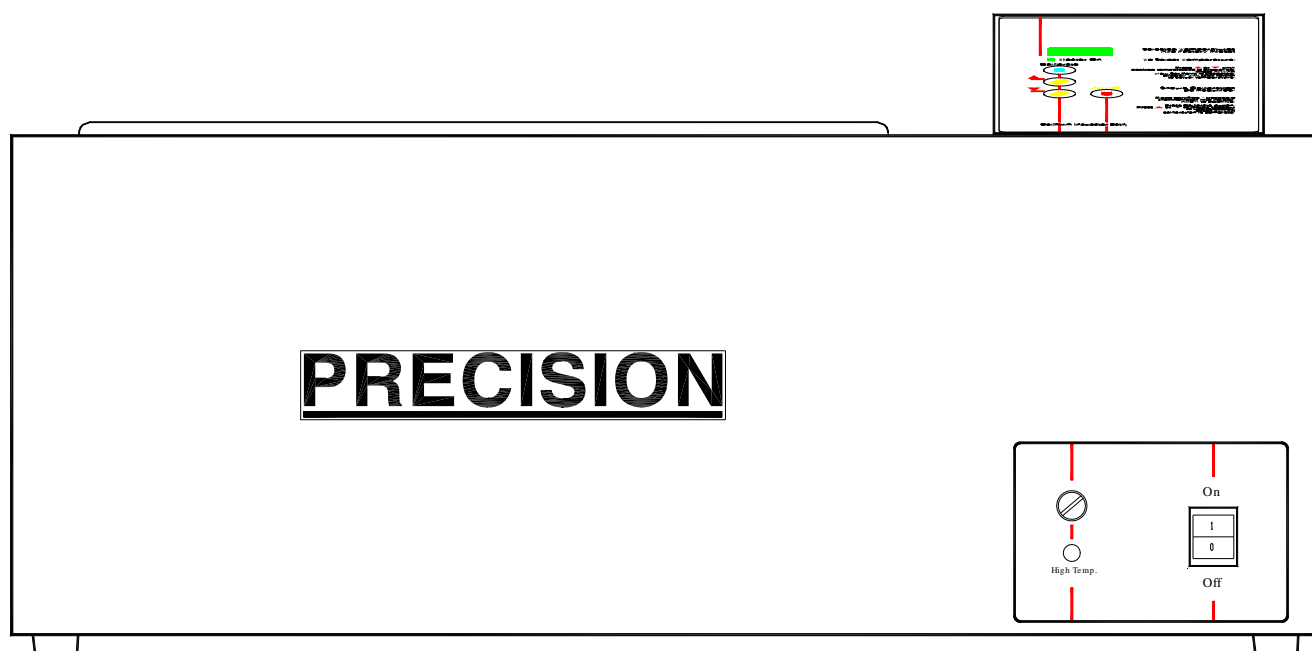


Installation/Service Manual
Reciprocal Shaking Water Baths
Models 2870/2871 (25) & 2872/2873 (50)



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Thermo
SCIENTIFIC

NOTE:

THE 240V UNITS DESCRIBED IN THIS MANUAL WERE DESIGNED SPECIFICALLY FOR THE EUROPEAN MARKET AND ARE SUPPLIED WITH A EUROPEAN STYLE POWER CORD. FOR DOMESTIC USE, A U.S. STYLE POWER CORD (P/N: 3176836) MUST BE ORDERED SEPARATELY.

NOTICE

THE MATERIAL IN THIS MANUAL IS FOR INFORMATION PURPOSES ONLY. THE CONTENTS AND THE PRODUCT IT DESCRIBES ARE SUBJECT TO CHANGE WITHOUT NOTICE. THERMO SCIENTIFIC MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THIS MANUAL. IN NO EVENT SHALL THERMO BE LIABLE FOR ANY DAMAGES, DIRECT OR INCIDENTAL, ARISING OUT OF OR RELATED TO THE USE OF THIS MANUAL.

For repair information or replacement parts assistance from the manufacturer, call Technical Services using our toll free telephone number.

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REVISION STATUS

INDEX	DATE	AMENDED PAGES	NOTES
A	6/99		Initial release
B	3/00	6, 12	added instructions for setting hi-limit thermostat, and updated resistance measurements for the current motor
C	07/01	2,18,26,27	updated electrical specifications
D	NOV01	7	Add caution "acidic & caustic substance"
E	JUL05	36100127 (34002571)	new manual #, manufacture location
F	JUN06	ECRs 23496, 23443, 23196	consolidated with 3177689 240V manual, removed CE symbol and declaration, updated electrical specs
G	SEP08	ECR24808	Revised water specifications
H	APR09	ECR25448/BA-670	Added UL required info
I	MAY09	ECR25227/BA-667	pg 24 probe - half coupling

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INTRODUCTION

Your satisfaction and safety are important to Thermo and a complete understanding of this unit is necessary to attain these objectives.

As the user of this apparatus, you have the responsibility to understand the proper function and operational characteristics of your bath. This instruction manual should be thoroughly read and all operators given adequate training before attempting to place this unit in service. Awareness of the stated cautions and warnings, and compliance with recommended operating parameters — together with maintenance requirements — are important for safe and satisfactory operation. The unit should be used as described in this manual and for its intended purpose; alterations or modifications will **VOID THE WARRANTY.**

WARNING

AS A ROUTINE LABORATORY PRECAUTION, ALWAYS WEAR SAFETY GLASSES WHEN WORKING WITH THIS APPARATUS.

This product is not intended, nor can it be used, as a sterile or patient connected device. In addition, this apparatus is not designed for use in Class I, II or III locations as defined by the National Electrical Code.

UNPACKING AND DAMAGE

Save all packing material until unit is put into service. This merchandise was carefully packed and thoroughly inspected before leaving our factory.

Responsibility for safe delivery was assumed by the carrier upon acceptance of the shipment; therefore, claims for loss or damage sustained in transit must be made upon the carrier by the recipient as follows:

1. **Visible Loss or Damage:** Note any external evidence of loss or damage on the freight bill, or express receipt, and have it signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusing to honor your damage claim. The form required to file such claim will be supplied by the carrier.
2. **Concealed Loss or Damage:** Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked and inspected. Should either occur, make a written request for inspection by carrier's agent within fifteen (15) days of the delivery date; then file a claim with the carrier since the damage is the carrier's responsibility.

If you follow the above instructions carefully, we will guarantee our full support of your claim to be compensated for loss or concealed damage.

DO NOT — FOR ANY REASON — RETURN THIS UNIT WITHOUT FIRST OBTAINING AUTHORIZATION. In any correspondence to Thermo, please supply the nameplate data, including catalog number and serial number.

GENERAL INFORMATION

Precision Reciprocal Shaking Water Baths are ideal for applications needing constant, controlled agitation and precise temperature uniformity. Two sizes are available: 14.5 liter (Model 2870/2871) and 26.5 liter (Model 2872/2873). These instructions are applicable to all models listed in Table 1.

The microprocessor control panel houses all functions necessary to operate the bath. The five push-button switches and single display window allow the operator to adjust bath temperature, motor speed, and calibration via a single set of controls.

The proportional integral derivative temperature control allows precise temperature control from 5°C above ambient to 55°C without cover and to 99.9°C with use of the gable cover provided.

A high limit thermostat is provided and can be set to prevent heater runaway in the event of temperature control failure.

Tray shaking speed is easily adjusted between 30 and 200 cycles per minute at 5 cpm intervals. The tray stroke can be adjusted to three different lengths: 0.5", 1" and 1.5". The drive mechanism contains self-lubricating bearings which require no maintenance.

The tray is easily removable and rides silently on four plastic balls.

The interior of the bath is constructed of stainless steel and is designed for operation with **distilled water** or equivalent. **Do not use deionized water.** The acceptable resistivity range is 50K to 1M ohm (conductivity 1 to 20 micro Siemens). The acceptable pH range is 7 to 9.

The body is made from galvanized steel and is painted for added protection. A drain is located at the far left end of the bath. A stainless steel gable cover is also provided with the bath.

The 230 volt units are identical in appearance to the 120 volt units.

Table 1. Listing of Models included in this Manual

Model No.	Volts	Hertz	Watts	Amps	Mains Fuse	Power Supply Board Fuse
2870	120	50/60	1050	8.8	N/A	N/A
2871	240	50/60	1050	4.4	N/A	N/A
2872	120	50/60	1550	12.9	FST-5x20-6.3A	FST-6.3x32-63mA
2873	240	50/60	1550	6.5	FST-5x20-10A	FST-6.3x32-63mA

PERFORMANCE DATA

The following table identifies specifications for Models 2870/2871 and 2872/2873 Shaker Baths.

Performance Data					
		Model 2870/2871		Model 2872/2873	
		With Cover	Without Cover	With Cover	Without Cover
Uniformity	37°C	±0.05	±0.15	±0.1	±0.2
	56°C	±0.05	±0.2	±0.2	±0.2

INSTALLATION

WARNING

INSTALLATION SHOULD BE COMPLETED BY QUALIFIED PERSONNEL ONLY.

Location - The most uniform operating conditions will be obtained by placing the bath on a level surface in an area remote from drafts, ventilating outlets, radiators, and other rapidly changing ambient conditions.

Environmental Conditions-

This instrument is designed to operate safely under the following conditions:

- Indoor Use Only
- Temperature: 5° to 40° C
- Maximum Relative Humidity: 80% for temperatures to 22°C
- Maximum Altitude 2000 meters
- Mains supply voltage fluctuation ± 10 , or per project plan
- Installation (Overvoltage) category II, Pollution Degree 2

1 Installation category (overvoltage category) defines the level of transient overvoltage which the instrument is designed to withstand safely. It depends on the nature of the electricity supply and its overvoltage protection means. For example, in CAT II which is the category used for instruments in installations supplied from a supply comparable to public mains such as hospital and research laboratories and most industrial laboratories, the expected transient overvoltage is 2500V for a 230V supply and 1500V for a 120V supply.

2 Pollution Degree describes the amount of conductive pollution present in the operating environment. Pollution Degree 2 assumes that normally only non-conductive pollution such as dust occurs with the exception of occasional conductivity caused by condensation.

Maximum performance is assured across the following temperature range:

- 15°C to 45°C

Electrical Connections -

IMPORTANT

FOR PERSONAL SAFETY, THIS APPARATUS MUST BE PROPERLY GROUNDED.

1. The power cord provided on this unit is equipped with a three-prong (grounding) plug which mates with standard three-prong grounding wall receptacle to minimize the possibility of electric shock hazard from this apparatus. If in doubt the user should have the wall receptacle and circuit checked by a qualified electrician to make sure the receptacle can provide adequate current and is properly grounded.
2. Where a standard two-prong wall receptacle is encountered, it is the personal responsibility and obligation of the user to have it replaced with a properly grounded three-prong wall receptacle. *Do not, under any circumstances, cut or remove the third (ground) prong from the power cord. Do not use a two-prong adapter plug.*

Determine the total amount of current being used by other apparatus connected to the circuit that will be used for this apparatus. It is critical that the added current demand (see nameplate) of this and other equipment used on the same circuit does not exceed the rating of the fuse or circuit breaker.

CAUTION

BE SURE THAT THE POWER SUPPLY IS OF THE SAME VOLTAGE AS SPECIFIED ON THE NAMEPLATE.

THE POWER CORD IS THE MAINS DISCONNECT. MAKE SURE THE OUTLET IS EASILY ACCESSIBLE AFTER INSTALLATION.

Shaker Clip Installation - The spring retainer clips provided are designed to firmly hold flask clips in shaking tray holes.

1. It is important that these clips be inserted into tray holes before inserting optional flask clips (refer to list of Accessories, pg. 24). To meet specific applications, a variety of flask sizes can be utilized simultaneously.

Stroke Length Adjustment - The length of the shaker stroke is set at the factory for a 1" stroke. The following procedure should be observed when changing stroke lengths.

WARNING

TURN OFF POWER TO THE BATH AND DISCONNECT THE BATH FROM ITS POWER SUPPLY.

