SETS TANKLESS WATER HEATER

Troubleshooting Guide

This Guide is intended for use by a Qualified Electrician.

This Troubleshooting Guide covers step by step all of the electrical check points required to ensure that the SETS Tankless Water Heater has been installed correctly and all of its components are working accordingly.

It explains and provides several examples to follow in order to ensure that the unit is producing the temperature rise as per the listed specifications, based on different flow rates.

You will need to have a Multi Meter available to perform the tests in this guide as you will be measuring both Voltage and Current.

IMPORTANT

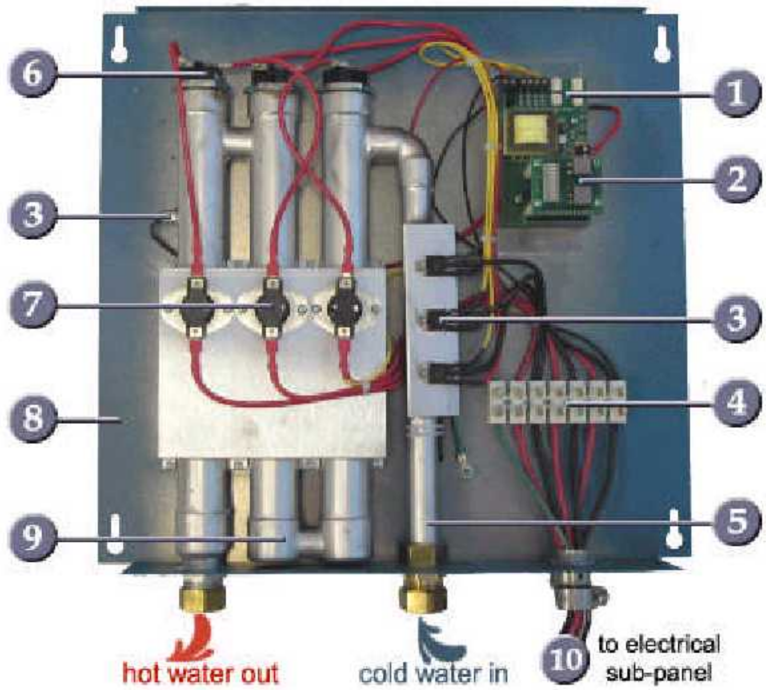
Before attempting to check or service this unit

YOU MUST OBTAIN AN AUTHORIZATION FROM THE MANUFACTURER or AUTHORIZED DISTRIBUTOR, FAILURE TO OBTAIN AUTHORIZATION WILL VOID YOUR WARRANTY.

ALL POWER TO THE UNIT MUST BE DISCONNECTED (SHUT OFF) BEFORE THE COVER OF THE UNIT IS REMOVED.

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN CAUSE SERIOUS INJURY OR DEATH.

SETS TANKLESSWATER HEATER
Components



1. Electronic Controller Board

2. Temperature Control Setting (daughter board) - a part of the electronic board design.

3. Time Proportional Triggering Devices (Triacs)

4. Terminal block

5. Flow Switch - One provided. Magnetic proximity sensor (Reed Switch) is used to detect water flow via magnetic float inside water inlet pipe. The Reed Switch is secured against the water inlet pipe as shown, by a minimum of two nylon cable ties.

6. Heating Elements

7. Thermal Protection - One provided for each heating element. Secured to the water reservoir holder with thermostat body secured against the water reservoir and with thermal transfer grease applied uniformly between each thermostat and the water reservoir.

8. Aluminum Case - Enclosure, painted metal, two piece construction. Provided with one entry for power and two openings for water pipes.

9. Heating Chambers - Water Reservoir - Copper

10. Electrical Sub-panel wiring supplied by manufacturer to meet UL and NEC requirements.

This Troubleshooting Guide will cover all the points and connections that need to be checked from an electrical standpoint, to ensure that your SETS TANKLESS WATER HEATER is working correctly and or determine what part or component needs to be replaced.

