.
2. Turn the **Select Knob** to program number 99. Program number 99 is the Manual Add Temperature Program.



**SELECT PROGRAM  
99 MAN - ADD TEMP**

**Figure 44**

3. Press the **Start Program** button to begin.
4. The display will read as shown below. Turn the **Select Knob** to the final temperature for this program.



**FINAL TEMP  
XXXX**

**Figure 45**

5. The HOLD TIME will be displayed as shown below. Turn the **Select Knob** to select the time you wish to hold the porcelain at the final temperature.



**HOLD TIME**

**Figure 46**

6. Press the **Next** button to continue.
7. COOL TIME will be displayed. Turn the **Select Knob** to the desired cool time. This is the time the furnace uses to bring the table to its fully down position. The table will be lowered in steps evenly spaced during the cool time.



**COOL TIME  
0:00**

**Figure 47**

8. Press the **Next** button. The table will rise and the program will run. All of the normal displays are available while running a manual program.

## Chapter Five — Maintenance

### Cleaning The Furnace

Your new furnace has been painted with an epoxy based paint and may be cleaned by using a soft cloth and kitchen cleaners such as Fantastic® or Formula 409®. The front panel should be cleaned with a window cleaner such as Windex®.

Never clean the display window with a dry cloth or tissue. Always moisten the cleaning cloth with a cleaner such as Windex® or water.

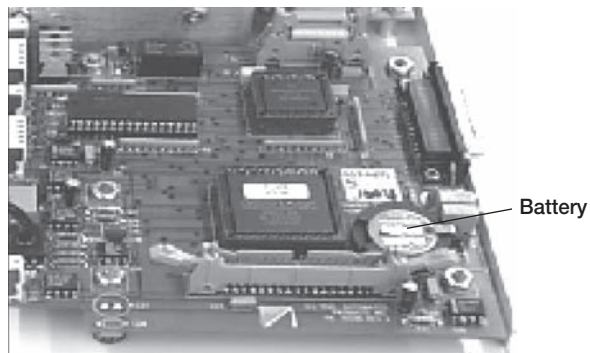
Only clean the table with Windex® or water and a towel. Using other cleaners will harm the anodized surface.



**USE WINDEX® OR WATER ONLY. YOU WILL ENCOUNTER PROBLEMS IF 409® OR FANTASTIC® IS USED TO CLEAN THE TABLE.**

### Battery Replacement

Your furnace contains a battery that is used to maintain power to the computer memory even when the power is turned off. This battery should be replaced every 5 years, and should be replaced with the power on. Contact your dealer or Whip Mix to order new batteries and printed instructions.



### Software Version Upgrade

The furnace has a unique feature that allows the operator to add new firing cycles whenever new materials come to market.

As new porcelains and new techniques for firing porcelains are introduced, the furnace can be easily upgraded.

New software versions will be available from your dealer in a “Blue Smart Box.” Obtain the “Blue Smart Box” from your dealer.

1. With the furnace on and the screen in the PRESS MENU BUTTON state, press the **Last** button. This will tell you the version of software currently on your furnace. Example — VER. 2.06.02 PR, PR = Pro Press 100 and P1 = Pro 100.
2. Locate the door on the right side of the furnace. Remove the two thumbscrews securing the door to expose the parallel port.
3. Check the software version of the “Blue Smart Box” to make sure the version is newer than the version currently on your furnace. Example — 2.02.01\*\* is older than 2.05.01\*\*. 2.05.01\*\* is older than 2.05.03\*\*, etc.
4. With the door removed, place the “Blue Smart Box” onto the parallel port connector.

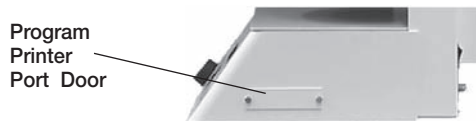


**DO NOT USE THE WRONG VERSION OF SOFTWARE. IF THE FURNACE IS A PRO PRESS 100, THE VERSION NUMBER SHOULD RESEMBLE 2.06.02 PR OR 2.06.02 P1 IF IT IS A PRO 100. IF UNSURE, PLEASE CONSULT CUSTOMER SERVICE.**

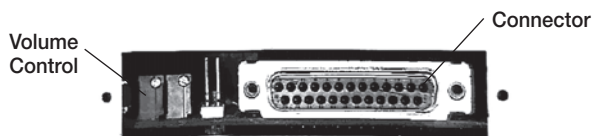


**Follow these instructions to upgrade the furnace:**

1. Locate the door on the right side of the furnace. Remove the two thumbscrews securing the door in place, and remove the door.



2. With the door removed, a connector can be seen in the opening. Look at the “Blue Smart Box” to make sure that it has the correct version number for your furnace on the label. Do not use a “Blue Smart Box” that has the wrong number on the label. Plug the “Blue Smart Box” into the connector.



3. Press the **Special Functions** button.
4. Turn the **Select Knob** counter-clockwise until the display reads CALIBRATE OVEN. Press the **Next** button to continue.

**SPECIAL FUNCTIONS  
CALIBRATE OVEN**

Figure 48

5. The display should read PASSWORD – 0. Turn the **Select Knob** to the right until the 0 has changed to 350. Press the **Next** button.

