Aqua-Hot®

HYDRONIC HEATING SYSTEM

450 – DE/DM

OWNER'S MANUAL

TABLE OF CONTENTS

2-YEAR LIMITED WARRANTY
AQUA-HOT® HYDRONIC HEATING SYSTEM
AHE-450-DE/DM

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 specifically 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 (8:00 AM to 5:00 PM Mountain Standard Time) or visit www.aqua-hot.com.

This manual should be maintained in legible condition and kept in a safe, easily accessible place for future reference.

Please read the complete Owner's Manual prior to operating the Aqua-Hot Hydronic Heating System.

The Aqua-Hot Heating System is a Hydronic Heating System that provides interior zone heating where and when it is needed, as well as a continuous, on-demand supply of domestic hot water. Both heating features are accomplished by a 12 Volt-DC powered diesel-burner and a 120 Volt-AC powered electric heating element, which maintains the temperature of the Aqua-Hot's antifreeze and water heating solution.

Both the Aqua-Hot 450-DE and 450-DM heaters include a motoraide feature, which uses the circulation of the motorhome's engine to transport the antifreeze and water heating solution from the Aqua-Hot's boiler tank to the motorhome's warm engine and back to the boiler tank. Through this process, the boiler tank is kept heated, which reduces the time required to bring the tank to operating temperature.

The Aqua-Hot 450-DE also includes an engine preheat feature. This preheat feature provides an easy engine start-up whenever cool weather conditions are present. Be sure to reference Figures 1 through 4 for a complete component overview.

NOTE: This Aqua-Hot product utilizes a propylene glycol based antifreeze and water heating solution. This Propylene glycol based solution is a boiler type antifreeze that is "Generally Recognized as Safe" (GRAS) by the FDA. For additional information regarding this "GRAS" antifreeze product, reference the Appendices, contact the Aqua-Hot Heating Systems Technical Support Department at **1-800-685-4298**, or visit the Web site **www.aqua-hot.com**.

Danger, Warning, Caution, and Note Boxes:

Danger, Warning, Caution, and Note boxes appear throughout this manual as a means of alerting the operator to important information.

⚠ DANGER! ⚠

INDICATES THAT PERSONAL INJURY IS LIKELY OR IMMINENT.

WARNING!

Indicates that serious damage to the heater will occur and personal injury is possible as well.

CAUTION:

Indicates that damage to the heater is possible.

NOTE: Indicates information that requires special attention by the operator.

