Service Manual

200 Series

Aqua-Hot®

An AIRXCEL Brand

AHE-250-P01

Contents

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.

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

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

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

NOTE: This manual will also use notes sections similar to this one to draw attention to features and practices which must be observed.

System Overview

The Aqua-Hot 250 Propane Series is a Hydronic (water-based) Heating Systems that can provide heat and tank-less, continuous hot water in one small, easy to install package.

The Aqua-Hot Heating is a 2-in-1 System

1. Interior heating system: provides moist, quiet, comfortable interior heat and even temperatures. It is equipped with one thermostatically-controlled temperature zone.
2. Tank-less hot water system: provides a flow of continuous hot water. It produces 90 gallons per hour (1.5 GPM).

The system uses one or a combination of heat sources to heat FDA-approved "Generally Recognized As Safe" (GRAS) **propylene glycol** based antifreeze solution contained within the Aqua-Hot boiler tank.

The 250P uses a 12-volt DC powered propane burner as the primary heating source. The propane burner should be used as the primary heating source for hot water and interior heating needs. The 250P also has one 120-Volt AC 1000-Watt electric element for use (when shore power is available) as a *supplemental* heating source. Once the tank has been brought to operating temperature by the propane burner, the electric element can be used to maintain this temperature, as well as provide hot water and interior heat for light-duty applications. The burner and the electric element can be used together or separately.

For continuous hot water or heat in colder conditions, it is recommended to utilize the propane burner. The electric heating element will provide heat only in mild conditions and provide light duty hot water needs.

Should additional assistance be needed, please contact the Technical Support at 574-AIR-XCEL (574-247-9235), Monday through Friday, between 7:00am and 4:00pm MST.

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 250P 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.

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.

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.

WARNING

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

Figure 1

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, and any other Aqua-Hot documentation relevant to this unit.

- Read this manual before installing or using 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.
- The Aqua-Hot must be installed in a compartment that is closed off from living quarters and accessible only from the exterior of the vehicle.
- **Propylene glycol** based antifreeze "Generally Recognized As Safe" (GRAS) by the FDA must be utilized for the antifreeze and water heating solution.
- An interlock switch prevents the Aqua-Hot heater from operating when the cover is not installed in the correct position.
- 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 0.0 PSI (zero pressure system). Air pressure to the tank must not exceed 20 PSI. Exceeding this rating will cause internal damage to the Aqua-Hot.
- Use caution when working on or near any propane/diesel fuel system.
- Do not store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance.
- The Aqua-Hot's exhaust is HOT and must be kept away from heat sensitive material.
- DO NOT connect the 12-volt DC power to the Aqua-Hot if the vehicle requires welding.
- At maximum operating temperature, the coolant will be very hot and scalding. Hot vapor or coolant may cause in serious burns or injury. Be aware of hot surfaces.
- Do NOT activate the burner until the antifreeze and water heating solution has been added to the boiler tank to avoid serious damage to the heater.
- Installation and repairs may only be carried out by an authorized, factory-trained Aqua-Hot technician. The heating system must be installed in accordance with local codes, or in accordance with the Standard for Recreational Vehicles, (RVIA) ANSI A 119.2/NFPA 501C, NFPA 1192.

CAUTION

WHAT TO DO IF YOU SMELL GAS

- Evacuate all persons from the vehicle.
- Shut off the gas supply as the gas container or source.
- Do not touch any electrical switch or use any phone or radio in the vehicle.
- Do not start the engine or electric generator (if equipped).
- Contact the nearest gas supplier or qualified service technician for repairs.
- If you cannot contact the nearest gas supplier or qualified service technician, contact the nearest fire department.
- Do not turn on the gas supply until the gas leak or leaks (if relevant) have been repaired.
- Installation and service must be performed by a qualified installer, service agency, or gas supplier.

The Aqua-Hot's exhaust is HOT!

- Do NOT park in areas where dry conditions exist (IE grassy, dry fields).
- Do NOT operate the burner inside an enclosed building.
- The heater must be switched OFF when refueling.

NOTE: Should any additional assistance be needed, please contact the Technical Support Department at 574-AIR-XCEL (574-247-9235).

WARNING

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

NOTICE

This appliance operates on both AC and DC power.

Use only nontoxic propylene glycol based boiler antifreeze with additives generally recognized as safe ("GRAS") by the FDA.

Failure to winterize your heater, when stored in freezing temperatures, will result in serious damage to the product's domestic hot water heating system.

Air pressure applied to the tank must not exceed 20 PSI. Excess pressure will result in internal damage.

For detailed information, reference the owner's manual or contact Aqua-Hot Heating System's, Inc., at 800-685-4298.

AVIS

Cet appareil fonctionne à la fois sur une alimentation a.c. et c.c.

Utiliser uniquement un antigel de chaudière à base de propylène glycol non toxique avec des additifs généralement jugés sans danger = GJSD =(= GRAS = / generally recognized as safe) par la FDA.

Ne pas hivériser l'appareil de chauffage lorsqu'il est entreposé à des températures inférieures à 0°C provoquera de graves dommages au système de chauffage d'eau chaude domestique du produit.

La presslon d'air appliquée au réservoir ne doit pas dépasser 20 PSI. Tout excès de pression provoquera des dommages internes.

Pour des informations détaillées, consulter le manuel d'utilisation et contacter Aqua-Hot Heating Systems, Inc. en compasant le 800-685-4298.

SAFETY INSTRUCTIONS

A. This appliance does not have a pilot. It is equipped with an ignition device, which automatically lights the burner. Do not try to light the burner by hand.

B. BEFORE OPERATING, smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

WHAT TO DO IF YOU SMELL GAS
- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Forced or attempted repair may result in fire or explosion.

D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

CONSIGNES DE SÉCURITÉ

A. Cet appareil n'a pas de veilleuse. Il est muni dun dispoitif d'allumage, qui allume automatiquement le brûleur. Ne tentez pas d'allumer le brûleur manuellement.

B. AVANT DE FAIRE FONCTIONNER, renifler tout autour de l'appareil pour déceler une odeur de gaz. Renifler près du plancher, car certains gaz song plus lourds que l'air et peuvent s'accumuler au niveau du sol. QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAS:
- Ne pas tenter d'allumer d'appareil
- Ne touchez à aucun interrupeur; ne pas vous servir des téléphones se trouvant dans le bâtiment.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur, appelez le service des incendes.

C. Ne poussez ou tourner la manette d'admission du gaz qu'á la main; ne jamais utliser d'outil. Si la manette reste coincé, ne pas tenter de la réparer, appelez un technicien qualifié. Le fait de forcer la manette ou de la réparer peut dédencher une explosion ou un incende.

D. N'utilisez pas cet appareil s'il a été plongé cans l'eau, méme partiellement. Fates inspecter l'appareil par un technicien qualifié et remplacer toute partie du système de contróle de toute commande qui été plongé dans l'eau.

Aqua-Hot®

250P

www.aqua-hot.com

OPERATING INSTRUCTIONS

1. STOP! Read the safety information to the left on this label.

2. This appliance is equipped with an ignition device, which automatically lights the burner. Do not try to light the burner by hand.

3. Ensure that the gas control valve is turned on. Follow "B" in the safety information to the left on this label. If you don't smell gas, go to the next step.

4. Refer to the Owner's Manual for information regarding normal operation of this heating system.

5. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" below on this label and refer to the Owner's Manual troubleshooting section or call the technical support department at 1-800-685-4298.

TO TURN OFF GAS TO APPLIANCE

1. Turn off all electric power to the appliance if service is to be performed.
2. Set all interior thermostats to their lowest setting.
3. Turn the gas control knob located on the heater's propane inlet port clockwise to the "OFF" position.

INSTRUCTIONS DE MISE IN MARCHE

1. ARRÊTEZ! Lisez les instructions de sécurité sur la portion à gauche de cette étiquette.

2. Cet appareil est muni d'un dispositif d'allumage qui allume automatiquemen le brúleur. Ne tentez pas d'allumer le brúleur manuellement.

3. Assurez-vous que la soupape de contróle de gaz est bien ouverte. Passez à l' étape B des instructions de sécurité sur la portion à gauche de cette étiquette. S'il n'y a pas d'odeur de gaz, passez à l'étape suivante.

4. Référer au Manuel du propriétaire pour des informations au sujet du fonctionnement normal de ce systéme de chauffage.

5. Si l'appareil ne fonctionne pas, veuillez suivre les instructions «Pour couper le gaz vers l'appareil» ci-dessous sur cette étiquette et référez à la section Dépannage du ,Manuel du propriétaire ou appelez le service de soutie n technique au 1.800.685.4298.

COMMENT COUPLER L'ADMISSION DE GAZ DE L'APPAREIL

1. Couper l'alimentation électrique de l'appareil s'il faut procéder l'entretien.
2. Réglez tous les thermostats intérieurs à leur réglage le plus bas.
3. Tournez le bouton de controlé du gaz, situé sur le port dentrée de propane du chauffe-eau, vers la droite á la position «OFF» (Arrét).

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 bottle; reference Figure 10 on page 15.

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 bottle.

It is also recommended to run the propane burner once a month for a full cycle (at least 20 minutes) to ensure optimum heater condition.

Annual Maintenance

The Aqua-Hot 250P has an extremely simple annual service procedure. Remove the flame sensor and clean with a light abrasive pad like a Scotch-Brite pad.

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 10 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.

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.

WARNING

DO NOT operate the propane burner and/or electric heating element without antifreeze and distilled water heating solution present in the Aqua-Hot's boiler tank. Doing so will cause serious damage to the heater.

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 250P boiler tank holds approximately 3.7 gallons.

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 -35°F and a boiling point of approximately 223°F. Refer to the table below to determine the best protection mixture ratio. Reference page 62 for measuring the antifreeze mixture with a refractometer.

Propylene Glycol

Freeze Point (°F)	0	-4	-7	-9	-12	-15	-18	-23	-29	-34	-40	-46
Concentration (%)	0	12	19	25	30	34	38	44	49	53	57	60

Overheat Protection

Every Aqua-Hot is equipped with at least two overheat protection devices. These are commonly known as the high-limit thermostats. These thermostats operate by maintaining a circuit while the unit is below 218°F.

In the event of an overheat condition, the high limit thermostats will cut the operating signal to the propane burner, and/or the electric element. When this signal is interrupted, the electric element and propane burner will immediately disengage. Contact Aqua-Hot Heating Systems LLC for assistance in locating a qualified person to service this heater after an overheat situation.

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.

WARNING

DO NOT attempt to reset the high-limit thermostats after an overheat condition until the unit has been serviced by a qualified technician. Failure to do so could result in damage to the unit, personal injury, or death.

Aqua-Hot®
An AIRXCEL Brand

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.

Suitable for water (potable) heating and space heating.

THIS APPLIANCE OPERATES ON BOTH DC AND AC POWER.

USE COPPER CONDUCTORS ONLY!

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 Service Clearances
Front - Open Access
Back - 1 Inches
Top - 8 Inches
Sides - 1 Inches
This appliance must be installed in accordance with local codes or, in the absence of local codes, the Standard for Recreational Vehicles, ANSI A119.2/NFPA 1192 or CAN/CSA-Z240 RV

Intertek
3069328

For Direct Vent Installation in a Recreational Vehicle.

Meets or Exceeds: ANSI Z21.10.1/CSA 4.1
UL 307B, UL 174
CSA-C22.2 No. 110-94

Max Tank Pressure	0 PSI
Watts (DC)	92.5
Watts (AC)	1000
Tank Capacity	3.7 gal
Orifice Size	0.093"
Volts/Amps	12VDC, 7.7A
Volts/Amps/Frequency	120VAC, 9.6A, 50/60Hz
Input Firing Rate	6000 BTU/hr, 17.6 kWh
Minimum Inlet Pressure	8"wc (in. H_2O)
Manifold Pressure	10"wc (in. H_2O)
Max Inlet Pressure	13"wc (in. H_2O)
Fuel Type	PROPANE

Model Number: 250P
Serial Number: A250P-170001

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

Patent Pending

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

Figure 2

System Specifications

Electric Element

Power Consumption .....1000 W (maximum)
Voltage .....120V AC

DC Power

Heat Input .....60,000 BTU/hr ± 10%
Fuel Consumption .....0.66 gallon/hr
Power Consumption ..... 42W (maximum)

Zone Heat Circulation

Pumps 1
Power Consumption (max)..... 21W
Voltage ..... 12V DC

Heating Zones

Maximum 1

Domestic Water Heating

Maximum ..... 1.5 GPM

Physical Specifications

Dimensions (250P).....22.44"L x 12.46"W x 17.2"H
Dry Weight ..... 84lbs.
Wet Weight..... 104lbs.

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.

250 Propane Components

1. Access Cover Screw
2. Drain Valve
3. Propane Burner Controller
4. Tempering Valve
5. 3-Way Valve
6. Propane Burner Assembly
7. Domestic Cold Water Inlet
8. Domestic Hot Water Outlet
9. Propane Inlet Ball Valve
10. 12V DC Harness Junction
11. Expansion Tank Connection
12. Heating Zone Outlet Port
13. Heating Zone Return Port
14. 120V AC Connection
15. Boiler Tank
16. Domestic Hot-Water Coil
17. Interlock Switch
18. Zone Circulation Pump

NOTE: The side and top panels in the view below have been made transparent to aid in the explanation of the heater. DO NOT remove these panels. Doing so risks irreparable damage to the Aqua-Hot. Only remove the service panel for service.

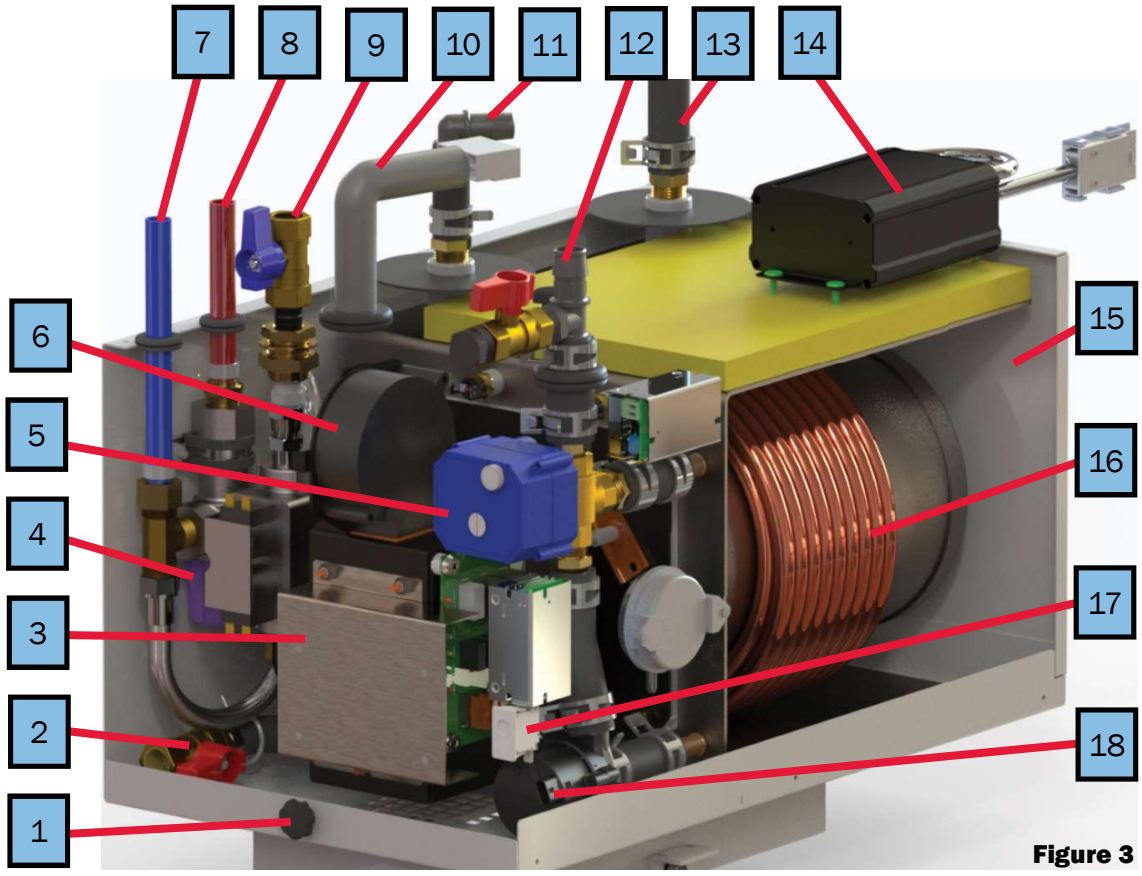
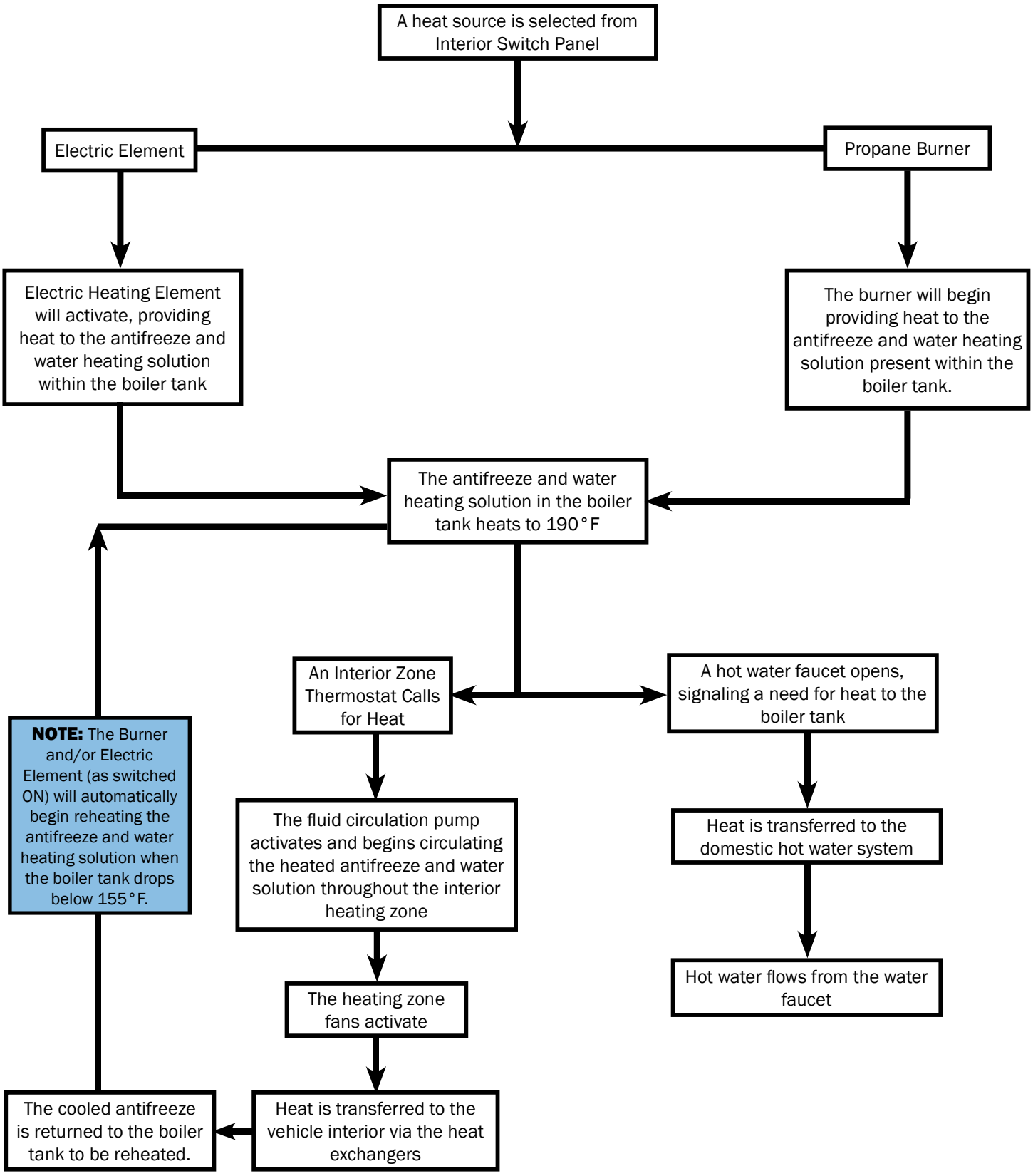


Figure 3

Operational Flow Chart



Relay Control Board

The relay control board at use in your Aqua-Hot 250 Propane Series is designed to function in conjunction with the Fenwal Burner Control Card to allow the heater to operate. This section will introduce you to the basic functions of the board.

Indicator lights line the bottom of the relay control board and are designated D1 through D6. Each of these lights indicates a function or event that is taking place. The detailed function of these lights will be explained on the next page.

- **D1:** Heating Status Light (orange)
- **D2:** Electric Element Power (green)
- **D3:** Pump Power (blue)
- **D4:** Low-Temperature Cutoff Status (yellow)
- **D5:** Burner Status (green)
- **D6:** Interior Zone Heating (orange)

Fuse Functions, Locations, and Ratings:

There are three fast-blow fuses included with this relay board and may need to be replaced if they cease to function. The cradles for these fuses are labeled FH1, FH2, and FH3 and will contain either a 5A or 10A fuse. The 250P will utilize the 5A fuse in slot FH3.

- **FH1:** 10A - AC Activation Circuit and Burner
- **FH2:** 5A - Switch Power
- **FH3:** 5A - Burner Controller Power

Note on Diagnosing the Relay Control Board:

If after diagnosing the Aqua-Hot you believe that the relay control board is at fault, it is very strongly advised that you contact Aqua-Hot Heating Systems Technical Support to ensure that the issue has been accurately diagnosed. These components have a very low rate of failure, and for that reason, we recommend contacting us before replacing it in an attempt to reduce down time and unit repair costs.

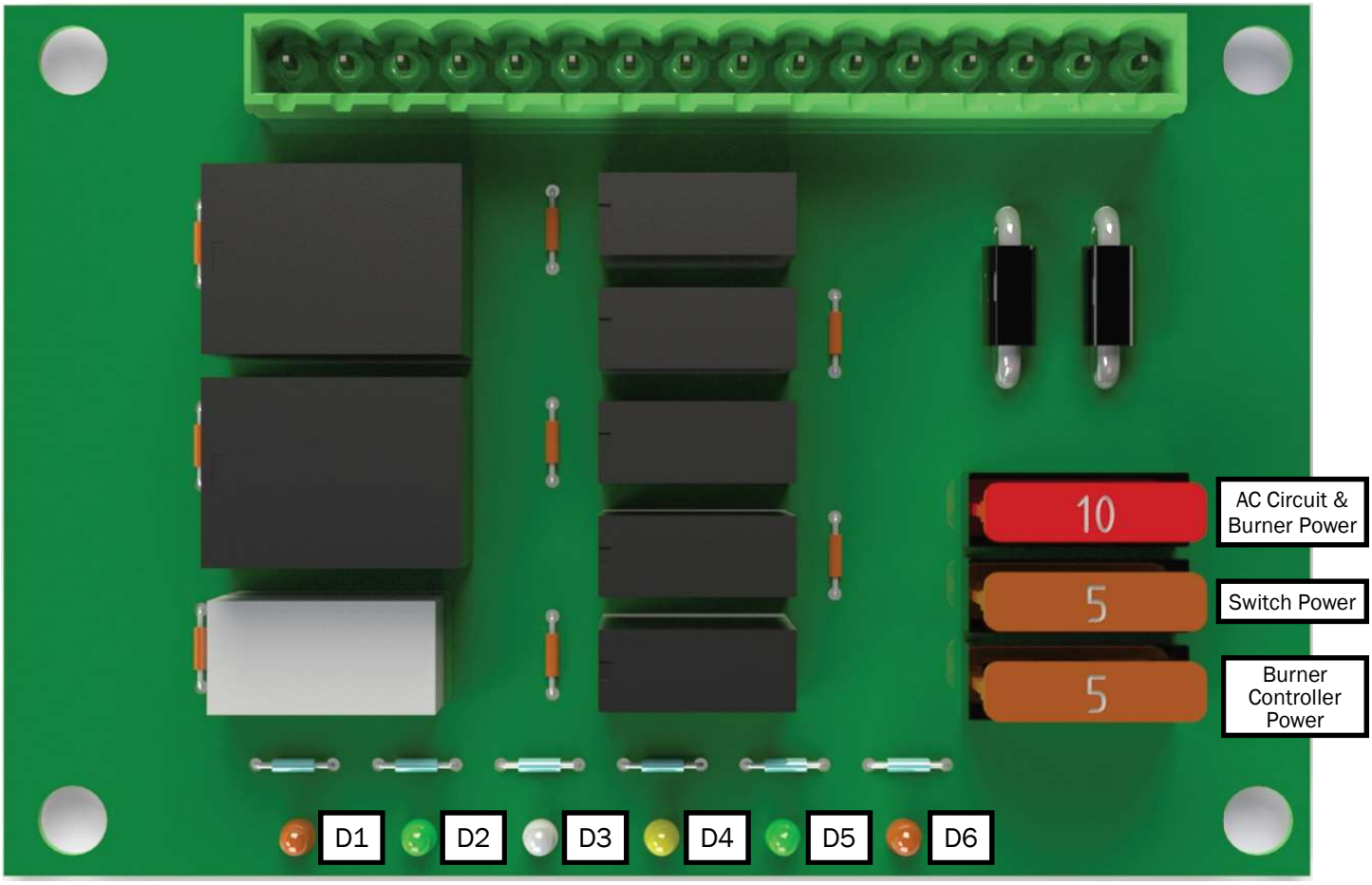


Figure 4

Heating Status (D1):

This indicator light will illuminate orange when the burner and/or electric element switch on the interior switch panel is ON and the control thermostat is calling for heat.

