

# TESTING, SERVICE & REPAIR GUIDE

## (For "SH" Space Heating Models & "RA" Water Heating Models)

**WARNING** - HIGH VOLTAGE AC electrical circuits are connected to this heater. Do not attempt any service work on the heater without first turning off all the power to the heater and verifying the power is off with a voltmeter. If unsure, call Tech Support at 888-296-9293 during normal working hours, Central Time.

### PRECAUTIONS

1. **SMOKE/WATER:** Do not remove the protective cover to the heater if there is smoke present or water leaking from the heater. Immediately turn off all power and water/fluid supply to the heater.
2. **POWER:** There may be up to four (4) electrical circuits connected to your heater. You must verify that all breakers and/or disconnects serving these circuits are turned off before performing service and repair work.
3. **TOOLS:** Testing & repairs may require special tools and training to use them. If you do not have the tools and experience, contact a local electrician or heating & air-conditioning technician to perform these procedures. Note: you may be subject to labor charges for this service.
4. **ELECTRONICS:** When performing service work on the heater, try not to drip water or other fluids onto the control board. If water or fluids do get on the control board, dry it off with a hair dryer. Do not attempt to turn on the power until the control board has been thoroughly dried.
5. **TIGHTENING:** Do not over tighten or over torque parts such as heating elements, temperature sensors and limit switches. See appropriate repair section for maximum torque specifications.

### VISUAL CHECKS

1. **INSTALLATION:** Is the heater mounted upright with the plumbing on top? See "Installation Guide" that is included with your heater.
2. **CONNECTIONS:** Is the heater connected to the plumbing system correctly (hot on the left, cold on the right)? See "Installation Guide" that is included with your heater.
3. **LEAKS:** Are there any water or fluid leaks around the heater?
4. **FAUCETS:** Are the sink fixtures plumbed correctly (hot on the left, cold on the right)?
5. **DAMAGE:** Does there appear to be any damage to the heater or did any occur during installation (plumbers solder, sheetrock mud, paint, or water on the circuit board)?
6. **WIRES:** Are there any wires disconnected or hanging from the heater? (All wires should be securely connected to a terminal or lug)

### FUNCTIONAL CHECKS

1. **BREAKERS:** Are *all* of the breakers turned on?
2. **VOLTAGE:** Is there voltage at the control board? Measure across power lugs L1 & L2. See "Power Check" Section #1.
3. **FLOW:** Is the flow usage at the faucet too high for the water heater capacity rating of your Model? The question applies to space heater models and their requirements for heat circulating systems as well. See "Model Specifications – Flow Ratings and Temperature Rise"
4. **HEATING:** Does the outlet pipe above the heater on the left get hot to touch while running hot water at the faucet? If so and the faucet runs cold, check faucet or plumbing for correct installation. If the pipe does not get hot, proceed with following diagnostics and testing for the heater.

## SELF DIAGNOSTIC CODES

1. TURN OFF ALL THE POWER TO THE SEISCO!
2. Carefully remove the protective cover.
3. Turn all the power back on to the heater, using the circuit breakers or disconnects.
4. You are now ready to check for diagnostic codes as follows:

### LOCATE FLASHING CODE LIGHT

When you first turn power on to the heater it is normal for the heater to flash two to four red flashes (depending upon the model) before returning to its normal status. After which, **generally** if the heater is not experiencing a problem, the LED light on the control panel flashes ALL GREEN. If a problem is detected, the same LED light will alternate a RED flashing diagnostic code.

Some codes automatically reset if the problem corrects itself, such as high or low voltages. Others have to be manually reset for safety reasons, such as high temperature detection. If the status LED light is flashing a solid **green**, skip this section and go directly to the Diagnostics and Repair Sections.

### AUDIBLE CODE OPTION

It may be easier or necessary in some instances **to be able to hear** the diagnostic code. Press and hold the small **blue "status button"** on the control board for **2-3 seconds (NOT LONGER)** to activate the **audible alarm**. The audible alarm will make it easier to identify the code sequence or allow an assisting service technician to hear the code over the phone and determine the problem. The audible code will stop after all codes repeat twice about 30 seconds and if desired it can be restarted. By identifying the code the heater may be emitting, the technician can identify if a part is defective or needing repair. A complete list of codes and their meanings can be found in Section 8, *Diagnostic Code Table*.