1. To gain access to the motor drive hub, remove four screws in upper side panel corners, and carefully open the control panel. Once opened, the 3-position drive hub will be immediately visible at top-center of control housing.
2. To alter the stroke length, unscrew the bearing mounting screw from its present position and rethread the screw firmly into the hole that will provide the desired stroke length. The hole closest to the hub center provides the shortest stroke; the one furthest away, the longest. The three threaded openings provide stroke lengths of 0.5", 1.0", and 1.5".
3. After selecting desired stroke length, close control panel and replace the four screws. Reconnect the bath to power source.
6. Insert the plastic tubing (coming from the bottom of the water level regulator) into the elbow connector (at the drain) & tighten the elbow connector fitting firmly to insure a good seal.
7. Uncoil Tygon tubing & press onto 1/4" Hose Barb Fitting (located at the top of water level regulator).
8. Hook up other end of the tygon tubing to water supply & turn on water. (Water pressure should fall within the following range: minimum is approximately 15 PSI, maximum is approximately 75 PSI)

NOTE

WATER LINE MARKING ON THE WATER LEVEL REGULATOR IS AN INDICATOR OF THE APPROXIMATE WATER LEVEL THAT WILL BE MAINTAINED IN BATH. THE ASSEMBLY HAS BEEN SET TO MAINTAIN APPROXIMATELY 1-3/4" OF WATER. TO RAISE THE SET WATER LEVEL, LOOSEN THUMBSCREW & RAISE WATER LEVEL REGULATOR TO DESIRED LEVEL (COINCIDE WITH WATER LINE MARK) & TIGHTEN THUMBSCREW TO HOLD WATER LEVEL REGULATOR IN PLACE.

WATER LEVEL REGULATOR (OPTIONAL)

INSTALLATION INSTRUCTIONS - Use the following steps along with Fig. 1 & 2 shown on the following page.

1. Turn off unit, disconnect power & drain water from the bath.
2. Unscrew drain plug from side of bath body.
3. Replace with elbow connector (shipped loose).

NOTE

DO NOT OVER-TIGHTEN THUMBSCREW

NOTE

TO INSURE GOOD SEAL, WRAP THREADS WITH TEFLON TAPE OR EQUIVALENT SEALER.

4. Tighten elbow connector so open end (tube fitting) faces straight down.
5. Place Water Level Regulator Bracket Assembly on the lip of the bath pan (drain side of the bath towards the rear of the unit). The small flange with gasketing near the top of the bracket should rest against the inside of the bath pan. The other 2 flanges with gasketing should rest against the outside of the bath body.

WATER LEVEL REGULATOR ASSEMBLY

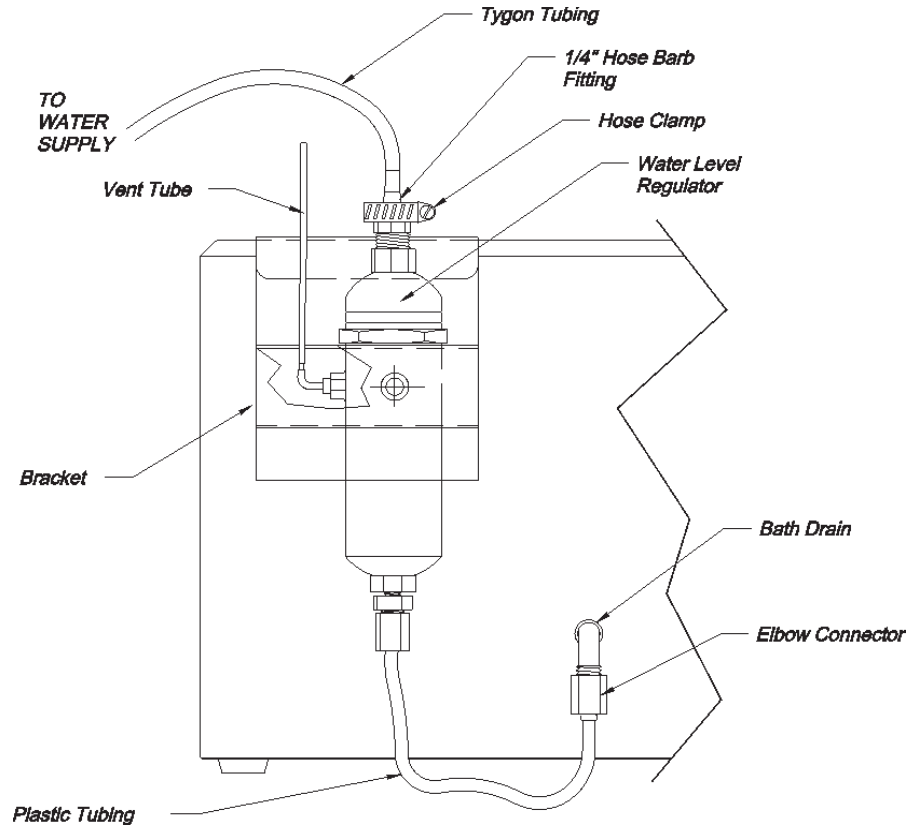


FIGURE 1
SIDE VIEW OF BATH

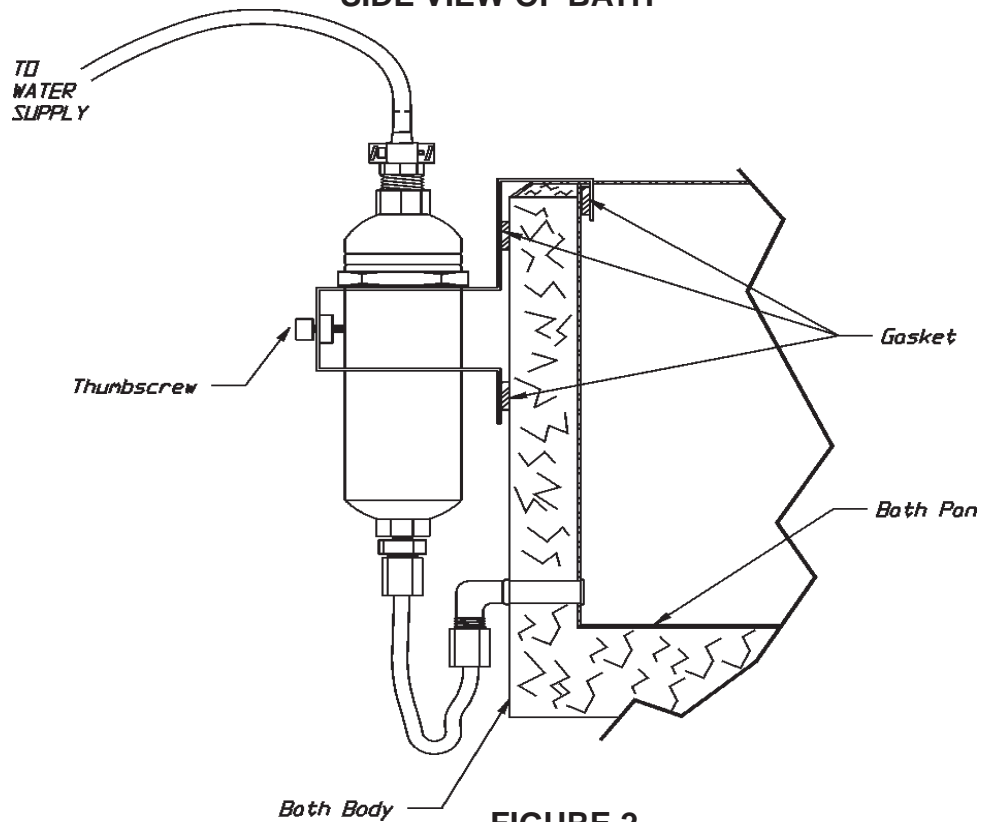


FIGURE 2
CUTAWAY FRONT VIEW OF BATH

EXPLANATION OF CONTROLS

Power Switch - The power switch is located on the lower right hand side of the bath, it provides power for the entire unit.

Hi-Limit Thermostat - is located immediately to the left of the power switch on the lower right corner of the bath. The high limit is an adjustable control used to prevent thermal runaway in the event that the primary control fails. After the bath temperature has stabilized, use a standard screwdriver to adjust the potentiometer. When delivered, the Hi-Limit is turned fully clockwise (highest setting). In this position the Hi-Limit light will be **OFF**. Turn the potentiometer counter-clockwise until the Hi-Limit light is **ON**, and then adjust clockwise 1/8 of a turn. Verify that the Hi-Limit light is **OFF**. Now if your bath temperature rises above the desired setting, the Hi-Limit protection will be activated.

The Control Panel- is located on top of the bath.

1. LED Display - The three-digit LED display used to show both the actual and setpoint values for the temperature/shaking speed.

2. Heater On Lamp - The "Heater ON" lamp is illuminated when power is applied to the heater.

3. Indicator Lamps - These lamps indicate which of 4 parameters (Actual Temp, Actual Speed, Setpoint Temp, and Setpoint Speed) is displayed in the LED window.

4. Enter Key - The Enter Key is used to choose which parameter is displayed in the LED window, and is also used to store a new setpoint value.

5. UP & DOWN Keys-are used to adjust temperature and speed setpoint values. Pressing & holding these keys will increment/decrement the display value slowly at first, and then rapidly.

6. Offset Key- is used to adjust the temperature to match a calibrated reference thermometer.

7. Shaker Start/ Stop Key - This key is used to toggle the tray shaking motion on or off.

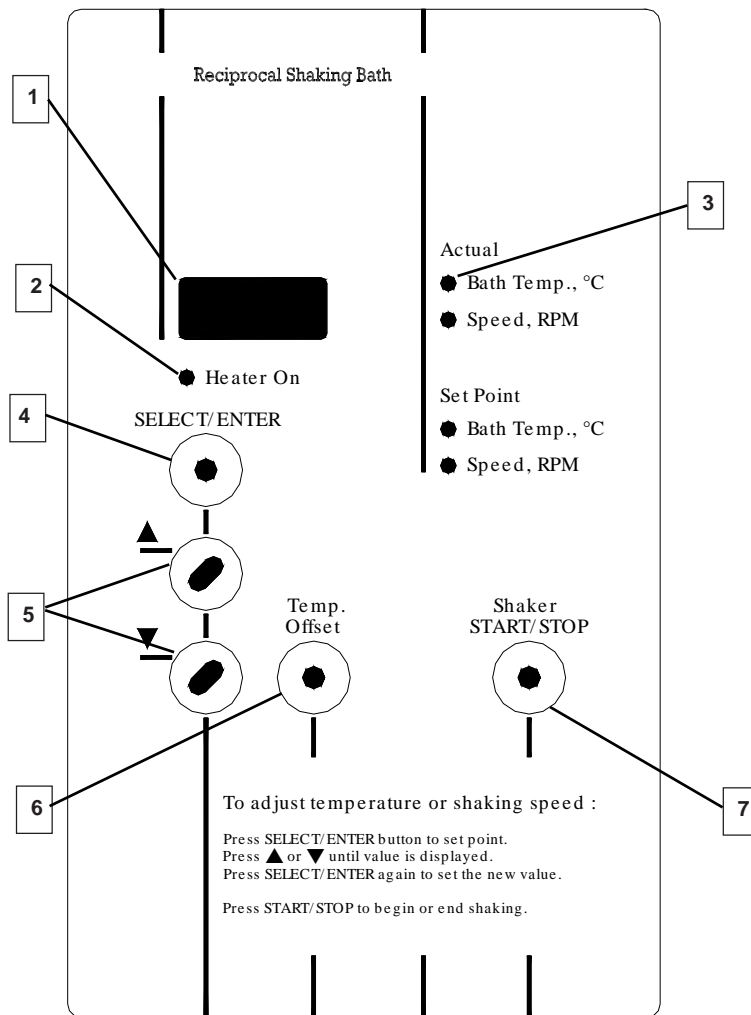


FIGURE A

OPERATION

CAUTION

EXERCISE CARE WHEN USING ACIDIC OR CAUSTIC SOLUTIONS AS THEY WILL ATTACK THE GALVANIZED STEEL BATH BODY IF SPILLED INTO THE BATH. IF SPILLS DO OCCUR, THE BATH LIQUID SHOULD BE IMMEDIATELY DRAINED AND THE UNIT THOROUGHLY FLUSHED. SPILLS AND CONDENSATION SHOULD BE CLEANED/ REMOVED FROM ALL METAL SURFACES AFTER EACH USE. THE USER IS RESPONSIBLE FOR DECONTAMINATION IF HAZARDOUS MATERIAL IS SPILLED ON OR IN THE BATH.

When filling the bath with water, allowance must be made for the displacement of water upon immersion of samples. Also make allowance for splashing of water from tray oscillation movement.

