

Service Manual

# 200 Series



AHE-250-D03



## Contents

Caution Notes.....	2
Introduction .....	3
Maintenance Schedule.....	5
System Features .....	6
Component Cut-Away.....	7
Operational Flowchart.....	8
Operating the Aqua-Hot .....	9
Aqua-Hot Controller.....	11
Exhaust System.....	18
Interlock Switch.....	19
Fluid Level Sensor.....	20
ETS Module .....	22
AC High-Limit Thermostat.....	24
Burner High-Limit Thermostats.....	26
Low-Temperature Cutoff Thermostat.....	27
Three-Way Valve .....	29
Tempering Valve.....	31
Fluid Circulation and Stir Pump .....	32
AC Electric System.....	34
AC Relay .....	36
<b>Diesel Burner .....</b>	<b>37</b>
Diesel Burner Operation.....	43
Detaching the Diesel Burner.....	47
Reattaching the Diesel Burner.....	50
<b>Diesel Burner Components.....</b>	<b>53</b>
Diesel Burner Motor .....	53
Flame Sensor.....	57
Ignition Electrodes.....	59
Ignition Coil .....	61
Fuel Nozzle.....	62
Fuel Solenoid .....	64
Fuel Pump .....	65
Bearings .....	68
Diesel Burner Controller.....	71
Checking Fuel Pressure.....	73
Adjusting Fuel Pressure.....	76
Annual Maintenance .....	78
Cold Weather Operation .....	90
Fill and Purge Procedure .....	91
Draining the Aqua-Hot.....	92
Winterization.....	93
General Troubleshooting.....	94
Lack of Hot Water .....	94
Lack of Heat.....	95
Blue/White Smoke.....	96

## Caution Notes

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

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

# NOTICE

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



# CAUTION

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



# WARNING

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



# DANGER

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

Black Smoke.....	96
Burner Troubleshooting .....	97
System Schematics.....	98
Measuring Antifreeze.....	102
Antifreeze Information .....	103
Warranty .....	105

## System Overview

The Aqua-Hot 200 Diesel 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 250-D03 uses a 12-volt DC powered diesel burner as the primary heating source. The diesel burner should be used as the primary heating source for hot water and interior heating needs. The 250 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 diesel 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 diesel 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.

## Introduction to this Document

Welcome to the Aqua-Hot 250-D03 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.



**Figure 1**

**NOTE:** The Aqua-Hot LCD Screen is optional. The coach may be equipped with a coach LCD with the RV-C network communication. Either will work with the Aqua-Hot system and the display screens will be similar. The screens will be referred to as “LCD Screen” or “interior/coach control panel”.

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

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



# CAUTION

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



# WARNING

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

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

- Read this manual before servicing 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 RV 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 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).

**NOTE:** Service parts and accessories are available through Aqua-Hot Factory Authorized Service Centers or at [www.aquahot.com](http://www.aquahot.com).



# WARNING

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



## 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 26 on page 20.

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 diesel 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.

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

### Annual Maintenance

To maintain the Aqua-Hot at its full potential, it is highly recommended to have the diesel burner tuned up annually. This involves the fuel nozzle and fuel filter replaced, burner cleaned, inspecting the exhaust and combustion air lines for damage and ensure they are clear, checking the fuel lines for any leaks, checking the hoses and wiring to make sure there is no damage or cracks. See Page 79 for more in-depth information.

### Replenishing the 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 26 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 water heating solution, but if 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 diesel 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 250-D03 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 and also reference page 55 for the proper tool and instructions for use in measuring the system's antifreeze mixture ratio.

Propylene Glycol to Distilled Water Ratio												
Freeze Point (°F)	32	24	19	15	10	5	0	-10	-20	-30	-40	-50
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 gas burner, and/or the electric element. When this signal is interrupted, the electric element and gas 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.



## 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.**



## 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.**



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/C SA-Z240 RV.

---



**For Direct Vent Installation in a Recreational Vehicle.**

Meets or Exceeds: UL 307A, UL 174  
 CSA/CAN B140.0-03  
 CAN/C SA-C22.2 No.110-94

---

Max Tank Pressure	0 PSI
Watts (DC)	146.4
Watts (AC)	1000
Tank Capacity	3.7 gal
Orifice Size/Angle	0.35/60°
Volts/Amps	12VDC, 12.2A
Volts/Amps/Frequency	120VAC, 9.6A, 50/60Hz
Pump Pressure	145 PSI/10.0 bar
Input Firing Rate	56,000 BTU/hr / 16.4kW
Diesel Burner Model	Webasto
Fuel Type	Diesel

Diesel Burner Serial XXXXXX

Number: XXXXXX

Model Number: 250-D03

Serial Number: A250D-XXXXXX

---

7501 Miller Drive • Frederick, CO 80504 • 574-AIR-XCEL • [www.aquahot.com](http://www.aquahot.com)

**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.....56,000 BTU/hr ± 10%  
 Fuel Consumption .....0.40 gallon/hr  
 Power Consumption ..... 108W (maximum)

### Zone Heat Circulation

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

**NOTE:** Control Panel “Quiet Mode” reduces heat exchanger power consumption by 20%

### Heating Zones

Maximum .....1

### Domestic Water Heating

Maximum ..... 1.5 GPM

### Physical Specifications

Dimensions (US).....26”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.

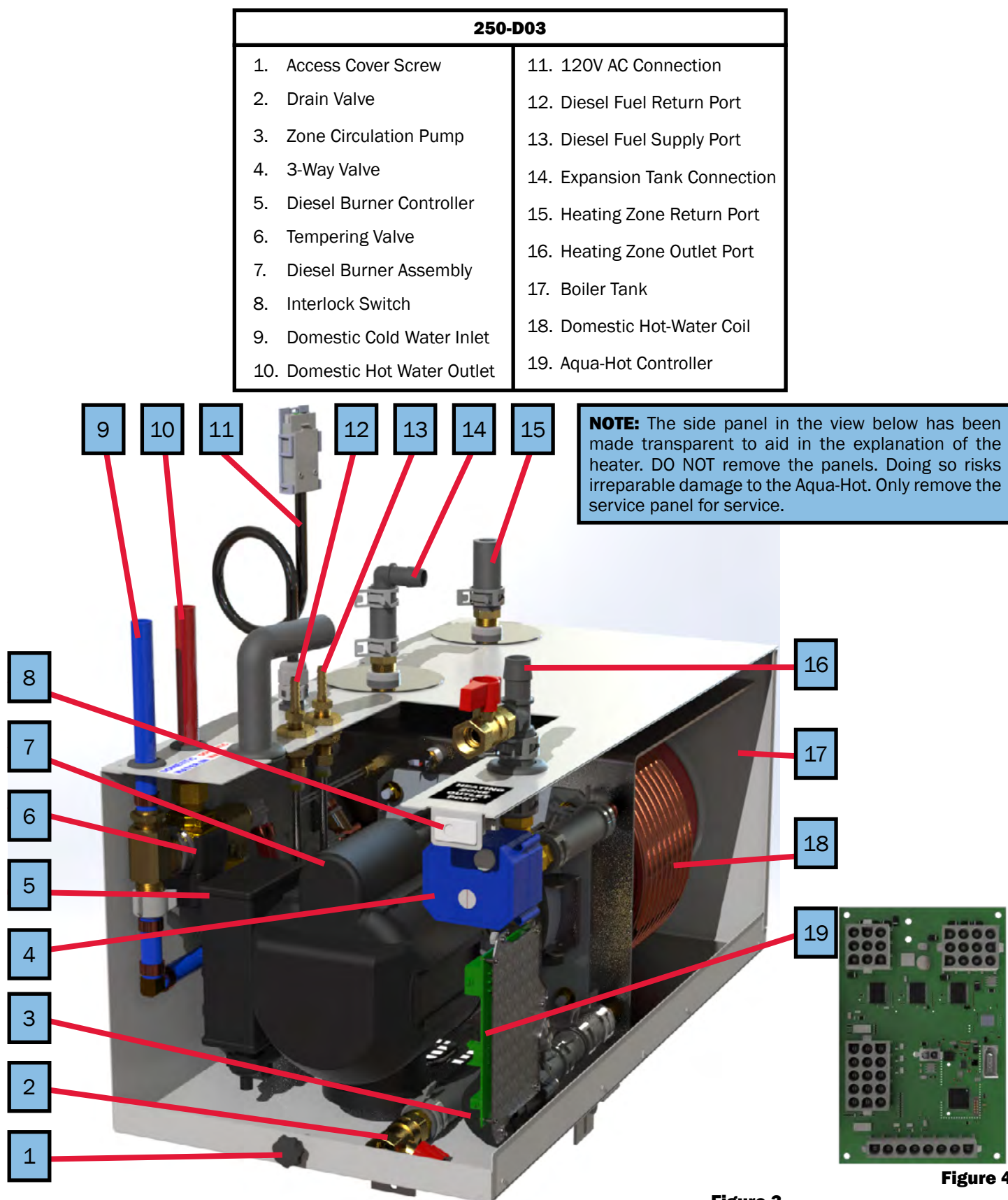
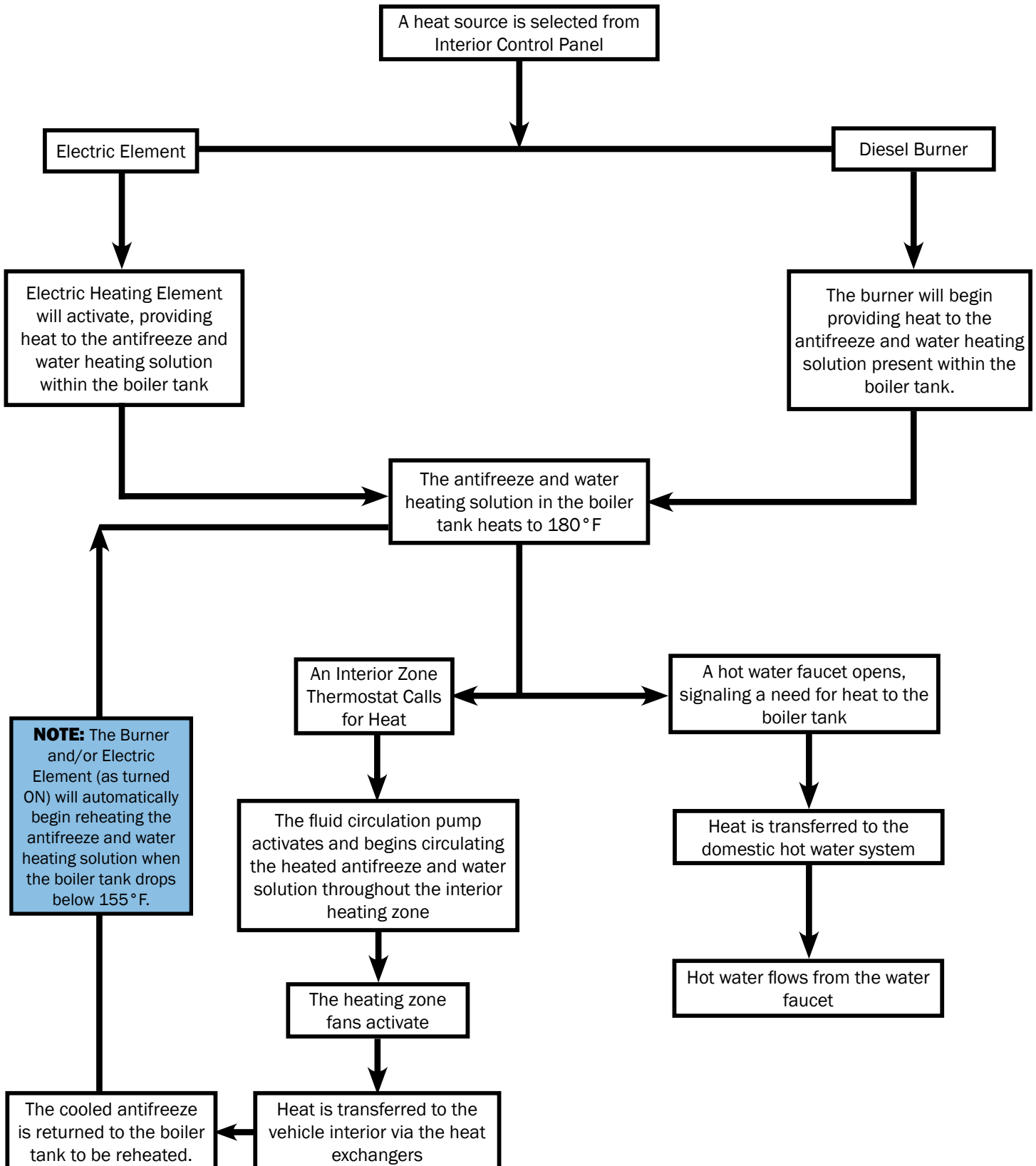


Figure 3

Figure 4

## Operational Flow Chart





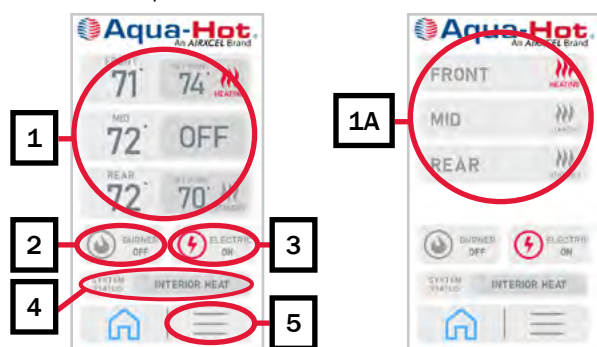
## Operating the Aqua-Hot

### Introduction:

This document will outline the basic operating instructions for the Aqua-Hot using either the optional LCD Screen or the coach LCD via the RV-C network communication. Contact your coach manufacturer to determine which control panel you may have. The screens will appear the same on either control panel.

### Climate Pages:

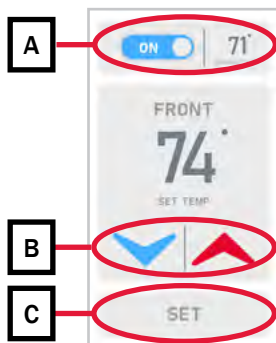
The climate pages are for all intents and purposes the “Home” of the display screen. From here, the end-user will select their interior temperature set-points, activate or deactivate the diesel burner and/or the electric element.



### Zone Control **1**

Precise zone control display will differ depending on the type of zone thermostats used within the coach.

Section 1A demonstrates the appearance of the zone control section when ON/OFF thermostats are used within the coach. In this use-case, these buttons serve only as ON/OFF toggle switches.



Tapping on one of the zones shown above will display a new screen where the interior temperature can be set.

**NOTE:** The Aqua-Hot LCD is an **OPTIONAL** add-on. It is encouraged that RVs already equipped with an RV-C enabled touchscreen have all Aqua-Hot screens and features mirrored on the coach display.

### Section **A**

This section shows the current zone temperature (shown as 71°F in the example above) as well as a button to turn the zone on or off. (Setting specific temperatures can only be done *if* thermistors are installed. Thermostats would only show ON/OFF.)

If the zone temperature is set, but this item is not set to ON, the zone heat exchanger will not activate.

### Section **B**

These arrows are used to increase or decrease the desired set-point temperature of the zone thermistor.

### Section **C**

After the desired temperature set-point has been selected tap “SET” on the display to set that temperature. The Aqua-Hot will now work to maintain this interior temperature, and the screen will return home.

### Diesel Burner Activation **2**

The diesel burner of the Aqua-Hot can be activated by tapping on the “burner” item on-screen. The diesel burner has two modes: ON and OFF.

#### ON:

While set to ON, the Aqua-Hot diesel burner will work to maintain a tank temperature of 180° F, with a minimum tank temperature of 160° F.

#### OFF:

While off, the diesel burner will not serve to provide any heat to the boiler of the Aqua-Hot whatsoever.

### Electrical Element Activation **3**

Similar to the diesel burner, tapping this button will signal to the controller to activate the AC electric relay, energizing the 1000W electric element within the Aqua-Hot.

#### ON:

While set to ON, the electric element will work to maintain a tank temperature of 180° F, with a minimum tank temperature of 160° F.

#### OFF:

While off, the element will not serve to provide any heat to the boiler of the Aqua-Hot whatsoever.



### System Status **4**

This item will indicate the current operational status of the Aqua-Hot. If any faults have triggered, those will be displayed here.

During normal operation, this should display either INTERIOR HEAT or HOT WATER relating to the priority and position of the 3-way valve.

While in INTERIOR HEAT mode, the 3-way valve is oriented so as to circulate heated antifreeze and water solution through the heating zones of the coach.

While in HOT WATER mode, the 3-way valve is oriented so that the heated antifreeze and water solution is circulated immediately back into the boiler tank. This is known as “stirring” the tank, and it is done to provide as much heat as possible to the domestic water line while water is flowing.

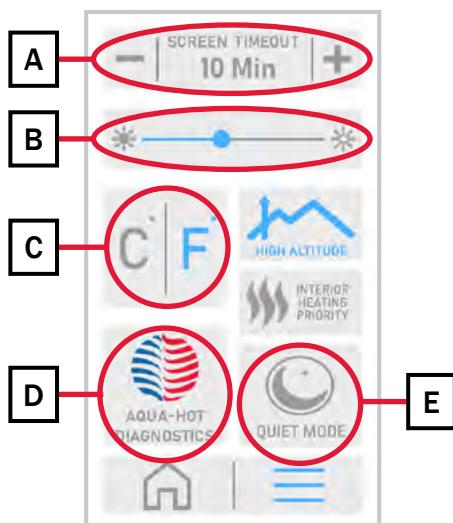
**NOTE:** For networked control of the Aqua-Hot Controller, Aqua-Hot requires system integrators ensure that individual commands are received and processed. Aqua-Hot requires that commands be repeated or confirmed so that if a single message were dropped, or if there is a brief network disturbance, the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

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

**NOTE:** The Aqua-Hot LCD is an **OPTIONAL** add-on. It is encouraged that RVs already equipped with an RV-C enabled touchscreen have all Aqua-Hot screens and features mirrored on the coach display.

### Module Options **5**

Tapping on the module options screen (the 3 lines on the bottom right of the home screen) will display the screen shown below. This is known as the Module Options screen. From here, it is possible to access unit diagnostics, activate Quiet Mode, change the temperature units, adjust screen brightness, and unit timeout.



#### Screen Timeout **A**

The screen timeout item sets the amount of time required to allow the screen to shut-off when idle.

#### Screen Brightness **B**

This setting changes the screen brightness.

#### Unit of Measurement **C**

This setting will change the display units of the Aqua-Hot. Either Fahrenheit or Celsius can be selected.

#### Aqua-Hot Diagnostics **D**

Tapping on this element will direct you to the Aqua-Hot's built-in diagnostic, testing, and troubleshooting tools.

#### Quiet Mode **E**

This option toggles the Aqua-Hot's quiet mode. Quiet mode is a setting where the speed and output of the heat exchanger fans is reduced to 80%. This is done to reduce noise of the heat exchangers.

Please note that this feature must be activated and deactivated as needed.

## The Aqua-Hot Controller

### Introduction:

The Aqua-Hot 250-D03 operates on a controller platform which has been modernized and updated from the previously used Electronic Controllers and Relay Control Boards of older Aqua-Hot units.



**Figure 5**

This controller is best utilized with either the Aqua-Hot display or RV LCD display. Using the Aqua-Hot with either displays will ensure that you can take advantage of all of the tools and features of this controller.



**Figure 6**

### Features:

This new controller brings with it new features to it which effect functionality from every stage of operation. Fail safe functionality, climate control, and troubleshooting and diagnostics have all been overhauled on this new control architecture. These features will be explained in detail below.

### Troubleshooting:

The new troubleshooting functionality is perhaps the largest and most substantial change to come about from the new controller architecture. Many faults and failures within the Aqua-Hot can now be relayed in plain language to the technician servicing the Aqua-Hot. There are five system faults which will be utilized; System Voltage, Low-Level Cutoff, Over-Current,

Overheat, and Burner Failed to Ignite. These will be explained below.

### System Voltage:

System voltage faults indicate that there is a problem with the RV-side power supply which powers the Aqua-Hot.

The Aqua-Hot can only operate within a voltage range of 11V DC to 16V DC. If voltage drops below 11V, or exceeds 16V DC, the controller will shut down the Aqua-Hot as a safety mechanism.

### Low-Level Cutoff:

The Low-Level Cutoff fault will only trigger if the minimum fluid level within the Aqua-Hot is below an acceptable operational threshold.

If the controller is showing a low-level cutoff fault, begin by diagnosing the fluid sensor.

### Over-Current:

Over-current faults are triggered by an output channel (pump, fan, etc) that is attempting to draw too much current through the controller. This fault will be accompanied by the component which triggered the fault, for example "PUMP 2 OVER-CURRENT" will display if Pump 2 is not operating correctly.

If over-current faults are appearing on the display, troubleshoot the offending component listed as being over-current.

### Overheat:

Overheat faults indicate that the unit has exceeded its overheat threshold of 210 °F.

If an overheat condition has occurred, diagnose the cause of the overheat by investigating the heating sub-systems of the Aqua-Hot (electric and/or diesel burner ).

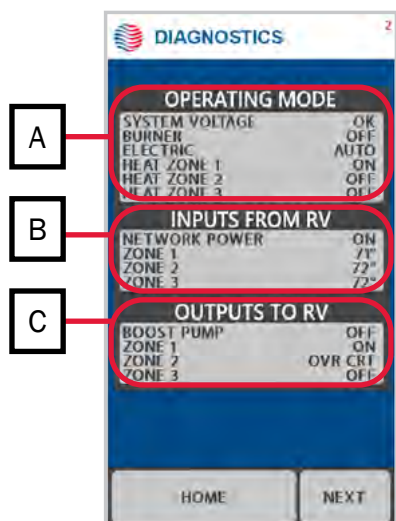
### Under-Current

Under-current faults indicate that the unit does not have enough voltage to properly operate. If voltage drops below 11V, the controller will shut down the Aqua-Hot as a safety mechanism.

If an under-current fault is displayed on the screen, troubleshoot the offending component listed and also check power into the Aqua-Hot.

The fault codes shown above will cover the most common Aqua-Hot related issues. For more complex issues, it may be

necessary to utilize the DIAG screens, which will be explained next.



**Figure 7**

## Diagnostic Screens (DIAG)

The diagnostic screens will show the current operational status of different elements within the Aqua-Hot. By comparing these operational statuses against the expected results it is possible to discern operational issues.

Shown below are the diagnostic screens. From these screens it is possible to see the current status of elements within both the Aqua-Hot and the status of certain elements within the RV such as zone thermostats and on/off signals. Each element on the screens listed below will be explained in detail.

### Operating Mode **A**

The operating mode contains six items which relay at-a-glance information about the function of the Aqua-Hot.

#### System Voltage:

This section of the Operating Mode page indicates the status of the supply voltage to the Aqua-Hot. This will display "OK" if the supply voltage is between 11V DC and 16V DC.

If this element displays anything except "OK" begin troubleshooting the RV-side voltage.

#### Burner:

This indicates the current burner status as either ON, OFF or FAULT. ON indicates that the burner is active, and able to fire to provide heat.

OFF indicates that heat is either not required or not requested by the controller.

FAULT indicates that there is an issue with the burner.

#### Electric:

The Electric section indicates the controller's current handling status of the AC electric relay.

This status indicates that the controller is attempting to activate the element relay only. This does NOT indicate whether the electric element is in working order or not.

#### Heat Zone #:

The next three elements indicate the current status of the heating zones (maximum 3).

This element (ON or OFF) only indicates that the zone thermostat is requesting heat, AND that the controller is providing power to the zone fans.

### Inputs from RV **B**

The Inputs from RV section will display the signals received from within the RV as pertaining to the RVC network and the heating zone thermostats.

With respect to the zones, there will be three different items displayed next to the Zone # items depending on the type of RV-side thermostat in use.

- **ON:** This indicates that the zone is active, and the zone thermostat is calling for heat
- **OFF:** This indicates that heat is either not needed, or not requested by the zone thermostat
- **71°:** This indicates the set-point of the RV thermostats. The example in Figure 7 is showing the RV thermostat is requesting it be 71°F in Zone 1. This is only available with certain RV thermostats.

### Outputs to RV **C**

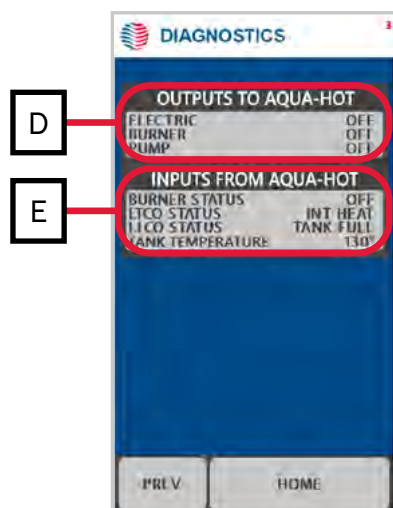
The Outputs to RV indicates that the controller is sending power to components within the RV. This section may also show faults with components in each zone.

In the example in Figure 7, the controller is not sending power to the boost pump, so the boost pump is shown as OFF.

Zone 1 is ON, meaning that the controller is sending power to the Zone 1 fans.

Zone 2 is Over Current, indicating that there may be a problem with the fans in this zone.

Zone 3 is not active. The controller is not receiving a request for heat from the RV, and it is not powering the zone fans.

**Figure 8****Outputs to Aqua-Hot D**

The Outputs to Aqua-Hot section describes the current status of the controllable elements within the Aqua-Hot which are the Burner Status, Fluid Circulation Pump, and the Electric Element.

This indicates only that the controller is attempting to operate these elements, not their current functional status.

**Inputs from Aqua-Hot E**

The Inputs to Aqua-Hot will contain the current readings from sensors within the Aqua-Hot. Four elements will be shown on this page; Burner Status, LTCO Status, LLCO Status, and Tank Temperature.

**Burner Status:**

The Burner Status element on this page indicates the status of the diesel burner.

**LTCO Status:**

The LTCO status indicates the sensor reading from the Low-Temperature Cutoff Thermostat, which is the device that governs whether to provide heat or hot water.

**LLCO Status:**

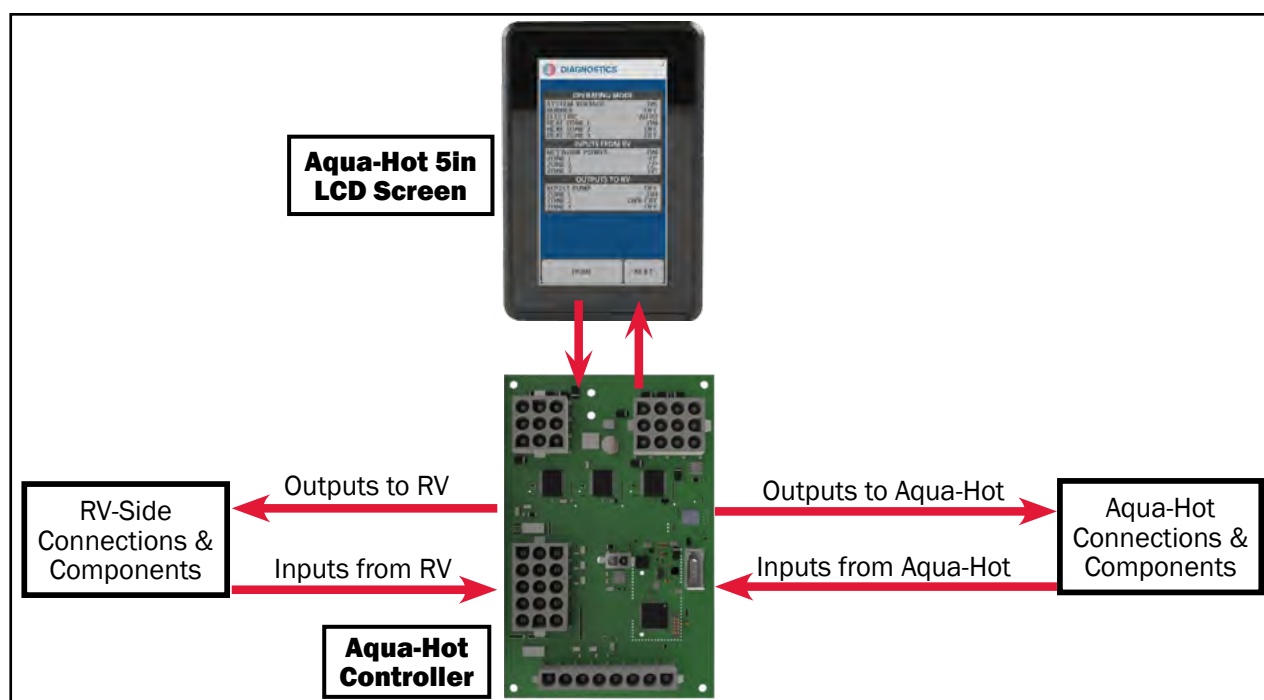
LLCO status relays the current sensor reading of the Low-Level Cutoff sensor within the overflow bottle.

The LLCO is implemented to measure the fluid level within the overflow bottle to ensure that it does not drop below a safe threshold.

**Tank Temperature:**

The Tank Temperature will display the current temperature of the antifreeze and water heating solution within the Aqua-Hot.

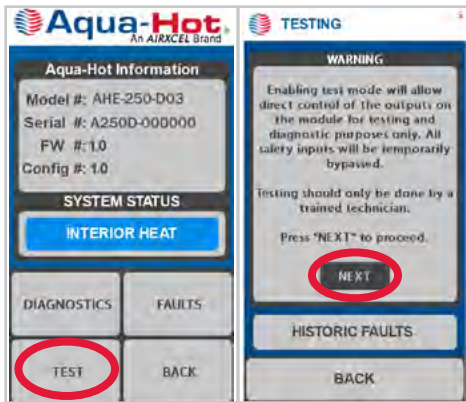
The ETS Thermistor (short for engine temperature sensor) provides this temperature information to the controller, which then governs when the diesel burner and/or electric element shut off.

**Figure 9**



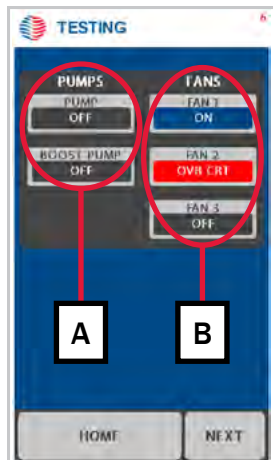
## Testing Functionality:

One of the new features of this control system is the ability to independently activate specific elements within the Aqua-Hot for testing purposes.



**Figure 10**

This will allow a technician to activate specific elements within the Aqua-Hot as needed without jumping wires or utilizing external power supplies in most troubleshooting cases. Any elements activated via the testing screen will remain active for a maximum of five minutes.



**Figure 11**

### Pumps **A**

Both the zone circulation pump and the boost pump (if applicable) can be activated by tapping the corresponding pump on the test screen.

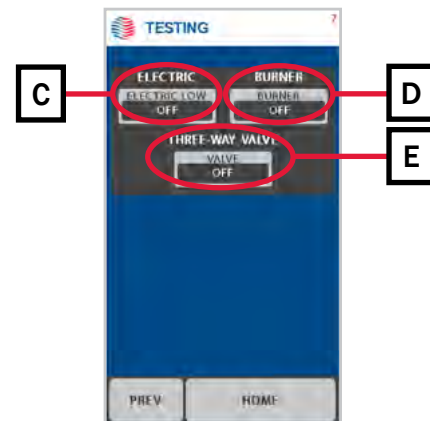
### Fans **B**

All three zone fans can be activated as needed to test communication between the zone fans and the controller. Please note that this will only work if the zones have been directly wired to the Aqua-Hot as described in the installation manual.

Heating sub-systems can be activated independent of their control circuits and other control sensors as a means of testing functionality. These systems will activate for a maximum of five minutes before shutting down.

Activating heating sub-systems in this manner will disregard all sensor inputs while attempting to activate these heating systems. As such, if the unit is near operating temperature, activating these systems may trigger an overheat condition.

**DO NOT attempt to activate these sub-systems while the unit is near operating temperature**



**Figure 12**

### Electric **C**

Activating the Electric heating sub-system will energize the relay which controls the AC electric element.

After tapping this button on the screen, there should be an audible click from within the Aqua-Hot cabinet. If there is no such click, verify the functionality of the AC electric relay.

This test CANNOT directly energize the AC electric element. It is used only to verify the functionality of the command and control system.

### Burner **D**

This element will energize the Diesel Burner signal wire, which will then trigger the heat source to activate.

### Three-Way Valve **E**

The final element on this screen is not directly related to the heating subsystems of the Aqua-Hot.

The three-way valve (sometimes known as the summer/winter valve) controls the flow of the antifreeze and water heating solution within the Aqua-Hot to deliver either hot water, or interior heat as requested.

Tapping on this element will change the valve's orientation. When this element displays "INT. HEAT" this valve is oriented to provide interior heat by circulating heating solution throughout the interior heating zone. When this element displays "HOT WATER" the valve is oriented such that heating solution is routed so that hot water can be provided.



# WARNING

**Heating sub-system testing is NOT a substitute for normal operation, and attempting to use it as such may result in catastrophic damage to the Aqua-Hot.**



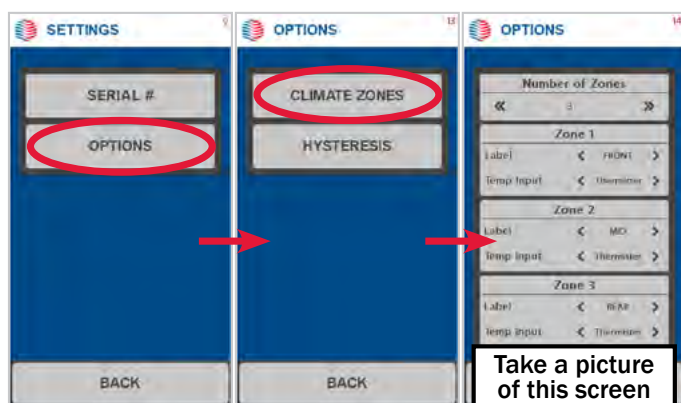
## Controller Replacement Procedure:

1. If possible, tap the three lines icon at the bottom right corner of the LCD screen.
  - Tap the AQUA-HOT DIAGNOSTICS icon. Record all the information in the “Aqua-Hot Information Section”.
  - Tap and hold (for 3 seconds) within the information section.



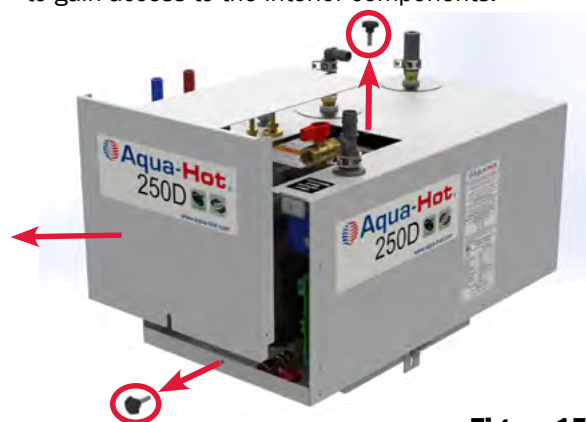
**Figure 13**

- Tap OPTIONS, CLIMATE ZONES, and take a picture of this screen.



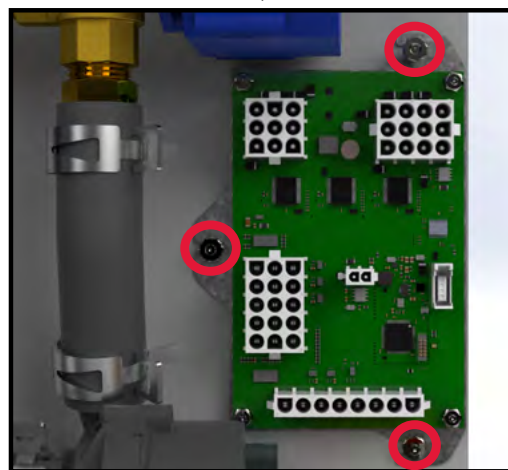
**Figure 14**

2. Disconnect all power to the Aqua-Hot.
3. Remove the two bolts securing the cover of the Aqua-Hot to gain access to the interior components.



**Figure 15**

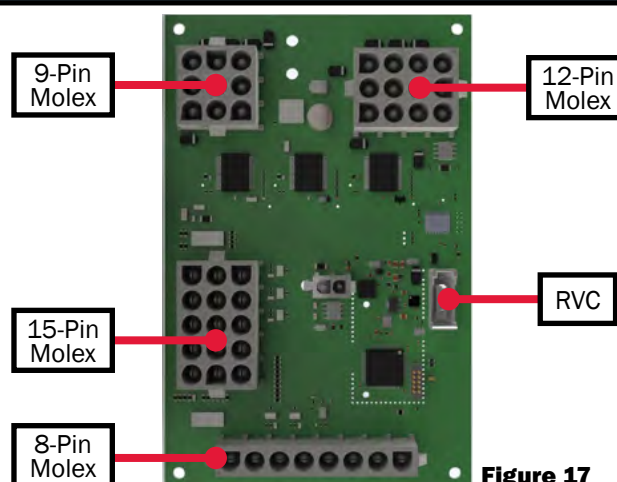
4. Using a  $\frac{3}{8}$ " (10mm) socket, remove the 3 hex nuts from the top, left side, and bottom of the mounting plate (SAVE THE NUTS TO USE AGAIN)



**Figure 16**

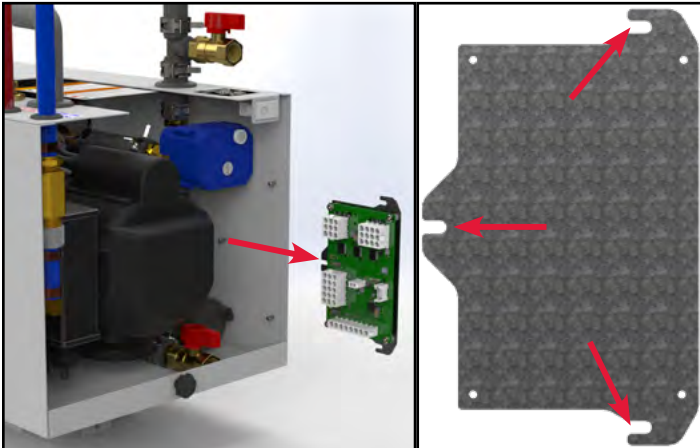
5. Gently pull out the controller bracket and remove the plugs as they become accessible.
6. Disconnect the DC harness from the controller.
  - Suggested disconnect order (see Figure 17):
    - 3-Pin Molex power connector
    - 12-Pin Molex (top right of the controller)
    - 9-Pin Molex (top left of the controller)
    - RVC (middle right of the controller)
    - 15-Pin Molex (middle left of the controller)
    - 8-Pin Molex (bottom of the controller)

**NOTE: DO NOT DISCONNECT THE DC HARNESS FROM ANY OTHER ELECTRICAL CONNECTION IN THE UNIT.**



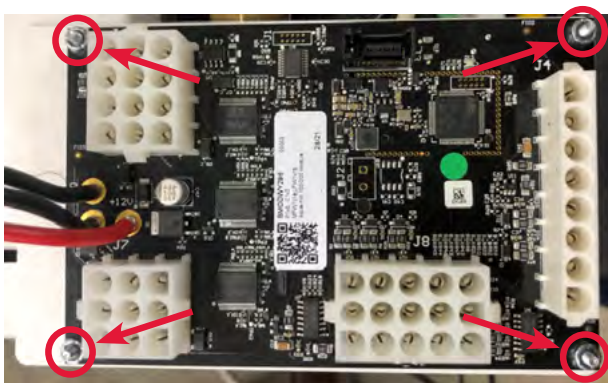
**Figure 17**

7. Slide the controller and mounting plate outwards and out of the unit.
  - The mounting plate has three key-ways holding it in place (no nuts or other fasteners).



**Figure 18**

8. With the controller and mounting plate out of the unit, use a ¼" socket or nut driver to remove the four nuts attaching the controller to the bracket. The controller is supported by four small bushings - ensure that all four bushings remain on the bracket screws. Remove and discard the defective controller.



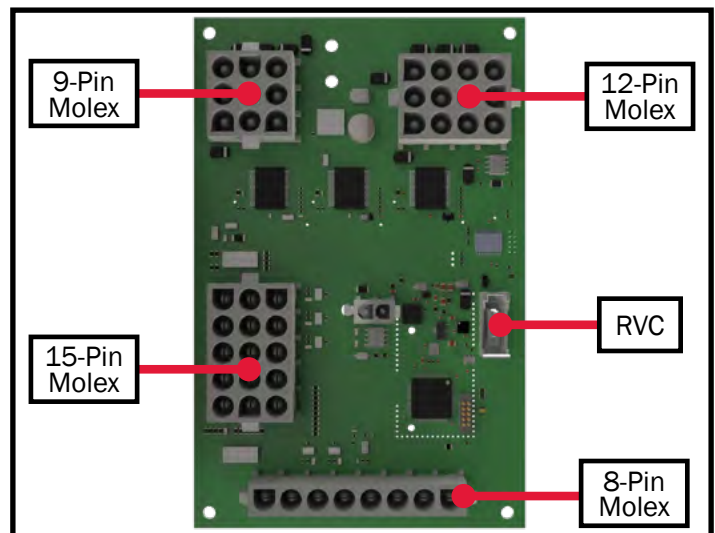
**Figure 19**

9. Plate new controller onto the mounting plate.
  - Ensure the controller is properly oriented - reference Figure 20.
10. Using the 4 nuts previously removed, fasten the controller to the mounting plate.
11. Insert the controller and mounting plate into the Aqua-Hot. As you insert the controller and mounting plate into the Aqua-Hot, the mounting plate should slide along the wall to ensure the key-ways catch the mounting studs (Figure 18).

12. Once the controller and mounting plate are properly seated on the mounting studs, fasten the mounting plate to the wall of the Aqua-Hot using the previously removed hex nuts.

