



INSTALLATION MANUAL

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Aqua-Hot Hydronic Heating System

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Introduction to the Aqua-Hot 600-D:

This installation manual is designed to aid in the installation process of the Aqua-Hot 600-D Hydronic Heating System by a trained and experienced installer. The Aqua-Hot features a 12 Volt-DC powered diesel-burner and two 120 Volt-AC, 2000 Watt electric heating elements. These heating sources are used in conjunction with an FDA-approved “GRAS” (Generally Recognized As Safe) propylene glycol based boiler antifreeze and water heating solution in order to provide a continuous supply of domestic hot water, interior/fresh water tank heating, independent interior zone heating, motoraide, and engine preheating. Be sure to reference Figures 1 through 5 for a complete component overview.

Please note that all Danger, Warning, Caution, and Note boxes, appearing as needed throughout this manual, must be reviewed and adhered to during the installation procedure in order to avoid potential hazards, which could result in injury, death, product damage, or property damage.

Should additional assistance be needed, please contact the Product Application Department at 1-800-685-4298, Monday through Friday, between the hours of 8:00 AM and 5:00 PM Mountain Standard Time.

Danger, Warning, Caution, and Note Boxes:

Danger, Warning, Caution, and Note boxes appear throughout this manual as a means of alerting the installer 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 installer.

Aqua-Hot Hydronic Heating System



Figure 1

Diesel-Burner, Heat Input (Firing Rate)	56,000 BTU/hr.
Diesel-Burner, Fuel Consumption (Continuous Operation)	0.40 gal/hr.
Heater, Voltage/Maximum Power Consumption	12 Volt-DC/60 watts
Electric Heating Element specifications.	(2) 120 Volt-AC/2000 watts
Zone Heat Circulation Pump specifications.	(3) 12 Volt-DC/21 watts each
Number of Heating Zones	maximum of 5, plus Engine Preheat
Domestic Water Heating Capacity.	continuous/on-demand
Dimensions	18.5"H x 18.5"W x 36.75"L
Dry Weight.	approximately 186 lbs.
Wet Weight	approximately 303 lbs.

Aqua-Hot Hydronic Heating System

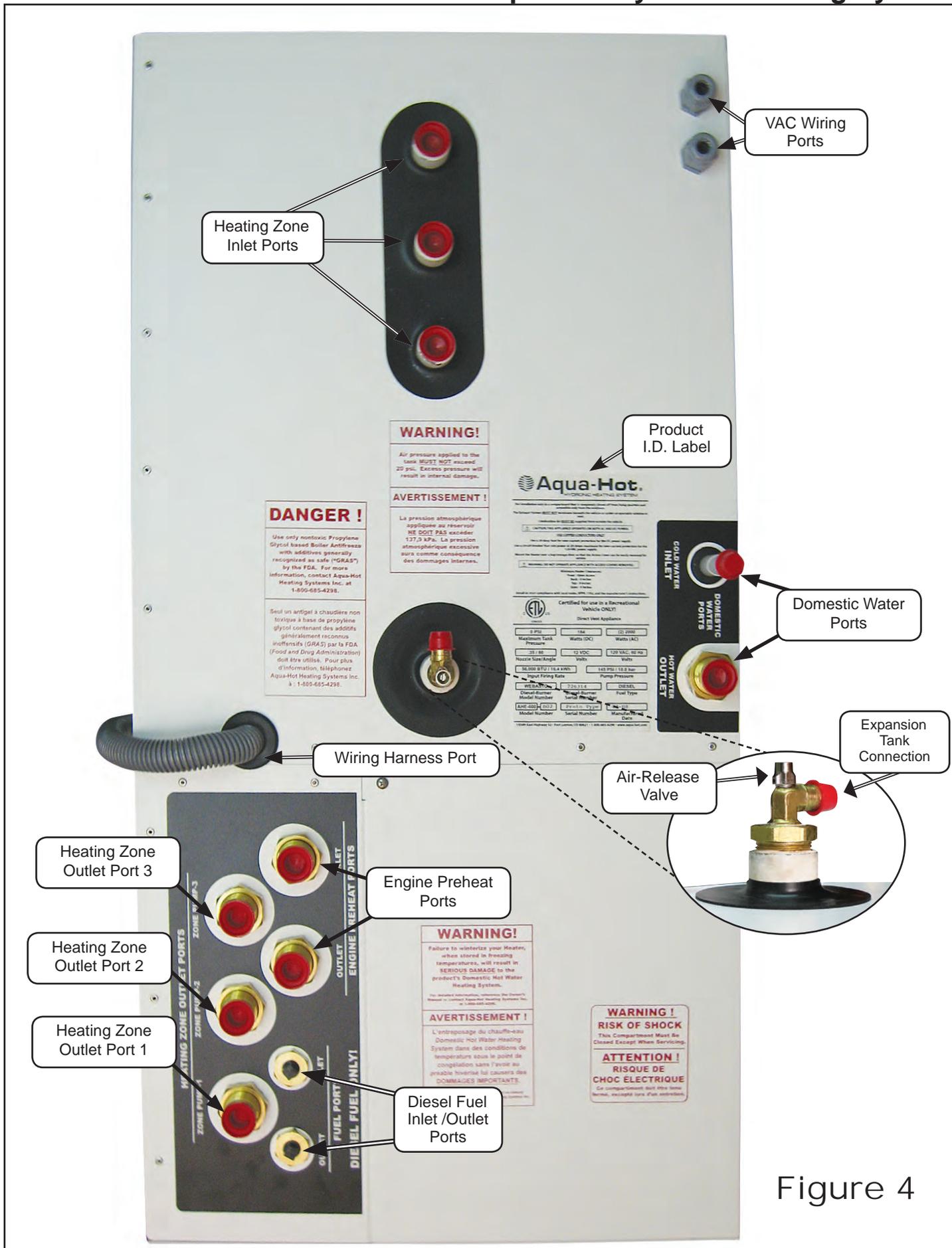


Figure 4

Aqua-Hot Hydronic Heating System

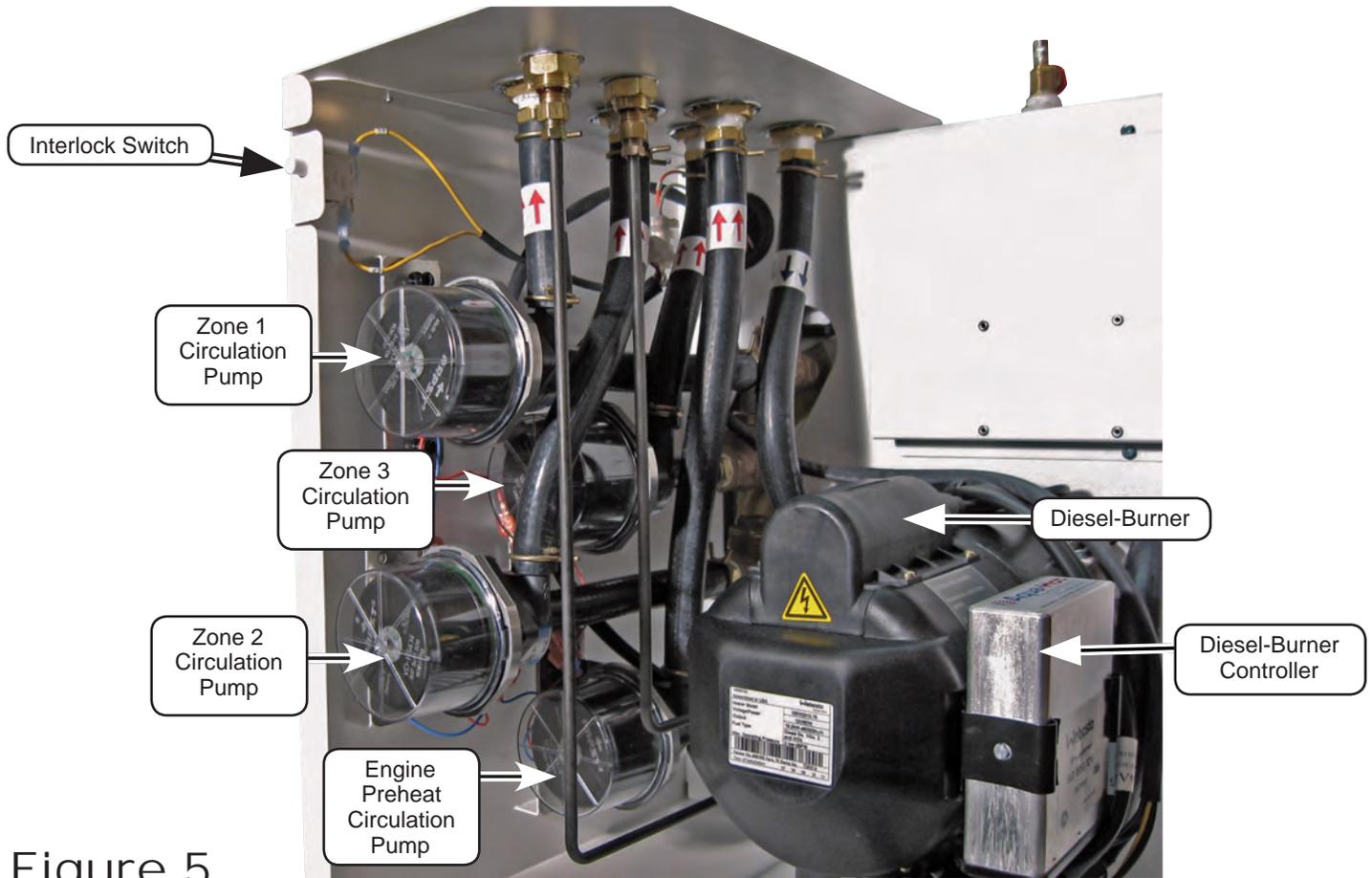
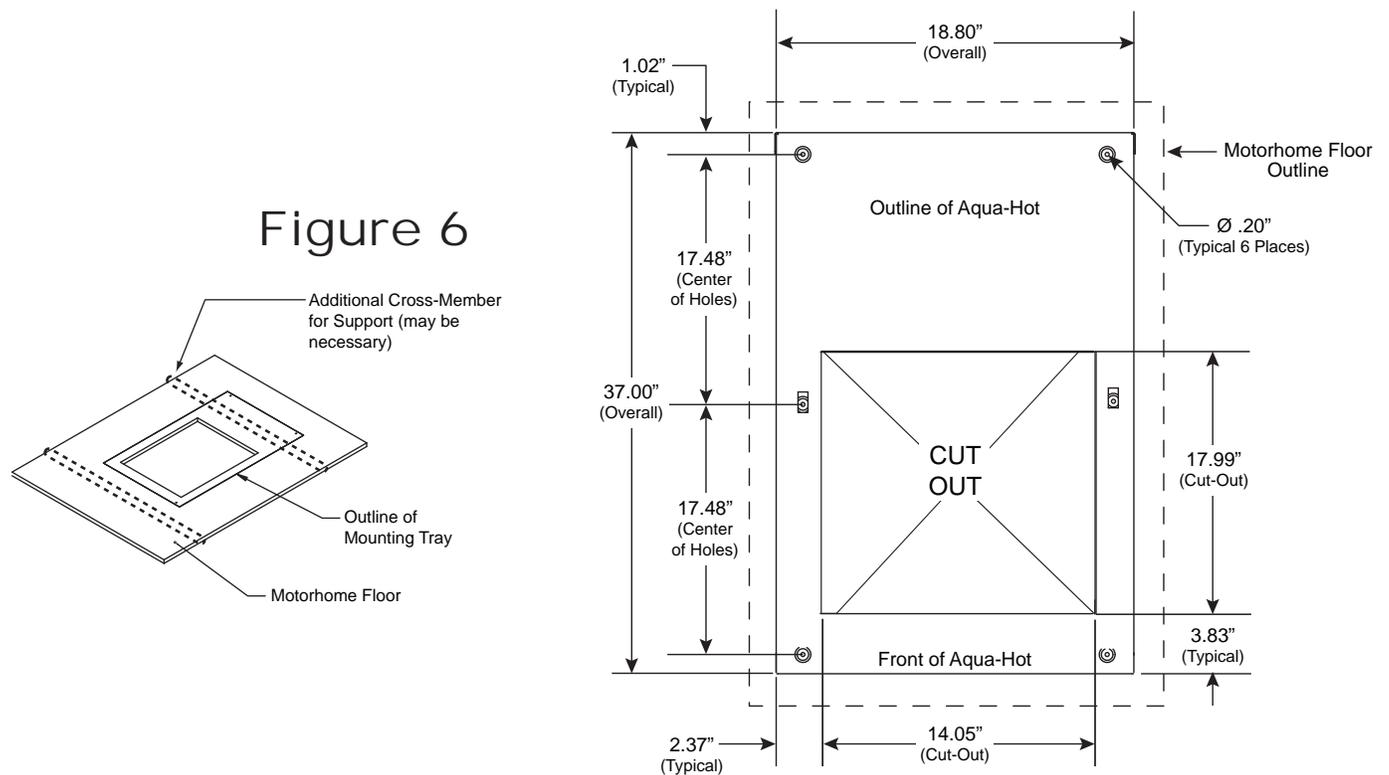


Figure 5



NOTE: All measurements are in inches.

Section 1: Aqua-Hot Installation

Installing the Mounting Tray and the Aqua-Hot:

1. Reference the following illustrations for mounting information:
 - Overall Aqua-Hot dimensions - Figure 8
 - Mounting tray information - Figure 6
 - I.D. Label noting the “Open Access” clearance requirement for the front of the heater - Figure 2
 - Service access clearances - Figure 7
2. Cut out the required mounting tray opening. Reference Figure 6.
3. Install the mounting tray flange into the cut-out opening. Reference Figure 6.

NOTE: Be sure to secure the mounting tray into place prior to installing the Aqua-Hot.

Be sure to mount the Aqua-Hot securely into the mounting tray to ensure that the unit does not move or shift under normal operating conditions.

Be sure the access cover fastener is removed from the Aqua-Hot prior to placement into the installed mounting tray. Reference Figure 9.

Be sure to provide an adequate support system for the mounting tray; if adequate support is not present, a cross-member will need to be installed. Reference Figure 6.

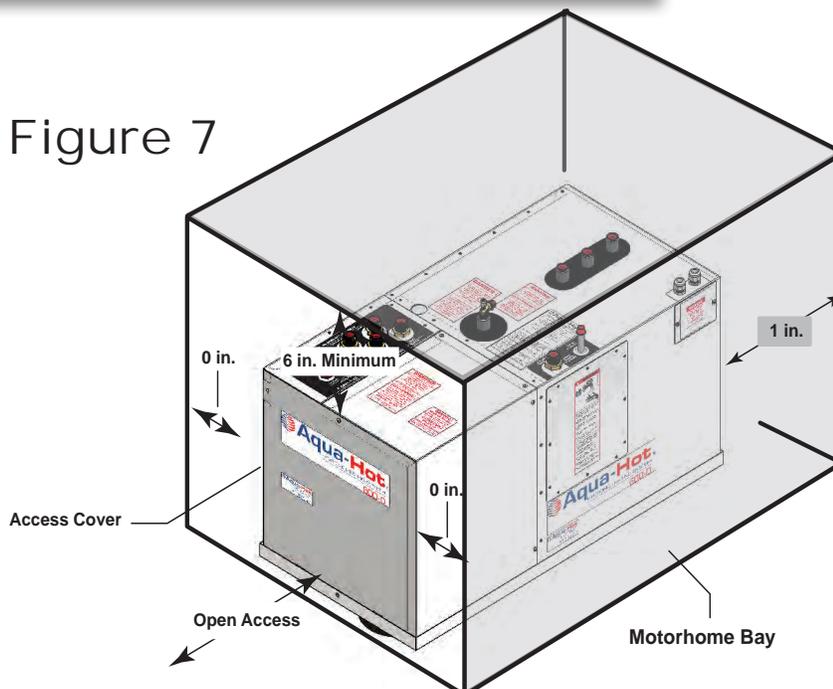
Inspect the area beneath the mounting location to insure no structural members will interfere with the cut-out for the mounting tray.

4. Insert a #10 machine screw into each of the embossed holes in the mounting tray (total of six required) and tighten to secure the mounting tray to the motorhome. Reference Figure 6.
5. Place the Aqua-Hot into the mounting tray. Reference Figure 10.
6. Install the combustion-air sleeve onto the diesel-burner’s air intake. Reference Figure 8.
 - A) Slide the end of the combustion-air sleeve with the clamp up through the mounting tray and underside of the Aqua-Hot unit.
 - B) Loosen the adjustable clamp and slide over the diesel-burner’s air intake.
 - C) Tighten the clamp to secure the sleeve to the diesel-burner.
7. Re-install the access cover fastener and tighten once the total installation procedure is complete.

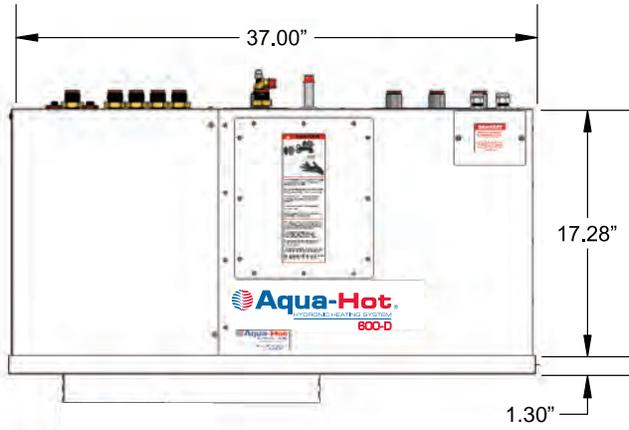


Figure 8

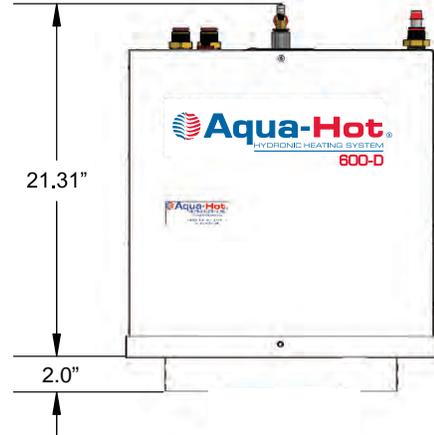
Figure 7



Section 1: Aqua-Hot Installation



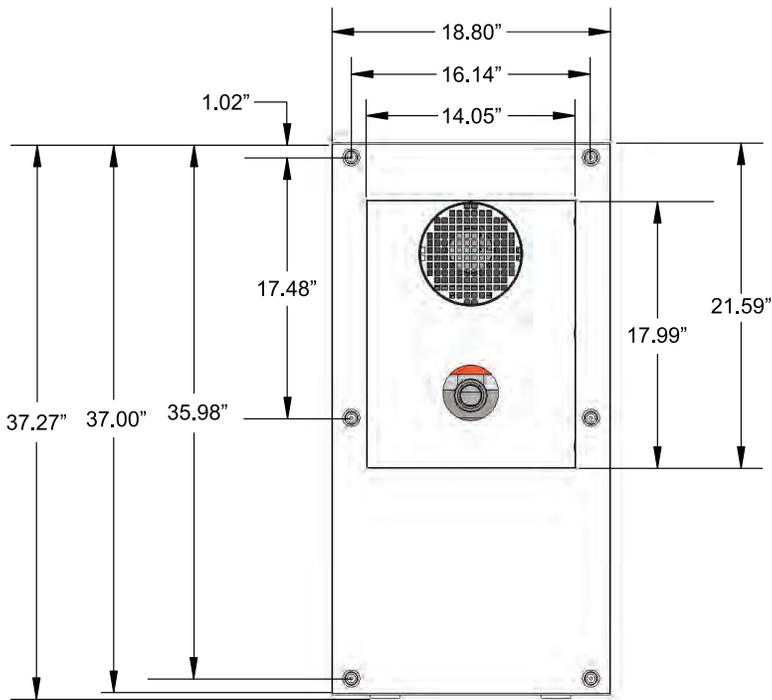
Side View



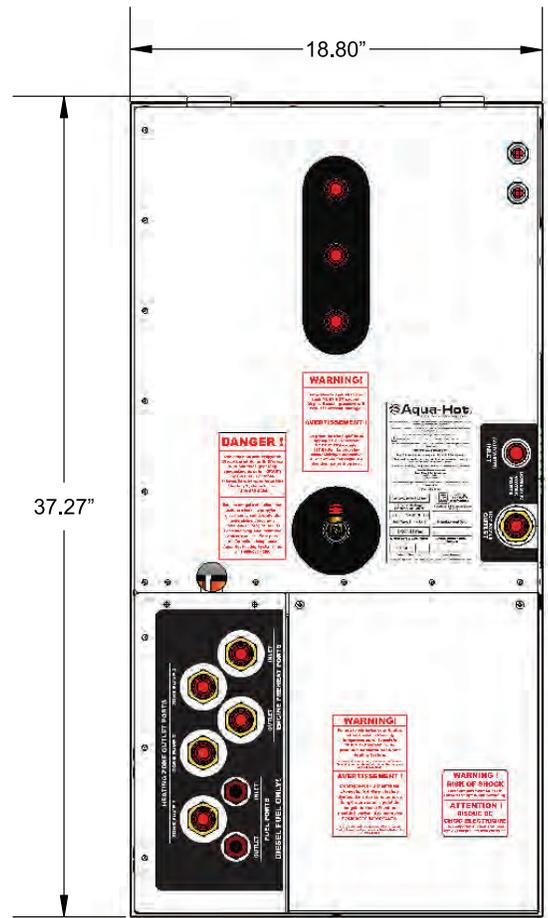
Front View

NOTE: All measurements are in inches.

