

# Service Instructions

CeramPress Q50

DENTSPLY Ceramco  
Yucaipa, CA

## **SAFETY FIRST**

- \* Don't bypass the power cord's ground lead with two-wire extension cords or plug adaptors.
- \* Don't disconnect green and yellow safety-earth ground wire that connects the ground lug of the power receptacle to the chassis ground.
- \* Don't plug in the power cord until directed by the installation instructions.
- \* Don't repair the furnace unless you are a qualified electronics technician and know how to work with hazardous voltages.
- \* Pay attention to the **WARNING** statements. They point out situations that can cause injury.
- \* Pay attention to **CAUTION** statements. They point out situations that can cause equipment damage.

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# SECTION 1

## CIRCUIT DESCRIPTION

### 1.1 INTRODUCTION

The purpose of this section is to familiarize the user or service personnel with the circuit level operation of the CERAMPRESS Q50. This knowledge is necessary to aid in troubleshooting of a unit failure and may also allow the user to gain greater insight into the CERAMPRESS Q50 versatility for particular applications.

The block diagram of the CERAMPRESS Q50 is shown on page 11. The operational description that follows is separated into seven functional blocks:

- \* Transducer Path consisting of the thermocouple, operational amplifier, millivolt source, A/D converter, and overtemperature protection circuit.

- \* Display Communication consisting of the display connector and display board assembly.

- \* Front Panel Control consisting of the power ON/OFF switch, and membrane switch panel.

- \* Muffle Control consisting of the peripheral driver, opto-triac driver, muffle triac, and relays K1, K2.

- \* Vacuum Control consisting of the peripheral driver, solenoids, and relay K3.

- \* Power Supply  
Refer to table 2-3, 2-4, Troubleshooting, for a more detailed look at voltage levels.

- \* Motor Drive Control  
Consisting of the motor drive I.C., 12VDC motor and connector.

### 1.2 DETAILED CIRCUIT DESCRIPTION

#### 1.2.1 Transducer Path

##### 1.2.1.1 General Description

All signal paths are filtered, amplified, and converted to a digital signal. The microprocessor accesses this digital signal at regular time intervals and calculates the respective variables.

##### 1.2.1.2 Thermocouple

The muffle temperature is derived from a Platinel Thermocouple (type "K") which generates an output of up to 50mV. This signal is compared with a maximum allowable temperature signal to produce an error code in case of missing thermocouple outputs.

##### 1.2.1.3 Reference Voltage

A reference voltage path is obtained from a reference diode to obtain a temperature reading of 960°C.

##### 1.2.1.4 Cold Junction Compensation

To reduce the Seebeck effect typically associated with thermocouple connections a compensation IC is connected to the IC amplifier circuit.

##### 1.2.1.5 Vacuum Transducer

The vacuum inside the muffle is sensed by a pressure transducer which outputs a differential voltage.

##### 1.2.1.6 Current Transformer

The muffle AC current is converted to a voltage by a current to voltage transformer. The voltage is then rectified and compared to a reference voltage.

#### 1.2.2 Display Communication

##### 1.2.2.1 General Description

The display board converts serial data to 8-bit parallel data. Each byte transferred is either a command or a data byte depending on the state of the two control bits RS and E (DIS ENA). The LED's are accessed by two control bits strobed and LED ENA (see schematic S004).

##### 1.2.2.2 LCD Display

The LCD module is controlled by the microprocessor via its Serial Peripheral Interface (SPI) port. The display is updated every 0.5 sec or when a corresponding front panel key has been activated.

##### 1.2.2.3 LED Display

The 11 status LED's are controlled by a serial input, latched driver integrated circuit. After the serial data is received, the strobe signal latches this data. The state of the LED's can only be changed by accepting new data.

#### 1.2.3 Front Panel Control

##### 1.2.3.1 General Description

The front panel switches are arranged in an 8x4 matrix. The microprocessor scans the entire matrix every 50 msec by setting one column at a time to a logic 0 and then reading the rows. Once a contact closure has been detected this value is stored. At the next scan the closure is compared with the stored value and if a match has been established the command is carried out. This prevents erroneous data due to contact bounce.

#### 1.2.4 Muffle Control

##### 1.2.4.1 General Description

The microprocessor (U10) sends a serial digital signal to a peripheral driver (U12) which in turn converts and latches it to parallel data. This parallel data is then used to drive several peripheral devices (See S003). U12-13 is connected to an opto isolator (U14). The isolator's output is connected to the gate of the muffle triac. The muffle triac may be activated and deactivated when the AC sine wave passes through 0 volts. U10 accesses U16 0.5 msec before zero crossing to turn the triac off or on.

#### 1.2.5 Vacuum Control

##### 1.2.5.1 General Description

The microprocessor (U10) sends a serial digital signal to an octal peripheral driver (U12) which in turn converts and latches it to parallel data. This parallel data is then used to drive several peripheral devices (See S003). U12-13, and U12-14 are connected to 12V dc normally closed solenoids which in turn control the flow of vacuum. At the command to pull vacuum solenoid 1 is opened to allow passage to the muffle and relay K3 is closed to activate the vacuum pump. Once the desired level of vacuum has been reached solenoid 1 closes and K3 is deactivated. To release the vacuum from the muffle solenoid 2 is opened. U10 determines the time for solenoid 2 to be deactivated again once it can no longer detect a vacuum.

#### 1.2.6 Power Supply

##### 1.2.6.1 General Description

Two DC power supply voltages are generated on the control circuit board; +12V and +5V. These voltages are generated either from 115Vac or 230Vac.

##### 1.2.6.2 +12V Power Supply

Refer to schematic S001. The transformer T1 provides an AC voltage with a ground referenced center tap. This voltage is rectified by diode bridge D1 and filtered by capacitor C3. This provides unregulated positive DC voltage for the switching regulator U1. The capacitor C42 protects against high voltage transients on the AC line that could otherwise couple into the transformer secondary. The output U1-2 is a pulse train with a period T of typically 19.2µsec. The catch diode D3 is a Schottky device which provides a return path for the load current when the output switch is off. Inductor L2 and capacitor C5 filter and stabilize the +12V regulated DC voltage.

##### 1.2.6.3 +5V Power Supply

Refer to schematic, S001 page 16. DC voltage from the output of U1 is used by the +5V linear regulator U2 to generate the +5V. The capacitor C6 provides additional filtering.

#### 1.2.7 Motor Drive Control

##### 1.2.7.1 General Description

The +12VDC motor which moves the muffle vertically is controlled by a 16 pin motor controller/driver I.C. This I.C. provides all necessary functions for a complete closed loop system. A two wire cable connects the motor to the 1 Amp H-(bridge) switch on the I.C. The microprocessor (U10) activates the H-switch through two input pins. If both are low the motor will turn in one direction, if both are high the motor turns in the opposite direction. A third pin sends a signal from the motor controller driver I.C. to the motor when the motor has stalled.

### 2.1 FACTORY REPAIR

DENTSPLY Ceramco maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the CERAMPRESS Q50. If a unit is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to minimize turn-around time. Call factory for RMA number before shipping at 909-795-2461.

### 2.2 BEFORE YOU START

Since no troubleshooting guide can possibly cover all the potential problems, the aim of this guide is to give a methodology which, if applied consistently, will lead to the problem area. Therefore it is necessary to familiarize yourself with the furnace by reviewing the functional description and the detailed circuit description (Section 1) in conjunction with the schematics (Section 2.8). Successful troubleshooting depends upon understanding the circuit operation within each functional block as well as the block relationships.

#### WARNING

With covers removed, dangerous voltage points may be exposed. Contact with any of these points could cause serious injury.

The intent of this section is to provide the information to return the furnace to proper operation. Information is divided into two parts. Part one contains the overall furnace troubleshooting block diagram (figure 2-1) which is useful in isolating defective blocks within the furnace. Part two consists of a series of circuit guides (table 2-1), one for each block shown in figure 2-1, that provides settings and measurements for troubleshooting an individual block. Also, each circuit guide references related schematics and circuit descriptions.

Inspect the components, wiring and circuit boards for damage. Finally, ensure that the fuses are intact and the internal power supplies, +12V, and +5V are good.

#### 2.2.1 Isolating a Problem

To successfully troubleshoot this furnace, the symptoms must first be identified, the faulty block isolated, the block analyzed, and the defective component located and replaced.

To identify the symptoms, use the front panel switches and measurement results from the Test Points. For example if the motor is not responding to the key switch command, are any other peripheral controls defective or not responding?

Once the symptom is identified use figure 2-1 to isolate the circuit block. After the block is isolated, refer to the appropriate functional circuit guide (table 2-1).

The circuit guide provides some but not necessarily all of the possible failure modes for a particular circuit. Where applicable, a furnace setup procedure is given to help isolate the problem for a particular failure mode. Section 2.4 gives component troubleshooting information.

#### 2.2.2 Understanding the error codes

The microprocessor constantly checks for proper circuit operation. If it detects a faulty signal an error code will be displayed on the display. In some cases, a program cycle will be aborted and the muffle travels to its up position. All peripherals will be disabled. In order to troubleshoot, the furnace must be turned off, then on again.

#### 2.2.3 Troubleshooting digital circuits

Most of the digital circuits in this furnace are dynamic. Even with no change made to the front panel keys, internal circuits are running and lines are changing states. This makes troubleshooting difficult without the use of powerful tools.

There is, however, a technique using an oscilloscope which will usually helps isolate an abnormal signal. The basis for this technique is looking for stuck bits. A normal digital signal will switch between a logical "1" (high) and a logical "0" (low). A stuck bit may not switch at all. It may always be high, always low, or always between logic levels in an undefined state. A stuck bit may also switch between high or low levels and an undefined state.

### 2.3 TROUBLESHOOTING GUIDES

Refer to table 2-1 for functional circuit guide information

#### 2.3.1 Power Supply

To determine a faulty power supply use table 2-3. To troubleshoot a faulty power supply use the procedures listed in table 2-4.

If the desired results are obtained in each of the steps in table 2-4, replace D3, U1 or U2 as appropriate.

#### 2.3.2 Microprocessor

Generally, when the furnace is totally nonfunctional, i.e., display is unintelligible, no display, random relay clicking or, no key response, the problem is in the microprocessor section. However, before troubleshooting this section, check the appropriate dedicated circuits for correct operation. Detailed reading of the circuit description is also very helpful before attempting to find and correct a problem.

Use table 2-5 to troubleshoot the microprocessor.

### 2.3.3 Peripheral Drive

The peripheral driver U12 is accessed at every line voltage zero crossing (TP5=0) by the microprocessor (U10-2). The logic state of the eight output drivers, Y0 -Y7, is latched into the shift register at time t0 on the high to low transition of SIOE. Input data present at the SI input is clocked into the shift register on the high to low transition of SCLK.

Use table 2-6 to troubleshoot the peripheral driver.

### 2.3.4 Motor Drive

The motor driver U13 is accessed by the microprocessor to lift or lower the muffle. Two LED's are connected across the internal power H-switch to indicate its state. When both LED's are either on or off the motor is deactivated. If one of the LED's is on the motor is activated. U13-15 provides a feedback to the microprocessor to indicate an overcurrent condition which is set at approximately 450mA by resistor R27.

Use table 2-7 to troubleshoot the motor driver.

### 2.3.5 Analog Circuitry

The reference voltages used to control temperature and compare voltage signals are derived from the output of U2-2 (+5V). See section 2.4 for troubleshooting individual components.

Use table 2-8 to troubleshoot the analog circuitry.

### 2.3.6 Display Board

Serial data present on the input of U1-2 and U2-2 is transferred to the shift register on the logic "0" to logic "1" transition of the Clock input pulse. Information present at any register of U2 is transferred to its respective latch when the Strobe is high (U2-4). A serial to parallel conversion takes place. As long as the Strobe is held high ("1") the latches will accept new data.

The LCD display module will accept valid data on D0 - D7 when the Enable (J1-6) goes from a high to low transition. Use table 2-9 to troubleshoot the display circuit board.

## 2.4 TROUBLESHOOTING COMPONENTS

### 2.4.1 Diode

A diode (except a zener) is defective if there is greater than 1 Vdc (typically 0.7 Vdc) forward voltage across it.

### 2.4.2 Operational Amplifier

Generally the "+" and "-" inputs of an operational amplifier will have less than 15 mV voltage difference when operating under normal conditions. (U3, U4:B, U15:B). When the output of the amplifier is connected to the "-" input (voltage follower connection), the output should be the same voltage as the "+" input voltage; otherwise, the amplifier is defective (U17:A).

If the output voltage stays at maximum positive (typically 1/3 of the supply voltage), the "+" input voltage should be more positive than the "-" input voltage (U17:B, U18:A, U4:A). If the output voltage stays at minimum (typically 1-5 mV), the "-" input voltage should be more positive than the "+" input voltage (U15:A).

### 2.4.3 Triac

The gate to power line return voltage (K1) under load measures typically 1-2 Vac, while the MT2 to return voltage measures between 1.3-1.8 Vac.

A triac without connections can be checked for a go-nogo condition with an ohmmeter. The gate to MT1 resistance for a power triac (20-40A) should be between 50 and 100 ohms; there should be infinite resistance between MT1 and MT2.

### 2.4.4 Capacitor

Shorted capacitors have 0V across their terminals.

Open capacitors can be located by using a good capacitor connected in parallel with the capacitor under test and observing the resulting effect.

Leaking capacitors will often have a decreased voltage across their terminals.

### 2.4.5 Logic levels

Microprocessor:	High	+3.5	-	+5.0V
	Low	0.0	-	+1.0V
74LSXXX:	High	+2.0	-	+5.0V
	Low	0.0	-	+0.5V
4XXX:	High	+3.5	-	+5.0V
	Low	0.0	-	+1.5V

#### 2.4.6 Motor

If Err 15 occurs frequently it is an indication that the motor might be running too slow. This can occur as the brushes become worn. Refer to section 2.3.4 to determine whether both of the motor LED's are on or off when this message occurs.

Objects placed on top of the cabinet can cause the motor to work harder thus producing this error message. Remove any objects placed on the top enclosure.

Err 15 can also occur if the valves release slowly. Run a cycle without vacuum to determine if the error still occurs. If so, check for obstructions in one of the tubing lines.

#### 2.4.7 Valves

It is important to note that vacuum leaks may not always be an indication of a bad valve. Before replacing a valve, isolate both sides of the valve to verify that the leak is indeed in the valve and not in the chamber or the vacuum transducer.

Indications of a leaky valve can be Err 4 or Err 5.

It may be possible to clean contaminants from the valve by blowing high pressure (>50psi) air through all the ports.

When replacing a plastic fitting, care must be taken not to cross thread. Torque fittings to at least 25 in-lbs (3.0 N-m).