If the heater is functioning and the light is not illuminated, or the heater is not functioning and the light is illuminated, there is an issue with the wiring or one of the components.

Electric Heating Element Status (D2):

This indicator light shows the status of the electric heating element by illuminating green when the electric element switch is ON. If the green LED does not illuminate, the electric element switch is OFF or the unit is low on fluid.

The D2 light functions with the interior electric element switch to provide functionality when requested. When the electric element switch is ON, the D2 light should also be on.

If the D2 indicator light is not illuminated, but the electric switch on the interior switch panel is in the ON position, there is a short in the 12V DC side of the electric element circuit. This could be due to a bad connection, a bad switch, a bad fluid level sensor, or the fuse present in FH2 is not functional.

NOTE: It is possible for the Electric Heating Element and Heating Status lights to be illuminated, and the electric element not function due to an issue with the 110V AC power supply.

Circulation Pump (D3):

This indicator light shows the power status of the circulation pump within the Aqua-Hot. The circulation pump is responsible for circulating fluid through the heating zone, and stirring the fluid within the tank while it is heating.

The system functions correctly if the coach thermostat is calling for heat, the pump is operating, ad the light is illuminated blue.

If the light is off while the coach thermostat is calling for heat or hot water, there may be an issue with the coach wiring or with the relay control board.

Low-Temperature Cutoff Status (D4):

The low-temp cutoff status thermostat deactivates interior heat when domestic hot water is being used, and activates the stir pump in conjunction with the burner switch.

When this light is on, it indicates that there is either a demand for hot water, or the Aqua-Hot is not yet up to operating temperature.

Burner Status (D5):

This indicator light shows the status of the burner by illuminating green when the burner switch is on.

If the burner switch is in the ON position and the control thermostat is calling for heat, the D5 indicator light should illuminate in addition to the D1 heating status light.

If the indicator light remains off while the burner switch is in the ON position, it could indicate that there is a short present, the fuse in FH2 may be burned out, or the unit may be low on fluid.

Heating Zone Status (D6):

This light indicates that status of the coach thermostat and the heat exchanger fans. The indicator light will illuminate orange when the coach thermostat is requesting interior heat, or hot water is being requested.

If a fault condition occurs, it could be due to a wiring issue, a faulty thermostat, or issues with the heat exchanger fans.

Interior Switch Panel

Introduction:

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

Burner Switch:

When the burner switch is in the ON position, the control thermostat will communicate with the relay control board and the burner controller that heat is needed for the tank. The burner will activate and the unit will begin to warm up.

A cold boiler tank can be expected to reach temperature in approximately 10-20 minutes, depending on the ambient temperature. In colder temperatures, it may take longer to heat the unit to its operating temperature.

In order to reach and maintain temperature under all demands, the burner switch must be in the ON position. Keep in mind that the electric element is a *supplemental-only* heat source. This means that the element can provide hot water for simple tasks such as hand-washing, and maintaining tank temperature at times when there is no load. The burner is intended as the primary heat source.

Additionally, the burner switch can be used to reset a low-voltage condition. This is accomplished by turning the switch OFF for 30 seconds, and then turning it back on. This is known as "power-cycling".

Electric Element Switch:

When the coach is plugged into an AC power source (i.e. shore power or a generator) 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 1-2 hours depending on the ambient temperature. The electric element is intended as a *secondary, supplementary* heating source. If used alone, the electric element will NOT be able to provide enough heat for continuous hot water or interior heat.

Figure 5

Exhaust System Requirements

Introduction:

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

- The exhaust must not be directed downward as a fire could result when parked in dry, grassy areas.
- The exhaust must not terminate underneath the vehicle, underneath an openable window or vent, in the awning area of the coach (if applicable), or near the slide-out areas.
- The exhaust must be able to freely exit away from the vehicle without any obstructions.
- Use standard two-inch automotive-type exhaust piping and avoid bends if possible.
- The 3-inch and 4-inch black pipe nipple and the exhaust elbow, originally supplied with the Aqua-Hot must be used (kit sold separately).
- The exhaust tip must be used to prevent the burner from extinguishing in winds of up to 40 MPH.
- Mounting must be place every three feet to adequately support the exhaust system.
- Total exhaust system length must not exceed 30ft in total length, and shall contain no more than two 90° bends.

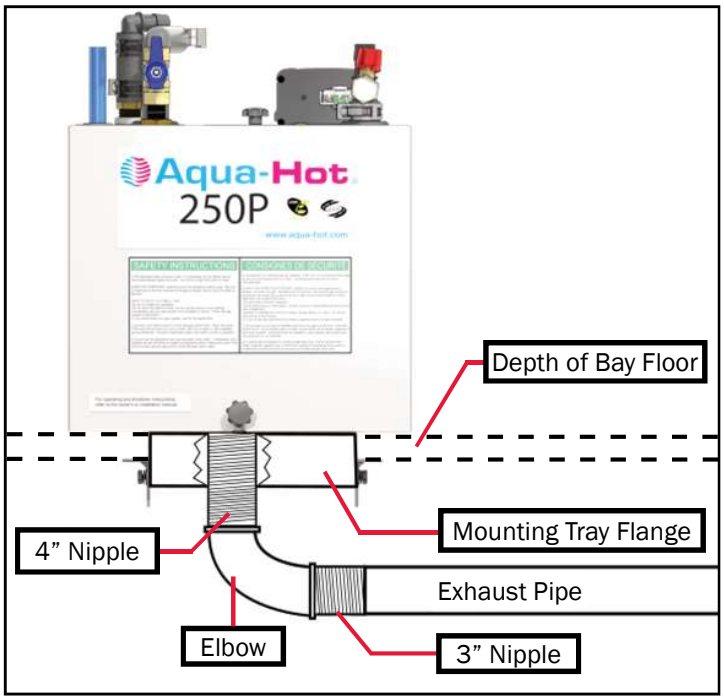


Figure 6

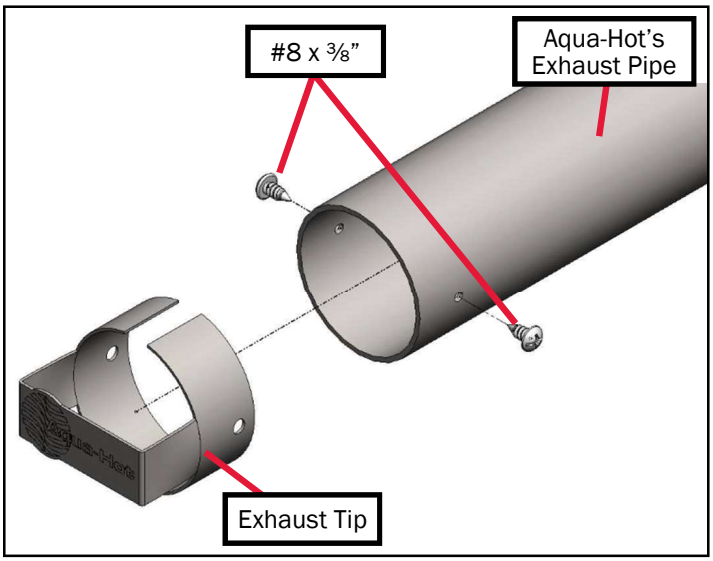


Figure 7

Components

Introduction:

This section of the Service Manual details various components of the Aqua-Hot that may require troubleshooting and/or replacement in the event of malfunction.

Replacement parts can be ordered online through Aqua-Hot's webstore at www.aquahot.com.

If additional assistance is needed, the technical support team can be contacted at 574-AIR-XCEL (574-247-9235) Monday through Friday, 7am to 4pm Mountain Standard Time.

NOTE: Before attempting to troubleshoot any Aqua-Hot component, please check all wiring to ensure that there is no corrosion, loose and/or faulty wiring connection present which may be causing failure.

Interlock Switch

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

Troubleshoot the interlock switch if the following conditions occur:

- The burner fails to operate
- The burner indicator light does not illuminate when the switch is in the ON position

Troubleshooting:

1. Ensure that the boiler tank has sufficiently cooled in order to require heat from the burner.
2. Activate the burner switch located on the interior switch panel.
3. Locate wires #37 and #24 on the wiring harness as they lead into the interlock switch.
4. Disconnect the wires from the switch, noting that wire #24 is connected to the terminal labeled "NO" and #37 is connected to the terminal labeled "COM".
5. Using an ohmmeter, check the interlock switch for continuity while the switch button is manually depressed.
6. If continuity is not present with the button pressed in, follow the instructions in this section to replace the interlock switch.

DANGER

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

Replacement Procedure

1. Disconnect the interlock switch wires by pulling the quick connectors from the switch 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 into the Aqua-Hot ensuring that the locking tabs snap into place.
5. Connect the Aqua-Hot's replacement wires to the replacement interlock switch with wire #24 connected to the terminal labeled "NO" and wire #37 connected to the terminal labeled "COM".

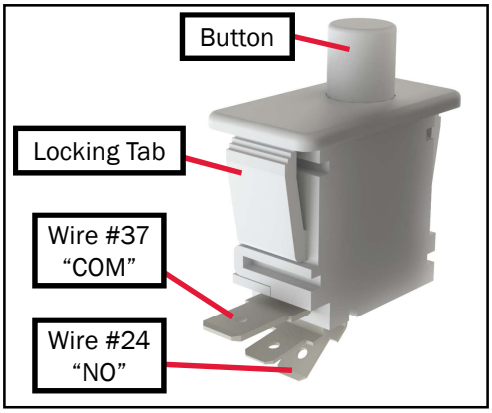


Figure 8

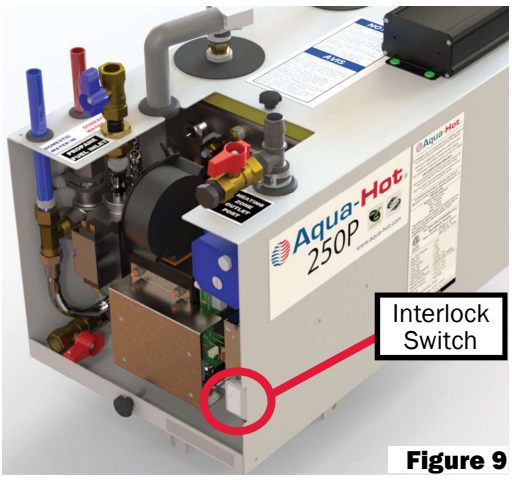


Figure 9

Fluid Level Sensor

Introduction:

The fluid level sensor monitors the current fluid level within the Aqua-Hot. This device is intended as a fail-safe measure which will disengage the Aqua-Hot if the fluid ever drops below a set threshold. The fluid level sensor is located on the expansion bottle, which is mounted to the side of the unit (see below).

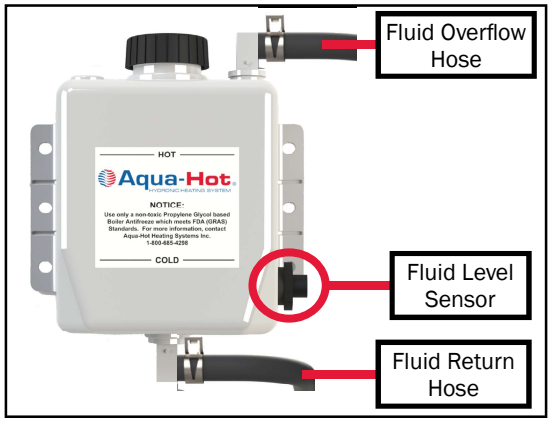


Figure 10

If the fluid level sensor is malfunctioning, the Aqua-Hot will show no signs of operation whatsoever. Troubleshoot this sensor if there is an adequate amount of fluid present within the Aqua-Hot, and the unit does not operate:

- The burner fails to operate
- The burner switch indicator light fails to illuminate
- The electric element fails to operate
- The indicator light on the electric switch does not illuminate

DANGER

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

Troubleshooting Guidelines:

Before troubleshooting the fluid level sensor, ensure that the following requirements have been met.

- The fluid expansion bottle is filled to at least the “COLD” mark.
- Verify that all coach-side 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.
- Ensure that the fluid level sensor is oriented correctly (see below).

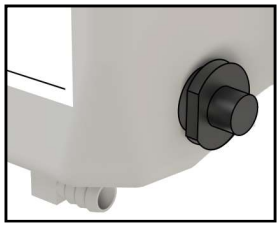


Figure 11

If any of the requirements above are not fulfilled, correct them before continuing to diagnose the fluid level sensor. Reference the troubleshooting guide below.

Troubleshooting Procedure:

1. Verify that the Aqua-Hot’s expansion bottle is full of antifreeze and water heating solution.
2. Verify that the wiring is secure, and in good working condition.
3. Locate the wiring harness for the unit. Find wires #10, #15, and #16. Wires #10 and #15 will co-terminate in a yellow connector.
4. Disconnect these wires from th expansion bottle, and test for continuity across the expansion bottle sensor.
5. If the bottle contains fluid and continuity does not exist across the fluid level sensor, the sensor will need to be replaced.

WARNING

Before continuing to the replacement procedure, ensure that the unit has cooled to ambient temperature, all power sources have been disconnected, and the unit is completely shut off.

Replacement Procedure:

In order to replace the fluid level sensor, the overflow bottle must also be replaced. Please visit www.aquahot.com or call 574-AIR-XCEL (574-247-9235) to order the expansion bottle kit. Once you have the replacement part in hand, follow the procedure below.

1. Locate the fluid expansion bottle.
2. Clamp the overflow hose as close to the bottom fitting as possible.
3. Grab a bucket or drain receptacle and place it directly under the lower fitting of the expansion bottle.
4. Remove the clamp from the lower fitting of the expansion bottle.
5. Remove the hose and allow the excess fluid to drain into the bucket.
6. Remove the overflow hose from the upper fitting of the expansion bottle.
7. Remove the old expansion bottle, disconnect the Faston connectors, and discard the old bottle.
8. Secure the new bottle in position.
9. Crimp the new faston connectors to the new fluid level sensor.
10. Connect these wires to their receptacles on the Aqua-Hot harness.
11. Reconnect the overflow hose to the upper fitting.
12. Reconnect the expansion hose to the lower fitting.
13. Fill the bottle with the previously drained fluid.
14. Remove the hose clamps.
15. Test the Aqua-Hot for normal functionality.

If additional assistance is required please contact the Aqua-Hot Heating Systems Technical support department at 574-AIR-XCEL (574-247-9235) from 7:00am to 4:00pm MST Monday through Friday.

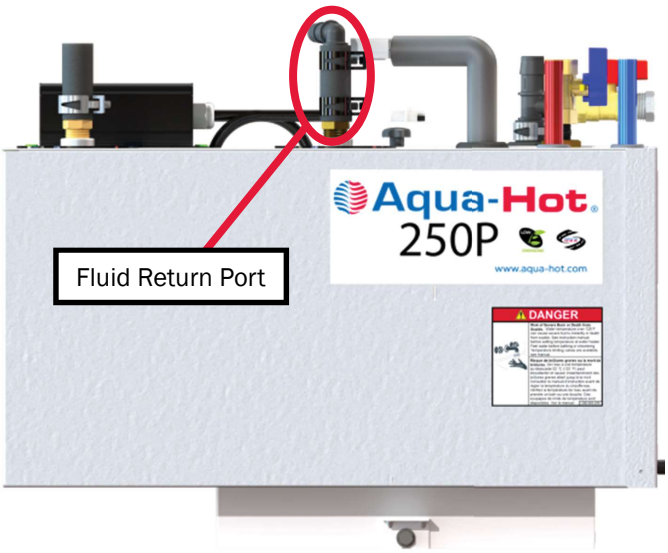


Figure 12

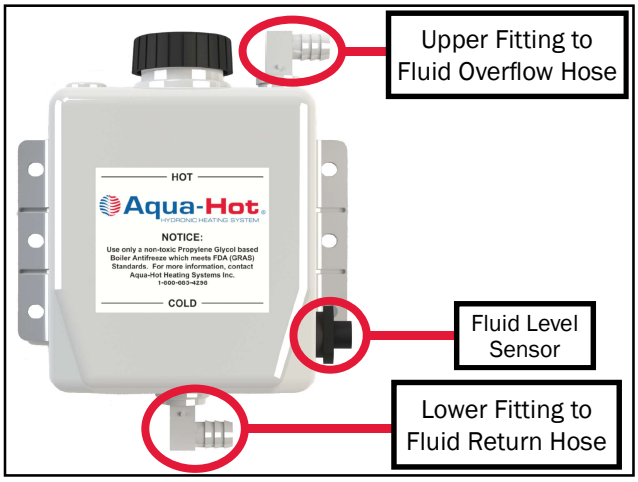


Figure 13

Control Thermostat

The control thermostat is installed into the Aqua-Hot's boiler tank and monitors the temperature of the antifreeze and water heating solution to determine when it is at operating temperature and when it requires heat. The Aqua-Hot is considered to be at operating temperature between 155°F and 188°F. Please reference Page 11 for the relay control board LED indicator information.

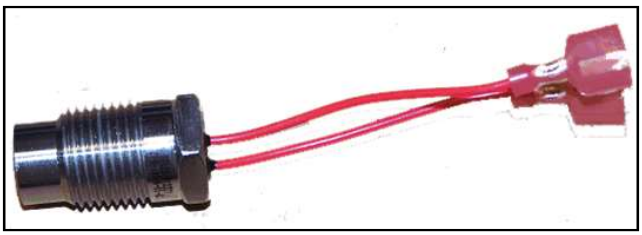


Figure 14

Troubleshooting Conditions:

Troubleshoot the control thermostat if one of the following conditions has occurred:

- There is a lack of hot domestic water and/or interior heat.
- The orange heating status light (D1) does not illuminate while the unit is below 175°F.

Troubleshooting:

1. Verify the following before troubleshooting the control thermostat:
   - The Interlock Switch is depressed (access cover is properly installed).
   - The overflow bottle is adequately filled.
   - The High-Limit Thermostats are not tripped.
   - Fuses in the relay control board are functional.
2. Turn the burner and/or electric element switch to the ON position.
3. Check the relay control board to ensure that "Electric Heating Element Status" (D2) and/or "Burner Status" (D5) indicator light is illuminated.
4. Verify that the "Heating Status" (D1) indicator light on the relay control board is illuminated as it should be whenever the Aqua-Hot is below 175°F.

NOTE: The Burner and/or Electric Element switch must be in the ON position for the "Heating Status" indicator light on the relay control board to illuminate.

If the "Heating Status" (D1) indicator light is not illuminated, check the following:

- Verify that the temperature of the boiler tank has fallen below the 175°F minimum operating temperature by checking with an infrared thermometer. Take the reading within 12 inches from the painted tank surface with the thermometer set to "High Emissivity" or similar. Do not attempt to take readings on a shiny surface.
- If below 175°F, disconnect the control thermostat's wires from their connection. Using an ohmmeter, check for continuity across the control thermostat.

If continuity does not exist across the control thermostat under these conditions, follow the directions in this section for replacing the control thermostat.

If continuity exists across this thermostat, inspect it, and the wiring harness for any damage.

Figure 15

Control Thermostat Replacement Procedure

1. Ensure that the Aqua-Hot has been completely shut down, all power sources disconnected, and the unit has been allowed to cool completely.
2. Clamp the hoses indicated below with pinch off pliers to prevent drainage of the heating zone loop.
3. Drain one gallon of antifreeze and water heating solution into an external contained to be reused later.
4. Disconnect the defective control thermostat wires by separating the quick disconnect terminals.
5. Using a ⅞" deep wall socket, unscrew the control thermostat from the Aqua-Hot's boiler tank.
6. Wrap the threads of the replacement control thermostat with 6 wraps of thread seal tape.
7. Reconnect wire #14A and wire #23 to the new control thermostat.
8. Refill the Aqua-Hot's boiler tank with the previously drained antifreeze and water heating solution.
9. Refill the Aqua-Hot using an external fill pump, filling through the zone fill port.
10. Test the Aqua-Hot for normal operation.
11. Test the interior heating loop to ensure that there are no air pockets trapped within the interior heating loop.
12. If necessary, purge the interior heating loop according to the guide on Page 55.

DANGER

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

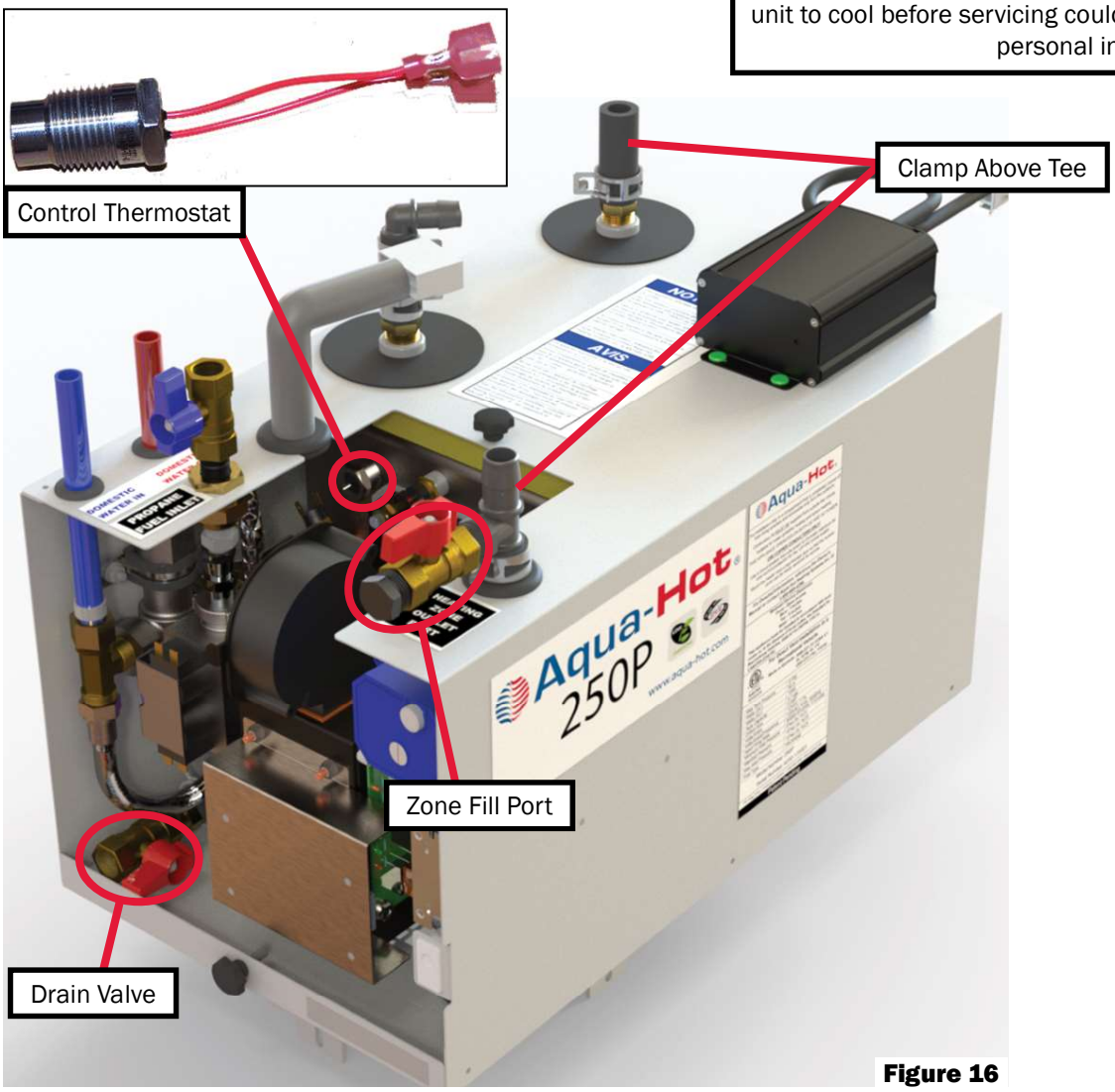


Figure 16

Figure 17

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 has been reached. The high-limit thermostat allows the current for the heating element to pass through 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, preventing the element to continue to operate.

NOTE: If the high-limit thermostat is tripped, it is recommended to test the control thermostat and AC relay for proper operation.

Begin troubleshooting the AC High-Limit Thermostat if the electric 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.

DANGER

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

Troubleshooting Procedure:

1. Verify the following before troubleshooting the AC high-limit thermostat:
   - The control thermostat is calling for heat.
   - The interlock switch is depressed.
   - The overflow bottle is adequately filled.
   - The high-limit thermostats are not tripped.
   - The fuses in the relay control board are functional.
2. Ensure that the unit has been shut down and completely cooled before continuing.
3. Shut off the coach-side power breaker to the Aqua-Hot.
4. Disconnect the 3-pin AC Molex plug from the AC relay enclosure. Leave the DC power supply connected.
5. Activate the "ELECTRIC" switch on the switch panel inside the coach.
6. Using a multimeter, test for continuity across the AC high-limit thermostat by placing one lead on the unit-side Molex connection as shown below.

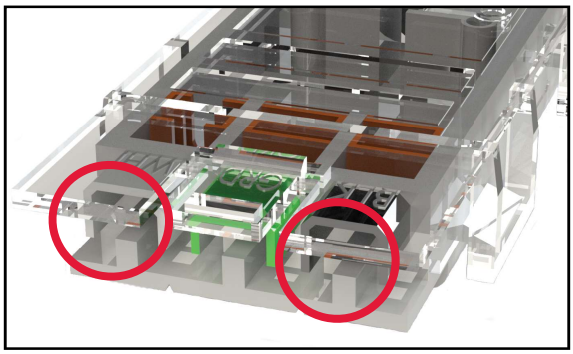


Figure 18

7. If no continuity exists, locate the AC high-limit thermostat and depress the center button to reset it. Retest for continuity.