Figure 9



Bottom View



Top View

Section 1: Aqua-Hot Installation

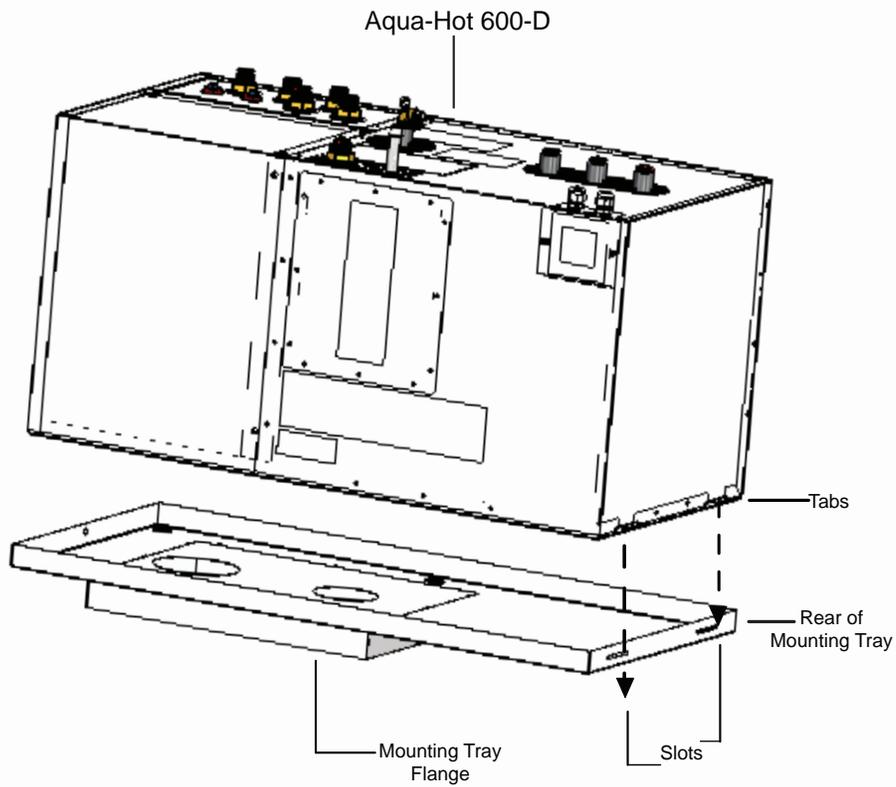
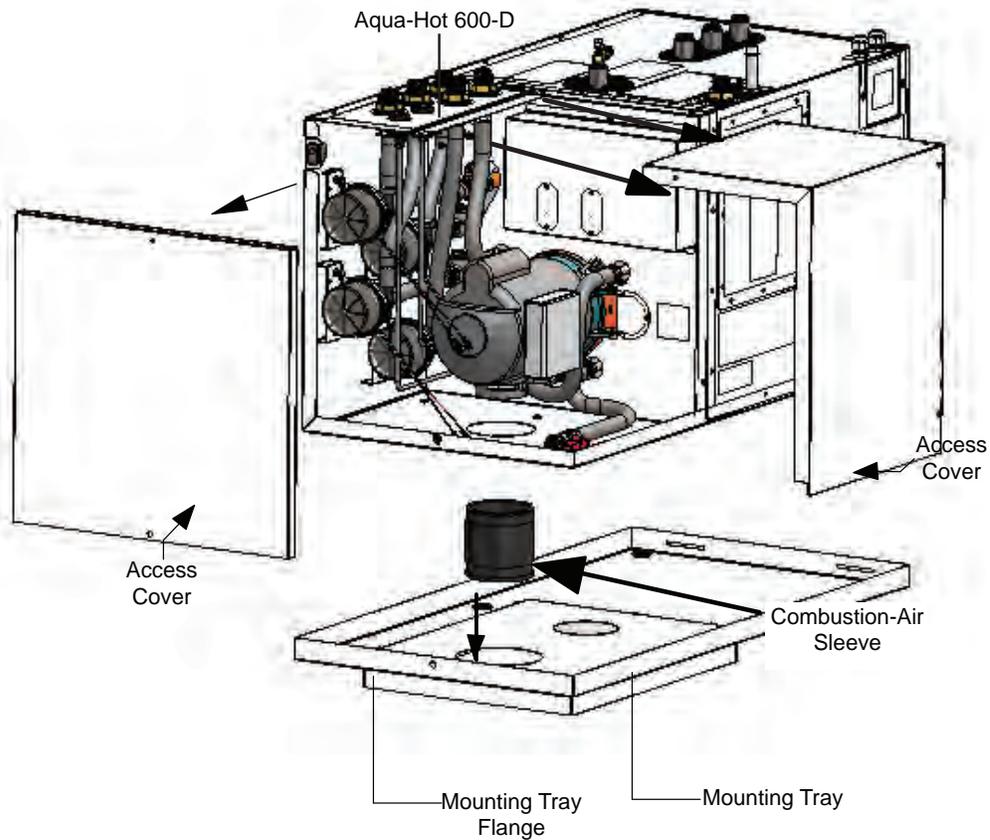


Figure 10



Section 1: Aqua-Hot Installation

Installing the Expansion Tank:

Select a mounting location that allows for easy access and clear visibility whenever the particular storage bay door is open.

NOTE: The top of the expansion tank should always be mounted at least 4 inches higher than the highest point on the Aqua-Hot. Reference Figure 11.

1. Mount the expansion tank as illustrated in Figure 11.
2. Connect and clamp the overflow tubing from the expansion tank to the Aqua-Hot's expansion tank connection. Reference Figure 11.

NOTE: Avoid any dips and bends in the overflow tubing from the Aqua-Hot to the expansion tank as air can become trapped in these dips and bends, preventing the expansion of the heating solution from properly depositing into the expansion tank.

3. Drill a hole in the bay floor and connect (secure with a clamp) a long enough piece of overflow tubing so that it can be connected to the top of the expansion tank and extend through the bay floor.

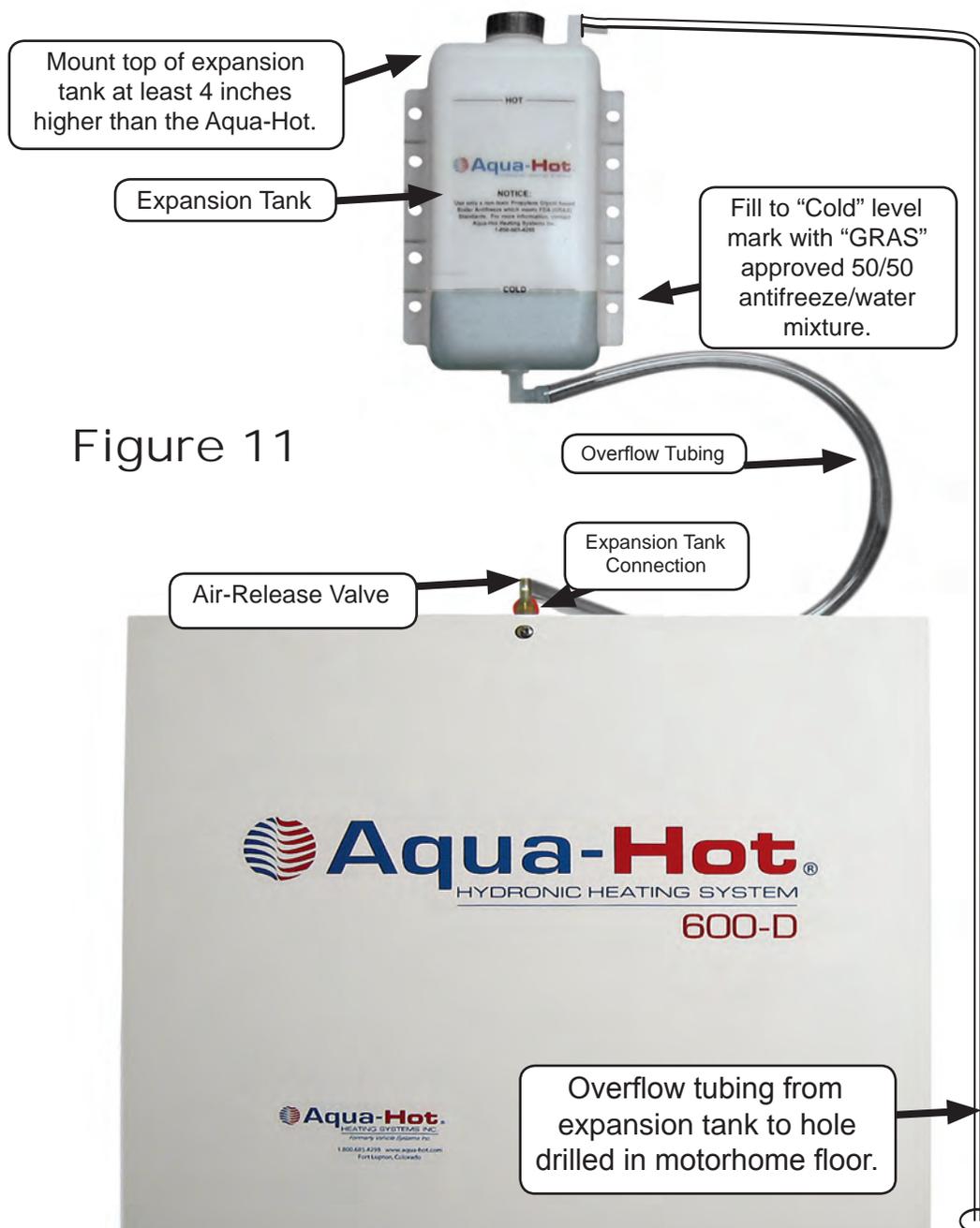


Figure 11

Section 2: Hydronic Heating System

Location and Clearances:

Place the heat exchangers so that even heat distribution will be felt throughout the interior of the motorhome. Reference Figures 12 through 19.

NOTE: For single slideout configurations, it is usually simplest to place a heat exchanger on the opposite side of the motorhome pointing towards the slideout.

Place the heat exchangers where they will be accessible for potential servicing and cleaning.

Centralize and position a heat exchanger in the fresh water storage tank plumbing bay. Reference Figure 12.

NOTE: In order to achieve the best heating results, place the heat exchanger as close to the floor of the plumbing bay as possible (heat will naturally rise).

Reference Figures 14 and 17 for mounting location information.

Reference Figure 13 for clearance information.

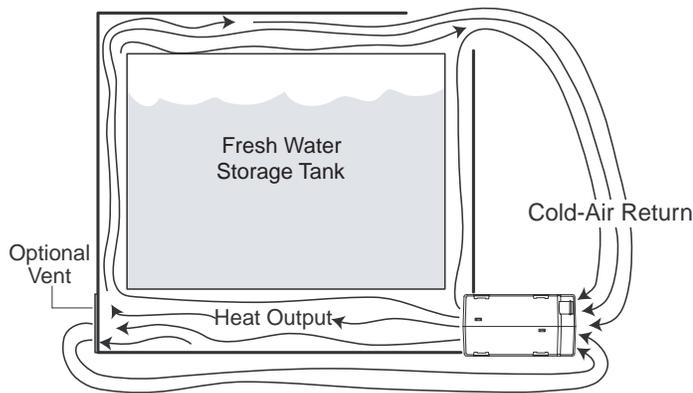


Figure 12

NOTE: An accessory device is available for the Cozy Heat Exchanger for the purpose of redirecting the airflow from the heat exchanger. Reference Figure 16.

Mounting Requirements:

Sufficient ventilation (return-air) must be supplied to each interior heat exchanger. Reference Figures 14 and 15.

NOTE: Mounting the heat exchangers without sufficient ventilation will severely reduce their overall heating performance (heat output).

In order to provide sufficient ventilation, the return-air registers must be the same size, or larger, than the outlet-air registers.

Return-air must be supplied from the corresponding interior heating zones.

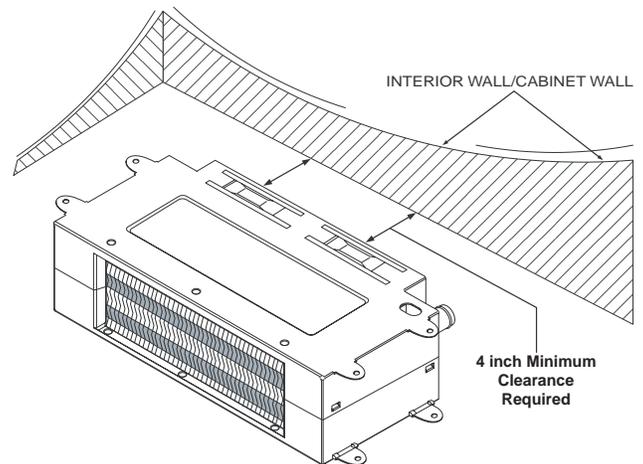


Figure 13

Interior Zone Heating/Heat Exchanger Layout

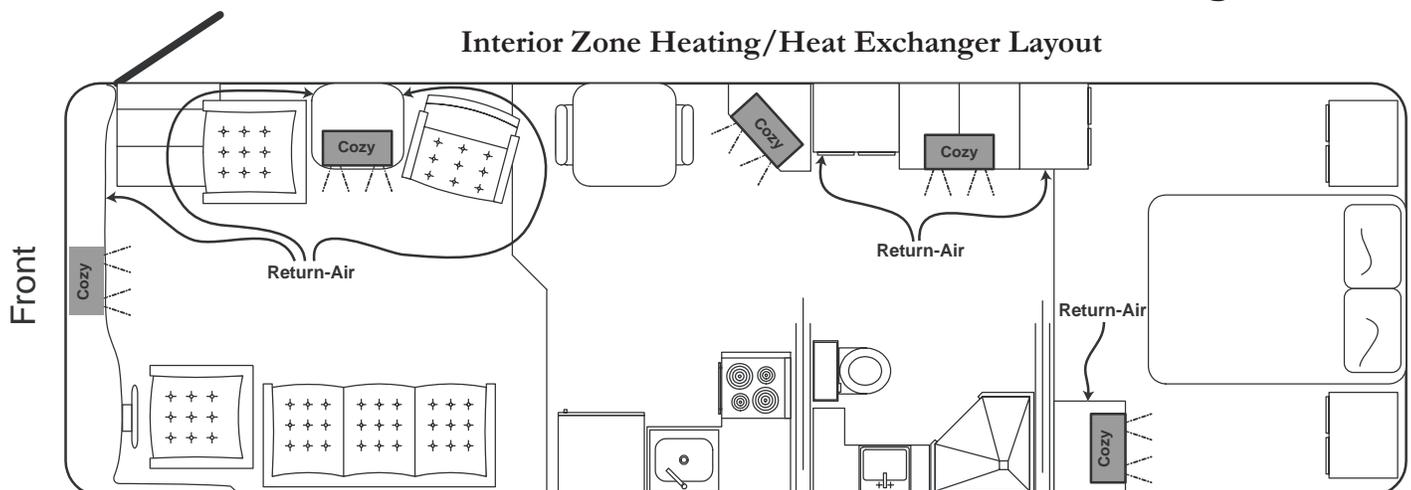


Figure 14

Cozy Indicates generally recommended mounting locations for the Cozy Heat Exchangers

Section 2: Hydronic Heating System

Mounting the Heat Exchangers:

1. Cut out a 2.5 inch H x 10 inch W opening for each heat exchanger outlet and cold-air return register. Reference Figure 15.
2. Mount each heat exchanger permanently into place. Reference Figures 18 and 19.
3. Install the hot-air outlet and cold-air return registers. Reference Figure 16.

NOTE: Please note that a return air register may not be required; however, adequate return-air must be provided to each particular heat exchanger. This means that the total cross-sectional area of the return-air opening must be equal to or greater than the cross-sectional area of the hot-air outlet opening of the heat exchanger.