**PASSWORD  
- 0**

Figure 49

6. The display will read LOAD SOFTWARE? NO. Turn the **Select Knob** in either direction to change the NO to YES. Press the **Next** button.

**LOAD SOFTWARE  
NO**

Figure 50

7. The furnace will load and verify the new software, then reset. Remove the “Blue Smart Box.” Replace the door with the thumbscrews.



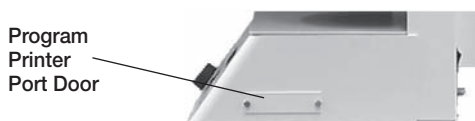
**CAUTION: USE ONLY A “BLUE SMART BOX” FOR SOFTWARE UPGRADES, AND THEN ONLY IF THE “BLUE SMART BOX” HAS THE CORRECT SOFTWARE VERSION NUMBER ON THE LABEL. USE OF ANYTHING OTHER THAN THE CORRECT “BLUE SMART BOX” COULD DAMAGE YOUR FURNACE.**

**Printer Requirements and Installation**

The printer attachment on the furnace is designed to work as a parallel port for a Whip Mix Thermal Printer. Some Epson® dot matrix and Hewlett Packard® printers do work, but are not guaranteed to work.

**To install the printer:**

- Attach a printer cable to the printer cable port on the printer.
- Remove the cover over printer/program port on the furnace.
- Attach the printer cable to the printer/programs port on the furnace, located as shown in the photo below.
- Plug the printer power cord into an outlet and turn the printer on.



**Note:** If you have a Whip Mix Thermal Printer the furnace will be pre-set to print a narrow width, however, if your printer is not a Whip Mix Thermal Printer and uses 8 1/2 x 11" paper, and you would like to change the width of the print, use the following instructions:

- Press the **Special Functions** button.
- Turn the **Select Knob** to CALIBRATE OVEN.
- Press the **Next** button.
- Turn the **Select Knob** clockwise to select password number 320.
- Press the **Next** button.
- The display will read as is shown in Figure 51 below.

**NARROW PRINTING?  
YES**

Figure 51

- Turn the **Select Knob** to select NO.
- Press the **Next** button.

Run a test print to make sure your printer is printing correctly.

## Argon Gas Requirements and Installation (Pro 100 only)



**USE ONLY ARGON GAS IN THE PRO 100 FURNACE. ATTACHING ANY FLAMMABLE OR NOXIOUS GAS TO THIS FURNACE COULD CAUSE EXPLOSION OR PERSONAL INJURY!**

The best source of Argon is from your local bottled gas dealer. Usually the same dealer who furnishes Oxygen can also supply Argon. If not, he can recommend a reliable source. There are generally three grades of Argon available and your dealer can tell you the cost of each. Most furnace buyers use the lower cost commercial or industrial grade of Argon.

The same dealer should be able to supply a regulator for the bottled Argon. The regulator should be similar to the one on an Oxygen tank. It should have a gauge showing the pressure inside the tank, and a smaller gauge showing the pressure applied to the outside system. The smaller gauge should be no more than 120 PSI maximum.

The furnace requires between one and two PSI of Argon gas pressure. The use of more pressure will not improve the performance of the furnace. If you plan to use the Argon gas feature of this furnace you should purchase a low-pressure Argon post regulator kit.

The low-pressure post regulator kit attaches to the regulator supplied by your gas supplier. Installation of the low-pressure regulator is as follows:



**DO NOT REMOVE THE REGULATOR SUPPLIED BY YOUR BOTTLED GAS SUPPLIER. THE LOW-PRESSURE REGULATOR IS IN ADDITION TO THE REGULATOR SUPPLIED WITH YOUR BOTTLE.**

1. The regulator supplied by the bottled gas company usually has a hose barb fitting to attach your hose. Remove this fitting.
2. The low-pressure regulator kit has a 1/4 inch male pipe thread fitting supplied on one end. The other end has a hose barb fitting for the supply hose to the furnace. Attach the male pipe thread end to the regulator on the bottle. The first gauge reads the bottle pressure, the second gauge reads the pre-regulator pressure, and the third gauge reads from 0 to 15 PSI.



**DO NOT ATTACH THE GAS TO THE FURNACE YET.**

3. Attach one end of the supplied hose to the low-pressure regulator.



**DO NOT ATTACH THE OTHER END TO THE FURNACE YET.**

4. Turn on the gas supply to the regulators.
5. Adjust the pre-regulator (supplied by your gas dealer) to around 20 PSI.
6. Pull the red locking ring on the low-pressure regulator towards the black knob on the bottom of the regulator to release the knob. Turn the black knob fully counter-clockwise. The pressure should be 0.
7. Turn the black knob clockwise until the low-pressure gauge reads between 1.0 and 1.5 PSI.
8. Push the red locking ring up towards the gauge. This will lock the pressure setting.
9. Turn off the gas supply from the bottle. Be sure to turn off the supply when the gas is not being used to avoid the loss of gas due to fitting leaks.
10. Attach the hose to the Argon connector on the back of the furnace.