#### 2.4.8 Chamber Leaks

If it was determined in Section 2.4.7 or Section 5.4.5 that there is a chamber leak, then the following procedure should be performed:

- a. A likely source for a vacuum leak in the chamber is due to an obstruction at the door O-ring seal. With a clean rag, wipe away any material around the O-ring.
- b. Next, check that there are no obstructions which prevent the chamber from closing all the way. Press the "up" then "down" keys. If the chamber does not close entirely, remove the door insulation and try again as the door insulation may have moved out of position.

- c. If the unit still does not pull vacuum, press down on the top cover while in a "VAC" cycle after the pump turns on. If vacuum still does not pull, the leak is elsewhere in the chamber.

- d. Check the vacuum hose connections, thermocouple seal, muffle termination connections and the view window seal. Check the tightness of the muffle termination connections as these can take a "set" after extended time at high temperatures. Tighten to 12-15 in-lbs (1.5 N-m).



## 2.5 ERROR CODES

### Err 1 Muffle Over Temperature

The controller monitored a temperature above 1220°C. This could mean a faulty thermocouple (mV reading too high) or an erratic thermocouple performance (the temperature readout is not stable at elevated temperatures).

### Err 2 Open TC Detected

To check for open TC, turn power to furnace off and short TC input terminals. Turn power back on. If ERR 2 disappears, then replace TC. Other possible causes:

\* U7-6 = .7V, check D6  
Change PCB if problem persists.

### Err 3 Tmax Over Temp

The controller monitored a temperature above Tmax + 20°C. This could mean:

\* The Tmax was set up too low for this program.  
\* The destination temperature is relatively low compared to the programmed heat rate, eg. too much temperature overshoot.

### Err 4 No VACUUM

After the start of a vacuum pump request the controller checks for a vacuum level of at least 40 mm before the Vac Strt LED is turned off. The absence of this reading during a specified time will generate an audible warning signal before Err 4 appears on the display. Check all vacuum hose connections, and operation of the vacuum pump (plug into outlet to check). Otherwise check:

\* U7-1 : .5V at medium vacuum level  
\* Check U6

### Err 5 Low VAC

The controller uses the Setup Vac Cal constant to calculate the programmed vacuum level. It tries to reach this level and will stop pumping when no more increase in vacuum can be detected. If this level cannot be reached the processor checks to see if the vacuum level is at least within 100 mm of the requested value.

\* VAC calibration set to high (Setup)  
(For each 500m elevation subtract 30mm from 740mm) or run program 102.  
\* Pump lost its performance  
\* Hose connections, Fittings  
Check for kinked hoses, loose muffle terminals  
\* See Err4

### Err 6 Open muffle (Low or no AC current)

This error code will be displayed at power up and if the muffle wire should open during idle mode, the display will eventually show ERR 6 at a low temperature. Turn the furnace off, then on again to verify this diagnostic. Otherwise check:

\* Power relays click on at power up  
\* Line Voltage within specifications  
\* Muffle resistance present  
\* Continuous wiring  
\* MT2 to MT1: < 2Vac (on muffle triac)

To operate the motor under an Err6 condition use muffle movement key.

### Err 7 Low Line Voltage

When the line voltage drops below the required operating level for the microprocessor and its peripherals, the processor receives a signal from U3-7 and terminates its normal operation. This error is most likely displayed after power outages or the power line is downloaded by other high power equipment.

\* Turn the furnace off, then on again  
\* Check "AC+" or "AC-" at power up.

### Err 8 EEPROM read/write error

Program parameters entered during the idle mode are transferred and stored in a 16K-bit Electrically Erasable Programmable Read Only Memory (EEPROM) device. The serial data on U11-5 is monitored and any abnormal behavior from the devices' specs is answered with an error code.

\* Replace device

If Err8 occurs at power up, the program number might be scrambled. Reprogram EEPROM. Turn furnace off. Hold down °C/°F key and power up.

**Err 9** TC input short/reversed. The control monitors the increase in temperature if less than 64°C. If no increase in muffle temperature is detected during a 60 second period, the power relays open and the Err9 code is displayed.

- \* Check for correct TC polarity on circuit board
- \* Check for shorts on top of Thermocouple

**Err 15** Motor jam  
This error code is called whenever the muffle is requested to go to its open position and exceeds 12 seconds of travel after pressing start.

- \* Mechanical obstruction
- \* At up position DS1, DS2 on
- \* Check +12 V.

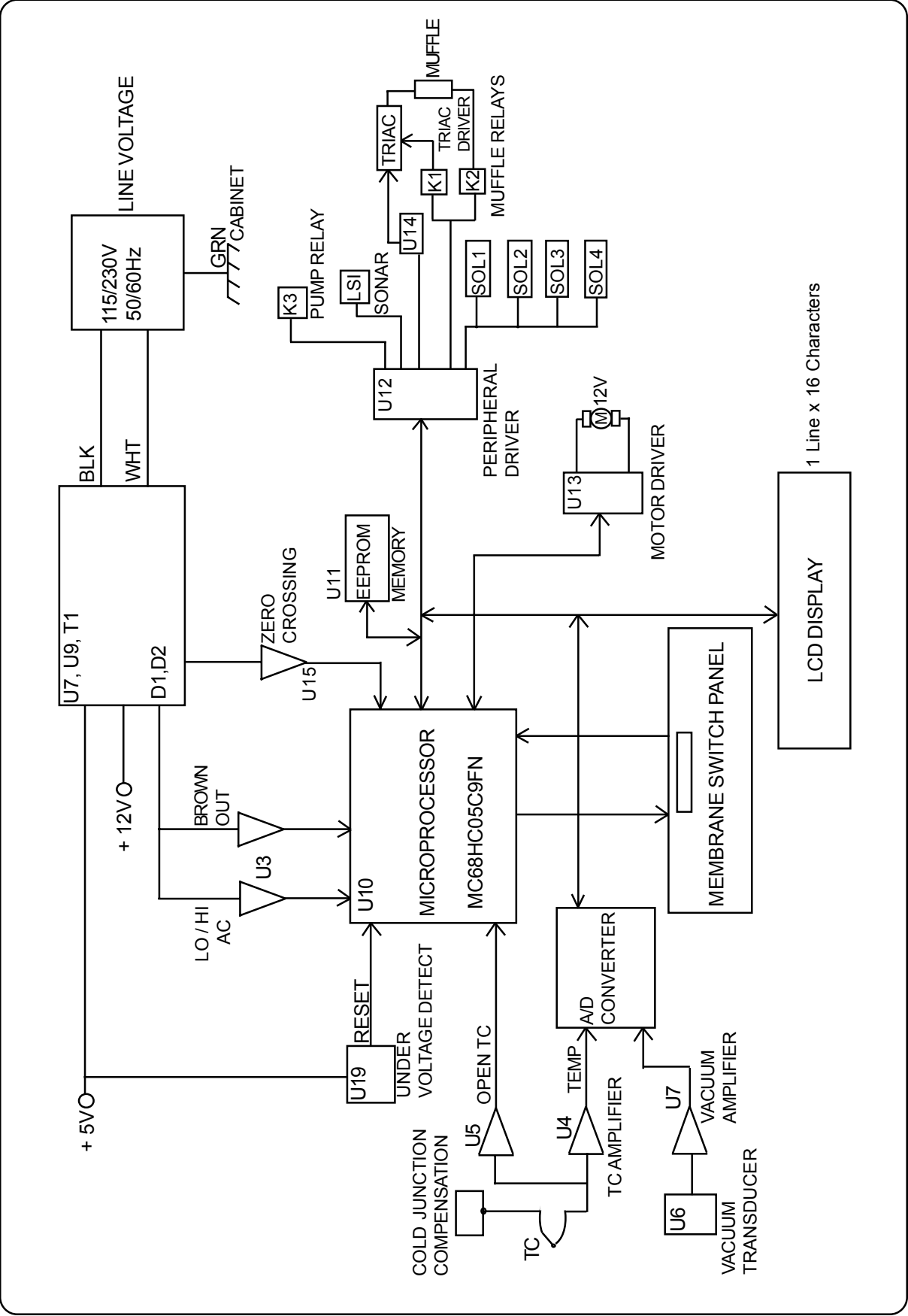
**Err 18** Triac driver input short

- \* Check U14-1,2 diode
- U14-2 shorted to ground?

**Err 19** No line frequency detected

- \* Check TP5, 100 or 120 Hz pulse train
- \* Remove Power
- D4-5 diode check
- U15-2 = .7V, check D6
- Check F2.

2.6 BLOCK DIAGRAM



## 2.7 DIAGNOSTIC TABLES

Table 2-1 Functional Circuit guides

Circuit guide	Paragraph	Troubleshooting Tables	Schematic Diagrams
Power Supply	1.2.6, 2.3.1	2-3, 2-4	S001
Temperature	1.2.1, 2.3.5	2-8	S002
Microprocessor	1.2.2, 2.3.2	2-5	S003
Motor Drive Circuit	1.2.7, 2.3.4, 2.4.6	2-7	S003
Display	1.2.2	2-9	S004

Table 2-2 Furnace Setup Common Errors

Symptom	Possible Setup Error
Display blank	No line voltage Power switch failure J3 disconnected
No or little Vacuum	Check door insulation fit Rotate door 90 degrees Pump electrical connections if used Air hose connections Venturi pump connection
Muffle does not heat after power up	One of the membrane keys made contact during power up. Turn furnace off then on again. Power up with muffle temperature less than 64°C
No muffle movement after key is pressed	Possible Vacuum inside chamber Furnace is in TEST mode Motor connector J5 loose Furnace is running a firing cycle. Press Stop (red S) key and retry.

Table 2-3 Power Supply Voltages

Output Voltage	Voltage Tolerance	Output Ripple	Test At	Input Ripple	Test At
+12V	+/-350mV	0.02Vac	U2-1	3Vac	D1-1
+ 5V	+/-250mV	0.02Vac	U2-2	3Vac	U2-1

Table 2-4 Power Supply

Fault	Setup	Check	Results desired
No dc output and no dc to U1-1 (15-30V)	Power off	F1 T1 winding D1,2 C3	< 1 ohm Not shorted or open Not shorted or open Not shorted
Low or no +12V dc output	Power off  Disconnect J3 turn Power on	D3  C5 U1-2 U2	Not shorted or open  Not shorted Pulse train of 50kHz No excessive heat

Table 2-5 Microprocessor

Fault	Setup	Check	Results desired
Nonfunctional operation	N/A	U10-39 X1	4MHz, sinusoid approximately 0-4V
		U10-1,3,34,40 U10-2 U10-16thru28 U10-12thru15 U10-4thru11 U10-29,30 U10-31,32,33	>4.5V TP1 waveform digital low No stuck bits No stuck bits digital high No stuck bits
	Disconnect J3	Listen	Relay clicks, Sonar
Non-responsive to membrane switches	Disconnect J2	+5V to U10-16 U10-17 U10-18 U10-19 U10-21thru28	Sonar beeps low strobe

Table 2-6 Peripheral Drive Circuit

Fault	Setup	Check	Results desired
All Y outputs high	N/A	U12-11 U12-5,7,6	No stuck bits
	Turn furnace Off then On	Display	No Error codes Display OK
	Turn furnace Off	D12,13	Not shorted or open
U12-11 (Reset) low	N/A	U3-7	digital low

Table 2-7 Motor Drive Circuit

Fault	Setup	Check	Results desired
No up or down	Furnace in idle Disconnect J5 Turn furnace on Press Up arrow Press Down arrow Turn furnace off Turn furnace on	U13-11 DS1,2  DS1 DS2 D16,17 U13-15	+12 V DS1,2 On  DS1 off, DS2 on DS2 off, DS1 on Not shorted or open digital high
		Membrane keys	Other keys respond
At up or down position one LED stays off	Add mA meter in series at J5	Stall current	> 550 mA at up or down
	N/A	U13-15	High to low at up or down

Table 2-8 Analog Circuitry

Fault	Setup	Check	Results desired
Muffle heats but display shows same temperature	N/A	TC red, yellow U4-2	correct connection Same mV (1-40) as IC red
		U4-6	D-1200°C = 0 - 1 Vdc
Erratic temperature display	N/A	TP2	1.23V stable
		U8	replace

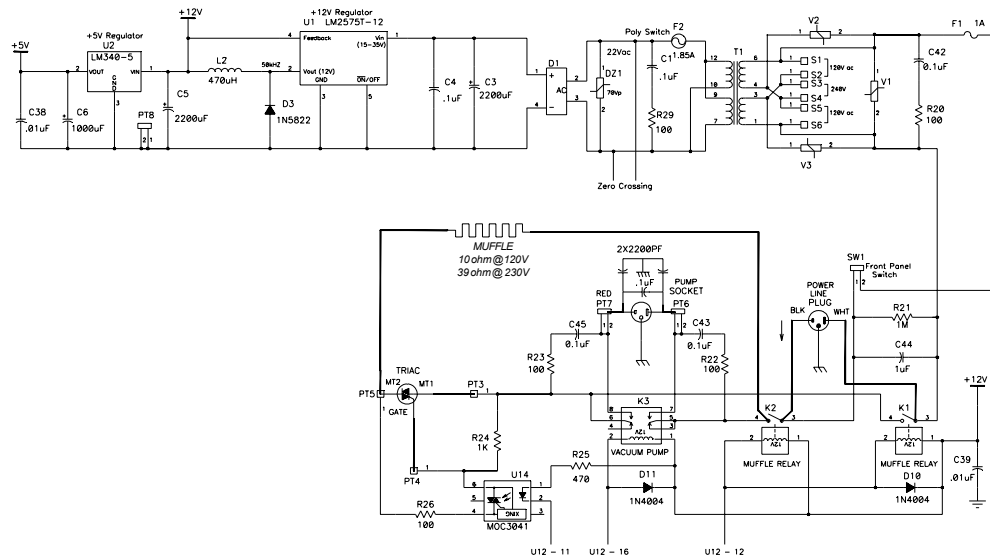
Table 2-8 Analog Circuitry (continued)

Fault	Setup	Check	Results desired
Temperature drift	Hi T = 960°C	TP1	mV dc stable
		U5-7	mV stable (.2mV/°C ambient increase typical)
Vacuum readout too high or too low	Furnace in idle	U7-1 U6-2,4	1-3 mV Same Voltage (2.5V)
	VAC calibration	Display	Adjust to gage level
	VAC cycle (101%) level reading	Display	Obtain previous gage reading.