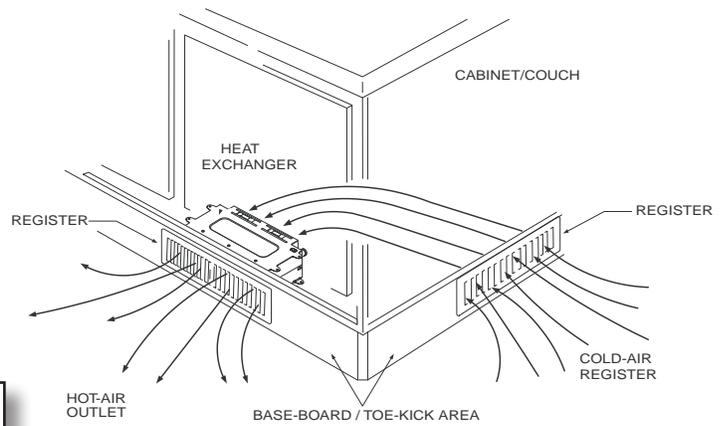


Figure 15

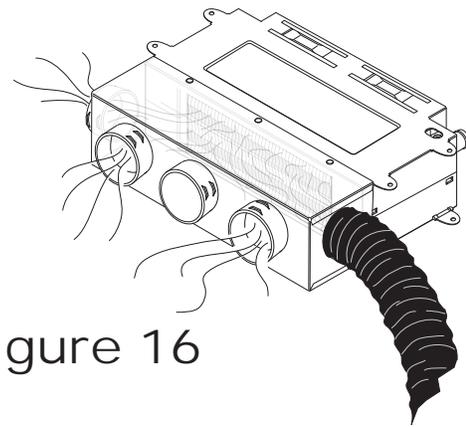


Figure 16

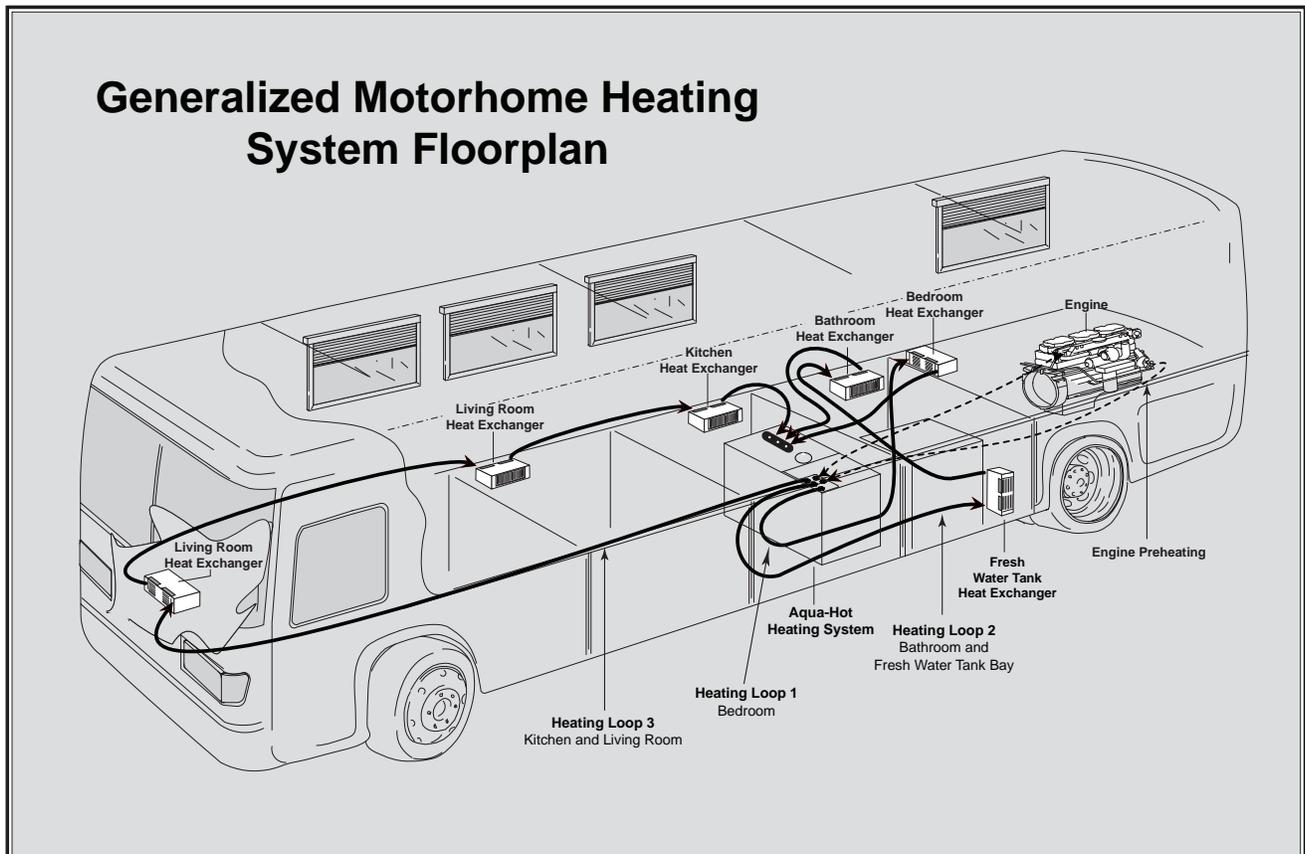
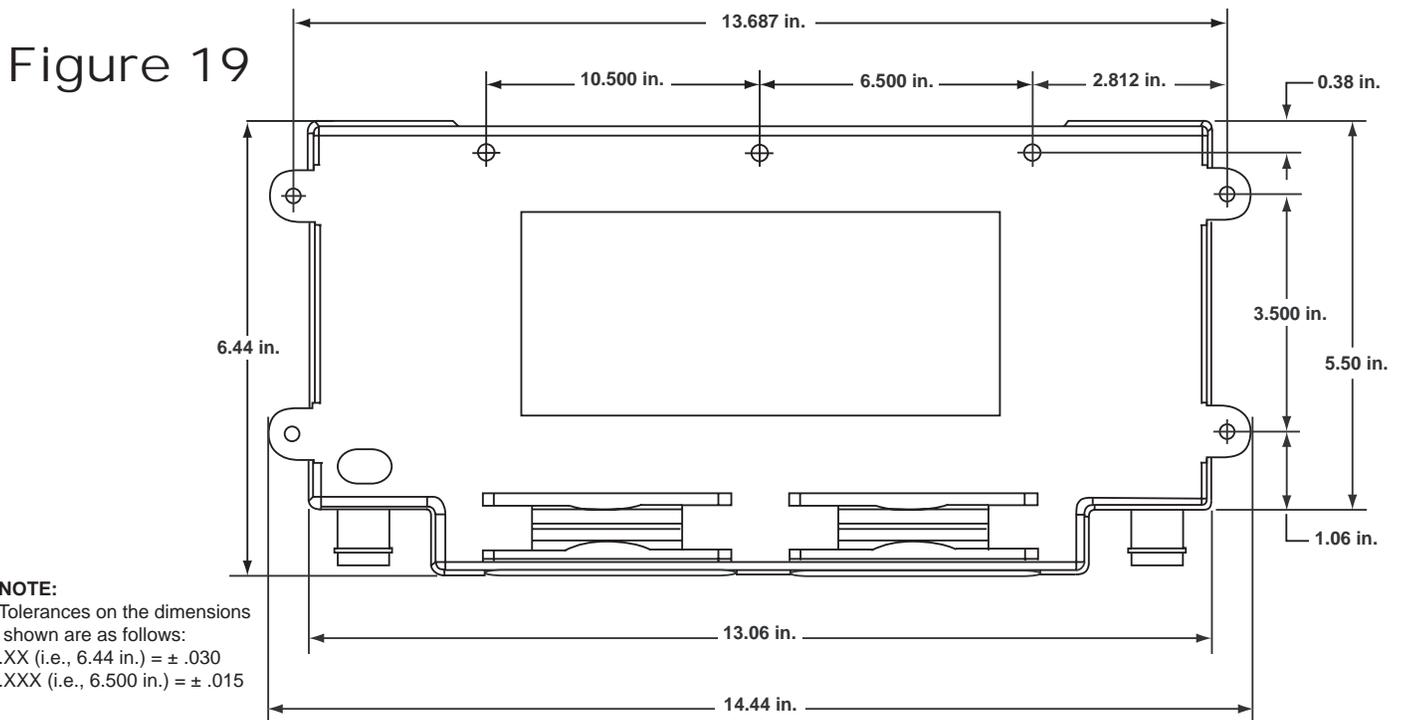
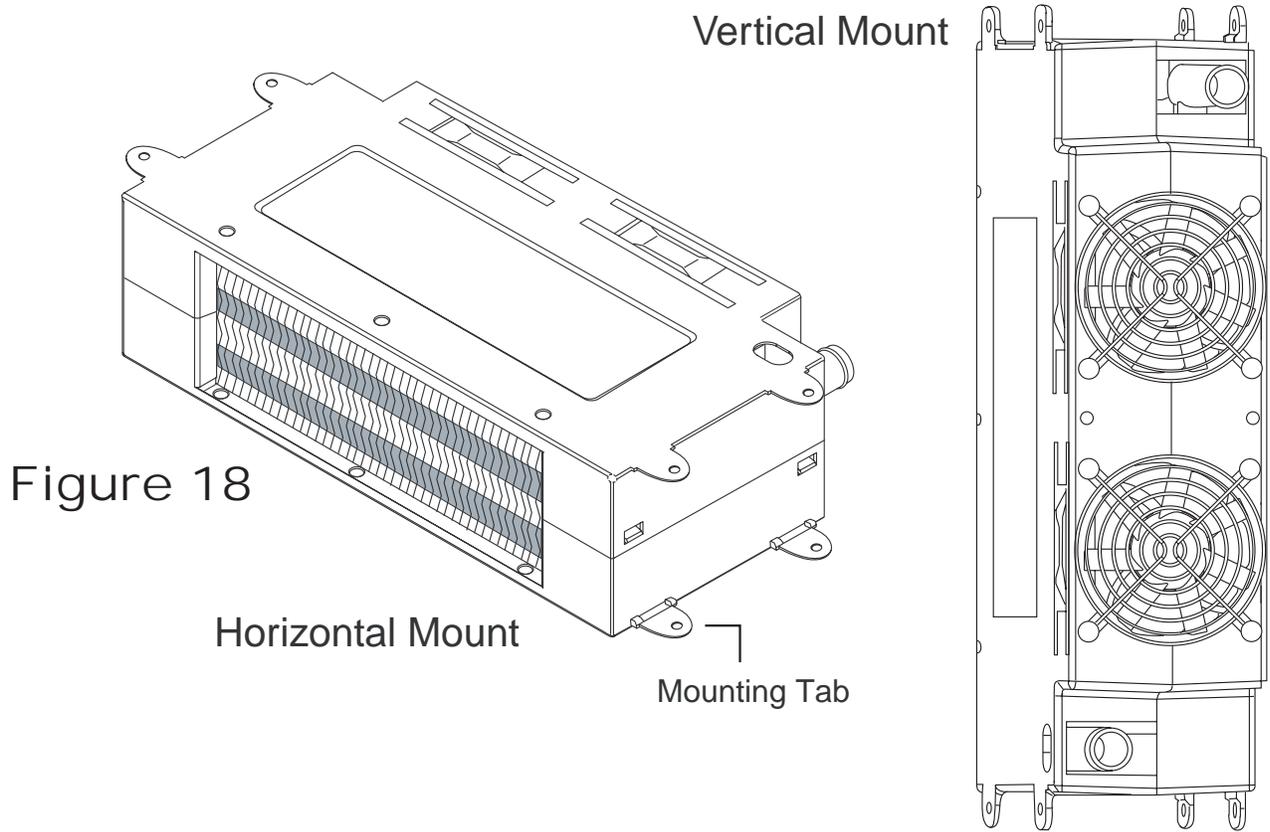


Figure 17

Section 2: Hydronic Heating System



Section 2: Hydronic Heating System

Wiring the Heat Exchangers:

1. Run two 18-gauge wires, red for (+) and black for (-), from each particular heating zone's heat exchanger to the electronic controller. Reference Figure 21.
2. Label the wires indicating the heating zone they pertain to (e.g., Living Room, Bathroom, Bedroom, etc.).
3. Insert all heat exchanger wires into the appropriate terminal/heating zone location on the electronic controller. Reference Figure 21 and Appendix A.
4. Wire all heat exchangers in the same zone in-series.
5. Connect all electronic controller wires to the positive and negative leads of the heat exchanger. Reference Figure 21.

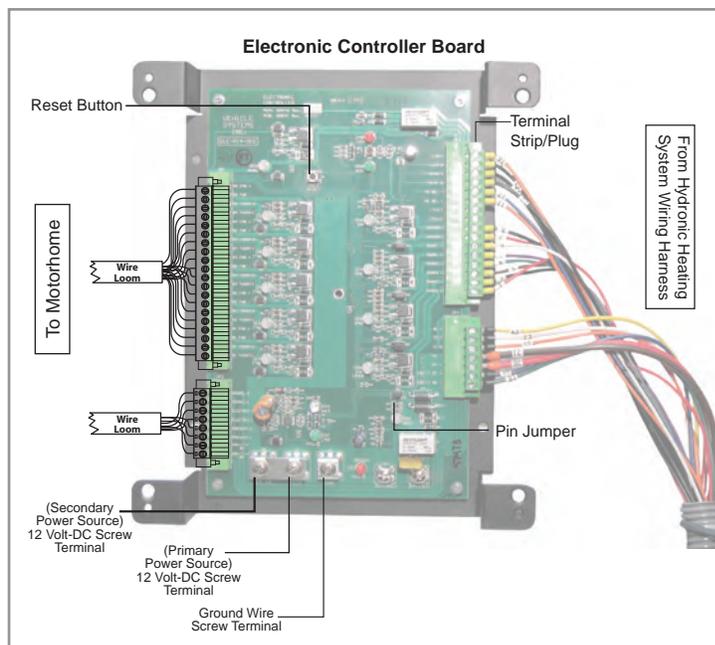


Figure 20

NOTE: Tolerance
+/- .030

+ (Positive) Red Wires
To Aqua-Hot's Terminal
Block

- (Ground) Black Wires
To a chassis ground source

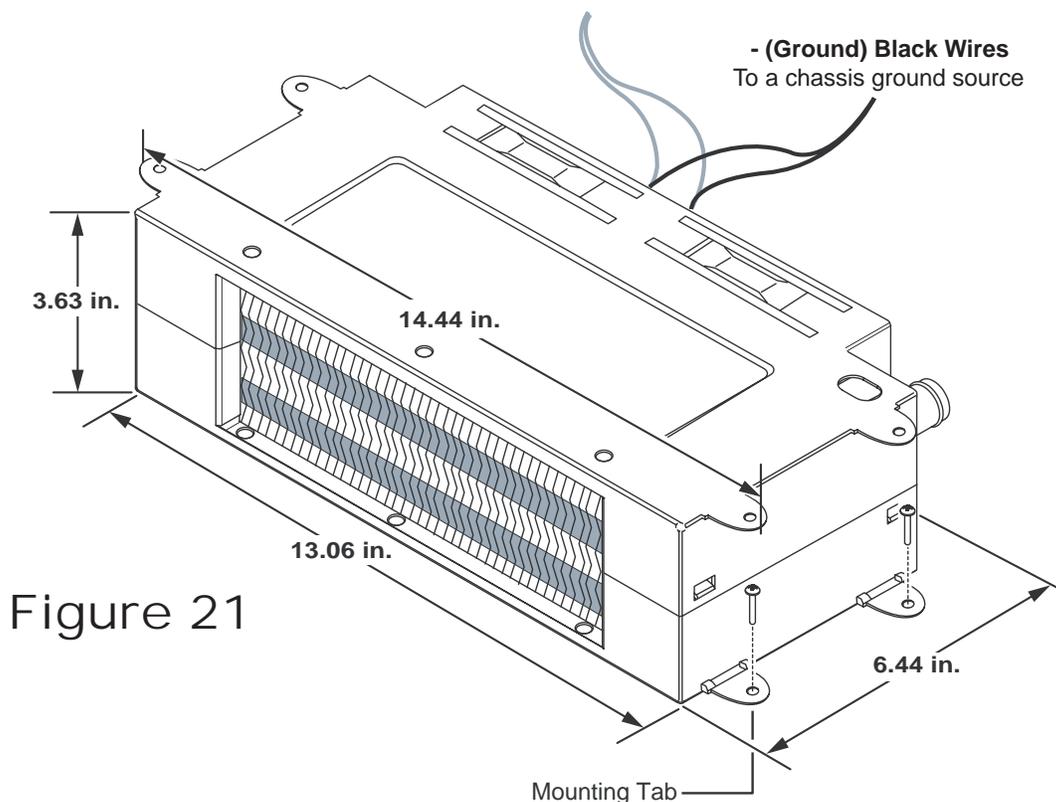


Figure 21

Section 2: Hydronic Heating System

Plumbing Requirements:

Once all heat exchangers have been mounted, formulate a plan for the routing of the plumbing lines from each heating zone to the Aqua-Hot.

All plumbing lines should be laid as flat as possible, and any extreme rises in height should be avoided to eliminate any potential air-traps.

The kitchen and living room heat exchangers (typically three) must be plumbed together **in-series** on “Heating Loop 3.” Reference Figure 22.

The fresh water tank, and bathroom heat exchangers (typically 3) must be plumbed together **in-series** on “Heating Loop 2.” Reference Figure 22.

The bedroom heat exchanger must be plumbed on “Heating Loop 1.” Reference Figure 22.

Use 3/8 inch I.D. (Inside Diameter) plumbing lines for all heating loops.

Use wide-sweeping elbows or “bend supports” whenever the plumbing lines may be susceptible to kinking (i.e., 90° bends).

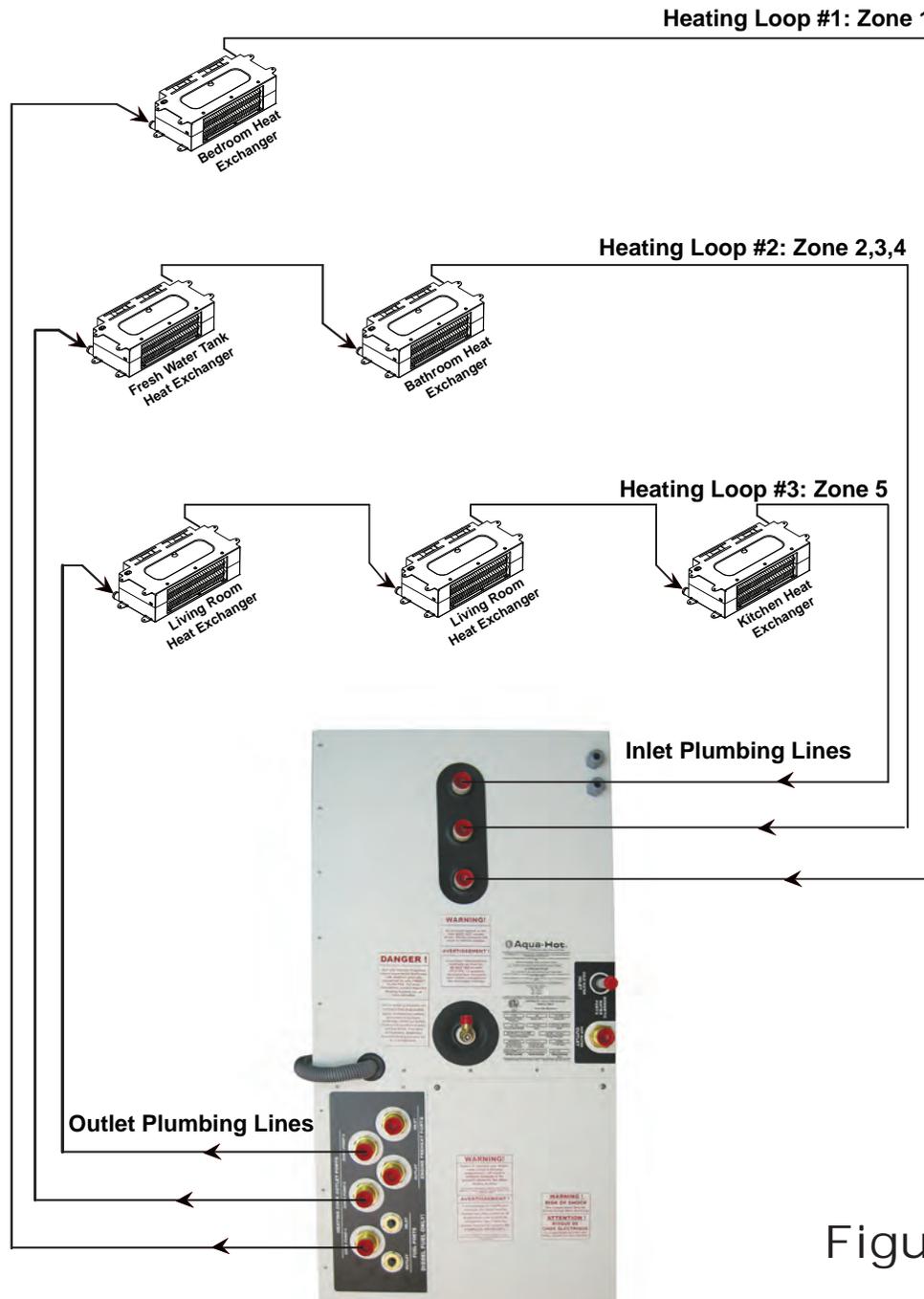


Figure 22

Section 2: Hydronic Heating System

Plumbing the Hydronic Heating System:

1. Lay out the plumbing lines for all heat exchangers.
2. Label each line with the heating loop number and designate as an inlet or an outlet line.

NOTE: Run all plumbing lines in areas where they cannot be pinched off or damaged under normal operating conditions.

Be sure to secure all lines where necessary and apply protective shielding in areas where chafing may occur.

Rubber Coated/Closed-Type clamps are recommended when securing the plumbing lines.

3. Connect and clamp the outlet line from the Aqua-Hot to the lowest port on the closest heat exchanger for both heating loops. Reference Figures 23 and 24. Then, connect each additional heat exchanger in the same arrangement (low to high). Reference Figure 22.
4. Connect and clamp the inlet line from the heater to the highest port on the last heat exchanger for both heating loops. Reference Figure 22.

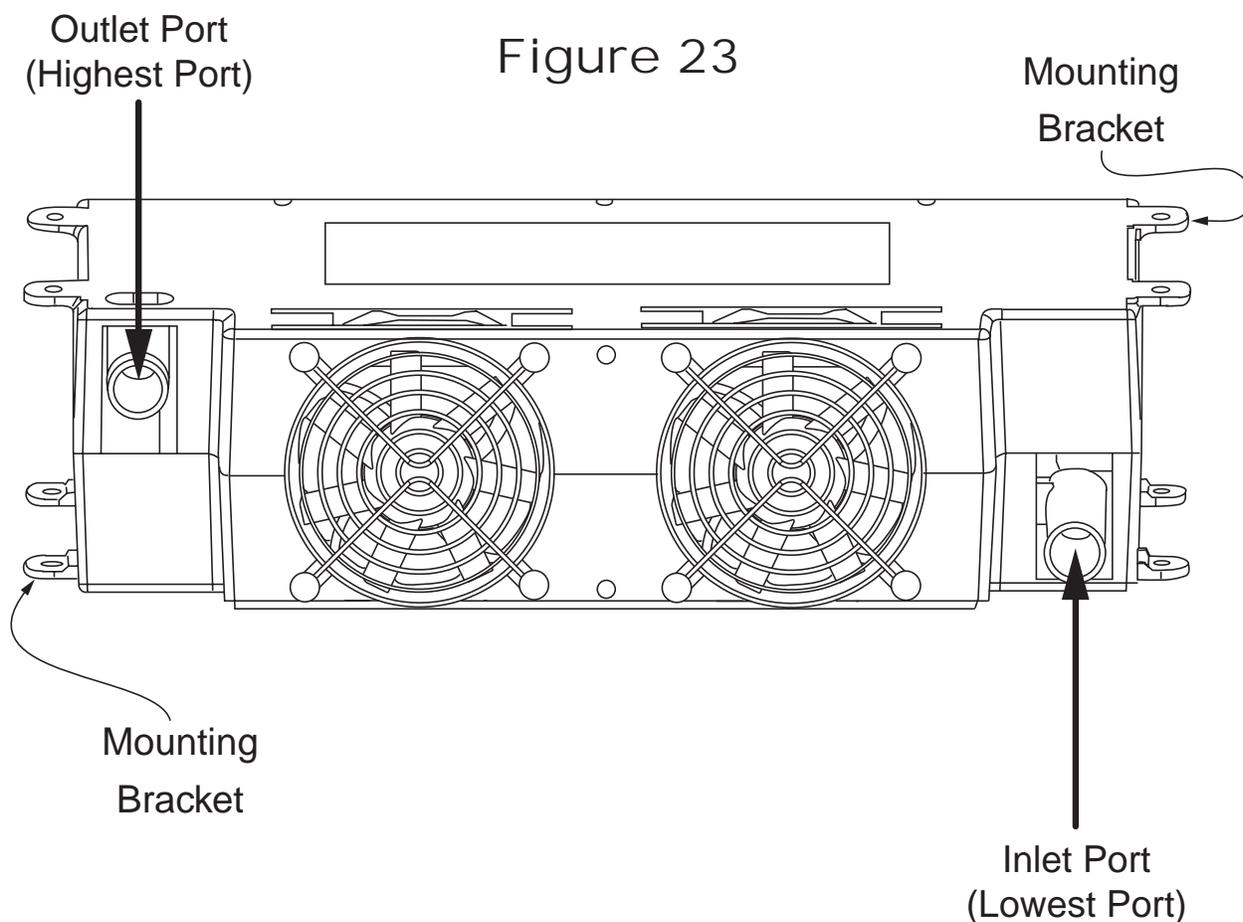
NOTE: Reference Figure 24 for visual instructions on connecting PEX-type tubing to each heat exchanger.

Plumbing heat exchangers in this manner will allow air to escape naturally. If air is trapped in any heat exchanger, it will significantly reduce the heat exchanger's overall heating performance (heat output).

5. Connect and tighten all interior plumbing lines, outlet and inlet, to the Aqua-Hot's appropriate heating loop ports. Reference Figure 25.