13. Carefully reinstall all of the plugs from the DC harness.
  - Ensure that both tabs for all Molex connectors click into place indicating a properly seated connection.
  - Ensure that the single tab for the RVC cable clicks into place indicating a properly seated connection.
  - Suggested order:
    - 8-Pin Molex (bottom of the controller)
    - 15-Pin Molex (middle left of the controller)
    - RVC (middle right of the controller)
    - 9-Pin Molex (top left of the controller)
    - 12-Pin Molex (top right of the controller)
    - 3-Pin Molex power connector

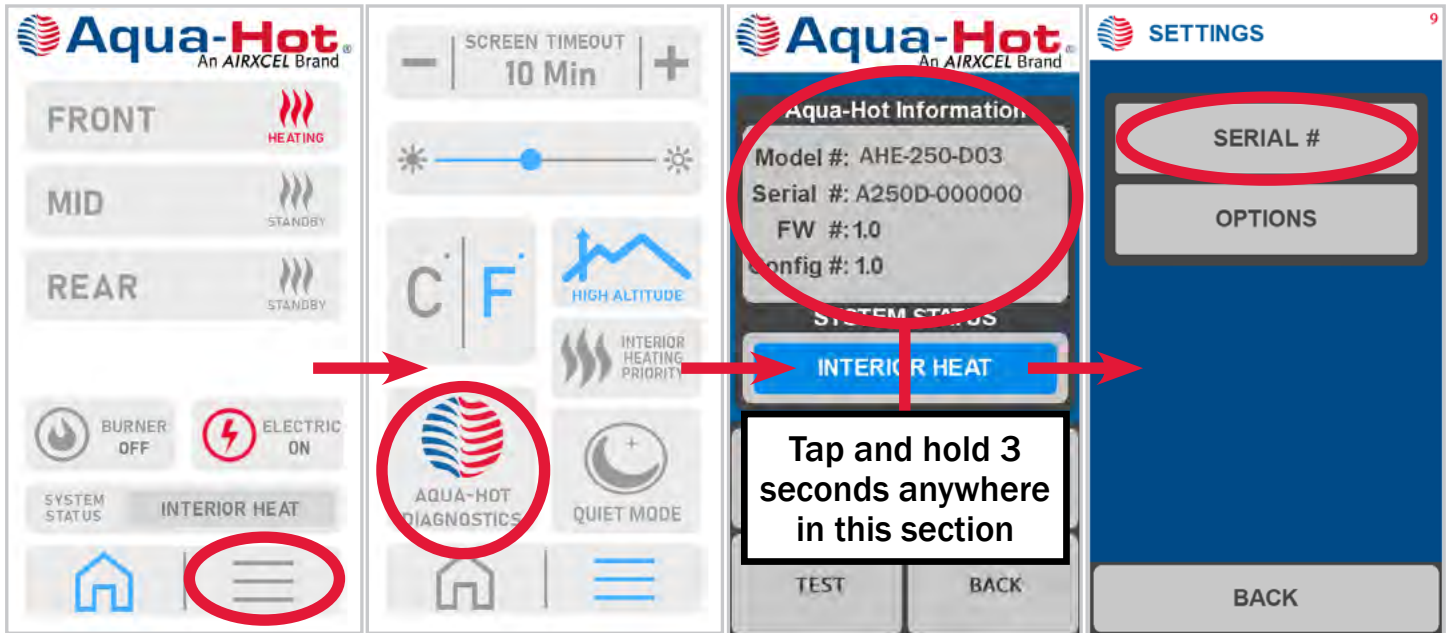
**NOTE:** All plugs have only ONE correct orientation. Do **NOT** force the plug into place.



**Figure 20**

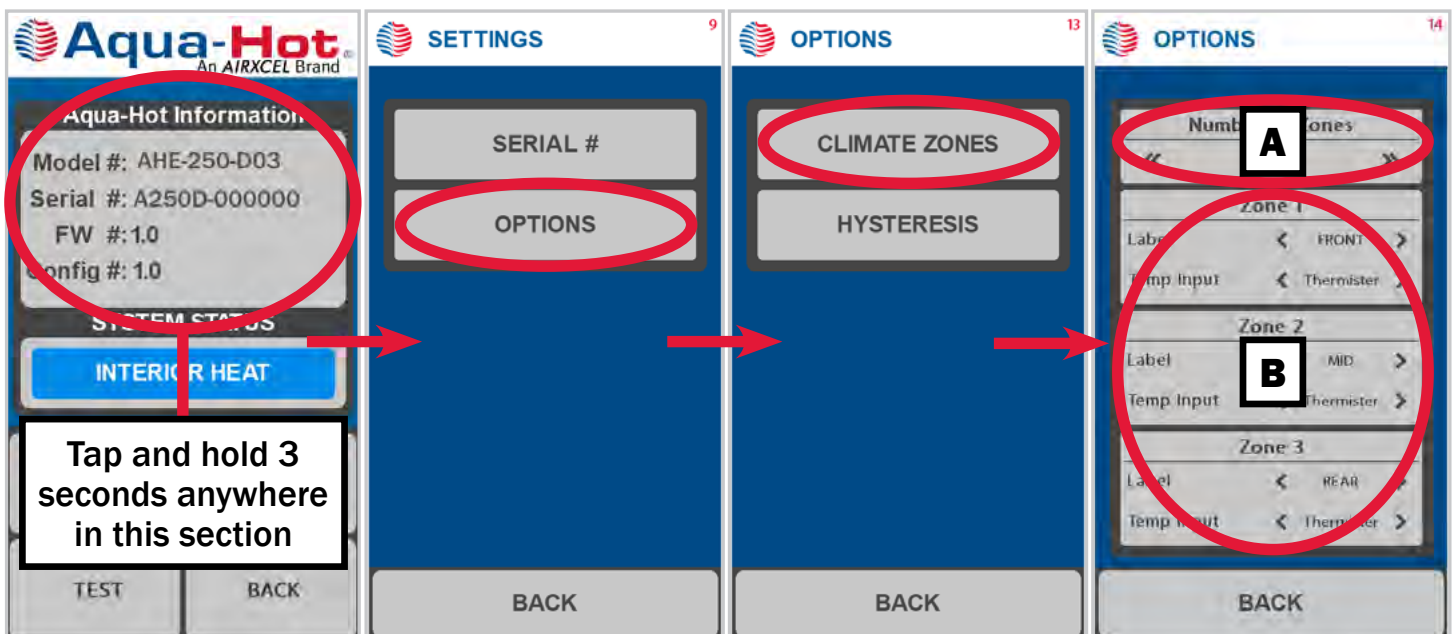
## Instructions for Controller Setup after Installation:

1. Provide power to the main harness of the Aqua-Hot. After the screen lights up, tap the three lines icon on the bottom right corner. Tap the AQUA-HOT DIAGNOSTICS icon. Then tap and hold (for 3 seconds) within the Aqua-Hot Information section. Tap SERIAL NUMBER and follow the prompts on the screen.



**Figure 21**

2. On the Diagnostics page, tap and hold (for 3 seconds) in the Aqua-Hot Information section. Tap OPTIONS, CLIMATE ZONES, and select the number of climate zones **A**. Choose a label and temperature input type for each zone **B**. Tap BACK until you've reached the Home Screen.



**Figure 22**



### 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 RV (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).
- 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.

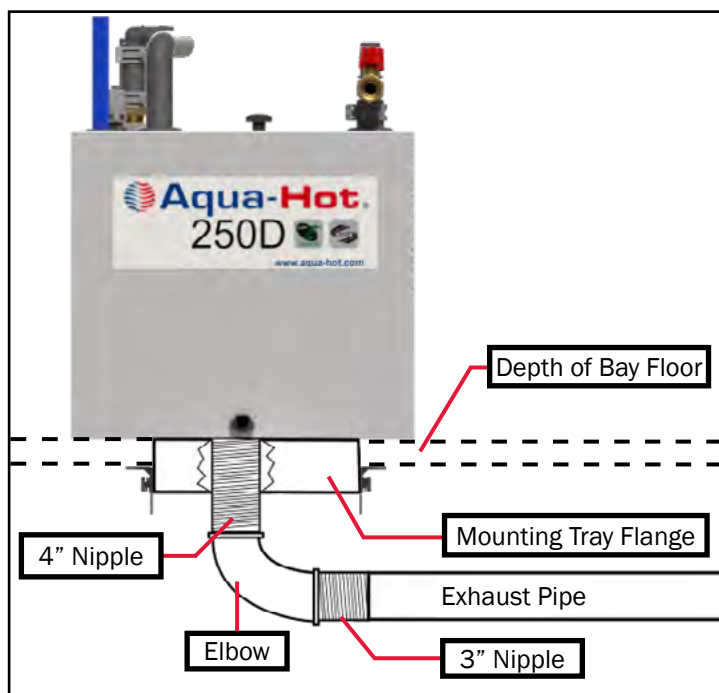
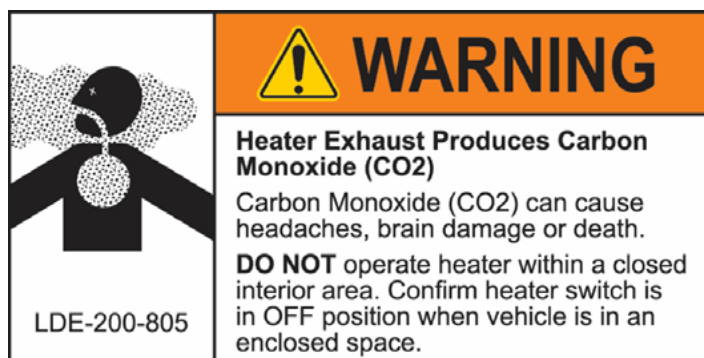


Figure 23



## 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](http://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 status does not show ON on the LCD screen or RV control panel with the burner on

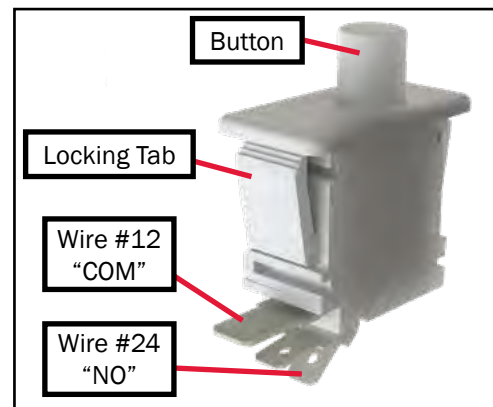
### Troubleshooting:

1. Ensure that the boiler tank has sufficiently cooled in order to require heat from the burner.
2. Activate the burner located on the interior control panel.
3. Locate wires #12 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 #12 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.

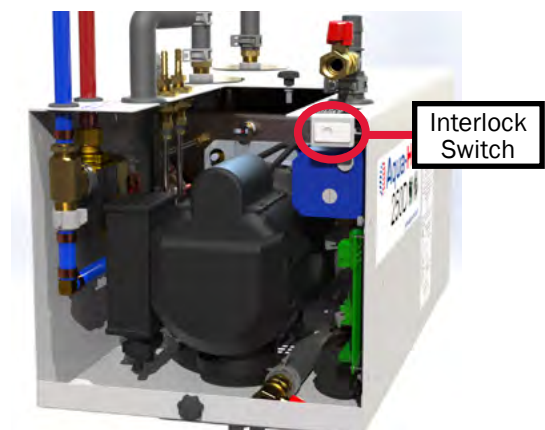


### Replacement Procedure

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 #12 connected to the terminal labeled "COM".



**Figure 24**



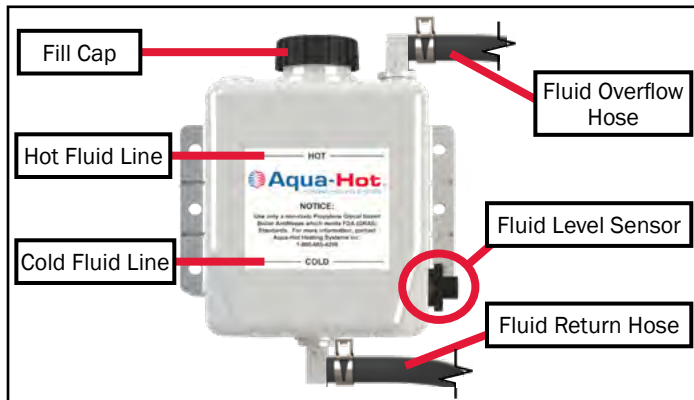
**Figure 25**



## 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 (see below).



**Figure 26**

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 status does not show ON
- The electric element fails to operate
- The electric status does not show ON

# 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 RV-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 27**

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. Using a multimeter, test for continuity across the fluid level sensor. If no continuity and the expansion bottle is filled to at least the COLD level, replace the fluid level sensor.
4. If there is continuity, locate the LCD screen or control panel and navigate to the INPUTS FROM AQUA-HOT section. Locate “LLCO”.
  - If it does not display TANK FULL, replace the controller.
  - If it displays TANK FULL, the fluid level sensor is functioning as intended.



**Figure 28**



## WARNING

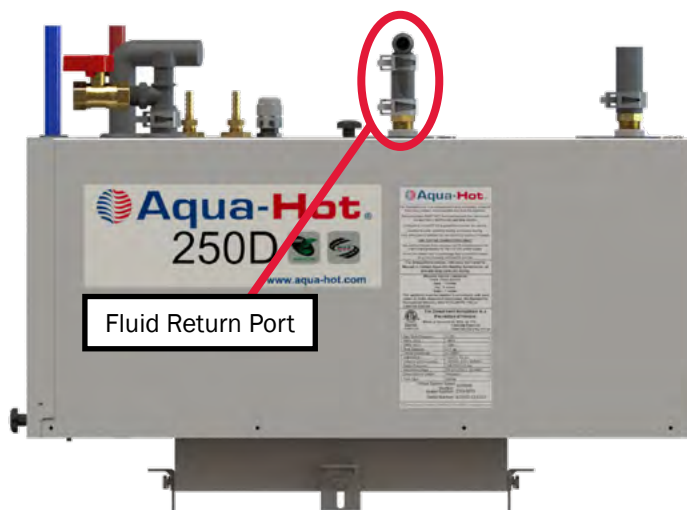
**Before continuing to the replacement procedure, ensure that the unit has cooled to ambient temperature, all power sources have been disconnected, and the unit is completely shut off.**

### Replacement Procedure:

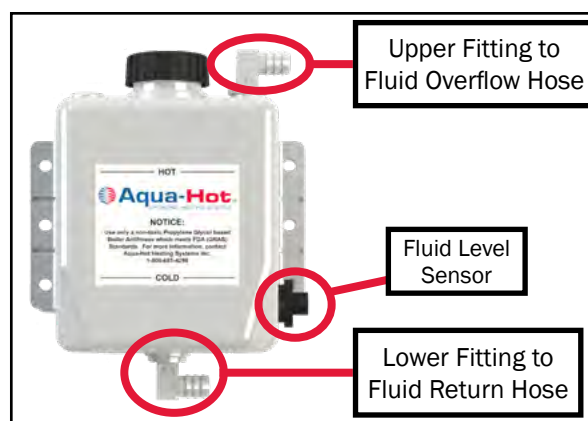
In order to replace the fluid level sensor, the overflow bottle must also be replaced. Please visit [www.aquahot.com](http://www.aquahot.com) or call 574-AIR-XCEL (574-247-9235) to order the expansion bottle kit. Once you have the replacement part in hand, follow the procedure below.

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.



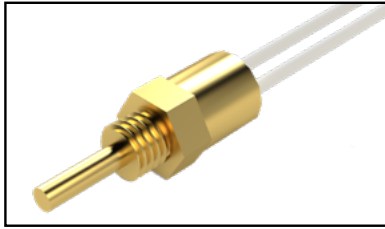
**Figure 29**



**Figure 30**

## ETS Module

The ETS (Engine Temperature Sensor) Module is a brass thermistor that continually measures the temperature of the fluid within the Aqua-Hot boiler tank. This module then relays the information to the Aqua-Hot controller, thereby allowing the controller to activate and deactivate the unit as heating and hot water needs change.



**Figure 31**

### Troubleshooting Conditions:

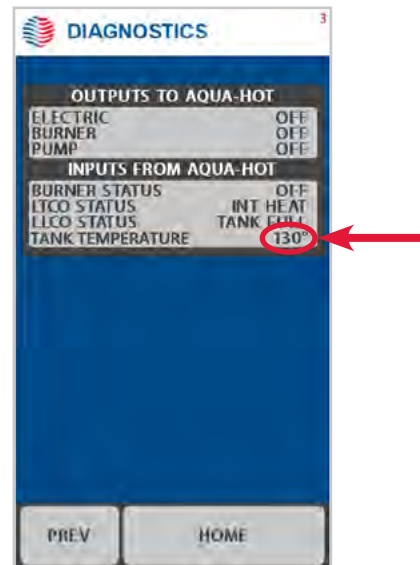
Troubleshooting the ETS module is a relatively straight forward process. Follow the instructions below to diagnose the ETS module. Troubleshoot the ETS module if the following conditions have occurred:

- A lack of hot water.
- A lack of interior heat.
- The Aqua-Hot is not operating.

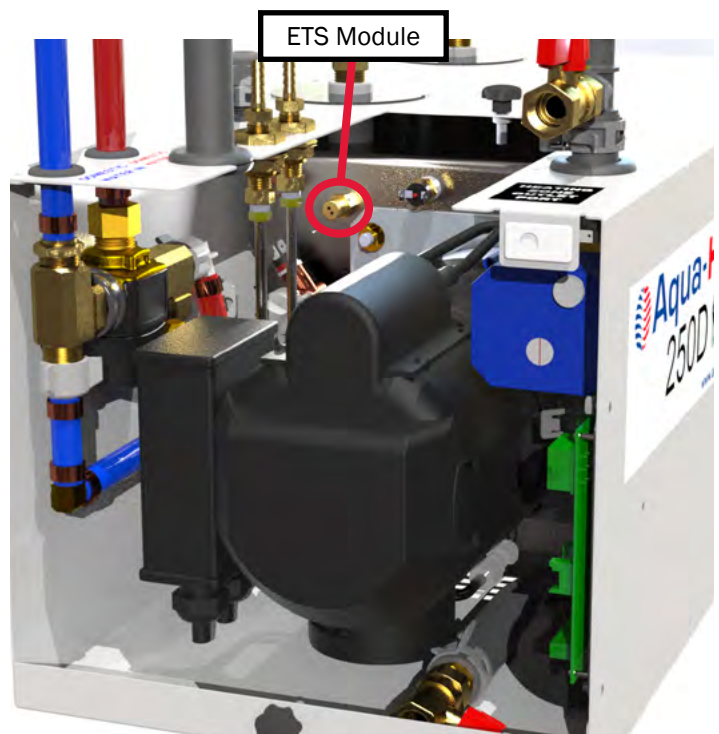
### Troubleshooting:

1. Verify the following before troubleshooting the ETS module:
  - The Interlock Switch is depressed (access cover is properly installed).
  - The overflow bottle is adequately filled.
  - 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.
  - The high-limit thermostats are not tripped.
  - All fuses are in working order.
2. Turn the burner and/or electric element to the ON position.
3. Using a meat thermometer, measure the temperature of the tank face. Record this temperature on paper.
4. Locate the LCD screen or RV control panel. Navigate to the DIAG page. Find INPUTS FROM AQUA-HOT and record the temperature listed by TANK TEMPERATURE (Figure 32). Record this number on the sheet.

5. If the temperatures do not match, disconnect the ETS module from its leads on the wire harness.
6. Navigate back to the INPUTS FROM AQUA-HOT section of the LCD/RV display screen.
  - If the display screen does display a temperature, the controller will need to be replaced.
  - If the display screen does not show any temperature, the ETS module will need to be replaced.



**Figure 32**



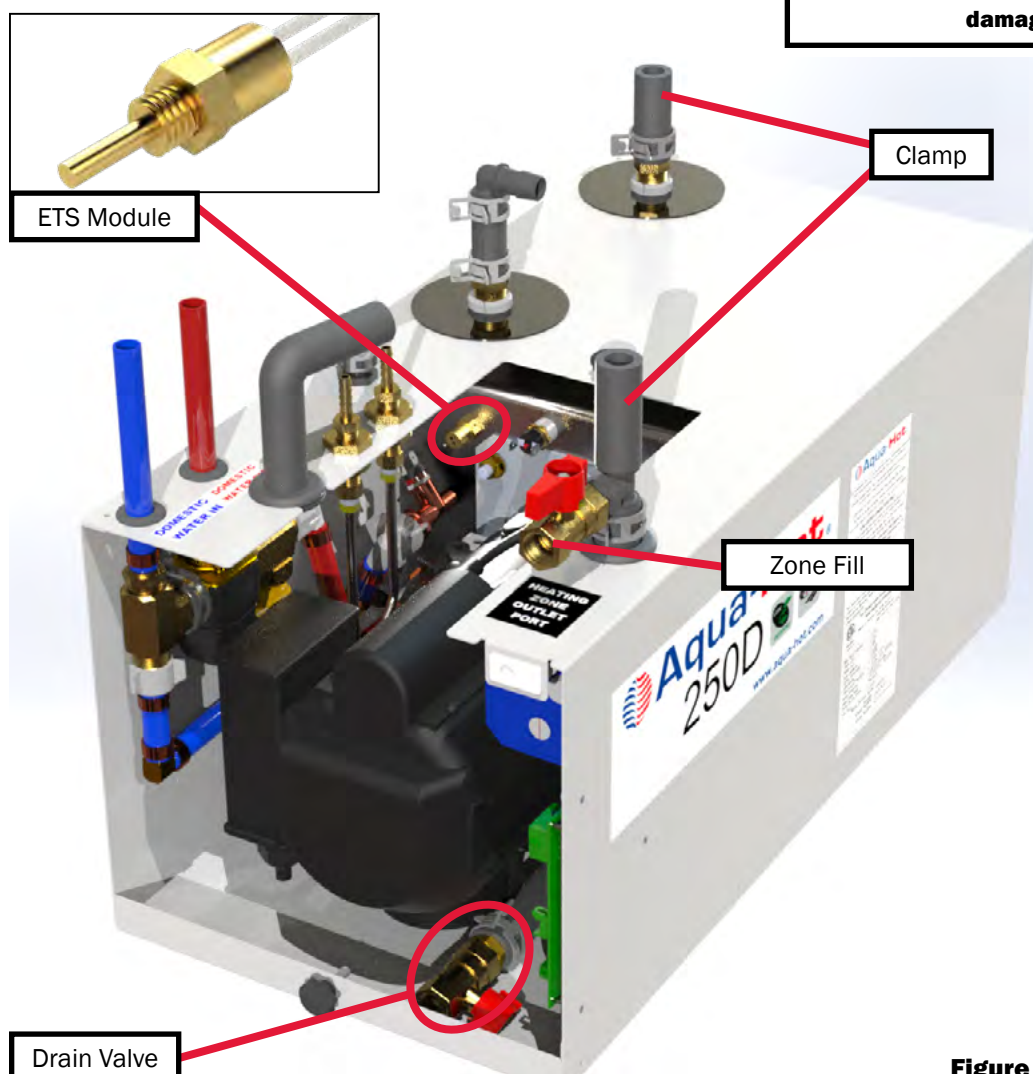
**Figure 33**

## 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 container to be reused later.
4. Disconnect the defective ETS module's wires.
5. Using a 14mm wrench or deep socket, unscrew the ETS module from the Aqua-Hot's boiler tank.
6. Wrap the threads of the replacement ETS module with 6 wraps of thread seal tape.
7. Place the replacement ETS module in its position on the tank face, and finger tighten into place.
8. Using the 14mm wrench, tighten the module until snug.
9. Reconnect wire J4-5 and wire J4-6 to the new ETS module.
10. Refill the Aqua-Hot's boiler tank with the previously drained antifreeze and water heating solution using an external fill pump, filling through the zone fill.
11. Once this has been completed, locate the LCD screen, navigate to the TEST section, and run the fluid circulation pump (and if applicable, the boost pump) for at least twenty minutes to purge the heating loop of air.
12. Continually fill the fluid expansion bottle as the fluid level drops.
13. Test the Aqua-Hot 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 35**

**Figure 34**



## 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 ETS module 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.



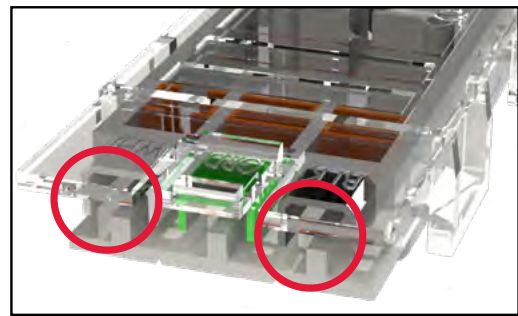
# DANGER

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

### Troubleshooting Procedure:

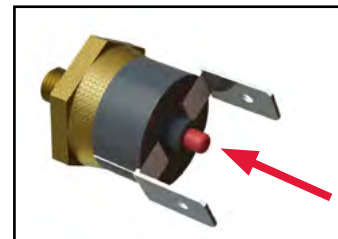
1. Verify the following before troubleshooting the AC high-limit thermostat:
  - The ETS module is calling for heat.
  - The interlock switch is depressed.
  - The overflow bottle is adequately filled.
  - The high-limit thermostats are not tripped.

2. Ensure that the unit has been shut down and completely cooled before continuing.
3. Shut off the RV-side power breaker to the Aqua-Hot.
4. Disconnect the 3-pin AC Molex plug. Leave the DC power supply connected.
5. Activate “ELECTRIC” on the LCD control panel inside the RV.
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.



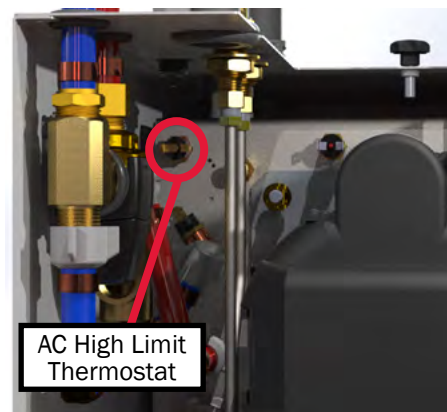
**Figure 36**

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



**Figure 37**

8. Move the electric to the OFF position. Retest for continuity. If continuity still exists, replace the AC relay.
9. Move the electric to ON. Retest for continuity at the high-limit thermostat. If no continuity, replace the thermostat.



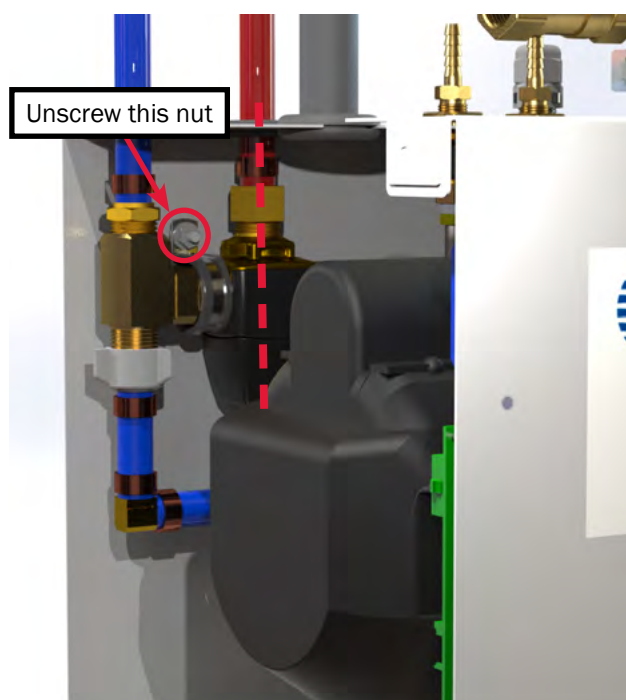
**Figure 38**



## Replacement Procedure:

If it has been determined that the AC 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.

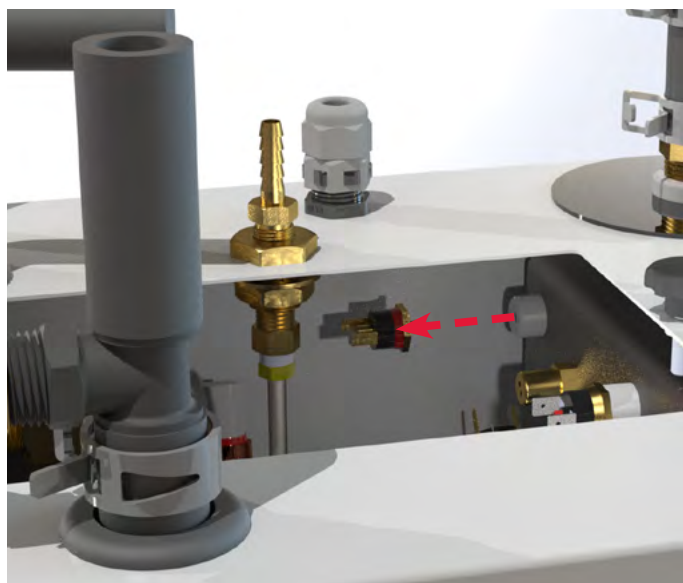


**Figure 39**

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  $\frac{5}{8}$ " 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  $\frac{5}{8}$ " socket or crow's foot.
10. Re-secure the wires (AOT1 & AOT2) 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 40**

## 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 fuel solenoid, preventing diesel fuel from entering the combustion chamber.

Begin troubleshooting the High-Limit Thermostats if the following conditions have occurred:

- The fuel solenoid fails to operate.

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

### Troubleshooting Guidelines:

The following conditions must be met before the DC High-Limit Thermostat(s) can be diagnosed, and if necessary, replaced.

- The fluid expansion bottle is filled to at least the “COLD” mark.
- Verify that all in-line fuses are functional.
- 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 41).
2. Disconnect the burner thermostats using the information below:
  - Wires #32 and jumper (left) or wires #33 and jumper wire (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 5/8" 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 Jumper wire and wire #32 (left) and/or wires #33 and jumper wire (right) to the high-limit thermostat which has just been replaced.
6. Test for normal operation.



**Figure 41**

## 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 42**

### Troubleshooting Condition:

This thermostat should be diagnosed if there is a lack of interior heat or hot water, and the tank is up to operating temperature.

### Troubleshooting Procedure:

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

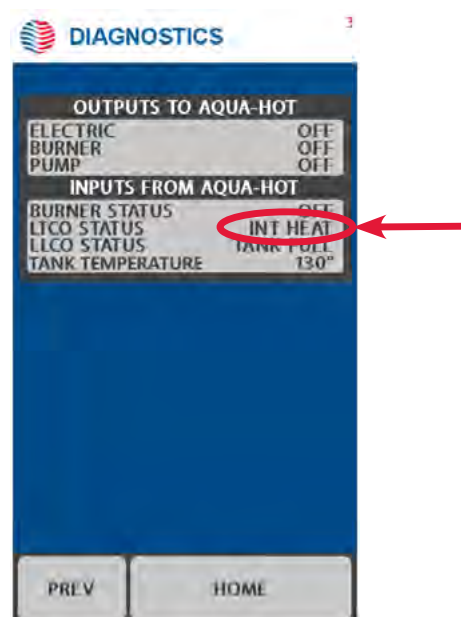
1. Verify the following before troubleshooting the low-temperature cutoff thermostat.
  - The ETS module is calling for heat
  - The interlock switch is depressed
  - The overflow bottle is adequately filled
  - The high-limit thermostats are not tripped
  - The fuses are all functional
2. Determine if the unit is ready to provide heat by verifying that the LCD screen shows the LTCO status properly.
  - 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.
  - The display screen should display "INT HEAT".

3. If the 'Low-Temperature Cutoff Status' display shows HOT WATER when no hot water is running, complete the following:

- Disconnect wire J4-1 and J4-2 from the low-temperature cutoff thermostat.
- If the LTCO status does not change from HOT WATER to INT HEAT 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 display shows INT HEAT 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 RV 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.



**Figure 43**

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. See Figure 44.
- 3. Disconnect the defective LTCO thermostat by separating the quick-disconnect terminals.
- 4. Using a 5/8" 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 J4-1 and wire J4-2 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.**

Low-Temperature Cutoff

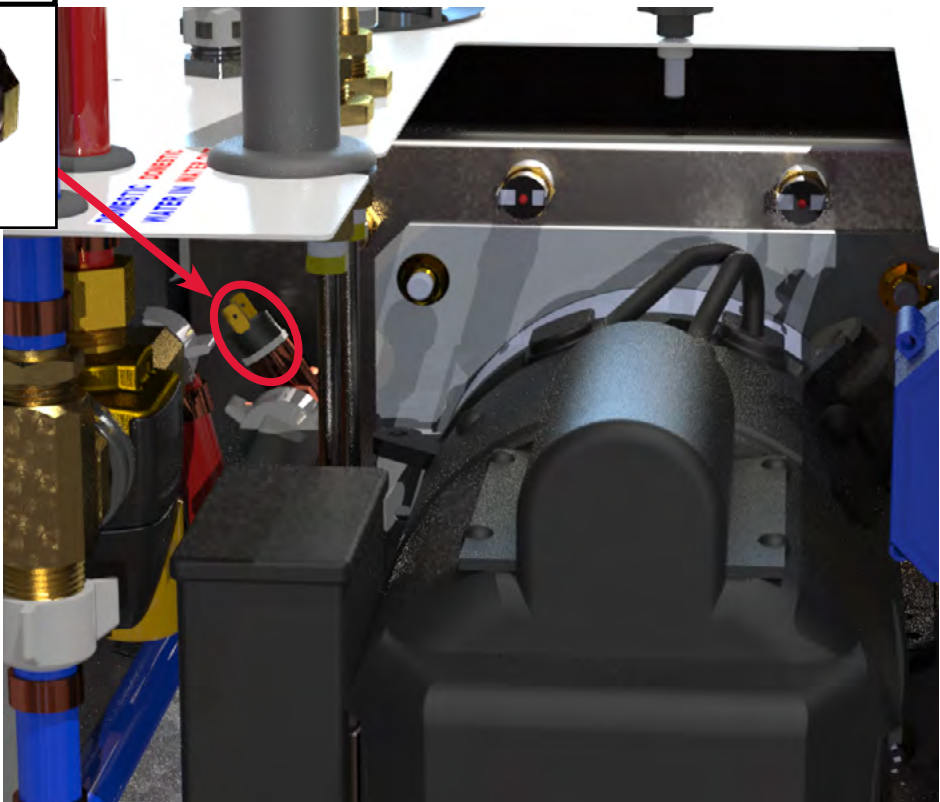


Figure 44



## 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 45**

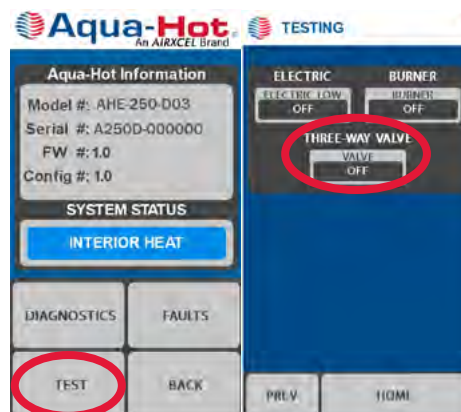
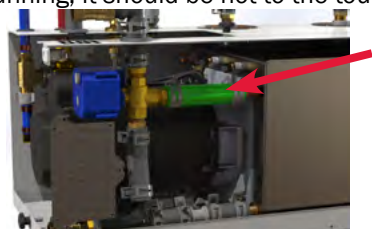
### Troubleshooting Condition:

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

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

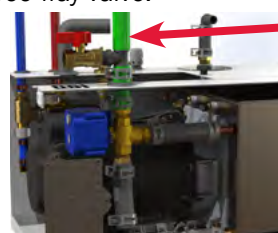
### Troubleshooting:

1. Verify the following before troubleshooting the three-way valve:
  - The ETS module is calling for heat
  - The interlock switch is depressed
  - The overflow bottle is adequately filled
  - The high-limit thermostats are not tripped
  - There are no faults on the LCD screen/control panel
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 LCD screen. Navigate to the TESTING page (Figure 46).
  - Tap NEXT, and then select THREE-WAY VALVE. The three-way valve should begin to actuate. This can be heard outside the cabinet.
4. If the three-way valve actuates, activate the burner/electric and allow the heater to heat to temperature.
  - Open a hot water faucet and grab the hose highlighted green as shown below. While hot water is running, it should be hot to the touch.



**Figure 46**

- If the hose is hot not to the touch while hot water is running, replace the three-way valve.
- Grab the other hose highlighted green as shown below. While hot water is running, these should be cool. If not cool while hot water is running, replace the three-way valve.




5. If the three-way valve does not actuate, locate the J6 plug and test for voltage between pins J6-10 and J6-11.
  - If no voltage at these pins, replace the controller.
6. If there is voltage, leave the probes of the multimeter in place and go back to the LCD screen. Navigate to the TEST page and tap NEXT.
7. Tap THREE-WAY VALVE to actuate the three-way valve and check the multimeter.
  - If the voltage polarity measured by the meter inverts, replace the three-way valve.
  - If it does not invert, replace the controller.



**Figure 47**

### 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 48.
  3. Remove the valve wires from the green connector plugged into the controller.
  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 49.
  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.
  8. Install the replacement three-way valve according to the specific instructions below.
- **DANGER**

**Failure to disconnect all power supplies and/or allow the unit to cool before servicing could cause serious damage or personal injury.**
- Reconnect the red wire to J6-11, and the green/black wire to J6-10 of the Aqua-Hot Controller J6 pin.
9. Refill the Aqua-Hot's boiler tank, purging the heating loop if necessary.
  10. Monitor the newly installed parts and fittings for leaks.
  11. Test for normal operation.

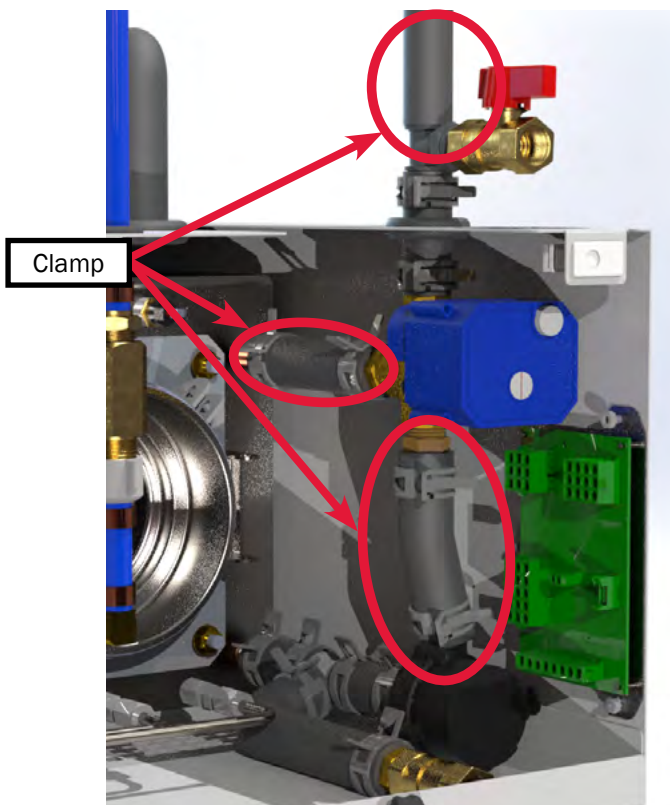


Figure 48

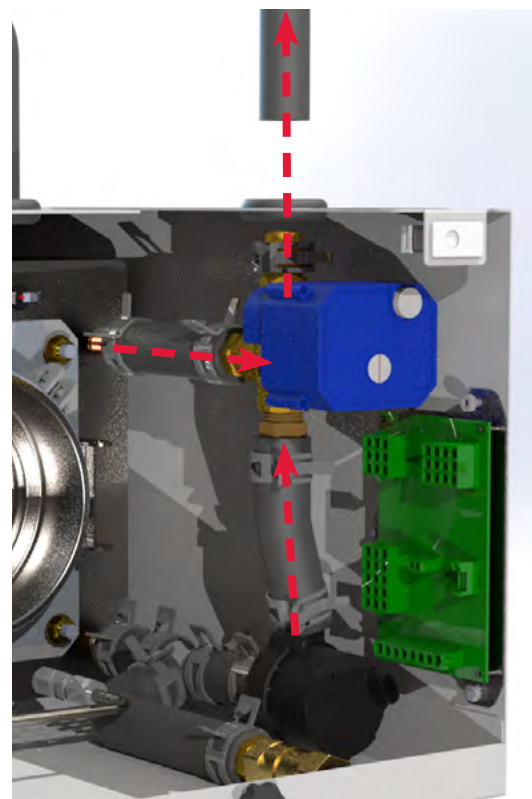


Figure 49

## 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” 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.

### Troubleshooting Condition:

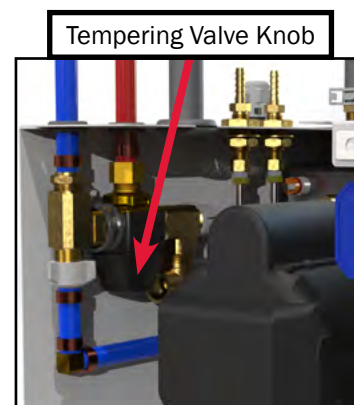
1. Inspect the tempering valve to ensure that it is not leaking.
2. Activate the burner and allow the unit to heat unit the burner shuts off. This test cannot to be accomplished with the electric element.
3. Open the hot water valve on an interior faucet without a hot-stop and allow the temperature to 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 50). 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.



### Replacement Procedure:

1. Turn off the RV water supply.
2. Drain the water pressure by opening the faucets and allowing the water to drain.
3. Disconnect the RV 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 50**

## 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.



**Figure 51**

### Troubleshooting Condition:

Troubleshoot the circulation pump if the following conditions have occurred:

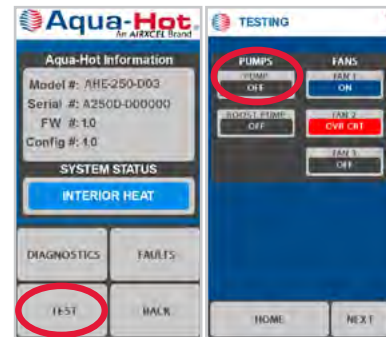
- A lack of interior heat.
- Lack of hot water or supply is uneven.

### Troubleshooting Procedure:

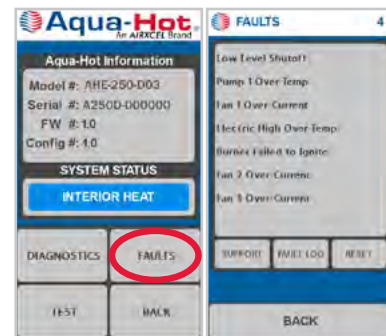
Follow the procedure to diagnose the fluid circulation pump.

1. Verify the following before troubleshooting the circulation and stir pump:
  - The ETS module is calling for heat
  - The interlock switch is depressed
  - The overflow bottle is adequately filled
  - The high-limit thermostats are not tripped
  - There are no faults on the LCD screen.
2. Locate the LCD screen. Navigate to the TESTING page (Figure 52a). Activate the internal circulation pump and if necessary, the boost pump.
3. If the pump activates, navigate to the FAULTS page (Figure 52b).
  - If there are any pump over-current faults displayed, replace the circulation pump.
  - If no faults, the pump is operating as intended.

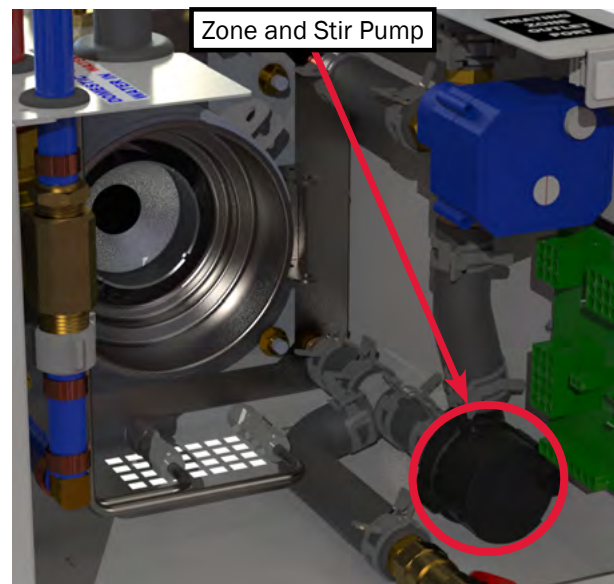
4. If the circulation pump does not activate, navigate to the TEST screen and activate the internal circulation pump.
5. Using a multimeter, test for voltage between pins J6-7 and J6-8.
  - If there is voltage at these pins, the pump will need to be replaced.
  - If there is no voltage at these pins, replace the Aqua-Hot controller.