### READING DIAGNOSTIC CODE

Each diagnostic code uses **3 sequences of numbers** (flashes-beeps). A sequence of red flashes or audible beeps contains a pause between each number that makes up the error code.

For instance, a 1 – 2 – 2 will first indicate the (1) with a single **red** flash or beep followed by a pause, then the (2) is indicated by 2 quick red flashes or beeps, followed by a pause and then the second (2) by 2 more quick red flashes or beeps. **Green flashes indicating the end of the error code sequence follow the sequence of red flashes momentarily. There may be more than one diagnostic error code**, so it is necessary to read all codes before determining corrective service to the heater. **As long as the problem with the heater exists, the red flashes will continue to repeat the error code(s) separated by green flashes until the problem with the heater is corrected. Once corrective measures have been taken, turn power off to the heater and then back on to reset the processor.**

**IN THE EVENT YOU ARE NOT SUCCESSFUL IN OBTAINING THE CORRECTIVE MEASURE FROM A DIAGNOSTIC CODE CONTINUE WITH THE FOLLOWING:**

<u>Symptom</u>	<u>Action</u>
<b>1. No Hot Water or Unit Not Heating</b>	<b>use sections 1 &amp; 2</b>
<b>2. Fluctuating temperature</b>	<b>use section 3</b>
<b>3. Not enough Hot Water or Heated Fluid</b>	<b>use section 5</b>

## TESTING AND REPAIR SECTIONS

1. **Power Check**
2. **High Temperature Limit Protection Switch Test**
3. **Temperature Sensor Resistance Test**
4. **Replacing a Temperature Sensor**
5. **Heating Element Resistance Check**
6. **Element Replacement**
7. **Rematch Procedure**
8. **Diagnostic Codes**

### Section 1. POWER CHECK

#### **POWER LUGS**

Verify the voltage from the incoming power supply at L1 and L2 power lugs for each circuit to the control board. Identify the power lugs to the far right of control board where the incoming power supply wires connect to the board. With your voltmeter set to a range of 250 VAC or more and **place the red probe on the very top right power lug on the control board marked (L1) and the black probe on the lug immediately below (L2)** to verify voltage is 220 Volts to 250 Volts (AC). After verifying the voltage is in this range at this circuit move down to the next pair of power lugs beginning with L1 and L2 performing the same check. Repeat voltage verification for all sets of lugs.

#### **CIRCUIT PHASING CHECK**

If you do not measure voltage or the circuit voltage is 0 then the incoming power supply is **not connected or is out of phase**. This means that one of the wires is the same phase as the other. In either case you will not get power. First check all the breakers in the panel box for the heater by turning them off and then back on again. If the breakers are all back on and you still do not have the voltage between 220 Volts and 250 Volts, then identify which 2 circuits do not show the proper voltage. If this is the case, then this would indicate that these two circuits are miswired out of phase. To verify, perform the following phase check.

Start as you did above with the red probe on the L1 lug of the circuit that does not have voltage between 220 Volts and 250 Volts. Take your black probe and move it to the L1 power lug of the 2<sup>nd</sup> circuit that does not indicate proper voltage. If you do not measure voltage between these two L1 lugs, then move the black probe to the L2 lug of the 2<sup>nd</sup> circuit. You should get the proper power with one of these combinations indicating that one of the wires in each circuit should be removed and placed on the other to obtain the voltage through proper **phasing**.

#### **CORRECTING THE CIRCUIT PHASING**

1. Identify which pair of wires on the circuit, where you have the red probe, gives you the proper voltage. Then turn off all power and verify. Remove the **L2 wire** in this first circuit and swap it with **the wire from the second circuit** that gave you the proper voltage.
2. Put the wire removed from the first circuit in its place. Make sure all the wire strands are in the lug and no strand is out of the lug in contact with the board.
3. Turn the power back on and again verify the power to each of the individual circuits between their respective L1 and L2 connections as described in the first paragraph of the "Power Check" even though you read "0" voltage on a pair of wires each individual wire may still have 120 volts measured to the ground.