CAUTION

WATER LEVEL REQUIREMENTS

MINIMUM LEVEL - ONE INCH OF WATER SHOULD BE MAINTAINED AT ALL TIMES. THIS LEVEL WILL KEEP HEATERS COVERED AND WILL HELP PREVENT HEATER FAILURE.

MAXIMUM LEVEL - WATER LEVEL SHOULD BE KEPT LOWER THAN THE TRAY SHAFT FITTING. WATER FILLED BEYOND THIS LEVEL COULD POSSIBLY SEEP INTO CONTROL PANEL AND CAUSE DAMAGE.

To conserve energy, reduce evaporation and increase temperature control accuracy, use the gable cover provided. Do not use aluminum foil as a cover, as it may cause corrosion due to an electrochemical reaction.

1. Add distilled water to bath. Use water levels as instructed above.
2. Power up: Depress the power switch located at the lower right hand corner of the bath. The unit is fully operational upon application of power. The display will show the actual bath temperature.
3. **To set temperature control point:**
 - a. Press ENTER until setpoint temperature is displayed.
 - b. Press UP or DOWN until desired setpoint is displayed.
 - c. Press ENTER again to set the new value.
 - d. Display will return to actual temperature.
 - e. If ENTER is not pressed, new value will not be set and display will return to actual temperature.
4. **To set new speed:**
 - a. Press ENTER until setpoint speed is displayed.
 - b. Press UP or DOWN until desired speed is displayed.
 - c. Press ENTER again to set new speed.
 - d. Display will show actual speed for 10 seconds, then return to actual temperature.
 - e. If ENTER is not pressed, new value will not be set and display will return to actual temperature.
5. **To begin or end shaking motion:**
 - a. Press START/STOP key.
6. **To set temperature offset:**
 - a. Temperature offset should be used to match a stable bath's actual temperature display to a calibrated thermometer. The offset value is entered as the difference between the two values.
 - b. Press ENTER until actual temperature is displayed.
 - c. While pressing OFFSET, press UP or DOWN keys to desired value. Continue holding offset and press ENTER to set new value.
 - d. If ENTER is not pressed, new values will not be set and display will return to previous temperature value.
 - e. Display should now match your calibrated thermometer.
 - f. Temperature setpoint will now control at previous setpoint plus offset value.
 - g. Repeat step 3 to readjust setpoint to desired value.
 - h. Example: Setpoint is 37° and actual display bath temperature is stable at 37°. Calibrated reference thermometer reads 37.2°. Press OFFSET and the UP key until display reads 0.2. Press ENTER while still holding OFFSET key. Release keys. Display and Setpoint will now be 37.2. Readjust setpoint to 37°.

NOTE

AS WATER BATHS ARE OPERATED, ESPECIALLY AT ELEVATED TEMPERATURES, CONDENSATION WILL FORM ON THE UNDERSIDE OF THE GABLE COVER. THE AMOUNT OF CONDENSATION CAN BE CONSIDERABLE. CARE SHOULD BE EXERCISED WHEN REMOVING THE COVER SO THAT WATER WILL FALL BACK INTO THE BATH CHAMBER, AND NOT ON THE BATH SURFACE. THE COVER SHOULD BE PLACED UPSIDE DOWN WHEN REMOVED TO MAINTAIN A DRY WORK AREA.

CAUTION

WHEN OPERATING AT TEMPERATURES GREATER THAN 60°C, DO NOT TOUCH THE METAL SURFACE OF THE GABLE COVER. LIFT THE GABLE COVER BY THE HANDLE ONLY.

WARNING

EXPLOSION, IMPLOSION, OR THE RELEASE OF TOXIC OR FLAMMABLE GASES RISING FROM THE MATERIAL BEING HEATED IS THE SOLE RESPONSIBILITY OF THE USER.

MAINTENANCE

OPTICAL DISC - Check the optical disc monthly. Verify that the optical disc is free of foreign material. If not, wipe disc clean. Rotate disc by hand one turn clockwise and verify that disc does not rub against optical sensor, loosen 2 set screws on eccentric and reposition disc.

CLEANING - Stainless steel will resist corrosion; however, it is not impervious to it. Proper maintenance of the stainless steel bath chamber will help assure many years of service. It should be cleaned regularly with mild soapy water and rinsed with distilled water. Always thoroughly dry the chamber after cleaning. Should algae or other undesirable microorganisms form on the top of the bath media, add a little formaldehyde or quaternary ammonium germicide available from **Thermo** (P/N 3166250).

CAUTION

AVOID SPILLING HARSH CHEMICALS ONTO THE BATH AS CORROSION OF THE STAINLESS STEEL MAY RESULT.

IMPORTANT

IF IT IS NECESSARY TO USE THE FOLLOWING CHEMICALS, LIMIT THE TIME TO A MAXIMUM OF FOUR HOURS. CLEAN SURFACES IMMEDIATELY AFTER USE.

- | | |
|-------------------------|----------------------|
| -Aluminum Chloride | -Barium Chloride |
| -Bichloride of Mercury | -Calcium Chloride |
| -Carbolic Acid | -Chlorinated Lime |
| -Citric Acid (boiling) | -Dakin's Solution |
| -Ferrous Chloride | -Mercury Salts |
| -Lysol | -Mercuric Chloride |
| -Potassium Permanganate | -Phenol |
| -Potassium Thiocyanate | -Sodium Hypochlorite |
| -Stannous Chloride | -Tartaric Acid |

CAUTION

NEVER USE THE FOLLOWING CHEMICALS.

- | | |
|----------------|------------------|
| -Aqua Regia | -Ferric Chloride |
| -Iodine | -Sodium Azide |
| -Sulfuric Acid | |

Removing Discoloration - Should the stainless steel ever become discolored by iron rust, use the following procedure to remove all traces of the rust and restore the stainless steel.

WARNING

OBSERVE THE FOLLOWING SAFETY PRECAUTIONS! USE HEAVY GLOVES OR OTHER ADEQUATE PROTECTION. ONLY WORK IN AREAS WITH ADEQUATE VENTILATION.

Prepare a solution of 20% nitric and 1.5% hydrochloric acid (if preferred, a 2% to 5% solution of warm oxalic acid may be used). Swab solution over surface, allowing it to remain until all rust is loosened. This will usually take 1 to 2 minutes.

As soon as rust is loosened, immediately flush with clean distilled water until all acid is removed.

PERIODIC SAFETY CHECK

Test operation of the Hi-Limit thermostat, as described on page 6, every three months.

TROUBLESHOOTING

WARNING

SERVICE SHOULD BE PERFORMED BY A QUALIFIED TECHNICIAN. BEFORE REPLACING ANY ELECTRICAL OR MECHANICAL COMPONENTS, UNPLUG THE LINE CORD. IF ELECTRICAL POWER IS REQUIRED FOR SERVICE, USE EXTREME CARE.

Refer to Problems and Solutions for troubleshooting information on the baths. This guide provides the basic information required to repair the bath.

The following is a list of the tools and instruments required to perform the procedures outlined in the Troubleshooting Procedures table.

Tools Needed:

- Phillips or Flat Blade Screwdriver
- 7/16" Socket or Adjustable Wrench
- Ohmmeter
- DC Voltmeter
- AC Voltmeter
- 5V DC Power Supply

When changing circuit boards, please use CAUTION when re-installing the flat cable connectors that come from the display board. Make sure the pins are NOT bent or broken. Boards that are fine will not operate correctly if these pins have been abused because they will not receive the necessary signals from other boards.

Before attempting any troubleshooting for a particular problem, it is good practice to verify power supply voltages of the POWER SUPPLY board #3176677. Read these steps before performing them to get acquainted with the procedure.

1. Be sure that the main power source is OFF or disconnected.
2. Connect J101 and J105 to the POWER SUPPLY BOARD. DO NOT connect J102 that comes from the CPU and the DISPLAY at this time.
3. Connect the negative lead of the voltmeter to TP2 - COM. Select a VDC of 20. Connect the positive lead to TP1 - UNREG.

4. Turn ON the main power.
5. The voltmeter should be reading approximately 14 volts DC ± 2 .
6. Connect the positive lead to TP3 $\pm 5V$. The voltmeter should be reading +5 volts DC ± 0.5 .
7. Turn OFF main power. Change the scale of the voltmeter to 200 VDC. On later versions of the POWER SUPPLY board there is a jumper JP1, located near the transformer, that must be installed to measure the following voltage.
8. Connect the negative lead of the meter to anode (non-stripped end) of CR6 and the positive lead to the cathode (stripped end) of CR7.
9. Turn ON the main power and measure the voltage. The measured voltage should be between 140 and 150 VDC.
10. Turn OFF the main power.
11. Connect the display board ribbon connector the power supply board at J102 and then repeat steps 3 thru 6. Do not connect the connector to the CPU board at this time. If the above voltages are not measured again, the display board has a bad component which is loading down the voltages. If the voltages are still present, continue to step 12.
12. Connect the display board ribbon connector to the CPU board J310 and repeat steps 3 thru 6. If the above voltages are not measured again, the CPU board has a bad component which is loading down the voltages. This board will have to be replaced.

GENERAL INFORMATION: The POWER SUPPLY PCB ASSEMBLY #3176677 has the triac (solid state AC voltage switch) on it which supplies the power to the heater. This triac is "told" to operate, when need be, by the microprocessor.

There is another device known as an octo-coupler which serves as the high/low voltage isolator between the triac and the microprocessor.

When the bath starts experiencing temperature problem and/or variations, due to known controller malfunctioning, these two components become prime suspects. The reason being they are under higher operating stress than other components.

If the bath starts experiencing temperature problems such as no heat, or "creeping" upward heat, then follow the troubleshooting instructions below. These instructions require the use of a voltmeter being able to measure DC and AC voltages (preferably digital) and an ohmmeter.

WARNING

THE FOLLOWING TROUBLESHOOTING INSTRUCTIONS REQUIRE THAT POWER BE ON. ONLY QUALIFIED SERVICE PERSONNEL SHOULD PERFORM THESE PROCEDURES.

Open the control cover and familiarize yourself with the POWER SUPPLY assembly #33176677. Locate the triac (Q2), the opto-isolator (U1), the resistor (R4), and the test point #2 (TP2-COM). The first measurements will be DC voltage measurements, a DC scale of at least 10 volts should be selected.

PROBLEMS & SOLUTIONS

***** **Problem A : No Heat** *****

1. Verify that the setpoint temperature is greater than the actual water temperature.
2. Verify that the HIGH TEMP light is "OFF". If the light is "ON", turn the HIGH LIMIT CONTROL fully clockwise.
3. Check temperature probe voltage reference. These measurements are on the CPU board #3176678.
 - a. Place the negative lead of a DC voltmeter on TP1-COM test point. Measure the voltage at U7-pin 2. It should be approximately 14 volts DC. Then measure the voltage at U7-Pin 6. It should be approximately 5 volts DC. If the 14 volts is present but not the 5 volts, the CPU board must be replaced.

4. Check temperature probe.
 - a. Measure the bath water temperature and make note of it. Make sure it will not change drastically during this check.
 - b. With a DC voltmeter, measure the supply of the temperature sensor at J302 pins 1 & 3. It should be approximately 5 volts. If it is, then continue on to step C. If not, see Step 3a.
 - c. Measure the output of the temperature sensor at J302 pins 2 & 3. Pin 3 being the reference or ground. The output relationship of voltage to degrees centigrade is listed in the table below. Compare the measured voltage to the temperatures listed to determine if the probe is working.

Temp °C	Volt	Temp °C	Volt
10	0.500V	60	1.400V
20	0.680V	70	1.580V
30	0.860V	80	1.760V
40	1.040V	90	1.940V
50	1.220V	99	2.218V

5. The bath is not heating when it should be requesting heat. Voltage measurements are made on the POWER SUPPLY BOARD #3176677.
 - a. Select a setpoint temperature at least 10° above what the actual temperature is. The bath should be requesting heat as indicated by the heater "ON" indicator lamp on the front panel. It should be on continuously, not flashing.
 - b. Measure the voltage at U1-PIN 2 with respect to TP2-COM. It should be no greater than 4 VDC.
 - c. Measure the DC voltage across R4, since the bath is requesting heat, there should be current flowing through this resistor making the voltage drop equal to 3 vdc ±0.5.
 - d. If the last two steps are not as stated, then most likely the CPU board is bad and it will have to be replaced.