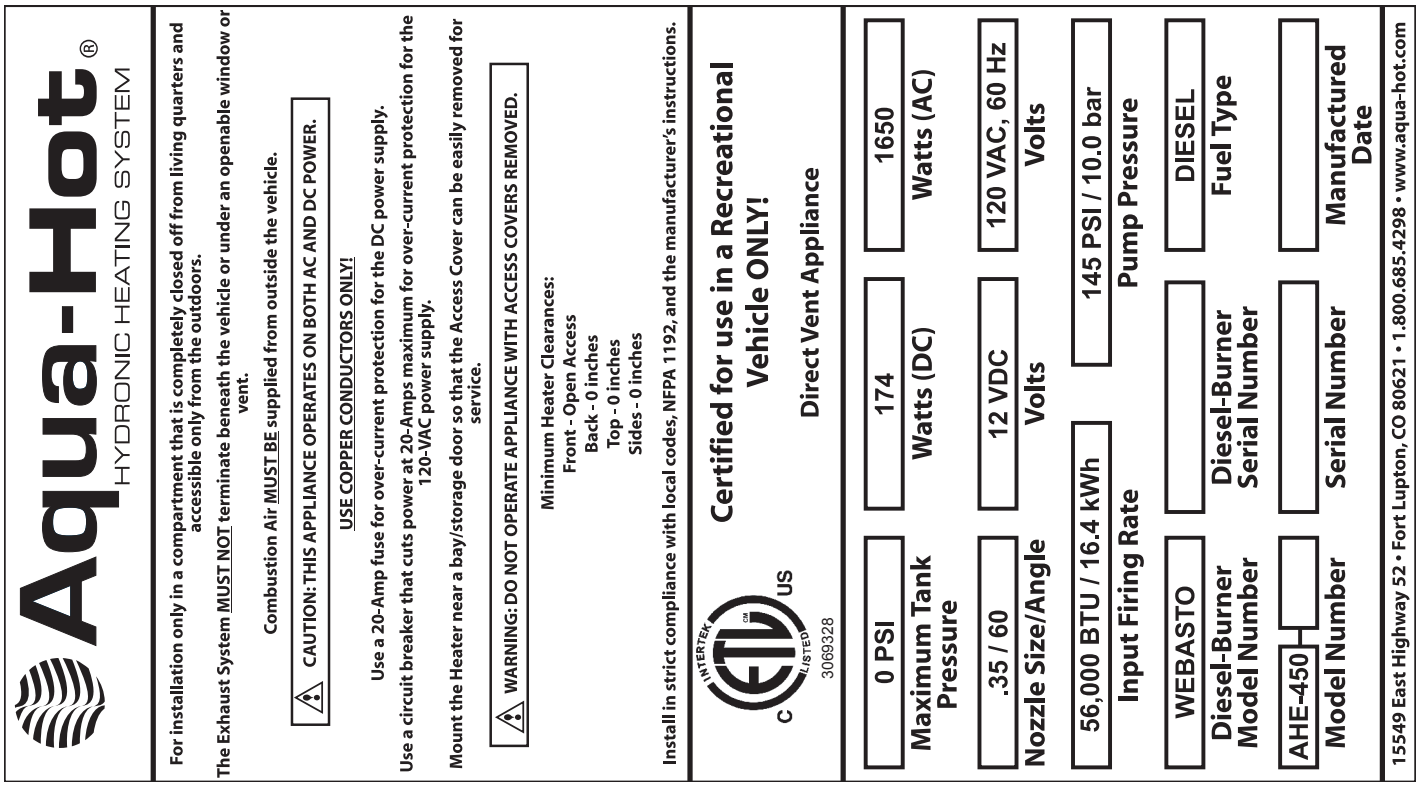


Figure 1

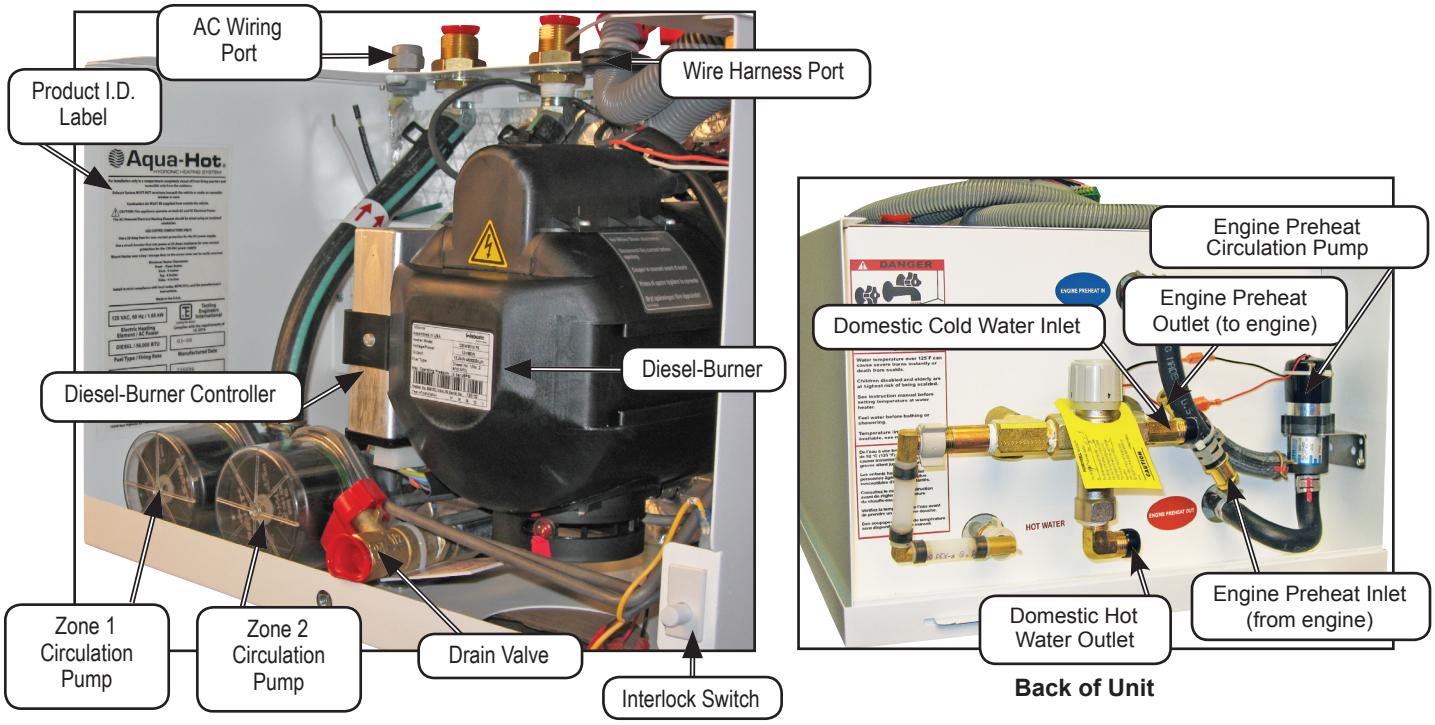


Figure 2

Top of 450-D

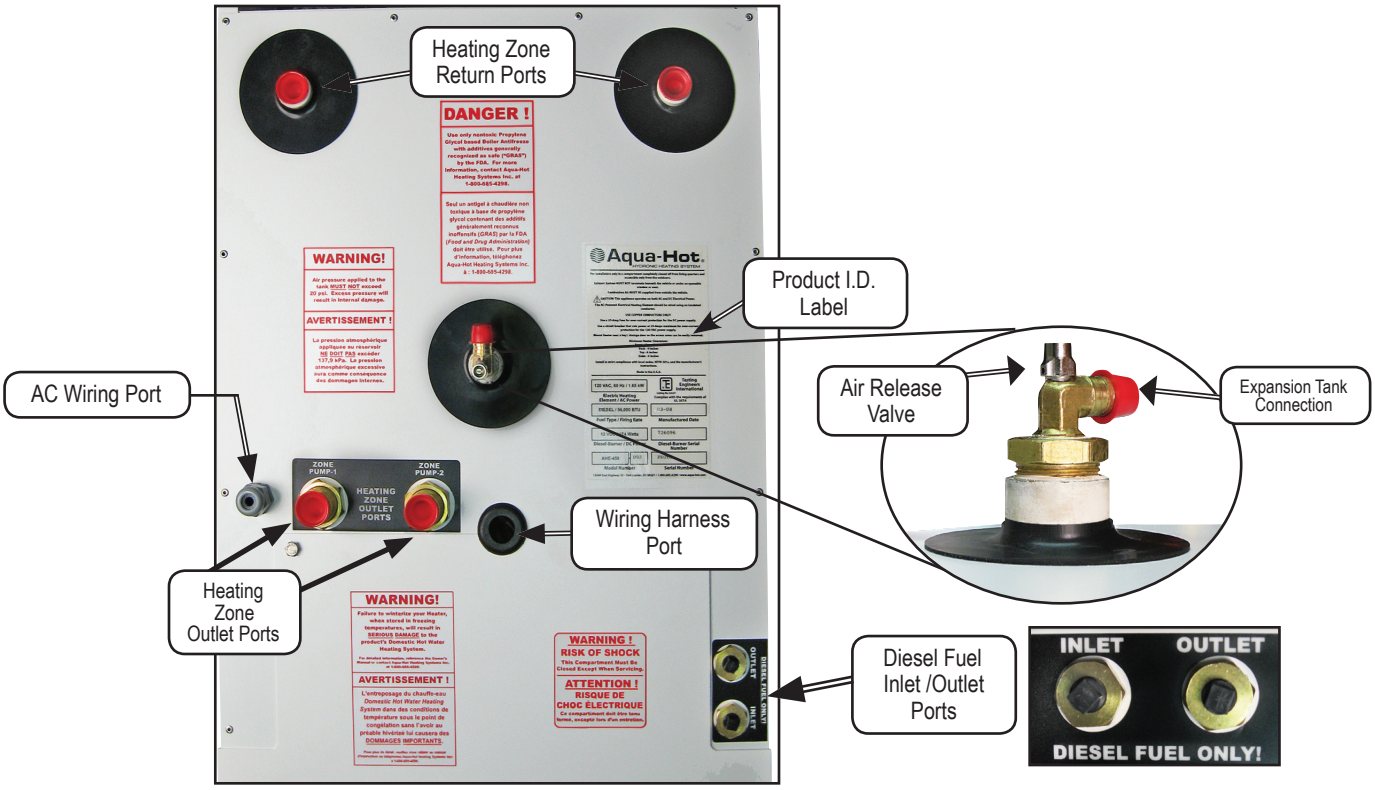


Figure 3

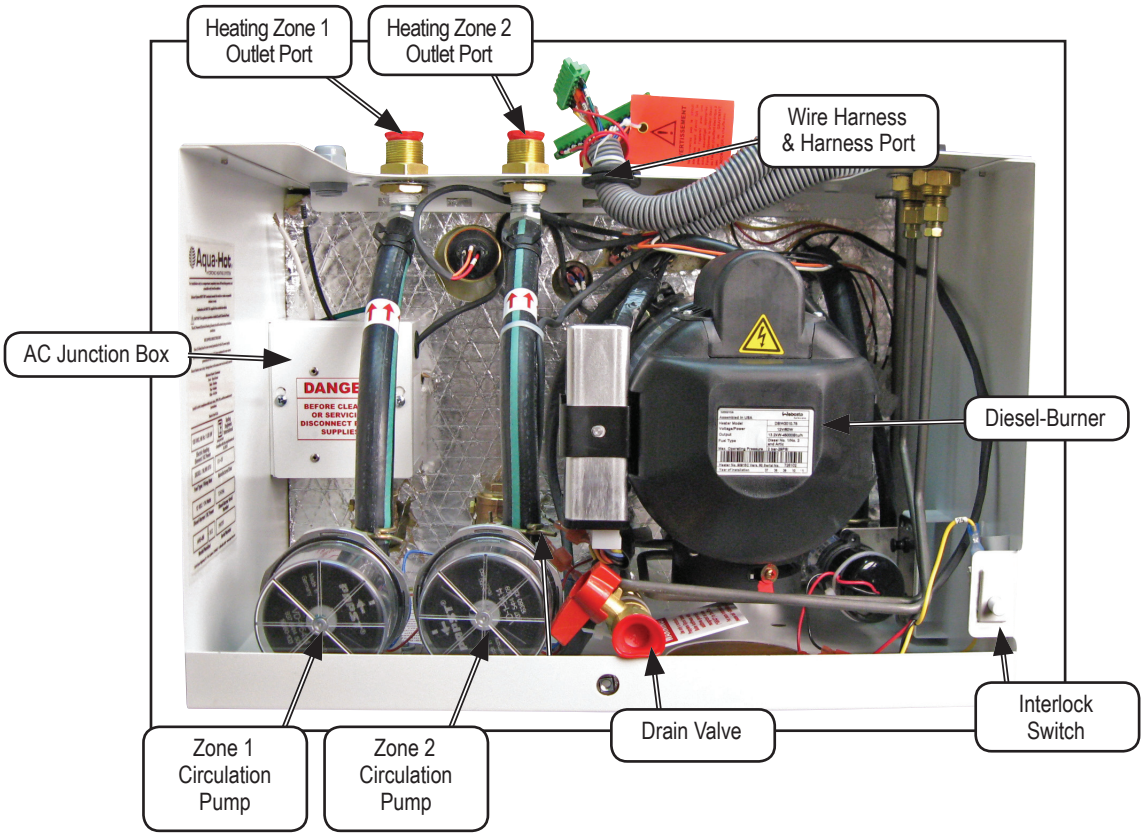


Figure 4

WARNING!

The Aqua-Hot's Exhaust is HOT!

DO NOT park in areas where dry conditions exist underneath the vehicle, (e.g., in a dry, grassy field) as a fire may result!

DO NOT operate the Aqua-Hot's diesel-burner inside an enclosed building!

The heater must be switched OFF when refueling.

CAUTION:

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

Activating the Aqua-Hot Heating System:

Diesel-Burner:

Turn the diesel-burner switch **ON.** Reference Figure 5. This procedure will activate the diesel-burner and the indicator light located on the diesel-burner switch. Allow 10-20 minutes for the Aqua-Hot System to reach operating temperature. Please note that the diesel-burner is the **primary heat source** for heating both the interior and the domestic hot water (such as when cool ambient temperatures exist and/or when there is a high demand for domestic hot water).

Electric Heating Element:

Turn the electric element switch **ON.** Reference Figure 5. This procedure will activate the 120 Volt-AC electric heating element and the indicator light located on the electric element switch. Allow 1-2 hours for the Aqua-Hot System to reach operating temperature.