Table 2-9 Display Board

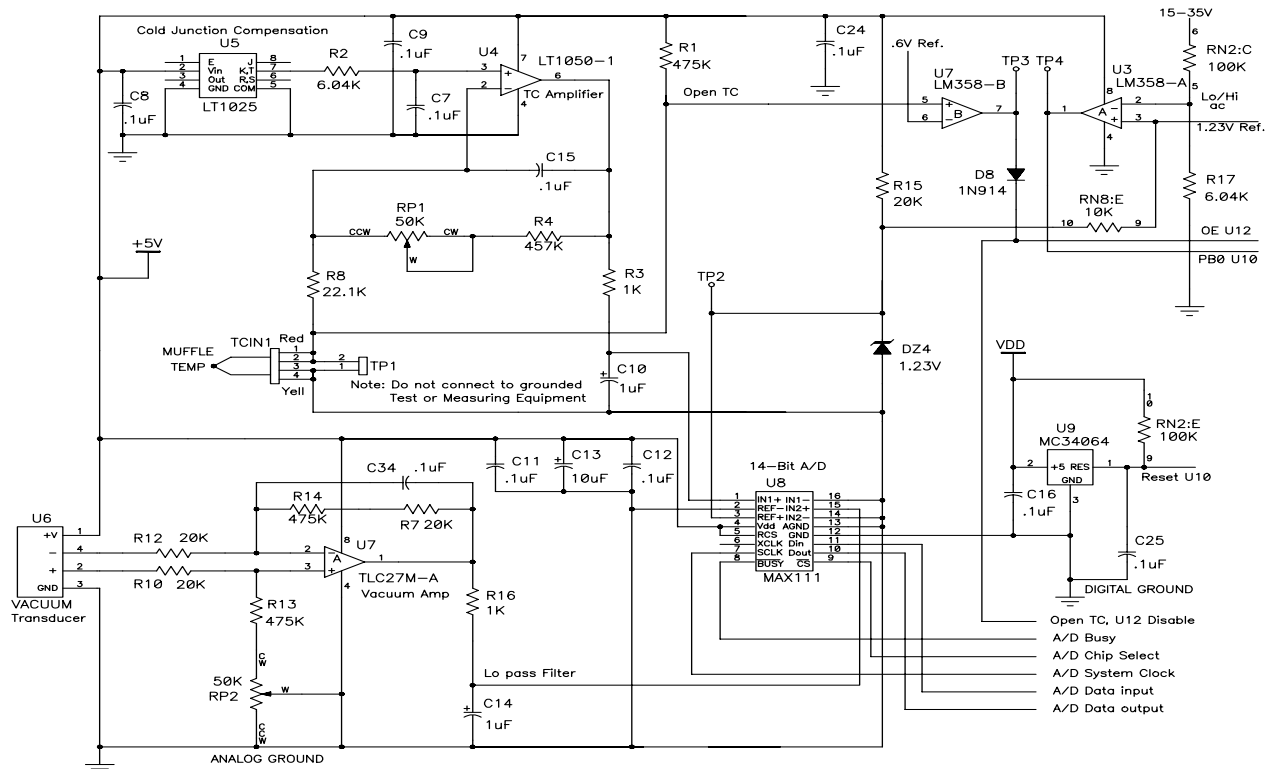
Fault	Setup	Check	Results desired
LCD dots are all on or off at power up	Furnace in idle	J2-8	See Table 2-3
		U10	See Table 2-5
		J3	Tight fit
		U2-8,2	No stuck bits
LCD display dim	N/A	Life of Display	Backlight dims with age
LCD display dark	Turn furnace off	Temperature on panel	Less than 40°C
	Turn furnace on	Temperature on panel	LCD lighter shade

## 2.8 SCHEMATICS



POWER SUPPLY AND RELAY CONTROL

S001

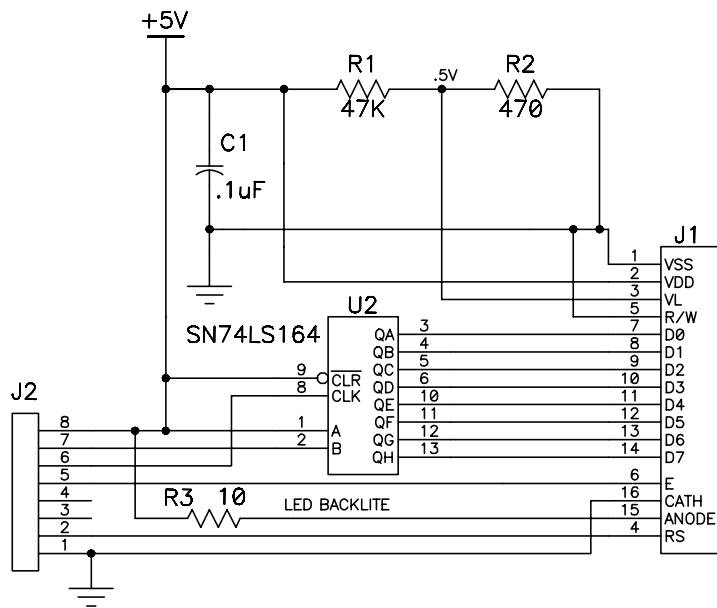


TEMPERATURE AND VACUUM

S002



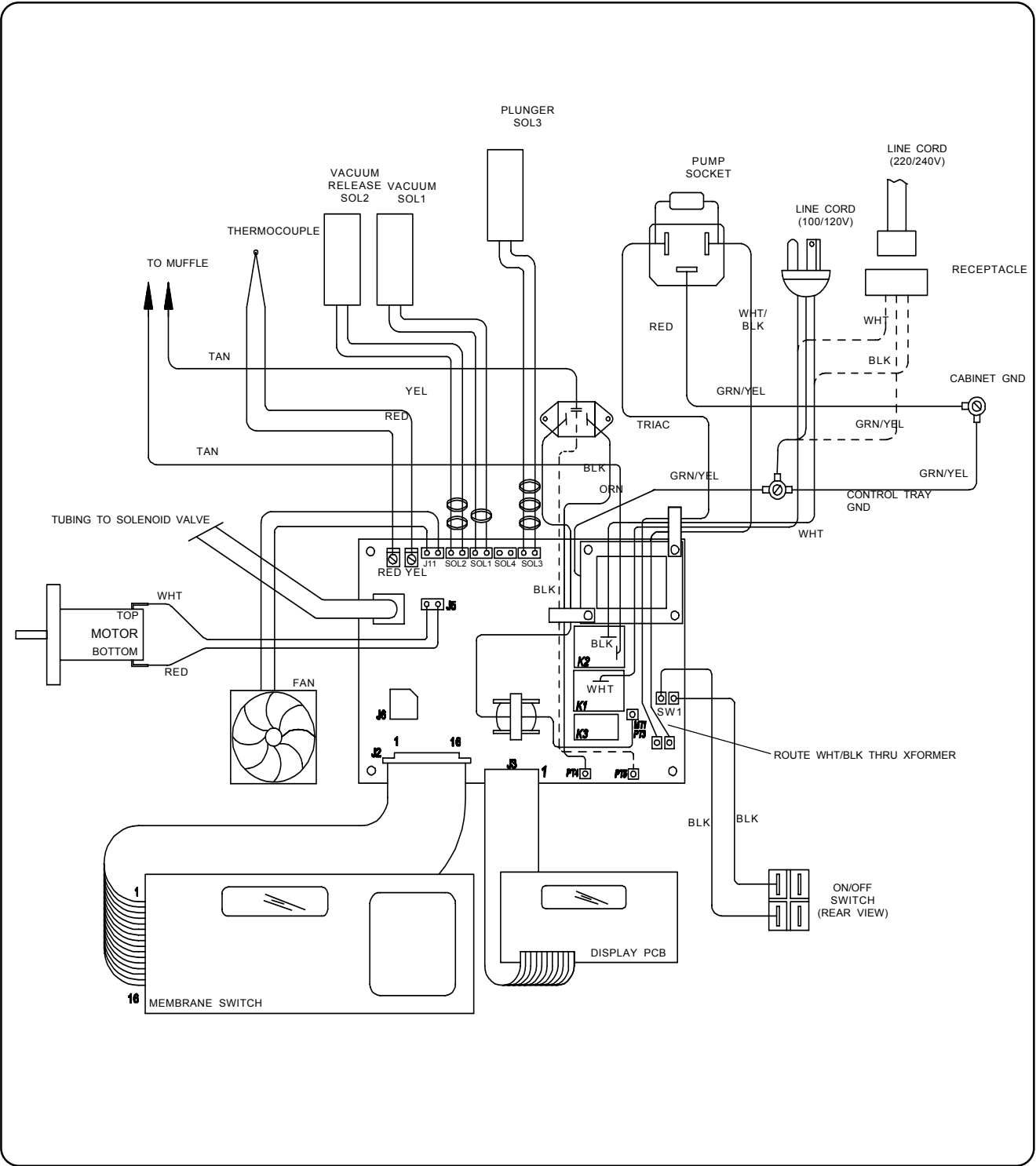




DISPLAY BOARD

S004

2.9 WIRING DIAGRAM



## ADJUSTMENTS/CALIBRATION

### 3.1 SCOPE

This section gives the procedures to be used for the calibration and specification verification of the furnace. The furnace specifications itself are given in the Owner & Operator's Manual.

### 3.2 FACTORY REPAIR

DENTSPLY Ceramco maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the CERAMPRESS Q50. If a unit is returned to the factory for calibration or repair, a detailed description of the specific problem should be included to minimize turnaround time. Call factory for RMA number before shipping at 909-795-2461.

### 3.3 ADJUSTMENT/CALIBRATION

#### 3.3.1 Temperature

To calibrate the furnace (or to verify its calibration) by means of the silver coupon method refer to the owners manual. However, in most cases the temperature error at or near 960°C is known and this error can now be corrected by using the Tcal Setup feature. Simply ask yourself: What is the real muffle temperature when the display shows 960°C? Subtract this value from 960°C and add the difference to the Tcal setting. The following example should clarify this procedure further:

It is determined that a certain porcelain overfires for a given program cycle. But, since many other program cycles have similar Hi Temp values it is desired to lower the calibration rather than to reprogram every Hi Temp. It is now estimated that a lowering of the Hi Temp by 5°C would eliminate the overfiring, thus, the muffle temperature at a display reading of 960°C is actually 965°C. The new setup temperature Tcal is now found by the following calculation:

$$Tcal = Tcal + (960^{\circ}C - 965^{\circ}C)$$

or in this case:

$$Tcal = Tcal - 5^{\circ}C$$

If the Tcal is still at its factory setting of 960°C reprogram it to 955°C. If it has been modified previously, let's say to 950°C reprogram it to 945°C. If the porcelain underfires simply add the result obtained from the equation to the setup Tcal. The limits for Tcal are 860°C to 1060°C.

#### 3.3.2 Vacuum

Since the atmospheric pressure varies from sea level to higher elevations, it is necessary to adjust the Vcal setup for a particular geographic location. The factory setting is done for this location and determined to correspond to 710mm Hg (This takes into consideration a strong vacuum pump). For higher elevations the following adjustments for Vcal should be made:

For each 300m of additional elevation subtract 20mm from 760mm. Add 20mm to the factory setting for a sea level location. Or to determine exact capability of furnace with pump and altitude, run prog 88.

Should a value be known which a particular vacuum pump is able to obtain at this location, enter this value for Vcal. For example, a firing cycle with a VAC setting of 101% showed a maximum vacuum of 680mm on the display. Enter the setup mode (Owner's Manual) and program the new Vcal value. This new Vcal value represents the maximum value (100%) the vacuum pump is able to obtain at this location. If the VAC level should be changed to 50% the pump would stop at a display reading of 340mm.

### 3.4 CIRCUIT BOARD CALIBRATION

Calibration of the circuit board is performed in two steps: Software and hardware.

#### 3.4.1 Required Test Equipment

- 4 1/2 digit millivoltmeter
- Temperature calibrator; Type K
- Pot adjustment tool
- Vacuum gage (0 - 760mm)

#### **WARNING**

With covers removed, dangerous voltage points may be exposed. Contact with any of these points could cause serious injury.

#### **CAUTION**

Observe antistatic procedures when touching circuit board components.

#### 3.4.2 Temperature

Enter the setup mode (Owner's Manual page 9) and enter 1150°C for Tcal. Disconnect the muffle thermocouple from the control circuit board and connect the temperature calibrator on its place. Set the output of the calibrator to 1150°C. Adjust RP1 to read 1150°C on the furnace display. Instead of a calibrator, a low output impedance mV source set to 47.0 mV can be used.

A  $\pm 5^\circ\text{C}$  calibration can be obtained without the temperature calibrator by performing the following sequence: Leave the control thermocouple connected and adjust RP1 to read 39.7mV at TP3.

#### 3.4.3 Vacuum

#### **CAUTION**

Before a vacuum calibration is made let the furnace operate for several hours to ensure a dry muffle.

Disconnect the Vacuum hose from the transducer (U6 on the control circuit board) and connect its end to a standard reference vacuum gage. Reconnect the other end from the gage to the vacuum transducer. Run a vacuum cycle (Pump or air flow stays on). Compare the reading of the gage with the reading of the furnace display and adjust RP2 until both readings are the same. (Note: if a reference gage is not available, use best estimate).

Vacuum Calibration using Software: Program 74 will automatically place the control into a 101% Vac cycle. At Enter, the muffle closes and the vacuum is pulled until the control cannot detect anymore Vac increase.

At this time, the display prompts: Vcal=\_\_\_\_. The operator can now key in a new value taken from a second reference gage or their best estimate. At Enter, the cycle is aborted.

It is recommended to run program 88 to automatically adjust the setup V% for the local altitude. Press program number - enter. (see 3.3.2).