Cozy Heat Exchanger (Rear View)

Figure 23



Section 2: Hydronic Heating System

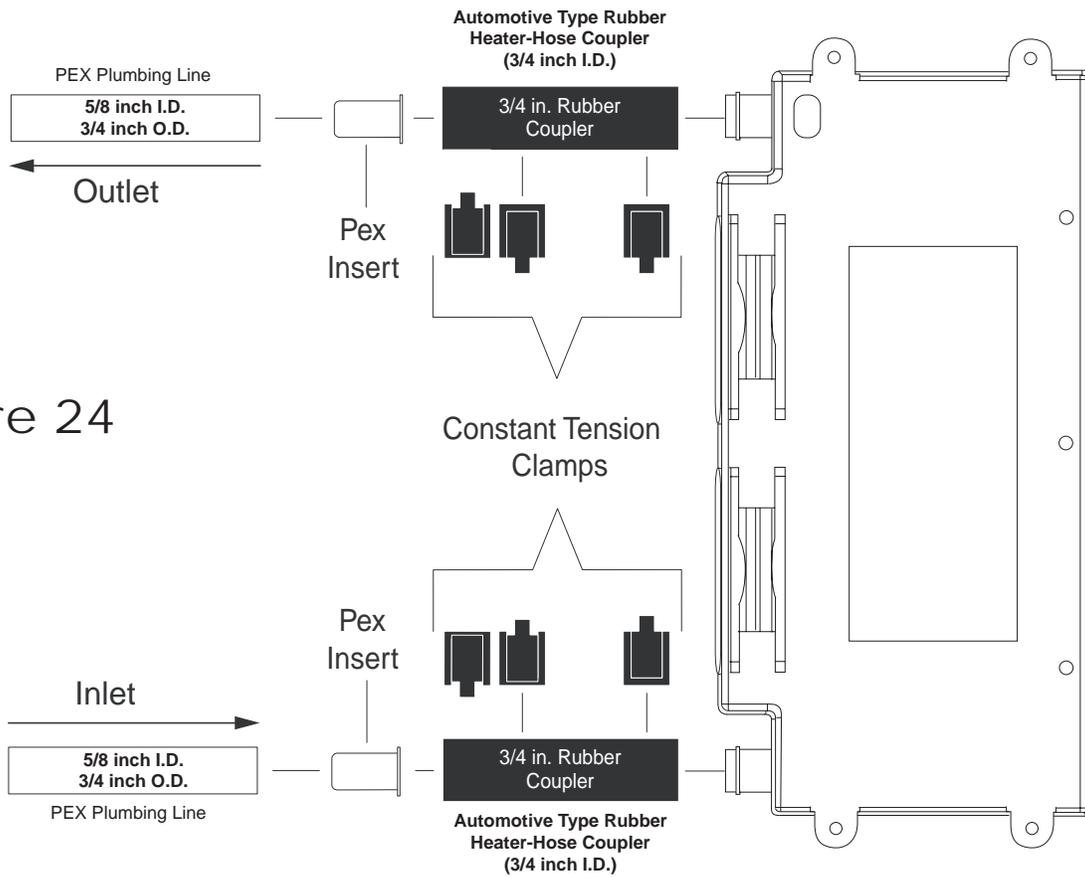
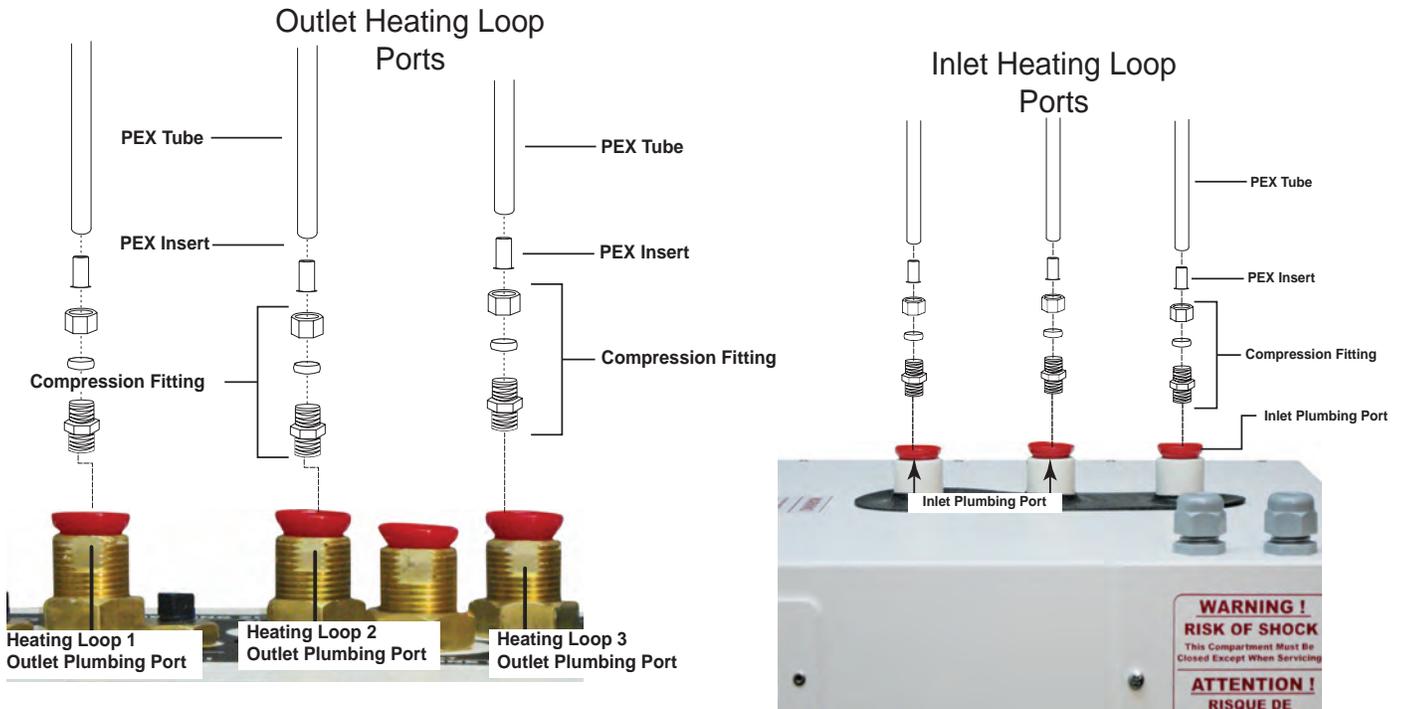
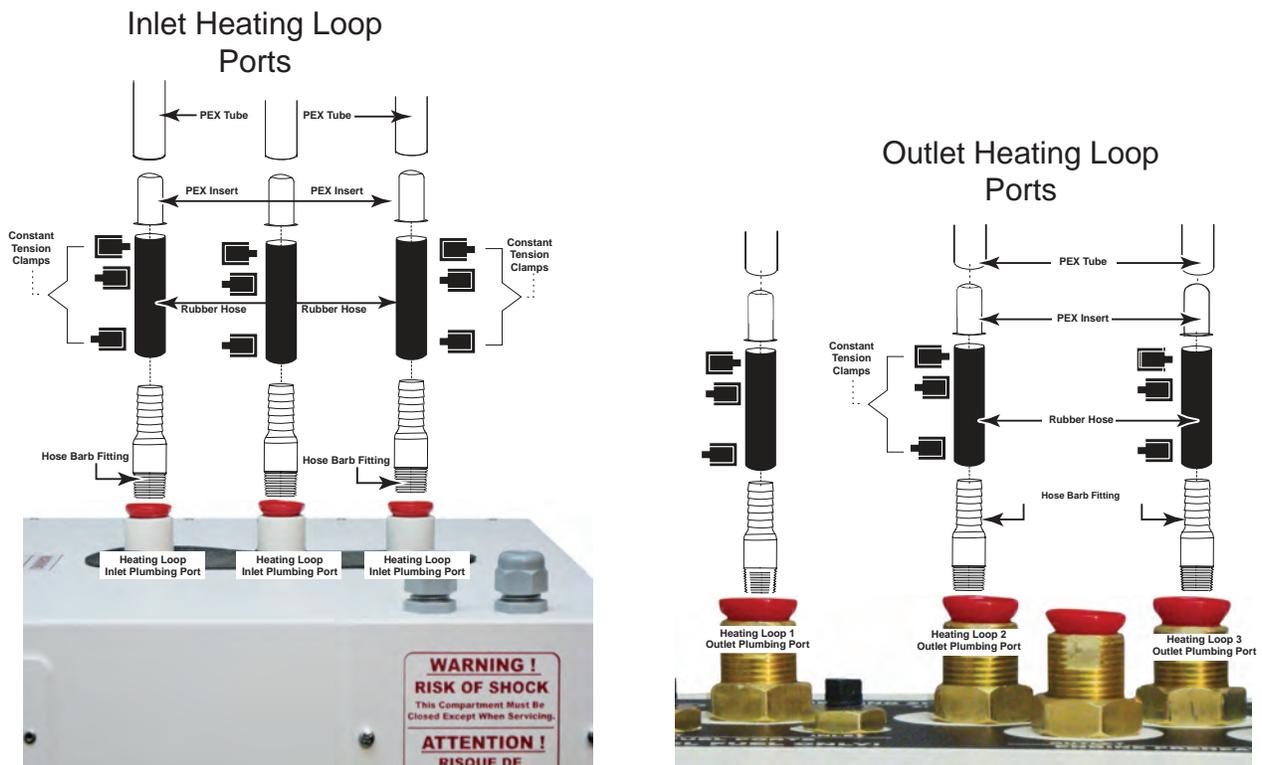


Figure 24

Section 2: Hydronic Heating System



Heating Loop Connection Options
Figure 25



Fresh Water Tank Thermostat Location:

Select a location that will ensure even-heat distribution throughout the fresh water storage tank bay compartment in order to prevent the domestic water and plumbing system from freezing.

Typically, only the bulb of the thermostat needs to be physically mounted in the area requiring heat (usually in close proximity to the domestic water pump). Reference Figure 26.

Do not mount the thermostat bulb in a drafty area.

The selected mounting location should allow for easy operator access. Reference Figure 26.

Avoid mounting the fresh water tank thermostat's bulb too close to the bay heat exchanger.

Fresh Water Tank Thermostat Mounting:

1. Determine a location for the thermostat based upon the previous location information.
2. Once the thermostat has been completely wired, permanently mount the thermostat in place. Reference Figure 26.

Fresh Water Tank Thermostat Wiring:

1. Run two 18-gauge wires from the thermostat's mounting location to the Aqua-Hot's electronic controller.

NOTE: It is recommended that the wire numbers in Appendix A be used when installing the Aqua-Hot in order to assist with differentiating between the separate heating zones and to aid service personnel with troubleshooting.

2. Insert each thermostat wire into the appropriate terminal/heating zone location in the electronic controller. Reference Appendix A and Figure 27.
3. Connect both wires to the appropriate leads of the thermostat. Reference Figure 26.

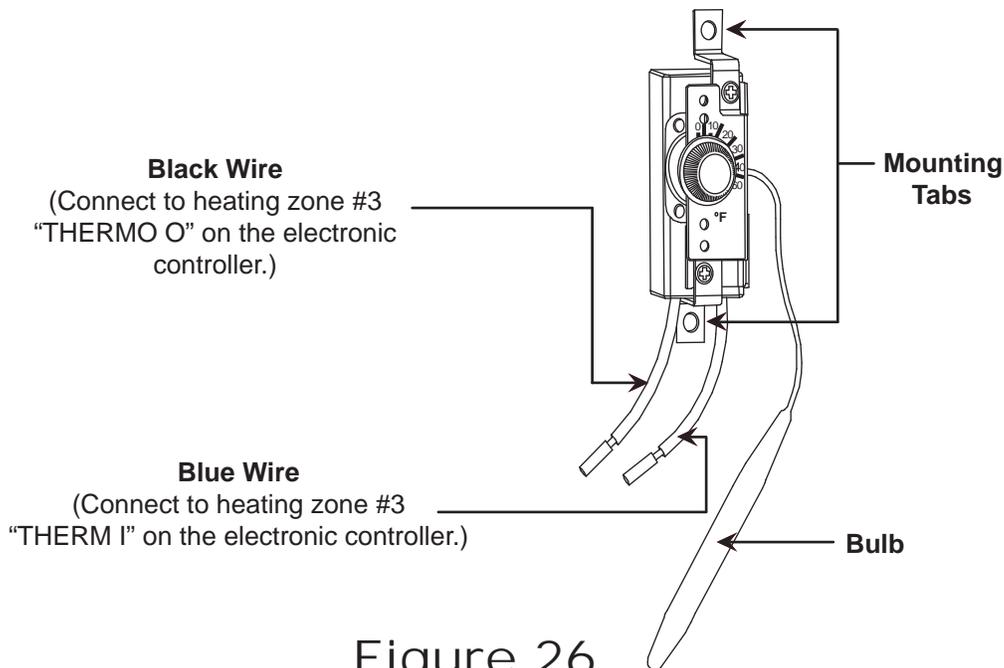


Figure 26

Room Thermostat Location:

Select a location that will ensure even-heat throughout each heating zone. The selected location should prevent the thermostat from being affected by:

- drafts or dead spots behind doors and in corners
- hot or cold air from ducts
- radiant heat from the sun or appliances
- heat from concealed pipes and chimneys
- unheated or uncooled areas such as an outside wall behind the thermostat

Locate each thermostat at approximately chest level, if applicable.

Room Thermostat Mounting:

Once the room thermostat has been wired, permanently mount the thermostat in place.

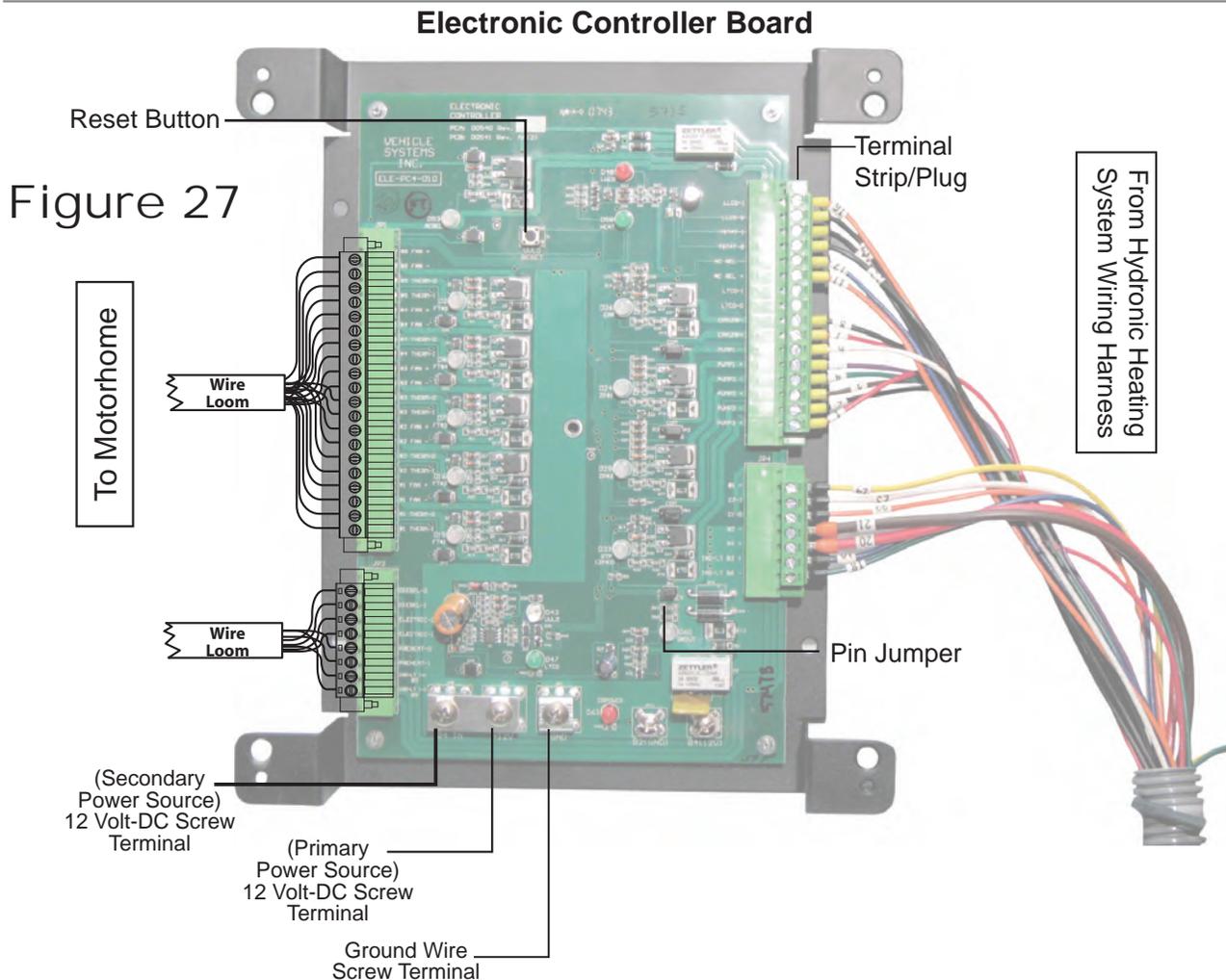
Be sure to then turn **OFF** all interior room thermostats.

Room Thermostat Wiring:

1. Run two 18 gauge wires from each room thermostat mounting location to the Aqua-Hot's electronic controller. Reference Appendix A.

NOTE: It is recommended that the wire numbers in Appendix A be used when installing the Aqua-Hot in order to assist with differentiating between the separate heating zones and to aid service personnel with troubleshooting.

2. Insert all room thermostat wires into the corresponding zone number location on the electronic controller. Reference Appendix A and Figure 27.
3. Connect all wires to the appropriate leads of each room thermostat.



Section 4: Domestic Water System

Domestic Water System Requirements:

NOTE: Please note that it may be necessary to utilize an accumulator tank within the domestic water system. Reference Figure 29. Although the Aqua-Hot is equipped with a pressure-relief valve, the use of an accumulator tank will help prevent excessive “weeping” of the valve. Manufacturers of pressure-relief valves indicate that excessive weeping of these valves will cause the “seat” in the valve to deteriorate, and, in turn, the valve will fail prematurely. For additional information regarding accumulator tanks, please be sure to reference the Recreational Vehicle Industry Association’s (RVIA) technical publication titled “Recreational Vehicle Plumbing Systems.” To obtain a copy of this particular publication, please contact RVIA at (703) 620-6003 or visit them online at www.rvia.org.

Use the RVIA-provided table below in order to determine the proper sizing of pipe and tubing required to ensure maximum efficiency.

The size of water supply piping and branch line shall not be less than specified in the table below.

NOTE: A water heater or ice maker shall not be counted as a “water-using fixture” when computing pipe sizes.

NOTE: As stated directly from the ANSI A119.2/NFPA 501C Standard on Recreation Vehicles, 1993 Edition:

“Piping Systems shall be sized to provide an adequate quantity of water to each Plumbing Fixture at a flow rate sufficient to keep the Fixture in a clean and sanitary condition without any danger of back-flow or siphoning.”

NOTE: The Aqua-Hot is equipped with a pressure-relief valve, which releases excessive pressure in the domestic water system, as well as a tempering valve in order to regulate the temperature of the hot water.

Domestic Water System Plumbing:

1. Connect a domestic water plumbing line from the domestic water demand pump/water manifold to the cold water inlet port on the Aqua-Hot. Reference Figures 28 and 29.
2. Connect a domestic water plumbing line from the Aqua-Hot’s hot water outlet port to the hot water system’s distribution lines/water manifold. Reference Figures 28 and 29.

Minimum Size Tubing and Pipe for Water Distribution Systems* Table

Number of Fixtures	Tubing		Pipe
	Inner Dia. (inches)	Outer Dia. (inches)	Iron Pipe Size (inches)
1	1/4**	3/8**	3/8
2	1/4***	3/8***	3/8
3	3/8	1/2	1/2
4	3/8	1/2	1/2
5 or more	1/2	5/8	1/2

* Minimum size for toilet water supply line shall not be less than the size recommended by the toilet manufacturer.

