

PHOENIX

Programmable, Automatic, Vacuum Firing Porcelain Furnace



OPERATION AND MAINTENANCE MANUAL

IMPORTANT:
Review the installation and operation sections of this manual completely before unpacking or using your new PHOENIX Furnace. This will assure you maximum performance and safe, trouble-free operation.

Ceramco® Inc.
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1-800-487-0100

TOP PLATE OF FIRING CHAMBER

COOLING JACKET

INTRODUCTION

Thank you for choosing the PHOENIX® Furnace. Your new PHOENIX Furnace was developed based upon a proven system modified to complement and optimize the fine quality CERAMCO® Porcelains and other state-of-the-art porcelain materials. At its heart is an advanced E² PROM* microprocessor which enables you to control every aspect of the furnace's operation to exacting tolerances for consistent, dependable performance. The microprocessor memory is capable of storing 103 individual programs including 17 variable preset firing programs for your Ceramco products, 82 open firing programs and preset purge, calibration, night and hold operations. It allows you to modify any selected firing program either before or during operation. And, it stores your programs indefinitely, without the need for batteries.

Your new PHOENIX Furnace has been developed to give you dependable, long lasting service and convenience for many years to come. Enjoy it!

Help us to help you

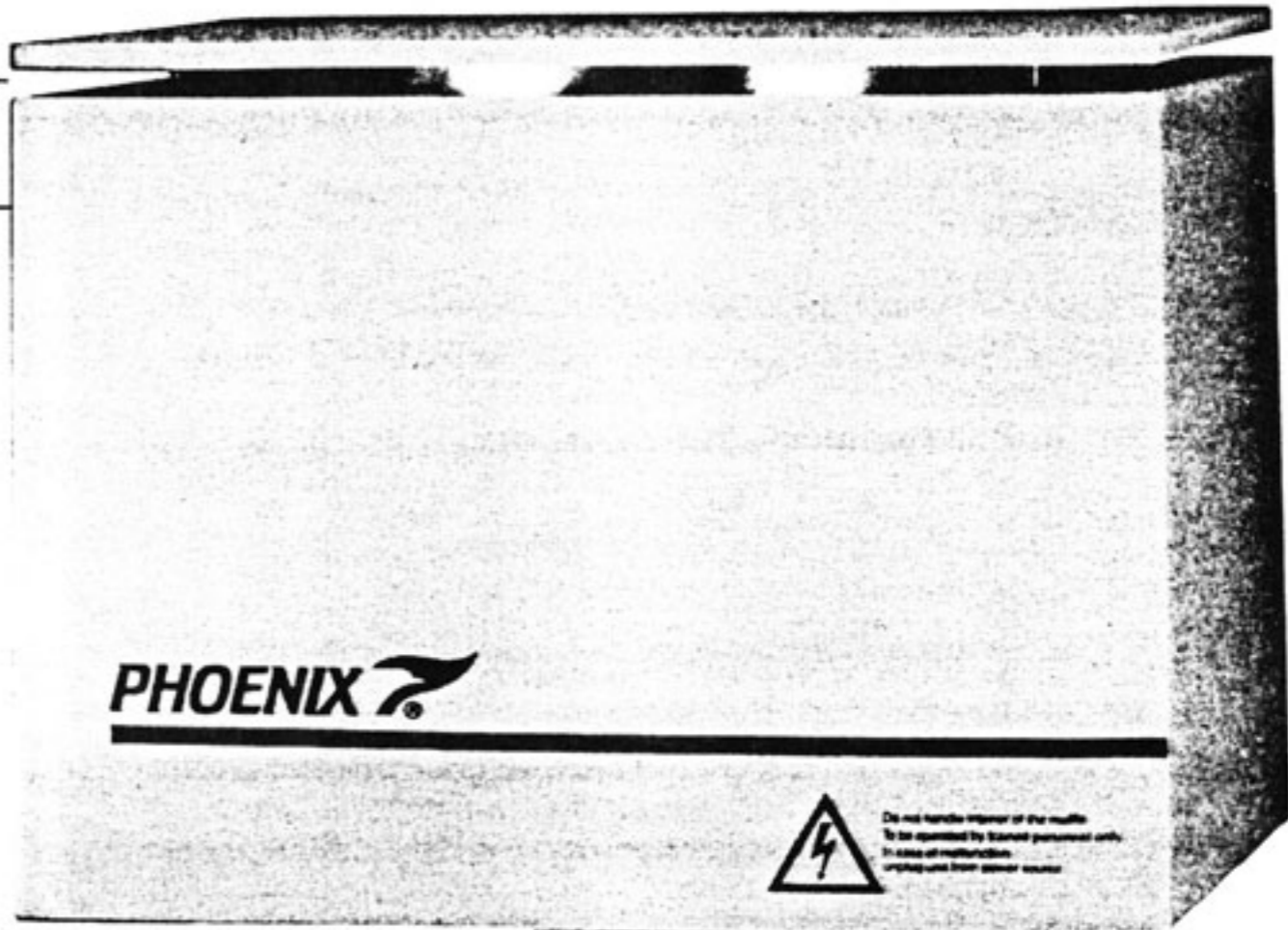
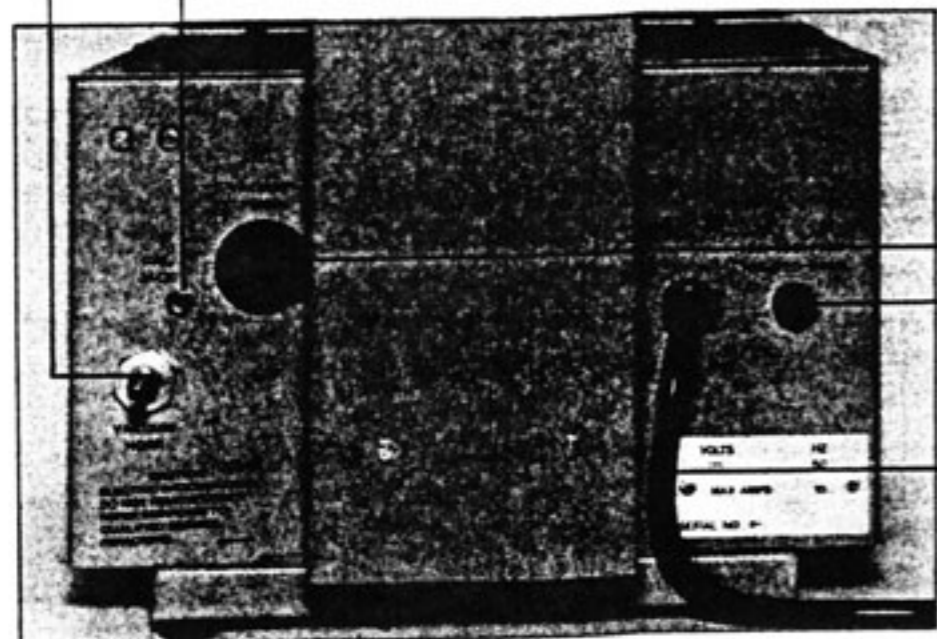
Read this manual carefully. If you need more information or assistance now or in the future, either for your PHOENIX Furnace or Ceramco products....please contact our Technical Services Department toll free at 1-800-487-0100.