### 3.5 CONVERSIONS

#### 3.5.1 Temperature

$$^{\circ}\text{C} = \frac{(^{\circ}\text{F} - 32^{\circ}\text{F})}{1.8}$$

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32^{\circ}\text{F}$$
$$^{\circ}\text{F/min} = (1.8 \times ^{\circ}\text{C})$$

#### 3.5.2 Vacuum

$$1 \text{ in (inch)} = 25.4\text{mm}$$

#### 3.5.3 Pressure

$$\text{PSI} = \text{kPa} \times .14504$$

$$\text{PSI} = \text{Atmospheres} \times 14.696$$

$$\text{PSI} = \text{kg/m}^2 \times 0.0014223$$

$$\text{PSI} = \text{Kg/cm}^2 \times 14.223$$

## SECTION 4

### SERVICE PARTS

#### 4.1 ORDERING INSTRUCTIONS

To order parts, select the part number required from the exploded view drawings in section 4.2 through section 4.6. When ordering parts please have the following information available:

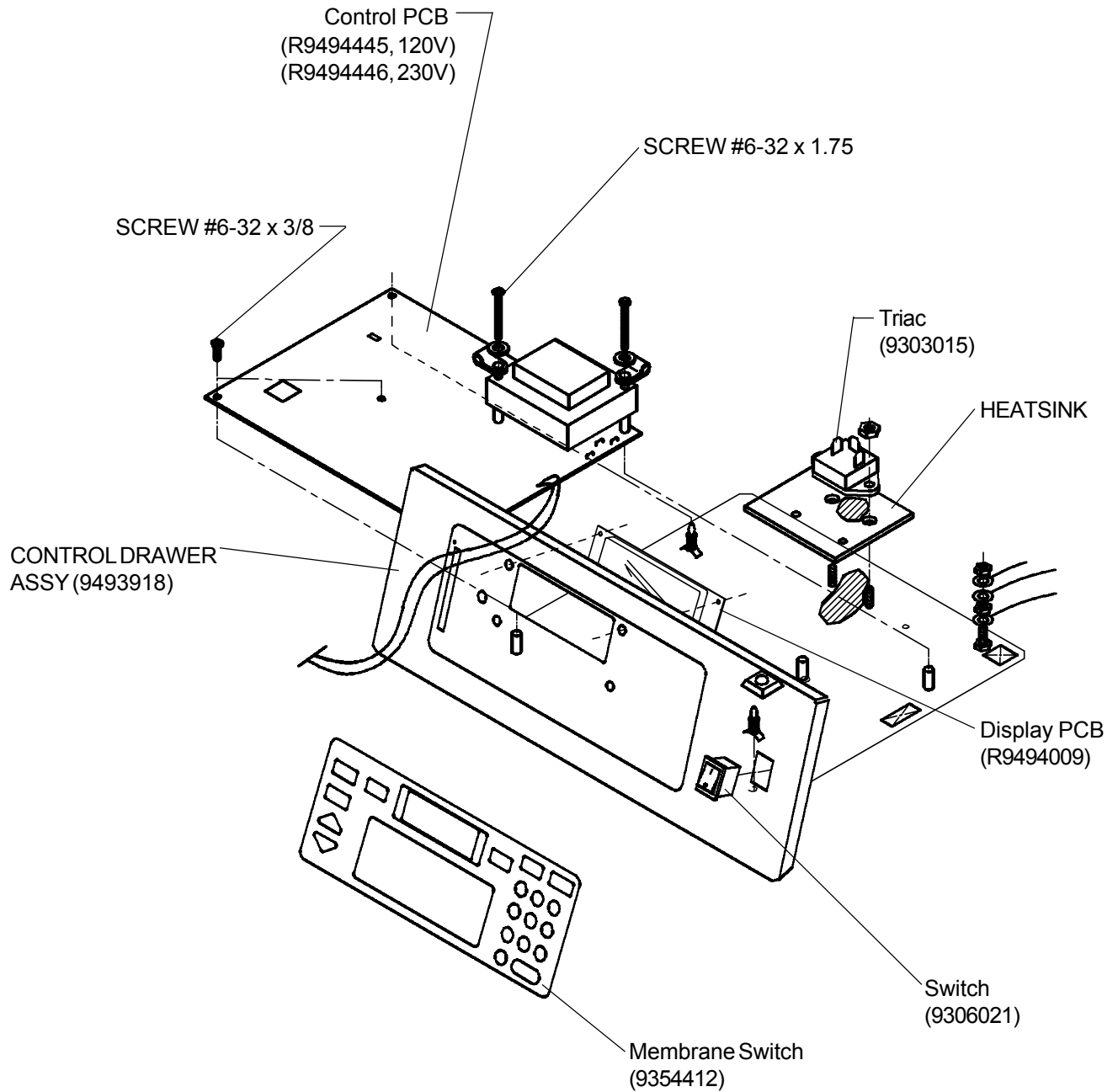
This information is needed to determine if the product is under warranty and to help us in tracking failures so that corrective action can be taken to prevent future problems.

1. Serial Number of Furnace
2. Date Purchased
3. Where Purchased
4. Symptom of Failure
5. Part Number of replacement part
6. Preferred Method of Shipment

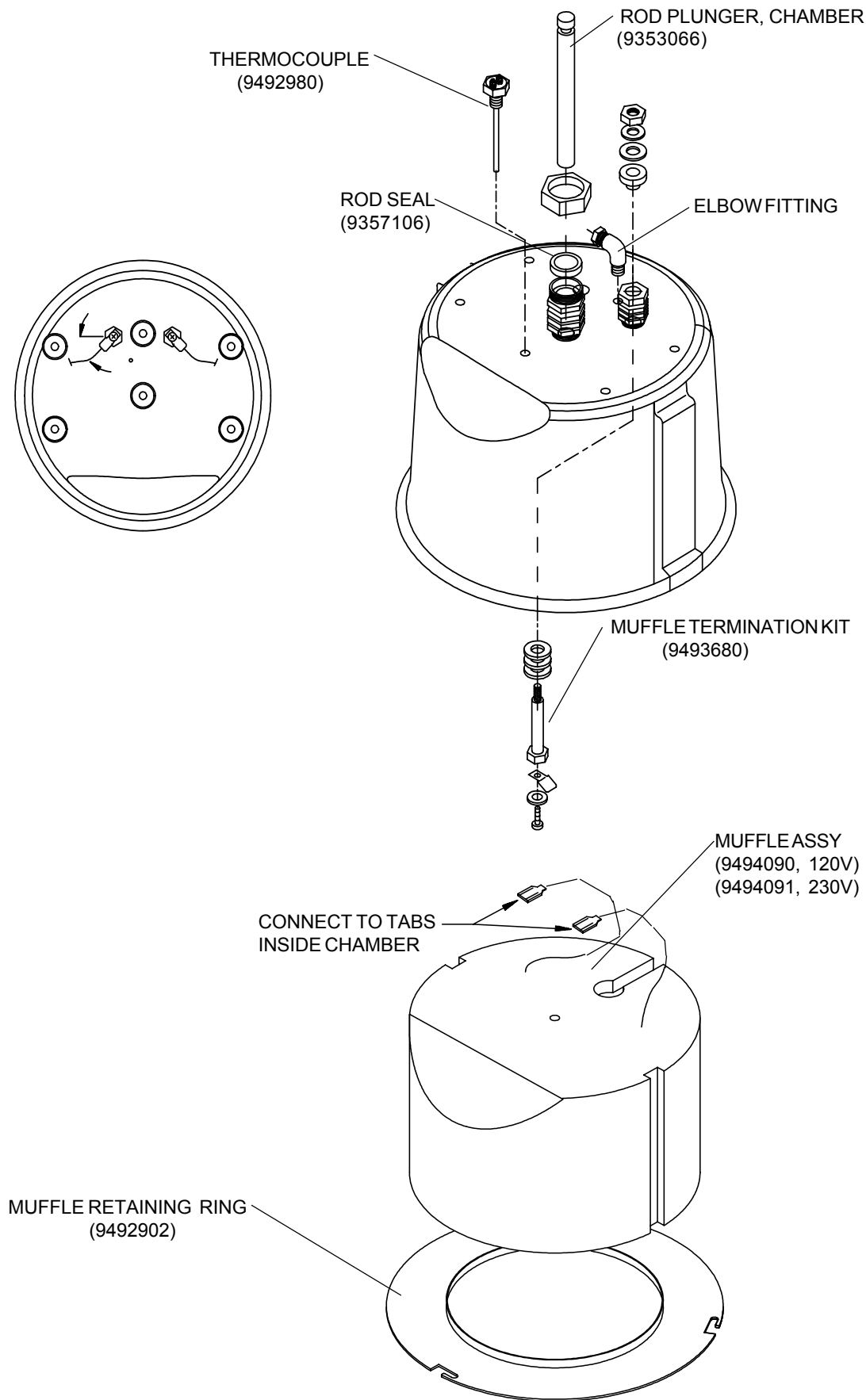
#### Miscellaneous Parts/ Accessories:

Ring Plunger Kit	9493630
Tongs, CCF	9493633
Tray, Plunger Preheat (Empress)	9493634
Tray, Plunger (Cerampress)	9493678
Log Cards, Pk of 5	9492975
Filter / Regulator Kit	9493998
Hose Set (vac & press hoses etc.)	9493635