***** **Problem B: Constant Heat** *****

- e. Switch the voltmeter to an AC volts scale capable of reading 120 volts.
- f. Measure the voltage between U1-PIN 4 and U1-PIN 6. It should be less than 1 VAC.
- g. If it is not, then most likely the opto-coupler U1 is bad and the POWER SUPPLY board will have to be replaced. If it is, continue on.
- h. Measure the voltage directly across the heater. It should be line voltage 110V AC to 120 VAC.
- i. If it is not, then most likely the triac Q2 is bad, and the POWER SUPPLY board will have to be replaced.

6. Check heater.

- a. Disconnect the bath from its electrical supply.
- b. Isolate the heater from any circuitry by disconnecting one of the heater leads.
- c. Using an ohmmeter, check the heater resistance. Appropriate heater resistance values are listed below:

MODEL	120 Volt	240 Volt
2870/2871	15 OHMS	57 OHMS
2872/2873	9 OHMS	38 OHMS

If the resistance reads 0 or infinity, then replace the heater.

- d. Check the resistance between the heater leads and ground (green wire). If the resistance reads 0 ohms, replace the heater.

- 1. Bath is heating when it is not requesting heat.
 - a. Select a setpoint temperature at least 10° below the actual temperature. The bath should not be requesting heat as indicated by the HEATER ON indicator lamp on the front panel. It should NOT be on continuously or even flashing.
 - b. Measure the voltage at U1-PIN 2 with respect to TP2-COM. It should be no less than 4 VDC.
 - c. Measure the DC voltage across R4. The voltage should be approximately zero volts.
 - d. If the last two steps are NOT as stated, then most likely the CPU board is bad and it will have to be replaced, otherwise go to the next step.
 - e. Switch the voltmeter to an AC volts scale capable of reading 120 volts.
 - f. Measure the voltage between U1-PIN 4 and U1-PIN 6. It should be line voltage 110 VAC to 120 VAC.
 - g. If it is not, most likely the opto-coupler U1 is bad and the POWER SUPPLY board will have to be replaced. If it is, continue on.
 - h. Measure the voltage directly across the heater. It should be approximately 0 VAC.
 - i. If it is not, then most likely the triac Q2 is bad, and the POWER SUPPLY board will have to be replaced.
- 2. Check Temperature Probe. Problem A, Step 4.
 - d. Slide the push rod back and forth. The push rod should slide very easily in its housing. If not, replace the push rod and the bearing housing.

***** Problem C: Unstable Temperature Control or Display *****

1. Use gable cover provided to improve temperature control.
2. If control is stable but not at desired temperature, then check temperature calibration. Re-adjust if necessary.
3. Check Temperature Probe, Problem A, Step 4.

**** Problem D: Display Reads NNNN or UUUU ****

The control boards have the ability to detect an OPEN or SHORTED temperature sensor. These two conditions are shown on the display as follows:

<u>DISPLAY</u>	<u>CONDITION</u>
UUUU	SHORT CIRCUIT
nnnn	OPEN CIRCUIT

Before coming to the conclusion that the probe is bad when one of these displays appear, check the connection of the probe to the circuit board for polarity and alignment.

**** Problem E: Display Reads all Eights (8888) ****

1. The most common problem which causes this is the failure of the driver integrated circuit on the DISPLAY/KEYBOARD board (#3176679). Replace it.

***** Problem F: Motor Does Not Shake Tray *****

1. Verify that the speed setpoint is greater than 0.
2. Later versions of the POWER SUPPLY board have a jumper JP1 located near the transformer. Verify that this jumper is installed if applicable.
3. Press the Start/Stop key. If the tray shakes violently for a few moments then stops, replace the optical sensor.
4. Check tray linkage for binding.
 - a. Remove tray from the bath.
 - b. Disconnect the push rod from eccentric by removing the bolt.
 - c. Slide the push rod back and forth. The push rod should slide very easily in its housing. If not, replace the push rod and the bearing housing.

5. Check motor.
 - a. Disconnect motor connector J103 from the power supply board.
 - b. Check resistance across the motor leads. The resistance should be approximately 145 ohms. Units built prior to 1996 used a motor with four leads (2 blue, 2 black.). Resistance checked across the black leads should be approximately 1.2 K ohms. Resistance checked across the blue leads should be approximately 110 ohms.
 - c. If either of the above resistances do not measure up, replace the motor.
 - d. On pre-1996 units, check to make sure there is an open circuit between any combination of black and blue leads. If a resistance is measured between any black and blue combination, replace the motor.
6. Check the DISPLAY board #3176679. Even though this check is for the DISPLAY board, the voltage measurements will be made on the POWER SUPPLY board. The command signal that drives the output circuit for the motor comes from the display board.
 - a. Be sure the main power is "OFF".
 - b. Place the negative lead of a DC voltmeter to TP2-COM and the positive lead of the voltmeter to the lead of R6 closer to J102. Disconnect the motor from the POWER SUPPLY board by disconnecting J103.
 - c. Turn "ON" the main power and select a speed of 200.
 - d. During normal operation, the voltage at R6 should be about 4.4 volts DC with the motor "OFF". Press the START/STOP key. For normal operation, this voltage will start to reduce to about 2.3 volts DC in approximately 15 seconds and then jump back to 4.4 volts DC and remain there until the START/STOP key is pressed again.
 - e. If this signal is NOT changing as mentioned above when the START/STOP key is pressed, then most likely the problem is in the DISPLAY board and it will have to be replaced.
 - f. Re-connect the motor back to J103 on the POWER SUPPLY board.

7. Check Power Supply Board #3166924.
 - a. If Step 6 has checked out fine, then possibly the power circuit for the motor has failed. Locate the diode CR11 on the POWER SUPPLY board and place a DC voltmeter across it with the positive lead on the cathode (band side) and the negative lead on the anode. The listed voltages appear across the diode for different speeds. Select a couple of these speeds and verify the voltages.

SPEED SELECTED	VOLTAGE ACROSS CR11 - VOLTS DC
30	20
50	30
70	40
90	50
110	60
130	70
150	80

**** Problem G: Motor Speed Erratic or Fully on ****

1. Check Optical Disc.
 - a. The optical disc should be free of foreign material. If not, clean disc.
 - b. The disc should be parallel to the bottom of the bath and centered in the optical sensor. If not, loosen the 2 set screws on eccentric and reposition the disc.
 - c. The disc should be smooth and flat. If the disc is bent or warped then replace the disc.
 - d. While the motor is operating, the disc should NOT come in contact with the optical sensor at any time.
2. Check Optical transmitter.
 - a. Connect the negative lead of a DC voltmeter to TP1-COM on the CPU board.

- b. With the bath "ON" and motor "OFF" or "ON", use the positive lead of the voltmeter to measure the voltage at J303-Pin 1 of the CPU board. The correct reading should be approximately 1.2 volts DC. If the reading deviates considerably from this, replace the optical sensor.
3. Check Optical Sensor. Just as the Optical Disc can be dirty, the lenses of the optical transmitter and sensor can also accumulate dust and dirt. It would be good practice before making the following voltage measurements to be sure these lenses are clean. The lenses are located on the inner walls of the sensor.
 - a. Connect the negative lead of a DC voltmeter to TP1-COM on the CPU board.
 - b. Connect the positive lead of the DC voltmeter to the lead of R4 which is closer to the edge of the circuit board.
 - c. Turn the bath power "ON" and the motor "OFF".
 - d. Turn the optical disc slowly by hand until a dark portion of the disc is centered between the optical sensor. The voltmeter reading should be greater than 4 volts DC.
 - e. Repeat Step D so a clear portion of the disc is centered between the optical sensor. The voltmeter reading should be less than 1 volt DC.
 - f. If the last two steps did not read correctly, then replace the optical sensor.
4. Check Display Board #3176679; Problem F, Step 6.
5. Check Power Supply Board #3166924; Problem F, Step 7.

PARTS REPLACEMENT

WARNING

BEFORE REPLACING ANY PART, BE SURE BATH IS DISCONNECTED FROM POWER SOURCE. SERVICE SHOULD BE PERFORMED BY A QUALIFIED TECHNICIAN.

Before removing any parts for replacement, verify part in question by following the instructions listed in the troubleshooting guide.

CAUTION

WHEN REPLACING TEMPERATURE SENSOR OR HEATER, MAKE SURE ALL SEALS ARE WATERTIGHT BEFORE APPLYING ELECTRICAL POWER.

Refer to Parts Replacement Table below for appropriate replacement procedures. Failure to follow parts replacement procedures may cause damage to the bath.

PARTS REPLACEMENT	
NOTE: For easiest access to the control housing, place bath on the edge of a bench or table. Remove four screws on upper side of control housing and carefully lower hinged control panel to the vertical position.	
Replace Motor	<ol style="list-style-type: none"> 1. Remove connector J103 from power supply board. 2. Remove bolt on top of plastic bearing and remove bearing. 3. Remove 2 screws from optical sensor and remove sensor. 4. Loosen 2 socket set screws from motor drive eccentric and remove eccentric from motor shaft. 5. Remove 4 screws holding motor bracket to wall, then remove 4 screws holding motor to bracket. 6. Reverse above procedure to install new motor.
Replace Optical Sensor	<ol style="list-style-type: none"> 1. Remove connector J303 from CPU board. 2. Remove 2 screws holding optical sensor to bracket. Remove sensor. 3. Reverse above procedure to install new sensor.
Replace Temperature Sensor	<ol style="list-style-type: none"> 1. Remove tray from bath. 2. Remove connector J302 from CPU board. 3. Remove temperature sensor fitting from inside bath pan, by first holding small nut on fitting firmly with a wrench. Then remove large fitting piece with another wrench. 4. Remove rubber grommet from temperature sensor. 5. Carefully slide sensor through the control housing and remove. 6. Reverse above procedure to install new temperature sensor. 7. Recalibrate new temperature sensor. See Temperature Calibration on page 17.

PARTS REPLACEMENT (CONT'D)

<p>Replace Heater</p>	<ol style="list-style-type: none"> 1. From inside control housing, remove 2 nuts and disconnect wires from heater leads. 2. Remove two hex nuts from heater ends using a 13/16" socket and remove heater 3. Reverse above procedure to install new heater.
<p>Replace "HI Limit" Thermostat</p>	<ol style="list-style-type: none"> 1. Remove four leads from thermostat terminals. 2. Remove two screws from thermostat bracket and remove bracket. 3. Carefully tilt bath on its side. 4. Remove eight screws from bottom plate and remove plate. 5. Remove insulation from bottom of pan and between pan and control panel wall. 6. Loosen two nuts from thermostat bulb bracket. 7. Carefully remove thermostat from control housing by sliding bulb through hole in control panel wall. 8. Reverse above procedure to install new Hi Limit thermostat. Use extreme care when installing new thermostat. A sharp bend in the thermostat capillary will crimp off flow of hydraulic fluid.
<p>Replace Power Supply Board</p>	<ol style="list-style-type: none"> 1. Remove connectors J101, J102, J103, and J105 from board. Use extra care when removing J102 to not bend connector pins. 2. Remove five nuts from board and remove board. 3. Reverse above procedure to install new power supply board.
<p>Replace Bearing Assembly</p>	<ol style="list-style-type: none"> 1. Remove bolt on top of plastic bearing and remove plastic bearing. 2. Disconnect tray from push rod and remove push rod. 3. Remove jam nut from control side of bearing assembly. 4. Slide bearing assembly out and into bath side of unit. 5. Remove bearing cap and wiper seal from assembly. 6. Reverse above procedure to install new bearing assembly.
<p>Replace CPU or Display/Keyboard Board See note on the following page **</p>	<ol style="list-style-type: none"> 1. Remove connectors J302 and J303 from CPU board. 2. Remove connector J102 from power supply board. Use extreme care when removing J102 to not bend connector pins. 3. Remove 4 nuts from CPU board and remove CPU board and Keyboard/Display board. 4. Remove J301 from CPU board. Use extreme care when removing J301 to not bend connector pins. Remove board. 5. Reverse above procedure to install new board.

PARTS REPLACEMENT (CONT'D)

Replace CPU or
Display/Keyboard Board
See note below **

6. The software must be configured to match the Bath model. To enter configuration mode, press the upper left push-button while applying power. The upper left push-button is labeled "Select/Enter." This push-button is used to enter configuration codes and steps through the different levels of configurations. When a triangle is shown in the chart, the push-button is to be depressed once for each symbol.

Immediately following power up with the push-button depressed, the readout will display a 3-digit number. This is the software revision. The readout will then begin to do a self-test of digits. Press the "Select/Enter" push-button once. The readout will display 0000. Follow the listing below to complete the configuration.

