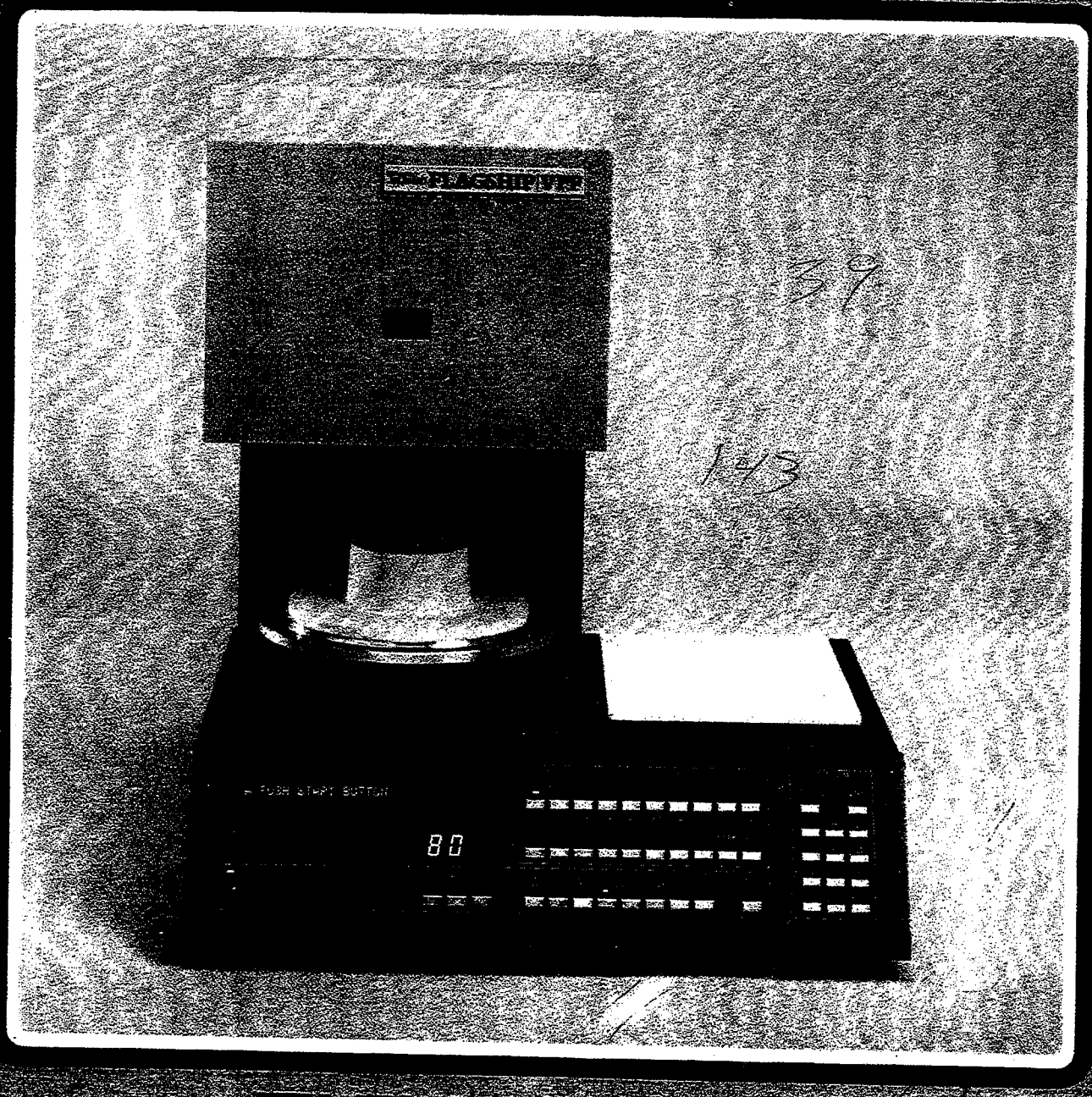


JELENKO FLAGSHIP™ VPT

Operating & Maintenance Instructions

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JELENKO FLAGSHIP™
VACUUM PORCELAIN FURNACE

SPECIFICATIONS

Maximum Temperature: 2100°F (1150°C)

Overall Dimensions: 17⅞" wide x 16¾" deep x 21¼" high
(45.4 cm wide x 42.5 cm deep x 54.0 cm high)

Muffle: Accepts any restoration 3" diameter x 2¼" high
(7.6 cm diameter x 5.7 cm high)

Electrical: 100V 50/60 Hz - 1100 Watts (PN 311102)
115V 50/60 Hz - 1100 Watts* (PN 311100)
230V 50/60 Hz - 1100 Watts* (PN 311101)

Net Weight (Unpacked): 60.1 lbs.
(27.1 kg)

Finish: Black and orange textured enamel over steel.

Number of Programs:

Twenty-one	- User-Programmable Firing Cycle Programs
One	- User-Programmable Idle Program
Twenty	- Fixed Firing Cycle Programs (Includes Automatic Purging and Automatic Calibration Programs)
One	- Fixed Idle Program
One	- Fixed Night Program
One	- Manual Override Feature (with Vacuum)
One	- Manual Override Feature (without Vacuum)

Supplied Accessories:

Set of three - Single-Point Sagger Trays
Set of two - Crown Sagger Trays
Full-Arch Sagger Tray
Calibration Kit (includes Calibration Instrument and Silver Wire)
Door Platform
Manual Door Crank Handle

*These models of the Flagship VPF have been designed to operate at plus or minus ten percent of the rated operating voltage, with no change in the performance of the furnace. Should the line voltage available to the furnace exceed these limits, the performance of the furnace may be affected.

INSTALLATION

1. Remove all packaging material from around the furnace.
2. Position the furnace in an area which provides a minimum of two inches (5.1 cm) of air space on all sides.
3. Connect the vacuum pump hose from your vacuum pump to the Vacuum Hose Connector at the rear of the furnace. Use of a Jelenko Oil-less Vacuum Pump (115V-PN 306230; 230V-PN 306235) is recommended.
4. Plug the vacuum pump line cord into the Vacuum Pump Receptacle at the rear of the furnace.
5. Plug the furnace into a wall receptacle rated for a minimum of 15 amperes. An independent electrical circuit must always be used (SEE NOTE BELOW).
6. Press the POWER SWITCH to the ON position. The indicator lamp above the switch will light; the TEMPERATURE DISPLAY will indicate the actual Muffle temperature; and the ALPHA-NUMERIC DISPLAY will read "SELECT PROGRAM NUMBER."
7. Depress the DOOR DOWN KEY and hold the key depressed until the furnace Door is completely open. Release the key.
8. Unpackage the Door Platform and position the platform on the Door within the raised ridge.
9. Calibrate the furnace as outlined under CALIBRATION on pages 33-34 of this manual.
10. Your furnace is now ready for operation.

IMPORTANT NOTE: **It is important that your Flagship™ furnace be operated only from an independent electrical outlet, with no other equipment on the same circuit.**

This furnace, as with all microprocessor controlled devices, will perform reliably when it is operated from a stable power source free from frequent voltage fluctuations.

MUFFLE CURING

The Muffle in the Flagship™ furnace has been designed and constructed of the most modern, lightweight, ceramic-fiber materials. As a result of this type of design, the Muffle is highly resistant to the absorption of atmospheric moisture and in most cases does not require an extensive Muffle Curing Procedure.

However, if vacuum loss is observed while operating the furnace after initial installation, or after replacing the Muffle, it is most likely the result of Muffle Outgassing,* and the Muffle Curing program outlined below should be performed two times.

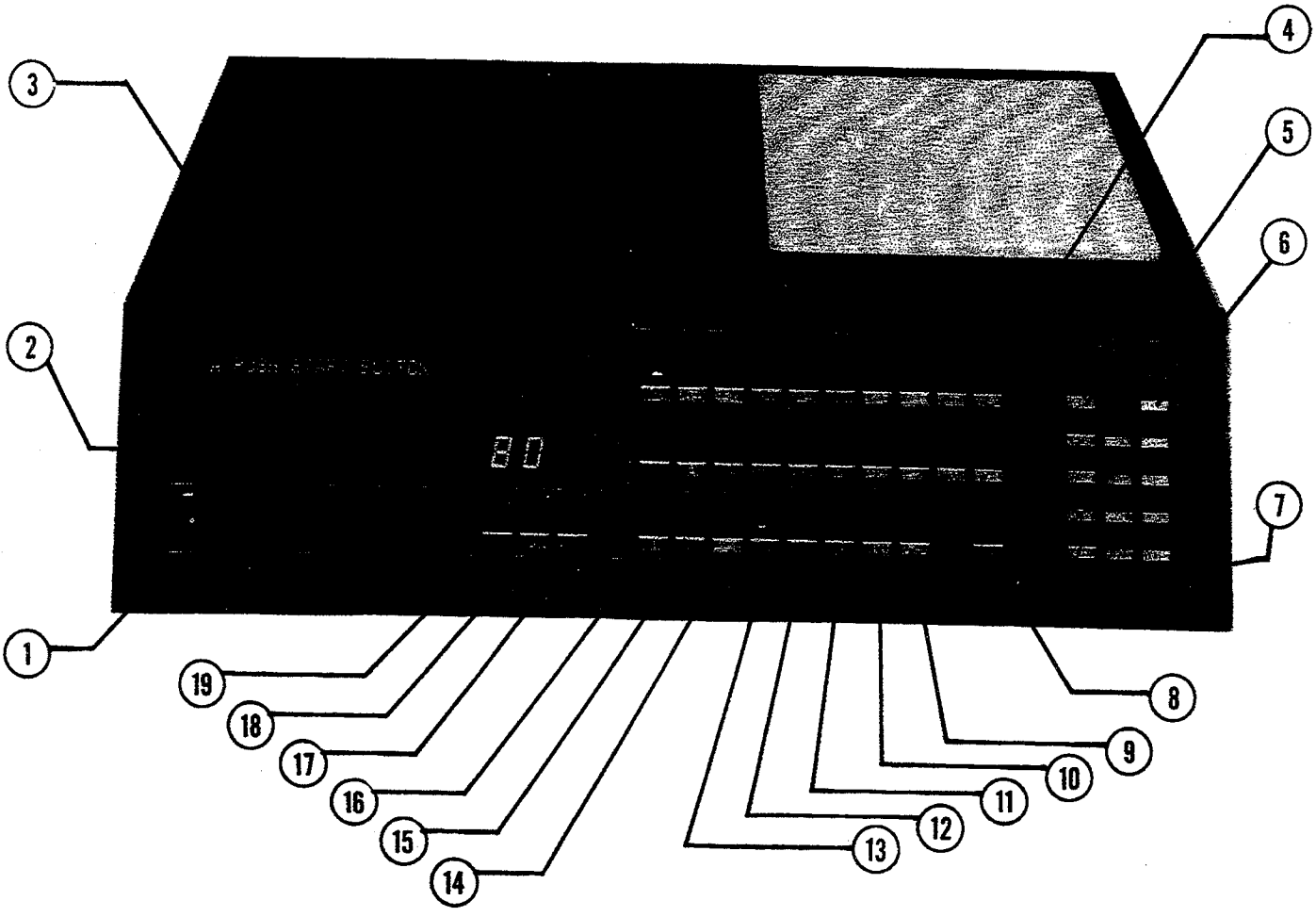
Using any available User-Program "A" through "T" or the Manual Program, program the following firing cycle parameters:

PREHEAT TIME	- 0 MINUTES 10 SECONDS
LOW TEMP	- 1000°F (538°C)
HEAT RATE	- 100°F (56°C)/MINUTE
VACUUM LEVEL	- 28 INCHES (71 CENTIMETERS) OF MERCURY
HIGH TEMP	- 1800°F (982°C)
HOLD TIME	- 20 MINUTES 0 SECONDS
VENT	- 20 MINUTES 0 SECONDS
COOL TIME	- 0 MINUTES 10 SECONDS

*Muffle outgassing occurs when moisture contained within the muffle insulation, or door platform, is boiled and changed into a gaseous state, usually at Muffle temperatures of 1000°F (538°C) and above.

This gas results in a reduction in the vacuum level within the furnace Vacuum Chamber, thus creating **apparent** vacuum leakage.

FRONT PANEL CONTROLS



1. POWER SWITCH
2. TEMPERATURE DISPLAY
3. ALPHA-NUMERIC DISPLAY
4. PROGRAM SELECTOR KEYBOARD
5. PROGRAM KEY
6. STEP KEY
7. NUMERIC KEYBOARD (INCLUDING CLEAR AND ENTER KEYS)
8. STOP KEY
9. START KEY
10. IDLE KEY
11. NIGHT KEY
12. MANUAL PROGRAM KEY
13. USER PROGRAM KEY
14. STOP OVERRIDE KEY
15. VACUUM OVERRIDE KEY
16. AIR OVERRIDE KEY
17. VIEWING LIGHT KEY
18. DOOR DOWN KEY
19. DOOR UP KEY

FRONT PANEL CONTROLS

POWER SWITCH (1): Turns the power to the furnace on or off. The indicator lamp above the switch will light when this switch is placed in the ON position.

TEMPERATURE DISPLAY (2): Indicates the actual temperature within the furnace Muffle, in either degrees Fahrenheit or Celsius, as determined by the position of the °F/°C SELECTOR SWITCH.

ALPHA-NUMERIC DISPLAY (3): A multiple function display capable of indicating up to 32 individual characters at one time to provide the user with one or more of the following units of information related to the furnace operation:

Indicates the particular firing cycle number or function being performed at all times.

During a firing cycle, indicates the exact portion of the firing being performed.

Indicates whether the furnace is in the process of Heating or Cooling before a firing cycle begins.

During operation of the furnace, directs the user by indicating which keys must be depressed to start a firing cycle or function.

During firing cycles with vacuum, displays the actual vacuum level at all times.

During programming or while reviewing a program, displays the name and programmed value for each parameter.

In the event of a furnace malfunction, displays the actual cause for the malfunction.

Indicates the exact reason for the furnace rejecting a data entry by the user.

PROGRAM SELECTOR KEYBOARD (4): A group of 20 keys with indicator lamps, labeled "A" through "T," for selecting the desired program. This keyboard is used in conjunction with the USER PROGRAM Key to access 20 "User" and 20 "Fixed" programs.

Note that the "S" Key is also labeled PURGE as it is used to operate the fixed automatic purging cycle, and the "T" Key is also labeled CALIB. and is used to operate the fixed automatic calibration cycle.

A brief tone response will be heard when any of the PROGRAM SELECTOR KEYS is depressed, and the indicator lamp above that key will light, indicating the program has been selected.

PROGRAM KEY (5): When this is depressed, the furnace is placed into the "program" mode and will accept firing cycle parameter changes entered through the NUMERIC KEYBOARD. This key must always be depressed when entering or changing parameters in any of the "User" programs, or when reviewing data in any of the "User" or "Fixed" programs.

Note that only the parameters within the "User" programs may be programmed and that all parameters within the "Fixed" programs are factory-programmed and cannot be changed by the user.

A brief tone response will be heard each time this key is depressed, and the indicator lamp above the key will light when the furnace is in the "program" mode.

STEP KEY (6):

Used in conjunction with the PROGRAM KEY during programming, or when reviewing a program, to advance the ALPHA-NUMERIC DISPLAY to the next parameter in the program. When the last parameter in a program (parameter number 8) has been reached, the display will return to the first parameter of the program (parameter number 1) when the key is depressed the next time.

Depressing the key once will cause the display to advance one parameter; holding the key depressed will cause the display to advance the parameters automatically, one parameter at a time, until the key is released. This feature allows the user to check all of the parameters of a firing cycle rapidly, or advance several parameters within a program, without having to operate the key many times.

Each time the key is depressed, a brief tone response will be heard. When advancing the parameters automatically, a brief tone will sound with each parameter advancement.

NUMERIC KEYBOARD (7):

A group of keys labeled 0 through 9, including CLEAR and ENTER Keys, used when programming the furnace. To program a desired parameter, the numbered keys are depressed to enter the parameter. As each numbered key is depressed, the number will appear on the ALPHA-NUMERIC DISPLAY, with the numbers advancing from right to left. If during the entry an error is made, the CLEAR Key is depressed to remove the incorrect entry from the display.

Once the correct entry appears on the display, the parameter is placed into the program by depressing the ENTER Key.

Each time a key on the NUMERICAL KEYBOARD is depressed, a brief tone response will be heard.

STOP KEY (8):

When depressed, this key will automatically terminate any firing cycle in progress, including the Night and Idle cycles, by venting vacuum within the furnace chamber, opening the furnace Door, and stopping Muffle heating. An eventual cooling ambient temperature will result.

A brief tone response will be heard each time this key is depressed.