*Electrically Erasable, Programmable Read Only Memory.

PROGRAM DISPLAY WINDOWS

VACUUM HOSE CONNECTION

CALIBRATION JACK



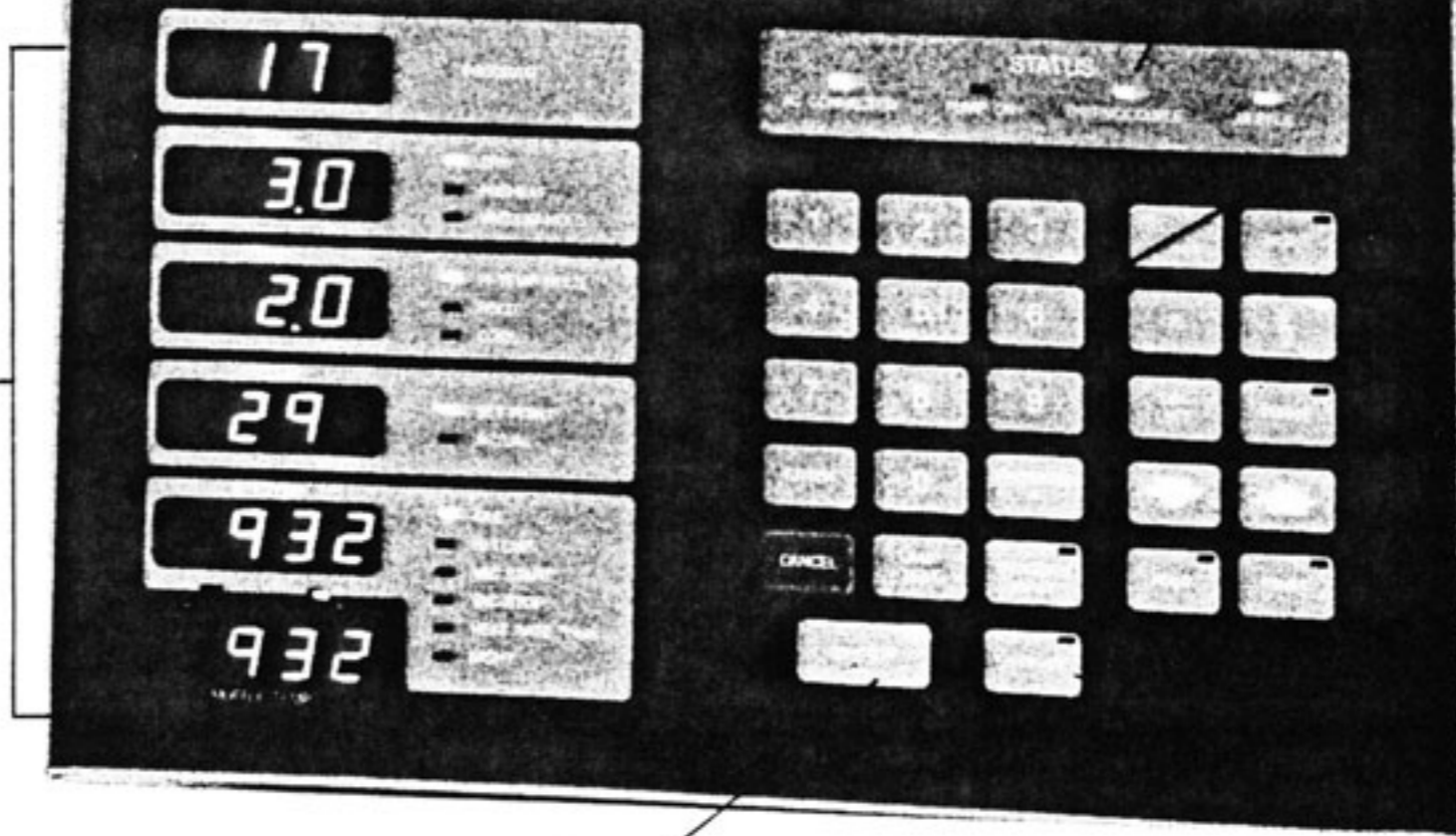
FIRING CHAMBER CARRIAGE

FIRING PLATFORM

FIRING PLATFORM SUPPORT

DIAGNOSTIC AND STATUS LEDs

WORK TABLE



ON/OFF KEY

PROGRAMMING KEYS

COMMAND KEYS

VACUUM PUMP ELECTRIC OUTLET

CIRCUIT BREAKER

POWER CABLE

OVERRIDE KEY

FIGURE 1. PHOENIX FURNACE, FRONT AND REAR VIEW

PART I. INSTALLATION AND OPERATION

SECTION A. GETTING STARTED

A1. UNPACKING

- Remove the furnace from the carton by lifting from the base section.
- Carefully remove and unwrap the firing platform and the calibration platform.
- Remove all the remaining packing material.
- Save the carton and packing material in case you need to store, move, or ship the furnace.
- Locate the furnace in an area with at least two inches of air space on all sides.

CAUTION: Do not lift the furnace by the upper section (muffle).

A2. INSTALLING THE FIRING PLATFORM

- When the furnace is placed on the bench, gently lift the upper section (muffle) to the fully open position and prop it up.
- Remove the packing material between the muffle and the firing platform support.
- Position the firing platform on the guide post in the center of the firing platform support.
- Remove the props and lower the upper section to the closed position.

CAUTION: Do not turn the furnace on until the firing platform has been positioned on the guide post and is firmly seated on the firing platform support. Failure to seat the firing platform correctly before turning the furnace on can result in damage to the "O-ring" vacuum seal on the platform support.

A3. CONNECTING THE POWER (USA domestic models)

Plug the furnace power cord into a properly grounded, three prong, 115 volt outlet, on a circuit capable of at least 15 amps.

- When the power cord is plugged in, the green LED directly over the words AC CONNECTED in the status area of the front panel will light, indicating that power is available to operate the furnace.

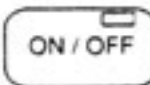
CAUTION: Do not plug the furnace into a circuit that is being used for other heavy equipment. Overloading a circuit will cause poor performance in all the equipment and can create a fire hazard.

A4. CONNECTING THE VACUUM PUMP


- Locate the vacuum pump below the furnace level. For example, on the floor below the furnace.
- Remove the caps from the suction and discharge ports.
- Plug the electrical cord from the vacuum pump into the vacuum pump receptacle located on the back of the furnace.
- Attach the vacuum pump hose to the hose connector at the back of the furnace and to the suction port on the pump.
- Consult the Operation and Maintenance Instructions for the vacuum pump for further details.