## **Section 2. HIGH TEMPERATURE LIMIT SWITCHES**

The high temperature limit protection switches also known as "high limit switches" are located at the top of your heater. These switches are designed to turn off and disable the heater if it has heated higher than the allowed threshold. If you have a two-chamber heater with 2 heating elements, you will have only one switch. If you have a four-chamber heater with 4 heating elements, there will be 2 switches.

### **LOCATING & TESTING THE HIGH LIMIT SWITCHES**

1. Locate the brown wires running from the top of the control board and follow them up to the top right heating chamber and the top of the second chamber from the left. There you will see a device that has two connections coming out of it. In the center of the device between where the two brown wires connect there will be a small red button. In some cases one of the devices is an auto switch and will not have this button.
2. Make sure you turn off all the power to the heater. This is a very low voltage circuit but close to the heating elements so use a small piece of wood or plastic that is flat and that you can use to push **firmly** on the red button to reset. You should hear a fairly loud click as the relays engage. This will indicate that you have reset the switch.
3. Turn the water on at a faucet or start the space heating system to verify it is hot and then run it for about 3 minutes then turn off the water abruptly.
4. Wait about 5 minutes then go back and turn the water back on or start the space heating system and verify that the heater is heating up. The switches are sometimes fairly sensitive so if you have repeated tripping, first turn the temperature knob down counterclockwise and see if this doesn't remedy the situation. If not contact Service help at 888-296-9293.

## **Section 3. TEMPERATURE SENSOR RESISTANCE CHECK**

Temperature sensors that have been damaged, failed or over time are simply not reading correctly can greatly affect the performance of the heater. The heater control provides an electronic means for rematching the sensors so that most sensor problems can be solved in just a few minutes. The following procedure is very important to proper corrective action.

**WARNING: ALL POWER MUST BE TURNED OFF AND VERIFIED BEFORE DOING THIS RESISTANCE CHECK.**

### **CHECKING THE SENSOR WIRES**

1. First, check the sensor wires (red & green wires) by performing a Continuity Test to verify they are not defective. Replace any bad sensor wires before proceeding with the following sensor checks:

### **TEMPERATURE SENSOR RESISTANCE CHECK**

2. Make sure power is off and run cold water or fluid through the heater for 5 minutes.

**Note:** Since the heater is not heating this will allow all the sensors to achieve the same temperature conditions for you to check. If it is determined by the following procedure that the resistance of one of the sensors is over 10% off from the others then you should replace it. (I.e. if you have the sensors connected with red and green wires and all your sensors but one are reading 250-260 ohms but one is reading 300 ohms high or 210 ohm low, you should replace this sensor.

3. Place the two multi-meter probes, one each on each of the two connection terminals of the sensor wires **that connect the wire to the control board** in order to correctly measure the resistance (ohms). It is best to place the probe in one of the shoulders of the terminal so that you get a good connection.

4. Start with the inlet water sensor. This is the sensor at the bottom of the inlet water tube under the heater on the right. Follow the wires up to the board and you will see its locations marked "THIN". Place your probes one into each of the wire **terminals** that connect the sensor wire to the board. Check your reading and record it. **Write down the sensor "TH" # and each reading.**

**Note:** The sensors using the **red and green wires** will give you a reading in hundreds of ohms such as "256". The colder the water the higher the reading so you may get readings of over 350 ohms. The sensors with the **white wires** will give you readings in the single to double-digit numbers such as 8 to 15 meaning 8,000 to 15,000 ohms. If you are not getting this kind of reading check your meter and the range that you have set. If you are confident your meter is set right or have a correct reading go to the next.

