

Service Manual

400 Series



AHE-400-P02



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Caution Notes

As you read this information, take particular note of the NOTICE, CAUTION, WARNING, and DANGER symbols when they appear. This information is important for safe and efficient use of the Aqua-Hot system.

NOTICE signals a situation where potential damage to the Aqua-Hot could occur.

NOTICE

CAUTION signals a situation where potential harm or risk of minor or moderate injury could occur if you do not follow instructions.



CAUTION

WARNING signals a hazardous situation where potential harm, risk of serious injury, or death could result if instructions are not followed.



WARNING

DANGER signals a situation where immediate risk of serious injury or death will result if instructions are not followed.



DANGER

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WARNING

If the information in this manual is not followed exactly, a fire may result, causing property damage, personal injury or death.

Read all instructions before servicing the Aqua-Hot unit. Aqua-Hot Heating Systems is not liable for damage resulting from failing to follow instructions contained in this manual, and any other Aqua-Hot documentation relevant to this unit.

- Read this manual before servicing the Aqua-Hot System to reduce the risk of injury to persons or damage to the equipment.
- The product identity label contains specifications of the unit, to what standards it has been tested, and important safety notices.
- Disconnect electric wiring to the Aqua-Hot System before welding or plasma cutting the coach to avoid damage to equipment.
- The Aqua-Hot tank and heating loop operate at 0 PSI (zero pressure system). Air pressure to the tank must not exceed 18 PSI. Exceeding this rating will cause internal damage to the Aqua-Hot.
- Use caution when working on or near any gas systems.



CAUTION

- DO NOT connect the 12-volt DC power to the Aqua-Hot if the vehicle requires welding.
- At maximum operating temperature, the coolant and vapor will be very hot and scalding that may result in serious burns or injury. Be aware of hot surfaces.
- Use special caution when children are present. Children must not be allowed to play with the heater or perform cleaning and/or maintenance.
- Installation and repairs may only be carried out by an authorized, factory-trained Aqua-Hot technician. The heating system must be serviced in accordance with local codes, or, in the absence of local codes, follow NFPA 1192. National safety regulations must be adhered to.



CAUTION

As with any appliance, allow the Aqua-Hot to completely shut down BEFORE disengaging the coach 12V power disconnect.

Introduction to this Document

Welcome to the Aqua-Hot 400P Service Manual. This manual will serve as a guide for diagnosing and repairing the Aqua-Hot, how to perform standard maintenance, and guide you through troubleshooting procedures to repair the Aqua-Hot. This service manual is designed to aid trained and qualified technicians to properly service and troubleshoot the Aqua-Hot 400P.

Each section in this manual is dedicated to the diagnosis of specific components within the Aqua-Hot which may be inhibiting the operation of the heater.

Troubleshooting and diagnosis of the Aqua-Hot is most efficiently and effectively accomplished with the Aqua-Hot Reporter, which will relay in plain-language, diagnosis of many Aqua-Hot related issues.

Aqua-Hot Reporter



Figure 1

If additional assistance is needed in diagnosing and repairing the Aqua-Hot, please contact our Technical Service Department at 574-AIR-XCEL (574-247-9235) from 7:00am to 4:00pm MST Monday through Friday.

NOTE: For networked control of the Reporter, Aqua-Hot requires system integrators ensure that individual commands are received and processed. Aqua-Hot requires that commands be repeated or confirmed so that if a single message were dropped, or if there is a brief network disturbance, the Reporter would get into the correct state as soon as the disruption was removed.

The Aqua-Hot Reporter monitors the heating system and handles all logic relating to safeties and heating control. As such, the system integrator is required to display all pertinent status information but not use that information to lock out operation or add additional safety layers that could impact the end of operation if a message from the Reporter was missed.

Aqua-Hot 400P

Introduction:

This service and parts manual is designed to aid trained and qualified service technicians with the process of troubleshooting and servicing the Aqua-Hot 400P Hydronic heating system.

About the Aqua-Hot:

The Aqua-Hot 400P heating system features a 12V DC powered propane-burner and a 120VAC 1650 Watt electric heating element. These two heating sources are used in conjunction with an FDA-approved "GRAS" (Generally Recognized as Safe) propylene glycol based boiler antifreeze and water heating solution in order to provide a continuous supply of domestic hot water, interior/fresh water tank heating, and independent interior zone heating. Be sure to reference Figures 5 through 8 for a complete component overview.

Understanding the Aqua-Hot 400's Major Systems:

The basis for the Aqua-Hot heating system's functionality is the antifreeze and water heating solution, which is comprised of water that is distilled, deionized, or soft, as well as FDA-approved "GRAS" propylene glycol based boiler antifreeze. Through this solution's ability to maintain and transfer heat, the Aqua-Hot's two major systems: the domestic water system and interior heating system, are able to function effectively. This antifreeze and water heating solution is contained within the Aqua-Hot's boiler tank and is heated by the propane-burner when its operating criteria are met and/or by the electric heating element when its operating criteria are met. In order for the propane-burner to be considered as a heating source by the Aqua-Hot, it must have an adequate fuel supply, receive power from the Reporter, and be selected as a heating source from the interior switch panel. In order for the electric heating element to be considered as a heating source by the Aqua-Hot, it must receive power from either a generator or from shore power and be selected as a heating source from the interior switch panel. Once the antifreeze and water heating solution achieves operating temperature (as determined by the Aqua-Hot's control thermostat/ETS Module), the domestic water system and the interior heating system are permitted to operate as needed.

Domestic Hot Water Priority System:

The Aqua-Hot 400P is a Hot Water Priority System. Meaning that the Aqua-Hot 400P cannot heat the interior of the motor home, and produce continuous hot water simultaneously. When

Domestic Hot Water is being used, the interior heating system will shut down, until no more Domestic Hot Water is called for.

The domestic hot water priority system is responsible for providing hot water whenever a hot water faucet is opened, such as with a shower or sink.

When hot water is requested, domestic water from the motor home's fresh water tank is transported through a copper coil in the Aqua-Hot's boiler tank where heat is transferred from the heated antifreeze and water heating solution to the domestic water flowing through the copper coil. The heated domestic water then flows through the tempering valve to be mixed with cool water from the fresh water tank to achieve an appropriate temperature before it flows to the faucet requesting hot water.

Interior Heating System:

The interior heating system is responsible for providing heat to the motor home's interior in order to maintain the temperature at a comfortable level.

For interior heating, it is the room thermostats that trigger the Aqua-Hot's interior heating system. When a thermostat recognizes that heat is required in a particular area, it sends a signal to the Aqua-Hot's Reporter calling for heat. The Aqua-Hot responds by activating the circulation pump for that zone, which sends the heated antifreeze and water heating solution through the Heating Loop corresponding to the zone requesting heat. The fans on the heat exchangers in the zone calling for heat are also activated; therefore, as the heated solution flows over the heat exchanger's fins, the heat is transferred to those fins and dispersed into the interior of the motor home by the fans. Until the thermostat signals that heat is no longer required, the Aqua-Hot will continue to send the heated antifreeze and water solution through the loop, which returns the cooled solution to the Aqua-Hot's boiler tank to be reheated before being sent back through the loop again. This process continues until the preset temperature of the interior is reached, and the interior room thermostat signals the Reporter that heat is no longer required.

AC Circuit:

Although the propane-burner is the primary heating source for the Aqua-Hot and is necessary for providing continuous domestic hot water, an alternate heat source exists for moderate temperatures, which functions with an AC circuit. Whenever the motor home is connected to an AC power source - plugged into shore power or using a generator, the Aqua-Hot's electric heating element has the ability to function in order to provide heat for the boiler tank.

When the antifreeze and water heating solution falls below operating temperature (as determined by the control thermo-

stat/ETS Module), a signal is sent to the Reporter requesting heat. Because the electric element switch is activated on the interior switch panel, the DC power from the Reporter is permitted to flow to the AC relay, which activates the relay in order to allow AC power to flow to the electric heating element. When the electric heating element receives power, it becomes active and supplies heat to the boiler tank until operating temperature is reached.

Maintenance Schedule

Monthly Maintenance

Check the Aqua-Hot's antifreeze and distilled water heating solution to ensure that it is at the proper level. This can be accomplished by visually checking the coolant level in the Aqua-Hot's expansion tank; reference Figure 136 on page 74.

Please note that the coolant level should be checked **ONLY** when the Aqua-Hot is at maximum operating temperature. This should be done immediately after the electric element disengages, or after the propane-burner has completed a cycle.

At maximum operating temperature, the antifreeze and distilled water heating solution should be at the level marked "HOT" on the expansion tank.

The fluid concentration should be checked regularly to ensure the mixture is at 50/50 propylene glycol and distilled water.

Replenishing the Antifreeze and Water Heating Solution

If the antifreeze and distilled water heating solution needs replenishing, remove the cap for the expansion bottle and fill it to the "HOT" mark (only when the tank is to temperature). Replace the expansion bottle cap when this is complete. **DO NOT** operate the unit without first replacing the cap of the bottle. Reference Figure 136 for additional information. Excess air will escape through this bottle as the stir pump of the unit operates. While bleeding this system of air, it will be necessary to continue to fill the bottle until this process is complete.

Reference the Appendix on page 10 for the proper tool and instructions for usage in measuring the system's antifreeze mixture ratio.

The Aqua-Hot does not need regular replacement of the propylene glycol antifreeze and distilled water heating solution, but in the event that more antifreeze is required, contact Aqua-Hot Heating Systems to purchase antifreeze, or for guidance in selecting an appropriate antifreeze product for use with this unit.



Figure 2

NOTE: Service parts and accessories are available through Aqua-Hot Factory Authorized Service Centers or at www.aquahot.com.



DANGER

When the Aqua-Hot is at maximum operating temperature, the coolant is very hot. If the Aqua-Hot heating system is accessed, scalding by hot vapor or coolant may occur. Before cleaning or servicing, disconnect all power supplies.

Aqua-Hot®
HEATING SYSTEMS INC.

For installation only in a compartment that is completely closed off from living quarters and accessible only from the outdoors.
Exhaust system MUST NOT terminate beneath the vehicle and not less than 3 feet from an openable window.
Combustion Air MUST BE supplied from outside the vehicle.
THIS APPLIANCE OPERATES ON BOTH AC AND DC POWER.
USE COPPER CONDUCTORS ONLY!
Use a 25-Amp fuse for over-current protection for the DC power supply.
Use a circuit breaker that cuts power at 20-Amps maximum for over-current protection for the 120-VAC power supply.
Mount the Heater near a bay/storage door so that the Access cover can be easily removed for service.

For Detailed Information, reference the Owner's Manual or contact Aqua-Hot Heating Systems Inc. at 574-AIR-XCEL (574-247-9235)

Minimum Heater Clearances
Front - Open Access
Back - 0 Inches
Top - 0 inches
Sides - 0 inches

This appliance must be installed in accordance with local codes or, in the absence of local codes, the Standard for Recreational Vehicles, NFPA 1192 or CAN/CSA Z240 RV.

For Direct Vent Installation in a Recreational Vehicle.
Meets or Exceeds: UL 307A, UL 174
CSA/CAN B140.0-03
CAN/CSA C22.2 No.110-94

Max Tank Pressure	0 PSI
Max Watts (DC)	925
Max Watts (AC)	1650
Orifice Size	.086
Volts	12 VDC
Volts	120VAC, 60Hz
Pump Pressure	145 PSI / 10.0 bar
Input Firing Rate	56,000 BTU/hr / 16.4kW
Burner Model	
Fuel Type	PROPANE

Burner Serial Number:
Model Number: AHE-400-P02
Heater Serial Number:

7501 Miller Drive • Frederick, CO 80504 • 574-AIR-XCEL • www.aquahot.com

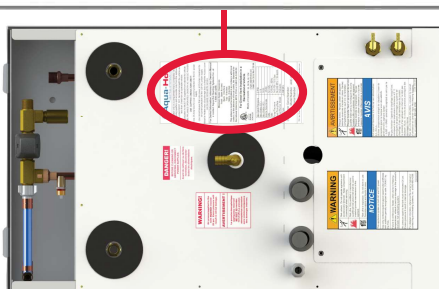


Figure 3

NOTE: This product label is attached to the top of the Aqua-Hot, and provides a ready reference to specifications, test standards, and important safety notices.



Figure 4

System Specifications

Propane Burner

Heat Input (Firing Rate)55,331 BTU/hr
Fuel Consumption0.72 gal/hr

Electric Element

Power Consumption1650 W (maximum)
Voltage120V AC

DC Power

Consumption174 W (maximum)

Zone Heat Circulation

Pumps2
Power Consumption (max).....21 W (each)
Voltage 12V DC

Heating Zones

Maximum5

Domestic Water Heating

Maximum1.5 GPM On-demand

Physical Specifications

Dimensions (US).....12" H x 18.5" W x 29.5" L
Dry Weight 127lbs.
Wet Weight..... 185lbs.

All vehicle installations must comply with the requirements listed in the Recreational Vehicle Industry Association's (RVIA) ANSI/NFPA 1192 Handbook for Recreational Vehicle Standards. To receive a copy of this handbook and other Pertinent RVIA Standards, write to: Recreation Vehicle Industry Association, 1896 Preston White Drive, PO Box 2999, Reston, VA 22090-0999. Call them at (703) 620-6003 or visit online at www.rvia.org.

Component Cut-Aways

- | | |
|-----------------------------|-------------------------------|
| 1. Drain Valve | 12. AC Terminal Block |
| 2. Zone 1 Circulation Pump | 13. AC Terminal Port |
| 3. Zone 2 Circulation Pump | 14. Aqua-Hot Reporter |
| 4. Dual Stage Gas Valve | 15. Electric Element |
| 5. Propane Burner | 16. Aqua-Hot Boiler Tank |
| 6. Interlock Switch | 17. Domestic Water Coil |
| 7. Propane Inlet Ball Valve | 18. Tempering Valve |
| 8. Propane Burner Controls | 19. Domestic Hot Water Outlet |
| 9. AC Terminal Port | 20. Domestic Cold Water Inlet |
| 10. Heating Zone 2 Outlet | |
| 11. Heating Zone 1 Outlet | |



Figure 5

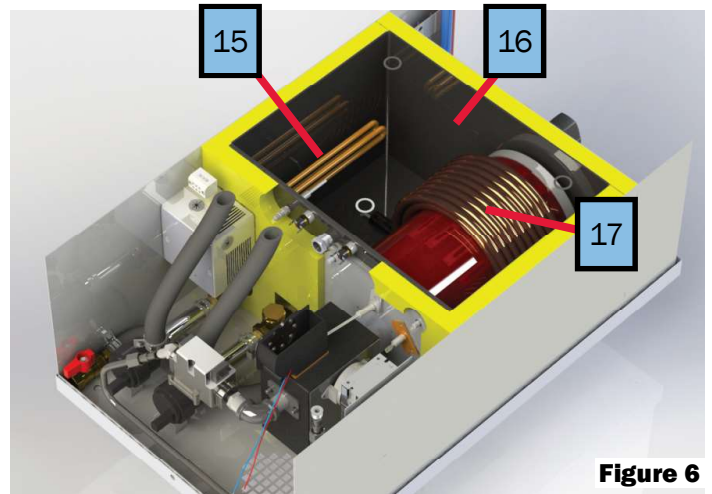


Figure 6

NOTE: The top panel has been made transparent in the view above to aid in the explanation of the heater. DO NOT remove the top panel. Doing so risks irreparable damage to the Aqua-Hot. Only remove the service panels.

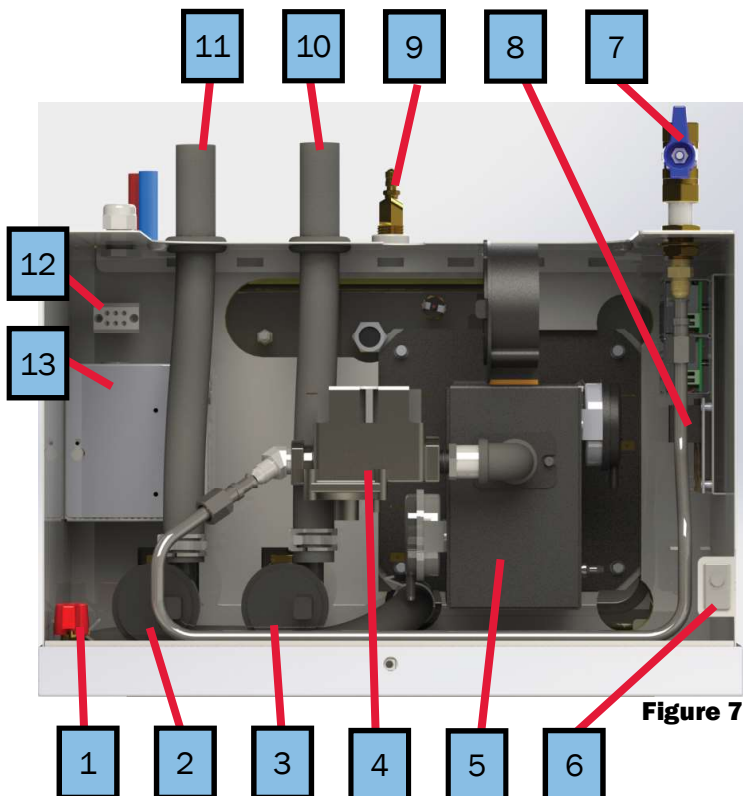


Figure 7

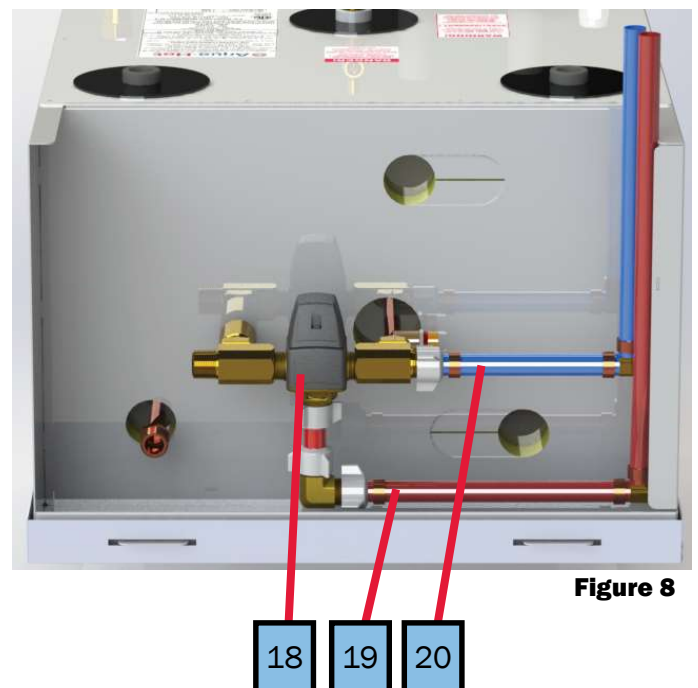
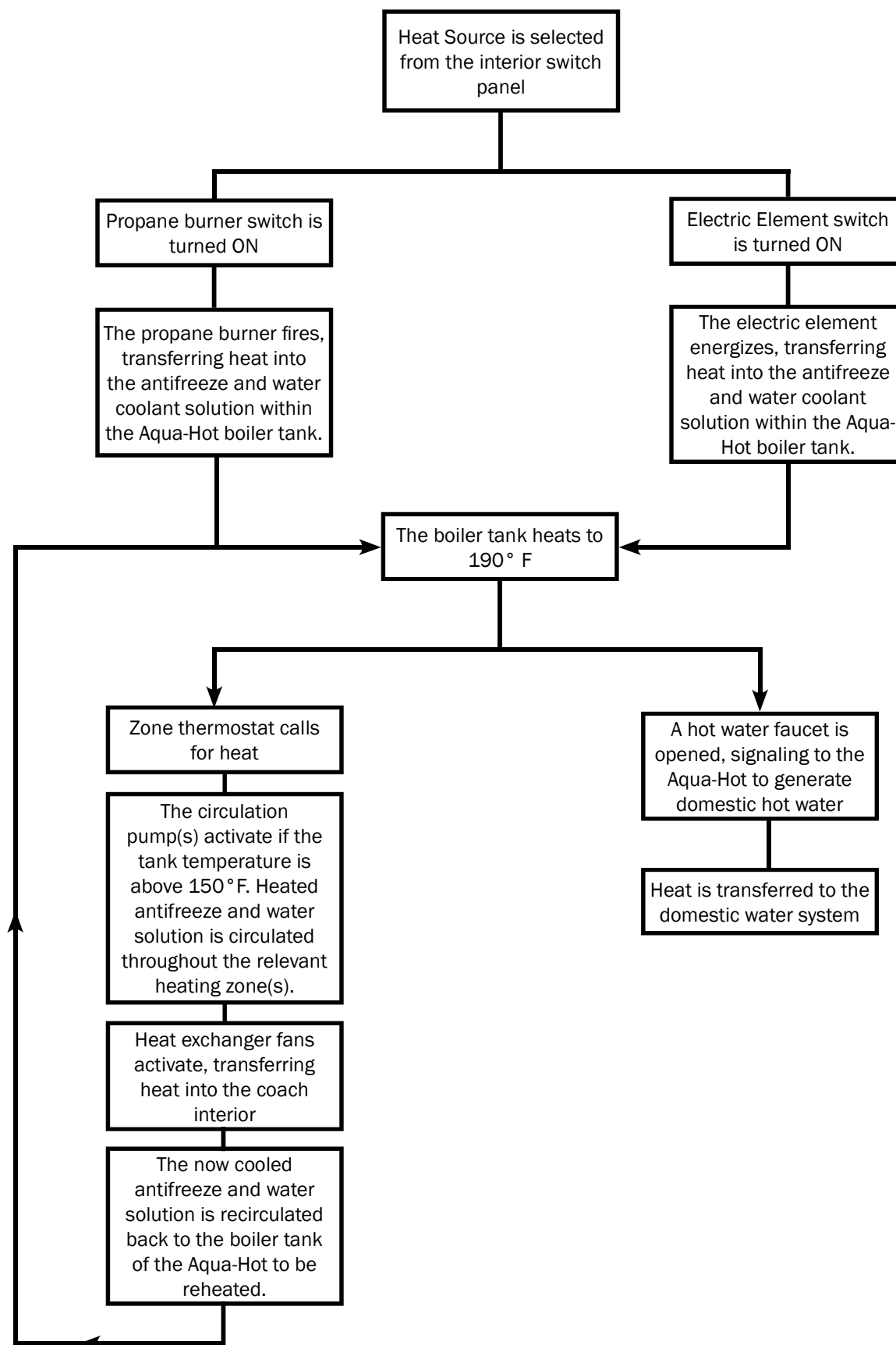


Figure 8

Operational Flow Chart



Antifreeze and Water Heating Solution

Introduction:

As the antifreeze type and mixture ratio is essential to the Aqua-Hot's performance and ability to comply with regulations, the following information is being supplied to understand various types of antifreeze, the quality of water necessary, and the mixture ratio. Aqua-Hot Heating Systems recommends Century Transfer Fluid.

Antifreeze Types:

The following information addresses the necessary usage of a propylene glycol based "boiler" type antifreeze in the Aqua-Hot. Propylene glycol is a safer alternative to the more toxic ethylene glycol antifreeze; however, as mandated by IAPMO (International Association of Plumbing and Mechanical Officials), only those propylene glycol based "boiler" type antifreezes deemed "Generally Recognized as Safe" (GRAS) by the FDA should be utilized.

Because of the significant impact various types of antifreeze can have on a Hydronic heating system, including the level of safety provided, it has been recognized that there is a need to provide an explanation regarding two additional prominent types of antifreeze/coolant available. The following information should be utilized as an educational means of ensuring that the proper type of propylene glycol based anti-freeze is selected.

RV and Marine Antifreeze:

These types of propylene glycol based antifreeze products are formulated specifically for "winterizing" applications only. Although RV & Marine antifreeze is often "Generally Recognized as Safe" by the FDA, it should never be used in the Aqua-Hot's Hydronic Heating System. This type of anti-freeze is not formulated to transfer heat, which is essential to the heating system's functionality and does not contain rust inhibitors. Please note, however, that RV & Marine anti-freeze can be utilized to winterize the Aqua-Hot's domestic water heating system.

Automotive Antifreeze/Coolant:

These types of propylene glycol based antifreeze products are formulated specifically to protect automotive engines against corrosion, freezing temperatures, and overheating. They also have excellent heat transfer and thermal conductivity characteristics. Although these types of antifreeze products are considered less toxic and safer than ethylene glycol for people, pets, and the environment, they are not "Generally Recognized as Safe" (GRAS) rated by the FDA. Therefore, they must be

marked with a "harmful if swallowed" warning. This additional warning is required because these types of antifreeze products contain high levels of chemical inhibitors. Due to their potentially hazardous properties, they should never be used in the Aqua-Hot's Hydronic Heating System.

Antifreeze Mixture Water Quality:

In order to ensure maximum performance and longevity of an Aqua-Hot heating system's boiler tank and associated components, it has been determined that there is a need to use distilled, deionized, or soft water in combination with concentrated propylene glycol for the Aqua-Hot's antifreeze and water heating solution,. Please note that this is only necessary when mixing concentrated propylene glycol antifreeze with water; suppliers of premixed antifreeze are responsible for the use of high quality (distilled, deionized, or soft) water when preparing their antifreeze for sale.

Hard water possesses a high-level of calcium and magnesium ions, which deplete the propylene glycol antifreeze's corrosion inhibitors. This, in turn, causes the antifreeze and water heating solution to begin turning acidic, which can corrode the Aqua-Hot's boiler tank and associated components prematurely. Therefore, concentrated propylene glycol should be diluted with distilled, deionized, or soft water that is 80 PPM or less in total hardness. The local water agency should have up-to-date water quality reports that should indicate if the local tap water is within this guideline.

Antifreeze Terms and Mixture Ratio:

The following information addresses the process of selecting an antifreeze and water mixture ratio that provides adequate freeze, boiling, and rust/anti-corrosive protection. A 50/50 mixture of propylene glycol/water ratio is recommended, which will result in a freeze point of approximately -28°F and a boil point of approximately 222°F.

The following information should be utilized for the purpose of clarifying some terms commonly associated with antifreeze.

Freeze Point and Burst Point:

Antifreeze lowers the freezing point of any liquid, to which it has been added, by preventing the formation of ice crystals; however, as the ambient temperature continues to decline, the water in the solution will attempt to attain a solid state. The point in which the water begins to solidify is termed the "Freeze Point." Although the water in the solution has begun to freeze, producing a "slushy" consistency, the anti-freeze in the solution will continue to combat the normal expansion of the solution as it freezes. The point in which the

solution can begin to expand, due to colder temperatures, is called the “burst point.” Once the solution reaches the burst point, the potential is present for ruptured pipes to exist. The burst point of the antifreeze and water heating solution is dependent upon the brand of propylene glycol employed.

Boiling Point:

The Aqua-Hot utilizes the antifreeze and water heating solution as a transportation means for the heat produced from the internal processes. The antifreeze absorbs the heat created until its boiling point is reached; it is at this point that the liquid turns to a gas and is expelled to prevent the heating system from overheating. Each time the boiling point is reached, a loss of efficiency occurs because the heat produced is expelled rather than used for the function of the heating system. Therefore, a higher boiling point is desired in order to combat the loss of efficiency, which allows the antifreeze to transport the heat created from the internal process throughout the motor home where it can be used productively rather than dissipating due to its change from a liquid to a gas.

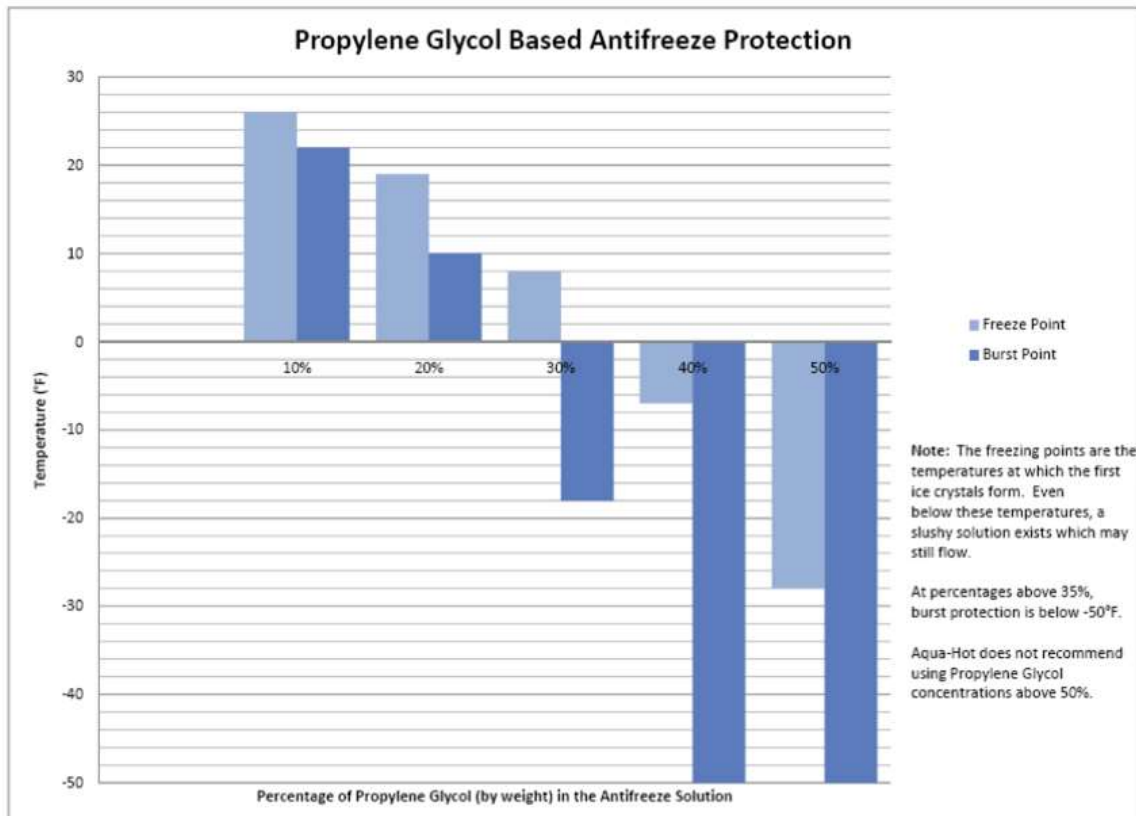
Rust and Corrosion Inhibitors:

Another major function of antifreeze is to provide protection to the internal metal components of the Aqua-Hot Hydronic heating system from corrosion and rust. Antifreeze is able to perform this function by the addition of rust-and anti-corrosive inhibitors, which are designed specifically to activate in a water solution.

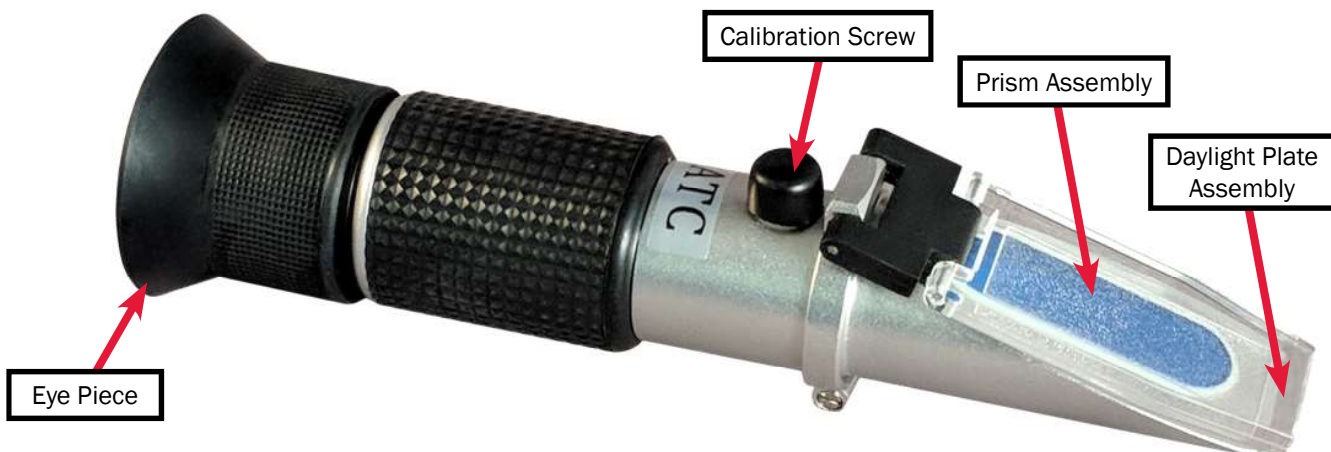
Summary:

Antifreeze has three basic functions: freeze protection, boil-over protection, and anti-corrosion and rust protection. Antifreeze is also primarily responsible for heat transfer characteristics. Therefore, as water is an excellent heat conductor, it is added to the mixture. A 50/50 solution of propylene glycol antifreeze and water is recommended to provide the best performance combination of the aforementioned functions. If excess propylene glycol exists within an antifreeze and water heating solution, the water’s heat absorption properties are compromised, which could ultimately inhibit the Aqua-Hot from providing adequate domestic hot water and interior heating.

Additionally, if the antifreeze and water heating solution contains over 70 percent antifreeze, the freezing point is actually raised, resulting in less freeze protection.



Measuring Antifreeze Using a Refractometer

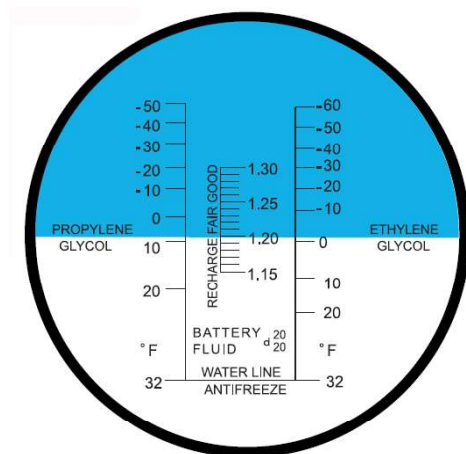


Properly Apply Antifreeze to the Prism Assembly

Use the guide below to properly apply the propylene glycol mixture to the prism assembly of the refractometer. Once that is complete, peer through the eyeglass of the refractometer to continue to the next step.

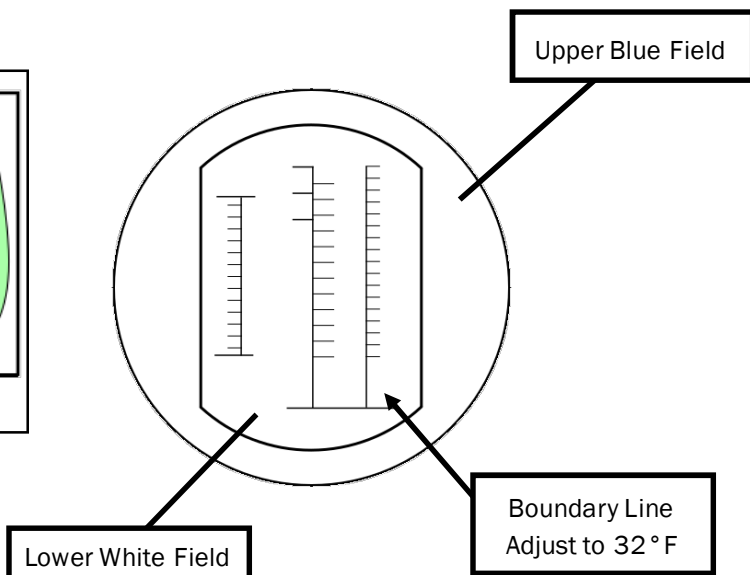
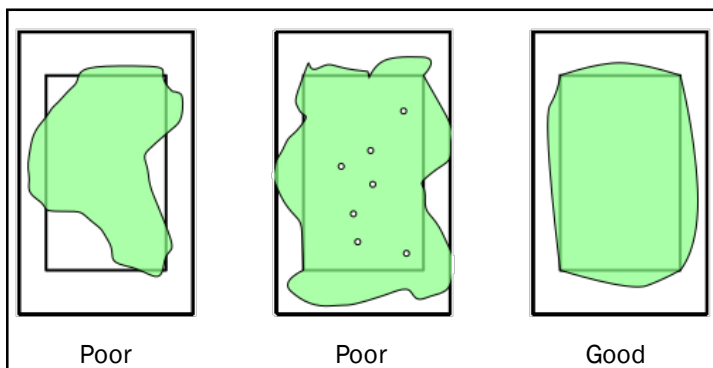
Adjust the Boundary Line

Once the glycol solution has been properly applied, adjust the calibration screw until the boundary line labeled “Propylene Glycol” is set to 32 °F. The graphic to the right has been designed as an aid, but note that it may differ from what is shown in the refractometer sight glass.



Refractometer Sight Glass

Application of Propylene Glycol



Interior Switch Panel

Introduction:

The interior switch panel is used to control the two potential heating sources for the Aqua-Hot's boiler tank. When a switch is activated, the indicator light on the switch will illuminate.

Coach Control Panel Screen:

Newer Aqua-Hot units that come equipped with the Reporter may have a coach touch-screen display instead of the interior switch panel. Please confirm with your coach dealer or vehicle manufacturer the location and functionality of your interior control screen.

Propane-Burner Switch:

When the propane-burner switch is in the ON position and the control thermostat or ETS Module tells the Reporter that heat is needed for the boiler tank, the propane-burner will respond by firing up and providing heat. A cold boiler tank can expect to be brought to operating temperature by the propane-burner in approximately 10 to 20 minutes. In order to obtain continuous hot water, the propane-burner switch must be activated.

Additionally, the propane-burner switch can be used to reset a low-voltage condition. This is accomplished by turning off the propane-burner switch for 30 seconds, then turning it back on, or by resetting the Reporter.

Electric Element Switch:

When the motor home is plugged into an AC power source (e.g., shore power, generator, etc) and the electric element switch is on, the electric heating element will be used to provide heat to the boiler tank if the need arises. A cold boiler tank can expect to be brought to operating temperature by the electric heating element in approximately 1 to 2 hours. The electric element, alone, will not be able to provide continuous hot water.

NOTE: If the propane burner fails to ignite, it will trigger a fault on the Aqua-Hot Reporter (P02 and newer).