A5. TURNING THE POWER ON

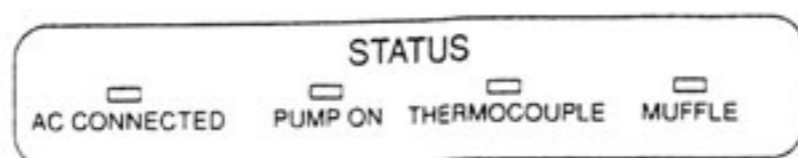
To begin using your PHOENIX Furnace, press the ON/OFF key.

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- The green LED for the ON/OFF key will light.
 - The muffle temperature will begin to rise to the preprogrammed temperature of 1200°F (649°C).
- Preset program #01 will be displayed in the upper left window. Thereafter, the number of the last program used will be displayed in the window when the power is turned on.

A6. RUNNING THE LAMP TEST

- 
- Press the LAMP TEST key.
 - Check the front panel to make sure all of the LEDs light up for at least two seconds.
- If an LED does not light, contact Ceramco's Technical Service Department for assistance.

A7. CONFIRMING THE WORK STATUS

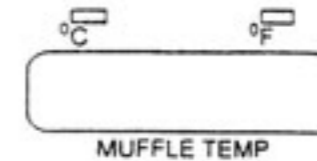


- Look at the LEDs in the STATUS section of the front panel to confirm that the LEDs over AC CONNECTED, THERMOCOUPLE, and MUFFLE are lit. The LED over PUMP ON will

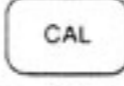
- light while the vacuum pump is running. The lit LED indicates the particular part of the furnace is functioning properly.
- If any of these LEDs do not light, contact the Ceramco Technical Service Department for assistance.

A8. MUFFLE POWER LED

A small red LED at the lower right corner of the MUFFLE TEMP window will light when power is being supplied to the muffle.



SECTION B. CALIBRATING THE FURNACE

 Your PHOENIX Porcelain Furnace has been factory calibrated. We recommend checking the calibration prior to initial operation and once each month as part of normal furnace maintenance.

CAL is a preset program which adjusts the furnace's temperature control to the melting point of pure silver (1761°F, 961°C).

B1. PREPARING THE FURNACE FOR CALIBRATION

Make sure the actual muffle temperature is within 3° (F or C) of the IDLE set temperature *before pressing the CAL key*. See Item J, Section D3 for details on the IDLE function.

CAUTION: If the ACTUAL temperature is not within 3° (F or C) of the IDLE set temperature, the muffle will remain open and the temperature will begin to rise to 1652°F (900°C). If this happens, press CANCEL and allow the muffle to reach the IDLE temperature.

B2. PREPARING THE CALIBRATION PLATFORM

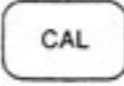
- Clean the two metal posts with fine abrasive paper (for example, emery cloth) to remove any oxidation or silver deposits.
- Cut a 2.5 to 2.75" (6.4 to 7.0 cm) long piece of the silver calibration wire.
- Securely wrap the wire three or four times around one post approximately 0.5" (1.3 cm) from the base.
- Extend the wire to the other post, allowing some slack in the wire between the posts.
- Securely wrap the wire around the second post.
- Trim excess wire.

CAUTION: Do not pull the wire taut between the posts. If the wire is stretched, it may break prematurely during the calibration cycle. This will cause the calibration to be inaccurate.

B3. INSTALLING THE CALIBRATION PLATFORM

- Open the muffle and remove the firing platform.
- Place the calibration platform on the platform support.
- Adjust the connector cable so that it is flat on the platform support.
- Insert the connector cable plug into the calibration jack located at the back of the furnace directly above the vacuum hose connection.

B4. STARTING THE CALIBRATION PROGRAM

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- Press the CAL key. The program will go through the following steps.
 - If the actual muffle temperature is within 3° (F or C) of the IDLE temperature, the muffle will move to within 0.5" (1.3 cm) of the fully closed position.
 - The muffle temperature will ramp up to 1652°F (900°C) and hold for 3.0 minutes.
 - After 3.0 minutes, the muffle will close as far as the cable will allow and 1868°F (1020°C) will appear in the SET TEMP window.
 - The temperature will slowly ramp up and calibration will occur when the wire melts.
 - After calibration occurs, the program will end and the muffle will move to the fully open position.
 - Remove the calibration platform, disconnect the plug and reposition the firing platform.

NOTE: If a long "beep" sounds or the letters CAL do not remain in the program window after pressing the CAL key, remove the calibration platform and check that the silver wire is making contact with clean metal on the upright posts. Replace the platform and press CAL again.

SECTION C. USING THE KEYPAD

1. UP and DOWN ARROWS



a. Press the UP ARROW key to raise the muffle from the closed position.



b. Press the DOWN ARROW key to lower the muffle to the closed position.
c. During the PROGRAM INPUT process, use these keys to move the flashing indicator to the function you wish to define.

NOTE: Pressing either key while the muffle is in motion will stop the movement. Raising or lowering the muffle can be continued by pressing the appropriate key.

2. PROGRAM



Use this key to select a program. For example, to select program #9, press PROGRAM #, 0, 9. This program number will be displayed in the program window.

NOTE: Always use two numbers to select a program.

3. START



Press START to activate the program displayed in the program window. The LED on the START key will light and will remain on while a program is running.

NOTE: The muffle must be in the open position before START is pressed. The program will start when the ACTUAL temperature is within 3° (C or F) of the IDLE temperature.

4. PROGRAM INPUT



Use this key to create a new program, or to examine or modify an existing program. The LED for PROGRAM INPUT will be lit when it is possible to input a new time or temperature value for a function. Press this key to enter and exit the INPUT mode. See Section D for programming details.

5. ENTER



Press the ENTER key to store program values into the microprocessor memory before leaving the PROGRAM INPUT function. See Section D for programming details.

6. CANCEL



Pressing CANCEL will abort any program that is in progress, and the muffle will open.

7. °C/°F STATUS



Press this key to switch the MUFFLE TEMP and all function displays from Centigrade to Fahrenheit values or the reverse.

NOTES: This key may be pressed at any time during a firing cycle or program input procedure.

A red LED above the MUFFLE TEMP display will indicate which temperature scale is in use.

8. TIME LEFT



Press this key to find the combined total of DRY, PREHEAT, HI TEMP HOLD, and COOL time values entered in a program. The display will appear for three seconds in the lower time window.

NOTE: If a program is running, pressing this key will give you the total time remaining in these functions. This does not include the ramp time from idle to the high temperature.

9. HOLD



Press this key after a program has started if you want to be able to reinsert work for up to two minutes additional firing time after the muffle has opened at the end of the firing cycle. See Section E3 for programming details.

10. TONE



Use this key to include or eliminate the tone that will sound whenever keys are pressed. A lit LED indicates that the TONE function is on.