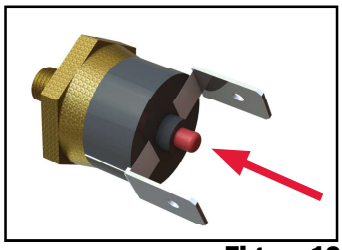


Figure 19

8. Move the electric switch to the OFF position. Reset for continuity. If continuity still exists, replace the AC relay.

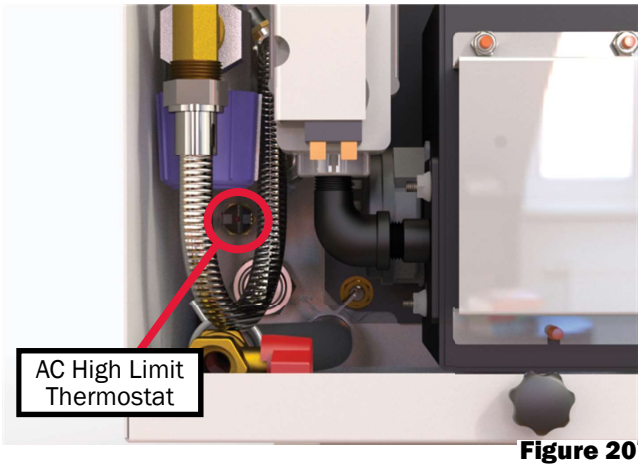


Figure 20

Replacement Procedure:

If it has been determined that the high-limit thermostat needs to be replaced, it can be easily replaced by following the directions below.

1. Shut off gas, electric, and water supply to the Aqua-Hot.
2. Disconnect the domestic water inlet and outlet line fittings from the Aqua-Hot.
3. Unscrew the nut that affixes the mixing valve to the left side of the Aqua-Hot cabinet wall.

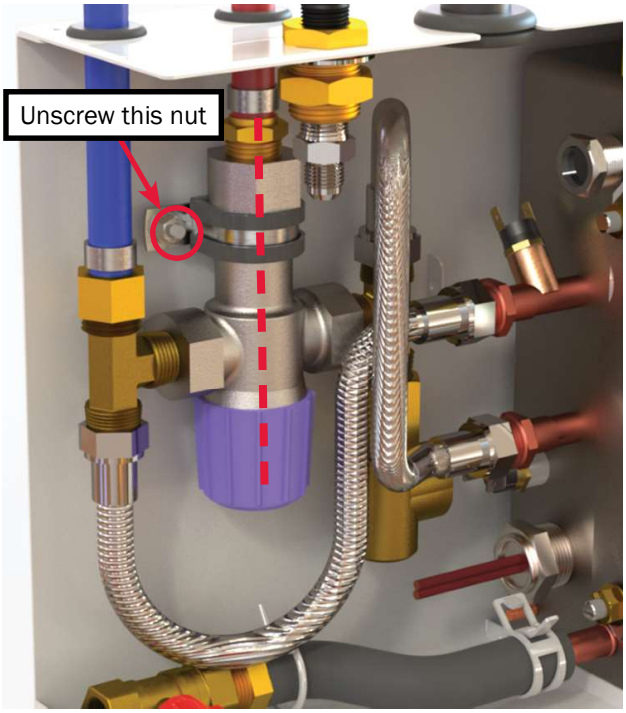


Figure 21

4. Push down on the mixing valve to expose access to the AC high-limit thermostat.
5. Cut the wire tie which wraps the wires on the left side of the unit.
6. Cut the black wires on the AC high-limit thermostat as close as possible to the body of the thermostat and strip the other end.
7. Remove the faulty high-limit thermostat using a ⅝" socket or crow's foot.
8. Butt-splice a new AC high-limit thermostat to the stripped wire.
9. Reinstall the AC high-limit thermostat using a ⅝" socket or crow's foot.
10. Re-secure the wires using the extra wire tie provided and reinstall the mixing valve assembly.
11. Make sure the replacement AC high-limit thermostat is functioning properly by testing for continuity across this thermostat.
12. Reposition the tempering valve assembly onto its mounting stud on the left cabinet wall.
13. Re-secure the tempering valve assembly with the previously removed nut.
14. Reconnect the domestic water connections to the PEX fittings of the tempering valve assembly.
15. Reestablish the gas, electric, and water supply to the Aqua-Hot.
16. Test for unit for normal operation.

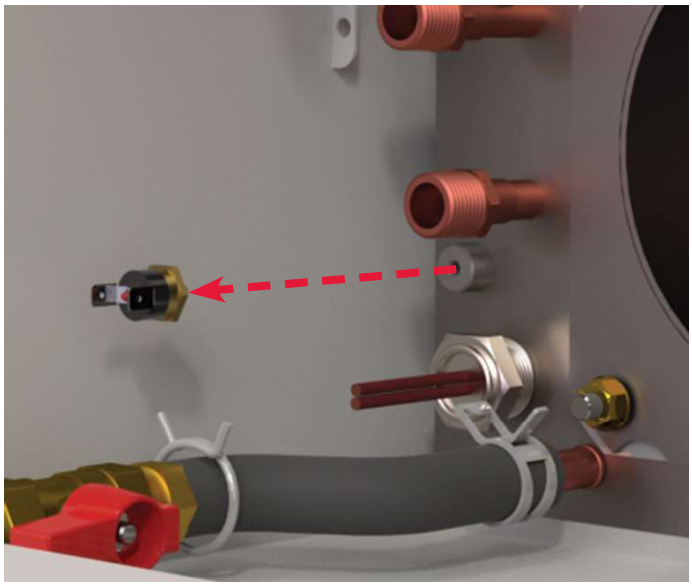


Figure 22

Burner High-Limit Thermostats

Introduction:

The burner high-limit thermostats serve as a safety measure in the event that the burner continues to operate after the maximum operating temperature (215°F) has been reached.

If the system reaches an over-temperature condition by interrupting the power signal (left thermostat) and the fan validation signal (right thermostat).

Begin troubleshooting the High-Limit Thermostats if the following condition has occurred:

- The blower fan runs, but the burner does not ignite.

NOTE: If the high-limit thermostat continues to trip, troubleshoot the control thermostat and verify that the boiler tank is full of antifreeze and water heating solution.

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.

DANGER

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

Troubleshooting Procedure:

1. Locate the high-limit thermostats (see Figure 23).
2. Disconnect the burner thermostats using the information below:
   - Wires #37 and #39 (left) or wires #38 and #36 (right)
3. Place a jumper wire between the two wires on the harness to bypass the high-limit thermostat. Check the Aqua-Hot for normal operation.

NOTE: Bypassing the high-limit thermostats is for testing ONLY and must ***not*** be used as a substitute for normal operation.

4. Disconnect the DC high-limit thermostat wires, then, using an ohmmeter, check the thermostat for continuity.
5. If continuity does not exist, depress the button in the center of the thermostat to reset. Reset for continuity.
6. If the thermostat at this point still does not have continuity, follow the instructions in this section to replace the thermostat.

Replacement Procedure:

1. Ensure that the Aqua-Hot has been completely shut down, all power sources disconnected, and the unit is allowed to cool completely before continuing.
2. Remove the two wires from the defective high-limit thermostat.
3. Using a ⅝" socket or crow's foot, remove the defective high-limit thermostat from the face of the tank.
4. Install the replacement high-limit thermostat into the port on the face of the boiler tank and finger-tighten into place.
5. Reconnect wire #37 and wire #39 (left) and/or wire #38 and wire #36 (right) to the high-limit thermostat which has just been replaced.
6. Test for normal operation.

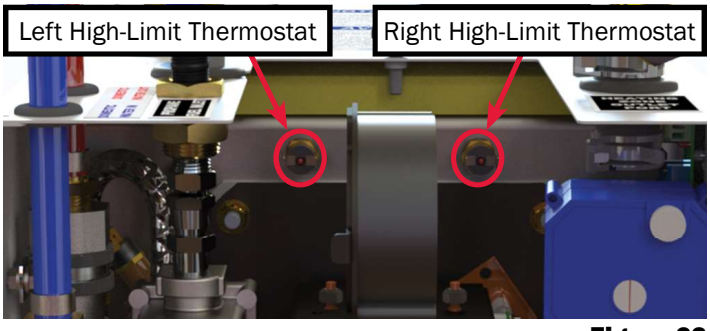


Figure 23

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 and other heavy-load applications. Ensure the Aqua-Hot is up to temperature before troubleshooting the Low-Temperature Cutoff Thermostat.

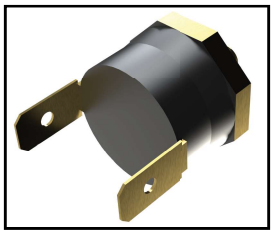


Figure 24

Troubleshooting Condition:

This thermostat should be diagnosed if there is a lack of interior heat or hot water, the D4 light is not illuminated, and the tank is up to operating temperature.

Troubleshooting Procedure:

Use the following troubleshooting tree to diagnose the Low-Temperature Cutoff Thermostat.

1. Verify the following before troubleshooting the low-temperature cutoff thermostat:
   - The control thermostat is calling for heat
   - The interlock switch is depressed
   - The overflow bottle is adequately filled
   - The high-limit thermostats are not tripped
   - The fuses on the relay board are functional
2. Determine if the unit is ready to provide heat by verifying that the "Low-Temperature Cutoff Status" light is *NOT* illuminated on the relay control board.
   - Verify that the Aqua-Hot is at operating temperature between 155°F and 185°F by using a meat thermometer secured to the tank face.
   - Verify that domestic hot water is not being used.
3. If the 'Low-Temperature Cutoff Status" light on the relay control board is illuminated after the unit has reached operating temperature, complete the following:
   - Disconnect wire #14B and #25 from the low-temperature cutoff thermostat.
   - If the light does not go out after disconnecting the low-temperature cutoff thermostat, contact Aqua-Hot Heating Systems for assistance in diagnosing this issue.

Lack of Hot Water

1. If the LTCO indicator light does not illuminate when domestic water is being used or when the Aqua-Hot falls below operating temperature, complete the following:
   - Using a temperature sensor, verify that the LTCO thermostat is below 90°F.
   - Inspect the wiring to ensure that the Aqua-Hot is wired properly and that the LTCO thermostat has not been disconnected.
2. Disconnect both wires from the Low-Temperature Cutoff Thermostat. Using a jumper wire, connect these two wires together.
3. With the jumper wire installed, check the coach for hot water availability. If after jumping these wires together and hot water has been established, the Low-Temperature Cutoff Thermostat will need to be replaced.

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 Aqua-Hot.
3. Disconnect the defective LTCO thermostat by separating the quick-disconnect terminals.
4. Using a ⅝" wrench or crow's foot wrench, remove the defective LTCO thermostat from the Aqua-Hot.
5. Install the replacement LTCO torquing it to **15 in-lbs** ONLY. Anything more than 15 in-lbs of torque will damage the thermostat and possibly the unit.
6. Connect wire #14B and wire #25 to the replacement Low-Temperature Cutoff Thermostat.
7. Test for normal operation.

DANGER

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

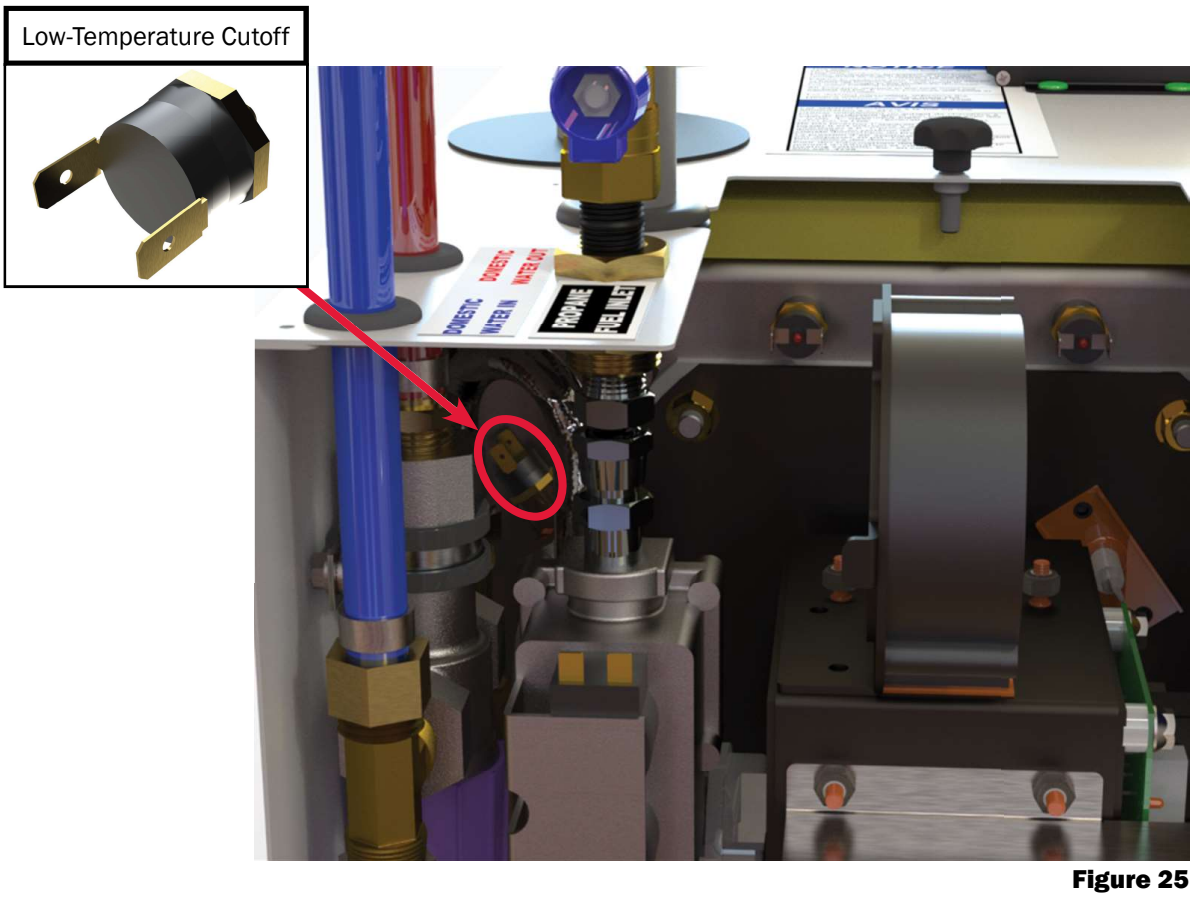


Figure 25

Three-Way Valve

Introduction:

The Aqua-Hot has a three-way directional valve to control coolant priority within the unit. This ensures that there will be a supply when heated water is being called for, but can provide interior heating when the need arises.

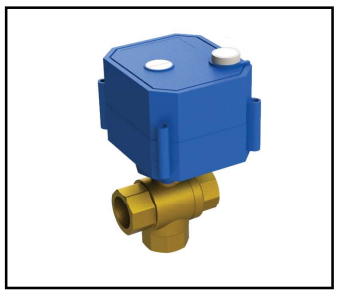


Figure 26

Troubleshooting Condition:

Troubleshoot the three-way valve if the following conditions have occurred:

- An absence of interior heat
- Inconsistent or complete lack of hot water

Troubleshooting:

1. Verify the following before troubleshooting the three-way valve:
   - The control thermostat is calling for heat
   - The interlock switch is depressed
   - The overflow bottle is adequately filled
   - The high-limit thermostats are not tripped
   - The fuses on the relay board are functional
2. Verify that the heating zone is operating properly by checking the hoses to see if they are hot to the touch when a heating zone is calling for heat.
3. Locate the relay control board and ensure that both the heating zone status (D6) and the pump status (D3) indicator lights are illuminated.
   - Verify that the line on the valve display window is vertical when interior heat is being called for. If this is not occurring, check the LTCO thermostat for functionality (reference Page 22).
   - Verify that the line on the valve display window is horizontal when hot water is being requested. This is known as “stir” mode.
4. Ensure that the modes change between interior heat (vertical) and hot water (horizontal), and verify that it matches the relay control board lights. D6 should illuminate while the sight glass is vertical.

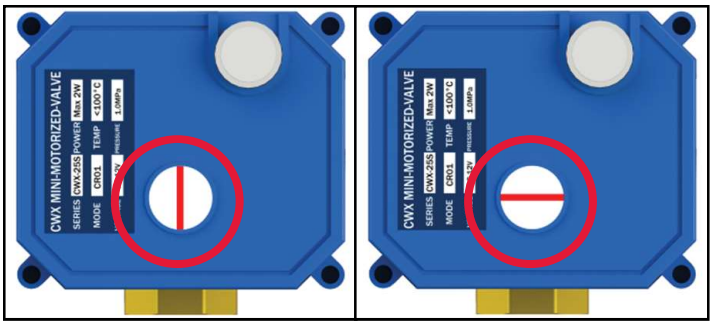


Figure 27a **Figure 27b**

5. Locate the wires traveling from the three-way valve as listed below:
   - The wires of the three-way valve will terminate in 2 fast-on connectors.

NOTE: The following tests (Steps 6 & 7) will verify functionality of the internal workings of the three-way valve with power directly applied. The valve should actuate, and the sight glass should rotate with at least one of the following tests.

6. Apply 12V DC power to the red wire, and attach a ground wire to the green/black wire. The motor within the three-way valve should activate, rotating the red line in the sight glass vertically (Figure 27a).
7. Apply 12V DC power to the green/black wire, and attach a ground wire to the red wire. The motor within the three-way valve should activate, rotating the red line in the sight glass horizontally into “stir” mode (Figure 27b).
8. If the three-way valve does not function in either of the above tests, it will need to be replaced. Follow the instructions on the next page to replace this component.

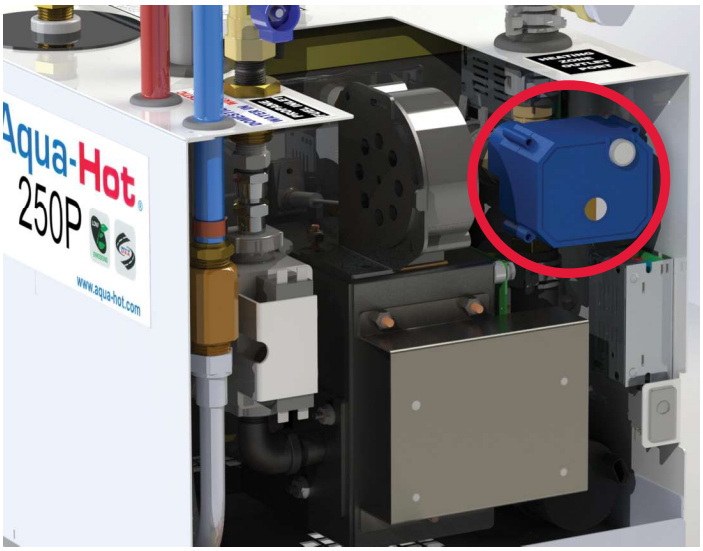


Figure 28

Replacement Procedure:

1. Ensure that the Aqua-Hot has been completely shut down, all power sources have been disconnected, and the unit has completely cooled.
2. Use clamp hose pliers to pinch tubing surrounding the three-way valve as indicated in Figure 29.
3. Disconnect the valve wires from the harness.
4. Using constant tension pliers, loosen and slide back the constant tension clamps securing the hose to the defective valve.
5. Remove the hose from the defective valve as shown in Figure 30.
6. Remove the two remaining hoses from the defective three-way valve.
7. Slide the hoses onto the valve and set the constant tension clamps back into place.

DANGER

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

8. Install the replacement three-way valve according to the specific instructions below:
   - Crimp a **male** 22-18AWG "Faston" connector to the red wire of the three-way valve. Connect to wire #21 "Faston" connector.
   - Crimp a **female** 22-18AWG "Faston" connector to the green/black wire of the three-way valve. Connect to wire #22 "Faston" connector.
9. Refill the Aqua-Hot's boiler tank, purging the heating loop if necessary.

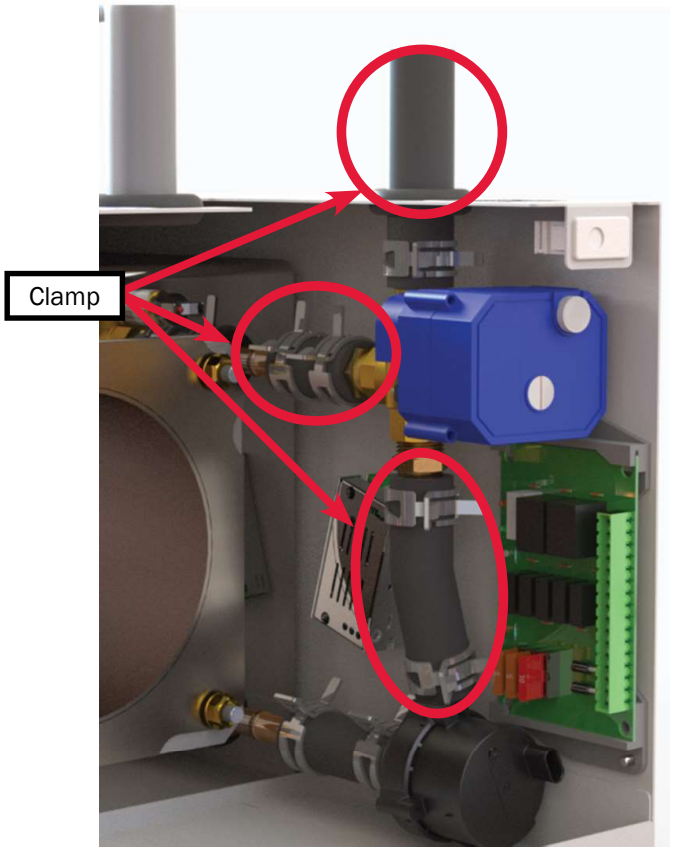


Figure 29

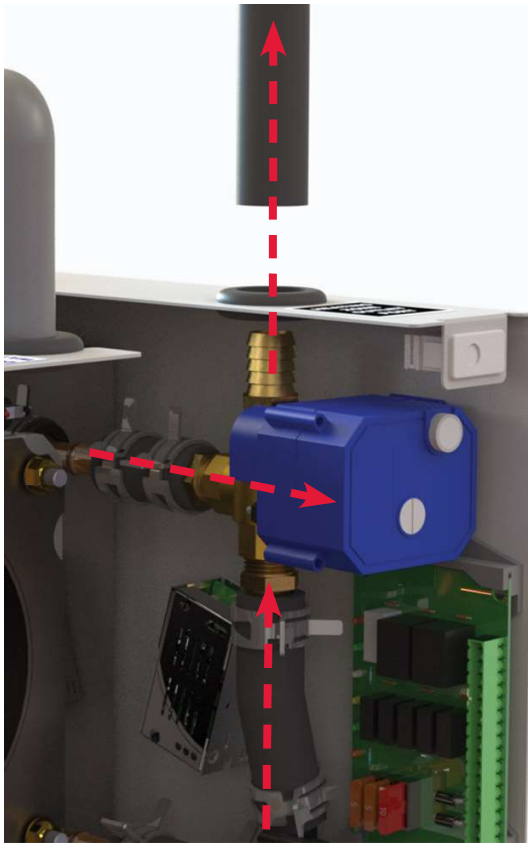


Figure 30

Tempering Valve

Introduction:

The tempering valve of the Aqua-Hot mixes the heated domestic water from the boiler tank with cold incoming domestic water at a preset ratio to deliver steady hot water and reduce the risk of scalding. It is recommended that you review the "Lack of Hot Water Troubleshooting Guide" on Page 57 prior to diagnosing the tempering valve.

Troubleshooting Condition:

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.
- The D4 light is not illuminated.

Troubleshooting Condition:

1. Inspect the tempering valve to ensure that it is not leaking.
2. Activate the burner and allow the unit to heat unit the burner shuts off. This test cannot to be accomplished with the electric element.
3. Open the hot water valve on an interior faucet without a hot-stop and allow the temperature to stabilize at its hottest point.
4. Using a meat thermometer, take temperature reading of the water. It should be between 115°F and 120°F. Be aware that a water source temperature of less than 65°F may prevent hot water from reaching this threshold.
5. Test the tempering valve's functionality by turning the knob (see Figure 31). If the knob does not rotate, this tempering valve will need to be replaced. On newer heaters, it will be necessary to remove a black plastic cap from the body of the tempering valve.
6. While running water, if the inlet pipe is excessively hot while the outlet is lukewarm and adjusting the mixing valve results in no change, it may be a faulty mixing valve.
7. If adjustment of the mixing valve is able to effect change in temperature, it must be continually adjusted until the output range of the hot water is between 115°F and 120°F.

NOTE: Adjusting the mixing valve beyond 120°F 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.

DANGER

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

Replacement Procedure:

1. Turn off the coach water supply.
2. Drain the water pressure by opening the faucets and allowing the water to drain.
3. Disconnect the coach water lines from the tempering valve assembly.
4. Disconnect the PEX pipe fittings from the tempering valve assembly.
5. Remove the pressure relief valve assembly from the tempering valve assembly.
6. Using a back-up wrench, unscrew the tempering valve from the Aqua-Hot. Failure to use a back-up wrench could result in damage to the cold water inlet pipe.
7. Remove the brass fittings from the defective tempering valve.
8. Install the brass fitting onto the replacement tempering valve. Use thread seal on the fittings.
9. Install the replacement tempering valve onto the Aqua-Hot using the back-up wrench to tighten.
10. Install the pressure relief valve onto the replacement tempering valve. Use thread seal tape.
11. Reconnect the PEX pipe and fittings onto the replacement tempering valve. Use thread seal tape. Be sure to inspect rubber seals and replace is necessary.
12. Reconnect the water lines to the tempering valve.