NOTE: The motorhome must be connected to shore power, or the generator must be running, in order to activate the electric heating element.

The electric heating element is a **secondary heat source** for heating both the interior and 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).

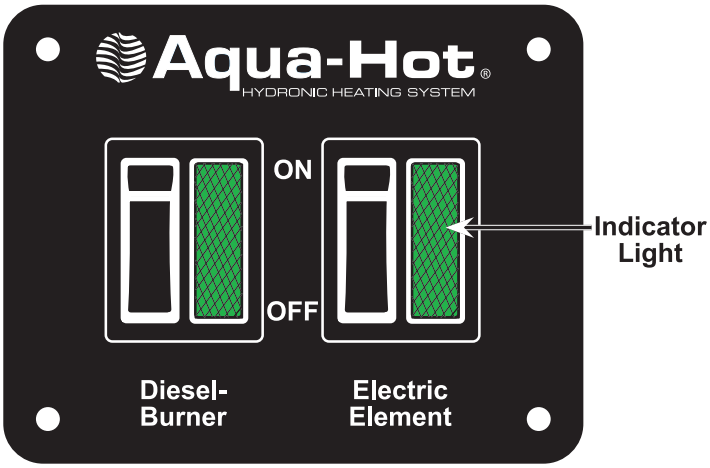


Figure 5

NOTE: Both the diesel-burner and the electric heating element are thermostatically controlled. Either, or both, heating sources will automatically maintain the temperature of the Aqua-Hot's antifreeze and water heating solution between approximately 160°F and 190°F (±5). Therefore, to heat the motorhome/domestic hot water, simply choose the desired heat source(s) and leave the switch(es) (i.e., diesel-burner and/or electric element) **ON**.

Zone Thermostat Operation

Interior Room Thermostat:

Simply adjust each interior room thermostat to the desired temperature. Then, whenever an interior room thermostat "calls for heat," the Aqua-Hot's circulation pump and interior heat exchanger fans will be activated. These devices, together, will supply warmth and comfort to each interior heating zone. The Aqua-Hot must be at operating temperature in order for the zones to function. Please contact the specific motorhome manufacturer for the exact location of the interior room thermostats.

Fresh Water Tank Thermostat:

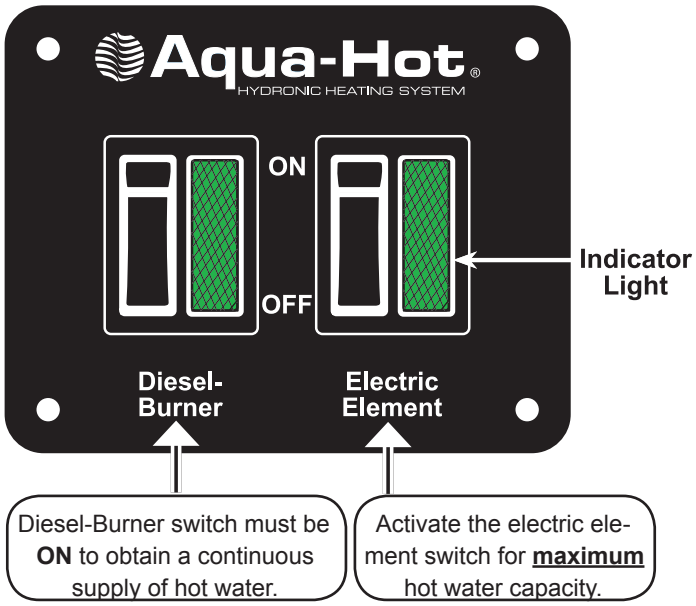
Simply adjust the thermostat for bay heating to a minimum of 40°F. This will prevent freezing of the domestic water storage system. Please contact the specific motorhome manufacturer for the exact location of the fresh water tank thermostat.