**Figure 52a**



**Figure 52b**





**Figure 53**

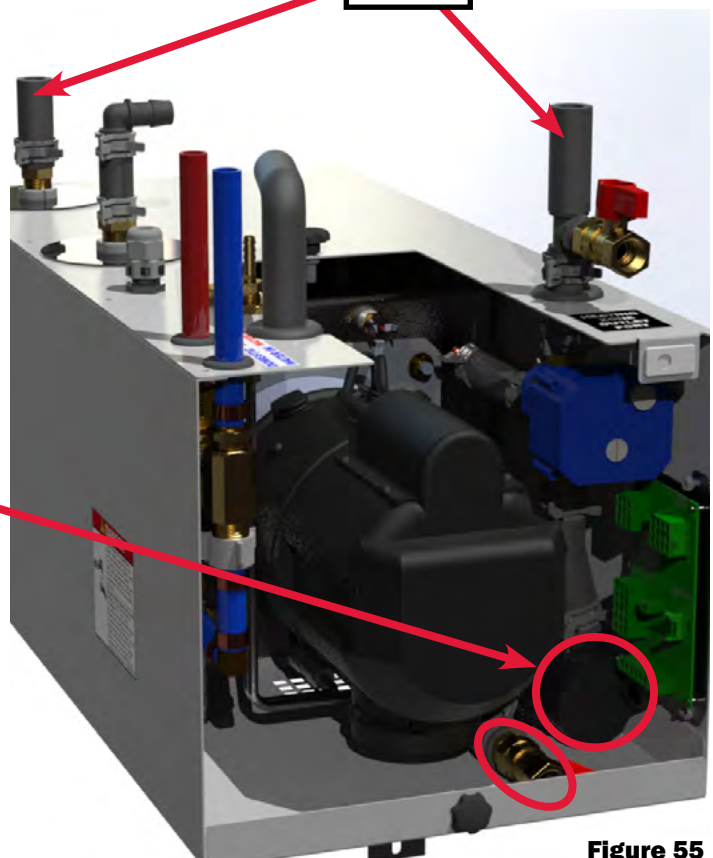


**Replacement Procedure:**

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 activating the circulation pump on the LCD screen for at least 20 minutes.

**Figure 54**

 <b>DANGER</b>	
<b>Failure to disconnect all power supplies and/or allow the unit to cool before servicing could cause serious damage or personal injury.</b>	
 <b>WARNING</b>	
<b>Burn Hazard</b> Hot Coolant Circuit with Hot Surfaces can cause severe burns.  <b>DO NOT</b> touch or service until equipment has cooled.	
LDE-200-810	

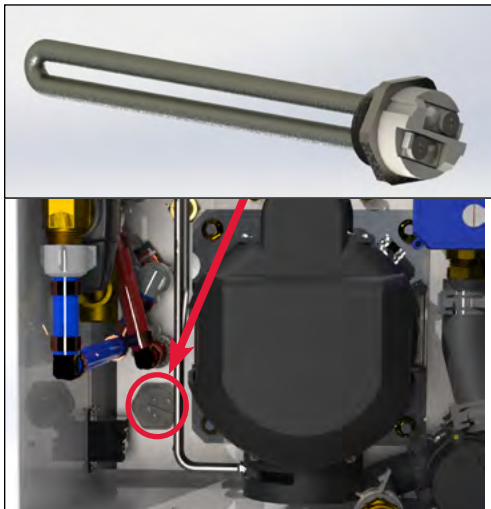
**CLAMP****Figure 55**

## 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 ETS module and the controller.

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 diesel burner.



**Figure 56**

### 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. Turn OFF both the electric and the burner on the LCD screen.
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 to ON.
6. Verify that the LCD screen shows electric status as ON.
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 ETS module is calling for heat
  - The interlock switch is depressed
  - The overflow bottle is adequately filled
  - The AC high-limit thermostat is not tripped
  - There are not faults on the LCD screen.
2. Locate the LCD screen and navigate to the TESTING page (Figure 58). Tap ELECTRIC.
  - The AC electric relay should let out an audible click from within the Aqua-Hot cabinet. If no click, verify the AC electric relay has functionality, and if no functionality, replace the relay.
  - If there is a click sound, leave the ELECTRIC to ON. Tap PREVIOUS and activate the pump. Allow the Aqua-Hot to get to 170°F (approximately 1 hour).
  - Verify the tank temperature on the screen, on the DIAG screen (180°F). See Figure 57. If the tank is not to temperature, check the element for 11.2-13 amps. If there is less than 11 ohms of resistance, replace the element.
3. Verify that the controller is sending 12V DC power to the AC relay using a voltmeter. Test wire J6-1 for 12V DC
  - If 12V DC is not present while the electric element is on, and status is ON on the LCD screen, the controller will need to be replaced.
  - If 12V DC power is present at wire J6-1, turn off all RV-side breakers providing power to the Aqua-Hot, then disconnect the Molex plug AC connection.

- Using an ohmmeter, check for continuity across wires J6-1 and J6-2 of the AC relay.

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

- Verify that the electric element has the proper resistance:
  - Disconnect the AC Molex plug from the 250 AC plug.
  - Move the electric on the interior control panel to the ON position. Using an ohmmeter, test for resistance on the white and black terminals of the Aqua-Hot Molex terminal (Figure 59).
- Open a hot water faucet within the RV.
  - If there is hot water, the AC electric system is operating as intended.
  - If there is no hot water, replace the electric element.
- Verify that the electric heating element is receiving adequate AC power by completing the following:
  - Plug the RV 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 RV-side power.
  - Using a digital clamp-meter, verify the electric element is drawing between 8A and 8.5A. If there is not power, replace the electric element.

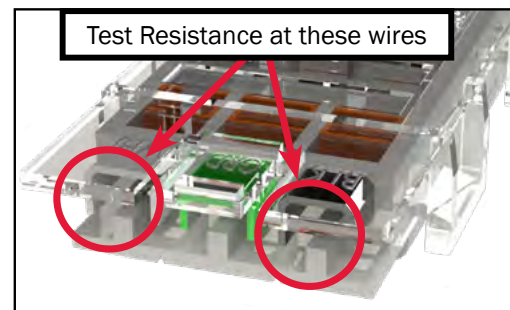


Figure 59

### Electric Element Replacement Procedure:

- 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.
- Using hose pinch-off pliers, clamp off the heating zone inlet and outlet ports.
- Drain the antifreeze and water solution from the Aqua-Hot's boiler tank into an external container to be reused.
- Remove the two wires secured to the defective electric heating element by releasing the screw terminals.
- Using a 1-1/2" (38mm) socket, remove the defective heating element from the Aqua-Hot's boiler tank.
- 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.
- Install the replacement 1kW electric element into the boiler tank and secure it with the 1-1/2" (38mm) socket.
- Reconnect the wires previously disconnected from the electric heating element and tighten the screw terminals.
- 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.
- 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.

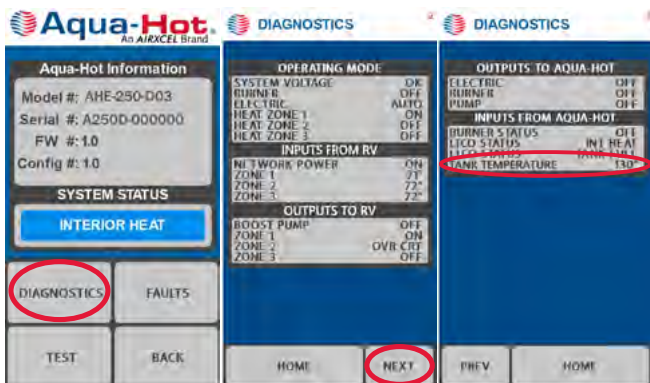


Figure 57

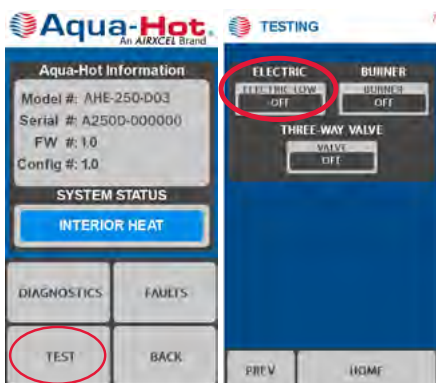


Figure 58



## AC Relay

### Introduction:

The AC relay is an electrical device where the DC circuit from the controller determines whether the AC power is permitted to flow to the electric heating element. This allows the controller to turn the electric heating element on and off in conjunction with the interior control panel and ETS module even though the electric element is on a separate circuit.

### Troubleshooting Procedure:

Troubleshoot the AC relay if the electric element fails to operate. The following conditions must be met before the AC relay can be diagnosed:

- The fluid expansion bottle is filled to at least the COLD line.
- All in-line fuses are functional
- The Aqua-Hot is completely cool
- DC electrical power is supplied to the Aqua-Hot
- AC electrical power is supplied to the electric element
- All thermostats are in working order

Correct any conditions above before continuing with troubleshooting. Results of the troubleshooting procedure cannot be verified if the conditions above are not fulfilled.

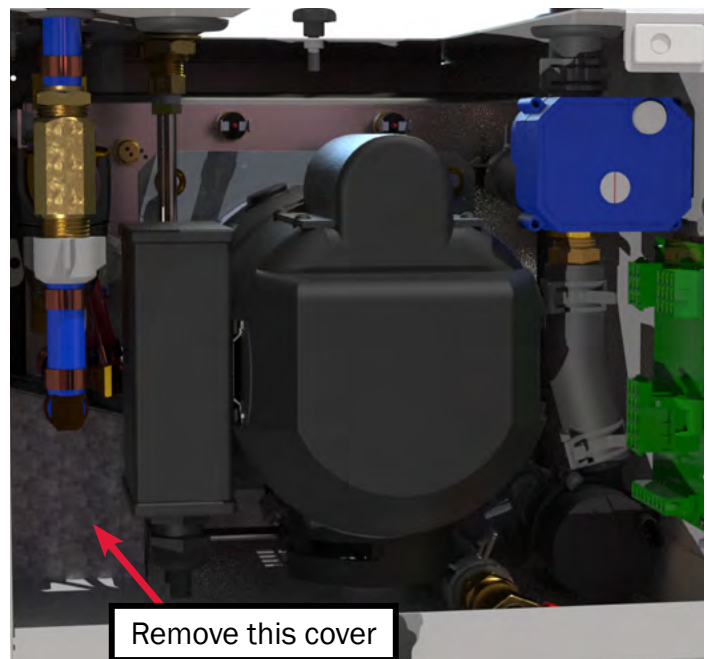
1. Locate the AC wires connected to the AC relay and remove the wires from the relay.
2. Using an ohmmeter, check the AC relay pins for continuity.
3. If no continuity exists, follow replacement procedure to replace the AC relay.

### AC Relay Replacement Procedure:

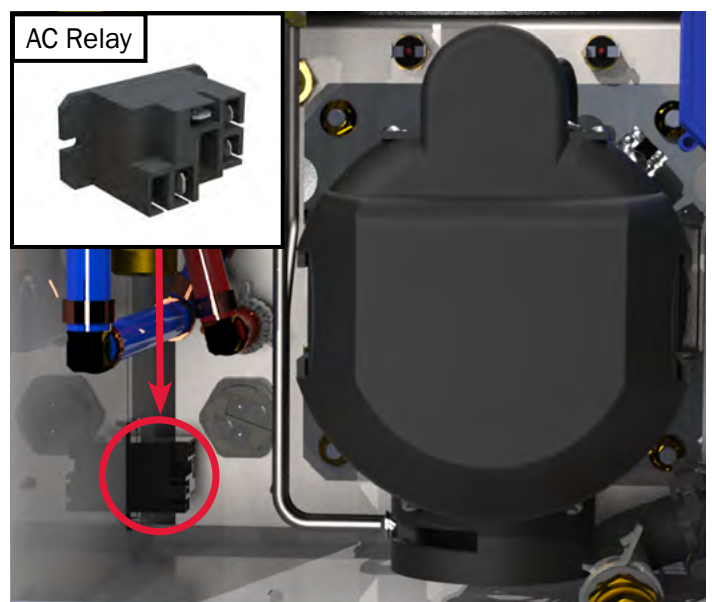
If it has been determined that the AC relay needs to be replaced, follow the outline below to replace the AC relay.

4. 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.
5. Ensure that the coach is not connected to shore power and that a generator is not connected during this procedure.
6. Remove the AC access cover to gain access to the relay. See Figure 60.
7. Remove all wires from the relay.
8. Remove the defective relay by drilling the rivets that hold the relay in place and discard the defective relay.
9. Rivet the replacement AC relay in place.

10. Using the wiring diagram on Page 100, connect the wires previously removed to the replacement relay.
11. Test for normal operation.



**Figure 60**



**Figure 61**



## Diesel Burner Overview

The diesel burner serves as the primary heating source for the Aqua-Hot 250-D03. The diesel burner is responsible for mixing and igniting diesel fuel within the combustion chamber. Heat energy is then transferred from this combustion reaction into the antifreeze and distilled water heating solution present in the Aqua-Hot's boiler tank, which is distributed to heat exchangers, or to the domestic hot water coil to provide hot water.

Standard automotive diesel fuel is to be used as the fuel source. Key components are called out below. The diesel burner has an identifying label with information such as specifications and the serial numbers.


Diesel Burner ID Label	
5000015A	<b>Webasto</b> <small>Heat the Drive</small>
Assembled in USA	
Heater Model	DBW2010.75
Voltage/Power	12V/60W
Output	13.2kW-45000Btu/h
Fuel Type	Diesel No. 1/No. 2 and Artic
Max. Operating Pressure	2 bar-29PSI
	
Heater No. 90915E Vers. 75 Serial No.	727107
Year of Installation	18 19 20 21 22

Figure 62

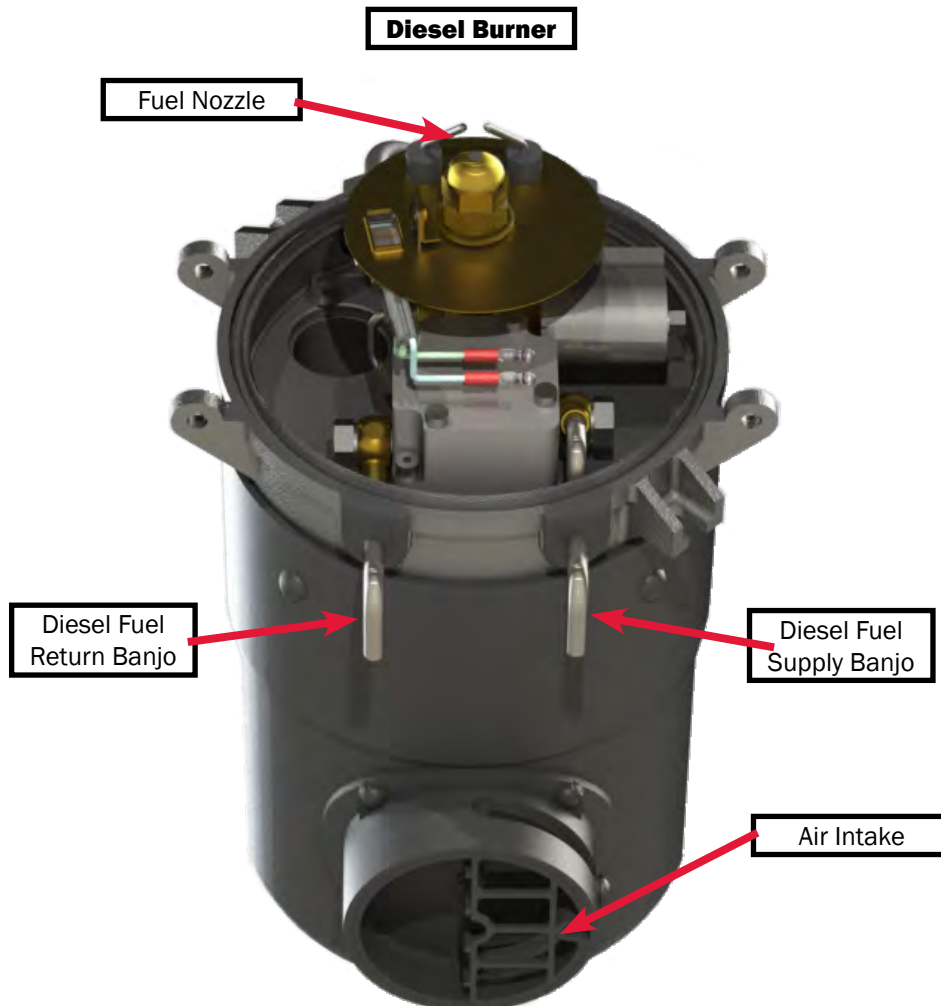
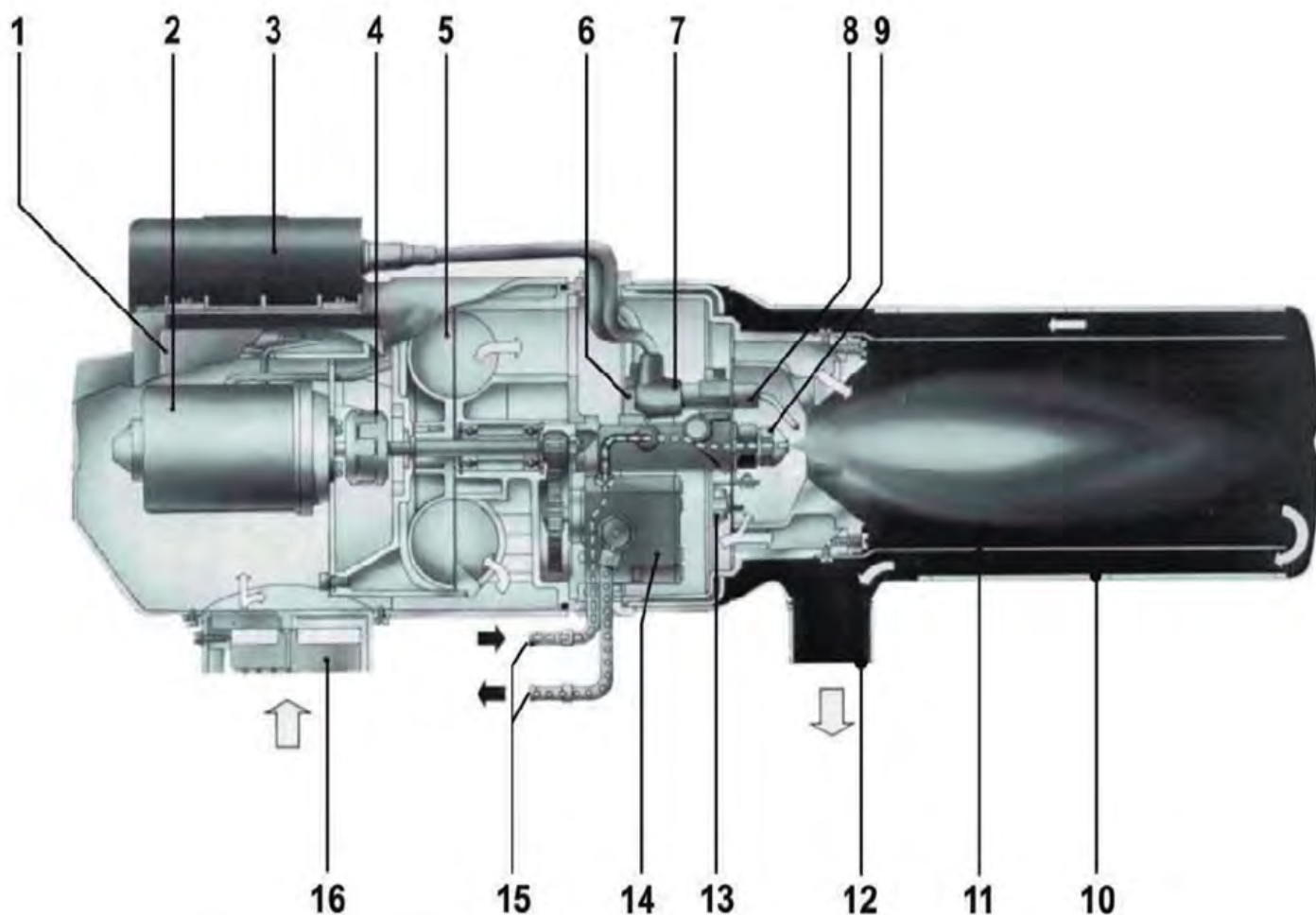
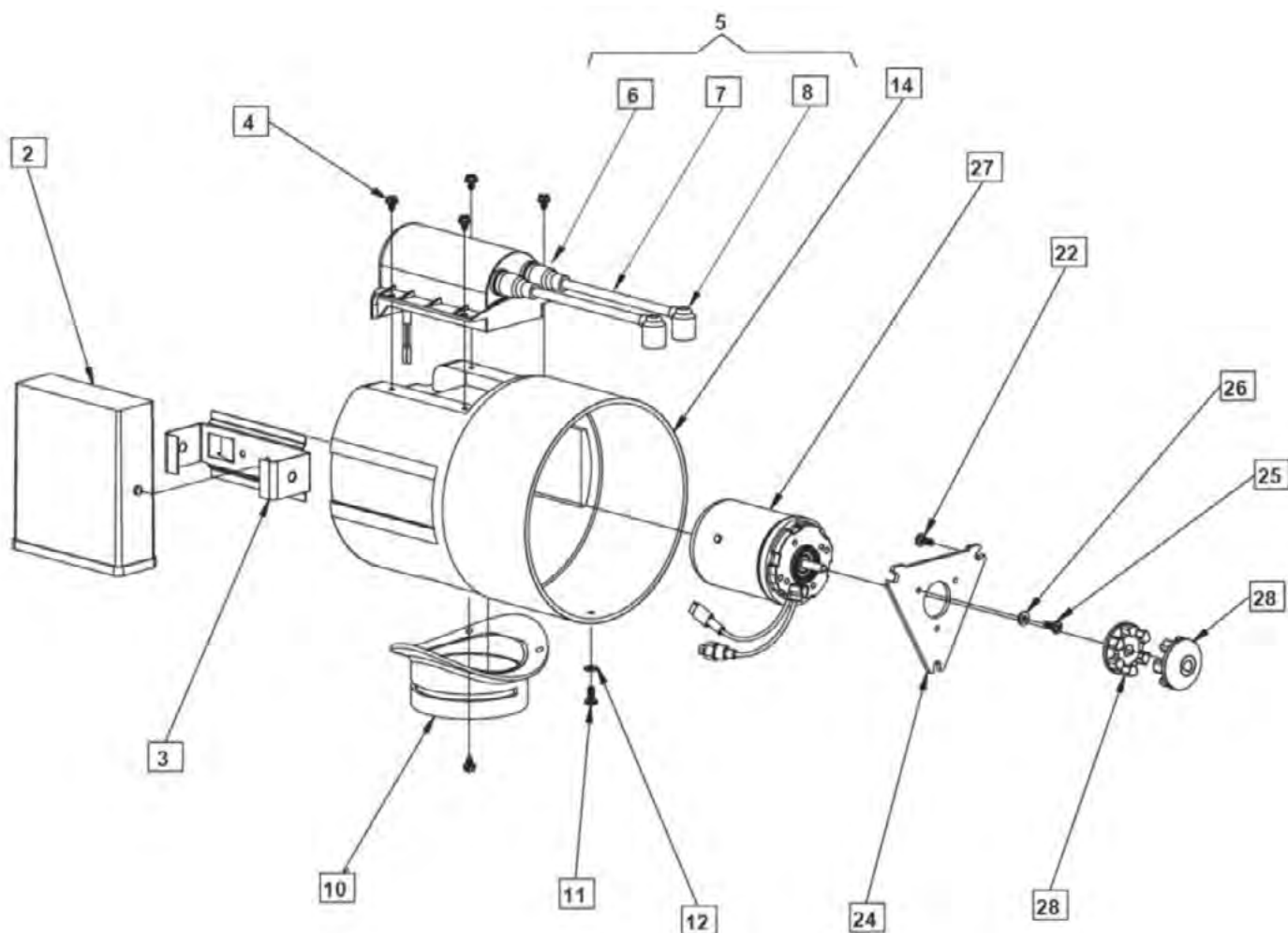


Figure 63

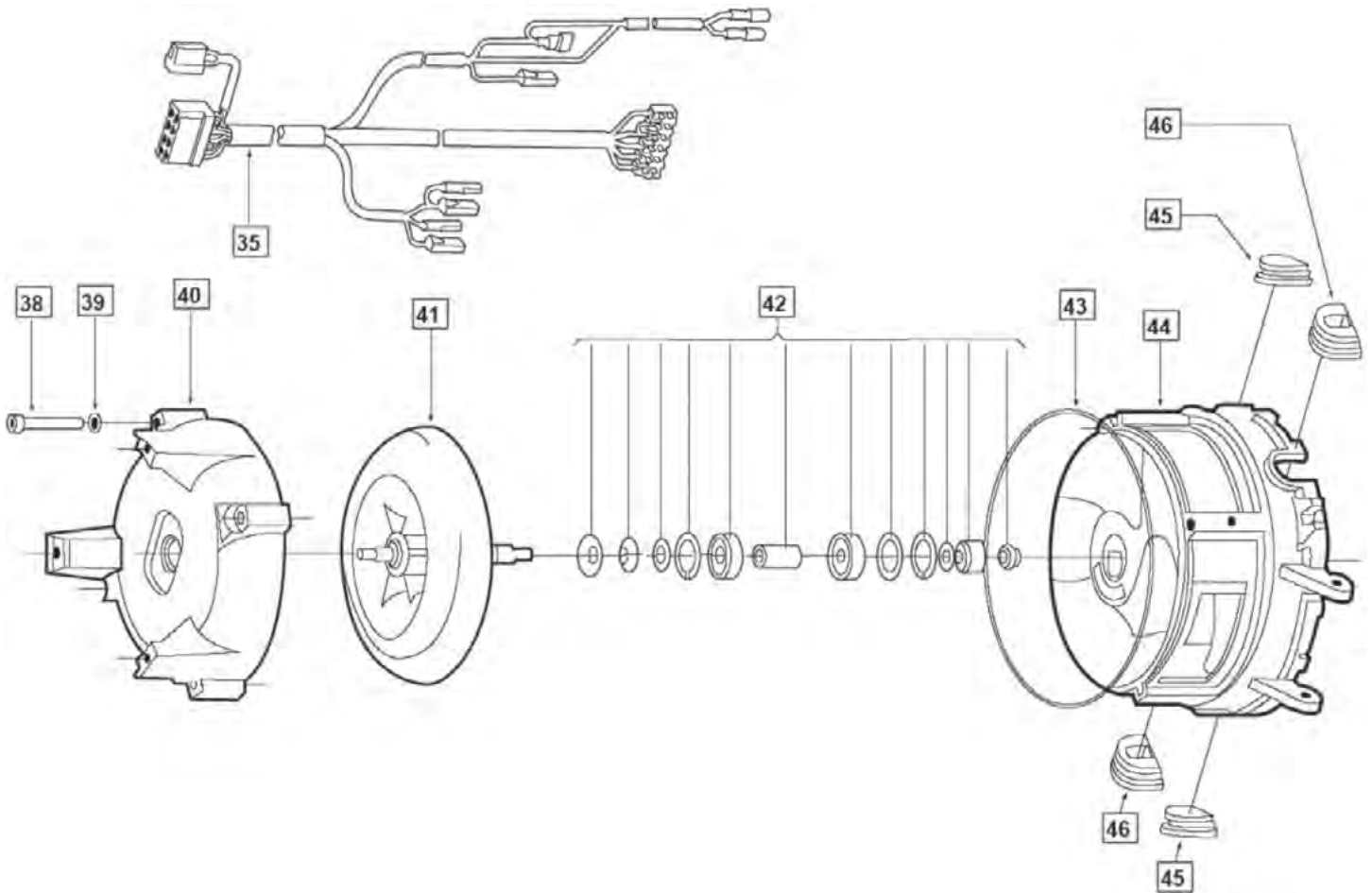
- |                             |   |
|-----------------------------|---|
| 1. Diesel-Burner Controller | 10. Heat Exchanger                                      |
| 2. Motor                    | 11. Combustion Chamber                                  |
| 3. Ignition Coil            | 12. Exhaust Port  |
| 4. Clutch                   | 13. Flame Sensor  |
| 5. Combustion Air Blower    | 14. Fuel Pump   |
| 6. Fuel Solenoid Valve      | 15. Fuel Tubes (Supply / Return)                        |
| 7. Electrode Boots          | 16. Combustion Air Intake Port, with Adjustable Shutter |
| 8. Ignition Electrodes      |   |
| 9. Fuel Nozzle              |   |





Torque Specs	
Item	Torque Value
4	2 Nm
10	1.0 +0.5 Nm
11	2 Nm (18 lb-in)
22	5 - 6 Nm(44 -53 lb-in)
25	5 - 6 Nm (44-53 lb-in)

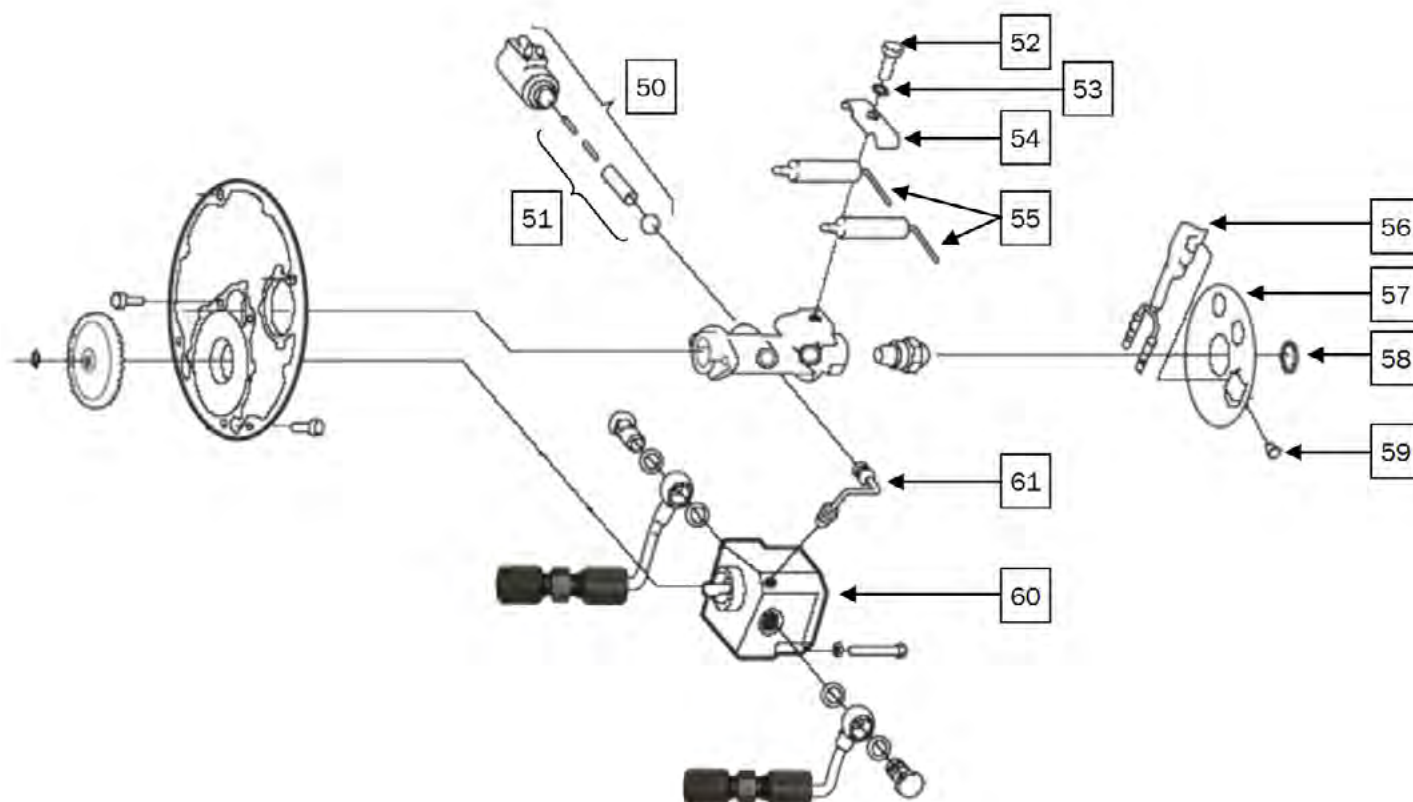
Key	Part Number	Description
2	WPE-300-901	Controller, 12V DC
3	WPX-362-107	Controller Mounting Bracket
4	WPX-470-562	Coil Mounting Screw
5	WPX-101-838	Ignition Coil, 12V DC
6	WPX-404-918	Ignition Wire Boot
7	WPX-178-624	Ignition Wire
8	WPX-176-494	Boot Ignition Wire, Elbow
10	WPX-350-427	Combustion Air Intake Shutter
11	WPX-432-377	Protection Housing Screw
12	WPX-152-269	Washer, Star, Protection Housing
14	WPX-436-216	Protection Cap
22	WPX-147-834	Screw, Flange, Blower Housing
24	WPX-425-05A	Motor Mounting Plate
25	WPX-432-377	Motor Plate Screw
26	WPX-152-269	Washer, Star, Motor Plate
27	WPX-425-060	Motor, Combustion Air/Fuel Pump 12V DC
28	WPX-350-516	Clutch Half, 6mm



Torque Specs	
Item	Torque Value
38	5.5 - 6.5 Nm (48.5-57.5 lb-in)
41 (Fan Gap)	.457mm + .05mm (STANDARD SHIM STOCK) - 0.0mm
42 (nut)	

Key	Part Number	Description
35	WPX-434-795	C-Plug Harness
38	WPX-148-210	Blower Casing Screw
39	WPX-152-552	Washer, Lock, Blower Casing
40	WPX-301-841	Blower Housing
41	WPX-373-001	Blower, Wheel with Shaft
42	WPX-378-313	Bearing Kit
43	WPX-412-244	O-Ring Blower Casing
44	WPX-225-67A	Blower Casing
45	WPX-298-964	Grommet, Blower Casing, Left
46	WPX-299-995	Grommet, Blower Casing, Right

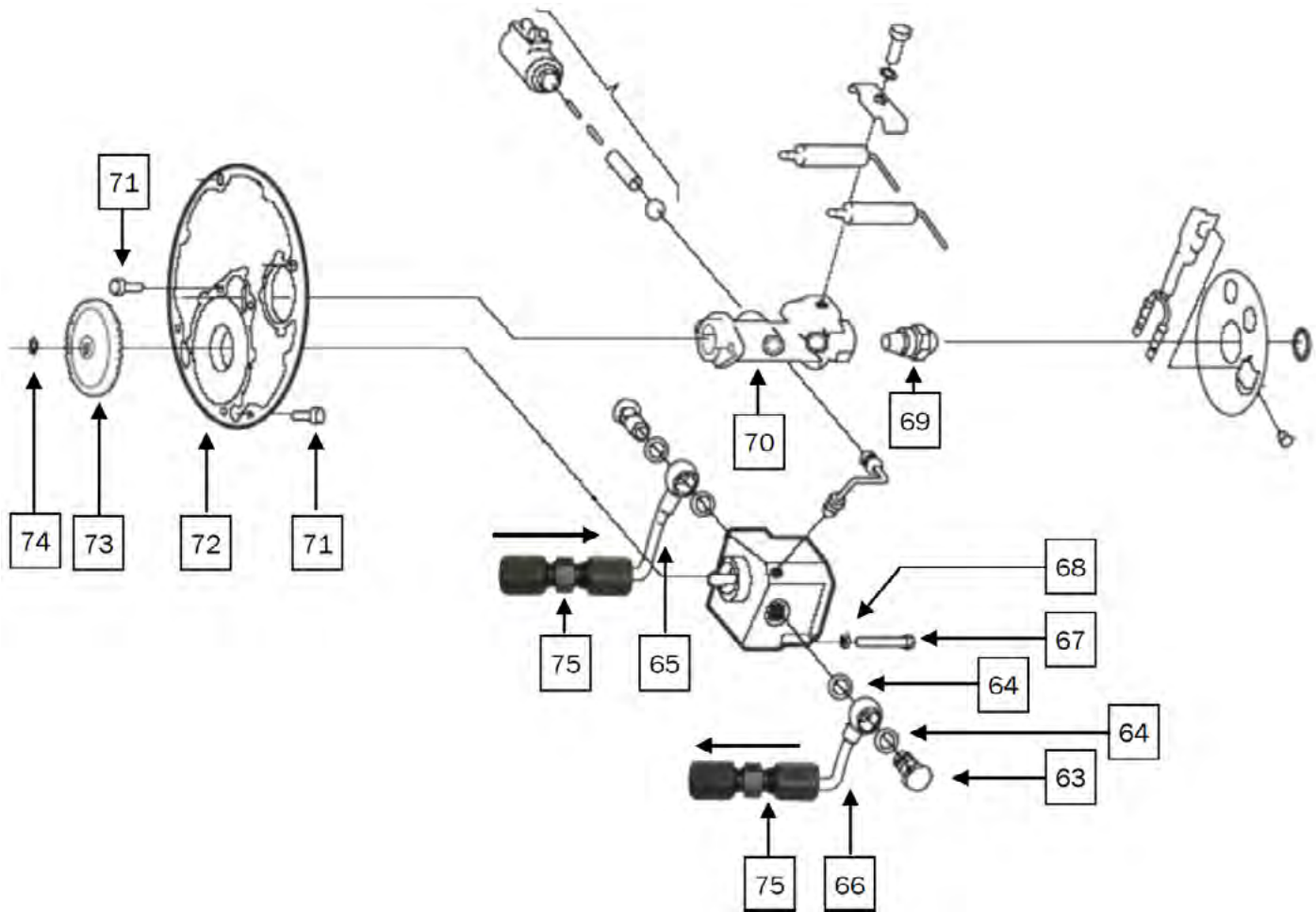




## Torque Specs

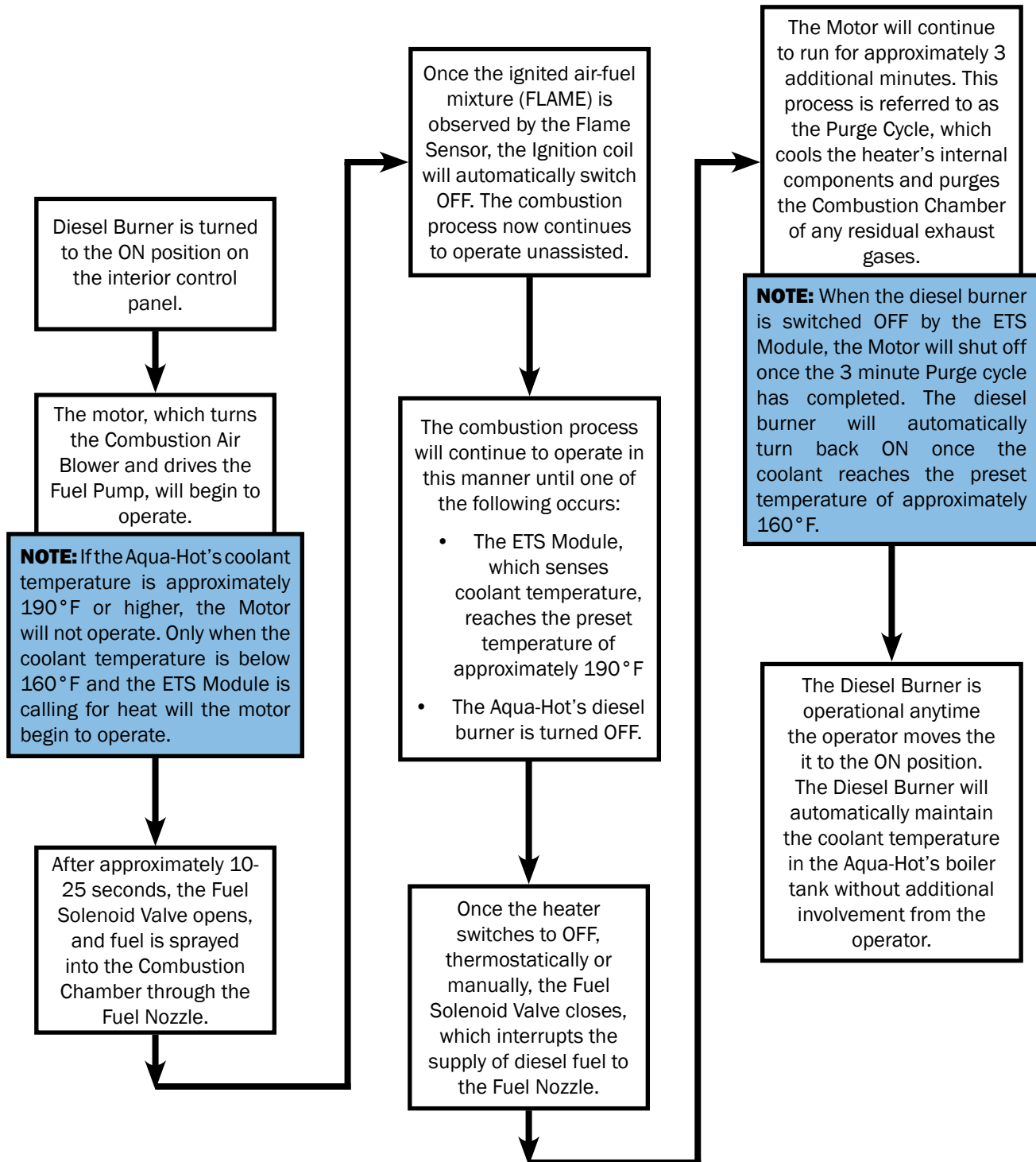
Item	Torque Value
50 (nut)	2 Nm
50 (fuel fitting to fuel tower)	11.5 Nm (8.5 lb-ft)
52	
59	5 Nm - 6 Nm (44-53 lb-in)
61	6 ± 0.6 Nm

Key	Part Number	Description
50	WPX-322-083	Valve, Fuel Solenoid 12V DC
51	WPX-386-650	Valve, Fuel Solenoid Kit
52	WPX-267-279	Electrode Bolt
53	WPX-152-560	Washer, Lock, Electrode
54	WPX-278-971	Electrode Clamp
55	WPX-274-313	Ignition Electrode
56	WPX-638-78A	Flame Sensor
57	WPX-887-71A	Photo Disc
58	WPX-453-048	Clip, Retaining, Photo Disc
59	WPX-147-699	Flame Sensor Screw
60	WPX-503-03A	Fuel Pump Kit
61	WPX-665-49A	High Pressure Fuel Tube

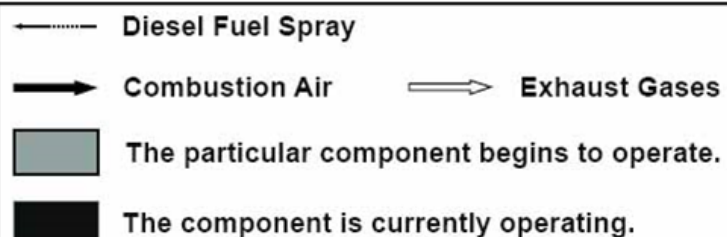


Torque Specs		Key	Part Number	Description
Item	Torque Value			
63	15 ± 1.5 Nm	63	WPX-150-754	Banjo Bolt
67	3 Nm	64	WPX-151-157	Copper Gasket Ring
69	20 Nm	65	WPX-661-002	Banjo Fuel Pipe - Supply, DBW 2010 (with Straight Tube)
71	5.5 Nm	66	WPX-661-001	Banjo Fuel Pipe - Return, DBW 2010 (with Straight Tube)
73	Use grease type : ISOFLEX LDS 18 Special A Lubricant P/N 143820 (45gram tube)	67	WPX-277-282	Fuel Pump Mounting Screw
75		68	WPX-152-544	Washer, Lock, Fuel Pump
		69	WPX-886-41A	Fuel Nozzle, 0.35 GPH
		70	WPX-412-198	Manifold, Fuel Nozzle, Brass
		71	WPX-277-150	Screw, Plate, Nozzle Stand
		72	WPX-102-861	Plate, Manifold
		73	WPX-371-289	Gear, Fuel Pump, Nylon
		74	WPX-152-390	Snap, Ring, Gear
		75	FLX-421-010	Fitting, Hex Union 1.4in Tube

### Diesel Burner Operational Flow Chart



## KEY

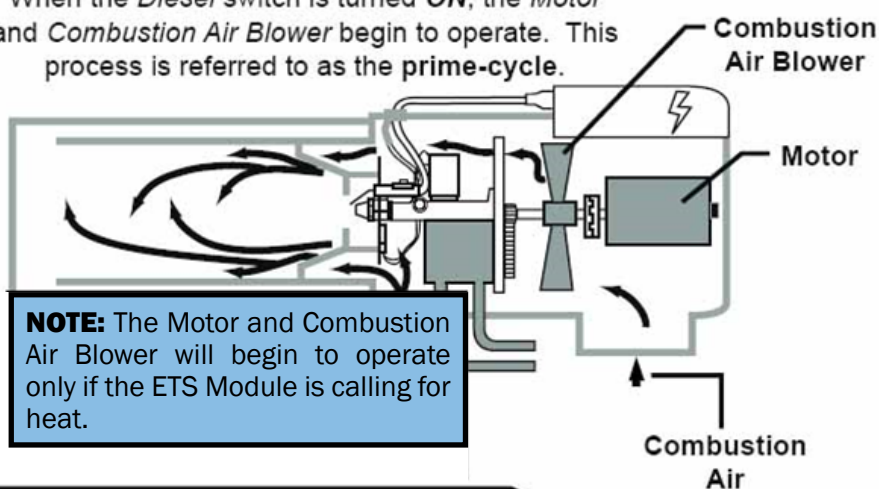


## Diesel-Burner Operation

# 1

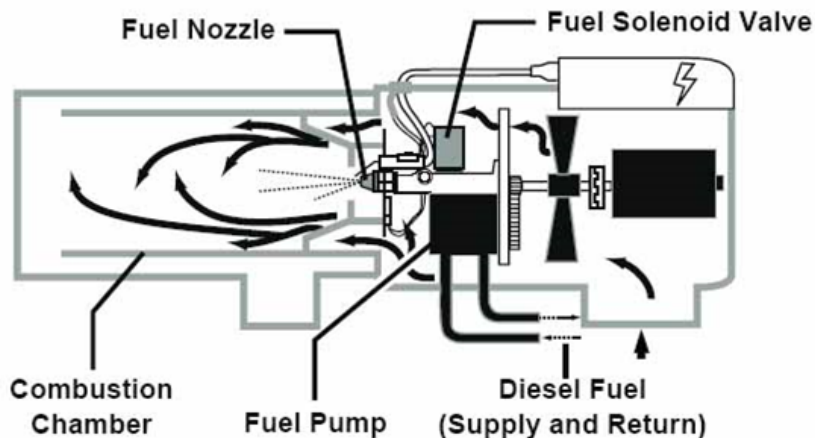
When the *Diesel* switch is turned **ON**, the *Motor* and *Combustion Air Blower* begin to operate. This process is referred to as the *prime-cycle*.