** 12-feet (3.7 m) maximum length allowable only from water service connection to a single fixture.

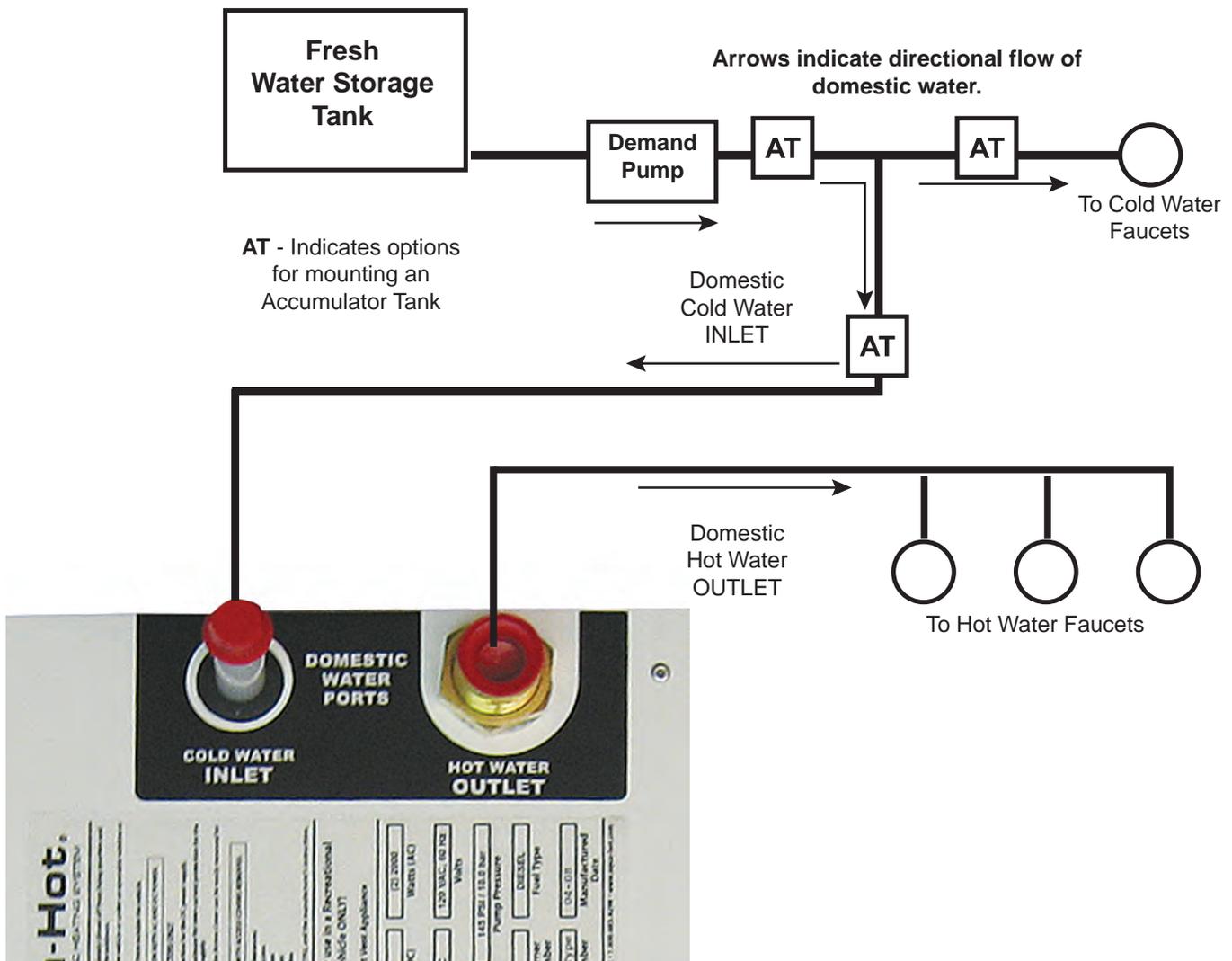
*** 6-feet (1.8 m) maximum length.

Section 4: Domestic Water System



Figure 28

Figure 29



Section 5: Switch Panel

Switch Panel Location:

Select a location in the interior of the coach that allows for easy operator access.

All electric installations, systems, and equipment shall comply with Article 551, Parts I and III through VI of NFPA 70, as well as the regulation of authorities having jurisdiction and CSA Standard B139.

Switch Panel Mounting:

1. Cut out an opening for the switch panel plate. The Aqua-Hot 600-D requires a 5 inch W x 1.25 inch H opening. Reference Figure 30.
2. Once the switch panel has been completely wired, permanently mount the switch panel in place. Reference Figure 30.
3. Move all switches to their **OFF** position by pressing them in a downward motion.

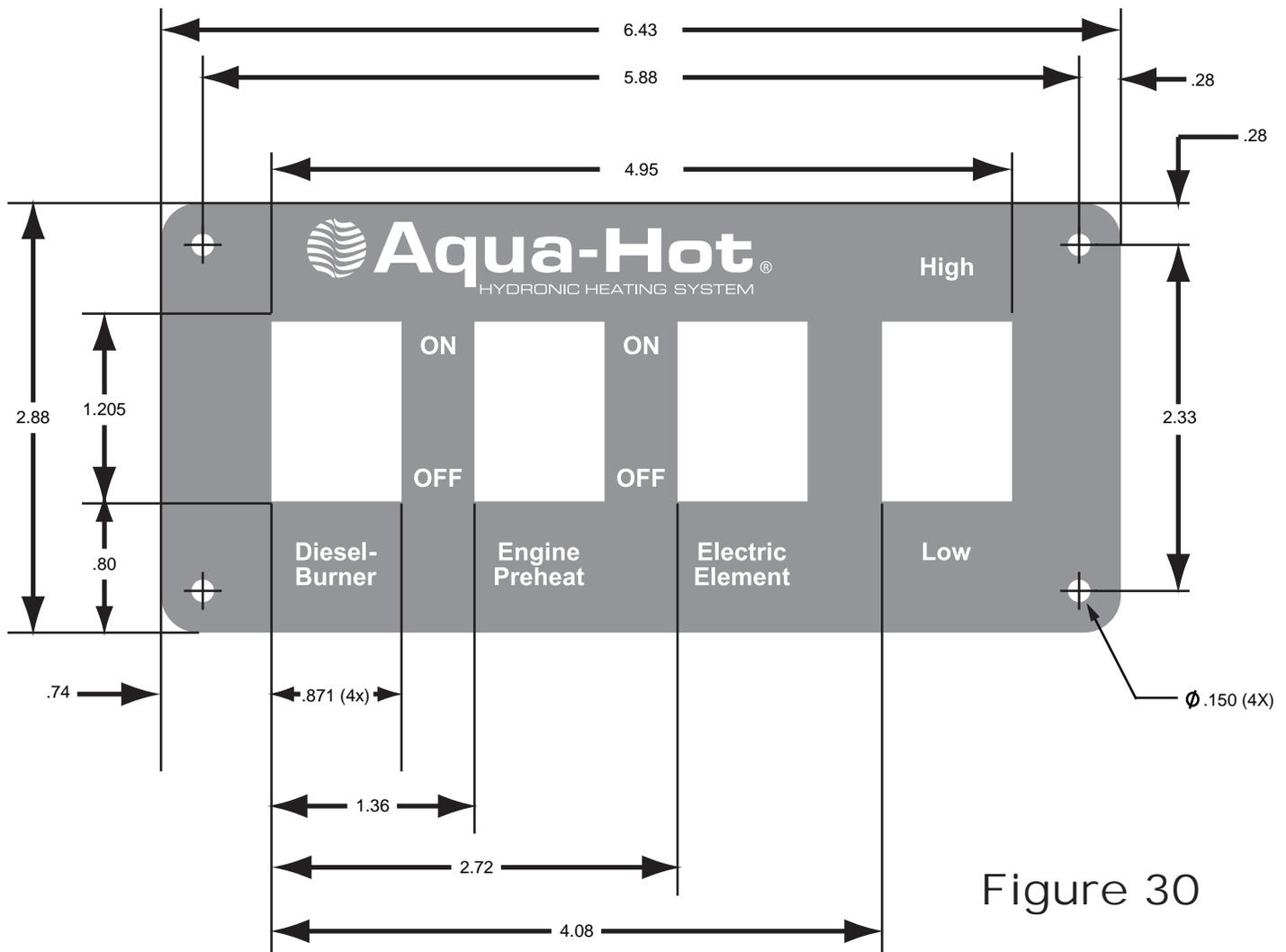


Figure 30

Section 5: Switch Panel

Switch Panel Wiring:

1. Run 16-gauge wires from the switch panel to the electronic controller.

NOTE: It is recommended that the wire colors illustrated in Appendix A be used when installing the switch panels. This will ensure installation consistency, differentiate between the separate switches, and assist service personnel with troubleshooting.

Reference Appendix B for proper wire-gauge sizing.

2. Strip and crimp insulated female terminals onto each wire at the switch panel location.

NOTE: Be sure to attach “Jumper Wires” where necessary. Reference Figure 31.

3. Connect all switch wires to the appropriate switch connections as illustrated in Figure 31. Reference Appendix A for additional wiring information.
4. Insert all switch wires into the appropriate terminal/switch panel connection on the electronic controller. Reference Appendix A.

Back of Switch Panel

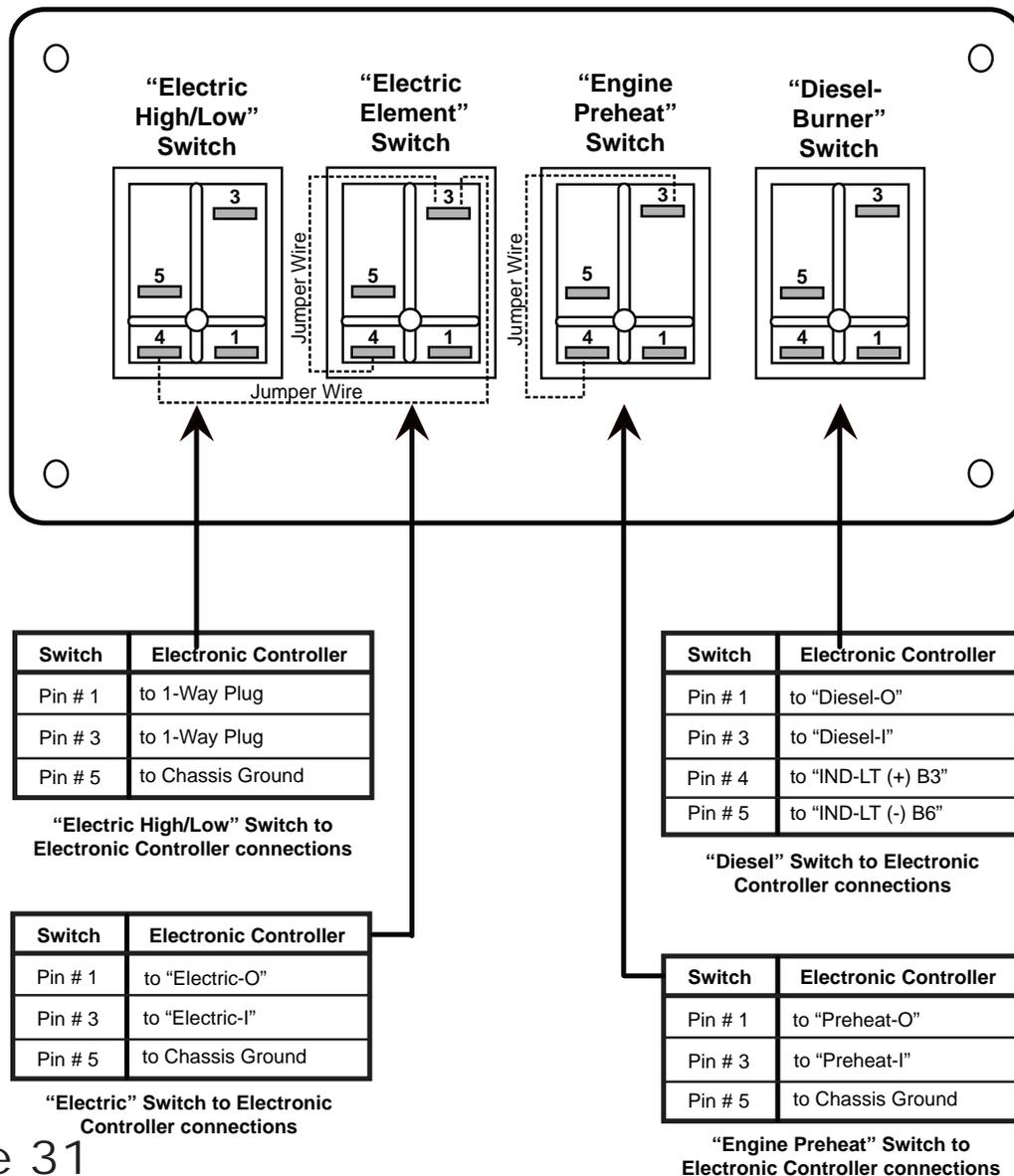


Figure 31

Section 6: Fuel System

CAUTION:

A kinked fuel line will increase the fuel pressure to hazardous levels and may cause a fuel line to rupture. A kinked fuel line could also severely damage the diesel-burner's internal fuel system.

Fuel System Location:

Mount the fuel filter in a location that provides easy access for changing the filter element and for catching any potential fuel spillage when servicing.

Fuel System Requirements:

The diesel fuel supply should be drawn directly from the vehicle's main fuel tank or from a separate auxiliary fuel tank, if applicable.

The fuel tank should be equipped with a dedicated fuel pick-up pipe (inlet port and outlet port). Reference Figure 32.

NOTE: If an auxiliary fuel tank is required, be sure to consult the ANSI/NFPA 1192 Handbook concerning heating systems' diesel fuel system specifications.

Also, be sure to reference the ANSI/NFPA 1192 handbook for information regarding fuel distribution system specifications.

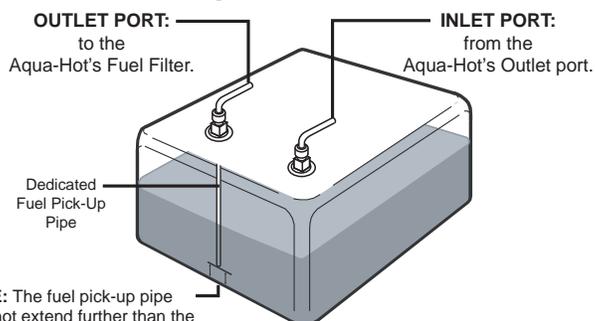
Fuel head pressure should not exceed 10 feet. Reference Figure 33.

Use a minimum of ¼ inch I.D. (internal diameter) fuel lines.

The combined length of the inlet and outlet fuel lines should not exceed 100 feet in total length. Reference Figures 32 and 33.

All fuel-fitting hardware (i.e., at the vehicle's fuel tank, fuel filter, and Aqua-Hot fuel parts) must be ¼ inch NPT or greater with a minimum of ¼ inch barbed fitting. Fuel fittings less than ¼ inch NPT may restrict fuel flow, thereby compromising the diesel-burner's performance.

Figure 32



NOTE: The fuel pick-up pipe should not extend further than the motorhome's engine fuel supply pick-up and should be consistent with the on-board generator's fuel supply pick-up length.

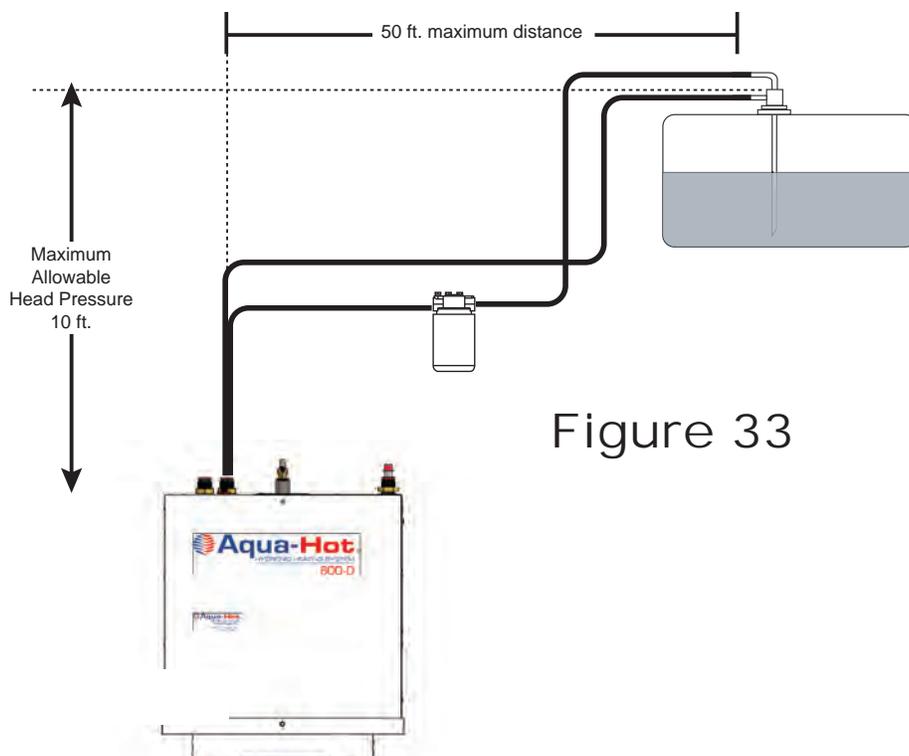


Figure 33

Section 6: Fuel System

Fuel System Installation:

1. Run two minimum of ¼ inch fuel lines from the fuel tank/fuel pick-up to the Aqua-Hot.

Both fuel lines should be laid as flat as possible and any extreme rises in height should be avoided in order to eliminate any potential air-traps.

Run both fuel lines in areas where they cannot be pinched, kinked, or damaged during normal operating conditions.

2. Be sure to secure all fuel lines where necessary and apply protective shielding in areas where chafing may occur.

3. Label both fuel lines indicating whether they are an outgoing line or an incoming line.
4. Connect the fuel lines to the fuel tank/fuel pick-up pipe. Reference Figure 34.
5. Install and tighten the appropriate fuel fittings onto the Aqua-Hot's fuel ports, as well as the two ports of the fuel filter. Reference Figures 35 and 36.
6. Connect the inlet and outlet fuel lines to the Aqua-Hot's fuel port connections. Reference Figure 35.
7. Cut the fuel line at the fuel filter mounting location and connect the fuel lines as illustrated in Figures 33 and 34.

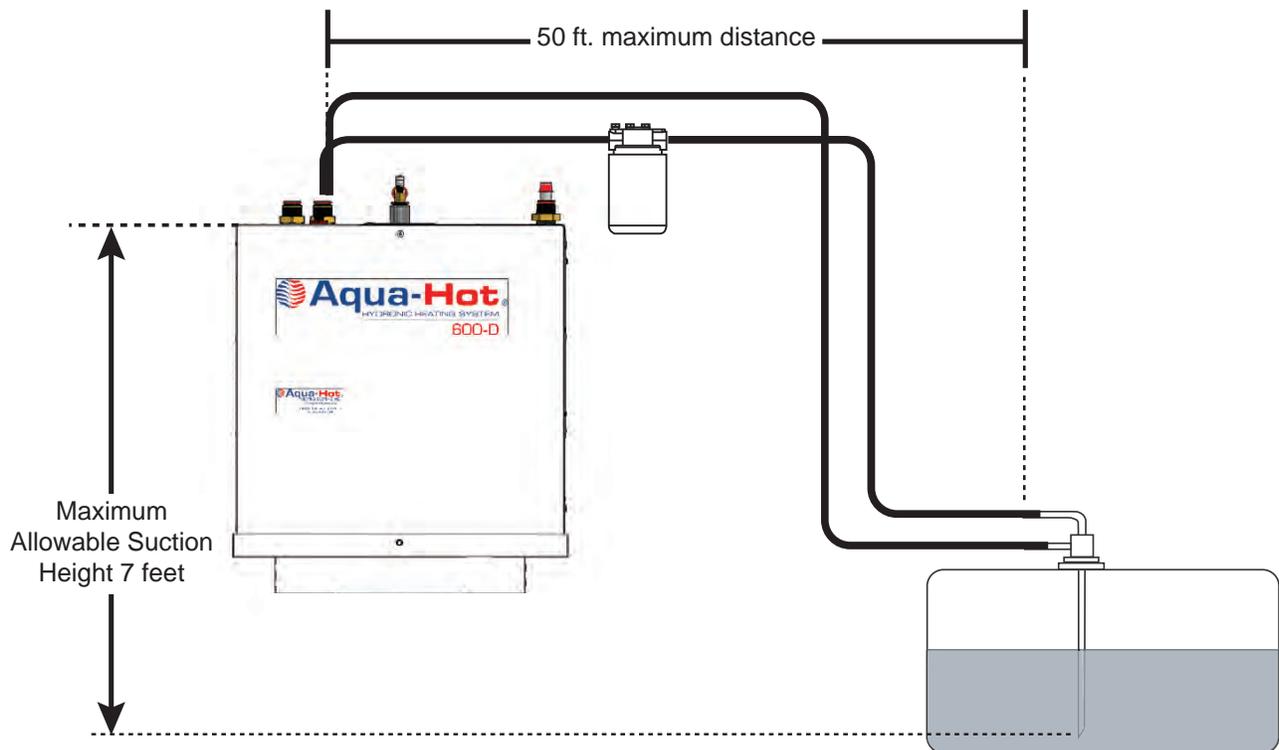


Figure 34

Figure 35

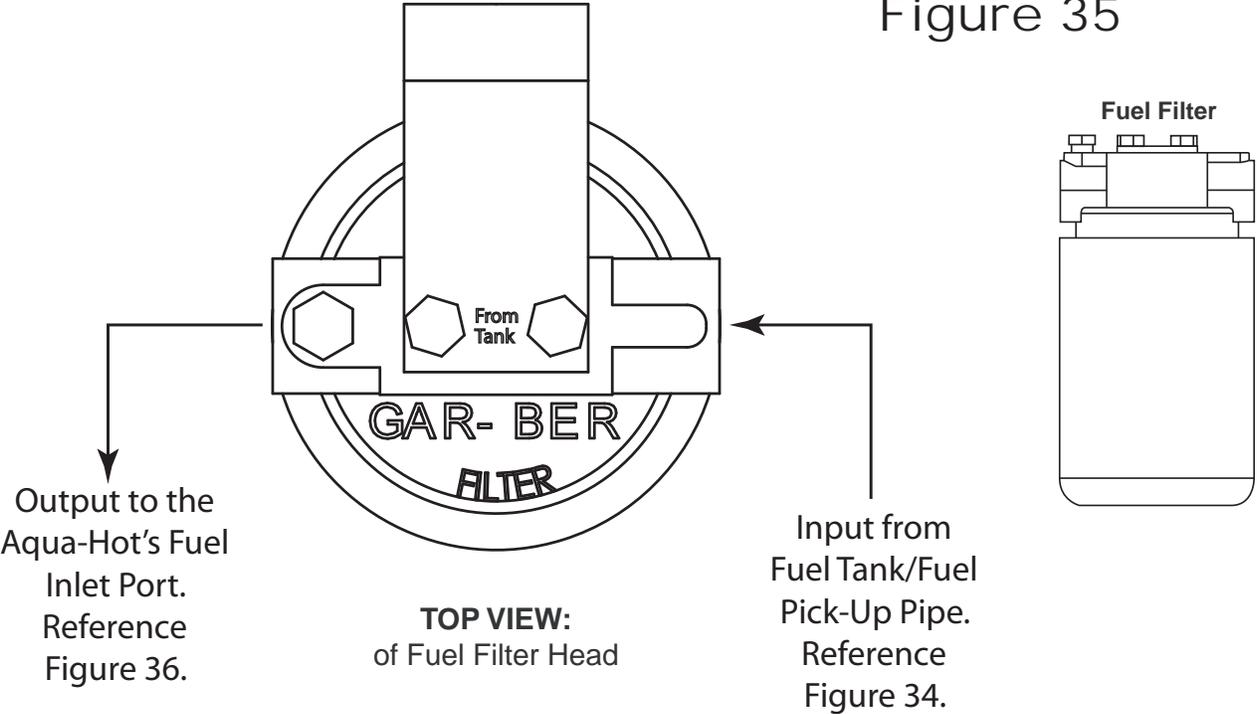


Figure 36

Section 7: Engine Preheat System

Engine Preheat System Location:

The Aqua-Hot 600-D includes an engine preheat feature. This preheat feature provides an easy engine start-up whenever cool weather conditions are present.