START KEY (9):

When this key is depressed, the selected firing cycle program, Night or Idle cycle, will begin. Prior to depressing the START Key, a Program number, Night or Idle cycle, must be selected and the ALPHA-NUMERIC DISPLAY must give the instruction for the user to "PUSH START BUTTON". Once the START Key is depressed, a brief tone response will be heard, the lamp above the key will light, and the ALPHA-NUMERIC DISPLAY will change to indicate the status of the furnace.

IDLE KEY (10):

Used in conjunction with the USER PROGRAM Key to select either the "User" or "Fixed" Idle cycles.

The Idle cycles are intended to be used during the workday to maintain the furnace at a temperature close to the programmed Low Temperature. This serves to reduce the amount of time required for the furnace to reach the programmed Low Temperature after the furnace Door has been opened.

When both the USER PROGRAM Key and the IDLE Key have been depressed and the indicator lamps above each key are lighted, the furnace will perform the "User" Idle program once the START Key is depressed. In the "User" Idle program, both temperature and vacuum level are fully programmable by the user.

If only the IDLE Key has been depressed and the indicator lamp above this key ONLY is lighted, the furnace will perform the "Fixed" Idle program once the START Key is depressed. In the "Fixed" Idle program, the furnace will maintain a temperature of 1130°F (610°C) without vacuum.

A brief tone response will be heard each time the IDLE Key is depressed, and the lamp above the key will light when the Idle cycle has been selected.

NIGHT KEY (11): Used to select the Night cycle when the furnace is to remain on overnight or for extended periods of time. Use of the Night cycle is recommended during these periods to prevent the accumulation of atmospheric moisture within the Muffle and to help extend Muffle life.

When the NIGHT Key is depressed and the indicator lamp above the key is lighted, the Night cycle will be started once the START Key is depressed. The Night cycle is a "Fixed" program which will maintain the furnace at a temperature of 590°F (310°C) with the vacuum pump being operated for one minute after the start of the cycle and then turning off automatically.

A brief tone response will be heard each time the NIGHT Key is depressed, and the indicator lamp above the key will light when the Night cycle has been selected.

MANUAL PROGRAM KEY (12): Used to select the Manual program, which is a full user-programmable cycle with eight complete firing cycle parameters.

Once programmed, the parameters within the Manual program will be retained, until changed by the user.

A brief tone response will be heard each time the MANUAL PROGRAM Key is depressed, and the lamp above the key will light when the Manual program has been selected.

USER PROGRAM KEY (13): Used in conjunction with the PROGRAM SELECTOR KEYBOARD and the IDLE Key to select either "User" or "Fixed" programs. When the USER PROGRAM Key is depressed, a brief tone response will be heard, and the indicator lamp above the key will light indicating the User Program mode has been selected.

In the User Program mode of operation, programs "A" through "T" and the Idle program are fully programmable by the user and will perform the firing cycle programmed by the user. These programs will be retained in the furnace and may be reused repeatedly by selecting the User Program mode and the desired program.

In the Fixed Program mode of operation, programs "A" through "T" and the Idle program will perform the "Fixed" program cycles outlined under FIRING CYCLE PARAMETERS FOR FIXED PROGRAMS "A" THROUGH "R" on pages 24-27 of this manual. These programs may also be used at any time by selecting the Fixed mode (indicator lamp above USER PROGRAM Key NOT lighted) and the desired program number. Note that when using the furnace in the "Fixed" mode of operation, a small letter "F" will appear to the left of the program number indicated on the ALPHA-NUMERIC DISPLAY.

STOP OVERRIDE KEY (14): Used during the override period which occurs at the end of the programmed Cool Time to terminate either the Air Override or Vacuum Override function. This key, rather than the program STOP Key, must be used to stop an override function as it will not terminate the complete firing cycle but will permit the override function to be used again, if necessary.

A brief tone response will be heard each time this key is depressed.

VACUUM OVERRIDE KEY (15): Used at the end of the firing cycle to automatically close the furnace Door and raise the Muffle temperature up to an additional 100°F (56°C) higher than the programmed High Temperature, under the vacuum level programmed for the firing cycle in use. The furnace will maintain the programmed High Temperature for approximately 45 seconds after the Door automatically opens at the end of the firing cycle, at which time this override feature may be used.
To operate, determine if a higher temperature is necessary when the furnace Door opens at the end of the firing cycle. If so, momentarily depress the VACUUM OVERRIDE Key. The furnace Door will close. The vacuum pump will operate until the vacuum level programmed for the firing cycle is achieved; then it will turn off. The Muffle temperature, as indicated on the TEMPERATURE DISPLAY, will increase at the Heat Rate programmed for the firing cycle in use.

Once the desired temperature has been reached, this temperature may be maintained by momentarily depressing the VACUUM OVERRIDE Key. The temperature may be further increased by again momentarily depressing the VACUUM OVERRIDE Key. Any desired temperature may again be maintained by momentarily depressing the VACUUM OVERRIDE Key. This overriding and holding process may be repeated as many times as desired.

If at any time during the vacuum override procedure it is necessary to open the furnace Door, the STOP OVERRIDE Key should be depressed. By using the STOP OVERRIDE Key, it is possible to again use either the vacuum override or air override feature.

Each time the VACUUM OVERRIDE Key is depressed, a brief tone response will be heard, and the indicator lamp above the key will light when the Vacuum Override function is in use.

AIR OVERRIDE KEY (16): Used at the end of the firing cycle to automatically close the furnace Door and raise the Muffle temperature up to an additional 100°F (56°C) higher than the programmed High Temperature, without vacuum. The furnace will maintain the programmed High Temperature for approximately 45 seconds after the Door automatically opens at the end of the firing cycle, at which time this override feature may be used.

To operate, determine if a higher temperature is necessary when the furnace Door opens at the end of the firing cycle. If so, momentarily depress the AIR OVERRIDE Key. The furnace Door will close, and the Muffle temperature, as indicated on the Temperature Display, will increase at the Heat Rate programmed for the firing cycle in use.

Once the desired temperature has been reached, this temperature may be maintained by momentarily depressing the AIR OVERRIDE Key. The temperature may be further increased by again momentarily depressing the AIR OVERRIDE Key. Any desired temperature may again be maintained by momentarily depressing the AIR OVERRIDE Key. This overriding and holding process may be repeated as many times as desired.

If at any time during the air override procedure it is necessary to open the furnace Door, the STOP OVERRIDE Key should be depressed. By using the STOP OVERRIDE Key, it is possible to again use either the air override or vacuum override feature.

Each time the AIR OVERRIDE Key is depressed, a brief tone response will be heard, and the indicator lamp above the key will light when the Air Override function is in use.

VIEWING LIGHT KEY (17): Turns the Viewing Lights, which illuminate the work area, on or off. During the opening or closing of the furnace Door, the Viewing Lights will be operated automatically by the furnace controls. The VIEWING LIGHT Key will also serve to override the automatic operation of the Viewing Lights to turn them either on or off.

Each time the VIEWING LIGHT Key is depressed, a brief tone response will be heard.

DOOR DOWN KEY (18): When depressed, this key will activate the motor to open (lower) the furnace Door. The Door may be stopped at any point along its travel by releasing the key.

The DOOR DOWN Key will also serve to override the automatic operation of the Door during a firing cycle.

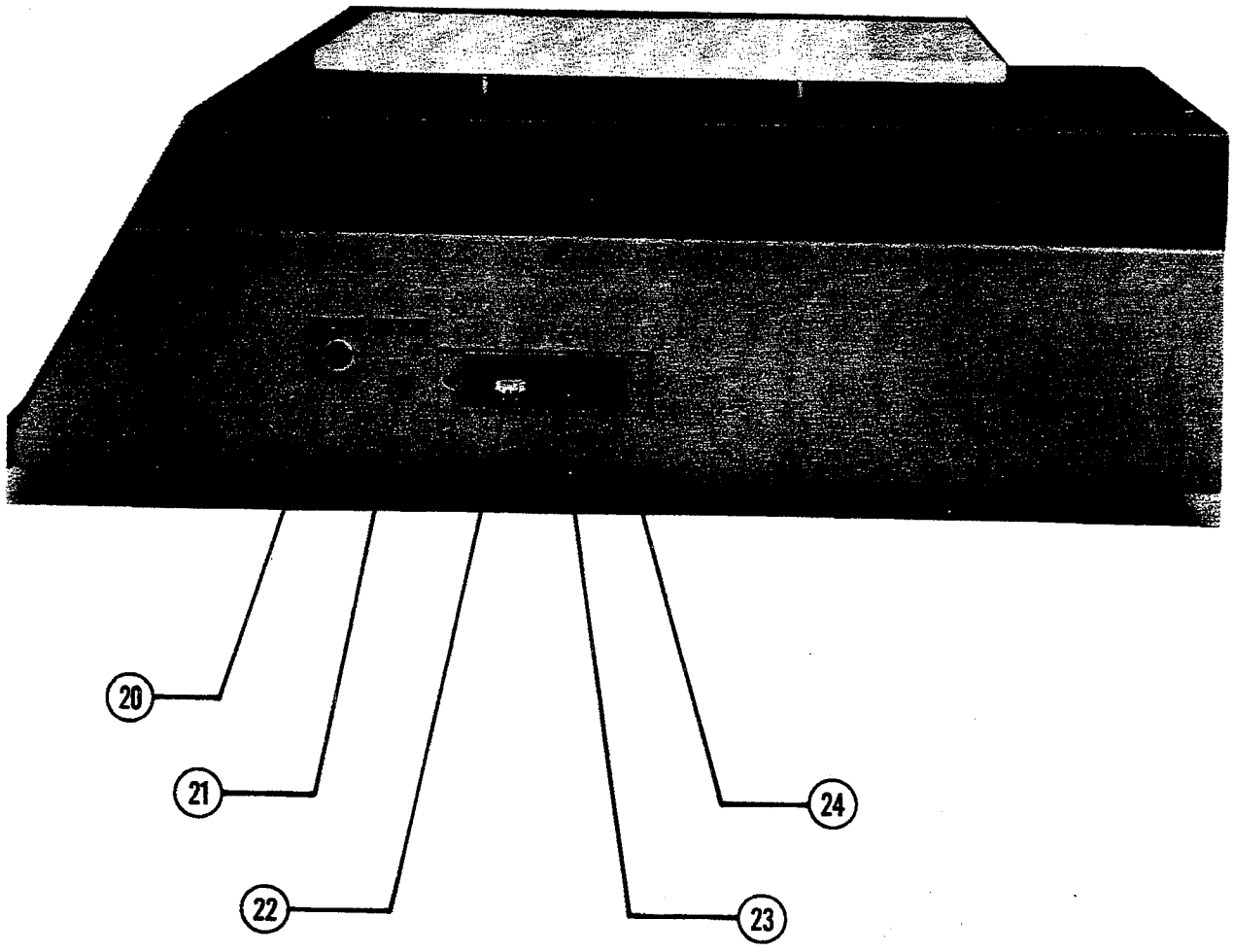
Each time the DOOR DOWN Key is depressed, a brief tone response will be heard.

DOOR UP KEY (19): When depressed, this key will activate the motor to close (raise) the furnace Door. The Door may be stopped at any point along its travel by releasing the key.

The DOOR UP Key will also serve to override the automatic operation of the Door during a firing cycle.

Each time the Door Up Key is depressed, a brief tone response will be heard.

RIGHT SIDE CONTROLS



20. CALIBRATION JACK
21. TONE VOLUME ADJUSTMENT
22. °F/°C SELECTOR SWITCH*
23. LANGUAGE SELECTOR SWITCH*
24. CALIBRATION RESET BUTTON*

*These components visible with access cover removed.

RIGHT SIDE CONTROLS

CALIBRATION JACK (20): Accepts the plug from the Calibration Instrument used during the furnace calibration procedure. Note that the furnace is equipped with a fully automatic self-adjusting calibration system, eliminating the need for manual adjustment by the user.

TONE VOLUME ADJUSTMENT (21): Using a small screwdriver, the volume of the tones produced by the furnace may be increased or decreased with this control. To adjust, insert the screwdriver through the access hole and engage the screwdriver with the control. Rotate the screwdriver clockwise to increase the tone volume or counter-clockwise to decrease the volume, until the desired volume is obtained.

°F/°C SELECTOR SWITCH (22): Used to select either degrees Fahrenheit and inches of mercury or degrees Celsius and centimeters of mercury as unit of measurement for temperature and vacuum on the furnace displays. When the Selector Switch is moved toward the rear of the furnace, the displays will indicate temperature and vacuum level in degrees Celsius and centimeters of mercury respectively; whereas positioning the switch toward the front of the furnace will result in display readings in degrees Fahrenheit and inches of mercury for temperature and vacuum.

The position of this switch may be changed by the user at any time and will cause all programmed parameters to change to the selected unit of measurement.

The °F/°C SELECTOR SWITCH is concealed by an access cover when not in use. This cover should always be replaced after making adjustments to this control.

LANGUAGE SELECTOR SWITCH (23): All Flagship™ Vacuum Porcelain Furnaces are equipped with the capability of operating in any one of nine different languages. When a language has been selected, all information displayed on the ALPHA-NUMERIC DISPLAY will appear in the selected language.

To select a language, rotate the small thumbwheel on the LANGUAGE SELECTOR SWITCH until the code number corresponding to the desired language appears in the "window" of the switch.
Any one of the nine languages programmed into the furnace may be selected by the user at any time. The nine languages and their corresponding code numbers are as follows:

Code Number	Language
0	Japanese
1	English
2	German
3	French
4	Italian
5	Spanish
6	Swedish
7	Norwegian
8	Greek
9, A, B, C, D, E & F	English

The LANGUAGE SELECTOR SWITCH is concealed by an access cover when not in use. This cover should always be replaced after making adjustments to this control.

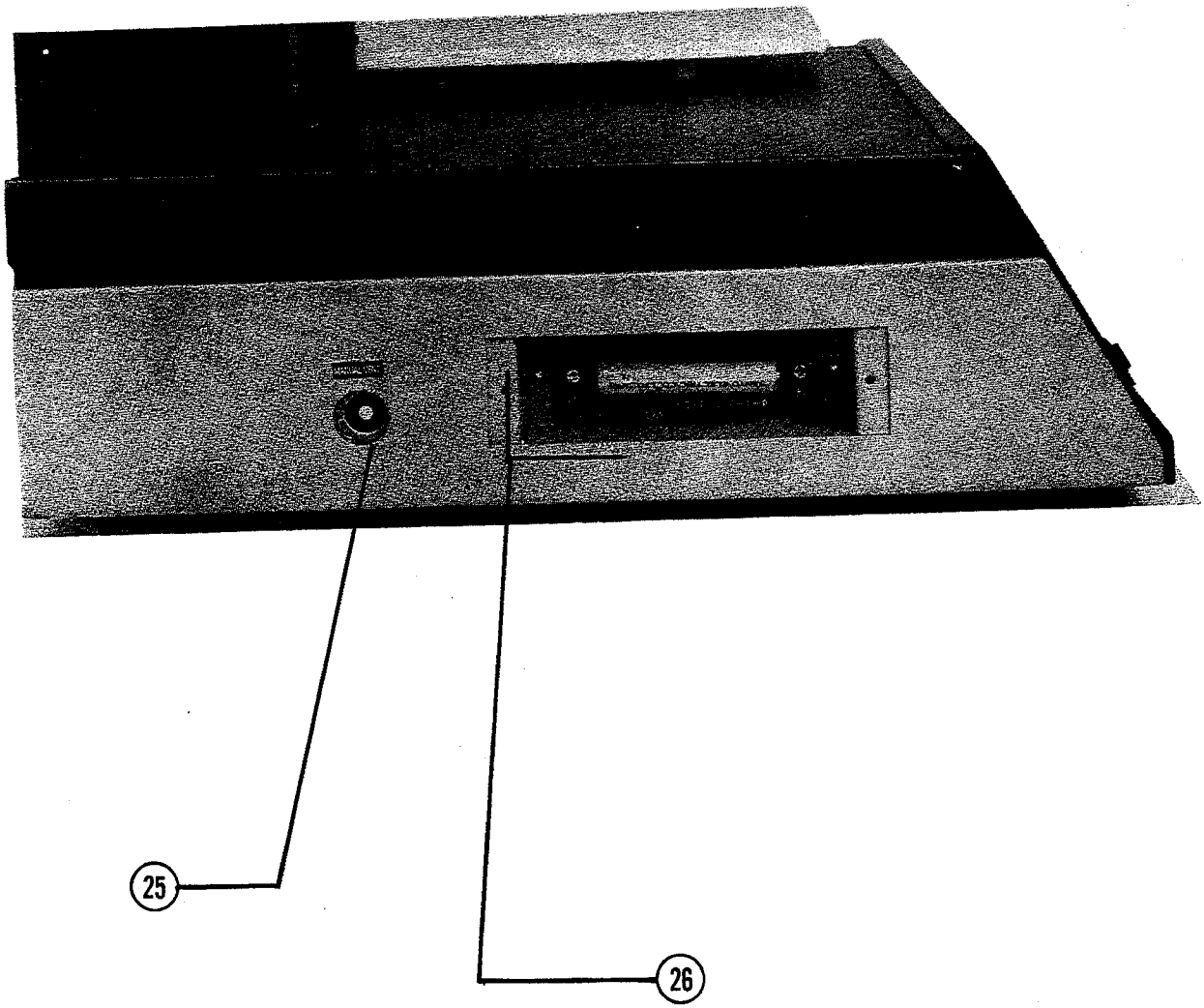
CALIBRATION RESET SWITCH (24):

When this switch is depressed, the furnace calibration will be restored to a factory-determined calibration standard value.