## 4.2 CONTROL DRAWER PARTS

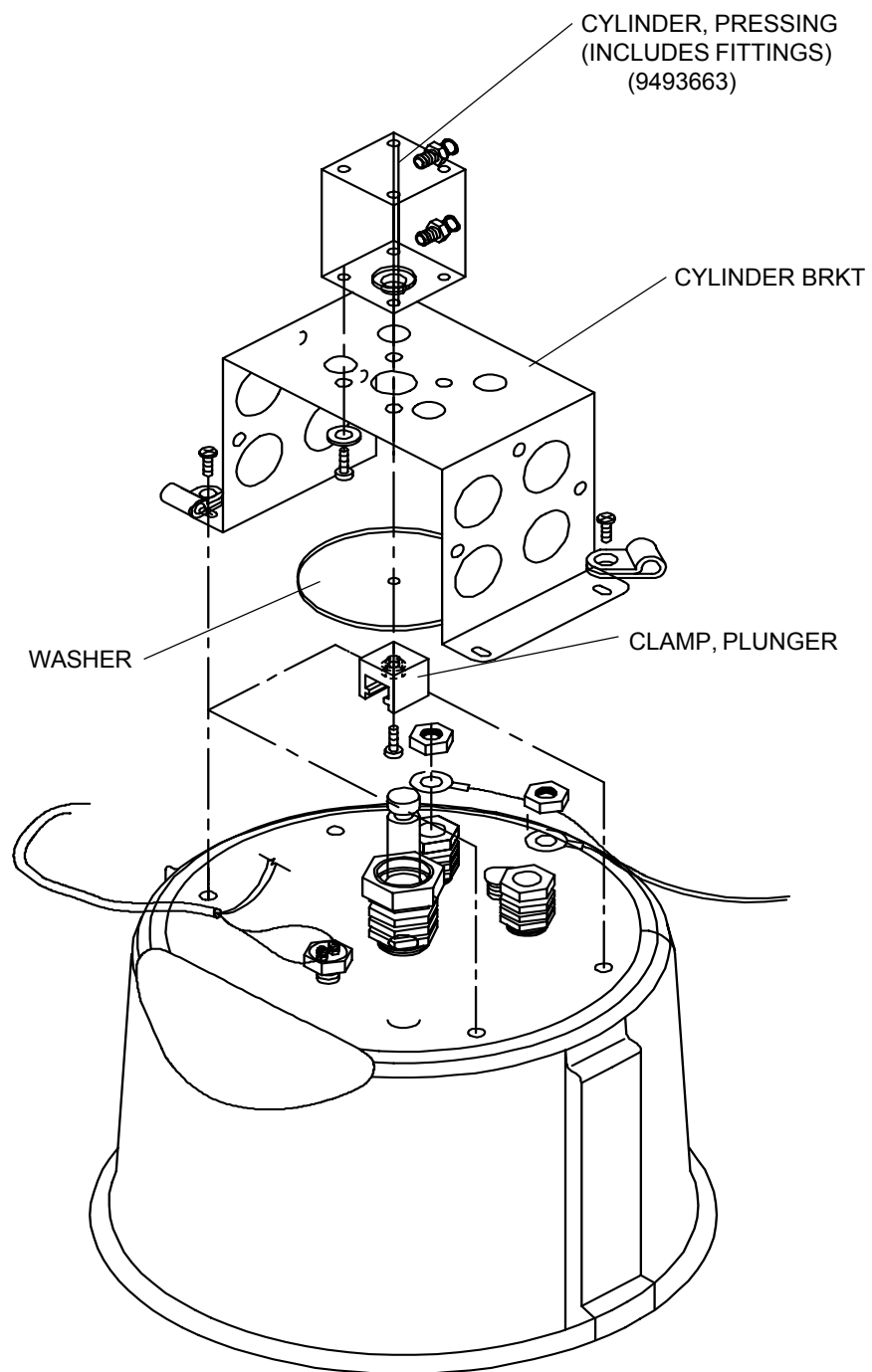


4.3 MUFFLE & VACUUM CHAMBER PARTS

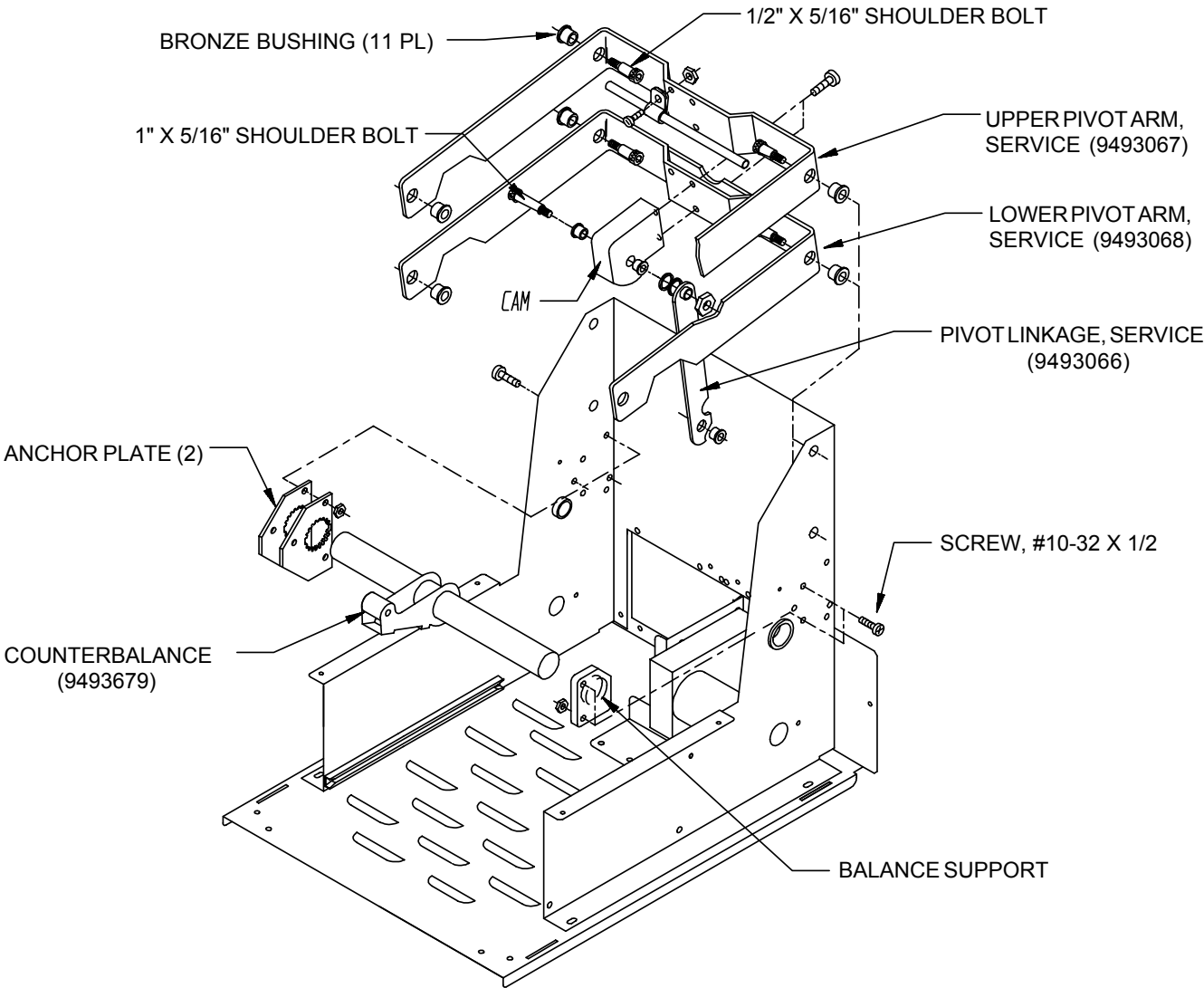




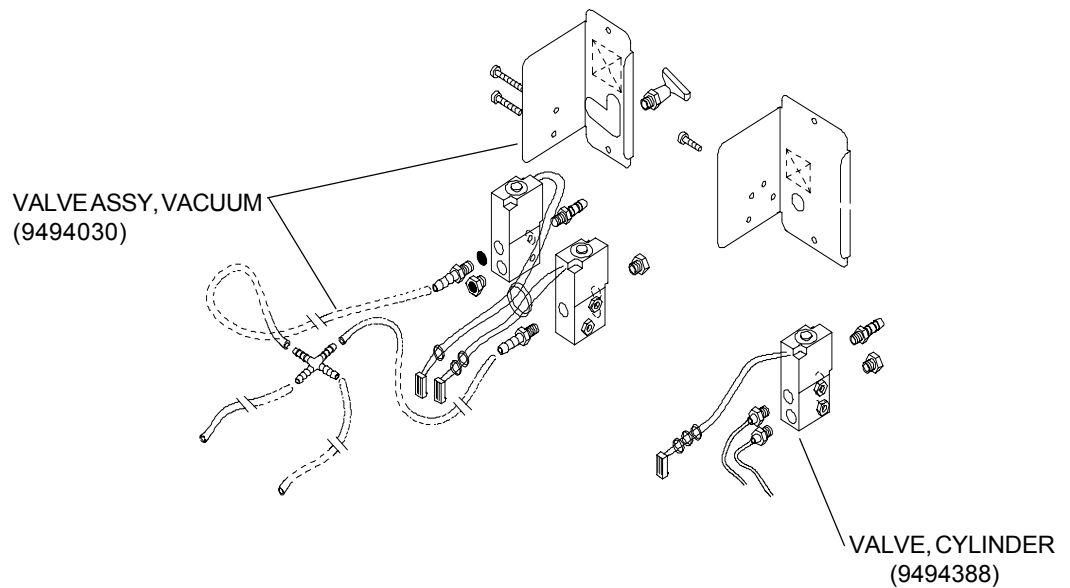
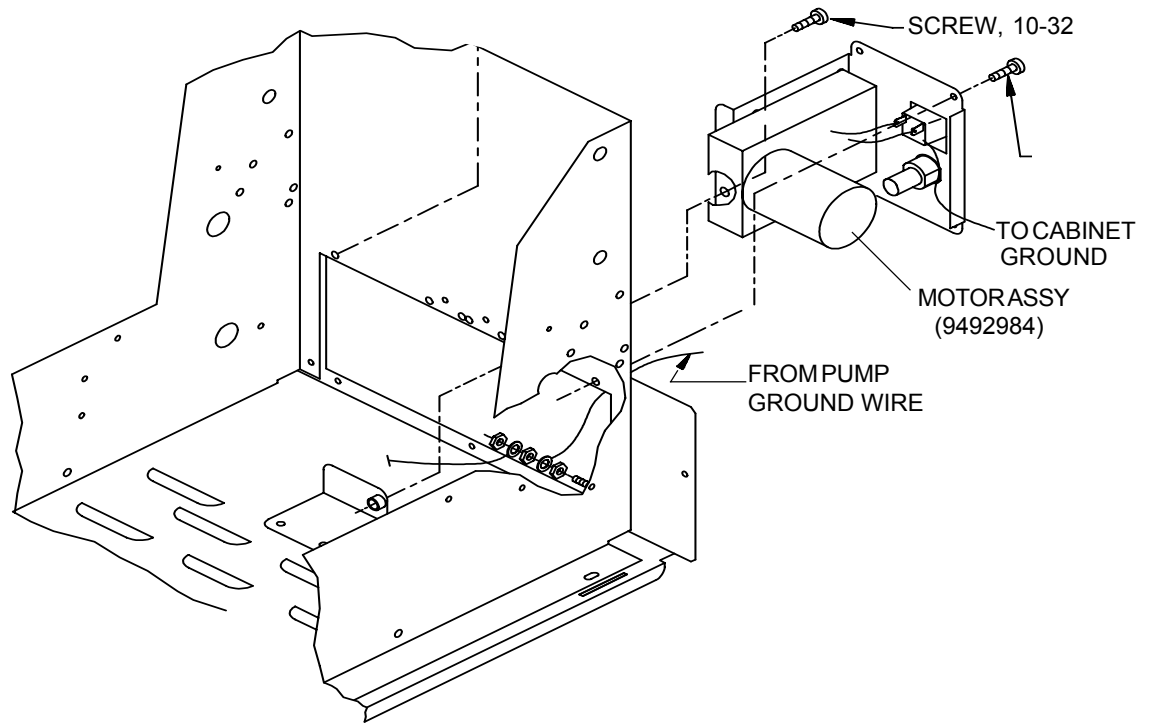
#### 4.4 PRESSING UNIT PARTS



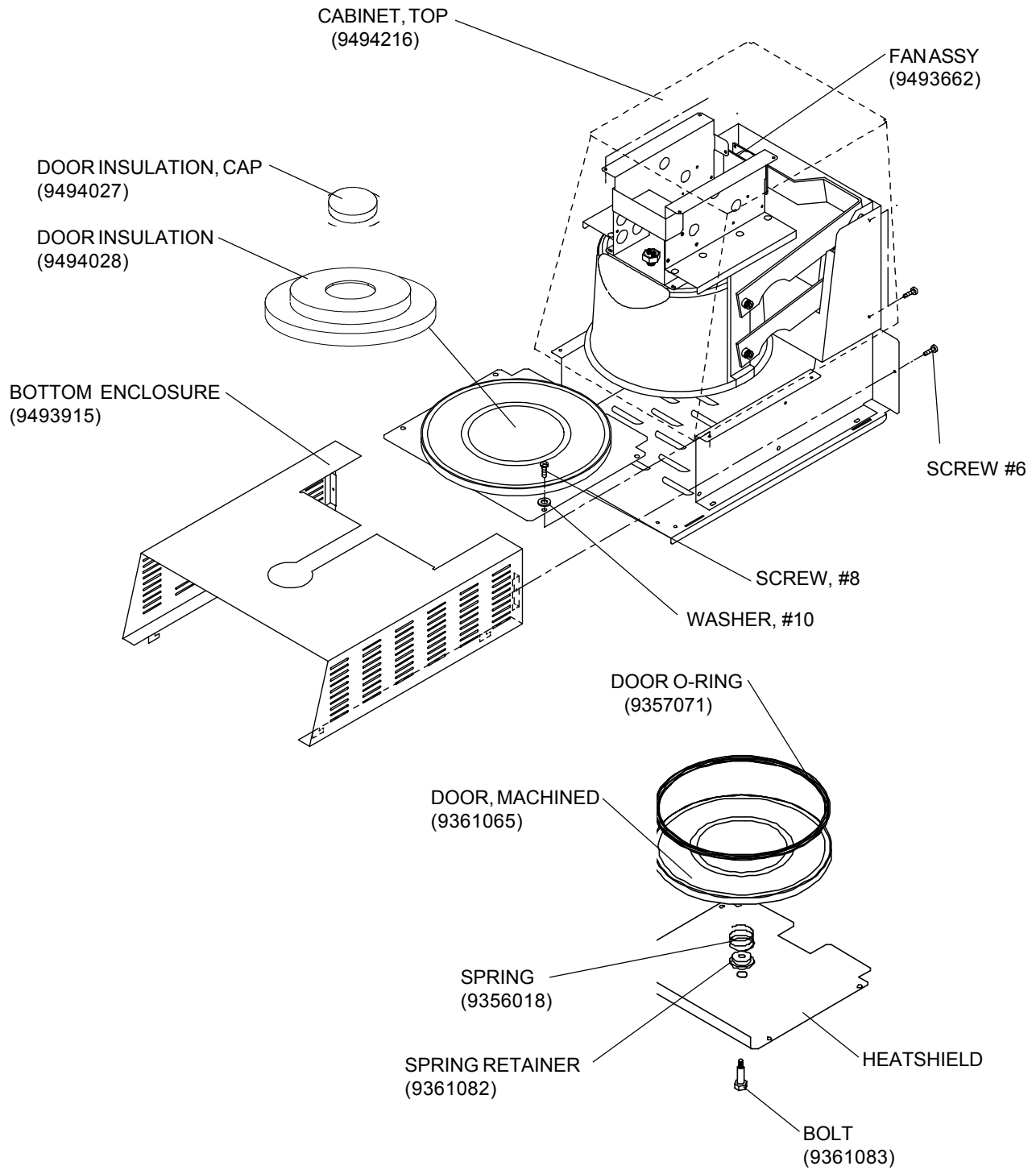
4.5 LIFT MECHANISM PARTS



## 4.6 MOTOR & VALVE PARTS



## 4.7 DOOR & CABINET PARTS

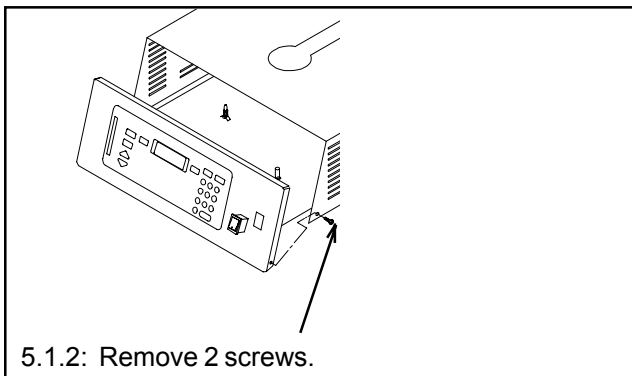
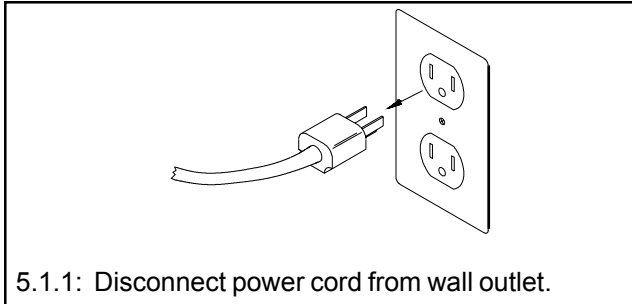


## SECTION 5

### DISASSEMBLY / REASSEMBLY

#### 5.1 CONTROL DRAWER

Tools : #2 Phillips screwdriver or 1/4" nut-driver



## 5.2 MUFFLE

Tools: #2 Phillips screwdriver (short)

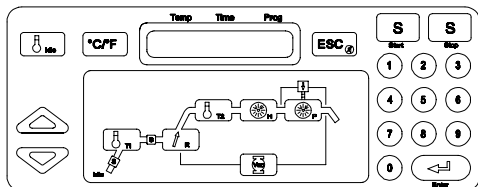
Pliers

Set-up: Move Muffle to "up" position. Allow to cool.

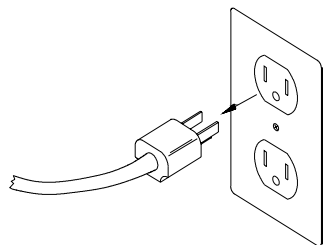
Note: To bypass Err6, Press "UP" key while turning on power.

### Caution:

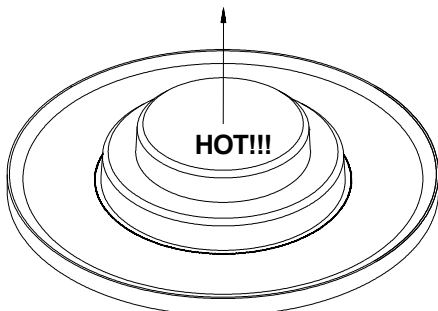
Do not touch the quartz spiral during muffle replacement. Handle on outer surface.



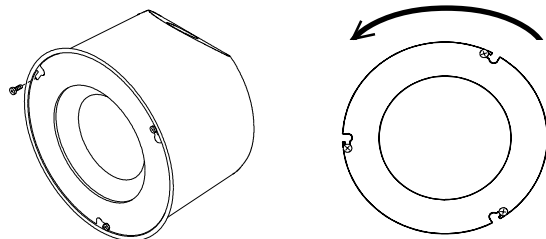
5.2.1: Press "up" key.



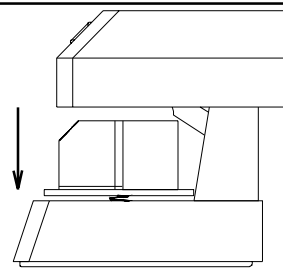
5.2.2: Disconnect power cord from wall outlet.



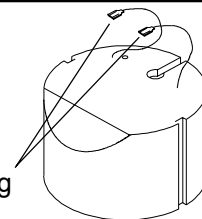
5.2.3: Remove door insulation (allow to cool first).



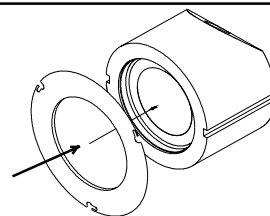
5.2.4: Turn furnace gently on it's side holding by column, not top enclosure. Loosen 3 screws and rotate ring.



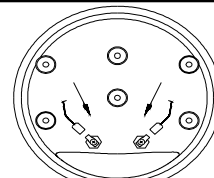
5.2.5: Slide out muffle and retaining ring.



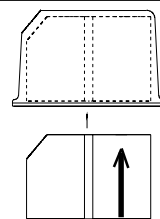
5.2.6: Disconnect terminals using pliers if needed & remove muffle.



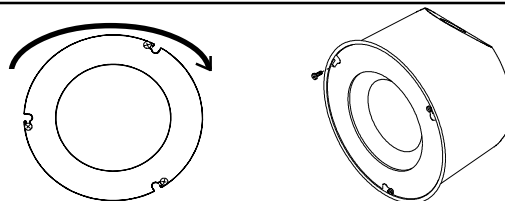
5.2.7: Center and press ring into new muffle.