Using the Domestic Hot Water System

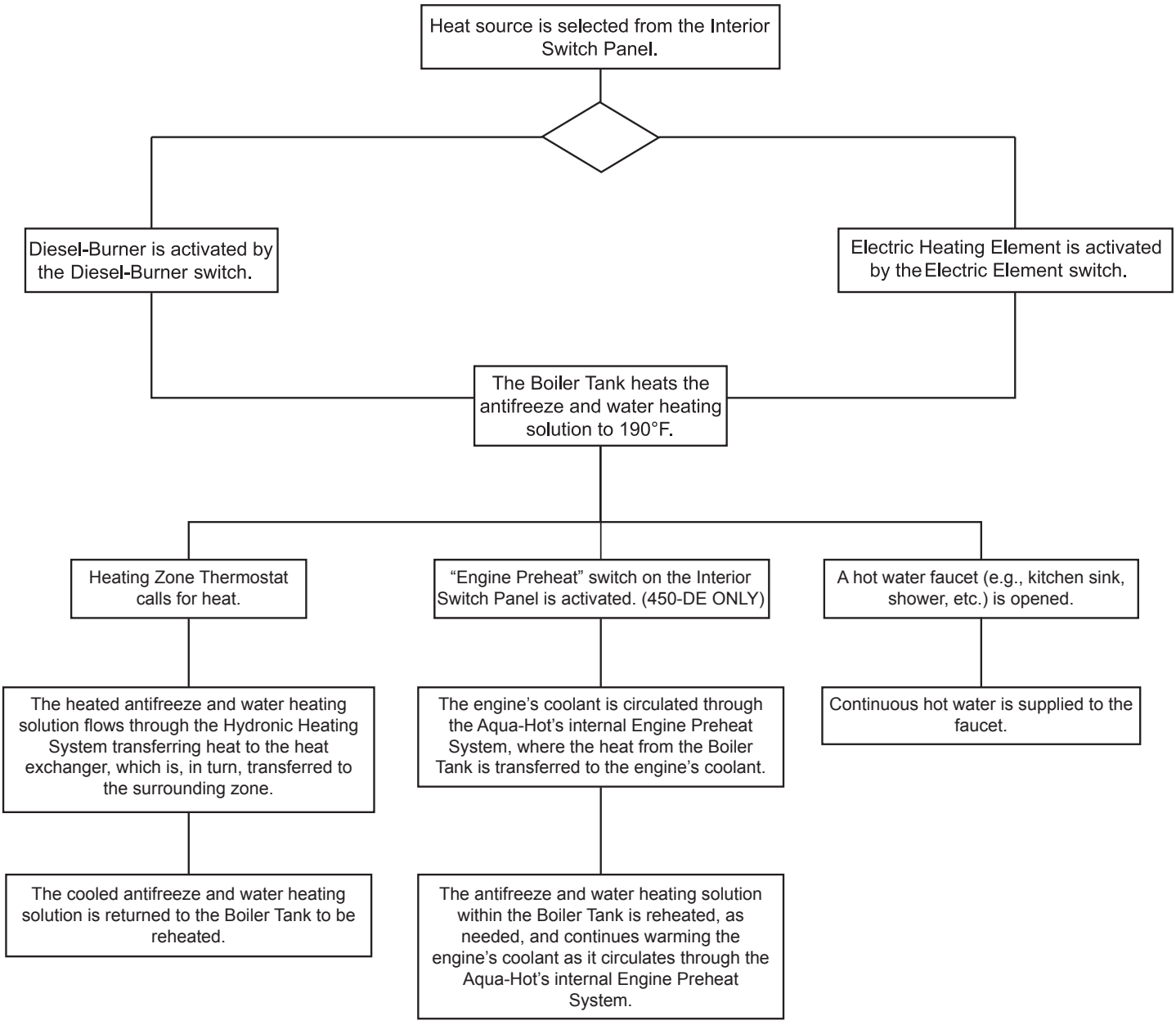
When the Aqua-Hot is at operating temperature, the domestic water is automatically heated as it is being used. Becayse the Aqua-Hot does not store any hot water, simply open any hot water faucet, and a continuous supply of domestic hot water will be present within a few seconds. This hot water feature is **continuous** and is accomplished by the Aqua-Hot's hot water heating system. The diesel-burner switch on the interior switch panel must be **ON** in order to obtain a continuous supply of hot water (e.g., during showers); be sure to also activate the electric element switch for **maximum** hot water capacity. Reference Figure 6.

NOTE: The Aqua-Hot's "Domestic Water Priority System" disables the interior zone heating fans and the zone circulation pumps whenever domestic hot water is being used on a continuous basis (e.g., during showers). Once the demand for continuous domestic hot water ceases, the Aqua-Hot will enable the fans and the pumps to operate and provide heat to the heating zones.

Figure 6



Aqua-Hot Operational Flow-Chart



⚠ DANGER! ⚠

When the Aqua-Hot is at maximum operating temperature, the coolant will be very HOT! If the Aqua-Hot's heating system is accessed, scalding by hot vapor or coolant could result!

Before cleaning or servicing, disconnect all power supplies!

WARNING!

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

Propylene Glycol that is "Generally Recognized As Safe" by the FDA must be utilized for the antifreeze and water heating solution.

NOTE: For additional information regarding this propylene glycol-based, boiler-type antifreeze that has been "Generally Recognized As Safe" by the FDA, please reference the Appendices, contact the Aqua-Hot Heating Systems Technical Support Department at **1-800-685-4298**, or visit the Web site at **www.aqua-hot.com**.

Maintenance Schedule

Monthly Maintenance:

Check the Aqua-Hot's antifreeze and water heating solution to ensure that it is at the proper level. This can be accomplished by visually checking the coolant level in the Aqua-Hot's expansion tank. Reference Figure 7. Please note that the coolant level should be checked **only** when the Aqua-Hot is at maximum operating temperature (i.e., immediately after the diesel-burner cycles OFF). When the Aqua-Hot is at maximum operating temperature, the antifreeze and water heating solution should be at the level marked "HOT" on the expansion tank.

Replenishing the Antifreeze and Water Heating Solution:

If the antifreeze and water heating solution needs replenishing, remove the expansion tank's cap and fill the expansion tank to the "HOT" level mark. When refilling, open the air release valve located on the expansion tank connection to release air pockets. Reference Figure 8. Hold the valve open until all air is released. If necessary, refill the expansion tank again. Be sure the valve is closed when finished by hand-tightening. Reference Appendices A through C to determine the correct ratio of antifreeze to water, the proper type of antifreeze, and the water quality recommendations for the Aqua-Hot Hydronic Heating System's antifreeze and water heating solution.

Figure 7

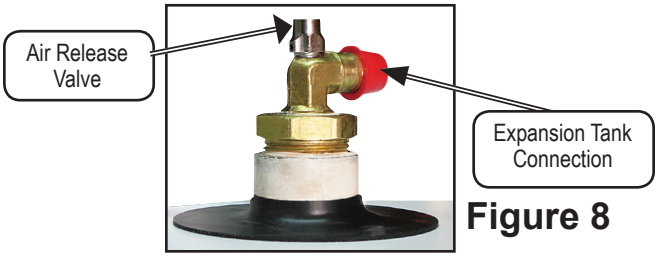


Figure 8

Annual Maintenance:

To keep the Aqua-Hot running smoothly, it is ideal to have the diesel-burner tuned-up annually. A tune-up should consist of a new fuel nozzle and fuel filter. Reference Figure 9. To ensure maximum diesel-burner performance, always use the recommended fuel nozzle and fuel filter when replacing these parts. Reference the Aqua-Hot's service and parts manual for spare parts information and detailed replacement instructions. Contact the Aqua-Hot Heating Systems Technical Support Department at **1-800-685-4298** for assistance or to locate the nearest Aqua-Hot Service Center or visit the web site at **www.aqua-hot.com.**

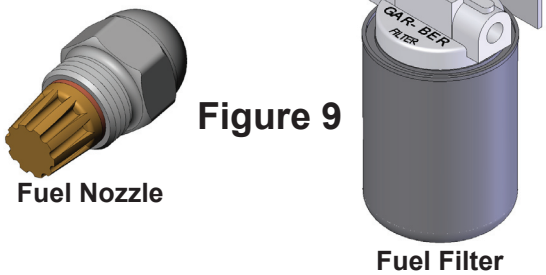


Figure 9

WARNING!