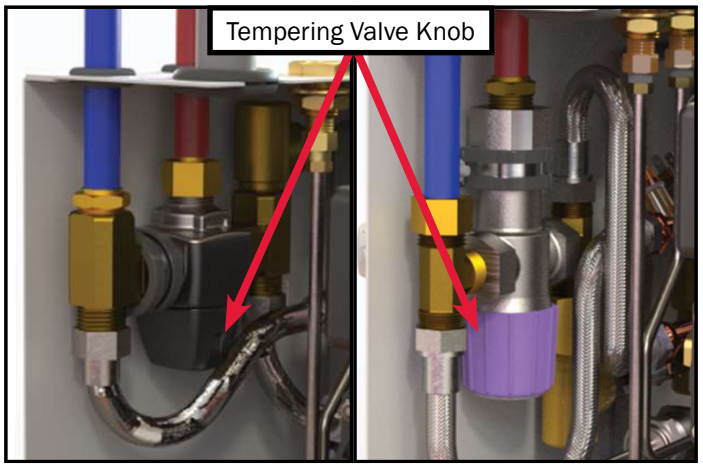


Figure 31

Circulation and Stir Pump

Introduction:

The fluid circulation pump operates to provide fluid circulation to either the interior heating zone or the antifreeze boiler tank depending on the heating and hot water needs at the time. It is used when interior heat is demanded by circulating propylene-glycol and water through the heating loop. It is used to stir the fluid mixture in the tank to ensure optimal hot water performance. The pump will also circulate the tank fluid while the burner cycles on to ensure that the tank is completely and evenly heated during a normal operating cycle.

Troubleshooting Condition:

Troubleshoot the circulation pump if the following conditions have occurred:

- A lack of interior heat.
- Lack of hot water or supply is uneven.

Troubleshooting Procedure:

Follow the procedure to diagnose the fluid circulation pump.

1. Verify the following before troubleshooting the circulation and stir pump:
2. Activate an interior zone for heating and the burner switch. Locate light D6 on the relay control board.
3. Light D6 should illuminate and the circulation pump should begin operating.
4. If the circulation pump still does not operate, locate wire #20 on the wire harness, and apply 12V DC current directly to the pump.
   - If the pump operates with 12V DC applied, begin diagnosing the relay control board.
   - If the pump does not operate with 12V DC directly applied to it, the pump will need to be replaced.

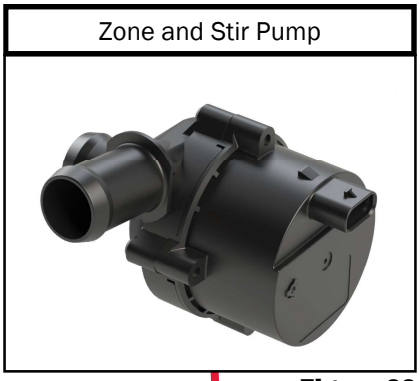


Figure 32

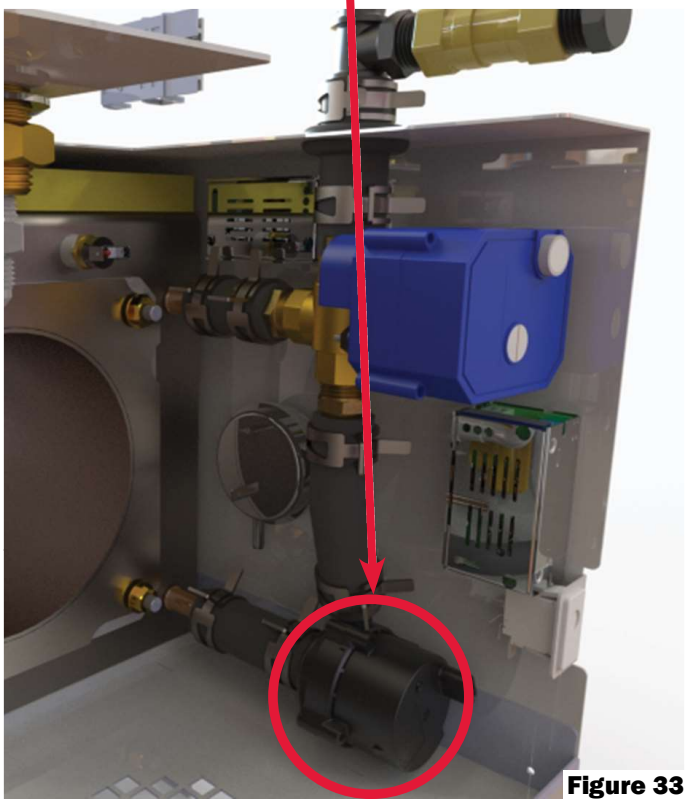


Figure 33

NOTE: The propane burner is hidden in the view above to better show the location of the zone/stir pump.

Replacement Procedure:

1. Ensure that the Aqua-Hot has been completely shut down, all power sources have been disconnected, and that the unit has been allowed to cool completely.
2. Clamp the zone outlet, and the zone return with hose pinch-pliers as shown below.
3. Drain the antifreeze and water heating solution from the Aqua-Hot's boiler tank using the drain valve.
4. Disconnect the defective pump's wires by removing the electrical plug from the pump body.
5. Using constant tension pliers, loosen and slide back the constant tension clamps securing the hoses to the circulation pump.
6. Remove the hoses from the defective circulation pump.
7. Set the defective pump aside, and put the replacement pump in the same position.
8. Slide the hoses back onto the replacement pump and set the constant tension clamps back into place.
9. Connect the wires to the replacement pump.
10. Refill the boiler tank with a 50/50 mixture of propylene glycol and distilled water.
11. Once the tank has been filled, purge the heating zones by directly connecting the fluid pump to 12V DC power for at least 20 minutes.

DANGER

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

CLAMP

Figure 34

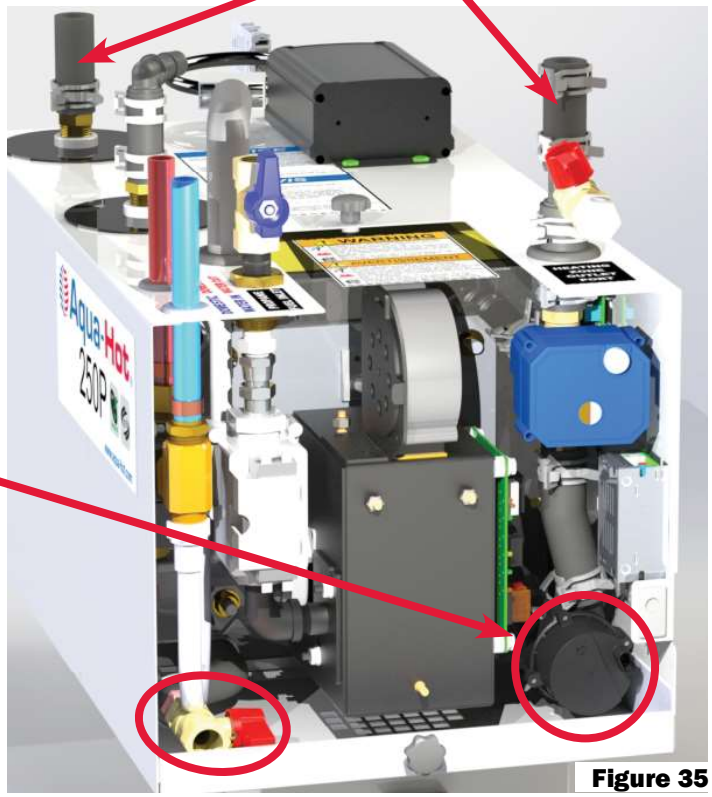


Figure 35

AC Electric System

Introduction:

The AC Electric system of the Aqua-Hot 200 Series unit functions to provide supplementary heat to the Aqua-Hot boiler tank. This is done with an electric element, an electric relay, and a DC "control circuit" which engages the electric element when determined necessary by the control thermostat and the relay control board.

The electric heating element is not intended to serve as the sole heating source of the Aqua-Hot. The AC electric system will provide enough heat for hand washing, and to maintain tank temperature. Any greater applications require the use of the propane burner.

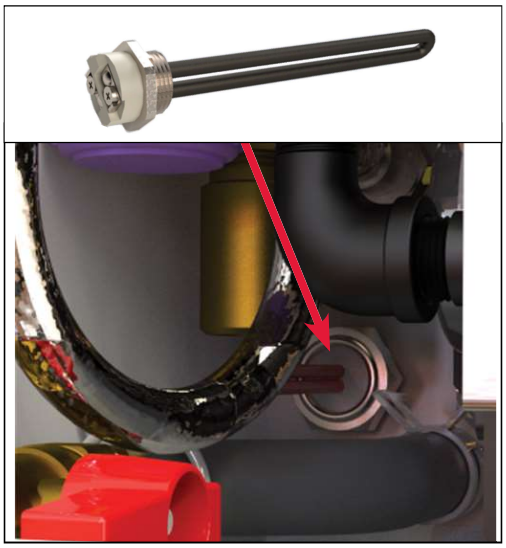


Figure 36

Troubleshooting Condition:

Troubleshoot the AC Electric system if the electric element is not functioning properly. This can be verified with a simple, but rather lengthy, test outlined below.

The following conditions must be met before the AC Electric system 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 element.
- Verify the thermostats are in working order.

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.

Verify Functionality:

1. Switch both the electric and the burner switches to the OFF position.
2. Allow the unit to cool completely.
3. Verify that the Aqua-Hot is connected to an AC power source such as shore power or an AC generator.
4. Using an infrared thermometer take the temperature of the tank face. The thermometer should be 12" away from the tank face and set to "high emissivity". Record this temperature on a notepad.
5. Move only the electric switch on the panel to the ON position.
6. Verify that the D2 light on the relay control board is active.
7. After an hour, take another temperature reading on the tank face. If the temperature of the tank face has risen, the electric element is correctly operating.

If through the above procedure it's been determined that the electric element is not functioning properly, follow the instructions below to troubleshoot.

Troubleshooting:

1. Verify the following before troubleshooting the AC Electric System:
    - The control thermostat is calling for heat
    - The interlock switch is depressed
    - The overflow bottle is adequately filled
    - The AC high-limit thermostat is not tripped
    - The fuses on the relay board are functional
2. Install a jumper wire on wires #26 and #15. This will circumvent the electric element switch and should cause the electric element to activate.
    - If the electric element status indicator light, DC illuminates on the relay control board with the jumper wire installed, troubleshoot the electric element switch on the interior switch panel.
    - If the electric element status indicator light does not illuminate when the jumper wire is installed, verify that the fluid expansion bottle is adequately filled, and that the fuse in FH2 is still functional.
    - Check the Aqua-Hot's boiler tank temperature. If the tank temperature is below 155°F and the electric element status light D2 is not illuminated, begin troubleshooting the control thermostat.
3. Verify that the relay control board is sending 12V DC power to the AC relay. Using a voltmeter, test wire #28 for 12V DC power.
    - If 12V DC is not present while the electric element switch is in the ON position, and the D2 light is

active, the relay control board will need to be replaced.

- If 12V DC power is present at wire #28, disassemble the AC relay enclosure and check for power at Pin #1 of the AC relay. If power is not present at Pin #1, inspect the wiring harness for damage.

4. If 12V DC is present at Pin #1 (wire #28) of the relay, complete the following:
    - Turn off all coach-side breakers providing power to the Aqua-Hot, then disconnect the Molex plug AC connection.
    - Using an ohmmeter, check for continuity across wires #1 and #4 of the AC relay.

If no continuity exists at this point, the relay must be replaced.

5. Verify that the electric heating element is receiving adequate AC power by completing the following:
    - Plug the coach into shore power or turn on the generator.
    - Using an AC voltmeter, verify that 110V AC are present at the Molex plug connected to the Aqua-Hot. If there is not 110V at this plug, there is a problem with the coach-side power.
    - Using a digital clamp-meter, verify the electric element is drawing between 8A and 8.5A.
6. Verify that the electric element has the proper resistance:
    - Disconnect the AC Molex plug from the 250 AC enclosure.
    - Move the electric switch on the interior switch panel to the ON position. Using an ohmmeter, test for resistance on the white and black terminals of the Aqua-Hot Molex terminal.
    - Resistance should be between approximately 11-13 ohms. If there are less than 11 ohms of resistance, the electric element can cause the coach-side breaker to trip (reference Figure 37 below).

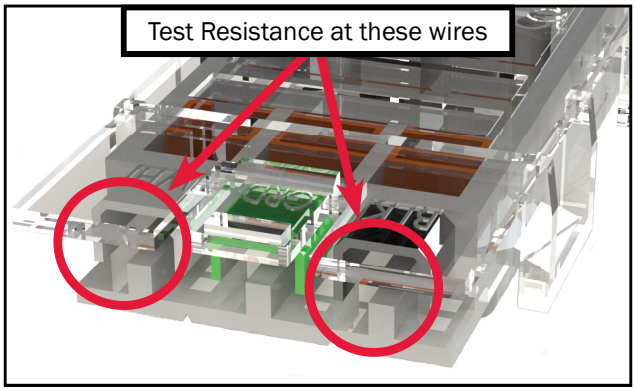


Figure 37

DANGER

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

Replacement Procedure:

1. Ensure that the Aqua-Hot has been completely shut down and all power sources have been disconnected. Be sure the boiler tank is completely cooled.
2. Using hose pinch-off pliers, clamp off the heating zone inlet and outlet ports.
3. Drain the antifreeze and water solution from the Aqua-Hot's boiler tank into an external container to be reused.
4. Remove the two wires secured to the defective electric heating element by releasing the screw terminals.
5. Using a 1-½" (38mm) socket, remove the defective heating element from the Aqua-Hot's boiler tank.
6. Use 6 wraps of Teflon tape and pipe dope around the threads of the new electric element to ensure that it forms an adequate seal.
7. Install the replacement 1kW electric element into the boiler tank and secure it with the 1-½" (38mm) socket.
8. Reconnect the wires previously disconnected from the electric heating element and tighten the screw terminals.
9. Refill the Aqua-Hot boiler tank with the previously drained fluid, add more 50/50 mix of propylene glycol and distilled water to the tank if needed.
10. If necessary, purge the heat exchanger lines to remove any and all air from the system by running the fluid circulation pump for 20 minutes.

Propane Burner Overview

The Aqua-Hot's propane burner is the heart of the Aqua-Hot unit. The propane burner is the device which ignites and sustains the combustion of a propane-air mixture. The propane burner functions as the primary source of heat in 250P units. Heat energy from the propane combustion reaction is transferred from the combustion chamber into the antifreeze and water heating solution, where it is then used for interior heat or hot water.

The propane burner operates on standard, readily available propane found at a local propane store.

The burner itself contains six user-serviceable components that can be repaired or replaced as part of standard service or in-depth repair.

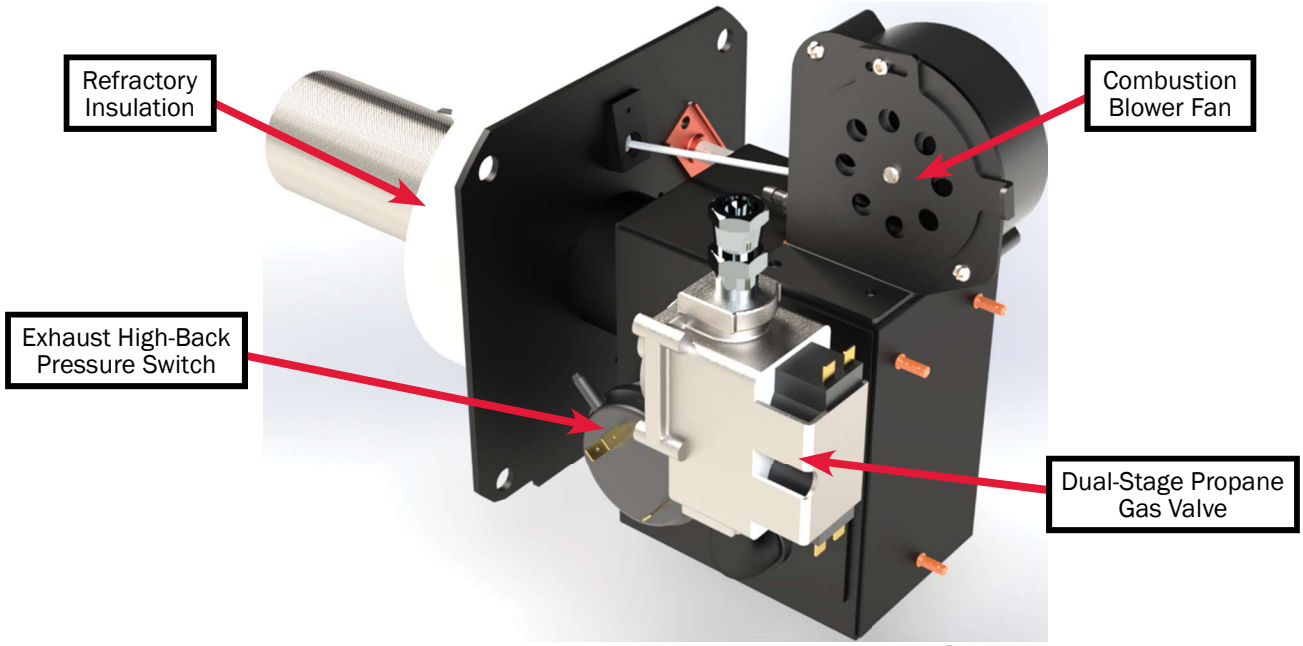


Figure 38

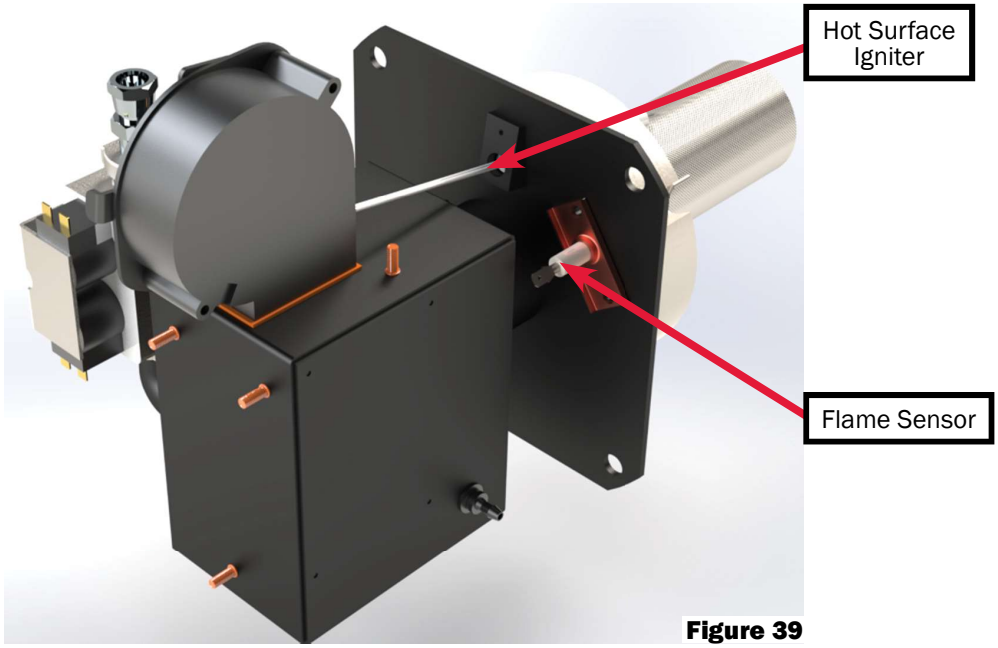
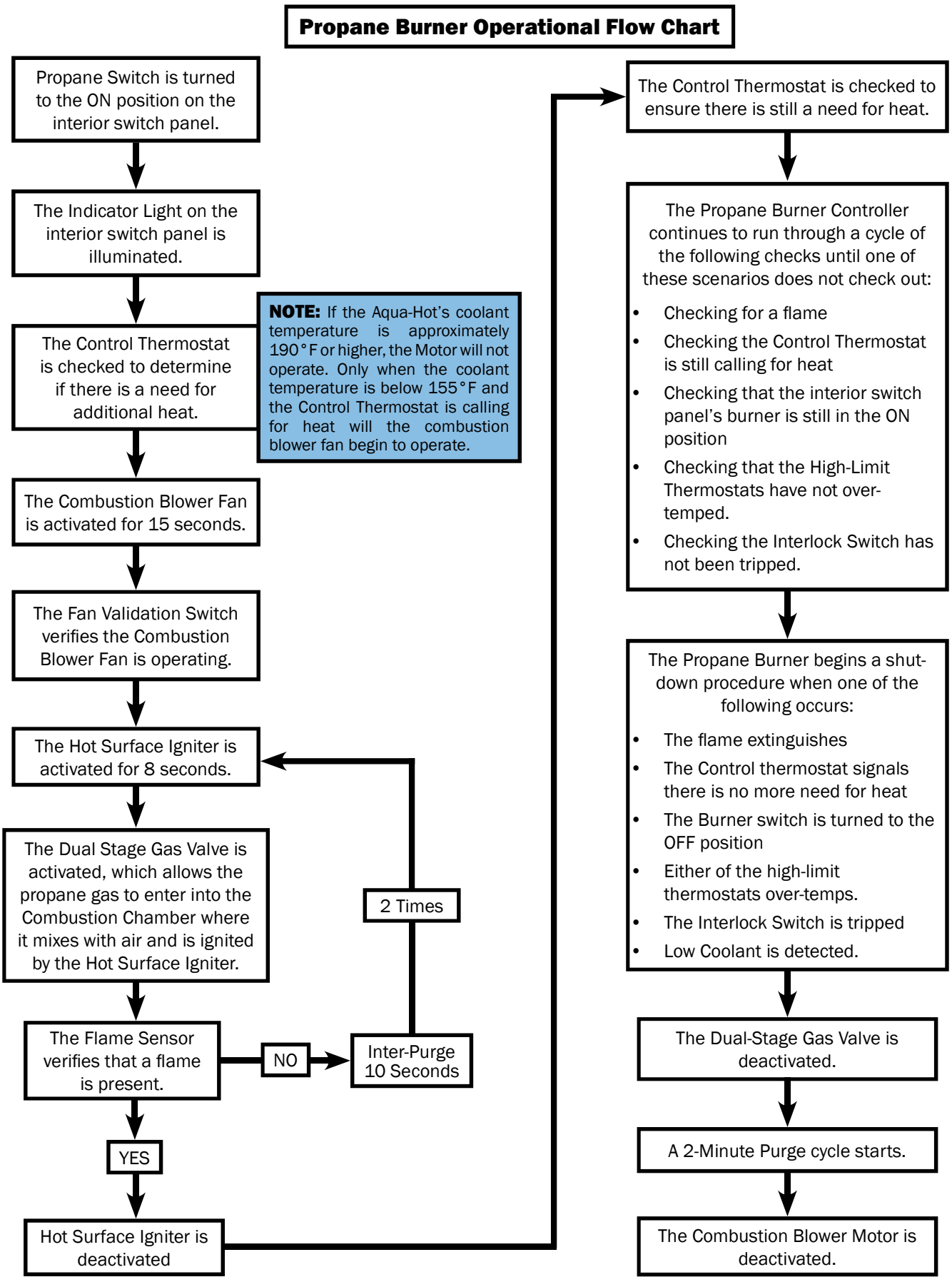


Figure 39


Propane Burner Operational Flow Chart
Propane Switch is turned to the ON position on the interior switch panel.
The Indicator Light on the interior switch panel is illuminated.
The Control Thermostat is checked to determine if there is a need for additional heat.
NOTE: If the Aqua-Hot's coolant temperature is approximately 190°F or higher, the Motor will not operate. Only when the coolant temperature is below 155°F and the Control Thermostat is calling for heat will the combustion blower fan begin to operate.
The Combustion Blower Fan is activated for 15 seconds.
The Fan Validation Switch verifies the Combustion Blower Fan is operating.
The Hot Surface Igniter is activated for 8 seconds.
The Dual Stage Gas Valve is activated, which allows the propane gas to enter into the Combustion Chamber where it mixes with air and is ignited by the Hot Surface Igniter.
The Flame Sensor verifies that a flame is present.
NO
Inter-Purge 10 Seconds
2 Times
YES
Hot Surface Igniter is deactivated
The Control Thermostat is checked to ensure there is still a need for heat.
The Propane Burner Controller continues to run through a cycle of the following checks until one of these scenarios does not check out:
• Checking for a flame
• Checking the Control Thermostat is still calling for heat
• Checking that the interior switch panel's burner is still in the ON position
• Checking that the High-Limit Thermostats have not over-temped.
• Checking the Interlock Switch has not been tripped.
The Propane Burner begins a shut-down procedure when one of the following occurs:
• The flame extinguishes
• The Control thermostat signals there is no more need for heat
• The Burner switch is turned to the OFF position
• Either of the high-limit thermostats over-temps.
• The Interlock Switch is tripped
• Low Coolant is detected.
The Dual-Stage Gas Valve is deactivated.
A 2-Minute Purge cycle starts.
The Combustion Blower Motor is deactivated.