5. Next go to the top of the chamber at the far right. This is counted as chamber 1 as it is the first chamber the water or fluid enters into.
6. At the top left, actually in the 2<sup>nd</sup> chamber, will be "TH1" check it and record reading.
7. Then go to the bottom of the same heating chamber and locate the sensor "TH2", check and record.
8. Then go to the top of the last chamber on the left and locate "TH3" check and record.
9. Lastly, go to the bottom of the same heating chamber to locate "TH4" check and record. If any sensor is over 10% off, you **MAY** need to replace it.

**Important:** If you find that the reading for **TH1** sensor is higher than **TH2** by more than 10 ohms and it is a sensor with red and green wires or 1000 ohms for the sensors with white wires, you should swap these sensors positions putting the TH1 in the place of the TH2 and TH2 in the place of TH1. **BEFORE ATTEMPTING THIS READ CAREFULLY THE FOLLOWING PROCEDURE FOR REPLACING A TEMPERATURE SENSOR.**

#### **Section 4. REPLACING A TEMPERATURE SENSOR**

1. **Turn off power and shut-off flow of water or fluid to the heater** - If the sensor is an upper sensor, **remove the base plate to the chamber** in which the sensor is located, and drain the heater. After draining the heater, clean the base plate's seal and sealing area and replace.
2. If the sensor is one having red and green wires, remove the sensor wires from the defective sensor. Do not remove the connections from the board unless it is a sensor with white wires and then while holding the board from flexing, use small pliers to pull the terminal loose- NEVER pull the wire itself. Then carefully remove the sensor unscrewing it counterclockwise.
3. Unscrew the seal from the sensor being careful not to damage the seal. Do not attempt to pull it off, as you will damage it. Remove the connector and save it. (The sensors with the white wires do not have the connector) Clean the seal off with water.
4. Take the new sensor and replace the connector (The sensors with the white wires do not have the connector) then gently screw the seal back on to the new sensor.
5. Place the sensor in the hole and with your fingers ONLY screw the sensor back into the chamber. Be careful not to cross thread the part. The sensor should go back in finger tight. Then take a small wrench and tighten up the sensor until it is snug. **Be careful not to over tighten the part as you may strip the threads of the chamber part.**
6. Turn on the water and check for leaks. If the sensor needs a little more tightening you can do it safely. **CAUTION:** If for any reason you get any water or fluid on the control board, use a hair dryer and immediately dry the board for several minutes.

**After performing the replacement ALWAYS PERFORM THE "MATCHING PROCEDURE" THAT FOLLOWS IN SECTION #7. (For Microprocessor Control Panel Boards)**

## Section 5. HEATING ELEMENT RESISTANCE CHECK

**WARNING:** DO NOT ATTEMPT THIS PROCEDURE UNLESS ALL THE POWER TO THE HEATER IS TURNED OFF AND YOU HAVE VERIFIED IT IS OFF WITH YOUR VOLT METER.

### **RESISTANCE CHECK**

1. Set your multi-meter to ohms (  $\Omega$  ) and the range at 10 or 20 ohms.
2. Place one of your meter probes in each of the two terminal screws at the top of the element. You do not have to remove the element wires. You should read from 7 to 15 ohms for a good heating element.
3. If you get zero, or no reading, then you need to replace the element. Call Service Help at 888-296-9296 or your local distributor to purchase the proper element.
4. If you need to replace the element with another brand, sure you do not use an element that is longer than the one in your heater (maximum 12" long) and that you follow the replacement instructions below.

**WARNING:** NEVER USE ANY "O" RING SEAL OTHER THAN THE ONE THAT IS ON YOUR ORIGINAL ELEMENT OR PROVIDED BY THE MANUFACTURER. THE USE OF ANY OTHER SEAL CAN DAMAGE YOUR HEAT EXCHANGER.