NOTE: The cycle tone, indicating the beginning and the end of a firing cycle, as well as the end of the vacuum portion of a firing cycle, is permanently stored in the microprocessor and cannot be turned off.

C11. PURGE



Press this key to activate the *preset* PURGE program. The purging method is detailed in Section G of this manual.

C12. CAL



After placing and plugging in the special calibration platform, use this key to activate the calibration program. The calibration method is detailed for you in Section B.

C13. NIGHT



a. Press this key to close the muffle and have the temperature remain at a low, pre-selected temperature.
b. To exit the NIGHT program, press this key to return the furnace to normal operation.

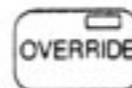
NOTE: The NIGHT program has been set at the factory to a value of 199°F (93°C).

NIGHT may be programmed from 199°F (93°C) to 500°F (260°C). If you wish to change the temperature for NIGHT, simply change the value in any program while in the PROGRAM INPUT mode. That value will then appear in all programs.

C14. NUMBER KEYS

Press these keys to select stored programs after pressing the PROGRAM # key and to input function values after pressing the PROGRAM INPUT key.

C15. OVERRIDE



Press this key to change the firing program values after a firing process has started. See Section E2 for details on using OVERRIDE.

SECTION D. PROGRAMMING THE PHOENIX® PORCELAIN FURNACE

Programs 01 to 17 have been preset for Ceramco® products. They are described in Section F with information on the variables that affect furnace performance and the recommended actions to adjust your programs. Read Section F before using any of the preset programs.

Programs 18 to 99 have no assigned values except for the factory preset IDLE temperature of 840°F (449°C), a HI TEMP of 840°F (449°C), a HEAT RATE of 400°F (222°C) and the NIGHT program value of 199°F (93°C).

Each of the 99 adjustable programs has 12 functions, described in D3 and D4. Each function has a range of acceptable values given in the text and in Table 1. *If you attempt to enter a value outside of this range, a long "error beep" will be heard, and you will not be able to move to the next function without correcting that value.*

NOTES: To change an incorrect value, press 0 once or twice, then reenter a value that is within the acceptable ranges.

During programming, the LED next to the function which is ready to receive input will be flashing.



Use the UP and DOWN arrow keys to move from one function to the next.



Press the ENTER key only after all function values are programmed as desired.

D1. CHOOSING A STORED PROGRAM

To choose a preset or individually stored program follow these steps:



a. Press the PROGRAM # key.



b. Press the number keys to recall the program you want to use.
c. Press START.

NOTE: The program will start when the ACTUAL temperature is within 3° (F or C) of the IDLE temperature.

D2. EDITING OR CHECKING A PROGRAM

To change one or more function values in a stored program, or to simply look at all program values without making changes, use the following steps:



a. Press the PROGRAM # key.



b. Press the number keys to recall the program you want to change or examine.
c. Press the PROGRAM INPUT key.



d. Press the DOWN arrow to move to the function you want to change or examine. Use the number keys to create the new value for that function if you want to change it. You can make as many changes as you need.



e. Press the ENTER key to store your program values.
f. Press the numbers for the program you are editing.
g. Press the PROGRAM INPUT key to exit the programming mode.

D3. CREATING A CUSTOM PROGRAM

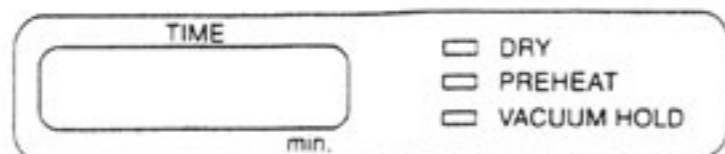
To create a custom program, follow these steps:

a. PROGRAM INPUT

Press this key to begin your programming sequence.



NOTE: If the UP or DOWN arrow key is not pressed within three minutes of starting a programming sequence, the microprocessor will automatically exit PROGRAM INPUT. If this happens, press the PROGRAM INPUT key again to continue.



b. DRY

Input a time value from 0 to 15 minutes in increments of 1 minute for the muffle to travel from the fully open position to within 0.5 inches (1.3 cm) of the fully closed position.

NOTE: The muffle will maintain the idle temperature during the DRY sequence.

c. PREHEAT

Input a value from 0 to 15 minutes in increments of 1 minute for the casework to be preheated before the temperature begins to rise.

NOTE: If 0 minutes is the value entered for PREHEAT, the muffle will close completely to initiate the next step in the program.

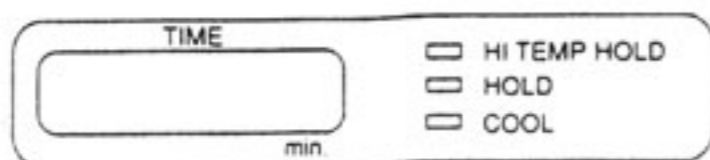
d. VAC HOLD

The PHOENIX Porcelain Furnace allows you to control vacuum by either time or temperature. The VACUUM HOLD function is used when the work being fired needs to be held under vacuum for a certain length of time at the high temperature. If you are setting up a program without vacuum or wish to control the vacuum by temperature, enter 0 minutes.

Input a value from 0.0 to 10.0 minutes in increments of 0.1 minute for the vacuum hold time at the high temperature.

- When the muffle is fully closed and the muffle temperature is within 3° (F or C) of the idle temperature, the vacuum pump will start.
- When the high temperature is reached, the vacuum will be held at that temperature for the time programmed.

NOTE: To control vacuum by time, you must enter a value of at least 0.1 minute for the VAC HOLD function and a value of at least 0.5 minute for the HI TEMP HOLD function.



e. HI TEMP HOLD

1. Input a value from 0.0 to 15.0 minutes in increments of 0.1 minute to control the total amount of time your work will be held at high temperature, including the vacuum hold time.
2. If no hold time is desired enter 0.0.

NOTE: If a VACUUM HOLD time value has been entered, add that value to the time value desired for holding the work at temperature without vacuum to derive the total value for HI TEMP HOLD.

IMPORTANT: The value for HI TEMP HOLD must be at least 0.4 minutes greater than the VAC HOLD value. The PHOENIX Furnace will not accept a lower value because time is needed for vacuum release.

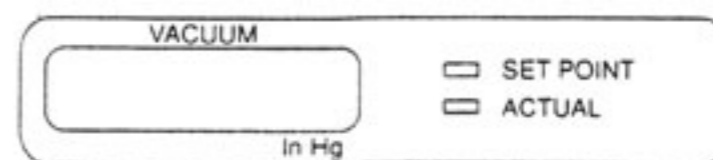
f. HOLD

See Section E3 for details on using this preset program. HOLD is not programmable by the user.