Tools Needed: Phillips screw driver-Clamp Multi Meter able to read Voltage and Amperage (Amperage reading requires a Clamp type meter)

As with all electrical appliances, it is **IMPORTANT** to **SHUT OFF** the **POWER** to the appliance before removing the cover. Failure to do so can damage the unit and or cause serious injury or death.

Remove cover by unscrewing the screws located at the top (2) and bottom (2) of unit.

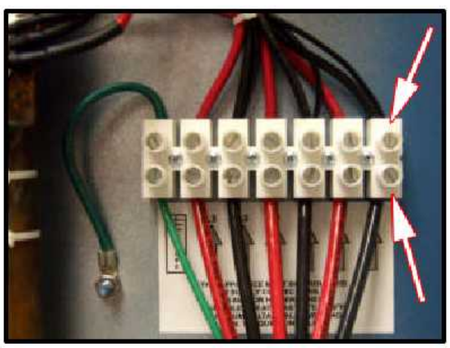
All electrical points or areas of the unit will be checked to ensure its proper operation.

Once the cover has been removed you will need to TURN the POWER BACK ON to the unit. We suggest you turn on a hot water tap at a good flow, preferably the tub.

When you have the power back on and a hot water tap running or open you should see the **RED** temperature indicator light turn on. Set the temperature indicator light to the highest setting by pressing the upper grey control button above the Red indicator light.

If the **RED** indicator light does not turn on, proceed to perform the test as follows…. Or if the **RED** indicator light turns on but you have no hot water, proceed to perform the test as follows…

You need to TURN OFF the hot water at this point.



First we will check to ensure there is current going to the unit from the service panel breakers that was provided with the unit and that the cables provided with the unit have been properly installed to the breakers in the service panel.

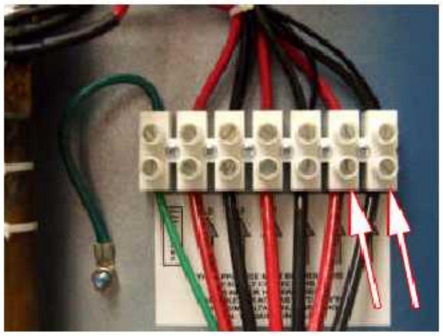
The (white) terminal block located at the lower right hand side of the unit is where the power supply is feeding the unit. This terminal block has 3 sets of wires attached for models 220 –280, two sets for Model 110 –180.

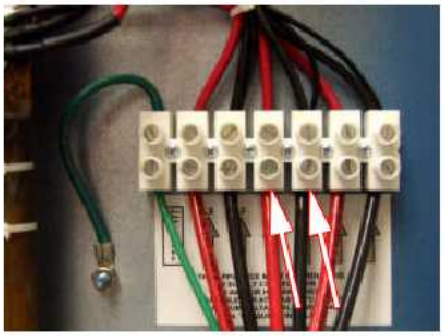
When facing the unit from right to left you have the wires in the following orientation:

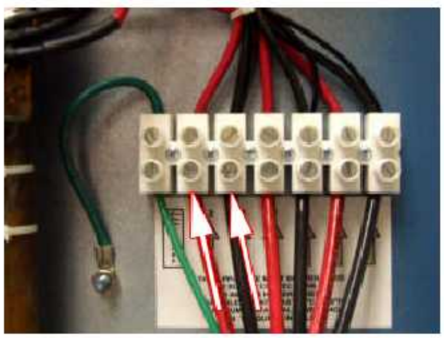
BLACK/RED-BLACK/RED -BLACK / RED AND A **GREEN** (for Ground)

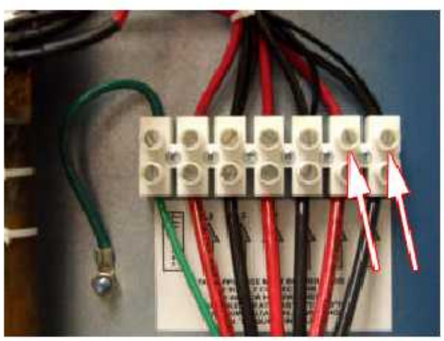
The white terminal block has two sets of screws across it, one set on the bottom and one set on the top. We will test the screws on the bottom of the terminal block first to ensure there is current coming from the service panel into the unit.