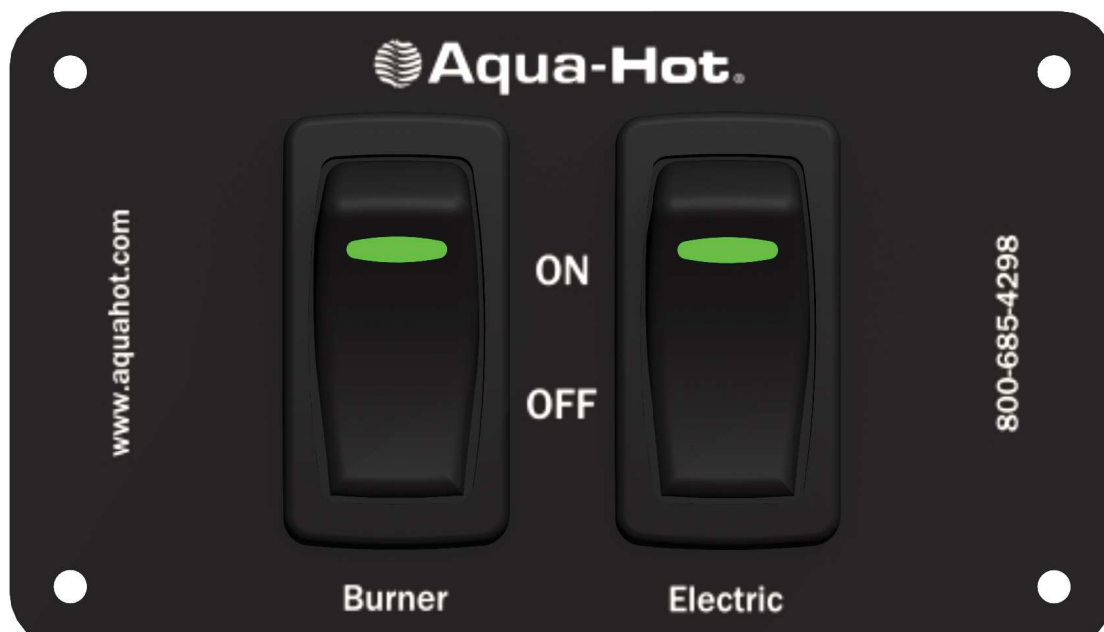
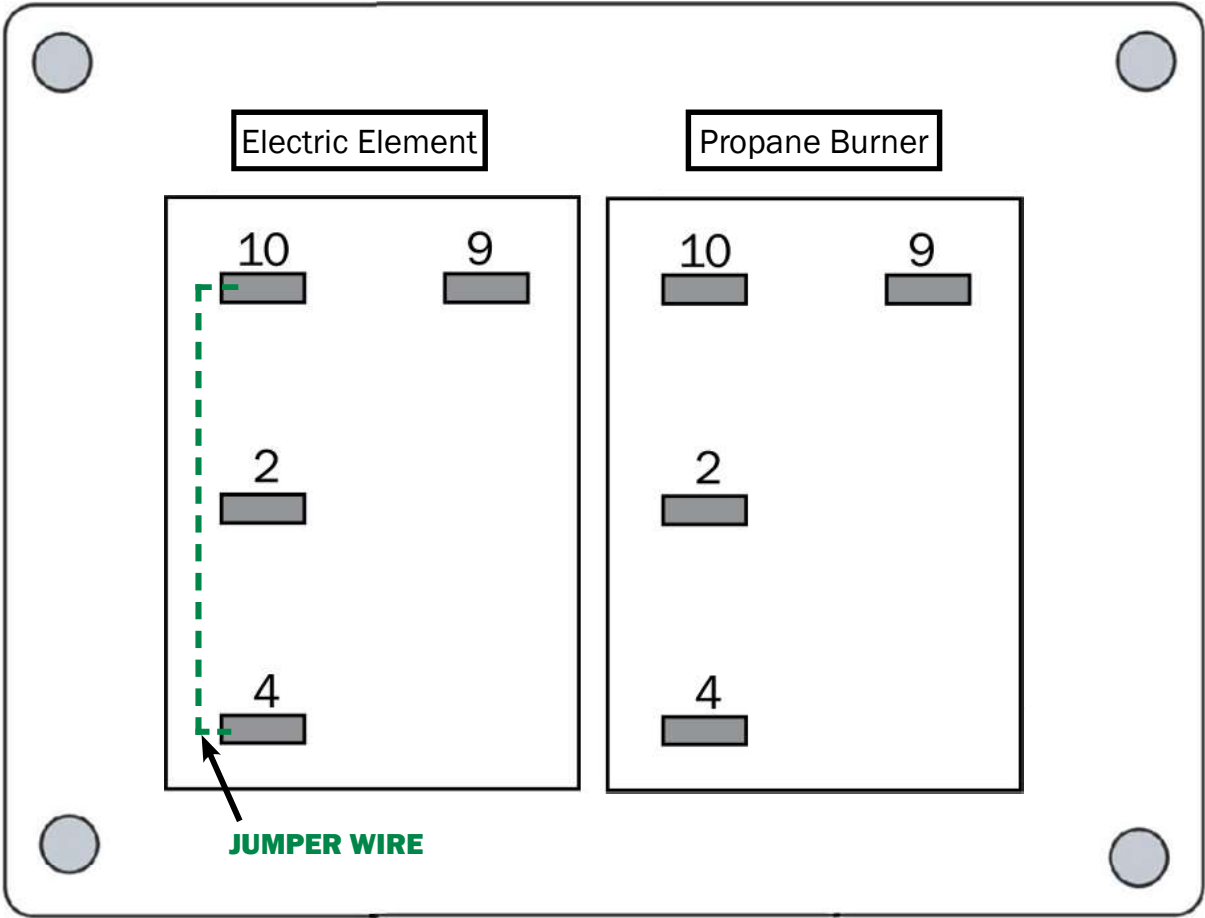


Figure 9

Switches Rear View



Switch Pin	Wire Harness
#2	J9-2
#4	J1-2
#9	Chassis Ground

Switch Pin	Wire Harness
#2	J1-1
#4	J9-3
#10	J7-3
#9	Chassis Ground

NOTE: The Electric Element switch possesses jumper wires that advance from terminal 4 to terminal 10.

Exhaust System Requirements

Introduction:

The following section will detail the specific Exhaust System Requirements of the Aqua-Hot 400P. Follow these requirements without deviation to ensure optimal unit operation.

Because the Aqua-Hot's exhaust is hot and must be kept away from any heat-sensitive material, the exhaust system should be checked to ensure that it continues to meet the following requirements:

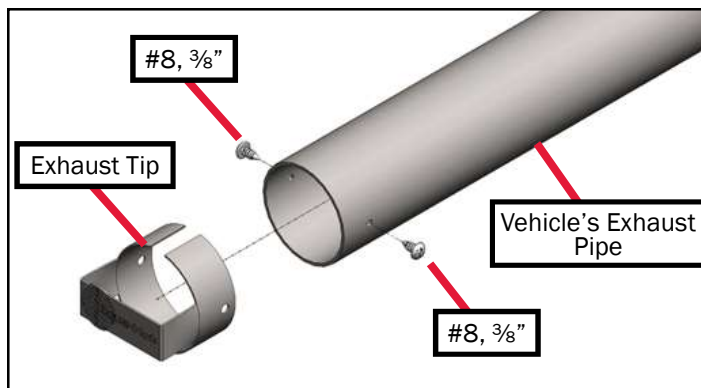


Figure 10

Installation Guidelines:

- The exhaust must NOT be directed downwards, as a fire could result under certain conditions
- The exhaust must NOT terminate beneath the vehicle, beneath an open-able window
- The exhaust must NOT vent in the awning area of the motor home or near the slide-out areas
- The exhaust must be able to freely exit away from the vehicle without any obstructions
- 2-in standard automotive-type exhaust pipe should be used
- Total exhaust length must NOT exceed 20 feet, and shall contain no more than two 90° bends
- The 3-in and 4-in black pipe nipples and the exhaust elbow - originally supplied with the Aqua-Hot must be present
- The exhaust tip must be used to prevent the burner from extinguishing in winds up to 40mph. See Figure 10.

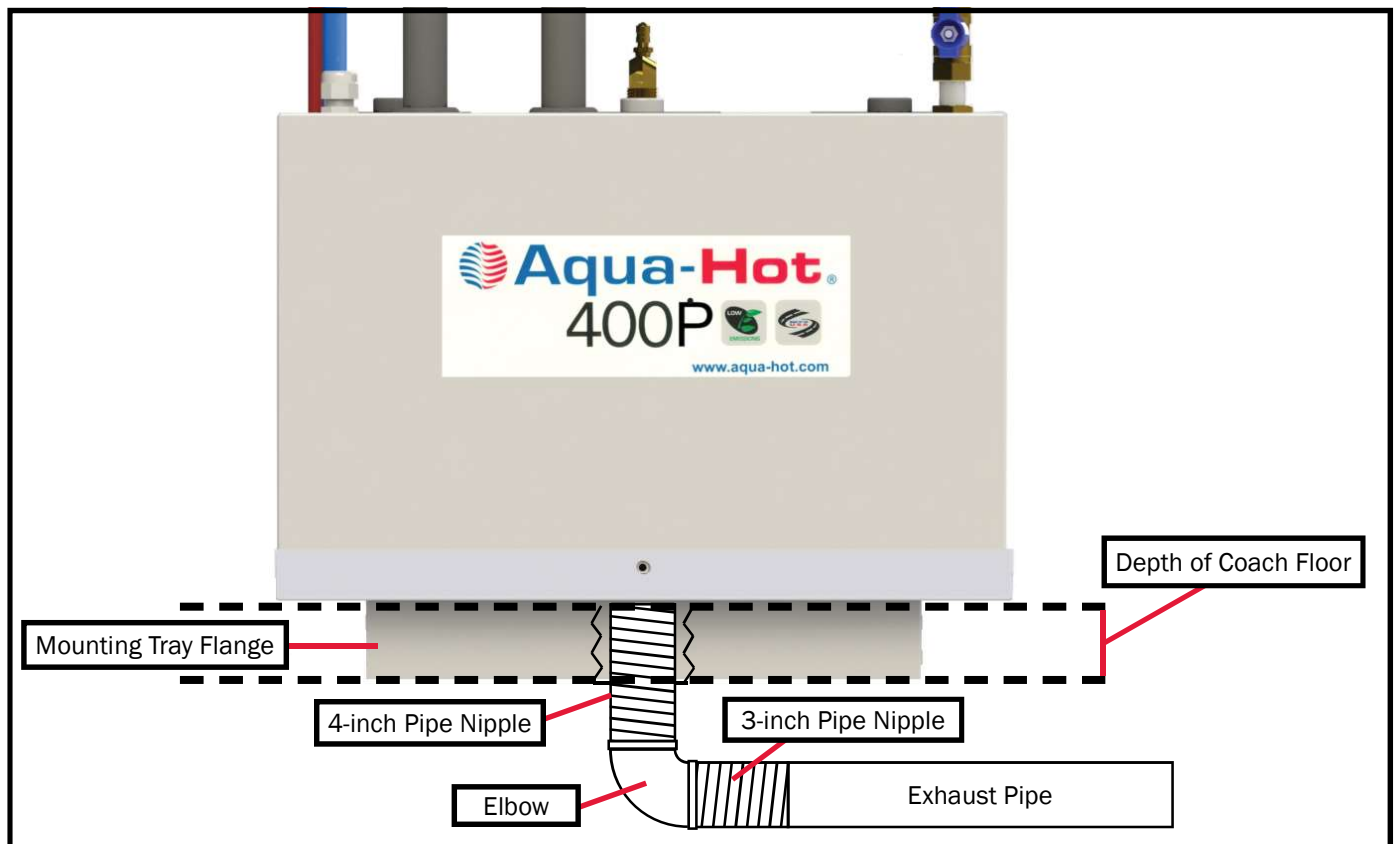


Figure 11

Interlock Switch

Introduction:

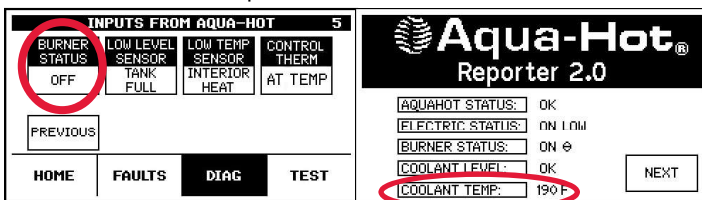
The interlock switch is a safety device designed to ensure that the Aqua-Hot's access cover is securely installed before allowing the propane-burner to operate.

If the Aqua-Hot fails to operate, and shows no illuminated lights or displays, it is possible that the interlock switch is faulty. Follow the directions below to troubleshoot, and if necessary, replace the interlock switch.

Troubleshooting:

NOTE: The interlock switch will prevent the propane-burner from operating without the access cover intact; therefore, the switch will need to be manually pressed during testing for the switch's functionality.

1. Turn the propane-burner switch on from the interior switch panel and ensure that the boiler tank has sufficiently cooled in order to require heat from the propane burner.
2. Verify that the "Burner Status" is ON on the Reporter, and that the tank temperature is below 190 °F.



3. Disconnect the two yellow wires from the interlock switch noting that wire #24 is connected to the terminal labeled "NO" and wire #25 is connected to the terminal labeled "COM."
4. Using an ohmmeter, check the interlock switch for continuity while the button is pushed in.

If continuity is not present with the button pushed in, follow the instructions in this section to replace the interlock switch.

Replacement Procedure:

1. Disconnect the Aqua-Hot from all power sources.
1. Disconnect the interlock switch's wires by pulling the quick connectors from the switch's spade terminals.
2. Release the interlock switch from the Aqua-Hot cabinet by pushing in on the locking tabs and pulling the interlock switch.
3. Remove the defective interlock switch from the Aqua-Hot.
4. Install the replacement interlock switch onto the Aqua-Hot ensuring that the locking tabs snap into place.
5. Connect the Aqua-Hot's wires to the replacement interlock switch with yellow wire #24 connected to the terminal labeled "NO" and yellow wire #25 connected to the terminal labeled "COM."

NOTE: If the interlock switch wires are reversed, the interlock switch will only allow the propane-burner to operate when the access cover is removed and the button on the switch is released.

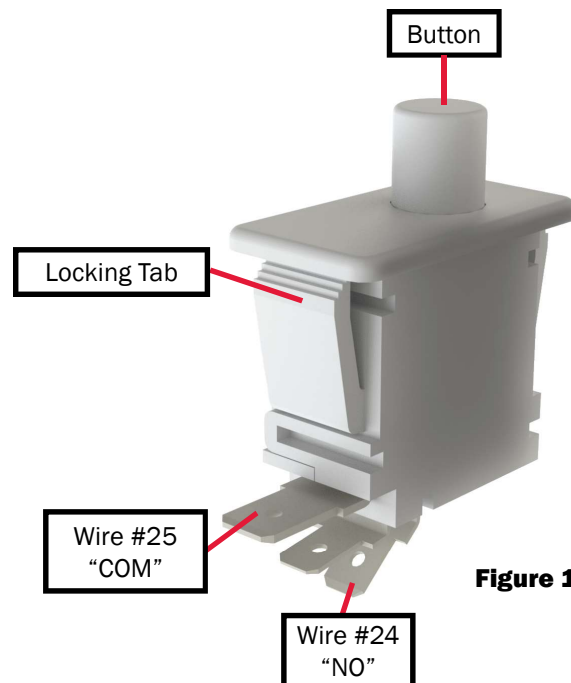


Figure 12



DANGER

FAILURE TO DISCONNECT ALL POWER SUPPLIES AND/OR TO ALLOW THE HEATER TO COOL BEFORE SERVICING COULD CAUSE SERIOUS DAMAGE OR PERSONAL INJURY.

Fluid-Level Sensor

Introduction:

The fluid-level sensor monitors the level of antifreeze and water heating solution within the Aqua-Hot's boiler tank to ensure that an adequate volume exists.

Troubleshoot the fluid-level sensor if the Reporter has issued a low fluid level fault and the Aqua-Hot is adequately filled.

The fluid-level sensor operates by relaying a continuity signal to the Reporter while it is wet. If this signal does not exist, then there may be an issue with the Reporter, OR the fluid level sensor may be physically damaged. Follow the directions below to troubleshoot the fluid level sensor.



Figure 13

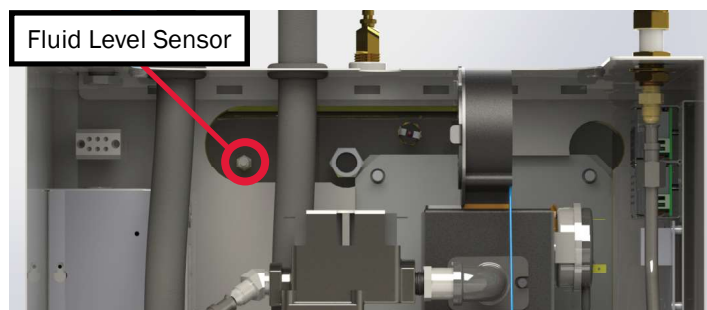


Figure 14

Troubleshooting Procedure:

1. Verify that the wires terminating at the fluid level sensor are not damaged, corroded, or otherwise faulty.
2. Verify that the wires terminating at the Reporter are not damaged, corroded, or otherwise faulty.
3. Clamp the zone hoses shut to prevent the zones from draining into the Aqua-Hot. Reference Figure 15.
4. Drain approximately two gallons of fluid into an external container to be reused.
5. Using a $\frac{3}{16}$ " wrench, or deep socket, loosen and remove the fluid level sensor from the tank face.

6. If the sensor is corroded or the stainless steel rod is corroded, rusted, or otherwise damaged the fluid level sensor will need to be replaced.

Please note that if the sensor is covered in residue, it may be functioning improperly. If this occurs, clean the sensor off and retest the Aqua-Hot for functionality BEFORE replacing the fluid level sensor.

Replacement Procedure:

1. Clamp the zone hoses shut to prevent the zones from draining into the Aqua-Hot. Reference Figure 15.
2. Drain approximately two gallons of fluid into an external container to be reused.
3. Remove the nut securing the wire in place on the fluid level sensor.
4. Using a $\frac{3}{16}$ " wrench, or deep socket, loosen and remove the fluid level sensor from the tank face.
5. Discard this sensor.
6. Place the new sensor in position on the tank face and finger tighten it into place.
7. Using a $\frac{3}{16}$ " wrench or deep socket, tighten the sensor until it is snug. DO NOT OVER TIGHTEN THIS SENSOR.
8. Reconnect the previously disconnected wire to the new fluid sensor.
9. Test the Aqua-Hot for normal operation.

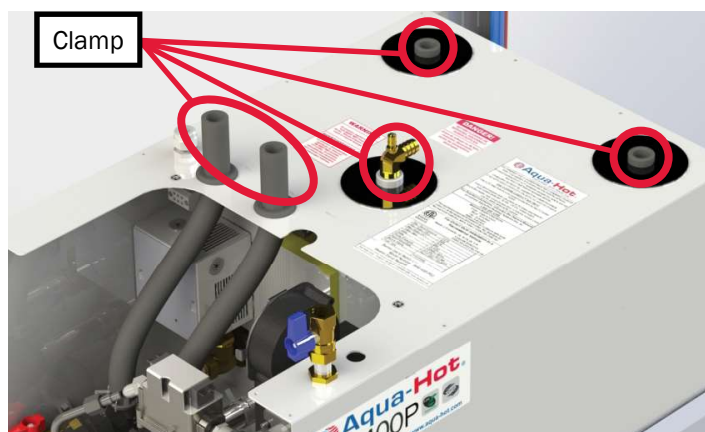


Figure 15

Coolant Temperature Sensor (ETS)

Introduction:

The ETS module precisely measures the temperature of the coolant inside of the Aqua-Hot boiler tank. This allows for very granular control of the unit to deliver precise heating and hot water as needed. The Aqua-Hot operating temperatures are between 155°F and 190°F.

The ETS module went live on the Aqua-Hot 400-P02 series. Older units utilized the control thermostat.

The ETS module should be diagnosed if the Reporter is displaying an incorrect temperature when accompanied by issues such as lack of interior heat or hot water.

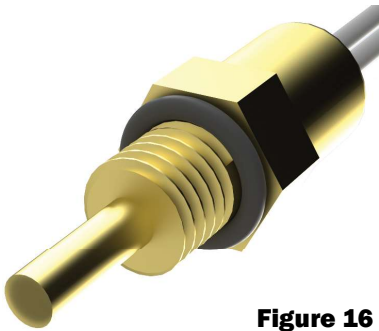


Figure 16

Troubleshooting Procedure:

1. Locate the thermostat within the Aqua-Hot and its associated wires.
2. Verify that these wires are not corroded, cut, or otherwise damaged.
3. Check the J8-6 and J8-3 pins on the Reporter to check for cut, corroded, or otherwise damaged wiring.
4. Using a meat thermometer, measure the temperature of the tank face of the Aqua-Hot.
5. Record this temperature on a notepad.
6. Locate the Reporter, and access the home page.
7. Find the element entitled "COOLANT TEMP".

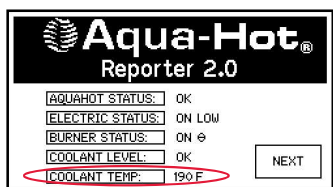


Figure 17

8. If the temperature displayed is not approximately the same as the temperature recorded earlier, the ETS module will need to be replaced.

Replacement Procedure:

1. Clamp shut the zone hoses to prevent the zone from draining.
2. Open the unit drain valve located on the bottom left of the heater, and allow approximately two gallons to drain from the unit.
3. Disconnect the wires of the existing ETS module.
4. Using a 10mm socket deep-well socket, remove the defunct ETS module and discard it.
5. Place the new ETS module onto the tank face, and finger tighten it.
6. Using a 10mm deep-well socket, tighten the ETS module until it is snug. **DO NOT OVER-TIGHTEN THE ETS MODULE.**
7. Reconnect the wires of the ETS module.
8. Test the Aqua-Hot for normal operation.

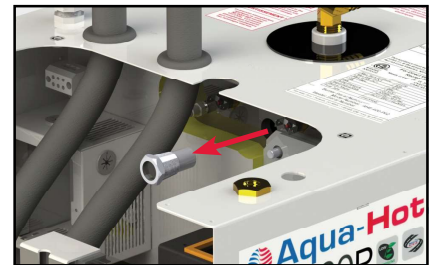


Figure 18

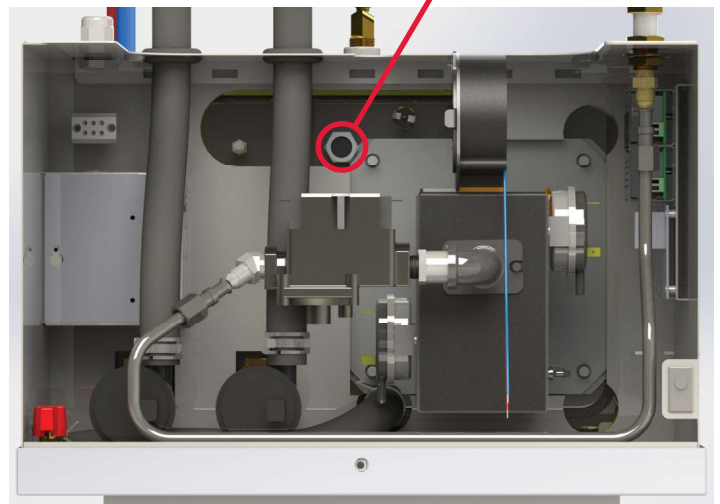


Figure 19

AC High-Limit Thermostat

Introduction:

The AC High-Limit thermostat serves as a safety measure in the event that the electric heating element continues to operate after the maximum operating temperature is reached. The high-limit thermostat allows the current for the heating element to pass through it until the boiler tank reaches a temperature of 215°F. Should this temperature be reached, the high-limit thermostat blocks the current to the element, which prevents it from continuing to provide heat to the boiler tank.



Figure 20

Begin troubleshooting the AC High-Limit Thermostat if the Reporter issues an overheat fault, or the electric heating element fails to operate correctly.

Troubleshooting Guidelines:

The following conditions must be met before the AC High-Limit Thermostat can be diagnosed, and if necessary, repaired.

- The fluid expansion bottle is filled to at least the “COLD” mark.
- Verify that all in-line fuses are functional.
- Ensure that the unit is completely cool.
- Ensure that DC electrical power is supplied to the Aqua-Hot.
- Ensure that AC electrical power is supplied to the Aqua-Hot's electric element.

If any of the above conditions are not met, correct them before continuing with troubleshooting. Results of the troubleshooting procedure cannot be verified if the conditions listed above are not fulfilled.

Troubleshooting Procedure:

1. Disconnect all power supplies.

NOTE: If the High-Limit Thermostat is tripped, it is recommended to test the control thermostat/ETS Module for proper operation.

2. Remove the AC access cover.
3. Verify that the boiler's tank temperature is below 215°F.
4. Locate the AC high-limit thermostat and remove its wires.
5. Using an ohmmeter, check the thermostat for continuity.
 - If there is no continuity, press the white reset button on the thermostat and recheck for continuity.
 - If continuity is still not present after the reset button has been pressed, follow the instructions in this section to replace the AC high-limit thermostat.

Replacement Procedure:

1. Ensure that the Aqua-Hot has been completely shut down, and that all power supplies have been disconnected.
2. Remove the AC access cover.
3. If applicable, remove the heat shrink insulation covering the wires and terminals on the defective high-limit thermostat.
4. Disconnect the high-limit thermostat from the electric element and AC relay by removing the screws with a Philips screw driver.
5. Using a $\frac{5}{8}$ " wrench or socket, remove the defective high-limit thermostat from the Aqua-Hot's boiler tank.
6. Install the replacement high-limit thermostat into the port on the Aqua-Hot's boiler tank and finger tighten only (**15 in-lbs**).
7. Connect the wires on the replacement high-limit thermostat in the same configuration as they were removed.

NOTE: One wire will attach to the electric heating element and one wire will attach to the AC relay.

8. Secure the AC access cover back into place.
9. Test for proper operation.

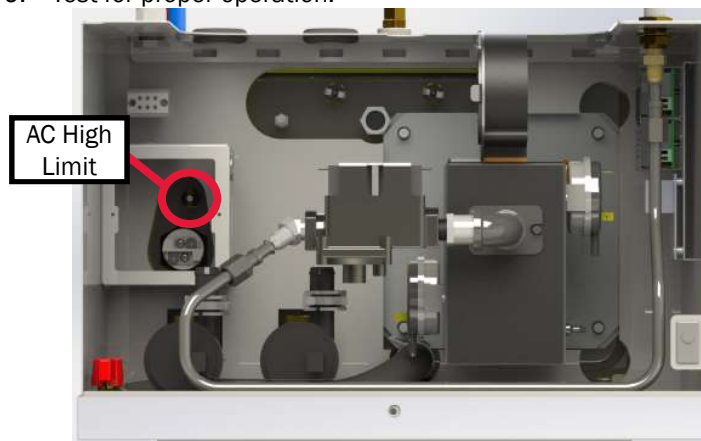


Figure 21

DC High-Limit Thermostat (Right)

Introduction:

The DC high-limit thermostats serve as a safety measure in the event that the propane-burner continues to operate after the maximum operating temperature is reached. The high-limit thermostats allow the current for the propane-burner to pass through them until the boiler tank reaches a temperature of 215°F. Should this temperature be reached, the high-limit thermostat blocks the current to the propane-burner's fuel solenoid valve, which prevents the propane-burner from operating.

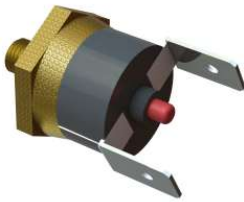


Figure 22

Begin troubleshooting the right DC High-Limit Thermostat if the Reporter issues an overheat fault, the gas valve on the burner fails to operate, or the blower fan runs but the burner does not ignite.

Troubleshooting Guidelines:

The following conditions must be met before the High-Limit Thermostats can be diagnosed, and if necessary, repaired.

- The fluid expansion bottle is filled to at least the "COLD" mark.
- Verify that all in-line fuses are functional.
- Ensure that the unit is completely cool.
- Ensure that DC electrical power is supplied to the Aqua-Hot.

If any of the above conditions are not met, correct them before continuing with troubleshooting. Results of the troubleshooting procedure cannot be verified if the conditions listed above are not fulfilled.

Troubleshooting Procedure:

1. Locate the right high-limit thermostat (wires 33 & 36) and disconnect the wires from the thermostat. Place a jumper wire between the blue and purple wires on the propane-burner's wire harness to bypass the high-limit thermostats. Check the Aqua-Hot for normal operation.

NOTE: Bypassing the high-limit thermostats is for testing only and must not be used for the Aqua-Hot's normal functioning.

2. Disconnect the DC high-limit thermostats' wires, then with an ohmmeter, check the thermostat for continuity.

If there is no continuity, complete the following:

- Press the reset button on the high-limit thermostat, then recheck for continuity.
- If an individual wire does not have continuity, that wire must be replaced.
- If a thermostat with the wires removed that has been reset does not have continuity, follow the instructions in this section to replace the right high-limit thermostat.

NOTE: If the high-limit thermostats continue to trip, troubleshoot the control thermostat/ETS Module, and verify the boiler tank is full of the heating solution.



DANGER

Failure to disconnect all power supplies and/or to allow the heater to cool before servicing could cause serious damage or personal injury.

Replacement Procedure:

1. Ensure that the Aqua-Hot has been completely shut down, and that all power supplies have been disconnected.
2. Remove the two wires from the defective high-limit thermostat by pulling firmly on the wires.
3. Using a 5/8" wrench or socket, remove the defective high-limit thermostat from the Aqua-Hot's boiler tank.
4. Install the replacement high-limit thermostat into the port on the Aqua-Hot's boiler tank and finger tighten only (**15 in-lbs**).
5. Connect the wires removed from the defective high-limit thermostat to the replacement high-limit thermostat.
6. Test for normal operation.

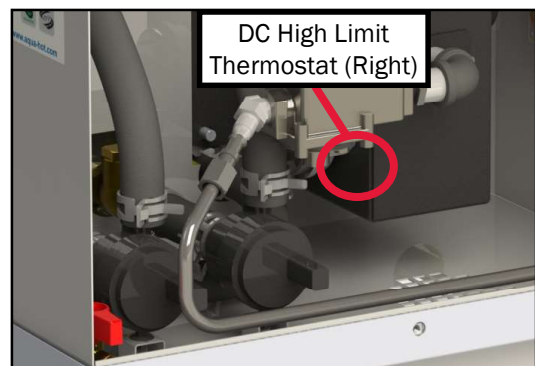


Figure 23

DC High-Limit Thermostat (Left)

Introduction:

The DC high-limit thermostats serve as a safety measure in the event that the propane-burner continues to operate after the maximum operating temperature is reached. The high-limit thermostats allow the current for the propane-burner to pass through them until the boiler tank reaches a temperature of 215°F. Should this temperature be reached, the high-limit thermostat blocks the current to the propane-burner's fuel solenoid valve, which prevents the propane-burner from operating.

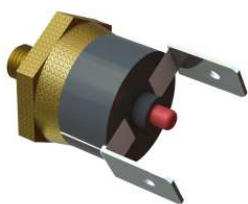


Figure 24

Begin troubleshooting the left DC High-Limit Thermostat if the Reporter issues an overheat fault or the burner does not attempt to start.

Troubleshooting Guidelines:

The following conditions must be met before the High-Limit Thermostats can be diagnosed, and if necessary, repaired.

- The fluid expansion bottle is filled to at least the "COLD" mark.
- Verify that all in-line fuses are functional.
- Ensure that the unit is completely cool.
- Ensure that DC electrical power is supplied to the Aqua-Hot.

If any of the above conditions are not met, correct them before continuing with troubleshooting. Results of the troubleshooting procedure cannot be verified if the conditions listed above are not fulfilled.

Troubleshooting Procedure:

1. Locate the right high-limit thermostat (wires 32 & 35) and disconnect the wires from the thermostat. Place a jumper wire between the blue and purple wires on the propane-burner's wire harness to bypass the high-limit thermostats. Check the Aqua-Hot for normal operation.

NOTE: Bypassing the high-limit thermostats is for testing only and must not be used for the Aqua-Hot's normal functioning.

2. Disconnect the DC high-limit thermostats' wires, then with an ohmmeter, check the thermostat for continuity.

If there is no continuity, complete the following:

- Press the reset button on the high-limit thermostat, then recheck for continuity.
- If an individual wire does not have continuity, that wire must be replaced.
- If a thermostat with the wires removed that has been reset does not have continuity, follow the instructions in this section to replace the right high-limit thermostat.

NOTE: If the high-limit thermostats continue to trip, troubleshoot the control thermostat/ETS Module, and verify the boiler tank is full of the heating solution.



DANGER

Failure to disconnect all power supplies and/or to allow the heater to cool before servicing could cause serious damage or personal injury.

Replacement Procedure:

1. Ensure that the Aqua-Hot has been completely shut down, and that all power supplies have been disconnected.
2. Remove the two wires from the defective high-limit thermostat by pulling firmly on the wires.
3. Using a 5/8" wrench or socket, remove the defective high-limit thermostat from the Aqua-Hot's boiler tank.
4. Install the replacement high-limit thermostat into the port on the Aqua-Hot's boiler tank and finger tighten only (**15 in-lbs**).
5. Connect the wires removed from the defective high-limit thermostat to the replacement high-limit thermostat.
6. Test for normal operation.

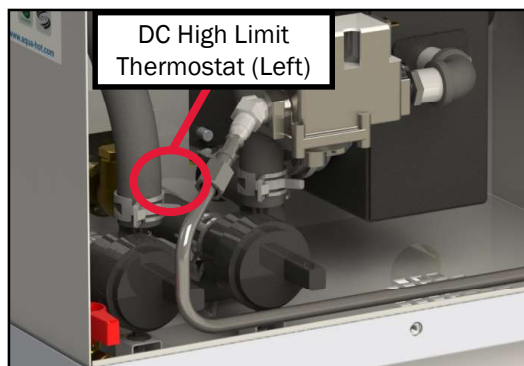


Figure 25

Low-Temperature Cutoff Thermostat

Introduction:

The low-temperature cutoff thermostat (LTCO) operates the domestic hot water priority system by blocking the interior heating feature when domestic hot water is being used. This ensures that even heat is provided for domestic hot water, which avoids the possibility of cold water pockets during showers, etc.



Figure 26

Begin troubleshooting the Low-Temperature Cutoff Thermostat if the following conditions have occurred:

- There is a lack of interior heat
- There is a lack of hot water

Troubleshooting Procedure:

1. Locate the Reporter and navigate to “INPUTS FROM AQUA-HOT”

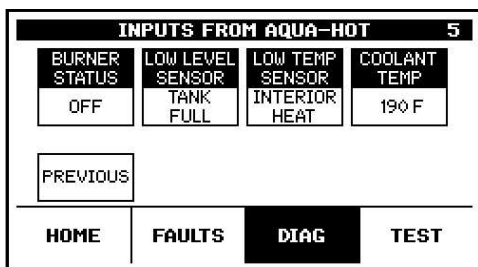


Figure 27

2. Turn on a hot water faucet within the coach. Monitor the Reporter screen.
3. Confirm the LTCO element displays “HOT WATER”. If it displays “INTERIOR HEAT”, locate the LTCO in the Aqua-Hot cabinet.
4. Using a multimeter, test the LTCO for continuity.
5. If the LTCO does not have continuity while hot water is running, follow the procedure to replace the LTCO.



Replacing the Low-Temperature Cutoff Thermostat:

1. Ensure that the Aqua-Hot has been completely shut down and that all the power sources have been disconnected.
2. Locate the low-temperature cutoff thermostat on the cold domestic water inlet pipe at the back of the Aqua-Hot (see Figure 28).
3. Disconnect the wires from the LTCO by separating the quick-disconnect terminals.
4. Remove and discard the defunct LTCO thermostat using a $\frac{5}{8}$ " wrench.
5. Position and secure the new LTCO thermostat into place. Hand tighten only to **15 in-lbs**. Do NOT over-tighten.
6. Connect the replacement low-temperature cutoff thermostat's wires in the same configuration as the removed thermostat's wires.

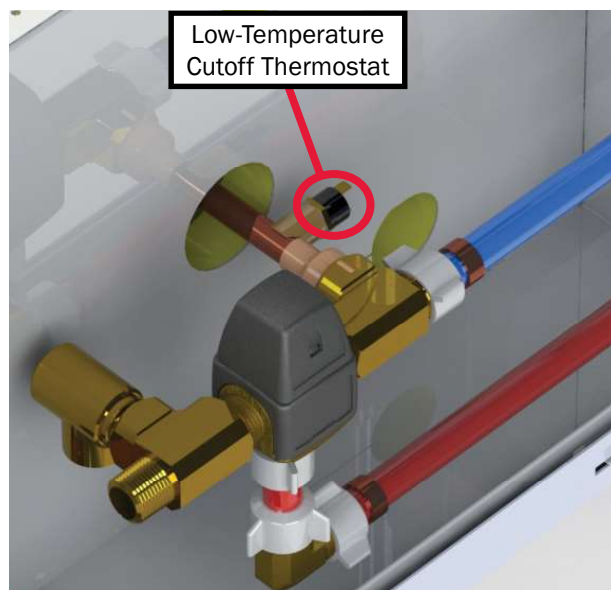


Figure 28

Check Valves

Introduction:

Check valves are installed into the zone outlet ports for each heating loop to ensure that the antifreeze and water heating solution only flows in one direction. If the heating solution attempts to back flow into the boiler tank, the check valve closes to prevent that from happening.



Figure 29

Troubleshoot the check valves if there is a lack of interior heat in a particular zone.

Troubleshooting Procedure:

1. Verify that the heating zone is operating properly by checking the following:
 - Check the Reporter “DIAG” screen on OPERATING MODE to ensure that the heating zone is on.

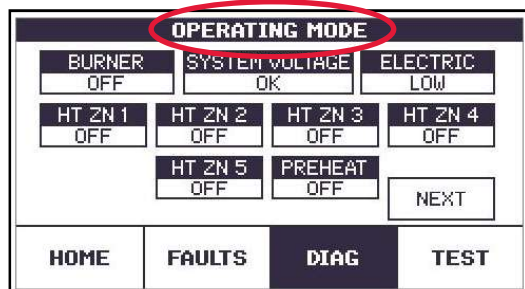


Figure 30

- Check the “OUTPUTS TO AQUA-HOT” to ensure the corresponding pump is on.

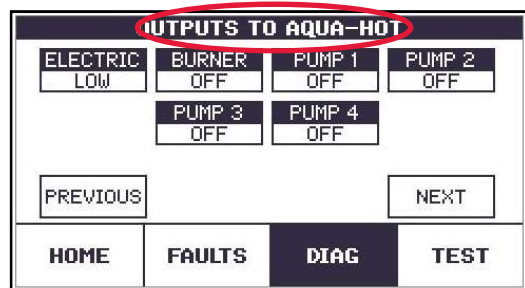


Figure 31

2. With the circulation pump operating, tap on the check valve and wait five minutes to evaluate if interior heat is now present.
 - If interior heat is present after tapping the check valve, the check valve was stuck closed and no further action is needed.
3. Check the Aqua-Hot's antifreeze and water heating solution's ratio of water to propylene glycol. The mixture ratio should be approximately 50/50. If the solution is comprised fully of antifreeze (100%), the check valves will continue to stick.

NOTE: Storing the motor home for an extended period of time can cause the check valves to stick. If after the initial release of the stuck check valve, it continues to stick, follow the instructions in this section to replace the check valve.

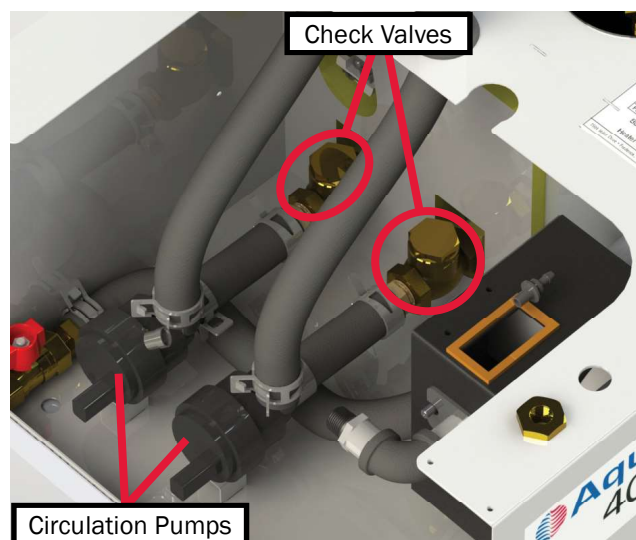


Figure 32

Replacing the Check Valve:

1. Ensure that the Aqua-Hot has been completely shut down and that all power sources have been disconnected. Be sure the boiler tank has adequately cooled.
2. Drain the antifreeze and water heating solution from the boiler tank using the drain valve.
3. Using constant tension pliers, loosen and slide back the constant tension clamp securing the hose to the defective check valve.
4. Remove the hose from the defective check valve.
5. Unscrew the defective check valve from the Aqua-Hot's boiler tank.