NOTE: Do not use HOLD if a COOL time is desired. Use of the HOLD program will override the COOL time.

g. COOL

Input a value from 0 to 60 minutes in increments of 1 minute to control the amount of time it takes the muffle to rise from the fully closed position to the fully open position.



h. SET POINT (Vacuum)

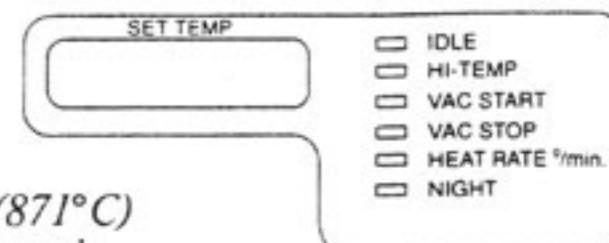
Input a value from 0 to 29 to set the level of vacuum you need for a firing cycle.

NOTES: Make sure the set point value is within 2" Hg of the capability of the vacuum pump you are using. If the set point value exceeds the actual level of vacuum by more than 2" Hg, the furnace will not proceed to the next step of the firing cycle.

CAUTION: Laboratories located at high elevations should not lower the vacuum setpoint in their programs. The ability to draw high vacuum levels decreases as elevation increases. The PHOENIX Furnace compensates for this lower pressure by raising the vacuum starting point. The ACTUAL vacuum reading will show 0" Hg at sea level and approximately 1" Hg for every 1000' above sea level.

i. ACTUAL (Vacuum)

This is not a function, but an indication that the firing cycle has entered the vacuum portion of the chosen program. The indicated value represents the vacuum level in the muffle. (See the CAUTION above.)



j. IDLE

Input a temperature value from 840°F (449°C) to 1600°F (871°C) in 1 degree increments for either scale.

- This low temperature will be maintained by the muffle while the furnace is idling and during the DRY and PREHEAT segments of the firing cycle.

NOTE: The IDLE set temperature must be less than or equal to the HI TEMP set temperature.

k. HI TEMP

Input a high temperature value from 840°F (449°C) to 2192°F (1200°C) in 1 degree increments for either scale.

NOTE: The HI TEMP set temperature should be greater than or equal to the IDLE set temperature.

SPECIAL NOTE: If the vacuum is being controlled by time (step d) the PROGRAM INPUT mode will bypass the VAC START and VAC STOP functions.

l. VAC START

1. Input a temperature value from 840°F (449°C) to 1600°F (871°C) in 1 degree increments for either scale to select the low temperature activation of the vacuum portion in a firing program.
2. If vacuum is not needed, input a value of 0.0.

m. VAC STOP

Input a temperature value from 840°F (449°C) to 2192°F (1200°C) in increments of 1 degree for either scale to select the high temperature release of the vacuum.

NOTE: This value must be greater than the VAC START temperature by at least 5°F (3°C), and should be less than or equal to the HI TEMP value.

n. HEAT RATE

Input the degrees per minute value, from 36° to 400°F or 20° to 222°C per minute, in 1 degree increments for either scale, at which you want the firing cycle to climb.

o. NIGHT

Input a temperature value from 199°F (93°C) to 500°F (260°C) for the temperature the muffle will maintain while in the NIGHT program.

NOTE: The last value entered for any stored program will be the temperature used for NIGHT and will be automatically input into all programs.

D4. STORING THE PROGRAM IN MEMORY

a. ENTER



1. Press ENTER to store your program values.
2. Press a two-digit number between 01 and 99 to give the program a location.

CAUTION: Remember that the preset programs have locations 01 to 17. Using these numbers will replace preset values with the new values.



3. Press the PROGRAM INPUT key to exit the programming mode.
4. Write the program function values into the PHOENIX PROGRAM LOG.

NOTE: Be sure to press the PROGRAM INPUT key to exit the programming mode before attempting to start the program you have just entered. Failure to exit from the PROGRAM INPUT mode before pressing START will erase the values you have created after the single firing cycle.

TABLE 1. RANGES AND INCREMENTS FOR PROGRAMMABLE INPUT

Function	Value Ranges		Increments
DRY	0 to 15 minutes		1 minute
PREHEAT	0 to 15 minutes		1 minute
VAC HOLD	0.0 to 10.0 minutes		0.1 minute
HI TEMP HOLD	0.0 to 15.0 minutes		0.1 minute
COOL	0 to 60 minutes		1 minute
VAC SETPOINT	0 to 29 inches Hg		1 inch
	°F	°C	
IDLE	840-1600	449-871	1° (F or C)
HI TEMP	840-2192	449-1200	1° (F or C)
VAC START	840-1600	449-871	1° (F or C)
VAC STOP	840-2192	449-1200	1° (F or C)
HEAT RATE	36-400	20-222	1° (F or C)
NIGHT	199-500	93-260	1° (F or C)

SECTION E. USING THE SPECIAL FEATURES AND CONTROLS

E1. CHANGING VALUES TEMPORARILY BEFORE STARTING A PROGRAM



This method is used to change one or more program function values for a firing cycle *without* storing those changes in the memory.



- a. Press the PROGRAM INPUT key.
- b. Press the UP or DOWN arrow key to move to the function you want to change.



- c. Use the number keys to create the new value. Make as many changes as needed.



- d. Press the PROGRAM INPUT key.
- e. Place your work on the firing platform.
- f. Press the START key.

E2. USING OVERRIDE TO CHANGE VALUES DURING FIRING



OVERRIDE is a unique PHOENIX Furnace program control that allows you to change unexpired program function values *after* a program has been started. For example, if a porcelain build-up has inadvertently been inserted in the furnace in an opaque firing cycle, OVERRIDE allows you to lower the vacuum release temperature, the high temperature and the heat rate while the firing is in progress.



- a. Press the OVERRIDE key.
- b. Use the arrow keys to move to the function you want to change.



- c. Use the number keys to create a new value. Make as many changes as needed.
- d. Press OVERRIDE to activate the changes and to exit this mode.

NOTES: Only functions which remain unexpired can be changed using OVERRIDE.

The firing cycle will continue as programmed while changes are being made. If the function in progress is being changed, any elapsed time in that function will be subtracted from the new value.

The OVERRIDE mode will be cancelled if no entry is made for one minute.

If the IDLE temperature is changed during the DRY phase, PREHEAT will not start until the new IDLE temperature is reached. The IDLE

temperature cannot be changed once PREHEAT has started.

If the HI TEMP value is changed during the HI TEMP HOLD phase, the new value may not be attained if sufficient time does not remain in the phase for the muffle to reach the new temperature value.

If the HI TEMP value is lowered when the actual temperature is approaching the original HI TEMP value, the actual muffle temperature may overshoot the new value.

The values which are input during OVERRIDE will not be stored in the memory.

E3. USING THE PRESET HOLD PROGRAM



HOLD is a program that is preset to two minutes. Use HOLD to replace work into the muffle at the high temperature after you have had a chance to evaluate your work at the end of a firing cycle. For example, if you are glazing a case and want to extend the hold at high temperature to increase the degree of gloss, using the HOLD key will allow you to reinsert the case without having to start another program. To activate HOLD, use the following steps.