Power Supply









Using your multi meter probes with the setting at ACV (Alternating Current Volts) in the range of 250 + you need to place one probe on the lower screw of the BLACK cable of the terminal block, again from right to left and the other probe on the RED lower screw to the left of the BLACK cable. You should have a voltage reading somewhere in the 220+ range. Proceed to take the same readings on the next set of BLACK/RED screws. (the lower screws as before) Write down the Voltage below.

1. Volts ____________ Bottom Screws	1. Volts ____________ Top Screws
2. Volts ____________ Bottom Screws	2. Volts ____________ Top Screws
3. Volts ____________ Bottom Screws	3. Volts ____________ Top Screws

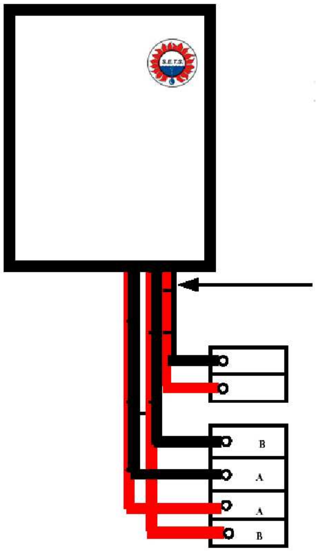
Now go ahead and follow the same steps, but this time measuring the TOP Screws. Write down the Voltage.

You should get a voltage reading when you measure across the screws in the 220 +. If you have NO READING at the bottom screws, make sure the breakers at the service panel and the main panel have been turned on.

If your breakers are turned on and you have no voltage readings you need to check your main supply line going into the service panel and breakers since this is a problem not related with the unit.

Once you have determined that there is power to the unit proceed to the next step.

Power Supply at Service Panel



In this section you will check to ensure the cables supplied from the unit have been installed correctly into the service panel breakers supplied with the unit. If these cables are not connected correctly the unit will produce NO HOT WATER even though all the components are carrying voltage and the **RED** LED light turns on.

One set taped together goes to one breaker.

The other two sets go to Quad Breaker

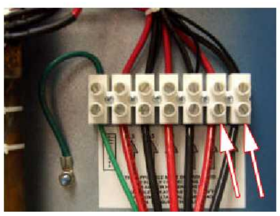
Quad Breaker Supplied

The two inside is one breaker (A)

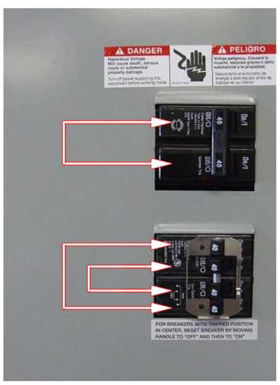
The two outside is another breaker. (B)

If the wires are crossed, one red from one set and one black from the other set are placed in the same breaker the unit will not operate correctly.

The Red LED Indicator will light up, but the unit will not heat properly.

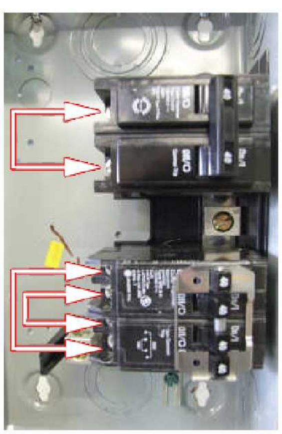


You can easily test and check by performing the test as you did for the Power Supply Section before. The service panel provided with the unit has 3 breakers (1 Double Pole and 1 Quad) each one of the breakers is dedicated to an element and therefore must be in continuity to the terminal block cables supplying power to that specific element.