This switch should be depressed ONLY after the furnace battery has been replaced, or in the event the ALPHA-NUMERIC DISPLAY indicates "CALIBRATION MALFUNCTION" after several consecutive attempts to perform the furnace calibration procedure.

The CALIBRATION RESET SWITCH is concealed by an access cover when not in use. This cover should always be replaced after using this switch.

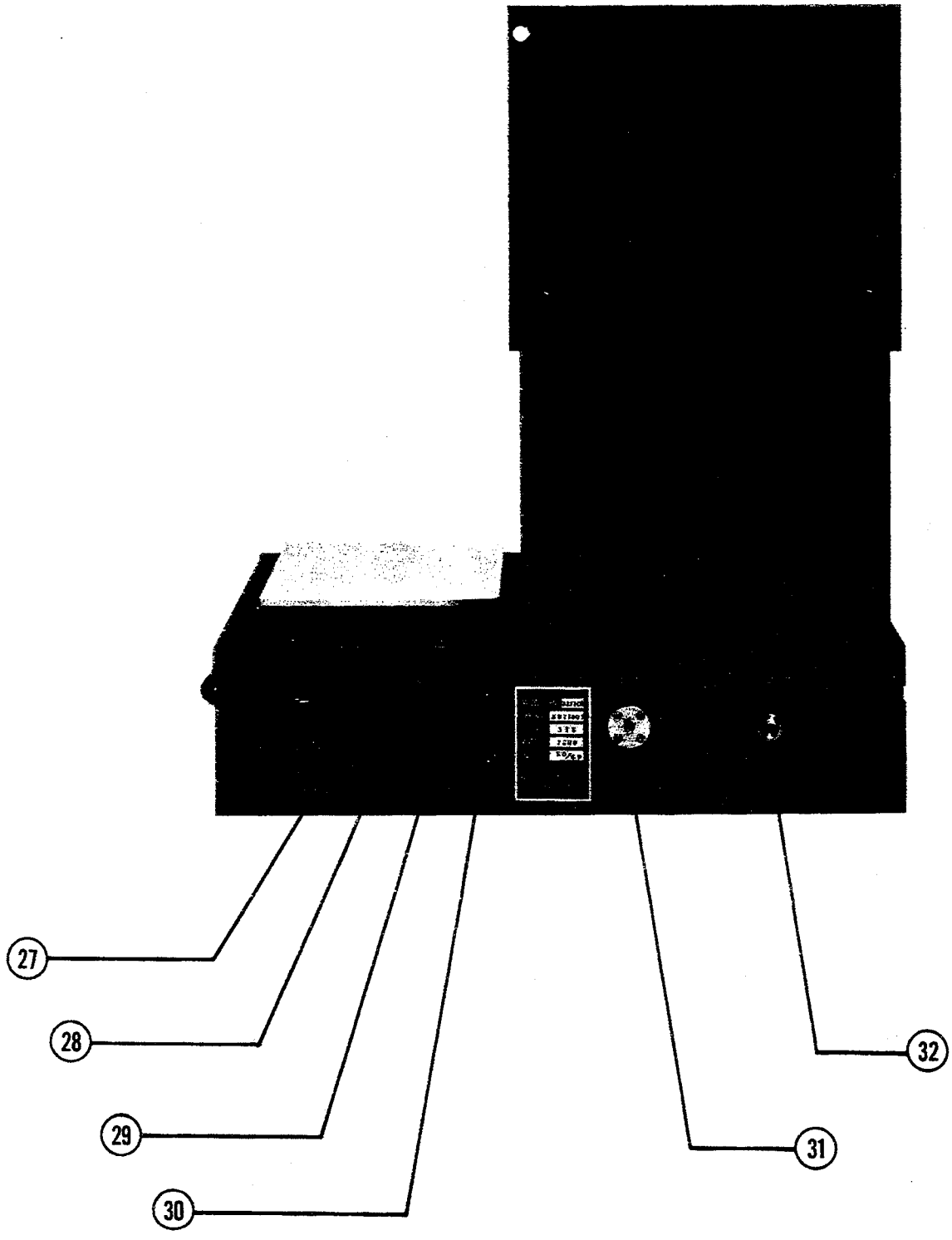
LEFT SIDE CONTROLS



25. MANUAL VACUUM VENT

26. BATTERY COMPARTMENT (ACCESS COVER REMOVED)

REAR VIEW



27. MAIN FURNACE FUSE
28. VACUUM PUMP FUSE
29. VACUUM PUMP RECEPTACLE
30. ELECTRICAL GROUND BINDING POST
31. MANUAL DOOR CRANK
32. VACUUM HOSE CONNECTOR

LEFT SIDE CONTROLS

MANUAL VACUUM VENT (25):

Provided as a means for venting the furnace Vacuum Chamber in the event of a power loss or furnace breakdown. The Vacuum Chamber may be vented by depressing and holding this button.

BATTERY COMPARTMENT (26):

Contains the furnace battery which is used to maintain firing cycle programs in microcomputer memory in the event of a line power failure. This battery will maintain memory for extended periods of time without discharge and is rated for long life.

In the event the battery fails, the TEMPERATURE DISPLAY will flash on and off continuously, indicating the battery requires replacement.

As part of normal furnace maintenance, the battery should be replaced every two years.

When replacing the battery, the precautions outlined on page 46 of this manual under BATTERY REPLACEMENT must be followed. The cover for the BATTERY COMPARTMENT should be replaced after servicing the battery.

REAR PANEL

MAIN FURNACE FUSE (27):

A safety device designed to protect the furnace electronics and Muffle in the event of a short circuit. This is one of two fuses provided on the furnace.

VACUUM PUMP FUSE (28):

An added safety device designed to protect the vacuum pump in the event of a short circuit or overload. This is the second of two fuses provided on the furnace.

VACUUM PUMP RECEPTACLE (29):

Controlled automatically by the furnace electronic controls, this outlet provides electrical power for the vacuum pump.

ELECTRICAL GROUND BINDING POST (30):

Provided as a means of attaching an electrical ground (earth) connection to the furnace, in the event the line cord ground cannot be used or additional equipment grounding is desired. The furnace must be grounded at all times, either through the line cord ground connection, this binding post connection, or both.

MANUAL DOOR CRANK (31):

Provided as a means for manually opening the furnace Door in the event of a line power failure or furnace breakdown.

The MANUAL DOOR CRANK is operated in the following manner:

1. Using the MANUAL VACUUM VENT, vent the furnace Vacuum Chamber completely.
2. Place the supplied Door Crank Handle on the exposed shaft of the door crank mechanism.
3. While pushing the Handle toward the front of the furnace, rotate the Handle counter-clockwise until the furnace Door has opened the desired distance.

VACUUM HOSE CONNECTOR (32):

The vacuum hose from the vacuum pump is connected to this fitting. The fitting is a standard one-quarter inch NPT.

DESCRIPTION OF FIRING CYCLE PARAMETERS

PREHEAT TIME —

The length of time, programmable in both minutes and seconds, required for the furnace Door to travel from the initial preheating position to the fully closed position. The furnace Door will not begin to close until the furnace temperature is within approximately 10°F (6°C) of the programmed Low Temperature.

Any Preheat Time from 10 seconds through 42 minutes and 30 seconds may be programmed into the furnace.

LOW TEMPERATURE —

The temperature at which the furnace Door will begin to close for preheating the restoration. Once the furnace Door has closed completely, the firing cycle will begin at this temperature.

Any Low Temperature between 200°F (100°C) and 2100°F (1150°C) may be programmed into the furnace.

HEAT RATE —

The rate of temperature rise within the Muffle, starting from the programmed Low Temperature up to the programmed High Temperature, in degrees per minute. The programmed Heat Rate will be maintained linearly throughout the firing cycle by the furnace electronic controls.

Any Heat Rate from 60°F (30°C) per minute through 300°F (165°C) per minute may be programmed into the furnace.

VACUUM LEVEL —

The level of vacuum which will be maintained within the furnace Vacuum Chamber throughout the programmed firing cycle.

The furnace has been designed to precisely maintain a programmed vacuum level automatically for the duration of the firing cycle.

Any vacuum level between 6 inches (15 centimeters) and 30 inches (76 centimeters) may be programmed into the furnace. For firing cycles where no vacuum is required, zero is programmed as the desired vacuum level.

HIGH TEMPERATURE —

The maximum temperature which will be obtained during a programmed firing cycle. Once the High Temperature has been attained, the furnace will maintain this temperature for the duration of the programmed Hold Time.

Any High Temperature between 200°F (100°C) and 2100°F (1150°C) may be programmed into the furnace.

HOLD TIME —

The length of time, programmable in both minutes and seconds, over which the programmed High Temperature will be maintained prior to the furnace Door opening.

At the end of the programmed Hold Time, the furnace Door will automatically open over the programmed Cool Time.

Any Hold Time from 0 seconds through 99 minutes and 59 seconds may be programmed into the furnace.

VENT —

Programmable as either a temperature or time quantity, this is the point during the firing cycle at which the vacuum within the furnace Vacuum Chamber will automatically vent.

When a temperature has been programmed, this will be the temperature during the firing cycle at which vacuum will be vented.

When a time has been programmed, this will be the length of time in minutes and seconds at which the vacuum will be maintained during the programmed Hold Time.

This method of programming allows the furnace operator to vent vacuum either before or at the programmed High Temperature, or maintain vacuum over any portion of the programmed Hold Time.

The vacuum Vent point may be programmed for any temperature between 200°F (100°C) and 2100°F (1150°C) OR any time from zero through 99 minutes and 59 seconds. Note that furnace controls have been designed to allow the operator to program ONLY one method of vacuum venting (time or temperature), and will not allow the operator to program a time which is longer than the programmed Hold Time.

COOL TIME —

The length of time, in minutes and seconds, required for the furnace Door to reach the fully opened position. At the end of the programmed Hold Time, the furnace Door will open at its maximum speed until it reaches a factory-predetermined position and then continue to open slowly over the programmed Cool Time.

The Cool Time is programmable over a range of 10 seconds to 20 minutes, in 10 steps, by entering the number which corresponds to the desired Cool Time as outlined below.

Cool Time Number	Actual Cool Time
<0>	10 Seconds
<1>	20 Seconds
<2>	30 Seconds
<3>	1 Minute 0 Seconds
<4>	1 Minute 30 Seconds
<5>	2 Minutes 30 Seconds
<6>	4 Minutes 0 Seconds
<7>	7 Minutes 0 Seconds
<8>	10 Minutes 0 Seconds
<9>	20 Minutes 0 Seconds

ERROR MESSAGES

The Flagship™ VPF has been designed to provide the user with a series of messages which explain the reason for the furnace not accepting an operator entry.

This feature makes it easier for the user to identify the exact nature of an improper entry.

The Error Messages provided by the furnace, their causes, and the action required by the user are outlined in this section.

1. "CAN'T INPUT"

   Causes

   a. User attempts to change parameters of a Fixed program.

   b. User attempts to change parameters of a User-program while a firing cycle is in progress.

   c. User attempts to change parameters of the Manual program while the firing cycle is in progress, at a time in the cycle when changes for that parameter are not permitted.

   Action Required by User

   a. Fixed program parameters cannot be changed by the user.

   b. Parameters of User-programs (except Manual program) cannot be changed while a firing cycle is in progress. Changes must be made prior to starting the program.

   c. Certain "in cycle" parameter changes are permitted when using the Manual program; however, these changes must be made at the correct times. The correct timing for "in cycle" parameter changes for the Manual program is outlined in the table on page 28 of this manual.

2. "DATA RANGE ERROR"

   Cause

   User attempts to enter a parameter with a value which is not within the limits for the parameter, as outlined in the table on page 23 of this manual.

   Action Required by User

   User must select a value for the parameter which is within the outlined limits.

3. "DATA ERROR"

   Cause

   Each time the START Key is depressed, the microcomputer checks all parameters to make certain they have been properly entered. In the event a parameter has not been entered (missing), is illogical, or out of the furnace range, this display will appear once the START Key is depressed.

   Action Required by User

   The user should review all parameters for the program being used to locate the parameter(s) causing this Error Message.

4. "PARAMETER ERROR X"

Cause

This display appears when entering parameters for a program if the value for the parameter being entered is in contradiction to a value previously programmed.

An example of this would be if the user enters a Low Temperature value which is higher than the High Temperature previously programmed into the furnace.

In addition to displaying "PARAMETER ERROR", a number will appear to the right of this phrase to indicate exactly which parameter contradicts the parameter being programmed.

Action Required by User

By observing the parameter number which appears to the right of the "PARAMETER ERROR" display, the user must advance the display to this parameter using the STEP Key, and enter the correct parameter.

Once this has been done, the user may return to the parameter originally being entered and resume programming.

PROGRAMMING USER-PROGRAMS "A" THROUGH "T"

The twenty User-programs "A" through "T" are fully programmable by the user, with each program consisting of eight different firing cycle parameters.

Once programmed, each of the twenty programs will be retained in the furnace memory for use as needed, even when the furnace POWER SWITCH has been turned OFF or line power to the furnace is disconnected.

Outlined below is the procedure to be used when programming User-programs "A" through "T." To illustrate this procedure, the following firing cycle parameters will be used to program user-program "A":*

PARAMETER NAME	PARAMETER VALUE
Preheat Time	2 Minutes 30 Seconds
Low Temp	1100°F (593°C)
Heat Rate	100°F/Minute (56°C/Minute)
Vacuum Level	27 Inches (69 centimeters)
High Temp	1850°F (1010°C)
Hold Time	0 Minutes 30 Seconds
Vent	1800°F (982°C)
Cool Time	10 Seconds

If, when following this procedure, an ERROR message appears on the display after depressing the ENTER Key, refer to the description of ERROR MESSAGES outlined on pages 18-19 of this manual for an explanation of the cause.

1. Make certain the Flagship™ furnace has been installed as outlined under INSTALLATION on page 2 of this manual and that the POWER SWITCH has been placed in the ON position.

   The ALPHA-NUMERIC DISPLAY will read "SELECT PROGRAM NUMBER."

2. Depress the USER PROGRAM Key. The indicator lamp above this key will light, indicating the furnace is in the User-Program mode of operation.

3. Depress PROGRAM SELECTOR Key "A." The indicator lamp above this key will light, indicating program "A" has been selected, and the ALPHA-NUMERIC DISPLAY will read "PUSH START BUTTON."

   Since the User-Program mode was selected in the previous step, the furnace is now operating in User Program "A." Had the USER PROGRAM Key not been depressed, the indicator lamp above this key would not be lighted and the furnace would therefore be operating in Fixed Program "A."

4. Depress the PROGRAM Key. The indicator lamp above this key will light, indicating the furnace is in the Program mode, and the ALPHA-NUMERIC DISPLAY will read "A1 PREHEAT TIME XX min XX sec."

   Note that the letter "A" in this display indicates the program number which has been selected, and the number "1" to the right of this letter indicates parameter number one (PREHEAT TIME) is being displayed.

5. Depress the following numbers on the NUMERICAL KEYBOARD:

   02 - to correspond to the desired number of minutes for Preheating
   AND
   30 - to correspond to the desired number of seconds for Preheating

   If, while making these entries, an incorrect key is depressed, the display may be cleared by depressing the CLEAR Key.

   You will note that, after depressing the first key for this entry (0), the small bars called CURSORS, which appear below the parameter, begin to flash on and off. This is an indication that an entry is being made.

Once the desired Preheat Time appears correctly on the display, depress the ENTER Key. This parameter will be entered, and the display will automatically advance to the next parameter and read "A2 LOW TEMP XXXX°F."

