

TECH TIP: Electrical Component Tests

(For trained service techs ONLY.)

Important: Be sure to read and understand Rheem's 'Residential Electric Water Heater Training Manual' before using this tip sheet.

Tools Needed:

- Phillips Screwdriver (to remove service panel covers).
- Flat screwdriver (to carefully remove thermostat cover).
- Multi-Meter (to make voltage and resistance readings).
- Optional: "Amp Clamp" (to measure current flow).

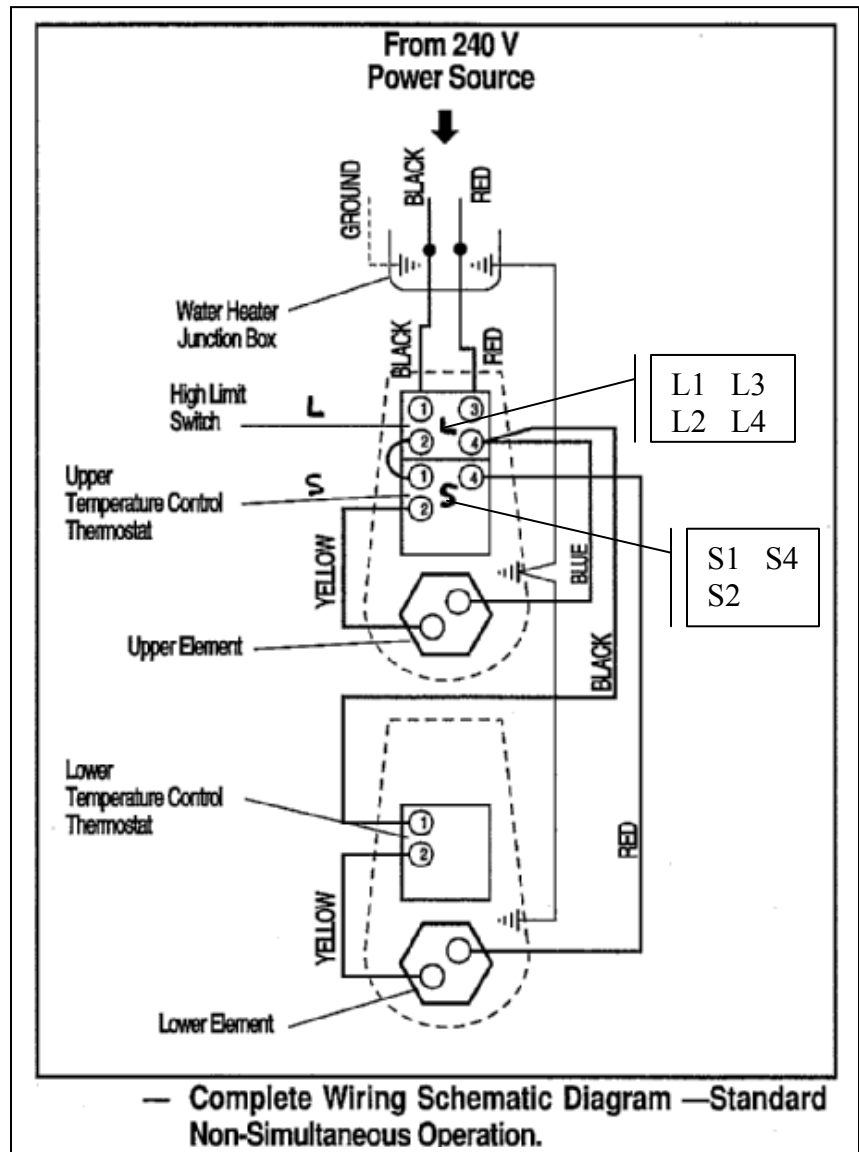


Multi-Meter



Amp Clamp

Note: 'Bulb type' resistance tester or 'buzzer tester' not recommended.



***CAUTION:** You are working with a system running at high voltages, amperages and temperatures. ***Read warnings in "Use and Care Manual"** (available at www.marathonheaters.com). Testing should only be conducted by trained service personnel.

MULTI-METER:

A multi-meter can be used to:

1. Test voltage.
2. Test resistance (ohms, Ω) of the elements.

At Junction Box: Is the unit getting power?**Testing at the Junction Box with multi-meter:****Voltage:**

1. Turn off power and remove junction box cover.
2. Set meter to ACV~300⁺ volt range.
3. **Caution***: Carefully turn power on.
4. At the wire nuts, carefully place one probe on the black wire and the other on the red wire. The reading should be in the 240-volt range. (A 208-volt circuit will work also, but at a 25% reduction in heating rate.) If reading is zero, the heater is not receiving power.