You only get 110 + when measuring across = Cables Crossed in Service Panel.

TURN OFF one of the breakers in the service panel, it does not matter which one. Proceed to get a voltage reading at the terminal block as you did before. With one breaker turned off you should get Voltage across a set of the terminal block as before. You will have 2 sets with power and 1 without any power or voltage readings. If you measure on one set of the screws and ONLY GET 110 + volts , this means that the set of wires coming from the terminal feeding the element are crossed (not connected to a single breaker, but has 1 cable on 1 breaker and the other cable on a different breaker.) This will prevent the unit from operating and producing hot water. You can get all the correct readings when measuring the unit at the different points for voltage, but the unit will not produce hot water.



If this is the case and the wires are crossed just make the proper connection at the service panel and proceed to the next step. Make sure you have 1 **RED**/**BLACK** set of cables which are taped together going into one breaker and the other sets going into the other breaker.

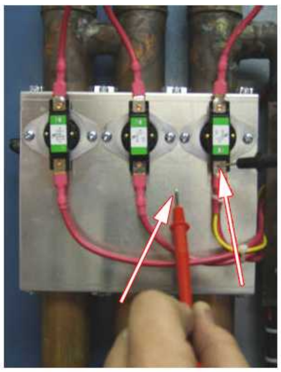
The **QUAD** breaker has four positions, the 2 OUTSIDE is 1 breaker and the 2 inside is another. Make sure you have 1 set of cables that are taped together **RED**/**BLACK** on the outside and the other **RED**/**BLACK** set that are taped together on the inside

Once this has been completed proceed to next step.

Thermostats

Make sure you have NO HOT WATER RUNNING when you perform this next test

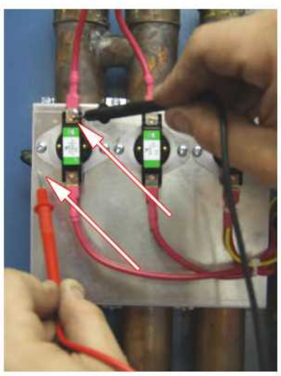
We are now going to continue checking all the other components to ensure they are operating correctly or determine if it needs to be replaced. The unit is supplied with safety thermostats mounted on the silver plate that holds the heat exchanger. These thermostats allow the current from one phase of the terminal block to flow to the element. If the thermostat is bad it will not supply the heating element with current and therefore the element will not turn on and produce heat. You will need to have your multi meter set to read Voltage (AC)



Test each thermostat both at the bottom section first, then the top section to make sure current is flowing through the thermostat.

You need to place one probe on the bottom metal part of the thermostat and the other probe to the metal (silver) plate to ground the probe. You should have a voltage reading of 110 + since this component is being fed by one leg of the electrical power coming off the terminal block.

Perform this test on all the thermostats, again measuring the bottom of each and then the top.



1. Volts ____________ Bottom   1. Volts ____________ Top

2. Volts ____________ Bottom   2. Volts ____________ Top

3. Volts ____________ Bottom   3. Volts ____________ Top

Write down the voltage. If you have volts both at the bottom and top of the thermostat the component is good. If you have voltage at the bottom of the thermostat but no voltage at the top, the thermostat is bad and needs to be replaced. The element that this thermostat is attached to, will not produce hot water.

Elements

You will need to have your multi meter set to read Voltage (ACV) We are going to measure the current going to the element to ensure it is being supplied with power from both phases, 1 the thermostat and 2 the triac. On the upper black section of the element you will see 2 screws with **RED** wires screwed to them. One wire comes in from the thermostat and the other from the triacs. Place one probe on one of the screws on top of the element and the other one to the silver plate to ground it. You should get voltage in the 115 –120 + range. Do the same for the other screw on the same element. Perform this test on all three elements. If you only get voltage on one side and not the other the triac or board might be bad since the test you performed before measuring current through the thermostat indicated the thermostats to be in good working order. If you do have voltage on both sides then we will test to make sure the elements are producing heat and we will check to see the overall current draw when the elements are heating.