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 an 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.

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

Winterizing the Domestic Water Heating System:

Please follow these instructions when winterizing the Aqua-Hot's domestic water heating system. Reference Figure 10:

1. Completely drain the fresh water storage tank.
2. Disconnect the domestic water demand pump's suction line from the fresh water storage tank.
3. Attach an adequate piece of hose onto the suction side of the domestic water demand pump.
4. Place the opposite end of the hose into an adequate supply of FDA-approved "GRAS" RV Antifreeze.
5. Open and close all interior and exterior water faucets, one at a time, until only pure RV Antifreeze is present. Perform this procedure for both the hot and cold faucets.
6. Remove the hose and reconnect the domestic water demand pump's suction line to the fresh water storage tank.

De-Winterizing the Domestic Water Heating System:

For de-winterization, completely fill the fresh water storage tank. Open and close all interior and exterior water faucets, one at a time, until only clear water is present/visible. Reference Figure 10.

If disinfecting the potable water system after de-winterizing, be sure to follow RVIA's "**Instructions for Disinfection of Potable Water Systems on Recreation Vehicles**." These instructions can be obtained by contacting the Recreational Vehicle Industry Association at **(703) 620-6003**, visiting them online at **www.rvia.com**, or writing to them at the following address:

Recreation Vehicle Industry Association
1896 Preston White Drive
P.O. Box 2999
Reston, VA 20195-0999

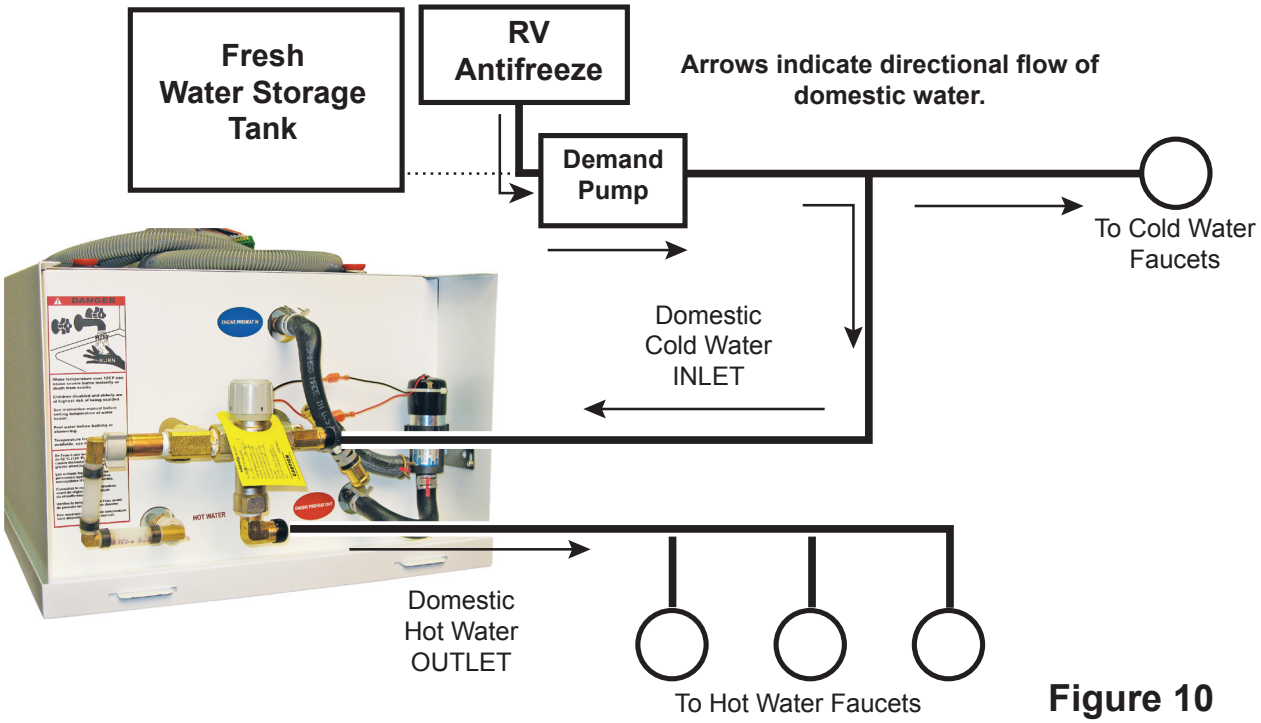


Figure 10

Remove the hose from the fresh water storage tank and attach an adequate piece of hose onto the suction side of the demand pump. Place this hose into a container of RV Antifreeze and allow this to pump through the domestic water system until the faucets run pure antifreeze.

General Information

Should the Aqua-Hot Hydronic Heating System fail to operate, complete the following checks:

1) Verify that the Aqua-Hot's access cover is securely installed. The Aqua-Hot Hydronic Heating System will not operate if the access cover is not fully installed.

2) Ensure that the vehicle's fuel tank contains a sufficient level of fuel. The Aqua-Hot system will not operate if the diesel fuel level is at or below 1/4 tank.

3) Ensure that the Aqua-Hot's boiler tank has an adequate supply of antifreeze and water heating solution by checking the level at the expansion tank. If the level is low, reference the "Maintenance" section of this manual for refilling instructions.