- a. Press the HOLD key *after* you have pressed START to activate a program.
 - The program will fire normally, and the muffle will open at the end of the cycle.
- b. Inspect your work. If additional air firing time is required, press the DOWN arrow.
 - The lower time window will display a countdown of the two minute cycle.
- c. If you need *less* than two minutes HOLD or want to inspect your work at intervals during the HOLD, press the UP arrow to open the muffle and stop the timer.
- d. Press the DOWN arrow to continue, or...
- e. Press the CANCEL or HOLD key to end the HOLD program.

NOTES: When the muffle is completely open in the HOLD mode, you have approximately 30 seconds to make a decision. If the DOWN arrow is not pressed within that time, the program ends automatically.

Do not use the HOLD function if a COOL time is desired, as this will override the COOL programming.

SECTION F. PRESET FIRING PROGRAMS FOR CERAMCO® PRODUCTS

Programs 01 to 17 have been preset for Ceramco products as shown in Table 2. These programs may be changed or adjusted like any other program. All testing for porcelain fused to metal was done with Ceramco II porcelain on a single coping. Ceramco Refractory Die Material schedules were created using single units and solid models. All given temperatures are $\pm 10^{\circ}\text{F}$ (6°C). You may desire to alter these programs to meet individual requirements or circumstances.

The following guidelines are recommended for quality results.

1. All casework should be dried on the platform for a minimum of 6 minutes prior to initiating the DRY and PREHEAT cycles. This will minimize the potential for steam tears and white mottling in the fired porcelain.
2. The volume of porcelain on casework and multiple units will affect the high temperature required and may affect the heating rate needed for proper sintering. Large cases and/or multiple units require a higher temperature or a lower heating rate.
3. The potential to draw vacuum decreases at high elevations. The PHOENIX Furnace has a built-in compensation for this phenomenon so it is not necessary to make adjustments in the vacuum setpoint at higher elevations. Generally, a setting of 26 to 29 inches will be effective. Insufficient vacuum or release of the vacuum too early in the firing cycle will reduce translucency.
4. The second body bake is usually 10°F (6°C) lower than the first bake, but the volume of porcelain added will influence the effective second bake temperature. Second bakes with minimum additions may be fired at a lower temperature ($10^{\circ}\text{F}/6^{\circ}\text{C}$) than preset in the program.

Visual results are the most important criteria for judging the adjustment of a firing program to your individual needs. Table 3 is presented as a guide.

TABLE 2. PRESET FIRING PROGRAMS FOR CERAMCO* PRODUCTS

FIRING PROGRAMS IN °F

Prog. #	Program Description	Time (min)			Time (min)			Vacuum	Set Temp		Temperature			
		Dry	Pre-Heat	Vac Hold	Hi Temp Hold	Hold	Cool	Set Point (in. Hg)	Idle	Hi Temp	Vac Start	Vac Stop	Heat Rate (°F/min)	Night
01	First Opaque	3	3	0.0	0.0	0.0	0	29	1200	1785	1200	1745	120	200
02	Second Opaque	3	3	0.0	0.0	0.0	0	29	1200	1750	1200	1710	120	200
03	First Shoulder	5	3	0.0	0.0	0.0	0	29	1200	1725	1200	1685	130	200
04	Second Shoulder	5	3	0.0	0.0	0.0	0	29	1200	1715	1200	1675	130	200
05	First Body-Single Unit	5	5	0.0	0.0	0.0	0	29	1150	1685	1150	1645	130	200
06	Second Body-Single Unit	5	5	0.0	0.0	0.0	0	29	1150	1675	1150	1640	130	200
07	Add-On Porcelain	3	3	0.0	0.0	0.0	0	0	1200	1645	0	0	100	200
08	Natural Glaze	3	3	0.0	0.5	0.0	0	0	1150	1685	0	0	150	200
09	Low Temperature Glaze	3	3	0.0	0.0	0.0	0	0	1200	1600	0	0	100	200
10	Low Fusing Opaque or Body	5	3	0.0	0.0	0.0	0	29	1150	1590	1150	1550	100	200
11	RDM Burnout - single die	6	6	0.0	2.0	0.0	2	0	1200	1850	0	0	50	200
12	RDM Burnout - solid model	6	10	0.0	4.0	0.0	4	0	1200	1850	0	0	50	200
13	First Veneer - single die	8	6	0.0	0.0	0.0	2	29	1000	1680	1000	1640	75	200
14	Second Veneer - single die	8	6	0.0	0.0	0.0	2	29	1000	1670	1000	1640	100	200
15	First Veneer - solid model	10	10	0.0	0.0	0.0	4	29	1000	1685	1000	1645	75	200
16	Second Veneer - solid model	10	10	0.0	0.0	0.0	4	29	1000	1675	1000	1640	90	200
17	ULTRA-PAKE™	3	3	1.0	2.0	0.0	0	29	932	1787	NA	NA	360	200

FIRING PROGRAMS IN °C

Prog. #	Program Description	Time (min)			Time (min)			Vacuum	Set Temp		Temperature			
		Dry	Pre-Heat	Vac Hold	Hi Temp Hold	Hold	Cool	Set Point (in. Hg)	Idle	Hi Temp	Vac Start	Vac Stop	Heat Rate (°C/min)	Night
01	First Opaque	3	3	0.0	0.0	0.0	0	29	649	974	649	952	67	93
02	Second Opaque	3	3	0.0	0.0	0.0	0	29	649	954	649	932	67	93
03	First Shoulder	5	3	0.0	0.0	0.0	0	29	649	941	649	918	72	93
04	Second Shoulder	5	3	0.0	0.0	0.0	0	29	649	935	649	913	72	93
05	First Body-Single Unit	5	5	0.0	0.0	0.0	0	29	621	918	621	896	72	93
06	Second Body-Single Unit	5	5	0.0	0.0	0.0	0	29	621	913	621	893	72	93
07	Add-On Porcelain	3	3	0.0	0.0	0.0	0	0	649	896	0	0	56	93
08	Natural Glaze	3	3	0.0	0.5	0.0	0	0	621	918	0	0	83	93
09	Low Temperature Glaze	3	3	0.0	0.0	0.0	0	0	649	871	0	0	56	93
10	Low Fusing Opaque or Body	5	3	0.0	0.0	0.0	0	29	621	866	621	843	56	93
11	RDM Burnout - single die	6	6	0.0	2.0	0.0	2	0	649	1010	0	0	28	93
12	RDM Burnout - solid model	6	10	0.0	4.0	0.0	4	0	649	1010	0	0	28	93
13	First Veneer - single die	8	6	0.0	0.0	0.0	2	29	538	916	538	893	42	93
14	Second Veneer - single die	8	6	0.0	0.0	0.0	2	29	538	910	538	893	56	93
15	First Veneer - solid model	10	10	0.0	0.0	0.0	4	29	538	918	538	896	42	93
16	Second Veneer - solid model	10	10	0.0	0.0	0.0	4	29	538	913	538	893	50	93
17	ULTRA-PAKE™	3	3	1.0	2.0	0.0	0	29	500	975	NA	NA	200	93

NOTES: CERAMCO* Porcelains and CERAMCO Refractory Die Material (RDM) were utilized. Veneers were fired on RDM. For veneers produced with the foil technique, use programs 05 and 06.