**NOTE:** The Motor and Combustion Air Blower will begin to operate only if the ETS Module is calling for heat.








# 2

The *Fuel Pump* builds up pressure against the *Fuel Solenoid Valve*. After approximately 10-25 seconds, the *Fuel Solenoid Valve* opens, and fuel is released into the *Fuel Nozzle*, then sprayed into the *Combustion Chamber*.





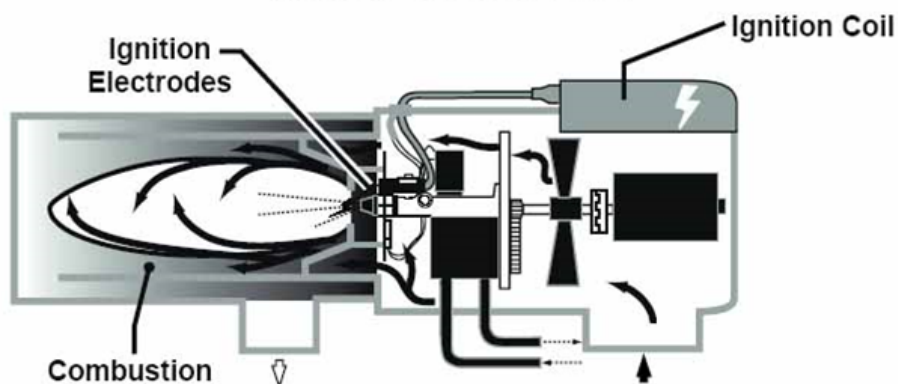
# KEY

-  Diesel Fuel Spray
-  Combustion Air
-  Exhaust Gases
-  The particular component begins to operate.
-  The component is currently operating.

## Diesel-Burner Operation, continued

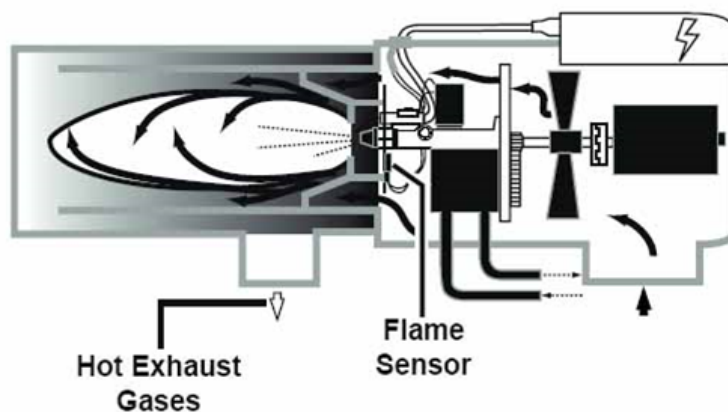
3

The *Ignition Coil* produces a high voltage spark, which is transferred across the *Ignition Electrodes*. The incoming air-fuel mixture is then ignited, creating combustion.








4

The combustion's flame is detected by the *Flame Sensor* and the *Ignition Coil* is then automatically switched off (no more spark across the *Ignition Electrodes*).



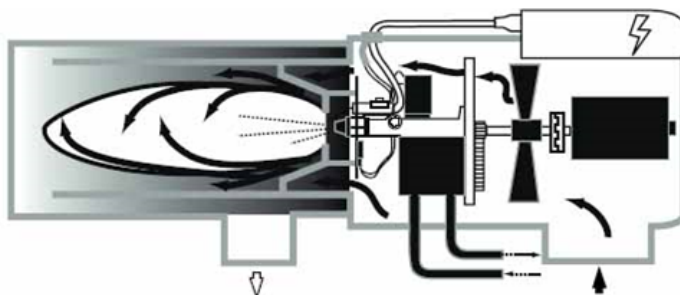
## KEY

-  Diesel Fuel Spray
-  Combustion Air 
-  The particular component begins to operate.
-  The component is currently operating.

## Diesel-Burner Operation, continued

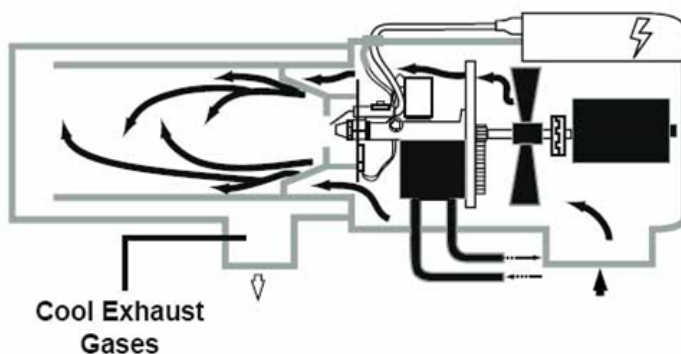
5

The *Diesel-Burner* will continue to produce heat in this manner until it is switched off either manually or by the *ETS Module*, which occurs when the coolant temperature in the Aqua-Hot's *Boiler Tank* reaches 190°F (±5).



6

Once the *Diesel-Burner* has switched **OFF**, the *Motor* and *Combustion Air Blower* will continue to operate for approximately 2-3 minutes. This process is referred to as the **purge-cycle**.



**NOTE:** Whenever the Diesel Burner is switched OFF by the ETS Module, it will automatically be reactivated once the Aqua-Hot boiler tank's coolant reaches the present temperature of approximately 160°F (±5°).

## Instructions for Detaching the Diesel Burner



# WARNING

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



# CAUTION

Be sure to clamp off the Fuel Supply and Return lines at the ports on top of the Aqua-Hot prior to beginning this replacement procedure.

### Step 1: Turn off the diesel burner

The diesel burner status should show OFF on the Aqua-Hot LCD screen or on the RV interior control panel.

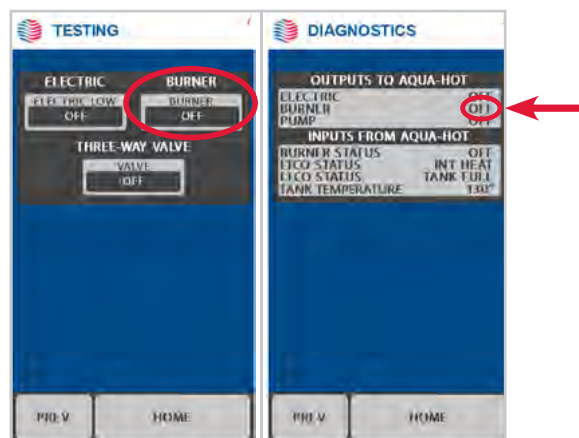


Figure 64

### Step 2: Remove the Access Cover

1. Locate the bolts securing the access cover in place, unscrew the bolts.
2. Remove the access cover.

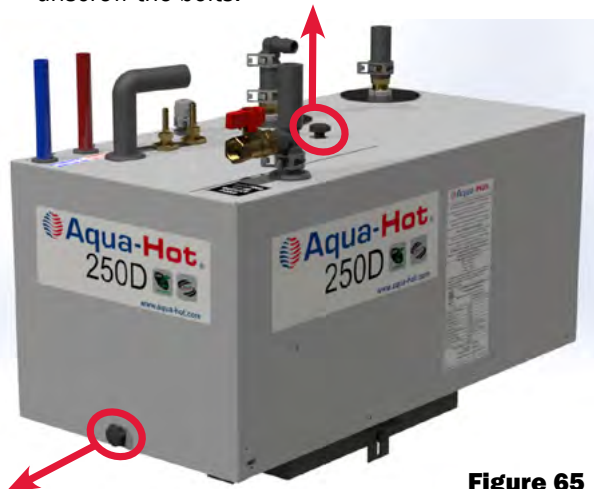


Figure 65

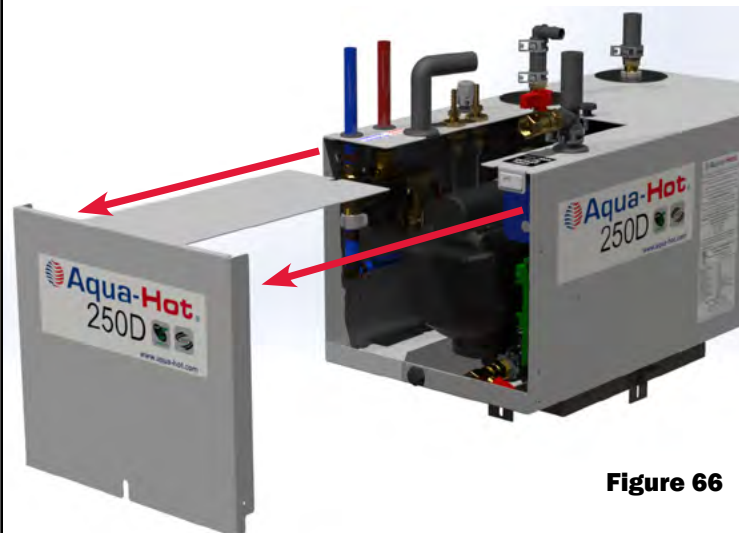


Figure 66

### Step 3: Disconnect the Diesel Burner's Controller

Locate the controller and disconnect both plugs.

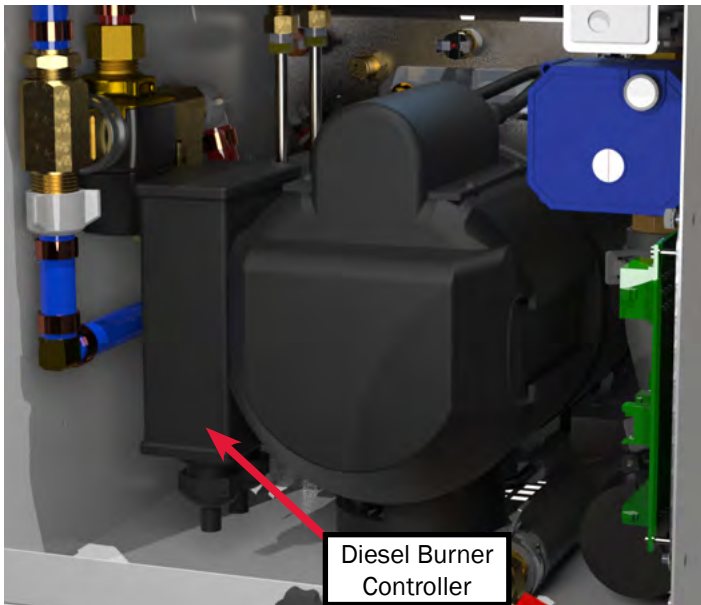


Figure 67

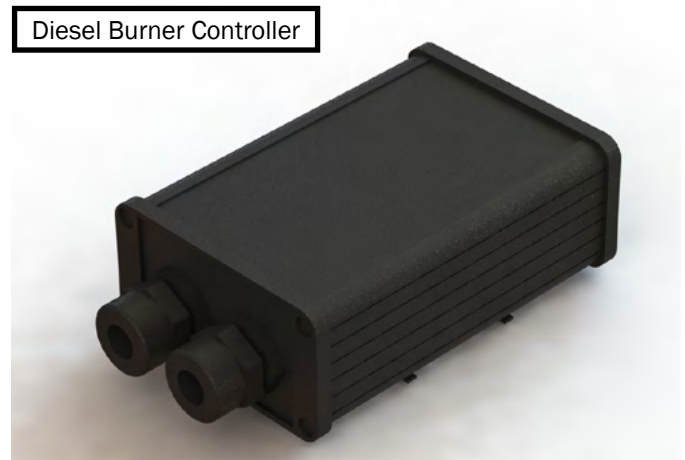


Figure 68

### Step 4: Remove the fuel lines from the Aqua-Hot

1. Locate where the fuel lines on the diesel burner connect to the Aqua-Hot bulkhead fittings.
2. Using a  $\frac{7}{16}$ " wrench, loosen the nuts securing each fuel line to the Aqua-Hot.

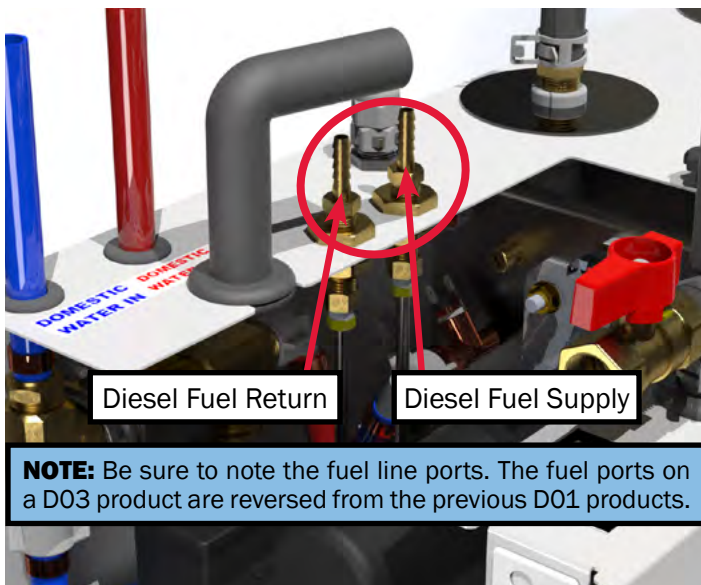


Figure 69

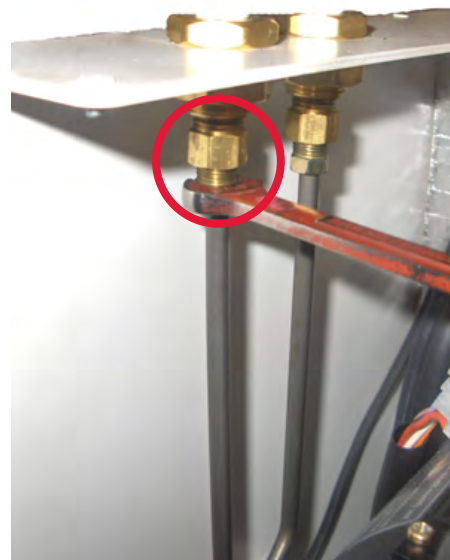
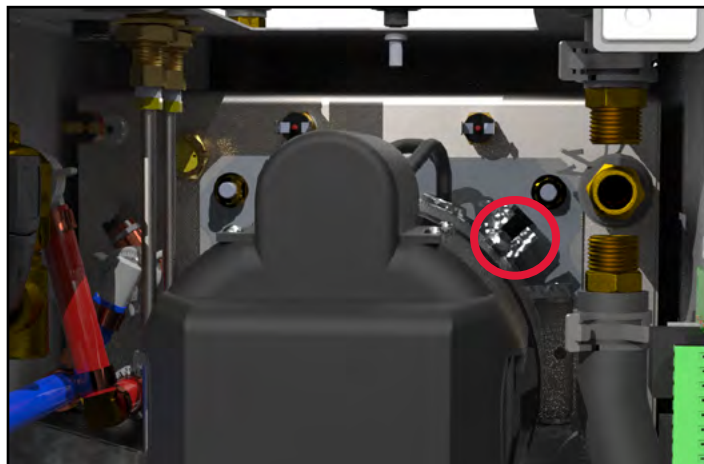


Figure 70



**Step 5: Remove the Diesel Burner from the Aqua-Hot**

The diesel burner is secured to the Aqua-Hot with two nuts that can be loosened, and swung out of the way by using a 10mm socket wrench with a 10" long extension.

**Figure 71****Figure 72**

Carefully pull the diesel burner away from the Aqua-Hot 4 to 5 inches before rotating the burner up, and then remove.

**Figure 73**

### Reattaching the Diesel Burner to the Aqua-Hot



## CAUTION

When reattaching the diesel burner, be sure to properly align the diesel burner before tightening the eye-bolt nuts. Visually inspect all the rubber grommets on the top and bottom of the burner's cast-aluminum blower casing to ensure they are in place. **DO NOT** over-tighten the eye-bolt nuts. Torque specifications are 20-40 in-Lb. An improper alignment or over tightening of the eye-bolt nuts can cause damage to the burner's cast-aluminum blower casing.

#### Step 1: Reattach the Diesel Burner to the Aqua-Hot

The diesel burner is secured to the Aqua-Hot with two eye-bolt nuts that can be swung into place, after the diesel burner has been properly aligned and set in place.

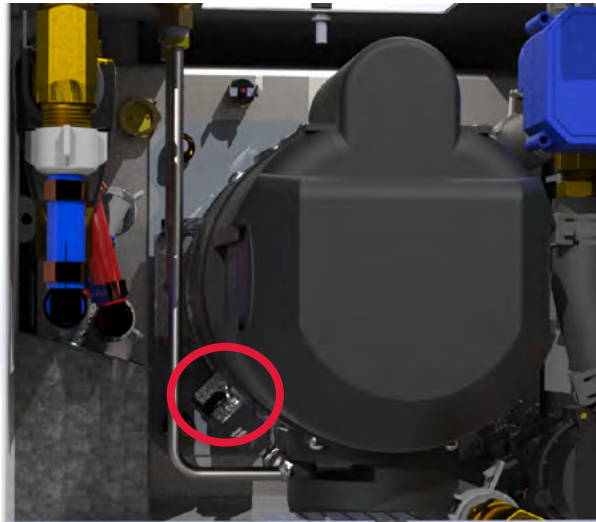


Figure 74

The eye-bolt nuts can then be tightened by using a 10mm socket with a 10 inch long extension. Use extreme caution when tightening down the eye-bolt nuts. Over-tightening the eye-bolt nuts can cause the aluminum blower casing to crack. (Torque Specifications are approximately 20-40 in-lbs.)



Figure 75

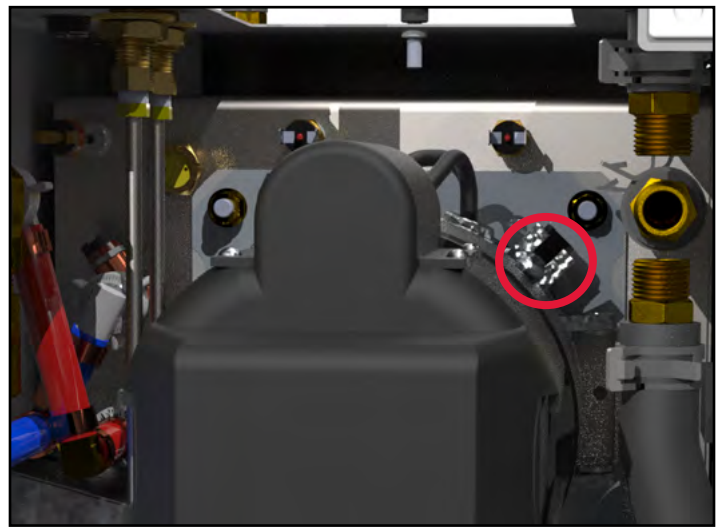


Figure 76

## Step 2: Reattach the fuel lines to the Aqua-Hot

Align the fuel lines on the diesel burner with the fittings on the Aqua-Hot, and using a  $\frac{7}{16}$ " wrench, tighten down both the supply and return fuel fittings.

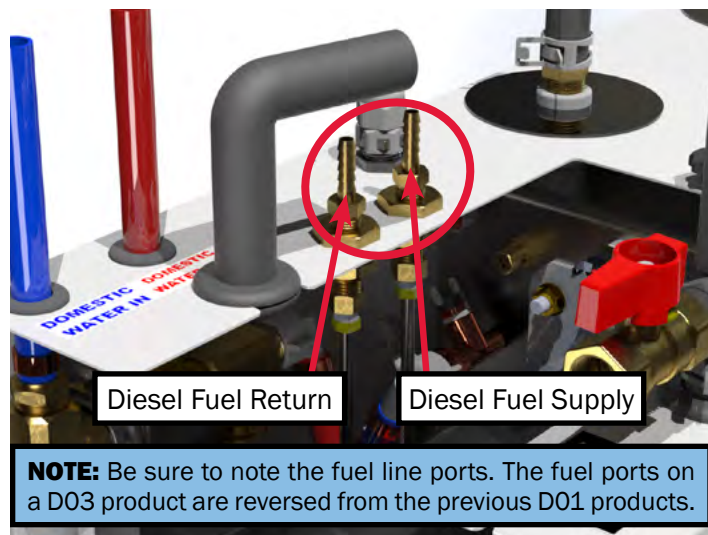


Figure 77

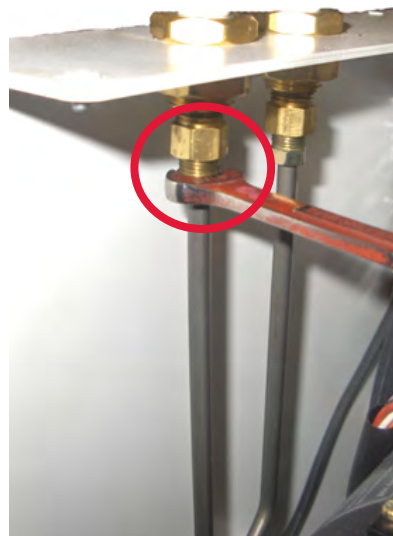


Figure 78



# CAUTION

**Be sure to clamp off the Fuel Supply and Return lines at the ports on top of the Aqua-Hot prior to beginning this replacement procedure.**

## Step 3: Reconnect the Controller and Mount

Locate the diesel burner's Controller and connect both plugs that were previously disconnected.



Figure 79

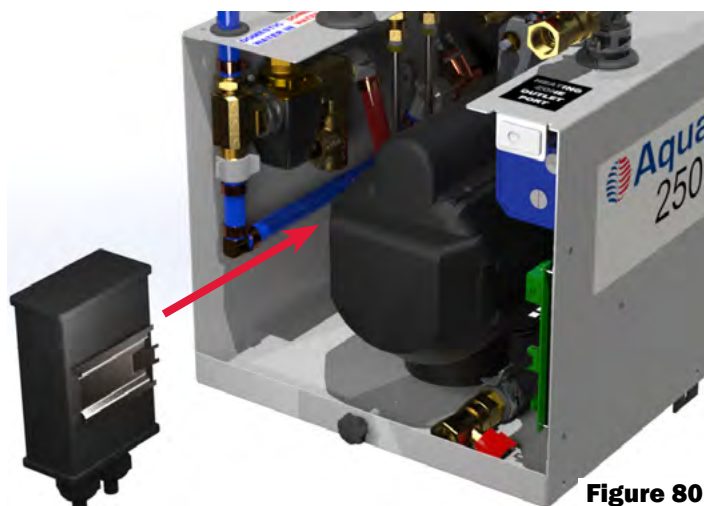


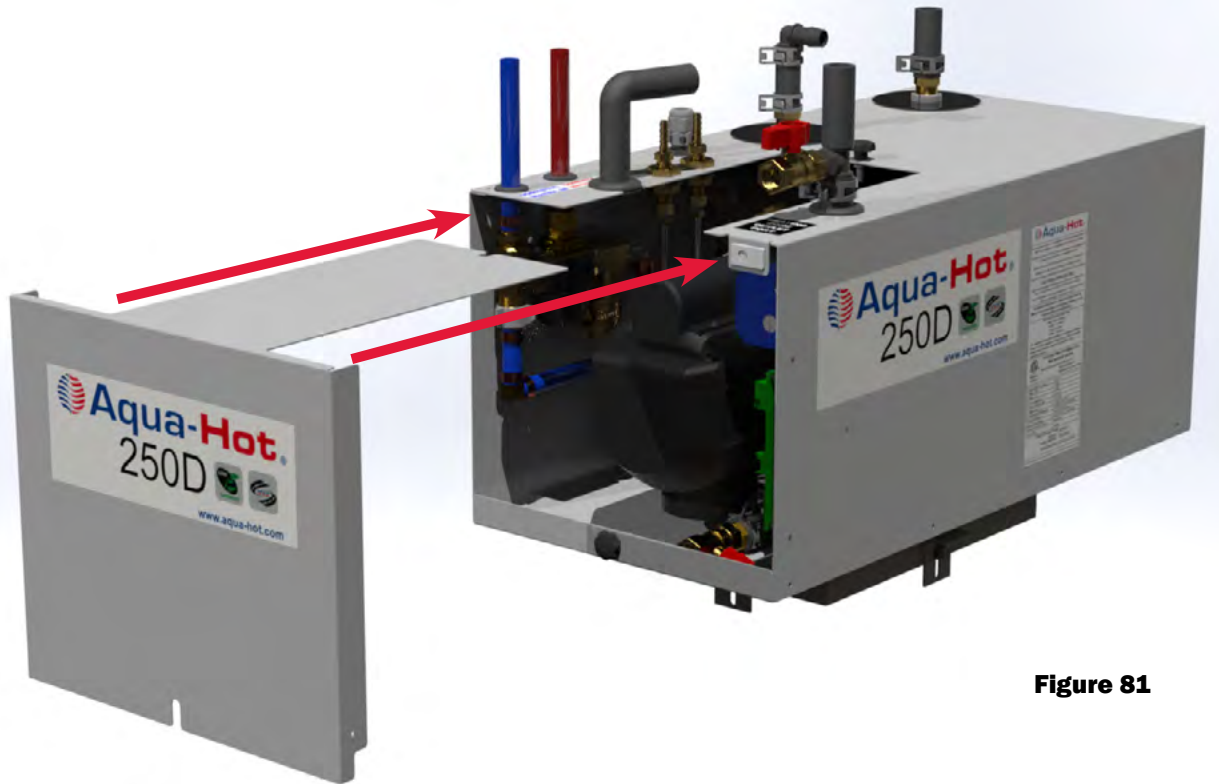
Figure 80

**NOTE:** The diesel burner's Controller might have to be mounted onto the side of the burner before the plugs are inserted into the Controller, otherwise it might not be possible to mount the Controller.



### Step 4: Reinstall the Access Cover

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



**Figure 81**

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



**Figure 82**



## Diesel Burner Motor

The diesel burner motor drives the combustion air blower and the fuel pump. In order to perform the following procedures, it may necessary to detach the diesel burner head.

**NOTE:** The Aqua-Hot 200 Series is equipped with a 20A Fast Blow Fuse, located on the J2-12 wire, between the Aqua-Hot main plug and diesel burner controller's B-plug. Reference Figure 86.

### Troubleshooting Procedure:

1. Locate the diesel burner controller's C-plug and insert the probes of a DC voltmeter into the C-2 (+) and the C-5 (-) locations.

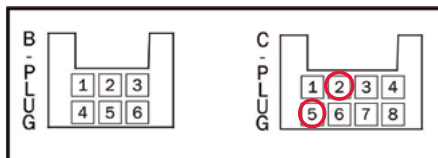


Figure 83

- Turn the burner ON and verify the burner status is ON, on the LCD screen.

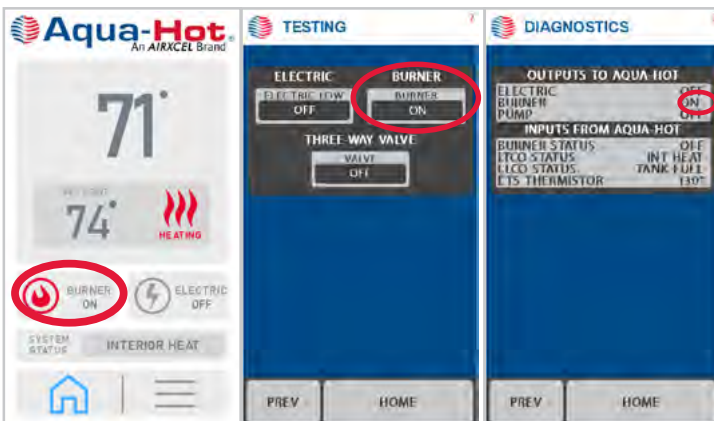


Figure 84

- Observe the voltage level. If a normal voltage range registers on the voltmeter and the motor is not operating, inspect the C-plug harness for any loose or damaged wire connections. If the C-plug harness and connections are in good condition and the motor is not in operation, the motor must be replaced.

If there is not 12V DC present on the C-2 pin, continue with the troubleshooting procedure.

2. Verify the controller is sending power to the diesel burner motor.
  - Using a voltmeter, check for 12V DC on the controller B-plug pin 4. If no power, verify the controller is receiving power from the batteries.

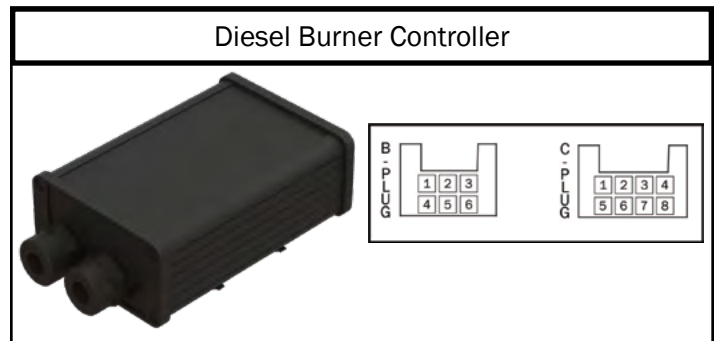


Figure 85

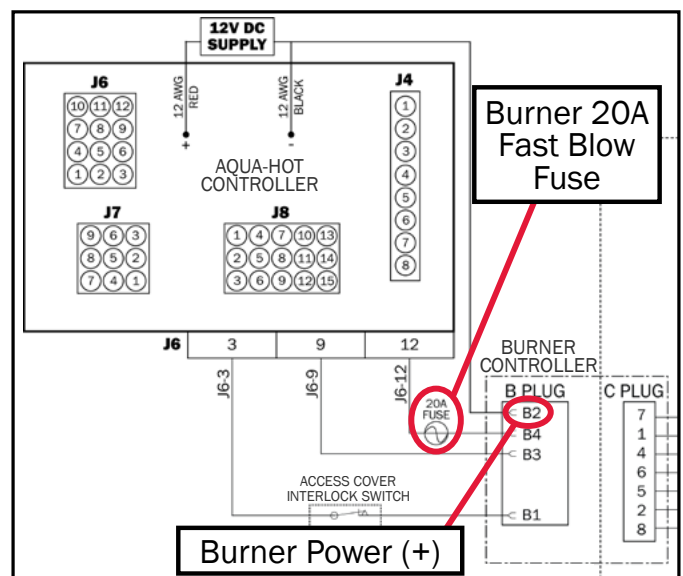


Figure 86

- Using a voltmeter, check for 12V DC on the controller at shown below.

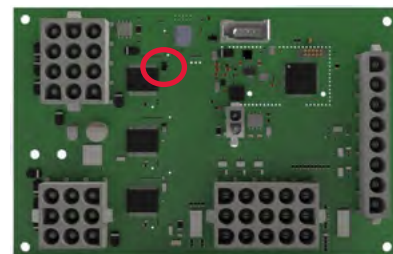


Figure 87

- If no power is present, verify there are no faults showing. If no wire damage or faults, the controller will have to be replaced.

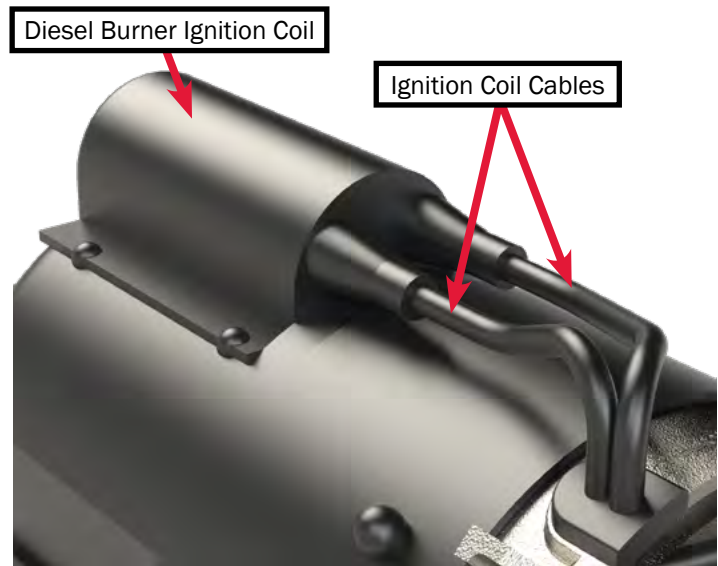
**NOTE:** The motor may have a flat spot and will cause the burner to work intermittently. When testing the motor, be sure to test it multiple times to find the intermittent problem.

### RPM Test:

1. Disconnect the ignition cables from the ignition electrodes.
2. Remove the four ignition coil screws that secure the ignition coil to the protection cap.
3. Lift the ignition coil and disconnect its wires from the C-plug harness prior to removing completely.
4. Remove the protection cap from the diesel burner so that the motor and clutch halves are exposed.

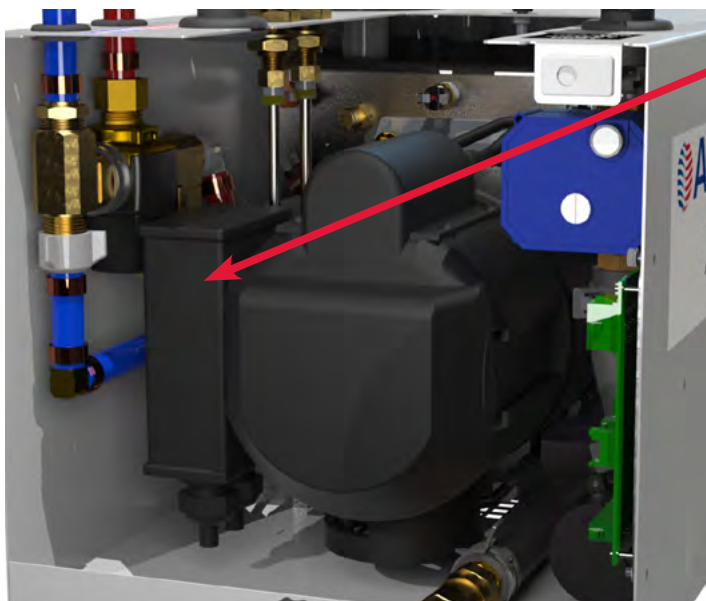
**NOTE:** It may be necessary to remove the diesel burner to remove the bottom two screws securing the protection cap in place. Follow the directions on detaching and reattaching the diesel burner starting on Page 47.

5. Place a few wraps of black electrical tape around the clutch halves, and then place a small piece of reflective tape over the black tape.
6. Disconnect the motor's black (+) and brown (-) wires from the C-plug harness' black (+) and brown (-) wires.
7. Connect the motor's wires directly to a 12V DC power supply.
8. Turn the power supply ON and use a photo-tachometer to test for a proper RPM reading.
9. At approximately 12V DC, the RPM reading should be 4500 RPM's ( $\pm 300$  RPM). If the motor's RPM reading is not within these specifications, the motor must be replaced.

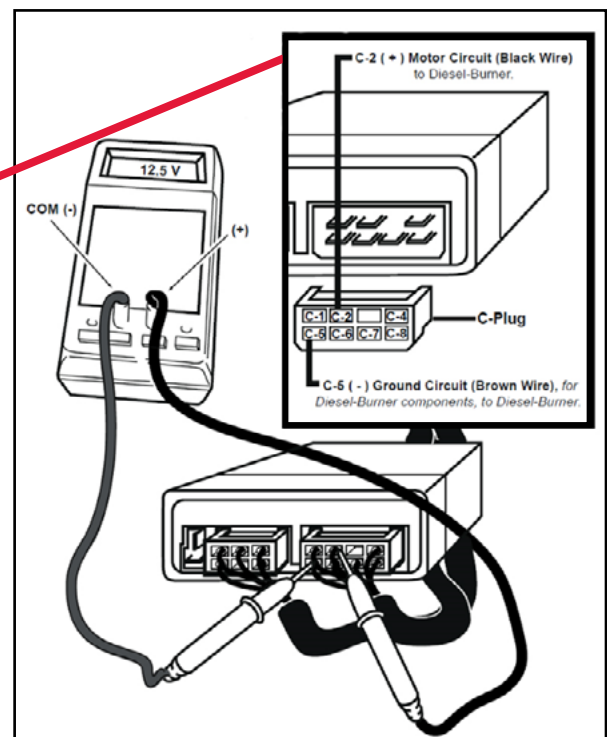


**Figure 88**

**NOTE:** Test the diesel burner's bearings prior to reattaching the diesel burner head or replacing the motor. Worn bearings can cause lower than normal RPM readings and premature motor wear. To properly test for worn bearings, reference the bearings function test section.



**Figure 89**



**Figure 90**

**Motor Replacement Procedure:**

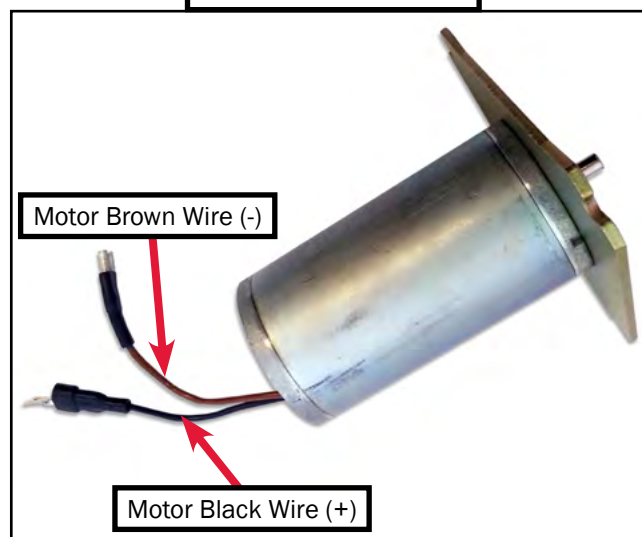
1. Follow the directions on Page 47 for detaching the diesel burner.
2. Remove the four ignition coil screws that secure the ignition coil to the protection cap. Lift the ignition coil to disconnect its wires from the C-plug harness prior to removing. Remove the protection cap from the diesel burner so that the motor clutch halves are exposed.
3. Remove the three Hex-Head screws that secure the motor and flange assembly to the blower housing. Remove the motor and flange assembly along with the clutch halves. Disconnect the motor's black (+) and brown (-) wires from the C-plug harness' wires.
4. Detach the motor from the motor flange by removing the two Philips heads screws that fasten the two parts together.
5. The motor must be mounted to the flange with the wires and drain hole pointing downward, and the recessed edge of the motor flange pointing upward. This will ensure a proper protection cap fit.
6. Reinstall a clutch half on both the new motor's shaft and the combustion air blower shaft. Attach the motor and flange assembly, with the recessed edge of the motor flange in-line with the wiring access slot of the blower casing to the blower housing with the three Hex-Head screws.
7. Connect the black (+) and the brown (-) wires of the new motor to the C-plug harness pin 8 (+) and pin 5 (-). Feed the C-plug harness' wires back through the wiring access hole in the protection cap.
8. Reinstall the protection cap. Reconnect the motor's wires ( $\pm$ ).
9. Reinstall the ignition coil and secure to the protection cap with the four ignition coil screws.
10. Follow the directions for reattaching the diesel burner on Page 50.
11. Test for proper operation.