Tempering Valve

6. Remove the hose barb and the ½" coupler from the defective check valve.

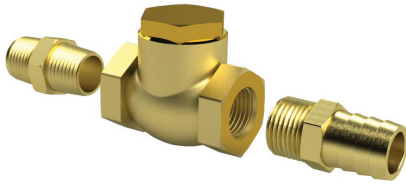


Figure 33

7. Clean the hose barb and coupler, then wrap the hose barb and ½" coupler pipe threads with Teflon tape.
8. Install the hose barb and ½" coupler on the replacement check valve, ensure that they are installed properly with the hose barb on the arrow side of the check valve.
9. Install the replacement check valve onto the boiler tank. The arrow on the check valve must point away from the tank.
10. Slide the hose back onto the replacement pump and set the constant tension clamp back into place.
11. Refill the Aqua-Hot's boiler tank with the antifreeze and water heating solution.

NOTE: Adjusting the mixing valve beyond 120°F (49°C) will result in a lack of hot water and may result in scalding. Do NOT attempt to adjust the tempering valve without assistance from Aqua-Hot Technical Support or a qualified Aqua-Hot technician.

1. Inspect the tempering valve to ensure that is not leaking.
2. Test the temperature of the hot water using a digital thermometer at one of the hot water faucets. Water temperature should range between 115°F - 123°F. If the proper range cannot be set follow the instructions in this section to replace the tempering valve.
3. Test the tempering valve's functionality by turning the knob. If the tempering valve knob does not turn freely, follow the instructions in this section to replace the tempering valve.

Tempering Valve



Figure 34

Introduction:

The tempering valve for the Aqua-Hot mixes the heated domestic water from the boiler tank with cold domestic water from the coach's fresh water tank to reduce the risk of scalding.

Testing Procedure:

Follow the testing procedure to the right in order to diagnose the tempering valve. Troubleshoot the tempering valve if the following conditions have occurred:

- A lack of hot water.
- Hot water supply is uneven.
- Hot water is too hot.

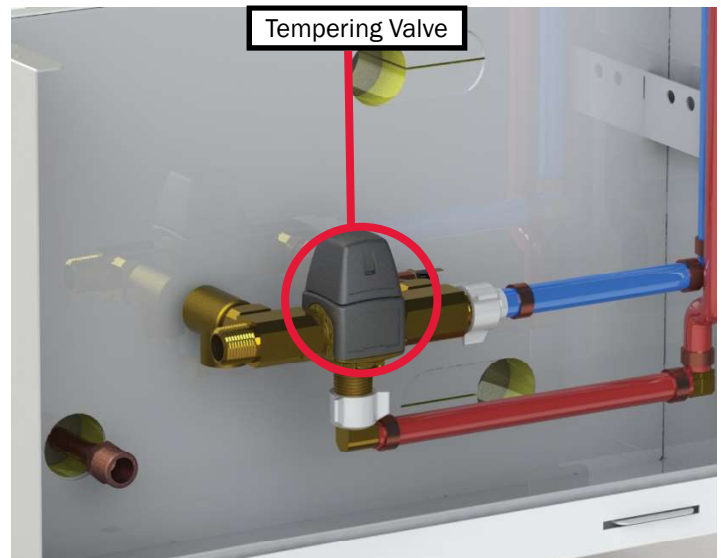


Figure 35

Replacement Procedure

1. Turn the motor home's water pump off.
2. Drain the water pressure by opening the faucets and allowing the water drain.
3. Disconnect the motor home's water lines from the tempering valve assembly.
4. Disconnect the PEX pipe and fittings from the tempering valve assembly.
5. Remove the pressure relief valve assembly from the tempering valve assembly as the tempering valve cannot

be removed from the Aqua-Hot with the pressure relief valve still attached.

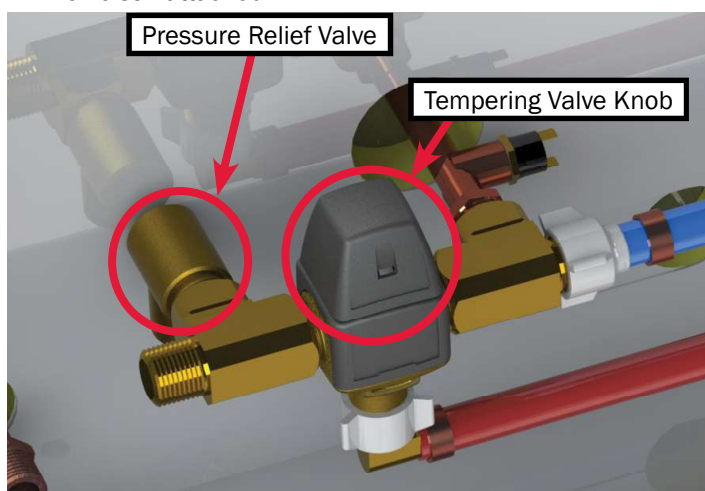


Figure 36

6. Using a back-up wrench, unscrew the tempering valve from the Aqua-Hot.
7. Remove the brass fittings from the defective tempering valve.

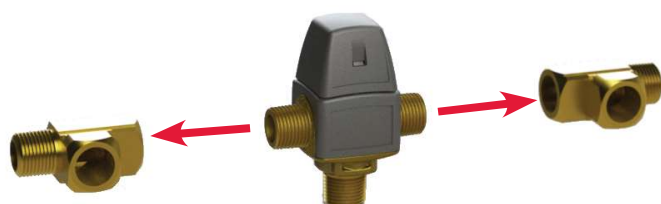


Figure 37

8. Install the brass fittings onto the replacement tempering valve.
9. Install the replacement tempering valve onto the Aqua-Hot using a back-up wrench to tighten.
10. Install the pressure relief valve onto the replacement tempering valve.
11. Reconnect the PEX tube and fittings to the tempering valve and the Aqua-Hot. Be sure to inspect the rubber seals and replace if necessary.
12. Reconnect the motor home's water lines to the tempering valve assembly.
13. Turn the motor home's water pump back on and check for leaks and for any presence of hot domestic water.
14. Verify that the replacement tempering valve has been set to the proper setting by taking a digital thermometer to a hot water faucet and set the water temperature between 115°F - 123°F.

Circulation Pumps

Introduction:

The circulation pumps first draw the heated antifreeze and water heating solution from the Aqua-Hot's boiler tank, then propel it through the Hydronic heating system's interior heat plumbing.



Figure 38

Troubleshoot the circulation pumps if the pump is not operating with the status ON on the Reporter, or the Reporter is showing an OVER-CURRENT fault for that pump.

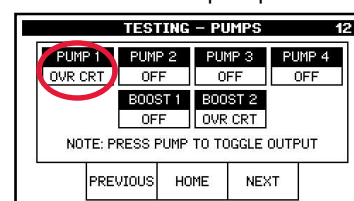


Figure 39

Troubleshooting Procedure:

1. Verify the Low Temp Cutoff (LTCO) is showing on the Reporter, as it will be whenever the boiler tank is at operating temperature and domestic hot water is not being used.

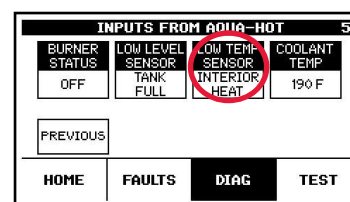


Figure 40

2. Turn on the interior room thermostat corresponding to the circulation pump not operating (heating zones 1 & 5 operate with pump #1, and heating zones 2, 3, & 4 operate with circulation pump #2). Check the Zone status on the Reporter as shown below.

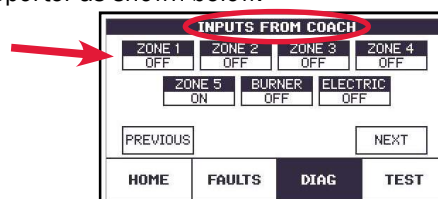


Figure 41

3. Test the pump directly to determine that the Reporter is sending a signal to the pump to operate. Follow the steps to test that the pump is receiving power from the Reporter.

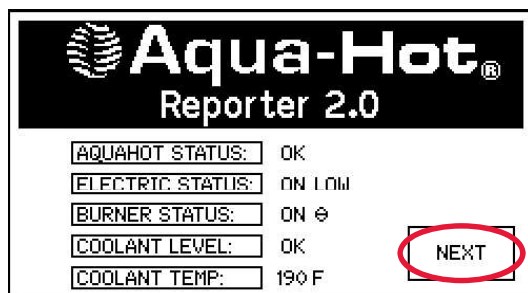


Figure 42

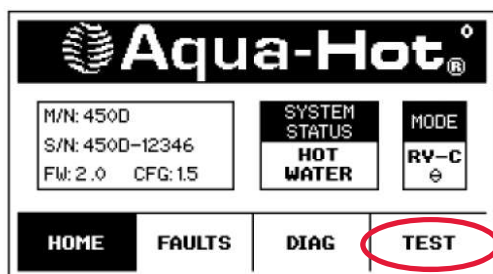


Figure 43

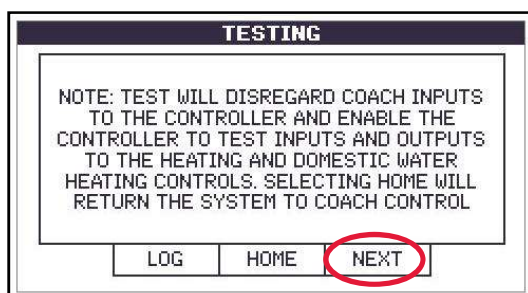


Figure 44

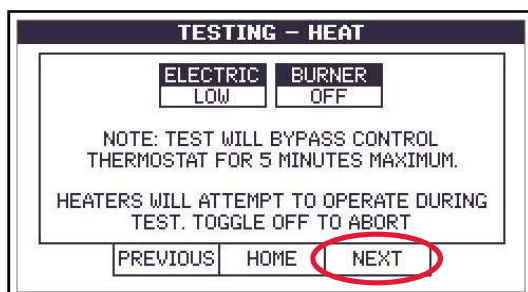
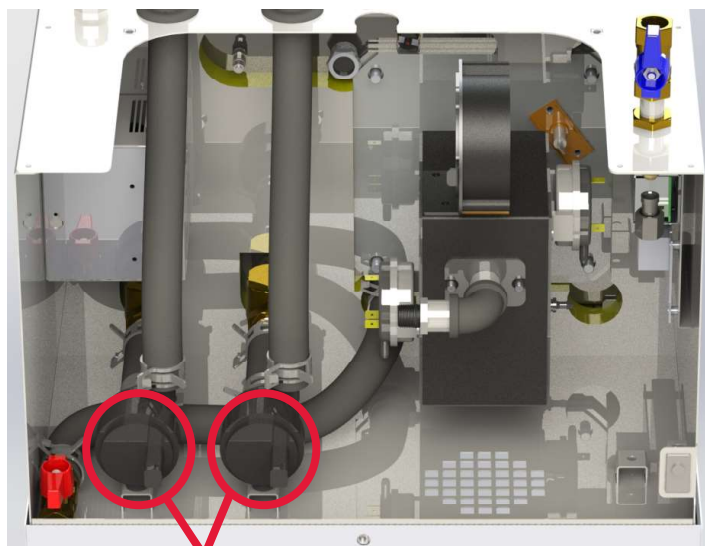


Figure 45

4. If the pump does not operate after testing, use a voltmeter to check for 12V DC power at the Reporter on J2 (pin # will depend on which pump is faulty - refer to the schematic on page 76).
 - If the pump testing is ON and there is not 12V DC power at the J2 pin, the Reporter will need to be replaced.
 - If the Reporter is sending 12V DC power to the pump, and the pump is not operating, follow the replacement procedure to replace the defective pump.



Zone Circulation Pumps

Figure 46

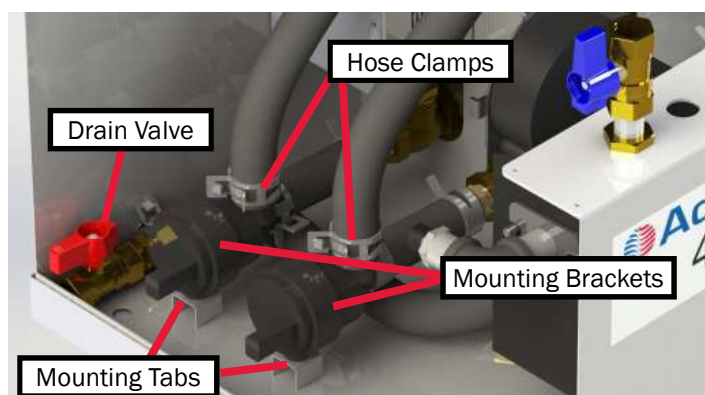


Figure 47

Replacement Procedure

1. Ensure that the Aqua-Hot has been completely shut down and that all power sources have been disconnected. Be sure the boiler tank has adequately cooled down.
2. Drain the antifreeze and water heating solution from the boiler tank using the drain valve.
3. Disconnect the defective pump's wires by pulling out on the "Red Locking" tab on the harness plug, and separate the harness plug from the defective pump.

Stir Pump / Circulation Pump #2

Introduction:

The stir pump circulates the antifreeze and water heating solution within the Aqua-Hot's boiler tank in order to ensure even heating of the solution. To accomplish this, the stir pump draws the solution from the bottom of the tank and immediately deposits it back into the top of the tank.

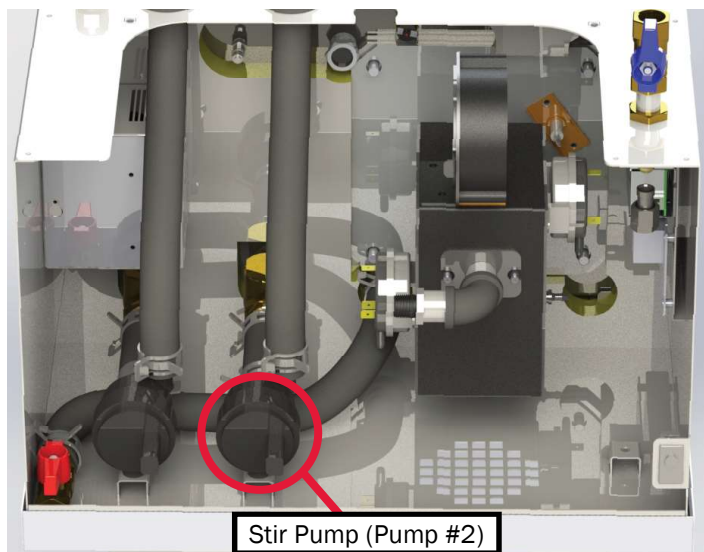


Figure 49

Troubleshoot the stir pump if there is a lack of hot water or the Reporter is showing an OVER-CURRENT fault for the pump.

NOTE: In order for the stir pump to operate, the propane burner switch must be on and the "LOW TEMP SENSOR" must be ON on the Reporter OR the propane burner blower fan must be running with the burner status ON on the Reporter.

Troubleshooting Procedure:

1. Verify the Low Temp Cutoff (LTCO) is showing on the Reporter, as it will be whenever the boiler tank is at operating temperature and domestic hot water is not being used.
2. Power cycle the Aqua-Hot to clear any current faults.
3. Navigate to the TESTING page on the Reporter and activate the stir pump. If the pump does not activate, test for voltage on the Reporter on pins J2-7 & J2-8.
 - If no voltage is present, the Reporter will have to be replaced.
 - If there is voltage, follow the steps to replace the stir pump.

4. Using constant tension pliers, loosen and slide back the constant tension clamps securing the hoses to the pump.
5. Remove the hoses from the defective pump.
6. Release the pump from the mounting bracket by inserting an AWL between the locking teeth and gently prying the locking teeth apart. Remove the defective pump.
7. Slide the hoses onto the replacement pump and set the constant tension clamps back into place.
8. Install the replacement pump onto the mounting bracket, and squeeze the pump bracket together with a pair of channel lock pliers to secure the pump.



Figure 48

9. Reconnect the harness plug into the replacement pump. Be sure to push in on the red locking tab to secure the plug into place.
10. Refill the boiler tank with the antifreeze and water heating solution previously drained.

Replacement Procedure

1. Ensure that the Aqua-Hot has been completely shut down and that all power sources have been disconnected. Be sure the boiler tank has adequately cooled down.
2. Drain the antifreeze and water heating solution from the boiler tank using the drain valve.
3. Disconnect the defective stir pump's wires by pulling out on the "Red Locking" tab on the harness plug, and separate the harness plug from the defective pump.
4. Using constant tension pliers, loosen and slide back the constant tension clamps securing the hoses to the pump.
5. Remove the hoses from the defective stir pump.
6. Release the pump from the mounting bracket by inserting an AWL between the locking teeth and gently prying the locking teeth apart. Remove the defective pump.
7. Slide the hoses onto the replacement pump and set the constant tension clamps back into place.
8. Install the replacement pump onto the mounting bracket, and squeeze the pump bracket together with a pair of channel lock pliers to secure the pump.
9. Reconnect the harness plug into the replacement pump. Be sure to push in on the red locking tab to secure the plug into place.
10. Refill the boiler tank with the antifreeze and water heating solution previously drained.

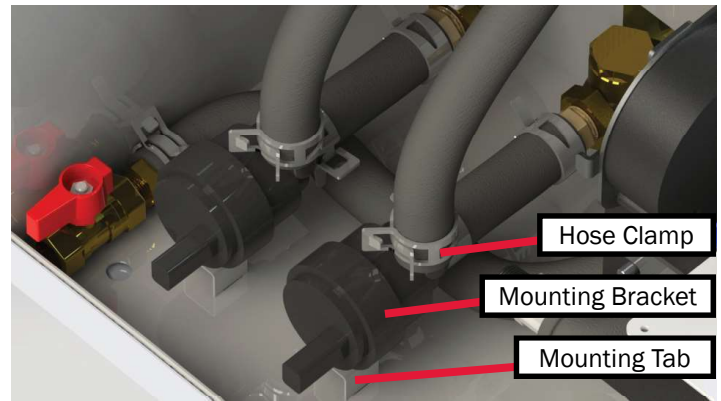


Figure 50

 LDE-200-810	 WARNING
	Burn Hazard Hot Coolant Circuit with Hot Surfaces can cause severe burns. DO NOT touch or service until equipment has cooled.

AC Electric Element

Introduction:

The electric heating element uses AC power as an alternate power source for heating the Aqua-Hot's boiler tank.



Figure 51

Begin troubleshooting the electric element if there is a lack of hot domestic water and/or interior heat when the electric element is selected as the heating source.

NOTE: For continuous domestic hot water, the propane burner must be selected as a heating source as well. The element is not able to provide continuous hot water.

Troubleshooting Guidelines:

The following conditions must be met before the electric heating element can be diagnosed, and if necessary, replaced.

- The fluid expansion bottle is filled to at least the "COLD" mark.
- Verify that all in-line fuses are functional.
- The AC high-limit thermostat is operating and not tripped.
- Ensure that the unit is completely cool.
- Ensure that DC electrical power is supplied to the Aqua-Hot.
- Ensure that AC electrical power is supplied to the Aqua-Hot's electric element.

If any of the above conditions are not met, correct them before continuing with troubleshooting. Results of the troubleshooting procedure cannot be verified if the conditions listed above are not fulfilled.

Troubleshooting Procedure:

1. Verify that the motor home is either plugged into shore power or that the generator is running to provide AC power and the electric switch is ON on the interior switch panel.

2. Verify that the Electric shows ON on the Reporter.

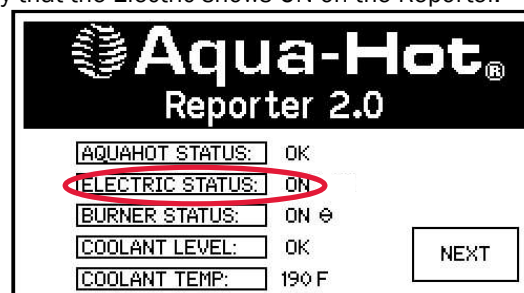


Figure 52

- If the interior switch is on, the Reporter is not showing the electric as ON, and the tank is below 215°F, the Reporter will need to be replaced.
3. Verify that the boiler's tank temperature is below 215°F.
 - If the boiler tank temperature is below 158°F, test the control thermostat/ETS Module.
 - If the boiler tank is above 158°F, the Aqua-Hot is at operating temperature and requires no heat.
 4. Verify the Reporter is sending 12V DC to the AC relay by going to the TESTING page and see if the AC relay makes a "click" sound. The AC electric relay should let out an audible click from within the Aqua-Hot cabinet

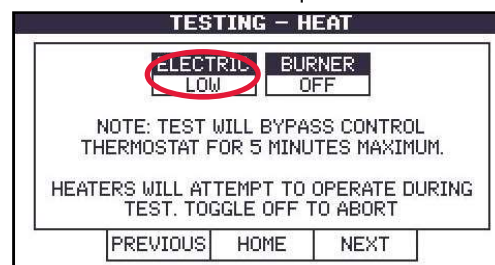


Figure 53

- If no "click sound", the AC relay and Reporter will need diagnosing.
 - If there is "click" sound, continue troubleshooting the element.
5. Verify the electric element is receiving adequate AC power with an AC voltmeter. Remove the AC access cover and test for 110V AC power at the terminal block. If there is no voltage at the terminal block, there is an issue inside the motor home.
 6. Verify the element's amp draw is between 11.2 - 13 amps.
 7. Check the element's wires for continuity:
 - Disconnect the motor from shore power, or shut off the generator.
 - Disconnect the wires from the element and the AC

Electric Element

terminal block.

- Check the black and white wires at the terminal block for continuity.
8. Check the element for functionality by testing resistance. Using an ohmmeter, the element should be between 8.5 - 9.5 ohms. If not, follow the replacement procedure to replace the element.

Replacement Procedure:

1. Ensure that the Aqua-Hot has been completely shut down and that all power sources have been disconnected. Make sure the boiler tank is adequately cooled.
2. Drain the antifreeze and water heating solution from the boiler tank using the drain valve.
3. Remove the AC access cover.
4. Remove the two wires secured to the defective electric element by releasing the screw terminals.
5. Using a 1-½" socket, remove the defective element from the Aqua-Hot's boiler tank.
6. Install the replacement 1650W element into the boiler tank ensuring that the "up" lettering on the element is installed in the proper position.
7. Connect the wires removed from the defective element to the replacement element and tighten the screw terminals.
8. Reinstall the AC access cover.
9. Refill the boiler tank with the previously drained antifreeze and water heating solution.

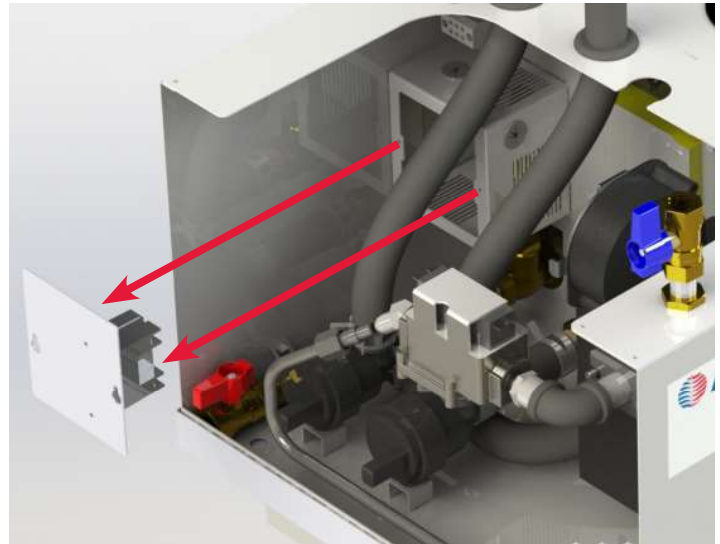


Figure 55

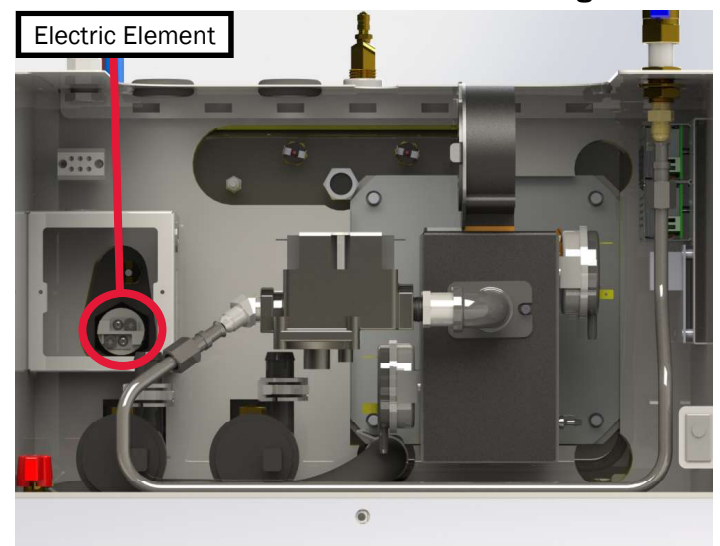


Figure 56

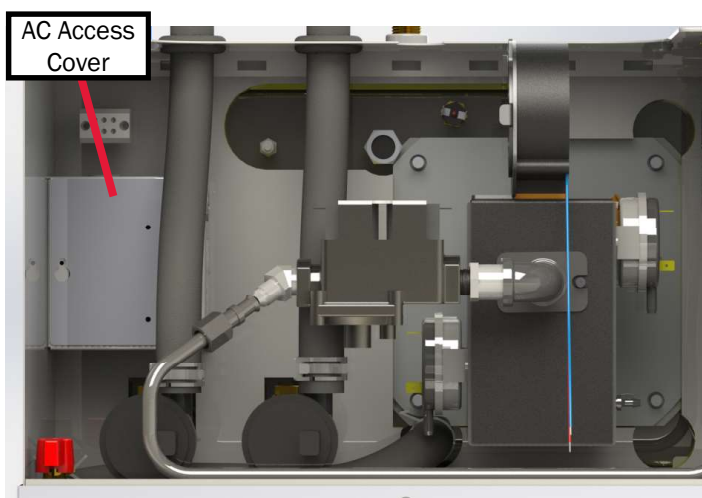


Figure 54

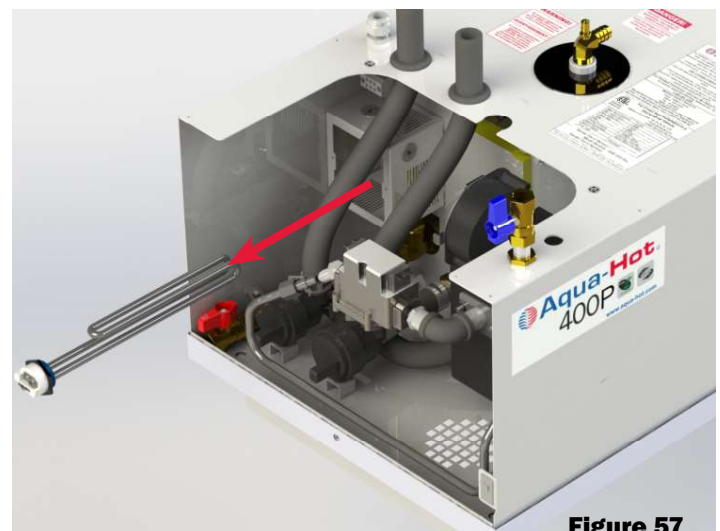


Figure 57

AC Relay

Introduction:

The AC relay is an electric where DC circuit from the Reporter determines whether AC power is permitted to flow to the electric heating element. This allows the Reporter to switch the electric heating element on and off in conjunction with the interior switch panel and ETS Module/control thermostat even though the electric heating element is on a separate circuit.



Figure 58

Begin troubleshooting the AC relay if the electric heating element fails to operate.

Troubleshooting Guidelines:

The following conditions must be met before the electric heating element can be diagnosed, and if necessary, replaced.

- The fluid expansion bottle is filled to at least the “COLD” mark.
- Verify that all in-line fuses are functional.
- The AC high-limit thermostat is operating and not tripped.
- Ensure that the unit is completely cool.
- Ensure that DC electrical power is supplied to the Aqua-Hot.
- Ensure that AC electrical power is supplied to the Aqua-Hot’s electric element.

If any of the above conditions are not met, correct them before continuing with troubleshooting. Results of the troubleshooting procedure cannot be verified if the conditions listed above are not fulfilled.

Troubleshooting Procedure:

1. Disconnect the AC power source to the motor home (unplug from shore power or shut off the generator).
2. Verify that the Electric shows ON on the Reporter.
 - If the interior switch is on, the Reporter is not showing the electric as ON, and the tank is below 215°F, the Reporter will need to be replaced.

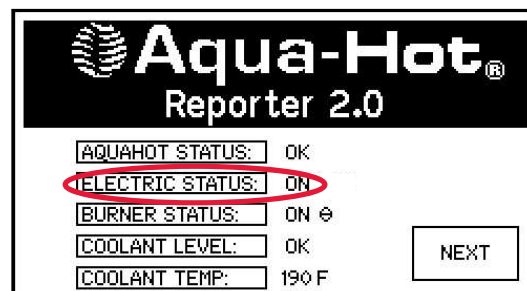


Figure 59

3. Using a voltmeter, check for 12V DC on pins 12 & 13 on the J2 plug of the Reporter.
 - If 12V DC are not present with the Electric status ON and the tank is below temperature, the Reporter will need to be replaced.
 - If 12V DC are present, locate the AC wires connected to the AC relay and remove the AC wires from the relay
 - Using an ohmmeter, check the AC relay pins for continuity. If no continuity exists, the AC relay will need to be replaced.

Replacement Procedure:

1. Ensure that the Aqua-Hot has been completely shut down and all power sources have been disconnected.
2. Make sure the motor home is not connected to shore power and the generator is not connected during this procedure.
3. Remove the AC access cover.
4. Release the wires from the defective AC relay by removing the corresponding screw terminals.
5. Remove the defective relay by drilling the rivets that hold the defective relay in place.



Figure 60

6. Rivet the replacement AC relay to the AC access cover.
7. Using the schematic on page 78, connect the wires previously removed to the replacement AC relay.
8. Reinstall the AC access cover and test for proper operation.

Aqua-Hot Reporter

Introduction:

The Aqua-Hot Reporter is a new generation of command and control module which manages all functions of the Aqua-Hot from start-up to shutdown. The previously used electronic control board has been retired on new units in favor of the Reporter.



Figure 61

Electrical Specifications:

The Reporter contains a single Amphenol ATP family connector that serves as the power connection to the coach side 12V DC power system. Mating connection components are not supplied by Aqua-Hot. Compatible part numbers and manufacturers are supplied below. The Reporter must be operated to the below listed specifications.

Minimum Voltage.....	11.0V DC
Maximum Voltage.....	15.0 V DC
Minimum Current.....	75mA
Maximum Current.....	15A

Please note that the minimum current rating is the minimum requirement for what will operate the Reporter. Operating at this current rating will not provide sufficient power to any components dependent upon the Reporter.

Input Load currents

Zone Thermostats (each).....	appx. 1mA
Diesel Burner Switch.....	appx. 1mA
Electric Element Switch.....	appx. 1mA
Low-Level Cutoff Switch.....	appx. 1mA
Control Thermostat (Reporter 1.0).....	appx. 1mA
Tank Temperature Sensor (Reporter 2.0).....	appx. 1mA
Low-Temperature Cutoff Thermostat.....	appx. 1mA

Output Load currents

Zone Fans (Reporter 1.0/all).....	3.0A max
Zone Fan 1 (Reporter 2.0).....	8.0A max
Zone Fans 2-5 (Reporter 2.0).....	5.0A max
Zone Fans (all).....	0.25A max
Circulation Pumps (each).....	2.0A max
AC Relay.....	0.5A max
Burner Power.....	6.0A max
Burner Master Control.....	2.0A max
Burner Thermostat Control.....	1.0A max

NOTE: For networked control of the Reporter, Aqua-Hot requires system integrators ensure that individual commands are received and processed. Aqua-Hot requires that commands be repeated or confirmed so that if a single message were dropped, or if there is a brief network disturbance, the Reporter would get into the correct state as soon as the disruption was removed.

The Aqua-Hot Reporter monitors the heating system and handles all logic relating to safeties and heating control. As such, the system integrator is required to display all pertinent status information but not use that information to lock out operation or add additional safety layers that could impact the end of operation if a message from the Reporter was missed.

Connection Terminal Information

RV-C Mating Connection		
Mfg.	Part Number	Description
3M	37104-A165-00E-MB	RV-C Connection Housing

Reporter Power Connection		
	Deuthsche	Amphenol
Pins	1060-12-0222	AT60-12-0222
Housing	DTP04-2P	ATP04-2P
Wedge	WP-2P	AWP-2P

Harness Connections			
Mfg.	Part Number	Description	Mate
TE	1-480706-0	09P UMNL Plug	J1
TE	1-480710-0	15P UMNL Plug	J2
3M	37104-2165-000 FL 100	CONN Plug 2MM 4POS 20-22 AWG	J3
TE	1-480708-0	12P UMNL Plug	J7
TE	1-480704-0	06P UMNL Plug	J8
TE	640582-1	08P UMNL Plug	J9

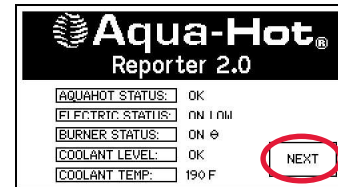
Sockets			
Mfg.	Part Number	Description	Mate
TE	350550-1	UMNL SOK 20-14 TIN/PHBZ L/P	J1 J2 J3 J7 J8 J9

Socket Crimping Tool		
Mfg.	Part Number	Description
TE	90547-1	ASSY Pro-Crimper M-N-L

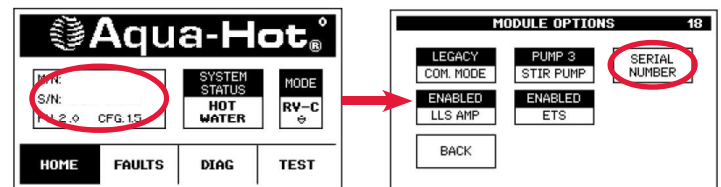
Replacement Procedure:

1. Ensure that the Aqua-Hot has been completely shut down and that all power sources have been disconnected.
2. Remove the four screws that are securing the Reporter.
3. Disconnect the positive and ground wires from the back of the Reporter.
4. Disconnect the Aqua-Hot terminal plugs by pushing on the tabs and pull away from the Reporter.
5. Disconnect the coach-side connections by loosening the screws on each plug and pull away from the Reporter.
6. Install each terminal strip and plug back to the Reporter and tighten the screws for the coach-side connections.
7. Connect the ground wire, followed by the main 12V DC power wire to the replacement Reporter.
8. Reinstall the replacement Reporter and secure with the four screws previously removed.
9. Ensure that all electrical connections are made with the Aqua-Hot and the onboard RV-C system (if applicable) and that power is supplied to the new Reporter.

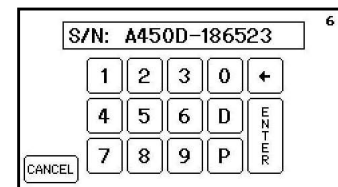
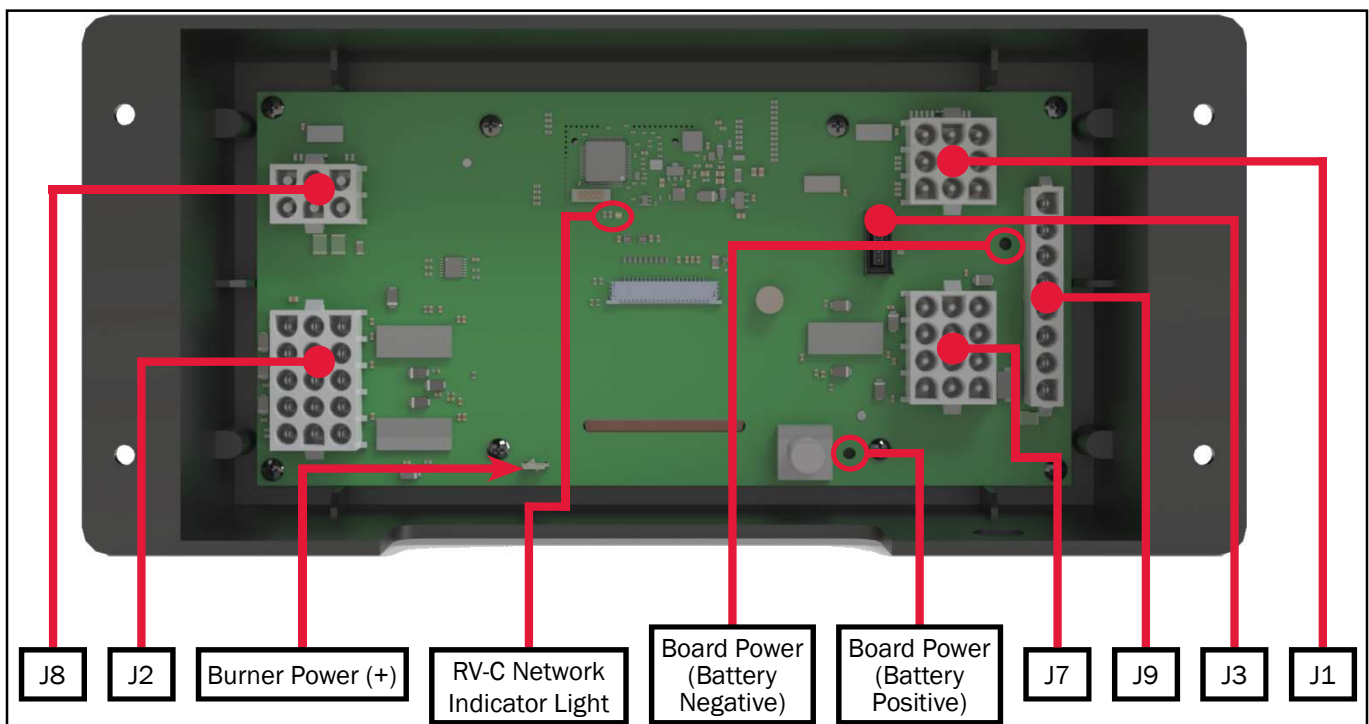
10. Tap the Reporter screen to wake the unit. Select "NEXT".



11. Press and hold "S/N" for 6 seconds and release. You will be displayed with an option screen.



12. Tap "SERIAL NUMBER". The data entry pad will be displayed and here you can enter the serial number shown on the Aqua-Hot Identification label. Tap "ENTER". The Reporter will not accept invalid serial numbers.

**Figure 62****Reporter Back Side****Figure 63**

Fault Conditions

Introduction:

The Reporter contains five distinct categories of fault conditions which will assist in diagnosing and repairing the Aqua-Hot should problems arise. Low-voltage, over-temperature, and over-voltage fault conditions will be accompanied by the component which triggered the fault. It is best practice to record all conditions at the "FAULT" screen. Fault conditions are also recorded in the fault log on the "TEST" tab. When using the fault log, it is important to know that this log cannot be cleared, and may contain information on faults not pertaining to a present issue.

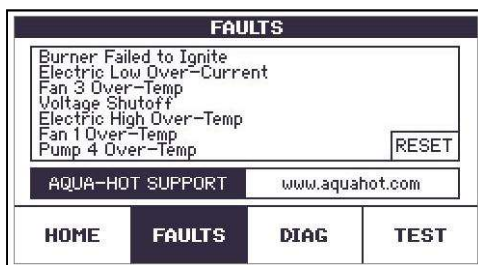


Figure 64

Reset Feature

The RESET button shown above on the Reporter fault screen can be used to reset the Reporter after a component has been changed or modified. Some components will require a full power-cycle in order to fully reset the Aqua-Hot system.

Over-Current

An over-current fault condition occurs when too much current is drawn by a component (output channel), usually a fan or pump. When an over-current condition occurs, the Reporter will deactivate the over-current component as a safety measure to prevent damage. This fault can only be cleared once the Reporter has been reset. Please note, that if the responsible component is not repaired or replaced, it can continually cause over-current fault conditions, thereby impacting the functionality of the Aqua-Hot unit.