4) Check the Aqua-Hot's electronic controller for any RED lights indicating a fault condition.

If the Aqua-Hot Heating System's failure to operate is not resolved with the above checks, please contact Aqua-Hot Heating Systems Technical Support Department. at **1-800-685-4298** for additional assistance or visit the Web site at **www.aqua-hot.com**.

If the Aqua-Hot's diesel-burner switch "Indicator Light" does not illuminate, and the diesel-burner is not functioning, locate the electronic controller and check the following:

1) Check the Aqua-Hot's electronic controller for any RED lights indicating a fault condition. Reference Figure 11.

2) Check for loose wire connections on the electronic controller's terminal strips/plugs. When checking for loose terminal strips/plugs, remove the electronic controller faceplate by unscrewing the four cover screws.

3) Remove the Aqua-Hot's access cover and check for loose plug connectors on the diesel-burner controller unit. Reference Figure 2.

4) Ensure the vehicle's fuel tank has a sufficient level of fuel.

5) If the Aqua-Hot still fails to operate, please contact the Aqua-Hot Heating Systems Technical Support Department at **1-800-685-4298** for additional troubleshooting assistance of visit the Web site at **www.aqua-hot.com**.

Electronic Controller Diagnostic

Low Tank-Level Cutoff Indicator Light:

This indicator light will illuminate RED when either the 120 Volt-AC electric heating element and/or diesel-burner have automatically shut down due to a low antifreeze and water heating solution level inside the Aqua-Hot's boiler tank. This fault will automatically reset when the low level condition is corrected.

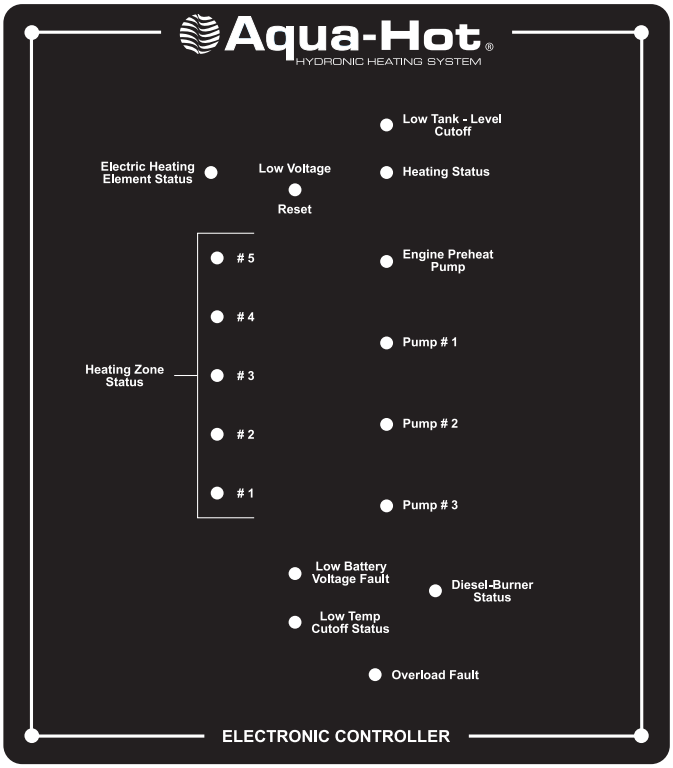
Low Battery Voltage Fault Indicator Light:

This indicator light will illuminate RED and the diesel-burner will shut down whenever the 12 Volt-DC voltage level is too low for the Aqua-Hot to operate properly. This fault must be manually reset after the voltage level has been restored to the 12 Volt-DC battery system. Reference the **Low Voltage** information below.

Low Voltage Fault Indicator Light and Reset Button:

The Aqua-Hot's electronic controller must be manually reset whenever the low battery voltage fault indicator light has been activated. The electronic controller can be reset by turning **OFF** the diesel-burner switch on the interior switch panel for approximately 30 seconds, then turning the switch back **ON**

Figure 11



or by pressing the "Low Voltage Reset" button located on the electronic controller (use a thin, straight, nonmetallic object to access the reset button through the small hole in the faceplate).

Overload Fault Indicator Light:

This indicator light will illuminate RED whenever one of the following conditions have occurred:

1) The Aqua-Hot is off due to an electrical overload (i.e., short) in the main 12 Volt-DC power supply circuitry.

2) The Aqua-Hot is off due to a combination of high electrical 12 Volt-DC power loads and a high surface temperature of the electronic controller.

The Aqua-Hot will automatically restart once the electrical overload (i.e., short) and/or high-heat condition is corrected.

Heating Zones Status Indicator Lights:

These five indicator lights (separately) will illuminate GREEN whenever a zone thermostat, for each particular zone, is calling for heat. The GREEN indicator lights also indicate that 12 Volt-DC power is being supplied to the particular interior heating zone's heat exchangers (i.e., fan motors). If any of the five indicator lights illuminate RED, it indicates that an electrical overload condition (i.e., short) has occurred in a particular heating zone's circuitry.

NOTE: The low temp cutoff light must be illuminated and heater must be up to operating temperature.

A short in either a heating zone's interior room thermostat or a heating zone's heat exchanger circuit will cause the indicator light to illuminate RED.

Pumps #1, #2, and #3 Indicator Lights:

These indicator lights (separately) will illuminate GREEN whenever a circulation pump is operating. If any of the three indicator lights illuminate RED, it indicates that an electrical overload condition (i.e., short) has occurred in the particular component's circuitry.

NOTE: Zone circulation pumps #1 and #2 are activated whenever a zone thermostat calls for heat. The #3 boiler tank stir pump is activated whenever the domestic water is being used on a continuous basis or the heater is not up to operating temperature.