A. Enter 37 using up/down arrows. Press "Select/Enter"

B. Enter 12 using up/down arrows. Press "Select/Enter"

C. Enter 2.0 using up/down arrows. Press "Select/Enter"

D. Enter 500 using up/down arrows. Press "Select/Enter"

E. Enter 1 using up/down arrows. Press "Select/Enter"

F. Display Not Used. Press "Select/Enter"

G. Display Not Used. Press "Select/Enter"

H. LOWTEMP CALIBRATION*
LITTLE c. Factory Setting. Press "Select/Enter"

I. HI TEMP CALIBRATION
BIG C. Factory Setting. Press "Select/Enter"

Configuration is now complete

** Calibration of the low and high end of the sensor input is done at the factory. Field calibration of the sensor may be performed using the following technique: Enter the configuration routine and press the top left switch until a little "c" (Item H) is displayed. Add water that is around 10°C to the bath completely covering the sensor. Insert a calibrated thermometer. After the thermometer stabilizes, match the display setting to the thermometer reading by pressing the "UP" or "DOWN" push button switch. Press the top left switch. The readout will now display a big "C" (Item I). Remove water from the bath and add hot water of about 70 - 80°C. After the unit stabilizes, match readout display to temperature on thermometer and press the top left switch. Calibration is now complete.*

****Note:**

When replacing CPU printed circuit board reprogramming may be necessary. Follow thoroughly instructions provided with the replacement circuit board.

TEMPERATURE CALIBRATION

The following provides a step-by-step procedure for temperature calibration. ***Do not deviate from the procedure or the calibration of your bath may be inaccurate.***

CAUTION

THIS PROCEDURE SHOULD ONLY BE PERFORMED AFTER INSTALLING A NEW TEMPERATURE PROBE INTO THE BATH.

1. Connect the temperature probe connector to J302 on CPU board.
2. Turn Power switch to the OFF position.
3. Press and hold UP, DOWN, and ENTER keys while turning Power ON.
4. The unit will now cycle through an LED display test. Press ENTER to end test.
5. The display will now read 0000. Press UP until display reads 0012.
6. Press ENTER - The unit is now in calibration mode. If some other value than 0012 is displayed and ENTER is pressed, the unit will return to normal operating mode and display will show actual bath temperature.
7. The display will now show CXX.X (XX.X is the actual bath temperature) - this is Low Temperature Calibration.
8. Place the temperature probe and a calibrated reference thermometer into an ice bath. Press UP or DOWN until the display value matches the reference thermometer. Press ENTER to store the new low temperature calibration value.
9. The display will now show CXX.X - this is High Temperature Calibration. (XX.X is the actual bath temperature).
10. Place the temperature probe and a calibrated reference thermometer into a steaming water bath. Press UP or DOWN until the display value matches the reference thermometer. Press ENTER to store the new high temperature calibration value.

NOTE

PRESSING OFFSET AT ANY TIME DURING THE CALIBRATION PROCESS WILL RETURN UNIT TO NORMAL OPERATION MODE AND DISPLAY WILL SHOW ACTUAL BATH TEMPERATURE.

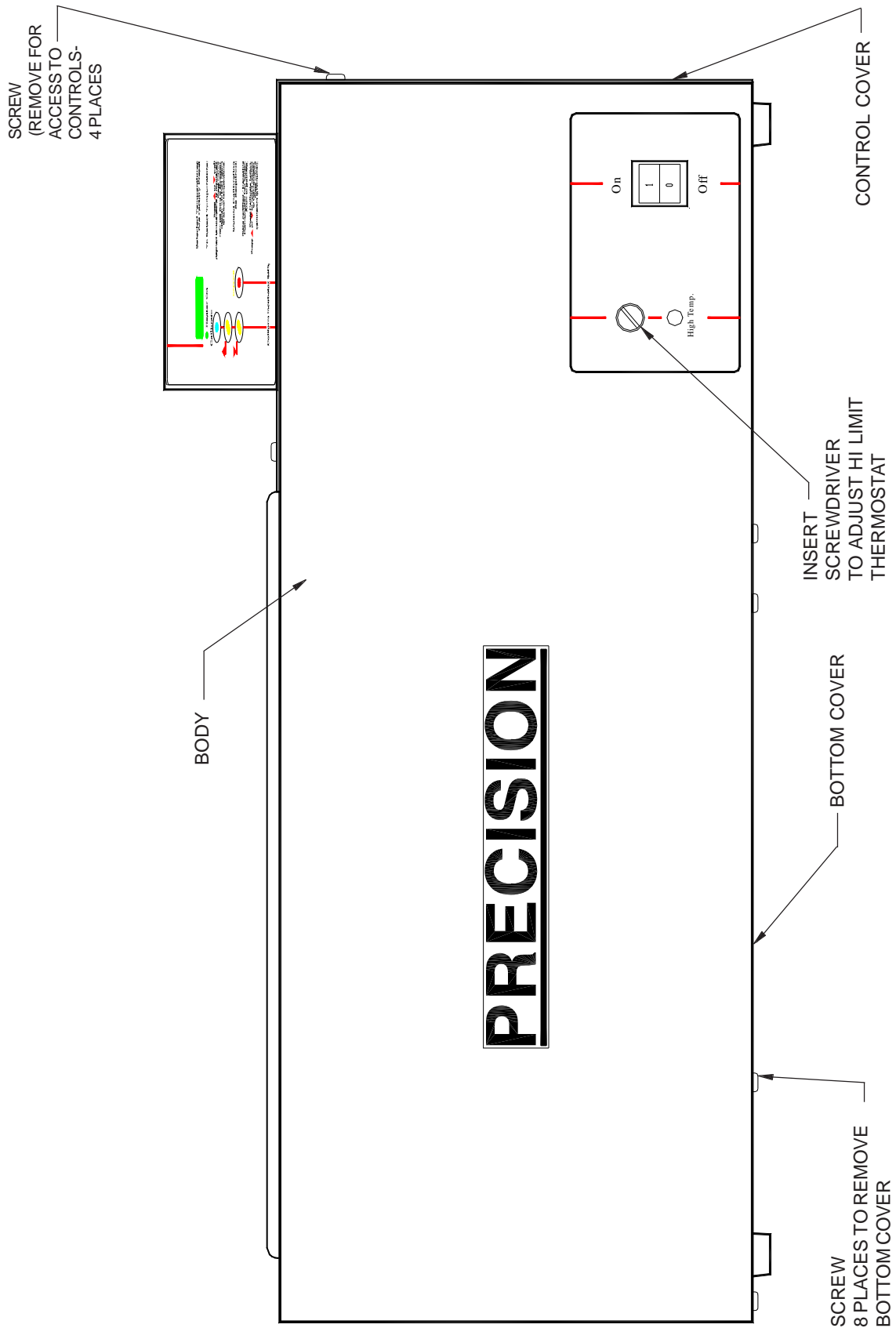
REPLACEMENT PARTS LIST

	Model #2870/2871		Model #2872/2873	
	120V	230V	120V	230V
Bath Pan Kit	3167154		3167148	
Tray Assembly	31662332		3166233	
PCB Asm Kit, Power Supply	3166924			
PCB Assembly Kit, CPU	3167119			
PCB Assembly, Display	3176679			
Wire Harness	3176700			
Temp. Probe Assembly	3167144			
RPM Optical Sensor Assembly	3167058			
Bearing Assembly Kit	3167155			
Push Rod	3177567			
"O" Ring Kit	3167129			
Drain Kit (Includes O'Ring & Nut)	3166191			
RPM Detector/Eccentric Kit	3167153			
Heater Kits	3167138	3167139	3167136	3167137
"HI LIMIT" Thermostat Kit	3167143			
On/Off Switch	3175318			
Hi Limit Light, Amber	3177575	3173907	3177575	3173907
Line Cord	3178034	3179481	34353081	3179481
Motor Assembly Kit	3167047			
Power Cord Receptacle	N/A	3179502	N/A	3179502
Mains Fuse (2 ea.)	N/A	3172449	N/A	3172443
Power Supply Board Fuse	N/A	3175930	N/A	3175930

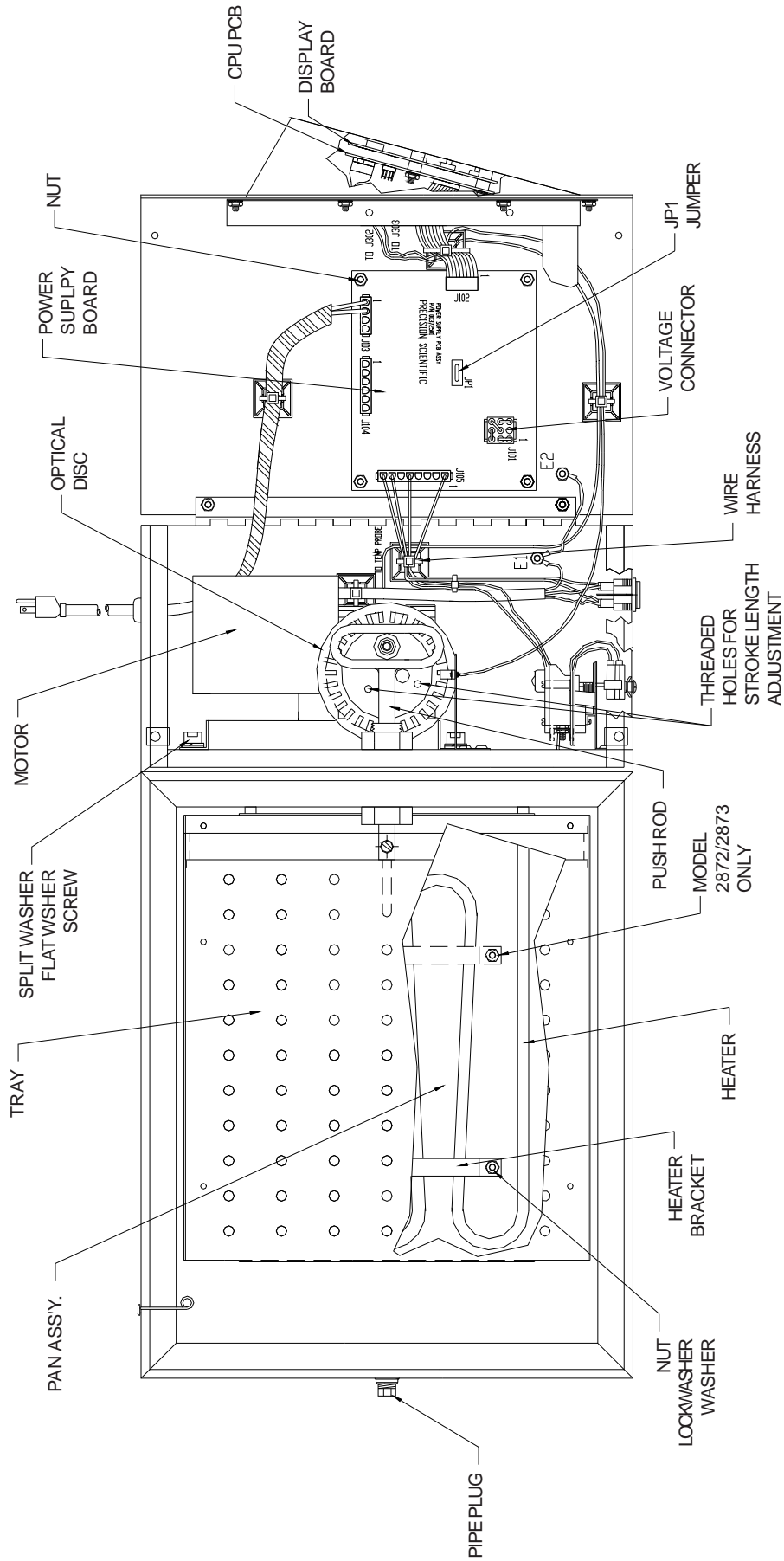
ACCESSORY PARTS LIST

Catalog Number	Description		
3166565	Gable Cover, Model 2870/2871 N/A		
3166208	Gable Cover, Model 2872/2873 N/A		
3166223	Water Level Regulator Kit		
3166250	Quarternary Ammonium Type Germicide		
Catalog Number	Description	Maximum Clip Capacity Model 2870/2871 Model 2872/2873	
3166216	Clip for 13mm to 25mm dia test tube	25	60
3166227	Clip for 25ml flask	20	48
3166198	Clip for 50ml flask	15	36
3166221	Clip for 125ml flask	9	24
3166566	Clip for 250ml flask	6	14
3166199	Clip for 500ml flask	4	12
3166200	Clip for 1000ml flask	2	5