## Section 6. REPLACING A HEATING ELEMENT

SEISCO uses standard thread emersion type heating elements, but the screw plugs are brass rather than plated steel. You should always use the manufacturer's replacement element, but in an emergency you can purchase suitable screw type elements from most wholesale plumbing supply companies. Follow these replacement instructions carefully:

### **REMOVAL & REPLACEMENT**

1. Shut off the water/fluid supply or flow to the heater and open a hot water faucet or valve to remove pressure.
2. Drain the heater compartment by removing the base plate at the bottom of the heater. Never attempt to replace an element without draining the heater.
3. Use a standard element wrench to remove the element (can be purchased at most retail home products stores).
4. Remove and save the "O" ring from the element and place it on the new element.
5. Insert the new element and screw in by finger only being careful not to cross thread the screw plug.
6. Tighten finger tight and then tighten the element only snugly until the flange is level and in contact with the top of the heat exchanger's plastic boss. **DO NOT OVERTIGHTEN.**
7. Place a towel or paper towels around the top of the element to catch any initial water seepage.
8. Turn the water/fluid supply back on very slowly (leave the hot water faucet open or system valve open to prevent pre-mature pressurization) and fill the heater slowly until it is full and water/fluid is flowing out of the faucet or flowing through the heating system. Check for leaks.
9. If no leaks, slowly shut off the hot water faucet or valve pressurizing the heater and continue to check for leaks. If none, leave a paper towel around the element and leave it sit for 15 minutes. If still no leaks, remove towel.
10. TURN ALL THE POWER BACK ON. VERIFY FOR AT LEAST 15 MINUTES THAT THERE IS NO LEAKS OR SEEPAGE. RUN HOT WATER or TURN ON THE HEATING SYSTEM, SHUTTING THE VALVE OR FAUCET OFF AND ON SEVERAL TIMES TO VERIFY NO SEEPAGE.

## Section 7. MATCHING PROCEDURE

This procedure enables the temperature sensors to be properly matched to the control's microprocessor and is required after replacing a control panel board. Also, it may be necessary to perform the matching procedure to an existing control board after adjusting or replacing Temperature sensors, Temperature sensor Wires or resetting a High Limit Switch.