Engine Preheat Pump Indicator Light:

This indicator light will illuminate GREEN whenever the engine preheat circulation pump is operating. Please note that this light will only be active if the engine preheat switch is **ON** in conjunction with either the diesel-burner and/or the electric element switch. If this indicator light illuminates RED, it indicates an electrical overload condition (i.e., short) has occurred in this particular component's circuitry.

NOTE: The Aqua-Hot must be up to operating temperature and the **Low Temp Cutoff Light** must be illuminated.

Heating Status Indicator Light:

This indicator light will illuminate GREEN whenever the Aqua-Hot's VDC/VAC control thermostat is calling for heat, allowing the antifreeze and water heating solution in the Aqua-Hot's boiler tank to be heated by either the diesel-burner and/or the electric heating element. When this indicator light is off, no heat is being supplied to the Aqua-Hot's boiler tank by either of these two heat sources.

NOTE: The Aqua-Hot's VDC/VAC Control Thermostat will automatically activate the diesel-burner and/or the electric heating element **only** if the diesel-burner and/or electric element switch is in the **ON** position.

Electric Heating Element Status Indicator Light:

This indicator light will illuminate GREEN whenever the Aqua-Hot's electric heating element is operating and providing heat to the Aqua-Hot's boiler tank. Please note that this light will only be active if the electric element switch is in the **ON** position. If this indicator light illuminates RED, it indicates an electrical overload condition (i.e., short) has occurred in the electric heating element's **12 Volt-DC** powered circuitry.

Antifreeze Types

APPENDIX A: ANTIFREEZE TYPES

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

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

Automotive Antifreeze/Coolant:

These types of propylene glycol based antifreeze products are formulated specifically to protect automotive engines against corrosion, freezing temperatures, and overheating. They also have excellent heat transfer and thermal conductivity characteristics. Although these types of antifreeze products are considered less toxic and safer than ethylene glycol for people, pets, and the environment, they are not "Generally Recognized as Safe" (GRAS) rated by the FDA. Therefore, they must be marked with a "harmful if swallowed" warning. This additional warning is required because these types of antifreeze products contain high levels of chemical rust inhibitors. Due to their potentially hazardous properties, they should never be used in the Aqua-Hot's Hydronic Heating System.

Appendix B

Antifreeze Mixture Water Quality Recommendations

APPENDIX B: ANTIFREEZE MIXTURE WATER 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, de-ionized, 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 pre-mixed antifreeze are responsible for the use of high-quality (distilled, de-ionized, 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, de-ionized, or soft water which is 80 ppm 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.

Appendix C

Antifreeze Terms and Mixture Ratio

APPENDIX C: ANTIFREEZE TERMS AND MIXTURE RATIO

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

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

Freeze Point and Burst Point:

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

Boiling Point:

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

Rust and Anti-Corrosive Inhibitors:

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

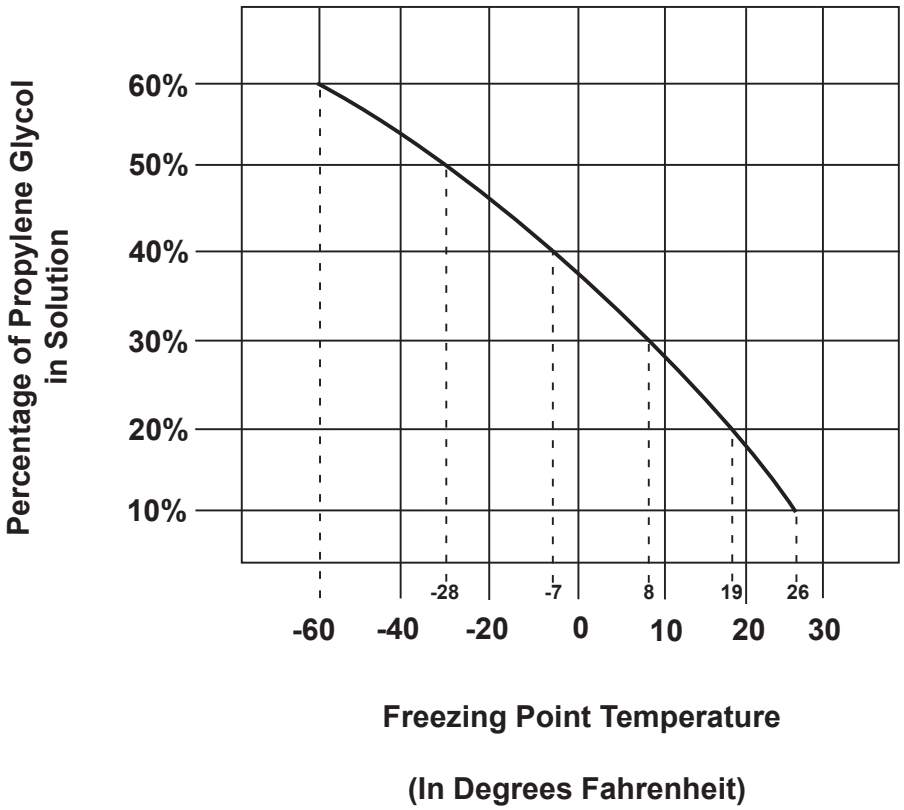
Summary:

Antifreeze has three basic functions: freeze protection, boil-over protection, and anti-corrosion and rust protection.

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

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

APPENDIX C: ANTIFREEZE TERMS AND MIXTURE RATIO



OWNER'S SERVICE LOG:

Date	Service Performed	Service Center

(Continued) # OWNER'S SERVICE LOG:

Date	Service Performed	Service Center

Aqua-Hot®
HEATING SYSTEMS INC.
Formerly Vehicle Systems Inc.

15549 East Highway 52 • Fort Lupton, Colorado 80621
1.800.685.4298 • Fax: 303.857.9000 • www.aqua-hot.com