The furnace is now ready to run titanium and sintering programs, which require Argon gas.

**Note:** The pressure reading may jump higher than 1.5 PSI between firing and at times during the purging process. This is normal. Pressure may be checked during the inert cool step in the firing sequence. At that time Argon is being applied at a constant pressure to the furnace. The gauge should read between 1 and 1.5 PSI. You may adjust the regulator at this time.

## Replacing the Muffle



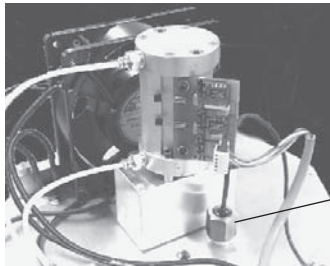
**UNPLUG THE UNIT FIRST!**

When replacing the muffle, **be careful not to touch the muffle power terminal screws with your finger or without insulated tools.** There is a lot of current at the terminals, so be very careful when replacing the muffle! Make sure you unplug the unit before replacing the muffle.

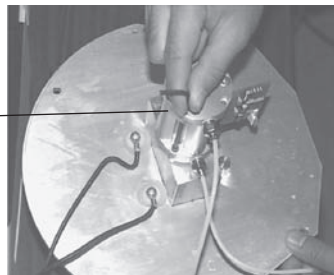
1. **Unplug the unit!** Give the muffle time to cool before starting.



2. Turn the furnace around until the back is facing you.
3. Using a #2 Phillips head screwdriver, remove the top cover of the furnace that covers the muffle assembly.



Thermocouple



Press Cylinder Removal

**Figure Muf. 1**

4. Remove or disconnect the wires from their connectors at the back of the furnace. Disconnect the Press Cylinder hoses by pushing on the metal that surrounds the hose at the connector and pulling on the hose simultaneously.

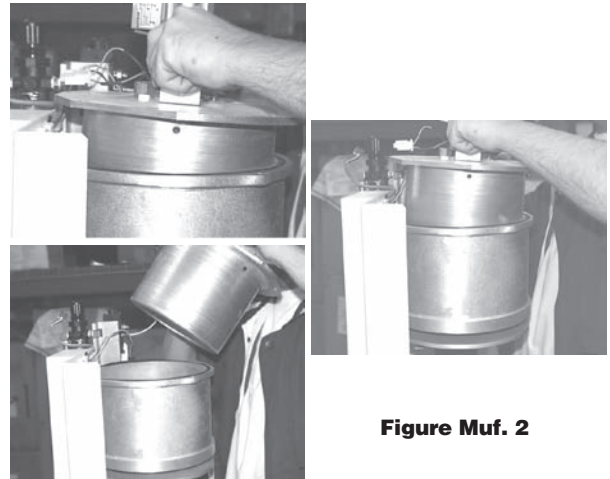
5. Remove the Press cylinder from the muffle assembly lid, as shown in Figure Muf. 1, with the  $\frac{7}{64}$ " Allen wrench. Loosen the steel Allen bolts very carefully as they may strip the aluminum threads in the lid.
  - Inspect the ceramic rod and replace if cracked or chipped.

6. **Thermocouple removal** — BE CAREFUL: THE THERMOCOUPLE IS VERY SENSITIVE! Make sure you first have a clean surface or paper towel to lay the thermocouple on. Disconnect the thermocouple wire from the connector at the back of the chassis. Then using a  $\frac{3}{4}$ " wrench turn the bolt counterclockwise until the thermocouple is free to be pulled out. Pull it carefully up and out of the top of the muffle after unscrewing it.



**DO NOT TOUCH THE THERMOCOUPLE WITH YOUR BARE HAND OR LAY IT ON A SURFACE CONTAINING ANY KIND OF CHEMICAL OR DUST! USE A PAPER TOWEL OR A CLEAN SURFACE TO LAY IT ON.**

7. Remove the four bolts that hold the muffle lid to the casting using a #3 Phillips head screwdriver.
8. Slide the muffle assembly carefully up and out of the casting then set it aside, as shown in the Figure Muf. 2.



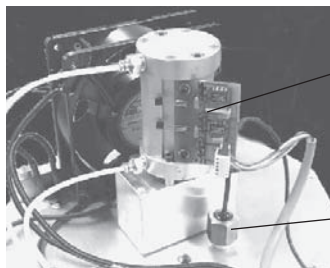
**Figure Muf. 2**

9. Remove and clean the top O-ring from the casting (using a dry cloth). Visually inspect the casting and O-ring groove for cracks or particles.