NA = not applicable

TABLE 3. VISUAL INDICATORS FOR CERAMCO PORCELAINS AND RELATED PRODUCTS

Firing Step	Indicator (desired appearance)
First Opaque	High sheen/not glazed
Second Opaque	Dull sheen, slight matte finish
Shoulder Porcelain	Granular appearance/neither milky nor glazed
Body/Incisal	Granular appearance/neither milky nor glazed
Add-On Porcelain	Smooth, satiny gloss*
Low Fusing Porcelain	Smooth, satiny gloss*
Natural Glaze	Satiny gloss*
Low Temp Glaze	High gloss*
RDM Burnout	White with no greyish areas or spots
ULTRA-PAKE™	Rough, reflective surface

*Degree of gloss may be higher or lower based upon individual preferences.

If the results achieved with these schedules do not conform to your needs, the guidelines in Table 4 will help you in making adjustments.

TABLE 4. PROGRAM ADJUSTMENT GUIDELINES

Result	Possible Cause	Solutions
Value too low	Overfired body	Lower the high temperature ¹ Increase the heating rate ²
Chroma too low	Overfired opaque	Lower the high temperature ¹ Increase the heating rate ²
	Dried too rapidly	Increase drying time prior to starting program
Chroma too high	Underfired opaque	Increase the high temperature ³
White spots/ chalkiness	Dried too rapidly/	Increase drying time
	insufficient vacuum	Increase vacuum stop temp ⁴ Check hoses for leaks

¹ If the discrepancy with the visual indicator is extreme, lower the high temperature 30°F (16°C). If the discrepancy is small, lower the high temperature by 10°F (6°C).

² Increase the heating rate in 10°F/min (6°C/min) increments.

³ If the discrepancy with the visual indicator is extreme, increase the high temperature 30°F (16°C). If the discrepancy is small, increase the high temperature by 10°F (6°C).

⁴ Increase the VAC STOP temperature by 20°C (12°C).

SECTION G. USING THE PURGE PROGRAM

This preset program is designed to remove contaminants from the muffle by firing a carbon block to 2012°F (1100°C). Purging is sustained for 30 minutes with vacuum being held for the first 20 minutes of the cycle. Use the following procedure:

1. Raise the muffle to the full open position.

2. Place the carbon block on the firing platform.

3. Press the PURGE Key.

- The LEDs by the PURGE key and the START key will light.

- The letters Pu will appear in the program window.

4. At the end of the purging cycle: remove and discard the spent carbon block.

NOTE: Do not press the START key after pressing the PURGE key.

PART II. MAINTAINING AND SERVICING THE PHOENIX PORCELAIN FURNACE

The following service and maintenance instructions provide information and guidance relative to Troubleshooting Analysis, Component Replacement and Periodic Maintenance. Should you need assistance or repair service, contact the Ceramco Technical Service Department at 1-800-487-0100.

SECTION A. FURNACE COMPONENTS

The furnace has two main sections: the muffle chamber and the base assembly.

A1. MUFFLE CHAMBER

The muffle chamber (upper section of the furnace) contains the muffle and thermocouple. The muffle chamber moves vertically along the firing chamber support column. This column contains the electrical wiring connections leading from the lower base assembly to the upper muffle chamber, and the track and belt components that are used to move the muffle chamber up and down. The muffle chamber is insulated with non-asbestos, refractory fibers that minimize heat radiation.

NOTE: In case of a power failure during a firing cycle, the vacuum will be released automatically and the muffle chamber can be lifted manually to retrieve the work on the firing platform.

A2. BASE ASSEMBLY

The base assembly houses the lift motor, vacuum solenoid and connections, electrical power cord, vacuum pump electric receptacle, associated wiring and circuitry, and the components detailed below:

a. MICROPROCESSOR CONTROL MODULE

The microprocessor control module is located at the front of the base assembly. This module controls programming and operating functions and encompasses the front control panel and displays and the E² PROM microprocessor. Refer to the OPERATION section of this manual for programming details.

NOTE: The microprocessor control module can be easily removed from the base assembly. An economical exchange program is available should out-of-warranty repair become necessary.

b. FIRING PLATFORM SUPPORT

The firing platform support has an opening through which the air in the closed muffle chamber is evacuated during the vacuum portion of a firing cycle. The firing platform support holds the firing platform and acts as a guide for proper positioning of the firing platform. (See Figure 1.)

c. CIRCUIT BREAKER

The 15 ampere circuit breaker is located on the back panel near the power cord entrance. This breaker is in the 115 volt AC main power circuit.

SECTION B. TROUBLESHOOTING ANALYSIS

B1. USING THE DIAGNOSTIC STATUS DISPLAY

a. Most deviations from normal operation can be corrected by the operator. Probable causes include:

- Open muffle circuit
- Open thermocouple circuit
- Incomplete vacuum seal

NOTE: If any of these problems occur while a program is running, the program will be aborted. The selected program will be displayed

again and the LEDs in the STATUS window can be used to diagnose the problem as follows:

AC CONNECTED The LED should be continuously lit if the power cable is plugged into a 115V/60Hz circuit and power is available, whether the furnace is turned on or off.

PUMP ON The LED should be lit if the vacuum pump is operating.

THERMOCOUPLE The LED should be lit unless the thermocouple wire is broken or not properly connected.

MUFFLE The LED should be lit unless the current is not flowing through the muffle coil.

B2. TROUBLESHOOTING CHART

When more than one possible corrective measure is listed, follow the sequence given in the Troubleshooting Chart. If the corrective measures fail to eliminate the malfunction, contact the Ceramco Technical Service Department for additional assistance, 1-800-487-0100.

DIAGNOSTIC TROUBLESHOOTING FOR THE PHOENIX FURNACE

Symptom	Possible Causes	Correction Actions
Unit will not go on. AC CONNECTED LED is not lit.	Faulty power supply.	Check power circuit.
	Circuit breaker is open.	Reset or replace.
	Cable assembly to the microprocessor is not connected properly.	Check the cable assembly and reseat properly.
	Faulty microprocessor.	Replace microprocessor control module.
Loud noises from the lift motor.	Microprocessor lost muffle position data.	Press DOWN arrow to reestablish position.
Unit will not go on when ON/OFF switch is pressed.	Microprocessor malfunction.	Replace microprocessor control module.
Can't turn unit off.	Muffle is open.	Close muffle completely.
Erratic Displays: • Missing segments • Extra segments • Erratic or unstable display	Microprocessor malfunction.	Replace microprocessor control module.
	Leak in vacuum systems.	Check for loose vacuum system connections.
Constant cycling of vacuum pump.	Dust on vessel seals or dust on "O-ring."	Clean with a damp cloth.
	Damaged "O-ring."	Replace "O-ring."
	Leaking pump.	Replace Pump.
Will not calibrate properly.	Oxidation on wire posts.	Clean with emery cloth.
	Stretched silver wire is breaking prematurely.	See Operation Section of this manual for the calibration technique.
Key functions will not work (long beep).	Procedural problem, unacceptable entry.	Consult Operation Section of this manual.
LED not on. (Verify with LAMP TEST key).	LED burned out.	Replace microprocessor control module.