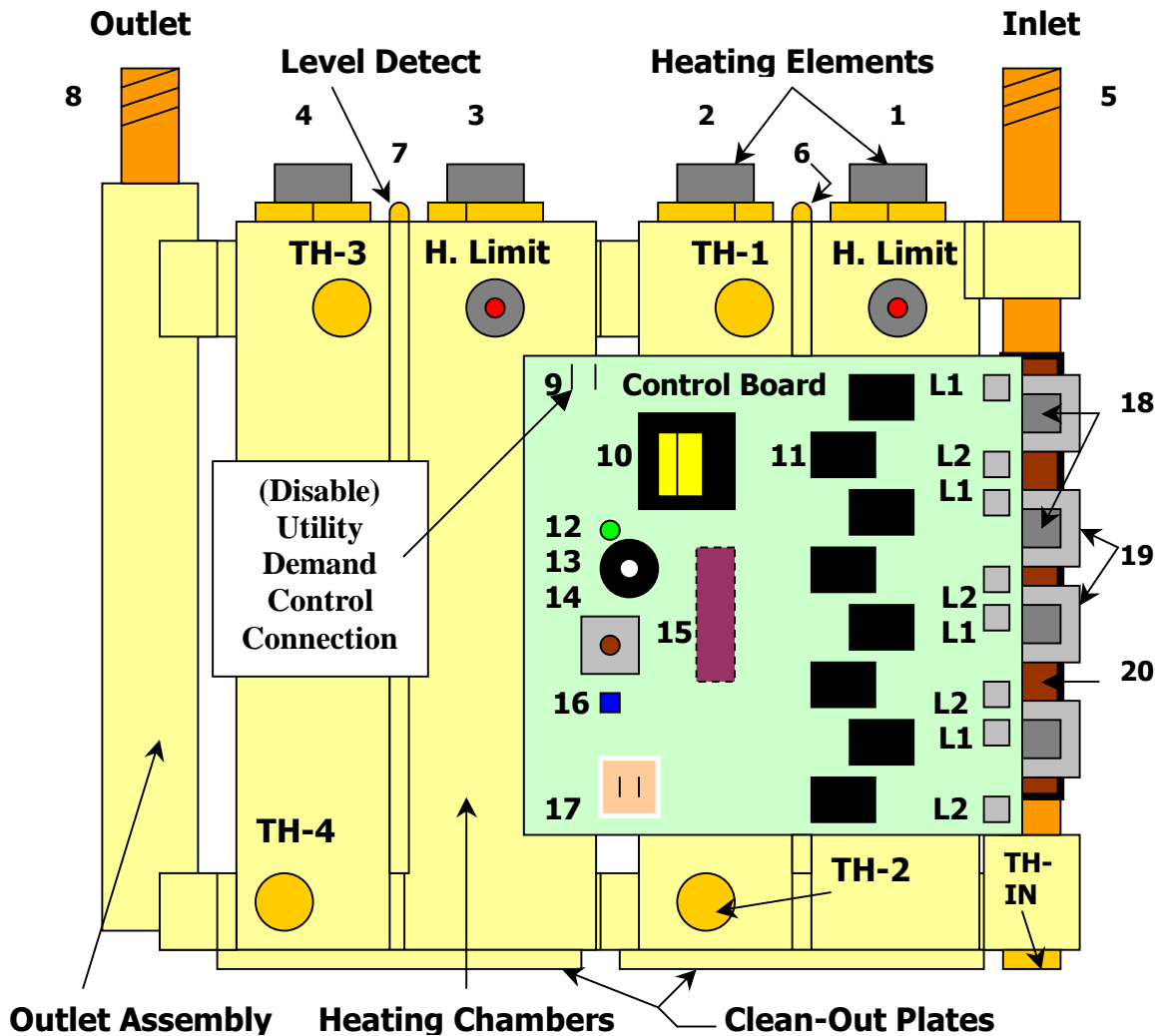
1. *TURN OFF ALL POWER* to the heater. Note: many models have multiple power circuits and breakers – make sure they are all turned off before proceeding.
2. *RUN COLD WATER or COOLED HEATING FLUID* through the heater for approximately 5 minutes to allow the heater to cool down and to allow the chamber temperature to become uniform. LEAVE THE WATER / FLUID RUNNING WHILE DOING THIS PROCEDURE
3. With the power off and water/fluid flowing through the heater, *DISCONNECT ONE OF THE HIGH TEMPERATURE PROTECTION LIMIT WIRES* (brown wire) (HIGH LIMIT SWITCH) from near the top of the control board. This will prevent the heater from heating while you are performing the balance of the procedure.
4. *TURN THE POWER BACK ON* to the heater. The control board will beep and the LED will flash red and green. This is normal.
5. *LOCATE THE BLUE BUTTON* on the control board, located left side of the board below the thermostat knob. (Or lower left corner of a two element heater)
6. *PUSH & HOLD BLUE BUTTON* in continuously for about **10 seconds**, then release.
7. After releasing the blue button, there should be a distinct **LOW TONE BEEP**. This is the confirmation tone that the match was successful. If no low tone beep is present, go to the previous step #6 and try again\*(**SEE NOTE**).
8. After confirmation tone is heard, **TURN OFF ALL POWER** to the heater **AND VERIFY**.
9. TURN OFF THE FAUCET or SHUT OFF THE FLOW THROUGH THE HEATER.
10. *RECONNECT THE BROWN WIRE* to the control board OR High limit switch.
11. **TURN ON ALL THE POWER** to the heater; make sure all the breakers are on.

\* **NOTE: If there is no confirmation *tone* beep after 3 or 4 attempts, then perform the "Temperature Sensor Resistance Check" in Section #3.**

