

## RESIDENTIAL GAS AND ELECTRIC WATER HEATER TROUBLESHOOTING and SERVICE HANDBOOK

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Since the element (s) are - very nearly - totally immersed in the tank, thermal efficiency is assumed to be 100%. – all of the Btu (Watts) generated, enter the water.



A.



B.



C.

**Watt Density** = the density of the wattage output of the element compared to the surface area of the element (i.e. “High Watt Density Element” will have the most wattage per square inch of element surface. If the above elements generated 4,500 w. each, “B” might be considered a “high” watt density element, “A” a medium and “C” a low.)

<b>Symptom</b>		
<b>Repeated element failure</b>		
<b>Possible Cause</b>	<b>Test</b>	<b>Remedy</b>
1. Sediment build up in bottom of tank	1. Drain tank to check for sediment	1. Remove sediment from tank bottom. See Tank Cleaning Instruction sheet.
2. Very hard water	2. Perform water hardness/pH/dissolved solids test	2. Install water softening equipment
3. Watt density of elements too high	3. Refer to Element Data	3. Install lower watt density elements (3800 or 3000 watt)
4. Aggressive (Extreme pH) water	4. Check element series and wattage	4. Install Titanium sheathed elements
5. Loose wire connection	5. Check connections	5. Tighten any loose connections

## ELECTRIC WATER HEATER HANDBOOK

**Amperage** (Amps) (1 phase) = **Watts** divided by Volts

**Amperage** (3 phase) = (Watts X .577) divided by Volts

**KW Required** = (GPH X 8.25 X Temp. Rise X 1.0) divided by (3413)

**Ohms** = Volts divided by Amperes

**One kilowatt** is equal to 1000 watts

**One kilowatt** is equal to 3,413 BTU

**Recovery Rate** = (KW X 3413) divided by (Temp. Rise X 8.25)

**Rise (F )** = (KW X 3413) divided by (GPH X 8.25)

**Supply electrical fusing** or breakers should be sized at least 125% of expected heater amperage.

**Water weighs** 8.25 pounds per gallon at 120 F (49 C).

**% of Hot water** = (Mixed temp. – Cold) divided by (Hot temp. – Cold)

### Heating element(s)

This style water heater will have one or two electric, heating elements immersed in the tank.

One element will always be located low in the tank; a second element is commonly located

down about 1/3 of the tank height from the top of the tank. These elements will seldom be wired to operate at the same time. (If they operate at the same time, amperage draw doubles, wire gauge size increases, fuse size increases and little is gained in heat recovery.)

1 KW	Temperature Rise					
	80	90	100	110	120	130
Gallons Per Hour	5.2	4.6	4.1	3.8	3.5	3.2

More formulas

<http://waterheatertimer.org/pdf/Water-heater-energy-formulas-1212.pdf>