Voltage to ground at junction box:

1. Turn off power and remove junction box cover.
2. Set meter to ACV~200⁺ volt range.
3. **Caution***: Carefully turn power on.
4. Carefully place one probe on the red wire and the other probe on the green ground wire. The reading should be approximately 120-volts. Zero reading means no power on this leg (this is not normal). Caution: Power could still be on in black leg.
5. Carefully place the probe on the black wire and the green ground wire. The reading should be approximately 120-volts. Zero reading means no power on this leg (this is not normal). Caution: Power could still be on in red leg.

Testing Ohms at junction box:

1. Turn off power and remove junction box cover.
2. Set meter to 20 ohms (Ω) range.
3. **Caution***: Keep the power off!
4. Carefully place the probes on the red wire and the black wire.
 - a. An infinity (∞) reading indicates that:
 - i. The water in the tank is hot enough and the thermostats are not calling for heat.
 - ii. If the tank is cold, the upper element (most probable) or a thermostat (less probable) is defective.
 - iii. High temp limit (ECO reset) could be tripped.

At Upper Thermostat: Is the unit getting power?**Testing at the Upper Thermostat with a multi-meter:**

The “upper stat” is actually two devices (see diagram on page 1): A High Limit Switch (L1-L4) to protect the unit from overheating and the Upper Temperature Control Thermostat (S1, S2, S4) to adjust water temperature.

Voltage:

1. Turn off power and remove access panel covers, insulation, and protective cover. (**Important:** It’s critical to reinstall everything, in the proper order, for the unit to run properly. Keep parts in order!)
2. Set meter to ACV~300⁺ volt range.
3. **Caution***: Carefully turn power on.

4. Carefully place one probe on the L1 (black) and L3 (red). The reading should be in the 240-volt range. (A 208-volt circuit will work also, but at a 25% reduction in heating rate.) If zero, the heater is not receiving power.
5. Testing the ECO: If the voltage is correct across L1 and L3, now carefully place probes on L2 and L4. The reading should be in the 240-volt range. (A 208-volt circuit will work also, but at a 25% reduction in heating rate.) If zero, the ECO (high limit/energy cut off switch) has been activated for some reason. Correct the problem (probably a thermostat is set too high or an element is shorted to ground and heating continuously regardless of thermostat setting) and push re-set button.

Note: For high-temp operation (i.e. dairy barn) a special upper thermostat might be needed. For low-temp operation (i.e. daycare center) both a special upper & lower thermostat might be needed.

Heating Element Properties Table					
		120-Volts		240-Volts	
Wattage	Amps (Approx)*	Ohms	Amps (Approx)*	Ohms	
2000	16.7	7.2 +/- 0.4			
3000			12.5	19.2 +/- 1.0	
3800			15.8	15.2 +/- 0.8	
4500			18.8	12.8 +/- 0.6	

*Amps will vary with actual voltage and with actual resistance.

TESTING ELEMENTS:

Element Testing: Ohms (Ω , resistance of elements):

(Grounded Element: The coil inside the element has shorted to the external sheath and water is being continuously heated. This occurs even if the thermostats are not calling to heat water. Symptom: Water is too hot even if stat is turned down to minimum, and ECO 'reset button' popping and/or T&P valve discharging water.)

STANDARD METHOD: At each element.

Upper Element:

1. Turn off power to the heater.
2. Remove upper access panel cover, access panel and all insulation. (Important: It's critical to reinstall everything, in the proper order, for the unit to run properly. Keep parts in order!)
3. No need to remove thermostat protector.
4. **Caution***: Keep power off!
5. Remove wires from element. (Optional: Do not remove wires from element. However, load control equipment etc. could create a false reading. Better to remove wires from element.)
6. Set meter to 20 ohms (Ω) range.

- a. Blue wire:
 - i. A reading of zero indicates the upper element is not heating. However, it does not mean the wire is not energized.
 - ii. A reading, in amps, from the Heating Element Properties Table (page 3) indicates the upper element is heating properly.
 - iii. A reading of less than the specified amperage (and not zero) indicates the possibility of a grounded upper element. A reading of zero on the yellow wire confirms this.
- b. Red wire:
 - i. A reading of zero indicates the lower element is not heating.
 - ii. A reading, in amps, that corresponds the Heating Element Properties Table (page 3) indicates the lower element is heating properly.
 - iii. A reading of less than specified amps (not zero) indicates the possibility of a grounded lower element. A reading of zero on the black wire attached to S4 confirms this.

III. Testing at the Lower Thermostat with amp clamp:

- 1. Turn-off the power to begin.
- 2. At the Lower Thermostat, with the power off, carefully place the clamp around each wire separately, only then turn the power on.
 - a. Red wire:
 - i. A reading of zero indicates the lower element is not heating. However, it does not mean that the wire is not energized.
 - ii. A reading per the Heating Element Properties Table (page 3) indicates that the lower element is probably heating properly.
 - iii. A read less than found on the Heating Element Properties Table (not zero) indicates the possibility of a grounded element. A reading of zero on the yellow wire confirms this.
 - b. Yellow wire: A reading per the Heating Element Properties Table (page 3) indicates the lower element is heating properly.