# DANGER

**Be sure to turn the Diesel Burner on the LCD display screen to OFF and disconnect the burner's power supply before detaching the burner from the Aqua-Hot. Failure to turn off the burner and disconnect power could result in serious bodily injury.**

**Diesel Burner Motor**



**Figure 91**

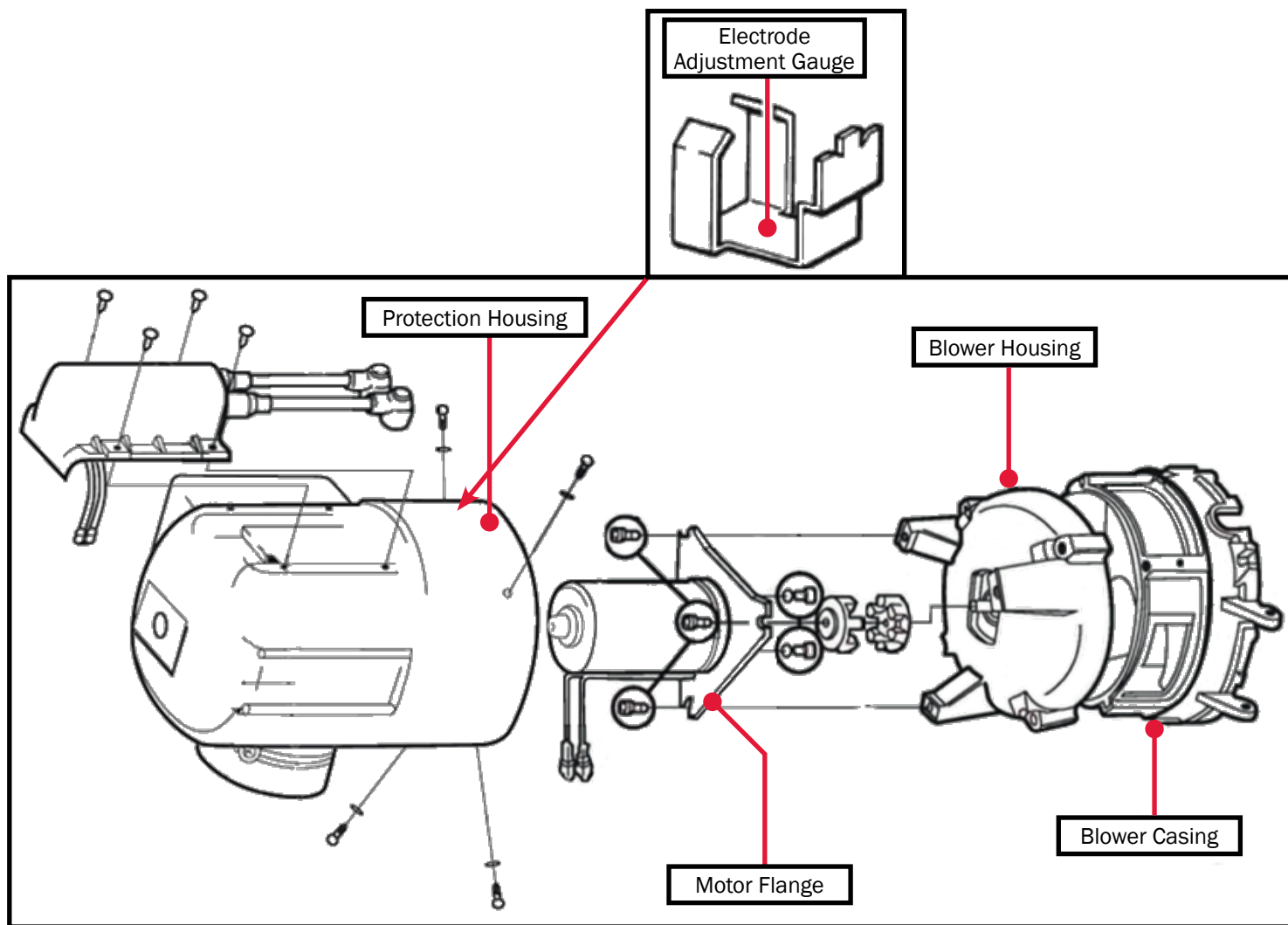


Figure 92



## Flame Sensor

The flame sensor is a photo resistive device which supplies the diesel burner's controller with a DC voltage signal when it detects a flame. When the flame sensor senses the light of the flame, it will shut the ignition coil off, and send a signal to the Controller indicating that everything is working properly. If the flame sensor does not sense the flame, it will shut the diesel burner down in a default after 20 seconds.

**NOTE:** In order to perform the following procedures, it is necessary to detach and reattach the diesel burner head. Be sure to review the detaching/reattaching procedure starting on Page 47.

### Component Test: Ohms

1. Detach the diesel burner.
2. Once the diesel burner has been removed, locate and detach the flame sensor's green and blue wires from the C-plug harness wires.

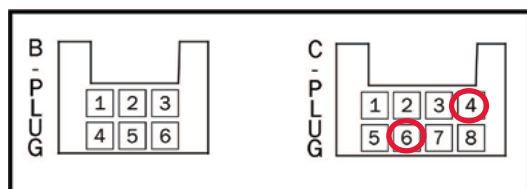


Figure 93

3. Connect the flame sensor's green and blue wires to an ohmmeter.
4. Check resistance by placing a shop rag over the flame sensor's glass surface, to simulate a no-flame condition. Remove the rag and expose to a light source to simulate a flame condition.
5. If the flame sensor is operating properly, the ohmmeter should register high resistance, over 100K  $\Omega$  when the glass surface is covered, and less than 200  $\Omega$  when exposed to a light source.
6. If these resistance numbers cannot be obtained, verify the flame sensor's glass sensor is clean. If the flame sensor is clean and the resistance numbers cannot be obtained, the flame sensor must be replaced.

### Flame Sensor Maintenance:

1. For light dirt, dust, and/or carbon deposits, simply wipe off the flame sensor with a soft cloth.
2. Should heavy carbon deposits be present, completely remove the flame sensor from the photo disc and clean with brake cleaner.

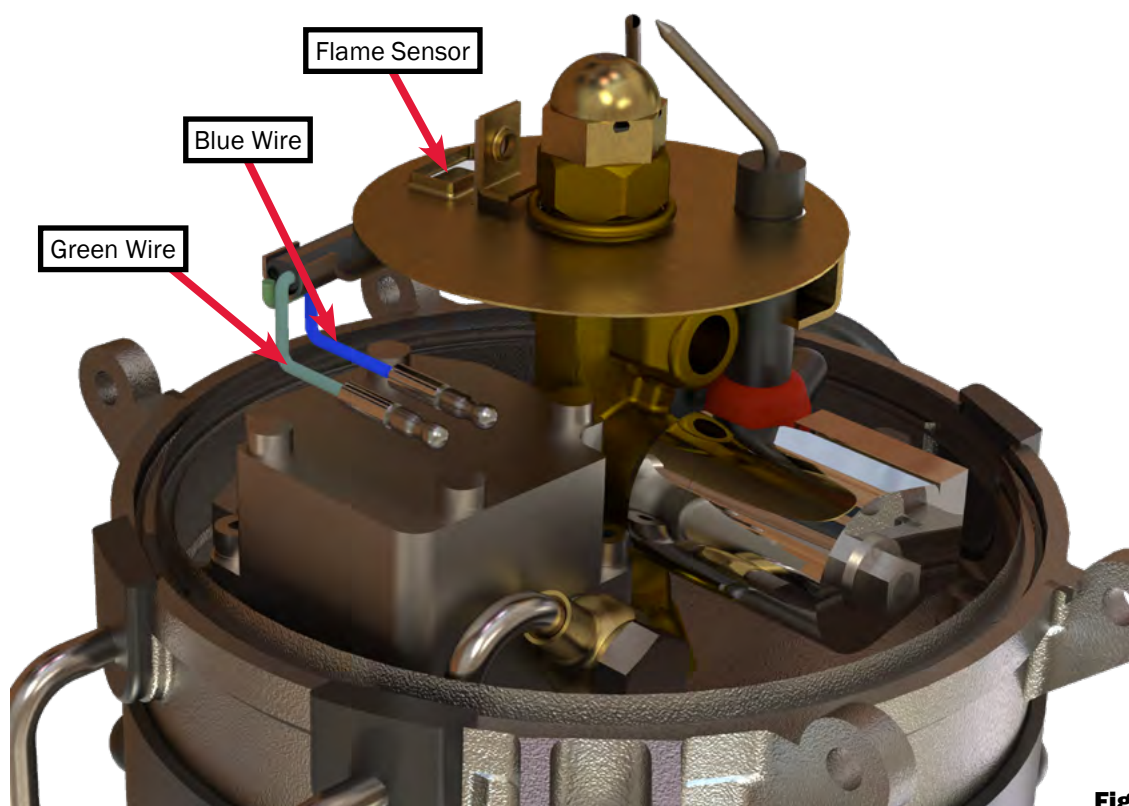
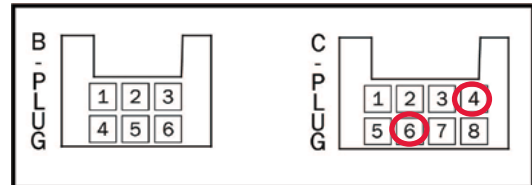


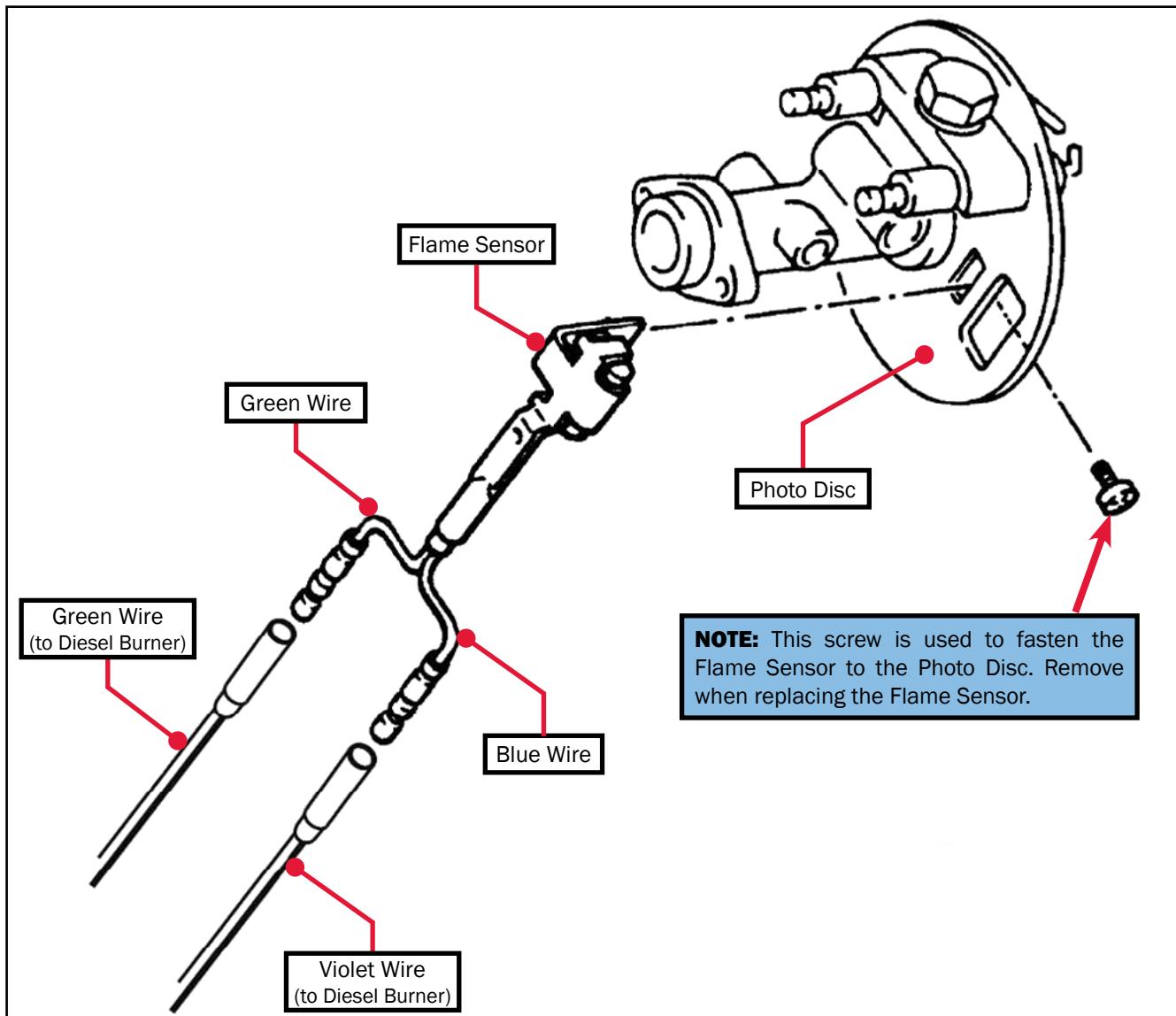
Figure 94

### Flame Sensor Replacement:

1. In order to perform the following procedures, it is necessary to detach the diesel burner head. Be sure to review the detaching/reattaching instructions starting on Page 47.
2. Remove the screw that fastens the flame sensor to the photo disc (as shown in Figure 96), and detach the flame sensor's green and blue wires from the C-plug harness' green and violet wires. Remove the defective flame sensor.
3. Slide the tab of the new flame sensor into the provided slot in the photo disc and secure in place with the screw.
4. Connect the flame sensor's green wire to the green C-plug harness wire (pin 6), and connect the blue wire to the C-plug harness' violet wire (pin 4).
5. Follow the instructions for reattaching the diesel burner head on Page 50.



**Figure 95**



**Figure 96**

## Ignition Electrodes

The diesel burner's ignition coil produces a high voltage ignition spark (approximately 8000 volts) across the ignition electrodes, which ignites the incoming air/fuel mixture.

**NOTE:** In order to perform the following procedures, it is necessary to detach and reattach the diesel burner head. Be sure to review the detaching/reattaching procedure starting on Page 47.

### Cleaning & Maintenance:

1. Polish away any carbon deposits that may have baked onto the metal tips of the ignition electrodes with a coarse sponge.
2. If the ignition electrode's electrical insulator is cracked or damaged, the ignition electrode must be replaced.

### Ignition Electrode Adjustment Procedure:

1. Follow the directions for detaching/reattaching the diesel burner on Page 47.
2. Using a 10mm socket, lightly loosen the retaining clamp bolt.
3. Place the electrode adjustment gauge on the fuel nozzle manifold hex and insert the metal tips of the ignition electrodes into the appropriate notches of the electrode adjustment gauge.
4. Using a 10mm socket, tighten the retaining clamp bolt.
5. Remove the electrode adjustment gauge and reattach to the diesel burner head.

**NOTE:** The electrode gauge is mounted to the side of the burner cap. The gauge goes on the fuel nozzle and the tips of the electrodes should be perfectly lined up in the notches.

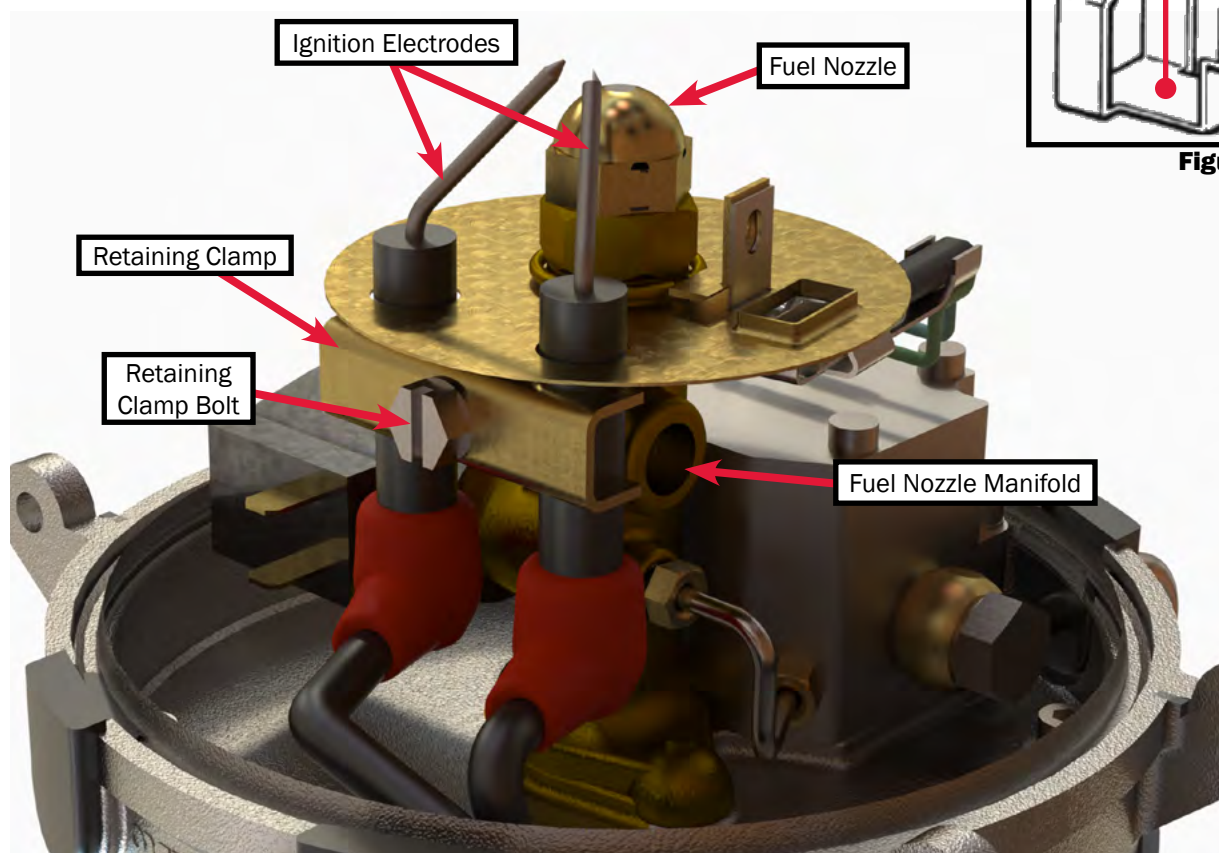


Figure 98

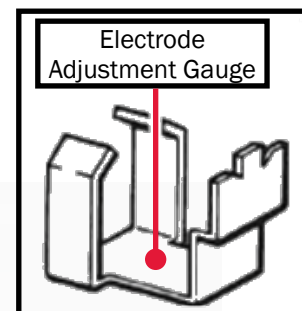
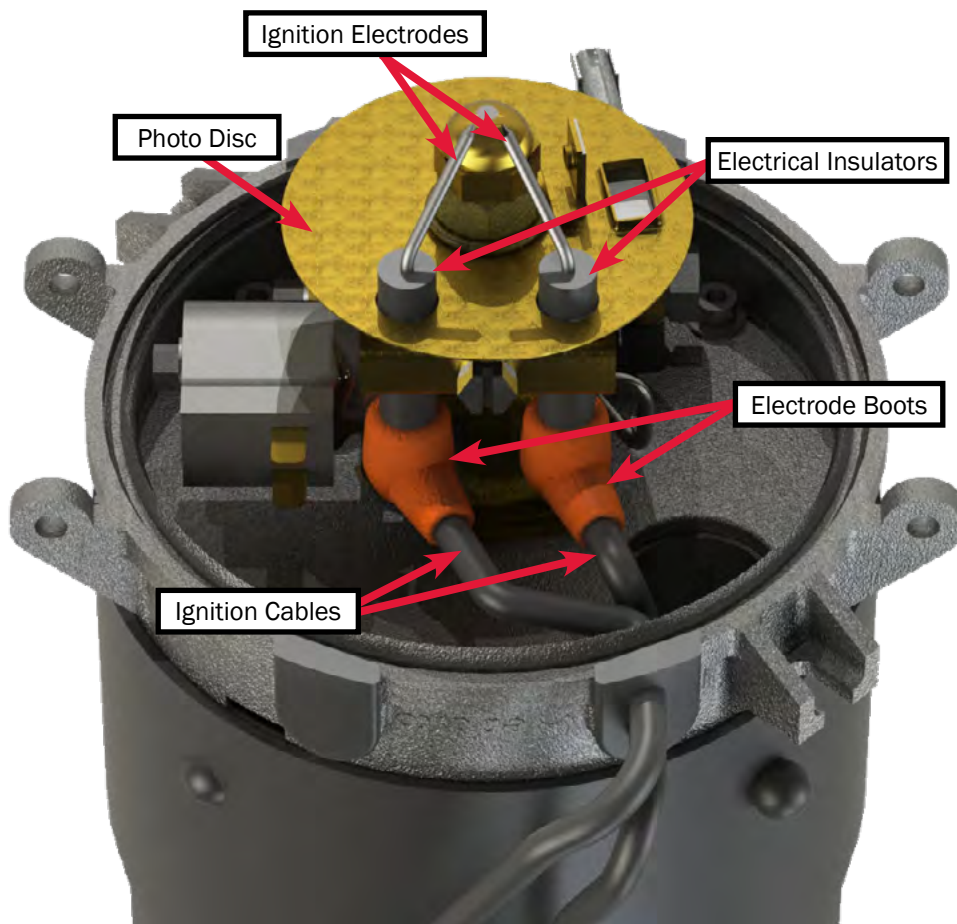


Figure 97

### Replacement Procedure:

1. Using a 10mm socket, loosen and remove the retaining clamp bolt and the retaining clamp.
2. Slide the electrode out of the photo disc.
3. To remove the electrode, hold onto the orange electrode boot, and pull firmly on the electrode.
4. Once the electrode has been removed inspect inside the orange electrode boot for the retaining clip, which holds the electrode in place. If it is missing, replace the electrode boot.
5. Insert the new electrode into the orange electrode boot, and snap into place. Pull firmly on the electrode to make sure the retaining clip has secured the electrode in place.
6. Slide the electrode into the photo disc.
7. Install retaining clamp and retaining clamp bolt and finger tighten.
8. Follow the ignition electrode adjustment procedure to properly adjust the electrodes.

**NOTE:** Be sure not to over-tighten the retaining clamp bolt when readjusting the ignition electrodes. Over-tightening the retaining clamp bolt will bend the retaining clamp and prevent the photo disc from floating freely. Not allowing the photo disc to float freely will cause poor combustion and result in a smoky exhaust. A bent retaining clamp can be re-straightened with a punch and hammer. Lay the clamp's beveled side down on a solid flat surface and align the thick end of the punch at dead center. Tap the punch lightly until the retaining clamp returns to proper form.



**Figure 99**



## Ignition Coil

The diesel burner's ignition coil produces a high voltage ignition spark (approximately 8000 volts), which is released across the metal tips on the ignition electrodes during the initial diesel burner start up.

**Use extreme care when testing the ignition coil, as a High Voltage Shock may result.**

**NOTE:** In order to perform the following procedures, it is necessary to detach and reattach the diesel burner head. Be sure to review the detaching/reattaching procedure starting on Page 47.

### Component Test:

1. Remove the four ignition coil screws that secure the ignition coil in place.
2. Disconnect the ignition coil's black (+) and brown (-) wires from the C-plug harness' yellow (+) and brown (-) wires.
3. Connect the ignition coil wires directly to a 12V DC power supply (black + wire to + lead and brown - wire to - lead).
4. Turn the power supply ON and watch for a spark to appear across the metal tips of the ignition electrodes. If a spark does not appear, the ignition coil must be replaced.

**NOTE:** Some ignition coils are intermittent and will need to be tested numerously. If the ignition coil tests well, and it still will not operate, it is possible there is an issue with the Reporter.



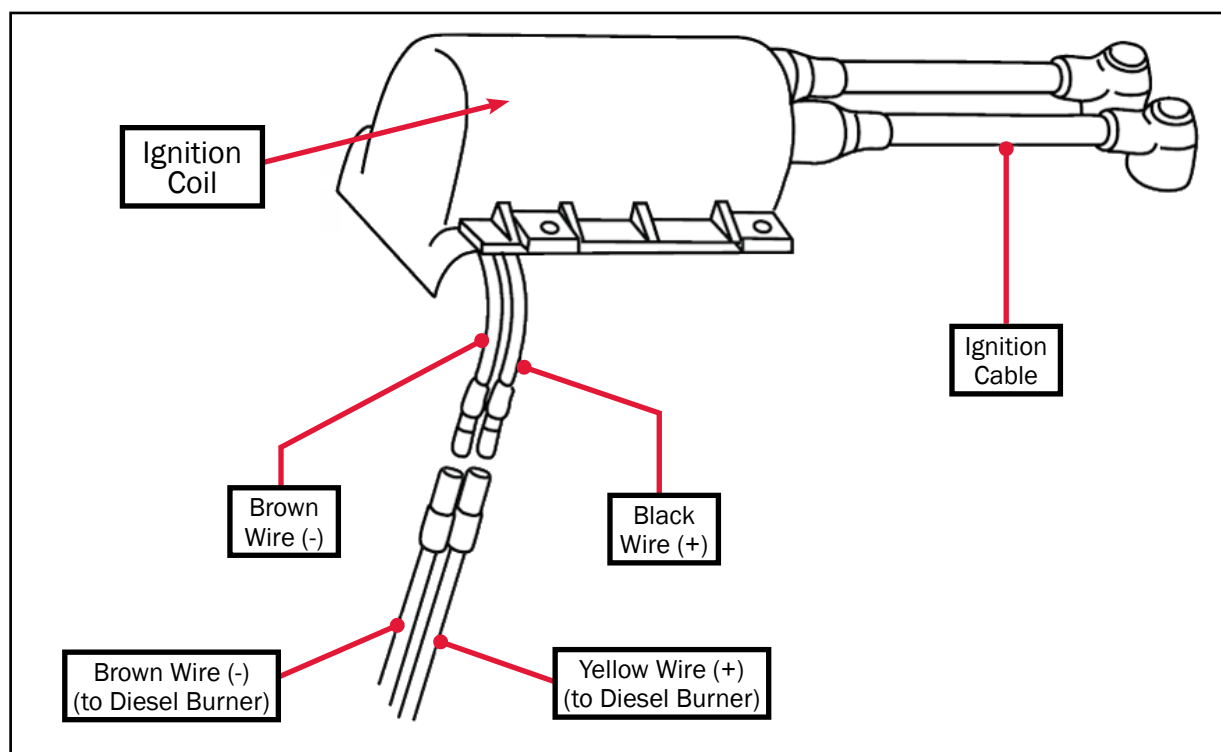
## CAUTION

**Before replacing the ignition coil, verify the electrodes are not cracked or broken, and they are adjusted properly. Ensure the electrode boots are securely holding the electrodes in place and that they are not broken inside the ignition coil wires.**

### Replacement Procedure:

1. Disconnect the ignition cables from the ignition electrodes. Remove the four ignition coil screws that secure the ignition coil to the protection cap. Lift the ignition coil and disconnect its wires from the C-plug harness wires, prior to removing.
2. Connect the new ignition coil's black (+) and brown (-) wires to the C-plug harness' yellow (+) and brown (-) wires. Attach the ignition coil to the protection cap with the four ignition coil screws, then reconnect the ignition cables to the ignition electrodes.
3. Follow the instructions for reattaching the diesel burner and test for proper operation.

**NOTE:** If the new ignition coil does not function, check wire connections and ensure they are properly connected and the electrodes are properly adjusted.



**Figure 100**

### Fuel Nozzle

The fuel nozzle is simply a fuel atomizer. It reduces the diesel fuel into a fine spray which is mixed with incoming combustion air, and is ignited within the combustion chamber.

#### Fuel Nozzle Component Test:

**NOTE:** In order to perform the following procedures, it is necessary to detach and reattach the diesel burner head. Be sure to review the detaching/reattaching procedure starting on Page 47.

1. Detach the diesel burner.
2. Hook the diesel burner up to an alternate fuel source.
  - Disconnect the steel fuel lines from the diesel burner.
  - Install the fuel line bypass adapter fitting onto the diesel burner.
  - Install rubber fuel lines on both the supply and return fuel pipes, and install the other end of the rubber fuel lines into an adequate supply of diesel fuel. Reference Figure 101.
3. Remove both the ignition cables from the ignition electrodes, or connect a jumper wire (with alligator clips) across the metal tips of the electrodes.
4. Remove the B-plug from the diesel burner's controller.
5. Turn the diesel burner ON (on the interior control panel), and plug the B-plug back into the diesel burner's controller to activate the diesel burner. After approximately 20 seconds, the fuel solenoid will "click" and a fine mist of fuel should appear from the fuel nozzle in a cone-shaped spray pattern.
6. Remove the B-plug from the diesel burner controller.
7. If the cone-shaped spray pattern did not appear, follow the troubleshooting guides for the following components, and verify they are operating properly:
  - Fuel Solenoid
  - Fuel Pump
  - DC High-Limit Thermostats
8. If the components listed above are operating properly, and there is still no fuel coming out of the nozzle, replace the fuel nozzle.



**Figure 101**



# DANGER

**Be sure to reattach the diesel burner head prior to turning the heater ON. Failure to do so may result in ignition of the diesel burner and serious bodily injury.**

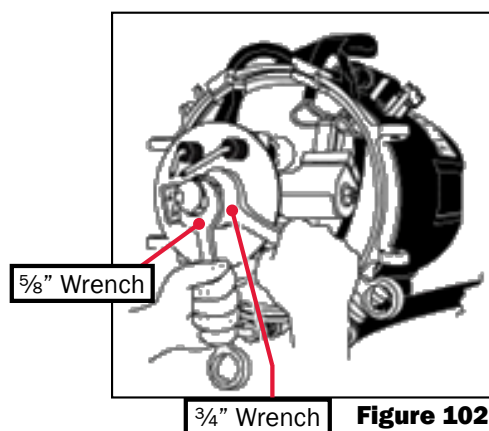
**NOTE:** Be sure to use care when handling the new fuel nozzle. Oils and/or small dust or dirt particles from your hands may plug the nozzle's small orifice. A partially plugged orifice will restrict fuel flow, which will affect the combustion process of the diesel burner.

## Fuel Nozzle Cleaning and Maintenance:

The fuel nozzle is a precision calibrated part and **cannot** be cleaned or serviced. A replacement of the fuel nozzle is recommended annually.

## Fuel Nozzle Replacement Procedure:

1. Use a  $\frac{3}{4}$ " wrench to hold the fuel nozzle stand hex while loosening the fuel nozzle with a  $\frac{5}{8}$ " wrench and remove as shown in Figure 102.
2. When replacing the fuel nozzle, be sure to tighten the nozzle, loosen it a  $\frac{1}{4}$  turn, and then firmly re-tighten. This will establish a seated fit and avoid any leaks.

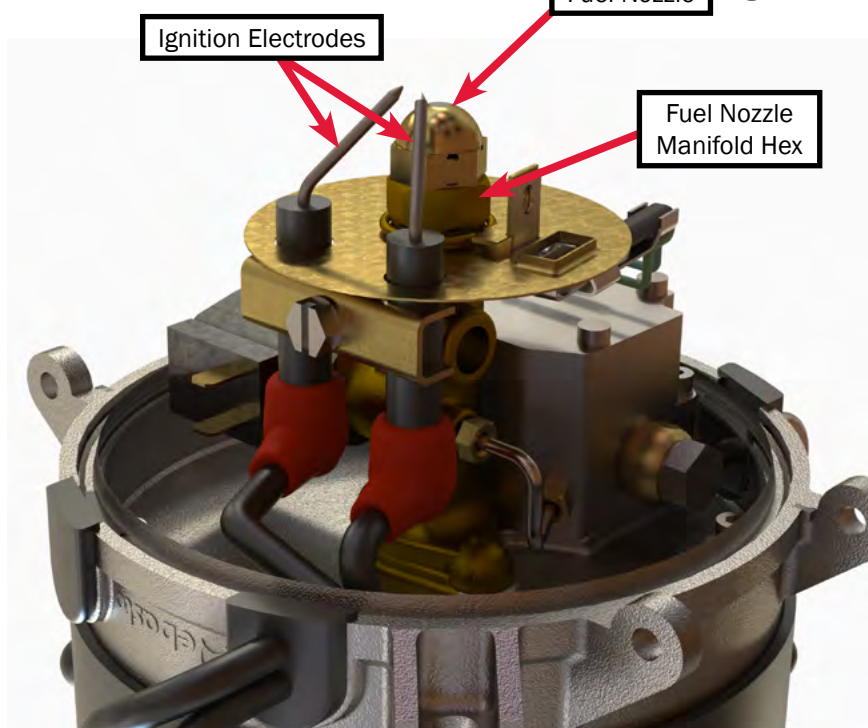


**Figure 102**



**Fuel Nozzle**

**Figure 103**



**Figure 104**

## Fuel Solenoid

The fuel solenoid allows the flow of diesel fuel to the diesel burner's fuel nozzle.

**NOTE:** If a long after-smoking condition exists during the diesel burner's purge cycle, the fuel solenoid valve kit may need to be replaced.

### Fuel Solenoid Component Test:

1. Locate and detach the C-plug harness' violet (+) and brown (-) wires from the fuel solenoid.
2. Connect the (-) lead of a 12V DC power supply to the fuel solenoid's (-) electrical terminal.
3. Intermittently apply the (+) lead of the power supply to the fuel solenoid's (+) electrical terminal.
4. Listen for the fuel solenoid to click (open and close).
5. If the fuel solenoid does not click, it must be replaced.

**NOTE:** If the fuel solenoid is not working, troubleshoot the diesel burner's high-limit thermostats (2). If they are tripped, they will not allow the fuel solenoid to operate.

### Fuel Solenoid Replacement Procedure:

1. Disconnect the C-plug harness' violet (+) and brown (-) wires from the fuel solenoid.
2. Using a 8mm wrench, remove the lock nut and flat washer from the end of the fuel solenoid shaft and then pull the fuel solenoid away from the nozzle stand approximately  $\frac{1}{2}$ ". Remove the fuel solenoid shaft from the nozzle manifold using a 16mm wrench. Discard the shaft and valve kit, as replacements are provided with the new fuel solenoid assembly.
3. Insert the contents of the new fuel solenoid valve kit into the new fuel solenoid shaft. Slide the new fuel solenoid onto the fuel solenoid shaft. Thread the new fuel solenoid shaft with the fuel solenoid to the fuel nozzle manifold and tighten. Secure the fuel solenoid in place with the new flat washer and lock nut.
4. Connect the C-plug harness' (+) and brown (-) wires to the fuel solenoid's (+) and (-) electrical terminals.
5. Test for normal operation.

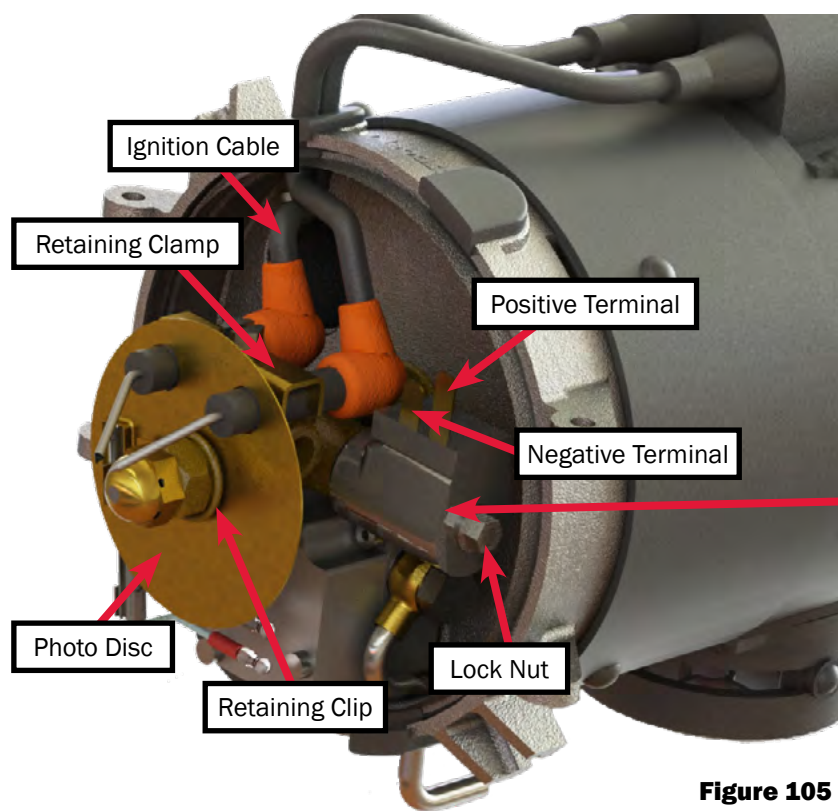


Figure 105

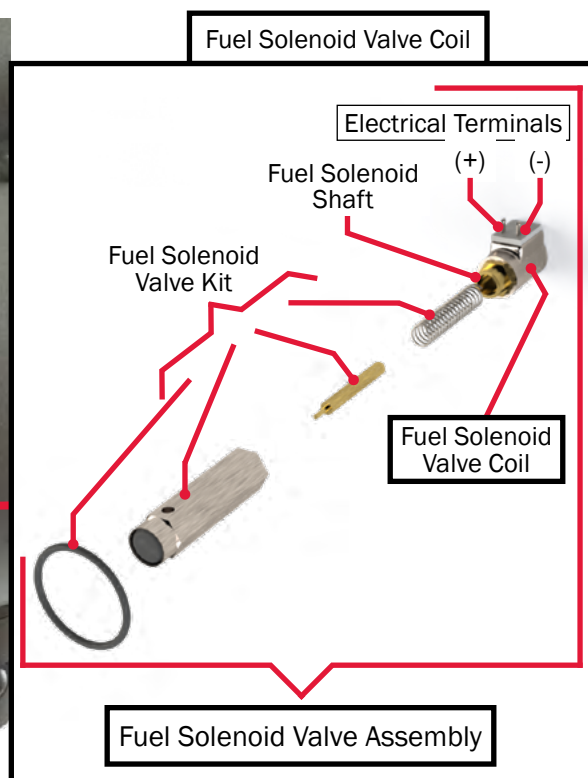


Figure 106



## Fuel Pump

The fuel pump draws diesel fuel from the vehicle's fuel tank and creates a preset pressure of 145 PSI, which is required for proper fuel atomization. Reference the illustration below for a basic overview and understanding of how the fuel pump functions.

### Fuel Pump Cleaning and Maintenance:

1. Check all fuel connections for tightness.
2. Check the screen filter located in the fuel supply inlet of the fuel pump for dirt particles. Clean and/or replace if necessary.
3. To adjust the fuel pressure, refer to Page 73 - Fuel pressure check and adjustment.



# DANGER

**DO NOT remove the diesel burner at this time. Failure to do so may result in serious bodily injury.**

### Fuel Pump Testing Procedure:

1. Clamp off and remove the fuel return and fuel supply lines coming into the Aqua-Hot unit.
2. Attach a short piece of fuel line to both the fuel return and fuel supply ports.
3. Submerge the opposite end of the temporary fuel supply line in a container of diesel fuel.
4. Place the opposite end of the temporary fuel return line in an empty container.
5. Turn the diesel burner ON to activate the diesel burner, and wait ten seconds.

6. If fuel does not flow out of the return line into the empty container, the fuel pump must be replaced,
7. If fuel does flow through the fuel pump when ran off an external source, inspect the following in the RV:

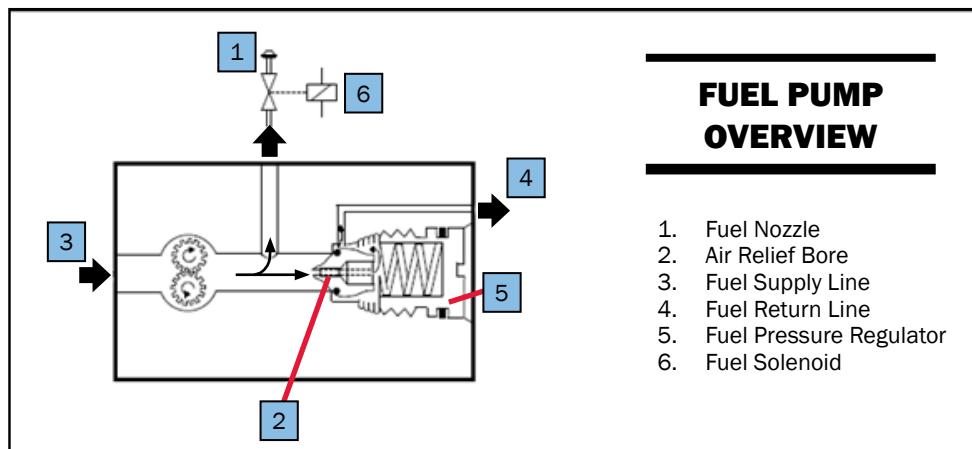
**NOTE:** Prior to replacing the fuel pump, be sure to inspect the screen filter in the supply inlet of the fuel pump for dirt particles. Clean and/or replace if necessary. A plugged screen filter will restrict fuel from entering the fuel pump.

- Check the motor home fuel tank for diesel fuel. If the fuel level is below  $\frac{1}{4}$ , the Aqua-Hot diesel burner will not operate.
- Inspect the supply fuel line for any kinks, which would prohibit fuel flow.
- Inspect the supply fuel line for cuts, which would cause the diesel burner to suck air.
- Inspect the fuel filter to make sure all fittings are tight, including hose clamps. Make sure the fuel filter is tight.
- Inspect the Aqua-Hot for loose or cracked fittings.
- Inspect the supply fuel system for loose hose clamps.
- Inspect the fuel pick-up tube in the tank for any loose connections and/or pin holes in the tube.

### Fuel Pump Replacement Procedure:

**NOTE:** In order to perform the following procedures, it is necessary to detach and reattach the diesel burner head. Be sure to review the detaching/reattaching procedure starting on Page 47.

1. Locate and disconnect the C-plug harness wires that connect to the flame sensor and the fuel solenoid. Also, disconnect the ignition cables from the ignition electrodes.
2. Remove the retaining clip that secures the photo disc in place. Gently lift the photo disc so that it releases from the



**Figure 107**

nozzle stand and the ignition electrodes.

3. Loosen the supply and return banjo bolts to remove the fuel supply and return pipes from the fuel pump. Disconnect the high pressure fuel pipe from both the fuel pump and the nozzle stand. Discard the high pressure fuel pipe, gasket rings, and banjo bolts, as replacements are provided in the new fuel pump kit.
4. Remove the four nozzle stand plate screws that secure the nozzle stand plate in place. Remove the nozzle stand plate by pulling on the nozzle stand until the plate releases from the cast-aluminum blower casing.
5. Remove the two pump mounting screws that secure the fuel pump in place. Turn the nozzle stand plate over and remove the snap ring from the fuel pump shaft, using snap ring pliers. Remove the nylon drive gear and then the fuel pump.
6. Attach the new fuel pump to the nozzle stand plate with the two pump mounting screws. Turn the nozzle stand plate over to install the nylon drive gear on the fuel pump's shaft and secure in place with the snap ring. Dab the teeth of the nylon drive gear with white lithium grease (IsoFlex LDS-18 is recommended).
7. Fit the nozzle stand plate inside the cast-aluminum blower casing and secure in place with the four nozzle stand plate screws. Install the grommets on the fuel return and supply banjo pipes and secure the pipes to the fuel pump with the new banjo bolts and gasket rings.