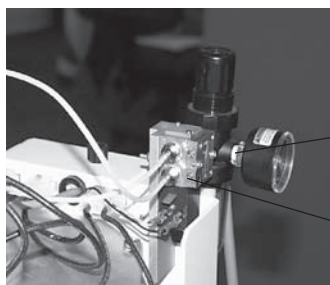
**Figure Muf. 3**

10. Retrieve the new muffle assembly and inspect it for particles and cracks
11. Reinsert the O-ring and carefully place the muffle assembly onto the O-ring and casting. Some alignment may be needed.
12. Place the fan on top of the lid of the new muffle assembly and insert the bolts loosely. Make sure to insert one tab of the fan thermostat under the fan mount before tightening the screws. Make sure to center the fan thermostat in the thermal joint compound (white paste).
13. Insert the other two bolts toward the back and tighten all four in a crisscross pattern until the muffle assembly is tightly connected to the casting.
14. Replace the press cylinder and tighten into place with the four Allen bolts. While inserting the cylinder be careful not to damage the insulation. Also check for rod clearance.
15. Reconnect press valve hoses by gently tugging on the hose to confirm catch. Remember, the hose on the bottom of the valve goes to the top of the press cylinder and the hose to the top of the valve goes to the bottom of the press cylinder.



Press Board  
**Note:** Make sure the wires face the back of the furnace.

Thermocouple



Press Regulator

Press Adjust



Top O-ring

**Figure 52**

16. Wrap the thermocouple bolt threads with 1/2" Teflon tape clockwise with the tip facing you at least three full (360 degree) revolutions.
17. Insert the thermocouple into the lid and slowly tighten.
18. Reconnect all other wires and replace top cover. Make sure to orient the press sensor wire correctly on the press cylinder (wires facing the back). (See Figure 52.)
19. Run vacuum test again with idle temperature set at 0° C.
  - 2 Bottom O-ring Checks:
    - Cracking or peeling
    - Suppleness
    - Loose particles

**Moisture burnout and muffle burn in procedures**

**1. Muffle Burnout**



**DO NOT FORGET TO PLACE THE FIRING TRAY ON THE LIFT TABLE!**

- A. Press the **Special Functions** button.



**Figure 53**

- B. Turn the **Select Knob** to select CHANGE IDLE TEMP. Press the **Next** button.



**Figure 54**

- C. Turn the **Select Knob** to indicate NEW IDLE – 651C. Press the **Next** button.



**Figure 55**

- D. Push the **↓ Down** arrow button to run the table all the way down.
- E. Let the furnace sit at least two hours.

This will burn out all binders in the ceramic fiber insulation. When the table lowers, clean the table with a paper towel and Windex® or water. (Do not use Fantastic® or 409® as these will remove the anodized finish and ruin the table.)

## 2. Muffle Burn In



**DO NOT FORGET TO PLACE THE FIRING TRAY ON THE LIFT TABLE!**

- A. Press the **Change Programs** button.
- B. Turn the **Select Knob** right to select ADD A PROGRAM. Press the **Next** button.
- C. Select program 0. Press the **Next** button.
- D. The furnace will ask for a porcelain type. Turn the **Select Knob** to select SPEC. Press the **Next** button.
- E. The furnace will tell you to enter a program name. Turn the **Select Knob** and press the **Next** button after every letter. For blank spaces merely press the enter button without turning the **Select Knob**. Enter the name BURN\_IN.

**0 SPEC - BURN IN  
ENTRY TEMP 500C**

**Figure 56**

- F. Enter an entry time of 1 minute by turning the **Select Knob**. Press the **Next** button.
- G. Turn the **Select Knob** to select an entry temperature of 500C. Press the **Next** button.
- H. The furnace will ask for a soak temperature, press the **Next** button to skip this item.
- I. The furnace will ask for a soak time, press the **Next** button to skip this item.
- J. Turn the **Select Knob** to select a heat rate of 40C/Minute. Press the **Next** button.

**0 SPEC - BURN IN  
HEAT RATE 40C/M**

**Figure 57**

- K. Turn the **Select Knob** to enter a final temperature of 1000C. Press the **Next** button.

**0 SPEC - BURN IN  
FINAL TEMP**

**Figure 58**

- L. Turn the **Select Knob** to select a hold time of 15 minutes. Press the **Next** button.

**0 SPEC - BURN IN  
HOLD TIME 15:00**

**Figure 59**

- M. The furnace will prompt you to enter an SP CL TIME, press the **Next** button to skip.
- N. Turn the **Select Knob** to select a temperature of 1000C to lower the table. Press the **Next** button.

**0 SPEC - BURN IN  
LOWER TABLE 1000C**

**Figure 60**

- O. The furnace will ask you to enter a cool time, press the **Next** button to skip. This will automatically enter a cool time of 0:00.

**0 SPEC - BURN IN  
COOL TIME 0:00**

**Figure 61**

- P. Turn the **Select Knob** to select NO vacuum. Press the **Next** button.

**0 SPEC - BURN IN  
USE VACUUM NO**

**Figure 62**

- Q. Press the **Run Program** button.
- R. Turn the **Select Knob** to select Program 0 SPEC - BURN IN.

**SELECT PROGRAM?  
0 SPEC - BURN IN**

**Figure 63**

- S. Press the **Special Functions** button.
- T. Turn the **Select Knob** to CALIBRATE OVEN. Press the **Next** button.
- U. Turn the **Select Knob** to the password number 260. Press the **Next** button.

The program will begin to run immediately and will cycle until the **Stop Program** button is pressed. Leave the furnace to cycle this program for eight hours. When you return press the **Stop Program** button.