Over-Temperature (Reporter 2.0)

The Over-Temperature fault condition occurs when the tank temperature sensor indicates that the unit has overheated. An overheat is realized when the antifreeze and water heating solution within the Aqua-Hot exceeds 210°F.

Low-Voltage

The Reporter is designed to operate between 11V Direct Current (DC) and 16V DC. If the Reporter detects that it is receiving less than 11.8V DC, it will display a low-voltage fault. If the Reporter drops below 11.2V DC for more than 30 seconds, a safety mechanism will activate, shutting down the Aqua-Hot.

Low-Level Cut Off

Aqua-Hot units require a minimum amount of antifreeze in order to function correctly. Keep in mind that the exact fluid

volume may differ depending on the layout of your coach. If the heater drops below the minimum fill level as indicated on the expansion bottle, the Reporter will shut down all fans, pumps, and heat sources until the unit has been refilled and the Reporter has been reset.

Ignition Failure

Ignition failure fault conditions will occur if the burner inside the heater fails to ignite. This is all the fault condition will display. Precise diagnosis herein will require in-depth troubleshooting.

Testing

Introduction:

The Reporter retains the functionality to independently activate certain components and sub-systems within the Aqua-Hot heater. The systems that can be independently activated are the burner, electric element, and burner indicator light. For testing procedures, only one system can be activated as independent components. These components and sub-systems will remain active for only five minutes, and are NOT a substitute for normal operation. Aqua-Hot Heating Systems is not liable for damages resulting from attempting to use testing functions in place of standard operation.

Pumps

Pumps on your heater can be independently activated using the Reporter. These can be used to verify functionality, or to purge fluid lines of air. Select each pump from the screen to activate. Keep in mind that these testing screens will ignore input from the fluid level sensor. On Reporter units with firmware version 1v7 and earlier, pump 2 will serve as the stir pump on the 400 Series.

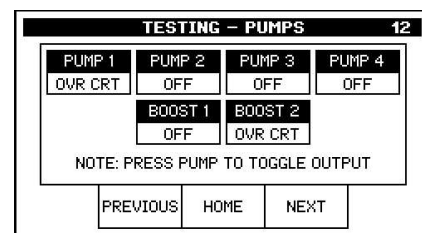


Figure 65

Fans

Using the "FANS" screen, it is possible to activate fans in each zone to test for functionality. This is similar to the pumps screen, allowing you to activate one or multiple fans at the same time by selecting the desired fan.

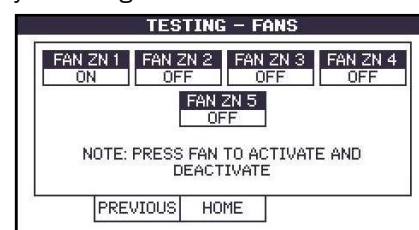


Figure 66

Heating

The heating tab will allow the burner, the burner indicator light, and the electric element to be activated and run for five minutes to test for functionality. During this time, inputs from the control thermostat are ignored to allow the test to take place. Do NOT activate the burner heat test without allowing the unit to cool. Not doing so could complicate further diagnosis and may cause irreparable damage to the Aqua-Hot.

Figure 67

Diagnostic

The “DIAG” tab of the Reporter allows the user or technician to access input and output information to record communication information within the Aqua-Hot heater, and between the heater and the coach. This tab is read-only and will not allow the manipulation of the elements listed. There are four screens maintained under this tab: Inputs from Coach, Outputs to Coach, Inputs from Aqua-Hot, and Outputs to Aqua-Hot.

Figure 68

Manual Mode

The 2.0 Reporters with CFG 1.9 and greater come with a Manual Mode in case the general coach RVC network fails. It will allow for limited operation while the larger network/module problem is addressed.

To determine the version of Reporter, the Reporter 2.0 modules are shipped with version decals affixed to the back of the circuit board, OR shown on the home screen - “FW: 2.0”.

This mode can be accessed under the test page of the Aqua-Hot Reporter (see below).

Figure 69

Once the test page is open, select the MANUAL MODE and select “NEXT”. Manual mode will continue to run for up to 3 days without any user intervention. Pressing the reset button at any time while enabled will reset the timer, and run for an additional 3 days.

Figure 70

All heating zones are linked together and can be run at 25%, 50%, 75%, and 100% (as shown below). The burner and electric can be enabled or disabled. For all levels, there is a 10 minute duty cycle period that will allow Cozy fans to be on for the specified percentage of 10 minutes. Example, 25% would be on for 2.5 minutes, and then off for 7.5 minutes. It always starts with the on-cycle, then shuts off for the remainder of the 10 minute period.

Figure 71

If the system power is cycled, the manual mode will be disabled and must be manually reactivated. Leaving the manual mode page will also disable manual mode and restore normal operation. Leaving manual mode should be done once the system failure has been resolved and normal operation can resume.

NOTE: If using the rocker switches, burner & electric switches must be toggled on/off after leaving Manual Mode.

Propane Burner

Introduction:

The Aqua-Hot's propane burner is a device that ignites a mixture of propane gas and air within a controlled setting to serve as a heat source. The flame is established in a combustion chamber within the Aqua-Hot's boiler tank, and the heat from the flame is transferred to the antifreeze and water heating solution where it can be used for each system of the Aqua-Hot - domestic hot water and interior heat.

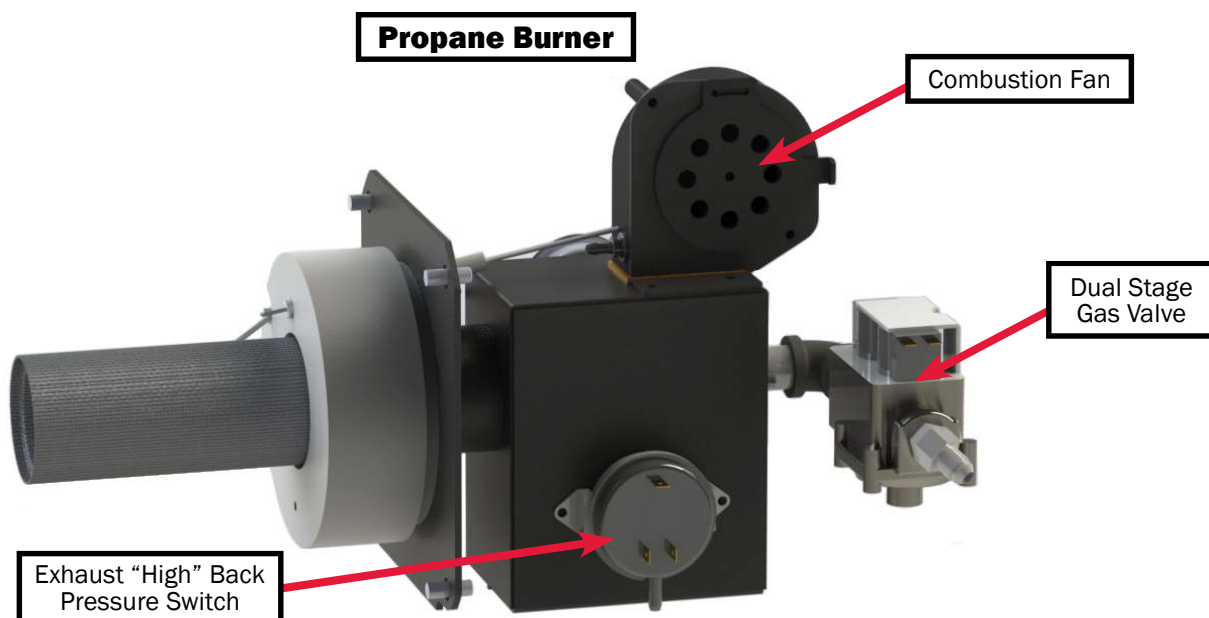


Figure 72

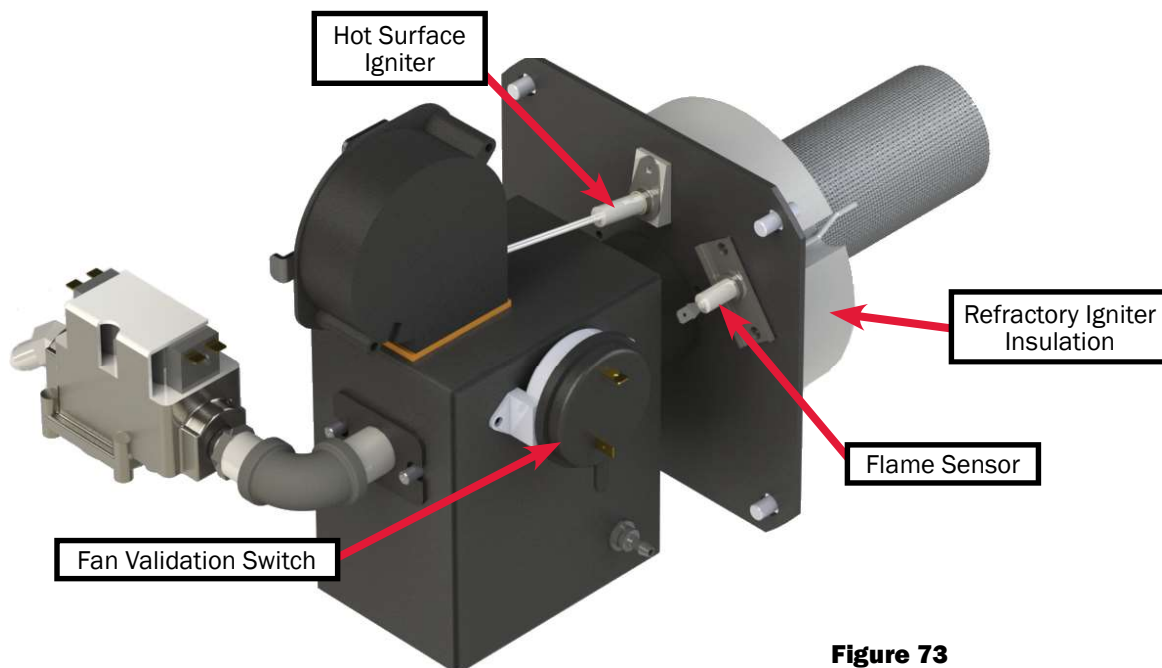


Figure 73

Buck Boost



Figure 74

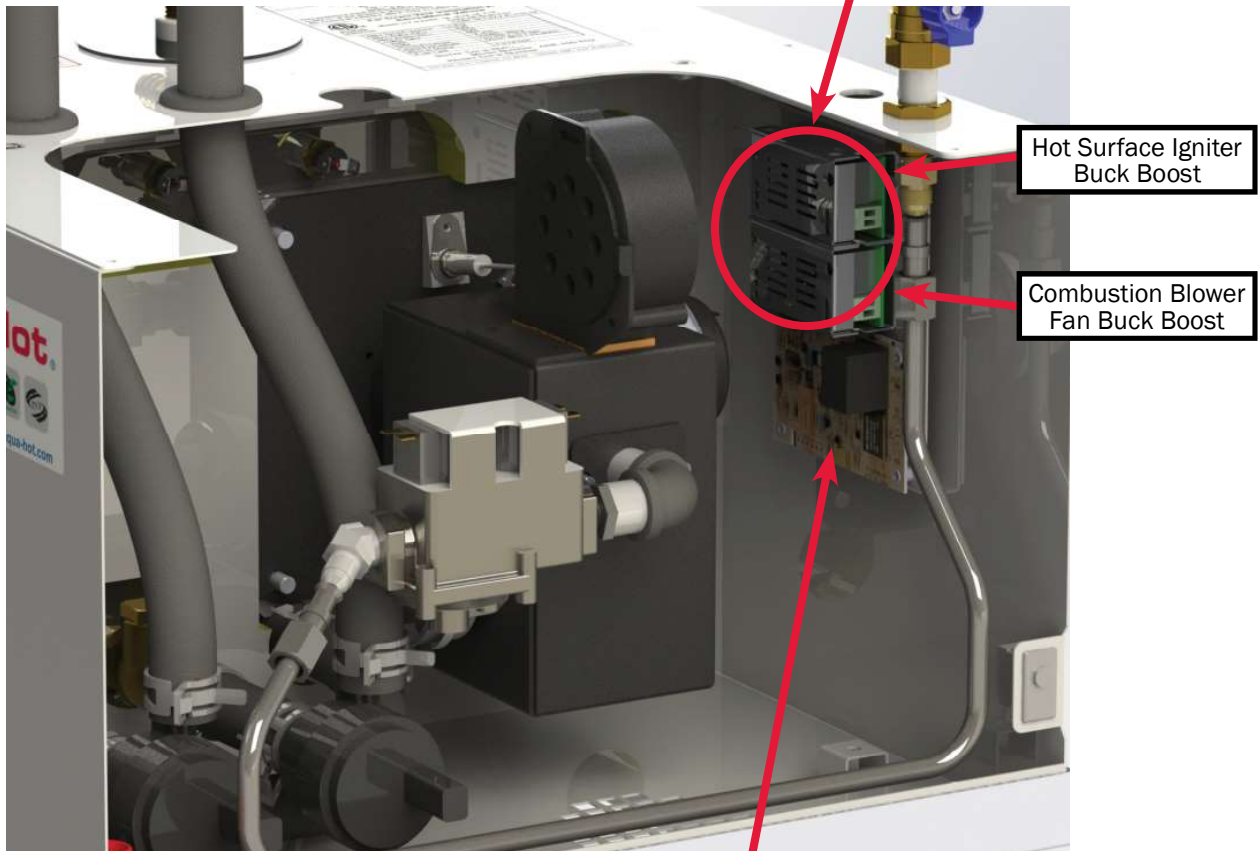


Figure 75

Burner Controller

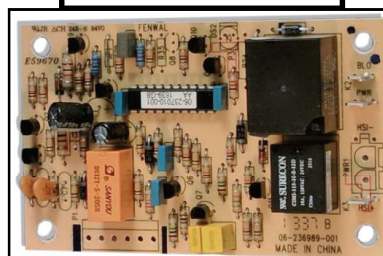
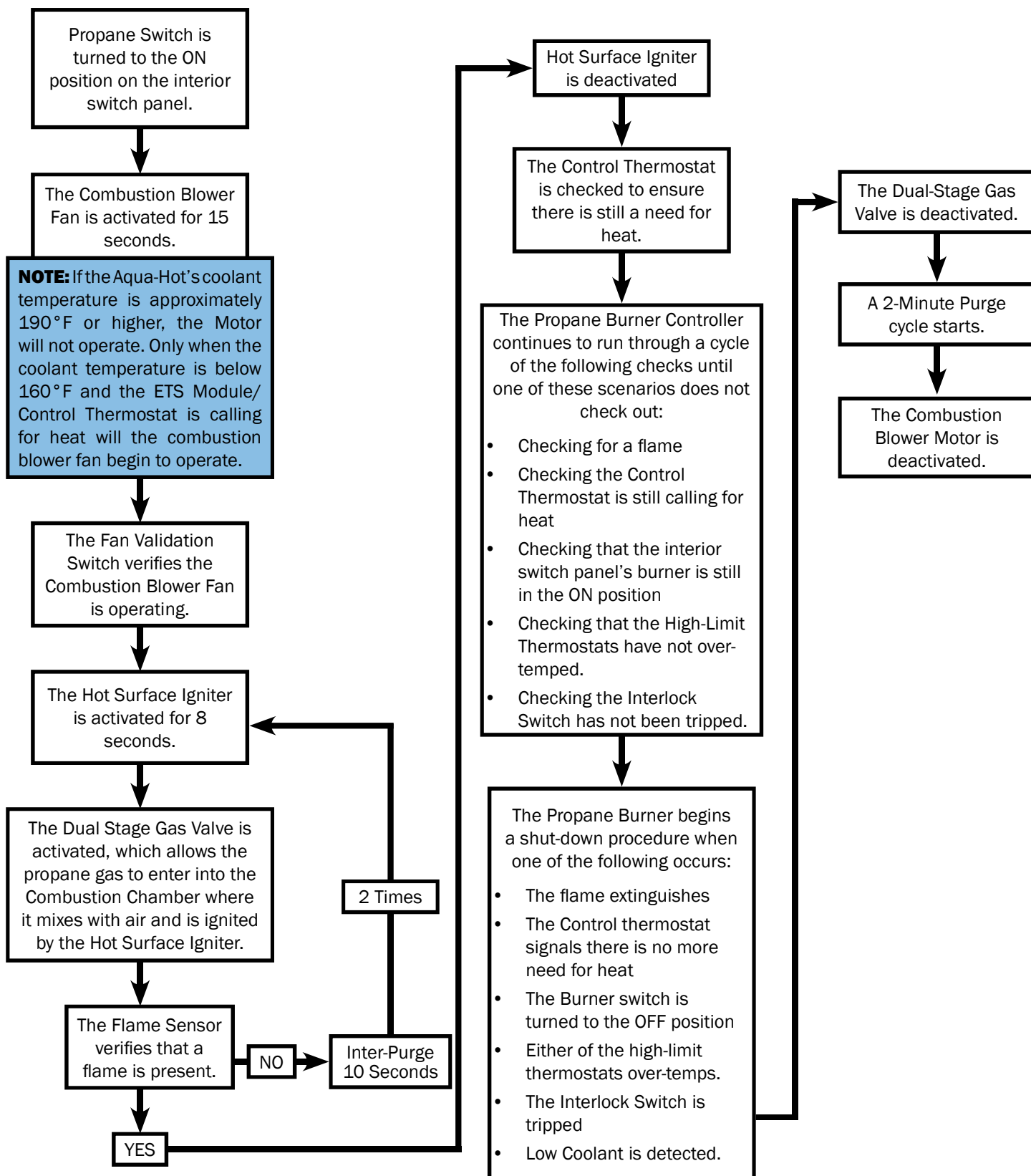
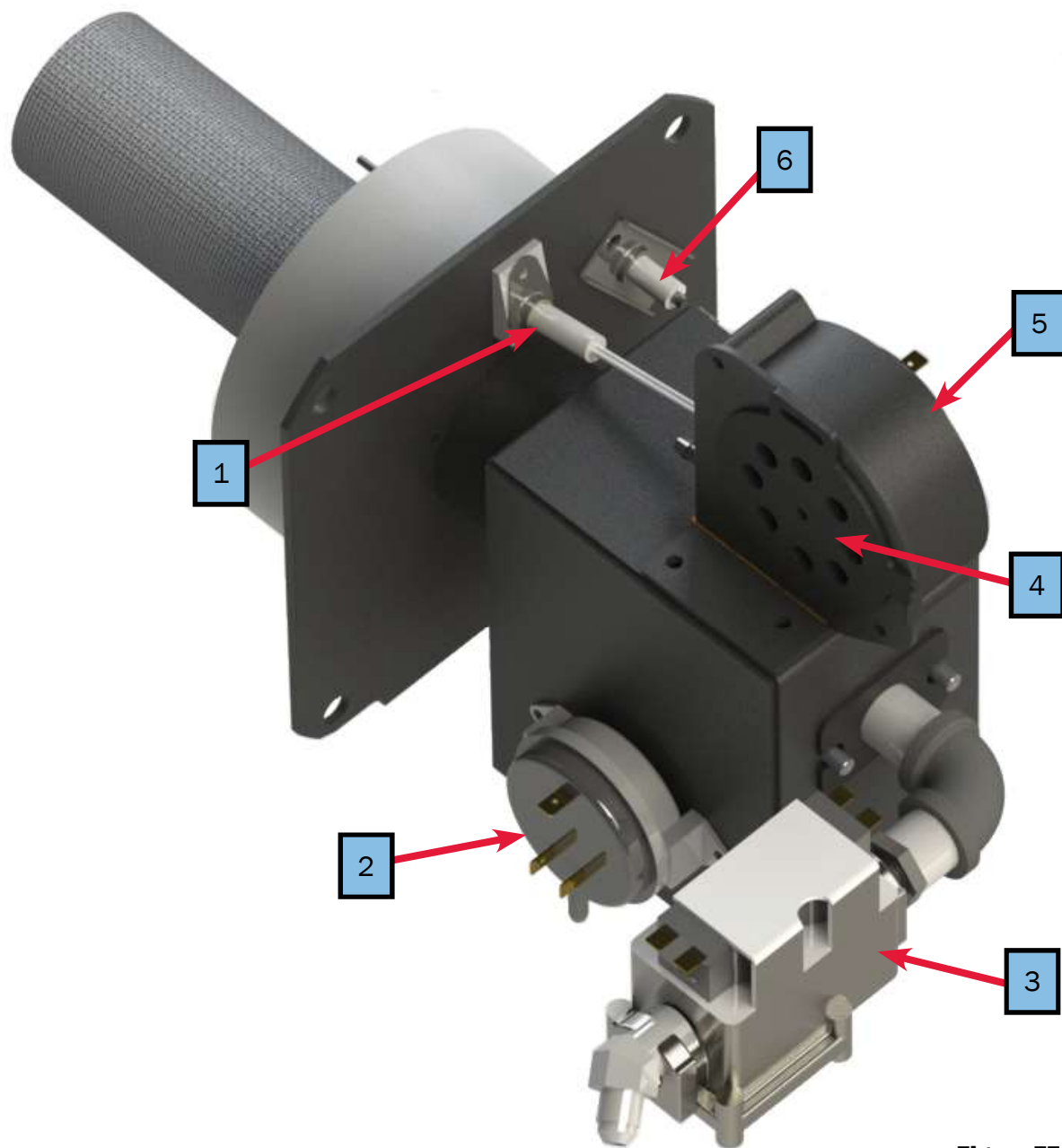


Figure 76

Propane Burner Operational Flow Chart



**Figure 77**

Key	Part Number	Description
1	ELX-375-030	Hot Surface Igniter
2	ELX-375-035	Exhaust Back Pressure Switch
3	PLX-375-045	Dual Stage Gas Valve
4	SME-375-025	Air Intake Shutter
5	ELX-375-020	Combustion Fan Blower
6	ELX-375-015	Flame Sensor

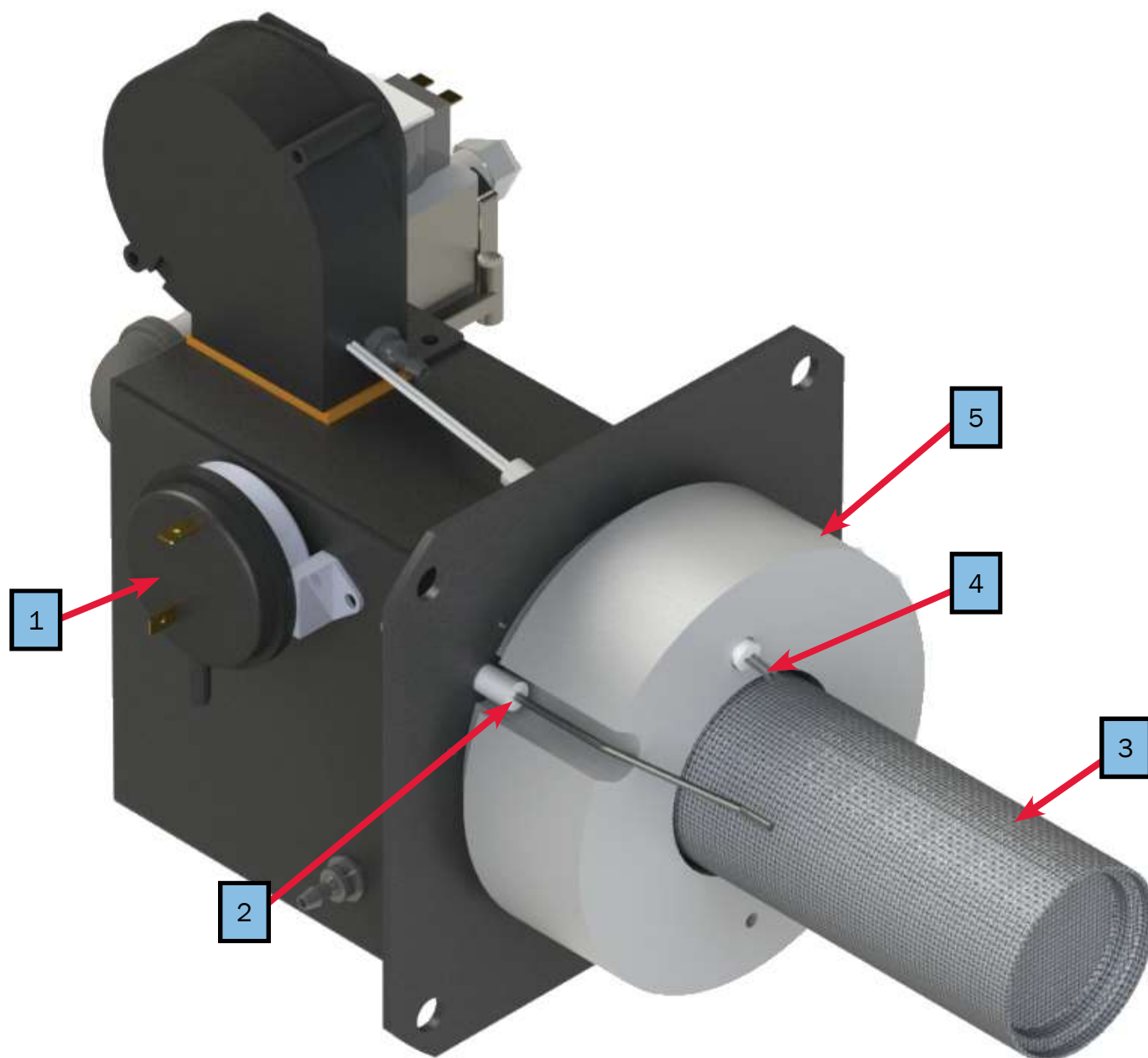


Figure 78

Key	Part Number	Description
1	ELX-375-010	Fan Validation Switch
2	ELX-375-015	Flame Sensor
3	PBX-375-010	Mixing Tube
4	ELX-375-030	Hot Surface Igniter
5	MSE-375-015	Refractory Insulation

Instructions for Detaching the Propane Burner



WARNING

Be sure to move the propane burner's switch on the interior switch panel to the OFF position and disconnect the propane burner's power supply before detaching the propane burner from the Aqua-Hot. Failure to turn off the propane burner and disconnect power could result in serious bodily injury.



CAUTION

Be sure to turn the Propane Supply Shutoff Valve to the top position prior to beginning this replacement procedure.

Step 1: Turn off the propane switch

Light on the interior switch panel should turn OFF when switch is turned to OFF. Or the burner status should show OFF on the coach interior control panel and the Reporter. Make sure the propane supply is shut off at the valve on the top of the Aqua-Hot.

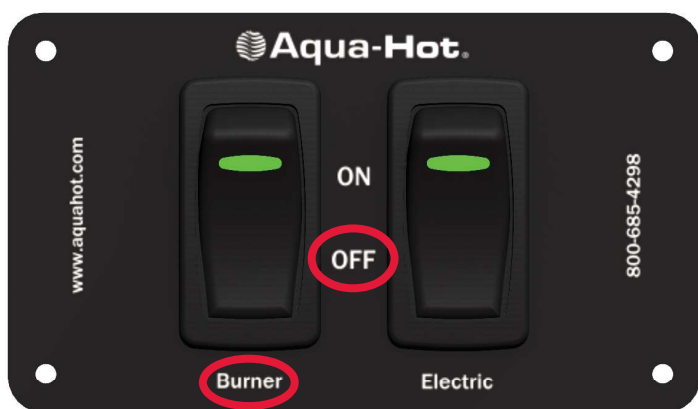


Figure 79



Figure 80

Step 2: Remove the Access Cover

Locate the bolts securing the access cover in place, unscrew the bolts.

Remove the access cover.

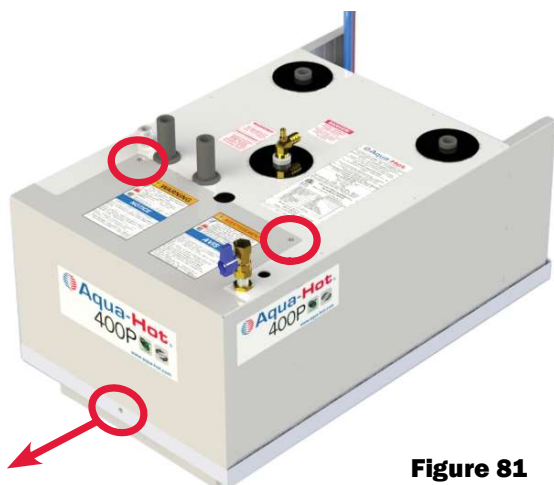


Figure 81

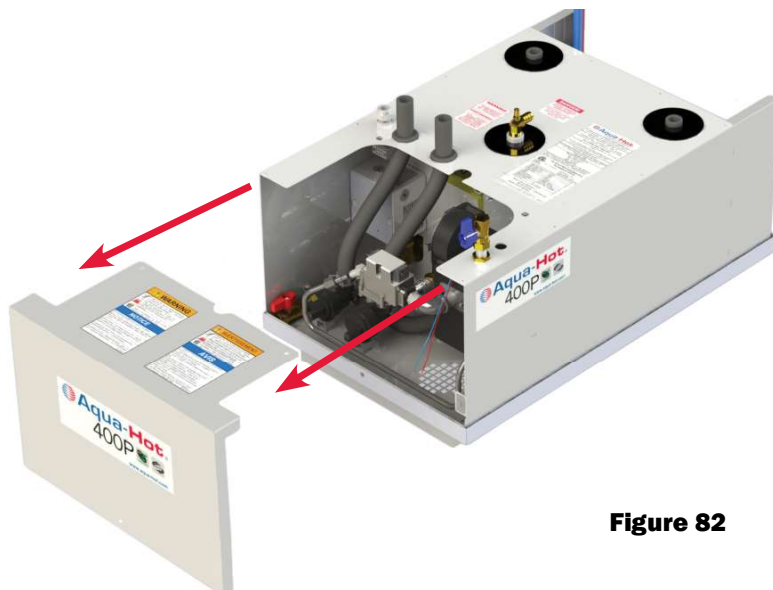


Figure 82

Step 3: Disconnect the Propane Burner's Controller

Locate both the Propane Burner's white, electrical plug connection to the Propane Burner Controller, and both of the green plug connections to the Buck Boosts.

Pull the plugs completely out of the Propane Burner Controller and the Buck Boosts.

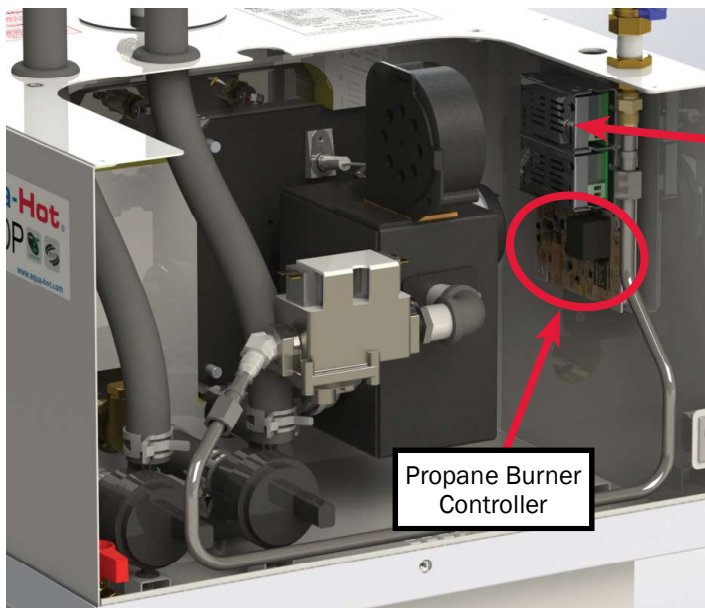


Figure 83

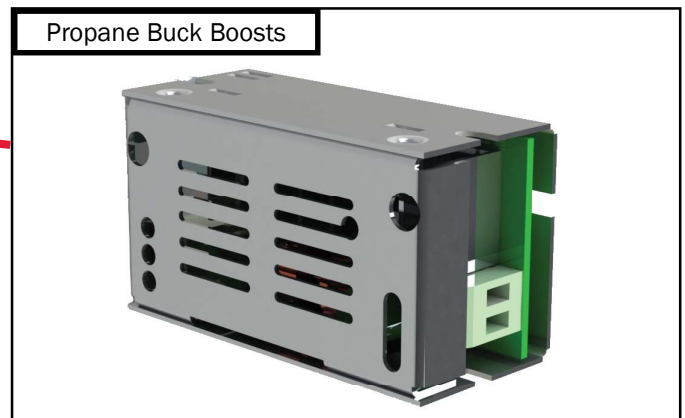


Figure 84

NOTE: There are also 3 wires connected to the propane burner controller that will need to be removed. They can be removed by firmly pulling on the connections.

Step 4: Remove the gas line from the Aqua-Hot

Locate the gas valve assembly on the propane burner and the corresponding gas lines..

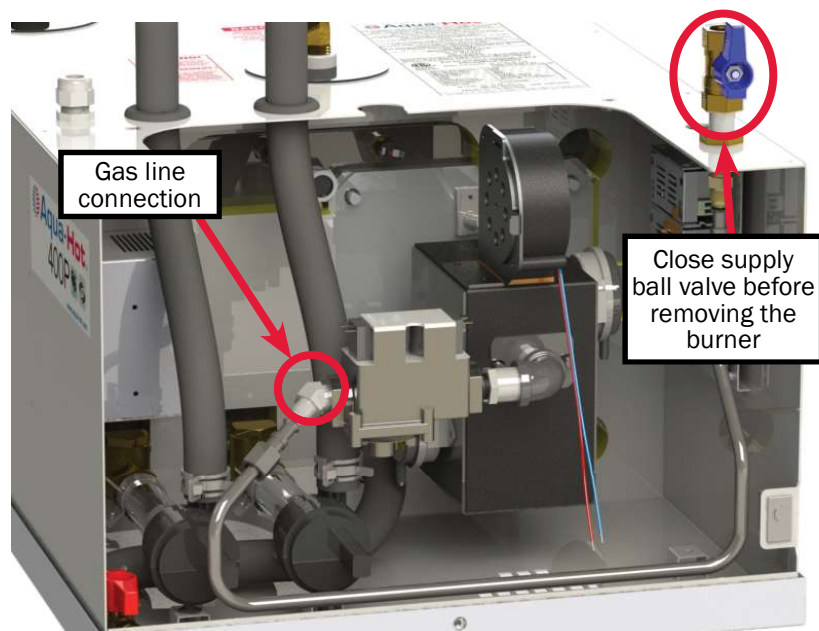
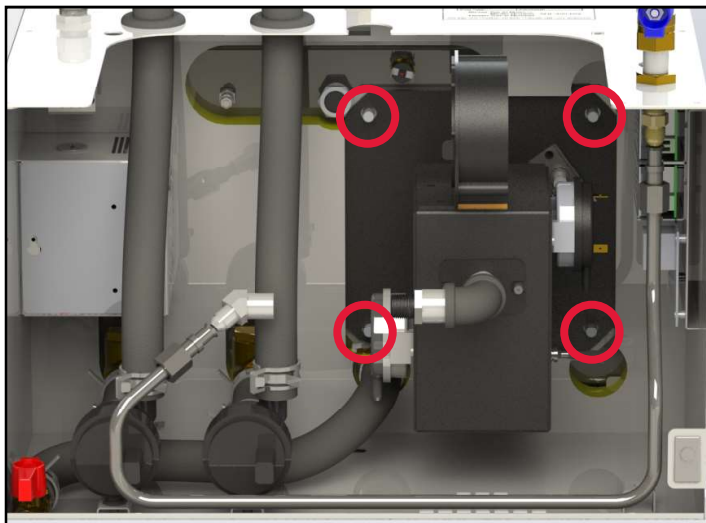
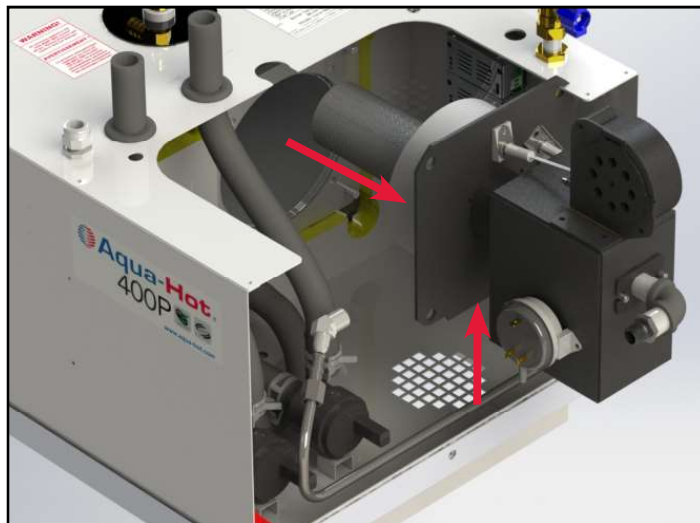


Figure 85

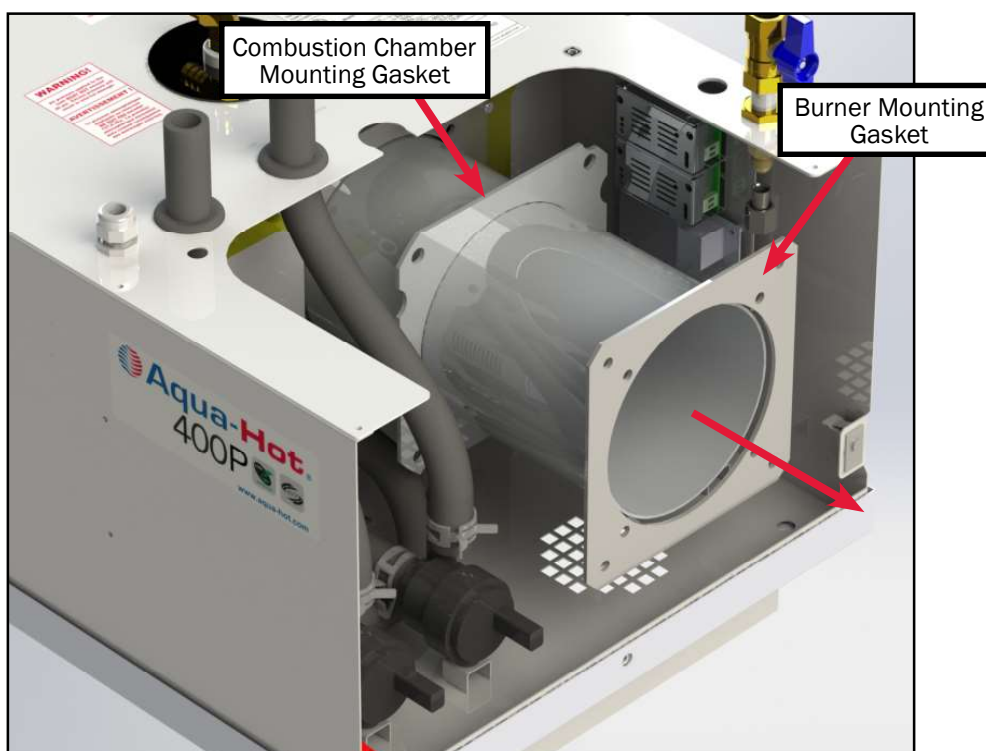
Step 5: Remove the Propane Burner from the Aqua-Hot

The propane burner is secured to the Aqua-Hot with four nuts that can be removed by using a $\frac{1}{2}$ inch socket wrench with a wobble extension.

Carefully lift the propane burner away from the Aqua-Hot.

**Figure 86****Figure 87**

Remove the combustion chamber and the propane burner's mounting gaskets.

**Figure 88**

Reattaching the Propane Burner to the Aqua-Hot

Step 1: Replace the Mounting Gasket

Clean the old gasket off the combustion chamber and boiler tank's front plate.