CAUTION: Whenever repairs are to be performed inside the furnace, disconnect the power source.

SECTION C. REPLACING COMPONENTS

The interior section of the muffle chamber is accessed by removing the four screws on the muffle top plate.

The base assembly components are accessed by raising the muffle to the fully open position, then removing the four screws that hold the left and right side covers to the top of the platform assembly panel. (See Figure 2.)

Always remove the firing platform from the platform support before starting repair procedures.

C1. REPLACING THE MICROPROCESSOR CONTROL MODULE (See Figure 2)

- Raise the muffle to the fully open position, then remove the right and left side covers of the base assembly.
- Disconnect the two-conductor thermocouple plug (green wire) and the vacuum hose at the right rear of the module. (Note where the hose is attached.)
- Remove the wing nut at the rear center of the control module (fastening it to the frame) and carefully push and slide the control module out of the front of the base assembly.
- Disconnect the cable assembly from the control module and remove the module from the front of the base assembly.
- To install the replacement module, reconnect the cable assembly.
- Slide the module back into position and replace and tighten the wing nut.
- Reconnect the thermocouple plug and the vacuum hose.
- Replace the side panels and tighten the screws to secure them in place.

CAUTION: The microprocessor control module is not field serviceable. It must be returned to Ceramco Inc. for service. Attempting to repair the module in the lab will void the warranty.

C2. REPLACING THE LIFT MOTOR (See Figure 3)

- Manually raise the muffle chamber. Securely prop the muffle chamber in the open position so that it will not drop when the motor is removed.
- Remove the left and right side covers of the base assembly (Figure 2).
- IMPORTANT:** Mark the wires with terminal numbers for re-assembly procedures. Cut the plastic ty-raps from around the motor wires, and disconnect the wires from the terminal strip at the relay board.
- Loosen the motor bracket locknuts to relieve the belt tension.
- Remove the four bolts holding the motor and gear assembly to the bracket.
- Remove the old lift motor and replace it with the new lift motor.
- Tighten the locknuts partially to secure the new motor to the bracket.
- Adjust the tension on the toothed belt by pulling the motor/bracket assembly toward the front of the furnace, then complete tightening the locknuts.
- Connect the motor wires to the terminal strip and secure the wires with the ty-raps. Be sure the wires and terminal numbers are correctly aligned.
- Replace the left and right side covers of the base assembly.
- Remove the props from the muffle chamber and carefully position it on the belt support column.

C3. REPLACING THE VACUUM SOLENOID VALVE (See Figure 4)

- Raise the muffle chamber, then remove the left and right side panels of the base assembly.
- Remove the vacuum hose from the solenoid fitting with a pair of needle-nosed pliers. Use light pressure.
- Mark the wires to identify them for reassembly procedures, then remove the wires from the terminal strip at the relay board.
- Remove the two retaining screws used to mount the solenoid valve to the rear panel.
- Install the replacement valve, and secure it to the rear panel with the retaining screws.
- Re-attach the wires to the terminal strip.
- Replace the vacuum hose, making sure it is secure. Then, replace the side panels.

C4. REPLACING THE TRANSFORMER (See Figure 4)

- Completely raise the muffle chamber, then remove the left and right side panels of the base assembly.
- Mark the wires to identify them for reassembly procedures. Cut the ty-raps from around the transformer wires, then disconnect the wires from the terminal strip at the relay board.
- Remove the two nuts securing the transformer to the base, and remove the transformer.
- Install the new transformer, securing it with the two nuts.
- Reconnect the wires to the terminal strip, making sure they are completely seated.
- Replace the side panels.

C5. REPLACING THE RELAY P.C. BOARD ASSEMBLY (See Figure 4)

- Completely raise the muffle chamber, then remove the left and right side panels of the base assembly.
- Mark the wire connection points to identify them for reassembly procedures, then remove the wires from both right and left terminal strips.
- Disconnect the cable assembly toward the front of the furnace.
- Remove the five nuts holding the P.C. relay board to the furnace chassis.
- Install the replacement P.C. relay board, and secure it in place with the five nuts.
- Replace the cable assembly and reconnect the wires to the terminal strips.

NOTE: Make sure all the wires are reconnected to the proper points and that they are completely seated. (See Figure 9)

C6. REPLACING THE FIRING PLATFORM SUPPORT (See Figure 5)

- Use a 1/2" wrench on the female pipe adapter below the platform assembly to stabilize the assembly while removing the pipe cap.
- Remove the pipe cap with a 5/8" wrench by turning counter-clockwise.
- Lift the platform support from the platform seal.
- Place the new platform support onto the platform seal.
- Stabilize the assembly by using the 1/2" wrench to hold the pipe adapter securely.
- Tighten the pipe cap in a clock-wise direction with a torque wrench. (Torque to 18 inch/lbs.)

NOTE: Do not over-tighten the pipe cap. If you do not have a torque wrench, tighten the pipe cap by hand.

C7. REPLACING THE "O-RING" (See Figure 5)

- Use a flat, blunt tool (for example, a cement spatula) to gently pry the worn "O-ring" out of the channel on the firing platform support.
- Wipe the channel clean with a soft, lint-free cloth.
- Position the replacement ring over the channel and push into place with your fingers.

CAUTION: Do not use sharp instruments during this procedure. Nicks in the channel area or cuts in the "O-ring" will cause vacuum leaks.

C8. REPLACING THE THERMOCOUPLE (See Figures 6 & 7)

- Disconnect the main power cord and allow the furnace to cool to room temperature.
- Remove the four screws from the top plate of the muffle chamber.
- Remove the top plate, vessel seal ring, and insulating disc.
- Mark the terminal studs for polarity. Red is negative, black is positive. Note the red sleeve on one of the thermocouple wires.
- Disconnect the thermocouple wires from the two terminal studs, lift and remove the old thermocouple assembly.
- Insert the new thermocouple assembly and connect the wires to the terminal studs.

NOTES: Connect the thermocouple wire with the red sleeve to the terminal stud with the solid red wire. Avoid nicking, kinking, or stretching the platinum thermocouple wires during the replacement procedure.

- Replace the insulating disc, vessel seal ring, and top plate. Use a damp cloth to remove dust from the vessel seal ring.
- Tighten the screws in the top plate, but do not over-tighten.