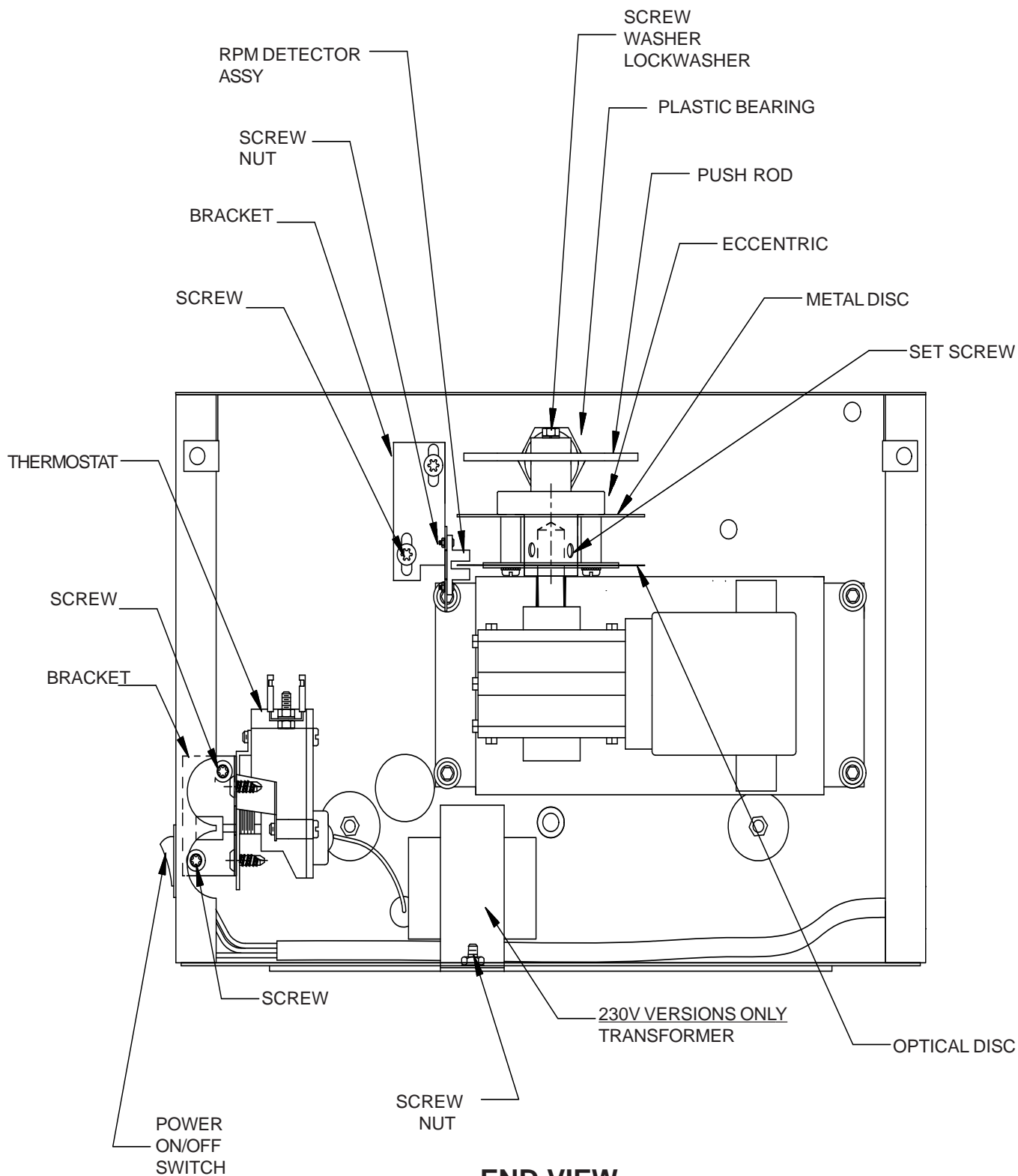
ASSEMBLY & SCHEMATIC DWGS.



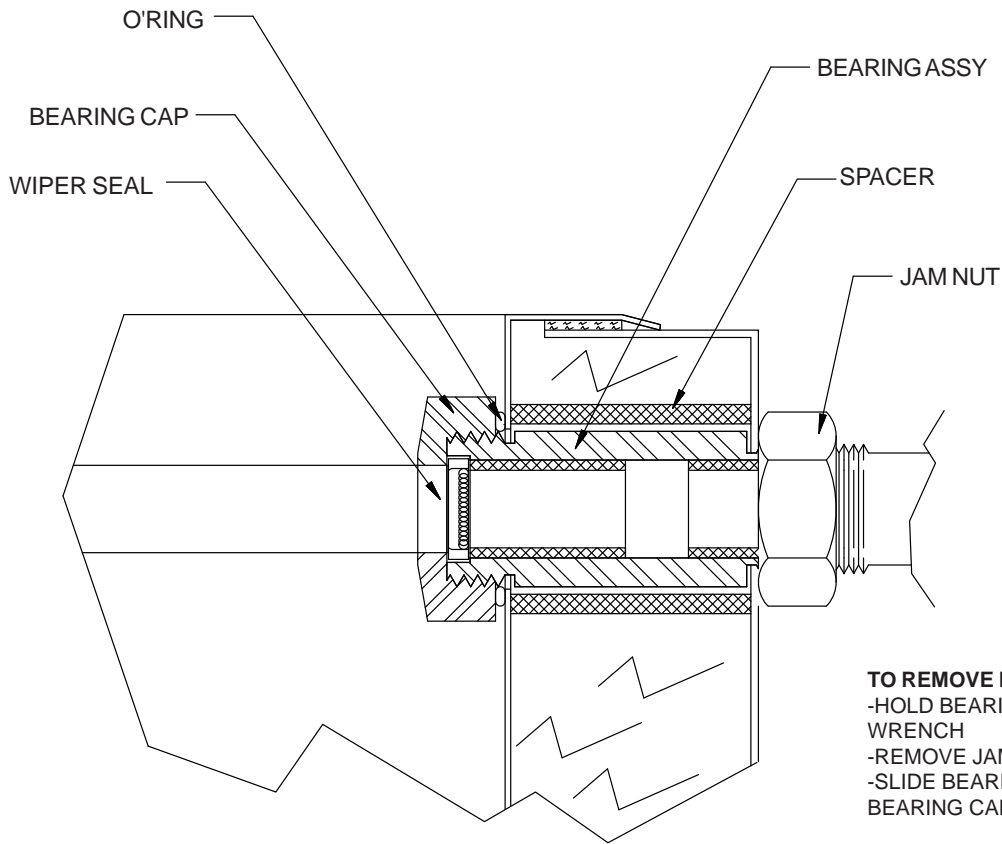
FRONT VIEW



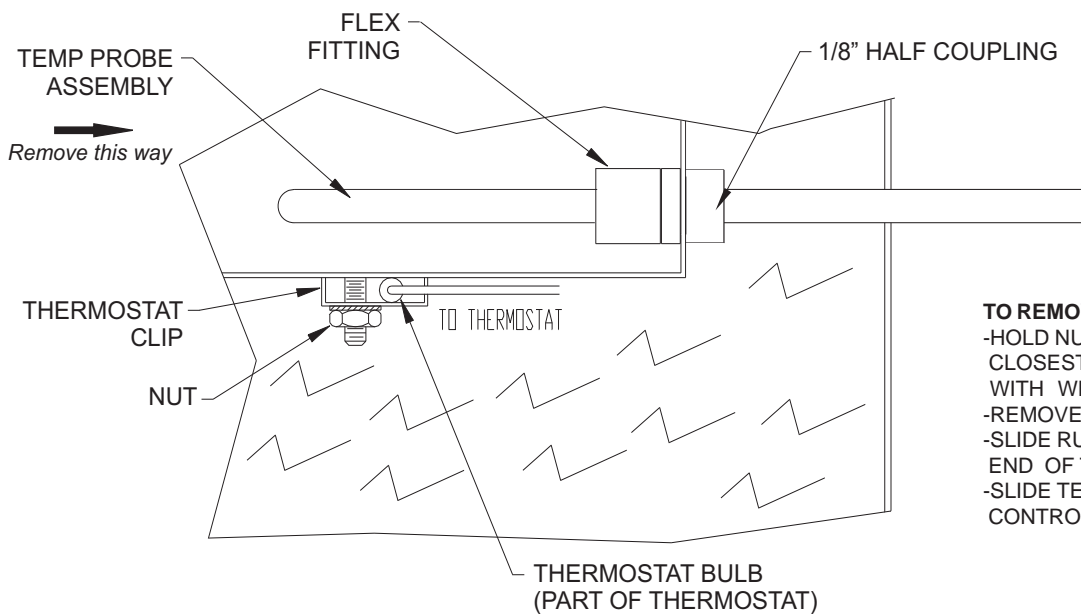
TOP VIEW
(WITH CONTROL COVER OPEN)



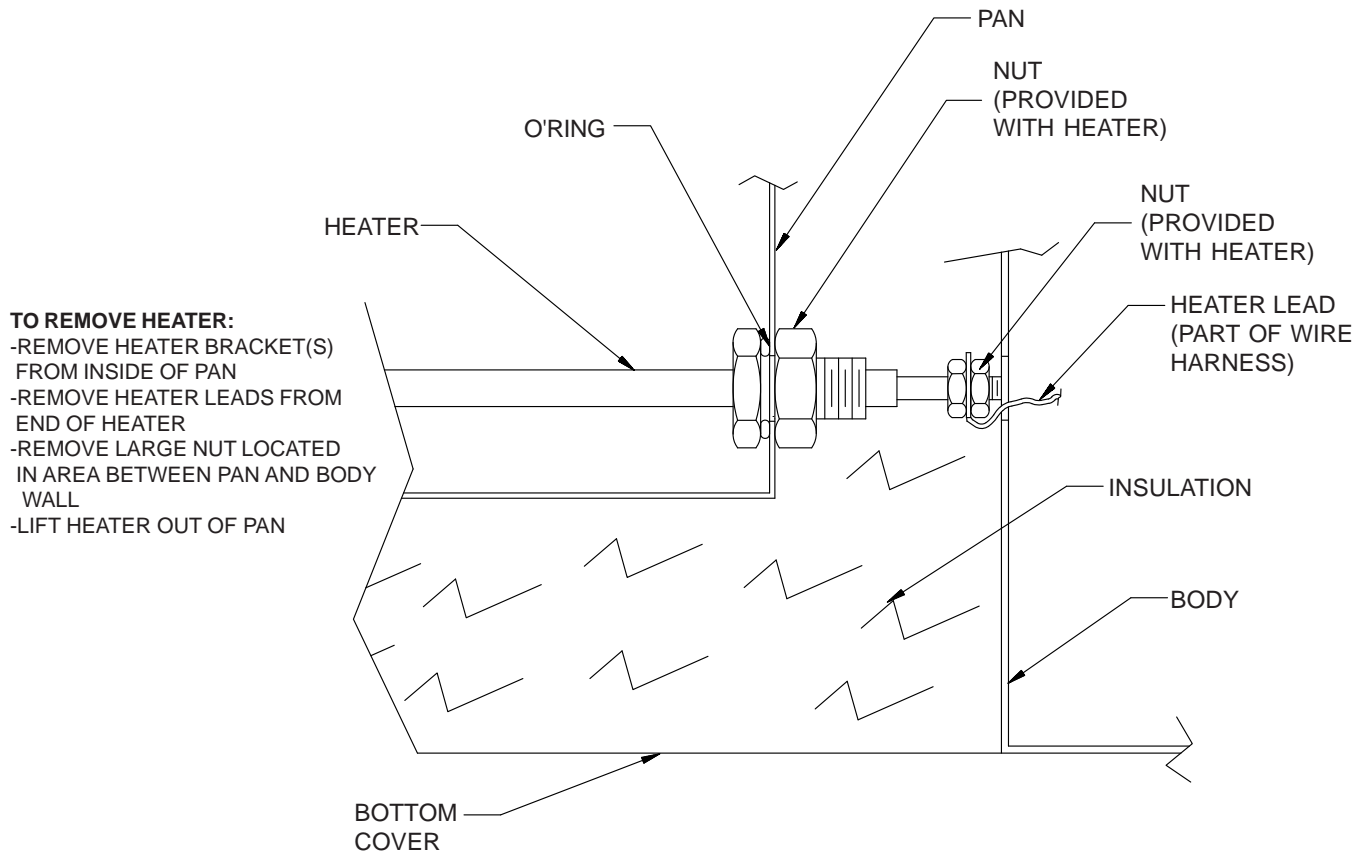
END VIEW
(WITH CONTROL COVER REMOVED AND WIRING EXCLUDED)