5.2.8: Connect muffle wires to terminals inside vacuum chamber.



5.2.9: Slide muffle and ring into chamber lining up guides.



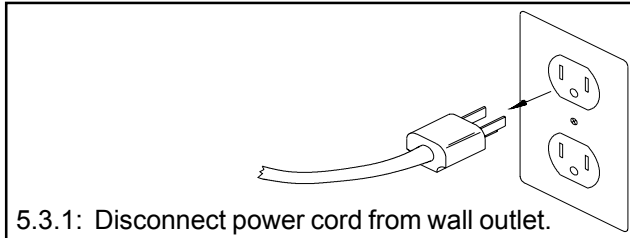
5.2.10: Rotate retaining ring into the locked position then tighten 3 screws.

### 5.3 THERMOCOUPLE

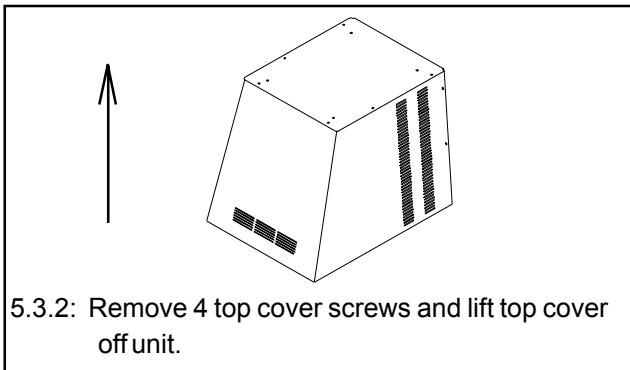
Tools: 3/4" wrench or adjustable wrench  
3/16" nut driver  
#2 Phillips screwdriver

**Caution:**

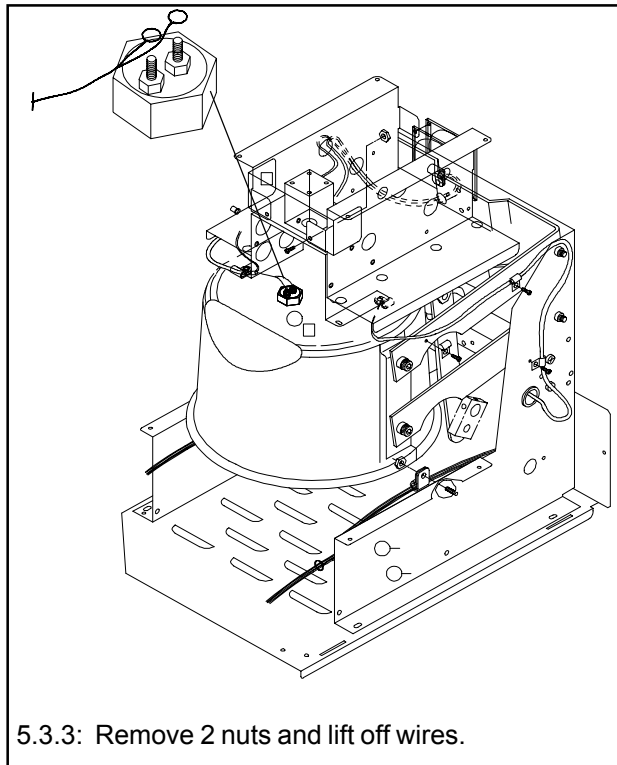
Muffle must be in down position to prevent damage to lift mechanism.



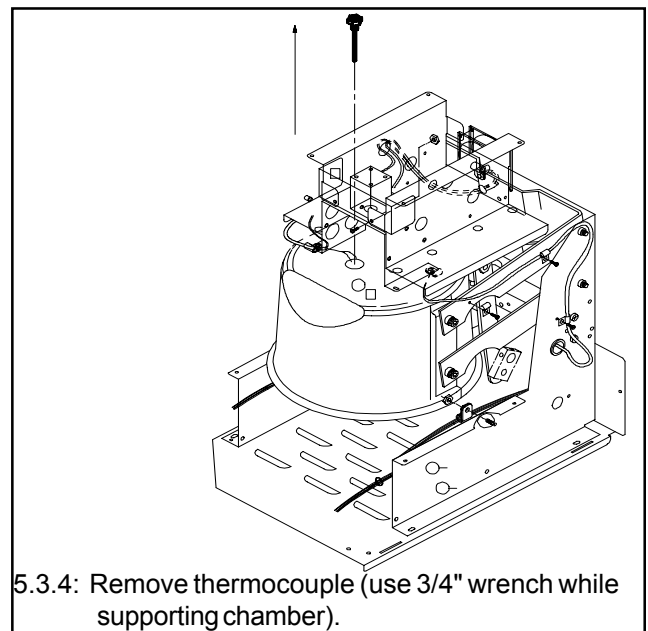
5.3.1: Disconnect power cord from wall outlet.



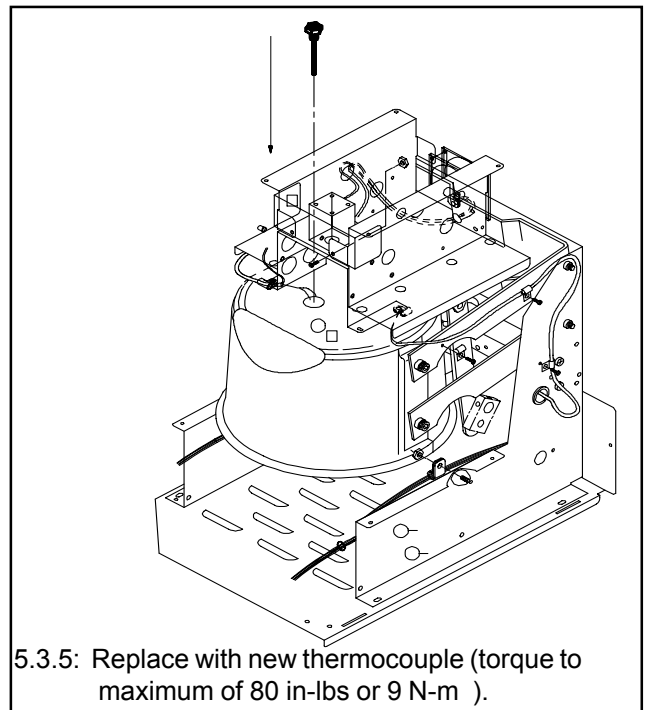
5.3.2: Remove 4 top cover screws and lift top cover off unit.



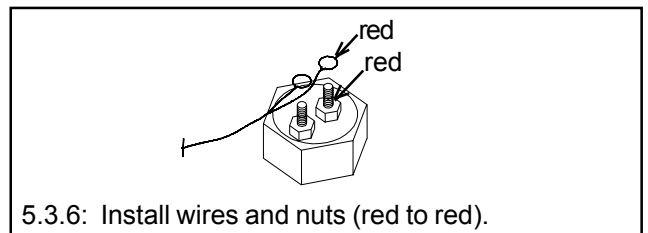
5.3.3: Remove 2 nuts and lift off wires.



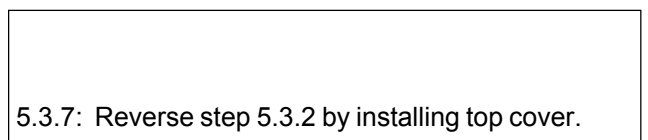
5.3.4: Remove thermocouple (use 3/4" wrench while supporting chamber).



5.3.5: Replace with new thermocouple (torque to maximum of 80 in-lbs or 9 N-m ).



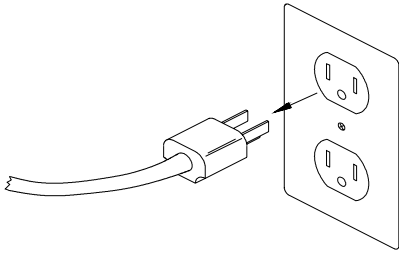
5.3.6: Install wires and nuts (red to red).



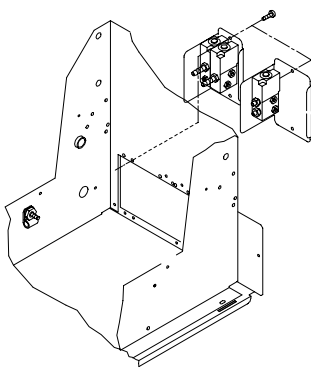
5.3.7: Reverse step 5.3.2 by installing top cover.

## 5.4 MOTOR

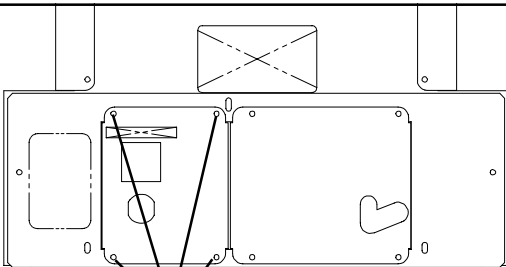
Tools: Long #2 Phillips screwdriver  
5/32" Allen wrench  
Large adjustable wrench (1" or 25 mm )



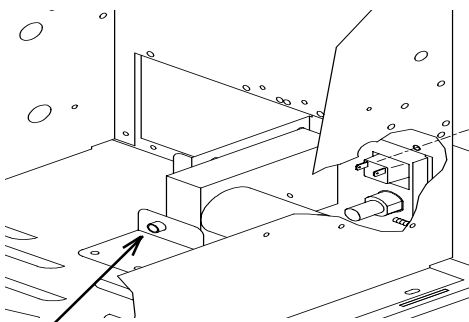
5.4.1: Disconnect line cord from wall outlet.



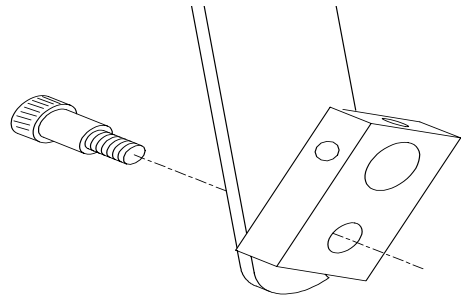
5.4.2: Remove valve bracket (4 screws) first.



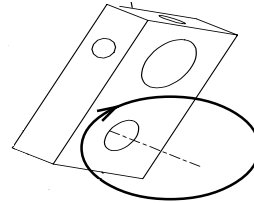
5.4.3: Remove 4 screws from motor bracket.



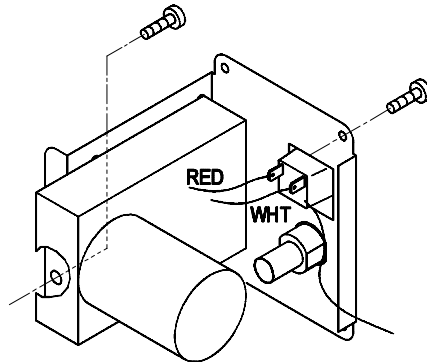
5.4.4: Remove this screw (from rear).



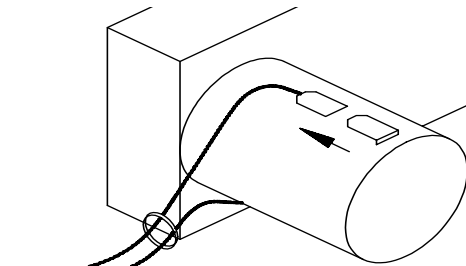
5.4.5: Remove shoulder bolt and push linkage away from block. Unloading the motor by lifting up and down on the chamber may help.



5.4.6: Rotate drive block into horizontal position with large adjustable wrench.



5.4.7: Remove motor from bracket (4 screws).



5.4.8: Disconnect motor wires.

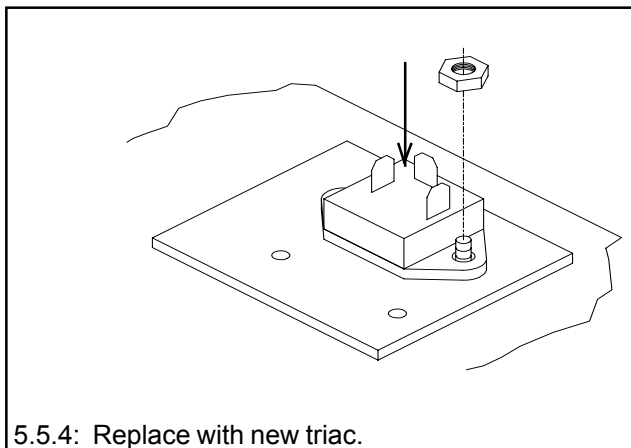
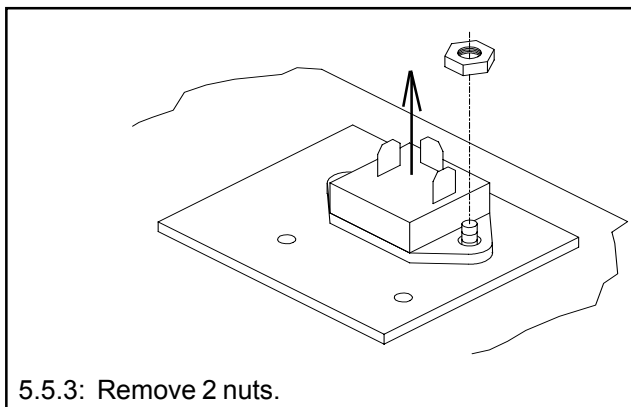
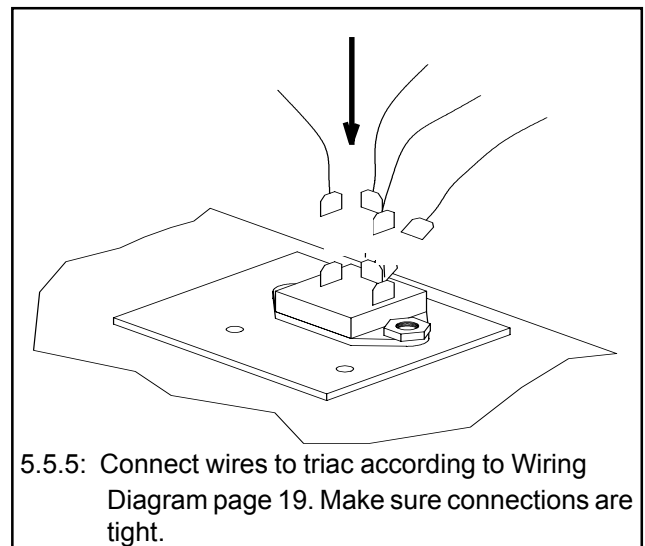
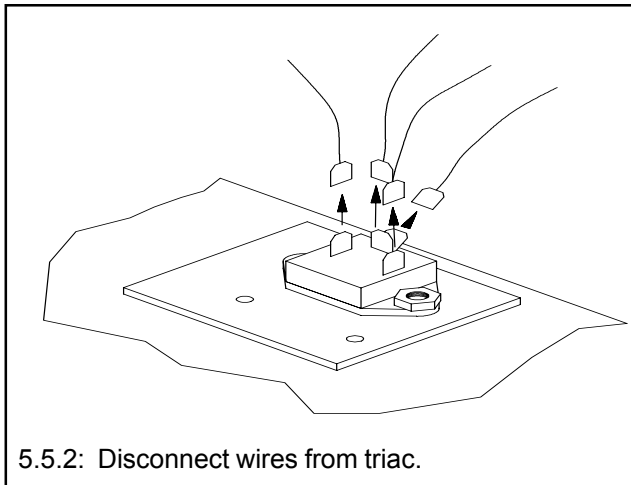
5.4.9: Install new motor by reversing Steps 5.8.8 through 5.8.3. Torque all screws to 25-30 in-lb (3 N-m).