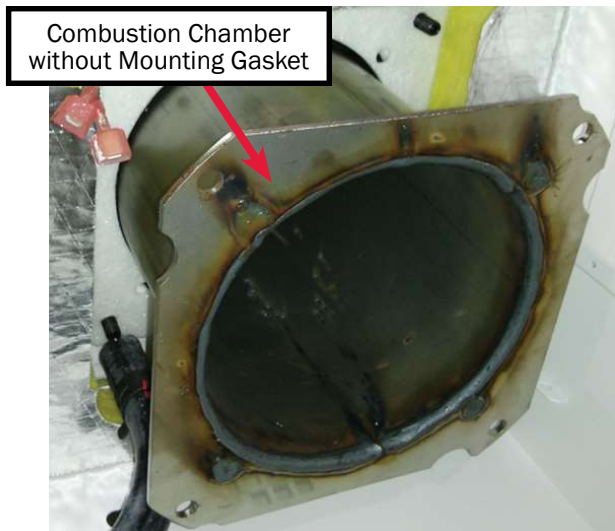


Figure 89

Install the new mounting gaskets and reinstall the combustion chamber.

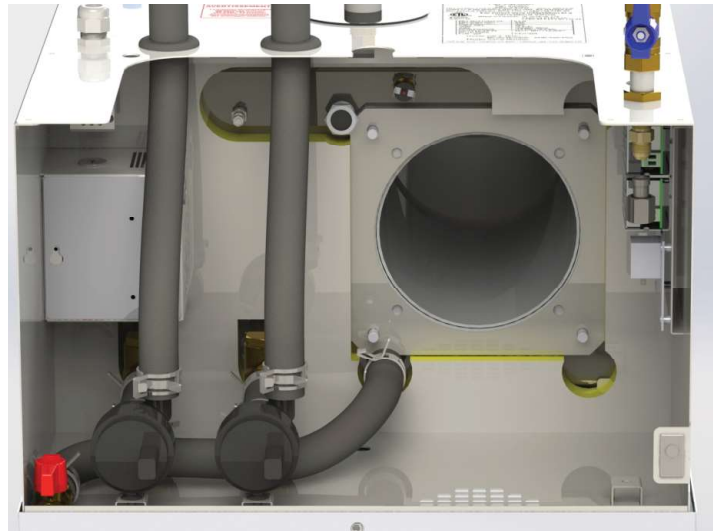


Figure 90

Step 2: Reinstall the Propane Burner

Align the propane burner's front air-tube plate with the combustion chamber and slide onto the bolts protruding from the boiler tank.

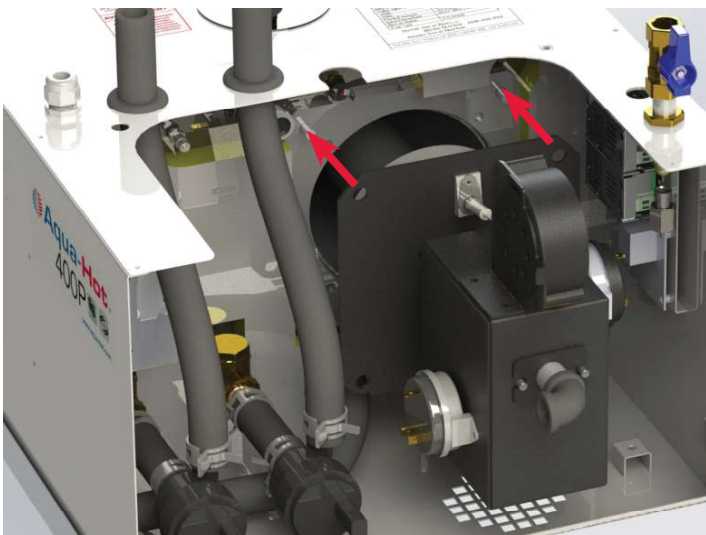


Figure 91

Finger tighten all four nuts previously removed to secure the propane burner to the boiler tank.

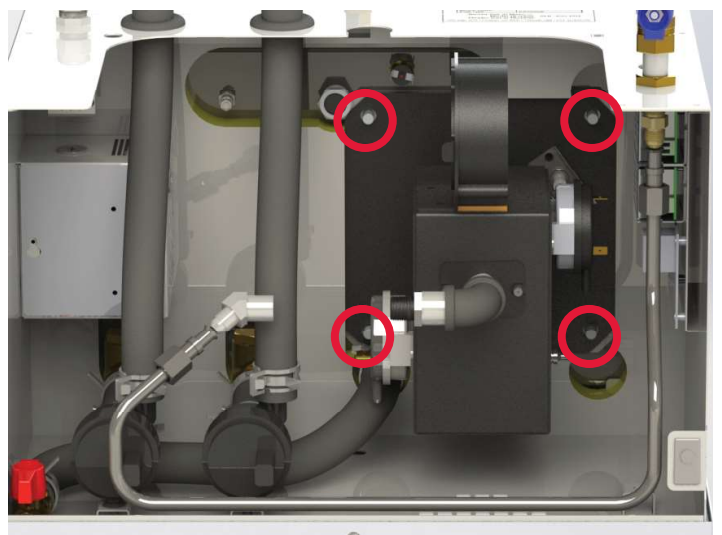


Figure 92

Step 2: Reinstall the Propane Burner

Using a ½ inch socket wrench with a wobble extension, tighten the three nuts securely. Tighten to 65 in/lbs.



Figure 93

Step 3: Reconnect the Propane Gas Line

Connect the Supply Gas Line to the Propane Burner's gas valve assembly.

Using a 11/16" wrench, tighten the nut on the gas line to the gas valve assembly to secure the line in place.

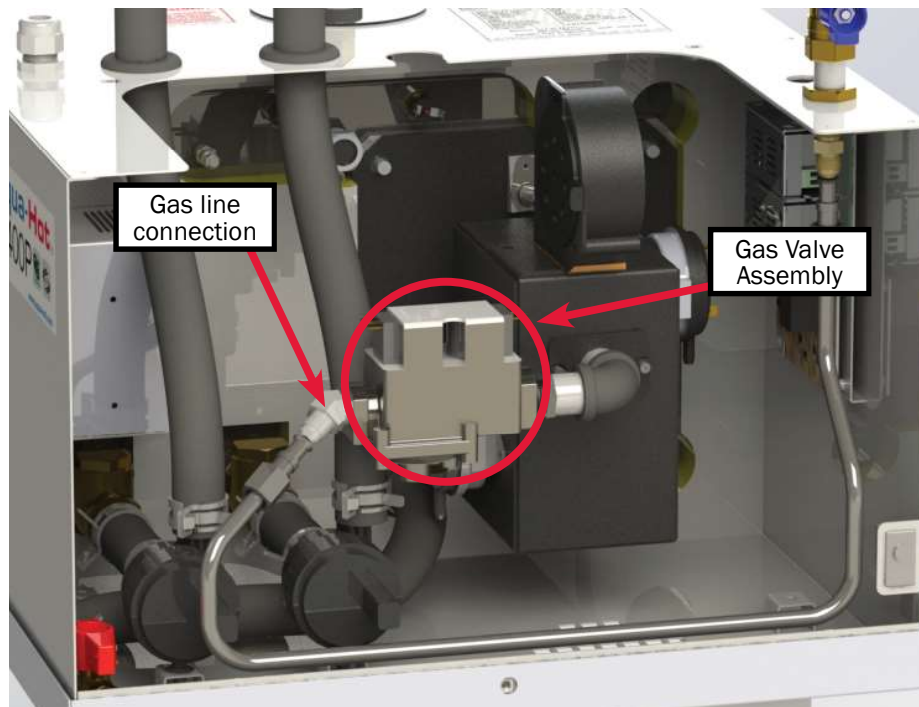


Figure 94

Step 4: Reconnect the Propane Burner to the Propane Burner Controller

Connect the propane burner harness to the propane burner controller and buck boost converters. Remember to attach the 3 separate wires, previously disconnected from the propane burner controller. See the schematic in Figure

Firmly press on the connectors to secure them to the Propane Burner Controller. Secure the buck boost converter plugs by screwing in the set screws, previously loosened.

Firmly press on the connectors to secure them to the Propane Burner Controller. Secure the buck boost converter plugs by screwing in the set screws, previously loosened.

- Wire #86 connects to the PWR terminal.
- Wire #92 connects to the BLO terminal.
- Wire #82 connects to the HSI+ terminal.

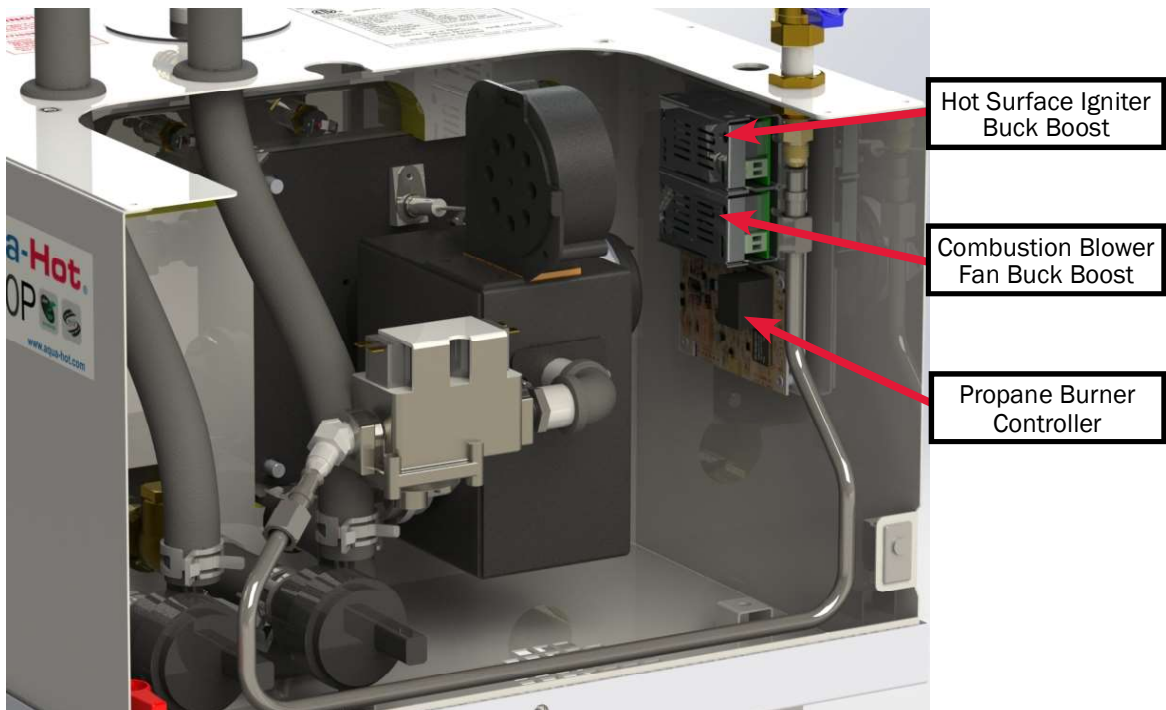


Figure 95

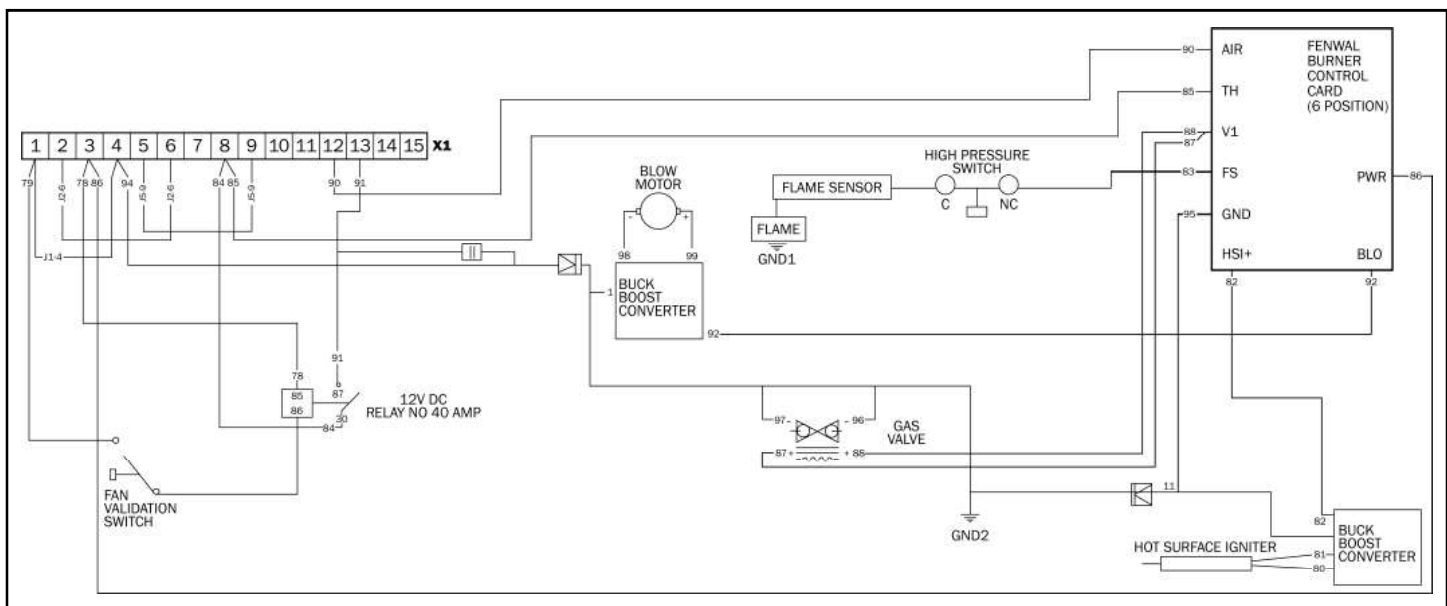
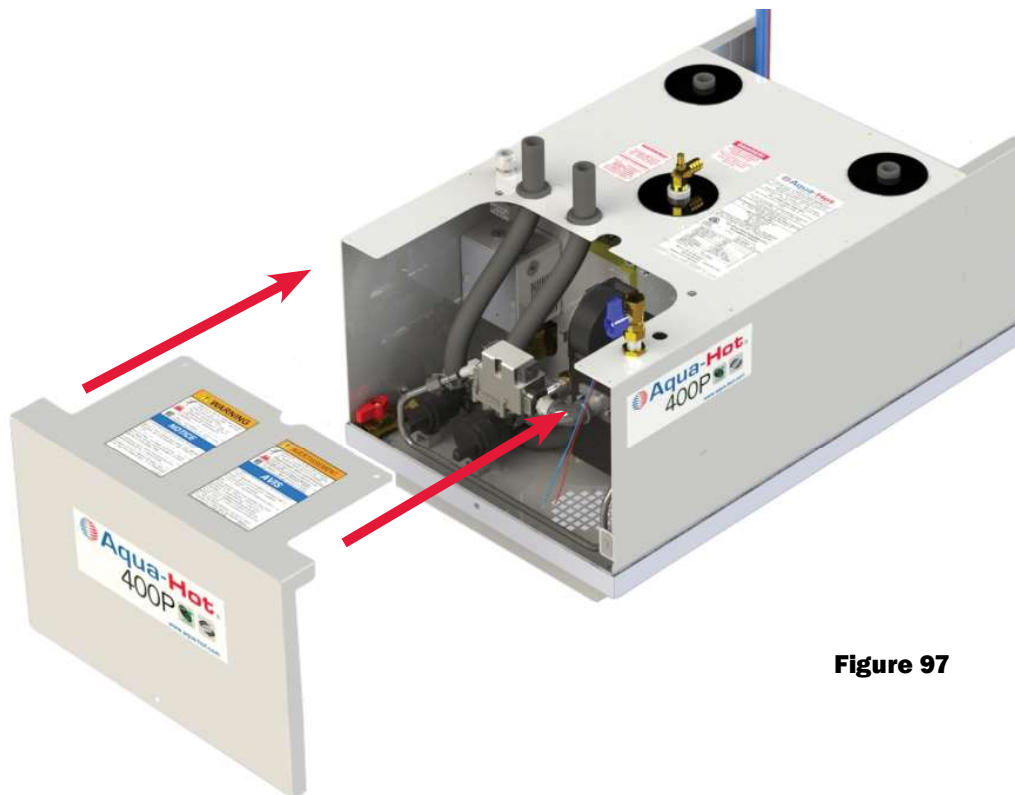
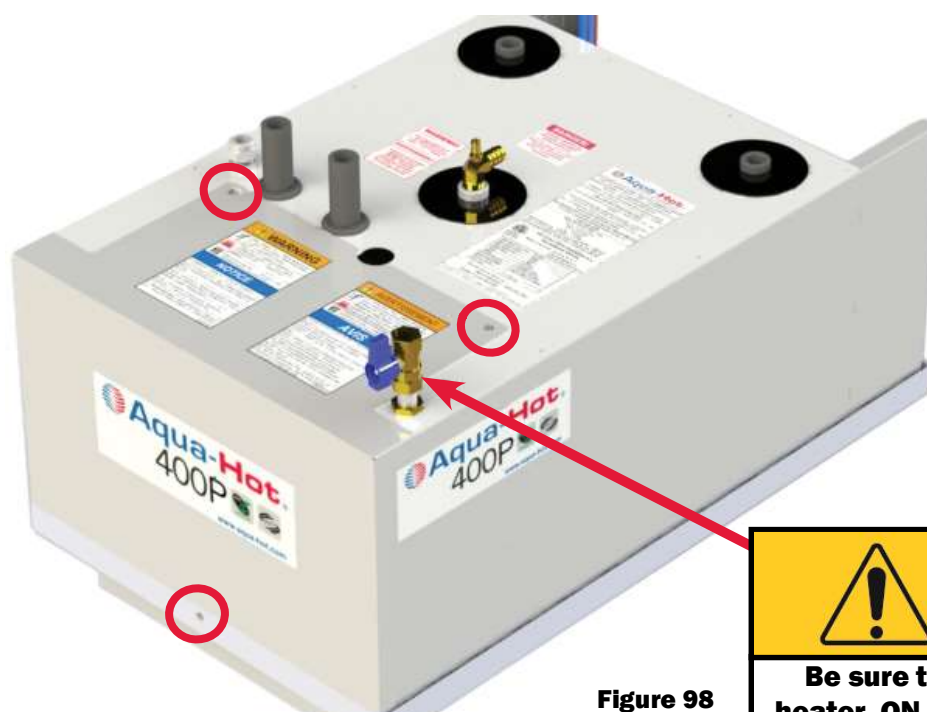


Figure 96

Step 4: Reinstall the Access Cover

Reinstall the Aqua-Hot's access cover and securely tighten the three bolts securing the access cover in place.

**Figure 97****Figure 98**

NOTE: The access cover must be installed prior to operation as a safety switch (interlock) exists. It will prevent the Aqua-Hot from operating whenever the access cover is not properly installed.



CAUTION

Be sure to turn the Gas Valve, on top of the heater, ON prior to starting the propane burner. Failure to do so could result in a propane burner malfunction.

Mounting Gasket

The mounting gaskets create a tight seal between the Boiler Tank and the Combustion Chamber, the Combustion Chamber and the Propane Burner Mounting Plate.

Replacement Indicator:

The Mounting Gasket should be replaced every time the Propane Burner is detached from the Aqua-Hot.

Replacement Procedure:



Be sure to shut off the Gas Supply line prior to beginning this replacement procedure.

1. Follow the “Detaching and Reattaching the Propane Burner” procedure starting on page 39.
2. Remove the existing Mounting Gasket from the Boiler Tank’s front plate and from the Propane Burner Mounting Plate. Be sure to clean the old gasket completely off of both plates.
3. Set the replacement Mounting Gasket into place on the Boiler Tank’s front plate.
4. Follow the procedure for reattaching the propane burner on page 42.

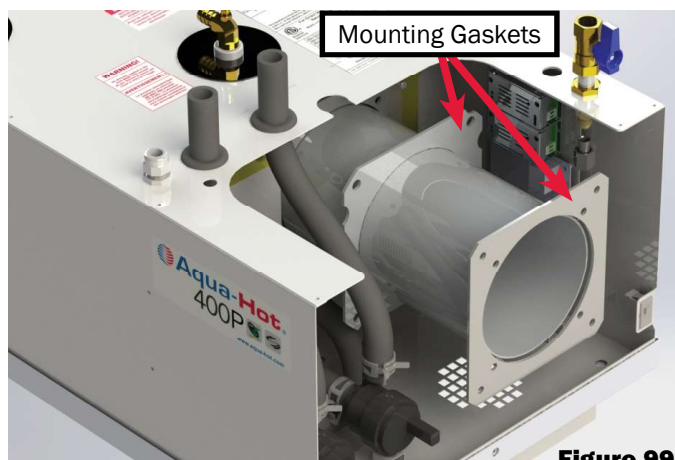


Figure 99



Be sure to open the shut-off valve for the Gas Supply prior to starting the propane burner.

Hot Surface Igniter

The Hot Surface Igniter ignites the propane gas. It will activate approximately 10 seconds after the initial start up process begins, and will be activated approximately 5 seconds prior to the propane dual stage gas valve opening, to ensure it is up to the proper ignition temperature 1300 °F, before propane enters the burn chamber.



DANGER

The Aqua-Hot operates on both AC and DC power. Be sure to disconnect the 120 V-AC power supply from the Aqua-Hot prior to servicing. Failure to do so could result in serious personal injury, electrical shock, or even death.

Replacement Indicator:

Replace the Hot Surface Igniter if:

- It fails to ignite the propane gas.
- If it is cracked or damaged.

NOTE: The Interlock Switch will prevent the propane burner from operating without the access cover intact; therefore, the switch will need to be manually pressed during this troubleshooting procedure.

Troubleshooting:

1. Turn the propane burner switch to the ON position, on the interior switch panel.
2. Approximately 10 seconds, after the propane burner’s blower fan starts blowing, the propane burner controller will activate the Hot Surface Igniter.

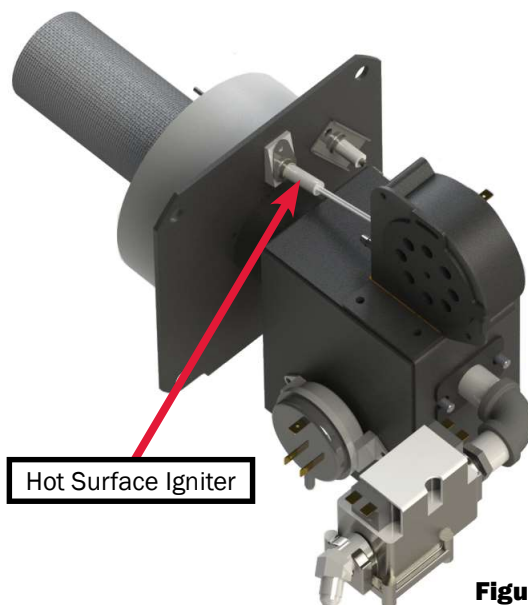


Figure 100

- Check the burner controller for 12V DC at the Hot Surface Igniter wire (wire #82). If no voltage exists, follow the procedure for replacing the Burner Controller.
- Check the Hot Surface Igniter Buck Boost for 12 VDC at wires #80 and #81. If no voltage is present, follow the procedure for replacing the Buck Boost converter.

If voltage does exist:

- Using a DC clamp-on type amp meter, test the Hot Surface Igniter wires (#80 & 81) to see if the Hot Surface Igniter is pulling amps. It should pull approximately 2 amps. If the Hot Surface Igniter is not pulling amps, or low amps, follow the Hot Surface Igniter Replacement Procedure.

Visual Inspection Procedure:

It is possible to view the Hot Surface Igniter to view functionality.

1. Turn the Propane Burner switch to the OFF position on the interior switch panel.
2. Close the Propane Gas Ball Valve, on the top of the heater, where the propane line connects to the heater.
3. Using a $\frac{7}{64}$ " Allen Wrench, loosen the Hot Surface Igniter and remove.

NOTE: The Hot Surface Igniter may be held in place by a Philips head screw.



CAUTION

The Hot Surface Igniter is extremely HOT. Use caution when handling or serious burns may occur. Be careful not to drop or hit the Hot Surface Igniter's ceramic casing.

4. With the Hot Surface Igniter removed, and the Propane Gas Ball Valve closed, turn the Propane Burner switch to the ON position on the interior switch panel.
5. Approximately 10 seconds after the blower fan starts, the Propane Burner Controller will activate the Hot Surface Igniter.

NOTE: The Hot Surface Igniter will be activated for 10 seconds before the Propane Burner Controller deactivates it, due to a no flame condition.

6. After the Hot Surface Igniter is activated, watch the tip to make sure it gets glowing, red hot. The tip should glow for approximately 10 seconds.

7. If the igniter does get glowing red hot, it is working properly. If it does not glow, or only glows 1-2 seconds, follow the Hot Surface Igniter replacement procedure.

NOTE: If the Igniter only glows for 1-2 seconds, the igniter is defective and will need to be replaced.

Replacement Procedure:

1. Turn the Propane Burner Switch to the OFF position on the interior switch.
2. Disconnect the wires by pulling firmly on the red quick disconnect fitting.
3. Using $\frac{7}{64}$ " Allen Wrench, loosen the Hot Surface Igniter and remove.
4. Install the replacement Hot Surface Igniter.
5. Using a $\frac{7}{64}$ " Allen Wrench, tighten the Hot Surface Igniter in place.
6. Reconnect the wires previously disconnected.
7. Test for proper operation.

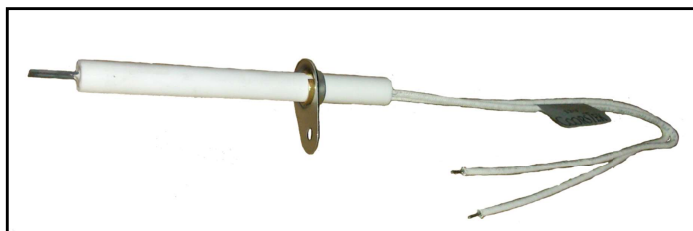


Figure 101

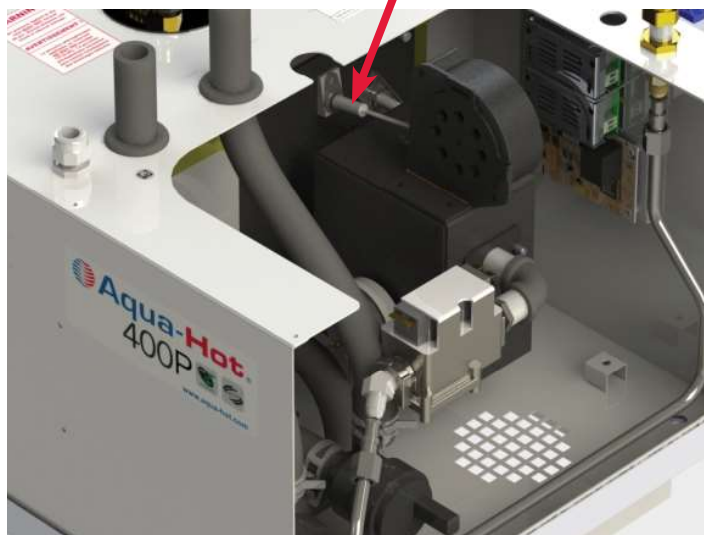


Figure 102

Refractory

The Refractory acts as an insulator, to protect the hot surface igniter from being overheated by the flame. Troubleshoot the Refractory if the propane burner “pops” on ignition, or if the propane burner fails to ignite.

Replacement Indicator:

Replace the Refractory if it becomes damaged.

NOTE: Improper handling of the burner may cause the Refractory to shift its position on the propane burner, causing it to cover the hot surface igniter. This will result in the propane gas being ignited late, or not at all.

Troubleshooting:

NOTE: The interlock switch will prevent the propane burner from operating without the access cover intact; therefore, the switch will need to be manually pressed during this troubleshooting procedure.

1. Follow the instructions for troubleshooting the Hot Surface Igniter.
2. If the Hot Surface Igniter is functioning properly follow the instructions for removing the Propane Burner on page 38.
3. With the Propane Burner removed, ensure the Refractory is securely in place on the propane burner, seated against the Propane Burner mounting plate.

NOTE: If the Refractory is cracked or damaged, it will need to be replaced.

Replacement Procedure:

1. Turn the Propane Burner switch OFF on the interior panel.
2. Turn the propane gas supply valve, located on the top of the heater, to the OFF position.
3. Loosen and disconnect the propane gas line, from the dual stage gas valve, on the propane burner.
4. Using a ½” socket, loosen and remove the four nuts, securing the propane burner to the heater.
5. Locate and remove both the Hot Surface Igniter and the Flame Sensor.
6. Remove the defective Refractory.
7. Install the replacement refractory onto the propane burner, ensuring both the flame sensor and hot surface igniter holes are aligned properly.



DANGER

The Aqua-Hot operates on both AC and DC power. Be sure to disconnect the 120V AC power supply from the Aqua-Hot prior to servicing. Failure to do so could result in serious personal injury, electrical shock, or even death.

8. Reinstall both the Hot Surface Igniter and the Flame Sensor.
9. Install the Refractory to the burner.
10. Reinstall the propane burner to the heater, and tighten the nuts securing the burner in place.
11. Connect the propane gas line to the dual stage gas valve, and securely tighten to 140 in-lbs.
12. Turn the propane gas supply valve to the ON position.
13. Test for proper operation.

Propane Burner

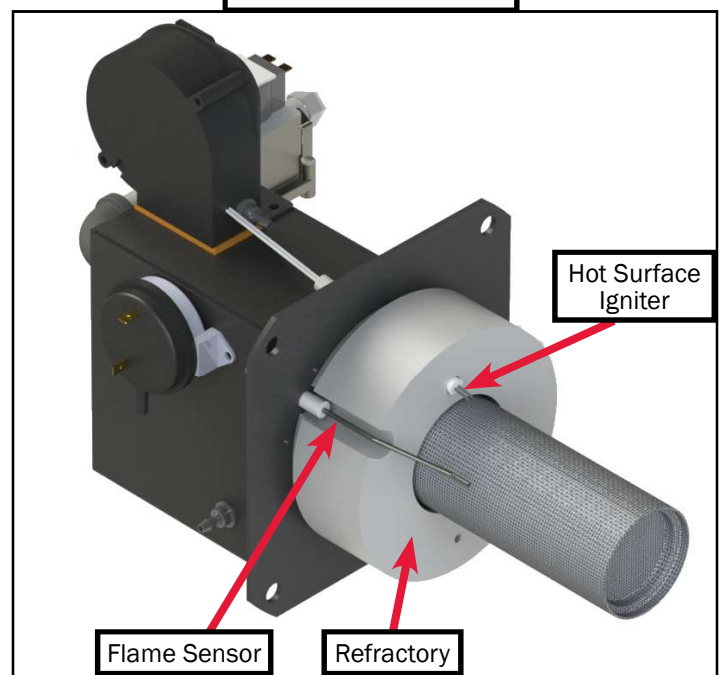


Figure 103

Dual Stage Propane Gas Valve

The Dual Stage Propane Gas Valve will activate approximately 6 seconds after the Hot Surface Igniter has been activated, to allow propane gas to enter the combustion chamber.

NOTE: Both Stages of the Dual Stage Propane Gas Valve must be activated before propane gas will flow into the combustion chamber.

Replacement Indicator:

Replace the Dual Stage Propane Gas Valve if either stage fails to open, failing to allow propane gas to enter the combustion chamber.

NOTE: Before troubleshooting the Dual Stage Propane Gas Valve, verify the coach has propane, and that all Propane shut off valves are in the open position.

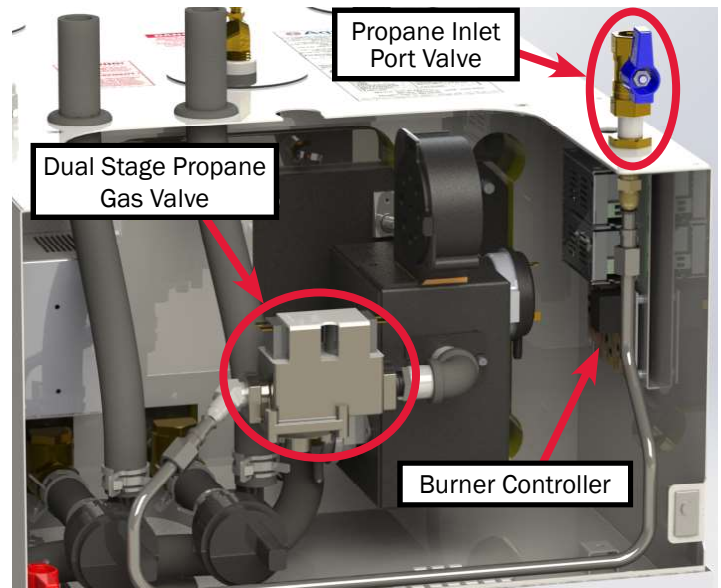


Figure 104

Troubleshooting:

1. Turn the Propane Burner switch to ON, on the interior panel.
2. Once it has been determined that the Dual Stage Propane Gas Valve should be activated, verify that the Propane Burner Controller is sending 12V DC to both Stages of the Dual Stage Propane Gas Valve.
 - Using a digital voltmeter, check the #87 (green) wire, on the white plug, plugged into the Propane Burner Controller for 12V DC (see Figure 105). If no voltage is present, replace the Propane Burner Controller.
3. Once it has been determined that the Propane Burner Controller is sending power to the Dual Stage Propane Gas Valve, verify there is 12V DC at both sides of the Dual Stage Gas Valve.
 - Using a digital voltmeter, check the #87 (green) wire, on the right side of the gas valve for 12V DC, and the #88 (blue) wire, on the left side of the gas valve for 12V DC (see Figure 105). If no voltage is present, inspect wire harness for damage.
4. If both stages of the Dual Stage Propane Gas Valve are receiving 12V DC, but either stage fails to open, the Dual Stage Propane Gas Valve must be replaced.
5. If the Dual Stage Gas Valve is not receiving power, test the Fan Validation Switch, relay, and the right high-limit thermostat for proper functionality.

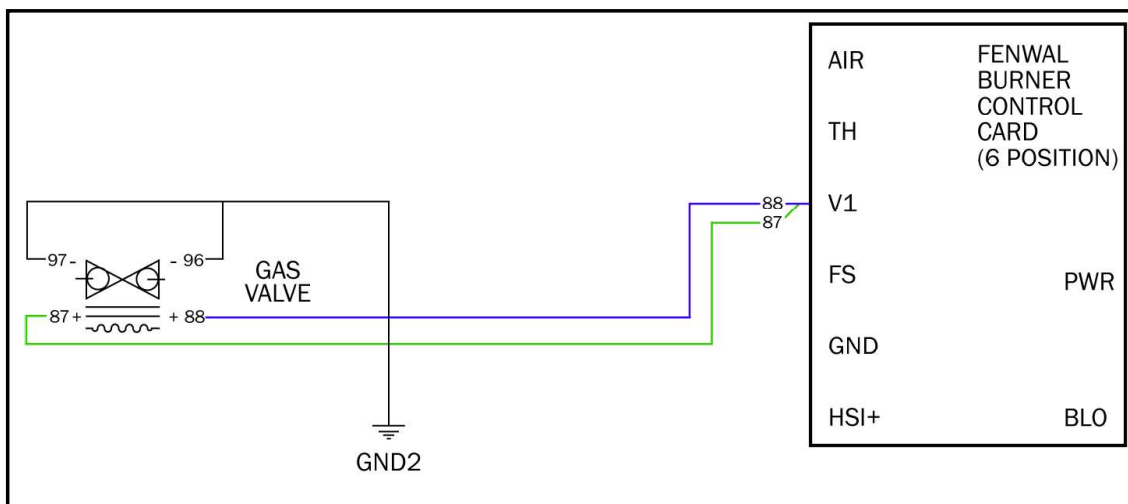


Figure 105

Dual Stage Propane Gas Valve



CAUTION

Be sure to turn OFF the Propane Gas Supply at the port on top of the Aqua-Hot prior to beginning this replacement procedure.



DANGER

The Aqua-Hot operates on both AC and DC power. Be sure to disconnect the 120V AC power supply from the Aqua-Hot prior to servicing. Failure to do so could result in serious personal injury, electrical shock, or even death.

1. Shut off the propane gas supply, by turning the propane inlet port valve to the OFF position.
2. Using an $11/16$ " wrench, remove the propane supply line from the Dual Stage Propane Gas Valve.
3. Disconnect the wires from the propane gas valve. Be sure to note the location of the wires.
4. Using $1/2$ " wrench, loosen and remove the dual stage propane gas valve from the propane burner.

NOTE: It may be necessary to use a back up wrench to prevent damage to the propane burner when removing the dual stage gas valve.

5. Remove and clean the steel fittings on the defective dual stage gas valve, to use on the replacement dual stage gas valve.
6. Wrap the threads of the steel fittings with a thread sealant recommended for use with propane gas fittings.
7. Install the steel fittings onto the dual stage gas valve, as they were previously removed.
8. Connect the dual stage gas valve to the propane burner.
9. Connect the propane supply line to the dual stage gas valve.
10. Reconnect the wires previously disconnected. Refer to the schematic on Page 77 for proper wire locations.
11. Turn the Propane inlet port ball valve to the ON position.
12. Test the propane leaks.

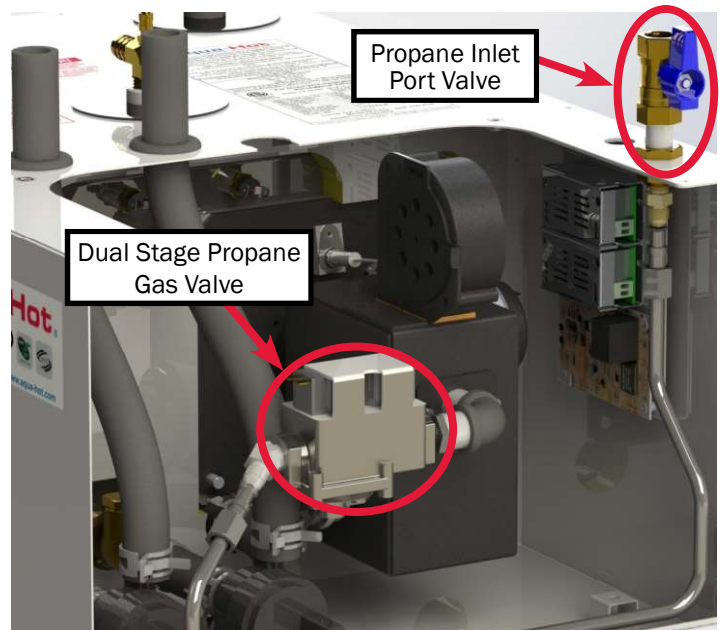


Figure 106

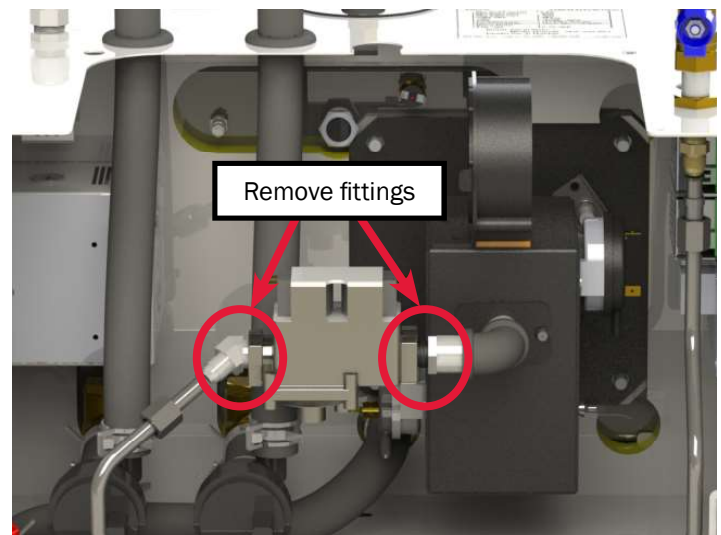


Figure 107

Combustion Blower Fan

The Combustion Blower Fan creates combustion air, which is blown into the combustion chamber to mix with the propane gas, before it is ignited. Reference Page 71 for the proper adjustment procedure.