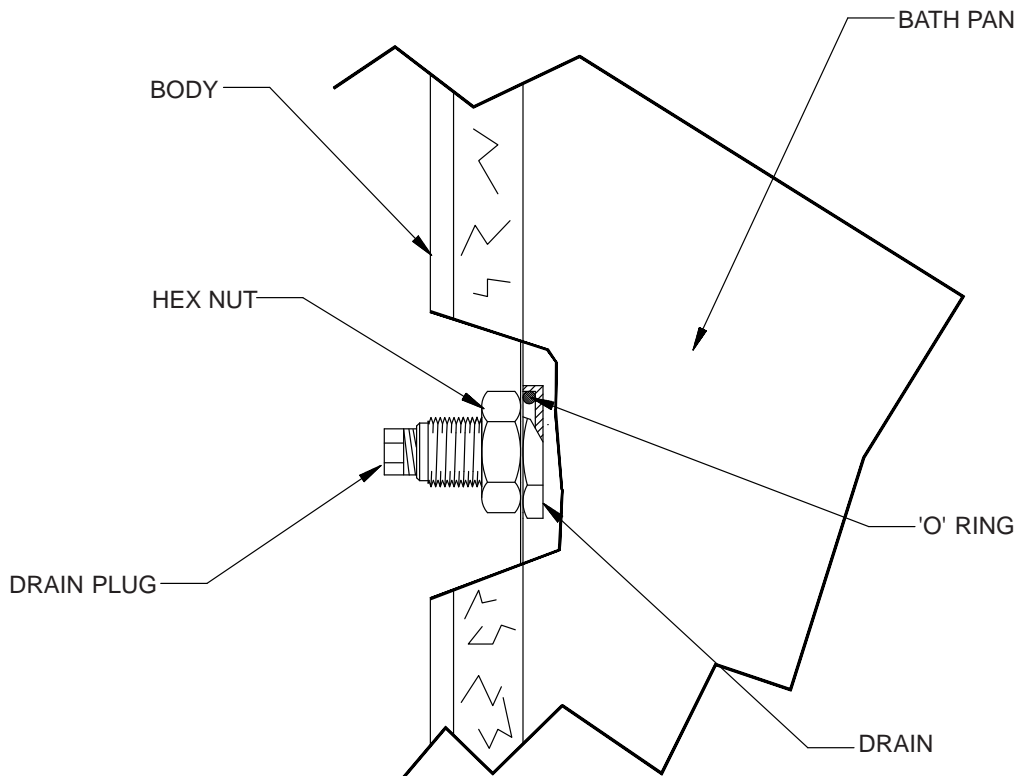
**UPPER VIEW
 BEARING ASSEMBLY**



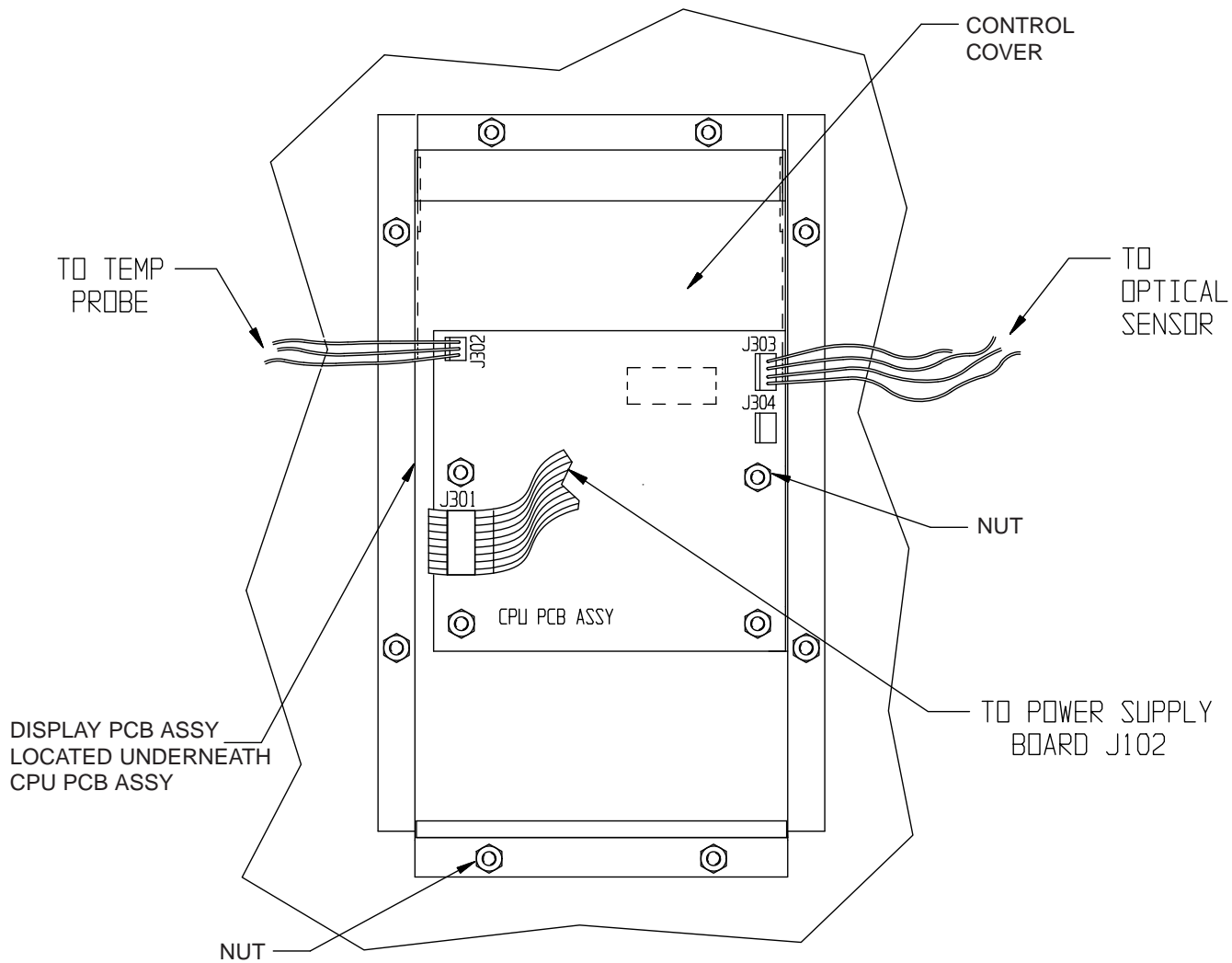
**LOWER VIEW
 TEMPERATURE PROBE ASSEMBLY DETAIL**



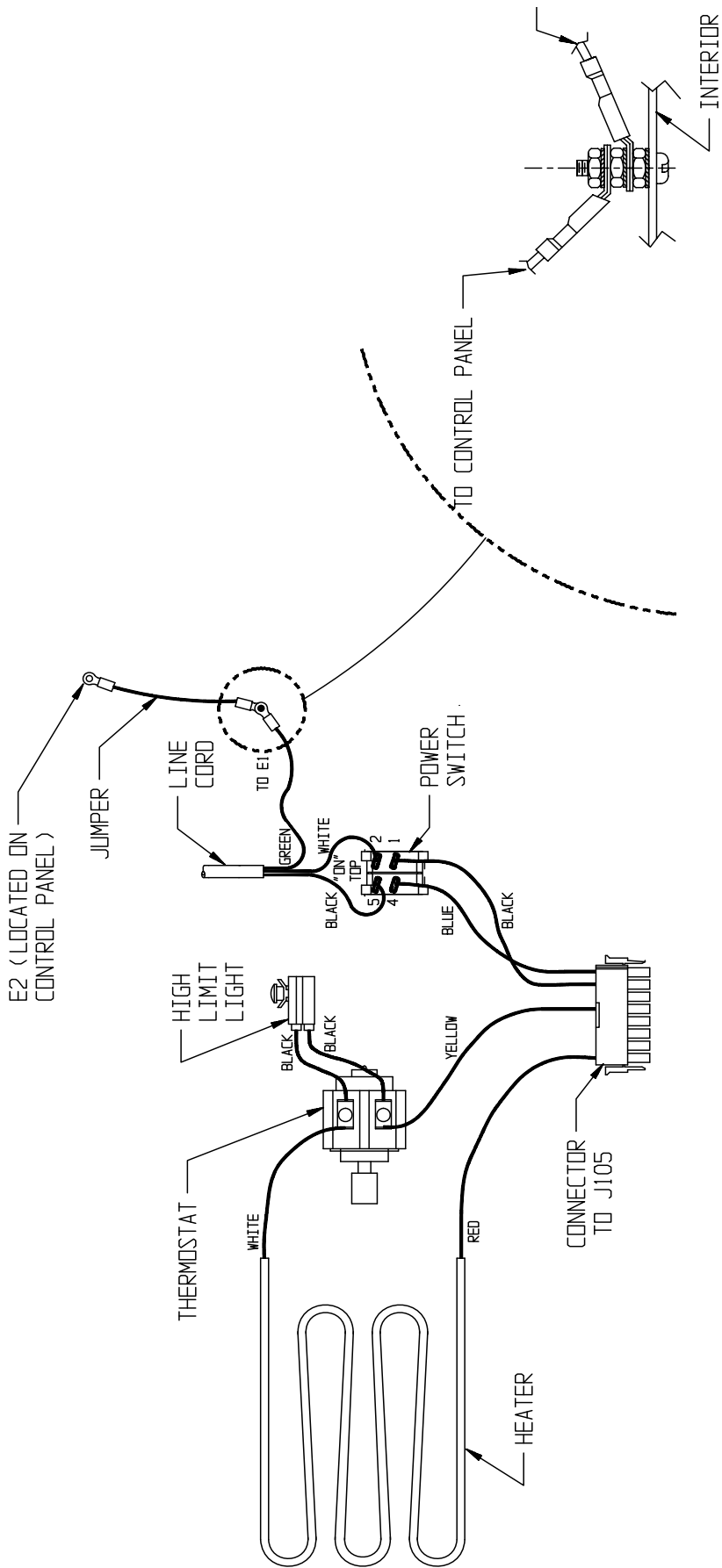
HEATER REMOVAL DETAIL



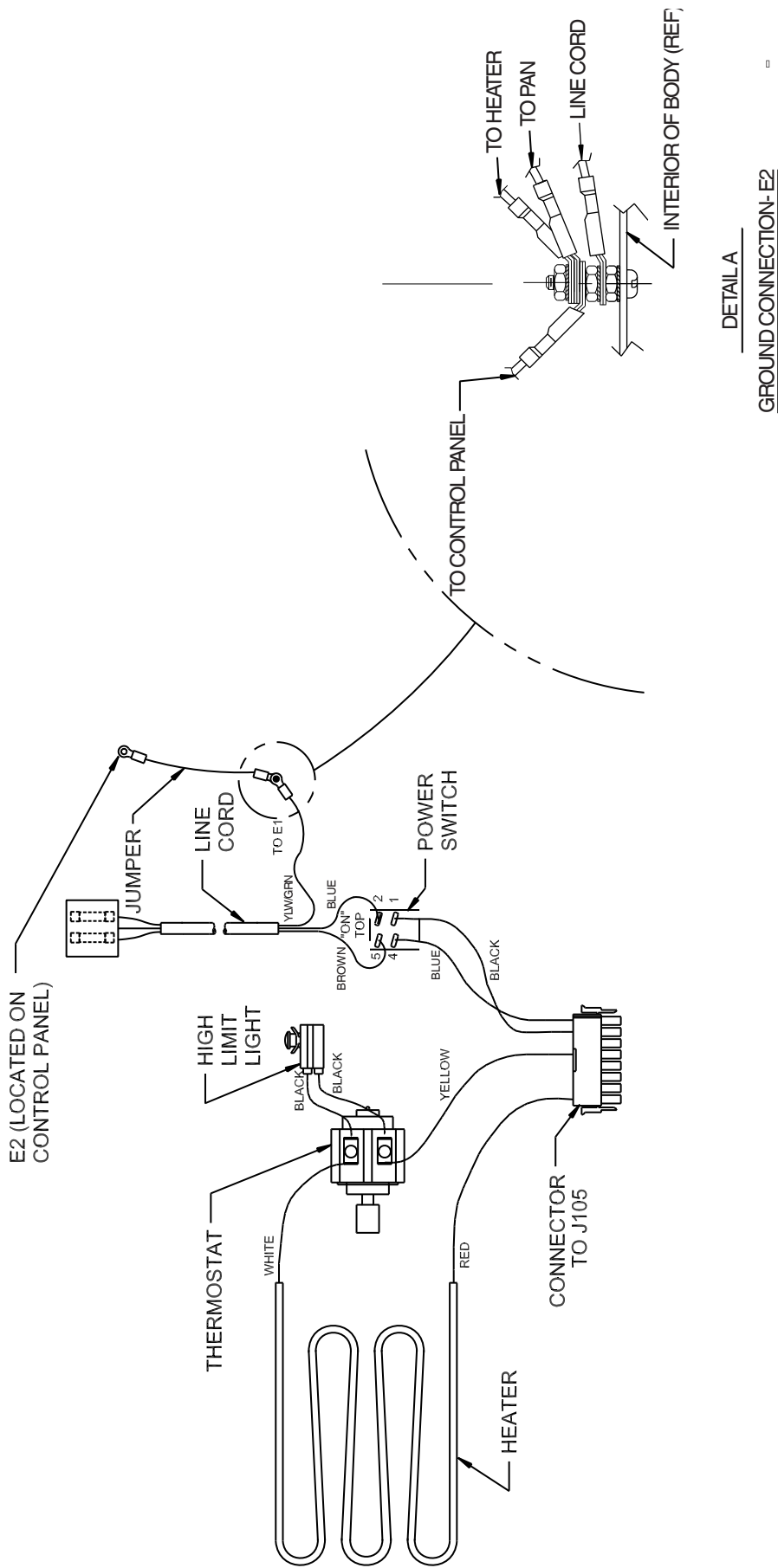
CUTAWAY VIEW OF DRAIN



CPU /PCB ASSEMBLY CONFIGURATION



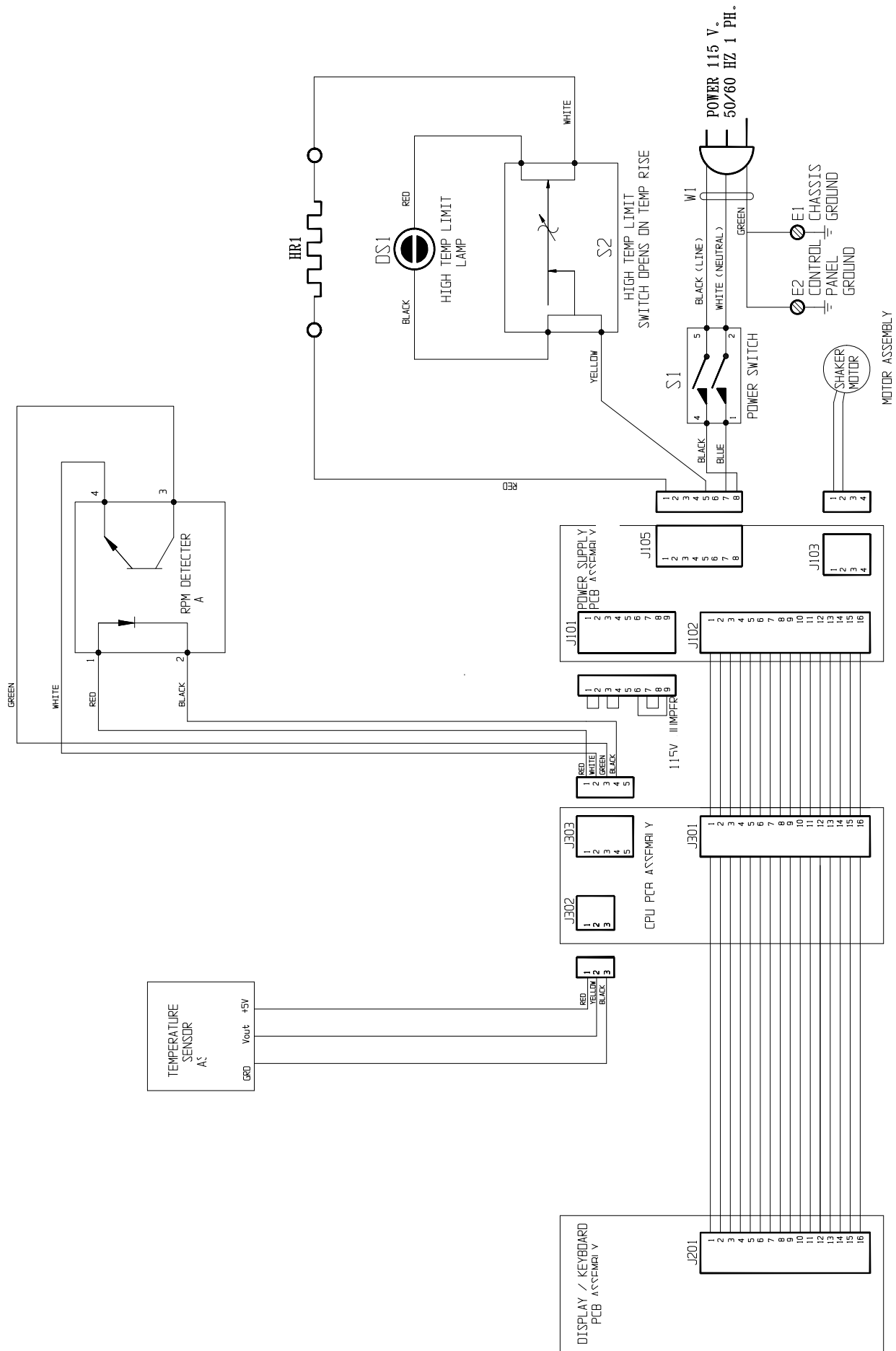
WIRING CONNECTION DIAGRAM
120V



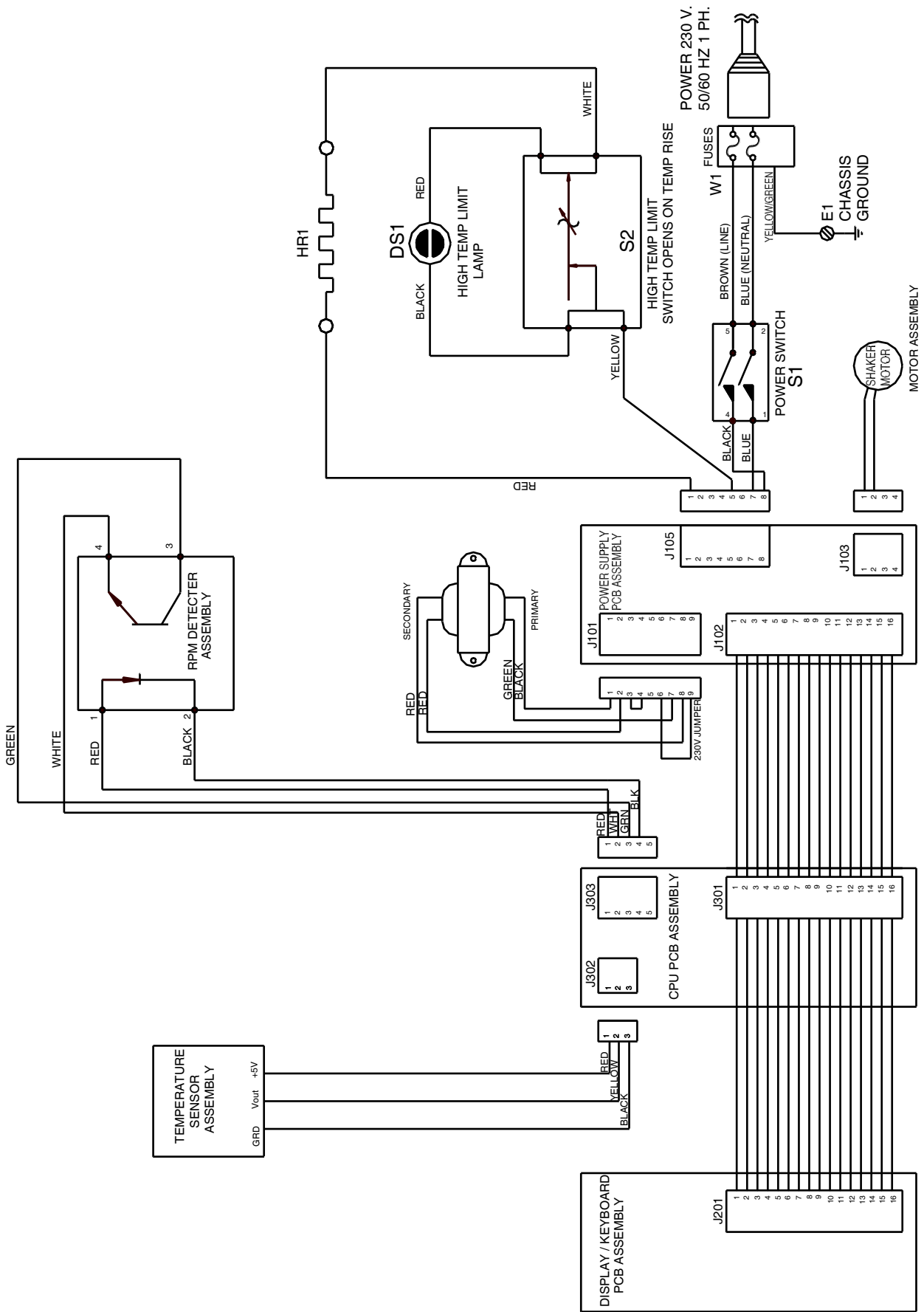
WIRING CONNECTION DIAGRAM

240V

DETAIL A
GROUND CONNECTION-E2



120 WIRING DIAGRAM



240V WIRING DIAGRAM

THERMO FISHER SCIENTIFIC STANDARD PRODUCT WARRANTY

The Warranty Period starts two weeks from the date your equipment is shipped from our facility. This allows for shipping time so the warranty will go into effect at approximately the same time your equipment is delivered. The warranty protection extends to any subsequent owner during the first year warranty period.

During the first year, component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, labor included. Installation and calibration are not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to performance of any repairs. Expendable items, glass, filters and gaskets are excluded from this warranty.

Replacement or repair of components parts or equipment under this warranty shall not extend the warranty to either the equipment or to the component part beyond the original warranty period. The Technical Services Department must give prior approval for return of any components or equipment. At Thermo's option, all non-conforming parts must be returned to Thermo Electron Corporation postage paid and replacement parts are shipped FOB destination.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED. NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY. Thermo shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits or loss of products.

Your local Thermo Sales Office is ready to help with comprehensive site preparation information before your equipment arrives. Printed instruction manuals carefully detail equipment installation, operation and preventive maintenance.