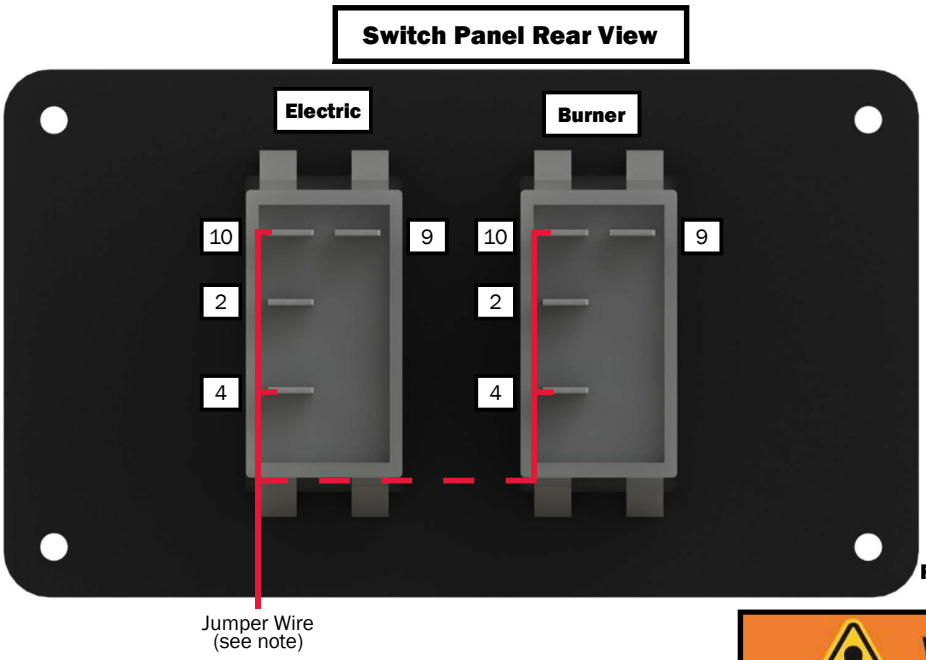


Figure 40

NOTE: The Burner and Electric Element switches must possess a jumper wire between Pin 4 and Pin 10 as depicted.

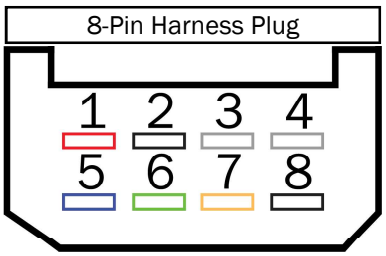


Figure 41

8-Pin Harness Plug		
Manufacturer	Part No.	Common Name
TE Connectivity	163007	8-Way Fastin Receptacle

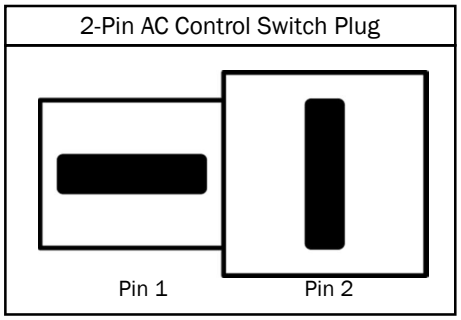


Figure 42

2-Pin AC Control Switch Plug		
Manufacturer	Part No.	Description
TE Connectivity	180907	Fastin-Faston Series

WARNING

DO NOT INSTALL JUMPER WIRES ACROSS THE SWITCHES IN THE SWITCH PANEL. JUMPER WIRES ARE ONLY TO BE INSTALLED BETWEEN PIN 4 AND PIN 10 ON EACH SWITCH. FAILURE TO ADHERE TO THIS GUIDELINE MAY RESULT IN DAMAGE TO YOUR AQUA-HOT AND/OR COACH.

Switch Panel Wiring	
AC Electric Switch	**AC Control Switch Plug**
Pin 4	Pin 1
Pin 2	Pin 2
Pin 9	Chassis Ground
Burner Switch	**8-Pin Harness Plug**
Pin 4	Pin 3
Pin 2	Pin 4
Pin 9	Chassis Ground

Pin-Out Information		
Pin	**Wire**	**8-Pin Harness Connection**
Pin 1	#3	Vehicle Battery (+)
Pin 2	#2	Vehicle Battery (-)
Pin 3	#11	Burner ON signal
Pin 4	#10	Burner Switch Power
Pin 5	#14C	Thermostat Power Output
Pin 6	#19	Thermostat Power Input
Pin 7	#18	Heat Exchanger Fans (+)
Pin 8	#1	Heat Exchanger Fans (-)
Pin	**Wire**	**2-Pin AC Control Switch Plug**
Pin 1	#26	Electric ON Signal
Pin 2	#15	AC Switch Power

Fenwal Control Card

Function:

The purpose of the Fenwal card is to control the propane burner. Please note that the Aqua-Hot 250P units do not have a unified "controller" as it traditionally known, and instead, use a combination of the relay control board and Fenwal control card to accomplish these needs.

When a call for heat is received from the control thermostat, the controller will reset, perform a self-check routine, and a pre-purge delay will begin. Following this pre-purge period, the igniter and gas valve will be engaged. Once the flame detector recognizes a flame, the hot surface igniter is shut off, and the dual-stage gas valve remains engaged.

Replacement Indicator:

Replace the Fenwal control card if it fails to operate properly or is damaged.

Troubleshooting Procedure:

The following conditions must be met before the Fenwal control card 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 on the relay control board are functional.
- Ensure that the unit is completely cool.
- Ensure that DC power is supplied to the Aqua-Hot.
- Verify the control thermostat (page 17) and the high-limit thermostats (page 21) are in working order.
- Verify the functionality of the fan validation switch (page 49)

NOTE: The interlock switch will prevent the propane burner from operating. Ensure that the interlock switch is depressed before continuing troubleshooting procedures.

1. Using a ⅜" wrench, remove the two nuts affixing the Fenwal control card to the propane burner assembly. This will grant access to the Fenwal card for diagnostic. See below.

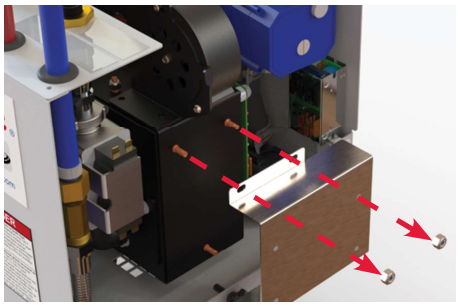


Figure 43

2. Temporarily depress the interlock switch for the purpose of this test alone.
3. Locate a multimeter and set it to test for voltage.
4. Move the burner switch on the interior switch panel to the ON position.
   - Verify that 12V DC power is present at Pin 10 of the relay control board while the D5 indicator light is illuminated. If 12V DC is not present, the relay control board will need to be replaced.
5. Test for voltage at pins PWR, HSI+, and BLO on the Fenwal control card.

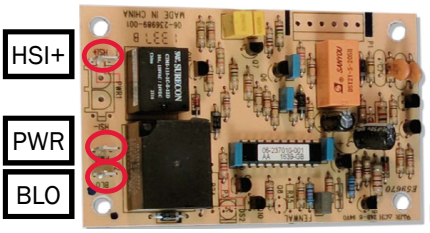
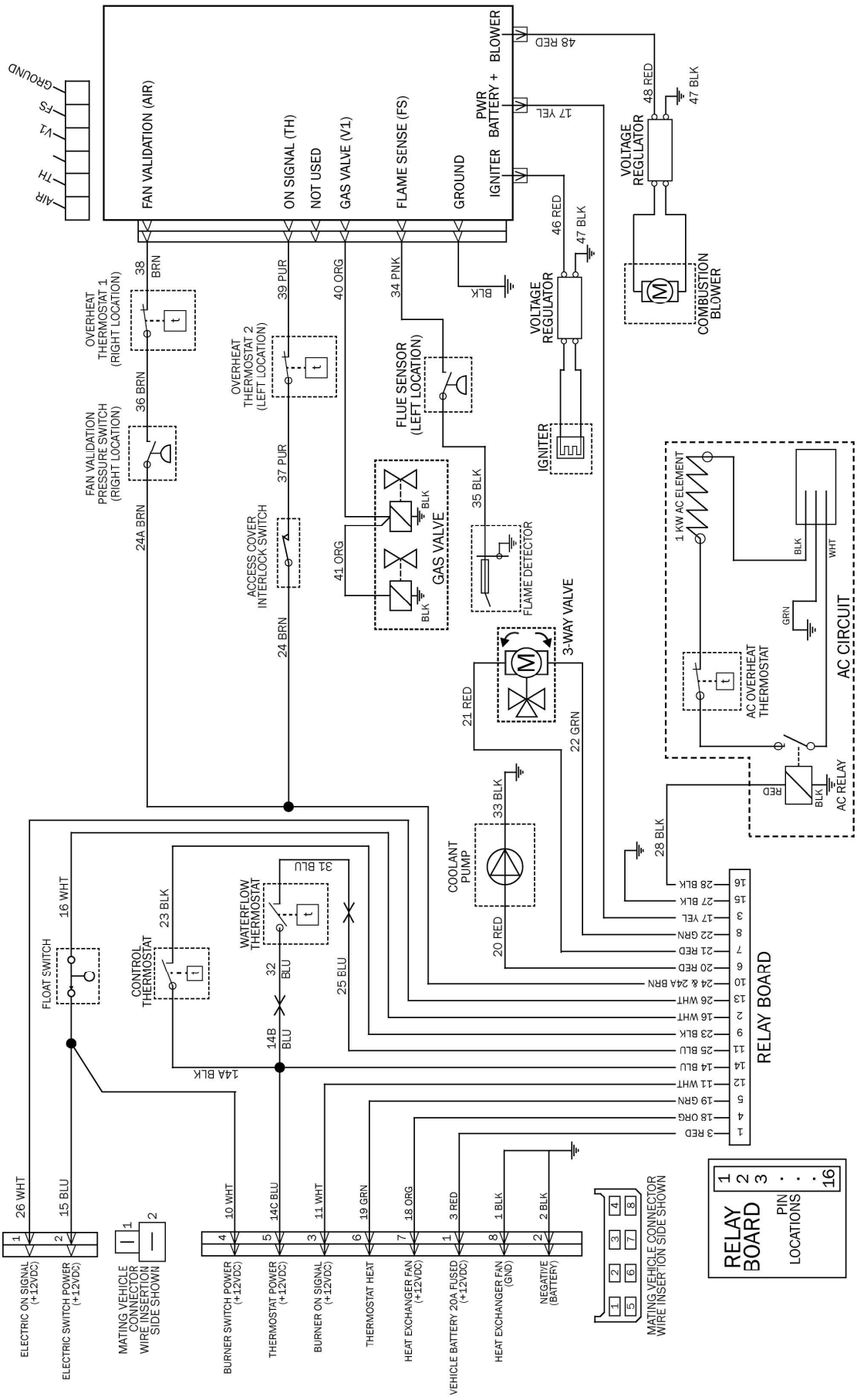


Figure 44

6. Power should be present on PWR.
   - If no power, check the wiring harness for damage.
7. Pin BLO should have 12V DC power during start-up.
   - If 12V DC are not present at this pin during attempted start-up, the card will need to be replaced.
8. Pin HSI+ will have power late in the start-up cycle. In order to test this pin, it is necessary to test voltage throughout the start-up sequence.
   - If Pin HSI+ never receives 12V DC from start-up to automated shut down, the Fenwal card will need to be replaced.

Fenwal Control Card Specifications	
Input Power	9.5-15V or 50/60hz AC
Input Current Drain	200mA @ 12V DC
Gas Valve Rating	1.0A @ 12V DC
Operating Temperature	-40°F to +167°F -40°C to +75°F
Flame Sensitivity	0.7µA minimum
Flame Failure Response Time	0.8 seconds maximum
Types of Gases	Natural, LP, or Manufactured
Spark Rate	10 sparks/second
Dimensions	4.00 x 2.30 x 1.50 inches 10.16 x 5.84 x 3.81 cm
Weight	3.0 ounces (85kg)
Enclosure	Uncovered with integral stand-offs or potted module
Moisture Resistance	Conformal coated to 95% RH. Do not directly expose to water
Tries for Ignition	3 attempts
Trial for Ignition Periods	7.0 seconds (this model)
Prepurge & Interpurge Times	15 seconds


GROUND
FS
VI
TH
AIR
FAN VALIDATION (AIR)
ON SIGNAL (TH)
NOT USED
GAS VALVE (V1)
FLAME SENSE (FS)
GROUND
IGNITER
PWR BATTERY +
BLOWER
48 RED
47 BLK
VOLTAGE REGULATOR
COMBUSTION BLOWER
OVERHEAT THERMOSTAT 1 (RIGHT LOCATION)
OVERHEAT THERMOSTAT 2 (LEFT LOCATION)
FLUE SENSOR (LEFT LOCATION)
FAN VALIDATION PRESSURE SWITCH (RIGHT LOCATION)
ACCESS COVER INTERLOCK SWITCH
GAS VALVE
FLAME DETECTOR
IGNITER
3-WAY VALVE
1 KW AC ELEMENT
AC OVERHEAT THERMOSTAT
AC RELAY
AC CIRCUIT
COOLANT PUMP
FLOAT SWITCH
CONTROL THERMOSTAT
WATERFLOW THERMOSTAT
RELAY BOARD
ELECTRIC ON SIGNAL (+12VDC)
ELECTRIC SWITCH POWER (+12VDC)
MATING VEHICLE CONNECTOR WIRE INSERTION SIDE SHOWN
BURNER SWITCH POWER (+12VDC)
THERMOSTAT POWER (+12VDC)
BURNER ON SIGNAL (+12VDC)
THERMOSTAT HEAT
HEAT EXCHANGER FAN (+12VDC)
VEHICLE BATTERY 20A FUSED (+12VDC)
HEAT EXCHANGER FAN (GND)
NEGATIVE (BATTERY)
MATING VEHICLE CONNECTOR WIRE INSERTION SIDE SHOWN
RELAY BOARD PIN LOCATIONS

Detaching the Propane Burner

Introduction:

The instructions in this section detail how to safely remove the propane burner found on the Aqua-Hot 250P.

WARNING

Disconnect the Aqua-Hot from any and all power sources and shut off the fuel supply to the unit before detaching the burner from the Aqua-Hot. Failure to do so before service may lead to unit damage and/or personal injury.

Procedure:

1. Disconnect the Aqua-Hot from all electrical sources.
2. Close the propane ball valve on top of the Aqua-Hot cabinet.
3. Shut off the coach propane bottle at the source.
4. Using a ⅜" socket or nut driver, remove the two nuts from the ground studs located on top of the propane burner assembly.

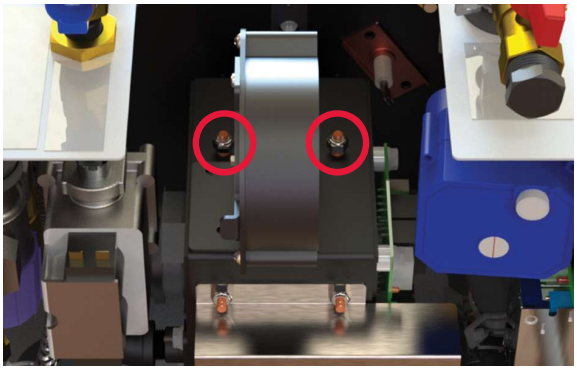


Figure 45

5. Gently remove the wires anchored to these studs.
6. Disconnect wire #39 from the left high-limit thermostat.
7. Disconnect wire #38 from the right high-limit thermostat.
8. Remove the Fenwal control card using a ⅜" socket or nut driver to remove the top two nuts. See below.

Figure 46

9. Disconnect wire #46 from the Fenwal control card at the tab labeled "HSI+".
10. Disconnect wire #48 from the Fenwal control card at the tab labeled "BLO".
11. Disconnect wire #17 from the Fenwal control card at the tab labeled "PWR".
12. Set the Fenwal control card and steel enclosure aside.
13. It will be necessary to loosen the bulkhead fitting of the propane line. Using two ⅜" wrenches, loosen the bulkhead fitting so that it is possible to grant clearance between the fitting and the dual-stage propane valve.

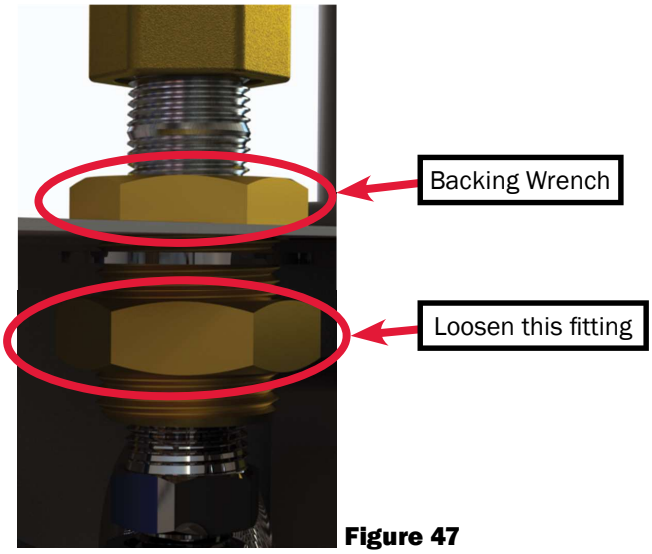


Figure 47

14. Using two $^{11}/_{16}$" wrenches, loosen the fittings securing the propane line to the bulkhead fittings. Use one as a backing wrench, loosening only the bottom nut.

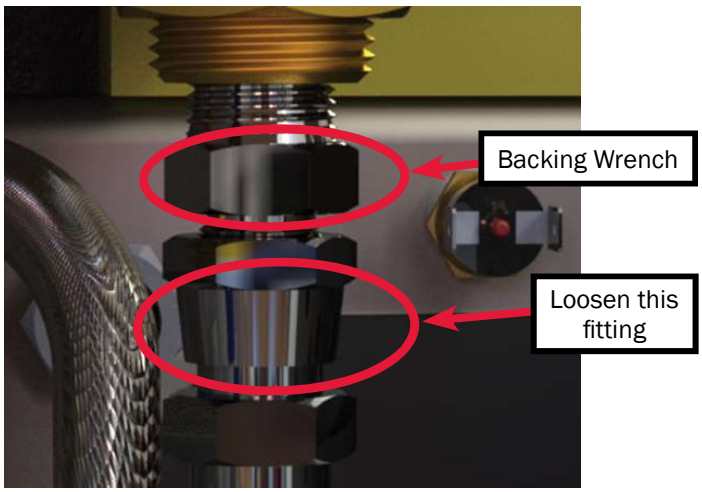


Figure 48

15. Using a ½" socket and extension, remove the four corner bolts securing the propane burner in place. It may be necessary to use a swivel fitting in order to gain access to all four corner nuts.

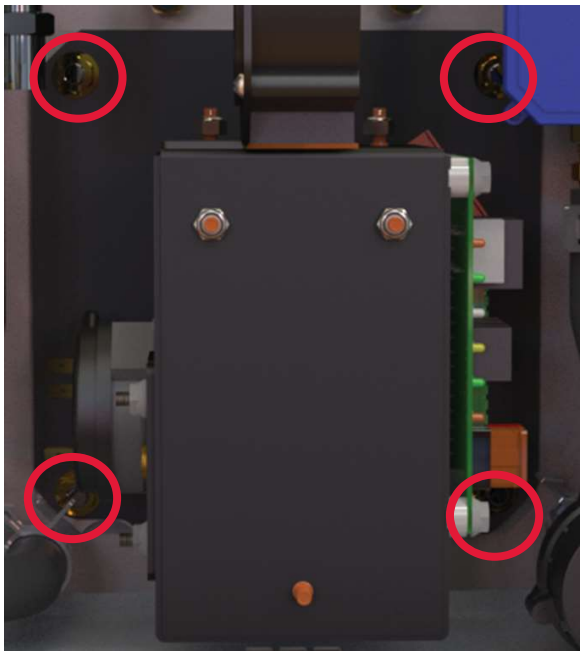


Figure 49

16. Very carefully slide the burner back from the tank face until you can gain access to the relay control board.
17. Disconnect the main wire harness from the relay control board by removing the 16-pin connector from its mate on the relay control board.
18. Carefully remove the clear tubing from the pressure switch located on the right side of the Aqua-Hot cabinet.

Figure 50

19. Continue to carefully remove the burner from the Aqua-Hot cabinet. Please note that wires may have become entangled in your unit complicating removal. Take care to not damage any wires or other hardware within the Aqua-Hot.

Reinstalling the Propane Burner

Introduction:

The instructions in this section detail how to safely reinstall the propane burner on the Aqua-Hot 250P.

Procedure:

1. Before reinstalling the propane burner, the mounting gaskets must be replaced. Locate these replacement gaskets and prep them to be installed.
2. Slide the combustion chamber and the old gaskets forward until they are completely removed from the Aqua-Hot.

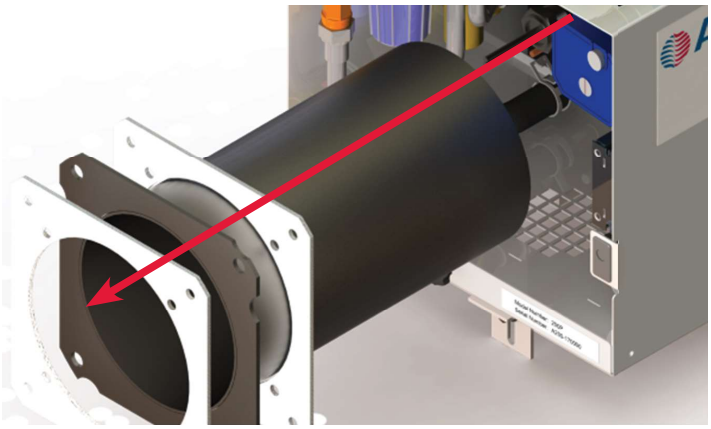


Figure 51

3. Remove and discard these old gaskets.
4. Locate the replacement gaskets. Slide one gasket into place between the combustion chamber and the tank face of the Aqua-Hot.
5. Slide the combustion chamber back into place.
6. Position the second gasket into place on above the combustion chamber flange.
7. Position the propane burner so that it can be easily slid back into place, but do not slide the burner forward completely.
8. Reconnect the main wire harness to the relay control board at the 16-Pin connection.
9. Reattach the clear tubing to the pressure switch located on the right side of the Aqua-Hot cabinet.
10. Very carefully slide the propane burner assembly back into the combustion chamber. Take great care to not damage the refractory insulation.
11. Using a ½" socket and extension, re-secure the propane burner to the mounting studs on the Aqua-Hot tan face as shown in Figure 52. It may be necessary to use a swivel fitting to gain access to all mounting hardware.

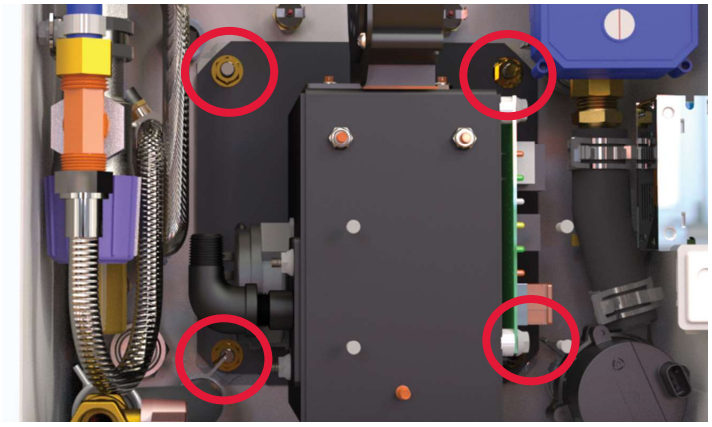


Figure 52

12. Slide the bulkhead fitting back into place over the propane valve fittings.
13. Using two ⅜" wrenches, re-secure the bulkhead fittings.
14. Using two $^{11}/_{16}$" wrenches, tighten the fitting securing the propane line to the bulkhead fittings. Use one as a backing wrench and tighten only the bottom fitting until it is secure.

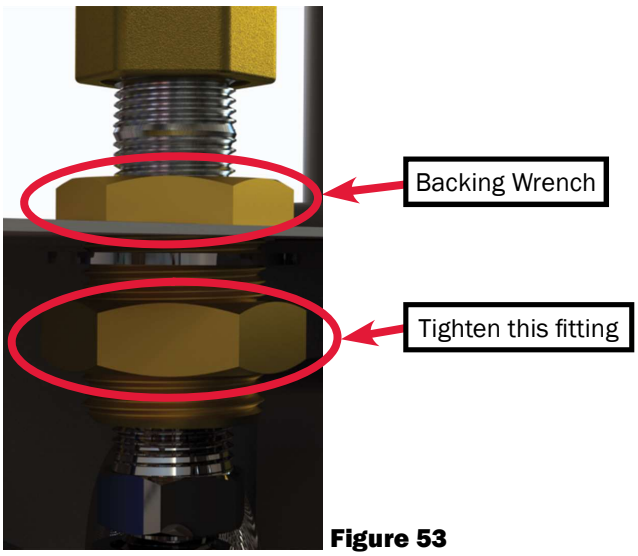


Figure 53

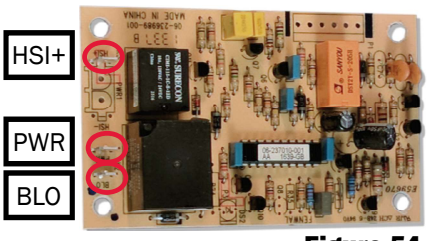


Figure 54

15. Retrieve the Fenwal control card and reconnect wire #17 to the pin labeled "PWR".
16. Reconnect wire #48 to pin labeled "BLO".

17. Reconnect wire #46 to pin labeled “HSI+”.
18. Secure the Fenwal control card and its housing to the side of the propane burner assembly using a ⅜” socket or nut driver to secure two nuts to the top of the enclosure.

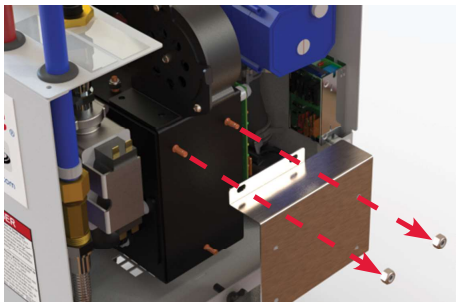


Figure 55

19. Reconnect wire #38 to the right high-limit thermostat.
20. Reconnect wire #39 to the left high-limit thermostat.
21. Reconnect wires #1, #2, and #45 to the left ground stud.
22. Reconnect wires #47, #33, and #27 to the right ground stud.
23. Secure these ground wires with the previously removed $^{3}/_{16}$” nuts on top of the propane burner subassembly.