You need to **TURN ON** a hot water tap preferably at the tub to ensure a good flow rate through the unit. Once you turn on the hot water turn the temperature control on the unit to the maximum setting. This will activate all 3 elements and allow for an accurate reading.

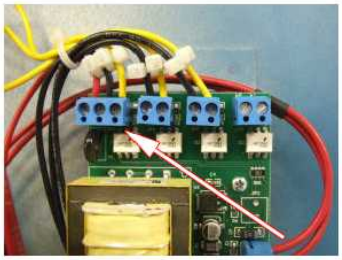
With the hot water tap opened and the temperature setting to the maximum, place one probe on one screw and the other probe on the other screw within the same element. You should be getting a reading of 220 + volts. Check all 3 elements and write down the voltage.

1. Volts ____________
   Element 1

2. Volts ____________
   Element 2

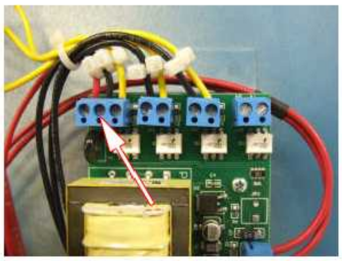
3. Volts ____________
   Element 3

Electronic Board



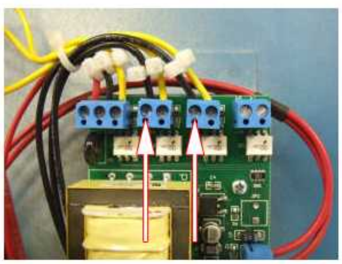
You will need to have your multi meter set to read Voltage (AC). We are going to measure the current going to each of the power supplies on the Electronic Board.

At the top of the Electronic Board there are 4 sets of terminal blocks, from Left to Right you have a **RED** / **BLACK** / **YELLOW** cable, the second terminal has a **BLACK / YELLOW** and the third a **BLACK / YELLOW**. (the fourth set is no longer used)



You will be getting a voltage reading at each of the **BLACK** cables to ensure there is current going to the electronic board as follows.

Place one probe on the terminal block were the **BLACK** wire is connected and the other probe to the silver metal plate to ground as you have done before. You should get a voltage reading somewhere in the range of 115 - 120V.



Proceed to test voltage on the other two terminal blocks **BLACK** cable to ground.

1. Volts ____________
   1st Terminal

2. Volts ____________
   2nd Terminal

3. Volts ____________
   3rd Terminal

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For your No Charge replacement part as per your Lifetime Warranty

Amperage Reading

You need to **TURN ON** a hot water tap preferably at the tub to ensure a good flow rate through the unit. Once you turn on the hot water, turn the temperature control on the unit to the maximum setting. This will activate all 3 elements and allow for an accurate reading. You will need to have your clamp multi meter set to read Amperage (ACA) We are going to measure the amperage the element is drawing to determine the output wattage of each element. These readings will later be used to determine the temperature rise you should be getting. With the hot water tap opened and the temperature setting to the maximum, clamp your meter around the **RED** cable that goes from the top of the thermostat to the top of the heating element. You will get an amperage reading. Check all 3 elements and write down the amperage below.

You need to take this reading with a high flow rate and the temperature setting at maximum to check the maximum draw on each of the elements and also check for a steady amperage draw. You might get some quick variation on your meter but this is normal, if you see that your amperage draw is going down slowly and then goes back up slowly then you will experience temperature fluctuations since this amperage draw is in direct relation to temperature rise. Write down the amperage draw for each element.

NOTE: Now perform this same test with the HOT WATER TURNED OFF. You should get a ZERO reading at each of the elements since the element should only draw amperage when there is a hot water tap opened. If you get an Amperage reading with the Hot Water TURNED OFF then the TRIAC(S) are bad and needs to be replaced.