If equipment service is required, please call your Technical Services Department at 1-800-438-4851 (USA and Canada) or 1-740-373-4763. We're ready to answer your questions on equipment warranty, operation, maintenance, service and special application. Outside the USA, contact your local distributor for warranty information.



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THERMO FISHER SCIENTIFIC INTERNATIONAL DEALER WARRANTY

The Warranty Period starts two months from the date your equipment is shipped from our facility. This allows for shipping time so the warranty will go into effect at approximately the same time your equipment is delivered. The warranty protection extends to any subsequent owner during the first year warranty period. Dealers who stock our equipment are allowed an additional six months for delivery and installation, provided the warranty card is completed and returned to the Technical Services Department.

During the first year, component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, labor excluded. Installation and calibration are not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to performance of any repairs. Expendable items, glass, filters, reagents, tubing, and gaskets are excluded from this warranty.

Replacement or repair of components parts or equipment under this warranty shall not extend the warranty to either the equipment or to the component part beyond the original warranty period. The Technical Services Department must give prior approval for return of any components or equipment. At Thermo's option, all non-conforming parts must be returned to Thermo postage paid and replacement parts are shipped FOB destination.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED. NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY.

Thermo shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits or loss of products.

Your local Thermo Sales Office is ready to help with comprehensive site preparation information before your equipment arrives. Printed instruction manuals carefully detail equipment installation, operation and preventive maintenance.

Contact your local distributor for warranty information. We're ready to answer your questions on equipment warranty, operation, maintenance, service and special application.



Rev. 4 2/09