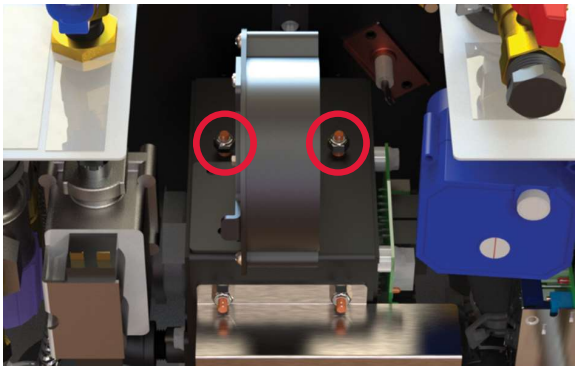


Figure 56

24. Reconnect the Aqua-Hot to a propane source to check for leaks in the propane fittings.
25. Open the propane ball valve on the Aqua-Hot and open any propane shutoff valves present within the coach.
26. Check for propane leaks around the recently reconnected propane fittings using an approved propane leak detection method.
27. If excess propane is found anywhere around these fittings, address the leaks and repeat the above process. Repeat as necessary until no leaks remain.
28. Once complete, reinstall the access cover of the Aqua-Hot.

Mounting Gaskets

Function:

The mounting gaskets create a tight seal between the boiler tank and the combustion chamber, and the combustion chamber and the burner mounting plate.

Replacement Indicator:

The mounting gasket should be replaced each time the burner is detached from the Aqua-Hot.

CAUTION

Ensure that the gas supply line has been shut off prior to the start of this replacement procedure.

Replacement Procedure:

1. Follow the instructions on Page 36 to detach the propane burner.
2. Remove the existing gasket from the front of the combustion chamber of the Aqua-Hot.
3. Remove the second gasket from the back side of the combustion chamber.
4. Note that it may be necessary to use a scraping tool such as putty knife to completely remove the old gasket from the combustion chamber.
5. Set the replacement mounting gasket into place on the boiler tank's front plate.
6. Follow the procedure on Page 38 to reattach the propane burner to the Aqua-Hot.

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

DANGER

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

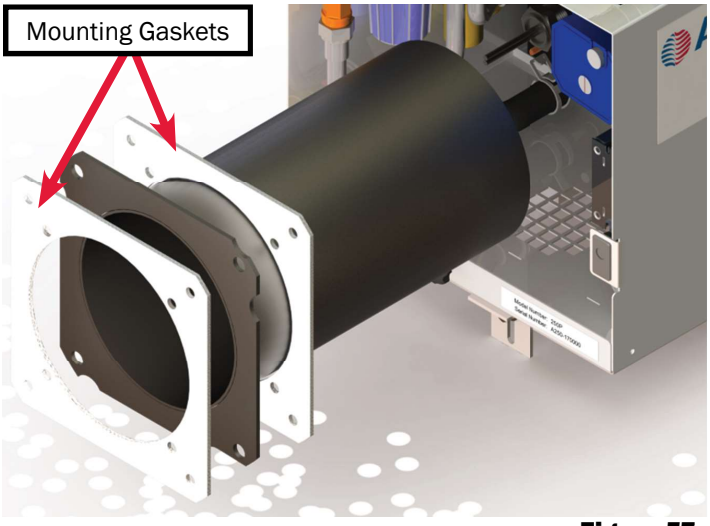


Figure 57

Hot Surface Igniter

Function:

The hot surface igniter ignites the propane gas and air mixture inside of the combustion chamber. It will activate approximately 10 seconds after the initial start-up sequence begins, and approximately five seconds before the dual-stage propane gas valve opens to ensure that it is up to proper ignition temperature of 1300°F before propane enters the combustion chamber.

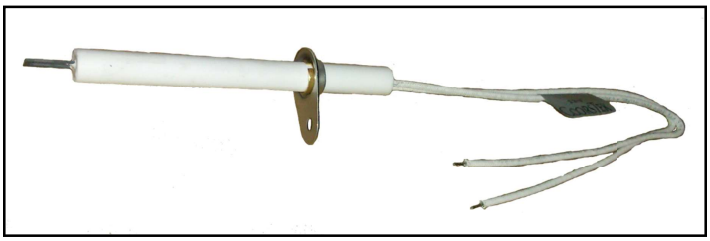


Figure 58

Replacement Indicator:

Replace the hot surface igniter if:

- The unit fails to ignite the propane gas.
- If the igniter is cracked or otherwise damaged.
- If there is a "popping" sound during start-up.

Troubleshooting:

1. Verify the following before troubleshooting the hot surface igniter:
    - The control thermostat is calling for heat
    - The interlock switch is depressed
    - The overflow bottle is adequately filled
    - The high-limit thermostats are not tripped
    - The fuses on the relay board are functional
2. Turn the propane burner switch to the "ON" position on the interior switch panel.
3. Approximately 10 seconds after the blower fan begins operating, the propane burner controller will activate the hot surface igniter.
4. Check the burner controller for 12V DC at the hot surface igniter wire (#46 Red).
    - If no voltage is present, proceed to Page 34 to diagnose the Fenwal control card.
5. Check the hot surface igniter buck boost for 12V DC at wires #48 (red) and #49 (black).
    - If less than 12V DC are present, replace the buck boost module.

DANGER

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

6. If voltage exists on step 4, locate a DC clamp-on type meter and test the hot surface igniter wires, #46 (red) or #47 (black), for amp draw.
    - If the amp draw is less than 1.5A, replace the hot surface igniter.

CAUTION

The Hot Surface Igniter is extremely HOT, use caution when handling or serious burns may occur.

Visual Inspection Procedure:

It is possible to view the hot surface igniter as a means to verify functionality.

1. Turn the Propane Burner switch on the interior switch panel to the OFF position.
2. Close the propane gas ball valve located on top of the heater where the coach-side propane line connects to the heater.
3. Using a Phillips screwdriver, loosen the hot surface igniter and carefully remove it from its mounting position.
4. With the hot surface igniter removed, and the propane shut off valve in the closed position, move the propane burner switch to the ON position.
5. Approximately 10 seconds after the blower fan starts, the hot surface igniter should start warming. The tip should glow red for approximately 10 seconds.
    - If the tip does not glow, the hot surface igniter will need to be replaced.
6. If the hot surface igniter is in working condition, very carefully reinstall it. If the ceramic casing or tip of the hot surface igniter is damaged, it will cease to function.

Replacement Procedure:

1. If not done so already, shut off all power sources to the Aqua-Hot.
2. Turn off the propane at the ball valve on top of the Aqua-Hot.
3. Remove the access cover of the Aqua-Hot to gain access to internal components.
4. Disconnect the hot surface igniter from the buck boost module.
5. Using a Phillips screwdriver, remove the screw on the burner which is securing the hot surface igniter.
6. Discard the defunct igniter.
7. Position the replacement igniter on the face of the burner.
8. Secure the igniter in place with the previously removed Phillips screw.
9. Reconnect the hot surface igniter to the igniter buck boost. Red wire to “OUT +” and the black to “OUT -”.

Figure 59

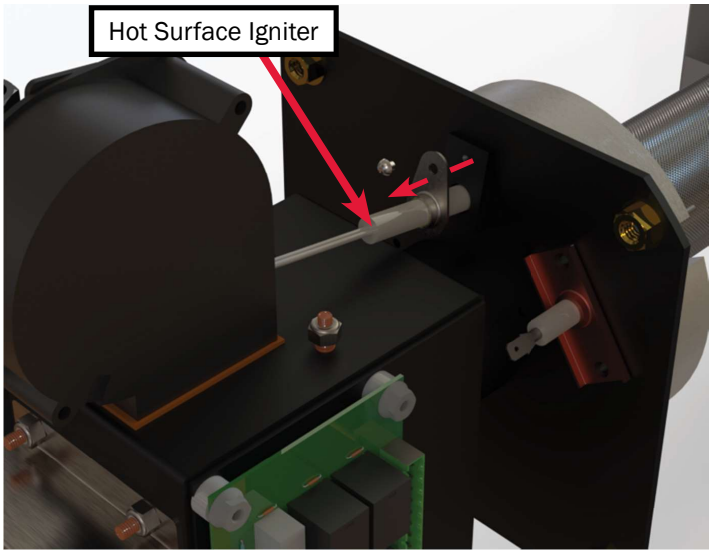


Figure 60

NOTE: The propane burner shown above is removed to aid in the location and demonstration purposes. It is not necessary to remove the propane burner to replace this component.

Refractory Insulation

Function:

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. The refractory should be replaced if it is ever damaged.

Troubleshooting:

1. Follow the instructions starting on page 36 to remove the propane burner.
2. Once the propane burner has been removed, carefully inspect the refractory for any damage.
   - If the refractory has been damaged, it needs to be replaced.
3. With the burner removed, ensure that the refractory is secured in place on the propane burner, seated against the mounting plate.

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 can inhibit the function of the propane burner.

DANGER

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

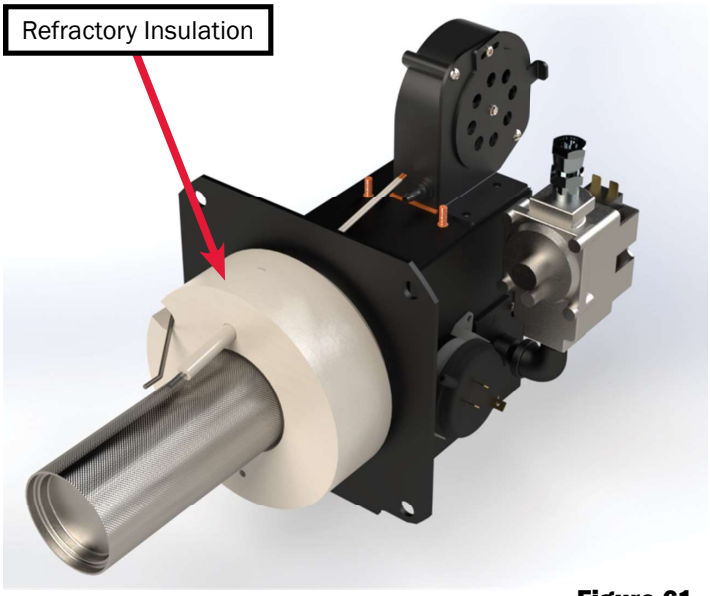


Figure 61

Replacement Procedure:

1. Turn the propane burner switch located on the interior switch panel to the OFF position.
2. Turn the propane gas supply valve located on top of the Aqua-Hot to the OFF position.
3. Turn off the coach propane supply valve.
4. If you have not already done so, follow the instructions on Page 36 to remove the propane burner.
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 that both the flame sensor, and hot surface igniter holes are aligned.
8. Reinstall the flame sensor and hot surface igniter onto the propane burner.
9. Reinstall the propane burner onto the heater, and tighten the nuts securing the burner in place.
10. Connect the propane gas line to the dual stage gas valve and securely tighten the fittings to 30 ft/lbs.
11. Test the Aqua-Hot for proper operation.

Dual-Stage Propane Gas Valve

Function:

The dual-stage propane gas valve will activate approximately 6 seconds after the hot surface igniter has been activated allowing propane gas to enter the combustion chamber and achieve combustion. Given that the propane gas valve is dual-stage, both stages must be activated for propane fuel to 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.

Before troubleshooting the dual-stage propane gas valve, ensure that the coach has an adequate supply of propane gas, and that all valves and shutoffs are open, allowing propane flow to the Aqua-Hot.

Troubleshooting:

1. Verify the following before troubleshooting the dual stage propane gas valve:
    - The control thermostat is calling for heat
    - The interlock switch is depressed
    - The overflow bottle is adequately filled
    - The high-limit thermostats are not tripped
    - The fuses on the relay board are functional
2. Turn the propane burner switch, located on the interior switch panel to the ON position.
3. Verify that the tank face is less than 155°F. If it is not, allow the unit time to cool before continuing. These tests will not work with a hot unit.
4. Verify that the dual stage gas valve is receiving voltage during the first fifteen seconds of the start-up cycle when the unit is activated from a cold state.
    - Test for voltage at wire #41 at the Fenwal control card. If there is no voltage here, begin troubleshooting the Fenwal control card on Page 34.
5. If the Fenwal card is sending voltage to the dual stage gas valve, check for voltage at the dual stage propane valve as denoted by Figure 62.
    - If voltage is not present at the gas valve, inspect the wiring harness for damage.

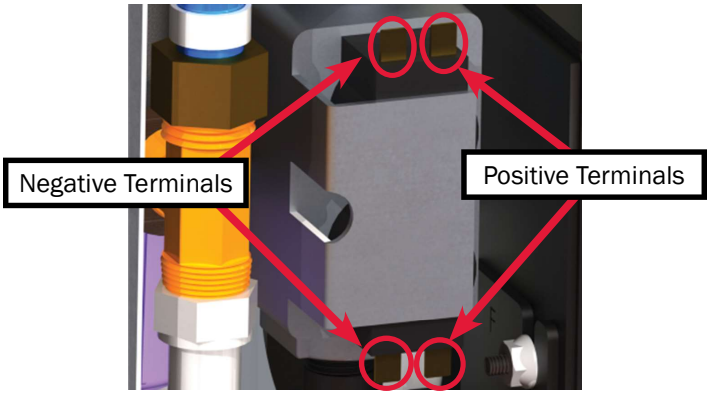


Figure 62

6. If voltage is present, but the gas valve is non-functioning replace the dual stage gas valve.

Replacement Procedure:

1. Shut off the propane gas supply by turning the propane inlet port ball valve to the OFF position.
2. Shut off the coach-side propane supply valve.
3. Using an $^{11}/_{16}$" wrench, remove the propane supply line from the dual stage gas valve.

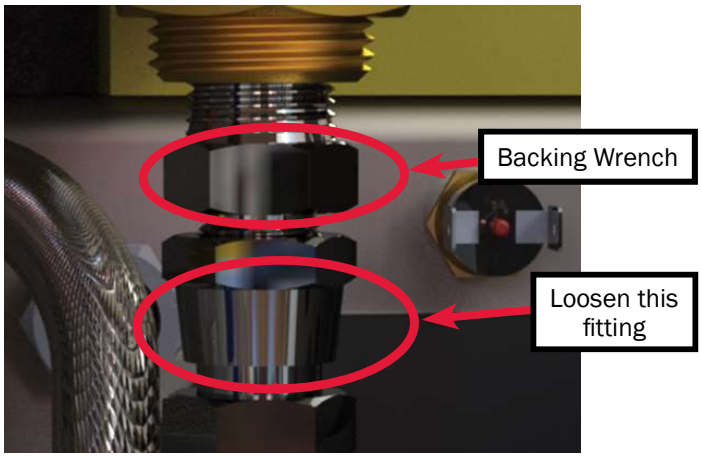


Figure 63

4. Using two ¾" wrenches, loosen, but do not completely remove the bulkhead fitting. Reference Figure 63.
5. Disconnect wires #40, #41, and the ground wires from the gas valve.

6. Remove the two nuts securing the dual stage valve to the burner plenum.

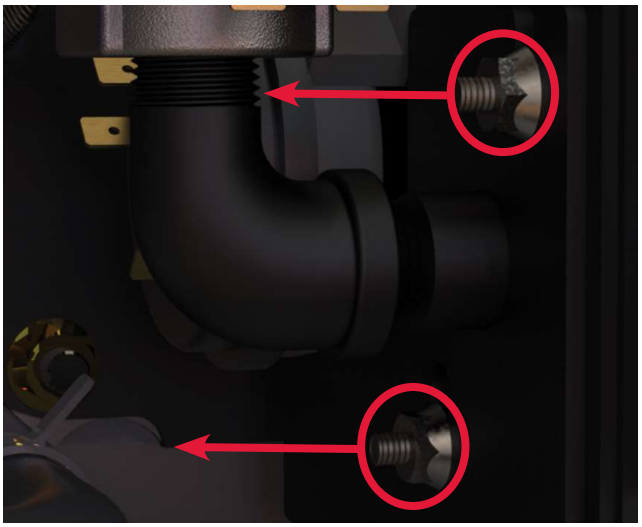


Figure 64

7. Remove the fittings present at the top and bottom of the dual stage propane gas valve shown below.

Figure 65

8. Clean these now-removed fittings, then apply new thread seal tape.
9. Reinstall these fittings onto the new dual stage propane gas valve.
10. Re-secure the nozzle into place on the side of the burner plenum assembly as previously removed in step 6. Take great care to ensure that grease does not cover the fuel nozzle.
11. Reattach the propane supply valve to the bulkhead fitting.

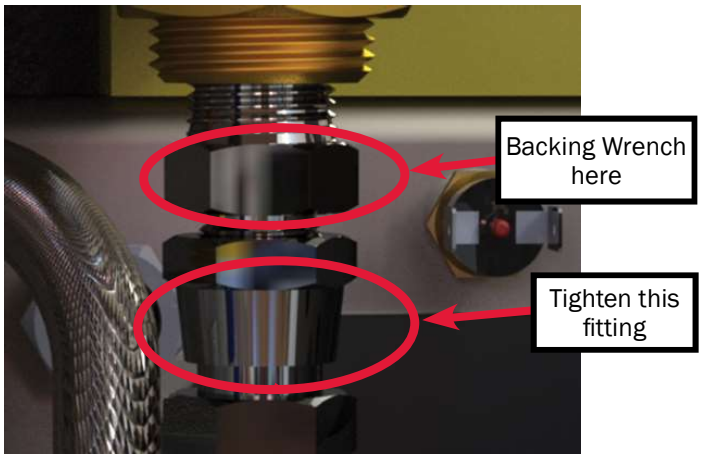


Figure 66

12. Tighten the bulkhead fitting to the Aqua-Hot cabinet.

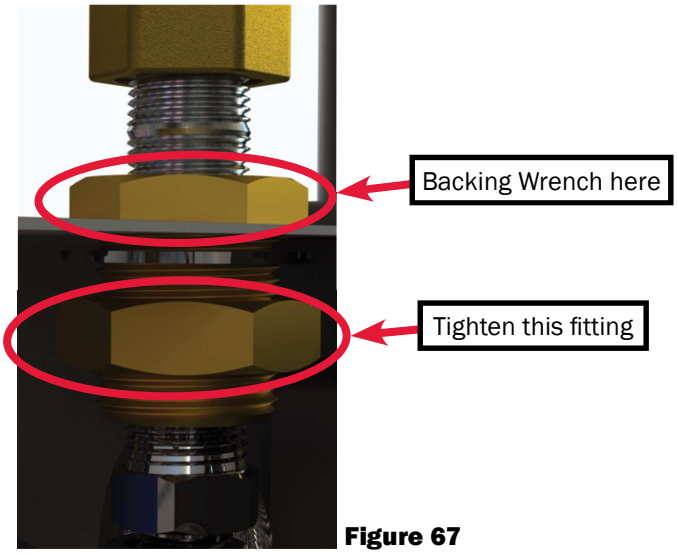


Figure 67

13. Reconnect wires # 40 and #41 to the dual stage gas valve. Wire #41 will terminate at the top positive connection, and wire #40 will terminate at the bottom positive connection. Connect the ground wires in a similar fashion. Reference Figure 62.
14. Turn the propane ball valve back to the ON position, and inspect the propane fittings for any propane leaks using an approved propane detection method.
15. If propane leaks are found, shut off the propane valve, and address the leak. Repeat this process until no leaks remain.
16. Test the unit for normal operation.

Propane Combustion Blower Fan

Function:

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 47 for the adjustment procedure.

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

Replacement Indicator:

Replace the combustion blower fan if, after troubleshooting, the unit still fails to operate.

Troubleshooting:

1. Verify the following before troubleshooting the propane combustion blower fan:
    - The control thermostat is calling for heat
    - The interlock switch is depressed
    - The overflow bottle is adequately filled
    - The high-limit thermostats are not tripped
    - The fuses on the relay board are functional
2. Turn the propane burner switch, located on the interior switch panel to the ON position.
3. Verify that the burner controller is sending power to the combustion blower motor.
    - Using a digital voltmeter, check wire #48 for 12V DC. If no voltage is present, begin diagnosing the Fenwal control card using the instructions on Page 34.
4. Verify that the buck boost module is functioning properly by using a digital voltmeter to test for voltage at the buck boost. It should read 12.5V DC. If there is no voltage exiting the buck boost module, it will need to be replaced.
5. If at this point, all tests of the combustion blower fan are successful but the blower still fails to operate, the blower fan will need to be replaced.

Replacement Procedure:

1. Turn the propane burner switch located on the interior switch panel to the OFF position.
2. Disconnect the wires connecting the blower fan to the buck boost module. Using a ⅜" socket, loosen the nuts securing the combustion blower fan to the top of the burner assembly.
3. Discard the orange gasket which seals the blower fan to the propane burner assembly.

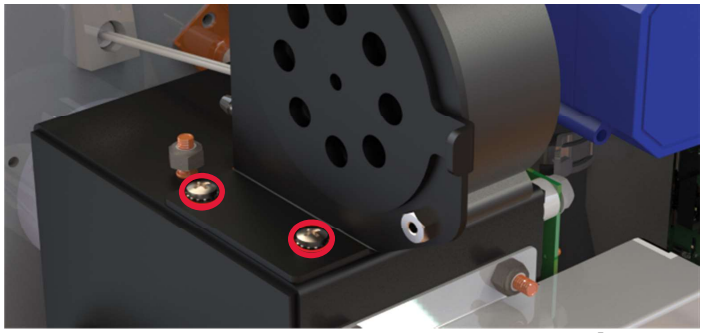


Figure 68

4. Using a Phillips screwdriver and a 9mm socket, separate the defective blower fan from the air shutter assembly by loosening the nuts shown below.

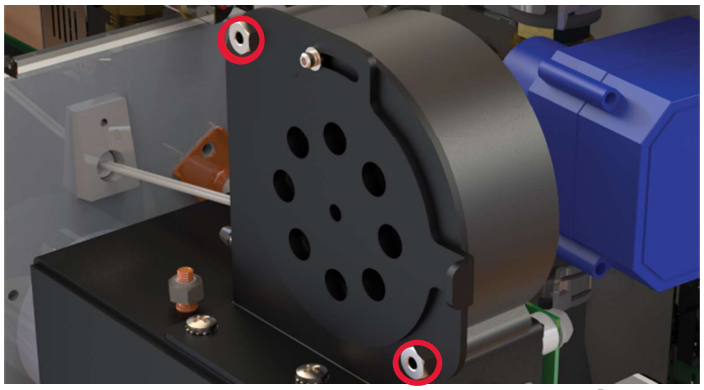


Figure 69

5. Remove the hose from the barb on the blower fan.
6. Discard the defective blower fan, and secure the new blower fan to the air shutter assembly using the previously mentioned Phillips screwdriver and the 9mm socket. Tighten this hardware to 12 in-lbs.
7. Reattach the hose to the barb of the blower fan.
8. Reposition the air shutter assembly and new blower fan to the propane burner assembly. Take care to ensure that the orange sealing gasket is properly aligned.
9. Using a ⅜" socket, secure the now repaired assembly to the top of the propane burner.
10. Reconnect the wires of the blower fan to the buck boost module.

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 $^{9}/_{32}$" 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.

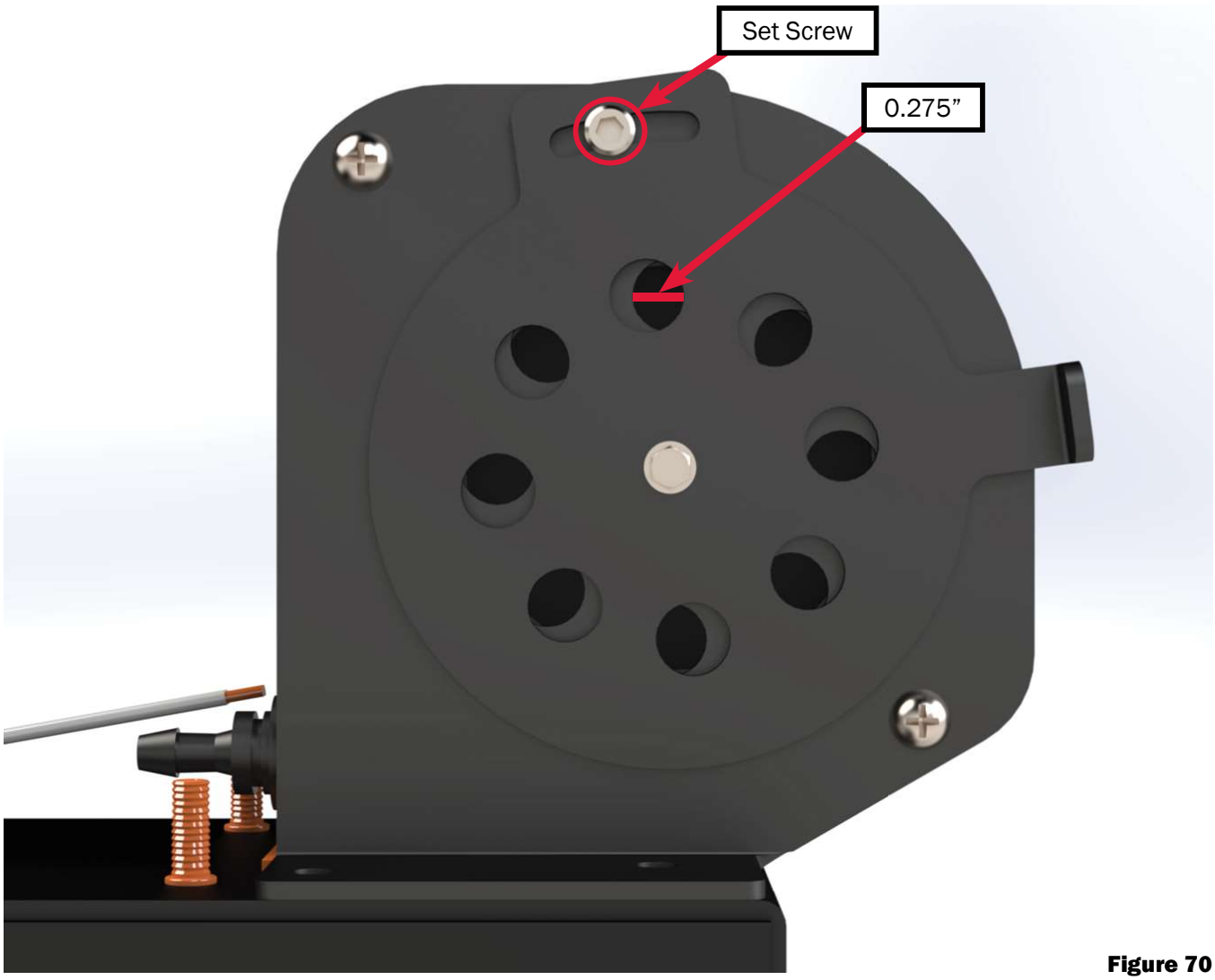


Figure 70

Exhaust "High Back Pressure" Switch

Function:

The purpose of the high back pressure switch is to monitor back pressure inside the combustion chamber and shut the burner down if it senses high back pressure. This switch is normally closed, moving to the open position if excessive back pressure is detected inside the combustion chamber.