## Section 8. Diagnostic Codes

<b>Code</b>	<b>Meaning</b>	<b>Condition</b>	<b>Action Required</b>
111	Inlet Temperature Sensor (THIN)	Open or Disconnected	Test Sensor & Wires / Replace if necessary
112	Temperature Sensor #1	" "	" "
113	Temperature Sensor #2	" "	" "
114	Temperature Sensor #3	" "	" "
115	Temperature Sensor #4	" "	" "
116	Matching Problem	Temperature Sensors not reading the same when heater is cooled at constant temperature – with no power applied to elements	Do Matching Procedure
118	Open Temperature Sensor	One of the temperature sensors is not reading. Always preceded by 111, 112, 113, 114 or 115	Test Sensor & Wires / Replace if necessary
121	Disable Switch Open	Cut trace on circuit board or optional Disable Switch Open	If there is no optional Disable Switch, replace circuit board
122	Open High Limit Switch	A High Limit Switch is tripped	Reset Switch(s) (most models have two switches one of which will automatically reset when heater cools)
123	Level Detect	Air in the heating chamber	Check plumbing, bleed air out of heater
124	High Temp. Shutdown	Over temperature software shutdown	Heater will restart after it cools down
126	Leak Detect	Leak Detect sensor is wet	Check for leaks / dry off the sensor
127	Element not heating	No power to element, element wire disconnected, element is bad or flow is too high	Test elements, element wires, power and flow rate
131	Temperature Sensors not matched	Temperature Sensors not matched to circuit board	Do a Matching Procedure
132	High Mains Voltage	Incoming voltage exceeds 20% of the nominal 220/240 volts (AC)	Check voltage at the power lugs with heater running
133	Low Mains Voltage	Incoming voltage is 20% less than nominal 220/240 volts (AC)	" "
134	Element #1	Element #1 is bad, has no power, wire is disconnected, or TH1 is bad	Test element, power, wire and TH1
135	Element #2	Element #2 is bad, has no power, wire is disconnected, or TH2 is bad	Test element, power, wire and TH2
136	Element #3	Element #3 is bad, has no power, wire is disconnected or TH3 is bad	Test element, power, wire, and TH3
137	Element #4	Element #4 is bad, has no power, wire is disconnected or TH4 is bad	Test element, power, wire and TH4
141	EPROM Error	Circuit board component	Turn power off and back on
142	A/D Error	" "	" "

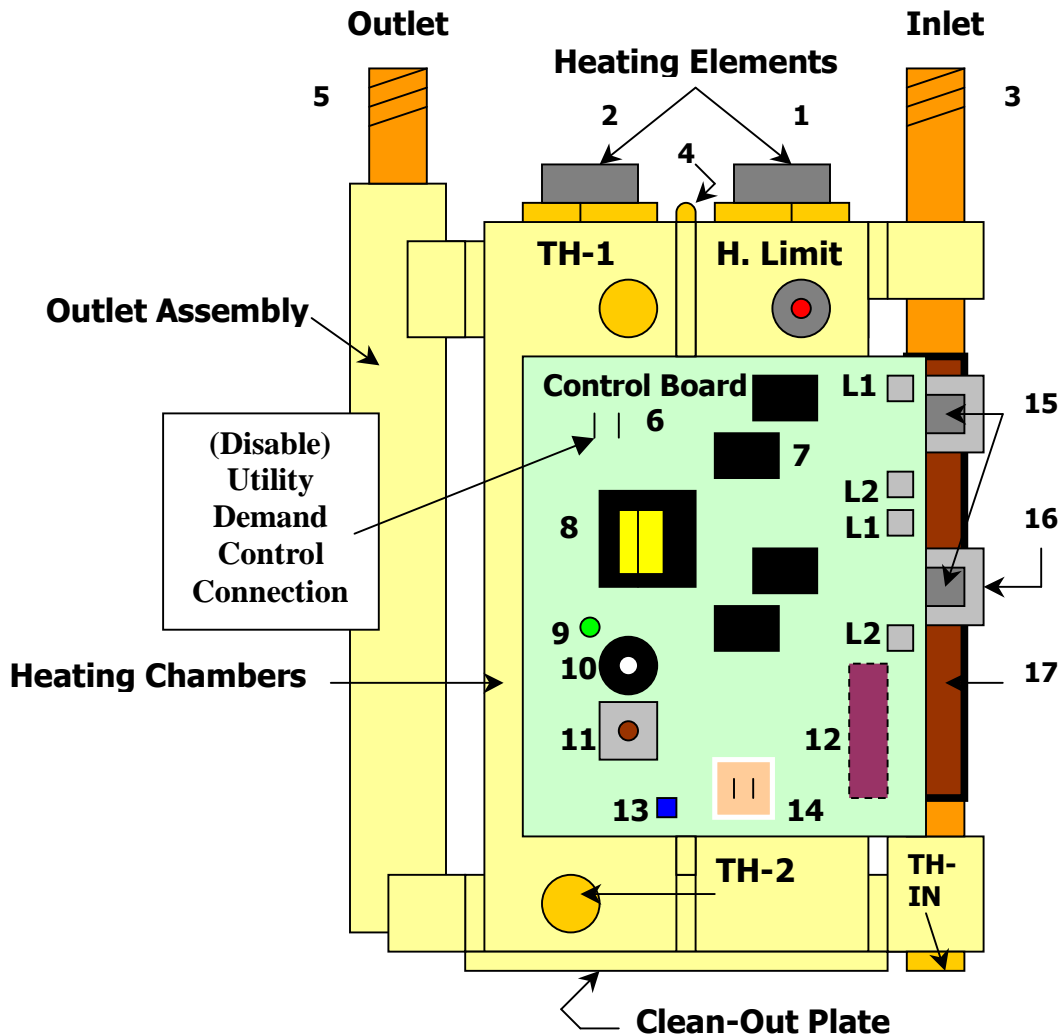
# SH & RA Four-Chamber Models (18, 22, 24 & 28 KW) Internal Workings and Parts Identification