## 5.5 TRIAC

Tools:     Phillips screwdriver  
           1/4" nut driver

5.5.1: Follow steps 5.1.1 through 5.1.3 of  
CONTROL DRAWER REMOVAL



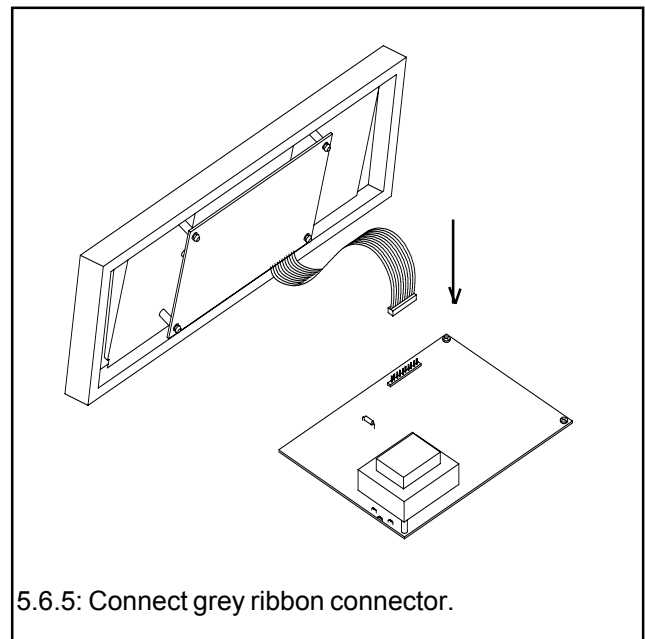
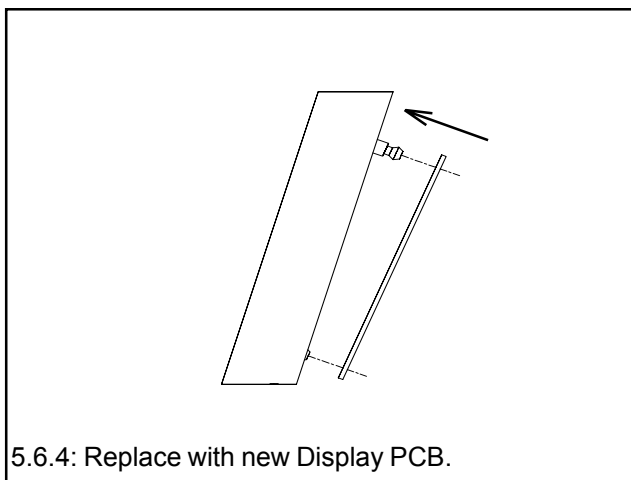
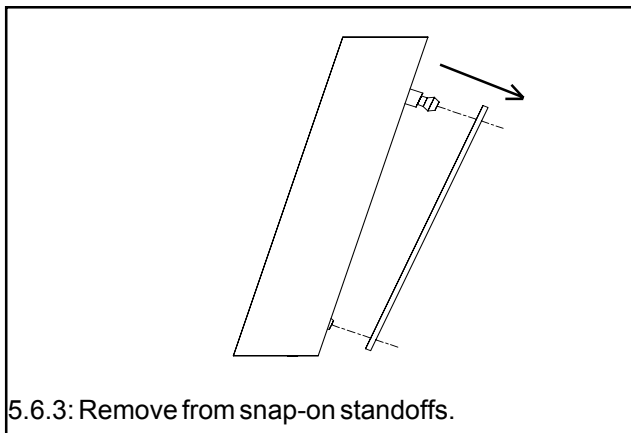
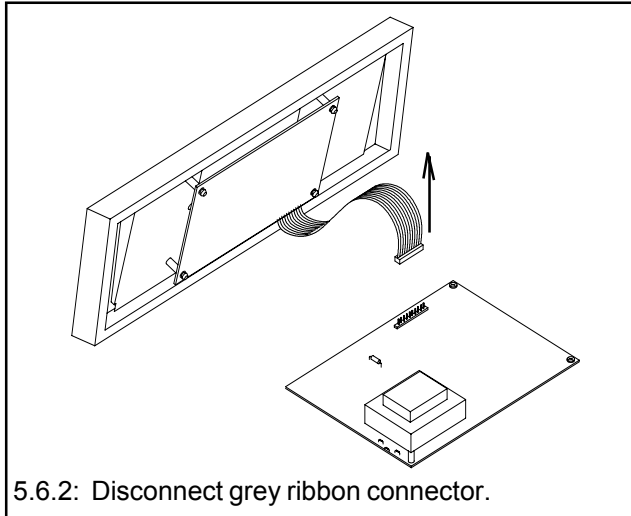
## 5.6 DISPLAY BOARD

Tools: Phillips screwdriver

### CAUTION!

Use proper ESD grounding techniques when handling electronic components.

5.6.1: Follow steps 5.1.1 though 5.1.3 of CONTROL DRAWER REMOVAL



5.6.6 Reassemble Control Module.

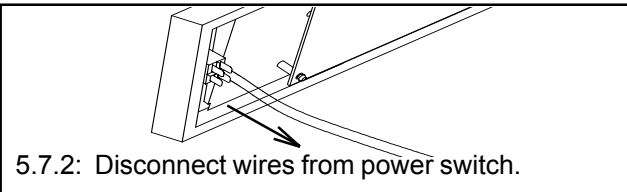
## 5.7 CONTROL BOARD

Tools: Phillips screwdriver; Bladed screwdriver  
Needle nose pliers

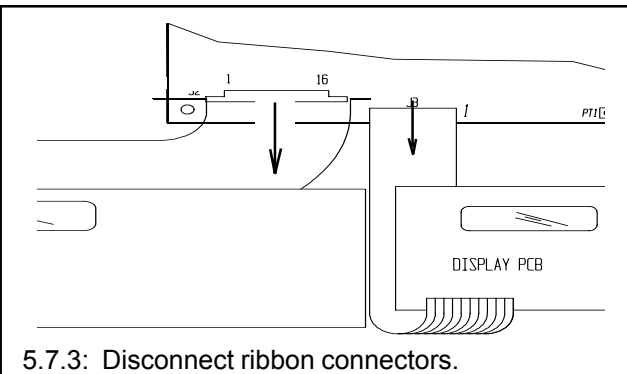
### CAUTION!

Use proper ESD grounding techniques when handling electronic components

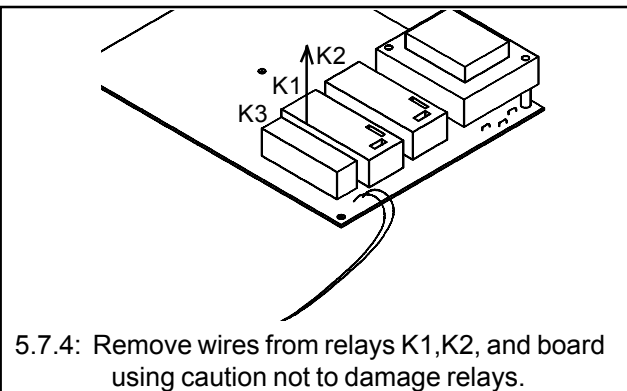
5.7.1: Follow steps 5.1.1 through 5.1.3 of CONTROL DRAWER REMOVAL



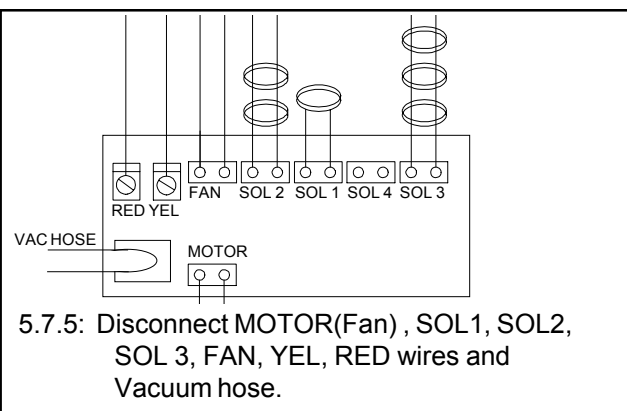
5.7.2: Disconnect wires from power switch.



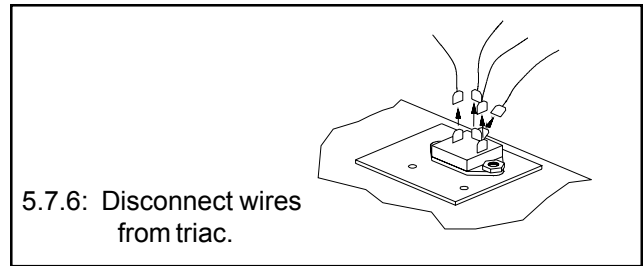
5.7.3: Disconnect ribbon connectors.



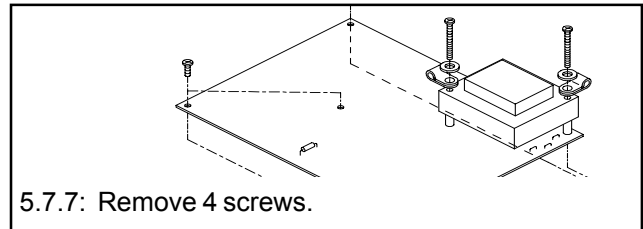
5.7.4: Remove wires from relays K1, K2, and board using caution not to damage relays.



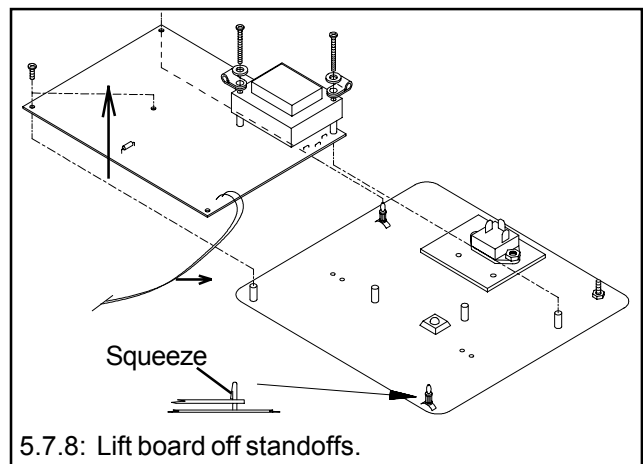
5.7.5: Disconnect MOTOR(Fan), SOL1, SOL2, SOL3, FAN, YEL, RED wires and Vacuum hose.



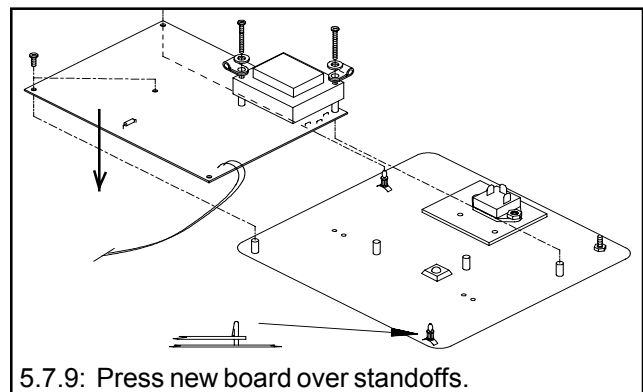
5.7.6: Disconnect wires from triac.



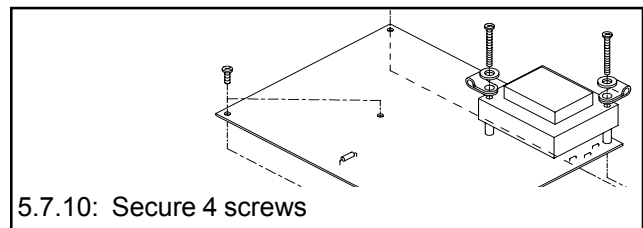
5.7.7: Remove 4 screws.



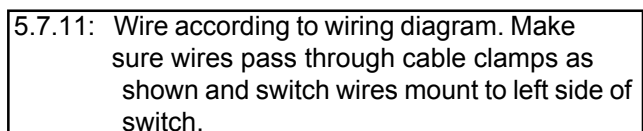
5.7.8: Lift board off standoffs.



5.7.9: Press new board over standoffs.



5.7.10: Secure 4 screws

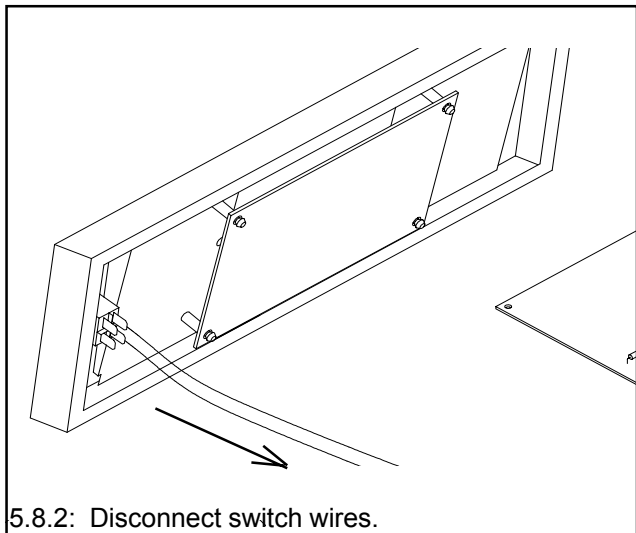


5.7.11: Wire according to wiring diagram. Make sure wires pass through cable clamps as shown and switch wires mount to left side of switch.