This function serves as a safety mechanism, deactivating the burner if exhaust and gaseous fuel "back-flows" into the cabinet of the Aqua-Hot, or if there is an obstruction or damage to the exhaust system.

Replacement Indicator:

The high back pressure switch will need to be replaced if it ceases to function correctly, or if the switch is physically damaged.

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

Troubleshooting Procedure:

1. Verify the following before troubleshooting the back pressure switch:
    - The control thermostat is calling for heat
    - The interlock switch is depressed
    - The overflow bottle is adequately filled
    - The high-limit thermostats are not tripped
    - The fuses on the relay board are functional
2. Turn the propane burner switch, located on the interior switch panel to the OFF position. If necessary, allow the Aqua-Hot to completely shut down.
3. Locate the exhaust "high back pressure" switch, located on the left side of the propane burner assembly.
4. Disconnect the two wires connected to the switch by firmly pulling on the quick disconnect terminals. Be careful not to damage these terminals.
5. Using a digital multimeter, check the switch for continuity as described below. Reference Figure 72 for the exact pin locations.
    - Check for continuity between the pins labeled "C" and "NO". There should be NO continuity between these pins. If continuity exists, replace this switch.
    - Check for continuity between the pins labeled "C" and "NC". If continuity does NOT exist between these pins, this switch will need to be replaced.

Replacement Procedure:

1. Disconnect the two wires connected to the switch by firmly pulling on the quick disconnect terminals.
2. Using a #2 Phillips 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.
5. Reconnect wire #35 to the Pin labeled "NC".
6. Reconnect wire #34 to the Pin labeled "C".
7. Test for proper operation.

Figure 71

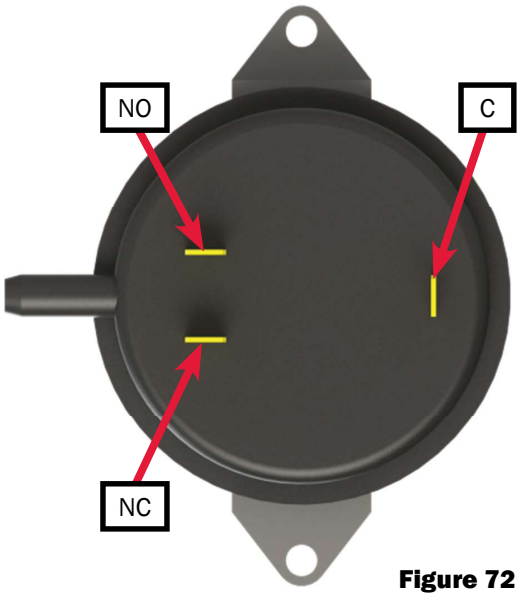


Figure 72

Fan Validation Switch

Function:

The purpose of the fan validation switch is to monitor the combustion blower fan and verify that it is operating correctly. This switch is normally open. If the fan validation switch fails to operate, the fuel valve solenoid will not open, and the combustion chamber will not be supplied with combustible fuel.

Replacement Indicator:

Replace the fan validation switch if the switch fails to operate or if its physically damaged.

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

Troubleshooting Procedure:

1. Verify the following before troubleshooting the fan validation switch:
    - The control thermostat is calling for heat
    - The interlock switch is depressed
    - The overflow bottle is adequately filled
    - The high-limit thermostats are not tripped
    - The fuses on the relay board are functional
2. Turn the propane burner switch, located on the interior switch panel to the OFF position. If necessary, allow the Aqua-Hot to completely shut down.
3. Locate the fan validation switch. It is attached to the cabinet wall on the right of the propane burner assembly. Reference Figure 73.
4. Disconnect the two wires connected to the switch by firmly pulling on the quick disconnect terminals. Take care to ensure that the terminals are not damaged during this process.
5. Using a digital multimeter, check the fan validation switch for continuity.
    - If continuity exists across the two terminals on the fan validation switch, it will need to be replaced.
6. Move the burner switch on the interior switch panel to the ON position. Test for continuity across this switch while the combustion blower fan is on. If continuity does not exist, replace the fan validation switch.

Replacement Procedure:

1. Move the propane burner switch on the interior switch panel to the OFF position. If necessary, allow the propane burner to completely shut down.
2. Locate the fan validation switch. It is attached to the cabinet wall on the right of the propane burner assembly. Reference Figure 73.
3. Disconnect the two wires connected to the switch firmly pulling on the quick disconnect terminals.
4. Using a $^{3}/_{16}$" Allen wrench, remove the nuts securing the fan validation switch to the cabinet wall of the Aqua-Hot.
5. Remove the defective switch.
6. Secure the replacement switch to the side of the Aqua-Hot cabinet in place of the defunct component.
7. Secure the previously removed nuts to the cabinet wall with a $^{3}/_{16}$" Allen wrench.
8. Reconnect the previously disconnected wires to the switch.
9. Test unit for proper operation.

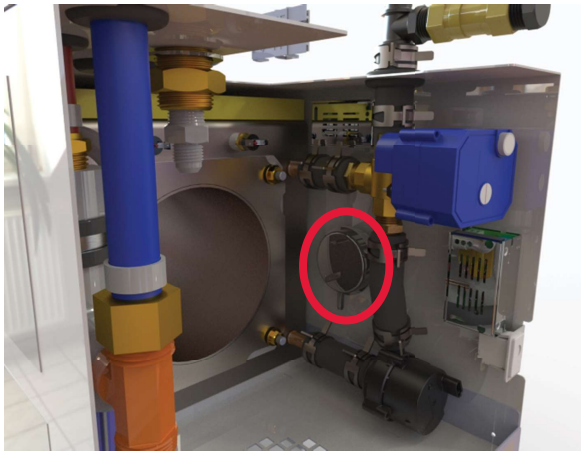


Figure 73

Figure 74

Buck Boost Converter - Combustion Blower Fan

Function:

The purpose of the buck boost converter is to maintain a preset output voltage supplied to the combustion blower fan. This provides predictable and controllable operation of the blower fan to ensure the most ideal conditions for sustaining burner operation.

NOTE: There are two buck boost converters on the 250 Propane Series. Reference Figures 75 and 77 to ensure that you are troubleshooting the correct module.

Replacement Indicator:

Replace the buck boost converter if it fails to provide 12V DC power, or if it is physically damaged.

Troubleshooting Procedure:

1. Turn the propane burner switch, located on the interior switch panel to the ON position.
2. Verify the following before troubleshooting the buck boost module:
    - The control thermostat is calling for heat
    - The interlock switch is depressed
    - The overflow bottle is adequately filled
    - The high-limit thermostats are not tripped
    - The fuses on the relay board are functional
    - The fan validation switch is functioning properly - see Page 49.
    - The D5 indicator light is illuminated.
3. Verify that the propane burner controller is sending 12V DC power to the buck boost module 15 seconds from initial start-up. Check voltage at the Pin labeled “BLO”.
    - If the propane burner controller is not supplying power while all of the above criteria are met, the Fenwal control card needs to be replaced.
4. If the propane burner controller is sending power on the “BLO” Pin, check the wiring harness for damage. Repair or replace the wiring harness if necessary.
5. Verify that the buck boost converter is sending power to the combustion blower motor. This voltage should be approximately 12.5V DC when the supply voltage is between 11V DC and 15V DC.
    - If the buck boost converter does not output approximately 12.5V DC and the supply voltage is between 11V DC and 15V DC, the buck boost will need to be replaced.

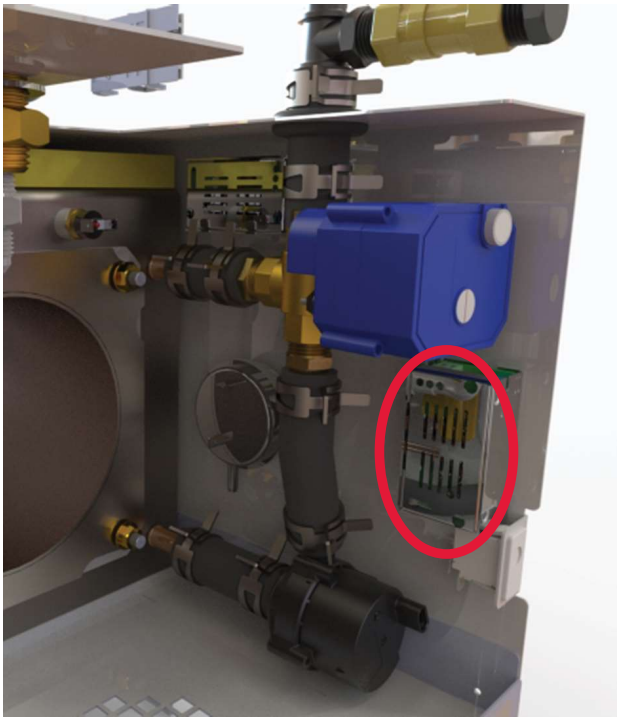


Figure 75

Figure 76

Buck Boost Converter - Hot Surface Igniter

Function:

The purpose of the buck boost converter is to maintain a preset output voltage, allowing the hot surface igniter to function optimally under normal conditions.

NOTE: There are two buck boost converters on the 250 Propane Series. Reference Figures 75 and 77 to ensure that you are troubleshooting the correct module.

Replacement Indicator:

Replace the buck boost converter if it fails to provide steady 12V DC power, or if it is physically damaged.

Troubleshooting Procedure:

1. Turn the propane burner switch, located on the interior switch panel to the ON position.
2. Verify the following before troubleshooting the buck boost module:
    - The control thermostat is calling for heat
    - The interlock switch is depressed
    - The overflow bottle is adequately filled
    - The high-limit thermostats are not tripped
    - The fuses on the relay board are functional
    - The fan validation switch is functioning properly - see Page 49.
    - The D5 indicator light is illuminated.
3. Verify that the Fenwal control controller is sending 12V DC power to the buck boost module at Pin labeled “HSI+”.
    - If the propane burner controller is not supplying power while all of the above criteria are met, the Fenwal control card needs to be replaced.
4. If the propane burner controller is sending power on the “HSI+” Pin, check the wiring harness for damage. Repair or replace the wiring harness if necessary.
5. Verify that the buck boost converter is sending power to the hot surface igniter. This voltage should be approximately 12.5V DC when the supply voltage is between 11V DC and 15V DC.
    - If the buck boost converter does not output approximately 12.5V DC and the supply voltage is between 11V DC and 15V DC, the buck boost will need to be replaced.

Figure 77

Figure 78

Replacing the Buck Boost Modules

Introduction:

If it has been determined that one or both of the buck boost modules must be replaced, follow the instructions below to correctly remove and replace a buck boost module.

Replacement Procedure:

1. Move the propane burner switch on the interior switch panel to the OFF position. If necessary, allow the propane burner to completely shut down.
2. Disconnect the Aqua-Hot from any power source.
3. Locate the buck boost module to be replaced. Reference Figure 80.
4. Carefully remove the buck boost module from its position on the side of the Aqua-Hot cabinet.
5. Using a flat head screwdriver, loosen the four terminal screws found at both ends of the buck boost module as shown below.

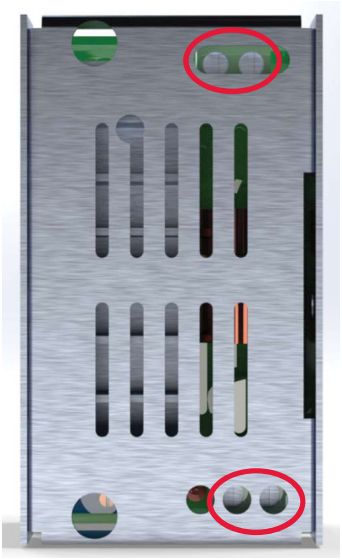


Figure 79

6. Discard the non-functional buck boost module.
7. Insert the previously removed leads into their respective positions on the buck boost module. Each end of the boost is labeled “IN” and “OUT”. See below for specific pin-out information.

Hot Surface Igniter

- Connect wires #46 to the Pin labeled “IN (+)” and #47 to “IN (-)” on the buck boost module.
- Connect the Hot Surface Igniter wires to the side labeled “OUT”.

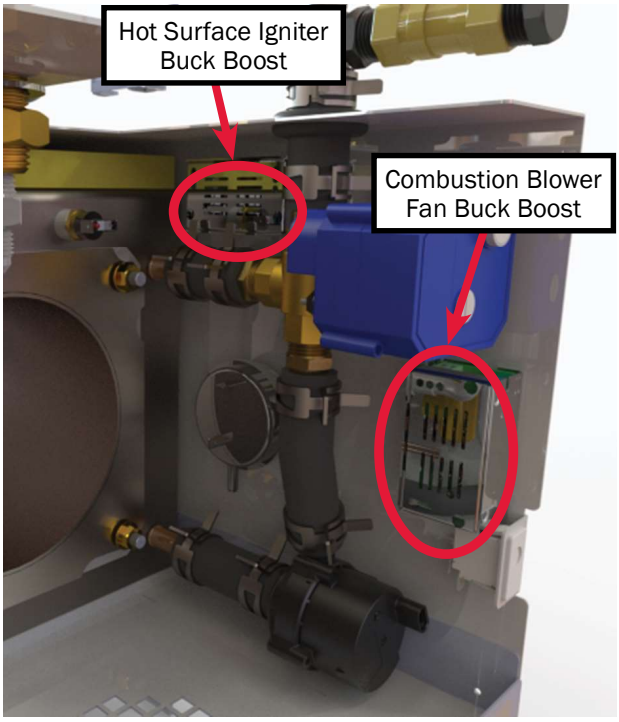


Figure 80

Hot Surface Igniter

- Connect wires #48 to the Pin labeled “IN (+)” and #47 to “IN (-)” on the buck boost module.
- Connect the wires of the blower fan to the replacement buck boost module pins labeled “OUT” - red to positive, black to negative.

8. Affix a mating piece of hook and loop tape to the back of the buck boost module, and attach it to the inside of the Aqua-Hot cabinet.
9. Test the unit for normal operation.

Propane Flame Sensor

Function:

The purpose of the flame sensor is to monitor the flame of the propane burner and verify that a flame is present within the combustion chamber. The flame sensor itself completes a path to ground.

Service Information:

The flame sensor should be cleaned using a heavy duty scouring pad (such as a Scotch-Brite pad) if functionality seems to be impacted. **DO NOT** use sand paper on the flame sensor.

Replacement Indicator:

Replace the flame sensor if it fails to operate or is physically damaged.

Troubleshooting Procedure:

Before continuing, there are considerations to take into account. The flame sensor produces a small current, measured in micro-amperes (µA). This current is too small to be detected by most retail multimeter. This functionality is necessary to troubleshoot properly. Please contact Aqua-Hot Heating Systems at 574-AIR-XCEL (574-247-9235) to assist in diagnosing the flame sensor.

1. Disconnect wire #35 from the flame sensor.
2. Connect the multimeter in-line between the disconnected wire and the flame sensor.
3. Set the multimeter to measure µA.
4. Move the propane burner switch on the interior switch panel to the ON position.
5. Check the amp draw on the multimeter. It should be 0.7 µA or higher while a flame is established.

NOTE: If the multimeter reads below "0" on scale, the meter leads have been reversed. Disconnect power and reconnect the meter leads to record the proper polarity.

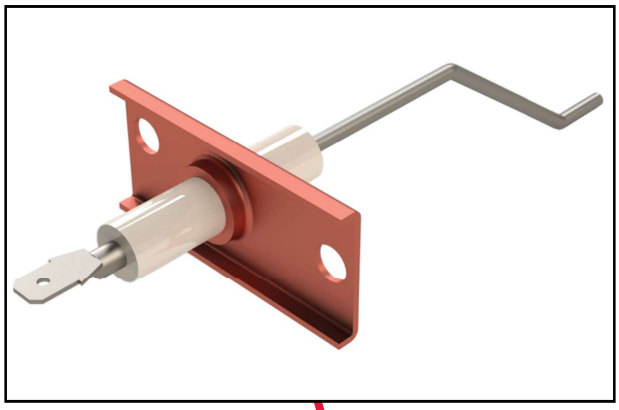


Figure 81

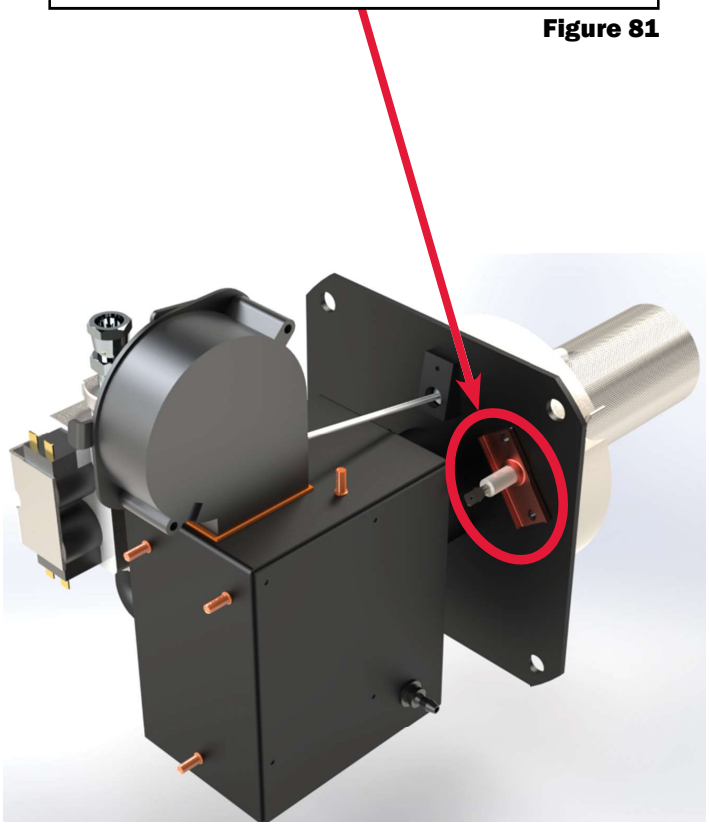


Figure 82

Flame Sensor Replacement Procedure

Introduction:

The following instructions will assist in replacing the propane flame sensor once it has been deemed to be non-functional.

Replacement Procedure:

1. Disconnect the Aqua-Hot from any and all power sources.
2. Ensure that the Aqua-Hot has cooled down completely.
3. Disconnect #35 from the flame sensor.
4. Using a 5/32" hex-head Allen wrench or driver, remove the two bolts securing the flame sensor in place:

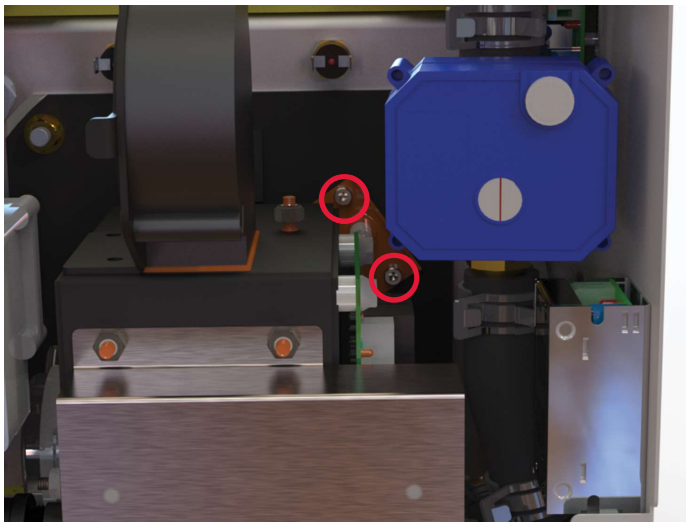


Figure 83

5. Very carefully remove the flame sensor once these bolts have been removed by gently twisting while pulling the flame sensor out of the burner assembly.
6. Discard the defunct flame sensor.
7. Locate the replacement flame sensor and twist it into place.
8. Using a 5/32" hex-head Allen wrench, re-secure the flame sensor in place with the previously removed screws.
9. Reconnect wire #35 to the flame sensor.
10. Test the unit for normal operation.

Filling and Purging the Aqua-Hot 250P

Outlined below is the procedure for filling the Aqua-Hot with a 50/50 solution of propylene glycol and distilled water. Follow the directions below to fill and purge the Aqua-Hot.

A 50/50 mixture of "GRAS" (Generally Recognized as Safe) approved **propylene glycol** antifreeze and distilled or de-ionized water is recommended. The mixture may be modified to provide the most adequate freezing, boiling, and rust/anti-corrosive protection. Reference pages 60-61 for more information about antifreeze.

Procedure:

1. Locate the fill valve at the zone port outlet (Figure 85).
2. Make a ½" NPT connection from the propylene glycol source to the fill valve.
3. Remove the access cover and locate the 3-way valve in the Aqua-Hot. Ensure that the sight glass is oriented as shown below. Reference Page 8, Figure 3 (Item #5) for the 3-Way Valve location.

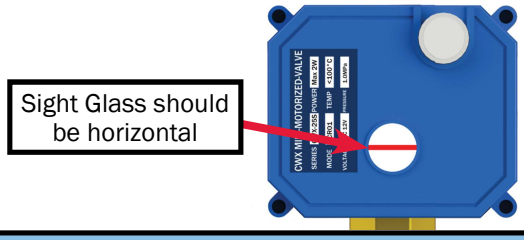


Figure 84

NOTE: If the sight glass is not oriented in this way while the unit is cold, apply power to the main harness connection and the valve will return to horizontal.

4. Activate the fluid transfer pump and begin filling the Aqua-Hot through the fill valve.
5. When the fluid level reaches the cold mark on the expansion bottle, deactivate the fluid pump.
6. Close the fill valve and disconnect the pump.
7. Reattach the access cover.
8. Turn on the burner at the interior control panel and set the thermostat to its maximum temperature to allow for interior heating. Let the Aqua-Hot run for at least 20 minutes to ensure that any air in the heating loop has been purged. If necessary, top off the propylene glycol solution at the fluid expansion bottle.

WARNING

Only Propylene Glycol based "boiler" antifreeze deemed "GRAS" by the FDA shall be used in the Aqua-Hot's hydronic heating system, Failure to use approved antifreeze could cause serious injury or death.

CAUTION

Ensure that the expansion tube is connected to both the expansion bottle and to the Aqua-Hot. Also ensure that the overflow hose is connected to the top port on the expansion bottle and is allowed to flow out of the coach through the floor of the bay as shown below.

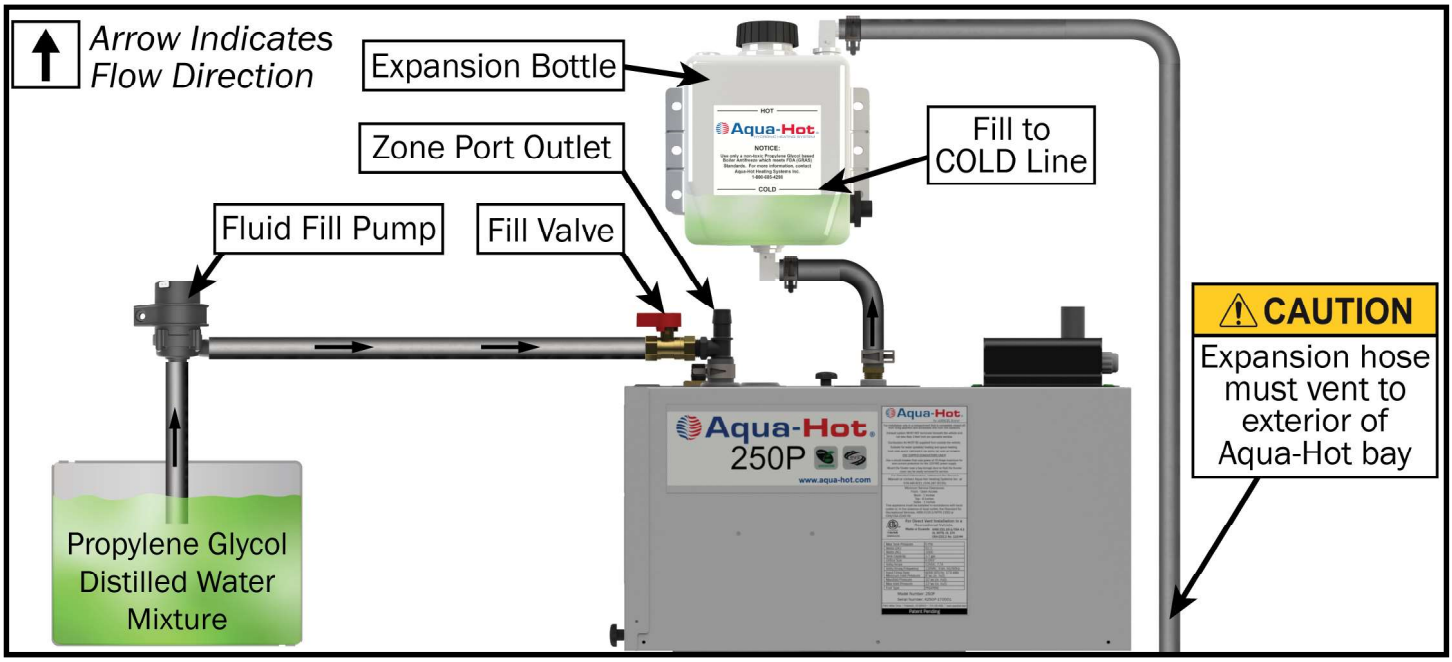


Figure 85

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 86 for a system overview and pages 60 and 61 for selecting the appropriate winterization antifreeze.