The inlet and outlet ports on the vehicle's engine should be kept as far apart as possible. This will ensure that the entire engine is thoroughly preheated. Reference Figure 37.

NOTE: If assistance is needed in determining the best inlet and outlet ports for a specific engine, please contact the particular engine's manufacturer or chassis supplier.

The engine's coolant should be allowed to flow as freely as possible to maximize the Aqua-Hot's engine preheating system.

The engine's inlet port is where the heated coolant is transported to the engine block from the Aqua-Hot. This port should be a high connection point on the engine block. Reference Figure 37.

The engine's outlet port is where the engine's coolant is transported to the Aqua-Hot. This port should be a low connection point on the engine block or a pressure outlet port on the engine's water pump. Reference Figure 37.

Ensure that the engine preheat inlet and outlet hoses are not placed too close to the engine's turbo charger.

Engine Preheat System Plumbing Requirements:

Use 3/4 inch I.D. (Inside Diameter) plumbing lines/automotive-type heater-hose for the engine preheating system.

Lay both engine preheat lines as flat as possible and avoid any extreme rises in height in order to eliminate the potential for air traps.

Run both plumbing lines in areas where they cannot be pinched off or damaged during normal operating conditions.

Secure both plumbing lines where necessary and apply protective shielding in areas where chafing may occur.

NOTE: Rubber coated/closed-type clamps are recommended when securing the plumbing lines.

Use one-piece engine plumbing fittings in order to reduce the potential for coolant leaks. It is recommended that pipe thread sealant be used on all engine plumbing fittings.

Engine Preheat System Plumbing Installation:

1. Install both engine preheat plumbing lines and mark with arrows and/or labels at both ends.

NOTE: The labels should indicate whether the plumbing line is transporting coolant to the Aqua-Hot or whether it will be transporting heated coolant to the vehicle's engine. Reference Figure 37.

2. Drain the engine's coolant.
3. Remove the selected inlet and outlet port "plugs" from the engine.

NOTE: Should one or both of the selected engine ports already have plumbing fittings attached to them, it may be necessary to "tee" into those existing plumbing fittings. Please contact the Aqua-Hot Heating Systems product application department at 1-800-685-4298 for additional assistance.

4. Install and tighten the plumbing fittings into the inlet and outlet ports on the vehicle's engine.
5. Install and clamp both the inlet and outlet engine plumbing lines/automotive-type heater hoses to the engine's plumbing fittings. Reference Figure 37.
6. Install and tighten a plumbing fitting into the "Inlet" port on the Aqua-Hot's engine preheating system. Reference Figures 4 and 38.

NOTE: It is recommended that two wrenches be used when tightening these plumbing fittings.

7. Attach and clamp the engine's incoming plumbing line to the Aqua-Hot's outlet connection. Reference Figure 38.
8. Attach and clamp the engine's outgoing plumbing line to the Aqua-Hot's inlet connection. Reference Figure 38.
9. Verify that all fittings and connections have been tightened, then refill the engine's coolant system.

Section 7: Engine Preheat System

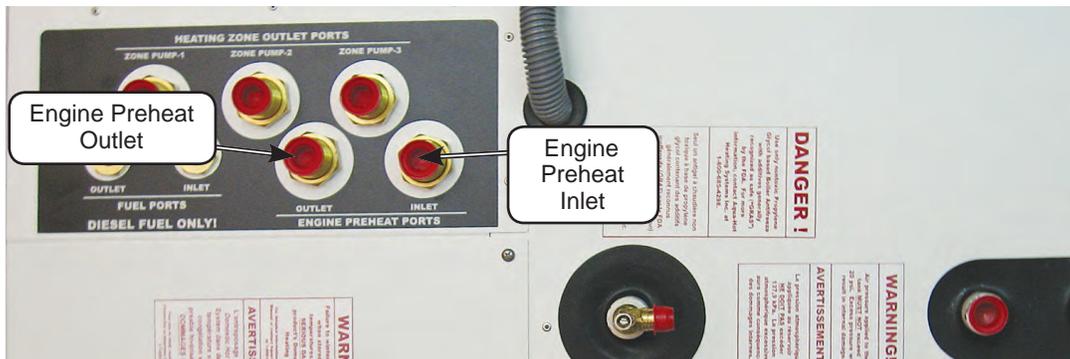
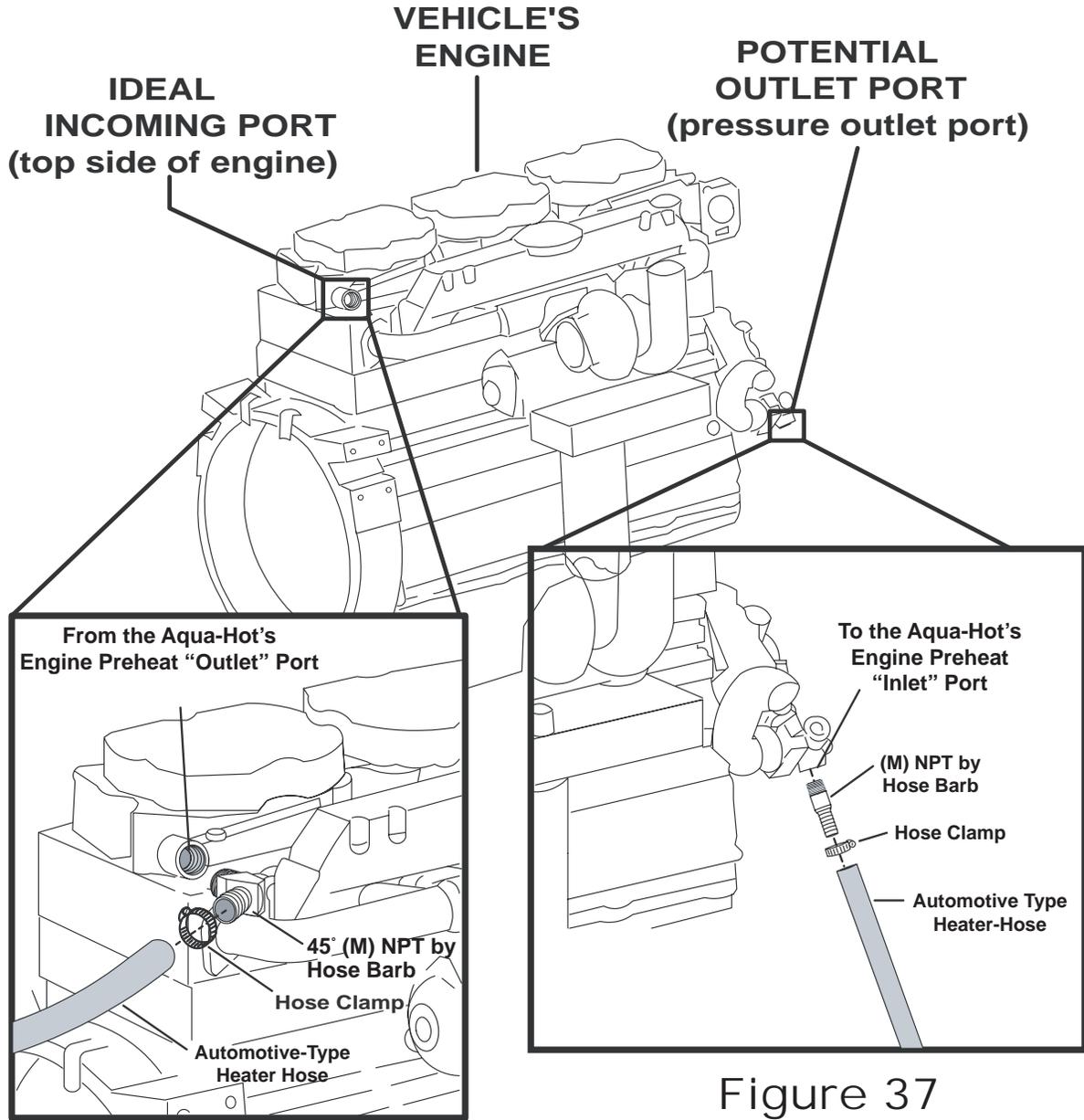


Figure 38

WARNING!

The Aqua-Hot's exhaust is **HOT** and must be kept away from any heat-sensitive material.

DO NOT direct exhaust downward as a fire may result when parked in dry, grassy areas.

Exhaust must not terminate beneath the vehicle or beneath an openable window or vent.

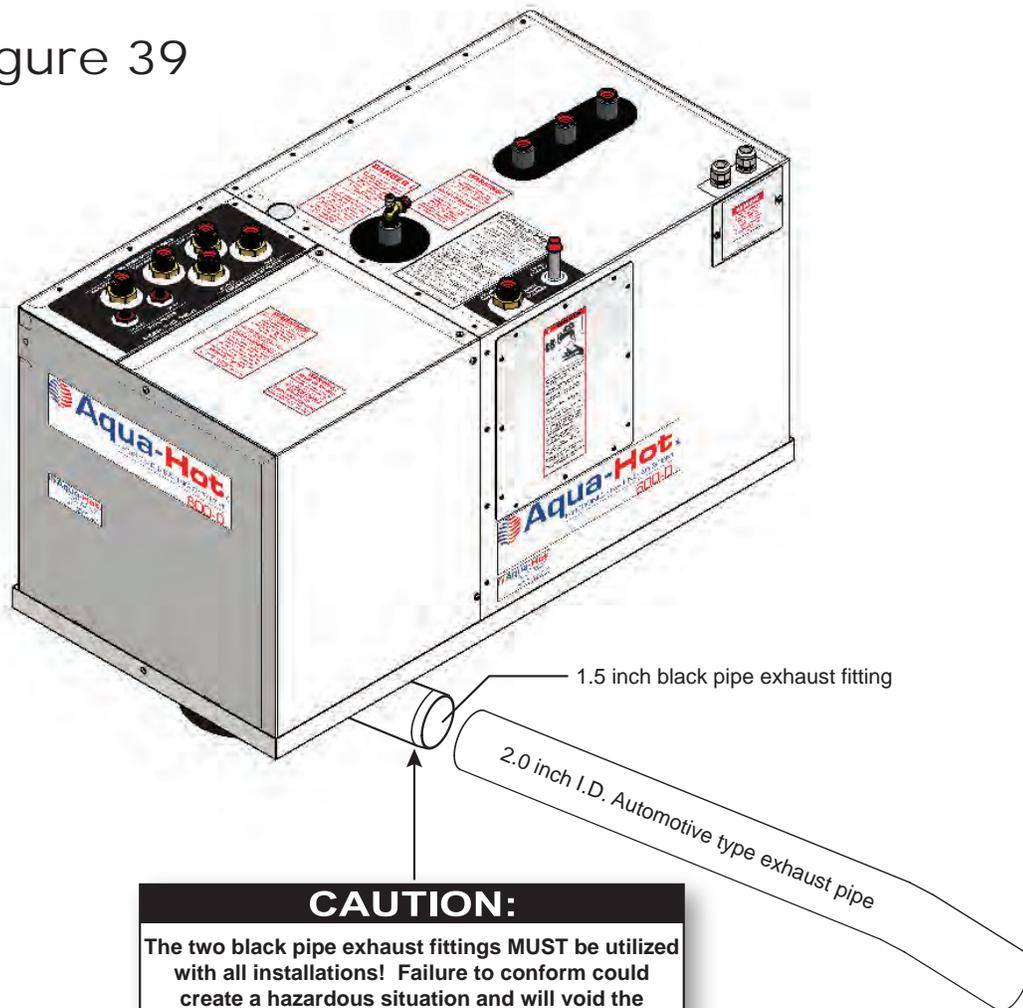
DO NOT terminate the exhaust pipe within the awning area of the motorhome, if applicable. Be sure to keep the exhaust away from the slideout areas.

CAUTION:

All Aqua-Hot exhaust system installations **MUST** utilize the two black pipe nipples and the black pipe elbow, which are provided with the heating system, in the configuration best suited for the particular recreational vehicle application. Failure to conform could create a hazardous situation and will void the Aqua-Hot's ETL product listing.

NOTE: Refer to "Internal Combustion Engine Exhausts and Vehicle Wall Openings" in RVIA's ANSI/NFPA 1192 Handbook for the Recreational Vehicle Standards, as well as the National Fire Protection Association's (NFPA) 1192 Standard on Recreational Vehicles for additional information.

Figure 39



CAUTION:

The two black pipe exhaust fittings **MUST** be utilized with all installations! Failure to conform could create a hazardous situation and will void the Aqua-Hot's ETL product listing.

NOTE: A maximum of two 90° bends are allowed in the exhaust pipe. Also, the exhaust pipe cannot be longer than 20 feet.

Section 8: Exhaust System

Exhaust System Requirements:

The exhaust must be able to freely exit away from the vehicle without any obstructions.

Angle the exhaust pipe towards the rear of the vehicle so that the exhaust fumes will naturally move away while the vehicle is in motion. Reference Figure 40.

Use standard 2 inch automotive-type exhaust piping and avoid bends, if possible. Reference Figure 39.

A maximum of two 90° exhaust pipe bends are allowed. Reference Figure 39.

Do not use galvanized pipe or fittings; only black-iron pipe and fittings should be used.

The total length of exhaust pipe should not exceed 20 feet.

The Aqua-Hot is supplied with a 3 inch and a 4 inch black pipe nipple (1½ inch diameter) along with a 1½ inch exhaust elbow. Reference Figure 39. These three exhaust system components **MUST BE** utilized with all product installations. Be sure to reference Figure 41 to determine which exhaust nipple should be connected directly to the Aqua-Hot's exhaust port (i.e., the 3 inch or the 4 inch black pipe nipple).

NOTE: Should the particular application require more than 20 feet of exhaust pipe, please contact the Aqua-Hot Heating Systems Product Application Department at 1-800-685-4298 for assistance.

NOTE: The exhaust elbow can be rotated 270° as shown in the illustration; however, the exhaust must not terminate beneath the vehicle or beneath an openable window or vent.

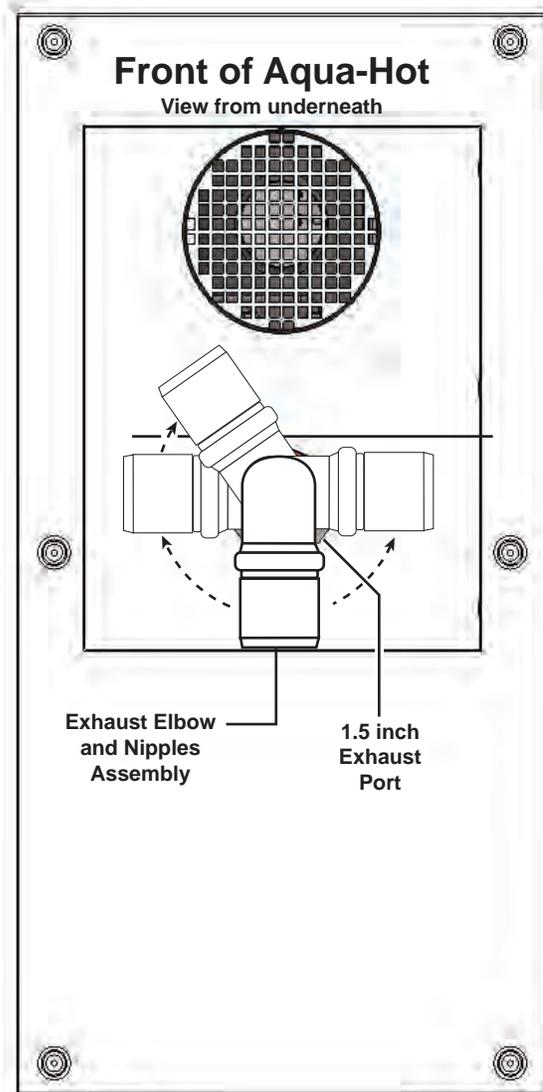


Figure 40

Section 8: Exhaust System

Installing the Exhaust System:

1. Run the exhaust pipe to the driver's side of the vehicle and ensure that the exhaust fumes cannot enter into the passenger compartment. Be sure to keep the exhaust away from the slide-out areas.
2. Be sure to secure the end of the exhaust pipe to the vehicle with the proper exhaust hanger/support hardware.

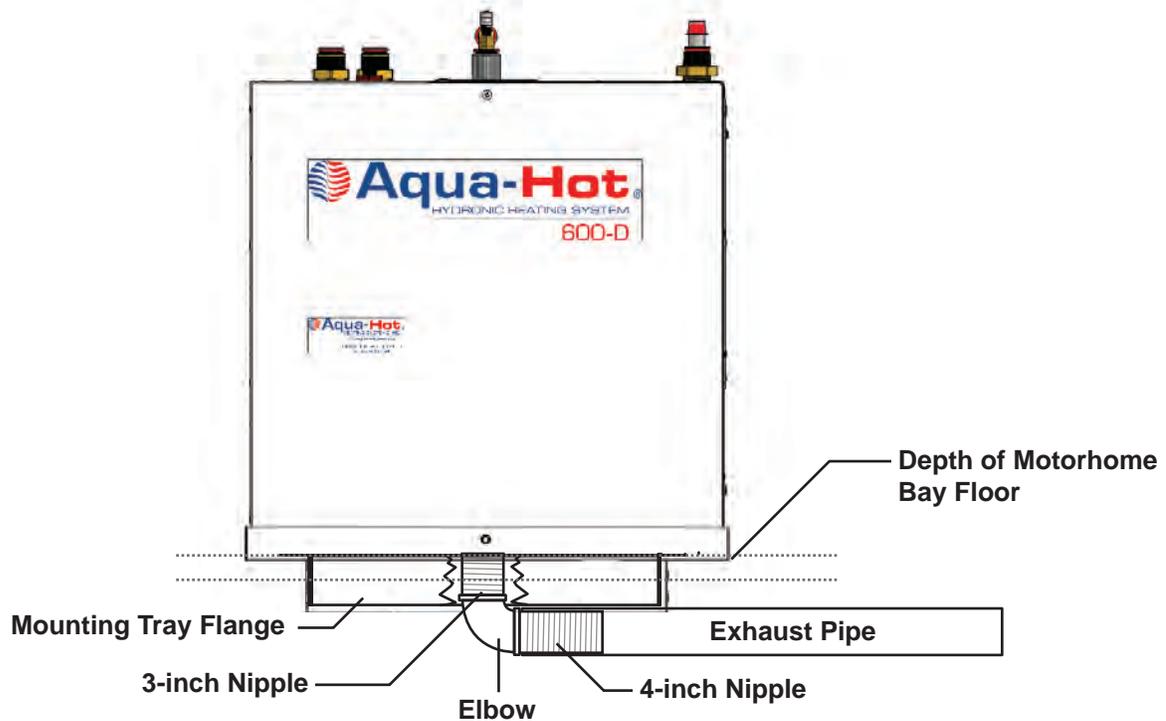
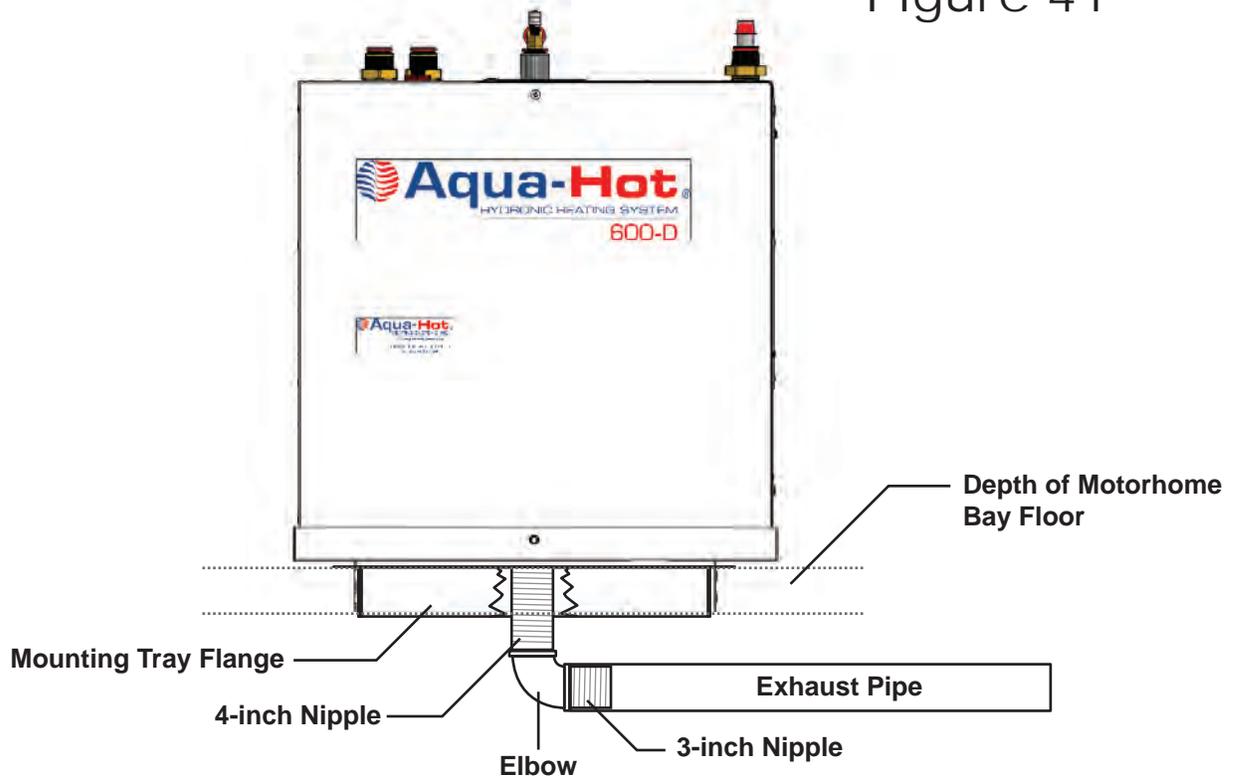


Figure 41



Section 9: Electronic Controller Wiring

Electronic Controller Wiring:

NOTE: Please reference Appendix A for specific wiring information.