NOTE: The interlock switch will prevent the propane burner from operating without the access cover intact; therefore, the switch will need to be manually pressed during this troubleshooting procedure.

Replacement Indicator:

Replace the Combustion Blower Fan if it is damaged or not working.

NOTE: If the Fan Validation Switch has continuity before the combustion blower fan is activated, the Propane Controller will not allow the combustion blower fan to start.

NOTE: If the air shutter is not adjusted properly, the burner may not ignite, or it may make a loud rumbling sound. Refer to the adjustment procedure on Page 71.

NOTE: If the left High-Limit Thermostat (wires 32 & 35), is tripped (does not have continuity), the blower fan will not operate.

Troubleshooting Procedure:

1. Turn the Propane Burner ON, on the interior panel.
2. Verify the following:
 - The Control Thermostat/ETS Module is calling for heat.
 - The interlock switch is not tripped.
 - The fluid sensor is not tripped.
 - There is 12V DC going to the Propane Burner Controller.
 - The High-Limit thermostat is not tripped.
 - The Blower Motor 10A fuse (on the fuse block) is not blown.
3. Verify that the Propane Burner Controller is sending power to the Combustion Blower Motor.
 - Using a digital voltmeter, check wire #92 (green) for 12V DC at the white plug, plugged into the Propane Burner Controller. If no voltage is present, replace the Propane Burner Controller.
4. If the Propane Burner Controller is sending power out on wire #92 (green), verify that the left High-Limit thermostat is operating properly. Follow the troubleshooting guide for

the left DC High-Limit Thermostat on Page 18.

5. If the Left DC High-Limit thermostat is functioning properly, verify that the Buck Boost converter for the blower motor is operating properly.
 - Using a digital voltmeter, check the #92 wire going into the Buck Boost converter for 12V DC. If there is no voltage, inspect the wire for loose connections or damage.
 - If there is power going into the Buck Boost converter on wire #92, check wire #99 for 12V DC exiting the Buck Boost converter, going to the combustion blower fan. If there is no power exiting the Buck Boost, replace the Buck Boost converter.

If there is power going to the Combustion Blower Fan, but it still fails to operate, replace the Combustion Blower Fan.

Replacement Procedure:

NOTE: When replacing the Propane Burner's blower fan use replacement part number ELX-375-020-FRU.

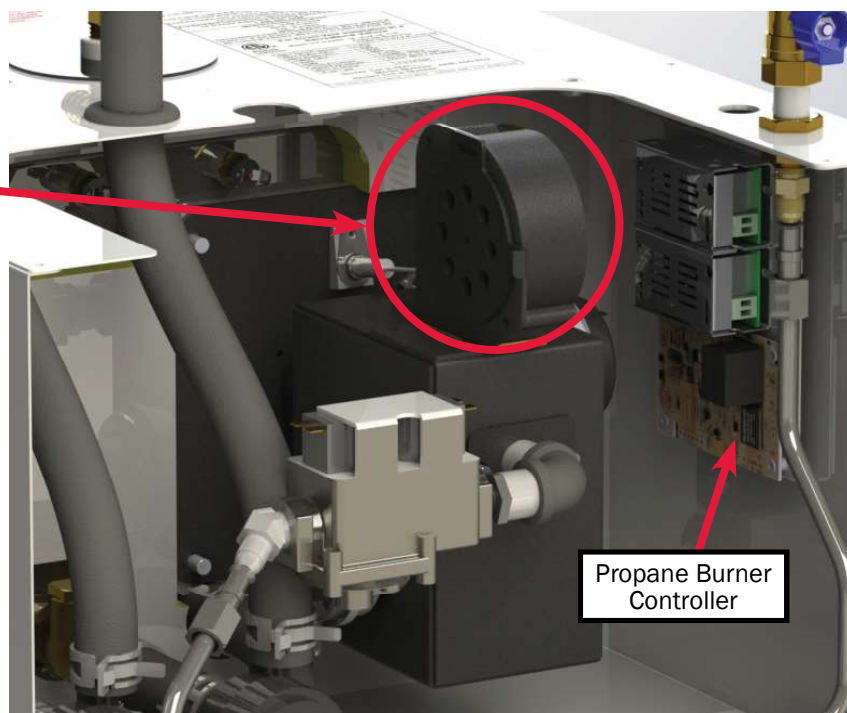
1. Turn the Propane Burner switch to the OFF position on the interior switch panel.
2. Disconnect the wires, connecting the combustion blower fan to the harness.
3. Using a $\frac{3}{8}$ " socket, loosen the nuts securing the combustion blower fan to the propane burner. Reference Figure 110.
4. Discard the gasket sealing the combustion blower fan to the propane burner.
5. Using a Philips head screwdriver and a 9mm socket, remove the air shutter assembly from the defective combustion blower fan. Reference Figure 111.
6. Using a Philips head screwdriver and a 9mm socket, install the Air Shutter assembly onto the replacement combustion blower fan. Torque = 12 in/lbs.
7. Replace discarded gasket with a new replacement gasket.
8. Using a $\frac{3}{8}$ " socket, secure the combustion blower fan assembly to the propane burner. Torque = 35 in/lbs.
9. Reconnect the wires, previously disconnected.
10. Test for proper operation.

NOTE: The Propane burner's blower fan will be preset. If the burner fails to ignite or is excessively noisy, contact the Service Department at 574-AIR-XCEL (574-247-9235).

Combustion Blower Fan



Figure 108



Propane Burner
Controller

Figure 109

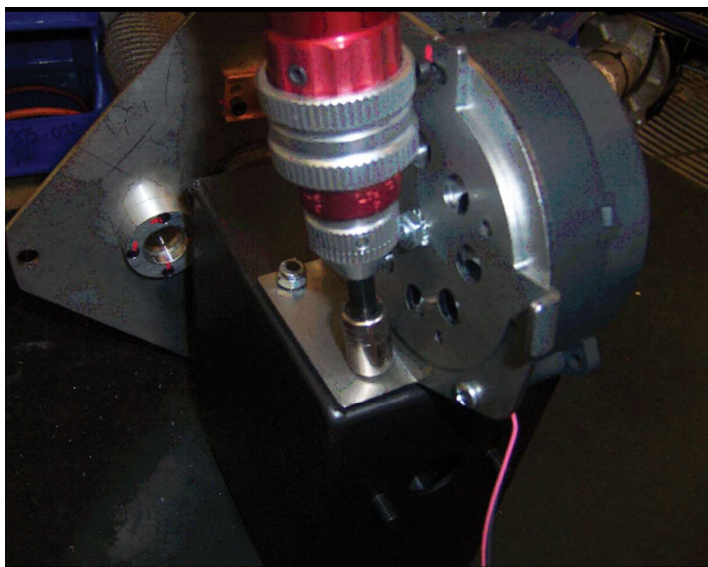


Figure 110

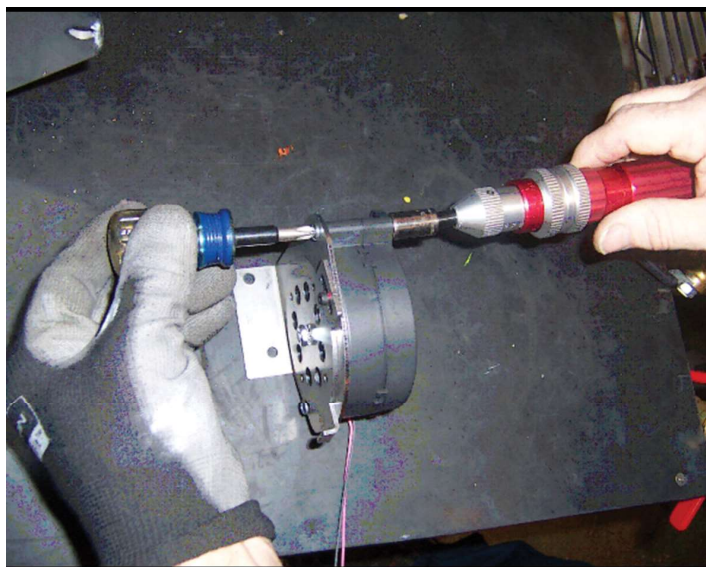


Figure 111

Exhaust “High Back Pressure” Switch

The purpose of the Exhaust “High Back Pressure” Switch, is to monitor back pressure inside the combustion chamber, and shut the burner down if it sense high back pressure. It is normally closed, and if it senses high back pressure, it will trip and will interrupt the Flame Sensor signal, shutting down the propane burner.

Replace the Exhaust “High Back Pressure” Switch if it fails to operate properly or is damaged.

NOTE: The interlock switch will prevent the propane burner from operating without the access cover intact; therefore, the switch will need to be manually pressed during this troubleshooting procedure.

Troubleshooting Procedure:

1. Turn the Propane Burner to ON on the interior switch panel.
2. Locate the Exhaust “High Back Pressure” Switch on the left side of the propane burner.
3. Disconnect the two wires, connected to the switch, by firmly pulling on the quick disconnect terminals.
4. Using a digital voltmeter, check the Exhaust “High Back Pressure” Switch for continuity.
 - If no continuity exists, replace the Exhaust “High Back Pressure” Switch.
 - If there is continuity while the propane burner is off, inspect the exhaust for signs of damage. This may cause back pressure into the exhaust chamber.

NOTE: Before replacing the High Back Pressure Switch, it is recommended to inspect the exhaust pipe for damage or restrictions and to ensure the exhaust tip is installed properly.

Replacement Procedure:

1. Disconnect the two wires, connected to the switch, by firmly pulling on the quick disconnect terminals.
2. Using a #2 Philips screwdriver, loosen the two screws, securing the switch to the left side of the propane burner.
3. Remove the defective switch.
4. Secure the replacement switch to the side of the propane burner, using the screws previously removed.
5. Reconnect the wires, previously removed from the defective switch.
6. Test for proper operation.

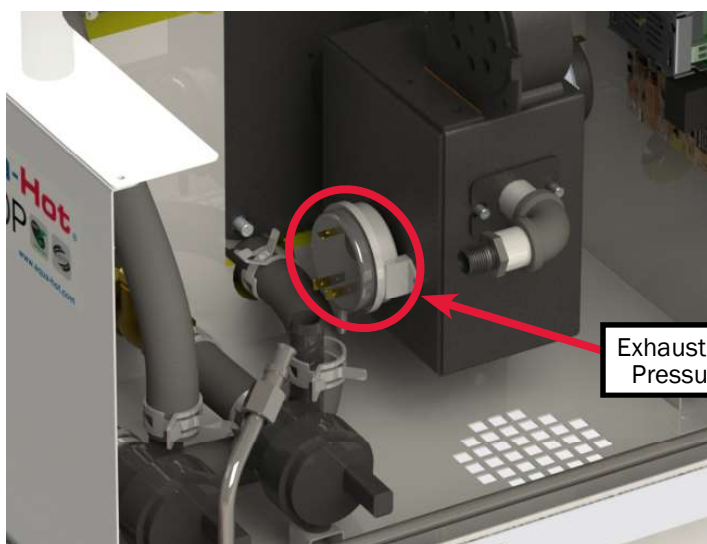


Figure 112

NOTE: Image above shows the High Back Pressure Switch with the Dual Stage Gas Valve and gas lines removed.

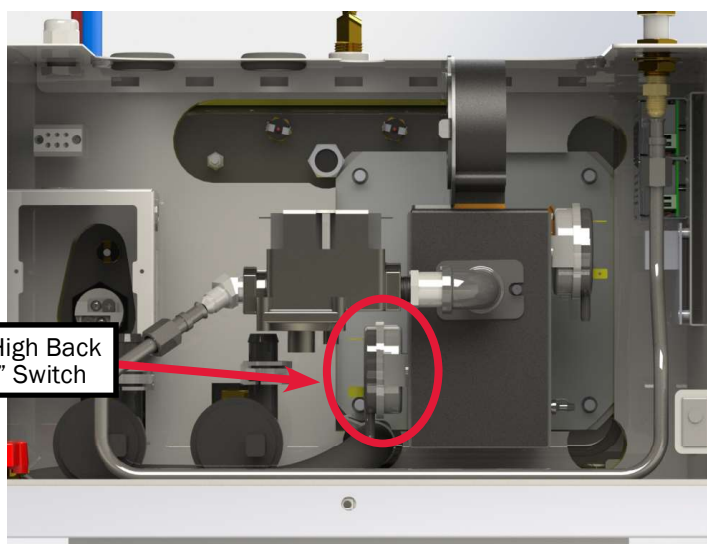


Figure 113

Fan Validation Switch

The purpose of the Fan Validation Switch is to monitor the combustion blower fan, and verify that it is operating properly. The Fan Validation Switch is normally open. If the fan validation switch fails to operate properly, the gas valve will not function.

Replacement Indicator:

Replace the Fan Validation Switch if it fails to operate properly or is damaged.

NOTE: The interlock switch will prevent the propane burner from operating without the access cover intact; therefore, the switch will need to be manually pressed during this troubleshooting procedure.

NOTE: If the Fan Validation Switch has continuity before the combustion blower fan is activated, the Propane Controller will not allow the combustion blower fan to start.

Troubleshooting Procedure:

1. Turn the Propane Burner Switch ON, on the interior switch panel.
2. Locate the Fan Validation Switch on the right side of Propane Burner.
3. Disconnect the two wires, connected to the switch, by firmly pulling on the quick disconnect terminals.
4. Using a digital voltmeter, check the Fan Validation Switch for continuity.
 - If continuity exists when the combustion blower fan is NOT running, replace the fan validation switch.
 - If there is no continuity while the propane burner is OFF, turn the Propane Burner to the ON position, and verify that the combustion blower fan is running.
 - With the combustion blower fan running, use a digital voltmeter and recheck the fan validation switch for continuity.
 - If there is continuity with the combustion blower fan running, the fan validation switch is operating properly.
 - If there is no continuity with the combustion blower fan running, the fan validation switch is defective and will need to be replaced.

Replacement Procedure:

NOTE: If the air is not adjusted properly, it may cause the fan validation switch to fail.

1. Disconnect the two wires, connected to the fan validation switch, by firmly pulling on the quick disconnect terminals.
2. Using a #2 Philips screwdriver, loosen the two screws, securing the fan validation switch to the right side of the propane burner.
3. Remove the defective fan validation switch.
4. Secure the replacement fan validation switch to the side of the propane burner, using the screws previously removed.
5. Reconnect the wires, previously removed from the defective fan validation switch.
6. Test for proper operation.

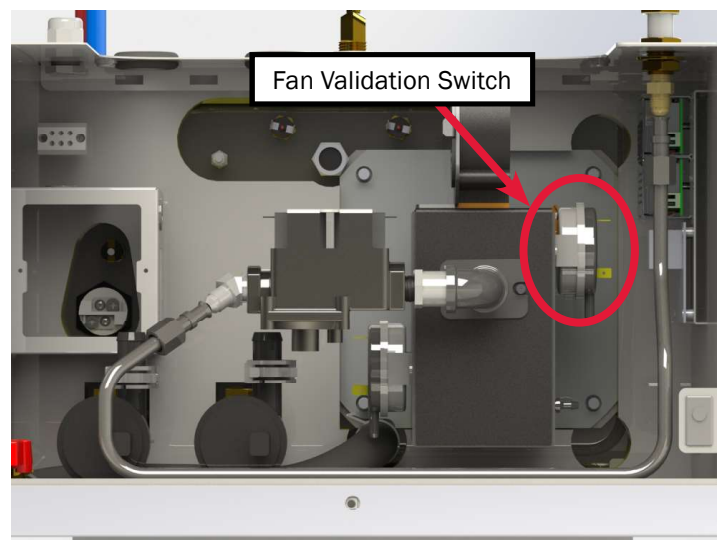


Figure 114

Fan Validation Switch Relay

The purpose of the Fan Validation Switch Relay is to reduce the amount of amps going to the Fan Validation Switch. It takes the normal .5 amps and reduces it to 1 amps, to extend the life of the Fan Validation Switch.

Replacement Indicator:

Replace the Fan Validation Switch Relay if it fails to operate properly or is damaged.

NOTE: The interlock switch will prevent the propane burner from operating without the access cover intact; therefore, the switch will need to be manually pressed during this troubleshooting procedure.

Troubleshooting Procedure:

1. Turn the Propane Burner Switch, on the interior switch panel to the OFF position, and let the Propane Burner completely shut down.
2. Locate the Fan Validation Switch Relay, on the right side of the Propane Burner.
3. Disconnect the two wires, #84 & #91, connected to the relay, by firmly pulling on the quick disconnect terminals.
4. Using a digital voltmeter, check the fan validation switch relay for continuity.
 - If continuity exists when the combustion blower fan is

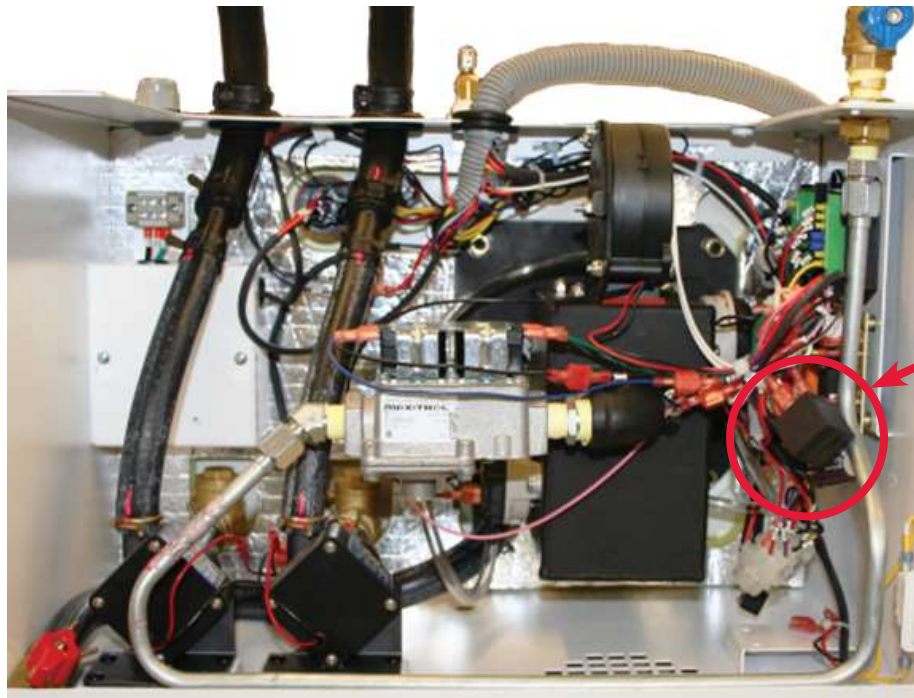
NOT running, replace the fan validation switch relay.

- If there is no continuity while the propane burner is off, turn the propane burner to the ON position, and verify that the combustion blower fan is running.
- With the combustion blower fan running, using a digital voltmeter and recheck the fan validation switch relay for continuity.
 - If there is continuity with the combustion blower fan running, the fan validation switch is operating properly.
 - If there is no continuity with the combustion blower fan running, the fan validation switch is defective and will need to be replaced.

NOTE: If the air is not adjusted properly, it may cause the fan validation switch to fail.

Replacement Procedure:

1. Locate the Fan Validation Switch Relay.
2. Disconnect the wires connected to the Fan Validation Switch Relay. Note the location of each wire.
3. Reconnect the wires to the new Fan Validation Switch Relay. Refer to the wiring schematic on Page 76 for proper replacement of the wires on the relay.
4. Test for proper operation.



Fan Validation Switch Relay

Figure 115

Buck Boost Converter - Combustion Blower Fan

The purpose of the Buck Boost Converter is to maintain a preset output voltage.

NOTE: There are two Buck Boost Converters. One is for the Combustion Blower Fan, and the other one is for the Hot Surface Igniter.

Replacement Indicator:

Replace the Buck Boost Converter if it fails to operate properly or is damaged.

Troubleshooting Procedure:

NOTE: The interlock switch will prevent the propane burner from operating without the access cover intact; therefore, the switch will need to be manually pressed during this troubleshooting procedure.

1. Turn the Propane Burner Switch to the ON position, on the interior switch panel.
2. Verify the following:
 - The Control Thermostat/ETS Module is calling for heat.
 - The Interlock Switch is not tripped.
 - The fluid sensor is not tripped.
 - There is 12V DC going to the Propane Burner Controller.
 - The left High-Limit Thermostat (wires #32 & #35) is not tripped.
 - The 10 Amp blower fan fuse is not blown.
3. Verify that the Propane Burner Controller is sending power to the Buck Boost Converter at the BLO pin, on the controller.
 - If the propane burner controller is not sending a power signal to the buck boost converter, replace the propane burner controller.

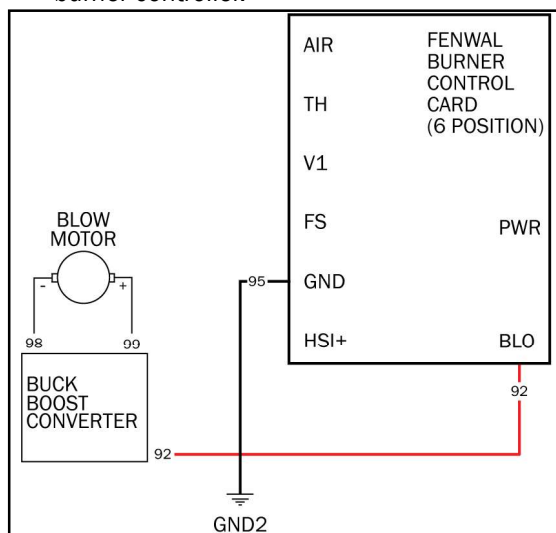


Figure 116

4. Verify that the Propane Burner Controller is sending a ground signal to the buck boost converter at the GND pin, on the Controller.
5. If the Propane Burner Controller is sending power and ground to the buck boost converter, verify that the buck boost converter is receiving the power and ground signals. Through the individual wires. The power wire is #92, the ground wire is #95.

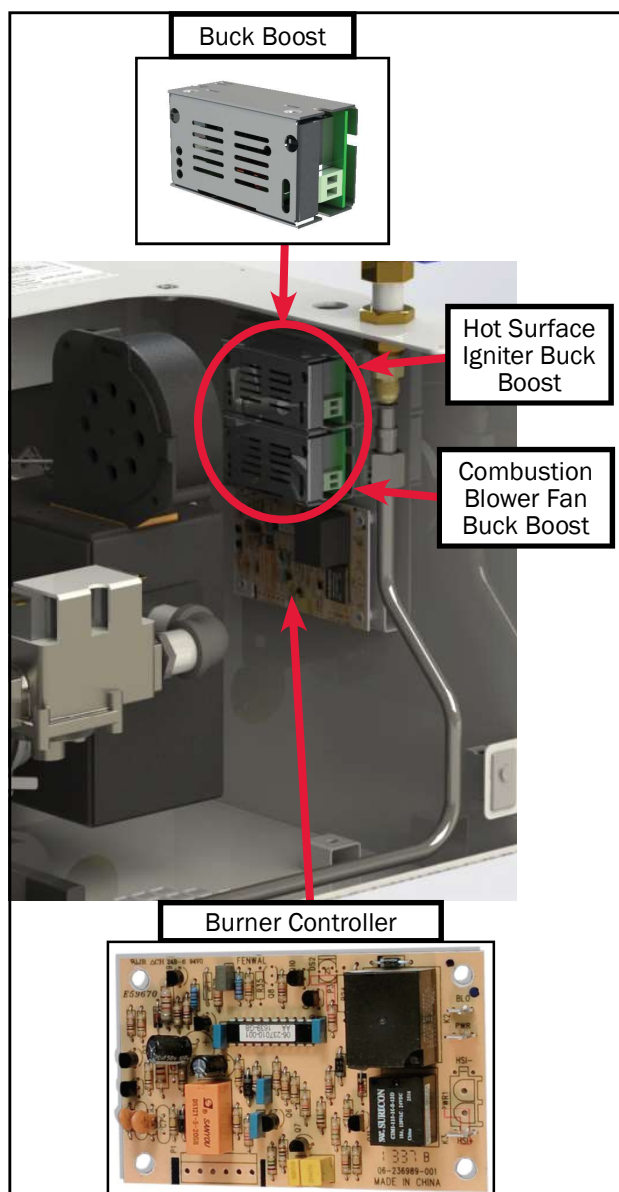


Figure 117

Buck Boost Converter - Hot Surface Igniter

The purpose of the Buck Boost Converter is to maintain a preset output voltage.

NOTE: There are two Buck Boost Converters. One is for the Combustion Blower Fan, and the other one is for the Hot Surface Igniter.

Replacement Indicator:

Replace the Buck Boost Converter if it fails to operate properly or is damaged.

NOTE: The interlock switch will prevent the propane burner from operating without the access cover intact; therefore, the switch will need to be manually pressed during this troubleshooting procedure.

Troubleshooting Procedure:

1. Turn the Propane Burner Switch to the ON position, on the interior switch panel.
2. Verify the following:
 - The Control Thermostat/ETS Module is calling for heat.
 - The Interlock Switch is not tripped.
 - The fluid sensor is not tripped.
 - There is 12V DC going to the Propane Burner Controller.
 - The right High-Limit Thermostat (wires #33 & #36) is not tripped.
 - The Propane Burner Blower fan activates.
3. Verify that the Propane Burner Controller is sending power to the Buck Boost Converter at the HSI pin, on the controller.

- If the propane burner controller is not sending a power signal to the buck boost converter, replace the propane burner controller.

NOTE: The Propane Burner Controller sends a GND signal out on wire #95. Wire #95 then goes to the combustion blower fan's buck boost and is tied into wire #11, which is the ground wire for the Hot Surface Igniter's Buck Boost.

4. Verify that the Propane Burner Controller is sending a ground signal to the buck boost converter at the GND pin, on the Controller.
 - If the propane burner controller is not sending a power signal to the buck boost converter, replace the propane burner controller.
5. If the Propane Burner Controller is sending power and ground to the buck boost converter, verify that the buck boost converter is receiving the power and ground signals. Through the individual wires. The power wire is #82, the ground wire is #11.
 - If an individual wire is not sending the proper signal, replace that individual wire.
6. Verify that the buck boost converter is sending the proper power and ground signals to the hot surface igniter, wire #80 is the power wire, and wire #81 is the ground wire. This voltage should be approximately 12.5V DC when the supply voltage is between 11V DC - 15V DC.
 - If the voltage going to the motor from the buck boost converter is not 12.5V DC when the supply voltage is between 11V DC - 15V DC, replace the buck boost converter.

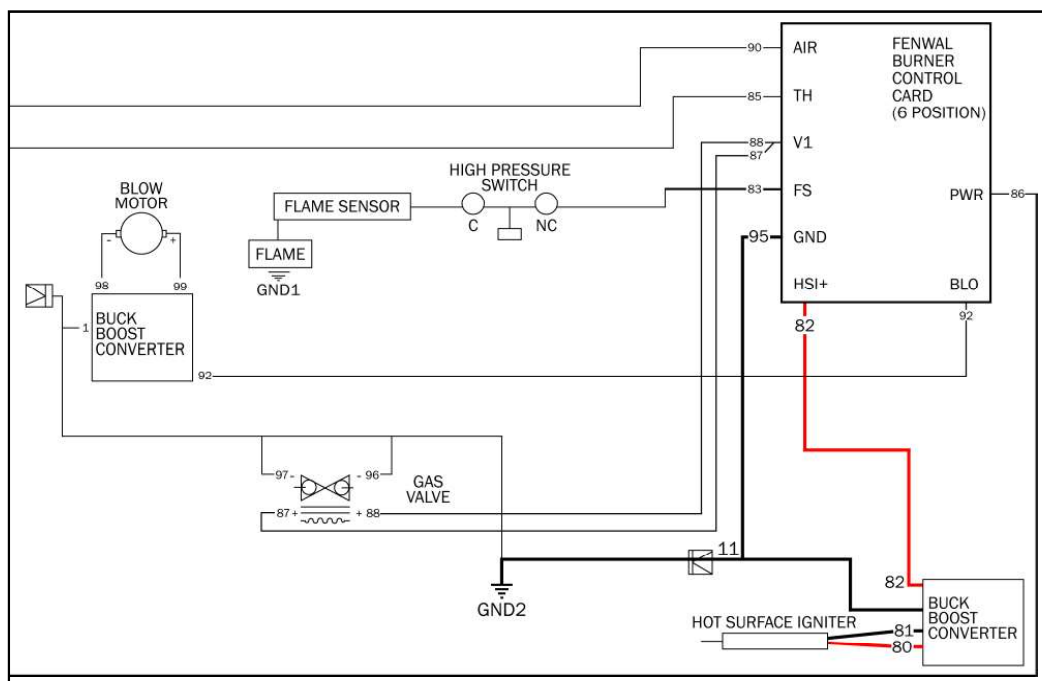


Figure 118

Flame Sensor

The purpose of the Flame Sensor is to monitor the flame of the propane burner and verify that it is burning properly. The flame sensor turns the heat from the flame into a millivolt signal that the propane burner controller senses.

Replacement Indicator:

Replace the Flame Sensor if it fails to operate properly or is damaged.

Troubleshooting Procedure:

NOTE: The interlock switch will prevent the propane burner from operating without the access cover intact; therefore, the switch will need to be manually pressed during this troubleshooting procedure.

1. Flame current is the current which passes through the flame from the sensor to ground to complete the primary safety circuit. The minimum flame current necessary to keep the system from lockout is $0.7 \mu\text{A}$ micro amps. To measure flame current, DISCONNECT INPUT VOLTAGE, then insert a $0\text{--}50 \mu\text{A}$ or higher while flame is established. If meter reads below "0" on scale, meter leads are reversed. Disconnect power and reconnect meter leads for proper polarity.

NOTE: A defective flame sensor will usually allow the burner to ignite for approximately 2-5 seconds, and then shut down into default mode.

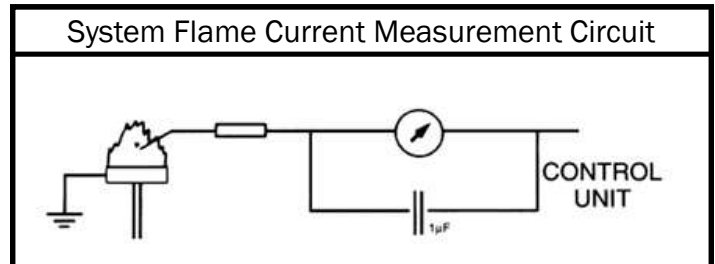


Figure 119

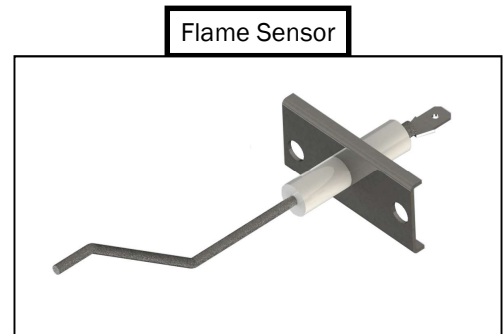


Figure 120

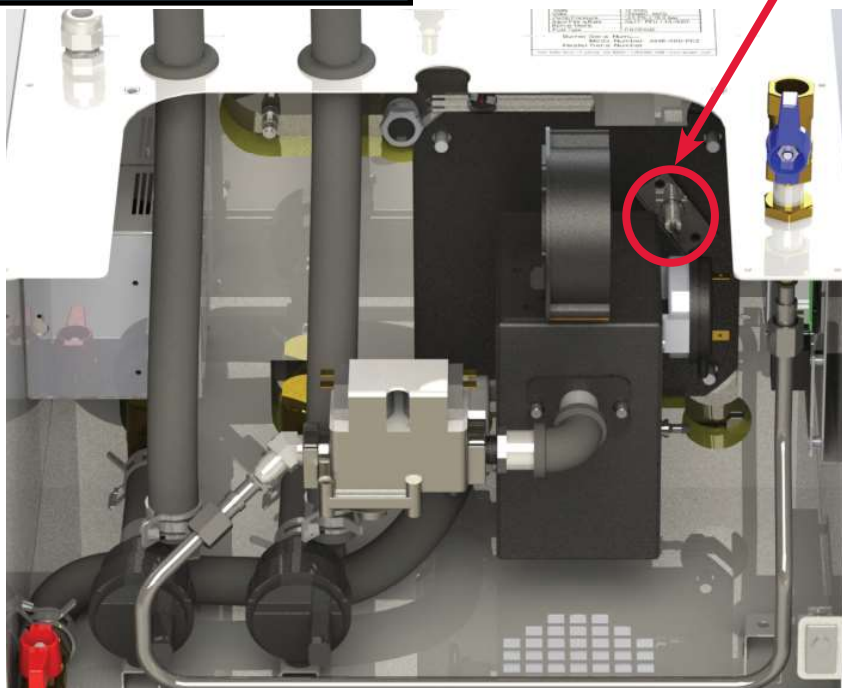


Figure 121

Fenwall Burner Controller

When a call for heat is received from the Control Thermostat/ETS Module supplying 12V to PWR, the controller will reset, perform a self-check routine, and a pre-purge delay begins. Following the pre-purge period, the igniter and gas valve are energized.

When a flame is detected during the trial for ignition, the Hot Surface Igniter is shut off immediately and the gas valve remains energized. The thermostat and main burner flame are constantly monitored to assure the system continues to operate properly. When the thermostat is satisfied and the demand for heat ends, the main valve is de-energized immediately.

Replacement Indicator:

Replace the Propane Burner Controller if it fails to operate properly or is damaged.

NOTE: The interlock switch will prevent the propane burner from operating without the access cover intact; therefore, the switch will need to be manually pressed during this troubleshooting procedure.

Troubleshooting Procedure:

Failure to Light - Lockout

- Should the Propane Burner fail to light, or the flame is not detected during the first trial or ignition period, the gas valve is de-energized and the control goes through an inter-purge delay before another ignition attempt. The Controller will attempt two additional trials before going into lockout and the valve relay will be de-energized immediately.

Flame Failure - Re-Ignition

- If the established flame signal is lost while the burner is operating, the control will respond within 0.8 seconds. The Hot Surface Igniter will be energized for a trial for ignition period in an attempt to relight the burner. If the burner does not light, the controller will de-energize the gas valve. The Controller will make two more attempts to relight the burner. If the burner does not relight, the control will go into lockout as noted above in “Failure to Light”. If the flame is re-established, normal operation resumes.

Flame Current Check

- Flame current is the current which passes through the flame from the sensor to ground to complete the primary safety circuit. The minimum flame current necessary to keep the system from lockout is 0.7 μ A micro amps. To

measure flame current, DISCONNECT INPUT VOLTAGE, then insert a 0-50 μ A DC meter and capacitor in series with the sensor electrode and wire per Figure 122. Meter should read 0.7 μ A or higher while flame is established. If meter reads below “0” on the scale, meter leads are reversed. Disconnect power and reconnect meter leads for proper polarity.



WARNING

When monitoring the flame current, use a 1.5 μ F bypass capacitor to protect the meter from damage.

System Flame Current Measurement Circuit

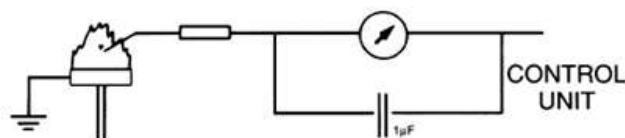


Figure 122

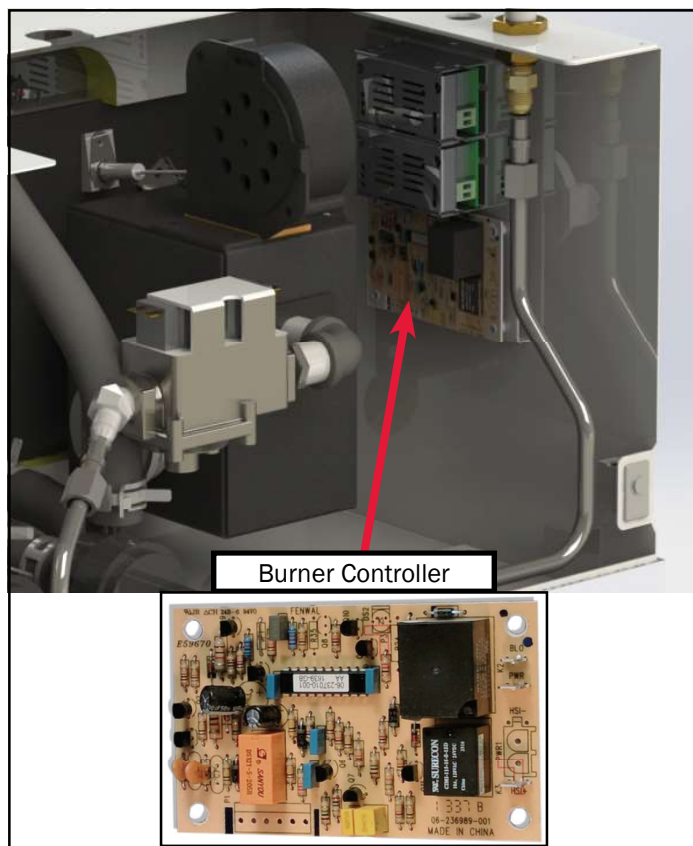
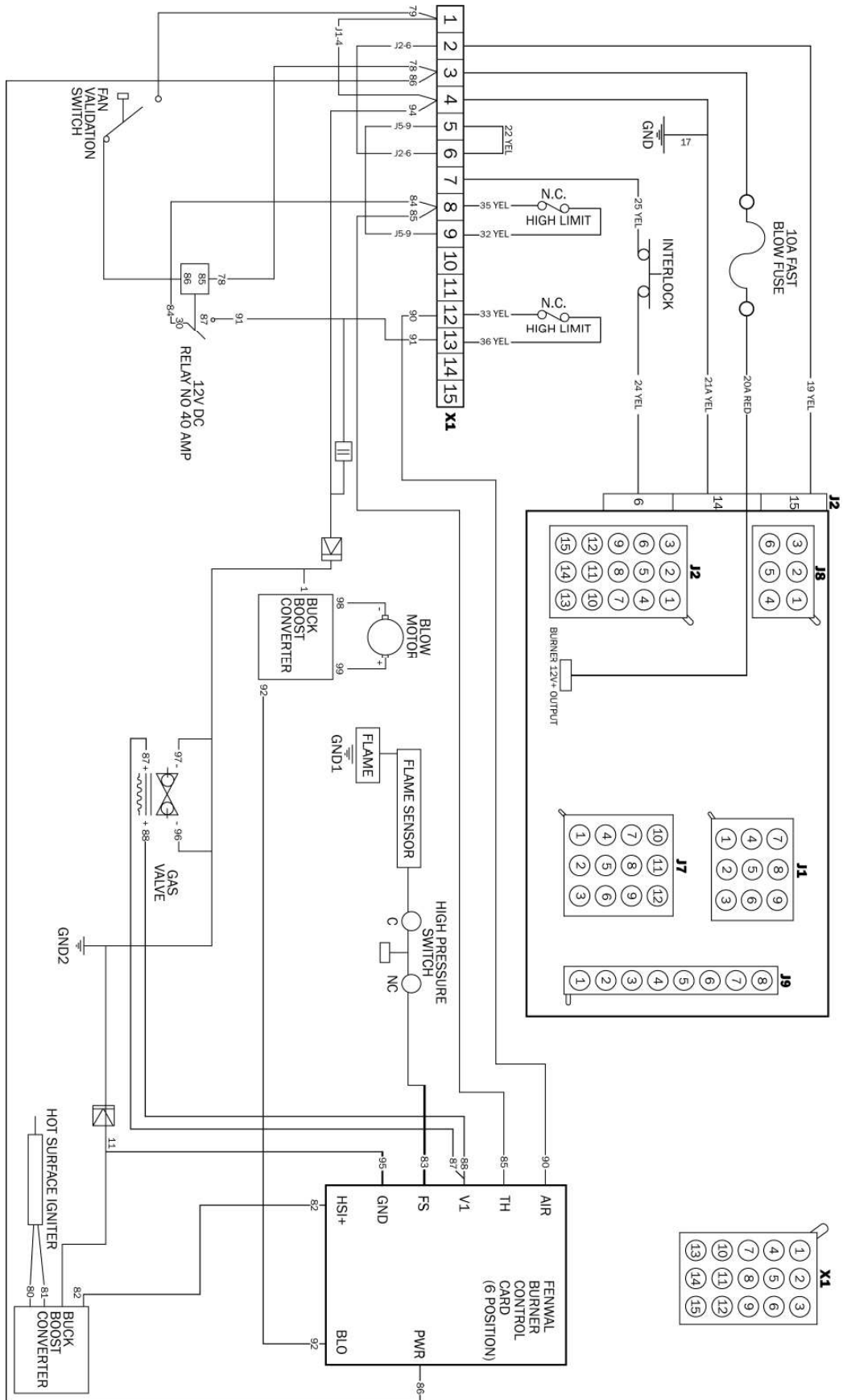


Figure 123

Burner Components



SPECIFICATIONS

Input Power	Control: 9.5 to 15 VDC from a storage battery or full wave rectified unfiltered 50/60 Hz AC
Input Current Drain	200 mA @ 12 VDC, gas valve relay energized(control only)
Gas Valve Rating	1.0A @ 12 VDC
Operating Temperature	-40°F to +167°F -40°C to +75°C
Flame Sensitivity	0.7μA minimum
Flame Failure Response Time	0.8 seconds maximum
Types of Gases	Natural, LP, or manufactured
Spark Rate	10 sparks per second
Size (LxWxH)	4.00 x 2.30 x 1.50 inches 10.16 x 5.84 x 3.81 cm
Weight	3.0 ounces nominal (85 grams), uncovered version
Enclosure	Uncovered with integral standoffs or Potted Module
Moisture Resistance (Uncovered)	Conformal coated to operate to 95% R.H. Care must be taken to protect module from direct exposure to water
Tries for Ignition	One or three try versions available
Trial for Ignition Periods	5.0, 7.0, 10.0, or 25.0 seconds available
Prepurge & Interpurge Timings	None, 15 or 25 seconds depending on model. Without prepurge there is a 1 second safe start delay before the first try for ignition

If one of the Aqua-Hot Heating Zones will not get hot: If there is a Lack of Domestic Hot Water:

1. General Issues:

- Propane/Electric not operating (coolant is cold)
- Heater is not up to operating temperature
- Interior Zone Thermostat is not calling for heat
- Zone Circulation Pump Not operating
- Heat Exchanger Fans Not Operating
- The Low-Temperature Cutoff is not ON
- The Reporter is wired incorrectly
- Not enough heat exchangers installed
- Heat exchangers improperly installed

2. If the Fans and Pumps ARE running:

- Stuck Check Valve
- Kinked Line
- No antifreeze in the system
- Air locked

1. General Information:

- The heater is only rated for water flow of 1.25 GPM.
- The heater is only rated for a 55 °F temperature rise on the cold water coming into the unit.
- The propane burner must be on for continuous hot water - the electric element is for limited, light duty use only.