Fire a chip of porcelain to test the firing temperature of the new muffle. Adjust the calibration as described in **Chapter Four — Running a Program**. Adjust furnace calibration to match your porcelain. Run Vacuum Test, see page 38.

## Trouble Shooting Guide

The **Pro 100** and **Pro Press 100** furnaces offer a number of self checks and warning messages that are designed to identify problems. Several of these are listed below:

### No Vacuum

This error occurs if the furnace has not achieved its target vacuum level within 90 seconds. The program will abort automatically. Check the vacuum level setting. If the barometric pressure is unusual, you may have to call for fewer vacuums.

### Duplicate Name

This error occurs if you have entered a program name that is identical to one already stored in memory. Press the **Next** button to continue. Enter a different name for this program.

### Printer Error

This occurs if the printer is not online, paper is out or an error signal is received from the printer. Press the **Next** button to continue. Reset the printer, make sure it has paper, make sure the online light is on. Attempting to print again.

### Check Programs

The computer has detected a corruption of the memory in the area where programs are stored. Check all programs and correct any that have been changed.

### Temp Cal Error

An error has been detected in the temperature calibration. Recalibrate the temperature to correct this problem.

### Vac Cal Error

An error has been detected in the vacuum calibration. Recalibrate the vacuum temperature to correct this problem.

### Max Temp Error

The computer has detected a temperature reading higher than the maximum allowed. The furnace will automatically shut the heating elements off. Turn the power off to reset this error. If the error occurs again call for assistance.

### Thermocouple Error

This error occurs if the furnace detects an open thermocouple for a period of 25 seconds. The furnace will automatically turn off the heating elements. The furnace should be turned off and on again to clear this error. If the error occurs again, the thermocouple should be replaced.

### Start = Load Code

This error occurs if the internal battery fails. Contact your dealer or a factory technician.

### Illegal Opcode

This is an internal computer error. Turn the furnace off, wait 20 seconds, and turn the furnace back on. This process will assure that the computer is reset. If the error is persistent, contact your dealer.

## Vacuum Test

1. Press the **↑ Up** arrow button to raise the table fully up.  
You cannot start a vacuum test until the table is fully up.
2. Press the **Special Functions** button.
3. Turn the **Select Knob** counterclockwise to TEST FURNACE. Press the **Next** button.

**SELECT ITEM:  
TEST FURNACE**

Figure 64

4. Turn the **Select Knob** clockwise to VACUUM TEST. Press the **Next** button. The vacuum test will automatically begin.

**SELECT ITEM:  
VACUUM TEST**

Figure 65

There will be three, numerical indicators on the screen, each has its own individual meaning.

- The number to the far left is the vacuum count.  
That is the vacuum sensor reading.

**VACUUM TEST**  
240      71CM    99

**VACUUM TEST**  
240      29 IN    99

Figure 66

- The second in the middle is the centimeters or inches of mercury.
- The third is the current condition of the table  
0 = moving, 99 = fully up or fully down.

5. Watch the numerical indicators as they rise.
6. The third value should stay at 99 and not change. Sometimes the value changes from 99 to 0 when the vacuum pump starts. This is normal and happens on some units.
7. Once the vacuum has reached 240, press the **Next** button. This will place the test in the hold position and allow you to watch for changes in vacuum pressure and readings.

The acceptable loss is 2 cm within six minutes.

8. Once the test has been in HOLD for 6 minutes, press the **Next** button and the test will end.
9. If the numbers dropped outside the acceptable loss range, then the vacuum system has a leak and it must be repaired and recalibrated.

## Fuses

The furnace contains four fuses:

- On the rear, just below and to the right of the power cord, there are two 12 Amp (115 VAC) or two 6 Amp (220 VAC), .25 x 1.25 inch ceramic fuses.
- Inside the furnace there is a 5 Amp, 5 mm x 20 mm fuse in fuse clips.
- Inside the furnace, on the power board, there is a 1 Amp slow blow .25 x 1.25 inch fuse.

---

## If More Help is Needed

We hope you have many years of trouble-free service from your furnace. If you do have problems with the furnace, or if you have questions about the furnace not covered in the manual, contact your dealer or Whip Mix at:

[www.whipmix.com](http://www.whipmix.com)

Phone: 800-626-5651

Fax: 502-634-4512

E-Mail: [tops@whipmix.com](mailto:tops@whipmix.com)

Be prepared to provide the following information:

1. Your name
2. Your lab's name and address
3. Your lab's phone number
4. Your lab's fax number
5. Furnace model and serial number (serial number can be found on the rear of the furnace)
6. Your question/problem

When you call, it would be helpful if you are near the furnace. The technician will probably ask you to run tests and report the results, or read the display while the test is running.