NOTE: A maximum power consumption of 24 Watts can be supplied by the electronic controller for each “FAN” heating zone.

Most electronic controller thermostat and switch connections possess an “(I)” or an “(O)” symbol. The “(O)” symbol indicates a positive 12 Volt-DC **output** to a particular thermostat or switch, while the “(I)” symbol indicates a positive 12 Volt-DC **input** signal from a particular thermostat or switch. The 12 Volt-DC **output** signal is always present as long as the electronic controller is powered by a 12 Volt-DC power source, while the 12 Volt-DC **input** signal is only present whenever a switch is activated or whenever a thermostat is calling for heat. Reference Appendix A.

All electronic controller fan power connections (and two switch connections) illustrate a “(+)” or a “(-)” symbol, which indicates that they are polarity-sensitive. Therefore, be sure to use care when wiring these particular components to the electronic controller.

Each heating zone “FAN” circuit can supply up to 2.0 Amps of direct current. This 12 Volt-DC power source allows for multiple Cozy III heat exchangers to be wired “in-parallel.” Reference Figure 42 and Appendix A.

Heating Zone 1 is reserved electrically for the “Living Room/Kitchen Heating Zone” (Heating Loop 1) **ONLY**, and Heating Zones 2, 3, and 4 are reserved electrically for the “Bathroom, Fresh Water Tank, and Bedroom Heating Zone” (Heating Loop 2) **ONLY**.

Heating Zone 5 is reserved electrically for the “Optional Heating Zone” (Heating Loop 1) **ONLY**.

All switch connections are to be wired directly to the Aqua-Hot’s interior switch panel. Reference Figure 41 and Appendix A. Both the “IND-LT (+) B3” and the “IND-LT(-) B6” connections on the electronic controller are reserved electrically **ONLY** for the diesel-burner switch indicator light connections.

The Aqua-Hot’s electronic controller is designed to work with most electronic room thermostats; however, the chosen thermostat must produce a constant 12 Volt-DC output signal and must receive its 12 Volt-DC power supply from the electronic controller (i.e., “THERM-O”) in order to ensure that the thermostat and electronic controller are properly **fuse protected**.

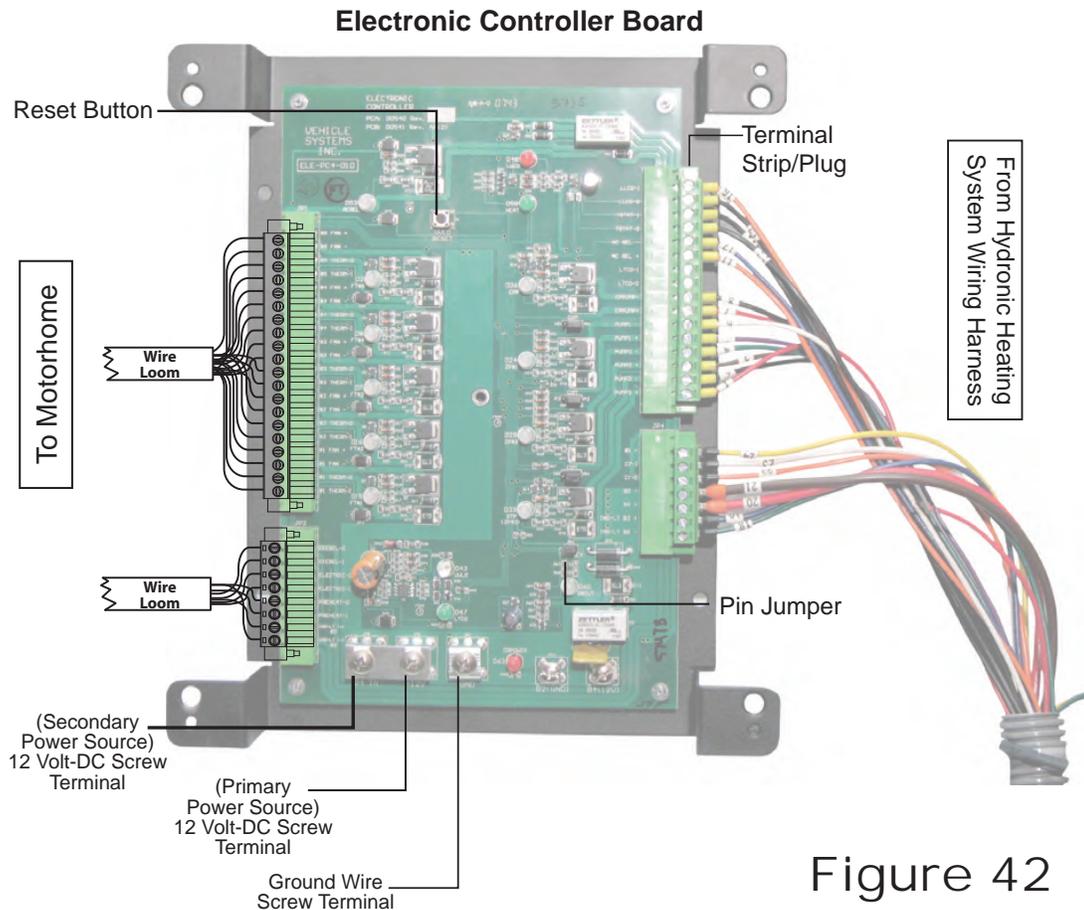


Figure 42

Section 9: Electronic Controller Wiring

NOTE: Reference Appendix B for proper wire-gauge sizing. Please note that each “FAN” circuit on the electronic controller can supply a maximum of 2.0 Amps of direct current.

Because the Aqua-Hot is designed to shut down in the event that the DC voltage level drops too low to properly operate, it is imperative that the proper wire gauge be determined and utilized.

All electric installations, systems, and equipment shall comply with Article 551, Parts I and III through VI of NFPA 70, as well as the regulation of authorities having jurisdiction and CSA Standard B139.

Wiring Harness Connection:

1. Attach the wiring harness connectors to the electronic controller. Reference Figure 43 and Appendix A.

2. Tighten the screw-type fasteners on the terminal strips to secure them to the electronic controller. Reference Appendix C.

Connecting the 12 Volt-DC Power:

CAUTION:

DO NOT connect the 12 Volt-DC power to the Aqua-Hot if the vehicle requires welding. Electrical welding will cause serious damage to the diesel-burner controller.

NOTE: The Aqua-Hot is designed to shut down in the event that the DC voltage level drops too low to properly operate; therefore, it is imperative that the proper wire gauge be determined and used.

Be sure to protect against accidental shorting (i.e., chassis shorting) by incorporating a 30-Amp rated in-line fuse into the power wire at the battery location. Reference Figure 45.

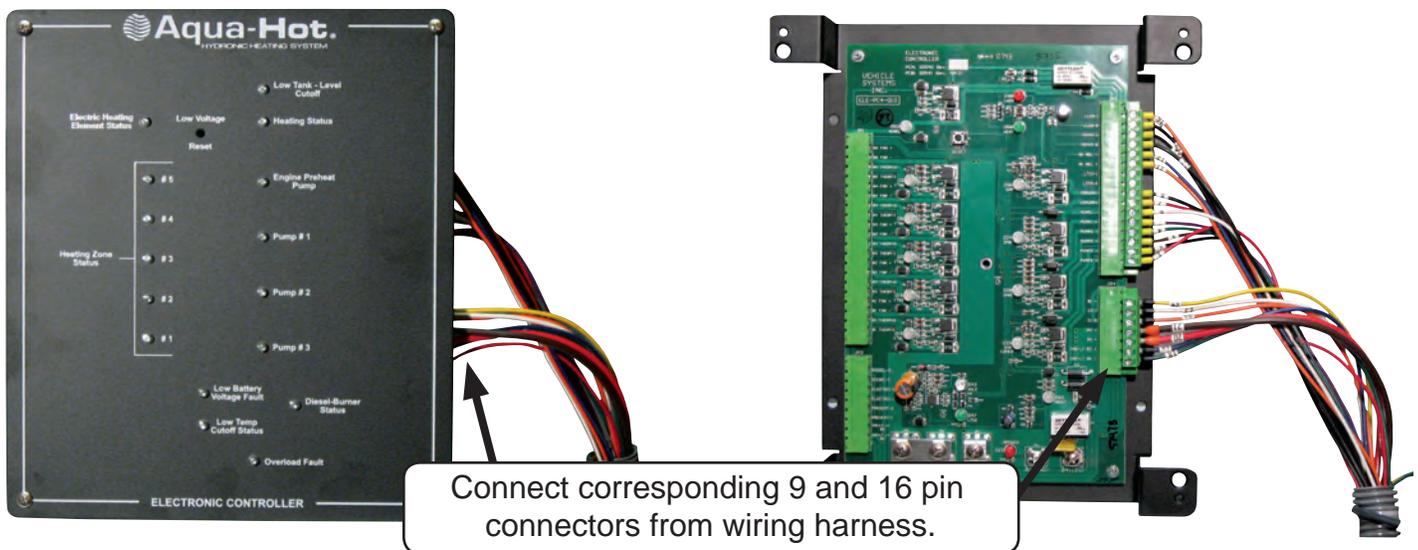
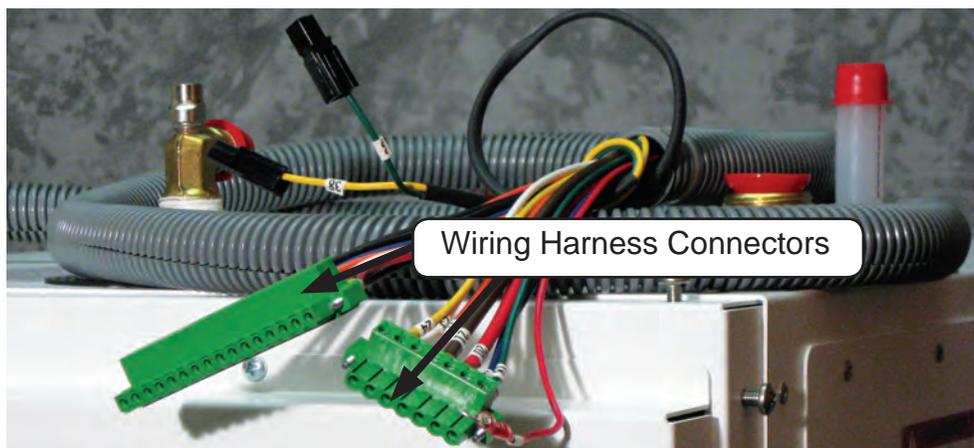


Figure 43



Section 9: Electronic Controller Wiring

1. Calculate the necessary wire gauge for the 12 Volt-DC power and ground wires.
 - A. Determine the total maximum amperage draw of the Aqua-Hot heating system by adding the total maximum Amps of the installed heat exchangers (consult the heat exchanger manufacturer for Amp-draw information) to the Aqua-Hot heater's 22 Amps.

NOTE: Each heating zone "FAN" circuit can supply up to 2.0 Amps of direct current. Each Aqua-Hot heat exchanger draws .23 Amps of direct current.

For example, an Aqua-Hot heater with six Aqua-Hot Cozy heat exchangers draws a total of 23.38 Amps ((6x.23)+22).

- B. Determine the total length of wire required to connect the Electronic Controller to the vehicle's battery.
 - C. Reference Appendix B with the total Amps and length of wire to determine the necessary wire gauge. For example, an Aqua-Hot heater with 6 Aqua-Hot Cozy heat exchangers with the Electronic Controller placed 15 feet from the vehicle's battery would require an 8-gauge wire.
2. Run and connect two wires — one red (+) wire and one black (-) wire (power and ground), from the vehicle's battery to the Aqua-Hot's electronic controller. Reference Appendix A and Figure 45.
3. Label the wires indicating whether they are a power or a ground wire.
4. Attach the DC power wires onto the appropriate ter-

minal/battery connections on the electronic controller. Reference Appendix A.

5. Connect both power and ground wires **directly** to the vehicle's batteries.

CAUTION:

DO NOT activate the diesel-burner until the antifreeze and water heating solution has been added to the boiler tank and the heating system has been completely bled of air. Operating the Aqua-Hot without the antifreeze and water heating solution will cause **serious damage** to the Aqua-Hot's boiler tank.

Connecting the 120 Volt-AC Power:

1. Route and insert three 120 VAC power source wires into the terminal block access area through the appropriate port's cable clamp fitting and into the proper terminal. Reference Appendix A and Figure 44.
2. Secure the wires into their terminals by tightening the corresponding screw on the terminal block.
3. Re-install the terminal block access cover and tighten the screws securing the cover to the Aqua-Hot.

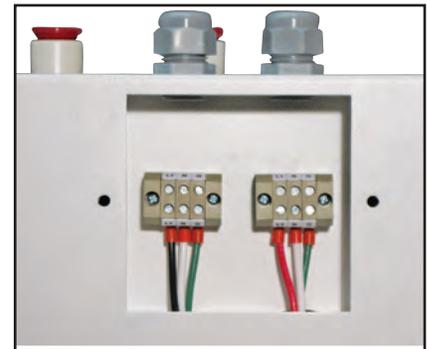


Figure 44

NOTE: If the optional power connection is used, remove the jumper plate from the two power terminals - "JP5" and "JP8."

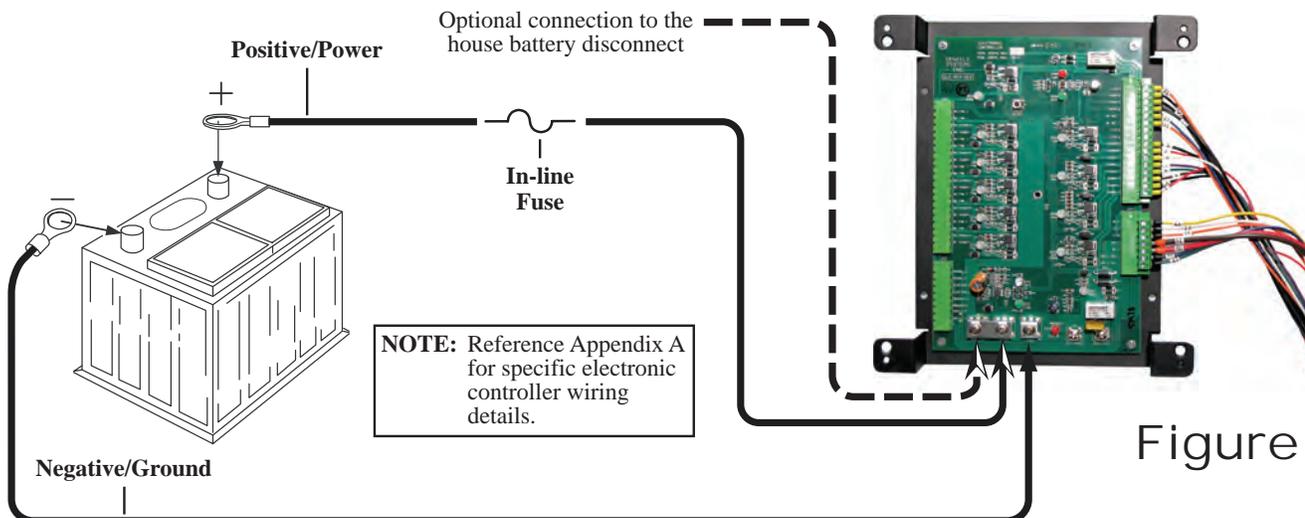


Figure 45

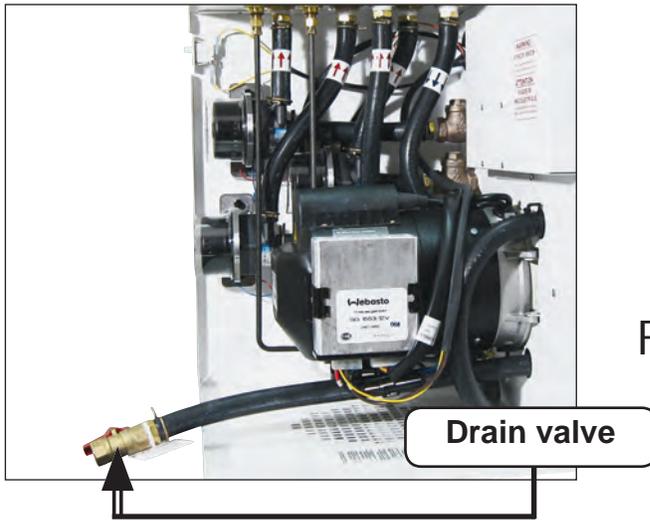
Section 10: Purging the System

⚠ DANGER! ⚠

ONLY PROPYLENE GLYCOL BASED “BOILER” TYPE ANTIFREEZE DEEMED “GRAS” (GENERALLY RECOGNIZED AS SAFE) BY THE FDA SHALL BE USED IN THE AQUA-HOT’S HYDRONIC HEATING SYSTEM. FAILURE TO USE THE ABOVE SPECIFIED ANTIFREEZE TYPE COULD RESULT IN SERIOUS INJURY OR DEATH.

CAUTION:

Ensure that the overflow tube is connected from the Aqua-Hot’s expansion tank connection to the expansion tank’s bottom connection and from the expansion tank’s top connection through the overflow tube hole in the motorhome’s bay floor prior to beginning this antifreeze and water heating solution fill procedure. Failure to do so could result in an antifreeze spill in the motorhome’s bay. Reference Figure 11.



Purging the Hydronic Heating System:

In order to provide the best freeze protection, boil-over protection, and anti-corrosion and rust protection, a 50/50 mixture of “GRAS” approved propylene glycol antifreeze and water is recommended.

Reference Appendices D through F for additional information regarding the antifreeze and water heating solution. Be sure to use a “GRAS” boiler-type propylene glycol based antifreeze rather than an RV and Marine antifreeze or an automotive antifreeze/coolant.

If assistance is needed in selecting an appropriate 50/50 antifreeze and water mixture, please contact the Aqua-Hot Heating Systems Product Application Department at 1-800-685-4298.

1. Open the Aqua-Hot’s drain valve located at the front of the heater. Reference Figure 46.
2. Connect a piece of ½ inch PEX tubing (this piece should be long enough to be used to transport the antifreeze and water heating solution from its source to the Aqua-Hot) to the drain valve.