1. Amperage ___________
   Element 1
   from Right to Left

2. Amperage ___________
   Element 2
   from Right to Left

3. Amperage ___________
   Element 3
   from Right to Left

Now that you have checked and written down all the voltage and amperage readings of the system you can proceed to the next step. In this next step you will figure out the temperature rise and other information regarding the operation of the system.

Is system putting out temperature as designed? This worksheet will verify it….

Now that you have checked out the system and gotten all the readings both on Voltage and Amperage you can determine if the system is heating as designed based on Inlet Temperature and Flow Rates. The following is an example and simple formula that you can use to determine the temperature rise you should be getting from your SETS unit based on your actual readings.

Please READ and SET your temperature control on your SETS unit following the instructions in your HOMEOWNERS MANUAL.

NOTE: Voltage X Amperage = Wattage (It takes 1,470 watts to raise 1 gallon of water 10°)

To determine the temperature rise your SETS unit should be producing, you are going to take the Voltage readings you got before and also the Amperage readings.

Example: Voltage reading at the terminal block-Volts: 237

Amperage at each element-Element 1: 29 amps + Element 2: 29 amps + Element 3: 29 amps - you add the 3 amperage readings to come up with the total current draw, in this example it would be an 87 amp draw.

Voltage X Amperage = Wattage : 237 X 87 = 20,619 Watts.

To determine the temperature rise divide the Watts (20,619) by 147 to determine what the unit should produce at a 1 gallon per minute flow rate, take this 1 gallon per minute flow rate and divide by the actual flow rate, (if running a showerhead assume a 2 gallon per minute flow rate)

Example: 20,619 Watts Divided by 147 = 140° at 1 GPM (remember that the unit is designed not to exceed 140° F, so if the output is that of over 140° F, it will start to disconnect and trip the safety thermostats giving you hot and cold water fluctuation. That's why we suggest you use a 2 gallon per minute flow rate (showerhead using just the Hot Water Handle or Setting your single lever to FULL HOT) to do this test.

Take your 1 gallon per minute temperature rise you determined before (140) and divide by your Flow Rate (showerhead assume 2 gallons per minute) 140 divided by 2 = 70 this is the temperature rise you should get over your inlet temperature if you are flowing 2 gallons of water through the unit. Now take your inlet temperature (let's assume 48°) and add your temperature rise of 70° to come up with your actual outlet temperature (40° + 70° = 110°). Your outlet temperature in this example should be coming out at around 110° +/- 2° based on the Voltage and Amperage reading you got.

Use this worksheet to determine temperature rise and flow rates.

This worksheet will help you determine temperature rise and also help you determine the flow rates you are flowing through the unit.

DETERMINING TEMPERATURE RISE

Voltage ____________ X Amperage ____________ = Watts ____________ Divided by 147 = TR____________
Watts (Divided by 147) = Temp Rise

Temp Rise (divided by FLOW RATE) TR divided by FR = Temperature Rise over your inlet.

Example: 240 Volts X 65 AMPS = 15,600 Watts (15600 / 147 = 106°)

106° / 2 gpm = 53° rise over inlet temperature. Inlet is 55 and you are running 2 gpm the outlet will be that of 108° +/- 2°

DETERMINING FLOW RATE

Take your INLET temperature and subtract your OUTLET temperature to determine the Temperature Rise that you are getting.

Example: Inlet is 55° - Outlet is 108° (55 - 108 = 53° Temperature Rise)

If the Voltage is 240 and the Amps are 65 the Watts are that of (Voltage X Amperage) 15,600 Watts.

Take the Watts (15,600) and divide by 147 to get the 1 GPM Temperature Rise (15,600 divided by 147 = 106° at a 1 GPM flow.)

You know that you are getting a 53° temperature rise, so what is your Flow Rate based on the Voltage and Amperage Readings? In this example, 53° is what you are getting and at a 1 gpm flow rate it would be that of 106°.