6. Depress the following numbers on the NUMERICAL KEYBOARD:

   1 1 0 0 - to correspond to the desired Low Temperature

   Once the desired Low Temperature appears correctly on the display, depress the ENTER Key. This parameter will be entered, and the display will automatically advance to the next parameter and read "A3 HEAT RATE XXX°F/min."

7. Depress the following numbers on the NUMERICAL KEYBOARD:

   1 0 0 - to correspond to the desired Heat Rate

   Once the desired Heat Rate appears correctly on the display, depress the ENTER Key. This parameter will be entered, and the display will automatically advance to the next parameter and read "A4 VACUUM LEVEL XX in Hg."

8. Depress the following numbers on the NUMERICAL KEYBOARD:

   2 7 - to correspond to the desired Vacuum Level

   Once the desired Vacuum Level appears correctly on the display, depress the ENTER Key. This parameter will be entered, and the display will automatically advance to the next parameter and read "A5 HIGH TEMP XXXX°F."

9. Depress the following numbers on the NUMERICAL KEYBOARD:

   1 8 5 0 - to correspond to the desired High Temperature

   Once the desired High Temperature appears correctly on the display, depress the ENTER Key. This parameter will be entered, and the display will automatically advance to the next parameter and read "A6 HOLD TIME XX min XX sec."

10. Depress the following numbers on the NUMERICAL KEYBOARD:

    0 0 - to correspond to the number of minutes desired to maintain High Temperature
    AND
    3 0 - to correspond to the number of seconds desired to maintain High Temperature

    Once the desired Hold Time appears correctly on the display, depress the ENTER Key. This parameter will be entered, and the display will automatically advance to the next parameter and read "A7 VENT XXX°F XXX min XX sec."

11. The Vent parameter may be expressed as either temperature or time. If it is desired to vent vacuum at or before the programmed High Temperature (as in this exercise), the desired Vent Temperature would be programmed at this time by depressing the following numbers on the NUMERICAL KEYBOARD:

    1 8 0 0 - to correspond to the desired venting temperature

    If for this parameter it is desirable to maintain vacuum for a portion of or the entire programmed Hold Time, the STEP Key should be depressed once and the display will read "A7 VENT °F XX min XX sec."

    You will note that the CURSORS now appear below the Vent Time, rather than temperature, and the Vent Time may be entered by depressing the corresponding numbers on the Numerical Keyboard as follows:

X X - to correspond to the number of minutes desired to maintain vacuum during the Hold Time.
AND
X X - to correspond to the number of seconds desired to maintain vacuum during the Hold Time.

Once the desired Vent value appears correctly on the display, depress the ENTER Key, and the desired vacuum venting point will be entered.

If the furnace has been programmed to vent vacuum by time, the next parameter will be displayed immediately after the ENTER Key is depressed.

If vacuum has been programmed to vent by temperature, the STEP Key must be depressed after depressing the ENTER Key to advance to the next parameter.

At this time the display will read "A8 COOL TIME <X> X min XX sec."

12. In accordance with the table which appears on page 17 of this manual, the code number which corresponds to the Cool Time used for this exercise is "0."

    Depress "0" on the NUMERICAL KEYBOARD, and note that actual Cool Time which corresponds to this code number appears on the display to the right of the code number.

    Once the correct code number appears on the display, depress the ENTER Key. This parameter will be entered, and the display will automatically advance to the first parameter programmed, indicating that programming for this Program is complete.

    At this time, all parameters should be checked for entry errors by advancing through the Program, one parameter at a time, using the STEP Key.

    If an error is found, it may be corrected by depressing the keys on the NUMERICAL KEYBOARD which correspond to the correct value, and depressing the ENTER Key. The correct value will automatically replace the value previously entered.

13. Depress the PROGRAM Key. The indicator lamp above the key will turn off, and the ALPHA-NUMERIC DISPLAY will read "PUSH START BUTTON."

14. User-Program "A" has now been completely programmed and may be used to perform the programmed firing cycle by depressing the START Key.

    Once the START Key has been depressed to begin a firing cycle, the ALPHA-NUMERIC DISPLAY will read either "* WARM UP *" or "* COOLING *" to show that the furnace is in the process of either heating or cooling to the programmed Low Temperature. The firing cycle will not begin until the actual Muffle temperature is within approximately 10°F (6°C) of the programmed Low Temperature.

    User-Programs "B" through "T" are programmed, using the procedure outlined for Program "A" in this section.

* NOTE: The procedure illustrated in this section uses degrees Fahrenheit for temperature and inches of mercury for vacuum. If the furnace is being used with the °F/°C SELECTOR SWITCH in the °C position, degrees Celsius for temperature and centimeters of mercury for vacuum (numbers in parentheses) should be used.

UPPER AND LOWER LIMITS FOR EIGHT FIRING CYCLE PARAMETERS

Parameter Number	Parameter	Lower Limit	Upper Limit
1	PREHEAT TIME	10 SECONDS	42 MINUTES 30 SECONDS
2	LOW TEMPERATURE	200°F (100°C)	2100°F (1150°C)
3	HEAT RATE	60°F (30°C)/MINUTE	300°F (165°C)/MINUTE
4	VACUUM LEVEL	0 OR 6 INCHES (15cm)	30 INCHES (76cm)
5	HIGH TEMPERATURE	200°F (100°C)	2100°F (1150°C)
6	HOLD TIME	0 SECONDS	99 MINUTES 59 SECONDS
7	VENT	0 SECONDS 200°F (100°C)	99 MINUTES 59 SECONDS OR 2100°F (1150°C)
8	COOL TIME*	<0> THROUGH	<9>

*Refer to Table of Cool Times as outlined under DESCRIPTION OF FIRING CYCLE PARAMETERS on page 17 of this manual.

NOTE: When a Vacuum Level of zero (0) is programmed, the Vent parameter automatically will not be displayed during programming or when reviewing program parameters.

OPERATING FIXED PROGRAMS "A" THROUGH "R"

The Flagship™ VPF is equipped with 18 "Fixed" programs, lettered "A" through "R," which may be used for performing Opaque, Dentine and Glazing cycles on five commonly used dental porcelains.

The firing cycle parameters for each of these "Fixed" programs are listed in the table at the end of this section and are based upon the porcelain manufacturers' recommended firing cycle parameters.

Any of the 18 "Fixed" programs may be operated in the following manner:

1. Make certain the Flagship furnace has been installed as outlined under INSTALLATION on page 2 of this manual and that the POWER SWITCH has been placed in the ON position.

   The ALPHA-NUMERIC DISPLAY will read "SELECT PROGRAM NUMBER."

2. The furnace must not be in either the User-Program or Program mode of operation. This may be verified by making certain that the indicator lamps above each of these keys are not lighted.

3. Depress the PROGRAM SELECTOR Key which corresponds to the desired "Fixed" program. The indicator lamp above the key will light to show that the program has been selected, and the display will read "FX PUSH START BUTTON."

4. To begin the firing cycle, depress the START Key. The indicator lamp above this key will light to show that the program has been started, and the ALPHA-NUMERIC DISPLAY will read either "* WARM UP *" or "* COOLING *" to show that the furnace is in the process of either heating or cooling to the programmed Low Temperature.

   The firing cycle will not begin until the actual Muffle temperature is within approximately 10°F (6°C) of the programmed Low Temperature.

5. If necessary, the firing cycle may be terminated at any point by depressing the STOP Key.

FIRING CYCLE PARAMETERS FOR FIXED PROGRAMS "A" THROUGH "R"

PROGRAM "A" - JELENKO™ PORCELAIN/OPAQUE CYCLE

PREHEAT TIME	- 3 MINUTES 0 SECONDS
LOW TEMP	- 1100°F (593°C)
HEAT RATE	- 100°F/MINUTE (56°C/MINUTE)
VACUUM LEVEL	- 28 INCHES (71 CENTIMETERS)/MERCURY
HIGH TEMP	- 1850°F (1010°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- 1800°F (982°C)
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "B" - JELENKO PORCELAIN/DENTINE CYCLE

PREHEAT TIME	- 5 MINUTES 0 SECONDS
LOW TEMP	- 1100°F (593°C)
HEAT RATE	- 100°F/MINUTE (56°C/MINUTE)
VACUUM LEVEL	- 28 INCHES (71 CENTIMETERS)/MERCURY
HIGH TEMP	- 1775°F (968°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- 1725°F (941°C)
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "C" - JELENKO PORCELAIN/GLAZING CYCLE

PREHEAT TIME	- 3 MINUTES 0 SECONDS
LOW TEMP	- 1100°F (593°C)
HEAT RATE	- 100°F/MINUTES (56°C/MINUTE)
VACUUM LEVEL	- 0 INCHES (0 CENTIMETERS)/MERCURY
HIGH TEMP	- 1725°F (941°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- PARAMETER NOT DISPLAYED
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "D" - CERAMCO®[1] PORCELAIN/OPAQUE CYCLE

PREHEAT TIME	- 3 MINUTES 0 SECONDS
LOW TEMP	- 1200°F (649°C)
HEAT RATE	- 100°F/MINUTE (56°C/MINUTE)
VACUUM LEVEL	- 28 INCHES (71 CENTIMETERS)/MERCURY
HIGH TEMP	- 1830°F (999°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- 1730°F (943°C)
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "E" - CERAMCO PORCELAIN/DENTINE CYCLE

PREHEAT TIME	- 5 MINUTES 0 SECONDS
LOW TEMP	- 1200°F (649°C)
HEAT RATE	- 100°F/MINUTE (56°C/MINUTE)
VACUUM LEVEL	- 28 INCHES (71 CENTIMETERS)/MERCURY
HIGH TEMP	- 1775°F (968°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- 1725°F (940°C)
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "F" - CERAMCO® PORCELAIN/GLAZING CYCLE

PREHEAT TIME	- 5 MINUTES 0 SECONDS
LOW TEMP	- 1200°F (649°C)
HEAT RATE	- 100°F/MINUTE (56°C/MINUTE)
VACUUM LEVEL	- 0 INCHES (0 CENTIMETERS)/MERCURY
HIGH TEMP	- 1800°F (982°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- PARAMETER NOT DISPLAYED
COOL TIME	- 0 MINUTES 10 SECONDS

Fixed programs "G," "H" and "I" are for Will-Ceram®[2] Porcelain when the °F/°C Selector Switch is in the °F position ONLY. The parameters are as follows:

PROGRAM "G" - WILL-CERAM PORCELAIN/OPAQUE CYCLE

PREHEAT TIME	- 6 MINUTES 0 SECONDS
LOW TEMP	- 1000°F
HEAT RATE	- 100°F/MINUTE
VACUUM LEVEL	- 28 INCHES
HIGH TEMP	- 1825°F
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- 1825°F
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "H" - WILL-CERAM PORCELAIN/DENTINE CYCLE

PREHEAT TIME	- 9 MINUTES 0 SECONDS
LOW TEMP	- 1000°F
HEAT RATE	- 100°F/MINUTE
VACUUM LEVEL	- 28 INCHES
HIGH TEMP	- 1760°F
HOLD TIME	- 1 MINUTE 0 SECONDS
VENT	- 1760°F
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "I" - WILL-CERAM PORCELAIN/GLAZING CYCLE

PREHEAT TIME	- 3 MINUTES 0 SECONDS
LOW TEMP	- 1000°F
HEAT RATE	- 100°F/MINUTE
VACUUM LEVEL	- 0 INCHES
HIGH TEMP	- 1725°F
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- PARAMETER NOT DISPLAYED
COOL TIME	- 0 MINUTES 10 SECONDS

Fixed programs "G," "H" and "I" are for Crystar®[3] Porcelain when the °F/°C Selector Switch is in the °C position ONLY. The parameters are as follows:

PROGRAM "G" - CRYSTAR PORCELAIN/OPAQUE CYCLE

PREHEAT TIME	- 3 MINUTES 0 SECONDS
LOW TEMP	- 800°C
HEAT RATE	- 45°C/MINUTE
VACUUM LEVEL	- 70 CENTIMETERS/MERCURY
HIGH TEMP	- 960°C
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- 960°C
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "H" - CRYSTAR® PORCELAIN/DENTINE CYCLE

PREHEAT TIME	- 5 MINUTES 0 SECONDS
LOW TEMP	- 800°C
HEAT RATE	- 45°C/MINUTE
VACUUM LEVEL	- 70 CENTIMETERS/MERCURY
HIGH TEMP	- 960°C
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- 950°C
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "I" - CRYSTAR PORCELAIN/GLAZING CYCLE

PREHEAT TIME	- 3 MINUTES 0 SECONDS
LOW TEMP	- 800°C
HEAT RATE	- 45°C/MINUTE
VACUUM LEVEL	- 0 CENTIMETERS/MERCURY
HIGH TEMP	- 940°C
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- PARAMETER NOT DISPLAYED
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "J" - VITA®-LUMIN®[4] PORCELAIN/OPAQUE CYCLE

PREHEAT TIME	- 2 MINUTES 0 SECONDS
LOW TEMP	- 1470°F (800°C)
HEAT RATE	- 60°F/MINUTE (33°C/MINUTE)
VACUUM LEVEL	- 28 INCHES (71 CENTIMETERS)/MERCURY
HIGH TEMP	- 1760°F (960°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- 1760°F (960°C)
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "K" - VITA-LUMIN PORCELAIN/DENTINE CYCLE

PREHEAT TIME	- 5 MINUTES 0 SECONDS
LOW TEMP	- 1380°F (749°C)
HEAT RATE	- 60°F/MINUTE (33°C/MINUTE)
VACUUM LEVEL	- 28 INCHES (71 CENTIMETERS)/MERCURY
HIGH TEMP	- 1760°F (960°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- 1760°F (960°C)
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "L" - VITA-LUMIN PORCELAIN/GLAZING CYCLE

PREHEAT TIME	- 2 MINUTES 0 SECONDS
LOW TEMP	- 1380°F (749°C)
HEAT RATE	- 60°F/MINUTE (33°C/MINUTE)
VACUUM LEVEL	- 0 INCHES (0 CENTIMETERS)/MERCURY
HIGH TEMP	- 1760°F (960°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- PARAMETER NOT DISPLAYED
COOL TIME	- 1 MINUTE 30 SECONDS

PROGRAM "M" - BIOBOND®[5] PORCELAIN/OPAQUE CYCLE

PREHEAT TIME	- 4 MINUTES 0 SECONDS
LOW TEMP	- 1350°F (732°C)
HEAT RATE	- 100°F/MINUTE (56°C/MINUTE)
VACUUM LEVEL	- 28 INCHES (71 CENTIMETERS)/MERCURY
HIGH TEMP	- 1750°F (954°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- 1750°F (954°C)
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "N" - BIOBOND® PORCELAIN/DENTINE CYCLE

PREHEAT TIME	- 5 MINUTES 0 SECONDS
LOW TEMP	- 1100°F (593°C)
HEAT RATE	- 100°F/MINUTE (56°C/MINUTE)
VACUUM LEVEL	- 28 INCHES (71 CENTIMETERS)/MERCURY
HIGH TEMP	- 1725°F (927°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- 1700°F (927°C)
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "O" - BIOBOND PORCELAIN/GLAZING CYCLE

PREHEAT TIME	- 4 MINUTES 0 SECONDS
LOW TEMP	- 1450°F (788°C)
HEAT RATE	- 100°F/MINUTE (56°C/MINUTE)
VACUUM LEVEL	- 0 INCHES (0 CENTIMETERS)/MERCURY
HIGH TEMP	- 1750°F (954°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- PARAMETER NOT DISPLAYED
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "P" - JELENKO "0"/CAMEO® DEGASSING

PREHEAT TIME	- 0 MINUTES 10 SECONDS
LOW TEMP	- 1200°F (649°C)
HEAT RATE	- 100°F/MINUTE (56°C/MINUTE)
VACUUM LEVEL	- 0 INCHES (0 CENTIMETERS)/MERCURY
HIGH TEMP	- 1900°F (1038°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- PARAMETER NOT DISPLAYED
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "Q" - OLYMPIA® DEGASSING

PREHEAT TIME	- 0 MINUTES 10 SECONDS
LOW TEMP	- 1300°F (704°C)
HEAT RATE	- 100°F/MINUTE (56°C/MINUTE)
VACUUM LEVEL	- 0 INCHES (0 CENTIMETERS)/MERCURY
HIGH TEMP	- 1900°F (1038°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- PARAMETER NOT DISPLAYED
COOL TIME	- 0 MINUTES 10 SECONDS

PROGRAM "R" - JELSTAR® DEGASSING

PREHEAT TIME	- 0 MINUTES 10 SECONDS
LOW TEMP	- 1200°F (649°C)
HEAT RATE	- 100°F/MINUTE (56°C/MINUTE)
VACUUM LEVEL	- 0 INCHES (0 CENTIMETERS)/MERCURY
HIGH TEMP	- 1900°F (1038°C)
HOLD TIME	- 0 MINUTES 0 SECONDS
VENT	- PARAMETER NOT DISPLAYED
COOL TIME	- 0 MINUTES 10 SECONDS

IMPORTANT NOTE: The firing cycle parameters contained in the 18 "Fixed" programs, "A" through "R," are based upon manufacturers' most current published data.