## Replacement Parts

| Part Number | Description                           |
|-------------|---------------------------------------|
| 96004       | Power Cord 115V                       |
| 96008       | Power Cord 230V                       |
| 96001       | Ceramic Plunger Rods Pkg of 2         |
| 96020       | Investment Ringliner Pkg of 10        |
| 96085       | Red Program Transfer Box              |
| 96147       | Vacuum Valve Plunger 3 way            |
| 96070       | Vacuum Valve Plunger 2 way            |
| 96026       | Lift Limit Switch                     |
| 96021       | Lift Belt                             |
| 96027       | Lift Limit Switches on bracket        |
| 96025       | Table                                 |
| 96216       | Press Regulator                       |
| 96012       | Press Insert Trays                    |
| 96013       | Firing Tray with recess (Press)       |
| 96015       | Firing Tray Regular (Pro 100 & Press) |
| 96016       | Fuses (115 VAC – 12 Amp) Pkg of 2     |
| 96017       | Fuses (230 VAC – 6.3 Amp) Pkg of 2    |

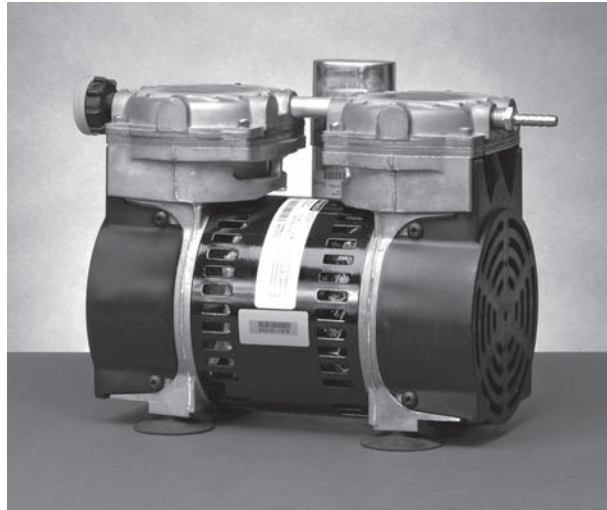
**Note:** Other replacement parts available. Contact TOPS at 800-626-5651 for assistance. **Must have serial number on unit to identify correct part.**