2. Things to test for with a lack of hot water issue:

- Aqua-Hot heater bypassed
- Outside water faucet is left on
- Washing machine valve defective
- Antifreeze concentration is incorrect
 - 30-50% antifreeze concentration
- Operating range of the heater (Control Thermostat/ETS Module) is incorrect
 - Temperature range of tank should be between 155 °F - 185 °F
- Water flow is too fast
 - Must be 1.25 GPM or less
- Mixing/Tempering valve is stuck (knob does not turn freely)
- Low Temperature Cutoff Thermostat is not functioning properly
 - Needs to trip within 1-2 minutes when running hot water
 - Needs to turn the stir pump on, if the propane burner is ON as well
- Stir pump is not functioning properly
 - Needs to be running when the propane burner is ON, and the Low Temperature Cutoff thermostat is tripped.
 - Hold onto both upper and lower hose to make sure both get hot.

If the Antifreeze is Leaking:

NOTE: To find an antifreeze leak, the system must be HOT (up to operating temperature), OR pressurized to 15PSI.

Inspect the following components on the Aqua-Hot system for leaks:

On the Front Side of the Aqua-Hot:

1. Fluid Level Sensor
 - It might be necessary to cut away some of the insulation around the fluid level sensor to locate the leak.
2. Control Thermostat/ETS Module
 - It might be necessary to cut away some of the insulation around the Control Thermostat/ETS Module to locate the leak.
3. Drain Valve and Hose going to the drain valve
4. Electric Element
5. Circulation/Stir Pump
 - Hoses
 - Tank Ports
 - It might be necessary to cut away some of the insulation around the tank ports to locate the leak.
 - Pump
6. Burn Chamber Leak
 - If antifreeze is running out of the tip of the exhaust pipe, remove the burner and combustion chamber, and inspect inside of the burn chamber for leaks.

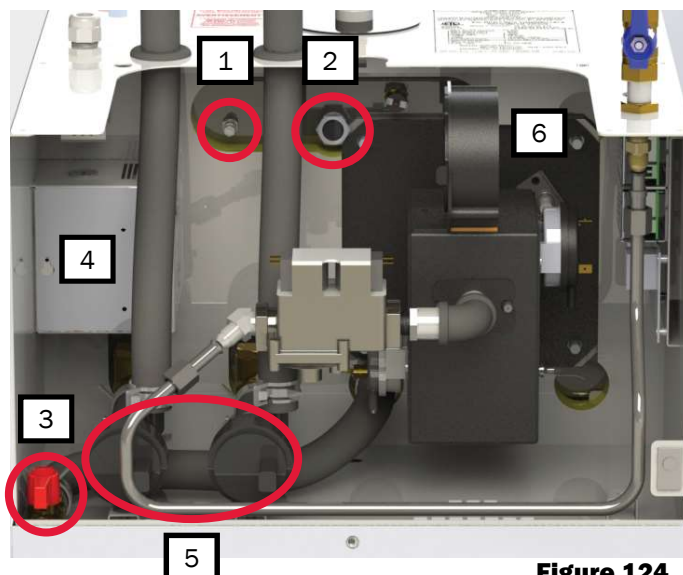


Figure 124

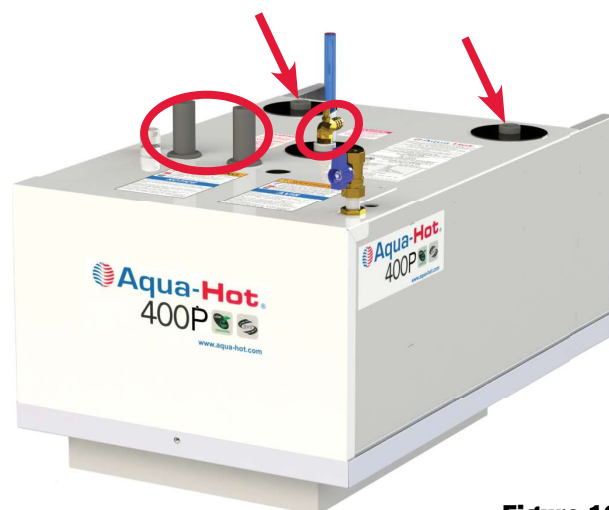


Figure 125

On the Top Side of the Aqua-Hot:

1. Expansion Tank Connection
 - Cracked expansion tank tubing
 - Loose air release valve
 - Brass hose barb fitting defective or loose
2. Return Ports
 - Defective fitting
 - Leaking Fitting

On the Rear Side of the Aqua-Hot:

1. Copper Pipe
 - The copper pipes come out of the tank so they can be possible points of antifreeze leaks. Either where the brass fittings go into the tank, or at the copper pipe where they go through the brass fittings.

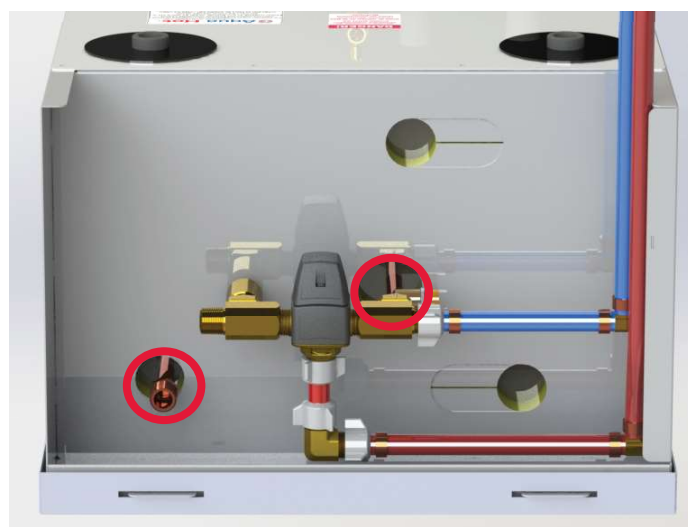


Figure 126

NOTE: If no leaks are found on the Aqua-Hot, it is possible that there is a leak within the motor home. Check all heat exchangers, connections, and tubing for leaks.

Wire Gauge Information:

Because all Aqua-Hot heating systems are designed to operate only when there is an adequate supply of DC (Direct Current) voltage, it is imperative that the proper wire gauge be determined and used for the DC power supply and ground wires. This section addresses how to determine the DC amperage draw of the heating system, including heat exchangers, and how to determine the proper wire gauge based upon those findings for a specific application.

Aqua-Hot Model	Base DC Amp Draw*
400P	19 Amps
* Excludes heat exchangers	

On the Front Side of the Aqua-Hot:

1. Review the chart above for the amperage draw of the Aqua-Hot heater
2. Determine the number of heat exchangers installed with the heating system.

NOTE: Each heating zone "FAN" circuit can supply up to 2.0 amps of direct current.

3. Consult the heat exchanger's manufacturer for amp-draw information

NOTE: Each Aqua-Hot Cozy heat exchanger draws 0.23 amps of direct current. Each Aqua-Hot Whisper heat exchanger draws 0.38 amps of direct current.

4. Determine the total amperage draw for all heat exchangers installed.
 - For example, if six Aqua-Hot Cozy heat exchangers have been installed, multiply the amperage draw of each heat exchanger (0.23 amps) by the number of heat exchangers (6). The total amperage draw in this scenario would be 1.38 amps.
5. Add the total heat exchanger amperage draw to the amperage of the installed Aqua-Hot.
 - For example, an Aqua-Hot 400P with six Cozy heat exchangers has a total amperage draw of 20.38 amps.

Determining the Proper Wire Gauge:

1. Measure the total length of wire required for the distance between the vehicle's battery and the Reporter for the 400P.
2. Using the determined length and total amperage draw, consult the wire gauge chart included in this section. Round up to the closest amp draw listed on the left, then round up to the closest length at the top of the chart.
 - For example, the 400P heater with six Cozy heat exchangers with the Reporter placed 15 feet from the vehicle's battery would require an 8-gauge wire.

WIRE GAUGE CHART

CONDUCTOR SIZING TABLE - MAXIMUM 10% VOLTAGE DROP - (12VDC)

CURRENT DRAW (AMPS)

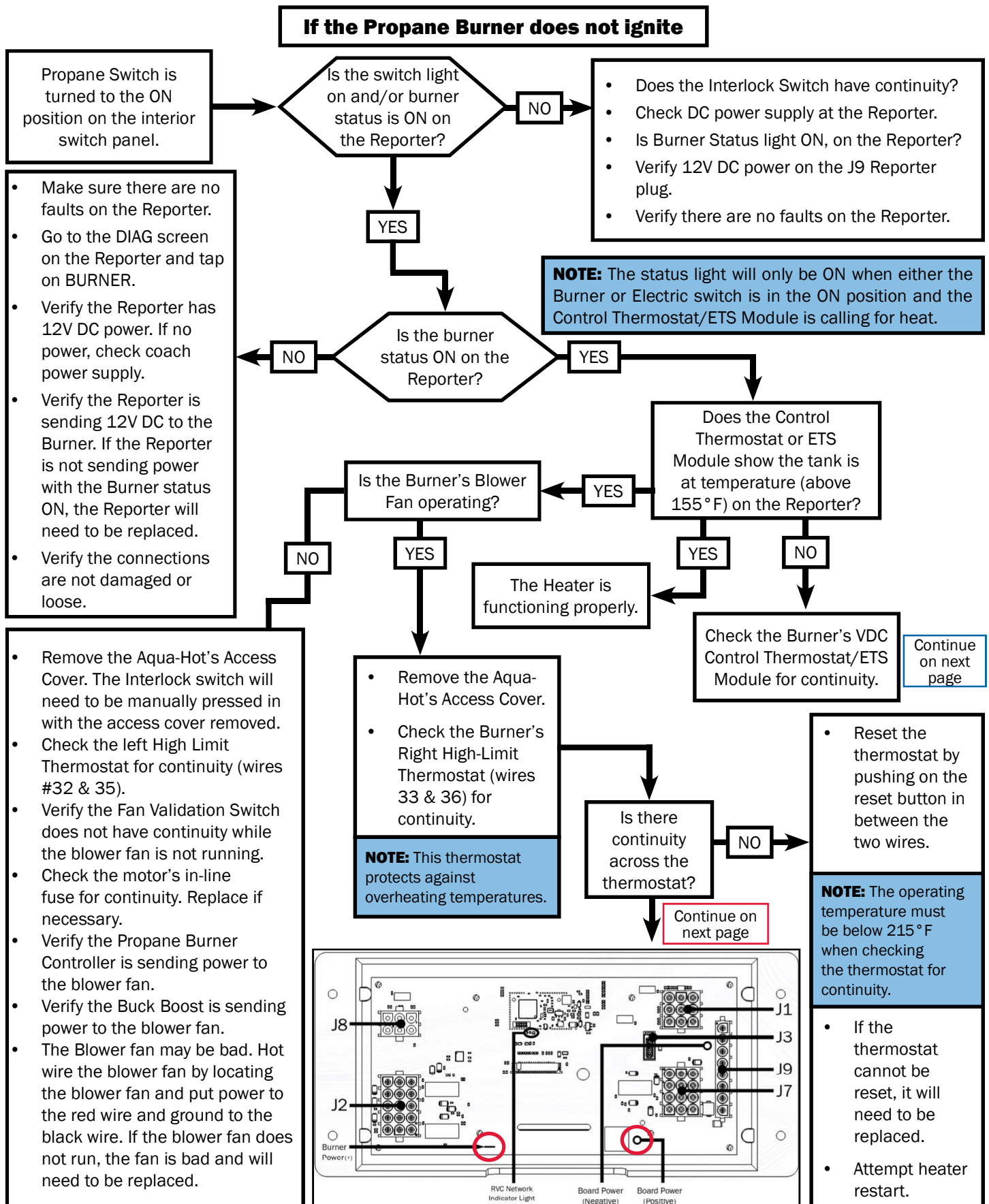
1 2 3 4 5 6 7 8 9 10 15 20 25 30 40 50 60 70 80 100

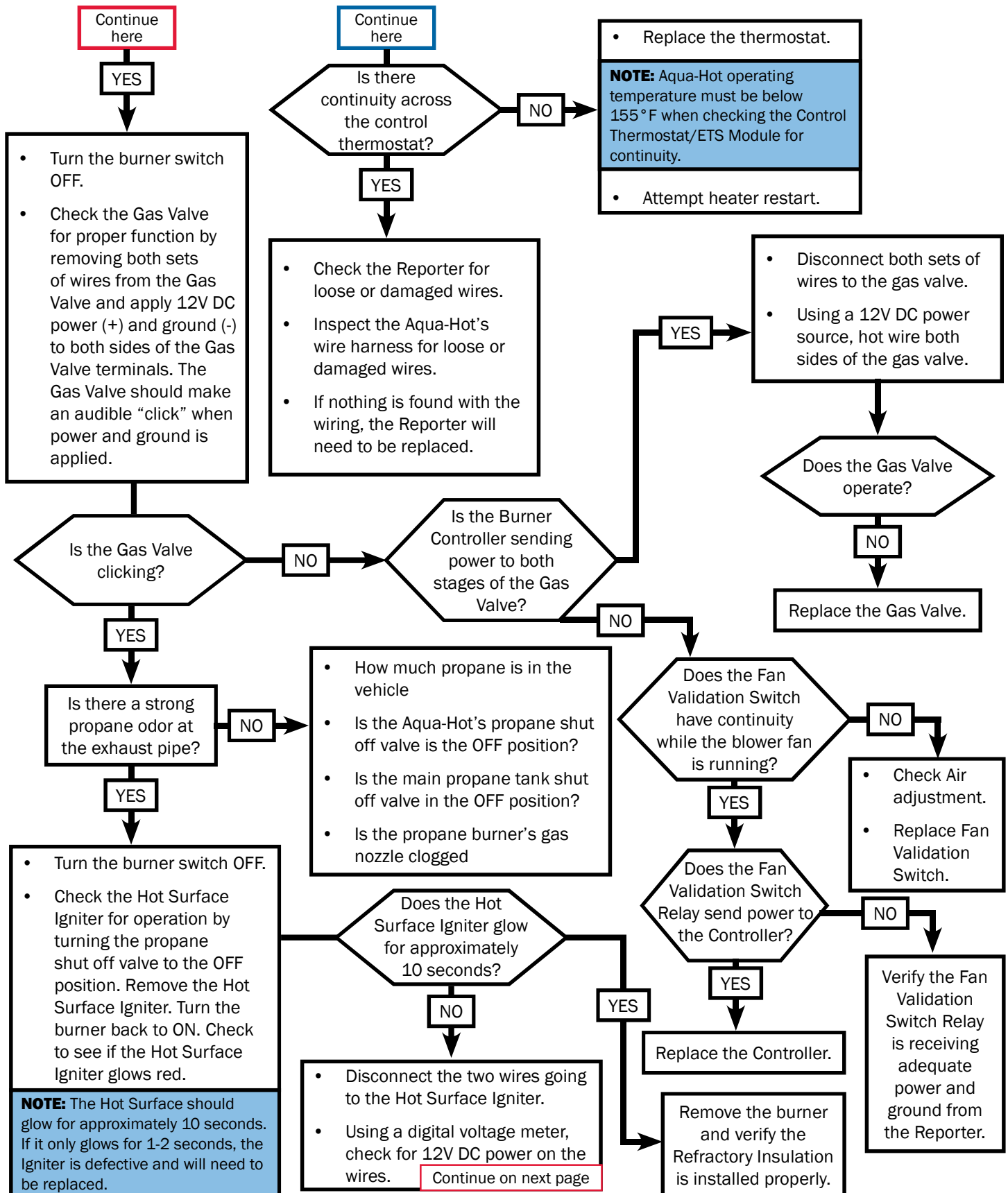
GAGE MAXIMUM LENGTH OF SAE CONDUCTOR (in feet) FROM SOURCE TO DEVICE

20	107	53	36	27	21	18	15	13	12	11	7									
18	172	86	57	43	34	29	25	21	19	17	11	9								
16	261	130	87	65	52	43	37	33	29	26	17	13	10							
14	413	207	138	103	83	69	59	52	46	41	28	21	17	14						
12	651	326	217	163	130	109	91	81	72	65	43	33	26	22	16					
10	1043	521	348	261	208	174	149	130	116	104	70	52	42	35	26	21	17			
8	1653	827	551	413	331	276	236	207	184	165	110	83	66	55	41	33	28	24	21	
6	2892	1446	954	723	578	482	413	362	321	289	193	145	116	96	72	58	48	41	36	29
4	4170	2085	1390	1043	834	695	596	521	463	417	278	209	167	139	104	83	70	60	52	42

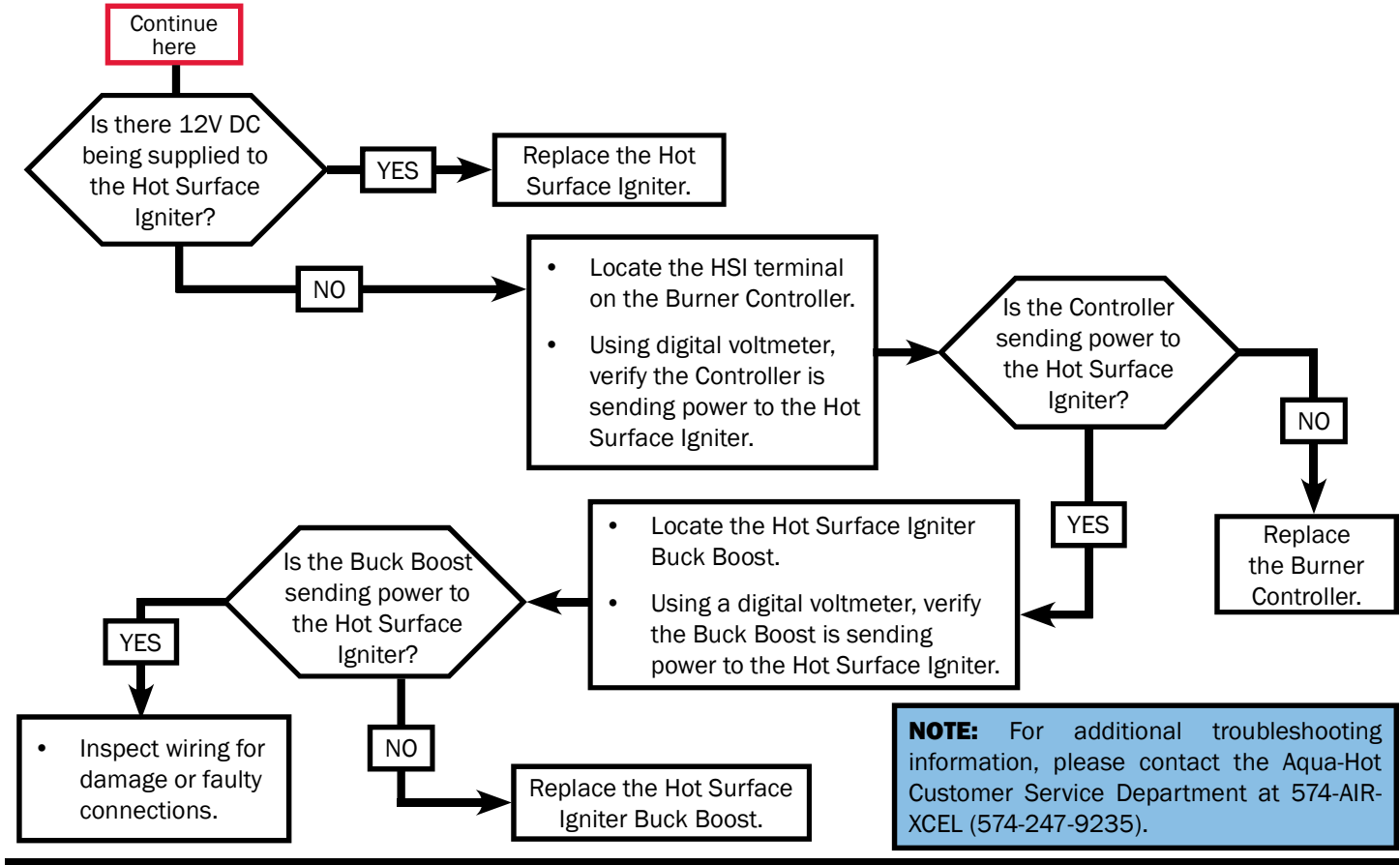
MAXIMUM LENGTH OF AWG CONDUCTOR (in feet) FROM SOURCE TO DEVICE

20	115	57	38	29	23	19	16	14	13	11	8									
18	182	81	61	45	36	30	26	23	20	18	12	9								
16	288	144	96	72	58	48	41	36	32	29	19	14	12							
14	458	229	153	115	92	76	65	57	51	46	31	23	18	15						
12	729	364	243	182	146	121	104	91	81	73	49	36	29	23	19					
10	1159	579	386	290	232	193	166	145	129	116	77	58	46	39	29	23	19			
8	1738	869	579	435	348	290	248	217	193	174	116	87	70	58	43	35	29	25	22	
6	2930	1465	977	733	586	488	419	366	326	293	195	147	117	98	73	59	49	42	37	29
4	4659	2330	1553	1165	932	777	666	582	518	466	311	232	186	155	116	93	78	67	58	47

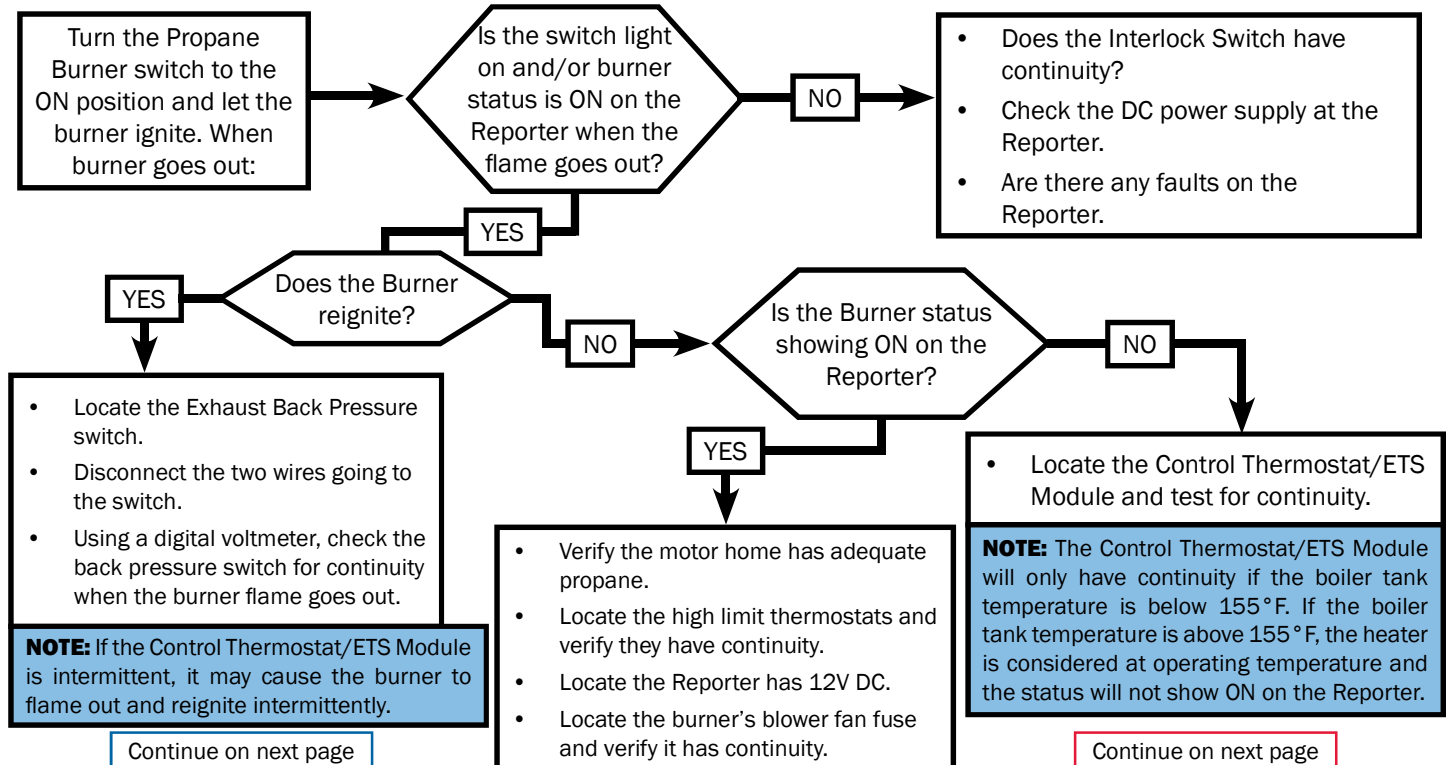




Burner Troubleshooting

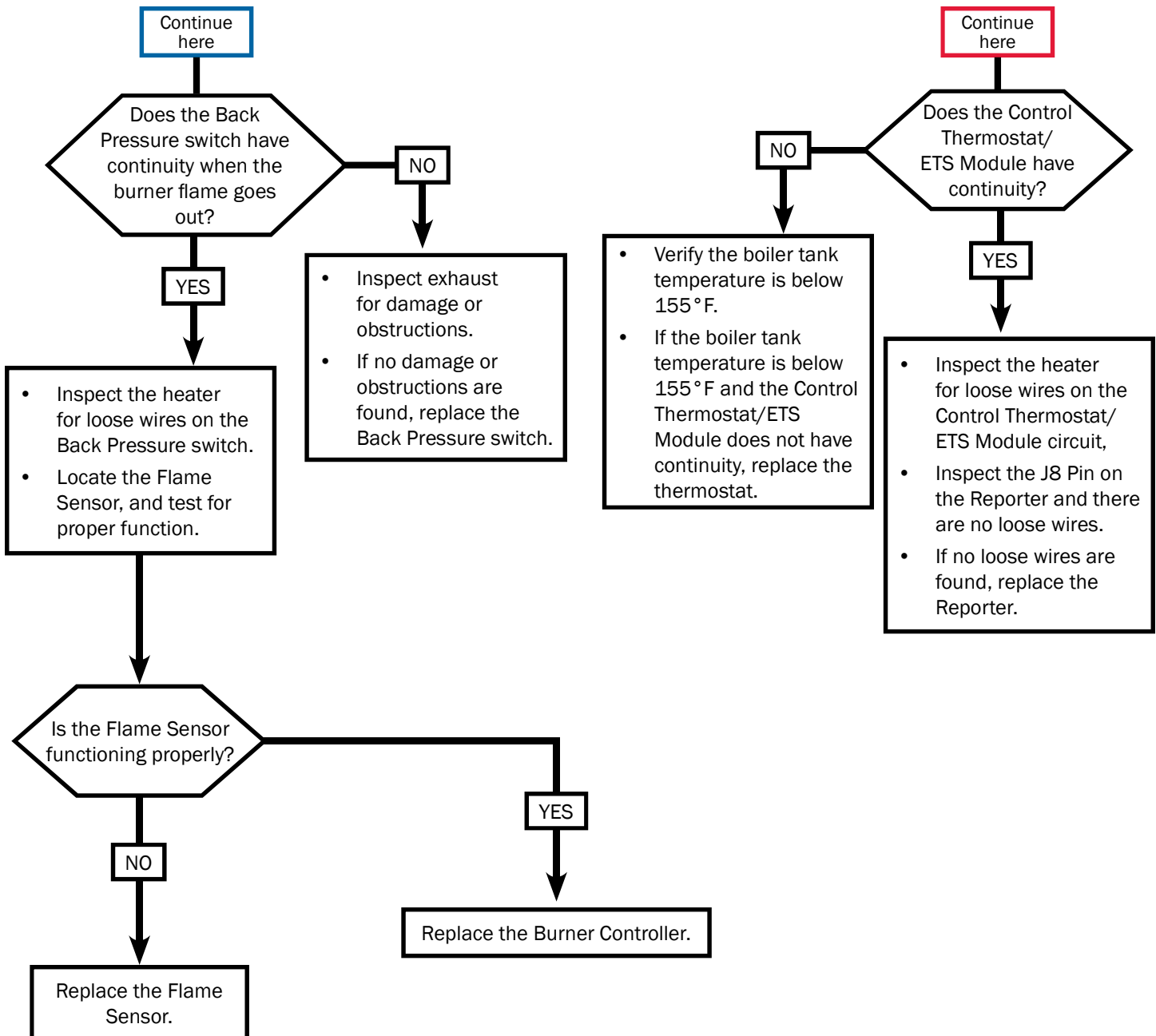


If the Propane Burner does ignite and flames out



Continue on next page

Continue on next page



NOTE: For additional troubleshooting information, please contact the Aqua-Hot Customer Service Department at 574-AIR-XCEL (574-247-9235).

Extreme Cold Weather Operation



WARNING

When storing the motor home: not winterizing the Aqua-Hot when freezing temperatures are present will result in serious damage to the Aqua-Hot's Domestic Water Heating System. Also, be sure to use a FDA-Approved "GRAS" rated antifreeze for winterization.

NOTE: The Aqua-Hot can continue to be used for interior zone heating once the domestic water heating system has been drained and winterized.

120V AC Electric Element

Please note that the 120V AC Electric Heating Element is the Aqua-Hot's *secondary heat source* for heating both the interior and/or the domestic hot water during low heating demand situations (such as when moderate ambient temperatures exist and/or when there is a low demand for domestic hot water).

If the 120V AC Electric Heating Element is not providing enough heat, turn the propane burner ON in conjunction with the 120V AC Electric Heating Element.

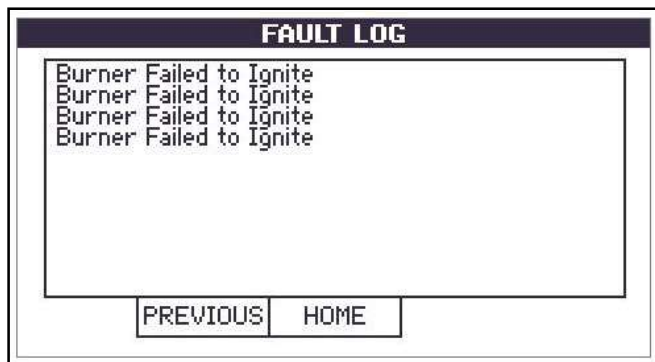


Figure 127

Propane Burner

If the Propane Burner fails to operate:

- Determine the motor home's propane tank is at least 50% full.
- Verify if the motor home's propane tank is filled with propane, not butane. (Butane has a lower boiling point than propane. In colder climates, Butane may not allow the burner to function properly.)
- Check the Reporter for any faults (see Figure 127).

Things to Check for Lack of Interior Heat:

1. Propane burner must be on
2. Propane burner operating properly
3. Antifreeze concentration in the boiler tank must be between 30-50%
4. Heating system must be properly installed according to the 400P Installation manual
 - At least 5 heat exchangers installed in the interior of the coach
 - Must be cold air returns installed for every heat exchanger (reference Figure 129).
 - Heat exchangers should be mounted as close to the hot air outlet grill as possible (reference Figure 128)

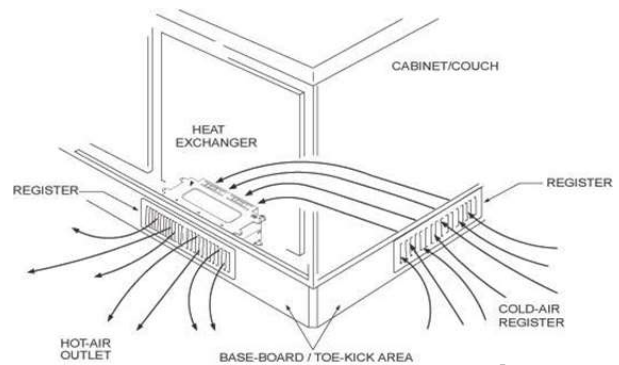


Figure 128

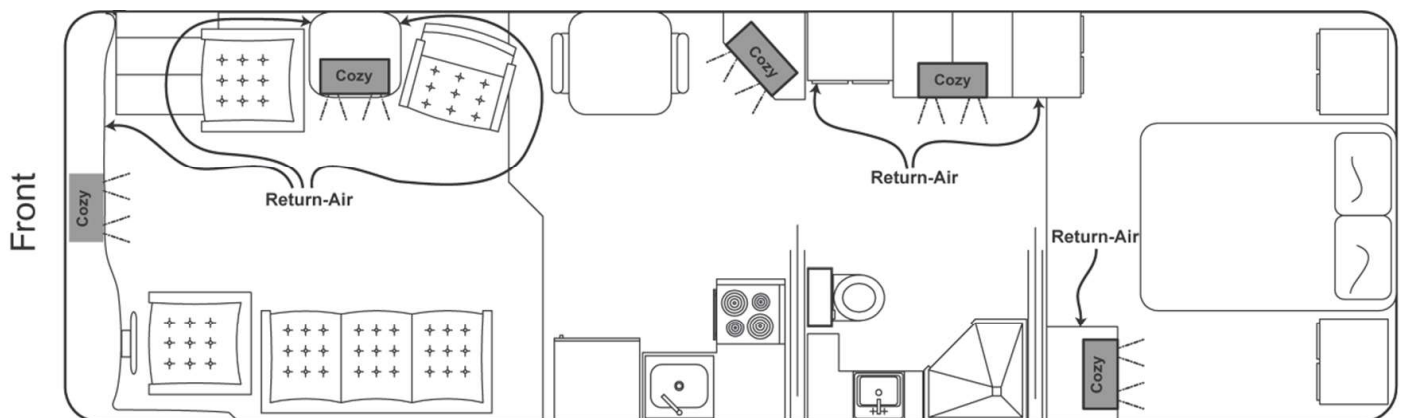


Figure 129

Aqua-Hot Maintenance

Monthly Maintenance:

Check the antifreeze and water heating solution to ensure that it is at the proper level by visually checking the solution level in the expansion tank. The level of the antifreeze and water heating solution within the expansion tank should only be checked when the Aqua-Hot is at maximum operating temperature.

If additional antifreeze and water heating solution is required, fill the expansion tank to the “HOT” level mark. Reference Figure 130. Be sure to reference page 8 for the type of antifreeze and heating solution.

Additionally, it is recommended that the propane burner be fired and allowed to run monthly to keep it in good working order.



DANGER

Failure to disconnect all power supplies and/or to allow the heater to cool before servicing could cause serious damage or personal injury.

Annual Maintenance:

There is no recommended annual service for the propane-burner. If it fails to operate, refer to the Propane-Burner Troubleshooting section in this manual.

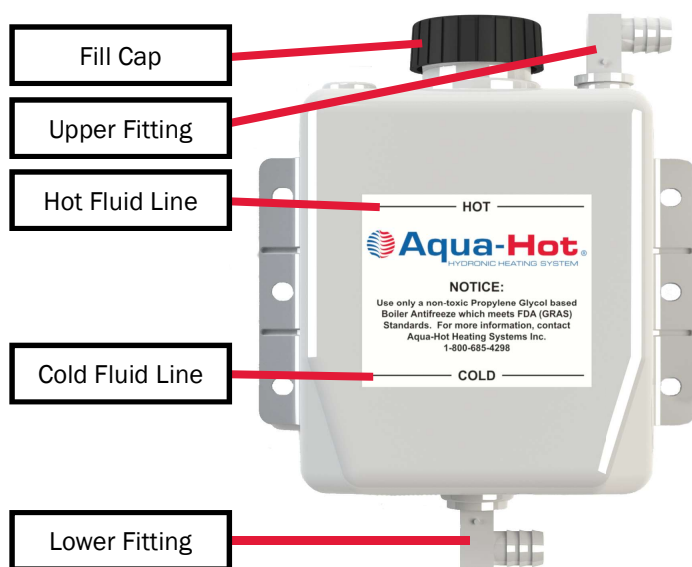


Figure 130

Adjustment of the Propane Air Shutter

Should the propane air shutter come out of adjustment, follow the instructions below.

1. Loosen, but do not remove the set screw on the air shutter assembly.
2. Place a $\frac{9}{32}$ " drill bit, or a 0.275" pin gauge in the center of the top hole of the air shutter. Keeping the bit in the center of the hole, close the air shutter until it stops. This will set the gap at approximately 0.275".
3. While holding the bit in place, tighten the set screw.
4. Remove the drill bit and ensure that the air shutter is secure.