- LEGEND**
- 1 – Heating Element #1
  - 2 – Heating Element #2
  - 3 – Heating Element #3
  - 4 – Heating Element #4
  - 5 – Inlet Tube (3/4 in. Threaded)
  - 6 – Water-Level Detection Screw
  - 7 – Water-Level Detection Screw
  - 8 – Outlet Tube 3/4 in. Threaded)
  - 9 – Disable, Spade Connections
  - 10 – Transformer
  - 11 – Heating Element Relays (8)
  - 12 – LED Light Indicator
  - 13 – Audible Speaker
  - 14 – Output Temperature Control

- LEGEND**
- 15 – Microprocessor Control Chip
  - 16 - Blue Button; Manual Audible Activation
  - 17 – Terminal Spades for Leak Detect Wires
  - 18 – Triacs (4 each)
  - 19 – Triac Mounting Blocks to Heat Sink (4 ea.)
  - 20 – Copper Heat Sink Tube
  - L1 – Power Connection Lugs (208 – 240 VAC)
  - L2 – Power Connection Lugs (208 – 240 VAC)
  - H. Limit : High-Temperature Limit Switches (2)
  - TH-IN : Inlet Temperature Sensor
  - TH-1 : Chamber Temperature Sensor #1
  - TH-2 : Chamber Temperature Sensor #2
  - TH-3 : Chamber Temperature Sensor #3
  - TH-4 : Chamber Temperature Sensor #4

# SH & RA Two-Chamber Models (5, 7, 9, 11, 12, & 14 KW) Internal Workings and Parts Identification



<b>LEGEND</b>	
1	– Heating Element #1
2	– Heating Element #2
3	– Inlet Water Tube (3/4 in. Threaded)
4	– Water-Level Detection Screw
5	– Outlet Tube (3/4 in. Threaded)
6	– Disable, Spade Connections
7	– Heating Element Relays (4)
8	– Transformer
9	– LED Light Indicator
10	– Audible Speaker
11	– Output Temperature Control
12	– Microprocessor Control Chip
13	– Blue Button; Manual Audible Activation

<b>LEGEND</b>	
14	– Terminal Spades for Leak Detect Wires
15	– Triacs (2)
16	– Triac Mounting Blocks to Heat Sink (2)
17	– Copper Heat Sink Tube
L1	– Power Connection Lugs (208 – 240 VAC)
L2	– Power Connection Lugs (208 – 240 VAC)
H. Limit	: High Temperature Limit Switch
TH-IN	: Inlet Temperature Sensor
TH-1	: Chamber Temperature Sensor #1
TH-2	: Chamber Temperature Sensor #2