## Also Available from Whip Mix



**Pro 100 Plus**

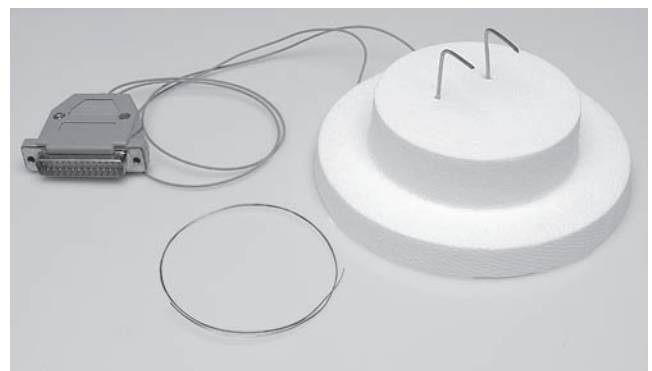
## Pro Series Accessories



**High-Efficiency Vacuum Pump**



**Pro Series' Smart Box**



**Silver Calibration Kit**



**ProCheck Calibration Check Device**

### Fahrenheit to Centigrade

| ° F | ° C | ° F   | ° C | ° F   | ° C | ° F   | ° C   |
|-----|-----|-------|-----|-------|-----|-------|-------|
| 100 | 38  | 630   | 332 | 1,160 | 627 | 1,690 | 921   |
| 110 | 43  | 640   | 338 | 1,170 | 632 | 1,700 | 927   |
| 120 | 49  | 650   | 343 | 1,180 | 638 | 1,710 | 932   |
| 130 | 54  | 660   | 349 | 1,190 | 643 | 1,720 | 938   |
| 140 | 60  | 670   | 354 | 1,200 | 649 | 1,730 | 943   |
| 150 | 66  | 680   | 360 | 1,210 | 654 | 1,740 | 949   |
| 160 | 71  | 690   | 366 | 1,220 | 660 | 1,750 | 954   |
| 170 | 77  | 700   | 371 | 1,230 | 666 | 1,760 | 960   |
| 180 | 82  | 710   | 377 | 1,240 | 671 | 1,770 | 966   |
| 190 | 88  | 720   | 382 | 1,250 | 677 | 1,780 | 971   |
| 200 | 93  | 730   | 388 | 1,260 | 682 | 1,790 | 977   |
| 210 | 99  | 743   | 393 | 1,270 | 688 | 1,800 | 982   |
| 220 | 104 | 750   | 399 | 1,280 | 693 | 1,810 | 988   |
| 230 | 110 | 760   | 404 | 1,290 | 699 | 1,820 | 993   |
| 240 | 116 | 770   | 410 | 1,300 | 704 | 1,830 | 999   |
| 250 | 121 | 780   | 416 | 1,310 | 710 | 1,840 | 1,004 |
| 260 | 127 | 790   | 421 | 1,320 | 716 | 1,850 | 1,010 |
| 270 | 132 | 800   | 427 | 1,330 | 721 | 1,860 | 1,016 |
| 280 | 138 | 810   | 432 | 1,340 | 727 | 1,870 | 1,021 |
| 290 | 143 | 820   | 438 | 1,350 | 732 | 1,880 | 1,027 |
| 300 | 149 | 830   | 443 | 1,360 | 738 | 1,890 | 1,032 |
| 310 | 154 | 840   | 449 | 1,370 | 743 | 1,900 | 1,038 |
| 320 | 160 | 850   | 454 | 1,380 | 749 | 1,910 | 1,043 |
| 330 | 166 | 860   | 460 | 1,390 | 754 | 1,920 | 1,049 |
| 340 | 171 | 870   | 466 | 1,400 | 760 | 1,930 | 1,054 |
| 350 | 177 | 880   | 471 | 1,410 | 766 | 1,940 | 1,060 |
| 360 | 182 | 890   | 477 | 1,420 | 771 | 1,950 | 1,066 |
| 370 | 188 | 900   | 482 | 1,430 | 777 | 1,960 | 1,071 |
| 380 | 193 | 910   | 488 | 1,440 | 782 | 1,970 | 1,077 |
| 390 | 199 | 920   | 493 | 1,450 | 788 | 1,980 | 1,082 |
| 400 | 204 | 930   | 499 | 1,460 | 793 | 1,990 | 1,088 |
| 410 | 210 | 940   | 504 | 1,470 | 799 | 2,000 | 1,093 |
| 420 | 216 | 950   | 510 | 1,480 | 804 | 2,010 | 1,099 |
| 430 | 221 | 960   | 516 | 1,490 | 810 | 2,020 | 1,104 |
| 440 | 227 | 970   | 521 | 1,500 | 816 | 2,030 | 1,110 |
| 450 | 232 | 980   | 527 | 1,510 | 821 | 2,040 | 1,116 |
| 460 | 238 | 990   | 532 | 1,520 | 827 | 2,050 | 1,121 |
| 470 | 243 | 1,000 | 538 | 1,530 | 832 | 2,060 | 1,127 |
| 480 | 249 | 1,010 | 543 | 1,540 | 838 | 2,070 | 1,132 |
| 490 | 254 | 1,020 | 549 | 1,550 | 843 | 2,080 | 1,138 |
| 500 | 260 | 1,030 | 554 | 1,560 | 849 | 2,090 | 1,143 |
| 510 | 266 | 1,040 | 560 | 1,570 | 854 | 2,100 | 1,149 |
| 520 | 271 | 1,050 | 566 | 1,580 | 860 | 2,110 | 1,154 |
| 530 | 277 | 1,060 | 571 | 1,590 | 866 | 2,120 | 1,160 |
| 540 | 282 | 1,070 | 577 | 1,600 | 871 | 2,130 | 1,166 |
| 550 | 288 | 1,080 | 582 | 1,610 | 877 | 2,140 | 1,171 |
| 560 | 293 | 1,090 | 588 | 1,620 | 882 | 2,150 | 1,177 |
| 570 | 299 | 1,100 | 593 | 1,630 | 888 | 2,160 | 1,182 |
| 580 | 304 | 1,110 | 599 | 1,640 | 893 | 2,170 | 1,188 |
| 590 | 310 | 1,120 | 604 | 1,650 | 899 | 2,180 | 1,193 |
| 600 | 316 | 1,130 | 610 | 1,660 | 904 | 2,190 | 1,199 |
| 610 | 321 | 1,140 | 616 | 1,670 | 910 | 2,200 | 1,204 |
| 620 | 327 | 1,150 | 621 | 1,680 | 916 | 2,210 | 1,210 |