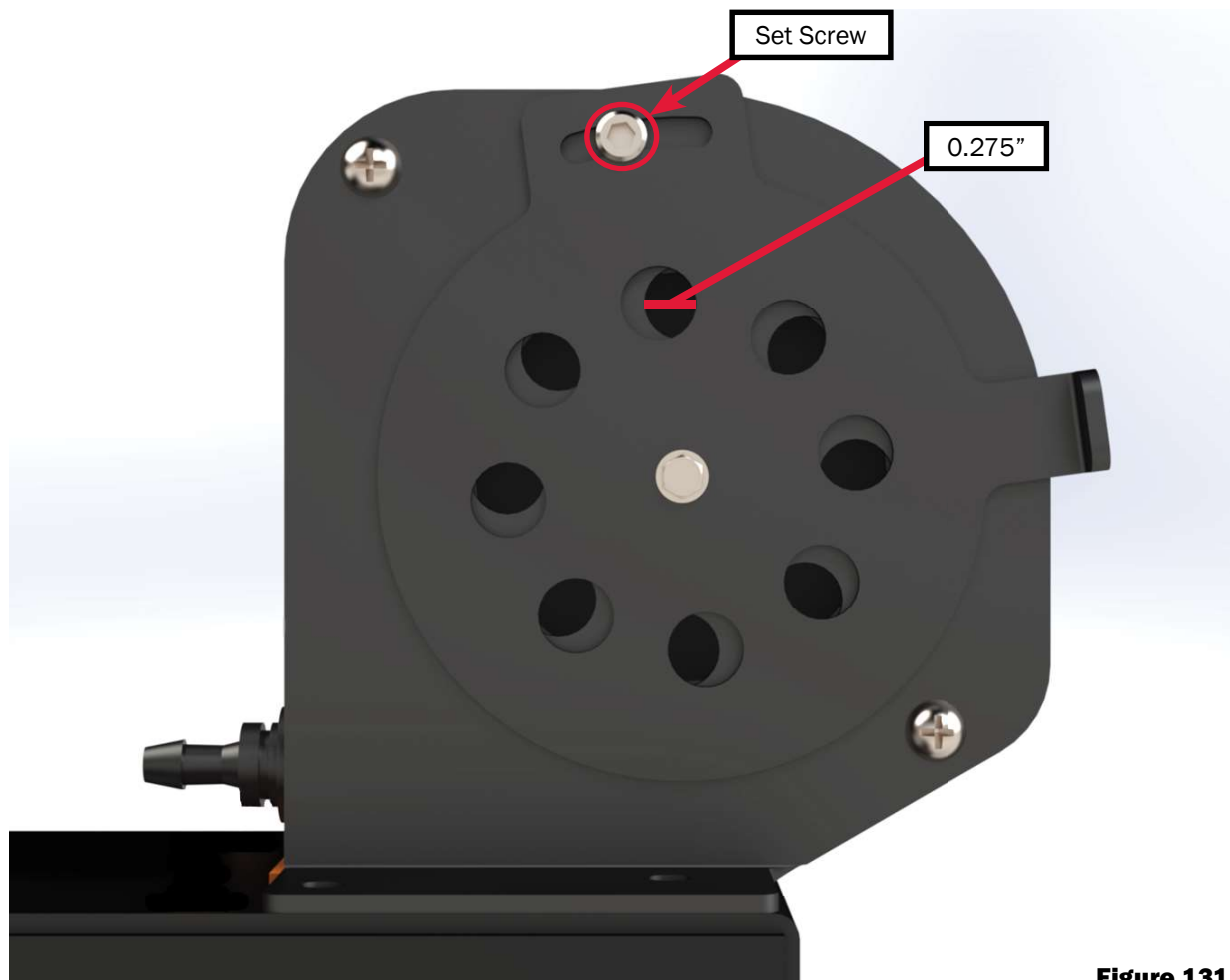


Figure 131

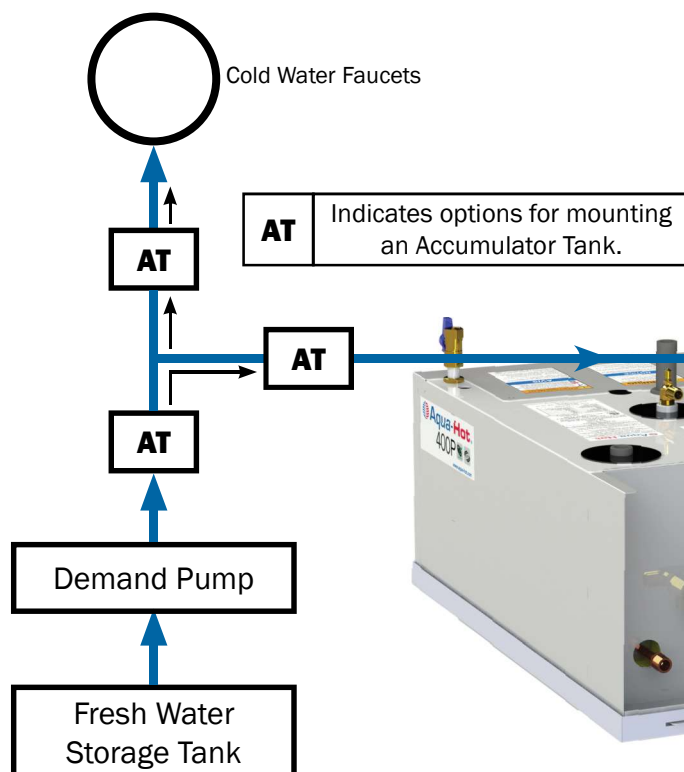
Winterizing the Aqua-Hot

The Aqua-Hot's domestic water heating system must be completely drained of domestic water at any time the heater is stored where freezing temperatures may be experienced.

Please follow these instructions when winterizing the Aqua-Hot domestic water heating system. Reference Figure 132 for a system overview.

NOTE: The Aqua-Hot can continue to be used for interior heat once the domestic hot water system has been winterized.

1. Completely drain the fresh water storage tank.
2. Disconnect the domestic water demand pump suction line from the fresh water storage tank.
3. Attach an adequate piece of hose onto the suction side of the domestic water demand pump.
4. Place the opposite end of the hose into an adequate supply of non-toxic RV winterization antifreeze (FDA certified as "GRAS" Generally Recognized As Safe must be used) and allow the fluid to pump through.
5. Open and close all interior and exterior water faucets one at a time, until ONLY pure RV antifreeze is present. Perform this procedure for both cold and hot water faucets.
6. Remove the hose and reconnect the domestic water demand pump's suction line to the fresh water storage tank.



WARNING

Not winterizing the Aqua-Hot when freezing temperatures are present will result in SERIOUS damage to the Aqua-Hot domestic water heating system. Ensure that only non-toxic RV antifreeze (FDA approved "GRAS" antifreeze) rated for winterization is used when winterizing this unit. The warranty does not cover freeze damage.

De-Winterization

To de-winterize the Aqua-Hot system, completely fill the fresh water storage tank. Open and close the interior and exterior faucets, one at a time, until only clear water is present.

NOTICE

Disinfecting the Domestic Water System

The Aqua-Hot Heating systems contain copper tubing and are not compatible to prolonged exposure to sodium hypochlorite (bleach or liquid bleach). Using products containing bleach, including water refreshers, may cause corrosion of the domestic water lines, resulting in a catastrophic failure of the Aqua-Hot system by creating leaks that cannot be repaired. This damage is not covered by the Aqua-Hot warranty.

If disinfecting the hot water system, be sure to follow NFPA 1192 Standard on Recreational Vehicles "Instructions for Disinfection of Potable Water Systems" or any other applicable local standards for Potable Water Systems.

NOTE: Extended exposure to household bleach will corrode the components of the Aqua-Hot will potentially dramatically shorten the operational lifetime of the Aqua-Hot. Under no circumstances is the Aqua-Hot to be exposed to household bleach for extended periods of time.

Figure 132

Filling the Aqua-Hot

In order to provide the best freeze protection, boil-over protection, anti-corrosion, and rust protection, a mixture of 50/50 propylene glycol antifreeze and distilled water is recommended. The Aqua-Hot 400P boiler tank holds approximately 5 gallons.

Be sure to use a “GRAS” (Generally Recognized As Safe) boiler-type propylene glycol base antifreeze, rather than a RV and Marine antifreeze or an automotive antifreeze/coolant. Reference the Owner’s manual for additional information regarding the antifreeze and water heating solution.

The mixture may be modified to provide the most adequate freezing, boiling, and rust/anti-corrosive protection. A 50/50 mixture of propylene glycol and distilled water has a freeze point of approximately -34°C (-29°F) and a boiling point of approximately 106°C (223°F).

Fill Instructions:

1. Locate the following items:
 - Exterior fluid pump (a diagram pump if possible)
 - The Aqua-Hot fluid expansion tank
 - A bucket or pale
2. Fill the bucket with the heating solution. Ensure the fluid expansion tank is connected to its port on the Aqua-Hot.
3. Open the Aqua-Hot’s drain valve located at the front of the heater. Reference Figure 134.

NOTE: The Aqua-Hot’s boiler tank must be filled with the antifreeze and water heating solution through the drain valve, not through the top of the unit, to avoid air traps.

4. Connect the external fluid fill pump to the fluid drain valve. A ½” NPT barbed fitting is best for this task.
5. Place the supply line of the external pump in the receptacle that contains the heating solution.
6. Locate the Reporter, and navigate to the “INPUTS FROM AQUA-HOT” page.
7. Pay attention to the “LOW LEVEL SENSOR” item on this page.

INPUTS FROM AQUA-HOT				5
BURNER STATUS	LOW LEVEL SENSOR	LOW TEMP SENSOR	COOLANT TEMP	
OFF	TANK FULL	INTERIOR HEAT	190°F	
PREVIOUS				
HOME	FAULTS	DIAG	TEST	

Figure 133

8. Fill the tank to approximately ¾ full, or until the “LOW LEVEL SENSOR” item displays “TANK FULL”, approximately four gallons.
9. Once the tank is partially full, deactivate the external fluid fill pump and close the drain valve. DO NOT disconnect the fluid pump.
10. Proceed to the next page to purge the zone before attempting to start the unit.

NOTE: Do not fill this unit completely. Filling the unit completely runs the risk of air-locking, preventing the heating zone from correctly circulating and draining the air.

CAUTION

Only propylene glycol based “boiler” type antifreeze deemed “GRAS” (Generally Recognized As Safe) by the FDA shall be used in the Aqua-Hot’s hydronic heating system. Failure to use the above specified antifreeze type could result in serious injury or death.

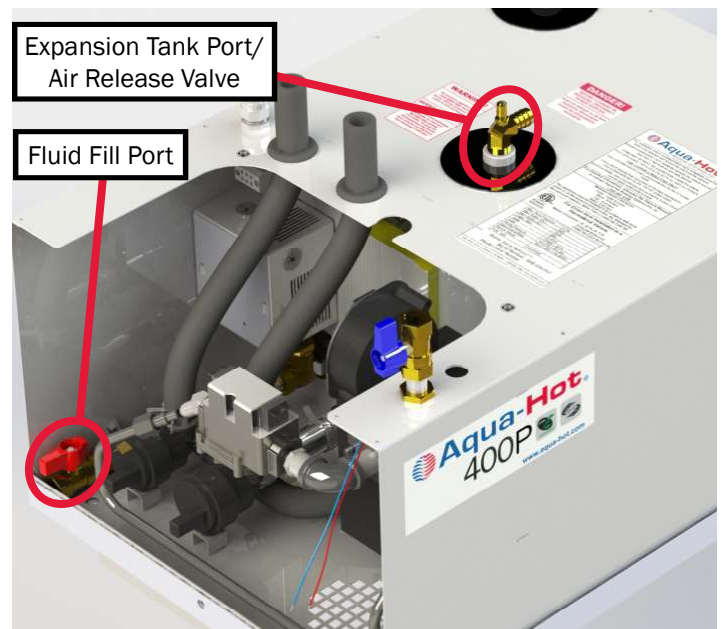


Figure 134

Purging the Interior Heating Loop

In order to provide interior heat to the vehicle, antifreeze and water heating solution is circulated within an interior “heating loop” which distributes heat throughout the coach. During installation or service, it is possible that air may become trapped within the heating loop and hamper unit performance.

Follow this procedure to purge any air from the interior heating loop.

Please note that if an RVC or multiplex system is used in lieu of the Aqua-Hot display, you must contact the manufacturer, or connect a display to the on-board RVC network to perform this procedure.

Purge Procedure:

1. Locate the fluid expansion tank of the Aqua-Hot. As any air is purged, it will exit through to this expansion tank.
2. Locate a gallon of glycol antifreeze. This will be used to top-off the fluid expansion bottle as air is purged from the system.
3. Navigate to the “PUMPS” page of the “TESTING” section on the Reporter as displayed below.

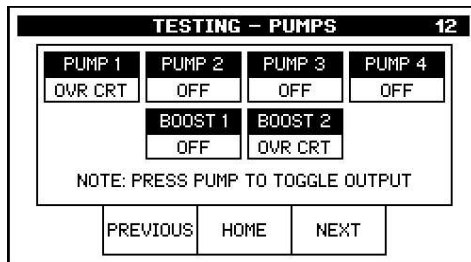


Figure 135

4. Tap each of the pumps to independently activate them, beginning the heating loop purge procedure. These pumps will remain active for a maximum of 5 minutes. They will need to be reactivated as needed until the purge procedure is complete (at least 20 minutes).
5. Continue to fill the unit as air is purged from the interior heating loop.
6. Once the air is no longer returned from the heating zone return ports, deactivate the fluid circulation pumps.
7. Open the fluid drain valve, and activate the external fluid fill pump. Fill the unit with GRAS propylene glycol antifreeze and water heating solution until it reaches the “COLD” mark on the fluid expansion tank.

Draining the Aqua-Hot

NOTE: The Aqua-Hot 400P tank holds approximately five gallons of the antifreeze and water heating solution.

Drain Procedure:

1. Connect a piece of ½” PEX-type tubing or rubber hose to the drain valve. This piece should be long enough to transport the antifreeze and water heating solution from the Aqua-Hot to a bucket.
2. Open the Aqua-Hot’s drain valve located at the front of the heater. See Figure 137.

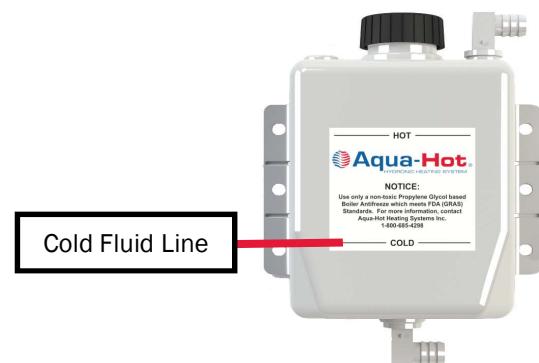


Figure 136

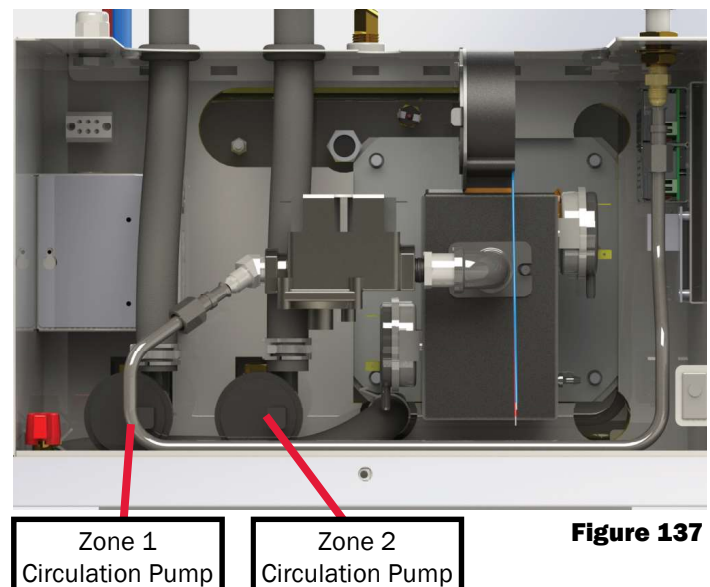
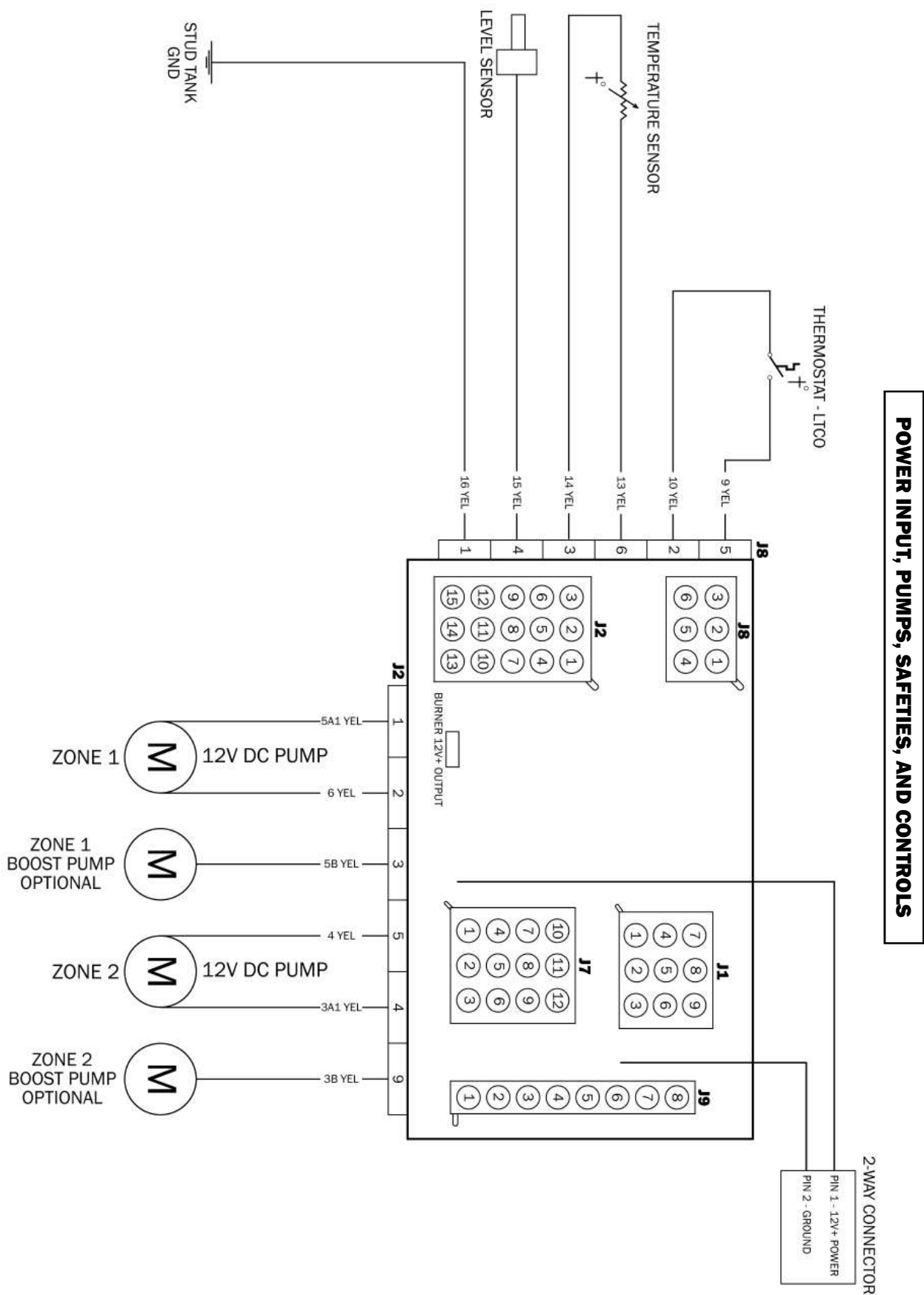
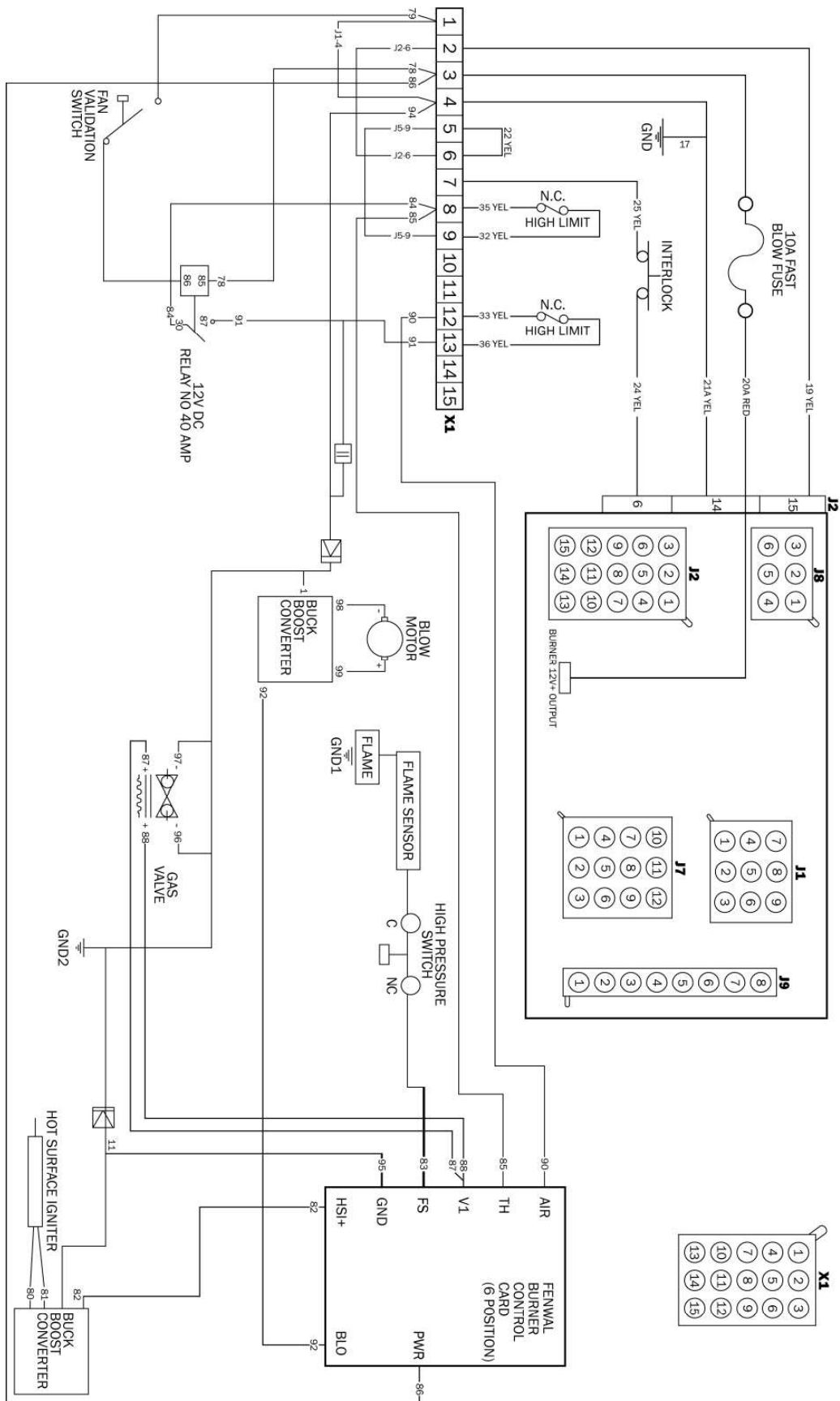


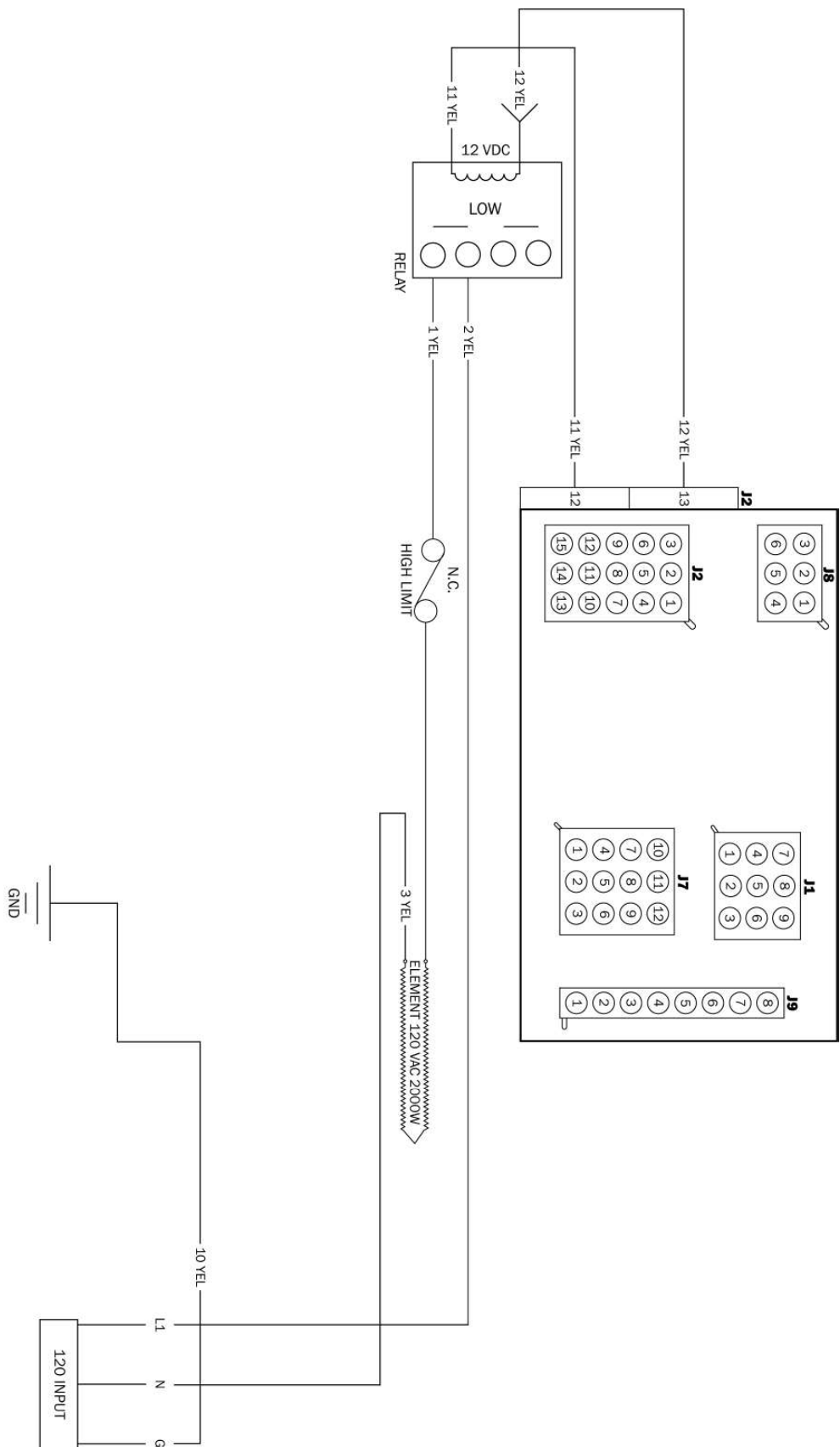
Figure 137

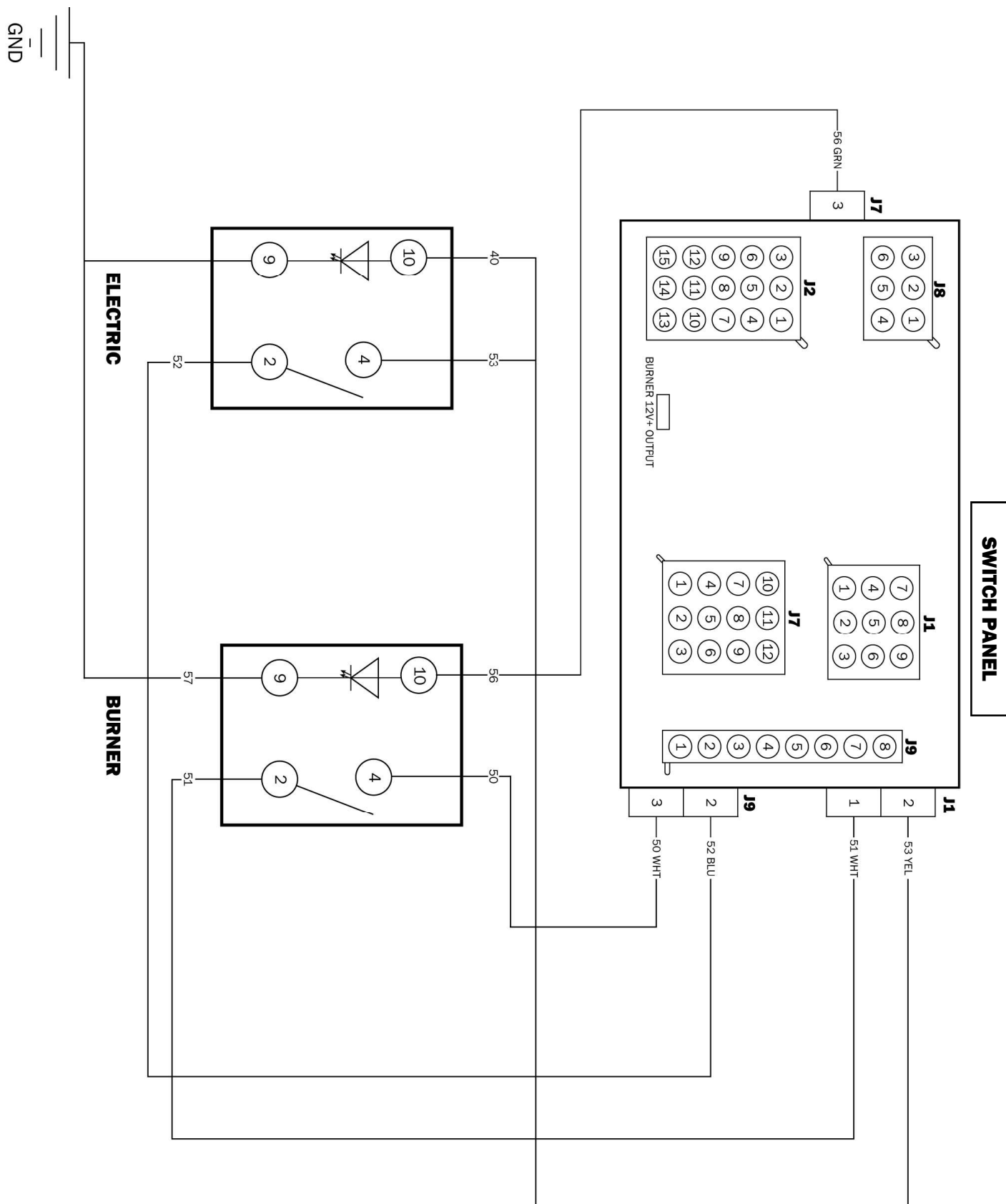


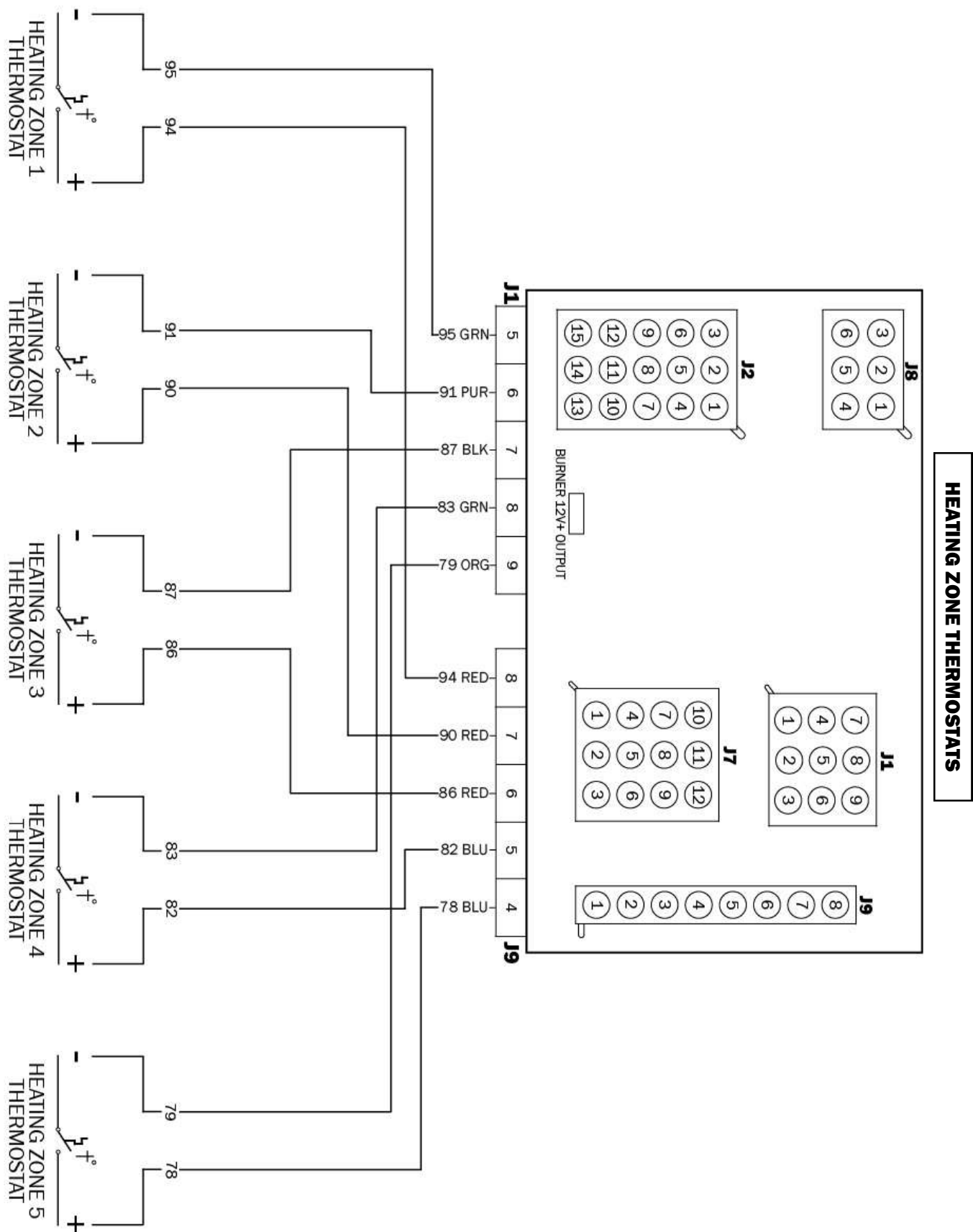
PROPANE BURNER

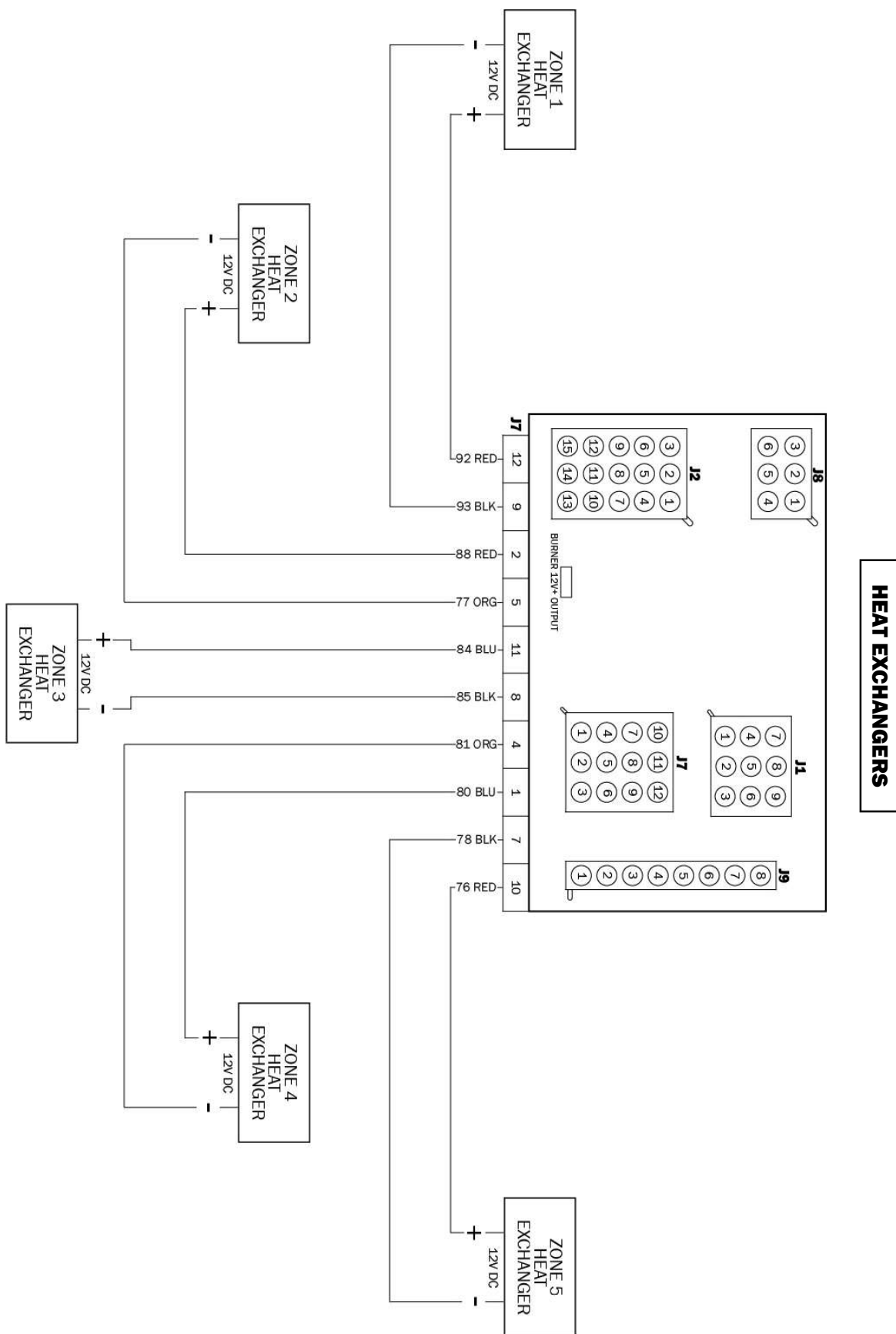


ELECTRIC ELEMENT, HIGH-LIMIT THERMOSTATS











2-YEAR LIMITED WARRANTY AQUA-HOT® HYDRONIC HEATING SYSTEM

Aqua-Hot Heating Systems Inc. warrants the Aqua-Hot Heater to be free from defects in material and workmanship under normal use and service for a period of two years on both parts and labor commencing upon the original date of registration of the vehicle. Replacement parts are warranted for the remainder of the Heater's standard warranty coverage or for six months, whichever is greater. The intent of this warranty is to protect the heater's end-user from such defects, which would occur in the manufacturing of the product. Thus, problems due to improper specifications, improper installations, improper use, the use of accessory parts or parts not authorized by Aqua-Hot Heating Systems Inc., repair by unauthorized persons, and damage or abuse of the heater are specially excluded from warranty coverage.

For additional information, or to obtain a warranty repair authorization, please contact the Aqua-Hot Heating Systems Warranty Administrator at 1-800-685-4298 (7:00 AM to 4:00 PM Mountain Standard Time) or visit www.aquahot.com.

My Comfort Zones are On-Board

Vehicle:

Purchased From:

Dealer Information:

Name:

Location:

Phone Number:

Heating System:

Serial Number:

Service Manual

400_{SERIES}

 **Aqua-Hot**®
An AIRXCEL Brand



Aqua-Hot Heating Systems, LLC
7501 Miller Drive, Frederick, CO 80504

Visit us online at www.aquahot.com
Call us at (800) 685-4298 or (303) 651-5500

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