The Jelenko Company does not warrant the results produced by any of these "Fixed" programs, nor imply a warranty therefor.

[1]CERAMCO is a registered trademark of Johnson & Johnson.
[2]Will-Ceram is a registered trademark of Williams Gold.
[3]Crystar is a registered trademark of Shofu Dental Corporation.
[4]Vita and Lumin are registered trademarks of Vita-Zahnfabrik AG.
[5]Biobond is a registered trademark of Dentsply International Inc.

PROGRAMMING THE MANUAL PROGRAM

The Manual program is fully programmable by the user and consists of eight different firing cycle parameters, as with the "User" and "Fixed" programs "A" through "T."

The Manual program is programmed in the same manner as User-Programs "A" through "T" and is operated by depressing the MANUAL Key in place of a PROGRAM SELECTOR Key.

When the MANUAL Key has been depressed, the indicator lamp above the key will light to show that the Manual program has been selected.

The status of the USER PROGRAM Key (whether selected or not) has no effect on the operation of the Manual program.

An added feature of the Manual program is the ability to change firing cycle parameters while a firing cycle is in progress, according to the table given below.

PARAMETER CHANGE CAPABILITIES OF THE MANUAL PROGRAM DURING A FIRING CYCLE

PARAMETER	Prior to depressing START Key	Cycle started-furnace has not reached programmed Low Temp.	Furnace has reached programmed Low Temperature	Furnace has started temp. increase from programmed Low to programmed High Temp.	Furnace has reached programmed High Temp. and is holding for programmed Hold Time	Furnace Door is opening over programmed Cool Time
PREHEAT TIME	A	A	U	U	U	U
LOW TEMP	A	U	U	U	U	U
HEAT RATE	A	A	A	U	U	U
VACUUM LEVEL	A	A	A	U	A(1)	A
HIGH TEMP	A	A	A	U	U	U
HOLD TIME	A	A	A	U	U	U
VENT	A	A	A	A	U	U
COOL TIME	A	A	A	A	A	(2)U

A=ACCEPTED BY FURNACE U=UNACCEPTED BY FURNACE

NOTES: (1) When vacuum venting is programmed by time, the Vacuum Level may be changed after vacuum has been vented.

(2) After using either the air or vacuum override functions, the Cool Time may be input again.

PROGRAMMING THE USER IDLE PROGRAM

The "User" Idle Program is fully programmable by the user for both temperature and vacuum. This program is programmed and operated as outlined below.

Programming "User" Idle

To illustrate the procedure for programming the "User" Idle Program, an idle temperature of 1000°F (538°C) and vacuum level of 27 inches (69 cm) of mercury will be programmed.

1. With the furnace POWER SWITCH in the ON position, depress the USER PROGRAM Key and IDLE Key.

   The indicator lamps above each of these keys will light to show that they have been selected.

2. Depress the PROGRAM Key. The indicator lamp above this key will light to show that it has been selected, and the display will read "IDLE XXXX°F - XX in Hg."*

3. Depress the following numbers on the NUMERICAL KEYBOARD:

   1 0 0 0 - to correspond to the desired Idle temperature.

   Once the desired Idle temperature appears correctly on the display, depress the ENTER Key. This parameter will be entered, and the CURSORS which appear below the Temperature parameter will automatically move to appear below the Vacuum Level Parameter. At this time the display will read "IDLE 1000°F - XX in Hg."*

4. Depress the following numbers on the NUMERICAL KEYBOARD:

   2 7 - to correspond to the desired Vacuum Level

   Once the desired Vacuum Level appears correctly on the display, depress the ENTER Key. This parameter will be entered, and the CURSORS which appear below the Vacuum Level parameter will move to again appear below the Temperature parameter.

5. Programming the "User" Idle Program is now complete. Depress the PROGRAM Key to remove the furnace from the Program mode of operation. The indicator lamp above this key should no longer be lighted.

Operating "User" Idle

Once the "User" Idle program has been programmed with Temperature and Vacuum Level parameters, it should be operated in the following manner.

1. With the furnace POWER SWITCH in the ON position, make certain the PROGRAM Key has not been selected and the indicator lamp above this key is not lighted.

2. Depress the USER PROGRAM Key and the IDLE Key. The indicator lamps above each of these keys will light to show that they have been selected, and the display will read "PUSH START BUTTON".

3. Depress the START Key. The indicator lamp above this key will light, the furnace Door will begin to close, and the display will read "IDLE - in Hg."*

4. If vacuum has been programmed for the "User" Idle Program, the vacuum pump will turn on as soon as the furnace Door closes completely. The vacuum pump will operate until the programmed vacuum level is achieved and then automatically turn off. If a vacuum level greater than 27 inches (69 cm) of mercury is programmed, but this programmed vacuum level is not achieved, the vacuum pump will operate for one minute after achieving 27 inches (69 cm) of mercury. Once the vacuum pump has turned off, the pump will not turn on again should the vacuum level within the Vacuum Chamber drop below the programmed value.

5. To stop the "User" Idle program, the STOP Key should be depressed. The vacuum within the furnace Vacuum Chamber will be vented (if vacuum is programmed), and the furnace Door will automatically open.

*If the °F/°C SELECTOR SWITCH has been placed in the °C position, this display will appear in °C and centimeters of mercury.

OPERATING THE FIXED IDLE PROGRAM

The "Fixed" Idle program will maintain the furnace at a temperature of 1130°F (610°C), without vacuum, with the furnace Door closed.

The "Fixed" Idle program is operated as follows:

1. With the furnace POWER SWITCH in the ON position, make certain that the PROGRAM Key has not been selected and the indicator lamp above this key is not lighted.

2. Depress the IDLE Key. The indicator lamp above this key will light, and the display will read "F PUSH START BUTTON."

3. Depress the START Key. The indicator lamp above this key will light, the furnace Door will begin to close, and the display will read "F IDLE - in Hg."*

4. Since this "Fixed" program does not call for the use of vacuum, no vacuum level will be indicated on the display.

   The Temperature Display will indicate the actual Muffle temperature at all times.

5. To stop the Idle program, the STOP Key should be depressed, and the furnace Door will automatically open.

*If the °F/°C SELECTOR SWITCH has been placed in the °C position, this display will appear in centimeters of mercury (cm Hg).

OPERATING THE NIGHT PROGRAM

The Night program is a fixed program which will maintain the furnace at a temperature of 590°F (310°C) with the vacuum pump being operated for one minute after the start of the cycle and then turning off automatically.

The Night program is operated as follows:

1. With the furnace POWER SWITCH in the ON position, make certain that the PROGRAM Key has not been selected and the indicator lamp above this key is not lighted.

2. Depress the NIGHT Key. The indicator lamp above this key will light, and the display will read "N PUSH START BUTTON."

3. Depress the START Key. The indicator lamp above this key will light, the furnace Door will begin to close, and the display will read "N NIGHT - in Hg."*

4. Once the furnace Door closes completely, the vacuum pump will turn on, operate for one minute, and then turn off automatically. The vacuum pump will not turn on again should the vacuum level within the Vacuum Chamber drop.

   The display will indicate the actual vacuum level within the furnace Vacuum Chamber, and the Temperature Display will indicate the actual Muffle temperature at all times.

5. To stop the Night program, the STOP Key should be depressed. The vacuum within the furnace Vacuum Chamber will be vented, and the furnace Door will automatically open.

*If the °F/°C SELECTOR SWITCH has been placed in the °C position, this display will appear in centimeters of mercury (cm Hg).

TRANSFERRING PROGRAMS

The Flagship™ VPF has the added capability of transferring entire programs from one program to another.

This capability allows the user, for example, to fire a restoration in the Manual Program, making parameter changes as required until the desired result is achieved. Once satisfied, the user may transfer this program, in its entirety, into any User Program where it can be retained for use at any time.

Another example of the capability of this transfer feature would be if the user wished to use a "Fixed" Program with some parameter changes. The desired "Fixed" Program could be transferred into either the Manual or a "User" Program where changes to the individual parameters can be made. This modified "Fixed" Program could be retained for future use as desired.

It is not possible, however, to transfer programs to a "Fixed" Program.

The following program transfers are possible with the Flagship furnace.

- User Programs "A" through "T" TO Another User Program "A" through "T"
- Fixed Programs "A" through "R" TO User Programs "A" through "T"
- Fixed Programs "A" through "R" TO the Manual Program
- User Programs "A" through "T" TO the Manual Program
- The Manual Program TO User Programs "A" through "T"

Transferring from one User Program to another User Program

1. With the furnace POWER SWITCH in the ON position, depress the PROGRAM Key and the USER PROGRAM Key.

   The indicator lamps above each of these keys will light to show that they have been selected.

2. Depress the PROGRAM SELECTOR Key which corresponds to the "User" program that is to be transferred; then depress the PROGRAM SELECTOR Key corresponding to the program which is to accept the new program.

   The indicator lamp above this key will light to show that it has been selected, and the display will read X1 PREHEAT TIME X X min X X sec."

3. Depress the ENTER Key. Two brief tone responses will be heard to acknowledge the program transfer.

   Using the STEP Key, review the program parameters individually to make certain all parameters were transferred completely.

4. Depress the PROGRAM Key. The indicator lamp above this key will turn off to show that the furnace is no longer in the Program mode. The program transfer is now complete.

Transferring from a Fixed Program to a User Program

1. With the furnace POWER SWITCH in the ON position, make certain the USER PROGRAM Key has not been selected and the indicator lamp above this key is not lighted.

2. Depress the PROGRAM Key. The indicator lamp above this key will light to show that it has been selected.

3. Depress the PROGRAM SELECTOR Key which corresponds to the "Fixed" program that is to be transferred; then depress the PROGRAM SELECTOR Key corresponding to the "User" program that is to accept the new program. The indicator lamps above each of these keys will light to show that they have been selected, and the display will read "FX1 PREHEAT TIME X X min X X sec."

4. Depress the ENTER Key. Two brief tone responses will be heard to acknowledge the program transfer. Depress the USER PROGRAM Key. The indicator lamp above this key will light to show that it has been selected.

   Using the STEP Key, review the program parameters individually to make certain all parameters were transferred from the "Fixed" program completely.

5. Depress the PROGRAM Key. The indicator lamp above this key will turn off to show that the furnace is no longer in the Program mode. The program transfer is now complete.

Transferring from a Fixed Program to the Manual Program

1. With the furnace POWER SWITCH in the ON position, make certain the USER PROGRAM Key has not been selected and the indicator lamp above this key is not lighted.

2. Depress the PROGAM Key. The indicator lamp above this key will light to show that it has been selected.

3. Depress the PROGRAM SELECTOR Key which corresponds to the "Fixed" program that is to be transferred; then depress the MANUAL Program Key. The indicator lamp above this key will light to show that it has been selected, and the display will read "M1 PREHEAT TIME X X min X X sec."

4. Depress the ENTER Key. Two brief tone responses will be heard to acknowledge the program transfer.

   Using the STEP Key, review the program parameters individually to make certain all parameters were transferred from the "Fixed" program completely.

5. Depress the PROGRAM Key. The indicator lamp above this key will turn off to show that the furnace is no longer in the Program mode. The program transfer is now complete.

Transferring from a User Program to the Manual Program

1. With the furnace POWER SWITCH in the ON position, depress the PROGRAM Key and the USER PROGRAM Key.

   The indicator lamps above each of these keys will light to show that they have been selected.

2. Depress the PROGRAM SELECTOR Key which corresponds to the "User" Program that is to be transferred; then depress the MANUAL Program Key. The indicator lamp above this key will light to show that it has been selected, and the display will read "M1 PREHEAT TIME X X min X X sec."

3. Depress the ENTER Key. Two brief tone responses will be heard to acknowledge the program transfer.

   Using the STEP Key, review the program parameters individually to make certain all parameters were transferred completely.

4. Depress the PROGRAM Key. The indicator lamp above this key will turn off to show that the furnace is no longer in the Program mode. The program transfer is now complete.

Transferring from the Manual Program to a User Program

1. With the furnace POWER SWITCH in the ON position, depress the PROGRAM Key and the USER PROGRAM Key. The indicator lamps above each of these keys will light to show that they have been selected.

2. Depress the MANUAL Program Key; then depress the PROGRAM SELECTOR Key which corresponds to the "User" program that is to accept the new program. The indicator lamps above each of these keys will light to show that they have been selected, and the display will read "X1 PREHEAT TIME X X min X X sec."

3. Depress the ENTER Key. Two brief tone responses will be heard to acknowledge the program transfer.

   Using the STEP Key, review the program parameters individually to make certain all parameters were transferred completely.

4. Depress the PROGRAM Key. The indicator lamp above this key will turn off to show that the furnace is no longer in the Program mode. The program transfer is now complete.

CALIBRATION

Your Flagship™ VPF has been factory-calibrated. However, it is recommended that the calibration be checked prior to initial operation and once each month as part of normal furnace maintenance.

The Flagship features an automatic, self-adjusting calibration system which performs the calibration process electronically, eliminating the need for user adjustments.

To calibrate the furnace, follow the calibration procedure outlined below:

1. Prepare the Calibration Instrument by bridging the two electrodes of the instrument with pure silver wire as shown in the photograph.

2. Using the DOOR DOWN Key, open the furnace Door completely and remove the Door Brick Platform from the Door.

3. Place the Calibration Instrument on the furnace Door.

4. Make certain that the USER PROGRAM Key has not been selected and that the indicator lamp above this key is not lighted.

5. Depress PROGRAM SELECTOR Key "T" (also labeled CALIBRATE) and the START Key. The Indicator lamps above each of these keys will light to show that they have been selected, and the display will read "FT INSERT CALIBRATION PLUG."

6. Insert the plug from the Calibration Instrument into the Calibration Jack located on the right side of the furnace. The display will again read "FT PUSH START BUTTON."

7. Depress the START Key again.

8. When the Muffle temperature, as indicated on the TEMPERATURE DISPLAY, reaches 1300°F (704°C), the furnace Door will close and the Muffle temperature will begin to increase. The display will read "FT * CALIBRATING *" during the temperature increase.

9. When the pure silver wire across the two electrodes of the Calibrating Instrument melts, the actual Muffle temperature is 1760°F (960°C). The furnace will automatically adjust the Temperature Display to read 1760°F, or 960°C if the °F/°C SELECTOR SWITCH is in the °C position; a tone will sound briefly; and the furnace Door will open automatically.

10. The calibration procedure is now complete, and the Calibration Instrument may be unplugged and removed from the furnace Door.