Figure 46

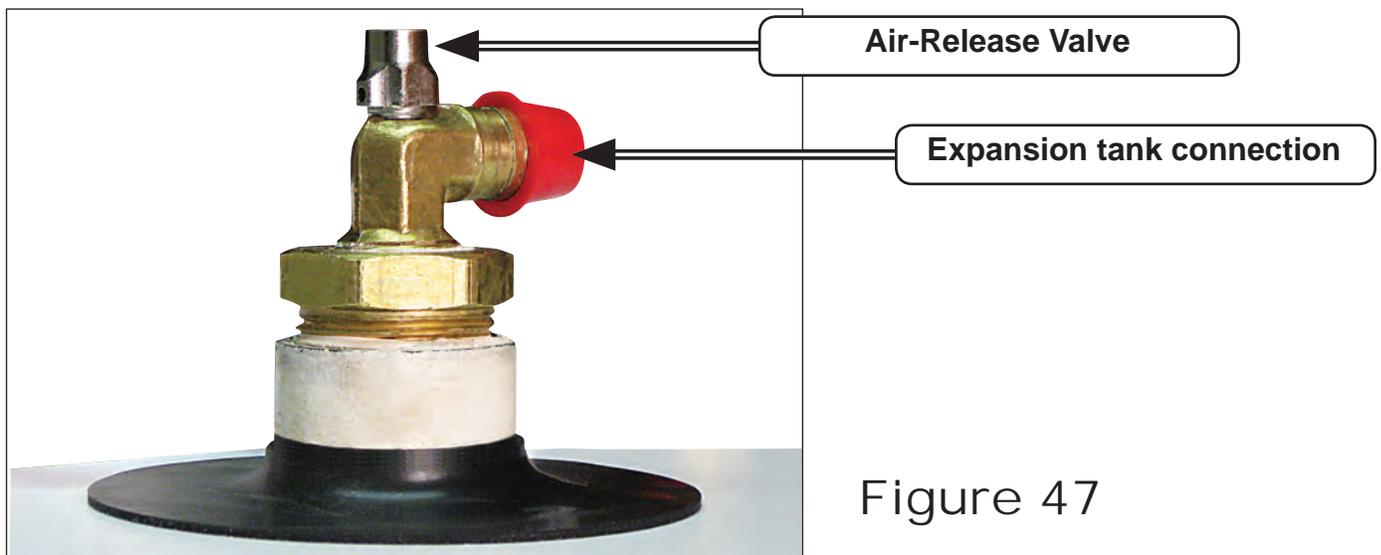


Figure 47

Section 10: Purging the System

3. Fill the Aqua-Hot completely with the 50/50 mixture of antifreeze and water heating solution. This will take approximately 16 gallons of antifreeze and water heating solution.
4. When refilling, open the air release valve located on the expansion tank connection to release air pockets. Reference Figure 46. Hold the valve open until all air is released. Be sure the valve is closed when finished by hand-tightening. Look for the solution to enter the overflow tube attached to the expansion tank connection on top of the Aqua-Hot.
5. Close the drain valve.

Purging the System by Grounding the Zone Circulation Pumps:

1. Ensure that the boiler tank has been filled with the appropriate 50/50 mixture of antifreeze and water heating solution.
2. Locate the heating zone circulation pumps. Reference Figures 3 and 48.
3. Take the circulation pump's blue (negative) wire and disconnect it from the connector of the opposing wire. Reference Appendix A.

4. Connect an alligator clip to the spade terminal on the circulation pump's blue (negative) wire and clip the opposite end of the cable to a ground source.

NOTE: The circulation pump will activate as soon as the pump is connected to a ground source; therefore, disconnect the alligator clip from the ground source during the antifreeze and water heating solution filling procedure.

5. Allow the circulation pump to operate for approximately 1-3 minutes in order to purge the corresponding heating loop, then remove the alligator clip from the ground source.
6. Open the drain valve and completely fill the Aqua-Hot's boiler tank with additional antifreeze and water heating solution.
7. Repeat steps 5 and 6 for both heating loops until all air has been completely bled from the entire heating system.

NOTE: All air is bled from the heating system when both plumbing lines are free of air..

8. Once the systems have been purged, disconnect the alligator clips from the ground source and the circulation pump's wires. Reconnect the pump's wires as originally configured. Reference Figure 48.

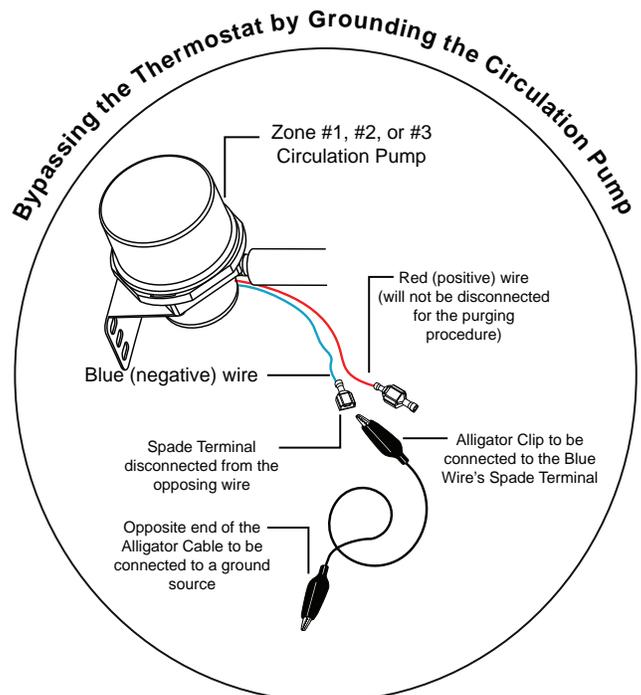
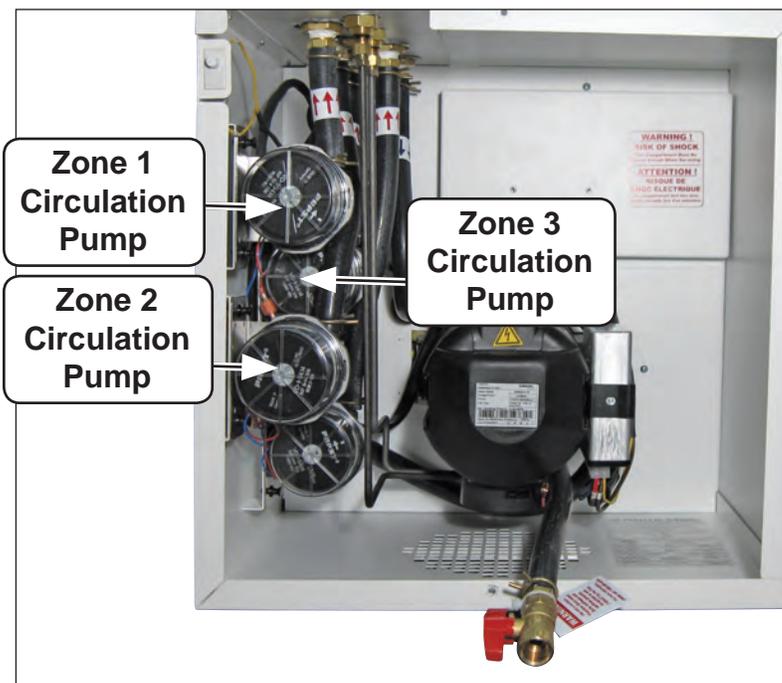


Figure 48

Section 10: Purging the System

9. Check the Aqua-Hot's expansion tank and top it off to the cold level mark with the 50/50 antifreeze and water mixture, if necessary.
10. Ensure that each circulation pump's wiring has been returned to its original configuration. Reference Figure 48.

CAUTION:

Verify that the domestic water tank contains fresh water prior to bleeding the fresh water system.

Purging the Domestic Water System:

1. Ensure that the vehicle's domestic water pump has 12 Volt-DC power, then activate it by opening each hot water faucet, one at a time, and running the water until all air is purged from the domestic water system.
2. Once the domestic water system is completely bled, check for leaks in the domestic water system.

Activating the Aqua-Hot:

1. Reinstall the Aqua-Hot's main access cover and the fastener, which secures the front of the Aqua-Hot's access cover to the mounting tray

The main access cover must be installed prior to operation; a safety switch exists, which will prevent the Aqua-Hot from operating whenever the main access cover is not properly installed.

2. Move the diesel-burner switch to the **ON** position for approximately ten seconds **ONLY**, then switch it **OFF**.

NOTE: This procedure will purge the diesel-burner's fuel system by allowing the heater's fuel pump to complete its normal 30-150 second shutdown/purge cycle.

3. After the purge cycle has ended, repeat once more.
4. Move the diesel-burner switch to the **ON** position and leave it on in order to activate the diesel-burner.

NOTE: It will take approximately 10 seconds before the diesel-burner will ignite and exhaust can be heard exiting the heater.

Allow approximately 10-20 minutes for the Aqua-Hot to reach normal operating temperature (approximately 190°F).

5. Move the Aqua-Hot's electric element switch to the **ON** position in order to supply 120 Volt-AC power to the electric heating element.

NOTE: Both the 12 Volt-DC powered diesel-burner and the electric heating element are thermostatically controlled. Either or both heating sources will automatically maintain the temperature of the boiler tank's antifreeze and water heating solution depending on the heating source activated at the interior switch panel.

The Aqua-Hot is now ready for normal operation and use.

Appendix A: Wiring Diagram

Appendix B: Wire Gauge Information

Appendix B: Wire Gauge Information

AMERICAN BOAT AND YACHT COUNCIL RECOMMENDATIONS

CONDUCTORS SIZES FOR 3% DROP IN VOLTAGE

TOTAL
CURRENT
ON CIRCUIT
IN AMPS.

Length of Conductor from Source of Current to Device and back to Source—Feet

	10	15	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	
12 Volts - 3% Drop Wire Sizes (gage) - Based on Minimum CM Area																				
5	18	16	14	12	12	10	10	10	8	8	8	6	6	6	6	6	6	6	6	6
10	14	12	10	10	10	8	6	6	6	6	4	4	4	4	2	2	2	2	2	2
15	12	10	10	8	8	6	6	6	4	4	2	2	2	2	2	1	1	1	1	1
20	10	10	8	6	6	6	4	4	2	2	2	2	1	1	1	0	0	0	0	2/0
25	10	8	6	6	6	4	4	2	2	2	1	1	0	0	0	2/0	2/0	2/0	2/0	3/0
30	10	8	6	6	4	4	2	2	1	1	0	0	0	2/0	2/0	3/0	3/0	3/0	3/0	3/0
40	8	6	6	4	4	2	2	1	0	0	2/0	2/0	3/0	3/0	3/0	4/0	4/0	4/0	4/0	4/0
50	6	6	4	4	2	2	1	0	2/0	2/0	3/0	3/0	4/0	4/0	4/0					
60	6	4	4	2	2	1	0	2/0	3/0	3/0	4/0	4/0	4/0							
70	6	4	2	2	1	0	2/0	3/0	3/0	4/0	4/0									
80	6	4	2	2	1	0	3/0	3/0	4/0	4/0										
90	4	2	2	1	0	2/0	3/0	4/0	4/0											
100	4	2	2	1	0	2/0	3/0	4/0												

	10	15	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	
24 Volts - 3% Drop Wire Sizes (gage) - Based on Minimum CM Area																				
5	18	18	18	16	16	14	12	12	12	10	10	10	10	10	8	8	8	8	8	8
10	18	16	14	12	12	10	10	10	8	8	8	6	6	6	6	6	6	6	6	6
15	16	14	12	12	10	10	8	8	6	6	6	6	6	4	4	4	4	4	4	2
20	14	12	10	10	10	8	6	6	6	6	4	4	4	4	2	2	2	2	2	2
25	12	12	10	10	8	6	6	6	4	4	4	4	2	2	2	2	2	2	2	1
30	12	10	10	8	8	6	6	4	4	4	2	2	2	2	2	2	1	1	1	1
40	10	10	8	6	6	6	4	4	2	2	2	2	1	1	1	0	0	0	0	2/0
50	10	8	6	6	6	4	4	2	2	2	1	1	0	0	0	2/0	2/0	2/0	2/0	2/0
60	10	8	6	6	4	4	2	2	1	1	0	0	0	2/0	2/0	3/0	3/0	3/0	3/0	3/0
70	8	6	6	4	4	2	2	1	1	0	0	2/0	2/0	3/0	3/0	3/0	3/0	3/0	4/0	4/0
80	8	6	6	4	4	2	2	1	0	0	2/0	2/0	3/0	3/0	3/0	4/0	4/0	4/0	4/0	4/0
90	8	6	4	4	2	2	1	0	0	2/0	2/0	3/0	3/0	4/0	4/0	4/0	4/0	4/0	4/0	
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Appendix C: Electronic Controller Features

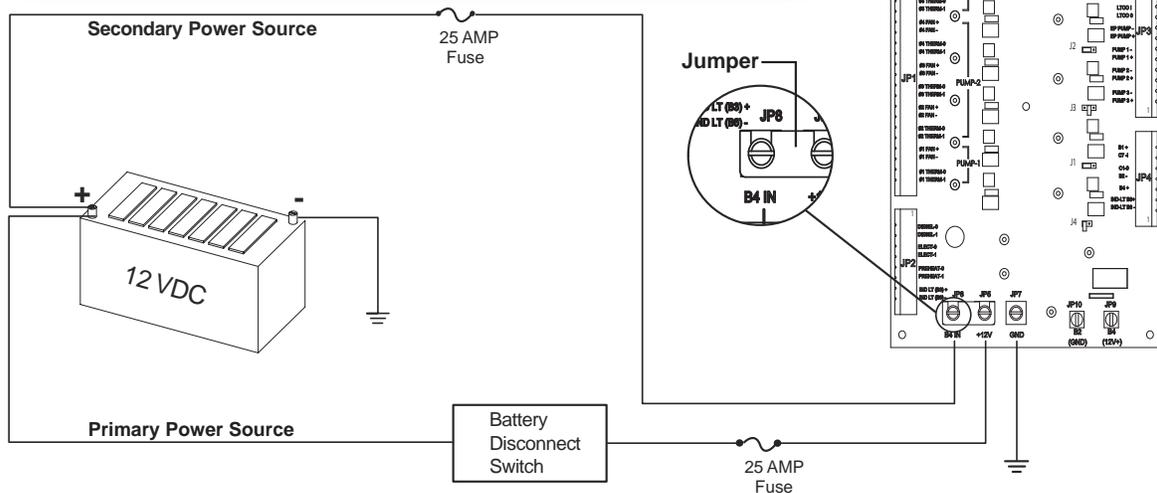
Appendix C: Electronic Controller Features

Secondary 12 Volt-DC Battery Connection:

The electronic controller is equipped with two 12 Volt-DC power source connections, which allow for a secondary 12 Volt-DC battery connection. This 12 Volt-DC battery connection is a product-safety feature that should be utilized whenever the Aqua-Hot's main 12 Volt-DC power supply is connected to a battery disconnect switch. This feature will ensure that the

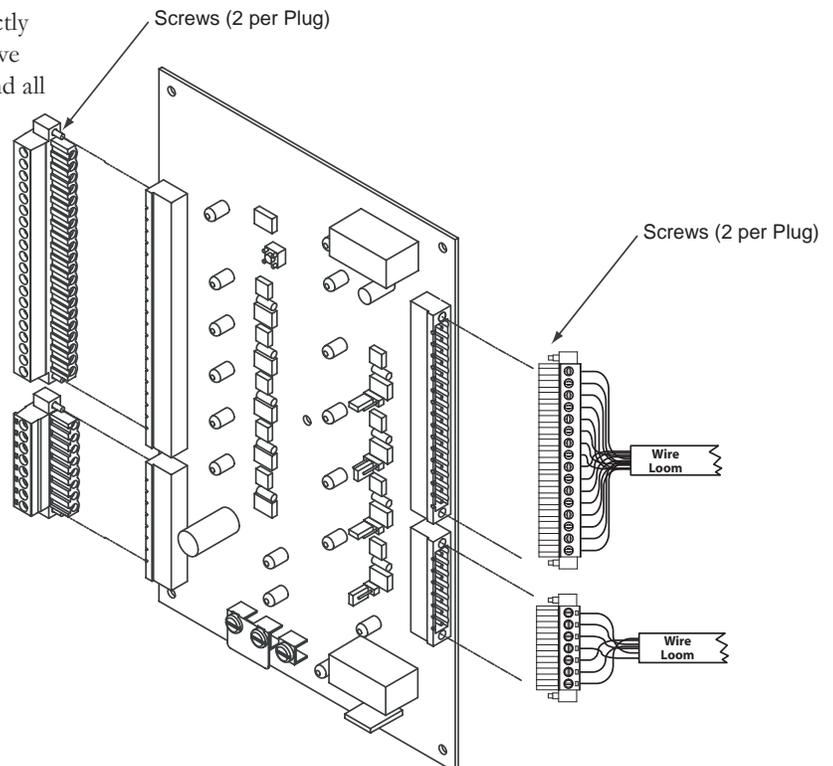
Aqua-Hot will be protected in the event that the primary power is interrupted while the Diesel-Burner is operating (e.g., during a burn-cycle). This secondary 12 Volt-DC battery connection will ensure completion of the required 3-minute "purge cycle" of the Aqua-Hot's diesel-burner.

NOTE: This illustration details the proper wiring requirements for the usage of the battery disconnect switch feature. If connecting the optional battery disconnect wire, the jumper connecting the terminals on the electronic controller must be removed.



Terminals Strips with Screw-Type Fasteners:

The electronic controller utilizes terminal strips/plugs that are equipped with screw-type fasteners, which are molded directly into the terminal strip/plug, itself. This will ensure a positive mechanical connection between the electronic controller and all wire harnesses attached to it.

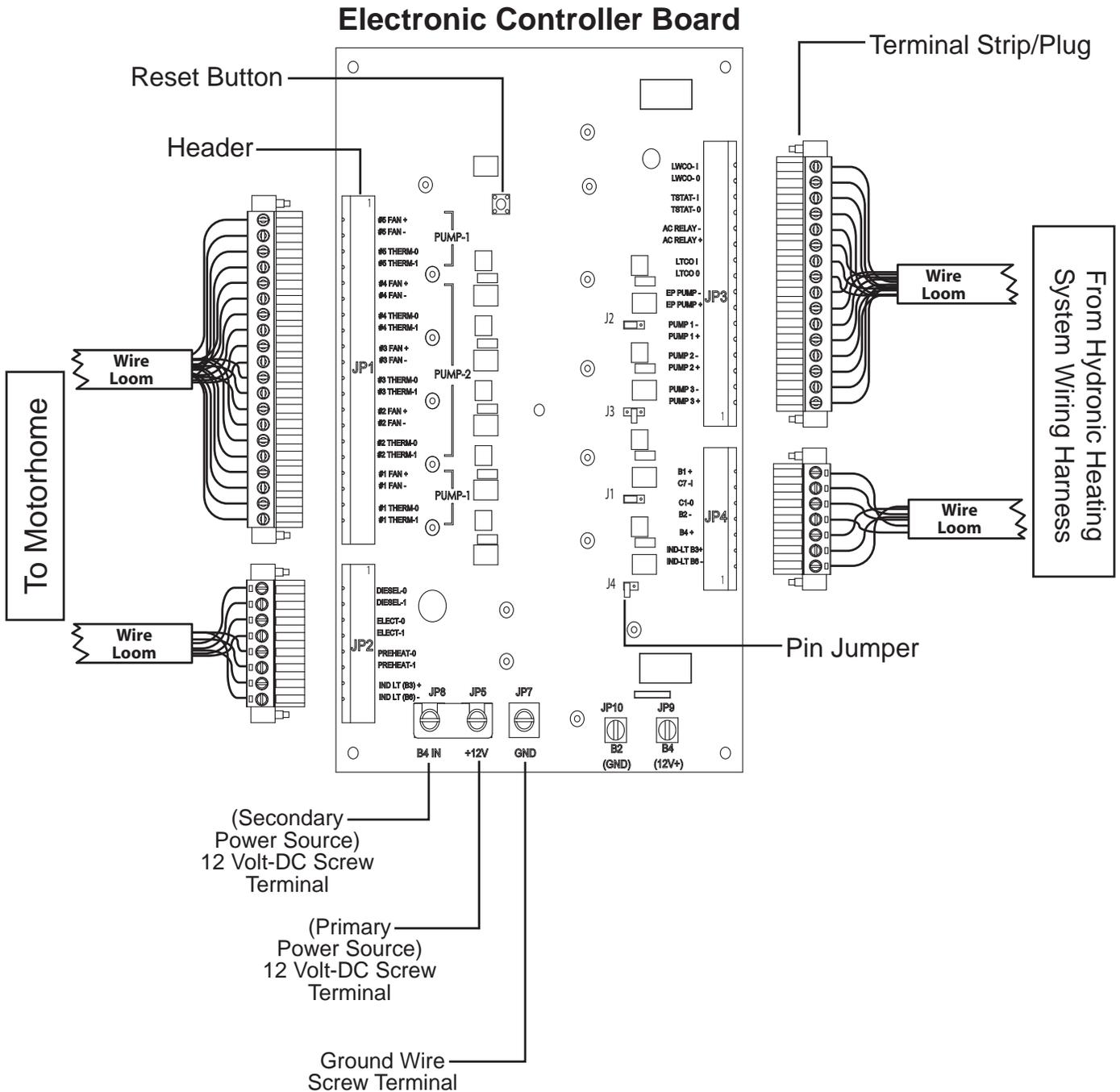


Appendix C: Electronic Controller Features

“Low Voltage Reset” Feature:

Whenever the Aqua-Hot’s DC power is interrupted, the “low voltage reset” red indicator light on the electronic controller will illuminate. Reset the electronic controller by pressing the “low voltage reset” button on the electronic controller (use a thin,

straight, nonmetallic object to access the button through the faceplate) or by turning OFF the diesel-burner switch on the interior switch panel for approximately 30 seconds, then turning the switch back ON.



Appendix D: Antifreeze Types

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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 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 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 E:
Antifreeze
Mixture Water Quality
Recommendations**

Appendix E: Antifreeze Mixture Water Quality

Antifreeze Mixture Water Quality:

In order to ensure maximum performance and longevity of an Aqua-Hot heating system's boiler tank and associated components, it has been determined that there is a need to use distilled, 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 F: Antifreeze Terms and Mixture Ratio

Appendix F: 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 -28°F and a boil point of approximately 222°F.

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

Freeze Point and Burst Point:

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