**NOTE:** Do not adjust the fuel pressure regulator of the new fuel pump, as it has been factory preset.



## CAUTION

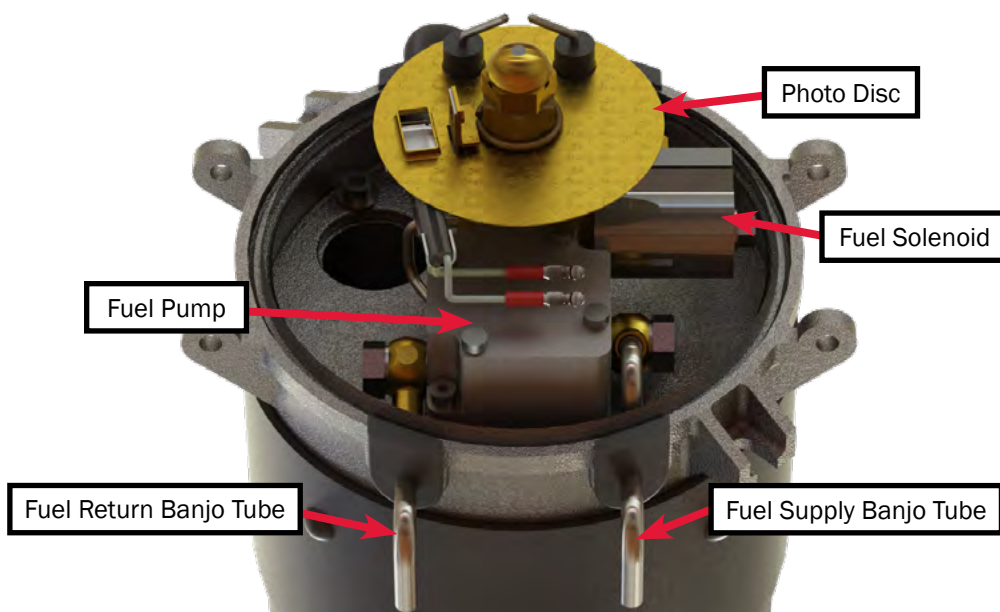
**Inspect the nylon drive gear's cavity inside the cast-aluminum blower casing for fuel stains. If fuel stains are present, a replacement of the bearings and/or the entire blower casing may be necessary. Leaking fuel could cause bearing seizure, resulting in potential damage to the internal bore/bearing of the blower casing.**

8. Reconnect the C-plug harness' violet (+) and brown (-) wires to the fuel solenoid's (+) and (-) electrical terminals.
9. Insert both the ignition cables into the rubber grommet and slide into the appropriate notch on the blower casing.

**NOTE:** Failure to use the new gasket rings or the correct order placement could result in a fuel leak.

10. Reconnect the ignition cables to the ignition electrodes.
11. Reinstall the photo disc and secure it in place with the retaining clip.
12. Reconnect the flame sensor's green wire to the green C-plug harness and the blue wire to the C-plug harness' violet wire. Install rubber grommets around the harness wires, and set into place.
13. Follow the directions for reattaching the diesel burner on Page 50.
14. Test for normal operation.

**NOTE:** Check the ignition electrodes for proper adjustment prior to reattaching the diesel burner.



**Figure 108**

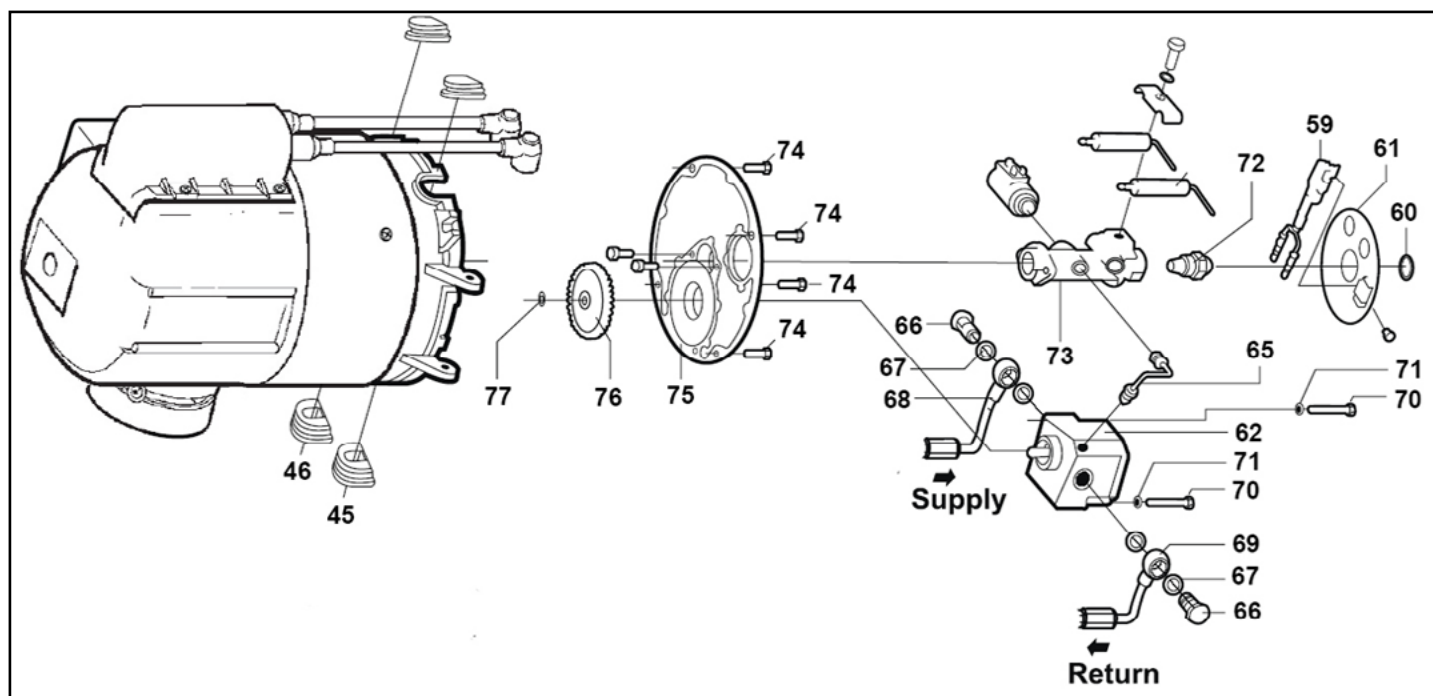


Figure 109

Key	Description
45	Grommet, Blower Casing, Left
46	Grommet, Blower Casing, Right
59	Flame Sensor
60	Retaining Clip, Photo Disc
61	Photo Disc
62	Fuel Pump
65	High Pressure Fuel Tube
66	Banjo Bolt
67	Gasket Ring, Copper
68	Banjo Fuel Tube, Supply
69	Banjo Fuel Tube, Return
70	Mounting Screw, Fuel Pump
71	Washer, Lock, Fuel Pump
72	Fuel Nozzle, 0.35 GPH
73	Fuel Nozzle Manifold, Brass
74	Manifold Plate Screw
75	Manifold Plate
76	Fuel Pump Nylon Gear
77	Snap Ring

### Bearings

The bearings support the combustion air blower's shaft and allows the blower to turn smoothly.

#### Bearings Test:

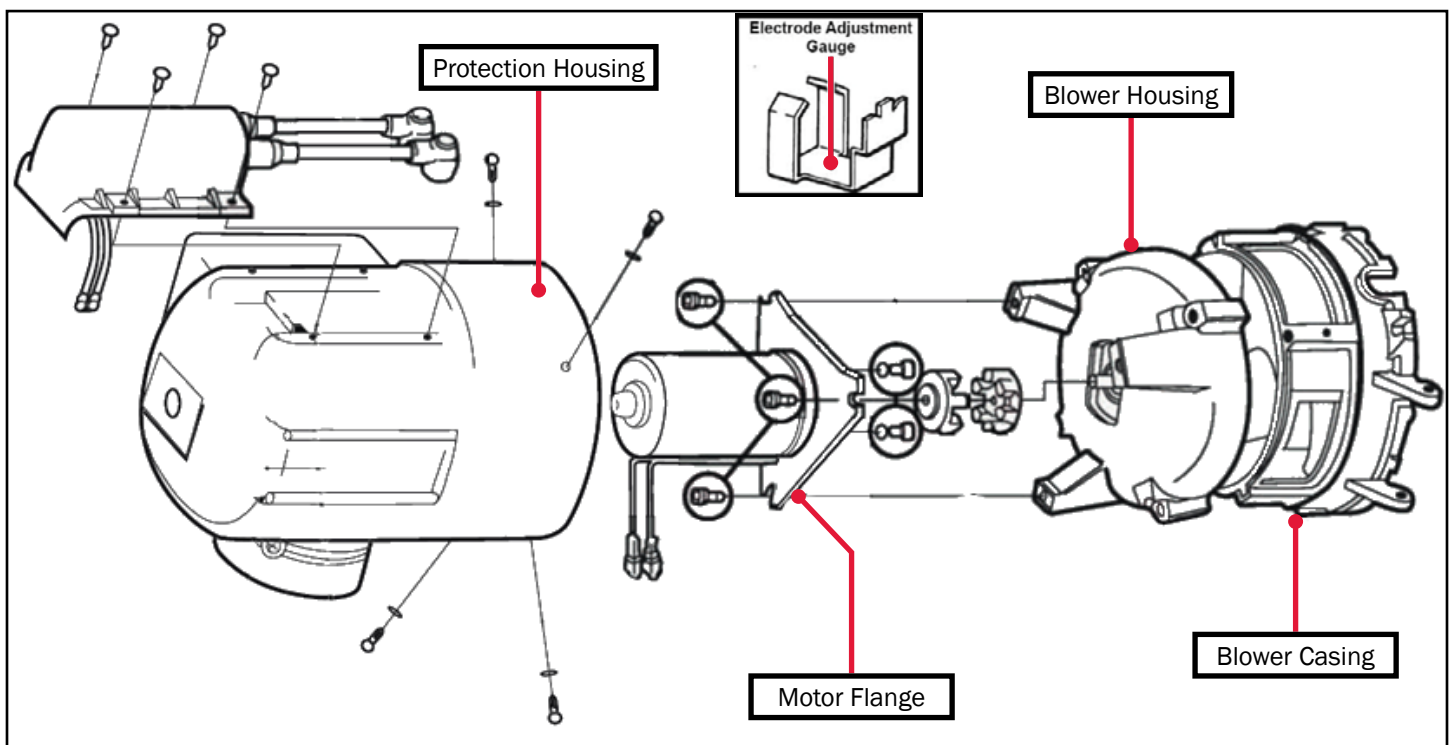
1. In order to perform the following procedure, it is necessary to detach and reattach the diesel burner head. Be sure to review the detaching and reattaching section for detaching and reattaching instructions starting on Page 47.
2. Locate and disconnect the C-plug harness wires that connect to the flame sensor and fuel solenoid. Disconnect the ignition cables from the ignition electrodes.
3. Remove the four nozzle stand plate screws that secure the nozzle stand plate in place. Remove the nozzle stand plate by pulling on the nozzle stand until the plate releases from the cast-aluminum blower casing.
4. Remove the four ignition coil screws that secure the ignition coil to the protection cap. Lift the ignition coil and disconnect the black (+) and brown (-) wires from the C-plug harness wires, prior to removing. Remove the protection cap from the diesel burner, so that the motor and clutch halves are exposed.
5. Remove the three hex-head screws that secure the motor and motor flange to the blower housing. Remove the motor and flange assembly along with the clutch halves.

Disconnect the motor's black (+) and brown (-) wires from the C-plug harness' wires.

6. Remove the four blower housing screws that secure the blower housing to the blower casing. Remove the blower housing so that the combustion air blower is exposed.
7. Spin the combustion air blower by hand. Placing one of the clutch halves to the end of the shaft, assists with the spinning of the bearings.
8. If the combustion air blower rotates smoothly, without any friction or noise, the bearings are in proper working condition. If the combustion air blower does not rotate smoothly and/or produces noise, the bearings are worn and must be replaced.

#### Bearings Replacement:

1. In order to perform the following procedure, it is necessary to detach and reattach the diesel burner head. Be sure to review the detaching and reattaching section on Page 47.
2. Locate and disconnect the C-plug harness wires that connect to the flame sensor and fuel solenoid. Disconnect the ignition cables from the ignition electrodes.
3. Remove the four nozzle stand plate screws that secure the nozzle stand plate in place. Remove the nozzle stand plate by pulling on the nozzle stand until the plate releases from the cast-aluminum blower casing,



**Figure 110**



- Remove the four ignition coil screws that secure the ignition coil to the protection cap. Lift the ignition coil and disconnect its black (+) and brown (-) wires from the C-plug harness wires, prior to removing. Remove the protection cap from the diesel burner so that the motor and clutch halves are exposed.

**NOTE:** It is recommended to mark the internal components of the diesel burner prior to disassembling of the burner. Mark between the motor flange and the blower housing, and also between the blower housing and the blower casing. If the burner is assembled improperly, the protection cap will not go on.

- Remove the three hex head screws that secure the motor and motor flange to the blower housing. Remove the motor and flange assembly along with the clutch halves. Disconnect the motor's black (+) and brown (-) wires from the C-plug harness' wires.
- Remove the four blower housing screws that secure the blower housing to the blower casing. Remove the blower housing so that the combustion air blower is exposed.
- Hold side-B (see Figure 112b) of the blower casing and loosen the retaining nut located in side-A of the blower casing. Remove the retaining nut, steel drive gear and thick flat washer from the combustion air blower's shaft. Lightly tap the threaded end of the shaft so that the combustion air blower can be easily removed from the blower casing.
- With a pair of snap-ring pliers, remove the snap rings from both side-A and side-B of the blower casing. Push all the contents of the bearing kit out of the blower casing's bore/bearing cavity. Discard the retaining nut, steel drive gear, snap rings, bearings, spacer tube, and washers, as replacements are provided in the new bearing kit.
- Install a new snap ring into side-A of the blower casing. Once the snap ring is in place, insert the remaining contents of the new bearing kit into side-B of the blower casing, starting with the wave washer. Secure the bearing kit assembly in place with the remaining snap ring.

**NOTE:** Be sure to observe the placement of the three washers of the bearing kit. To ensure proper tension, the same order and direction of the dished surfaces of the washers must be followed when reassembling. See Figure 111.

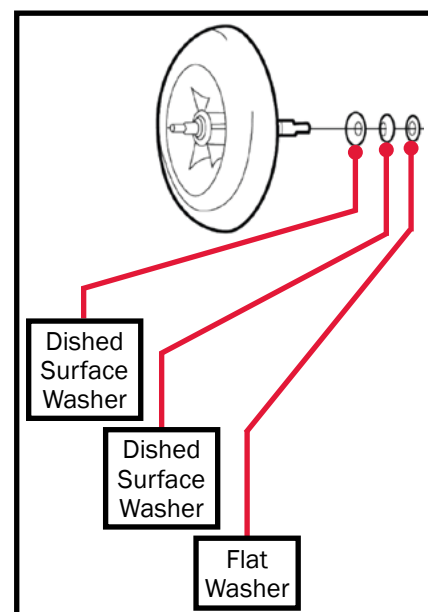
- Inspect the combustion air blower for warping and/or damage. If warping or damage is visible, the combustion air blower must be replaced.
- Reference Figure 111 for exact placement of the three washers that slide over the threaded end of the combustion air blower's shaft prior to installation. Failure to follow the correct order and direction of the dished surfaces on the washers will result in a restricted rotation of the combustion air blower.

**NOTE:** Be sure to inspect the blower casing's bore/bearing cavity for signs of damage due to potentially seized bearings. If damage is present, the blower casing must be replaced.

- Slide the combustion air blower's shaft (with the three washers) up through the bearing kit assembly until the threaded portion appears on side-A of the blower casing. Place the new thick flat washer and steel drive gear on the threaded end of the combustion air blower's shaft. Thread the new retaining nut on the combustion air blower's shaft until it is finger tight (DO NOT TIGHTEN).
- Place a feeler gauge between the combustion air blower and the flat surface of the blower casing. Slowly tighten (or loosen) the retaining nut, holding the combustion air blower, until a .018 - .020 gap is achieved. Remove feeler gauge. Reference Figure 112a.
- Spin the combustion air blower to ensure a friction free rotation.

**NOTE:** If the combustion air blower is rubbing, loosen the retaining nut slightly, and lightly tap on the combustion air blower's shaft (opposite side) then readjust the gap.

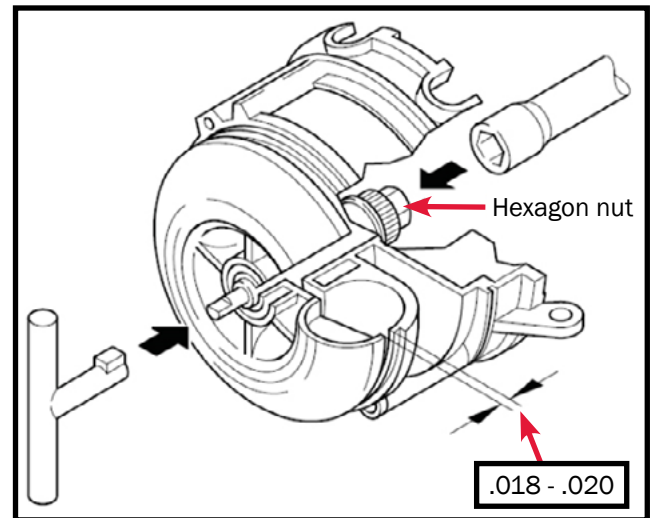
- Reattach the blower housing to the blower casing using the four blower housing screws. Reinstall the clutch half on both the motor's shaft and the combustion air blower's shaft. Attach the motor and flange assembly, with the recessed edge of the motor flange in-line with the wiring access slot of the blower casing, to the blower housing with the three hex head screws. Reconnect the black (+) and brown (-) wires of the motor to the C-plug harness' black (+) and brown (-) wires. Feed the C-plug harness' yellow and brown wires back through the wiring access hole in the protection cap.



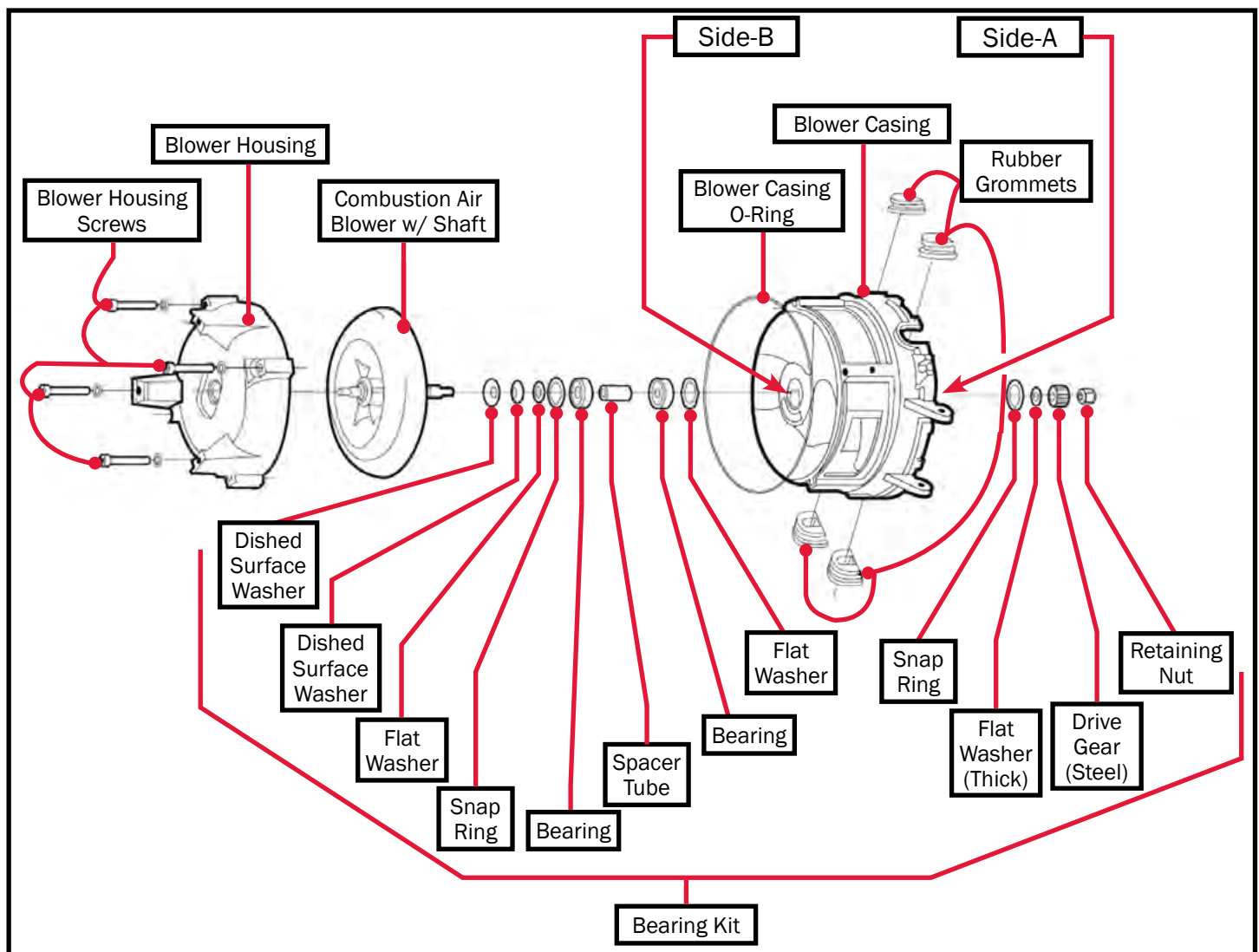
**Figure 111**

16. Reinstall the protection cap. Reconnect the black (+) and brown (-) wires of the ignition coil to the C-plug harness' yellow (+) and brown (-) wires. Reinstall the ignition coil and secure to the protection cap with the four ignition coil screws. Reconnect the ignition cables to the ignition electrodes.
17. Fit the nozzle stand plate inside the cast aluminum blower casing and secure in place with the four nozzle stand plate screws. Reattach the fuel supply and return lines to the diesel-burner head.
18. Follow the instructions for reattaching the diesel burner, in the detaching/reattaching section in this manual.

**NOTE:** Inspect the clutch halves for cracks and ensure the flat portion in each shaft hole is free of wear and tear. Too much play on the shaft produces a loud clacking noise. If any cracks or wear are detected, the clutch half must be replaced.



**Figure 112a**



**Figure 112b**

## Diesel Burner Controller



**Figure 113**

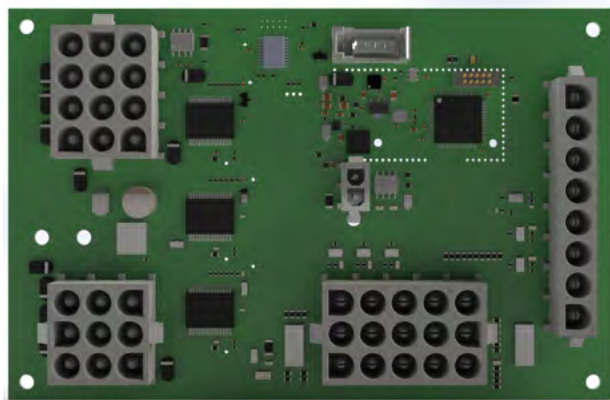
The diesel burner controller operates all the components of the diesel burner head and safely shuts the heater OFF in the event of an overheat, flame-out, and low voltage condition. It also receives diesel burner operation status signals from the flame sensor, control thermostat, and DC high-limit thermostat.

**NOTE:** Before troubleshooting the Diesel Burner Controller, verify that the Burner has voltage at Pin 4 as shown in Figure 115. There will only be voltage on that pin if the burner status is shown as ON.

### Component Test:

The following conditions must exist prior to performing the following diesel burner controller circuit tests. If one of the conditions below does not exist, please contact Technical Support at 1 (800) 685-4298 for assistance.

### Aqua-Hot Controller



**Figure 114**

### Condition 1:

A battery voltage level between 11.6-14 Volts DC must be present at the diesel burner controller during all testing. It may be necessary to perform a voltage check to ensure that this condition exists. To perform the voltage check, locate the controller's B-plug and insert the probes of a DC voltmeter into the B-4 (+) and B-2 (-) pins.

### Condition 2:

A voltage level of between 11.6-14 volts must be present at the diesel ON/OFF switch circuit of the diesel burner controller during all testing. It may be necessary to perform a voltage check to ensure that this condition exists. To perform the voltage check, locate the controller's B-plug and insert the probes of a DC voltmeter into the B-1 (+) and B-2 (-) locations. Turn the diesel burner ON and observe the voltage levels.

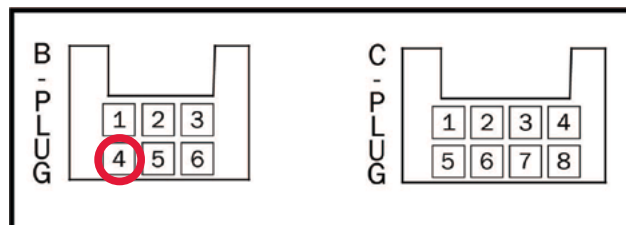
### Ground Circuit Test:

Locate the controller's B-plug and C-plug. Insert the probes of a DC voltmeter into the B-4 (+) and C-5 (-) locations and turn the diesel burner ON. If a voltage reading does not register on the voltmeter, the controller must be replaced. If voltage is present, proceed to the next test.

### ETS Module Circuit Test:

Locate the diesel-burner controller's B-plug and C-plug. Insert the probes of a DC voltmeter into the C-1 (+) and B-2 (-) locations and turn the diesel burner ON. If a voltage reading does not register on the voltmeter, the

### Controller B-Plug & C-Plug



**Figure 115**

diesel-burner controller must be replaced. If voltage is present, proceed to the next circuit test.

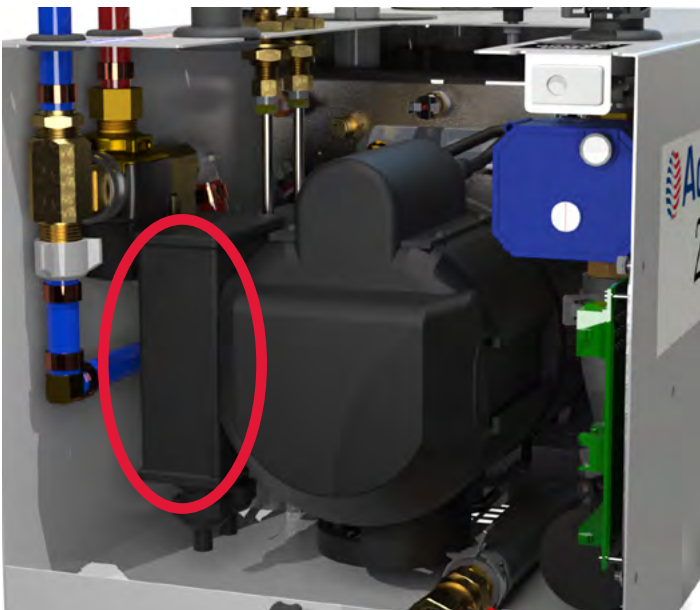
### DC High-Limit Thermostat Circuit Test:

Locate the diesel-burner controller's B-plug and C-plug. Insert the probes of a DC voltmeter into the C-4 (+) and B-2 (-) locations and turn the diesel burner ON. If a voltage reading does not register on the voltmeter, the diesel-burner controller must be replaced. If voltage is present, proceed to the next circuit test.

### Motor Circuit Test:

Locate the diesel-burner controller's B-plug and C-plug. Use a jumper wire to make a connection from the C-1 location to the C-7 location. Turn the diesel burner ON and insert the probes of a DC voltmeter into the C-2 (+) and C-5 (-) locations. If no voltage reading registers on the voltmeter, the diesel-burner controller must be replaced. If voltage is present, proceed to the next circuit test.

**NOTE:** Be sure to remove the jumper wire that was used to make the connection from the C-1 location to the C-7 location. Failure to do so will result in an overheating condition during normal operation.



**Figure 116**

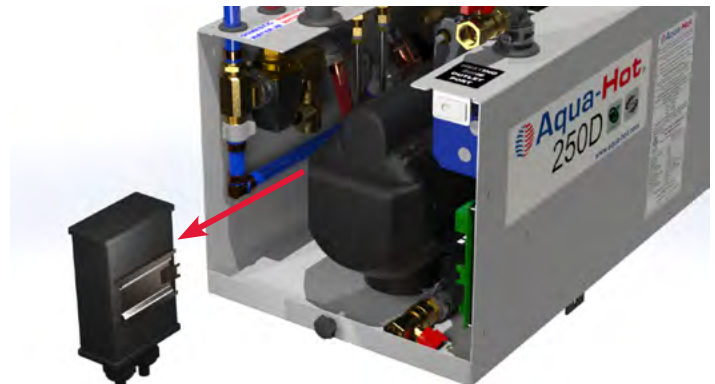
### Ignition Coil Circuit Test:

Turn the diesel burner OFF and locate the diesel-burner controller's C-plug. Also, locate the VDC high-limit thermostat and disconnect its 2-way male plug from the (white plastic) 6-way female connector. Insert the probes of a DC voltmeter into the C-8 (+) and C-5 (-) locations and turn the diesel burner ON. If a voltage reading does not register on the voltmeter 18-25 seconds after the initial start-up, the diesel-burner controller must be replaced.

**NOTE:** Be sure to reconnect the VDC high-limit thermostat's 2-way male plug to the 6-way female plug. The diesel burner will not ignite during normal operation if the VDC high-limit thermostat is left disconnected.

### Replacement Procedure:

1. Disconnect the Aqua-Hot from any and all power sources.
2. Remove the B-plug and C-plug from the controller. Gently slide out the controller from the side of the diesel burner:



**Figure 117**

3. Slide the new controller onto the side of the diesel burner.
4. Reconnect the B-plug and C-plug.
5. Test for normal operation.

**NOTE:** Be sure to install the controller with the plug ports facing downward. Failure to do so will result in moisture collecting in the ports and potential damage to the controller's internal circuitry.



## Instructions for Checking Fuel Pressure:

**NOTE:** A fuel pressure gauge is used to properly check the fuel pump's pressure setting. The fuel pump is preset to 145 PSI. Perform the following procedure to check for a proper fuel pressure setting.

### Step 1: Remove the diesel burner

Refer to the section on detaching the diesel burner on page 47.



**Figure 118**

### Step 2: Install the fuel line bypass fittings onto the diesel burner.

1. Locate the  $\frac{1}{4}$ " fuel tube unions on the bottom side of the diesel burner.
2. Using a 13mm and a  $\frac{9}{16}$ " wrench, remove the steel fuel lines from the diesel burner.



**Figure 119**



**Figure 120**

3. Using a 13mm and a  $\frac{9}{16}$ " wrench, install the fuel bypass fittings onto the diesel burner.

### Step 3: Install the fuel pressure gauge

---

1. Using a  $\frac{5}{8}$ " and  $\frac{3}{4}$ " wrench, remove the fuel nozzle.



**Figure 121**

2. Using a  $\frac{5}{8}$ " and  $\frac{3}{4}$ " wrench, install the fuel pressure gauge.



**Figure 122**

#### Step 4: Running burner off an external fuel source

1. Using an external fuel source and rubber fuel lines, hook the burner supply and return fuel lines up to run off the external fuel source.



Figure 123

WARNING

**A spark will appear across the ignition electrodes for a brief moment after the diesel burner has been activated. DO NOT attempt to make any fuel pressure adjustments until the spark has disappeared. Failure to do so may result in serious bodily injury. In some installations, it may be necessary to shine a light on the flame sensor to simulate a flame condition to shut off the ignition coil.**

2. Turn the diesel burner ON, either on the LCD screen or the RV control panel. A pressure will register on the fuel pressure gauge once the fuel solenoid opens (after approximately 10-20 seconds).

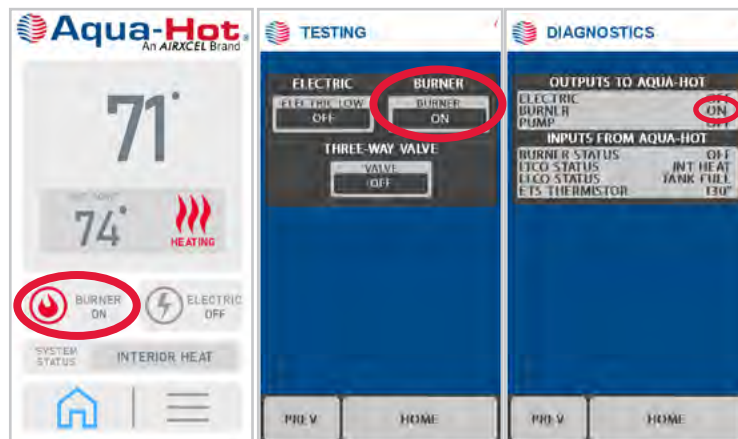


Figure 123

## Instructions for Adjusting Fuel Pressure:

### Step 1: Follow the directions for Adjusting the Fuel Pressure

1. Using an external fuel source and rubber fuel lines, hook the burner supply and return fuel lines up to run off the external fuel source.



Figure 125

## WARNING

A spark will appear across the ignition electrodes for a brief moment after the diesel burner has been activated. **DO NOT** attempt to make any fuel pressure adjustments until the spark has disappeared. Failure to do so may result in serious bodily injury. In some installments, it may be necessary to shine a light on the flame sensor to simulate a flame condition to shut off the ignition coil.

2. Turn the diesel burner ON, either on the LCD screen or the RV control panel. A pressure will register on the fuel pressure gauge once the fuel solenoid opens (after approximately 10-20 seconds).

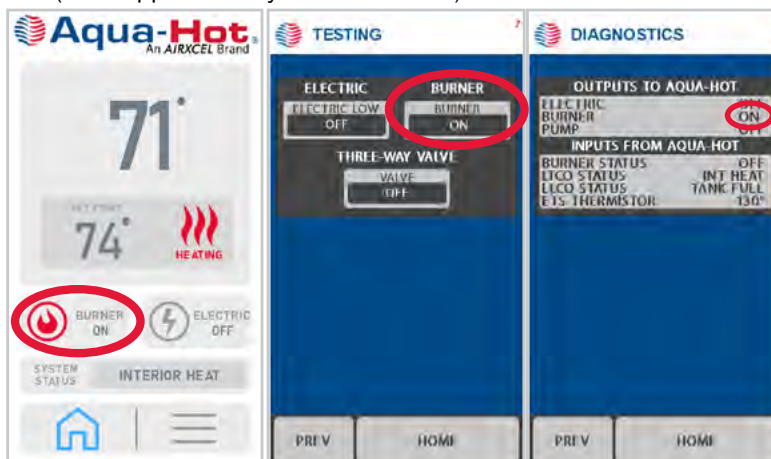
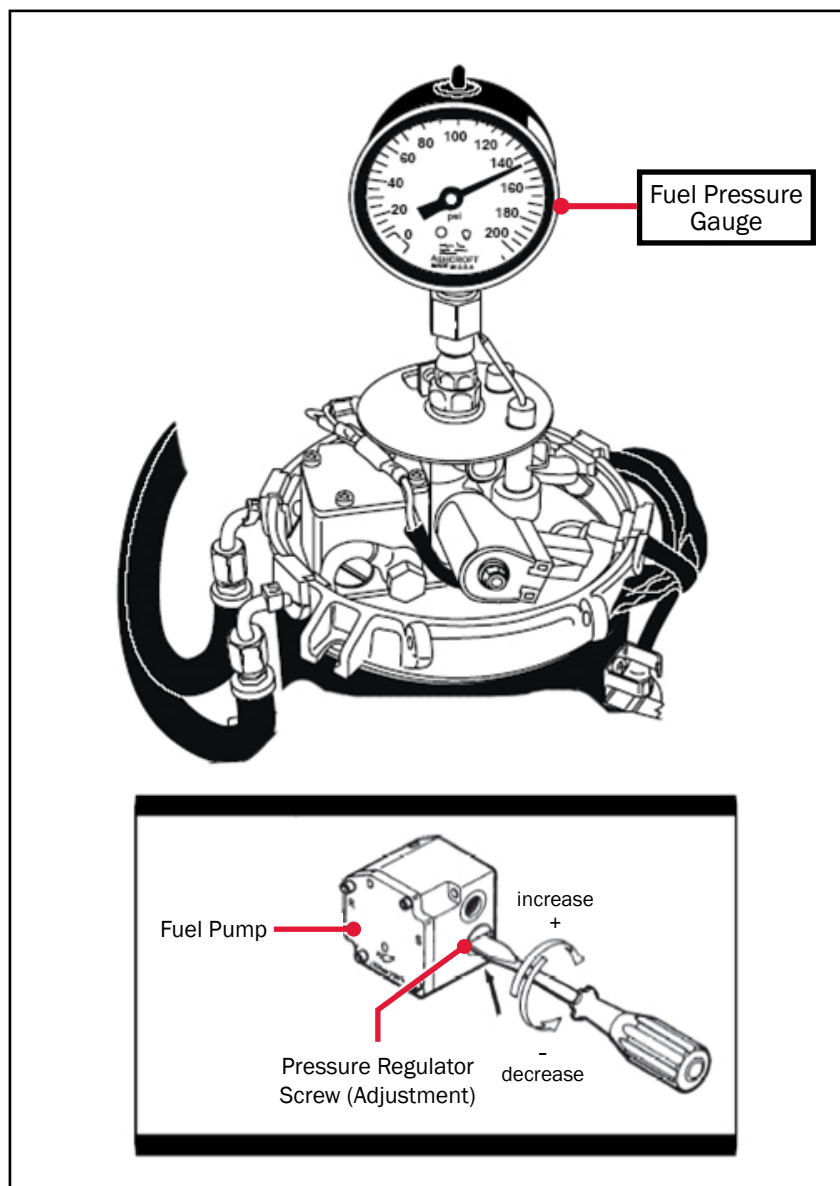


Figure 126



**Step 2: Adjust the Fuel Pressure to 145 PSI**

1. Once the fuel solenoid has been activated, and the fuel pressure gauge is registering a pressure, the fuel pressure can be adjusted. To increase the fuel pressure turn the pressure adjustment screw clockwise, and to reduce the fuel pressure, turn the pressure adjustment screw counter clockwise.

**Figure 127**

**NOTE:** If the fuel pressure cannot be adjusted, refer to the fuel pump section on Page 65 for more information and troubleshooting instructions.

## Aqua-Hot Maintenance

### Monthly Maintenance:

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

If additional antifreeze and water heating solution is required, fill the expansion tank to the "HOT" level mark. Reference Figure 128. Be sure to reference pages 102-103 for the type of antifreeze and heating solution.

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

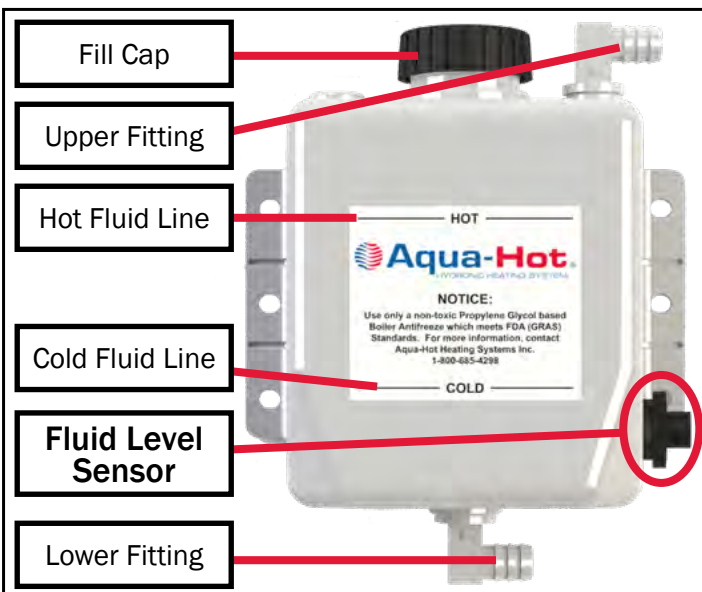


Figure 128



# DANGER

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

### Annual Maintenance:

To keep the Aqua-Hot running smoothly, it is recommended to have the diesel burner tuned up annually or after the RV has been stored unused for a long period of time. A tune-up should consist of a new fuel nozzle and fuel filter, along with a thorough cleaning of the combustion chamber. To ensure maximum diesel burner performance, always use the recommended fuel nozzle and fuel filter when replacing these parts.

**NOTE:** Be sure to use care when handling the fuel nozzle. Oils and/or small dust or dirt particles from hands may plug the nozzle's small orifice. A partially plugged orifice will restrict fuel flow, which will affect the combustion process of the diesel burner.



Figure 129

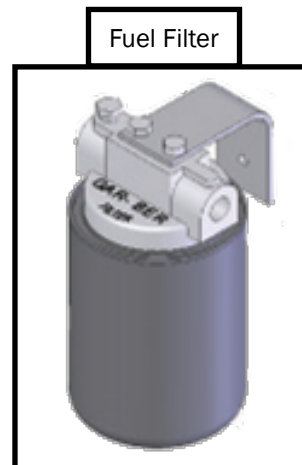


Figure 130

## Aqua-Hot Maintenance Procedure

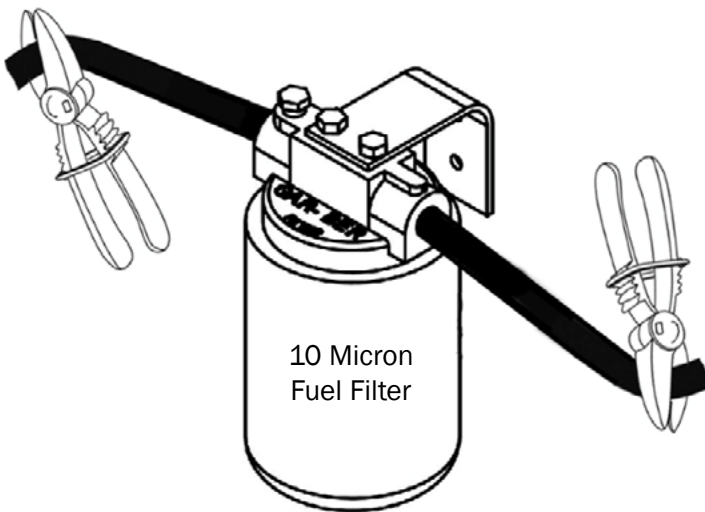
**NOTE:** Before performing an annual maintenance, it is recommended to test run the diesel burner. While testing, inspect the exhaust for smoke.

### Step 1: Test Run the Diesel Burner

1. Turn the diesel burner ON, either on the LCD screen or RV control panel.
2. After the diesel burner has ignited, inspect the exhaust for smoke.
3. Shut the diesel burner off and wait for unit to completely shut down.

**NOTE:** The diesel burner can either be shut off by:

- Turning the diesel burner OFF on the LCD screen
- Disconnecting the ETS module wires
- Unplugging the diesel burner controller (Figure 132)



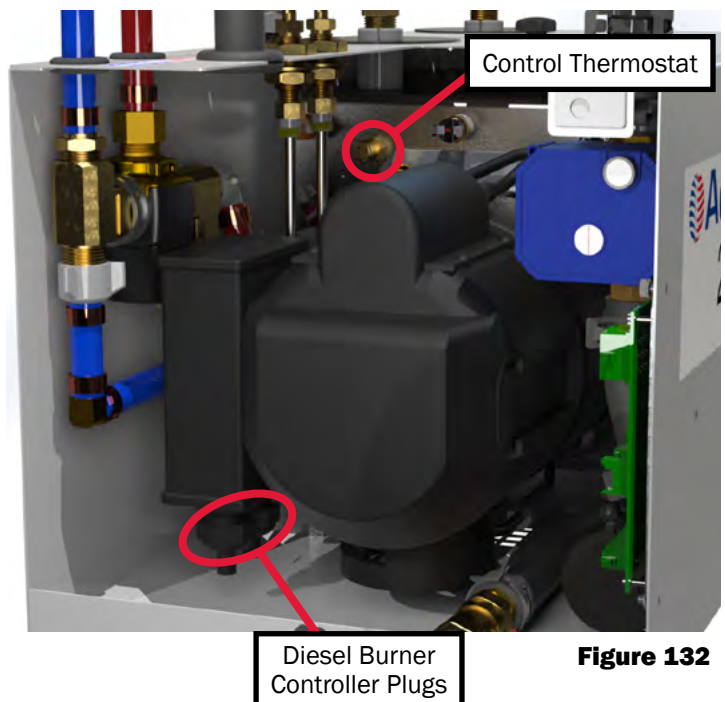
**Figure 131**

### Step 2: Replace the Fuel Filter

1. Locate the fuel filter
2. Using hose pinch off pliers, clamp off both fuel lines going to the fuel filter. Reference Figure 131.
3. Remove the old fuel filter. Replace the fuel filter with the proper replacement canister.
4. Remove the hose pinch off pliers.