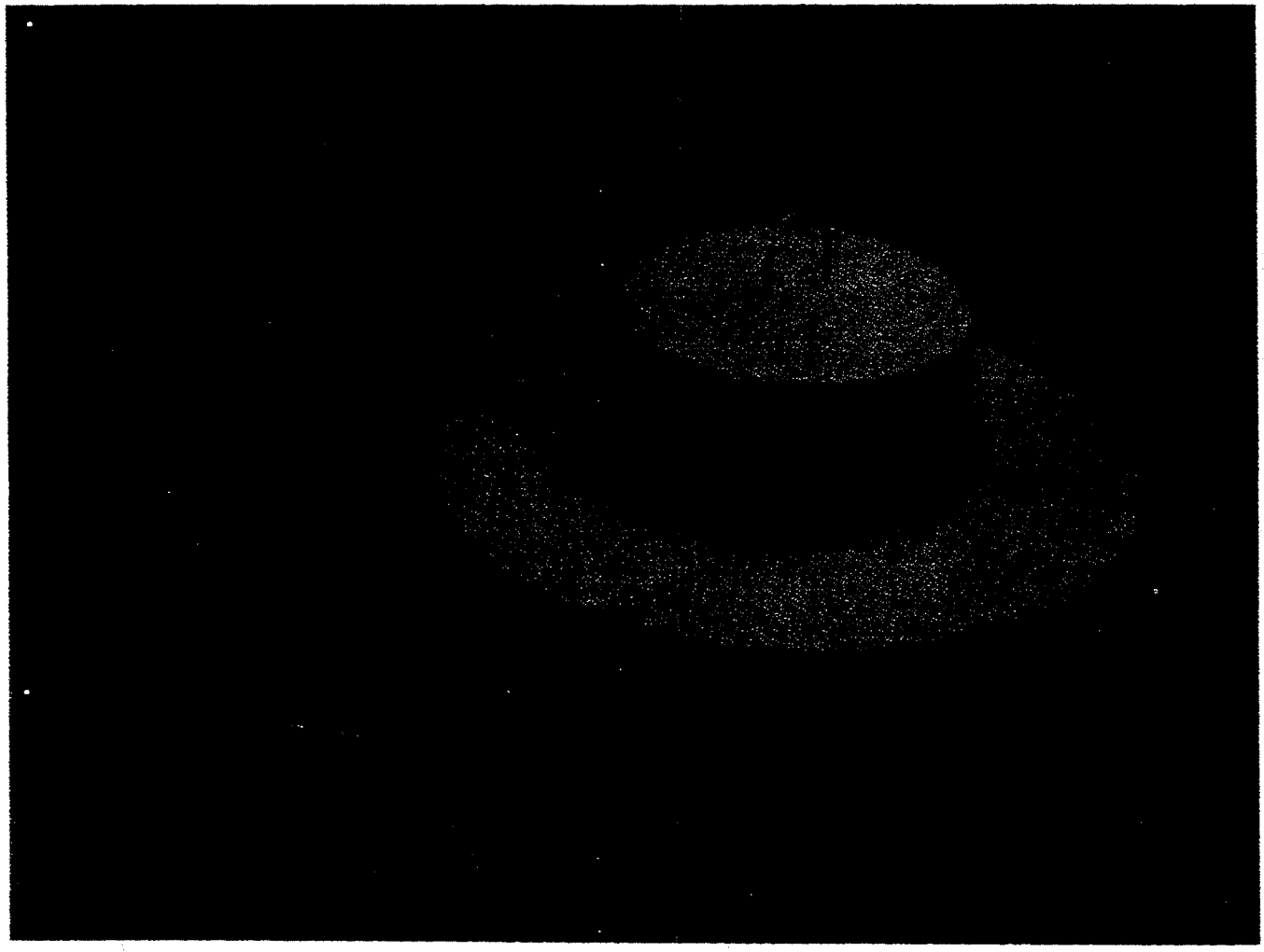
IMPORTANT NOTE: If during the furnace calibration procedure the display reads "CALIBRATION MALFUNCTION," the following items should be checked:

1. Make certain the silver wire has been wrapped tightly around the electrodes of the Calibration Instrument.

2. Make certain the electrodes are scraped clean prior to use.

If after performing the above steps this "malfunction" display occurs three times, refer to the description of "CALIBRATION MALFUNCTION" as outlined under SELF DIAGNOSTIC SYSTEM on page 37 of this manual.

CALIBRATING INSTRUMENT



Bridge the electrodes of the Calibrating Instrument, as shown, with pure silver wire. The wire should be wrapped around each electrode three times, leaving a small loop of wire between the electrodes.

It is important NOT to stretch the wire between the two electrodes.

MUFFLE PURGING

The Flagship™ VPF features a self-purging cycle which is designed to remove impurities from the muffle.

When using the Muffle Purging program, a Carbon Purging Rod (Jelenko Product Number 220116) may be used to supplement the vacuum used during the purging cycle.

When the Muffle Purging program is used, the furnace will perform the following cycle:

The Muffle temperature will increase to 1300°F (704°C), and the furnace Door will automatically close.

Once the Door closes, the vacuum pump will automatically turn on and remain on for two minutes after the furnace reaches 1900°F (1038°C), which is the programmed High Temperature.

After two minutes at this temperature, the vacuum pump will automatically turn off, and the vacuum in the furnace Vacuum Chamber will be completely vented.

Once the chamber has vented, the vacuum pump will again turn on and operate for two minutes. After this time, the pump will turn off, vacuum will be vented, and the furnace Door will open.

The Muffle Purging program is complete.

OPERATING THE MUFFLE PURGING PROGRAM

1. With the furnace POWER SWITCH in the ON position, make certain the USER PROGRAM Key has not been selected and that the indicator lamp above this key is not lighted
2. Using the DOOR DOWN Key, open the furnace Door completely. If desired, place Carbon Purging Rod(s), positioned on a ceramic tray, on the Door Brick Platform.
3. Depress PROGRAM SELECTOR Key "S" (also labeled PURGE). The indicator lamp above this key will light to show that it has been selected, and the display will read "FS PUSH START BUTTON."
4. Depress the START Key. The indicator lamp above the key will light to show that it has been selected, and the display will read "FS *MUFFLE PURGING* - in Hg."*
5. Once the programmed Low Temperature is reached, the furnace Door will close and the Muffle Purging program will be executed as outlined above.

*If the °F/°C SELECTOR SWITCH has been placed in the °C position, this display will appear in centimeters of mercury.

SELF-DIAGNOSTIC SYSTEM

The Flagship™ VPF has been designed with a seven-point self-diagnostic system which continuously monitors the vital functions of the furnace.

In the event a major component in the furnace system malfunctions, a warning tone will sound and the ALPHA-NUMERIC DISPLAY will indicate the exact nature of the malfunction.

Described below are the seven types of "malfunction" displays which may be indicated by the furnace and the corrective action which must be taken if one should appear.

"CPU MALFUNCTION X"

This display will appear with a warning tone* and a code number in place of the "X" indicated above, to indicate five forms of malfunction which may occur with the microprocessor (called a CPU) located on the Control Circuit Board.

When this display appears, the furnace POWER SWITCH should be turned OFF for approximately five minutes and then turned back ON again. Should the display reappear after doing this, the Control Circuit Board should be replaced.

"EXCESS TEMP"

In the event the furnace temperature exceeds 2150°F (1180°C), this display will appear, a warning tone will sound*, vacuum within the furnace chamber will be vented, and the furnace Door will automatically open to lower the temperature within the Muffle.

Causes for this type of malfunction are listed below, in order of probability. When replacing components to correct this problem, it is recommended that they be replaced in the order indicated.

1. Defective Solid-State Relay.
2. Defective Control Circuit Board.

"PLATFORM MALFUNCTION"

As the furnace Door opens and closes, the furnace control system monitors the travel of the Door. If at any time the furnace Door does not reach either the fully opened or fully closed position within the proper period of time, this display will appear and a warning tone will sound.*

Causes for this type of malfunction are listed below, in order of probability.

1. An obstruction which prevents the Door from reaching either the fully opened or fully closed position. This obstruction must be removed.
2. A defective door "up" or door "down" Limit Switch.

"HEATER MALFUNCTION"

Once the START Key has been depressed to start a cycle, the furnace control system monitors the actual furnace temperature and compares this temperature to the programmed temperature.

If, after a predetermined period of time, the programmed temperature is not achieved or the actual furnace temperature varies excessively from the programmed temperature, this display will appear. In addition to the display, a warning tone will sound.*

Causes for this type of malfunction are listed below, in order of probability. When replacing components to correct this problem, it is recommended that they be replaced in the order indicated.

1. Defective Muffle.
2. Defective Solid-State Relay.
3. Defective Control Circuit Board.

"VACUUM MALFUNCTION"

This display will appear for several reasons related to the vacuum function of the furnace. When the display appears, it will always be followed by a warning tone*, and if there is no vacuum detected in the furnace Vacuum Chamber, the Door will automatically open. The causes for this display and the corrective action necessary are outlined below.

1. When a program using vacuum has been started and no vacuum is achieved, this display will appear approximately ten seconds after the furnace Door closes. Possible causes are:

   a. Vacuum pump not plugged into the Vacuum Pump Receptacle at the rear of the furnace.

   b. Vacuum pump hose not connected to the Vacuum Hose Connector at the rear of the furnace.

   c. Defective Vacuum Pump.

   d. Defective Relay Circuit Board.

   e. Defective Control Circuit Board.

2. When a program using vacuum has been started and vacuum is achieved, but the programmed level or 27 inches (69 cm) of mercury is not attained within 45 seconds after the door closes, the possible causes are:

   a. Vacuum pump being used is not capable of producing sufficient vacuum.

   b. Furnace has a severe vacuum leak.

   c. Defective Control Circuit Board.

3. During a program using vacuum, the vacuum venting point is reached, but vacuum is not vented within 45 seconds. Possible causes are:

   a. Defective Vacuum Vent Valve.

   b. Defective Control Circuit Board.

"CALIBRATION MALFUNCTION"

This display appears and a warning tone will sound* during the furnace calibration procedure if the melting of the silver wire on the Calibration Instrument occurs before 1580°F (860°C) or after 1940°F (1060°C). This could occur for one of the following reasons:

1. The silver wire has not been wrapped tightly around the electrodes of the Calibration Instrument.

2. The electrodes of the Calibration Instrument are covered with oxide and need to be scraped clean prior to use.

3. The Calibration Instrument is defective.

4. The Furnace POWER SWITCH must be turned off and back on again while holding the CALIBRATION RESET BUTTON depressed.**

5. Defective Control Circuit Board.

"THERMOCOUPLE MALFUNCTION"

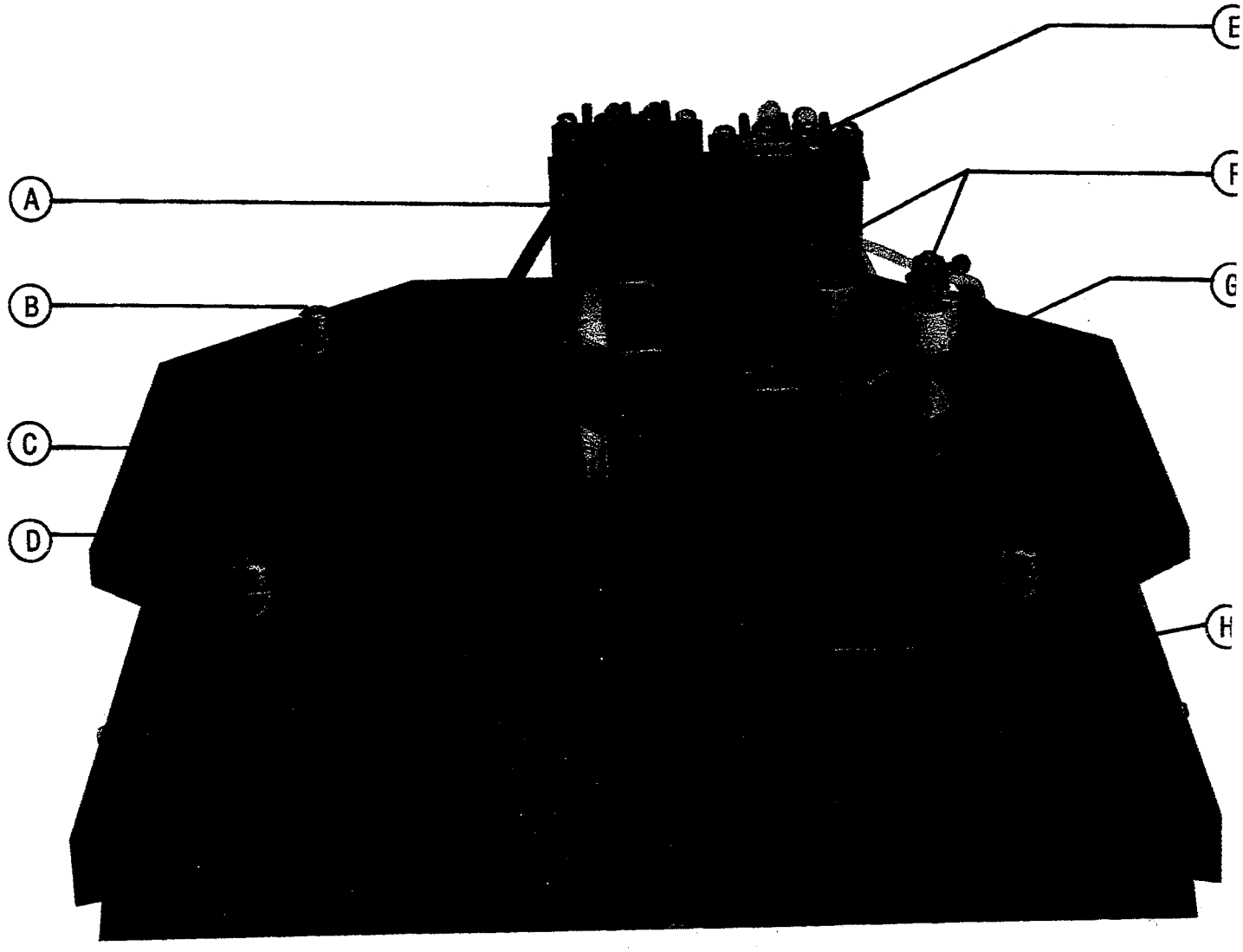
In the event the furnace Thermocouple fails, this display will appear, a warning tone will sound,* vacuum within the furnace chamber will be vented, and the furnace Door will automatically open.

When this display appears, the Thermocouple would almost always be defective and require replacement. However, it may also appear as a result of a Control Circuit Board defect.

*When the warning tone sounds, the CLEAR Key must be depressed, to silence the alarm.

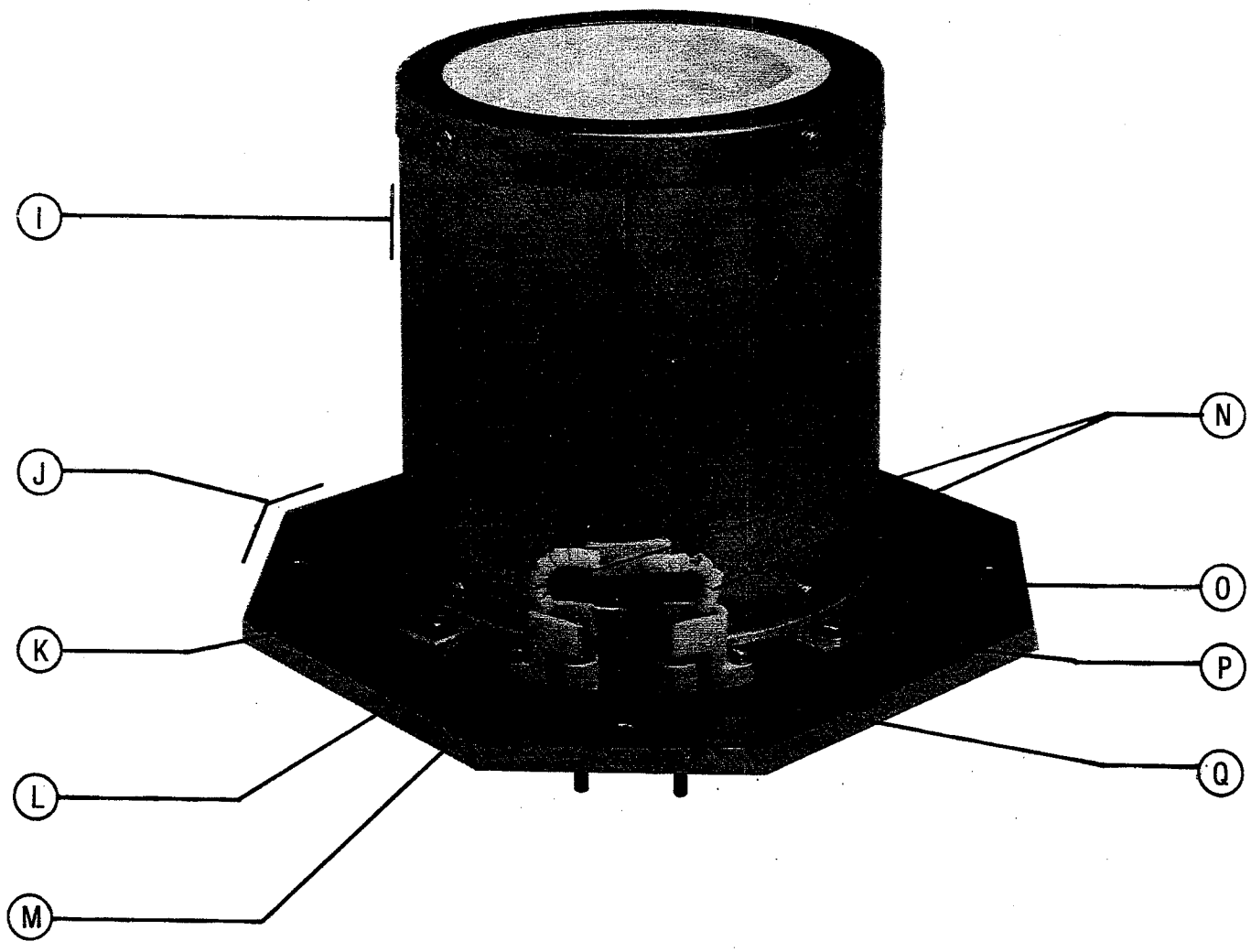
**If the CALIBRATION RESET BUTTON is depressed, the furnace must be recalibrated prior to use.