### Centigrade to Fahrenheit

| ° C | ° F | ° C | ° F   | ° C | ° F   | ° C   | ° F   | ° C   | ° F   |
|-----|-----|-----|-------|-----|-------|-------|-------|-------|-------|
| 35  | 95  | 300 | 572   | 565 | 1,049 | 830   | 1,526 | 1,095 | 2,003 |
| 40  | 104 | 305 | 581   | 570 | 1,058 | 835   | 1,535 | 1,100 | 2,012 |
| 45  | 113 | 310 | 590   | 575 | 1,067 | 840   | 1,544 | 1,105 | 2,021 |
| 50  | 122 | 315 | 599   | 580 | 1,076 | 845   | 1,553 | 1,110 | 2,030 |
| 55  | 131 | 320 | 608   | 585 | 1,085 | 850   | 1,562 | 1,115 | 2,039 |
| 60  | 140 | 325 | 617   | 590 | 1,094 | 855   | 1,571 | 1,120 | 2,048 |
| 65  | 149 | 330 | 626   | 595 | 1,103 | 860   | 1,580 | 1,125 | 2,057 |
| 70  | 158 | 335 | 635   | 600 | 1,112 | 865   | 1,589 | 1,130 | 2,066 |
| 75  | 167 | 340 | 644   | 605 | 1,121 | 870   | 1,598 | 1,135 | 2,075 |
| 80  | 176 | 345 | 653   | 610 | 1,130 | 875   | 1,607 | 1,140 | 2,084 |
| 85  | 185 | 350 | 662   | 615 | 1,139 | 880   | 1,616 | 1,145 | 2,093 |
| 90  | 194 | 355 | 671   | 620 | 1,148 | 885   | 1,625 | 1,150 | 2,102 |
| 95  | 203 | 360 | 680   | 625 | 1,157 | 890   | 1,634 | 1,155 | 2,111 |
| 100 | 212 | 365 | 689   | 630 | 1,166 | 895   | 1,643 | 1,160 | 2,120 |
| 105 | 221 | 370 | 698   | 635 | 1,175 | 900   | 1,652 | 1,165 | 2,129 |
| 110 | 230 | 375 | 707   | 640 | 1,184 | 905   | 1,661 | 1,170 | 2,138 |
| 115 | 239 | 380 | 716   | 645 | 1,193 | 910   | 1,670 | 1,175 | 2,147 |
| 120 | 248 | 385 | 725   | 650 | 1,202 | 915   | 1,679 | 1,180 | 2,156 |
| 125 | 257 | 390 | 734   | 655 | 1,211 | 920   | 1,688 | 1,185 | 2,165 |
| 130 | 266 | 395 | 743   | 660 | 1,220 | 925   | 1,697 | 1,190 | 2,174 |
| 135 | 275 | 400 | 752   | 665 | 1,229 | 930   | 1,706 | 1,195 | 2,183 |
| 140 | 284 | 405 | 761   | 670 | 1,238 | 935   | 1,715 | 1,200 | 2,192 |
| 145 | 293 | 410 | 770   | 675 | 1,247 | 940   | 1,724 | 1,205 | 2,201 |
| 150 | 302 | 415 | 779   | 680 | 1,256 | 945   | 1,733 | 1,210 | 2,210 |
| 155 | 311 | 420 | 788   | 685 | 1,265 | 950   | 1,742 | 1,215 | 2,219 |
| 160 | 320 | 425 | 797   | 690 | 1,274 | 955   | 1,751 | 1,220 | 2,228 |
| 165 | 329 | 430 | 806   | 695 | 1,283 | 960   | 1,760 | 1,225 | 2,237 |
| 170 | 338 | 435 | 815   | 700 | 1,292 | 965   | 1,769 | 1,230 | 2,246 |
| 175 | 347 | 440 | 824   | 705 | 1,301 | 970   | 1,778 | 1,235 | 2,255 |
| 180 | 356 | 445 | 833   | 710 | 1,310 | 975   | 1,787 | 1,240 | 2,264 |
| 185 | 365 | 450 | 842   | 715 | 1,319 | 980   | 1,796 | 1,245 | 2,273 |
| 190 | 374 | 455 | 851   | 720 | 1,328 | 985   | 1,805 | 1,250 | 2,282 |
| 195 | 383 | 460 | 860   | 725 | 1,337 | 990   | 1,814 | 1,255 | 2,291 |
| 200 | 392 | 465 | 869   | 730 | 1,346 | 995   | 1,823 | 1,260 | 2,300 |
| 205 | 401 | 470 | 878   | 735 | 1,355 | 1,000 | 1,832 | 1,265 | 2,309 |
| 210 | 410 | 475 | 887   | 740 | 1,364 | 1,005 | 1,841 | 1,270 | 2,318 |
| 215 | 419 | 480 | 896   | 745 | 1,373 | 1,010 | 1,850 | 1,275 | 2,327 |
| 220 | 428 | 485 | 905   | 750 | 1,382 | 1,015 | 1,859 | 1,280 | 2,336 |
| 225 | 437 | 490 | 914   | 755 | 1,391 | 1,020 | 1,868 | 1,285 | 2,345 |
| 230 | 446 | 495 | 923   | 760 | 1,400 | 1,025 | 1,877 | 1,290 | 2,354 |
| 235 | 455 | 500 | 932   | 765 | 1,409 | 1,030 | 1,886 | 1,295 | 2,363 |
| 240 | 464 | 505 | 941   | 770 | 1,418 | 1,035 | 1,895 | 1,300 | 2,372 |
| 245 | 473 | 510 | 950   | 775 | 1,427 | 1,040 | 1,904 | 1,305 | 2,381 |
| 250 | 482 | 515 | 959   | 780 | 1,436 | 1,045 | 1,913 | 1,310 | 2,390 |
| 255 | 491 | 520 | 968   | 785 | 1,445 | 1,050 | 1,922 | 1,315 | 2,399 |
| 260 | 500 | 525 | 977   | 790 | 1,454 | 1,055 | 1,931 | 1,320 | 2,408 |
| 265 | 509 | 530 | 986   | 795 | 1,463 | 1,060 | 1,940 | 1,325 | 2,417 |
| 270 | 518 | 535 | 995   | 800 | 1,472 | 1,065 | 1,949 | 1,330 | 2,426 |
| 275 | 527 | 540 | 1,004 | 805 | 1,481 | 1,070 | 1,958 | 1,335 | 2,435 |
| 280 | 536 | 545 | 1,013 | 810 | 1,490 | 1,075 | 1,967 | 1,340 | 2,444 |
| 285 | 545 | 550 | 1,022 | 815 | 1,499 | 1,080 | 1,976 | 1,345 | 2,453 |
| 290 | 554 | 555 | 1,031 | 820 | 1,508 | 1,085 | 1,985 | 1,350 | 2,462 |
| 295 | 563 | 560 | 1,040 | 825 | 1,517 | 1,090 | 1,994 | 1,355 | 2,471 |