### Step 3: Run the Diesel Burner

1. Turn the diesel burner ON.
2. After the diesel burner has ignited, let it burn for 1-2 minutes to purge the old fuel out of the nozzle holder, to prevent contamination of the replacement nozzle.
3. Shut the diesel burner OFF, and wait for the unit to completely shut off.



**Figure 132**

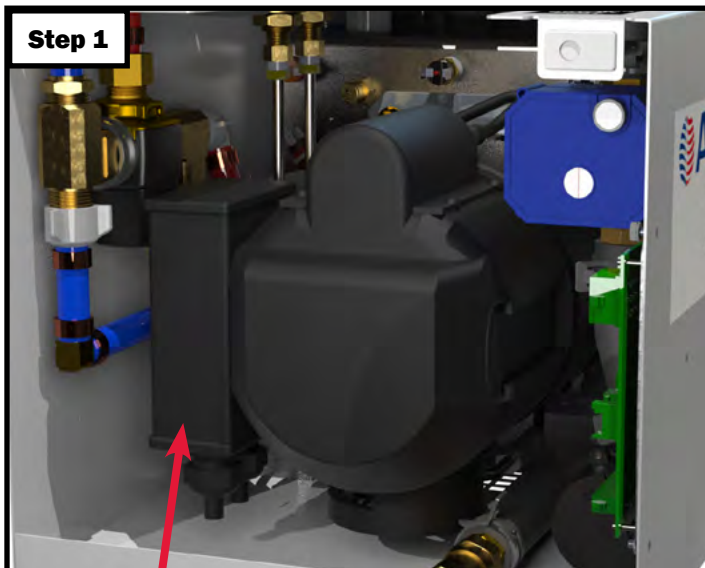


# CAUTION

**Be sure to clamp off the fuel supply and return lines at the ports on top of the Aqua-Hot PRIOR to beginning this replacement procedure.**

### Step 4: Remove the Diesel Burner

1. Locate the diesel burner's controller and disconnect both plugs.
2. Using a  $\frac{7}{16}$ " wrench, loosen the nuts securing each fuel line to the Aqua-Hot.
3. The diesel burner is secured to the Aqua-Hot with two nuts that can be loosened and swung out of the way by using a 10mm socket wrench with a 10 inch long extension.



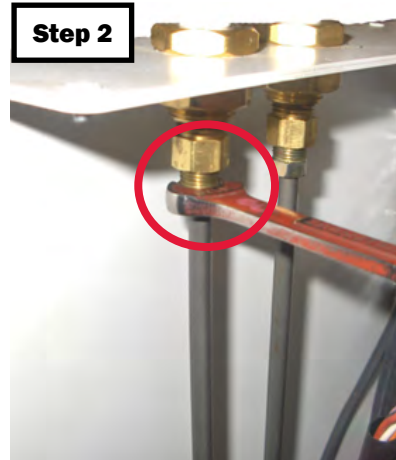
**Figure 133**

**Diesel Burner Controller**

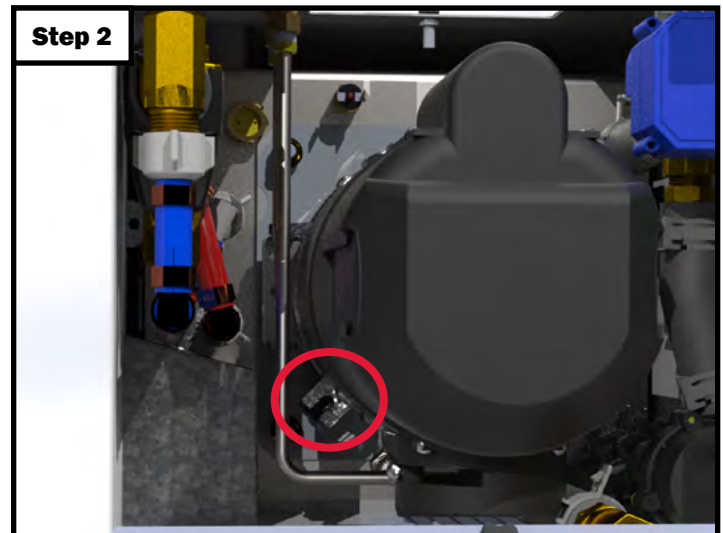


**Disconnect both Diesel Burner Controller Plugs**

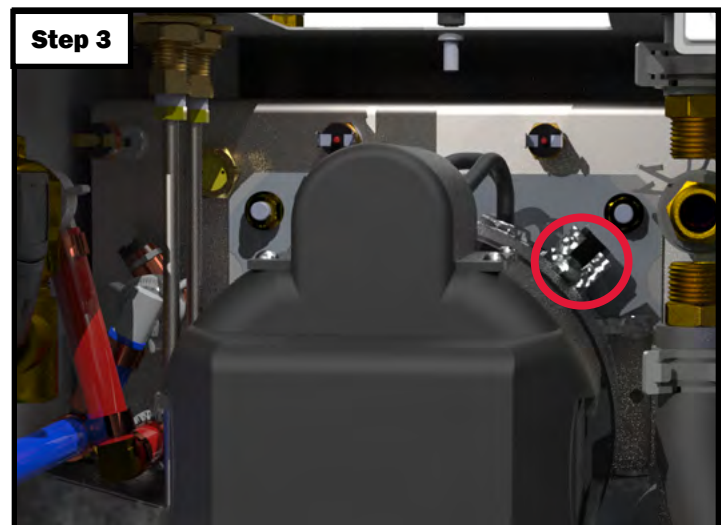
**Figure 134**



**Figure 135**



**Figure 136**



**Figure 137**



## Aqua-Hot Maintenance Procedure

**NOTE:** To remove the diesel burner, it may be necessary to disconnect the ETS Module and High-Limit Thermostats from the diesel burner's thermostat plug.

### Step 4: Remove the Diesel Burner (continued)

1. Carefully pull the diesel burner away from the Aqua-Hot 4 - 5 inches before rotating the burner, then remove completely as shown in Figure 138.



# DANGER

**Use caution when handling the combustion chamber, it may be extremely hot and serious burns could result from touching a hot combustion chamber.**

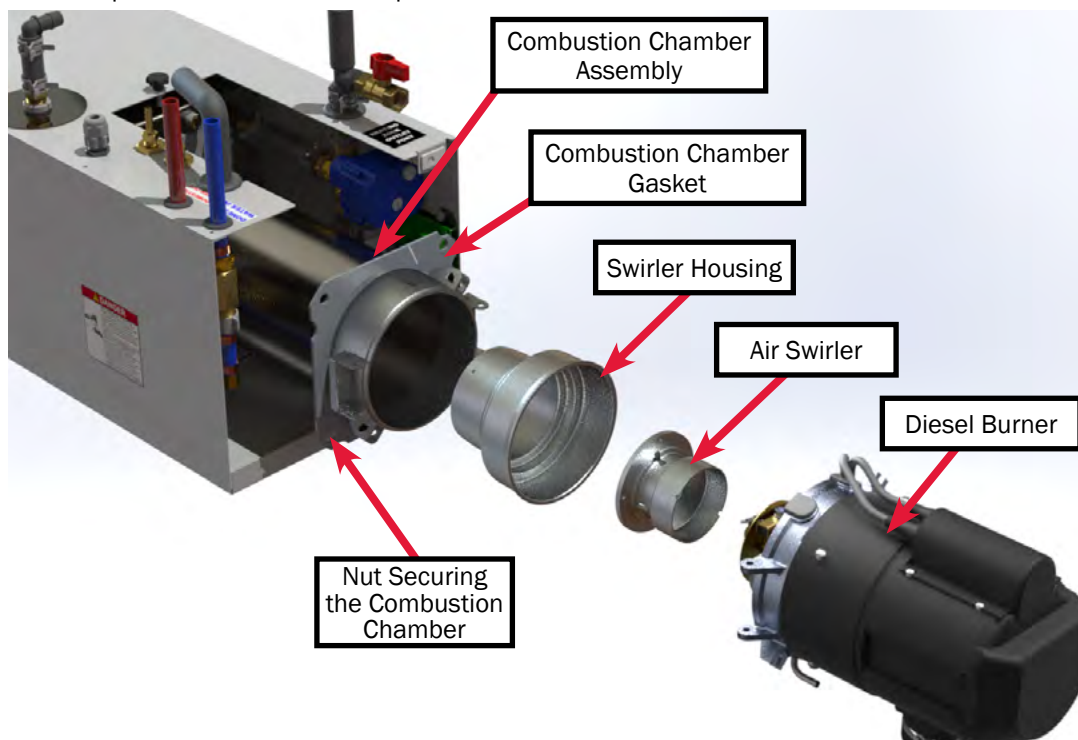


**Figure 138**

### Step 5: Clean and Inspect the Combustion Chamber and Heat Transfer Tabs

1. Remove the combustion chamber by loosening and removing the four nuts, securing the combustion chamber to the boiler tank and pulling it straight out, approximately 16 inches.
2. Once the combustion chamber has been removed, use a long handled wire brush, and brush the heat transfer tabs to loosen soot deposits. Failure to do so will reduce the Aqua-Hot's heat transfer capabilities.

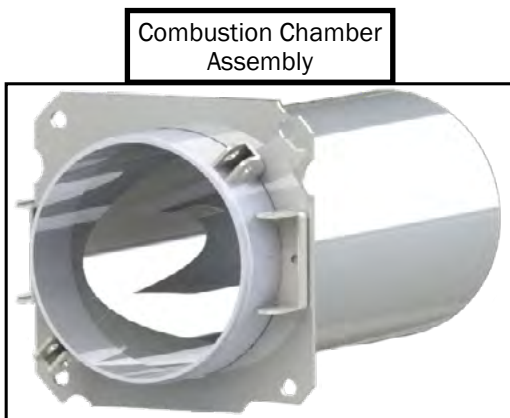
**NOTE:** If the heat transfer tabs are excessively sooty, it may be necessary to vacuum the soot out of the heat transfer tabs. If there is minimal soot, it may be left in the heat transfer tabs, and will be evacuated out of the exhaust pipe, upon start up of the diesel burner.



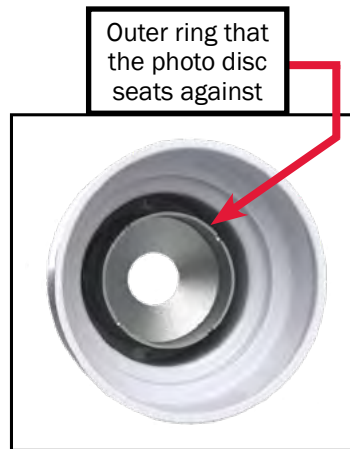
**Figure 139**

### Step 5: Clean and Inspect the Combustion Chamber and Heat Transfer Tabs (continued)

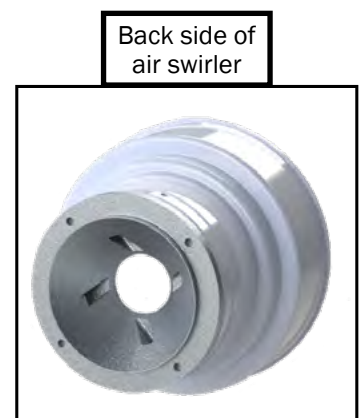
3. Inspect the Combustion Chamber assembly and Air Swirler for damage or signs of warping.
  - Inspect the outer ring that the photo disc seats against for signs of warping.
  - Inspect the back side of the Air Swirler for signs of warping between screws.



**Figure 140**



**Figure 141**



**Figure 142**



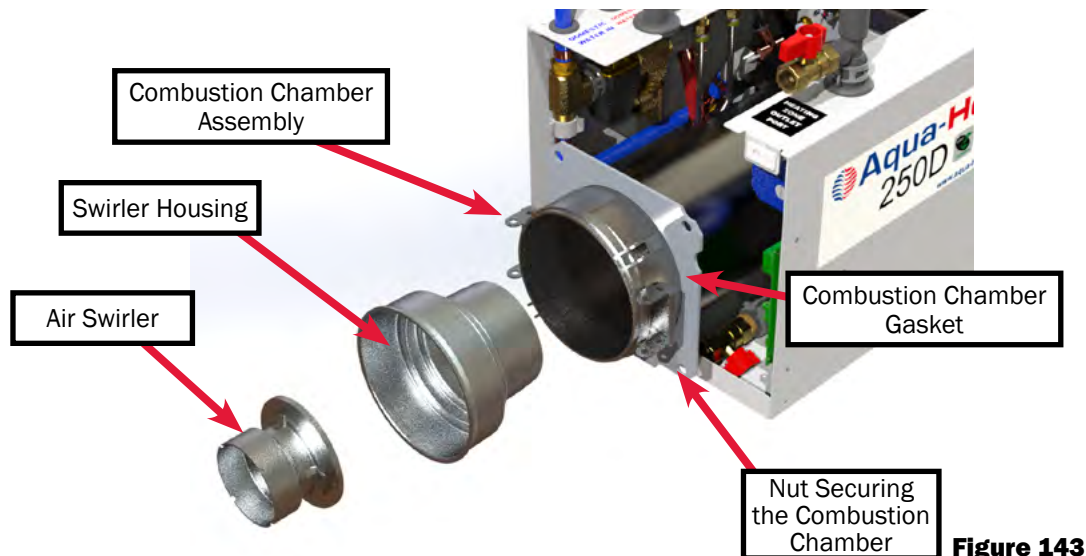
# CAUTION

**Failure to reinstall the combustion chamber will result in serious damage to the diesel burner.**

**NOTE:** It will be necessary to replace the combustion chamber gasket any time the combustion chamber is removed.

### Step 6: Reinstall the Combustion Chamber

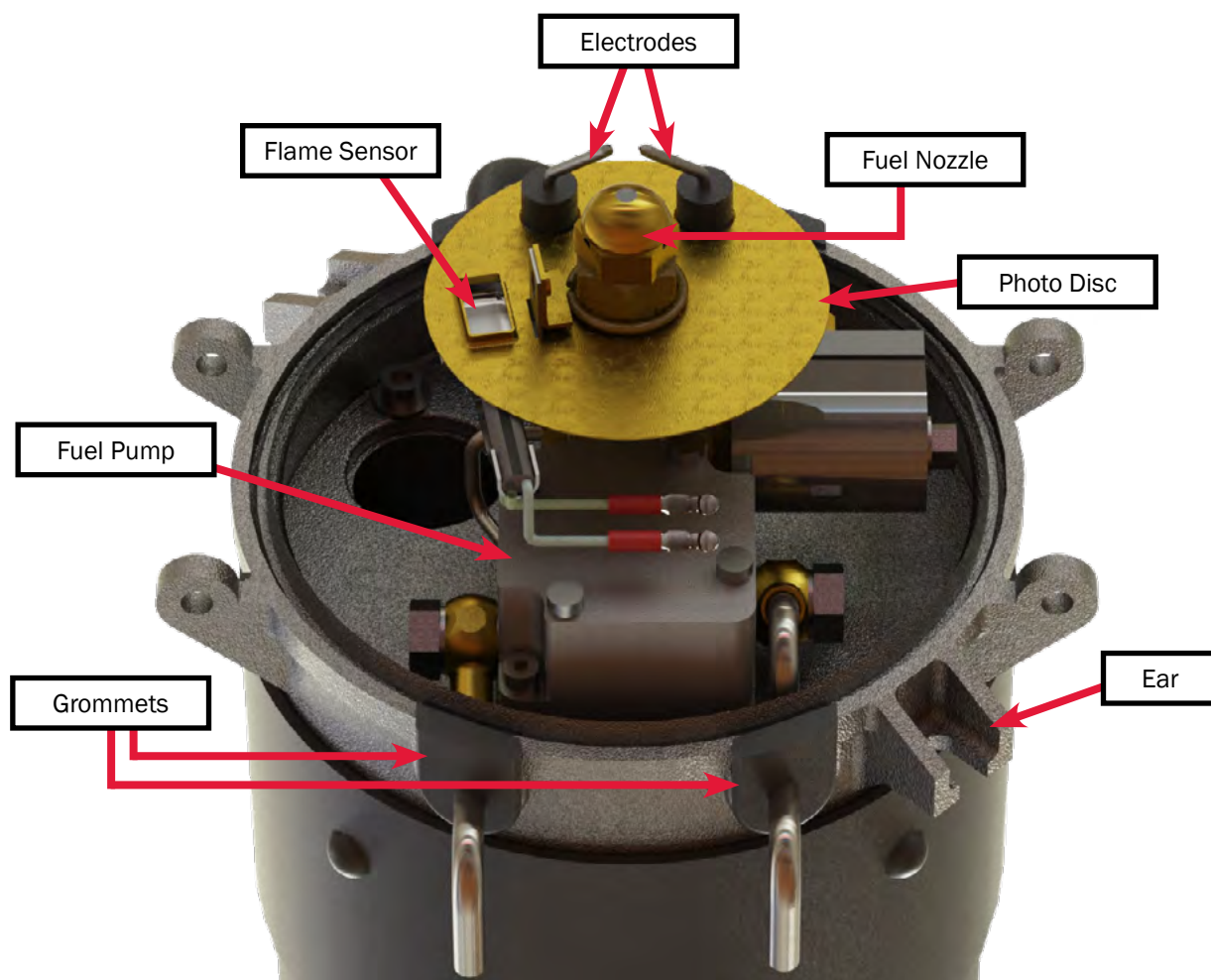
1. Reinstall the Combustion Chamber assembly and the Air Swirler into the Aqua-Hot.



**Figure 143**

## Step 7: Inspect the Diesel Burner

1. Reinstall the Combustion Chamber assembly and the Air Swirler into the Aqua-Hot.



**Figure 144**

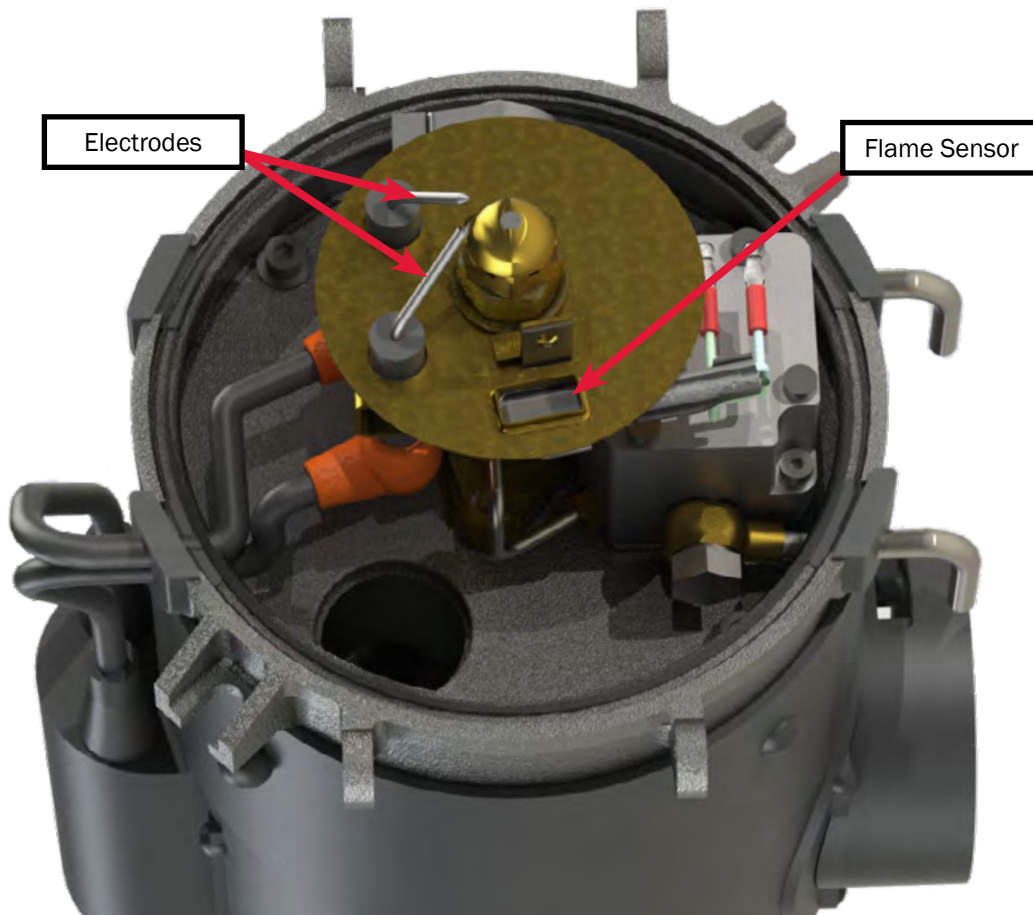
### Inspect the following:

1. Electrodes
  - Damaged
  - Improperly adjusted
2. Fuel Pump
  - Leaks
3. Photo Disc
  - Warped
  - Bent
4. Harness & Ignition Coil Wires
  - Cracked or bare wires
  - Hard or brittle wires
5. Flame Sensor
  - Cracked
  - Overheated (purple color)
  - Melted wires
  - Dirty
6. Rubber Grommets
  - Hard or brittle
  - Rubber has been cut out
  - Right & left properly positioned
7. Broken or cracked "Ears"
  - Due to over-tightening of eye-bolts

### Step 8: Clean Ignition Electrodes and Flame Sensor

---

1. Ignition Electrodes
  - Polish away any carbon deposits that may have baked onto the metal tips of the ignition electrodes with a coarse sponge
2. Flame Sensor
  - For light dirt, dust, and/or carbon deposits, simply wipe off the flame sensor with a soft cloth.
  - Should heavy carbon deposits be present, completely remove the flame sensor from the photo disc and clean with brake cleaner.



**Figure 145**



### Step 9: Replace Fuel Nozzle

1. Use a  $\frac{3}{4}$ " wrench to hold the fuel nozzle manifold hex, while loosening the fuel nozzle with a  $\frac{5}{8}$ " wrench and remove.
2. When replacing the fuel nozzle, be sure to tighten the nozzle, loosen it a  $\frac{1}{4}$  turn, and then firmly re-tighten. This will establish a seated fit and avoid any leaks.

**NOTE:** Be sure to use care when handling the new fuel nozzle. Oils and/or small dust or dirt particles from your hands may plug the nozzle's small orifice. A partially plugged orifice will restrict fuel flow, which will affect the combustion process of the diesel burner.

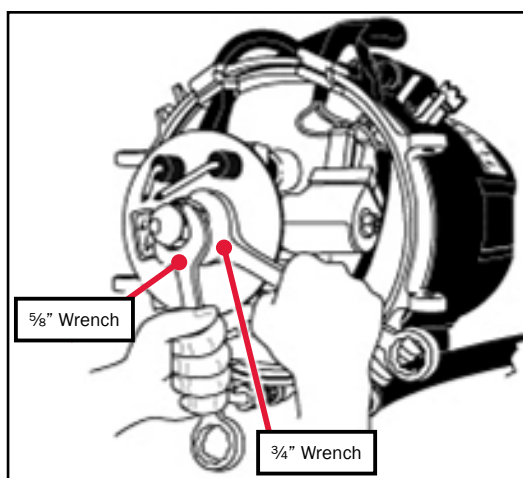


Figure 146

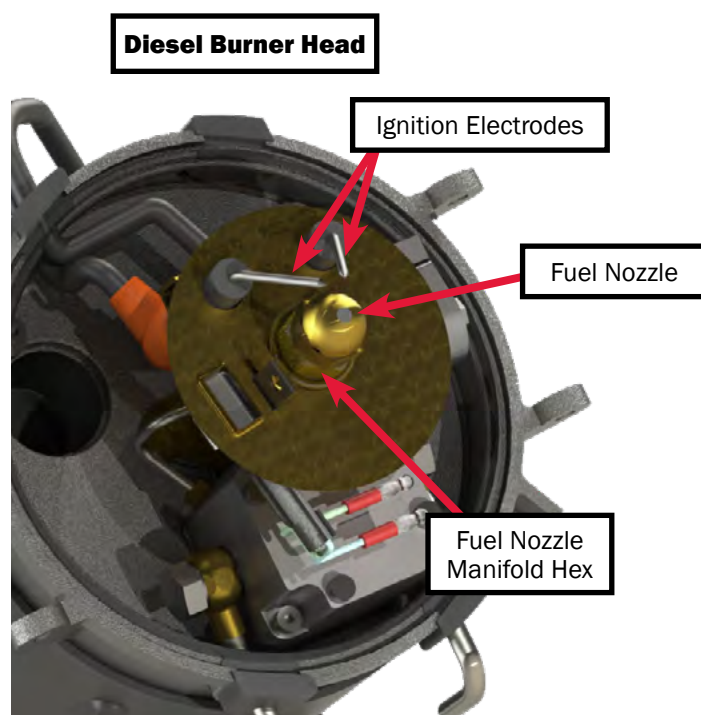


Figure 147



# DANGER

Be sure to reattach the diesel burner head prior to turning the heater ON. Failure to do so may result in ignition of the diesel burner and serious bodily injury.

### Step 10: Adjust Ignition Electrodes

1. Using a 10mm socket, slightly loosen the retaining clamp bolt.
2. Place the electrode adjustment gauge on the nozzle manifold hex and insert the metal tips of the ignition electrodes into the appropriate notches of the electrode adjustment gauge.
3. Using a 10mm socket, tighten the retaining clamp bolt.
4. Remove the electrode adjustment gauge.

**NOTE:** Be sure not to over-tighten the retaining clamp bolt when readjusting the ignition electrodes. Over-tightening the retaining clamp bolt will bend the retaining clamp and prevent the photo disc from floating freely. Not allowing the photo disc to float freely will cause poor combustion, and result in a smoky exhaust. A bent retaining clamp can be re-straightened with a punch and a hammer. Lay the clamp's beveled side down on a solid flat surface and align the thick end of the punch at dead center. Tap the punch lightly until the retaining clamp returns to proper form.

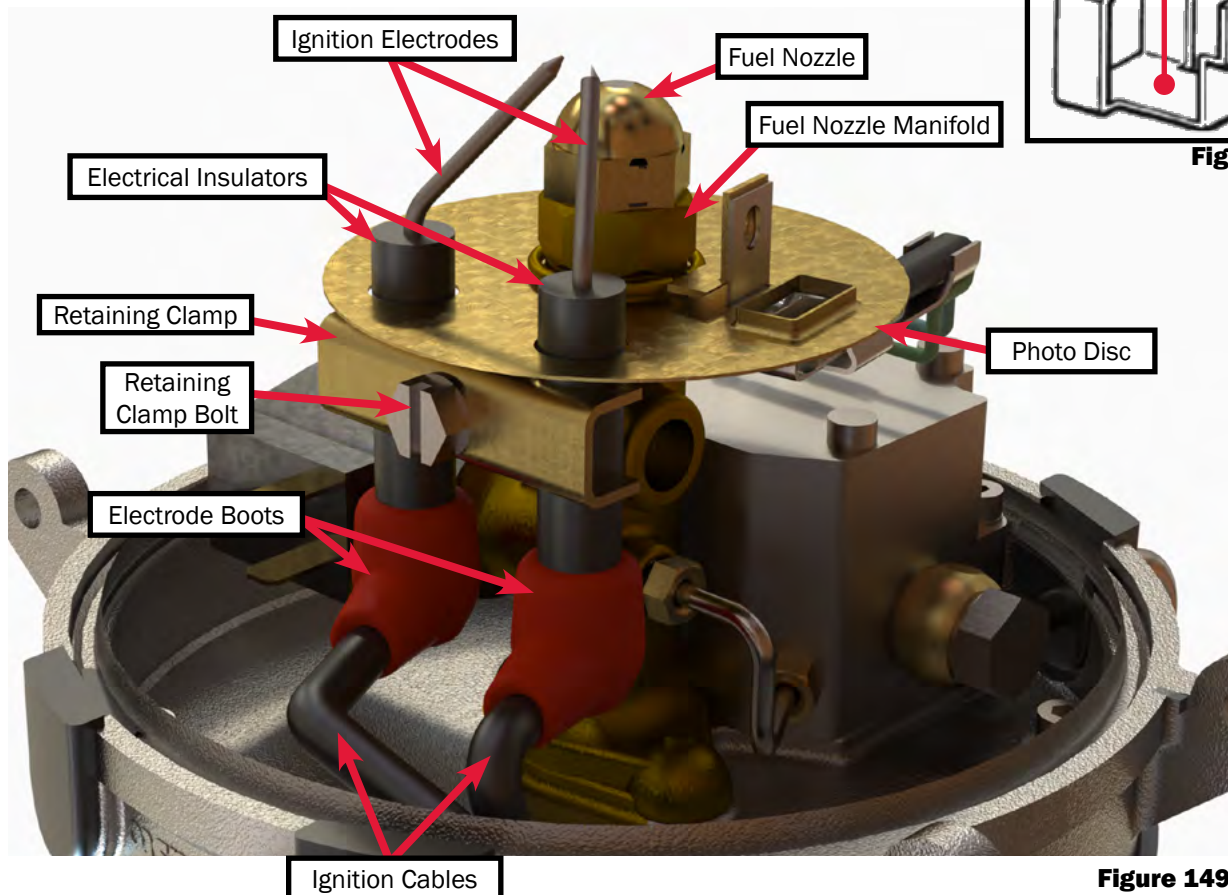


Figure 149

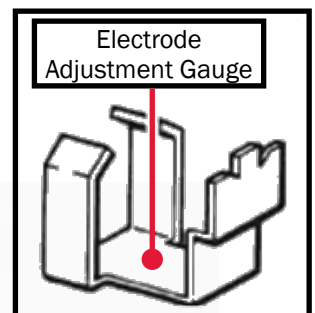
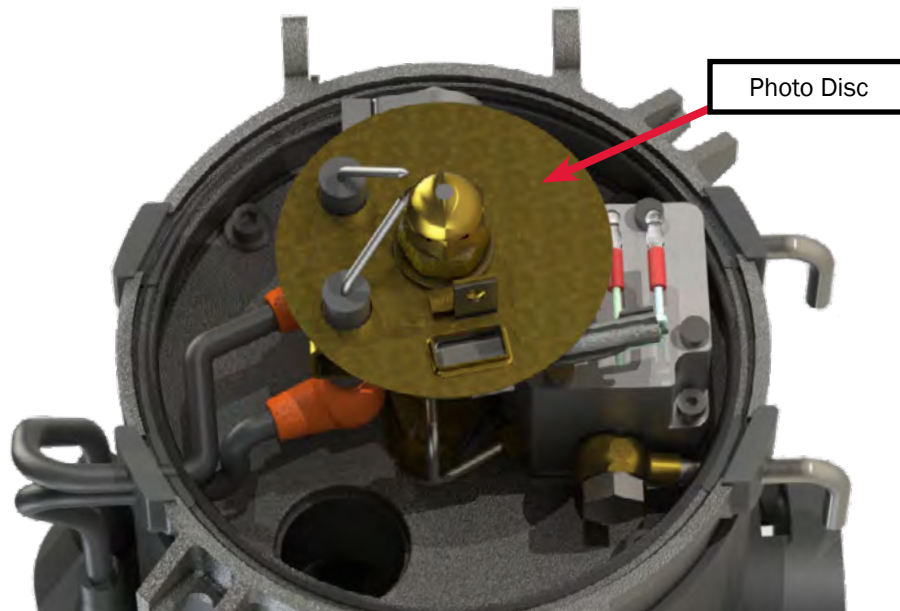


Figure 148

### Step 11: Inspect the Photo Disc

1. If the photo disc is not free-floating, the electrode clamp bolt has been over-tightened, and has bent the electrode clamp. Using a 10mm socket, remove the electrode clamp and re-straighten.
  - Lay the clamp's beveled side down on a solid flat surface and align the thick end of the punch at dead center. Tap the punch lightly until the retaining clamp returns to proper form.



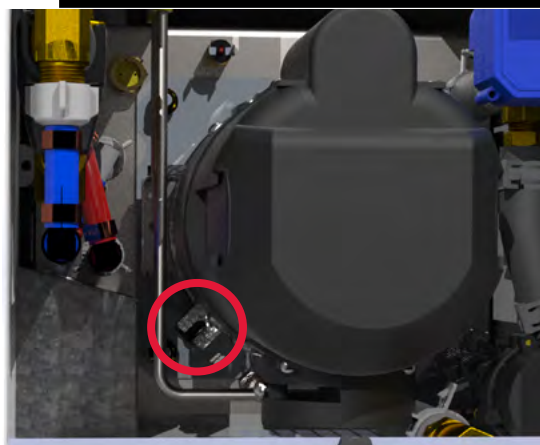
**Figure 150**

### Step 12: Reinstall the Diesel Burner

**NOTE:** When reinstalling the diesel burner, be careful not to damage the photo disc or bend the electrodes. Also, be careful not to pinch any wires between the burner and the Aqua-Hot boiler tank.

1. Align the diesel burner with the Aqua-Hot, using the alignment tabs welded on the Aqua-Hot.
2. Swing the eye-bolts around the "Ears" on the diesel burner and securely tighten, using a 10mm socket with a 10in long extension.

**Use extreme caution when tightening down the eye-bolt nuts. Over-tightening of the eye-bolt nuts can cause the aluminum blower casing to crack.**  
**Torque Specifications: Approximately 20-40 in-Lbs.**



**Figure 151**



**Figure 152**

### Step 13: Reconnect the Fuel Lines

1. Align the fuel lines on the diesel burner with the fittings on the Aqua-Hot. Using a  $\frac{7}{16}$ " wrench, tighten down both the supply and return fuel fittings.

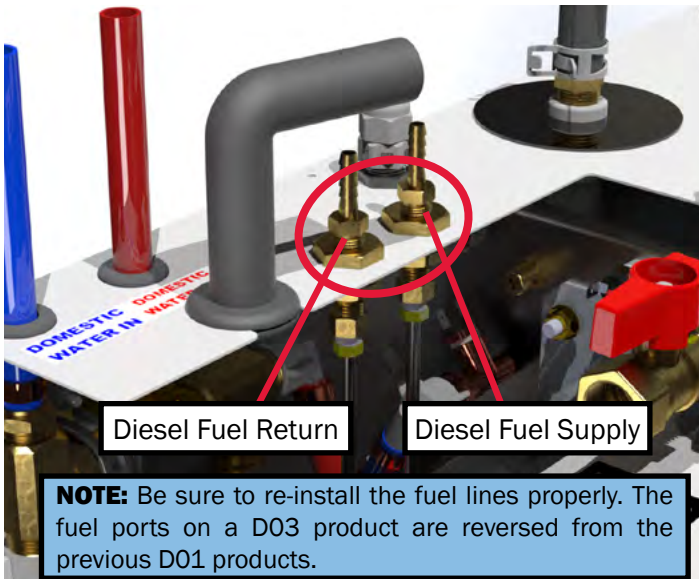


Figure 153

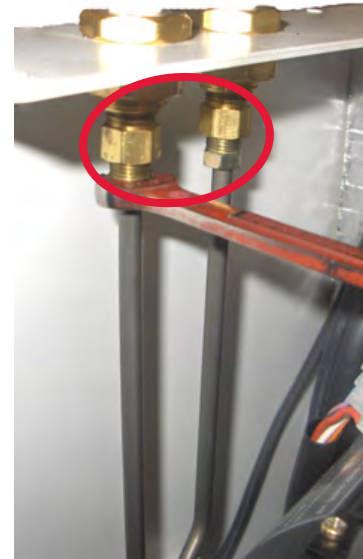
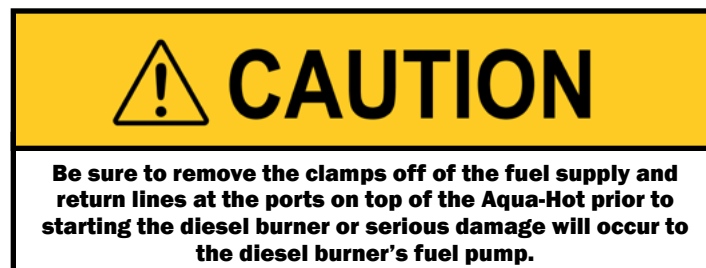


Figure 154



### Step 14: Plug in the Diesel Burner's Controller and Mount

1. Locate the diesel burner's controller and connect both plugs.

**NOTE:** The diesel burner's controller might have to be mounted onto the side of the diesel burner before the plugs are inserted into the controller, otherwise it might not be possible to mount the controller.

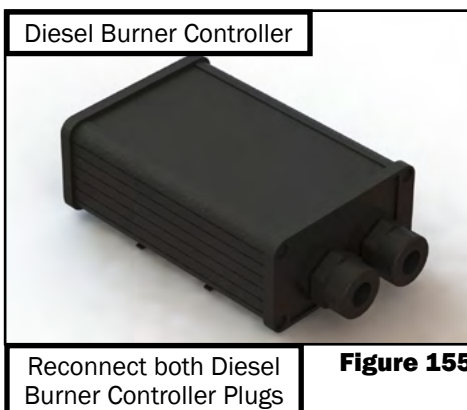


Figure 155

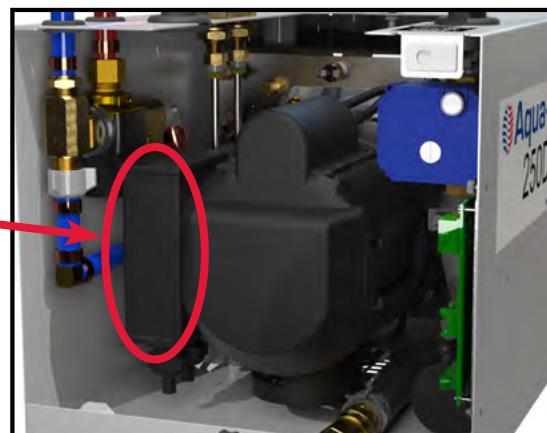


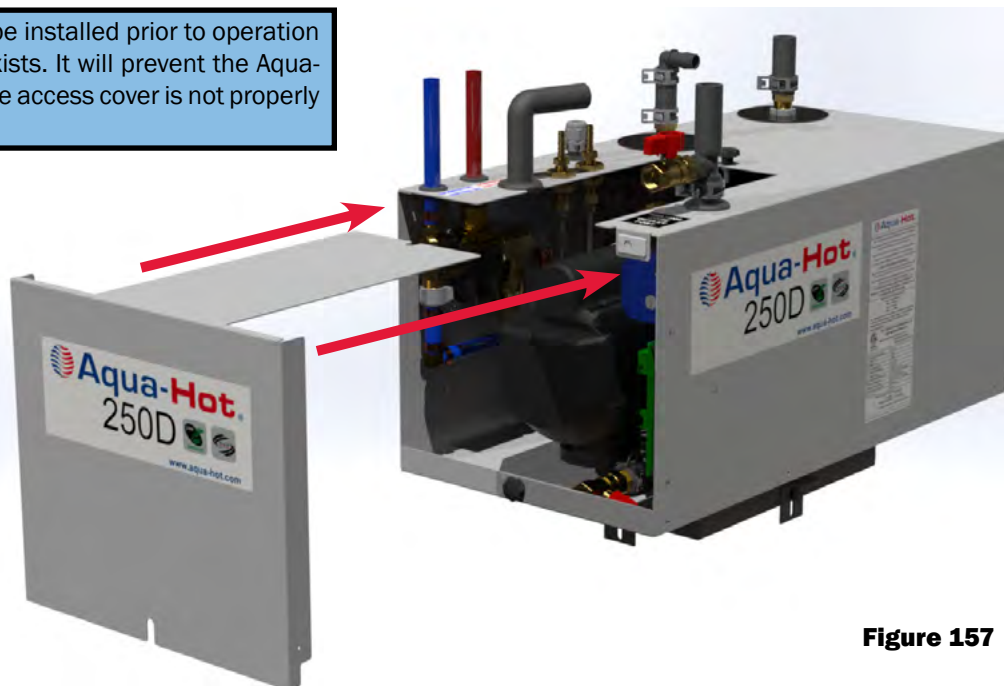
Figure 156



### Step 15: Reinstall the Aqua-Hot's Access Cover

1. Reinstall the Aqua-Hot's access cover.

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



**Figure 157**

2. Securely tighten the three bolts securing the access cover in place.



**Figure 158**

### Step 16: Test for Normal Operation

1. Turn the diesel burner ON and allow the diesel burner to run for a complete cycle, until it shuts off on its own.
2. After the diesel burner has shut off, turn on the interior heat or run hot water until the diesel burner cycles back on. When the diesel burner cycles back on, check the exhaust for any signs of smoke.

## Extreme Cold Weather Operation



# WARNING

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

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

### 120V AC Electric Element

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

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

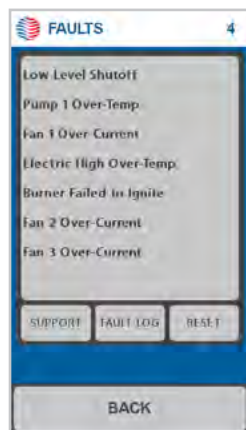


Figure 159

## Diesel Burner

If the Diesel Burner fails to operate:

- Determine if the diesel fuel in the motor home is winter or summer fuel
- Verify that the diesel fuel is liquid and not jelled
- Make sure the electrodes are properly adjusted
- Determine when the last annual service was performed
- Check the LCD screen for any faults (Figure 159)

### Things to Check for Lack of Interior Heat:

1. Diesel burner must be on
2. Diesel burner operating properly
3. Antifreeze concentration in the boiler tank must be between 30-50%
4. Heating system must be properly installed according to the 250-D03 Installation manual
  - At least 5 heat exchangers installed in the interior of the RV
  - Must be cold air returns installed for every heat exchanger (reference Figure 161)
  - Heat exchangers should be mounted as close to the hot air outlet grill as possible (reference Figure 160)

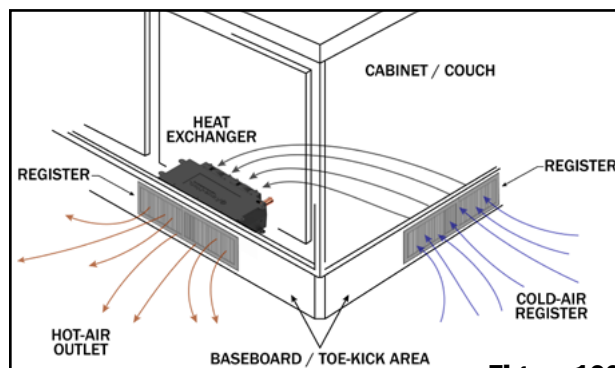


Figure 160

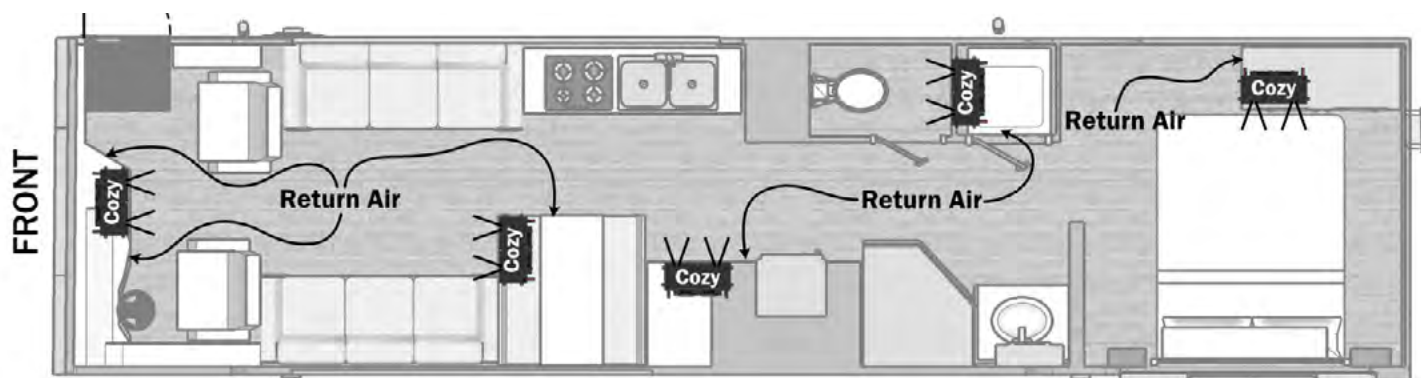


Figure 161

## **Filling and Purging the Aqua-Hot 250-D03**

Before the first activation of the Aqua-Hot, fill the unit with antifreeze and water heating solution. Without the solution present, the Aqua-Hot will not operate. 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 102-103 for more information about antifreeze.