FLAGSHIP™ TOP PLATE
(SHOWN WITH UPPER HOUSING COVER REMOVED)



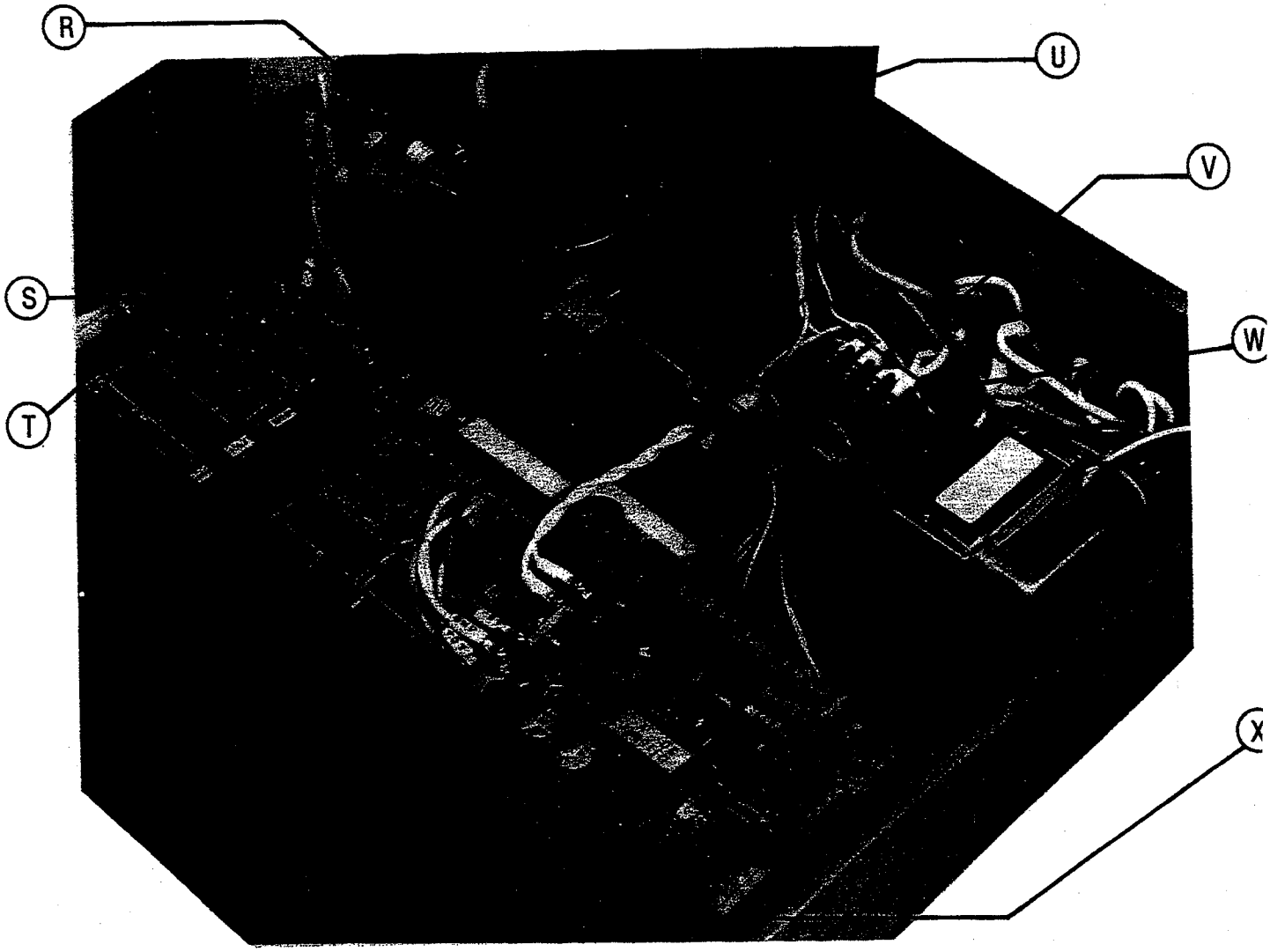
A. THERMOCOUPLE LEADS
B. TOP PLATE SCREW (1 OF 4)
C. THERMOCOUPLE NUT
D. THERMOCOUPLE FITTING
E. OVER-TEMPERATURE FUSE
F. MUFFLE POWER TERMINALS
G. MUFFLE POWER TERMINAL GASKET (1 OF 2)
H. VACUUM CHAMBER

FLAGSHIP™ MUFFLE
(SHOWN MOUNTED ON TOP PLATE)



I. MUFFLE
J. TOP PLATE
K. MUFFLE MOUNTING SCREW (1 OF 4)
L. TOP GASKET
M. MUFFLE POWER TERMINAL INSUL. (1 OF 2)
N. MUFFLE POWER LEADS
O. MUFFLE BASE
P. MUFFLE BASE MOUNTING SCREW (1 OF 4)
Q. MUFFLE POWER TERMINAL (1 OF 2)

FLAGSHIP™ INTERNAL VIEW (LOWER HOUSING COVER REMOVED)



R. VACUUM VALVE ASSEMBLY
S. THERMOCOUPLE TERMINALS (ON MAIN CIRCUIT BOARD)
T. CONTROL CIRCUIT BOARD
U. DOOR DRIVE MOTOR
V. SOLID-STATE RELAY
W. RELAY CIRCUIT BOARD
X. POWER SUPPLY CIRCUIT BOARD

REPLACEMENT OF THE THERMOCOUPLE

1. Press the furnace POWER SWITCH to the OFF position.
2. Unplug the Power Cord from your electrical outlet.
3. With the rear of the furnace facing you, loosen and remove the two screws located at the rear of the orange Upper Housing Cover. Also loosen and remove each screw on either side of the Upper Housing Cover.
4. With the front of the furnace facing you, lift the orange Upper Housing Cover off the furnace.
5. Locate and disconnect the two Thermocouple Leads which are attached to the Terminal Strip at the top of the furnace. Note the position and color coding of the two Thermocouple Leads so they may be reattached in the same manner.
6. Loosen the Thermocouple Nut and remove it from the Thermocouple Fitting.
7. Lift the Thermocouple out of the Thermocouple Fitting.
8. Reverse this procedure to install the replacement Thermocouple.
9. Recalibrate the furnace after replacing the Thermocouple, as outlined under "CALIBRATION" on pages 33-34 of this manual.

NOTE: The Thermocouple used in this furnace contains platinum and may be returned for credit against the purchase of the replacement Thermocouple.

REPLACEMENT OF THE MUFFLE

1. Press the furnace POWER SWITCH to the OFF position.
2. Unplug the Power Cord from your electrical outlet.
3. With the rear of the furnace facing you, loosen and remove the two screws located at the rear of the orange Upper Housing Cover. Also loosen and remove each screw on either side of the Upper Housing Cover.
4. With the front of the furnace facing you, lift the orange Upper Housing Cover off the furnace.
5. Locate and disconnect the two Power Leads which are attached to the two Power Terminals on the Top Plate. Note that the lug on each Power Lead is secured to the Power Terminal with a hex nut on either side. DO NOT attempt to loosen the top hex nut without first holding the bottom hex nut with a wrench or pliers.
6. Locate and disconnect the two Thermocouple Leads which are attached to the Terminal Strip at the top of the furnace. Note the position and color coding of the two Thermocouple Leads so they may be reattached in the same manner.
7. Loosen and remove the four Top Plate screws which secure the Top Plate to the Vacuum Chamber.
8. Lift the Top Plate off the Vacuum Chamber and place the Top Plate on a working surface with the open end of the Muffle facing you.
9. Locate the two Muffle Power Terminal Insulators. Loosen and remove the screw which secures each insulator to the Top Plate and remove both insulators.
10. Locate and disconnect the two Muffle Power Leads which are attached to the two Power Terminals on the exposed side of the Top Plate. Note that the lug on each Power Lead is secured to the Power Terminal with a hex nut on either side. DO NOT attempt to loosen the top hex nut without first holding the bottom hex nut with a wrench or pliers.

11. Loosen and remove the four screws which secure the Muffle to the Muffle Base.

12. Carefully lift the Muffle straight off the Muffle Base, which remains attached to the Top Plate. It is important not to "rock" the Muffle from side to side when removing it as this may damage the Thermocouple.

13. Reverse this procedure to install the replacement Muffle. When repositioning the Top Plate on the Vacuum Chamber, make certain the Top Gasket is properly seated between the Top Plate and the Vacuum Chamber.

REPLACEMENT OF THE MUFFLE VIEWING WINDOW

1. Press the furnace POWER SWITCH to the OFF position.

2. Unplug the Power Cord from your electrical outlet.

3. With the rear of the furnace facing you, loosen and remove the two screws located at the rear of the orange Upper Housing Cover. Also loosen and remove each screw on either side of the Upper Housing Cover.

4. With the front of the furnace facing you, lift the orange Upper Housing Cover off the furnace.

5. Loosen and remove the four screws which secure the Muffle Viewing Window retaining ring to the ring flange. Remove the retaining ring.

6. Reverse this procedure to install the replacement window, making certain that a vacuum seal 'O' ring is placed on either side of the window as originally positioned. When tightening the retaining ring screws, they should be tightened completely, but uniformly.

REPLACEMENT OF THE VIEWING LAMPS

1. Press the furnace POWER SWITCH to the OFF position.

2. Unplug the Power Cord from your electrical outlet.

3. With the rear of the furnace facing you, loosen and remove the two screws located at the rear of the orange Upper Housing Cover. Also loosen and remove each screw on either side of the Upper Housing Cover.

4. With the front of the furnace facing you, lift the orange Upper Housing Cover off the furnace.

5. Remove the defective Viewing Lamp(s) by pressing the Lamp upward and turning slightly counter-clockwise.

6. Reverse this procedure to install the replacement Viewing Lamp(s).

IMPORTANT: **The Viewing Lamps in this furnace are powered by a special power supply circuit, designed to eliminate lamp flickering. To prevent possible damage to this circuit, always use genuine Jelenko replacement lamps.**

REPLACEMENT OF THE POWER SUPPLY CIRCUIT BOARD

1. With the furnace POWER SWITCH in the ON position, use the DOOR UP Key to close the furnace Door completely.
2. Press the furnace POWER SWITCH to the OFF position.
3. Unplug the Power Cord from your electrical outlet.
4. With the front of the furnace facing you, loosen and remove the six screws which secure the two covers on each side of the Door Lift Arm. Remove these two covers.
5. Loosen and remove the two screws located on top of the Lower Housing Cover, at the rear of the furnace.
6. While facing each side of the furnace, loosen and remove the three screws located along the edge of the Lower Housing Cover. Note that one screw is located near the furnace control panel; whereas the remaining two screws are located inside the recessed portion on the side of the furnace.
7. Lift the Lower Housing Cover upward and off the furnace.
8. Locate and disconnect the two wires connected to the "AC 100V" terminals of the Terminal Strip on the Power Supply Circuit Board.
9. Unplug the connector for the wires which interconnect the Control Circuit Board and the Power Supply Circuit Board by depressing the small tab on the connector and pulling upward.
10. The Power Supply Circuit Board is held in place by four plastic standoffs with tabs. To release the circuit board from the standoff, use pliers to squeeze the two tabs together while pulling directly upward on the circuit board. The circuit board must be removed from each standoff, one at a time, until all four are disengaged.
11. Reverse this procedure to install the replacement Power Supply Circuit Board. When replacing the two wires to the "AC 100V" terminals (removed in Step 8), it is not critical which wire is connected to either terminal.
12. Recalibrate the furnace as outlined under CALIBRATION on pages 33-34 of this manual.

REPLACEMENT OF THE CONTROL CIRCUIT BOARD

1. With the furnace POWER SWITCH in the ON position, use the DOOR UP Key to close the furnace Door completely.
2. Press the furnace POWER SWITCH to the OFF position.
3. Unplug the Power Cord from your electrical outlet.
4. With the front of the furnace facing you, loosen and remove the six screws which secure the two covers on each side of the Door Lift Arm. Remove these two covers.
5. Loosen and remove the two screws located on top of the Lower Housing Cover, at the rear of the furnace.
6. While facing each side of the furnace, loosen and remove the three screws located along the edge of the Lower Housing Cover. Note that one screw is located near the furnace control panel; whereas the remaining two screws are located inside the recessed portion on the side of the furnace.
7. Lift the Lower Housing Cover upward and off the furnace.

8. Loosen and remove the two screws which secure the furnace control panel. These screws are located on the bottom of the furnace, along the front edge.

9. Unplug, from the Control Circuit Board, the connector for the flat cable which interconnects the Control Circuit Board and the Front Circuit Board. This connector is released by pressing the tabs located on both ends of the connector away from the connector.

10. Once the flat cable has been disconnected, lift the control panel upward and off the furnace. Position the control panel on the left side of the furnace so that it will not interfere with the removal of the Control Circuit Board.

11. Locate and disconnect the two Battery Wires which are connected to the terminals on the left side of the Control Circuit Board at the front. Before removing these wires, note the color coding on each so that they may be reconnected in the same manner. CAUTION: These wires are connected to the furnace memory back-up battery. Once disconnected, do not allow either wire to touch any metal part of the furnace, or each other, as damage to the battery will result. Always remove the wire connected to the negative (–) terminal first.

12. Locate and disconnect the two Thermocouple Wires which are connected to the terminals at the rear of the Control Circuit Board. Before removing these wires, note the color coding on each so that they may be reconnected in the same manner.

13. Locate and disconnect the two wires connected to the "AC 100V" terminals of the Terminal Strip on the Power Supply Circuit Board.

14. Unplug, from the Control Circuit Board, the large cable connector which is located behind the Power Supply Circuit Board. This connector is removed by depressing the small tab at the back of the connector and pulling upward.

15. Unplug, from the Control Circuit Board, the connector for the wires which interconnect the Control Circuit Board and the Power Supply Circuit Board. This connector is removed by depressing the small tab on the connector and pulling upward.

16. The Control Circuit Board is held in place by six plastic standoffs with tabs. To release the circuit board from the standoff, use pliers to squeeze the two tabs together while pulling directly upward on the circuit board. The circuit board must be removed from each standoff, one at a time, until all six are disengaged.

17. Once the Control Circuit Board has been removed from the furnace chassis, turn the circuit board over to expose the underside (non-component side) of the board.

    Following the same procedure used to release the Control Circuit Board from the standoffs, release the four standoffs which hold the Power Supply Circuit Board to the Control Circuit Board.

    The Power Supply Circuit Board should be removed from the Control Circuit Board with its four standoffs, and transferred to the new Control Circuit Board.

18. Reverse this procedure to install the replacement Control Circuit Board. When replacing the two wires to the "AC 100V" terminals (removed in Step 13), it is not critical which wire is connected to either terminal.

19. With the furnace POWER SWITCH in the OFF position, depress the CALIBRATION RESET BUTTON and hold depressed while placing the furnace POWER SWITCH in the ON position.

20. Recalibrate the furnace as outlined under CALIBRATION on pages 33-34 of this manual.

REPLACEMENT OF THE FRONT CIRCUIT BOARD

1. With the furnace POWER SWITCH in the ON position, use the DOOR UP Key to close the furnace Door completely.

2. Press the furnace POWER SWITCH to the OFF position.

3. Unplug the Power Cord from your electrical outlet.

4. With the front of the furnace facing you, loosen and remove the six screws which secure the two covers on each side of the Door Lift Arm. Remove these two covers.

5. Loosen and remove the two screws located on the top of the Lower Housing Cover, at the rear of the furnace.

6. While facing each side of the furnace, loosen and remove the three screws located along the edge of the Lower Housing Cover. Note that one screw is located near the furnace control panel; whereas the remaining two screws are located inside the recessed portion on the side of the furnace.

7. Lift the Lower Housing Cover upward and off the furnace.

8. Loosen and remove the two screws which secure the furnace control panel. These screws are located on the bottom of the furnace, along the front edge.

9. Unplug, from the Front Circuit Board, the connector for the flat cable which interconnects the Control Circuit Board and the Front Circuit Board. This connector is released by pressing the tabs located on both ends of the connector away from the connector.

10. Once the flat cable has been disconnected, lift the control panel upward and off the furnace. Position the control panel, face down, on a work surface on the left side of the furnace.

11. Loosen and remove the eight screws which secure the Front Circuit Board to the control panel. Once the screws have been removed, lift the circuit board away from the control panel.

12. Reverse this procedure when installing the replacement Front Circuit Board.

NOTE: Before installing the Front Circuit Board on the control panel, make certain that all of the indicator lamps (LED's) on the circuit board are positioned straight.