Take the 1 gpm rise and divide your actual rise to determine what flow you are getting.

106° (1 gpm rise) divided by 53° (actual rise) = 2.00 (this is the flow rate you are running through the system based on your Voltage and Amperage readings.

Great care has been taken in preparing this troubleshooting guide. If you find that this guide has still not helped you to rectify your problem, please don't hesitate to contact us at the toll free number listed throught this document.

For additional help call TECH SUPPORT TOLL FREE: 877-649-8589

It's a Tankless Job **11.10.05**

It's hiding in your home, probably in a closet or dark corner of the basement. You depend on it daily, but don't give it much thought until you become too demanding and it lets you down. It's your water heater, and thanks to some space-age technology, someday soon it just might be obsolete.

In most homes, having hot water when you need it means keeping a big heating tank at the ready -- day and night, 365 days a year. That means wasted energy. And at times of peak use – while doing multiple loads of laundry, running the dishwasher and supplying several showers -- the tank just can't meet all the demands at the same time.

One solution is the tankless water heater -- a phonebook-sized device that provides hot water on demand by heating the water as it is used. The idea isn't new, but design flaws in the past kept the devices from being efficient enough to accommodate the needs of an entire house. That's before Space Age know-how was applied to this problem on Earth through a partnership between NASA and private industry.

Image at Left: The wall-mounted SETS tankless water heater is about the size of a phonebook and can supply the hot water demands of an entire house thanks to help from NASA technology. Image credit: SETS Systems

SETS Systems, Inc. of Miami uses computer-chip technology to manufacture electronic, tankless water heaters built to serve an entire home, even during simultaneous uses. And even better, the heaters are designed to save up to half of the energy cost of heating the hot water in a traditional tank.

Back in 1995, the company faced a problem with the tank's flow switch that was tough to solve. Several expensive studies by testing and engineering firms produced only graphs and printouts, but no solutions. Then Jerome Morabito, owner of SETS turned to an innovative technology outreach program offered through NASA's Kennedy Space Center and the state of Florida.

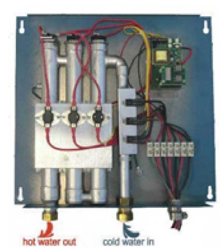

Image at Right: Inside the unit, computer-controlled technology and a redesigned flow switch put NASA technology to work to improve performance. Image credit: SETS Systems

To apply scientific and engineering expertise originally developed for space applications to the problem, the program matched his company with a veteran space engineer at Kennedy. The fix he came up with was simple but priceless. Not only did the new design pass the rigors of testing by working flawlessly, but it was cheaper to make and could be retrofitted into the older-model heaters, as well.

Just how dependable did the unit prove to be? In a mobile shower trailer used by rescue workers at New York's "ground zero" after the Sept. 11 terror attacks, each unit supported 100 to 200 showers per day for a period of three months. Currently hurricane relief workers in Gulfport, Miss. are using these showers.

Image at Left: The Kohler Mobile Shower Truck provided on-site showers for workers at the Red Cross Rescue Center near the World Trade Center site. Powered by a generator, with water supplied by a fire hydrant, the self contained nine-shower unit had an unlimited supply of hot water thanks to the SETS tankless water heaters. Image credit: SETS Systems

So when the company wanted to upgrade its computer-controlled technology, the SETS team knew just where to turn. In 2003, SETS Systems once again drew on the expertise at Kennedy Space Center. Through the Space Alliance Technology Outreach Program, the company received recommendations for improving its microprocessor, programming techniques and design. These innovations allowed SETS Systems to produce an improved product for the same manufacturing costs and maintain its status as “The Worlds' Leading Manufacturer of Tankless Water Heaters”.

So while it doesn't take a rocket scientist to produce hot water, it doesn't hurt to have one on your team when you want to improve the process.

Courtesy of NASA Innovative Partnerships Program and the Spinoff Office