### **Procedure:**

1. Locate the fill valve at the zone port outlet (Figure 163).
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 7, Figure 3 (Item #4) for the 3-Way Valve location.



**Figure 162**

**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.



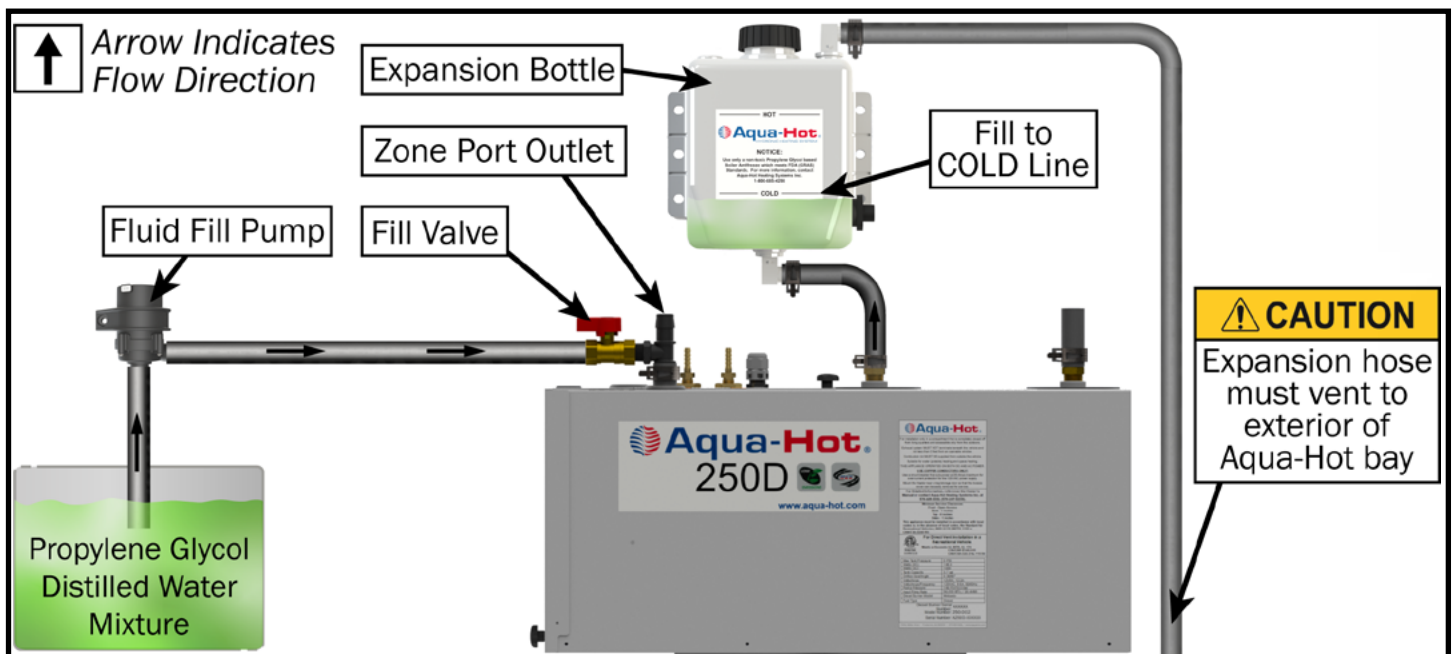
## **WARNING**

**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.**



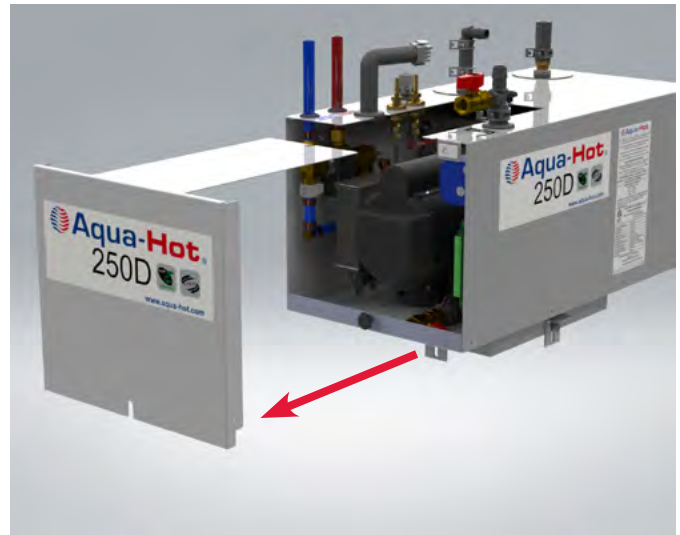
**Figure 163**

### Draining the Aqua-Hot

**NOTE:** The Aqua-Hot 250D tank holds approximately 4.5 gallons of the antifreeze and water coolant fluid. This does not include coolant in the heat exchangers or coolant hoses throughout the coach.

#### Drain Procedure:

1. Remove the front panel of the Aqua-Hot. The valve is located in the bottom right-hand corner, (see Figure 164).
2. Connect a piece of ½" PEX-type tubing or rubber hose to the drain valve. This piece should be long enough to transport the antifreeze/water coolant fluid from the Aqua-Hot to a 5-gallon or larger bucket.
3. Open the Fluid Drain Valve located at the front of the Aqua Hot system. See Figure 165.
4. Some coolant from the external hoses may drain into the bucket. If the bucket fills before the tank drains, shut off the valve and swap buckets for an empty one, then re-open the valve. Repeat this procedure until the tank is drained.



**Figure 164**

**NOTE:** If the fluid is to be re-used, make sure to use clean bucket(s) and cover after use.



**Figure 165**

Fluid Drain Valve



## 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 166 for a system overview and pages 102-103 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 RV 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 RV.
7. Once this has been completed, deactivate and disconnect the external fluid pump.
8. Close all but one faucet in the RV. 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.

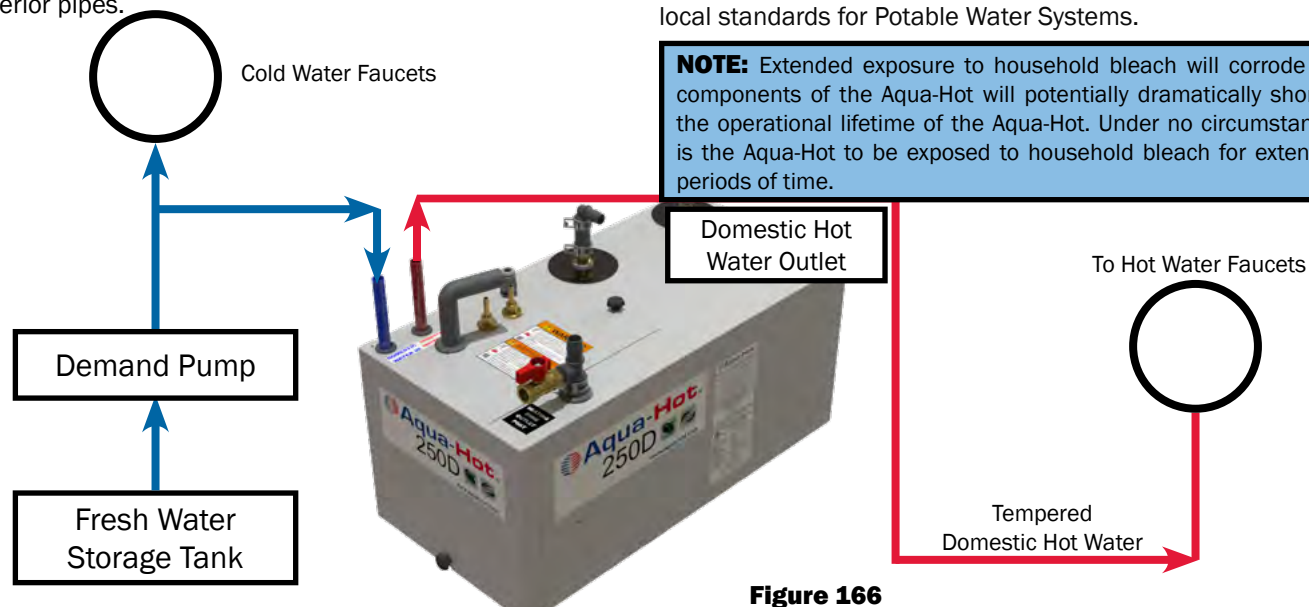


Figure 166



## 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 RV.
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.

### 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.

#### Troubleshooting Procedure:

If your 250-D03 has been unused for an extended period of time, performing the annual service may resolve many problems. Instructions for the annual service are on Page 78 or may be performed by an Aqua-Hot Factory Certified Service Center. They can be found on the website at [www.aquahot.com](http://www.aquahot.com).

- 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 RV-side hot water faucets are closed.
- Locate the controller within the Aqua-Hot unit. See Page 11 to identify this component.
- Visually inspect the interior cabinet of the Aqua-Hot unit, searching for any damaged or disconnected wires. Reconnect or repair any damaged wires.
- The 250-D03 contains a 20A fuse as part of the wiring harness. Check that this fuse has not been burned out.
- Locate the high-limit thermostats and follow the procedure on Page 26 to troubleshoot these components.
- 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 96 to begin the diesel burner troubleshooting.
  - If the burner begins to operate at this stage, choose a troubleshooting guide below 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 RV 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 32 to troubleshoot the stir pump.
- Three-Way Valve
  - Reference Page 29 to troubleshoot the three-way valve.
- Low-Temperature Cutoff Thermostat
  - Reference Page 27 to troubleshoot this component.
- Tempering Valve
  - Reference Page 31 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](http://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 RV heating loop
- A malfunctioning low-temperature cutoff thermostat

### Stage 1:

- The RV is supplied with power
- The Aqua-Hot has an adequate supply of fuel
- All RV-side fuses are functional and able to supply power
- All water sources connected to the RV are shut off
- 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.
- The 250-D03 contains a 20A fuse in the wiring harness. Make sure this fuse has not burned out.
- 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 96 to begin diesel burner troubleshooting.

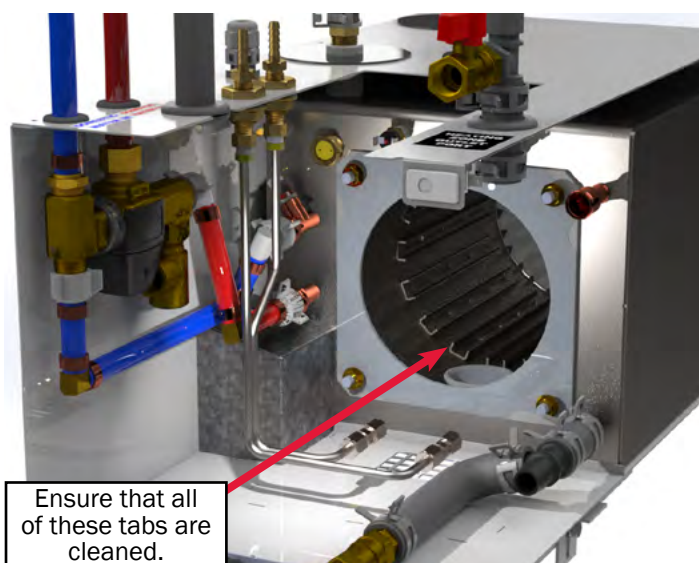
### Stage 3:

1. Begin troubleshooting the three-way valve. See Page 29.
2. Reference Page 27 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 32 for troubleshooting.

4. Locate all of the heat exchangers within the RV 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 91 for the heating loop fill & 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 RV to an Aqua-Hot Factory Authorized Service Center. One can be found at [www.aquahot.com](http://www.aquahot.com).



**Figure 167**

### 250-D03 Unit Smoke

#### Purpose:

It is possible that the Aqua-Hot 250-D03 may smoke upon first start-up. There are many possible causes for smoke as listed below.

If the unit has sat for an extended period of time unused, please perform the annual service.

- Clear exhaust or no smoke
  - The unit is operating correctly
- Blue/White smoke
  - Fuel Solenoid
  - Nozzle Tower
  - ETS Module
  - Short-cycling
- Black smoke
  - Low voltage
  - Exhaust system damage
  - Air intake
  - Burner is improperly seated
  - Combustion chamber damage
  - Fuel delivery system

As such, it is necessary to select the correct troubleshooting procedure to solve the issue quickly.

#### Blue/White Smoke

##### Smoke During Start-Up or Shut-Down:

1. Ensure that the unit is not short-cycling (rapid power-up and shut-down) during its start-up procedure. This can be caused by:
  - A faulty switch
  - Damaged wiring
  - A malfunctioning ETS module
2. Diagnose the ETS module by testing for continuity. Reference Page 22 for the procedure. Test the unit after this is complete.
3. Detach the diesel burner from the Aqua-Hot (see Page 47) to gain access to components for testing.
4. Remove the igniter coil flange to gain access to the fuel tower, nozzle, igniter module, and flame sensor.

5. Visually inspect this sub-assembly, looking for any damage or leak locations.

##### Smoke During the Burn Cycle:

1. It is possible that the electrodes of the igniter module have been knocked out of adjustment.
2. Follow the directions on Page 47 to gain access to the diesel burner head.
3. Using a Webasto electrode gauge, make sure the tips of the electrodes fit into the grooves of the gauge.
4. Air may be present in the fuel system, resulting in the uneven delivery of fuel to the nozzle and causing excessive smoke. Check the fuel delivery system for any damage or loose clamps which may introduce air into the fuel line.
5. Check the ignition coil for proper operation.

#### Black Smoke:

1. Ensure that the Aqua-Hot is receiving 12V DC power from the RV.
2. Inspect the exhaust system for any damage or restrictions. Remedy these issues.
3. Remove the access cover of the unit.
4. Attempt to shake the burner sub-assembly. If the burner moves, it has been improperly seated. Follow the directions on Page 47 to remove and reinstall the diesel burner.
5. If at this stage the burner is still producing black smoke, it is recommended that the annual service be performed. See Page 78 for the procedure.
6. Visually inspect the inside of the combustion chamber for any warping or apparent heat damage.
7. Remove the diesel burner from the Aqua-Hot - see Page 47.
8. Remove the combustion chamber to gain access to the heat exchanger tabs as shown in Figure 165.
9. Using a wire brush, scrub the heat exchanger inside the Aqua-Hot as shown in Figure 165.
10. If at this stage, black exhaust smoke is not remedied, contact the Aqua-Hot Technical Support at 574-AIR-XCEL (574-247-9235) or locate your nearest authorized service center.



## Diesel Burner Troubleshooting

This section will assist in troubleshooting the Aqua-Hot diesel burner.

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

### Troubleshooting Procedure:

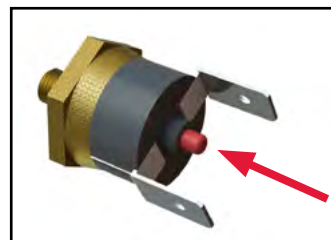
1. If this unit has been inactive for an extended period of time, perform the diesel service prior to beginning these troubleshooting steps. The annual service will typically resolve many common issues which may impede unit operation.
2. Locate the fluid overflow bottle and ensure that it is filled to at least the COLD mark.
3. Remove the cabinet access panel from the front of the Aqua-Hot.



**Figure 169**

4. Verify that the 20A fuse included as part of the diesel harness is functional. Replace if necessary.
5. Move the burner on the interior control panel to the ON position.
6. Make sure the interlock switch is depressed.
7. Verify that 12V DC power is present at Pin B4 of the diesel burner controller.
  - If 12V DC is not present, check the ETS module for functionality by following the directions on Page 22.

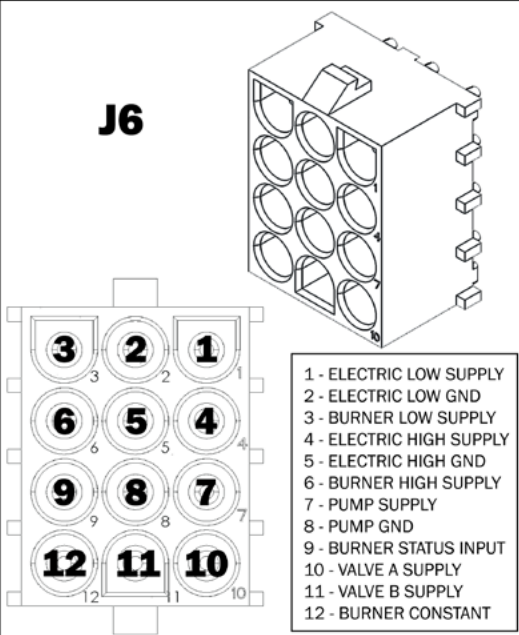
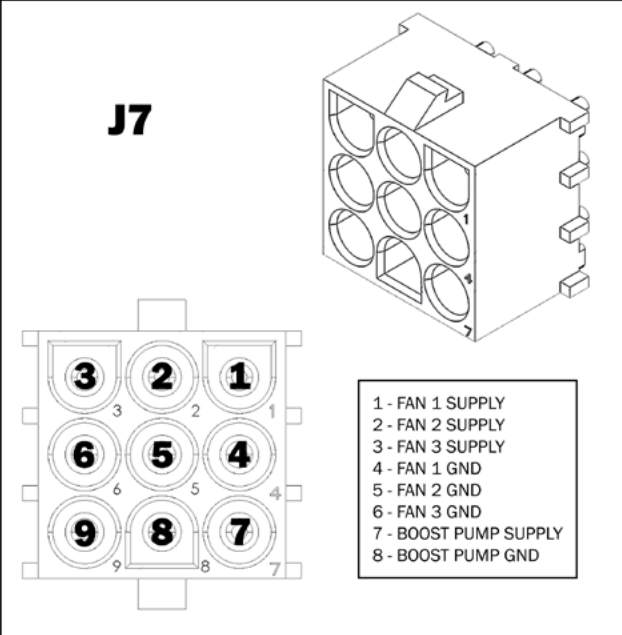
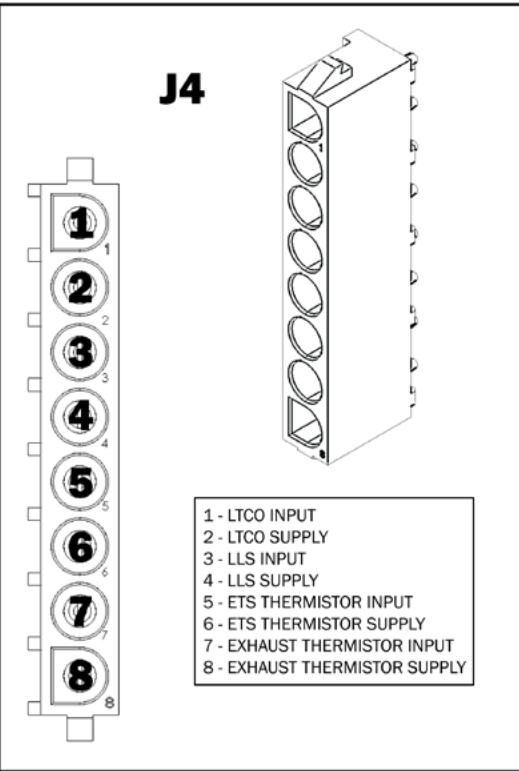
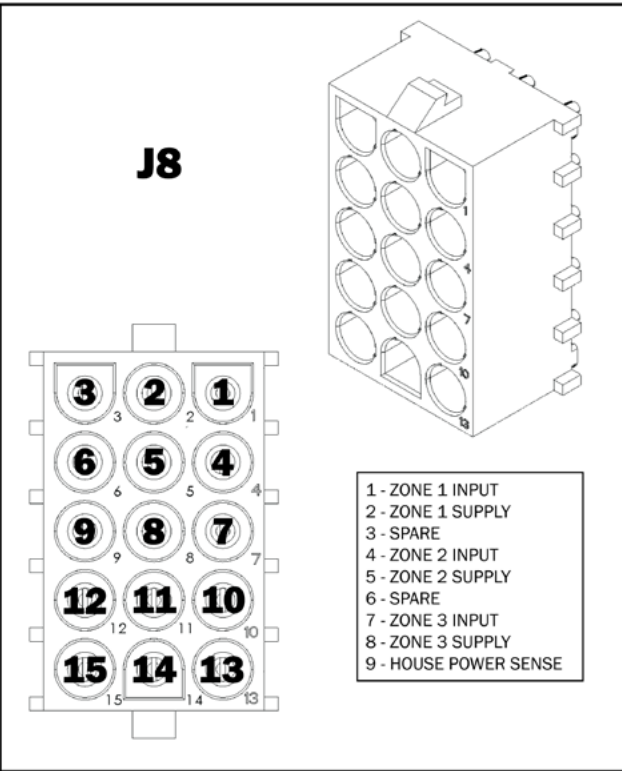
8. Locate the left and right high-limit thermostats and press the red center button on both thermostats to reset.
  - Test for continuity on both thermostats. Both should have continuity after reset. If one does not have continuity, follow the instructions on Page 26 to replace one or both.



**Figure 168**

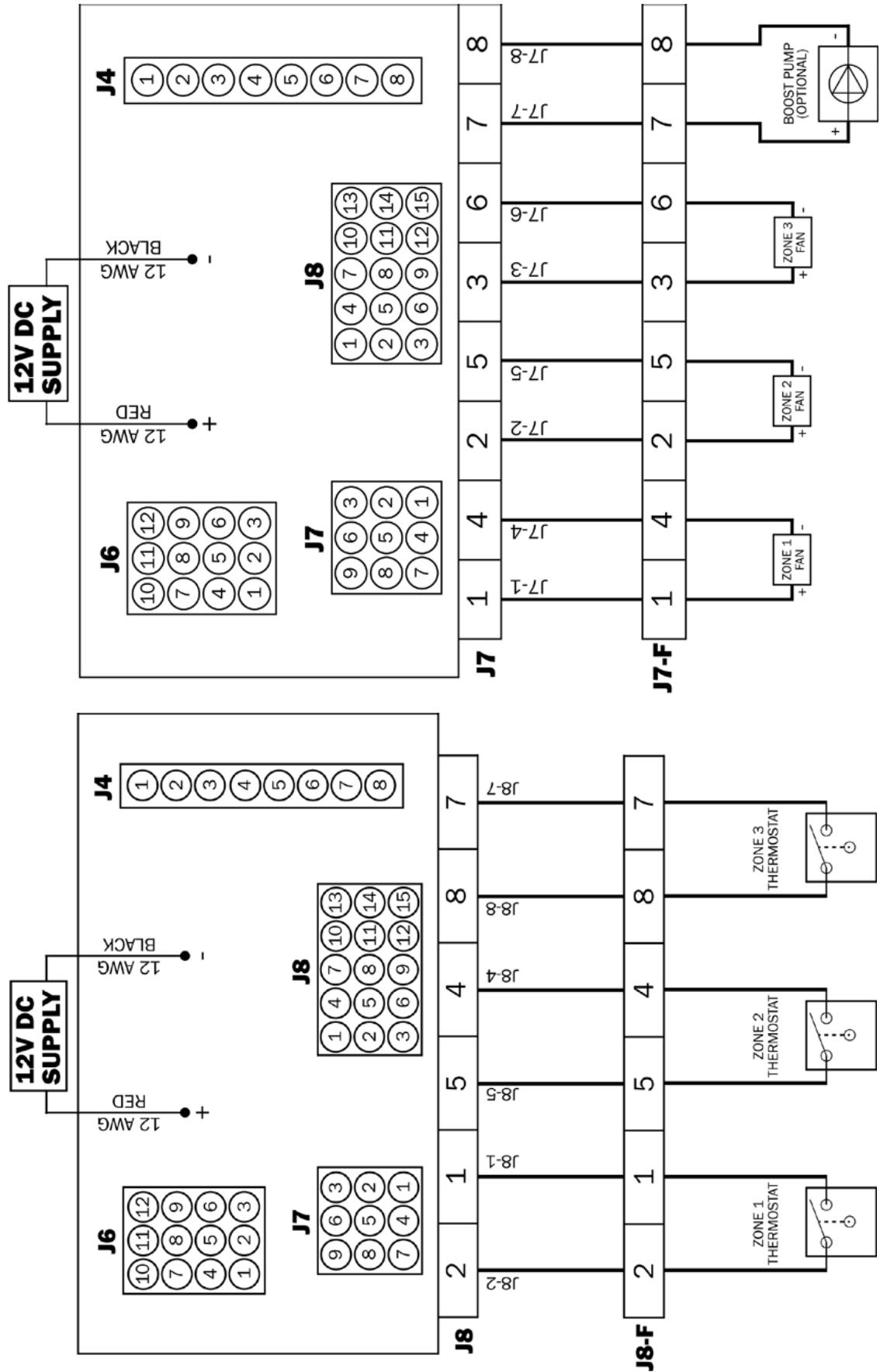
9. Check the ignition electrodes for functionality by following the directions on Page 59.
10. Troubleshoot the ignition coil referencing the procedure on Page 61.
11. Ensure that the flame sensor is functioning properly by completing the procedure on Page 57.

If at this stage the diesel burner is still not operational, contact technical support at 574-AIR-XCEL (574-247-9235) for assistance to diagnose and repair the diesel burner.

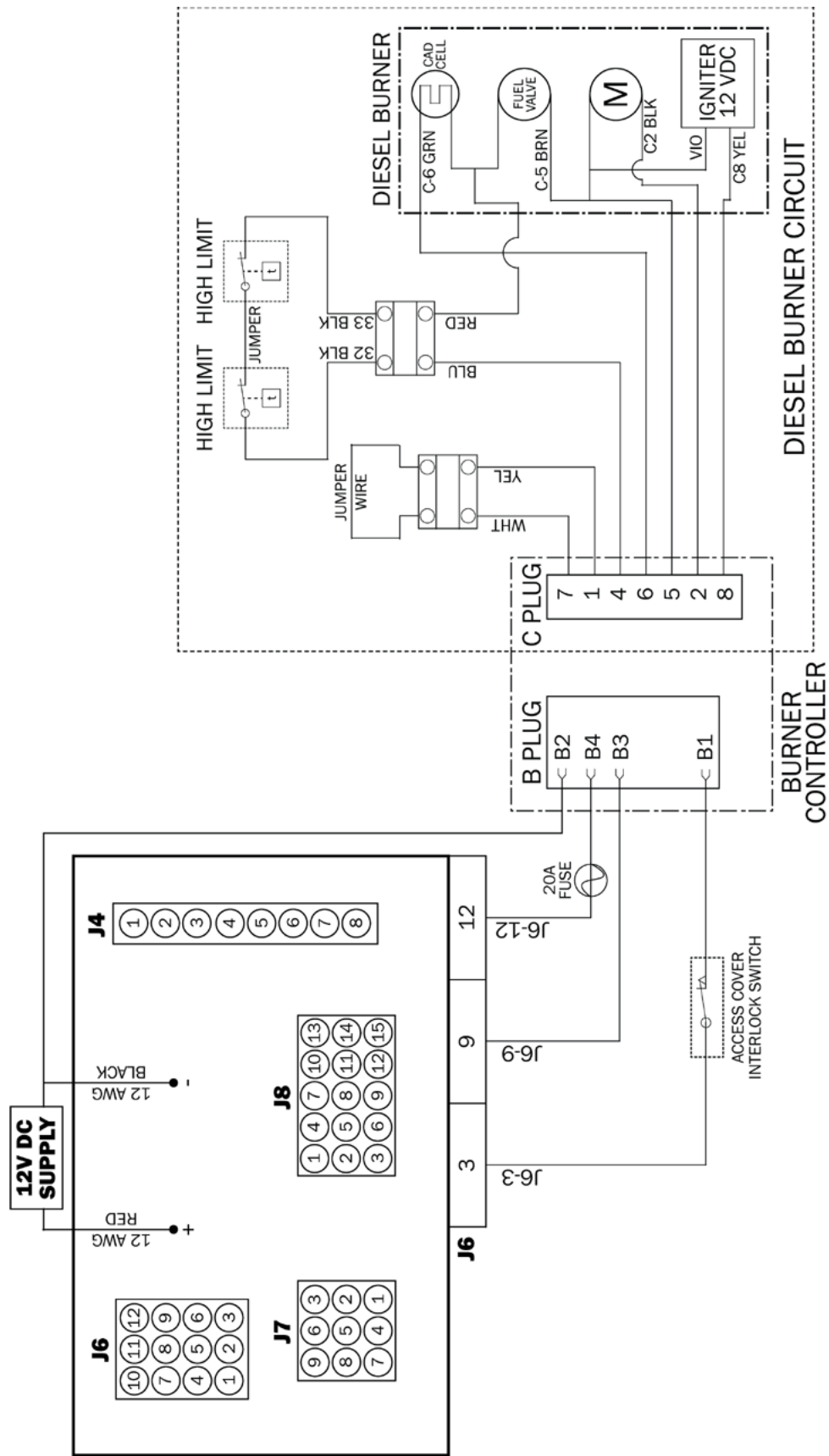
CONTROLLER PIN OUT REFERENCE			
<div>J6</div> 		<div>J7</div> 	
<div>J4</div> 		<div>J8</div> 	
PCB CONNECTOR DESIGNATION	HOUSING MANUFACTURER	HOUSING PART NUMBER	DC HARNESS MATING PART NUMBER (NOT PICTURED)
J4	TE CONNECTIVITY	641828-1	640582-1
J6	TE CONNECTIVITY	1-480708-0	350735-1
J7	TE CONNECTIVITY	1-480706-0	350720-1
J8	TE CONNECTIVITY	1-480710-0	350736-1

**NOTE:** All connectors are shown from Pin insertion side.

ZONE THERMOSTATS & ZONE HEAT EXCHANGERS

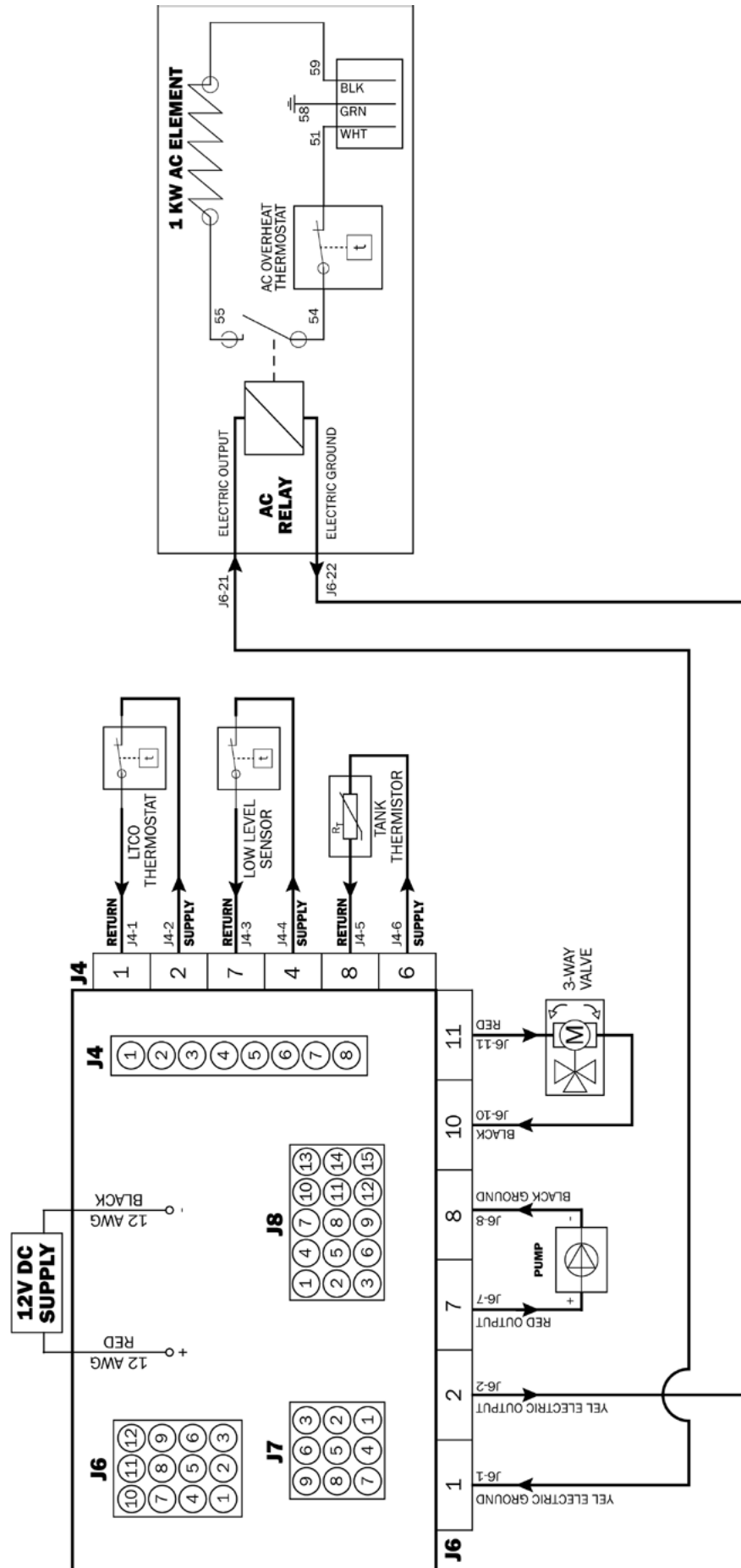


DIESEL BURNER

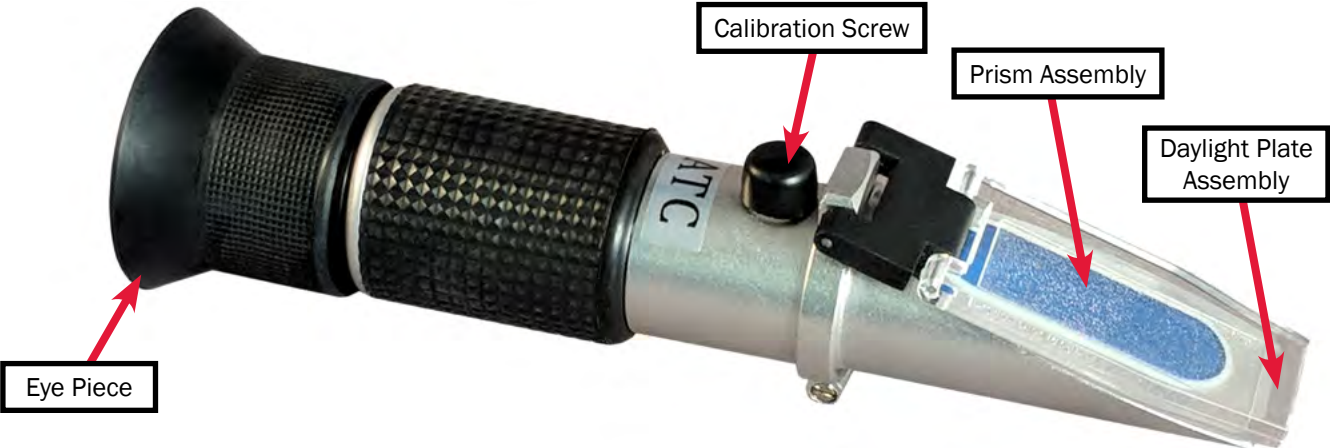




ELECTRIC ELEMENT, SENSORS, AND THERMOSTATS



Measuring Antifreeze Using a Refractometer

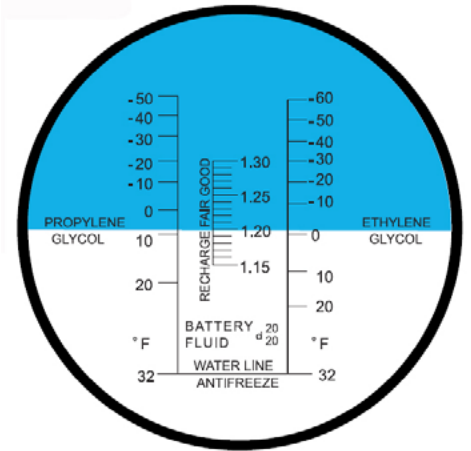


Properly Apply Antifreeze to the Prism Assembly

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.

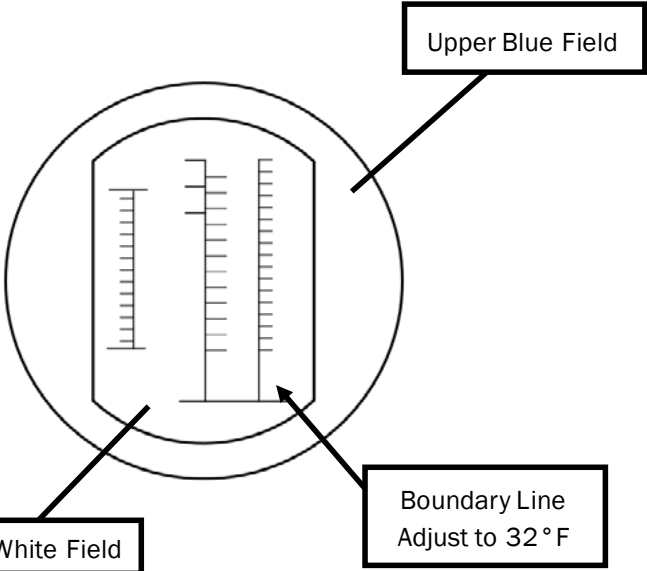
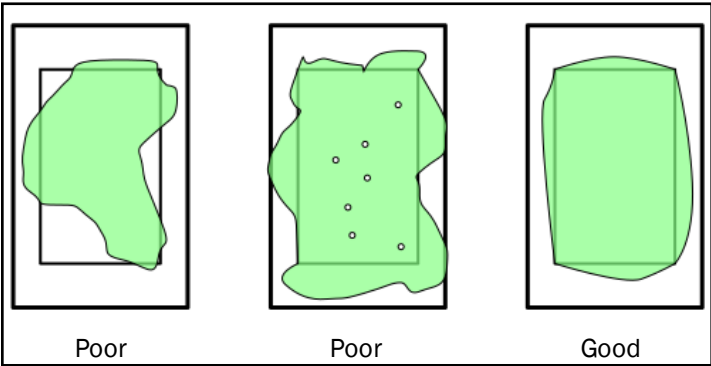
Adjust the Boundary Line

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



## 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

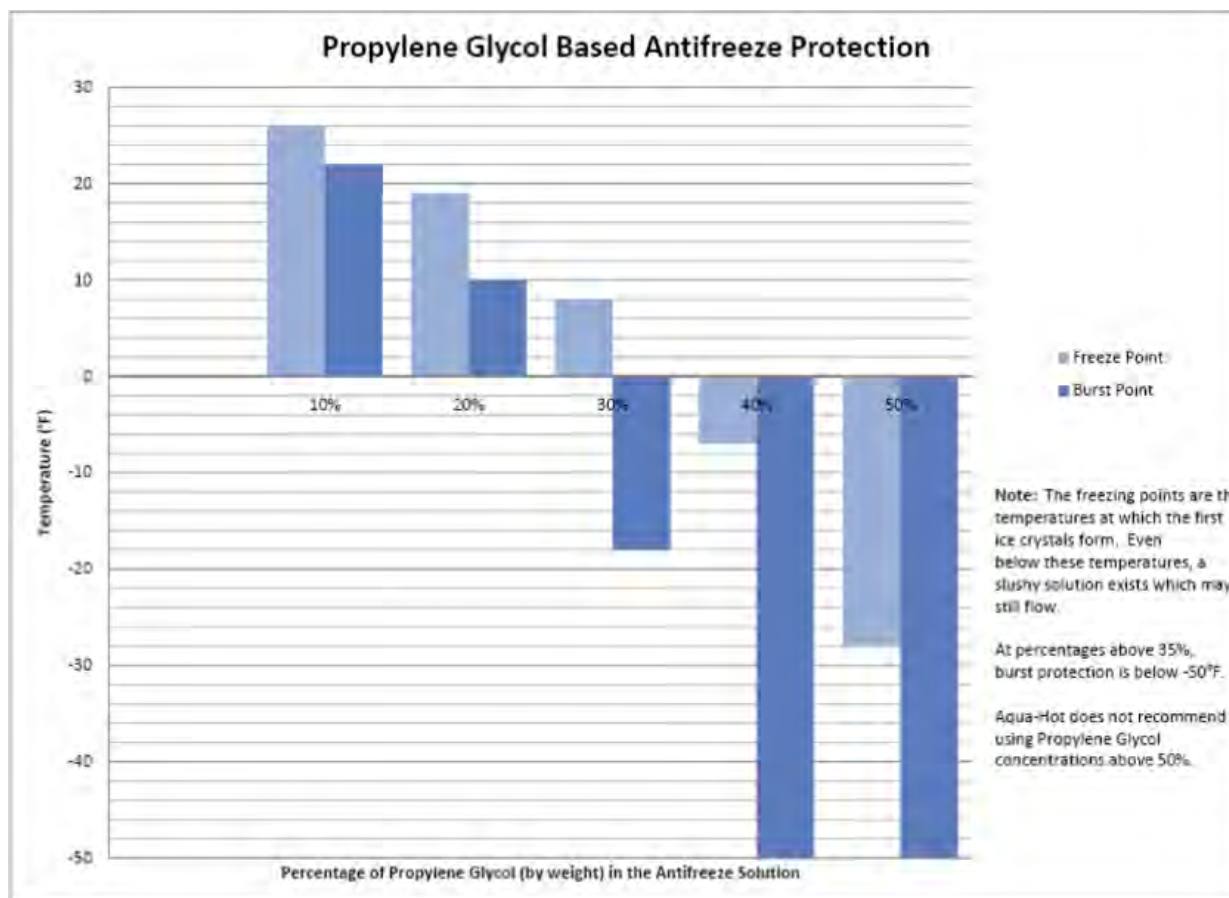
raised, resulting in less freeze protection. Please reference the attached graphical representation regarding the percentage of antifreeze to water and how it directly affects the solution's freezing point.

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 101 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
Concentration (%)	0	12	19	25	30	34	38	44	49	53	60

## DANGER

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







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

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

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

### **My Comfort Zones are On-Board**

Vehicle:

#### **Purchased From:**

Dealer Information:

Name:

Location:

Phone Number:

#### **Heating System:**

Serial Number:

Service Manual

# 200<sub>SERIES</sub>



AHE-250-D03



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

Visit us online at [www.aquahot.com](http://www.aquahot.com)  
Call us at 574-AIR-XCEL (574-247-9235).

©2022 Aqua-Hot Heating Systems, LLC. Printed in the USA