13. Recalibrate the furnace as outlined under CALIBRATION on pages 33-34 of this manual.

REPLACEMENT OF THE SOLID-STATE RELAY

1. With the furnace POWER SWITCH in the ON position, use the DOOR UP Key to close the furnace Door completely.

2. Press the furnace POWER SWITCH to the OFF position.

3. Unplug the Power Cord from your electrical outlet.

4. With the front of the furnace facing you, loosen and remove the six screws which secure the two covers on each side of the Door Lift Arm. Remove these two covers.

5. Loosen and remove the two screws located on top of the Lower Housing Cover, at the rear of the furnace.

6. While facing each side of the furnace, loosen and remove the three screws located along the edge of the Lower Housing Cover. Note that one screw is located near the furnace control panel; whereas the two remaining screws are located inside the recessed portion on the side of the furnace.

7. Lift the Lower Housing Cover upward and off the furnace.

8. Locate the Solid-State Relay and note the position and color coding of the wires on each of the four terminals. Disconnect the wires.

9. Loosen and remove the two screws which secure the Solid-State Relay to the furnace chassis. Remove the Solid-State Relay.

10. Reverse this procedure to install the replacement Solid-State Relay, replacing each wire on the terminal from which it was removed on the original part.

11. Recalibrate the furnace as outlined under CALIBRATION on pages 33-34 of this manual.

REPLACEMENT OF THE BATTERY

The Flagship™ VPF utilizes a long-life battery to provide memory back-up in the event line power to the furnace is interrupted.

This battery has a rated life in excess of four years. However, to be assured reliable, trouble-free service, it is recommended that this battery be replaced once every two years as part of normal furnace maintenance.

Outlined below is the procedure to be followed when replacing the battery:

1. Press the furnace POWER SWITCH to the OFF position.

2. Unplug the Power Cord from your electrical outlet.

3. With the left side of the furnace facing you, loosen and remove the two screws which secure the cover to the Battery Compartment. Remove the Battery Compartment cover.

4. Locate the negative (–) Battery Terminal and loosen and remove the screw which connects this terminal to the Battery Compartment.

   IMPORTANT: WHENEVER REPLACING THE BATTERY, THE NEGATIVE (–) TERMINAL MUST ALWAYS BE DISCONNECTED AND RECONNECTED FIRST. THIS PROCEDURE MUST BE FOLLOWED TO PREVENT DAMAGE TO THE CIRCUIT COMPONENTS.

5. Locate the positive (+) Battery Terminal and loosen and remove the screw which connects this terminal to the Battery Compartment. Remove the Battery from the Battery Compartment.

6. Reverse this procedure to install the replacement battery, making certain to connect the negative (–) terminal first, observing the "IMPORTANT" statement outlined above (Step 4).

7. With the furnace POWER SWITCH in the OFF position, depress the CALIBRATION RESET BUTTON and hold depressed while placing the POWER SWITCH in the ON position.

8. Recalibrate the furnace as outlined under CALIBRATION on pages 33-34 of this manual.

FLAGSHIP™ RENEWAL PARTS LIST

Product No.	Part Description
311105	Power Switch
311106	Vacuum Pump Receptacle-100/115V
311107	Vacuum Pump Receptacle-230V
311108	Viewing Lamp
311109	Viewing Lamp Fuse (Pkg of 5)
311110	Noise Filter
476000	Solid-State Relay
311111	Relay Circuit Board
311112	Power Transformer-100/115V
311113	Power Transformer-230V
311114	Battery
311115	Power Supply Circuit Board
311116	Control Circuit Board - 115V
311117	Front Circuit Board
311118	Calibration Jack
311119	Door Up/Down Limit Switch
311120	Over-Temperature Fuse
311121	Thermocouple Assembly
311123	Door Brick Platform
311124	Calibration Kit
311125	Control Circuit Board - 230V
311126	Muffle-115V
311127	Muffle-230V
311128	Upper Housing Cover Glass
311129	Door Drive Belt
311130	Vacuum Valve
311131	Door Drive Motor
311132	Muffle Power Terminal Insulator
311133	Muffle Power Terminal Replacement Kit
311134	Door Seal Gasket
311135	Top Gasket
311136	Viewing Window 'O' Ring
311137	Muffle Viewing Window
311138	Door Spring
311139	Door Pin
311140	Manual Door Handle
311141	Elevator Door
311142	Fuseholder
437096	15A Furnace Fuse (Pkg of 5)
429219	10A Vacuum Pump Fuse (Pkg of 5)
311143	Main Power Relay
311144	Thermocouple Nut
311145	Thermocouple Fitting
311146	Thermocouple 'O' Ring

Fahrenheit/Celsius Conversion Chart

Locate the temperature you wish to convert in the Reference Column ("REF.").

- **To find the FAHRENHEIT equivalent – read to the RIGHT.**
- **To find the CELSIUS equivalent – read to the LEFT.**

EXAMPLE: You are working at 990°C. Find 990 in the reference column. Read to the right. Fahrenheit equivalent is 1814°. If 990° is Fahrenheit, the equivalent in Centigrade is to the left, 532°.

C	REF.	F	C	REF.	F	C	REF.	F	C	REF.	F	C	REF.	F	C	REF.	F	C	REF.	F
-17.8	0	32	24.4	76	168.8	321	610	1130	743	1370	2498	1166	2130	3866	1588	2890	5234	2010	3650	6602	2432	4410	7970
-17.2	1	33.8	25.0	77	170.6	327	620	1148	749	1380	2516	1171	2140	3884	1593	2900	5252	2016	3660	6620	2438	4420	7988
-16.7	2	35.6	25.6	78	172.4	332	630	1166	754	1390	2534	1177	2150	3902	1599	2910	5270	2021	3670	6638	2433	4430	8006
-16.1	3	37.4	26.1	79	174.2	338	640	1184	760	1400	2552	1182	2160	3920	1604	2920	5288	2027	3680	6656	2449	4440	8024
-15.6	4	39.2	26.7	80	176.0	343	650	1202	766	1410	2570	1188	2170	3938	1610	2930	5306	2032	3690	6674	2454	4450	8042
-15.0	5	41.0	27.2	81	177.8	349	660	1220	771	1420	2588	1193	2180	3956	1616	2940	5324	2038	3700	6692	2460	4460	8060
-14.4	6	42.8	27.8	82	179.6	354	670	1238	777	1430	2606	1199	2190	3974	1621	2950	5342	1043	3710	6710	2466	4470	8078
-13.9	7	44.6	28.3	83	181.4	360	680	1256	782	1440	2624	1204	2200	3992	1627	2960	5360	2049	3720	6728	2471	4480	8096
-13.3	8	46.4	28.9	84	183.2	366	690	1274	788	1450	2642	1210	2210	4010	1632	2970	5378	2054	3730	6746	2477	4490	8114
-12.8	9	48.2	29.4	85	185.0	371	700	1292	793	1460	2660	1216	2220	4028	1638	2980	5396	2060	3740	6764	2482	4500	8132
-12.2	10	50.0	30.0	86	186.8	377	710	1310	799	1470	2678	1221	2230	4046	1643	2990	5414	2066	3750	6782	2488	4510	8150
-11.7	11	51.8	30.6	87	188.6	382	720	1328	804	1480	2696	1227	2240	4064	1649	3000	5432	2071	3760	6800	2493	4520	8168
-11.1	12	53.6	31.1	88	190.4	388	730	1346	810	1490	2714	1232	2250	4082	1654	3010	5450	2077	3770	6818	2499	4530	8186
-10.6	13	55.4	31.7	89	192.2	393	740	1364	816	1500	2732	1238	2260	4100	1660	3020	5468	2082	3780	6836	2504	4540	8204
-10.0	14	57.2	32.2	90	194.0	399	750	1382	821	1510	2750	1243	2270	4118	1666	3030	5486	2088	3790	6854	2510	4550	8222
-9.44	15	59.0	32.8	91	195.8	404	760	1400	827	1520	2768	1249	2280	4136	1671	3040	5504	2093	3800	6872	2516	4560	8240
-8.89	16	60.8	33.3	92	197.6	410	770	1418	832	1530	2786	1254	2290	4154	1677	3050	5522	2099	3810	6890	2521	4570	8258
-8.33	17	62.6	33.9	93	199.4	416	780	1436	838	1540	2804	1260	2300	4172	1682	3060	5540	2104	3820	6908	2527	4580	8276
-7.78	18	64.4	34.4	94	201.2	421	790	1454	843	1550	2822	1266	2310	4190	1688	3070	5558	2110	3830	6926	2532	4590	8294
-7.22	19	66.2	35.0	95	203.0	427	800	1472	849	1560	2840	1271	2320	4208	1693	3080	5576	2116	3840	6944	2538	4600	8312
-6.67	20	68.0	35.6	96	204.8	432	810	1490	854	1570	2858	1277	2330	4226	1699	3090	5594	2121	3850	6962	2543	4610	8330
-6.11	21	69.8	36.1	97	206.6	438	820	1508	860	1580	2876	1282	2340	4244	1704	3100	5612	2127	3860	6980	2549	4620	8348
-5.56	22	71.6	36.7	98	208.4	443	830	1526	866	1590	2894	1288	2350	4262	1710	3110	5630	2132	3870	6998	2554	4630	8366
-5.00	23	73.4	37.2	99	210.2	449	840	1544	871	1600	2912	1293	2360	4280	1716	3120	5648	2138	3880	7016	2560	4640	8384
-4.44	24	75.2	37.8	100	212.0	454	850	1562	877	1610	2930	1299	2370	4298	1721	3130	5666	2143	3890	7034	2566	4650	8402
-3.89	25	77.0	43	110	230	460	860	1580	882	1620	2948	1304	2380	4316	1727	3140	5684	2149	3890	7052	2571	4660	8420
-3.33	26	78.8	49	120	248	466	870	1598	888	1630	2966	1310	2390	4334	1732	3150	5702	2154	3910	7070	2577	4670	8438
-2.78	27	80.6	54	130	266	471	880	1616	893	1640	2984	1316	2400	4352	1738	3160	5720	2160	3920	7088	2582	4680	8456
-2.22	28	82.4	60	140	284	477	890	1634	899	1650	3002	1321	2410	4370	1743	3170	5738	2166	3930	7106	2588	4690	8474
-1.67	29	84.2	66	150	302	482	900	1652	904	1660	3020	1327	2420	4388	1749	3180	5756	2171	3940	7124	2593	4700	8492
-1.11	30	86.0	71	160	320	488	910	1670	910	1670	3038	1332	2430	4406	1754	3190	5774	2177	3950	7142	2599	4710	8510
-0.56	31	87.8	77	170	338	493	920	1688	916	1680	3056	1338	2440	4424	1760	3200	5792	2182	3960	7160	2604	4720	8528
0	32	89.6	82	180	356	499	930	1706	921	1690	3074	1343	2450	4442	1766	3210	5810	2188	3970	7178	2610	4730	8546
0.56	33	91.4	88	190	374	504	940	1724	927	1700	3092	1349	2460	4460	1771	3220	5828	2193	3980	7196	2616	4740	8564
1.11	34	93.2	93	200	392	510	950	1742	932	1710	3110	1354	2470	4478	1777	3230	5846	2199	3990	7214	2621	4750	8582
1.67	35	95.0	99	210	410	516	960	1760	938	1720	3128	1360	2480	4496	1782	3240	5864	2204	4000	7232	2627	4760	8600
2.22	36	96.8	100	212	413	521	970	1778	943	1730	3146	1366	2490	4514	1788	3250	5882	2210	4010	7250	2632	4770	8618
2.78	37	98.6	104	220	428	527	980	1796	949	1740	3164	1371	2500	4532	1793	3260	5900	2216	4020	7268	2638	4780	8636
3.33	38	100.4	110	230	446	532	990	1814	954	1750	3182	1377	2510	4550	1799	3270	5918	2221	4030	7286	2643	4790	8654
3.89	39	102.2	116	240	464	538	1000	1832	960	1760	3200	1382	2520	4568	1804	3280	5936	2227	4040	7304	2649	4800	8672
4.44	40	104.0	121	250	482	543	1010	1850	966	1770	3218	1388	2530	4586	1810	3290	5954	2232	4050	7322	2654	4810	8690
5.00	41	105.8	127	260	500	549	1020	1868	971	1780	3236	1393	2540	4604	1816	3300	5972	2238	4060	7340	2660	4820	8708
5.56	42	107.6	132	270	518	554	1030	1886	977	1790	3254	1399	2550	4622	1821	3310	5990	2243	4070	7358	2666	4830	8726
6.11	43	109.4	138	280	536	560	1040	1904	982	1800	3272	1404	2560	4640	1827	3320	6008	2249	4080	7376	2671	4840	8744
6.67	44	111.2	143	290	554	566	1050	1922	988	1810	3290	1410	2570	4658	1832	3330	6026	2254	4090	7394	2677	4850	8762
7.22	45	113.0	149	300	572	571	1060	1940	993	1820	3308	1416	2580	4676	1838	3340	6044	2260	4100	7412	2682	4860	8780
7.78	46	114.8	154	310	590	577	1070	1958	999	1830	3326	1421	2590	4694	1843	3350	6062	2266	4110	7430	2688	4870	8798
8.33	47	116.6	160	320	608	582	1080	1976	1004	1840	3344	1427	2600	4712	1849	3360	6080	2271	4120	7448	2693	4880	8816
8.89	48	118.4	166	330	626	588	1090	1994	1010	1850	3362	1432	2610	4730	1854	3370	6098	2277	4130	7466	2699	4890	8834
9.44	49	120.2	171	340	644	593	1100	2012	1016	1860	3380	1438	2620	4748	1860	3380	6116	2282	4140	7484	2704	4900	8852
10.0	50	122.0	177	350	662	599	1110	2030	1021	1870	3398	1443	2630	4766	1866	3390	6134	2288	4150	7502	2710	4910	8870
10.6	51	123.8	182	360	680	604	1120	2048	1027	1880	3416	1449	2640	4784	1871	3400	6152	2293	4160	7520	2716	4920	8888
11.1	52	125.6	188	370	698	610	1130	2066	1032	1890	3434	1454	2650	4802	1877	3410	6170	2299	4170	7538	2721	4930	8906
11.7	53	127.4	193	380	716	616	1140	2084	1038	1900	3452	1460	2660	4820	1882	3420	6188	2304	4180	7556	2727	4940	8924
12.2	54	129.2	199	390	734	621	1150	2102	1043	1910	3470	1466	2670	4838	1888	3430	6206	2310	4190	7574	2732	4950	8942
12.8	55	131.0	204	400	752	627	1160	2120	1049	1920	3488	1471	2680	4856	1893	3440	6224	2316	4200	7592	2738	4960	8960
13.3	56	132.8	210	410	770	632	1170	2138	1054	1930	3506	1477	2690	4874	1899	3450	6242	2321	4210	7610	2743	4970	8978
13.9	57	134.6	216	420	788	638	1180	2156	1060	1940	3524	1482	2700	4892	1904	3460	6260	2327	4220	7628	2749	4980	8996
14.4	58	136.4	221	430	806	643	1190	2174	1066	1950	3542	1488	2710	4910	1910	3470	6278	2332	4230	7646	2754	4990	9014
15.0	59	138.2	227	440	824	649	1200	2192	1071	1960	3560	1493	2720	4928	1916	3480	6296	2338	4240	7664	2760	5000	9032
15.6	60	140.0	232	450	842	654	1210	2210	1077	1970	3578	1499	2730	4946	1921	3490	6314	2343	4250	7682			
16.1	61	141.8	238	460	860	660	1220	2228	1082	1980	3596	1504	2740	4964	1927	3500	6332	2349	4260	7700			
16.7	62	143.6	243	470	878	666	1230	2246	1088	1990	3614	1510	2750	4982	1932	3510	6350	2354	4270	7718			
17.2	63	145.4	249	480	896	671	1240	2264	1093	2000	3632	1516	2760	5000	1938	3520	6368	2360	4280	7736			
17.8	64	147.2	254	490	914	677	1250	2282	1099	2010	3650	1521	2770	5018	1943	3530	6386	2365	4290	7754			
18.3	65	149.0	260	500	932	682	1260	2300	1104	2020	3668	1527	2780	5036	1949	3540	6404	2371	4300	7772			
18.9	66	150.8	266	510	950	688	1270	2318	1110	2030	3686	1532	2790	5054	1954	3550	6422	2377	4310	7790			
19.4	67	152.6	271	520	968	693	1280	2336	1116	2040	3704	1538	2800	5072	1960	3560	6440	2382	4320	7808			
20.0	68	154.4	277	530	986	699	1290	2354	1121	2050	3722	1543	2810	5090	1966	3570	6458	2388	4330	7826			
20.6	69	156.2	282	540	1004	704	1300	2372	1127	2060	3740	1549	2820	5108	1971	3580	6476	2393	4340	7844			