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

1. Disconnect or shut off any external sources of freshwater.
2. Open all faucets, shower heads, and similar. Open both the "HOT" and "COLD" valves on the faucet, if applicable.
   - If only one valve, open it to the "halfway point".
3. Ensure that the coach is connected to a waste collection point, such as a grey water tank.
4. Attach an external fluid pump to your fresh water connection.
5. Ensure that the fill pump intake hose is situated in a large enough supply of "GRAS" winterization antifreeze so that the pump does not run dry if left unattended.
6. Activate the external fill pump. Allow the pump to run until ONLY antifreeze is exiting the faucets in the coach.
7. Once this has been completed, deactivate and disconnect the external fluid pump.
8. Close all but one faucet in the coach. This will allow the winterization antifreeze to expand and contract as necessary with temperature changes, thereby greatly reducing the likelihood of pressure-related damage to interior pipes.

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:

1. To de-winterize the unit, connect a freshwater source to the coach.
2. Ensure that all the interior faucets have been re-opened. This includes both HOT and COLD valves have been opened.
3. Turn on the external water source, and allow it to run until winterization antifreeze no longer flows from any faucets.

NOTICE

Disinfecting the Domestic Water System

The Aqua-Hot Heating components 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 of 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.

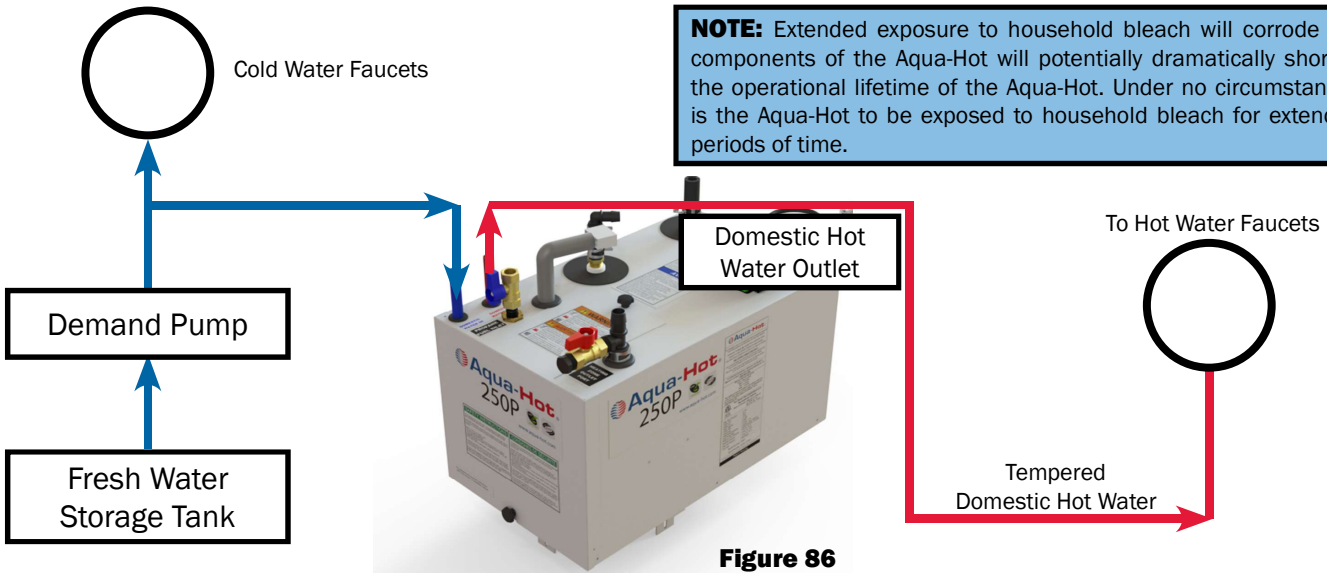


Figure 86

General Troubleshooting

Purpose:

This section serves to solve common operational problems, to reduce down-town and unit repair costs, by fixing the simplest problems first.

The Aqua-Hot 250P has an extremely simple annual service procedure. Remove the flame sensor and clean with a light abrasive pad like a Scotch-Brite pad.

Troubleshooting Procedure:

- Ensure that the Aqua-Hot is supplied with electrical power.
- Ensure there is an adequate supply of fuel (at least ¼ tank).
- Ensure that the Aqua-Hot boiler tank has an adequate supply of antifreeze and water heating solution by checking the level at the expansion bottle. If the level is low, reference the maintenance section of this guide for refilling instructions.
- Verify the functionality of any in-line fuses connected to the Aqua-Hot. Replace these fuses if necessary.
- Ensure that all coach-side hot water faucets are closed.
- Locate the relay control board within the Aqua-Hot unit. See Page 10 to identify this component.
- Verify that all of the fuses in the relay control board are in good working condition. Replace any non-functional fuses.
- Visually inspect the interior cabinet of the Aqua-Hot unit, searching for any damaged or disconnected wires. Reconnect or repair any damaged wires.
- Locate the left high-limit thermostat and follow the procedure on Page 21 to troubleshoot this component.
- Locate the right high-limit thermostat and follow the procedure on Page 21 to troubleshoot this component.
- Visually inspect the exhaust system of the Aqua-Hot to ensure that it has not been damaged or removed.
- Test for unit operation:
    - If the burner fails to operate, proceed to Page 59 for the propane burner troubleshooting.
    - If the burner begins to operate at this stage, choose a troubleshooting guide shown on the right based on the issue.

Lack of, or Uneven, Hot Water

A lack of hot water, or uneven delivery of hot water (hot water that contains cold spots), is typically due to a failure of one more of five components: the shower head, the stir pump, the three-way valve, the low-temperature cutoff thermostat, or the tempering valve.

- Shower Head
    - It is possible that the shower head in the coach is drawing hot water too quickly from the Aqua-Hot, overtaxing the unit resulting in hot water delivery problems. The shower head should be limited at 1.5GPM max.
- Stir Pump
    - Reference Page 27 to troubleshoot the stir pump.
- Three-Way Valve
    - Reference Page 24 to troubleshoot the three-way valve.
- Low-Temperature Cutoff Thermostat
    - Reference Page 22 to troubleshoot this component.
- Tempering Valve
    - Reference Page 26 to troubleshoot the tempering valve.

Once these components have been diagnosed, restart the Aqua-Hot and allow it to heat to operating temperature. Draw hot water to determine if the problem has been addressed.

If after troubleshooting and these components are found to be in good working condition, contact the Technical Support Department at 574-AIR-XCEL (574-247-9235) for assistance. You can also find a Factory Authorized Service Center for diagnostic and repair. Find your local service center online at www.aquahot.com.

Lack of Interior Heat

A lack of interior heat with a functioning burner can be attributed to many potential issues in the Aqua-Hot. Diagnosis will involve three stages. Stage 1 will outline common reasons for overall unit non-function that exists outside of the unit. Stage 2 will diagnose common issues inside the unit, including lack of burner operation. Stage 3 will address specific reasons for a lack of interior heat.

It is very important that troubleshooting proceed in the order outlined below. The issues most common with a lack of heat are:

- A non-functional three-way valve
- A seized circulation pump
- Air trapped in the coach heating loop
- A malfunctioning low-temperature cutoff thermostat

Stage 1:

- The coach is supplied with power
- The Aqua-Hot has an adequate supply of fuel
- All coach-side fuses are functional and able to supply power
- All water sources connected to the coach are shut off
- All fuses on the relay control board are functional
- The overflow bottle is filled to at least the COLD mark

Stage 2:

- Visually inspect the interior cabinet of the Aqua-Hot unit, searching for any damaged or disconnected wires. Reconnect or repair if necessary.
- Make sure the high-limit thermostats are not tripped or defective. Replace if necessary.
- Test for unit operation.
    - If the burner fails to operate, follow the procedure on Page 89 for the propane burner troubleshooting.

Stage 3:

1. Begin troubleshooting the three-way valve. See Page 24.
2. Reference Page 22 to diagnose the Low-Temperature Cutoff Thermostat.
3. Locate the circulation pump within the Aqua-Hot cabinet. It should begin operating immediately when the heater starts up. If the pump does not begin to operate, see the procedure on Page 27 for troubleshooting.
4. Locate all of the heat exchangers within the coach and determine if any of them are outputting heat.
    - If at least one heat exchanger is outputting heat, an air bubble may be preventing the flow of the antifreeze and water heating solution.
    - It may be possible to resolve this issue by allowing the circulation pump to run continuously, checking the heat exchangers periodically to determine if they have begun to function. See Page 55 for the heating loop purge procedure.

At this point, if steady interior heat cannot be achieved, contact Technical Support at 574-AIR-XCEL (574-247-9235), or take the coach to an Aqua-Hot Factory Authorized Service Center. One can be found at www.aquahot.com.

Propane Burner Troubleshooting

This section will cover troubleshooting the propane burner if it becomes inoperative.

If additional assistance if needed, please contact the technical support department at 574-AIR-XCEL (574-247-9235).

Troubleshooting Procedure:

1. Locate the fluid overflow bottle and ensure it is filled to at least the COLD mark.
2. Remove the cabinet access panel from the Aqua-Hot.

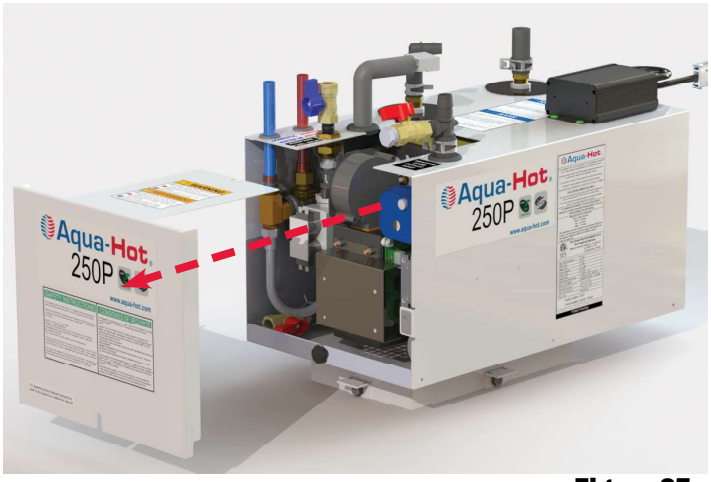


Figure 87

3. Move the burner switch on the interior switch panel to the ON position.
4. Depress the interlock switch.
5. If the blower fan begins to operate, continue to Step 7.
6. If the blower fan does NOT operate, turn to Page 46 to troubleshoot and repair the blower fan. Continue to Step 7 when the blower fan troubleshooting has been completed.
7. Troubleshoot the exhaust back pressure switch by following the procedure on Page 48.
8. Troubleshoot the fan validation switch on Page 49.
9. Troubleshoot the dual-stage gas valve using the procedure on Page 44.
10. Check the air shutter is properly adjusted by utilizing the information on Page 47.
11. Troubleshoot the hot surface igniter referencing Page 41.
12. Troubleshoot the hot surface igniter buck boost with the instructions on Page 51.
13. Following the procedure on Page 34, troubleshoot the Fenwal control card.
14. Follow the instructions on Page 36 to remove the propane burner from the Aqua-Hot. This will grant access to components for troubleshooting.

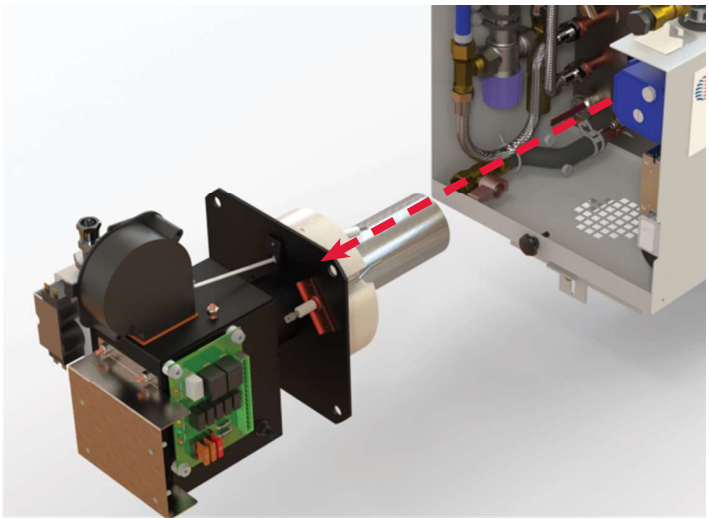


Figure 88

15. Check the refractory insulation to make sure it is not damaged by following the instructions on Page 43.
16. Check the mounting gaskets to ensure that they are not damaged or missing. Reference Page 40.

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 propylene glycol based "boiler" type antifreezes deemed "Generally Recognized As Safe" (GRAS) by the FDA should be utilized.

Due to 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 antifreeze is selected.

RV & 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 antifreeze 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 antifreeze can be utilized to winterize the Aqua-Hot's Domestic Hot Water Heating Systems.

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 rust inhibitors. Due to their potentially hazardous properties, they should never be used in the Aqua-Hot's Hydronic Heating System.

Antifreeze Mixture Quality Recommendations

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 which is 80ppm or less in total hardness. The local water agency should have up-to-date water quality reports, which should indicate if the local tap water is within this guideline.

Antifreeze Terms & Mixture Ratio

Propylene Glycol Based Antifreeze Solution

The following information addresses the process of selecting a propylene glycol based antifreeze solution that provides adequate freeze, boiling, and rust/anti-corrosive protection.

A propylene glycol antifreeze solution that is 35% to 50% propylene glycol to distilled water is recommended. Antifreeze solution with 50% propylene glycol will result in a freeze point of approximately -28°F and a boil point of approximately 222°F.

Freeze Point and Burst Point

NOTE: The installer of the Aqua-Hot system must refer to the information and chart to determine the percentage of propylene glycol the antifreeze solution should contain for the level of protection needed.

Antifreeze solution lowers the freezing point of any liquid, to which it has 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 and starts producing a "slushy" consistency, the antifreeze 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 antifreeze employed.

Rust and Anti-Corrosive Inhibitors

Another major function of antifreeze solution 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 solution has three basic functions: freeze protection, boil-over protection, and rust/anti-corrosion protection.

Propylene glycol antifreeze solution is also primarily responsible for heat transfer; however, propylene glycol itself does not possess acceptable heat transfer characteristics. Therefore, as water is an excellent heat conductor, it is added to the mixture. Propylene glycol antifreeze solution, mixed with distilled water, at a ratio of 35% to 50% is recommended to provide the best performance combination of the aforementioned functions. If excess propylene glycol exists within the heating solution, the water's heat absorption properties are compromised. Ultimately, this could inhibit the Aqua-Hot from providing adequate domestic hot water and interior heating.

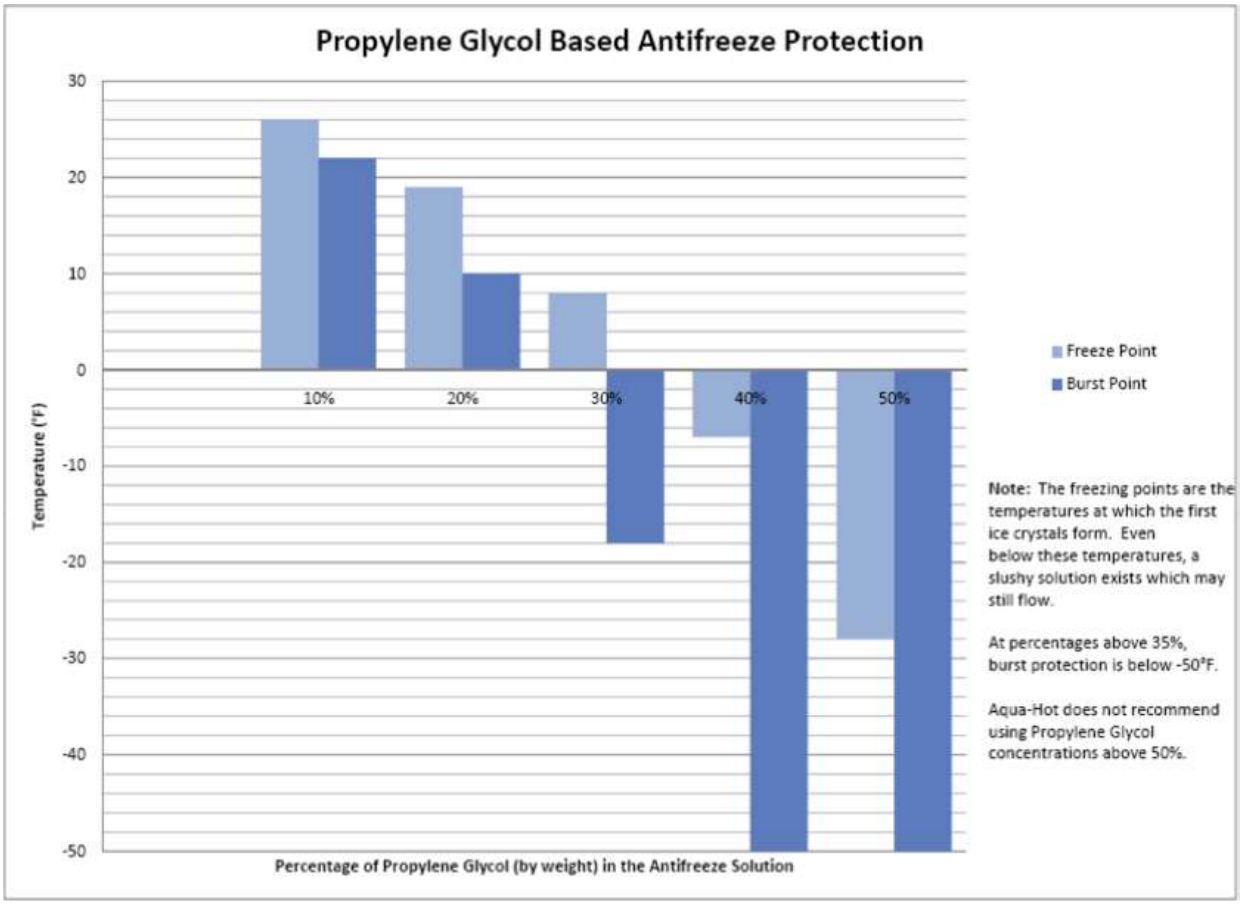
Additionally, if the antifreeze and water heating solution contains over 70% propylene glycol, the freezing point is actually raised, resulting in less freeze protection. Please reference the attached graphical representation regarding the percentage of antifreeze to water and how it directly affects the solution's freezing point.

In order to provide the best freeze protection, boil-over protection, anti-corrosion, and rust protection, a mixture of 50/50 "GRAS" approved **Propylene Glycol** antifreeze and distilled or de-ionized water is recommended. Reference Page 62 for measuring the antifreeze mixture with a refractometer and also the table below for the mixture ratios.

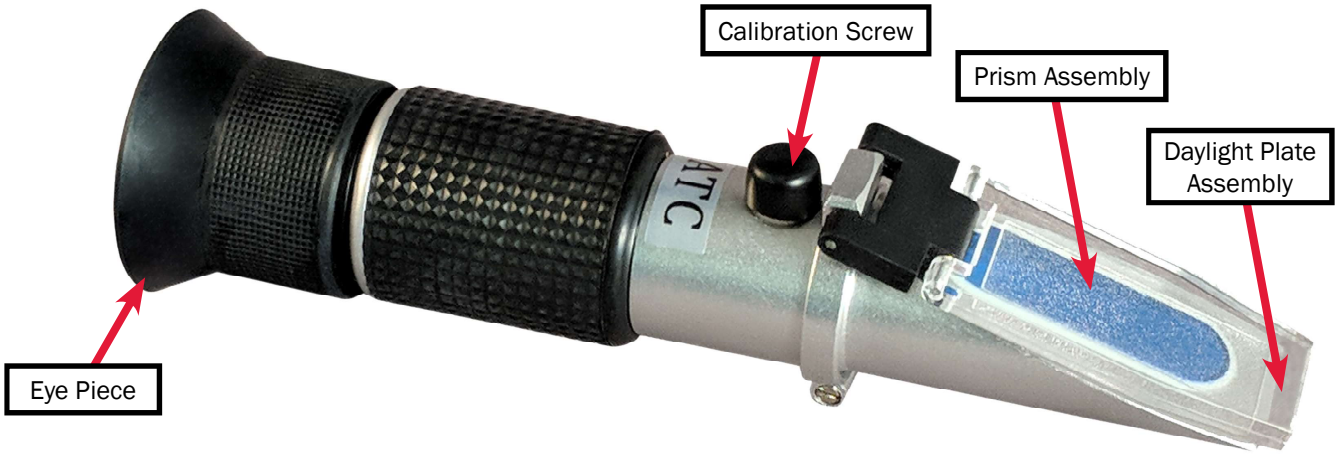
Propylene Glycol											
Freeze Point (°F)	0	-4	-7	-9	-12	-15	-18	-23	-29	-34	-40	-46
Concen-tration (%)	0	12	19	25	30	34	38	44	49	53	57	60

DANGER

Failure to utilize a propylene glycol which has been deemed Generally Recognized As Safe ("GRAS") by the FDA could result in serious bodily harm to damage to the Aqua-Hot system.



Measuring Antifreeze Using a Refractometer

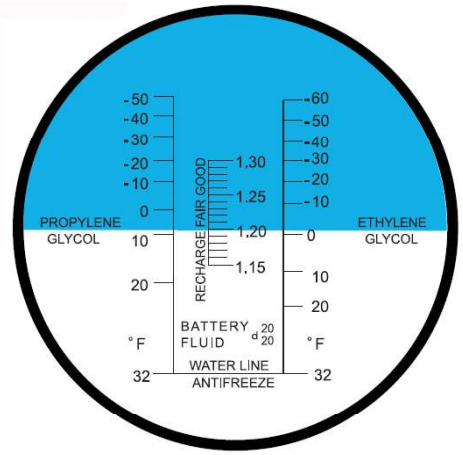


Properly Apply Antifreeze to the Prism Assembly

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.

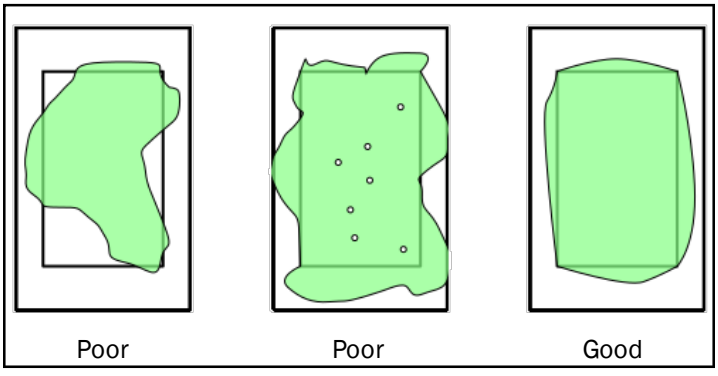
Adjust the Boundary Line

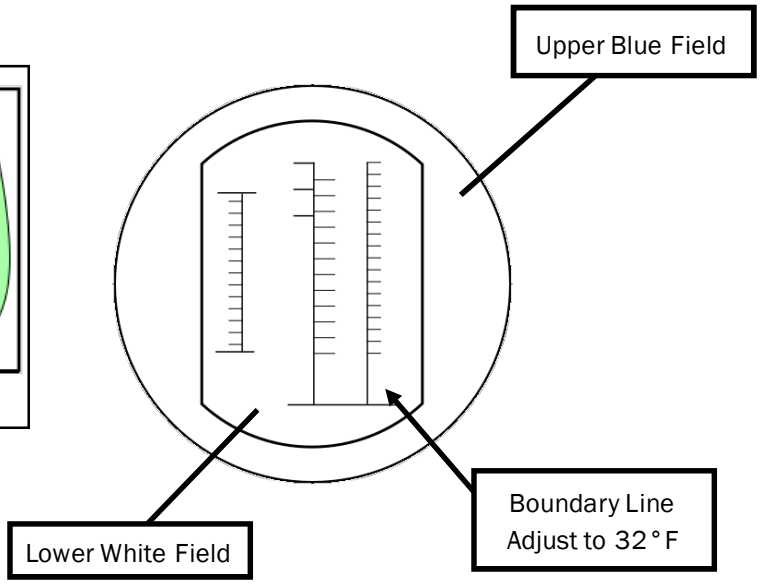
Once the glycol solution has been properly applied, adjust the calibration screw until the boundary line labeled “Propylene Glycol” is set to 32 °F. The graphic to the right has been designed as an aid, but note that it may differ from what is shown in the refractometer sight glass.



Refractometer Sight Glass

Application of Propylene Glycol





Service Manual

200 SERIES

Aqua-Hot®

An *AIRXCEL* Brand

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