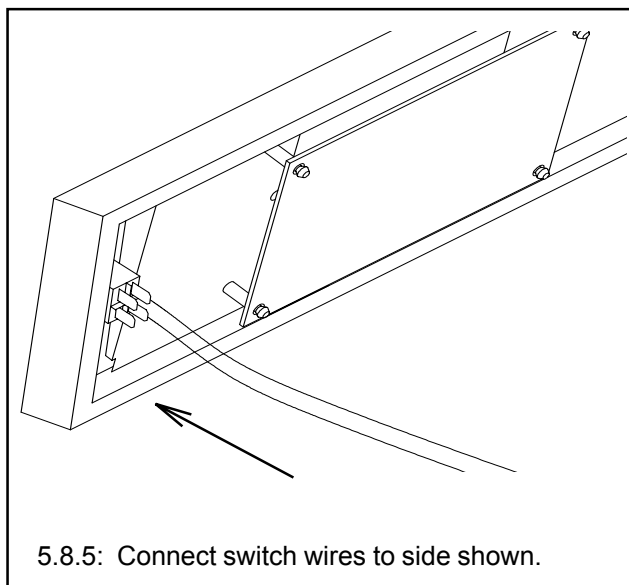
## 5.8 POWER SWITCH

Tools: Phillips screwdriver

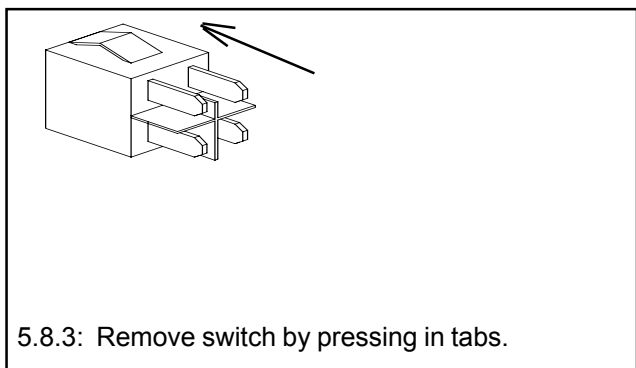
5.8.1: Follow steps 5.1.1 through 5.1.3 of  
CONTROL DRAWER REMOVAL



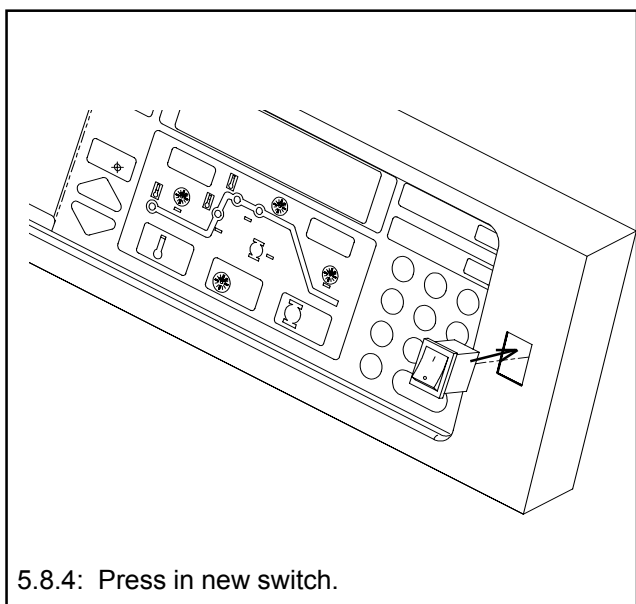
5.8.2: Disconnect switch wires.



5.8.5: Connect switch wires to side shown.



5.8.3: Remove switch by pressing in tabs.

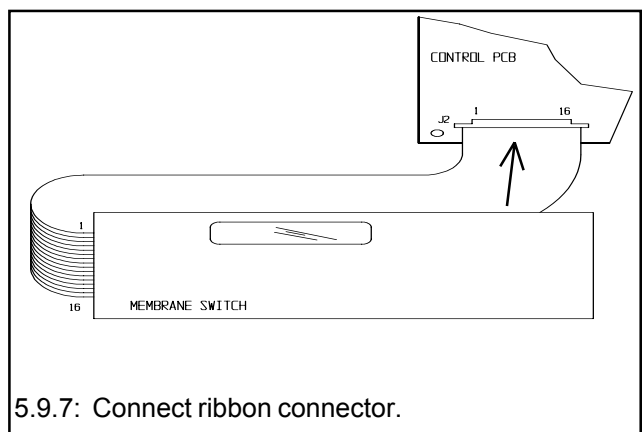
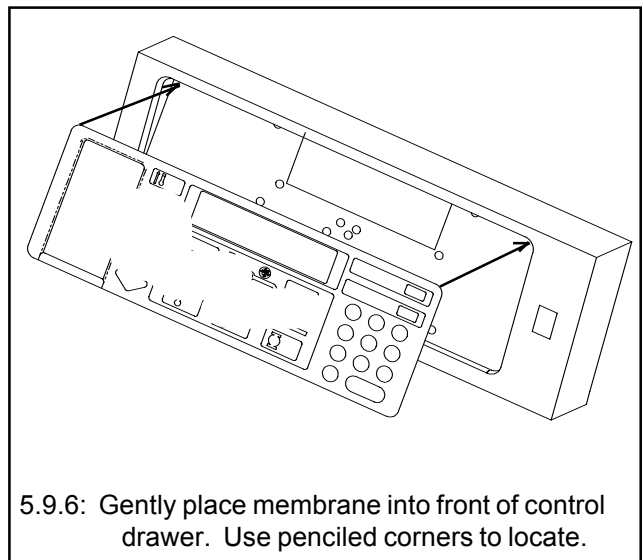
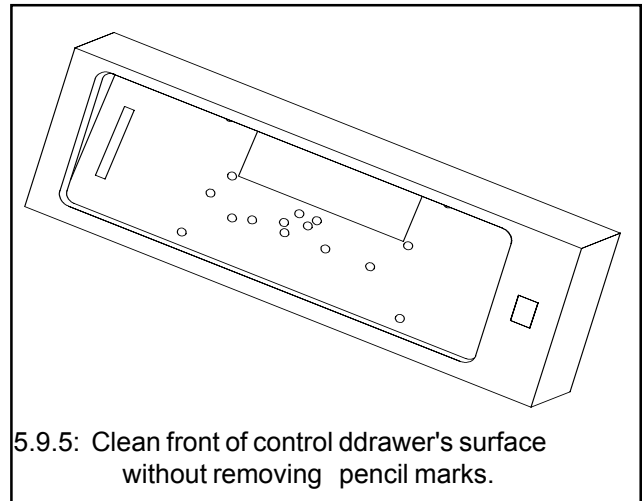
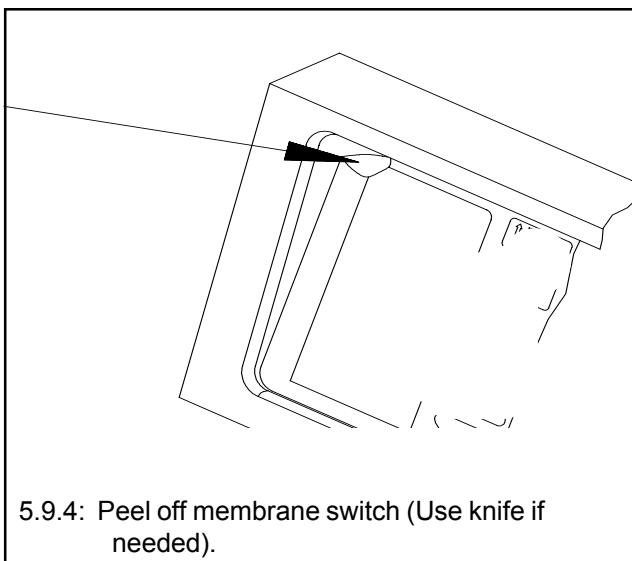
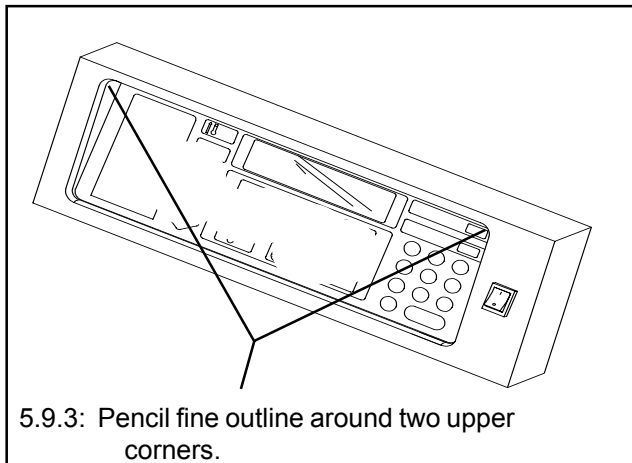
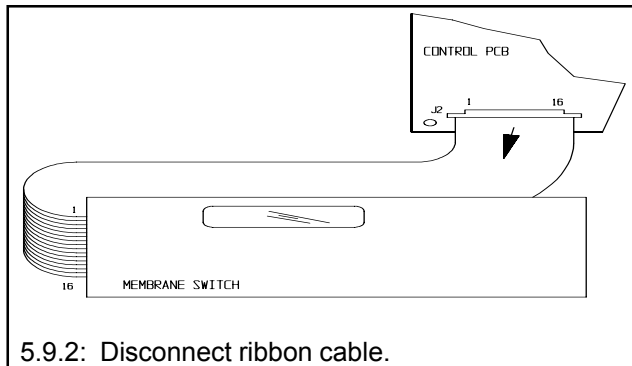


5.8.4: Press in new switch.

## 5.9 MEMBRANE SWITCH:

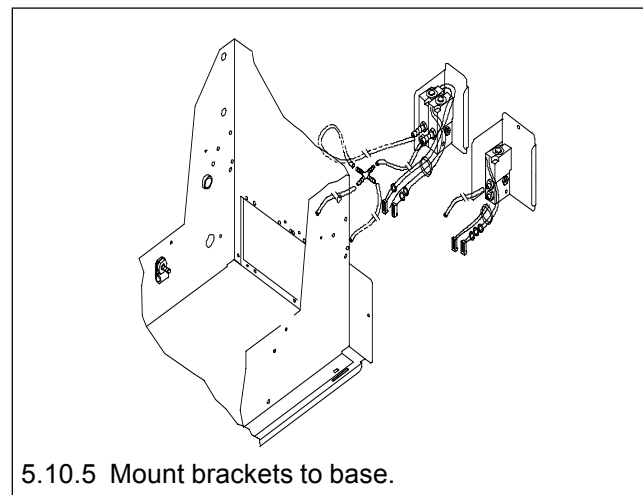
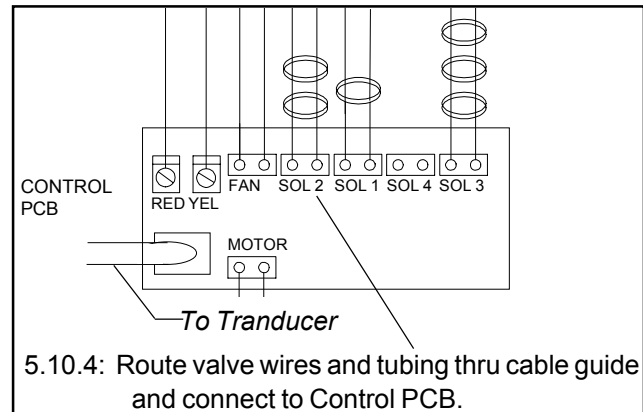
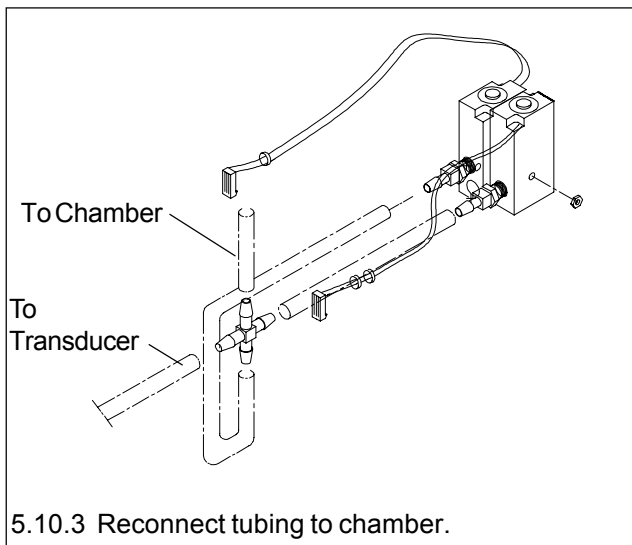
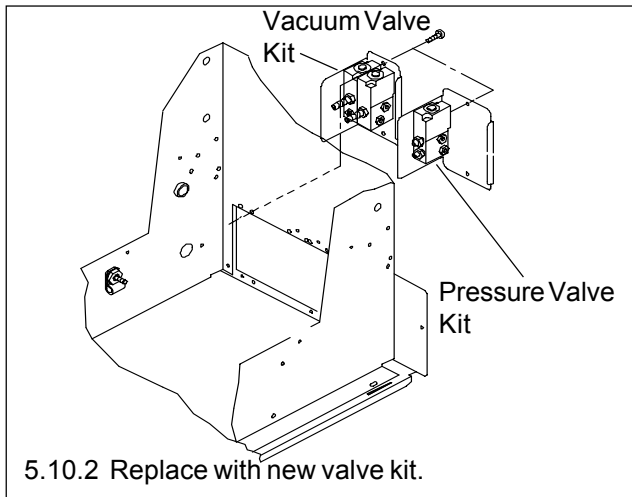
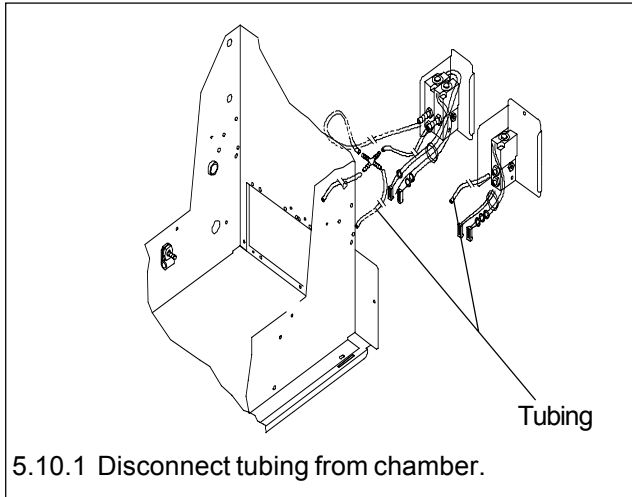
Tools: Phillips screwdriver or 1/4" nut driver  
Knife or other sharp edged device  
Fine point pencil

5.9.1: Follow steps 5.1.1 through 5.1.3 of  
CONTROL DRAWER REMOVAL



## 5.10 VALVES

Note: Replacing the valve kit attached to the bracket.



[illegible]